Application, Installation, & Service Manual

TF-Series
Triple Function Geothermal Heat Pump (GEN2)

Two-stage R410a
Model Sizes 45-80

ENERGY STAR

AHRI CERTIFIED™ www.ahridirectory.org
Water Source HP
ANSI/AHRI/ASHRAE/ISO13256-1

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SAFETY PRECAUTIONS

WARNING: **Ensure all access panels are in place and properly secured before applying power to the unit. Failure to do so may cause electrical shock.**

WARNING: **Before performing service or maintenance on the system, ensure all power sources are DISCONNECTED. Electrical shock can cause serious personal injury or death.**

WARNING: **Refrigeration systems contain refrigerant under high pressure and as such can be hazardous to work on. Only qualified service personnel should install, repair, or service the heat pump.**

CAUTION: **Safety glasses and work gloves should be worn at all times whenever the system is serviced. A fire extinguisher and proper ventilation should be present whenever brazing is performed.**

CAUTION: **Venting refrigerant to atmosphere is illegal. A proper refrigerant recovery system must be employed whenever repairs require removal of refrigerant from the equipment.**

Model Nomenclature

TF—65—HACW—P—1T—CC—SDERF—xx

Series:
TF = Active Cooling Liquid to Air & Liquid To Water

Nominal Size:
45 = 030 compressor
55 = 040 compressor
65 = 051 compressor
75 = 060 compressor
80 = 067/70 compressor

Functions:
H = Heating
AC = Active Cooling
W = Domestic Hot Water

Refrigerant:
P = R410a

Voltage Code:
1 = 208/230-1-60
2 = 208-3-60
3 = 265/277-1-60
4 = 460-3-60
6 = 220-1-50
7 = 380-3-50

Compressor:
S = 1 Stage Scroll
T = 2 Stage Scroll

Revision:
01, 02 etc.

Fan Outlet Orientation:
F = Field Configurable (top or side)

Fan Return Orientation:
L = Left Return
R = Right Return

Fan Motor:
E = ECM (Variable Speed)

Fan Type:
D = Direct Drive

Air Coil:
S = Standard
K = Coated

Indoor Loop Exchanger:
C = Copper
Y = CuNi coil & piping
Z = CuNi coil only

Outdoor Loop Exchanger:
C = Copper
Y = CuNi coil & piping
Z = CuNi coil only

APPLICATION TABLE														
MODEL	FUNCTION	REFRIGER-ANT	VOLTAGE	COMPRESSOR	OUTDOOR COIL	INDOOR COIL	AIR COIL/ BLOWER/ AIR RETURN	AIR RETURN	AIR OUTLET	REVISIONS			
TF-45	H A C W	P	1 2 4 6 7	T	C Y Z	C Y Z	S D E	L R	F	17			
TF-55	H A C W	P	1 2 4 6 7	T	C Y Z	C Y Z	S D E	L R	F	17			
TF-65	H A C W	P	1 2 4 6 7	T	C Y Z	C Y Z	S D E	L R	F	18			
TF-75	H A C W	P	1 2 4 6 7	T T T S T	C Y Z	C Y Z	S D E	L R	F	18			
TF-80	H A C W	P	1 2 4 7	S	C Y Z	C Y Z	S D E	L R	F	18			
This manual applies only to the models and revisions listed in this table.													

APPLICATION TABLE - FIRMWARE AND PC APP			
Firmware	Version	Associated PC APP	Version
MGT GEN2 Bootload Firmware	V3.60+	MGT GEN2 PC APP	V2.00+

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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TF System Description

General Overview

The Nordic TF-series, a unique product with a more than 20-year history of reliable operation, is a package water source heat pump that can heat or cool via a ducted forced air system, as well as heat water for hydronic applications like in-floor heating. It is the ground-source or geothermal version of the air source Nordic ATF-series.

Being a water source, 'geoexchange', or 'geothermal' heat pump, the TF-series does require either a **closed ground loop** or **open loop water well** for a heat source/sink.

The ducted air heating and cooling functions are controlled by a standard 3H/2C 24V room thermostat. The duct system can be zoned, but only to limited extent (see **Wiring** and **Ductwork** chapters).

The hydronic heating control is done by an internal routine that maintains the buffer tank temperature, without external sensors ('Setpoint Control'). BACnet or an accessory external aquastat can also be used.

In additional to the main hydronic water heating function, 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.

The indoor and outdoor loop hydronic heat exchangers are both heavy duty coaxial copper / steel models with optional Cu-Ni inner tube available. Most model sizes have modulation capability through the use of 2-stage compressors, for closer load matching and to reduce cycling. An Electronic Expansion Valve (EEV) is standard, for more precise superheat and system optimization than is possible with a TXV. Control is overseen by the Nordic GEN2 programmable control board, which has many advanced features like laptop connectivity via the free PC App software, data logging & graphing, and real time readout from electronic temperature & pressure sensors. A constant airflow electronically commutated (ECM) blower motor with adjustable airflow is standard. The cabinet is powder coated galvanized sheet metal.

1. Air Heating Mode

In air heating mode, the heat pump heats warm air in a duct system when heat is called for by the ducted air thermostat. Heat is extracted from the outdoor loop.

If a closed ground loop is used, the 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. Hydronic (Water) Heating Mode

In hydronic heating mode, the heat pump heats water in a buffer tank to a user-adjustable setpoint temperature, while extracting heat from the outdoor loop. A buffer tank is required, in order to maintain control over the water temperature and avoid mismatching between the heat pump's output and the heat load. An internal sampling routine and built-in temperature sensors determine when the buffer tank temperature has fallen below the user-adjustable setpoint and hydronic heating is required.

If a closed ground loop is used, the 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.

Hydronic heating systems are easily zoned, and zones may be in-floor heating, hydronic air handlers, or other hydronic devices suitable for water temperatures less than 120°F (49°C). When a zone requires heat, its zone thermostat calls for a zone circulator pump or zone valve to activate, so that hot water from the buffer tank is sent to the zone requiring heat. Note that there is no direct connection between the zone thermostat and the heat pump, the functions of each being separated by the buffer tank.

3. Air Cooling Mode

In air cooling mode, the heat pump cools air through the duct system when cooling is called for by the ducted air thermostat. Heat is rejected to the outdoor loop.

Mode and Priority Selection

The heat pump can be set to Air or Hydronic priority. Units are shipped set up for air priority. This is normally a good setting, since drops in the household air temperature normally occur sooner if there is a lag in the ducted air system than if there is a drop in the hydronic water temperature.

Whenever there is a stage 1 demand from both the air thermostat and aquastat, the unit steps up to stage 2 of the priority mode in order to satisfy the priority demand quickly and get to the non-priority mode. If this functionality was not present, the unit could run in stage 1 of the priority mode (67% compressor capacity) for a long time with a 'call waiting', allowing the overall supply of heat to the building to fall behind the load.

SINGLE MODE OPERATION:

If there is only one mode being called for, the unit operates in the mode and stage that is called for.

SIMULTANEOUS DEMANDS - AIR PRIORITY:

If there is a call for:

- both stage 1 air heat/cool and stage 1 hydronic heat
- both stage 2 air heat/cool and stage 1 hydronic heat
- both stage 1 air heat/cool and stage 2 hydronic heat
- both stage 2 air heat/cool and stage 2 hydronic heat

The unit operates in **air heating/cooling mode in stage 2**.

SIMULTANEOUS DEMANDS - HYDRONIC PRIORITY:

If there is a call for:

- both stage 1 air heat/cool and stage 1 hydronic heat
- both stage 2 air heat/cool and stage 1 hydronic heat
- both stage 1 air heat/cool and stage 2 hydronic heat
- both stage 2 air heat/cool and stage 2 hydronic heat

The unit operates in **hydronic heating mode in stage 2**.

Auxiliary Air Heat

While TF is operating in any mode, auxiliary heat (normally an electric plenum heater) will also be engaged if the air temperature drops below the air heat auxiliary (stage 3) setpoint as called for by the ducted air thermostat. Although a plenum heater is not required for geothermal heat pumps that are sized to 100% of the coldest day heat load, it is a good idea to have one installed.

The first function of the plenum heater is to act as an auxiliary heat source for the ducted air system. It will provide additional air heating on the coldest days, should the geothermal heat pump be sized to less than 100% of the heat load (intentionally or not).

The second function of the plenum heater is to provide emergency heat should a problem occur that causes the heat pump to be locked out on a safety control. The control board's emergency heat circuitry allows the thermostat to call for backup heat even if the heat pump is locked out on an alarm or the control board is not operational.

Electric plenum heaters are available as accessories. See the **Sizing**, **Wiring**, and **Ductwork** sections. These heaters are normally installed inside the TF unit, unless the fan is installed in the side discharge position, in which case it is installed the air discharge ductwork outside the heat pump.

Auxiliary Hydronic Heat

If the heating system is fully backed up through the ducted air system, hydronic backup heat may not be required. If required, the easiest way to provide hydronic backup is with electric elements in the buffer tank. Buffer tanks with larger elements certified for space heating use are available as factory accessories. Other tanks/elements or other types of devices may be used.

Hydronic backup heat is controlled as stage 3 by the internal buffer tank temperature sampling routine mentioned previously, through a 24VAC signal or dry contacts to the external device. See details in following sections.

Factory Options

Looking at the front of the heat pump (the side where piping connections and electrical box are), the unit 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.

Air Outlet Orientation

The unit can be changed from top to side air discharge in the field, so no factory specification is required. See **Installation Basics** section.

TF-Series Sizing

Heat Pump Sizing

The following table is a rough guideline as to the size of home 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***
45	**1400**	***130***
55	**2000**	***185***
65	**2600**	***240***
75	**3100**	***290***
80	**3500**	***325***

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***
45	**1800**	***165***
55	**2500**	***230***
65	**3200**	***295***
75	**3800**	***355***
80	**4200**	***390***

THE TABLES ABOVE ARE FOR INFORMATION ONLY. THEY SHOULD NOT BE USED TO SELECT A UNIT SIZE. They simply show on average what size unit is required for a *typical* two-level home (main level and below grade basement) with R-20 walls, R-40 ceiling and average size and number of windows. The Heated Area is the area of the main level. The tables account for a basement the same size as the heated area.

IT IS HIGHLY RECOMMENDED THAT A PROPER HEAT LOSS/GAIN ANALYSIS BE PERFORMED BY A PROFESSIONAL WITH APPROVED CSA F-280 SOFTWARE BEFORE SELECTING THE SIZE OF UNIT REQUIRED FOR THE APPLICATION. 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 be selected by comparing the calculated heat load to the standard capacity ratings, which are listed in the Model Specific Information section of this manual. For 100% heat pump sizing, choose a heat pump with a standard capacity rating that matches or just slightly exceeds the calculated heat load.

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.

The Standard Capacity Ratings for Ground Water (open loop) heat pumps assume a well water temperature of 50F (10C). If the groundwater is not close to this temperature, it will be necessary to consult the more detailed performance tables later in the section 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.**

Note that the 'triple function' nature of the heat pump has no effect on sizing procedure; it should still be sized for the total load according to the above procedure.

Plenum Heater Sizing

Plenum heaters are available as factory accessories in 5, 7, 10, 15 and 20kW sizes. For full backup, 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)**	
	Recommended	**Internally Possible**
45	**10**	**5, 7, 10**
55	**10**	**5, 7, 10, 15, 20**
65	**15**	**5, 7, 10, 15, 20**
75	**20**	**5, 7, 10, 15, 20**
80	**20**	**5, 7, 10, 15, 20**

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

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

Installation Basics

Sample Bill of Materials - Ground Loop Installations

Although not exhaustive, following is a list of materials needed for a typical ground loop installation:

FROM MARITIME GEOTHERMAL
- TF SERIES HEAT PUMP (L OR R RETURN)
- PLENUM HEATER __kW
- BUFFER TANK, WITH __kW ELEMENTS
- 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 FOR UNDER UNIT
- SOUND JACKET
- SECURE START
- ELECTROSTATIC FILTER
- AQUASTAT (IF NOT USING SETPOINT CONTROL)

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

HYDRONIC ZONES
- CIRCULATOR PUMP: HEAT PUMP TO TANK
- ZONES CIRCULATOR PUMP(S)
- ZONE TRANSFORMER & CIRC CONTACTOR
- ZONE VALVES (IF NOT INDIVIDUAL PUMPS)
- IN-FLOOR PIPING
- ZONE THERMOSTATS
- ZONE SUPPLY & RETURN HEADERS
- PIPE, FITTINGS, TAPS, BALL VALVES
- EXPANSION TANK

DHW
- PREHEAT TANK, 40 OR 60 GAL
- ½" COPPER PIPE
- ½" FITTINGS, BALL VALVES, BOILER DRAINS, CV

GROUND LOOP
- ¾" PE PIPE
- 1-1/4" PE PIPE
- PE PIPE FITTINGS
- 1" CLEAR / PVC SPA HOSE (HEAT PUMP - PUMP PACK)
- HYDRAULIC HOSE CLAMPS
- ANTIFREEZE: METHANOL OR PROP. GLYCOL

ELECTRICAL
- HEAT PUMP SERVICE WIRE: 6-3 OR 8-3
- PLENUM HEATER SERVICE WIRE
- BUFFER TANK ELEMENT SERVICE WIRE (IF REQ'D)
- HEAT PUMP BREAKER
- PLENUM HEATER / TANK ELEMENT BREAKER
- THERMOSTAT WIRE 18-8
- THERMOSTAT WIRE 18-4 (AQUASTAT)
- THERMOSTAT WIRE 18-2 (PLENUM HEATER)
- FORK TERMINALS FOR TSTAT WIRE
- CONDENSATE PUMP & HOSE (IF REQUIRED)

- 2" STYROFOAM INSUL. (IF PAD NOT PURCHASED)

Sample Bill of Materials - Open Loop Installations

Although not exhaustive, following is a list of materials needed for a typical open loop (groundwater) installation:

FROM MARITIME GEOTHERMAL
- TF SERIES HEAT PUMP (L OR R RETURN)
- PLENUM HEATER __kW
- BUFFER TANK, WITH __kW ELEMENTS
- THERMOSTAT (WIFI OR STD)
- P/T PORTS AND HOSE ADAPTERS (2)
- DOLE VALVE
- MOTORIZED WATER VALVE

OPTIONAL FROM MARITIME GEOTHERMAL
- ANTI-VIBRATION PAD FOR UNDER UNIT
- SOUND JACKET
- SECURE START
- ELECTROSTATIC FILTER
- AQUASTAT (IF NOT USING SETPOINT CONTROL)

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

HYDRONIC ZONES
- CIRCULATOR PUMP: HEAT PUMP TO TANK
- ZONES CIRCULATOR PUMPS(S)
- ZONE TRANSFORMER & CIRC CONTACTOR
- ZONE VALVES (IF NOT INDIVIDUAL PUMPS)
- IN-FLOOR PIPING
- ZONE THERMOSTATS
- ZONE SUPPLY & RETURN HEADERS
- PIPE, FITTINGS, TAPS, BALL VALVES
- EXPANSION TANK

DHW
- PREHEAT TANK, 40 OR 60 GAL
- ½" COPPER PIPE
- ½" FITTINGS, BALL VALVES, BOILER DRAINS, CV

WATER SYSTEM
- 1" BLACK PLASTIC WATER PIPE
- 1" BARBED FITTINGS & HYD. HOSE CLAMPS
- SUBMERSIBLE PUMP (IF NOT EXISTING)
- PRESSURE TANK (IF NOT EXISTING)
- CYCLE STOP VALVE (OPTIONAL)

ELECTRICAL
- HEAT PUMP SERVICE WIRE: 6-3 OR 8-3
- PLENUM HEATER SERVICE WIRE
- BUFFER TANK ELEMENT SERVICE WIRE (IF REQ'D)
- HEAT PUMP BREAKER
- PLENUM HEATER / TANK ELEMENT BREAKER
- THERMOSTAT WIRE 18-8
- THERMOSTAT WIRE 18-4 (AQUASTAT)
- THERMOSTAT WIRE 18-2 (PLENUM HEATER)
- FORK TERMINALS FOR TSTAT WIRE
- CONDENSATE PUMP & HOSE (IF REQUIRED)

- 2" STYROFOAM INSUL. (IF PAD NOT PURCHASED)

Unpacking the Unit

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

Unit Placement

Ducted or forced air heat pumps should be centrally located in the home with respect to the conditioned space. This provides the best in economy and comfort and usually can be accomplished in harmony with the design of the home. A heating system cannot be expected to produce an even warmth throughout the household 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 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. No access is required on the back side. 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.

Raising the indoor unit off the floor a few inches is generally a good practice since this will prevent rusting of the bottom panel of the unit and deaden vibrations. An anti-vibration pad, available as an accessory, or a piece of 2" styrofoam should be placed under the unit.

Air Return Orientation

The heat pump can be ordered as left or right 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.

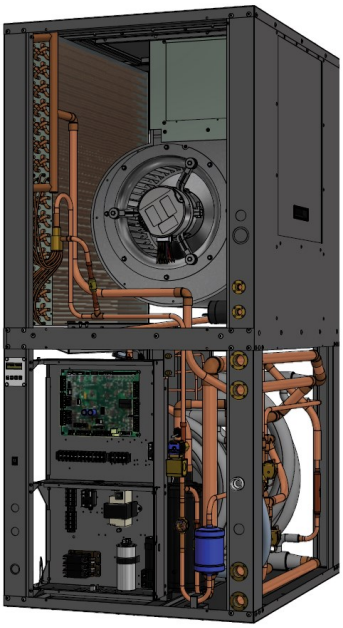
LEFT RETURN *RIGHT RETURN*

Air Outlet Orientation

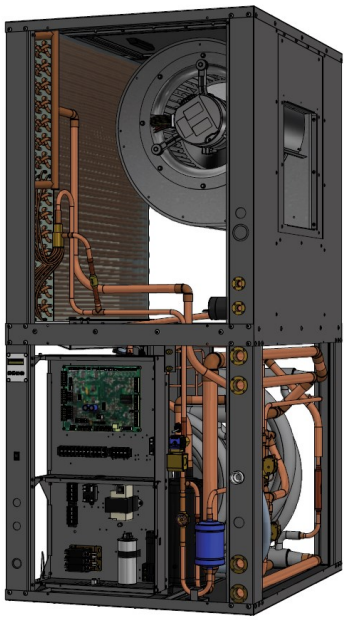
The unit has a field configurable blower position, resulting in top or side air discharge. Its default location from the factory is in the top of the unit, providing a "ninety" in the airflow. It can easily be placed in the side of the unit for straight through airflow. Note that if this is done, plenum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

To switch the location of the fan outlet:

1. Turn the power of to the unit.
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 wire harnesses and ground wire from the fan motor.
4. Repeat step 2 for the access panel with the fan mounted in it. Set the assembly on the floor.
5. Disconnect the plenum heater extension from the fan housing and from the access panel.
6. Mount the fan housing directly to the access panel.
7. Install the fan/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.



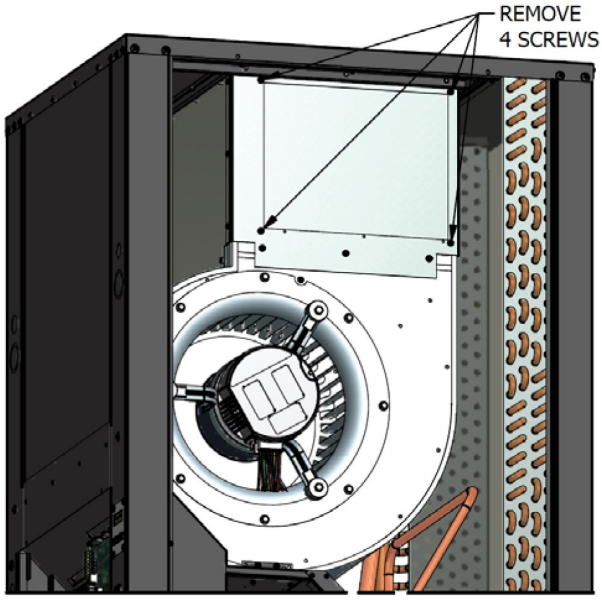
BLOWER IN TOP DISCHARGE POSITION (DEFAULT)



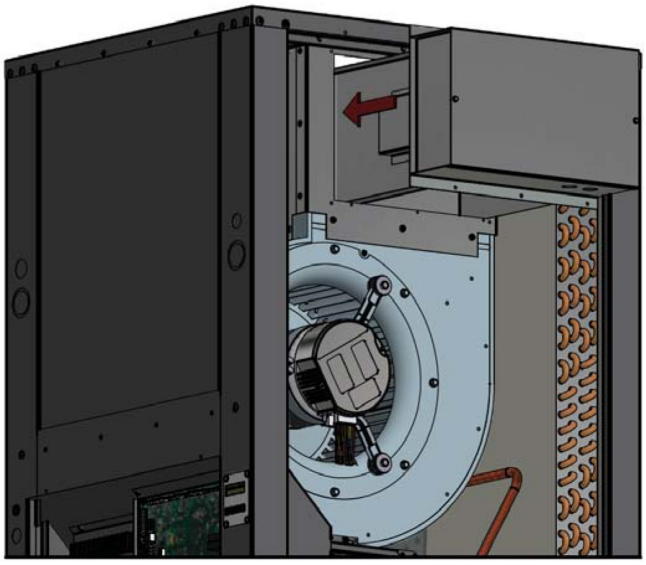
BLOWER IN SIDE DISCHARGE POSITION

Internal Plenum Heater Installation
R, TF, ATA, ATF, DX, DXTF Series

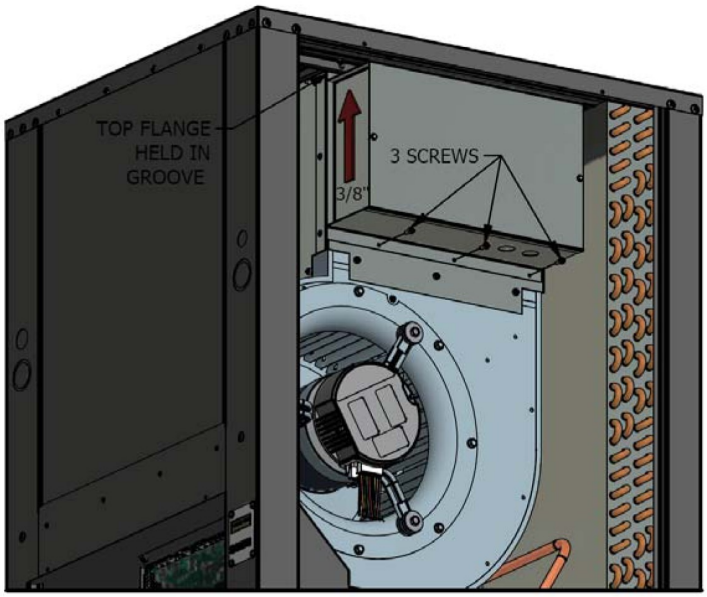
1. Remove four screws as shown, and remove blank panel.



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.



01	Initial Release	Dan Rheault	Dan Rheault	9-Jan-2015
REV	ECO#	IMPL BY	APVD BY	DATE

Drawn By: Dan Rheault	Date: 9-Jan-2015	
Checked By: Dan Rheault	Date: 9-Jan-2015	
Eng. Approved By	Date	
Mfg. Approved By	Date	
Approved By	Date	

MARITIME GEOTHERMAL LTD.
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Drawing Name: **Internal Plenum Heater Installation**

Size	Drawing Number	Revision	Sheet
LET	001915INF	01	1 / 1

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, optional aquastat, and indoor / 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** section of this manual. The Electrical Tables in the **Model Specific Information** section contain information about the wire and breaker

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, 380-3-50 (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** section 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.	

Indoor Loop Circulator Pump Wiring

There are provisions for connecting the indoor circulator pump (between the heat pump and buffer tank) so that it will be turned on whenever the compressor operates, or when sampling water temperature. Connect the circulator pump to the appropriate two terminals (115V or 230V) of the terminal strip marked **Indoor Circulators**, as per the voltage of the circulator pump. 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 **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 ICR terminal on the left side of the control board and the C (24V ground) terminal.

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 **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 bottom side of the control board and the C (24V ground) terminal.

TABLE 6 - Indoor & Outdoor Circulator Connections	
Terminal	**Description**
115V	**Connection for 115V circulator**
115V	
230V	**Connection for 230V circulator**
230V	
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, locate and correct the problem and then reset the breaker by pressing in on 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**
(6) 220-1-50	**Primary / Secondary fuses**
(7) 380-3-50	**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** section for details.

TABLE 8 - BACnet Connections	
Line	**Description**
A	**Communication +**
B	**Communication -**
GND	**Ground**
Use a shielded twisted pair cable.	

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 the main wiring diagram in the **Model Specific Information** section.

Setpoint Control (Hydronic Control) Connections

If using the on-board Setpoint Control routine with sampling to control buffer tank temperature, no external temperature probe or aquastat is required.

Note that an external buffer tank temperature sensor may be used to replace the internal water OUT line temperature sensor for use with the Setpoint Control routine. This is called **External HTS/CTS** Setpoint Control.

See **Operation** chapter for details.

Setpoint Control: Aux. Connections

When using Setpoint Control, there are 2 methods for activating hydronic auxiliary heat. See diagram on following page.

First, a dry contact on terminals **D1** and **D2** is available, to actuate a heating device that has its own temperature controller and transformer. Connection will be made to that device's **E-E** terminals or similar. **D1-D2** defaults to **ON** when heat pump is powered off. Therefore, it is necessary to set the temperature control on the external heating device to a limiting value, e.g. 125°F, and adjust its settings so it is only activated by the heat pump's controller. **This method should be used for the Thermo2000 AltSource tank that is available from Maritime Geothermal as an accessory;** see the setup instruction sheet that comes with tank and on a following page.

Second, a 24VAC signal can be used to power the coil of an external contactor to operate auxiliary heat. Choose this method if using a heating device that doesn't have its own electronic controller or control transformer, e.g. a bare heating element in the buffer tank. As per the diagram on the following page, connect a jumper between **R** and **D1** on the terminal strip, and use **D2** and **CD** to power the coil of the external contactor. Under this method, the auxiliary heat also defaults to ON (as long as the heat pump is powered ON to provide 24VAC), so the tank's temperature limiter must remain in operation.

Both D1-D2 and D2-CD default to ON and so must be used with an auxiliary heating device that has a HIGH TEMPERATURE LIMITER to avoid a serious safety hazard.

If it is not desired to have **D1-D2** default to **ON** when heat pump is powered off, make the following wiring changes in the heat pump's electrical box, while referring to the **Wiring/ Schematic** diagram in the **Model Specific Information** chapter.

- Find the light brown wire connected between terminal strip terminal **D1** and the **Elec. Aux. Relay**. Move it from pin **5** to pin **2** of the relay.
- Find the purple wire connected between the left side of the control board and the **Elec. Aux. Relay**. Move if from terminal **L4** (NOT_HYD_AUX) to **DO_2** (HYD_AUX) on the control board.

Now D1-D2 will work as before, but will default to OFF when heat pump is off.

TABLE 9 - Setpoint Control: Aux. Connections	
Signal	**Description**
D1	**Hydronic Auxiliary dry contacts**
D2	
R	**Jumper R and D1**
D1	
D2	**24vac to actuate aux. heat contactor coil**
CD	**Contactor coil ground**
Use a 2-conductor 18ga cable.	

Non-GEN2 Hydronic Backup Wiring

If not using Setpoint Control, backup device may use its own controls, provided they are accurate (i.e. devices with a digital controller). Setpoint should be set lower than stage 2.

Or stage 2 of the aquastat in conjunction with a delay timer may be used.

Air Thermostat Connections

A three-stage heating and two stage cooling heat pump configurable thermostat is required. 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 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 10 - 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)
AR	**Airflow reduction:** connect AR_1 to AR_2 with a dry contact to reduce the airflow for zoning. Connections located on control board.
24VAC	

Aquastat Connections (Optional)

Most installations will use the internal ***Setpoint Control*** routine to control buffer tank temperature, in which case no aquastat is required. However, an aquastat or aquastats can be used if required, for example if heating two loops with different setpoint temperatures. This is called ***Signals Control***.

The wiring connections are at the top right of the TF's control board, on the screw terminal connector section marked **AQUASTAT**. This is shown on the wiring (SCH) diagram in the Model Specific Information section. The external device needs to send the 24VAC signal from **RA** back to the **Y1A** and **Y2A** terminals to call for the two stages of hydronic heating. **C** or **CA** is the common or ground terminal for powering the external device.

TABLE 11 - Aquastat (Signals Control) Connections

Signal	Description
C/CA	24VAC common (ground)
R/RA	24VAC hot
Y1A	Compressor ON (part load)
Y2A	Compressor bump up to stage 2 (full load)

Open/Closed Loop Wiring

There are two low pressure safety controls 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 LPC, and ensure that the heat pump is properly protected from freezing. It will also ensure the water valve is open before starting the compressor. See wiring diagram for water valve wiring.

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.

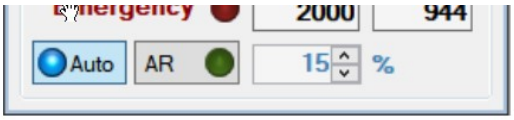
After the desuperheater is filled with water and purged of air, activate the built-in DHW circulator by connecting the brown wire with the blue insulated terminal to L1 of the compressor contactor as shown on the wiring diagram in the Model Specific Information section. **Ensure the power is off when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

Airflow Reduction for Zoning

For zoning purposes on the air heating/cooling side, 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.

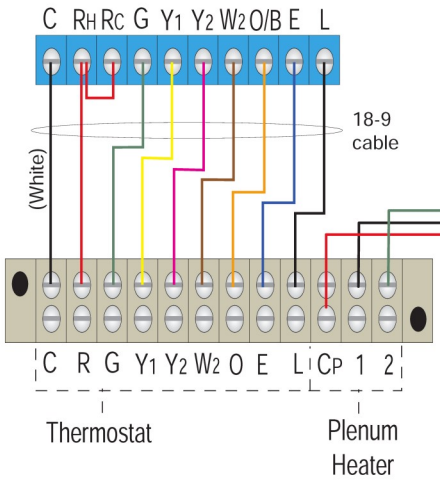
For more zoning advice, see Ductwork chapter.



Typical Thermostat Connections to GEN2 Control Board

Two-Stage Models (Compressor Stages = T)

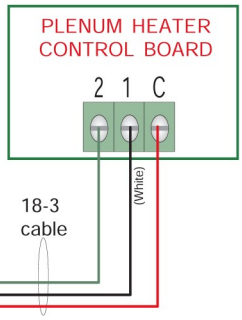
Typical 3 stage heat
2 stage cool
Heat Pump Thermostat



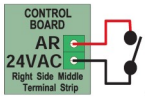
CONNECTION DESCRIPTION:

C	- 24VAC Common
R	- 24VAC Hot
G	- Fan
Y1	- Stage 1 Heat/Cool (Compressor)
Y2	- Stage 2 Heat/Cool (Compressor S2 solenoid coil)
W2	- Stage 3 Heat (Plenum Heater)
O	- Reversing Valve (Cooling)
E	- Emergency Heat
L	- Compressor Lock-out Light

NOTE: Configure O/B for energized in cooling.



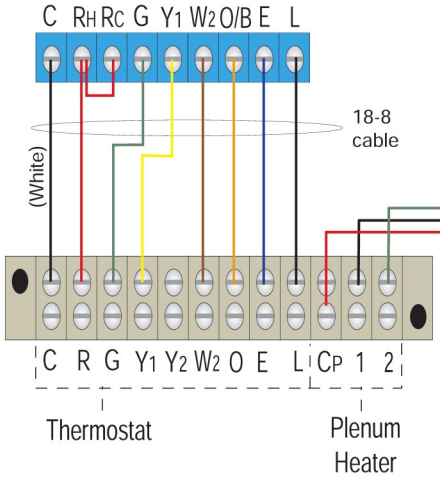
Note: If only using as single stage then only an 18-2 cable is required, place a jumper wire between 2 and 1 of the plenum heater terminals.



Note: Connect 24VAC amd AR together with a dry contact to invoke the airflow reduction function. Refer to the manual for more information.

Single-Stage Models (Compressor Stages = S)

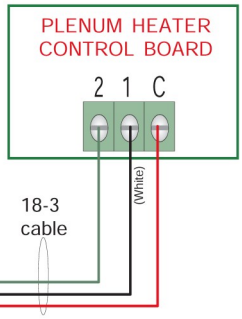
Typical 2 stage heat
1 stage cool
Heat Pump Thermostat



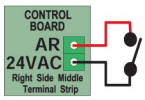
CONNECTION DESCRIPTION:

C	- 24VAC Common
R	- 24VAC Hot
G	- Fan
Y1	- Stage 1 Heat/Cool (Compressor)
W2	- Stage 3 Heat (Plenum Heater)
O	- Reversing Valve (Cooling)
E	- Emergency Heat
L	- Compressor Lock-out Light

NOTE: Configure O/B for energized in cooling.



Note: If only using as single stage then only an 18-2 cable is required, place a jumper wire between 2 and 1 of the plenum heater terminals.



Note: Connect 24VAC amd AR together with a dry contact to invoke the airflow reduction function. Refer to the manual for more information.

REV	ECO #	IMPL BY	APVD BY	DATE
01	Initial Release	C. GEDDES	C. GEDDES	21 APR 2016

Drawn By: Chris Geddes	Date: 21 APR 2016	
Checked By: Chris Geddes	Date: 21 APR 2016	
Approved By (ENG): Chris Geddes	Date: 21 APR 2016	
Approved By (MFG):	Date:	
Approved By:	Date:	

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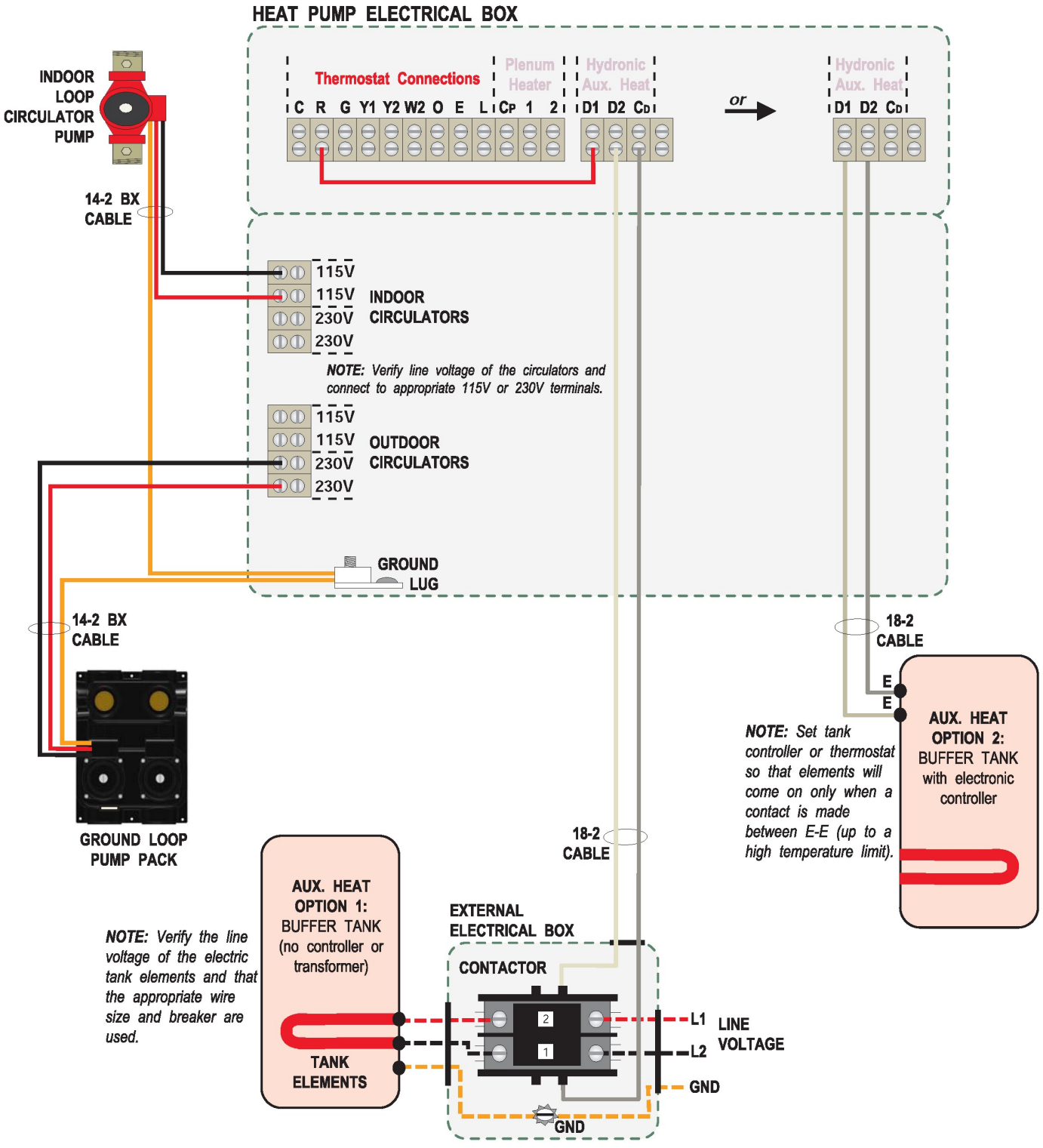
E4Z 6H4

Drawing Name: Typical Thermostat Connections to GEN2 Control Board

Size	Drawing Number	Drawing Rev	SHEET
A	002071CDG	01	1 of 1

Typical TF Series Auxiliary Heat and Circulator Wiring



REV	ECO #	IMPL BY	APVD BY	DATE
02	000308	Dan Rheault	Dan Rheault	23-Jan-2023
01	Initial Release	Dan Rheault	Dan Rheault	15-Jan-2019

Drawn By: Dan Rheault	Date: 15-Jan-2019	MARITIME GEOTHERMAL LTD. 170 Plantation Rd. Petitcodiac, NB E4Z 6H4
Checked By: Dan Rheault	Date: 15-Jan-2019	Drawing Name: Typical TF Auxiliary Heat and Circulator Wiring
Approved By (ENG)	Date	
Approved By (MFG)	Date	
Approved By	Date	

Size	Drawing Number	Drawing Rev	Sheet
A	002374CDG	02	1 of 1

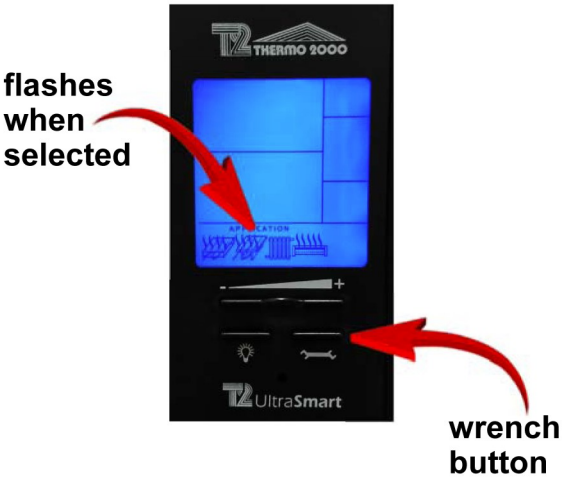
AltSource Tanks: Getting Started

A full product manual from Thermo2000 is included with the AltSource tank.
This sheet describes how to set the tank to work in conjunction with ***NORDIC*** heat pumps that are equipped with **D1-D2** terminals. *(Some W-series models may not have D1-D2 terminals; in this case the tank can instead be set up run under its own control with a setpoint lower than that of the heat pump.)*

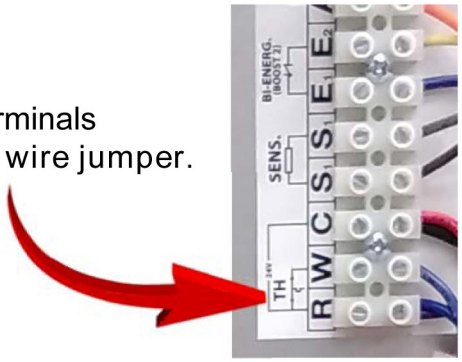
1. Put the tank in “Bi-Energy” rather than “Electric” mode, with switch on back of controller.

2. Set the tank to “joist heat” mode by holding the **wrench** button to display the **°F/°C** setting, press again to go to heating types, then toggle to second setting which is a picture of joists. Press wrench button three more times to exit.

(This doesn’t mean that joist heating is being done, it just sets a 125°F high temperature limit that works well with standard temperature range heat pumps.)



3. Connect tank terminals **R** and **W** with a wire jumper.



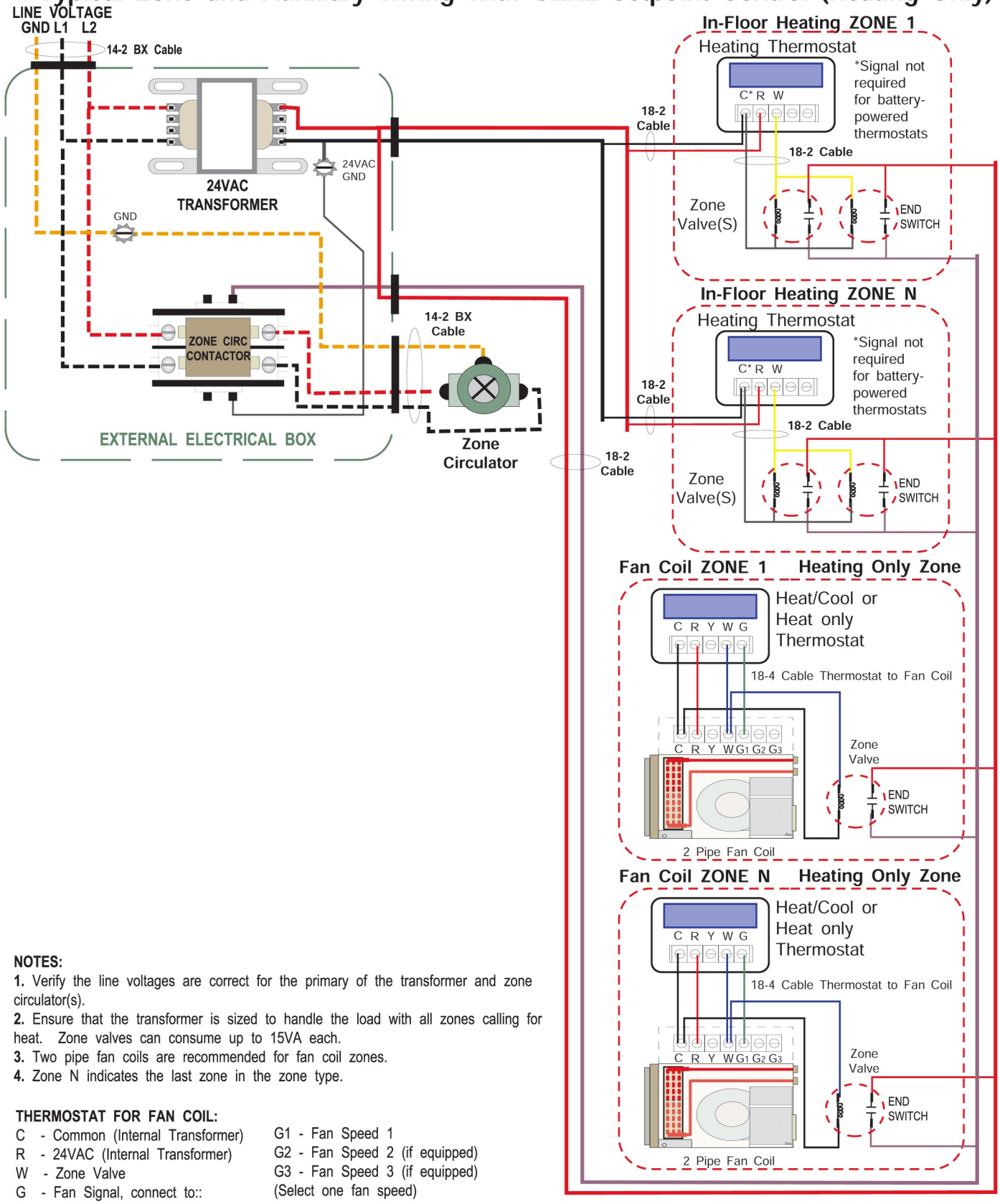
4. Now the tank elements will only be activated by a connection between the E_1-E_2 tank terminals, up to the 125°F maximum. This will be done by an 18-2 wire to the **D1-D2** terminals in the heat pump, activating the elements only when ***AUX*** heat is required.

See heat pump manual for further explanation.

With E_1 and E_2 *disconnected* (not connected by the heat pump’s **D1-D2** terminals), the tank’s screen will look like this.

With E_1 and E_2 *connected* by the heat pump, a temperature setpoint of **125°F** corresponding to “joist heat” will appear. This is fine for a high limit.

Typical Zone and Auxiliary Wiring With GEN2 Setpoint Control (Heating Only)



NOTES:

1. Verify the line voltages are correct for the primary of the transformer and zone circulator(s).

2. Ensure that the transformer is sized to handle the load with all zones calling for heat. Zone valves can consume up to 15VA each.

3. Two pipe fan coils are recommended for fan coil zones.

4. Zone N indicates the last zone in the zone type.

THERMOSTAT FOR FAN COIL:

C - Common (Internal Transformer)
R - 24VAC (Internal Transformer)
W - Zone Valve
G - Fan Signal, connect to::

G1 - Fan Speed 1
G2 - Fan Speed 2 (if equipped)
G3 - Fan Speed 3 (if equipped)
(Select one fan speed)

REV	ECO #	IMPL BY	APVD BY	DATE
02	000253	D. RHEAULT	D. RHEAULT	01-JUL-2017
01	Initial Release	C. GEDDES	C. GEDDES	04-APR-2017

Drawn By C. Geddes		Date 04-APR-2016
Checked By C. Geddes		Date 04-APR-2016
Approved By C. Geddes	(ENG)	Date 04-APR-2016
Approved By	(MFG)	Date
Approved By		Date

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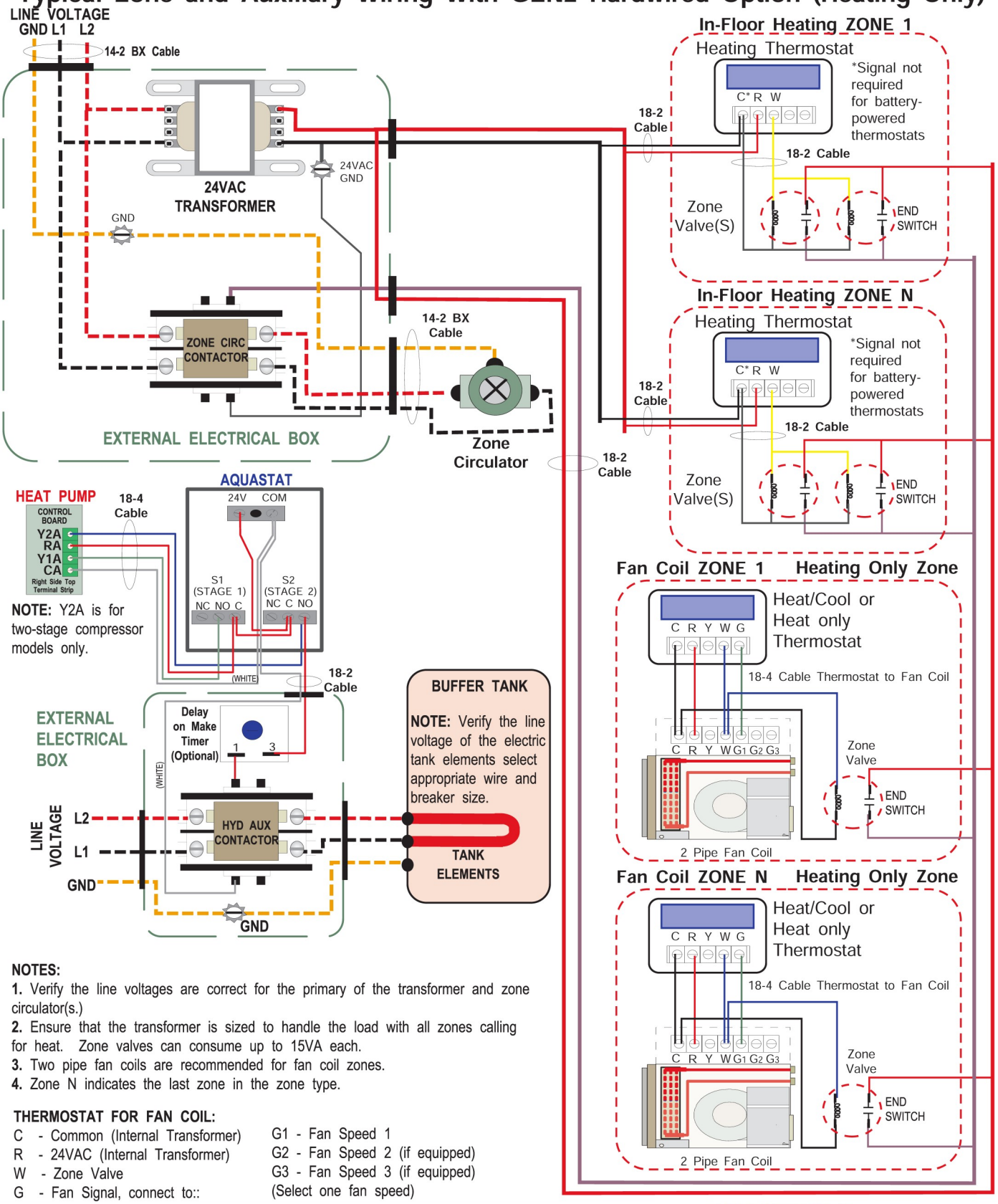
Drawing Name: Typical Zone and Auxiliary Wiring With GEN2 Setpoint Control (Heating Only)

Size	Drawing Number	Drawing Rev	Sheet
A	002067CDG	02	1 of 1

Typical Zone and Auxiliary Wiring With GEN2 Hardwired Option (Heating Only)



NOTES:

1. Verify the line voltages are correct for the primary of the transformer and zone circulator(s.)
2. Ensure that the transformer is sized to handle the load with all zones calling for heat. Zone valves can consume up to 15VA each.
3. Two pipe fan coils are recommended for fan coil zones.
4. Zone N indicates the last zone in the zone type.

THERMOSTAT FOR FAN COIL:

C - Common (Internal Transformer)
R - 24VAC (Internal Transformer)
W - Zone Valve
G - Fan Signal, connect to::
G1 - Fan Speed 1
G2 - Fan Speed 2 (if equipped)
G3 - Fan Speed 3 (if equipped)
(Select one fan speed)

REV	ECO #	IMPL BY	APVD BY	DATE
02	000253	D. RHEAULT	D. RHEAULT	01-JUL-2017
01	Initial Release	C. GEDDES	C. GEDDES	04-APR-2017

Drawn By C. Geddes		Date 04-APR-2016
Checked By C. Geddes		Date 04-APR-2016
Approved By C. Geddes	(ENG)	Date 04-APR-2016
Approved By	(MFG)	Date
Approved By		Date

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170 Plantation Rd.
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Drawing Name: Typical Zone and Auxiliary Wiring With GEN2 Hardwired Option (Heating Only)

Size	Drawing Number	Drawing Rev	Sheet
A	002069CDG	02	1 of 1

Piping

Indoor Loop

The connections for the Indoor Loop circuit are 1" brass female NPT. They are labelled as INDOOR IN and INDOOR OUT.

