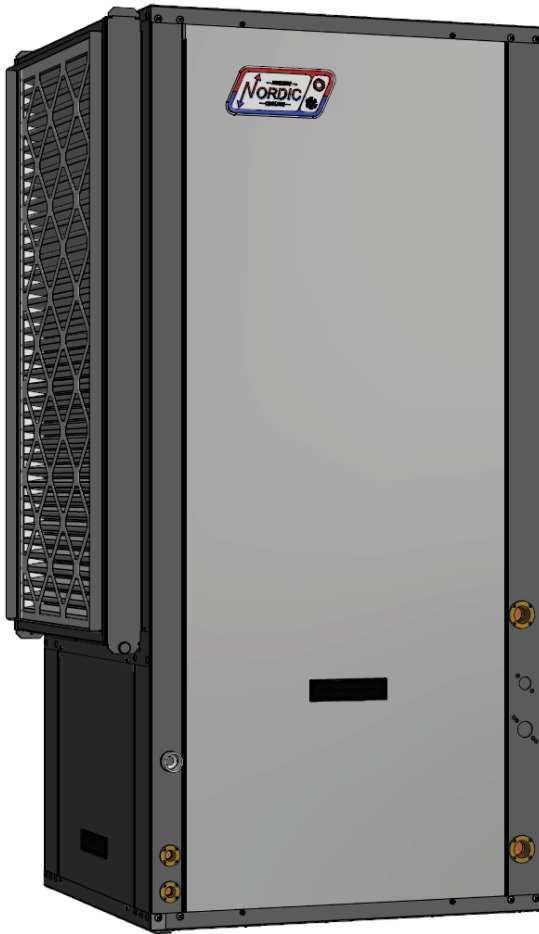




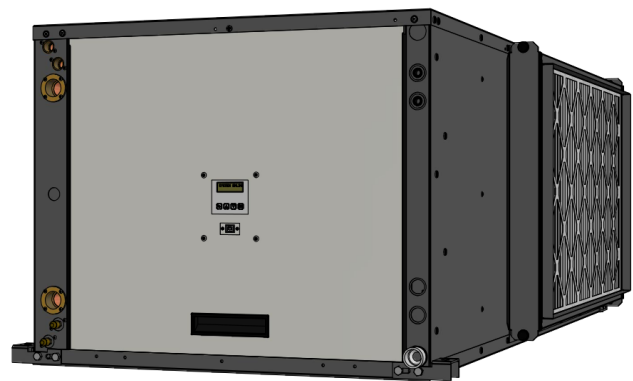
Application, Installation, & Service Manual

R/RH-Series Liquid to Air Geothermal Heat Pumps

Two-Stage, R454b, GEN2
Model Sizes 45-75



R-Series



RH-Series



Maritime Geothermal Ltd.
P.O. Box 2555, 170 Plantation Road
Petitcodiac, NB E4Z 6H4
(506) 756-8135



info@nordicghp.com
www.nordicghp.com
002740MAN-01

LOOK FOR GREY TEXT BOXES LIKE THIS ONE THROUGHOUT MANUAL FOR
A2L-SPECIFIC WARNINGS / INSTRUCTIONS



A2L refrigerant: mildly flammable.

Installation and service work should only be performed by properly certified technicians with **A2L-specific** training. See also [Service Procedures](#) chapter.

Refrigerant does NOT have an odour so is only detectable with suitable field instruments.

Do NOT pierce or burn. Do NOT use flame to defrost or clean. Check for presence of refrigerant using a detector before initiating any service work, especially work involving torches.

Unit equipped with electrically powered **A2L leak detection** system, so must be electrically powered at all times (other than during temporary outages or installation / service).

Installation of a unit with **A2L** refrigerant may require calculations involving the size of the mechanical room and/or rooms served by the unit. These calculations may affect installation procedures used and ventilation provided, and should be fully understood and considered to ensure code compliance.

GENERAL SAFETY PRECAUTIONS



To avoid electric shock, which can cause serious injury or death, ensure all access panels are in place and properly secured before applying power to the unit. Before performing service or maintenance on the heat pump system, ensure all power sources are **DISCONNECTED**.



Safety glasses and work gloves should be worn at all times whenever a heat pump is serviced. A fire extinguisher and proper ventilation should be present whenever brazing is performed.

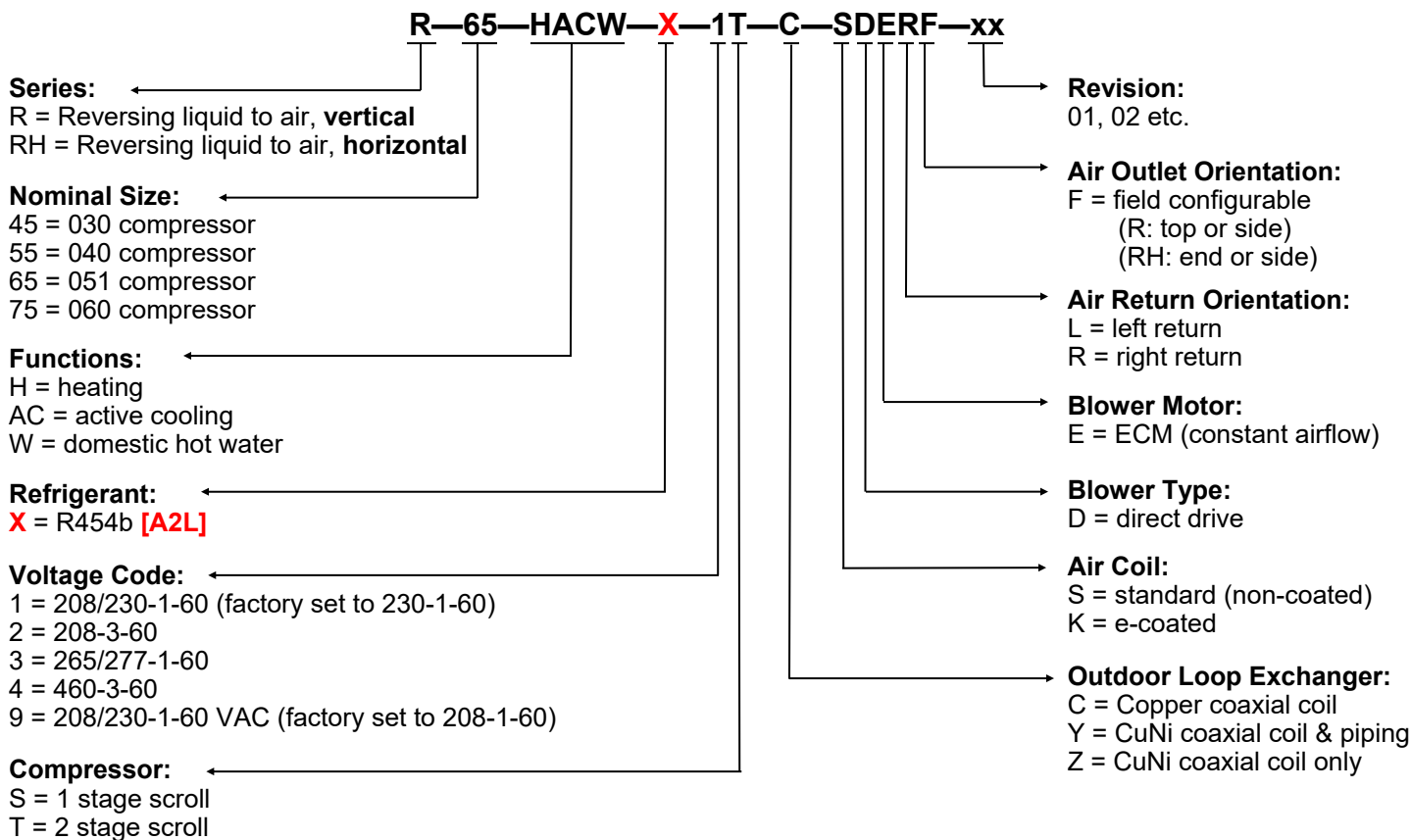


Venting refrigerant to atmosphere is illegal. A proper refrigerant recovery system must be employed whenever repairs require removal of refrigerant from the heat pump.



This appliance is not intended for intervention by persons with reduced physical, sensory, or mental capabilities or lack of experience and knowledge, unless suitably supervised. Children should be prevented from playing with appliance.

Model Nomenclature



APPLICATION/AVAILABILITY TABLE

MODEL SERIES	MODEL SIZE	FUNCTION	REFRIGERANT	VOLTAGE	COMPRESSOR	OUTDOOR COIL	FAN/CASE	REVISIONS			
R	45 55 65	HACW	X	1 2 3 4	T	C Y Z	SDELF SDERF	01			
R	75	HACW	X	1 2 4	T	C Y Z	SDELF SDERF	01			
RH	45 55 65	HACW	X	1 2 3 4	T	C Y Z	SDELF SDERF	01			
RH	75	HACW	X	1 2 4	T	C Y Z	SDELF SDERF	01			

This manual applies only to the models and revisions listed in this table.

Maritime Geothermal Ltd. has a continuous improvement policy and reserves the right to modify specification data at any time without prior notice .

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R/RH-Series Description

General Overview

The Nordic R/RH-series is a package water source heat pump that can heat or chill air in a forced air duct system. The duct system can be zoned, but only to limited extent (see [Wiring](#) and [Ductwork](#) chapters).

Being a 'ground source', 'water source', 'geoexchange', or 'geothermal' heat pump, the R/RH-series does require either a **closed ground loop** or **open loop water well** for a heat source/sink. There is no outdoor fan unit for ground source heat pumps.

The air heating and cooling functions are controlled by a standard 3H/2C 24V room thermostat.

In addition to space heating/cooling, there is a double-wall desuperheater for pre-heating domestic hot water with ~5% of the heat pump's capacity. This function is only active when the heat pump is running for space heating or cooling purposes. An energy-efficient bronze head circ pump for the desuperheater circuit is built in, along with a temperature control.

A two-stage scroll compressor with suction accumulator is standard. The blower motor is a premium constant-airflow ECM. The outdoor loop refrigerant to water heat exchanger is a heavy duty coaxial copper / steel model, with optional CuNi inner tube available for open loop applications. A single electronic expansion valve (EEV) regulates superheat. The cabinet is constructed from powder coated galvanized sheet metal.

1. Heating Mode

In heating mode, the heat pump heats warm air in a duct system. As the unit operates, heat is extracted from the ground loop or well water. The heat pump is activated by a standard 3H/2C 24V room thermostat, which will call for stage 1 or stage 2 heat according to its own algorithm. The thermostat can also call for stage 3 (due to air temperature falling further below the setpoint, or after a certain run time), which will activate the optional electric plenum heater. The plenum heater accessory is available in different sizes to provide either full backup or partial auxiliary heat.

If a closed ground loop is used, the circulation pumps are powered and controlled by the heat pump; if open loop, a water valve is opened by the heat pump during heating operation and closed when the heat pump is idle.

2. Cooling Mode

In cooling mode, the heat pump cools air in the duct system. As the unit operates, heat is extracted from the ducted air stream and rejected to the ground loop or well water.

Factory Options

Looking at the main service panel and piping connections, the heat pump can be ordered as a left or right hand air return from the factory. This must be specified at time of order as the physical construction of the two configurations is different.



Sizing

Heat Pump Sizing

The following table is a rough guideline as to the size of space each heat pump size can handle for **ground loop (closed loop)** installations.

TABLE 1 - Heat Pump Size vs. Heated Area for a Ground Loop System		
Model	ft ²	m ²
R/RH-45	1400	130
R/RH-55	2000	185
R/RH-65	2600	240
R/RH-75	3100	290

The following table is a rough guideline as to the size of home each heat pump size can handle for **ground water (open loop)** installations.

TABLE 2 - Heat Pump Size vs. Heated Area for an Open Loop System		
Model	ft ²	m ²
R/RH-45	1800	165
R/RH-55	2500	230
R/RH-65	3200	295
R/RH-75	3800	355

THE TABLES ABOVE ARE FOR ESTIMATION ONLY. THEY SHOULD NOT BE USED TO SELECT A FINAL UNIT SIZE. They simply show what size unit is required for a northern home with typical construction: R20 walls, R40 ceiling, and average size and number of windows. The heated area is the area of the above grade main level; the tables account for a basement the same size as the heated area.

MARITIME GEOTHERMAL LTD. HIGHLY RECOMMENDS THAT A PROPER HEAT LOSS/GAIN ANALYSIS BE PERFORMED BY A PROFESSIONAL WITH APPROVED CSA F-280 SOFTWARE BEFORE SELECTING THE HEAT PUMP SIZE. For heating dominant climates, we recommend sizing the unit to 100% of the heating design load for maximum long term efficiency with minimal supplementary heat. The unit should be installed as per CSA standard 448.2-02. For ground loop applications, the ground loop should be designed using suitable software with a multi-year analysis.

The analysis will result in a heat load for the coldest day, which is influenced by, for example, the number of levels, the size of the windows, the orientation of the home, attached garage, bonus rooms, walk-in basement, and coldest outdoor temperature for the region.

A heat pump model size can then be selected by comparing the calculated heat load to the heat pump capacity at the standard indoor air temperature, which can be found in the performance tables in the [Model Specific Information](#) chapter. For R-series, the *Standard Capacity Ratings* rather than detailed performance tables can be used for simplicity. For 100% heat pump sizing, choose a heat pump with a standard capacity rating that matches or just slightly exceeds the calculated heat load.

Some background on *Standard Capacity Ratings*: closed ground loops are normally designed to reach a minimum temperature of just below freezing at the end of the heating season, in order to take advantage of the latent heat of groundwater (at least in northern climates). Hence, the Standard Capacity Ratings for Ground Loop Heating should apply in all northern climates. Conversely, the Standard Capacity Ratings for Ground Water (open loop) heat pumps assume a well water temperature of 50°F (10° C). In more southerly climates, the groundwater or ground loop will probably be at a warmer minimum temperature, and it will be necessary to consult the more detailed performance tables for heat pump output at a different ELT.

In cooling dominant climates, the heat pump should be similarly sized using the Ground Loop Cooling or Ground Water Cooling Standard Capacity Ratings. **Even in northern heating dominant climates, it should be ensured that 100% of the cooling load will be covered when sizing the heat pump, since there is normally no auxiliary or backup cooling available.**

Plenum Heater Sizing

The plenum heater is available as an accessory in 5, 7, 10, 15 and 20kW sizes. If full backup is desired, choose a size that covers **100% of the coldest day heat load**, according to the heat loss analysis mentioned in the last section. If that is not available, use the following recommendation:

TABLE 3 - Plenum Heater Sizing			
Model	Plenum Heater Size (kW)		
	Full Backup	Possible	Not Possible
R/RH-45	10	5, 7, 10	15, 20*
R/RH-55	10	5, 7, 10, 15, 20	
R/RH-65	15	5, 7, 10, 15, 20	
R/RH-75	20	5, 7, 10, 15, 20	

* Although these plenum heaters will not fit inside heat pump, there are versions available for external mounting.

Two styles of plenum heater are available; the first is for R-series internal installation (inside the indoor unit). Note limit for size 45 in above table.

The second has a wider element profile for installation outside the unit, in the ductwork. For RH series or for R series when field-installing the fan in the convertible side discharge position, this type of plenum heater should be used.

Installation Basics



A2L-SPECIFIC WARNING / INSTRUCTION

The heat pump uses **R454b**, an **A2L** refrigerant which is a classification meaning “mildly flammable”.

Safety measures to mitigate **A2L** refrigerant leaks are outlined in standard **UL/CSA 60335-2-40** and also **CSA B52:23**.

*It is highly recommended that a **mechanical consulting engineer** be involved in any project involving **A2L** refrigerating units, whether for new installation or replacement of non-A2L units.* This is because the mechanical room requirements can be onerous and also difficult to decipher for the layperson.

The heat pump can be considered an “enhanced tightness refrigerating system” with refrigerant charge $m_1 < m_c < m_2$ for the purposes of UL/CSA 60335-2-40, clause GG.10.

A2L heat pumps like these with refrigerant charge $> m_1$ (as defined by UL/CSA 60335-2-40) are equipped with a refrigerant detector. In case refrigerant is detected inside the enclosure, the heat pump will shut down and display a permanent alarm as well as activate a 24VAC control board output. This output signal can be used to activate external fans or alarms when such action is required by codes.

Unpacking the Unit

When the heat pump arrives, it should be immediately unpacked to determine if any damage has occurred during shipment. Any visible damage should be noted on the carrier's freight bill and a claim filed at once.

The heat pump is well constructed and every effort has been made to ensure that it will arrive intact, however it is in the customer's best interest to inspect thoroughly when it arrives.

Unit Placement

Ducted or forced air heat pumps should be centrally located in the home with respect to the conditioned space. A heating system cannot be expected to produce an even temperature throughout the building when it is located at one end of the structure and the heated or cooled air is transmitted with uninsulated metal ductwork.

If possible the front (piping side) access panel and side access panel opposite the air return should remain clear of obstruction for a distance of **2 ft (0.7 m)** to facilitate servicing and general maintenance. For **vertical R-series**, no access is required on the back side; but attention should be paid to the fact that the electrical box and LCD interface are located on the side of the unit opposite the air return. Ensure the unit is level to eliminate any possible condensate draining issues.

The heat pump comes equipped with an air filter rack which can be installed with the removable end (where the filter is inserted) on either side to facilitate changing the filter. Be careful not to run piping in front of the filter rack access cover, since access is required in order to change the air filter.

Floor mounted units should be placed on an anti-vibration pad, available as an accessory, or a piece of 2" styrofoam.

Horizontal RH-series units may be hung using threaded rod and the four built-in hangers. Be sure the hanging system is suitable for **2X** the weight of the unit.

Plenum Heater Installation (Accessory)

Be sure to specify the type of installation anticipated, since the plenum heater models are different for internal or external (duct) installation.

- Vertical R-series, blower in top discharge position:**
Plenum heater is mounted inside heat pump cabinet. See diagram on following page. Remove the screws from the cover plate, remove the cover plate, and place the plenum heater in the cutout. Slide it up and secure the bottom flange with three cover plate screws. Use the indicated knockouts on the heat pump cabinet for electrical connections.
- When installation is complete, check the appropriate box of the label on the unit door to indicate which size heater was installed.**
- Vertical R-series, blower in side discharge position OR RH-series:**
Plenum heater should be installed in the air discharge duct outside the heat pump cabinet in a manner that allows all of the airflow to pass through it, to prevent any hot spots in the heater elements. Ensure that the plenum heater is mounted in an approved position as per its instructions.

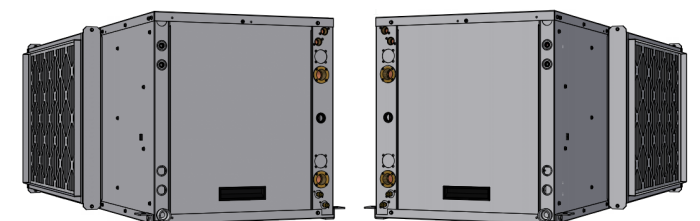
Air Return Orientation

The heat pump can be ordered as left or right air return from the factory. This must be specified at time of order as the physical construction of the two configurations is different. Refer to the **Dimensions** section toward the end of this manual for physical dimensions of the units.



LEFT RETURN

RIGHT RETURN

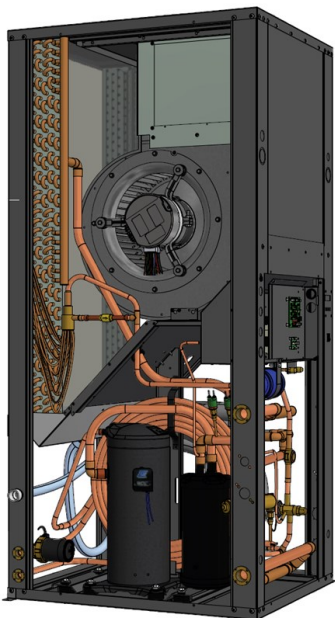


R-Series Air Outlet Orientation

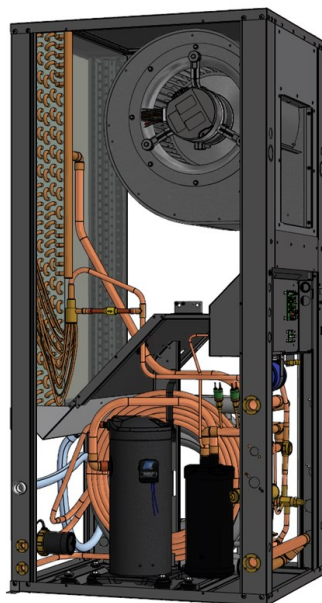
The **vertical R-series** has a field configurable blower position, resulting in **top** or **side** air discharge. Its default location from the factory is in the top of the unit, providing a “ninety” in the airflow. It can easily be placed in the side of the unit for straight through airflow. Note that if this is done, plenum heater will need to be placed in the ductwork outside unit.

To switch the location of the fan outlet:

1. Be sure power supply to unit is turned off.
2. Remove the screw that holds the side access panel in place and remove the access panel by pulling up on the handle and then outward from the bottom.
3. Disconnect the two wiring harnesses and ground wire from the blower motor.
4. Repeat step 2 for the access panel with the blower mounted in it. Set the assembly on the floor.
5. Disconnect the plenum heater extension from the blower housing and from the access panel.
6. Mount the blower housing directly to the access panel.
7. Install the blower in its panel in the new location and secure with the screw.
8. Reconnect both harnesses and ground wire.
9. Install the remaining access panel and secure with the remaining screw.



*BLOWER IN
TOP DISCHARGE
POSITION (DEFAULT)*



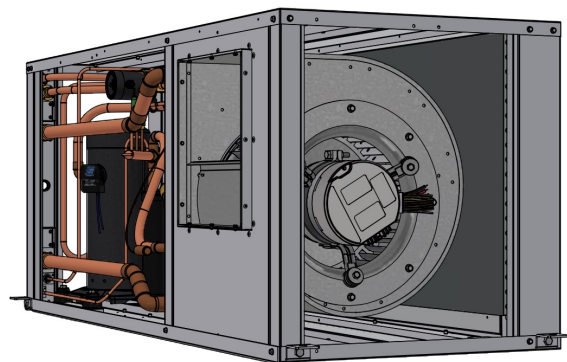
*BLOWER IN
SIDE DISCHARGE
POSITION*

RH-Series Air Outlet Orientation

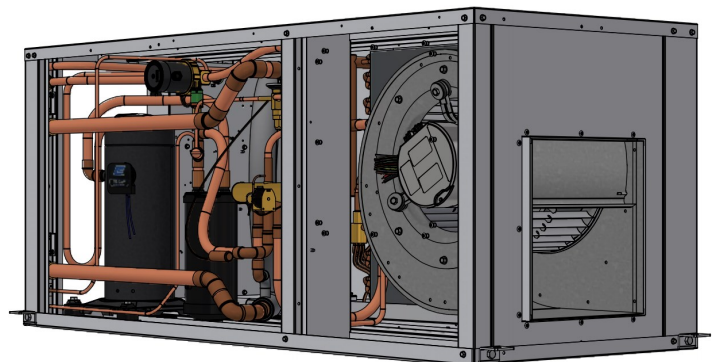
The **horizontal RH-series** has a field configurable blower position, resulting in **straight through (side)** or **end** air discharge. Its default location from the factory is in the straight through (side) position. It can easily be placed in the end of the unit to provide a 90° turn in the air flow.

To switch the location of the fan outlet:

1. Be sure power supply to unit is turned off.
2. Remove the screw that holds the access panel adjacent to the blower in place and remove it by pulling up on the handle and then outward from the bottom.
3. Disconnect the two wiring harnesses and ground wire from the fan motor.
4. Repeat step 2 for the access panel with the blower mounted in it.
5. Install the blower in its panel in the new location and secure with the screw. Be sure to **flip the blower over** so that the motor faces out the adjacent access panel, so that wiring harness may be reconnected and that service access to the motor is maintained even with ductwork connected.
6. Reconnect both harnesses and ground wire.
7. Install the remaining access panel and secure with the remaining screw.



*BLOWER IN SIDE DISCHARGE
POSITION (DEFAULT)*



*BLOWER IN END DISCHARGE
POSITION*

Sample Bill of Materials - Ground Loop Installations

FROM MARITIME GEOTHERMAL

- R/RH SERIES HEAT PUMP (L OR R RETURN)
- PLENUM HEATER ___ kW
- THERMOSTAT (WIFI OR STD)
- P/T PORTS AND HOSE ADAPTERS (2)
- 1 OR 2 PUMP PACK
- PIPE ADAPTERS FOR PUMP PACK

OPTIONAL FROM MARITIME GEOTHERMAL

- ANTI-VIBRATION PAD
- SOUND JACKET
- SECURE START
- ELECTROSTATIC FILTER

DUCTWORK

- OUTLET PLENUM ADAPTER W/ FLEXIBLE COLLAR
- RETURN AIR ADAPTER W/ FLEXIBLE COLLAR
- FIBREGLASS INSULATION (FOR NOISE, IF REQ'D)
- TRUNK DUCT W/ JOINERS (IF NOT EXISTING)
- 6" ROUND DUCT W/ADAPTERS (IF NOT EXISTING)
- ALUMINUM TAPE
- SHEET METAL SCREWS

DHW

- PREHEAT TANK, 40 OR 60 GAL
- 1/2" COPPER PIPE
- 1/2" FITTINGS, BALL VALVES, BOILER DRAINS, CV

GROUND LOOP

- 3/4" PE PIPE
- 1-1/4" PE PIPE
- PE PIPE FITTINGS
- 1" CLEAR HOSE (HEAT PUMP TO PUMP PACK)
- HOSE CLAMPS
- ANTIFREEZE: METHANOL OR PROP. GLYCOL

ELECTRICAL

- HEAT PUMP SERVICE WIRE: 6-3 OR 8-3
- PLENUM HEATER SERVICE WIRE
- HEAT PUMP BREAKER
- PLENUM HEATER BREAKER
- THERMOSTAT WIRE 18-8
- THERMOSTAT WIRE 18-2 (PLENUM HEATER)
- FORK TERMINALS FOR TSTAT WIRE (10)
- CONDENSATE PUMP & HOSE (IF REQUIRED)
- 2" STYROFOAM INSUL. (IF PAD NOT PURCHASED)

Sample Bill of Materials - Open Loop Installations

FROM MARITIME GEOTHERMAL

- R/RH SERIES HEAT PUMP (L OR R RETURN)
- PLENUM HEATER ___ kW
- THERMOSTAT (WIFI OR STD)
- P/T PORTS AND HOSE ADAPTERS (2)
- DOLE VALVE
- MOTORIZED WATER VALVE

OPTIONAL FROM MARITIME GEOTHERMAL

- ANTI-VIBRATION PAD
- SOUND JACKET
- SECURE START
- ELECTROSTATIC FILTER

DUCTWORK

- OUTLET PLENUM ADAPTER W/ FLEXIBLE COLLAR
- RETURN AIR ADAPTER W/ FLEXIBLE COLLAR
- FIBREGLASS INSULATION (FOR NOISE, IF REQ'D)
- TRUNK DUCT W/ JOINERS (IF NOT EXISTING)
- 6" ROUND DUCT W/ ADAPTERS (IF NOT EXISTING)
- ALUMINUM TAPE
- SHEET METAL SCREWS

DHW

- PREHEAT TANK, 40 OR 60 GAL
- 1/2" COPPER PIPE
- 1/2" FITTINGS, BALL VALVES, BOILER DRAINS, CV

WATER SYSTEM

- 1" BLACK PLASTIC WATER PIPE
- 1" BARBED FITTINGS & HOSE CLAMPS
- VSP SUBMERSIBLE PUMP (IF NOT EXISTING)
- PRESSURE TANK (IF NOT EXISTING)
- CYCLE STOP VALVE (IF FIXED SPEED PUMP)

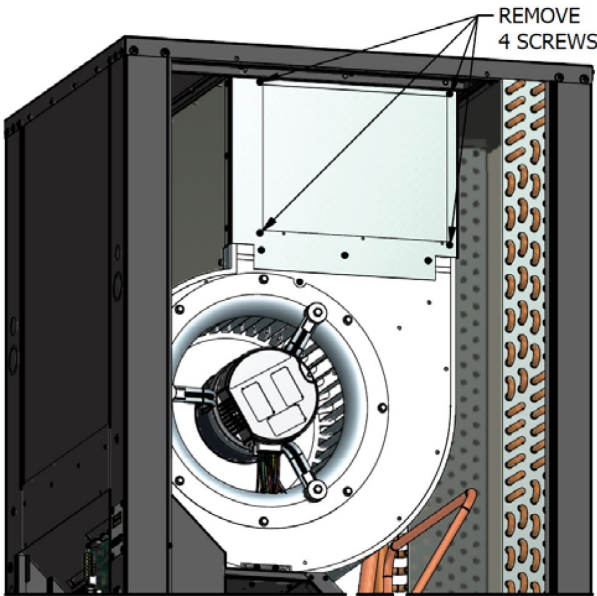
ELECTRICAL

- HEAT PUMP SERVICE WIRE: 6-3 OR 8-3
- PLENUM HEATER SERVICE WIRE
- HEAT PUMP BREAKER
- PLENUM HEATER BREAKER
- THERMOSTAT WIRE 18-8
- THERMOSTAT WIRE 18-2 (PLENUM HEATER)
- FORK TERMINALS FOR TSTAT WIRE (10)
- CONDENSATE PUMP & HOSE (IF REQUIRED)
- 2" STYROFOAM INSUL. (IF PAD NOT PURCHASED)

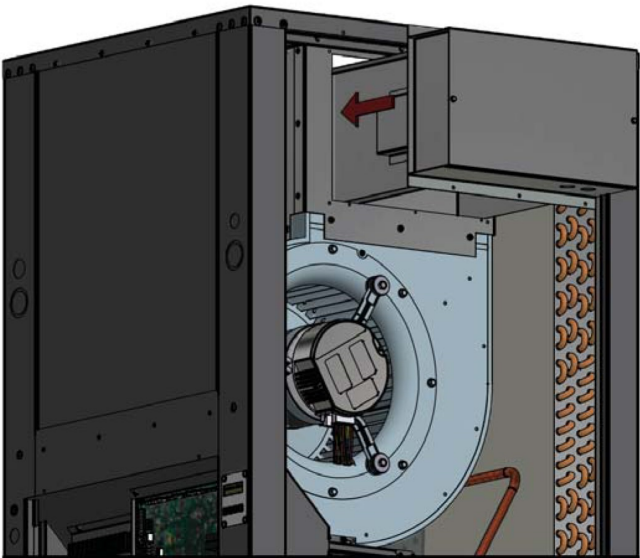
Internal Plenum Heater Installation

R, TF, ATA, ATF, DX, DXTF Series

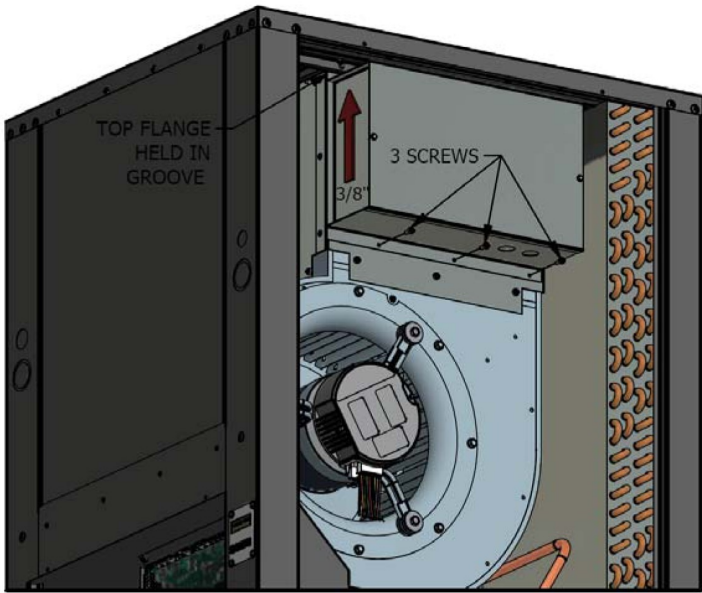
1. Remove four screws as shown, and remove blank panel.



2. Slide plenum heater into cutout until heater flange is flush with blower.



3. Slide plenum heater **UP** approximately 3/8". Top flange of heater is held in top groove of blower assembly and requires no fasteners. Install 3 screws through bottom flange of heater through pre-punched holes in heater and blower assembly.



					Drawn By Dan Rheault	Date 9-Jan-2015	<div><div>MARITIME GEOTHERMAL LTD.</div><div>P.O. Box 2555 170 Plantation Rd. Petitcodiac, NB CANADA E4Z 6H4</div></div>			
					Checked By Dan Rheault	Date 9-Jan-2015				
					Eng. Approved By	Date	Drawing Name Internal Plenum Heater Installation			
					Mfg. Approved By	Date				
01	Initial Release	Dan Rheault	Dan Rheault	9-Jan-2015	Approved By	Date	Size LET	Drawing Number 001915INF	Revision 01	Sheet 1 / 1
REV	ECO#	IMPL BY	APVD BY	DATE						

Wiring

Power Supply Connections

Power supply for the heat pump from the breaker panel is supplied to the unit via concentric 1.093" / 0.875" knockouts. There are also several 7/8" knockouts and a 1/2" opening with plastic grommet (grommet hole is 3/8") for connections to the air thermostat and outdoor loop circulators.

A schematic diagram (SCH) and electrical box layout diagram (ELB) can be found on the electrical box cover of the unit as well as in the [Model Specific Information](#) chapter of this manual. The Electrical Tables in the [Model Specific Information](#) chapter contain information about the wire and breaker size.



IMPORTANT NOTE: A properly qualified electrician should be retained for all connections to the heat pump and associated controls. The connections to the unit MUST CONFORM TO LOCAL CODES.



IMPORTANT NOTE FOR 3-PHASE UNITS: If on startup compressor is noisy and not pumping, reverse L1 and L2 supply wires.

TABLE 4 - Power Supply Connections

Line	Description	Voltages
L1	Line 1	All
L2	Line 2	All
L3	Line 3	3-phase only
N	Neutral	208/230-1-60*, 208-3-60* (optional) 460-3-60 (required)
GND	Ground	All (connect to ground lug)

* Only required if connecting 115VAC circulators.

Auxiliary Plenum Heater: Power Supply Connections

Auxiliary air heat will usually be provided by an electric duct heater (plenum heater). These are available as accessories in 5, 7, 10, 15, and 20 kW sizes, and are installed as previously noted in this manual. The plenum heater will have its own breaker and power supply wire. The Electrical Tables in the [Model Specific Information](#) chapter contain information about the size of wire for the connections, as well as the recommended breaker size.

Auxiliary Plenum Heater: Control Connections

There are two dry contacts to control the 2 stages of the plenum heater. These dry contacts can also be used to control other types of auxiliary air heat. Note that dry contacts are intended to activate equipment that has its own 24VAC transformer; if equipment does not have its own transformer, one will need to be installed in an external electrical box.

Connect the terminals **CP 1 2** on the heat pump terminal strip to the matching terminals on the plenum heater's control board using an 18-3 cable.

NOTE: If plenum heater has a jumper between its terminals **1** and **2**, remove and discard jumper so that plenum heater stages can operate independently.

TABLE 5 - Plenum Heater Control Connections

Signal	Description
CP	Common
1	Dry contact for auxiliary heat stage 1
2	Dry contact for auxiliary heat stage 2
Use a 3-conductor 18ga cable.	

Outdoor Loop Pump Module Wiring (Ground Loop Only)

There are provisions for connecting the ground loop circulator pump module so that the pumps will be turned on whenever the compressor operates. Connect the circulator pump module to the appropriate two terminals (**115V** or **230V**) of the terminal strip marked **Outdoor Circulators** in the heat pump, as per the voltage of the circulator pump module. Ground wires should be connected to the ground lug in the electrical box. Ensure that the total current draw does not exceed the value indicated on the label in the heat pump electrical box.

For **277VAC** and **460VAC** models, only 277VAC circulators may be powered directly from the heat pump. If other voltage circulators are used, they must be powered using an external contactor actuated by the STAGE 1 terminal on the control board (or OV1 signal on DO_0) and the C terminal.

TABLE 6 - Outdoor Loop Circulator Connections

Terminal	Description
115V	Connection for 115V circulator
115V	
230V	Connection for 230V circulator
230V	

Use a 2-conductor 14ga cable.

277	Connection for 265/277V circulator (heat pump voltage codes 3 & 4 only)
277	

Use a 2-conductor 14ga cable.

Control Transformer

The low voltage controls, including the control board, are powered by a 100VA class II transformer. 208/230-1-60 and 208-3-60 models have a resettable breaker on the secondary side for circuit protection. If the breaker trips, correct the problem and then reset the breaker by pressing it.

All other voltage models have primary and secondary fuses for circuit protection.



IMPORTANT NOTE: For 208/230VAC-1-60 units, if connecting to 208VAC power supply move the red wire connected to the 240 terminal of the transformer to the 208 terminal of the transformer.

TABLE 7 - Control Transformer

Voltage	Low Voltage Circuit Protection
(1) 208/230-1-60	Resettable breaker on transformer
(2) 208-3-60	Resettable breaker on transformer
(4) 460-3-60	Primary / Secondary fuses

BACnet Connections

If using BACnet for external control of heating/cooling demand and/or monitoring of status, use a shielded twisted pair to the connector at the bottom left of control board. There is an optional termination jumper located above the connector.

See the [BACnet Interface](#) chapter for details.

TABLE 8 - BACnet Connections

Line	Description
A	Communication +
B	Communication -
GND	Ground
Use a shielded twisted pair cable.	

Air Thermostat Connections

A three-stage heating and two stage cooling heat pump configurable thermostat is required (unless using BACnet). The stages are S1 = stage 1 compressor, S2 = stage 2 compressor and S3 = electric auxiliary (in heating mode only). One can be ordered with the unit, or other 24VAC heat pump thermostats with the same number of stages can be used. The air thermostat connections are located on a terminal strip in the indoor unit. Refer to diagram on a following page for connections between the thermostat and the heat pump.

Care should be taken to ensure that the unit does not trip a safety control in heating or cooling mode if the AR reduction is used in conjunction with lower air flow settings.

TABLE 9 - Air Thermostat Connections

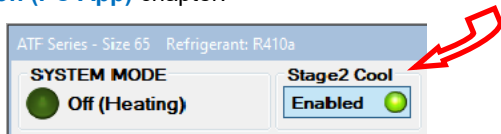
Signal	Description
C	24VAC common (ground)
R	24VAC hot
G	Fan low speed (for air recirculation)
Y1	Compressor ON (part load)
Y2	Compressor bump up to stage 2 (full load)
W2	Heating stage 3 (plenum heater)
O	Cooling mode (reversing valve)
E	Emergency heat (plenum heater)
L	Fault (24VAC when fault condition)

Use an unshielded 18-8 thermostat cable (18ga, 8 conductors).

Air Thermostat Operation

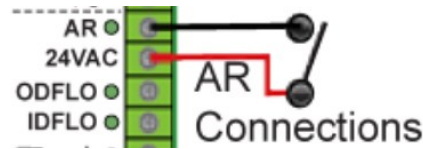
Demand for room heating or cooling through the ducted air system will come from the above thermostat. Refer to the thermostat's manual to set it up for 2-stage heat pump with electric backup, and for details on thermostat operation.

In heating dominant climates, better cooling mode dehumidification can be achieved by disabling compressor stage 2 in cooling. Then cooling mode will always operate at 67% compressor capacity, and longer run times will result. This setting must be made through the PC App's Control Panel; see [PC Application \(PC App\)](#) chapter.



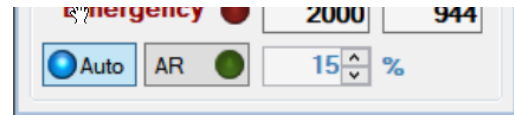
Airflow Reduction for Zoning

For zoning purposes, airflow may be reduced by a switch or dry contact using the connections on the right side of the control board. The dry contact may be from a relay and interconnected thermostats, or more commonly a zone controller.



The default reduction is 15%, but it may be adjusted from 5%-20% using the **View-->Indoor Fan** window in the PC App. See [PC Application](#) chapter. For airflow values including the reduction, see the **Indoor Airflow Data** table in the [Model Specific Information](#) chapter.

For more zoning advice, see [Ductwork](#) chapter.



Open/Closed Loop Wiring

There are two low pressure safety settings in the heat pump: 75 psi for open loop (water), and 55 psi for closed loop (antifreeze). As shipped, the closed loop LPC will be active.

If an open loop is used, it is very important to remove the jumper plug located in the wiring harness behind the piping post, and replace it with the water valve connection harness that comes with the water valve from Maritime Geothermal. This will automatically select the higher low pressure cutoff setting, and ensure that the heat pump is properly protected from freezing. It will also ensure the water valve is open before starting the compressor.



WARNING: Connecting an open loop water valve without a harness provided by Maritime Geothermal could lead to frozen and ruptured heat exchanger, voiding the warranty.

Domestic Hot Water (Desuperheater)

The desuperheater function for domestic hot water heating is pre-wired and no field connections are necessary. There is a built-in temperature switch to turn off the built-in DHW circulator when the output temperature reaches 140°F (60°C), and on again when the temperature falls to 120°F (49°C).

After the desuperheater is filled with water and purged of air, activate the built-in DHW circulator by connecting the brown wire with the blue insulated terminal to L1 of the compressor contactor as shown on the wiring diagram in the [Model Specific Information](#) chapter. **Ensure the power is off when connecting the wire.** Also, turn on the DHW ON/OFF switch.

Disable Switch (field installed)

A switch to disable demand from the control system may be installed. On control board, jumper COM_IN to GND, and toggle 12VDC to IN_SPARE to disable. See wiring diagram in the [Model Specific Information](#) chapter.

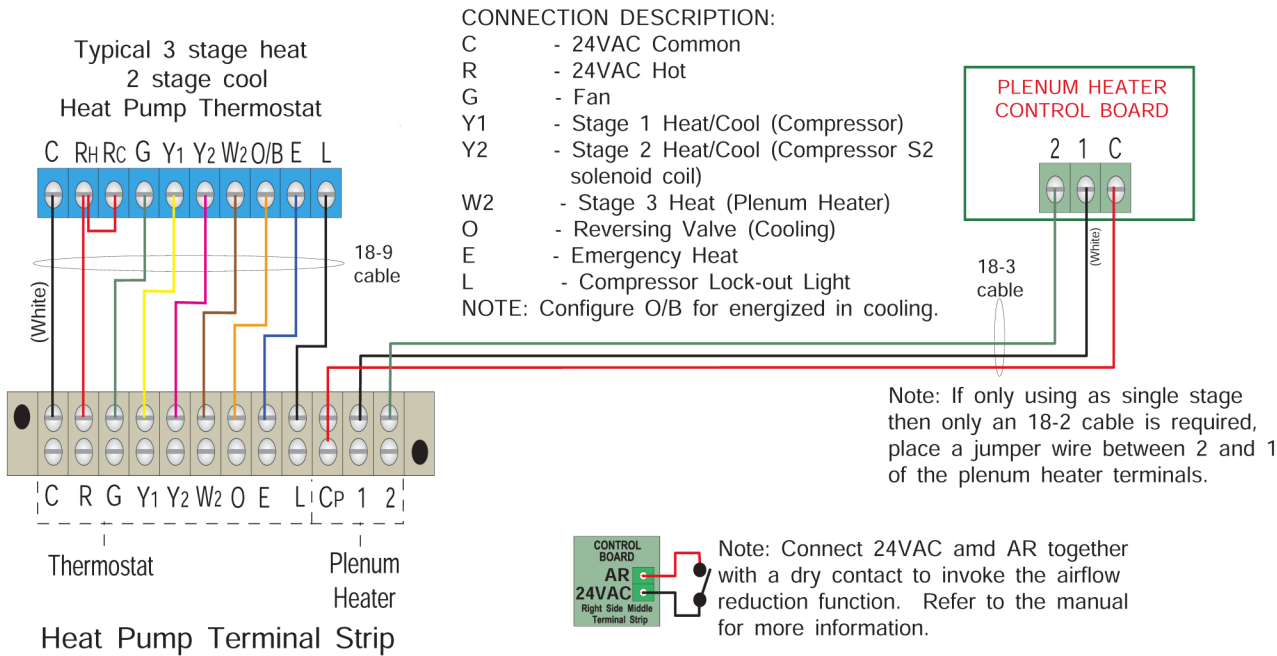
Refrigerant Vent Fan Connections

A 24VAC board output (labelled SOL#2) is available for activating a ventilation fan or alarm in case refrigerant is detected inside the enclosure.

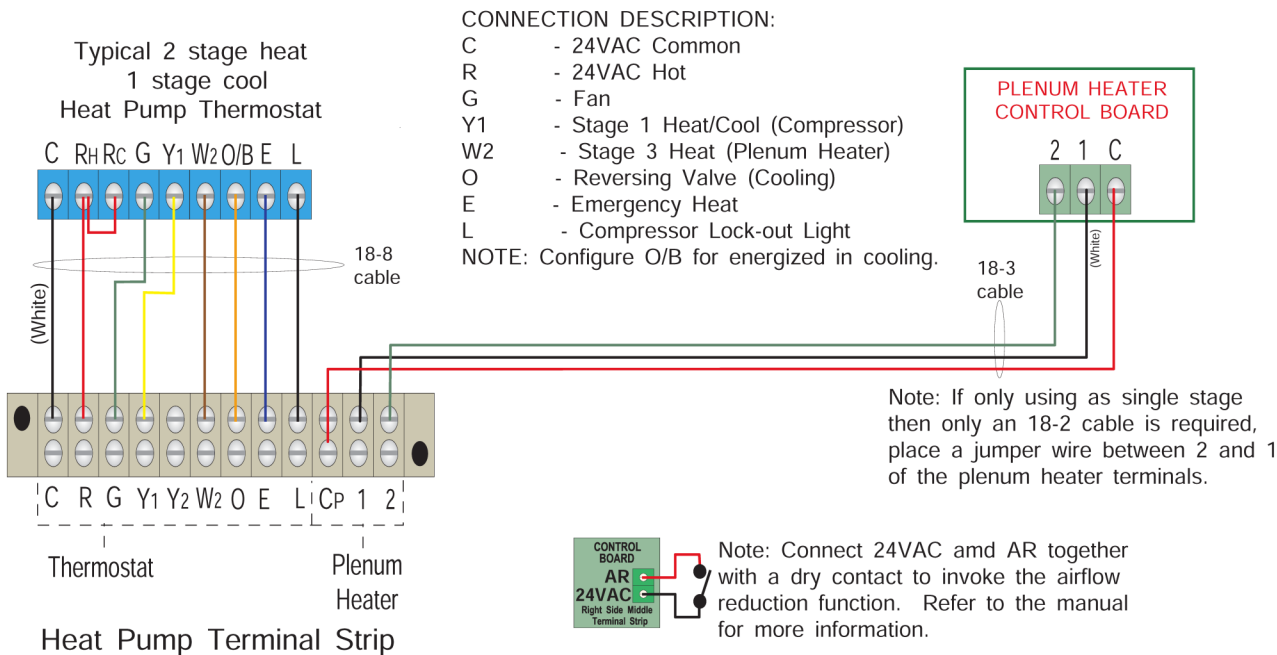
See wiring diagram in the [Model Specific Information](#) chapter.

Typical Thermostat Connections to GEN2 Control Board

Two-Stage Models (Compressor Stages = T)



Single-Stage Models (Compressor Stages = S)



					Drawn By Chris Geddes	Date 21 APR 2016	MARITIME GEOTHERMAL LTD. 170 Plantation Rd. Petitcodiac, NB E4Z 6H4	Typical Thermostat Connections to GEN2 Control Board		
					Checked By Chris Geddes	Date 21 APR 2016				
					Approved By (ENG) Chris Geddes	Date 21 APR 2016				
					Approved By (MFG)	Date				
01	Initial Release	C. GEDDES	C. GEDDES	21 APR 2016	Approved By	Date	Size A	Drawing Number 002071CDG	Drawing Rev 01	SHEET 1 of 1
REV	ECO #	IMPL BY	APVD BY	DATE						

Piping

Domestic Hot Water (Desuperheater) Connections

The connections for the DHW circuit are 1/2" brass FPT fittings. They are marked DHW IN and DHW OUT.

A typical piping diagram for a pre-heat tank configuration can be found in document **000970PDG** at the end of this chapter. Be sure to note the position of the check valve and the direction of water flow. Other configurations are possible, and there may be multiple units tied together in larger buildings.



WARNING: USE ONLY COPPER LINES TO CONNECT THE DESUPERHEATER. TEMPERATURES CAN BE >200°F NEAR THE UNIT WITH DESUPERHEATER TURNED OFF, POTENTIALLY MELTING & RUPTURING PLASTIC PIPING.

Ensure the tank is filled with water and under pressure before activating the built-in DHW circulator as described below. First, slightly loosen the boiler drain on the DHW Out pipe to allow air to escape from the system. This step will make certain that the domestic hot water circulator in the unit is flooded with water when it is started.



CAUTION: the domestic hot water pump is water lubricated; damage will occur to the pump if it is run dry for even a short period of time.

Activate the built-in DHW circulator by connecting the brown wire with the blue insulated terminal to L1 of the compressor contactor. **Ensure the power is off when connecting the wire.** Once connected the DHW switch on the front of the unit may be used to enable/disable the domestic hot water circulator.

The DHW loop may have to be purged of air several times before good circulation is obtained. A temperature difference between the DHW In and DHW Out can be felt by hand when the circulator pump is operating properly.

For the pre-heat tank setup, the final tank should be set to **140°F (60°C)**, which is required by most codes. The pre-heat tank does not require electric elements. This setup takes full advantage of the desuperheater as it is the sole heat provider to the pre-heat tank. The desuperheater remains active during the compressor runtime until the pre-heat tank has been completely heated by the desuperheater alone. This setup is more energy efficient than a single tank setup, and eliminates the possibility of reverse heating of the refrigerant gas under low condensing temperature operating conditions.



CAUTION: If two (2) shut-off valves are located on the domestic hot water lines as shown in the diagram, a pressure relief valve must be installed to prevent possible damage to the domestic hot water circulator pump should both valves be closed.

Note that connection and use of the desuperheater is optional, and there is no problem for the heat pump if desuperheater is left unconnected.

Condensate Drain

The unit comes equipped with one 3/4" female PVC socket drain connection. This drain allows the condensate which forms during the air conditioning cycle to be removed from the unit. The drain should be connected and vented as per local codes. During high humidity weather, there could be as much as 25 gallons of water formed per day.

R-series: The condensate drain is internally trapped and does not require an external trap.

RH-series: The condensate drain is **not** internally trapped, and an external trap and vent must be installed.

An external condensate pump may be installed if there is not sufficient slope to drain condensate under gravity to its destination.

To avoid overflow of the condensate pan, the drain line and trap should be inspected periodically to ensure they are not plugged with accumulated debris. There is an alarm for condensate overflow, which will disable unit operation.

