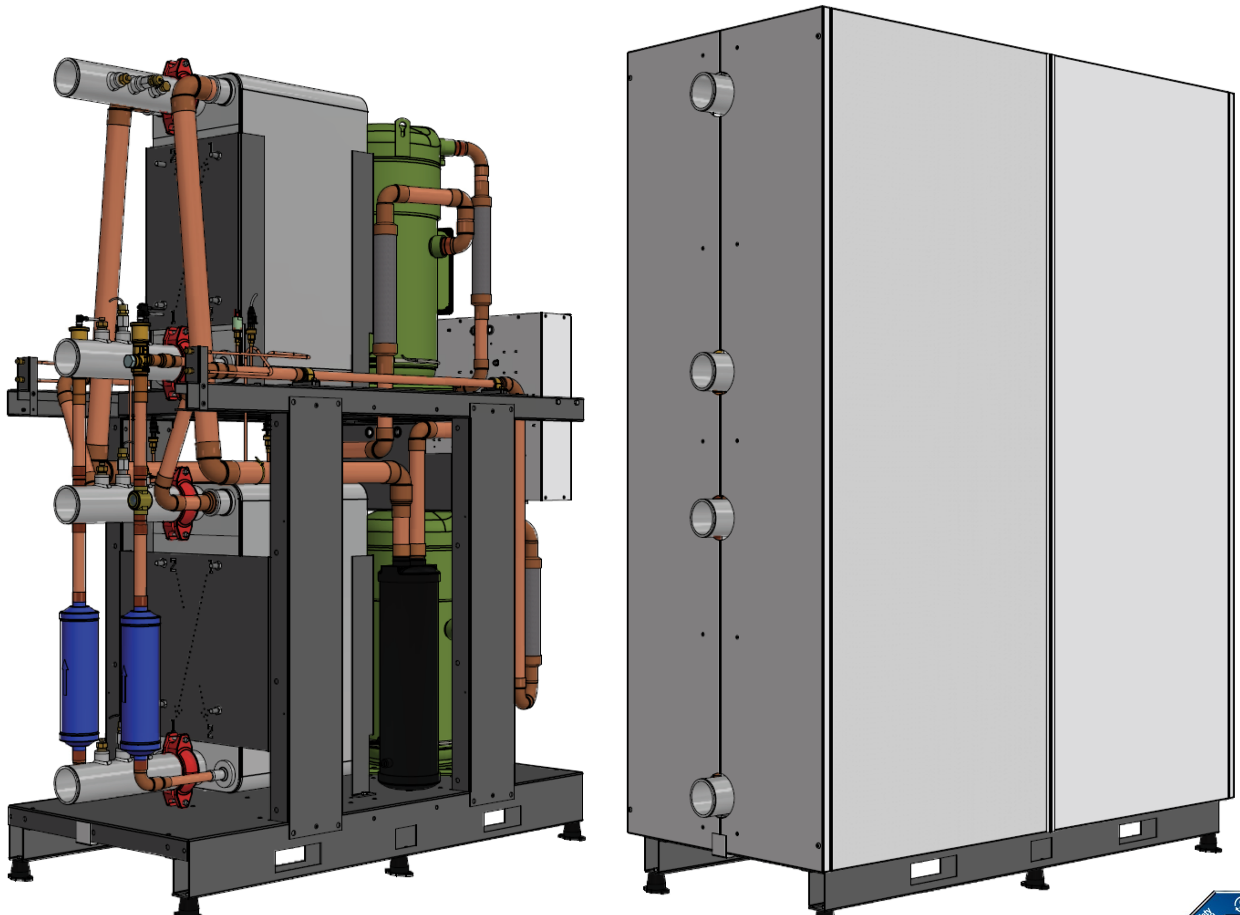
Application, Installation, & Service Manual

Commercial Water to Water Heat Pumps / Chillers

Dual Refrigeration Circuit

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

Model Sizes 150-1000 (12 to 81 ton)



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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 - 800 - H - X - 2D - PP - xx

Series:
W = liquid to water
WH = high temperature liquid to water
(sizes 150-800 only)

Nominal Size:
150 = 12 ton
185 = 15 ton
240 = 20 ton
300 = 23 ton
400 = 30 ton
500 = 40 ton
600 = 50 ton
800 = 65 ton
900 = 70 ton *(W only, no WH)*
1000 = 81 ton *(W only, no WH)*

Functions:
H = Heating
AC = reversing valve *(sizes 150-800 only)*
W = desuperheater for DHW *(sizes 150-400 only)*

Revision:
01, 02 etc.

Indoor Loop Exchanger:
P = brazed plate

Outdoor Loop Exchanger:
P = brazed plate

Compressor:
D = dual scroll

Voltage Code:
1 = 208/230-1-60
2 = 208-3-60
4 = 460-3-60
5 = 575-3-60
8 = 400-3-60

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

APPLICATION/AVAILABILITY TABLE - W-SERIES

MODEL	FUNCTION	REFRIGERANT	VOLTAGE	COMPR.	OUTDOOR COIL	INDOOR COIL	REVISIONS			
W-150	H HAC	X	1 2 4 5	D	P	P	01			
W-185 W-240 W-300 W-400	H HAC	X	2 4 5	D	P	P	01			
W-500 W-600 W-800	H HAC	X	4 5	D	P	P	01			
W-900 W-1000	H	X	4 5	D	P	P	01			

APPLICATION/AVAILABILITY TABLE - WH-SERIES

MODEL	FUNCTION	REFRIGERANT	VOLTAGE	COMPR.	OUTDOOR COIL	INDOOR COIL	REVISIONS			
WH-150	H HAC	Y	1 2 4 5	D	P	P	01			
WH-185 WH-240 WH-300 WH-400	H HAC	Y	2 4 5	D	P	P	01			
WH-500 WH-600 WH-800	H HAC	Y	4 5	D	P	P	01			

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

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System Description

General Overview

These units are 2-compressor dual refrigeration circuit water-to-water heat pumps. They have a 'vertical chiller' style design with external loop headers, for ease of passage through doors and convenience for multiple-unit installations.

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, and the indoor loop can reach **130°F (54°C)** leaving water temperature under standard ground loop conditions. (Note that for ice projects, the legacy *salt brine* is not an acceptable loop fluid; see later chapters.)

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 **45°F (7°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.

The units are built on industrial-strength steel frames, with removable enclosure insulated with 1" insulation. The indoor and outdoor loop hydronic heat exchangers are both true dual circuit stainless steel brazed plates with copper brazing. Two single-stage scroll compressors are standard, as are two 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.

1. Heating Mode

In heating mode, 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 normally sized and the system laid out by a mechanical consulting engineer. 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 side by side with zero clearance using horizontal headers, to provide redundancy as well as the ability to meet large loads. Control is normally 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 are also 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, 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.

2. Cooling Mode *(-HAC models only)*

Reversing valves to swap the hot and cold loops are available on model sizes up to 800 (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.

Four W-1000 heat pumps with enclosures installed, and 8" external horizontal loop headers

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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. The access panels on the ends of the units should remain clear of obstruction for a distance of **3 ft (1 m)** to facilitate installation and servicing.

Note that for multiple unit installations, horizontal 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 12" 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.

Since all serving can be done from the ends, **no access is required to the long side panels, which are fully removable from the ends.** This means that multiple units can be installed side by side with minimal clearance, although if large headers obstruct access to the piping-end panels, side clearance may be provided to ease access to the components located there.

The heat pumps are provided with rubber mounting feet (shipped inside electrical box), which must be installed on site. These will preserve the frame finish and dampen vibrations when used on solid concrete floors. Optional spring feet should be ordered when heat pump is installed on floors with flex, e.g. mezzanines.

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)
- INSULATED ENCLOSURE(S) [STANDARD]

OPTIONAL FROM MARITIME GEOTHERMAL
- SPRING FEET FOR MEZZANINE INSTALLATION
- OUTDOOR TEMPERATURE SENSOR FOR OUTDOOR RESET WHEN USING ONBOARD SETPOINT CONTROL
- HOT/COLD TANK TEMPERATURE SENSORS

LOOPS (AS SPECIFIED BY SYSTEM DESIGNER)
- FABRICATED HORIZONTAL HEADERS
- GROOVED (VICTAULIC) FLEXIBLE 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, OPT. W/ELEMENTS __kW
- SECONDARY WATER TO WATER HEAT EXCHANGERS

ZONES
- ZONES CIRCULATOR(S)
- ZONE TRANSFORMER & CIRC CONTACTOR
- ZONE VALVES (IF NOT INDIVIDUAL PUMPS)
- IN-FLOOR PIPING
- OTHER AIR HANDLERS, DUCTING
- ZONE THERMOSTATS
- RELAYS OR ZONE CONTR. (REVERSING SYSTEMS)
- 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 electrical box and also the enclosure (if used) have 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 power block 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	**Descr.**	**Voltages**
L1	**Line 1**	**All**
L2	**Line 2**	**All**
L3	**Line 3**	**All 3-phase (208-3-60, 460-3-60, 575)**
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 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 indoor circulator contactor with 24VAC coil, without an external 24VAC source. See “Indoor Water Valve Wiring - ON/OFF”, below.

The indoor circulator only will be activated at times when the compressor is not running, when using ***Setpoint Control*** (refer to **Operation** chapter of the manual). 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 **Setpoint Control** chapter of this manual). Under Setpoint Control, the heat pump will 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 connected 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

<u>ON/OFF</u>: Connect a 24VAC outdoor loop water valve 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 of all water valves does not exceed the value indicated on the diagram.

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

<u>**MODULATING**</u>: 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

<u>ON/OFF</u>: 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.

<u>MODULATING</u>: 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 of this manual. 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 Configuration page in the PC App. Default for W-series is 350 psi.

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 208/230-1-60 and 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.

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

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 MS/TP* 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 three 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 required to switch to cooling mode. **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.

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.

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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 , Y2A,** 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, to the **Y2A** terminal to call for compressor 2, and to **O** to select cooling mode (reversing HAC models only). **CA** is the common or ground terminal for use in powering the external device.

TABLE 7 - Signals Control Connections	
Signal	**Description**
CA	**24VAC common (ground)**
RA	**24VAC hot**
O*	**Cooling mode (reversing valve both stages)***
Y1A	**Compressor #1 (bottom)**
Y2A	**Compressor #2 (top)**
*** HAC models only**	

The following tables show typical settings for the aquastats. With these settings, stage 1 will activate when the tank temperature reaches the activation point. If the load is too great, the tank temperature will continue to drop when heating until stage 2 is activated. As the tank temperature stops dropping and begins to increase when heating, stage 2 will turn off before stage 1, rather than at the same time as stage 1. There are three main advantages to this:

- Less aquastat probe lag leading to reduced overshoot as the tank temperature rate of change is reduced when only stage 1 is active.
- Prolonged stage 1 runtime leads to increased efficiency.
- Reduced number of compressor starts.

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 **43°F (6°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 connected to stage 2 of the heating aquastat via an optional 0-2hour timer. Or if the tank has an electronic controller, it can be set to run according to its own setpint, 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 (aquastat)**		**Stage 2 (aquastat)**		Stage 3 (tank controller)	
	°F	°C	°F	°C	°F	°C
Setpoint	**108**	***42***	**105**	***41***	100	*38*
Delta	**8**	***4***	**8**	***4***	8	*4*
Activation *	100	*38*	97	*37*	92	*34*
Delay					**10 minutes**	
COOLING	**Stage 1**		**Stage 2**		*Activation is determined by the Setpoint and Delta values	
	°F	°C	°F	°C		
Setpoint	**45**	***7***	**48**	***9***		
Delta	**8**	***4***	**8**	***4***		
Activation *	53	*11*	56	*13*		

TABLE 8b - Typical WH-Series Aquastat Settings						
HEATING	**Stage 1 (aquastat)**		**Stage 2 (aquastat)**		Stage 3 (tank controller)	
	°F	°C	°F	°C	°F	°C
Setpoint	**150**	***66***	**147**	***64***	130	*54*
Delta	**8**	***4***	**8**	***4***	20	*10*
Activation *	142	*62*	139	*60*	110	*44*
Delay					**10 minutes**	
COOLING	**Stage 1**		**Stage 2**		*Activation is determined by the Setpoint and Delta values	
	°F	°C	°F	°C		
Setpoint	**45**	***7***	**48**	***9***		
Delta	**8**	***4***	**8**	***4***		
Activation *	53	*11*	56	*13*		

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.

Dry contacts to separately indicate stage 1 and stage 2 alarms 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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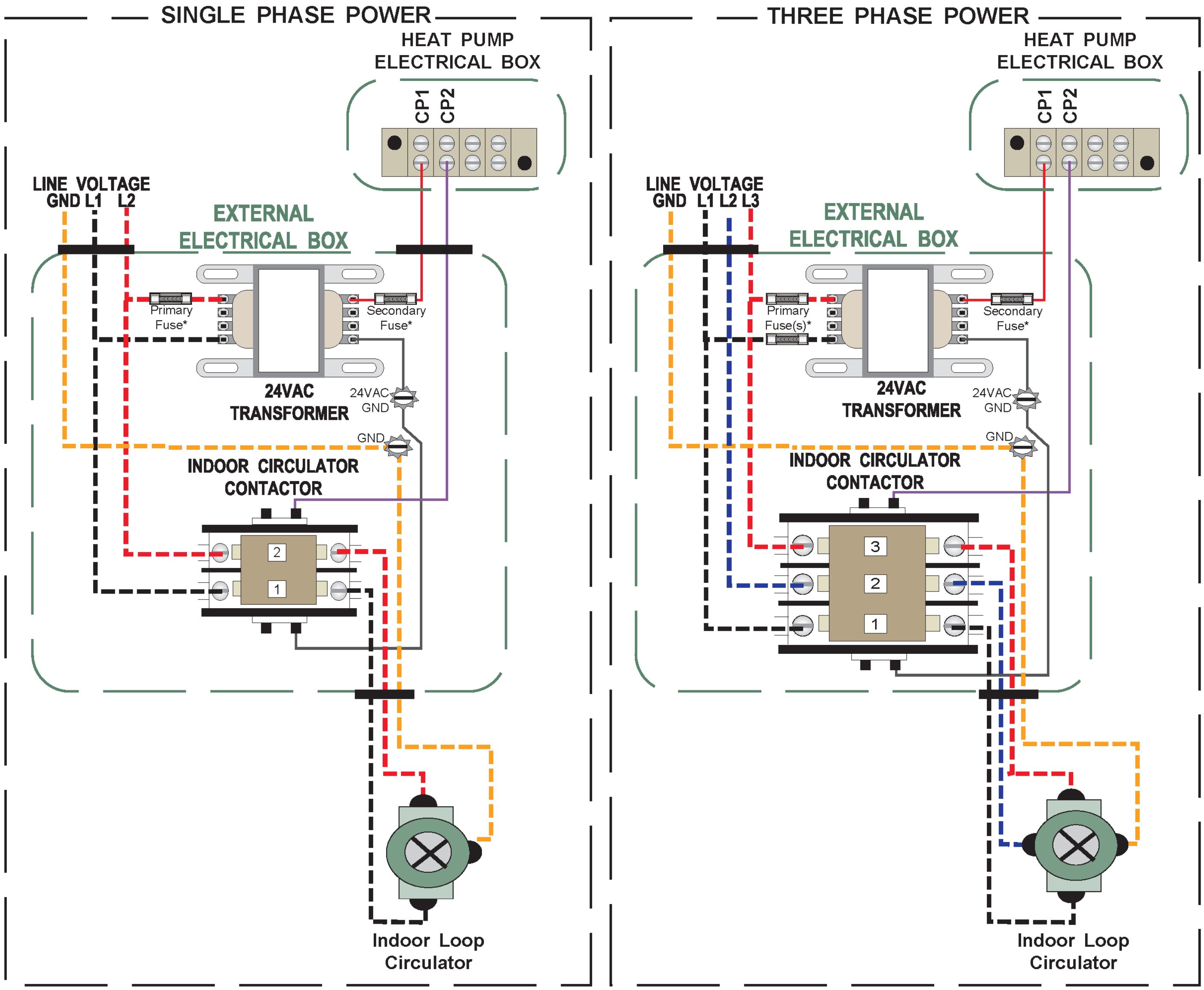
Typical Indoor Circulator Connections for Commercial W Models using GEN2 Setpoint Control



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

MARITIME GEOTHERMAL LTD.			170 Plantation Rd. Petitcodiac, NB E4Z 6H4
Drawing Name	Commercial W Typical ICR Connections for GEN2 Setpoint Control		
Size A	Drawing Number 002188CDG	Drawing Rev 01	Sheet 1 of 1

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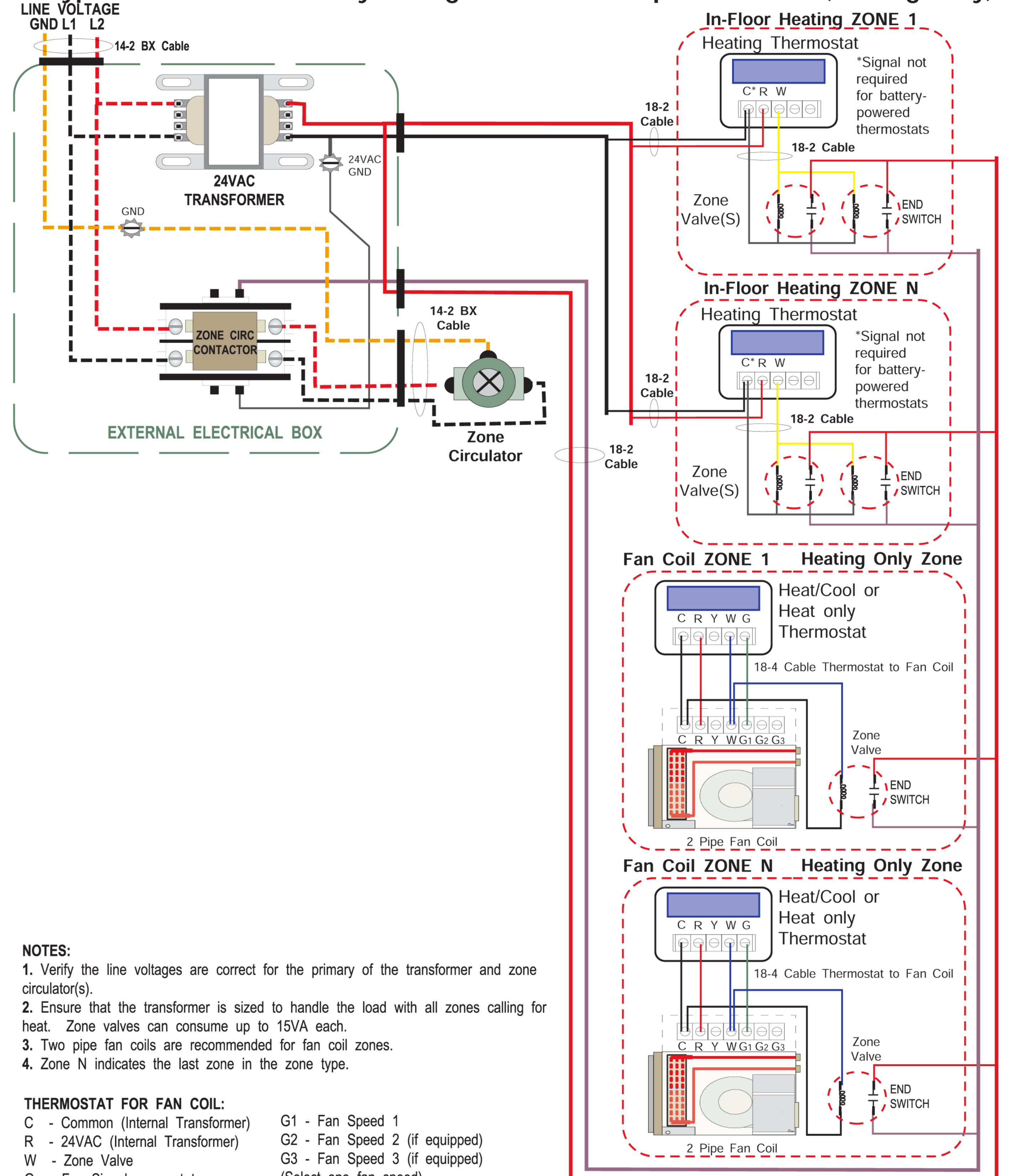
Typical Zone and Auxiliary Wiring With GEN2 Setpoint Control (Heating Only)



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)
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 Setpoint Control (Heating Only)		
Size	Drawing Number	Drawing Rev	Sheet
A	002067CDG	02	1 of 1

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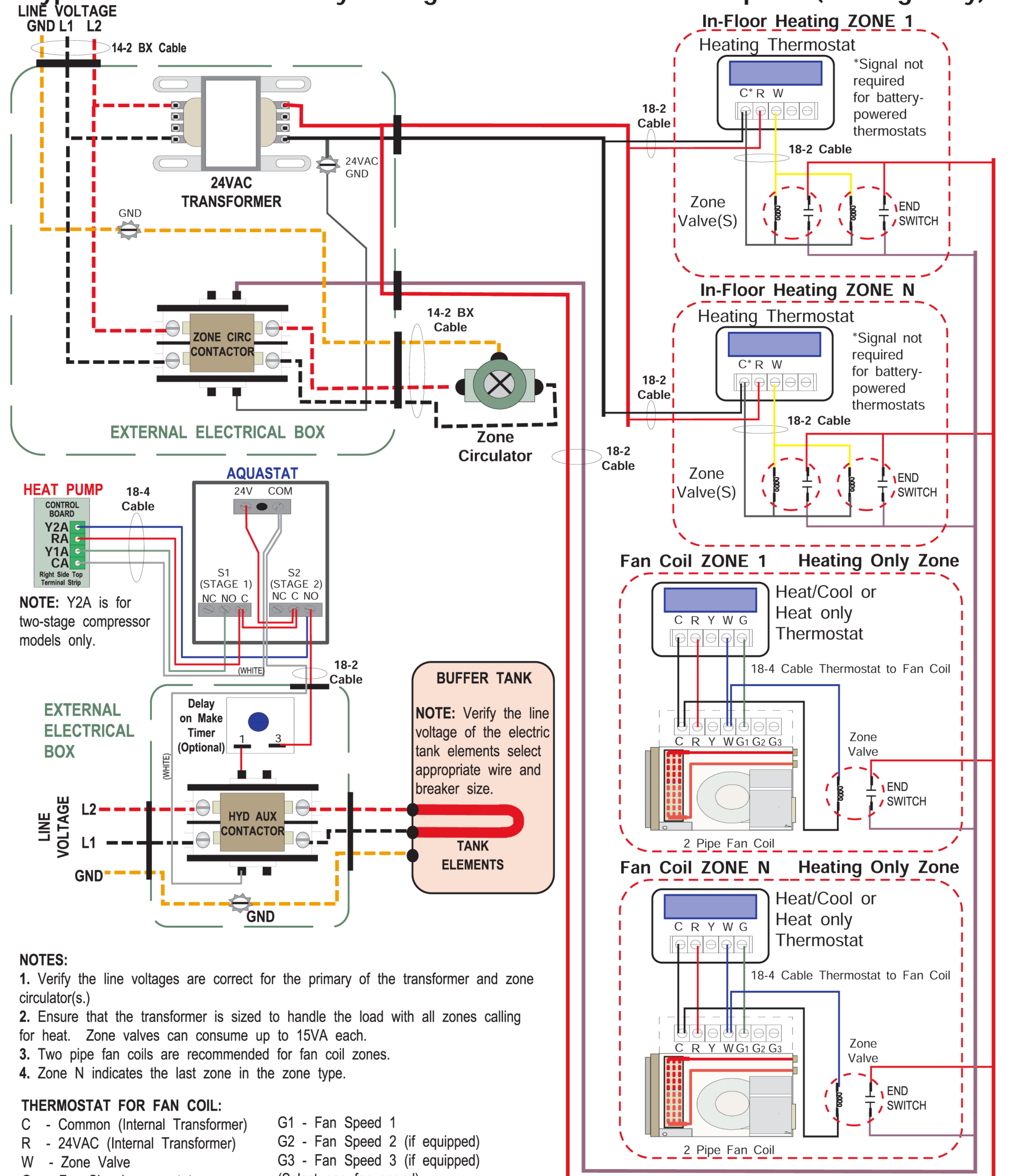
Typical Zone and Auxiliary Wiring With GEN2 Hardwired Option (Heating Only)



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

Water Loop Connections

The **Outdoor Loop (Supply)** and **Indoor Loop (Hot)** connections are stainless steel pipe designed for Victaulic connectors. The connection sizes are shown in the following table. Piping should be done as per the system piping diagram as well as local codes. It is recommended that all piping be insulated to prevent condensation. All piping connected to the unit must be sufficiently externally supported so as not to strain the heat exchanger connections.