Recommended buffer tank piping is shown in diagrams on following pages. They show all of the recommended components as well as where they should be placed. If other types of components are used or connected differently, this is done at user's discretion with the caution that heat pump may or may not work properly.

NOTE: It is recommended that the water lines between the heat pump and the buffer tank be copper or other high temperature piping.

NOTE: Care should be taken when routing the water lines to ensure that adequate access to the heat pump is maintained so as to not compromise ease of serviceability.

The *minimum* buffer tank size should follow the rule of 8 US gallons per ton of heat pump capacity. The following table shows the minimum buffer tank size for each heat pump along with the recommended size. The recommended size will minimize the number of starts per hour and provide longer runtimes for improved efficiency.

TABLE 12 - Buffer Tank Size

Heat Pump Size	Minimum Size gallons (Litres)	Recommended Size gallons (Litres)
45	24 (90)	50 (190)
55	32 (120)	70 (265)
65	40 (150)	70 (265)
75	48 (180)	70 (265)
80	52 (200)	70 (265)

If a tank size is not available, use the next size larger tank.

Outdoor Loop

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

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

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.

The condensate drain is internally trapped and does not require an external trap. 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 also the **Ductwork** section for a diagram showing condensate drain connection.

Domestic Hot Water (Desuperheater) Connections

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

A typical piping diagram for a pre-heat tank configuration can be found in **drawing 000970PDG** at the end of this section. 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 piped together in larger buildings.

WARNING: USE ONLY COPPER LINES TO CONNECT THE DESUPERHEATER. TEMPERATURES COULD REACH 200F SHOULD THE DHW CUTOUT SWITCH FAIL, 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.

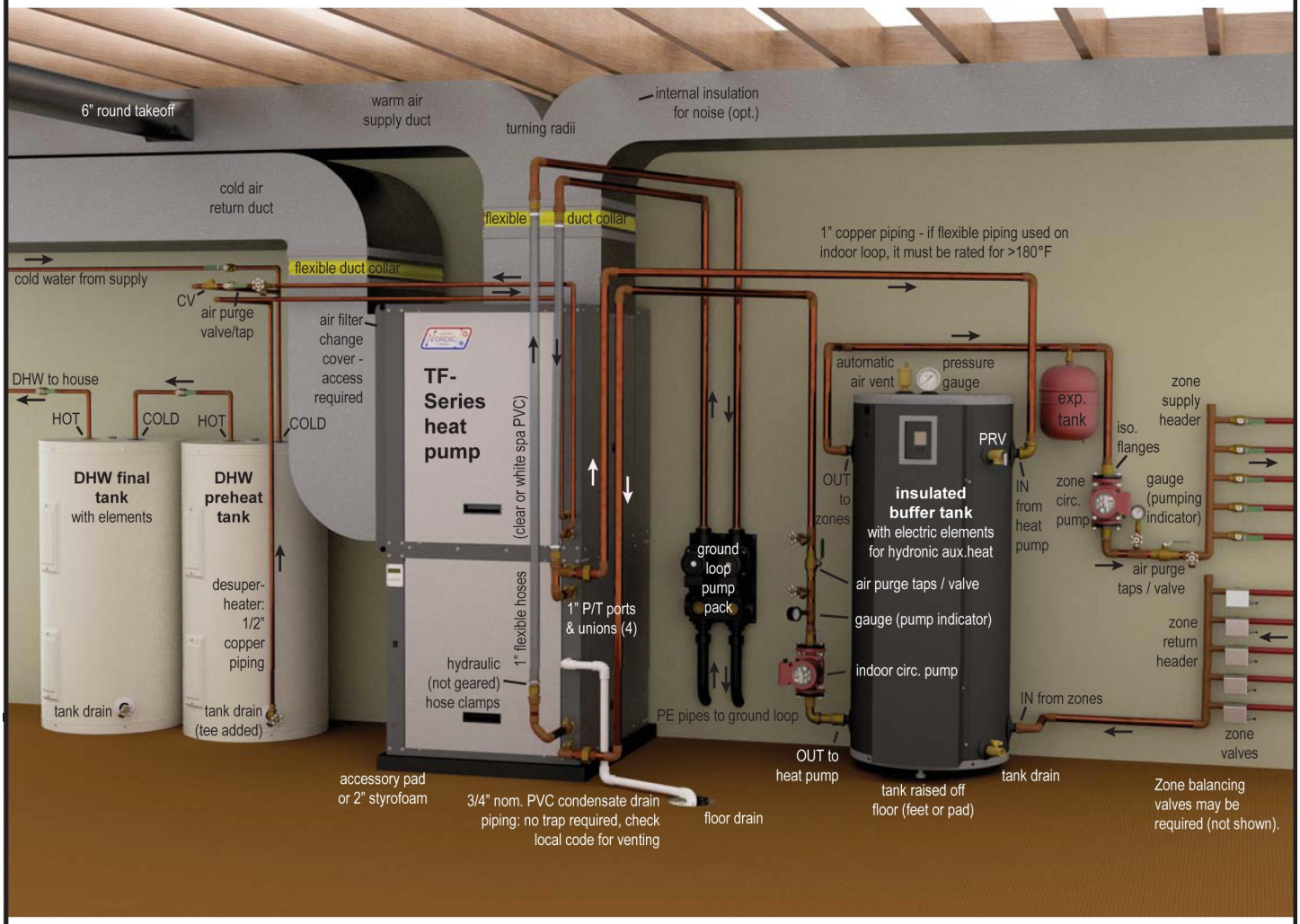
The DHW loop may have to be purged of air several times before good circulation is obtained. A temperature difference between the DHW In and DHW Out can be felt by hand when the circulator pump is operating properly.

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 in cooling mode.

CAUTION: If two (2) shut-off valves are located on the domestic hot water ines 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.

Typical Loop Connections - TF Series



See other diagrams and instructions in the manual for design, selection, and installation details of ground loop and hydronic heating accessories.

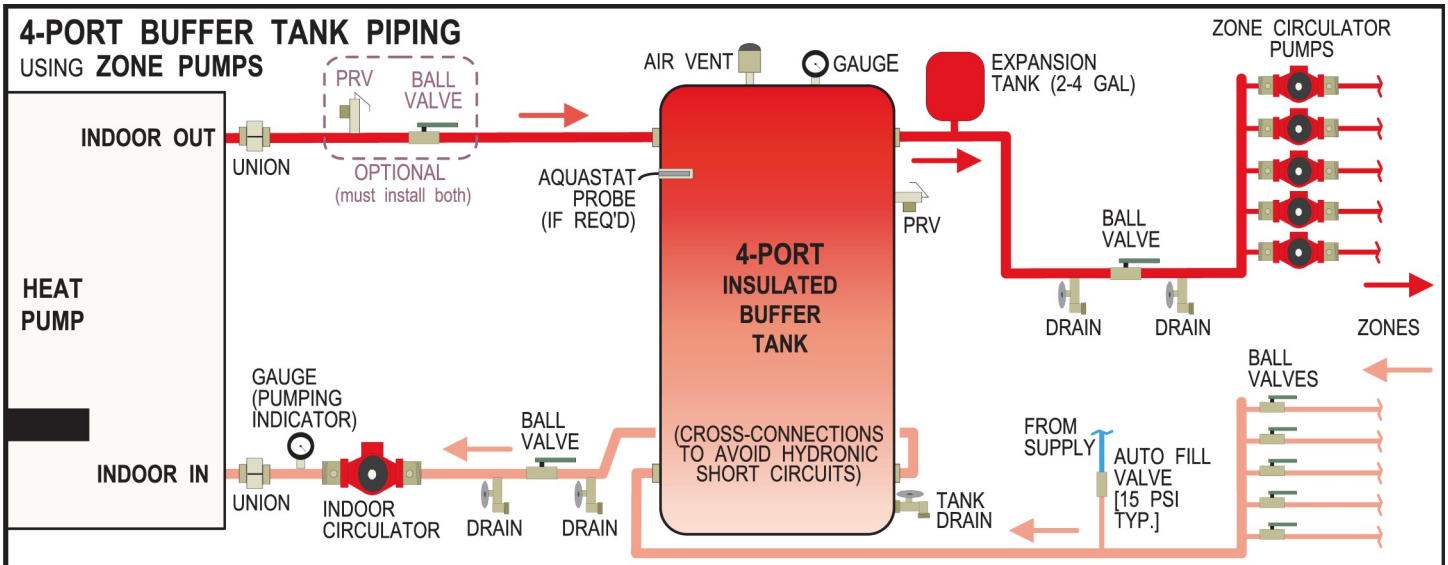
Many of the items illustrated in this diagram are available as accessories from Maritime Geothermal Ltd.. Other items are commonly available from plumbing or HVAC wholesalers.

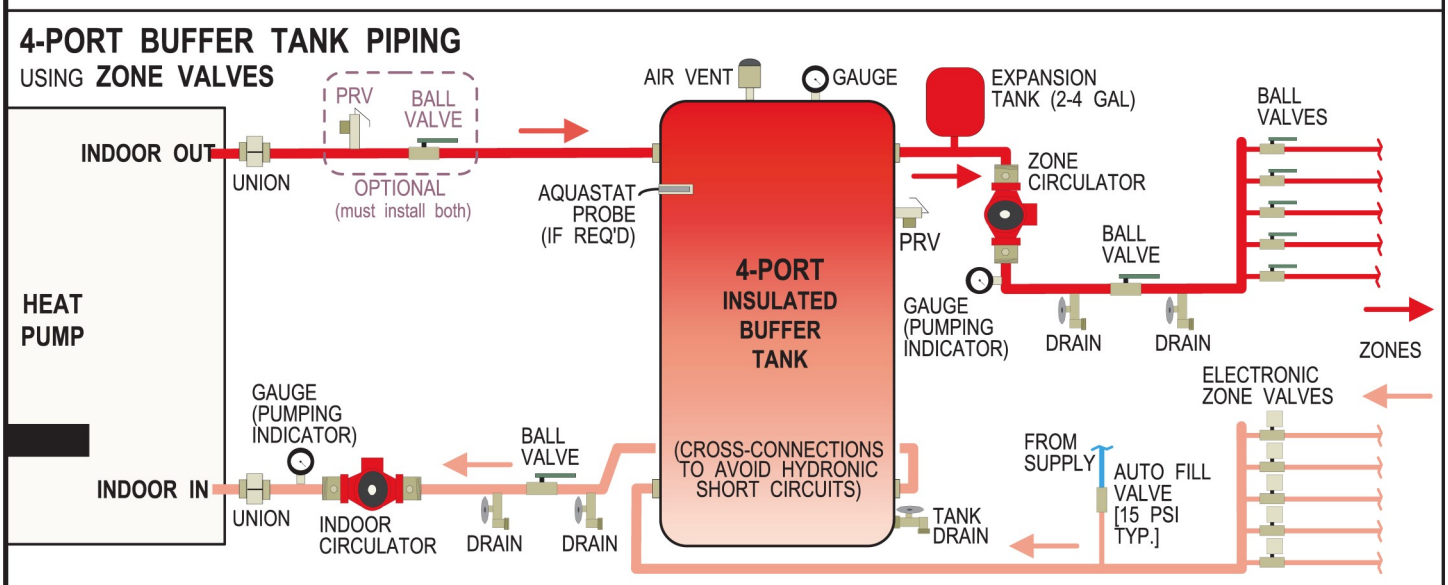
There are some valid connection methods or details which differ from those shown, including:

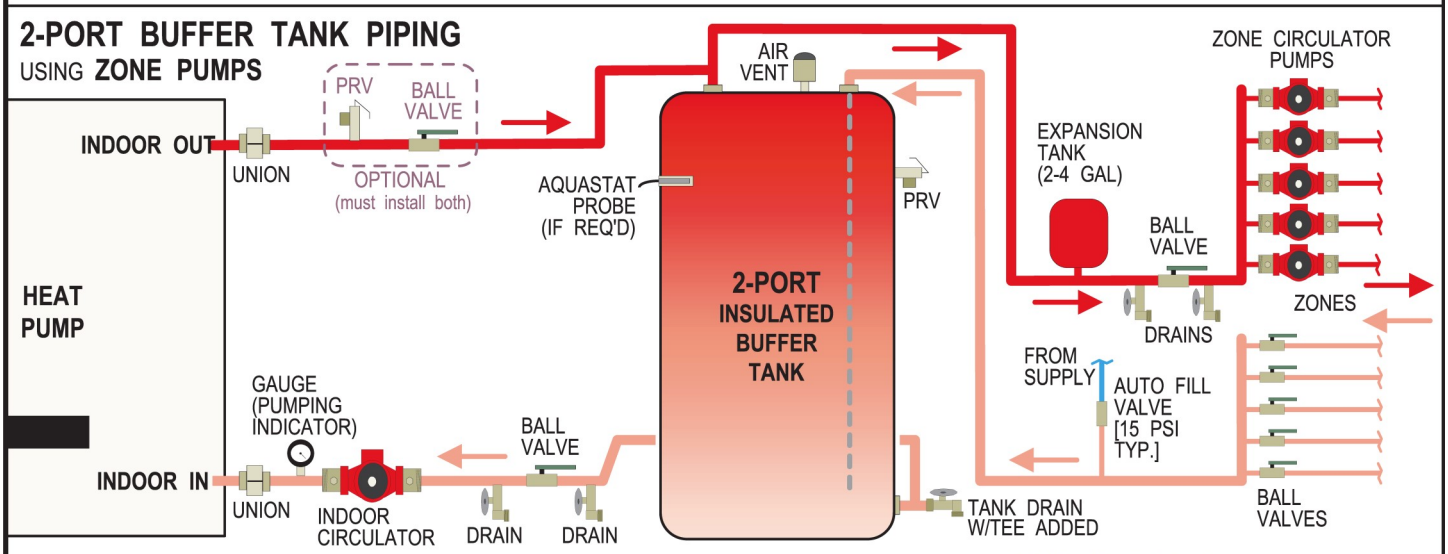
- Open loop installation, which uses a well water system in place of a ground loop.
- Hydronic in-floor heating zones that use one pump per zone instead of zone valves.
- Piping routed differently from that shown, or different piping & component types.

REV	ECO#	IMPL BY	APVD BY	DATE
02	000268	Dan Rheault	Dan Rheault	15-Jan-2019
01a	Initial Rel.	Dan Rheault	Dan Rheault	23-Aug-2017

Drawn By: Dan Rheault	Date: 23-Aug-2017	MARITIME GEOTHERMAL LTD.	P.O. Box 2555, 170 Plantation Rd., Petitcodiac, NB CANADA E4Z 6H4
Checked By: Dan Rheault	Date: 23-Aug-2017	Drawing Name: Typical Loop Connections - TF Series	
Eng. Approved By	Date		
Mfg. Approved By	Date		
Approved By	Date	Size: LET	Drawing Number: 002238PDG / Revision: 02 / Sheet: 1 / 1







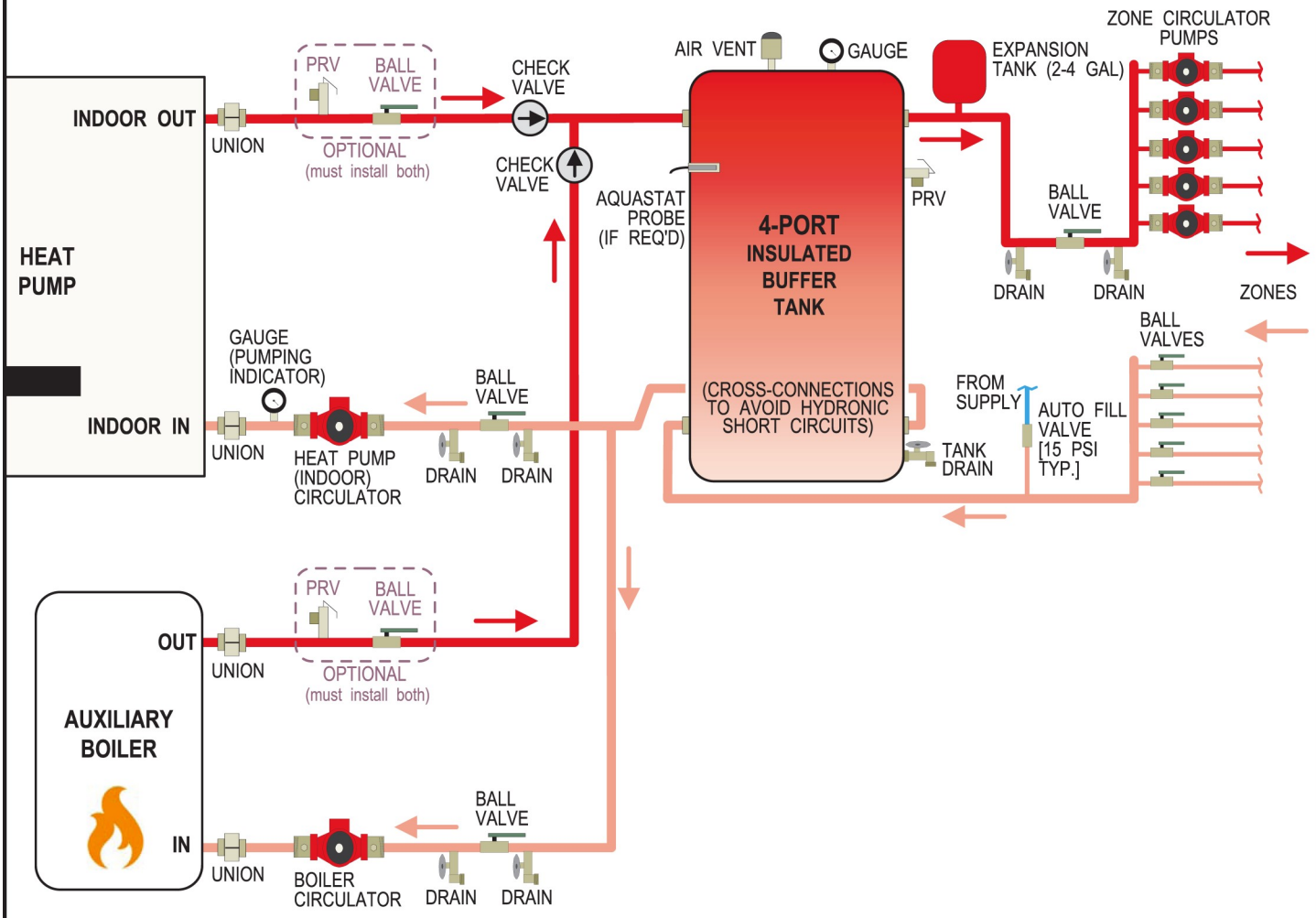
REV	ECO #	IMPL BY	APVD BY	DATE
02	(add fill valve)	D. RHEAULT	D. RHEAULT	1-Feb-2021
01	Initial Release	D. RHEAULT	D. RHEAULT	14-Dec-2018

Drawn By: Dan Rheault	Date: 14-Dec-2018	MARITIME GEOTHERMAL LTD. 170 Plantation Rd. Petitcodiac, NB E4Z 6H4
Checked By: Dan Rheault	Date: 14-Dec-2018	
Approved By (ENG)	Date	Drawing Name: Recommended Hydronic Buffer Tank Piping
Approved By (MFG)	Date	Size: A | Drawing Number: 002366PDG | REV: 02 | SHEET: 1 of 1
Approved By	Date	

Auxiliary Boiler Piping

NOTE: CHECK VALVES SHOULD BE SPRING TYPE, OTHERWISE UNINTENDED FLOW MAY OCCUR. SIZE CIRCULATORS INCLUDING PRESSURE DROP THROUGH SPRING CHECK VALVES.

SYSTEM WITH 4-PORT TANK & ZONE PUMPS SHOWN; SEE DIAGRAM **002366PDG** FOR SYSTEM USING 2-PORT TANK OR ZONE VALVES.



USING THIS PARALLEL ARRANGEMENT, BOILER MAY OPERATE ALONE (TO PROVIDE BACKUP HEAT) OR IN CONJUNCTION WITH HEAT PUMP (TO PROVIDE AUXILIARY HEAT).

BOILER MUST BE CONTROLLED AS 3RD STAGE OF HEAT BY HEAT PUMP CONTROL BOARD OR EXTERNAL CONTROLLER. BOILER MAY THEN OPERATE AT A HIGHER OUTPUT TEMPERATURE THAN HEAT PUMP WITHOUT CAUSING HIGH TEMPERATURE/HIGH PRESSURE PROBLEMS AT THE HEAT PUMP.

REV	ECO #	IMPL BY	APVD BY	DATE
02	(add fill valve)	D. RHEAULT	D. RHEAULT	1-Feb-2021
01	Initial Release	D. RHEAULT	D. RHEAULT	14-Dec-2018

Drawn By: Dan Rheault	Date: 14-Dec-2018	
Checked By: Dan Rheault	Date: 14-Dec-2018	
Approved By (ENG)	Date	
Approved By (MFG)	Date	
Approved By	Date	

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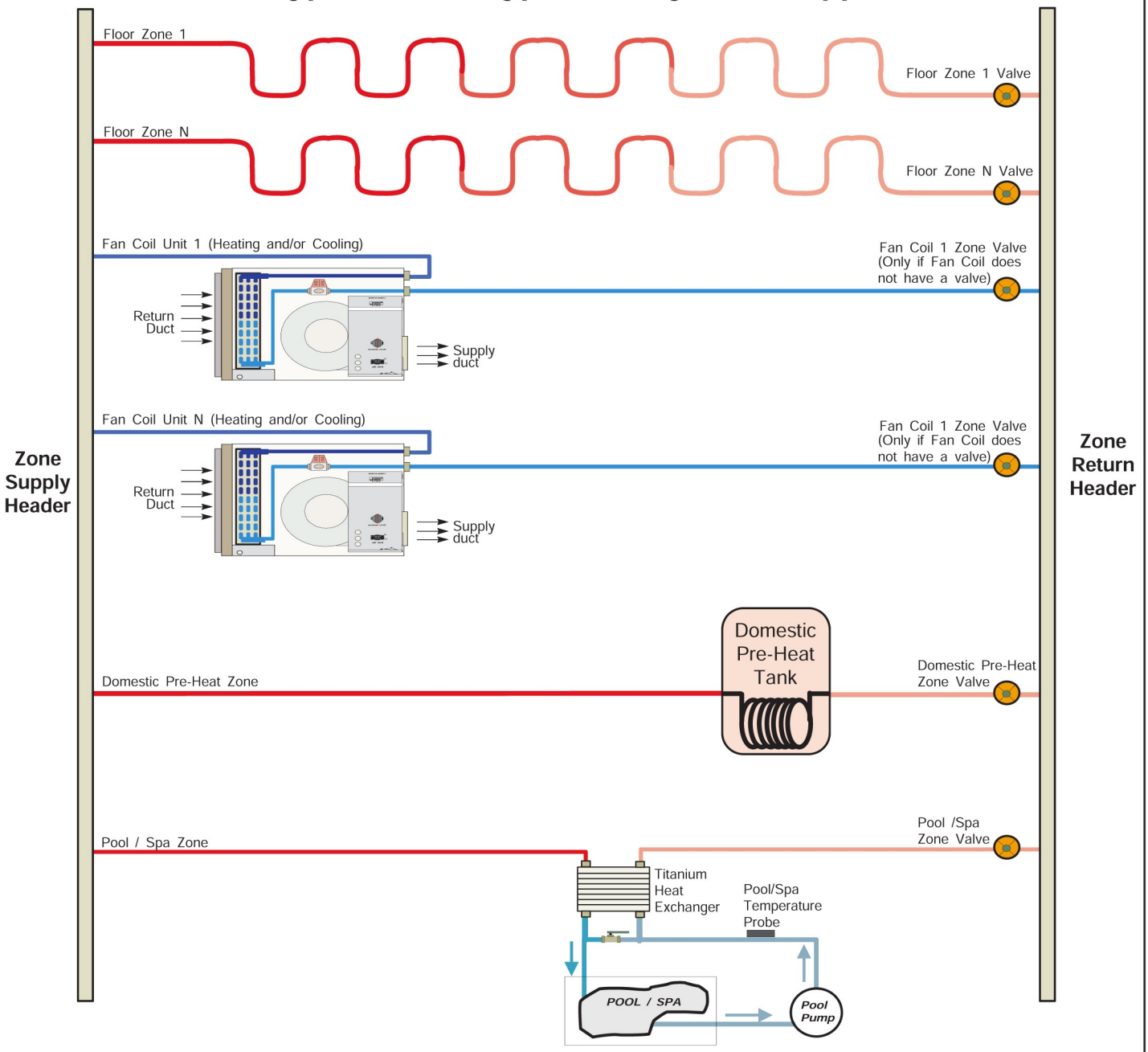
Drawing Name: **Auxiliary Boiler Piping**

Size	Drawing Number	REV	SHEET
A	**002367PDG**	**02**	1 of 1

Typical Zone Types for Hydronic Applications



NOTES:

1. Floor zones are heating only. Cooling a floor zone will cause condensation in the floor. Floor zone valves should be wired through a relay that is controlled by the cooling signal (O) that breaks the signal when in cooling mode to ensure that they cannot accidentally be energized.
2. There may be multiple floor zones.
3. There may be multiple fan coil units, (heating and /or cooling). A zone valve is not required if the unit has a internal valve.
4. Domestic Pre-Heat Tank is for on-demand apllications. The tank must have a heat eaxchanger in it or an external one must be used to separate the zone loop from the potable water supply.
5. Ensure the floor circulator is adequately sized to accomodate the type and number of zones connected to the system.
6. The pool aquastat will operate the Pool/Spa Zone Valve.

REV	ECO #	IMPL BY	APVD BY	DATE
01	Initial Release	C. GEDDES	C. GEDDES	06 SEP 07

Drawn By Chris Geddes	Date 06 SEP 07	
Checked By Chris Geddes	Date 06 SEP 07	
Approved By (ENG) Chris Geddes	Date 06 SEP 07	
Approved By (MFG)	Date	
Approved By	Date	

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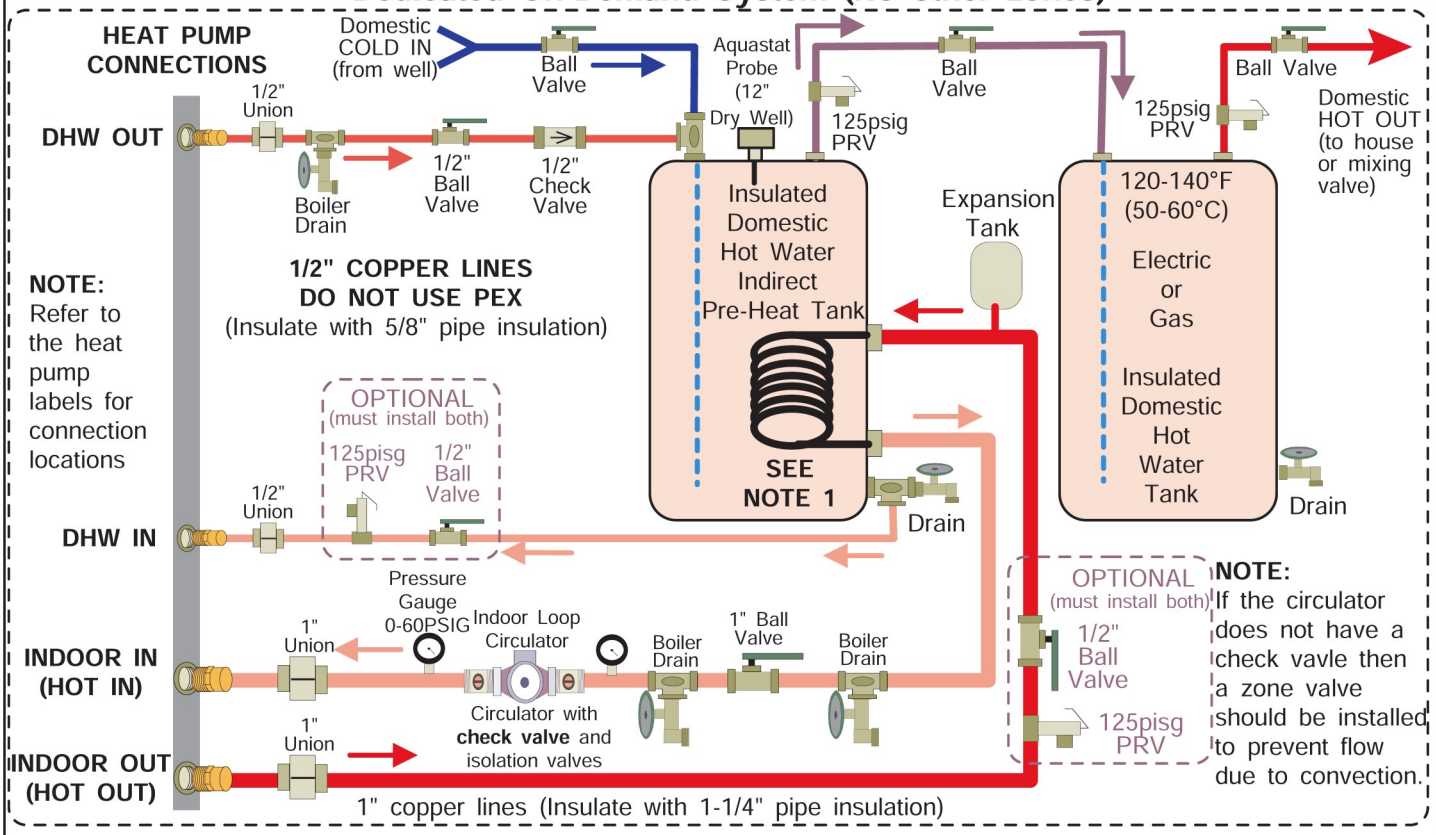
Drawing Name: Typical Zone Types for Hydronic Applications

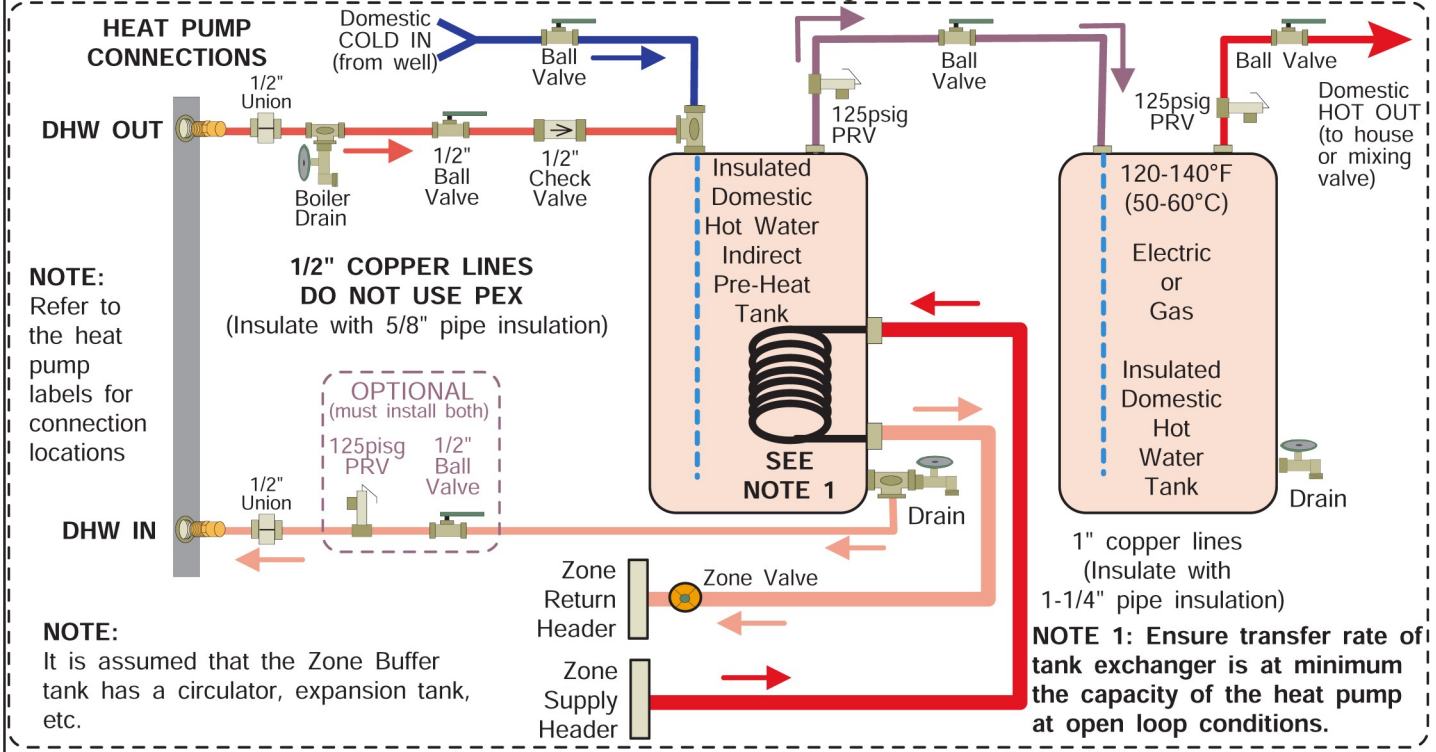
Size	Drawing Number	REV	SHEET
A	000530PDG	01	1 of 1

Single Unit Connection to On-Demand Domestic Hot Water Pre-Heat Tank

Dedicated On-Demand System (No other zones)



Zoned On-Demand System



REV	ECO #	IMPL BY	APVD BY	DATE
02	000161	C. GEDDES	C. GEDDES	05 FEB 10
01	Initial Release	C. GEDDES	C. GEDDES	29 JUN 09

Drawn By: Chris Geddes	Date: 29 JUN 09	
Checked By: Chris Geddes	Date: 29 JUN 09	
Approved By (ENG): Chris Geddes	Date: 29 JUN 00	
Approved By (MFG):	Date:	
Approved By:	Date:	

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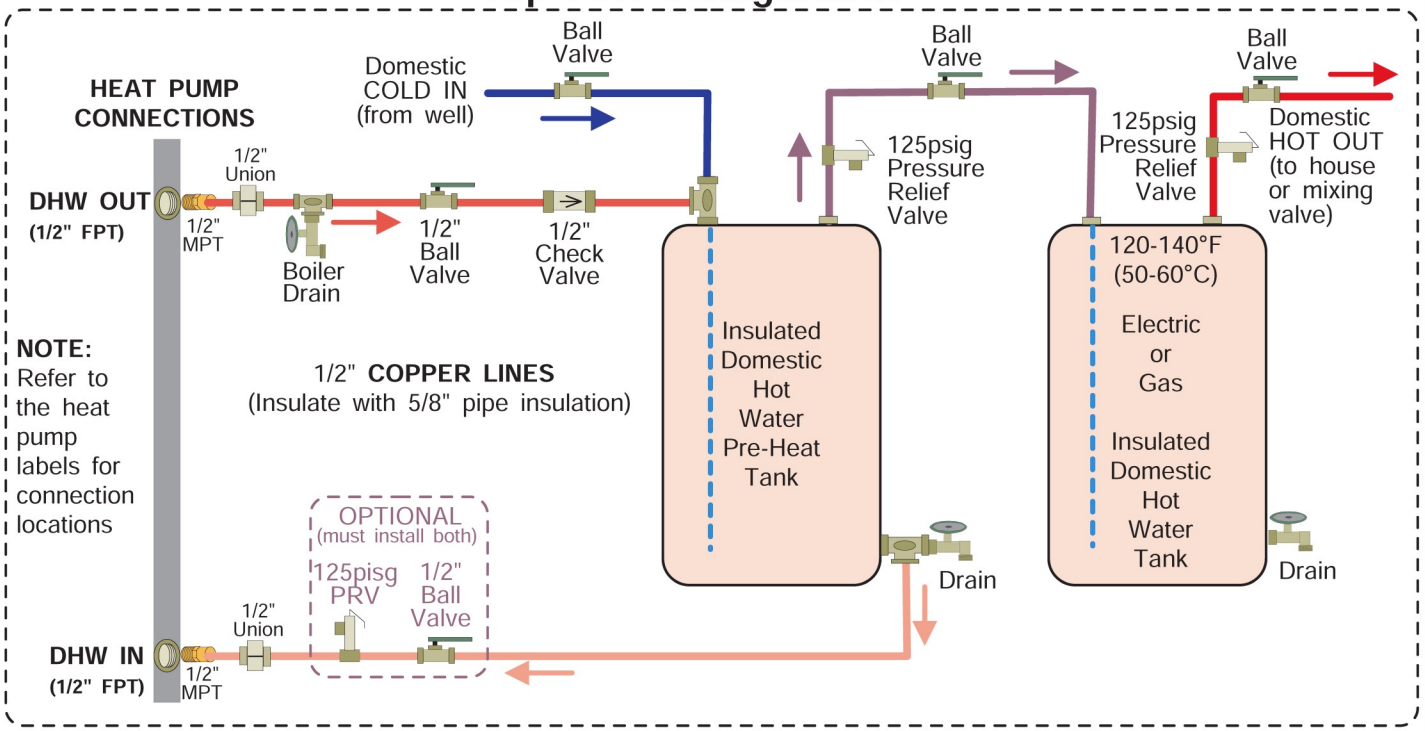
Drawing Name: Single Unit Connection toOn-Demand DHW Pre-Heat Tank (Brass FPT)

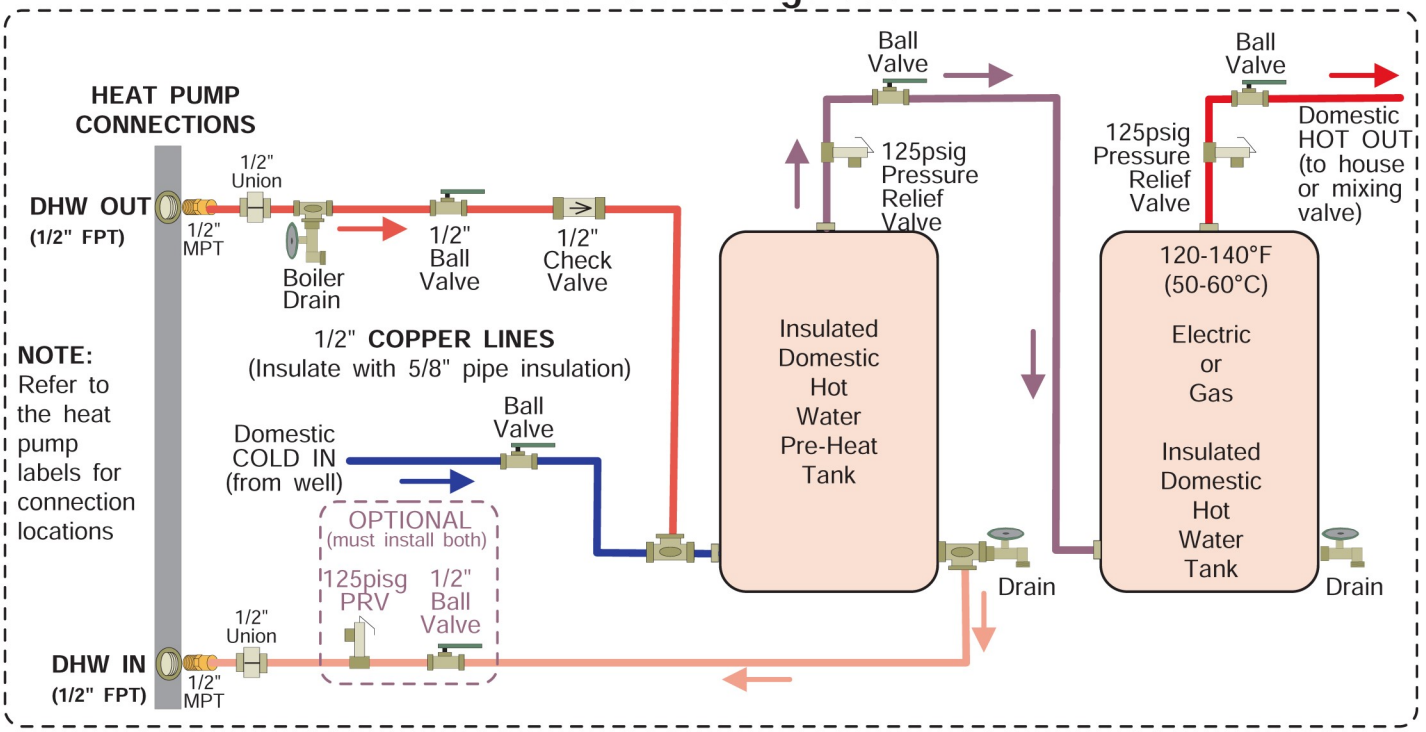
Size	Drawing Number	REV	SHEET
A	001055PDG	02	1 of 1

Desuperheater Connection to DHW Pre-Heat Tank

Top Port Configuration



Side Port Configuration



REV	ECO #	IMPL BY	APVD BY	DATE
01a	Re-titled	D. RHEAULT	D. RHEAULT	15 JAN 19
01	Initial Release	C. GEDDES	C. GEDDES	10 MAR 09

Drawn By: Chris Geddes	Date: 10 MAR 09	
Checked By: Chris Geddes	Date: 10 MAR 09	
Approved By (ENG): Chris Geddes	Date: 10 MAR 09	
Approved By (MFG):	Date:	
Approved By:	Date:	

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Drawing Name: Single Unit Connection to DHW Pre-Heat Tank (Brass FPT)

Size	Drawing Number	REV	SHEET
A	000970PDG	01a	1 of 1

Ground Loop Installations

Refer to diagrams **000608INF** & **000609INF** at the end of this section 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 FPT 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 section. 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** section for unit flow requirements.

Loop pressure drops can be calculated using software such as those mentioned in the Horizontal Ground loops section, 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** section. P/T ports, adapters, and gauge adapters and 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)** 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.

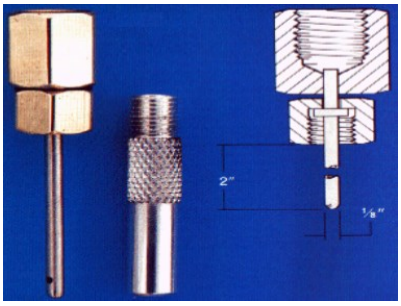
Figure 1: Ground Loop Accessories & Tools

2-pump module

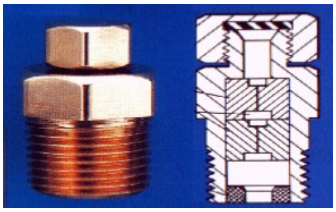
Barbed Adapters

PE Adapters

Purge Cart



Gauge adapter for P/T port



P/T port

P/T adapters for heat pump (1" NPT to barb)

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 table for details of freeze protection provided by different concentrations.

TABLE 13 - 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 anti-freeze 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 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 table; drain the equivalent amount of water from the flush cart or mixing barrel and replace it with the antifreeze.

TABLE 14 - 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.

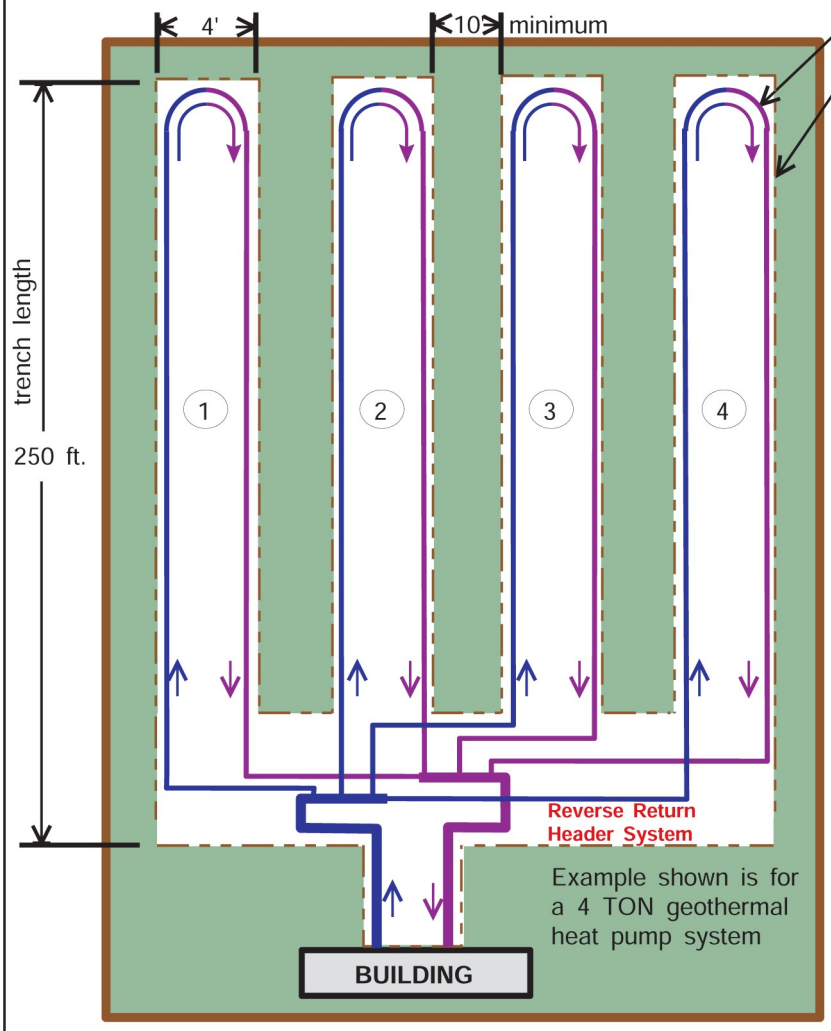
- Pressurize the loop to a static pressure of **45 psig**. when installing a system in the fall going into the heating season.
- Pressurize the loop to a static pressure of **25 psig**. when installing a system in the spring or summer going into the cooling season.

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

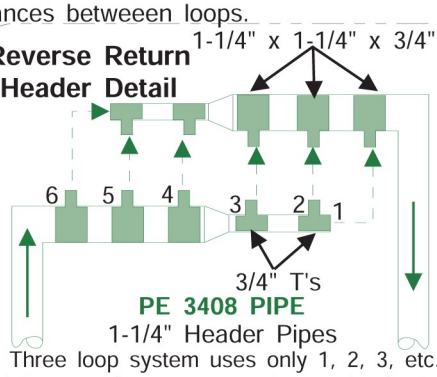
All ground loop piping inside the structure (between the structure entry point and the heat pump) should be insulated with 3/8" thick closed cell pipe insulation to prevent condensation and dripping onto floors or walls.

TYPICAL HORIZONTAL GROUND LOOP CONFIGURATION



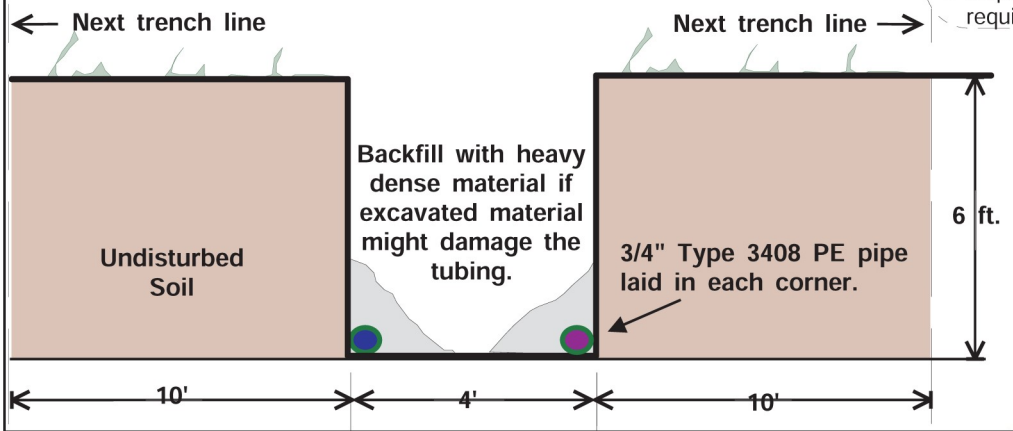
- Type PE 3408 Pipe
- Excavated trenches minimum 4' wide x 6' deep
- Trenches will be backfilled with material which will maximize the thermal conductivity of the adjacent earth.
- Each loop consists of 500ft. of 3/4" type 3408 PE 160 psig (SDR 11) geothermal heat pump polyethelene tubing.
- Each trench is 250ft. begining from the header. This allows one 500ft. rool 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 betweeen loops.

Reverse Return Header Detail



Three loop system uses only 1, 2, 3, etc. Minimum 2ft/sec to purge air. Each 3/4" loop requires 4USPGM 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.

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

REV	ECO #	IMPL BY	APVD BY	DATE
01	Initial Release	C. GEDDES	C. GEDDES	17 JAN 08

Drawn By	Chris Geddes	Date 17 JAN 08
Checked By	Chris Geddes	Date 17 JAN 08
Approved By (ENG)	Chris Geddes	Date 17 JAN 08
Approved By (MFG)		Date
Approved By		Date

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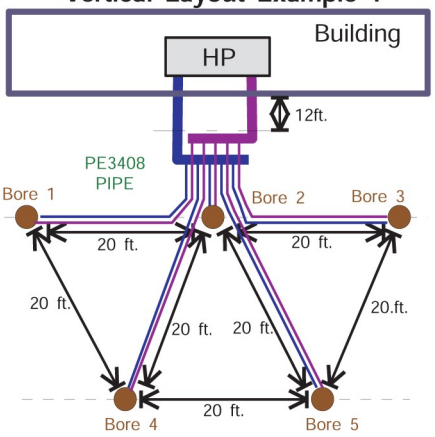
Drawing Name: Typical Horizontal Ground Loop Configuration

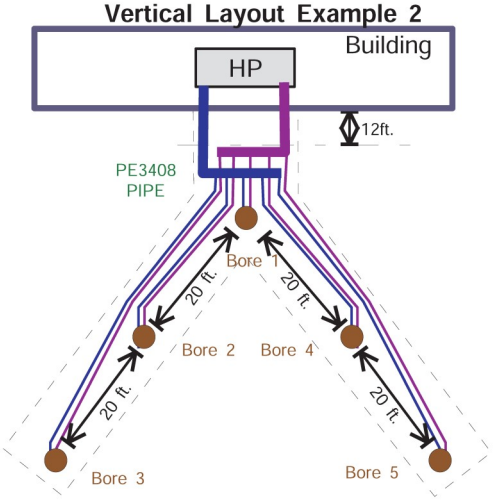
Size	Drawing Number	REV	SHEET
A	000608INF	01	1 of 1

TYPICAL VERTICAL GROUND LOOP CONFIGURATION

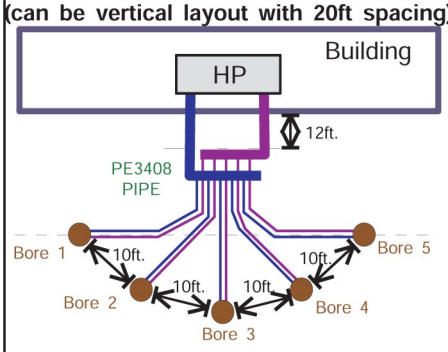
Vertical Layout Example 1



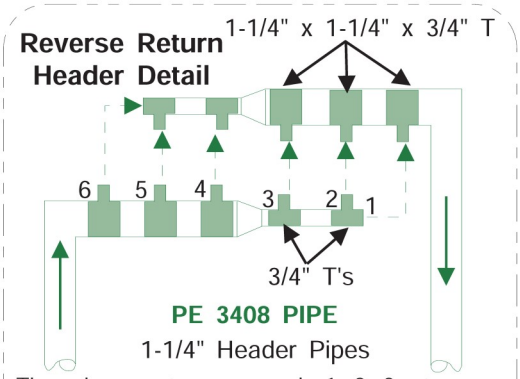
Vertical Layout Example 2



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

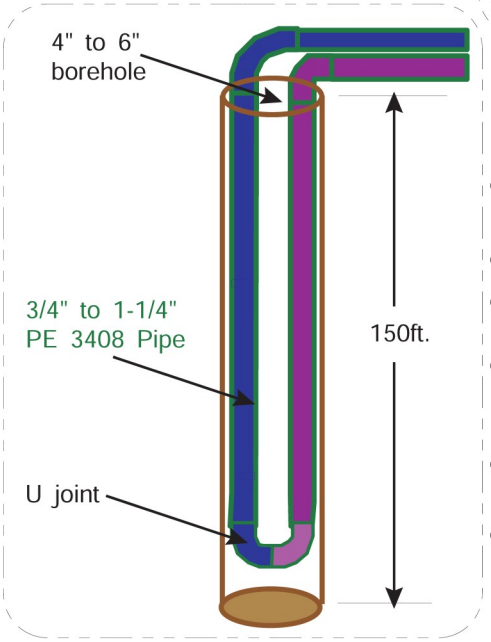


Reverse Return Header Detail



Three loop system uses only 1, 2, 3, etc. Minimum 2ft/sec to purge air. Each 3/4" loop requires 4USPGM 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 betweeen loops.
- The number of boreholes can be reduced by increasing the depth of the boreholes. Do not exceed 300ft depth and 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 exra 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.