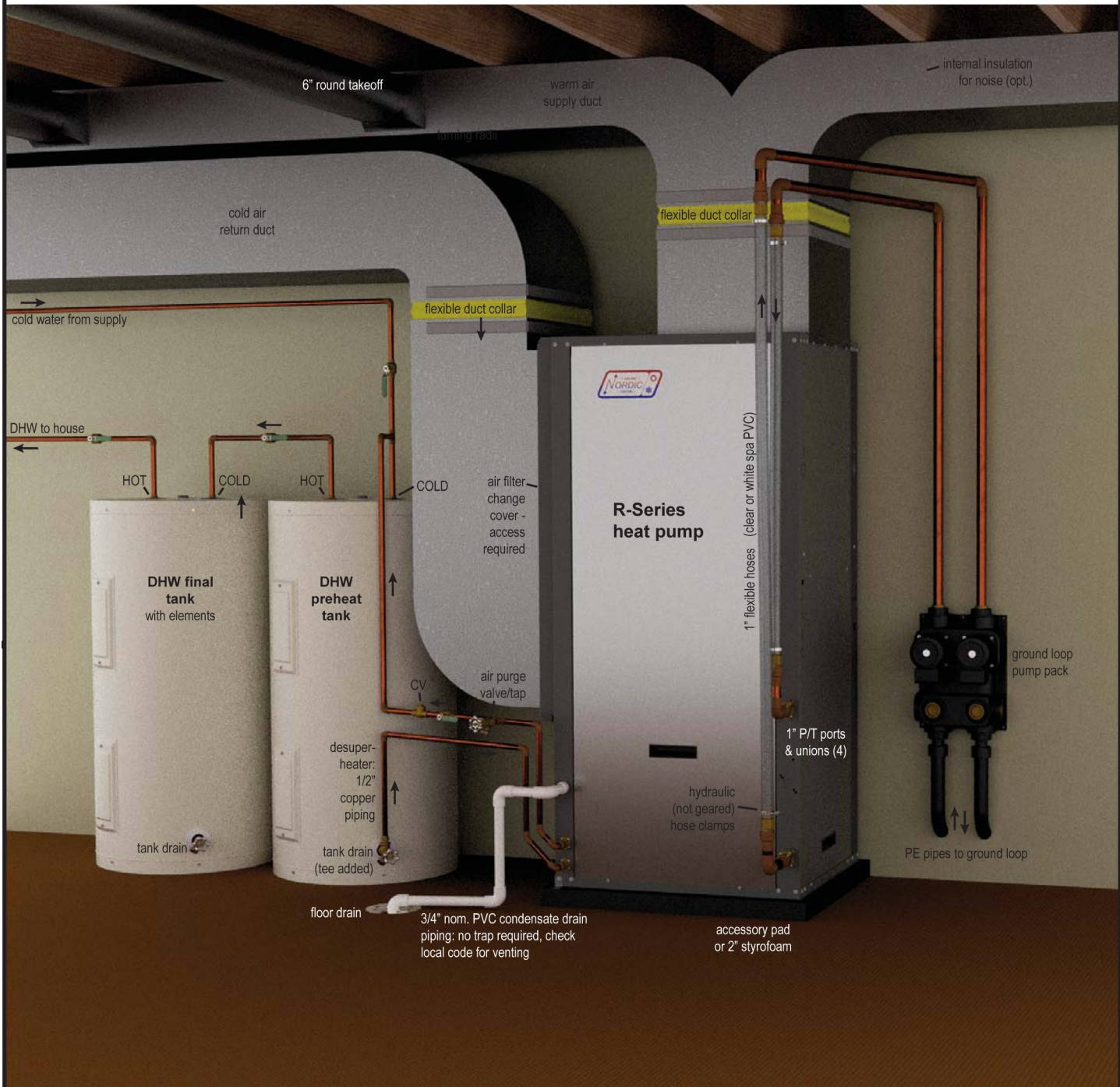
See following page and also **Ductwork** chapter for diagrams showing the condensate drain connection.

Outdoor Loop

The connections for the Outdoor Loop circuit are 1" brass female NPT. They are labelled **OUTDOOR IN** and **OUTDOOR OUT**.

See the following chapters for details on ground loop and open loop installations.

Typical Loop Connections - R Series



See other diagrams and instructions in the manual for design, selection, and installation details of ground loop and hydronic heating accessories. Many of the items illustrated in this diagram are available as accessories from Maritime Geothermal Ltd.. Other items are commonly available from plumbing or HVAC wholesalers.

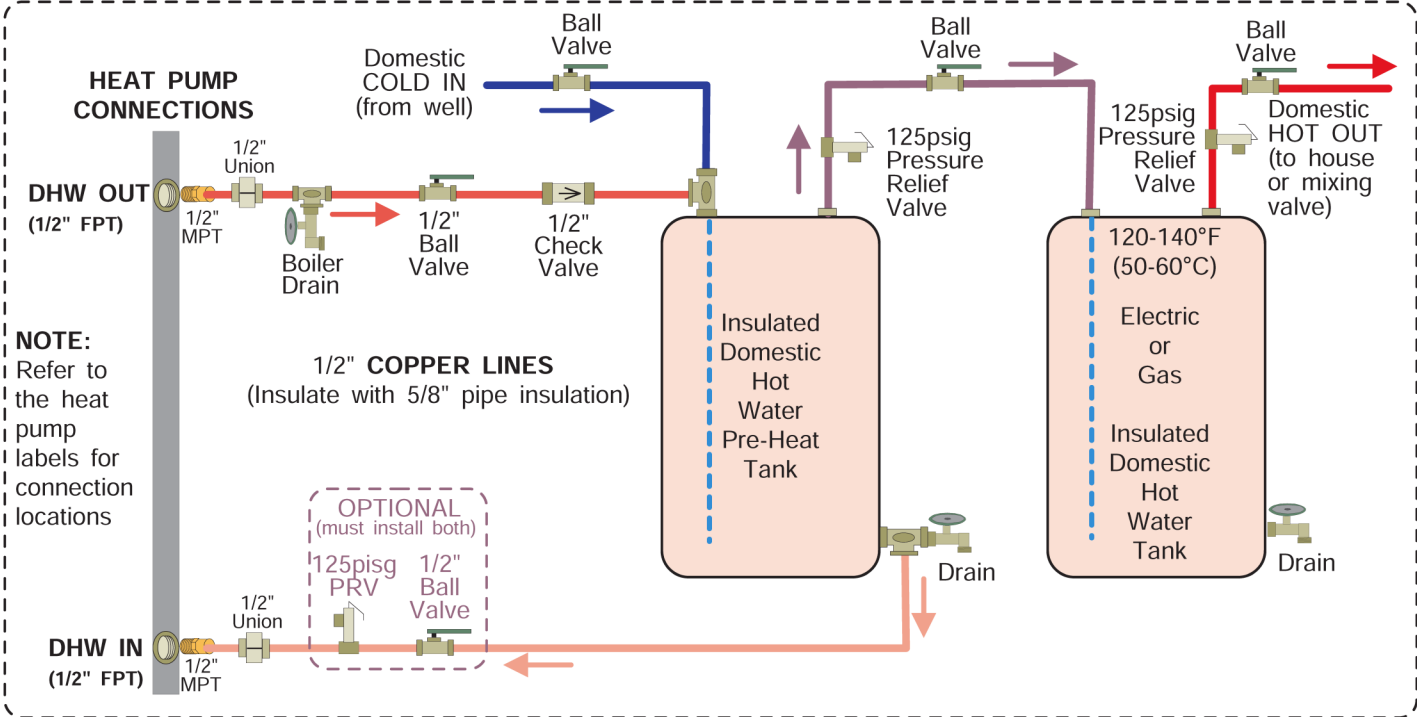
There are some valid connection methods or details which differ from those shown, including:

- Open loop installation, which uses a well water system in place of a ground loop.
- Piping routed differently from that shown, or different piping & component types.

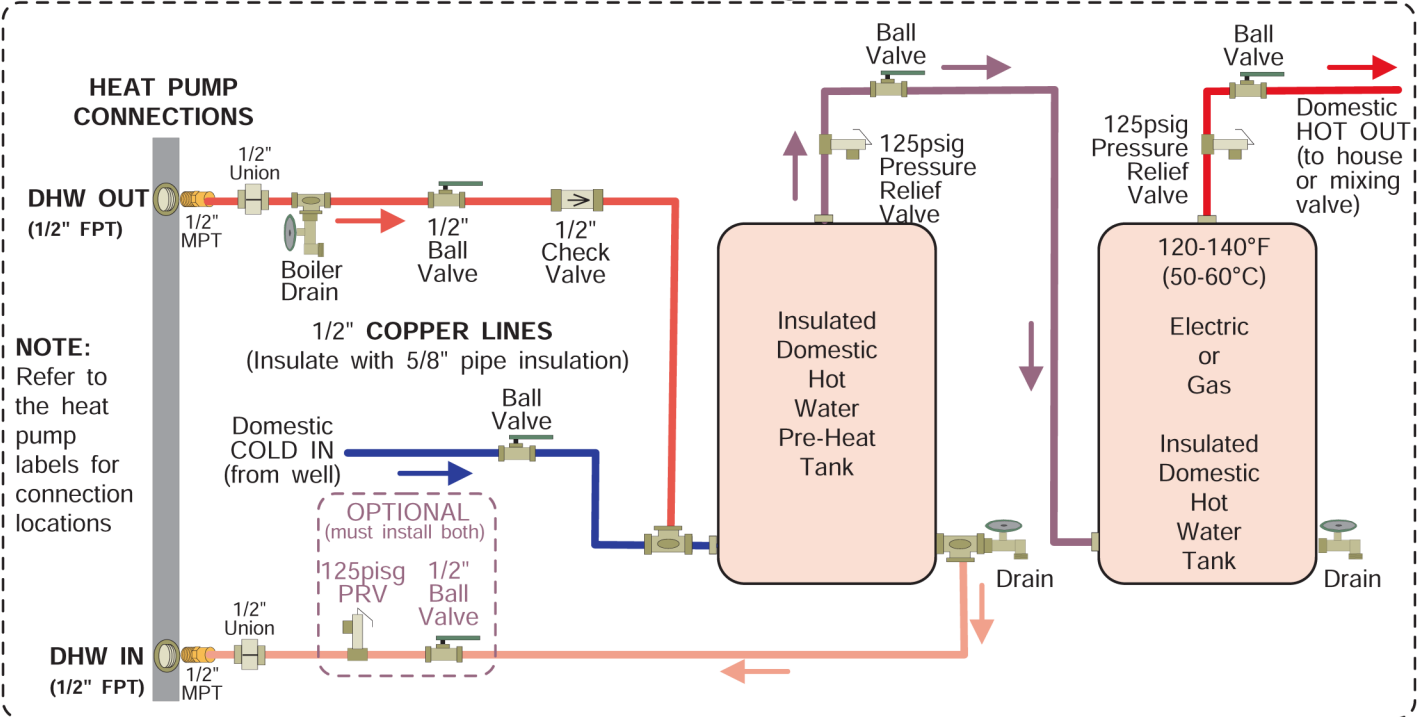
Piping routed differently from that shown, or different piping & component types.					Drawn By Dan Rheault	Date 6-Apr-2021	<div><div>MARITIME GEOTHERMAL LTD.</div><div>P.O. Box 2555 170 Plantation Rd. Petitcodiac, NB CANADA E4Z 6H4</div></div> <div>Drawing Name Typical Loop Connections - R Series</div> <div><div>Size</div><div>LET</div></div> <div><div>Drawing Number</div><div>002511PDG</div></div> <div><div>Revision</div><div>01</div></div> <div><div>Sheet</div><div>1 / 1</div></div>			
					Checked By Dan Rheault	Date 6-Apr-2021				
					Eng. Approved By	Date				
					Mfg. Approved By	Date				
01	Initial Rel.	Dan Rheault	Dan Rheault	6-Apr-2021	Approved By	Date				
REV	ECO#	IMPL BY	APVD BY	DATE						

Desuperheater Connection to DHW Pre-Heat Tank

Top Port Configuration



Side Port Configuration



					Drawn By Chris Geddes	Date 10 MAR 09	MARITIME GEOTHERMAL LTD.			170 Plantation Rd. Petitcodiac, NB E4Z 6H4			
					Checked By Chris Geddes	Date 10 MAR 09							
01a	Re-titled	D. RHEAULT	D. RHEAULT	15 JAN 19	Approved By Chris Geddes	(ENG) Date 10 MAR 09	Drawing Name Single Unit Connection to DHW Pre-Heat Tank (Brass FPT)						
01	Initial Release	C. GEDDES	C. GEDDES	10 MAR 09	Approved By	(MFG) Date							
REV	ECO #	IMPL BY	APVD BY	DATE	Approved By	Date	Size A	Drawing Number 000970PDG	REV 01a	SHEET 1 of 1			

Ductwork

Blower Motor

The indoor unit is equipped with a direct drive ECM blower. The motor features a soft start function, and will maintain the programmed airflow up to the maximum external static value.

The airflow can be set in increments of 100cfm within an allowed range using the **Indoor Fan** page of the **PC App**. Airflow will be reduced with decreasing outdoor temperature, to avoid progressively cooler heated air being delivered as heat pump capacity decreases due to cold weather.

Air Duct Zoning

Air zoning can be done with heat pumps that have 2-stage compressors, but only to a limited extent. With ducted air zoning, no zone should be less than 1/3 the total area, to avoid problems of high airflow and noise through one zone or safety control trips due to capacity mismatch between heat pump and zones.

The airflow can be reduced by an adjustable amount between 5 and 20% (value set in **PC App**) by making a dry contact across **24VAC** and **AR** on the right side middle terminal strip of the control board, as shown in **Wiring** chapter.

When only one zone of 50% or less is calling for heating or cooling, the compressor should be limited to **stage 1** operation by the zone controller by sending only a **Y1** (without Y2) control signal. Stage 1 corresponds to ~67% compressor capacity and ~80% airflow.

Refer to **Airflow Data** in the **Model Specific Information** chapter for actual airflows with the various reductions.

Duct Systems - General

Ductwork layout for a heat pump will differ from traditional hot air furnace design in the number of leads and size of main trunks required. Air temperature leaving the heat pump is normally **95°-105°F (35-40°C)**, much cooler than that of a conventional fossil fuel furnace. To compensate for this, larger volumes of lower temperature air must be moved and consequently duct sizing must be able to accommodate the greater airflow without creating a high static pressure or high velocity at the floor diffusers.

A duct system capable of supplying the required airflow is of utmost importance. Maritime Geothermal Ltd. recommends that the external static pressure from the duct system be kept below 0.2 inches of water total. In some instances the number of floor diffusers will actually double when compared to the number that would be used for a hot air oil-fired furnace. Refer to following tables.

1. Generally allow **100 cfm** for each floor grill.
2. All leads to the grills should be 6" in diameter (28sq.in. each).
3. The main hot air trunks should be at least 75% of the cross sectional area of leads being fed at any given point.
4. Return air grills should have a minimum of the same total cross sectional area as the total of the supply grills.
5. The cross sectional area of the return trunks should equal the cross sectional area of the grills being handled at any given point along the trunk.

It is **VERY IMPORTANT** that all turns in both the supply trunks and the return trunks be made with **TURNING RADII**. Air act like a fluid and, just like water, pressure drop is increased when air is forced to change direction rapidly around a sharp or irregular corner.

Flexible collars should be used to connect the main trunks to the heat pump. This helps prevent any vibrations from travelling down the ductwork. If a plenum heater is installed, the col-

lar should be at least 12" away from the heater elements.

If desired, the first 5-10 feet of the main supply trunks can be insulated internally with acoustical duct insulation to further inhibit any noise from the unit from travelling down the ductwork. If a plenum heater is installed, insulation should not be placed within 12" of the heater elements.

Duct Systems - Grill Layout

Most forced air heating systems in homes have the floor grills placed around the perimeter of the room. Supply grills should be placed under a window when possible to help prevent condensation on the window. Supply grill leads should be 6" in diameter (28 square inches each) to allow **100 cfm** of airflow.

In a typical new construction, there should be one supply grill for every 100 square feet of area in the room. When rooms require more than one grill, they should be placed in a manner that promotes even heat distribution, such as one at each end of the room. It is a good idea to place a damper in each grill supply or place adjustable grills so that any imbalances in the heat distribution can be corrected.

The total number of supply grills is based on the heat pump's nominal airflow. The table shows the number of grills recommended per heat pump size.

TABLE 10 - Number of Air Grills	
Model	# of Grills (@100 cfm)
45	12
55	15
65	19
75	21

Return grills should be mounted on the floor. At minimum they should be the same size as the supply grill, **it is highly recommended that they be 25% to 50% larger than the total supply**. They should be placed opposite the supply grills when possible to ensure distribution across the room. For rooms requiring more than one supply grill, it may be possible to use one larger return grill if it can be centrally positioned opposite of the supply grills, however it is preferred to have one return for each supply to optimize heat distribution across the room.

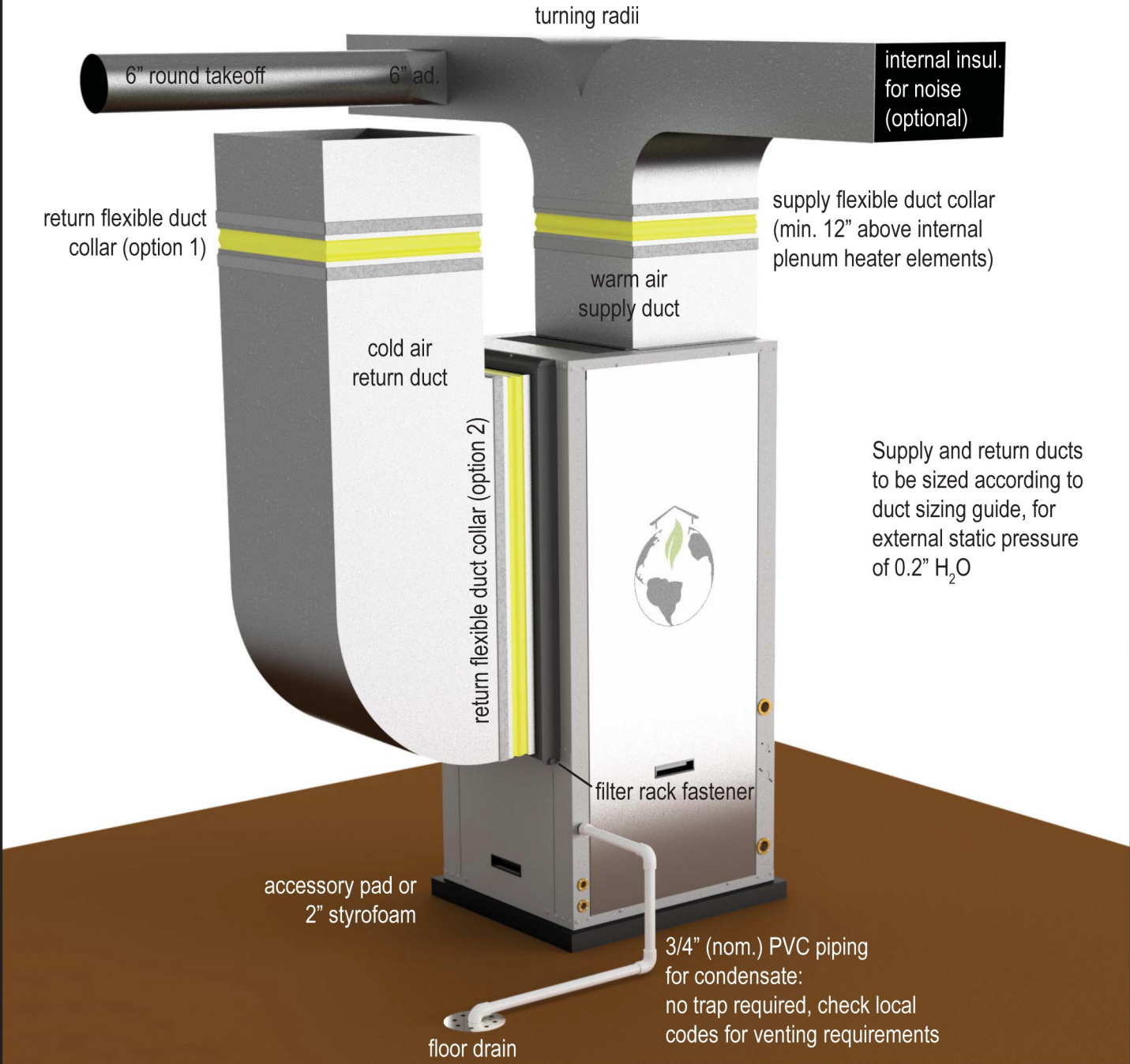
Thermostat Location

Most homes are a single ducted air zone with one thermostat. The thermostat should be centrally located within the home, typically on the main floor. It should be placed away from any supply grills, and should not be positioned directly above a return grill. Most installations have the thermostat located in a hallway, or on the inner wall of the living room. It should be noted that most homes do not have any supply ducts in the hallway. This can lead to a temperature lag at the thermostat if there is very little air movement in the hallway, causing the home to be warmer than indicated by the thermostat.

Plenum Heater

The plenum heater will be usually installed inside the heat pump, as described in the **Installation Basics** chapter. If the blower is installed in the side discharge position, the plenum heater will be installed in the discharge ductwork outside the unit, at least 12" away from any flexible duct collars. There is an accessory plenum heater with a wider cage profile available that is more suitable for duct installation.

Typical Duct & Condensate Connections - R Series



Note that proper duct system design is VERY IMPORTANT, since this is how the heat pump delivers heat into the living space.

					Drawn By Dan Rheault	Date 15-May-2017	<div>MARITIME GEOTHERMAL LTD.<div>P.O. Box 2555 170 Plantation Rd. Petitcodiac, NB CANADA E4Z 6H4</div></div>			
					Checked By Dan Rheault	Date 15-May-2017				
					Eng. Approved By	Date	Drawing Name Typical Duct & Condensate Connections - R Series			
					Mfg. Approved By	Date				
02	-	Dan Rheault	Dan Rheault	15-May-2017	Approved By	Date	Size LET	Drawing Number 001201PDG	Revision 02	Sheet 1 / 1
01	Initial Rel.	Chris Geddes	Chris Geddes	22-Jan-2008						
REV	ECO#	IMPL BY	APVD BY	DATE						

TABLE 11 - Duct Sizing Guide (external static of 0.20" H₂O)

Airflow (CFM)	Minimum Duct Area (sq.in)	Diameter (in)	Rectangular Equivalents (in)						Return Air Diameter (in)	Airflow (L/s)
37	20	5	2.25 x 10	3 x 8	3.5 x 6	4 x 5.5	5 x 5		← 5	17
63	20	5	2.25 x 10	3 x 8	3.5 x 6	4 x 5.5	5 x 5		↗ 6	30
100	28	6	3.25 x 10	4 x 8	5 x 6	5.5 x 5.5	6 x 6		← 7	47
152	38	7	3.25 x 14	4 x 11	5 x 8.5	6 x 7	6.5 x 6.5		← 8	72
212	50	8	4 x 15	5 x 12	6 x 10	7 x 8	8 x 8		← 9	100
226	50	8	4 x 15	5 x 12	6 x 10	7 x 8	8 x 8		↗ 10	107
277	64	9	5 x 15	6 x 12	7 x 10	8 x 9	8.5 x 8.5		← 10	131
304	64	9	5 x 15	6 x 12	7 x 10	8 x 9	8.5 x 8.5		↗ 12	143
393	79	10	6 x 15	7 x 13	8 x 11	9 x 10	9.5 x 9.5		← 12	185
411	113	12	7 x 18	8 x 16	9 x 14	10 x 12	11 x 11		← 12	194
655	113	12	7 x 18	8 x 16	9 x 14	10 x 12	11 x 11		↗ 14	309
680	154	14	8 x 22	9 x 19	10 x 17	11 x 15	12 x 14	13 x 13	← 14	321
995	154	14	8 x 22	9 x 19	10 x 17	11 x 15	12 x 14	13 x 13	↗ 16	470
1325	201	16	8 x 30	10 x 22	12 x 18	14 x 16	15 x 15		← 18	625
1450	201	16	8 x 30	10 x 22	12 x 18	14 x 16	15 x 15		↗ 20	684
1750	254	18	8 x 40	10 x 30	12 x 24	14 x 20	16 x 17	16.5 x 16.5	← 20	826
2000	254	18	8 x 40	10 x 30	12 x 24	14 x 20	16 x 17	16.5 x 16.5	↗ 22	944
2250	314	20	10 x 38	12 x 30	14 x 26	16 x 22	18 x 19	18.5 x 18.5	← 22	1062
2600	314	20	10 x 38	12 x 30	14 x 26	16 x 22	18 x 19	18.5 x 18.5	↗ 24	1227
2900	380	22	12 x 36	14 x 30	16 x 26	18 x 23	20 x 20		← 24	1369
3400	380	22	12 x 36	14 x 30	16 x 26	18 x 23	20 x 20		↗ 26	1605
3600	452	24	14 x 38	16 x 32	18 x 28	20 x 25	22 x 22		← 26	1699
4300	452	24	14 x 38	16 x 32	18 x 28	20 x 25	22 x 22		↗ 28	2029
5250	531	26	16 x 38	18 x 32	20 x 30	22 x 24	24 x 24		← 30	2478
6125	616	28	18 x 38	20 x 34	22 x 30	24 x 28	26 x 26		← 32	2891
6500	616	28	18 x 38	20 x 34	22 x 30	24 x 28	26 x 26		↗ 34	3068
7250	707	30	20 x 40	22 x 38	24 x 32	26 x 30	28 x 28		← 34	3422
7800	707	30	20 x 40	22 x 38	24 x 32	26 x 30	28 x 28		↗ 36	3681
8500	804	32	22 x 40	24 x 38	26 x 34	28 x 32	30 x 30		← 36	4012
9200	804	32	22 x 40	24 x 38	26 x 34	28 x 32	30 x 30		↗ 38	4342
9800	908	34	24 x 42	25 x 40	26 x 38	28 x 34	30 x 32	31 x 31	← 38	4625
10900	908	34	24 x 42	25 x 40	26 x 38	28 x 34	30 x 32	31 x 31	↗ 40	5144
			28 x 40	30 x 36	32 x 34	33 x 33			←	
			30 x 42	32 x 38	34 x 36	35 x 35			←	
			30 x 45	34 x 40	36 x 38	37 x 37			←	

Ground Loop Installations

Refer to diagrams **000608INF** & **000609INF** at the end of this chapter for typical ground loop configurations. They are for reference only, and should not be used to replace formal training and computerized loop design.

Once the ground loop has been pressure tested and the header pipes have been connected to the circulator pump module, the heat pump can be connected to the circulator pump module. **The port connections for the Outdoor Loop are 1" brass FNPT fittings. They are marked as OUTDOOR IN and OUTDOOR OUT.**

Circulator Pump Module

Maritime Geothermal Ltd. offers compact pump modules with built in three way valves to facilitate filling and purging the ground loop. Refer to drawing **000906CDG** at the end of this chapter. Alternatively, Grundfoss Model UPS 26-99 or Taco Model 0011 pumps or other brands with similar pumping capability may be used. The single pump module will typically handle systems up to 3 tons (model sizes 25, 35, and 45); the two pump module will typically handle 4 to 6 ton systems (model sizes 55, 65, 75, 80). This is based on a typical parallel system with one circuit per ton.

Maritime Geothermal recommends calculating the total pressure drop of the ground loop (including headers, indoor piping and heat pump exchanger drop) based on the antifreeze type and concentration at the desired minimum loop temperature. A pump module that can deliver the flow required for the unit at the calculated total pressure drop should be selected. Refer to the [Model Specific Information](#) chapter for unit flow requirements.

Loop pressure drops can be calculated using software such as those mentioned in the Horizontal Ground loops chapter, or can be calculated in a spreadsheet using the pipe manufacturer's pressure drop tables for pipe diameter and fittings.

The circulator pump module must be connected to the heat pump Outdoor Loop ports with a lineset suitable for the flow required with minimum pressure drop. 1" rubber or plastic lines should be used.

The installation of P/T plugs/ports (pressure / temperature, pronounced "Pete's plugs") is recommended on both the entering and leaving lines at the heat pump. This will allow the installer or homeowner to check water flow through the loop by measuring the pressure difference through the heat exchanger and comparing it to that listed in the [Model Specific Information](#) chapter. P/T ports, adapters, and gauge adapters are available as accessories from Maritime Geothermal Ltd..

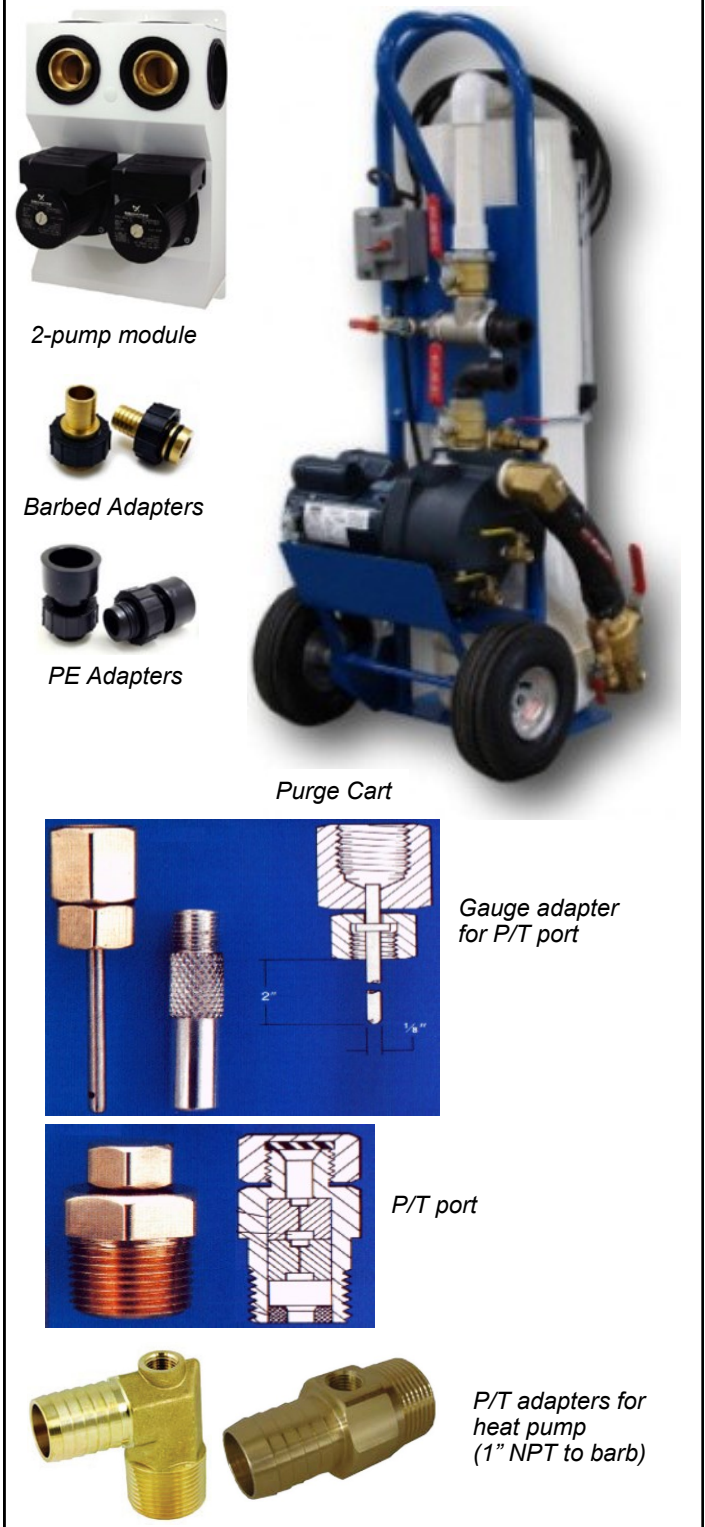
Flushing & Purging

Once the groundloop has been installed and all connections are completed between the heat pump, circulator pump module and ground loop, the entire ground loop system should be **pressure tested with air to 100 PSIG** to make sure there are no leaks on any of the inside fittings. Soap all joints and observe that the pressure remains constant for 1 hour.

When satisfied that all connections are leak free, release the air pressure and connect a purge cart (see [Figure 1](#)) to the flushing access ports at the pump module (refer to drawing **000906CDG**). A temporary flushing system can alternately be constructed using a 45 gal. barrel and a pump with sufficient volume and head capability to circulate fluid at a **velocity of at least 2 ft/min** through all parts of the loop.

Adjust the circulator pump module valves to connect the purge cart to the ground loop. Begin pumping water through the ground loop, ensuring that the intake of the pump stays submerged at all times by continuously adding water. Water flowing back from the return line should be directed below the water level in the barrel or flush tank to prevent air being mixed with the outgoing water.

Figure 1: Ground Loop Accessories & Tools



Once the lines have been filled and no more air bubbles are appearing in the line, adjust the circulator pump module valves to circulate water through the heat pump using the same technique as described above. When all air is removed reverse the flow of water through the lines by interchanging the flush cart lines and purge again. You will be able to visibly tell when all air is removed.

Adding Antifreeze Solution

In most mid and northern areas of the US and in all of Canada it is necessary to condition the loop fluid by the addition of some type of antifreeze solution so that it will not freeze during operation in the winter months. This antifreeze is required because the loop fluid will normally reach a low entering temperature of **28°F to 32°F (-2°C to 0°C)** and refrigerant temperatures inside the heat pump's heat exchanger may be as low as **20°F (11°C)** cooler. See following table for details of freeze protection provided by different concentrations.

TABLE 12 - Antifreeze Percentages

BY VOLUME				
Protection to:	10°F	15°F	20°F	25°F
Methanol	25%	21%	16%	10%
Propylene Glycol	38%	30%	22%	15%
BY WEIGHT				
Protection to:	10°F	15°F	20°F	25°F
Methanol	16.8%	13.6%	10%	6.3%
Propylene Glycol	30%	23.5%	18.3%	12.9%



WARNING: Add enough antifreeze to allow for a temperature 20°F (11°C) lower than the expected lowest loop fluid temperature entering the heat pump. Insufficient antifreeze concentration could cause the heat exchanger to freeze and rupture, voiding the warranty.

Although many different antifreeze solutions have been employed in geothermal systems, the alcohols such as methanol or ethanol have the most desirable characteristics for groundloop applications. The overall heat transfer characteristics of these fluids remain high although care must be taken when handling pure alcohols since they are extremely flammable. Once mixed in a typical 25% by volume ratio with water the solution is not flammable. In situations where alcohols are not allowed as a loop fluid due to local regulations then propylene glycol is a non-toxic alternative which can be substituted. Propylene glycol should only be used in cases where alcohols are not permitted since the heat transfer characteristics are less desirable and it becomes more viscous at low temperatures, increasing pumping power.

The volume of fluid that your loop system holds can be closely estimated by totaling the number of ft. of each size pipe in the system and referencing the following table for approximate volume per 100 ft.

When the volume of the loop has been calculated and the appropriate amount of antifreeze is ready for addition by referencing the table, drain the equivalent amount of water from the flush cart or mixing barrel and replace it with the antifreeze.

TABLE 13 - Volume of fluid per 100 ft. of pipe

		Volume /100ft.		
Type of Pipe	Diameter	l.gal	gal	L
Copper	1"	3.4	4.1	15.5
	1-1/4"	5.3	6.4	24.2
	1-1/2"	7.7	9.2	34.8
Rubber Hose	1"	3.2	3.9	14.8
Polyethylene	3/4" IPS SDR11	2.3	2.8	10.6
	1" IPS SDR11	3.7	4.5	17.0
	1-1/4" IPS SDR11	6.7	8.0	30.3
	1-1/2" IPS SDR11	9.1	10.9	41.3
	2" IPS SDR11	15.0	18.0	68.1
Other Item Volumes				
Heat Exchanger	Average	1.2	1.5	5.7
Purge Cart Tank	See cart manual	TBD		

When using alcohols, be sure to inject below the water line to reduce initial volatility of the pure antifreeze. If the loop is large it may be necessary to refill the tank with antifreeze several times to get all the antifreeze into the loop. Pump the loop for 5 to 10 minutes longer to ensure the remaining fluid has been well mixed.

Initial Pressurization

At this point open all valves in the flow circuit and slowly close off the supply and return flush cart valves in a manner that leaves about **20-30 psig.** on the system. If an air bladder expansion tank is used it should be charged to the above pressure before actual water pressure is put on the system. Systems without an expansion tank will experience greater fluctuations in pressure between the heating and cooling seasons, causing pressure gauges to have different values as the loop temperature changes. This fluctuation is normal since expansion and contraction of the loop fluid must be handled by the elasticity of the plastic loop.

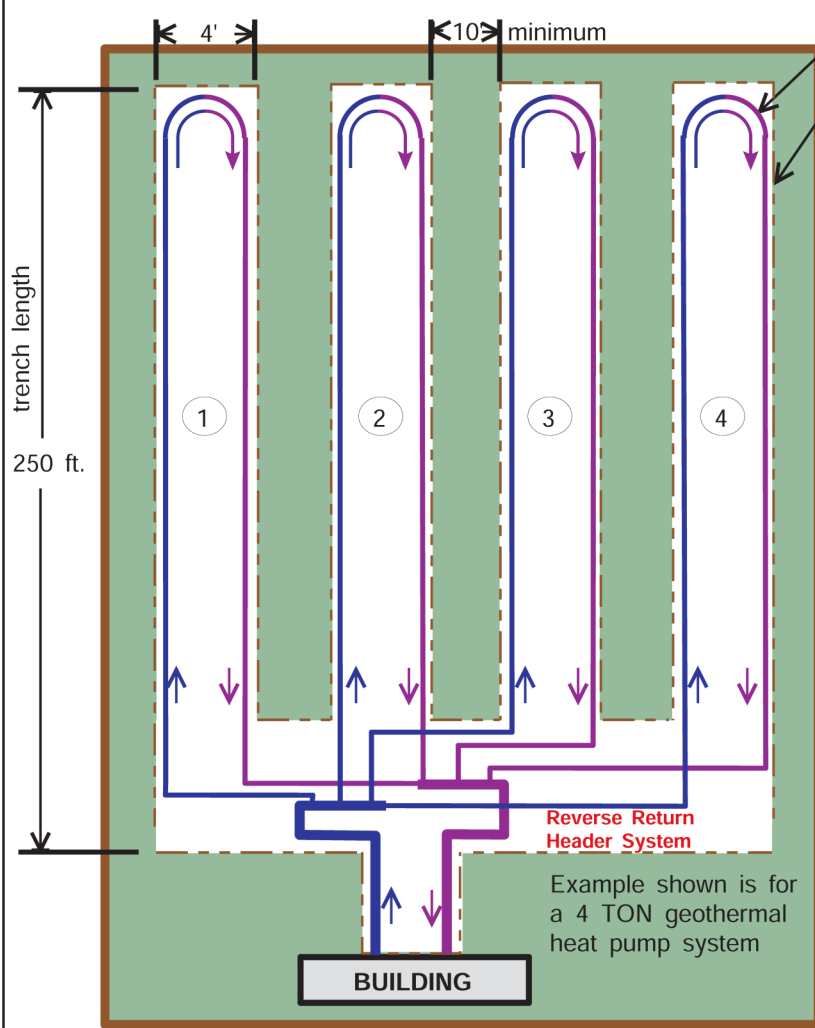
- Pressurize the loop to a static pressure of **45 psig.** when installing a system in the fall going into the heating season.
- Pressurize the loop to a static pressure of **25 psig.** when installing a system in the spring or summer going into the cooling season.

After operating the heat pump for a period of time, any residual air in the system should be bled off and the static pressure should be verified and adjusted if necessary. Add additional water / antifreeze mix with the purge cart to bring the pressure back to the original setting if required.

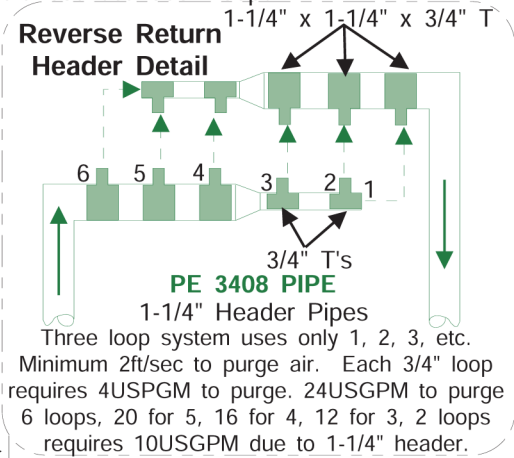
Pipe Insulation

All ground loop piping inside the structure (between the structure entry point and the heat pump) should be insulated with 3/8" thick closed cell pipe insulation to prevent condensation and dripping onto floors or walls.

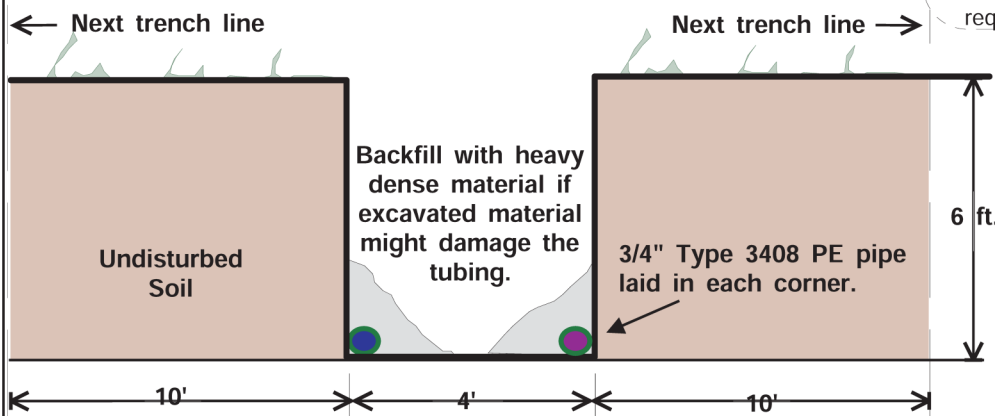
TYPICAL HORIZONTAL GROUND LOOP CONFIGURATION



- Type PE 3408 Pipe
- Excavated trenches minimum 4' wide x 6' deep
- Trenches will be backfilled with material which will maximize the thermal conductivity of the adjacent earth.
- Each loop consists of 500ft. of 3/4" type 3408 PE 160 psig (SDR 11) geothermal heat pump polyethylene tubing.
- Each trench is 250ft. beginning from the header. This allows one 500ft. roll of pipe to be used with only two fusion connections (one at each header).
- Allow a minimum of 10 ft. between each trench and preferably 15 - 20 ft. if space is available.
- Insulate all tubing within 12ft. of the structure with 1/2" thick closed cell armaflex insulation.
- Piping that is laid in a header trench should be insulated to a point where each loop branches to it's individual trench.
- The loop with the most pipe in the header trench could be left uninsulated to pick up heat from the header trench as long as the header trench is more than 12' out from the building.
- Reverse return headers minimize flow imbalances between loops.



Elevation View of Trench

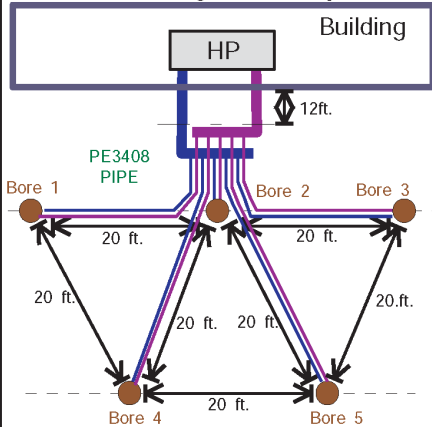


- Hand backfilling in the area just over the plastic pipe is recommended to prevent crushing or pinching of the pipe during backfilling operations.
- Horizontal style pipe runs should be placed 6' deep x minimum of 48" wide trench as shown above, with a minimum of 10ft. between trenches

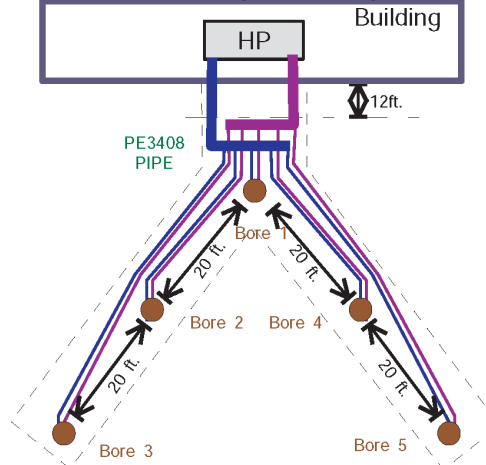
					Drawn By Chris Geddes	Date 17 JAN 08	MARITIME GEOTHERMAL LTD.			170 Plantation Rd. Petitcodiac, NB E4Z 6H4		
					Checked By Chris Geddes	Date 17 JAN 08						
					Approved By Chris Geddes	(ENG) Date 17 JAN 08						
					Approved By (MFG)	Date	Drawing Name Typical Horizontal Ground Loop Configuration					
01	Initial Release	C. GEDDES	C. GEDDES	17 JAN 08			Size A	Drawing Number 000608INF			REV 01	SHEET 1 of 1
REV	ECO #	IMPL BY	APVD BY	DATE	Approved By	Date						

TYPICAL VERTICAL GROUND LOOP CONFIGURATION

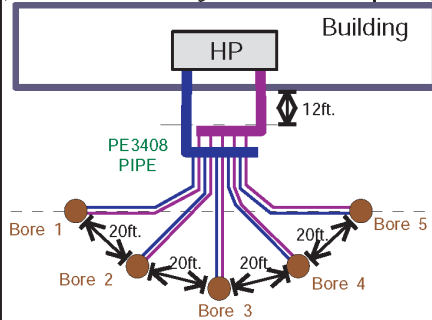
Vertical Layout Example 1



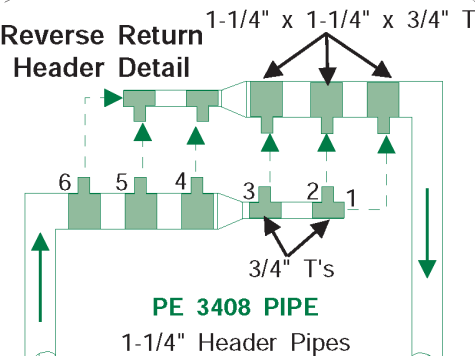
Vertical Layout Example 2



Angled Vertical Layout Example 1 (can be vertical layout with 20ft spacing)

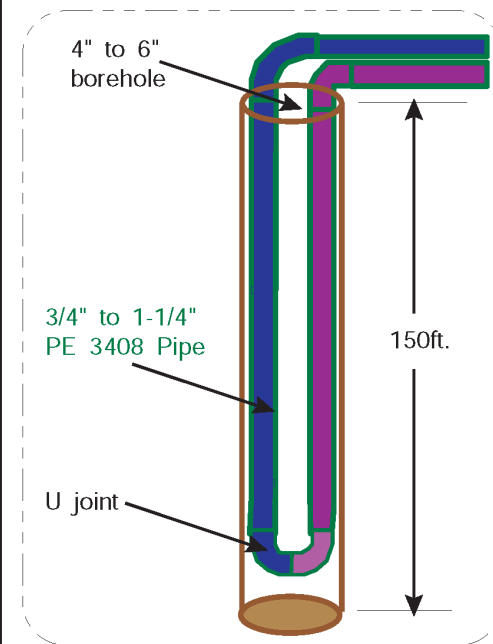


Reverse Return Header Detail



Three loop system uses only 1, 2, 3, etc. Minimum 2ft/sec to purge air. Each 3/4" loop requires 4USGPM to purge. 24USGPM to purge 6 loops, 20 for 5, 16 for 4, 12 for 3, 2 loops requires 10USGPM due to 1-1/4" header.

Borehole Detail

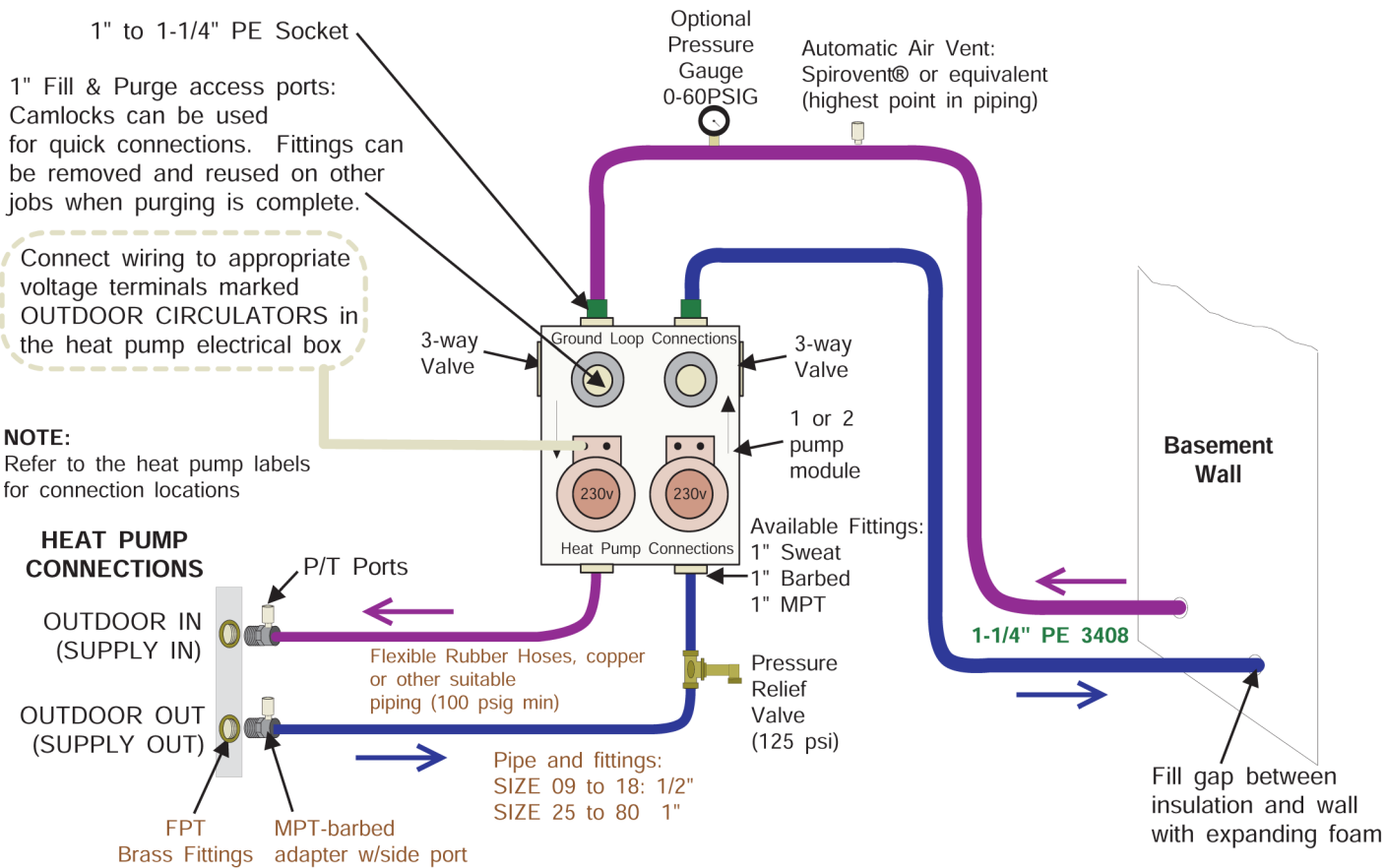


- Examples shown are for a 5 TON geothermal heat pump system
- **Type PE 3408 Pipe**
- Excavated trenches to boreholes minimum 4' wide x 6' deep
- Trenches should be backfilled with material which will maximize the thermal conductivity of the adjacent earth.
- Hand backfilling in the area just over the plastic pipe is recommended to prevent crushing or pinching of the pipe during backfilling operations.
- Allow a minimum of 20 ft. between each borehole for vertical boreholes and 10ft for vertical angled boreholes.
- Piping that is laid in a header trench should be insulated up to the individual trench to the borehole.
- Insulate all tubing within 12ft. of the structure with 1/2" thick closed cell armaflex insulation.
- Reverse return headers minimize flow imbalances between loops.
- The number of boreholes can be reduced by increasing the depth of the boreholes. Care must be taken to size the circulator pump module accordingly.
- Be sure to obtain permission prior to drilling if angled boreholes enter neighbouring properties.

- Each loop consists of minimum 300ft. of 3/4" type 3408 PE 160 psig (SDR 11) geothermal heat pump polyethelene tubing.
- Each borehole is 4-6" diameter and 150ft deep for 1 loop per ton applications.
- Allow enough extra pipe to be able to reach the headers to minimize the number of fusion joints.
- "U" tubes should be taped together every 10ft. A heavy piece of rebar or galvanized pipe can be taped to the last 10ft. to help keep the end straight and also for added weight.
- Fill each "U" tube with water and pressurize to 100PSIG before insertion. The added weight of the water will help with the insertion process
- Tremie grout from the bottom to within 10ft of the top of the borehole. Use neat cement or a mixture of neat cement and bentonite. Check local codes, there may be regulations that must be adhered to.