To avoid fouling of the brazed plate heat exchangers, a **strainer is required** on each loop IN connection. 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 port has a temperature sensor. The output is shown on the LCD Interface on the unit and may also be viewed via the PC APP. There is also a P/T port installed in each line, for measuring pressure drop for flow rate estimation. Both of the "**OUT**" ports have a flow switch on reversing models; only on the outdoor loop for non-reversing models.

Buffer 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.

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.

CAUTION: Salt brine, commonly found in arena retrofit applications, is not an acceptable heat pump loop fluid due to its corrosive nature.

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.

Headers for Multiple Units

Horizontal headers with equally spaced side connections for multiple units may be fabricated by the mechanical contractor (the usual practice), or ordered with the heat pumps. In either case, detailed plans and a list of required accessories (strainers, valves) must be provided.

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 9 - Loop Connection Sizes

Model Size	Connection Size (SS grooved/Victaulic)
150	2" (51 mm)
185	
240	
300	
400	
500	3" (76 mm)
600	
800	
900	
1000	

TABLE 10 - Horizontal Header Size for Multiple Units

Number of Heat Pumps	Heat Pump Connection Size	Min. Nominal SCH40 Pipe Size for Header
2	2" (51 mm)	3"
	3" (76 mm)	5"
3	2" (51 mm)	4"
	3" (76 mm)	6"
4	2" (51 mm)	5"
	3" (76 mm)	8"
5	2" (51 mm)	5"
	3" (76 mm)	8"
6	2" (51 mm)	6"
	3" (76 mm)	8"
7	2" (51 mm)	6"
	3" (76 mm)	10"
8	2" (51 mm)	6"
	3" (76 mm)	10"

TABLE 11 - Buffer Tank Size

Heat Pump Size	Minimum Size gal (L)	Recommended Size gal (L)
150	100 (380)	120 (450)
185	130 (500)	180 (680)
240	160 (600)	200 (750)
300	200 (750)	250 (950)
400	250 (950)	300 (1100)
500	320 (1200)	400 (1500)
600	400 (1500)	500 (1900)
800	520 (2000)	600 (2300)
900	560 (2100)	600 (2300)
1000	648 (2450)	800 (3000)

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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)** for the W-series and **45°F (7°C)** for the WH-series. 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.

Water Quality Guidelines

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 is a concern, since although the brazed plates are made of corrosion-resistant 316SS, the copper brazing is susceptible to attack by chlorides. The water should be tested and fall within the limits in the following table. If it doesn't, the use of an open loop system should be reconsidered.

TABLE 12 - Water Quality Limits

Water Property	Should be
Chlorides	< 300 ppm
pH	> 7.5
Ammonia (NH_3)	< 2 ppm
Hydrogen Sulfide (H_2S)	< 0.05 ppm
Sulfate (SO_4^{2-})	< 70 ppm
Solids (TDS)	< 1 ppm
Hardness	< 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.

The modulating water valve is available as an accessory from Maritime Geothermal Ltd., and can be installed on either the loop's IN or OUT connections at the heat pump. Depending on size, valve connections may be **threaded** or **flanged**, and two grooved (Victaulic) adapters should be used per valve.

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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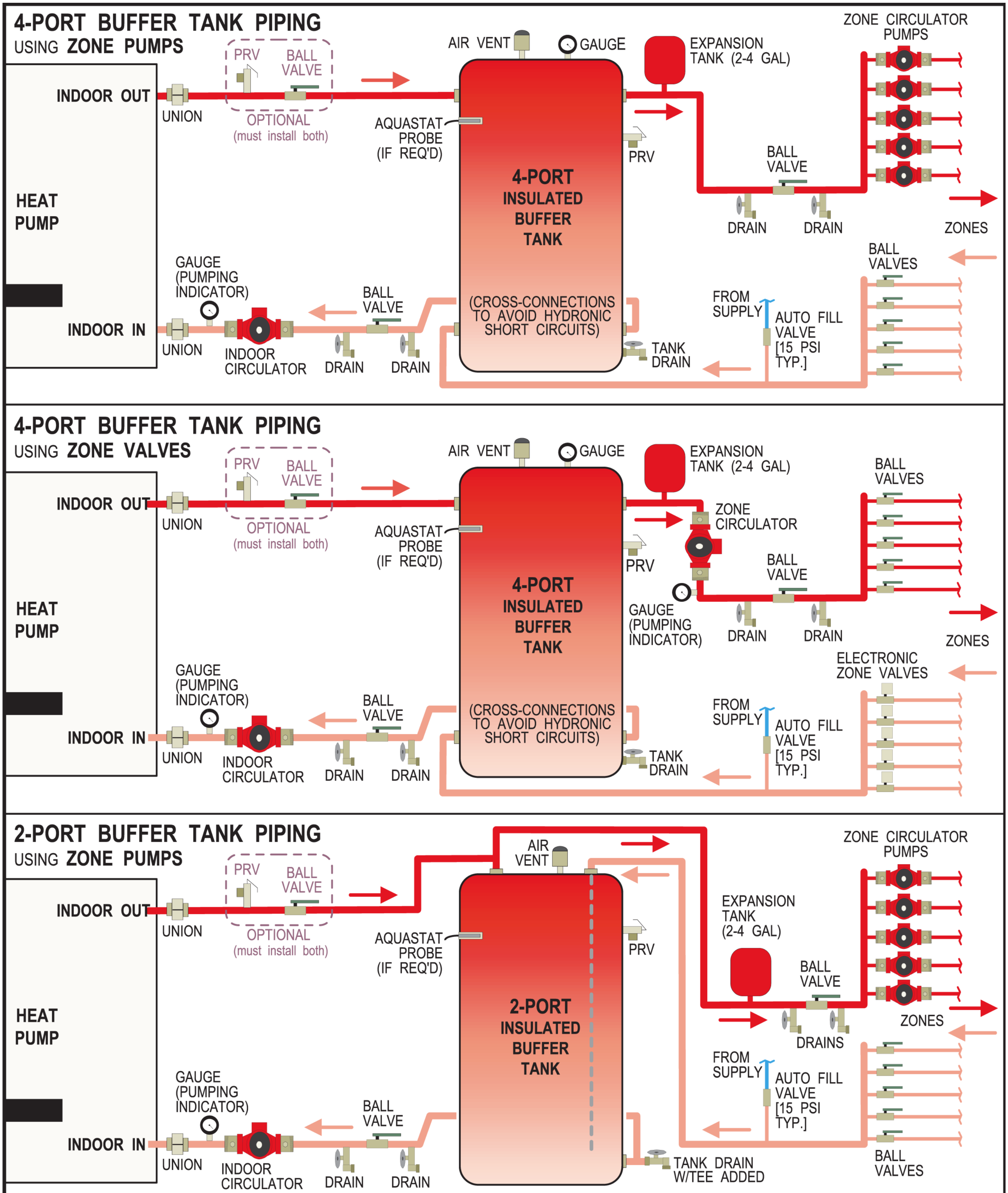

REV	ECO #	IMPL BY	APVD BY	DATE
02	(add fill valve)	D. RHEAULT	D. RHEAULT	1-Feb-2021
01	Initial Release	D. RHEAULT	D. RHEAULT	14-Dec-2018

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
E4Z 6H4

Drawing Name: **Recommended Hydronic Buffer Tank Piping**

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

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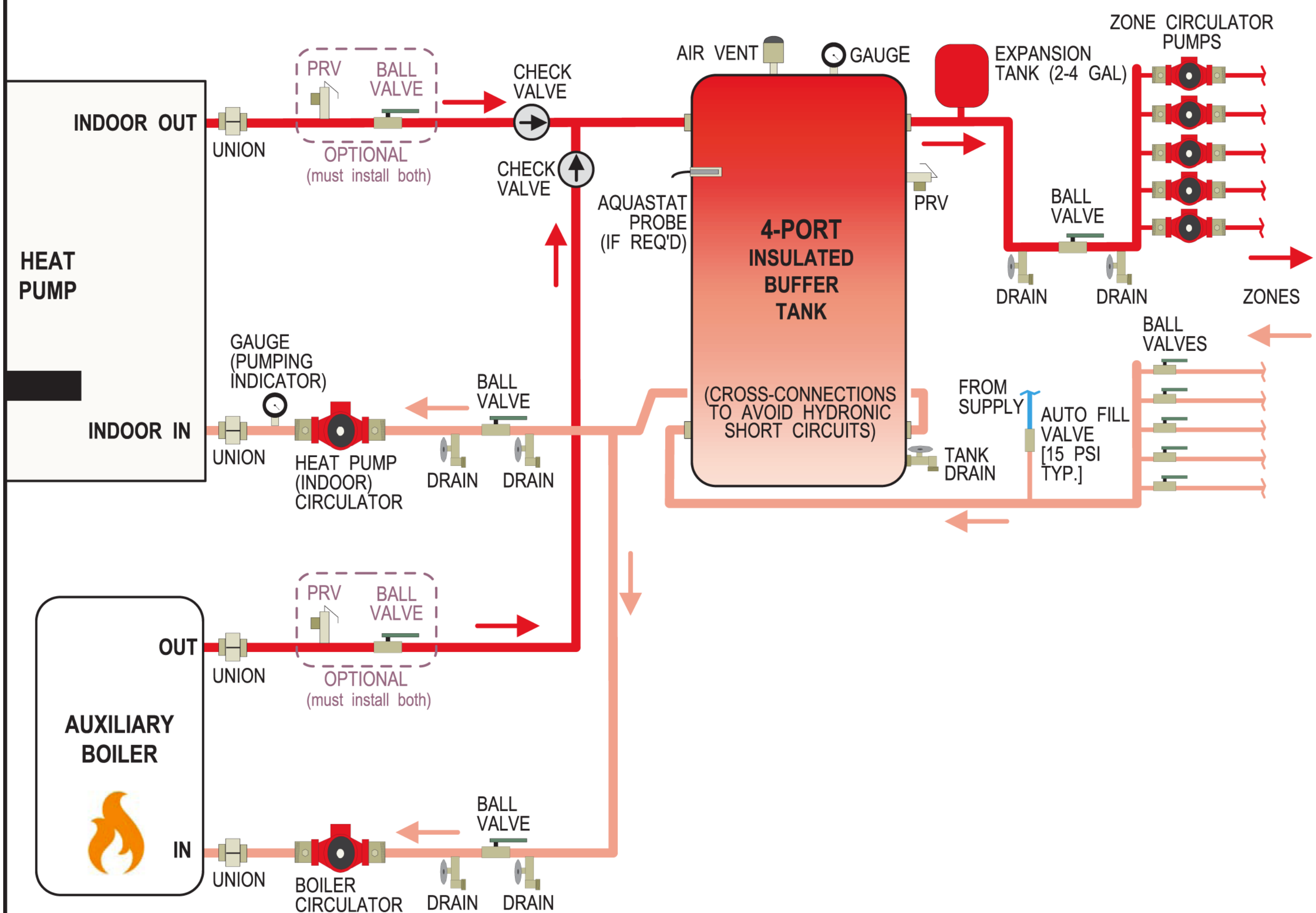
Auxiliary Boiler Piping

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

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



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

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

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

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

MARITIME GEOTHERMAL LTD.

170 Plantation Rd.
Petitcodiac, NB
E4Z 6H4

Drawing Name: **Auxiliary Boiler Piping**

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

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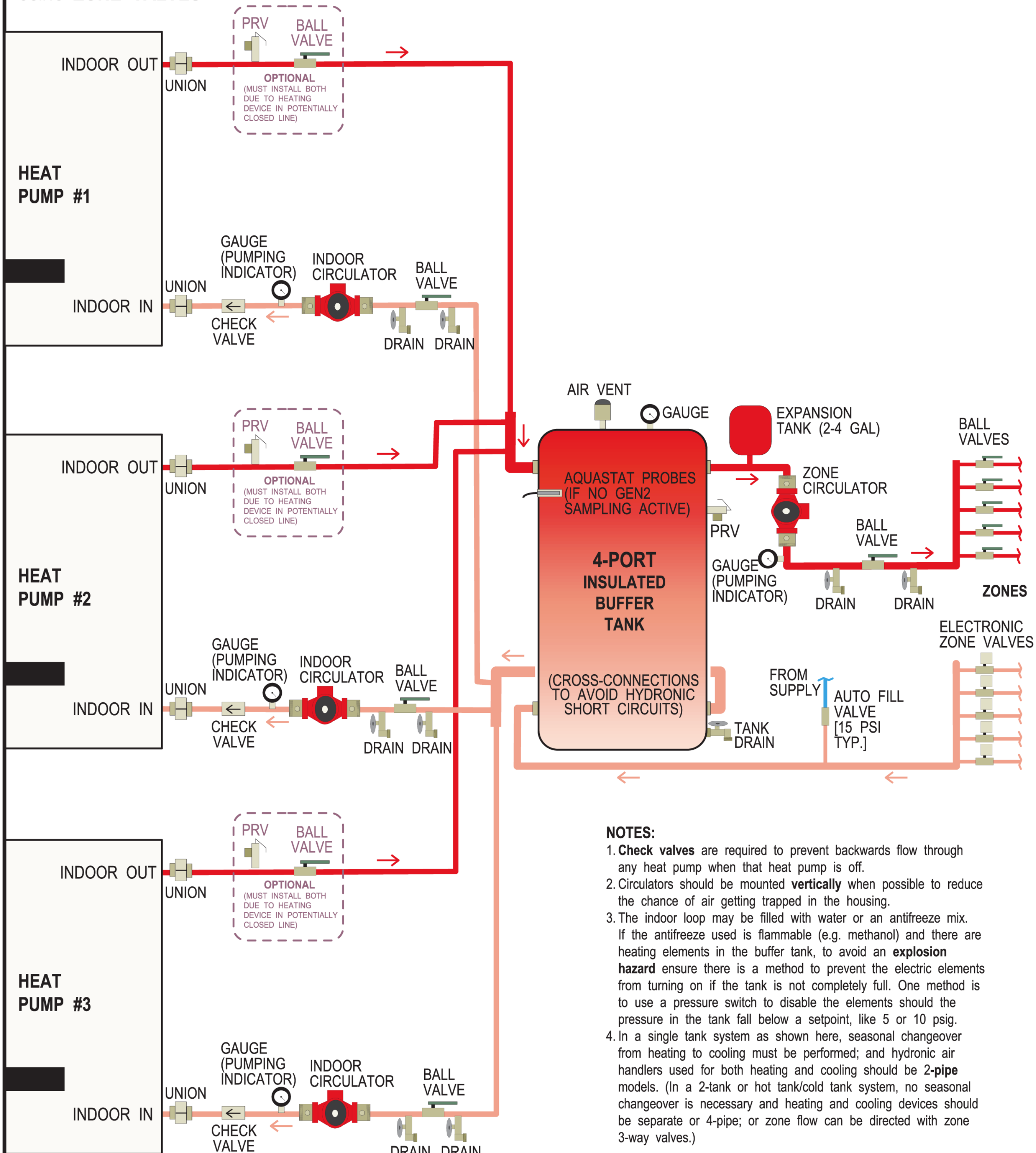
4-PORT BUFFER TANK PIPING FOR MULTIPLE HEAT PUMPS USING ZONE VALVES



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.)

REV	ECO #	IMPL BY	APVD BY	DATE
01	Initial Release	D. RHEAULT	D. RHEAULT	9-Aug-2021

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	Drawing Name: Buffer Tank Piping - Multiple Units	
Approved By (ENG)	Date		
Approved By (MFG)	Date	Size: A	Drawing Number: 002528PDG
Approved By	Date	REV: 01	SHEET: 1 of 1

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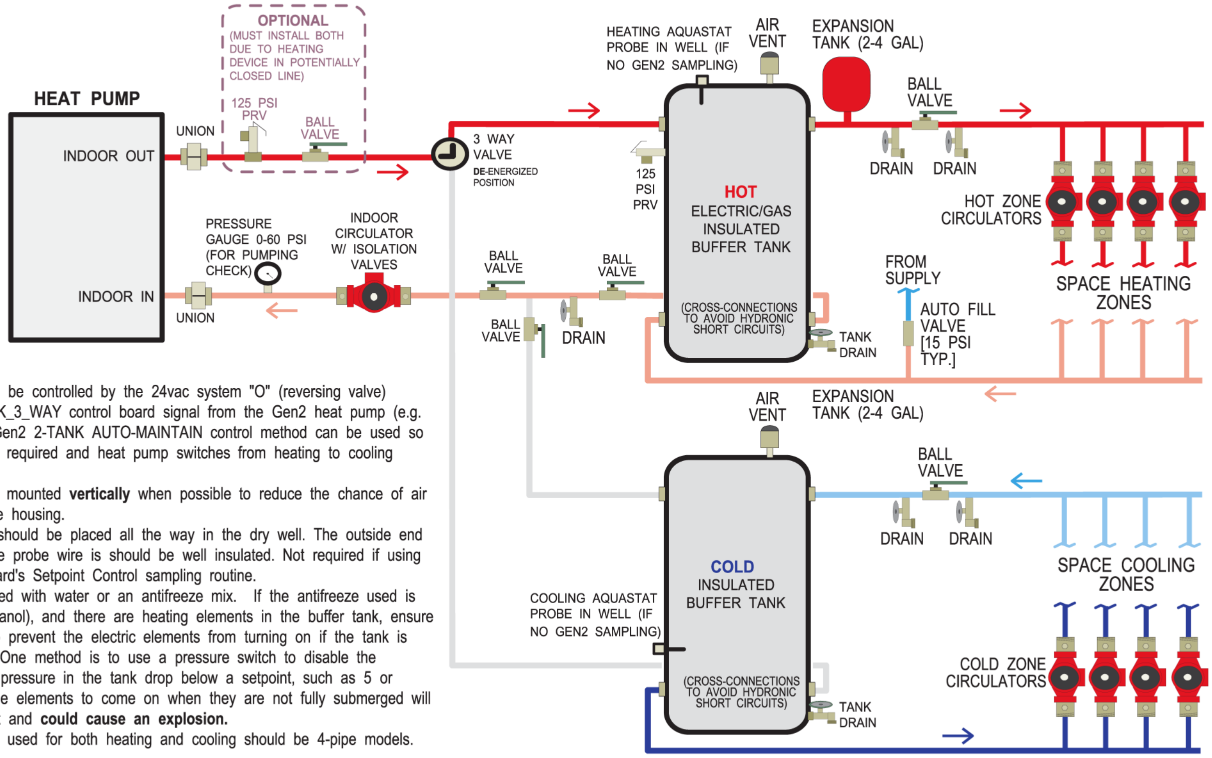
Two Tank System Piping with a Reversing Heat Pump