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Approved By (MFG)	Date	
Approved By	Date	

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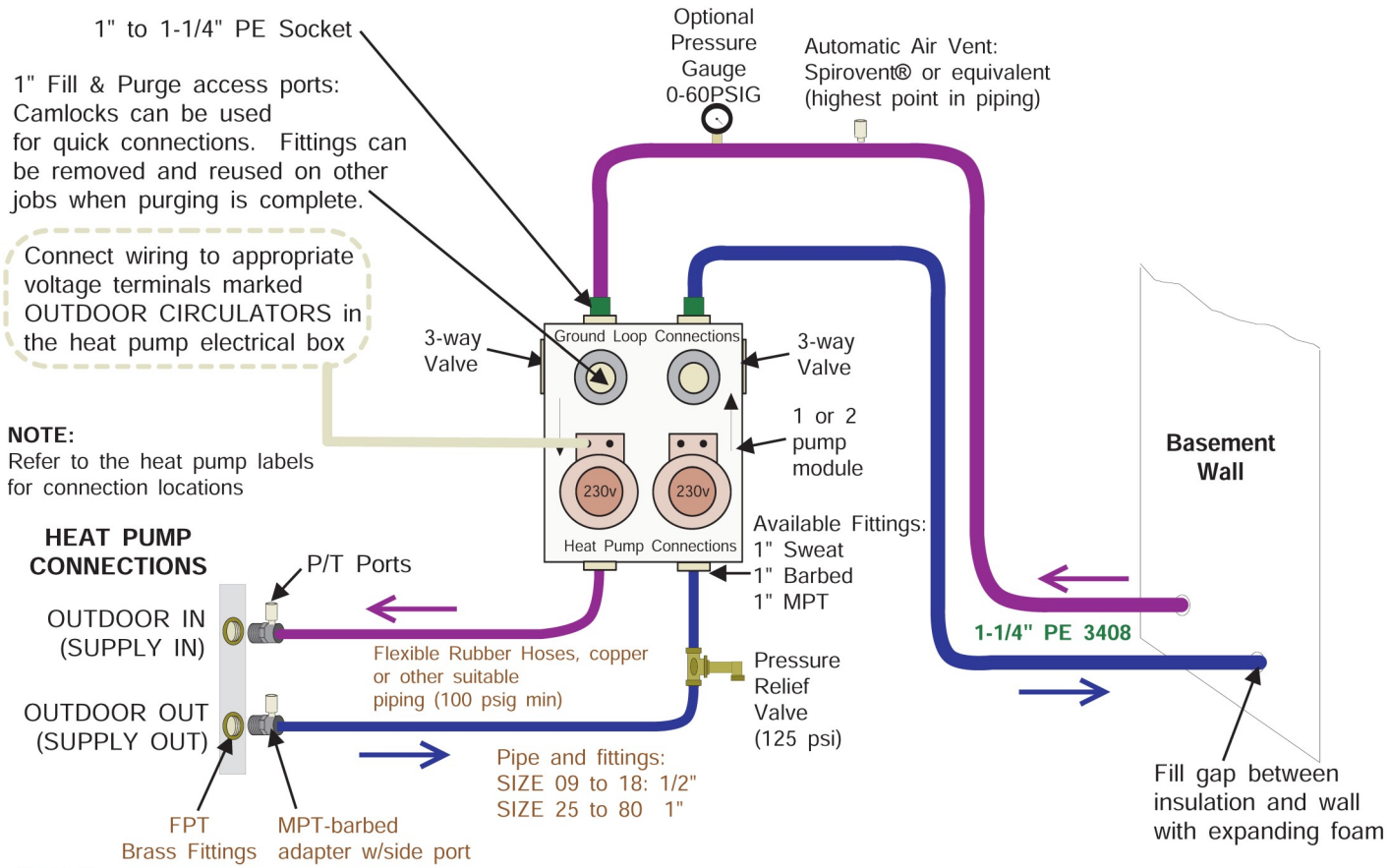
Drawing Name: Typical Vertical Ground Loop Configuration

Size	Drawing Number	REV	SHEET
A	000609INF	01	1 of 1

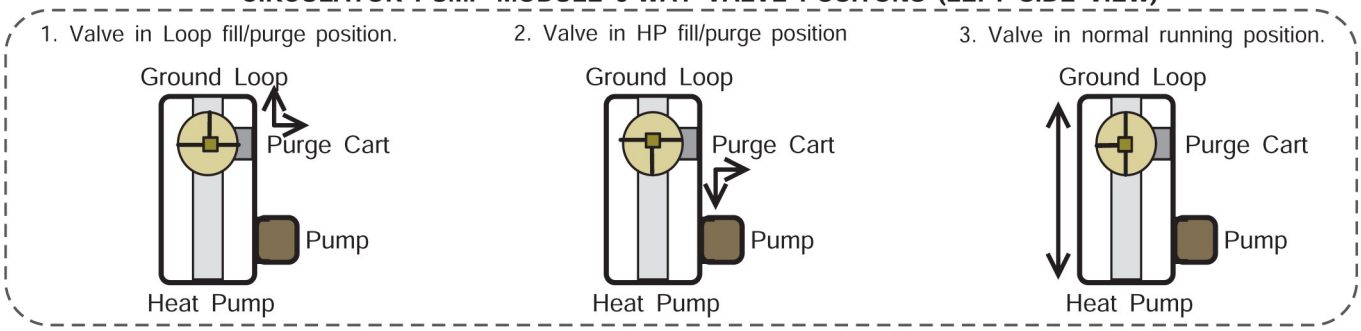
Geo-Flo Circulator Pump Module Installation
(Units with Brass FPT Fittings)



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 insualted 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)



REV	ECO #	IMPL BY	APVD BY	DATE
03	000264	D. RHEAULT	D. RHEAULT	21-Aug-2018
02	000213	C. GEDDES	C. GEDDES	21-May-2013
01	Initial Release	C. GEDDES	C. GEDDES	9-Dec-2008

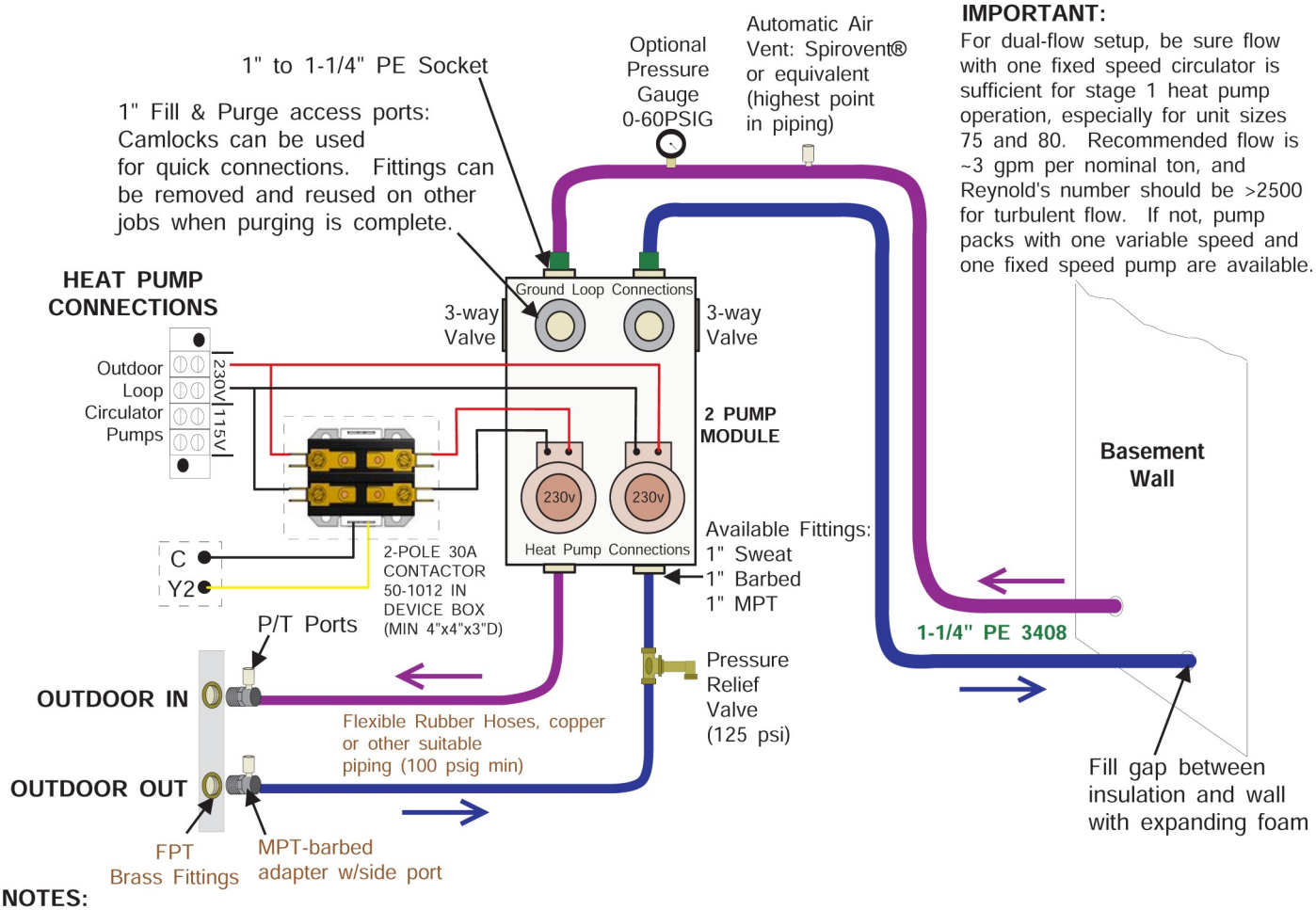
Drawn By	Chris Geddes	Date 09 DEC 08
Checked By	Chris Geddes	Date 09 DEC 08
Approved By (ENG)	Chris Geddes	Date 09 DEC 08
Approved By (MFG)		Date
Approved By		Date

MARITIME GEOTHERMAL LTD.
170 Plantation Rd.
Petitcodiac, NB
E4Z 6H4

Drawing Name: Geo-Flo Circulator Pump Module Installation (Brass FPT)

Size	Drawing Number	Drawing Rev	SHEET
A	000906PDG	03	1 of 1

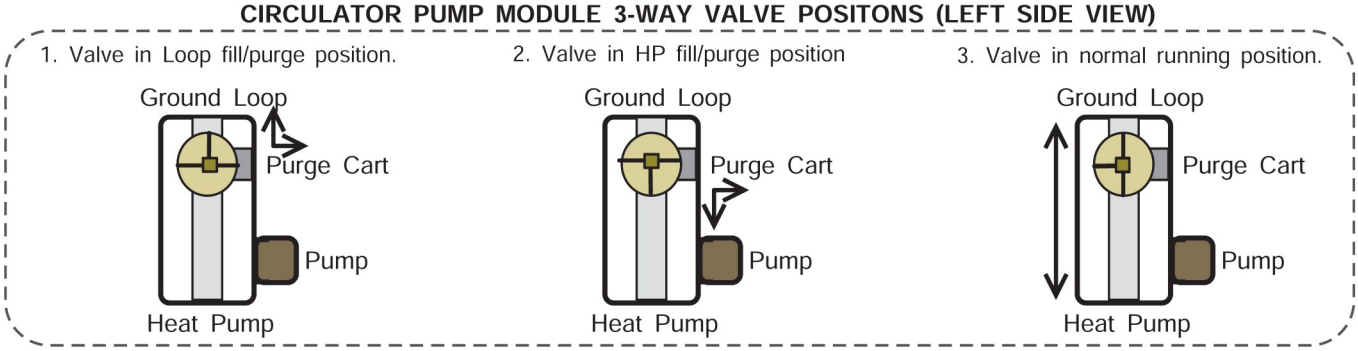
Dual Flow Circulator Pump Module Installation for 2-Stage Heat Pumps



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 insualted 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)



REV	ECO #	IMPL BY	APVD BY	DATE
03	000264	D. RHEAULT	D. RHEAULT	21-Aug-2018
02	-	D. RHEAULT	D. RHEAULT	20-May-2014
01	Initial Release	D. RHEAULT	D. RHEAULT	22-Nov-2013

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	Drawing Name: Dual Flow Circulator Pump Module Installation for 2-Stage Heat Pumps
Approved By (ENG)	Date	
Approved By (MFG)	Date	
Approved By	Date	Size: A; Drawing Number: 001823CDG; REV: 03; 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 groundwater 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 15 - Required Flow

Heat Pump Model Size	Heat Pump Flow* gpm (L/s)	Domestic Water Usage gpm (L/s)	Total Flow gpm (L/s)
25	8.0 (0.50)	4 (0.25)	12 (0.76)
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)
80	17.0 (1.07)	4 (0.25)	21 (1.32)

* 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 between 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 section). 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 **H_2S (>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 drawing 000907INF** 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 well for residential applications. The water returned to the well

Figure 2: Open Loop Accessories & Tools

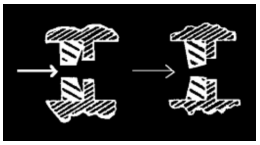
Water Level Sounder

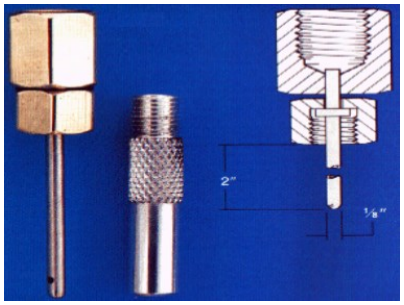
Cumulative Gallon Meter

Taco EBV

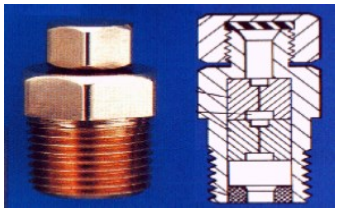
Rainbird Solenoid Valve

Dole Valve





Gauge adapter for P/T port



P/T port

P/T adapters for heat pump (1" NPT to barb)

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 powered open and powered closed.
- **Taco** slow acting **motorized ball valve**, which is powered on 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.

Plumbing the Heat Pump

The port connections for the outdoor loop are 1" brass FPT fittings. They are marked as OUTDOOR IN and OUTDOOR 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" copper or plastic line should be run to the Outdoor IN (Supply IN) pipe of the heat pump. Similarly, a 1"' 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 **Figure 1** in the Ground Loop section 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 section 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.

As mentioned earlier, the heat pump has an electrical connector plug 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.

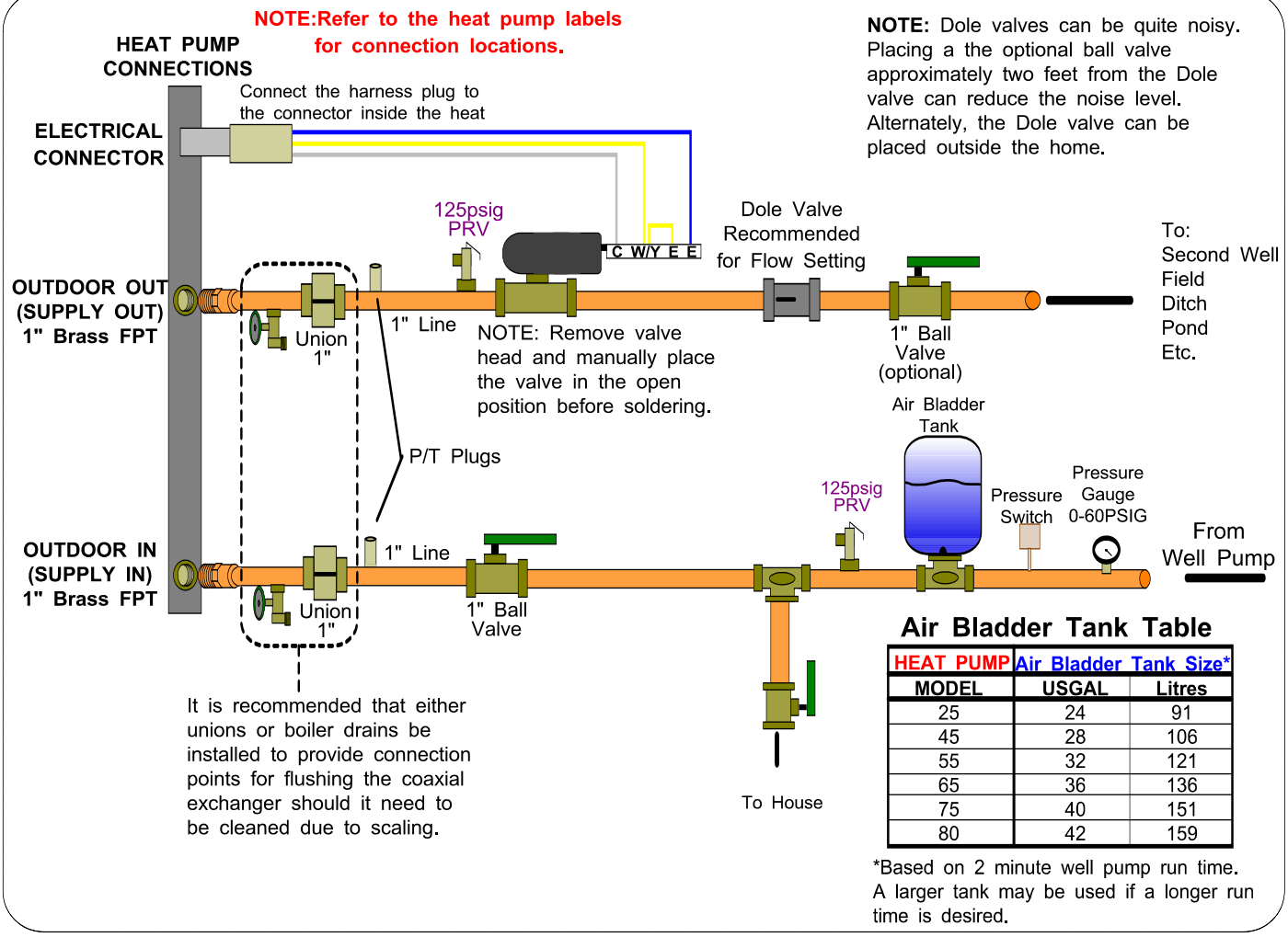
All water line valves on both the supply and discharge lines should be either BALL or GATE valves. GLOBE valves have a higher pressure drop, meaning more pumping power to maintain the required flow to the heat pump.

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)



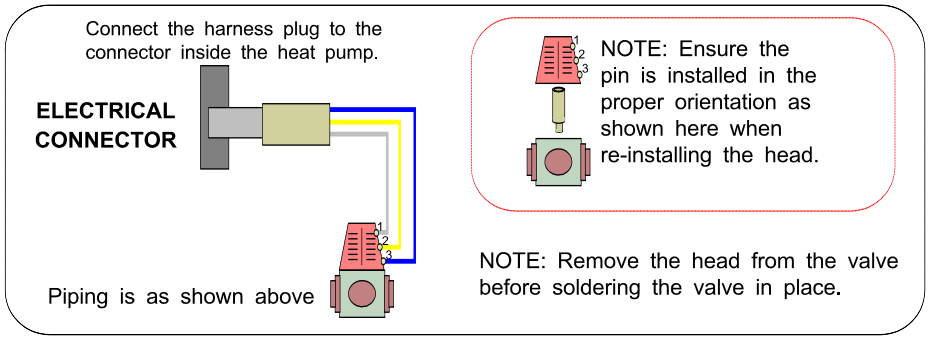
NOTE: Dole valves can be quite noisy. Placing a the optional ball valve approximately two feet from the Dole valve can reduce the noise level. Alternately, the Dole valve can be placed outside the home.

Air Bladder Tank Table

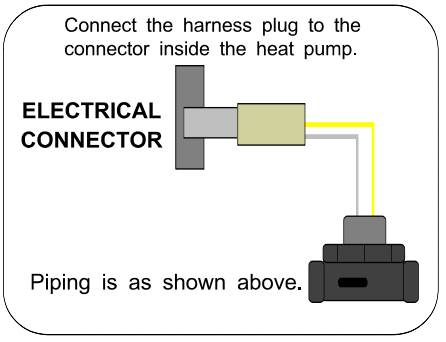
HEAT PUMP	Air Bladder Tank Size*	
MODEL	USGAL	Litres
25	24	91
45	28	106
55	32	121
65	36	136
75	40	151
80	42	159

*Based on 2 minute well pump run time. A larger tank may be used if a longer run time is desired.

TACO 24VAC Slow Close Water Valve



Generic 24VAC Solenoid Water Valve



REV	ECO #	IMPL BY	APVD BY	DATE
02	000228	C. GEDDES	C. GEDDES	21 MAY 2014
01	Initial Release	C. GEDDES	C. GEDDES	10 DEC 08

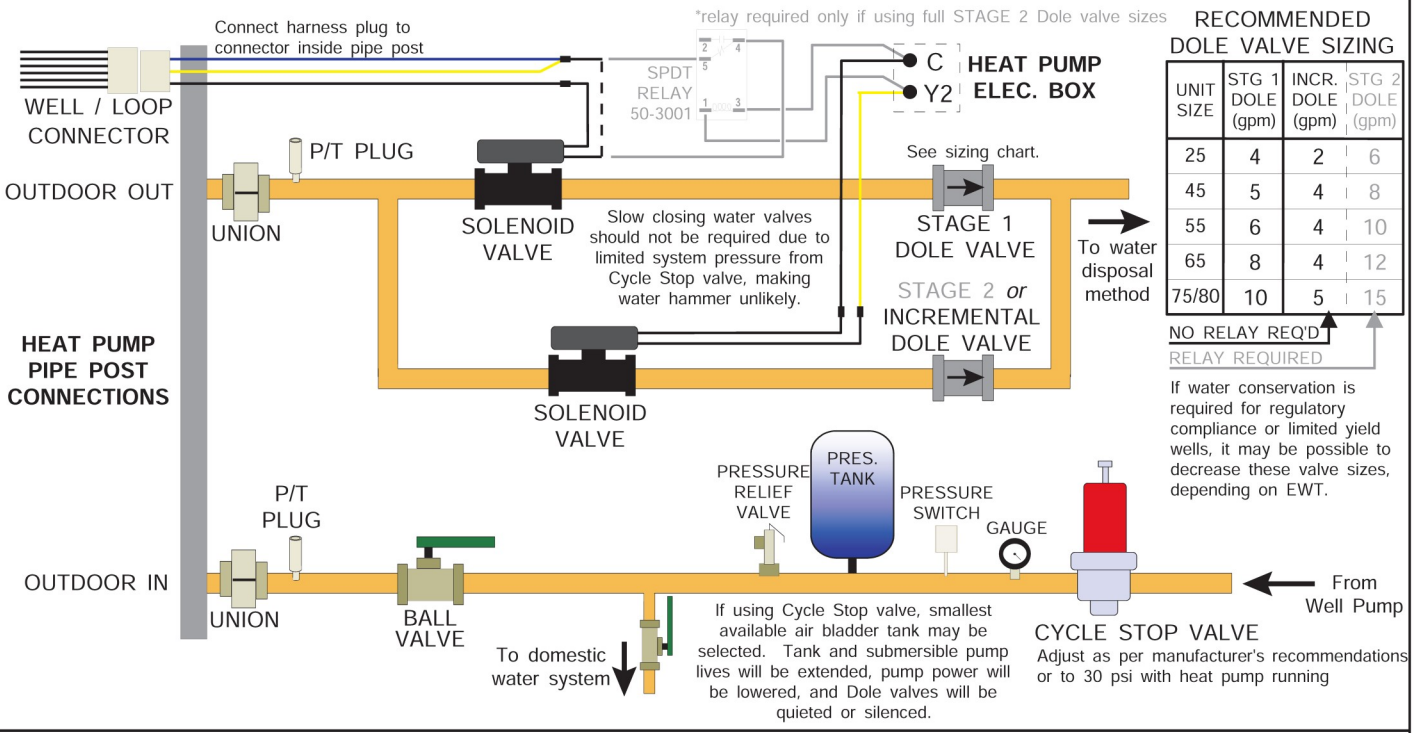
Drawn By	Chris Geddes	Date 10 DEC 08
Checked By	Chris Geddes	Date 10 DEC 08
Approved By (ENG)	Chris Geddes	Date 10 DEC 08
Approved By (MFG)		Date
Approved By		Date

MARITIME GEOTHERMAL LTD.
170 Plantation Rd.
Petitcodiac, NB
E4Z 6H4

Drawing Name: Typical Ground Water Installation for Size 25-80 Heat Pumps (Brass FPT)

Size	Drawing Number	Drawing Rev	SHEET
A	000907CDG	02	1 of 1

1. Dual-Flow Groundwater (Well) Installation



RECOMMENDED DOLE VALVE SIZING

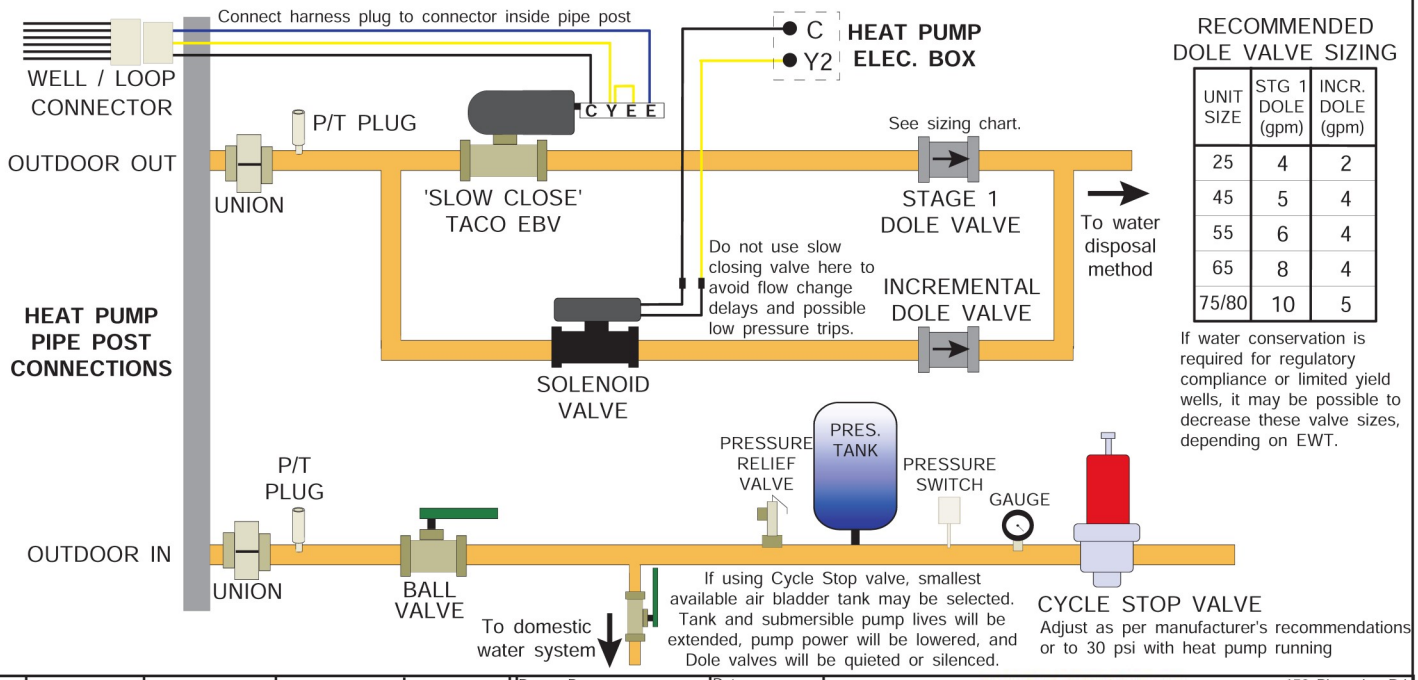
UNIT SIZE	STG 1 DOLE (gpm)	INCR. DOLE (gpm)	STG 2 DOLE (gpm)
25	4	2	6
45	5	4	8
55	6	4	10
65	8	4	12
75/80	10	5	15

NO RELAY REQ'D
RELAY REQUIRED

If water conservation is required for regulatory compliance or limited yield wells, it may be possible to decrease these valve sizes, depending on EWT.

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



RECOMMENDED DOLE VALVE SIZING

UNIT SIZE	STG 1 DOLE (gpm)	INCR. DOLE (gpm)
25	4	2
45	5	4
55	6	4
65	8	4
75/80	10	5

If water conservation is required for regulatory compliance or limited yield wells, it may be possible to decrease these valve sizes, depending on EWT.

REV	ECO #	IMPL BY	APVD BY	DATE
01	Initial Release	D. RHEAULT	D. RHEAULT	22-Nov-2013

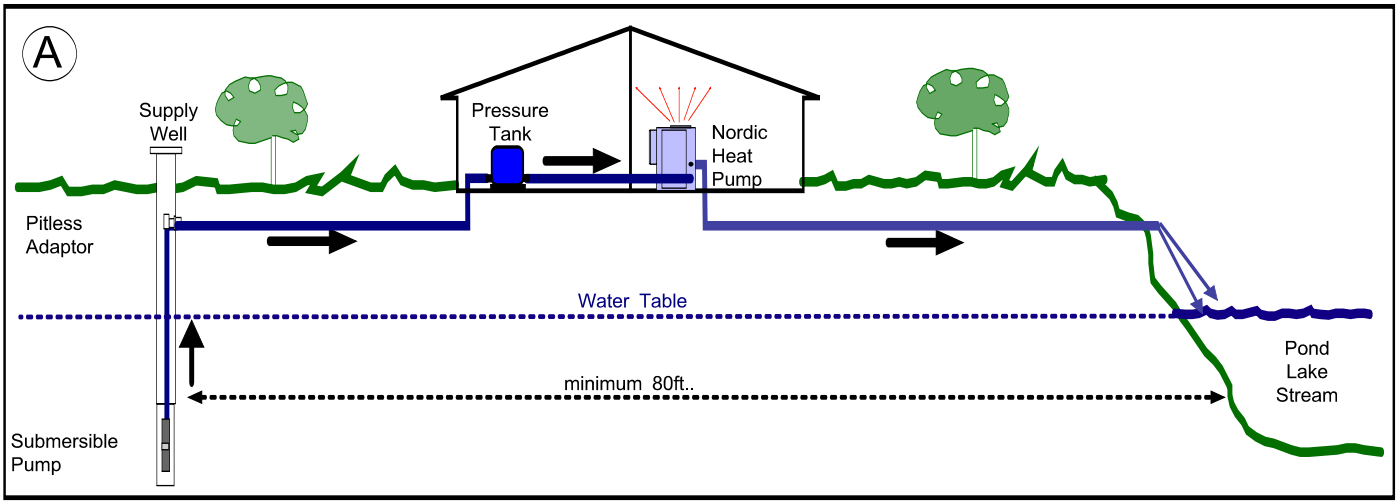
Drawn By	Dan Rheault	Date	22-Nov-2013
Checked By	Dan Rheault	Date	22-Nov-2013
Approved By	(ENG)	Date	
Approved By	(MFG)	Date	
Approved By		Date	

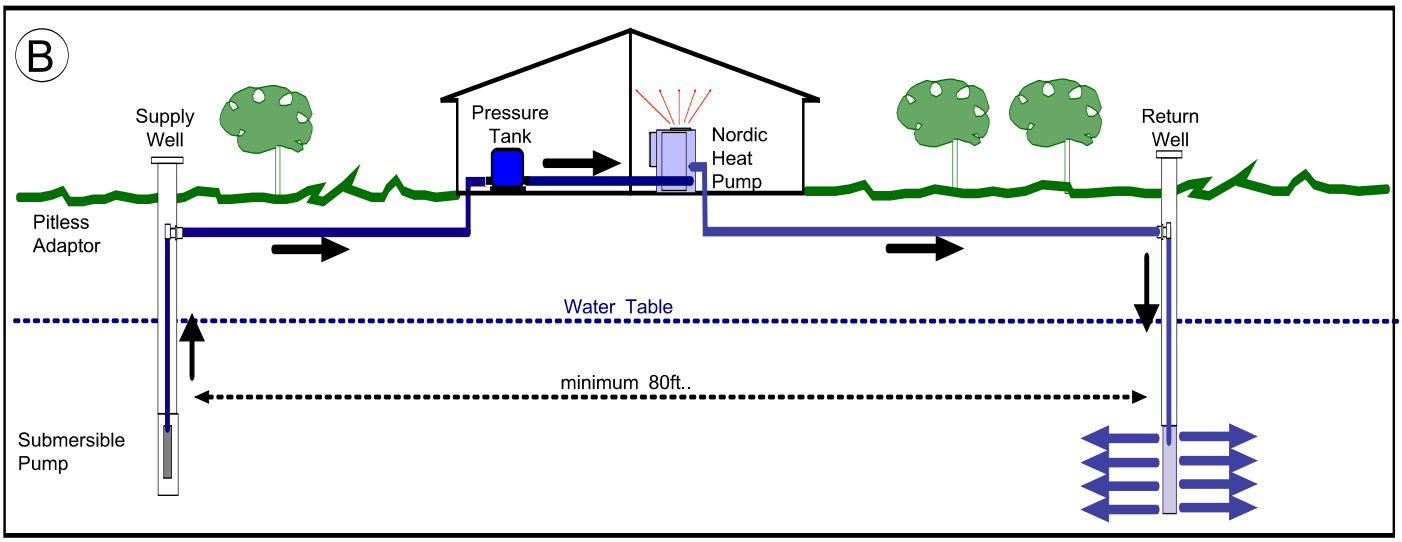
MARITIME GEOTHERMAL LTD.
170 Plantation Rd.
Petitcodiac, NB
E4Z 6H4

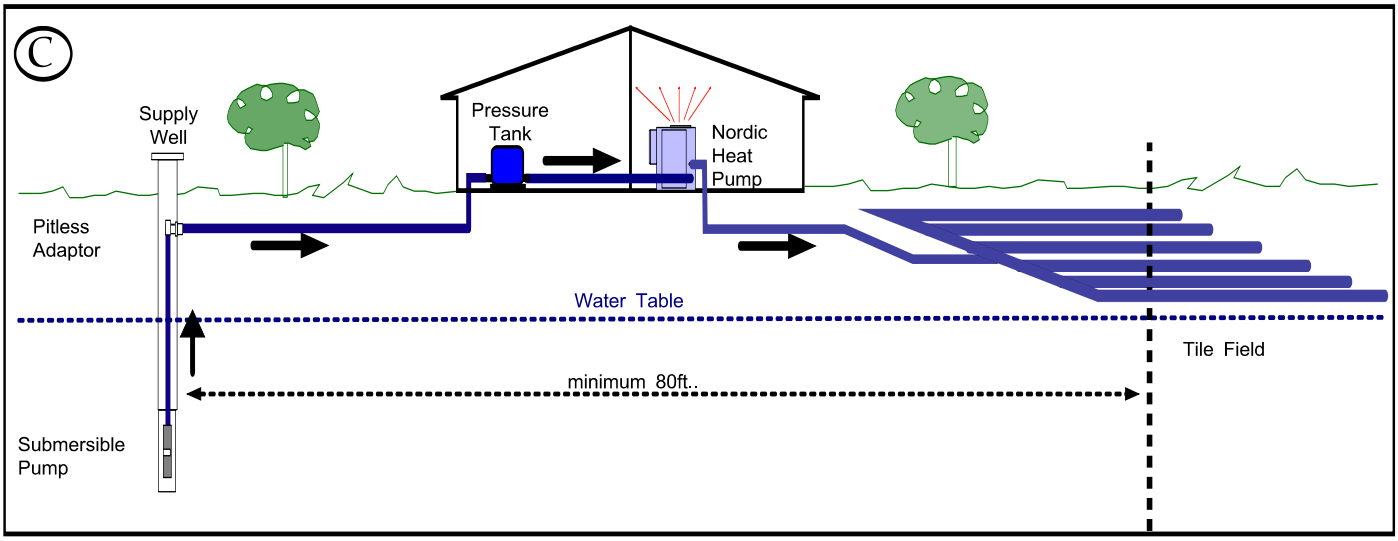
Drawing Name: Dual-Flow Groundwater (Well) Installation for Size 25-75 Heat Pumps

Size	Drawing Number	REV	SHEET
A	001822CDG	01	1 of 1

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	Drawing Name: Ground Water Disposal Methods
					Approved By (ENG): Chris Geddes	Date: 04 FEB 08	
01	Initial Release	C. GEDDES	C. GEDDES	04 FEB 08	Approved By (MFG):	Date:	Size: A
REV	ECO #	IMPL BY	APVD BY	DATE	Approved By:	Date:	Drawing Number: 000619INF; REV: 01; 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. It is recommended that heating zoning be done with the hydronic side instead. 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 show 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 **Indoor Airflow Data** in the **Model Specific Information** section 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 **95º-105ºF (35-40ºC)**, 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 collar 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 16 - Number of Air Grills

Model	# of Grills (@100 cfm)
45	12
55	15
65	19
75	21
80	24

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.

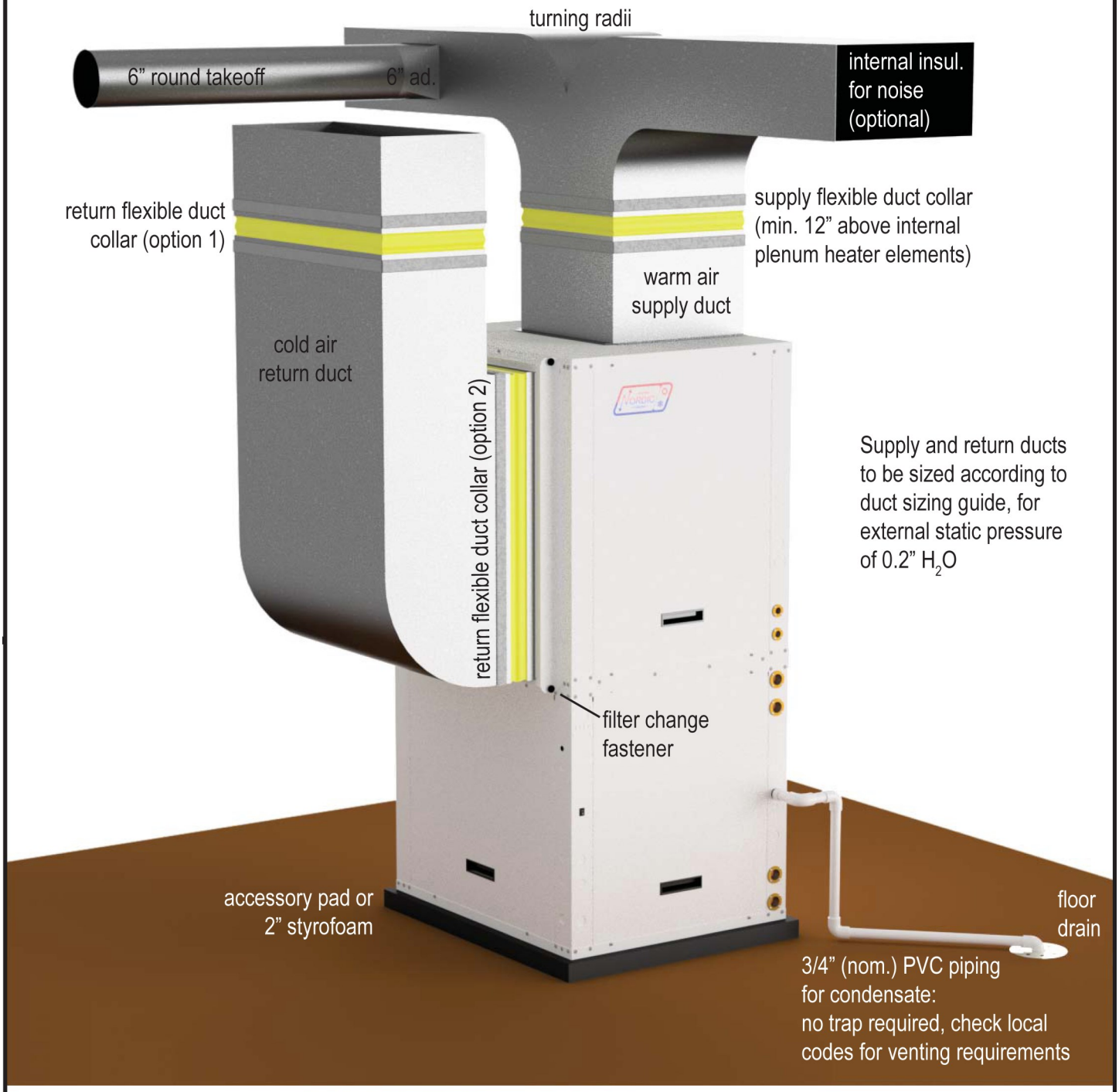
Thermostat Location

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** section. 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 - TF Series



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

REV	ECO#	IMPL BY	APVD BY	DATE
01	Initial Rel.	Dan Rheault	Dan Rheault	9-Jun-2017

Drawn By: Dan Rheault	Date: 9-Jun-2017	
Checked By: Dan Rheault	Date: 9-Jun-2017	
Eng. Approved By	Date	
Mfg. Approved By	Date	
Approved By	Date	

MARITIME GEOTHERMAL LTD.
P.O. Box 2555
170 Plantation Rd.
Petitcodiac, NB CANADA E4Z 6H4

Drawing Name: **Typical Duct & Condensate Connections - TF Series**

Size	Drawing Number	Revision	Sheet
LET	002222PDG	01	1 / 1

TABLE 17 - Duct Sizing Guide (external static of 0.20" H_2O)

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				

Operation

BACnet Control

If controlling the system via the BACnet interface, skip the entire **Operation** section. In this case, see the **BACnet Interface** section later in this manual for network specification and BACnet object names.

Air Thermostat Operation

Demand for room heating or cooling through the ducted air system will come from a 24V 3H/2C room thermostat, described in the **Wiring** section. 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)** section.

Hydronic Temperature Control

One of the features of the TF's GEN2 Control Board is built in aquastat functionality known as "Setpoint Control". This is an internal routine to sample the indoor water OUT temperature to determine if hydronic heat is required; both water IN and OUT temperatures are measured using sensors on water lines inside the unit. The indoor circulator pump is turned on at regular intervals to refresh the water temperature. If sampling is not desired, there is the option to use an external accessory temperature sensor.

There is also provision to connect an external aquastat or controller instead of using this routine, for example if two water loops with different setpoints are being heated.

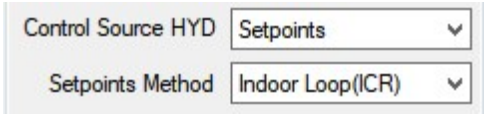
1. Hydronic Heating: Setpoint Control

It is recommended that this method be used to control the system's hydronic heat demand since it eliminates the need for an external temperature sensor or aquastat.

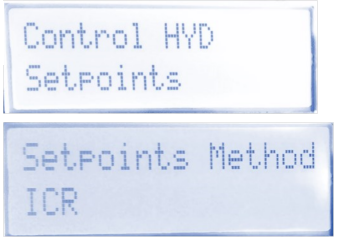
There are two options for Setpoint Control, Indoor Loop (ICR) method and HTS/CTS method.

Setpoint Control Method 1 - Indoor Loop (ICR)

PC APP: Tools-->Configuration



LCD Interface: Configuration



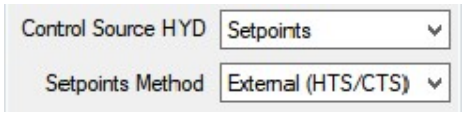
This is the default method and uses the Indoor OUT temperature probe inside the unit for temperature control. Its value is displayed in the **Hot Tank** box on the PC App's **View --> Setpoint Control** screen. If this temperature shows **NC**, then either the probe is not connected to the board or there is a problem with it.

The heat pump will cycle the indoor circulator on and off when the unit is idle or in air heating/cooling mode, in order to sample the water temperature. When hydronic heating mode ends, the indoor circulator will continue to run for 30 seconds. It will then cycle with an OFF time and ON time as set by the **Set ICR Sampling** popup which appears when ***SET*** is clicked on the **View --> Setpoint Control** screen. The timer counts down the time remaining before the next switch between ON/OFF. The indoor circulator indicator will indicate when the circulator is ON, OFF or SAMPLING. The default sampling times are 2 minutes ON and 6 minutes OFF. The LCD interface will also indicate when the ICR is sampling (ON). The ***Timer Override*** button will reduce the countdown timer to 10 seconds. When sampling is done, stage 1/2/AUX water heating will be initiated if water temperature is below the corresponding activation point.

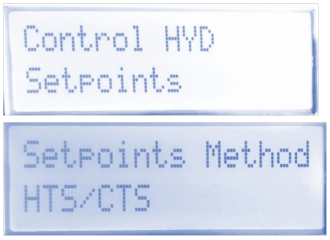
See below, and also the **PC Application (PC App)** section for full screenshots of the various windows.

Setpoint Control Method 2 - External HTS/CTS

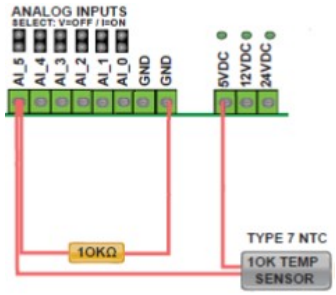
PC APP: Tools-->Configuration



LCD Interface: Configuration



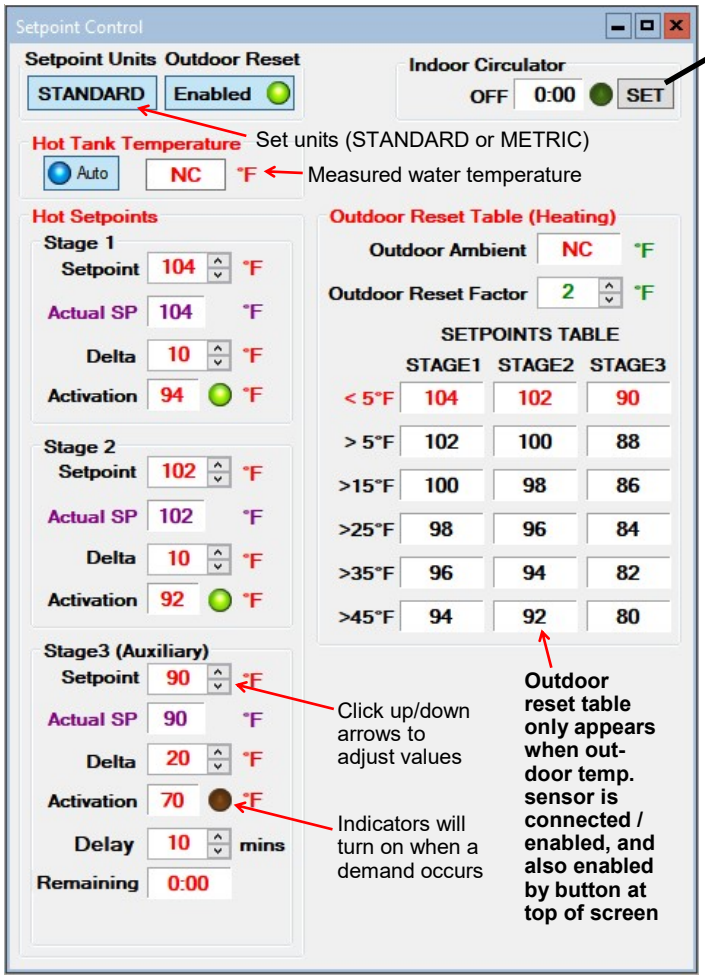
When this method is used, no indoor circulator control for temperature sampling will occur. It requires an external temperature sensor placed in a dry well in the top of the buffer tank. Its value is displayed in the **Hot Tank** box on the PC App's **View --> Setpoint Control** screen. If this temperature shows **NC**, then either the probe is not connected to the board or there is a problem with it.

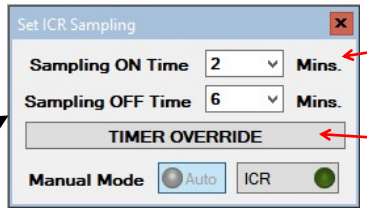


A 10K Type 7 (or Type 3) NTC thermistor along with a 10K 1% or better resistor must be connected to the control board in order to use the External HTS/CTS method. Connect the sensor to the AI_5 input as shown above and on the wiring diagram (SCH) in the **Model Specific Information** section. Remove the AI_5 jumper on the control board.

For both setpoint control methods, hydronic temperature setpoints are controlled through the LCD interface or PC App **(View-->Setpoint Control)**.

The **Setpoint Control** screen looks like this for both Method 1 (Indoor Loop) and Method 2 (HTS/CTS).





WARNING: When switching to Manual Override mode, the Activation no longer responds to the Setpoint Control values (i.e. if a stage is on it will not turn off when the setpoint is reached . Go to the Control Panel to turn demand ON/OFF with the Stage buttons when in Manual Override Mode .

