Application, Installation, & Service Manual

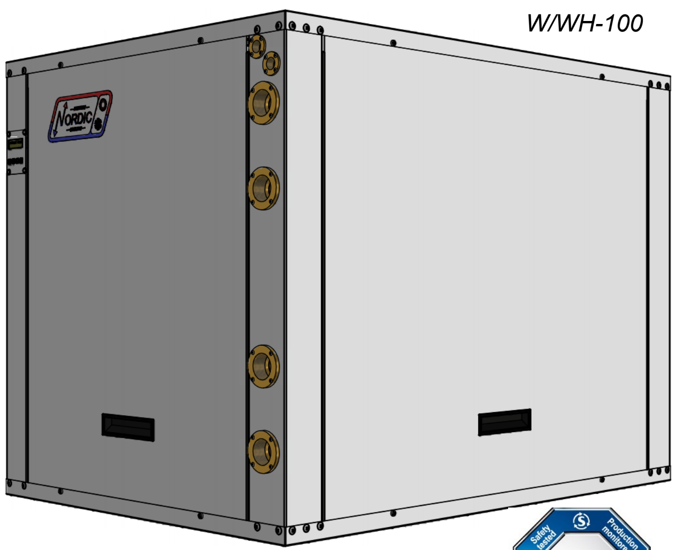
Commercial Water to Water Heat Pumps / Chillers

Single Refrigeration Circuit

W-series *(standard temperature, R454b)*
WH-series *(high temperature, R513a)*

Model Size 100 (9 ton, coaxial coils)
Model Sizes 120/140/180/235 (10 to 20 ton, brazed plates, opt. dedicated DHW)

W/WH-120/140/180/235



W/WH-100

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LOOK FOR GREY TEXT BOXES LIKE THIS ONE THROUGHOUT MANUAL FOR
***A2L-SPECIFIC WARNINGS / INSTRUCTIONS** (Applicable to **W-series** only, which uses **R454b** refrigerant)*

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.

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Model Nomenclature

W - 120 - H - X - 2S - PD - xx

Series:
W = liquid to water (hydronic)
WH = high temperature liquid to water

Nominal Size:
100 = 9 ton
120 = 10 ton
140 = 11.5 ton
180 = 15 ton
235 = 20 ton

Functions:
H = Heating
AC = Active Cooling (reversing valve)
W = desuperheater for DHW

Refrigerant:
X = R454b **[A2L]** (W series)
Y = R513a [A1] (WH series)

Revision:
01, 02 etc.

Indoor Loop Exchanger:
C = copper coaxial coil
Z = cupro-nickel (CuNi) coaxial
P = brazed plate
D = double wall brazed plate for DHW

Outdoor Loop Exchanger:
C = copper coaxial coil
Z = cupro-nickel (CuNi) coaxial
P = brazed plate

Compressor:
S = single stage scroll

Voltage Code:
2 = 208-3-60
4 = 460-3-60
5 = 575-3-60
8 = 400-3-60

APPLICATION/AVAILABILITY TABLE *Coaxial Coil models - desuperheater available*

MODEL	FUNCTION	REFRIGERANT	VOLTAGE	COMPR.	OUTDOOR COIL	INDOOR COIL	REVISIONS			
W-100	H HAC HACW HW	X	2 4 5	S	C Z	C Z	01			
WH-100	H HAC HACW HW	Y	2 4 5	S	C Z	C Z	01			

APPLICATION/AVAILABILITY TABLE *Brazed Plate models - no desuperheater, direct DHW heating available if non-reversing*

MODEL	FUNCTION	REFRIGERANT	VOLTAGE	COMPR.	OUTDOOR COIL	INDOOR COIL	REVISIONS			
W-120 W-140 W-180	H	X	2 4 5	S	P	P D	01			
	HAC	X	2 4 5	S	P	P	01			
W-235	H	X	4 5	S	P	P D	01			
	HAC	X	4 5	S	P	P	01			
WH-120 WH-140 WH-180	H	Y	2 4 5	S	P	P D	01			
	HAC	Y	2 4 5	S	P	P	01			
WH-235	H	Y	4 5	S	P	P D	01			
	HAC	Y	4 5	S	P	P	01			

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System Description

All of the water-to-water heat pumps described in this manual have a single compressor and refrigeration circuit, in size range 9-20 tons. (Dual compressor/dual refrigeration circuit **NORDIC** heat pumps in the 12-81 ton size range are also offered, detailed in a different manual.)

Single-stage scroll compressors are standard, as are Electronic Expansion Valves (EEV's). The electronic control board has full local unit hydronic temperature control, laptop connectivity via USB with free PC App, LCD interface, electronic readout of all pressures and temperatures, data logging & graphing, and BACnet.

These 'light commercial' models are designed in a traditional short cabinet, and can be stacked. They are available with or without a reversing valve, and with or without a desuperheater. The desuperheater option heats DHW in a separate preheat tank using a double wall heat exchanger with ~5% of the heat pump's capacity. It is only active when the heat pump is active due to a demand for space heating or cooling.

W-Series vs. WH-Series

All of the heat pumps described in this manual come in 2 varieties, which have identical features but differ in their temperature ranges:

The **W-series** uses **R454b** refrigerant (an **A2L**) to achieve a standard geothermal temperature range: the outdoor loop can operate at as low a temperature as **0°F (-17°C)** for ice production or geothermal / geoexchange applications, and the indoor loop can reach **130°F (54°C)** leaving water temperature (or **140° F (60°C)***with a reduced flow rate* for DHW applications).

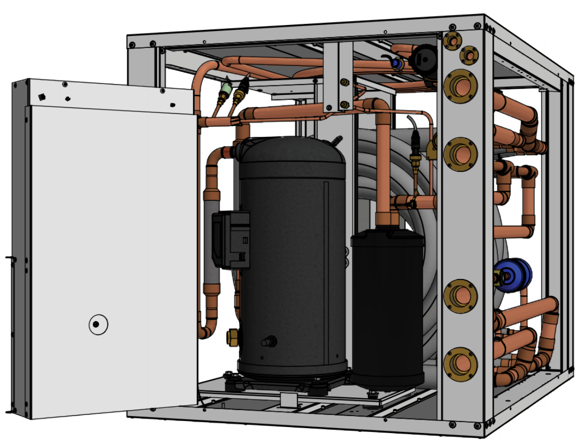
The **WH-series** uses **R513a** refrigerant (an **A1**) to achieve an upward shift in temperature range: the outdoor loop requires a minimum incoming water temperature of **40°F (4°C)**, so is suitable for use on many open loop or heat recovery applications, or closed ground loops in warm climates. The indoor loop can reach **160°F (71°C)** leaving water temperature.

Two Different Heat Pump Layouts

There are also two styles of single compressor heat pumps described here, each with its own advantages and applications:

1. Model Size 100: Coaxial Coils

The indoor and outdoor loop hydronic heat exchangers both consist of pairs of coaxial steel coils with fluted copper inner tube. Coaxial coils have large water channels so that particle fouling is unlikely, so are sometimes preferred for open loop applications. Also, copper nickel (CuNi) inner tube is available on both indoor and outdoor coils for more challenging water qualities.



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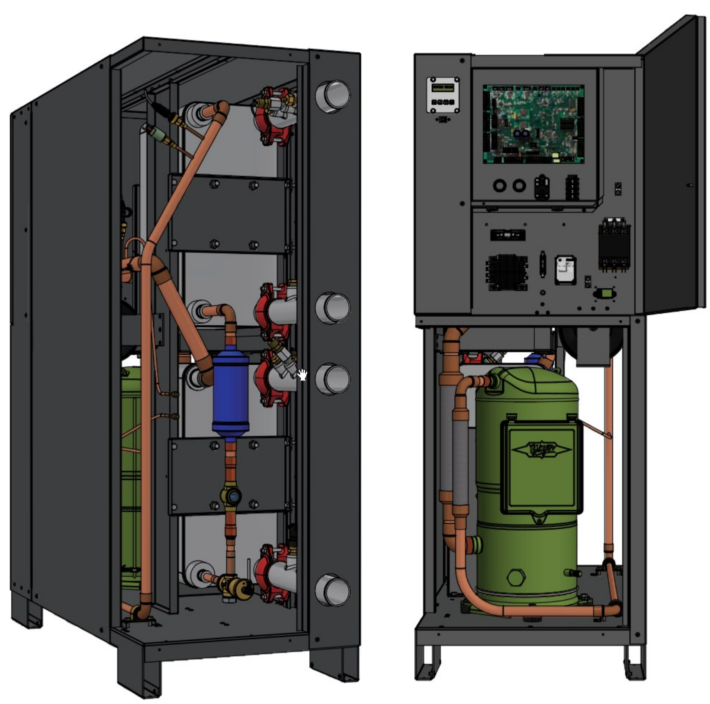
2. Model Sizes 120/140/180/235: Brazed Plates, DHW

The indoor and outdoor loop hydronic heat exchangers are brazed plates. These provide a high heat transfer efficiency and smaller refrigerant volume, but have smaller water channels so normally require field installed strainers to prevent particle fouling.

A further advantage to brazed plates is that they are available in a single wall variety for space heating, or optional double wall variety for direct heating of domestic hot water (DHW). This is an option that is not available on larger dual circuit NORDIC heat pumps, since true dual circuit brazed plates are not made in the double wall configuration. Note that single compressor heat pumps are particularly suitable for DHW heating because of the high temperature lift, leading to naturally longer compressor run times.

Reversing valves are available for space heating models with single wall condenser. If ordered with a double wall condenser for direct DHW heating, reversing valve is not available. Desuperheaters are not applicable to these models.

These models are designed in a vertical cabinet with no side clearance required, making side-by-side multiple unit installations easy.



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Space Heating Mode

In space heating mode with a single wall condenser heat pump, the heat pump heats water in an indoor loop or buffer tank, while extracting heat from an outdoor loop.

For commercial environments, heat pumps are often sized and the system laid out by a mechanical consulting engineer. For space heating/cooling, it is good practice to design the system with non-reversing heat pumps that always use 'heating mode': heating with the hot indoor loop, and cooling with the chilled outdoor loop. (See simultaneous heating-cooling diagrams in the **Piping** chapter.) Multiple units are easily installed using reverse return headers, to provide redundancy as well as the ability to meet large loads. However, reversing valves are available if required.

Control is often done using the building control system via BACnet, and includes lead/lag stage rotation to evenly distribute the run hours between compressors. Loop circulation pumps can also be centrally controlled via BACnet.

It is also possible to use the heat pump in standalone operation or in small numbers of units. In this case, the hydronic temperature control functionality built into the heat pump may be used, and circulation pumps and/or water valves (either on/off or modulating) can be powered and controlled by the heat pump. A third control option is through dry contacts by an external thermostat or controller.

Hydronic heating systems are easily zoned, and zones may be in-floor heating, hydronic air handlers, or other hydronic devices suitable for the water temperature. 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.

Space Cooling Mode *(-HAC* models only)*

Reversing valves to swap the hot and cold loops are available only for non-DHW (indoor coil "P" models, see Application Table on page 3). When reversing valve is activated, the indoor loop or buffer tank is chilled, and heat is rejected to the outdoor loop.

Hydronic cooling is usually done through hydronic air handlers, which have condensate drains to remove water that is removed while dehumidifying the air. In less humid climates, in-floor or radiant cooling is sometimes performed; such systems can't remove humidity from the air. In this case, care must be taken to ensure the cooling surface does not fall below the dew point temperature in order to prevent condensation on floor surfaces.

DHW Heating

When heating domestic hot water (DHW) with the optional double wall condenser, the heat pump heats water in a DHW tank, while extracting heat from an outdoor loop. Operation is very similar to space heating mode in other respects.

DHW Water Temperature

⇒ A commonly cited plumbing code DHW temperature requirement is **140°F (60°C)**.

⇒ The minimum temperature to prevent Legionella bacteria growth is 122°F (50°C). So to prevent bacteria growth, a safety factor of a couple of degrees would require a minimum of **124°F (51°C)** at the coolest spot in the hot water distribution system.

⇒ Above 122°F (50°C) and up to 131°F (55°C), Legionella bacteria survives, but will not multiply.

⇒ At 131°F (55°C), it takes 5 to 6 hours for the bacteria to die.

⇒ At **140°F (60°C)**, the bacteria dies in about 32 minutes.

⇒ At 151°F (66°C), the bacteria dies instantly. The recommended minimum disinfection temperature is a few degrees above 151°F, which is **158°F (70°C)** for about 5 minutes.

The above means that:

a) A **W**-120 to 235 heat pump with optional double wall condenser can heat DHW up to 140°F (60°C), the plumbing code temperature. Although the introduction of cold water from the mains will mean parts of the system will below 122°F (50°C), in the unlikely event any nascent bacteria forms it will be taken care of at the higher temperature.

A **W** series heat pump can handle low source loop temperatures, as would be found in a northern climate geothermal ground loop.

a) A **WH**-120 to 235 heat pump with optional double wall condenser can heat DHW up to 160°F (71°C) and provide DHW disinfecting capabilities for environments that are in some way susceptible to Legionella bacteria. This could be for example due to prolonged periods of water storage at low temperatures.

A **WH** series heat pump requires a source loop temperature that is always above 45°F (7°C). So it **can't** be used for typical geothermal ground loops in northern climates, but could be used for open loop installations in many places or in heat recovery applications.

If in doubt about the safety of a domestic hot water system, a specialist in this area of expertise should be consulted.

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Installation Basics

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

The **W-series** uses **R454b,** an **A2L** refrigerant which is a classification meaning "slightly flammable". (The **WH-series** uses the **A1** refrigerant **R513a**, so no special measures apply to WH units.)

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. If engineering services are unavailable, use of the **A1 WH-series** is suggested (after confirming temperature range is appropriate for the application).

The A2L W-series heat pump / chiller 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 W-series heat pumps 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 pumps reach the site, they 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 claim filed.

Unit Placement

Locate the unit as per the system design drawings.

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The access panels on the front and right side of the units should remain clear of obstruction for a distance of >**2 ft (0.6 m)** to facilitate installation and servicing. Although not required, clearance can be provided to the left side of the units for more convenient compressor service access; but note that the electrical box swings out from the front for compressor access.

Since all serving can be done from the front and sides, no access is required to the back.

It is recommended that the heat pump be placed on a piece of 2" Styrofoam, or the rubber pad available as an accessory from Maritime Geothermal. This will deaden compressor noise emitted from the bottom of the cabinet, and prevent cabinet corrosion. Multiple units can be stacked with such a pad between them up to 2 units high only; the pad must be continuous and not just point or corner supports.

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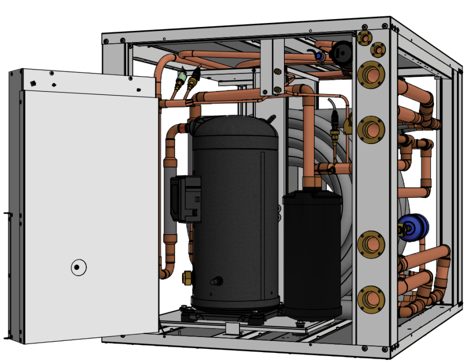
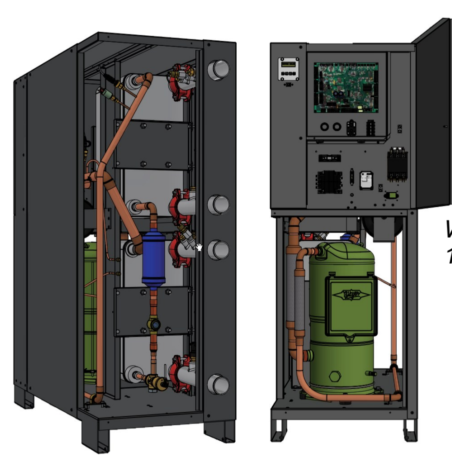


W/WH-120/140/180/235

These units are taller, and are designed to be installed next to one another with no side clearance.

Note that for multiple unit installations, headers will connect the units on the piping end. Extra space must be allotted for the headers, which can be of substantial size (up to 6" in diameter). Space for external accessories must also be planned for, e.g. strainers and valves (manual, electronic, balancing, or modulating). Headers and accessories are not included with the heat pump, and must be ordered or sourced separately.

Service clearance must be provided on the non-piping end as well, for access to the electrical box and compressor.



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General Bill of Materials

This is not an exhaustive list, but is an example of the materials that may be required for a commercial installation.

FROM MARITIME GEOTHERMAL
• W/WH SERIES HEAT PUMP(S)

OPTIONAL FROM MARITIME GEOTHERMAL
• OUTDOOR TEMPERATURE SENSOR FOR OUTDOOR RESET WHEN USING ONBOARD SETPOINT CONTROL
• HOT/COLD TANK TEMPERATURE SENSORS

LOOPS (AS SPECIFIED BY SYSTEM DESIGNER)
• PREFABRICATED HEADERS
• GROOVED (VICTAULIC) COUPLINGS
• STRAINERS - 16 MESH / 1 MM
• ON/OFF WATER VALVES
• BUTTERFLY (HAND) VALVES
• BALANCING VALVES
• CIRC. PUMPS, SIZED FOR REQUIRED FLOW & dP
• PIPE & FITTINGS
• ANTIFREEZE: METHANOL OR PROP. GLYCOL
• BUFFER TANK, W/ELEMENTS __kW
• SECONDARY WATER TO WATER HEAT EXCHANGERS

ZONES
• ZONE CIRCULATOR(S)
• ZONE TRANSFORMER & CIRC CONTACTOR
• ZONE VALVES (IF NOT INDIVIDUAL PUMPS)
• IN-FLOOR PIPING
• OTHER AIR HANDLERS, DUCTING
• ZONE THERMOSTATS
• RELAYS OR ZONE CONTROLLER
• ZONE SUPPLY & RETURN HEADERS
• PIPE & FITTINGS TO ZONES
• EXPANSION TANK

ELECTRICAL
• HEAT PUMP SERVICE WIRE
• BUFFER TANK ELEMENT SERVICE WIRE
• HEAT PUMP BREAKER
• BUFFER TANK ELEMENT BREAKER
• CONTACTOR & ELEC. BOX (IF NOT WITH TANK)
• THERMOSTAT WIRE 18-4
• THERMOSTAT WIRE 18-2
• FORK TERMINALS FOR TSTAT WIRE (6)

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Wiring

Power Supply Connections

The heat pump cabinet has several knockouts of various sizes for the electrical connections.

A schematic diagram (SCH) and electrical box layout diagram (ELB) can be found on the electrical box cover of the unit as well as in the **Model Specific Information** chapter of this manual.

The Electrical Specifications in the **Model Specific Information** chapter contain information about the size of wire for the connections, as well as the recommended breaker size. These should be checked by referencing MCA and FLA by a qualified professional to ensure conformance to local codes. Power supply connections to the unit are made directly to the compressor contactor inside the electrical box and are as per **TABLE 1.** Ground is to be connected to the **GND** lug inside the electrical box.

TABLE 1 - Power Supply Connections		
Line	**Description**	**Voltages**
L1	**Line 1**	**All**
L2	**Line 2**	**All**
L3	**Line 3**	**All**
N	Neutral	No Connection

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

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

Indoor Loop Circulator Pump Wiring

The indoor loop circulator provides flow between the heat pump and the buffer tank. In most multiple-unit commercial installations, the circulators (and the heat pump) will be controlled by the building automation system, since one circulator may serve several heat pumps. Connect circulator pumps as per site drawings.

If the heat pump is to control the indoor circulator, there are dry contacts provided to control the circulator pump so that it will be turned on whenever the compressor operates. Wire to **CP1** and **CP2** on the terminal strip, as shown on the following diagram **002188CDG** and the wiring diagram (SCH) in the **Model Specific Information** chapter of this manual. Ensure that the total current draw does not exceed the value indicated on the diagram.

There is also provision for directly connecting an indoor circulator contactor with 24VAC coil, without an external 24VAC transformer. See "Indoor Water Valve Wiring - ON/OFF", below.

When using ***Setpoint Control,*** the indoor circulator will also be activated at times when the compressor is not running (refer to **Operation** chapter). The heat pump will start and stop indoor circulators to sample the water temperature.

Outdoor Loop Circulator Pump Wiring

The outdoor loop circulator provides flow between the heat pump and the outdoor loop. In most multiple-unit commercial installations, the circulators (and the heat pump) will be controlled by the building automation system, since one circulator may serve several heat pumps. Connect circulator pumps as per site drawings.

If the heat pump is to control the outdoor circulator, there are dry contacts provided to control the circulator pump so that it will be turned on whenever the compressor operates. Wire to **CP1** and **CP2** on the terminal strip at the lower right side of electrical box, as shown on the following diagram **002188CDG** and the wiring diagram (SCH) in the **Model Specific Information** chapter of this manual. Ensure that the total current draw does not exceed the value indicated on the diagram.

There is also provision for directly connecting an outdoor circulator contactor with 24VAC coil, without external 24VAC transformer. See "Outdoor Water Valve Wiring - ON/OFF", below.

IMPORTANT: If the outdoor circulator is connected via **CP1** and **CP2,** it may be unnecessarily activated at times when the compressor is not running, if using the ***Setpoint Control*** option (refer to **Operation** chapter). Under Setpoint Control, the heat pump may start and stop indoor circulators connected via CP1 and CP2 to sample the water temperature when the heat pump is not operating. Therefore, if using Setpoint Control, outdoor circulators should be activated as per "*Outdoor Water Valve Wiring - ON/OFF*", below.

TABLE 2 - Indoor & Outdoor Circulator Connections	
Terminal	**Description**
CP1	**Dry contacts for circulator control**
CP2	
Use a 2-conductor 18ga cable.	

Outdoor Loop Water Valve Wiring

ON/OFF: Connect a 24VAC outdoor loop water valve (or outdoor loop circ pump contactor) between **OV1** and **GND** (terminals **DO_0** and **LC** on control board), as shown on the wiring diagram (SCH) in the **Model Specific Information** chapter. Ensure that the total current draw does not exceed the value indicated on the diagram.

The outdoor circulator contactor may be connected here, to avoid need for an external 24VAC transformer or to avoid activation during sampling when using Setpoint Control.

MODULATING: Connect a 0-10VDC or PWM water valve between **OV2** and **GND** (terminals **PWM3** and **GND** on control board), as shown on the wiring diagram (SCH) in the **Model Specific Information** chapter. An outdoor modulating water valve will give the control board the means to restrict the outdoor loop water flow in cooling mode on reversing units, in case a low outdoor loop temperature causes a dip in the head pressure and therefore suction pressure. This will prevent nuisance low pressure control trips, for example when using cold open loop well water in cooling mode. It will be closed when unit is off, and may act to limit suction pressure due to high outdoor loop temperature in heating mode depending on firmware revision.

The head pressure below which the modulating water valve will start restricting water flow can be adjusted via the Configuration page in the PC App. Default is 350 psi.

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Indoor Loop Water Valve Wiring

ON/OFF: Connect a 24VAC indoor loop water valve between **IV1** and **GND** (terminals **DO_1** and **LC** on control board), as shown on the wiring diagram (SCH) in the **Model Specific Information** chapter. Ensure that the total current draw of all water valves does not exceed the value indicated on the diagram.

The indoor circulator contactor may be connected in the same way, to avoid the need for external 24VAC transformer.

MODULATING: Connect a 0-10VDC or PWM water valve between **IV2** and **GND** (terminals **PWM4** and **GND** on control board), as shown on the wiring diagram (SCH) in the **Model Specific Information** chapter. An indoor modulating water valve will give the control board the means to restrict the indoor loop water flow in heating mode, in case a low indoor loop temperature causes a dip in the head pressure and therefore suction pressure. This will prevent nuisance low pressure control trips, for example in case a large zone containing cool water opens, or in case of generally low indoor loop temperature. It will be closed when unit is off (and not sampling for Setpoint Control). On reversing HAC units in cooling mode, valve may act to limit suction pressure due to high indoor loop temperature depending on firmware revision.

The head pressure below which the modulating water valve will start restricting water flow can be adjusted via the Configu-

TABLE 3 - Water Valve Connections		
Control Board Label	**Signal Name**	**Description**
PWM4	**IV2**	0-10VDC control signal for indoor modulating water valve
PWM3	**OV2**	0-10VDC control signal for outdoor modulating water valve
GND	**-**	Common/ground for IV2, OV2
DO_1	**IV1**	24VAC output to actuate indoor water valve or circulation pump contactor coil
DO_0	**OV1**	24VAC output to actuate outdoor water valve or circulation pump contactor coil
LC	**-**	Common/ground for IV1, OV1
Use 18ga cable.		

Control Transformer

The low voltage controls for 208-3-60 models are powered by a class II transformer with resettable breaker on the secondary side for circuit protection. Should the breaker trip, locate and correct the problem and then reset the breaker by pressing in on it.

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

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.

BACnet Control Connections

In most multiple-unit commercial installations, the heat pump will be controlled by the building automation system. If using BACnet for external control of heating/cooling demand and/or monitoring of status, use a shielded twisted pair to the connector at the bottom left of control board. There is an optional termination jumper located above the connector.

See the **BACnet Interface** chapter for wiring tips and object names.

TABLE 4 - BACnet Connections	
Line	**Description**
A	**Communication +**
B	**Communication -**
GND	**Ground**
Use a *shielded twisted pair* cable.	

Setpoint Control Connections

If not using a building automation system for control, the heat pump's built in aquastat functionality (with optional outdoor reset) known as "Setpoint Control" may be used. Refer to the **Operation** chapter of this manual for more information. If this control method is used, it eliminates the need for an external aquastat, and the ICR option also eliminates temperature probe in the tank(s). It provides a two stage system along with delay timer for the hydronic auxiliary heat.

No external control signals are required for non-reversing H models. For reversing HAC models, a dry contact between **RA** and the **O** signal is most often required to switch to cooling mode (see **Operation** chapter). **Drawing 002067CDG** shows a typical wiring setup for zones, zone circulator and hydronic auxiliary.

Note that for reversing models in cooling mode, it is important to choose zone thermostats or other control devices that continuously return an "**O**" signal, even when there is no cooling demand. This is to avoid repeated heating and cooling of the buffer tank on demand cycling, causing temperature lags and high electricity consumption.

Setpoint Control does not currently incorporate any lead/lag or other coordination between multiple units; that is, each heat pump operates independently. A small number of units connected to the same buffer tank may operate under Setpoint Control by using different setpoint temperatures for each stage of each heat pump.

TABLE 5 - Setpoint Control Connections	
Signal	**Description**
C or CA	**24VAC common (ground)**
R or RA	**24VAC hot**
O	**Reversing valve (HAC models only)**
Use a 3-conductor 18ga cable.	

An external temperature probe may be used with the onboard Setpoint Control routine, or two probes (one for hot tank and one for cold tank) may be used. This is HTS/CTS Setpoint Control; see **Piping** and **Operation** chapters for details.

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Setpoint Control: Aux. Connections

When using Setpoint Control, hydronic auxiliary heat is activated with a 24VAC signal from DO_2 (HYD_AUX) on the left side of control board.

This powers the coil of an external contactor to operate hydronic auxiliary heat. **This signal can provide a maximum of 500mA at 24VAC.** If using an auxiliary heating device with its own controller and transformer that requires dry contacts to activate, a relay with 24VAC coil must. be added.

TABLE 6 - Setpoint Control: Aux. Connections	
Signal	**Description**
LC	**24VAC common (ground)**
DO_2	**Hydronic Auxiliary (hot)**
Use a 2-conductor 18ga cable.	

Signals/Hardwired Control Connections

Most installations will use ***BACnet*** or the ***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, or using a time-of-day or other third-party programmable controller. This is ***Signals*** or ***Hardwired Control***.

The **CA, RA, Y1A,** and **O** connections are located on the right side towards the top of the control board, as shown on the wiring diagram in the **Model Specific Information** chapter. The external device needs to send the 24VAC signal from **RA** back to the **Y1A** terminal to call for compressor 1, and to **O** to select cooling mode (reversing HAC models only). **CA** is the common

TABLE 7 - Signals Control Connections	
Signal	**Description**
CA	**24VAC common (ground)**
RA	**24VAC hot**
O*	**Cooling mode (reversing valve)***
Y1A	**Compressor ON**
*** reversing W/WH-100-HAC/HACW models only**	

The following tables show typical settings for the aquastats. Stage 1 (the compressor) will activate when the tank temperature falls to the activation point, and remain on until the tank temperature rises to the setpoint.

The settings may be changed as desired; however stage 1 setpoint for heating should not exceed **130°F (54°C)** for W-series and **160°F (71°C)** for WH-series; stage 1 cooling setpoint should not be set below **37°F (3°C)** for W-series and **45°F (7°C)** for WH-series. Exceeding these setpoint limits will cause the heat pump operating pressures to approach the safety control settings, possibly causing nuisance shutdowns.

If only floor zones are being heated, it is highly recommended to drop each of the heating setpoints by 15°F (8°C) for increased efficiency.

A buffer tank with electric elements can be used to provide auxiliary heat. When using Hardwired Control, a mechanical 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; the contactor can be controlled by stage 2 of the heating aquastat. Or if the tank has an electronic controller, it can be set to run according to its own setpoint, which should be set lower than that of the heat pump. Diagram **002069CDG** show a typical wiring setup for zones, zone circulator, and hydronic auxiliary for a heating only system.

Note that for reversing models in cooling mode, it is important to choose zone thermostats or other control devices that continuously send an "O" signal, even when there is no cooling demand. This is to avoid repeated heating and cooling of the buffer tank on demand cycling, causing temperature lags and high electricity consumption.

TABLE 8a - Typical W-Series Aquastat Settings				
HEATING	**Stage 1**		**Stage 2 (Aux)**	
	°F	°C	°F	°C
Setpoint	**108**	***42***	**102**	***39***
Delta	**8**	***4***	**8**	***4***
Activation *	100	*38*	94	*35*
Delay			**10 minutes**	
DHW HEATING with double wall condenser option	**Stage 1**		**Stage 2 (Aux)**	
	°F	°C	°F	°C
Setpoint	**140**	***60***	**120**	***50***
Delta	**10**	***5***	**20**	***10***
Activation *	130	*55*	100	*40*
Delay			**15 minutes**	
COOLING *(HAC/HACW only)*	**Stage 1**		*Activation is determined by the Setpoint and Delta values	
	°F	°C		
Setpoint	**45**	***7***		
Delta	**8**	***4***		
Activation *	53	*11*		

TABLE 8b - Typical WH-Series Aquastat Settings				
HEATING	**Stage 1**		**Stage 2 (Aux)**	
	°F	°C	°F	°C
Setpoint	**150**	***65***	**150**	***65***
Delta	**10**	***5***	**20**	***10***
Activation *	140	*60*	130	*55*
Delay			**10 minutes**	
COOLING	**Stage 1**		*Activation is determined by the Setpoint and Delta values	
	°F	°C		
Setpoint	**45**	***7***		
Delta	**8**	***4***		
Activation *	53	*11*		

Disable Switch (field installed)

A switch or dry contact to disable demand from the control system may be installed. On control board, jumper **COM_IN** to **GND**, and toggle **12VDC** to **IN_SPARE** to disable. See wiring diagrams in the **Model Specific Information** chapter.

Other Connections

An accessory outdoor temperature sensor is available, to enable Setpoint Control's Outdoor Reset functionality. See **Operation** and **PC App** chapters, and wiring diagram in the **Model Specific Information** chapter for details.

Dry contacts to indicate an alarm are available, as is an "**L**" 24VAC trouble indicator signal. See wiring diagram in the **Model Specific Information** chapter for details.

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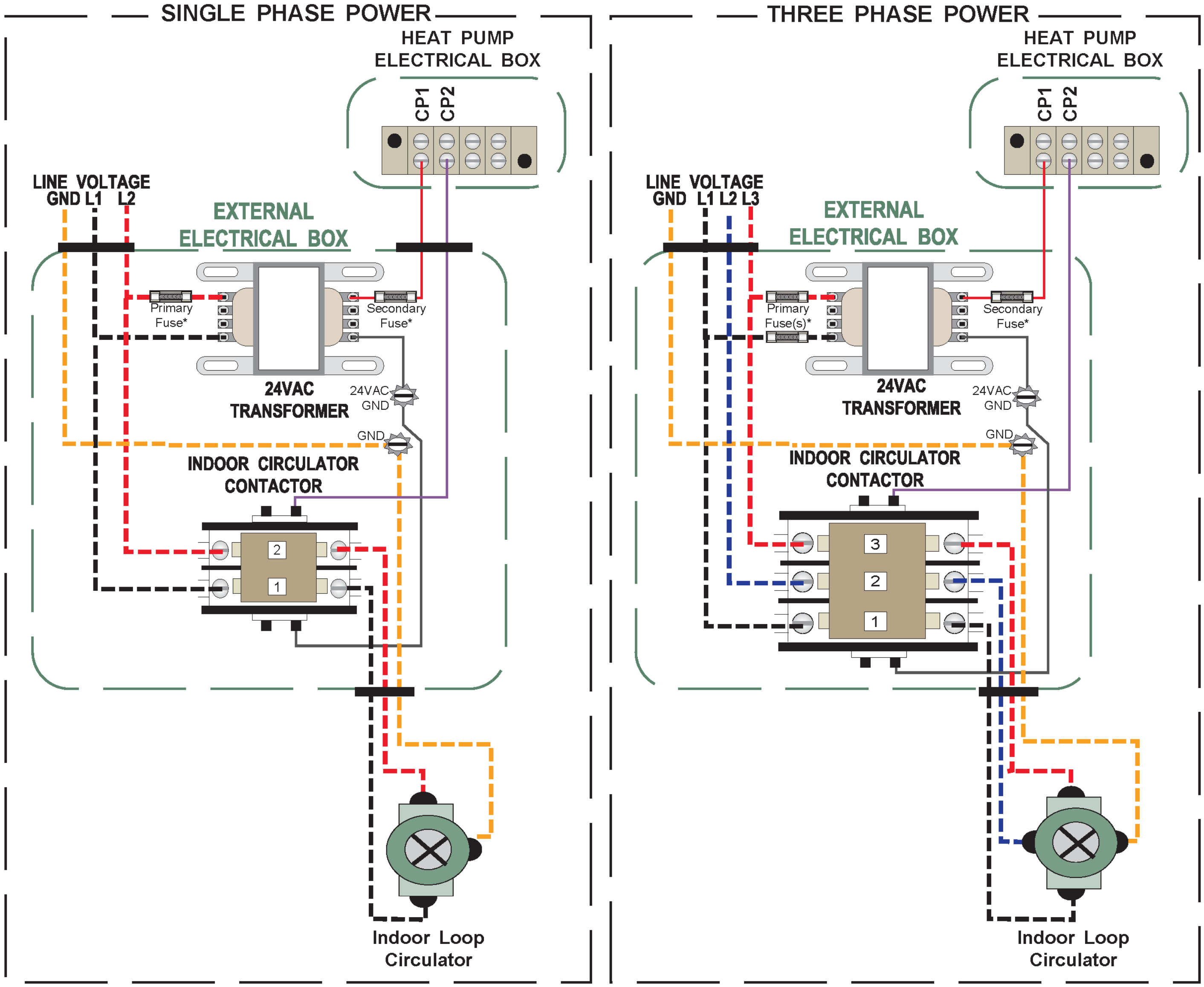
Typical Indoor Circulator Connections for Commercial W Models using GEN2 Setpoint Control



NOTES:

1. Verify the line voltages are correct for the primary of the transformer and for the floor circulator.
2. Ensure that the transformer is sized to handle the load.
3. Priramy fuse(s) required depending on transformer size and primary voltage. Check local codes.
4. Secondary fuse required unless transformer has internal fuse or breaker

01	Initial Release	Chris Geddes	Chris Geddes	04 NOV 2016
REV	ECO #	IMPL BY	APVD BY	DATE

Drawn By Chris Geddes	Date 04 NOV 2016
Checked By Chris Geddes	Date 04 NOV 2016
Approved By (ENG) Chris Geddes	Date 04 NOV 2016
Approved By (MFG)	Date
Approved By	Date

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Drawing Name: Commercial W Typical ICR Connections for GEN2 Setpoint Control

Size	Drawing Number	Drawing Rev	Sheet
A	002188CDG	01	1 of 1

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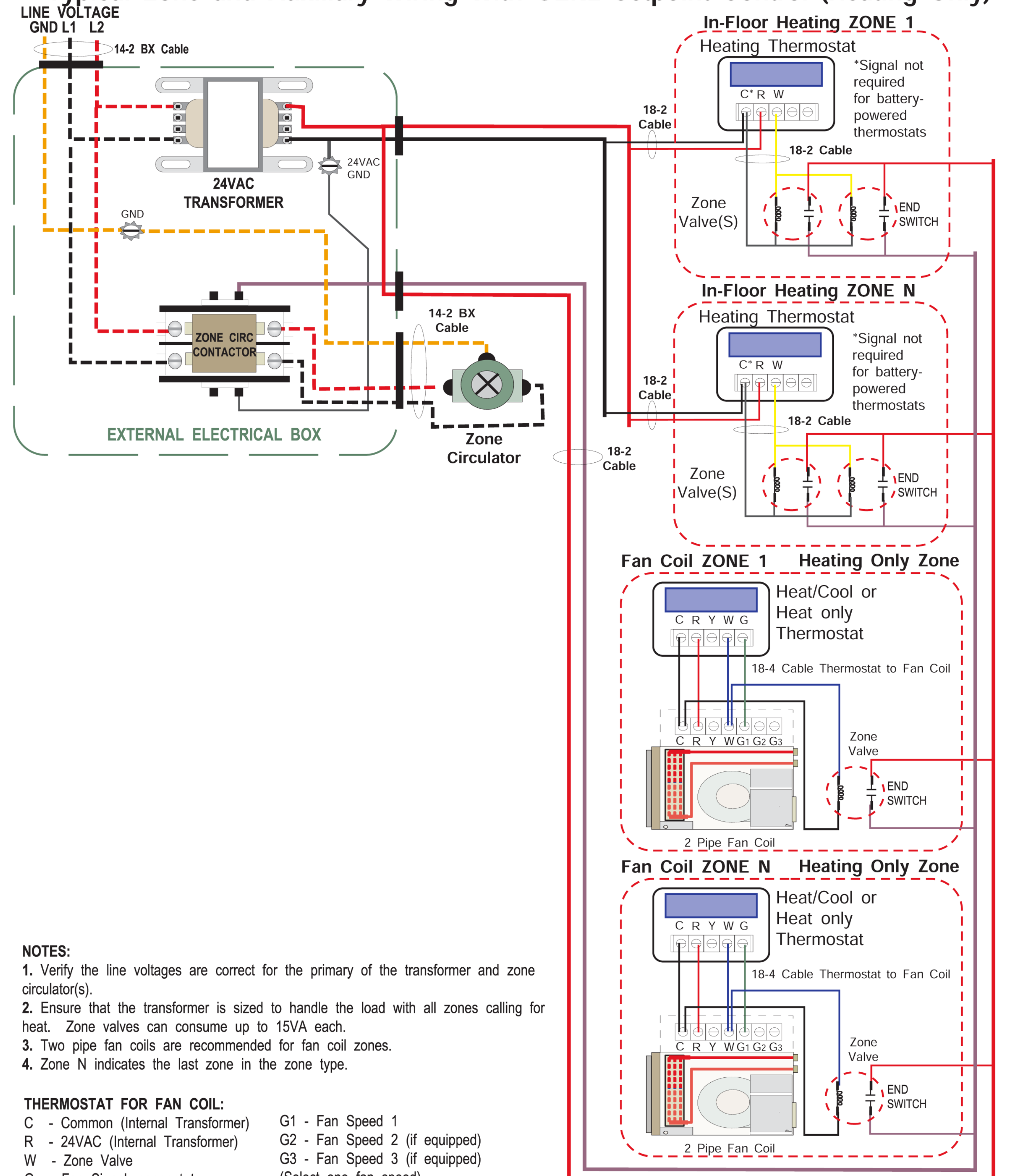
Typical Zone and Auxiliary Wiring With GEN2 Setpoint Control (Heating Only)



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

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

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

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

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

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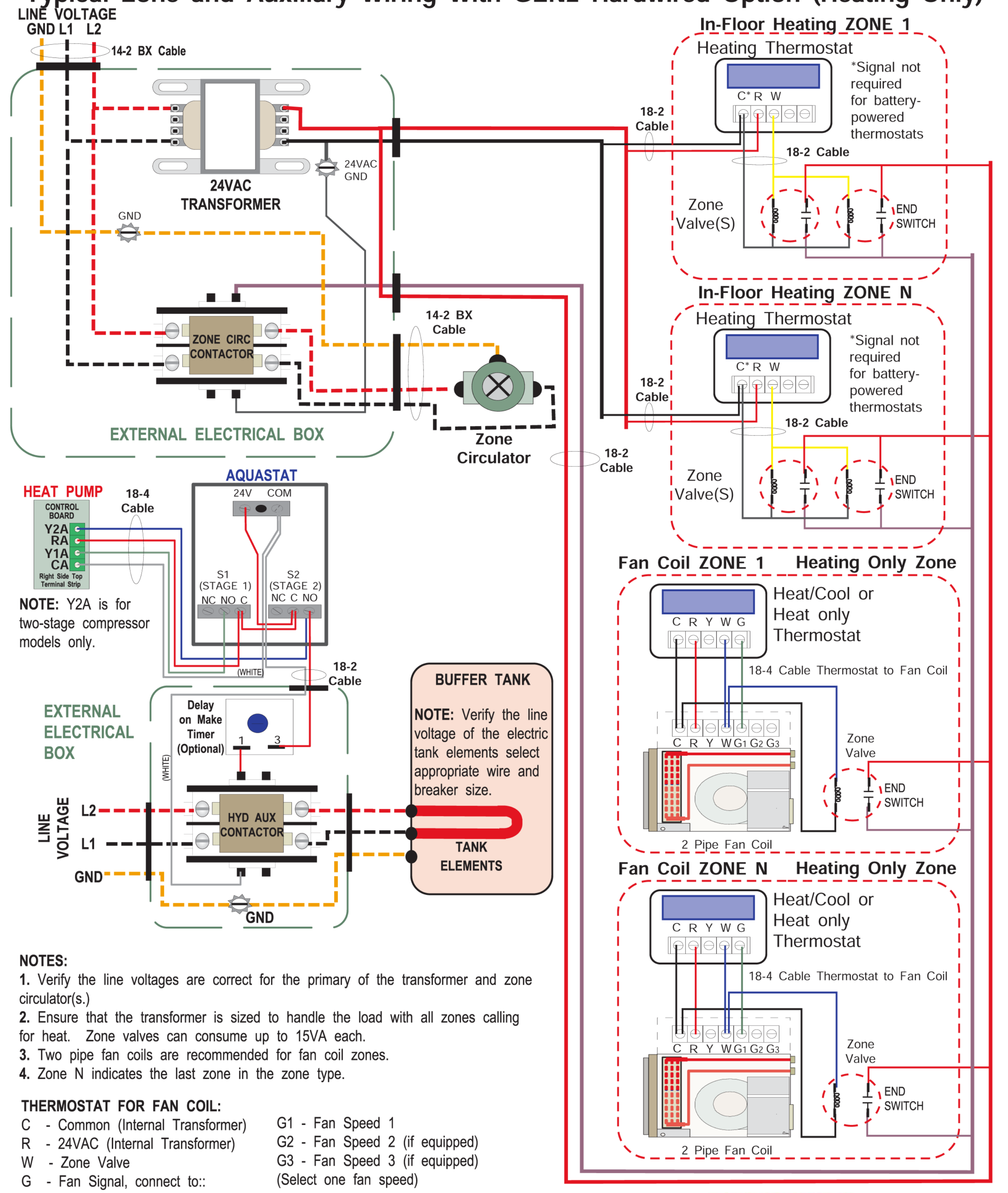
Typical Zone and Auxiliary Wiring With GEN2 Hardwired Option (Heating Only)



NOTES:

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

THERMOSTAT FOR FAN COIL:

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

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

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

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

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

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

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Piping & Loop Information

Loop/Direct DHW Connections

The **Outdoor Loop (Supply)** and **Indoor Loop (Hot)** connection types are shown in the table. Piping should be done as per the system piping diagram from the mechanical engineering firm as well as local codes. It is recommended that all piping be insulated to prevent condensation. All piping connected to the unit will have a significant weight when full of water and must be sufficiently externally supported so as not to strain the heat pump connections.

To prevent particle fouling, a strainer should be installed on both loop IN pipes to any heat pump that has brazed plate heat exchangers. Units that have brazed plate heat exchangers are shown in the table. The strainer should be specified to stop particles larger than 1 mm, and corresponds to a mesh size of 16-20 depending on wire diameter. For closed loops, the strainer may be able to be removed after startup and commissioning is complete and a cleaned filter shows no removed particles after 1 week of operation.

Each water line has a temperature sensor inside the heat pump. The output is shown on the LCD Interface on the unit and may also be viewed via the PC APP, and is available through BACnet. An external P/T port should be installed in each line (4 total), for measuring pressure drop for flow rate estimation.

Buffer or DHW tank sizing should be as per the engineering specifications for the jobsite. However, **the minimum buffer tank size should follow the rule of 8 US gallons per ton of heat pump capacity to avoid problems with short-cycling the heat pump(s)**. The table shows the minimum buffer tank size for each heat pump along with the recommended size. The recommended size will provide longer runtimes and fewer starts for improved efficiency.

IMPORTANT NOTE: Units are shipped configured for water for both the indoor and the outdoor loop. This prevents the heat exchangers from freezing when a low pressure alarm occurs regardless of the fluid type and mixture in the system loops. During startup the fluid type and mixture for both the indoor and outdoor loop must be configured via the PC APP using the Tools - Configuration menu. (There is no need for antifreeze with WH-series due to source temperature limitation of 45°F / 7°C.)

WARNING: ENSURE FLUID TYPE SETTING ARE ACCURATE. FAILURE TO DO SO COULD CAUSE THE HEAT EXCHANGER TO FREEZE AND RUPTURE, DESTROYING THE HEAT PUMP AND VOIDING THE WARRANTY.

WARNING: REPEATED RESETS OF A LOW PRESSURE LOCKOUT COULD CAUSE THE HEAT EXCHANGER TO FREEZE AND RUPTURE, DESTROYING THE HEAT PUMP AND VOIDING THE WARRANTY.

Direct Heating of DHW

To prevent scaling, direct heating of domestic hot water should be reconsidered if the water is prone to calcium scaling, which could make frequent flushing of the heat pump necessary, or even render the heat pump permanently inoperable. Total **hardness** should be less than **350 ppm / 350 mg/L**, confirmed by a water test.

Note the **lower flow rates used with DHW** (see Model Specific Information chapter). Also note that tanks and piping used directly for DHW heating should be properly certified for use with potable water according to local codes.

TABLE 9 - Connection Sizes

Model Size	Heat Pump Connection Size	Heat Exchanger Type
100	1 1/4" female NPT	Coaxial
120	2" grooved/ Victaulic	Brazed Plate *(Strainer Required)*
140		
180		
235		

TABLE 10 - Buffer or DHW Tank Size

Heat Pump Size	Minimum Size gal (L)	Recommended Size gal (L)
100	70 (265)	100 (380)
120	80 (300)	120 (450)
140	100 (380)	120 (450)
180	130 (500)	180 (680)
235	160 (600)	200 (750)

Headers for Multiple Units

Horizontal headers with equally spaced side connections for multiple units may be fabricated by the mechanical contractor.

The header pipe must have at least the capacity of all the heat pump connections combined. See the following table for minimum header sizes.

TABLE 11 - Header Size for W/WH-100

Number of W/WH-100 Units	Heat Pump Connection Size	Min. Nominal Pipe Size for Header
2	1 1/4" female NPT	2"
3		2 1/2"
4		2 1/2"
5		3"
6		4"

TABLE 12 - Header Size for W/WH-120/140/180/235

Number of W/WH-120/140/180/235 Units	Heat Pump Connection Size	Min. Nominal SCH40 Pipe Size for Header
2	2" grooved/ Victaulic	3"
3		4"
4		5"
5		5"
6		6"
7		6"
8		6"

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Ground Loop Systems

Note that in northern climates, **only the W-series** is suitable for use with a closed ground loop (**WH** is generally not suitable due to its minimum required source temperature of **45°F / 7°C**).

Commercial ground loop design is beyond the scope of this manual, and is normally performed by mechanical consulting engineering firms. For concept stage planning, it may be considered that approximately one vertical loop of 150 ft depth per nominal ton of heat pump capacity will be required; or there can be a smaller number of deeper wells. Note that a different borehole length per ton may be required if ground conductivity or load balance vary from the average, and that due to the cost of a commercial installation, a test well to measure ground conductivity is often drilled before ground loop design is finalized. Loops must be placed far enough apart to avoid excessive thermal interference, e.g. 20 ft / 6 m apart. Loops are normally headered together underground, with care taken to size the headers properly so that purging of air is possible with reasonably sized pumping equipment.

Note that adequate freeze protection for the loop fluid is required. The proper type and quantity of antifreeze must be added to the ground loop as per the system design.

WARNING: It is recommended that enough antifreeze be added to allow for a temperature 20°F (11°C) lower than the expected lowest loop fluid temperature entering the heat pump.

It is important to size ground loop circulation pumps to deliver the required flow as listed in the table in the **Model Specific Information** chapter, considering the expected pressure drop of the antifreeze mixture used through the heat pumps and ground loop and all accessories. Low flow rate due to undersized circulation pumps causing low heat pump performance or safety control trips is a common problem when commercial projects are commissioned.

Once the antifreeze solution has been added to the ground loop and all air has been purged from the system, the entire ground loop can be pressurized to the appropriate value as per the system design requirements. If possible, the ground loop circulators should be tested prior to starting the heat pump to ensure that the loop is functioning properly.

Open Loop Systems

The temperature of the well water for open loop installations should be a minimum of **42°F (6°C)**. Refer to the **Model Specific Information** chapter for a complete table of temperature operation limits.

Discharge water from the heat pump should be disposed of as per the system piping diagram and local codes. Most commonly, a return well will be required.

Open loop systems will require an ON/OFF or modulating water valve to shut off the water flow when heat pump is not running.

Well Water Quality

The well water should be tested to be sure it meets minimum standards. Poor water quality can lead to rapid heat exchanger failure or frequent servicing.

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 **Routine Maintenance**).

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. For models W/WH-100 that have coax coils, 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** or **H_2S** is present, the use of an open loop system should be reconsidered.

TABLE 13 - Water Quality Limits

Water Property	MODELS w/ COPPER COAX'S (SIZE 100)	MODELS w/ OPTIONAL CuNi COAX'S (SIZE 100)	MODELS w/ BRAZED PLATES (SIZES 120-235)
Chlorides	< 20 ppm	< 150 ppm	< 300 ppm
pH	> 7.5	> 7.5	> 7.5
Ammonia (NH_3)	< 0.5 ppm	< 0.5 ppm	< 2 ppm
Hydrogen Sulfide (H_2S)	< 0.05 ppm	< 0.05 ppm	< 0.05 ppm
Sulfate (SO_4^{2-})	< 70 ppm	< 70 ppm	< 70 ppm
Solids (TDS)	< 1 ppm	< 1 ppm	< 1 ppm
Hardness	< 350 ppm	< 350 ppm	< 350 ppm

Note that mg/L = ppm, and see notes above table.

Modulating Water Valve

A 0-10VDC modulating motorized water valve controlled by the Gen2 control board in the heat pump may be required on the indoor or outdoor loops depending on transient or steady state loop operating temperatures. See **Wiring** chapter, and the ***Operating Temperature Limits*** table in the **Model Specific Information** chapter.

A modulating water valve may be available as an accessory from Maritime Geothermal Ltd. or may be sourced elsewhere, and can be installed on either the loop's IN or OUT connections at the heat pump.

Note that where installed, the modulating water valve will act as the water shutoff valve, and no additional solenoid valve is required.

CAUTION: if a modulating water valve is not installed where its use is indicated, nuisance low pressure control trips may occur.

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Desuperheater Connections
(W/WH-100-HW/HACW ONLY)

As opposed to direct DHW heating, the desuperheater is an optional feature on the W/WH-100 only that heats domestic water with ~5% of the heat pump's capacity when it is on for space heating or cooling purposes. It doesn't respond to DHW demand.

The connections for the DHW circuit (if present) 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 document **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 CAN BE >200°F NEAR THE UNIT WITH DESUPERHEATER TURNED OFF, POTENTIALLY MELTING & RUPTURING PLASTIC PIPING.