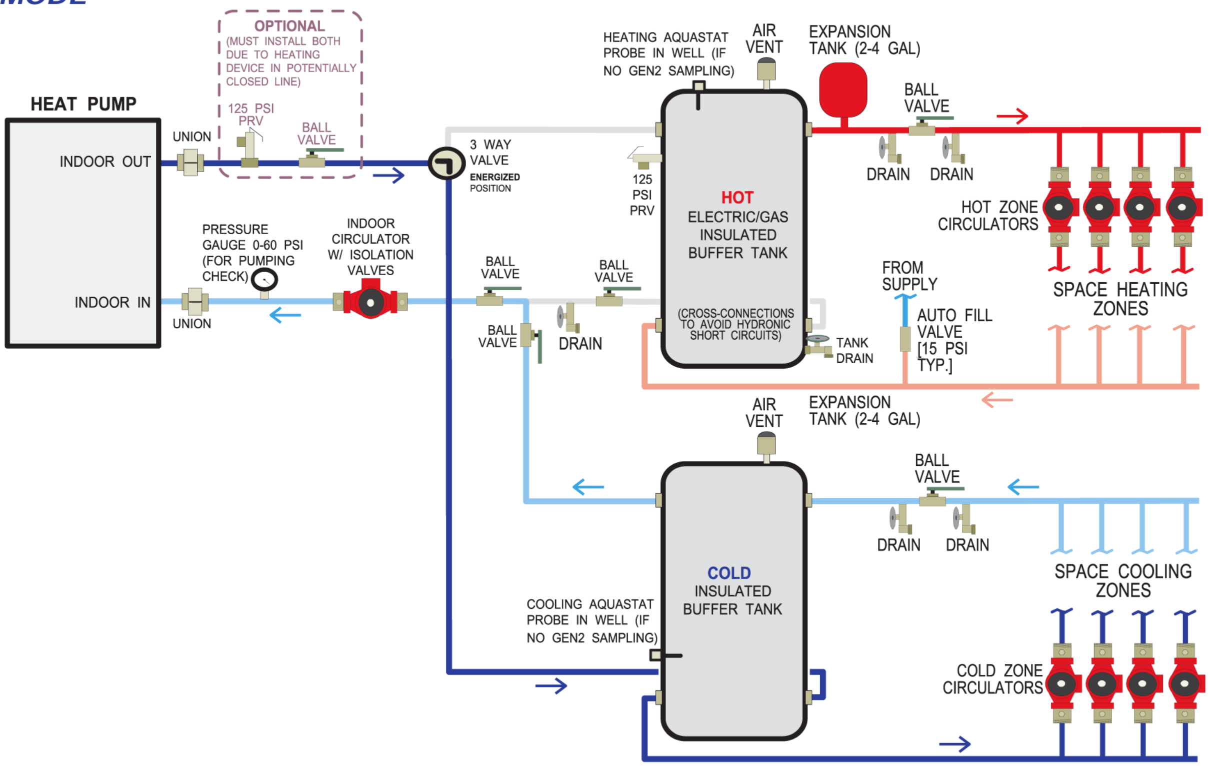
HEATING MODE



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



REV	ECO #	IMPL BY	APVD BY	DATE
02	-	D. RHEAULT	D. RHEAULT	6-Aug-2021
02	-	D. RHEAULT	D. RHEAULT	1-Mar-2018
01	Initial Release	D. RHEAULT	D. RHEAULT	25-Oct-2017

Drawn By: Dan Rheault	Date: 25-Oct-2017
Checked By: Dan Rheault	Date: 25-Oct-2017
Approved By (ENG): Dan Rheault	Date: 25-Oct-2017
Approved By (MFG)	Date
Approved By	Date

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

Drawing Name	Two Tank System Piping with a Reversing Heat Pump		
Size	**Drawing Number**	**REV**	**SHEET**
A	002252PDG	03	1 of 1

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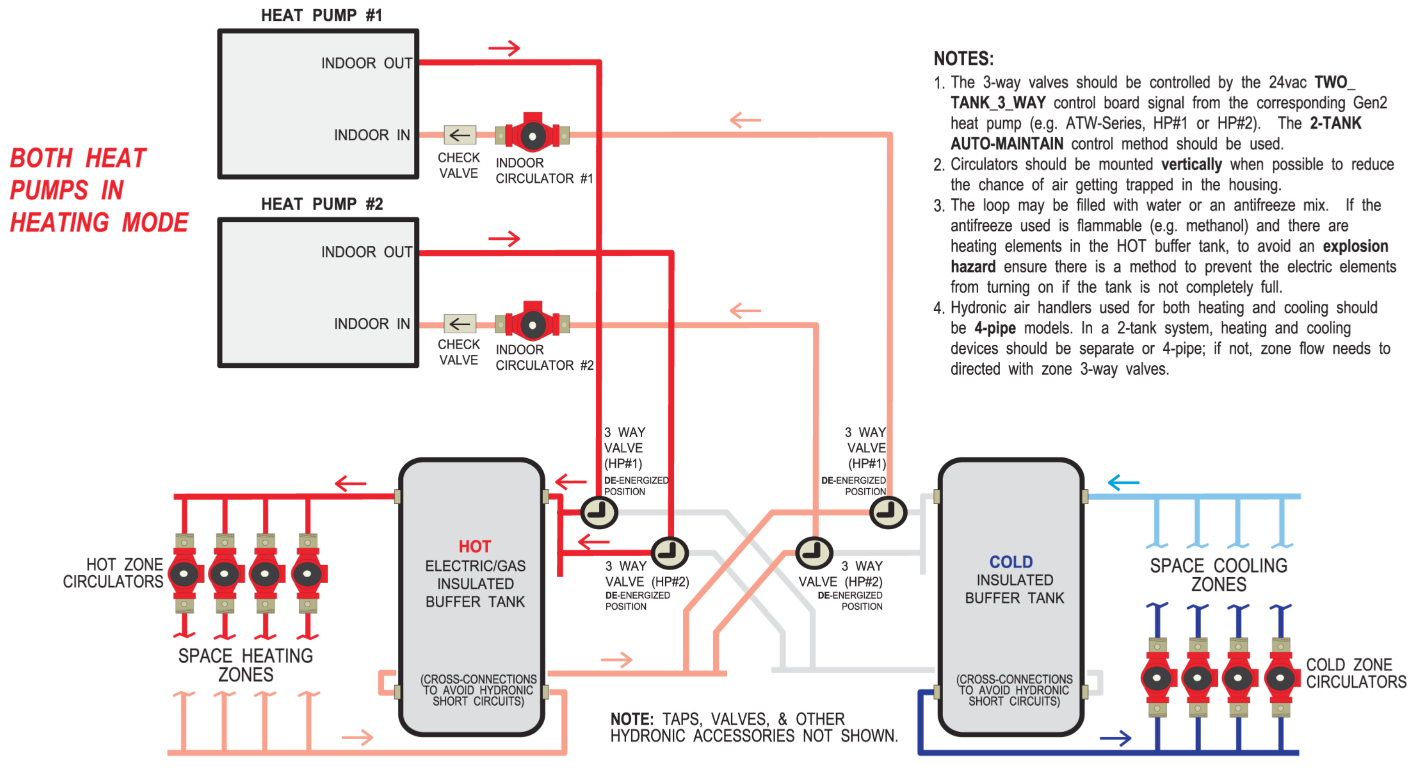
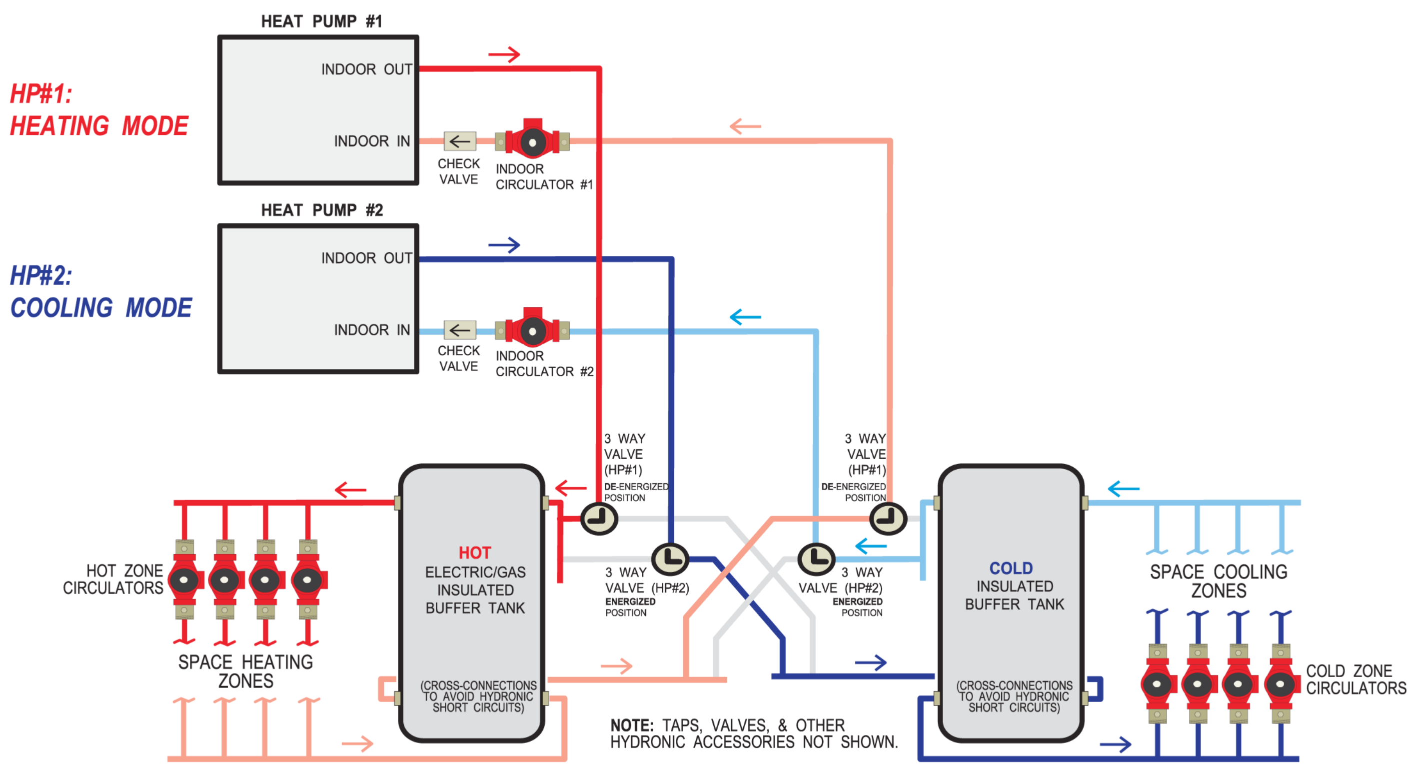
Two Tank System Piping with Multiple Reversing Heat Pumps



NOTES:

1. The 3-way valves should be controlled by the 24vac **TWO_ TANK_3_WAY** control board signal from the corresponding Gen2 heat pump (e.g. ATW-Series, HP#1 or HP#2). The **2-TANK AUTO-MAINTAIN** control method should be used.
2. Circulators should be mounted **vertically** when possible to reduce the chance of air getting trapped in the housing.
3. 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 HOT 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.
4. Hydronic air handlers used for both heating and cooling should be **4-pipe** models. In a 2-tank system, heating and cooling devices should be separate or 4-pipe; if not, zone flow needs to directed with zone 3-way valves.



REV	ECO #	IMPL BY	APVD BY	DATE
01	Initial Release	D. RHEAULT	D. RHEAULT	6-Aug-2021

Drawn By: Dan Rheault	Date: 6-Aug-2021
Checked By: Dan Rheault	Date: 6-Aug-2021
Approved By (ENG): Dan Rheault	Date: 6-Aug-2021
Approved By (MFG)	Date
Approved By	Date

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

Drawing Name	Two Tank System Piping with Multiple Reversing Heat Pumps		
Size	Drawing Number	REV	SHEET
A	002527PDG	01	1 of 1

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Two Tank Simultaneous Heating / Cooling

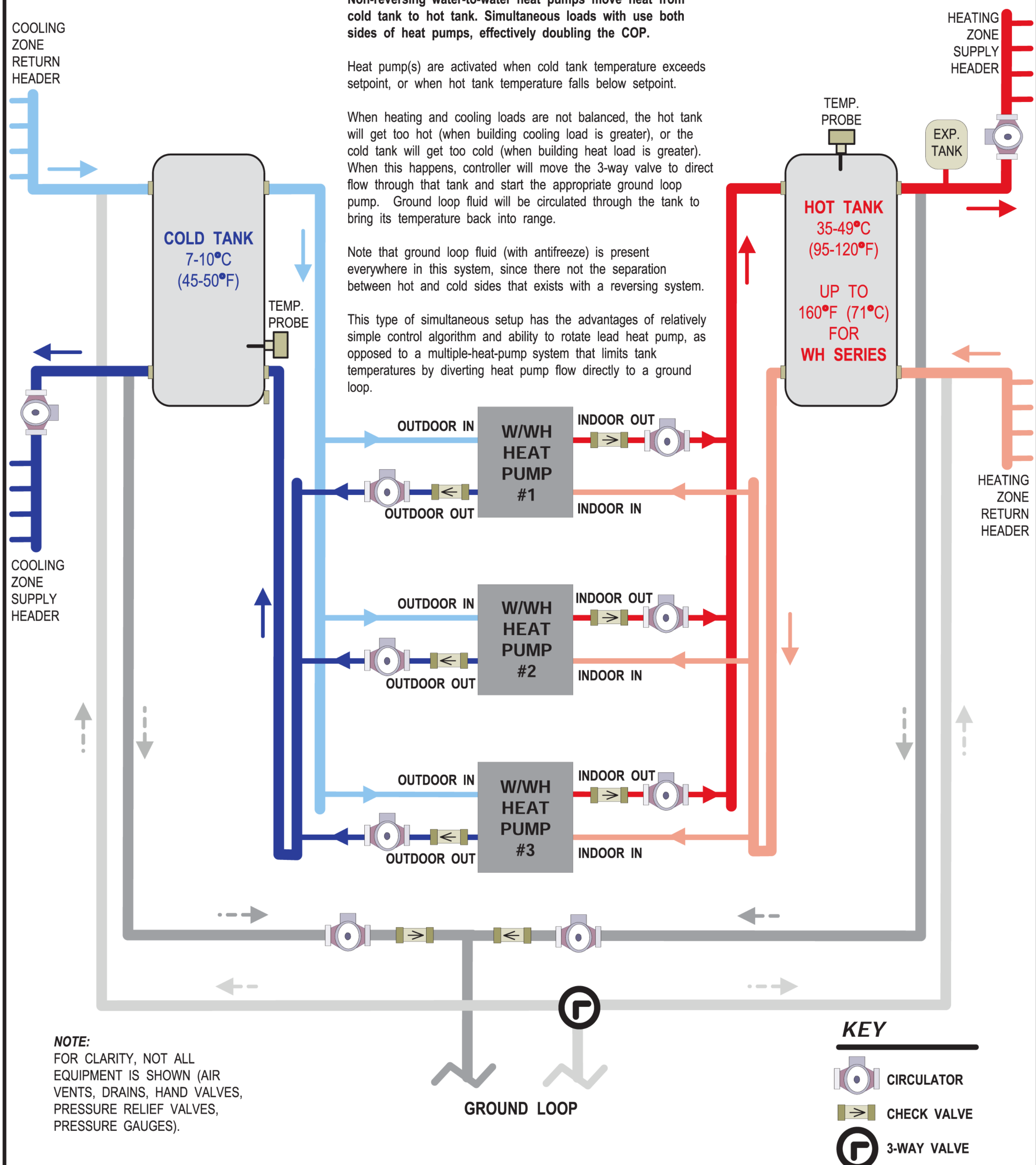
Non-reversing water-to-water heat pumps move heat from cold tank to hot tank. Simultaneous loads with use both sides of heat pumps, effectively doubling the COP.

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: Two Tank Simultaneous Heating / Cooling
					Approved By (ENG)	Date	
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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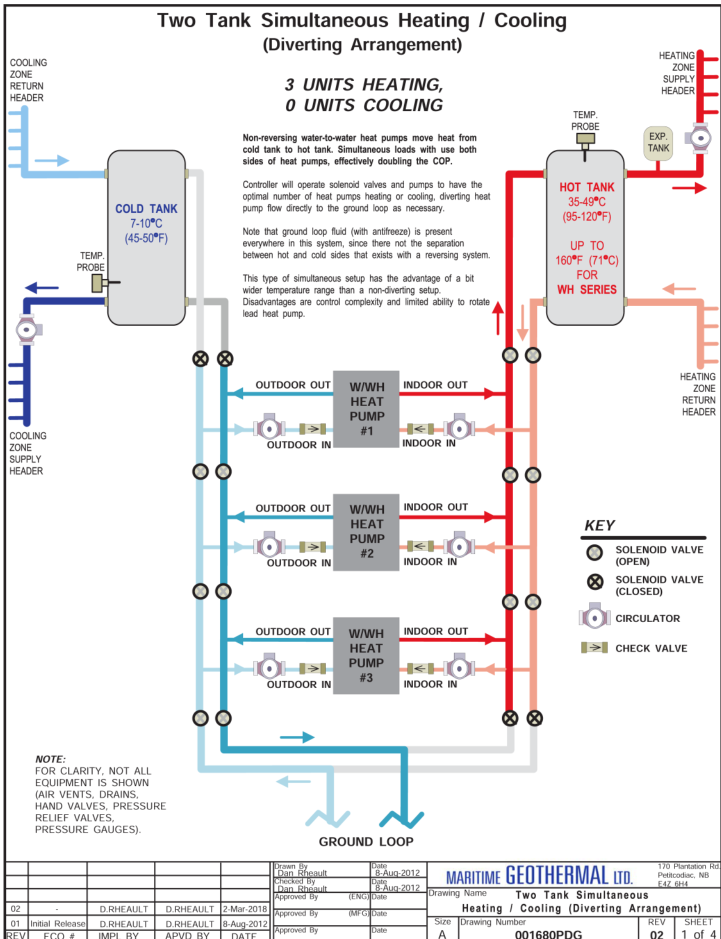

