# Application, Installation, & Service Manual

## TF-Series

### Triple Function Geothermal Heat Pump

***with Simultaneous Air Cooling & Hydronic Heating***

**Two-stage, R454b**
**Model Sizes 45-75**

ENERGY STAR

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


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**002749MAN-01**

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

# A2L refrigerant: mildly flammable.

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

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

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

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

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

# GENERAL SAFETY PRECAUTIONS

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

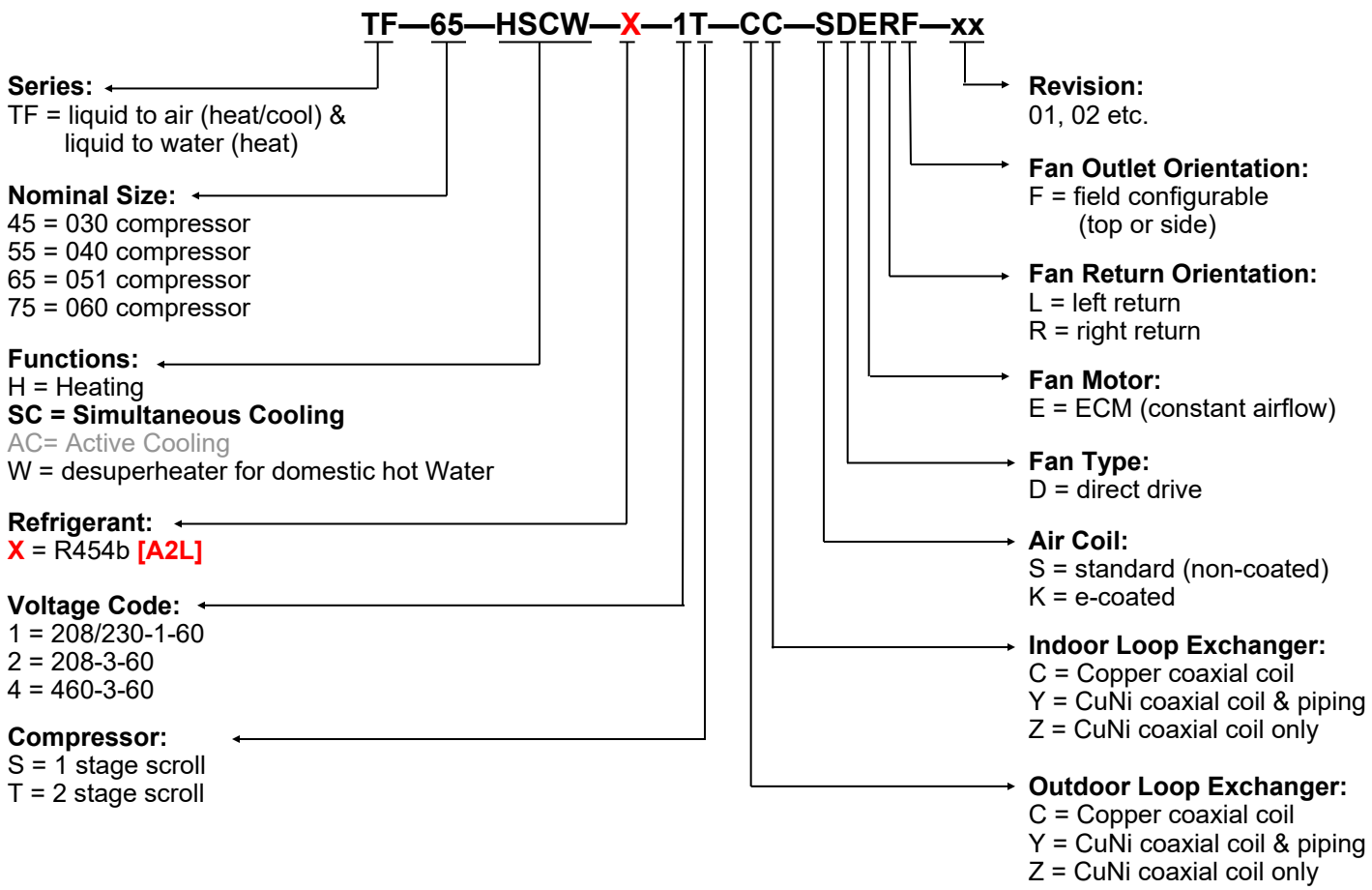
**Safety glasses and work gloves should be worn at all times whenever a heat pump is serviced. A fire extinguisher and proper ventilation should be present whenever brazing is performed.**

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

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

go to TABLE OF CONTENTS

# Model Nomenclature




**APPLICATION/AVAILABILITY TABLE**

| MODEL SERIES | MODEL SIZE | FUNCTION | REFRIGER-ANT | VOLTAGE | COMPRESSOR | OUTDOOR COIL | INDOOR COIL | AIR COIL/ BLOWER/ AIR RETURN | AIR RETURN | AIR OUTLET | REVISIONS | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TF | 45<br>55<br>65<br>75 | HSCW | X | 1<br>2<br>4 | T | C<br>Y<br>Z | C<br>Y<br>Z | S D E | L<br>R | F | 01 | | |

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

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

go to TABLE OF CONTENTS

# Table of Contents



go to TABLE OF CONTENTS

# Tables & Documents

## Tables



## Documents



go to TABLE OF CONTENTS

# TF System Description

## General Overview

The Nordic TF-series, a unique product with a more than 25-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. New in 2025, the R454b TF-series is also capable of **simultaneous air cooling and hydronic heating**, bypassing the ground loop.

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).

Hydronic heating, which is easily zoned, is controlled by an internal routine that maintains the buffer tank temperature without external sensors. BACnet or an external aquastat can also be used.

In additional to the main hydronic water heating function, a double-wall desuperheater pre-heats domestic hot water (DHW) 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, but can be expected to provide all of the household's DHW heating during peak heating season.

The indoor and outdoor loop hydronic heat exchangers are heavy duty coaxial copper / steel models with optional CuNi available. Modulation is achieved through the use of 2-stage compressors, for closer load matching and to reduce cycling. Electronic Expansion Valves (EEV's) are standard, for precise superheat and system optimization. The Nordic GEN2 programmable control board 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

The heat pump heats warm air in a duct system when heat is called for by the air thermostat. Heat is always 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

The heat pump heats water in a buffer tank to a user-adjustable setpoint temperature. The buffer tank maintains control over the water temperature and avoids mismatches 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.

Heat is extracted from the outdoor loop, unless there is also a call for air cooling. In this case, heat is extracted from the indoor air to achieve **simultaneous heating/cooling**, effectively doubling the COP (efficiency).

Zones may be in-floor heating 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

The heat pump cools air through the duct system when air conditioning is called for by the ducted air thermostat.

Heat is rejected to the outdoor loop, unless there is also a call for hydronic heating. In this case, heat is rejected to the hydronic buffer tank to achieve **simultaneous heating/cooling**, effectively doubling the COP (efficiency).


go to TABLE OF CONTENTS

## Priority Selection

The heat pump's heating function can be set to **air** or **hydronic** priority. Units are shipped set up for air priority. This is normally a good setting, since unwanted changes 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.

## 'Stage 2 Auto' Feature

Whenever there is a **stage 1 demand from both** the air thermostat and hydronic heating, 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 (at reduced 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. (This feature can be turned on and off in the PC App's **Tools-->Configuration** window.)

**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**.

**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**.

## Simultaneous Heating/Cooling

As mentioned previously: when there are simultaneous air cooling and hydronic heating demands, no heat will be exchanged with the closed ground loop or open loop water.

Instead, heat will be extracted from the ducted air system and sent into the hydronic buffer tank, effectively doubling the COP (efficiency).

## 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.

go to TABLE OF CONTENTS

# 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** | **ft²** | ***m²*** |
| **45** | **1400** | ***130*** |
| **55** | **2000** | ***185*** |
| **65** | **2600** | ***240*** |
| **75** | **3100** | ***290*** |

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

| TABLE 2 - Heat Pump Size vs. Heated Area for an Open Loop System | | |
|---|---|---|
| **Model** | **ft²** | ***m²*** |
| **45** | **1800** | ***165*** |
| **55** | **2500** | ***230*** |
| **65** | **3200** | ***295*** |
| **75** | **3800** | ***355*** |

**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** |

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.

go to TABLE OF CONTENTS

# Installation Basics

***A2L*-SPECIFIC WARNING / INSTRUCTION**

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

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

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

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

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

## Unpacking the Unit

When the heat pump 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. A heating system cannot be expected to produce an even temperature throughout the building when it is located at one end of the structure and the heated or cooled air is transmitted with uninsulated metal ductwork.

If possible the front 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 unit is level to eliminate possible condensate draining issues.

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

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

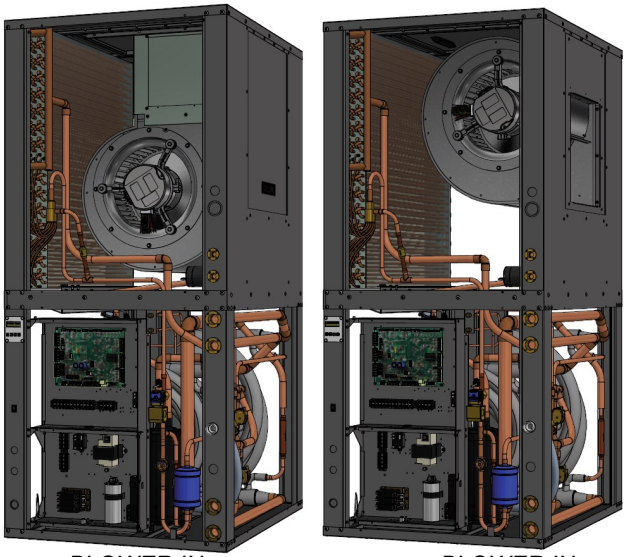

*LEFT RETURN* *RIGHT RETURN*

## 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*

go to TABLE OF CONTENTS

## 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

**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

**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)

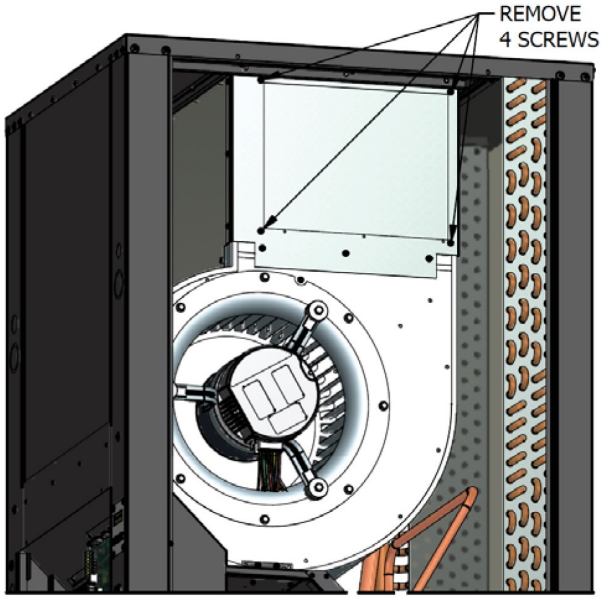
**ELECTRICAL**
- HEAT PUMP SERVICE WIRE: 6-3 OR 8-3
- PLENUM HEATER SERVICE WIRE
- BUFFER TANK ELEMENT SERVICE WIRE (IF REQ'D)
- HEAT PUMP BREAKER
- PLENUM HEATER / TANK ELEMENT BREAKER
- THERMOSTAT WIRE 18-8
- THERMOSTAT WIRE 18-4 (AQUASTAT)
- THERMOSTAT WIRE 18-2 (PLENUM HEATER)
- FORK TERMINALS FOR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

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

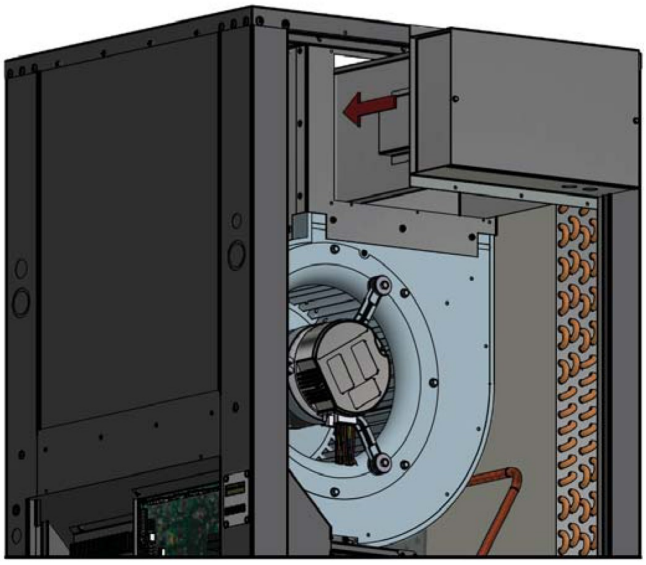
go to TABLE OF CONTENTS

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

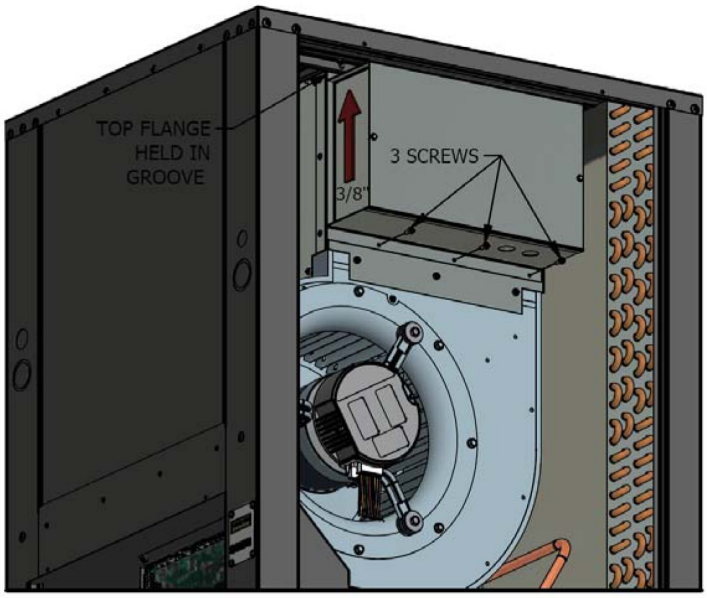
**1.** Remove four screws as shown, and remove blank panel.




**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.

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| 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.
P.O. Box 2555
170 Plantation Rd.
Petitcodiac, NB CANADA E4Z 6H4

Drawing Name: **Internal Plenum Heater Installation**

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

go to TABLE OF CONTENTS

# 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 size.

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

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

**TABLE 4 - Power Supply Connections**

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

* Only required if connecting 115VAC circulators.

## Auxiliary Plenum Heater: Power Supply Connections

Auxiliary air heat will usually be provided by an electric duct heater (plenum heater). These are available as accessories in 5, 7, 10, 15, and 20 kW sizes, and are installed as previously noted in this manual. The plenum heater will have its own breaker and power supply wire. The Electrical Tables in the **Model Specific Information** 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. | |

go to TABLE OF CONTENTS

## 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** |

## 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.

go to TABLE OF CONTENTS

## Air Thermostat Connections

A three-stage heating and two stage cooling heat pump configurable thermostat is required (unless using BACnet). The stages are S1 = stage 1 compressor, S2 = stage 2 compressor and S3 = electric auxiliary (in heating mode only). One can be ordered with the unit, or other 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.

**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) |

## 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) |

## Refrigerant Vent Fan Connections

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

See wiring diagram in the **Model Specific Information** chapter.

## Open/Closed Loop Wiring

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

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

See wiring diagram in the **Model Specific Information** section for wiring of the water valve harness with closed loop plug or open loop water valve.

**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.

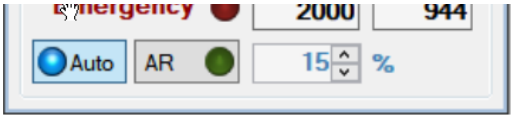
After the desuperheater is filled with water and purged of air, activate the built-in DHW circulator by connecting the brown wire with the blue insulated terminal to L1 of the compressor contactor as shown on the wiring diagram in the **Model Specific Information** section. **Ensure the power is off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

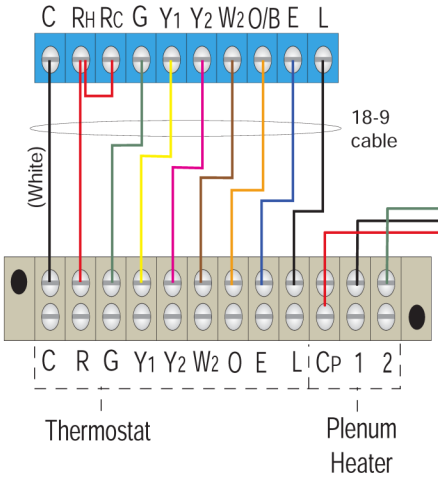



go to TABLE OF CONTENTS

# Typical Thermostat Connections to GEN2 Control Board

## Two-Stage Models (Compressor Stages = T)

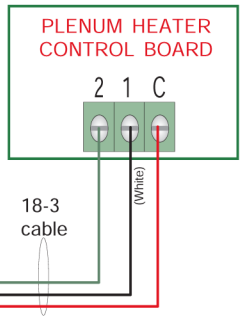
Typical 3 stage heat
2 stage cool
Heat Pump Thermostat



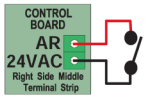

CONNECTION DESCRIPTION:

| | |
|---|---|
| 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.



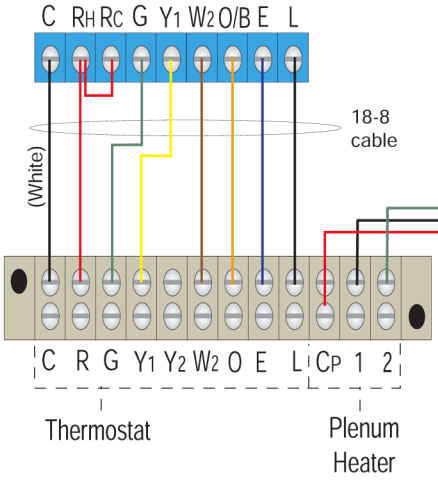

Note: If only using as single stage then only an 18-2 cable is required, place a jumper wire between 2 and 1 of the plenum heater terminals.




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)

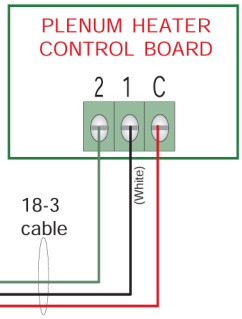
Typical 2 stage heat
1 stage cool
Heat Pump Thermostat



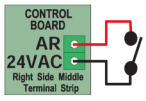

CONNECTION DESCRIPTION:

| | |
|---|---|
| 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 |
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| 01 | Initial Release | C. GEDDES | C. GEDDES | 21 APR 2016 |

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| 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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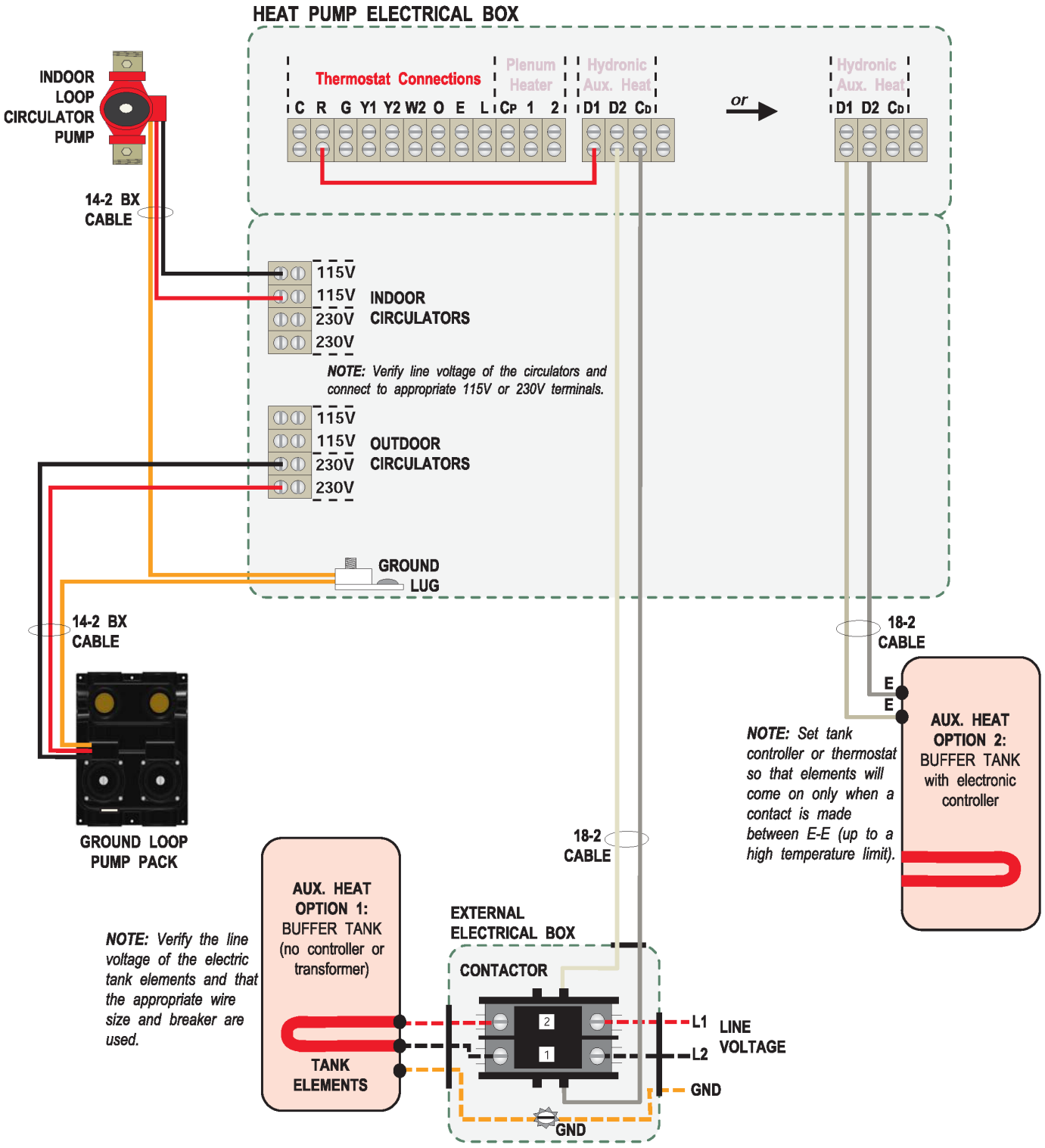
Drawing Name: Typical Thermostat Connections to GEN2 Control Board

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

go to TABLE OF CONTENTS

# 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 |

| | | Date |
|---|---|---|
| Drawn By | Dan Rheault | 15-Jan-2019 |
| Checked By | Dan Rheault | 15-Jan-2019 |
| Approved By | (ENG) | Date |
| Approved By | (MFG) | Date |
| Approved By | | Date |

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Drawing Name: Typical TF Auxiliary Heat and Circulator Wiring

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

go to TABLE OF CONTENTS

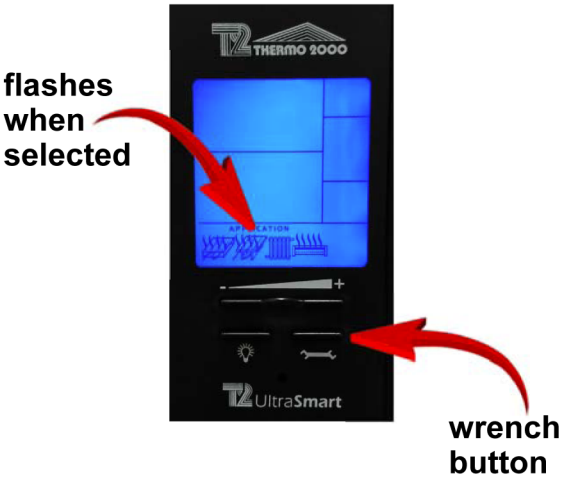
# AltSource Tanks: Getting Started

**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.)*

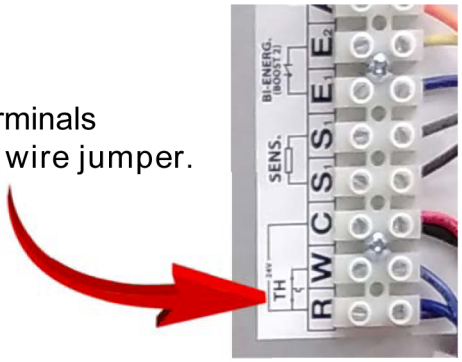
**1.** Put the tank in “Bi-Energy” rather than “Electric” mode, with switch on back of controller.

**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.



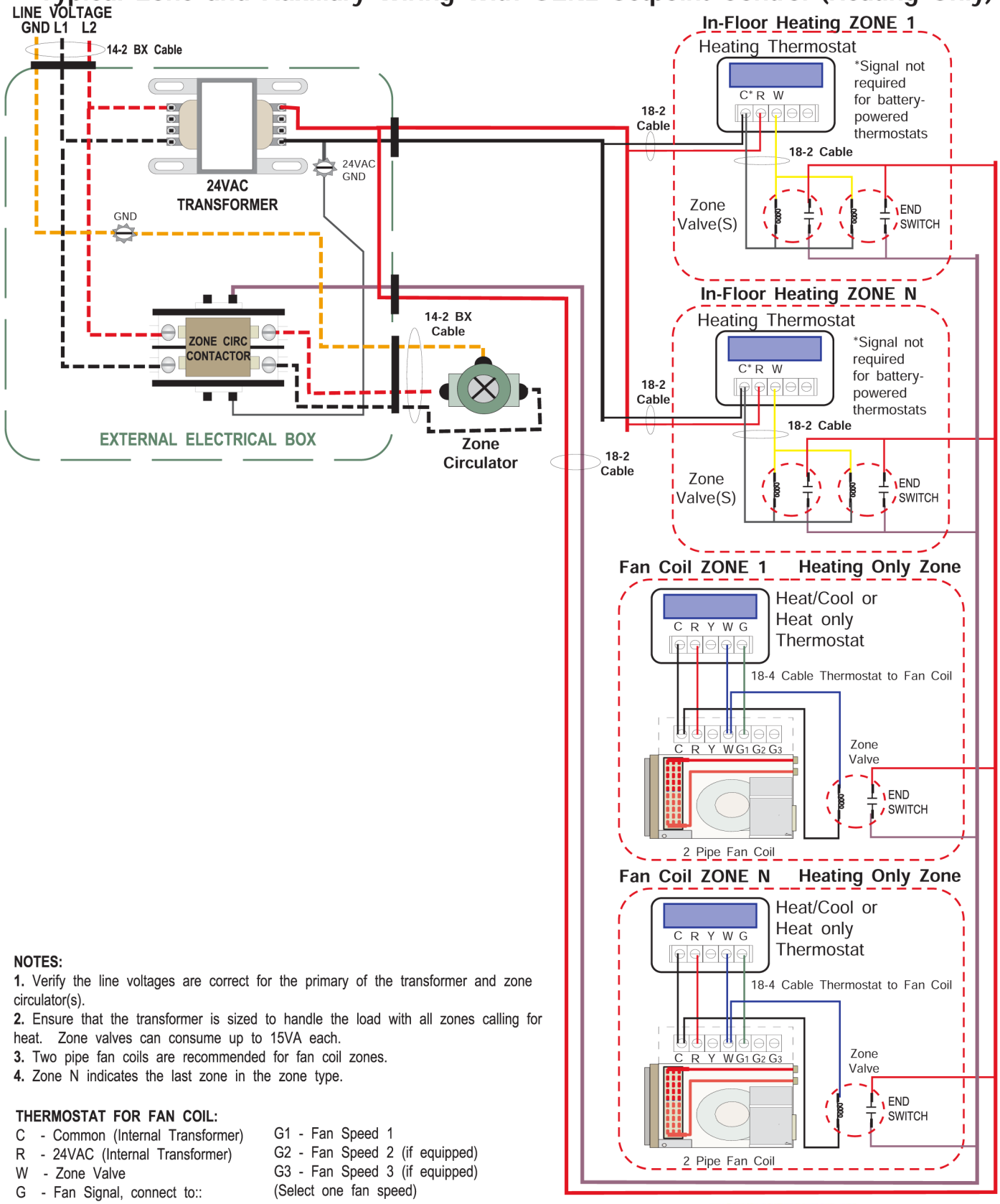

**4.** Now the tank elements will only be activated by a connection between the $E_1$-$E_2$ tank terminals, up to the 125°F maximum. This will be done by an 18-2 wire to the **D1-D2** terminals in the heat pump, activating the elements only when ***AUX*** heat is required.

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)

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| | | | | |
| 02 | 000253 | D. RHEAULT | D. RHEAULT | 01-JUL-2017 |
| 01 | Initial Release | C. GEDDES | C. GEDDES | 04-APR-2017 |

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| 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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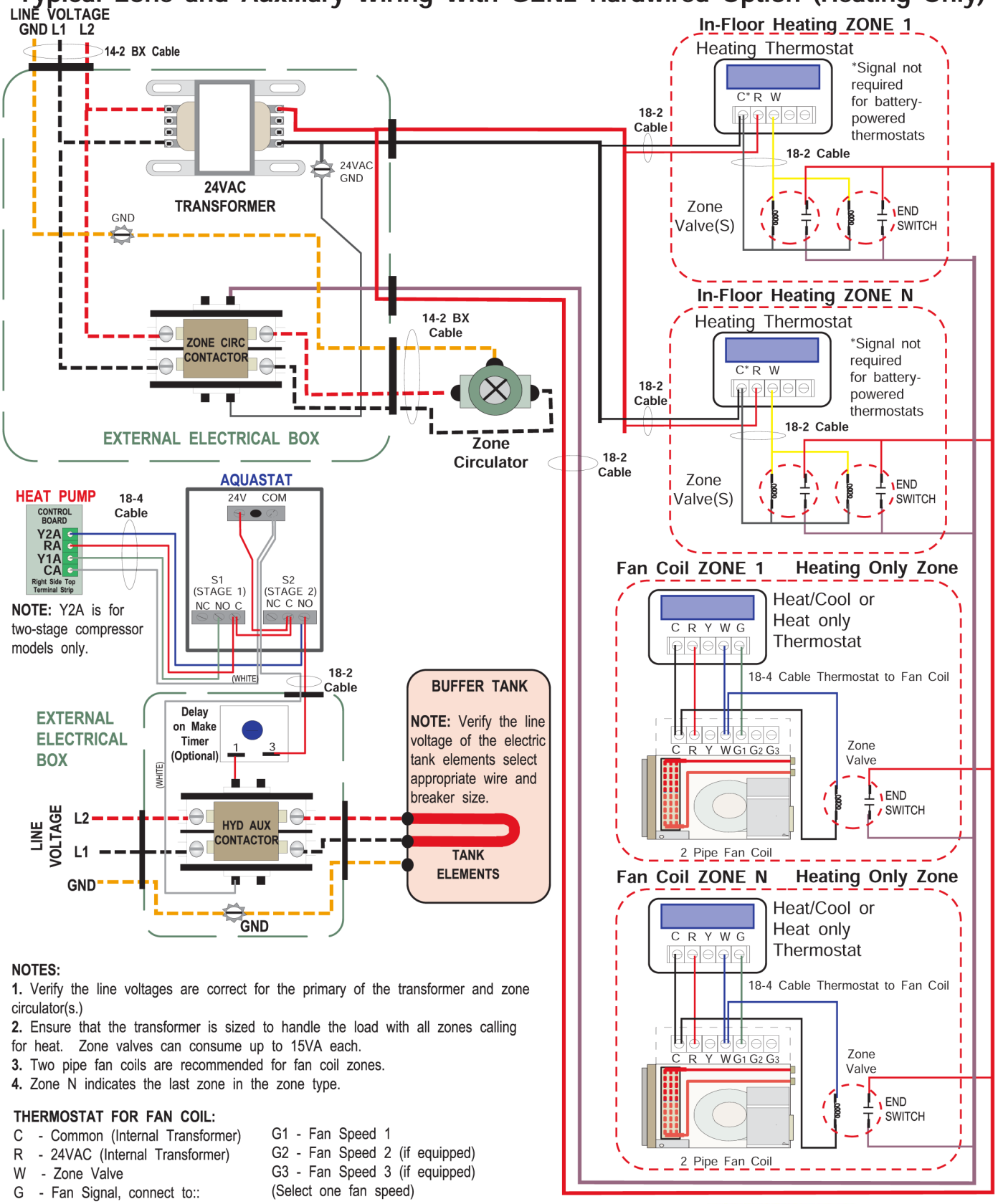
E4Z 6H4

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 |

go to TABLE OF CONTENTS

# 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 |

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

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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 |

go to TABLE OF CONTENTS

# 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) |

**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.

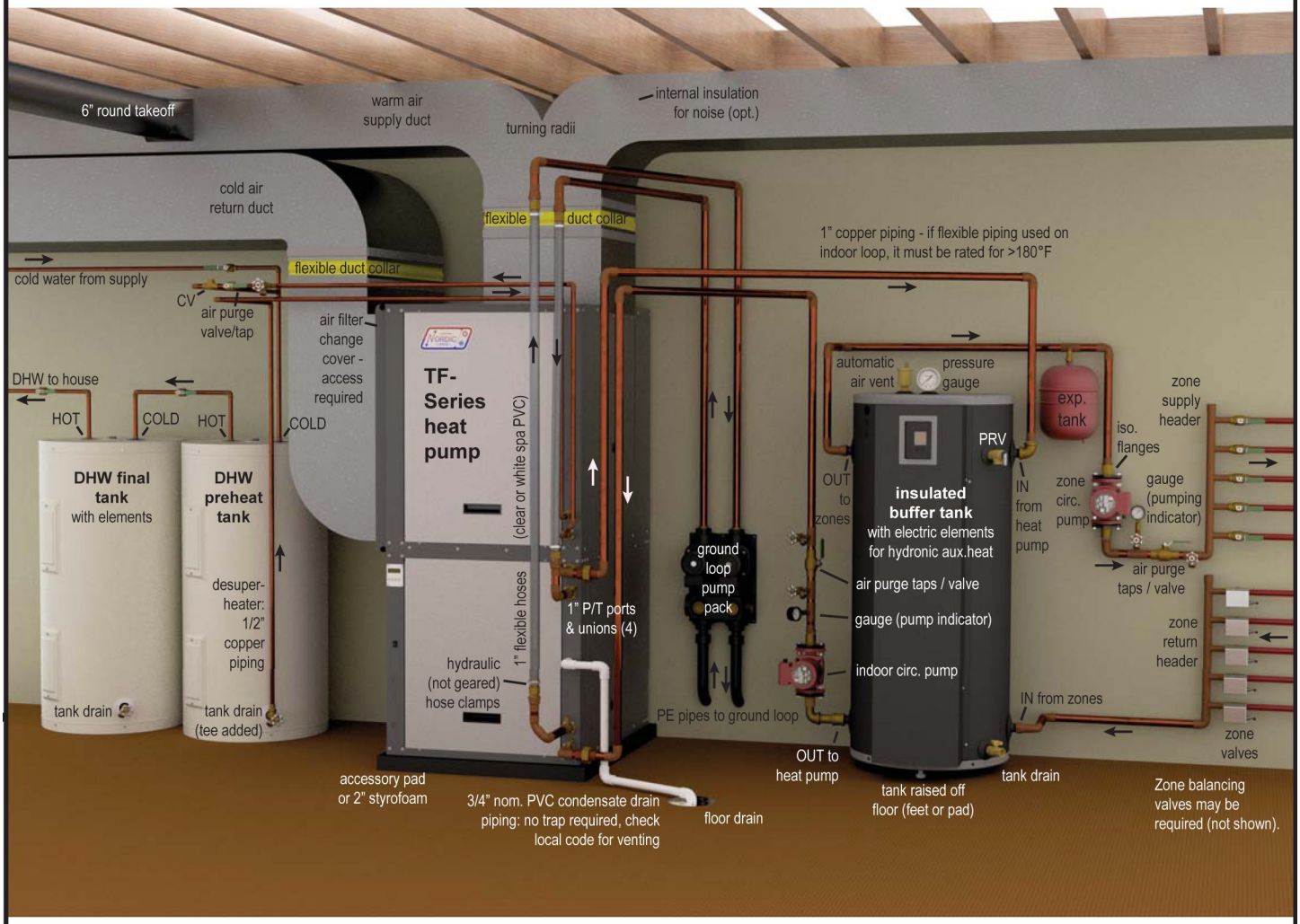
For the pre-heat tank setup, the final tank should be set to **140°F (60°C),** which is required by most codes. The pre-heat tank does not require electric elements. This setup takes full advantage of the desuperheater as it is the sole heat provider to the pre-heat tank. The desuperheater remains active 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.

go to TABLE OF CONTENTS

# 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 |
| Checked By | Dan Rheault | Date | 23-Aug-2017 |
| Eng. Approved By | | Date | |
| Mfg. Approved By | | Date | |
| Approved By | | Date | |

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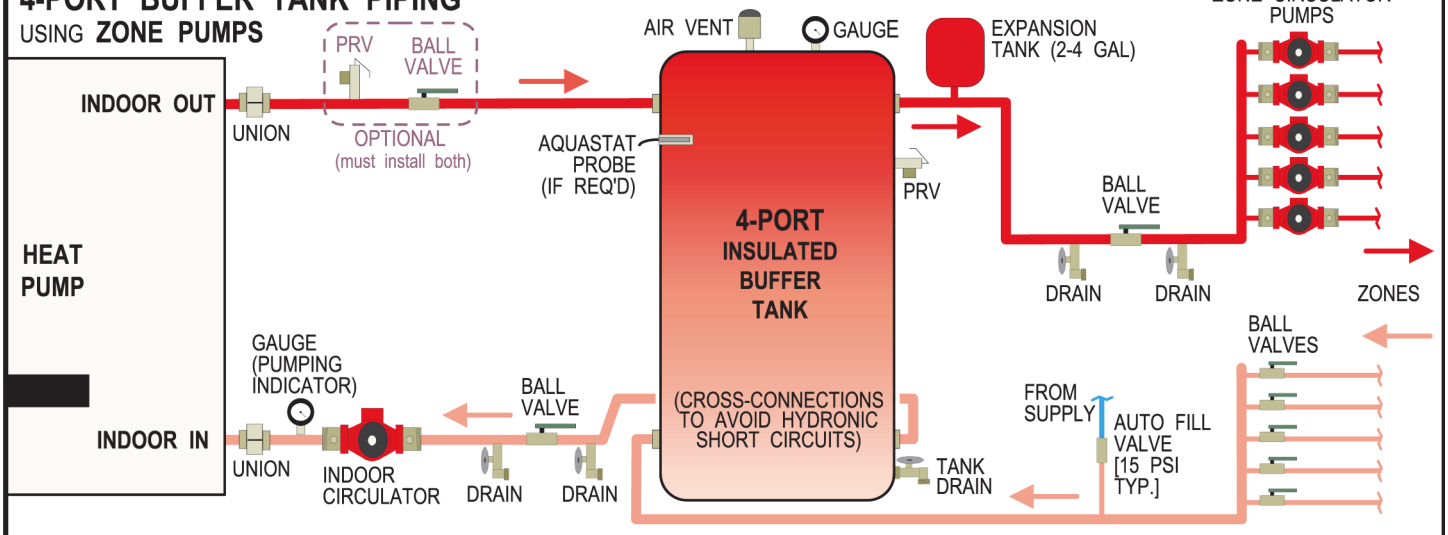
Drawing Name: **Typical Loop Connections - TF Series**

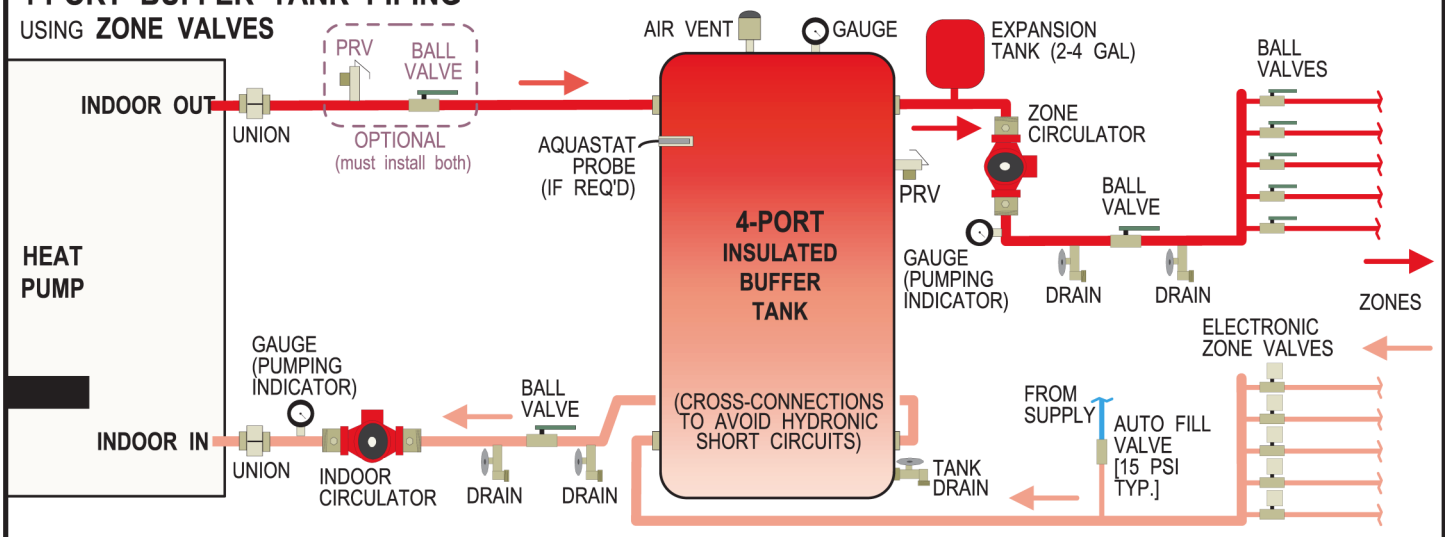
| Size | Drawing Number | Revision | Sheet |
|---|---|---|---|
| LET | 002238PDG | 02 | 1 / 1 |

go to TABLE OF CONTENTS

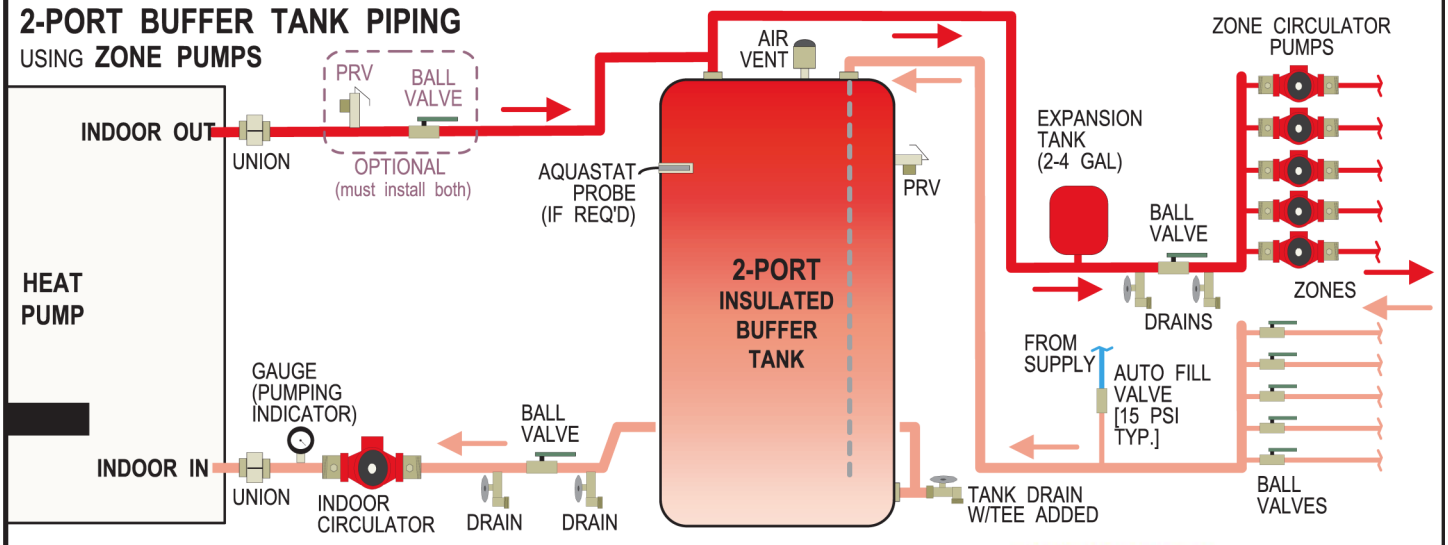
## 4-PORT BUFFER TANK PIPING
USING **ZONE PUMPS**




## 4-PORT BUFFER TANK PIPING
USING **ZONE VALVES**




## 2-PORT BUFFER TANK PIPING
USING **ZONE PUMPS**




| REV | ECO # | IMPL BY | APVD BY | DATE |
|---|---|---|---|---|
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| | | | | |
| 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: **Recommended Hydronic Buffer Tank Piping**