TABLE 18 - Typical Temperature Setpoints						
	Stage 1		Stage 2		Stage 3	
Item	°F	°C	°F	°C	°F	°C
Setpoint	**108**	***42***	**105**	***41***	**102**	***39***
Delta	**8**	***4***	**8**	***4***	**8**	***4***
Activation *	**100**	***38***	**97**	***37***	**94**	***35***
Delay					**10 minutes**	
*Activation is determined by the Setpoint and Delta values						

If using well-designed in-concrete-floor heating, the heating setpoints may be able to be lowered. Lower heating setpoints will translate directly into a higher COP (efficiency). Heating setpoints should be set to the lowest values that still maintain an acceptable temperature in the building on the coldest day of the year; this may take some trial and error. Increasing Delta values will also increase efficiency due to longer runtimes, and lead to less wear on compressor due to a reduced number of compressor starts.

The maximum water temperature setpoint is **120°F / 49°C**.

Outdoor Reset

Lower heating setpoints will translate directly into a higher COP (efficiency), so when **Control Source HYD** is set to **Setpoints**, an optional Outdoor Reset control algorithm is available for heating mode, which reduces the heating temperature setpoints at warmer outdoor temperatures. An accessory outdoor temperature sensor is required, and it should be enabled in the PC App's **Tools-->Configuration** or through the LCD. Then click on the **Outdoor Reset** button at the top of the **Setpoint Control** window. The button will change to say Enabled, the indicator will come on and the Outdoor Reset Table will appear.

The table is created by subtracting the value of the Outdoor Reset Factor from the original setpoints once for each table row. The table row in use based on current outdoor temperature is shown in red.

Summer Setback

The hydronic heating system may be idle for several months in the summer. In this case, the heat pump may be put in **Summer Setback** mode via the PC App's **Tools--> Configuration** window or the LCD interface. It may also be activated by a field-installed switch; see **Wiring** chapter and the wiring (schematic) diagrams in the **Model Specific Information** chapter.

Summer Setback disables stage 3 (AUX), drops setpoints to 70°F (21°C), and decreases temperature sampling frequency to 2 days. This minimizes electric power usage while keeping cast iron head circulation pumps operational.

2. Hydronic Heating: Signals Control

PC APP: Tools-->Configuration

LCD Interface: Configuration

Similar to BACnet control, with **Signals Control** the heat pump will turn the 2 compressor stages on and off and activate cooling mode when it is told to by 24VAC signals. These are provided via external dry contacts, most often from a 2-stage aquastat or aquastats (available as accessories). See **Wiring** section. The heat pump's internal control logic will not be used, except to limit temperatures and report operating data and alarms.

Most installations will instead use **Setpoint Control**; however, **Signals Control** provides control flexibility for certain situations, for example if two water loops with different setpoints are being heated. Temperature settings similar to those outlined in the previous **Setpoint Control** section should be used.

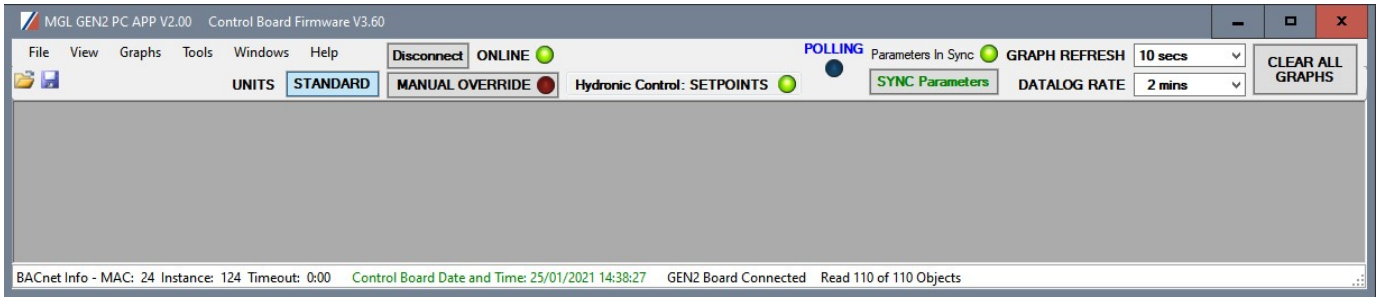
When using Signals Control, the backup tank element thermostat can be set to maximum, allowing the electric elements to be controlled by an external contactor placed in the power supply connections (see diagrams in **Wiring** section). The contactor can be connected to stage 2 of the heating aquastat via an optional 0-2 hour timer. Alternatively, tanks with their own programmable controller can be set to run independently with a lower temperature setpoint than the aquastat(s).

PC Application (PC App)

NOTE: Before using the PC Application, refer to **Appendices** for installation instructions for the PC Application and USB driver for the COM port. Both must be installed in order to run the PC App and communicate with the control board.

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, the number of Objects available and Read should appear (they should be the same) and the Polling LED will begin to flash. The PC time and date will appear at the bottom left corner of the screen. Clicking on "Control Board Date and Time" will display the current control board date and time. 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 under the current name.
File-->Save As: Save the current page arrangement under a new name.
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.

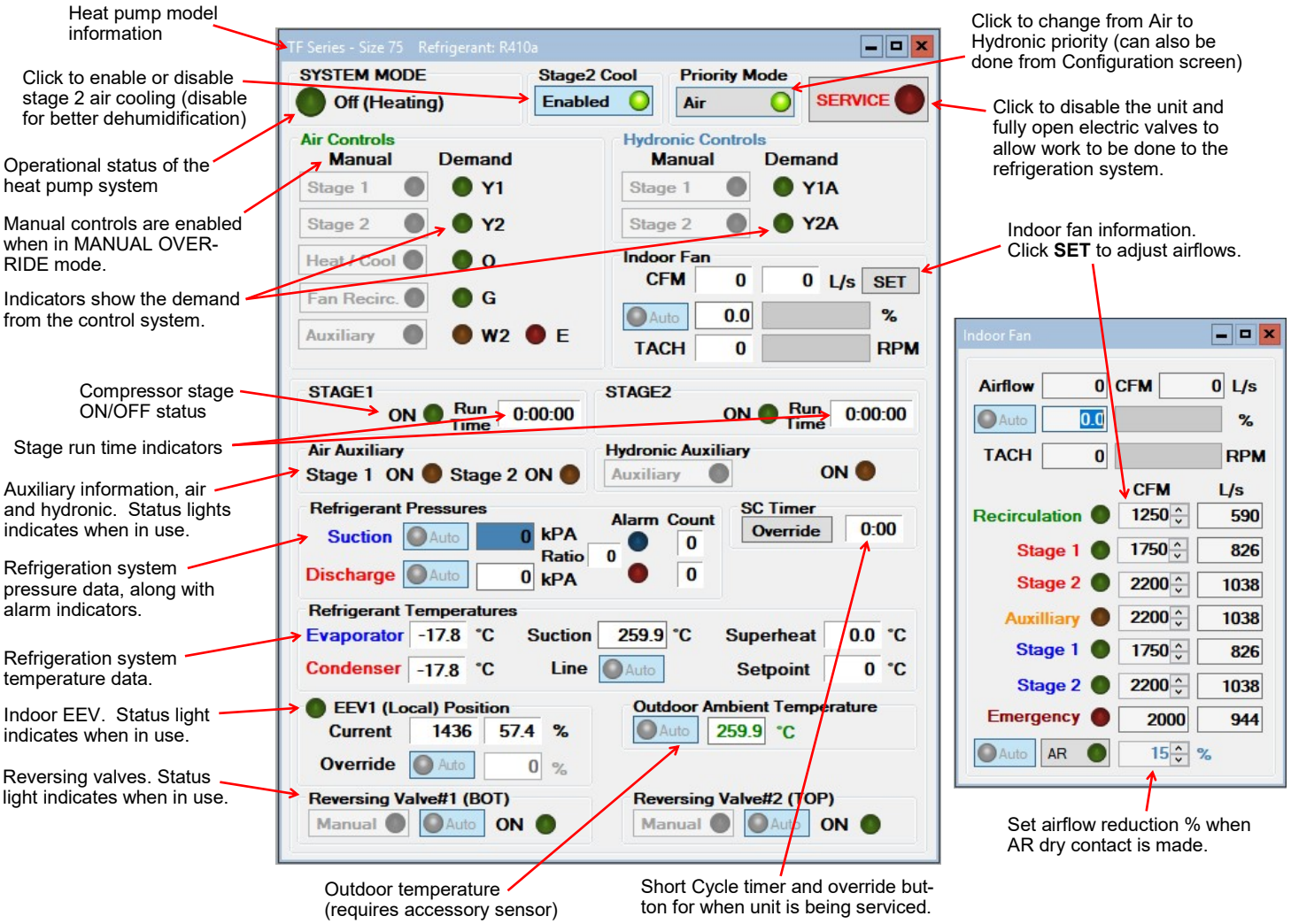
Help Menu: This shows information about the PC Application.

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

View Menu:

This menu handles all of the operational viewing screens. Clicking on the View submenus will open the page in the PC APP's frame. The next few pages of the manual show screenshots of each of the pages along with some descriptions of what is on each page.

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



View-->Setpoint Control:

Shows the on-board temperature control screen. This screen is only available when **Control Source HYD** on the Configuration Page is set to **Setpoints** (not **Signals** or **BACnet**).

Refer to the **Operation** section earlier in this manual for details.

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 Timer*** will start. When the ***SC Timer*** expires the compressor will re-start. If no further alarms occur within ***Count Reduce Time***, the alarm count will be reduced by 1. If another alarm occurs within ***Count Reduce Time*** (see **Configuration Page**) 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*** 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). Requires current sensor accessory.

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.

Comp. Not Pumping: 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).

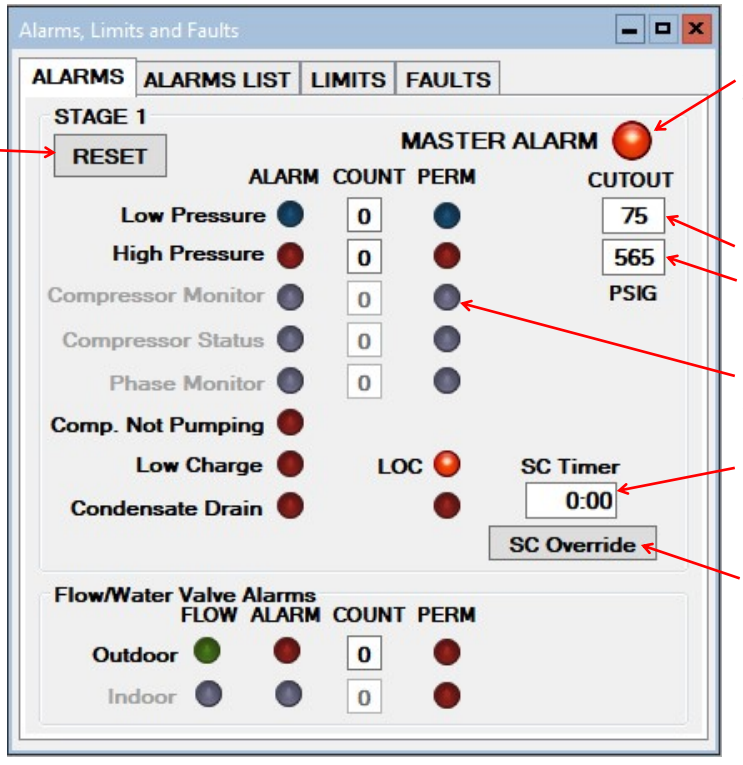
Condensate Drain: This alarm occurs if fluid level in the condensate tray rises to the level of the sensor (if equipped).

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.

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

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 resetting 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.

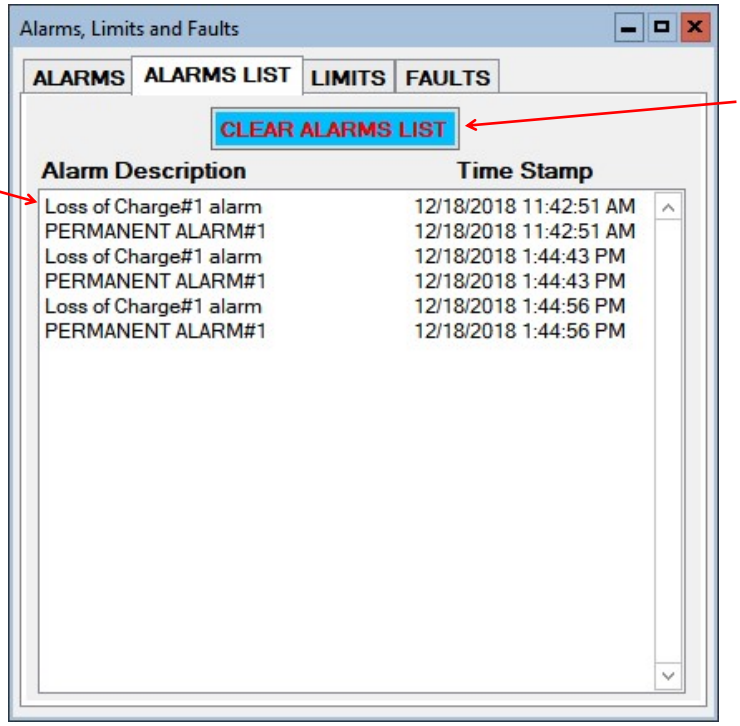
Short Cycle Timer counts down time until the next compressor start is allowed.

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

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

This tab show a history of alarms that have occurred since the PC APP was connected to the control board. This list will be lost when the PC APP is disconnected.

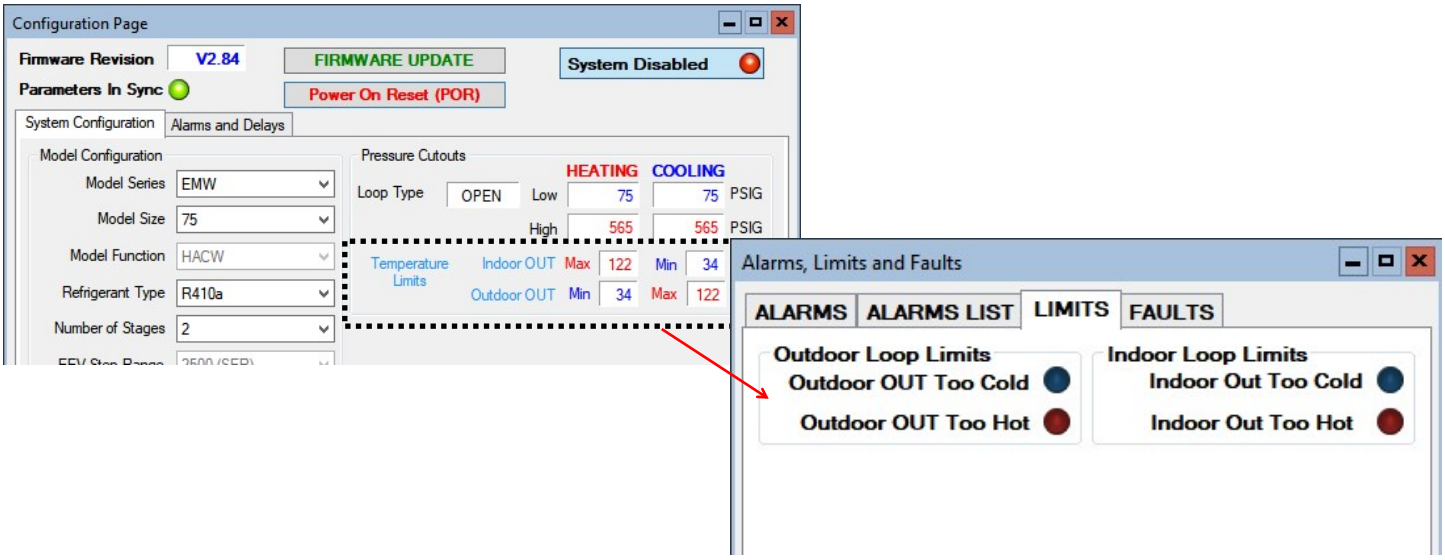
Each alarm that occurs while the PC APP is connected to the control board will appear here. The alarm type and a time stamp will be shown. The alarms list will be erased when the PC APP is disconnected from the control board.



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.



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

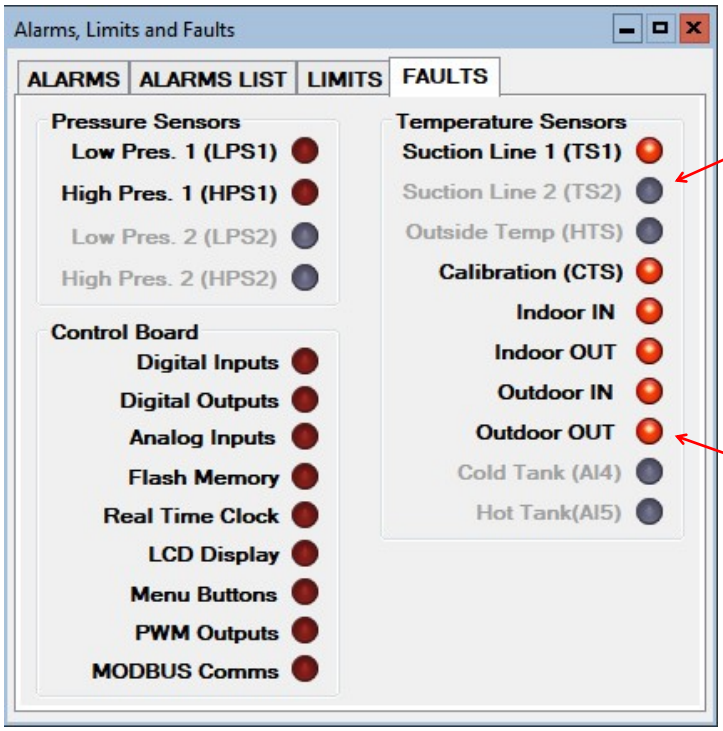
This tab shows hardware faults that could occur. If one of these faults occurs there may be a problem with the control board hardware, with LCD interface and buttons, or with a sensor.

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.

IMPORTANT NOTE: If the Indoor OUT (I_OUT) probe is faulty or disconnected, neither hydronic heating nor the auxiliary will operate if using Setpoint Control. They will continue to operate under Signals or BACnet control.

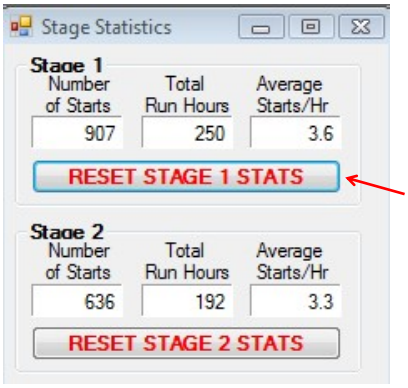


Greyed out do not apply.

Fault Indicators

View-->Stage Stats:

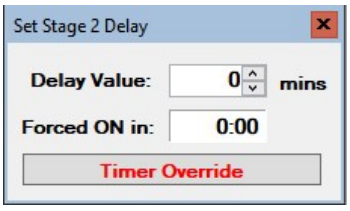
The compressor information: number of starts, run hours and starts per hour.



Erase the compressor statistics (only for if a compressor should need to be replaced).

View-->Set Stage 2 Delay:

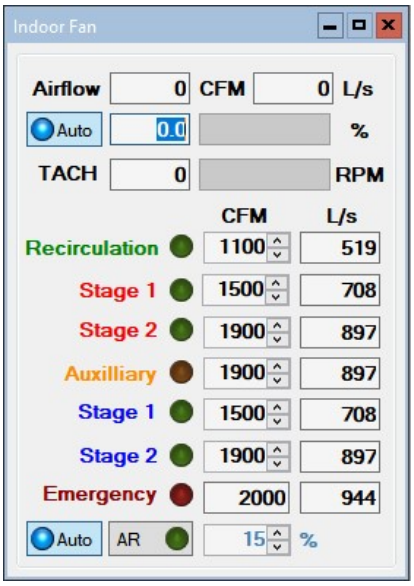
Sets the delay before stage 2 is engaged on a stage 1 demand. ("0" = no stage 2 engaged on a stage 1 call)



View-->Indoor Fan

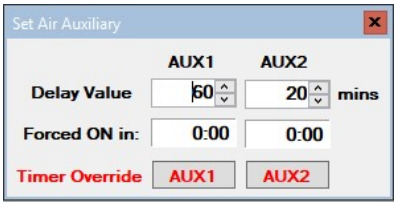
Shows the settings screen for the indoor fan/blower. Airflow may be adjusted up or down by the user within the allowed range. See **Indoor Airflow Data** section in the **Model Specific Information** chapter for airflow ranges.

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



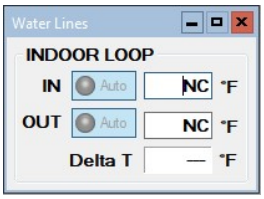
View-->Set Air Auxiliary Delays

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.



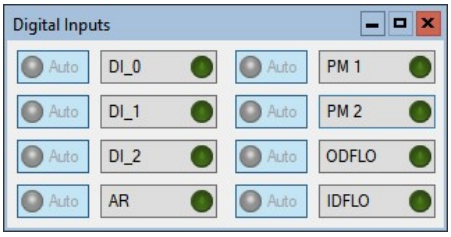
View-->Water Lines

Shows the water line temperatures.



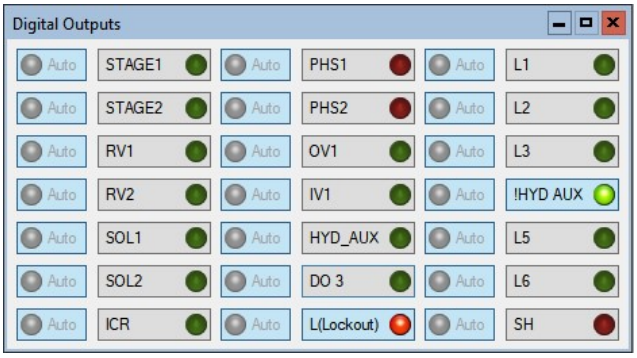
View-->Digital Inputs

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.



View-->Digital Outputs

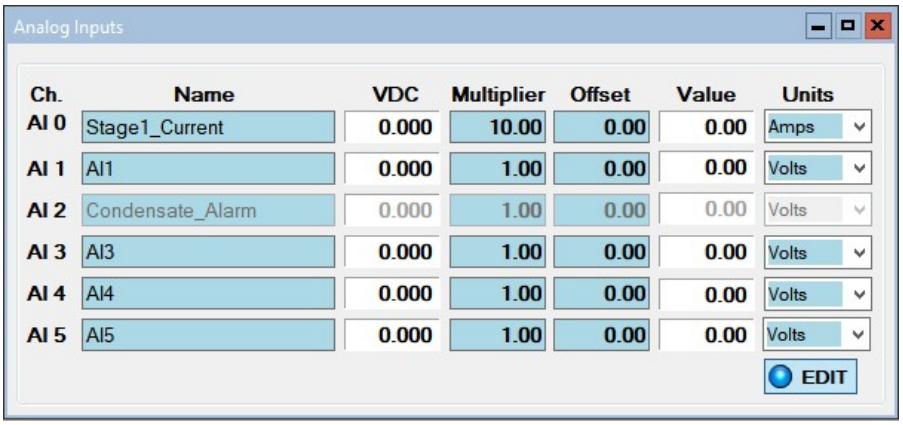
Shows the digital outputs and their individual status (ON/OFF). They may be individually controlled when in Manual Override Mode in order to facilitate troubleshooting.
.



View-->Analog Inputs

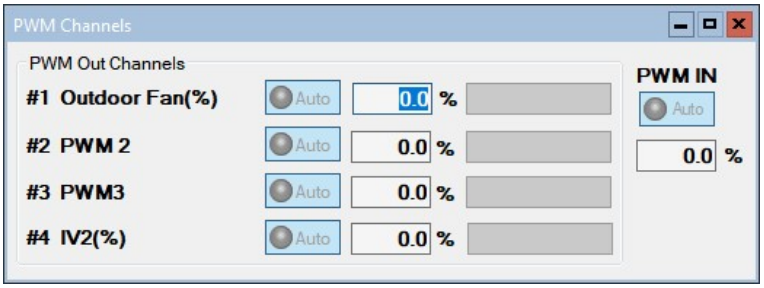
Shows the Analog inputs and their individual settings and values.

Click on the ***EDIT*** button to modify the blue boxes (button will now say ***SAVE***). For each channel a name may be selected (up to 16 characters), 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.



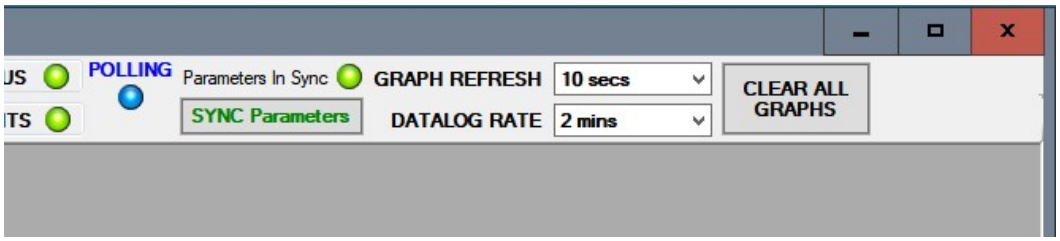
View-->PWM Channels

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.

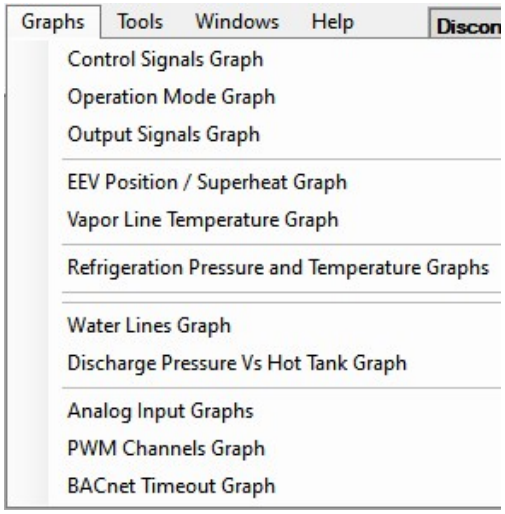


Graphs Menu:

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.



ON/OFF status of the system control signals (demands)

ON/OFF status of air heating, water heating, and air cooling modes

ON/OFF status of digital outputs

EEV position and resulting superheat

Suction temperature

Suction and discharge pressures, evaporating and condensing temperatures

Outdoor IN/OUT and Indoor IN/OUT temperatures and delta T

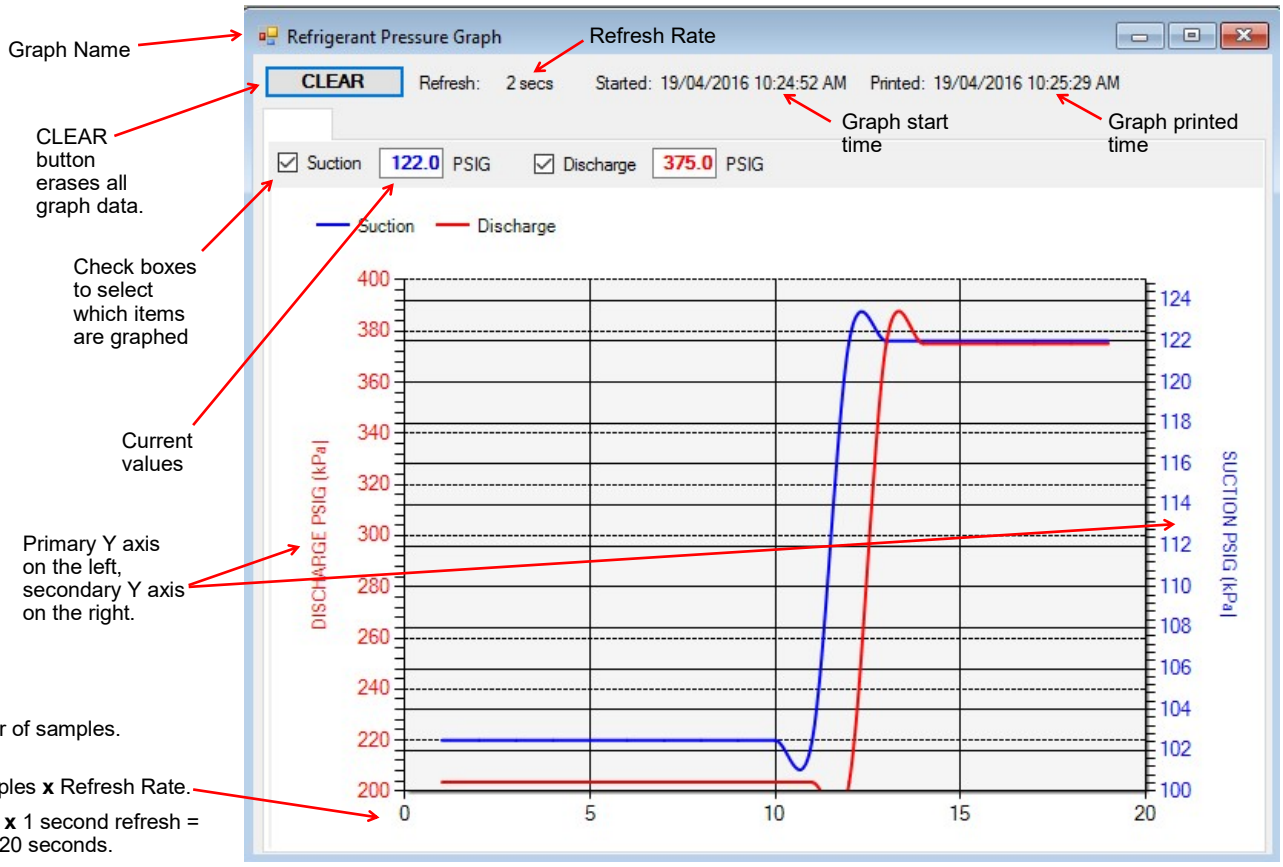
Discharge pressure vs tank temperature

All analog input channels (0-10VDC or 4-20mA).

All PWM / 0-10VDC output channels and one PWM / 0-10VDC input channel.

For troubleshooting synchronization with 3rd party BACnet controllers.

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.

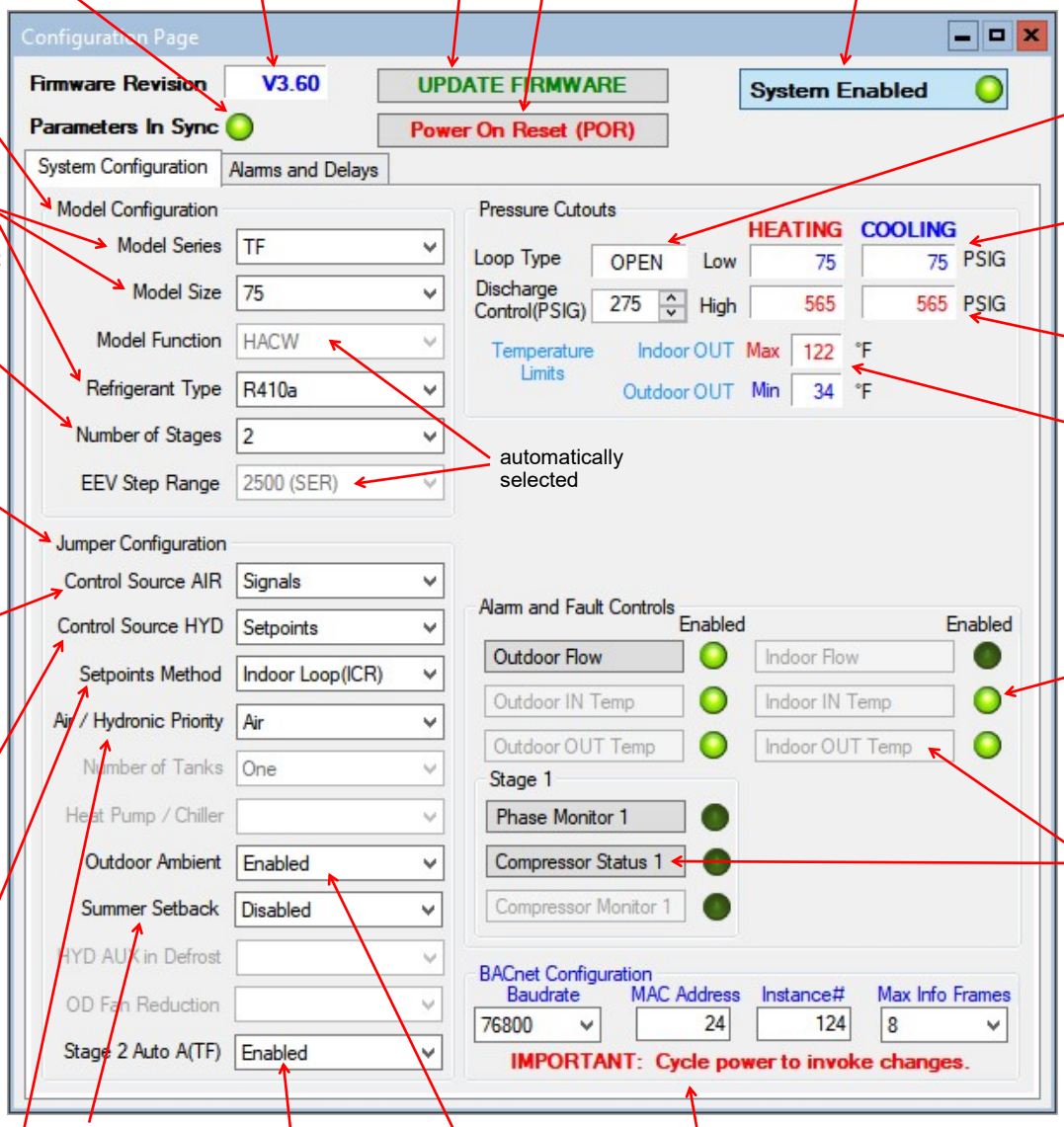


Tools Menu:

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.



Green when parameters have been updated, red during the update

Firmware revision can also be seen on the LCD during power up

Firmware update: see Appendix

POR: reset control system as would be done by cycling power

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

Model Configuration section to select the system type

Loop type as hardware selected by the closed loop jumper plug or open loop water valve harness

Select model series, size, & refrigerant (refer to unit nameplate; **will be set from factory**)

Low pressure cutouts determined by loop type (55 or 75 psig)

Compressor: 2 stage ("T" in unit model number) or 1 stage ("S" in unit model number)

High pressure cutout determined by refrigerant type

Temperature limits determined by series and loop type

automatically selected

Jumper configuration section to select system options. Greyed out means N/A.

Selects how the air heating/ cooling functions will be controlled, either BACnet or Signals.

The Enabled indicators show which alarms are enabled

Selects how the water heating function will be controlled: BACnet, Setpoints, or Signals.

If an alarm is mandatory or not available, the Enable button will be greyed out. For optional alarms (requiring Phase Monitor or Current Sensor accessories) the Enable button will be available; click to enable.

Selects whether or not to use the internal temp sensor (default) or external sensor(s). **This is for Setpoint Control operation only.**

Air or Hydronic priority. Can also be set from button on Control Panel screen.

When Summer Setback is enabled: disables stage 3 (AUX), drops setpoints to 70°F (21°C), and decreases temperature sampling frequency to 2 days. Can also be set through LCD.

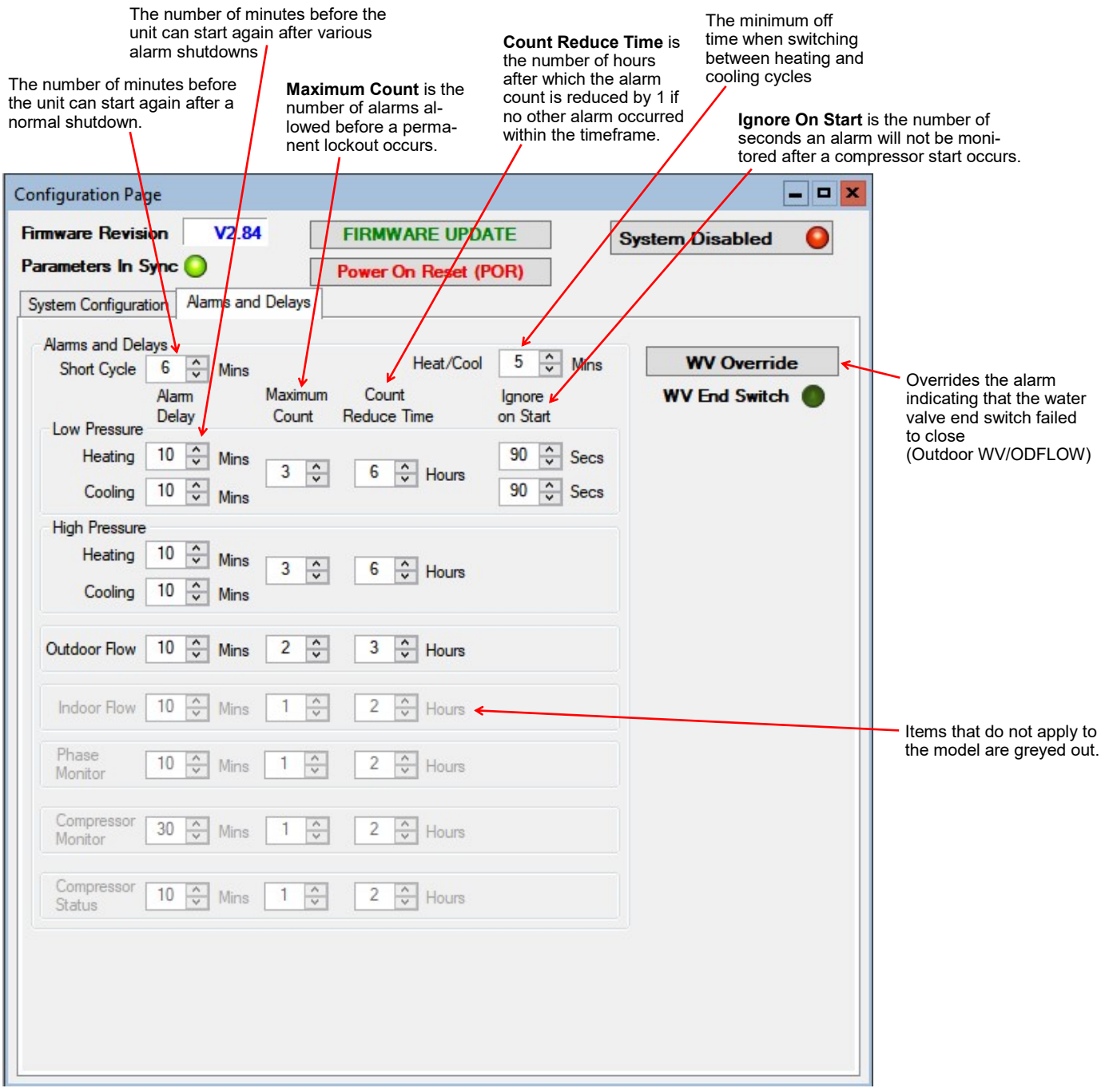
Selects whether or not compressor stage 2 is automatically activated whenever there is a simultaneous demand for air and water heat, so that the priority demand can be satisfied as soon as possible.

Enable outdoor temperature sensor accessory for Outdoor Reset function

If Control Source HYD is set to **BACnet**, set communication parameters. Disconnect PC App and cycle unit power to register changes to BACnet parameters.

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.

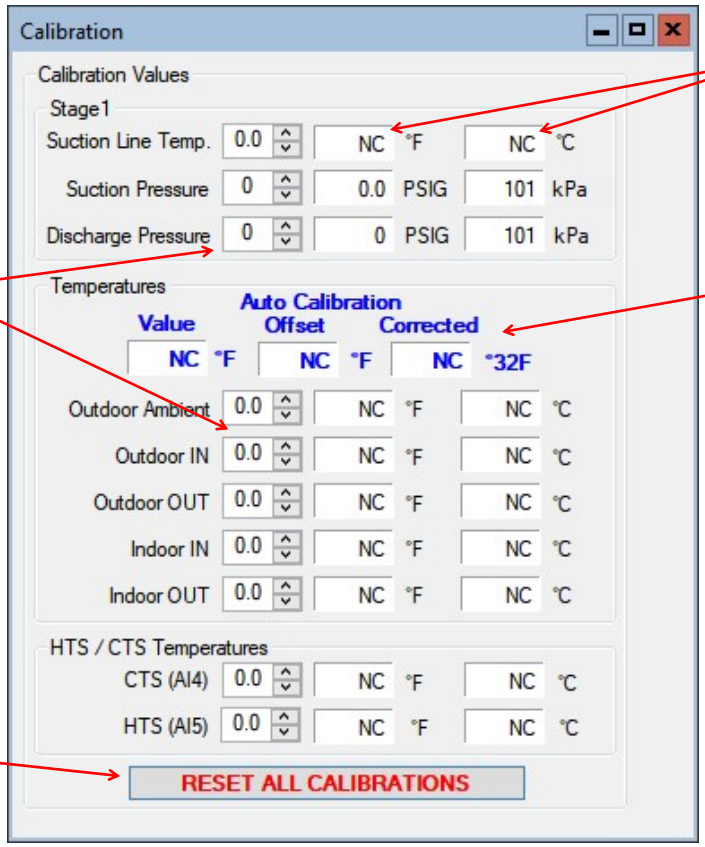


Tools-->Calibration:

Generally there is no need for calibration.

The suction and discharge pressures may be calibrated in increments of 1 psi if there is a discrepancy in the readings when compared to a known good reference.

Temperature sensors may be adjusted in increments of 0.1°F. There is an **AUTO CALIBRATION** routine in the program that continually calibrates the temperatures sensors against an on board reference resistor by applying an offset to the temperature sensors. Calibration adjustments made here are in addition to the Auto Calibration routine.



Current values in standard and metric.

Calibration adjustments

Temperature Auto Calibration information. The offset is applied to all temperature sensors. Calibration adjustments made to each sensor are in addition to the Auto Calibration values.

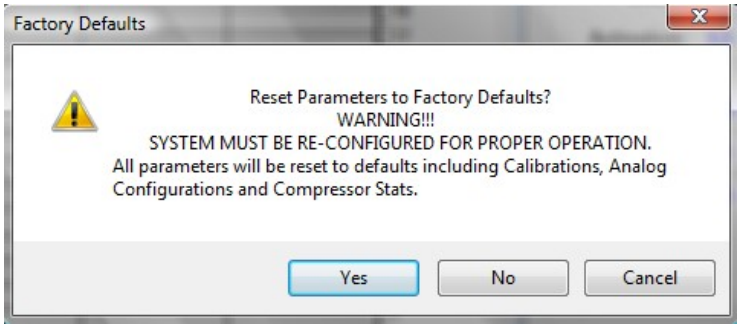
Click on the RESET ALL CALIBRATIONS button to clear all calibration data. A popup window will appear for confirmation.

Tools-->Reset to Factory Defaults:

This will reset all parameters to default values.

THE SYSTEM MUST BE RECONFIGURED AFTER A RESET IS PERFORMED.

A reset will default the system to a two stage ATW Series Size 65 with Signals as the control source. Calibrations, alarm delays, analog configurations, compressor statistics, and Setpoint Control values will be returned to defaults as well.



Tools-->Set Date and Time:

This will synchronize the date and time of the control board with the computer's date and time, and will be necessary for new units or units that have been powered off for several days or more.

The date and time of both the computer and the control board are shown in the status bar at the bottom of the PC App.

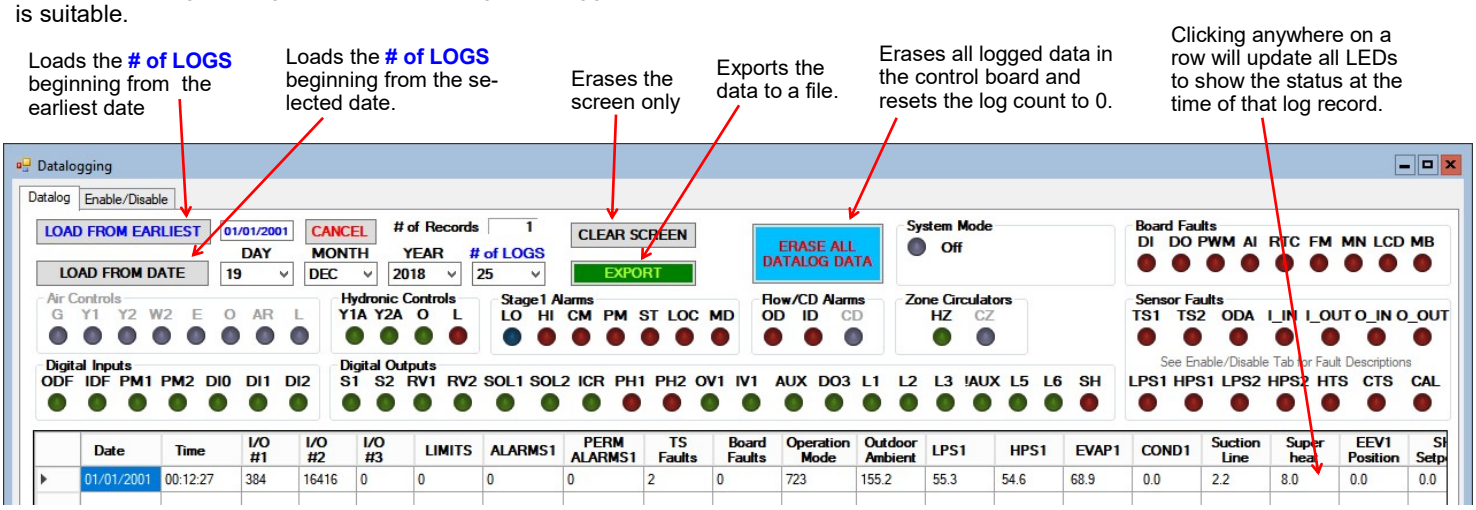
Tools-->Datalogging (Datalog tab):

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

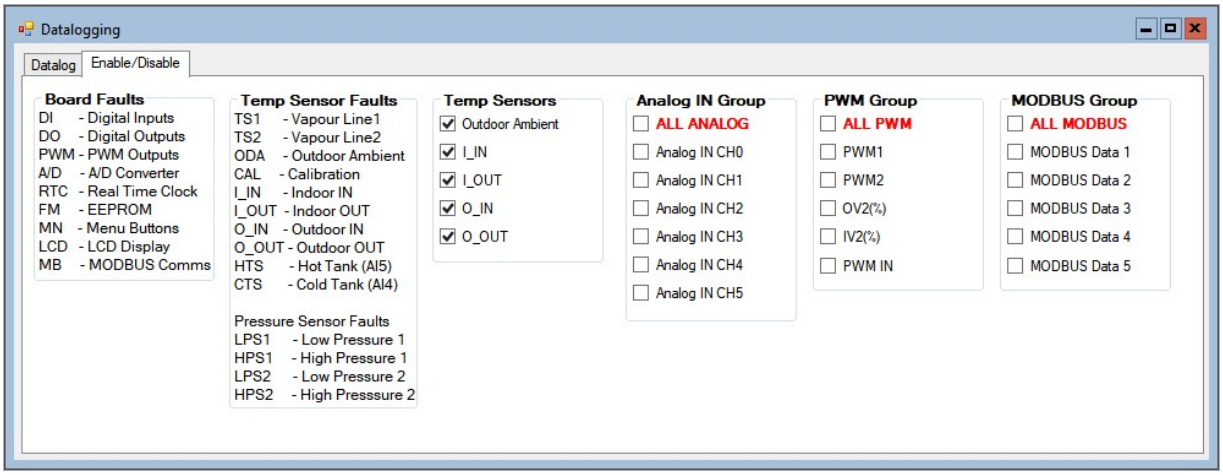
The maximum number of datalog records is 32,224, which will take 45 days to fill up at the default recording rate of 2 minutes.

Note that loading datalogs is time-consuming. It is suggested to leave the ***# of LOGS*** at **25** until it is shown that the start date selected is suitable.



Tools-->Datalogging (Enable/Disable tab):

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

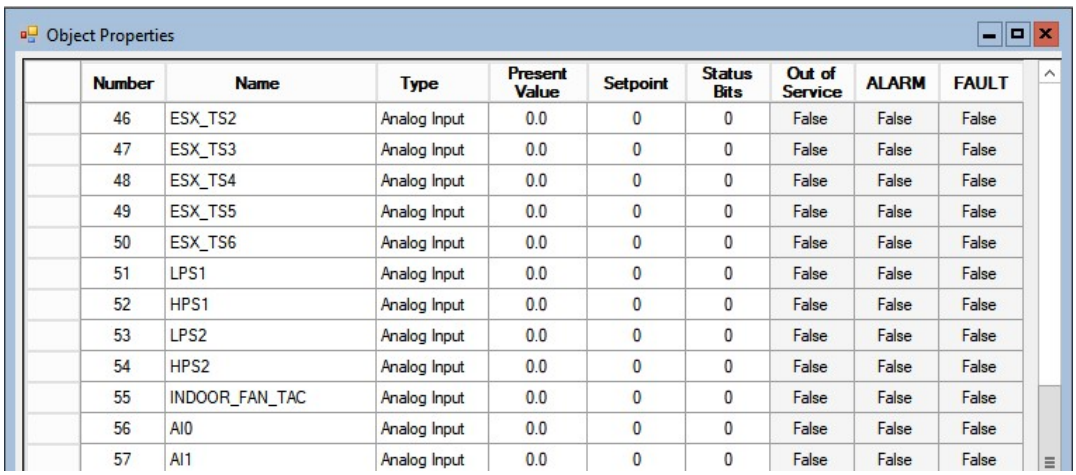


Tools-->MODBUS:

For future use.

Tools-->Objects:

This is a window to display the runtime data, which is not stored when the power is turned off. No changes are possible.