					Drawn By Chris Geddes	Date 22 JAN 08	MARITIME GEOTHERMAL LTD.		170 Plantation Rd. Petitcodiac, NB E4Z 6H4	
					Checked By Chris Geddes	Date 22 JAN 08				
					Approved By Chris Geddes	(ENG) Date 22 JAN 08	Drawing Name Typical Vertical Ground Loop Configuration		REV 01	
					Approved By (MFG)	Date				
01	ISSUE 02	D. RHEAULT	D. RHEAULT	11 SEP 24	Approved By	Date	Size A	Drawing Number 000609INF	SHEET 01	1 of 1
01	Initial Release	C. GEDDES	C. GEDDES	22 JAN 08						
REV	ECO #	IMPL BY	APVD BY	DATE						

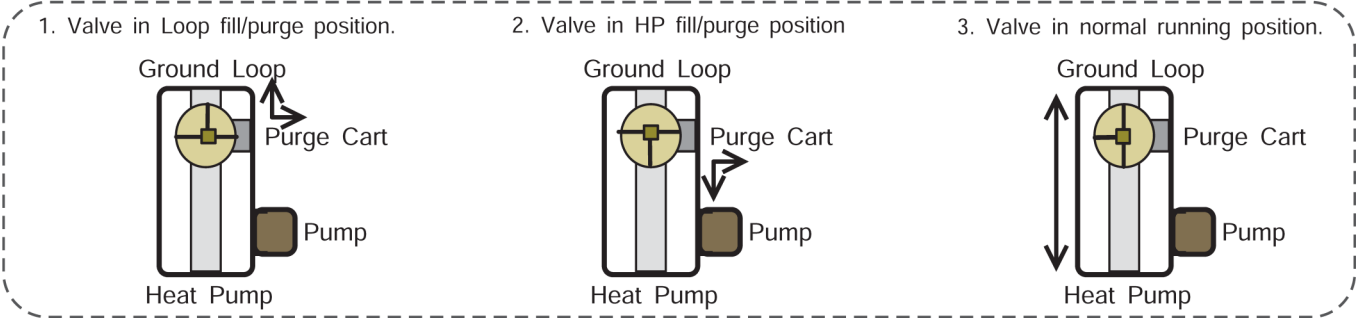
Geo-Flo Circulator Pump Module Installation (Units with Brass FPT Fittings)



NOTES:

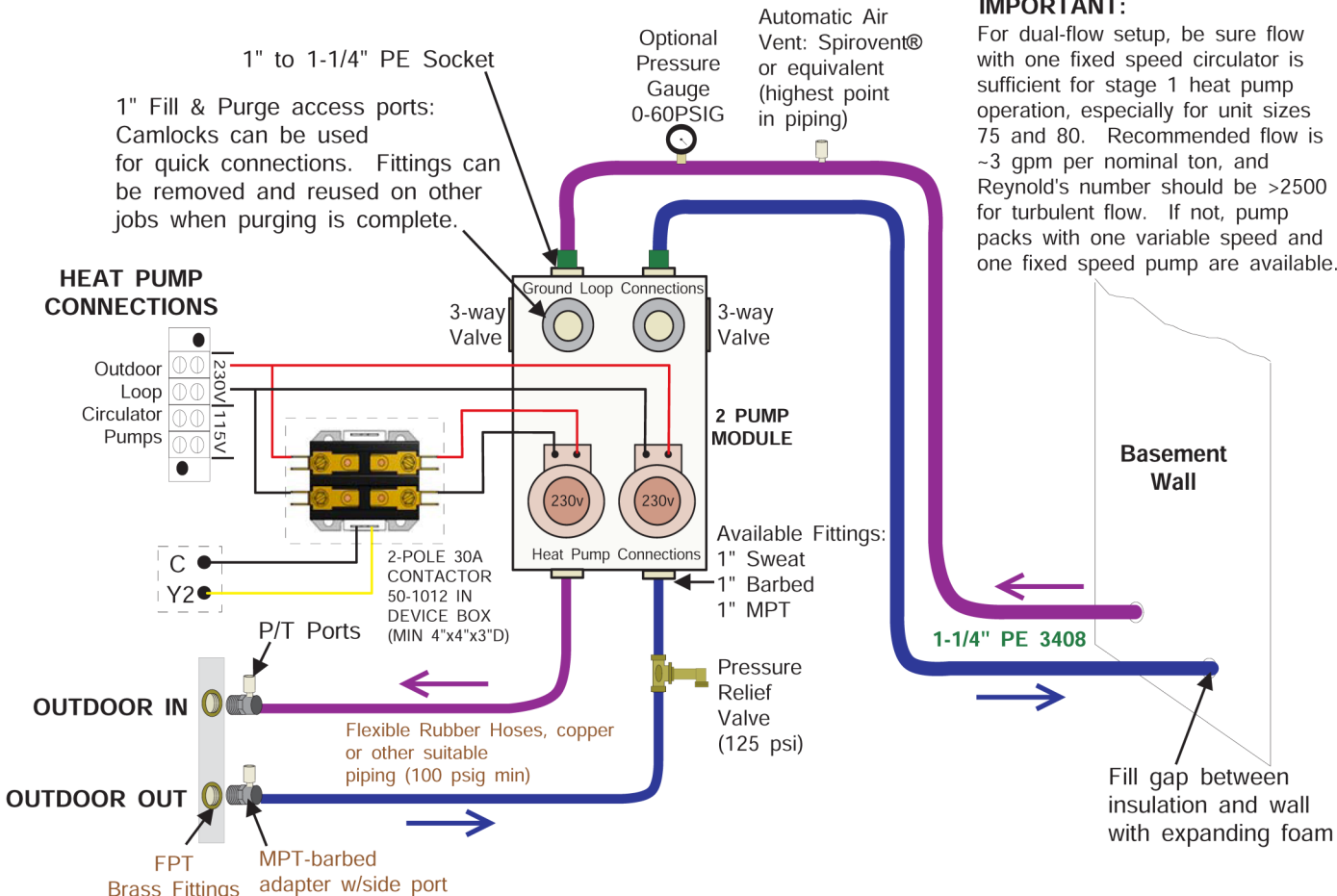
- Circulator Pump Module should be mounted vertically to minimize the possibility of air locking the circulators.
- All lines inside the structure and through the wall should be insulated with 3/8" to 1/2" thick closed cell pipe insulation.
- Holes through the foundation / structure should be filled with expanding foam from both sides to prevent leakage.
- Proper drainage material should be used on the outside of the wall to prevent water buildup.
- Pump module fittings are available from Maritime Geothermal Ltd.
- A pressure gauge is recommended if P/T plugs are not installed.
- For most applications, a 1 pump module will accommodate model sizes 09 to 45, and a 2 pump module will accommodate sizes 55 to 80. The total loop pressure drop including the headers, inside piping and heat exchanger drop should be calculated based on the antifreeze mixture and lowest desired entering water temperature. The pump module selected must provide the required flow at this calculated pressure drop value.

CIRCULATOR PUMP MODULE 3-WAY VALVE POSITIONS (LEFT SIDE VIEW)



					Drawn By Chris Geddes	Date 09 DEC 08	<div>MARITIME GEOTHERMAL LTD.</div>			170 Plantation Rd. Petitcodiac, NB E4Z 6H4		
					Checked By Chris Geddes	Date 09 DEC 08						
03	000264	D. RHEAULT	D. RHEAULT	21-Aug-2018	Approved By Chris Geddes	(ENG) Date 09 DEC 08	Drawing Name Geo-Flo Circulator Pump Module Installation (Brass FPT)					
02	000213	C. GEDDES	C. GEDDES	21-May-2013	Approved By	(MFG) Date						
01	Initial Release	C. GEDDES	C. GEDDES	9-Dec-2008	Approved By	Date	Size A	Drawing Number 000906PDG	Drawing Rev 03	SHEET 1 of 1		
REV	ECO #	IMPL BY	APVD BY	DATE	Approved By	Date						

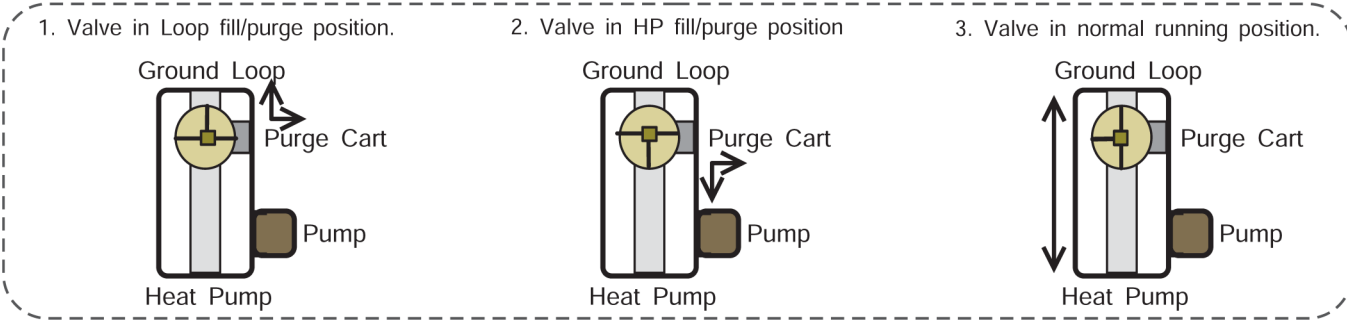
Dual Flow Circulator Pump Module Installation for 2-Stage Heat Pumps



IMPORTANT:
For dual-flow setup, be sure flow with one fixed speed circulator is sufficient for stage 1 heat pump operation, especially for unit sizes 75 and 80. Recommended flow is ~3 gpm per nominal ton, and Reynold's number should be >2500 for turbulent flow. If not, pump packs with one variable speed and one fixed speed pump are available.

- NOTES:**
- Circulator Pump Module should be mounted vertically to minimize the possibility of air locking the circulators.
 - All lines inside the structure and through the wall should be insulated with 3/8" to 1/2" thick closed cell pipe insulation.
 - Holes through the foundation / structure should be filled with expanding foam from both sides to prevent leakage.
 - Proper drainage material should be used on the outside of the wall to prevent water buildup.
 - Pump module fittings are available from Maritime Geothermal Ltd.
 - A pressure gauge is recommended if P/T plugs are not installed.
 - For most applications, a 1 pump module will accomodate model sizes 09 to 45, and a 2 pump module will accomodate sizes 55 to 80. The total loop pressure drop including the headers, inside piping and heat exchanger drop should be calculated based on the antifreeze mixture and lowest desired entering water temperature. The pump module selected must provide the required flow at this calculated pressure drop value.

CIRCULATOR PUMP MODULE 3-WAY VALVE POSITONS (LEFT SIDE VIEW)



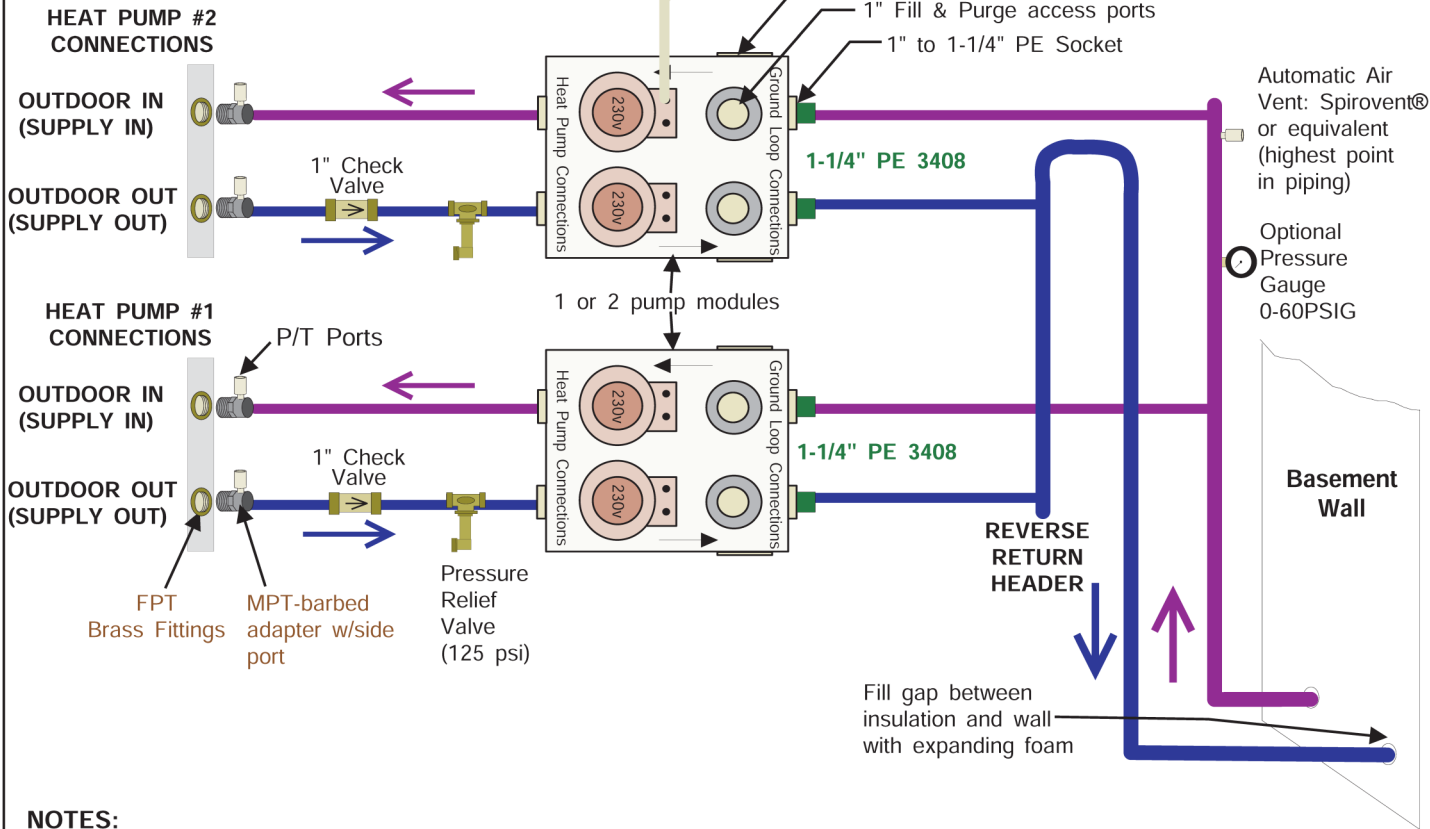
					Drawn By Dan Rheault	Date 22-Nov-2013	MARITIME GEOTHERMAL LTD. 170 Plantation Rd. Petitcodiac, NB E4Z 6H4			
					Checked By Dan Rheault	Date 22-Nov-2013				
03	000264	D. RHEAULT	D. RHEAULT	21-Aug-2018	Approved By (ENG)	Date	Drawing Name Dual Flow Circulator Pump Module Installation for 2-Stage Heat Pumps			
02	-	D. RHEAULT	D. RHEAULT	20-May-2014	Approved By (MFG)	Date				
01	Initial Release	D. RHEAULT	D. RHEAULT	22-Nov-2013	Approved By	Date				
REV	ECO #	IMPL BY	APVD BY	DATE	Approved By	Date	Size A	Drawing Number 001823CDG	REV 03	SHEET 1 of 1

Geo-Flo Circulator Pump Module Installation - Two Units On One Ground Loop

NOTE:

Refer to the heat pump labels for connection locations

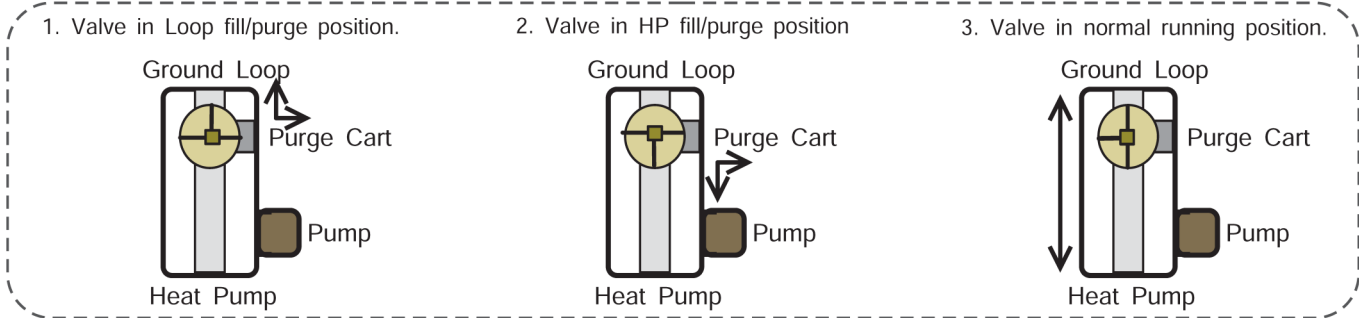
Connect wiring to appropriate voltage terminals marked OUTDOOR CIRCULATORS in the heat pump electrical box



NOTES:

- Circulator Pump Module should be mounted vertically to minimize the possibility of air locking the circulators.
- All lines inside the structure and through the wall should be insulated with 3/8" to 1/2" thick closed cell pipe insulation.
- Holes through the foundation / structure should be filled with expanding foam from both sides to prevent leakage.
- Proper drainage material should be used on the outside of the wall to prevent water buildup.
- Pump module fittings are available from Maritime Geothermal Ltd.
- A pressure gauge is recommended if P/T plugs are not installed.
- For most applications, a 1 pump module will accommodate model sizes 09 to 45, and a 2 pump module will accommodate sizes 55 to 80. The total loop pressure drop including the headers, inside piping and heat exchanger drop should be calculated based on the antifreeze mixture and lowest desired entering water temperature. The pump module selected must provide the required flow at this calculated pressure drop value.

CIRCULATOR PUMP MODULE 3-WAY VALVE POSITIONS (LEFT SIDE VIEW)



					Drawn By Dan Rheault	Date 21-Aug-2018	MARITIME GEOTHERMAL LTD. 170 Plantation Rd. Petitcodiac, NB E4Z 6H4
					Checked By Dan Rheault	Date 21-Aug-2018	
					Approved By Dan Rheault (ENG)	Date 21-Aug-2018	
					Approved By Dan Rheault (MFG)	Date	
01	Initial Release	D. RHEAULT	D. RHEAULT	21-Aug-2018	Approved By	Date	Drawing Name Geo Flo Circulator Pump Module Installation-Two Units on One Ground Loop
REV	ECO #	IMPL BY	APVD BY	DATE	Approved By	Date	Size A
							Drawing Number 002336PDG
							REV 01
							SHEET 1 of 1

Open Loop Installations

Well Water Temperature

The temperature of the well water should be a minimum of **41°F (5°C)**, and should normally be **45°F+ (7°C+)**. In general, groundwater temperatures across the Canadian prairie provinces and Northern Ontario may be close to the 41°F minimum, while in other parts of southern Canada it will probably be 46-50°F, although local exceptions will exist. In more southern locations, it will be warmer.

The well water temperature should be verified as the first step in a proposed open loop installation.

Well Water Flow

The water source is normally a drilled water well with submersible pump that is the same well which supplies domestic water needs. It must be able to supply the required water flow as listed under the Total Flow column in the table.

TABLE 14 - Required Open Loop Flow

Heat Pump Model Size	Heat Pump Flow* gpm (L/s)	Domestic Water Usage gpm (L/s)	Total Flow gpm (L/s)
45	10.0 (0.63)	4 (0.25)	14 (0.88)
55	12.0 (0.76)	4 (0.25)	16 (1.01)
65	14.0 (0.88)	4 (0.25)	18 (1.14)
75	16.0 (1.01)	4 (0.25)	20 (1.26)
* These are minimum water requirements based on an entering water temperature of 45° F.			

For groundwater temperatures of 50°F or greater, these flows can be reduced by 25% if required.

Rather than being estimated by a well driller, the flow from a proposed source well should be measured by performing an extended flow test to be sure it is capable of supplying the required flow over an extended period of time. This is done by flowing the well at the highest possible rate, noting the static water level in the well, and monitoring the pumping fluid level until stable. Unless the fluid level is very high, fluid level monitoring will require a device called a water level sounder. The flow rate can then be measured either by a cumulative gallon meter, a flowmeter, or by timing the filling of a bucket of known size. The test data can be recorded as follows:

TIME	METER READING (USGAL)	TOTAL FLOW (USGAL)	FLOW RATE (USGPM)	WATER LEVEL (FT)	(IN)	WATER LEVEL (FT)
20:25	131735.5	0		20	6	20.5
20:27	131756	20.5	10.3	24	0	24.0
20:30	131779	23	6.0	26	0	26.0
20:42	131847	68	6.1	29	0	29.0
20:51	131906	59	6.6	29	0	29.0
21:03	131982	76	6.3	29	0	29.0
21:32	132156	174	6.0	29	0	29.0

It is best to flow the well for as long as possible (e.g. 12 hours) at the flow rate required by the proposed heat pump size. However, if the test is performed before a larger submersible pump is installed, it may be assumed that any unused water level drop during the test (that is, any distance remaining be-

tween the pumping fluid level and the pump intake) would contribute linearly to the flow rate should a larger pump be installed.

In the above example, it was recorded that the flow rate stabilized at 6 gpm, while the water level dropped from 20 to 29 feet (9 feet). If the intake of a larger pump could be placed so that a further pumping fluid level drop of 9 feet could be achieved (total 18 feet), it can be assumed that the flow would double to 12 gpm. Of course, this should be verified with a second test once the larger pump is actually installed.

Well Water Quality

The well water should be tested to be sure it meets minimum standards. Although the threat of poor water quality to open loop installations is often exaggerated, poor water quality can lead to rapid heat exchanger failure or frequent servicing.

First, the well should not produce any sand. Sand will physically erode heat exchanger surfaces, and quickly clog return (injection) wells. **Solids** or **TDS** should be less than **1 ppm (1 mg/L)** if a return well is used.

To avoid scale formation on the inside of the heat pump's outdoor loop coil, total **hardness** should be less than **350 ppm / 350 mg/L**. In practice, scaling is very rarely a problem at northern groundwater temperatures of 50°F or less because scale does not generally form at low well water temperatures (unlike, for example, in a domestic hot water tank). In more southern climates, the hardness guideline will be a more important consideration. Should scale form, heat pump performance will gradually deteriorate, and will require periodic flushing with a calcium/lime removing solution (see General Maintenance chapter). If the need for periodic flushing is anticipated, the optional Cupro-Nickel (CuNi) coil and piping should be ordered.

Corrosive (salty) water can cause failure of the inner tube of the heat exchanger, leading to loss of refrigerant and water entering the refrigeration circuit, which ruins the heat pump. If **chlorides** exceed **20 ppm (20 mg/L)**, the optional CuNi coil and piping should be ordered. If chlorides exceed **150 ppm (150 mg/L)**, or significant **Ammonia (>0.5 ppm)** or **H₂S (>0.2 ppm)** is present, the use of an open loop system should be reconsidered.

Water Discharge Methods

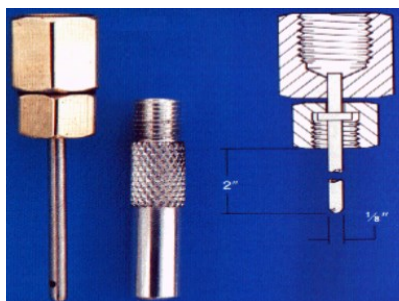
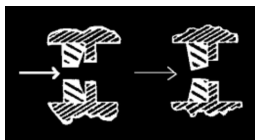
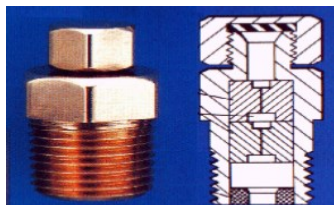
Water disposal methods vary from area to area. However, some consideration should be made to prevent the cooled discharge water from immediately coming in contact with the supply source. Attempting to return the water to the source well will eventually cool the water so much that the heat pump will shut off on its low pressure safety control.

Acceptable methods for disposing of the waste water are listed below. The waste water is clean; the heat pump has no effect other than reducing the temperature of the water. Refer to diagram on following page for typical disposal method diagrams.

- Second well (return well)
- Percolation (Drain, ditch, leaching field)
- Pond, river or stream

ENSURE SELECTED METHOD CONFORMS TO LOCAL REGULATIONS.

A return well should be a minimum of **80 ft.** from the supply

Figure 2: Open Loop Accessories & Tools*Water Level Sounder**Cumulative Gallon Meter**Motorized Water valve**Rainbird Solenoid Valve**Dole Valve**Gauge adapter for P/T port**P/T port**P/T adapters for heat pump (1" NPT to barb)*

well for residential applications. The water returned to the well will not necessarily be pumped into the same aquifer, depending on underground conditions. The return well must be able to supply at least the same quantity of water as the amount you wish to inject into it, preferably much more, since injection capacity will tend to decrease over time due to clogging. It may be necessary to place a pressure-tight cap on the well to keep the return water from flowing out the top of the well. This cap is commonly required since a certain amount of pressure may be needed to force the return water back down the well in cases of limited injectivity.

Water discharged by percolation will generally soak into the ground within a distance of 50 to 100 ft. If suitable care is taken to ensure that the drain pipe runs downhill and the end of the pipe is protected by a bale of hay or spruce bows, the end of the pipe will not freeze as the pipe will empty out when the heat pump shuts off and the water valve closes. A screen should be installed on the end of large discharge pipes, to prevent animals from building nests inside during extended 'off' periods and causing a backflooding risk for open water drains.

When snow comes it will usually cover the entire process much like a small spring. It is recommended that the pipe be below the frost line when possible for maximum freeze protection.

When discharging into a river or stream, or above the surface of a pond, the same guidelines should be followed as described in the paragraph above for the percolation method.

When discharging the waste water below the surface of a pond or lake, the discharge pipe should be placed below the frost line to prevent the pipe from freezing. As opposed to the percolation method, water will remain in the end of the pipe. It is recommended that the surface of the pond be lower than the installation location of the heat pump. This reduces the back pressure generated by the weight of the water in the pond.

Water Valve

Water flow through the heat pump is turned on and off by a water valve, which is controlled by a 24VAC signal from the heat pump. It should be installed on the OUT pipe of the heat pump, so that the heat exchanger remains full of water at all times. There are 3 types of water valves that may be available from Maritime Geothermal.

- **Hailin** or equivalent slow acting **motorized ball valve**, which is always powered with 24VAC from **R** and opened with a **Y** or **Y1** signal.
- **Taco** slow acting **motorized ball valve**, which is powered open and stores the energy required to close using a capacitor.
- **Rainbird** or equivalent fast acting **solenoid valve**.

Most installations use a slow closing motorized ball valve. These take 5-15 seconds to close, so avoid the water hammer which can occur with fast acting valves. A fast acting solenoid valve can be used for applications where water hammer is not expected.

All valves come from Maritime Geothermal Ltd. with a **wiring harness**, which plugs into a connector behind the pipe post of the heat pump. (If buying a water valve elsewhere, be sure to get the wiring harness from Maritime Geothermal.) This both allows the heat pump to properly control the valve, turning the water flow on and off with the compressor, and also tells the heat pump to select the higher low pressure safety control for open loop operation (since there is no antifreeze present).

Water Flow Control

A flow restricting ('Dole') valve is highly recommended, installed downstream of the water valve. This is a passive (non-electrical) device which automatically varies the size of its rubber orifice in order to restrict flow to its stamped gpm value, regardless of water pressure. This is important in order to provide some backpressure to the water system, which could otherwise be too low for the comfort of people taking showers or otherwise using the domestic water system. It also prevents excessively low refrigerant discharge pressure when in cooling mode. Dole valves are available as an accessory.

Dole valves can emit a 'whistling' sound if the pressure drop through them is high. Therefore, they should be placed where the noise will not cause a nuisance, e.g. outside the basement wall or perhaps in a well insulated box.

Submersible Pump Selection

Of course, the submersible pump must be large enough to supply the flow required by the heat pump. This is usually not a problem, pumps often being oversized by default.

However, if a conventional fixed speed pump is too large, its fixed capacity will exceed that of the Dole valve at reasonable pressure switch settings (<80 psi). This will cause the submersible pump to cycle on and off continuously while the heat pump is running, causing excessive wear to the submersible pump. The installation of a large air bladder tank will cause the cycles to have a longer duration, but will not solve the problem.

To avoid this problem, the fixed speed pump should be sized according to its head vs. flow curve. The required head should be calculated using height between the pumping fluid level in the well and the elevation of the heat pump, pipe pressure drop at nominal flow rate, desired system water pressure, and any back pressure from return well. Then a pump can be selected that delivers the nominal flow for the chosen heat pump size at that head. In case this calculation is not exact, a variety of Dole valves can be carried by the installer, and a larger Dole valve installed if submersible pump cycling is observed.

An alternate approach would be to install a variable speed submersible pump, which varies its speed to maintain a constant water system pressure. Or use a mechanical 'cycle stop' valve, which is installed upstream of the air bladder / pressure tank and varies its orifice to put backpressure on the pump during periods of low flow in order to keep it from cycling off.

Stage 1 vs. 2 on Open Loop

In an open loop installation, the submersible water pump draws significant power compared to the heat pump, especially for smaller heat pump sizes. This is particularly true when using a conventional fixed speed submersible pump. Under normal usage, the efficiency of such a pump is not particularly important, due to short run times in a domestic water system. When used with a geothermal heat pump, which can run all day on the coldest days of the year, it is highly recommended that effort be made to select an energy efficient submersible pump. However, these may be hard to find.

The significant power draw of submersible pump will probably negate the COP benefit of running the heat pump on stage 1. In this case, it is recommended to jumper Y1 and Y2 together at the heat pump terminal strip, in order to satisfy the heating demand as quickly as possible and minimize run time. For the same reason, slightly oversizing the heat pump is acceptable on open loop applications, although this will require higher water flow.

If Y1 and Y2 are jumpered together, it is recommended to consult diagram 001901PDG found earlier in this manual, so that stage 1 may be used for cooling in order to achieve better dehumidification. This should be done only if stage 1 alone (67% compressor capacity) can satisfy the cooling demand in the local climate.

Plumbing the Heat Pump

The port connections for the Outdoor Loop are 1" brass FPT fittings. They are marked as OUTDOOR IN and OUT.

Plumbing lines, both IN (supply) and OUT (discharge), must be of adequate size to handle the water flow necessary for the heat pump. A 1" or 1-1/4" copper or plastic line should be run to the Outdoor IN (Supply IN) pipe of the heat pump. Similarly, a 1" or 1-1/4" line should be run from the Outdoor OUT (Supply Out) pipe to the method of disposal. P/T plugs should be installed at each port. See diagram in the Ground Loop chapter for a description of P/T plugs. The water valve should be installed in the OUT (discharge) line. Refer to drawing **000907CDG** at the end of this chapter for the recommended setup. Placing the water valve in the discharge line ensures that the heat exchanger inside the heat pump remains full of water when the unit is not running. Unions or some other form of disconnect should be used so that the coaxial heat exchanger may be accessed should it required cleaning.

The heat pump has an electrical connector for the water valve just inside the cabinet. After the water valve is installed, run the valve harness into the cabinet through the hole provided. Remove the jumper plug from the Valve Connector and connect the harness in its place.

Optionally, a water flow meter can be installed in the discharge line so that the exact amount of water flowing can be determined at a glance. It should be placed between the Outdoor OUT (Supply OUT) pipe of the heat pump and the water valve.

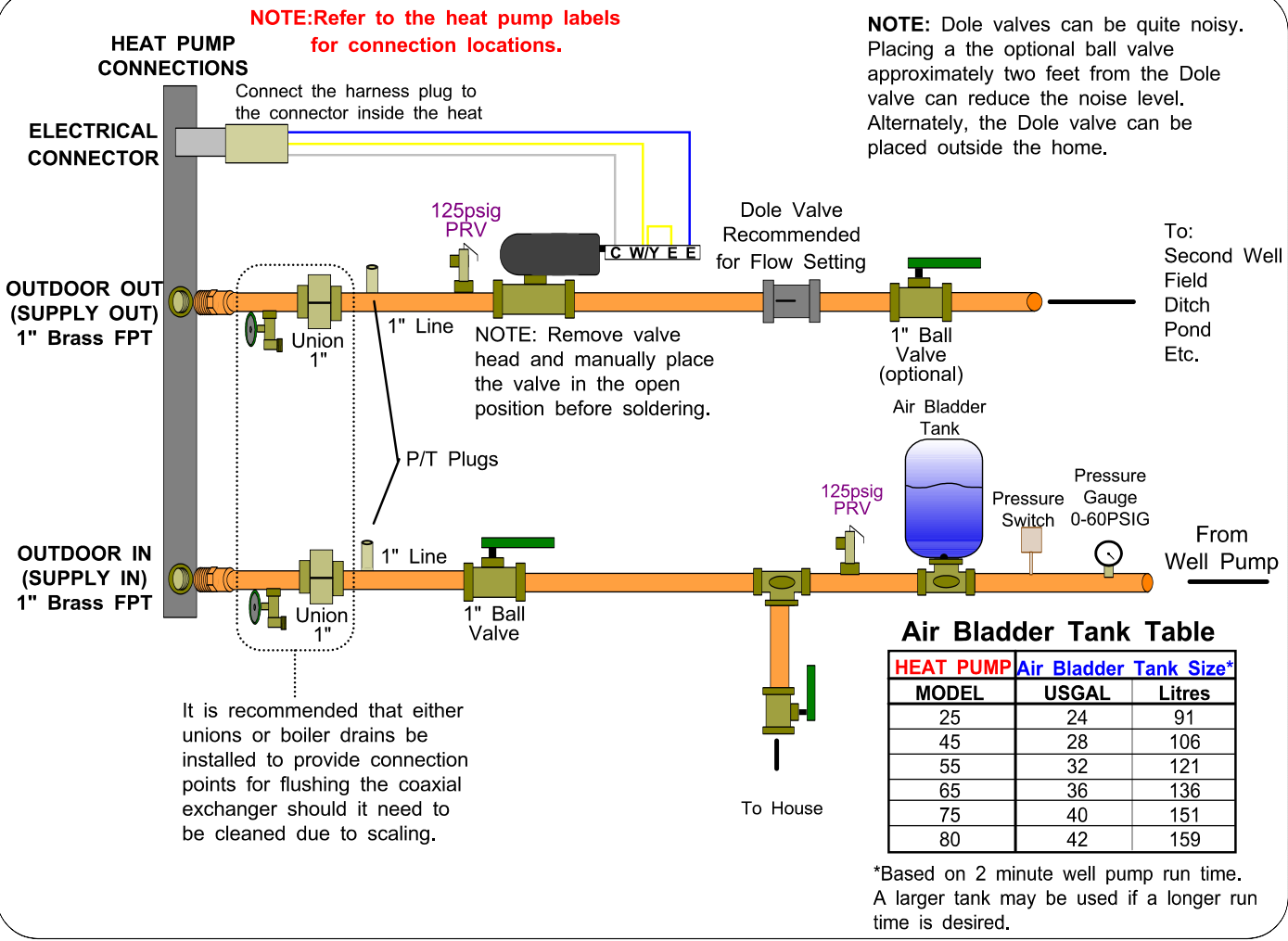
With proper flow, there should be **5-7°F (3-4°C)** delta T between the IN and OUT water temperatures of the heat pump when operating in the heating mode.

All water line valves on both the supply and discharge lines should be either BALL or GATE valves. GLOBE valves have a higher pressure drop, meaning more pumping power to maintain the required flow to the heat pump.

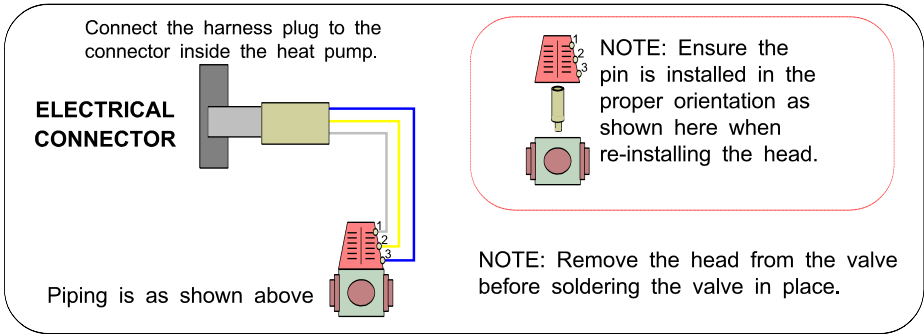
Pipe Insulation

All ground water piping to and from the Outdoor Loop ports on the heat pump should be insulated with 3/8" closed cell pipe insulation, to prevent condensation and dripping onto floors or walls.

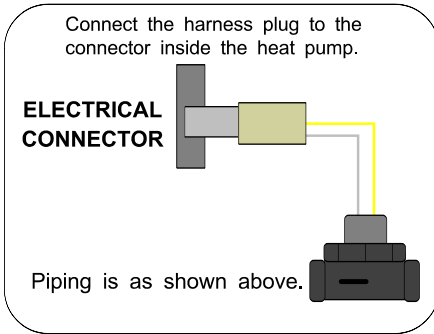
Typical Ground Water Installation for Size 25-80 Heat Pumps
for Units With Brass FPT Fittings
TACO 24VAC EBV (Electronic Ball Valve)



TACO 24VAC Slow Close Water Valve



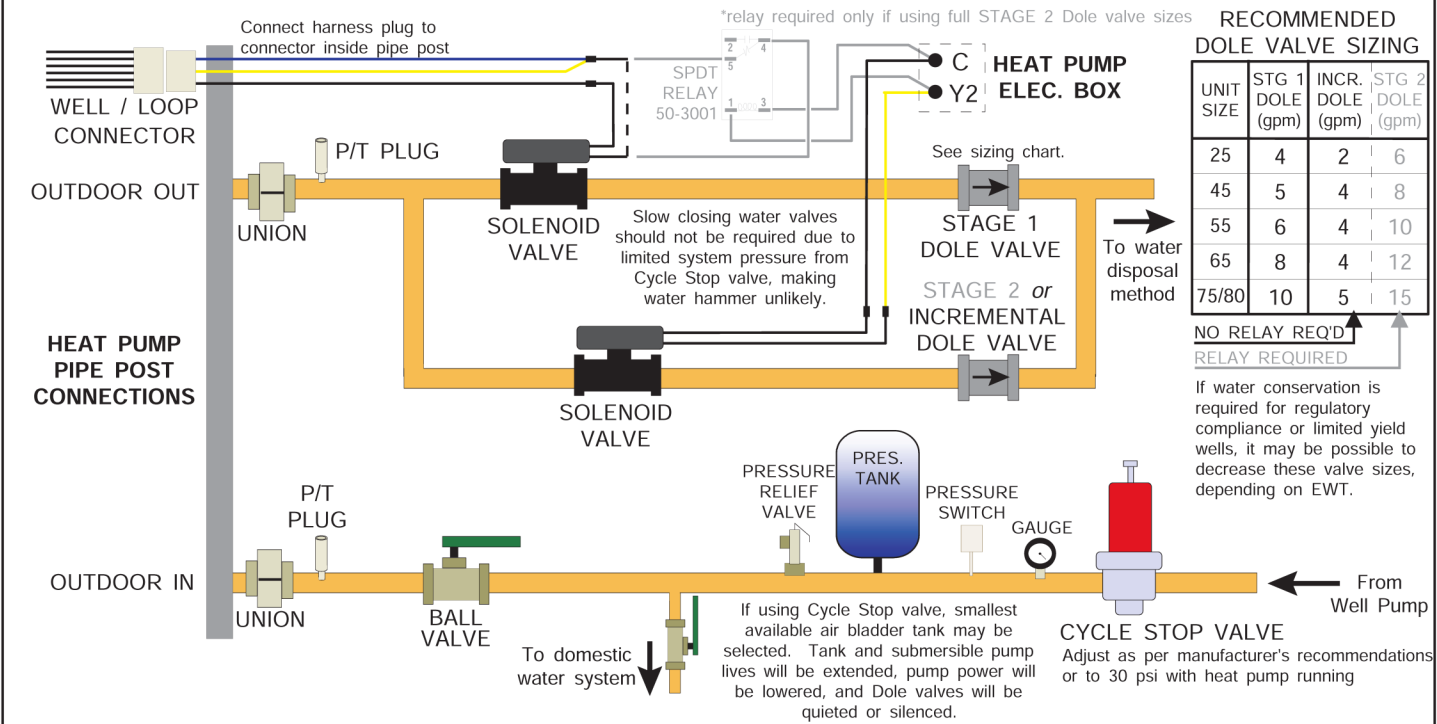
Generic 24VAC Solenoid Water Valve



					Drawn By Chris Geddes	Date 10 DEC 08	MARITIME GEOTHERMAL LTD. 170 Plantation Rd. Peticodiac, NB E4Z 6H4			
					Checked By Chris Geddes	Date 10 DEC 08				
02	000228	C. GEDDES	C. GEDDES	21 MAY 2014	Approved By Chris Geddes (ENG)	Date 10 DEC 08	Drawing Name Typical Ground Water Installation for Size 25-80 Heat Pumps (Brass FPT)			
01	Initial Release	C. GEDDES	C. GEDDES	10 DEC 08	Approved By (MFG)	Date				
REV	ECO #	IMPL BY	APVD BY	DATE	Approved By	Date	Size A	Drawing Number 000907CDG	Drawing Rev 02	SHEET 1 of 1

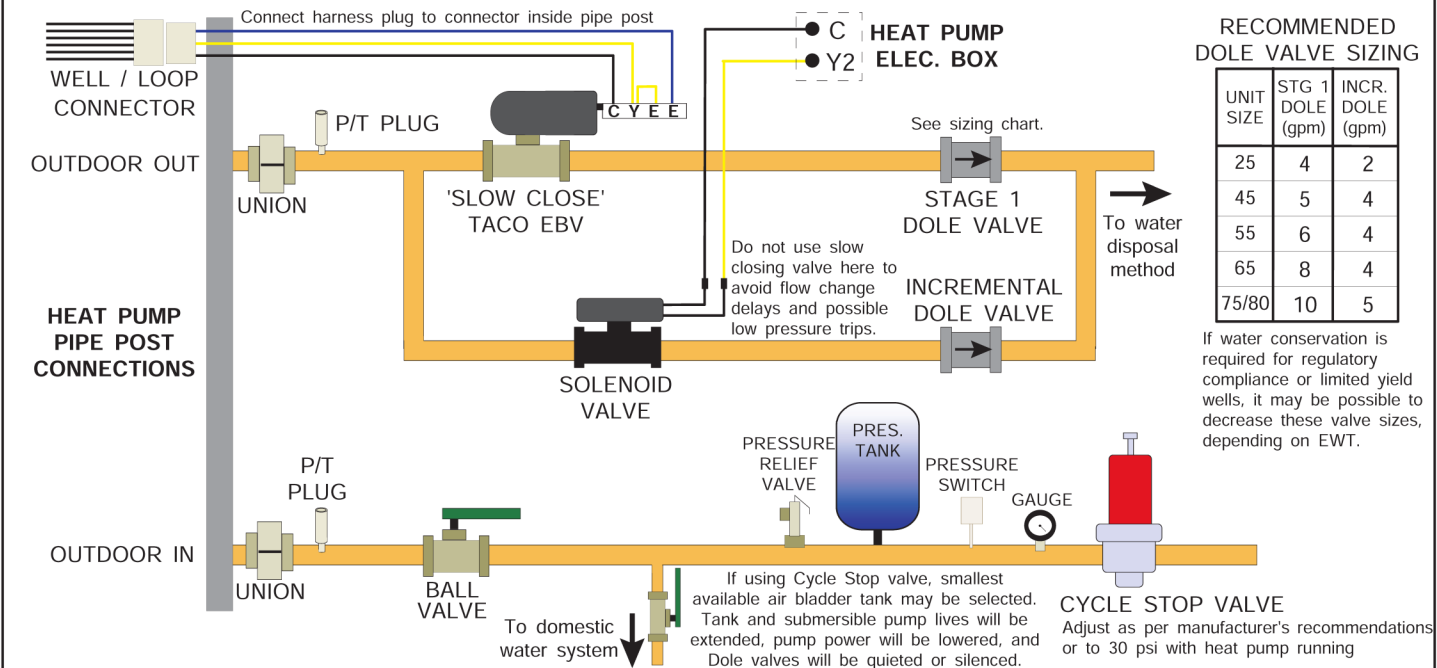
go to TABLE OF CONTENTS

1. Dual-Flow Groundwater (Well) Installation



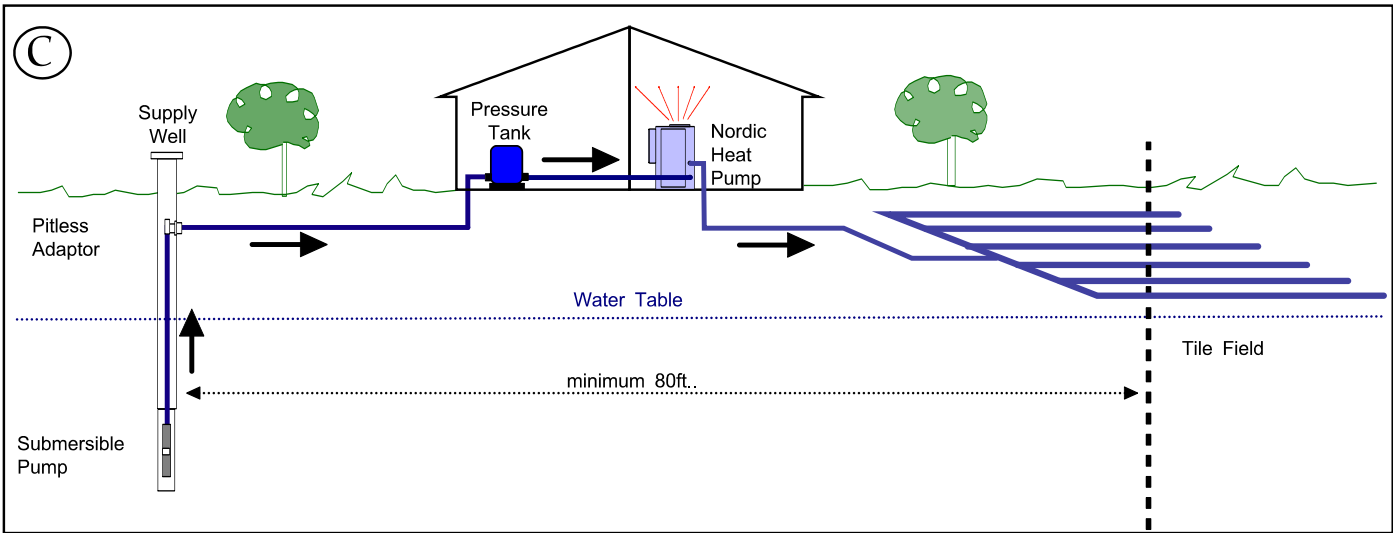
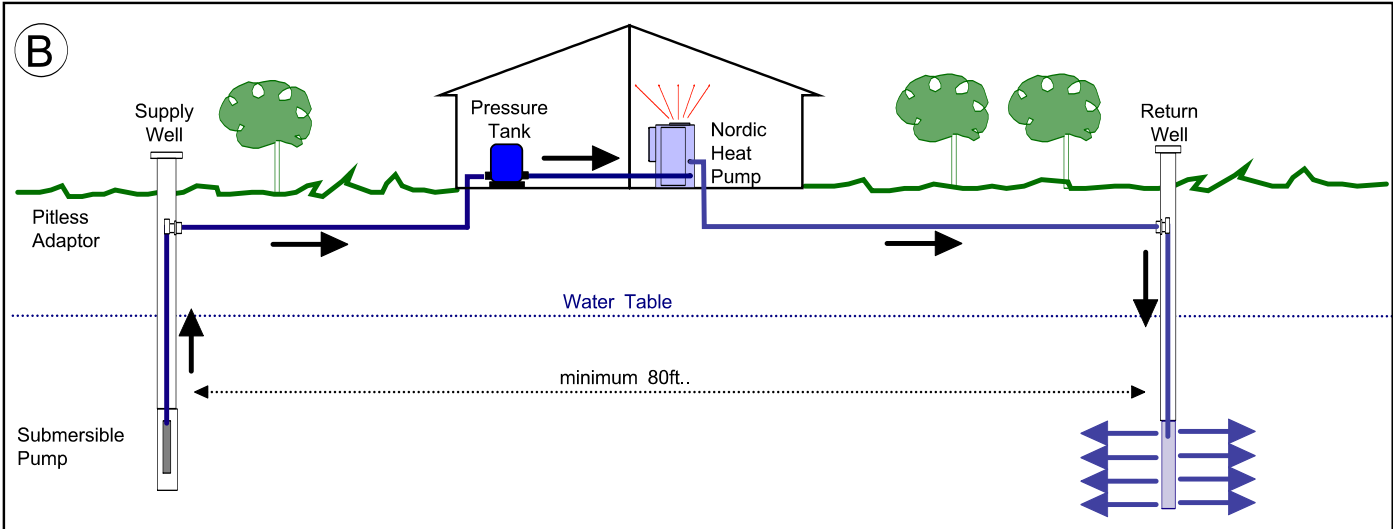
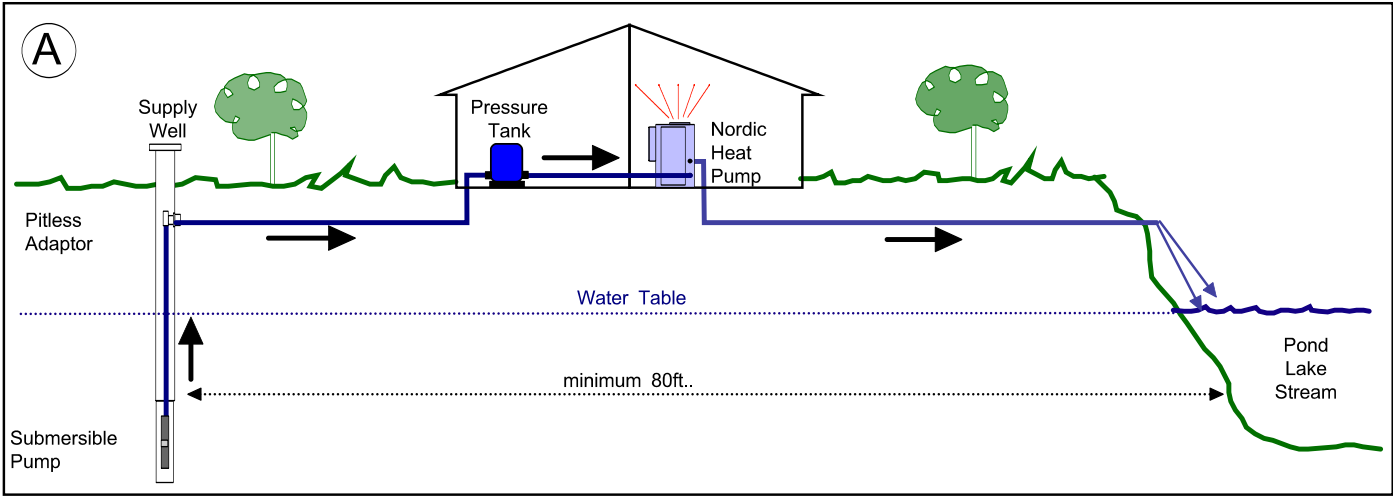
2. Dual-Flow Groundwater (Well) Installation with Slow Closing Water Valve

For Installations Subject to Water Hammer Even at Low System Pressures, or Without Cycle Stop Valve



					Drawn By Dan Rheault	Date 22-Nov-2013	<div>MARITIME GEOTHERMAL LTD.</div> 170 Plantation Rd. Petitcodiac, NB E4Z 6H4				
					Checked By Dan Rheault	Date 22-Nov-2013					
					Approved By (ENG)	Date	Drawing Name Dual-Flow Groundwater (Well) Installation for Size 25-75 Heat Pumps				
					Approved By (MFG)	Date					
01	Initial Release	D. RHEAULT	D. RHEAULT	22-Nov-2013			Size A	Drawing Number 001822CDG	REV 01	SHEET 1 of 1	
REV	ECO #	IMPL BY	APVD BY	DATE	Approved By	Date					

GROUND WATER DISPOSAL METHODS

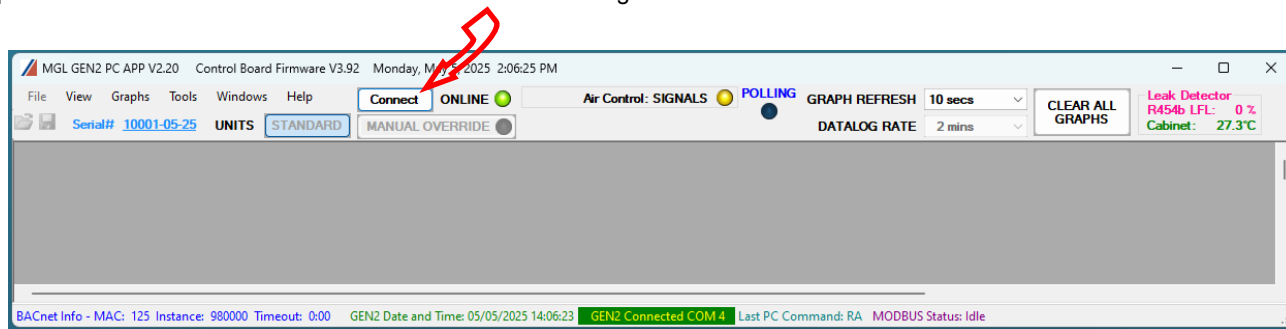


					Drawn By Chris Geddes	Date 04 FEB 08	MARITIME GEOTHERMAL LTD.		170 Plantation Rd. Petitcodiac, NB E4Z 6H4			
					Checked By Chris Geddes	Date 04 JAN 08						
					Approved By Chris Geddes	(ENG) Date 04 FEB 08	Drawing Name Ground Water Disposal Methods					
					Approved By (MFG)	Date						
01	Initial Release	C. GEDDES	C. GEDDES	04 FEB 08	Approved By	Date	Size A	Drawing Number 000619INF	REV 01	SHEET 1 of 1		
REV	ECO #	IMPL BY	APVD BY	DATE								

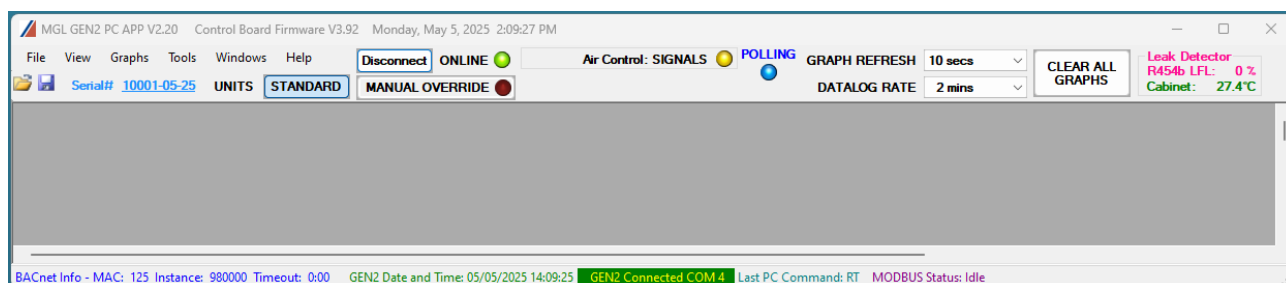
PC Application (PC App)

NOTE: Before using the PC Application, refer to [Appendices](#) for installation instructions for the PC App and USB driver.