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

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

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

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

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

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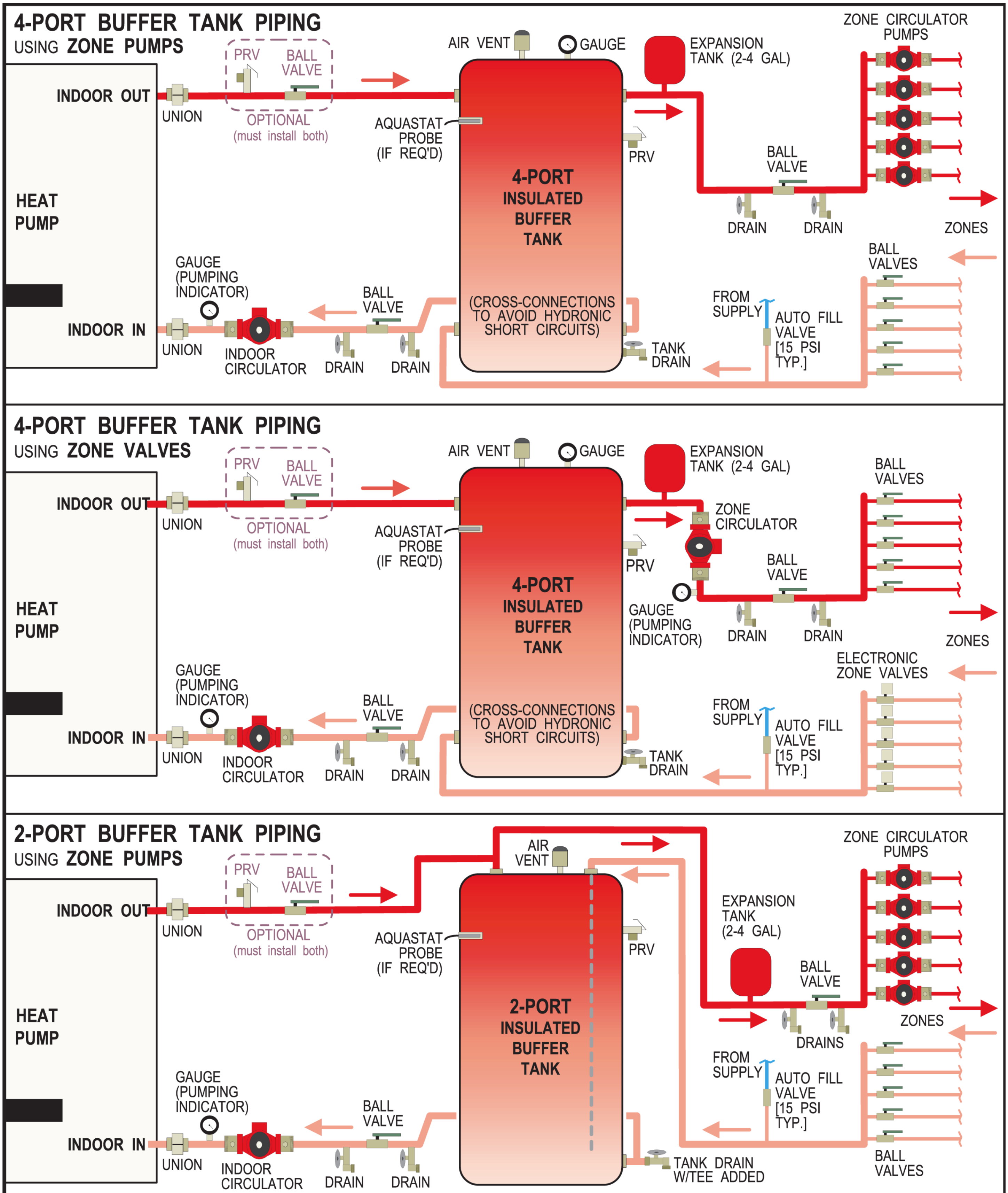

REV	ECO #	IMPL BY	APVD BY	DATE
02	(add fill valve)	D. RHEAULT	D. RHEAULT	1-Feb-2021
01	Initial Release	D. RHEAULT	D. RHEAULT	14-Dec-2018

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

MARITIME GEOTHERMAL LTD.
170 Plantation Rd.
Petitcodiac, NB
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Drawing Name: **Recommended Hydronic Buffer Tank Piping**

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

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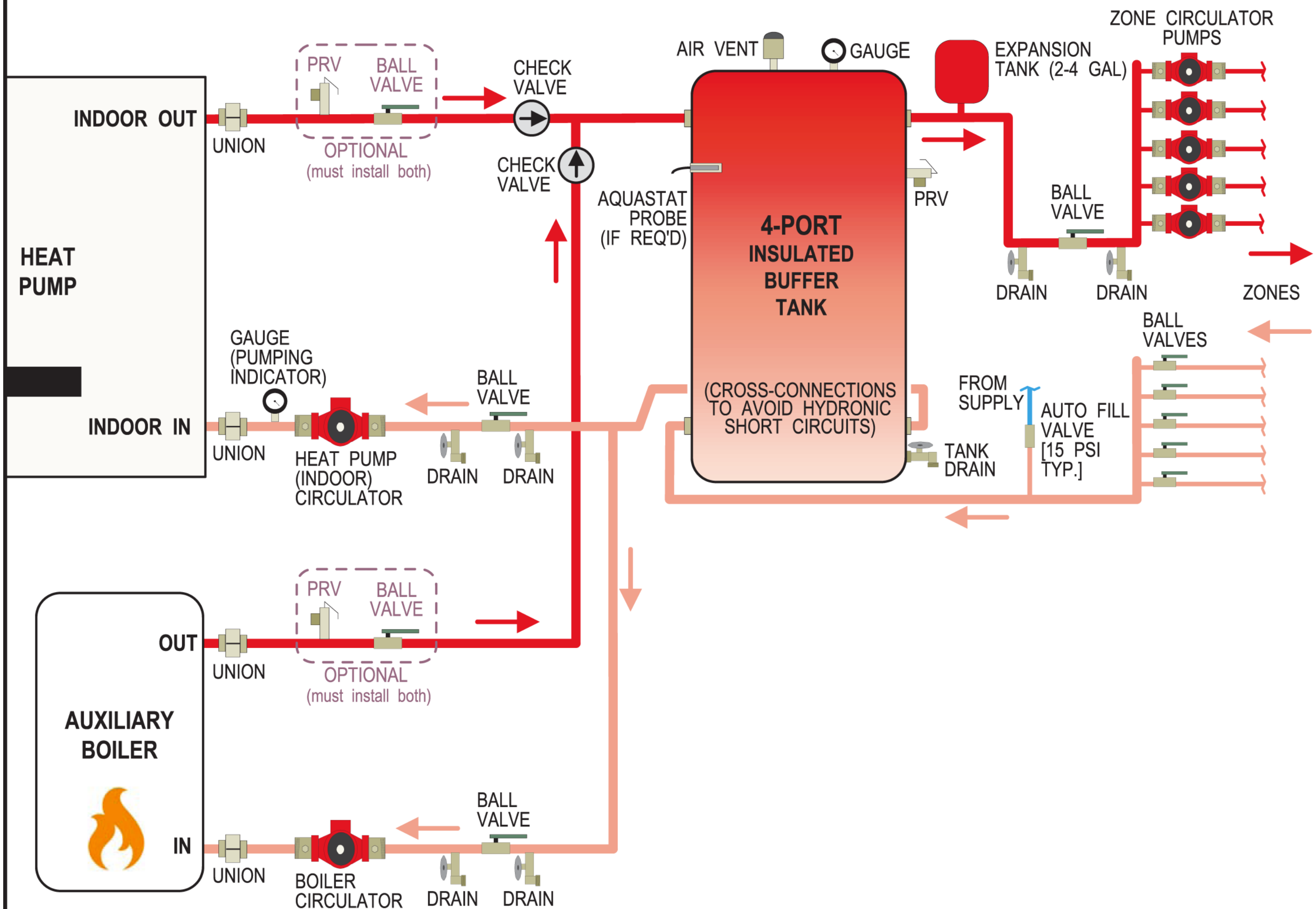
Auxiliary Boiler Piping

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	Size: A; Drawing Number: **002367PDG**; REV: **02**; SHEET: 1 of 1
Approved By (MFG)	Date	
Approved By	Date	

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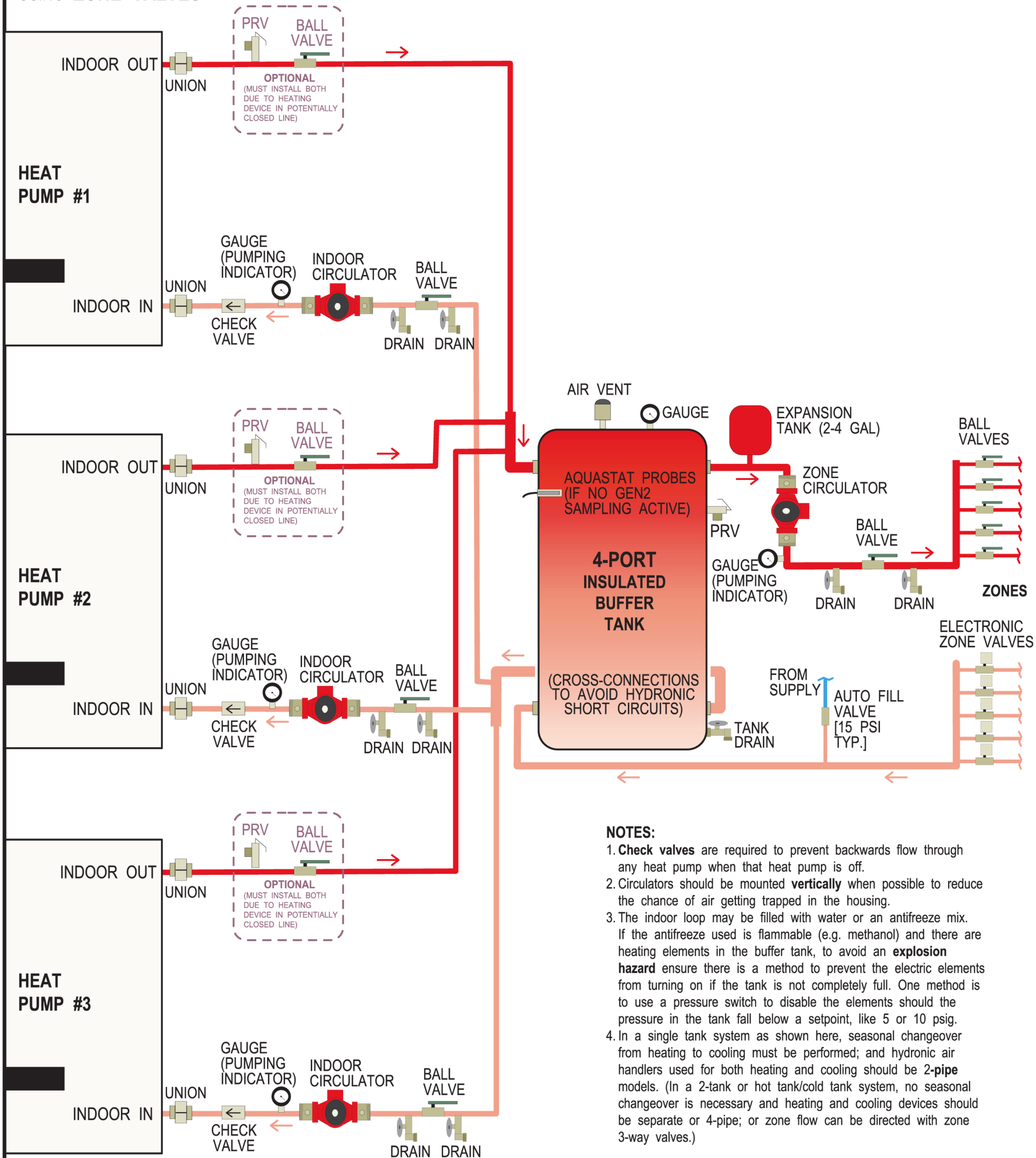
4-PORT BUFFER TANK PIPING FOR MULTIPLE HEAT PUMPS USING ZONE VALVES



NOTES:

1. **Check valves** are required to prevent backwards flow through any heat pump when that heat pump is off.
2. Circulators should be mounted **vertically** when possible to reduce the chance of air getting trapped in the housing.
3. The indoor loop may be filled with water or an antifreeze mix. If the antifreeze used is flammable (e.g. methanol) and there are heating elements in the buffer tank, to avoid an **explosion hazard** ensure there is a method to prevent the electric elements from turning on if the tank is not completely full. One method is to use a pressure switch to disable the elements should the pressure in the tank fall below a setpoint, like 5 or 10 psig.
4. In a single tank system as shown here, seasonal changeover from heating to cooling must be performed; and hydronic air handlers used for both heating and cooling should be **2-pipe** models. (In a 2-tank or hot tank/cold tank system, no seasonal changeover is necessary and heating and cooling devices should be separate or 4-pipe; or zone flow can be directed with zone 3-way valves.)

					Drawn By Dan Rheault	Date 9-Aug-2021	MARITIME GEOTHERMAL LTD.	170 Plantation Rd. Petitcodiac, NB E4Z 6H4
					Checked By Dan Rheault	Date 9-Aug-2021		
					Approved By (ENG)	Date	Drawing Name: Buffer Tank Piping - Multiple Units	
					Approved By (MFG)	Date		
01	Initial Release	D. RHEAULT	D. RHEAULT	9-Aug-2021	Approved By	Date	Size: A / Drawing Number: 002528PDG	REV: 01 / SHEET: 1 of 1
REV	ECO #	IMPL BY	APVD BY	DATE				

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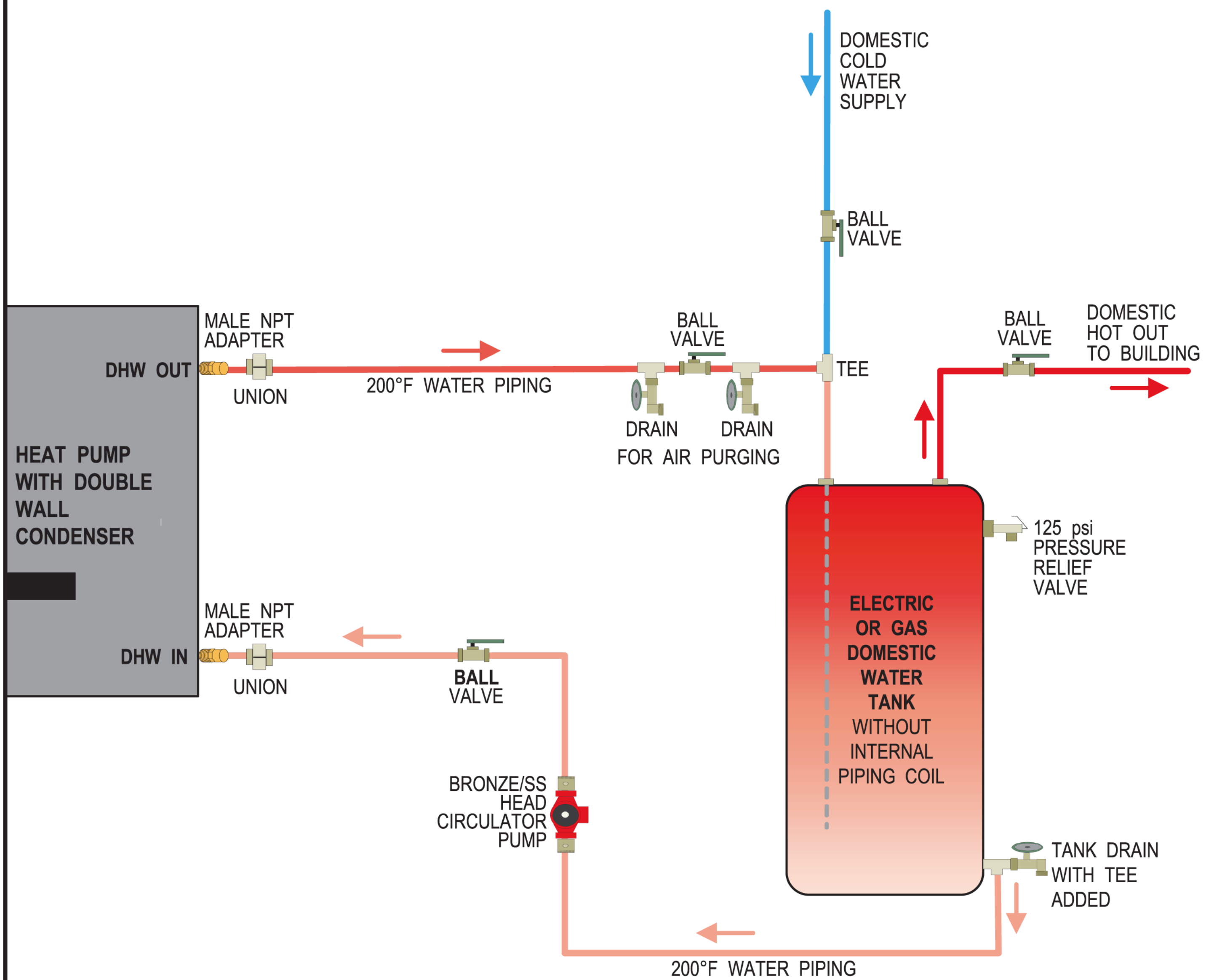
DHW Tank Piping for Direct Domestic Water Heating

For Heat Pumps with Double Wall Condenser



					Drawn By Dan Rheault	Date 22-Sep-2021	MARITIME GEOTHERMAL LTD.	170 Plantation Rd. Petitcodiac, NB E4Z 6H4
					Checked By Dan Rheault	Date 22-Sep-2021		
					Approved By (ENG) Dan Rheault	Date 22-Sep-2021	Drawing Name: Piping for Direct DHW Heating	
01	Initial Release	D. RHEAULT	D. RHEAULT	22-Sep-2021	Approved By (MFG)	Date	Size: A / Drawing Number: 002545PDG	REV: 01 / SHEET: 1 of 1
REV	ECO #	IMPL BY	APVD BY	DATE	Approved By	Date		

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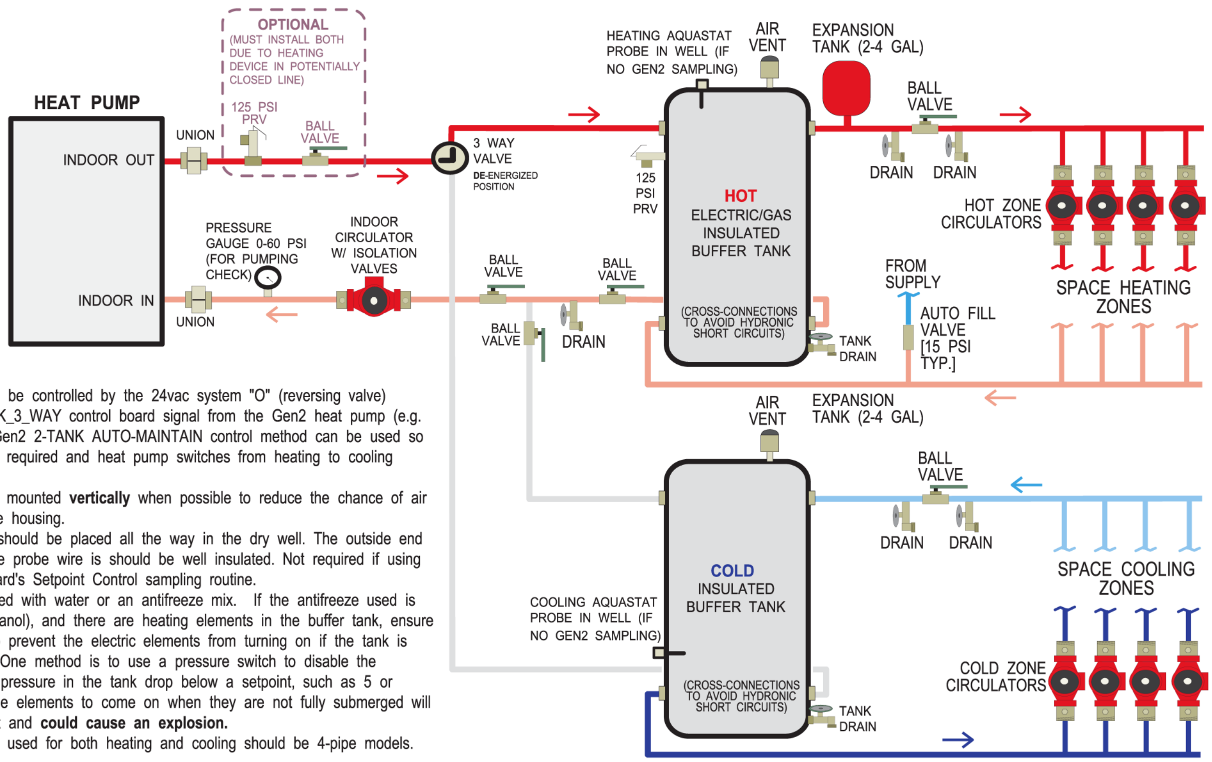
Two Tank System Piping with a Reversing Heat Pump

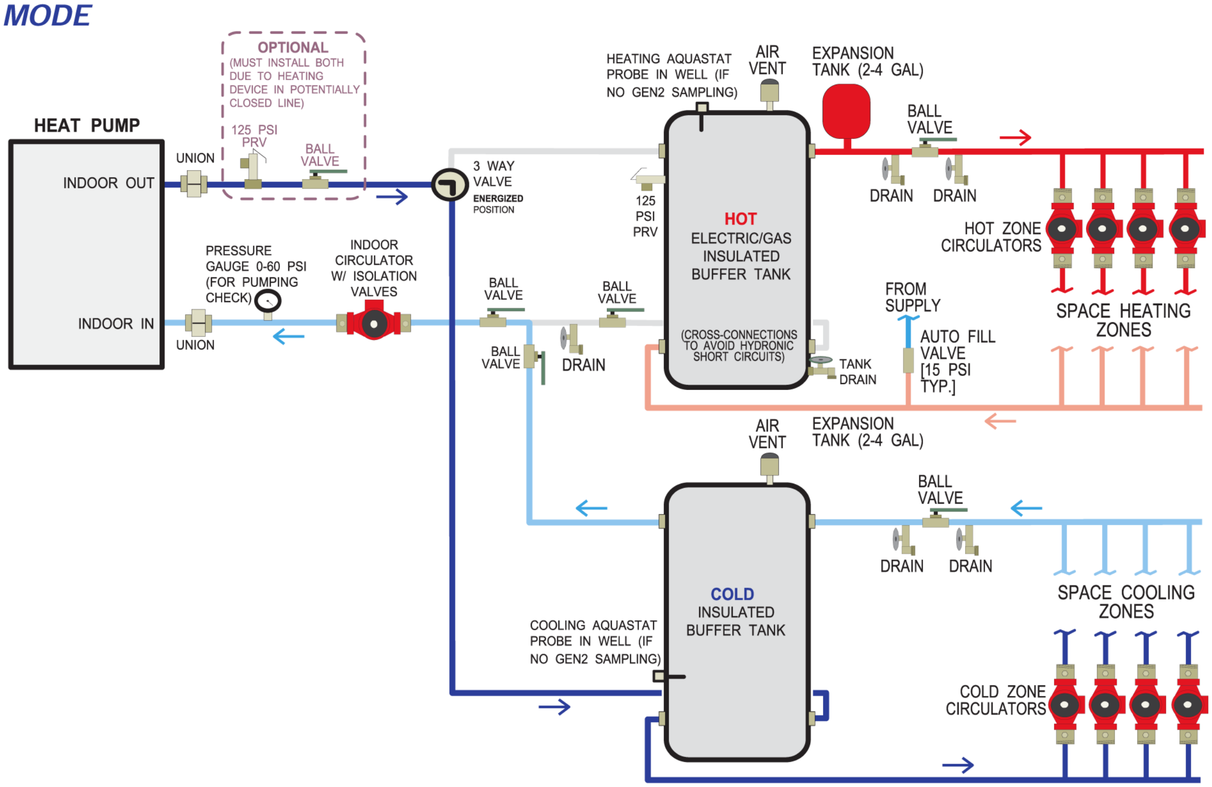
HEATING MODE



NOTES:

1. The 3-way valve can be controlled by the 24vac system "O" (reversing valve) signal, or TWO_TANK_3_WAY control board signal from the Gen2 heat pump (e.g. ATW-Series). The Gen2 2-TANK AUTO-MAINTAIN control method can be used so that no "O" signal is required and heat pump switches from heating to cooling automatically.
2. Circulators should be mounted **vertically** when possible to reduce the chance of air getting trapped in the housing.
3. The aquastat probe should be placed all the way in the dry well. The outside end of the well where the probe wire is should be well insulated. Not required if using the Gen2 control board's Setpoint Control sampling routine.
4. The loop may be filled with water or an antifreeze mix. If the antifreeze used is flammable (e.g. methanol), and there are heating elements in the buffer tank, ensure there is a method to prevent the electric elements from turning on if the tank is not completely full. One method is to use a pressure switch to disable the elements should the pressure in the tank drop below a setpoint, such as 5 or 10PSIG. Allowing the elements to come on when they are not fully submerged will burn the element out and **could cause an explosion.**
5. Hydronic air handlers used for both heating and cooling should be 4-pipe models.

COOLING MODE



					Drawn By Dan Rheault	Date 25-Oct-2017	MARITIME GEOTHERMAL LTD.		170 Plantation Rd. Petitcodiac, NB E4Z 6H4
					Checked By Dan Rheault	Date 25-Oct-2017			
02	-	D. RHEAULT	D. RHEAULT	6-Aug-2021	Approved By (ENG) Dan Rheault	Date 25-Oct-2017	Drawing Name	Two Tank System Piping with a Reversing Heat Pump	
02	-	D. RHEAULT	D. RHEAULT	1-Mar-2018	Approved By (MFG)	Date			
01	Initial Release	D. RHEAULT	D. RHEAULT	25-Oct-2017	Approved By	Date	Size A	Drawing Number 002252PDG	REV 03 / SHEET 1 of 1
REV	ECO #	IMPL BY	APVD BY	DATE					

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Two Tank Simultaneous Heating / Cooling

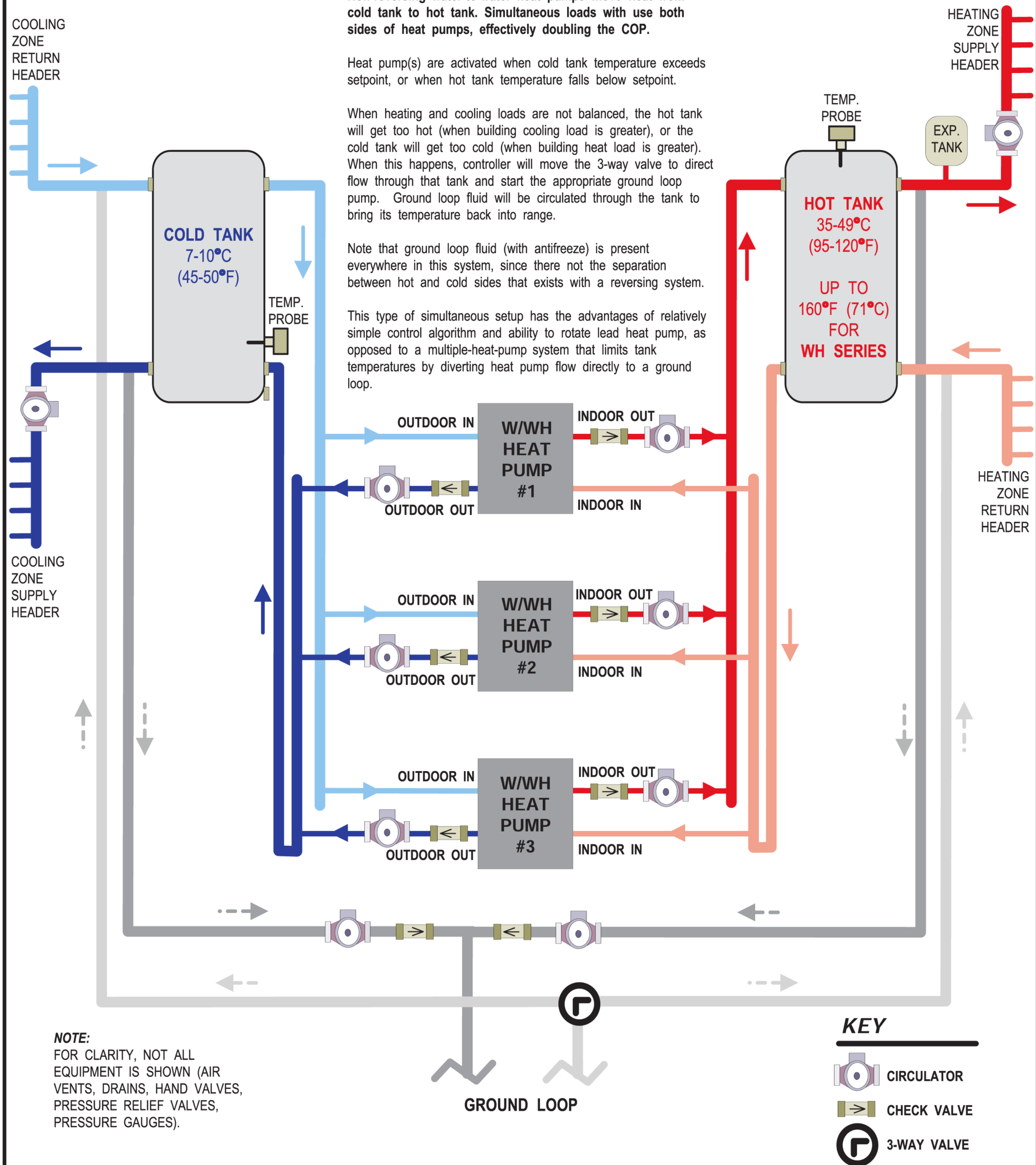
Non-reversing water-to-water heat pumps move heat from cold tank to hot tank. Simultaneous loads with use both sides of heat pumps, effectively doubling the COP.

Heat pump(s) are activated when cold tank temperature exceeds setpoint, or when hot tank temperature falls below setpoint.

When heating and cooling loads are not balanced, the hot tank will get too hot (when building cooling load is greater), or the cold tank will get too cold (when building heat load is greater). When this happens, controller will move the 3-way valve to direct flow through that tank and start the appropriate ground loop pump. Ground loop fluid will be circulated through the tank to bring its temperature back into range.

Note that ground loop fluid (with antifreeze) is present everywhere in this system, since there not the separation between hot and cold sides that exists with a reversing system.

This type of simultaneous setup has the advantages of relatively simple control algorithm and ability to rotate lead heat pump, as opposed to a multiple-heat-pump system that limits tank temperatures by diverting heat pump flow directly to a ground loop.



NOTE:
FOR CLARITY, NOT ALL EQUIPMENT IS SHOWN (AIR VENTS, DRAINS, HAND VALVES, PRESSURE RELIEF VALVES, PRESSURE GAUGES).

					Drawn By Dan Rheault	Date 2-Mar-2018	MARITIME GEOTHERMAL LTD.	170 Plantation Rd. Petitcodiac, NB E4Z 6H4
					Checked By Dan Rheault	Date 2-Mar-2018	Drawing Name	
					Approved By (ENG)	Date	Two Tank Simultaneous Heating / Cooling	
01	Initial Release	D. RHEAULT	D. RHEAULT	2-Mar-2018	Approved By (MFG)	Date	Size A / Drawing Number 002288PDG	REV 01 / SHEET 1 of 1
REV	ECO #	IMPL BY	APVD BY	DATE	Approved By	Date		

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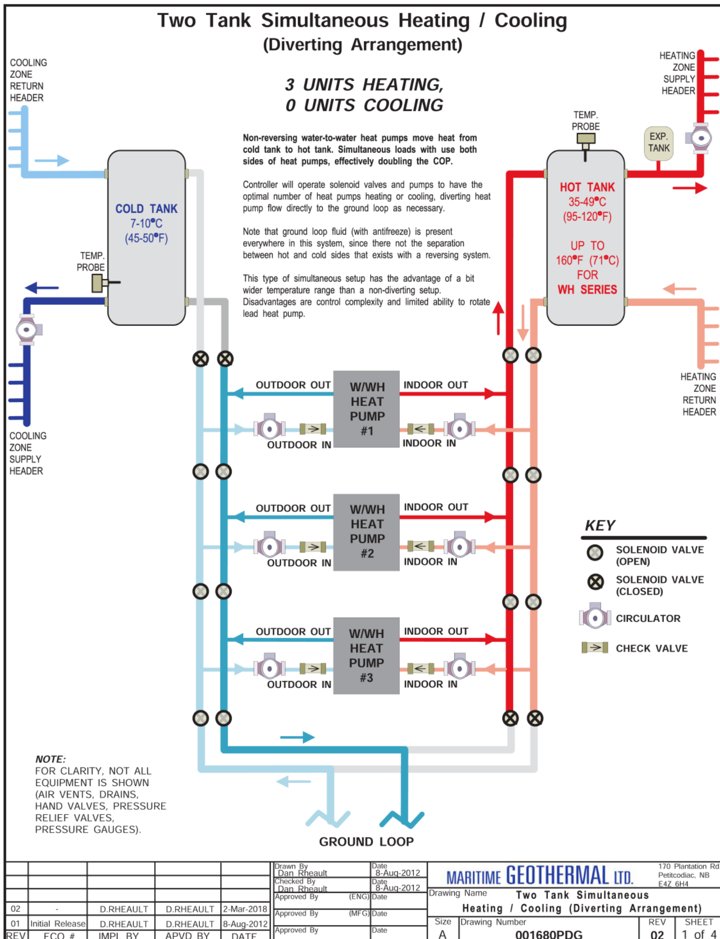

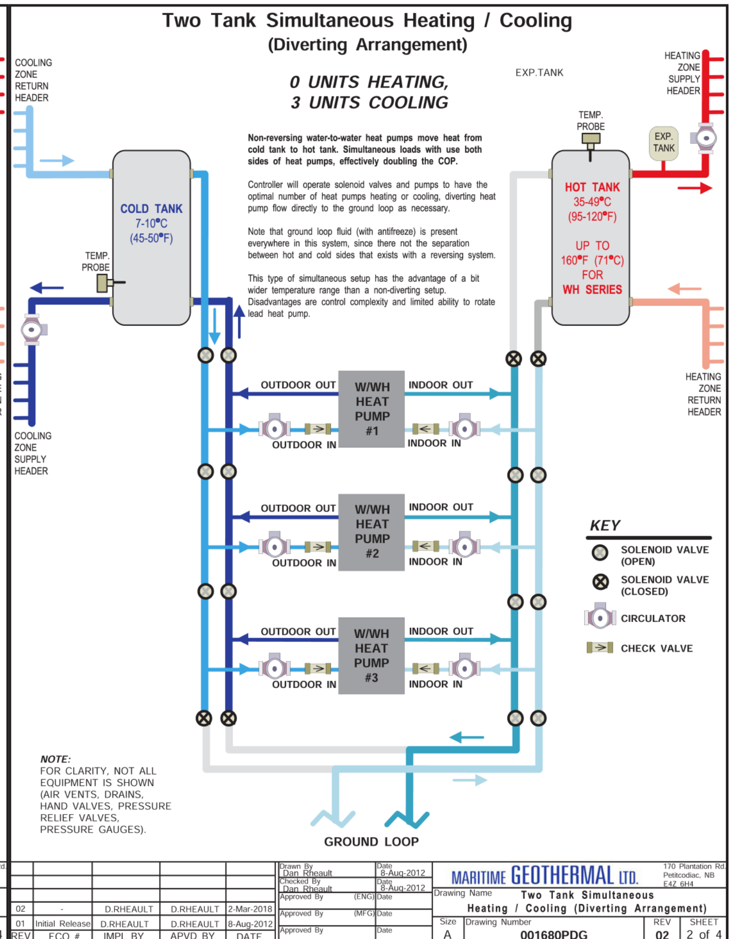

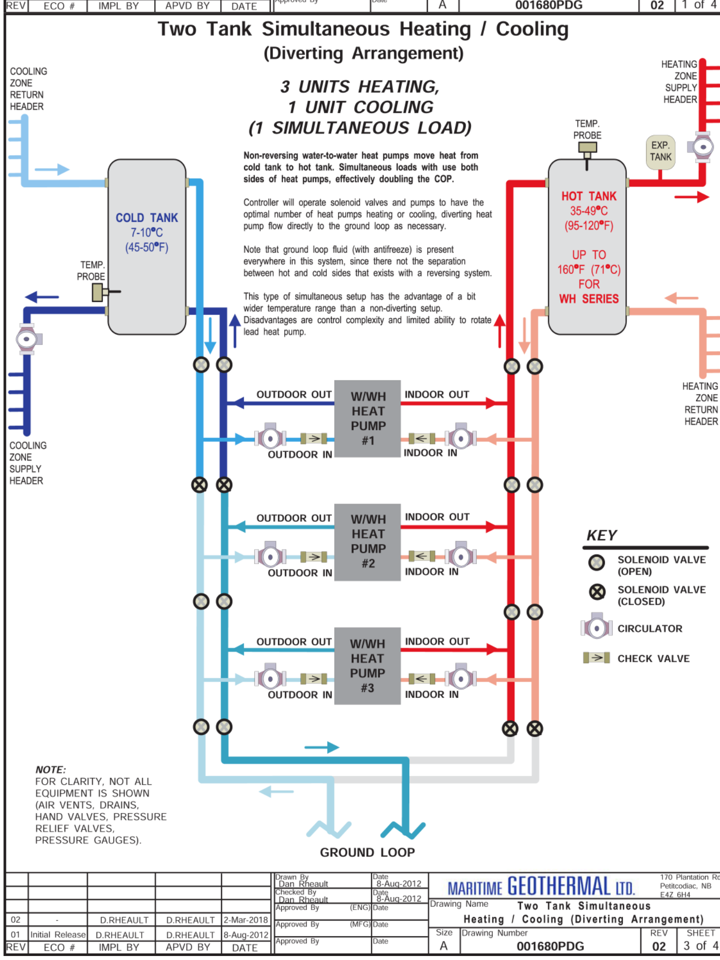

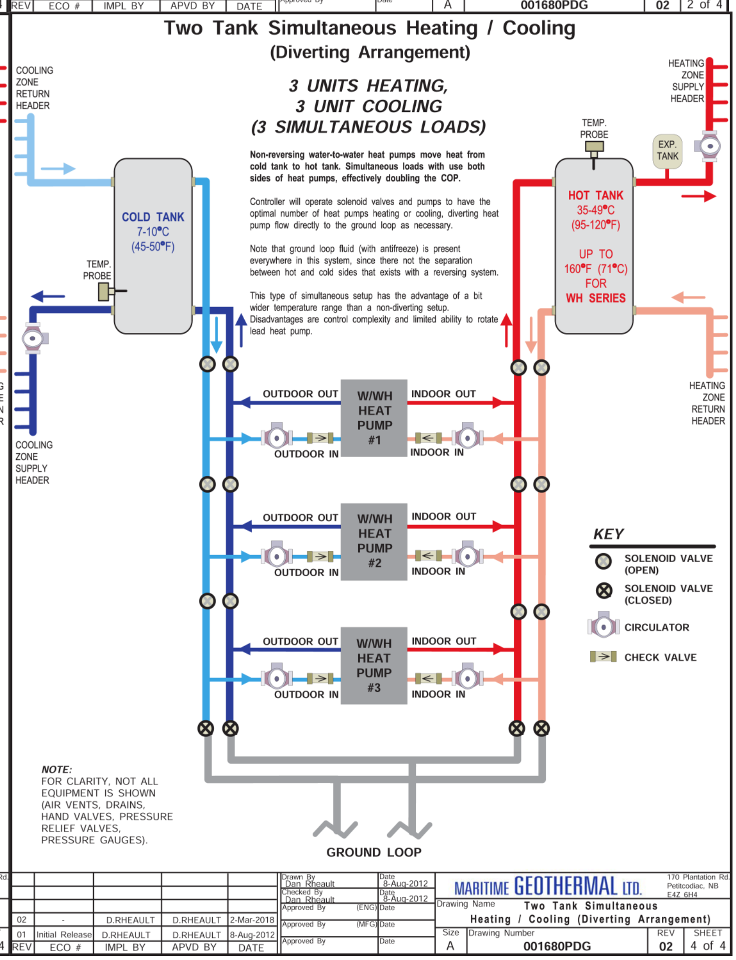

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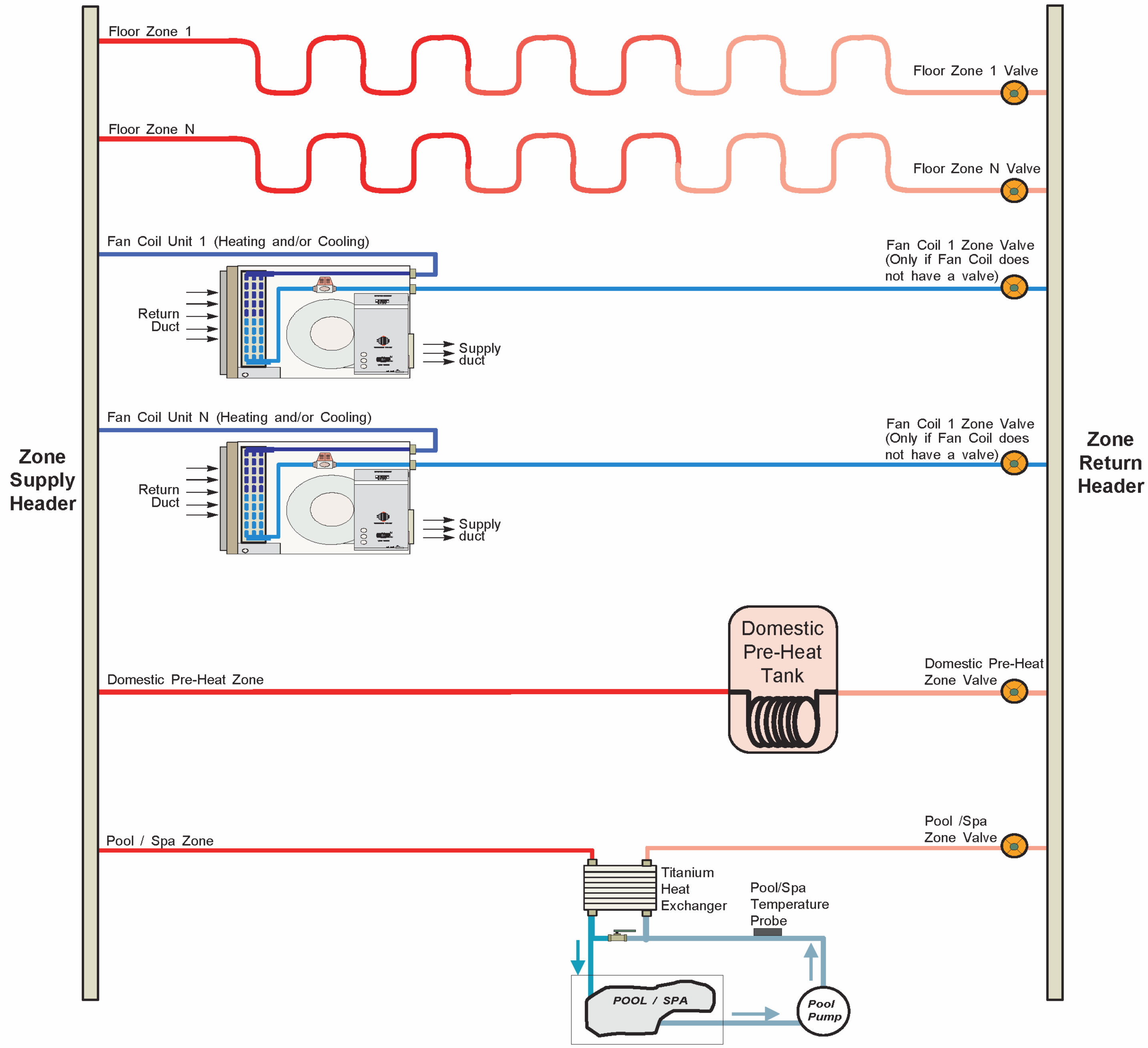
Typical Zone Types for Hydronic Applications



NOTES:

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

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

Drawn By: Chris Geddes	Date: 06 SEP 07	MARITIME GEOTHERMAL LTD. 170 Plantation Rd. Petitcodiac, NB E4Z 6H4
Checked By: Chris Geddes	Date: 06 SEP 07	Drawing Name: Typical Zone Types for Hydronic Applications
Approved By (ENG): Chris Geddes	Date: 06 SEP 07	
Approved By (MFG)	Date	
Approved By	Date	Size: A / Drawing Number: 000530PDG / REV: 01 / SHEET: 1 of 1

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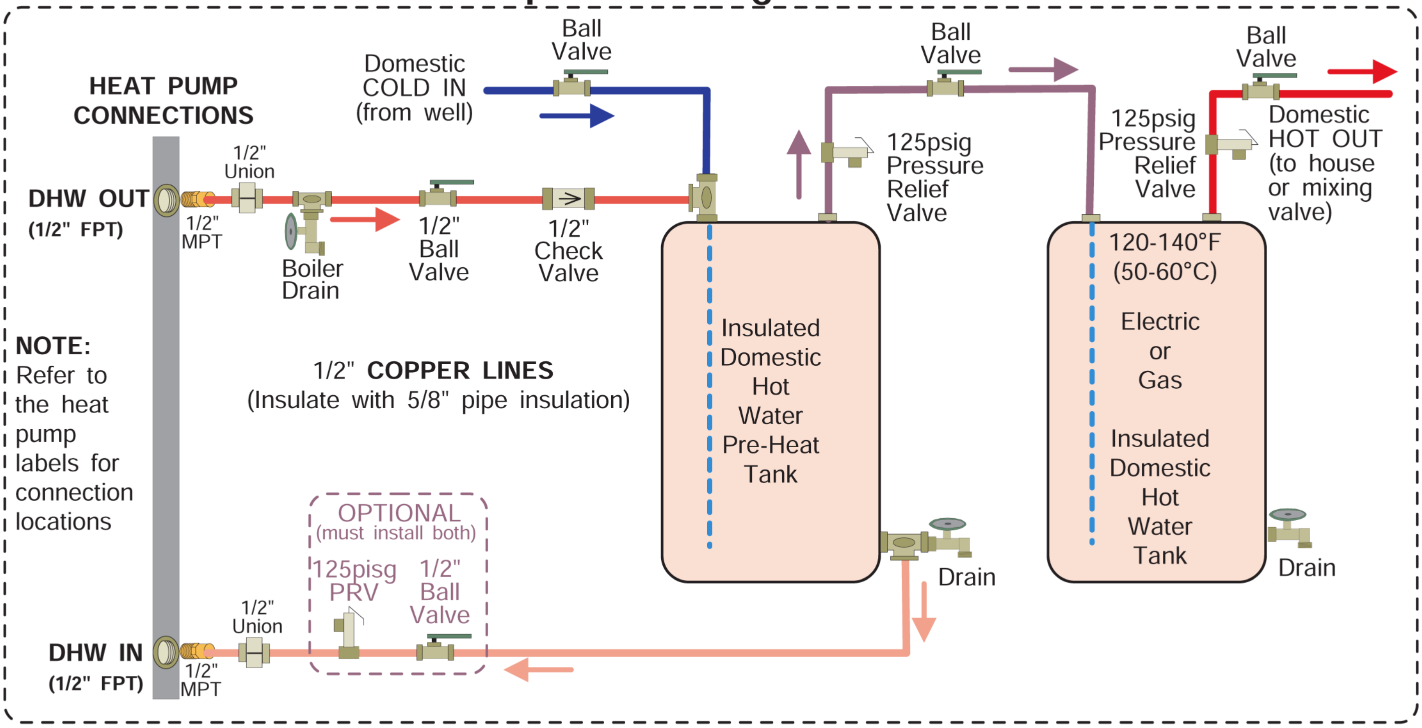
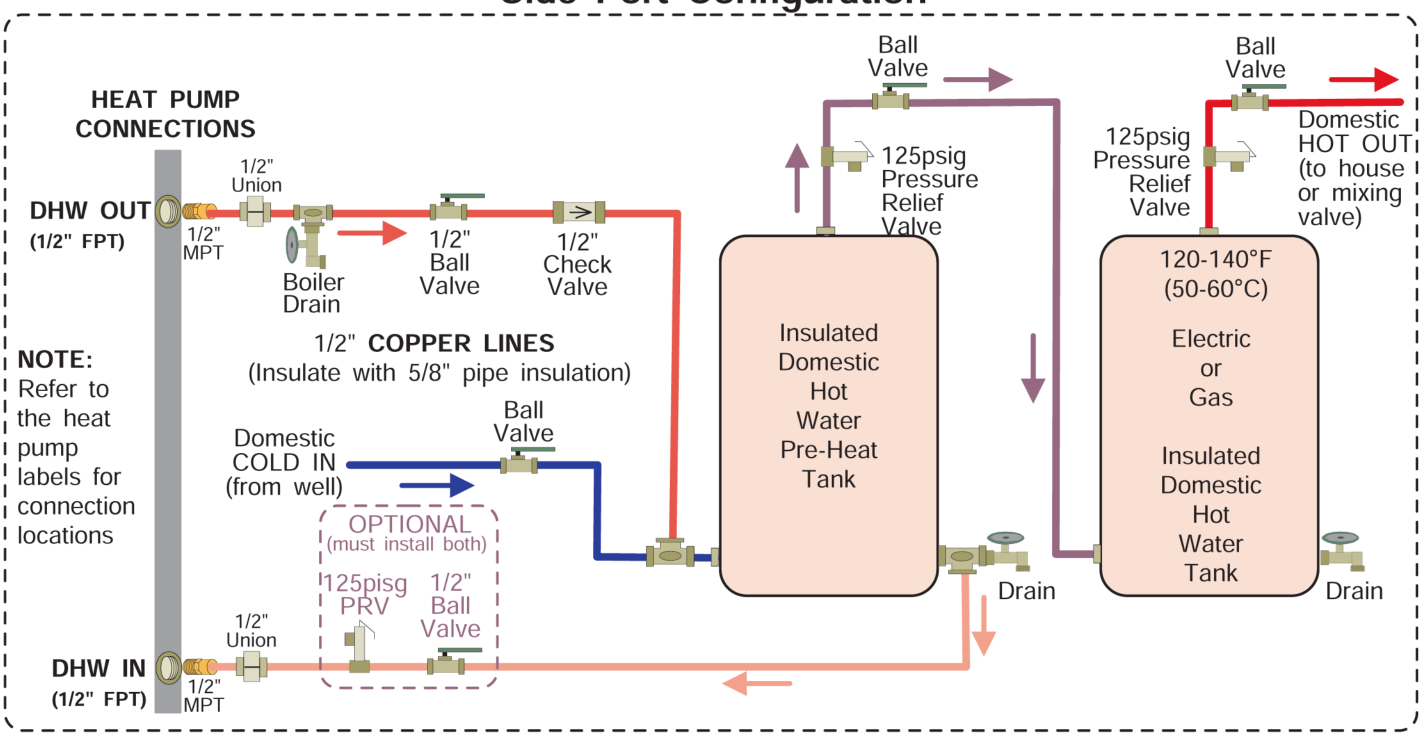
Desuperheater Connection to DHW Pre-Heat Tank

Top Port Configuration



Side Port Configuration



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

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

MARITIME GEOTHERMAL LTD.
170 Plantation Rd.
Petitcodiac, NB
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

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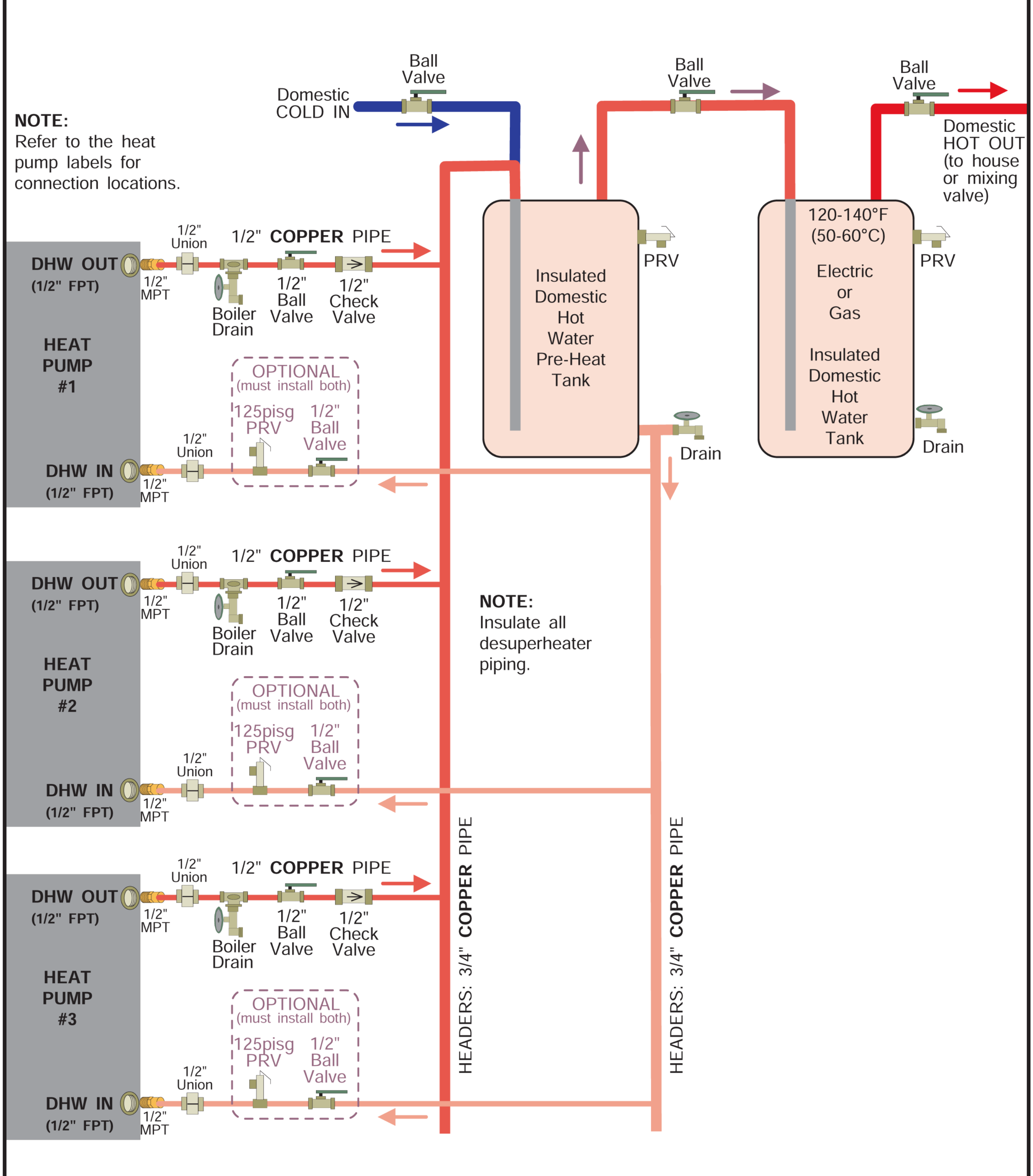
Desuperheater Connection to DHW Pre-Heat Tank - Multiple Units



01	Initial Release	D. RHEAULT	D. RHEAULT	24-Apr-2019
REV	ECO #	IMPL BY	APVD BY	DATE

Drawn By: Dan Rheault — Date: 24-Apr-2019
Checked By: Dan Rheault — Date: 24-Apr-2019
Approved By (ENG): Dan Rheault — Date: 24-Apr-2019
Approved By (MFG) — Date
Approved By — Date

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

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

Size	Drawing Number	REV	SHEET
A	002384PDG	01	1 of 1

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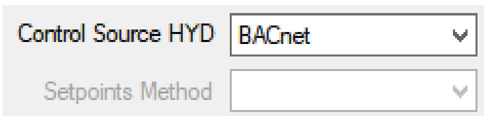
Operation

1. BACnet Control

If using **BACnet Control**, the heat pump will turn the compressors on and off and activate cooling mode (for HAC/HACW models) when it is told to by the building control system. This is the most commonly used control method for multiple-unit installations, since it allows lead/lag stage rotation and centralized control of circulation pumps and valves. The heat pump's internal control logic will not be used, except to ***limit loop temperatures*** and report operating data and alarms. See the **BACnet Interface** chapter later in this manual for network specification and BACnet object names.