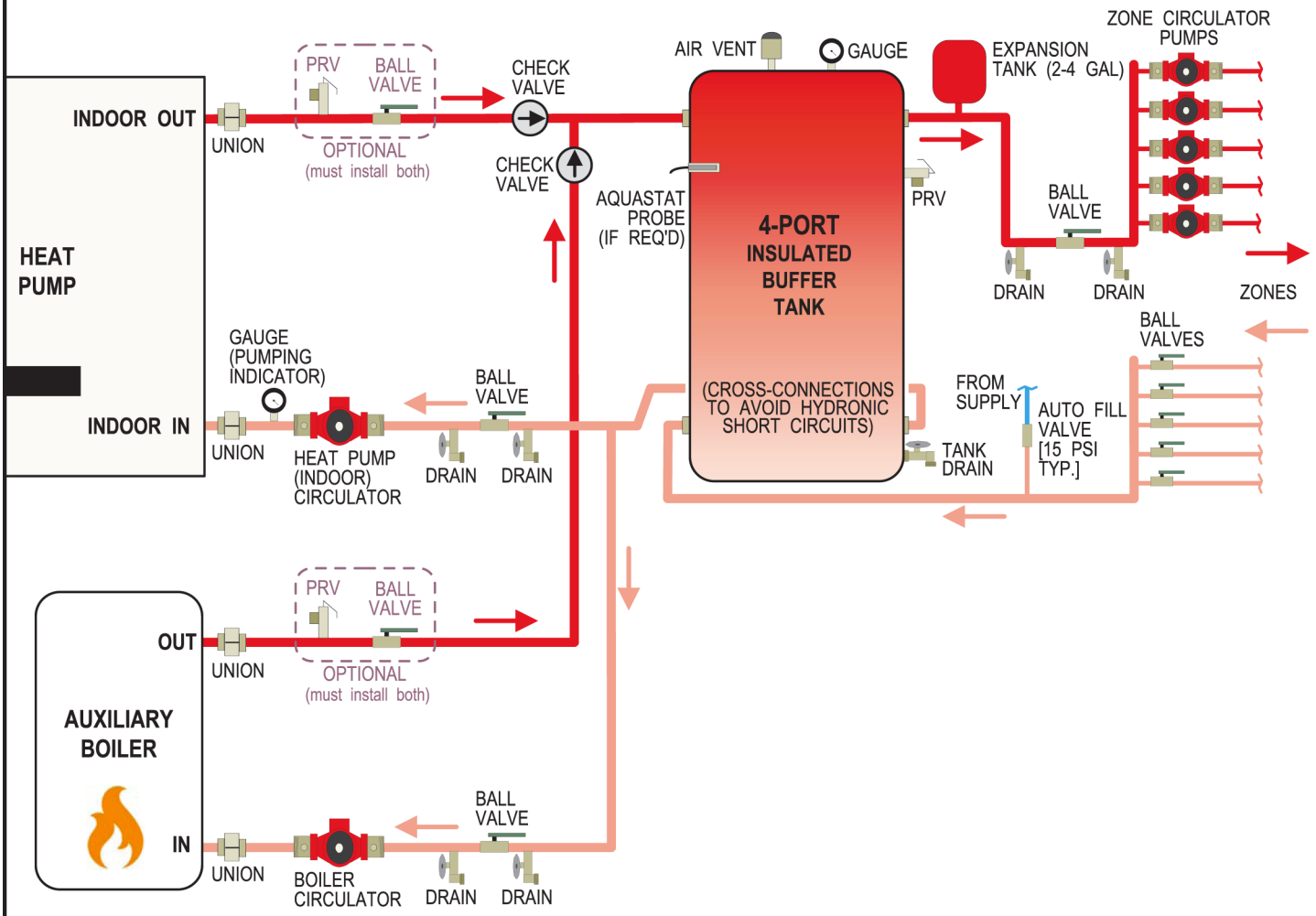
| Size | Drawing Number | REV | SHEET |
|---|---|---|---|
| A | 002366PDG | 02 | 1 of 1 |

go to TABLE OF CONTENTS

# 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.

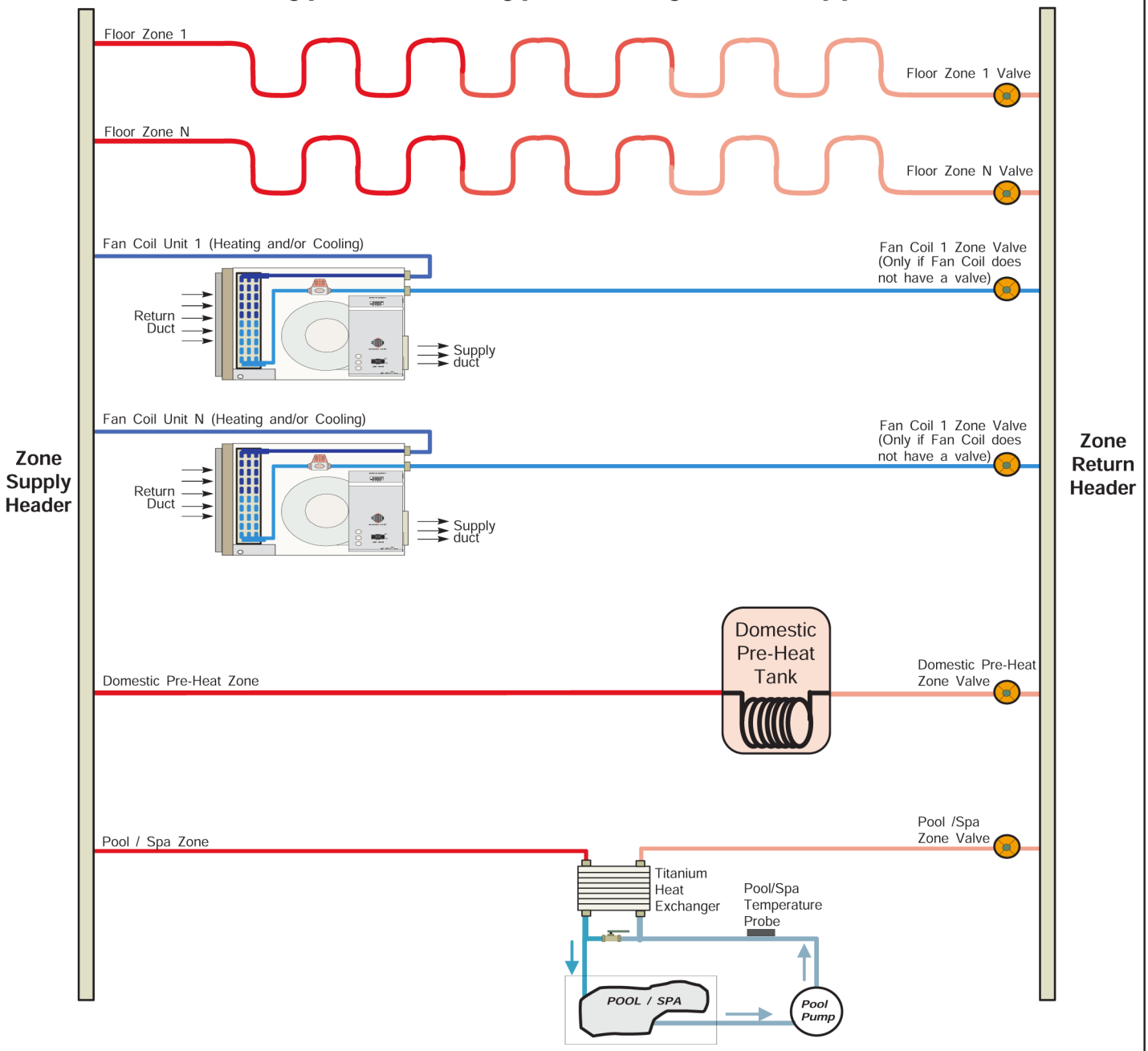
| REV | ECO # | IMPL BY | APVD BY | DATE |
|---|---|---|---|---|
| 02 | (add fill valve) | D. RHEAULT | D. RHEAULT | 1-Feb-2021 |
| 01 | Initial Release | D. RHEAULT | D. RHEAULT | 14-Dec-2018 |

| | | |
|---|---|---|
| Drawn By: Dan Rheault | Date: 14-Dec-2018 | MARITIME GEOTHERMAL LTD. 170 Plantation Rd. Petitcodiac, NB E4Z 6H4 |
| Checked By: Dan Rheault | Date: 14-Dec-2018 | Drawing Name: Auxiliary Boiler Piping |
| Approved By (ENG) | Date | |
| Approved By (MFG) | Date | |
| Approved By | Date | |

| Size | Drawing Number | REV | SHEET |
|---|---|---|---|
| A | 002367PDG | 02 | 1 of 1 |

go to TABLE OF CONTENTS

# 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 |
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| 01 | Initial Release | C. GEDDES | C. GEDDES | 06 SEP 07 |

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|---|---|---|
| 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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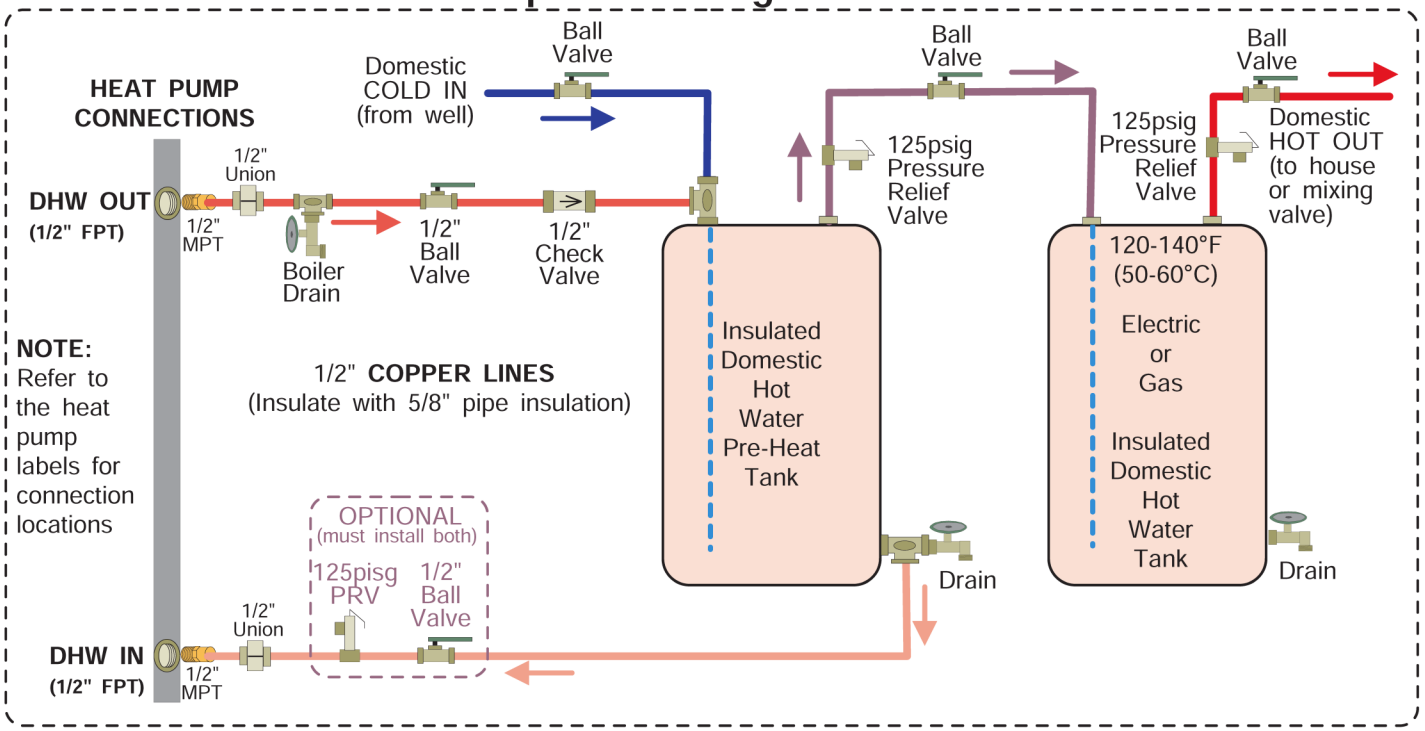
Drawing Name: Typical Zone Types for Hydronic Applications

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

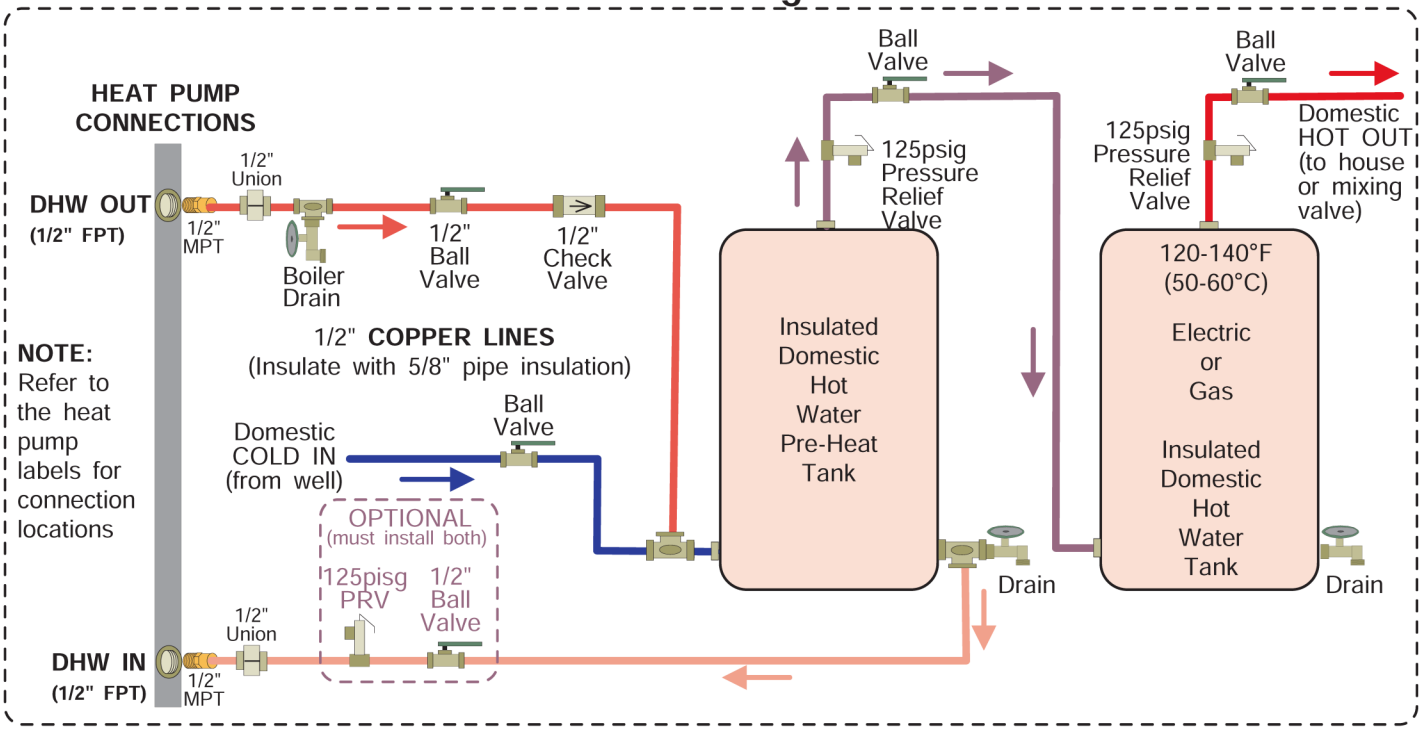
go to TABLE OF CONTENTS

# Desuperheater Connection to DHW Pre-Heat Tank

## Top Port Configuration




## Side Port Configuration




| REV | ECO # | IMPL BY | APVD BY | DATE |
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| | | | | |
| 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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E4Z 6H4

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

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

go to TABLE OF CONTENTS

# 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.

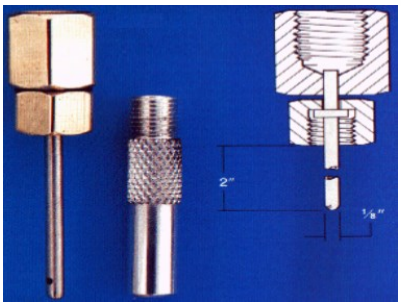
**Figure 1: Ground Loop Accessories & Tools**

*2-pump module*

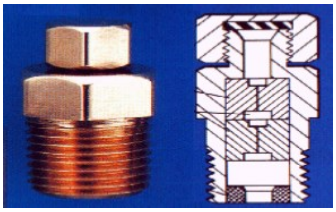
*Barbed Adapters*

*PE Adapters*

*Purge Cart*



*Gauge adapter for P/T port*



*P/T port*

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

go to TABLE OF CONTENTS

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.

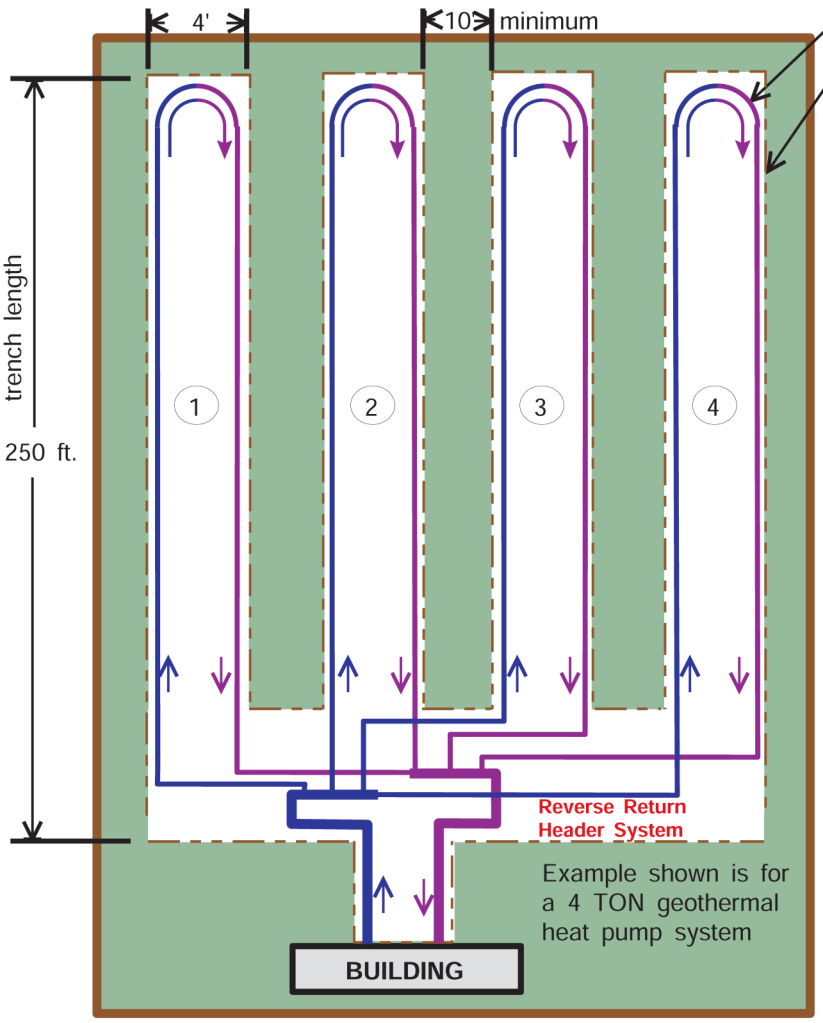
After operating the heat pump for a period of time, any residual air in the system should be bled off and the static pressure should be verified and adjusted if necessary. Add additional water / antifreeze mix with the purge cart to bring the pressure back to the original setting if required.

## 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.

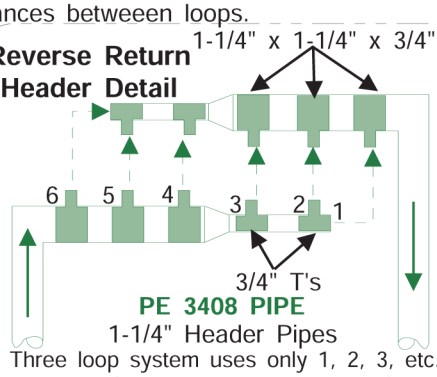
go to TABLE OF CONTENTS

# TYPICAL HORIZONTAL GROUND LOOP CONFIGURATION



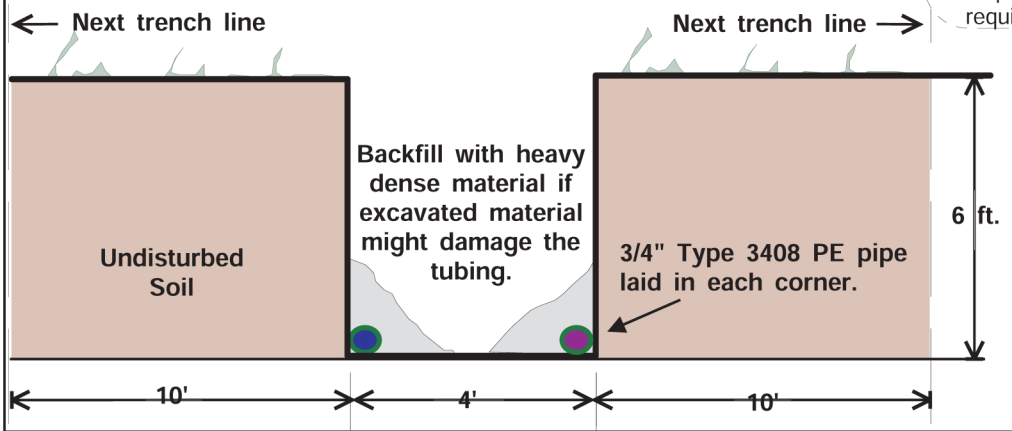

- Type PE 3408 Pipe
- Excavated trenches minimum 4' wide x 6' deep
- Trenches will be backfilled with material which will maximize the thermal conductivity of the adjacent earth.
- Each loop consists of 500ft. of 3/4" type 3408 PE 160 psig (SDR 11) geothermal heat pump polyethelene tubing.
- Each trench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

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| 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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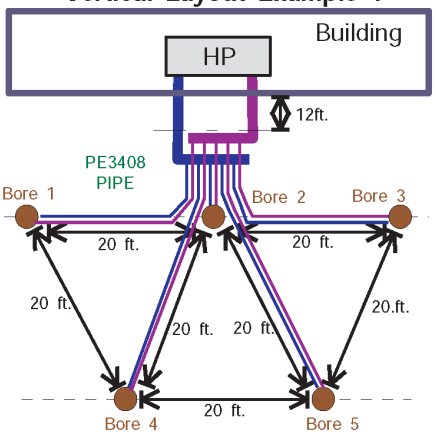
Drawing Name: Typical Horizontal Ground Loop Configuration

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

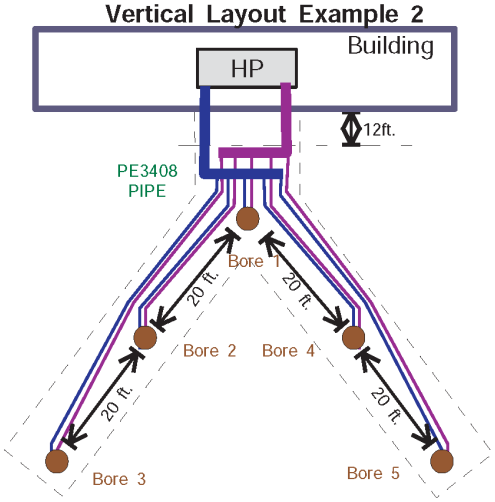
go to TABLE OF CONTENTS

# TYPICAL VERTICAL GROUND LOOP CONFIGURATION

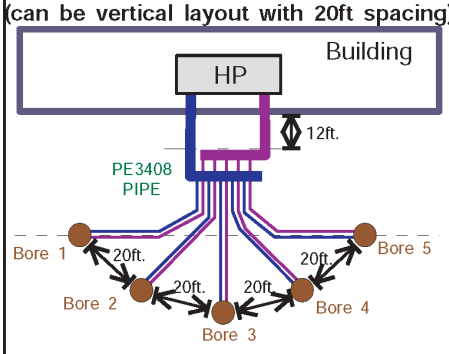
### Vertical Layout Example 1



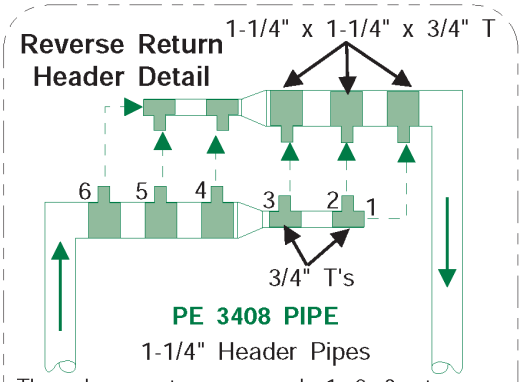

### Vertical Layout Example 2




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

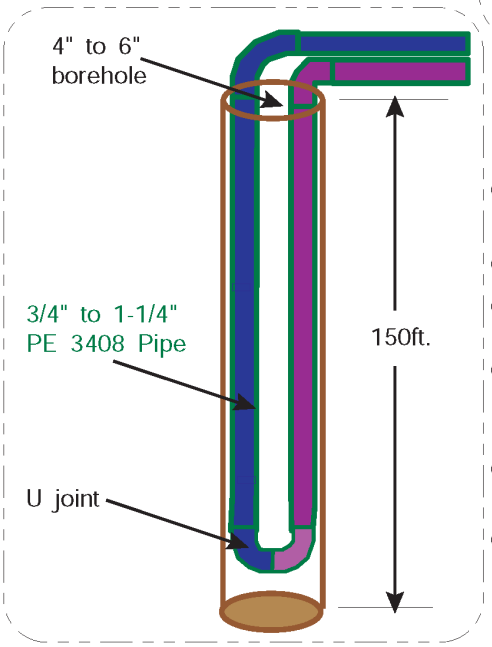



### Reverse Return Header Detail




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. 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.

| REV | ECO # | IMPL BY | APVD BY | DATE |
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| 01 | ISSUE 02 | D. RHEAULT | D. RHEAULT | 11 SEP 24 |
| 01 | Initial Release | C. GEDDES | C. GEDDES | 22 JAN 08 |

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| Drawn By Chris Geddes | Date | 22 JAN 08 |
| Checked By Chris Geddes | Date | 22 JAN 08 |
| Approved By (ENG) Chris Geddes | Date | 22 JAN 08 |
| Approved By (MFG) | Date | |
| Approved By | Date | |

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170 Plantation Rd.
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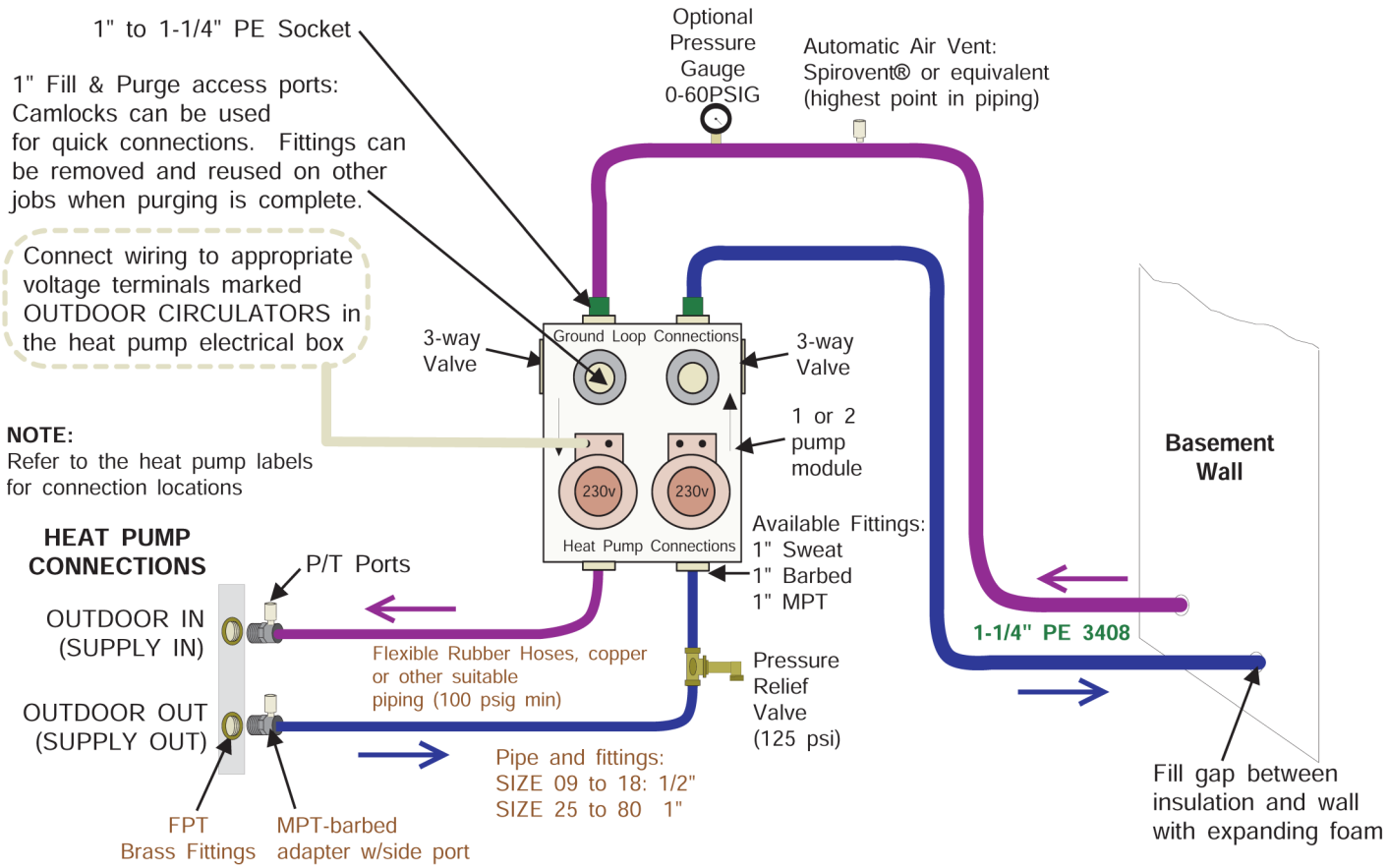
Drawing Name: Typical Vertical Ground Loop Configuration

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

go to TABLE OF CONTENTS

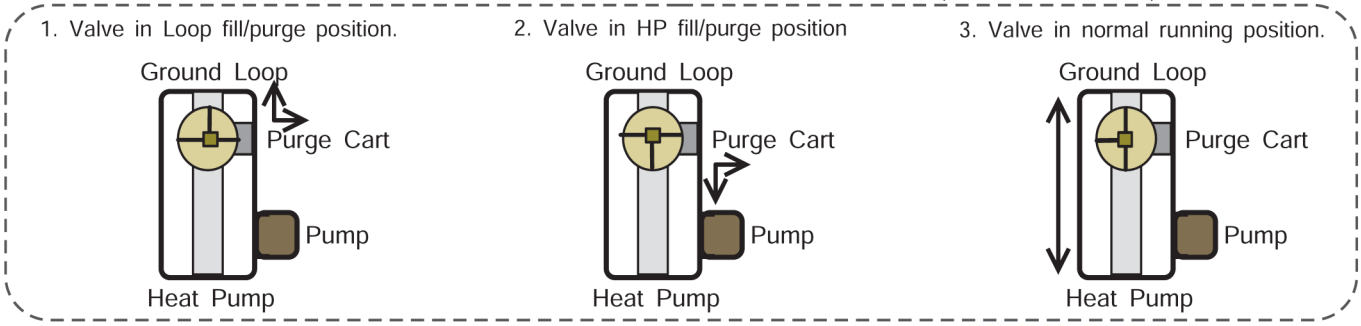
# Geo-Flo Circulator Pump Module Installation
# (Units with Brass FPT Fittings)




**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)

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| 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 |

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| 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 |

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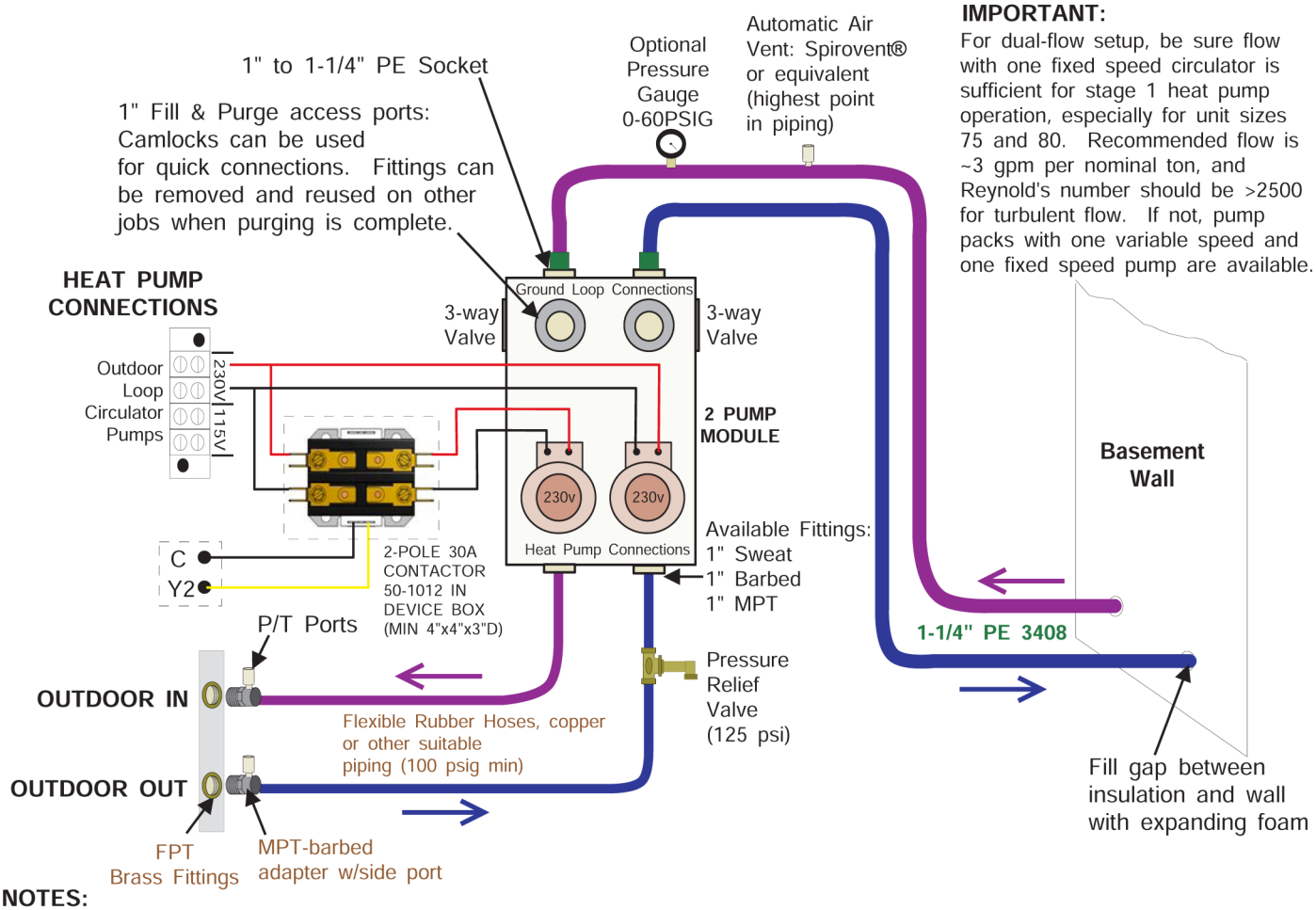
| Drawing Name | Size | Drawing Number | Drawing Rev | SHEET |
|---|---|---|---|---|
| Geo-Flo Circulator Pump Module Installation (Brass FPT) | A | 000906PDG | 03 | 1 of 1 |

go to TABLE OF CONTENTS

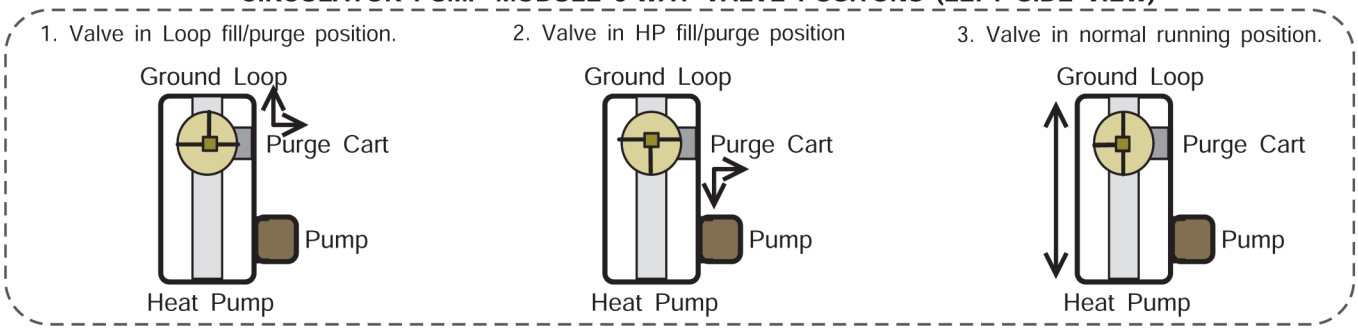
# Dual Flow Circulator Pump Module Installation for 2-Stage Heat Pumps




**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)

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| 03 | 000264 | D. RHEAULT | D. RHEAULT | 21-Aug-2018 |
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| 01 | Initial Release | D. RHEAULT | D. RHEAULT | 22-Nov-2013 |

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| 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 | |

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

| Size | Drawing Number | REV | SHEET |
|---|---|---|---|
| A | 001823CDG | 03 | 1 of 1 |

go to TABLE OF CONTENTS

# 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) |

* 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

go to TABLE OF CONTENTS

**Figure 2: Open Loop Accessories & Tools**

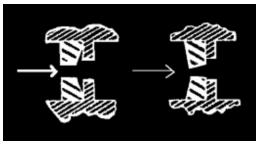
*Water Level Sounder*

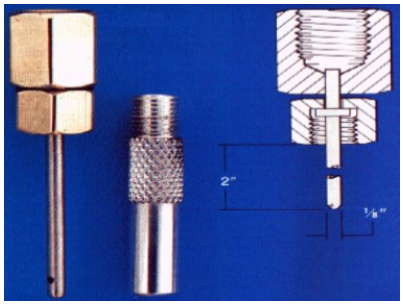
*Cumulative Gallon Meter*

*Motorized Water valve*

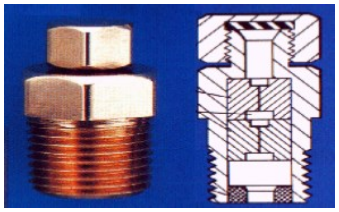
*Rainbird Solenoid Valve*

*Dole Valve*





*Gauge adapter for P/T port*



*P/T port*

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

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).

go to TABLE OF CONTENTS

## 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.

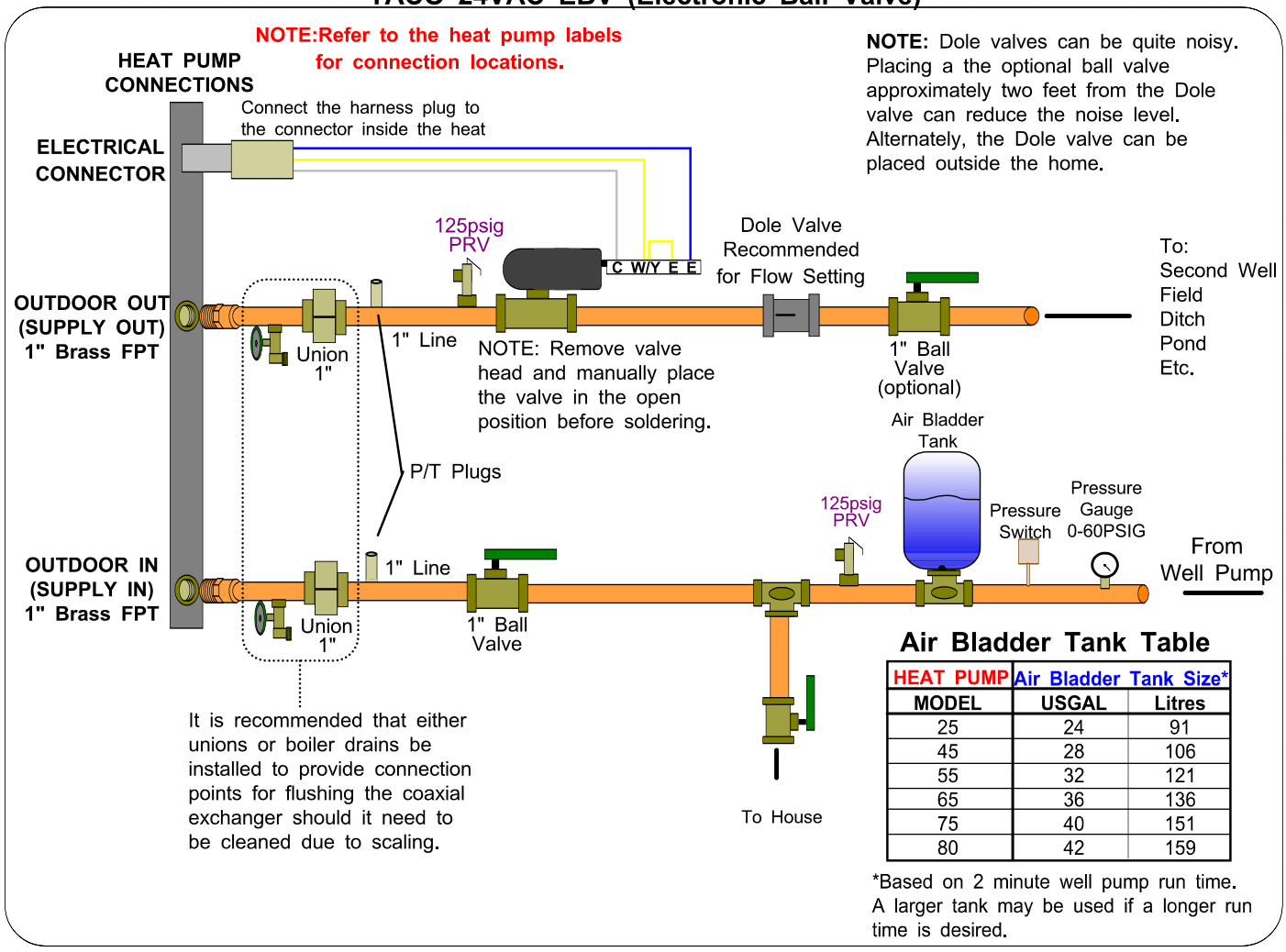
## Pipe Insulation

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.

go to TABLE OF CONTENTS

# Typical Ground Water Installation for Size 25-80 Heat Pumps for Units With Brass FPT Fittings

## TACO 24VAC EBV (Electronic Ball Valve)



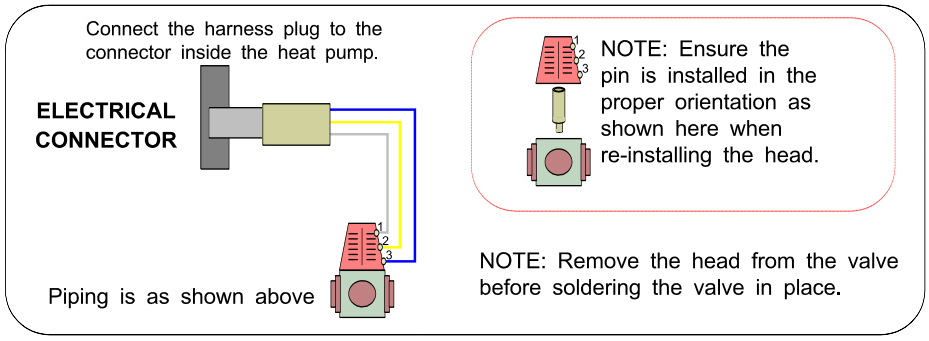

**NOTE:** Dole valves can be quite noisy. Placing a the optional ball valve approximately two feet from the Dole valve can reduce the noise level. Alternately, the Dole valve can be placed outside the home.