Connect a USB cable between the PC and the control board USB connector located at the bottom center of the board. Use the Windows Start menu to launch the PC App. You should see a screen similar to the one below. The revision of the PC APP is shown in the top left corner of the screen. Click the **Connect** button to begin communications with the control board.



Once connected, the menus and buttons will become accessible and the Polling LED will begin to flash. The PC time and date will appear at the bottom left corner of the screen. If the date and time need to be adjusted, click on menu [Tools-->Set Date and Time](#). The control board date and time will be set to that of the PC.



PC Application Menus

The following pages describe the PC App's menus in detail. There are six menus: **File, View, Graphs, Tools, Windows, Help**.

File Menu: This menu handles page arrangements. If one or multiple pages are open and arranged as desired for viewing, this page arrangement may be saved and re-used the next time the PC APP is used.

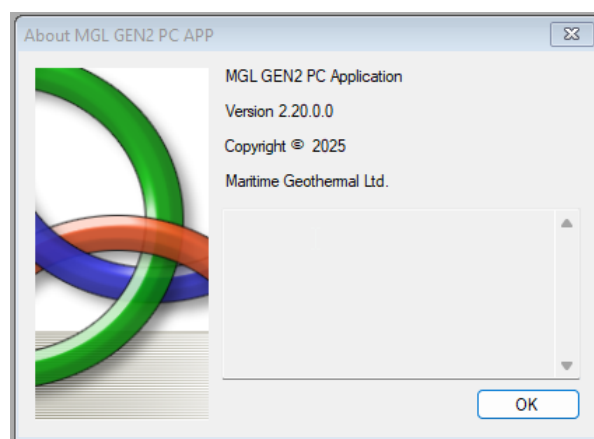
- File-->Open:** Opens a saved page arrangement.
- File-->Save:** Saves the current page arrangement.
- File-->Exit:** Exits the PC Application.

Windows Menu: This menu is used to arrange windows (pages), or to bring a particular window to the front.

- Windows-->Cascade:** Arranges windows one in front of the other each with a small right and down offset from the last.
- Windows-->Tile Vertical:** Arranges windows side by side, stretching them fully from top to bottom.
- Windows-->Tile Horizontal:** Arranges windows up and down, stretching them fully from left to right
- Windows-->Close All:** Closes all open windows.

Help Menu: This shows information about the PC Application.

- Help-->About:** Displays the window shown to the right.



View Menu:

This menu handles all of the operational viewing screens.

View-->Control Panel: The main control panel window will open, shown below.

Heat pump model information points to the window title: R(H) Series - Size 65 Refrigerant: R454b

Operational status of the heat pump system points to the **SYSTEM MODE** section, which shows **Off (Heating)** and a **SERVICE** button.

Manual controls are enabled when in MANUAL OVER-RIDE mode. points to the **Air Controls** section, which includes **Manual** and **Demand** modes.

Indicators show the demand from the control system (thermostat). points to the **Demand** section, which shows **Y1**, **Y2**, **O**, **G**, **W2**, and **E**.

Compressor stage ON/OFF status points to the **STAGE1** and **STAGE2** sections, which show **OFF** and **Run Time** indicators.

Stage run time indicators points to the **Run Time** indicators for **STAGE1** and **STAGE2**.

Auxiliary information (plenum heater). Status lights indicates when in use. points to the **Air Auxiliary** section, which shows **Stage 1 ON** and **Stage 2 ON**.

Refrigeration system pressure data, along with alarm indicators. points to the **Refrigerant Pressures** section, which shows **Suction** (102.2 PSIG) and **Discharge** (204 PSIG) pressures, along with **Alarm Count** and **SC Timer** indicators.

Refrigeration system temperature data. points to the **Refrigerant Temperatures** section, which shows **Evaporator** (37.6 °F) and **Condenser** (74.1 °F) temperatures, along with **Suction Line** (31.5 °F) and **Discharge Line** (73.7 °F) temperatures.

EEV data. Status light indicates when in use. points to the **EEV1 Position** section, which shows **Current** (0.0 %) and **Override** (0.0 %) indicators.

Superheat target points to the **Superheat** (0.0 °F) indicator.

Reversing valve: status light indicates when activated. points to the **Reversing Valve#1** section, which shows **Manual** and **Auto** modes, and an **ON** indicator.

Click to disable the unit and fully open electric valves to allow work to be done to the refrigeration system. (Also accessible from [Tools](#) --> [Service Tools](#) menu.) To exit service mode, main breaker must be turned off and then back on. points to the **SERVICE** button.

Indoor fan information. Click SET to adjust airflows. points to the **Indoor Fan** section, which shows **CFM** (0), **L/s** (0), and **TACH** (0) indicators, along with a **SET** button.

Set airflow reduction % when AR dry contact is made. points to the **AR** (15 %) indicator in the **Indoor Fan** section.

Short Cycle timer and override button for when unit is being serviced. points to the **SC Timer** (0:00) and **Override** button in the **Indoor Fan** section.

View-->Alarms, Limits and Faults

The alarms page has four tabs:

1. **ALARMS** - Current alarm status, alarm count, high and low refrigeration alarm cutout values, and short cycle timer.
2. **ALARMS LIST** - List of alarms that have occurred since the PC APP has been operating (this will be lost when the PC is disconnected from the control board.)
3. **LIMITS** - Limits in effect which prevent compressor operation but that do not cause an alarm.
4. **FAULTS** - List of board hardware faults.

[View-->Alarms, Limits and Faults \(ALARMS Tab\)](#)

NOTE: Greyed out Alarms in the PC APP are not applicable to the system setup and are not monitored by the control board.
NOTE: Refer to Alarms and Faults screenshot below to see which alarms have a count.

Alarms without a count: These alarms only occur one time at which point they immediately create a **Permanent Alarm**.

Alarms with a count: When an alarm occurs the compressor will stop, the alarm COUNT will increase and the **Short Cycle (SC) Timer** will start. When the **SC Timer** expires the compressor will re-start. If no further alarms occur within the **REDUCE** time (listed on 2nd tab of the [Configuration Page](#)), the alarm count will be reduced by 1. If another alarm occurs within **REDUCE** time, the count will increase by 1. If alarms continue to occur, when the alarm count reaches the **Maximum Count** value a **Permanent Alarm** will occur.

Master Alarm: This alarm occurs when any permanent alarm occurs. It is used to simply indicate that there is an alarm.

Permanent Alarm: The compressor will be locked out until the **Permanent Alarm** is manually reset either by cycling the power or clicking on the **RESET** button.

Low Pressure: A low pressure alarm occurs when the suction pressure drops to or below the **Low Pressure Cutout** value. The low pressure is checked just before a compressor start; if it is OK the compressor will start, otherwise an alarm will occur. When the compressor starts, the low pressure alarm will be ignored for the number of seconds that low pressure **Ignore on Start** (listed on 2nd tab of the [Configuration Page](#)) is set to, after which the low pressure alarm will be re-enabled. This allows a dip in suction pressure below the cutout point during startup without causing a nuisance alarm.

High Pressure: A high pressure alarm occurs when the discharge pressure rises to or above the **High Pressure Cutout** value.

Compressor Status: This alarm occurs when there is a current draw on the compressor but no call for the compressor to be on (i.e. welded contactor) or when there is a call for the compressor to be on but there is no compressor current draw (i.e. manual high pressure control is open or contactor failure).

Phase Monitor: This alarm occurs when the Phase Monitor detects a fault condition and sends a fault signal to the control board. For three phase units only and requires Phase Monitor accessory.

Not Pumping/Man HP: Discharge pressure is less than 30 psi higher than suction pressure after 1 minute run time. It indicates leaking reversing valve, manual high pressure control trip, bad contactor, or defective compressor.


Low Charge / EEV: This alarm occurs if the EEV has been at >99% for 20 minutes within first hour of a cycle.

LOC (Loss of Charge): This alarm occurs if both the low pressure and high pressure sensors are below 30 psig (207kPa).

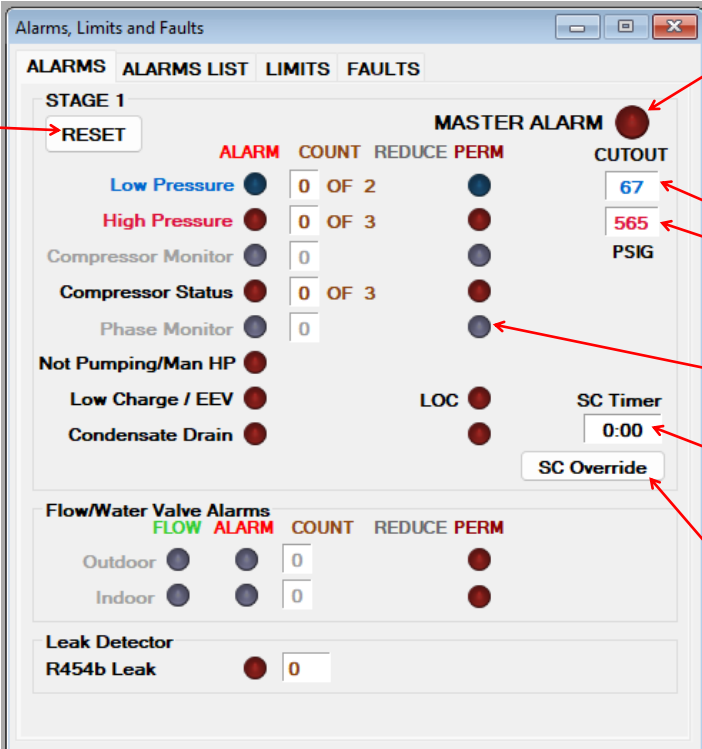
Condensate Drain: This alarm occurs if fluid level in the condensate tray rises to the level of the sensor.

Outdoor Flow: Outdoor loop water valve end switch did not close (open loop only).

Go the Alarms Troubleshooting section of the [Troubleshooting](#) chapter of the manual to address alarm issues.



WARNING: Repeated resets can freeze and rupture heat exchangers, ruining the heat pump and voiding the warranty. The source of the alarm should be determined before re-setting the unit if possible or during operation after a reset.



Master Alarm occurs when any alarm occurs.

Low Pressure cut out.
High Pressure cut out.

Greyed out alarms are not applicable to the system.

Short Cycle Timer counts down time until the next compressor start is allowed.

This button will reduce the short cycle timer value to 10 seconds.

This button will erase all alarms and alarm counters, including a permanent alarm.

View-->Alarms, Limits and Faults (ALARMS LIST Tab)

This tab show a history of alarms that have occurred while the PC App is connected, since it was last cleared.

Each alarm that occurs while the PC APP is connected to the control board will appear here. The alarm type and a time stamp will be shown.

Alarm Description	Time Stamp
Loss of Charge#1 alarm	12/18/2018 11:42:51 AM
PERMANENT ALARM#1	12/18/2018 11:42:51 AM
Loss of Charge#1 alarm	12/18/2018 1:44:43 PM
PERMANENT ALARM#1	12/18/2018 1:44:43 PM
Loss of Charge#1 alarm	12/18/2018 1:44:56 PM
PERMANENT ALARM#1	12/18/2018 1:44:56 PM

This button will erase the alarm events in the Alarm List.

View-->Alarms, Limits and Faults (LIMITS Tab)

This tab shows temperatures that are out of limits but have not caused an alarm. These limits are shown on the **Tools-->Configuration** page.

Configuration Page Monday, May 5, 2025 2:42:09 PM

Serial #: 10001 - 05 - 25 UPDATE FIRMWARE System Enabled

Firmware: V3.92 Power On Reset (POR)

Parameters In Sync

System Configuration Alarms and Delays MODBUS

Model Configuration

Model Series R(H)

Model Size 65

Model Function HACW

Refrigerant Type R454b

Number of Stages 2

Pressure Cutouts

Loop Type OPEN Low 67 67 PSIG

Discharge Control(PSIG) 350 High 565 565 PSIG

Temperature Limits

Outdoor OUT Min 34 Max 122

ALARMS	ALARMS LIST	LIMITS	FAULTS
Outdoor Loop Limits			
Outdoor OUT Too Cold			
Outdoor OUT Too Hot			

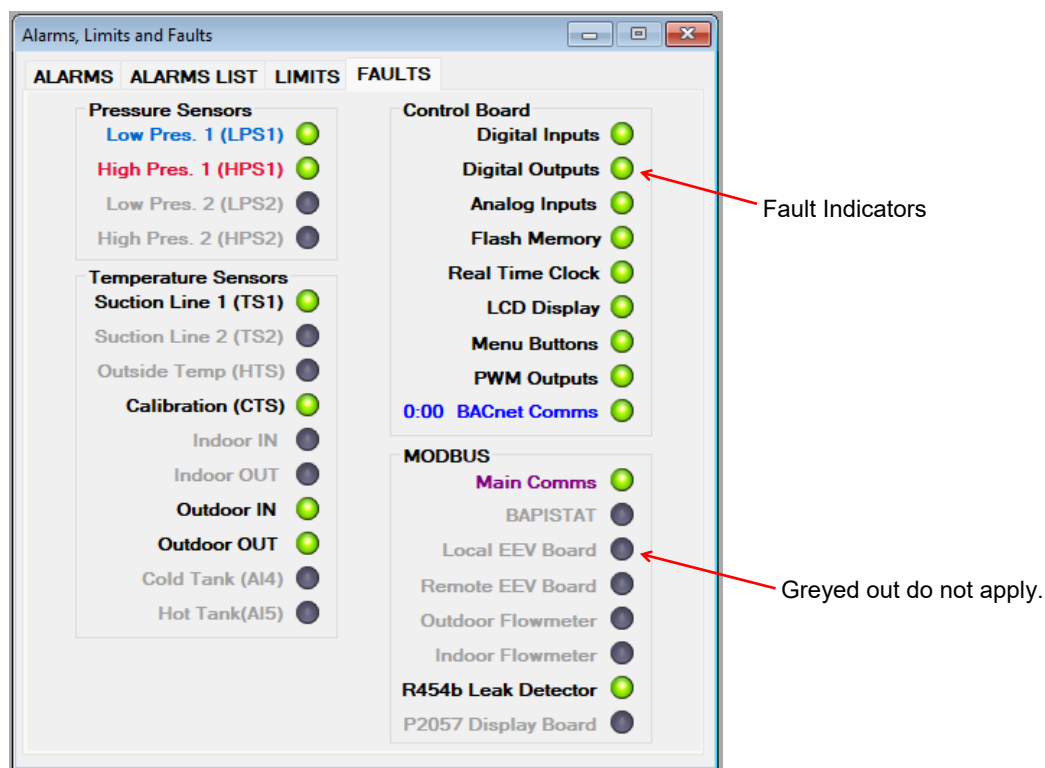
View-->Alarms, Limits and Faults (FAULTS tab)

This tab shows hardware faults that could occur. If one of these faults occurs there may be a problem with the control board hardware, with LCD interface and buttons, or with a sensor.

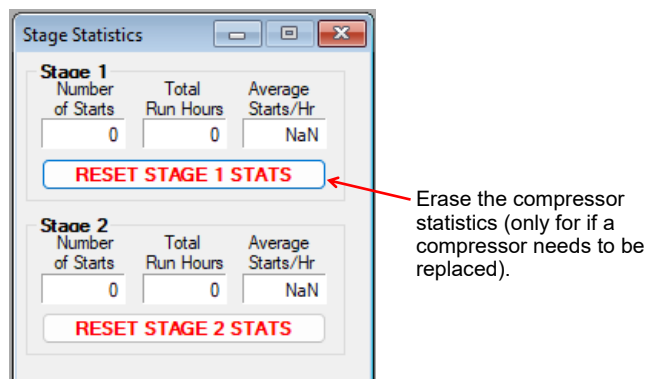
If a fault occurs, some things to try:

- Turn the power to the heat pump off for 20 seconds and then back on again.
- Use the menu item **Tools-->Reset to Factory Defaults**. If this clears the fault then the system configuration will have to be set up again.
- For LCD interface or Menu Button faults, turn off the power, disconnect and reconnect the cable between the LCD interface board and the control board, then turn the power back on again.

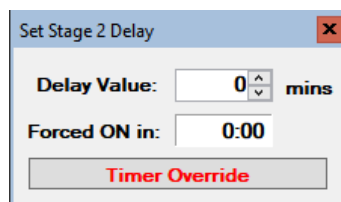
If the fault persists then there is most likely a hardware problem, and the sensor, control board, or LCD interface board will need to be replaced.

**View-->Stage Stats**

The compressor information: number of starts, run hours and starts per hour.

**View-->Set Stage 2 Delay**

Sets the delay before stage 2 is engaged on a stage 1 demand. ("0" = no stage 2 engaged on a stage 1 call)



View-->Indoor Fan

Shows the settings screen for the indoor fan/blower. Airflow may be adjusted up or down by the user within the allowed range. See **Indoor Airflow Data** section in the **Model Specific Information** chapter for airflow ranges.

NOTE: This screen may also be accessed from the SET button of the Indoor Fan section of the Control Panel screen.

Indoor Fan settings screen. It displays Airflow (0 CFM, 0 L/s) with an Auto button and a percentage input (0.0%). TACH is set to 0 RPM. Recirculation is set to 1100 CFM and 519 L/s. There are two sets of Stage 1 and Stage 2 settings, each with CFM and L/s values. An Auxiliary setting is also present. Emergency is set to 2000 CFM and 944 L/s. The screen includes an Auto button and an AR button.

View-->Set Air Auxiliary Delays

Sets the delay before auxiliary air heat (plenum heater) is engaged on a stage 1 or stage 2 demand.

Set to "0" for no auxiliary heat engaged on a compressor-only demand from thermostat.

Set Air Auxiliary Delays screen. It shows Delay Value for AUX1 (60 mins) and AUX2 (20 mins). Forced ON in is set to 0:00 for both. There are Timer Override buttons for AUX1 and AUX2.

View-->Water Lines

Displays the outdoor loop in, out, and delta temperatures.

Water Lines screen. It displays Outdoor Loop - GW IN (Auto, 32.0 °F), OUT (Auto, 32.0 °F), and Delta (ΔT, 0.0 °F).

View-->Digital Inputs

Shows the digital inputs and their individual status (ON/OFF). They may be individually controlled when in Manual Override Mode in order to facilitate troubleshooting.

Digital Inputs screen. It shows Air Thermostat inputs (G, Y1, Y2, O, W2, E) and Hydronic Thermostat inputs (Y1A, Y2A). There is also a section for Inputs (DI_2, DI_1, DI_0 (OL(0)/CL(1)), PM 2, PM 1, AR, ODFLO, IDFLO).

View-->Digital Outputs

Shows the digital outputs and their individual status (ON/OFF). They may be individually controlled when in Manual Override Mode in order to facilitate troubleshooting.

Digital Outputs screen. It shows Left Side outputs (ICR, DO_3, DO_2, DO_1, DO_0, L1, L2, L3, L4, L5, L6, SH) and Right Side outputs (PHS1, PHS2, L (Lockout)). There is also a Bottom section with STAGE1, STAGE2, RV1, RV2, SOL1, and SOL2.

View-->Analog Inputs

Shows the Analog inputs and their individual settings and values.

Click on the **EDIT** button to modify the blue boxes (button will now say **SAVE**). For each channel a name may be selected, and the Multiplier and Offset values may be set to accommodate the connected sensor scaling. Signals may be 4-20mA (channel jumper on board ON) or 0-10VDC (channel jumper on board OFF). A variety of units are also available for selection of common measurement types. Click on **SAVE** to save the changes. Values are kept even when power is removed from the unit.

Analog Inputs screen. It shows a table of channels with Name, VDC, Multiplier, Offset, Value, and Units. The table includes channels for Stage1_Current, AI1, Condensate_Alarm, Discharge_Temp, AI4, and AI5. A 10K NTC Thermistor Type is selected. An EDIT button is at the bottom.

Ch.	Name	VDC	Multiplier	Offset	Value	Units
AI 0	Stage1_Current	0.000	10.00	0.00	0.00	Amps
AI 1	AI1	0.000	1.00	0.00	0.00	Volts
AI 2	Condensate_Alarm	0.000	1.00	0.00	0.00	Volts
AI 3	Discharge_Temp		1.00	0.00	74.9	°F
AI 4	AI4	0.000	1.00	0.00	0.00	Volts
AI 5	AI5	0.000	1.00	0.00	0.00	Volts

View-->PWM Channels

Shows the PWM channels and their individual status (0-100%). They may be individually controlled when in Manual Override Mode in order to facilitate troubleshooting.

PWM Channels screen. It shows PWM Out Channels #1 PWM1, #2 PWM2, #3 PWM3, and #4 PWM4, each with an Auto button and a percentage input (0.0%). There is also a PWM IN status section.

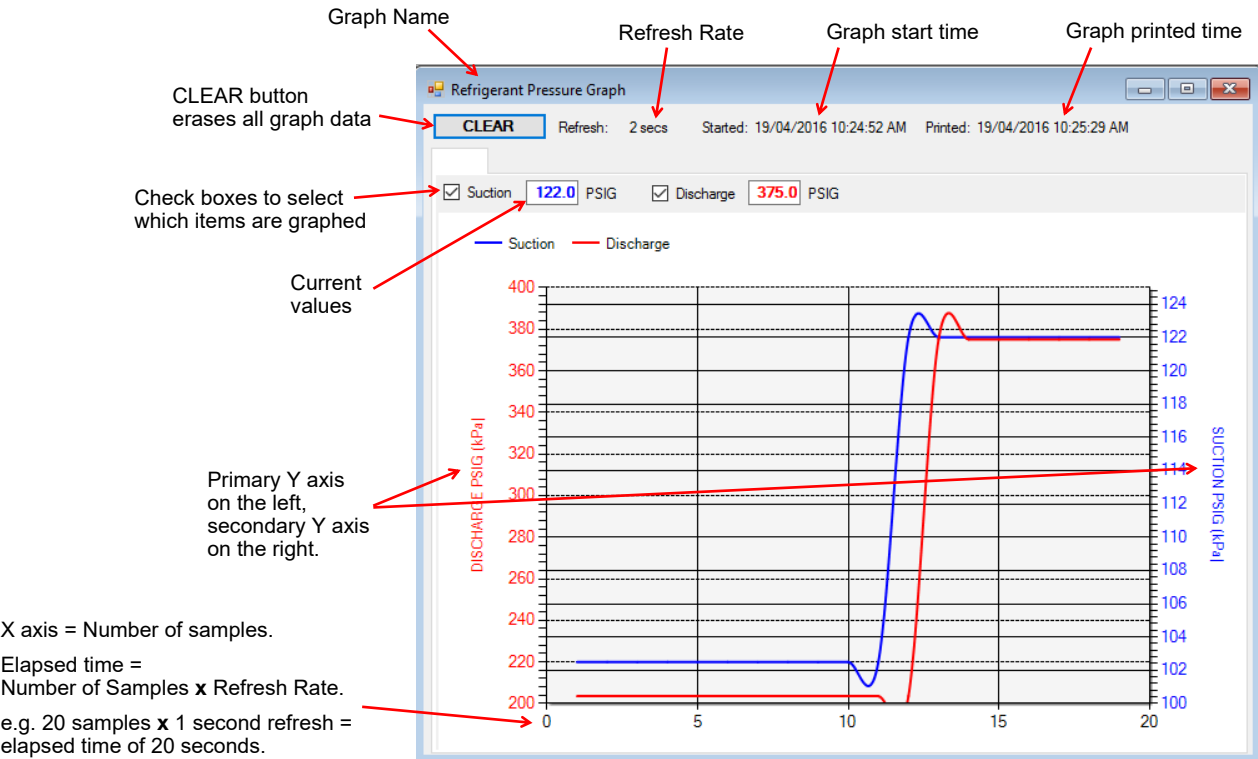
Graphs Menu:

This menu is a list of the available graphs. Graphs are real-time and show a time stamp of when the recording started as well as a current time which will show up if the graph is screen captured. Each graph has a CLEAR button which will erase the stored data and restart the graph. There is also a master CLEAR ALL GRAPHS button at the top right of the PC APP; this will clear all open graphs and re-start them all simultaneously to keep them in sync with each other. The refresh rate for the graphs is also located at the top right of the PC APP.

TIP: To screen print a graph and save it as a picture, press Print Screen on the keyboard and then paste into MS Paint or other graphics program. Select the desired graph with the selection tool and copy it to a new MS Paint, then save the file as the desired name.

Graphs	Tools	Windows	Help	Disconr
Control Signals Graph				ON/OFF status of the system control signals (demands)
Operation Mode Graph				ON/OFF status of air heating and air cooling modes
Input Signals Graph				ON/OFF status of digital inputs
Output Signals Graph				ON/OFF status of digital outputs
EEV Position / Superheat Graph				EEV position and resulting superheat
Vapor Line Temperature Graph				Suction temperature
Refrigeration Pressure and Temperature Graphs				Suction and discharge pressures, evaporating and condensing temperatures
Indoor Fan Graph				Blower demand in % and resulting RPM
Water Lines Graph				Outdoor IN/OUT temperatures and delta T
Analog Input Graphs				All analog input channels (0-10VDC or 4-20mA).
PWM Channels Graph				All PWM / 0-10VDC output channels and one PWM / 0-10VDC input channel.
BACnet Timeout Graph				For troubleshooting synchronization with 3rd party BACnet controllers.
Leak Detector Graph				LFL and cabinet temperature (cabinet temperature may read higher than actual)

Below is an example of a typical graph screen. Items that are checked will be plotted, unchecked items will not. The graph screens show the time the graph started as well as the current time to time stamp the graph when screen printed.



Tools Menu:

This is where various tools for system setup and monitoring are located.

Tools-->Configuration (System Configuration tab)

This is where the system setup is done. **Settings should only be changed by a person who has a good understanding of system operation.** Improper settings could cause the system to operate poorly or not at all.

The screenshot shows the 'Configuration Page' for a system, dated Tuesday, May 6, 2025, at 3:09:33 PM. The page is divided into several sections:

- Serial #:** 10001 - 05 25
- Firmware:** V3.92
- Parameters In Sync:** Indicated by a green dot.
- Buttons:** 'UPDATE FIRMWARE' (green), 'Power On Reset (POR)' (green), and 'System Enabled' (green).
- Model Configuration:**
 - Model Series: R(H)
 - Model Size: 65
 - Model Function: HACW
 - Refrigerant Type: R454b
 - Number of Stages: 2
 - EEV Step Range: 2500 (SER)
- Jumper Configuration:**
 - Control Source AIR: Signals
 - Control Source HYD: (greyed out)
 - Setpoints Method: (greyed out)
 - Air / Hydronic Priority: (greyed out)
 - Number of Tanks: (greyed out)
 - Heat Pump / Chiller: (greyed out)
 - Outdoor Ambient: (greyed out)
 - Summer Setback: (greyed out)
 - HYD AUX in Defrost: (greyed out)
 - OD Fan Reduction: (greyed out)
- Pressure Cutouts:**
 - Loop Type: OPEN
 - Discharge Control (PSIG): 350
 - Temperature Limits: Outdoor OUT Min 34, Max 122 °F
- Alarm and Fault Controls:**
 - Outdoor Flow Switch: Enabled
 - Indoor Flow Switch: Enabled
 - Outdoor IN Temp: Enabled
 - Indoor IN Temp: Enabled
 - Outdoor OUT Temp: Enabled
 - Indoor OUT Temp: Enabled
 - Stage 1:
 - Phase Monitor 1: Enabled
 - Compressor Status 1: Enabled
 - Compressor Monitor 1: Enabled
 - Discharge Temp 1: Enabled
- BACnet Configuration:**
 - Baudrate: 76800
 - MAC Address: 125
 - Instance#: 980000

Annotations:

- Green when parameters have been updated, red during update:** Points to the 'Parameters In Sync' green dot.
- Firmware revision can also be seen on the LCD during power up:** Points to the 'Firmware: V3.92' text.
- Heat pump serial number:** Points to the 'Serial #' text.
- Firmware update: see Appendix:** Points to the 'UPDATE FIRMWARE' button.
- POR: reset control system as would be done by cycling power:** Points to the 'Power On Reset (POR)' button.
- Enable/Disable the compressor (does not affect auxiliary heat). Units are shipped as Disabled to prevent an unintentional compressor startup:** Points to the 'System Enabled' button.
- Loop type as hardware selected by the closed loop jumper plug or open loop water valve harness:** Points to the 'Loop Type: OPEN' dropdown.
- Low pressure cut-outs determined by loop type and refrigerant type:** Points to the 'Discharge Control (PSIG): 350' field.
- High pressure cutout determined by refrigerant type:** Points to the 'High' pressure field (565 PSIG).
- Temperature limits determined by series and loop type:** Points to the 'Temperature Limits' section.
- The Enabled indicators show which alarms are enabled:** Points to the 'Enabled' indicators for various alarms.
- If an alarm is mandatory or not available, the Enable button will be greyed out. For optional alarms (e.g. requiring Phase Monitor accessory) the Enable button will be available; click to enable:** Points to the 'Compressor Monitor 1' button.
- IMPORTANT: Cycle power to invoke BACnet changes:** Points to the bottom of the BACnet Configuration section.
- Enable or disable stage 2 air cooling (disable for better dehumidification in northern climates where cooling load is much lower than heating load):** Points to the 'Number of Stages: 2' dropdown.
- If Control Source AIR is set to BACnet, set communication parameters. Disconnect PC App and cycle unit power to register changes to BACnet parameters:** Points to the BACnet Configuration section.

Tools-->Configuration (Alarms and Delays tab)

Click on the UP/DOWN arrows to change the value, noting that values have both a low and high limit.

The number of minutes before the unit can start again after various alarm shutdowns

The number of minutes before the unit can start again after a normal shutdown.

Maximum Count is the number of alarms allowed before a permanent lockout occurs.

Count Reduce Time is the number of hours after which the alarm count is reduced by 1 if no other alarm occurred within the timeframe.

The minimum off time when switching between heating and cooling cycles

Ignore On Start is the number of seconds an alarm will not be monitored after a compressor start occurs.

Overrides the alarm indicating that the water valve end switch failed to close (Outdoor WV/ODFLOW)

Items that do not apply to the model are greyed out.

Tools-->Configuration (MODBUS tab)

Use this tab to enable MODBUS accessories, or to initialize a replacement MODBUS device (e.g. refrigerant leak detector).

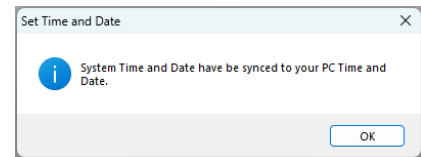
Click to enable/disable MODBUS device.

Green light indicates that MODBUS device is present.

To initialize a replacement device: Click "Configure New Device" button.

Tools-->Set Date and Time

This will synchronize the control board's time and date to that of the connected Windows PC. It is normally only necessary at installation or if electrical power has been off for several days.



Tools-->Datalogging (Datalog tab)

A log will be automatically recorded at the following rates:

- SYSTEM DISABLED: every 10 minutes
- SYSTEM ENABLED: logging frequency set via the dropdown box at the top right of the PC App main window
- ALARM: logging frequency automatically set to 10 seconds, for 2 hours
- PERMANENT ALARM: every 10 minutes

The maximum number of datalog records is 32,224, which will take 45 days to fill up at the default recording rate of 2 minutes.

Note that loading datalogs at the standard **Load Rate** is time-consuming. It is suggested to leave **QUANTITY** at **25** until it is shown that the start date selected contains data and that any relevant alarm has been located in time.

For large data sets, **Load Rate** can be increased from the default rate of 100, but may result in less reliable loading.

Annotations for the Datalog Page:

- LOAD FROM EARLIEST**: Loads the **QUANTITY** of logs beginning from earliest.
- LOAD FROM DATE**: Loads **QUANTITY** of logs beginning from selected date.
- CLEAR SCREEN**: Erases data from screen only.
- EXPORT**: Exports the data to a file.
- ERASE ALL DATALOG DATA**: Erases all logged data in the control board and resets the log count to zero (also available directly from **Tools** menu).
- Load Rate**: speed at which logs are retrieved from control board.
- Clicking anywhere on a row**: will update all LEDs to show the status at the time of that log record.

	HEX ADDR#	Date DD/MM/YY	Time	I/O #1	I/O #2	I/O #3	LIMITS	ALARMS1	PERM ALARMS1	TS Faults	Board Faults	Operation Mode	LPS1	HPS1	EVAP1	COND1	Suction Line	Super heat	EEV1 Position	SH Setpoint	OK
1	10000	06/05/2025	08:40:36	2	1024	0	0	0	0	0	0	0	102.1	203.5	37.6	74.1	31.3	0.0	0.0	8.0	
2	10080	06/05/2025	08:40:41	2	1024	0	0	0	0	0	0	0	102.1	203.5	37.6	74.1	31.3	0.0	0.0	8.0	
3	10100	06/05/2025	08:40:46	2	1024	0	0	0	0	0	0	0	102.1	203.5	37.6	74.1	31.3	0.0	0.0	8.0	

Tools-->Datalogging (Enable/Disable tab)

Click on the checkboxes to customize which columns are shown/hidden in the datalog table.

Annotations for the Enable/Disable tab:

- Datalog rate and capacity information**: Points to the Datalog Rate Table and Totals section.
- Load By Block: Developer use**: Points to the LOAD BY BLOCK section.

Datalog Rate Table

RATE	LOGS/DAY
5secs	17,280
10secs	8640
15secs	5760
30secs	2880
1min	1440
2mins	720
5mins	288
Sector	32 logs
Block	512 logs
Block	16 Sectors
TOTALS:	
Blocks	63
Sectors	1008
Logs	32,256

LOAD BY BLOCK

Start Block: 0, # of Blocks: 1

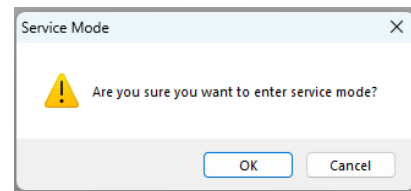
☒ SHOW LOG ADDRESS

Tools-->Service Tools

Tools-->Service Tools-->System Service Mode

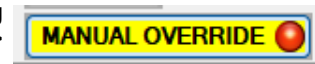
Disables the unit and fully opens electric valves to allow work to be done to the refrigeration system. (Also accessible via **SERVICE** button in **View -->Control Panel** window.)

To exit service mode, main breaker must be turned off and then back on.



Tools-->Service Tools-->Manual Override

Allows individual control system demands or sensor values to be manually overridden for troubleshooting or service purposes. Also accessible via **MANUAL OVERRIDE** button in main window top bar-->

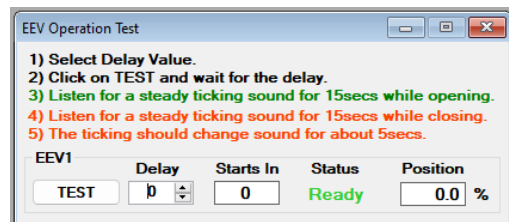


Tools-->Service Tools-->EEV Operation Test

Facilitates the audible EEV test described in the **Troubleshooting** chapter.

The EEV is operated through its range to OPEN and back to CLOSED, without an operator having to command it by using *Manual Override* mode.

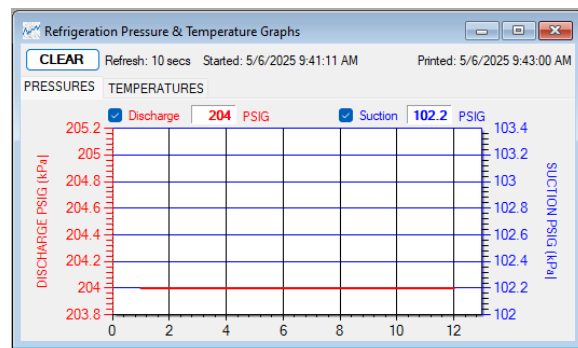
In addition, there is an adjustable delay so that the listener can go to the EEV's location before it starts to move. This is necessary when the EEV is in a remote location, as in air source split units like ATW-series.



Tools-->Service Tools-->Pressure Test Graphs

Opens an auto-scaling pressure and temperature graph to monitor pressure decline during nitrogen pressure tests which are typically performed after refrigeration system service.

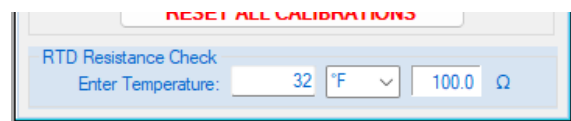
A declining pressure line (which is not associated with a declining temperature line) may indicate a leak.



Tools-->Service Tools-->RTD Resistance Check

This brings up the (rarely used) **Calibration** window, which at the bottom has a calculator for checking RTD temperature probes.

Enter the temperature of the probe, and the calculator will predict the resistance of the probe.

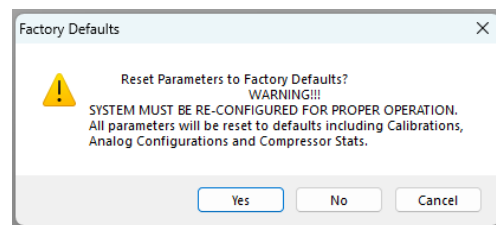


Tools-->Reset to Factory Defaults

This will reset all settings to default values.

THE SYSTEM MUST BE RECONFIGURED AFTER A RESET IS PERFORMED.

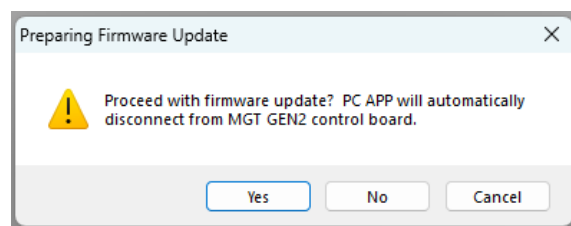
A reset will default the system to an ATW-65. Calibrations, alarm delays, analog configurations, compressor statistics, and Setpoint Control values will be returned to defaults as well.



Tools-->Update Firmware

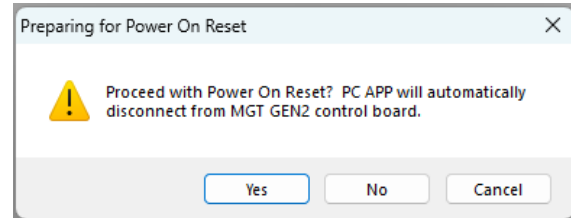
New function or bug fixes can be accessed by updating the firmware. This PC App function prepares the control board for a firmware update, by putting the board in boot loader mode and then disconnecting. The actual firmware update is done by a separate program which is downloaded along with the new firmware.

See appendix for details.



Tools-->Power On Reset (POR)

This function resets the control board as a power cycle off-on would.



Tools-->MODBUS-->Generic MODBUS

This window is for developer use.

The one useful function for users is that when troubleshooting MODBUS communications faults, *Communications Type* may be set to **SERIAL (Debug)** for a short time and then back to **MODBUS RTU** to see if that resets the fault and prevents fault re-occurrence.

Tools-->MODBUS-->Configuration

This brings up the 3rd tab of the **Tools-->Configuration** window, which is detailed on a previous page.

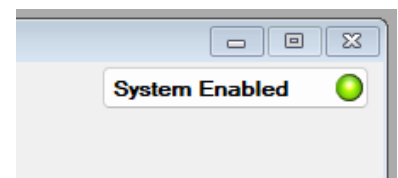
Tools-->Advanced

WARNING! This menu is for developer use only.
Changing parameter values can cause the system to stop functioning properly.

Tools-->Advanced-->Calibration**Tools-->Advanced-->Parameters****Tools-->Advanced-->EEV PID Parameters****Tools-->Advanced-->Objects****Tools-->Advanced-->Jumpers****Tools-->Advanced-->SYSTEM TIMERS****Tools-->Advanced-->Performance****Tools-->System Enable/Disable**

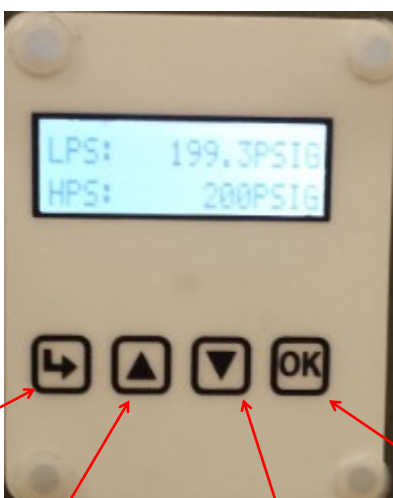
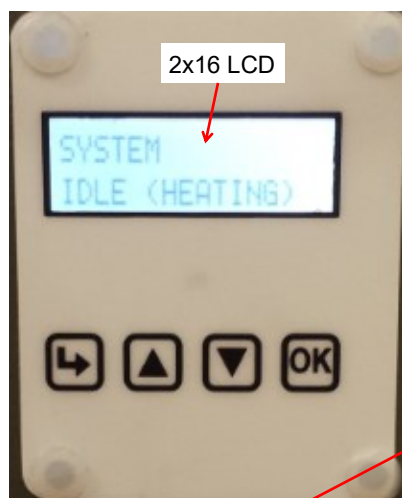
Enable/Disable the compressor (does not affect auxiliary heat).
 Units are shipped as Disabled to prevent an unintentional compressor startup.

This is the same function as button at the top right of the 1st tab of the **Tools-->Configuration** window.



LCD Interface & Menus

These are examples of the unit status and operating data displayed when at the message display level (top level). Pressing ENTER will enter into the menu levels beginning with the Main Menu.



ENTER button:
Use this to push down to the next menu level. Also saves value if at parameter menu level.

UP button:
Use this to scroll up through the items available at a menu level.

DOWN button:
Use this to scroll down through the items available at a menu level.

OK/EXIT button:
Use this to come back up one menu level. Also saves value if at parameter menu level.

Main Menu: This table shows what is displayed based on each press of the ENTER button starting at the Main Menu level.

ENTER (From Main)	ENTER (First Press)	ENTER (Second Press)	ENTER (Third Press)	Description
System EN/DIS	— Enable System?	— Disable		Disable compressor, auxiliary and ICR.
		— Enable		Enable compressor, auxiliary and ICR.
Service Mode	— Service Mode?	— No		Do not enter Service Mode.
		— Yes		Enter into Service Mode.
EEV Control	— EEV1 (Local)	— Auto/Manual	— Auto	Puts EEV in Auto mode
			— Manual	Puts EEV in Manual mode
		— Manual Position	— EEV Position (%)	Sets EEV to manual position
Configuration	— Control AIR	— BACnet		BACnet control—see BACnet chapter
		— Signals		Hardwired Signal control
	— Time Delays	— Short Cycle	— Delay (min)	Short-cycle timer delay in minutes
		— Heat/Cool	— Delay (min)	Heat / Cool timer delay in minutes
	— Units	— Standard		Standard units
		— Metric		Metric units
	— Set Time	— Hours	— Hours value	Set the system hours.
		— Minutes	— Minutes value	Set the system minutes.
	— Set Date	— Day	— Day value	Set the system day.
		— Month	— Month value	Set the system month.
Calibration	— Suction 1	— calibration adj.		Calibration in 1PSI intervals.
	— Discharge 1	— calibration adj.		Calibration in 1PSI intervals.
	— Vapour Line 1	— calibration adj.		Calibration in 0.1°F intervals
	— Outdoor IN Temp	— calibration adj.		Calibration in 0.1°F intervals
	— Outdoor OUT Temp	— calibration adj.		Calibration in 0.1°F intervals

NOTE: Calibration is generally not required. All temperature sensors have an Auto Calibration feature.

BACnet Interface

The BACnet interface is an **MS/TP** connection via RS-485 twisted pair. BACnet **IP** is not available.

Recommended wire: 22-24 AWG single twisted pair, 100-120 Ohms impedance, 17pF/ft or lower capacitance, with braided or aluminum foil shield, such as Belden 9841 or 89841.

The connector on the control board is a three wire removable screw connector. The signals are as follows:

- A: Communications line (+) (right pin)
- B: Communications line (-) (middle pin)
- C: Ground connection (left pin)

If connecting multiple units to one RS-485 connection point, connect the signal cable from the master building controller to the first unit. Connect the second unit to the first unit (in same connector), connect the third unit to the second unit, and so on until all units are connected (daisy-chain). Remove the TERM jumper (located just above the BACnet connector on control board) from all units except the last one. The shield ground should be connected only to the GND pin of the unit for single unit installations. For multiple units, the shield ground should only be connected to the GND pin of the last unit. The shield grounds for intermediate units should be connected together. The shield ground should be left unconnected at the building controller end for all cases.

Vendor: Maritime Geothermal Ltd.
Vendor ID: 260
Model Name: MGT GEN2 Control Board

The following parameters can be set via the PC App's *Configuration Window*:

- 1) **Baud rate**
9600, 19200, 38400, or 76800
- 2) **MAC address**
Maximum value is 125.
- 3) **Instance number**
Maximum value is 4194303.

The BACnet parameter **Max_Master** has a fixed value of **127** in this device.

BACnet data is available regardless of the selected control method. In order to control the unit via the BACnet interface, set **Control Source** to **BACnet** either by using the PC App's configuration window or the LCD menus.



IMPORTANT: When constructing BACnet code to control the heat pump/chiller, give careful consideration to MINIMIZING CYCLING and MAXIMIZING RUN TIMES.

The heat pump/chiller can't do its work properly and will incur excessive wear if it is turning on and off every few minutes.

Note: object names are subject to change without prior notice.

TABLE 15 - BACnet OBJECTS - CONTROL SIGNALS (READ/WRITE)

Name	Data Type	ID	Property	Description
SYSTEM_O	Binary Value	BV2	Present Value	Switch to air cooling mode (RV#1). Inactive= HEATING , Active= COOLING
SYSTEM_Y1	Binary Value	BV3	Present Value	Demand for air heating or cooling (active is on)
SYSTEM_Y2	Binary Value	BV4	Present Value	Demand for stage 2 air heating or cooling (active is on)
SYSTEM_W2	Binary Value	BV5	Present Value	Demand for air auxiliary heat / plenum heater (active is on)
SYSTEM_G	Binary Value	BV6	Present Value	Demand for air recirculation (active is on)
SYSTEM_AR	Binary Value	BV7	Present Value	Demand for airflow reduction (active is on)
BACnet_Units	Binary Value	BV9	Present Value	Select units for BACnet objects. OFF=US, ON=metric

TABLE 16 - BACnet OBJECTS - OPERATION MODE Description (Read Only)

Name	Data Type	ID	Present Value	Description
Operation Mode	Analog Value	AV5	0	Air heating
			1	Air cooling
			9	Air heating off
			10	Air cooling off

Note: Object is type Analog Value but value will always be an integer value.

TABLE 17 - BACnet OBJECTS - DATA (Read Only)

	Name	ID	Property	Units	Description
Type - Analog Input	AI0 (Comp1_Current)	AI0	Present Value	Amps	Compressor current draw
	AI1 (Comp2_Current)	AI1	Present Value	User	N/A
	AI2	AI2	Present Value	ohms	N/A (used for condensate sensor, see Alarms table)
	AI3	AI3	Present Value	degF (degC)	Compressor discharge line temperature
	AI4 (CTS)	AI4	Present Value	degF (degC)	N/A
	AI5 (HTS)	AI5	Present Value	degF (degC)	N/A
	LPS1	AI6	Present Value	PSIG (kPa)	Low pressure value (suction pressure)
	HPS1	AI7	Present Value	PSIG (kPa)	High pressure value (discharge pressure)
	EVAP1	AI8	Present Value	degF (degC)	Evaporating Temperature
	COND1	AI9	Present Value	degF (degC)	Condensing Temperature
	Suction Line 1	AI10	Present Value	degF (degC)	Suction line temperature
	Superheat 1	AI11	Setpoint Value	degF (degC)	Evaporator superheat
	EEV1 Position	AI12	Present Value	%	EEV position (% open)
	LPS2	AI13	Present Value	PSIG (kPa)	N/A
	HPS2	AI14	Present Value	PSIG (kPa)	N/A
	EVAP2	AI15	Present Value	degF (degC)	N/A
	COND2	AI16	Setpoint Value	degF (degC)	N/A
	Suction Line 2	AI17	Present Value	degF (degC)	N/A
	Superheat 2	AI18	Setpoint Value	degF (degC)	N/A
	EEV2 Position	AI19	Present Value	%	N/A
	Outside Ambient	AI20	Present Value	degF (degC)	N/A
	O_IN	AI21	Present Value	degF (degC)	Outdoor loop IN temperature
	O_OUT	AI22	Present Value	degF (degC)	Outdoor loop OUT temperature
	I_IN	AI23	Present Value	degF (degC)	N/A
	I_OUT	AI24	Present Value	degF (degC)	N/A
Type - Analog Value	PWM_IN	AV0	Present Value	%	N/A
	PWM1 (OD Fan)	AV1	Present Value	%	N/A
	PWM2	AV2	Present Value	%	N/A
	PWM3 (OV2)	AV3	Present Value	%	OV2 - PWM or 0-10VDC for outdoor loop water valve
	PWM4 (IV2)	AV4	Present Value	%	IV2 - PWM or 0-10VDC for indoor loop water valve
	Operation Mode	AV5	Present Value	N/A	Description of mode - see Operation Mode Description table
	Limits description	AV6	Present Value	N/A	Description of active limits - see Limits Description table
	Permanent Alarms 1	AV7	Present Value	N/A	Description of active alarms - see Alarm Descriptions table
	Permanent Alarms 2	AV8	Present Value	N/A	N/A
	Board Faults	AV9	Present Value	N/A	Description of active faults - see Fault Descriptions table
Type - Binary Output	STAGE1	BO0	Present Value	N/A	Compressor contactor
	STAGE2	BO1	Present Value	N/A	Compressor stage 2 solenoid (2-stage units only)
	ICR (Indoor Circ)	BO2	Present Value	N/A	N/A
	DO0 (OV1)	BO3	Present Value	N/A	OV1 (to 24VAC Outdoor Loop water valve)
	DO1 (IV1)	BO4	Present Value	N/A	N/A
	DO2 (HYD_AUX)	BO5	Present Value	N/A	N/A
	DO3 (AUX_ONLY)	BO6	Present Value	N/A	N/A
	PHS1	BO7	Present Value	N/A	Air plenum heater stage 1
	PHS2	BO8	Present Value	N/A	Air plenum heater stage 2
	CONTROLS	BV9	Present Value	N/A	Control indicator: 0=local (man.override), 1=remote (BACnet)
Type - Binary Value	Outdoor Flow	BV10	Present Value	N/A	Outdoor loop water valve ON
	Indoor Flow	BV11	Present Value	N/A	N/A
	Phase Monitor1	BV12	Present Value	N/A	3 Phase Monitor - requires accessory
	Phase Monitor2	BV13	Present Value	N/A	N/A
	Comp Monitor1	BV14	Present Value	N/A	N/A
	Comp Monitor2	BV15	Present Value	N/A	N/A

TABLE 18 - BACnet OBJECTS - LIMITS Description (Read Only)

Name	ID	BIT #	Decimal Value*	Bit Description
Limits (Present Value)	AV6	1	2	N/A
		2	4	Low Outdoor OUT temperature
		3	8	High Outdoor OUT temperature

Note: Limits object is type Analog Value but value is bit coded and may be decoded as such (integer value).

Note *: Value is for a single alarm and reference only.