PC APP: Tools-->Configuration



LCD Interface: Configuration

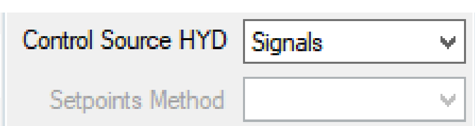
2. Signals / Hardwired Control

Similar to BACnet control, with **Signals Control** the heat pump will turn the compressors on and off and activate cooling mode when it is told to by 24VAC signals. These are provided via external dry contacts from aquastat(s) or a non-BACnet controller. See **Wiring** chapter. The heat pump's internal control logic will not be used, except to ***limit loop temperatures*** and activate alarms outputs.

Most single-unit 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. Typical temperature settings are shown in the table in the **Wiring** chapter.

When using Signals Control, the backup tank element thermostat can be set to a safe maximum, allowing the electric elements to be controlled by an external contactor placed in the power supply connections (see diagrams in **Wiring** chapter). Since the compressor is single stage for these model sizes, this contactor can be controlled by stage 2 of the heating aquastat. Alternatively, tanks with their own programmable controller can be set to run independently with a lower temperature setpoint than the aquastat(s).

PC APP: Tools-->Configuration



LCD Interface: Configuration

3. Setpoint Control

One of the features of the GEN2 Control Board is built in temperature control functionality called "**Setpoint Control**". It is a good method of controlling hydronic heating and cooling demand for a single heat pump or small number of heat pumps since it eliminates the need for an external aquastat or temperature sensor (although external sensors may be used, as described below).

There are four options for Setpoint Control, outlined as follows.

Setpoint Control Method 1 - Indoor Loop (ICR) One Tank

PC APP: Tools-->Configuration

LCD Interface: Configuration

ICR (Internal Circulator Relay) is the default method and uses the **Indoor OUT** temperature probe inside the unit for temperature control. Its value is displayed in the **Tank Temperature** box on the PC App's **View-->Setpoint Control** window, shown below. 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 to sample the water temperature. When 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** window. 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 display will also indicate when the ICR is sampling (ON). The ***Timer Override*** button will reduce the countdown timer to 10 seconds. The compressor(s) will only start when sampling is completed.

For reversing HAC/HACW models only, cooling mode is selected by making a dry contact connection between **R/RA** and **O** on the right side of control board. This is the one external control requirement.

To prevent the compressor from starting when the power is first turned on, the system is **DISABLED** from factory. The LCD screen will show "**SYSTEM DISABLED**". To enable the system, use either the ***System Enable/Disable*** button at the top right corner of the PC App's ***Tools-->Configuration*** window or use the LCD interface and select ***SYSTEM EN/DIS***.

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

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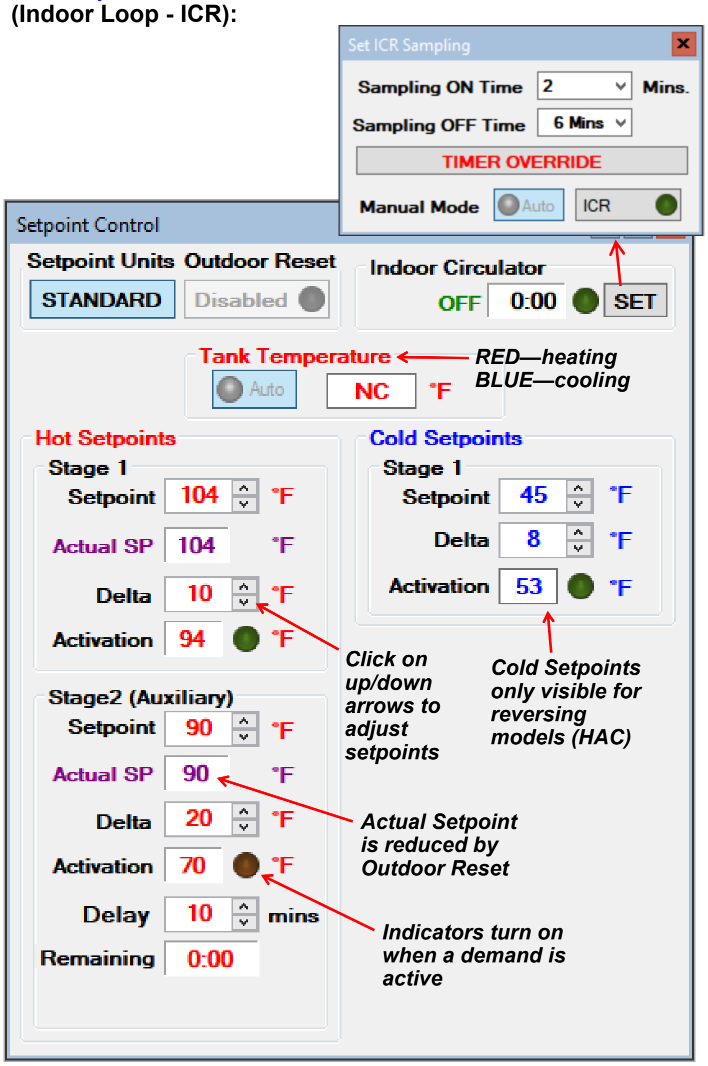
The **Setpoint Control** window looks like this for **Method 1 (Indoor Loop - ICR):**



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

Summer Setback

In locations where hydronic cooling is not required, or with non-reversing models, the 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.

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.

Setpoints

TABLE 14a - Typical W-Series Setpoints

HEATING	Stage 1		Stage 2 (Auxiliary)	
	°F	°C	°F	°C
Setpoint	**108**	***42***	**102**	***39***
Delta	**8**	***4***	**8**	***4***
Activation *	100	*38*	94	*35*
Delay			**10 minutes**	
DHW HEATING with double wall condenser option	**Stage 1**		**Stage 2 (Auxiliary)**	
	°F	°C	°F	°C
Setpoint	**140**	***60***	**120**	***50***
Delta	**20****	***11****	**20**	***10***
Activation *	130	*55*	100	*40*
Delay			**15 minutes**	
COOLING *(HAC/HACW only)*	**Stage 1**		*Activation is determined by the Setpoint and Delta values **MINIMUM delta for DHW heating at reduced flow	
	°F	°C		
Setpoint	**45**	***7***		
Delta	**8**	***4***		
Activation *	53	*11*		

TABLE 14b - Typical WH-series Setpoints

HEATING	Stage 1		Stage 2 (Aux)	
	°F	°C	°F	°C
Setpoint	**150**	***65***	**150**	***65***
Delta	**10**	***5***	**20**	***10***
Activation *	140	*60*	130	*55*
Delay			**10 minutes**	
COOLING *(HAC/HACW only)*	**Stage 1**		*Activation is determined by the Setpoint and Delta values	
	°F	°C		
Setpoint	**45**	***7***		
Delta	**8**	***4***		
Activation *	53	*11*		

For example, in heating mode: when the water temperature 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" temperature.

Heating setpoints will vary widely by application. Lower indoor loop water temperatures may be able to be used, or higher ones may be required. Lower heating setpoints will translate directly into a higher COP (efficiency). Increasing Delta values will also increase efficiency due to longer runtimes, and lead to less compressor wear due to reduced number of starts.

The maximum water temperature setpoint for the R454b space heating **W-series** with single wall condenser is **130°F / 54°C**, while for the DHW heating **W-series** with the double wall condenser option the maximum is **140°F / 60°C** with reduced flow rate. The minimum setpoint for cooling (HAC units only) is **37°F (3°C)**.

NOTE: for ***W-series DHW HEATING with double wall condenser*** option, the reduced flow rate and resulting higher temperature difference through heat pump means that the minimum delta T setting is **20°F** as noted in table. This is to prevent setpoint from being met immediately after compressor start.

The maximum water temperature setpoint for the R513a **WH-series** is **160°F / 71°C**, while the minimum setpoint for cooling (HAC units only) is **40°F (4°C)**.

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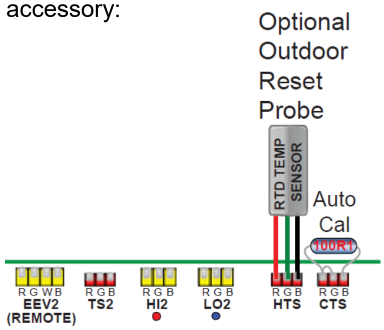
Outdoor Reset

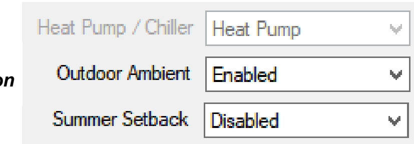
As mentioned earlier, lower heating setpoints will translate directly into a higher COP (efficiency). **Setpoint Control** has an optional Outdoor Reset control algorithm for heating mode, which reduces the heating temperature setpoints at warmer outdoor temperatures as measured by an accessory outdoor temperature sensor.

To enable outdoor reset, first connect the outdoor temperature sensor accessory:

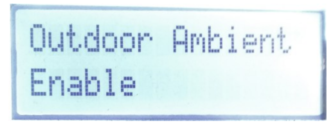


Then enable the outdoor sensor in the **Tools --> Configuration** window or LCD interface:

PC APP: Tools-->Configuration

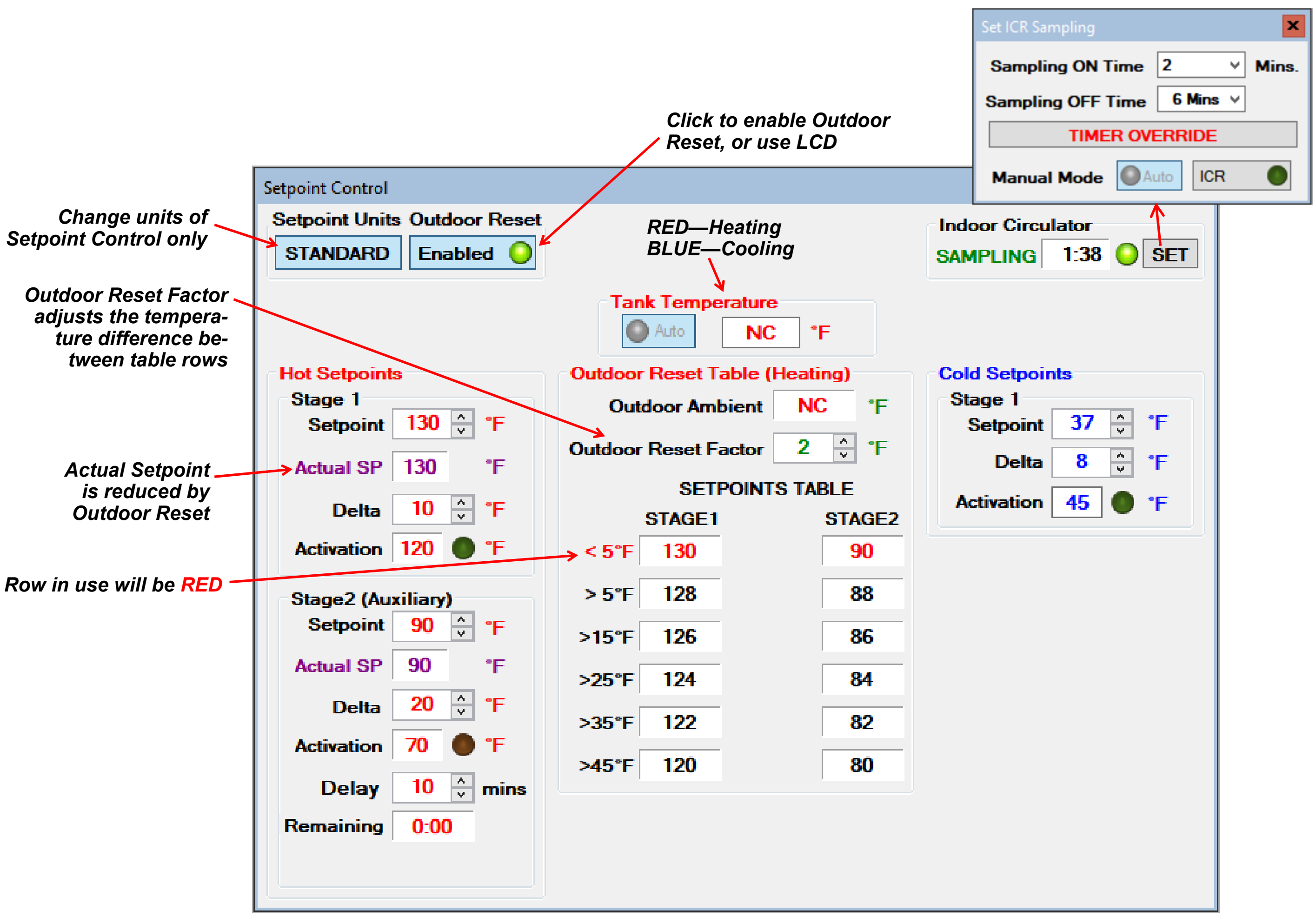


LCD Interface: Configuration



Next, 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 user-selected Hot Setpoints are located in the top row(<5°F), and the next row down equals the row above minus the Outdoor Reset Factor. The table row in use based on current outdoor temperature is shown in red.

It can be seen that as outdoor temperature rises and heating load falls, the heating mode buffer tank temperature will be decreased and a higher seasonal efficiency will result.



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Setpoint Control Method 2 - Indoor Loop (ICR) Two Tanks

It is possible to use all of the **Setpoint Control Method 1** settings, and operate two buffer tanks: one for heated water and one for chilled water. The heat pump will switch over to cooling tank in response to a dry contact between the **R/RA** and **O** terminals at the right side of control board. The **O** signal (along with **C/GND**) will also energize a 3-way valve to divert flow to the cold tank (see **Piping** chapter).

However, it is suggested to use **Method 4** (External HTS/CTS with two tanks) for this purpose. This will require two external tank temperature sensors, but has the benefit of both tank temperatures being constantly monitored and also has the added **Auto Maintain** option (maintaining both hot and cold tank setpoints without the requirement for an external "**O**" dry contact).

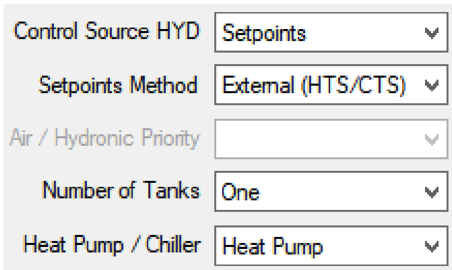
Setpoint Control Method 3 - External (HTS/CTS) One Tank

a) HTS/CTS w/ One Tank - Heat Pump Mode

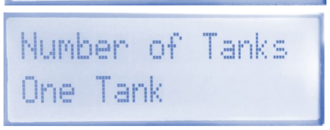
Most of the time, hydronic heating/cooling heat pumps work in response to the temperature of the indoor loop (indoor buffer tank). The previously described control methods (1, 2) work this way, as does this one. This is ***Heat Pump Mode***, and is the only control option for reversing models (HAC/HACW).

For non-reversing models (H), it is also possible to control demand based on the temperature of the outdoor or cold loop. This is ***Chiller Mode***, described on next page.

PC APP: Tools-->Configuration

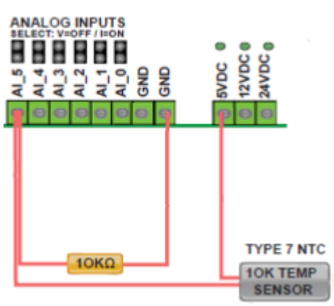


LCD Interface: Configuration



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 near the top of the buffer tank. Its value is displayed in the **Tank Temperature** 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. These are available as accessories. Connect the sensor to the AI_5 input as shown below and on the wiring diagram (SCH) in the **Model Specific Information** chapter. This sensor will be used for both heating and cooling. ***Remove the AI_5 jumper on the control board.***

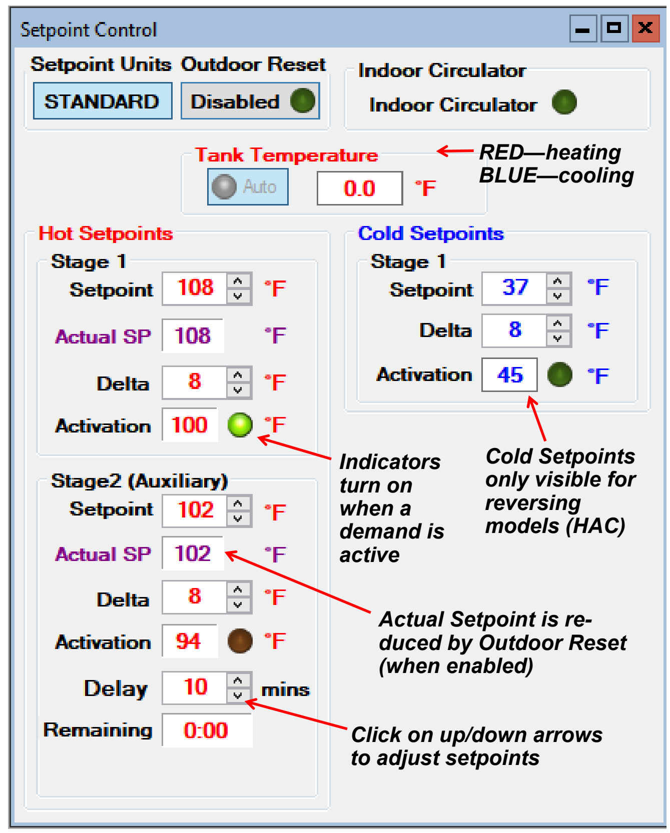


For reversing models only (HAC/HACW), cooling mode is selected by making a dry contact connection between **R/RA** and **O** on the right side of control board. This is the one external control requirement.

To prevent the compressor from starting when the power is first turned on, the system is **DISABLED** from factory. The LCD display will show "**SYSTEM DISABLED**". To enable the system, use either the ***System Enable/Disable*** button at the top right corner of the PC App's ***Tools-->Configuration*** window or use the LCD interface and select ***SYSTEM ENABLE***.

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

The **Setpoint Control** window looks like this for **Method 3a (External HTS/CTS with One Tank, Heat Pump Mode):**



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

The features explained in **Setpoint Control Method 1 - Indoor Loop ICR with One Tank** also apply to **Setpoint Control Method 3 - External HTS/CTS with One Tank:**

- **Typical Temperature Setpoints**
- **Summer Setback**
- **Outdoor Reset function**

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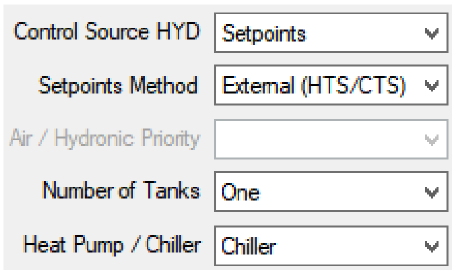
b) HTS/CTS w/ One Tank - Chiller Mode

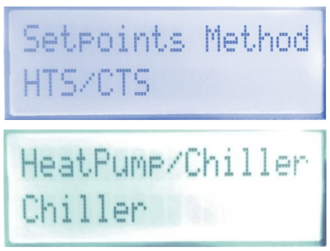
For ***non-reversing models only*** (H), **Chiller Mode** allows the heat pump to be controlled from the Outdoor Loop (cold side) rather than the Indoor Loop (hot side) for applications that require controlled cooling with high temp water rejection. The heat pump is still operating in "heating mode"; it is simply being started and stopped based on the cold side temperature.

Just as with Heat Pump Mode, a buffer tank should normally be used. With **Chiller Mode**, it will be on the cold side (outdoor) loop.

PC APP: Tools-->Configuration

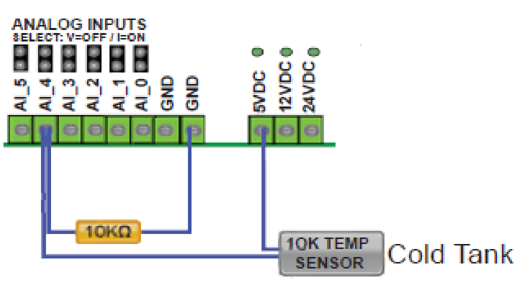


LCD Interface: Configuration



When this method is used, no circulator control for temperature sampling will occur. It requires an external temperature sensor placed in a dry well near the ***bottom*** of the cold buffer tank. Its value is displayed in the **Chilled Tank Temperature** or **Cold 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 used. These are available as accessories. Connect the sensor to the AI_4 input as shown below and on the wiring diagram (SCH) in the **Model Specific Information** chapter. This sensor will be used for both heating and cooling. ***Remove the AI_4 jumper on the control board.***



To prevent the compressor from starting when the power is first turned on, the system is **DISABLED** from factory. The LCD display will show "**SYSTEM DISABLED**". To enable the system, use either the ***System Enable/Disable*** button at the top right corner of the PC App's ***Tools-->Configuration*** window or use the LCD interface and select ***SYSTEM ENABLE***.

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

The **Setpoint Control** window looks like this for **Method 3b (External HTS/CTS with One Tank, Chiller Mode):**

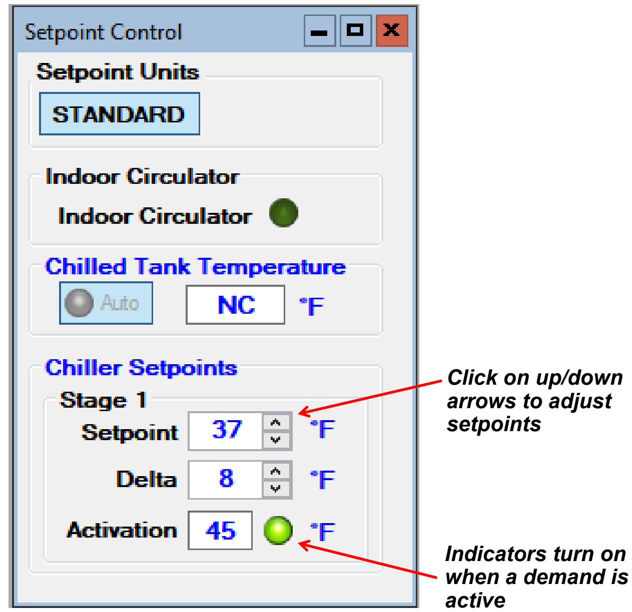
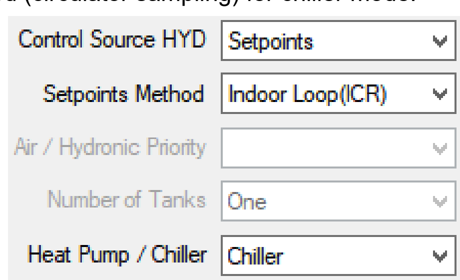


TABLE 15 - Typical Temperature Setpoints
HTS/CTS Method-Chiller Mode

	°F	°C	
Setpoint	**45**	***7***	*Activation is determined by the Setpoint and Delta values
Delta	**8**	***4***	
Activation *	**53**	***11***	

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

Above is outlined the recommended method to use Chiller Mode. However, it is also possible to use the ICR setpoint control method (circulator sampling) for chiller mode:



The complication is that sampling will actually be done with the *outdoor* loop circulator, and there is no built in outdoor circulator relay. So two approaches can be taken:

- Connect outdoor circulator to the indoor circulator terminal strip, and vice versa (indoor circulator to outdoor terminal strip) ***OR***
- Install an OCR relay, with coil connected between OV1 (control board DO_0) and C (24vac ground); and outdoor circulator powered from the normally open relay contacts.

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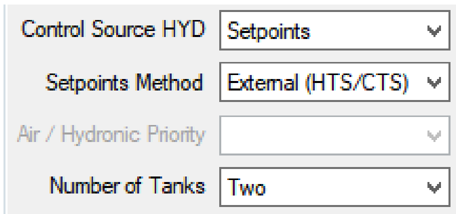
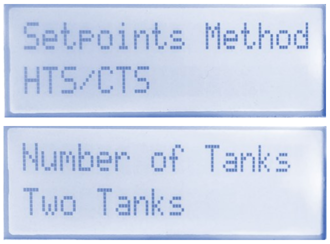
Setpoint Control Method 4 - External (HTS/CTS) Two Tanks

***REVERSING MODELS ONLY (HAC/HACW)**

PC APP: Tools-->Configuration

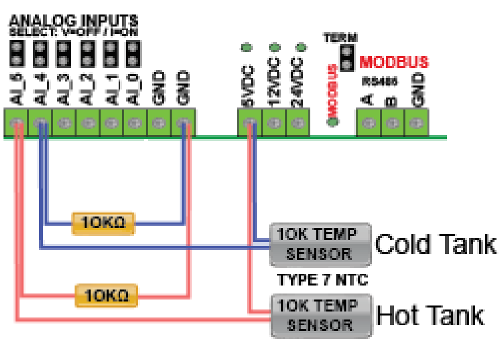


LCD Interface: Configuration



Like with Method 3, 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 hot buffer tank as well as one in the cold buffer tank. The values are displayed in the **Hot Tank** and **Cold Tank** boxes in the PC App's **View-->Setpoint Control** window. If either temperature shows **NC**, then either the probe is not connected to the board or there is a problem with it.

10K Type 7 (or Type 3) NTC thermistors along with 10K 1% or better resistors must be connected to the control board. Connect the Hot Tank sensor to the AI_5 input and the Cold Tank sensor to the AI_4 input as shown below and on the wiring diagram (SCH) in the **Model Specific Information** chapter. ***Remove the AI_5 and AI_4 jumpers on the control board.***



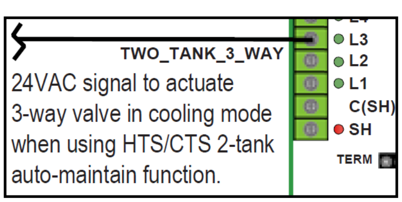
a) O Signal Control

Cooling mode may selected by making a dry contact connection between **R/RA** and **O** at the right side of control board. This results in one external control requirement. **O** and **C** can be used to energize a 3-way valve to divert flow to the cold tank (see **Piping** chapter).

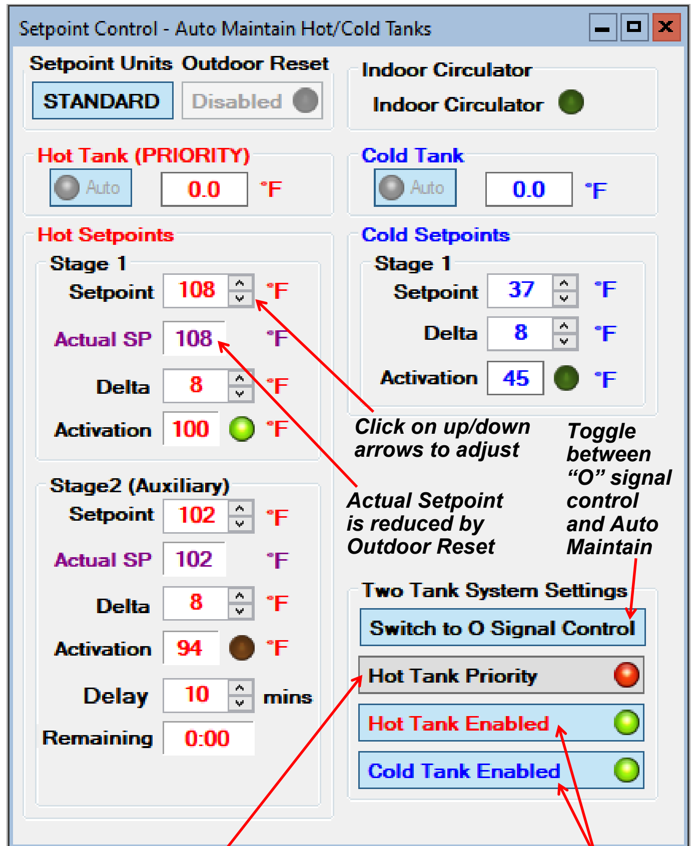
b) Auto Maintain

Alternatively, the heat pump can automatically switch between heating the hot tank and chilling the cold tank, without the need for any external control signals. Click the "**Switch to Auto Maintain**" button in following screenshot (PC App only). If using this function, hot tank or cold tank can be set as priority, and either tank can be disabled to turn it off.

For Auto Maintain, the **L3** signal from the left side of control board in conjunction with **C/GND** should be used to energize the 3-way valve in cooling, since there is no **O** signal.



The **Setpoint Control** window looks like this for **Method 4 (External HTS/CTS with Two Tanks):**



Toggle priority mode: heating or cooling (Auto Maintain only)

Enable or disable either tank (Auto Maintain only)

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

To prevent the compressor from starting when the power is first turned on, the system is **DISABLED** from factory. The LCD display will show "**SYSTEM DISABLED**". To enable the system, use either the ***System Enable/Disable*** button at the top right corner of the PC App's ***Tools-->Configuration*** window or use the LCD interface and select ***SYSTEM ENABLE***.

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

The features explained in **Setpoint Control Method 1 - Indoor Loop ICR with One Tank** also apply to **Setpoint Control Method 4 - External HTS/CTS with Two Tanks:**

- **Typical Temperature Setpoints**
- **Summer Setback**
- **Outdoor Reset function**

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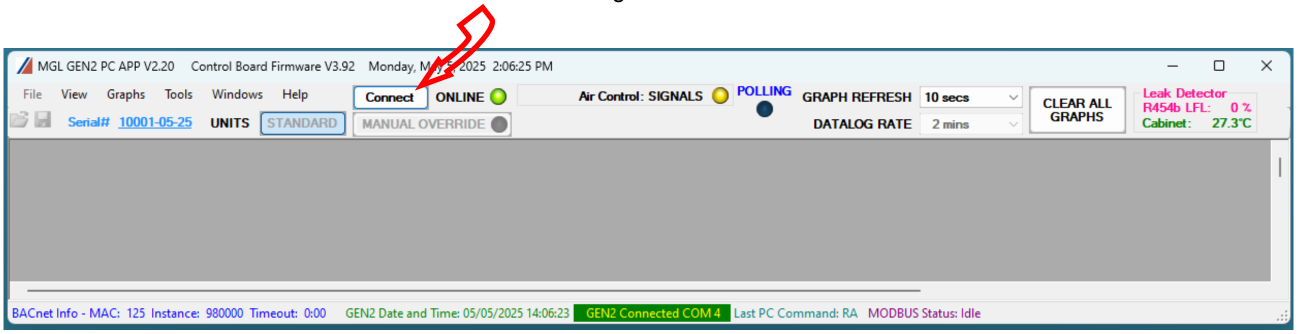
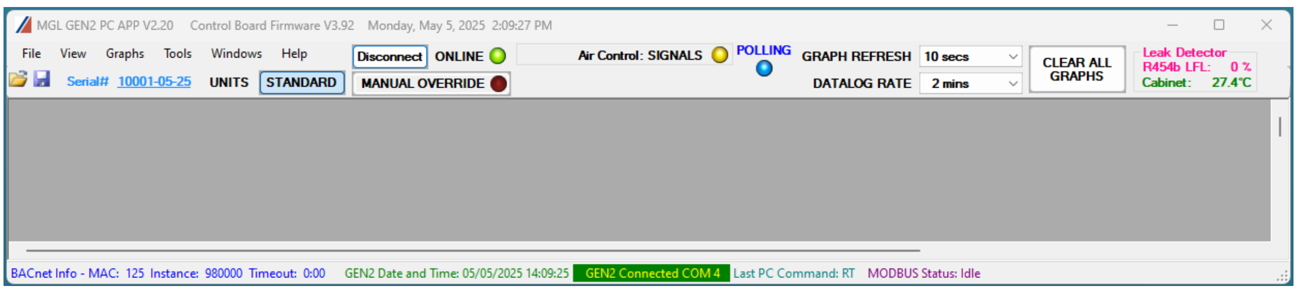
PC Application (PC APP)

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.

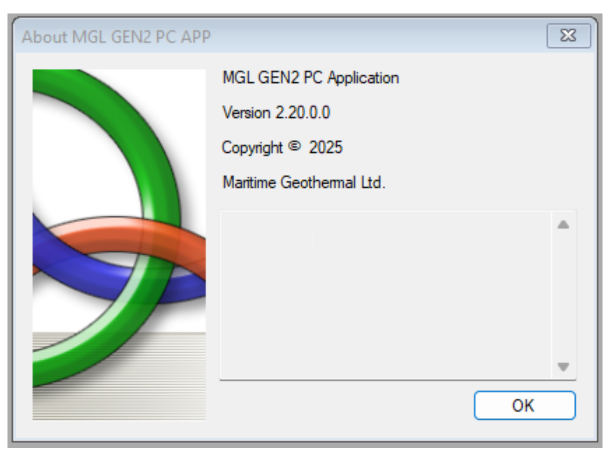
File-->Open: Opens a saved page arrangement.
File-->Save: Saves the current page arrangement.
File-->Exit: Exits the PC Application.

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.



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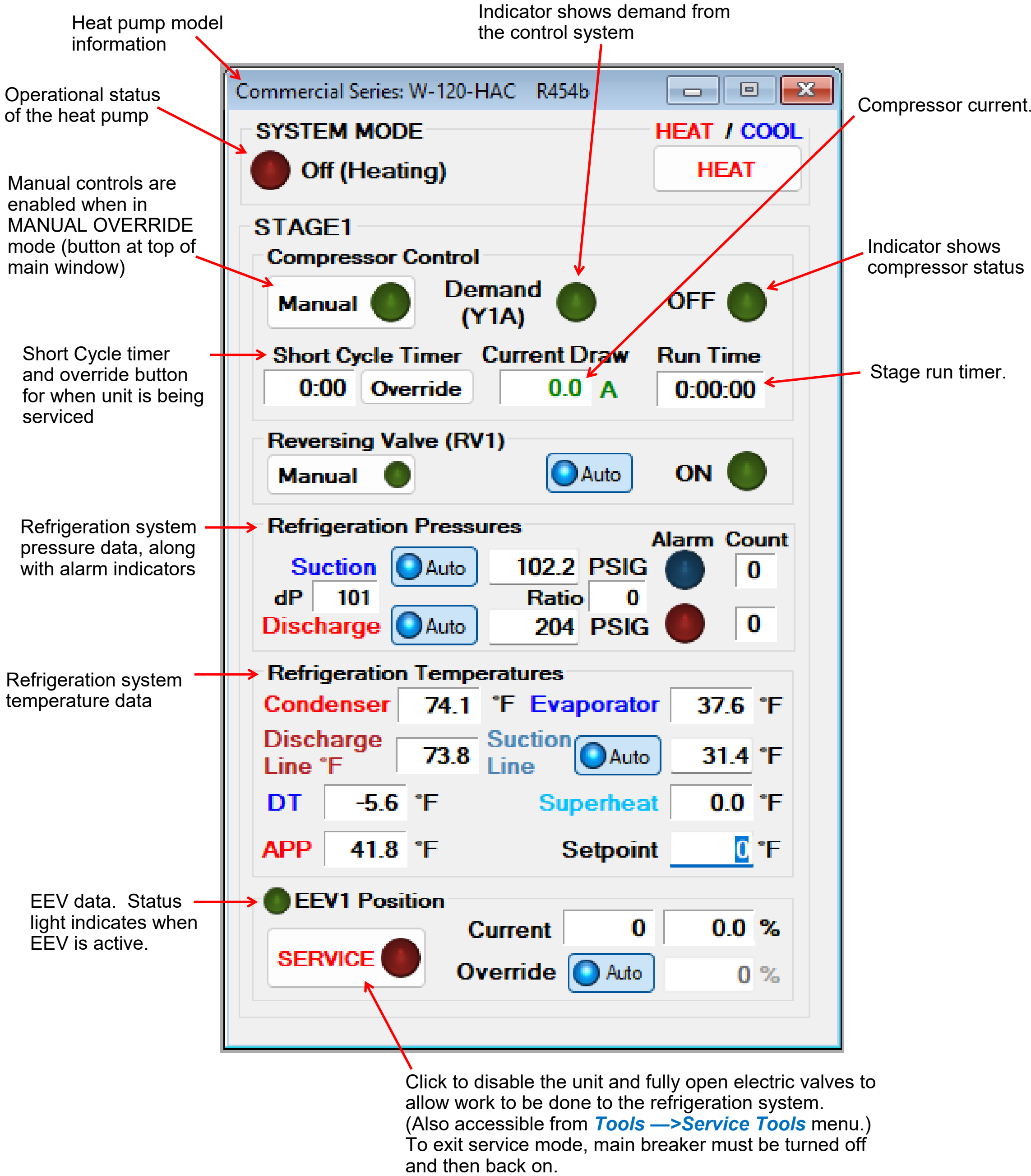
View Menu:

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.

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

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

Compressor Monitor: Occurs when the compressor protection module sends a fault signal to control board, generally due to the compressor windings overheating.   (Some smaller models do not have compressor protection modules.)

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 3-Phase Monitor detects a fault and sends a fault signal to control board.

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.

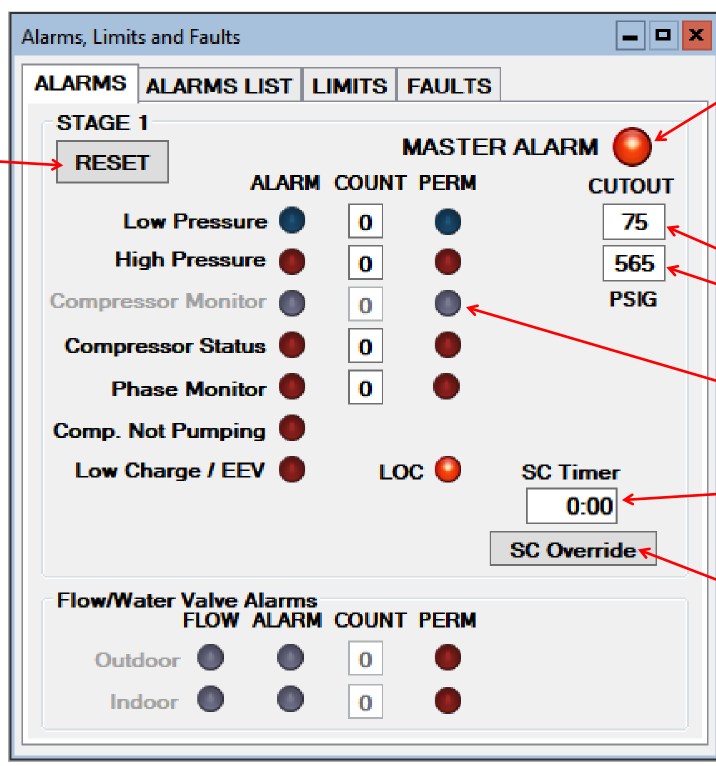
LOC (Loss of Charge): This alarm occurs if both the low pressure and high pressure sensors are below 30 psig (207kPa).

Flow: Outdoor or indoor loop flow switch did not detect flow. Non-reversing units do not have indoor flow switch.

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.

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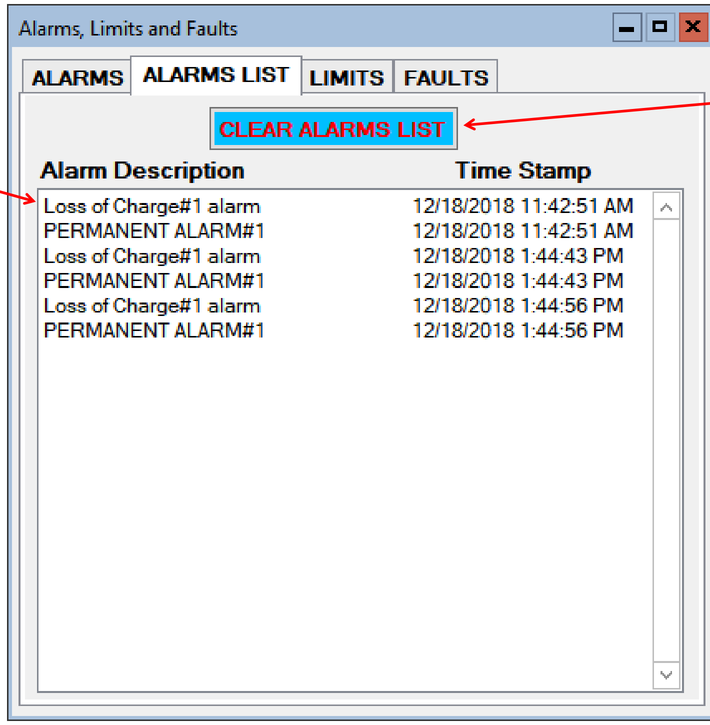
View-->Alarms, Limits and Faults (ALARMS LIST Tab)

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

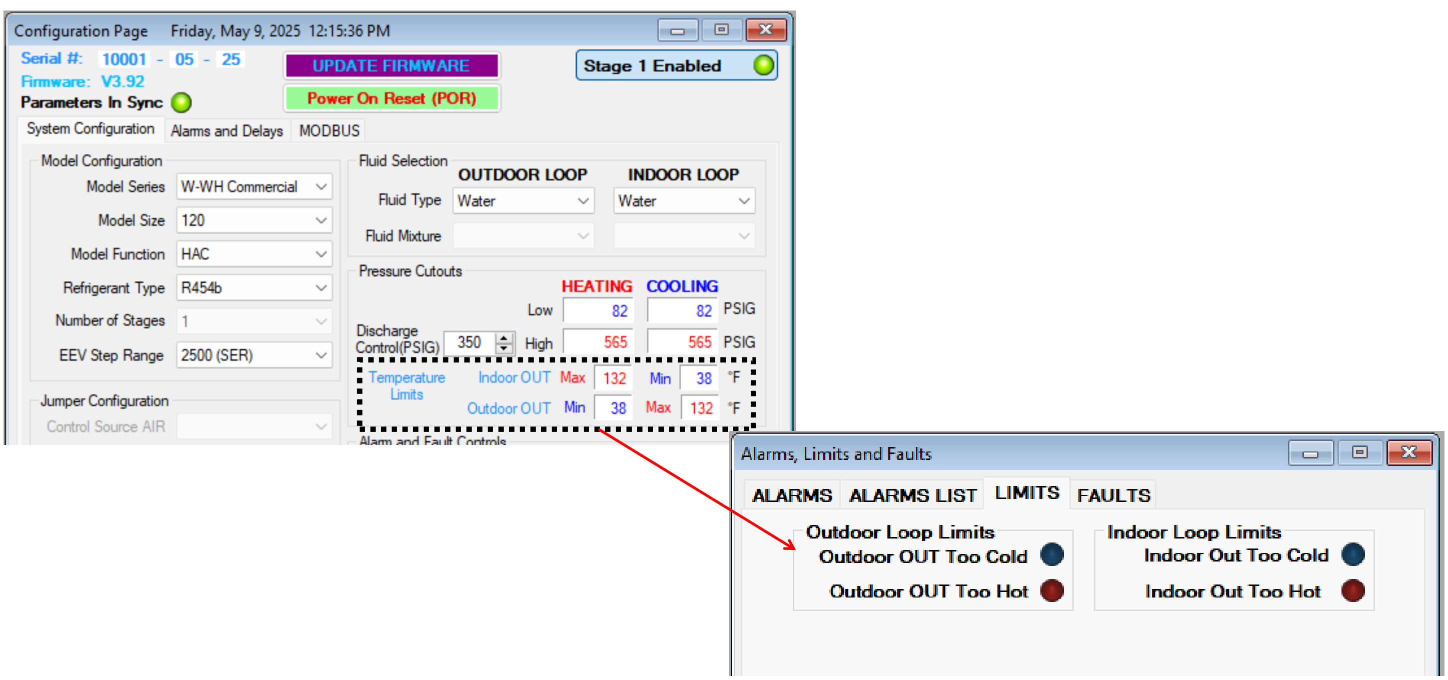
Each alarm that occurs while the PC APP is connected to the control board will appear here. The alarm type and a time stamp will be shown.



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.



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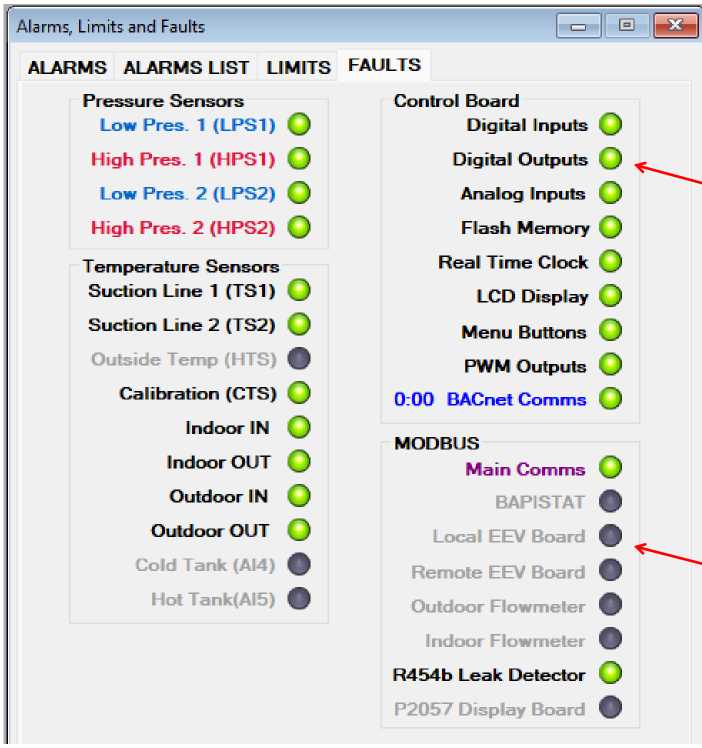
View-->Alarms, Limits and Faults (FAULTS tab)

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.

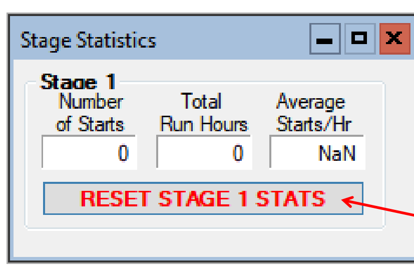


Fault Indicators

Greyed out do not apply.

View-->Stage Stats:

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



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

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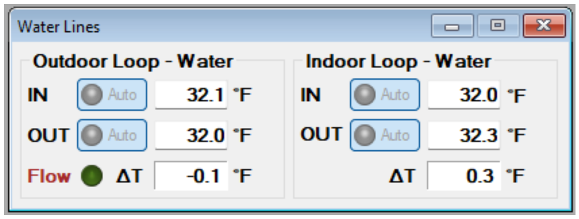
View-->Water Lines

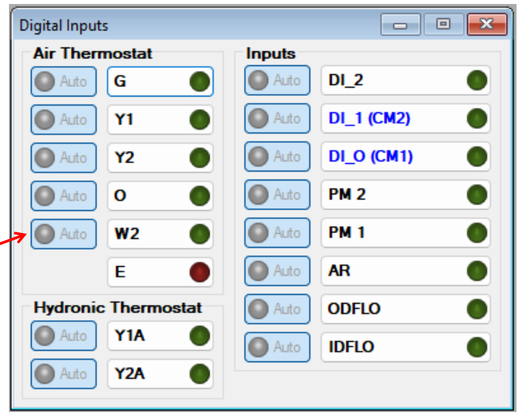
Displays the outdoor and indoor loop in, out, and delta temperatures.



View-->Digital Inputs

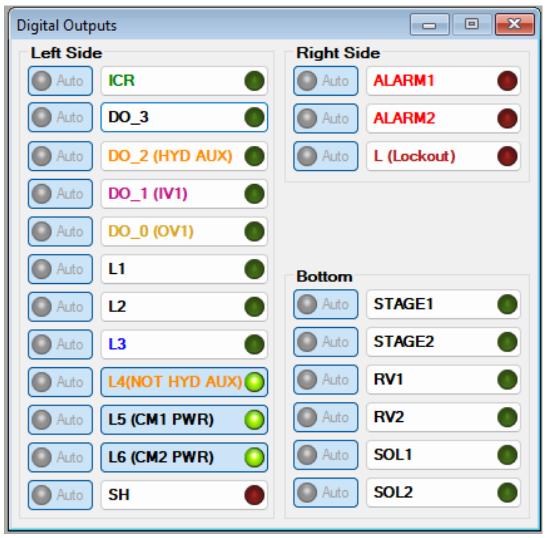
Shows the digital inputs and their individual status (ON/OFF). They may be individually controlled when in Manual Override Mode in order to facilitate troubleshooting.

N/A for W/WH series



View-->Digital Outputs

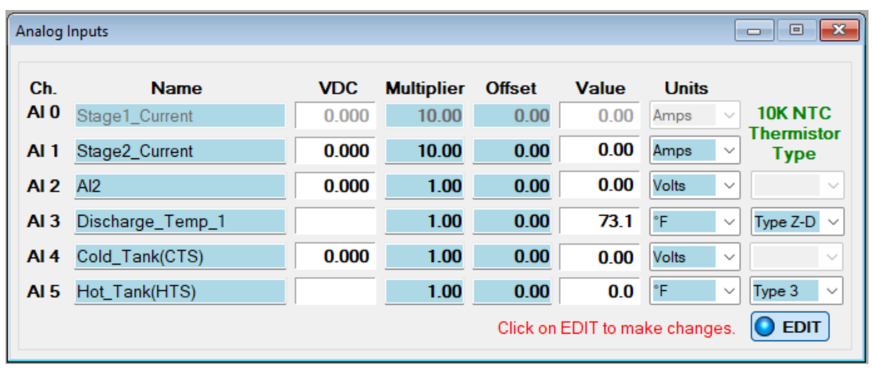
Shows the digital outputs and their individual status (ON/OFF). They may be individually controlled when in Manual Override Mode in order to facilitate troubleshooting.
.