### Air Bladder Tank Table

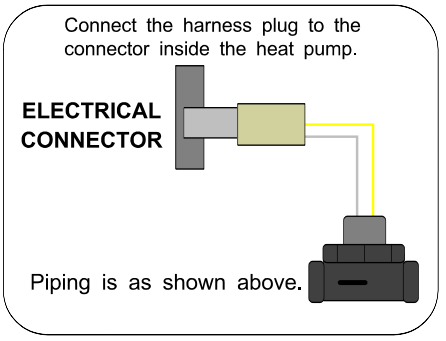
| HEAT PUMP | Air Bladder Tank Size* | |
|---|---|---|
| MODEL | USGAL | Litres |
| 25 | 24 | 91 |
| 45 | 28 | 106 |
| 55 | 32 | 121 |
| 65 | 36 | 136 |
| 75 | 40 | 151 |
| 80 | 42 | 159 |

*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

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| 02 | 000228 | C. GEDDES | C. GEDDES | 21 MAY 2014 |
| 01 | Initial Release | C. GEDDES | C. GEDDES | 10 DEC 08 |

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

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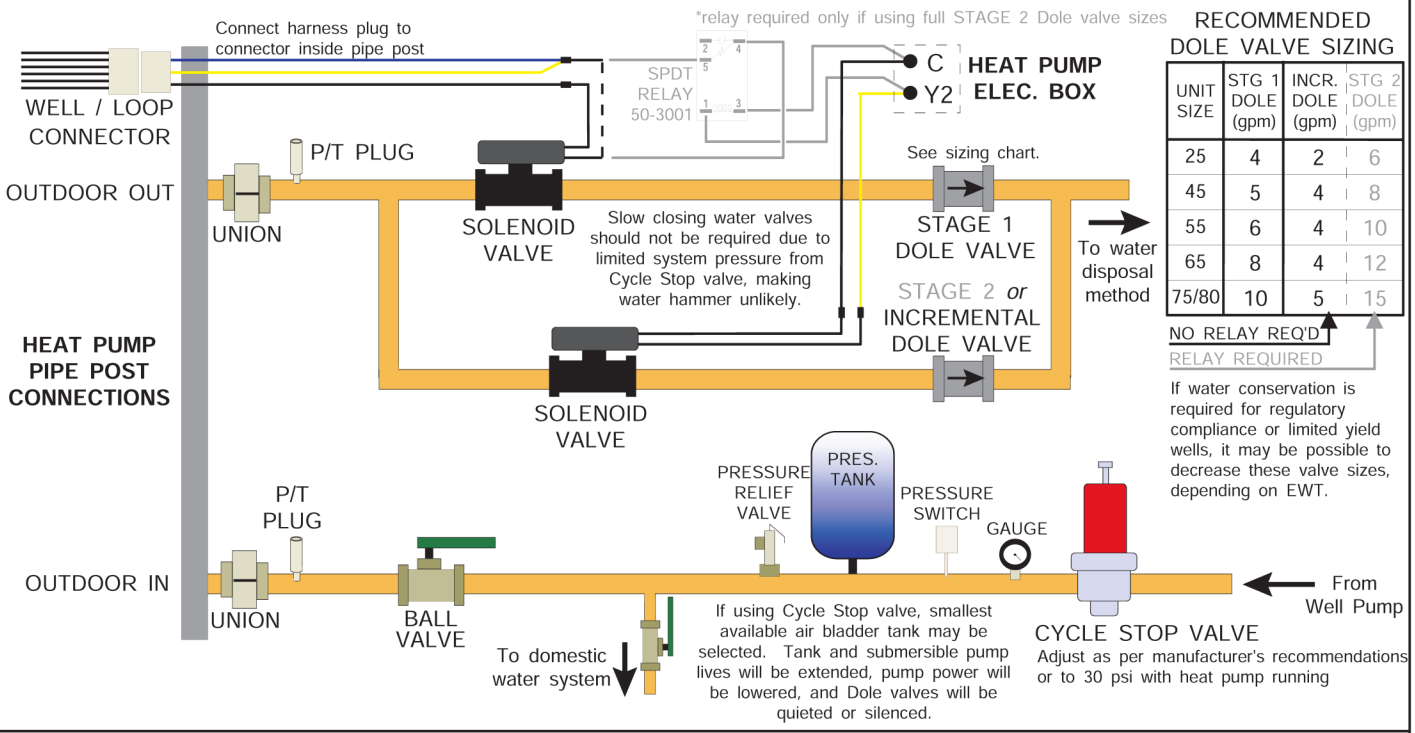
E4Z 6H4

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 |

go to TABLE OF CONTENTS

# 1. Dual-Flow Groundwater (Well) Installation




RECOMMENDED DOLE VALVE SIZING

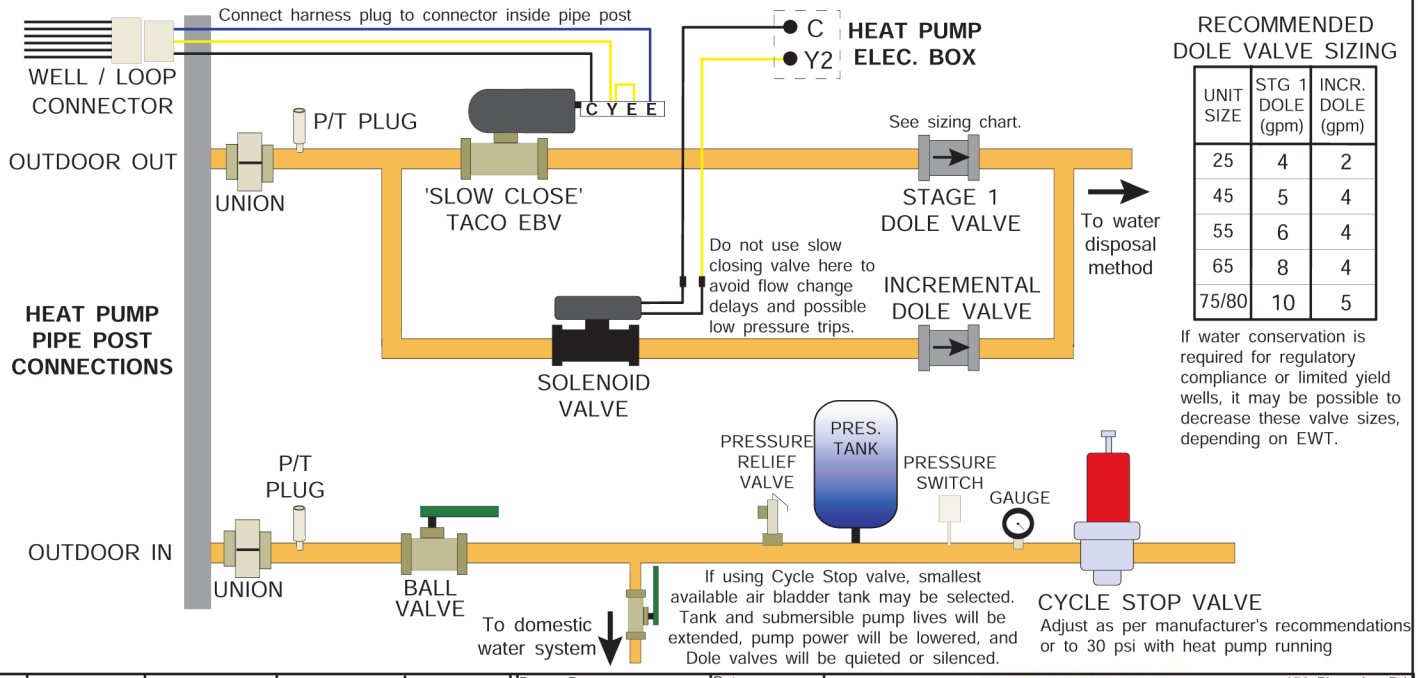
| UNIT SIZE | STG 1 DOLE (gpm) | INCR. DOLE (gpm) | STG 2 DOLE (gpm) |
|---|---|---|---|
| 25 | 4 | 2 | 6 |
| 45 | 5 | 4 | 8 |
| 55 | 6 | 4 | 10 |
| 65 | 8 | 4 | 12 |
| 75/80 | 10 | 5 | 15 |

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 |

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|---|---|---|---|
| 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 | |

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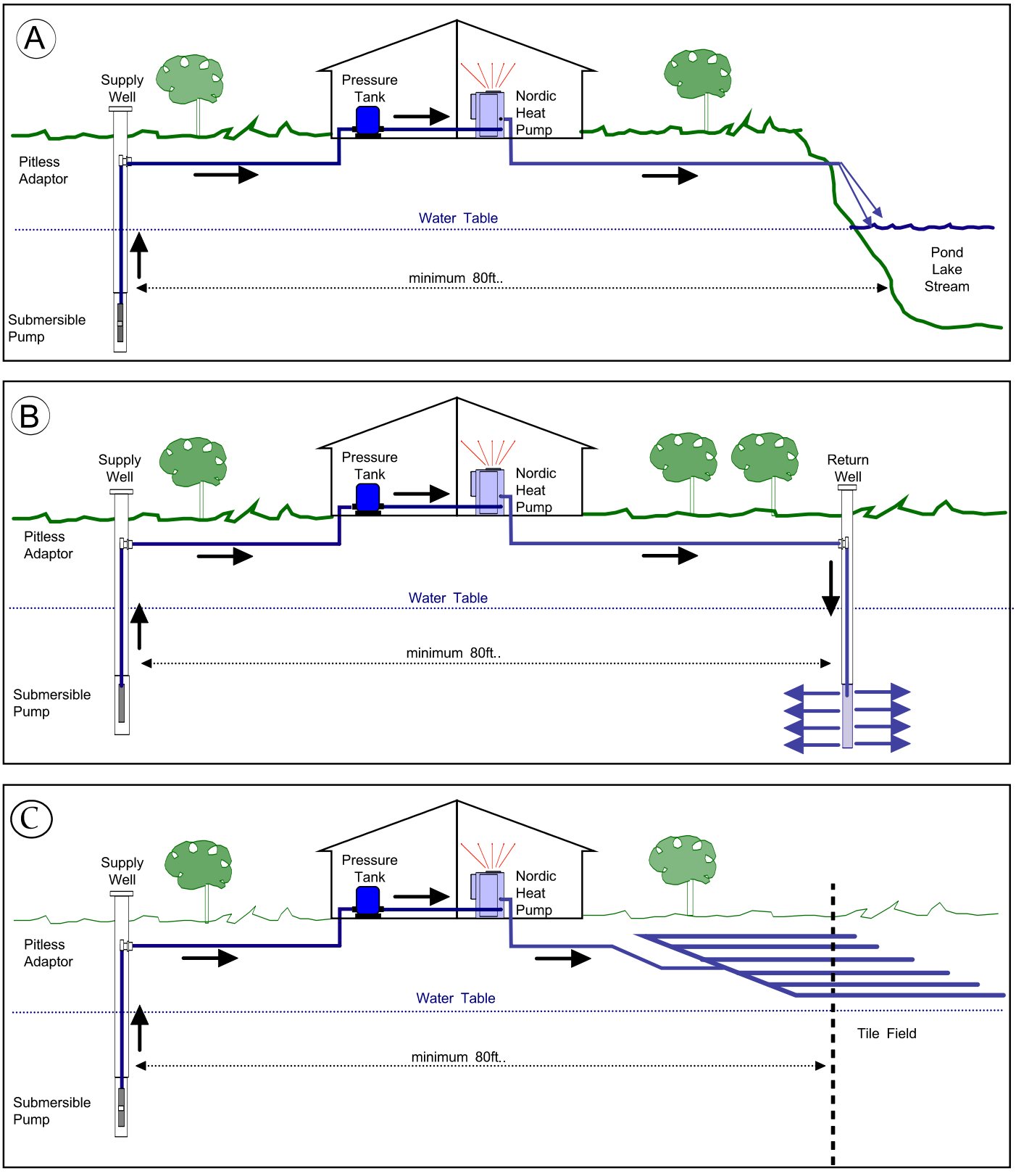
Drawing Name: Dual-Flow Groundwater (Well) Installation for Size 25-75 Heat Pumps

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

go to TABLE OF CONTENTS

# GROUND WATER DISPOSAL METHODS




| REV | ECO # | IMPL BY | APVD BY | DATE |
|---|---|---|---|---|
| 01 | Initial Release | C. GEDDES | C. GEDDES | 04 FEB 08 |

| | | |
|---|---|---|
| Drawn By: Chris Geddes | Date: 04 FEB 08 | |
| Checked By: Chris Geddes | Date: 04 JAN 08 | |
| Approved By (ENG): Chris Geddes | Date: 04 FEB 08 | |
| Approved By (MFG): | Date: | |
| Approved By: | Date: | |

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

Drawing Name: Ground Water Disposal Methods

| Size | Drawing Number | REV | SHEET |
|---|---|---|---|
| A | 000619INF | 01 | 1 of 1 |

go to TABLE OF CONTENTS

# 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 shown in **Wiring** chapter.

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

Refer to **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 |

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

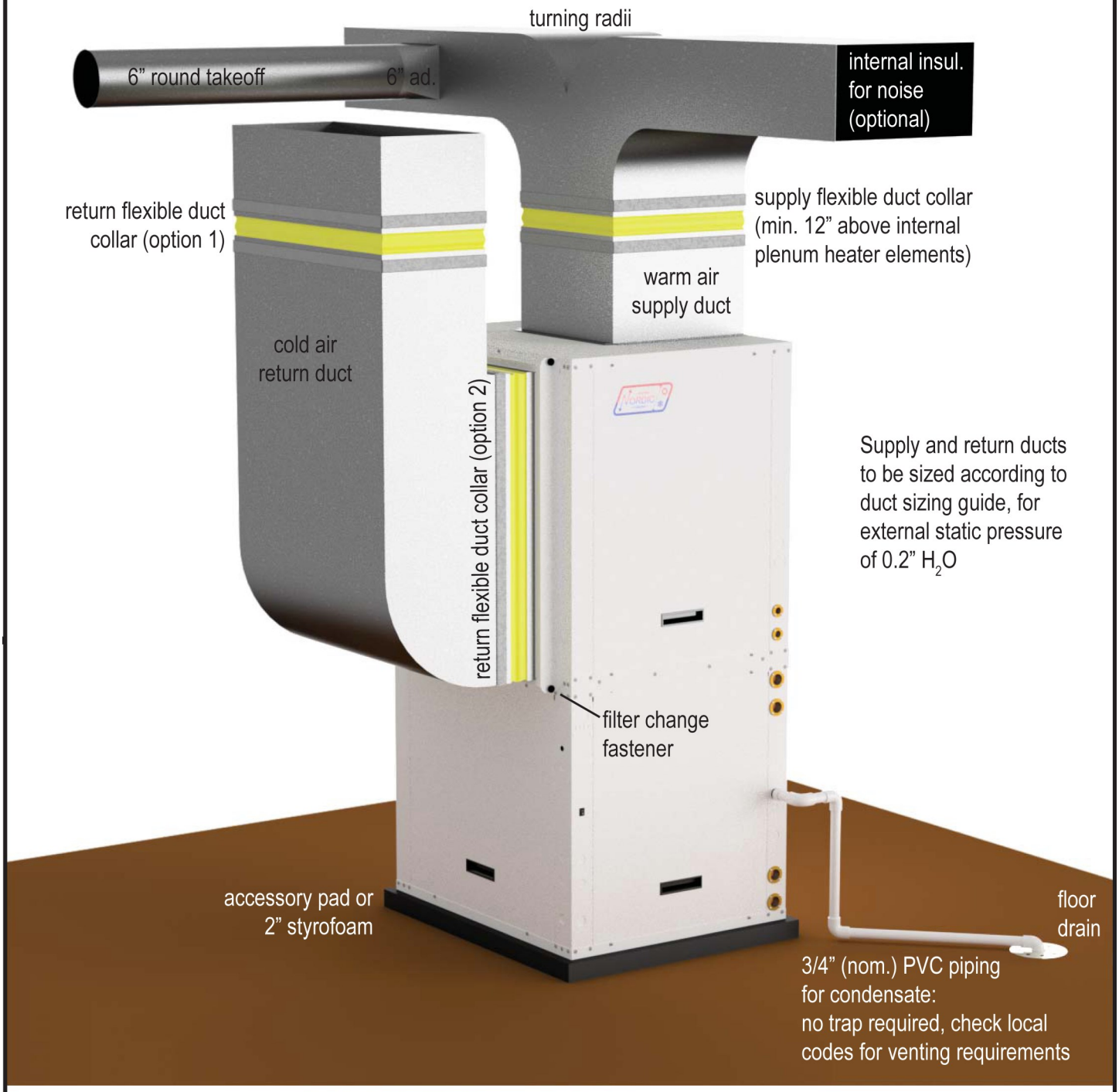
Most homes are a single ducted air zone with one thermostat. The thermostat should be centrally located within the home, typically on the main floor. It should be placed away from any supply grills, and should not be positioned directly above a return grill. Most installations have the thermostat located 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.

go to TABLE OF CONTENTS

# 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 |

go to TABLE OF CONTENTS

## 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 | | | | |

go to TABLE OF CONTENTS

# 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)** chapter.


## 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

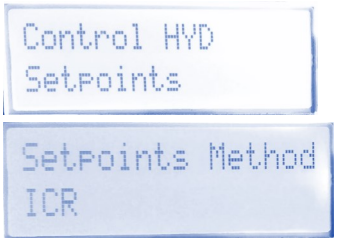
It is recommended that this method be used to control the system's hydronic heat demand since it eliminates the need for an external temperature sensor or aquastat.

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***



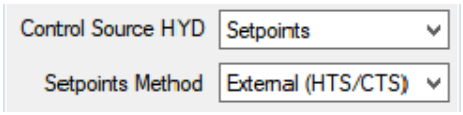

This is the default method and uses the Indoor OUT temperature probe inside the unit for temperature control. Its value is displayed in the **Hot Tank** box on the PC App's **View --> Setpoint Control** screen. If this temperature shows **NC**, then either the probe is not connected to the board or there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

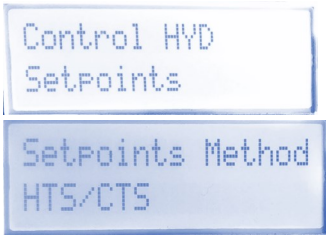
See below, and also the **PC Application (PC App)** section for full screenshots of the various windows.

### *Setpoint Control Method 2 - External HTS/CTS*

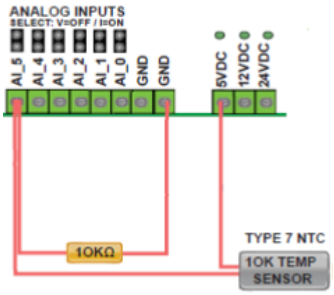
***PC APP: Tools-->Configuration***




***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.

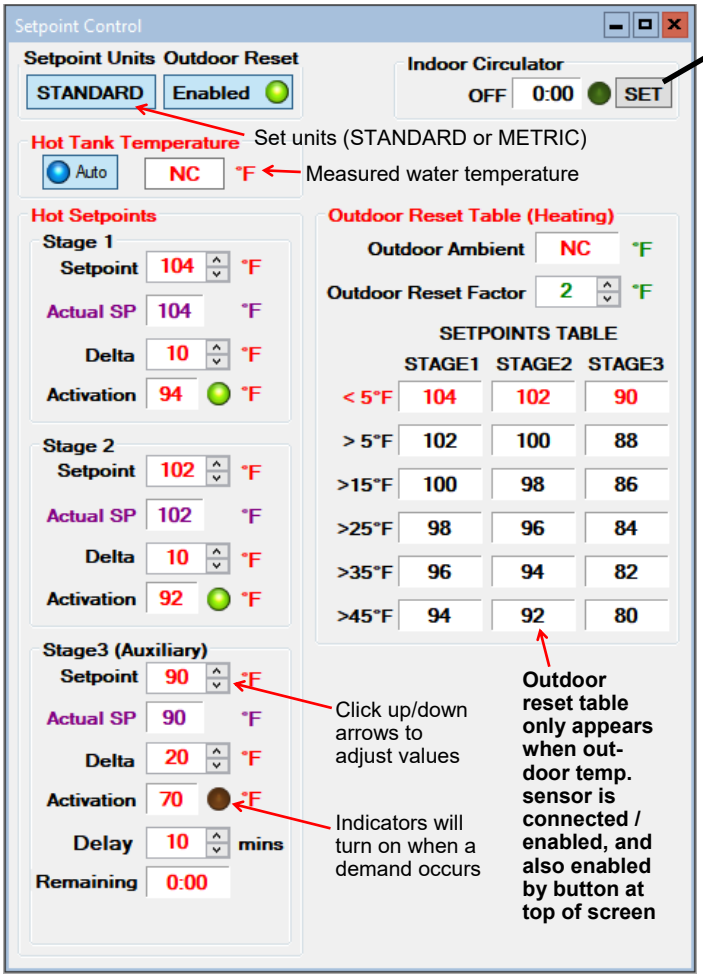


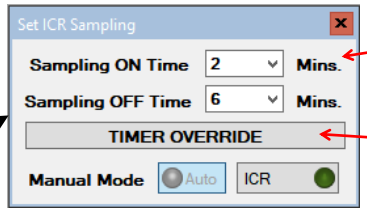

A 10K Type 7 (or Type 3) NTC thermistor along with a 10K 1% or better resistor must be connected to the control board in order to use the External HTS/CTS method. Connect the sensor to the AI_5 input as shown above and on the wiring diagram (SCH) in the **Model Specific Information** section. Remove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

go to TABLE OF CONTENTS

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




**WARNING: When using Manual Override mode, 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 Control Panel to turn demand ON/OFF with Stage buttons when in Manual Override Mode .**

| TABLE 18 - Typical Temperature Setpoints | | | | | | |
|---|---|---|---|---|---|---|
| | Stage 1 | | Stage 2 | | Stage 3 | |
| | °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 | | | | | | |

**For example, in heating mode: when water temp falls by the "Delta" amount below the "Setpoint", the stage is activated (at the board-calculated "Activation" temp). The stage stays on until water is heated to the "Setpoint".**

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.

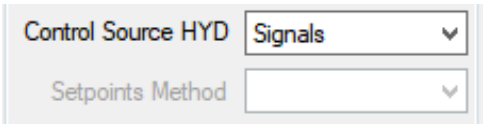
### Summer Setback

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.

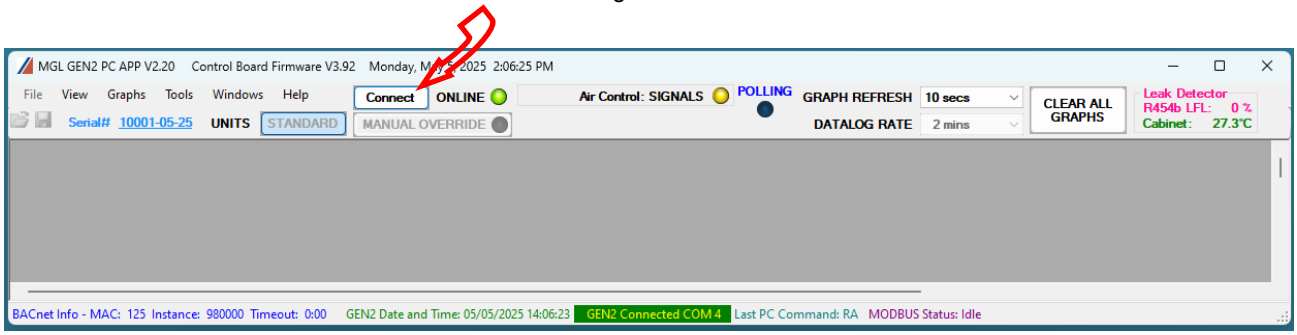
When using Signals Control, the backup tank element thermostat can be set to maximum, allowing the electric elements to be controlled by an external contactor placed in the power supply connections (see diagrams in **Wiring** section). The contactor can be connected to stage 2 of the heating aquastat 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).

go to TABLE OF CONTENTS

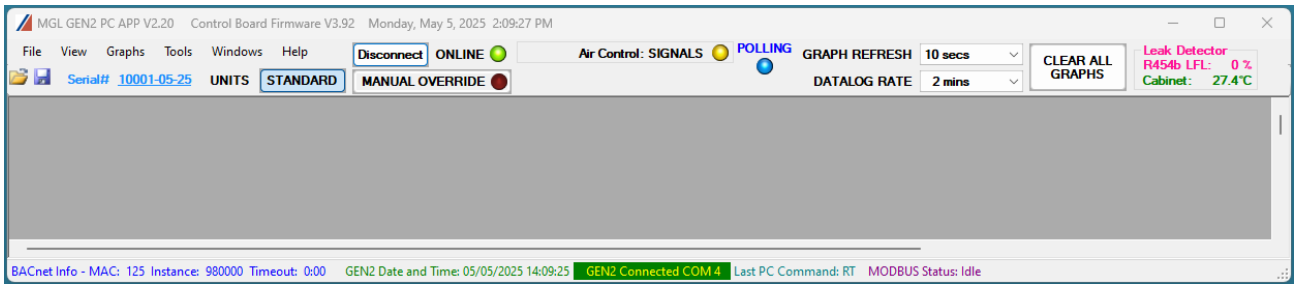
# PC Application (PC App)

**NOTE:** Before using the PC Application, refer to **Appendices** for installation instructions for the PC App and USB driver.

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




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




## PC Application Menus

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

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

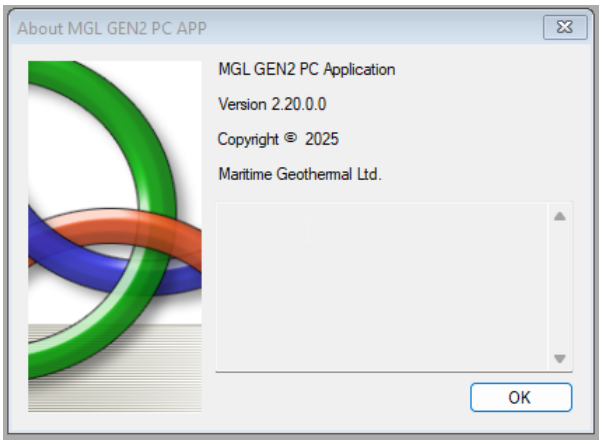
***File-->Open***: Opens a saved page arrangement.
***File-->Save***: Saves the current page arrangement.
***File-->Exit***: Exits the PC Application.

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

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

***Help Menu:*** This shows information about the PC Application.

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

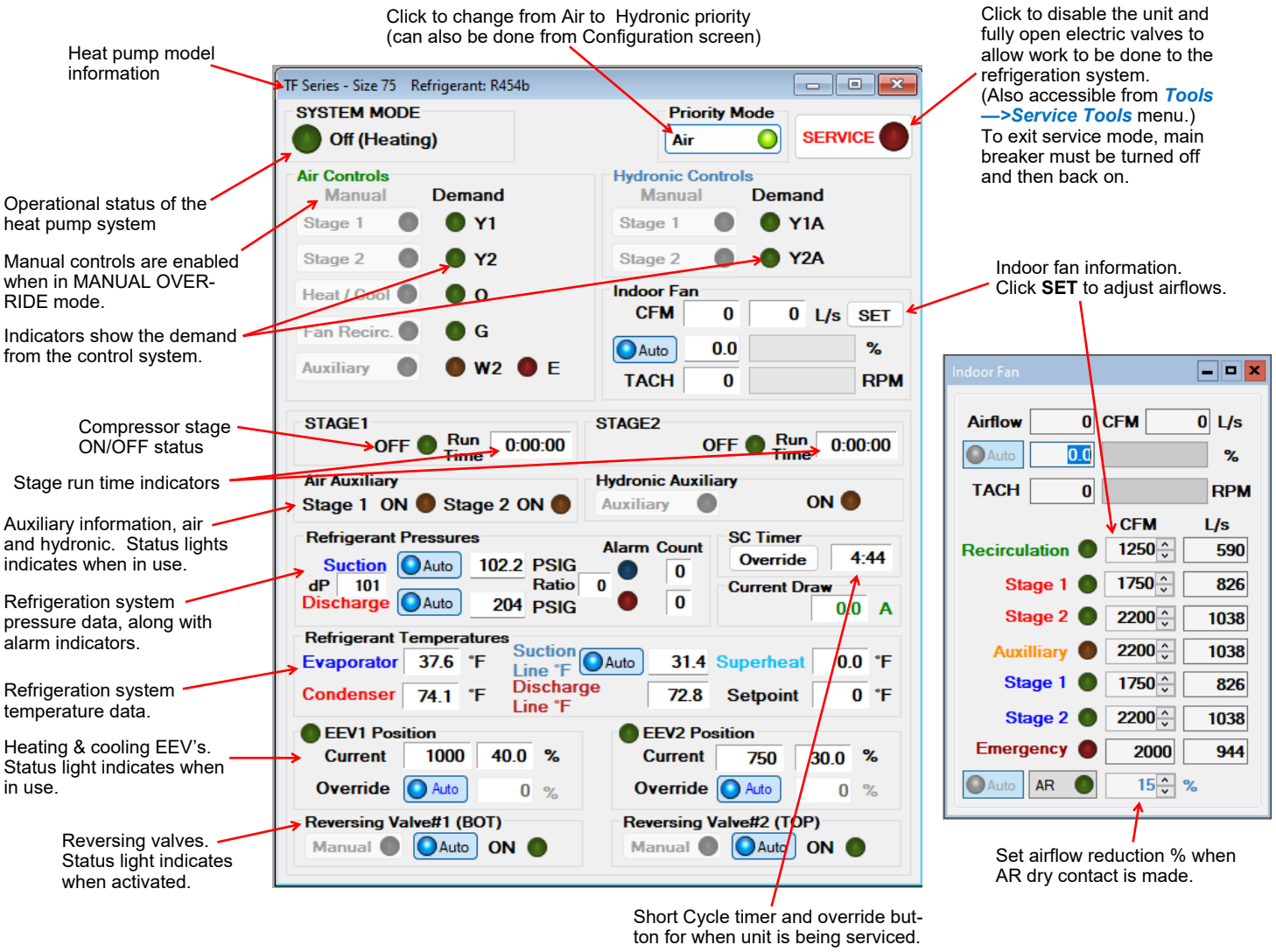



go to TABLE OF CONTENTS

## *View* Menu:

This menu handles all of the operational viewing screens.

***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.

go to TABLE OF CONTENTS

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

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

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

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

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

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

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

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

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

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

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

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

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

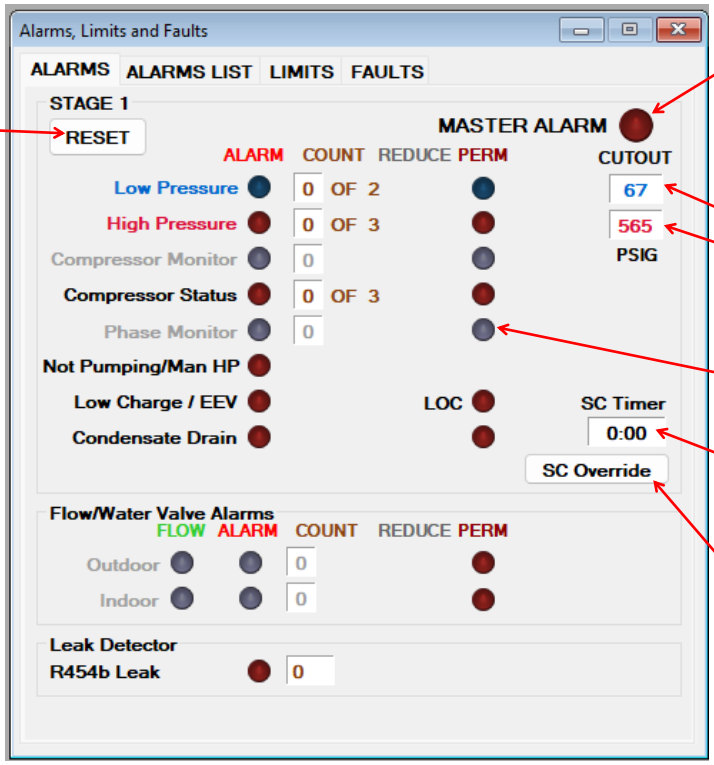
***Condensate Drain:*** This alarm occurs if fluid level in the condensate tray rises to the level of the sensor.

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

**Go the Alarms Troubleshooting section of the Troubleshooting chapter of the manual to address alarm issues.**

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.

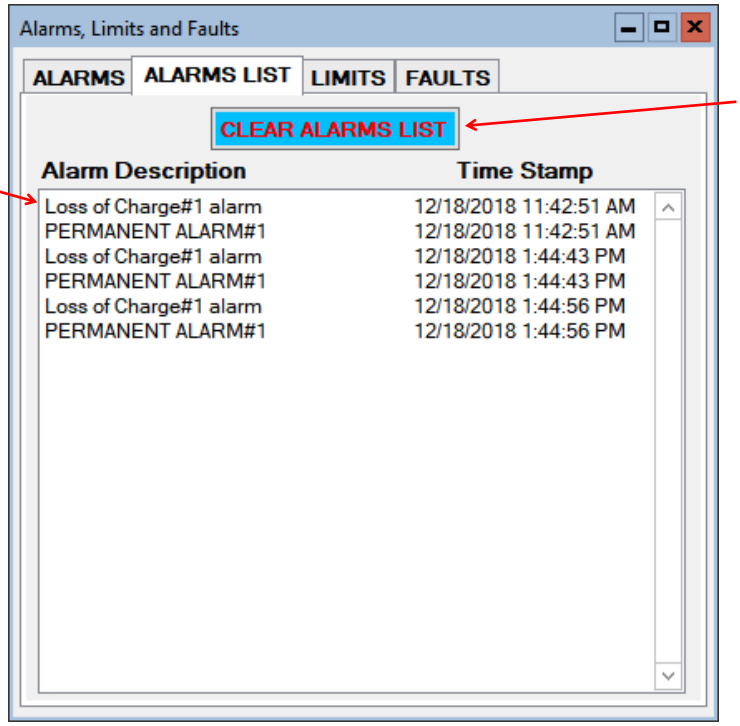
This button will reduce the short cycle timer value to 10 seconds.

go to TABLE OF CONTENTS

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

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

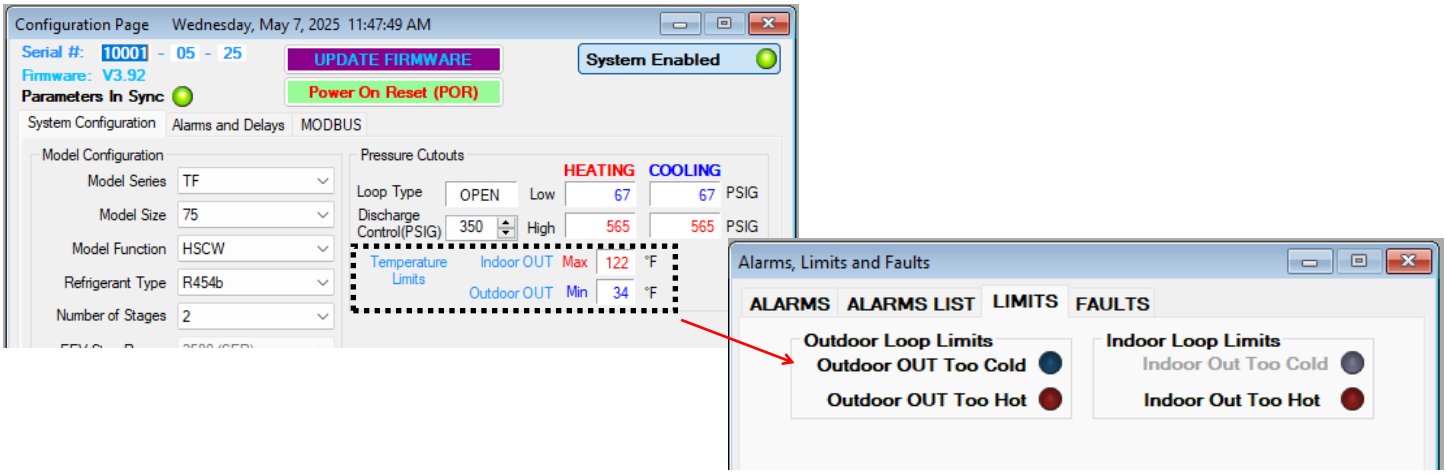
Each alarm that occurs while the PC APP is connected to the control board will appear here. The alarm type and a time stamp will be shown.




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.




go to TABLE OF CONTENTS

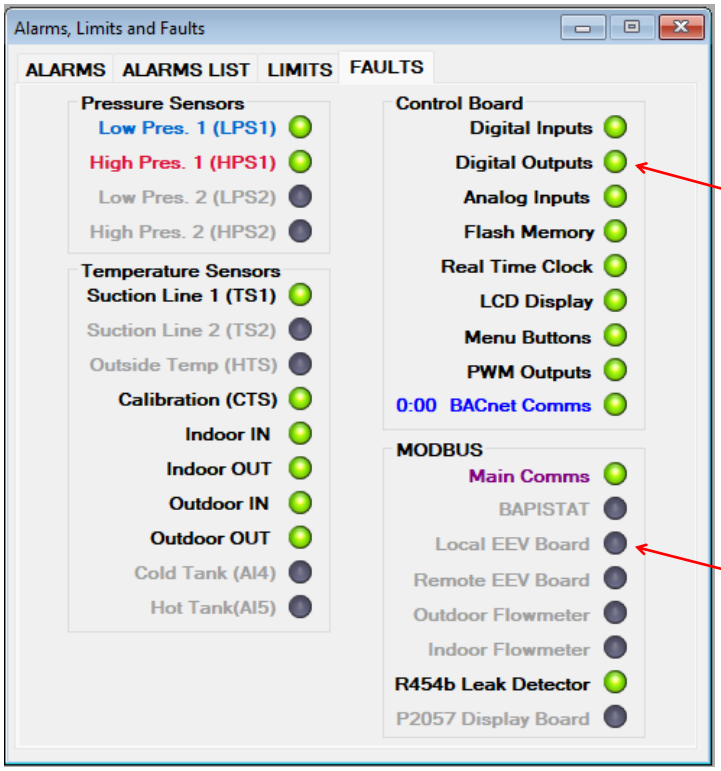
### *View-->Alarms, Limits and Faults (FAULTS tab)*

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

**If a fault occurs, some things to try:**

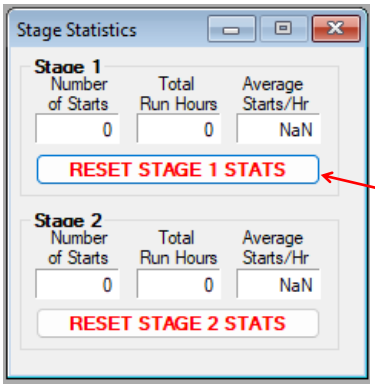
- Turn the power to the heat pump off for 20 seconds and then back on again.
- Use the menu item ***Tools-->Reset to Factory Defaults***. If this clears the fault then the system configuration will have to be set up again.
- For LCD interface or Menu Button faults, turn off the power, disconnect and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

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



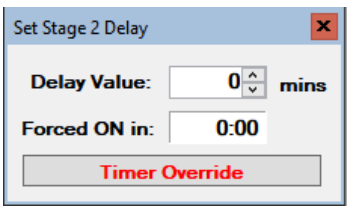

### *View-->Stage Stats*

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




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

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

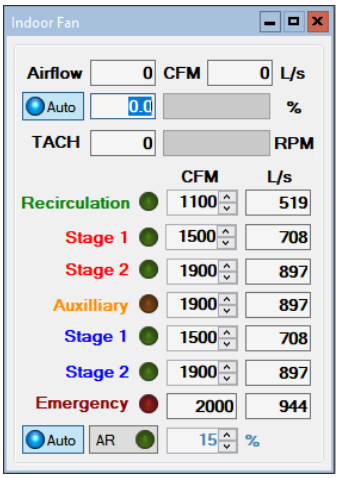



go to TABLE OF CONTENTS

### View-->Indoor Fan

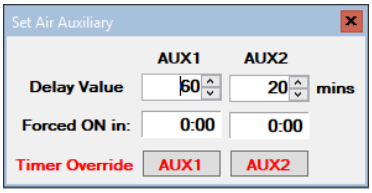
Shows the settings screen for the indoor fan/blower. Airflow may be adjusted up or down by the user within the allowed range. See **Indoor Airflow Data** section in the **Model Specific Information** chapter for airflow ranges.