TABLE 19 - BACnet OBJECTS - ALARM Descriptions (Read Only)

Name	Data Type	ID	Description
AI0 (Comp1 Current)	Analog Input	AI0	Status alarm (start / stop failure, from current sensor)
AI1 (Comp2 Current)	Analog Input	AI1	N/A
LPS1	Analog Input	AI6	Low pressure alarm
HPS1	Analog Input	AI7	High pressure alarm
LPS2	Analog Input	AI13	N/A
HPS2	Analog Input	AI14	N/A
Outdoor Flow	Binary Value	BV10	Outdoor loop water valve
Indoor Flow	Binary Value	BV11	N/A
Phase Monitor1	Binary Value	BV12	3-Phase Monitor alarm - requires accessory
Phase Monitor2	Binary Value	BV13	N/A
Comp Monitor1	Binary Value	BV14	N/A
Comp Monitor2	Binary Value	BV15	N/A

Name	ID	BIT #	Decimal Value*	Bit Description
Permanent Alarms 1 (Present Value)	AV7	0	1	Master permanent alarm (occurs when any alarm occurs)
		1	3	Low pressure heating mode alarm (suction pressure)
		2	5	Low pressure cooling mode alarm (suction pressure)
		3	9	High pressure heating mode alarm (discharge pressure)
		4	17	High pressure cooling mode alarm (discharge pressure)
		5	33	Loss of charge alarm
		6	65	Phase monitor alarm - requires accessory
		7	129	Compressor monitor alarm - N/A
		8	257	Status alarm (from current sensor)
		10	1025	Condensate overflow alarm
		14	16,385	Outdoor loop water valve
Permanent Alarms 2 (Present Value)	AV8	13	8192	A2L refrigerant leak detector alarm (may or may not be a permanent alarm)

Note: Permanent Alarm objects are type Analog Value but values are bit coded and may be decoded as such (integer value).

Note *: Value is for a single alarm and reference only. Value includes + 1 for Master Alarm

TABLE 20 - BACnet OBJECTS - FAULT Descriptions (Read Only)

Name	Data Type	ID	Description
AI3 (Disch Temp)	Analog Input	AI3	Compressor discharge line temperature sensor faulty or disconnected
AI4 (Cold Tank)	Analog Input	AI0	N/A
AI5 (Hot Tank)	Analog Input	AI1	N/A
LPS1	Analog Input	AI6	Low pressure sensor faulty or disconnected
HPS1	Analog Input	AI7	High pressure sensor faulty or disconnected
LPS2	Analog Input	AI13	N/A
HPS2	Analog Input	AI14	N/A
Suction Line1	Analog Input	AI10	Suction line 1 temperature sensor faulty or disconnected.
Suction Line2	Analog Input	AI17	N/A
Outdoor Ambient	Analog Input	AI20	N/A
O_IN	Analog Input	AI21	Outdoor IN temperature sensor faulty or disconnected
O_OUT	Analog Input	AI22	Outdoor OUT temperature sensor faulty or disconnected
I_IN	Analog Input	AI23	N/A
I_OUT	Analog Input	AI24	N/A

Name	ID	BIT #	Decimal Value*	Bit Description
Board Faults (Present Value)	AV9	0	1	Digital inputs
		1	2	Digital outputs
		2	4	PWM outputs
		3	8	Analog to digital conversion
		4	16	Real time clock
		5	32	EEPROM memory
		6	64	Menu buttons
		7	128	LCD interface
Sensor Faults (Present Value)	AV10	0	1	Suction line temperature sensor
		1	2	N/A
		2	4	N/A
		3	8	Calibration temperature resistor plug
		4	16	N/A
		5	32	N/A
		6	64	Outdoor IN temperature sensor
		7	128	Outdoor OUT temperature sensor
		8	256	N/A
		9	512	N/A

Note: Board and Sensor Fault objects are type Analog Value but values are bit coded and may be decoded as such (integer value).
Note *: Value is for a single fault and reference only.

Startup Procedure

The R/RH-Series Startup Record located in this manual is used in conjunction with this startup procedure to provide a detailed record of the installation. A completed copy should be left on site, a copy kept on file by the installer and a copy should be sent to Maritime Geothermal Ltd.

Check the boxes or fill in the data as each step is completed. For data boxes, circle the appropriate units.

Pre-Start Inspection

Ductwork:

1. Verify that all ductwork has been completed and is firmly attached to the unit. Verify that any dampers or diverters are properly set for operation of the heat pump.
2. Verify that all registers are open and clear of any objects that would restrict the airflow.
3. Verify that a new air filter is installed and the cover is secured.
4. Verify the condensate drain is connected, properly vented and free of debris.
5. If a plenum heater has been installed, verify that it is securely fastened.

Outdoor Loop (Ground Loop):

1. Verify that all shutoff valves are fully open and there are no restrictions in the piping from the heat pump to the ground loop, and that full flow is available to the heat pump.
2. Verify that the entire system has been flooded and all the air has been purged as much as possible. Further purging may be required after the system has been operating for a while.
3. Verify that the loop contains the proper mix of antifreeze for the intended application. Record the type of antifreeze and the mixture value on the startup sheet; circle % Vol. or % Weight.
4. Record the static loop pressure on the startup sheet.

Outdoor Loop (Open Loop):

1. Verify there are no leaks in the connections to the unit. Verify the water valve is installed and properly oriented in the water out line.
2. Verify that there is flow control in water out line.

Domestic Hot Water (Desuperheater):

1. Verify that all shutoff valves are fully open and there are no restrictions in the piping from the heat pump to the domestic hot water tank.
2. Verify that the entire system has been flooded and all the air has been purged as much as possible. Further purging may be required after the system has been operating for a while.
3. Verify that the brown wire with the insulated terminal is disconnected in the electrical box. Refer to the schematic diagram for more information.

Electrical:

1. **Ensure the power to the unit is off. Ensure the power to the plenum heater is off if equipped.**
2. Verify all high voltage connections. Ensure that there are no stray wire strands, all connections are tight and the ground wire is connected tightly to the ground connector for the heat pump and plenum heater.
3. Record the fuse / circuit breaker size and wire gauge for the heat pump. Record the fuse / circuit breaker size, wire gauge and size of the plenum heater if installed.
4. Verify that the control connections to the thermostat and plenum heater (if installed) are properly connected and all control signals are off, so that the unit will not start up when the power is turned on.
5. Ensure all access panels except the lower one that provides access to the electrical box are in place.

Unit Startup

The unit is now ready to be started. The steps below outline the procedure for starting the unit and verifying proper operation of the unit. **It is recommended that safety glasses be worn during the following procedures.**

IMPORTANT NOTE: The unit is shipped with the compressor DISABLED in order to prevent the unit from starting when the power is first turned on. Follow the instructions below in the Preparation section to enable the compressor.

When power is on, the LCD Interface will alternate to show the low (suction) pressure, high (discharge) pressure, superheat, EEV position, and water in/out temperatures.

Preparation:

1. Set up the thermostat as per the instructions provided with it so that it will function properly with the heat pump system (set for system type: heat pump). The O signal should be set to active in cooling mode. Set the thermostat to OFF.
2. Turn the power on to the heat pump. All LED's on the control board should turn on, the LCD interface should say "**MGT GEN2 VERx.xx**" on line 1 and "**Zeroing EEV's**" on line 2. You should be able to hear the EEV moving (a clicking sound).
3. Measure the following voltages on the compressor contactor and record them on the startup sheet: L1-L2, L2-L3, L1-L3.
4. Connect a USB cable between the USB connector on the board and a laptop with the PC App installed (recommended but optional).
5. Enable the system either with the PC App's Configuration Page **System Enable/Disable** button or via the LCD interface.

Heating Mode:

1. Set the air thermostat to heating mode and adjust the setpoint to activate stage 1 and stage 2. The fan should slowly ramp up to speed after the time delay of the thermostat expires (if applicable) and the compressor will start.
2. Check the PC App or LCD interface. The suction and discharge pressures will vary based on the outdoor temperature and indoor air temperature, but they should be **90-110PSIG** and **260-360PSIG** respectively for a typical start-up.
3. Monitor the PC App or LCD while the unit runs. Record the following after 10 minutes of runtime:
 - a. Suction pressure
 - b. Discharge pressure
 - c. Duct Return temperature (poke a small hole in the flex collar and insert probe in airstream)
 - d. Duct Supply temperature (poke a small hole in the flex collar and insert probe in airstream)
 - e. Duct Delta T (should be between **22-32°F, 12-18°C**)
 - f. Outdoor Loop Temperatures: In, Out, & Delta T (should be **5-8°F, 3-4°C**)
 - g. Compressor L1(C) current (black wire, place meter between electrical box and compressor)
4. Adjust the thermostat setpoint to the desired room temperature and let the unit run through a cycle.
5. For units with a desuperheater, turn the power off to the unit. Connect the brown wire with the blue insulated terminal to the compressor contactor as shown in the electrical box diagram. Turn the DHW Switch in the unit post on. Turn the power to the unit on.
6. Verify the DHW IN and DHW OUT temperatures (if applicable) by hand (**caution: pipes get hot**). If the DHW OUT line does not become hotter than the DHW IN line the circulator is air locked. Bleed the air from the system and check the temperature differential again to ensure there is flow from the circulator.
7. Remove the electrical cover from the plenum heater. Place a current clamp meter around one of the supply wires. Turn on the power to the plenum heater. Adjust the thermostat setpoint to **85°F (29°C)**. Verify that the current draw increase as each electric heat stage is activated. (10kW has 2 stages, 15kW has 3 stages and 20kW has 4 stages).

Cooling Mode:

1. Set the air thermostat to cooling mode and adjust the setpoint to activate stage 1 and stage 2.
2. Monitor the PC App or LCD while the unit runs. Record the following after 10 minutes of runtime:
 - a. Suction pressure
 - b. Discharge pressure
 - c. Duct Return temperature
 - d. Duct Supply temperature
 - e. Duct Delta T
 - f. Outdoor Loop Temperatures: In, Out, & Delta T (should be **10-11°F, 5-6°C**)
3. Adjust the thermostat setpoint to the desired room temperature if possible, otherwise set it just low enough to start the unit (e.g. 1°F / 0.5°C less than room temperature) and let the unit run through a cycle.

Final Inspection:

1. Turn the power off to the unit (and plenum heater if installed) and remove all test equipment.
2. Install the electrical box cover and the access panel on the heat pump. Install the service port caps securely to prevent refrigerant loss. Install the electrical cover on the plenum heater if applicable.
3. Do a final check for leaks/spills and ensure the area is clean.
4. Turn the power on to the unit and the plenum heater if installed. Set the thermostat and water heat to the final settings.

Startup Record:

1. Sign and date the Startup Record and have the homeowner sign as well. Leave the Startup Record with the homeowner, retain a copy for filing and send a copy to Maritime Geothermal Ltd. for warranty registration.

Startup Record:

1. The installer shall sign and date the Startup Record and have the homeowner sign as well. The installer shall leave the Startup Record with the homeowner, retain a copy for filing and send a copy to Maritime Geothermal Ltd. for warranty registration.

Startup Record: R/RH-Series

Installation Site		Startup Date	Installer	
City			Company	
Province			Model	
Country			Serial #	
Homeowner Name		Homeowner Phone #		

Check boxes unless asked to record data. Circle data units.

PRE-START INSPECTION

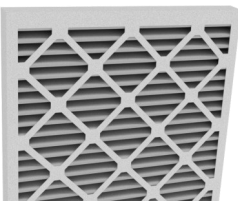




Ductwork	Ductwork is completed, dampers/ diverters are adjusted					
	Registers are open and clear of objects					
	Air filter and end cap are installed					
	Condensate Drain is connected, properly vented and free of debris					
	Plenum heater is securely fastened (if applicable)					
Closed Loop	All shut-off valve are open (full flow available)					
	Loop is full and purged of air					
	Antifreeze type					
	Antifreeze concentration		% Volume	% Weight		
	Loop static pressure		psi	kPa		
Open Loop	Water Valve installed in return line					
	Flow control installed in return line					
Domestic Hot Water	All shut-off valves are open					
	Lines are full and purged					
	Desuperheater pump wire is disconnected					
Electrical	High voltage connections are correct and securely fastened					
	Circuit breaker (or fuse) size and wire gauge for Heat Pump		A		Ga.	
	Circuit breaker (or fuse) size, wire gauge, and Plenum Heater size		A		Ga.	kW
	Low voltage connections are correct and securely fastened					

STARTUP DATA

Preparation	Voltage across L1 and L2, L1 and L3, L2 and L3					VAC
Heating Mode (10 minutes)	Suction Pressure / Discharge Pressure			psi	kPa	
	Duct Return, Duct Supply, and Delta T		In	Out	°F	°C
	Outdoor loop temperatures: In, Out, & Delta T		In	Out	°F	°C
	Outdoor Flow		lgpm	gpm	L/s	
	Compressor L1 (black wire) current		A			
	Domestic Hot Water functioning					
	Thermostat setpoint, suction and discharge pressures at cycle end		°F	°C		psi
Cooling Mode (10 minutes)	Suction Pressure / Discharge Pressure			psig	kPa	
	Duct Return, Duct Supply, and Delta T		In	Out	°F	°C
	Outdoor loop temperatures: In, Out, & Delta T		In	Out	°F	°C
	Thermostat setpoint, suction and discharge pressures at cycle end		°F	°C		psi

Date:		Installer Signature:		Homeowner Signature:	
A total of three copies are required, one for the homeowner, one for the installer and on to be sent to Maritime Geothermal Ltd.					

Routine Maintenance

MAINTENANCE SCHEDULE			
Item		Interval	Procedure
Air Filter		6 months	Inspect for dirt. Replace if necessary.
Compressor Contactor		1 year	Inspect for pitted or burned points. Replace if necessary.
Condensate Drain		1 year	Inspect for clogs. Clean if necessary.
LCD Interface or PC App		When heat pump problem is suspected	Check for alarms and faults (only necessary if alarms not reported through a BACnet system). Rectify problem if alarms found. See Troubleshooting chapter.
Coaxial Heat Exchanger		When experiencing performance degradation that is not explained by a refrigeration circuit problem or low ground loop flow rate	Disconnect the outdoor loop and flush heat exchanger with a calcium removing solution. Generally not required for closed loop or cold water open loop systems; whenever system performance is reduced for warm water open loop systems (unusual).

Coaxial Heat Exchanger Flushing Procedure - Open Loop

1. Isolate the heat exchanger by closing the valves in the IN and OUT ports to the heat exchanger.
2. Blow out the heat exchanger into a clean 5 gallon bucket using compressed air.
3. If a purge cart is not available, use a 5 gallon plastic bucket, a circulator and some plastic piping to create a make-shift pump system. Connect a the inlet and outlet to the heat exchanger ports.
4. Place 2 gallons of RYDLYME or similar in the purge cart (or bucket). Circulate the fluid through the heat exchanger for at least 2 hours (3 hours recommended).
5. Disconnect the purge system and dispose of the solution. RYDLYME is non-toxic and biodegradable and as such can be poured down a drain.
6. Connect fresh water and a drain to the heat exchanger ports and flush the exchanger for several minutes.
7. Return the plumbing to its original configuration and open the IN and OUT valves. Operate the system and check for improved performance.

Coaxial Heat Exchanger Flushing Procedure - Closed Ground Loop

1. Isolate the heat exchanger by placing the pump module valves in the exchanger flushing position.
2. Connect a compressed air and a drain pipe to the pump module purge ports and blow the anti-freeze solution into a clean 5 gallon bucket.
3. Connect a purge cart to the pump module purge ports.
4. Place 2 gallons of RYDLYME or similar in the purge cart. Circulate the fluid through the heat exchanger for at least 2 hours (3 hours recommended).
5. Disconnect the purge cart and dispose of the solution. RYDLYME is non-toxic and biodegradable and as such can be poured down a drain. Clean the purge cart thoroughly.
6. Connect fresh water and a drain to the pump module purge ports and flush the exchanger for several minutes.
7. Blow the heat exchanger out with compressed air as per STEP 2 and dump the water down a drain.
8. Connect the purge cart to the pump module purge ports. Re-fill and purge the heat exchanger with as per standard procedures (the antifreeze from STEP 2 can be re-used).
9. Disconnect the purge cart and set the pump module valves back to the original positions. Operate the system and check for improved performance.

Troubleshooting Guide

The following steps are for troubleshooting the heat pump. If the problem is with the domestic hot water or the plenum heater, proceed to those sections at the end of the troubleshooting guide. Repair procedures and reference refrigeration circuit diagrams can be found later in this manual.

STEP 1: Verify that the LCD interface is functioning . If it is not, proceed to POWER SUPPLY TROUBLE SHOOTING, otherwise proceed to STEP 2.

STEP 2: Record the alarm shown on the LCD interface or use the PC APP Alarms page to determine the alarm type. Proceed to the ALARMS TROUBLESHOOTING section.

STEP 3: If there are no alarms and STAGE1 is showing ON (LCD interface, PC APP or LED on control board) but the compressor is not operating, does not attempt to start, attempts to start but cannot, starts hard, or starts but does not sound normal, proceed to the COMPRESSOR TROUBLESHOOTING section.

STEP 4: If the compressor starts and sounds normal, this means the compressor is most likely OK. Proceed to the OPERATION TROUBLESHOOTING section.

NOTE: To speed up the troubleshooting process, if using the PC Application, click on SC Override to reduce the short cycle timer to 10 seconds.

POWER SUPPLY TROUBLESHOOTING			
Fault	Possible Cause	Verification	Recommended Action
No power to the heat pump	Disconnect switch open (if installed)	Verify disconnect switch is in the ON position.	Determine why the disconnect switch was opened; if all is OK close the switch.
	Fuse blown / breaker tripped	At heat pump disconnect box, voltmeter shows 230VAC on the line side but not on the load side.	Reset breaker or replace fuse with proper size and type. (Time-delay type "D")
No heartbeat on control board	Transformer breaker tripped (or fuse blown for those without breaker)	Breaker on transformer is sticking out (or fuse looks burnt).	Push breaker back in. If it trips again locate cause of short circuit and correct (or replace fuse) .
	Faulty transformer	Transformer breaker is not tripped (or fuse not blown), 230VAC is present across L1 and L3 of the compressor contactor but 24VAC is not present across 24VAC and COM of the control board.	Replace transformer.
	Faulty Control Board	24VAC is present across 24VAC and COM of the control board.	Replace the control board.
No display on air thermostat	No power from transformer	See No Heartbeat on control board .	
	Faulty wiring between heat pump and thermostat	24VAC is not present across R and C of the thermostat.	Correct the wiring.
	Faulty thermostat	24VAC is present across R and C of the thermostat but thermostat has no display.	Replace thermostat .

ALARM TROUBLESHOOTING		
Alarm/Fault	Description	Recommended Action
The data logging function of the GEN2 Control Board is a very useful tool for troubleshooting alarms. It provides a history of the unit operation up to and including the time at which the alarm(s) occurred.		
Low Pressure	A low pressure alarm occurs when the suction pressure drops to or below the Low Pressure Cutout value. The low pressure is checked just before a compressor start; if it is OK the compressor will start, otherwise an alarm will occur. When the compressor starts, the low pressure alarm will be ignored for the number of seconds that Low Pressure Ignore is set to, after which the low pressure alarm will be re-enabled. This allows a dip in suction pressure below the cutout point during startup without causing a nuisance alarm.	Go to the Low Pressure section of the mode the unit was operating in at the time of the alarm.
High Pressure	A high pressure alarm occurs when the discharge pressure rises to or above the High Pressure Cutout value.	Go to the High Pressure section of the mode the unit was operating in at the time of the alarm.
Compressor Status (current sensor)	This alarm occurs when there is a current draw on the compressor but no call for the compressor to be on (welded contactor) or when there is a call for the compressor to be on but there is no compressor current draw (manual high pressure control is open or contactor failure). Current sensor is now standard.	Check contactor if compressor is staying on when it should be off. Go to Compressor section if compressor is not on when it should be. Also check for tripped manual high pressure control.
Not Pumping / Man HP	Discharge pressure is less than 30 psi higher than suction pressure after 2 minutes run time. It indicates leaking reversing valve, compressor very hot and tripped on internal overload, manual high pressure control trip, bad contactor, or defective compressor.	Check for reversing valve not seated properly, tripped manual high pressure control, or a contactor or compressor problem.
Low Charge / EEV	EEV position has been above 99% for 20 minutes within the first hour of cycle.	Check system for refrigerant leak. Also check that EEV for proper operation (see EEV Troubleshooting section)
LOC (Loss of Charge)	This alarm occurs if the low pressure and/or high pressure sensors are below 30 psig (207 kPa).	Check system for refrigerant leak. Check for incorrect pressure sensor reading.
Condensate Drain	Water level in the condensate tray has risen to sensor level, indicating condensate drain is blocked.	Check condensate drain(s) for obstructions.
Outdoor Flow (ODFLOW)	For open loop, 24vac signal from water valve end switch indicating water valve open was not received in the time limit (90 seconds).	Verify water valve operation and that it is wired properly using the factory wiring harness (see wiring diagram in the Model Specific Information chapter later in this manual).
Leak Detector / R454b Leak	Refrigerant sensor detected the presence of refrigerant inside the PC cabinet.	Locate and fix leak, taking all necessary precautions associated with A2L refrigerants. See Service Procedures chapter.

FAULT TROUBLESHOOTING		
Alarm/Fault	Description	Recommended Action
Pressure Sensors	The sensor is reading outside of the acceptable range. Check to ensure connector is on securely.	Replace the pressure sensor. If this does not rectify the problem, replace the control board.
Temperature Sensors	The sensor is reading outside of the acceptable range. Check to ensure connector is on securely.	Replace the temperature sensor. If this does not rectify the problem, replace the control board.
Control Board: - <i>Digital Inputs</i> - <i>Digital Outputs</i> - <i>Analog Inputs</i> - <i>Real Time Clock</i> - <i>PWM Outputs</i>	A failure has occurred and the indicated section of the control board may no longer work properly.	Cycle the power a few times; if the fault persists replace the control board.
Control Board: - <i>Flash Memory</i>	A failure has occurred and stored data may be corrupt.	It may be possible to correct this by using the menu item Tools—Reset to Factory Defaults . If this clears the fault then the system configuration will have to be set up again.
Control Board: - <i>Menu Buttons</i>	A failure has occurred and the control board may no longer respond to menu button key presses.	Try turning off the power, disconnecting and reconnecting the cable between the LCD Interface board and the Control Board, and then turning the power back on again. If this does not work then either the LDC Display board, the cable, or the driver section of the Control Board may be faulty.
Control Board: - <i>LCD Interface / LCD Display</i>	A failure has occurred and display may show erratic data, no data or may not turn on at all.	
Control Board: - <i>BACnet Comms</i>	BACnet communications experienced a timeout.	See BACnet TROUBLESHOOTING on next page.
MODBUS: - <i>Main Comms</i>	Hardware problem on heat pump control board.	24VDC is not present across 24VDC and GND at the lower right of control board. Replace board if voltage not correct. Remove MODBUS screw terminal connector from board as well as jumper from TERM (located just above the MODBUS connector). Using a multimeter set to DC volts with negative probe on B and positive probe on A , confirm there is +2.5VDC . Replace board if voltage not correct.
	MODBUS termination problem.	Verify MODBUS TERM jumper is in place on control board. Install jumper if missing.
MODBUS: - <i>R454b Leak Detector</i>	Refrigerant detector communications experienced a timeout.	See LEAK DETECTOR TROUBLESHOOTING on next page.

BACnet TROUBLESHOOTING

Fault	Possible Cause	Verification	Recommended Action
BACnet communications not working properly or BACnet fault indication	Selected baud rate does not match building control system	Check baud rate of system.	Adjust BACnet parameters in the PC App's Tools-->Configuration window. Cycle power to invoke any changes.
	Selected MAC address and/or Instance # conflict with other devices on the network	Check MAC address and Instance # in relation to other system devices.	
	BACnet wiring or termination problem	Verify correct twisted pair wire and termination in the BACnet Interface chapter (earlier).	Correct wiring.
	Hardware problem on heat pump control board	Remove BACnet screw terminal connector from board & jumper from TERM (located above BACnet connector). Using multimeter set to DC volts with black probe on B and red probe on A , confirm there is +2.5VDC .	Replace board if voltage not correct.

LEAK DETECTOR TROUBLESHOOTING

Fault	Possible Cause	Verification	Recommended Action
Refrigerant detector not working properly or MODBUS R454b Leak Detector fault indication	Hardware problem on heat pump control board	5VDC is not present across 5VDC and GND at the lower right of control board.	Replace board if voltage not correct.
		Remove MODBUS screw terminal connector from board & jumper from TERM (located above BACnet connector). Using multimeter set to DC volts with black probe on B and red probe on A , confirm there is +2.5VDC .	Replace board if voltage not correct.
	MODBUS termination problem	Verify MODBUS TERM jumper is in place on control board.	Install jumper if missing.
	Faulty refrigerant leak detector	5VDC is present on board as per above, termination is correct, but problem persists.	Replace leak detector.

COMPRESSOR TROUBLESHOOTING

Fault	Possible Cause	Verification	Recommended Action
Compressor will not start	Faulty control board	No 24vac output on STAGE1 when compressor should be operating.	Replace control board.
	Faulty run capacitor (Single phase only)	Check value with capacitance meter. Should match label on capacitor. Compressor will hum while trying to start and then trip its overload.	Replace if faulty.
	Loose or faulty wiring	Check all compressor wiring, including inside compressor electrical box.	Fix any loose connections. Replace any damaged wires.
	Faulty compressor contactor	Voltage on line side with contactor held closed, but no voltage on one or both terminals on the load side. Points pitted or burned. Or, 24VAC across coil but contactor will not engage.	Replace contactor.
	Thermal overload on compressor tripped	Ohmmeter shows reading when placed across R and S terminals and infinity between C & R or C & S. A valid resistance reading is present again after the compressor has cooled down.	Proceed to Operation Troubleshooting (particularly <i>high suction pressure</i> and <i>high discharge pressure</i>) to determine the cause of the thermal overload trip.
	Burned out motor (open winding)	Remove wires from compressor. Ohmmeter shows infinite resistance between any two terminals. Note: Be sure compressor overload has had a chance to reset. If compressor is hot this may take several hours.	Replace the compressor.
	Burned out motor (shorted windings)	Remove wires from compressor. Resistance between any two terminals is below the specified value.	Replace the compressor.
	Motor shorted to ground	Remove wires from compressor. Check for infinite resistance between each terminal and ground.	If any terminal to ground is not infinite replace the compressor.
	Seized compressor due to locked or damaged mechanism	Compressor attempts to start but trips its internal overload after a few seconds. (Run capacitor already verified)	Attempt to “rock” compressor free. If normal operation cannot be established, replace compressor.
Compressor starts hard	Start capacitor faulty. (Single phase only)	Check with capacitance meter. Check for black residue around blowout hole on top of capacitor.	Replace if faulty. Remove black residue in electrical box if any.
	Potential relay faulty (Single phase only)	Replace with new one and verify compressor starts properly.	Replace if faulty.
	Compressor is “tight” due to damaged mechanism	Compressor attempts to start but trips its internal overload after a few seconds. Run capacitor has been verified already.	Attempt to “rock” compressor free. If normal operation cannot be established, replace compressor.
Compressor stage 2 will not activate	Faulty stage 2 plug (solenoid is in plug)	Verify if 24VAC is present across Y2 and C of the terminal strip.	Replace plug if signal is present. Check wiring if signal is not present.

OPERATION TROUBLESHOOTING - HEATING MODE

Fault	Possible Cause	Verification	Recommended Action
High or low suction or discharge pressure	Faulty sensor	Compare pressure sensor reading against a known reference such as a new refrigeration manifold set.	Check wiring, replace sensor. If problem persists, replace control board.
High discharge pressure	Low airflow	See Fan Troubleshooting section	Correct the problem.
	EEV stuck almost closed or partially blocked by foreign object	Manually adjusting the EEV does not affect the superheat or the suction pressure. High superheat and low suction pressure.	Go to EEV troubleshooting section.
	Filter-dryer plugged	Feel each end of the filter-dryer; they should be the same temperature. If there is a temperature difference then it is plugged. Also causes low suction pressure.	Replace filter-dryer.
	Unit is overcharged (Only possible if unit has been field serviced and incorrectly charged)	High subcooling, low Indoor Loop delta T.	Remove 1/2lb of refrigerant at a time and verify that the discharge pressure reduces. Or remove charge and weigh back in the amount listed on nameplate.
Low suction pressure	Low or no outdoor loop liquid flow	Delta T across the Outdoor Loop ports should be 5-7°F (3-4°C), or compare pressure drop to the tables for the unit.	Determine the cause of the flow restriction and correct it. Verify pumps are working and sized correctly for ground loop systems. Verify well pump and water valve is working for ground water systems.
	Outdoor loop entering liquid temperature too cold	Measure the entering liquid temperature to see if it is less than ~25F.	Increase the size of the ground loop.
	Dirty or fouled outdoor loop coaxial coil (more likely for open loop, unlikely for ground loop)	Disconnect the water lines and check the inside of the pipes for scale deposits.	Backflush the coaxial exchanger with a calcium-removing cleaning solution.
	Return air too cold	Measure return air temperature. Should be above 60°F (15°C).	Restrict air flow temporarily until room comes up to temperature.
	TS1 temperature sensor not reading properly	If the sensor is reading low it will cause the superheat to appear high, which causes the EEV to continually close.	Verify EEV position is low compared to normal. Check temperature sensor, replace if necessary.
	Filter-dryer plugged	Feel each end of the filter-dryer; they should be the same temperature. If there is a temperature difference then it is plugged. Also causes high discharge pressure.	Replace filter-dryer.
	EEV stuck almost closed or partially blocked by foreign object	Manually adjusting the EEV does not affect the superheat or the suction pressure. High superheat and discharge pressure.	Go to EEV troubleshooting section.
	Low refrigerant charge	Superheat is high, EEV position is high.	Locate the leak and repair it. Spray Nine, a sniffer, and/or dye are common methods of locating a leak.

OPERATION TROUBLESHOOTING - HEATING MODE			
Fault	Possible Cause	Verification	Recommended Action
High suction pressure (may appear to not be pumping)	EEV stuck open	Manually adjusting the EEV does not affect the superheat or the suction pressure. Low super heat and discharge pressure.	Go to EEV troubleshooting section.
	Leaking 4-way (reversing) valve RV1 (can cause compressor to overheat and trip internal overload)	Valve is the same temperature on both ends of body, common suction line is warm, compressor is running hot, low discharge pressure.	Tap reversing valve, and switch it back and forth between heating and cooling positions. If this does not work, replace reversing valve.
	Faulty compressor, not pumping	Pressures change only slightly from static values when compressor is started.	Replace compressor.
Compressor frosting up	See Low Suction Pressure in this section		
EEV frosting up	EEV stuck almost closed or partially blocked by foreign object	Manually adjusting the EEV does not affect the superheat or the suction pressure. High superheat and discharge pressure.	Go to EEV troubleshooting section.
Random high pressure trip (may not occur while on site)	Fan/blower problem	Go to Fan/Blower Troubleshooting section.	
Random manual high pressure trip (may not occur while on site)	Faulty compressor contactor	Points pitted or burned. Contactor sometimes sticks causing the compressor to run when it should be off.	Replace contactor.

OPERATION TROUBLESHOOTING - COOLING MODE

Fault	Possible Cause	Verification	Recommended Action
Heating instead of cooling	Thermostat not set up properly	Verify that there is 24VAC across O and C of the terminal strip when calling for cooling.	Correct setup.
	Faulty reversing valve	A click can be heard when the coil is energized but the unit continues to heat instead of cool.	Replace reversing valve.
High discharge pressure	Low or no outdoor loop liquid flow	Delta T across the outdoor loop ports should be 8-12°F (4-7°C), or compare pressure drop to the tables for the unit.	Determine the cause of the flow restriction and correct it. Verify pumps are working for ground loop systems. Verify well pump and water valve is working for ground water systems.
	EEV stuck almost closed or partially blocked by foreign object	Manually adjusting the EEV does not affect the superheat or the suction pressure. High superheat and low suction pressure.	Go to EEV troubleshooting section.
	Outdoor loop entering liquid temperature too warm	Most likely caused by undersized ground loop.	Verify the ground loop sizing. Increase the size of the ground loop if undersized.
	Dirty or fouled outdoor loop coil (more likely for open loop, unlikely for ground loop)	Disconnect the water lines and check the inside of the pipes for scale deposits.	Backflush the coaxial exchanger with a calcium-removing cleaning solution.
	Filter-dryer plugged	Feel each end of the filter-dryer; they should be the same temperature. If there is a temperature difference then it is plugged. Also causes low suction pressure.	Replace filter-dryer.
	Unit is overcharged. (Only possible if unit has been field serviced and incorrectly charged)	High subcooling.	Remove 1/2lb of refrigerant at a time and verify that the discharge pressure reduces. Or remove charge and weigh back in the amount listed on nameplate.

OPERATION TROUBLESHOOTING - COOLING MODE

Fault	Possible Cause	Verification	Recommended Action
High suction pressure (may appear to not be pumping)	EEV stuck open	Manually adjusting the EEV does not affect the superheat or the suction pressure. Low superheat and discharge pressure.	Go to EEV troubleshooting section.
	Leaking 4-way (reversing) valve RV1 (can cause compressor to overheat and trip internal overload)	Valve is the same temperature on both ends of body, common suction line is warm, compressor is running hot, low discharge pressure.	Tap reversing valve, and switch it back and forth between heating and cooling positions. If this does not work, replace reversing valve.
	Faulty compressor, not pumping	Pressures change only slightly from static values when compressor is started.	Replace compressor.
Low suction pressure	Low airflow	See Fan/Blower Troubleshooting section. Note: low airflow will cause the air coil to ice up once the suction drops below 90PSIG .	Correct the problem.
	EEV stuck almost closed or partially blocked by foreign object	Manually adjusting the EEV does not affect the superheat or the suction pressure. High superheat and discharge pressure.	Go to EEV troubleshooting section.
	TS1 temperature sensor not reading properly	If the sensor is reading low it will cause the superheat to appear high, which causes the EEV to continually close.	Verify EEV position is low compared to normal. Check temperature sensor, replace if necessary.
	Filter-dryer plugged	Feel each end of the filter-dryer; they should be the same temperature. If there is a temperature difference then it is plugged. Also causes high discharge pressure.	Replace filter-dryer.
	Low refrigerant charge	Superheat is high, EEV position is high.	Locate the leak and repair it. Spray Nine, a sniffer, and dye are common methods of locating a leak.
Compressor frosting up	See Low Suction Pressure in this section		
EEV frosting up	EEV stuck almost closed or partially blocked by foreign object	Manually adjusting the EEV does not affect the superheat or the suction pressure. High superheat and high discharge pressure.	Go to EEV troubleshooting section.
Random manual high pressure trip (may not occur while on site)	Faulty compressor contactor	Points pitted or burned. Contactor sometimes sticks causing the compressor to run when it should be off.	Replace contactor.

FAN/BLOWER TROUBLESHOOTING

Fault	Possible Cause	Verification	Recommended Action
Low airflow	Dirty air filter	Inspect.	Replace.
	Dirty air coil	Inspect.	Clean.
	Poor ductwork	Measure delta T between supply and return ducts at the unit. In heating mode; it should not be above 30°F(17°C).	The ECM fan will provide proper airflow up to 0.5 inH ₂ O. The ductwork is poorly designed or greatly undersized if the fan motor cannot provide the required airflow.
	Airflow selected is too low	Check airflow settings on Indoor Fan page of the PC APP.	Select a higher setting.
	Airflow reduction is enabled	AR1 and AR2 are connected with a dry contact or jumper.	Airflow reduction may not be feasible with lower airflow selections. Increase settings until unit operates properly.
Fan not operating at correct speeds	Wrong model size selected	Verify that the model size is correct on the Configuration Page of the PC APP.	Select the correct model size.
Fan not operating or operating intermittently	Fan control signal harness and/or fan power harness is loose	Verify that the connector is properly inserted into the fan motor. Gently tug on each wire to verify it is properly inserted into the connector.	Repair any loose connections.
	Control board not configured properly	Verify that the model series is correct on the Configuration Page of the PC APP.	Correct the configuration. If the wrong series is selected there may not be any fan output.
	Faulty control board outputs Note: cycle the power once to see if the fan begins operating properly first	Create a call for the fan from the thermostat or use a jumper R-G (24VAC on G terminal in heat pump). On the ECM Fan connector on the left side of the control board : 1) verify that there is 12 to 20VDC between pin G (grey wire) and pin C (white wire). 2) Verify that there is 2 to 6VDC between pin P (dark green wire) and pin C (white wire)	If there is no voltage present on either of the pins (G and P) replace the control board. Ensure control board model series is correct, see above.
	Faulty control signal harness or faulty motor head	Create a call for the fan from the thermostat or use a jumper R-G (24VAC on G terminal in heat pump). On the ECM Fan connector at the fan motor : 1) verify that there is 12 to 20VDC between pin G (grey wire) and pin C (white wire). 2) Verify that there is 2 to 6VDC between pin P (dark green wire) and pin C (white wire)	If proper signal isn't present, replace the fan control signal harness. If proper signal is present, replace fan motor.
	Faulty fan power harness or faulty motor	Insert the tips of the voltmeter probes into the back of the connector at the fan to measure the voltage across the red and black wires. Value should be ~230VAC.	Replace power harness if 230VAC is not present, replace motor if 230VAC is present.

EEV (Electronic Expansion Valve) TROUBLESHOOTING

Electronic expansion valves are a great advancement over TVX's, allowing more precise refrigerant control, but they do have a couple of limitations.

- a) EEV's receive commands to open or close from the control board, but they don't send any feedback to the control board to confirm that command has been received and acted upon. If they aren't reliably acted upon (due to pulses missed due to a wiring issue or EEV being mechanically stuck), the actual valve opening position won't match what the control board thinks it is. In extreme cases, the resulting repeated commands can cause the *apparent* valve position to go to **15%** (minimum) or **100%**, when the valve is actually in between.
- b) A restriction in the refrigeration circuit (particularly the liquid line, e.g. plugged filter-dryer) or shortage of refrigerant due to a leak can cause a similar issue. If the EEV opens to allow more refrigerant flow to lower the superheat but liquid refrigerant is not available at its inlet, the EEV will continue to open to attempt to let more refrigerant through and will work its way towards **100%** (full open). **High superheat** is also a symptom.

If there is low suction pressure and the EEV position is also low then the problem is generally not in the refrigeration system; check the water or airflow of the indoor or outdoor loop, whichever is currently the cold side (evaporator).

Tests to determine if an EEV is working

- Sound test: turn the power to the heat pump off and back on again. Or manually set the EEV to 25% and wait for it to stop, then set the EEV to "–1%". Both actions will cause the EEV to overdrive closed. You should hear the valve clicking and then the clicking should change and get louder when the valve reaches 0%. If there is no sound, then it is likely that the EEV is faulty or stuck.
- Using the PC APP, put the system in manual override mode. Manually adjust the EEV position by at least 25% either up or down and check to see that the suction pressure, discharge pressure and superheat react to the change. If there is no reaction, then it is likely that the EEV is faulty or stuck.
- Set the EEV back to AUTO and then turn the heating or cooling demand off (but leave power on). Once the demand is off, if the EEV is working then the discharge pressure should remain significantly higher than the suction pressure, i.e. the system will not equalize (since EEV's are closed when there is no demand). If the system does equalize it is likely that the EEV is not working and is partially open.

There are 3 possible causes for EEV problems: the control board is not working properly, the wire/cable is faulty, or the EEV is faulty.

The EEV can be checked electrically:

- RED to GREEN 75ohms
- WHITE to BLACK 75ohms

If this test fails, EEV is bad and should be replaced, but if it passes it still may be mechanically defective.

Check with a new EEV:

A further check that can be performed is to connect a new EEV and cable to the control board and visually check the EEV so see if it opens and closes by setting the position to 0 and 100% If the new EEV works then the EEV in the unit or the cable needs to be replaced.

- 1) Connect a test EEV and test cable to the control board.
- 2) Set the EEV position to 0%.
- 3) Set the EEV position to 100% and then listen for clicking and watch to see if the pintle in the EEV moves open.
- 4) Set the EEV position to 0% and then listen for clicking and watch to see if the pintle in the EEV moves closed.
- 5) If the EEV does not move in one or both directions then the control board must be replaced.
- 6) If the test EEV moves in both directions then either the cable or the EEV in the unit is faulty.
- 7) Disconnect the test EEV from the test cable and connect it to the cable in the unit.
- 8) Repeat steps 2 to 4.
- 9) If the test EEV moves in both directions then the EEV in the unit is faulty and must be replaced.
- 10) If the test EEV does not move in one or both directions then the cable must be replaced.

PLENUM HEATER TROUBLE SHOOTING			
Fault	Possible Cause	Verification	Recommended Action
No 230VAC across plenum heater L1 and L2	Disconnect switch open. (if installed)	Verify disconnect switch is in the ON position.	Determine why the disconnect switch was opened, if all is OK close the switch.
	Fuse blown / breaker tripped	At plenum heater disconnect box (if installed), voltmeter shows voltage on the line side but not on the load side. Check if breaker is tripped.	Reset breaker or replace fuse at plenum heater disconnect box. Replace fuse with proper size and type. (Time-delay type "D")
	Same "Line" to L1 and L2	Measuring L1 to ground and L2 to ground both yield 115VAC, but L1 to L2 yields 0VAC.	Correct wiring.
No W2 signal at heat pump terminal strip	No call for auxiliary or emergency heat from thermostat	Verify that the thermostat is indicating that auxiliary or emergency heat should be on.	Set thermostat to engage auxiliary or emergency heat. (Note that some thermostats require a jumper between auxiliary and emergency. Check the tstat manual.)
	Faulty thermostat	Thermostat doesn't indicate a call for auxiliary or emergency when it should. Or indicates auxiliary or emergency but no 24VAC signal present across C and the auxiliary and/or emergency pin at the thermostat.	Replace thermostat.
	Faulty thermostat wiring	24VAC signal is present across C and the auxiliary and/or emergency pin at the thermostat but no 24VAC signal is present across W2 and C at the heat pump terminal strip.	Correct wiring.
No 24VAC signal from C to ground at the plenum heater control board	Plenum heater transformer is burned out	Voltmeter does not show 24VAC across transformer secondary.	Replace transformer.
	Plenum heater control board is faulty	Transformer tested OK in previous step.	Replace control board.
No 24VAC signal from 1 to ground at the plenum heater control board (when a plenum heater demand is present)	Faulty wiring	24VAC present across C and ground at the plenum heater, but not across ground of the plenum heater and C _P of the heat pump terminal strip	Correct the wire which should run from heat pump C _P to plenum heater C.
		If above tested OK, 24VAC is present across ground of plenum heater and 1 of the heat pump terminal strip, but not across ground of plenum heater and 1 of the plenum heater.	Correct the wire which should run from heat pump terminal "1" to plenum heater terminal "1".
Plenum heater thermal overload is tripped.	Indoor fan not operating	See Indoor Fan/Blower Troubleshooting section.	Correct problem. Reset thermal overload.
	Plenum heater is not positioned so that majority of airflow passes over elements (if installed in ductwork outside heat pump)	Plenum heater meant for internal heat pump installation is installed in a larger duct outside heat pump, or is positioned after duct elbow.	Reposition plenum heater, or obtain a plenum heater model with a wider element cage (contact Maritime Geothermal).
	Faulty overload	Reset thermal overload.	Replace if faulty.

DOMESTIC HOT WATER (DESUPERHEATER) TROUBLE SHOOTING			
Fault	Possible Cause	Verification	Recommended Action
Insufficient hot water (tank problem)	Thermostat on hot water tank set too low (should be set at 120°F to 140°F)	Visually inspect the setting.	Adjust the setting.
	Breaker tripped, or fuse blown in electrical supply to hot water tank	Check both line and load sides of fuses. If switch is open determine why (possible shorted element).	Correct problem, and replace blown fuse or reset breaker.
	Reset button tripped on hot water tank	Check voltage at elements with multimeter.	Push reset button.
Insufficient hot water (heat pump problem)	DHW switch is turned off	Inspect switch, located on heat pump cabinet post.	Turn switch on.
	Brown wire with insulated terminal at compressor contactor not connected during installation	Inspect wire with insulated terminal as shown on electrical diagrams.	Connect wire as instructed on electrical box diagram and/or wiring schematic diagram.
	Circulator pump seized or motor failed	Use an amprobe to measure current draw.	Replace if faulty.
	Blockage or restriction in the water line or hot water heat exchanger	Check water flow and power to pump. Check water lines for obstructions.	Remove obstruction in water lines. Acid treat the domestic hot water coil.
	Faulty DHW cutout (failed open)	Check contact operation. Should close at 120°F and open at 140°F.	Replace DHW cutout if faulty.
	Heat pump not running enough hours to make sufficient hot water	Note the amount of time the heat pump runs in any given hour.	Temporarily turn up the tank thermostats until colder weather creates longer run cycles.
Water is too hot.	Faulty DHW cutout (failed closed)	Check contact operation. Should close at 120°F and open at 140°F.	Replace DHW cutout if faulty.
	Thermostat on hot water tank set too high (should be set at 120°F to 140°F)	Visually inspect the setting.	Adjust the setting.

Service Procedures



A2L-SPECIFIC WARNING / INSTRUCTION

Servicing a Unit with an A2L Refrigerant

1. Work procedure

Work should be undertaken under a controlled procedure, for example according to an ordered checklist. This may be in contrast to how refrigeration service work has normally been performed in the past, and is to minimize the risk of flammable gas being present while the work is being performed.

2. General work area

All maintenance staff and others working in the local area should be instructed on the nature of work being carried out. Work in confined spaces should be avoided.

3. Checking for presence of refrigerant

The area should be checked with a refrigerant detector prior to and during work, to ensure the technician is aware of potentially oxygen-deprived or flammable atmospheres.

Ensure that the leak detection equipment being used is suitable for use with A2L refrigerants, i.e. non-sparking, and adequately sealed or intrinsically safe. Under no circumstances should a torch or flame be used in the searching for refrigerant leaks.

Electronic leak detectors may be used but for A2L's they may need re-calibration in a refrigerant-free area. Leak detection equipment should be set at a percentage of the LFL (lower flammability limit) of the refrigerant (25% maximum). The worst-case LFL for R454b is **0.296 kg/m³** or **11.3%** by volume.

Leak detection fluids are also suitable for use with most refrigerants but the use of detergents containing chlorine should be avoided as the chlorine can react with the refrigerant and corrode the copper pipe-work.

If a leak is suspected at any time, all naked flames should be removed/extinguished.

If a leakage of refrigerant is found which requires brazing, all of the refrigerant should be first recovered from the system, or isolated (by means of shut-off valves) in a part of the system remote from the leak.

5. Presence of fire extinguisher

If any torch work (brazing) or refrigerant charging or removal is to be conducted, a dry powder or CO2 fire extinguisher should be ready at hand.

6. No ignition sources

Sources of ignition should be eliminated in the vicinity of work being carried out on a system containing an A2L refrigerant. Prior to work taking place, the area around the equipment should be surveyed to make sure that there are no flammable hazards or ignition risks. "No Smoking" signs should be displayed.

6. Ventilation of area

Ensure that the area is open to the outdoors or that it is adequately ventilated before breaking into the system or conducting any hot work. Ventilation should continue during the work, and can function to disperse any released refrigerant into a large space or preferably expel it into the outdoors.

7. Checks of the refrigeration equipment

- The refrigerant charge is in accordance with the size of the room within which the system is installed.
- The ventilation equipment (if any) is operating adequately and is not obstructed.
- The water/glycol/pool water loop should be checked for the presence of refrigerant, which might show up with a refrigerant detector or by over-pressure in that loop.
- Equipment markings continue to be visible and legible. Illegible signs or markings should be corrected.
- Refrigeration piping is installed in a position where it is unlikely to be exposed to corrosive substances, unless the piping is constructed of materials which are inherently resistant to corrosion from that substance.

**A2L-SPECIFIC WARNING / INSTRUCTION****Servicing a Unit with an A2L Refrigerant (continued)****8. Checks to electrical devices & wiring**

Where electrical components are being changed, they should be as specified by Maritime Geothermal Ltd.. If in doubt, consult technical support for assistance.

Electrical components should be inspected. If a fault is found, electrical supply should not be connected to the circuit until the fault is rectified. If the fault cannot be corrected immediately but it is necessary to continue operation, an adequate temporary solution should be used. This should be reported to the owner of the equipment so all parties are advised.

Initial safety checks should include:

- Capacitors are discharged - this should be done in a safe manner to avoid possibility of sparking.
- No live electrical components and wiring are exposed while charging, recovering or purging the system.
- There is continuity of earth grounding/bonding.
- Check cabling for wear, corrosion, excessive pressure, vibration, sharp edges or any other adverse environmental effects. The check should take into account the effects of aging or continual vibration from sources such as compressors or fans.

9. Refrigerant removal and circuit evacuation

When breaking into the refrigerant circuit to make repairs - or for any other purpose - conventional procedures should be used. However, with flammable refrigerants it is important that best practice is followed:

- a) Safely remove refrigerant following local and national regulations, recovering into the correct recovery cylinders.
- b) Evacuate (vacuum). Ensure that the outlet of the vacuum pump is not close to any potential ignition sources and that ventilation is available.
- c) Purge the circuit by breaking the vacuum in the system with dry nitrogen and continuing to fill until the working pressure is achieved, then venting to atmosphere.
- d) Evacuate (vacuum) again, then vent to atmospheric pressure to enable work to take place.
- e) Open the circuit with torch, continuously flushing with dry nitrogen.

10. Charging

In addition to conventional charging procedures, the following should be observed.

- Ensure that contamination between different refrigerants does not occur when using charging equipment. Hoses should be as short as possible to minimize the amount of refrigerant contained in them.
- Cylinders should be kept in an appropriate position according to the instructions.
- Ensure that the refrigerating system is grounded prior to charging the system with refrigerant.
- Label the system when charging is complete (if final refrigerant charge is different from factory label).
- Extreme care should be taken not to over-charge the refrigerating system.

Prior to recharging the system, it should be pressure-tested with dry nitrogen. In addition, the system should be A2L leak-tested on completion of charging but prior to commissioning. A final A2L leak test should be carried out prior to leaving the site.

Pumpdown Procedure

1. Place the unit in SERVICE mode via the PC App or LCD interface; this will open the EEVs and start the indoor circulator (as long that circulator is powered and controlled by the heat pump). **DO NOT** turn off electrical power at the breaker panel, since the coaxial coils **must have full water flow** during refrigerant recovery.
2. Connect the refrigerant recovery unit to the heat pump's internal service ports via a refrigeration charging manifold and to a recovery tank as per the instructions in the recovery unit manual. Plan to dispose of refrigerant if there was a compressor burnout.
3. All refrigerant to water heat exchangers (coaxial coils, brazed plates) **must either have full flow or be completely drained** of fluid before recovery begins. Failure to do so can freeze and rupture the heat exchanger, voiding its warranty. (Note that this does not apply to desuperheater coils.)
4. Ensure all hose connections are properly purged of air. Start the refrigerant recovery as per the instructions in the recovery unit manual.
5. Allow the recovery unit suction pressure to reach a vacuum. Once achieved, close the charging manifold valves. Shut down, purge and disconnect the recovery unit as per the instructions in its manual. Ensure the recovery tank valve is closed before disconnecting the hose to it.
6. Connect a nitrogen tank to the charging manifold and add nitrogen to the heat pump until a positive gauge pressure of 5-10 psig is reached. This prevents air from being sucked into the unit by the vacuum when the hoses are disconnected.

Turn off power to heat pump. The heat pump is now ready for repairs.

General Repair Procedure

1. Perform repairs to system.
 - Always ensure nitrogen is flowing through the system at the lowest flow rate that can be felt at the discharge during any brazing procedures to prevent soot buildup inside the pipes.
 - It is recommended to replace the liquid line filter-dryer any time the refrigeration system has been exposed to the atmosphere.
 - Place a wet rag around any valves being installed, as almost all valve types have non-metallic seats or seals that will be damaged by excessive heat, and aim the torch flame away from the valve body. Solder only one joint at a time and cool joints down in between.
2. Pressure test the system with nitrogen. It is recommended to check for leaks using leak detection spray, Spray Nine, or soapy water. Check at 10, 25, 50 and 100 psig. Allow the system to sit at 100 psig for at least an hour, then re-check. With a laptop connected, the **PC App** may be used to graph the nitrogen pressure (**Graphs** menu--> **Refrigeration Pressure and Temperature Graphs**) to make any downward trend due to a leak apparent. Be aware that changing room temperature can also cause upward or downward trends in nitrogen pressure.

Vacuumping & Charging Procedure

After completion of repairs and nitrogen pressure testing, the refrigeration circuit is ready for vacuumping.