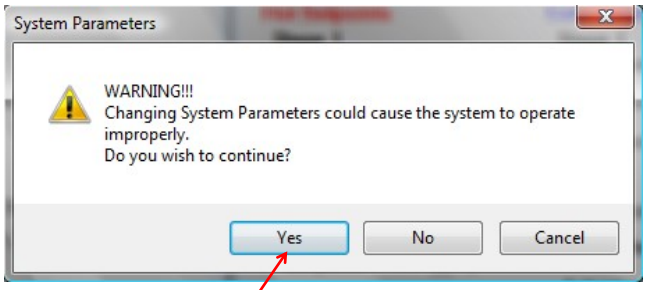


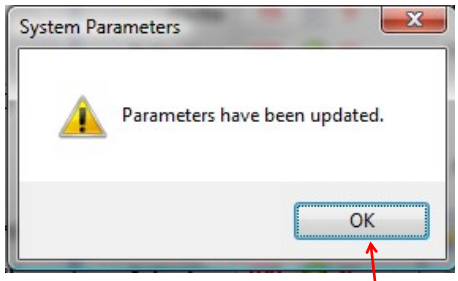
Number	Name	Type	Present Value	Setpoint	Status Bits	Out of Service	ALARM	FAULT
46	ESX_TS2	Analog Input	0.0	0	0	False	False	False
47	ESX_TS3	Analog Input	0.0	0	0	False	False	False
48	ESX_TS4	Analog Input	0.0	0	0	False	False	False
49	ESX_TS5	Analog Input	0.0	0	0	False	False	False
50	ESX_TS6	Analog Input	0.0	0	0	False	False	False
51	LPS1	Analog Input	0.0	0	0	False	False	False
52	HPS1	Analog Input	0.0	0	0	False	False	False
53	LPS2	Analog Input	0.0	0	0	False	False	False
54	HPS2	Analog Input	0.0	0	0	False	False	False
55	INDOOR_FAN_TAC	Analog Input	0.0	0	0	False	False	False
56	AI0	Analog Input	0.0	0	0	False	False	False
57	AI1	Analog Input	0.0	0	0	False	False	False

Tools-->Parameters:

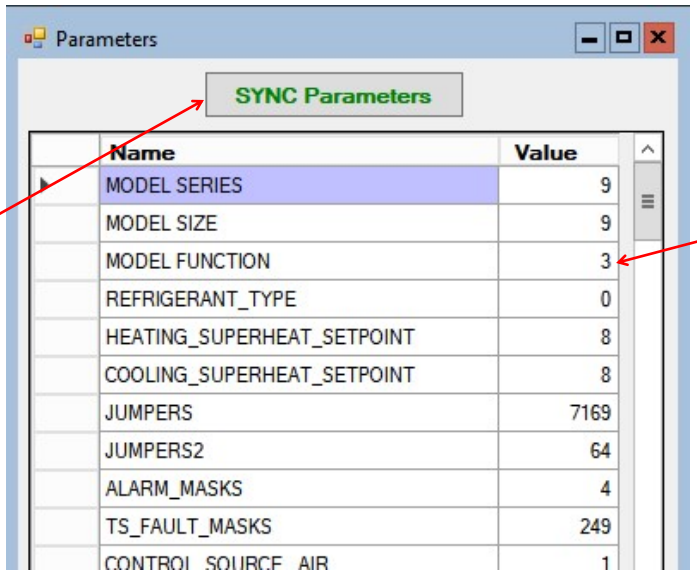
WARNING! The Parameters page is for advanced use only.
Changing parameter values can cause the system to stop functioning properly.

The parameters page shows all configurable memory spaces with their name and current value and allows them to be edited directly. To change a parameter value type in the new value and press ENTER.





Clicking on menu item ***Tools-->Parameters*** will display this warning. Click on **YES** to open the parameters page.

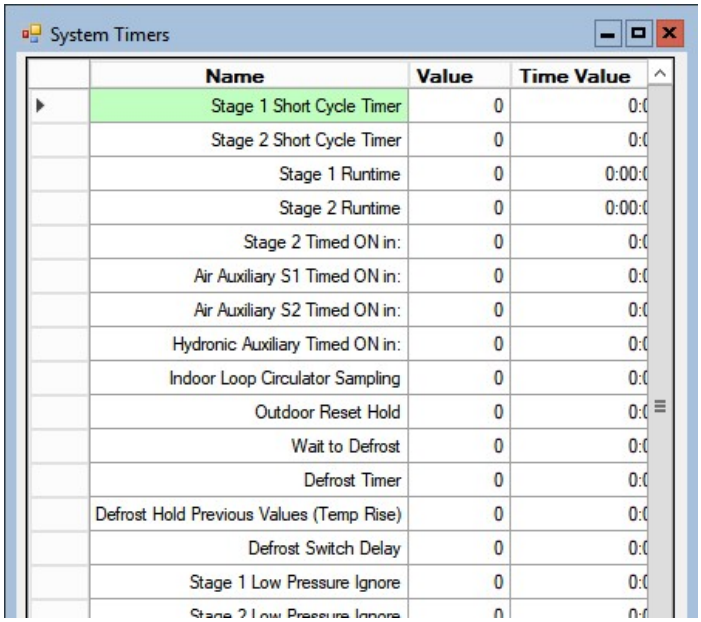


Click this button to reload the table with the values from the control board memory.

Type in the new value and press **ENTER**, the confirmation popup will appear, click on **OK**.

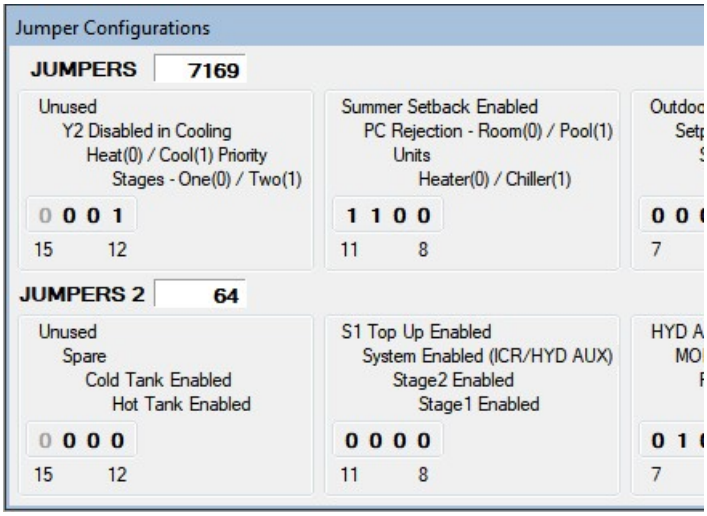
Tools-->SYSTEM TIMERS:

This page shows all internal timers by name along with their current values.



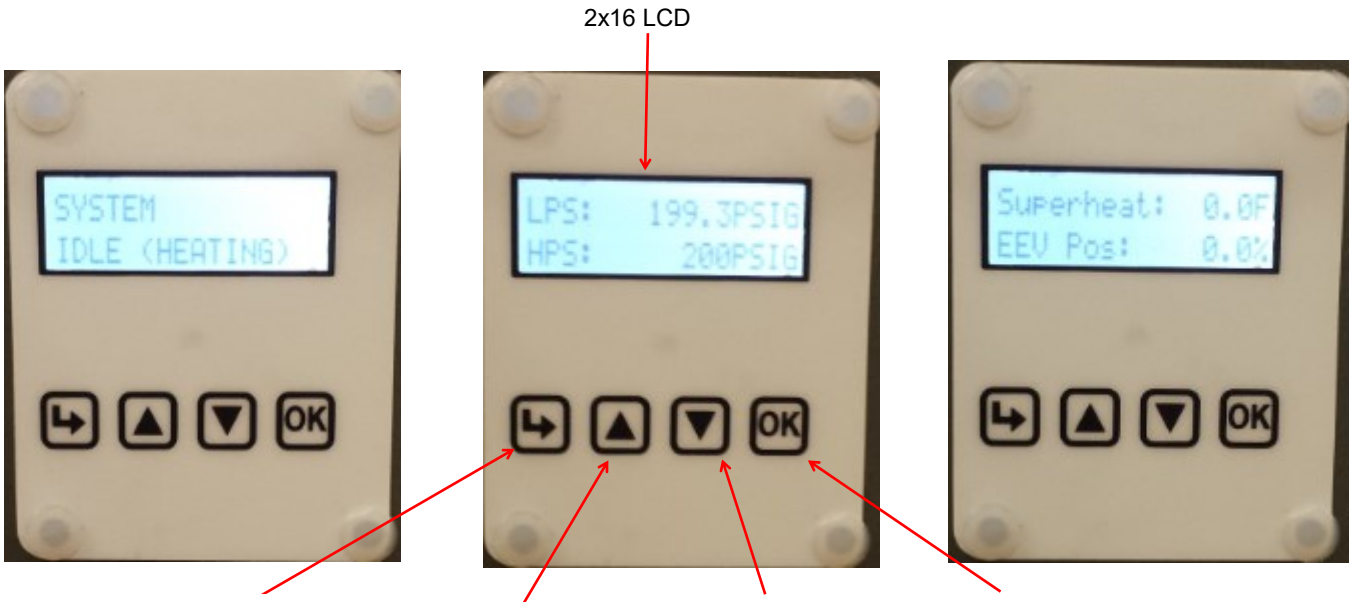
Tools-->Jumpers:

This page shows internal jumper configurations, for developers.



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.



Main Menu: This is a list of the various tools are used for system setup and monitoring.
The 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
Setpoint Control (only if using Setpoint control)	***— Setpoints***	***— Heating***	***— Stage 1 Setpoint***	Stage 1 stops when water temperature rises to this point.
			— Stage 1 Delta	Stage 1 starts when water temperature drops below setpoint by this amount.
			— Stage 2 Setpoint	Stage 2 stops when water temperature rises to this point.
			— Stage 2 Delta	Stage 2 starts when water temperature drops below setpoint by this amount.
			— AUX (S3) Setpoint	Stage 3 stops when water temperature rises to this point.
			— AUX (S3) Delta	Stage 3 time delay starts when water temperature drops below setpoint by this amount. (Stage 3 starts immediately if time delay is set to 0).
			— AUX (S3) Delay	Delays Stage 3 start by timer amount.
			— Outdoor Reset (only if enabled)	Temperature factor to use in the outdoor reset table.
Summer Setback	***— Enable Setback?***	***— Enable***		Enable summer setback.
		— Disable		Disable summer setback.
System EN/DIS	***— Enable System?***	***— Disable***		Disable compressor, auxiliary and ICR.
		— Enable		Enable compressor, auxiliary and ICR.

Main Menu Continued				
ENTER (From Main)	**ENTER (First Press)**	**ENTER (Second Press)**	**ENTER (Third Press)**	**Description**
Service Mode	***— Service Mode?***	***— No***		Do not enter Service Mode.
		— Yes		Enter into Service Mode.
EEV Control	***— EEV1***	***— Auto/Manual***	***— Auto***	Puts EEV in Auto mode
			— Manual	Puts EEV in Manual mode
		— Manual Position	***— EEV Position (%)***	Sets EEV to manual position
Configuration	***— Priority***	***— Air***		Sets the priority to air modes.
		— Hydronic		Sets the priority to hydronic mode.
	— Control AIR	***— BACnet***		BACnet control—see BACnet section.
		— Signals		Hardwired Signal control.
	— Control HYD	***— BACnet***		BACnet control—see BACnet section
		— Signals		Hardwired Signal control
		— Setpoints		On-board aquastat control—see SET-POINT CONTROL section.
	— Outdoor Reset	***— Enable***		Enables Outdoor Reset functionality
		— Disable		Disables Outdoor Reset functionality
	— Outdoor Ambient	***— Enable***		Enables the outdoor temperature sensor.
		— Disable		Disables the outdoor temperature sensor.
	— Setpoints Method	***— ICR***		Use Indoor Circulator Relay sampling
		— HTS/CTS		Use external temperature sensors
	— 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 (does not affect calibration 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.
		— Year	***— Year value***	Set the system year.
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 Ambient	***— 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
	— Indoor IN Temp	***— calibration adj.***		Calibration in 0.1°F intervals
	— Indoor OUT Temp	***— calibration adj.***		Calibration in 0.1°F intervals

NOTE: Calibration is generally not required. Pressure sensors may be calibrated against a known source if needed. 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.

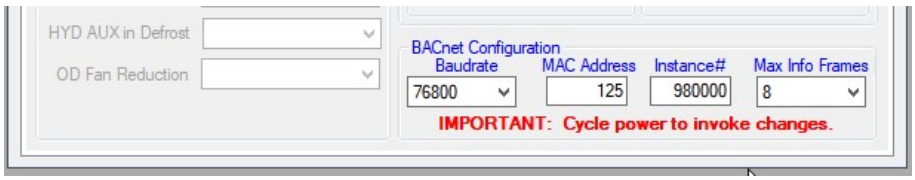
The connector on the control board is a three wire removable screw connector. The signals are as follows:
A: Communications line (+) (right pin)
B: Communications line (-) (middle pin)
C: Ground connection (left pin)

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.

TABLE 19 - BACnet OBJECTS - CONTROL SIGNALS (READ/WRITE)

Name	Data Type	ID	Property	Description
SYSTEM_Y1A	Binary Value	BV0	Present Value	Demand for hydronic (water) heating (active is on)
SYSTEM_Y2A	Binary Value	BV1	Present Value	Demand for stage 2 hydronic (water) heating (active is on)
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 20 - 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
			2	Hydronic (water) heating
			9	Air heating off
			10	Air cooling off
			11	Hydronic (water) heating off
Note: Object is type Analog Value but value will always be an integer value.				

TABLE 21 - BACnet OBJECTS - DATA (Read Only)					
	Name	**ID**	**Property**	**Units**	**Description**
Type - Analog Input	AI0 (Comp1_Current)	AI0	Present Value	Amps	Compressor current draw (AI0) - requires accessory
	AI1 (Comp2_Current)	AI1	Present Value	User	User defined (0-5VDC or 4-20mA)
	AI2	AI2	Present Value	User	User defined (0-5VDC or 4-20mA)
	AI3	AI3	Present Value	User	User defined (0-5VDC or 4-20mA)
	AI4 (CTS)	AI4	Present Value	degF (degC)	User defined (0-5VDC or 4-20mA)
	AI5 (HTS)	AI5	Present Value	degF (degC)	Hot tank temperature from sensor - requires accessory
	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)	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)	Outdoor Ambient temperature - requires accessory
	O_IN	AI21	Present Value	degF (degC)	Outdoor IN temperature
	O_OUT	AI22	Present Value	degF (degC)	Outdoor OUT temperature
	I_IN	AI23	Present Value	degF (degC)	Indoor IN temperature
	I_OUT	AI24	Present Value	degF (degC)	Indoor OUT temperature
Type - Analog Value	PWM_IN	AV0	Present Value	%	PWM input (from external source)
	PWM1 (OD Fan)	AV1	Present Value	%	PWM output value (spare)
	PWM2	AV2	Present Value	%	PWM output value (spare)
	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
	Sensor Faults	AV10	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	Indoor circulator control
	DO0 (OV1)	BO3	Present Value	N/A	OV1 (to 24VAC Outdoor Loop water valve)
	DO1 (IV1)	BO4	Present Value	N/A	IV1 (to 24VAC Indoor Loop water valve)
	DO2 (HYD_AUX)	BO5	Present Value	N/A	Hydronic Auxiliary ON
	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
Type - Binary Value	CONTROLS	BV9	Present Value	N/A	Control indicator: 0=local (man.override), 1=remote (BACnet)
	Outdoor Flow	BV10	Present Value	N/A	Outdoor loop water valve ON
	Indoor Flow	BV11	Present Value	N/A	Indoor Loop flow switch - requires accessory
	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 22 - BACnet OBJECTS - LIMITS Description (Read Only)				
Name	**ID**	**BIT #**	**Decimal Value***	**Bit Description**
Limits (Present Value)	**AV6**	1	2	High Indoor OUT temperature
		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 23 - BACnet OBJECTS - ALARM Descriptions (Read Only)			
Name	**Data Type**	**ID**	**Description**
AI0 (Comp1 Current)	Analog Input	AI0	Status alarm (Start / Stop Failure) - requires current sensor accessory
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	Indoor loop flow alarm - requires accessory
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 - requires accessory
		14	16,385	Outdoor loop water valve
		15*	32,769	Indoor loop flow alarm - requires accessory
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				

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

TABLE 24 - BACnet OBJECTS - FAULT Descriptions (Read Only)			
Name	**Data Type**	**ID**	**Description**
AI4 (Cold Tank)	Analog Input	AI0	N/A
AI5 (Hot Tank)	Analog Input	AI1	Hot tank temperature sensor faulty or disconnected - requires accessory
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
Outside Ambient	Analog Input	AI20	Outside temperature sensor faulty or disconnected - requires accessory
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	Indoor IN temperature sensor faulty or disconnected
I_OUT	Analog Input	AI24	Indoor OUT temperature sensor faulty or disconnected

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	Outdoor Ambient temperature sensor - accessory
		3	8	Calibration temperature resistor plug
		4	16	Indoor IN temperature sensor
		5	32	Indoor OUT temperature sensor
		6	64	Outdoor IN temperature sensor
		7	128	Outdoor OUT temperature sensor
		8	256	N/A
		9	512	Hot tank temperature sensor on AI5 - accessory

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.

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

Startup Procedure

The TF-Series Two-Stage R410a 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.

Indoor Loop (Hydronic Loop):

1. Verify that all shutoff valves are fully open and there are no restrictions in the piping from the heat pump to the indoor 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 (if used) for the intended application. If applicable, 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 (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 & plenum heater.
3. Record the circuit breaker size and wire gauge for the heat pump & plenum heater.
4. Verify that the control connections to the unit are properly connected and all control signals are off, so that the unit will not start up when the power is turned on.
5. Verify that the circulator pumps are connected to the proper voltage terminals in the heat pump. Record the voltages of the circulator pumps.
6. Ensure all access panels except the 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 outdoor temperature (if sensor present), low (suction) pressure, high (discharge) pressure, superheat, EEV position and water in/out temperatures.

Preparation:

1. Turn the power on to the heat pump and set the thermostat(s) to OFF. 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).

2. Measure the following voltages on the compressor contactor and record them on the startup sheet: L1-L2, L2-L3, L1-L3.
3. Connect a USB cable between the USB connector on the board and a laptop with the PC App installed (recommended but optional).
4. Select the desired Control Source HYD via the PC APP Configuration Page or via the LCD interface Configuration Menu. **Set the water setpoints to a low value (e.g. 50°F) to prevent the compressor from coming on in water heating mode.**
5. Enable the system either with the PC App's Configuration Page **System Enable/Disable** button or via the LCD interface.

Air 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:
    1. Suction pressure
    2. Discharge pressure
    3. Duct Return temperature (poke a small hole in the flex collar and insert probe in airstream)
    4. Duct Supply temperature (poke a small hole in the flex collar and insert probe in airstream)
    5. Duct Delta T (should be between **22-32°F, 12-18°C**)
    6. Outdoor Loop Temperatures: In, Out, & Delta T (should be **5-8°F, 3-4°C**)
    7. 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).

Air 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:
    1. Suction pressure
    2. Discharge pressure
    3. Duct Return temperature
    4. Duct Supply Out temperature
    5. Duct Delta T
    6. 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.

Water Heating Mode:

1. Set air thermostat to "off". Adjust the Setpoint Control settings via the PC App or LCD (or adjust aquastat if used) to activate stage 1 and stage 2. The EEV will begin to open and the compressor will start, as will the circulator pumps.
2. Check the PC App or LCD interface. The suction and discharge pressures will vary based on the outdoor temperature and the indoor loop temperature, but they should be **90-110PSIG** and **260-360PSIG** respectively for a typical start-up.
3. Monitor the unit via the PC APP or LCD interface while the unit runs, and record the following after 10 minutes of run time:
    1. Suction pressure
    2. Discharge pressure
    3. Indoor Loop Temperatures: In, Out, & Delta T (should be **6-11°F, 3-6°C**)
    6. Outdoor Loop Temperatures: In, Out, & Delta T (should be **5-8°F, 3-4°C**)
    7. Compressor L1(C) current (black wire, place meter between electrical box and compressor)
4. Adjust the control setpoints to the desired buffer tank 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 - TF-Series Two-Stage R410a				
Installation Site		**Startup Date**	**Installer**	
City			**Company**	
Province		**Check boxes unless asked to record data. Circle units.**	**Model**	
Country			**Serial #**	
Customer Name		**Customer Phone #**		

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, & 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 & concentration							%
	Loop static pressure			psi	kPa			
Open Loop	Water valve & flow control installed in return line							
Indoor Loop (Hydronic)	All shut-off valves are open (full flow available)							
	Loop is full and purged of air							
	Loop static pressure			psig	kPa			
Domestic Hot Water	All shut-off valves are open, lines are full and purged							
	Desuperheater pump wire is disconnected							
Electrical	High/low 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	

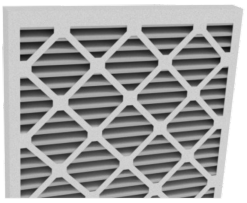
STARTUP DATA

Preparation	Voltage across L1 and L2, L1 and L3, L2 and L3							VAC
Air Heating 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
	Compressor L1 (black wire) current		A					
	Domestic Hot Water functioning							
Air 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
Hydronic Heating Mode (10 minutes)	Suction Pressure / Discharge Pressure						psig	kPa
	Indoor loop temperatures: In, Out, & Delta T		In		Out		°F	°C
	Outdoor loop temperatures: In, Out, & Delta T		In		Out		°F	°C
	Compressor L1 (black wire) current		A					

Date:		**Installer Signature:**		**Homeowner Signature:**	

A total of three copies are required: one for the homeowner, one for the installer, and one 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 Exchangers		When experiencing performance degradation that is not explained by a refrigeration circuit problem or low loop flow rate	Disconnect the loop and flush heat exchanger with a calcium removing solution. Generally not required for closed loop or cold water open loop systems or indoor loops; whenever system performance is reduced for warm water open loop systems (unusual). See below.

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. Note that some alarms require accessory components.		
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 (accessory)	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). Requires current sensor accessory.	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.
Comp. Not Pumping	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 (if present), indicating condensate drain is blocked.	Check condensate drain.
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** section later in this manual).

FAULT TROUBLESHOOTING		
Alarm/Fault	**Description**	**Recommended Action**
Digital Inputs **Digital Outputs** **Analog Inputs** **MODBUS Comms** **PWM Outputs** **Real Time Clock**	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.
Flash Memory	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.
Menu Buttons	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.
LCD Interface	A failure has occurred and display may show erratic data, no data or may not turn on at all.	
BACnet Comms	BACnet communications experienced a timeout.	See below.
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.

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 connector from board as well as jumper from TERM (located just above the BACnet 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.

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 *high suction pressure* and *high discharge pressure*) 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 - WATER 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 or no indoor loop flow	Verify that indoor delta T is 8-12°F (4-7°C), or compare pressure drop to the tables for the unit.	Verify pump is working and sized correctly. Check for restrictions in the circuit, e.g. valve partially closed.
	Temperature setpoint(s) too high (if using external aquastat or BACnet control)	Use PC APP to verify that Indoor OUT does not exceed 120°F (49°C)	Reduce setpoint(s).
	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	High subcooling, low Indoor Loop delta T.	Remove 1/2 lb of refrigerant at a time and verify that the discharge pressure reduces.
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.

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OPERATION TROUBLESHOOTING - WATER HEATING MODE			
Fault	**Possible Cause**	**Verification**	**Recommended Action**
Low suction pressure *(continued)*	Leaking NC solenoid valve	Check for temperature difference across valve, which should be closed in this mode.	Replace solenoid or valve if faulty.
	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.
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 or RV2 (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 compressor 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)	Faulty indoor circulator relay	Using the PC APP, manually turn the ICR on/off several times and ensure the indoor circulator(s) start and stop.	Replace relay.
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 - WATER HEATING MODE *(Signals Method Only)*			
Fault	**Possible Cause**	**Verification**	**Recommended Action**
No display on aquastat.	Transformer breaker tripped	230VAC is present across L1 and L3 of the compressor contactor but 24VAC is not present across R and C.	Push breaker back in. If it trips again locate cause of short circuit and correct.
	Faulty transformer	Transformer breaker is not tripped, 230VAC is present across L1 and L3 of the compressor contactor but 24VAC is not present across R and C.	Replace transformer.
	Faulty wiring between heat pump and aquastat	24VAC is not present across 24V and COM at the top of the aquastat.	Correct the wiring.
	Faulty aquastat	24VAC is present across 24Vand COM of the aquastat but there is no display.	Replace aquastat.
No Y1A signal to heat pump	Incorrect aquastat setup	Aquastat does not indicate S1 on the display.	Correct the setup.
	Faulty aquastat to heat pump wiring	24VAC not present across Stage 1 C and COM of the aquastat.	Correct or replace wiring.
	Faulty aquastat to heat pump wiring	24VAC signal present across Stage 1 NO and COM of the aquastat but not present across Y1A and CA of the control board.	Correct or replace wiring.
	Faulty aquastat	No 24VAC between Stage 1 NO and COM of the aquastat when S1 is indicated on the aquastat display.	Replace aquastat.
No Y2A signal to heat pump	Incorrect aquastat setup	Aquastat does not indicate S2 on the display.	Correct the setup.
	Faulty aquastat to heat pump wiring	24VAC not present across Stage 2 C and COM of the aquastat.	Correct or replace wiring.
	Faulty aquastat to heat pump wiring	24VAC signal present across Stage 2 NO and COM of the aquastat but not present across Y2A and CA of the control board.	Correct or replace wiring.
	Faulty aquastat	No 24VAC between Stage 2 NO and COM of the aquastat when S2 is indicated on the aquastat display.	Replace aquastat.
Setting(s) not retained	Faulty aquastat	E2 error message. Can cause the unit to trip a safety control if the set-ting is too high or low.	Replace aquastat.

OPERATION TROUBLESHOOTING - AIR 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.
	Faulty NC solenoid valve or coil	Verify solenoid by removing it from the shaft while the unit is running. There should be an audible click sound if the solenoid is working. Valve may be cold if restricted.	Replace solenoid or valve if faulty.
	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.

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OPERATION TROUBLESHOOTING - AIR HEATING MODE			
Fault	**Possible Cause**	**Verification**	**Recommended Action**
Low suction pressure *(continued)*	Faulty NC solenoid valve or coil	Verify solenoid by removing it from the shaft while the unit is running. There should be an audible click sound if the solenoid is working. Valve may be cold if restricted.	Replace solenoid or valve if faulty.
	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.
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 or RV2 (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.
	Leaking check valve (located in the indoor water coil “out” refrigerant line)	Check valve is cold.	Try tapping the valve and switching from air cool to water heat a few times. Replace the check valve if the problem persists.
	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 - AIR 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 solenoid coil	Verify solenoid by removing it from the shaft while the unit is running. There should be a loud “whoosh” sound when it is removed.	Replace solenoid if faulty.
	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.
	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.
	Faulty NC solenoid valve or coil	Verify solenoid by removing it from the shaft while the unit is running. There should be an audible click sound if the solenoid is working. Valve may be cold if restricted.	Replace solenoid or valve if faulty.

OPERATION TROUBLESHOOTING - AIR 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 or RV2 (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.
	Leaking check valve (located in the indoor water coil “out” refrigerant line)	Check valve is cold.	Try tapping the valve and switching from air cool to water heat a few times. Replace the check valve if the problem persists.
	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.
	Faulty NC solenoid valve or coil	Verify solenoid by removing it from the shaft while the unit is running. There should be an audible click sound if the solenoid is working. Valve may be cold if restricted.	Replace solenoid or valve if faulty.
	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_2O. 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 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.

Repair Procedures

Pumpdown Procedure

1. Place the unit in SERVICE mode via the PC App or LCD interface; this will open the EEV and start the circulators (as long circulators are 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.

Vacuuming & Charging Procedure

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

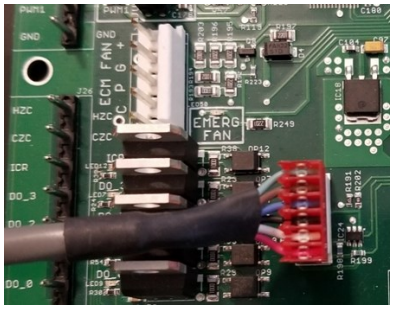
1. Release the nitrogen pressure and connect the vacuum pump to the charging manifold. Start the vacuum pump and open the charging manifold valves. Vacuum until the vacuum gauge remains at less than 500 microns for at least 1 minute with the vacuum pump valve closed.
2. Close the charging manifold valves 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.

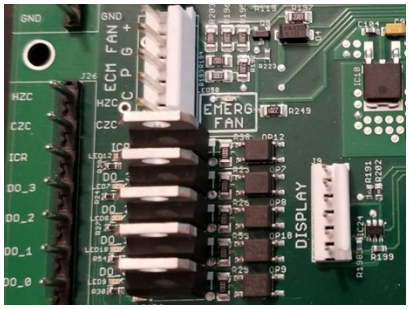
Compressor Replacement Procedure

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).





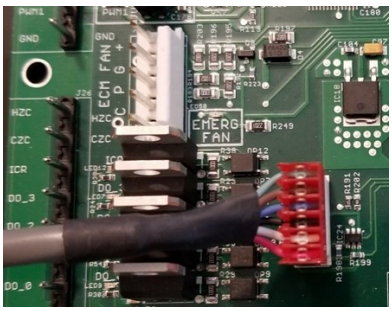
5. Remove all connectors from the top of the control board. Each connector (or wire) should be marked already from the factory, e.g. HPS1, LP1, TS1, etc.. This matches the marking on the control board.
6. The control board is held in place at its four corners. Squeeze each standoff by hand or with needle 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 Interface 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.

Model Specific Information

Table 25 - Shipping Information				
MODEL	WEIGHT lb. (kg)	DIMENSIONS in (cm)		
		L	W	H
TF-45	520 (236)	44 (112)	36 (91)	68 (173)
TF-55	575 (261)	44 (112)	36 (91)	68 (173)
TF-65	635 (288)	44 (112)	36 (91)	68 (173)
TF-75	680 (308)	44 (112)	36 (91)	68 (173)
TF-80	695 (315)	44 (112)	36 (91)	68 (173)

Table 26 - Refrigerant Charge				
MODEL	lb	*kg*	Refrigerant	Oil Type
TF-45	6.0	*2.7*	R410a	POE
TF-55	8.0	*3.6*	R410a	POE
TF-65	10.0	*4.5*	R410a	POE
TF-75	12.0	*5.5*	R410a	POE
TF-80	12.0	*5.5*	R410a	POE

- Oil capacity is marked on the compressor label.
- **Refrigerant charge is subject to revision;** actual charge is indicated on the unit nameplate.

Table 27 - Required Loop Flow Rates				
MODEL	OUTDOOR LOOP		INDOOR LOOP	
	gpm	*L/s*	gpm	*L/s*
TF-45	10	*0.63*	10	*0.63*
TF-55	12	*0.76*	12	*0.76*
TF-65	14	*0.88*	14	*0.88*
TF-75	16	*1.0*	16	*1.0*
TF-80	17	*1.1*	17	*1.1*

Table 28 - Operating Temperature Limits					
Loop	Mode	Parameter	(°F)	*(°C)*	Note
INDOOR	AIR Heating	Minimum EAT	60	*16*	Reduce air flow if necessary during startup.
	AIR Heating	Maximum EAT	100	*38*	
	WATER Heating	Minimum ELT	60	*16*	Reduce flow if necessary during startup.
	WATER Heating	Maximum LLT	120	*49*	
	AIR Cooling	Minimum EAT	50	*10*	Reduce flow if necessary during startup.
	AIR Cooling	Maximum EAT	100	*38*	
OUTDOOR (CLOSED LOOP)	Heating	Minimum ELT	23	*-5*	Adequate antifreeze concentration required.
	Heating	Maximum ELT	80	*27*	Operation above this temperature by reducing flow.
	Cooling	Minimum ELT	41	*5*	Flow reduction may be required.
	Cooling	Maximum ELT	113	*45*	
OUTDOOR (OPEN LOOP)	Heating	Minimum EWT	41	*5*	
	Heating	Maximum EWT	80	*27*	Operation above this temperature by reducing flow.
	Cooling	Minimum EWT	41	*5*	Flow reduction may be required.
	Cooling	Maximum EWT	113	*45*	

Pressure Drop Data

Table 29a: OUTDOOR Loop Pressure Drop Data

			Water 104°F		Water 50°F		15% Methanol 32°F		35% propylene glycol 32°F	
	gpm	*L/s*	psi	*kPa*	psi	*kPa*	psi	*kPa*	psi	*kPa*
TF-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*
TF-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*
TF-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*

Table 29a: OUTDOOR Loop Pressure Drop Data (cont'd)			Water 104°F		Water 50°F		15% Methanol 32°F		35% propylene glycol 32°F	
	gpm	*L/s*	psi	*kPa*	psi	*kPa*	psi	*kPa*	psi	*kPa*
TF-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*
TF-80	9	*0.57*	1.2	*8.3*	1.3	*9.0*	1.4	*10*	1.8	*13*
	10	*0.63*	1.5	*10*	1.6	*11*	1.7	*12*	2.2	*15*
	11	*0.69*	1.8	*12*	1.9	*13*	2.2	*15*	2.9	*20*
	12	*0.76*	2.2	*15*	2.4	*17*	2.6	*18*	3.4	*24*
	13	*0.82*	2.5	*17*	2.7	*19*	3.1	*21*	4.1	*28*
	14	*0.88*	2.9	*20*	3.1	*21*	3.5	*24*	4.6	*32*
	15	*0.95*	3.1	*21*	3.3	*23*	3.8	*26*	5.0	*34*
	16	*1.01*	3.3	*23*	3.6	*25*	4.1	*28*	5.4	*37*
	17	***1.07***	**3.7**	***26***	**4.1**	***28***	**4.6**	***32***	**6.0**	***42***
	18	*1.14*	4.2	*29*	4.5	*31*	4.9	*34*	6.4	*44*

Table 29b: INDOOR Loop Pressure Drop Data		Water 104°F									
		TF-45		TF-55		TF-65		TF-75		TF-80	
gpm	*L/s*	psi	*kPa*	psi	*kPa*	psi	*kPa*	psi	*kPa*	psi	*kPa*
5	*0.32*	1.1	*7.6*								
6	*0.38*	1.6	*11*	1.1	*7.6*	1.1	*7.6*	1.1	*7.6*	1.1	*7.6*
7	*0.44*	1.9	*13*	1.5	*10*	1.5	*10*	1.4	*10*	1.4	*10*
8	*0.50*	2.6	*18*	1.8	*12*	1.8	*12*	1.8	*12*	1.8	*12*
9	*0.57*	3.2	*22*	2.2	*15*	2.2	*15*	2.1	*14*	2.1	*14*
10	*0.63*	**3.8**	***26***	2.7	*19*	2.7	*19*	2.4	*17*	2.4	*17*
11	*0.69*	4.3	*30*	2.8	*19*	2.8	*19*	2.9	*20*	2.9	*20*
12	*0.76*	5.2	*36*	**3.4**	***23***	3.4	*23*	3.6	*25*	3.6	*25*
13	*0.82*	5.9	*41*	4	*28*	4	*28*	4.1	*28*	4.1	*28*
14	*0.88*	6.7	*46*	4.7	*32*	**4.7**	***32***	4.7	*32*	4.7	*32*
15	*0.95*	8.0	*55*	5.6	*39*	5.6	*39*	5.5	*38*	5.5	*38*
16	*1.01*			6.1	*42*	6.1	*42*	**6.3**	***43***	6.3	*43*
17	*1.07*							7.0	*48*	**7.0**	***48***

Standard Capacity Ratings

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

Table 30 - 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	Nominal Size	Liquid Flow		Mode	Airflow		Input Energy	Capacity		COP_H
	tons	gpm	*L/s*		cfm	*L/s*	Watts	Btu/hr	*kW*	W/W
TF-45	3	10	*0.63*	Stage 1	1030	*486*	1,550	20,100	*5.9*	4.10
				Stage 2	1200	*566*	2,290	25,200	*7.4*	3.60
TF-55	4	12	*0.76*	Stage 1	1240	*585*	2,250	28,300	*8.3*	4.17
				Stage 2	1500	*708*	3,000	35,400	*10.4*	3.80
TF-65	5	14	*0.88*	Stage 1	1540	*727*	2,615	35,500	*10.4*	4.00
				Stage 2	1900	*897*	3,510	43,800	*12.8*	3.70
TF-75	6	16	*1.01*	Stage 1	1660	*783*	3,600	42,300	*12.4*	3.70
				Stage 2	2100	*991*	4,465	52,600	*15.4*	3.50
TF-80	6.5	17	*1.07*	Stage 1	2400	*1133*	5,155	61,900	*18.1*	3.52

Table 31 - Standard Capacity Ratings - Ground Water Heating 60Hz

EAT 68°F (20°C) ELT 50°F (10°C)

Model	Nominal Size	Liquid Flow		Mode	Airflow		Input Energy	Capacity		COP_H
	tons	gpm	*L/s*		cfm	*L/s*	Watts	Btu/hr	*kW*	W/W
TF-45	3	10	*0.63*	Stage 1	1030	*486*	1,500	24,200	*7.1*	4.50
				Stage 2	1200	*566*	2,480	34,300	*10.1*	4.20
TF-55	4	12	*0.76*	Stage 1	1240	*585*	2,315	33,400	*9.8*	4.70
				Stage 2	1500	*708*	3,305	47,100	*13.8*	4.40
TF-65	5	14	*0.88*	Stage 1	1540	*727*	2,645	42,600	*12.5*	4.60
				Stage 2	1900	*897*	3,790	58,400	*17.1*	4.40
TF-75	6	16	*1.01*	Stage 1	1660	*783*	3,610	51,200	*15.0*	4.20
				Stage 2	2100	*991*	4,880	67,200	*19.7*	4.10
TF-80	6.5	17	*1.07*	Stage 1	2400	*1133*	5,600	77,100	*22.6*	4.04

Table 32 - 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	Size	Liquid Flow		Mode	Airflow		Input Energy	Capacity		COP_c	EER
	tons	gpm	*L/s*		cfm	*L/s*	Watts	Btu/hr	*kW*	W/W	Btu/W
TF-45	3	10	*0.63*	Stage 1	1030	*486*	1,060	27,400	*8.0*	7.48	25.5
				Stage 2	1200	*566*	1,965	36,200	*10.6*	4.75	16.2
TF-55	4	12	*0.76*	Stage 1	1240	*585*	1,750	36,300	*10.6*	6.98	23.8
				Stage 2	1500	*708*	3,015	45,400	*13.3*	5.01	17.1
TF-65	5	14	*0.88*	Stage 1	1540	*727*	2,025	45,200	*13.2*	6.54	22.3
				Stage 2	1900	*897*	3,500	57,400	*16.8*	4.87	16.6
TF-75	6	16	*1.01*	Stage 1	1660	*783*	2,790	51,800	*15.2*	6.01	20.5
				Stage 2	2100	*991*	4,460	65,800	*19.3*	4.43	15.1
TF-80	6.5	17	*1.07*	Stage 1	2400	*1133*	5,235	77,200	*22.6*	4.32	14.7

Table 33 - Standard Capacity Ratings - Ground Water Cooling 60Hz

EAT 80.6°F (27°C), RH=46% ELT 59°F (15°C)

Model	Size	Liquid Flow		Mode	Airflow		Input Energy	Capacity		COP_c	EER
	tons	gpm	*L/s*		cfm	*L/s*	Watts	Btu/hr	*kW*	W/W	Btu/W
TF-45	3	10	*0.63*	Stage 1	1030	*486*	895	28,900	*8.5*	7.98	27.2
				Stage 2	1200	*566*	1,640	39,200	*11.5*	6.10	20.8
TF-55	4	12	*0.76*	Stage 1	1240	*585*	1,525	40,100	*11.8*	7.92	27.0
				Stage 2	1500	*708*	2,515	51,100	*15.0*	6.60	22.5
TF-65	5	14	*0.88*	Stage 1	1540	*727*	1,760	46,900	*13.7*	8.01	27.3
				Stage 2	1900	*897*	2,950	62,500	*18.3*	6.36	21.7
TF-75	6	16	*1.01*	Stage 1	1660	*783*	2,485	53,800	*15.8*	7.07	24.1
				Stage 2	2100	*991*	3,875	70,200	*20.6*	5.66	19.3
TF-80	6.5	17	*1.07*	Stage 1	2400	*1133*	4,350	84,100	*24.6*	5.66	19.3

Standard Capacity Ratings

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

Table 34 - Standard Capacity Ratings - Ground Loop Hydronic Heating* 60Hz								
EWT 104°F (40°C) * 15% Methanol by Weight Ground Loop Fluid							STAGE 1 - ELT 41°F (5°C) STAGE 2 - ELT 32°F (0°C)	
Model	Nominal Size	Liquid Flow (Indoor & Outdoor)		Mode	Input Energy	Capacity		COP_H
	tons	gpm	*L/s*		Watts	Btu/hr	*kW*	W/W
TF-45	3	10.0	*0.63*	Stage 1	1,940	20,400	*6.0*	3.10
				Stage 2	2,665	24,000	*7.0*	3.10
TF-55	4	12.0	*0.76*	Stage 1	2,920	28,400	*8.3*	3.15
				Stage 2	3,950	34,300	*10.0*	3.10
TF-65	5	14.0	*0.88*	Stage 1	3,340	34,400	*10.1*	3.10
				Stage 2	4,340	43,000	*12.6*	3.10
TF-75	6	16.0	*1.01*	Stage 1	4,395	38,800	*11.4*	3.10
				Stage 2	5,425	48,500	*14.2*	3.10
TF-80	6.5	17.0	*1.07*	Stage 1	6,490	56,600	*16.6*	2.83

Table 35 - Standard Capacity Ratings - Ground Water Hydronic Heating 60Hz								
EWT 104°F (40°C)							ELT 50°F (10°C)	
Model	Nominal Size	Liquid Flow (Indoor & Outdoor)		Mode	Input Energy	Capacity		COP_H
	tons	gpm	*L/s*		Watts	Btu/hr	*kW*	W/W
TF-45	3	10.0	*0.63*	Stage 1	1,840	23,800	*7.0*	3.70
				Stage 2	2,595	33,500	*9.8*	3.70
TF-55	4	12.0	*0.76*	Stage 1	2,860	31,200	*9.1*	3.70
				Stage 2	3,910	44,200	*13.0*	3.80
TF-65	5	14.0	*0.88*	Stage 1	3,305	39,800	*11.7*	3.70
				Stage 2	4,365	55,200	*16.2*	3.70
TF-75	6	16.0	*1.01*	Stage 1	4,335	47,200	*13.8*	3.60
				Stage 2	5,565	64,100	*18.8*	3.80
TF-80	6.5	17.0	*1.07*	Stage 1	6,245	73,300	*21.5*	3.44

Air Heating/Cooling Performance

TF-45-HACW-P-1T *R410a, 60 Hz, ZPS30K5E-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	26	15	10	22	4.1	19,393	8.4	179	2,128	68	96	1,200	84	22.7	**26,396**	**3.63**
	32	20	10	28	4.4	21,005	8.8	179	2,211		99	1,200	86	24.3	**28,290**	**3.75**
	38	25	10	33	4.8	22,718	9.1	179	2,295		102	1,200	89	26.0	**30,291**	**3.87**
	44	30	10	39	5.3	25,249	9.5	179	2,404		105	1,200	92	28.5	**33,196**	**4.05**
	49	35	10	43	5.6	28,175	9.8	179	2,479		107	1,200	94	31.3	**36,401**	**4.30**
	55	40	10	49	6.1	30,329	10.2	179	2,572		110	1,200	96	33.4	**38,873**	**4.43**
	61	45	10	55	6.5	32,592	10.6	179	2,669		113	1,200	100	35.6	**41,467**	**4.55**
	67	50	10	60	7.0	34,965	11.1	179	2,770		116	1,200	103	38.0	**44,185**	**4.67**

	OUTDOOR LOOP *(15% Methanol)*						ELECTRICAL			INDOOR LOOP *(Air @ 46% RH)*								
	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**
COOLING	51	70	10	61	9.5	47,375	6.0	171	1,642	80.6	44	1,200	57	23.2	13,299	28,417	**41,716**	**25.4**
	56	75	10	66	9.5	47,222	6.4	171	1,766		44	1,200	58	22.9	13,115	28,024	**41,140**	**23.3**
	61	80	10	70	9.4	47,190	6.9	171	1,892		45	1,200	58	22.6	12,968	27,709	**40,677**	**21.5**
	66	85	10	75	9.4	46,908	7.4	171	2,036		46	1,200	58	22.2	12,721	27,182	**39,904**	**19.6**
	72	90	10	82	9.8	46,530	7.9	171	2,192		46	1,200	59	21.9	12,344	26,670	**39,014**	**17.8**
	77	95	10	87	9.8	46,441	8.4	171	2,332		47	1,200	59	21.6	12,165	26,283	**38,447**	**16.5**
	82	100	10	92	9.7	46,200	9.0	171	2,478		48	1,200	59	21.2	11,931	25,777	**37,707**	**15.2**
	87	105	10	97	9.7	45,950	9.6	171	2,632		48	1,200	60	20.7	11,685	25,246	**36,931**	**14.0**

METRIC

	OUTDOOR LOOP *(15% Methanol)*						ELECTRICAL			INDOOR LOOP *(Air)*						
	ELT (°C)	Evap. Temp.	Flow (L/s)	LLT (°C)	Delta T (°C)	Heat Abs. (W)	Compressor Current (A)	Fan (W)	Input Power (W)	EAT (°C)	Cond. Temp.	Airflow (L/s)	LAT (°C)	Delta T (°C)	**Heating** (W)	**COP_H**
HEATING	-3.3	-9.4	0.63	-5.6	2.3	5,682	8.4	179	2,128	20	35.6	566	28.7	12.6	**7,734**	**3.63**
	0.0	-6.7	0.63	-2.5	2.5	6,154	8.8	179	2,211		37.2	566	30.2	13.5	**8,289**	**3.75**
	3.3	-3.9	0.63	0.7	2.7	6,656	9.1	179	2,295		38.9	566	31.7	14.5	**8,875**	**3.87**
	6.7	-1.1	0.63	3.7	3.0	7,398	9.5	179	2,404		40.6	566	33.1	15.8	**9,726**	**4.05**
	9.4	1.7	0.63	6.3	3.1	8,255	9.8	179	2,479		41.7	566	34.6	17.4	**10,665**	**4.30**
	12.8	4.4	0.63	9.4	3.4	8,886	10.2	179	2,572		43.3	566	35.8	18.6	**11,390**	**4.43**
	16.1	7.2	0.63	12.5	3.6	9,549	10.6	179	2,669		45.0	566	37.6	19.8	**12,150**	**4.55**
	19.4	10.0	0.63	15.6	3.9	10,245	11.1	179	2,770		46.7	566	39.4	21.1	**12,946**	**4.67**

	OUTDOOR LOOP *(15% Methanol)*						ELECTRICAL			INDOOR LOOP *(Air @ 46% RH)*								
	ELT (°C)	Cond. Temp.	Flow (L/s)	LLT (°C)	Delta T (°C)	Heat Rej. (W)	Compressor Current (A)	Fan (W)	Input Power (W)	EAT (°C)	Evap. Temp.	Airflow (L/s)	LAT (°C)	Delta T (°C)	Latent (W)	Sensible (W)	**Cooling** (W)	**COP_C**
COOLING	10.6	21.1	0.63	15.8	5.3	13,881	6.0	171	1,642	27	6.6	566	14.1	12.9	3,897	8,326	**12,223**	**7.44**
	13.3	23.9	0.63	18.6	5.3	13,836	6.4	171	1,766		6.8	566	14.3	12.7	3,843	8,211	**12,054**	**6.82**
	16.1	26.7	0.63	21.4	5.2	13,826	6.9	171	1,892		7.2	566	14.4	12.6	3,800	8,119	**11,918**	**6.30**
	18.9	29.4	0.63	24.1	5.2	13,744	7.4	171	2,036		7.6	566	14.7	12.3	3,727	7,964	**11,692**	**5.74**
	22.2	32.2	0.63	27.7	5.4	13,633	7.9	171	2,192		7.9	566	14.8	12.2	3,617	7,814	**11,431**	**5.22**
	25.0	35.0	0.63	30.4	5.4	13,607	8.4	171	2,332		8.3	566	15.0	12.0	3,564	7,701	**11,265**	**4.83**
	27.8	37.8	0.63	33.2	5.4	13,537	9.0	171	2,478		8.6	566	15.2	11.8	3,496	7,552	**11,048**	**4.46**
	30.6	40.6	0.63	35.9	5.4	13,463	9.6	171	2,632		8.9	566	15.5	11.5	3,424	7,397	**10,821**	**4.11**

Hydronic Performance

TF-45-HACW-P-1T *R410a, 60 Hz, ZPS30K6E-PFV*

	OUTDOOR LOOP *(15% Methanol)*						ELECTRICAL		INDOOR LOOP *(Water)*						
	ELT (°F)	Evap. Temp.	Flow (gpm)	LLT (°F)	Delta T (°F)	Heat Abs. (Btu/hr)	Compressor Current (A)	Input Power (W)	EWT (°F)	Cond. Temp.	Flow (gpm)	LWT (°F)	Delta T (°F)	**Heating** (Btu/hr)	**COP_H**
HEATING	25	14	10	22	3	14,300	9.4	2,240	104	112	10	108	4	**21,700**	**2.84**
	30	19	10	27	3	16,000	9.6	2,288		113	10	109	5	**23,600**	**3.02**
	35	24	10	31	4	17,900	9.8	2,332		113	10	109	5	**25,600**	**3.22**
	40	29	10	36	4	19,900	10.0	2,377		114	10	110	6	**27,800**	**3.43**
	45	33	10	41	5	22,100	10.2	2,417		114	10	110	6	**30,100**	**3.65**
	50	38	10	45	5	24,500	10.4	2,458		115	10	111	7	**32,700**	**3.90**
	55	43	10	50	6	27,100	10.6	2,497		116	10	111	7	**35,400**	**4.15**
	60	47	10	54	6	29,800	10.8	2,531		116	10	112	8	**38,300**	**4.43**
	25	15	10	22	3	13,100	10.6	2,511	116	123	10	120	4	**21,400**	**2.50**
	30	20	10	27	3	14,700	10.8	2,542	115	123	10		5	**23,100**	**2.66**
	35	25	10	32	3	16,500	10.9	2,574	115	123	10		5	**25,100**	**2.86**
	40	29	10	36	4	18,500	11.0	2,600	115	123	10		5	**27,200**	**3.07**
	45	34	10	41	4	20,500	11.2	2,627	114	124	10		6	**29,300**	**3.27**
	50	39	10	45	5	22,900	11.3	2,648	114	124	10		6	**31,700**	**3.51**
	55	43	10	50	5	25,400	11.4	2,666	113	124	10		7	**34,300**	**3.77**
	60	48	10	54	6	28,000	11.5	2,684	113	124	10		7	**37,000**	**4.04**