View-->Analog Inputs

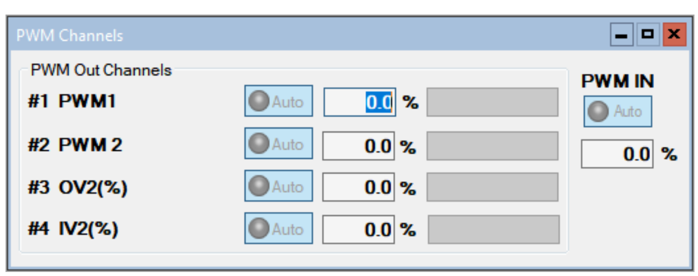
Shows the Analog inputs and their individual settings and values.

Click on the ***EDIT*** button to modify the blue boxes (button will now say ***SAVE***). For each channel a name may be selected (up to 16 characters), and the Multiplier and Offset values may be set to accommodate the connected sensor scaling. Signals may be 4-20mA (channel jumper on board ON) or 0-10VDC (channel jumper on board OFF). A variety of units are also available for selection of common measurement types. Click on ***SAVE*** to save the changes. Values are kept even when power is removed from the unit.



View-->PWM Channels

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



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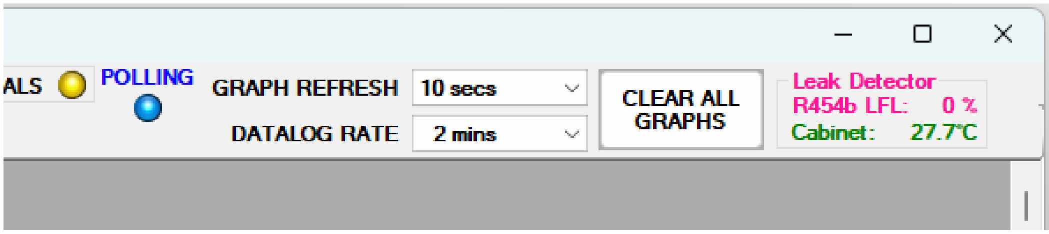
Graphs Menu:

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

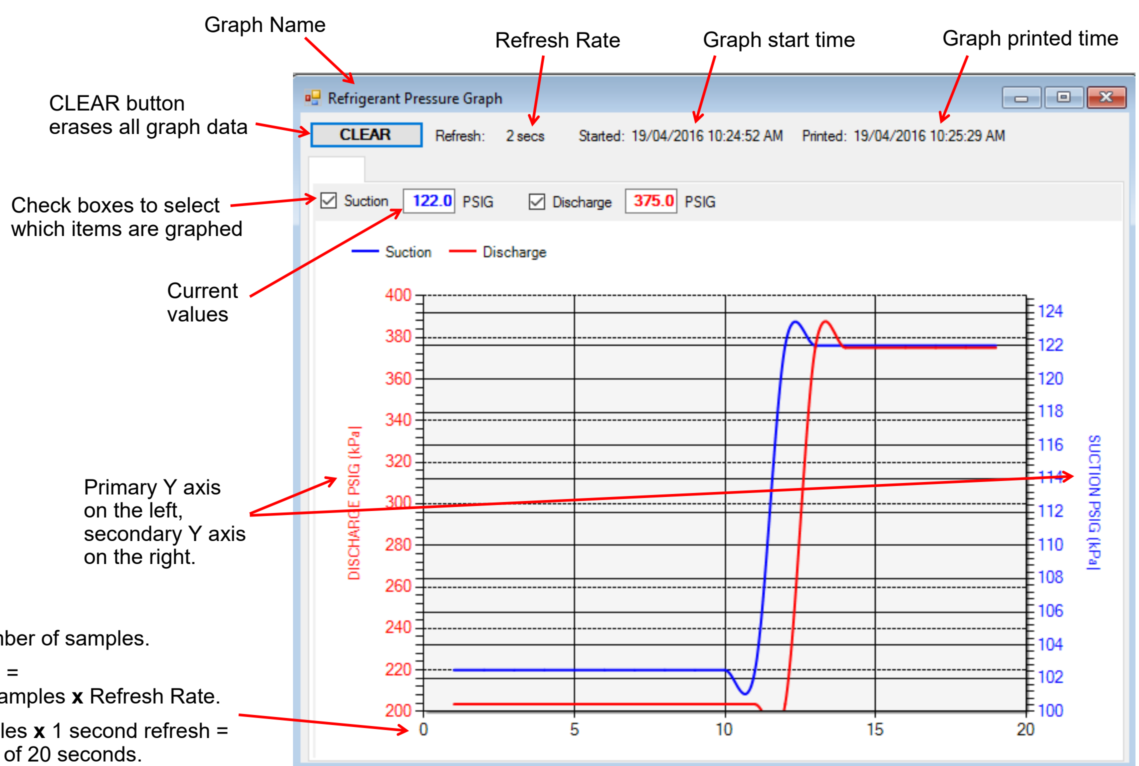


TIP: To screen print a graph and save it as a picture, press Print Screen on the keyboard and then paste into MS Paint or other graphics program. Select the desired graph with the selection tool and copy it to a new MS Paint, then save the file as the desired name.

Graphs | Tools | Windows | Help | Disconr

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

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



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.

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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

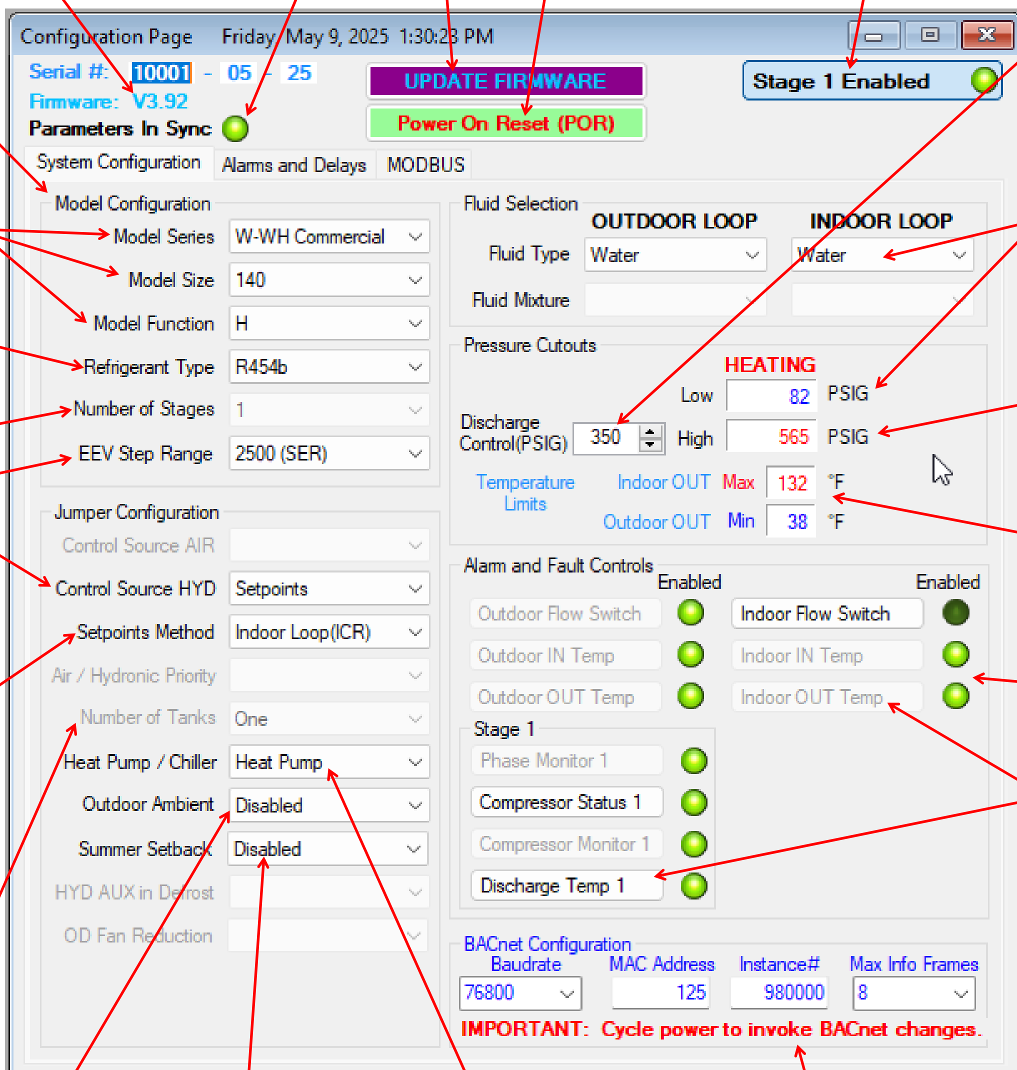
Firmware update: see Appendix

Enable/disable compressor. Units are shipped as Disabled to prevent an unintentional compressor startup.

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

Model Configuration chapter to select the system type

The head pressure below which the modulating water valve will start restricting water flow, to avoid a low suction pressure alarm



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

R454b for W-series *or* **R513a** for WH-series.

These units are 1-stage

Always 2500

Selects how the heating/cooling demand will be controlled: BACnet, Setpoints, or Signals.

Setpoint Control only: Selects whether to use the internal temp sensor (Indoor Loop/ ICR) or external sensor (External HTS/CTS).

Setpoint Control with HTS/ CTS method only: Selects whether there are one or two tanks (hot and cold) in the system. Default value is One.

Setpoint Control only: **Outdoor Ambient** Enable if using optional sensor to measure outside temperature which is used in conjunction with the Outdoor Reset functionality of Setpoint Control.

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

Non-reversing units using Setpoint Control only. **Heat Pump / Chiller** Heat Pump is default, controls based on hot tank temperature. Chiller mode control based on chilled water temperature.

Fluid selection determines the low pressure cutout values. Select the appropriate Fluid Type and Fluid Mixture **by volume**.

High pressure cutout is determined by refrigerant type.

Temperature limits determined by series, function, and loop type

The Enabled indicators show which alarms are active

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

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

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Tools-->Configuration (Alarms and Delays tab)

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

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

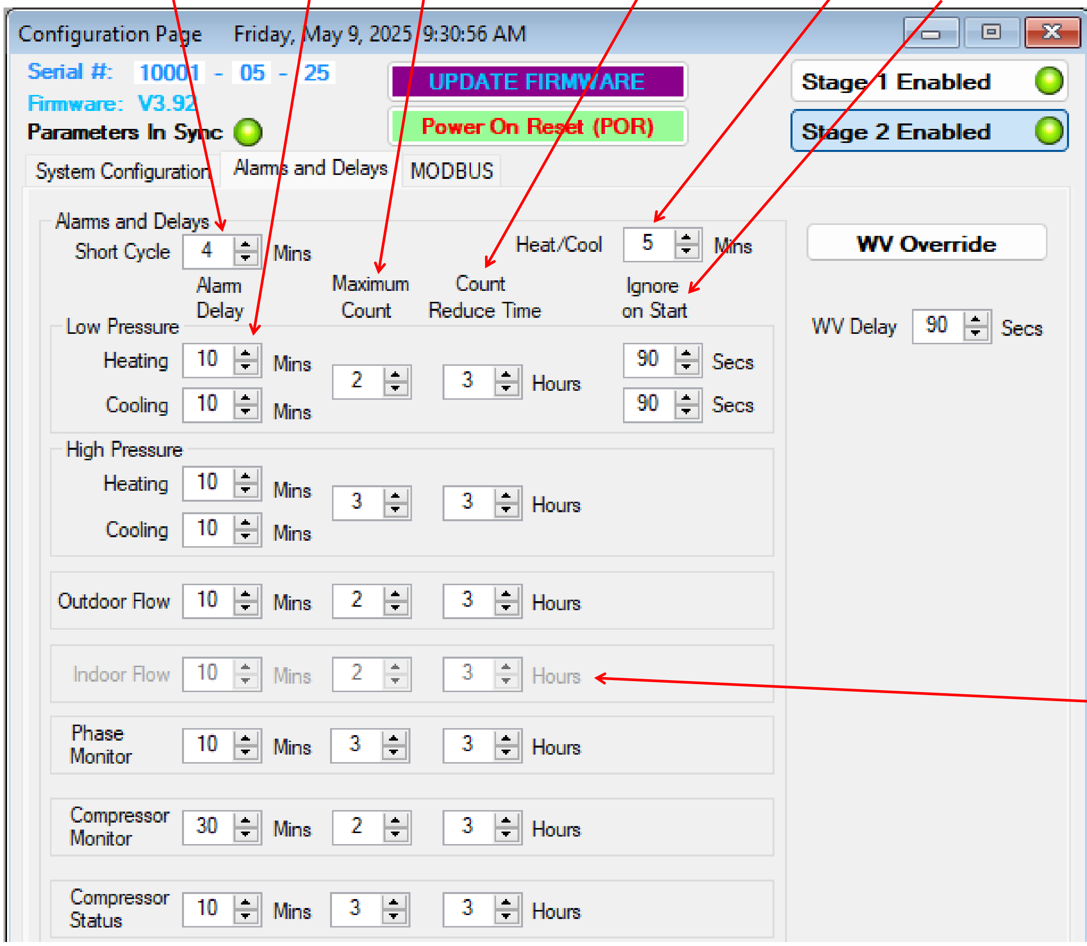
The number of minutes before the unit can start again after a normal shutdown.

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

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

The minimum off time when switching between heating and cooling cycles

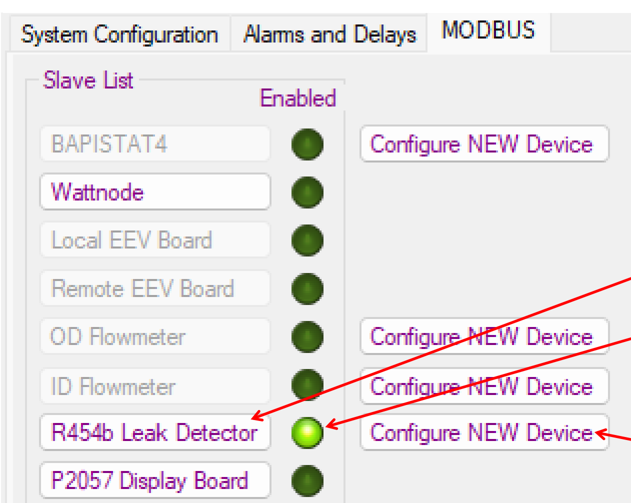
Ignore On Start is the number of seconds an alarm will not be monitored after a compressor start occurs.



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

Tools-->Configuration (MODBUS tab)

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



Click to enable/disable MODBUS device.

Green light indicates that MODBUS device is present.

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

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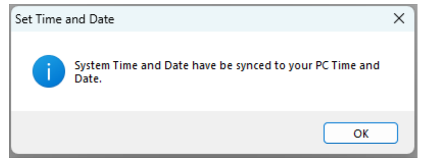
Tools-->Set Date and Time

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.

Loads the **QUANTITY** of logs beginning from earliest

Loads **QUANTITY** of logs beginning from selected date

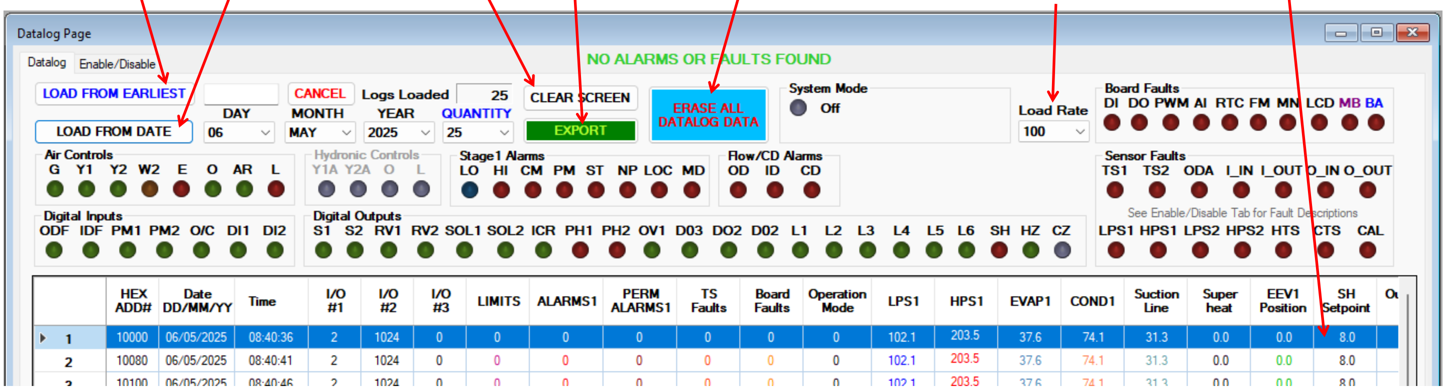
Erases data from screen only

Exports the data to a file.

Erases all logged data in the control board and resets the log count to zero (also available directly from ***Tools*** menu)

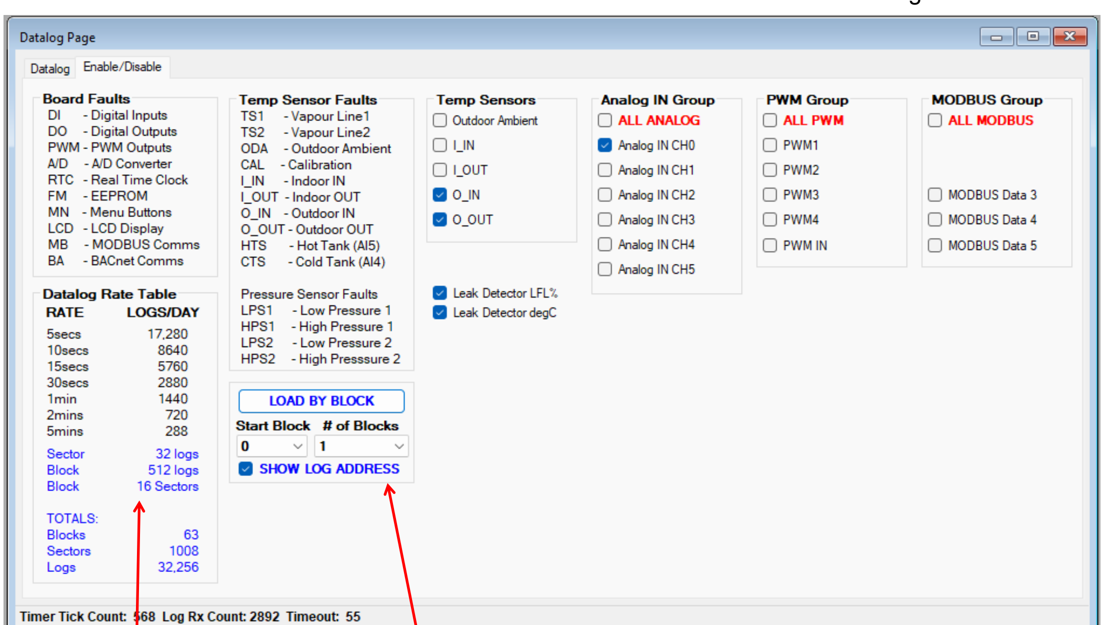
Load Rate: speed at which logs are retrieved from control board

Clicking anywhere on a row will update all LEDs to show the status at the time of that log record.



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

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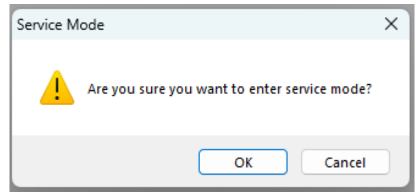
Tools-->Service Tools

Tools-->Service Tools-->Stage 1 Service Mode



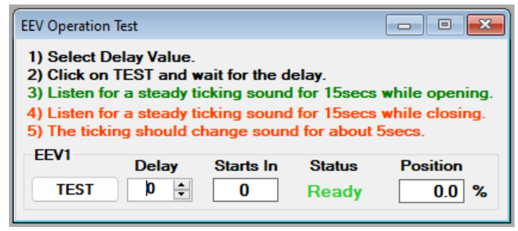
Disables the unit and fully opens electric valves to allow work to be done to the refrigeration system. (Also accessible via **SERVICE** button in ***View -->Control Panel*** window.)

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

Tools-->Service Tools-->Manual Override

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

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

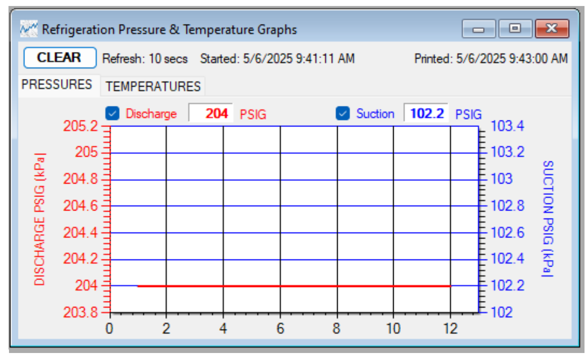


Facilitates the audible EEV test described in the **Troubleshooting** chapter.

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

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

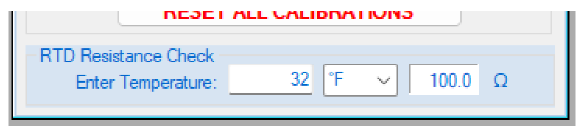
Tools-->Service Tools-->Pressure Test Graphs



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

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

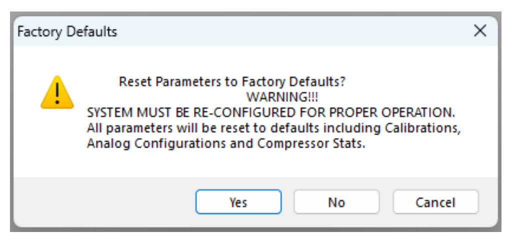
Tools-->Service Tools-->RTD Resistance Check



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

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

Tools-->Reset to Factory Defaults

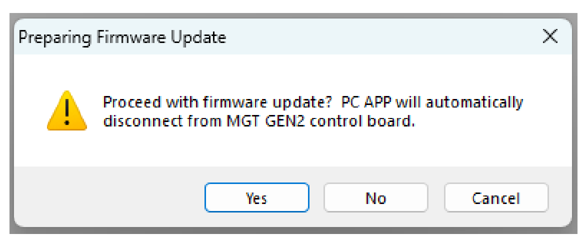


This will reset all settings to default values.

THE SYSTEM MUST BE RECONFIGURED AFTER A RESET IS PERFORMED.

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

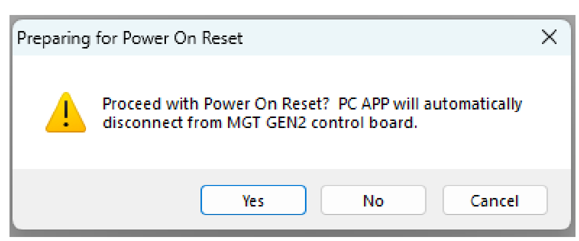
Tools-->Update Firmware



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

See appendix for details.

Tools-->Power On Reset (POR)



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

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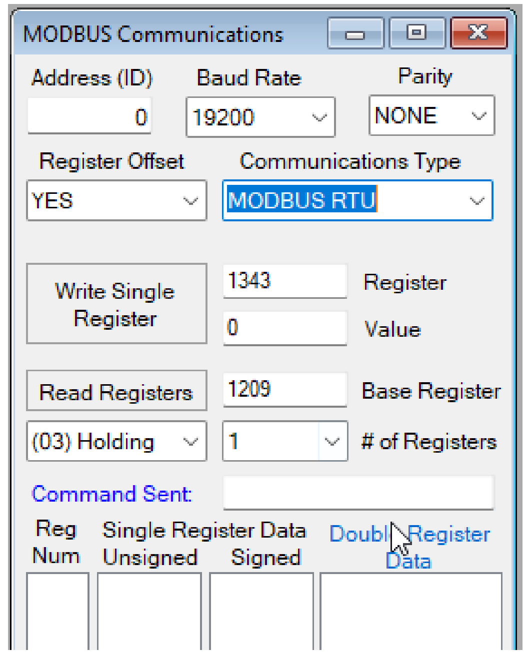
Tools-->MODBUS-->Generic MODBUS



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

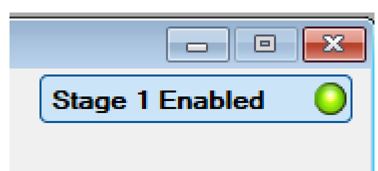
Tools-->Advanced-->Objects

Tools-->Advanced-->Jumpers

Tools-->Advanced-->SYSTEM TIMERS

Tools-->Advanced-->Performance

Tools-->Stage 1 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.

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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.

2x16 LCD Display

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

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

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

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

Main Menu: This 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.
			— AUX (S2) Setpoint	Stage 3 stops when water temperature rises to this point.
			— AUX (S2) Delta	Stage 3 time delay starts when water temperature drops below setpoint by this amount.
			— AUX (S3) Delay	Delays Stage 3 start by timer amount.
			— Outdoor Reset	Outdoor reset factor (diff. between steps)
		— Cooling	***— Stage 1 Setpoint***	Stage 1 stops when water temperature drops to this point.
			— Stage 1 Delta	Stage 1 starts when water temperature rises above setpoint by this amount.

...continued on next page

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Menu Tree Continued				
ENTER (From Main)	**ENTER (First Press)**	**ENTER (Second Press)**	**ENTER (Third Press)**	**Description**
Summer Setback *(only if using Setpoint Control)*	***— Enable Setback?***	***— Enable***		Enable summer setback.
		— Disable		Disable summer setback.
System EN/DIS	***— Enable System?***	***— Enable***		Enable compressor, auxiliary, and ICR.
		— Disable		Disable compressor, auxiliary, and ICR.
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 (%)***	Enter desired EEV position
Configuration	***— Control HYD***	***— Setpoints***		On-board water temp. control—see **Operation** chapter
		— Signals		Hardwired Signal control
		— BACnet		BACnet control—see **BACnet** chapter
	— Outdoor Reset *(only if using Setpoint Control)*	***— Enable***		Enables Outdoor Reset functionality
		— Disable		Disables Outdoor Reset functionality
	— Outdoor Ambient	***— Enable***		Enables accessory outdoor temp. sensor
		— Disable		Disables accessory outdoor temp. sensor
	— Setpoints Method *(only if using Setpoint Control)*	***— ICR***		Use Indoor Circulator Relay sampling
		— HTS/CTS		Use external temperature sensors
	— Heat Pump / Chiller *(only if using Setpoint Control, H/HW models)*	***— Heat Pump***		Control on indoor loop water temperature
		— Chiller		Control on outdoor loop water temperature
	— Number of Tanks *(only if using Setpoint control with HTS/CTS)*	***— One Tank***		One tank for heating/cooling functions
		— Two Tanks		Separate hot and cold tanks
	— Time Delays	***— Short Cycle***	***— Short Cycle (min)***	Enter short-cycle timer value
		— Heat/Cool	***— Heat/Cool (min)***	Enter minimum off time between modes
	— Units	***— Standard***		Standard units
		— Metric		Metric units (does not affect calibration units)
	— Set Time	***— Hours***		Set the system hours.
		— Minutes		Set the system minutes.
	— Set Date	***— Day***		Set the system day.
		— Month		Set the system month.
		— Year		Set the system year.
Calibration	***— Suction 1***		Suction Pressure.	Calibration in 1PSI intervals.
	— Discharge 1		Discharge Pressure	Calibration in 1PSI intervals.
	— Vapour Line 1		Suction line temperature	Calibration in 0.1°F intervals
	— Outdoor Ambient		Outside air temperature	Calibration in 0.1°F intervals
	— Outdoor IN Temp			Calibration in 0.1°F intervals
	— Outdoor OUT Temp			Calibration in 0.1°F intervals
	— Indoor IN Temp			Calibration in 0.1°F intervals
	— Indoor OUT Temp			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.

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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.

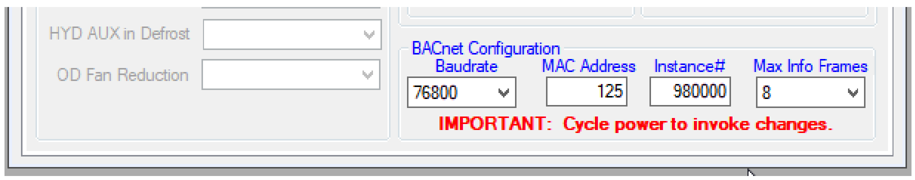
The connector on the control board is a three wire removable screw connector. The signals are as follows:
A: Communications line (+) (right pin)
B: Communications line (-) (middle pin)
C: Ground connection (left pin)

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 16 - BACnet OBJECTS - CONTROL SIGNALS (READ/WRITE)

Name	Data Type	ID	Property	Description
SYSTEM_Y1A	Binary Value	BV0	Present Value	Compressor (active is on)
SYSTEM_O	Binary Value	BV2	Present Value	Reversing valve. Inactive=HEATING, Active=COOLING (HAC units only)
BACnet_Units	Binary Value	BV9	Present Value	Select units for BACnet objects. OFF=US standard, ON=metric

TABLE 17 - BACnet OBJECTS - OPERATION MODE Description (Read Only)

Name	Data Type	ID	Present Value	Description
Operation Mode	Analog Value	**AV5**	2	Hydronic heating
			3	Hydronic cooling (HAC units only)
			11	Hydronic heating OFF
			12	Hydronic cooling OFF (HAC units only)
Note: Object is type Analog Value but value will always be an integer value.				

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

Name	ID	BIT #	Decimal Value*	Bit Description
Limits (Present Value)	**AV6**	0	1	Low Indoor OUT temperature
		1	2	High Indoor OUT temperature
		2	4	Low Outdoor OUT temperature
		3	8	High Outdoor OUT temperature
Note: Limits object is type Analog Value but value is bit coded and may be decoded as such (integer value). Note * : Value is for a single alarm and reference only.				

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TABLE 19 - BACnet OBJECTS - DATA (Read Only)

	Name	ID	Property	Units	Description
Type - Analog Input	AI0 (Comp1_Current)	AI0	Present Value	Amps	Compressor current draw
	AI1 (Comp2_Current)	AI1	Present Value	User	N/A
	AI2	AI2	Present Value	User	N/A
	AI3	AI3	Present Value	degF (degC)	Compressor discharge line temperature
	AI4 (CTS)	AI4	Present Value	degF (degC)	Cold tank temperature from sensor - requires accessory
	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	N/A
	ICR (Indoor Circ)	BO2	Present Value	N/A	Indoor circulator control
	DO0 (OV1)	BO3	Present Value	N/A	OV1 - 24VAC for outdoor loop water valve
	DO1 (IV1)	BO4	Present Value	N/A	IV1 - 24VAC for indoor loop water valve
	DO2 (HYD_AUX)	BO5	Present Value	N/A	Hydronic Auxiliary
	DO3 (AUX_ONLY)	BO6	Present Value	N/A	N/A
	PHS1	BO7	Present Value	N/A	Stage 1 dry contact pin for locked out on alarm
	PHS2	BO8	Present Value	N/A	N/A
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 flow switch
	Indoor Flow	BV11	Present Value	N/A	Indoor Loop flow switch (reversing models only)
	Phase Monitor1	BV12	Present Value	N/A	3-phase monitor
	Phase Monitor2	BV13	Present Value	N/A	N/A
	Comp Monitor1	BV14	Present Value	N/A	Compressor monitor
	Comp Monitor2	BV15	Present Value	N/A	N/A

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TABLE 20 - 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 flow alarm
Indoor Flow	Binary Value	BV11	Indoor loop flow alarm (HAC models only)
Phase Monitor1	Binary Value	BV12	3-phase monitor alarm
Phase Monitor2	Binary Value	BV13	N/A
Comp Monitor1	Binary Value	BV14	Compressor monitor alarm (from compressor protection module, if present)
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	3-phase monitor alarm
		7	129	Compressor monitor alarm (from compressor protection module)
		8	257	Status alarm (start / stop failure, from current sensor)
		9	513	Compressor not pumping / Manual high pressure switch alarm
		14	16,385	Outdoor loop flow alarm
		15*	32,769	Indoor loop flow alarm (reversing models only)
Permanent Alarms 2 (Present Value)	**AV8**	13	8192	A2L refrigerant leak detector alarm (may or may not be a permanent alarm)
Note: Permanent Alarm objects are type Analog Value but values are bit coded and may be decoded as such (integer value). Note * : Value is for a single alarm and reference only. Value includes + 1 for Master Alarm				

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

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TABLE 21 - 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	AI4	Cold tank temperature sensor faulty or disconnected - requires accessory
AI5 (Hot Tank)	Analog Input	AI5	Hot tank temperature sensor faulty or disconnected - requires accessory
LPS1	Analog Input	AI6	Low pressure sensor faulty or disconnected
HPS1	Analog Input	AI7	High pressure sensor faulty or disconnected
LPS2	Analog Input	AI13	N/A
HPS2	Analog Input	AI14	N/A
Suction Line1	Analog Input	AI10	Suction line 1 temperature sensor faulty or disconnected.
Suction Line2	Analog Input	AI17	N/A
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	Stage 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	Cold tank temperature sensor on AI4 - accessory
		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.

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Startup Procedure

The 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

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 (Ground Water):

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

Domestic Hot Water (Desuperheater): *HACW/HW only*

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.**
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.
3. Record the circuit breaker size and wire gauge for the heat pump.
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 voltages. 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.
7. **Turn on power at least 2 hours before startup so that crankcase heaters are energized (to prevent flooded starts).**

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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 SYSTEM 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.

The LCD will automatically scroll through various data including low (suction) pressure, high (discharge) pressure, superheat, EEV position and water in/out temperatures.

Preparation:

1. Set all controls (including zone thermostats) to OFF. Turn power on to the heat pump. All LED's on the control board should turn on, the LCD should say "**MGT GEN2 VERx.xx**" on line 1 and "**Zeroing EEV's**" on line 2. You should be able to hear the EEV moving (a clicking sound).
2. Measure the following voltages on the compressor contactor and record them on the startup sheet: L1-L2, L2-L3, L1-L3.
3. Connect a USB cable between the USB connector on the board and a laptop with the PC App installed (recommended but optional).
4. Select the desired *Control Source HYD* via the PC APP Configuration Page or via the LCD Configuration Menu.
5. Enable the system either with the PC App's Configuration Page **System Enable/Disable** button or via the LCD display.

Heating Mode:

1. Adjust the Setpoint Control settings via the PC App or LCD to activate stage 1 (or activate via BACnet or 24V signal if used). The EEV will begin to open and the compressor will start, as will the circulator pumps.
2. Check the PC App or LCD. The suction and discharge pressures will vary based on the outdoor loop temperature and the indoor loop temperature, but for a typical startup they should be **90-110 psig** and **260-360 psig** for W/WP-series or **25-35 psig** and **105-200 psig** for WH-series.
3. Monitor the unit via the PC APP or LCD while the unit runs, and record the following after 10 minutes of run time:
    1. Suction pressure
    2. Discharge pressure
    3. Four water line temperatures: Indoor IN, Indoor OUT, Outdoor IN, Outdoor OUT
    4. Outdoor Delta T (should be **5-8°F, 3-4°C**)
    5. Indoor Delta T (should be **8-12°F, 4-6°C**)
    6. 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.
5. For units with desuperheater (HACW/HW), turn the power off to the unit. Connect the brown wire with the blue insulated terminal to the compressor contactor as shown on the electrical box diagram. Turn the DHW switch in the unit post on. Turn the power to the unit on.
6. Open a zone (or zones) and let the tank cool down until stage 1 is activated. Close the zone(s) again.
7. Verify the DHW IN and DHW OUT temperatures (if applicable) by hand **(caution: pipes can 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.
8. Activate AUX heat if equipped by changing the AUX setpoints. Be sure the auxiliary heat breaker at the panel is ON. Measure the L1 current draw with an clamp meter and record the value.

Cooling Mode: *HACW/HAC only*

1. Set a zone thermostat to cooling mode or otherwise activate cooling mode by sending an "O" signal to the heat pump. Adjust the setpoints via the PC App or LCD to activate stage 1.
2. Monitor the unit via the PC APP or LCD Display while the unit runs, and record the following after 10 minutes of run time:
    1. Suction pressure
    2. Discharge pressure
    3. Four water line temperatures: Indoor IN, Indoor OUT, Outdoor IN, Outdoor OUT
    4. Outdoor Delta T (should be **8-12°F, 4-6°C**)
    5. Indoor Delta T (should be **5-8°F, 3-4°C**)
3. Adjust the setpoints and let the unit run through a cycle.

Final Inspection:

1. Turn the power off to the unit 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.
3. Do a final check for leaks/spills and ensure the area is clean.
4. Turn the power on to the unit. Set the heat pump setpoints and zone thermostats to their final settings.

Startup Record:

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

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Startup Record

Installation Site		**Startup Date**	**Installer**	
City			**Company**	
Province		**Check boxes unless asked to record data. Circle data units.**	**Model**	
Country			**Serial #**	
Customer Name		**Customer Phone #**		

PRE-START INSPECTION

Indoor Loop (Hydronic)	All shut-off valve are open (full flow available)							
	Loop is full and purged of air							
	Antifreeze type, if any							
	Antifreeze concentration, if any		% Volume		% Weight			
	Loop static pressure		PSI	kPa				
Ground Loop System	All shut-off valve are open (full flow available)							
	Loop is full and purged of air							
	Antifreeze type							
	Antifreeze concentration		% Volume		% Weight			
	Loop static pressure		PSI	kPa				
Ground Water System	Water valve installed in OUT line							
	Flow control installed in OUT line							
Domestic Hot Water *HACW/HW only*	All shut-off valves are open							
	Lines are full and purged							
	Desuperheater pump wire is disconnected							
Electrical	High voltage connections are correct and securely fastened							
	Circuit breaker (or fuse) size and wire gauge for Heat Pump		A		Ga.			
	Circulator pump voltages (Outdoor 1, Outdoor 2, Indoor 1)		V		V		V	
	Low voltage connections are correct and securely fastened							

STARTUP DATA

Preparation	Voltage across L1 and L2, L1 and L3, L2 and L3							VAC
Heating Mode (10 minutes)	Suction Pressure / Discharge Pressure					psig	kPa	
	Outdoor In, Outdoor Out, and Delta T		In		Out		°F	°C
	Outdoor Flow		Igpm	USgpm		L/s		
	Compressor L1 (black wire) current		A					
	Heating setpoint and discharge pressure at cycle end		°F	°C		psig	kPa	
	Domestic Hot Water functioning (if equipped)?							
Cooling Mode (10 minutes) *HACW/HAC only*	Suction Pressure / Discharge Pressure					psig	kPa	
	Outdoor In, Outdoor Out, and Delta T		In		Out		°F	°C
	Cooling setpoint and suction pressure at cycle end		°F	°C		psig	kPa	
Final Setpoints	Heating S1 Setpoint, S1 Delta, S2 Setpoint, S2 Delta					°F	°C	
	Cooling S1 Setpoint, S1 Delta, S2 Setpoint, S2 Delta					°F	°C	

Date:		**Installer Signature:**		**Client 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.

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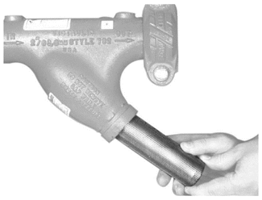
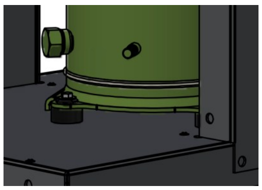
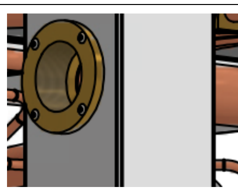
Routine Maintenance

MAINTENANCE SCHEDULE			
Item		**Interval**	**Procedure**
Strainers (if present)		Monthly (more frequently immediately after initial startup)	Inspect and clean if necessary.
Compressor Crankcase Heaters		Monthly	Check if operational and not shorted out. Replace if necessary. (Prevents flooded starts.)
Compressor Contactor		1 year	Inspect for pitted / burned points or loose wires. If necessary, replace contactor or tighten wires.
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 **Trouble-shooting** chapter.
Heat Exchangers		When experiencing performance degradation that is not explained by a refrigeration circuit problem or low loop flow rate	Disconnect the affected loop and flush heat exchanger with a lime removing solution. Generally not required for closed loop or cold water open loop systems; whenever system performance is reduced for warm water open loop systems.

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Troubleshooting Guide

The following steps are for troubleshooting the heat pump. 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 as 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 208-575VAC 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), 208-575VAC 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 aquastat (if used)	No power from transformer	See **No heartbeat on control board**.	
	Faulty wiring between heat pump and aquastat	24VAC is not present across 24V and COM of the aquastat.	Correct the wiring.
	Faulty aquastat	24VAC is present across COM and 24V of the aquastat but aquastat has no display.	Replace aquastat.

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ALARM TROUBLESHOOTING

Alarm	Description	Recommended Action
Note that the data logging function of the GEN2 Control Board is a very useful tool for troubleshooting alarms. It provides a history of the unit operation up to and including the time at which the alarm(s) occurred.		
Low Pressure	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 compressor will start, otherwise alarm will occur. When compressor starts, a low pressure condition 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 Monitor (Stage 1 or Stage 2)	This alarm occurs when the compressor protection module (if present) sends a fault signal to the control board, generally due to the compressor windings overheating.	Go to Compressor section.
Compressor Status	This alarm occurs when there is a current draw on the compressor as measured by the current sensor 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).	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.
Phase Monitor	This alarm occurs when the 3-phase monitor detects a fault condition and sends a fault signal to the control board.	Verify power supply for under/over voltages as well as phase balance. Check compressor contactors for pits or burns. 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.
Outdoor Flow	Low or no outdoor loop flow from flow switch. Ignored on compressor start for number of seconds the Outdoor Flow ***Ignore on Start*** is set to. Alarm monitoring will begin when timer expires.	Check outdoor flow switch. Check outdoor loop flow.
Indoor Flow	Reversing -HAC units only: low or no indoor loop flow from flow switch. Ignored on compressor start for number of seconds the Indoor Flow ***Ignore on Start*** is set to. Alarm monitoring will begin when timer expires.	Check indoor flow switch. Check indoor loop flow.
Leak Detector / R454b Leak (A2L W-series only)	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.

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FAULT TROUBLESHOOTING

Fault	Possible Cause	Verification	Recommended Action
Pressure Sensor (e.g. LPS)	First, check for loose connection at **LPS** control board connector. If that looks ok: the sensor, sensor cable, or control board may be faulty.	1. Swap the high and low pressure sensor connectors **LPS** and **HPS** at control board.	If fault remains at **LPS**, replace control board. If fault changes to **HPS**, control board is OK; continue with step 2.
		2. Leaving control board connections as per step 1, swap connectors at high and low pressure sensors.	If fault remains at **HPS**, replace low pressure sensor (**LPS**). If fault changes to **LPS**, check continuity of and replace **LPS** cable.
Temperature Sensor (e.g. INDOOR IN)	First, check for loose connection at control board connector. If that looks ok: the sensor (with its cable) or control board may be faulty.	1. Swap the **INDOOR IN** and **INDOOR OUT** connectors at control board.	If fault remains at **INDOOR IN**, replace control board. If fault changes to **INDOOR OUT**, control board is OK; replace sensor with its built in cable.
Control Board: - *Digital Inputs* - *Digital Outputs* - *Analog Inputs* - *Real Time Clock* - *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: - *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: - *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 and the Control Board, and then turning the power back on again. If this does not work then either the LCD Interface, the cable, or the driver section of the Control Board may be faulty.
Control Board: - *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: - *BACnet Comms*	BACnet communications experienced a timeout.		See **BACnet TROUBLESHOOTING** on following page.
MODBUS: - *Main Comms*	Hardware problem on heat pump control board.	Check if 24-36V**DC** is present across **24VDC** and **GND** at lower right of control board.	Replace control board if voltage not in range.
		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 control board if voltage not correct.
	MODBUS termination problem.	Verify MODBUS **TERM** jumper is in place on control board.	Install jumper if missing.
MODBUS: - *R454b Leak Detector*	Refrigerant detector communications experienced a timeout.		See **LEAK DETECTOR TROUBLESHOOTING** on following page.

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BACnet TROUBLESHOOTING

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

LEAK DETECTOR TROUBLESHOOTING

Fault	Possible Cause	Verification	Recommended Action
Refrigerant detector not working properly **or** **MODBUS R454b Leak Detector fault indication**	Hardware problem on heat pump control board	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.

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COMPRESSOR TROUBLESHOOTING

Fault	Possible Cause	Verification	Recommended Action
Compressor will not start	Faulty control board	No 24vac output on STAGE1 or STAGE2 when compressor should be operating.	Replace control board.
	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. Verify 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 for single phase units.)	Attempt to “rock” compressor free. If normal operation cannot be established, replace compressor.
Compressor starts hard	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.

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OPERATION TROUBLESHOOTING - HEATING MODE

Fault	Possible Cause	Verification	Recommended Action
High or low suction or discharge pressure	Faulty sensor	Compare pressure sensor reading against a known reference such as a new refrigeration manifold set.	Check wiring, replace sensor. If problem persists replace control board.
High Discharge Pressure	Low or no indoor loop flow	Delta T across the indoor loop ports should be 8-12°F (3-6°C), or compare pressure drop to the tables for the unit.	Increase flow rate if new installation, check for fouled heat exchanger if existing installation.
	Temperature setpoint(s) too high (if using BACnet or Signals control)	Use PC APP to verify that Indoor OUT does not exceed 130°F (54°C) for W-series or 160°F (71°C) for WH-series.	Reduce setpoint(s).
	EEV stuck almost closed or partially blocked by foreign object	Manually adjusting the EEV does not affect the superheat or the suction pressure. High superheat and low suction pressure.	Go to EEV troubleshooting section.
	Filter-dryer plugged	Feel each end of the filter-dryer; they should be the same temperature. If there is a temperature difference then it is plugged. Also causes low suction pressure.	Replace filter-dryer.
	Unit is overcharged (after servicing)	High subcooling, low indoor loop delta T.	Remove 1/2 lb 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	Indoor OUT temperature too cold (on startup or if unit has been off for extended period).	Ensure Indoor OUT temperature is above the low limit indicated in the **Model Specific Information** chapter.	Reduce flow temporarily until Indoor OUT temperature has risen sufficiently.
	Low or no outdoor loop flow	Delta T across the outdoor loop ports should be 5-7°F (3-4°C), or compare pressure drop to the tables for the unit.	Determine the cause of the flow restriction and correct it. Verify pumps are working and sized correctly for ground loop systems. Verify well pump and water valve is working for ground water systems.
	Entering liquid temperature too cold	Measure the entering liquid temperature. Most likely caused by undersized ground loop.	Increase the size of the ground loop.
	Dirty or fouled outdoor loop coaxial heat exchanger (typically for open loop, unlikely for ground loop)	Disconnect the water lines and check the inside of the pipes for scale deposits.	Backflush the heat exchanger with a calcium-removing cleaning solution.
	TS1 temperature sensor not reading properly	If the sensor is reading low, the superheat will 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 low suction pressure.	Replace filter-dryer.

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OPERATION TROUBLESHOOTING - HEATING MODE			
Fault	**Possible Cause**	**Verification**	**Recommended Action**
Low suction pressure (continued)	EEV stuck almost closed or partially blocked by foreign object	Manually adjusting the EEV does not affect the superheat or the suction pressure. High superheat and discharge pressure.	Go to EEV troubleshooting section.
	Low refrigerant charge	Superheat is high, EEV position is high.	Locate the leak and repair it. Spray Nine, a sniffer, and/or dye are common methods of locating a leak.
High Suction Pressure (may appear to not be pumping)	EEV stuck open	Manually adjusting the EEV does not affect the superheat or the suction pressure. Low superheat and discharge pressure.	Go to EEV troubleshooting section.
	Leaking reversing valve if present (can cause compressor to overheat and trip internal overload)	Reversing valve is the same temperature on both ends of body, common suction line is warm, compressor is running hot, low compressor discharge pressure.	Switch back and forth into cooling mode to try to free up valve. If it can't be freed, replace reversing valve.
	Faulty compressor, not pumping	Pressures change only slightly from static values when compressor is started.	Replace compressor.
Compressor frosting up	See Low Suction Pressure in this section.		
EEV frosting up	EEV stuck almost closed or partially blocked by foreign object	Manually adjusting the EEV does not affect the superheat or the suction pressure. High superheat and discharge pressure.	Go to EEV troubleshooting section.
Random high pressure trip (may not occur while on site)	Faulty indoor circulator relay	Using the PC APP, manually turn the ICR on/off several times and ensure the 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.

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OPERATION TROUBLESHOOTING - COOLING MODE (HAC / HACW models only)

Fault	Possible Cause	Verification	Recommended Action
Heating instead of cooling	Zone thermostat interconnection or external control system not set up properly	Verify that there is 24VAC across O and C/CA of the aquastat strip on control board when cooling should be active.	Correct thermostat or external control system setup.
	Faulty reversing valve solenoid coil or motorized actuator	Verify solenoid by removing it from the shaft while the unit is running. There should be a loud “whoosh” sound when it is removed. Or for motorized actuator, verify shaft rotates 90° when changing modes.	Replace solenoid or motorized actuator if faulty.
	Faulty or stuck reversing valve	A click can be heard when the coil is energized but the unit continues to heat instead of cool, or shaft will not turn.	Replace reversing valve.
High discharge pressure	Low or no outdoor loop flow	Delta T across the outdoor loop ports should be 8-12°F (4-7°C), or compare pressure drop to the tables for the unit.	Determine the cause of the flow restriction and correct it. Verify pumps are working for ground loop systems. Verify well pump and water valve is working for ground water systems.
	Outdoor loop entering liquid temperature too warm	Measure the entering liquid temperature. 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 coaxial heat exchanger (typically for open loop, unlikely for ground loop)	Disconnect the water lines and check the inside of the pipes for scale deposits.	Backflush the heat 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 (after servicing)	High subcooling.	Remove 1/2 lb of refrigerant at a time and verify that the discharge pressure reduces. Or remove charge and weigh back in the amount listed on nameplate.

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OPERATION TROUBLESHOOTING - COOLING MODE (HAC / HACW models only)

Fault	Possible Cause	Verification	Recommended Action
High suction pressure (may appear to not be pumping)	EEV stuck open	Manually adjusting the EEV does not affect the superheat or the suction pressure. Low superheat and discharge pressure.	Go to EEV troubleshooting section.
	Leaking reversing valve (can cause compressor to overheat and trip internal overload)	Reversing valve is the same temperature on both ends of body, common suction line is warm, compressor is running hot, low compressor discharge pressure.	Switch back and forth into cooling mode to try to free up valve. If it can't be freed, replace reversing valve.
	Faulty compressor, not pumping	Pressures change only slightly from static values when compressor is started.	Replace compressor.
Low suction pressure	Low indoor loop liquid flow	Check for high delta T with the PC APP. The EEV will be at a lower position than normal as well.	Verify pump is working and sized correctly. Check for restrictions in the circuit, e.g. valve partially closed.
	Temperature setpoint(s) too low (if using BACnet or Signals control)	Use PC APP to verify that Indoor OUT is not less than the minimums listed in the **Model Specific Information** chapter.	Reduce setpoint(s).
	EEV stuck almost closed or partially blocked by foreign object	Manually adjusting the EEV does not affect the superheat or the suction pressure. High superheat and high 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	Indoor loop EWT and flow are good but suction is low. Check static refrigeration pressure of unit for a low value. Weigh out charge to verify amount.	Locate the leak and repair it. Spray Nine, a sniffer, and dye are common methods of locating a leak.
Compressor frosting up	See Low Suction Pressure in this section		
EEV frosting up	EEV stuck almost closed or partially blocked by foreign object	Manually adjusting the EEV does not affect the superheat or the suction pressure. High superheat and 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.

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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).

<u>Tests to determine if an EEV is working</u>

- 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.

<u>The EEV can be checked electrically</u>:

- RED to GREEN 75-105 ohms
- WHITE to BLACK 75-105 ohms

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

<u>Check with a new EEV:</u>

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.

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Service Procedures

A2L-SPECIFIC WARNING / INSTRUCTION (W-series only)

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.

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A2L-SPECIFIC WARNING / INSTRUCTION (W-series only)

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.

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Pumpdown Procedure

1. Place the unit in SERVICE mode via the PC App or LCD interface; this will open the EEVs and start the circulators (if circulators are controlled by the heat pump). **DO NOT** turn off electrical power at the breaker panel, since the heat exchangers **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 **must either have full flow or be completely drained** of fluid before recovery begins. If necessary, start circulation pumps via building control system. 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.