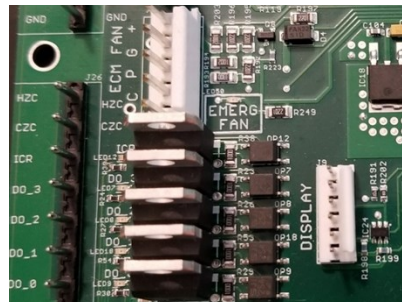
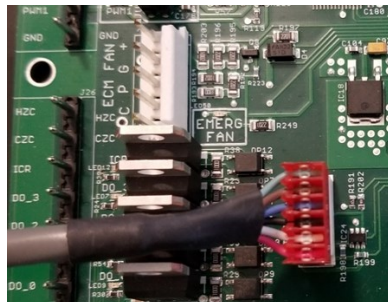
1. Release the nitrogen pressure and connect the vacuum pump to the charging manifold. Start the vacuum pump and open the charging manifold valves. Vacuum until the vacuum gauge remains at less than 500 microns for at least 1 minute with the vacuum pump valve closed.
2. Close the charging manifold valves then shut off and disconnect the vacuum pump. Place a refrigerant tank with the proper refrigerant on a scale and connect it to the charging manifold. Purge the hose to the tank.
3. Weigh in the appropriate amount **and type** of refrigerant through the low pressure (suction) service port. Refer to the nameplate label on the unit for the proper refrigerant type and charge amount.
4. If the unit will not accept the entire charge, the remainder can be added through the low pressure service port after the unit has been restarted.

Compressor Replacement Procedure

1. Pump down the unit as per the Pumpdown Procedure above. **If there was a compressor burn out (motor failure), the refrigerant cannot be reused and must be disposed of according to local codes.**
2. Disconnect piping.
3. Replace the compressor. Replace the liquid line filter-dryer. Always ensure nitrogen is flowing through the system at the lowest flow rate that can be felt at the discharge during any brazing procedures to prevent soot buildup inside the pipes.
4. Vacuum the unit as per above procedure.
5. If there was a compressor burnout:
 - a) Charge the unit with **new** refrigerant and operate it for continuously for 2 hours. Pump down the unit and replace the filter-dryer. Vacuum the unit as per above procedure.
 - b) Charge the unit (refrigerant can be re-used) and operate it for 2-3 days. Perform an acid test. If it fails, pump down the unit and replace the filter-dryer.
 - c) Charge the unit (refrigerant can be re-used) and operate it for 2 weeks. Perform and acid test. If it fails, pump down the unit and replace the filter-dryer.
6. Charge the unit a final time. Unit should now be clean and repeated future burn-outs can be avoided.

Control Board Replacement Procedure

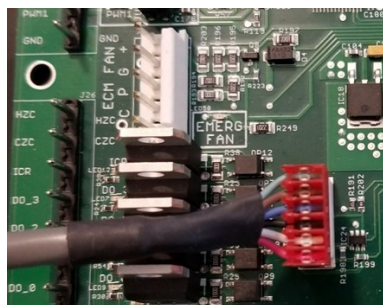
1. Turn the power off to the unit.
2. Take a picture of the control board and connectors for reference. The picture in [Appendix A](#) may also be helpful.
3. Carefully remove all green terminal strips on the left side, the right side and the bottom of the control board. They pull straight off the board, with no need to disconnect wires from their screw terminals. You may need to wiggle them from both ends for the 8 pin ones.
4. Remove the red six pin display board connector from the left side of the control board (marked DISPLAY on the board).



5. Remove all connectors from the top of the control board. Each connector (or wire) should be marked already from the factory, e.g. HPS1, LP1, TS1, etc.. This matches the marking on the control board.
6. The control board is held in place at its four corners. Squeeze each standoff by hand or with needle nose pliers if necessary and carefully pull the corner of the board off of the standoff.
7. Once the control board has been removed, if there are any other standoffs left (they have the bottom snap cut off) remove them as well.
8. Carefully remove the new control board from the static bag it was shipped in. Place any cut off standoffs from the old board into the same locations on the new board.
9. Align the control board with the four corner standoffs in the electrical box then push on each corner until they snap in place.
10. Connect the top connectors to the control board. Refer to the **Step 2** picture if necessary for proper locations.
Note that the connector with the resistor (no cable) goes on **CTS**.
Note that the connector to the left of **CTS** is marked **HTS** on older boards, and **ODTS** on newer boards.
11. Check each of the connectors from Step 10 to ensure they are properly aligned and that no pins are showing.
12. Connect the green terminal strips to the left side, right side and bottom of the control board. Refer to the **Step 2** picture if necessary for locations.
13. Turn the power on to the heat pump. Ensure the LCD display comes on. Note the firmware version. After EEV zeroing and Random Start countdown the display should begin alternating data.
14. If the replacement control board was pre-configured for this unit at the factory then the system is ready for operation. If it was not then use the PC App corresponding to the unit's firmware version to configure the unit. Refer to the **Tools -> Configuration** menu in the **PC APP** section.

LCD Interface (Display) Board Replacement Procedure

1. Turn the power off to the unit.
2. Remove the display board cable connector from the control board.
3. Using a sharp utility knife with a long blade, slice each of the display board standoff heads off, taking care to not damage the lexan cover.



4. Pull the display board from the unit.
5. Remove the display board cable connector from the back of the display board.
6. Place a new display board standoff into each of the four holes in the cabinet.
7. Remove the new display board from the static bag it was shipped in.
8. Connect one end of the display board cable to the back of the display board. Ensure the connector is properly aligned and that no pins are showing.
9. Place the display board in position and align the four standoffs into the four holes of the board.
10. Push on each corner of the board until each standoff snaps in place, while pushing on the front of the standoff to keep it from popping out of the cabinet hole.
11. Connect the other end of the display board cable to the control board, ensuring the connector is aligned properly and that no pins are showing.
12. Turn the power on to the unit and verify the display works.
13. Once the display begins to scroll data, test each of the buttons to ensure they work. Push the Arrow button to enter the Main Menu, then use the Up and Down to move through the list, then push the OK button to exit again. If any of the buttons seem hard to press, repeat Step 10 and then test the buttons again.

Decommissioning

When the heat pump has reached the end of its useful lifetime after many years of service, it must be decommissioned.

Before carrying out this procedure, it is essential that the technician is completely familiar with the system and all its connected equipment. It is good practice that all refrigerants are recovered safely. Prior to the task being carried out, an oil and refrigerant sample should be taken in case analysis is required prior to re-use of recovered refrigerant. It is essential that electrical power is available before the task is commenced.

1. Examine all parts of the system to become familiar with the equipment and its operation.
2. Isolate system electrically.
3. Before starting the procedure, ensure that:
 - a) equipment is available for handling refrigerant and refrigerant cylinders.
 - b) recovery equipment and cylinders conform to the appropriate standards.
 - c) all personal protective equipment is available and being used correctly.
 - d) personnel are appropriately qualified.
4. Pump down refrigerant system.
5. If solenoid valves are closed and can't be powered open or there are other obstructions in the refrigeration system, make a manifold so that refrigerant can be removed from various parts of the system.
6. Make sure that the cylinder is situated on a scale before recovery takes place.
7. Start the recovery machine and operate in accordance with instructions.
8. Do not overfill cylinders (no more than 80 % volume liquid charge).
9. Do not exceed the maximum working pressure of the cylinder, even temporarily.
10. When all the refrigerant has been removed and the process completed, make sure that the cylinders and the equipment are removed from site promptly and all isolation valves on the equipment are closed off.
11. Recovered refrigerant should not be charged into another refrigerating system unless it has been checked and/or cleaned.

Equipment should be labelled stating that it has been de-commissioned and emptied of refrigerant. The label should be dated and signed.

Every effort should be made to check and **RE-USE** refrigerant and **RECYCLE** mechanical equipment.

Model Specific Information



Table 21 - Refrigerant Charge				
MODEL	lb	kg	Refrigerant	Oil Type
R/RH-45	7.0	3.2	R454b	POE
R/RH-55	7.5	3.4	R454b	POE
R/RH-65	9.0	4.1	R454b	POE
R/RH-75	11.0	5.1	R454b	POE
- Oil capacity is marked on the compressor label. - Refrigerant charge is subject to revision; actual charge is indicated on the unit nameplate.				

Table 22 - Weights and Shipping Dimensions					
MODEL	SHIPPING WEIGHT	HANGING WEIGHT	SHIPPING DIMENSIONS		
	lb. (kg)	lb. (kg)	inches (cm)		
			L	W	H
R-45	390 (177)		44 (112)	36 (91)	66 (167)
R-55	460 (209)		44 (112)	36 (91)	66 (167)
R-65	490 (222)		44 (112)	36 (91)	66 (167)
R-75	530 (240)		44 (112)	36 (91)	66 (167)
RH-45	420 (191)	361 (164)	60 (152)	30 (76)	28 (71)
RH-55	463 (210)	404 (183)	70 (178)	36 (91)	29 (74)
RH-65	511 (232)	452 (205)	70 (178)	36 (91)	29 (74)
RH-75	550 (249)	491 (222)	70 (178)	36 (91)	29 (74)

Table 23 - Operating Temperature Limits					
Loop	Mode	Parameter	°F	°C	Note
OUTDOOR (ground loop)	Heating (water/open loop)	Minimum ELT	41	5	
	Heating (antifreeze/ground loop)	Minimum ELT	23	-5	Adequate antifreeze concentration required.
	Heating	Maximum ELT	80	27	Reduce flow above this temperature.
	Cooling	Minimum ELT	41	5	Flow reduction may be required.
	Cooling	Maximum ELT	110	43	
INDOOR (air duct)	Heating	Minimum EAT	60	16	Reduce air flow if necessary during heating startup.
	Heating	Maximum EAT	100	38	
	Cooling	Minimum EAT	50	10	
	Cooling	Maximum EAT	100	38	Reduce air flow if necessary during cooling startup.
* Values in this table are for rated liquid and airflow values.					

Standard Capacity Ratings

Standards C13256-1 / ISO13256-1 / ARI 13256-1

Table 24 - Standard Capacity Ratings - Ground Loop Heating*									60Hz
EAT 68°F (20°C)			* 15% Methanol by Weight Ground Loop Fluid				STAGE 1 - ELT 41°F (5°C) STAGE 2 - ELT 32°F (0°C)		
Model	Liquid Flow		Mode	Airflow		Input Energy	Capacity		COP _H
	gpm	L/s		cfm	L/s		Btu/hr	kW	
R/RH-45	10	0.63	Stage 1	1030	486	1,438	20,800	6.1	4.24
			Stage 2	1200	566	2,119	25,700	7.5	3.55
R/RH-55	12	0.76	Stage 1	1240	585	1,947	27,500	8.1	4.14
			Stage 2	1500	708	2,681	33,600	9.8	3.67
R/RH-65	14	0.88	Stage 1	1540	727	2,522	33,900	9.9	3.94
			Stage 2	1900	897	3,342	41,500	12.2	3.64
R/RH-75	16	1.01	Stage 1	1660	783	3,251	42,600	12.5	3.84
			Stage 2	2100	991	4,143	50,200	14.7	3.55

Table 25 - Standard Capacity Ratings - Ground Water Heating								60Hz	
EAT 68°F (20°C)						ELT 50°F (10°C)			
Model	Liquid Flow		Mode	Airflow		Input Energy	Capacity		COP _H
	gpm	L/s		cfm	L/s		Watts	Btu/hr	
R/RH-45	10	0.63	Stage 1	1030	486	1,609	25,200	7.4	4.59
			Stage 2	1200	566	2,352	35,200	10.3	4.39
R/RH-55	12	0.76	Stage 1	1240	585	2,040	34,100	10.0	4.90
			Stage 2	1500	708	2,978	46,600	13.7	4.59
R/RH-65	14	0.88	Stage 1	1540	727	2,631	42,200	12.4	4.70
			Stage 2	1900	897	3,729	57,900	17.0	4.55
R/RH-75	16	1.01	Stage 1	1660	783	3,425	51,300	15.0	4.39
			Stage 2	2100	991	4,618	67,600	19.8	4.29

Table 26 - Standard Capacity Ratings - Ground Loop Cooling*									60Hz	
EAT 80.6°F (27°C), RH=46%			* 15% Methanol by Weight Ground Loop Fluid				STAGE 1 - ELT 68°F (20°C) STAGE 2 - ELT 77°F (25°C)			
Model	Liquid Flow		Mode	Airflow		Input Energy	Capacity		COP _c	EER
	gpm	L/s		cfm	L/s		Watts	Btu/hr		
R/RH-45	10	0.63	Stage 1	1030	486	1,088	25,800	7.6	6.95	23.7
			Stage 2	1200	566	2,024	33,800	9.9	4.89	16.7
R/RH-55	12	0.76	Stage 1	1240	585	1,404	34,400	10.1	7.18	24.5
			Stage 2	1500	708	2,570	43,700	12.8	4.98	17.0
R/RH-65	14	0.88	Stage 1	1540	727	1,939	43,800	12.8	6.62	22.6
			Stage 2	1900	897	3,317	55,400	16.2	4.89	16.7
R/RH-75	16	1.01	Stage 1	1660	783	2,416	50,700	14.9	6.15	21.0
			Stage 2	2100	991	4,233	63,900	18.7	4.43	15.1

Table 27 - Standard Capacity Ratings - Ground Water Cooling										60Hz
EAT 80.6°F (27°C), RH=46%						ELT 59°F (15°C)				
Model	Liquid Flow		Mode	Airflow		Input Energy	Capacity		COP _c	EER
	gpm	L/s		cfm	L/s		Watts	Btu/hr		
R/RH-45	10	0.63	Stage 1	1030	486	1,022	28,000	8.2	8.03	27.4
			Stage 2	1200	566	1,706	36,500	10.7	6.27	21.4
R/RH-55	12	0.76	Stage 1	1240	585	1,238	35,400	10.4	8.38	28.6
			Stage 2	1500	708	2,106	47,600	14.0	6.62	22.6
R/RH-65	14	0.88	Stage 1	1540	727	1,647	44,800	13.1	7.97	27.2
			Stage 2	1900	897	2,750	59,400	17.4	6.33	21.6
R/RH-75	16	1.01	Stage 1	1660	783	2,102	51,500	15.1	7.18	24.5
			Stage 2	2100	991	3,542	68,000	19.9	5.63	19.2

Pressure Drop Data

Table 28: Loop Pressure Drop Data

			Water 104°F		Water 50°F		15% Methanol 32°F		35% prop. glycol 32°F	
	gpm	L/s	psi	kPa	psi	kPa	psi	kPa	psi	kPa
R/RH-45	4	0.25	0.8	5.5	0.9	6.2	1.0	6.9	1.3	9.0
	5	0.32	1.1	7.6	1.2	8.3	1.4	9.6	1.8	13
	6	0.38	1.6	11	1.7	12	2.0	14	2.6	18
	7	0.44	1.9	13	2.1	14	2.5	17	3.3	23
	8	0.50	2.6	18	2.8	19	3.0	21	4.0	27
	9	0.57	3.2	22	3.5	24	3.8	26	5.0	34
	10	0.63	3.8	26	4.0	28	4.7	32	6.2	43
	11	0.69	4.3	30	4.6	32	5.5	38	7.2	50
	12	0.76	5.2	36	5.5	38	6.6	45	8.7	60
	13	0.82	5.9	41	6.2	43	7.4	51	9.7	67
	14	0.88	6.7	46	7.0	48	8.6	59	11.3	78
	15	0.95	8.0	55	8.2	57	9.5	65	12.5	86
R/RH-55	6	0.38	1.1	7.6	1.2	8.3	1.3	9.0	1.7	12
	7	0.44	1.5	10	1.6	11	1.6	11	2.1	14
	8	0.50	1.8	12	1.9	13	2.1	14	2.8	19
	9	0.57	2.2	15	2.4	17	2.4	17	3.2	22
	10	0.63	2.7	19	2.9	20	3.1	21	4.1	28
	11	0.69	2.8	19	3.1	21	3.6	25	4.7	33
	12	0.76	3.4	23	3.7	26	4.4	30	5.8	40
	13	0.82	4	28	4.3	30	5	34	6.6	45
	14	0.88	4.7	32	5	34	5.7	39	7.5	52
	15	0.95	5.6	39	5.8	40	6.4	44	8.4	58
	16	1.01	6.1	42	6.3	43	7.1	49	9.3	64

**Table 28: Loop Pressure
(cont'd) Drop Data**

			Water 104°F		Water 50°F		15% Methanol 32°F		35% prop. glycol 32°F	
	gpm	L/s	psi	kPa	psi	kPa	psi	kPa	psi	kPa
R/RH-65	6	0.38	1.1	7.6	1.2	8.3	1.3	9.0	1.7	12
	7	0.44	1.4	10	1.5	10	1.8	12	2.4	16
	8	0.50	1.8	12	1.9	13	2.2	15	2.9	20
	9	0.57	2.1	14	2.3	16	2.7	19	3.6	24
	10	0.63	2.4	17	2.6	18	3.3	23	4.3	30
	11	0.69	2.9	20	3.2	22	4	28	5.3	36
	12	0.76	3.6	25	3.9	27	4.6	32	6.0	42
	13	0.82	4.1	28	4.4	30	5.2	36	6.8	47
	14	0.88	4.7	32	5	34	5.8	40	7.6	53
	15	0.95	5.5	38	5.7	39	6.5	45	8.5	59
	16	1.01	6.3	43	6.5	45	7.3	50	9.6	66
R/RH-75	6	0.38	0.6	4.1	0.7	4.8	0.9	6.2	1.2	8.2
	7	0.44	0.8	5.5	0.9	6.2	1.0	6.9	1.3	9.0
	8	0.50	1.2	8.3	1.3	9.0	1.3	9.0	1.7	12
	9	0.57	1.5	10	1.6	11	1.6	11	2.1	14
	10	0.63	1.8	12	1.9	13	2.1	14	2.8	19
	11	0.69	2.1	14	2.3	16	2.4	17	3.2	22
	12	0.76	2.4	17	2.6	18	2.9	20	3.8	26
	13	0.82	2.8	19	3.0	21	3.3	23	4.3	30
	14	0.88	2.9	20	3.2	22	3.7	26	4.9	33
	15	0.95	3.2	22	3.5	24	4.1	28	5.4	37
	16	1.01	3.8	26	4.0	28	4.7	32	6.2	43
	17	1.07	4.2	29	4.4	30	5.2	36	6.8	47

Performance Tables

R/RH-45-HAC*-X-1T R454b, 60 Hz, YAS30K1E-PFV

	OUTDOOR LOOP (15% Methanol)						ELECTRICAL			INDOOR LOOP (Air)						
	ELT (°F)	Evap. Temp.	Flow (gpm)	LLT (°F)	Delta T (°F)	Heat Abs. (Btu/hr)	Compressor Current (A)*	Fan (W)	Input Power (W)	EAT (°F)	Cond. Temp.	Airflow (cfm)	LAT (°F)	Delta T (°F)	Heating (Btu/hr)	COP _H
HEATING	25	15	10	22	-3.2	15,900	8.3	179	2,034	68	99	1200	86	18	22,600	3.26
	30	20	10	26	-3.6	17,800	8.6	179	2,095		101	1200	87	19	24,800	3.47
	35	24	10	31	-4.1	20,000	8.9	179	2,157		102	1200	89	21	27,200	3.70
	40	29	10	35	-4.6	22,300	9.2	179	2,219		104	1200	91	23	29,700	3.92
	45	34	10	40	-5.1	24,700	9.5	179	2,284		105	1200	93	25	32,300	4.14
	50	38	10	44	-5.6	27,300	9.8	179	2,352		107	1200	95	27	35,200	4.39
	55	43	10	49	-6.2	30,200	10.1	179	2,421		108	1200	98	30	38,300	4.64
	60	48	10	53	-6.8	33,200	10.5	179	2,491		110	1200	100	32	41,600	4.89
	65	52	10	58	-7.5	36,500	10.8	179	2,564		112	1200	103	35	45,100	5.16
	70	57	10	62	-8.3	40,100	11.2	179	2,635		113	1200	106	38	49,000	5.45

	OUTDOOR LOOP (15% Methanol)						ELECTRICAL			INDOOR LOOP (Air @ 46% RH)								
COOLING	ELT (°F)	Cond. Temp.	Flow (gpm)	LLT (°F)	Delta T (°F)	Heat Rej. (Btu/hr)	Compressor Current (A)*	Fan (W)	Input Power (W)	EAT (°F)	Evap. Temp.	Airflow (cfm)	LAT (°F)	Delta T (°F)	Latent (Btu/hr)	Sensible (Btu/hr)	Cooling (Btu/hr)	EER
	50	73	10	59	8.8	43,000	6.2	171	1,571	80.6	47	1200	61	-19	12,500	25,300	37,800	24.1
	55	78	10	64	8.7	42,500	6.6	171	1,644		48	1200	61	-19	12,000	25,000	37,000	22.5
	60	83	10	69	8.7	42,100	6.9	171	1,723		48	1200	62	-19	11,600	24,800	36,400	21.1
	65	89	10	74	8.6	41,700	7.3	171	1,805		49	1200	62	-19	11,200	24,500	35,700	19.8
	70	94	10	79	8.5	41,200	7.6	171	1,892		49	1200	62	-19	10,700	24,200	34,900	18.4
	75	100	10	83	8.4	40,700	8.0	171	1,985		49	1200	62	-18	10,300	23,800	34,100	17.2
	80	105	10	88	8.3	40,200	8.4	171	2,085		50	1200	63	-18	9,900	23,400	33,300	16.0
	85	110	10	93	8.2	39,800	8.9	171	2,191		50	1200	63	-18	9,500	23,000	32,500	14.8
	90	116	10	98	8.2	39,300	9.3	171	2,304		51	1200	63	-17	9,000	22,600	31,600	13.7
	95	121	10	103	8.1	38,800	9.9	171	2,425		51	1200	64	-17	8,600	22,100	30,700	12.7

METRIC

OUTDOOR LOOP (15% Methanol)							ELECTRICAL			INDOOR LOOP (Air)						
HEATING	ELT (°C)	Evap. Temp.	Flow (L/s)	LLT (°C)	Delta T (°C)	Heat Abs. (kW)	Compressor Current (A)*	Fan (W)	Input Power (W)	EAT (°C)	Cond. Temp.	Airflow (L/s)	LAT (°C)	Delta T (°C)	Heating (kW)	COP _H
	-3.9	-9.5	0.63	-5.7	-1.8	4.7	8.3	179	2,034	20.0	37.2	566	29.8	9.8	6.6	3.26
	-1.1	-6.9	0.63	-3.1	-2.0	5.2	8.6	179	2,095		38.1	566	30.7	10.7	7.3	3.47
	1.7	-4.3	0.63	-0.6	-2.3	5.9	8.9	179	2,157		38.9	566	31.7	11.7	8.0	3.70
	4.4	-1.7	0.63	1.8	-2.6	6.5	9.2	179	2,219		39.8	566	32.8	12.8	8.7	3.92
	7.2	0.8	0.63	4.4	-2.8	7.2	9.5	179	2,284		40.7	566	33.9	13.9	9.5	4.14
	10.0	3.4	0.63	6.9	-3.1	8.0	9.8	179	2,352		41.6	566	35.2	15.2	10.3	4.39
	12.8	6.1	0.63	9.4	-3.4	8.9	10.1	179	2,421		42.4	566	36.5	16.5	11.2	4.64
	15.6	8.6	0.63	11.8	-3.8	9.7	10.5	179	2,491		43.3	566	37.9	17.9	12.2	4.89
	18.3	11.2	0.63	14.1	-4.2	10.7	10.8	179	2,564		44.2	566	39.4	19.4	13.2	5.16
21.1	13.8	0.63	16.5	-4.6	11.8	11.2	179	2,635	45.1		566	41.1	21.1	14.4	5.45	

OUTDOOR LOOP (15% Methanol)							ELECTRICAL			INDOOR LOOP (Air @ 46% RH)								
COOLING	ELT (°C)	Cond. Temp.	Flow (L/s)	LLT (°C)	Delta T (°C)	Heat Rej. (kW)	Compressor Current (A)*	Fan (W)	Input Power (W)	EAT (°C)	Evap. Temp.	Airflow (L/s)	LAT (°C)	Delta T (°C)	Latent (kW)	Sensible (kW)	Cooling (kW)	COP _c
	10.0	22.5	0.63	14.9	4.9	12.6	6.2	171	1,571	27.0	8.4	75.7	16.2	-10.8	3.7	7.4	11.1	7.06
	12.8	25.5	0.63	17.6	4.8	12.5	6.6	171	1,644		8.6	75.7	16.3	-10.7	3.5	7.3	10.8	6.59
	15.6	28.5	0.63	20.4	4.8	12.3	6.9	171	1,723		8.9	75.7	16.4	-10.6	3.4	7.3	10.7	6.18
	18.3	31.5	0.63	23.1	4.8	12.2	7.3	171	1,805		9.2	75.7	16.6	-10.4	3.3	7.2	10.5	5.80
	21.1	34.5	0.63	25.8	4.7	12.1	7.6	171	1,892		9.4	75.7	16.7	-10.3	3.1	7.1	10.2	5.39
	23.9	37.5	0.63	28.6	4.7	11.9	8.0	171	1,985		9.7	75.7	16.8	-10.2	3.0	7.0	10.0	5.04
	26.7	40.6	0.63	31.3	4.6	11.8	8.4	171	2,085		9.9	75.7	17.0	-10.0	2.9	6.9	9.8	4.69
	29.4	43.6	0.63	34.0	4.6	11.7	8.9	171	2,191		10.2	75.7	17.2	-9.8	2.8	6.7	9.5	4.34
	32.2	46.6	0.63	36.8	4.6	11.5	9.3	171	2,304		10.4	75.7	17.4	-9.6	2.6	6.6	9.3	4.02
	35.0	49.6	0.63	39.5	4.5	11.4	9.9	171	2,425		10.7	75.7	17.6	-9.4	2.5	6.5	9.0	3.72

* Divide by 2.2 for 460VAC

Performance Tables

R/RH-55-HAC*-X-1T R454b, 60 Hz, YAS40K1E-PFV

	OUTDOOR LOOP (15% Methanol)						ELECTRICAL			INDOOR LOOP (Air)						
	ELT (°F)	Evap. Temp.	Flow (gpm)	LLT (°F)	Delta T (°F)	Heat Abs. (Btu/hr)	Compressor Current (A)*	Fan (W)	Input Power (W)	EAT (°F)	Cond. Temp.	Airflow (cfm)	LAT (°F)	Delta T (°F)	Heating (Btu/hr)	COP _H
HEATING	25	15	12	22	-3.5	20,900	10.8	185	2,570	68	98	1500	86	18	29,400	3.35
	30	20	12	26	-4.0	23,600	11.2	185	2,649		99	1500	88	20	32,400	3.58
	35	24	12	31	-4.5	26,500	11.6	185	2,729		101	1500	90	22	35,600	3.82
	40	29	12	35	-5.0	29,600	12.0	185	2,808		102	1500	92	24	38,900	4.06
	45	33	12	39	-5.6	33,000	12.4	185	2,894		104	1500	95	27	42,600	4.31
	50	38	12	44	-6.3	36,700	12.8	185	2,978		105	1500	97	29	46,600	4.59
	55	42	12	48	-7.0	40,600	13.2	185	3,065		107	1500	100	32	50,900	4.87
	60	47	12	52	-7.7	44,800	13.7	185	3,160		108	1500	102	34	55,400	5.14
	65	51	12	57	-8.4	49,200	14.1	185	3,255		110	1500	105	37	60,100	5.41
	70	56	12	61	-9.3	53,900	14.6	185	3,355		111	1500	108	40	65,200	5.70

	OUTDOOR LOOP (15% Methanol)						ELECTRICAL			INDOOR LOOP (Air @ 46% RH)								
COOLING	ELT (°F)	Cond. Temp.	Flow (gpm)	LLT (°F)	Delta T (°F)	Heat Rej. (Btu/hr)	Compressor Current (A)*	Fan (W)	Input Power (W)	EAT (°F)	Evap. Temp.	Airflow (cfm)	LAT (°F)	Delta T (°F)	Latent (Btu/hr)	Sensible (Btu/hr)	Cooling (Btu/hr)	EER
	50	72	12	60	9.5	55,800	7.7	192	1,974	80.6	48	1500	60	-21	15,300	34,000	49,300	25.0
	55	77	12	64	9.4	55,000	8.3	192	2,038		48	1500	60	-21	14,700	33,600	48,300	23.7
	60	82	12	69	9.3	54,400	8.8	192	2,126		49	1500	60	-20	14,200	33,200	47,400	22.3
	65	88	12	74	9.2	53,800	9.4	192	2,232		49	1500	61	-20	13,600	32,800	46,400	20.8
	70	93	12	79	9.1	53,100	10.0	192	2,359		50	1500	61	-20	13,000	32,300	45,300	19.2
	75	98	12	84	9.0	52,500	10.6	192	2,508		50	1500	61	-20	12,500	31,700	44,200	17.6
	80	104	12	89	8.9	51,900	11.3	192	2,673		51	1500	62	-19	11,900	31,100	43,000	16.1
	85	109	12	94	8.9	51,300	12.0	192	2,855		51	1500	62	-19	11,300	30,500	41,800	14.6
	90	114	12	99	8.8	50,600	12.8	192	3,061		51	1500	62	-18	10,700	29,700	40,400	13.2
	95	120	12	104	8.7	50,000	13.6	192	3,280		52	1500	63	-18	10,200	28,900	39,100	11.9

METRIC

OUTDOOR LOOP (15% Methanol)							ELECTRICAL			INDOOR LOOP (Air)						
HEATING	ELT (°C)	Evap. Temp.	Flow (L/s)	LLT (°C)	Delta T (°C)	Heat Abs. (kW)	Compressor Current (A)*	Fan (W)	Input Power (W)	EAT (°C)	Cond. Temp.	Airflow (L/s)	LAT (°C)	Delta T (°C)	Heating (kW)	COP _H
	-3.9	-9.3	0.76	-5.8	-1.9	6.1	10.8	185	2,570	20.0	36.4	708	30.2	10.2	8.6	3.35
	-1.1	-6.8	0.76	-3.3	-2.2	6.9	11.2	185	2,649		37.2	708	31.2	11.2	9.5	3.58
	1.7	-4.3	0.76	-0.8	-2.5	7.8	11.6	185	2,729		38.1	708	32.3	12.3	10.4	3.82
	4.4	-1.8	0.76	1.6	-2.8	8.7	12.0	185	2,808		38.9	708	33.4	13.4	11.4	4.06
	7.2	0.7	0.76	4.1	-3.1	9.7	12.4	185	2,894		39.8	708	34.7	14.7	12.5	4.31
	10.0	3.2	0.76	6.5	-3.5	10.8	12.8	185	2,978		40.6	708	36.1	16.1	13.7	4.59
	12.8	5.7	0.76	8.9	-3.9	11.9	13.2	185	3,065		41.4	708	37.6	17.6	14.9	4.87
	15.6	8.2	0.76	11.3	-4.3	13.1	13.7	185	3,160		42.3	708	39.1	19.1	16.2	5.14
	18.3	10.7	0.76	13.6	-4.7	14.4	14.1	185	3,255		43.2	708	40.7	20.7	17.6	5.41
21.1	13.2	0.76	15.9	-5.2	15.8	14.6	185	3,355	44.0		708	42.4	22.4	19.1	5.70	

OUTDOOR LOOP (15% Methanol)							ELECTRICAL			INDOOR LOOP (Air @ 46% RH)								
COOLING	ELT (°C)	Cond. Temp.	Flow (L/s)	LLT (°C)	Delta T (°C)	Heat Rej. (kW)	Compressor Current (A)*	Fan (W)	Input Power (W)	EAT (°C)	Evap. Temp.	Airflow (L/s)	LAT (°C)	Delta T (°C)	Latent (kW)	Sensible (kW)	Cooling (kW)	COP _c
	10.0	22.0	0.76	15.3	5.3	16.4	7.7	192	1,974	27.0	8.7	94.6	15.4	-11.6	4.5	10.0	14.4	7.33
	12.8	24.9	0.76	18.0	5.2	16.1	8.3	192	2,038		8.9	94.6	15.6	-11.4	4.3	9.9	14.2	6.95
	15.6	27.9	0.76	20.8	5.2	15.9	8.8	192	2,126		9.2	94.6	15.7	-11.3	4.2	9.7	13.9	6.54
	18.3	30.9	0.76	23.4	5.1	15.8	9.4	192	2,232		9.5	94.6	15.8	-11.2	4.0	9.6	13.6	6.10
	21.1	33.8	0.76	26.2	5.1	15.6	10.0	192	2,359		9.7	94.6	16.0	-11.0	3.8	9.5	13.3	5.63
	23.9	36.8	0.76	28.9	5.0	15.4	10.6	192	2,508		10.0	94.6	16.2	-10.8	3.7	9.3	13.0	5.16
	26.7	39.8	0.76	31.6	4.9	15.2	11.3	192	2,673		10.3	94.6	16.4	-10.6	3.5	9.1	12.6	4.72
	29.4	42.7	0.76	34.3	4.9	15.0	12.0	192	2,855		10.6	94.6	16.6	-10.4	3.3	8.9	12.3	4.28
	32.2	45.7	0.76	37.1	4.9	14.8	12.8	192	3,061		10.8	94.6	16.9	-10.1	3.1	8.7	11.8	3.87
35.0	48.7	0.76	39.8	4.8	14.7	13.6	192	3,280	11.1		94.6	17.2	-9.8	3.0	8.5	11.5	3.49	

* Divide by 2.2 for 460VAC

Performance Tables

R/RH-65-HAC*-X-1T R454b, 60 Hz, YAS51K1E-PFV

HEATING	OUTDOOR LOOP (15% Methanol)						ELECTRICAL			INDOOR LOOP (Air)						
	ELT (°F)	Evap. Temp.	Flow (gpm)	LLT (°F)	Delta T (°F)	Heat Abs. (Btu/hr)	Compressor Current (A)*	Fan (W)	Input Power (W)	EAT (°F)	Cond. Temp.	Airflow (cfm)	LAT (°F)	Delta T (°F)	Heating (Btu/hr)	COP _H
	25	15	14	21	-3.8	25,800	14.0	300	3,197	68	98	1900	86	18	36,300	3.33
	30	20	14	26	-4.2	29,100	14.5	300	3,302		99	1900	88	20	40,000	3.55
	35	24	14	30	-4.8	32,700	15.0	300	3,403		101	1900	90	22	43,900	3.78
	40	29	14	35	-5.4	36,600	15.5	300	3,512		102	1900	92	24	48,200	4.02
	45	33	14	39	-6.0	41,000	16.0	300	3,617		104	1900	94	26	53,000	4.29
	50	38	14	43	-6.7	45,500	16.6	300	3,729		105	1900	97	29	57,900	4.55
	55	42	14	48	-7.4	50,400	17.1	300	3,841		107	1900	99	31	63,200	4.82
	60	47	14	52	-8.2	55,800	17.6	300	3,950		109	1900	102	34	69,000	5.12
	65	51	14	56	-9.0	61,400	18.2	300	4,065		110	1900	105	37	75,000	5.41
	70	56	14	60	-9.9	67,400	18.7	300	4,176		112	1900	108	40	81,400	5.71

	OUTDOOR LOOP (15% Methanol)						ELECTRICAL			INDOOR LOOP (Air @ 46% RH)								
COOLING	ELT (°F)	Cond. Temp.	Flow (gpm)	LLT (°F)	Delta T (°F)	Heat Rej. (Btu/hr)	Compressor Current (A)*	Fan (W)	Input Power (W)	EAT (°F)	Evap. Temp.	Airflow (cfm)	LAT (°F)	Delta T (°F)	Latent (Btu/hr)	Sensible (Btu/hr)	Cooling (Btu/hr)	EER
	50	72	14	60	10.2	69,300	10.7	325	2,454	80.6	48	1900	61	-20	19,600	41,600	61,200	24.9
	55	77	14	65	10.1	68,800	11.3	325	2,621		48	1900	61	-20	18,900	41,300	60,200	23.0
	60	83	14	70	10.1	68,400	11.9	325	2,783		48	1900	61	-20	18,300	40,900	59,200	21.3
	65	88	14	75	10.0	67,900	12.5	325	2,937		49	1900	61	-20	17,600	40,600	58,200	19.8
	70	93	14	80	9.9	67,200	13.2	325	3,095		49	1900	61	-19	17,000	40,000	57,000	18.4
	75	99	14	85	9.8	66,600	13.9	325	3,255		50	1900	62	-19	16,300	39,600	55,900	17.2
	80	104	14	90	9.8	66,000	14.6	325	3,414		50	1900	62	-19	15,700	39,000	54,700	16.0
	85	109	14	95	9.6	65,200	15.4	325	3,584		51	1900	62	-19	15,000	38,400	53,400	14.9
	90	115	14	100	9.5	64,400	16.2	325	3,756		51	1900	62	-18	14,400	37,600	52,000	13.8
	95	120	14	104	9.4	63,600	17.0	325	3,944		52	1900	63	-18	13,700	36,900	50,600	12.8

METRIC

OUTDOOR LOOP (15% Methanol)							ELECTRICAL			INDOOR LOOP (Air)						
HEATING	ELT (°C)	Evap. Temp.	Flow (L/s)	LLT (°C)	Delta T (°C)	Heat Abs. (kW)	Compressor Current (A)*	Fan (W)	Input Power (W)	EAT (°C)	Cond. Temp.	Airflow (L/s)	LAT (°C)	Delta T (°C)	Heating (kW)	COP _H
	-3.9	-9.4	0.88	-6.0	-2.1	7.6	14.0	300	3,197	20.0	36.4	897	29.9	9.9	10.6	3.33
	-1.1	-6.9	0.88	-3.4	-2.3	8.5	14.5	300	3,302		37.3	897	30.9	10.9	11.7	3.55
	1.7	-4.4	0.88	-1.0	-2.7	9.6	15.0	300	3,403		38.2	897	32.0	12.0	12.9	3.78
	4.4	-1.9	0.88	1.4	-3.0	10.7	15.5	300	3,512		39.1	897	33.2	13.2	14.1	4.02
	7.2	0.6	0.88	3.9	-3.3	12.0	16.0	300	3,617		39.9	897	34.5	14.5	15.5	4.29
	10.0	3.1	0.88	6.3	-3.7	13.3	16.6	300	3,729		40.8	897	35.8	15.8	17.0	4.55
	12.8	5.6	0.88	8.7	-4.1	14.8	17.1	300	3,841		41.7	897	37.2	17.2	18.5	4.82
	15.6	8.2	0.88	11.0	-4.6	16.4	17.6	300	3,950		42.5	897	38.8	18.8	20.2	5.12
	18.3	10.7	0.88	13.3	-5.0	18.0	18.2	300	4,065		43.4	897	40.4	20.4	22.0	5.41
21.1	13.2	0.88	15.6	-5.5	19.8	18.7	300	4,176	44.2		897	42.2	22.2	23.9	5.71	

OUTDOOR LOOP (15% Methanol)							ELECTRICAL			INDOOR LOOP (Air @ 46% RH)								
COOLING	ELT (°C)	Cond. Temp.	Flow (L/s)	LLT (°C)	Delta T (°C)	Heat Rej. (kW)	Compressor Current (A)*	Fan (W)	Input Power (W)	EAT (°C)	Evap. Temp.	Airflow (L/s)	LAT (°C)	Delta T (°C)	Latent (kW)	Sensible (kW)	Cooling (kW)	COP _c
	10.0	22.2	0.88	15.7	5.7	20.3	10.7	325	2,454	27.0	8.6	119.9	15.8	-11.2	5.7	12.2	17.9	7.30
	12.8	25.1	0.88	18.4	5.6	20.2	11.3	325	2,621		8.8	119.9	15.9	-11.1	5.5	12.1	17.6	6.74
	15.6	28.1	0.88	21.2	5.6	20.0	11.9	325	2,783		9.1	119.9	16.0	-11.0	5.4	12.0	17.3	6.24
	18.3	31.1	0.88	23.9	5.6	19.9	12.5	325	2,937		9.4	119.9	16.1	-10.9	5.2	11.9	17.1	5.80
	21.1	34.1	0.88	26.6	5.5	19.7	13.2	325	3,095		9.6	119.9	16.3	-10.7	5.0	11.7	16.7	5.39
	23.9	37.1	0.88	29.3	5.4	19.5	13.9	325	3,255		9.9	119.9	16.4	-10.6	4.8	11.6	16.4	5.04
	26.7	40.0	0.88	32.1	5.4	19.3	14.6	325	3,414		10.2	119.9	16.6	-10.4	4.6	11.4	16.0	4.69
	29.4	43.0	0.88	34.7	5.3	19.1	15.4	325	3,584		10.4	119.9	16.7	-10.3	4.4	11.3	15.7	4.37
	32.2	45.9	0.88	37.5	5.3	18.9	16.2	325	3,756		10.7	119.9	16.9	-10.1	4.2	11.0	15.2	4.04
35.0	48.9	0.88	40.2	5.2	18.6	17.0	325	3,944	10.9		119.9	17.1	-9.9	4.0	10.8	14.8	3.75	

* Divide by 2.2 for 460VAC

Performance Tables

R/RH-75-HAC*-X-1T R454b, 60 Hz, YAS60K1E-PFV

	OUTDOOR LOOP (15% Methanol)						ELECTRICAL			INDOOR LOOP (Air)						
	ELT (°F)	Evap. Temp.	Flow (gpm)	LLT (°F)	Delta T (°F)	Heat Abs. (Btu/hr)	Compressor Current (A)*	Fan (W)	Input Power (W)	EAT (°F)	Cond. Temp.	Airflow (cfm)	LAT (°F)	Delta T (°F)	Heating (Btu/hr)	COP _H
HEATING	25	16	16	21	-4.0	31,200	16.9	410	3,967	68	98	2100	88	20	44,400	3.28
	30	20	16	26	-4.5	34,900	17.4	410	4,092		100	2100	90	22	48,500	3.47
	35	25	16	30	-5.0	38,800	18.0	410	4,219		102	2100	92	24	52,800	3.67
	40	29	16	35	-5.5	42,900	18.6	410	4,354		104	2100	94	26	57,400	3.86
	45	34	16	39	-6.1	47,500	19.1	410	4,485		105	2100	96	28	62,400	4.08
	50	38	16	43	-6.7	52,300	19.7	410	4,618		107	2100	98	30	67,600	4.29
	55	43	16	48	-7.4	57,500	20.3	410	4,749		109	2100	101	33	73,300	4.52
	60	48	16	52	-8.1	63,100	20.8	410	4,881		110	2100	103	35	79,300	4.76
	65	52	16	56	-8.9	69,000	21.4	410	5,015		112	2100	106	38	85,700	5.01
	70	57	16	60	-9.7	75,200	21.9	410	5,143		114	2100	109	41	92,300	5.26

	OUTDOOR LOOP (15% Methanol)						ELECTRICAL			INDOOR LOOP (Air @ 46% RH)								
COOLING	ELT (°F)	Cond. Temp.	Flow (gpm)	LLT (°F)	Delta T (°F)	Heat Rej. (Btu/hr)	Compressor Current (A)*	Fan (W)	Input Power (W)	EAT (°F)	Evap. Temp.	Airflow (cfm)	LAT (°F)	Delta T (°F)	Latent (Btu/hr)	Sensible (Btu/hr)	Cooling (Btu/hr)	EER
	50	73	16	60	10.3	80,300	14.1	450	3,273	80.6	46	2100	60	-21	21,500	48,000	69,500	21.2
	55	78	16	65	10.3	79,900	14.5	450	3,415		46	2100	60	-21	21,100	47,500	68,600	20.1
	60	84	16	70	10.2	79,600	14.9	450	3,576		47	2100	60	-21	20,600	47,200	67,800	19.0
	65	89	16	75	10.2	79,200	15.5	450	3,749		47	2100	60	-20	20,200	46,600	66,800	17.8
	70	94	16	80	10.2	78,800	16.3	450	3,937		48	2100	61	-20	19,600	46,100	65,700	16.7
	75	100	16	85	10.1	78,200	17.2	450	4,147		48	2100	61	-20	19,100	45,300	64,400	15.5
	80	105	16	90	10.0	77,600	18.1	450	4,371		49	2100	61	-20	18,500	44,600	63,100	14.4
	85	110	16	95	10.0	76,900	19.2	450	4,615		49	2100	62	-19	17,900	43,700	61,600	13.3
	90	116	16	100	9.9	76,400	20.4	450	4,885		49	2100	62	-19	17,300	42,800	60,100	12.3
	95	121	16	105	9.8	75,700	21.7	450	5,171		50	2100	62	-18	16,700	41,800	58,500	11.3

METRIC

OUTDOOR LOOP (15% Methanol)							ELECTRICAL			INDOOR LOOP (Air)						
HEATING	ELT (°C)	Evap. Temp.	Flow (L/s)	LLT (°C)	Delta T (°C)	Heat Abs. (kW)	Compressor Current (A)*	Fan (W)	Input Power (W)	EAT (°C)	Cond. Temp.	Airflow (L/s)	LAT (°C)	Delta T (°C)	Heating (kW)	COP _H
	-3.9	-9.2	1.0	-6.1	-2.2	9.1	16.9	410	3,967	20.0	36.9	991	31.0	11.0	13.0	3.28
	-1.1	-6.6	1.0	-3.6	-2.5	10.2	17.4	410	4,092		37.8	991	32.0	12.0	14.2	3.47
	1.7	-4.1	1.0	-1.1	-2.8	11.4	18.0	410	4,219		38.8	991	33.1	13.1	15.5	3.67
	4.4	-1.6	1.0	1.3	-3.1	12.6	18.6	410	4,354		39.8	991	34.2	14.2	16.8	3.86
	7.2	1.0	1.0	3.8	-3.4	13.9	19.1	410	4,485		40.7	991	35.4	15.4	18.3	4.08
	10.0	3.6	1.0	6.3	-3.7	15.3	19.7	410	4,618		41.7	991	36.7	16.7	19.8	4.29
	12.8	6.1	1.0	8.7	-4.1	16.9	20.3	410	4,749		42.6	991	38.1	18.1	21.5	4.52
	15.6	8.7	1.0	11.1	-4.5	18.5	20.8	410	4,881		43.6	991	39.6	19.6	23.2	4.76
	18.3	11.2	1.0	13.4	-4.9	20.2	21.4	410	5,015		44.6	991	41.2	21.2	25.1	5.01
21.1	13.7	1.0	15.7	-5.4	22.0	21.9	410	5,143	45.5		991	42.8	22.8	27.1	5.26	

OUTDOOR LOOP (15% Methanol)							ELECTRICAL			INDOOR LOOP (Air @ 46% RH)								
COOLING	ELT (°C)	Cond. Temp.	Flow (L/s)	LLT (°C)	Delta T (°C)	Heat Rej. (kW)	Compressor Current (A)*	Fan (W)	Input Power (W)	EAT (°C)	Evap. Temp.	Airflow (L/s)	LAT (°C)	Delta T (°C)	Latent (kW)	Sensible (kW)	Cooling (kW)	COP _c
	10.0	22.8	1.0	15.7	5.7	23.5	14.1	450	3,273	27.0	7.7	132.5	15.3	-11.7	6.3	14.1	20.4	6.21
	12.8	25.8	1.0	18.5	5.7	23.4	14.5	450	3,415		7.9	132.5	15.4	-11.6	6.2	13.9	20.1	5.89
	15.6	28.8	1.0	21.3	5.7	23.3	14.9	450	3,576		8.2	132.5	15.6	-11.4	6.0	13.8	19.9	5.57
	18.3	31.7	1.0	24.0	5.7	23.2	15.5	450	3,749		8.4	132.5	15.7	-11.3	5.9	13.7	19.6	5.22
	21.1	34.7	1.0	26.8	5.7	23.1	16.3	450	3,937		8.7	132.5	15.8	-11.2	5.7	13.5	19.3	4.89
	23.9	37.7	1.0	29.5	5.6	22.9	17.2	450	4,147		8.9	132.5	16.0	-11.0	5.6	13.3	18.9	4.54
	26.7	40.6	1.0	32.3	5.6	22.7	18.1	450	4,371		9.2	132.5	16.2	-10.8	5.4	13.1	18.5	4.22
	29.4	43.6	1.0	35.0	5.6	22.5	19.2	450	4,615		9.4	132.5	16.4	-10.6	5.3	12.8	18.1	3.90
	32.2	46.6	1.0	37.7	5.5	22.4	20.4	450	4,885		9.7	132.5	16.6	-10.4	5.1	12.5	17.6	3.60
35.0	49.5	1.0	40.4	5.4	22.2	21.7	450	5,171	9.9		132.5	16.8	-10.2	4.9	12.3	17.1	3.31	

* Divide by 2.2 for 460VAC

Electrical Specifications

TABLE 29 - R-Series (R454b) Electrical Specifications

	Code	Power Supply			Compressor		Fan	Out-door Circ.	FLA	MCA	Max. Fuse/Breaker	Min. Wire Size
		V-ø-Hz	MIN	MAX	RLA	LRA	RLA	Max A	Amps	Amps	Amps	ga
R/RH-45	1	208/230-1-60	187	253	14.6	90	3.5	4.0	22.9	26.6	40	#8-2*
	2	208-3-60	187	229	9.9	82	3.5	4.0	18.2	20.7	30	#10-3*
	3	265/277-1-60	226	304	TBA	TBA	TBA	TBA	TBA	TBA	30	#10-2
	4	460-3-60	414	506	4.8	44	3.5		9.1	10.3	15	#14-4
R/RH-55	1	208/230-1-60	187	253	18.3	138	4.0	5.0	28.1	32.7	50	#8-2*
	2	208-3-60	187	229	11.9	112	4.0	5.0	21.7	24.7	40	#8-3*
	3	265/277-1-60	226	304	TBA	TBA	TBA	TBA	TBA	TBA	40	#8-2
	4	460-3-60	414	506	6.8	62	4.0	-	11.6	13.3	20	#12-4
R/RH-65	1	208/230-1-60	187	253	25.2	147	5.5	5.0	36.5	42.8	60	#6-2*
	2	208-3-60	187	229	13.8	5.5	5.5	5.0	25.1	28.6	40	#8-3*
	3	265/277-1-60	226	304	TBA	TBA	TBA	TBA	TBA	TBA	50	#8-2
	4	460-3-60	414	506	6.9	58	5.5	-	13.2	14.9	20	#12-4
R/RH-75	1	208/230-1-60	187	253	28.0	166	6.5	5.0	40.3	47.3	60	#6-2*
	2	208-3-60	187	229	19.2	162	6.5	5.0	31.5	36.3	50	#8-3*
	3	-	-	-	-	-	-	-	-	-	-	-
	4	460-3-60	414	506	9.1	71	6.5	-	16.4	18.7	30	#10-4

* additional conductor required if connecting 115VAC circulators to the unit

TABLE 30 - Plenum Heater Electrical Specifications

Size (kW)	(230-1-60)					(208-1-60)				
	Actual (kW)	FLA (A)	MCA (A)	Breaker (A)	Wire Size	Actual (kW)	FLA (A)	MCA (A)	Breaker (A)	Wire Size
5	5	20.8	26.0	30	#10	3.8	18.1	22.6	30	#10
7	7	29.2	36.5	40	#8	5.3	25.3	31.6	40	#8
10	10	41.7	52.1	60	#6	7.5	36.1	45.1	50	#6
15	15	62.5	78.1	80	#4	11.3	54.2	67.7	80	#4
20	20	83.3	104.2	100	#3	15.0	72.2	90.3	100	#3

Airflow Data

TABLE 31 - Airflow Range for STAGE 2 (Full Load)

Model Size	Nominal		Range		Airflow Reduction - 20%		Airflow Reduction - 15%		Airflow Reduction - 10%		Airflow Reduction - 5%	
	cfm	L/s	cfm	L/s	cfm	L/s	cfm	L/s	cfm	L/s	cfm	L/s
45	1150	540	900-1400	430-660	920	430	980	460	1040	490	1090	520
55	1500	710	1200-1800	570-850	1200	570	1280	600	1350	640	1430	670
65	1900	900	1500-2300	710-1090	1520	720	1620	760	1710	810	1810	850
75	2200	1040	1750-2500	830-1180	1760	830	1870	880	1980	940	2090	990

TABLE 32 - Airflow Range for STAGE 1 (Part Load)

Model Size	Nominal		Range		Airflow Reduction - 20%		Airflow Reduction - 15%		Airflow Reduction - 10%		Airflow Reduction - 5%	
	cfm	L/s	cfm	L/s	cfm	L/s	cfm	L/s	cfm	L/s	cfm	L/s
45	900	430	700-1100	330-520	720	340	770	360	810	380	860	400
55	1200	570	950-1450	450-680	960	450	1020	480	1080	510	1140	540
65	1500	710	1200-1800	570-850	1200	570	1280	600	1350	640	1430	670
75	1750	830	1400-2100	660-990	1400	660	1490	700	1580	740	1660	790

TABLE 33 - Airflow Range for STAGE 3 (Auxiliary)

Model Size	Nominal		Range		Airflow Reduction - 20%		Airflow Reduction - 15%		Airflow Reduction - 10%		Airflow Reduction - 5%	
	cfm	L/s	cfm	L/s	cfm	L/s	cfm	L/s	cfm	L/s	cfm	L/s
45	1150	540	900-1400	430-660	920	430	980	460	1040	490	1090	520
55	1500	710	1200-1800	570-850	1200	570	1280	600	1350	640	1430	670
65	1900	900	1700-2300	800-1090	1520	720	1620	760	1710	810	1810	850
75	2200	1040	2000-2500	940-1180	1760	830	1870	880	1980	940	2090	990

TABLE 34 - Airflow Range for Fan Recirculation

Model Size	Nominal		Range		Airflow Reduction - 20%		Airflow Reduction - 15%		Airflow Reduction - 10%		Airflow Reduction - 5%	
	cfm	L/s	cfm	L/s	cfm	L/s	cfm	L/s	cfm	L/s	cfm	L/s
45	650	310	500-800	240-380	520	250	550	260	590	280	620	290
55	850	400	700-1000	330-470	680	320	720	340	770	360	810	380
65	1100	520	900-1300	430-610	880	420	940	440	990	470	1050	490
75	1250	590	1000-1500	470-710	1000	470	1060	500	1130	530	1190	560

TABLE 35 - Airflow Range for Emergency Heat

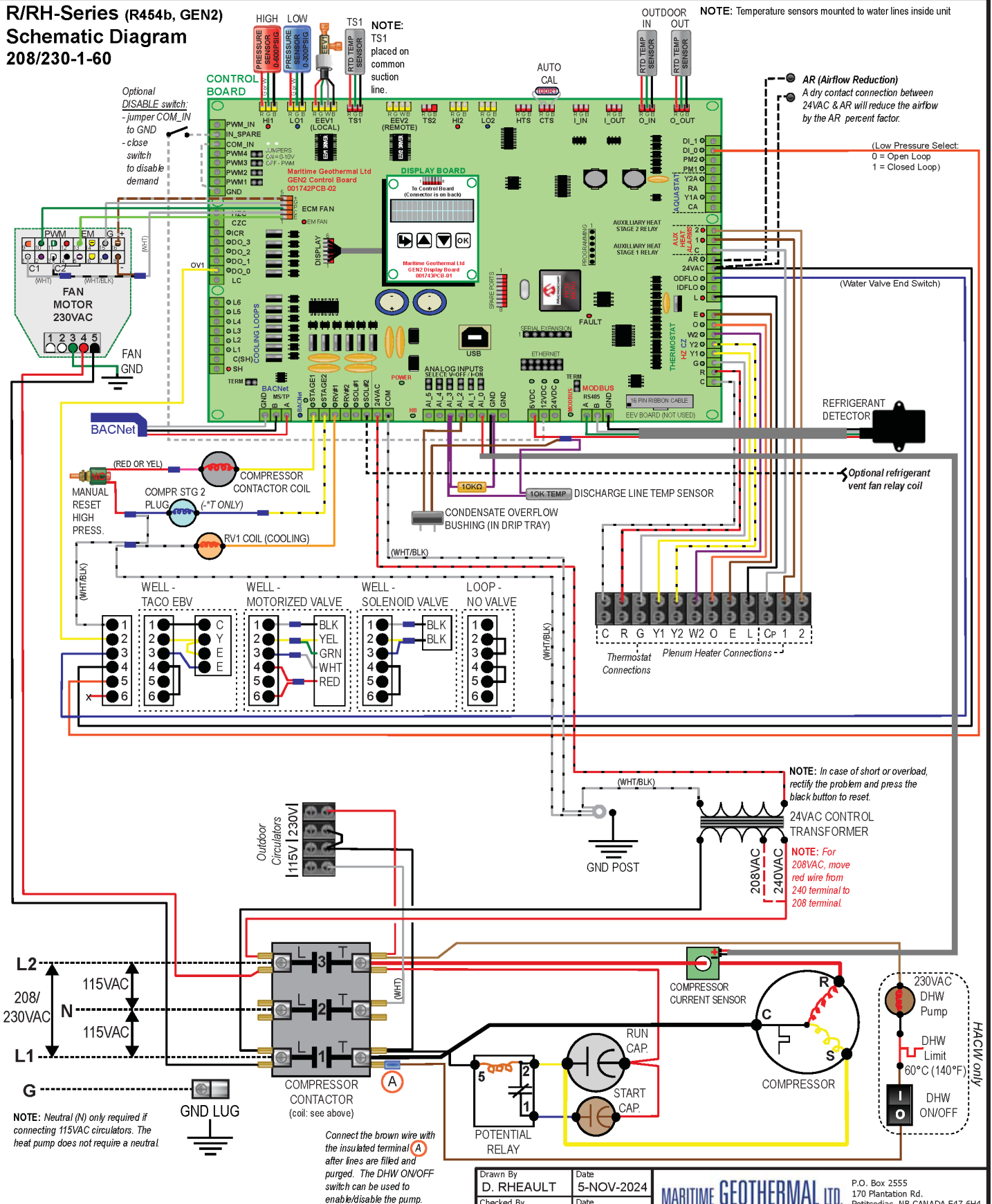
Model Size	cfm	L/s
45	1200	566
55/65/75	2000	940

Maximum external static pressure:
0.50in H₂O

To obtain the AR airflow values, use a dry contact to connect AR to 24VAC on the right side of control board.