METRIC

	OUTDOOR LOOP *(15% Methanol)*						ELECTRICAL		INDOOR LOOP *(Water)*						
	ELT (°C)	Evap. Temp.	Flow (L/s)	LLT (°C)	Delta T (°C)	Heat Abs. (kW)	Compressor Current (A)	Input Power (W)	EWT (°C)	Cond. Temp.	Flow (L/s)	LWT (°C)	Delta T (°C)	**Heating** (kW)	**COP_H**
HEATING (METRIC)	-3.9	-9.8	0.63	-5.5	1.6	4.2	9.4	2,240	40	44.6	0.63	42.4	2.4	**6.4**	**2.84**
	-1.1	-7.2	0.63	-2.9	1.8	4.7	9.6	2,288		44.9	0.63	42.6	2.6	**6.9**	**3.02**
	1.7	-4.6	0.63	-0.4	2.1	5.3	9.8	2,332		45.2	0.63	42.8	2.8	**7.5**	**3.22**
	4.4	-1.9	0.63	2.1	2.3	5.8	10.0	2,377		45.5	0.63	43.1	3.1	**8.2**	**3.43**
	7.2	0.7	0.63	4.7	2.5	6.5	10.2	2,417		45.8	0.63	43.3	3.3	**8.8**	**3.65**
	10.0	3.3	0.63	7.2	2.8	7.2	10.4	2,458		46.1	0.63	43.6	3.6	**9.6**	**3.90**
	12.8	5.9	0.63	9.7	3.1	7.9	10.6	2,497		46.4	0.63	43.9	3.9	**10.4**	**4.15**
	15.6	8.6	0.63	12.2	3.4	8.7	10.8	2,531		46.7	0.63	44.3	4.3	**11.2**	**4.43**
	-3.9	-9.3	0.63	-5.4	1.5	3.8	10.6	2,511	46.5	50.5	0.63	49	2.4	**6.3**	**2.50**
	-1.1	-6.7	0.63	-2.8	1.7	4.3	10.8	2,542	46.3	50.6	0.63		2.6	**6.8**	**2.66**
	1.7	-4.1	0.63	-0.2	1.9	4.8	10.9	2,574	46.1	50.7	0.63		2.8	**7.4**	**2.86**
	4.4	-1.5	0.63	2.3	2.1	5.4	11.0	2,600	45.9	50.7	0.63		3.0	**8.0**	**3.07**
	7.2	1.1	0.63	4.9	2.3	6.0	11.2	2,627	45.6	50.8	0.63		3.3	**8.6**	**3.27**
	10.0	3.7	0.63	7.4	2.6	6.7	11.3	2,648	45.4	50.9	0.63		3.5	**9.3**	**3.51**
	12.8	6.3	0.63	9.9	2.9	7.4	11.4	2,666	45.1	50.9	0.63		3.8	**10.1**	**3.77**
	15.6	8.8	0.63	12.4	3.2	8.2	11.5	2,684	44.8	51.1	0.63		4.1	**10.8**	**4.04**

Air Heating/Cooling Performance

TF-55-HACW-P-1T *R410a, 60 Hz, ZPS40K5E-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**
27	15	12	22	4.7	26,809	11.8	185	2,718	68	98	1,500	92	23.6	**35,782**	**3.86**
33	20	12	28	5.2	29,763	12.1	185	2,784		100	1,500	94	25.7	**38,963**	**4.10**
39	25	12	33	5.8	32,940	12.5	185	2,850		102	1,500	96	28.0	**42,364**	**4.36**
45	30	12	39	6.3	36,095	12.8	185	2,942		104	1,500	98	30.3	**45,834**	**4.56**
50	35	12	43	6.6	39,435	13.1	185	3,033		106	1,500	100	32.0	**49,511**	**4.78**
56	40	12	49	7.2	43,264	13.4	185	3,102		108	1,500	103	34.7	**53,577**	**5.06**
62	45	12	54	7.9	47,338	13.8	185	3,174		110	1,500	106	37.5	**57,895**	**5.34**
68	50	12	59	8.6	51,663	14.1	185	3,247		112	1,500	108	40.4	**62,471**	**5.64**

COOLING

OUTDOOR LOOP *(15% Methanol)*						ELECTRICAL			INDOOR LOOP *(Air @ 46% RH)*								
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**
51	70	12	61	10.1	60,504	8.5	192	2,151	80.6	44	1,500	58	22.3	16,911	36,135	**53,046**	**24.7**
56	75	12	66	10.0	60,047	9.1	192	2,297		44	1,500	59	21.9	16,606	35,484	**52,090**	**22.7**
61	80	12	71	9.9	59,555	9.7	192	2,444		44	1,500	59	21.5	16,289	34,806	**51,095**	**20.9**
66	85	12	76	9.8	58,920	10.3	192	2,530		44	1,500	60	21.1	15,993	34,173	**50,166**	**19.8**
71	90	12	81	10.2	58,230	11.0	192	2,614		45	1,500	60	20.4	16,727	32,470	**49,197**	**18.8**
76	95	12	86	10.1	57,809	11.6	192	2,764		45	1,500	61	20.0	16,409	31,853	**48,262**	**17.5**
81	100	12	91	10.0	57,166	12.3	192	2,920		45	1,500	61	19.5	16,009	31,077	**47,087**	**16.1**
86	105	12	96	9.9	56,499	13.0	192	3,083		45	1,500	62	19.0	15,594	30,270	**45,864**	**14.9**

METRIC

HEATING

OUTDOOR LOOP *(15% Methanol)*						ELECTRICAL			INDOOR LOOP *(Air)*						
ELT (°C)	Evap. Temp.	Flow (L/s)	LLT (°C)	Delta T (°C)	Heat Abs. (W)	Compressor Current (A)	Fan (W)	Input Power (W)	EAT (°C)	Cond. Temp.	Airflow (L/s)	LAT (°C)	Delta T (°C)	**Heating** (W)	**COP_H**
-2.8	-9.4	0.76	-5.4	2.6	7,855	11.8	185	2,718	20	36.7	708	33.1	13.1	**10,484**	**3.86**
0.6	-6.7	0.76	-2.3	2.9	8,721	12.1	185	2,784		37.8	708	34.3	14.3	**11,416**	**4.10**
3.9	-3.9	0.76	0.7	3.2	9,651	12.5	185	2,850		38.9	708	35.5	15.5	**12,413**	**4.36**
7.2	-1.1	0.76	3.7	3.5	10,576	12.8	185	2,942		40.0	708	36.8	16.8	**13,429**	**4.56**
10.0	1.7	0.76	6.3	3.7	11,554	13.1	185	3,033		41.1	708	37.8	17.8	**14,507**	**4.78**
13.3	4.4	0.76	9.3	4.0	12,676	13.4	185	3,102		42.2	708	39.3	19.3	**15,698**	**5.06**
16.7	7.2	0.76	12.3	4.4	13,870	13.8	185	3,174		43.3	708	40.8	20.8	**16,963**	**5.34**
20.0	10.0	0.76	15.2	4.8	15,137	14.1	185	3,247		44.4	708	42.5	22.5	**18,304**	**5.64**

COOLING

OUTDOOR LOOP *(15% Methanol)*						ELECTRICAL			INDOOR LOOP *(Air @ 46% RH)*								
ELT (°C)	Cond. Temp.	Flow (L/s)	LLT (°C)	Delta T (°C)	Heat Rej. (W)	Compressor Current (A)	Fan (W)	Input Power (W)	EAT (°C)	Evap. Temp.	Airflow (L/s)	LAT (°C)	Delta T (°C)	Latent (W)	Sensible (W)	**Cooling** (W)	**COP_C**
10.6	21.1	0.76	16.2	5.6	17,727	8.5	192	2,151	27	6.4	708	14.6	12.4	4,955	10,587	**15,542**	**7.23**
13.3	23.9	0.76	18.9	5.6	17,593	9.1	192	2,297		6.6	708	14.8	12.2	4,866	10,397	**15,262**	**6.64**
16.1	26.7	0.76	21.6	5.5	17,449	9.7	192	2,444		6.7	708	15.1	11.9	4,773	10,198	**14,971**	**6.12**
18.9	29.4	0.76	24.3	5.5	17,263	10.3	192	2,530		6.8	708	15.3	11.7	4,686	10,013	**14,699**	**5.81**
21.7	32.2	0.76	27.3	5.7	17,061	11.0	192	2,614		7.0	708	15.7	11.3	4,901	9,514	**14,415**	**5.51**
24.4	35.0	0.76	30.1	5.6	16,938	11.6	192	2,764		7.2	708	15.9	11.1	4,808	9,333	**14,141**	**5.12**
27.2	37.8	0.76	32.8	5.6	16,749	12.3	192	2,920		7.3	708	16.1	10.9	4,691	9,106	**13,796**	**4.72**
30.0	40.6	0.76	35.5	5.5	16,554	13.0	192	3,083		7.4	708	16.4	10.6	4,569	8,869	**13,438**	**4.36**

Hydronic Performance

TF-55-HACW-P-1T *R410a, 60 Hz, ZPS40K6E-PFV*

	OUTDOOR LOOP *(15% Methanol)*						ELECTRICAL		INDOOR LOOP *(Water)*						
	ELT (°F)	Evap. Temp.	Flow (gpm)	LLT (°F)	Delta T (°F)	Heat Abs. (Btu/hr)	Compressor Current (A)	Input Power (W)	EWT (°F)	Cond. Temp.	Flow (gpm)	LWT (°F)	Delta T (°F)	**Heating** (Btu/hr)	**COP_H**
HEATING	25	14	12	22	4	20,600	14.0	3,145	104	115	12	109	5	**31,100**	**2.90**
	30	19	12	26	4	22,800	14.4	3,234		116	12	110	6	**33,600**	**3.04**
	35	24	12	31	4	25,100	14.8	3,317		116	12	110	6	**36,200**	**3.20**
	40	29	12	35	5	27,600	15.2	3,405		117	12	111	7	**39,000**	**3.36**
	45	33	12	40	5	30,300	15.5	3,485		117	12	111	7	**42,000**	**3.53**
	50	38	12	44	6	33,100	15.9	3,568		118	12	112	8	**45,100**	**3.70**
	55	43	12	49	6	36,000	16.3	3,649		119	12	112	8	**48,200**	**3.87**
	60	47	12	53	7	39,200	16.7	3,723		119	12	113	9	**51,700**	**4.07**
	25	15	12	22	3	18,800	15.8	3,548	115	125	12	120	5	**30,600**	**2.53**
	30	20	12	27	4	20,800	16.1	3,609	115	125	12		6	**32,900**	**2.67**
	35	25	12	31	4	23,100	16.4	3,673	114	125	12		6	**35,400**	**2.82**
	40	29	12	36	4	25,500	16.6	3,730	114	125	12		6	**38,000**	**2.99**
	45	34	12	40	5	28,000	16.9	3,787	113	126	12		7	**40,700**	**3.15**
	50	39	12	45	5	30,800	17.1	3,838	113	126	12		7	**43,700**	**3.34**
	55	43	12	49	6	33,800	17.4	3,885	112	126	12		8	**46,900**	**3.54**
	60	48	12	54	6	36,900	17.6	3,934	112	126	12		8	**50,100**	**3.73**

METRIC

	OUTDOOR LOOP *(15% Methanol)*						ELECTRICAL		INDOOR LOOP *(Water)*						
	ELT (°C)	Evap. Temp.	Flow (L/s)	LLT (°C)	Delta T (°C)	Heat Abs. (kW)	Compressor Current (A)	Input Power (W)	EWT (°C)	Cond. Temp.	Flow (L/s)	LWT (°C)	Delta T (°C)	**Heating** (kW)	**COP_H**
HEATING	-3.9	-9.8	0.76	-5.8	1.9	6.0	14.0	3,145	40	46.2	0.76	42.9	2.9	**9.1**	**2.90**
	-1.1	-7.2	0.76	-3.3	2.2	6.7	14.4	3,234		46.6	0.76	43.1	3.1	**9.9**	**3.04**
	1.7	-4.6	0.76	-0.7	2.4	7.4	14.8	3,317		46.8	0.76	43.3	3.3	**10.6**	**3.20**
	4.4	-1.9	0.76	1.8	2.6	8.1	15.2	3,405		47.2	0.76	43.6	3.6	**11.4**	**3.36**
	7.2	0.7	0.76	4.3	2.9	8.9	15.5	3,485		47.4	0.76	43.9	3.9	**12.3**	**3.53**
	10.0	3.3	0.76	6.9	3.1	9.7	15.9	3,568		47.8	0.76	44.2	4.2	**13.2**	**3.70**
	12.8	5.9	0.76	9.4	3.4	10.6	16.3	3,649		48.1	0.76	44.4	4.4	**14.1**	**3.87**
	15.6	8.6	0.76	11.9	3.7	11.5	16.7	3,723		48.4	0.76	44.8	4.8	**15.2**	**4.07**
	-3.9	-9.3	0.76	-5.7	1.8	5.5	15.8	3,548	46.1	51.7	0.76	49	2.8	**9.0**	**2.53**
	-1.1	-6.7	0.76	-3.0	1.9	6.1	16.1	3,609	45.8	51.7	0.76		3.1	**9.6**	**2.67**
	1.7	-4.1	0.76	-0.5	2.2	6.8	16.4	3,673	45.6	51.8	0.76		3.3	**10.4**	**2.82**
	4.4	-1.5	0.76	2.0	2.4	7.5	16.6	3,730	45.4	51.9	0.76		3.5	**11.1**	**2.99**
	7.2	1.1	0.76	4.5	2.7	8.2	16.9	3,787	45.1	52.0	0.76		3.8	**11.9**	**3.15**
	10.0	3.7	0.76	7.1	2.9	9.0	17.1	3,838	44.8	52.1	0.76		4.1	**12.8**	**3.34**
	12.8	6.3	0.76	9.6	3.2	9.9	17.4	3,885	44.6	52.1	0.76		4.3	**13.7**	**3.54**
	15.6	8.8	0.76	12.1	3.5	10.8	17.6	3,934	44.2	52.2	0.76		4.7	**14.7**	**3.73**

Air Heating/Cooling Performance

TF-65-HACW-P-1T *R410a, 60 Hz, ZPS51K5E-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	26	15	14	21	4.8	31,644	14.9	300	3,573	68	97	1,900	91	22.6	**43,391**	**3.56**
	32	20	14	27	5.2	34,798	15.3	300	3,667		99	1,900	92	24.4	**46,866**	**3.74**
	38	25	14	32	5.7	37,954	15.9	300	3,806		102	1,900	94	26.3	**50,495**	**3.89**
	44	30	14	38	6.4	42,566	16.3	300	3,903		104	1,900	97	28.9	**55,440**	**4.16**
	49	35	14	42	6.8	47,314	16.9	300	4,045		107	1,900	99	31.0	**60,717**	**4.40**
	55	40	14	48	7.4	51,599	17.4	300	4,144		109	1,900	101	33.4	**65,344**	**4.62**
	61	45	14	53	8.0	56,159	17.8	300	4,247		111	1,900	104	35.9	**70,253**	**4.85**
	67	50	14	58	8.7	61,001	18.3	300	4,353		113	1,900	107	38.6	**75,456**	**5.08**

	OUTDOOR LOOP *(15% Methanol)*						ELECTRICAL			INDOOR LOOP *(Air @ 46% RH)*								
	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**
COOLING	49	70	14	60	11.1	77,969	10.8	325	2,663	80.6	45	1,900	56	24.6	19,665	49,095	**68,760**	**25.8**
	54	75	14	65	11.1	77,594	11.6	325	2,864		45	1,900	56	24.2	19,362	48,337	**67,698**	**23.6**
	59	80	14	70	11.0	77,174	12.4	325	3,067		45	1,900	57	23.8	19,043	47,542	**66,585**	**21.7**
	64	85	14	75	10.8	75,547	13.2	325	3,186		46	1,900	58	23.1	18,462	46,091	**64,553**	**20.3**
	70	90	14	81	11.1	73,856	14.0	325	3,307		46	1,900	58	22.6	18,682	43,799	**62,481**	**18.9**
	75	95	14	86	11.0	73,315	14.8	325	3,513		46	1,900	59	22.1	18,309	42,926	**61,235**	**17.4**
	80	100	14	91	10.9	72,743	15.7	325	3,728		47	1,900	59	21.7	17,919	42,012	**59,931**	**16.1**
	85	105	14	96	10.8	72,145	16.6	325	3,952		47	1,900	59	21.2	17,512	41,056	**58,567**	**14.8**

METRIC

	OUTDOOR LOOP *(15% Methanol)*						ELECTRICAL			INDOOR LOOP *(Air)*						
	ELT (°C)	Evap. Temp.	Flow (L/s)	LLT (°C)	Delta T (°C)	Heat Abs. (W)	Compressor Current (A)	Fan (W)	Input Power (W)	EAT (°C)	Cond. Temp.	Airflow (L/s)	LAT (°C)	Delta T (°C)	**Heating** (W)	**COP_H**
HEATING	-3.3	-9.4	0.88	-6.0	2.6	9,272	14.9	300	3,573	20	36.1	900	32.6	12.6	**12,713**	**3.56**
	0.0	-6.7	0.88	-2.9	2.9	10,196	15.3	300	3,667		37.2	900	33.6	13.6	**13,732**	**3.74**
	3.3	-3.9	0.88	0.2	3.2	11,120	15.9	300	3,806		38.9	900	34.6	14.6	**14,795**	**3.89**
	6.7	-1.1	0.88	3.1	3.6	12,472	16.3	300	3,903		40.0	900	36.1	16.1	**16,244**	**4.16**
	9.4	1.7	0.88	5.7	3.8	13,863	16.9	300	4,045		41.7	900	37.2	17.2	**17,790**	**4.40**
	12.8	4.4	0.88	8.7	4.1	15,118	17.4	300	4,144		42.8	900	38.5	18.5	**19,146**	**4.62**
	16.1	7.2	0.88	11.7	4.5	16,455	17.8	300	4,247		43.9	900	39.9	19.9	**20,584**	**4.85**
	19.4	10.0	0.88	14.6	4.8	17,873	18.3	300	4,353		45.0	900	41.4	21.4	**22,108**	**5.08**

	OUTDOOR LOOP *(15% Methanol)*						ELECTRICAL			INDOOR LOOP *(Air @ 46% RH)*								
	ELT (°C)	Cond. Temp.	Flow (L/s)	LLT (°C)	Delta T (°C)	Heat Rej. (W)	Compressor Current (A)	Fan (W)	Input Power (W)	EAT (°C)	Evap. Temp.	Airflow (L/s)	LAT (°C)	Delta T (°C)	Latent (W)	Sensible (W)	**Cooling** (W)	**COP_C**
COOLING	9.4	21.1	0.88	15.6	6.2	22,845	10.8	325	2,663	27	7.1	900	13.3	13.7	5,762	14,385	**20,147**	**7.56**
	12.2	23.9	0.88	18.4	6.2	22,735	11.6	325	2,864		7.3	900	13.5	13.5	5,673	14,163	**19,835**	**6.93**
	15.0	26.7	0.88	21.1	6.1	22,612	12.4	325	3,067		7.4	900	13.8	13.2	5,580	13,930	**19,509**	**6.36**
	17.8	29.4	0.88	23.8	6.0	22,135	13.2	325	3,186		7.6	900	14.2	12.8	5,409	13,504	**18,914**	**5.94**
	21.1	32.2	0.88	27.3	6.2	21,640	14.0	325	3,307		7.8	900	14.4	12.6	5,474	12,833	**18,307**	**5.54**
	23.9	35.0	0.88	30.0	6.1	21,481	14.8	325	3,513		7.9	900	14.7	12.3	5,365	12,577	**17,942**	**5.11**
	26.7	37.8	0.88	32.7	6.1	21,314	15.7	325	3,728		8.1	900	15.0	12.0	5,250	12,309	**17,560**	**4.71**
	29.4	40.6	0.88	35.5	6.0	21,138	16.6	325	3,952		8.3	900	15.2	11.8	5,131	12,029	**17,160**	**4.34**

Hydronic Performance

TF-65-HACW-P-1T *R410a, 60 Hz, ZPS51K6E-PFV*

	OUTDOOR LOOP *(15% Methanol)*						ELECTRICAL		INDOOR LOOP *(Water)*						
	ELT (°F)	Evap. Temp.	Flow (gpm)	LLT (°F)	Delta T (°F)	Heat Abs. (Btu/hr)	Compressor Current (A)	Input Power (W)	EWT (°F)	Cond. Temp.	Flow (gpm)	LWT (°F)	Delta T (°F)	**Heating** (Btu/hr)	**COP_H**
HEATING	25	15	14	21	4	25,600	16.9	3,893	104	116	14	110	6	**38,400**	**2.89**
	30	20	14	26	4	28,200	17.4	3,992		117	14	110	6	**41,400**	**3.04**
	35	25	14	31	5	31,000	17.9	4,084		117	14	110	6	**44,500**	**3.19**
	40	29	14	35	5	34,000	18.3	4,176		118	14	111	7	**47,800**	**3.35**
	45	34	14	40	5	37,100	18.8	4,261		118	14	111	7	**51,300**	**3.53**
	50	39	14	44	6	40,400	19.2	4,346		119	14	112	8	**54,900**	**3.70**
	55	43	14	49	6	43,900	19.6	4,429		120	14	112	8	**58,700**	**3.88**
	60	48	14	53	7	47,700	20.0	4,506		120	14	113	9	**62,800**	**4.08**
	25	16	14	22	3	23,200	19.2	4,376	115	126	14	120	5	**37,600**	**2.52**
	30	21	14	26	4	25,800	19.6	4,449	114	126	14		6	**40,500**	**2.67**
	35	25	14	31	4	28,500	19.9	4,520	114	126	14		6	**43,500**	**2.82**
	40	30	14	35	5	31,400	20.2	4,580	113	126	14		7	**46,600**	**2.98**
	45	35	14	40	5	34,400	20.6	4,639	113	126	14		7	**49,800**	**3.15**
	50	39	14	45	6	37,700	20.8	4,689	112	126	14		8	**53,300**	**3.33**
	55	44	14	49	6	41,100	21.1	4,734	112	127	14		8	**56,900**	**3.52**
	60	48	14	54	7	44,600	21.3	4,780	111	127	14		9	**60,600**	**3.72**

METRIC

	OUTDOOR LOOP *(15% Methanol)*						ELECTRICAL		INDOOR LOOP *(Water)*						
	ELT (°C)	Evap. Temp.	Flow (L/s)	LLT (°C)	Delta T (°C)	Heat Abs. (kW)	Compressor Current (A)	Input Power (W)	EWT (°C)	Cond. Temp.	Flow (L/s)	LWT (°C)	Delta T (°C)	**Heating** (kW)	**COP_H**
HEATING	-3.9	-9.3	0.88	-6.0	2.1	7.5	16.9	3,893	40	46.8	0.88	43.1	3.1	**11.3**	**2.89**
	-1.1	-6.7	0.88	-3.4	2.3	8.3	17.4	3,992		47.1	0.88	43.3	3.3	**12.1**	**3.04**
	1.7	-4.1	0.88	-0.8	2.5	9.1	17.9	4,084		47.4	0.88	43.6	3.6	**13.0**	**3.19**
	4.4	-1.6	0.88	1.6	2.8	10.0	18.3	4,176		47.7	0.88	43.8	3.8	**14.0**	**3.35**
	7.2	1.1	0.88	4.2	3.0	10.9	18.8	4,261		48.0	0.88	44.1	4.1	**15.0**	**3.53**
	10.0	3.6	0.88	6.7	3.3	11.8	19.2	4,346		48.3	0.88	44.3	4.3	**16.1**	**3.70**
	12.8	6.2	0.88	9.2	3.6	12.9	19.6	4,429		48.7	0.88	44.7	4.7	**17.2**	**3.88**
	15.6	8.8	0.88	11.7	3.9	14.0	20.0	4,506		48.9	0.88	45.0	5.0	**18.4**	**4.08**
	-3.9	-8.9	0.88	-5.8	1.9	6.8	19.2	4,376	45.9	52.1	0.88	49	3.0	**11.0**	**2.52**
	-1.1	-6.3	0.88	-3.2	2.1	7.6	19.6	4,449	45.7	52.1	0.88		3.2	**11.9**	**2.67**
	1.7	-3.7	0.88	-0.6	2.3	8.4	19.9	4,520	45.4	52.2	0.88		3.4	**12.7**	**2.82**
	4.4	-1.2	0.88	1.8	2.6	9.2	20.2	4,580	45.2	52.3	0.88		3.7	**13.7**	**2.98**
	7.2	1.4	0.88	4.4	2.8	10.1	20.6	4,639	44.9	52.4	0.88		3.9	**14.6**	**3.15**
	10.0	3.9	0.88	6.9	3.1	11.0	20.8	4,689	44.7	52.4	0.88		4.2	**15.6**	**3.33**
	12.8	6.5	0.88	9.5	3.3	12.0	21.1	4,734	44.4	52.5	0.88		4.5	**16.7**	**3.52**
	15.6	9.1	0.88	12.0	3.6	13.1	21.3	4,780	44.1	52.6	0.88		4.8	**17.8**	**3.72**

Air Heating/Cooling Performance

TF-75-HACW-P-1T *R410a, 60 Hz, ZPS60K5E-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**
28	15	16	23	5.1	38,593	17.5	410	4,094	68	97	2,100	93	24.6	**52,075**	**3.73**
34	20	16	28	5.6	42,497	17.9	410	4,186		99	2,100	95	26.5	**56,292**	**3.94**
40	25	16	34	6.1	46,404	18.5	410	4,320		102	2,100	97	28.6	**60,659**	**4.11**
46	30	16	39	6.7	50,856	19.0	410	4,466		104	2,100	99	30.9	**65,609**	**4.30**
51	35	16	44	6.9	55,258	19.7	410	4,643		107	2,100	101	32.7	**70,689**	**4.46**
57	40	16	50	7.5	60,316	20.1	410	4,743		109	2,100	103	35.2	**76,088**	**4.70**
63	45	16	55	8.2	65,697	20.6	410	4,845		111	2,100	106	37.8	**81,818**	**4.95**
69	50	16	60	8.9	71,411	21.1	410	4,951		113	2,100	109	40.6	**87,893**	**5.20**

COOLING

OUTDOOR LOOP *(15% Methanol)*						ELECTRICAL			INDOOR LOOP *(Air @ 46% RH)*								
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**
52	70	16	63	10.9	86,865	13.1	450	3,412	80.6	44	2,100	59	21.2	24,039	51,083	**75,123**	**22.0**
57	75	16	68	10.8	86,123	13.9	450	3,619		44	2,100	60	20.7	23,576	50,099	**73,675**	**20.4**
62	80	16	73	10.7	85,342	14.7	450	3,828		44	2,100	60	20.3	23,097	49,082	**72,179**	**18.9**
67	85	16	78	10.6	84,654	15.6	450	3,941		44	2,100	61	20.0	22,755	48,353	**71,108**	**18.0**
73	90	16	84	11.0	83,917	16.5	450	4,050		44	2,100	60	20.3	21,843	48,167	**70,010**	**17.3**
78	95	16	89	10.9	82,973	17.4	450	4,263		45	2,100	61	19.8	21,321	47,017	**68,338**	**16.0**
83	100	16	94	10.8	82,003	18.3	450	4,485		45	2,100	61	19.3	20,782	45,828	**66,610**	**14.9**
88	105	16	99	10.7	81,008	19.3	450	4,717		45	2,100	62	18.8	20,225	44,599	**64,824**	**13.7**

METRIC

HEATING

OUTDOOR LOOP *(15% Methanol)*						ELECTRICAL			INDOOR LOOP *(Air)*						
ELT (°C)	Evap. Temp.	Flow (L/s)	LLT (°C)	Delta T (°C)	Heat Abs. (W)	Compressor Current (A)	Fan (W)	Input Power (W)	EAT (°C)	Cond. Temp.	Airflow (L/s)	LAT (°C)	Delta T (°C)	**Heating** (W)	**COP_H**
-2.2	-9.4	1.0	-5.0	2.8	11,308	17.5	410	4,094	20	36.1	990	33.6	13.6	**15,258**	**3.73**
1.1	-6.7	1.0	-2.0	3.1	12,452	17.9	410	4,186		37.2	990	34.7	14.7	**16,493**	**3.94**
4.4	-3.9	1.0	1.1	3.4	13,596	18.5	410	4,320		38.9	990	35.9	15.9	**17,773**	**4.11**
7.8	-1.1	1.0	4.1	3.7	14,901	19.0	410	4,466		40.0	990	37.2	17.2	**19,223**	**4.30**
10.6	1.7	1.0	6.7	3.8	16,191	19.7	410	4,643		41.7	990	38.2	18.2	**20,712**	**4.46**
13.9	4.4	1.0	9.7	4.2	17,672	20.1	410	4,743		42.8	990	39.5	19.5	**22,294**	**4.70**
17.2	7.2	1.0	12.7	4.6	19,249	20.6	410	4,845		43.9	990	41.0	21.0	**23,973**	**4.95**
20.6	10.0	1.0	15.6	5.0	20,923	21.1	410	4,951		45.0	990	42.6	22.6	**25,752**	**5.20**

COOLING

OUTDOOR LOOP *(15% Methanol)*						ELECTRICAL			INDOOR LOOP *(Air @ 46% RH)*								
ELT (°C)	Cond. Temp.	Flow (L/s)	LLT (°C)	Delta T (°C)	Heat Rej. (W)	Compressor Current (A)	Fan (W)	Input Power (W)	EAT (°C)	Evap. Temp.	Airflow (L/s)	LAT (°C)	Delta T (°C)	Latent (W)	Sensible (W)	**Cooling** (W)	**COP_C**
11.1	21.1	1.0	17.1	6.0	25,451	13.1	450	3,412	27	6.7	990	15.2	11.8	7,043	14,967	**22,011**	**6.45**
13.9	23.9	1.0	19.9	6.0	25,234	13.9	450	3,619		6.7	990	15.5	11.5	6,908	14,679	**21,586**	**5.96**
16.7	26.7	1.0	22.6	5.9	25,005	14.7	450	3,828		6.8	990	15.7	11.3	6,767	14,381	**21,148**	**5.52**
19.4	29.4	1.0	25.3	5.9	24,803	15.6	450	3,941		6.8	990	15.9	11.1	6,667	14,167	**20,834**	**5.29**
22.8	32.2	1.0	28.9	6.1	24,587	16.5	450	4,050		6.9	990	15.7	11.3	6,400	14,113	**20,513**	**5.06**
25.6	35.0	1.0	31.6	6.1	24,311	17.4	450	4,263		6.9	990	16.0	11.0	6,247	13,776	**20,023**	**4.70**
28.3	37.8	1.0	34.3	6.0	24,027	18.3	450	4,485		7.0	990	16.3	10.7	6,089	13,427	**19,517**	**4.35**
31.1	40.6	1.0	37.0	5.9	23,735	19.3	450	4,717		7.1	990	16.6	10.4	5,926	13,067	**18,993**	**4.03**

Hydronic Performance

TF-75-HACW-P-1T *R410a, 60 Hz, ZPS60K6E-PFV*

	OUTDOOR LOOP *(15% Methanol)*						ELECTRICAL		INDOOR LOOP *(Water)*						
	ELT (°F)	Evap. Temp.	Flow (gpm)	LLT (°F)	Delta T (°F)	Heat Abs. (Btu/hr)	Compressor Current (A)	Input Power (W)	EWT (°F)	Cond. Temp.	Flow (gpm)	LWT (°F)	Delta T (°F)	**Heating** (Btu/hr)	**COP_H**
HEATING	25	16	16	21	4	28,800	21.3	4,530	104	113	16	110	6	**43,900**	**2.84**
	30	20	16	26	4	32,200	21.6	4,596		114	16	110	6	**47,500**	**3.03**
	35	25	16	30	5	35,700	21.9	4,665		115	16	110	6	**51,300**	**3.22**
	40	29	16	35	5	39,600	22.1	4,728		115	16	111	7	**55,400**	**3.43**
	45	33	16	39	6	43,800	22.4	4,795		116	16	112	8	**59,800**	**3.65**
	50	37	16	44	6	48,300	22.7	4,854		117	16	112	8	**64,500**	**3.89**
	55	42	16	48	7	53,200	23.0	4,914		117	16	113	9	**69,600**	**4.15**
	60	46	16	53	7	58,300	23.3	4,978		118	16	113	9	**74,900**	**4.41**
	25	17	16	22	3	26,300	23.5	5,077	115	123	16	120	5	**43,300**	**2.50**
	30	21	16	26	4	29,500	23.6	5,110	114	123	16		6	**46,600**	**2.67**
	35	25	16	31	4	32,900	23.8	5,147	114	123	16		6	**50,100**	**2.85**
	40	30	16	35	5	36,700	24.0	5,181	113	123	16		7	**54,000**	**3.05**
	45	34	16	40	5	40,800	24.1	5,205	113	124	16		7	**58,200**	**3.28**
	50	38	16	44	6	45,100	24.2	5,234	112	124	16		8	**62,600**	**3.51**
	55	42	16	49	6	49,800	24.3	5,261	112	124	16		8	**67,400**	**3.75**
	60	47	16	53	7	54,900	24.4	5,281	111	124	16		9	**72,500**	**4.02**

METRIC

	OUTDOOR LOOP *(15% Methanol)*						ELECTRICAL		INDOOR LOOP *(Water)*						
	ELT (°C)	Evap. Temp.	Flow (L/s)	LLT (°C)	Delta T (°C)	Heat Abs. (kW)	Compressor Current (A)	Input Power (W)	EWT (°C)	Cond. Temp.	Flow (L/s)	LWT (°C)	Delta T (°C)	**Heating** (kW)	**COP_H**
HEATING	-3.9	-8.9	1.0	-6.0	2.1	8.4	21.3	4,530	40	45.2	1.0	43.1	3.1	**12.9**	**2.84**
	-1.1	-6.6	1.0	-3.4	2.3	9.4	21.6	4,596		45.5	1.0	43.3	3.3	**13.9**	**3.03**
	1.7	-4.2	1.0	-0.9	2.6	10.5	21.9	4,665		45.9	1.0	43.6	3.6	**15.0**	**3.22**
	4.4	-1.8	1.0	1.6	2.8	11.6	22.1	4,728		46.2	1.0	43.8	3.8	**16.2**	**3.43**
	7.2	0.6	1.0	4.1	3.1	12.8	22.4	4,795		46.6	1.0	44.2	4.2	**17.5**	**3.65**
	10.0	3.0	1.0	6.6	3.4	14.2	22.7	4,854		46.9	1.0	44.5	4.5	**18.9**	**3.89**
	12.8	5.4	1.0	9.0	3.8	15.6	23.0	4,914		47.3	1.0	44.8	4.8	**20.4**	**4.15**
	15.6	7.8	1.0	11.5	4.1	17.1	23.3	4,978		47.7	1.0	45.2	5.2	**22.0**	**4.41**
	-3.9	-8.6	1.0	-5.8	1.9	7.7	23.5	5,077	45.9	50.5	1.0	49	3.0	**12.7**	**2.50**
	-1.1	-6.2	1.0	-3.2	2.1	8.6	23.6	5,110	45.7	50.6	1.0		3.2	**13.7**	**2.67**
	1.7	-3.8	1.0	-0.6	2.3	9.6	23.8	5,147	45.4	50.7	1.0		3.5	**14.7**	**2.85**
	4.4	-1.4	1.0	1.8	2.6	10.8	24.0	5,181	45.1	50.8	1.0		3.8	**15.8**	**3.05**
	7.2	1.0	1.0	4.3	2.9	12.0	24.1	5,205	44.8	50.8	1.0		4.1	**17.1**	**3.28**
	10.0	3.4	1.0	6.8	3.2	13.2	24.2	5,234	44.6	50.9	1.0		4.3	**18.3**	**3.51**
	12.8	5.8	1.0	9.2	3.6	14.6	24.3	5,261	44.2	51.1	1.0		4.7	**19.8**	**3.75**
	15.6	8.2	1.0	11.7	3.9	16.1	24.4	5,281	43.8	51.1	1.0		5.1	**21.2**	**4.02**

Air Heating/Cooling Performance

TF-80-HACW-P-1S *R410a, 60 Hz, ZP72KCE-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	17	20	4.9	40,600	22.2	410	5,173	68	99	2,300	93	25.2	**57,900**	**3.28**
30	19	17	25	5.3	44,000	22.5	410	5,246		100	2,300	95	26.8	**61,600**	**3.44**
35	24	17	29	5.7	47,500	22.8	410	5,316		102	2,300	96	28.4	**65,300**	**3.60**
40	28	17	34	6.1	51,200	23.1	410	5,393		104	2,300	98	30.1	**69,200**	**3.76**
45	33	17	38	6.6	54,900	23.4	410	5,465		106	2,300	100	31.8	**73,200**	**3.93**
50	37	17	43	7.1	59,000	23.7	410	5,540		107	2,300	102	33.7	**77,500**	**4.10**
55	42	17	47	7.6	63,200	24.0	410	5,618		109	2,300	104	35.6	**81,900**	**4.27**
60	46	17	52	8.1	67,500	24.4	410	5,702		111	2,300	106	37.6	**86,500**	**4.45**

COOLING

OUTDOOR LOOP *(15% Methanol)*						ELECTRICAL			INDOOR LOOP *(Air @ 46% RH)*								
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**
55	79	17	67	12.2	101,200	17.5	308	4,209	80.6	46	2,300	54	26.7	26,300	61,300	**87,600**	**20.8**
60	84	17	72	12.1	100,600	18.7	308	4,452		46	2,300	54	26.2	25,900	60,300	**86,200**	**19.4**
65	90	17	77	12.0	100,000	20.0	308	4,695		46	2,300	55	25.8	25,400	59,400	**84,800**	**18.1**
70	95	17	82	11.9	99,500	21.2	308	4,942		47	2,300	55	25.4	25,000	58,400	**83,400**	**16.9**
75	100	17	87	11.9	98,900	22.4	308	5,199		47	2,300	56	25.0	24,600	57,400	**82,000**	**15.8**
80	106	17	92	11.8	98,600	23.7	308	5,470		48	2,300	56	24.6	24,200	56,500	**80,700**	**14.8**
85	111	17	97	11.8	98,000	25.0	308	5,757		48	2,300	57	24.1	23,700	55,500	**79,200**	**13.8**
90	116	17	102	11.7	97,500	26.5	308	6,068		48	2,300	57	23.6	23,300	54,300	**77,600**	**12.8**

METRIC

HEATING

OUTDOOR LOOP *(15% Methanol)*						ELECTRICAL			INDOOR LOOP *(Air)*						
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	-9.6	1.1	-6.6	2.7	11.90	22.2	410	5,173	20	37.0	1,085	34.0	14.0	**17.00**	**3.28**
-1.1	-7.1	1.1	-4.0	2.9	12.90	22.5	410	5,246		37.9	1,085	34.9	14.9	**18.10**	**3.44**
1.7	-4.6	1.1	-1.5	3.2	13.90	22.8	410	5,316		38.9	1,085	35.8	15.8	**19.10**	**3.60**
4.4	-2.1	1.1	1.0	3.4	15.00	23.1	410	5,393		39.9	1,085	36.7	16.7	**20.30**	**3.76**
7.2	0.3	1.1	3.5	3.7	16.10	23.4	410	5,465		40.8	1,085	37.7	17.7	**21.50**	**3.93**
10.0	2.8	1.1	6.1	3.9	17.30	23.7	410	5,540		41.8	1,085	38.7	18.7	**22.70**	**4.10**
12.8	5.3	1.1	8.6	4.2	18.50	24.0	410	5,618		42.7	1,085	39.8	19.8	**24.00**	**4.27**
15.6	7.8	1.1	11.1	4.5	19.80	24.4	410	5,702		43.7	1,085	40.9	20.9	**25.40**	**4.45**

COOLING

OUTDOOR LOOP *(15% Methanol)*						ELECTRICAL			INDOOR LOOP *(Air @ 46% RH)*								
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 (W)	Sensible (kW)	**Cooling** (kW)	**COP_C**
12.8	26.1	1.1	19.6	6.8	29.66	17.5	308	4,209	27	7.5	1,085	12.2	14.8	7.71	18.00	**25.70**	**6.10**
15.6	29.1	1.1	22.3	6.7	29.48	18.7	308	4,452		7.7	1,085	12.4	14.6	7.59	17.70	**25.30**	**5.69**
18.3	32.0	1.1	25.0	6.7	29.31	20.0	308	4,695		7.9	1,085	12.7	14.3	7.44	17.40	**24.90**	**5.30**
21.1	34.9	1.1	27.7	6.6	29.20	21.2	308	4,942		8.2	1,085	12.9	14.1	7.33	17.10	**24.40**	**4.95**
23.9	37.9	1.1	30.5	6.6	29.00	22.4	308	5,199		8.4	1,085	13.1	13.9	7.21	16.80	**24.00**	**4.63**
26.7	40.8	1.1	33.3	6.6	28.90	23.7	308	5,470		8.7	1,085	13.3	13.7	7.09	16.60	**23.70**	**4.34**
29.4	43.8	1.1	36.0	6.6	28.70	25.0	308	5,757		8.9	1,085	13.6	13.4	6.95	16.30	**23.20**	**4.04**
32.2	46.7	1.1	38.7	6.5	28.60	26.5	308	6,068		9.1	1,085	13.9	13.1	6.83	15.90	**22.70**	**3.75**

Hydronic Performance

TF-80-HACW-P-1T *R410a, 60 Hz, ZP72KCE-PFV*

	OUTDOOR LOOP *(15% Methanol)*						ELECTRICAL		INDOOR LOOP *(Water)*						
	ELT (°F)	Evap. Temp.	Flow (gpm)	LLT (°F)	Delta T (°F)	Heat Abs. (Btu/hr)	Compressor Current (A)	Input Power (W)	EWT (°F)	Cond. Temp.	Flow (gpm)	LWT (°F)	Delta T (°F)	**Heating** (Btu/hr)	**COP_H**
HEATING	25	16	17	21	4	33,300	24.1	5,488	104	117	17	110	6	**51,700**	**2.76**
	30	20	17	26	5	37,100	24.5	5,578		117	17	111	7	**55,800**	**2.93**
	35	24	17	30	5	41,100	24.9	5,672		118	17	111	7	**60,100**	**3.11**
	40	28	17	35	6	45,400	25.3	5,759		119	17	112	8	**64,700**	**3.29**
	45	32	17	39	6	50,000	25.7	5,852		119	17	112	8	**69,700**	**3.49**
	50	37	17	43	7	55,000	26.2	5,941		120	17	113	9	**75,000**	**3.70**
	55	41	17	48	7	60,400	26.6	6,032		121	17	114	10	**80,700**	**3.92**
	60	45	17	52	8	66,000	27.0	6,135		121	17	114	10	**86,600**	**4.14**
	25	16	17	21	4	30,300	27.1	6,186	114	126	17	120	6	**51,100**	**2.42**
	30	20	17	26	4	33,800	27.3	6,237	114	126	17		7	**54,800**	**2.58**
	35	25	17	31	5	37,700	27.6	6,292	113	126	17		7	**58,800**	**2.74**
	40	29	17	35	5	41,900	27.8	6,336	113	126	17		7	**63,200**	**2.92**
	45	33	17	39	6	46,300	28.1	6,384	112	126	17		8	**67,800**	**3.11**
	50	37	17	44	6	51,200	28.3	6,426	111	126	17		9	**72,800**	**3.32**
	55	41	17	48	7	56,400	28.5	6,470	111	127	17		9	**78,200**	**3.54**
	60	45	17	53	7	61,900	28.7	6,523	110	127	17		10	**83,900**	**3.77**

METRIC

	OUTDOOR LOOP *(15% Methanol)*						ELECTRICAL		INDOOR LOOP *(Water)*						
	ELT (°C)	Evap. Temp.	Flow (L/s)	LLT (°C)	Delta T (°C)	Heat Abs. (W)	Compressor Current (A)	Input Power (W)	EWT (°C)	Cond. Temp.	Flow (L/s)	LWT (°C)	Delta T (°C)	**Heating** (W)	**COP_H**
HEATING	-3.9	-9.2	1.1	-6.1	2.2	9.8	24.1	5,488	40	47.1	1.1	43.4	3.4	**15.2**	**2.76**
	-1.1	-6.8	1.1	-3.6	2.5	10.9	24.5	5,578		47.4	1.1	43.7	3.7	**16.4**	**2.93**
	1.7	-4.5	1.1	-1.0	2.7	12.0	24.9	5,672		47.8	1.1	43.9	3.9	**17.6**	**3.11**
	4.4	-2.2	1.1	1.3	3.1	13.3	25.3	5,759		48.2	1.1	44.2	4.2	**19.0**	**3.29**
	7.2	0.2	1.1	3.9	3.3	14.7	25.7	5,852		48.6	1.1	44.6	4.6	**20.4**	**3.49**
	10.0	2.5	1.1	6.3	3.7	16.1	26.2	5,941		48.9	1.1	44.9	4.9	**22.0**	**3.70**
	12.8	4.8	1.1	8.7	4.1	17.7	26.6	6,032		49.2	1.1	45.3	5.3	**23.7**	**3.92**
	15.6	7.2	1.1	11.2	4.4	19.3	27.0	6,135		49.6	1.1	45.7	5.7	**25.4**	**4.14**
	-3.9	-8.7	1.1	-5.9	2.0	8.9	27.1	6,186	45.6	52.1	1.1	49	3.3	**15.0**	**2.42**
	-1.1	-6.4	1.1	-3.4	2.3	9.9	27.3	6,237	45.3	52.1	1.1		3.6	**16.1**	**2.58**
	1.7	-4.1	1.1	-0.8	2.5	11.0	27.6	6,292	45.1	52.2	1.1		3.8	**17.2**	**2.74**
	4.4	-1.8	1.1	1.6	2.8	12.3	27.8	6,336	44.8	52.3	1.1		4.1	**18.5**	**2.92**
	7.2	0.5	1.1	4.1	3.1	13.6	28.1	6,384	44.4	52.4	1.1		4.4	**19.9**	**3.11**
	10.0	2.8	1.1	6.6	3.4	15.0	28.3	6,426	44.1	52.4	1.1		4.8	**21.3**	**3.32**
	12.8	5.2	1.1	9.0	3.8	16.5	28.5	6,470	43.8	52.5	1.1		5.1	**22.9**	**3.54**
	15.6	7.4	1.1	11.5	4.1	18.1	28.7	6,523	43.4	52.6	1.1		5.5	**24.6**	**3.77**

Electrical Specifications

TABLE 36 - TF-Series Electrical Specifications ** equipped with K6E compressors where available*

	Code	Power Supply			Compressor		Fan	Circulators	FLA	MCA	Max. Breaker	Min. Wire
		V-ø-Hz	MIN	MAX	RLA	LRA	RLA	Max A	Amps	Amps	Amps	ga
TF-45	1	208/230-1-60	187	253	**14.1**	**84**	3.5	5.0	**23.4**	**26.9**	**40**	**#8-2 ***
	2	208-3-60	187	229	**9.6**	**74**	3.5	5.0	**18.9**	**21.3**	**30**	**#10-3 ***
	4	460-3-60	414	506	**5.1**	**37**	3.5	5.0	**14.4**	**15.7**	**20**	**#12-4**
	6	220-1-50	187	253	**12.4**	**67**	3.5	5.0	**21.9**	**25.0**	**40**	**#8-2**
	7	380-3-50	342	418	**4.9**	**37**	3.5	5.0	**14.2**	**15.4**	**20**	**#12-4**
TF-55	1	208/230-1-60	187	253	**20.4**	**122**	4.0	7.0	**32.2**	**37.3**	**50**	**#8-2 ***
	2	208-3-60	187	229	**14.0**	**83**	4.0	7.0	**25.8**	**29.3**	**40**	**#8-3 ***
	4	460-3-60	414	506	**6.4**	**41**	4.0	7.0	**18.2**	**19.8**	**30**	**#10-4**
	6	220-1-50	187	253	**15.5**	**100**	4.0	7.0	**27.5**	**21.4**	**50**	**#8-2**
	7	380-3-50	342	418	**6.1**	**43**	4.0	7.0	**17.9**	**19.4**	**30**	**#10-4**
TF-65	1	208/230-1-60	187	253	**22.8**	**147**	5.5	7.0	**36.1**	**41.8**	**60**	**#6-2 ***
	2	208-3-60	187	229	**16.5**	**110**	5.5	7.0	**29.8**	**33.9**	**50**	**#8-3 ***
	4	460-3-60	414	506	**7.2**	**52**	5.5	7.0	**20.5**	**22.3**	**30**	**#10-4**
	6	220-1-50	187	253	**21.5**	**126**	5.5	7.0	**35.0**	**40.4**	**60**	**#6-2**
	7	380-3-50	342	418	**6.9**	**52**	5.5	7.0	**20.2**	**21.9**	**30**	**#10-4**
TF-75	1	208/230-1-60	187	253	**27.6**	**190**	6.5	7.0	**41.9**	**48.8**	**60**	**#6-2 ***
	2	208-3-60	187	229	**18.6**	**149**	6.5	7.0	**32.9**	**37.6**	**50**	**#8-3 ***
	4	460-3-60	414	506	**9.0**	**61**	6.5	7.0	**23.3**	**25.6**	**30**	**#10-4**
	6	220-1-50	187	253	**28.2**	**155**	6.5	7.0	**42.7**	**49.8**	**60**	**#6-2**
	7	380-3-50	342	418	**7.7**	**59**	6.5	7.0	**22.0**	**23.9**	**30**	**#10-4**
TF-80	1	208/230-1-60	187	253	**36.9**	**185**	7.0	7.0	**51.7**	**60.9**	**80**	**#4-2 ***
	2	208-3-60	187	229	**23.2**	**164**	7.0	7.0	**38.0**	**43.8**	**60**	**#8-3 ***
	4	460-3-60	414	506	**11.2**	**75**	7.0	7.0	**26.0**	**28.8**	**40**	**#8-4**
	6	-	-	-	-	-	-	-	-	-	-	-
	7	380-3-50	342	418	**11.2**	**75**	7.0	7.0	**26.0**	**28.8**	**40**	**#8-4**

* If connecting 115V indoor circulator, additional conductor required for NEUTRAL connection.