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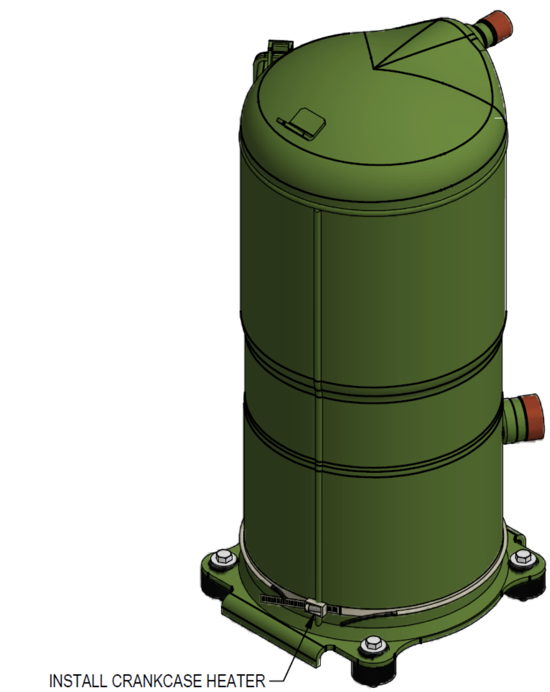
Compressor Replacement Procedure

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. Remove crankcase heater, leaving electrically connected.
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 an acid test. If it fails, pump down the unit and replace the filter-dryer.
5. Charge the unit a final time. Unit should now be clean and repeated future burn-outs can be avoided.
6. Check crankcase heater to be sure it is operational and not shorted out. Procure a replacement if necessary. Install crankcase heater with worm screw over weld seam of compressor as shown.



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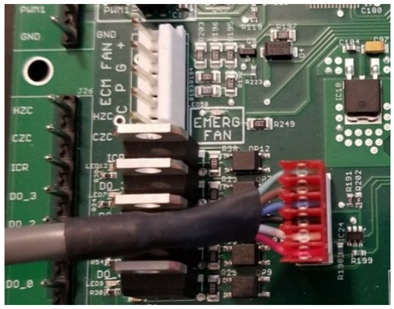
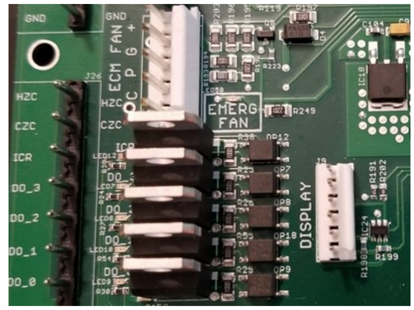
Control Board Replacement Procedure

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





5. Remove all connectors from the top of the control board. Each connector (or wire) should be marked already from the factory, e.g. HPS1, LP1, TS1, etc.. This matches the marking on the control board.
6. The control board is held in place at its four corners. Squeeze each standoff by hand or with needle nose pliers if necessary and carefully pull the corner of the board off of the standoff.
7. Once the control board has been removed, if there are any other standoffs left (they have the bottom snap cut off) remove them as well.
8. Carefully remove the new control board from the static bag it was shipped in. Place any cut off standoffs from the old board into the same locations on the new board.
9. Align the control board with the four corner standoffs in the electrical box then push on each corner until they snap in place.
10. Connect the top connectors to the control board. Refer to the **Step 2** picture if necessary for proper locations.

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

11. Check each of the connectors from Step 10 to ensure they are properly aligned and that no pins are showing.
12. Connect the green terminal strips to the left side, right side and bottom of the control board. Refer to the **Step 2** picture if necessary for locations.
13. Turn the power on to the heat pump. Ensure the LCD display comes on. Note the firmware version. After EEV zeroing and Random Start countdown the display should begin alternating data.
14. If the replacement control board was pre-configured for this unit at the factory then the system is ready for operation. If it was not then use the PC App corresponding to the unit's firmware version to configure the unit. Refer to the **Tools --> Configuration** menu in the **PC APP** chapter.

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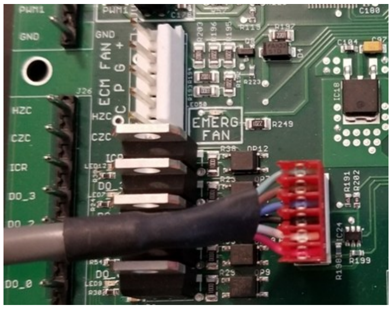
LCD Interface (Display) Board Replacement Procedure

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.

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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.

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Model Specific Information

Table 22 - Recommended Flow Rates

MODEL	OUTDOOR LOOP		INDOOR LOOP (MAX. 130°F)		INDOOR LOOP (DHW to 140°F)	
	gpm(US)	*L/s*	gpm(US)	*L/s*	gpm(US)	*L/s*
W-100	28	*1.8*	28	*1.8*	-	-
W-120	30	*1.9*	30	*1.9*	18	*1.1*
W-140	34	*2.1*	34	*2.1*	20	*1.3*
W-180	45	*2.8*	45	*2.8*	25	*1.6*
W-235	60	*3.8*	60	*3.8*	35	*2.2*

MODEL	OUTDOOR & INDOOR LOOPS	
	gpm(US)	*L/s*
WH-100	28	*1.8*
WH-120	30	*1.9*
WH-140	34	*2.1*
WH-180	45	*2.8*
WH-235	60	*3.8*

Table 23 - Heat Pump Holdup Volumes

MODEL	OUTDOOR LOOP		INDOOR LOOP (SINGLE WALL '–PP')		INDOOR LOOP (DOUBLE WALL '–PD')	
	US gal	*L*	US gal	*L*	US gal	*L*
W/WH-100	3.05	*11.5*	3.30	*12.5*	-	-
W/WH-120	2.04	*7.74*	2.04	*7.74*	2.38	*9.01*
W/WH-140	2.29	*8.66*	2.29	*8.66*	2.67	*10.1*
W/WH-180	2.96	*11.2*	2.96	*11.2*	3.43	*13.0*
W/WH-235	3.70	*14.0*	3.70	*14.0*	4.39	*16.6*

A2L

Table 24 - Refrigerant Charge

MODEL	TYPE	lb	*kg*	OIL
W-100	R454b	15.5	*7.0*	POE
W-120	R454b	10	*4.5*	PVE-BVC32
W-140	R454b	11.5	*5.2*	PVE-BVC32
W-180	R454b	15	*6.8*	PVE-BVC32
W-235	R454b	20	*9.1*	PVE-BVC32

Note that in all cases the R454b charge per refrigeration circuit is below '***m2***' in the UL/CSA 60335-2-40 standard.

MODEL	TYPE	lb	*kg*	OIL
WH-100	R513a	17	*7.7*	POE
WH-120	R513a	11	*5.0*	POE
WH-140	R513a	12.5	*5.7*	POE
WH-180	R513a	16.5	*8.3*	POE
WH-235	R513a	21.5	*9.8*	POE

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

Table 25 - Shipping Information

MODEL	WEIGHT lb (kg)	DIMENSIONS in (cm)		
		L	W	H
W/WH-100	700 (318)	46 (117)	46 (117)	36 (92)
W/WH-120	645 (293)	60 (152)	30 (76)	60 (152)
W/WH-140	675 (307)	60 (152)	30 (76)	60 (152)
W/WH-180	745 (339)	60 (152)	30 (76)	60 (152)
W/WH-235	959 (436)	60 (152)	30 (76)	60 (152)

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Table 26a - W-SERIES Operating Temperature Limits					
Loop	**Mode**	**Parameter**	**(°F)**	**(°C)**	**Note**
Indoor Loop	**HEATING** (indoor is hot loop)	Minimum ELT/EWT	50	*10*	0-10VDC modulating water valve required on indoor loop at temperatures < 80°F (27°C), or manual flow reduction at startup
		Maximum LLT/LWT	130	*54*	
		Maximum LLT/LWT	140	*60*	Domestic hot water (DHW) heating with double wall condenser option and reduced flow rate.
	COOLING (reversing HAC units only, indoor is cold loop)	Minimum LWT	40	*4*	Indoor loop with water only (no antifreeze).
		Minimum LLT	-->	-->	Indoor loop with antifreeze: depends on antifreeze type & %
		Maximum ELT	80	*27*	0-10VDC modulating water valve required on indoor loop above this temperature, or manual flow reduction at startup
Outdoor Loop	**HEATING** (outdoor is cold loop)	Minimum LWT	37	*3*	For water loops without antifreeze, e.g. open loop systems
		Minimum LLT	-->	-->	Ground loop system: depends on antifreeze type and % settings.
		Maximum ELT/EWT	80	*27*	0-10VDC modulating water valve required on outdoor loop above this temperature to limit suction pressure
	COOLING (reversing HAC units only, outdoor is hot loop)	Minimum ELT/EWT	50	*10*	0-10VDC modulating water valve required on outdoor loop at temperatures < 80°F (27°C) to keep head pressure up
		Maximum LLT/LWT	130	*54*	

ELT: Entering Liquid Temperature (implies antifreeze present)
LLT: Leaving Liquid Temperature (implies antifreeze present)
EWT: Entering Water Temperature
LWT: Leaving Water Temperature

Values in these tables are for rated liquid and water flows.

Table 26b - WH-SERIES Operating Temperature Limits					
Loop	**Mode**	**Parameter**	**(°F)**	**(°C)**	**Note**
Indoor Loop	**HEATING** (indoor is hot loop)	Minimum EWT	70 - 110	*21 - 43*	Use formula (Outdoor EWT + 20°F) or (Outdoor EWT + 11°C). Lower temperatures require 0-10VDC modulating water valve, or manual flow reduction at startup.
		Maximum LWT	160	*71*	
	COOLING (reversing HAC units only, indoor is cold loop)	Minimum LWT NEW	**32**	***0***	EWT should normally be **40°F** or greater.
		Maximum ELT	90	*32*	0-10VDC modulating water valve required on indoor loop above this temperature, or manual flow reduction at startup
Outdoor Loop	**HEATING** (outdoor is cold loop)	Minimum LWT NEW	**32**	***0***	EWT should normally be **40°F** or greater.
		Maximum ELT	90	*32*	0-10VDC modulating water valve required on outdoor loop above this temperature to limit suction pressure
	COOLING (reversing HAC units only, outdoor is hot loop)	Minimum EWT	70 - 110	*21 - 43*	Use formula (Outdoor EWT + 20°F) or (Outdoor EWT + 11°C). Lower temperatures require 0-10VDC modulating water valve.
		Maximum LLT/LWT	160	*71*	

Values in these tables are for rated liquid and water flows.

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Table 27:
Pressure Drop Data
(US UNITS)

Model	USgpm	OUTDOOR LOOP & INDOOR LOOP w/ SINGLE WALL OPTION: water 130°F (psi)	water 104°F (psi)	water 50°F (psi)	15% methanol 32°F (psi)	35% prop. glycol 32°F (psi)	INDOOR LOOP w/ DOUBLE WALL OPTION: DHW 140°F (psi)	DHW 50°F (psi)
W/WH-100	16	1.8	1.8	1.9	2.2	2.9	-	-
	20	2.4	2.4	2.6	3.3	4.3	-	-
	24	3.6	3.6	3.9	4.6	6.0	-	-
	28	**4.7**	**4.7**	**5.0**	**5.8**	**7.6**	-	-
	32	6.3	6.3	6.5	7.3	9.6	-	-
W/WH-120	**18**	0.7	0.7	0.7	0.8	1.1	**0.7**	**0.8**
	20	0.8	0.8	0.9	1.0	1.3	0.9	1.0
	22	1.0	1.0	1.0	1.2	1.6	1.1	1.1
	24	1.1	1.2	1.2	1.4	1.8	1.3	1.4
	26	1.3	1.4	1.4	1.6	2.1	1.5	1.6
	28	1.5	1.6	1.6	1.8	2.4	1.7	1.8
	30	**1.7**	**1.8**	**1.9**	**2.0**	**2.7**	1.9	2.1
	32	2.0	2.0	2.1	2.3	3.1	2.2	2.4
W/WH-140	**20**	0.7	0.7	0.7	0.9	1.1	**0.8**	**0.8**
	22	0.8	0.8	0.8	1.0	1.3	0.9	0.9
	24	0.9	0.9	1.0	1.1	1.5	1.0	1.1
	26	1.1	1.1	1.1	1.3	1.7	1.2	1.3
	28	1.2	1.2	1.3	1.5	1.9	1.4	1.5
	30	1.4	1.4	1.5	1.7	2.2	1.6	1.7
	32	1.6	1.6	1.7	1.9	2.5	1.8	1.9
	34	**1.8**	**1.8**	**1.9**	**2.1**	**2.7**	2.0	2.1
	36	2.0	2.0	2.1	2.3	3.0	2.2	2.4
W/WH-180	**25**	0.6	0.6	0.7	0.8	1.0	**0.7**	**0.8**
	30	0.9	0.9	0.9	1.2	1.4	1.0	1.1
	35	1.2	1.2	1.2	1.5	1.9	1.4	1.5
	40	1.5	1.5	1.6	2.0	2.4	1.8	1.9
	45	**1.9**	**1.9**	**2.0**	**2.4**	**2.9**	2.3	2.4
	50	2.3	2.4	2.5	2.9	3.5	2.8	3.0
W/WH-235	**35**	0.8	0.9	0.9	1.2	1.3	**1.0**	**1.1**
	40	1.1	1.1	1.1	1.5	1.7	1.3	1.4
	45	1.4	1.4	1.4	1.9	2.1	1.6	1.7
	50	1.7	1.7	1.8	2.3	2.5	2.0	2.1
	55	2.0	2.0	2.1	2.7	3.0	2.4	2.6
	60	**2.4**	**2.4**	**2.5**	**3.2**	**3.5**	2.9	3.0
	65	2.8	2.8	2.9	3.7	4.0	3.4	3.6

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METRIC

Table 28: Pressure Drop Data (METRIC UNITS)

Model	L/s	OUTDOOR LOOP & INDOOR LOOP w/ SINGLE WALL OPTION: water 130°F	water 104°F	water 50°F	15% methanol 32°F	35% prop. glycol 32°F	INDOOR LOOP w/ DOUBLE WALL OPTION: DHW 140°F	DHW 50°F
	L/s	kPa	kPa	kPa	kPa	kPa	kPa	kPa
W/WH-100	1.0	12	12	13	15	20	-	-
	1.3	17	17	18	23	30	-	-
	1.5	25	25	27	32	41	-	-
	1.8	**32**	**32**	**34**	**40**	**52**	-	-
	2.0	43	43	45	50	66	-	-
W/WH-120	**1.1**	5	5	5	6	8	**5**	**5**
	1.3	6	6	6	7	9	6	7
	1.4	7	7	7	8	11	7	8
	1.5	8	8	8	9	13	9	9
	1.6	9	9	10	11	15	10	11
	1.8	11	11	11	12	17	12	13
	1.9	**12**	**12**	**13**	**14**	**19**	13	14
	2.0	14	14	15	16	21	15	16
W/WH-140	**1.3**	5	5	5	6	8	**5**	**5**
	1.4	5	5	6	7	9	6	6
	1.5	6	6	7	8	10	7	8
	1.6	7	7	8	9	12	8	9
	1.8	8	9	9	10	13	9	10
	1.9	10	10	10	12	15	11	12
	2.0	11	11	12	13	17	12	13
	2.1	**12**	**12**	**13**	**15**	**19**	14	15
	2.3	14	14	14	16	21	15	16
W/WH-180	**1.6**	4	4	4	6	7	**5**	**6**
	1.9	6	6	6	8	10	7	8
	2.2	8	8	9	11	13	10	10
	2.5	10	11	11	13	16	12	13
	2.8	**13**	**13**	**14**	**17**	**20**	16	17
	3.2	16	16	17	20	24	19	20
W/WH-235	**2.2**	6	6	6	8	9	**7**	**7**
	2.5	7	8	8	11	12	9	10
	2.8	9	10	10	13	14	11	12
	3.2	11	12	12	16	17	14	15
	3.5	14	14	15	19	21	17	18
	3.8	**16**	**17**	**17**	**22**	**24**	20	21
	4.1	19	19	20	26	28	23	25

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Standard Capacity Ratings - W-Series

Note: There are no Standard Capacity Ratings for the WH-Series; see WH Performance Tables.

Table 29 - W-SERIES Standard Capacity Ratings

Standard Capacity Ratings - Ground Loop Heating* EWT 104°F (40°C), ELT 32°F (0°C) **60Hz**

Model	Nominal Size	Liquid Flow (Outdoor & Indoor)		Input Energy	Condenser Capacity		COP_H
	tons	gpm	L/s	watts	Btu/hr	kW	W/W
W-100	**9**	28	*1.8*	7,347	**78,500**	***23***	**3.13**
W-120	**10**	30	*1.9*	7,900	**91,000**	***27***	**3.38**
W-140	**11.5**	34	*2.1*	8,980	**104,600**	***31***	**3.41**
W-180	**15**	48	*3.0*	11,783	**136,200**	***40***	**3.39**
W-235	**20**	60	*3.8*	15,284	**177,100**	***52***	**3.40**

*** 35% Propylene Glycol by Volume Outdoor (Ground) Loop Fluid**

Standard Capacity Ratings - Ground Water Heating EWT 104°F (40°C), ELT 50°F (10°C) **60Hz**

Model	Nominal Size	Liquid Flow (Outdoor & Indoor)		Input Energy	Condenser Capacity		COP_H
	tons	gpm	L/s	watts	Btu/hr	kW	W/W
W-100	**9**	28	*1.8*	7,675	**107,800**	***32***	**4.12**
W-120	**10**	30	*1.9*	8,127	**125,000**	***37***	**4.51**
W-140	**11.5**	34	*2.1*	9,284	**143,700**	***42***	**4.54**
W-180	**15**	48	*3.0*	12,156	**187,300**	***55***	**4.52**
W-235	**20**	60	*3.8*	15,794	**243,700**	***71***	**4.52**

Standard Capacity Ratings - Ground Loop Cooling* EWT 53.6°F (12°C), ELT 77°F (25°C) **60Hz**

Model	Nominal Size	Liquid Flow (Outdoor & Indoor)		Input Energy	Evaporator Capacity		COP_C	EER
	tons	gpm	L/s	watts	Btu/hr	kW	W/W	Btu/hr/W
W-100	**9**	28	*1.8*	6,175	**95,100**	***28***	**4.51**	**15.4**
W-120	**10**	30	*1.9*	7,205	**109,500**	***32***	**4.45**	**15.2**
W-140	**11.5**	34	*2.1*	8,225	**125,800**	***37***	**4.48**	**15.3**
W-180	**15**	48	*3.0*	10,871	**164,100**	***48***	**4.43**	**15.1**
W-235	**20**	60	*3.8*	14,037	**213,400**	***63***	**4.45**	**15.2**

*** 35% Propylene Glycol by Volume Outdoor (Ground) Loop Fluid**

Standard Capacity Ratings - Ground Water Cooling EWT 53.6°F (12°C), ELT 59°F (15°C) **60Hz**

Model	Nominal Size	Liquid Flow (Outdoor & Indoor)		Input Energy	Evaporator Capacity		COP_C	EER
	tons	gpm	L/s	watts	Btu/hr	kW	W/W	Btu/hr/W
W-100	**9**	28	*1.8*	4,956	**103,100**	***30***	**6.10**	**20.8**
W-120	**10**	30	*1.9*	5,522	**117,100**	***34***	**6.21**	**21.2**
W-140	**11.5**	34	*2.1*	6,324	**134,700**	***39***	**6.24**	**21.3**
W-180	**15**	48	*3.0*	8,322	**175,600**	***51***	**6.18**	**21.1**
W-235	**20**	60	*3.8*	10,766	**228,200**	***67***	**6.21**	**21.2**

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Performance Tables - W-Series (US UNITS)

W-100-H***-X-*S-CC

R454b, 60 Hz, YA104K1E-TFD (460-3-60)

*Compressor current is for 460-3-60.
Multiply by 2.2 for 208-3-60, by 0.8 for 575-3-60.

	EVAPORATOR LOOP *(35% Propylene Glycol)*						ELECTRICAL		CONDENSER 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	13	28	22	-3.5	45,600	10.4	7,187	104	115	28	109	4.9	**69,000**	**2.81**
	30	18	28	26	-4.0	51,900	10.6	7,300		115	28	109	5.4	**75,800**	**3.04**
	35	22	28	31	-4.5	58,500	10.7	7,410		116	28	110	5.9	**82,800**	**3.27**
	40	27	28	35	-5.1	65,800	10.9	7,504		117	28	111	6.5	**90,500**	**3.53**
	45	31	28	39	-5.7	73,700	11.0	7,598		117	28	111	7.1	**98,800**	**3.81**
	50	36	28	44	-6.3	82,400	11.2	7,675		118	28	112	7.7	**107,800**	**4.12**
	55	40	28	48	-7.0	91,800	11.3	7,746		119	28	112	8.4	**117,500**	**4.45**
	60	45	28	52	-7.8	101,800	11.4	7,820		119	28	113	9.2	**127,900**	**4.79**
	65	50	28	56	-8.6	112,900	11.6	7,879		120	28	114	10.0	**139,200**	**5.18**
	70	54	28	61	-9.5	124,600	11.7	7,944		121	28	115	10.8	**151,200**	**5.58**
	25	14	28	22	-3.2	41,400	11.2	7,923	115.2	125	28	120	4.8	**67,300**	**2.49**
	30	18	28	26	-3.6	47,300	11.3	7,997	114.7	125	28		5.3	**73,600**	**2.70**
	35	23	28	31	-4.1	53,800	11.4	8,062	114.2	125	28		5.8	**80,300**	**2.92**
	40	27	28	35	-4.7	60,900	11.6	8,123	113.7	125	28		6.3	**87,700**	**3.16**
	45	32	28	40	-5.3	68,700	11.7	8,178	113.1	125	28		6.9	**95,800**	**3.43**
	50	36	28	44	-5.9	77,200	11.8	8,226	112.5	126	28		7.5	**104,500**	**3.72**
	55	41	28	48	-6.6	86,400	11.9	8,270	111.8	126	28		8.2	**113,900**	**4.04**
	60	45	28	53	-7.4	96,600	12.0	8,310	111.1	126	28		8.9	**124,300**	**4.38**
	65	50	28	57	-8.2	107,600	12.0	8,344	110.3	126	28		9.7	**135,500**	**4.76**
	70	54	28	61	-9.1	119,500	12.1	8,375	109.4	126	28		10.6	**147,600**	**5.17**
DHW												**140 (DHW)**			

N/A - coaxial coil condenser without double wall option

	EVAPORATOR LOOP *(Water)*						ELECTRICAL		CONDENSER LOOP *(35% Propylene Glycol)*						
	ELT (°F)	Evap. Temp.	Flow (gpm)	LLT (°F)	Delta T (°F)	**Cooling (Btu/hr)**	Compressor Current (A)*	Input Power (W)	EWT (°F)	Cond. Temp.	Flow (gpm)	LWT (°F)	Delta T (°F)	Heat Rej. (Btu/hr)	**EER**
COOLING	54	35	28	46	-7.7	107,200	7.5	4,349	50	73	28	59	9.3	**121,000**	**24.6**
		35	28	46	-7.5	105,100	7.8	4,691	55	78	28	64	9.2	**120,100**	**22.4**
		36	28	46	-7.4	103,000	8.1	5,020	60	83	28	69	9.1	**119,100**	**20.5**
		36	28	46	-7.2	100,700	8.5	5,356	65	88	28	74	9.0	**118,000**	**18.8**
		37	28	47	-7.1	98,400	8.8	5,693	70	94	28	79	8.9	**116,800**	**17.3**
		37	28	47	-6.9	96,100	9.2	6,032	75	99	28	84	8.8	**115,700**	**15.9**
		38	28	47	-6.7	93,600	9.6	6,389	80	104	28	89	8.7	**114,400**	**14.7**
		38	28	47	-6.5	91,100	10.0	6,765	85	109	28	94	8.6	**113,200**	**13.5**
		39	28	47	-6.4	88,600	10.4	7,153	90	114	28	99	8.5	**112,000**	**12.4**
		39	28	47	-6.2	85,800	10.9	7,574	95	119	28	103	8.4	**110,700**	**11.3**

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Performance Tables - W-Series (METRIC UNITS)

W-100-H***-X-*S-CC

R454b, 60 Hz, YA104K1E-TFD (460-3-60)

*Compressor current is for 460-3-60.
Multiply by 2.2 for 208-3-60, by 0.8 for 575-3-60.

METRIC

	EVAPORATOR LOOP *(35% Propylene Glycol)*						ELECTRICAL		CONDENSER 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	-10.6	1.8	-5.8	-1.9	13.4	10.4	7,187	40	45.9	1.8	42.7	2.7	**20.2**	**2.81**
	-1.1	-8.0	1.8	-3.3	-2.2	15.2	10.6	7,300		46.3	1.8	43.0	3.0	**22.2**	**3.04**
	1.7	-5.5	1.8	-0.8	-2.5	17.1	10.7	7,410		46.7	1.8	43.3	3.3	**24.3**	**3.27**
	4.4	-2.9	1.8	1.6	-2.8	19.3	10.9	7,504		47.0	1.8	43.6	3.6	**26.5**	**3.53**
	7.2	-0.4	1.8	4.0	-3.2	21.6	11.0	7,598		47.4	1.8	43.9	3.9	**29.0**	**3.81**
	10.0	2.1	1.8	6.5	-3.5	24.1	11.2	7,675		47.7	1.8	44.3	4.3	**31.6**	**4.12**
	12.8	4.7	1.8	8.9	-3.9	26.9	11.3	7,746		48.1	1.8	44.7	4.7	**34.4**	**4.45**
	15.6	7.2	1.8	11.3	-4.3	29.8	11.4	7,820		48.4	1.8	45.1	5.1	**37.5**	**4.79**
	18.3	9.7	1.8	13.5	-4.8	33.1	11.6	7,879		48.8	1.8	45.6	5.6	**40.8**	**5.18**
	21.1	12.2	1.8	15.8	-5.3	36.5	11.7	7,944		49.2	1.8	46.0	6.0	**44.3**	**5.58**
	-3.9	-10.1	1.8	-5.7	-1.8	12.1	11.2	7,923	46.2	51.4	1.8	49	2.7	**19.7**	**2.49**
	-1.1	-7.6	1.8	-3.1	-2.0	13.9	11.3	7,997	45.9	51.6	1.8		2.9	**21.6**	**2.70**
	1.7	-5.1	1.8	-0.6	-2.3	15.8	11.4	8,062	45.7	51.7	1.8		3.2	**23.5**	**2.92**
	4.4	-2.6	1.8	1.8	-2.6	17.8	11.6	8,123	45.4	51.8	1.8		3.5	**25.7**	**3.16**
	7.2	-0.1	1.8	4.3	-2.9	20.1	11.7	8,178	45.1	51.9	1.8		3.8	**28.1**	**3.43**
	10.0	2.4	1.8	6.7	-3.3	22.6	11.8	8,226	44.7	52.0	1.8		4.2	**30.6**	**3.72**
	12.8	4.9	1.8	9.1	-3.7	25.3	11.9	8,270	44.3	52.1	1.8		4.6	**33.4**	**4.04**
	15.6	7.4	1.8	11.5	-4.1	28.3	12.0	8,310	43.9	52.2	1.8		4.9	**36.4**	**4.38**
	18.3	9.9	1.8	13.7	-4.6	31.5	12.0	8,344	43.5	52.3	1.8		5.4	**39.7**	**4.76**
	21.1	12.4	1.8	16.0	-5.1	35.0	12.1	8,375	43.0	52.4	1.8		5.9	**43.3**	**5.17**
DHW												60 (DHW)			

N/A - coaxial coil condenser without double wall option

	EVAPORATOR LOOP *(Water)*						ELECTRICAL		CONDENSER LOOP *(35% Propylene Glycol)*						
	ELT (°C)	Evap. Temp.	Flow (L/s)	LLT (°C)	Delta T (°C)	**Cooling (kW)**	Compressor Current (A)*	Input Power (W)	EWT (°C)	Cond. Temp.	Flow (L/s)	LWT (°C)	Delta T (°C)	Heat Rej. (kW)	**COP_C**
COOLING	12	1.5	1.8	7.7	-4.3	31.4	7.5	4,349	10.0	22.7	1.8	15.2	5.2	**35.5**	**7.21**
		1.8	1.8	7.8	-4.2	30.8	7.8	4,691	12.8	25.6	1.8	17.9	5.1	**35.2**	**6.56**
		2.1	1.8	7.9	-4.1	30.2	8.1	5,020	15.6	28.4	1.8	20.7	5.1	**34.9**	**6.01**
		2.3	1.8	8.0	-4.0	29.5	8.5	5,356	18.3	31.3	1.8	23.3	5.0	**34.6**	**5.51**
		2.6	1.8	8.1	-3.9	28.8	8.8	5,693	21.1	34.2	1.8	26.0	4.9	**34.2**	**5.07**
		2.9	1.8	8.2	-3.8	28.2	9.2	6,032	23.9	37.0	1.8	28.8	4.9	**33.9**	**4.66**
		3.2	1.8	8.3	-3.7	27.4	9.6	6,389	26.7	39.9	1.8	31.5	4.8	**33.5**	**4.31**
		3.4	1.8	8.4	-3.6	26.7	10.0	6,765	29.4	42.8	1.8	34.2	4.8	**33.2**	**3.96**
		3.7	1.8	8.4	-3.6	26.0	10.4	7,153	32.2	45.6	1.8	36.9	4.7	**32.8**	**3.63**
		4.0	1.8	8.6	-3.4	25.1	10.9	7,574	35.0	48.5	1.8	39.7	4.7	**32.4**	**3.31**

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Performance Tables - W-Series (US UNITS)

W-120-H**-X-*S-P*

R454b, 60 Hz, GSD60120VL (460-3-60)

*Compressor current is for 460-3-60.
Multiply by 2.2 for 208-3-60, by 0.8 for 575-3-60.

	EVAPORATOR LOOP *(35% Propylene Glycol)*						ELECTRICAL		CONDENSER 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	30	21	-3.9	54,000	11.4	7,842	104	113	30	109	5.4	**80,400**	**3.00**
	30	19	30	26	-4.4	61,300	11.4	7,881		114	30	110	5.9	**87,800**	**3.27**
	35	24	30	30	-5.0	69,200	11.4	7,927		115	30	110	6.4	**95,900**	**3.55**
	40	28	30	34	-5.6	77,900	11.5	7,981		115	30	111	7.0	**104,800**	**3.85**
	45	33	30	39	-6.3	87,300	11.6	8,047		116	30	112	7.7	**114,400**	**4.17**
	50	38	30	43	-7.0	97,600	11.7	8,128		117	30	112	8.4	**125,000**	**4.51**
	55	42	30	47	-7.8	108,500	11.8	8,224		118	30	113	9.1	**136,300**	**4.86**
	60	47	30	51	-8.6	120,500	11.9	8,342		118	30	114	10.0	**148,700**	**5.22**
	65	52	30	55	-9.5	133,500	12.1	8,481		119	30	115	10.9	**162,200**	**5.61**
	70	57	30	59	-10.5	147,500	12.2	8,646		120	30	116	11.8	**176,700**	**5.99**
	25	15	30	21	-3.6	49,300	12.2	8,599	115	124	30	120	5.3	**78,300**	**2.67**
	30	19	30	26	-4.0	56,300	12.2	8,647	114	124	30		5.7	**85,400**	**2.89**
	35	24	30	30	-4.6	63,900	12.3	8,705	114	124	30		6.3	**93,200**	**3.14**
	40	29	30	35	-5.2	72,500	12.4	8,788	113	124	30		6.9	**102,100**	**3.40**
	45	33	30	39	-5.9	81,700	12.5	8,875	113	124	30		7.5	**111,600**	**3.69**
	50	38	30	43	-6.6	91,900	12.7	8,982	112	125	30		8.2	**122,200**	**3.99**
	55	43	30	48	-7.4	102,900	12.9	9,110	111	125	30		9.0	**133,700**	**4.30**
	60	48	30	52	-8.2	115,000	13.1	9,262	110	125	30		9.8	**146,300**	**4.63**
	65	52	30	56	-9.1	128,000	13.3	9,451	109	125	30		10.8	**160,000**	**4.96**
	70	57	30	60	-10.1	142,100	13.6	9,659	108	126	30		11.8	**174,800**	**5.30**
DHW	25	12	30	22	-3.5	49,200	15.8	11,401	130	137	**18**	**140 (DHW)**	9.9	**87,700**	**2.25**
	30	17	30	26	-4.0	55,000	15.5	11,115	130	138	**18**		10.4	**92,600**	**2.44**
	35	22	30	31	-4.4	61,400	15.1	10,847	129	138	**18**		11.1	**98,100**	**2.65**
	40	26	30	35	-4.9	68,100	14.8	10,609	128	138	**18**		11.7	**104,000**	**2.87**
	45	31	30	40	-5.4	75,400	14.5	10,379	128	138	**18**		12.5	**110,500**	**3.12**
	50	36	30	44	-6.0	83,300	14.2	10,171	127	139	**18**		13.3	**117,700**	**3.39**
	55	41	30	48	-6.6	91,800	13.9	9,984	126	139	**18**		14.2	**125,600**	**3.69**
	60	46	30	53	-7.2	101,000	13.6	9,820	125	139	**18**		15.1	**134,200**	**4.01**
	65	51	30	57	-7.9	110,900	13.4	9,692	124	139	**18**		16.2	**143,700**	**4.35**
	70	56	30	61	-8.7	121,500	13.3	9,572	123	139	**18**		17.4	**153,900**	**4.71**

	EVAPORATOR LOOP *(Water)*						ELECTRICAL		CONDENSER LOOP *(35% Propylene Glycol)*						
	ELT (°F)	Evap. Temp.	Flow (gpm)	LLT (°F)	Delta T (°F)	**Cooling (Btu/hr)**	Compressor Current (A)*	Input Power (W)	EWT (°F)	Cond. Temp.	Flow (gpm)	LWT (°F)	Delta T (°F)	Heat Rej. (Btu/hr)	**EER**
COOLING	54	34	30	46	-8.0	120,600	7.9	4,883	50	73	30	60	9.8	**136,900**	**24.7**
		35	30	46	-7.9	118,800	8.3	5,223	55	78	30	65	9.7	**136,300**	**22.7**
		36	30	46	-7.8	116,800	8.8	5,603	60	83	30	70	9.7	**135,600**	**20.8**
		36	30	46	-7.7	114,800	9.3	6,019	65	88	30	75	9.6	**135,000**	**19.1**
		37	30	46	-7.5	112,600	9.9	6,483	70	94	30	80	9.6	**134,400**	**17.4**
		37	30	46	-7.4	110,500	10.5	6,987	75	99	30	85	9.5	**134,000**	**15.8**
		38	30	46	-7.2	108,000	11.2	7,547	80	104	30	90	9.5	**133,400**	**14.3**
		38	30	47	-7.0	105,600	11.9	8,155	85	109	30	95	9.5	**133,100**	**12.9**
		39	30	47	-6.9	102,800	12.7	8,828	90	115	30	99	9.4	**132,600**	**11.6**
		39	30	47	-6.7	100,100	13.7	9,556	95	120	30	104	9.4	**132,400**	**10.5**

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Performance Tables - W-Series (METRIC UNITS)

W-120-H**-X-*S-P*

R454b, 60 Hz, GSD60120VL (460-3-60)

*Compressor current is for 460-3-60.
Multiply by 2.2 for 208-3-60, by 0.8 for 575-3-60.

METRIC

	EVAPORATOR LOOP *(35% Propylene Glycol)*						**ELECTRICAL**		**CONDENSER 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	1.9	-6.1	-2.2	15.8	11.4	7,842	40	45.2	1.9	43.0	3.0	**23.6**	**3.00**
	-1.1	-7.2	1.9	-3.5	-2.4	18.0	11.4	7,881		45.6	1.9	43.3	3.3	**25.7**	**3.27**
	1.7	-4.6	1.9	-1.1	-2.8	20.3	11.4	7,927		45.9	1.9	43.6	3.6	**28.1**	**3.55**
	4.4	-2.0	1.9	1.3	-3.1	22.8	11.5	7,981		46.3	1.9	43.9	3.9	**30.7**	**3.85**
	7.2	0.6	1.9	3.7	-3.5	25.6	11.6	8,047		46.7	1.9	44.3	4.3	**33.5**	**4.17**
	10.0	3.2	1.9	6.1	-3.9	28.6	11.7	8,128		47.1	1.9	44.7	4.7	**36.6**	**4.51**
	12.7	5.8	1.9	8.4	-4.3	31.8	11.8	8,224		47.5	1.9	45.1	5.1	**40.0**	**4.86**
	15.5	8.4	1.9	10.7	-4.8	35.3	11.9	8,342		47.9	1.9	45.6	5.6	**43.6**	**5.22**
	18.3	11.0	1.9	13.0	-5.3	39.1	12.1	8,481		48.3	1.9	46.1	6.1	**47.5**	**5.61**
	21.1	13.6	1.9	15.3	-5.8	43.2	12.2	8,646		48.7	1.9	46.6	6.6	**51.8**	**5.99**
	-3.9	-9.7	1.9	-5.9	-2.0	14.4	12.2	8,599	45.9	50.8	1.9	49	2.9	**22.9**	**2.67**
	-1.1	-7.1	1.9	-3.3	-2.2	16.5	12.2	8,647	45.7	50.9	1.9		3.2	**25.0**	**2.89**
	1.7	-4.5	1.9	-0.9	-2.6	18.7	12.3	8,705	45.4	51.1	1.9		3.5	**27.3**	**3.14**
	4.4	-1.8	1.9	1.5	-2.9	21.2	12.4	8,788	45.1	51.2	1.9		3.8	**29.9**	**3.40**
	7.2	0.8	1.9	3.9	-3.3	23.9	12.5	8,875	44.7	51.3	1.9		4.2	**32.7**	**3.69**
	10.0	3.4	1.9	6.3	-3.7	26.9	12.7	8,982	44.3	51.4	1.9		4.6	**35.8**	**3.99**
	12.8	6.0	1.9	8.7	-4.1	30.2	12.9	9,110	43.9	51.6	1.9		5.0	**39.2**	**4.30**
	15.6	8.6	1.9	11.0	-4.6	33.7	13.1	9,262	43.4	51.7	1.9		5.4	**42.9**	**4.63**
	18.3	11.2	1.9	13.2	-5.1	37.5	13.3	9,451	42.9	51.8	1.9		6.0	**46.9**	**4.96**
	21.1	13.8	1.9	15.5	-5.6	41.7	13.6	9,659	42.3	51.9	1.9		6.6	**51.2**	**5.30**
DHW	-3.9	-11.3	1.9	-5.8	-1.9	14.4	15.8	11,401	54.5	58.6	**1.1**	**60 (DHW)**	5.5	**25.7**	**2.25**
	-1.1	-8.6	1.9	-3.3	-2.2	16.1	15.5	11,115	54.2	58.7	**1.1**		5.8	**27.1**	**2.44**
	1.7	-5.8	1.9	-0.7	-2.4	18.0	15.1	10,847	53.8	58.8	**1.1**		6.2	**28.8**	**2.65**
	4.4	-3.1	1.9	1.7	-2.7	20.0	14.8	10,609	53.5	58.9	**1.1**		6.5	**30.5**	**2.87**
	7.2	-0.4	1.9	4.2	-3.0	22.1	14.5	10,379	53.1	59.1	**1.1**		6.9	**32.4**	**3.12**
	10.0	2.3	1.9	6.7	-3.3	24.4	14.2	10,171	52.6	59.2	**1.1**		7.4	**34.5**	**3.39**
	12.8	5.1	1.9	9.1	-3.7	26.9	13.9	9,984	52.1	59.3	**1.1**		7.9	**36.8**	**3.69**
	15.6	7.8	1.9	11.6	-4.0	29.6	13.6	9,820	51.6	59.4	**1.1**		8.4	**39.3**	**4.01**
	18.3	10.6	1.9	13.9	-4.4	32.5	13.4	9,692	51.0	59.6	**1.1**		9.0	**42.1**	**4.35**
	21.1	13.3	1.9	16.3	-4.8	35.6	13.3	9,572	50.3	59.7	**1.1**		9.7	**45.1**	**4.71**

	EVAPORATOR LOOP *(Water)*						**ELECTRICAL**		**CONDENSER LOOP** *(35% Propylene Glycol)*						
	ELT (°C)	Evap. Temp.	Flow (L/s)	LLT (°C)	Delta T (°C)	**Cooling (kW)**	Compressor Current (A)*	Input Power (W)	EWT (°C)	Cond. Temp.	Flow (L/s)	LWT (°C)	Delta T (°C)	Heat Rej. (kW)	**COP_C**
COOLING	12	1	1.9	7.6	-4.4	35.3	7.9	4,883	10.0	23	1.9	15.4	5.4	**40.1**	**7.24**
		2	1.9	7.6	-4.4	34.8	8.3	5,223	12.8	25	1.9	18.2	5.4	**40.0**	**6.65**
		2	1.9	7.7	-4.3	34.2	8.8	5,603	15.6	28	1.9	21.0	5.4	**39.7**	**6.10**
		2	1.9	7.7	-4.3	33.6	9.3	6,019	18.3	31	1.9	23.6	5.3	**39.6**	**5.60**
		3	1.9	7.8	-4.2	33.0	9.9	6,483	21.1	34	1.9	26.4	5.3	**39.4**	**5.10**
		3	1.9	7.9	-4.1	32.4	10.5	6,987	23.9	37	1.9	29.2	5.3	**39.3**	**4.63**
		3	1.9	8.0	-4.0	31.7	11.2	7,547	26.7	40	1.9	32.0	5.3	**39.1**	**4.19**
		4	1.9	8.1	-3.9	31.0	11.9	8,155	29.4	43	1.9	34.7	5.3	**39.0**	**3.78**
		4	1.9	8.2	-3.8	30.1	12.7	8,828	32.2	46	1.9	37.4	5.2	**38.9**	**3.40**
		4	1.9	8.3	-3.7	29.3	13.7	9,556	35.0	49	1.9	40.2	5.2	**38.8**	**3.08**

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Performance Tables - W-Series (US UNITS)

W-140-H**-X-*S-P*

R454b, 60 Hz, GSD60137VL (460-3-60)

*Compressor current is for 460-3-60.
Multiply by 2.2 for 208-3-60, by 0.8 for 575-3-60.

	EVAPORATOR LOOP *(35% Propylene Glycol)*						ELECTRICAL		CONDENSER 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	34	21	-4.0	62,400	12.6	8,893	104	114	34	110	5.5	**92,300**	**3.04**
	30	19	34	26	-4.5	70,800	12.7	8,951		114	34	110	6.0	**100,900**	**3.30**
	35	24	34	30	-5.1	80,000	12.8	9,020		115	34	111	6.5	**110,300**	**3.58**
	40	29	34	34	-5.7	89,900	12.9	9,097		116	34	111	7.1	**120,500**	**3.88**
	45	33	34	39	-6.4	100,700	13.0	9,176		116	34	112	7.8	**131,600**	**4.20**
	50	38	34	43	-7.1	112,400	13.1	9,284		117	34	113	8.5	**143,700**	**4.54**
	55	43	34	47	-7.9	124,800	13.3	9,413		118	34	113	9.3	**156,500**	**4.87**
	60	47	34	51	-8.7	138,600	13.5	9,563		118	34	114	10.1	**170,900**	**5.24**
	65	52	34	55	-9.7	153,400	13.7	9,758		119	34	115	11.0	**186,300**	**5.60**
	70	57	34	59	-10.6	169,300	14.0	9,992		120	34	116	12.0	**203,000**	**5.95**
	25	15	34	21	-3.6	56,800	13.7	9,805	115	124	34	120	5.3	**89,800**	**2.68**
	30	20	34	26	-4.1	64,900	13.8	9,882	114	124	34		5.8	**98,200**	**2.91**
	35	24	34	30	-4.7	73,900	13.9	9,950	114	124	34		6.4	**107,400**	**3.16**
	40	29	34	35	-5.3	83,700	14.1	10,039	113	124	34		7.0	**117,500**	**3.43**
	45	34	34	39	-6.0	94,400	14.2	10,130	112	125	34		7.6	**128,500**	**3.72**
	50	38	34	43	-6.7	105,900	14.3	10,253	112	125	34		8.3	**140,500**	**4.02**
	55	43	34	48	-7.5	118,500	14.5	10,390	111	125	34		9.1	**153,600**	**4.33**
	60	48	34	52	-8.3	132,100	14.8	10,571	110	125	34		10.0	**167,800**	**4.65**
	65	53	34	56	-9.3	147,000	15.0	10,778	109	126	34		10.9	**183,400**	**4.99**
	70	57	34	60	-10.2	162,900	15.4	11,040	108	126	34		11.9	**200,200**	**5.31**
DHW	25	12	34	21	-3.6	56,700	17.9	12,899	130	138	**20**	**140 (DHW)**	10.2	**100,300**	**2.28**
	30	17	34	26	-4.0	63,700	17.5	12,616	129	138	**20**		10.8	**106,300**	**2.47**
	35	22	34	31	-4.5	71,100	17.1	12,328	129	138	**20**		11.4	**112,700**	**2.68**
	40	27	34	35	-5.0	78,800	16.7	12,058	128	138	**20**		12.1	**119,500**	**2.90**
	45	32	34	40	-5.5	87,200	16.4	11,781	127	139	**20**		12.9	**127,000**	**3.16**
	50	37	34	44	-6.1	95,900	16.0	11,519	126	139	**20**		13.7	**134,800**	**3.43**
	55	41	34	48	-6.6	105,100	15.6	11,273	126	139	**20**		14.5	**143,200**	**3.72**
	60	46	34	53	-7.3	115,200	15.3	11,054	125	139	**20**		15.5	**152,600**	**4.05**
	65	51	34	57	-7.9	125,600	15.1	10,870	124	139	**20**		16.5	**162,300**	**4.38**
	70	56	34	61	-8.6	136,900	14.8	10,706	122	140	**20**		17.6	**173,100**	**4.74**

	EVAPORATOR LOOP *(Water)*						ELECTRICAL		CONDENSER LOOP *(35% Propylene Glycol)*						
	ELT (°F)	Evap. Temp.	Flow (gpm)	LLT (°F)	Delta T (°F)	**Cooling** (Btu/hr)	Compressor Current (A)*	Input Power (W)	EWT (°F)	Cond. Temp.	Flow (gpm)	LWT (°F)	Delta T (°F)	Heat Rej. (Btu/hr)	**EER**
COOLING	54	35	34	45	-8.2	139,400	8.6	5,611	50	72	34	60	10.0	**158,100**	**24.8**
		35	34	46	-8.0	136,900	9.1	5,991	55	78	34	65	9.9	**156,900**	**22.9**
		36	34	46	-7.9	134,200	9.6	6,414	60	83	34	70	9.8	**155,600**	**20.9**
		36	34	46	-7.8	131,900	10.2	6,881	65	88	34	75	9.8	**154,900**	**19.2**
		37	34	46	-7.6	129,200	10.9	7,403	70	93	34	80	9.7	**154,000**	**17.5**
		37	34	46	-7.5	126,800	11.6	7,977	75	99	34	85	9.7	**153,600**	**15.9**
		38	34	46	-7.3	124,200	12.4	8,617	80	104	34	90	9.6	**153,200**	**14.4**
		38	34	46	-7.2	121,700	13.3	9,319	85	109	34	95	9.6	**153,100**	**13.1**
		39	34	47	-7.0	118,900	14.4	10,100	90	114	34	100	9.6	**153,000**	**11.8**
		40	34	47	-6.8	116,200	15.5	10,953	95	120	34	105	9.6	**153,200**	**10.6**

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Performance Tables - W-Series (METRIC UNITS)

W-140-H**-X-*S-P*

R454b, 60 Hz, GSD60137VL (460-3-60)

*Compressor current is for 460-3-60.
Multiply by 2.2 for 208-3-60, by 0.8 for 575-3-60.

METRIC

	EVAPORATOR LOOP *(35% Propylene Glycol)*						ELECTRICAL		CONDENSER 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	-9.7	2.1	-6.1	-2.2	18.3	12.6	8,893	40	45.3	2.1	43.1	3.1	**27.1**	**3.04**
	-1.1	-7.1	2.1	-3.6	-2.5	20.7	12.7	8,951		45.7	2.1	43.3	3.3	**29.6**	**3.30**
	1.7	-4.4	2.1	-1.1	-2.8	23.4	12.8	9,020		46.1	2.1	43.6	3.6	**32.3**	**3.58**
	4.4	-1.8	2.1	1.2	-3.2	26.3	12.9	9,097		46.4	2.1	43.9	3.9	**35.3**	**3.88**
	7.2	0.8	2.1	3.6	-3.6	29.5	13.0	9,176		46.8	2.1	44.3	4.3	**38.6**	**4.20**
	10.0	3.4	2.1	6.1	-3.9	32.9	13.1	9,284		47.2	2.1	44.7	4.7	**42.1**	**4.54**
	12.7	5.9	2.1	8.3	-4.4	36.6	13.3	9,413		47.6	2.1	45.2	5.2	**45.9**	**4.87**
	15.5	8.6	2.1	10.7	-4.8	40.6	13.5	9,563		47.9	2.1	45.6	5.6	**50.1**	**5.24**
	18.3	11.2	2.1	12.9	-5.4	45.0	13.7	9,758		48.3	2.1	46.1	6.1	**54.6**	**5.60**
	21.1	13.8	2.1	15.2	-5.9	49.6	14.0	9,992		48.7	2.1	46.7	6.7	**59.5**	**5.95**
	-3.9	-9.6	2.1	-5.9	-2.0	16.6	13.7	9,805	45.9	50.8	2.1	49	2.9	**26.3**	**2.68**
	-1.1	-6.9	2.1	-3.4	-2.3	19.0	13.8	9,882	45.7	51.0	2.1		3.2	**28.8**	**2.91**
	1.7	-4.3	2.1	-0.9	-2.6	21.7	13.9	9,950	45.3	51.1	2.1		3.6	**31.5**	**3.16**
	4.4	-1.7	2.1	1.5	-2.9	24.5	14.1	10,039	45.0	51.3	2.1		3.9	**34.4**	**3.43**
	7.2	0.9	2.1	3.9	-3.3	27.7	14.2	10,130	44.7	51.4	2.1		4.2	**37.7**	**3.72**
	10.0	3.6	2.1	6.3	-3.7	31.0	14.3	10,253	44.3	51.6	2.1		4.6	**41.2**	**4.02**
	12.8	6.2	2.1	8.6	-4.2	34.7	14.5	10,390	43.8	51.7	2.1		5.1	**45.0**	**4.33**
	15.6	8.8	2.1	11.0	-4.6	38.7	14.8	10,571	43.3	51.8	2.1		5.6	**49.2**	**4.65**
	18.3	11.4	2.1	13.1	-5.2	43.1	15.0	10,778	42.8	51.9	2.1		6.1	**53.8**	**4.99**
	21.1	14.0	2.1	15.4	-5.7	47.7	15.4	11,040	42.3	52.1	2.1		6.6	**58.7**	**5.31**
DHW	-3.9	-11.2	2.1	-5.9	-2.0	16.6	17.9	12,899	54.3	58.7	**1.3**	**60 (DHW)**	5.7	**29.4**	**2.28**
	-1.1	-8.5	2.1	-3.3	-2.2	18.7	17.5	12,616	54.0	58.8	**1.3**		6.0	**31.2**	**2.47**
	1.7	-5.7	2.1	-0.8	-2.5	20.8	17.1	12,328	53.7	58.9	**1.3**		6.3	**33.0**	**2.68**
	4.4	-3.0	2.1	1.6	-2.8	23.1	16.7	12,058	53.3	59.1	**1.3**		6.7	**35.0**	**2.90**
	7.2	-0.2	2.1	4.1	-3.1	25.6	16.4	11,781	52.8	59.2	**1.3**		7.2	**37.2**	**3.16**
	10.0	2.5	2.1	6.6	-3.4	28.1	16.0	11,519	52.4	59.3	**1.3**		7.6	**39.5**	**3.43**
	12.8	5.2	2.1	9.1	-3.7	30.8	15.6	11,273	51.9	59.4	**1.3**		8.1	**42.0**	**3.72**
	15.6	8.0	2.1	11.5	-4.1	33.8	15.3	11,054	51.4	59.5	**1.3**		8.6	**44.7**	**4.05**
	18.3	10.7	2.1	13.9	-4.4	36.8	15.1	10,870	50.8	59.7	**1.3**		9.2	**47.6**	**4.38**
	21.1	13.5	2.1	16.3	-4.8	40.1	14.8	10,706	50.2	59.8	**1.3**		9.8	**50.7**	**4.74**

	EVAPORATOR LOOP *(Water)*						ELECTRICAL		CONDENSER LOOP *(35% Propylene Glycol)*						
	ELT (°C)	Evap. Temp.	Flow (L/s)	LLT (°C)	Delta T (°C)	**Cooling (kW)**	Compressor Current (A)*	Input Power (W)	EWT (°C)	Cond. Temp.	Flow (L/s)	LWT (°C)	Delta T (°C)	Heat Rej. (kW)	**COP_C**
COOLING	12	1	2.1	7.4	-4.6	40.9	8.6	5,611	10.0	22	2.1	15.6	5.6	**46.3**	**7.27**
		2	2.1	7.6	-4.4	40.1	9.1	5,991	12.8	25	2.1	18.3	5.5	**46.0**	**6.71**
		2	2.1	7.6	-4.4	39.3	9.6	6,414	15.6	28	2.1	21.0	5.4	**45.6**	**6.13**
		2	2.1	7.7	-4.3	38.7	10.2	6,881	18.3	31	2.1	23.7	5.4	**45.4**	**5.63**
		3	2.1	7.8	-4.2	37.9	10.9	7,403	21.1	34	2.1	26.5	5.4	**45.1**	**5.13**
		3	2.1	7.8	-4.2	37.2	11.6	7,977	23.9	37	2.1	29.3	5.4	**45.0**	**4.66**
		3	2.1	7.9	-4.1	36.4	12.4	8,617	26.7	40	2.1	32.0	5.3	**44.9**	**4.22**
		4	2.1	8.0	-4.0	35.7	13.3	9,319	29.4	43	2.1	34.7	5.3	**44.9**	**3.84**
		4	2.1	8.1	-3.9	34.9	14.4	10,100	32.2	46	2.1	37.5	5.3	**44.8**	**3.46**
		4	2.1	8.2	-3.8	34.1	15.5	10,953	35.0	49	2.1	40.3	5.3	**44.9**	**3.11**

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Performance Tables - W-Series (US UNITS)

W-180-H**-X-*S-P*

R454b, 60 Hz, GSD60182VL (460-3-60)

*Compressor current is for 460-3-60.
Multiply by 2.2 for 208-3-60, by 0.8 for 575-3-60.