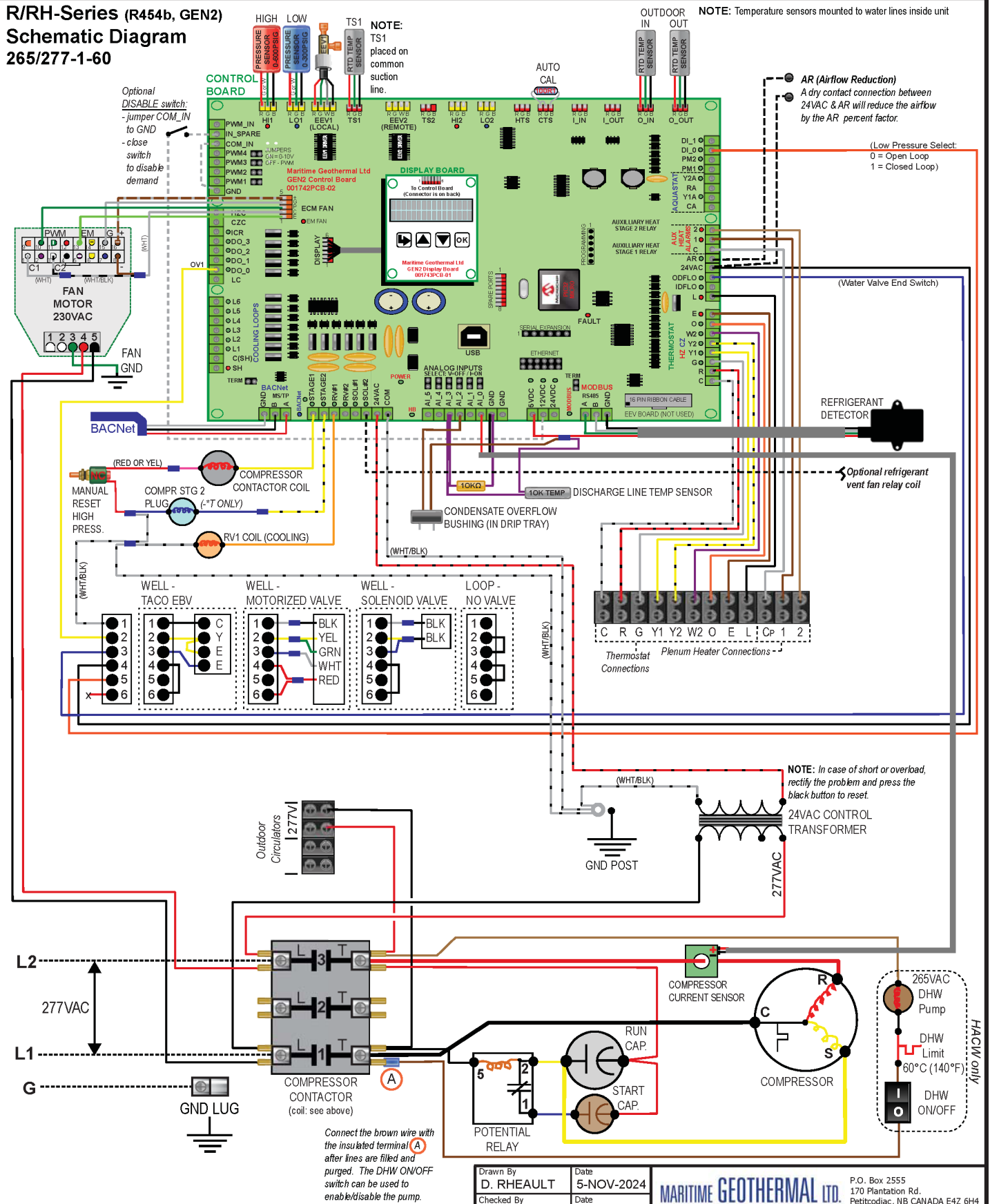
Airflow reduction % is set through PC App.

R/RH-Series (R454b, GEN2) Schematic Diagram 208/230-1-60

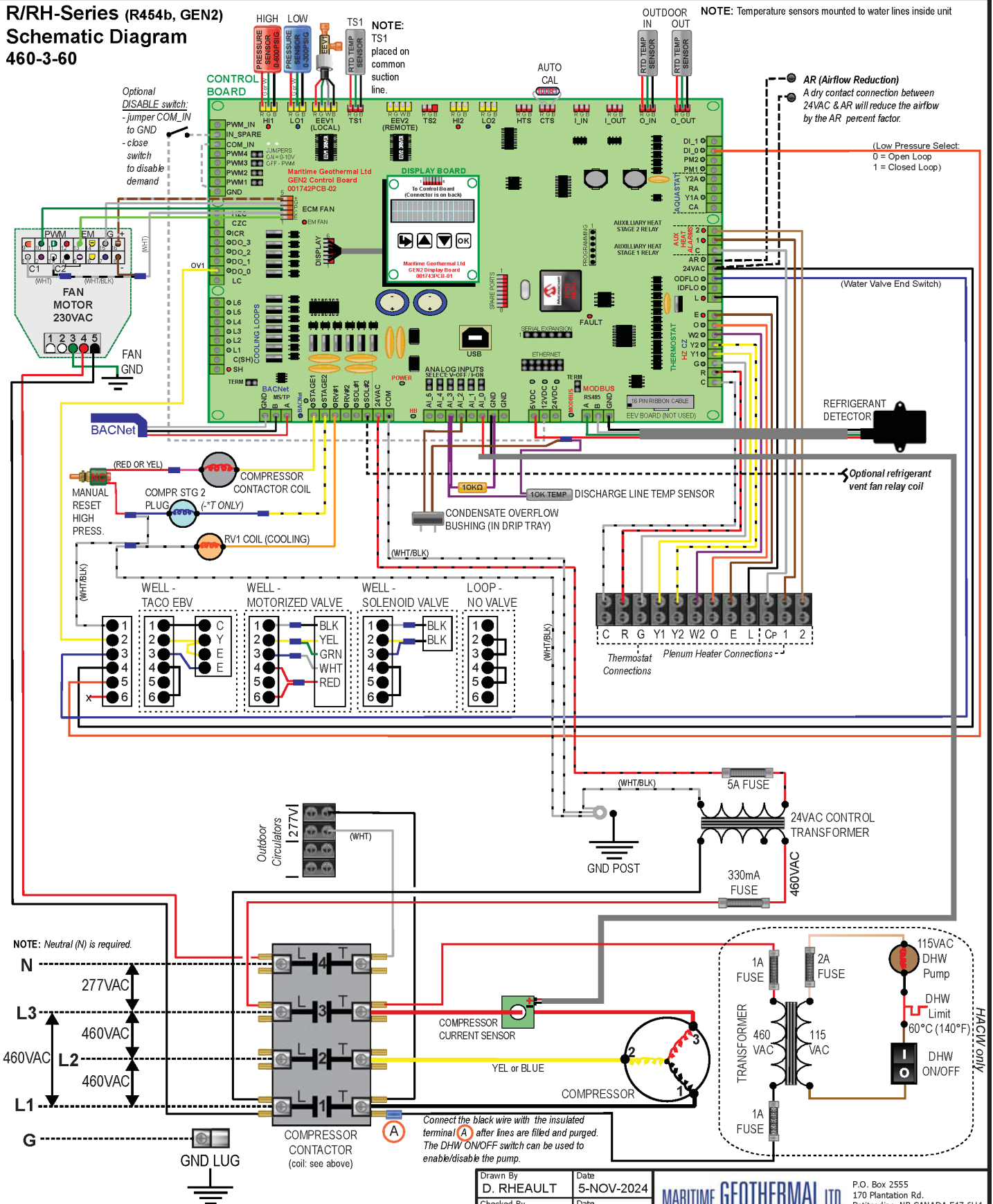


[illegible]

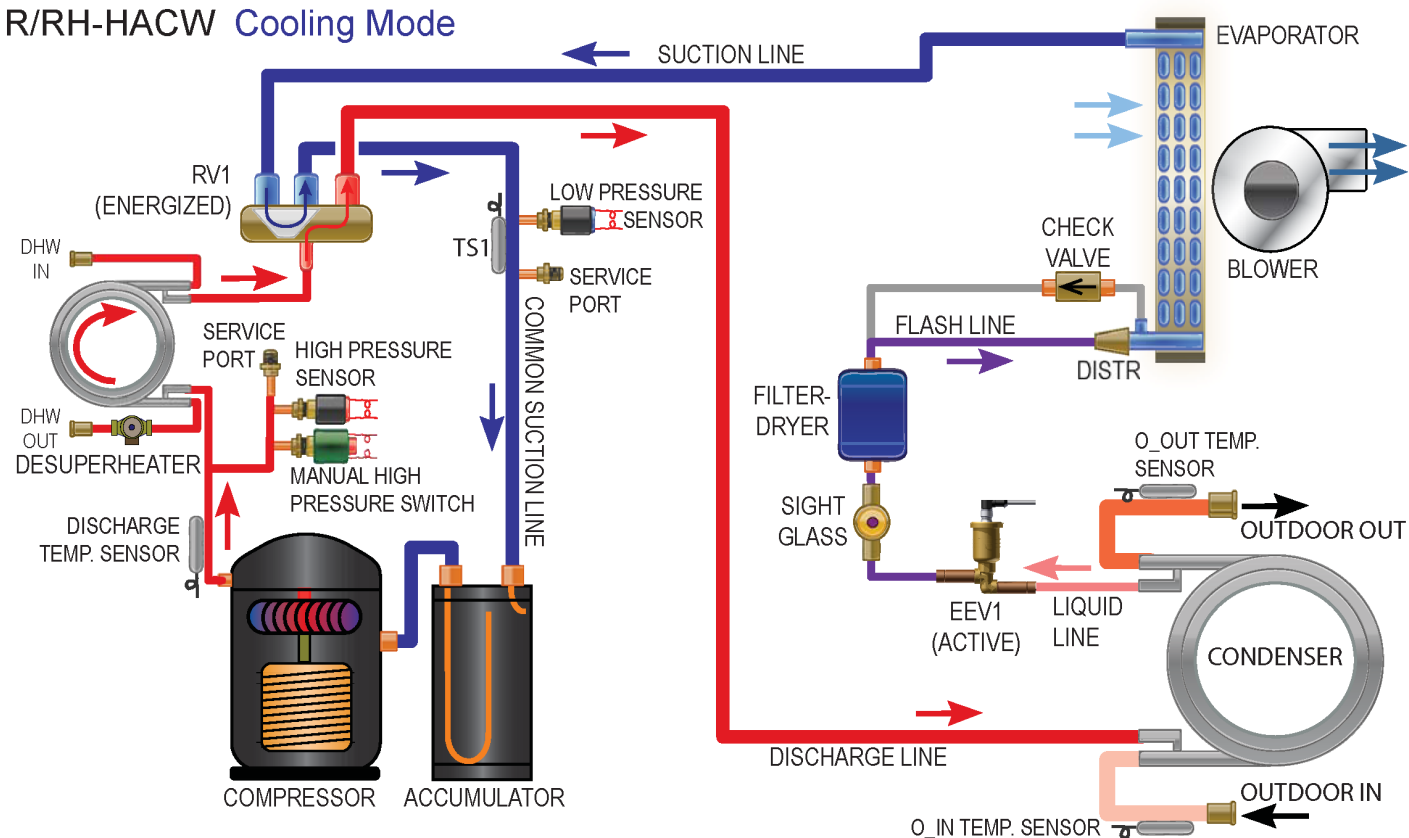
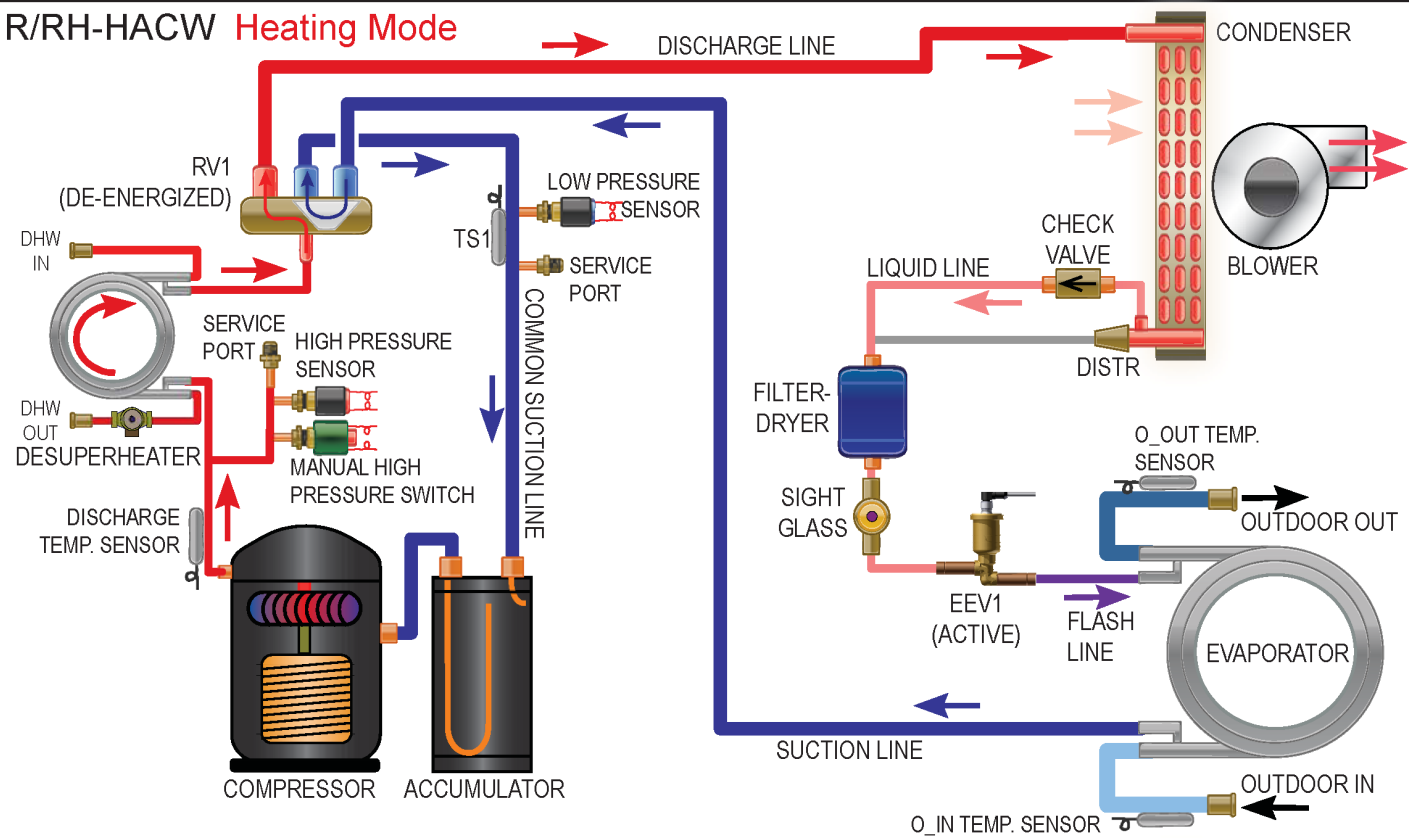
R/RH-Series (R454b, GEN2) Schematic Diagram 265/277-1-60



R/RH-Series (R454b, GEN2) Schematic Diagram 460-3-60

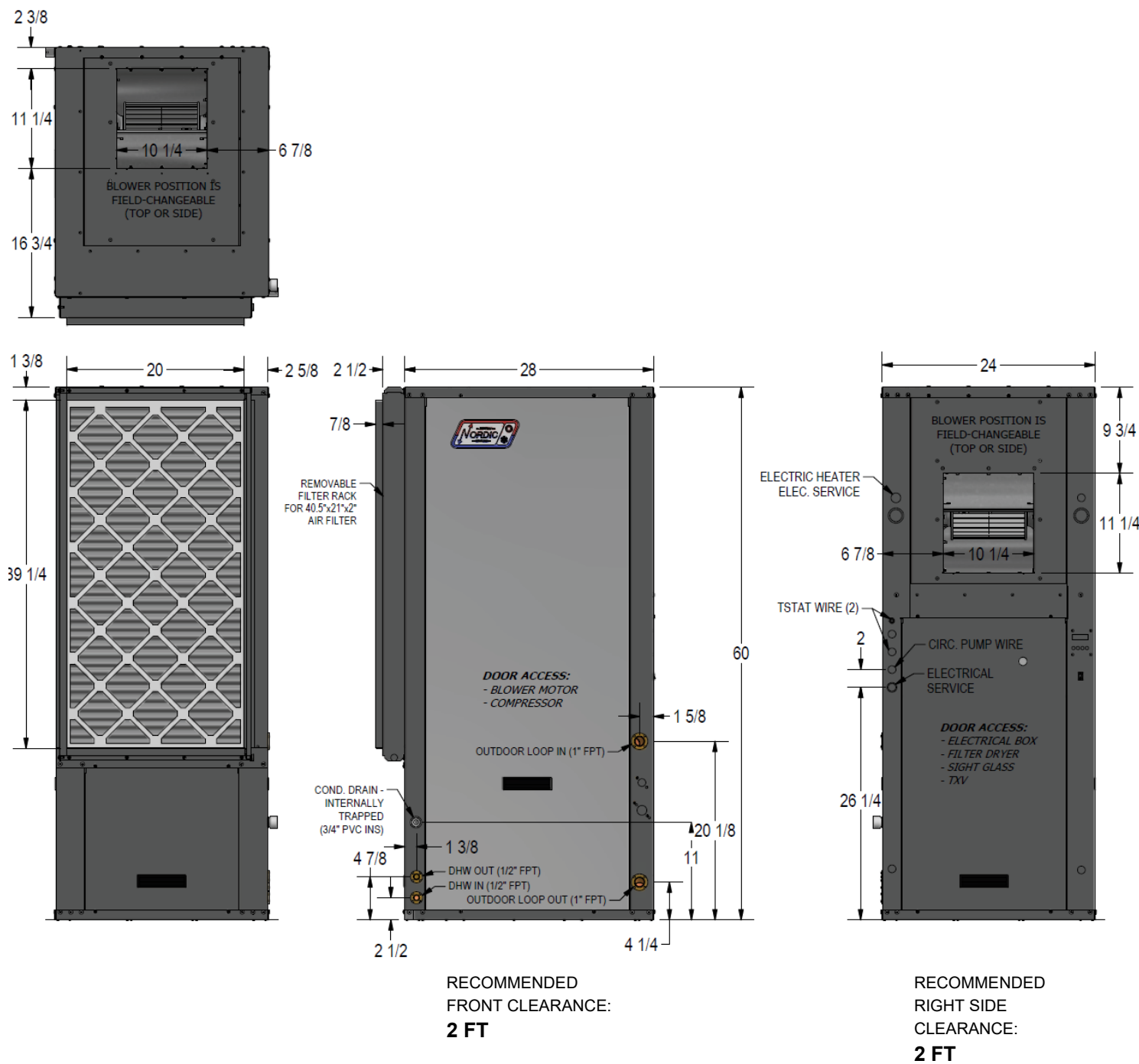


01	Initial Release	D. RHEAULT	D. RHEAULT	5-NOV-2024	Drawn By D. RHEAULT	Date 5-NOV-2024	MARITIME GEOTHERMAL LTD. P.O. Box 2555 170 Plantation Rd. Petitcodiac, NB CANADA E4Z 6H4	Drawing Name R/RH-**-HAC*-X-4*-**DE*F (Gen2) Schematic Diagram	Size LET	Drawing Number 002813SCH	Drawing Rev 01	Sheet 1 / 1
REV	ECO#	IMPL BY	APVD BY	DATE	Checked By D. RHEAULT	Date 5-NOV-2024						
					Eng. Approved By	Date						
					Mfg. Approved By	Date						
					Approved By	Date						

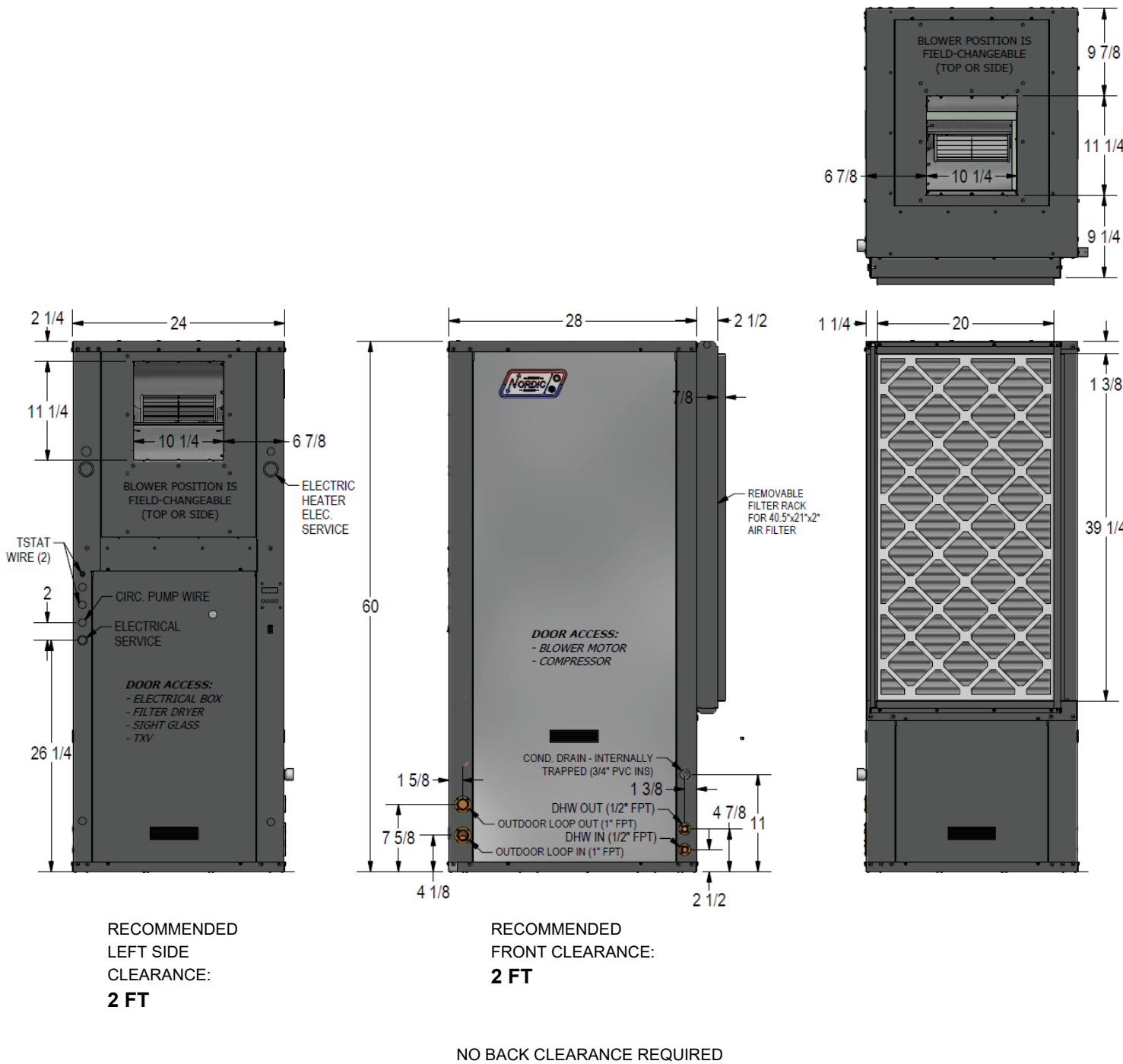


					Drawn By D. RHEAULT	Date 8-NOV-2024	MARITIME GEOTHERMAL LTD. P.O. Box 2555 170 Plantation Rd. Petitcodiac, NB CANADA E4Z 6H4			
					Checked By D. RHEAULT	Date 8-NOV-2024				
					Eng. Approved By	Date	Drawing Name R/RH-HACW (Gen2) Refrigeration Circuit			
					Mfg. Approved By	Date				
01	Initial Release	D. RHEAULT	D. RHEAULT	8-NOV-2024	Approved By	Date	Size LET	Drawing Number 002824RCD	Drawing Revision 01	Sheet 1 / 1
REV	ECO#	IMPL BY	APVD BY	DATE						

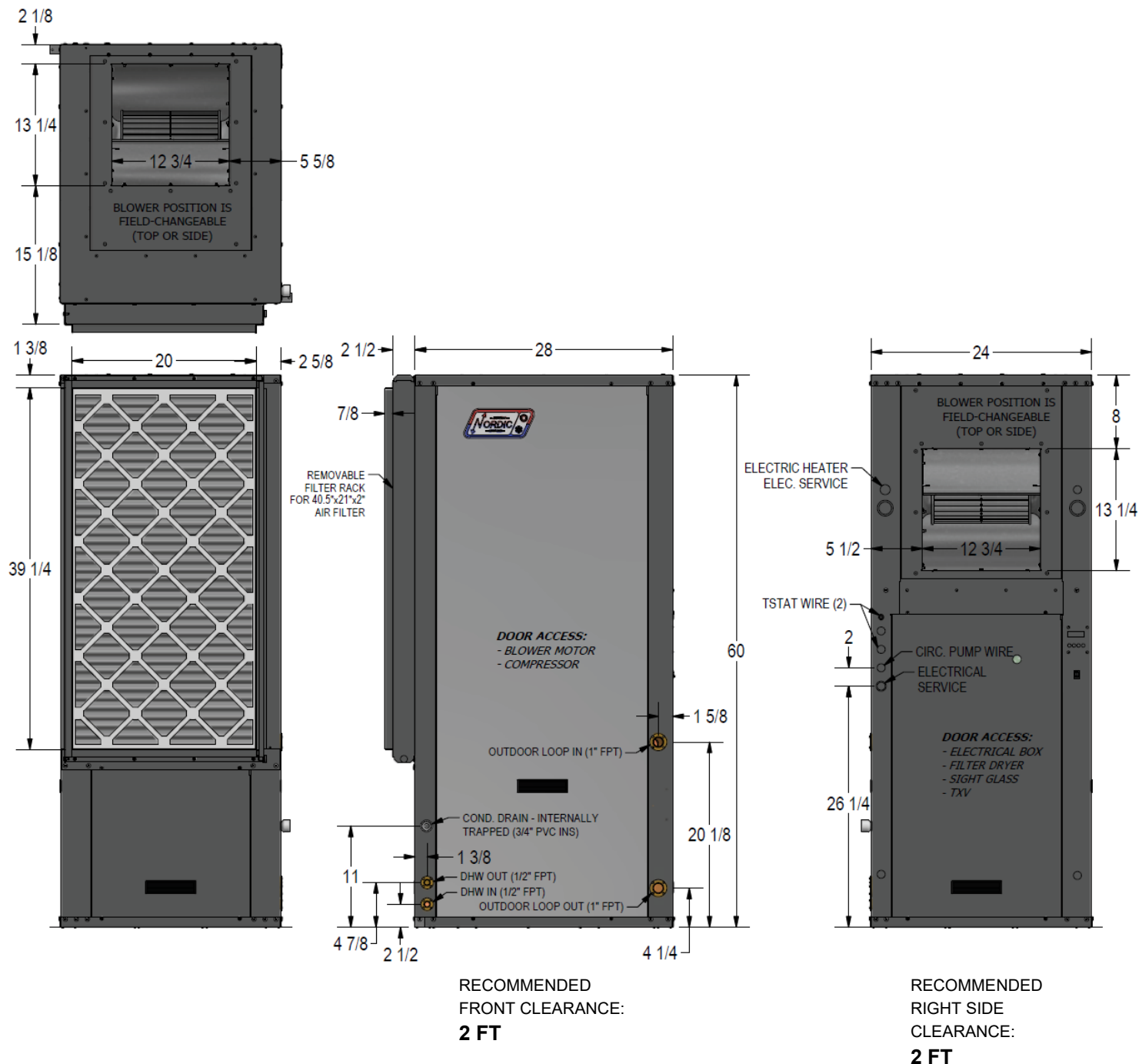
Dimensions: R-45 Left Return



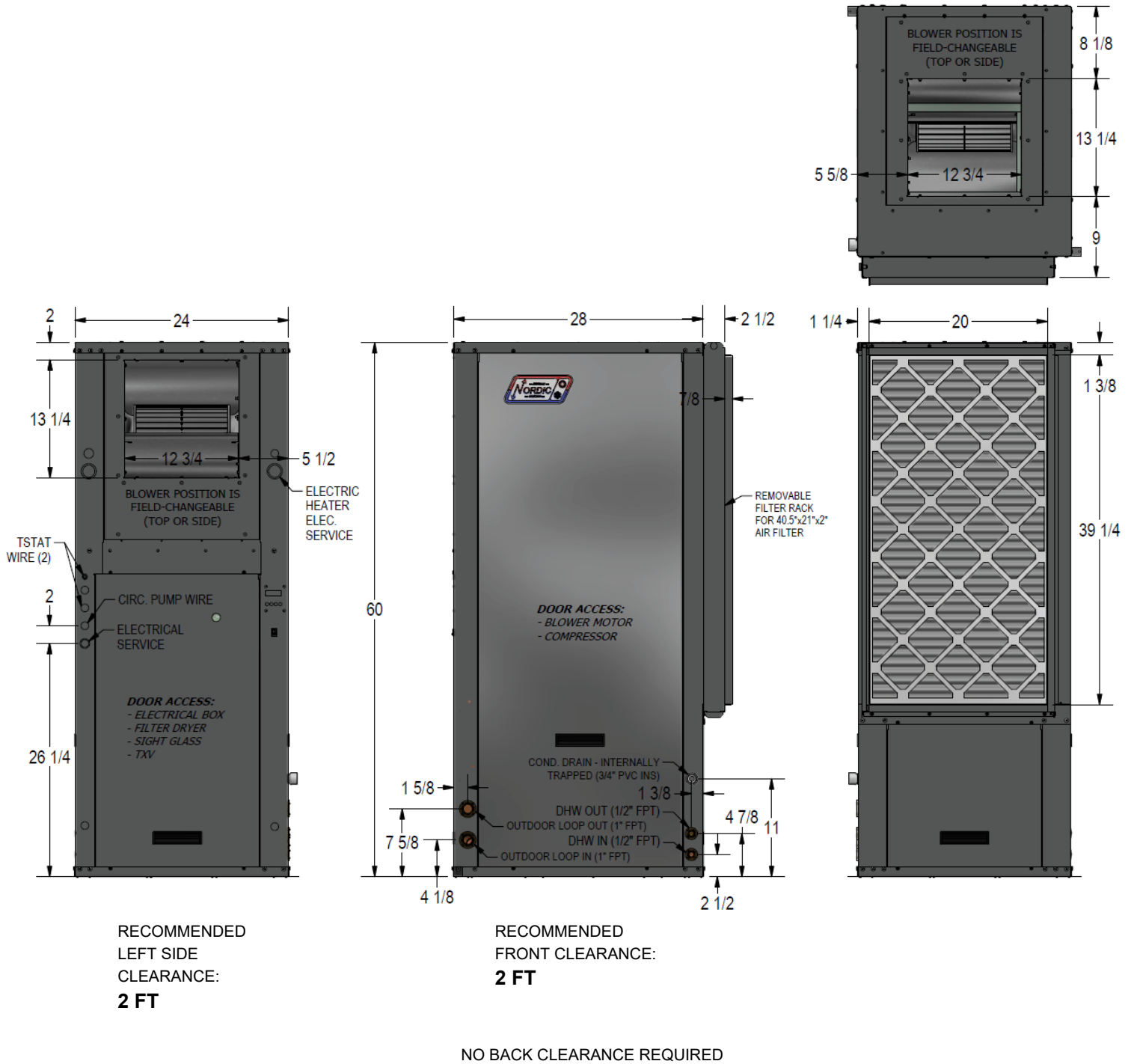
Dimensions: R-45 Right Return



Dimensions: R-55/65/75 Left Return



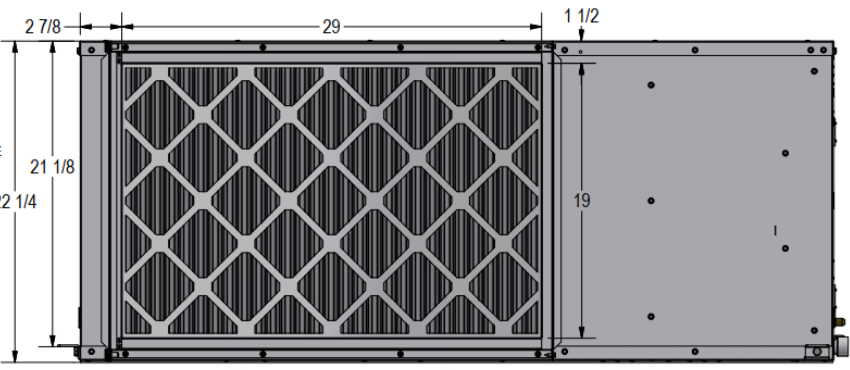
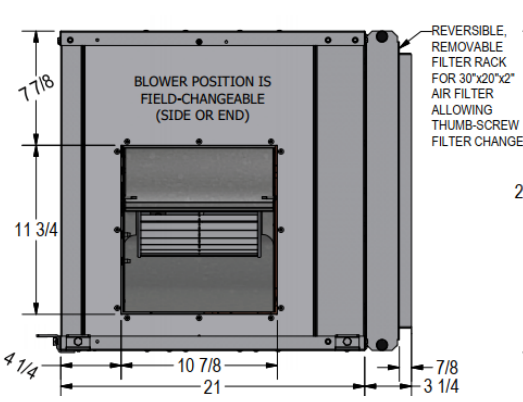
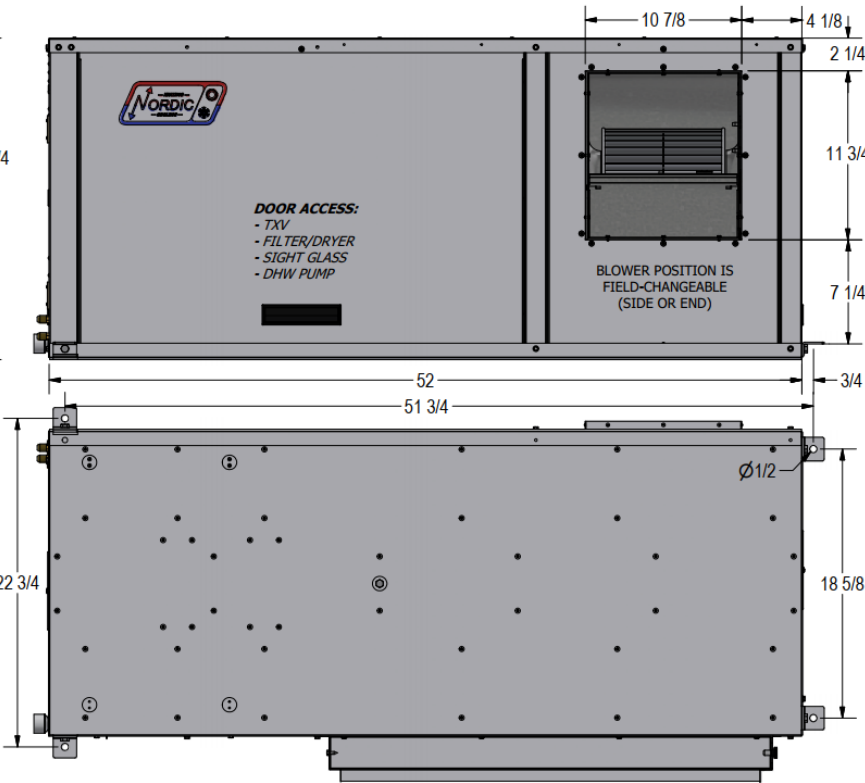
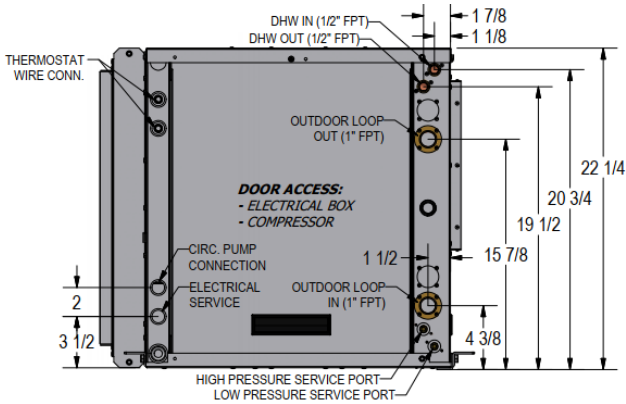
Dimensions: R-55/65/75 Right Return



Dimensions: RH-45 Left Return

RECOMMENDED
FRONT CLEARANCE:
2 FT

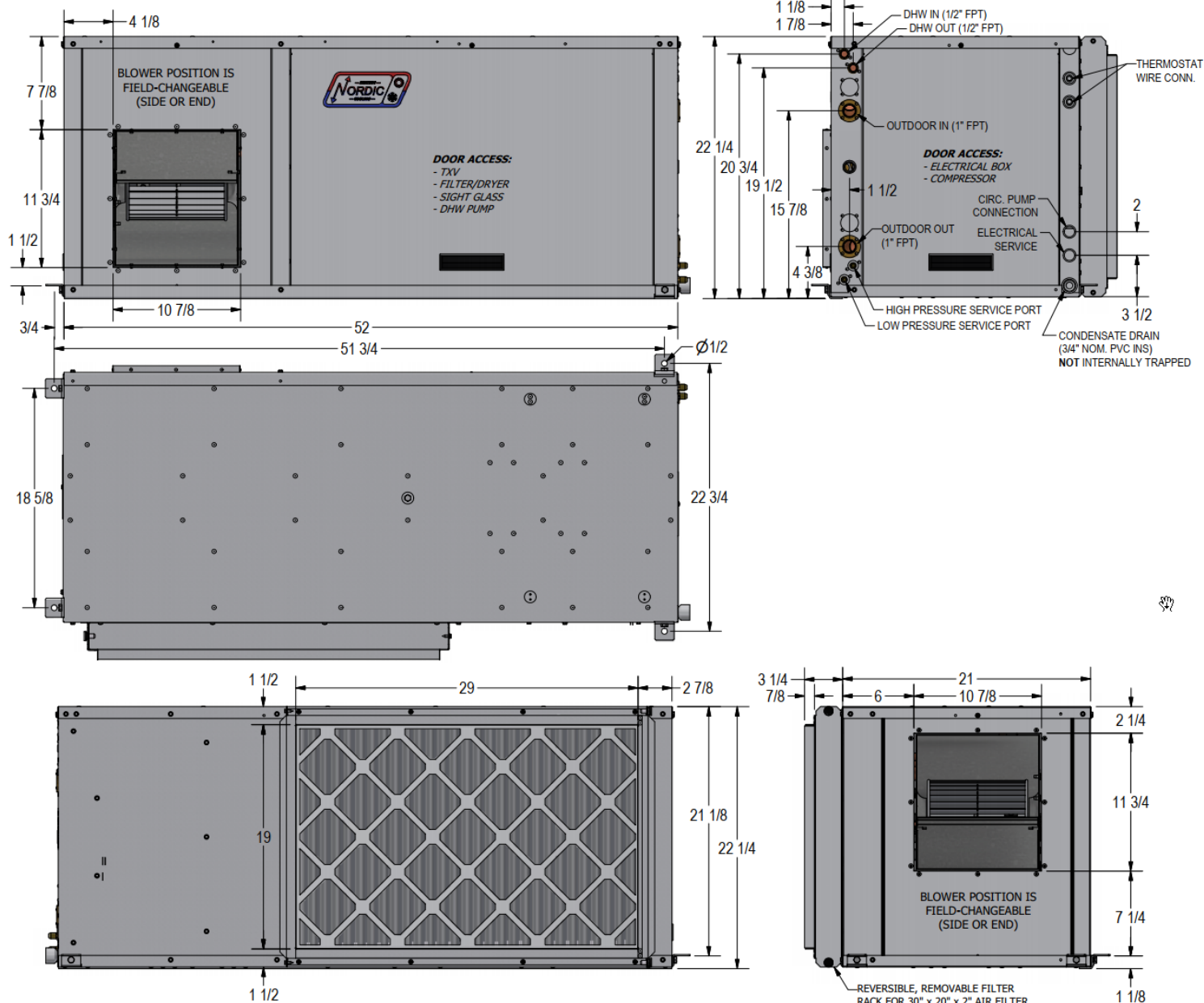
RECOMMENDED RIGHT SIDE CLEARANCE:
2 FT



Dimensions: RH-45 Right Return

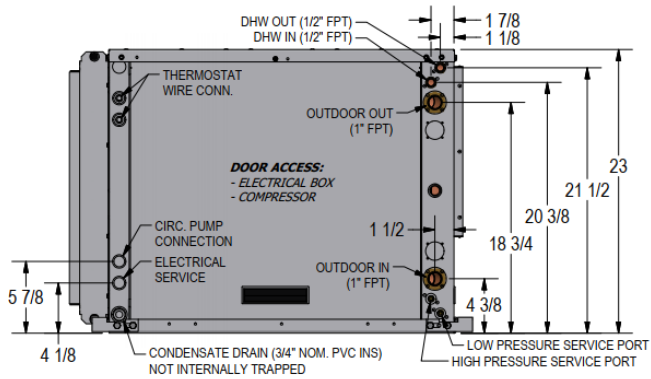
RECOMMENDED LEFT SIDE CLEARANCE:
2 FT

RECOMMENDED
FRONT CLEARANCE:
2 FT

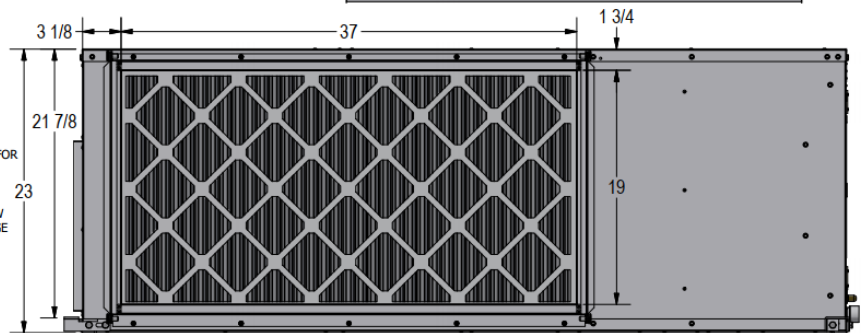
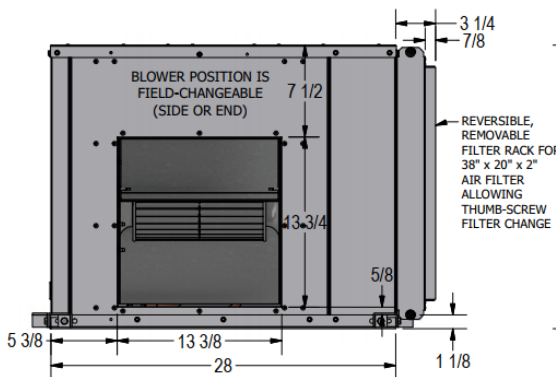
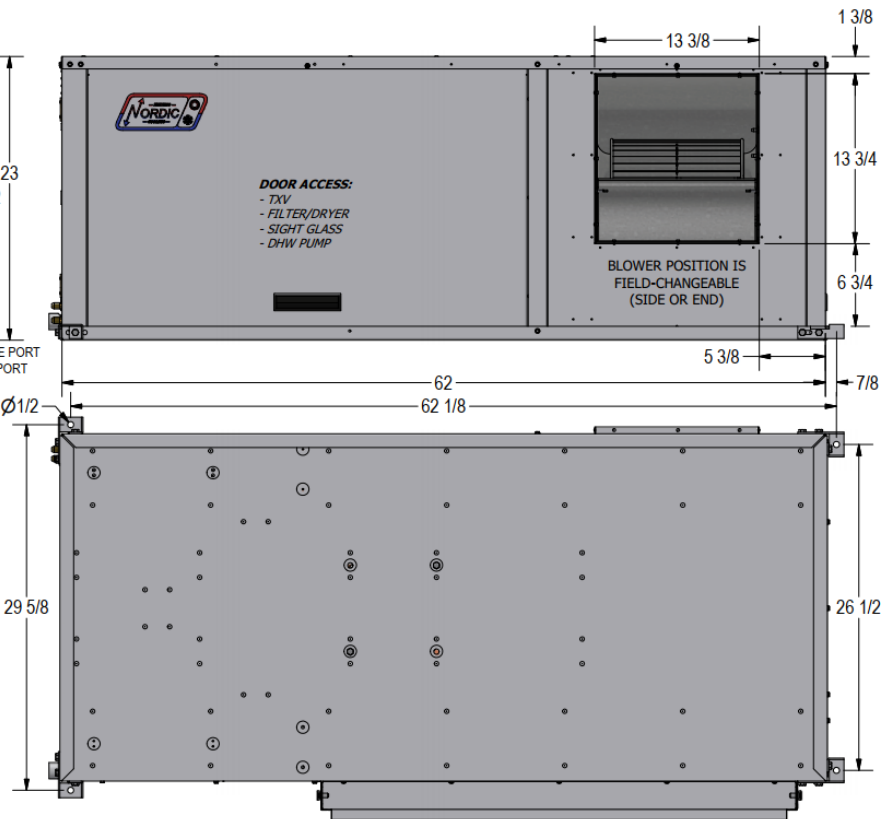


Dimensions: RH-55/65/75 Left Return

RECOMMENDED
FRONT CLEARANCE:
2 FT



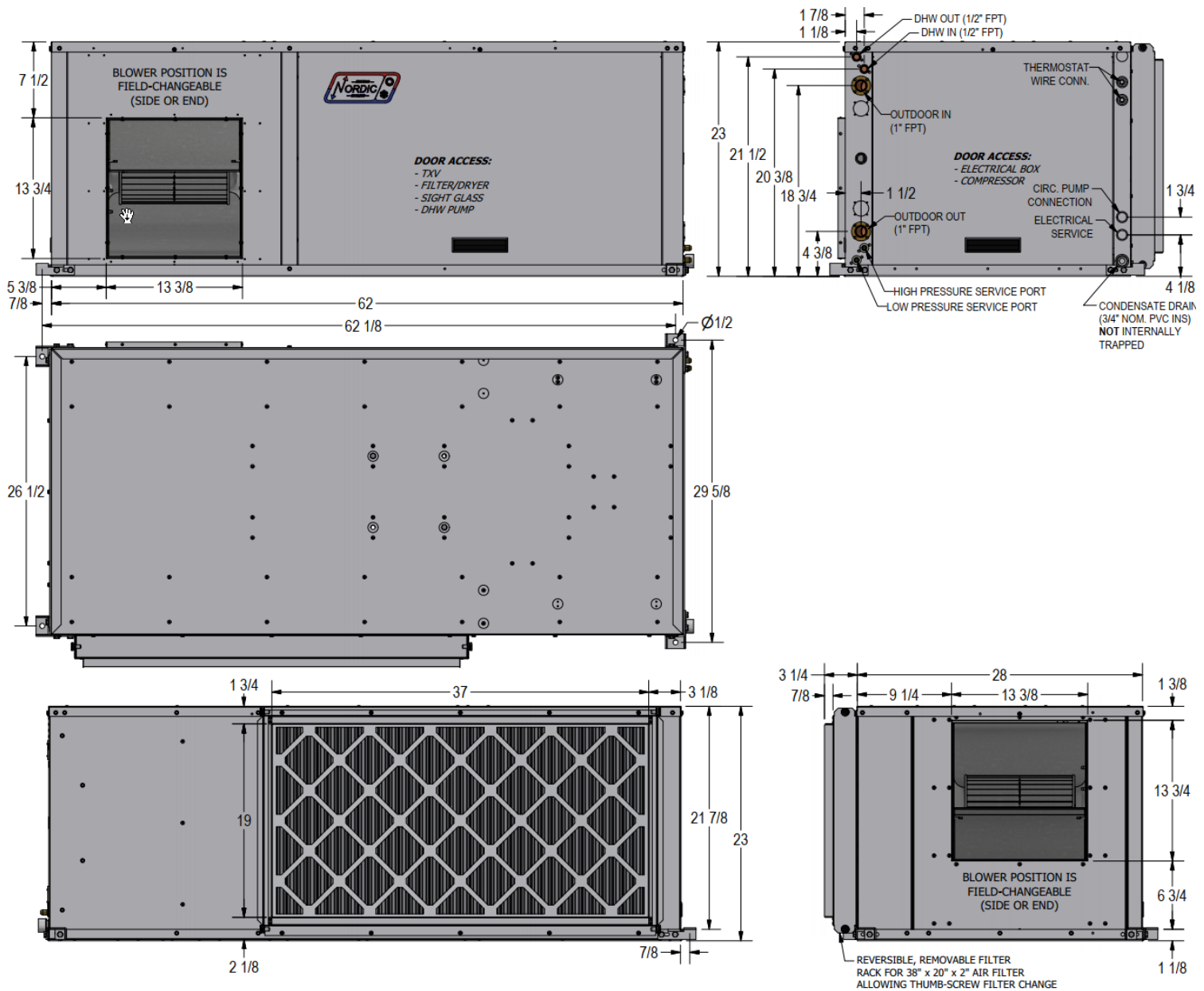
RECOMMENDED RIGHT SIDE CLEARANCE:
2 FT



Dimensions: RH-55/65/75 Right Return

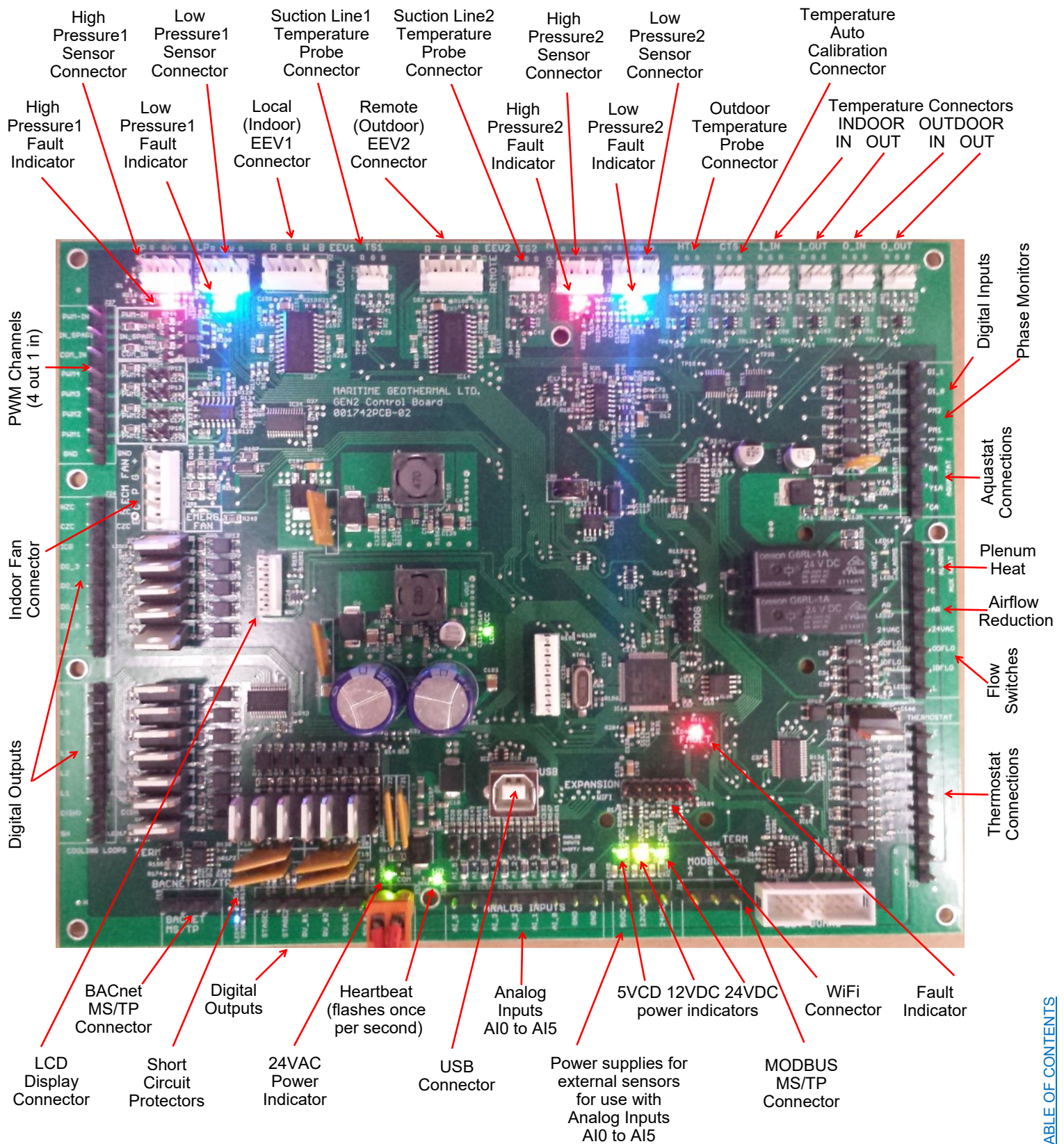
RECOMMENDED LEFT SIDE CLEARANCE:
2 FT

RECOMMENDED
FRONT CLEARANCE:
2 FT



Appendix A - GEN2 Control Board Description

The picture below shows the locations of the connectors and LED indicators of the control board. The control board offers many features such as short circuit protection on all digital outputs, Real Time Clock with super capacitor for backup power, WiFi capability, relay outputs for plenum heater control (if equipped), USB port, PIC32 microcontroller, etc.