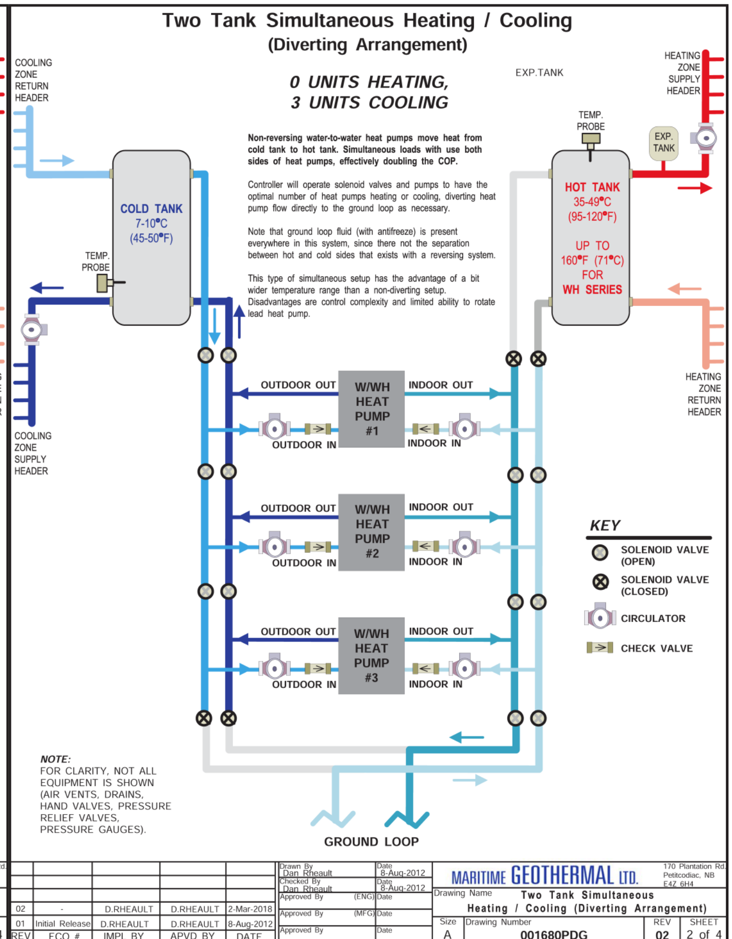

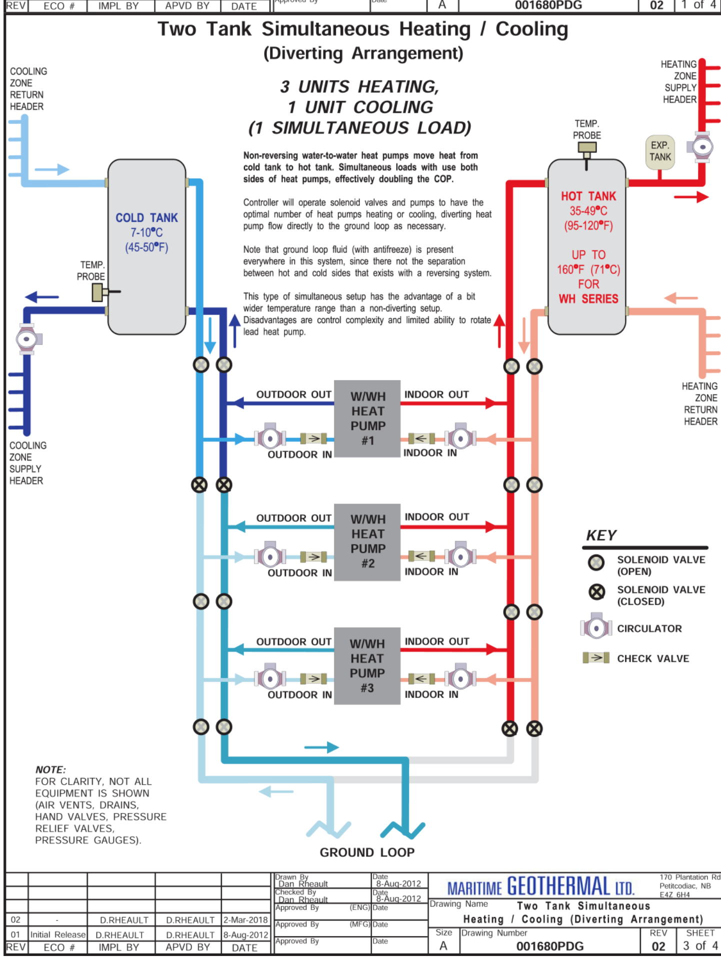

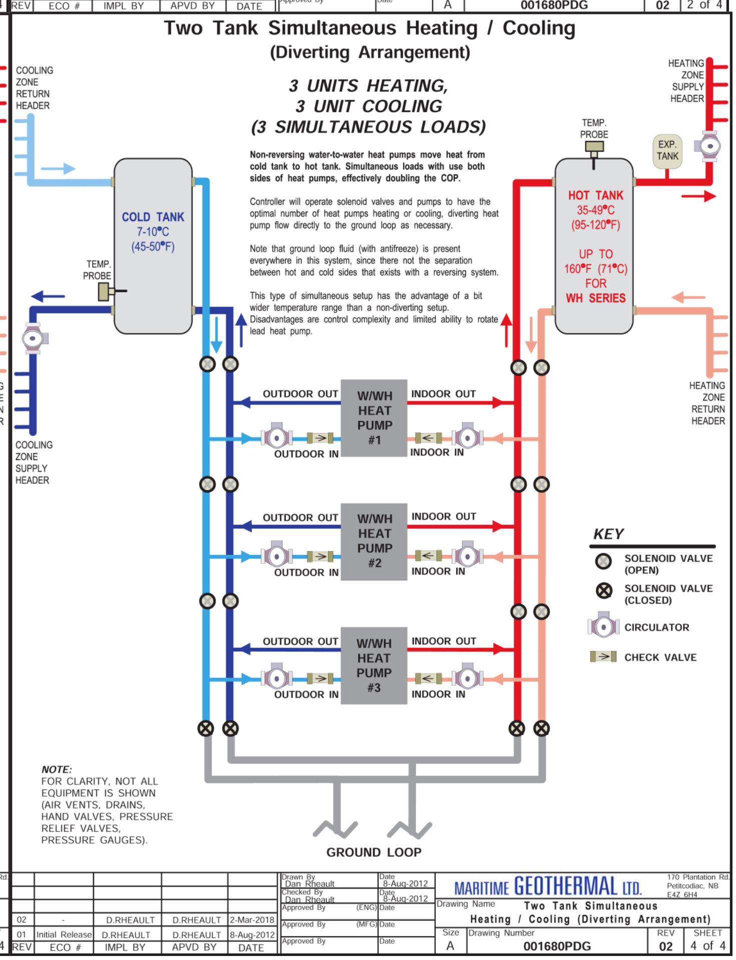

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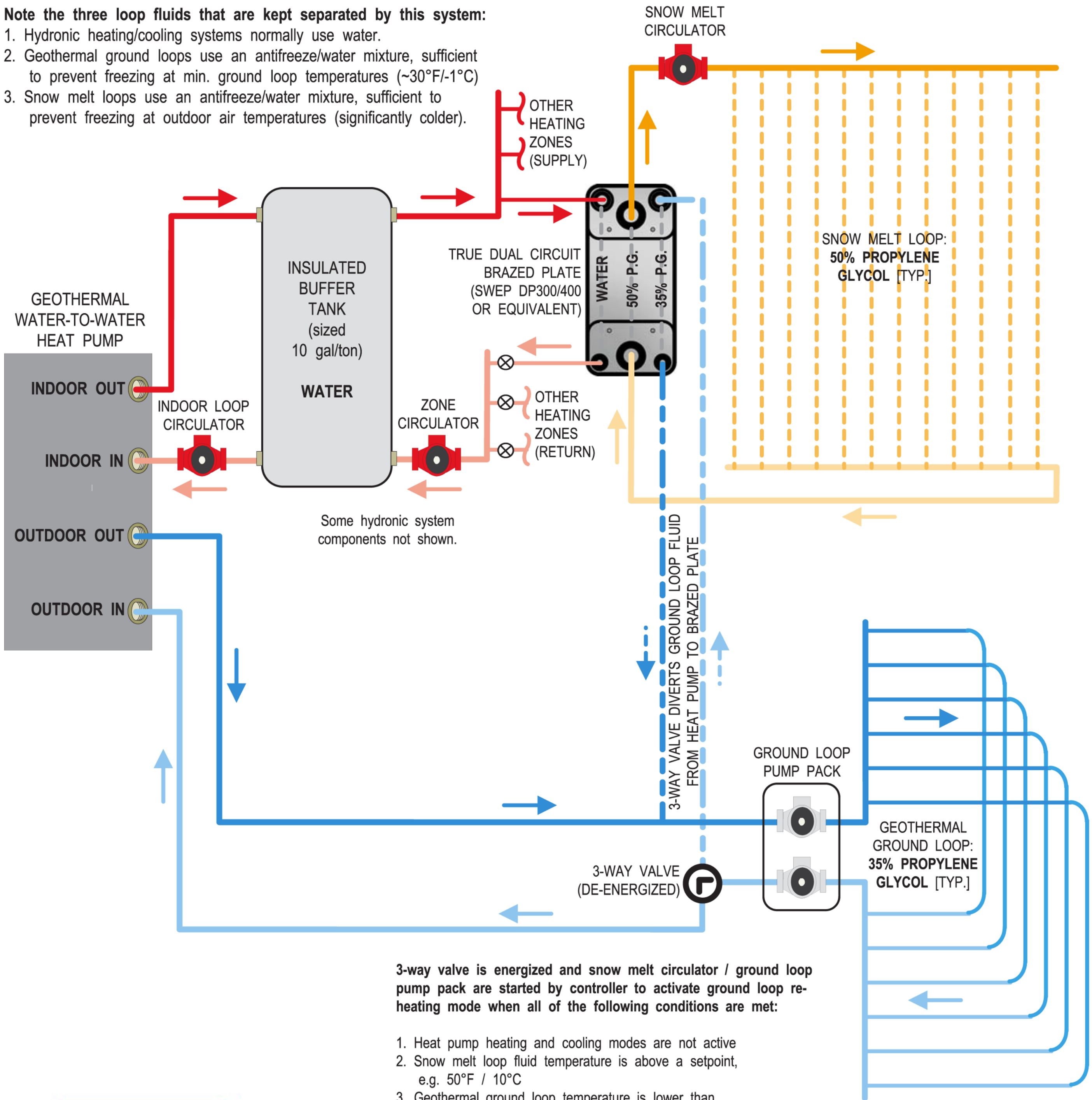
Geothermal Snow Melt System with Warm-Weather Ground Loop Re-heating

The geothermal snow melt system, designed according to ASHRAE guidelines, will efficiently **melt snow and ice** in the winter, and will act as a **solar collector** during warn weather to re-heat the geothermal ground loop and increase its cold-weather performance.

Note the three loop fluids that are kept separated by this system:

1. Hydronic heating/cooling systems normally use water.
2. Geothermal ground loops use an antifreeze/water mixture, sufficient to prevent freezing at min. ground loop temperatures (~30°F/-1°C)
3. Snow melt loops use an antifreeze/water mixture, sufficient to prevent freezing at outdoor air temperatures (significantly colder).



3-way valve is energized and snow melt circulator / ground loop pump pack are started by controller to activate ground loop re-heating mode when all of the following conditions are met:

1. Heat pump heating and cooling modes are not active
2. Snow melt loop fluid temperature is above a setpoint, e.g. 50°F / 10°C
3. Geothermal ground loop temperature is lower than snow melt loop temperature by e.g. 10°F / 5°C

When 3-way valve is energized, snow melt hydronic heating zone is locked out.

01	Initial Release	D. RHEAULT	D. RHEAULT	31-Jan-2018
REV	ECO #	IMPL BY	APVD BY	DATE

Drawn By: Dan Rheault	Date: 31-Jan-2018
Checked By: Dan Rheault	Date: 31-Jan-2018
Approved By (ENG): Dan Rheault	Date: 31-Jan-2018
Approved By (MFG)	Date
Approved By	Date

MARITIME GEOTHERMAL LTD. www.nordicghp.com

Drawing Name	Piping for Snow Melt with Ground Loop Re-heating		
Size	Drawing Number	REV	SHEET
A	002286PDG	01	1 of 1

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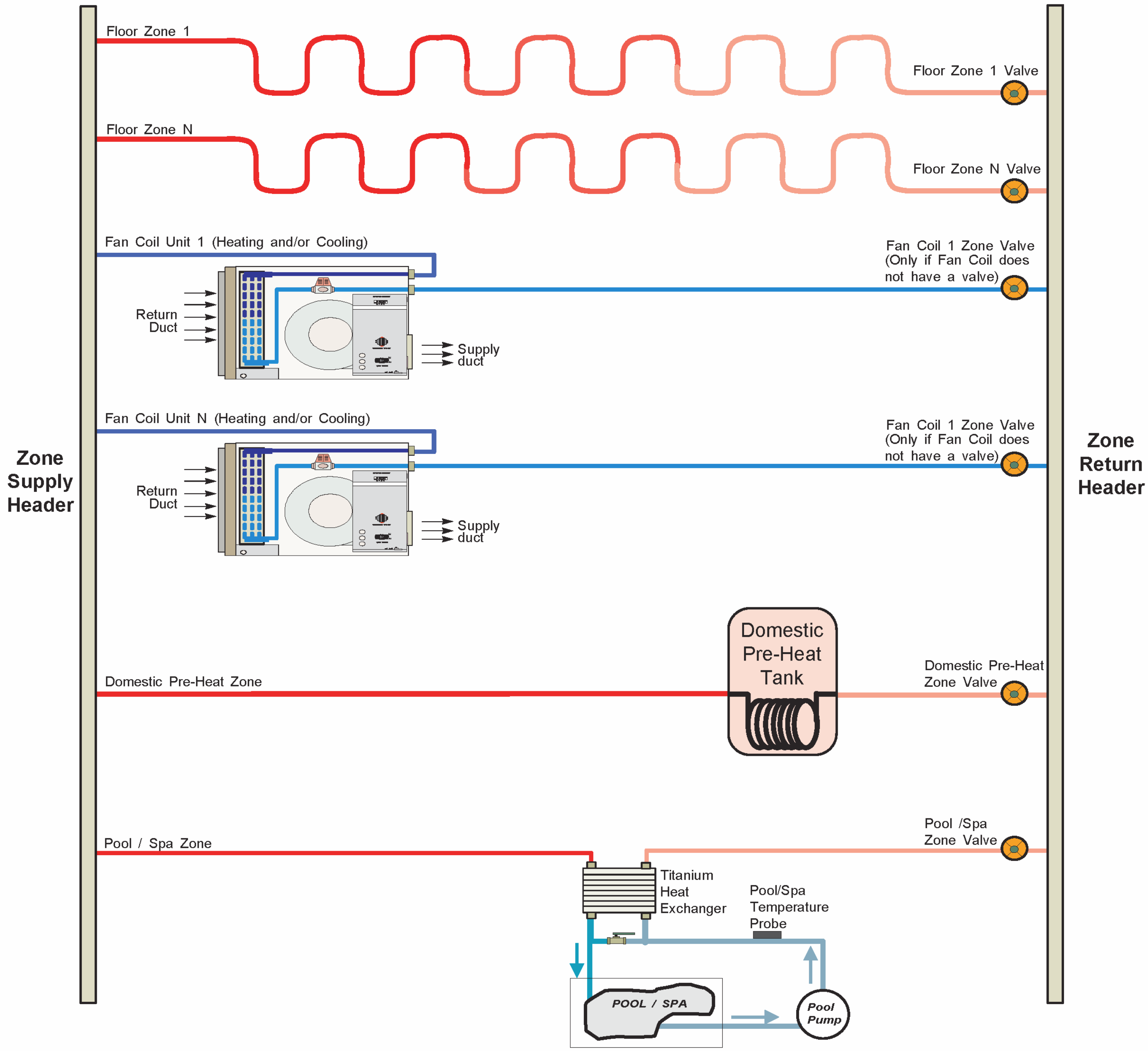
Typical Zone Types for Hydronic Applications



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

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

Drawing Name			
Typical Zone Types for Hydronic Applications			
Size	Drawing Number	REV	SHEET
A	000530PDG	01	1 of 1

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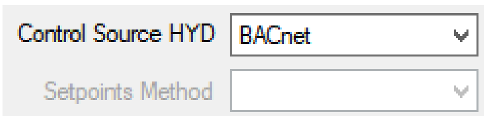
Operation

1. BACnet Control

If using **BACnet Control**, the heat pump will turn the compressors on and off and activate cooling mode (for HAC 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

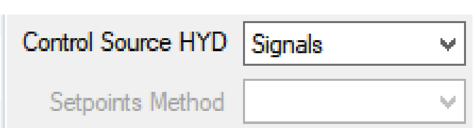
2. Signals / Hardwired Control

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 2-stage 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.

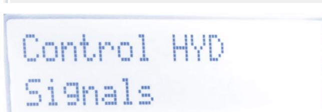
Most single-unit installations will instead use **Setpoint Control**; however, **Signals Control** provides control flexibility for certain situations, for example if two water loops with different setpoints are being heated. Temperature settings similar to those outlined in the following **Setpoint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

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). The contactor can be controlled by stage 2 of the heating aquastat through a 2-hour timer. Alternatively, tanks with their own programmable controller can be set to run independently with a lower temperature setpoint than the aquastat(s).

PC APP: Tools-->Configuration



LCD Interface: Configuration



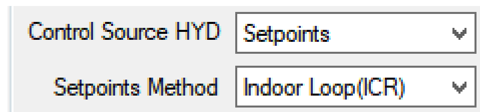
3. Setpoint Control

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).

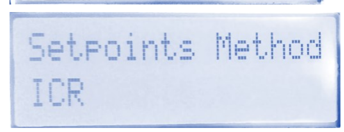
There are four options for Setpoint Control, outlined as follows.

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 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, stage 1 and stage 2 are **DISABLED** from factory. The LCD display will show "**STAGE1 DISABLED**" and "**STAGE2 DISABLED**" . To enable, use either the ***Stage 1 Enabled/Disabled*** and ***Stage 2 Enabled/Disabled*** buttons 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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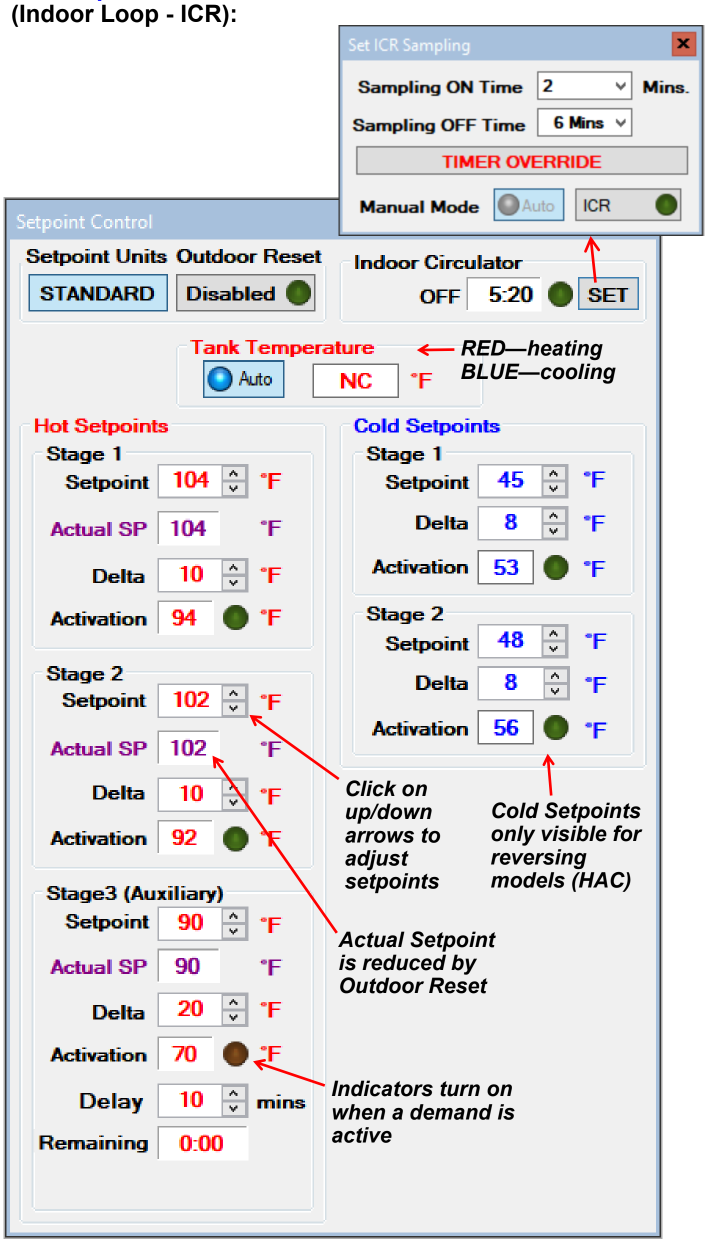
The **Setpoint Control** window looks like this for **Method 1 (Indoor Loop - ICR):**



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.

TABLE 13a - Typical W-Series Setpoints

HEATING	Stage 1		Stage 2		Stage 3 (Auxiliary)	
	°F	°C	°F	°C	°F	°C
Setpoint	**108**	***42***	**105**	***41***	**100**	***38***
Delta	**8**	***4***	**8**	***4***	**8**	***4***
Activation *	100	*38*	97	*37*	92	*34*
Delay					**10 minutes**	
COOLING *(HAC only)*	**Stage 1**		**Stage 2**		*Activation is determined by the Setpoint and Delta values	
	°F	°C	°F	°C		
Setpoint	**45**	*7*	**48**	***9***		
Delta	**8**	*4*	**8**	***4***		
Activation *	53	*11*	56	*13*		

TABLE 13b - Typical WH-Series Setpoints

HEATING	Stage 1		Stage 2		Stage 3 (Auxiliary)	
	°F	°C	°F	°C	°F	°C
Setpoint	**150**	***66***	**147**	***64***	**130**	***54***
Delta	**8**	***4***	**8**	***4***	**20**	***10***
Activation *	142	*62*	139	*60*	110	*44*
Delay					**10 minutes**	
COOLING *(HAC only)*	**Stage 1**		**Stage 2**		*Activation is determined by the Setpoint and Delta values	
	°F	°C	°F	°C		
Setpoint	**45**	***7***	**48**	***9***		
Delta	**8**	***4***	**8**	***4***		
Activation *	53	*11*	56	*13*		

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 wear on compressor due to a reduced number of compressor starts.

The maximum water temperature setpoint for the R454b **W-series** is **130°F / 54°C**, while the minimum setpoint for cooling (HAC units only) is **40°F (4°C)**.

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 **45°F (7°C)**.

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.

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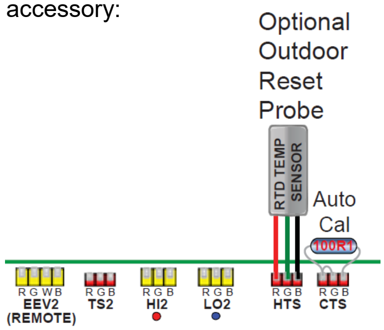
Outdoor Reset

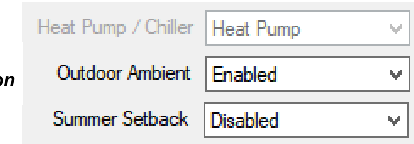
As mentioned earlier, lower heating setpoints will translate directly into a higher COP (efficiency). **Setpoint Control** has an optional Outdoor Reset control algorithm for heating mode, which reduces the heating temperature setpoints at warmer outdoor temperatures as measured by an accessory outdoor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

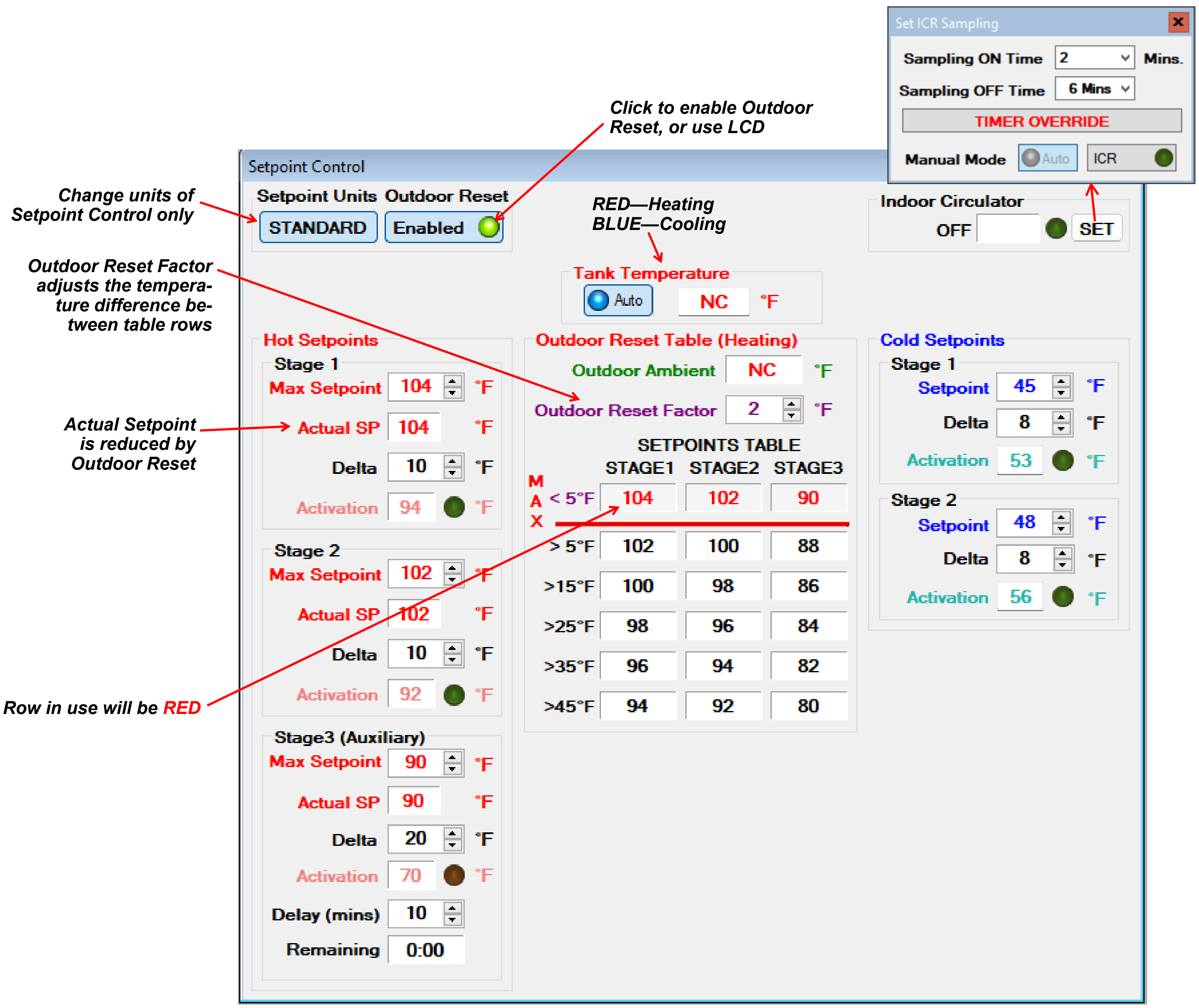
PC APP: Tools-->Configuration



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).