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



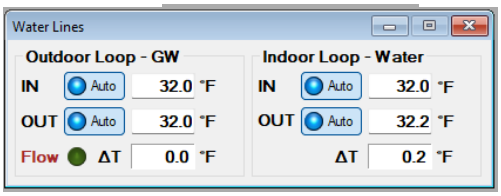

### View-->Set Air Auxiliary Delays

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.**



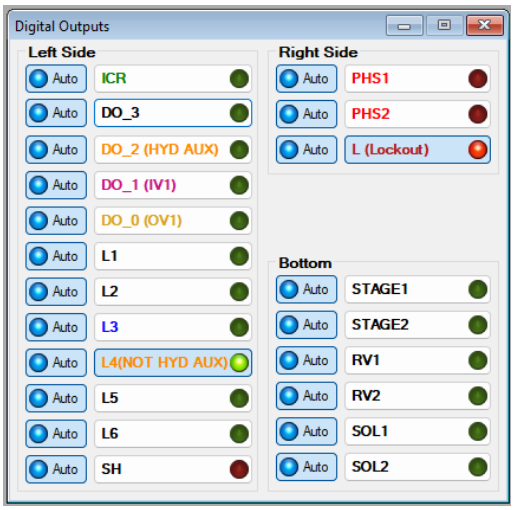

### View-->Water Lines

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



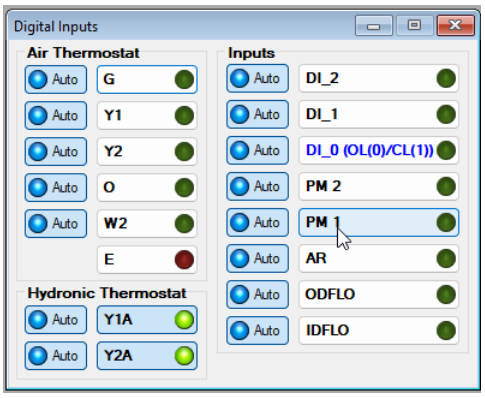

### View-->Digital Outputs

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




### View-->Digital Inputs

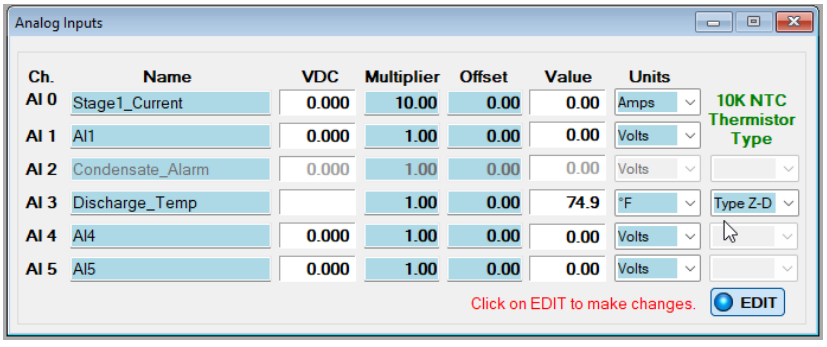
Shows the digital inputs and their individual status (ON/OFF). They may be individually controlled when in Manual Override Mode in order to facilitate troubleshooting.




### View-->Analog Inputs

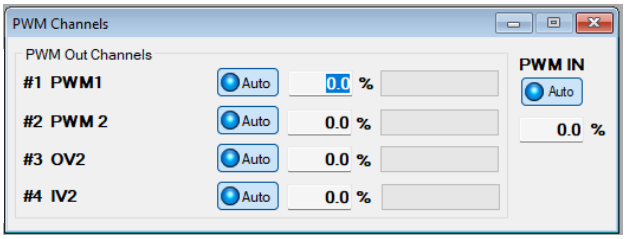
Shows the Analog inputs and their individual settings and values.

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




### View-->PWM Channels

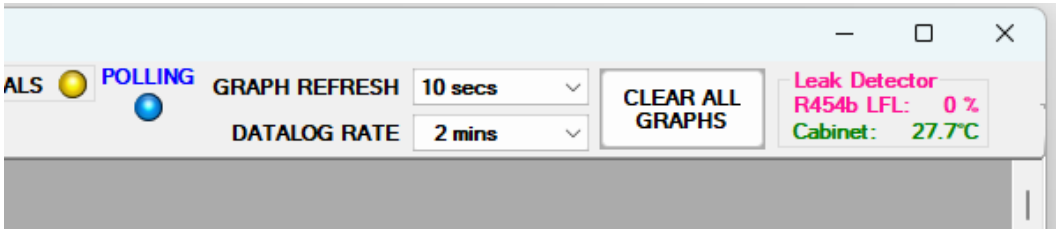
Shows the PWM channels and their individual status (0-100%). They may be individually controlled when in Manual Override Mode in order to facilitate troubleshooting.



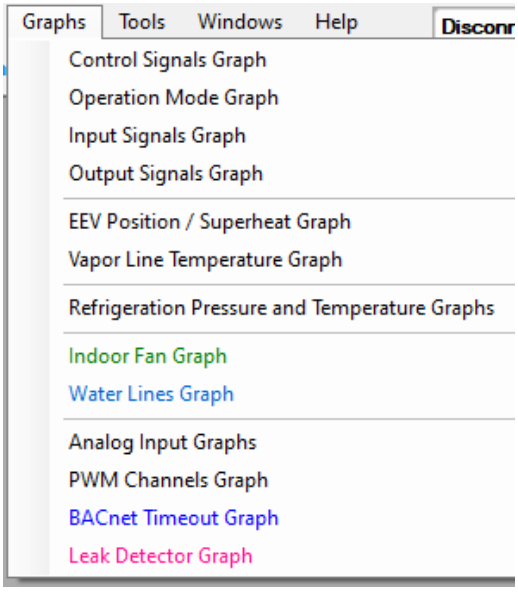

go to TABLE OF CONTENTS

## *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 and air cooling modes
ON/OFF status of digital inputs
ON/OFF status of digital outputs

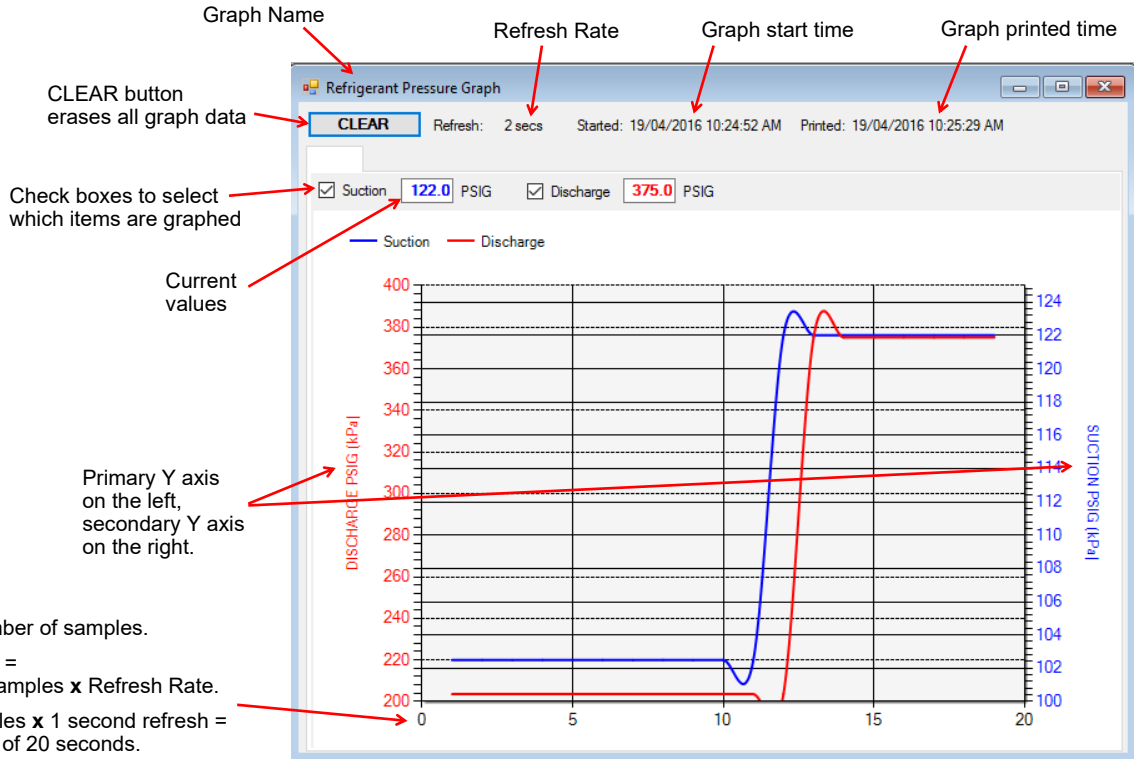
EEV position and resulting superheat
Suction temperature

Suction and discharge pressures, evaporating and condensing temperatures

Blower demand in % and resulting RPM
Outdoor & Indoor IN/OUT temperatures and delta T

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.
LFL and cabinet temperature (cabinet temperature may read higher than actual)

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




X axis = Number of samples.

Elapsed time =
Number of Samples **x** Refresh Rate.

e.g. 20 samples **x** 1 second refresh = elapsed time of 20 seconds.

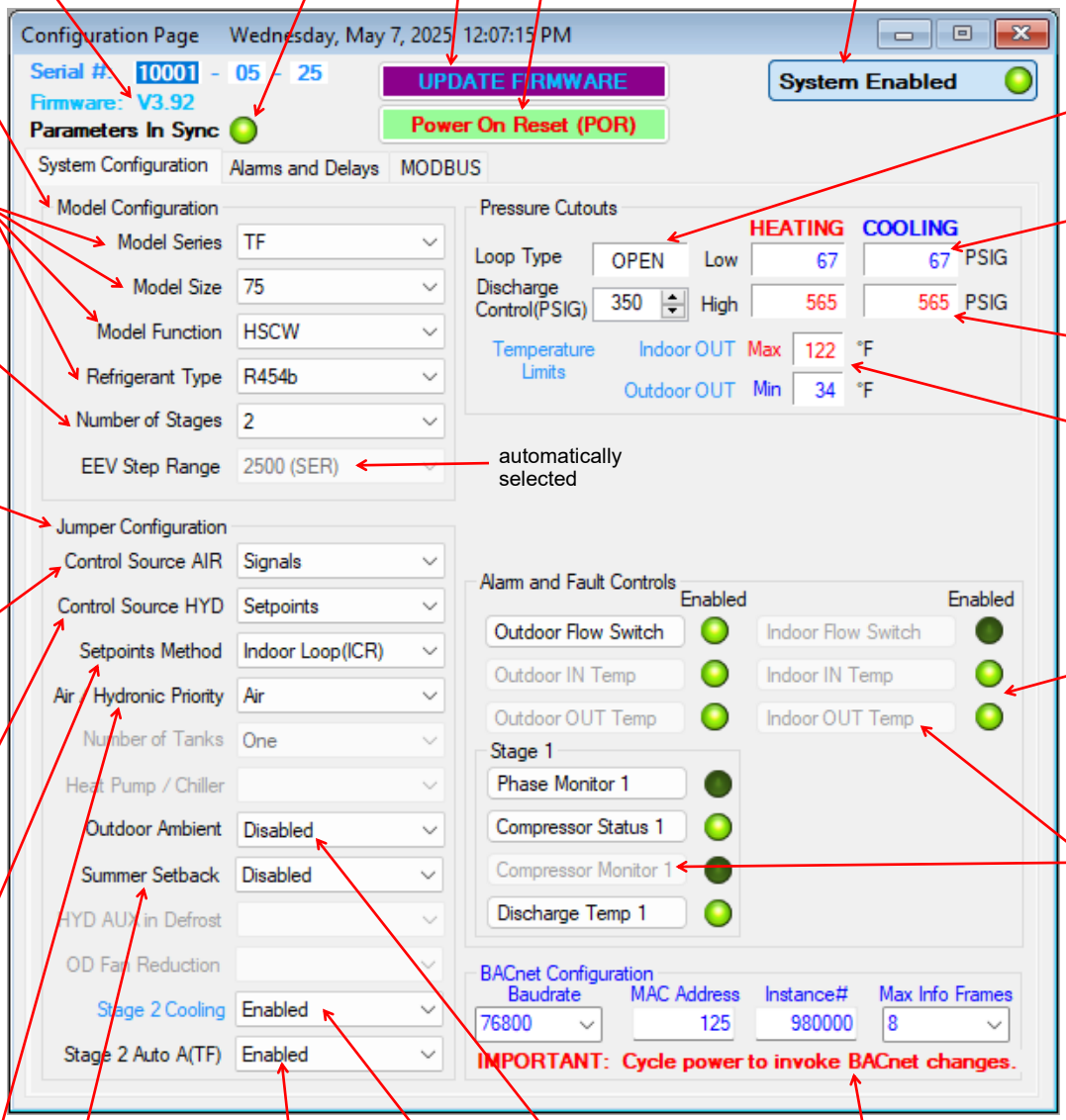
go to TABLE OF CONTENTS

## *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 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

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

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

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.

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

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

Click to enable or disable stage 2 air cooling (disable for better dehumidification)

If used, set BACnet communication parameters. Disconnect PC App and cycle unit power to register changes to BACnet parameters.

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

Low pressure cutouts determined by loop type

High pressure cutout determined by refrigerant type

Temperature limits determined by series and loop type

automatically selected

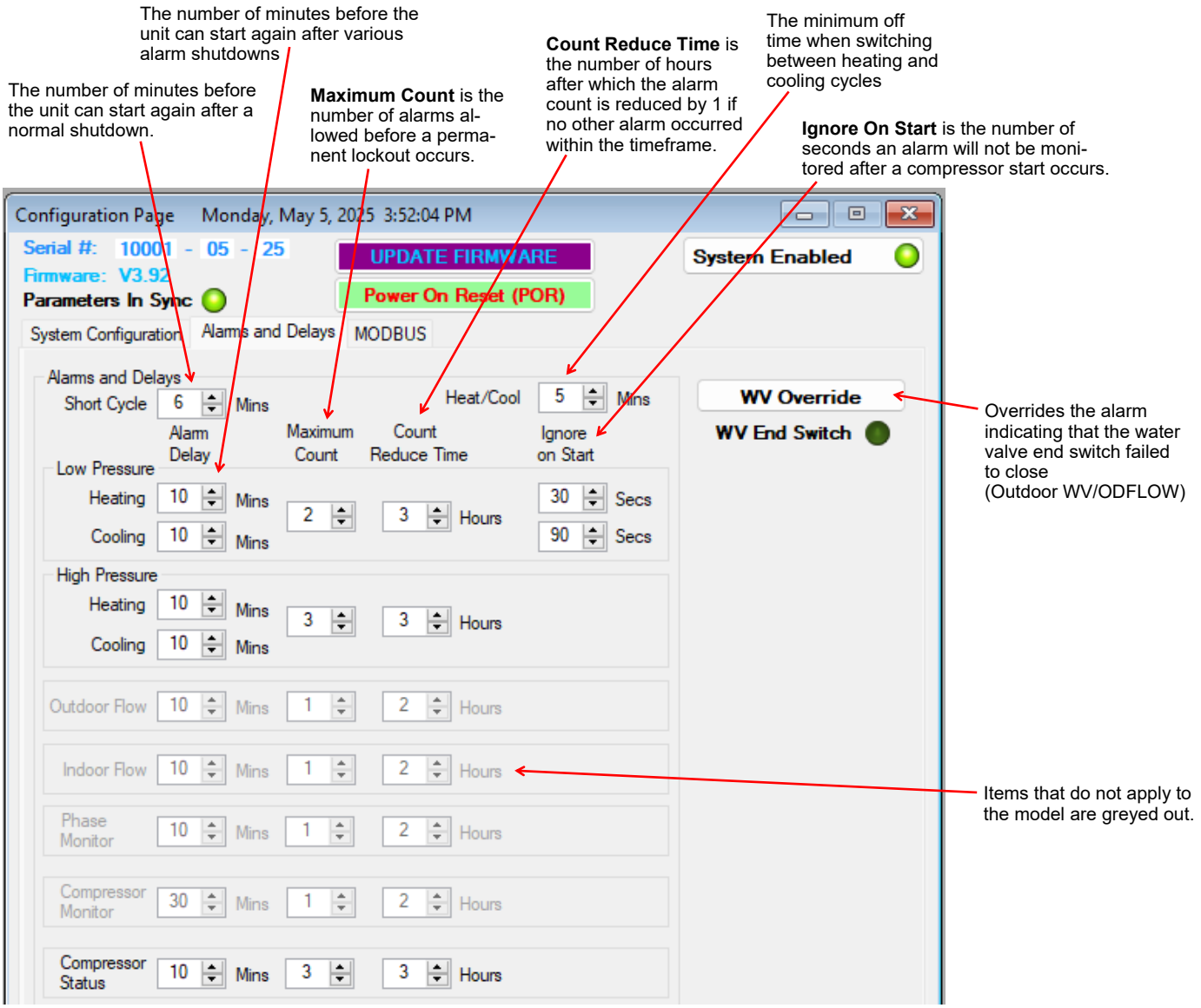
The Enabled indicators show which alarms are enabled

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

go to TABLE OF CONTENTS

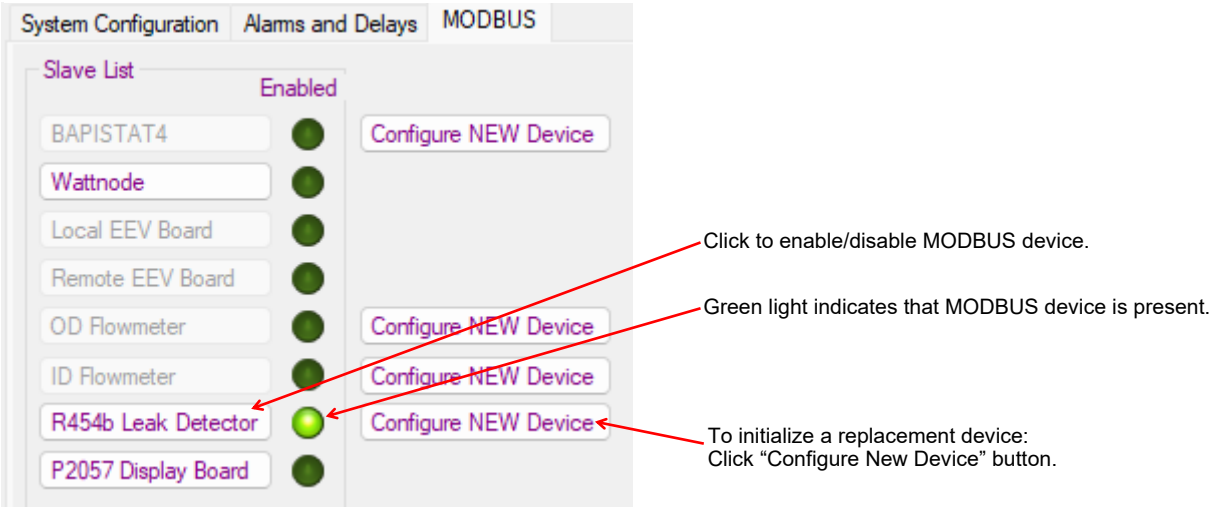
### *Tools-->Configuration (Alarms and Delays tab)*

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




### *Tools-->Configuration (MODBUS tab)*

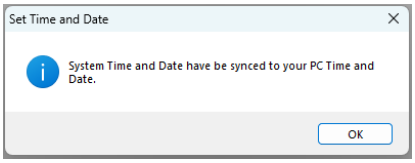
Use this tab to enable MODBUS accessories, or to initialize a replacement MODBUS device (e.g. refrigerant leak detector).




go to TABLE OF CONTENTS

### *Tools-->Set Date and Time*

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




### *Tools-->Datalogging (Datalog tab)*

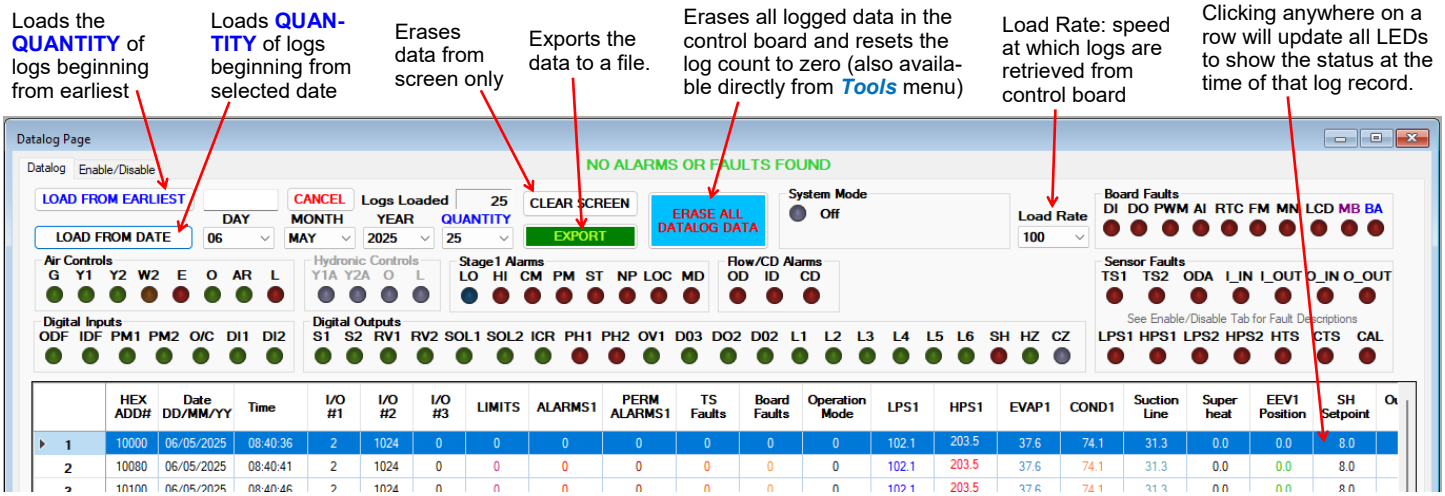
A log will be automatically recorded at the following rates:

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

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

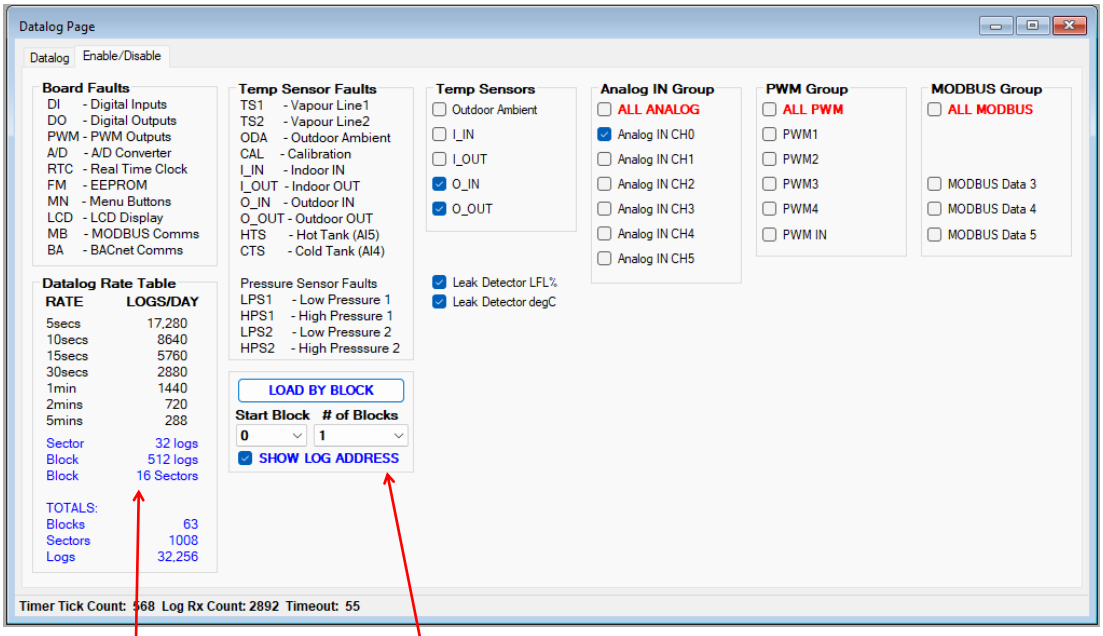
Note that loading datalogs at the standard **Load Rate** is time-consuming. It is suggested to leave **QUANTITY** at **25** until it is shown that the start date selected contains data and that any relevant alarm has been located in time.

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




### *Tools-->Datalogging (Enable/Disable tab)*

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

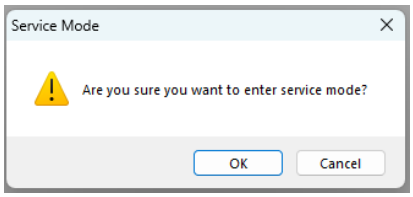



Datalog rate and capacity information

Load By Block: Developer use

go to TABLE OF CONTENTS

## Tools-->Service Tools




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

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

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

### Tools-->Service Tools-->Manual Override

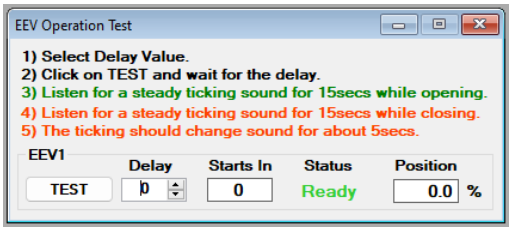
Allows individual control system demands or sensor values to be manually overridden for troubleshooting or service purposes. Also accessible via **MANUAL OVERRIDE** button in main window top bar—->


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

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

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

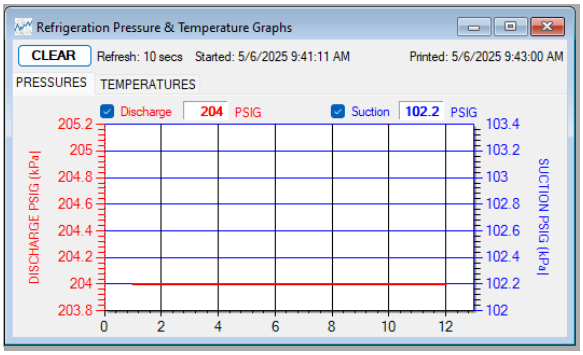
In addition, there is an adjustable delay so that the listener can go to the EEV's location before it starts to move. This is necessary when the EEV is in a remote location, as in air source split units like ATW-series.




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

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

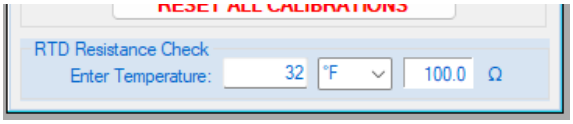
A declining pressure line (which is not associated with a declining temperature line) may indicate a leak.




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

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

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

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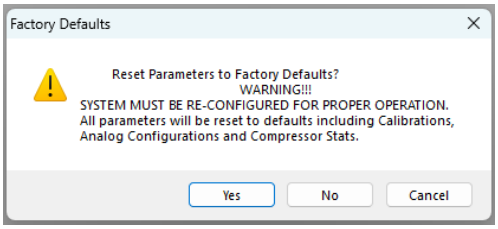
### Tools-->Reset to Factory Defaults

This will reset all settings to default values.

**THE SYSTEM MUST BE RECONFIGURED AFTER A RESET IS PERFORMED.**

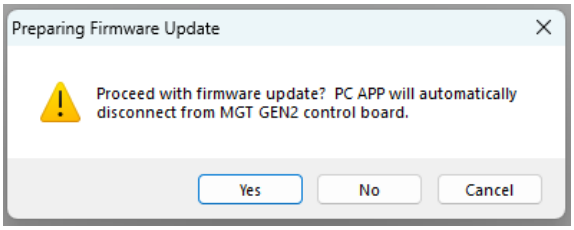
A reset will default the system to an ATW-65. Calibrations, alarm delays, analog configurations, compressor statistics, and Setpoint Control values will be returned to defaults as well.




### Tools-->Update Firmware

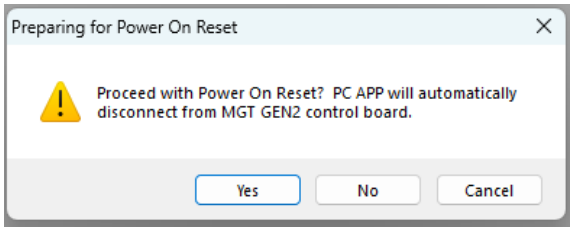
New function or bug fixes can be accessed by updating the firmware. This PC App function prepares the control board for a firmware update, by putting the board in boot loader mode and then disconnecting. The actual firmware update is done by a separate program which is downloaded along with the new firmware.

See appendix for details.




### Tools-->Power On Reset (POR)

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

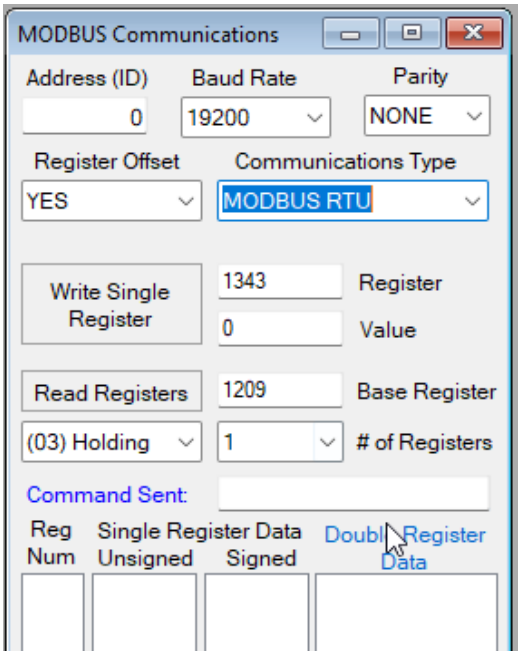



go to TABLE OF CONTENTS

### *Tools-->MODBUS-->Generic MODBUS*

This window is for developer use.

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




### *Tools-->MODBUS-->Configuration*

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

### *Tools-->Advanced*

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

***Tools-->Advanced-->Calibration***

***Tools-->Advanced-->Parameters***

***Tools-->Advanced-->EEV PID Parameters***

***Tools-->Advanced-->Objects***

***Tools-->Advanced-->Jumpers***

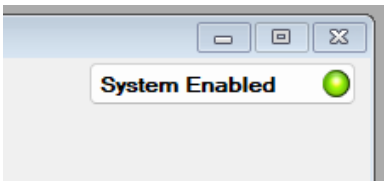
***Tools-->Advanced-->SYSTEM TIMERS***

***Tools-->Advanced-->Performance***

### *Tools-->System Enable/Disable*

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

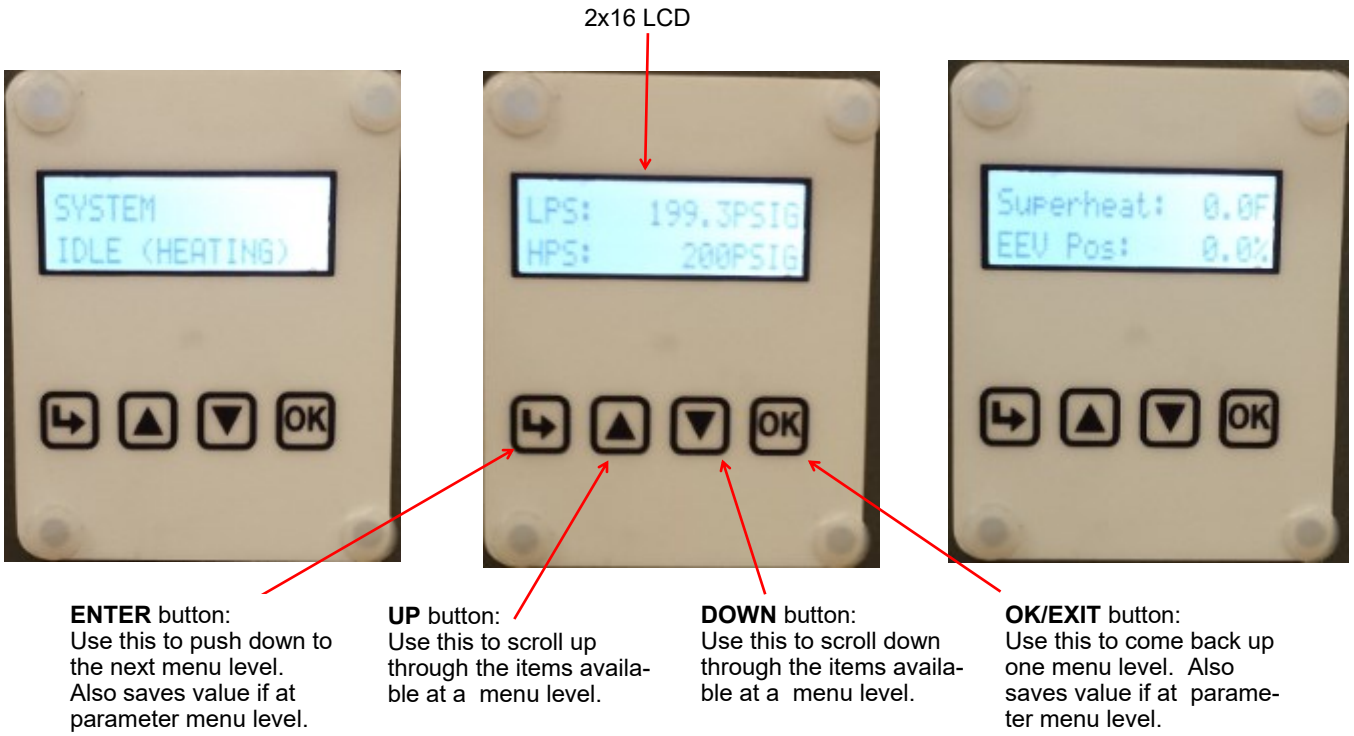
This is the same function as button at the top right of the 1st tab of the ***Tools-->Configuration*** window.




go to TABLE OF CONTENTS

# 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. |

go to TABLE OF CONTENTS

| 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.

go to TABLE OF CONTENTS

# BACnet Interface

The BACnet interface is an **MS/TP** connection via RS-485 twisted pair. BACnet **IP** is not available.
Recommended wire: 22-24 AWG single twisted pair, 100-120 Ohms impedance, 17pF/ft or lower capacitance, with braided or aluminum foil shield, such as Belden 9841 or 89841.

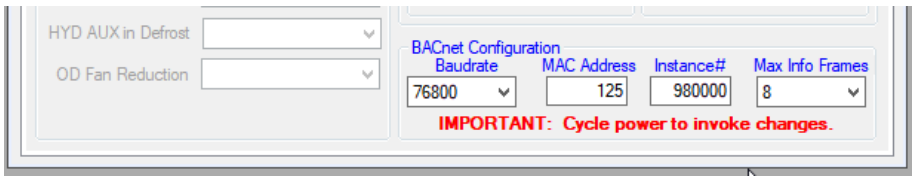
The connector on the control board is a three wire removable screw connector. The signals are as follows:
A: Communications line (+) (right pin)
B: Communications line (-) (middle pin)
C: Ground connection (left pin)

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

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

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

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




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

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

**IMPORTANT: When constructing BACnet code to control the heat pump/chiller, give careful consideration to**
**MINIMIZING CYCLING and MAXIMIZING RUN TIMES.**
*The heat pump/chiller can't do its work properly and will incur excessive wear if it is turning on and off every few minutes.*

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

**TABLE 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 |
| | | | 25 | Simultaneous air cooling & hydronic heating |
| Note: Object is type Analog Value but value will always be an integer value. | | | | |

go to TABLE OF CONTENTS

| 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) |
| | AI1 (Comp2_Current) | AI1 | Present Value | User | N/A |
| | AI2 | AI2 | Present Value | User | N/A (used for condensate sensor, see Alarms table) |
| | AI3 | AI3 | Present Value | degF (degC) | Compressor discharge line temperature |
| | AI4 (CTS) | AI4 | Present Value | degF (degC) | N/A |
| | AI5 (HTS) | AI5 | Present Value | degF (degC) | 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) | Evaporator superheat |
| | EEV1 Position | AI12 | Present Value | % | EEV position (% open) |
| | LPS2 | AI13 | Present Value | PSIG (kPa) | N/A |
| | HPS2 | AI14 | Present Value | PSIG (kPa) | N/A |
| | EVAP2 | AI15 | Present Value | degF (degC) | N/A |
| | COND2 | AI16 | **Setpoint Value** | degF (degC) | N/A |
| | Suction Line 2 | AI17 | Present Value | degF (degC) | N/A |
| | Superheat 2 | AI18 | **Setpoint Value** | degF (degC) | N/A |
| | EEV2 Position | AI19 | Present Value | % | N/A |
| | Outside Ambient | AI20 | Present Value | degF (degC) | 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 | % | N/A |
| | PWM1 (OD Fan) | AV1 | Present Value | % | N/A |
| | PWM2 | AV2 | Present Value | % | N/A |
| | PWM3 (OV2) | AV3 | Present Value | % | OV2 - PWM or 0-10VDC for outdoor loop water valve |
| | PWM4 (IV2) | AV4 | Present Value | % | IV2 - PWM or 0-10VDC for indoor loop water valve |
| | Operation Mode | AV5 | Present Value | N/A | Description of mode - see Operation Mode Description table |
| | Limits description | AV6 | Present Value | N/A | Description of active limits - see Limits Description table |
| | Permanent Alarms 1 | AV7 | Present Value | N/A | Description of active alarms - see Alarm Descriptions table |
| | Permanent Alarms 2 | AV8 | Present Value | N/A | N/A |
| | Board Faults | AV9 | Present Value | N/A | Description of active faults - see Fault Descriptions table |
| | 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 |

go to TABLE OF CONTENTS

| 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).<br>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, from current sensor) |
| AI1 (Comp2 Current) | Analog Input | AI1 | N/A |
| LPS1 | Analog Input | AI6 | Low pressure alarm |
| HPS1 | Analog Input | AI7 | High pressure alarm |
| LPS2 | Analog Input | AI13 | N/A |
| HPS2 | Analog Input | AI14 | N/A |
| Outdoor Flow | Binary Value | BV10 | Outdoor loop water valve |
| Indoor Flow | Binary Value | BV11 | 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 from current sensor |
| | | 10 | 1025 | Condensate overflow alarm |
| | | 14 | 16,385 | Outdoor loop water valve |
| | | 15* | 32,769 | Indoor loop flow alarm - requires accessory |
| **Permanent Alarms 2** (Present Value) | **AV8** | 13 | 8192 | A2L refrigerant leak detector alarm (may or may not be a permanent alarm) |
| Note: Permanent Alarm objects are type Analog Value but values are bit coded and may be decoded as such (integer value).<br>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.***

go to TABLE OF CONTENTS

| TABLE 24 - BACnet OBJECTS - FAULT Descriptions (Read Only) | | | |
|---|---|---|---|
| **Name** | **Data Type** | **ID** | **Description** |
| AI3 (Disch Temp) | Analog Input | AI3 | Compressor discharge line temperature sensor faulty or disconnected |
| AI4 (Cold Tank) | Analog Input | AI0 | N/A |
| AI5 (Hot Tank) | Analog Input | AI1 | 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 temperature sensor faulty or disconnected. |
| Suction Line2 | Analog Input | AI17 | N/A |
| Outdoor Ambient | Analog Input | AI20 | Outdoor 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.***

go to TABLE OF CONTENTS

# Startup Procedure

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

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

## Pre-Start Inspection

**Ductwork:**

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

**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. Set up the airt thermostat as per the instructions provided with it so that it will function properly with the heat pump system (set for system type: heat pump). The O signal should be set to active in cooling mode. Set the thermostat to OFF.

1.

go to TABLE OF CONTENTS

2. Turn the power on to the heat pump. All LED's on the control board should turn on, the LCD interface should say "**MGT GEN2 VERx.xx**" on line 1 and "**Zeroing EEV's**" on line 2. You should be able to hear the EEV moving (a clicking sound).
3. Measure the following voltages on the compressor contactor and record them on the startup sheet: L1-L2, L2-L3, L1-L3.
4. Connect a USB cable between the USB connector on the board and a laptop with the PC App installed (recommended but optional).
5. 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.**
6. 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:
    a. Suction pressure
    b. Discharge pressure
    c. Duct Return temperature (poke a small hole in the flex collar and insert probe in airstream)
    d. Duct Supply temperature (poke a small hole in the flex collar and insert probe in airstream)
    e. Duct Delta T (should be between **22-32°F, 12-18°C**)
    f. Outdoor Loop Temperatures: In, Out, & Delta T (should be **5-8°F, 3-4°C**)
    g. Compressor L1(C) current (black wire, place meter between electrical box and compressor)
4. Adjust the thermostat setpoint to the desired room temperature and let the unit run through a cycle.
5. For units with a desuperheater, turn the power off to the unit. Connect the brown wire with the blue insulated terminal to the compressor contactor as shown in the electrical box diagram. Turn the DHW Switch in the unit post on. Turn the power to the unit on.
6. Verify the DHW IN and DHW OUT temperatures (if applicable) by hand **(caution: pipes get hot).** If the DHW OUT line does not become hotter than the DHW IN line the circulator is air locked. Bleed the air from the system and check the temperature differential again to ensure there is flow from the circulator.
7. Remove the electrical cover from the plenum heater. Place a current clamp meter around one of the supply wires. Turn on the power to the plenum heater. Adjust the thermostat setpoint to **85°F (29°C)**. Verify that the current draw increase as each electric heat stage is activated. (10kW has 2 stages, 15kW has 3 stages and 20kW has 4 stages).

**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:
    a. Suction pressure
    b. Discharge pressure
    c. Duct Return temperature
    d. Duct Supply Out temperature
    e. Duct Delta T
    f. Outdoor Loop Temperatures: In, Out, & Delta T (should be **10-11°F, 5-6°C**)
3. Adjust the thermostat setpoint to the desired room temperature if possible, otherwise set it just low enough to start the unit (e.g. 1°F / 0.5°C less than room temperature) and let the unit run through a cycle.