The tables describe the connections starting with the top of the board and working around the board counter clock-wise.

TABLE A1 - Control Board Connector Descriptions (Top)

Name	Description	
HPS1/HI1	High Pressure Sensor 1	Measures discharge pressure.
LPS1/LO1	Low Pressure Sensor 1	Measures suction pressure.
EEV1	Local EEV	Control of Electronic Expansion Valve.
TS1	Suction Line Temperature 1	Mounted to common suction line inside unit.
EEV2	Remote EEV	Not used.
TS2	Suction Line Temperature 2	Not used.
HPS2/HI2	High Pressure Sensor 2	Not used.
LPS2/LO2	Low Pressure Sensor 2	Not used.
HTS	Outdoor Temperature	Not used.
CTS	Auto Calibration	Resistor in connector for auto-calibration reference (32°F—0°C).
I_IN	Indoor Loop IN	Not used.
I_OUT	Indoor Loop OUT	Not used.
O_IN	Outdoor Loop IN	Mounted to pipe inside unit.
O_OUT	Outdoor Loop OUT	Mounted to pipe inside unit.

TABLE A2 - Control Board Connector Descriptions (Left Side)

Name	Description	
PWM_IN	Signal for PWM IN	Not used.
IN_SPARE	Spare digital input	Switch or dry contact from 12VDC to disable unit (also COM_IN to GND).
COM_IN	Common for PWM IN	Jumper to GND for disable functionality.
PWM4	PWM / 0-10VDC output	Not used.
PWM3	PWM / 0-10VDC output	Not used.
PWM2	PWM / 0-10VDC output	Not used.
PWM1	PWM / 0-10VDC output	Not used.
GND	Ground	Used with COM_IN above.
HZC	Hot Zone Circulator	Not used.
CZC	Cold Zone Circulator	Not used.
ICR	Internal Circulator Relay	Not used.
DO_3	Auxiliary Only	Not used.
DO_2	HYD_AUX	Not used.
DO_1	Digital output	Not used.
DO_0	OV1	To open loop water valve end switch or closed loop jumper plug (back to ODFLO).
LC	Loop common (ground)	Not used.
L6	Loop6	Not used.
L5	Loop5	Not used.
L4	NOT_HYD_AUX	Not used.
L3	Loop3	Not used.
L2	Loop2	Not used.
L1	Loop1	Not used.
C(SH)	Soaker Hose common	Not used.
SH	Soaker Hose	Not used.

TABLE A3 - Control Board Connector Descriptions (Bottom)

Name	Description	
GND	BACnet MS/TP	Ground for shield if required.
B	BACnet MS/TP	RS-485.
A	BACnet MS/TP	RS-485.
STAGE1	Compressor Stage 1	Starts / stops the compressor.
STAGE2	Compressor Stage 2	Turns the compressor Stage 2 solenoid on/off.
RV_#1	Reversing Valve#1	Off in heating mode, on in cooling mode.
RV_#2	Reversing Valve#2	Not used.
SOL#1	Solenoid#1	Not used.
SOL#2	Solenoid#2	Optional refrigerant vent fan relay/contactactor.
24VAC	Power supply for board	24VAC power for control board.
COM	Power supply for board	GND for control board.
AI_5	Analog In Channel 5	Not used.
AI_4	Analog In Channel 4	Not used.
AI_3	Analog In Channel 3	Compressor discharge line temperature sensor.
AI_2	Analog In Channel 2	Condensate overflow sensor.
AI_1	Analog In Channel 1	Not used.
AI_0	Analog In Channel 0	Compressor current sensor.
GND	Ground pin	Ground for analog sensors.
GND	Ground pin	Ground for analog sensors.
5VDC	Power for analog sensors	5VDC regulated power supply for sensors.
12VDC	Power for analog sensors	12VDC regulated power supply for sensors.
24VDC	Power for analog sensors	24VDC unregulated power supply for sensors.
A	MODBUS	RS485 communication for refrigerant leak detector.
B	MODBUS	RS485 communication for refrigerant leak detector.
GND	MODBUS	Ground for shield if required.

TABLE A4 - Control Board Connector Descriptions (Right Side)

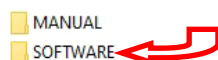
Name	Description	
DI_1	Digital Input1	Not used.
DI_0	Digital Input0	Low pressure select from open/closed loop harness (0=open loop, 1=closed loop)
PM2	Phase Monitor2	Not used.
PM1	Phase Monitor1	Not used.
Y2A*	Aquastat Stage2	Not used.
RA*	Aquastat Power (24VAC)	Not used.
Y1A*	Aquastat Stage1	Not used.
CA*	Aquastat Power (Ground)	Not used.
2	Plenum Heat Stage2	Dry contact output to activate air plenum heater stage 2.
1	Plenum Heat Stage1	Dry contact output to activate air plenum heater stage 1.
C	Plenum Heat Common	Common terminal for air plenum heater dry contacts.
AR	Airflow Reductions	Digital input to reduce airflow for zoning applications.
24VAC	Power	Power to external dry contact for AR terminal & low pressure select (DI_0).
ODFLO	Outdoor Flow Switch	Return signal from open loop water valve end switch, or closed loop jumper plug.
IDFLO	Indoor Flow Switch	Not used.
L	Thermostat Lockout Indicator	24VAC to external trouble indicator.
E	Thermostat Emergency Heat	24VAC input from external dry contact (air thermostat); activates plenum heater.
O	Thermostat Heat/Cool	24VAC input from external dry contact (air thermostat); activates cooling mode.
W2	Thermostat Auxiliary Heat	24VAC input from external dry contact (air thermostat); activates plenum heater.
Y2	Thermostat Stage2	24VAC input from external dry contact (air thermostat); activates compressor stg. 2.
Y1	Thermostat Stage1	24VAC input from external dry contact (air thermostat); starts compressor.
G	Thermostat Fan Recirculation	24VAC input from external dry contact (air thermostat); activates fan recirculation.
R	Thermostat Power (24VAC)	24VAC to air thermostat.
C	Thermostat Power (Ground)	24VAC ground for powering air thermostat.
*NOTE: There is no need for an external aquastat for most systems, since the Setpoint Control Method provides built in aquastat functionality.		

Appendix B - USB Driver Installation (Windows 10 & earlier)

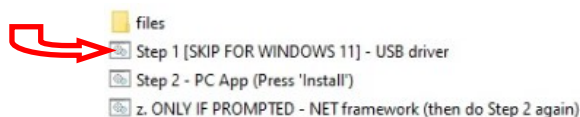
NOTE: This step is *not necessary* for **Windows 11**.

The first step in connecting a **Windows 10 or earlier** laptop computer to the control board is to install the USB driver.

The easiest way to install the USB driver is from the **USB drive included with the unit**. Insert the USB stick into a Windows computer, and open a File Explorer window to view its contents:



Double click on the **SOFTWARE** folder to show its contents:



To install the USB driver, double click on **Step 1** and follow the prompts, clicking “allow” or “yes” as required.

If the USB drive is not available, the same files can be **downloaded from the web page**.

- Go to www.nordicghp.com, Download Software page:



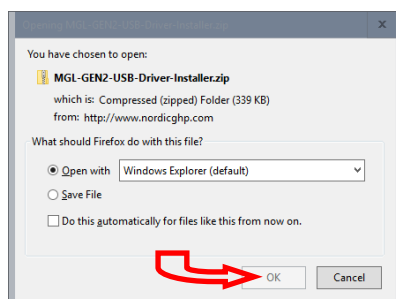
- Click on **MGL GEN2 USB Driver Installer** to download it:

DOWNLOAD Heat Pump Firmware:
MGL GEN2 Bootload Firmware V3.76

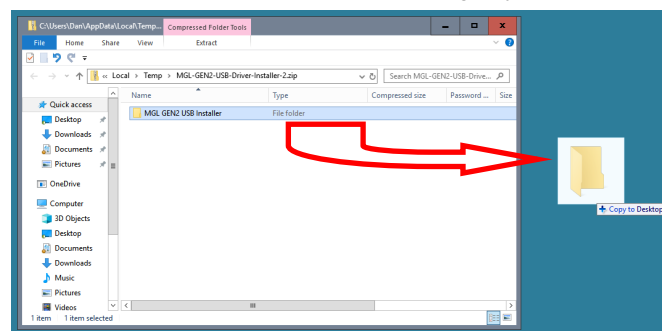
DOWNLOAD PC App (software for Windows laptop):
MGL GEN2 PC APP V2.05

DOWNLOAD USB driver (one time installation):
MGL GEN2 USB Driver Installer

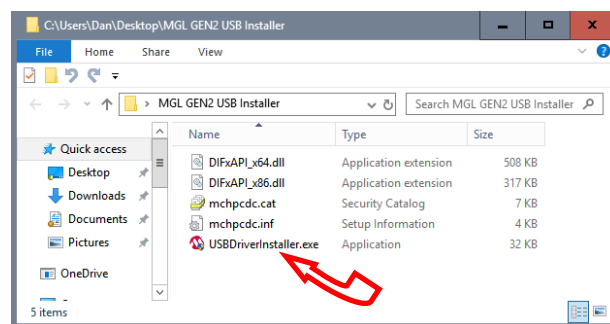
- Choose “Open with Windows Explorer”, and hit “OK”.
(If the choice window doesn't pop up, find the downloaded file in your browser downloads and double click on it.)



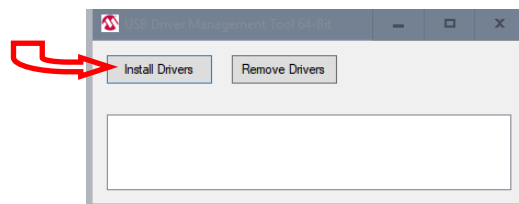
- In the window that is displayed, click and hold down the mouse button on the folder name, and drag to your desktop:



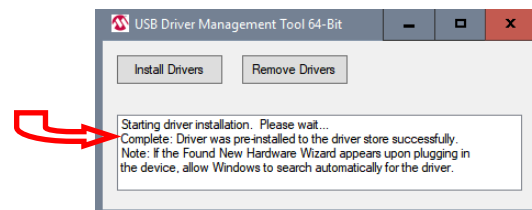
- Double click on the folder you just dragged onto the desktop, then double click on the “USBDriverInstaller” file:



- In the next window, click on “Install Drivers”:



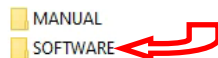
- You will see a message indicating the driver was installed successfully. You are now ready to install the PC App.



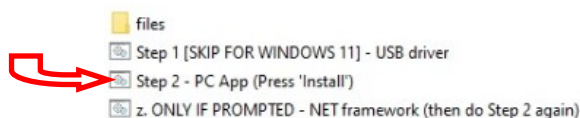
Appendix C - PC App Installation (Windows 11)

The PC App allows detailed interfacing with the control board using a Windows laptop computer. These instructions are for **Windows 11**.

The easiest way to install the PC App is from the **USB drive included with the unit**. Insert the USB stick into a Windows computer, and open a File Explorer window to view its contents:



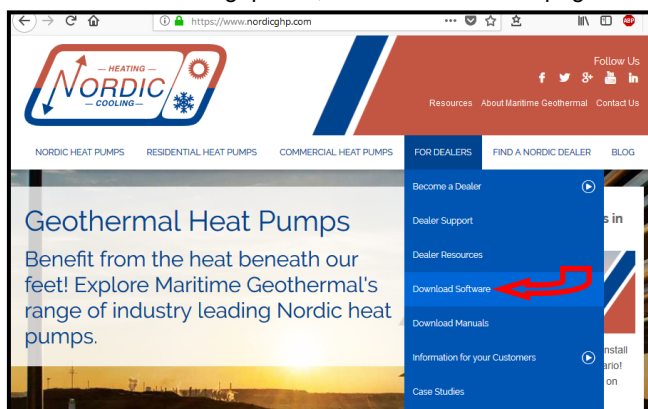
Double click on the **SOFTWARE** folder to show its contents:



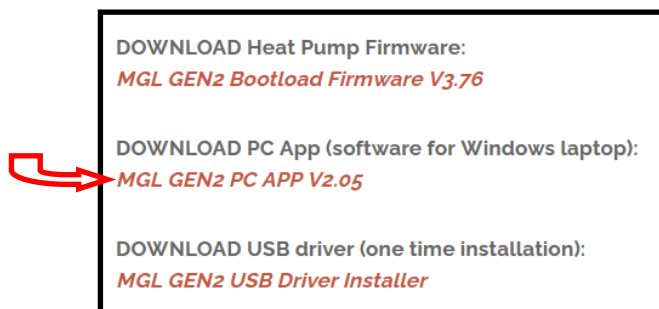
Double click on **Step 2** and follow the prompts, clicking “More info”, “Run anyway”, “Install”, or similar on any warning windows which pop up, perhaps more than once. Pictures of warning windows you might encounter are shown below in step 8.

If the USB stick drive is not available, the same file can be **downloaded from the web page**.

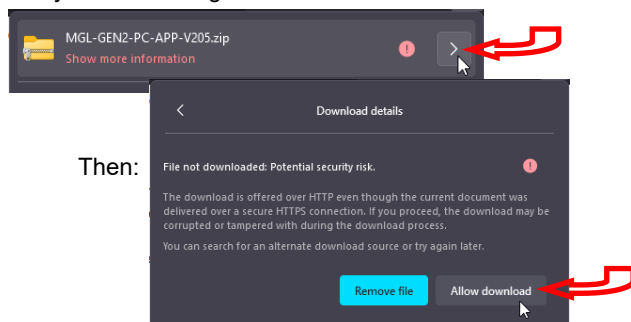
- Go to www.nordicghp.com, Download Software page:



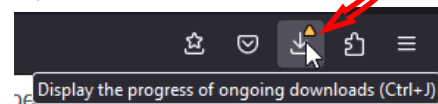
- Click on **MGL GEN2 PC APP V2__** to download it:



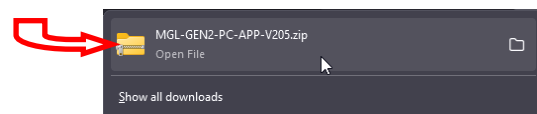
- You may see a warning like this one. Click as shown:



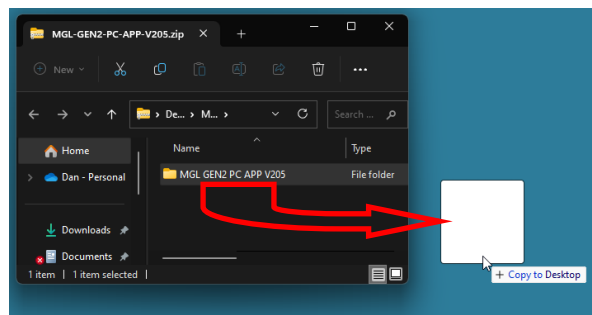
- Click on the downloads icon on your browser, or otherwise view a list of your downloaded files:



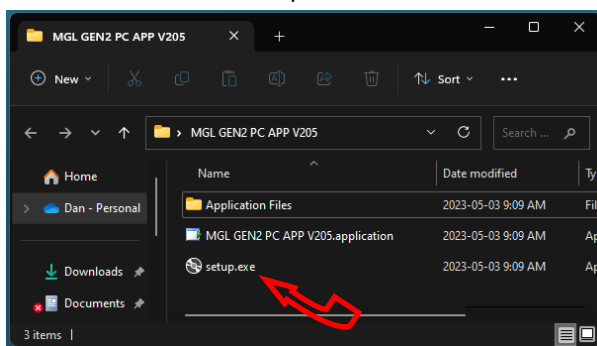
- Then click on the .zip file to open it in a File Explorer window:



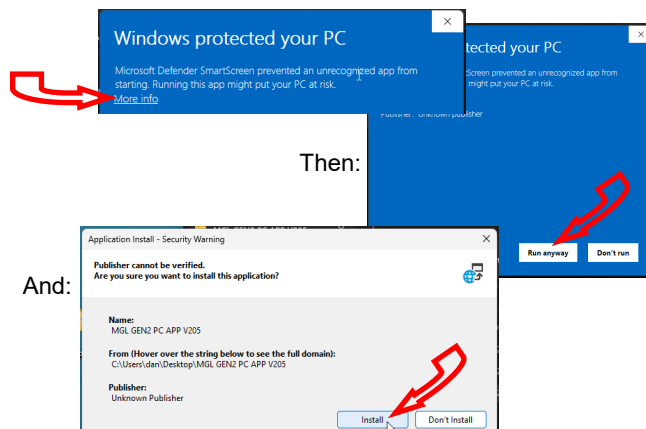
- In the window that is displayed, click and hold down the mouse button on the folder name, and drag to your desktop:



- Double click on the folder you just dragged onto the desktop, then double click on the “setup” file:



- Click “More info”, “Run anyway”, “Install”, or similar on any warning windows which pop up, perhaps more than once.

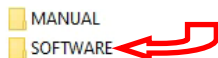


- The PC App will open when it is finished installing. (In the future, it should be started from the start menu.) You are now ready to connect a USB cord between the laptop computer and GEN2 control board, and connect.

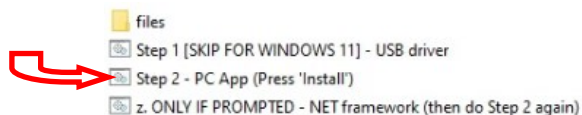
Appendix D - PC App Installation (Windows 10 & earlier)

The PC App allows detailed interfacing with the control board using a Windows laptop computer. These instructions are for **Windows 10 or earlier**. First, install the USB driver as per the previous appendix.

The easiest way to install the PC App is from the **USB drive included with the unit**. Insert the USB stick into a Windows computer, and open a File Explorer window to view its contents:



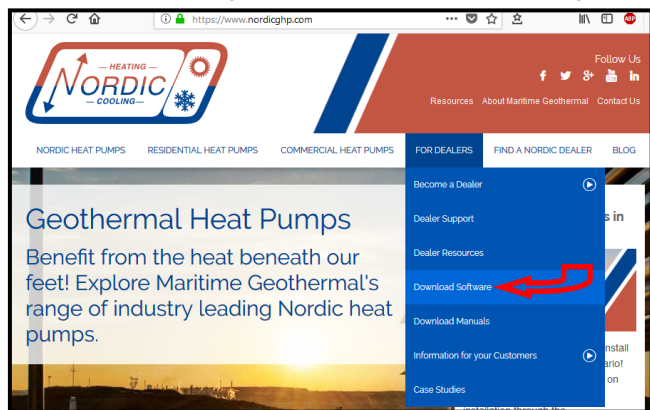
Double click on the **SOFTWARE** folder to show its contents:



Double click on **Step 2** and follow the prompts, clicking “allow” or “yes” as required. If you get a warning that .NET framework is required, go back and double click on step z, then try **Step 2** again.

If the USB stick drive is not available, the same file can be **downloaded from the web page**.

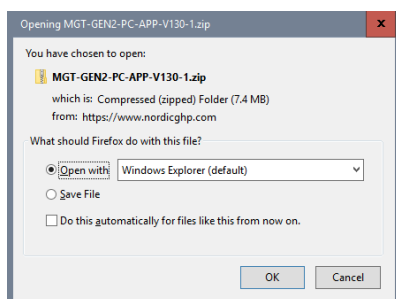
- Go to www.nordicghp.com, Download Software page:



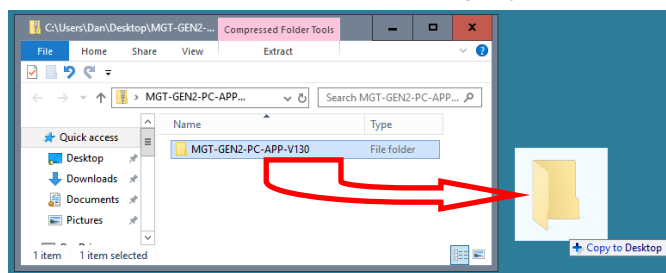
- Click on **MGL GEN2 PC APP V2__** to download it:



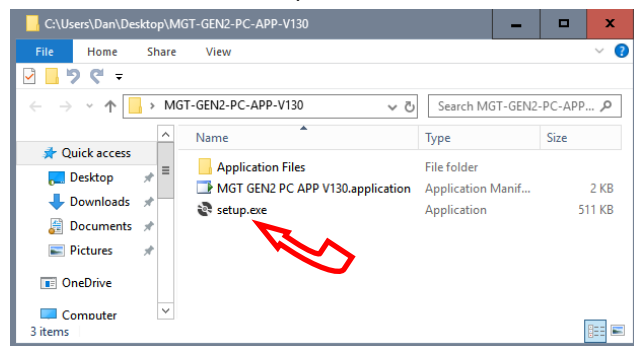
- Choose “Open with Windows Explorer”, and hit “OK”:



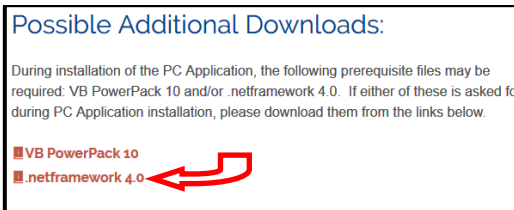
- In the window that is displayed, click and hold down the mouse button on the folder name, and drag to your desktop:



- Double click on the folder you just dragged onto the desktop, then double click on the “setup” file:



- Click “Yes”, “Run”, “Install”, or similar on any warning windows which pop up. If an error message is encountered regarding .NET framework, exit the installation and use the link on the Download Software page to install the missing item:



Then go back to step 5.

- The PC App will open when it is finished installing. You are now ready to connect a USB cord between the laptop computer and GEN2 control board, and connect.

Appendix E: Updating Firmware

METHOD 1: Updating Firmware Using PC App

This method can be used when updating newer control boards with bootloader version 2.0. This method will not work for older control boards with bootloader version 1.0 (approx. unit serial numbers -17 and lower); for those, see **METHOD 2**. Note that **METHOD 2** will work for all control boards.

The firmware comes as a .ZIP file named:

MGL GEN2 Bootload Firmware Vxxx.zip

where xxx is the version reference, e.g. 376 (version 3.76).

This file can be downloaded from www.nordicghp.com, menu *For Dealers --> Download Software*.

- Download the file to your PC. When prompted, "Open" the zip file. If the zip file is *Saved* instead of *Opened*, find it in the web browser's Downloads list or at the bottom of browser window and click on it to open. In the window that comes up, drag the folder containing the required files onto your desktop so that it can be found easily, e.g.:

Desktop\MGL GEN2 Bootload Firmware V376

Also be sure the latest PC App version (e.g. v2.05) is installed, which is listed alongside the firmware on the web page. If needed, install a new version as per those instructions, and uninstall older PC App versions to avoid their accidental use (which can corrupt control board parameters).

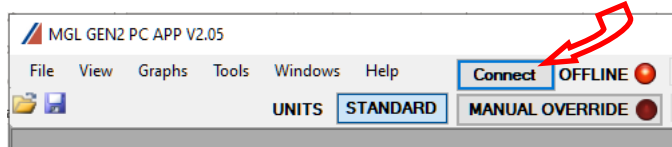
- In that folder on the Desktop, there will be three files:

MGL_GEN2_V376.production.hex	(firmware file)
PIC32UBL.exe	(the programmer)
USB Bootloader Instructions.pdf	(these instructions)

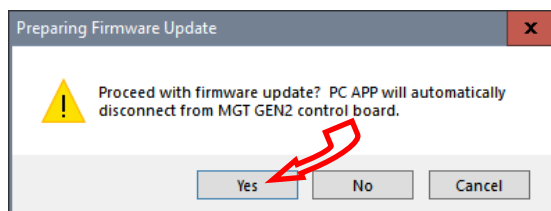
Note that on most computers, the file extensions (.exe, .pdf) will be hidden.

- Connect a USB (printer) cable between computer and control board.
- Launch the PC App version that matches the firmware (e.g. PC App 2.05 for firmware V3.76). After it is installed, the PC App can be started using the entry found under the "M" section in the Windows **START** menu, which is accessed using the 4-rectangles icon normally found at the bottom left corner of the computer screen.

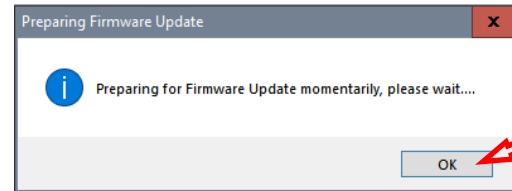
- In the PC App, click on the **Connect** button to connect to the control board.



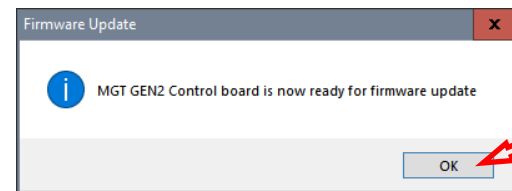
- Go to menu **Tools --> Update Firmware**. The following message box will appear:



- Click on **YES**. The following message box will appear:

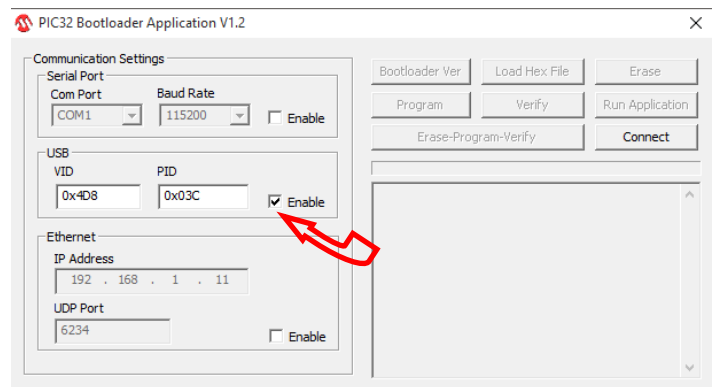


- Click on **OK**. After a minute, the following message box will appear:

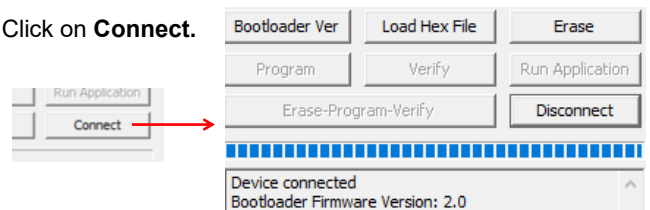


- Click on **OK**. The control board is now in bootloader mode and is ready to be programmed.

- Double click on the downloaded file PIC32UBL.exe to run it. In the window that opens, click on the USB **Enable** check box.

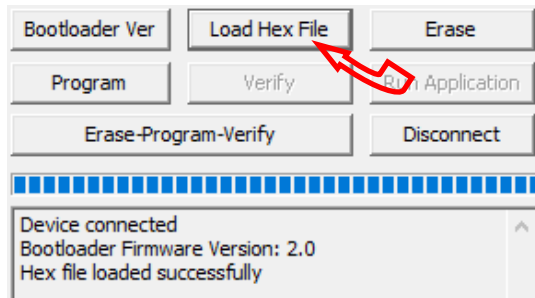


- Click on **Connect**.

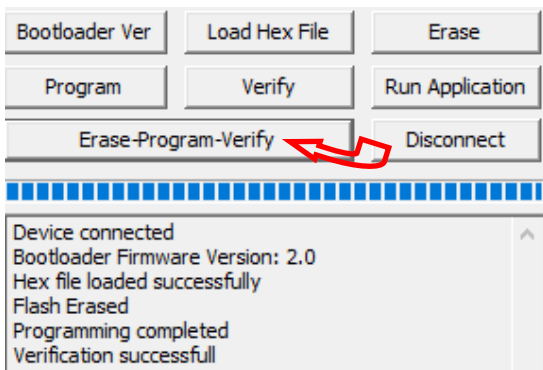


*If device fails to connect and an error message is displayed, the board's bootloader may be older than v2.0. It will be necessary to instead update the firmware via jumper pins (**METHOD 2**), as per the next section.*

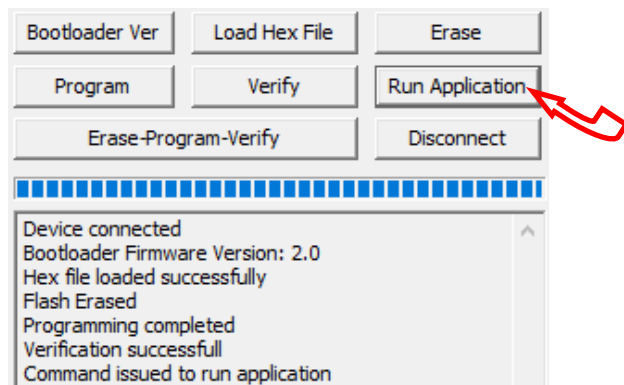
12. Click on **Load Hex File**. Select the **MGL_GEN2_V376.production.hex** (or higher version number) file, which is in the folder you created on the Desktop.



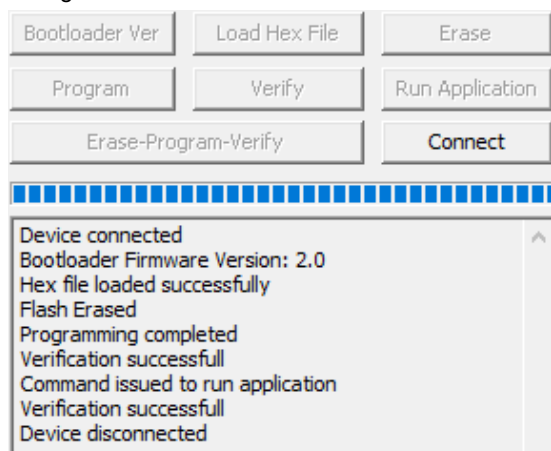
13. Click on **Erase—Program—Verify**. Programming.... Wait while status bar shows progress. The messages should read as below when finished:



11. "Programming completed. Verification successful." Click on **Run Application**. This will take the control board out of bootloader mode and back into normal operational mode, so that the PC App can connect again.



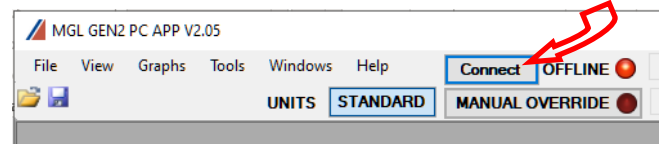
15. Wait until the programmer disconnects itself. The messages should read as follows:



16. Close the PIC32 program.

17. **WAIT APPROXIMATELY 10 SECONDS**. This gives the control board time to reset, initialize and re-connect to the PC USB port.

18. Go back to the PC APP and click on the **Connect** button. Verify that the firmware version, shown in the title bar after connection, has been updated. Perform any configuration needed.



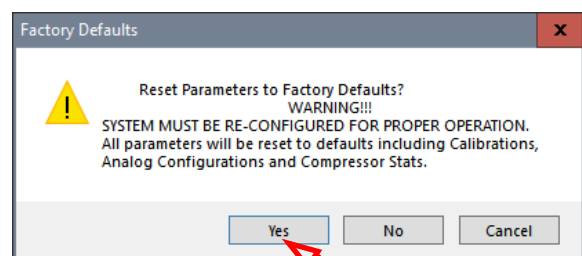
NOTE: Updating the firmware does not affect the configuration settings.

Reset to Defaults?

When updating from **firmware V3.75 or earlier**, the following steps must be taken after the update as there are significant differences in the internal parameters used to operate the system. These steps may also be performed for troubleshooting, when the control system is not acting as it should.

Note that if the firmware on a heat pumps is 2.45 or earlier, chances are that it will have an older bootloader version that requires the use of **METHOD 2** to update the firmware (see following page).

1. With PC App connected, go to menu **Tools --> Configuration** and note all settings. They will need to be re-set later.
2. Go to menu **Tools --> Reset To Factory Defaults**. Click **YES** in the pop up window, and OK in the next window.



3. Go back to menu **Tools --> Configuration**. Re-select the Model Series even if it already indicates the proper series, as clicking on it will load the parameters for that series.
4. Select the Model Size and make any other changes that apply to the particular system setup such as number of stages, control method, etc.

METHOD 2: Updating Firmware Using Jumper Pins

This method should be used when updating older control boards that have bootloader version 1.0, or where the PC App has trouble connecting to older firmware. This method will work for all control boards and can be used on all units.

The firmware comes as a .ZIP file named:

MGL GEN2 Bootload Firmware Vxxx.zip

where xxx is the version reference, e.g. 376 (version 3.76). This file can be downloaded from www.nordicghp.com, menu *For Dealers* --> *Download Software*.

- Download the file to your PC. When prompted, "Open" the zip file. If the zip file is *Saved* instead of *Opened*, find it in the web browser's Downloads list or at the bottom of browser window and click on it to open. In the window that comes up, drag the folder containing the required files onto your desktop so that it can be found easily, e.g.:

Desktop\MGL GEN2 Bootload Firmware V376

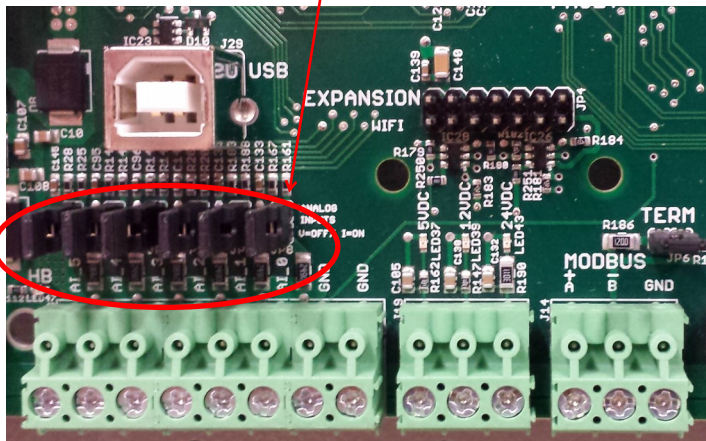
- In that folder on the Desktop, there will be three files:

MGL_GEN2_V376.production.hex	(firmware file)
PIC32UBL.exe	(the programmer)
USB Bootloader Instructions.pdf	(these instructions)

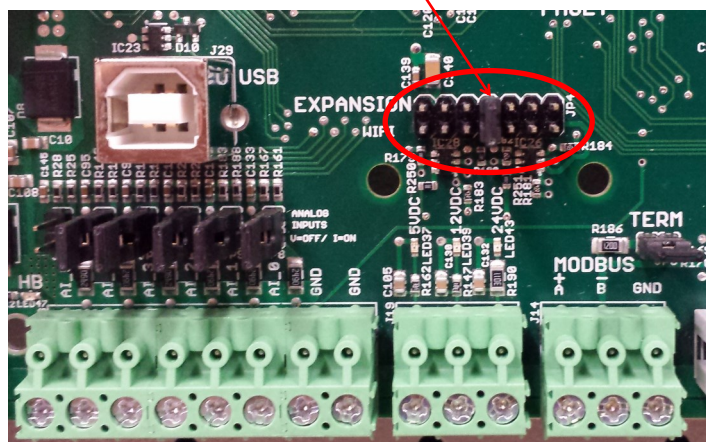
Note that on most computers, the file extensions (.exe, .pdf) will be hidden.

- Connect a USB (printer) cable between computer and control board.
- Turn power off to the heat pump.
- Remove one of the black pin jumpers from just below the USB connector on the board and place in on the center pin pair of the EXPANSION header as shown below.

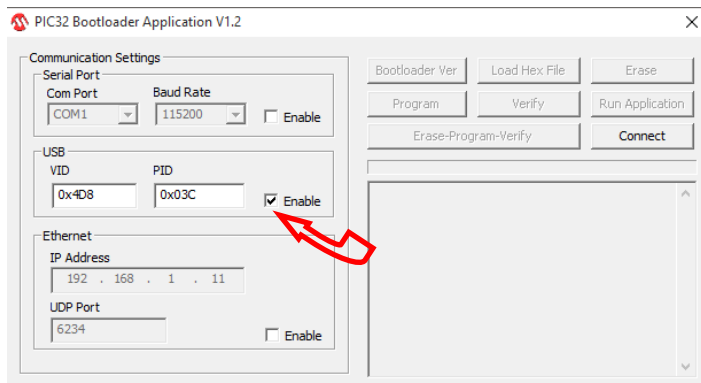
Borrow any one of these jumpers (however many are present)



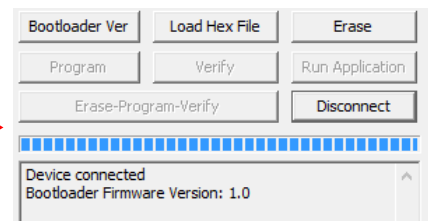
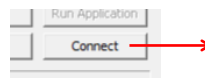
Place jumper here



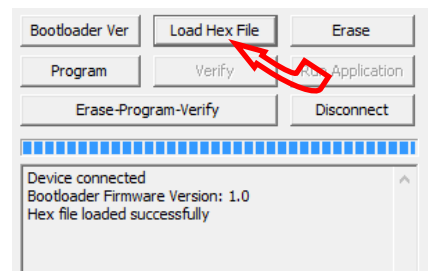
- Turn the power back on. The control board is now in boot loader mode and is ready to be programmed.
- Double click on the downloaded PIC32UBL.exe to run it. In the window that opens, click on the USB **Enable** check box.



- Click on **Connect**.

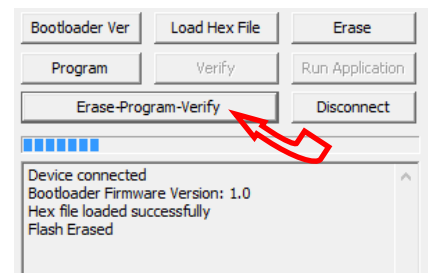


- Click on **Load Hex File**. Select the **MGL_GEN2_V376.production.hex** (or higher version number) file, which is in the folder you created on the Desktop.

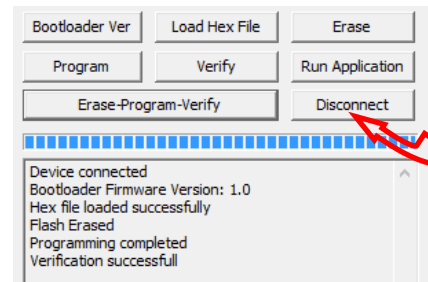


- Click on **Erase—Program—Verify**

Programming...



- "Programming completed. Verification successful." Click on **Disconnect** and close the program.



- Turn power off to the heat pump again.
- Move the jumper back to where it was taken from.
- Turn the power back on. Check that the LCD Display shows e.g. **MGL GEN2 V3.76** on the top line during power up.

Warranty: R/RH-Series

RESIDENTIAL LIMITED EXPRESS WARRANTY

Unless a statement is specifically identified as a warranty, statements made by Maritime Geothermal Ltd. ("MG") or its representatives relating to MG's products, whether oral, written or contained in any sales literature, catalogue or agreement, are not express warranties and do not form a part of the basis of the bargain, but are merely MG's opinion or commendation of MG's products.

SET FORTH HERE IS THE ONLY EXPRESS WARRANTY THAT APPLIES TO MG'S PRODUCTS. MG MAKES NO WARRANTY AGAINST LATENT DEFECTS. MG MAKES NO WARRANTY OF MERCHANTABILITY OF THE GOODS OR OF THE FITNESS OF THE GOODS FOR ANY PARTICULAR PURPOSE.

LIMITED EXPRESS RESIDENTIAL WARRANTY - PARTS

MG warrants its Residential Class products, purchased and retained in the United States of America and Canada, to be free from defects in material and workmanship under normal use and maintenance as follows:

- (1) Air conditioning, heating and/or heat pump units built or sold by MG ("MG Units") for five (5) years from the Warranty Inception Date (as defined below).
- (2) Thermostats, auxiliary electric heaters and geothermal pumping modules built or sold by MG, when installed with MG Units, for five (5) years from the Warranty Inception Date (as defined below).
- (3) Sealed refrigerant circuit components of MG Units (which components only include the compressor, refrigerant to air/water heat exchangers, reversing valve body and refrigerant metering device) for ten (10) years from the Warranty Inception Date (as defined below).
- (4) Other accessories and parts built or sold by MG, when installed and purchased with MG Units, for five (5) years from the date of shipment from MG.
- (5) Other accessories, when purchased separately, for (1) year from the date of shipment from MG.

The "Warranty Inception Date" shall be the date of original unit installation, as per the date on the installation Startup Record; or six (6) months from date of unit shipment from MG, whichever comes first.

To make a claim under this warranty, parts must be returned to MG in Petitediac, New Brunswick, freight prepaid, no later than ninety (90) days after the date of the failure of the part. If MG determines the part to be defective and within MG's Limited Express Residential Warranty, MG shall, when such part has been either replaced or repaired, return such to a factory recognized distributor, dealer or service organization, freight prepaid. The warranty on any part repaired or replaced under warranty expires at the end of the original warranty period.

LIMITED EXPRESS RESIDENTIAL WARRANTY - LABOUR

This Limited Express Residential Labour Warranty shall cover the **labour** incurred by MG authorized service personnel in connection with the installation of a new or repaired warranty part that is covered by this Limited Express Residential Warranty only to the extent specifically set forth in the current **labour** allowance schedule "A" provided by MG's Warranty Department and only as follows:

- (1) MG Units for two (2) years from the Warranty Inception Date.
- (2) Thermostats, auxiliary electric heaters and geothermal pump modules built or sold by MG, when installed with MG Units, for two (2) years from the Warranty Inception Date.
- (3) Sealed refrigerant circuit components of MG Units (which components only include the compressor, refrigerant to air/water heat exchangers, reversing valve body and refrigerant metering device) for five (5) years from the Warranty Inception Date.

Labour costs are not covered by this Limited Express Residential Warranty to the extent they **exceed** the amount allowed under said allowance schedule, they are not specifically provided for in said allowance schedule, they are not the result of work performed by MG authorized service personnel, they are incurred in connection with a part not covered by this Limited Express Residential Warranty, or they are incurred more than the time periods set forth in this paragraph after the Warranty Inception Date.

This warranty does not cover and does not apply to:

- (1) Air filters, fuses, refrigerant, fluids, oil.
- (2) Products relocated after initial installation.
- (3) Any portion or component of any system that is not supplied by MG, regardless of the cause of the failure of such portion or component.
- (4) Products on which the unit identification tags or labels have been removed or defaced.
- (5) Products on which payment to MG, or to the owner's seller or installing contractor, is in default.
- (6) Products subjected to improper or inadequate installation, maintenance, repair, wiring or voltage conditions.
- (7) Products subjected to accident, misuse, negligence, abuse, fire, flood, lightning, unauthorized alteration, misapplication, contaminated or corrosive liquid or air supply, operation at abnormal air or liquid temperatures or flow rates, or opening of the refrigerant circuit by unqualified personnel.
- (8) Mold, fungus or bacteria damage
- (9) Corrosion or abrasion of the product.
- (10) Products supplied by others.
- (11) Products which have been operated in a manner contrary to MG's printed instructions.
- (12) Products which have insufficient performance as a result of improper system design or improper application, installation, or use of MG's products.
- (13) Electricity or fuel, or any increases or unrealized savings in same, for any reason whatsoever.

Except for the limited **labour** allowance coverage set forth above, MG is not responsible for:

- (1) The costs of fluids, refrigerant or system components **supplied by others**, or associated **labour** to repair or replace the same, which is incurred as a result of a defective part covered by MG's Limited Residential Warranty.
- (2) The costs of **labour**, refrigerant, materials or service incurred in diagnosis and removal of the defective part, or in obtaining and replacing the new or repaired part.
- (3) Transportation costs of the defective part from the installation site to MG, or of the return of that part if not covered by MG's Limited Express Residential Warranty.
- (4) The costs of normal maintenance.

This Limited Express Residential Warranty applies to MG Residential Class products manufactured on or after February 15, 2010. MG'S LIABILITY UNDER THE TERMS OF THIS LIMITED WARRANTY SHALL APPLY ONLY TO THE MG UNITS REGISTERED WITH MG THAT BEAR THE MODEL AND SERIAL NUMBERS STATED ON THE INSTALLATION START UP RECORD, AND MG SHALL NOT, IN ANY EVENT, BE LIABLE UNDER THE TERMS OF THIS LIMITED WARRANTY UNLESS THIS INSTALLATION START UP RECORD HAS BEEN ENDORSED BY OWNER & DEALER/INSTALLER AND RECEIVED BY MG LIMITED WITHIN 90 DAYS OF START UP.

Limitation: This Limited Express Residential Warranty is given in lieu of all other warranties. If, notwithstanding the disclaimers contained herein, it is determined that other warranties exist, any such express warranty, including without limitation any express warranties or any implied warranties of fitness for particular purpose and merchantability, shall be limited to the duration of the Limited Express Residential Warranty.

LIMITATION OF REMEDIES

In the event of a breach of the Limited Express Residential Warranty, MG will only be obligated at MG's option to repair the failed part or unit, or to furnish a new or rebuilt part or unit in exchange for the part or unit which has failed. If after written notice to MG's factory in Petitediac, New Brunswick of each defect, malfunction or other failure, and a reasonable number of attempts by MG to correct the defect, malfunction or other failure, and the remedy fails of its essential purpose, MG shall refund the purchase price paid to MG in exchange for the return of the sold good(s). Said refund shall be the maximum liability of MG. **THIS REMEDY IS THE SOLE AND EXCLUSIVE REMEDY OF THE BUYER OR PURCHASER AGAINST MG FOR BREACH OF CONTRACT, FOR THE BREACH OF ANY WARRANTY OR FOR MG'S NEGLIGENCE OR IN STRICT LIABILITY.**

LIMITATION OF LIABILITY

MG shall have no liability for any damages if MG's performance is delayed for any reason or is prevented to any extent by any event such as, but not limited to: any war, civil unrest, government restrictions or restraints, strikes, or work stoppages, fire, flood, accident, shortages of transportation, fuel, material, or labour, acts of God or any other reason beyond the sole control of MG. **MG EXPRESSLY DISCLAIMS AND EXCLUDES ANY LIABILITY FOR CONSEQUENTIAL OR INCIDENTAL DAMAGE IN CONTRACT, FOR BREACH OF ANY EXPRESS OR IMPLIED WARRANTY, OR IN TORT, WHETHER FOR MG'S NEGLIGENCE OR AS STRICT LIABILITY.**

OBTAINING WARRANTY PERFORMANCE

Normally, the dealer or service organization who installed the products will provide warranty performance for the owner. Should the installer be unavailable, contact any MG recognized distributor, dealer or service organization. If assistance is required in obtaining warranty performance, write or call Maritime Geothermal Ltd.

NOTE: Some states or Canadian provinces do not allow limitations on how long an implied warranty lasts, or the limitation or exclusions of consequential or incidental damages, so the foregoing exclusions and limitations may not apply to you. This warranty gives you specific legal rights, and you may also have other rights which vary from state to state and from Canadian province to Canadian province.