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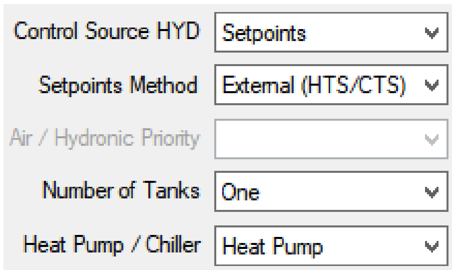
Setpoint Control Method 3 - External (HTS/CTS) One Tank

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

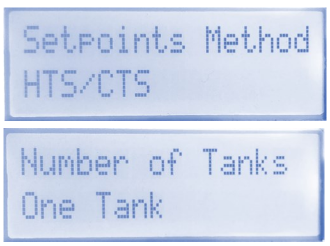
Most of the time, hydronic heating/cooling heat pumps work in response to the temperature of the indoor loop (indoor buffer tank). The previously described control methods (1, 2) work this way, as does this one. This is ***Heat Pump Mode***, and is the only control option for reversing models (HAC).

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

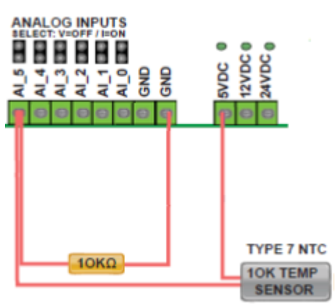


LCD Interface: Configuration



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.***

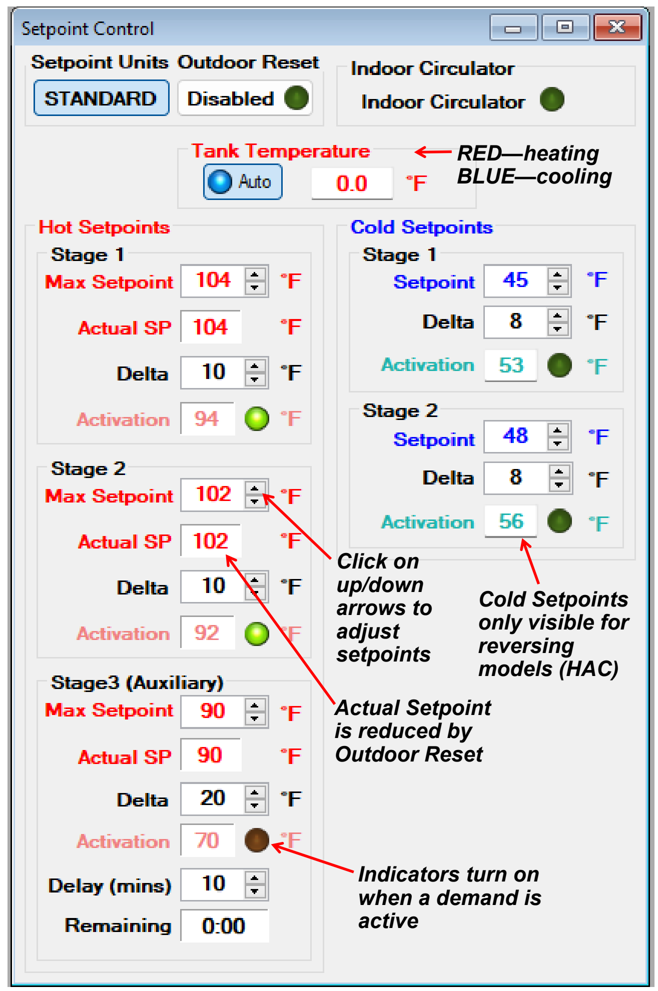


For reversing models only (HAC), cooling mode is selected by making a dry contact connection between **R/RA** and **O** on the right side of control board. This is the one external control requirement.

To prevent the compressor from starting when the power is first turned on, stage 1 and stage 2 are **DISABLED** from factory. The LCD display will show "**STAGE1 DISABLED**" and "**STAGE2 DISABLED**". To enable, use either the ***Stage 1 Enabled/Disabled*** and ***Stage 2 Enabled/Disabled*** buttons 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.

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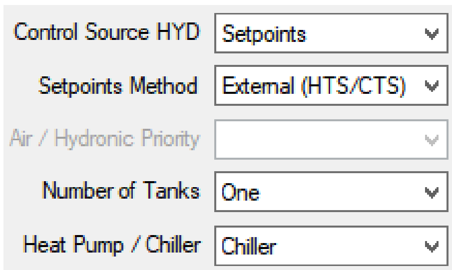
b) HTS/CTS w/ One Tank - Chiller Mode

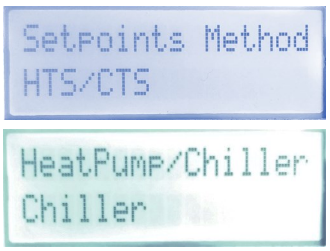
For ***non-reversing models only*** (H), **Chiller Mode** allows the heat pump to be controlled from the Outdoor Loop (cold side) rather than the Indoor Loop (hot side) for applications that require controlled cooling with high temp water rejection. The heat pump is still operating in "heating mode";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

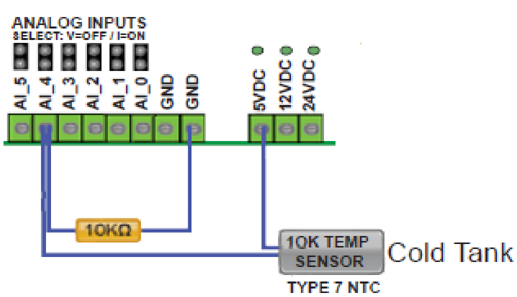


LCD Interface: Configuration



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, stage 1 and stage 2 are **DISABLED** from factory. The LCD display will show "**STAGE1 DISABLED**" and "**STAGE2 DISABLED**" . To enable, use either the ***Stage 1 Enabled/Disabled*** and ***Stage 2 Enabled/Disabled*** buttons 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.

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

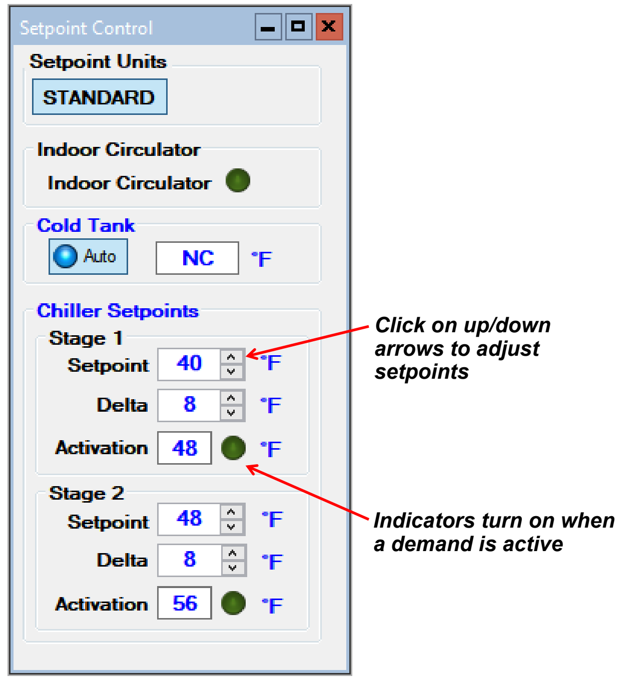
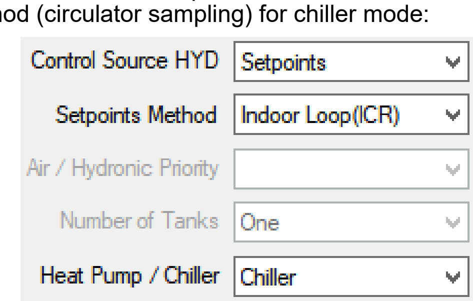


TABLE 14 - Typical Setpoints
HTS/CTS Method-Chiller Mode

	Stage 1		Stage 2		
	°F	°C	°F	°C	*Activation is determined by the Setpoint and Delta values
Setpoint	45	*7*	48	*9*	
Delta	8	*4*	8	*4*	
Activation *	53	*11*	56	*13*	

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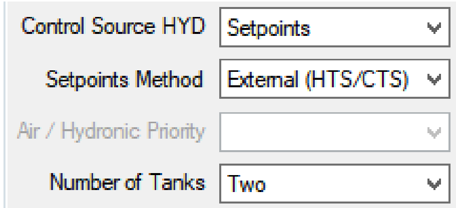
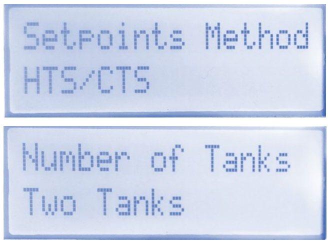
Setpoint Control Method 4 - External (HTS/CTS) Two Tanks

****REVERSING MODELS ONLY (HAC)***

PC APP: Tools-->Configuration

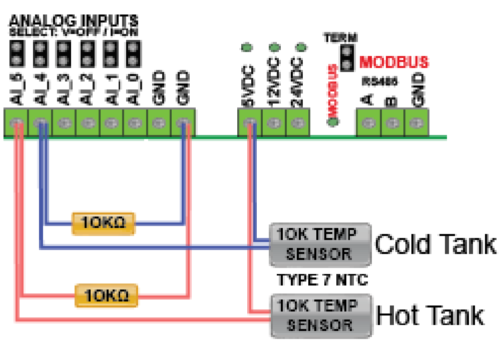


LCD Interface: Configuration



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.***



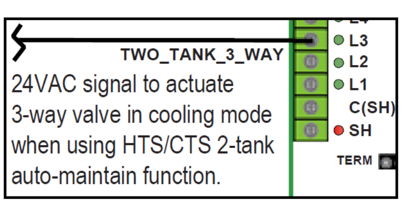
a) O Signal Control

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).

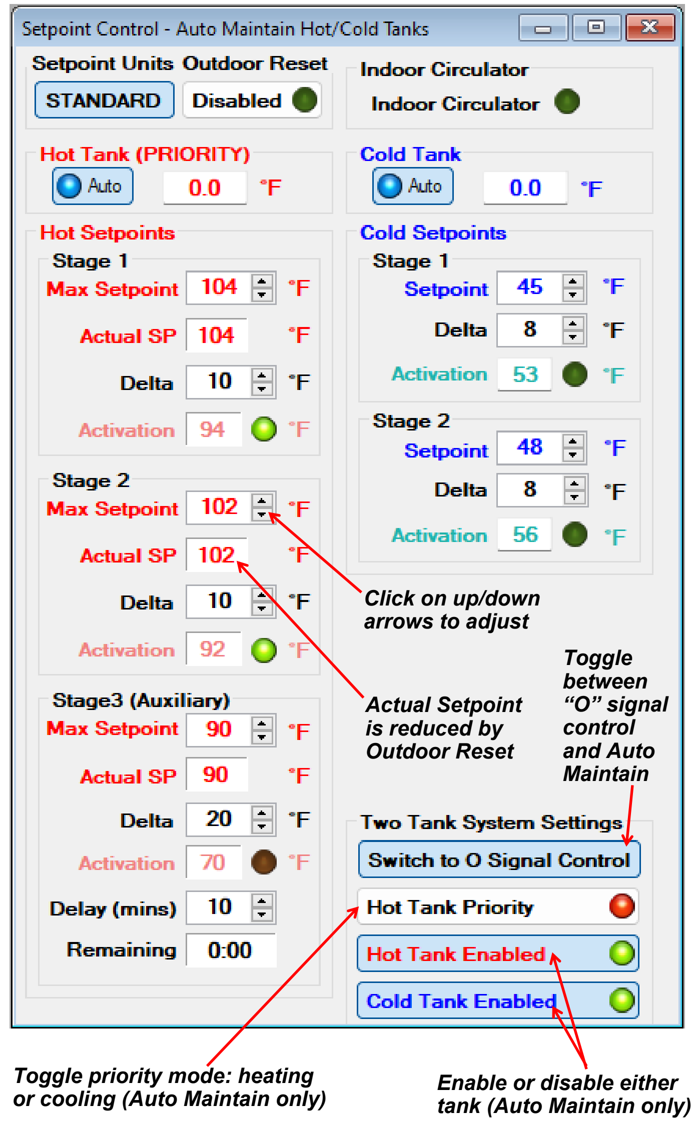
b) Auto Maintain

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):**



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, stage 1 and stage 2 are **DISABLED** from factory. The LCD display will show "**STAGE1 DISABLED**" and "**STAGE2 DISABLED**". To enable, use either the ***Stage 1 Enabled/Disabled*** and ***Stage 2 Enabled/Disabled*** buttons at the top right corner of the PC App's ***Tools-->Configuration*** window, or use the LCD interface and select ***SYSTEM EN/DIS***.

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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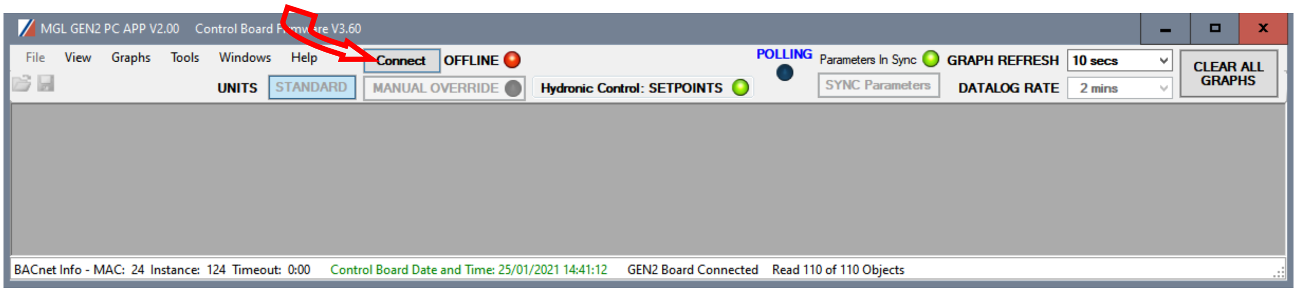
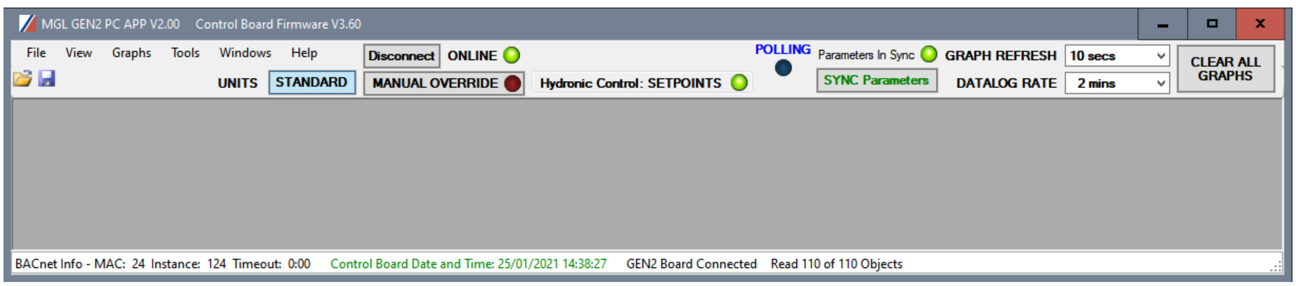
PC Application (PC APP)

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

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



Once connected, the menus and buttons will become accessible, the number of Objects available and Read should appear (they should be the same) and the Polling LED will begin to flash. The PC time and date will appear at the bottom left corner of the screen. Clicking on "Control Board Date and Time" will display the current control board date and time. If the date and time need to be adjusted, click on menu ***Tools—>Set Date and Time***. The control board date and time will be set to that of the PC.



PC Application Menus

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

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

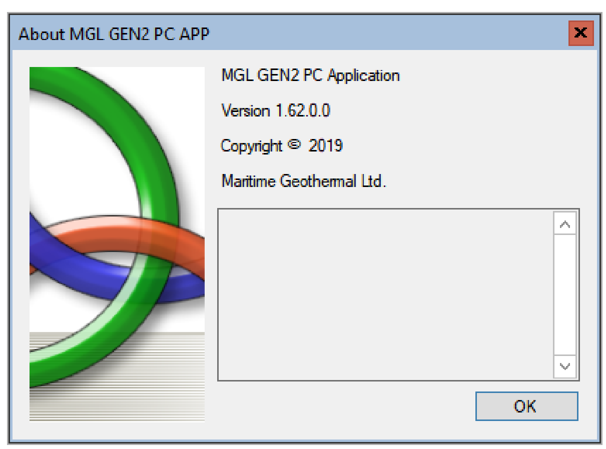
File-->Open: Opens a saved page arrangement.
File-->Save: Saves the current page arrangement under the current name.
File-->Exit: Exits the PC Application.

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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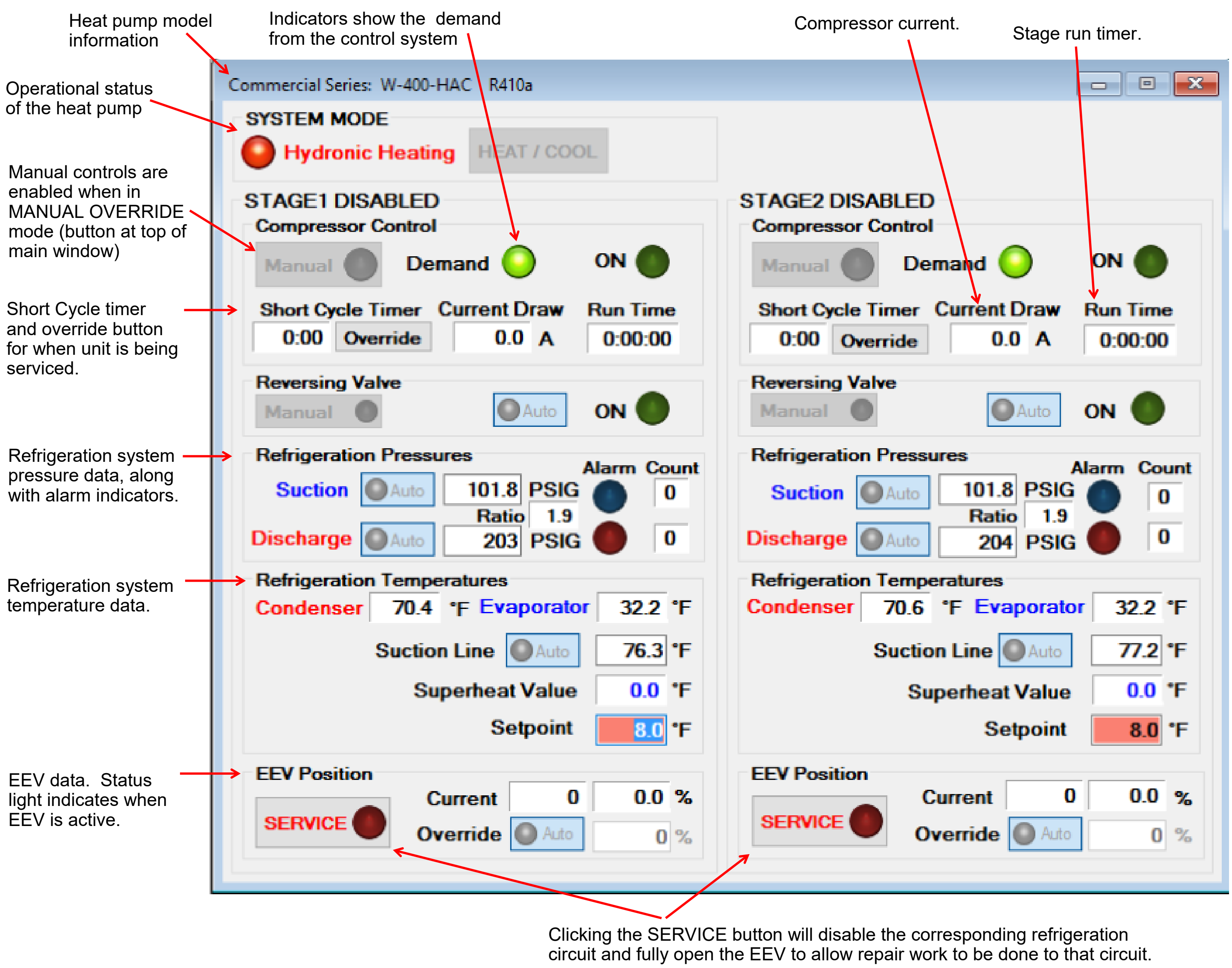
View Menu:

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

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



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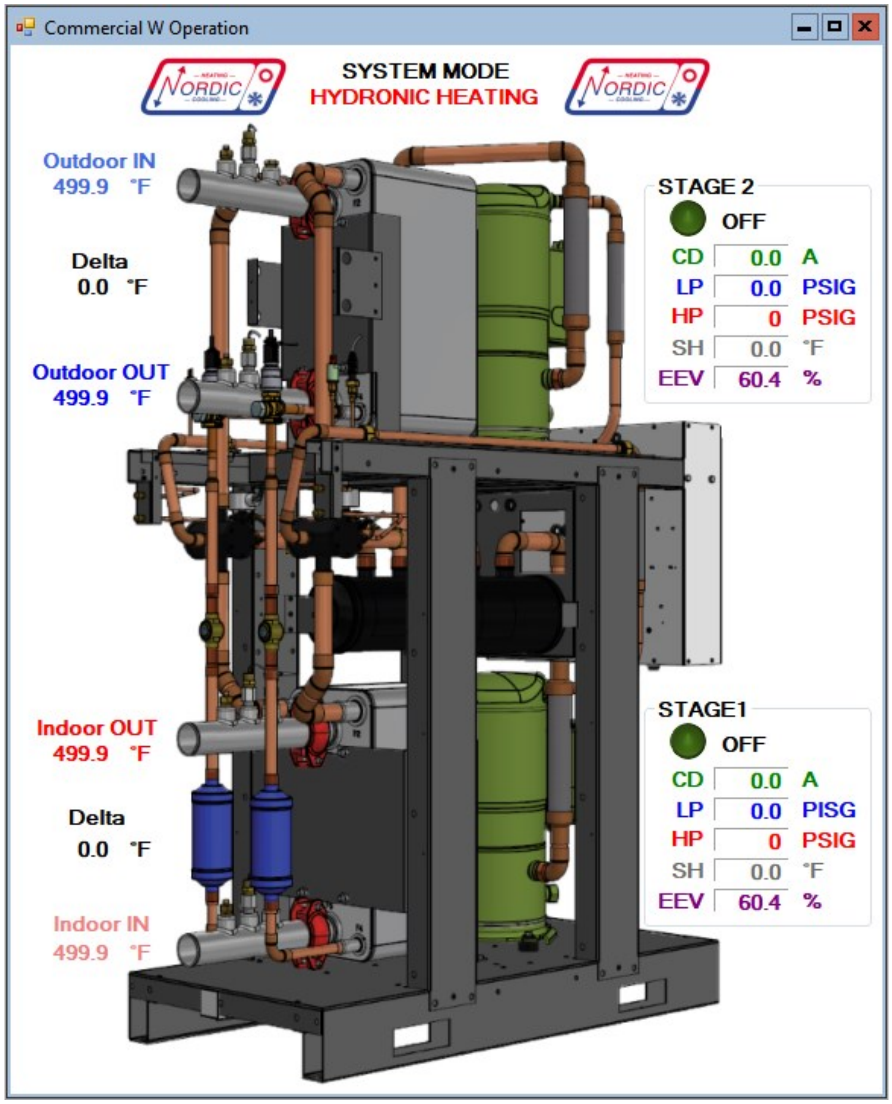
View-->Commercial W Operation:

Shows a graphical display that allows convenient monitoring of heat pump operation, including:

- operation mode, and stage 1 & 2 on/off status
- water line in/out temperatures and delta T
- compressor current draw
- low & high refrigeration pressures
- superheat and EEV % open



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 **BACnet** or **Signals**).

Refer to the **Operation** chapter 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 only occur one time at which point they immediately create a **Permanent Alarm**.

Alarms with a count: when an alarm occurs the compressor will stop, the alarm count will increase, and the ***Short Cycle Timer*** will start. When the ***SC Timer*** expires the compressor will re-start. If no further alarms occur within ***Count Reduce Time***, the alarm count will be reduced by 1. If another alarm occurs within ***Count Reduce Time*** (see **Configuration** window) 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. The compressor will be locked out until the ***Permanent Alarm*** is manually reset either by cycling the power or clicking on the ***RESET*** button.

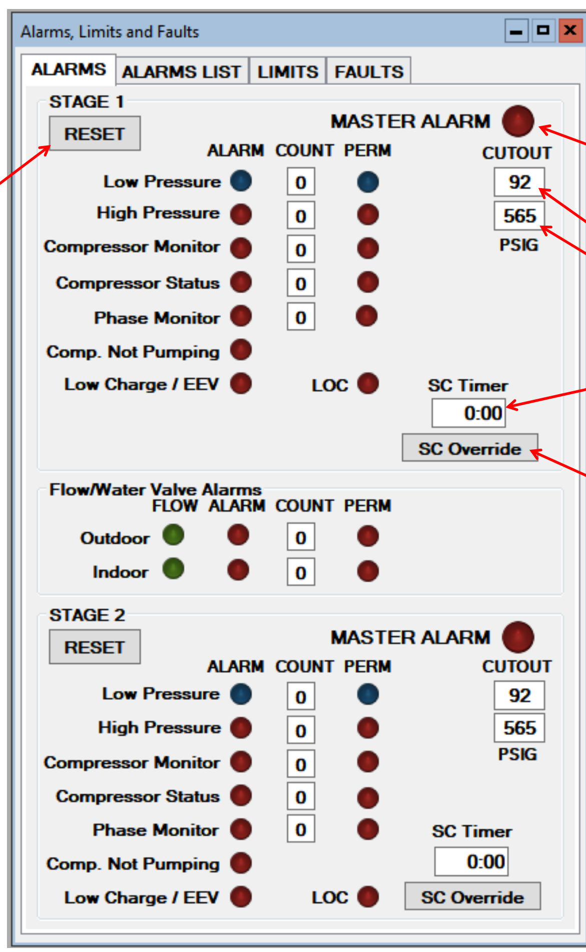
Master Alarm is active when any permanent alarm is active. It is used to simply indicate that there is an alarm.

Low Pressure:	The suction pressure has dropped to or below the ***Low Pressure Cutout*** value. When the compressor starts, a low pressure condition will be ignored for the number of seconds that ***Low Pressure Ignore on Start*** *(menu* ***Tools-->Configuration, Alarms and Delays*** *tab)* is set to, after which the low pressure alarm will be re-enabled. This allows a dip in suction pressure below the cutout point during startup without causing a nuisance alarm.
High Pressure:	The discharge pressure has risen to or above the ***High Pressure Cutout*** value.
Compressor Monitor:	The compressor protection module (if present) has sent a fault signal to the control board, generally due to the compressor windings overheating.
Compressor Status:	There is a current draw as sensed by current sensor but no call for the compressor to be on (i.e. stuck contactor) or there is a call for the compressor to be on but there is no current draw (i.e. manual high pressure control is open or contactor failure).
Phase Monitor:	The phase monitor has detected a fault condition and sent a fault signal to the control board. For three phase units only.
Comp. Not Pumping:	Discharge pressure is less than 30 psi higher than suction pressure after 1 minute run time. It indicates leaking reversing valve, manual high pressure control trip, bad contactor, or defective compressor.
Low Charge / EEV:	The EEV has been at >99% for 20 minutes within first hour of a cycle.
LOC (Loss of Charge):	This alarm occurs if the low pressure and/or high pressure sensors read 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

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.

Greyed out alarms (if any) are not applicable to the system.

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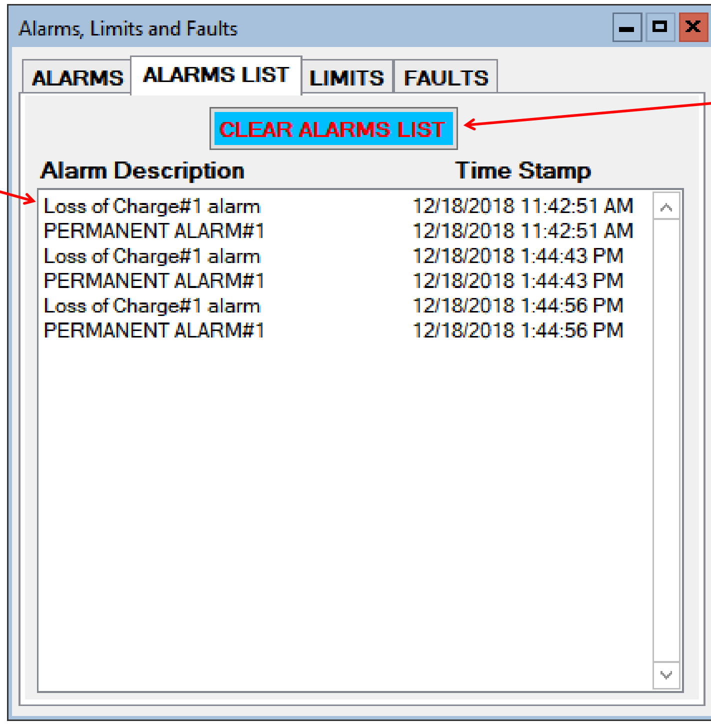
View-->Alarms, Limits and Faults (ALARMS LIST Tab):

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

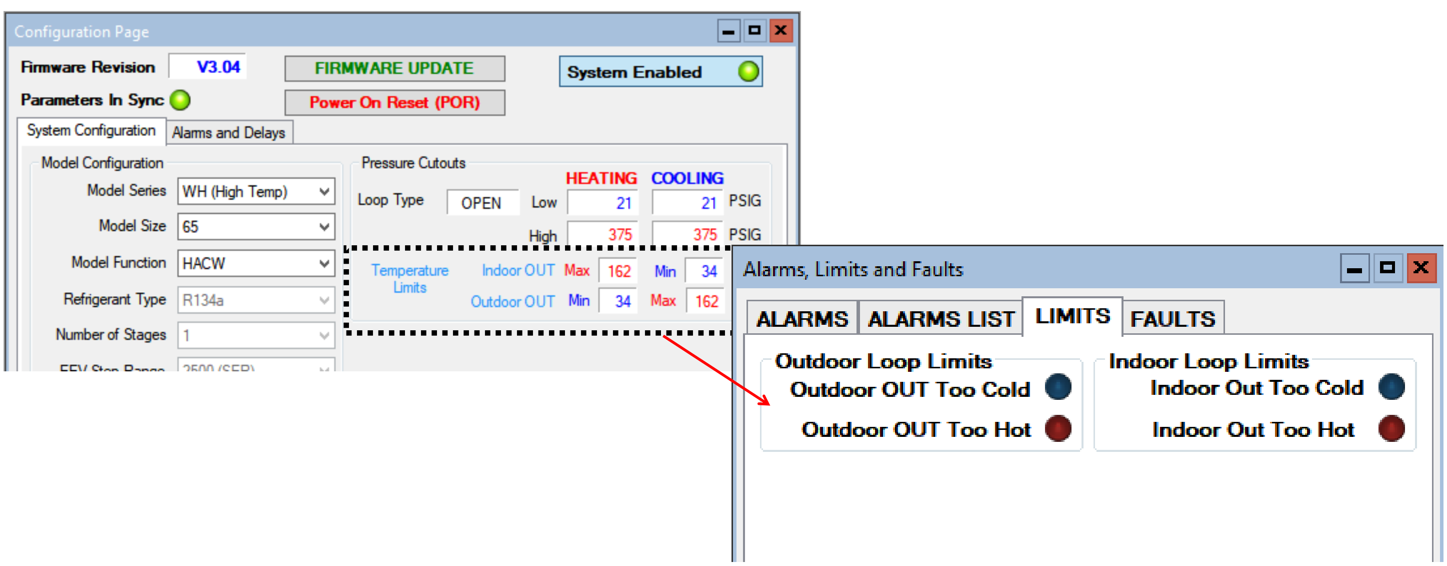
Each alarm that occurs while the PC APP is connected to the control board will appear here. The alarm type and a time stamp will be shown. The alarms list will be erased when the PC APP is disconnected from the control board.



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

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

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



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

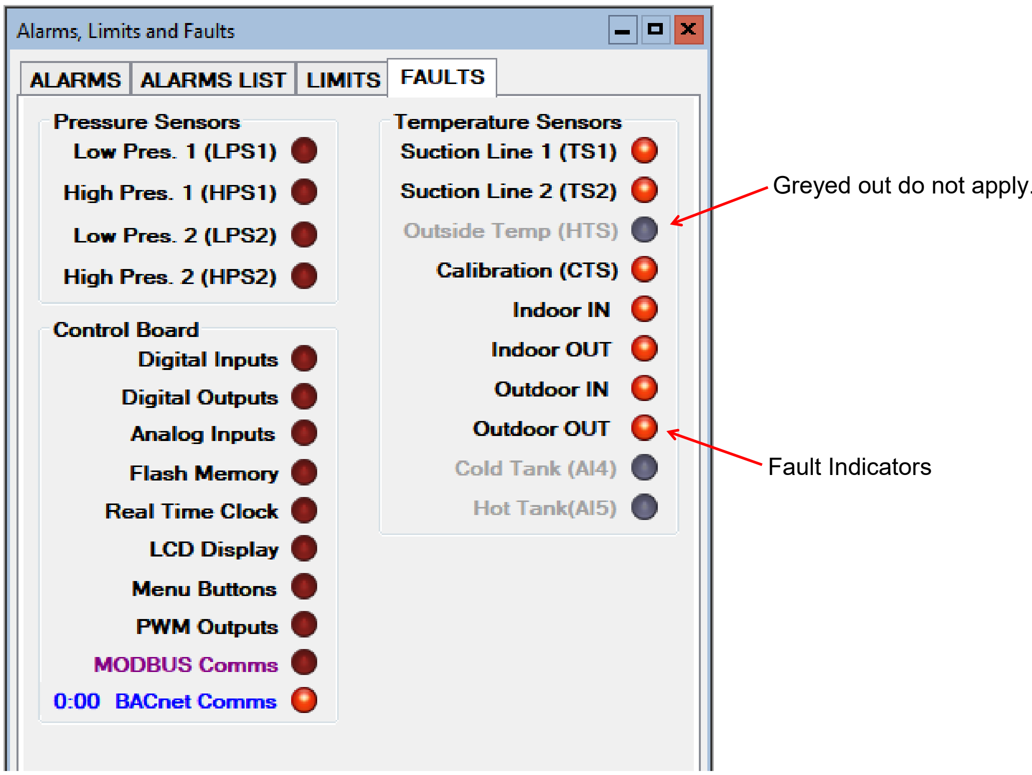
This tab shows hardware faults that could occur. If one of these faults occurs there may be a problem with the control board hardware, with LCD Display and buttons, or with a sensor.

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 Display or Menu Button faults, turn off the power, disconnect and reconnect the cable between the LCD display board and the control board, then turn the power back on again.

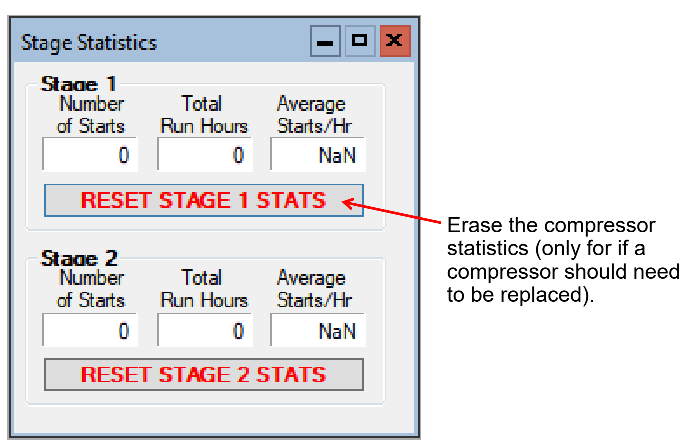
If the fault persists then there is most likely a hardware problem, and the sensor, control board, or LCD display board will need to be replaced.

IMPORTANT NOTE: If the Indoor OUT (I_OUT) temperature sensor is faulty or disconnected, neither the heat pump nor the auxiliary will operate if using Setpoint Control. They will continue to operate under BACnet control.



View-->Stage Stats:

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



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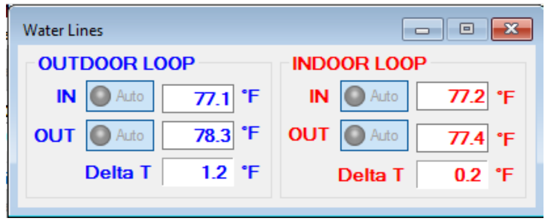
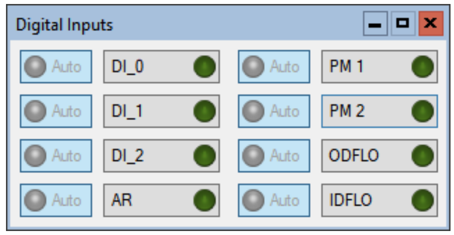
View-->Water Lines

Shows the water line temperatures.



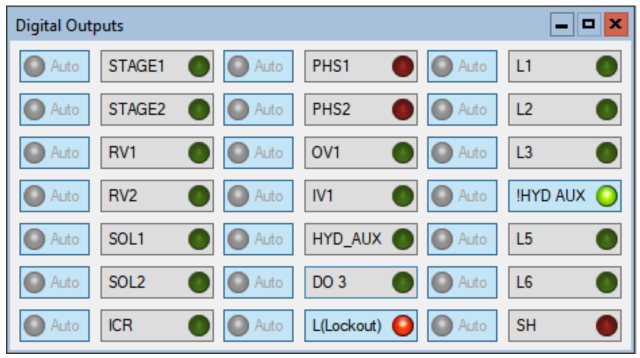
View-->Digital Inputs

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



View-->Digital Outputs

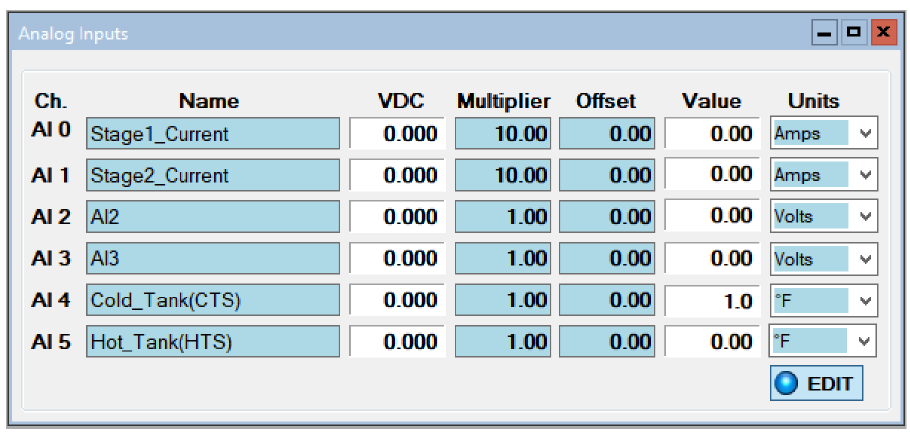
Shows the digital outputs and their individual status (ON/OFF). They may be individually controlled when in Manual Override Mode in order to facilitate troubleshooting.
.



View-->Analog Inputs

Shows the Analog inputs and their individual settings and values.

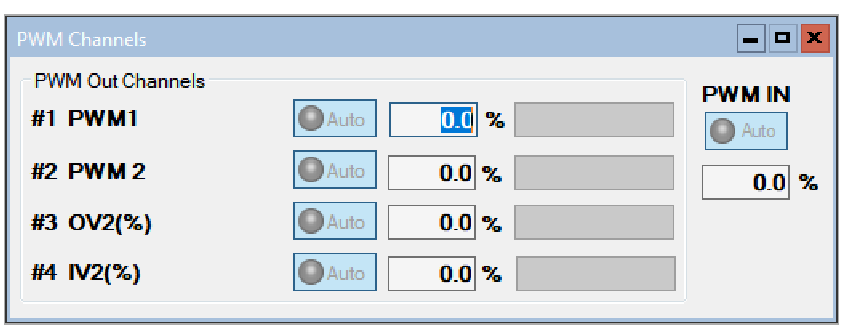
Click on the ***EDIT*** button to modify the blue boxes (button will now say ***SAVE***). For each channel a name may be selected (up to 16 characters), and the multiplier and Offset values may be set to accommodate the connected sensor scaling. Signals may be 4-20mA (channel jumper on board ON) or 0-10VDC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



View-->PWM Channels

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

EMW-series does not use any PWM channels.



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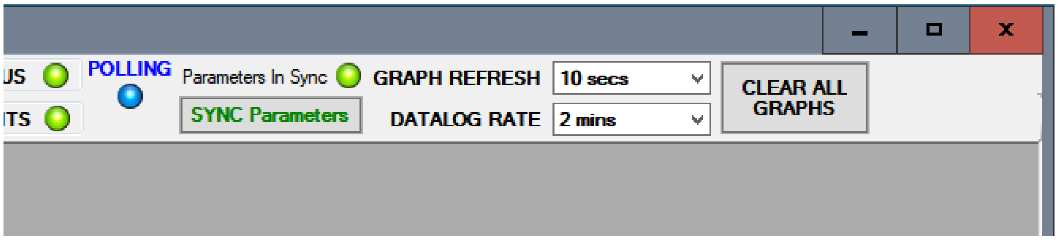
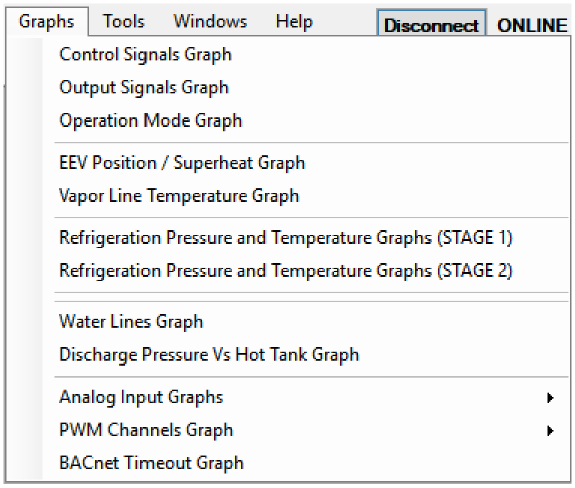
Graphs Menu:

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.