**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:
    a. Suction pressure
    b. Discharge pressure
    c. Indoor Loop Temperatures: In, Out, & Delta T (should be **6-11°F, 3-6°C**)
    d. Outdoor Loop Temperatures: In, Out, & Delta T (should be **5-8°F, 3-4°C**)
    e. 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.

go to TABLE OF CONTENTS

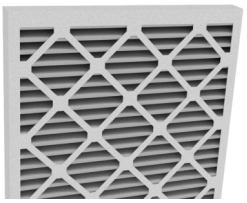
| Startup Record - TF-Series | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Installation Site** | | **Startup Date** | | **Installer** | | | | | | | |
| **City** | | | | **Company** | | | | | | | |
| **Province** | | **Check boxes unless asked to record data. Circle units.** | | **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.

go to TABLE OF CONTENTS

# 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.

go to TABLE OF CONTENTS

## *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.

go to TABLE OF CONTENTS

# 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 . |

go to TABLE OF CONTENTS

## 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 (current sensor)** | This alarm occurs when there is a current draw on the compressor but no call for the compressor to be on (welded contactor) or when there is a call for the compressor to be on but there is no compressor current draw (manual high pressure control is open or contactor failure). Current sensor is now standard. | Check contactor if compressor is staying on when it should be off. Go to Compressor section if compressor is not on when it should be. Also check for tripped manual high pressure control. |
| **Not Pumping / Man HP** | Discharge pressure is less than 30 psi higher than suction pressure after 2 minutes run time. It indicates leaking reversing valve, compressor very hot and tripped on internal overload, manual high pressure control trip, bad contactor, or defective compressor. | Check for reversing valve not seated properly, tripped manual high pressure control, or a contactor or compressor problem. |
| **Low Charge / EEV** | EEV position has been above 99% for 20 minutes within the first hour of cycle. | Check system for refrigerant leak. Also check that EEV for proper operation (see **EEV Troubleshooting** section) |
| **LOC (Loss of Charge)** | This alarm occurs if the low pressure and/or high pressure sensors are below 30 psig (207 kPa). | Check system for refrigerant leak. Check for incorrect pressure sensor reading. |
| **Condensate Drain** | Water level in the condensate tray has risen to sensor level, indicating condensate drain is blocked. | Check condensate drain(s) for obstructions. |
| **Outdoor Flow (ODFLOW)** | For open loop, 24vac signal from water valve end switch indicating water valve open was not received in the time limit (90 seconds). | Verify water valve operation and that it is wired properly using the factory wiring harness (see wiring diagram in the **Model Specific Information** section later in this manual). |
| **Leak Detector / R454b Leak** | Refrigerant sensor detected the presence of refrigerant inside the cabinet. | Locate and fix leak, taking all necessary precautions associated with **A2L** refrigerants. See **Service Procedures** chapter. |

go to TABLE OF CONTENTS

## FAULT TROUBLESHOOTING

| Alarm/Fault | Description | Recommended Action |
|---|---|---|
| **Pressure Sensors** | The sensor is reading outside of the acceptable range. Check to ensure connector is on securely. | Replace the pressure sensor. If this does not rectify the problem, replace the control board. |
| **Temperature Sensors** | The sensor is reading outside of the acceptable range. Check to ensure connector is on securely. | Replace the temperature sensor. If this does not rectify the problem, replace the control board. |
| **Control Board:**<br>*- Digital Inputs*<br>*- Digital Outputs*<br>*- Analog Inputs*<br>*- Real Time Clock*<br>*- PWM Outputs* | A failure has occurred and the indicated section of the control board may no longer work properly. | Cycle the power a few times; if the fault persists replace the control board. |
| **Control Board:**<br>*- 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. |
| **Control Board:**<br>*- 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. |
| **Control Board:**<br>*- LCD Interface / LCD Display* | A failure has occurred and display may show erratic data, no data or may not turn on at all. | |
| **Control Board:**<br>*- BACnet Comms* | BACnet communications experienced a timeout. | See **BACnet TROUBLESHOOTING** on next page. |
| **MODBUS:**<br>*- Main Comms* | Hardware problem on heat pump control board. | 24V**DC** is not present across **24VDC** and **GND** at the lower right of control board. Replace board if voltage not correct. |
| | | Remove MODBUS screw terminal connector from board as well as jumper from **TERM** (located just above the MODBUS connector). Using a multimeter set to DC volts with negative probe on **B** and positive probe on **A**, confirm there is **+2.5VDC**. Replace board if voltage not correct. |
| | MODBUS termination problem. | Verify MODBUS **TERM** jumper is in place on control board. Install jumper if missing. |
| **MODBUS:**<br>*- R454b Leak Detector* | Refrigerant detector communications experienced a timeout. | See **LEAK DETECTOR TROUBLESHOOTING** on next page. |

go to TABLE OF CONTENTS

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

| LEAK DETECTOR TROUBLESHOOTING | | | |
|---|---|---|---|
| **Fault** | **Possible Cause** | **Verification** | **Recommended Action** |
| **Refrigerant detector not working properly**<br><br>**or**<br><br>**MODBUS R454b Leak Detector fault indication** | Hardware problem on heat pump control board | 5V**DC** is not present across **5VDC** and **GND** at the lower right of control board. | Replace board if voltage not correct. |
| | | Remove MODBUS screw terminal connector from board & jumper from TERM (located above BACnet connector). Using multimeter set to DC volts with black probe on **B** and red probe on **A**, confirm there is **+2.5VDC**. | Replace board if voltage not correct. |
| | New / replacement refrigerant leak detector not initialized. | Go to **Tools-->Configuration** window, **MODBUS** tab and press the "Configure NEW Device" button beside **R454b Leak Detector.** | |
| | MODBUS termination problem | Verify MODBUS **TERM** jumper is in place on control board. | Install jumper if missing. |
| | Faulty refrigerant leak detector | 5V**DC** is present on board as per above, termination is correct, but problem persists. | Replace leak detector. |

go to TABLE OF CONTENTS

| 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. |

go to TABLE OF CONTENTS

| 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). |
| | EEV1 stuck almost closed or partially blocked by foreign object | Manually adjusting EEV1 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.<br>Verify pumps are working and sized correctly for ground loop systems.<br>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. |
| | EEV1 stuck almost closed or partially blocked by foreign object | Manually adjusting EEV1 does not affect the superheat or the suction pressure. High superheat and discharge pressure. | Go to EEV troubleshooting section. |

*continued on next page...*

go to TABLE OF CONTENTS

| OPERATION TROUBLESHOOTING - WATER HEATING MODE | | | |
|---|---|---|---|
| **Fault** | **Possible Cause** | **Verification** | **Recommended Action** |
| **Low suction pressure** *(continued)* | 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)** | EEV1 stuck open | Manually adjusting EEV1 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 | | |
| **EEV1 frosting up** | EEV1 stuck almost closed or partially blocked by foreign object | Manually adjusting EEV1 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. |

go to TABLE OF CONTENTS

| 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. |

go to TABLE OF CONTENTS

| 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. |
| | EEV1 stuck almost closed or partially blocked by foreign object | Manually adjusting EEV1 does not affect the superheat or the suction pressure. High superheat and low suction pressure. | Go to EEV troubleshooting section. |
| | Filter-dryer plugged | Feel each end of the filter-dryer; they should be the same temperature. If there is a temperature difference then it is plugged. Also causes low suction pressure. | Replace filter-dryer. |
| | Unit is overcharged (Only possible if unit has been field serviced and incorrectly charged) | High subcooling, low Indoor Loop delta T. | Remove 1/2lb of refrigerant at a time and verify that the discharge pressure reduces. Or remove charge and weigh back in the amount listed on nameplate. |
| **Low suction pressure** | Low or no outdoor loop liquid flow | Delta T across the Outdoor Loop ports should be 5-7°F (3-4°C), or compare pressure drop to the tables for the unit. | Determine the cause of the flow restriction and correct it.<br>Verify pumps are working and sized correctly for ground loop systems.<br>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. |
| | EEV1 stuck almost closed or partially blocked by foreign object | Manually adjusting EEV1 does not affect the superheat or the suction pressure. High superheat and discharge pressure. | Go to EEV troubleshooting section. |
| | Low refrigerant charge | Superheat is high, EEV position is high. | Locate the leak and repair it. Spray Nine, a sniffer, and/or dye are common methods of locating a leak. |

go to TABLE OF CONTENTS

| OPERATION TROUBLESHOOTING - AIR HEATING MODE | | | |
|---|---|---|---|
| **Fault** | **Possible Cause** | **Verification** | **Recommended Action** |
| **High suction pressure (may appear to not be pumping)** | EEV1 stuck open | Manually adjusting EEV1 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** | EEV1 stuck almost closed or partially blocked by foreign object | Manually adjusting EEV1 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. |

go to TABLE OF CONTENTS

| 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. |
| | EEV2 stuck almost closed or partially blocked by foreign object | Manually adjusting EEV2 does not affect the superheat or the suction pressure. High superheat and low suction pressure. | Go to EEV troubleshooting section. |
| | Outdoor loop entering liquid temperature too warm | Most likely caused by undersized ground loop. | Verify the ground loop sizing. Increase the size of the ground loop if undersized. |
| | Dirty or fouled outdoor loop coil (more likely for open loop, unlikely for ground loop) | Disconnect the water lines and check the inside of the pipes for scale deposits. | Backflush the coaxial exchanger with a calcium-removing cleaning solution. |
| | Filter-dryer plugged | Feel each end of the filter-dryer; they should be the same temperature. If there is a temperature difference then it is plugged. Also causes low suction pressure. | Replace filter-dryer. |
| | Unit is overcharged. (Only possible if unit has been field serviced and incorrectly charged) | High subcooling. | Remove 1/2lb of refrigerant at a time and verify that the discharge pressure reduces. Or remove charge and weigh back in the amount listed on nameplate. |

go to TABLE OF CONTENTS

| OPERATION TROUBLESHOOTING - AIR COOLING MODE | | | |
|---|---|---|---|
| **Fault** | **Possible Cause** | **Verification** | **Recommended Action** |
| **High suction pressure (may appear to not be pumping)** | EEV2 stuck open | Manually adjusting EEV2 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. |
| | EEV2 stuck almost closed or partially blocked by foreign object | Manually adjusting EEV2 does not affect the superheat or the suction pressure. High superheat and discharge pressure. | Go to EEV troubleshooting section. |
| | TS1 temperature sensor not reading properly | If the sensor is reading low it will cause the superheat to appear high, which causes the EEV to continually close. | Verify EEV position is low compared to normal. Check temperature sensor, replace if necessary. |
| | Filter-dryer plugged | Feel each end of the filter-dryer; they should be the same temperature. If there is a temperature difference then it is plugged. Also causes high discharge pressure. | Replace filter-dryer. |
| | Low refrigerant charge | Superheat is high, EEV position is high. | Locate the leak and repair it. Spray Nine, a sniffer, and dye are common methods of locating a leak. |
| **Compressor frosting up** | See Low Suction Pressure in this section | | |
| **EEV frosting up** | EEV2 stuck almost closed or partially blocked by foreign object | Manually adjusting EEV2 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. |

go to TABLE OF CONTENTS

| 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 in$H_2O$. 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<br><br>**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).<br>On the ECM Fan connector **on the left side of the control board:**<br>1) verify that there is 12 to 20VDC between pin G (grey wire) and pin C (white wire).<br>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.<br><br>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).<br>On the ECM Fan connector **at the fan motor:**<br>1) verify that there is 12 to 20VDC between pin G (grey wire) and pin C (white wire).<br>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. |

go to TABLE OF CONTENTS

## 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.

go to TABLE OF CONTENTS

| 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. |

go to TABLE OF CONTENTS

| 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. |

go to TABLE OF CONTENTS

*A2L-SPECIFIC WARNING / INSTRUCTION*

## *Servicing a Unit with an A2L Refrigerant*

### *1. Work procedure*

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

### *2. General work area*

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

### *3. Checking for presence of refrigerant*

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

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

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

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

If a leak is suspected at any time, all naked flames should be removed/extinguished.
If a leakage of refrigerant is found which requires brazing, all of the refrigerant should be first recovered from the system, or isolated (by means of shut-off valves) in a part of the system remote from the leak.

### *5. Presence of fire extinguisher*

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

### *6. No ignition sources*

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

### *6. Ventilation of area*

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

### *7. Checks of the refrigeration equipment*

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

go to TABLE OF CONTENTS

*A2L-SPECIFIC WARNING / INSTRUCTION*

# *Servicing a Unit with an A2L Refrigerant (continued)*

### *8. Checks to electrical devices & wiring*

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

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

Initial safety checks should include:

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

### *9. Refrigerant removal and circuit evacuation*

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

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

### *10. Charging*

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

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

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

go to TABLE OF CONTENTS

## *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.

go to TABLE OF CONTENTS

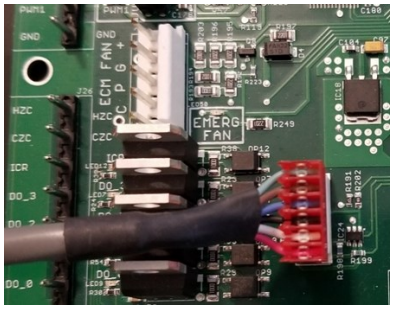
## *Compressor Replacement Procedure*

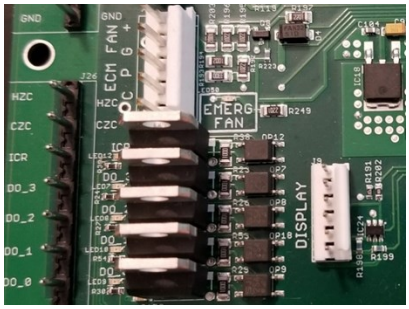
1. Pump down the unit as per the Pumpdown Procedure above. **If there was a compressor burn out (motor failure), the refrigerant cannot be reused and must be disposed of according to local codes**.
2. Disconnect piping.
3. Replace the compressor. Replace the liquid line filter-dryer. Always ensure nitrogen 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.

go to TABLE OF CONTENTS

## *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.

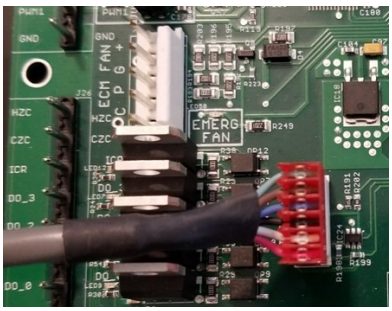
    Note that the connector with the resistor (no cable) goes on **CTS**.
    Note that the connector to the left of **CTS** is marked **HTS** on older boards, and **ODTS** on newer boards.

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.

go to TABLE OF CONTENTS

## *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.

go to TABLE OF CONTENTS

## *Decommissioning*

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

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

1. Examine all parts of the system to become familiar with the equipment and its operation.
2. Isolate system electrically.

3. Before starting the procedure, ensure that:
   a) equipment is available for handling refrigerant and refrigerant cylinders.
   b) recovery equipment and cylinders conform to the appropriate standards.
   c) all personal protective equipment is available and being used correctly.
   d) personnel are appropriately qualified.

4. Pump down refrigerant system.
5. If solenoid valves are closed and can't be powered open or there are other obstructions in the refrigeration system, make a manifold so that refrigerant can be removed from various parts of the system.
6. Make sure that the cylinder is situated on a scale before recovery takes place.
7. Start the recovery machine and operate in accordance with instructions.
8. Do not overfill cylinders (no more than 80 % volume liquid charge).
9. Do not exceed the maximum working pressure of the cylinder, even temporarily.
10. When all the refrigerant has been removed and the process completed, make sure that the cylinders and the equipment are removed from site promptly and all isolation valves on the equipment are closed off.
11. Recovered refrigerant should not be charged into another refrigerating system unless it has been checked and/or cleaned.

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

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

go to TABLE OF CONTENTS

# Model Specific Information


| Table 25 - Refrigerant Charge | | | | |
|---|---|---|---|---|
| **MODEL** | **lb** | ***kg*** | **Refrigerant** | **Oil Type** |
| **TF-45** | 6.0 | *2.7* | R454b | POE |
| **TF-55** | 8.0 | *3.6* | R454b | POE |
| **TF-65** | 10.0 | *4.5* | R454b | POE |
| **TF-75** | 12.0 | *5.5* | R454b | POE |

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

| Table 26 - Shipping Information | | | | |
|---|---|---|---|---|
| **MODEL** | **WEIGHT** | **DIMENSIONS in (cm)** | | |
| | **lb. (kg)** | **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) |

| 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* |

| 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* | |

go to TABLE OF CONTENTS

# 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* |

go to TABLE OF CONTENTS

| 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*** |

go to TABLE OF CONTENTS

# 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)<br>STAGE 2 - ELT 32°F (0°C) | |
| Model | Liquid Flow | | Mode | Airflow | | Input Energy | Capacity | | $COP_H$ |
| | gpm | *L/s* | | cfm | *L/s* | Watts | Btu/hr | *kW* | W/W |
| TF-45 | 10 | *0.63* | Stage 1 | 1030 | *486* | 1,438 | 20,800 | 6.1 | 4.24 |
| | | | Stage 2 | 1200 | *566* | 2,119 | 25,700 | 7.5 | 3.55 |
| TF-55 | 12 | *0.76* | Stage 1 | 1240 | *585* | 1,947 | 27,500 | 8.1 | 4.14 |
| | | | Stage 2 | 1500 | *708* | 2,681 | 33,600 | 9.8 | 3.67 |
| TF-65 | 14 | *0.88* | Stage 1 | 1540 | *727* | 2,522 | 33,900 | 9.9 | 3.94 |
| | | | Stage 2 | 1900 | *897* | 3,342 | 41,500 | 12.2 | 3.64 |
| TF-75 | 16 | *1.01* | Stage 1 | 1660 | *783* | 3,251 | 42,600 | 12.5 | 3.84 |
| | | | Stage 2 | 2100 | *991* | 4,143 | 50,200 | 14.7 | 3.55 |

| Table 31 - Standard Capacity Ratings - Ground Water Heating | | | | | | | | | 60Hz |
|---|---|---|---|---|---|---|---|---|---|
| EAT 68°F (20°C) | | | | | | | | ELT 50°F (10°C) | |
| Model | Liquid Flow | | Mode | Airflow | | Input Energy | Capacity | | $COP_H$ |
| | gpm | *L/s* | | cfm | *L/s* | Watts | Btu/hr | *kW* | W/W |
| TF-45 | 10 | *0.63* | Stage 1 | 1030 | *486* | 1,609 | 25,200 | 7.4 | 4.59 |
| | | | Stage 2 | 1200 | *566* | 2,352 | 35,200 | 10.3 | 4.39 |
| TF-55 | 12 | *0.76* | Stage 1 | 1240 | *585* | 2,040 | 34,100 | 10.0 | 4.90 |
| | | | Stage 2 | 1500 | *708* | 2,978 | 46,600 | 13.7 | 4.59 |
| TF-65 | 14 | *0.88* | Stage 1 | 1540 | *727* | 2,631 | 42,200 | 12.4 | 4.70 |
| | | | Stage 2 | 1900 | *897* | 3,729 | 57,900 | 17.0 | 4.55 |
| TF-75 | 16 | *1.01* | Stage 1 | 1660 | *783* | 3,425 | 51,300 | 15.0 | 4.39 |
| | | | Stage 2 | 2100 | *991* | 4,618 | 67,600 | 19.8 | 4.29 |

| Table 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)<br>STAGE 2 - ELT 77°F (25°C) | | |
| Model | Liquid Flow | | Mode | Airflow | | Input Energy | Capacity | | $COP_c$ | EER |
| | gpm | *L/s* | | cfm | *L/s* | Watts | Btu/hr | *kW* | W/W | Btu/W |
| TF-45 | 10 | *0.63* | Stage 1 | 1030 | *486* | 1,088 | 25,800 | 7.6 | 6.95 | 23.7 |
| | | | Stage 2 | 1200 | *566* | 2,024 | 33,800 | 9.9 | 4.89 | 16.7 |
| TF-55 | 12 | *0.76* | Stage 1 | 1240 | *585* | 1,404 | 34,400 | 10.1 | 7.18 | 24.5 |
| | | | Stage 2 | 1500 | *708* | 2,570 | 43,700 | 12.8 | 4.98 | 17.0 |
| TF-65 | 14 | *0.88* | Stage 1 | 1540 | *727* | 1,939 | 43,800 | 12.8 | 6.62 | 22.6 |
| | | | Stage 2 | 1900 | *897* | 3,317 | 55,400 | 16.2 | 4.89 | 16.7 |
| TF-75 | 16 | *1.01* | Stage 1 | 1660 | *783* | 2,416 | 50,700 | 14.9 | 6.15 | 21.0 |
| | | | Stage 2 | 2100 | *991* | 4,233 | 63,900 | 18.7 | 4.43 | 15.1 |

| Table 33 - Standard Capacity Ratings - Ground Water Cooling | | | | | | | | | | 60Hz |
|---|---|---|---|---|---|---|---|---|---|---|
| EAT 80.6°F (27°C), RH=46% | | | | | | | | | ELT 59°F (15°C) | |
| Model | Liquid Flow | | Mode | Airflow | | Input Energy | Capacity | | $COP_c$ | EER |
| | gpm | *L/s* | | cfm | *L/s* | Watts | Btu/hr | *kW* | W/W | Btu/W |
| TF-45 | 10 | *0.63* | Stage 1 | 1030 | *486* | 1,022 | 28,000 | 8.2 | 8.03 | 27.4 |
| | | | Stage 2 | 1200 | *566* | 1,706 | 36,500 | 10.7 | 6.27 | 21.4 |
| TF-55 | 12 | *0.76* | Stage 1 | 1240 | *585* | 1,238 | 35,400 | 10.4 | 8.38 | 28.6 |
| | | | Stage 2 | 1500 | *708* | 2,106 | 47,600 | 14.0 | 6.62 | 22.6 |
| TF-65 | 14 | *0.88* | Stage 1 | 1540 | *727* | 1,647 | 44,800 | 13.1 | 7.97 | 27.2 |
| | | | Stage 2 | 1900 | *897* | 2,750 | 59,400 | 17.4 | 6.33 | 21.6 |
| TF-75 | 16 | *1.01* | Stage 1 | 1660 | *783* | 2,102 | 51,500 | 15.1 | 7.18 | 24.5 |
| | | | Stage 2 | 2100 | *991* | 3,542 | 68,000 | 19.9 | 5.63 | 19.2 |

go to TABLE OF CONTENTS

# 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)<br>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 | 1,720 | 17,900 | 5.2 | 3.05 |
| | | | | Stage 2 | 2,303 | 24,000 | 7.0 | 3.05 |
| TF-55 | 4 | 12.0 | *0.76* | Stage 1 | 2,498 | 26,000 | 7.6 | 3.05 |
| | | | | Stage 2 | 3,140 | 32,700 | 9.6 | 3.05 |
| TF-65 | 5 | 14.0 | *0.88* | Stage 1 | 3,094 | 32,200 | 9.4 | 3.05 |
| | | | | Stage 2 | 3,867 | 40,200 | 11.8 | 3.05 |
| TF-75 | 6 | 16.0 | *1.01* | Stage 1 | 3,610 | 38,800 | 11.4 | 3.15 |
| | | | | Stage 2 | 4,450 | 46,300 | 13.6 | 3.05 |

| 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 | 1,792 | 22,500 | 6.6 | 3.68 |
| | | | | Stage 2 | 2,436 | 33,100 | 9.7 | 3.98 |
| TF-55 | 4 | 12.0 | *0.76* | Stage 1 | 2,394 | 31,700 | 9.3 | 3.88 |
| | | | | Stage 2 | 3,445 | 44,400 | 13.0 | 3.78 |
| TF-65 | 5 | 14.0 | *0.88* | Stage 1 | 3,090 | 38,800 | 11.4 | 3.68 |
| | | | | Stage 2 | 4,206 | 54,200 | 15.9 | 3.78 |
| TF-75 | 6 | 16.0 | *1.01* | Stage 1 | 3,660 | 47,200 | 13.8 | 3.78 |
| | | | | Stage 2 | 4,691 | 63,700 | 18.7 | 3.98 |

go to TABLE OF CONTENTS

# Air Heating/Cooling Performance

## TF-45-HACW-X-1T *R454b, 60 Hz, YAS30K1E-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 | 10 | 22 | -3.2 | 15,900 | 8.3 | 179 | 2,034 | 68 | 99 | 1200 | 86 | 18 | **22,600** | **3.26** |
| 30 | 20 | 10 | 26 | -3.6 | 17,800 | 8.6 | 179 | 2,095 | | 101 | 1200 | 87 | 19 | **24,800** | **3.47** |
| 35 | 24 | 10 | 31 | -4.1 | 20,000 | 8.9 | 179 | 2,157 | | 102 | 1200 | 89 | 21 | **27,200** | **3.70** |
| 40 | 29 | 10 | 35 | -4.6 | 22,300 | 9.2 | 179 | 2,219 | | 104 | 1200 | 91 | 23 | **29,700** | **3.92** |
| 45 | 34 | 10 | 40 | -5.1 | 24,700 | 9.5 | 179 | 2,284 | | 105 | 1200 | 93 | 25 | **32,300** | **4.14** |
| 50 | 38 | 10 | 44 | -5.6 | 27,300 | 9.8 | 179 | 2,352 | | 107 | 1200 | 95 | 27 | **35,200** | **4.39** |
| 55 | 43 | 10 | 49 | -6.2 | 30,200 | 10.1 | 179 | 2,421 | | 108 | 1200 | 98 | 30 | **38,300** | **4.64** |
| 60 | 48 | 10 | 53 | -6.8 | 33,200 | 10.5 | 179 | 2,491 | | 110 | 1200 | 100 | 32 | **41,600** | **4.89** |
| 65 | 52 | 10 | 58 | -7.5 | 36,500 | 10.8 | 179 | 2,564 | | 112 | 1200 | 103 | 35 | **45,100** | **5.16** |
| 70 | 57 | 10 | 62 | -8.3 | 40,100 | 11.2 | 179 | 2,635 | | 113 | 1200 | 106 | 38 | **49,000** | **5.45** |

**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** |
| 50 | 73 | 10 | 59 | 8.8 | **43,000** | 6.2 | 171 | 1,571 | 80.6 | 47 | 1200 | 61 | -19 | 12,500 | 25,300 | 37,800 | **24.1** |
| 55 | 78 | 10 | 64 | 8.7 | **42,500** | 6.6 | 171 | 1,644 | | 48 | 1200 | 61 | -19 | 12,000 | 25,000 | 37,000 | **22.5** |
| 60 | 83 | 10 | 69 | 8.7 | **42,100** | 6.9 | 171 | 1,723 | | 48 | 1200 | 62 | -19 | 11,600 | 24,800 | 36,400 | **21.1** |
| 65 | 89 | 10 | 74 | 8.6 | **41,700** | 7.3 | 171 | 1,805 | | 49 | 1200 | 62 | -19 | 11,200 | 24,500 | 35,700 | **19.8** |
| 70 | 94 | 10 | 79 | 8.5 | **41,200** | 7.6 | 171 | 1,892 | | 49 | 1200 | 62 | -19 | 10,700 | 24,200 | 34,900 | **18.4** |
| 75 | 100 | 10 | 83 | 8.4 | **40,700** | 8.0 | 171 | 1,985 | | 49 | 1200 | 62 | -18 | 10,300 | 23,800 | 34,100 | **17.2** |
| 80 | 105 | 10 | 88 | 8.3 | **40,200** | 8.4 | 171 | 2,085 | | 50 | 1200 | 63 | -18 | 9,900 | 23,400 | 33,300 | **16.0** |
| 85 | 110 | 10 | 93 | 8.2 | **39,800** | 8.9 | 171 | 2,191 | | 50 | 1200 | 63 | -18 | 9,500 | 23,000 | 32,500 | **14.8** |
| 90 | 116 | 10 | 98 | 8.2 | **39,300** | 9.3 | 171 | 2,304 | | 51 | 1200 | 63 | -17 | 9,000 | 22,600 | 31,600 | **13.7** |
| 95 | 121 | 10 | 103 | 8.1 | **38,800** | 9.9 | 171 | 2,425 | | 51 | 1200 | 64 | -17 | 8,600 | 22,100 | 30,700 | **12.7** |

*METRIC*

**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 | -9.5 | 0.63 | -5.7 | -1.8 | 4.7 | 8.3 | 179 | 2,034 | 20.0 | 37.2 | 566 | 29.8 | 9.8 | **6.6** | **3.26** |
| -1.1 | -6.9 | 0.63 | -3.1 | -2.0 | 5.2 | 8.6 | 179 | 2,095 | | 38.1 | 566 | 30.7 | 10.7 | **7.3** | **3.47** |
| 1.7 | -4.3 | 0.63 | -0.6 | -2.3 | 5.9 | 8.9 | 179 | 2,157 | | 38.9 | 566 | 31.7 | 11.7 | **8.0** | **3.70** |
| 4.4 | -1.7 | 0.63 | 1.8 | -2.6 | 6.5 | 9.2 | 179 | 2,219 | | 39.8 | 566 | 32.8 | 12.8 | **8.7** | **3.92** |
| 7.2 | 0.8 | 0.63 | 4.4 | -2.8 | 7.2 | 9.5 | 179 | 2,284 | | 40.7 | 566 | 33.9 | 13.9 | **9.5** | **4.14** |
| 10.0 | 3.4 | 0.63 | 6.9 | -3.1 | 8.0 | 9.8 | 179 | 2,352 | | 41.6 | 566 | 35.2 | 15.2 | **10.3** | **4.39** |
| 12.8 | 6.1 | 0.63 | 9.4 | -3.4 | 8.9 | 10.1 | 179 | 2,421 | | 42.4 | 566 | 36.5 | 16.5 | **11.2** | **4.64** |
| 15.6 | 8.6 | 0.63 | 11.8 | -3.8 | 9.7 | 10.5 | 179 | 2,491 | | 43.3 | 566 | 37.9 | 17.9 | **12.2** | **4.89** |
| 18.3 | 11.2 | 0.63 | 14.1 | -4.2 | 10.7 | 10.8 | 179 | 2,564 | | 44.2 | 566 | 39.4 | 19.4 | **13.2** | **5.16** |
| 21.1 | 13.8 | 0.63 | 16.5 | -4.6 | 11.8 | 11.2 | 179 | 2,635 | | 45.1 | 566 | 41.1 | 21.1 | **14.4** | **5.45** |

**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 (kW) | Sensible (kW) | **Cooling (kW)** | **$COP_C$** |
| 10.0 | 22.5 | 0.63 | 14.9 | 4.9 | **12.6** | 6.2 | 171 | 1,571 | 27.0 | 8.4 | 75.7 | 16.2 | -10.8 | 3.7 | 7.4 | 11.1 | **7.06** |
| 12.8 | 25.5 | 0.63 | 17.6 | 4.8 | **12.5** | 6.6 | 171 | 1,644 | | 8.6 | 75.7 | 16.3 | -10.7 | 3.5 | 7.3 | 10.8 | **6.59** |
| 15.6 | 28.5 | 0.63 | 20.4 | 4.8 | **12.3** | 6.9 | 171 | 1,723 | | 8.9 | 75.7 | 16.4 | -10.6 | 3.4 | 7.3 | 10.7 | **6.18** |
| 18.3 | 31.5 | 0.63 | 23.1 | 4.8 | **12.2** | 7.3 | 171 | 1,805 | | 9.2 | 75.7 | 16.6 | -10.4 | 3.3 | 7.2 | 10.5 | **5.80** |
| 21.1 | 34.5 | 0.63 | 25.8 | 4.7 | **12.1** | 7.6 | 171 | 1,892 | | 9.4 | 75.7 | 16.7 | -10.3 | 3.1 | 7.1 | 10.2 | **5.39** |
| 23.9 | 37.5 | 0.63 | 28.6 | 4.7 | **11.9** | 8.0 | 171 | 1,985 | | 9.7 | 75.7 | 16.8 | -10.2 | 3.0 | 7.0 | 10.0 | **5.04** |
| 26.7 | 40.6 | 0.63 | 31.3 | 4.6 | **11.8** | 8.4 | 171 | 2,085 | | 9.9 | 75.7 | 17.0 | -10.0 | 2.9 | 6.9 | 9.8 | **4.69** |
| 29.4 | 43.6 | 0.63 | 34.0 | 4.6 | **11.7** | 8.9 | 171 | 2,191 | | 10.2 | 75.7 | 17.2 | -9.8 | 2.8 | 6.7 | 9.5 | **4.34** |
| 32.2 | 46.6 | 0.63 | 36.8 | 4.6 | **11.5** | 9.3 | 171 | 2,304 | | 10.4 | 75.7 | 17.4 | -9.6 | 2.6 | 6.6 | 9.3 | **4.02** |
| 35.0 | 49.6 | 0.63 | 39.5 | 4.5 | **11.4** | 9.9 | 171 | 2,425 | | 10.7 | 75.7 | 17.6 | -9.4 | 2.5 | 6.5 | 9.0 | **3.72** |

** Divide by 2.2 for 460VAC*

go to TABLE OF CONTENTS

# Hydronic Performance

## TF-45-HACW-X-1T *R454b, 60 Hz, YAS30K1E-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 | -2.8 | 13,700 | 9.4 | 2,247 | 104 | 112 | 10 | 108 | 4.2 | **21,100** | **2.75** |
| | 30 | 19 | 10 | 27 | -3.2 | 15,600 | 9.6 | 2,288 | | 113 | 10 | 109 | 4.6 | **23,200** | **2.97** |
| | 35 | 24 | 10 | 31 | -3.6 | 17,600 | 9.8 | 2,325 | | 113 | 10 | 109 | 5.1 | **25,300** | **3.19** |
| | 40 | 29 | 10 | 36 | -4.1 | 19,900 | 10.0 | 2,364 | | 114 | 10 | 110 | 5.6 | **27,800** | **3.45** |
| | 45 | 33 | 10 | 40 | -4.6 | 22,300 | 10.2 | 2,399 | | 114 | 10 | 110 | 6.1 | **30,300** | **3.70** |
| | 50 | 38 | 10 | 45 | -5.1 | 25,000 | 10.4 | 2,436 | | 115 | 10 | 111 | 6.6 | **33,100** | **3.98** |
| | 55 | 43 | 10 | 49 | -5.7 | 27,800 | 10.6 | 2,474 | | 116 | 10 | 111 | 7.2 | **36,100** | **4.28** |
| | 60 | 47 | 10 | 54 | -6.4 | 31,000 | 10.8 | 2,509 | | 116 | 10 | 112 | 7.9 | **39,400** | **4.60** |
| | 65 | 52 | 10 | 58 | -7.1 | 34,400 | 11.0 | 2,546 | | 117 | 10 | 113 | 8.6 | **42,900** | **4.94** |
| | 70 | 57 | 10 | 62 | -7.9 | 38,100 | 11.1 | 2,581 | | 117 | 10 | 113 | 9.4 | **46,800** | **5.31** |
| | 25 | 15 | 10 | 23 | -2.5 | 12,500 | 10.6 | 2,518 | 115.8 | 123 | 10 | 120 | 4.2 | **20,900** | **2.43** |
| | 30 | 20 | 10 | 27 | -2.9 | 14,300 | 10.8 | 2,543 | 115.4 | 123 | 10 | | 4.6 | **22,800** | **2.63** |
| | 35 | 25 | 10 | 32 | -3.3 | 16,300 | 10.9 | 2,571 | 115.0 | 123 | 10 | | 5.0 | **24,900** | **2.84** |
| | 40 | 29 | 10 | 36 | -3.8 | 18,500 | 11.0 | 2,592 | 114.6 | 123 | 10 | | 5.4 | **27,100** | **3.06** |
| | 45 | 34 | 10 | 41 | -4.3 | 20,800 | 11.1 | 2,615 | 114.1 | 124 | 10 | | 5.9 | **29,500** | **3.31** |
| | 50 | 39 | 10 | 45 | -4.8 | 23,400 | 11.3 | 2,634 | 113.5 | 124 | 10 | | 6.5 | **32,200** | **3.58** |
| | 55 | 43 | 10 | 50 | -5.4 | 26,200 | 11.4 | 2,651 | 112.9 | 124 | 10 | | 7.1 | **35,100** | **3.88** |
| | 60 | 48 | 10 | 54 | -6.0 | 29,200 | 11.5 | 2,673 | 112.3 | 124 | 10 | | 7.7 | **38,200** | **4.19** |
| | 65 | 53 | 10 | 58 | -6.7 | 32,600 | 11.6 | 2,689 | 111.6 | 124 | 10 | | 8.4 | **41,600** | **4.53** |
| | 70 | 57 | 10 | 63 | -7.5 | 36,200 | 11.7 | 2,708 | 110.9 | 124 | 10 | | 9.1 | **45,300** | **4.90** |

*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 | 0.63 | -5.5 | -1.6 | 4.0 | 9.4 | 2,247 | 40 | 44.6 | 0.63 | 42.3 | 2.3 | **6.2** | **2.75** |
| | -1.1 | -7.2 | 0.63 | -2.9 | -1.8 | 4.6 | 9.6 | 2,288 | | 44.9 | 0.63 | 42.6 | 2.6 | **6.8** | **2.97** |
| | 1.7 | -4.6 | 0.63 | -0.3 | -2.0 | 5.2 | 9.8 | 2,325 | | 45.2 | 0.63 | 42.8 | 2.8 | **7.4** | **3.19** |
| | 4.4 | -1.9 | 0.63 | 2.1 | -2.3 | 5.8 | 10.0 | 2,364 | | 45.5 | 0.63 | 43.1 | 3.1 | **8.2** | **3.45** |
| | 7.2 | 0.7 | 0.63 | 4.6 | -2.6 | 6.5 | 10.2 | 2,399 | | 45.8 | 0.63 | 43.4 | 3.4 | **8.9** | **3.70** |
| | 10.0 | 3.3 | 0.63 | 7.2 | -2.8 | 7.3 | 10.4 | 2,436 | | 46.1 | 0.63 | 43.7 | 3.7 | **9.7** | **3.98** |
| | 12.8 | 5.9 | 0.63 | 9.6 | -3.2 | 8.1 | 10.6 | 2,474 | | 46.4 | 0.63 | 44.0 | 4.0 | **10.6** | **4.28** |
| | 15.6 | 8.6 | 0.63 | 12.0 | -3.6 | 9.1 | 10.8 | 2,509 | | 46.7 | 0.63 | 44.4 | 4.4 | **11.5** | **4.60** |
| | 18.3 | 11.2 | 0.63 | 14.4 | -3.9 | 10.1 | 11.0 | 2,546 | | 47.1 | 0.63 | 44.8 | 4.8 | **12.6** | **4.94** |
| | 21.1 | 13.8 | 0.63 | 16.7 | -4.4 | 11.2 | 11.1 | 2,581 | | 47.3 | 0.63 | 45.2 | 5.2 | **13.7** | **5.31** |
| | -3.9 | -9.3 | 0.63 | -5.3 | -1.4 | 3.7 | 10.6 | 2,518 | 46.6 | 50.5 | 0.63 | 49 | 2.3 | **6.1** | **2.43** |
| | -1.1 | -6.7 | 0.63 | -2.7 | -1.6 | 4.2 | 10.8 | 2,543 | 46.3 | 50.6 | 0.63 | | 2.6 | **6.7** | **2.63** |
| | 1.7 | -4.1 | 0.63 | -0.1 | -1.8 | 4.8 | 10.9 | 2,571 | 46.1 | 50.7 | 0.63 | | 2.8 | **7.3** | **2.84** |
| | 4.4 | -1.5 | 0.63 | 2.3 | -2.1 | 5.4 | 11.0 | 2,592 | 45.9 | 50.7 | 0.63 | | 3.0 | **7.9** | **3.06** |
| | 7.2 | 1.1 | 0.63 | 4.8 | -2.4 | 6.1 | 11.1 | 2,615 | 45.6 | 50.8 | 0.63 | | 3.3 | **8.7** | **3.31** |
| | 10.0 | 3.7 | 0.63 | 7.3 | -2.7 | 6.9 | 11.3 | 2,634 | 45.3 | 50.9 | 0.63 | | 3.6 | **9.4** | **3.58** |
| | 12.8 | 6.3 | 0.63 | 9.8 | -3.0 | 7.7 | 11.4 | 2,651 | 44.9 | 50.9 | 0.63 | | 3.9 | **10.3** | **3.88** |
| | 15.6 | 8.8 | 0.63 | 12.3 | -3.3 | 8.6 | 11.5 | 2,673 | 44.6 | 51.1 | 0.63 | | 4.3 | **11.2** | **4.19** |
| | 18.3 | 11.4 | 0.63 | 14.6 | -3.7 | 9.6 | 11.6 | 2,689 | 44.2 | 51.1 | 0.63 | | 4.7 | **12.2** | **4.53** |
| | 21.1 | 14.1 | 0.63 | 16.9 | -4.2 | 10.6 | 11.7 | 2,708 | 43.8 | 51.2 | 0.63 | | 5.1 | **13.3** | **4.90** |

go to TABLE OF CONTENTS

# Air Heating/Cooling Performance

## TF-55-HACW-X-1T *R454b, 60 Hz, YAS40K1E-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 | 12 | 22 | -3.5 | 20,900 | 10.8 | 185 | 2,570 | 68 | 98 | 1500 | 86 | 18 | **29,400** | **3.35** |
| 30 | 20 | 12 | 26 | -4.0 | 23,600 | 11.2 | 185 | 2,649 | | 99 | 1500 | 88 | 20 | **32,400** | **3.58** |
| 35 | 24 | 12 | 31 | -4.5 | 26,500 | 11.6 | 185 | 2,729 | | 101 | 1500 | 90 | 22 | **35,600** | **3.82** |
| 40 | 29 | 12 | 35 | -5.0 | 29,600 | 12.0 | 185 | 2,808 | | 102 | 1500 | 92 | 24 | **38,900** | **4.06** |
| 45 | 33 | 12 | 39 | -5.6 | 33,000 | 12.4 | 185 | 2,894 | | 104 | 1500 | 95 | 27 | **42,600** | **4.31** |
| 50 | 38 | 12 | 44 | -6.3 | 36,700 | 12.8 | 185 | 2,978 | | 105 | 1500 | 97 | 29 | **46,600** | **4.59** |
| 55 | 42 | 12 | 48 | -7.0 | 40,600 | 13.2 | 185 | 3,065 | | 107 | 1500 | 100 | 32 | **50,900** | **4.87** |
| 60 | 47 | 12 | 52 | -7.7 | 44,800 | 13.7 | 185 | 3,160 | | 108 | 1500 | 102 | 34 | **55,400** | **5.14** |
| 65 | 51 | 12 | 57 | -8.4 | 49,200 | 14.1 | 185 | 3,255 | | 110 | 1500 | 105 | 37 | **60,100** | **5.41** |
| 70 | 56 | 12 | 61 | -9.3 | 53,900 | 14.6 | 185 | 3,355 | | 111 | 1500 | 108 | 40 | **65,200** | **5.70** |

**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** |
| 50 | 72 | 12 | 60 | 9.5 | **55,800** | 7.7 | 192 | 1,974 | 80.6 | 48 | 1500 | 60 | -21 | 15,300 | 34,000 | 49,300 | **25.0** |
| 55 | 77 | 12 | 64 | 9.4 | **55,000** | 8.3 | 192 | 2,038 | | 48 | 1500 | 60 | -21 | 14,700 | 33,600 | 48,300 | **23.7** |
| 60 | 82 | 12 | 69 | 9.3 | **54,400** | 8.8 | 192 | 2,126 | | 49 | 1500 | 60 | -20 | 14,200 | 33,200 | 47,400 | **22.3** |
| 65 | 88 | 12 | 74 | 9.2 | **53,800** | 9.4 | 192 | 2,232 | | 49 | 1500 | 61 | -20 | 13,600 | 32,800 | 46,400 | **20.8** |
| 70 | 93 | 12 | 79 | 9.1 | **53,100** | 10.0 | 192 | 2,359 | | 50 | 1500 | 61 | -20 | 13,000 | 32,300 | 45,300 | **19.2** |
| 75 | 98 | 12 | 84 | 9.0 | **52,500** | 10.6 | 192 | 2,508 | | 50 | 1500 | 61 | -20 | 12,500 | 31,700 | 44,200 | **17.6** |
| 80 | 104 | 12 | 89 | 8.9 | **51,900** | 11.3 | 192 | 2,673 | | 51 | 1500 | 62 | -19 | 11,900 | 31,100 | 43,000 | **16.1** |
| 85 | 109 | 12 | 94 | 8.9 | **51,300** | 12.0 | 192 | 2,855 | | 51 | 1500 | 62 | -19 | 11,300 | 30,500 | 41,800 | **14.6** |
| 90 | 114 | 12 | 99 | 8.8 | **50,600** | 12.8 | 192 | 3,061 | | 51 | 1500 | 62 | -18 | 10,700 | 29,700 | 40,400 | **13.2** |
| 95 | 120 | 12 | 104 | 8.7 | **50,000** | 13.6 | 192 | 3,280 | | 52 | 1500 | 63 | -18 | 10,200 | 28,900 | 39,100 | **11.9** |

*METRIC*

**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 | -9.3 | 0.76 | -5.8 | -1.9 | 6.1 | 10.8 | 185 | 2,570 | 20.0 | 36.4 | 708 | 30.2 | 10.2 | **8.6** | **3.35** |
| -1.1 | -6.8 | 0.76 | -3.3 | -2.2 | 6.9 | 11.2 | 185 | 2,649 | | 37.2 | 708 | 31.2 | 11.2 | **9.5** | **3.58** |
| 1.7 | -4.3 | 0.76 | -0.8 | -2.5 | 7.8 | 11.6 | 185 | 2,729 | | 38.1 | 708 | 32.3 | 12.3 | **10.4** | **3.82** |
| 4.4 | -1.8 | 0.76 | 1.6 | -2.8 | 8.7 | 12.0 | 185 | 2,808 | | 38.9 | 708 | 33.4 | 13.4 | **11.4** | **4.06** |
| 7.2 | 0.7 | 0.76 | 4.1 | -3.1 | 9.7 | 12.4 | 185 | 2,894 | | 39.8 | 708 | 34.7 | 14.7 | **12.5** | **4.31** |
| 10.0 | 3.2 | 0.76 | 6.5 | -3.5 | 10.8 | 12.8 | 185 | 2,978 | | 40.6 | 708 | 36.1 | 16.1 | **13.7** | **4.59** |
| 12.8 | 5.7 | 0.76 | 8.9 | -3.9 | 11.9 | 13.2 | 185 | 3,065 | | 41.4 | 708 | 37.6 | 17.6 | **14.9** | **4.87** |
| 15.6 | 8.2 | 0.76 | 11.3 | -4.3 | 13.1 | 13.7 | 185 | 3,160 | | 42.3 | 708 | 39.1 | 19.1 | **16.2** | **5.14** |
| 18.3 | 10.7 | 0.76 | 13.6 | -4.7 | 14.4 | 14.1 | 185 | 3,255 | | 43.2 | 708 | 40.7 | 20.7 | **17.6** | **5.41** |
| 21.1 | 13.2 | 0.76 | 15.9 | -5.2 | 15.8 | 14.6 | 185 | 3,355 | | 44.0 | 708 | 42.4 | 22.4 | **19.1** | **5.70** |