	EVAPORATOR LOOP *(35% Propylene Glycol)*						ELECTRICAL		CONDENSER 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	48	21	-3.7	81,100	16.6	11,650	104	113	48	109	5.0	**120,100**	**3.02**
	30	19	48	26	-4.1	92,000	16.7	11,743		114	48	110	5.5	**131,400**	**3.28**
	35	24	48	30	-4.7	104,000	16.8	11,837		115	48	110	6.0	**143,700**	**3.56**
	40	29	48	35	-5.2	117,000	16.9	11,936		116	48	111	6.6	**157,100**	**3.86**
	45	33	48	39	-5.9	130,900	17.1	12,041		116	48	111	7.2	**171,400**	**4.17**
	50	38	48	44	-6.5	146,400	17.2	12,156		117	48	112	7.8	**187,300**	**4.52**
	55	43	48	48	-7.3	162,700	17.4	12,282		118	48	113	8.6	**204,100**	**4.87**
	60	47	48	52	-8.1	180,800	17.6	12,423		118	48	113	9.3	**222,700**	**5.25**
	65	52	48	56	-8.9	200,300	17.8	12,583		119	48	114	10.2	**242,800**	**5.66**
	70	57	48	60	-9.8	221,000	18.0	12,758		120	48	115	11.1	**264,100**	**6.07**
	25	15	48	22	-3.3	74,000	17.8	12,744	115	123	48	120	4.9	**116,800**	**2.69**
	30	20	48	26	-3.8	84,600	18.0	12,881	115	124	48		5.4	**127,900**	**2.91**
	35	24	48	31	-4.3	96,200	18.2	13,004	114	124	48		5.9	**139,900**	**3.15**
	40	29	48	35	-4.9	108,800	18.4	13,146	114	124	48		6.4	**153,000**	**3.41**
	45	34	48	40	-5.5	122,800	18.6	13,279	113	124	48		7.0	**167,500**	**3.70**
	50	38	48	44	-6.2	137,900	18.8	13,437	112	125	48		7.7	**183,200**	**4.00**
	55	43	48	48	-6.9	154,100	19.0	13,590	112	125	48		8.4	**200,000**	**4.31**
	60	48	48	52	-7.7	172,000	19.3	13,776	111	125	48		9.2	**218,500**	**4.65**
	65	52	48	56	-8.5	191,500	19.6	13,965	110	125	48		10.0	**238,700**	**5.01**
	70	57	48	60	-9.5	212,500	19.9	14,192	109	126	48		11.0	**260,500**	**5.38**
DHW	25	12	48	22	-3.3	74,300	23.4	16,871	129	137	**25**	**140 (DHW)**	10.7	**131,200**	**2.28**
	30	17	48	26	-3.7	83,000	23.0	16,544	129	138	**25**		11.3	**138,800**	**2.46**
	35	22	48	31	-4.2	92,500	22.5	16,210	128	138	**25**		12.0	**147,200**	**2.66**
	40	27	48	35	-4.6	102,500	22.0	15,869	127	138	**25**		12.7	**156,100**	**2.88**
	45	32	48	40	-5.1	113,500	21.5	15,528	127	139	**25**		13.5	**165,900**	**3.13**
	50	36	48	44	-5.6	125,000	21.1	15,187	126	139	**25**		14.3	**176,300**	**3.40**
	55	41	48	49	-6.1	137,300	20.6	14,849	125	139	**25**		15.2	**187,500**	**3.70**
	60	46	48	53	-6.7	150,900	20.1	14,518	124	139	**25**		16.2	**200,000**	**4.04**
	65	51	48	58	-7.4	165,100	19.7	14,193	123	140	**25**		17.3	**213,100**	**4.40**
	70	56	48	62	-8.1	180,700	19.2	13,879	122	140	**25**		18.5	**227,700**	**4.81**

	EVAPORATOR LOOP *(Water)*						ELECTRICAL		CONDENSER LOOP *(35% Propylene Glycol)*						
	ELT (°F)	Evap. Temp.	Flow (gpm)	LLT (°F)	Delta T (°F)	**Cooling (Btu/hr)**	Compressor Current (A)*	Input Power (W)	EWT (°F)	Cond. Temp.	Flow (gpm)	LWT (°F)	Delta T (°F)	Heat Rej. (Btu/hr)	**EER**
COOLING	54	34	48	46	-7.5	180,900	11.6	7,358	50	73	48	59	9.2	**205,400**	**24.6**
		35	48	46	-7.4	178,300	12.2	7,870	55	78	48	64	9.1	**204,500**	**22.7**
		35	48	46	-7.3	175,100	12.9	8,446	60	83	48	69	9.1	**203,300**	**20.7**
		36	48	46	-7.2	172,200	13.7	9,076	65	88	48	74	9.0	**202,600**	**19.0**
		37	48	47	-7.0	168,800	14.6	9,778	70	94	48	79	9.0	**201,600**	**17.3**
		37	48	47	-6.9	165,500	15.5	10,539	75	99	48	84	8.9	**200,900**	**15.7**
		38	48	47	-6.7	161,800	16.5	11,382	80	104	48	89	8.9	**200,000**	**14.2**
		38	48	47	-6.6	158,300	17.7	12,288	85	109	48	94	8.9	**199,700**	**12.9**
		39	48	47	-6.4	154,300	18.9	13,284	90	115	48	99	8.8	**199,100**	**11.6**
		39	48	47	-6.3	150,500	20.2	14,349	95	120	48	104	8.8	**198,900**	**10.5**

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Performance Tables - W-Series (METRIC UNITS)

W-180-H**-X-*S-P*

R454b, 60 Hz, GSD60182VL (460-3-60)

*Compressor current is for 460-3-60.
Multiply by 2.2 for 208-3-60, by 0.8 for 575-3-60.

METRIC

	EVAPORATOR LOOP *(35% Propylene Glycol)*						ELECTRICAL		CONDENSER 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	-9.6	3.0	-6.0	-2.1	23.8	16.6	11,650	40	45.2	3.0	42.8	2.8	**35.2**	**3.02**
	-1.1	-7.1	3.0	-3.4	-2.3	27.0	16.7	11,743		45.6	3.0	43.1	3.1	**38.5**	**3.28**
	1.7	-4.4	3.0	-0.9	-2.6	30.5	16.8	11,837		46.0	3.0	43.3	3.3	**42.1**	**3.56**
	4.4	-1.8	3.0	1.5	-2.9	34.3	16.9	11,936		46.4	3.0	43.7	3.7	**46.0**	**3.86**
	7.2	0.7	3.0	3.9	-3.3	38.4	17.1	12,041		46.8	3.0	44.0	4.0	**50.2**	**4.17**
	10.0	3.3	3.0	6.4	-3.6	42.9	17.2	12,156		47.2	3.0	44.3	4.3	**54.9**	**4.52**
	12.7	5.9	3.0	8.6	-4.1	47.7	17.4	12,282		47.6	3.0	44.8	4.8	**59.8**	**4.87**
	15.6	8.5	3.0	11.1	-4.5	53.0	17.6	12,423		47.9	3.0	45.2	5.2	**65.3**	**5.25**
	18.3	11.1	3.0	13.4	-4.9	58.7	17.8	12,583		48.3	3.0	45.7	5.7	**71.2**	**5.66**
	21.1	13.7	3.0	15.7	-5.4	64.8	18.0	12,758		48.7	3.0	46.2	6.2	**77.4**	**6.07**
	-3.9	-9.6	3.0	-5.7	-1.8	21.7	17.8	12,744	46.2	50.8	3.0	49	2.7	**34.2**	**2.69**
	-1.1	-6.9	3.0	-3.2	-2.1	24.8	18.0	12,881	45.9	50.9	3.0		3.0	**37.5**	**2.91**
	1.7	-4.3	3.0	-0.7	-2.4	28.2	18.2	13,004	45.6	51.1	3.0		3.3	**41.0**	**3.15**
	4.4	-1.7	3.0	1.7	-2.7	31.9	18.4	13,146	45.3	51.2	3.0		3.6	**44.8**	**3.41**
	7.2	0.9	3.0	4.1	-3.1	36.0	18.6	13,279	45.0	51.3	3.0		3.9	**49.1**	**3.70**
	10.0	3.5	3.0	6.6	-3.4	40.4	18.8	13,437	44.6	51.5	3.0		4.3	**53.7**	**4.00**
	12.7	6.1	3.0	8.9	-3.8	45.2	19.0	13,590	44.2	51.6	3.0		4.7	**58.6**	**4.31**
	15.5	8.7	3.0	11.2	-4.3	50.4	19.3	13,776	43.8	51.8	3.0		5.1	**64.0**	**4.65**
	18.3	11.3	3.0	13.6	-4.7	56.1	19.6	13,965	43.3	51.9	3.0		5.6	**70.0**	**5.01**
	21.1	13.9	3.0	15.8	-5.3	62.3	19.9	14,192	42.8	52.1	3.0		6.1	**76.4**	**5.38**
DHW	-3.9	-11.3	3.0	-5.7	-1.8	21.8	23.4	16,871	54.1	58.5	**1.6**	**60 (DHW)**	5.9	**38.5**	**2.28**
	-1.1	-8.6	3.0	-3.2	-2.1	24.3	23.0	16,544	53.7	58.7	**1.6**		6.3	**40.7**	**2.46**
	1.7	-5.8	3.0	-0.6	-2.3	27.1	22.5	16,210	53.3	58.8	**1.6**		6.7	**43.1**	**2.66**
	4.4	-3.1	3.0	1.8	-2.6	30.0	22.0	15,869	52.9	59.0	**1.6**		7.1	**45.8**	**2.88**
	7.2	-0.3	3.0	4.4	-2.8	33.3	21.5	15,528	52.5	59.2	**1.6**		7.5	**48.6**	**3.13**
	10.0	2.4	3.0	6.9	-3.1	36.6	21.1	15,187	52.1	59.3	**1.6**		7.9	**51.7**	**3.40**
	12.8	5.2	3.0	9.4	-3.4	40.2	20.6	14,849	51.6	59.5	**1.6**		8.4	**55.0**	**3.70**
	15.6	7.9	3.0	11.9	-3.7	44.2	20.1	14,518	51.0	59.7	**1.6**		9.0	**58.6**	**4.04**
	18.3	10.7	3.0	14.2	-4.1	48.4	19.7	14,193	50.4	59.8	**1.6**		9.6	**62.5**	**4.40**
	21.1	13.4	3.0	16.6	-4.5	53.0	19.2	13,879	49.7	60.0	**1.6**		10.3	**66.7**	**4.81**

	EVAPORATOR LOOP *(Water)*						ELECTRICAL		CONDENSER LOOP *(35% Propylene Glycol)*						
	ELT (°C)	Evap. Temp.	Flow (L/s)	LLT (°C)	Delta T (°C)	**Cooling (kW)**	Compressor Current (A)*	Input Power (W)	EWT (°C)	Cond. Temp.	Flow (L/s)	LWT (°C)	Delta T (°C)	Heat Rej. (kW)	**COP_C**
COOLING	12	1	3.0	7.8	-4.2	53.0	11.6	7,358	10.0	23	3.0	15.1	5.1	**60.2**	**7.21**
		2	3.0	7.9	-4.1	52.3	12.2	7,870	12.8	25	3.0	17.9	5.1	**59.9**	**6.65**
		2	3.0	7.9	-4.1	51.3	12.9	8,446	15.6	28	3.0	20.7	5.1	**59.6**	**6.07**
		2	3.0	8.0	-4.0	50.5	13.7	9,076	18.3	31	3.0	23.3	5.0	**59.4**	**5.57**
		3	3.0	8.1	-3.9	49.5	14.6	9,778	21.1	34	3.0	26.1	5.0	**59.1**	**5.07**
		3	3.0	8.2	-3.8	48.5	15.5	10,539	23.9	37	3.0	28.8	4.9	**58.9**	**4.60**
		3	3.0	8.3	-3.7	47.4	16.5	11,382	26.7	40	3.0	31.6	4.9	**58.6**	**4.16**
		3	3.0	8.3	-3.7	46.4	17.7	12,288	29.4	43	3.0	34.3	4.9	**58.5**	**3.78**
		4	3.0	8.4	-3.6	45.2	18.9	13,284	32.2	46	3.0	37.1	4.9	**58.4**	**3.40**
		4	3.0	8.5	-3.5	44.1	20.2	14,349	35.0	49	3.0	39.9	4.9	**58.3**	**3.08**

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Performance Tables - W-Series (US UNITS)

W-235-H**-X-*S-P*

R454b, 60 Hz, GSD60235VL (460-3-60)

*Compressor current is for 460-3-60.
Multiply by 0.8 for 575-3-60.

	EVAPORATOR LOOP *(35% Propylene Glycol)*						ELECTRICAL		CONDENSER 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	60	21	-3.8	105,700	22.2	15,126	104	114	60	109	5.2	**156,200**	**3.03**
	30	19	60	26	-4.3	120,000	22.3	15,232		115	60	110	5.7	**170,900**	**3.29**
	35	24	60	30	-4.9	135,400	22.4	15,357		115	60	110	6.3	**186,800**	**3.56**
	40	29	60	35	-5.5	152,300	22.6	15,476		116	60	111	6.8	**204,100**	**3.87**
	45	34	60	39	-6.1	170,700	22.8	15,630		117	60	112	7.5	**223,100**	**4.18**
	50	38	60	43	-6.8	190,700	23.0	15,794		117	60	112	8.2	**243,700**	**4.52**
	55	43	60	47	-7.6	212,100	23.2	15,989		118	60	113	8.9	**265,800**	**4.87**
	60	48	60	52	-8.4	235,600	23.5	16,243		118	60	114	9.7	**290,200**	**5.24**
	65	52	60	56	-9.3	261,100	23.9	16,531		119	60	115	10.6	**316,700**	**5.61**
	70	57	60	60	-10.3	288,500	24.3	16,891		120	60	116	11.6	**345,300**	**5.99**
	25	15	60	22	-3.5	96,400	24.0	16,748	115	124	60	120	5.1	**152,400**	**2.67**
	30	20	60	26	-4.0	110,100	24.2	16,882	114	124	60		5.6	**166,600**	**2.89**
	35	24	60	31	-4.5	125,100	24.4	17,003	114	124	60		6.1	**182,100**	**3.14**
	40	29	60	35	-5.1	141,800	24.6	17,155	113	125	60		6.7	**199,300**	**3.40**
	45	34	60	39	-5.7	159,900	24.8	17,309	113	125	60		7.3	**218,000**	**3.69**
	50	39	60	44	-6.4	179,600	25.1	17,511	112	125	60		8.0	**238,400**	**3.99**
	55	43	60	48	-7.2	201,100	25.4	17,731	111	125	60		8.8	**260,700**	**4.31**
	60	48	60	52	-8.0	224,500	25.8	18,014	110	126	60		9.6	**285,100**	**4.64**
	65	53	60	56	-8.9	250,100	26.2	18,332	110	126	60		10.5	**311,800**	**4.98**
	70	57	60	60	-9.9	277,600	26.7	18,730	109	126	60		11.5	**340,700**	**5.33**
DHW	25	12	60	22	-3.4	95,400	31.8	22,411	130	138	**35**	**140 (DHW)**	9.9	**170,800**	**2.23**
	30	17	60	26	-3.8	106,800	31.0	21,851	130	138	**35**		10.5	**180,300**	**2.42**
	35	22	60	31	-4.3	119,400	30.2	21,286	129	138	**35**		11.1	**191,000**	**2.63**
	40	27	60	35	-4.8	132,900	29.3	20,701	128	139	**35**		11.7	**202,600**	**2.87**
	45	32	60	40	-5.3	147,700	28.5	20,153	128	139	**35**		12.5	**215,500**	**3.13**
	50	37	60	44	-5.8	163,300	27.8	19,622	127	139	**35**		13.3	**229,400**	**3.43**
	55	42	60	49	-6.4	180,200	27.0	19,116	126	139	**35**		14.2	**244,600**	**3.75**
	60	47	60	53	-7.1	198,900	26.3	18,640	125	140	**35**		15.2	**261,700**	**4.11**
	65	51	60	57	-7.8	218,800	25.6	18,171	124	140	**35**		16.2	**280,000**	**4.52**
	70	56	60	61	-8.6	240,400	25.0	17,762	123	140	**35**		17.4	**300,200**	**4.95**

	EVAPORATOR LOOP *(Water)*						ELECTRICAL		CONDENSER LOOP *(35% Propylene Glycol)*						
	ELT (°F)	Evap. Temp.	Flow (gpm)	LLT (°F)	Delta T (°F)	**Cooling (Btu/hr)**	Compressor Current (A)*	Input Power (W)	EWT (°F)	Cond. Temp.	Flow (gpm)	LWT (°F)	Delta T (°F)	Heat Rej. (Btu/hr)	**EER**
COOLING	54	34	60	46	-7.8	235,100	15.7	9,415	50	73	60	60	9.5	**266,200**	**25.0**
		35	60	46	-7.7	231,600	16.6	10,146	55	78	60	65	9.5	**265,300**	**22.8**
		36	60	46	-7.6	227,500	17.6	10,932	60	83	60	69	9.4	**263,900**	**20.8**
		36	60	46	-7.5	223,700	18.6	11,763	65	88	60	74	9.4	**263,000**	**19.0**
		37	60	46	-7.3	219,400	19.7	12,666	70	94	60	79	9.3	**261,800**	**17.3**
		37	60	46	-7.2	215,200	20.9	13,629	75	99	60	84	9.3	**261,000**	**15.8**
		38	60	47	-7.0	210,500	22.2	14,682	80	104	60	89	9.2	**259,900**	**14.3**
		38	60	47	-6.9	206,000	23.6	15,811	85	109	60	94	9.2	**259,300**	**13.0**
		39	60	47	-6.7	200,900	25.2	17,052	90	115	60	99	9.2	**258,500**	**11.8**
		39	60	47	-6.5	195,900	26.9	18,387	95	120	60	104	9.2	**258,100**	**10.7**

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Performance Tables - W-Series (METRIC UNITS)

W-235-H**-X-*S-P*

R454b, 60 Hz, GSD60235VL (460-3-60)

*Compressor current is for 460-3-60.
Multiply by 0.8 for 575-3-60.

METRIC

	EVAPORATOR LOOP *(35% Propylene Glycol)*						ELECTRICAL		CONDENSER 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	-9.6	3.8	-6.0	-2.1	31.0	22.2	15,126	40	45.5	3.8	42.9	2.9	**45.8**	**3.03**
HEATING	-1.1	-7.0	3.8	-3.5	-2.4	35.2	22.3	15,232		45.8	3.8	43.2	3.2	**50.1**	**3.29**
HEATING	1.7	-4.4	3.8	-1.0	-2.7	39.7	22.4	15,357		46.2	3.8	43.5	3.5	**54.8**	**3.56**
HEATING	4.4	-1.8	3.8	1.3	-3.1	44.6	22.6	15,476		46.6	3.8	43.8	3.8	**59.8**	**3.87**
HEATING	7.2	0.8	3.8	3.8	-3.4	50.0	22.8	15,630		46.9	3.8	44.2	4.2	**65.4**	**4.18**
HEATING	10.0	3.4	3.8	6.2	-3.8	55.9	23.0	15,794		47.3	3.8	44.6	4.6	**71.4**	**4.52**
HEATING	12.7	6.0	3.8	8.5	-4.2	62.2	23.2	15,989		47.6	3.8	44.9	4.9	**77.9**	**4.87**
HEATING	15.5	8.6	3.8	10.8	-4.7	69.1	23.5	16,243		48.0	3.8	45.4	5.4	**85.1**	**5.24**
HEATING	18.3	11.2	3.8	13.1	-5.2	76.5	23.9	16,531		48.3	3.8	45.9	5.9	**92.8**	**5.61**
HEATING	21.1	13.8	3.8	15.4	-5.7	84.6	24.3	16,891		48.7	3.8	46.4	6.4	**101.2**	**5.99**
HEATING	-3.9	-9.5	3.8	-5.8	-1.9	28.3	24.0	16,748	46.1	51.0	3.8	49	2.8	**44.7**	**2.67**
HEATING	-1.1	-6.9	3.8	-3.3	-2.2	32.3	24.2	16,882	45.8	51.2	3.8		3.1	**48.8**	**2.89**
HEATING	1.7	-4.3	3.8	-0.8	-2.5	36.7	24.4	17,003	45.5	51.3	3.8		3.4	**53.4**	**3.14**
HEATING	4.4	-1.6	3.8	1.6	-2.8	41.6	24.6	17,155	45.2	51.4	3.8		3.7	**58.4**	**3.40**
HEATING	7.2	1.0	3.8	4.0	-3.2	46.9	24.8	17,309	44.8	51.6	3.8		4.1	**63.9**	**3.69**
HEATING	10.0	3.6	3.8	6.4	-3.6	52.6	25.1	17,511	44.4	51.7	3.8		4.4	**69.9**	**3.99**
HEATING	12.8	6.2	3.8	8.8	-4.0	58.9	25.4	17,731	44.0	51.8	3.8		4.9	**76.4**	**4.31**
HEATING	15.6	8.8	3.8	11.2	-4.4	65.8	25.8	18,014	43.6	52.0	3.8		5.3	**83.6**	**4.64**
HEATING	18.3	11.4	3.8	13.4	-4.9	73.3	26.2	18,332	43.1	52.1	3.8		5.8	**91.4**	**4.98**
HEATING	21.1	14.1	3.8	15.6	-5.5	81.4	26.7	18,730	42.5	52.3	3.8		6.4	**99.9**	**5.33**
DHW	-3.9	-11.2	3.8	-5.8	-1.9	28.0	31.8	22,411	54.5	58.7	**2.2**	**60 (DHW)**	5.5	**50.1**	**2.23**
DHW	-1.1	-8.4	3.8	-3.2	-2.1	31.3	31.0	21,851	54.2	58.9	**2.2**		5.8	**52.8**	**2.42**
DHW	1.7	-5.7	3.8	-0.7	-2.4	35.0	30.2	21,286	53.8	59.1	**2.2**		6.2	**56.0**	**2.63**
DHW	4.4	-2.9	3.8	1.7	-2.7	39.0	29.3	20,701	53.5	59.2	**2.2**		6.5	**59.4**	**2.87**
DHW	7.2	-0.2	3.8	4.3	-2.9	43.3	28.5	20,153	53.1	59.3	**2.2**		6.9	**63.2**	**3.13**
DHW	10.0	2.6	3.8	6.8	-3.2	47.9	27.8	19,622	52.6	59.5	**2.2**		7.4	**67.2**	**3.43**
DHW	12.8	5.3	3.8	9.2	-3.6	52.8	27.0	19,116	52.1	59.7	**2.2**		7.9	**71.7**	**3.75**
DHW	15.6	8.1	3.8	11.7	-3.9	58.3	26.3	18,640	51.6	59.8	**2.2**		8.4	**76.7**	**4.11**
DHW	18.3	10.8	3.8	14.0	-4.3	64.1	25.6	18,171	51.0	59.9	**2.2**		9.0	**82.1**	**4.52**
DHW	21.1	13.6	3.8	16.3	-4.8	70.5	25.0	17,762	50.3	60.1	**2.2**		9.7	**88.0**	**4.95**

	EVAPORATOR LOOP *(Water)*						ELECTRICAL		CONDENSER LOOP *(35% Propylene Glycol)*						
	ELT (°C)	Evap. Temp.	Flow (L/s)	LLT (°C)	Delta T (°C)	**Cooling (kW)**	Compressor Current (A)*	Input Power (W)	EWT (°C)	Cond. Temp.	Flow (L/s)	LWT (°C)	Delta T (°C)	Heat Rej. (kW)	**COP_C**
COOLING	12	1	3.8	7.7	-4.3	68.9	15.7	9,415	10.0	23	3.8	15.3	5.3	**78.0**	**7.33**
COOLING		2	3.8	7.7	-4.3	67.9	16.6	10,146	12.8	25	3.8	18.1	5.3	**77.8**	**6.68**
COOLING		2	3.8	7.8	-4.2	66.7	17.6	10,932	15.6	28	3.8	20.8	5.2	**77.3**	**6.10**
COOLING		2	3.8	7.8	-4.2	65.6	18.6	11,763	18.3	31	3.8	23.5	5.2	**77.1**	**5.57**
COOLING		3	3.8	7.9	-4.1	64.3	19.7	12,666	21.1	34	3.8	26.3	5.2	**76.7**	**5.07**
COOLING		3	3.8	8.0	-4.0	63.1	20.9	13,629	23.9	37	3.8	29.1	5.2	**76.5**	**4.63**
COOLING		3	3.8	8.1	-3.9	61.7	22.2	14,682	26.7	40	3.8	31.8	5.1	**76.2**	**4.19**
COOLING		4	3.8	8.2	-3.8	60.4	23.6	15,811	29.4	43	3.8	34.5	5.1	**76.0**	**3.81**
COOLING		4	3.8	8.3	-3.7	58.9	25.2	17,052	32.2	46	3.8	37.3	5.1	**75.8**	**3.46**
COOLING		4	3.8	8.4	-3.6	57.4	26.9	18,387	35.0	49	3.8	40.1	5.1	**75.6**	**3.14**

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Performance Tables - WH-Series

WH-100-H***-Y-*S-CC *R513a, 60 Hz, ZH40KCE-TFD (460-3-60)*

** Cooling via reversing models (-HAC), or switching indoor/outdoor*
*** Lower cooling mode outdoor loop ELT's may require flow control*
† Compressor current is for 460-3-60. [Multiply by 2.2 for 208-3-60, by 0.8 for 575-3-60.]

	OUTDOOR LOOP *(Water)*						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	50	39	28	47	-3.5	49,400	9.8	6,180	115	127	28	120	5.0	**69,800**	**3.31**
	60	48	28	56	-4.3	60,900	10.0	6,299	114	127	28		5.9	**81,700**	**3.80**
	70	57	28	65	-5.3	73,800	10.2	6,429	113	128	28		6.8	**95,000**	**4.33**
	80	66	28	74	-6.3	88,300	10.4	6,581	112	128	28		7.9	**110,100**	**4.90**
	90	75	28	83	-7.5	104,400	10.7	6,762	111	129	28		9.1	**126,800**	**5.50**
	50	39	28	47	-3.0	42,200	11.0	7,488	135	146	28	140	4.8	**67,000**	**2.62**
	60	49	28	56	-3.7	51,800	11.1	7,580	135	146	28		5.5	**77,000**	**2.98**
	70	58	28	66	-4.4	61,800	11.3	7,679	134	147	28		6.3	**87,300**	**3.33**
	80	67	28	75	-5.2	72,600	11.5	7,793	133	147	28		7.1	**98,500**	**3.70**
	90	76	28	84	-6.0	83,800	11.7	7,932	132	148	28		8.0	**110,200**	**4.07**
	50	42	28	48	-2.4	33,600	12.5	9,014	155	166	28	160	4.6	**63,600**	**2.07**
	60	50	28	57	-3.0	41,400	12.7	9,124	155	166	28		5.2	**71,800**	**2.31**
	70	59	28	67	-3.5	49,500	12.8	9,235	154	167	28		5.8	**80,300**	**2.55**
	80	68	28	76	-4.1	57,500	13.0	9,357	154	167	28		6.4	**88,700**	**2.78**
	90	77	28	85	-4.7	65,700	13.2	9,496	153	167	28		7.1	**97,400**	**3.01**

	ELT (°F)	Cond. Temp.	Flow (gpm)	LLT (°F)	Delta T (°F)	Heat Rej. (Btu/hr)	Compressor Current (A)†	Input Power (W)	EWT (°F)	Evap. Temp.	Flow (gpm)	LWT (°F)	Delta T (°F)	**Cooling (Btu/hr)**	EER
COOLING*	50	74	28	55	5.2	**72,800**	6.8	3,407	54	36	28	49	-4.5	62,200	**18.3**
	55	79	28	60	5.1	**71,800**	6.9	3,535		36	28	49	-4.4	60,800	**17.2**
	60	84	28	65	5.1	**70,900**	7.0	3,670		37	28	49	-4.3	59,400	**16.2**
	65	89	28	70	5.0	**69,800**	7.0	3,820		37	28	49	-4.2	57,800	**15.1**
	70	95	28	75	4.9	**68,700**	7.1	3,979		38	28	50	-4.0	56,100	**14.1**
	75	100	28	80	4.8	**67,400**	7.2	4,148		38	28	50	-3.9	54,300	**13.1**
	80	105	28	85	4.8	**66,300**	7.4	4,333		39	28	50	-3.8	52,500	**12.1**
	85	110	28	90	4.7	**65,000**	7.5	4,533		39	28	50	-3.6	50,500	**11.1**
	90	115	28	95	4.6	**63,700**	7.7	4,742		40	28	50	-3.5	48,500	**10.2**
	95	120	28	100	4.5	**62,400**	7.8	4,971		40	28	50	-3.4	46,400	**9.3**

METRIC

	OUTDOOR LOOP *(Water)*						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	10.0	3.9	1.8	8.1	-1.9	14.5	9.8	6,180	46.1	52.6	1.8	49	2.8	**20.5**	**3.31**
	15.6	8.9	1.8	13.2	-2.4	17.8	10.0	6,299	45.6	52.9	1.8		3.3	**23.9**	**3.80**
	21.1	13.9	1.8	18.2	-2.9	21.6	10.2	6,429	45.1	53.2	1.8		3.8	**27.8**	**4.33**
	26.7	18.9	1.8	23.2	-3.5	25.9	10.4	6,581	44.5	53.4	1.8		4.4	**32.3**	**4.90**
	32.2	23.9	1.8	28.0	-4.2	30.6	10.7	6,762	43.8	53.7	1.8		5.1	**37.2**	**5.50**
	10.0	4.1	1.8	8.3	-1.7	12.4	11.0	7,488	57.3	63.3	1.8	60	2.7	**19.6**	**2.62**
	15.6	9.2	1.8	13.5	-2.1	15.2	11.1	7,580	56.9	63.6	1.8		3.1	**22.6**	**2.98**
	21.1	14.3	1.8	18.7	-2.4	18.1	11.3	7,679	56.5	63.8	1.8		3.5	**25.6**	**3.33**
	26.7	19.4	1.8	23.8	-2.9	21.3	11.5	7,793	56.1	64.0	1.8		3.9	**28.9**	**3.70**
	32.2	24.4	1.8	28.9	-3.3	24.6	11.7	7,932	55.6	64.2	1.8		4.4	**32.3**	**4.07**
	10.0	5.3	1.8	8.7	-1.3	9.8	12.5	9,014	68.6	74.3	1.8	71	2.6	**18.6**	**2.07**
	15.6	10.2	1.8	13.9	-1.7	12.1	12.7	9,124	68.2	74.6	1.8		2.9	**21.0**	**2.31**
	21.1	15.2	1.8	19.2	-1.9	14.5	12.8	9,235	67.9	74.8	1.8		3.2	**23.5**	**2.55**
	26.7	20.1	1.8	24.4	-2.3	16.9	13.0	9,357	67.6	75.0	1.8		3.6	**26.0**	**2.78**
	32.2	25.0	1.8	29.6	-2.6	19.3	13.2	9,496	67.2	75.2	1.8		3.9	**28.5**	**3.01**

	ELT (°C)	Cond. Temp.	Flow (L/s)	LLT (°C)	Delta T (°C)	Heat Rej. (W)	Compressor Current (A)†	Input Power (W)	EWT (°C)	Evap. Temp.	Flow (L/s)	LWT (°C)	Delta T (°C)	**Cooling (W)**	COP_C
COOLING*	10.0	23	1.8	12.9	2.9	**21.3**	6.8	3,407	12.0	2	1.8	9.5	-2.5	18.2	**5.36**
	12.8	26	1.8	15.6	2.8	**21.0**	6.9	3,535		2	1.8	9.6	-2.4	17.8	**5.04**
	15.6	29	1.8	18.4	2.8	**20.8**	7.0	3,670		3	1.8	9.6	-2.4	17.4	**4.75**
	18.3	32	1.8	21.1	2.8	**20.5**	7.0	3,820		3	1.8	9.7	-2.3	16.9	**4.43**
	21.1	35	1.8	23.8	2.7	**20.1**	7.1	3,979		3	1.8	9.8	-2.2	16.4	**4.13**
	23.9	38	1.8	26.6	2.7	**19.8**	7.2	4,148		3	1.8	9.8	-2.2	15.9	**3.84**
	26.7	40	1.8	29.4	2.7	**19.4**	7.4	4,333		4	1.8	9.9	-2.1	15.4	**3.55**
	29.4	43	1.8	32.0	2.6	**19.0**	7.5	4,533		4	1.8	10.0	-2.0	14.8	**3.25**
	32.2	46	1.8	34.8	2.6	**18.7**	7.7	4,742		4	1.8	10.1	-1.9	14.2	**2.99**
	35.0	49	1.8	37.5	2.5	**18.3**	7.8	4,971		5	1.8	10.1	-1.9	13.6	**2.73**

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Performance Tables - WH-Series

WH-120-H**-Y-*S-P* *R513a, 60 Hz, ZH50KCE-TFD (460-3-60)*

* *Cooling via reversing models (-HAC), or switching indoor/outdoor*
** *Lower cooling mode outdoor loop ELT's may require flow control*
† *Compressor current is for 460-3-60.*
[Multiply by 2.2 for 208-3-60, by 0.8 for 575-3-60.]

	OUTDOOR LOOP (Water)						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	50	40	30	46	-4.2	63,900	12.1	6,793	114	126	30	120	5.8	**86,800**	**3.74**
	60	48	30	55	-5.2	77,300	12.5	7,028	113	126	30		6.8	**101,100**	**4.22**
	70	57	30	64	-6.2	92,800	12.9	7,274	112	126	30		7.9	**117,400**	**4.73**
	80	65	30	73	-7.4	110,900	13.3	7,548	111	127	30		9.2	**136,400**	**5.30**
	90	74	30	81	-8.8	131,900	13.8	7,866	109	127	30		10.7	**158,500**	**5.91**
	50	41	30	46	-3.7	55,700	13.4	8,204	134	145	30	140	5.6	**83,500**	**2.98**
	60	50	30	56	-4.5	67,300	13.8	8,467	134	146	30		6.5	**96,000**	**3.32**
	70	58	30	65	-5.4	80,400	14.2	8,716	133	146	30		7.4	**109,900**	**3.70**
	80	67	30	74	-6.4	95,500	14.6	8,986	132	146	30		8.5	**125,900**	**4.11**
	90	75	30	82	-7.6	112,700	15.1	9,274	130	146	30		9.7	**144,100**	**4.55**
	50	42	30	47	-3.1	46,200	14.8	9,700	155	166	30	160	5.4	**79,100**	**2.39**
	60	51	30	56	-3.7	56,200	15.3	10,013	154	166	30		6.1	**90,100**	**2.64**
	70	60	30	66	-4.5	67,100	15.7	10,320	153	166	30		6.9	**102,100**	**2.90**
	80	68	30	75	-5.3	79,300	16.2	10,612	152	167	30		7.8	**115,300**	**3.18**
	90	77	30	84	-6.3	93,300	16.7	10,914	151	167	30		8.8	**130,300**	**3.50**

	ELT (°F)	Cond. Temp.	Flow (gpm)	LLT (°F)	Delta T (°F)	Heat Rej. (Btu/hr)	Compressor Current (A)†	Input Power (W)	EWT (°F)	Evap. Temp.	Flow (gpm)	LWT (°F)	Delta T (°F)	**Cooling (Btu/hr)**	**EER**
COOLING*	50	74	30	57	6.7	**101,200**	9.0	3,784	54	35	30	48	-5.9	88,700	**23.4**
	55	79	30	62	6.7	**100,500**	9.5	4,087		36	30	48	-5.8	86,900	**21.3**
	60	84	30	67	6.6	**99,600**	9.9	4,419		37	30	48	-5.7	84,900	**19.2**
	65	89	30	72	6.6	**98,800**	10.4	4,777		37	30	48	-5.5	82,900	**17.4**
	70	95	30	77	6.6	**98,100**	10.9	5,170		38	30	48	-5.4	80,800	**15.6**
	75	100	30	82	6.5	**97,400**	11.4	5,591		38	30	48	-5.3	78,700	**14.1**
	80	105	30	87	6.5	**96,700**	12.0	6,053		39	30	49	-5.1	76,400	**12.6**
	85	110	30	91	6.4	**96,200**	12.6	6,547		39	30	49	-5.0	74,200	**11.3**
	90	116	30	96	6.4	**95,600**	13.3	7,089		40	30	49	-4.8	71,700	**10.1**
	95	121	30	101	6.4	**95,100**	14.0	7,668		40	30	49	-4.6	69,300	**9.0**

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	OUTDOOR LOOP (Water)						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	10.0	4.2	1.9	7.7	-2.3	18.7	12.1	6,793	45.7	52.1	1.9	49	3.2	**25.4**	**3.74**
	15.6	8.9	1.9	12.7	-2.9	22.7	12.5	7,028	45.1	52.2	1.9		3.8	**29.6**	**4.22**
	21.1	13.7	1.9	17.7	-3.4	27.2	12.9	7,274	44.5	52.4	1.9		4.4	**34.4**	**4.73**
	26.7	18.4	1.9	22.6	-4.1	32.5	13.3	7,548	43.8	52.6	1.9		5.1	**40.0**	**5.30**
	32.2	23.1	1.9	27.3	-4.9	38.7	13.8	7,866	42.9	52.7	1.9		5.9	**46.5**	**5.91**
	10.0	4.9	1.9	7.9	-2.1	16.3	13.4	8,204	56.9	63.0	1.9	60	3.1	**24.5**	**2.98**
	15.6	9.7	1.9	13.1	-2.5	19.7	13.8	8,467	56.4	63.2	1.9		3.6	**28.1**	**3.32**
	21.1	14.4	1.9	18.1	-3.0	23.6	14.2	8,716	55.9	63.3	1.9		4.1	**32.2**	**3.70**
	26.7	19.2	1.9	23.1	-3.6	28.0	14.6	8,986	55.3	63.4	1.9		4.7	**36.9**	**4.11**
	32.2	23.9	1.9	28.0	-4.2	33.0	15.1	9,274	54.6	63.6	1.9		5.4	**42.2**	**4.55**
	10.0	5.6	1.9	8.3	-1.7	13.5	14.8	9,700	68.1	74.2	1.9	71	3.0	**23.2**	**2.39**
	15.6	10.4	1.9	13.5	-2.1	16.5	15.3	10,013	67.7	74.4	1.9		3.4	**26.4**	**2.64**
	21.1	15.3	1.9	18.6	-2.5	19.7	15.7	10,320	67.3	74.6	1.9		3.8	**29.9**	**2.90**
	26.7	20.1	1.9	23.8	-2.9	23.2	16.2	10,612	66.8	74.8	1.9		4.3	**33.8**	**3.18**
	32.2	24.9	1.9	28.7	-3.5	27.3	16.7	10,914	66.2	74.9	1.9		4.9	**38.2**	**3.50**

	ELT (°C)	Cond. Temp.	Flow (L/s)	LLT (°C)	Delta T (°C)	Heat Rej. (W)	Compressor Current (A)†	Input Power (W)	EWT (°C)	Evap. Temp.	Flow (L/s)	LWT (°C)	Delta T (°C)	**Cooling (W)**	**COP$_C$**
COOLING*	10.0	23	1.9	13.7	3.7	**29.7**	9.0	3,784	12.0	2	1.9	8.7	-3.3	26.0	**6.86**
	12.8	26	1.9	16.5	3.7	**29.5**	9.5	4,087		2	1.9	8.8	-3.2	25.5	**6.24**
	15.6	29	1.9	19.3	3.7	**29.2**	9.9	4,419		3	1.9	8.8	-3.2	24.9	**5.63**
	18.3	32	1.9	22.0	3.7	**29.0**	10.4	4,777		3	1.9	8.9	-3.1	24.3	**5.10**
	21.1	35	1.9	24.8	3.7	**28.8**	10.9	5,170		3	1.9	9.0	-3.0	23.7	**4.57**
	23.9	38	1.9	27.5	3.6	**28.5**	11.4	5,591		3	1.9	9.1	-2.9	23.1	**4.13**
	26.7	41	1.9	30.3	3.6	**28.3**	12.0	6,053		4	1.9	9.2	-2.8	22.4	**3.69**
	29.4	43	1.9	33.0	3.6	**28.2**	12.6	6,547		4	1.9	9.2	-2.8	21.7	**3.31**
	32.2	46	1.9	35.8	3.6	**28.0**	13.3	7,089		4	1.9	9.3	-2.7	21.0	**2.96**
	35.0	49	1.9	38.6	3.6	**27.9**	14.0	7,668		5	1.9	9.4	-2.6	20.3	**2.64**

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Performance Tables - WH-Series

WH-140-H**-Y-*S-P*

R513a, 60 Hz, ZH64KCE-TED (460-3-60)

* *Cooling via reversing models (-HAC), or switching indoor/outdoor*
** *Lower cooling mode outdoor loop ELT's may require flow control*
† *Compressor current is for 460-3-60. [Multiply by 2.2 for 208-3-60, by 0.8 for 575-3-60.]*

	OUTDOOR LOOP *(Water)*						ELECTRICAL		INDOOR LOOP *(Water)*						
HEATING	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**
	50	40	34	45	-4.6	78,500	14.0	8,366	114	126	34		6.3	**106,700**	**3.74**
	60	48	34	54	-5.6	95,400	14.5	8,668	113	126	34		7.4	**124,700**	**4.22**
	70	57	34	63	-6.8	115,000	15.0	8,999	111	126	34	120	8.6	**145,400**	**4.74**
	80	65	34	72	-8.1	137,800	15.5	9,375	110	126	34		10.1	**169,500**	**5.30**
	90	74	34	80	-9.7	164,100	16.2	9,816	108	127	34		11.7	**197,300**	**5.89**
	50	41	34	46	-4.0	68,500	15.8	10,077	134	145	34		6.1	**102,600**	**2.98**
	60	50	34	55	-4.9	83,100	16.3	10,401	133	146	34		7.1	**118,300**	**3.33**
	70	58	34	64	-5.9	99,500	16.8	10,735	132	146	34	140	8.1	**135,800**	**3.71**
	80	67	34	73	-7.0	118,500	17.4	11,120	131	146	34		9.3	**156,100**	**4.11**
	90	75	34	82	-8.3	140,100	18.0	11,550	129	146	34		10.7	**179,200**	**4.55**
	50	42	34	47	-3.3	56,600	17.7	11,953	154	165	34		5.8	**97,100**	**2.38**
	60	51	34	56	-4.1	69,100	18.3	12,326	153	166	34		6.6	**110,800**	**2.63**
	70	60	34	65	-4.9	82,800	18.9	12,726	153	166	34	160	7.5	**125,900**	**2.90**
	80	68	34	74	-5.8	98,300	19.5	13,144	151	166	34		8.6	**142,800**	**3.18**
	90	77	34	83	-6.9	116,000	20.2	13,610	150	167	34		9.7	**162,100**	**3.49**

COOLING*	ELT (°F)	Cond. Temp.	Flow (gpm)	LLT (°F)	Delta T (°F)	Heat Rej. (Btu/hr)	Compressor Current (A)†	Input Power (W)	EWT (°F)	Evap. Temp.	Flow (gpm)	LWT (°F)	Delta T (°F)	Cooling (Btu/hr)	EER
	50	73	34	57	7.3	**123,600**	10.1	4,589		36	34	47	-6.4	108,400	**23.6**
	55	79	34	62	7.2	**123,100**	10.6	5,012		36	34	47	-6.3	106,500	**21.2**
	60	84	34	67	7.2	**122,500**	11.2	5,463		37	34	48	-6.1	104,300	**19.1**
	65	89	34	72	7.2	**122,100**	11.8	5,936		37	34	48	-6.0	102,300	**17.2**
	70	94	34	77	7.2	**121,500**	12.4	6,445	54	38	34	48	-5.9	99,900	**15.5**
	75	100	34	82	7.1	**121,000**	13.1	6,982		38	34	48	-5.7	97,600	**14.0**
	80	105	34	87	7.1	**120,400**	13.8	7,565		39	34	48	-5.6	95,000	**12.6**
	85	110	34	92	7.1	**120,000**	14.6	8,185		39	34	48	-5.4	92,500	**11.3**
	90	115	34	97	7.1	**119,500**	15.5	8,861		40	34	48	-5.3	89,700	**10.1**
	95	121	34	102	7.1	**119,300**	16.4	9,584		41	34	49	-5.1	87,000	**9.1**

METRIC

	OUTDOOR LOOP *(Water)*						ELECTRICAL		INDOOR LOOP *(Water)*						
HEATING	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**
	10.0	4.3	2.1	7.4	-2.6	23.0	14.0	8,366	45.4	51.9	2.1		3.5	**31.3**	**3.74**
	15.6	9.1	2.1	12.5	-3.1	28.0	14.5	8,668	44.8	52.1	2.1		4.1	**36.6**	**4.22**
	21.1	13.8	2.1	17.3	-3.8	33.7	15.0	8,999	44.1	52.3	2.1	49	4.8	**42.6**	**4.74**
	26.7	18.5	2.1	22.2	-4.5	40.4	15.5	9,375	43.3	52.4	2.1		5.6	**49.7**	**5.30**
	32.2	23.2	2.1	26.8	-5.4	48.1	16.2	9,816	42.4	52.6	2.1		6.5	**57.8**	**5.89**
	10.0	5.1	2.1	7.8	-2.2	20.1	15.8	10,077	56.6	62.9	2.1		3.4	**30.1**	**2.98**
	15.6	9.8	2.1	12.9	-2.7	24.4	16.3	10,401	56.1	63.1	2.1		3.9	**34.7**	**3.33**
	21.1	14.6	2.1	17.8	-3.3	29.2	16.8	10,735	55.5	63.2	2.1	60	4.5	**39.8**	**3.71**
	26.7	19.3	2.1	22.8	-3.9	34.7	17.4	11,120	54.8	63.3	2.1		5.2	**45.8**	**4.11**
	32.2	24.1	2.1	27.6	-4.6	41.1	18.0	11,550	54.1	63.4	2.1		5.9	**52.5**	**4.55**
	10.0	5.7	2.1	8.2	-1.8	16.6	17.7	11,953	67.9	74.1	2.1		3.2	**28.5**	**2.38**
	15.6	10.6	2.1	13.3	-2.3	20.3	18.3	12,326	67.4	74.3	2.1		3.7	**32.5**	**2.63**
	21.1	15.4	2.1	18.4	-2.7	24.3	18.9	12,726	66.9	74.5	2.1	71	4.2	**36.9**	**2.90**
	26.7	20.2	2.1	23.5	-3.2	28.8	19.5	13,144	66.3	74.7	2.1		4.8	**41.9**	**3.18**
	32.2	25.0	2.1	28.4	-3.8	34.0	20.2	13,610	65.7	74.8	2.1		5.4	**47.5**	**3.49**

COOLING*	ELT (°C)	Cond. Temp.	Flow (L/s)	LLT (°C)	Delta T (°C)	Heat Rej. (W)	Compressor Current (A)†	Input Power (W)	EWT (°C)	Evap. Temp.	Flow (L/s)	LWT (°C)	Delta T (°C)	Cooling (W)	COP_C
	10.0	23	2.1	14.1	4.1	**36.2**	10.1	4,589		2	2.1	8.4	-3.6	31.8	**6.92**
	12.8	26	2.1	16.8	4.0	**36.1**	10.6	5,012		2	2.1	8.5	-3.5	31.2	**6.21**
	15.6	29	2.1	19.6	4.0	**35.9**	11.2	5,463		3	2.1	8.6	-3.4	30.6	**5.60**
	18.3	32	2.1	22.3	4.0	**35.8**	11.8	5,936		3	2.1	8.7	-3.3	30.0	**5.04**
	21.1	35	2.1	25.1	4.0	**35.6**	12.4	6,445	12.0	3	2.1	8.7	-3.3	29.3	**4.54**
	23.9	38	2.1	27.8	3.9	**35.5**	13.1	6,982		4	2.1	8.8	-3.2	28.6	**4.10**
	26.7	41	2.1	30.6	3.9	**35.3**	13.8	7,565		4	2.1	8.9	-3.1	27.8	**3.69**
	29.4	43	2.1	33.3	3.9	**35.2**	14.6	8,185		4	2.1	9.0	-3.0	27.1	**3.31**
	32.2	46	2.1	36.1	3.9	**35.0**	15.5	8,861		4	2.1	9.1	-2.9	26.3	**2.96**
	35.0	49	2.1	38.9	3.9	**35.0**	16.4	9,584		5	2.1	9.2	-2.8	25.5	**2.67**

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Performance Tables - WH-Series

* *Cooling via reversing models (-HAC), or switching indoor/outdoor*
** *Lower cooling mode outdoor loop ELT's may require flow control*
† *Compressor current is for 460-3-60.*
[Multiply by 2.2 for 208-3-60, by 0.8 for 575-3-60.]