TABLE 37 - Plenum Heater Electrical Specifications

Size (kW)	(230-1-60)					(208-1-60)					(208-3-60)				
	Actual (kW)	FLA (A)	MCA (A)	Breaker (A)	Wire Size	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**	**5**	**13.9**	**17.4**	**30**	**#10**
7	**7**	**29.2**	**36.5**	**40**	**#8**	**5.3**	**25.3**	**31.6**	**40**	**#8**	**7**	**19.5**	**24.3**	**30**	**#10**
10	**10**	**41.7**	**52.1**	**60**	**#6**	**7.5**	**36.1**	**45.1**	**50**	**#6**	**10**	**27.8**	**34.7**	**40**	**#8**
15	**15**	**62.5**	**78.1**	**80**	**#4**	**11.3**	**54.2**	**67.7**	**80**	**#4**	**15**	**41.7**	**52.1**	**60**	**#6**
20	**20**	**83.3**	**104.2**	**100**	**#3**	**15.0**	**72.2**	**90.3**	**100**	**#3**	**-**	**-**	**-**	**-**	**-**

Airflow Data

TABLE 38 - 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***
80	**2300**	***1085***	**1850-2500**	***873-1180***	**1840**	***870***	**1955**	***920***	**2070**	***980***	**2185**	***1030***

TABLE 39 - 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***
80	**-**	***-***	**-**	***-***	**-**	***-***	**-**	***-***	**-**	***-***	**-**	***-***

TABLE 40 - 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***
80	**2300**	***1085***	**1850-2500**	***873-1180***	**1840**	***870***	**1955**	***920***	**2070**	***980***	**2185**	***1030***

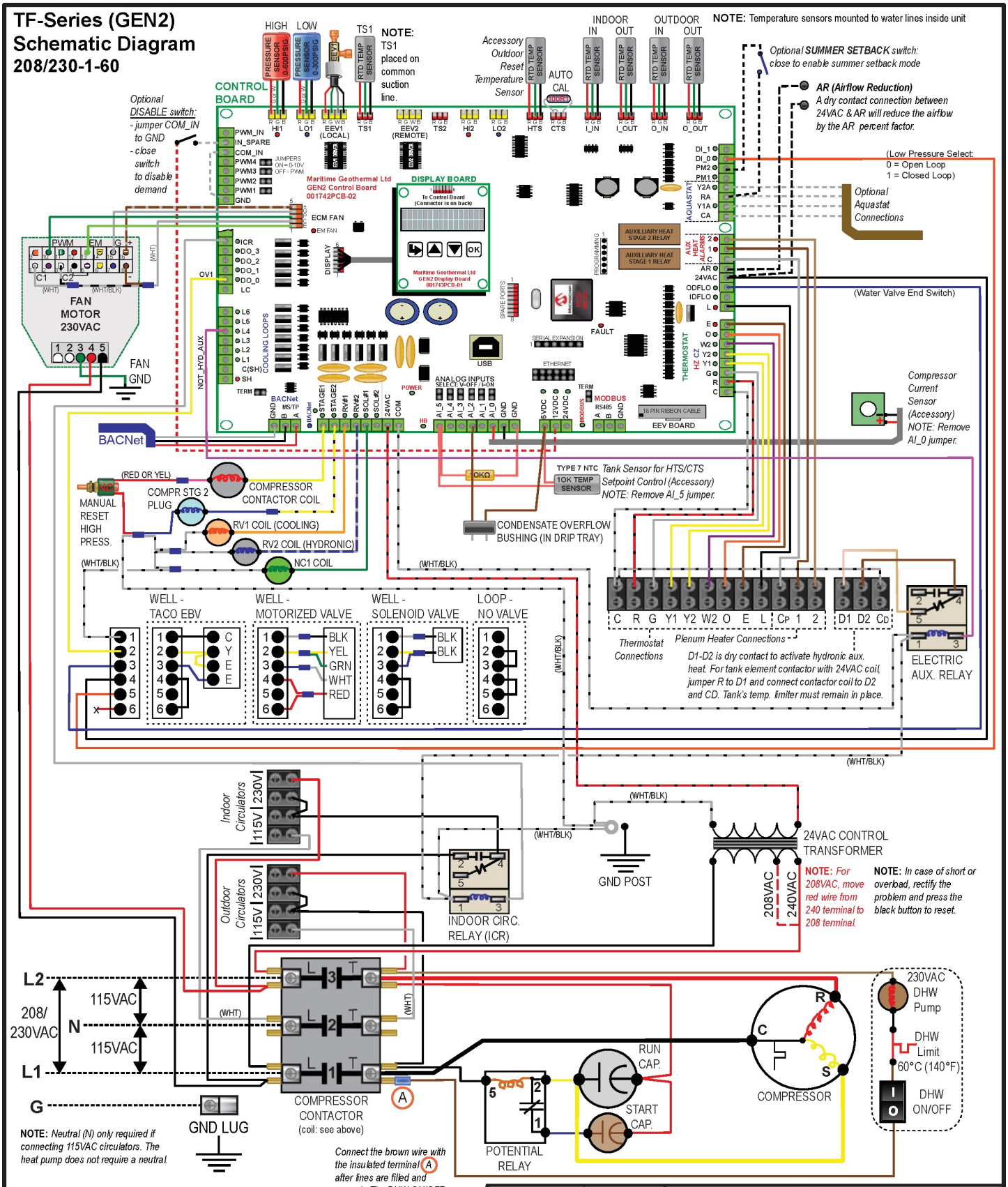
TABLE 41 - Airflow Range for Fan Recirculation												
Model Size	Nominal		Range		Airflow Reduction - 20%		Airflow Reduction - 15%		Airflow Reduction - 10%		Airflow Reduction - 5%	
	cfm	*L/s*	cfm	*L/s*	cfm	*L/s*	cfm	*L/s*	cfm	*L/s*	cfm	*L/s*
45	**650**	***310***	**500-800**	***240-380***	**520**	***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***
80	**1300**	***615***	**1050-1550**	***496-732***	**1040**	***490***	**1105**	***520***	**1170**	***550***	**1235**	***585***

TABLE 42 - Airflow Range for Emergency Heat		
Model Size	cfm	*L/s*
45	**1200**	***566***
55/65/75/80	**2000**	***940***

Maximum external static pressure:
0.50in H_2O

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.

TF-Series (GEN2) Schematic Diagram 208/230-1-60



REV	ECO#	IMPL BY	APVD BY	DATE
03	000308	D. RHEAULT	D. RHEAULT	23-Jan-2023
02	-	D. RHEAULT	D. RHEAULT	10-Mar-2020
01	Initial Release	D. RHEAULT	D. RHEAULT	4-Jan-2019

Drawn By	Dan Rheault	Date	4-Jan-2019
Checked By	Dan Rheault	Date	4-Jan-2019
Eng. Approved By	Dan Rheault	Date	4-Jan-2019
Mfg. Approved By		Date	
Approved By		Date	

MARITIME GEOTHERMAL LTD.
P.O. Box 2555
170 Plantation Rd.
Petitcodiac, NB CANADA E4Z 6H4

Drawing Name: TF-**-HACW-P-1*-**-*DE*F Schematic Diagram

Size	Drawing Number	Drawing Rev	Sheet
LET	002368SCH	03	1 / 1

TF-Series Electrical Box Diagram
208/230-1-60

SYSTEM CONTROL DESCRIPTION

Sytem Control by BACNet or External Control Signals		
BACNet Object	External	Activation
SYSTEM G	G	Fan Recirculation Mode
SYSTEM_ Y1	Y1	Compressor Stage 1 (Air)
SYSTEM_Y2	Y2	Compressor Stage 2 (Air)
SYSTEM_W2	W2	Auxiliary Heat (Air)
SYSTEM_O	O	Air Heating (OFF) / Air Cooling (ON)
SYSTEM_Y1A	Y1A	Compressor Stage 1 (Hydronic)
SYSTEM_Y2A	Y2A	Compressor Stage 2 (Hydronic)

BACNet INTERFACE CONNECTIONS (MS/TP RS-485)

Use twisted pair shielded, conductor cable to connect the BACNet connections to the control board connector.
A - Communication (+)
B - Communication (-)
GND - Ground

EXT. AIR CONTROL CONNECTIONS (24VAC)

Use an 18-9 cable to connect the air thermostat to the Thermostat Connections terminal strip:

C - 24VAC Common
R - 24VAC Hot
G - Fan Recirculation Mode
Y1 - Compressor Stage1
Y2 - Compressor Stage2
W2 - Auxiliary Heat (Air)
E - Emergency Heat (Air)
O - Cooling Mode Active
L - Lockout indicator (24VAC if lockout)

A dry contact R to [G, Y1, Y2, W2, E, or O] will activate the input.

EXT. HYDRONIC CONTROL CONNECTIONS (24V)

If using an external aquastat (*Signals* control method), use an 18-4 cable to connect the screw terminals on the right side of the control board to the aquastat:

CA - 24VAC Common
RA - 24VAC Hot
Y1A - Compressor Stage1
Y2A - Compressor Stage2

A dry contact RA to Y1A / Y2A will activate the input.

CIRCULATOR CONNECTIONS (230/115VAC)

REFER TO LABEL IN UNIT FOR MAX LOAD (AMPS)
Connect 115VAC circulators to 115V
Connect 230VAC circulators to 230V

HYDRONIC AUX. HEAT CONTROL CONNECTIONS

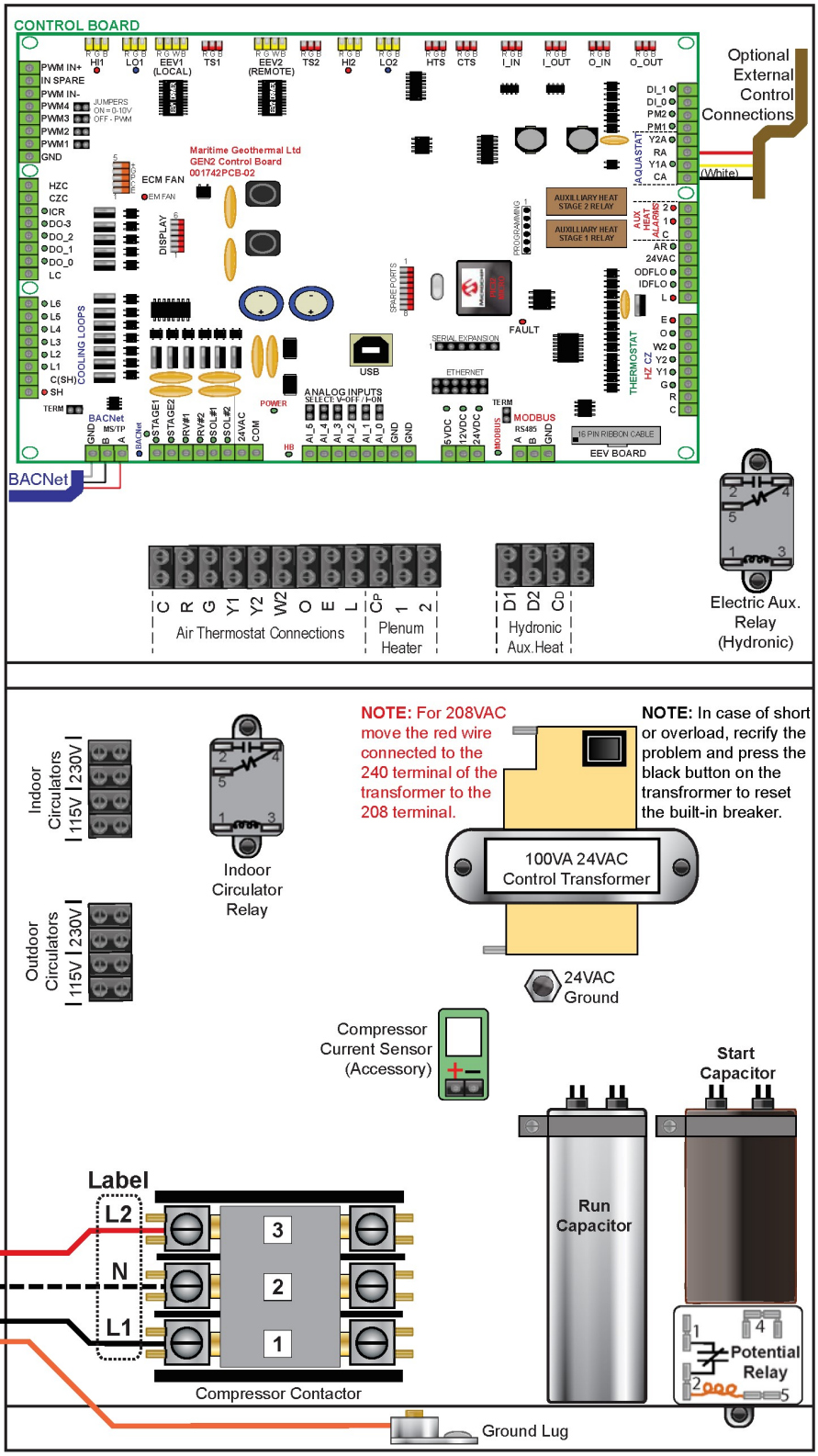
Use an 18-2 conductor cable.
Choose one of two types of auxiliary heat connections.
In either case, default is "ON".
Tank's temperature limiter must remain in place.

D1 D2	Dry contacts, closed during call for auxiliary heat
R D1 D2 CD	To use tank element contactor that has a 24VAC coil, jumper R to D1 and connect contactor coil between D2 and CD.

POWER SUPPLY CONNECTIONS

*NOTE: Neutral (N) is only required if connecting 115VAC circulators.

208/230/115VAC CONNECTIONS		
Wire	Colour	Contactor (Label)
Line 2	Red	L2
Neutral*	White	N*
Line 1	Black	L1
Connect "GND" to ground lug		

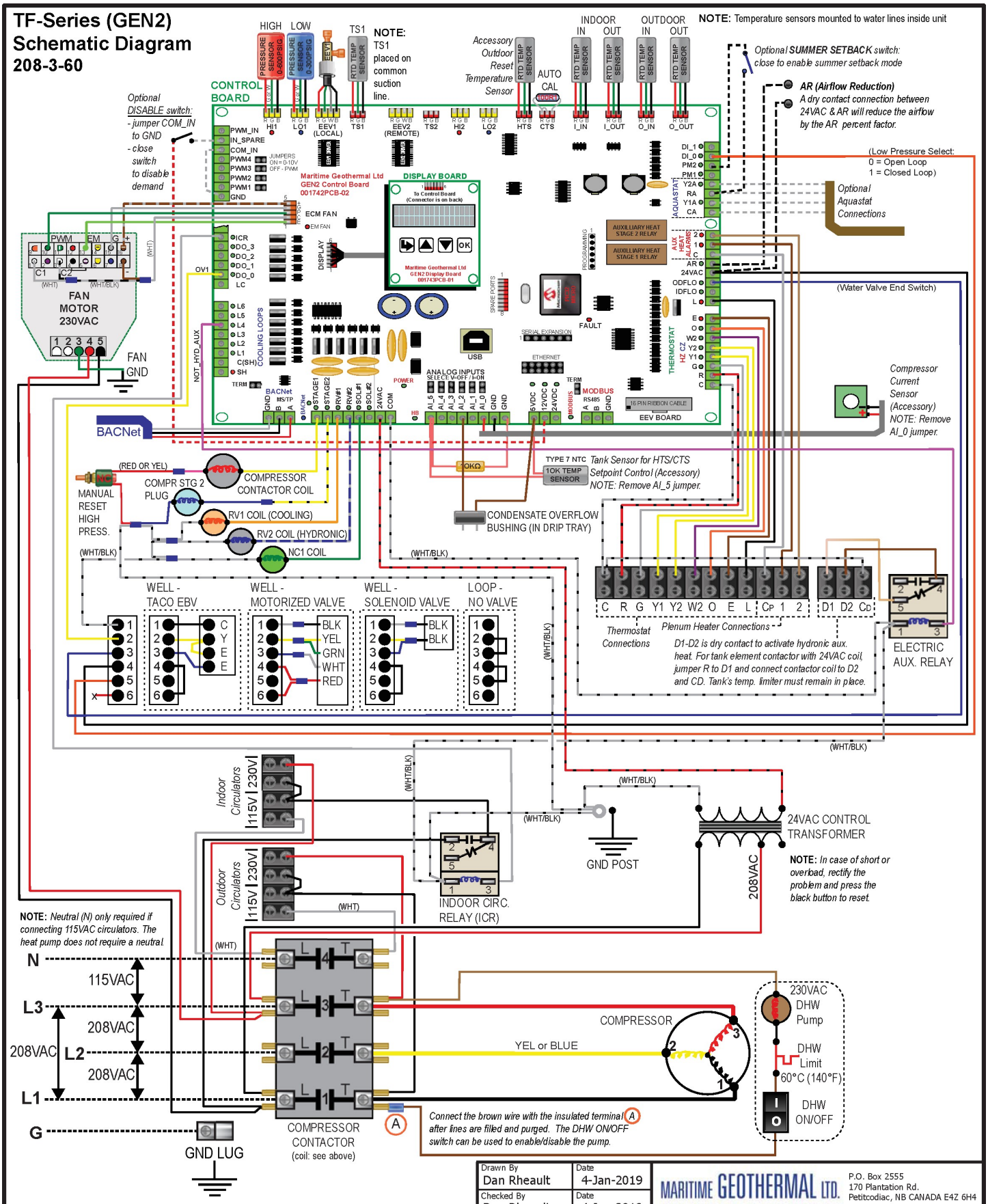


02	000308	D. RHEAULT	D. RHEAULT	23-Jan-2023
01	Initial Release	D. RHEAULT	D. RHEAULT	4-Jan-2019
REV	ECO#	IMPL BY	APVD BY	DATE

Drawn By: Dan Rheault	Date: 4-Jan-2019	MARITIME GEOTHERMAL LTD.	P.O. Box 2555 170 Plantation Rd. Petitcodiac, NB CANADA E4Z 6H4
Checked By: Dan Rheault	Date: 4-Jan-2019	Drawing Name: TF-**-HACW-P-1*-**-*DE*F Electrical Box Diagram	
Eng. Approved By: Dan Rheault	Date: 4-Jan-2019		
Mfg. Approved By	Date		
Approved By	Date		

Size	Drawing Number	Drawing Rev	Sheet
LET	002369ELB	02	1 / 1

TF-Series (GEN2) Schematic Diagram 208-3-60



REV	ECO#	IMPL BY	APVD BY	DATE
04	000308	D. RHEAULT	D. RHEAULT	23-Jan-2023
03	000296	D. RHEAULT	D. RHEAULT	1-Feb-2022
02	-	D. RHEAULT	D. RHEAULT	10-Mar-2020
01	Initial Release	D. RHEAULT	D. RHEAULT	4-Jan-2019

Drawn By: Dan Rheault	Date: 4-Jan-2019		
Checked By: Dan Rheault	Date: 4-Jan-2019		
Eng. Approved By: Dan Rheault	Date: 4-Jan-2019		
Mfg. Approved By:	Date:		
Approved By:	Date:		

MARITIME GEOTHERMAL LTD.
P.O. Box 2555
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Petitcodiac, NB CANADA E4Z 6H4

Drawing Name: TF-**-HACW-P-2*-**-*DE*F Schematic Diagram

Size	Drawing Number	Drawing Rev	Sheet
LET	002370SCH	04	1 / 1

TF-Series Electrical Box Diagram
208-3-60

SYSTEM CONTROL DESCRIPTION

Sytem Control by BACNet or External Control Signals		
BACNet Object	External	Activation
SYSTEM G	G	Fan Recirculation Mode
SYSTEM_Y1	Y1	Compressor Stage 1 (Air)
SYSTEM_Y2	Y2	Compressor Stage 2 (Air)
SYSTEM_W2	W2	Auxiliary Heat (Air)
SYSTEM_O	O	Air Heating (OFF) / Air Cooling (ON)
SYSTEM_Y1A	Y1A	Compressor Stage 1 (Hydronic)
SYSTEM_Y2A	Y2A	Compressor Stage 2 (Hydronic)

BACNet INTERFACE CONNECTIONS (MS/TP RS-485)

Use twisted pair shielded, conductor cable to connect the BACNet connections to the control board connector.
A - Communication (+)
B - Communication (-)
GND - Ground

EXT. AIR CONTROL CONNECTIONS (24VAC)

Use an 18-9 cable to connect the air thermostat to the Thermostat Connections terminal strip:

C - 24VAC Common
R - 24VAC Hot
G - Fan Recirculation Mode
Y1 - Compressor Stage1
Y2 - Compressor Stage2
W2 - Auxiliary Heat (Air)
E - Emergency Heat (Air)
O - Cooling Mode Active
L - Lockout indicator (24VAC if lockout)

A dry contact R to [G, Y1, Y2, W2, E, or O] will activate the input.

EXT. HYDRONIC CONTROL CONNECTIONS (24V)

If using an external aquastat (*Signals* control method), use an 18-4 cable to connect the screw terminals on the right side of the control board to the aquastat:

CA - 24VAC Common
RA - 24VAC Hot
Y1A - Compressor Stage1
Y2A - Compressor Stage2

A dry contact RA to Y1A / Y2A will activate the input.

CIRCULATOR CONNECTIONS (230/115VAC)

REFER TO LABEL IN UNIT FOR MAX LOAD (AMPS)
Connect 115VAC circulators to 115V
Connect 230VAC circulators to 230V

HYDRONIC AUX. HEAT CONTROL CONNECTIONS

Use an 18-2 conductor cable.
Choose one of two types of auxiliary heat connections.
In either case, default is "ON".
Tank's temperature limiter must remain in place.

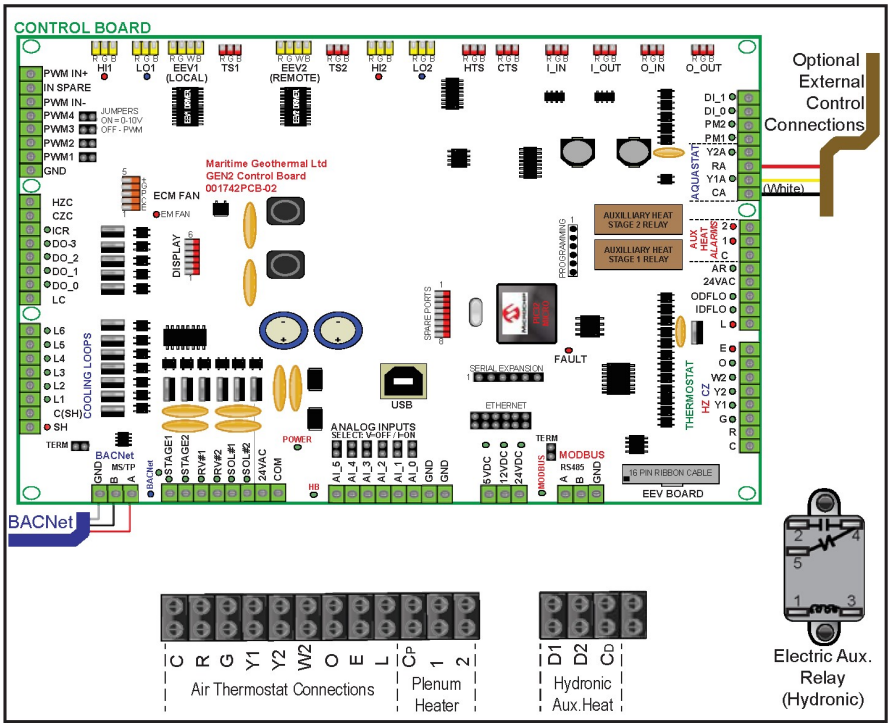
D1, D2 — Dry contacts, closed during call for auxiliary heat

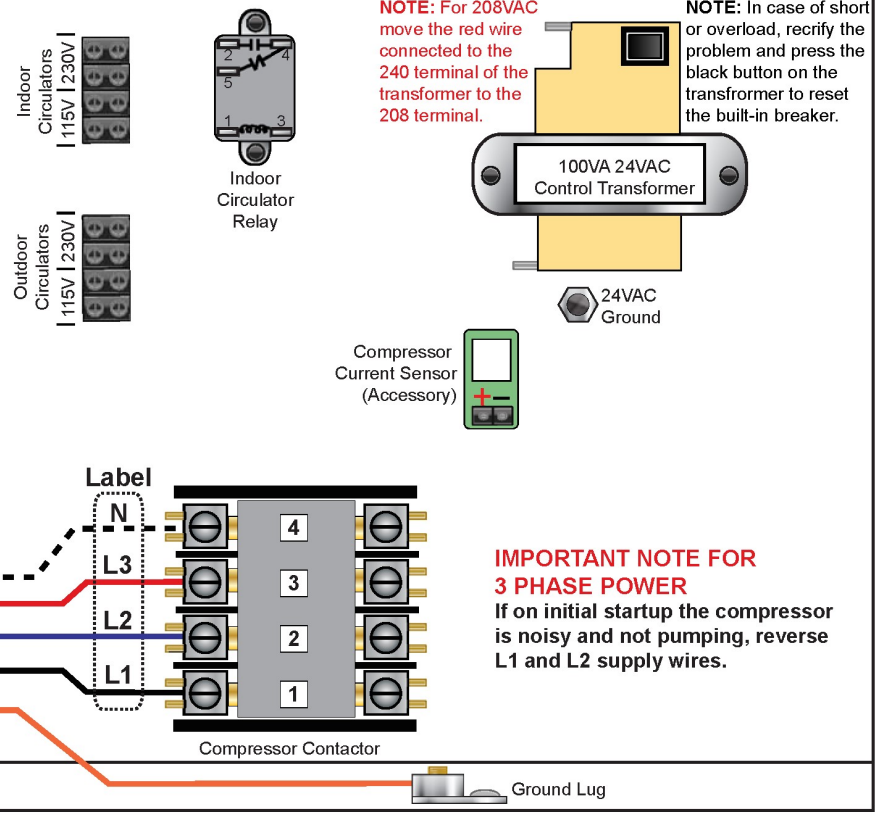
R, D1, D2, CD — To use tank element contactor that has a 24VAC coil, jumper R to D1 and connect contactor coil between D2 and CD.

208V POWER SUPPLY CONNECTIONS

*NOTE: Neutral (N) is only required if connecting 115VAC circulators.

Wire	Colour	Contactor (Label)
Neutral*	White	N*
Line 3	Red	L3
Line 2	Blue	L2
Line 1	Black	L1
Connect "GND" to ground lug		





REV	ECO#	IMPL BY	APVD BY	DATE
02	000308	D. RHEAULT	D. RHEAULT	23-Jan-2023
01	Initial Release	D. RHEAULT	D. RHEAULT	4-Jan-2019

Drawn By: Dan Rheault	Date: 4-Jan-2019	
Checked By: Dan Rheault	Date: 4-Jan-2019	
Eng. Approved By: Dan Rheault	Date: 4-Jan-2019	
Mfg. Approved By:	Date:	
Approved By:	Date:	

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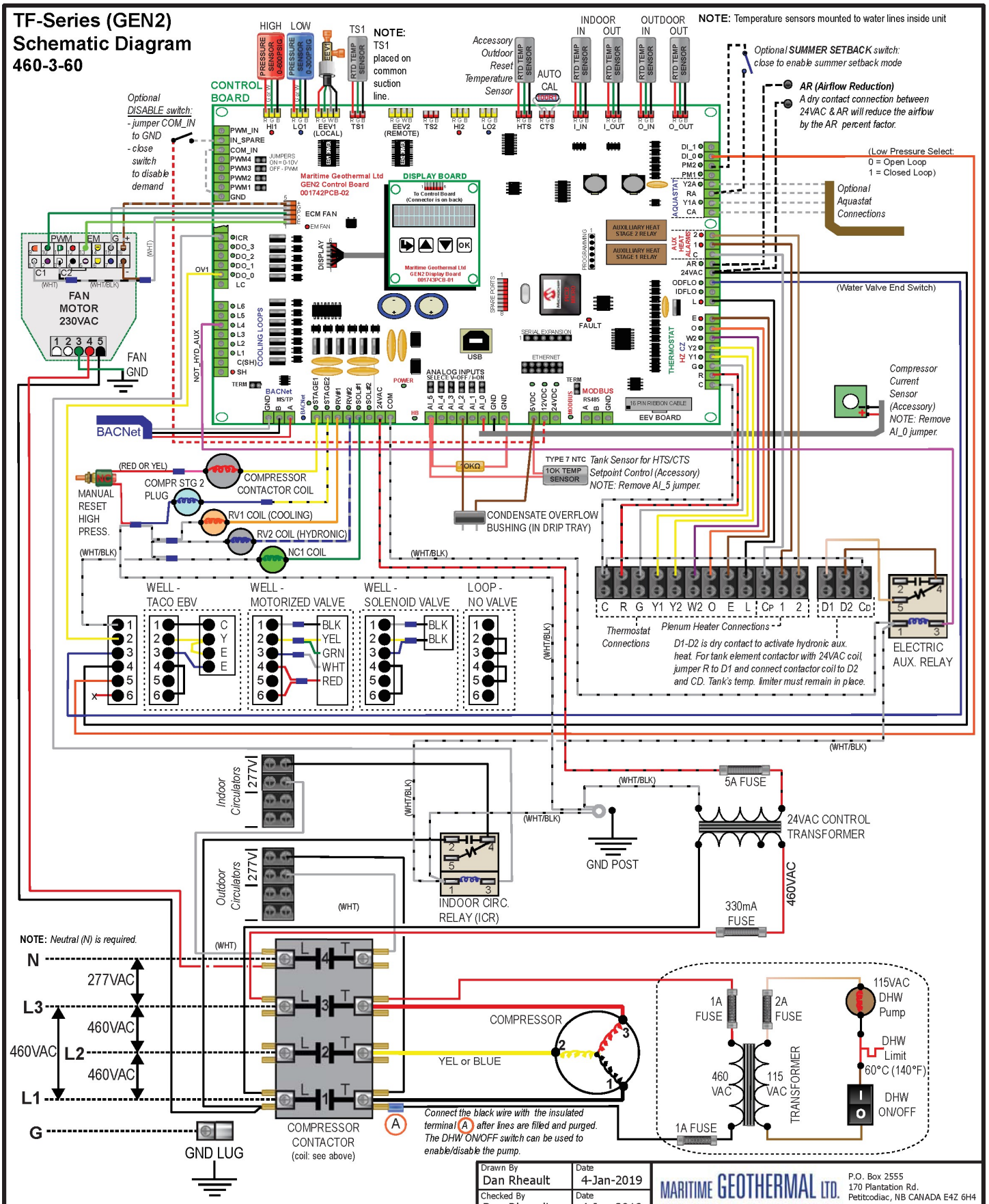
Drawing Name: TF-**-HACW-P-2*-**-*DE*F Electrical Box Diagram

Size	Drawing Number	Drawing Rev	Sheet
LET	002371ELB	02	1 / 1

TF-Series (GEN2) Schematic Diagram 460-3-60



REV	ECO#	IMPL BY	APVD BY	DATE
04	000308	D. RHEAULT	D. RHEAULT	23-Jan-2023
03	000296	D. RHEAULT	D. RHEAULT	1-Feb-2022
02	-	D. RHEAULT	D. RHEAULT	10-Mar-2020
01	Initial Release	D. RHEAULT	D. RHEAULT	4-Jan-2019

Drawn By: Dan Rheault	Date: 4-Jan-2019	
Checked By: Dan Rheault	Date: 4-Jan-2019	
Eng. Approved By: Dan Rheault	Date: 4-Jan-2019	
Mfg. Approved By	Date	
Approved By	Date	

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Drawing Name: TF-**-HACW-P-4*-**-*DE*F Schematic Diagram

Size	Drawing Number	Drawing Rev	Sheet
LET	002372SCH	04	1 / 1

TF-Series Electrical Box Diagram
460-3-60

SYSTEM CONTROL DESCRIPTION

Sytem Control by BACNet or External Control Signals		
BACNet Object	External	Activation
SYSTEM G	G	Fan Recirculation Mode
SYSTEM_Y1	Y1	Compressor Stage 1 (Air)
SYSTEM_Y2	Y2	Compressor Stage 2 (Air)
SYSTEM_W2	W2	Auxiliary Heat (Air)
SYSTEM_O	O	Air Heating (OFF) / Air Cooling (ON)
SYSTEM_Y1A	Y1A	Compressor Stage 1 (Hydronic)
SYSTEM_Y2A	Y2A	Compressor Stage 2 (Hydronic)

BACNet INTERFACE CONNECTIONS (MS/TP RS-485)

Use twisted pair shielded, conductor cable to connect the BACNet connections to the control board connector.
A - Communication (+)
B - Communication (-)
GND - Ground

EXT. AIR CONTROL CONNECTIONS (24VAC)

Use an 18-9 cable to connect the air thermostat to the Thermostat Connections terminal strip:

C - 24VAC Common
R - 24VAC Hot
G - Fan Recirculation Mode
Y1 - Compressor Stage1
Y2 - Compressor Stage2
W2 - Auxiliary Heat (Air)
E - Emergency Heat (Air)
O - Cooling Mode Active
L - Lockout indicator (24VAC if lockout)

A dry contact R to [G, Y1, Y2, W2, E, or O] will activate the input.

EXT. HYDRONIC CONTROL CONNECTIONS (24V)

If using an external aquastat (*Signals* control method), use an 18-4 cable to connect the screw terminals on the right side of the control board to the aquastat:

CA - 24VAC Common
RA - 24VAC Hot
Y1A - Compressor Stage1
Y2A - Compressor Stage2

A dry contact RA to Y1A / Y2A will activate the input.

CIRCULATOR CONNECTIONS (277VAC)

REFER TO LABEL IN UNIT FOR MAX LOAD (AMPS)
Connect 277VAC circulators to 277V terminals.

HYDRONIC AUX. HEAT CONTROL CONNECTIONS

Use an 18-2 conductor cable.
Choose one of two types of auxiliary heat connections.
In either case, default is "ON".
Tank's temperature limiter must remain in place.

D1 / D2 : Dry contacts, closed during call for auxiliary heat

R / D1 / D2 / CD : To use tank element contactor that has a 24VAC coil, jumper R to D1 and connect contactor coil between D2 and CD.

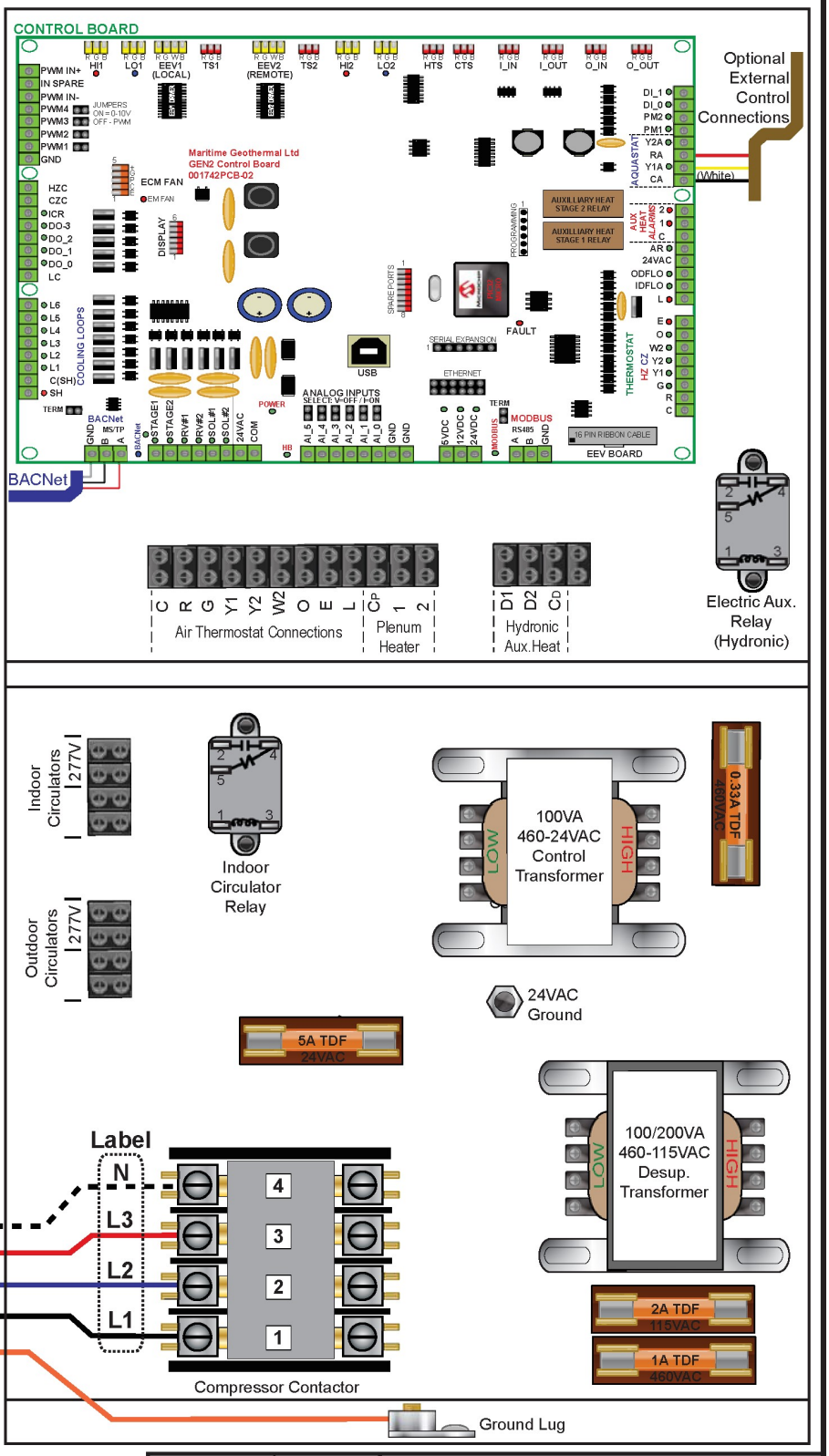
460V POWER SUPPLY CONNECTIONS

*NOTE: Neutral (N) is required.

Wire	Colour	Contactor (Label)
Neutral*	White	N*
Line 3	Red	L3
Line 2	Blue	L2
Line 1	Black	L1
Connect "GND" to ground lug		

IMPORTANT NOTE FOR 3 PHASE POWER

If on initial startup the compressor is noisy and not pumping, reverse L1 and L2 supply wires.



02	000308	D. RHEAULT	D. RHEAULT	23-Jan-2023
01	Initial Release	D. RHEAULT	D. RHEAULT	4-Jan-2019
REV	ECO#	IMPL BY	APVD BY	DATE

Drawn By: Dan Rheault	Date: 4-Jan-2019	
Checked By: Dan Rheault	Date: 4-Jan-2019	
Eng. Approved By: Dan Rheault	Date: 4-Jan-2019	
Mfg. Approved By	Date	
Approved By	Date	

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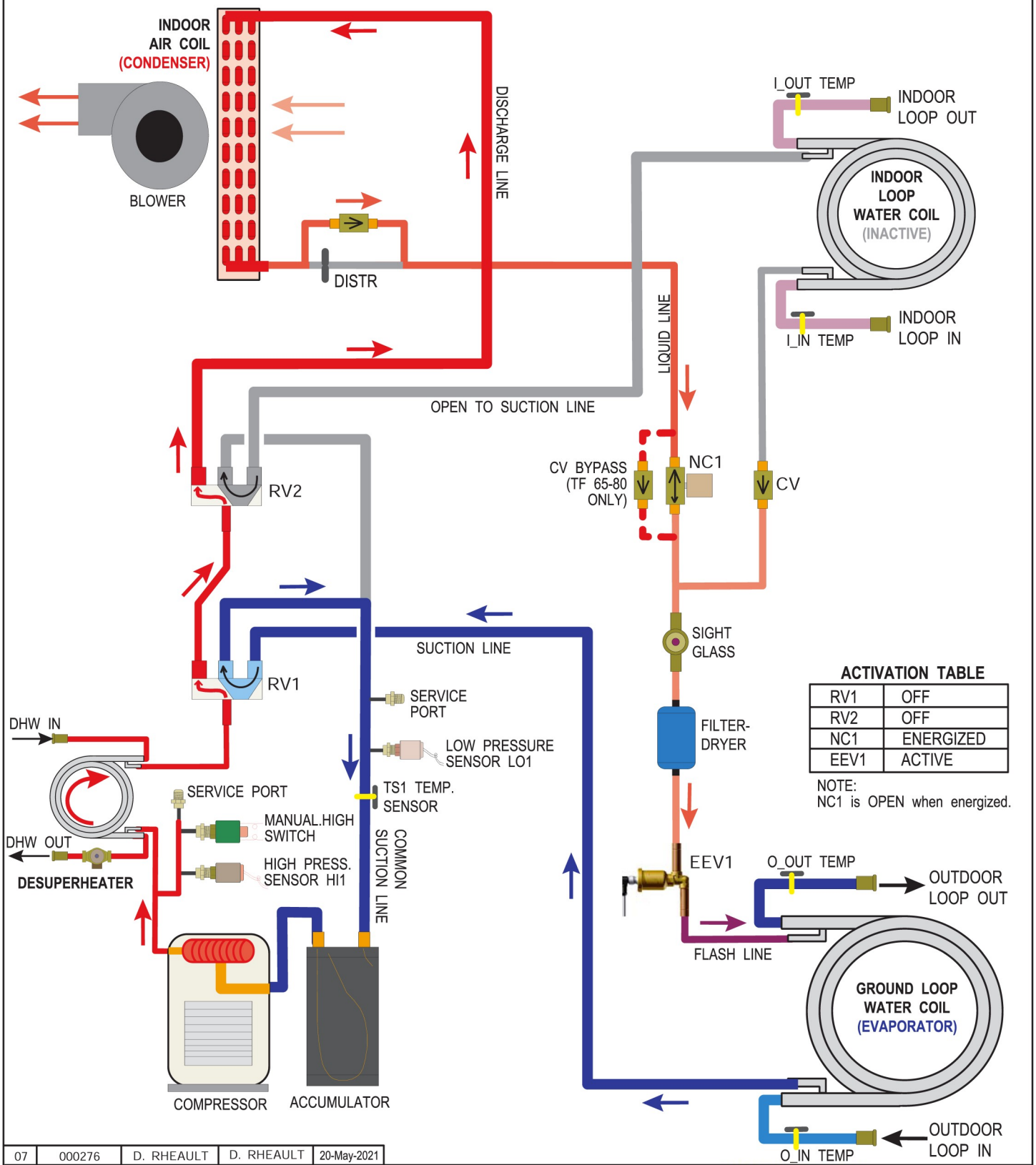
Drawing Name: TF-**-HACW-P-4*-**-*DE*F Electrical Box Diagram

Size	Drawing Number	Drawing Rev	Sheet
LET	002373ELB	02	1 / 1

TF-Series Refrigeration Circuit - Air Heating Mode



ACTIVATION TABLE

RV1	OFF
RV2	OFF
NC1	ENERGIZED
EEV1	ACTIVE

NOTE:
NC1 is OPEN when energized.

REV	ECO #	IMPL BY	APVD BY	DATE
07	000276	D. RHEAULT	D. RHEAULT	20-May-2021
06	000268	D. RHEAULT	D. RHEAULT	01-Jan-2019
05	000250	D. RHEAULT	D. RHEAULT	01-Jul-2017
04	000217	D. RHEAULT	D. RHEAULT	01-Jan-2014
03	000192	D. RHEAULT	D. RHEAULT	01-Jun-2012
02	000166	C. GEDDES	C. GEDDES	01-Dec-2010

Drawn By D. RHEAULT		Date 12-Jan-2010	
Checked By D. RHEAULT		Date 12-Jan-2010	
Approved By D. RHEAULT	(ENG)	Date 12-Jan-2010	
Approved By	(MFG)	Date	
Approved By		Date	

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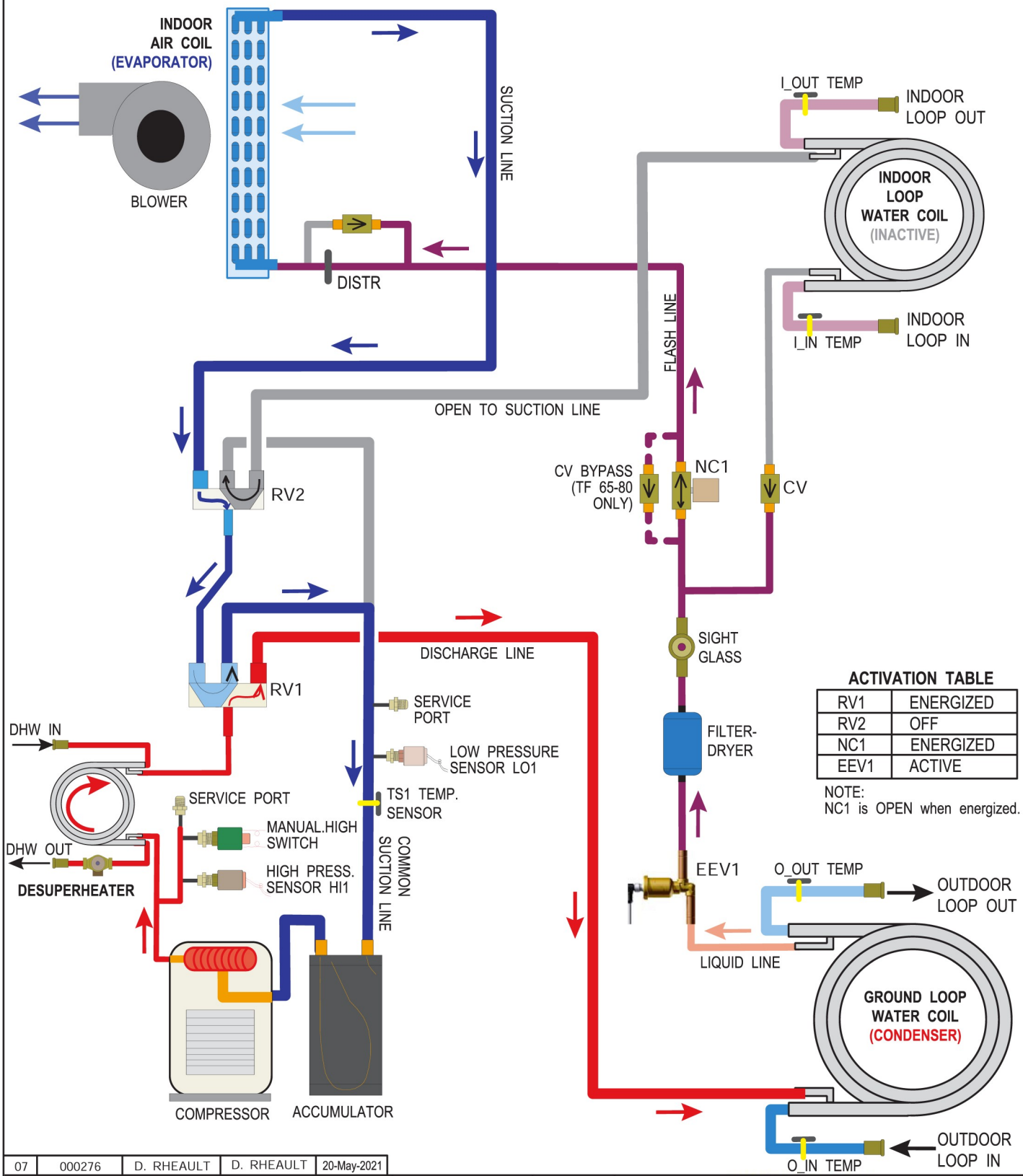
Drawing Name
TF Refrigeration Circuit - Air Heating Mode

Size	Drawing Number	REV	SHEET
A	001197RCD	07	1 of 1

TF-Series Refrigeration Circuit - Air Cooling Mode



ACTIVATION TABLE

RV1	ENERGIZED
RV2	OFF
NC1	ENERGIZED
EEV1	ACTIVE

NOTE:
NC1 is OPEN when energized.

REV	ECO #	IMPL BY	APVD BY	DATE
07	000276	D. RHEAULT	D. RHEAULT	20-May-2021
06	000268	D. RHEAULT	D. RHEAULT	01-Jan-2019
05	000250	D. RHEAULT	D. RHEAULT	01-Jul-2017
04	000217	D. RHEAULT	D. RHEAULT	01-Jan-2014
03	000192	D. RHEAULT	D. RHEAULT	01-Jun-2012
02	000166	C. GEDDES	C. GEDDES	01-Dec-2010

Drawn By D. RHEAULT	Date 12-Jan-2010	
Checked By D. RHEAULT	Date 12-Jan-2010	
Approved By (ENG) D. RHEAULT	Date 12-Jan-2010	
Approved By (MFG)	Date	
Approved By	Date	

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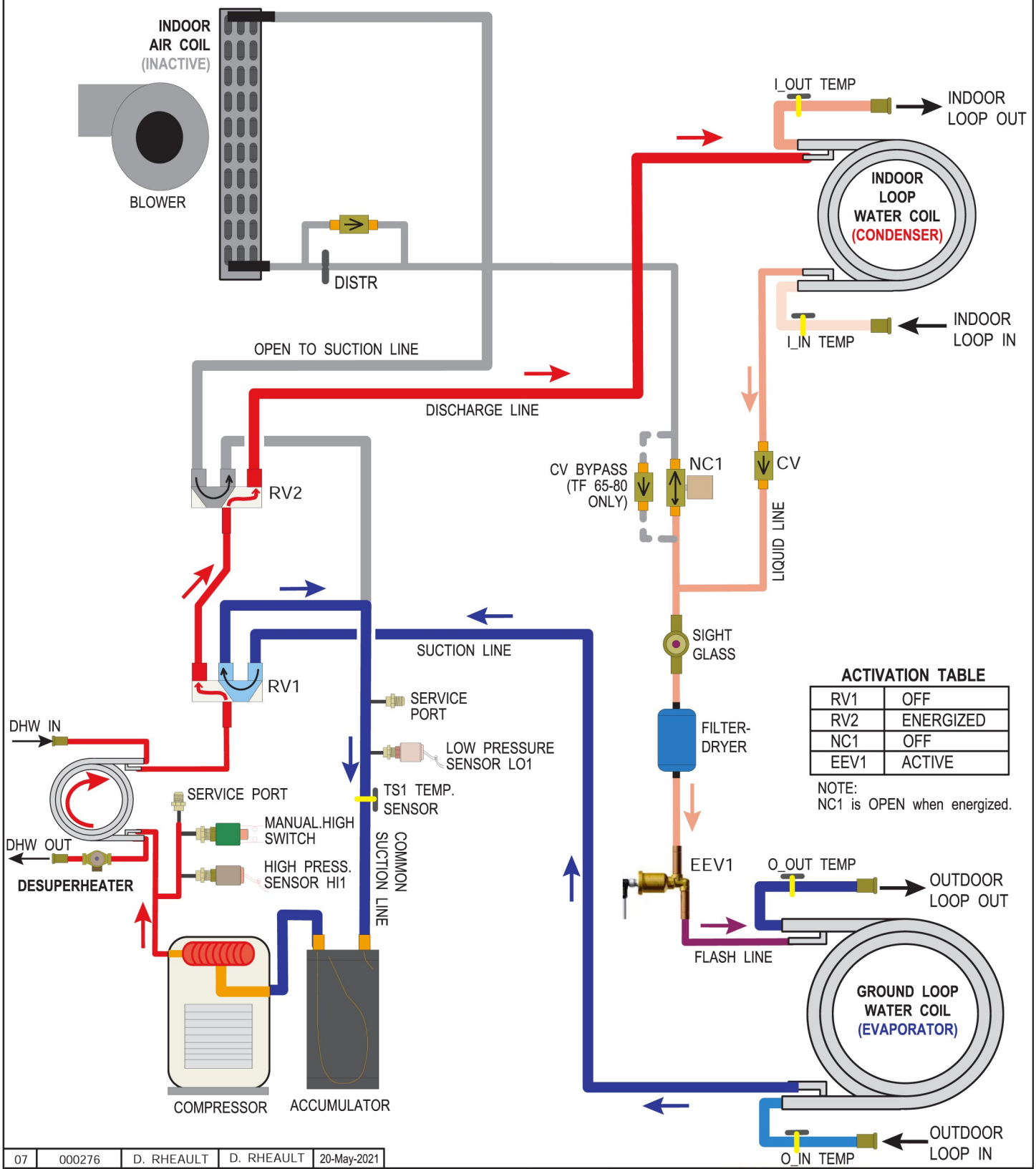
Drawing Name
TF Refrigeration Circuit - Air Cooling Mode

Size	Drawing Number	REV	SHEET
A	001198RCD	07	1 of 1

TF-Series Refrigeration Circuit - Hydronic Heating Mode



ACTIVATION TABLE

RV1	OFF
RV2	ENERGIZED
NC1	OFF
EEV1	ACTIVE

NOTE:
NC1 is OPEN when energized.