**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 (kW) | Sensible (kW) | **Cooling (kW)** | **$COP_C$** |
| 10.0 | 22.0 | 0.76 | 15.3 | 5.3 | **16.4** | 7.7 | 192 | 1,974 | 27.0 | 8.7 | 94.6 | 15.4 | -11.6 | 4.5 | 10.0 | 14.4 | **7.33** |
| 12.8 | 24.9 | 0.76 | 18.0 | 5.2 | **16.1** | 8.3 | 192 | 2,038 | | 8.9 | 94.6 | 15.6 | -11.4 | 4.3 | 9.9 | 14.2 | **6.95** |
| 15.6 | 27.9 | 0.76 | 20.8 | 5.2 | **15.9** | 8.8 | 192 | 2,126 | | 9.2 | 94.6 | 15.7 | -11.3 | 4.2 | 9.7 | 13.9 | **6.54** |
| 18.3 | 30.9 | 0.76 | 23.4 | 5.1 | **15.8** | 9.4 | 192 | 2,232 | | 9.5 | 94.6 | 15.8 | -11.2 | 4.0 | 9.6 | 13.6 | **6.10** |
| 21.1 | 33.8 | 0.76 | 26.2 | 5.1 | **15.6** | 10.0 | 192 | 2,359 | | 9.7 | 94.6 | 16.0 | -11.0 | 3.8 | 9.5 | 13.3 | **5.63** |
| 23.9 | 36.8 | 0.76 | 28.9 | 5.0 | **15.4** | 10.6 | 192 | 2,508 | | 10.0 | 94.6 | 16.2 | -10.8 | 3.7 | 9.3 | 13.0 | **5.16** |
| 26.7 | 39.8 | 0.76 | 31.6 | 4.9 | **15.2** | 11.3 | 192 | 2,673 | | 10.3 | 94.6 | 16.4 | -10.6 | 3.5 | 9.1 | 12.6 | **4.72** |
| 29.4 | 42.7 | 0.76 | 34.3 | 4.9 | **15.0** | 12.0 | 192 | 2,855 | | 10.6 | 94.6 | 16.6 | -10.4 | 3.3 | 8.9 | 12.3 | **4.28** |
| 32.2 | 45.7 | 0.76 | 37.1 | 4.9 | **14.8** | 12.8 | 192 | 3,061 | | 10.8 | 94.6 | 16.9 | -10.1 | 3.1 | 8.7 | 11.8 | **3.87** |
| 35.0 | 48.7 | 0.76 | 39.8 | 4.8 | **14.7** | 13.6 | 192 | 3,280 | | 11.1 | 94.6 | 17.2 | -9.8 | 3.0 | 8.5 | 11.5 | **3.49** |

** Divide by 2.2 for 460VAC*

go to TABLE OF CONTENTS

# Hydronic Performance

## TF-55-HACW-X-1T *R454b, 60 Hz, YAS40K1E-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 | -3.2 | 18,900 | 12.9 | 3,012 | 104 | 115 | 12 | 109 | 4.8 | **28,900** | **2.81** |
| | 30 | 19 | 12 | 26 | -3.6 | 21,200 | 13.2 | 3,106 | | 116 | 12 | 109 | 5.3 | **31,500** | **2.97** |
| | 35 | 24 | 12 | 31 | -4.1 | 23,800 | 13.6 | 3,192 | | 116 | 12 | 110 | 5.7 | **34,400** | **3.16** |
| | 40 | 29 | 12 | 36 | -4.5 | 26,600 | 14.0 | 3,279 | | 117 | 12 | 110 | 6.3 | **37,500** | **3.35** |
| | 45 | 33 | 12 | 40 | -5.1 | 29,700 | 14.4 | 3,360 | | 117 | 12 | 111 | 6.8 | **40,900** | **3.57** |
| | 50 | 38 | 12 | 44 | -5.6 | 32,900 | 14.8 | 3,445 | | 118 | 12 | 111 | 7.4 | **44,400** | **3.78** |
| | 55 | 43 | 12 | 49 | -6.2 | 36,300 | 15.3 | 3,530 | | 119 | 12 | 112 | 8.0 | **48,100** | **3.99** |
| | 60 | 47 | 12 | 53 | -6.9 | 40,000 | 15.7 | 3,611 | | 119 | 12 | 113 | 8.7 | **52,100** | **4.23** |
| | 65 | 52 | 12 | 57 | -7.6 | 44,000 | 16.1 | 3,699 | | 120 | 12 | 113 | 9.4 | **56,400** | **4.47** |
| | 70 | 57 | 12 | 62 | -8.3 | 48,200 | 16.6 | 3,787 | | 120 | 12 | 114 | 10.2 | **60,900** | **4.71** |
| | 25 | 15 | 12 | 22 | -2.9 | 17,200 | 14.6 | 3,388 | 115.2 | 125 | 12 | 120 | 4.8 | **28,500** | **2.47** |
| | 30 | 20 | 12 | 27 | -3.3 | 19,400 | 14.9 | 3,459 | 114.8 | 125 | 12 | | 5.2 | **30,900** | **2.62** |
| | 35 | 25 | 12 | 31 | -3.7 | 21,900 | 15.1 | 3,529 | 114.4 | 125 | 12 | | 5.6 | **33,700** | **2.80** |
| | 40 | 29 | 12 | 36 | -4.2 | 24,600 | 15.3 | 3,589 | 113.9 | 125 | 12 | | 6.1 | **36,600** | **2.99** |
| | 45 | 34 | 12 | 40 | -4.7 | 27,500 | 15.6 | 3,652 | 113.3 | 126 | 12 | | 6.7 | **39,700** | **3.19** |
| | 50 | 39 | 12 | 45 | -5.2 | 30,700 | 15.9 | 3,706 | 112.8 | 126 | 12 | | 7.2 | **43,100** | **3.41** |
| | 55 | 43 | 12 | 49 | -5.8 | 34,100 | 16.1 | 3,758 | 112.2 | 126 | 12 | | 7.8 | **46,700** | **3.64** |
| | 60 | 48 | 12 | 54 | -6.5 | 37,800 | 16.4 | 3,816 | 111.5 | 126 | 12 | | 8.5 | **50,600** | **3.89** |
| | 65 | 53 | 12 | 58 | -7.2 | 41,700 | 16.7 | 3,867 | 110.8 | 126 | 12 | | 9.2 | **54,700** | **4.15** |
| | 70 | 57 | 12 | 62 | -7.9 | 45,900 | 17.1 | 3,928 | 110.1 | 126 | 12 | | 9.9 | **59,100** | **4.41** |

*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 | -5.7 | -1.8 | 5.5 | 12.9 | 3,012 | 40 | 46.2 | 0.76 | 42.7 | 2.7 | **8.5** | **2.81** |
| | -1.1 | -7.2 | 0.76 | -3.1 | -2.0 | 6.2 | 13.2 | 3,106 | | 46.6 | 0.76 | 42.9 | 2.9 | **9.2** | **2.97** |
| | 1.7 | -4.6 | 0.76 | -0.6 | -2.3 | 7.0 | 13.6 | 3,192 | | 46.8 | 0.76 | 43.2 | 3.2 | **10.1** | **3.16** |
| | 4.4 | -1.9 | 0.76 | 1.9 | -2.5 | 7.8 | 14.0 | 3,279 | | 47.2 | 0.76 | 43.5 | 3.5 | **11.0** | **3.35** |
| | 7.2 | 0.7 | 0.76 | 4.4 | -2.8 | 8.7 | 14.4 | 3,360 | | 47.4 | 0.76 | 43.8 | 3.8 | **12.0** | **3.57** |
| | 10.0 | 3.3 | 0.76 | 6.9 | -3.1 | 9.6 | 14.8 | 3,445 | | 47.8 | 0.76 | 44.1 | 4.1 | **13.0** | **3.78** |
| | 12.8 | 5.9 | 0.76 | 9.4 | -3.4 | 10.6 | 15.3 | 3,530 | | 48.1 | 0.76 | 44.4 | 4.4 | **14.1** | **3.99** |
| | 15.6 | 8.6 | 0.76 | 11.8 | -3.8 | 11.7 | 15.7 | 3,611 | | 48.4 | 0.76 | 44.8 | 4.8 | **15.3** | **4.23** |
| | 18.3 | 11.2 | 0.76 | 14.1 | -4.2 | 12.9 | 16.1 | 3,699 | | 48.7 | 0.76 | 45.2 | 5.2 | **16.5** | **4.47** |
| | 21.1 | 13.8 | 0.76 | 16.5 | -4.6 | 14.1 | 16.6 | 3,787 | | 49.0 | 0.76 | 45.7 | 5.7 | **17.8** | **4.71** |
| | -3.9 | -9.3 | 0.76 | -5.5 | -1.6 | 5.0 | 14.6 | 3,388 | 46.2 | 51.7 | 0.76 | 49 | 2.7 | **8.4** | **2.47** |
| | -1.1 | -6.7 | 0.76 | -2.9 | -1.8 | 5.7 | 14.9 | 3,459 | 46.0 | 51.7 | 0.76 | | 2.9 | **9.1** | **2.62** |
| | 1.7 | -4.1 | 0.76 | -0.4 | -2.1 | 6.4 | 15.1 | 3,529 | 45.8 | 51.8 | 0.76 | | 3.1 | **9.9** | **2.80** |
| | 4.4 | -1.5 | 0.76 | 2.1 | -2.3 | 7.2 | 15.3 | 3,589 | 45.5 | 51.9 | 0.76 | | 3.4 | **10.7** | **2.99** |
| | 7.2 | 1.1 | 0.76 | 4.6 | -2.6 | 8.1 | 15.6 | 3,652 | 45.2 | 52.0 | 0.76 | | 3.7 | **11.6** | **3.19** |
| | 10.0 | 3.7 | 0.76 | 7.1 | -2.9 | 9.0 | 15.9 | 3,706 | 44.9 | 52.1 | 0.76 | | 4.0 | **12.6** | **3.41** |
| | 12.8 | 6.3 | 0.76 | 9.6 | -3.2 | 10.0 | 16.1 | 3,758 | 44.6 | 52.1 | 0.76 | | 4.3 | **13.7** | **3.64** |
| | 15.6 | 8.8 | 0.76 | 12.0 | -3.6 | 11.1 | 16.4 | 3,816 | 44.2 | 52.2 | 0.76 | | 4.7 | **14.8** | **3.89** |
| | 18.3 | 11.4 | 0.76 | 14.3 | -4.0 | 12.2 | 16.7 | 3,867 | 43.8 | 52.3 | 0.76 | | 5.1 | **16.0** | **4.15** |
| | 21.1 | 14.1 | 0.76 | 16.7 | -4.4 | 13.5 | 17.1 | 3,928 | 43.4 | 52.4 | 0.76 | | 5.5 | **17.3** | **4.41** |

go to TABLE OF CONTENTS

# Air Heating/Cooling Performance

## TF-65-HACW-X-1T *R454b, 60 Hz, YAS51K1E-PFV*

**HEATING**

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

**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** |
| 50 | 72 | 14 | 60 | 10.2 | **69,300** | 10.7 | 325 | 2,454 | 80.6 | 48 | 1900 | 61 | -20 | 19,600 | 41,600 | 61,200 | **24.9** |
| 55 | 77 | 14 | 65 | 10.1 | **68,800** | 11.3 | 325 | 2,621 | | 48 | 1900 | 61 | -20 | 18,900 | 41,300 | 60,200 | **23.0** |
| 60 | 83 | 14 | 70 | 10.1 | **68,400** | 11.9 | 325 | 2,783 | | 48 | 1900 | 61 | -20 | 18,300 | 40,900 | 59,200 | **21.3** |
| 65 | 88 | 14 | 75 | 10.0 | **67,900** | 12.5 | 325 | 2,937 | | 49 | 1900 | 61 | -20 | 17,600 | 40,600 | 58,200 | **19.8** |
| 70 | 93 | 14 | 80 | 9.9 | **67,200** | 13.2 | 325 | 3,095 | | 49 | 1900 | 61 | -19 | 17,000 | 40,000 | 57,000 | **18.4** |
| 75 | 99 | 14 | 85 | 9.8 | **66,600** | 13.9 | 325 | 3,255 | | 50 | 1900 | 62 | -19 | 16,300 | 39,600 | 55,900 | **17.2** |
| 80 | 104 | 14 | 90 | 9.8 | **66,000** | 14.6 | 325 | 3,414 | | 50 | 1900 | 62 | -19 | 15,700 | 39,000 | 54,700 | **16.0** |
| 85 | 109 | 14 | 95 | 9.6 | **65,200** | 15.4 | 325 | 3,584 | | 51 | 1900 | 62 | -19 | 15,000 | 38,400 | 53,400 | **14.9** |
| 90 | 115 | 14 | 100 | 9.5 | **64,400** | 16.2 | 325 | 3,756 | | 51 | 1900 | 62 | -18 | 14,400 | 37,600 | 52,000 | **13.8** |
| 95 | 120 | 14 | 104 | 9.4 | **63,600** | 17.0 | 325 | 3,944 | | 52 | 1900 | 63 | -18 | 13,700 | 36,900 | 50,600 | **12.8** |

*METRIC*

**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 | -9.4 | 0.88 | -6.0 | -2.1 | 7.6 | 14.0 | 300 | 3,197 | 20.0 | 36.4 | 897 | 29.9 | 9.9 | **10.6** | **3.33** |
| -1.1 | -6.9 | 0.88 | -3.4 | -2.3 | 8.5 | 14.5 | 300 | 3,302 | | 37.3 | 897 | 30.9 | 10.9 | **11.7** | **3.55** |
| 1.7 | -4.4 | 0.88 | -1.0 | -2.7 | 9.6 | 15.0 | 300 | 3,403 | | 38.2 | 897 | 32.0 | 12.0 | **12.9** | **3.78** |
| 4.4 | -1.9 | 0.88 | 1.4 | -3.0 | 10.7 | 15.5 | 300 | 3,512 | | 39.1 | 897 | 33.2 | 13.2 | **14.1** | **4.02** |
| 7.2 | 0.6 | 0.88 | 3.9 | -3.3 | 12.0 | 16.0 | 300 | 3,617 | | 39.9 | 897 | 34.5 | 14.5 | **15.5** | **4.29** |
| 10.0 | 3.1 | 0.88 | 6.3 | -3.7 | 13.3 | 16.6 | 300 | 3,729 | | 40.8 | 897 | 35.8 | 15.8 | **17.0** | **4.55** |
| 12.8 | 5.6 | 0.88 | 8.7 | -4.1 | 14.8 | 17.1 | 300 | 3,841 | | 41.7 | 897 | 37.2 | 17.2 | **18.5** | **4.82** |
| 15.6 | 8.2 | 0.88 | 11.0 | -4.6 | 16.4 | 17.6 | 300 | 3,950 | | 42.5 | 897 | 38.8 | 18.8 | **20.2** | **5.12** |
| 18.3 | 10.7 | 0.88 | 13.3 | -5.0 | 18.0 | 18.2 | 300 | 4,065 | | 43.4 | 897 | 40.4 | 20.4 | **22.0** | **5.41** |
| 21.1 | 13.2 | 0.88 | 15.6 | -5.5 | 19.8 | 18.7 | 300 | 4,176 | | 44.2 | 897 | 42.2 | 22.2 | **23.9** | **5.71** |

**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 (kW) | Sensible (kW) | **Cooling (kW)** | **$COP_C$** |
| 10.0 | 22.2 | 0.88 | 15.7 | 5.7 | **20.3** | 10.7 | 325 | 2,454 | 27.0 | 8.6 | 119.9 | 15.8 | -11.2 | 5.7 | 12.2 | 17.9 | **7.30** |
| 12.8 | 25.1 | 0.88 | 18.4 | 5.6 | **20.2** | 11.3 | 325 | 2,621 | | 8.8 | 119.9 | 15.9 | -11.1 | 5.5 | 12.1 | 17.6 | **6.74** |
| 15.6 | 28.1 | 0.88 | 21.2 | 5.6 | **20.0** | 11.9 | 325 | 2,783 | | 9.1 | 119.9 | 16.0 | -11.0 | 5.4 | 12.0 | 17.3 | **6.24** |
| 18.3 | 31.1 | 0.88 | 23.9 | 5.6 | **19.9** | 12.5 | 325 | 2,937 | | 9.4 | 119.9 | 16.1 | -10.9 | 5.2 | 11.9 | 17.1 | **5.80** |
| 21.1 | 34.1 | 0.88 | 26.6 | 5.5 | **19.7** | 13.2 | 325 | 3,095 | | 9.6 | 119.9 | 16.3 | -10.7 | 5.0 | 11.7 | 16.7 | **5.39** |
| 23.9 | 37.1 | 0.88 | 29.3 | 5.4 | **19.5** | 13.9 | 325 | 3,255 | | 9.9 | 119.9 | 16.4 | -10.6 | 4.8 | 11.6 | 16.4 | **5.04** |
| 26.7 | 40.0 | 0.88 | 32.1 | 5.4 | **19.3** | 14.6 | 325 | 3,414 | | 10.2 | 119.9 | 16.6 | -10.4 | 4.6 | 11.4 | 16.0 | **4.69** |
| 29.4 | 43.0 | 0.88 | 34.7 | 5.3 | **19.1** | 15.4 | 325 | 3,584 | | 10.4 | 119.9 | 16.7 | -10.3 | 4.4 | 11.3 | 15.7 | **4.37** |
| 32.2 | 45.9 | 0.88 | 37.5 | 5.3 | **18.9** | 16.2 | 325 | 3,756 | | 10.7 | 119.9 | 16.9 | -10.1 | 4.2 | 11.0 | 15.2 | **4.04** |
| 35.0 | 48.9 | 0.88 | 40.2 | 5.2 | **18.6** | 17.0 | 325 | 3,944 | | 10.9 | 119.9 | 17.1 | -9.9 | 4.0 | 10.8 | 14.8 | **3.75** |

** Divide by 2.2 for 460VAC*

go to TABLE OF CONTENTS

# Hydronic Performance

## TF-65-HACW-X-1T *R454b, 60 Hz, YAS51K1E-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 | 22 | -3.4 | 23,400 | 16.6 | 3,734 | 104 | 116 | 14 | 109 | 5.1 | **35,700** | **2.80** |
| | 30 | 20 | 14 | 26 | -3.8 | 26,200 | 17.1 | 3,831 | | 117 | 14 | 110 | 5.5 | **38,800** | **2.97** |
| | 35 | 25 | 14 | 31 | -4.3 | 29,300 | 17.6 | 3,922 | | 117 | 14 | 110 | 6.0 | **42,300** | **3.16** |
| | 40 | 29 | 14 | 35 | -4.8 | 32,700 | 18.0 | 4,019 | | 118 | 14 | 111 | 6.6 | **46,000** | **3.35** |
| | 45 | 34 | 14 | 40 | -5.3 | 36,400 | 18.5 | 4,110 | | 118 | 14 | 111 | 7.2 | **50,000** | **3.57** |
| | 50 | 39 | 14 | 44 | -5.9 | 40,200 | 19.0 | 4,206 | | 119 | 14 | 112 | 7.8 | **54,200** | **3.78** |
| | 55 | 43 | 14 | 49 | -6.5 | 44,400 | 19.4 | 4,301 | | 120 | 14 | 112 | 8.4 | **58,700** | **4.00** |
| | 60 | 48 | 14 | 53 | -7.2 | 48,900 | 19.9 | 4,390 | | 120 | 14 | 113 | 9.1 | **63,500** | **4.24** |
| | 65 | 52 | 14 | 57 | -7.9 | 53,600 | 20.3 | 4,482 | | 121 | 14 | 114 | 9.8 | **68,600** | **4.49** |
| | 70 | 57 | 14 | 61 | -8.7 | 58,800 | 20.7 | 4,567 | | 121 | 14 | 115 | 10.6 | **74,100** | **4.76** |
| | 25 | 16 | 14 | 22 | -3.1 | 21,300 | 18.6 | 4,192 | 115.0 | 126 | 14 | 120 | 5.0 | **35,200** | **2.46** |
| | 30 | 21 | 14 | 27 | -3.5 | 24,100 | 19.0 | 4,261 | 114.5 | 126 | 14 | | 5.5 | **38,200** | **2.63** |
| | 35 | 25 | 14 | 31 | -3.9 | 27,000 | 19.4 | 4,333 | 114.1 | 126 | 14 | | 5.9 | **41,400** | **2.80** |
| | 40 | 30 | 14 | 36 | -4.4 | 30,200 | 19.7 | 4,401 | 113.6 | 126 | 14 | | 6.4 | **44,800** | **2.98** |
| | 45 | 35 | 14 | 40 | -4.9 | 33,700 | 20.1 | 4,473 | 113.0 | 126 | 14 | | 7.0 | **48,600** | **3.18** |
| | 50 | 39 | 14 | 45 | -5.5 | 37,500 | 20.4 | 4,539 | 112.4 | 126 | 14 | | 7.6 | **52,600** | **3.40** |
| | 55 | 44 | 14 | 49 | -6.1 | 41,500 | 20.7 | 4,603 | 111.8 | 127 | 14 | | 8.2 | **56,900** | **3.62** |
| | 60 | 48 | 14 | 53 | -6.7 | 45,900 | 21.1 | 4,671 | 111.2 | 127 | 14 | | 8.8 | **61,500** | **3.86** |
| | 65 | 53 | 14 | 58 | -7.4 | 50,600 | 21.4 | 4,731 | 110.4 | 127 | 14 | | 9.6 | **66,400** | **4.11** |
| | 70 | 58 | 14 | 62 | -8.2 | 55,500 | 21.7 | 4,794 | 109.7 | 127 | 14 | | 10.3 | **71,500** | **4.37** |

*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 | -5.8 | -1.9 | 6.9 | 16.6 | 3,734 | 40 | 46.8 | 0.88 | 42.8 | 2.8 | **10.5** | **2.80** |
| | -1.1 | -6.7 | 0.88 | -3.2 | -2.1 | 7.7 | 17.1 | 3,831 | | 47.1 | 0.88 | 43.1 | 3.1 | **11.4** | **2.97** |
| | 1.7 | -4.1 | 0.88 | -0.7 | -2.4 | 8.6 | 17.6 | 3,922 | | 47.4 | 0.88 | 43.3 | 3.3 | **12.4** | **3.16** |
| | 4.4 | -1.6 | 0.88 | 1.7 | -2.7 | 9.6 | 18.0 | 4,019 | | 47.7 | 0.88 | 43.7 | 3.7 | **13.5** | **3.35** |
| | 7.2 | 1.1 | 0.88 | 4.3 | -2.9 | 10.7 | 18.5 | 4,110 | | 48.0 | 0.88 | 44.0 | 4.0 | **14.7** | **3.57** |
| | 10.0 | 3.6 | 0.88 | 6.7 | -3.3 | 11.8 | 19.0 | 4,206 | | 48.3 | 0.88 | 44.3 | 4.3 | **15.9** | **3.78** |
| | 12.8 | 6.2 | 0.88 | 9.2 | -3.6 | 13.0 | 19.4 | 4,301 | | 48.7 | 0.88 | 44.7 | 4.7 | **17.2** | **4.00** |
| | 15.6 | 8.8 | 0.88 | 11.6 | -4.0 | 14.3 | 19.9 | 4,390 | | 48.9 | 0.88 | 45.1 | 5.1 | **18.6** | **4.24** |
| | 18.3 | 11.3 | 0.88 | 13.9 | -4.4 | 15.7 | 20.3 | 4,482 | | 49.3 | 0.88 | 45.4 | 5.4 | **20.1** | **4.49** |
| | 21.1 | 13.9 | 0.88 | 16.3 | -4.8 | 17.2 | 20.7 | 4,567 | | 49.6 | 0.88 | 45.9 | 5.9 | **21.7** | **4.76** |
| | -3.9 | -8.9 | 0.88 | -5.6 | -1.7 | 6.2 | 18.6 | 4,192 | 46.1 | 52.1 | 0.88 | 49 | 2.8 | **10.3** | **2.46** |
| | -1.1 | -6.3 | 0.88 | -3.0 | -1.9 | 7.1 | 19.0 | 4,261 | 45.8 | 52.1 | 0.88 | | 3.1 | **11.2** | **2.63** |
| | 1.7 | -3.7 | 0.88 | -0.5 | -2.2 | 7.9 | 19.4 | 4,333 | 45.6 | 52.2 | 0.88 | | 3.3 | **12.1** | **2.80** |
| | 4.4 | -1.2 | 0.88 | 2.0 | -2.4 | 8.9 | 19.7 | 4,401 | 45.3 | 52.3 | 0.88 | | 3.6 | **13.1** | **2.98** |
| | 7.2 | 1.4 | 0.88 | 4.5 | -2.7 | 9.9 | 20.1 | 4,473 | 45.0 | 52.4 | 0.88 | | 3.9 | **14.2** | **3.18** |
| | 10.0 | 3.9 | 0.88 | 6.9 | -3.1 | 11.0 | 20.4 | 4,539 | 44.7 | 52.4 | 0.88 | | 4.2 | **15.4** | **3.40** |
| | 12.8 | 6.5 | 0.88 | 9.4 | -3.4 | 12.2 | 20.7 | 4,603 | 44.3 | 52.5 | 0.88 | | 4.6 | **16.7** | **3.62** |
| | 15.6 | 9.1 | 0.88 | 11.9 | -3.7 | 13.5 | 21.1 | 4,671 | 44.0 | 52.6 | 0.88 | | 4.9 | **18.0** | **3.86** |
| | 18.3 | 11.6 | 0.88 | 14.2 | -4.1 | 14.8 | 21.4 | 4,731 | 43.6 | 52.7 | 0.88 | | 5.3 | **19.5** | **4.11** |
| | 21.1 | 14.2 | 0.88 | 16.5 | -4.6 | 16.3 | 21.7 | 4,794 | 43.2 | 52.8 | 0.88 | | 5.7 | **21.0** | **4.37** |

go to TABLE OF CONTENTS

# Air Heating/Cooling Performance

## TF-75-HACW-X-1T *R454b, 60 Hz, YAS60K1E-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 | 16 | 16 | 21 | -4.0 | 31,200 | 16.9 | 410 | 3,967 | 68 | 98 | 2100 | 88 | 20 | **44,400** | **3.28** |
| 30 | 20 | 16 | 26 | -4.5 | 34,900 | 17.4 | 410 | 4,092 | | 100 | 2100 | 90 | 22 | **48,500** | **3.47** |
| 35 | 25 | 16 | 30 | -5.0 | 38,800 | 18.0 | 410 | 4,219 | | 102 | 2100 | 92 | 24 | **52,800** | **3.67** |
| 40 | 29 | 16 | 35 | -5.5 | 42,900 | 18.6 | 410 | 4,354 | | 104 | 2100 | 94 | 26 | **57,400** | **3.86** |
| 45 | 34 | 16 | 39 | -6.1 | 47,500 | 19.1 | 410 | 4,485 | | 105 | 2100 | 96 | 28 | **62,400** | **4.08** |
| 50 | 38 | 16 | 43 | -6.7 | 52,300 | 19.7 | 410 | 4,618 | | 107 | 2100 | 98 | 30 | **67,600** | **4.29** |
| 55 | 43 | 16 | 48 | -7.4 | 57,500 | 20.3 | 410 | 4,749 | | 109 | 2100 | 101 | 33 | **73,300** | **4.52** |
| 60 | 48 | 16 | 52 | -8.1 | 63,100 | 20.8 | 410 | 4,881 | | 110 | 2100 | 103 | 35 | **79,300** | **4.76** |
| 65 | 52 | 16 | 56 | -8.9 | 69,000 | 21.4 | 410 | 5,015 | | 112 | 2100 | 106 | 38 | **85,700** | **5.01** |
| 70 | 57 | 16 | 60 | -9.7 | 75,200 | 21.9 | 410 | 5,143 | | 114 | 2100 | 109 | 41 | **92,300** | **5.26** |

**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** |
| 50 | 73 | 16 | 60 | 10.3 | **80,300** | 14.1 | 450 | 3,273 | 80.6 | 46 | 2100 | 60 | -21 | 21,500 | 48,000 | 69,500 | **21.2** |
| 55 | 78 | 16 | 65 | 10.3 | **79,900** | 14.5 | 450 | 3,415 | | 46 | 2100 | 60 | -21 | 21,100 | 47,500 | 68,600 | **20.1** |
| 60 | 84 | 16 | 70 | 10.2 | **79,600** | 14.9 | 450 | 3,576 | | 47 | 2100 | 60 | -21 | 20,600 | 47,200 | 67,800 | **19.0** |
| 65 | 89 | 16 | 75 | 10.2 | **79,200** | 15.5 | 450 | 3,749 | | 47 | 2100 | 60 | -20 | 20,200 | 46,600 | 66,800 | **17.8** |
| 70 | 94 | 16 | 80 | 10.2 | **78,800** | 16.3 | 450 | 3,937 | | 48 | 2100 | 61 | -20 | 19,600 | 46,100 | 65,700 | **16.7** |
| 75 | 100 | 16 | 85 | 10.1 | **78,200** | 17.2 | 450 | 4,147 | | 48 | 2100 | 61 | -20 | 19,100 | 45,300 | 64,400 | **15.5** |
| 80 | 105 | 16 | 90 | 10.0 | **77,600** | 18.1 | 450 | 4,371 | | 49 | 2100 | 61 | -20 | 18,500 | 44,600 | 63,100 | **14.4** |
| 85 | 110 | 16 | 95 | 10.0 | **76,900** | 19.2 | 450 | 4,615 | | 49 | 2100 | 62 | -19 | 17,900 | 43,700 | 61,600 | **13.3** |
| 90 | 116 | 16 | 100 | 9.9 | **76,400** | 20.4 | 450 | 4,885 | | 49 | 2100 | 62 | -19 | 17,300 | 42,800 | 60,100 | **12.3** |
| 95 | 121 | 16 | 105 | 9.8 | **75,700** | 21.7 | 450 | 5,171 | | 50 | 2100 | 62 | -18 | 16,700 | 41,800 | 58,500 | **11.3** |

*METRIC*

**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 | -9.2 | 1.0 | -6.1 | -2.2 | 9.1 | 16.9 | 410 | 3,967 | 20.0 | 36.9 | 991 | 31.0 | 11.0 | **13.0** | **3.28** |
| -1.1 | -6.6 | 1.0 | -3.6 | -2.5 | 10.2 | 17.4 | 410 | 4,092 | | 37.8 | 991 | 32.0 | 12.0 | **14.2** | **3.47** |
| 1.7 | -4.1 | 1.0 | -1.1 | -2.8 | 11.4 | 18.0 | 410 | 4,219 | | 38.8 | 991 | 33.1 | 13.1 | **15.5** | **3.67** |
| 4.4 | -1.6 | 1.0 | 1.3 | -3.1 | 12.6 | 18.6 | 410 | 4,354 | | 39.8 | 991 | 34.2 | 14.2 | **16.8** | **3.86** |
| 7.2 | 1.0 | 1.0 | 3.8 | -3.4 | 13.9 | 19.1 | 410 | 4,485 | | 40.7 | 991 | 35.4 | 15.4 | **18.3** | **4.08** |
| 10.0 | 3.6 | 1.0 | 6.3 | -3.7 | 15.3 | 19.7 | 410 | 4,618 | | 41.7 | 991 | 36.7 | 16.7 | **19.8** | **4.29** |
| 12.8 | 6.1 | 1.0 | 8.7 | -4.1 | 16.9 | 20.3 | 410 | 4,749 | | 42.6 | 991 | 38.1 | 18.1 | **21.5** | **4.52** |
| 15.6 | 8.7 | 1.0 | 11.1 | -4.5 | 18.5 | 20.8 | 410 | 4,881 | | 43.6 | 991 | 39.6 | 19.6 | **23.2** | **4.76** |
| 18.3 | 11.2 | 1.0 | 13.4 | -4.9 | 20.2 | 21.4 | 410 | 5,015 | | 44.6 | 991 | 41.2 | 21.2 | **25.1** | **5.01** |
| 21.1 | 13.7 | 1.0 | 15.7 | -5.4 | 22.0 | 21.9 | 410 | 5,143 | | 45.5 | 991 | 42.8 | 22.8 | **27.1** | **5.26** |

**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 (kW) | Sensible (kW) | **Cooling (kW)** | **$COP_C$** |
| 10.0 | 22.8 | 1.0 | 15.7 | 5.7 | **23.5** | 14.1 | 450 | 3,273 | 27.0 | 7.7 | 132.5 | 15.3 | -11.7 | 6.3 | 14.1 | 20.4 | **6.21** |
| 12.8 | 25.8 | 1.0 | 18.5 | 5.7 | **23.4** | 14.5 | 450 | 3,415 | | 7.9 | 132.5 | 15.4 | -11.6 | 6.2 | 13.9 | 20.1 | **5.89** |
| 15.6 | 28.8 | 1.0 | 21.3 | 5.7 | **23.3** | 14.9 | 450 | 3,576 | | 8.2 | 132.5 | 15.6 | -11.4 | 6.0 | 13.8 | 19.9 | **5.57** |
| 18.3 | 31.7 | 1.0 | 24.0 | 5.7 | **23.2** | 15.5 | 450 | 3,749 | | 8.4 | 132.5 | 15.7 | -11.3 | 5.9 | 13.7 | 19.6 | **5.22** |
| 21.1 | 34.7 | 1.0 | 26.8 | 5.7 | **23.1** | 16.3 | 450 | 3,937 | | 8.7 | 132.5 | 15.8 | -11.2 | 5.7 | 13.5 | 19.3 | **4.89** |
| 23.9 | 37.7 | 1.0 | 29.5 | 5.6 | **22.9** | 17.2 | 450 | 4,147 | | 8.9 | 132.5 | 16.0 | -11.0 | 5.6 | 13.3 | 18.9 | **4.54** |
| 26.7 | 40.6 | 1.0 | 32.3 | 5.6 | **22.7** | 18.1 | 450 | 4,371 | | 9.2 | 132.5 | 16.2 | -10.8 | 5.4 | 13.1 | 18.5 | **4.22** |
| 29.4 | 43.6 | 1.0 | 35.0 | 5.6 | **22.5** | 19.2 | 450 | 4,615 | | 9.4 | 132.5 | 16.4 | -10.6 | 5.3 | 12.8 | 18.1 | **3.90** |
| 32.2 | 46.6 | 1.0 | 37.7 | 5.5 | **22.4** | 20.4 | 450 | 4,885 | | 9.7 | 132.5 | 16.6 | -10.4 | 5.1 | 12.5 | 17.6 | **3.60** |
| 35.0 | 49.5 | 1.0 | 40.4 | 5.4 | **22.2** | 21.7 | 450 | 5,171 | | 9.9 | 132.5 | 16.8 | -10.2 | 4.9 | 12.3 | 17.1 | **3.31** |

** Divide by 2.2 for 460VAC*

go to TABLE OF CONTENTS

# Hydronic Performance

## TF-75-HACW-X-1T *R454b, 60 Hz, YAS60K1E-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 | 22 | -3.3 | 26,300 | 13.3 | 4,352 | 104 | 114 | 16 | 109 | 5.1 | **40,800** | **2.75** |
| | 30 | 20 | 16 | 26 | -3.8 | 29,900 | 13.4 | 4,420 | | 115 | 16 | 110 | 5.6 | **44,600** | **2.96** |
| | 35 | 25 | 16 | 31 | -4.3 | 33,900 | 13.6 | 4,493 | | 116 | 16 | 110 | 6.1 | **48,900** | **3.19** |
| | 40 | 29 | 16 | 35 | -4.9 | 38,200 | 13.7 | 4,558 | | 116 | 16 | 111 | 6.7 | **53,400** | **3.43** |
| | 45 | 34 | 16 | 40 | -5.5 | 43,000 | 13.9 | 4,629 | | 117 | 16 | 111 | 7.3 | **58,500** | **3.70** |
| | 50 | 38 | 16 | 44 | -6.2 | 48,000 | 14.1 | 4,691 | | 118 | 16 | 112 | 8.0 | **63,700** | **3.98** |
| | 55 | 42 | 16 | 48 | -6.9 | 53,500 | 14.2 | 4,751 | | 118 | 16 | 113 | 8.7 | **69,400** | **4.28** |
| | 60 | 47 | 16 | 52 | -7.6 | 59,500 | 14.4 | 4,813 | | 119 | 16 | 114 | 9.5 | **75,600** | **4.60** |
| | 65 | 51 | 16 | 57 | -8.5 | 65,900 | 14.6 | 4,866 | | 119 | 16 | 114 | 10.3 | **82,200** | **4.95** |
| | 70 | 56 | 16 | 61 | -9.4 | 72,800 | 14.8 | 4,919 | | 120 | 16 | 115 | 11.2 | **89,300** | **5.32** |
| | 25 | 17 | 16 | 22 | -3.0 | 23,900 | 15.2 | 4,867 | 115.0 | 124 | 16 | 120 | 5.0 | **40,100** | **2.41** |
| | 30 | 21 | 16 | 27 | -3.5 | 27,400 | 15.2 | 4,906 | 114.5 | 125 | 16 | | 5.5 | **43,800** | **2.62** |
| | 35 | 25 | 16 | 31 | -4.0 | 31,200 | 15.2 | 4,949 | 114.0 | 125 | 16 | | 6.0 | **47,700** | **2.82** |
| | 40 | 30 | 16 | 36 | -4.5 | 35,400 | 15.2 | 4,988 | 113.5 | 125 | 16 | | 6.5 | **52,100** | **3.06** |
| | 45 | 34 | 16 | 40 | -5.1 | 39,900 | 15.2 | 5,019 | 112.9 | 125 | 16 | | 7.1 | **56,700** | **3.31** |
| | 50 | 38 | 16 | 44 | -5.8 | 44,900 | 15.2 | 5,052 | 112.2 | 125 | 16 | | 7.8 | **61,800** | **3.59** |
| | 55 | 42 | 16 | 49 | -6.4 | 50,200 | 15.3 | 5,083 | 111.5 | 125 | 16 | | 8.5 | **67,200** | **3.87** |
| | 60 | 47 | 16 | 53 | -7.2 | 56,100 | 15.3 | 5,102 | 110.8 | 126 | 16 | | 9.2 | **73,200** | **4.20** |
| | 65 | 51 | 16 | 57 | -8.0 | 62,400 | 15.4 | 5,124 | 110.0 | 126 | 16 | | 10.0 | **79,600** | **4.55** |
| | 70 | 55 | 16 | 61 | -8.9 | 69,200 | 15.5 | 5,140 | 109.1 | 126 | 16 | | 10.9 | **86,500** | **4.93** |

*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 | -9.1 | 1.0 | -5.7 | -1.8 | 7.7 | 13.3 | 4,352 | 40 | 45.7 | 1.0 | 42.8 | 2.8 | **12.0** | **2.75** |
| | -1.1 | -6.6 | 1.0 | -3.2 | -2.1 | 8.8 | 13.4 | 4,420 | | 46.1 | 1.0 | 43.1 | 3.1 | **13.1** | **2.96** |
| | 1.7 | -4.1 | 1.0 | -0.7 | -2.4 | 9.9 | 13.6 | 4,493 | | 46.4 | 1.0 | 43.4 | 3.4 | **14.3** | **3.19** |
| | 4.4 | -1.7 | 1.0 | 1.7 | -2.7 | 11.2 | 13.7 | 4,558 | | 46.8 | 1.0 | 43.7 | 3.7 | **15.7** | **3.43** |
| | 7.2 | 0.8 | 1.0 | 4.1 | -3.1 | 12.6 | 13.9 | 4,629 | | 47.2 | 1.0 | 44.1 | 4.1 | **17.1** | **3.70** |
| | 10.0 | 3.3 | 1.0 | 6.6 | -3.4 | 14.1 | 14.1 | 4,691 | | 47.5 | 1.0 | 44.4 | 4.4 | **18.7** | **3.98** |
| | 12.8 | 5.7 | 1.0 | 9.0 | -3.8 | 15.7 | 14.2 | 4,751 | | 47.8 | 1.0 | 44.8 | 4.8 | **20.3** | **4.28** |
| | 15.6 | 8.2 | 1.0 | 11.4 | -4.2 | 17.4 | 14.4 | 4,813 | | 48.2 | 1.0 | 45.3 | 5.3 | **22.2** | **4.60** |
| | 18.3 | 10.7 | 1.0 | 13.6 | -4.7 | 19.3 | 14.6 | 4,866 | | 48.6 | 1.0 | 45.7 | 5.7 | **24.1** | **4.95** |
| | 21.1 | 13.2 | 1.0 | 15.9 | -5.2 | 21.3 | 14.8 | 4,919 | | 48.9 | 1.0 | 46.2 | 6.2 | **26.2** | **5.32** |
| | -3.9 | -8.6 | 1.0 | -5.6 | -1.7 | 7.0 | 15.2 | 4,867 | 46.1 | 51.3 | 1.0 | 49 | 2.8 | **11.8** | **2.41** |
| | -1.1 | -6.2 | 1.0 | -3.0 | -1.9 | 8.0 | 15.2 | 4,906 | 45.8 | 51.4 | 1.0 | | 3.1 | **12.8** | **2.62** |
| | 1.7 | -3.8 | 1.0 | -0.5 | -2.2 | 9.1 | 15.2 | 4,949 | 45.6 | 51.5 | 1.0 | | 3.3 | **14.0** | **2.82** |
| | 4.4 | -1.4 | 1.0 | 1.9 | -2.5 | 10.4 | 15.2 | 4,988 | 45.3 | 51.6 | 1.0 | | 3.6 | **15.3** | **3.06** |
| | 7.2 | 1.0 | 1.0 | 4.4 | -2.8 | 11.7 | 15.2 | 5,019 | 44.9 | 51.7 | 1.0 | | 3.9 | **16.6** | **3.31** |
| | 10.0 | 3.4 | 1.0 | 6.8 | -3.2 | 13.2 | 15.2 | 5,052 | 44.6 | 51.8 | 1.0 | | 4.3 | **18.1** | **3.59** |
| | 12.8 | 5.8 | 1.0 | 9.2 | -3.6 | 14.7 | 15.3 | 5,083 | 44.2 | 51.9 | 1.0 | | 4.7 | **19.7** | **3.87** |
| | 15.6 | 8.2 | 1.0 | 11.6 | -4.0 | 16.4 | 15.3 | 5,102 | 43.8 | 51.9 | 1.0 | | 5.1 | **21.5** | **4.20** |
| | 18.3 | 10.6 | 1.0 | 13.9 | -4.4 | 18.3 | 15.4 | 5,124 | 43.3 | 52.1 | 1.0 | | 5.6 | **23.3** | **4.55** |
| | 21.1 | 12.9 | 1.0 | 16.2 | -4.9 | 20.3 | 15.5 | 5,140 | 42.8 | 52.2 | 1.0 | | 6.1 | **25.4** | **4.93** |

go to TABLE OF CONTENTS

# Electrical Specifications

**TABLE 36 - TF-Series (R454b) Electrical Specifications**

| | 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 | **14.6** | **90** | 3.5 | 5.0 | **23.9** | **27.6** | **40** | **#8-2 *** |
| | 2 | 208-3-60 | 187 | 229 | **9.9** | **82** | 3.5 | 5.0 | **19.2** | **21.7** | **30** | **#10-3 *** |
| | 4 | 460-3-60 | 414 | 506 | **4.8** | **44** | 3.5 | 5.0 | **14.1** | **15.3** | **20** | **#12-4** |
| TF-55 | 1 | 208/230-1-60 | 187 | 253 | **18.3** | **138** | 4.0 | 7.0 | **30.1** | **34.7** | **50** | **#8-2 *** |
| | 2 | 208-3-60 | 187 | 229 | **11.9** | **112** | 4.0 | 7.0 | **23.7** | **26.7** | **40** | **#8-3 *** |
| | 4 | 460-3-60 | 414 | 506 | **6.8** | **62** | 4.0 | 7.0 | **18.6** | **20.3** | **30** | **#10-4** |
| TF-65 | 1 | 208/230-1-60 | 187 | 253 | **25.2** | **147** | 5.5 | 7.0 | **38.5** | **44.8** | **60** | **#6-2 *** |
| | 2 | 208-3-60 | 187 | 229 | **13.8** | **150** | 5.5 | 7.0 | **27.1** | **30.6** | **50** | **#8-3 *** |
| | 4 | 460-3-60 | 414 | 506 | **6.9** | **58** | 5.5 | 7.0 | **20.2** | **21.9** | **30** | **#10-4** |
| TF-75 | 1 | 208/230-1-60 | 187 | 253 | **28.0** | **166** | 6.5 | 7.0 | **42.3** | **49.3** | **60** | **#6-2 *** |
| | 2 | 208-3-60 | 187 | 229 | **19.2** | **162** | 6.5 | 7.0 | **33.5** | **38.3** | **50** | **#8-3 *** |
| | 4 | 460-3-60 | 414 | 506 | **9.1** | **71** | 6.5 | 7.0 | **23.4** | **25.7** | **30** | **#10-4** |