WH-180-H**-Y-*S-P*

R513a, 60 Hz, ZH76KCE-TED (460-3-60)

	OUTDOOR LOOP *(Water)*						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	50	40	48	46	-4.0	96,900	18.9	10,202	115	125	48	120	5.5	**131,300**	**3.77**
	60	48	48	55	-4.9	117,500	19.5	10,556	114	126	48		6.4	**153,100**	**4.25**
	70	57	48	64	-5.9	141,300	20.1	10,959	113	126	48		7.5	**178,300**	**4.77**
	80	65	48	73	-7.1	168,700	20.8	11,436	111	126	48		8.7	**207,300**	**5.31**
	90	74	48	82	-8.4	200,100	21.5	12,016	110	127	48		10.1	**240,700**	**5.87**
	50	41	48	47	-3.5	85,000	20.7	12,299	135	145	48	140	5.3	**126,500**	**3.01**
	60	50	48	56	-4.3	102,700	21.2	12,597	134	145	48		6.1	**145,300**	**3.38**
	70	58	48	65	-5.1	122,900	21.7	12,916	133	146	48		7.0	**166,600**	**3.78**
	80	67	48	74	-6.1	146,100	22.3	13,310	132	146	48		8.1	**191,100**	**4.21**
	90	75	48	83	-7.2	172,400	22.9	13,774	131	146	48		9.2	**219,000**	**4.66**
	50	42	48	47	-2.9	70,200	22.9	14,659	155	165	48	160	5.1	**119,800**	**2.40**
	60	51	48	57	-3.5	85,200	23.4	14,968	154	166	48		5.8	**135,900**	**2.66**
	70	60	48	66	-4.3	102,100	23.9	15,317	154	166	48		6.5	**153,900**	**2.94**
	80	68	48	75	-5.1	121,400	24.4	15,696	153	166	48		7.4	**174,500**	**3.26**
	90	77	48	84	-6.0	143,600	25.0	16,146	152	167	48		8.4	**198,300**	**3.60**

	ELT (°F)	Cond. Temp.	Flow (gpm)	LLT (°F)	Delta T (°F)	Heat Rej. (Btu/hr)	Compressor Current (A)†	Input Power (W)	EWT (°F)	Evap. Temp.	Flow (gpm)	LWT (°F)	Delta T (°F)	**Cooling (Btu/hr)**	**EER**
COOLING*	50	74	48	56	6.1	**147,900**	13.3	5,527	54	35	48	48	-5.4	129,700	**23.5**
	55	79	48	61	6.1	**147,000**	14.0	6,011		36	48	48	-5.3	127,100	**21.1**
	60	84	48	66	6.1	**145,700**	14.7	6,521		36	48	48	-5.2	124,100	**19.0**
	65	89	48	71	6.0	**144,500**	15.4	7,049		37	48	49	-5.1	121,100	**17.2**
	70	95	48	76	6.0	**143,200**	16.1	7,611		38	48	49	-4.9	117,800	**15.5**
	75	100	48	81	5.9	**142,000**	16.9	8,200		38	48	49	-4.8	114,600	**14.0**
	80	105	48	86	5.9	**140,600**	17.8	8,835		39	48	49	-4.6	111,000	**12.6**
	85	110	48	91	5.8	**139,500**	18.7	9,504		39	48	49	-4.5	107,600	**11.3**
	90	116	48	96	5.8	**138,000**	19.7	10,230		40	48	49	-4.3	103,700	**10.1**
	95	121	48	101	5.7	**137,000**	20.7	11,002		40	48	49	-4.2	100,000	**9.1**

METRIC

	OUTDOOR LOOP *(Water)*						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	10.0	4.4	3.0	7.8	-2.2	28.4	18.9	10,202	45.8	51.9	3.0	49	3.1	**38.5**	**3.77**
	15.6	9.1	3.0	12.9	-2.7	34.4	19.5	10,556	45.3	52.1	3.0		3.6	**44.9**	**4.25**
	21.1	13.8	3.0	17.8	-3.3	41.4	20.1	10,959	44.7	52.2	3.0		4.2	**52.3**	**4.77**
	26.7	18.6	3.0	22.8	-3.9	49.4	20.8	11,436	44.1	52.4	3.0		4.8	**60.8**	**5.31**
	32.2	23.3	3.0	27.5	-4.7	58.6	21.5	12,016	43.3	52.6	3.0		5.6	**70.5**	**5.87**
	10.0	5.1	3.0	8.1	-1.9	24.9	20.7	12,299	57.1	62.8	3.0	60	2.9	**37.1**	**3.01**
	15.6	9.9	3.0	13.2	-2.4	30.1	21.2	12,597	56.6	63.0	3.0		3.4	**42.6**	**3.38**
	21.1	14.6	3.0	18.3	-2.8	36.0	21.7	12,916	56.1	63.1	3.0		3.9	**48.8**	**3.78**
	26.7	19.4	3.0	23.3	-3.4	42.8	22.3	13,310	55.5	63.3	3.0		4.5	**56.0**	**4.21**
	32.2	24.1	3.0	28.2	-4.0	50.5	22.9	13,774	54.9	63.4	3.0		5.1	**64.2**	**4.66**
	10.0	5.8	3.0	8.4	-1.6	20.6	22.9	14,659	68.3	74.1	3.0	71	2.8	**35.1**	**2.40**
	15.6	10.6	3.0	13.7	-1.9	25.0	23.4	14,968	67.9	74.2	3.0		3.2	**39.8**	**2.66**
	21.1	15.4	3.0	18.7	-2.4	29.9	23.9	15,317	67.5	74.4	3.0		3.6	**45.1**	**2.94**
	26.7	20.2	3.0	23.9	-2.8	35.6	24.4	15,696	67.0	74.6	3.0		4.1	**51.1**	**3.26**
	32.2	25.1	3.0	28.9	-3.3	42.1	25.0	16,146	66.4	74.8	3.0		4.7	**58.1**	**3.60**

	ELT (°C)	Cond. Temp.	Flow (L/s)	LLT (°C)	Delta T (°C)	Heat Rej. (W)	Compressor Current (A)†	Input Power (W)	EWT (°C)	Evap. Temp.	Flow (L/s)	LWT (°C)	Delta T (°C)	**Cooling (W)**	**COP_C**
COOLING*	10.0	23	3.0	13.4	3.4	**43.4**	13.3	5,527	12.0	2	3.0	9.0	-3.0	38.0	**6.89**
	12.8	26	3.0	16.2	3.4	**43.1**	14.0	6,011		2	3.0	9.1	-2.9	37.3	**6.18**
	15.6	29	3.0	19.0	3.4	**42.7**	14.7	6,521		2	3.0	9.1	-2.9	36.4	**5.57**
	18.3	32	3.0	21.6	3.3	**42.4**	15.4	7,049		3	3.0	9.2	-2.8	35.5	**5.04**
	21.1	35	3.0	24.4	3.3	**42.0**	16.1	7,611		3	3.0	9.3	-2.7	34.5	**4.54**
	23.9	38	3.0	27.2	3.3	**41.6**	16.9	8,200		3	3.0	9.3	-2.7	33.6	**4.10**
	26.7	41	3.0	30.0	3.3	**41.2**	17.8	8,835		4	3.0	9.4	-2.6	32.5	**3.69**
	29.4	44	3.0	32.6	3.2	**40.9**	18.7	9,504		4	3.0	9.5	-2.5	31.5	**3.31**
	32.2	46	3.0	35.4	3.2	**40.4**	19.7	10,230		4	3.0	9.6	-2.4	30.4	**2.96**
	35.0	49	3.0	38.2	3.2	**40.2**	20.7	11,002		5	3.0	9.7	-2.3	29.3	**2.67**

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Performance Tables - WH-Series

WH-235-H**-Y-*S-P*

R513a, 60 Hz, ZH101KCE-TED (460-3-60)

* *Cooling via reversing models (-HAC), or switching indoor/outdoor*
** *Lower cooling mode outdoor loop ELT's may require flow control*
† *Compressor current is for 460-3-60. [Multiply by 0.8 for 575-3-60.]*

	OUTDOOR LOOP *(Water)*						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	50	40	60	46	-4.2	124,900	20.8	13,366	114	126	60		5.7	**169,800**	**3.72**
	60	48	60	55	-5.0	151,500	21.4	13,824	113	126	60		6.6	**197,900**	**4.20**
	70	57	60	64	-6.1	182,400	22.1	14,323	112	126	60	120	7.7	**230,500**	**4.72**
	80	65	60	73	-7.3	218,000	22.8	14,878	111	126	60		9.0	**268,000**	**5.28**
	90	74	60	81	-8.7	259,000	23.7	15,509	110	127	60		10.5	**311,200**	**5.88**
	50	41	60	46	-3.7	110,200	23.2	15,739	135	145	60		5.5	**163,200**	**3.04**
	60	50	60	56	-4.4	133,000	23.8	16,199	134	146	60		6.3	**187,500**	**3.39**
	70	58	60	65	-5.3	159,100	24.5	16,658	133	146	60	140	7.3	**215,200**	**3.79**
	80	67	60	74	-6.3	189,100	25.2	17,170	132	146	60		8.3	**247,000**	**4.22**
	90	75	60	83	-7.5	223,100	25.9	17,714	130	146	60		9.6	**282,800**	**4.68**
	50	42	60	47	-3.0	90,000	27.2	19,129	155	165	60		5.2	**154,500**	**2.37**
	60	51	60	56	-3.6	109,200	27.8	19,599	154	166	60		5.9	**175,300**	**2.62**
	70	60	60	66	-4.4	131,000	28.5	20,088	153	166	60	160	6.7	**198,800**	**2.90**
	80	68	60	75	-5.2	155,900	29.1	20,568	152	166	60		7.6	**225,300**	**3.21**
	90	77	60	84	-6.2	184,700	29.8	21,079	151	167	60		8.7	**255,900**	**3.56**

	ELT (°F)	Cond. Temp.	Flow (gpm)	LLT (°F)	Delta T (°F)	Heat Rej. (Btu/hr)	Compressor Current (A)†	Input Power (W)	EWT (°F)	Evap. Temp.	Flow (gpm)	LWT (°F)	Delta T (°F)	**Cooling (Btu/hr)**	**EER**
COOLING*	50	74	60	57	6.5	**195,600**	14.1	7,377		35	60	48	-5.7	171,400	**23.2**
	55	79	60	62	6.5	**194,000**	14.9	7,983		36	60	48	-5.6	167,700	**21.0**
	60	84	60	66	6.4	**192,100**	15.7	8,638		37	60	48	-5.5	163,500	**18.9**
	65	89	60	71	6.4	**190,600**	16.6	9,332		37	60	48	-5.3	159,600	**17.1**
	70	95	60	76	6.3	**188,900**	17.6	10,087	54	38	60	48	-5.2	155,300	**15.4**
	75	100	60	81	6.3	**187,600**	18.6	10,891		38	60	49	-5.1	151,200	**13.9**
	80	105	60	86	6.2	**186,100**	19.7	11,768		39	60	49	-4.9	146,600	**12.5**
	85	110	60	91	6.2	**185,000**	20.9	12,705		39	60	49	-4.8	142,300	**11.2**
	90	116	60	96	6.2	**183,800**	22.2	13,730		40	60	49	-4.6	137,500	**10.0**
	95	121	60	101	6.1	**182,900**	23.6	14,827		40	60	49	-4.4	132,900	**9.0**

METRIC

	OUTDOOR LOOP *(Water)*						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	10.0	4.3	3.8	7.7	-2.3	36.6	20.8	13,366	45.7	51.9	3.8		3.2	**49.8**	**3.72**
	15.6	9.1	3.8	12.8	-2.8	44.4	21.4	13,824	45.2	52.1	3.8		3.7	**58.0**	**4.20**
	21.1	13.8	3.8	17.7	-3.4	53.5	22.1	14,323	44.6	52.3	3.8	49	4.3	**67.6**	**4.72**
	26.7	18.5	3.8	22.6	-4.1	63.9	22.8	14,878	43.9	52.4	3.8		5.0	**78.5**	**5.28**
	32.2	23.2	3.8	27.4	-4.8	75.9	23.7	15,509	43.1	52.6	3.8		5.8	**91.2**	**5.88**
	10.0	5.1	3.8	7.9	-2.1	32.3	23.2	15,739	56.9	62.9	3.8		3.1	**47.8**	**3.04**
	15.6	9.8	3.8	13.2	-2.4	39.0	23.8	16,199	56.5	63.1	3.8		3.5	**55.0**	**3.39**
	21.1	14.6	3.8	18.2	-2.9	46.6	24.5	16,658	55.9	63.2	3.8	60	4.1	**63.1**	**3.79**
	26.7	19.3	3.8	23.2	-3.5	55.4	25.2	17,170	55.4	63.3	3.8		4.6	**72.4**	**4.22**
	32.2	24.1	3.8	28.0	-4.2	65.4	25.9	17,714	54.7	63.4	3.8		5.3	**82.9**	**4.68**
	10.0	5.7	3.8	8.3	-1.7	26.4	27.2	19,129	68.2	74.1	3.8		2.9	**45.3**	**2.37**
	15.6	10.6	3.8	13.6	-2.0	32.0	27.8	19,599	67.8	74.3	3.8		3.3	**51.4**	**2.62**
	21.1	15.4	3.8	18.7	-2.4	38.4	28.5	20,088	67.4	74.5	3.8	71	3.7	**58.3**	**2.90**
	26.7	20.2	3.8	23.8	-2.9	45.7	29.1	20,568	66.9	74.7	3.8		4.2	**66.0**	**3.21**
	32.2	25.0	3.8	28.8	-3.4	54.1	29.8	21,079	66.3	74.8	3.8		4.8	**75.0**	**3.56**

	ELT (°C)	Cond. Temp.	Flow (L/s)	LLT (°C)	Delta T (°C)	Heat Rej. (W)	Compressor Current (A)†	Input Power (W)	EWT (°C)	Evap. Temp.	Flow (L/s)	LWT (°C)	Delta T (°C)	**Cooling (W)**	**COP$_C$**
COOLING*	10.0	23	3.8	13.6	3.6	**57.3**	14.1	7,377		2	3.8	8.8	-3.2	50.2	**6.80**
	12.8	26	3.8	16.4	3.6	**56.9**	14.9	7,983		2	3.8	8.9	-3.1	49.2	**6.15**
	15.6	29	3.8	19.2	3.6	**56.3**	15.7	8,638		3	3.8	8.9	-3.1	47.9	**5.54**
	18.3	32	3.8	21.9	3.6	**55.9**	16.6	9,332		3	3.8	9.1	-2.9	46.8	**5.01**
	21.1	35	3.8	24.6	3.5	**55.4**	17.6	10,087	12.0	3	3.8	9.1	-2.9	45.5	**4.51**
	23.9	38	3.8	27.4	3.5	**55.0**	18.6	10,891		3	3.8	9.2	-2.8	44.3	**4.07**
	26.7	41	3.8	30.1	3.4	**54.5**	19.7	11,768		4	3.8	9.3	-2.7	43.0	**3.66**
	29.4	43	3.8	32.8	3.4	**54.2**	20.9	12,705		4	3.8	9.3	-2.7	41.7	**3.28**
	32.2	46	3.8	35.6	3.4	**53.9**	22.2	13,730		4	3.8	9.4	-2.6	40.3	**2.93**
	35.0	49	3.8	38.4	3.4	**53.6**	23.6	14,827		5	3.8	9.6	-2.4	39.0	**2.64**

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Electrical Specifications

Table 30 - W-Series (R454b) Electrical Specifications										
	Nomenclature Identifier	Power Supply			Compressor		FLA	MCA	Maximum Fuse/Breaker	Minimum Wire Size
		V-ø-Hz	MIN	MAX	RLA	LRA	Amps	Amps	Amps	ga
W-100	2	208-3-60	187	229	28.5	255	29.4	36.5	60	#6-3
	4	460-3-60	414	506	13.5	123	14.4	17.8	30	#10-3
	5	575-3-60	518	632	10.7	94	11.6	14.3	20	#12-3
W-120	2	208-3-60	187	229	40.4	217	40.9	51.0	80	#4-3
	4	460-3-60	414	506	21.2	122	21.7	27.0	40	#8-3
	5	575-3-60	518	632	15.4	97	15.9	19.8	30	#10-3
W-140	2	208-3-60	187	229	44.2	252	44.7	55.8	100	#3-3
	4	460-3-60	414	506	22.6	137	23.1	28.8	50	#8-3
	5	575-3-60	518	632	19.2	103	19.7	24.5	40	#8-3
W-180	2	208-3-60	187	229	57.7	330	58.2	72.6	125	#2-3
	4	460-3-60	414	506	26.9	180	27.4	34.1	60	#6-3
	5	575-3-60	518	632	21.5	132	22.0	27.4	50	#8-3
W-235	4	460-3-60	414	506	32.1	211	32.6	40.6	60	#6-3
	5	575-3-60	518	632	27.8	162	28.3	35.3	60	#6-3

Table 31 - WH-Series (R513a) Electrical Specifications										
	Nomenclature Identifier	Power Supply			Compressor		FLA	MCA	Maximum Fuse/Breaker	Minimum Wire Size
		V-ø-Hz	MIN	MAX	RLA	LRA	Amps	Amps	Amps	ga
WH-100	2	208-3-60	187	229	29.5	195	30.4	37.8	60	#6-3
	4	460-3-60	414	506	13.1	95	14.0	17.3	30	#10-3
	5	575-3-60	518	632	12.5	80	13.4	16.5	30	#10-3
WH-120	2	208-3-60	187	229	37.2	239	37.7	47.0	80	#4-3
	4	460-3-60	414	506	20.1	125	20.6	25.6	40	#8-3
	5	575-3-60	518	632	12.8	80	13.3	16.5	30	#10-3
WH-140	2	208-3-60	187	229	57.1	300	57.6	71.9	125	#2-3
	4	460-3-60	414	506	23.7	150	24.2	30.1	50	#8-3
	5	575-3-60	518	632	20.5	109	21.0	26.1	40	#8-3
WH-180	2	208-3-60	187	229	64.2	340	64.7	80.8	125	#2-3
	4	460-3-60	414	506	28.6	179	29.1	36.3	60	#6-3
	5	575-3-60	518	632	25.8	132	26.3	32.8	50	#8-3
WH-235	4	460-3-60	414	506	34.9	225	35.4	44.1	60	#6-3
	5	575-3-60	518	632	28.7	180	29.2	36.4	60	#6-3

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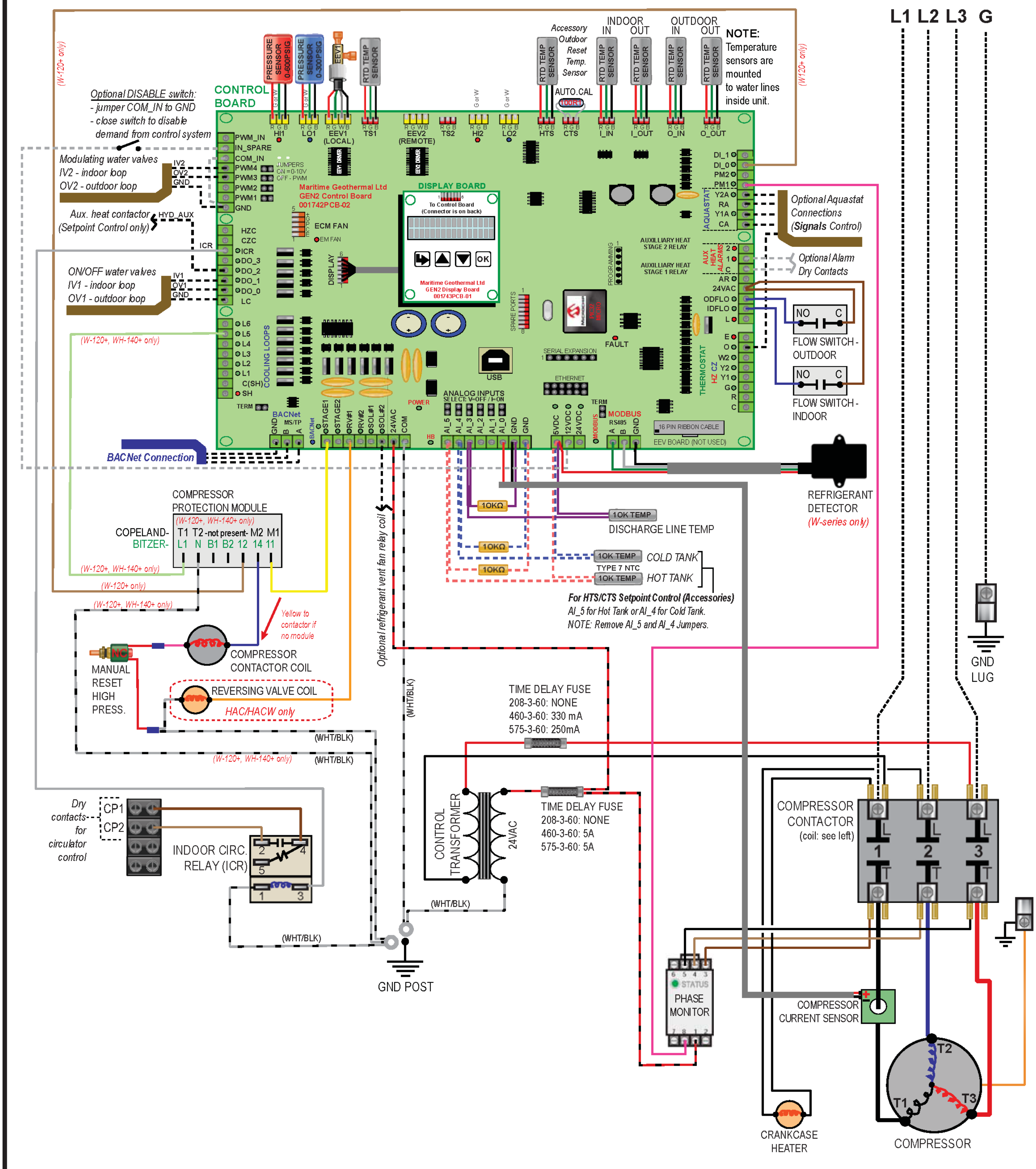
W/WH-Commercial Schematic Diagram - Single Circuit / Single Compressor (-H/HAC)



Drawn By	Date
D. RHEAULT	23-SEP-2024
Checked By: D. RHEAULT	Date: 23-SEP-2024
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: W/WH-Single Compressor Schematic Diagram (-H/HAC)

Size	Drawing Number	Drawing Rev	Sheet
LET	002753SCH	01	1 / 1

REV	ECO#	IMPL BY	APVD BY	DATE
01	Initial Release	D. RHEAULT	D. RHEAULT	23-SEP-2024

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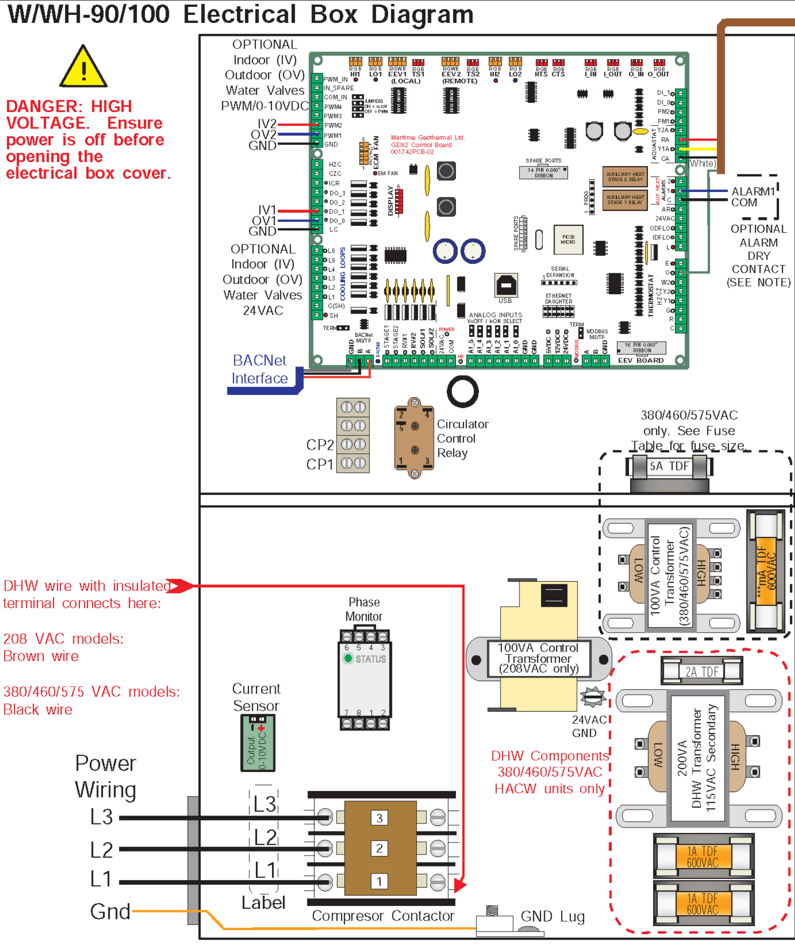
W/WH-100 Electrical Box Layout

W/WH-90/100 Electrical Box Diagram

Scroll / Reversing / BACNet Interface
Optional Domestic Hot Water



CONTROL CONNECTIONS (HARD WIRED / SIGNALS OPTION)
RA(24VAC)
Y1A(Compressor #1)
CA(Common)
O(Cooling)

POWER SUPPLY CONNECTIONS	
Wire	Compressor Contactor
Line 3	L3
Line 2	L2
Line 1	L1
Connect "Gnd" to Gnd. Lug	

FUSE TABLE ***	
Supply Voltage	Fuse Value*
208-3-60	--------
460-3-60	330mA
575-3-60	250mA
380-3-50	500mA

*Value is marked in electrical box.

IMPORTANT NOTE FOR 3 PHASE SCROLL COMPRESSORS
This unit is quipped with a scroll compressor which must rotate in the proper direction. After the initial connection, if the phase protection module(s) indicate a fault on power up, turn the power off and reverse the L1 and L2 supply leads. Turn the power on and clear the fault(s).

DANGER: HIGH VOLTAGE. Ensure power is off before opening the electrical box cover.

NOTE: Control of the unit is done **either** via the BACNet interface, Setpoint Control or low voltage wiring.

BACNet Interface (MS/TP) (RS-485)

Use twisted pair shielded conductor cable.
A - Communication
B - Communication
GND - Ground

NOTE: There is a 5 minute anti-short cycle timer for the compressor.

NOTE: CP1 and CP2 provide a dry contact that can be used as a control signal to turn on circulator pumps when the compressor starts. **MAX 5amps @ 24VAC**

Low Voltage Wiring (24VAC)

Use an 18-5 conductor cable.
C - 24VAC Common
R - 24VAC Hot
Y1A - Stage 1 (Compressor#1)
O - Heating/Cooling Mode (active for cooling mode)

A dry contact from **R** to **Y1** will start compressor.

A dry contact from **R** to **O** will activate cooling mode.

NOTE: 24VAC is present across OV1 and GND in heating mode (IV1 and GND in cooling mode) to power an external water valve when either compressor starts. **MAX 1amp @ 24VAC**

NOTE: Alarm1 signals are dry contacts (NO), max 1A@24VAC each. Connect the signal source to COM. Alarm1 relay will be energized when a permanent alarm occurs.

DHW NOTE: If the heat pump is to be operated without the hot water circulator connected to the water tank and flooded with water, remove the brown (or light brown) wire with the insulated terminal from the location(s) shown in the diagram above. **The pump is water lubricated and must not be run dry.**

REV	ECO #	IMPL BY	APVD BY	DATE
01	ISSUE 02	D. RHEAULT	D. RHEAULT	1 APR 2022
01	000226 (IR)	C. GEDDES	C. GEDDES	14 NOV 2014

Drawn By: Chris Geddes	Date: 14 NOV 2014
Checked By: Chris Geddes	Date: 14 NOV 2014
Approved By (ENG): Chris Geddes	Date: 14 NOV 2014
Approved By (MFG)	Date
Approved By	Date

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

Drawing Name			
W/WH-90/100-H***-*-*S-** Electrical Box Diagram			
Size	Drawing Number	Drawing Rev	Sheet
A	001904ELB	01(i2)	1 of 1

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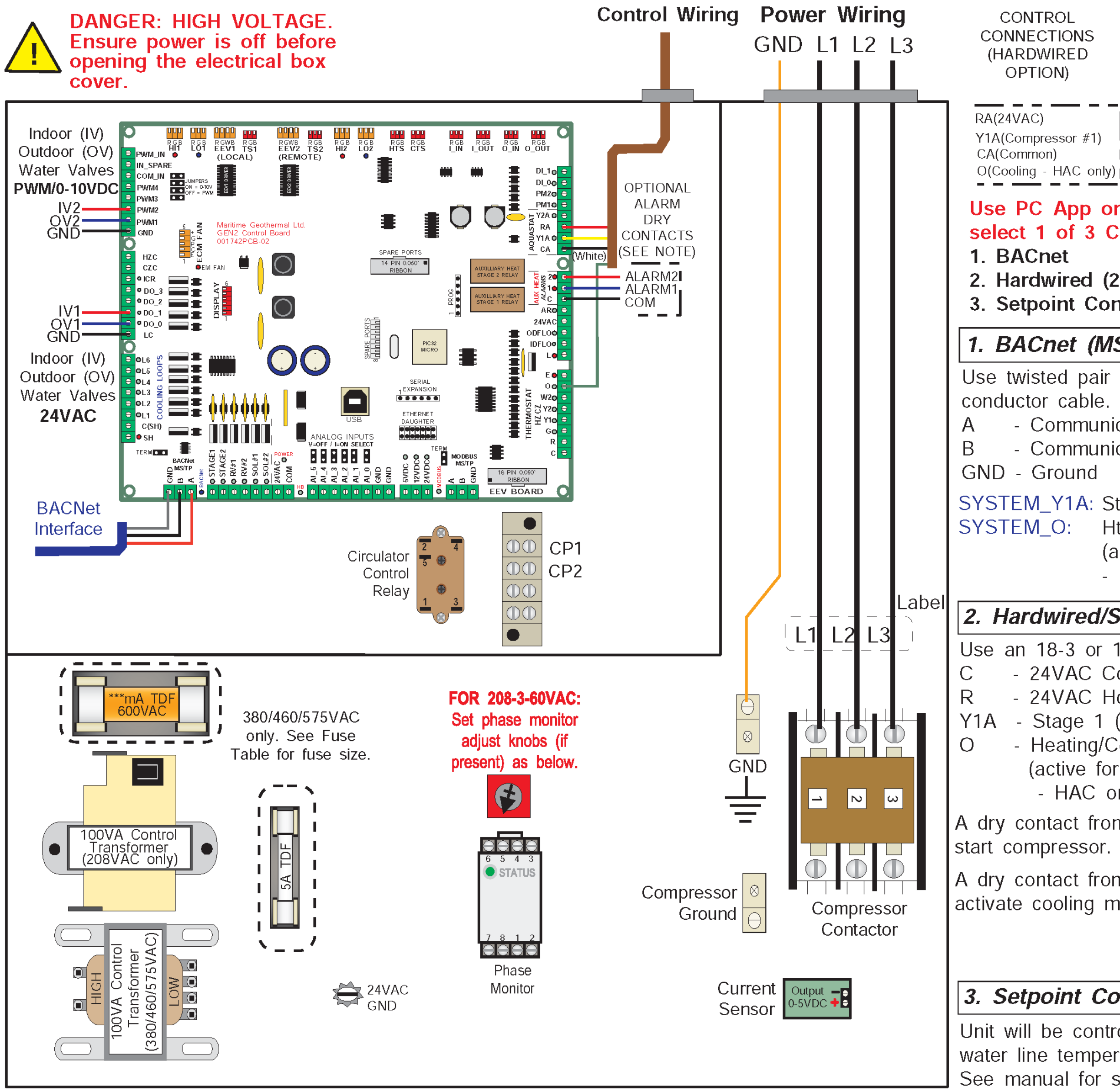
W/WH-120/140/180/235 Electrical Box Layout

W/WH Commercial Single Compressor Electrical Box Diagram

FUSE TABLE ***	
Supply Voltage	Fuse Value*
208-3-60	--------
460-3-60	330mA
575-3-60	250mA
380-3-50	500mA

*Value is marked in electrical box.



Use PC App or LCD menus to select 1 of 3 Control Methods:
1. BACnet
2. Hardwired (24VAC signals)
3. Setpoint Control (internal)

1. BACnet (MS/TP RS-485)

Use twisted pair shielded-conductor cable.
- A - Communication
- B - Communication
- GND - Ground

SYSTEM_Y1A: Stage 1 (compr.1)
SYSTEM_O: Htg/Cooling Mode (active in cooling - HAC only)

2. Hardwired/Signals (24VAC)

Use an 18-3 or 18-4 cable.
- C - 24VAC Common
- R - 24VAC Hot
- Y1A - Stage 1 (Compressor 1)
- O - Heating/Cooling Mode (active for cooling mode - HAC only)

A dry contact from **R** to **Y1A** will start compressor.

A dry contact from **R** to **O** will activate cooling mode (HAC only)

3. Setpoint Control

Unit will be controlled by internal water line temperature sensors. See manual for setup instructions.

IMPORTANT NOTES:

- **3 PHASE SCROLL COMPRESSORS** must rotate in the proper direction. After the initial connection, if the phase protection module(s) indicate a fault on power up, turn the power off and reverse the L1 and L2 supply leads. Turn the power on and clear the fault(s).

- **IMPORTANT:** Ensure sufficient antifreeze concentration is used and correctly set in control board via the PC App, so that the correct low pressure cutout value is implemented to prevent freezing conditions. Failure to do so could cause the heat exchanger to freeze and rupture, voiding the warranty.

- **Anti-short cycle timer** of 6 minutes.
- **Alarm1** signal is dry contacts (NO). Connect the signal source to COM. MAX 1amp @ 24VAC

- **CP1 and CP2** are a dry contact that can be used to turn on circulator pumps when either compressor starts. In Setpoint Control mode, it is indoor circulators only (sampling). MAX 5amps @ 24VAC

- **Water Valve:** 24VAC is present across OV1/IV1 and GND to power an external ON/OFF water valve when either compressor starts. Modulating water valves can be connected between OV2/IV2 and GND. MAX 1amp @ 24VAC

REV	ECO #	IMPL BY	APVD BY	DATE
01	ISSUE 02	D. RHEAULT	D. RHEAULT	15-Mar-2022
01	Initial Release	C. GEDDES	C. GEDDES	28-JUN-2019

Drawn By: Chris Geddes	Date: 28-JUN-2019
Checked By: Chris Geddes	Date: 28-JUN-2019
Approved By (ENG): Chris Geddes	Date: 28-JUN-2019
Approved By (MFG)	Date
Approved By	Date

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

Drawing Name: W~WH-Commercial Single Compressor Electrical Box Diagram

Size	Drawing Number	Drawing Rev	SHEET
A	002400ELB	01(i2)	1 of 1

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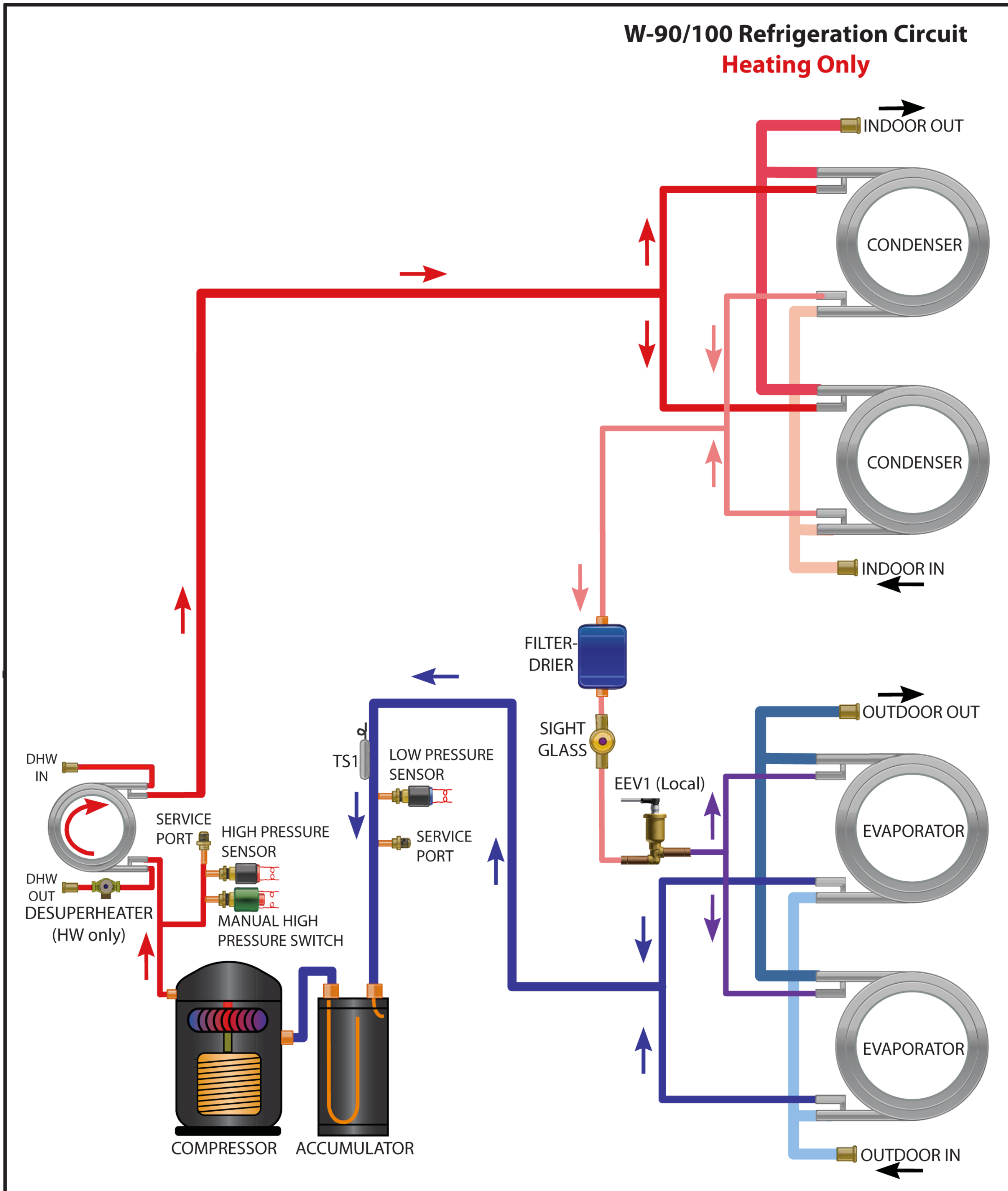
W/WH-100 Refrigeration Circuit Diagram: H/HW Models



REV	ECO#	IMPL BY	APVD BY	DATE
02	000226	C. GEDDES	C. GEDDES	15 NOV 2014
01	Initial Release	C. GEDDES	C. GEDDES	04 MAY 2009

Drawn By C.GEDDES — Date 04 MAY 2014
Checked By C.GEDDES — Date 04 MAY 2014
Eng. Approved By C.GEDDES — Date 04 MAY 2014
Mfg. Approved By — Date
Approved By — Date

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

Drawing Name
W-90/100 EEV Refrigeration Circuit
Heating Only

Size LET | Drawing Number 000995RCD | Drawing Revision 02 | Sheet 1 / 1

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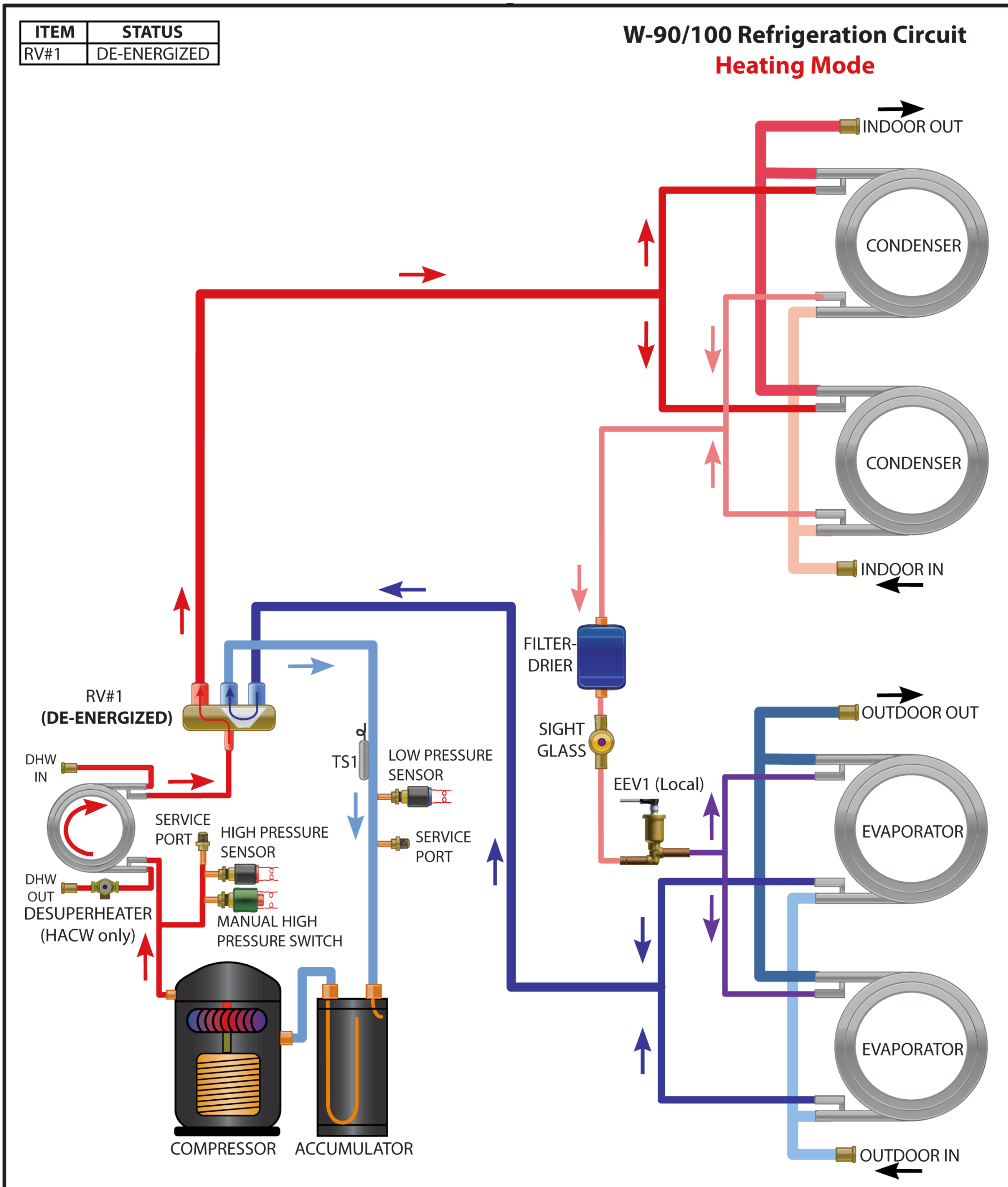
W/WH-100 Refrigeration Circuit Diagram: HAC/HACW Models



REV	ECO#	IMPL BY	APVD BY	DATE
02	000226	C. GEDDES	C. GEDDES	15 NOV 2014
01	Initial Release	C. GEDDES	C. GEDDES	04 MAY 2009

Drawn By C.GEDDES	Date 04 MAY 2014
Checked By C.GEDDES	Date 04 MAY 2014
Eng. Approved By C.GEDDES	Date 04 MAY 2014
Mfg. Approved By	Date
Approved By	Date

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

Drawing Name: W-90/100 EEV Refrigeration Circuit Heating Mode

Size	Drawing Number	Drawing Revision	Sheet
LET	000992RCD	02	1 / 1

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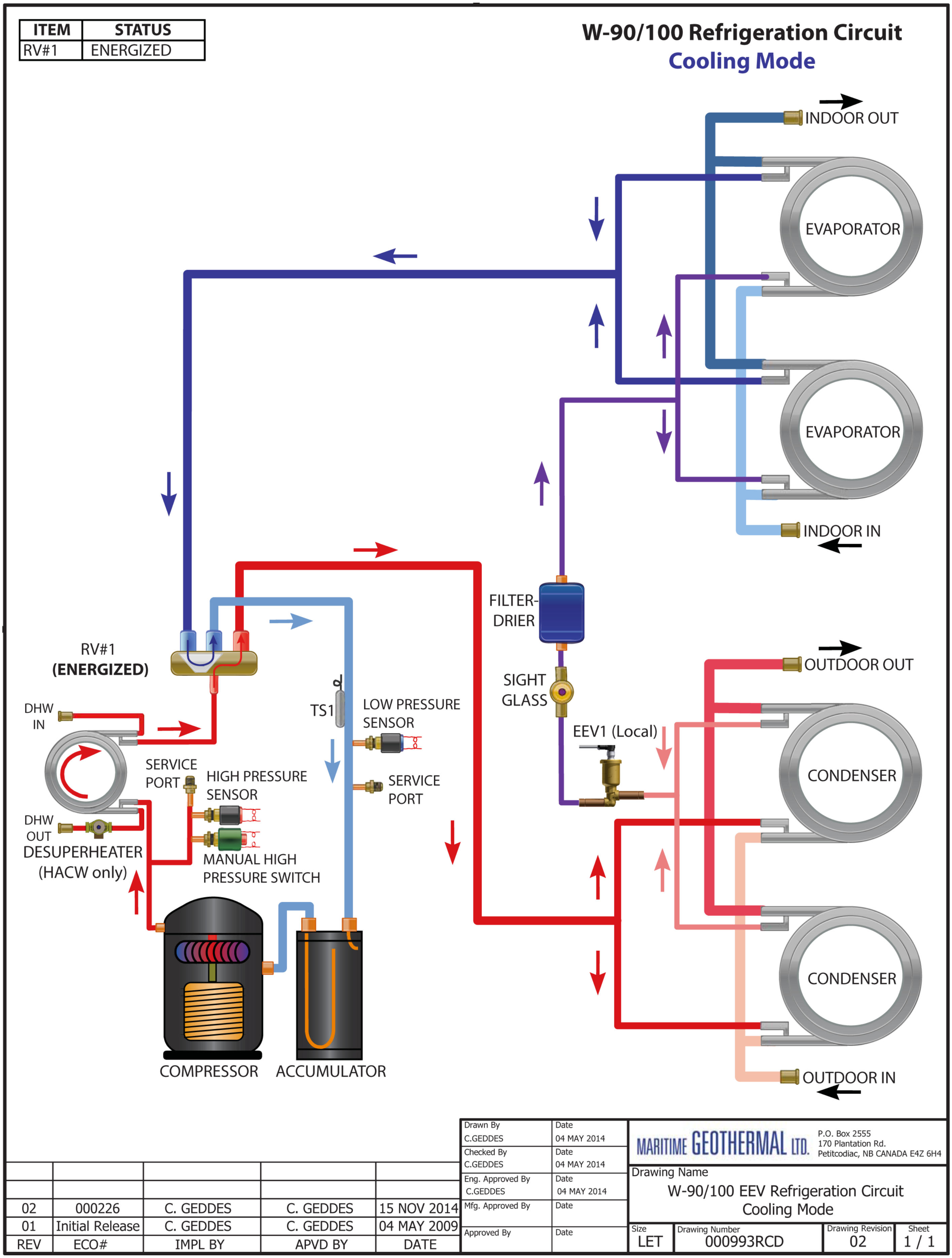
W/WH-100 Refrigeration Circuit Diagram: HAC/HACW Models



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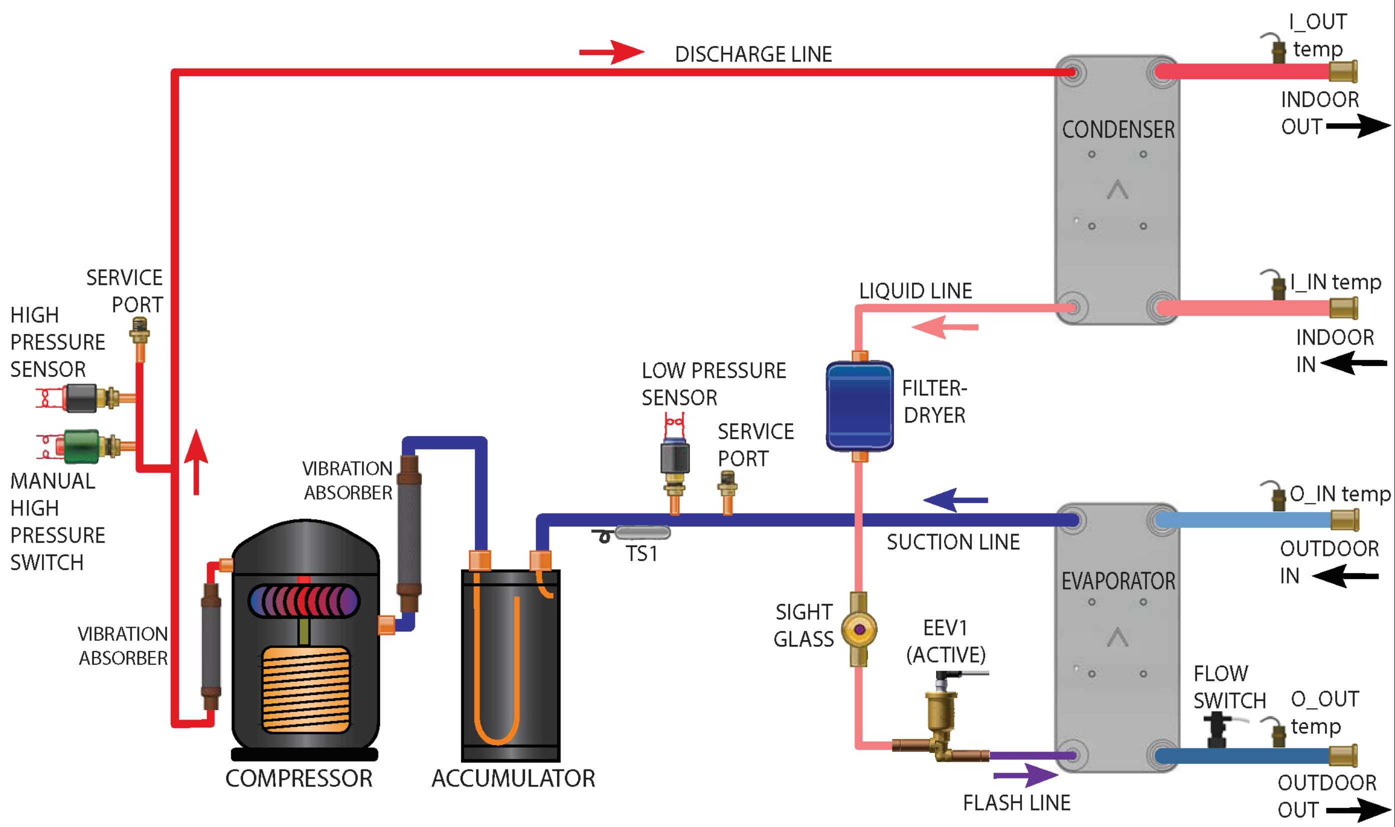
W/WH-120/140/180/235 Refrigeration Circuit Diagram: H/HW Models

W/WH-H Heating Mode



REV	ECO#	IMPL BY	APVD BY	DATE
01	ISSUE 02	D. RHEAULT	D. RHEAULT	19-JUN-2023
01	Initial Release	D. RHEAULT	D. RHEAULT	15-JUL-2019

Drawn By: D. RHEAULT	Date: 15-JUL-2019
Checked By: D. RHEAULT	Date: 15-JUL-2019
Eng. Approved By: D. RHEAULT	Date: 15-JUL-2019
Mfg. Approved By	Date
Approved By	Date

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

Drawing Name: W/WH-H Refrigeration Circuit (Single Compressor, Brazed Plates, Non-Reversing)

Size	Drawing Number	Drawing Revision	Sheet
LET	002403RCD	01(i2)	1 / 1

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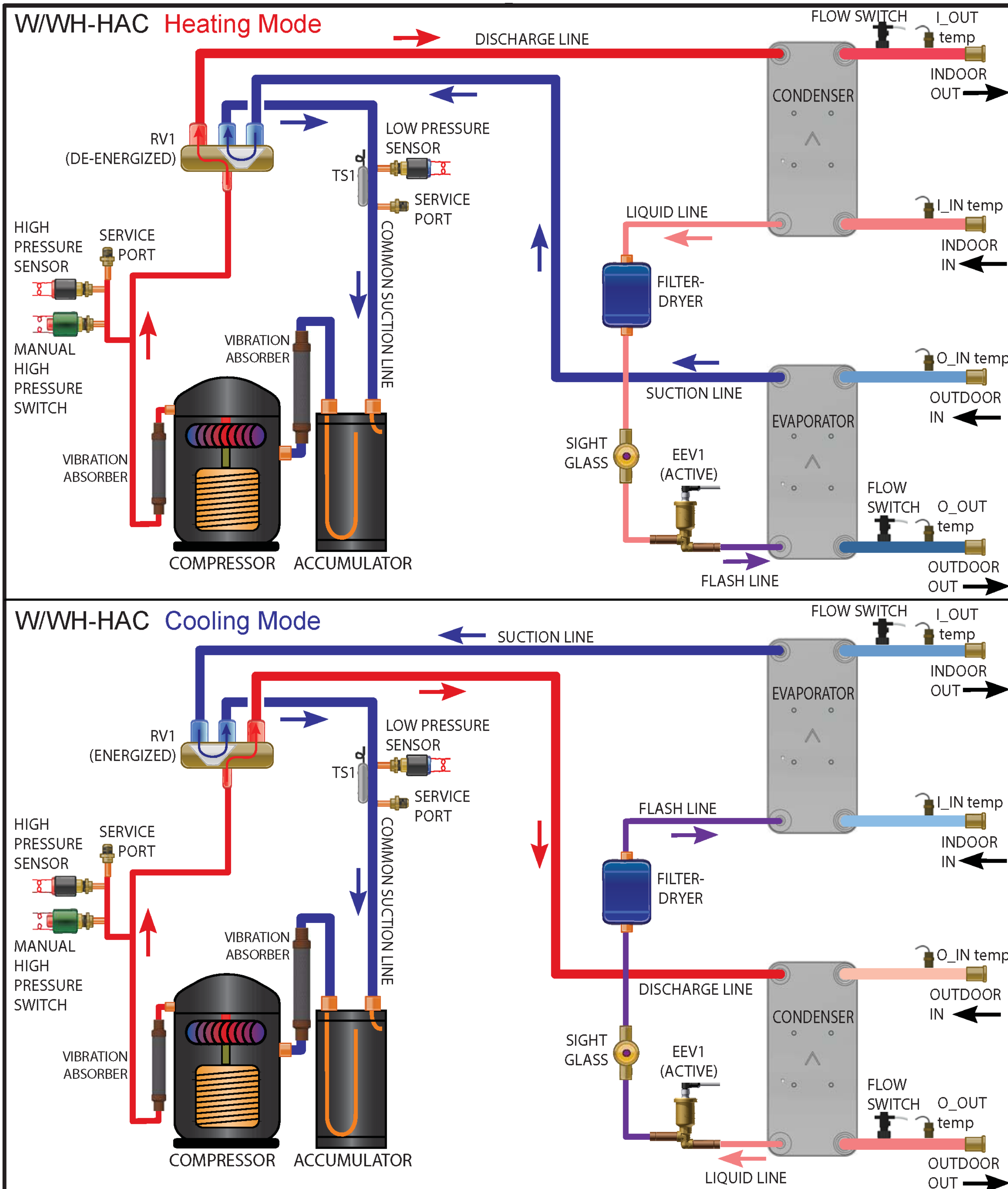
W/WH-120/140/180/235 Refrigeration Circuit Diagram: HAC/HACW Models



REV	ECO#	IMPL BY	APVD BY	DATE
01	Initial Release	D. RHEAULT	D. RHEAULT	19-JUN-2023

Drawn By	Dan Rheault	Date 19-JUN-2023
Checked By	Dan Rheault	Date 19-JUN-2023
Eng. Approved By	Dan Rheault	Date 19-JUN-2023
Mfg. Approved By		Date
Approved By		Date

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

Drawing Name: W/WH-HAC Refrigeration Circuit (Single Compressor, Brazed Plates, Reversing)

Size	Drawing Number	Drawing Revision	Sheet
LET	002644RCD	01	1 / 1

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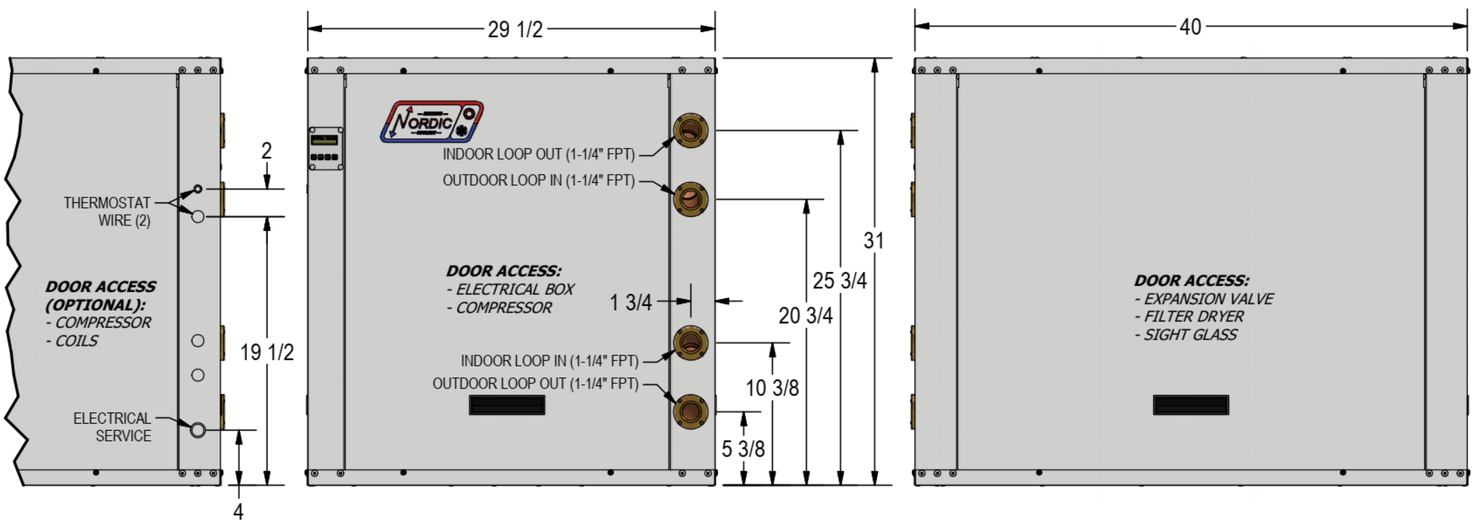
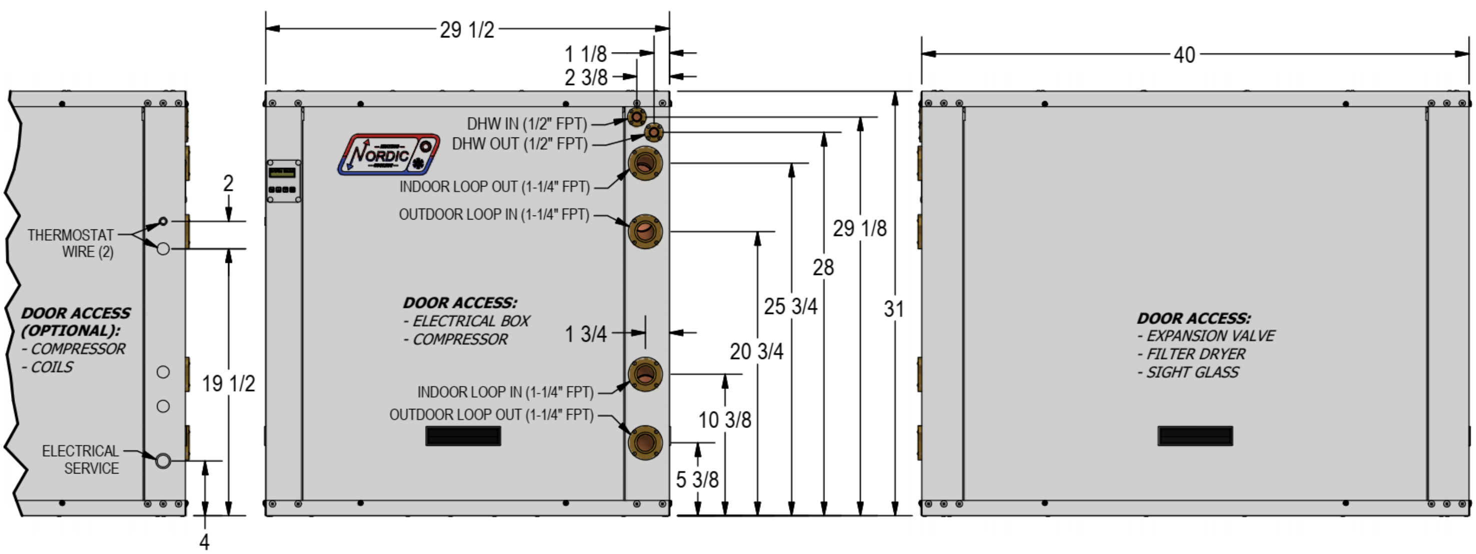
Dimensions: W/WH-100-H/HAC

All dimensions in inches.