REV	ECO #	IMPL BY	APVD BY	DATE
07	000276	D. RHEAULT	D. RHEAULT	20-May-2021
06	000268	D. RHEAULT	D. RHEAULT	01-Jan-2019
05	000250	D. RHEAULT	D. RHEAULT	01-Jul-2017
04	000217	D. RHEAULT	D. RHEAULT	01-Jan-2014
03	000192	D. RHEAULT	D. RHEAULT	01-Jun-2012
02	000166	C. GEDDES	C. GEDDES	01-Dec-2010

Drawn By D. RHEAULT	Date 12-Jan-2010	
Checked By D. RHEAULT	Date 12-Jan-2010	
Approved By (ENG) D. RHEAULT	Date 12-Jan-2010	
Approved By (MFG)	Date	
Approved By	Date	

MARITIME GEOTHERMAL LTD.
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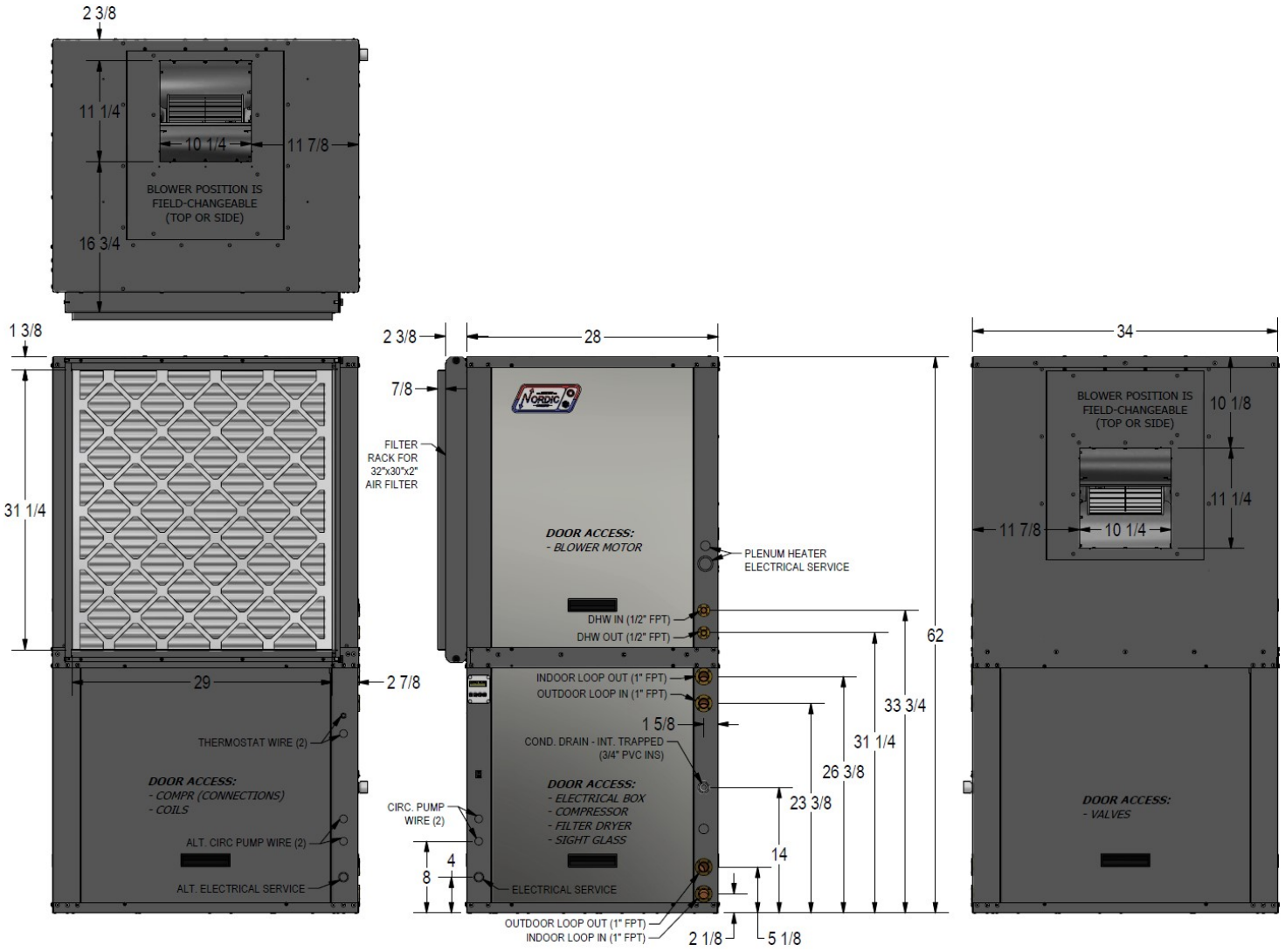
Drawing Name: TF Refrigeration Circuit - Hydronic Heating Mode

Size	Drawing Number	REV	SHEET
A	001199RCD	07	1 of 1

Dimensions: TF-45 Left Return

All dimensions in inches.



LEFT SIDE:
optional
compressor access

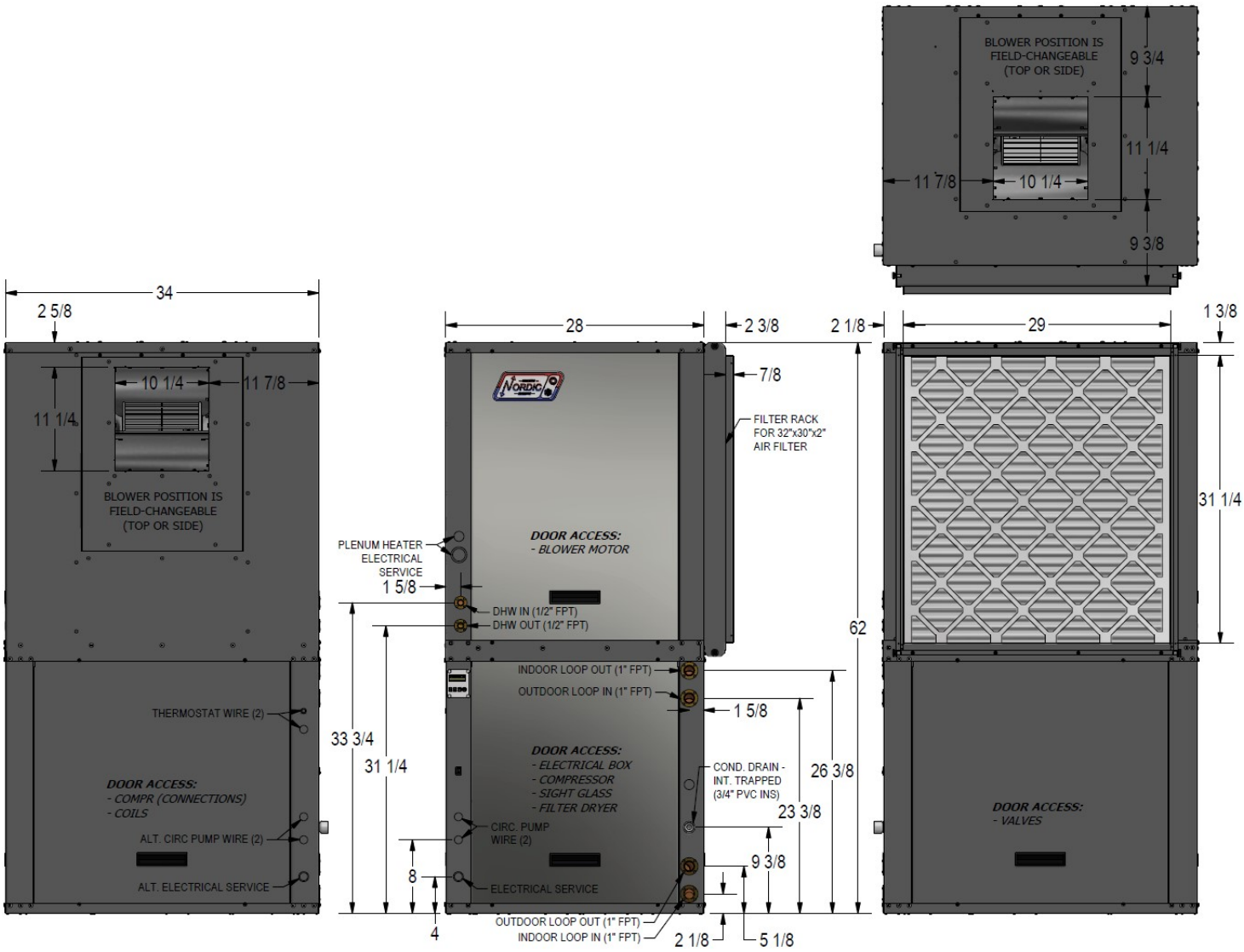
FRONT:
> **2 FT** service access clearance required

RIGHT SIDE:
> **2 FT** service access clearance required

BACK:
no clearance required

Dimensions: TF-45 Right Return

All dimensions in inches.



LEFT SIDE:
> **2 FT** service access clearance required

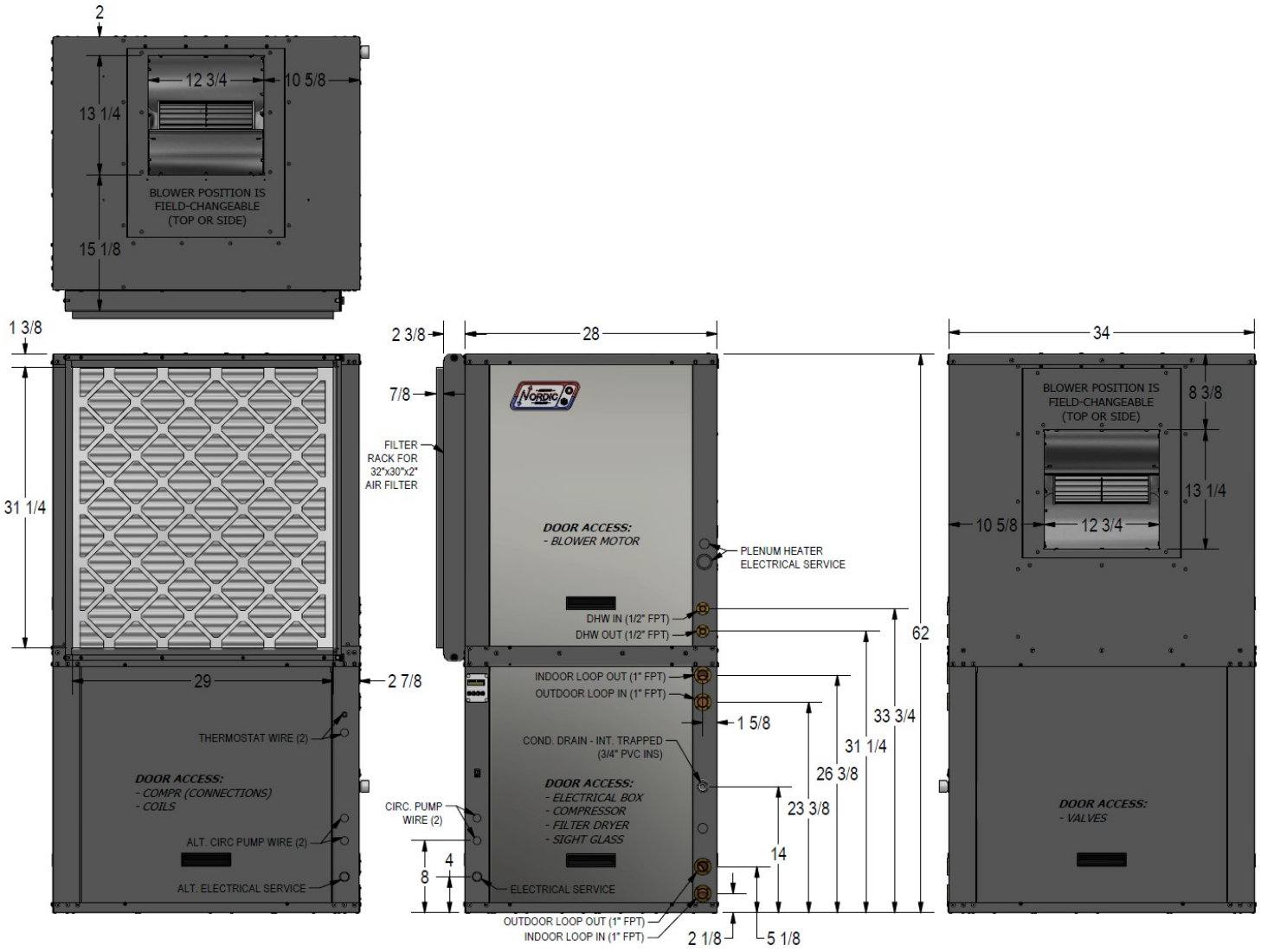
FRONT:
> **2 FT** service access clearance required

RIGHT SIDE:
optional compressor access

BACK:
no clearance required

Dimensions: TF-55/65/75/80 Left Return

All dimensions in inches.



LEFT SIDE:
optional
compressor access

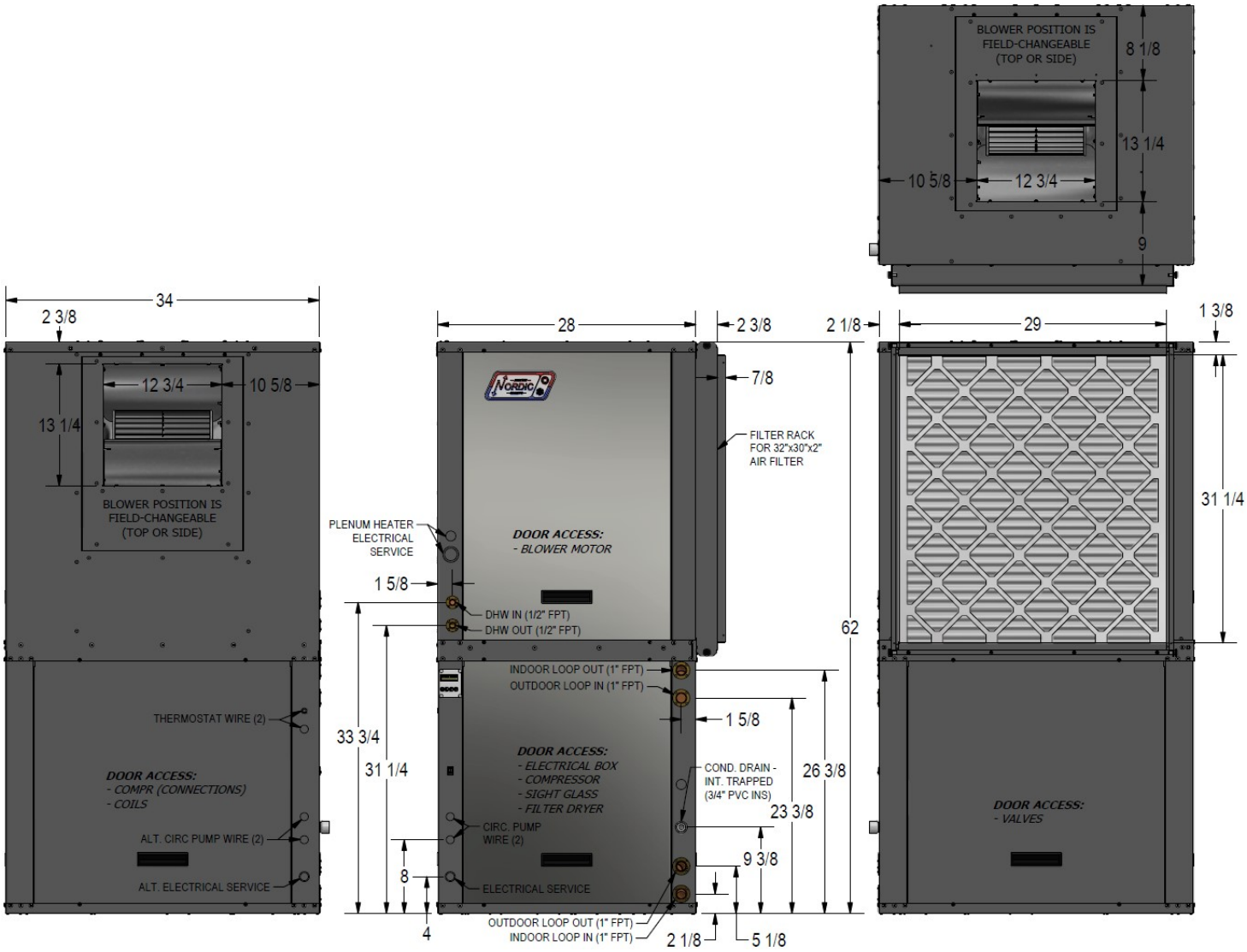
FRONT:
> **2 FT** service access
clearance required

RIGHT SIDE:
> **2 FT** service access
clearance required

BACK:
no clearance required

Dimensions: TF-55/65/75/80 Right Return

All dimensions in inches.



LEFT SIDE:
> **2 FT** service access clearance required

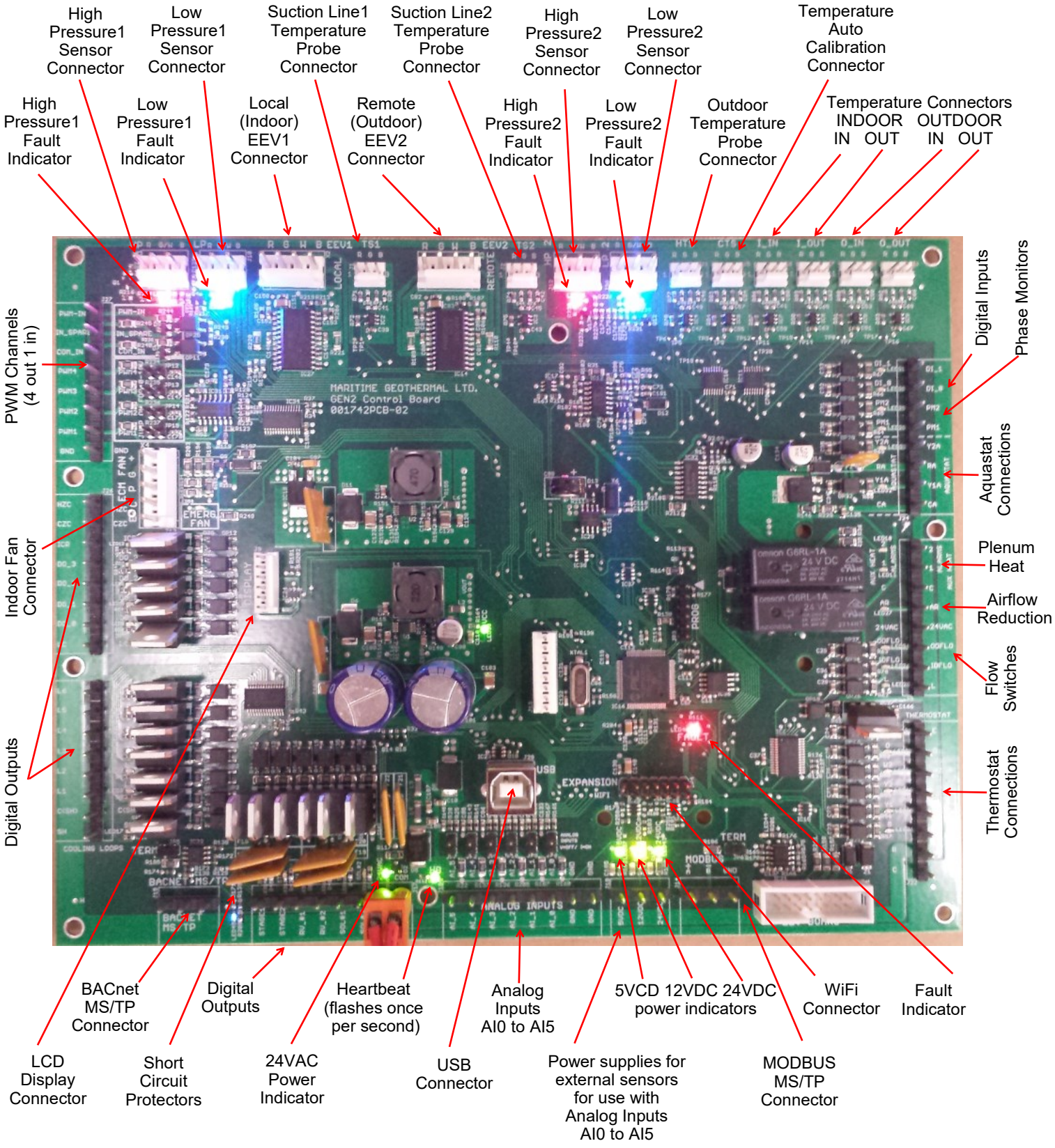
FRONT:
> **2 FT** service access clearance required

RIGHT SIDE:
optional compressor access

BACK:
no clearance required

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	Unused.
TS2	Suction Line Temperature 2	Unused.
HPS2/HI2	High Pressure Sensor 2	Unused.
LPS2/LO2	Low Pressure Sensor 2	Unused.
HTS	Outdoor Temperature	Optional outdoor temperature sensor for outdoor reset feature.
CTS	Auto Calibration	Resistor in connector for auto-calibration reference (32°F—0°C).
I_IN	Indoor Loop IN	Mounted to pipe inside unit.
I_OUT	Indoor Loop OUT	Mounted to pipe inside unit.
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	Unused.
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	Unused.
PWM3	PWM / 0-10VDC output	Unused.
PWM2	PWM / 0-10VDC output	Unused.
PWM1	PWM / 0-10VDC output	Unused.
GND	Ground	Unused.
HZC	Hot Zone Circulator	Unused.
CZC	Cold Zone Circulator	Unused.
ICR	Internal Circulator Relay	Operates the Indoor Circulator.
DO_3	Auxiliary Only	Unused.
DO_2	Hydronic Auxiliary	Operates the hydronic auxiliary, pin 1A (Setpoint Control only).
DO_1	Digital output	Unused.
DO_0	Digital output	To open loop water valve end switch or closed loop jumper plug (back to ODFLO).
LC	Loop common (ground)	Unused.
L6	Loop6	Unused.
L5	Loop5	Unused.
L4	NOT_HYD_AUX	Output OFF when auxiliary heat required; operates D1-D2 dry contacts.
L3	Loop3	Unused.
L2	Loop2	Unused.
L1	Loop1	Unused.
C(SH)	Soaker Hose common	Unused.
SH	Soaker Hose	Unused.

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 modes, on in air cooling mode.
RV_#2	Reversing Valve#2	Off in air heating or cooling modes, on in water heating mode.
SOL#1	Solenoid#1	Operates NC solenoid valve: energized in air heating & cooling modes.
SOL#2	Solenoid#2	Unused.
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	Optional type 3/7 10k hot tank temperature sensor for HTS/CTS Setpoint Control.
AI_4	Analog In Channel 4	0 to 5VDC or 4-20mA user settable with board jumper.
AI_3	Analog In Channel 3	0 to 5VDC or 4-20mA user settable with board jumper.
AI_2	Analog In Channel 2	Condensate sensor.
AI_1	Analog In Channel 1	0 to 5VDC or 4-20mA user settable with board jumper.
AI_0	Analog In Channel 0	Optional compressor current sensor.
GND	Ground pin	Ground for analog sensors.
GND	Ground pin	Ground for analog sensors.
5VDC	Power for analog sensors	Provides 5VDC power supply for sensors.
12VDC	Power for analog sensors	Provides 12VDC power supply for sensors.
24VDC	Power for analog sensors	Provides 24VDC power supply for sensors.
A	MODBUS	RS-485.
B	MODBUS	RS-485.
GND	MODBUS	Ground for shield if required.

TABLE A4 - Control Board Connector Descriptions (Right Side)		
Name	**Description**	
DI_1	Digital Input1	Unused.
DI_0	Digital Input0	Low pressure select from open/closed loop harness (0=open loop, 1=closed loop)
PM2	Phase Monitor2	Switch or dry contact from R to activate Summer Setback mode.
PM1	Phase Monitor1	Accessory for 3 phase models.
Y2A*	Aquastat Stage2	Optional water heat stage 2 24VAC input for use with Signals/Hardwired control.
RA*	Aquastat Power (24VAC)	Optional 24VAC output for aquastat used with Signals/Hardwired control.
Y1A*	Aquastat Stage1	Optional water heat stage 1 24VAC input for use with Signals/Hardwired control.
CA*	Aquastat Power (Ground)	Optional 24VAC ground for aquastat used with Signals/Hardwired control.
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	Unused.
L	Thermostat Lockout Indicator	24VAC to external trouble indicator.
E	Thermostat Emergency Heat	24VAC input from air thermostat.
O	Thermostat Heat/Cool	24VAC input from air thermostat.
W2	Thermostat Auxiliary Heat	24VAC input from air thermostat.
Y2	Thermostat Stage2	24VAC input from air thermostat.
Y1	Thermostat Stage1	24VAC input from air thermostat.
G	Thermostat Fan Recirculation	24VAC input from air thermostat.
R	Thermostat Power (24VAC)	24VAC to air thermostat.
C	Thermostat Power (Ground)	24VAC ground for air thermostat.

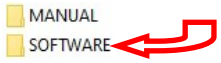
*NOTE: There is no need for an external aquastat for most systems, since the Setpoint Control Method provides built in aquastat functionality.

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

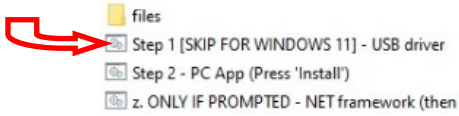
NOTE: This step is ***not necessary*** for **Windows 11**.

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:



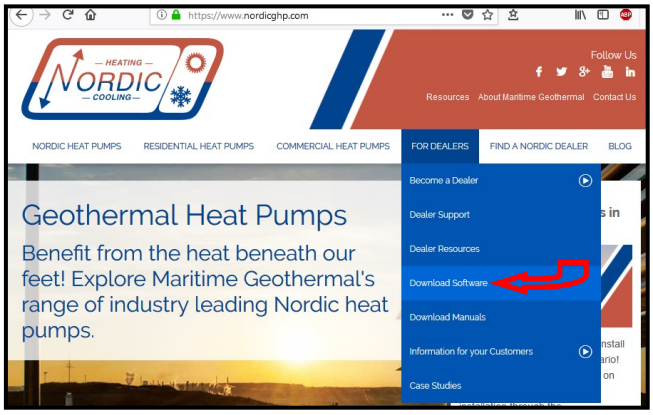
Double click on the SOFTWARE folder to show its contents:



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

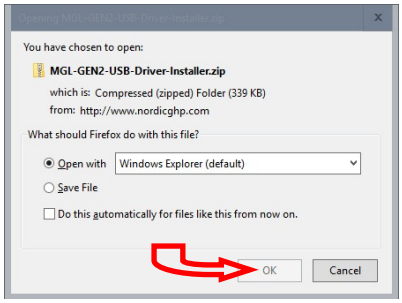
If the USB drive is not available, the same files can be **down-loaded from the web page**.

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

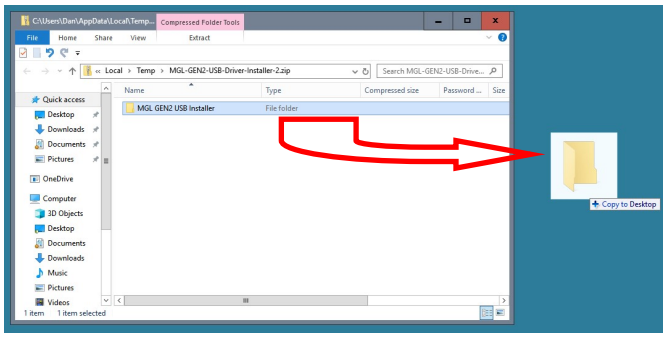


2. Click on **MGL GEN2 USB Driver Installer** to download it:

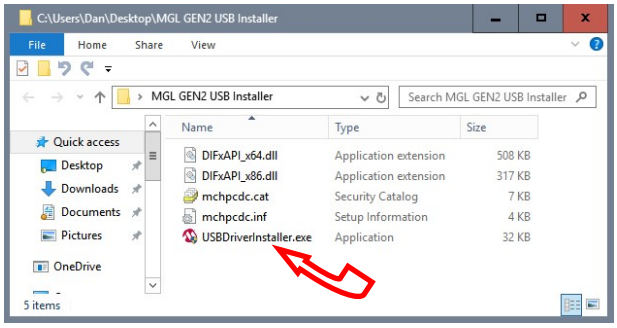
3. Choose "Open with Windows Explorer", and hit "OK". *(If the choice window doesn't pop up, find the downloaded file in your browser downloads and double click on it.)*



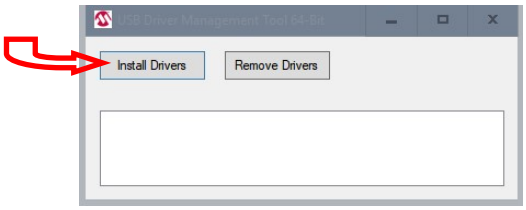
4. In the window that is displayed, click and hold down the mouse button on the folder name, and drag to your desktop:



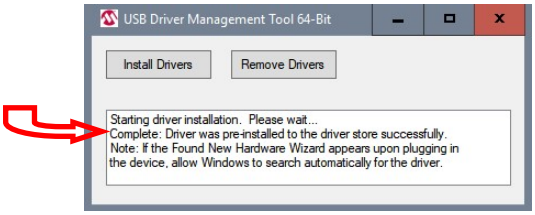
5. Double click on the folder you just dragged onto the desktop, then double click on the "USBDriverInstaller" file:



6. In the next window, click on "Install Drivers":



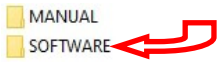
7. You will see a message indicating the driver was installed successfully. You are now ready to install the PC App.



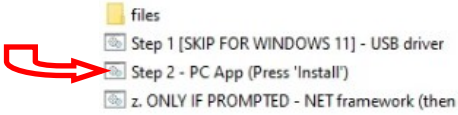
Appendix C - PC App Installation (Windows 11)

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:



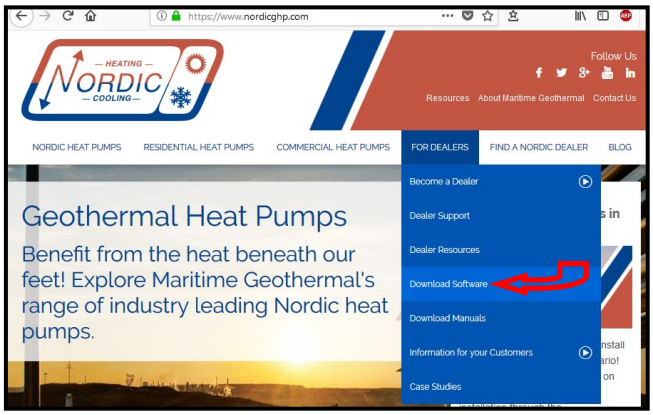
Double click on the SOFTWARE folder to show its contents:



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**.

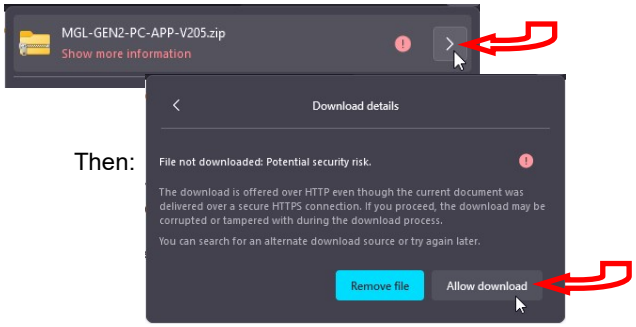
If the USB stick drive is not available, the same file can be **downloaded from the web page**.

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

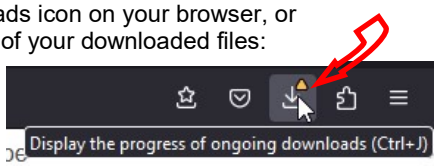


2. Click on **MGL GEN2 PC APP V2__** to download it:

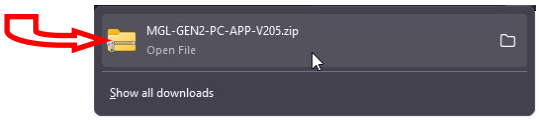
3. You may see a warning like this one. Click as shown:



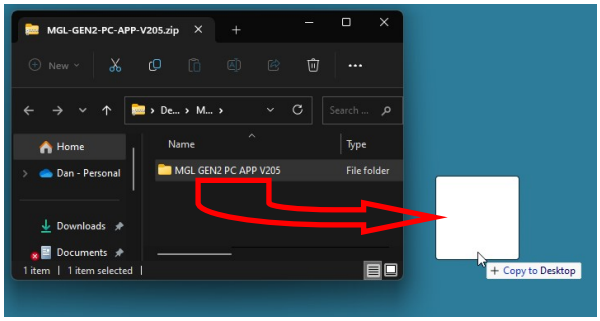
4. Click on the downloads icon on your browser, or otherwise view a list of your downloaded files:



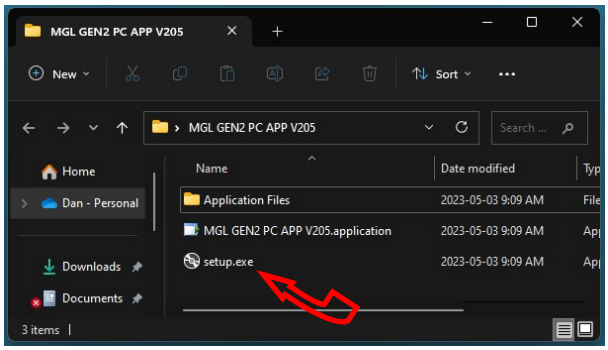
5. Then click on the .zip file to open it in a File Explorer window:



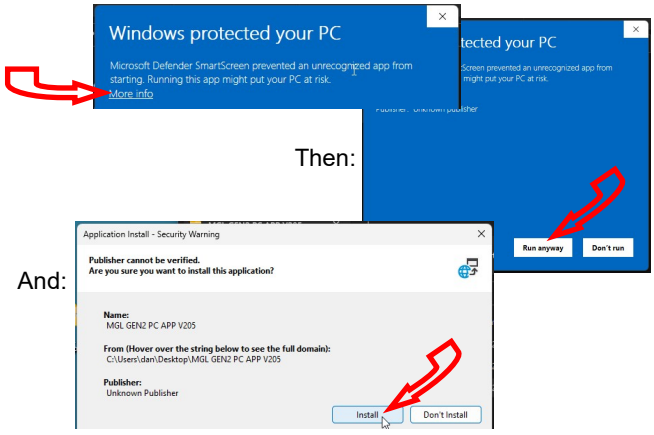
6. In the window that is displayed, click and hold down the mouse button on the folder name, and drag to your desktop:



7. Double click on the folder you just dragged onto the desktop, then double click on the "setup" file:



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

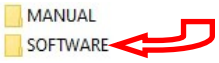


9. The PC App will open when it is finished installing. (In the future, it should be started from the start menu.) You are now ready to connect a USB cord between the laptop computer and GEN2 control board, and connect.

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:

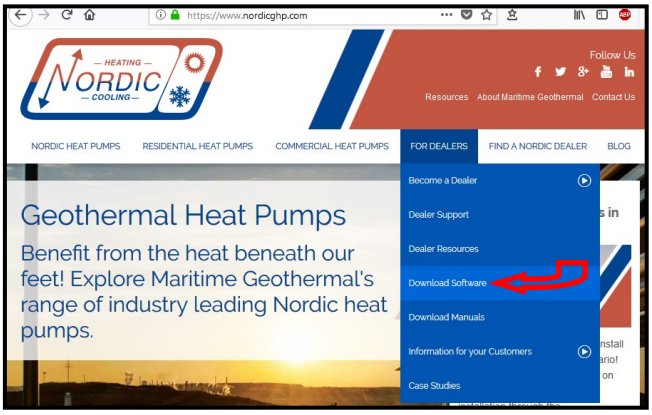


Double click on the SOFTWARE folder to show its contents:

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.

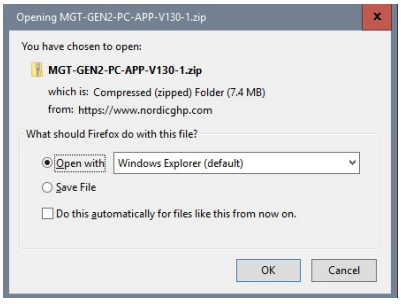
If the USB stick drive is not available, the same file can be **downloaded from the web page**.

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

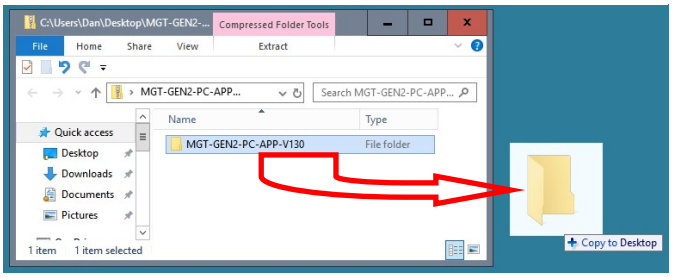


2. Click on **MGL GEN2 PC APP V2__** to download it:

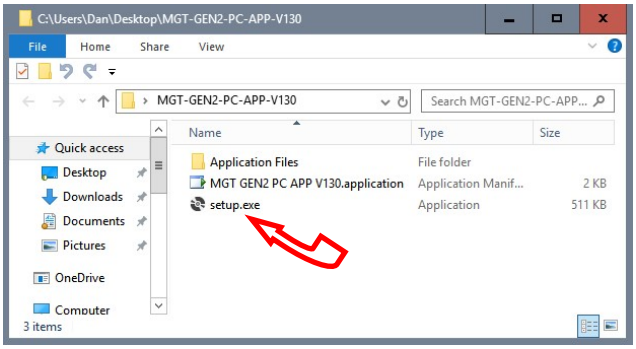
3. Choose "Open with Windows Explorer", and hit "OK":



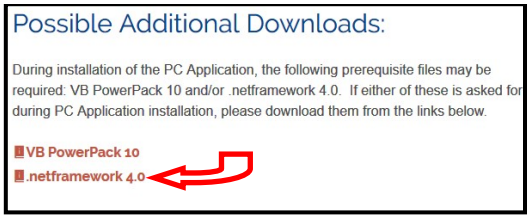
4. In the window that is displayed, click and hold down the mouse button on the folder name, and drag to your desktop:



5. Double click on the folder you just dragged onto the desktop, then double click on the "setup" file:



6. 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.

7. 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*.

1. 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).

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

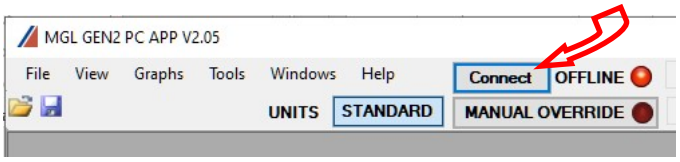
MGL_GEN2_V376.production.hex	(firmware file)
PIC32UBL.exe	(the programmer)
USB Bootloader Instructions.pdf	(these instructions)

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

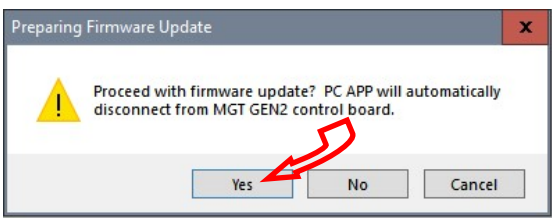
3. Connect a USB (printer) cable between computer and control board.

4. 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.

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

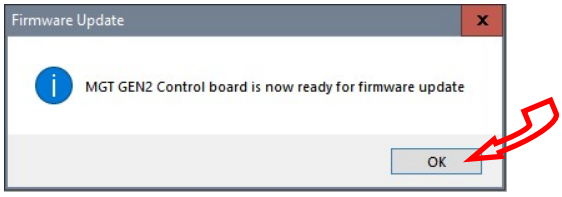


6. Go to menu **Tools --> Update Firmware**. The following message box will appear:



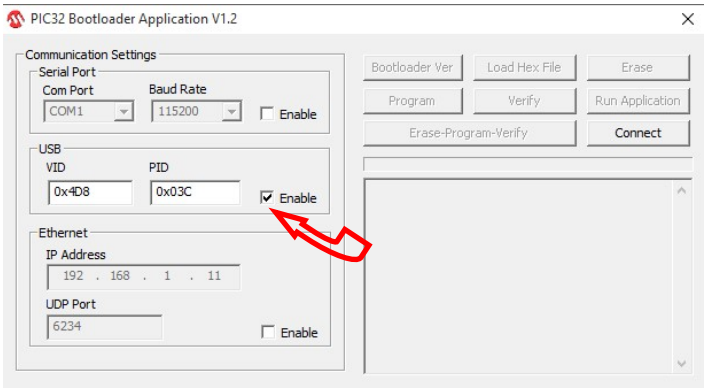
7. Click on **YES**. The following message box will appear:

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

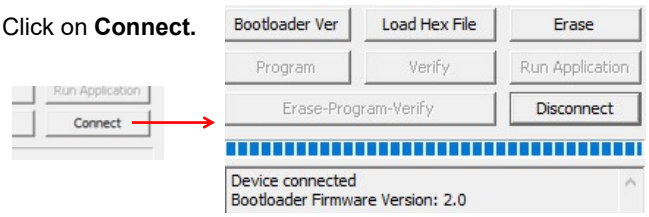


9. Click on **OK**. The control board is now in bootloader mode and is ready to be programmed.

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

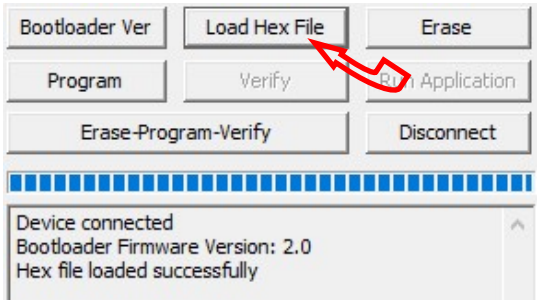


11. Click on **Connect.**

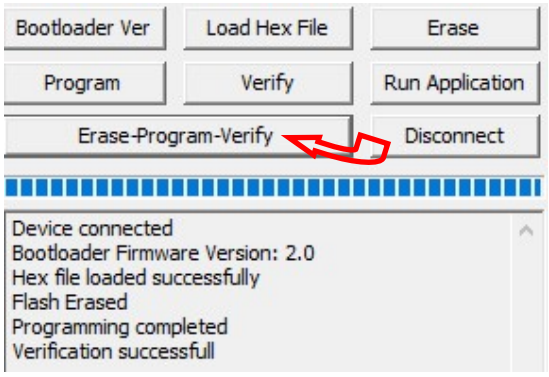


*If device fails to connect and an error message is displayed, the board's bootloader may be older than v2.0. It will be necessary to instead update the firmware via jumper pins (**METHOD 2**), as per the next section.*

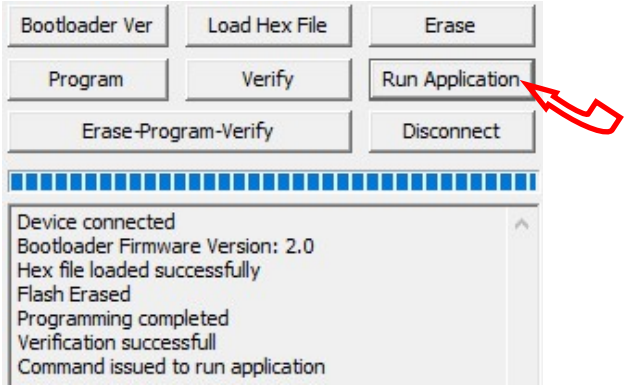
12. Click on **Load Hex File**. Select the M*GL_GEN2_V376.production.hex* (or higher version number) file, which is in the folder you created on the Desktop.



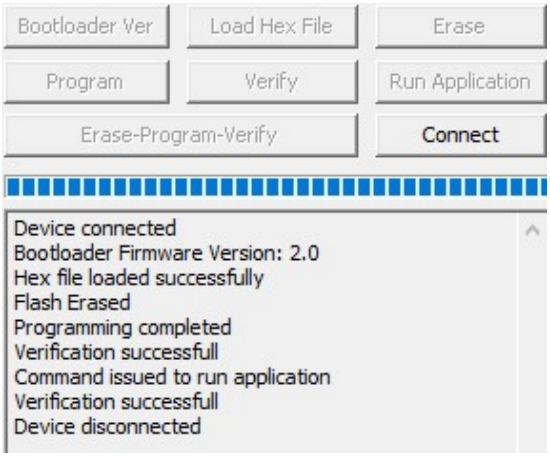
13. Click on **Erase—Program—Verify.** Programming…. Wait while status bar shows progress. The messages should read as below when finished:



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.



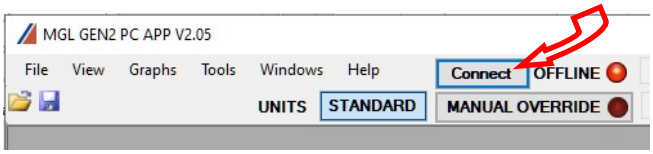
15. **Wait until the programmer disconnects itself.** The messages should read as follows:



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.



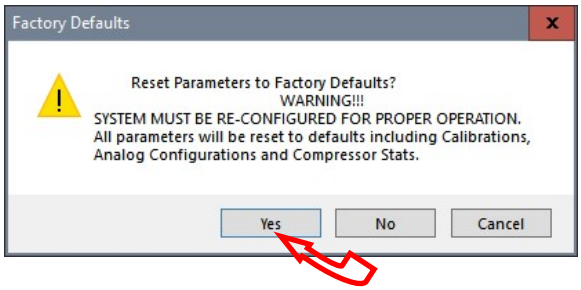
NOTE: Updating the firmware does not affect the configuration settings.

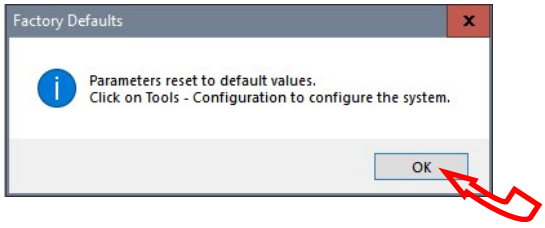
Reset to Defaults?

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 <u>even if it already indicates the proper series,</u> 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.*

1. 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

2. 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)

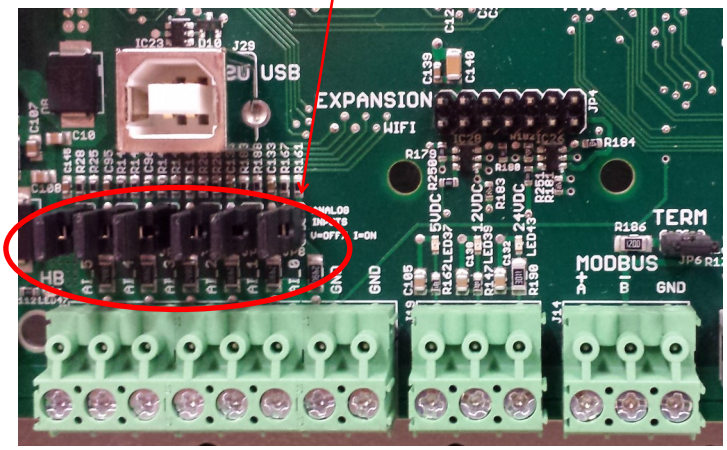
   Note that on most computers, the file extensions (.exe, .pdf) will be hidden.

3. Connect a USB (printer) cable between computer and control board.

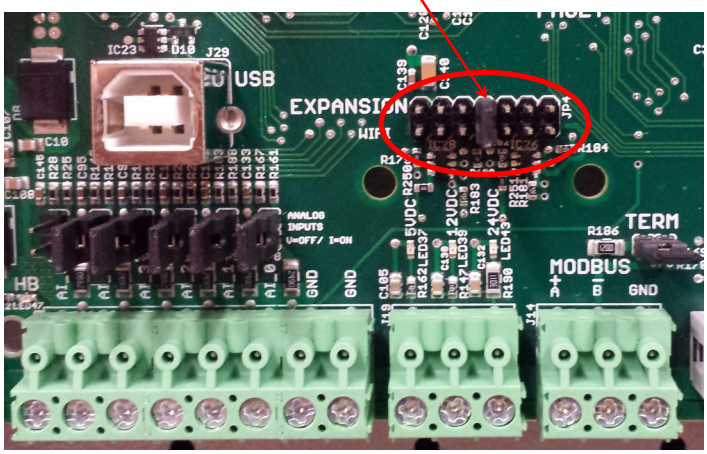
4. Turn power off to the heat pump.

5. 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)

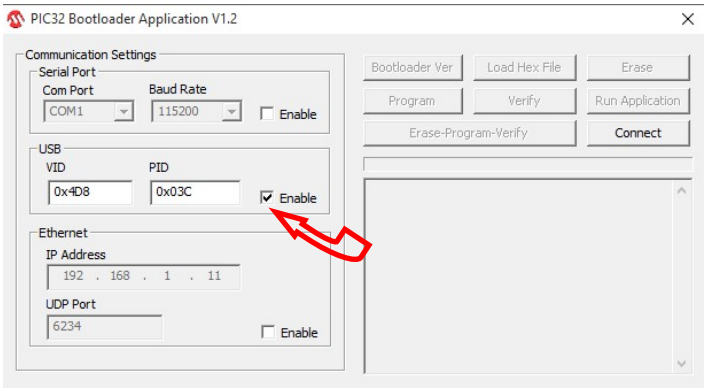


Place jumper here

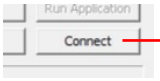


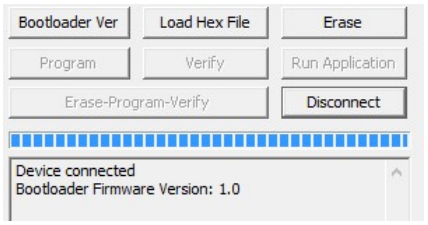
6. Turn the power back on. The control board is now in boot loader mode and is ready to be programmed.

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

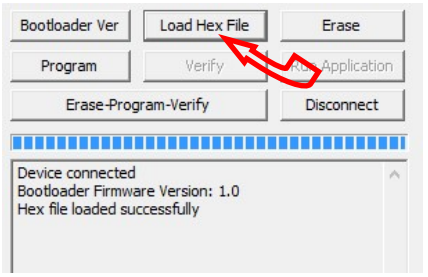


8. Click on **Connect.**



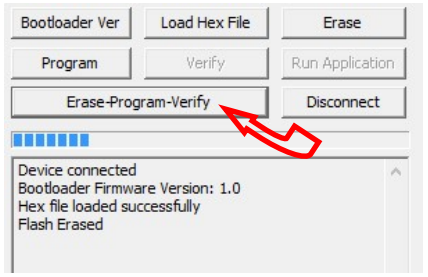


9. Click on **Load Hex File**. Select the *MGL_GEN2_V376.production.hex* (or higher version number) file, which is in the folder you created on the Desktop.

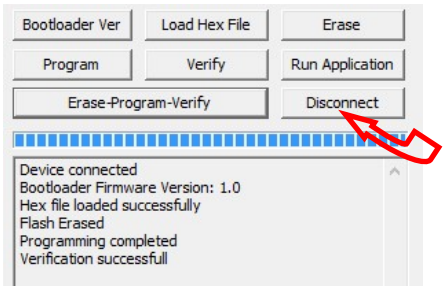


10. Click on **Erase—Program—Verify**

Programming…



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



12. Turn power off to the heat pump again.

13. Move the jumper back to where it was taken from.

14. 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: TF-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 Petitcodiac, 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 RECIEVED 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 imitation 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 Petitcodiac, 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.