* 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** | **-** | **-** | **-** | **-** | **-** |

go to TABLE OF CONTENTS

# 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*** |

| 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*** |

| 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*** |

| 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*** |

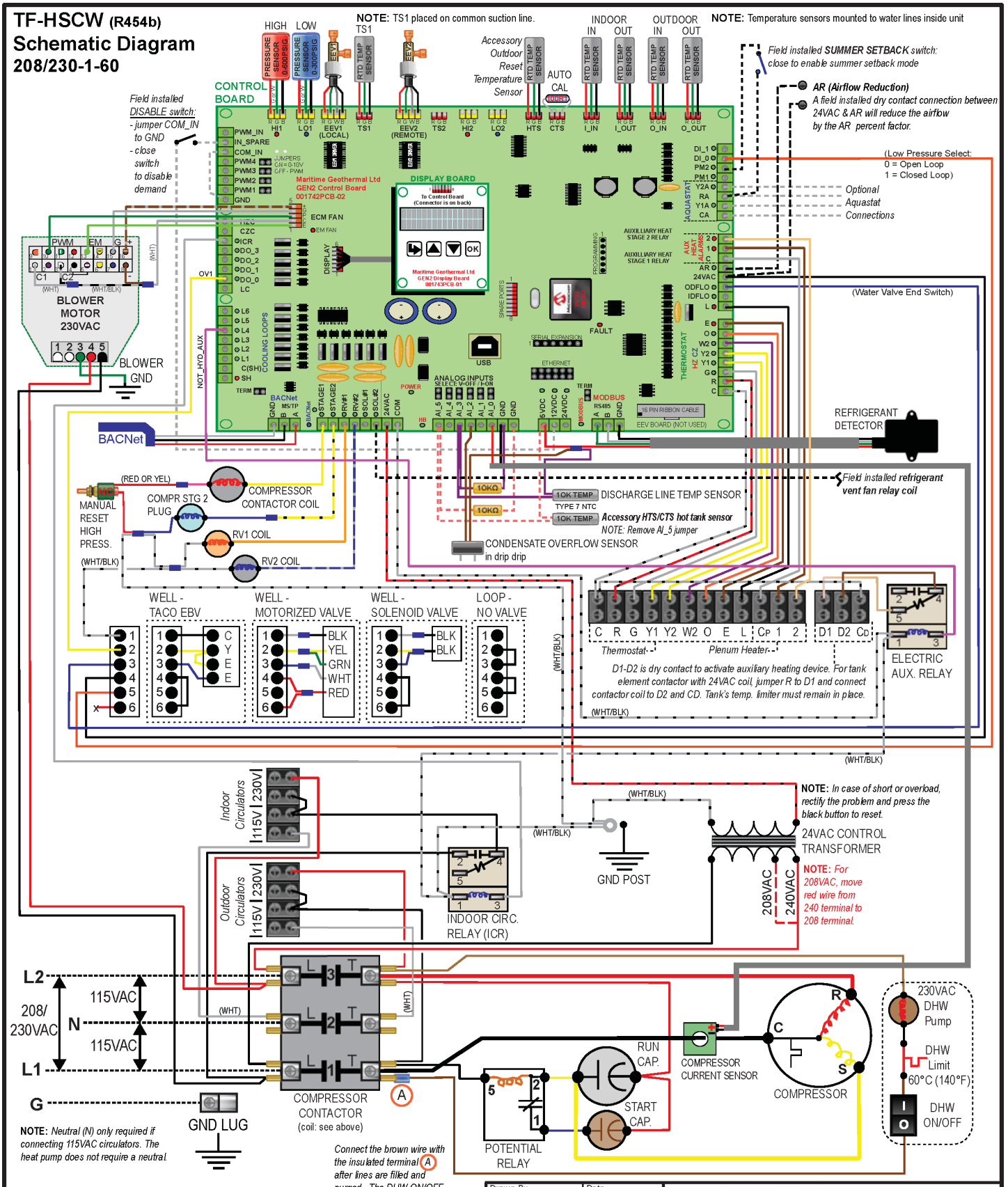
| TABLE 42 - Airflow Range for Emergency Heat | | |
|---|---|---|
| **Model Size** | cfm | *L/s* |
| **45** | **1200** | ***566*** |
| **55/65/75** | **2000** | ***940*** |

**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.

go to TABLE OF CONTENTS

# TF-HSCW (R454b) Schematic Diagram 208/230-1-60




| | | | | |
|---|---|---|---|---|
| | | | | |
| | | | | |
| | | | | |
| 01 | Initial Release | D. RHEAULT | D. RHEAULT | 9-Apr-2025 |
| REV | ECO# | IMPL BY | APVD BY | DATE |

| | |
|---|---|
| Drawn By: D. RHEAULT | Date: 9-Apr-2025 |
| Checked By: D. RHEAULT | Date: 9-Apr-2025 |
| Eng. Approved By | Date |
| Mfg. Approved By | Date |
| Approved By | Date |

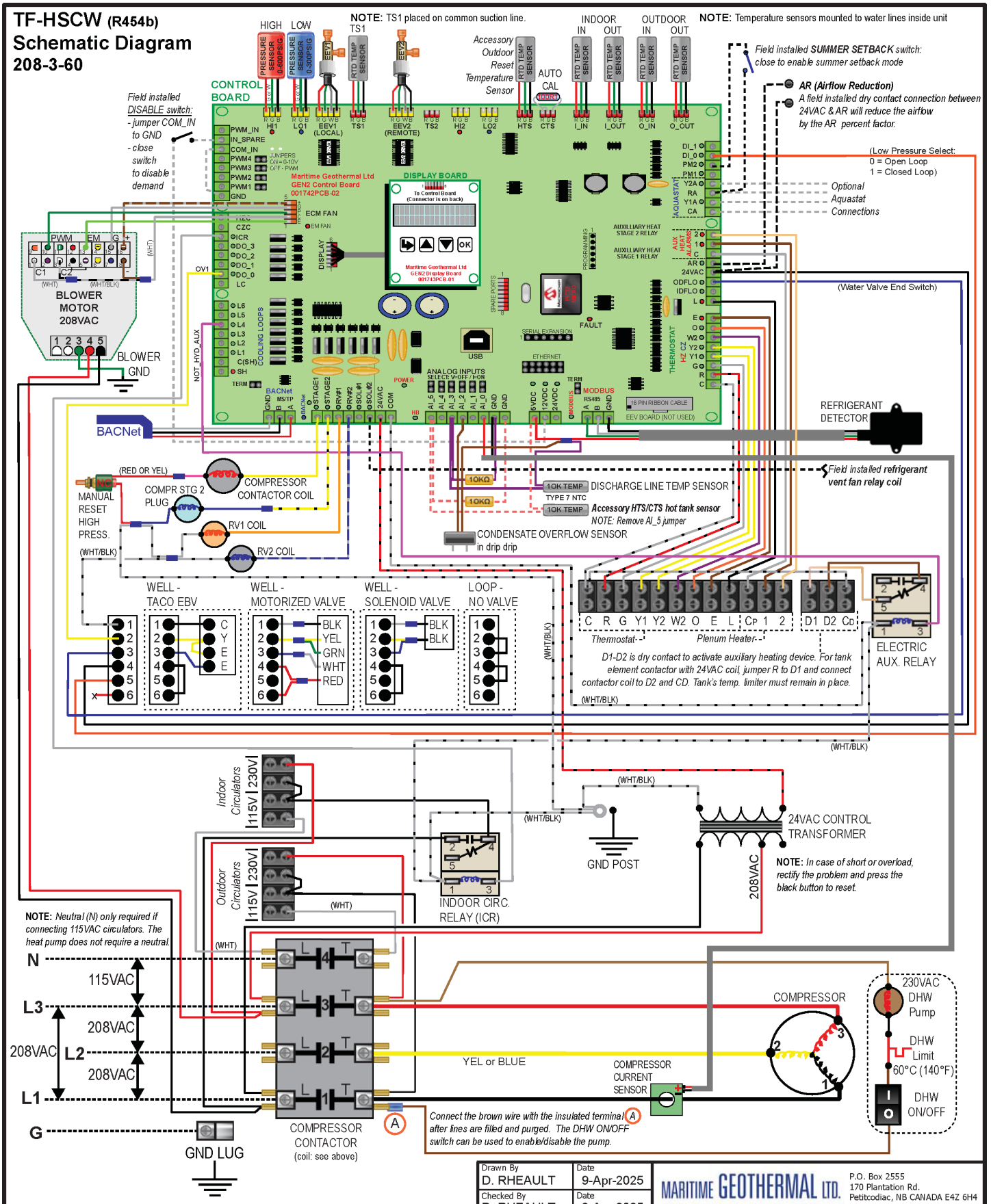
MARITIME GEOTHERMAL LTD.
P.O. Box 2555
170 Plantation Rd.
Petitcodiac, NB CANADA E4Z 6H4

Drawing Name: TF-**-HSCW-X-1*-**-*DE*F Schematic Diagram

| Size | Drawing Number | Drawing Rev | Sheet |
|---|---|---|---|
| LET | 002987SCH | 01 | 1 / 1 |

go to TABLE OF CONTENTS

# TF-HSCW (R454b) Schematic Diagram 208-3-60




| REV | ECO# | IMPL BY | APVD BY | DATE |
|---|---|---|---|---|
| 01 | Initial Release | D. RHEAULT | D. RHEAULT | 9-Apr-2025 |

| | | |
|---|---|---|
| Drawn By | D. RHEAULT | Date 9-Apr-2025 |
| Checked By | D. RHEAULT | Date 9-Apr-2025 |
| Eng. Approved By | | Date |
| Mfg. Approved By | | Date |
| Approved By | | Date |

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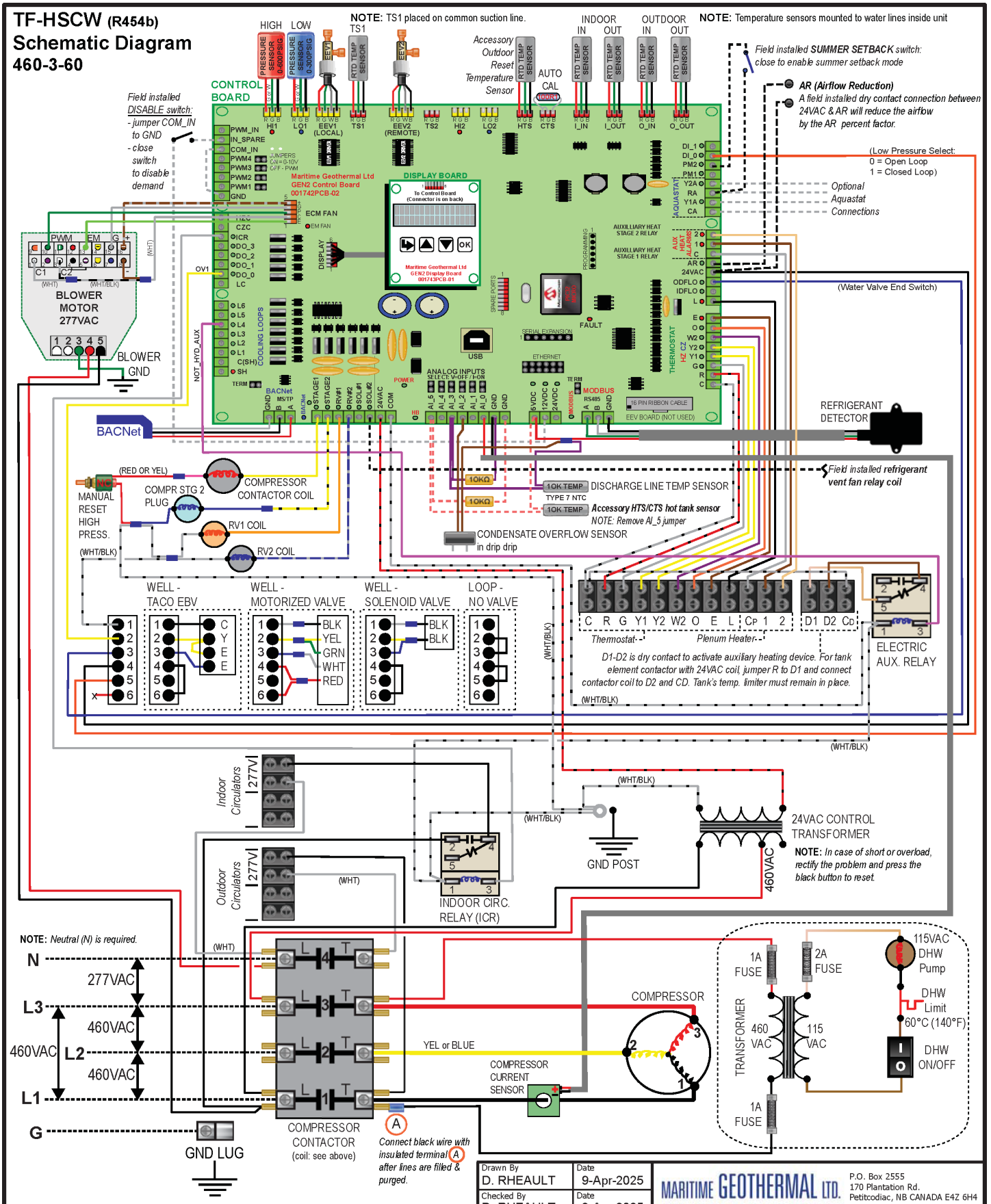
Drawing Name: TF-**-HSCW-X-2*-**-*DE*F Schematic Diagram

| Size | Drawing Number | Drawing Rev | Sheet |
|---|---|---|---|
| LET | 002989SCH | 01 | 1 / 1 |

go to TABLE OF CONTENTS

# TF-HSCW (R454b) Schematic Diagram 460-3-60




| REV | ECO# | IMPL BY | APVD BY | DATE |
|---|---|---|---|---|
| 01 | Initial Release | D. RHEAULT | D. RHEAULT | 9-Apr-2025 |

| | | | |
|---|---|---|---|
| Drawn By | D. RHEAULT | Date | 9-Apr-2025 |
| Checked By | D. RHEAULT | Date | 9-Apr-2025 |
| Eng. Approved By | | Date | |
| Mfg. Approved By | | Date | |
| Approved By | | Date | |

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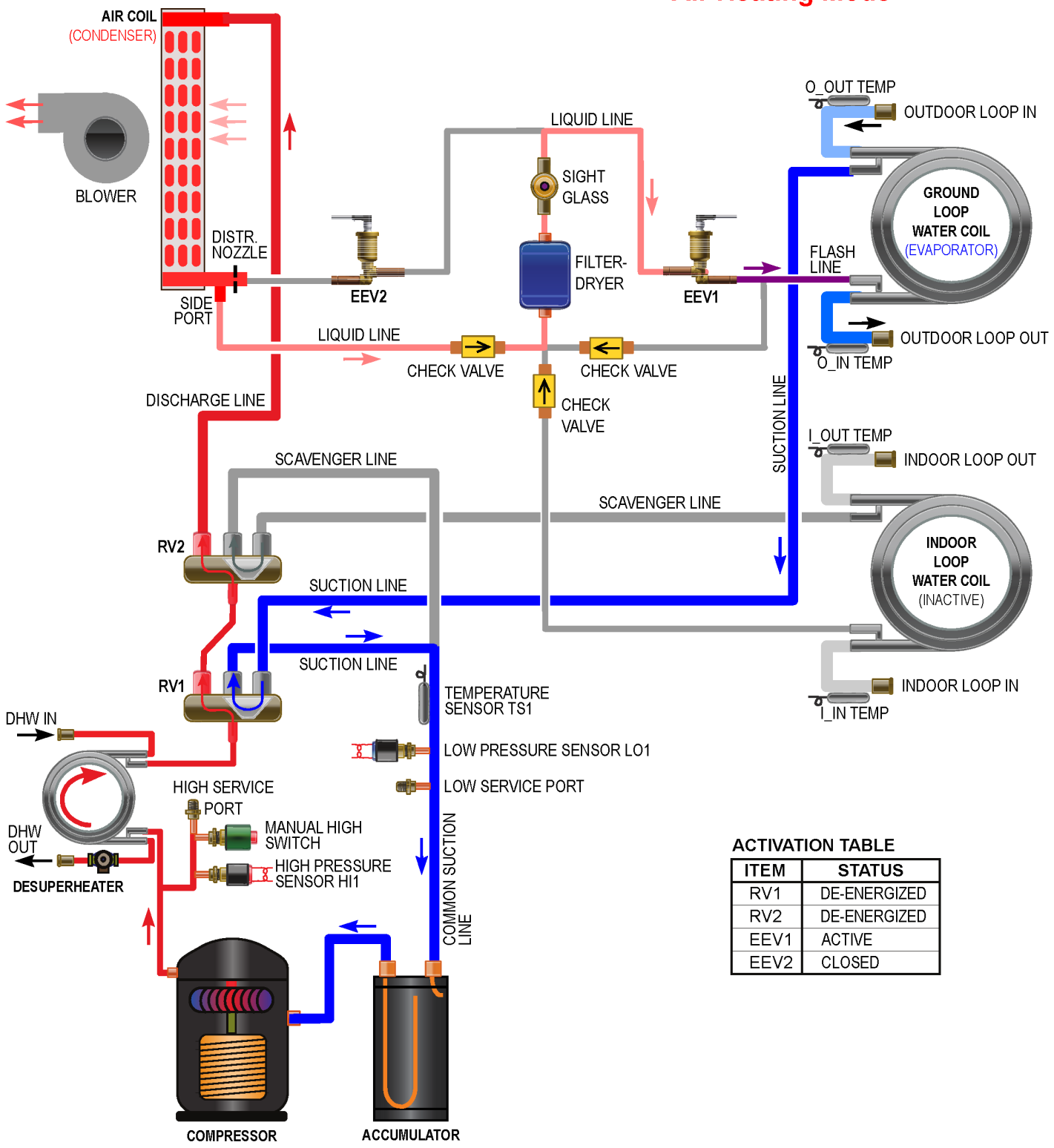
Petitcodiac, NB CANADA E4Z 6H4

Drawing Name: TF-**-HSCW-X-4*-**-*DE*F Schematic Diagram

| Size | Drawing Number | Drawing Rev | Sheet |
|---|---|---|---|
| LET | 002991SCH | 01 | 1 / 1 |

go to TABLE OF CONTENTS

# TF-HSCW Refrigeration Circuit
## Air Heating Mode




**ACTIVATION TABLE**

| ITEM | STATUS |
|---|---|
| RV1 | DE-ENERGIZED |
| RV2 | DE-ENERGIZED |
| EEV1 | ACTIVE |
| EEV2 | CLOSED |

| REV | ECO# | IMPL BY | APVD BY | DATE |
|---|---|---|---|---|
| 01 | Initial Release | D. RHEAULT | D. RHEAULT | 9-DEC-2022 |

| | | |
|---|---|---|
| Drawn By: D. RHEAULT | Date: 9-DEC-2022 | |
| Checked By: D. RHEAULT | Date: 9-DEC-2022 | |
| Eng. Approved By: D. RHEAULT | Date: 9-DEC-2022 | |
| Mfg. Approved By: | Date: | |
| Approved By: | Date: | |

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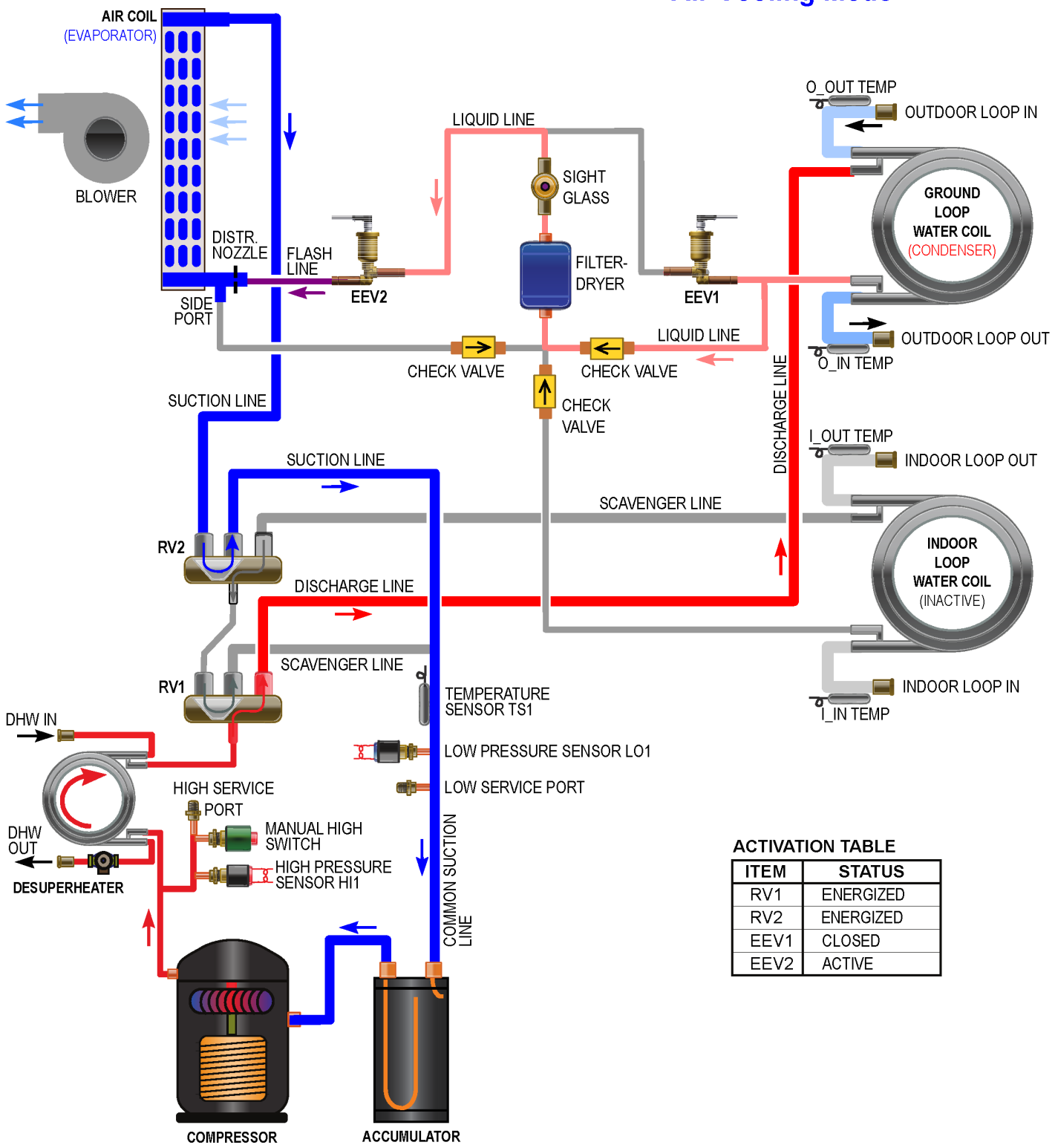
Petitcodiac, NB CANADA E4Z 6H4

Drawing Name: TF-HSCW Refrigeration Circuit Air Heating Mode

| Size | Drawing Number | Drawing Revision | Sheet |
|---|---|---|---|
| LET | 002611RCD | 01 | 1 / 1 |

go to TABLE OF CONTENTS

# TF-HSCW Refrigeration Circuit
## Air Cooling Mode




**ACTIVATION TABLE**

| ITEM | STATUS |
|---|---|
| RV1 | ENERGIZED |
| RV2 | ENERGIZED |
| EEV1 | CLOSED |
| EEV2 | ACTIVE |

| REV | ECO# | IMPL BY | APVD BY | DATE |
|---|---|---|---|---|
| 01 | Initial Release | D. RHEAULT | D. RHEAULT | 9-DEC-2022 |

| | | |
|---|---|---|
| Drawn By: D. RHEAULT | Date: 9-DEC-2022 | |
| Checked By: D. RHEAULT | Date: 9-DEC-2022 | |
| Eng. Approved By: D. RHEAULT | Date: 9-DEC-2022 | |
| Mfg. Approved By: | Date: | |
| Approved By: | Date: | |

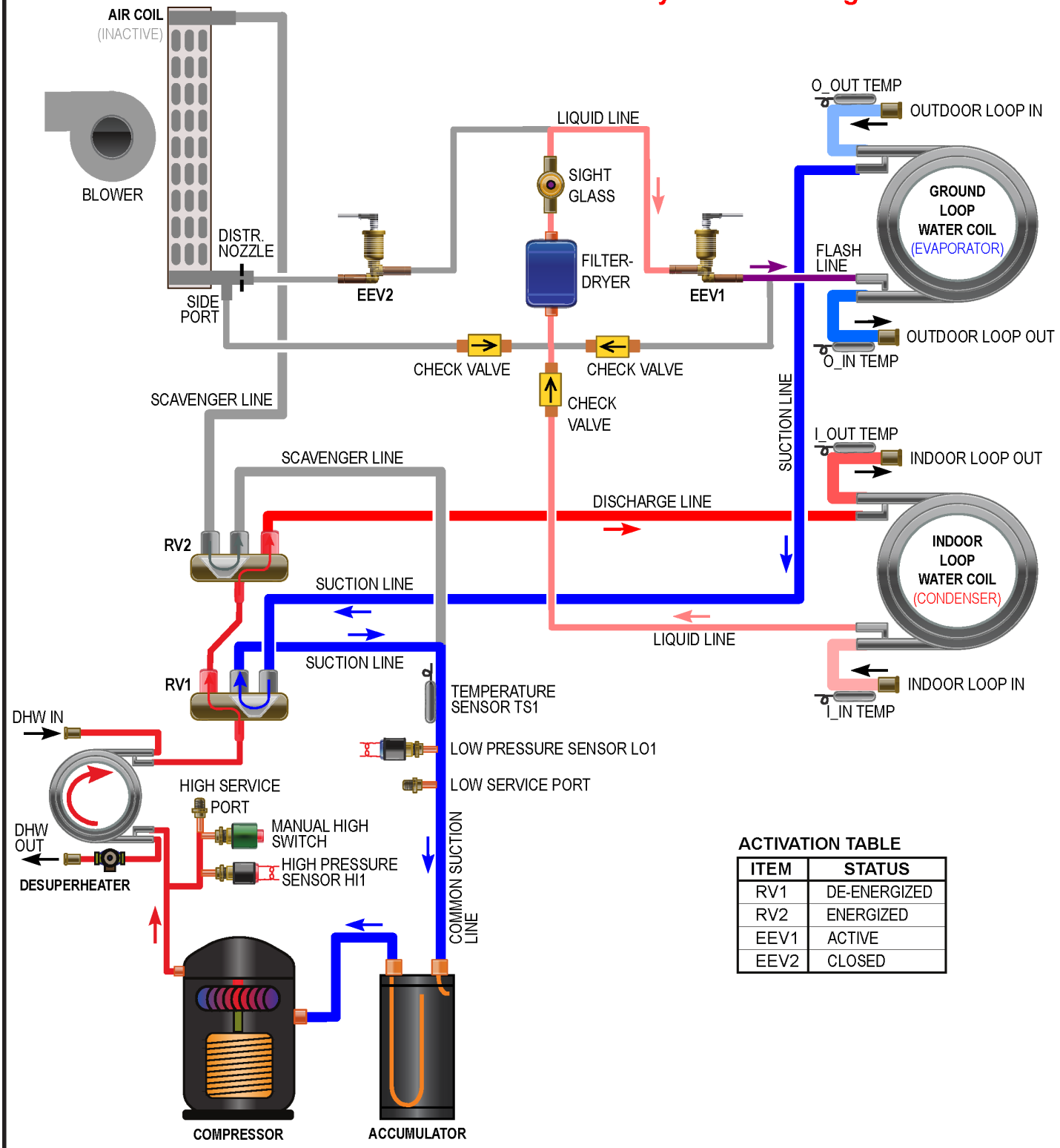
MARITIME GEOTHERMAL LTD.
P.O. Box 2555
170 Plantation Rd.
Petitcodiac, NB CANADA E4Z 6H4

Drawing Name: TF-HSCW Refrigeration Circuit
Air Cooling Mode

| Size | Drawing Number | Drawing Revision | Sheet |
|---|---|---|---|
| LET | 002612RCD | 01 | 1 / 1 |

go to TABLE OF CONTENTS

# TF-HSCW Refrigeration Circuit
## Hydronic Heating Mode




**ACTIVATION TABLE**

| ITEM | STATUS |
|---|---|
| RV1 | DE-ENERGIZED |
| RV2 | ENERGIZED |
| EEV1 | ACTIVE |
| EEV2 | CLOSED |

| REV | ECO# | IMPL BY | APVD BY | DATE |
|---|---|---|---|---|
| 01 | Initial Release | D. RHEAULT | D. RHEAULT | 9-DEC-2022 |

| | | |
|---|---|---|
| Drawn By: D. RHEAULT | Date: 9-DEC-2022 | |
| Checked By: D. RHEAULT | Date: 9-DEC-2022 | |
| Eng. Approved By: D. RHEAULT | Date: 9-DEC-2022 | |
| Mfg. Approved By: | Date: | |
| Approved By: | Date: | |

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170 Plantation Rd.
Petitcodiac, NB CANADA E4Z 6H4

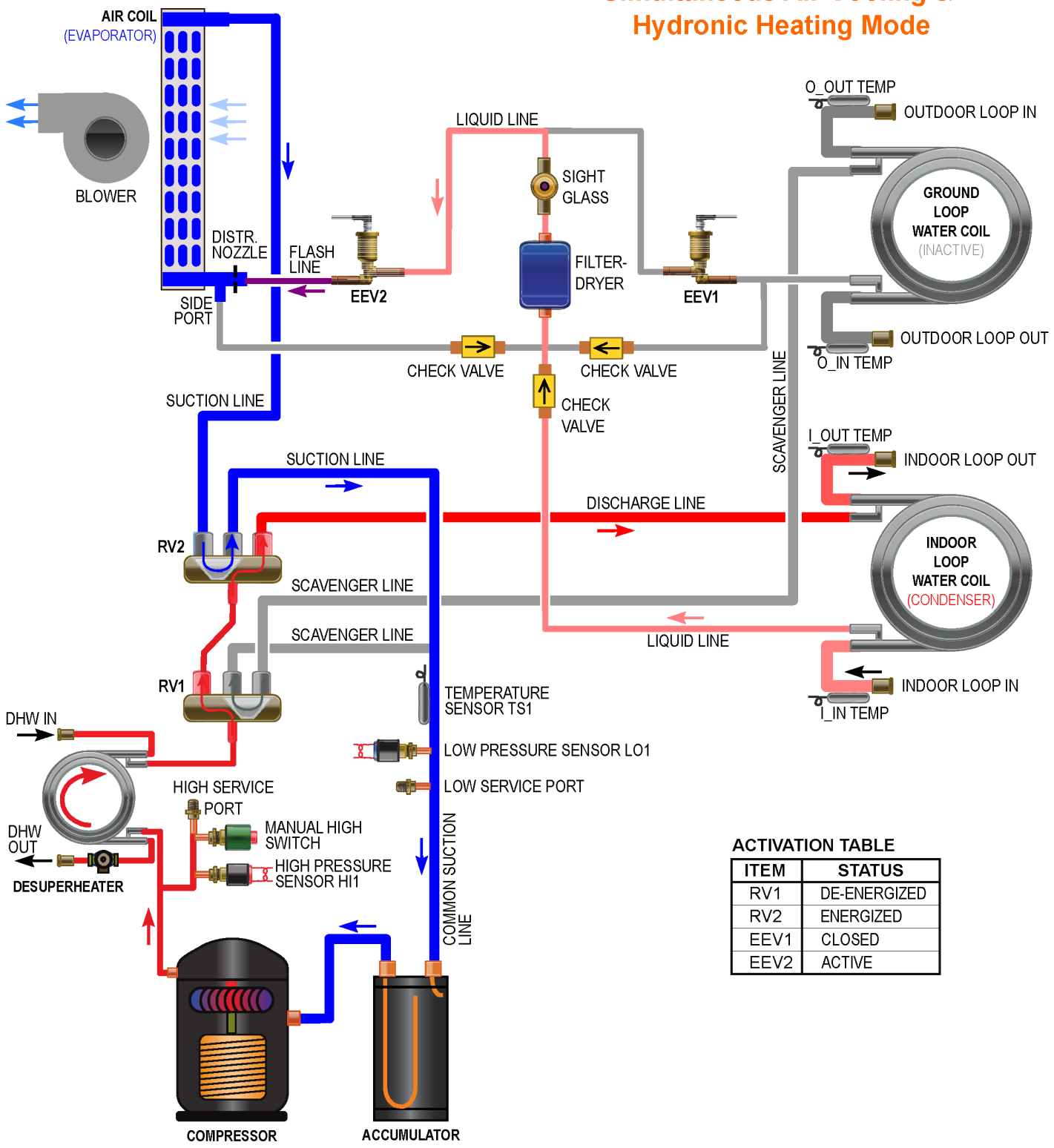
Drawing Name: TF-HSCW Refrigeration Circuit Hydronic Heating Mode

| Size | Drawing Number | Drawing Revision | Sheet |
|---|---|---|---|
| LET | 002613RCD | 01 | 1 / 1 |

go to TABLE OF CONTENTS

# TF-HSCW Refrigeration Circuit

## Simultaneous Air Cooling & Hydronic Heating Mode




**ACTIVATION TABLE**

| ITEM | STATUS |
|---|---|
| RV1 | DE-ENERGIZED |
| RV2 | ENERGIZED |
| EEV1 | CLOSED |
| EEV2 | ACTIVE |

| REV | ECO# | IMPL BY | APVD BY | DATE |
|---|---|---|---|---|
| 01 | Initial Release | D. RHEAULT | D. RHEAULT | 9-DEC-2022 |

| | | |
|---|---|---|
| Drawn By: D. RHEAULT | Date: 9-DEC-2022 | |
| Checked By: D. RHEAULT | Date: 9-DEC-2022 | |
| Eng. Approved By: D. RHEAULT | Date: 9-DEC-2022 | |
| Mfg. Approved By: | Date: | |
| Approved By: | Date: | |

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

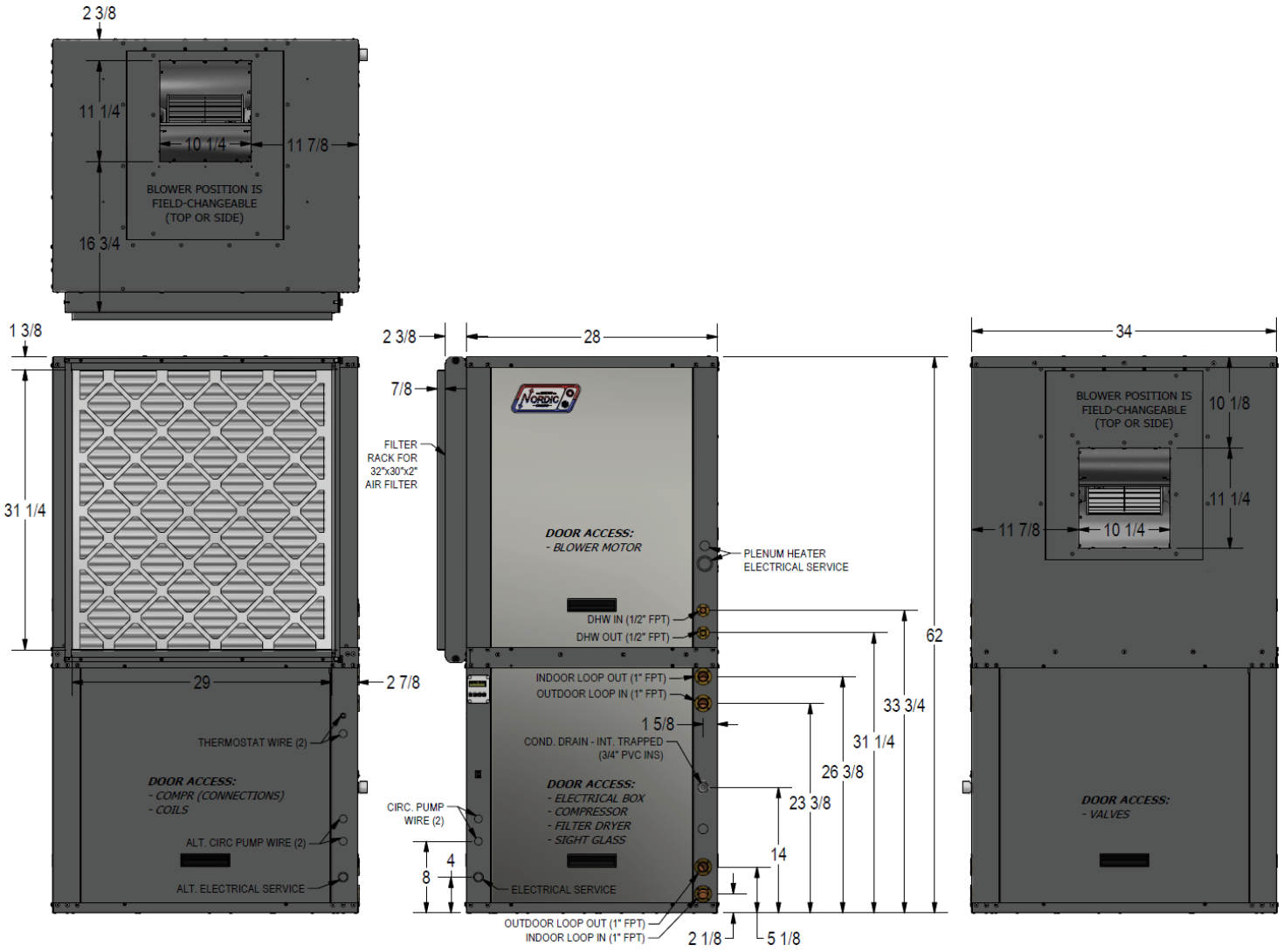
Drawing Name: TF-HSCW Refrigeration Circuit
Air Cooling & Hydronic Heating Mode

| Size | Drawing Number | Drawing Revision | Sheet |
|---|---|---|---|
| LET | 002614RCD | 01 | 1 / 1 |

go to TABLE OF CONTENTS

# Dimensions: TF-45 Left Return

All dimensions in inches.




**LEFT SIDE:**
optional
compressor access

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

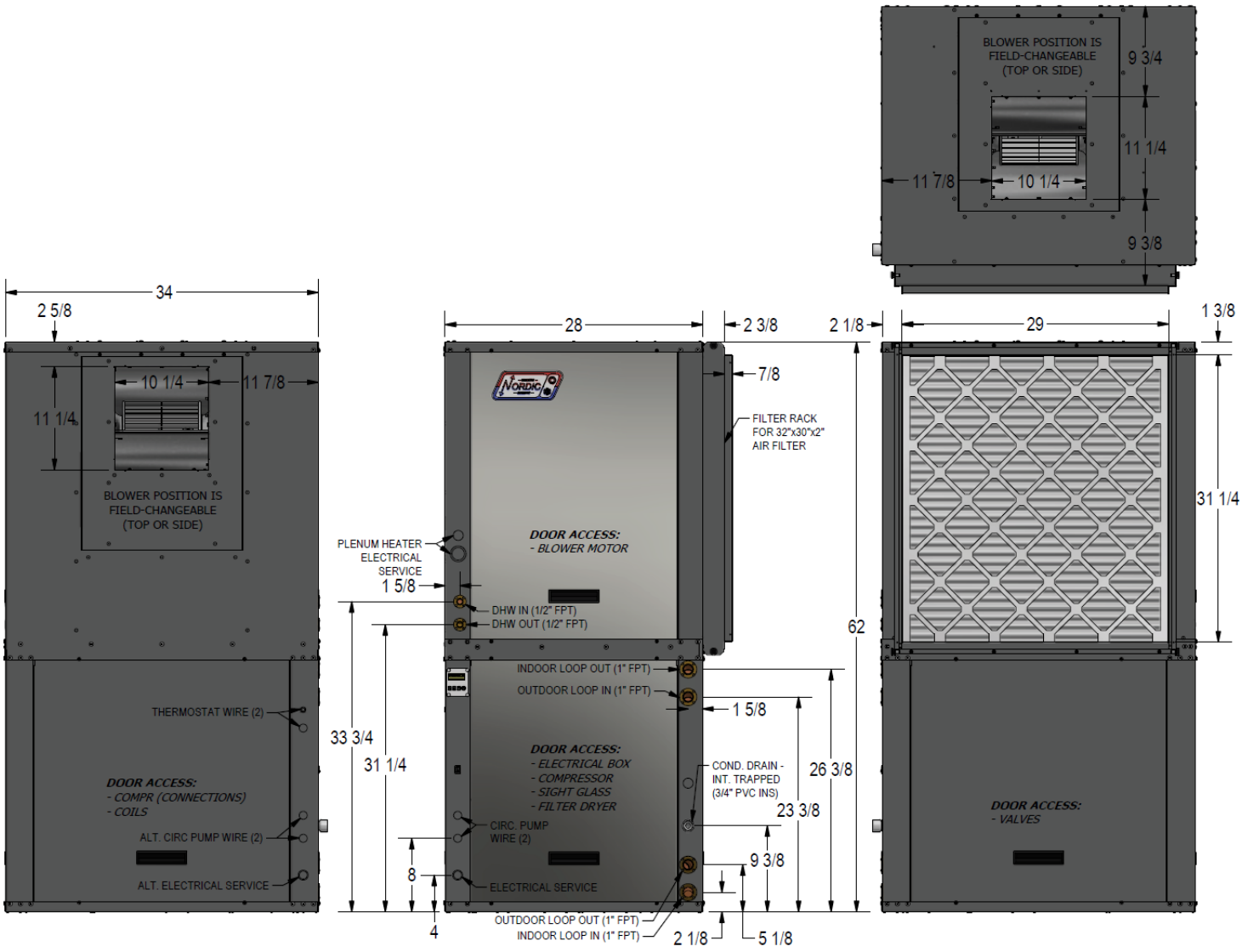
**RIGHT SIDE:**
> **2 FT** service access clearance required

**BACK:**
no clearance required

go to TABLE OF CONTENTS

# Dimensions: TF-45 Right Return

All dimensions in inches.