Dimensions: W/WH-100-HW/HACW (with desuperheater)



LEFT SIDE CLEARANCE OPTIONAL

RECOMMENDED FRONT CLEARANCE: **3 FT**

RECOMMENDED RIGHT SIDE CLEARANCE: **3 FT**

NO BACK SIDE CLEARANCE REQUIRED

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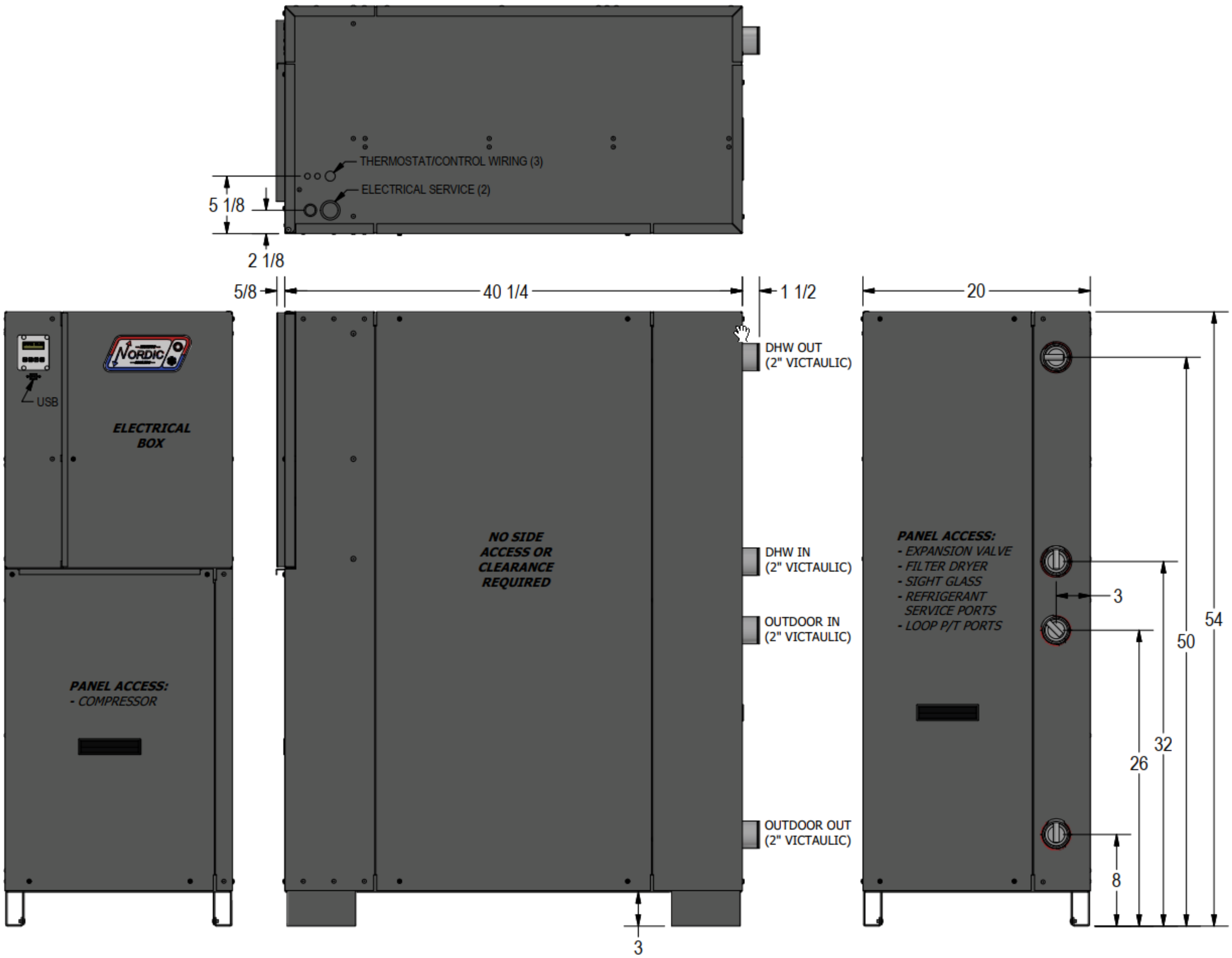
Dimensions: W-120/140/180/235 WH-120/140/180

All dimensions in inches.



RECOMMENDED FRONT CLEARANCE:
3 FT

NO SIDE CLEARANCE REQUIRED

RECOMMENDED RIGHT SIDE CLEARANCE:
3 FT + HEADERS

Double wall condenser option ("**-PD**") for direct DHW heating shown.

For single wall space heating models ("**-PP**"), DHW IN/OUT connections shown above become indoor closed loop connections.

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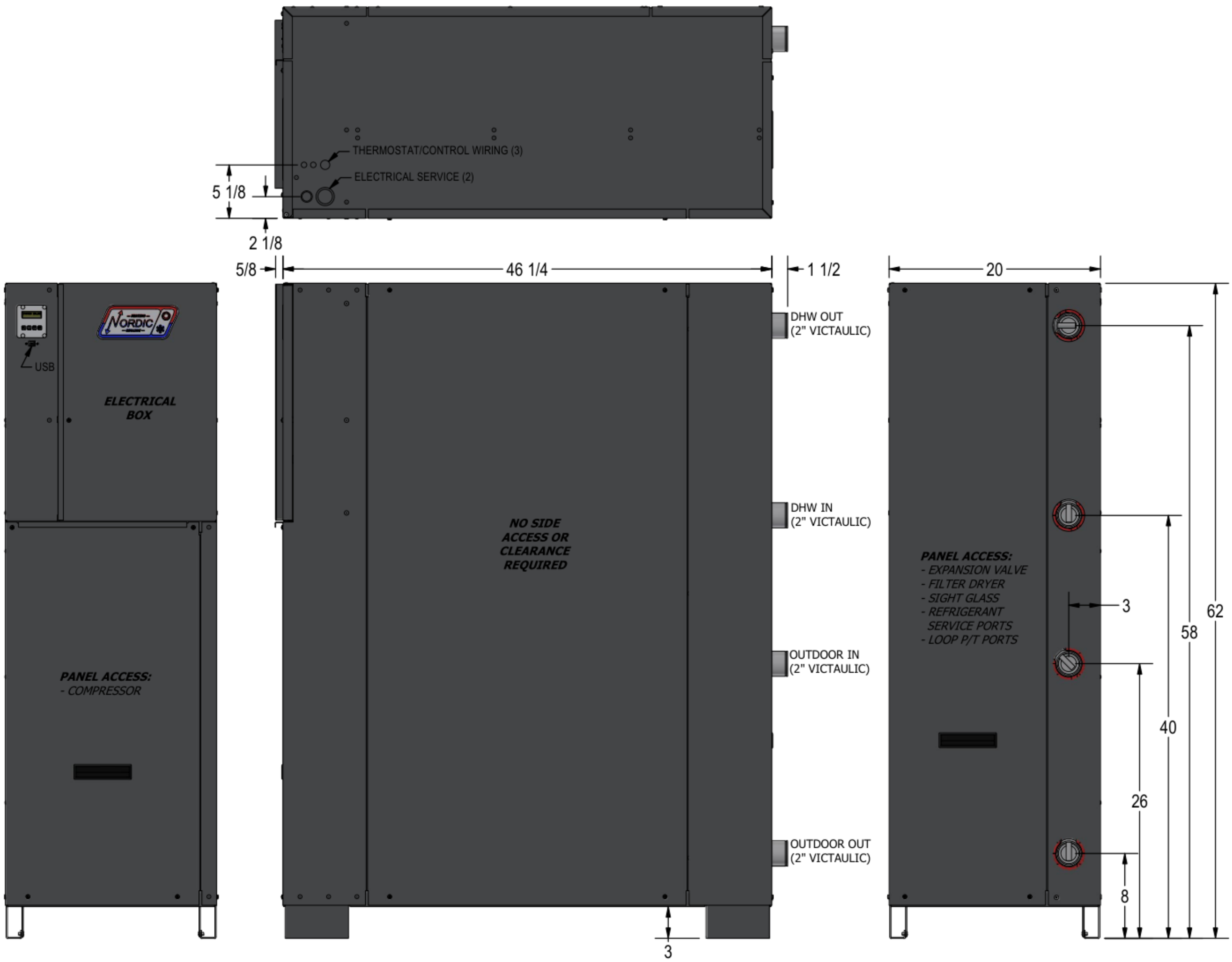
Dimensions: WH-235

All dimensions in inches.

NOTE: *Dimensions for **WH-235** are larger than other single compressor models in this series (W-120/140/180/235 and WH-120/140/180).*



RECOMMENDED FRONT CLEARANCE:
3 FT

NO SIDE CLEARANCE REQUIRED

RECOMMENDED BACK CLEARANCE:
3 FT + HEADERS

Double wall condenser option ("**-PD**") for direct DHW heating shown.

For single wall space heating models ("**-PP**"), DHW IN/OUT connections shown above become indoor closed loop connections.

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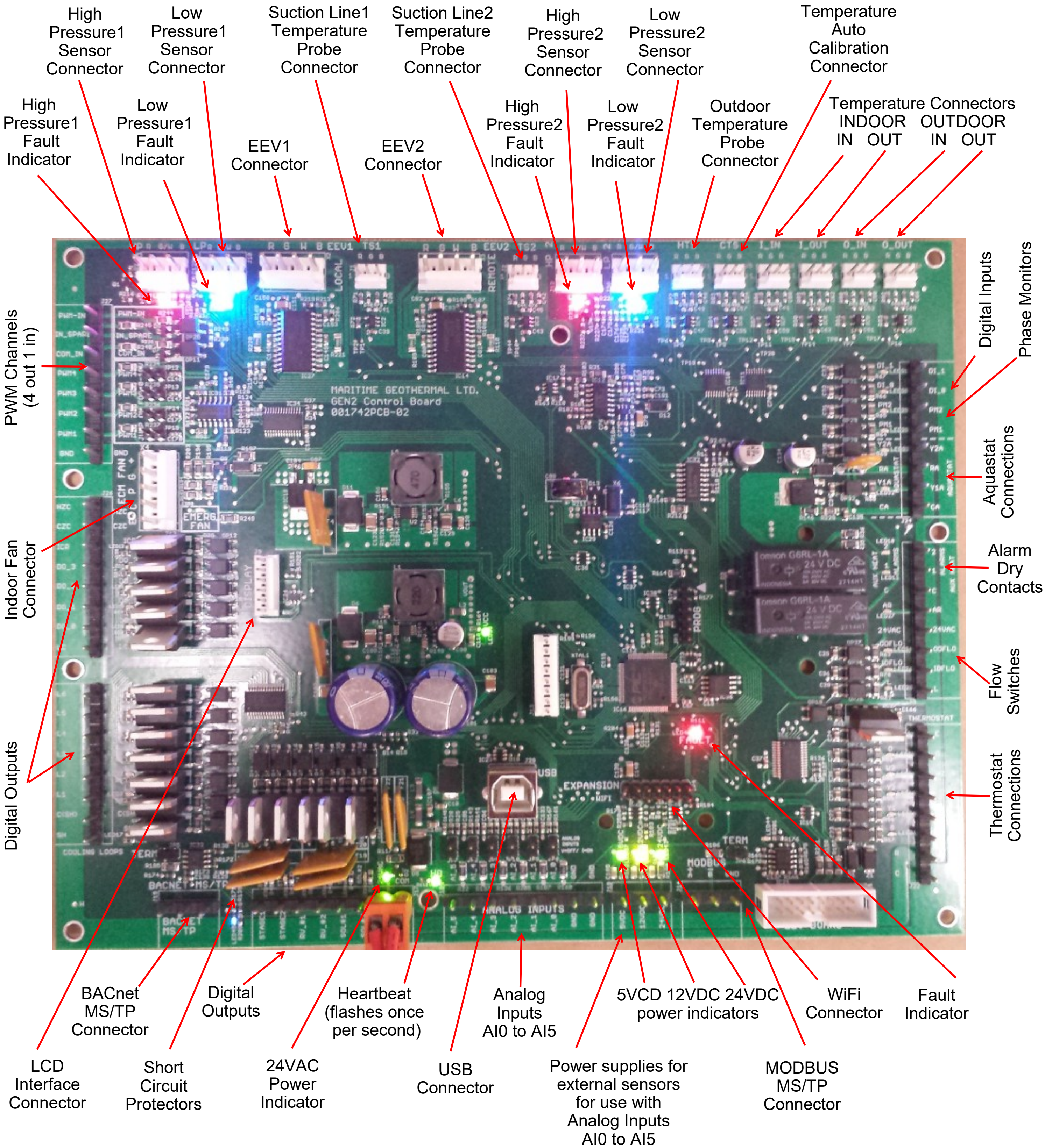
Appendix A - GEN2 Control Board Description

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.



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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 compressor discharge pressure
LPS1/LO1	Low Pressure Sensor 1	Measures compressor 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/ODTS	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	Temperature sensor mounted to pipe inside unit
I_OUT	Indoor Loop OUT	Temperature sensor mounted to pipe inside unit
O_IN	Outdoor Loop IN	Temperature sensor mounted to pipe inside unit
O_OUT	Outdoor Loop OUT	Temperature sensor 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 jumper COM_IN to GND)
COM_IN	Common for PWM IN	Jumper to GND for disable functionality
PWM4	IV2	Control of 0-10VDC modulating water valve for indoor loop
PWM3	OV2	Control of 0-10VDC modulating water valve for outdoor loop
PWM2	PWM / 0-10VDC output	Not used.
PWM1	PWM / 0-10VDC output	Not used.
GND	Ground	Jumper to COM_IN for disable functionality
HZC	Hot Zone Circulator	Not used.
CZC	Cold Zone Circulator	Not used.
ICR	Internal Circulator Relay	Signal for dry contact circulator control (CP1 and CP2)
DO_3	Digital output	Not used.
DO_2	HYD_AUX	ON when hydronic auxiliary on (Setpoint Control only).
DO_1	IV1	24VAC water valve or circulator control for indoor loop
DO_0	OV1	24VAC water valve or circulator control for outdoor loop
LC	Loop common (ground)	Ground for 24VAC water valve / circulator controls
L6	Loop6	Not used.
L5	Loop5	Compressor protection module 24VAC power (sizes W-120/WH-140 and up)
L4	Loop4	Not used.
L3	TWO_TANK_3_WAY	Energizes 3-way valve to direct flow to cold tank when using HTS/CTS with 2 tanks
L2	Loop2	Not used.
L1	Loop1	Not used.
C(SH)	Soaker Hose common	Not used.
SH	Soaker Hose	Not used.

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TABLE A3 - Control Board Connector Descriptions (Bottom)		
Name	**Description**	
GND	BACnet MS/TP	Ground for shield if required (see BACnet Interface section)
B	BACnet MS/TP	RS-485
A	BACnet MS/TP	RS-485
STAGE1	Compressor Stage 1	Starts / stops compressor
STAGE2	Compressor Stage 2	Not used.
RV#1	Reversing Valve#1	Off in heating mode, on in cooling mode (reversing -HAC models only)
RV#2	Reversing Valve#2	Not used.
SOL#1	Solenoid#1	Not used.
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	Optional type 3/7 10k cold tank temperature sensor for HTS/CTS Setpoint Control
AI_3	Analog In Channel 3	Compressor discharge line temperature sensor
AI_2	Analog In Channel 2	Not used.
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	
GND	MODBUS	Ground for shield if required

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TABLE A4 - Control Board Connector Descriptions (Right Side)		
Signal	**Description**	
DI_1	Digital Input 1	Not used.
DI_0	Digital Input 0	Compressor protection module alarm input (sizes W-120 and up)
PM2	Phase Monitor 2	Not used.
PM1	Phase Monitor 1	Phase monitor alarm input
Y2A	Aquastat stage 2	Not used.
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	Stage 2 alarm	Not used.
1	Stage 1 alarm	Dry contact to indicate alarm, used with C
C	Alarm Common	Used with 1 above
AR	Airflow Reductions	Not used.
24VAC	Power	24VAC to flow switches
ODFLO	Outdoor Flow Switch	Return signal from outdoor loop flow switch
IDFLO	Indoor Flow Switch	Return signal from indoor loop flow switch
L	Thermostat Lockout Indicator	24VAC output for trouble LED
E	Thermostat Emergency Heat	Not used.
O	Thermostat Heat/Cool	24VAC input from external dry contact to activate cooling mode (-HAC models only)
W2	Thermostat Auxiliary Heat	Not used.
Y2	Thermostat Stage2	Not used.
Y1	Thermostat Stage1	Not used.
G	Thermostat Fan	Not used.
R	Thermostat Power (24VAC)	Not used.
C	Thermostat Power (Ground)	Not used.
*NOTE: There is no need for an external aquastat for most systems, since BACnet or Setpoint Control are more commonly used.		

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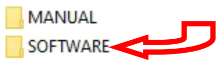
Appendix B - USB Driver Installation (Windows 10 & earlier)

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

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

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

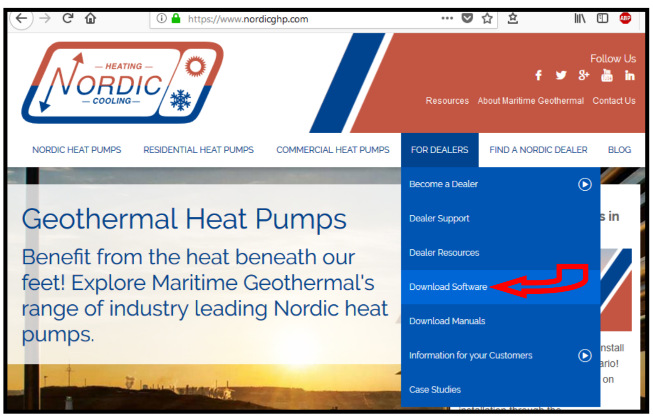


Double click on the SOFTWARE folder to show its contents:

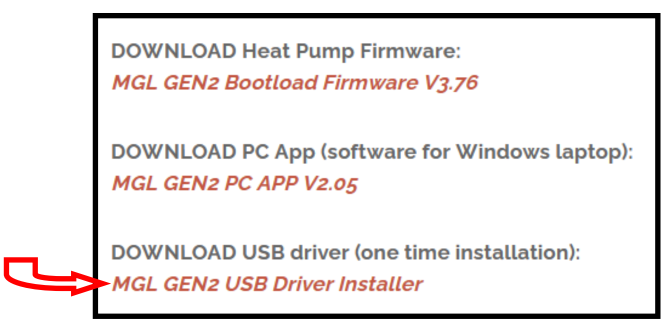
To install the USB driver, double click on **Step 1** and follow the prompts, clicking “allow” or “yes” as required.

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

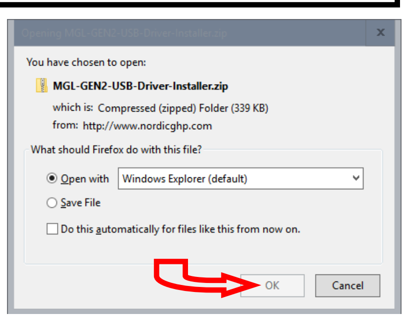
1. Go to www.nordicghp.com, Download Software page:



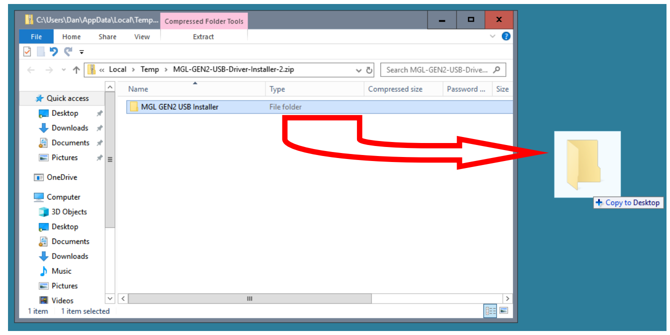
2. Click on **MGL GEN2 USB Driver Installer** to download it:



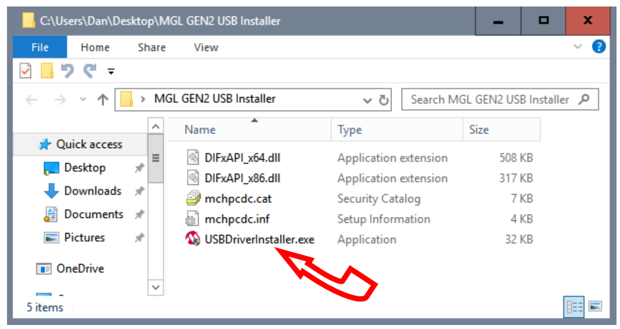
3. Choose “Open with Windows Explorer”, and hit “OK”. *(If the choice window doesn’t pop up, find the downloaded file in your browser downloads and double click on it.)*



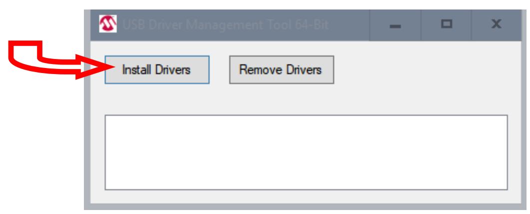
4. In the window that is displayed, click and hold down the mouse button on the folder name, and drag to your desktop:



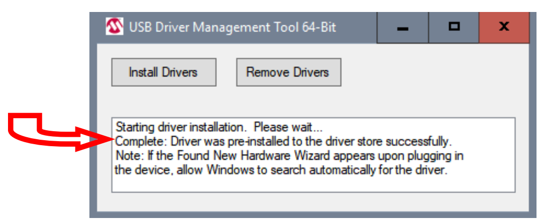
5. Double click on the folder you just dragged onto the desktop, then double click on the “USBDriverInstaller” file:



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.



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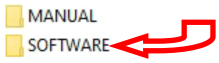
Appendix C - PC App Installation (Windows 11)

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:

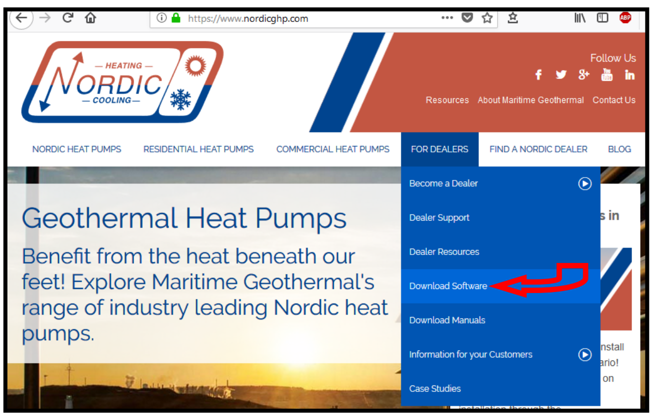


Double click on the SOFTWARE folder to show its contents:

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**.

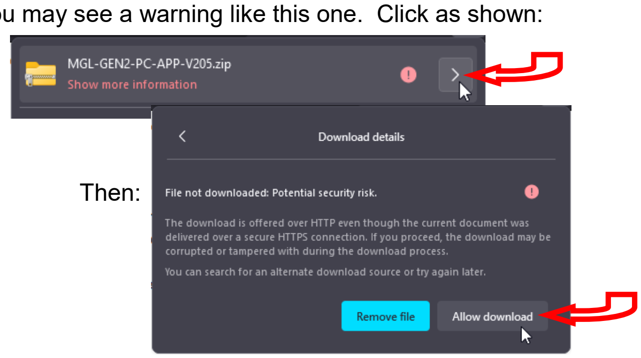
If the USB stick drive is not available, the same file can be **downloaded from the web page**.

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

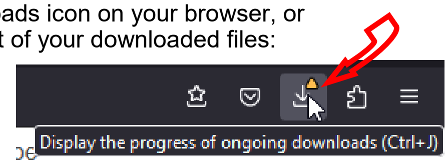


2. Click on **MGL GEN2 PC APP V2__** to download it:

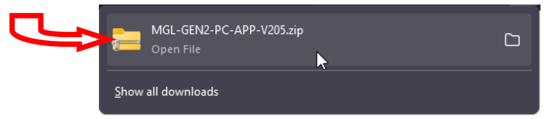
3. You may see a warning like this one. Click as shown:



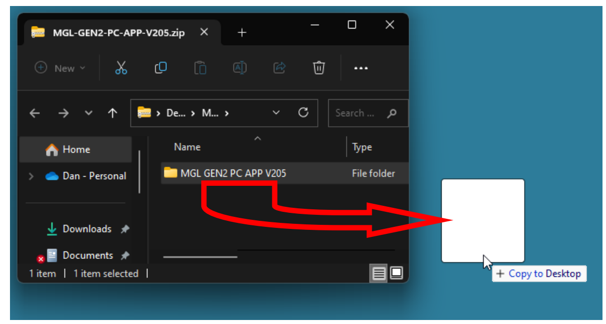
4. Click on the downloads icon on your browser, or otherwise view a list of your downloaded files:



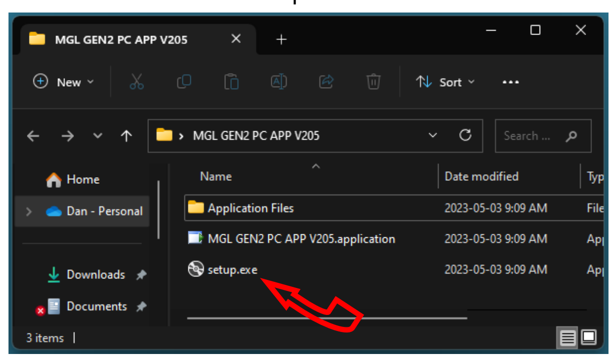
5. Then click on the .zip file to open it in a File Explorer window:



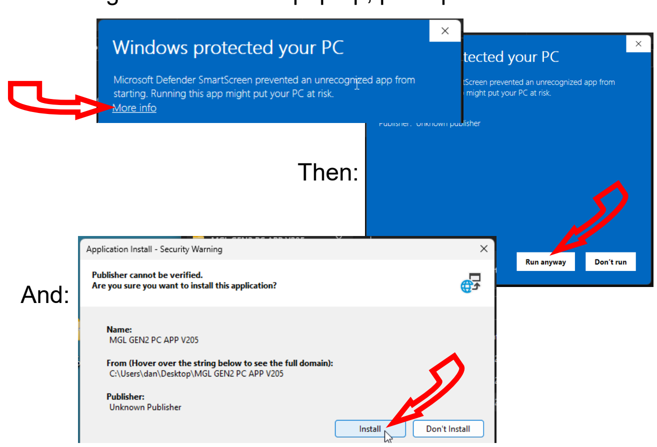
6. In the window that is displayed, click and hold down the mouse button on the folder name, and drag to your desktop:



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.

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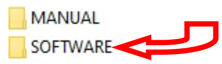
Appendix D - PC App Installation (Windows 10 & earlier)

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:

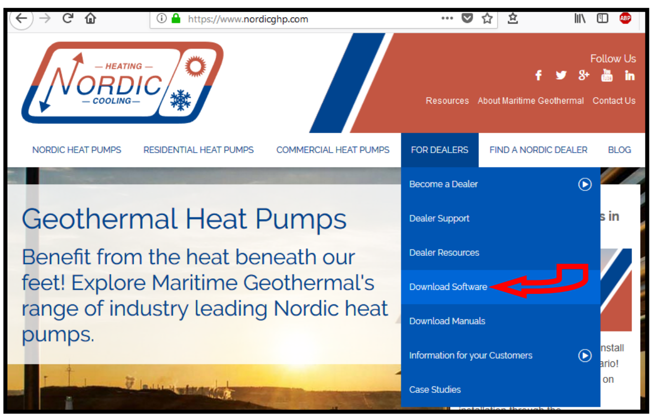


Double click on the SOFTWARE folder to show its contents:

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.

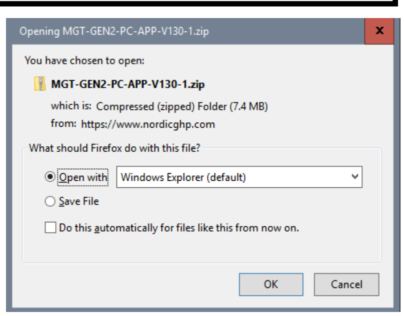
If the USB stick drive is not available, the same file can be **downloaded from the web page**.

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

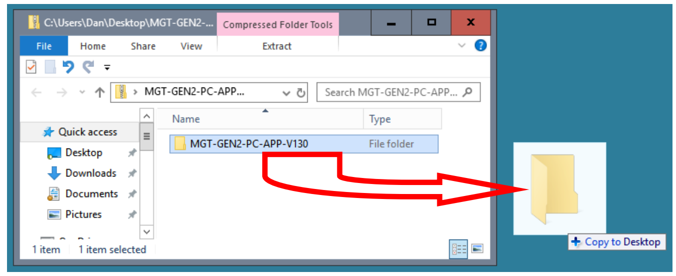


2. Click on **MGL GEN2 PC APP V2__** to download it:

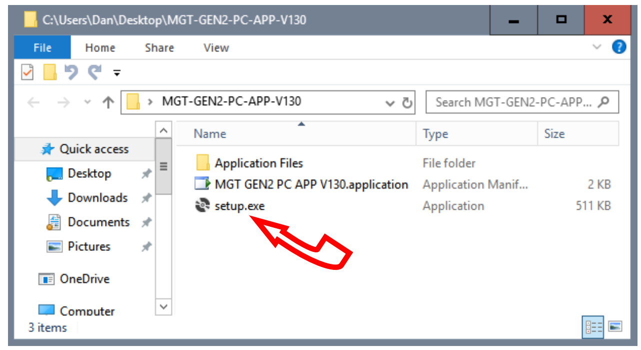
3. Choose "Open with Windows Explorer", and hit "OK":



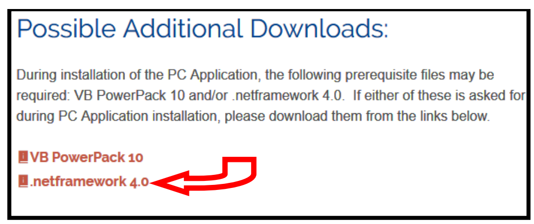
4. In the window that is displayed, click and hold down the mouse button on the folder name, and drag to your desktop:



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.

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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:

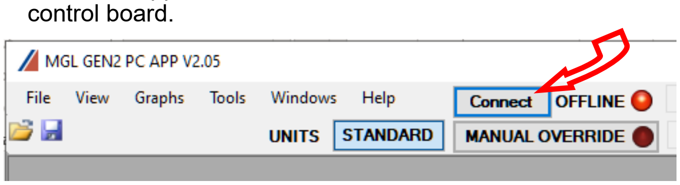
MGL_GEN2_V376.production.hex	(firmware file)
PIC32UBL.exe	(the programmer)
USB Bootloader Instructions.pdf	(these instructions)

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

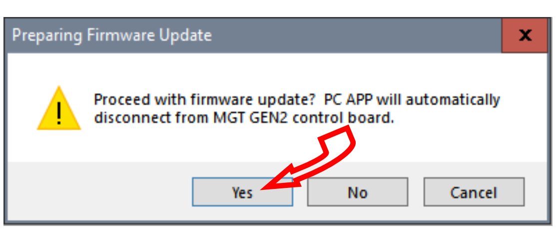
3. Connect a USB (printer) cable between computer and control board.

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.

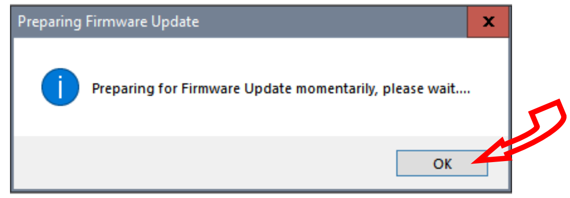
5. In the PC App, click on the **Connect** button to connect to the control board.



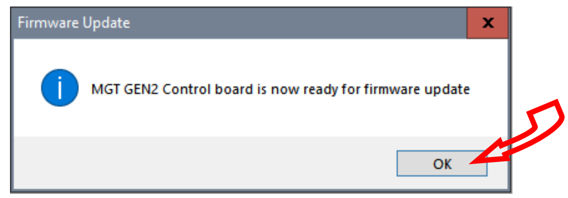
6. Go to menu **Tools --> Update Firmware**. The following message box will appear:



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

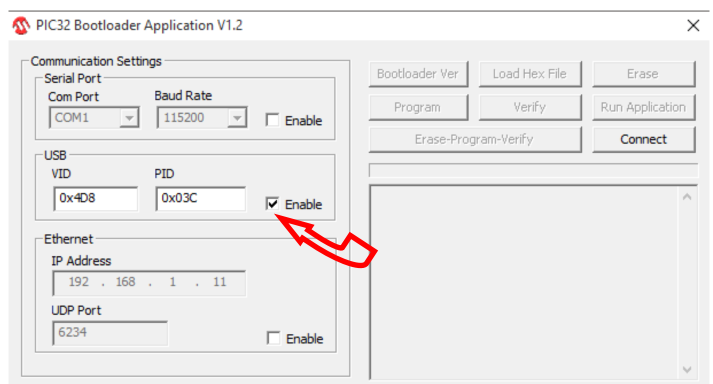


8. Click on **OK**. After a minute, the following message box will appear:

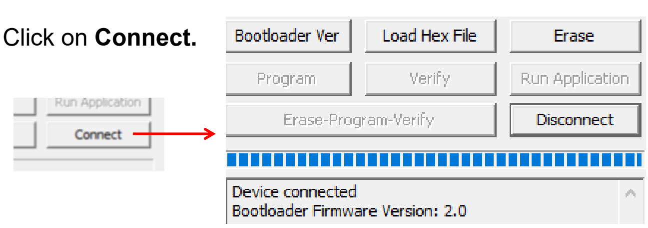


9. Click on **OK**. The control board is now in bootloader mode and is ready to be programmed.

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.*

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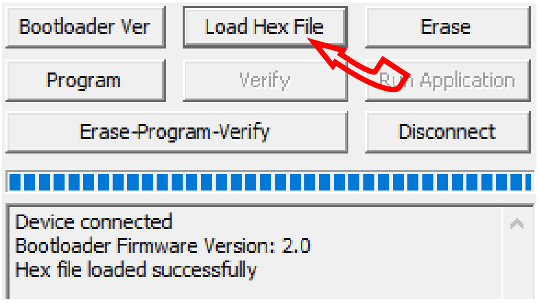
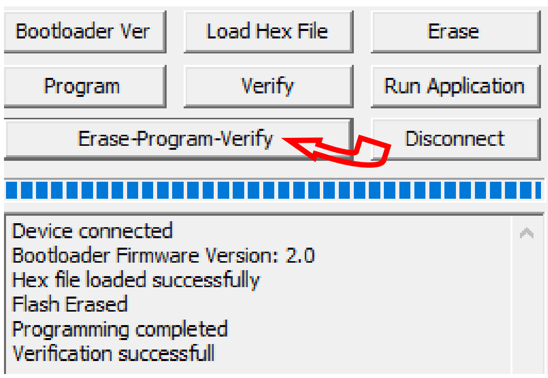
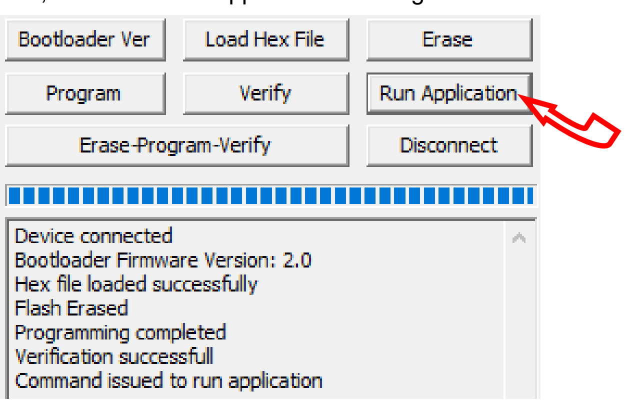
12. Click on **Load Hex File**. Select the *MGL_GEN2_V376.production.hex* (or higher version number) file, which is in the folder you created on the Desktop.



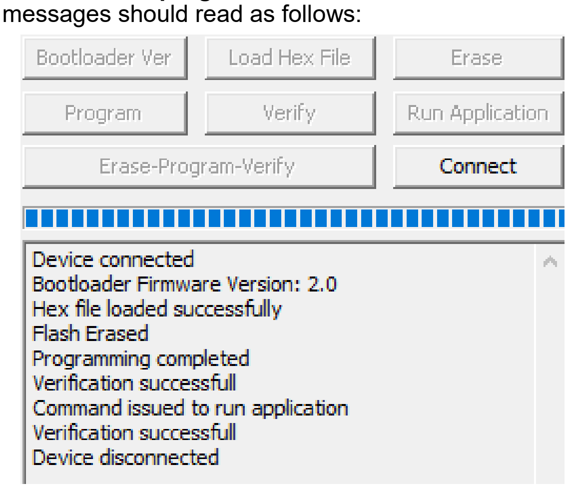
13. Click on **Erase—Program—Verify.** Programming…. Wait while status bar shows progress. The messages should read as below when finished:



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



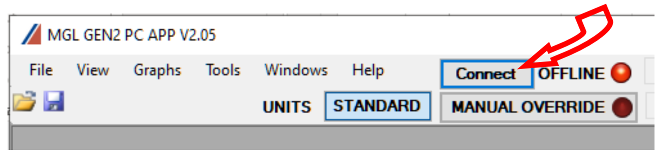
15. **Wait until the programmer disconnects itself.** The messages should read as follows:



16. Close the PIC32 program.

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

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



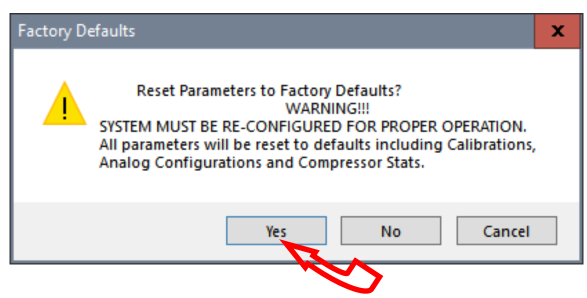
NOTE: Updating the firmware does not affect the configuration settings.

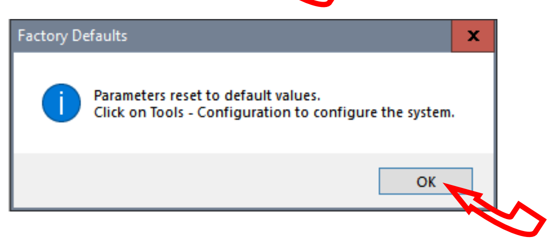
Reset to Defaults?

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

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

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





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

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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

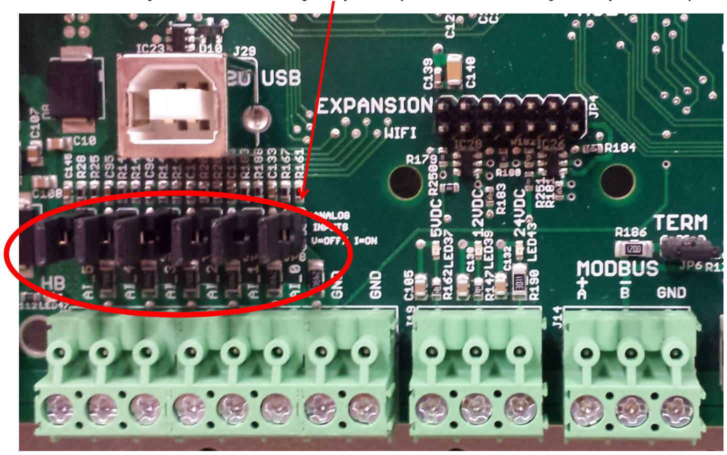
2. In that folder on the Desktop, there will be three files:

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

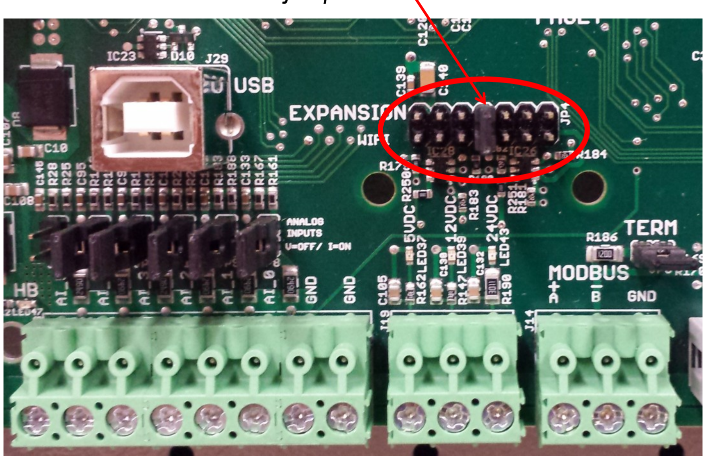
   Note that on most computers, the file extensions (.exe, .pdf) will be hidden.

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.

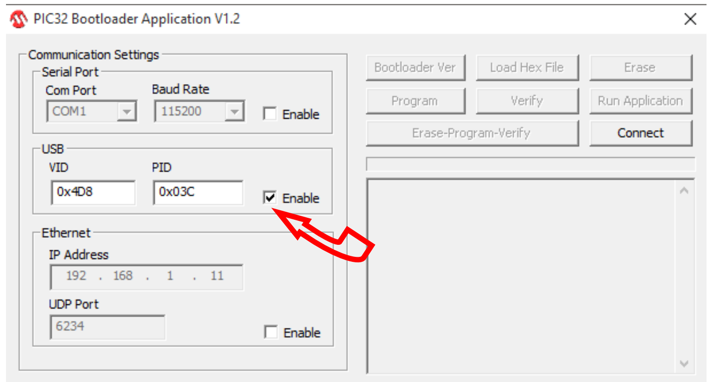
Borrow any one of these jumpers (however many are present)



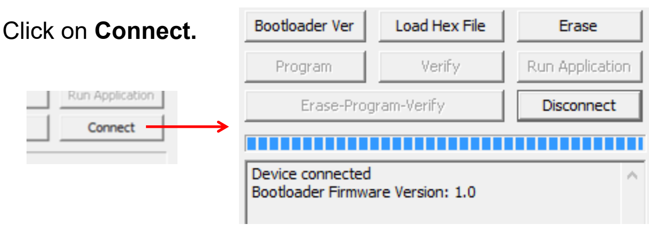
Place jumper here



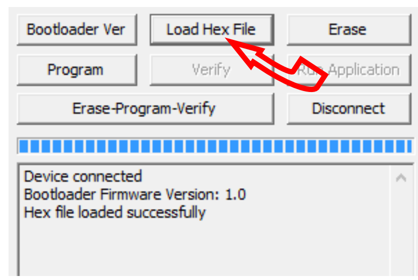
6. Turn the power back on. The control board is now in boot loader mode and is ready to be programmed.
7. Double click on the downloaded PIC32UBL.exe to run it. In the window that opens, click on the USB **Enable** check box.



8. Click on **Connect.**

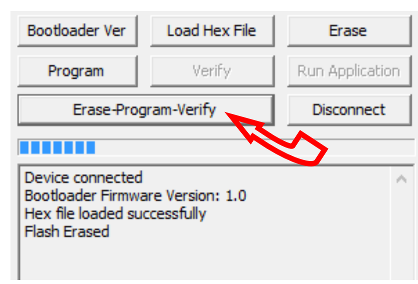


9. Click on **Load Hex File**. Select the *MGL_GEN2_V376. production.hex* (or higher version number) file, which is in the folder you created on the Desktop.

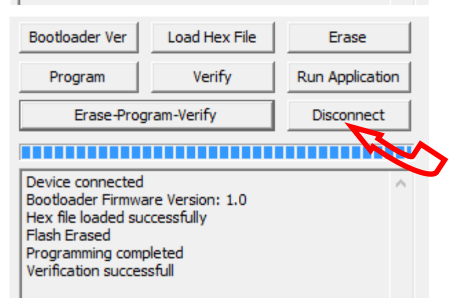


10. Click on **Erase—Program—Verify**

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.

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Warranty: W/WH-Commercial Series

COMMERCIAL 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 COMMERCIAL WARRANTY - PARTS
MG warrants its Commercial 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) Heat pumps / chillers built or sold by MG for one (1) year from the Warranty Inception Date (as defined below).
(3) Compressors of above units for five (5) years from the Warranty Inception Date (as defined below).
(4) 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 sixty (60) days 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 Commercial 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 COMMERCIAL WARRANTY - LABOUR
MARITIME GEOTHERMAL LTD. will not be responsible for any consequential damages or labour costs incurred.

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, including but not limited to:
- Indoor or outdoor loop flow lower than listed in engineering specification or as expressly approved by MARITIME GEOTHERMAL LTD.
- Operating the heat pump either manually or with automated controls so that the unit is forced to function outside its normal operating range
- Disabling of safety controls
- Insufficient loop antifreeze concentration for loop temperature, or antifreeze concentration incorrectly set in control board
- Fouled heat exchangers due to poor water quality
- Failure to use strainers or clean them regularly
- Impact or physical damage sustained by the heat pump
- Poor refrigeration maintenance practices, including brazing without nitrogen flow, or using wrong braze/flux
- Incorrect voltage or missing phase supplied to unit
- Unit modified electrically or mechanically from factory supplied condition
- Water quality outside of recommended limits (e.g. salinity or pH)
- Unit not mounted with supplied anti-vibration grommets when specified for use
- Corrosion damage due to corrosive ambient environment
- Failure due to excessive cycling caused by improper mechanical setup or improperly programmed external controller
- Physical loads or pressures placed on unit from external equipment

(7) Mold, fungus or bacteria damage
(8) Corrosion or abrasion of the product.
(9) Products supplied by others.
(10) Electricity or fuel, or any increases or unrealized savings in same, for any reason whatsoever.

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 Commercial Warranty.
(2) The costs of **labour**, refrigerant, materials, or service incurred in diagnosis and removal of 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 warranty coverage declined.
(4) The costs of normal maintenance.

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 Commercial 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 Commercial Warranty.

LIMITATION OF REMEDIES
In the event of a breach of the Limited Express Commercial 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.

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