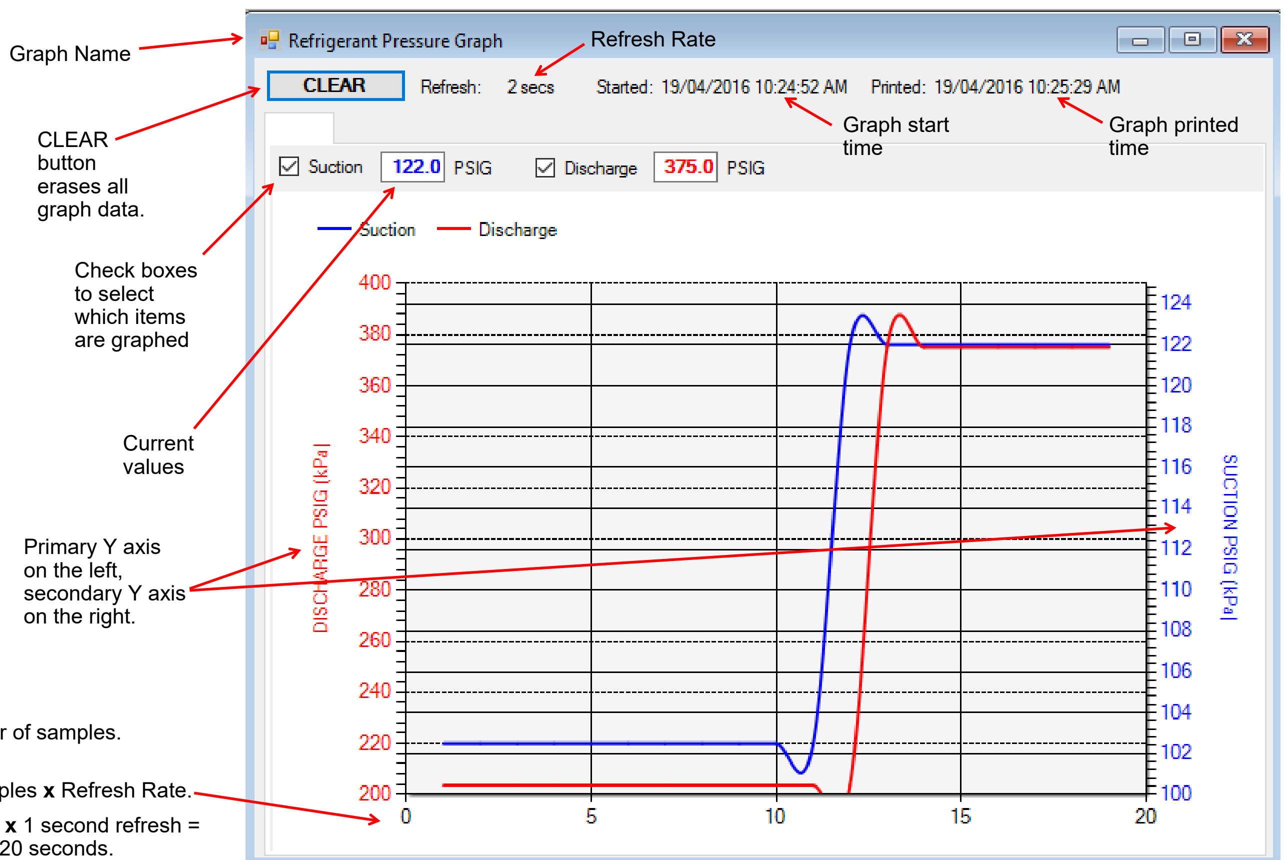


TIP: To screen print a graph and save it as a picture, press Print Screen on the keyboard and then paste into MS Paint or other graphics program. Select the desired graph with the selection tool and copy it to a new MS Paint, then save the file as the desired name.



ON/OFF status of the system control signals (demands).
ON/OFF status of digital outputs.
ON/OFF status of heating and cooling modes.
EEV position and resulting superheat.
Suction temperature.
Suction and discharge pressures & temperatures for Stage 1.
Suction and discharge pressures & temperatures for Stage 2.
2 tabs: one for Indoor IN/OUT/Delta T, and one for Outdoor IN/OUT/Delta T.
Discharge pressure vs. hot tank temperature.
All analog input channels (0-10VDC or 4-20mA).
All PWM / 0-10VDC output channels and one PWM / 0-10VDC input channel.
For troubleshooting synchronization with 3rd party BACnet controllers.

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



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 the update

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

Firmware update: see Appendix

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

Enable/disable compressor 1 and 2. Units are shipped as Disabled to prevent an unintentional compressor startup.

Model Configuration chapter to select the system type

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

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

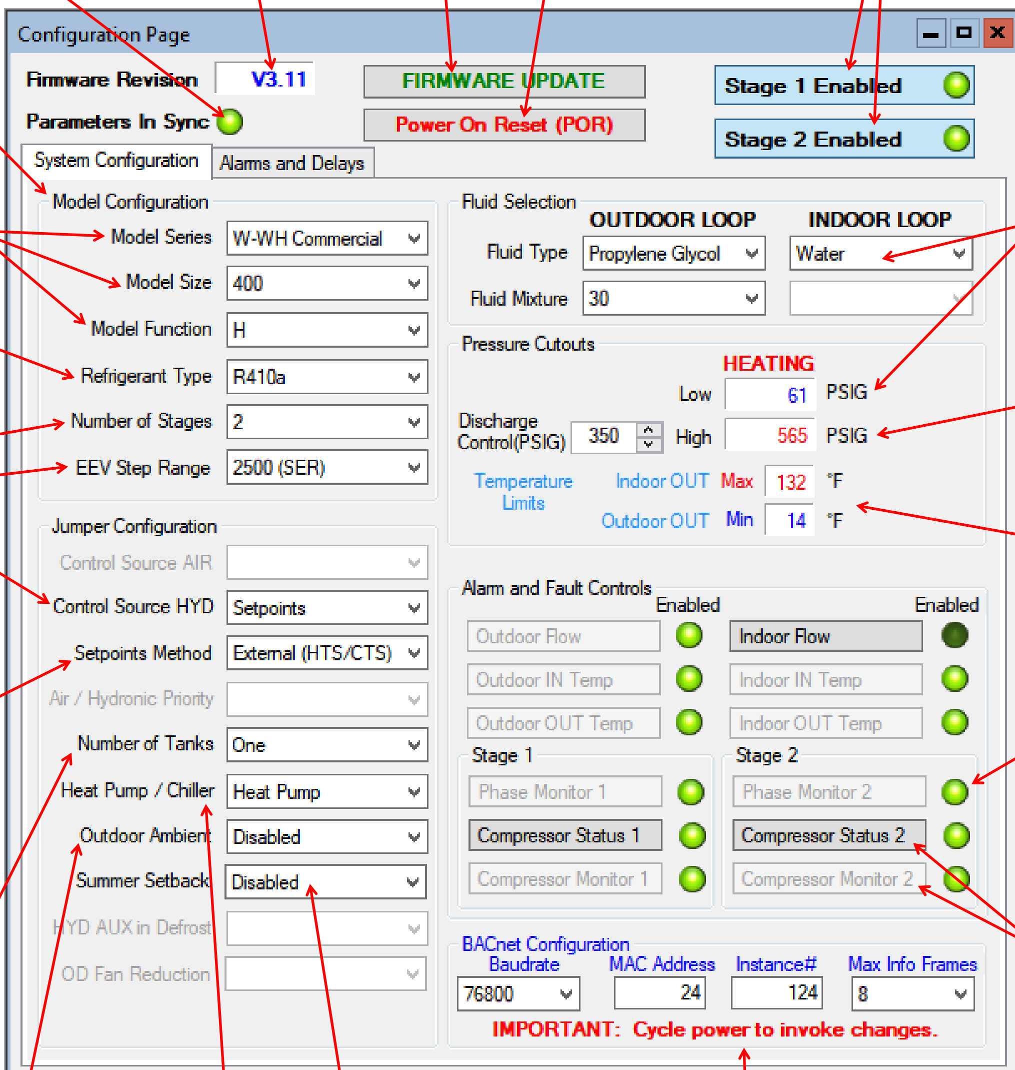
Most commercial units are 2-stage

Always 2500

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

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

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



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 Phase Monitor or Current Sensor accessories) the Enable button will be available; click to enable.

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.

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

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

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

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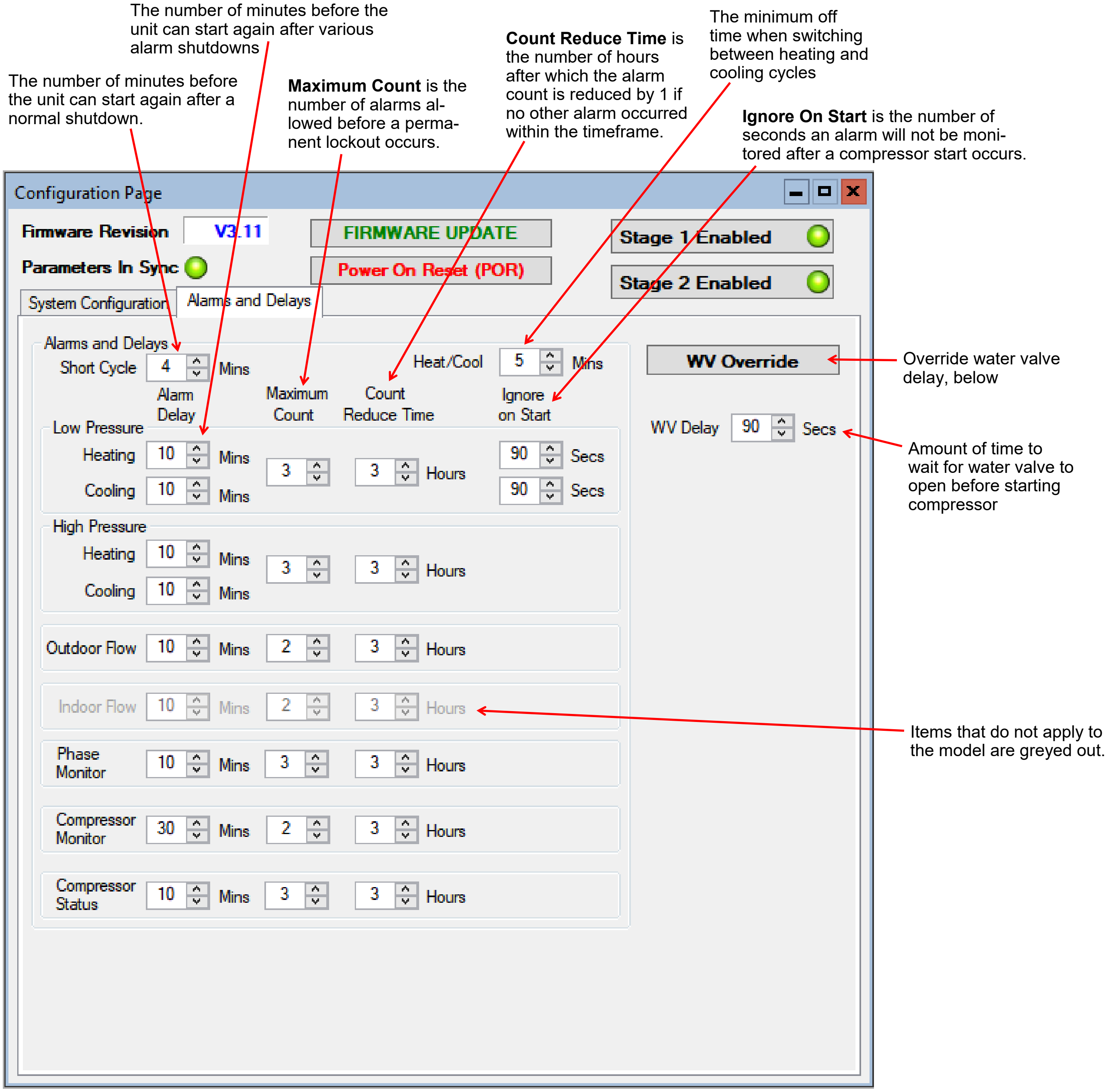
Tools-->Configuration (Alarms and Delays tab):

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



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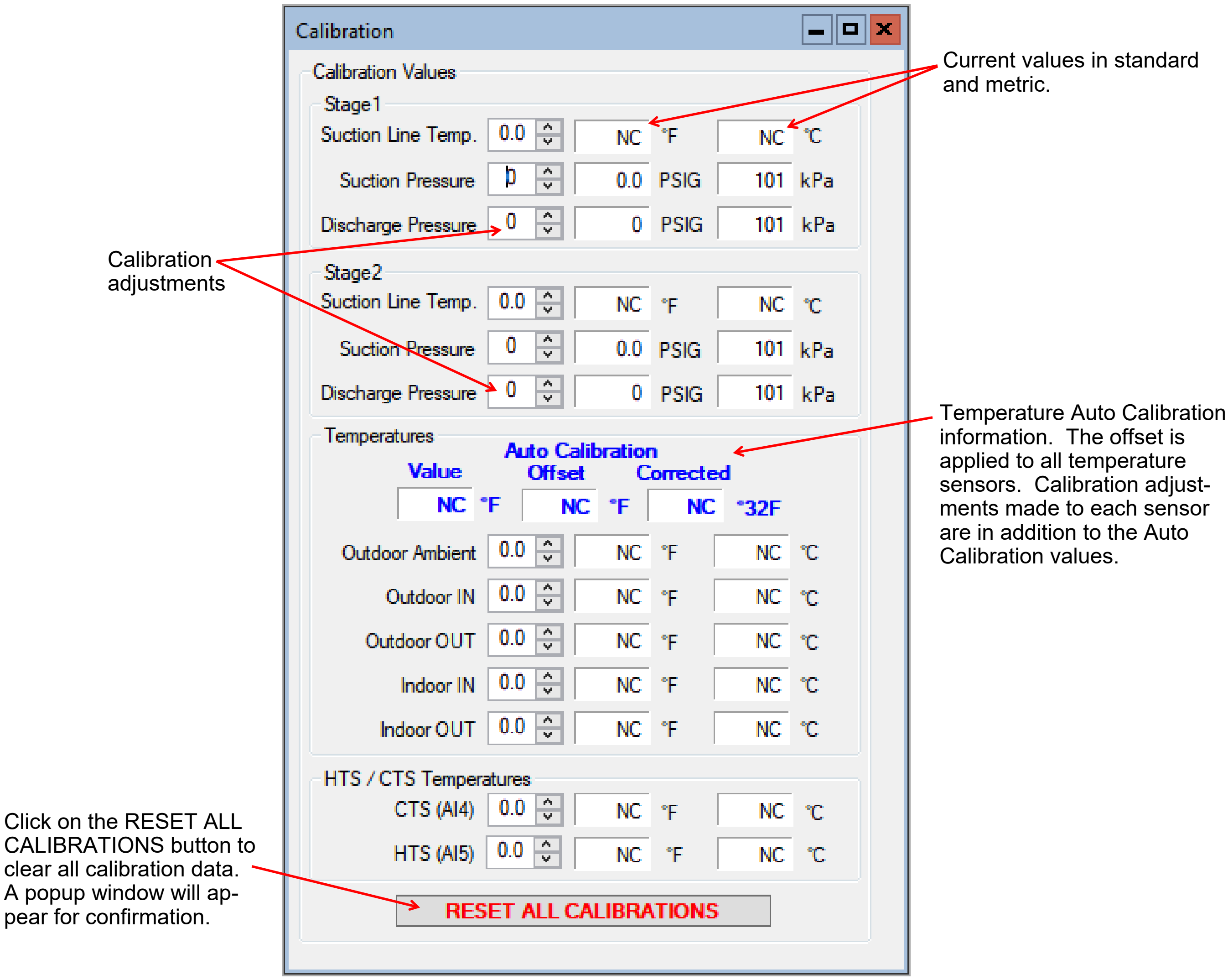
Tools-->Calibration:

Generally there is no need for calibration.

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

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

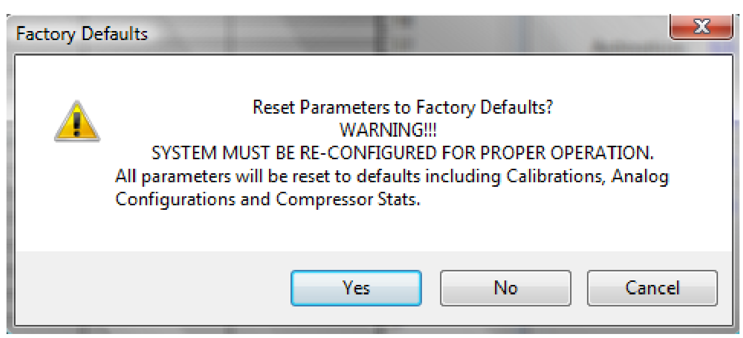


Tools-->Reset to Factory Defaults:

This will reset all parameters to default values.

THE SYSTEM MUST BE RECONFIGURED AFTER A RESET IS PERFORMED.

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



Tools-->Set Date and Time:

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

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

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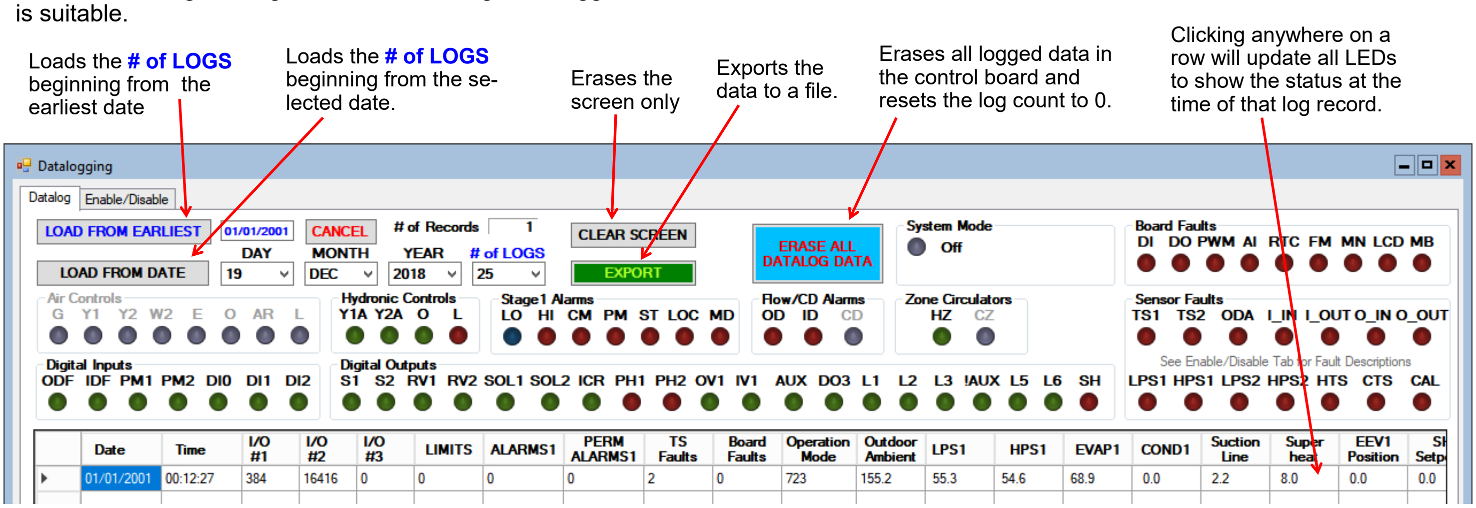
Tools-->Datalogging (Datalog tab):

A log will be automatically recorded at the following rates:

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

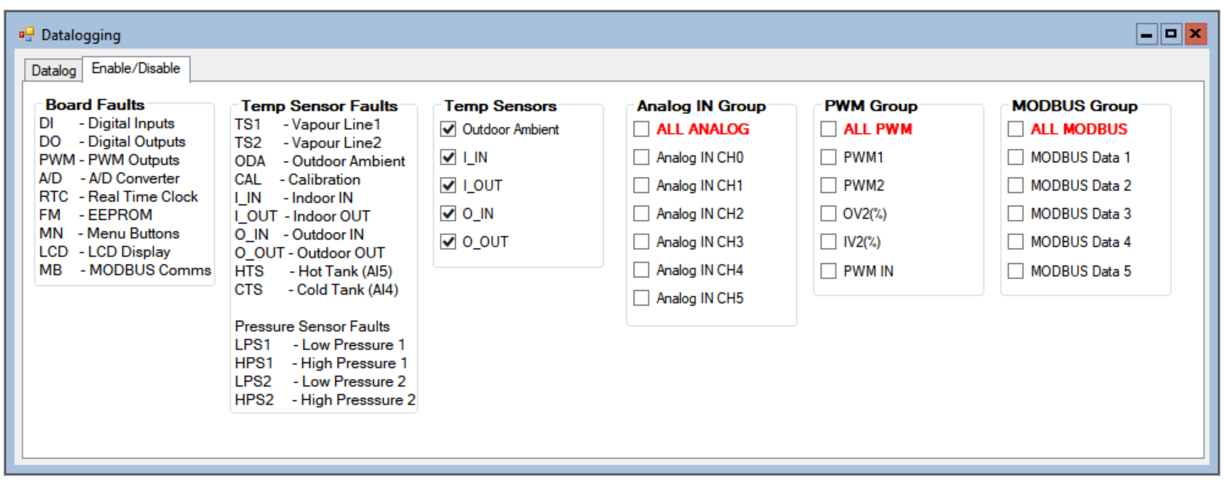
The maximum number of datalog records is 32,224, which will take 45 days to fill up at the default recording rate of 2 minutes.