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

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

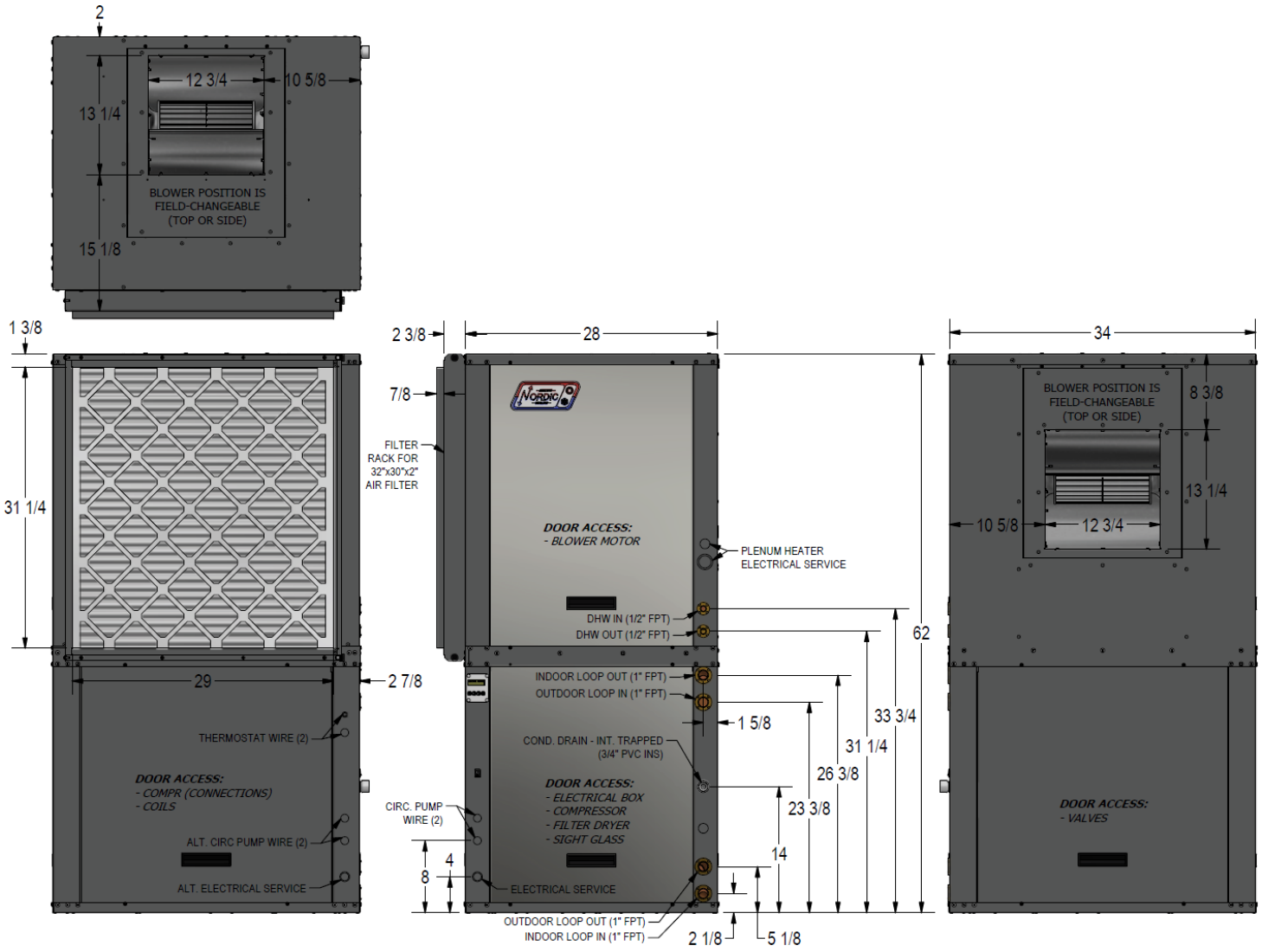
**RIGHT SIDE:**
optional compressor access

**BACK:**
no clearance required

go to TABLE OF CONTENTS

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

All dimensions in inches.




**LEFT SIDE:**
optional
compressor access

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

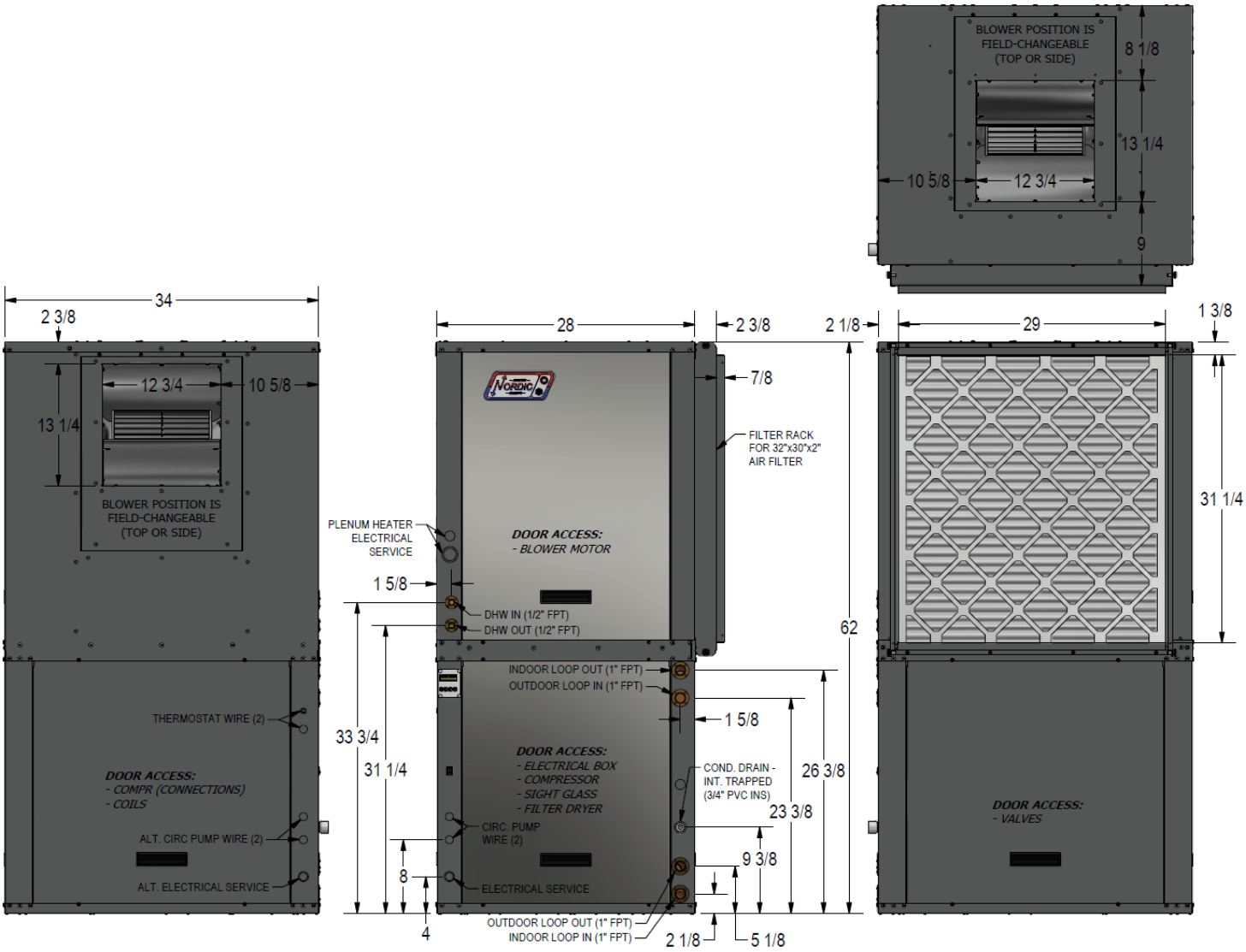
**RIGHT SIDE:**
> **2 FT** service access
clearance required

**BACK:**
no clearance required

go to TABLE OF CONTENTS

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

All dimensions in inches.




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

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

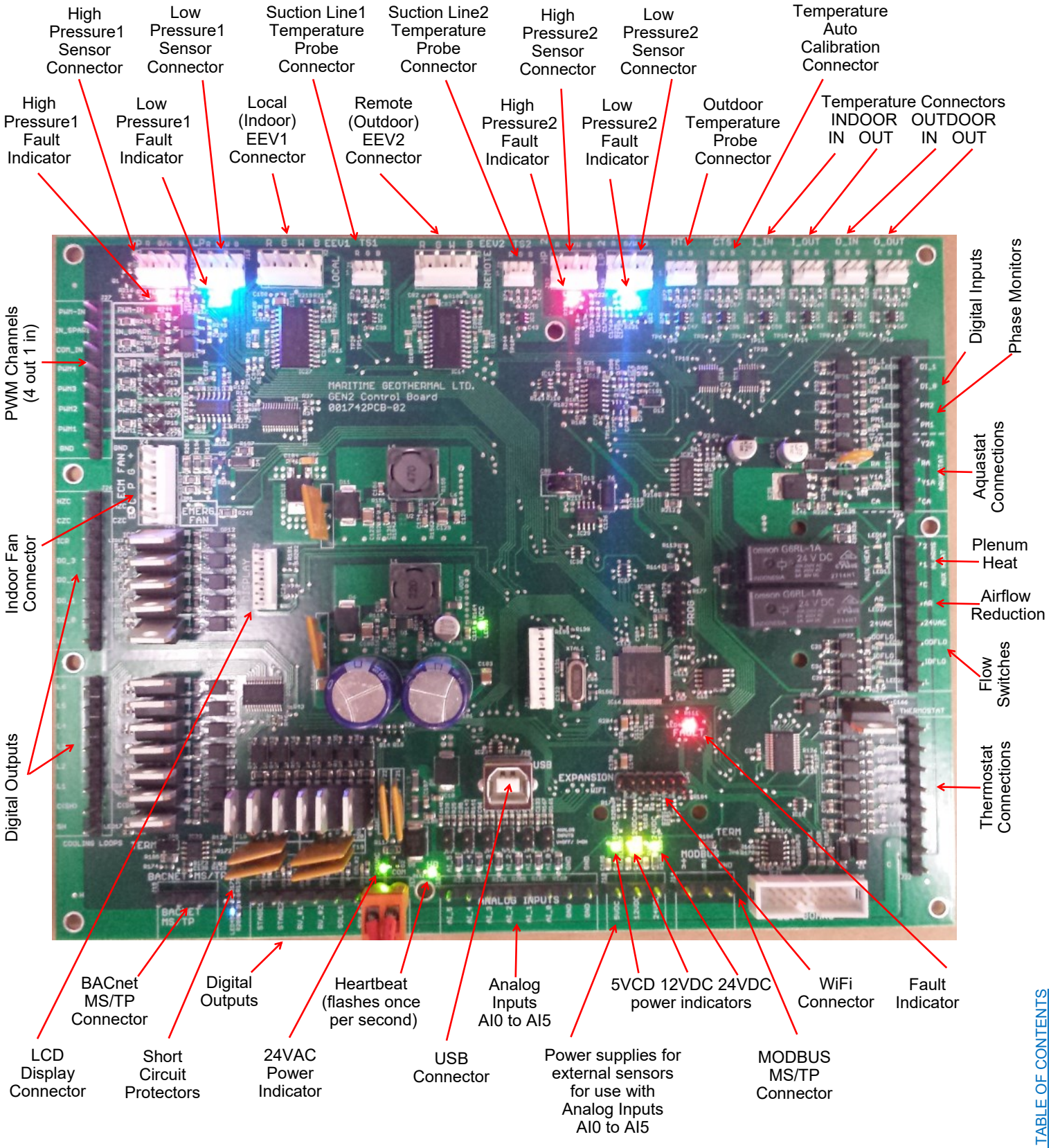
**RIGHT SIDE:**
optional compressor access

**BACK:**
no clearance required

go to TABLE OF CONTENTS

# 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.




go to TABLE OF CONTENTS

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

| TABLE A1 - Control Board Connector Descriptions (Top) | | |
|---|---|---|
| **Name** | **Description** | |
| HPS1/HI1 | High Pressure Sensor 1 | Measures discharge pressure. |
| LPS1/LO1 | Low Pressure Sensor 1 | Measures suction pressure. |
| EEV1 | Local EEV | Control of Electronic Expansion Valve. |
| TS1 | Suction Line Temperature 1 | Mounted to common suction line inside unit. |
| EEV2 | Remote EEV | Not used. |
| TS2 | Suction Line Temperature 2 | Not used. |
| HPS2/HI2 | High Pressure Sensor 2 | Not used. |
| LPS2/LO2 | Low Pressure Sensor 2 | Not used. |
| HTS | Outdoor Temperature | Optional RTD 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 | Not used. |
| IN_SPARE | Spare digital input | Switch or dry contact from 12VDC to disable unit (also COM_IN to GND). |
| COM_IN | Common for PWM IN | Jumper to GND for disable functionality. |
| PWM4 | PWM / 0-10VDC output | Not used. |
| PWM3 | PWM / 0-10VDC output | Not used. |
| PWM2 | PWM / 0-10VDC output | Not used. |
| PWM1 | PWM / 0-10VDC output | Not used. |
| GND | Ground | Not used. |
| | | |
| HZC | Hot Zone Circulator | Not used. |
| CZC | Cold Zone Circulator | Not used. |
| ICR | Internal Circulator Relay | Operates the Indoor Circulator. |
| DO_3 | Auxiliary Only | Not used. |
| DO_2 | HYD_AUX | ON when hydronic auxiliary on (Setpoint Control only). |
| DO_1 | Digital output | Not used. |
| DO_0 | OV1 | To open loop water valve end switch or closed loop jumper plug (back to ODFLO). |
| LC | Loop common (ground) | Not used. |
| | | |
| L6 | Loop6 | Not used. |
| L5 | Loop5 | Not used. |
| L4 | NOT_HYD_AUX | Output OFF when auxiliary heat required; operates D1-D2 dry contacts. |
| L3 | Loop3 | Not used. |
| L2 | Loop2 | Not used. |
| L1 | Loop1 | Not used. |
| C(SH) | Soaker Hose common | Not used. |
| SH | Soaker Hose | Not used. |

go to TABLE OF CONTENTS

| 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 | Optional refrigerant vent fan relay/contactor. |
| 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 | Not used. |
| AI_3 | Analog In Channel 3 | Compressor discharge line temperature sensor. |
| AI_2 | Analog In Channel 2 | Condensate overflow sensor. |
| AI_1 | Analog In Channel 1 | Not used. |
| AI_0 | Analog In Channel 0 | Compressor current sensor. |
| GND | Ground pin | Ground for analog sensors. |
| GND | Ground pin | Ground for analog sensors. |
| | | |
| 5VDC | Power for analog sensors | 5VDC regulated power supply for sensors. |
| 12VDC | Power for analog sensors | 12VDC regulated power supply for sensors. |
| 24VDC | Power for analog sensors | 24VDC unregulated power supply for sensors. |
| | | |
| A | MODBUS | RS485 communication for refrigerant leak detector. |
| B | MODBUS | RS485 communication for refrigerant leak detector. |
| GND | MODBUS | Ground for shield if required. |

go to TABLE OF CONTENTS

| TABLE A4 - Control Board Connector Descriptions (Right Side) | | |
|---|---|---|
| **Name** | **Description** | |
| DI_1 | Digital Input1 | Not used. |
| DI_0 | Digital Input0 | Low pressure select from open/closed loop harness (0=open loop, 1=closed loop) |
| PM2 | Phase Monitor2 | Switch or dry contact from R to activate Summer Setback mode. |
| PM1 | Phase Monitor1 | Not used. |
| Y2A* | Aquastat Stage2 | Optional water heat stage 2 24VAC input for use with Signals/Hardwired control. |
| RA* | Aquastat Power (24VAC) | Optional 24VAC 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 | Not used. |
| L | Thermostat Lockout Indicator | 24VAC to external trouble indicator. |
| | | |
| E | Thermostat Emergency Heat | 24VAC input from external dry contact (air thermostat); activates plenum heater. |
| O | Thermostat Heat/Cool | 24VAC input from external dry contact (air thermostat); activates cooling mode. |
| W2 | Thermostat Auxiliary Heat | 24VAC input from external dry contact (air thermostat); activates plenum heater. |
| Y2 | Thermostat Stage2 | 24VAC input from external dry contact (air thermostat); activates compressor stg. 2. |
| Y1 | Thermostat Stage1 | 24VAC input from external dry contact (air thermostat); starts compressor. |
| G | Thermostat Fan Recirculation | 24VAC input from external dry contact (air thermostat); activates fan recirculation. |
| R | Thermostat Power (24VAC) | 24VAC to air thermostat. |
| C | Thermostat Power (Ground) | 24VAC ground for powering air thermostat. |
| *NOTE: There is no need for an external aquastat for most systems, since the Setpoint Control Method provides built in aquastat functionality. | | |

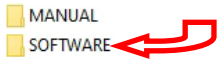
go to TABLE OF CONTENTS

# 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:



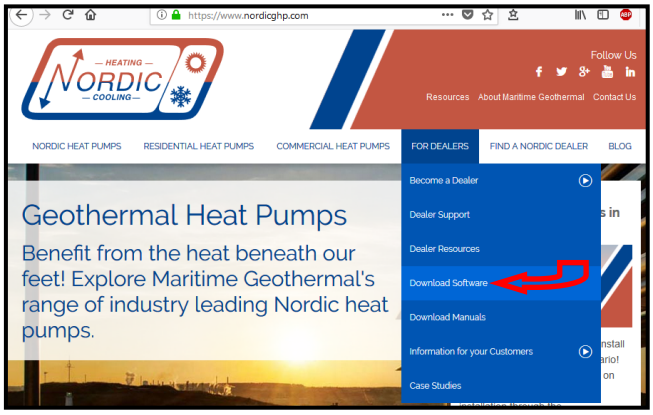

Double click on the SOFTWARE folder to show its contents:


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

---

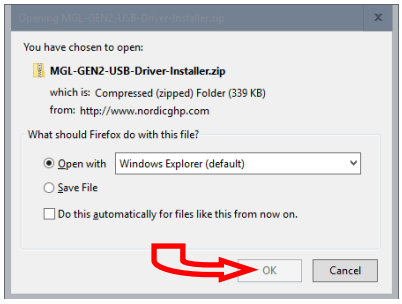
If the USB drive is not available, the same files can be **down-loaded from the web page**.

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

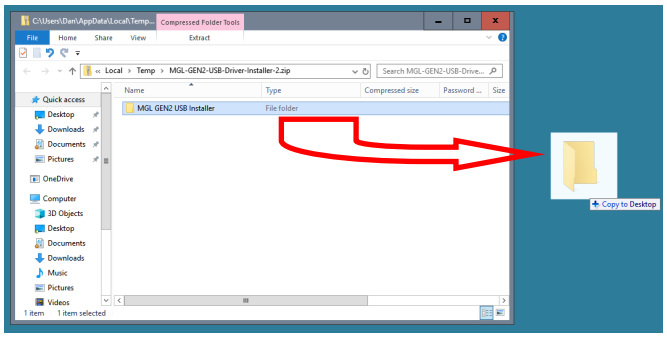



2. Click on **MGL GEN2 USB Driver Installer** to download it:

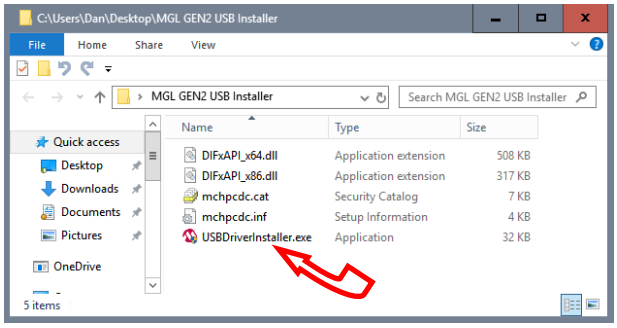

3. Choose "Open with Windows Explorer", and hit "OK". *(If the choice window doesn't pop up, find the downloaded file in your browser downloads and double click on it.)*



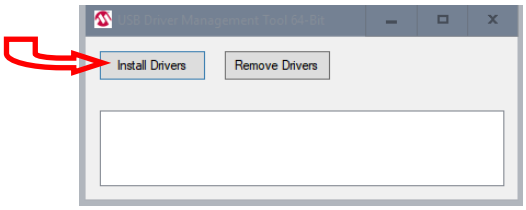

4. In the window that is displayed, click and hold down the mouse button on the folder name, and drag to your desktop:



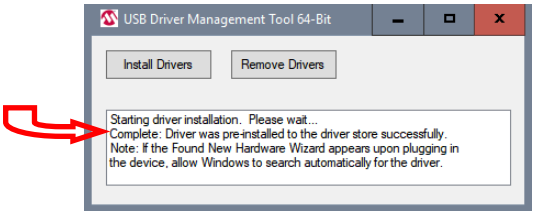

5. Double click on the folder you just dragged onto the desktop, then double click on the "USBDriverInstaller" file:




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.

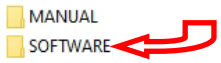



go to TABLE OF CONTENTS

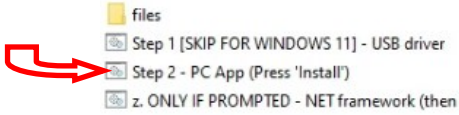
# Appendix C - PC App Installation (Windows 11)

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:

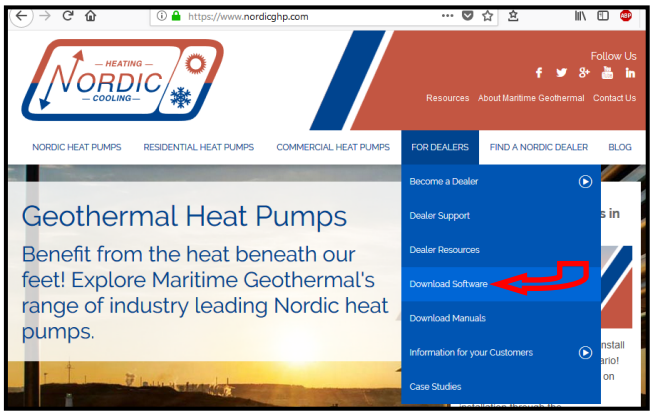



Double click on **Step 2** and follow the prompts, clicking "More info", "Run anyway", "Install", or similar on any warning windows which pop up, perhaps more than once. Pictures of warning windows you might encounter are shown below in step **8**.

---

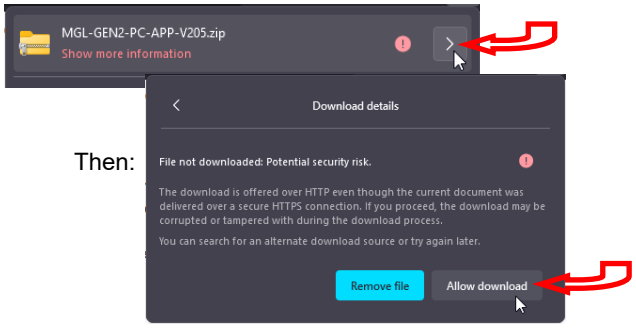
If the USB stick drive is not available, the same file can be **downloaded from the web page**.

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

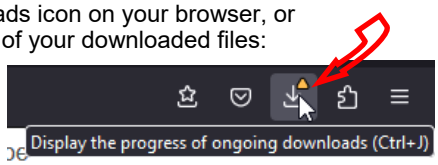



2. Click on **MGL GEN2 PC APP V2__** to download it:

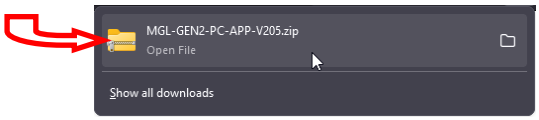

3. You may see a warning like this one. Click as shown:



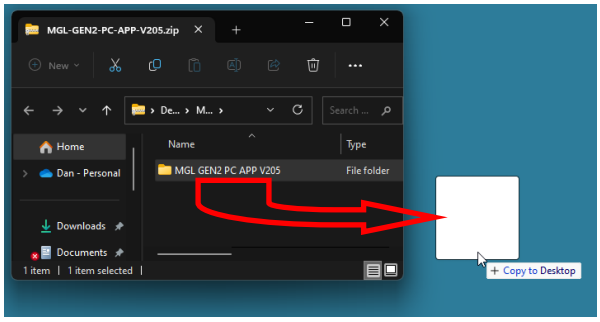

4. Click on the downloads icon on your browser, or otherwise view a list of your downloaded files:



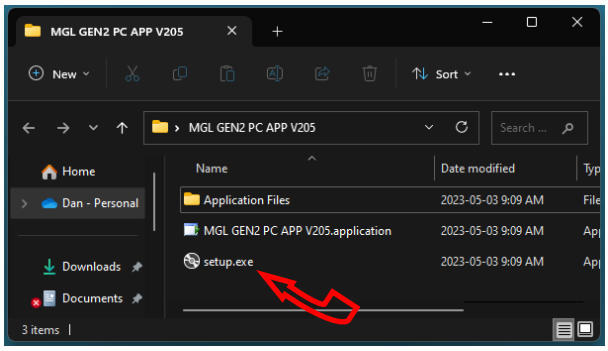

5. Then click on the .zip file to open it in a File Explorer window:



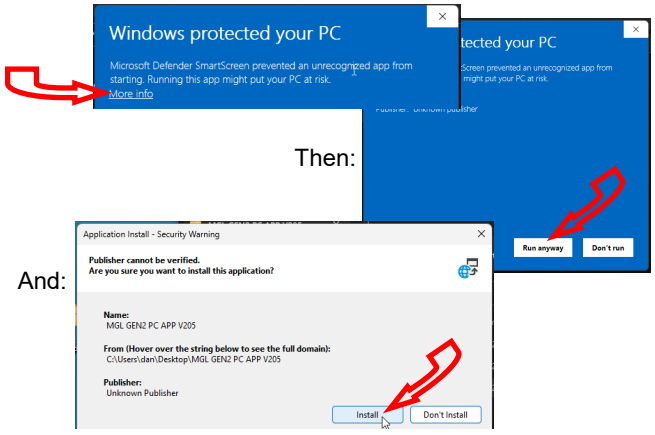

6. In the window that is displayed, click and hold down the mouse button on the folder name, and drag to your desktop:




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.



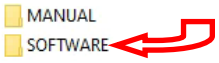

9. The PC App will open when it is finished installing. (In the future, it should be started from the start menu.) You are now ready to connect a USB cord between the laptop computer and GEN2 control board, and connect.

go to TABLE OF CONTENTS

# 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:



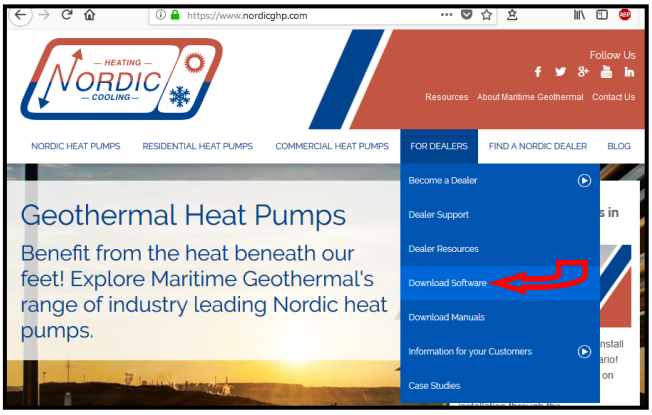

Double click on the SOFTWARE folder to show its contents:


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.

---

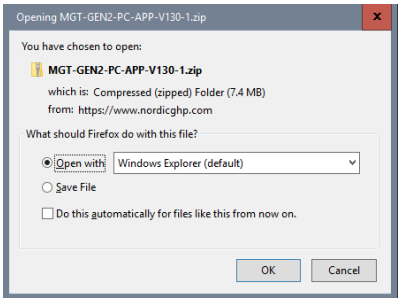
If the USB stick drive is not available, the same file can be **downloaded from the web page**.

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

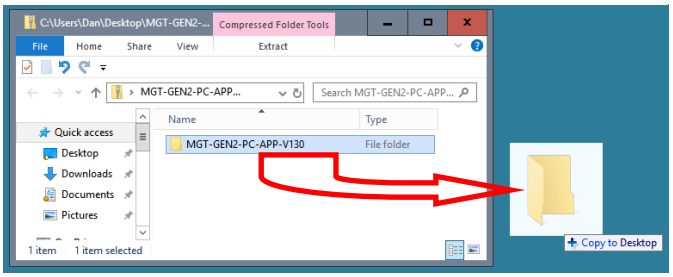



2. Click on **MGL GEN2 PC APP V2__** to download it:

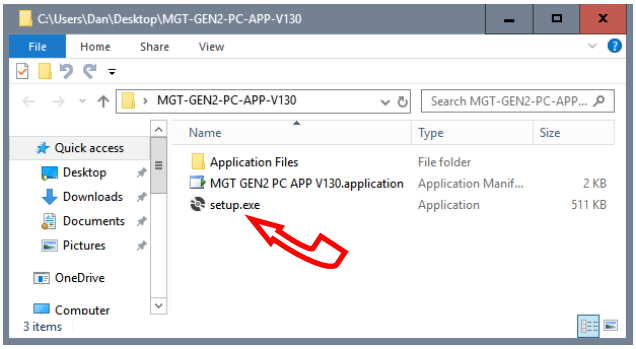

3. Choose "Open with Windows Explorer", and hit "OK":



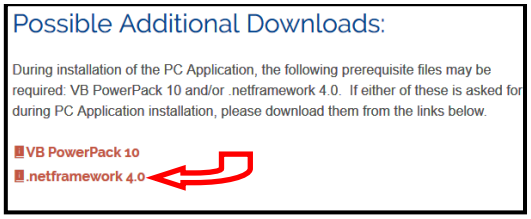

4. In the window that is displayed, click and hold down the mouse button on the folder name, and drag to your desktop:




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.

go to TABLE OF CONTENTS

# 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:

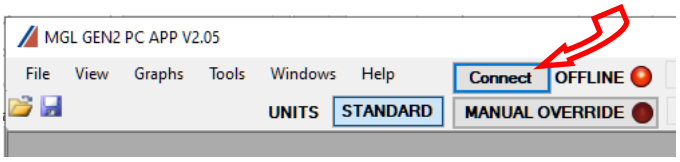
   | | |
   |---|---|
   | MGL_GEN2_V376.production.hex | (firmware file) |
   | PIC32UBL.exe | (the programmer) |
   | USB Bootloader Instructions.pdf | (these instructions) |

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

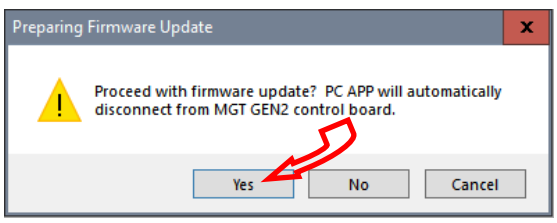
3. Connect a USB (printer) cable between computer and control board.

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.

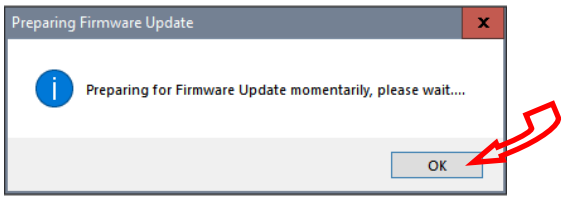
5. In the PC App, click on the **Connect** button to connect to the control board.



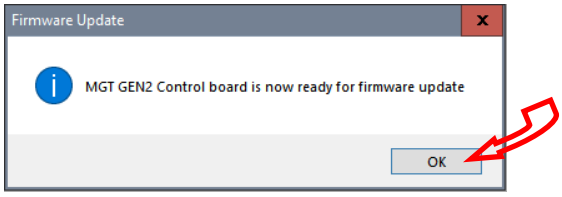

6. Go to menu **Tools --> Update Firmware**. The following message box will appear:




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

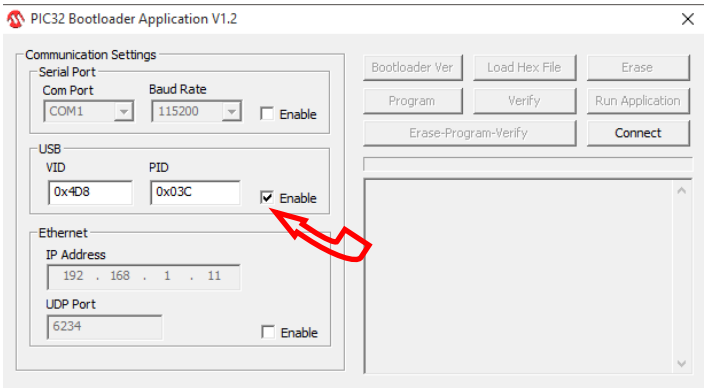



8. Click on **OK**. After a minute, the following message box will appear:

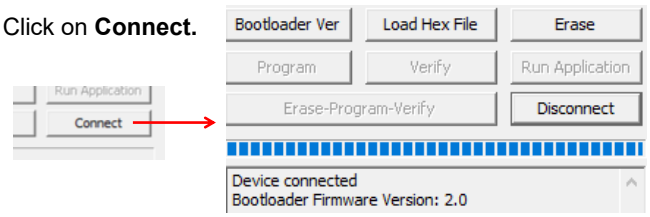



9. Click on **OK**. The control board is now in bootloader mode and is ready to be programmed.

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



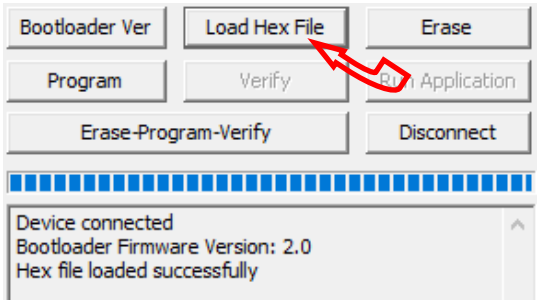

11. Click on **Connect.**



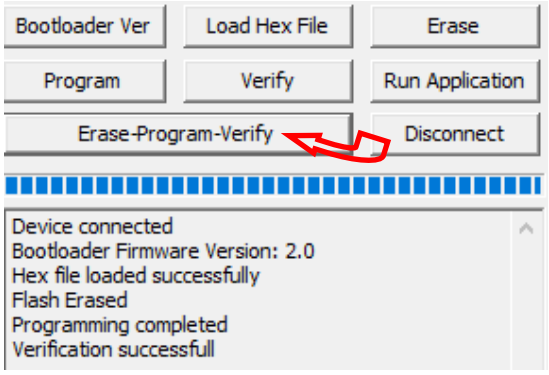

*If device fails to connect and an error message is displayed, the board's bootloader may be older than v2.0. It will be necessary to instead update the firmware via jumper pins (**METHOD 2**), as per the next section.*

go to TABLE OF CONTENTS

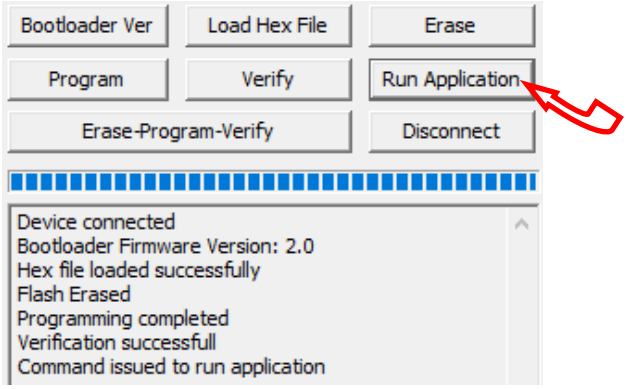
12. Click on **Load Hex File**. Select the M*GL_GEN2_V376.production.hex* (or higher version number) file, which is in the folder you created on the Desktop.



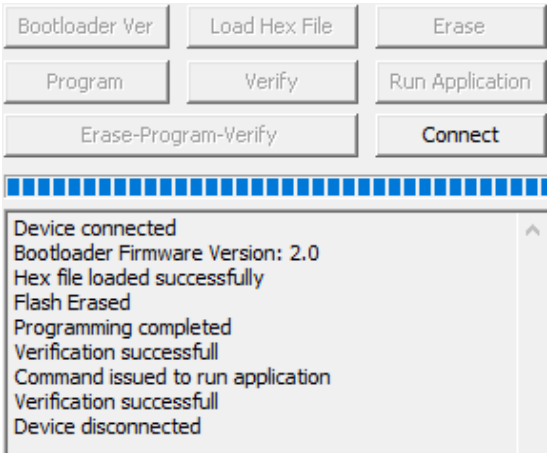

13. Click on **Erase—Program—Verify.** Programming…. Wait while status bar shows progress. The messages should read as below when finished:




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.



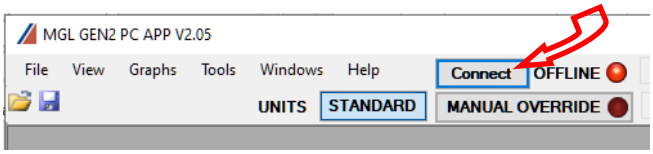

15. **Wait until the programmer disconnects itself.** The messages should read as follows:




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.



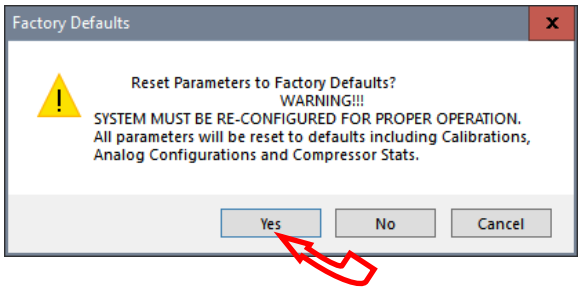

**NOTE: Updating the firmware does not affect the configuration settings.**

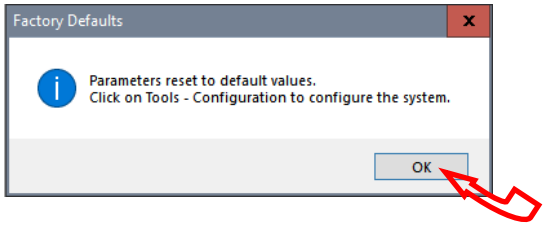
# Reset to Defaults?

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 even if it already indicates the proper series, as clicking on it will load the parameters for that series.
4. Select the Model Size and make any other changes that apply to the particular system setup such as number of stages, control method, etc.

go to TABLE OF CONTENTS

# 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) |

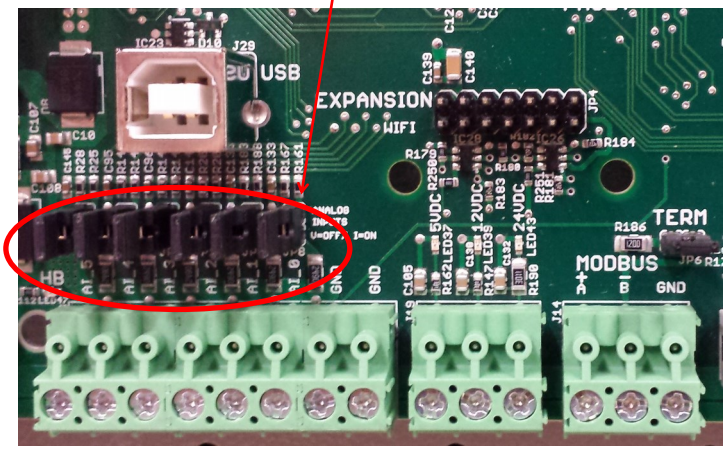
   Note that on most computers, the file extensions (.exe, .pdf) will be hidden.

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

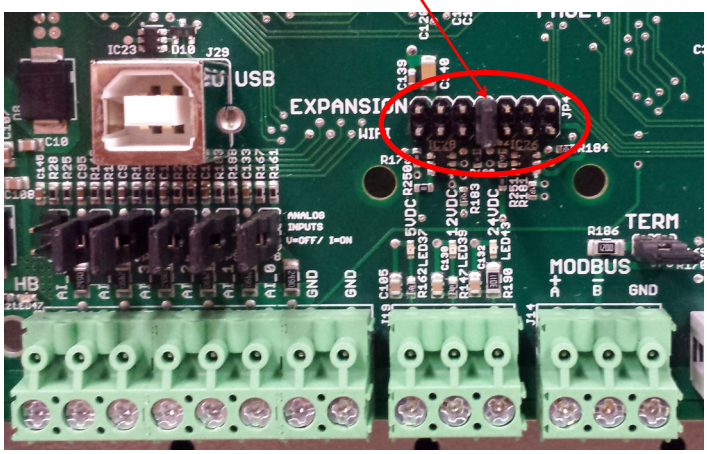
4. Turn power off to the heat pump.

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)*

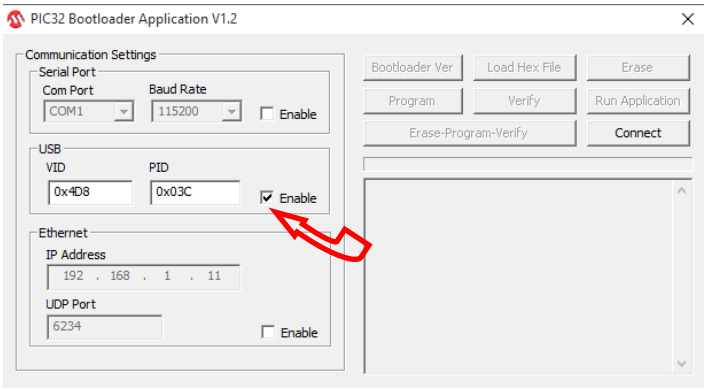



*Place jumper here*

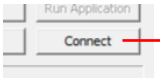


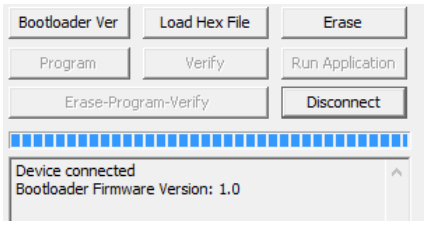

6. Turn the power back on. The control board is now in boot loader mode and is ready to be programmed.

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

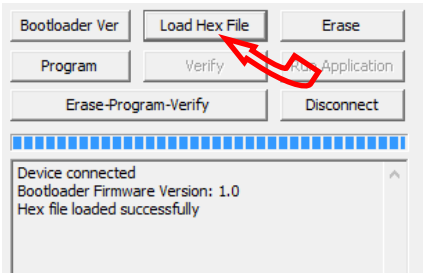



8. Click on **Connect.**



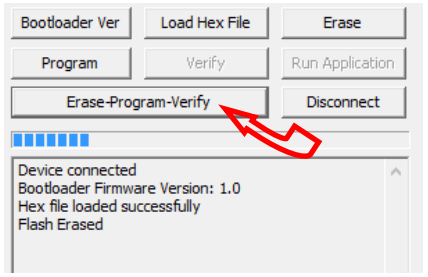




9. Click on **Load Hex File**. Select the *MGL_GEN2_V376.production.hex* (or higher version number) file, which is in the folder you created on the Desktop.




10. Click on **Erase—Program—Verify**

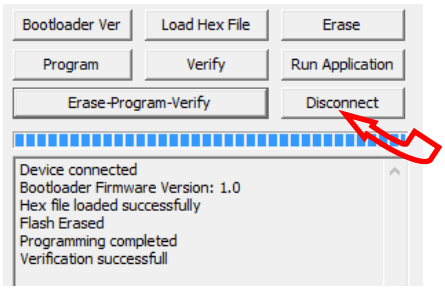
Programming…




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.

go to TABLE OF CONTENTS

# 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.

go to TABLE OF CONTENTS