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



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

Click on the checkboxes to customize which columns are shown/hidden in the datalog table. Boxes must be checked to be included in exported data.

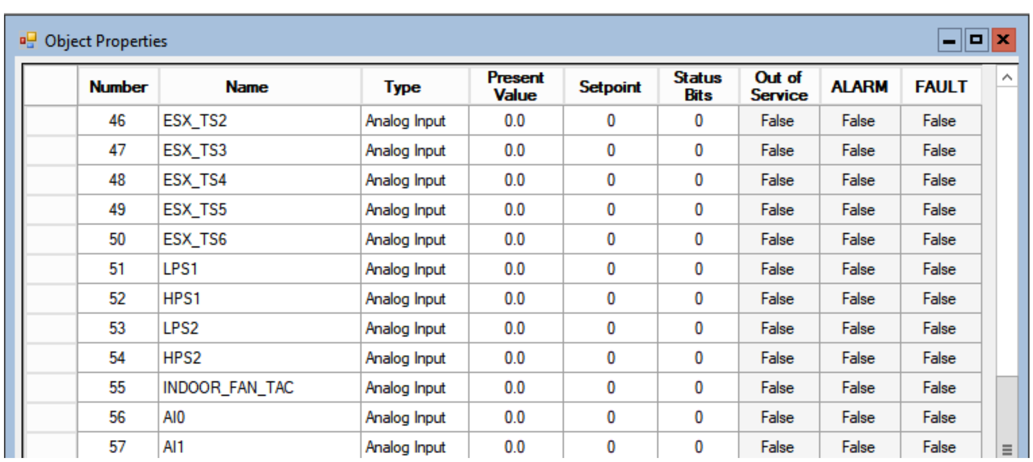


Tools-->MODBUS:

For future use.

Tools-->Objects:

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



Object Properties

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

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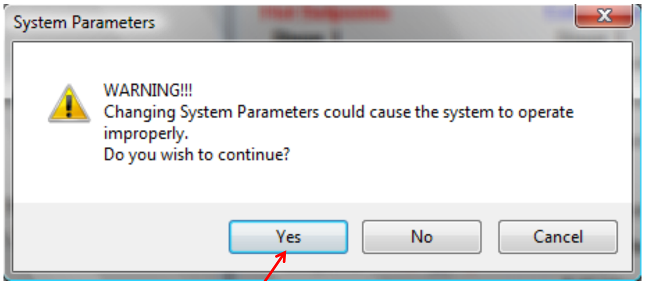
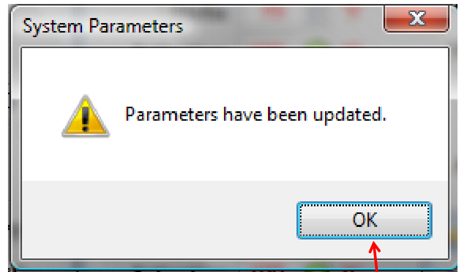
Tools-->Parameters:

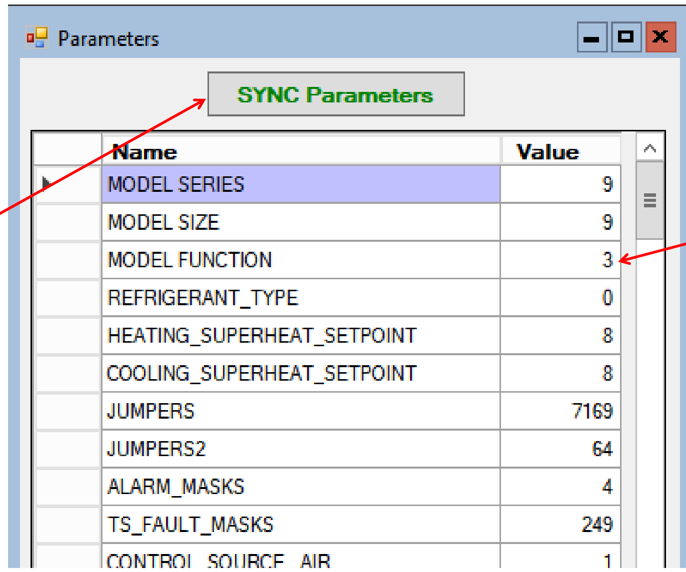
WARNING! The Parameters page is for advanced use only.
Changing parameter values can cause the system to stop functioning properly.

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





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

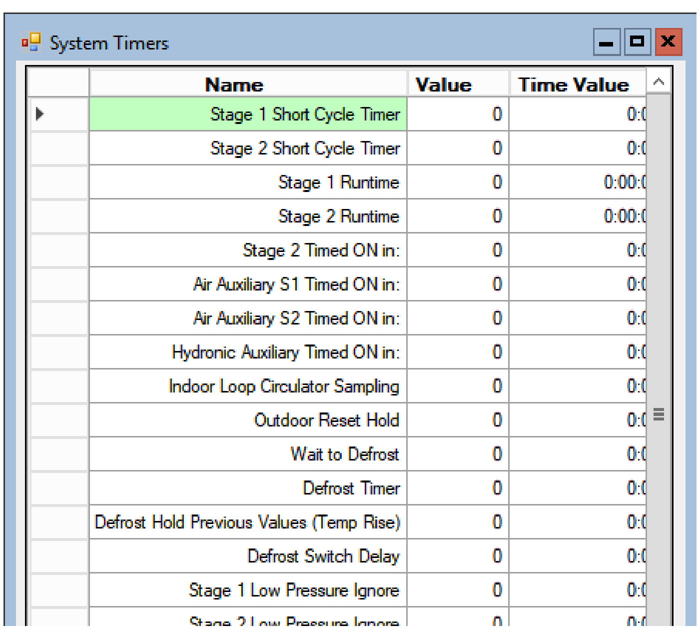


Click this button to reload the table with the values from the control board memory.

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

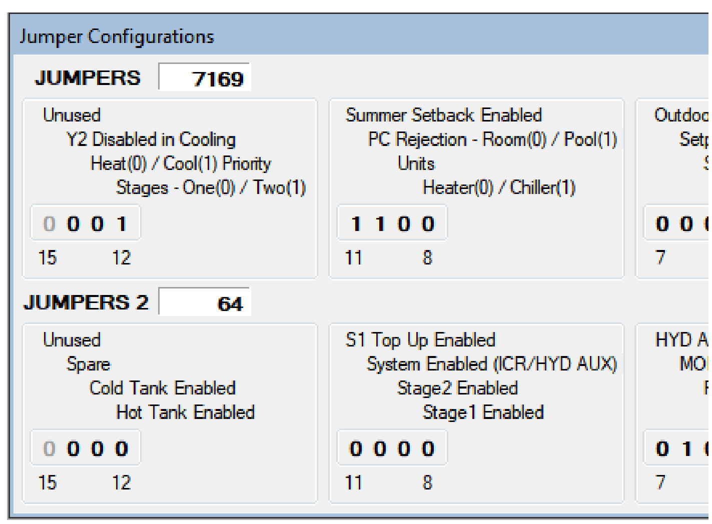
Tools-->SYSTEM TIMERS:

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



Tools-->Jumpers:

This page shows internal jumper configurations, for developers.



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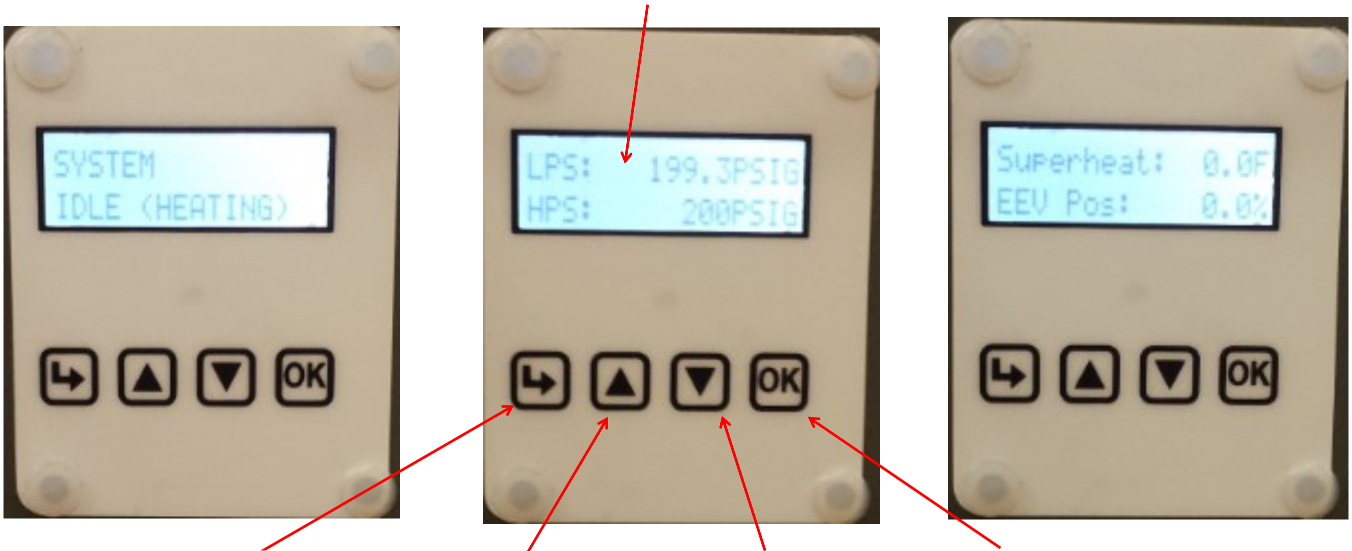
LCD Interface & Menus

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.
			— Stage 2 Setpoint	Stage 2 stops when water temperature rises to this point.
			— Stage 2 Delta	Stage 2 starts when water temperature drops below setpoint by this amount.
			— AUX (S3) Setpoint	Stage 3 stops when water temperature rises to this point.
			— AUX (S3) Delta	Stage 3 time delay starts when water temperature drops below setpoint by this amount.
			— 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.
			— Stage 2 Setpoint	Stage 2 stops when water temperature drops to this point.
			— Stage 2 Delta	Stage 2 starts when water temperature rises above setpoint by this amount.
Summer Setback	***— Enable Setback?***	***— Enable***		Enable summer setback.
		— Disable		Disable summer setback.

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ENTER (From Main)	ENTER (First Press)	ENTER (Second Press)	ENTER (Third Press)	Description
System EN/DIS	***— STAGE 1 (Bot)***	***— Enable***		Enable compressor 1, auxiliary, and ICR.
		— Disable		Disable compressor 1, auxiliary, and ICR.
	— STAGE 2 (Top)	***— Enable***		Enable compressor 2, auxiliary, and ICR.
		— Disable		Disable compressor 2, auxiliary, and ICR.
Service Mode	***— STAGE 1 (Bot)***	***— No***		Do not enter Service Mode for stage 1.
		— Yes		Enter into Service Mode for stage 1.
	— STAGE 2 (Top)	***— No***		Do not enter Service Mode for stage 2.
		— Yes		Enter into Service Mode for stage 2.
EEV Control	***— EEV1 (Bot)***	***— Auto/Manual***	***— Auto***	Puts EEV1 in Auto mode
			— Manual	Puts EEV1 in Manual mode
		— Manual Position	***— EEV1 Position (%)***	Enter desired EEV1 position
	— EEV2 (Top)	***— Auto/Manual***	***— Auto***	Puts EEV2 in Auto mode
			— Manual	Puts EEV2 in Manual mode
		— Manual Position	***— EEV2 Position (%)***	Enter desired EEV2 position
Configuration	***— Control HYD***	***— Setpoints***		On-board water temperature control - see **Operation** chapter
		— Signals		Hardwired 24VAC 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 models)*	***— Heat Pump***		Control on indoor loop water temperature
		— Chiller		Control on outdoor loop water temperature
	— Number of Tanks *(for Setpoint control with HTS/CTS, HAC only)*	***— 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 calibr. 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 1 pressure	Calibration in 1PSI intervals.
	— Discharge 1		Discharge 1 pressure	Calibration in 1PSI intervals.
	— Vapour Line 1		Suction line 2 temp.	Calibration in 0.1°F intervals
	— Suction 2		Suction 2 pressure	Calibration in 1PSI intervals.
	— Discharge 2		Discharge 2 pressure	Calibration in 1PSI intervals.
	— Vapour Line 2		Suction line 2 temp.	Calibration in 0.1°F intervals
	— Outdoor Ambient		Outside air temp.	Calibration in 0.1°F intervals
	— Outdoor IN Temp		Loop temperature	Calibration in 0.1°F intervals
	— Outdoor OUT Temp		Loop temperature	Calibration in 0.1°F intervals
	— Indoor IN Temp		Loop temperature	Calibration in 0.1°F intervals
	— Indoor OUT Temp		Loop temperature	Calibration in 0.1°F intervals

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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.

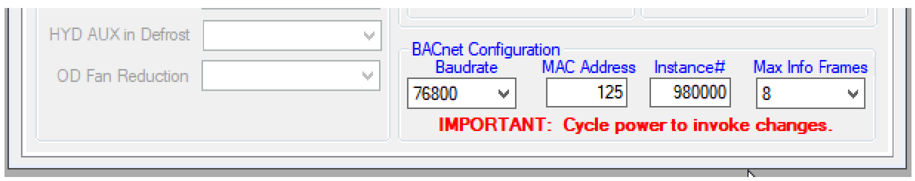
The connector on the control board is a three wire removable screw connector. The signals are as follows:
A: Communications line (+) (right pin)
B: Communications line (-) (middle pin)
C: Ground connection (left pin)

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

Name	Data Type	ID	Property	Description
SYSTEM_Y1A	Binary Value	BV0	Present Value	Stage 1 - bottom compressor (active is on)
SYSTEM_Y2A	Binary Value	BV1	Present Value	Stage 2 - top 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 16 - 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 17 - 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 18 - BACnet OBJECTS - DATA (Read Only)					
	Name	ID	Property	Units	Description
Type - Analog Input	AI0 (Comp1_Current)	AI0	Present Value	Amps	Stage 1 compressor current draw (AI0)
	AI1 (Comp2_Current)	AI1	Present Value	User	Stage 2 compressor current draw (AI1)
	AI2	AI2	Present Value	degF (degC)	Stage 2 compressor discharge line temperature
	AI3	AI3	Present Value	degF (degC)	Stage 1 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)	Stage 1 low pressure value (suction pressure)
	HPS1	AI7	Present Value	PSIG (kPa)	Stage 1 high pressure value (discharge pressure)
	EVAP1	AI8	Present Value	degF (degC)	Stage 1 evaporating Temperature
	COND1	AI9	Present Value	degF (degC)	Stage 1 condensing Temperature
	Suction Line 1	AI10	Present Value	degF (degC)	Stage 1 suction line temperature
	Superheat 1	AI11	**Setpoint Value**	degF (degC)	Stage 1 superheat
	EEV1 Position	AI12	Present Value	%	Stage 1 EEV position (% open)
	LPS2	AI13	Present Value	PSIG (kPa)	Stage 2 low pressure value (suction pressure)
	HPS2	AI14	Present Value	PSIG (kPa)	Stage 2 high pressure value (discharge pressure)
	EVAP2	AI15	Present Value	degF (degC)	Stage 2 evaporating Temperature
	COND2	AI16	**Setpoint Value**	degF (degC)	Stage 2 condensing Temperature
	Suction Line 2	AI17	Present Value	degF (degC)	Stage 2 suction line temperature
	Superheat 2	AI18	**Setpoint Value**	degF (degC)	Stage 2 superheat
	EEV2 Position	AI19	Present Value	%	Stage 2 EEV position (% open)
	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	Descr. of active stg 1 alarms - see Alarm Descriptions table
	Permanent Alarms 2	AV8	Present Value	N/A	Descr. of active stg 2 alarms - see Alarm Descriptions table
	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	Stage 1 compressor contactor
	STAGE2	BO1	Present Value	N/A	Stage 2 compressor contactor
	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	Stage 2 dry contact pin for locked out on alarm
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	Stage 1 3-phase monitor
	Phase Monitor2	BV13	Present Value	N/A	Stage 2 3-phase monitor
	Comp Monitor1	BV14	Present Value	N/A	Stage 1 compressor monitor
	Comp Monitor2	BV15	Present Value	N/A	Stage 2 compressor monitor

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

Name	Data Type	ID	Description
AI0 (Comp1 Current)	Analog Input	AI0	Stage 1 status alarm (start / stop failure, from current sensor)
AI1 (Comp2 Current)	Analog Input	AI1	Stage 2 status alarm (start / stop failure, from current sensor)
LPS1	Analog Input	AI6	Stage 1 low pressure alarm
HPS1	Analog Input	AI7	Stage 1 high pressure alarm
LPS2	Analog Input	AI13	Stage 2 low pressure alarm
HPS2	Analog Input	AI14	Stage 2 high pressure alarm
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	Stage 1 3-phase monitor alarm
Phase Monitor2	Binary Value	BV13	Stage 2 3-phase monitor alarm
Comp Monitor1	Binary Value	BV14	Stage 1 compressor monitor alarm (from compressor protection module)
Comp Monitor2	Binary Value	BV15	Stage 2 compressor monitor alarm (from compressor protection module)

Name	ID	BIT #	Decimal Value*	Bit Description
Permanent Alarms 1 (Present Value)	**AV7**	0	1	Stage 1 master permanent alarm (occurs when any alarm occurs)
		1	3	Stage 1 low pressure heating mode alarm (suction pressure)
		2	5	Stage 1 low pressure cooling mode alarm (suction pressure)
		3	9	Stage 1 high pressure heating mode alarm (discharge pressure)
		4	17	Stage 1 high pressure cooling mode alarm (discharge pressure)
		5	33	Stage 1 loss of charge alarm
		6	65	Stage 1 3-phase monitor alarm
		7	129	Stage 1 compressor monitor alarm (from compressor prot. module)
		8	257	Stage 1 status alarm (start / stop failure, from current sensor)
		14	16,385	Outdoor loop flow alarm
		15*	32,769	Indoor loop flow alarm (reversing models only)
Permanent Alarms 2 (Present Value)	**AV8**	0	1	Stage 2 master permanent alarm (occurs when any alarm occurs)
		1	3	Stage 2 low pressure heating mode alarm (suction pressure)
		2	5	Stage 2 low pressure cooling mode alarm (suction pressure)
		3	9	Stage 2 high pressure heating mode alarm (discharge pressure)
		4	17	Stage 2 high pressure cooling mode alarm (discharge pressure)
		5	33	Stage 2 loss of charge alarm
		6	65	Stage 2 3-phase monitor alarm
		7	129	Stage 2 compressor monitor alarm (from compressor prot. module)
		8	257	Stage 2 status alarm (start / stop failure, from current sensor)
		14	16,385	Outdoor loop flow alarm
		15*	32,769	Indoor loop flow alarm (reversing models only)

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 20 - BACnet OBJECTS - FAULT Descriptions (Read Only)			
Name	**Data Type**	**ID**	**Description**
AI4 (Cold Tank)	Analog Input	AI0	Cold tank temperature sensor faulty or disconnected - requires accessory
AI5 (Hot Tank)	Analog Input	AI1	Hot tank temperature sensor faulty or disconnected - requires accessory
LPS1	Analog Input	AI6	Stage 1 low pressure sensor faulty or disconnected
HPS1	Analog Input	AI7	Stage 1 high pressure sensor faulty or disconnected
LPS2	Analog Input	AI13	Stage 2 low pressure sensor faulty or disconnected
HPS2	Analog Input	AI14	Stage 2 high pressure sensor faulty or disconnected
Suction Line1	Analog Input	AI10	Stage 1 suction line temperature sensor faulty or disconnected
Suction Line2	Analog Input	AI17	Stage 2 suction line temperature sensor faulty or disconnected
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	Stage 2 suction line temperature sensor
		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 W/WH-Series Startup Record located in this manual is used in conjunction with this startup procedure to provide a detailed record of the installation. A completed copy should be left on site, a copy kept on file by the installer, and a copy should be sent to Maritime Geothermal Ltd..

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

Pre-Start Inspection

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.

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 *Stage 1* and *Stage 2 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 compressors.

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 interface should say "**MGT GEN2 VERx.xx**" on line 1 and "**Zeroing EEV's**" on line 2. You should be able to hear the EEV moving (a clicking sound).
2. Measure the following voltages on the compressor contactor and record them on the startup sheet: L1-L2, L2-L3, L1-L3.
3. Connect a USB cable between the USB connector on the board and a laptop with the PC App installed (recommended but optional).
4. Select the desired *Control Source HYD* via the PC APP or Configuration Menu.
5. Enable the system either from the Configuration Page of the PC APP or through the menu buttons.

Heating Mode:

1. Adjust the Setpoint Control settings via the PC App or LCD to activate stage 1 and stage 2 (or activate via BACnet or 24V signal if used). The EEV's will begin to open and the compressors 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-series or **25-35 psig** and **105-200 psig** for WH-series.
3. Monitor the unit via the PC APP or LCD Interface while the unit runs, and record the following after 10 minutes of run time:
    1. Suction pressure (both stages)
    2. Discharge pressure (both stages)
    3. Indoor Loop In (Hot In) temperature
    4. Indoor Loop Out (Hot Out) temperature
    5. Indoor Delta T (should be **8-12°F, 4-6°C**)
    6. Indoor flow (if available)
    7. Outdoor Loop In (Supply In) temperature
    8. Outdoor Loop Out (Supply Out) temperature
    9. Outdoor Delta T (should be **5-8°F, 3-4°C**)
    10. Outdoor flow (if available)
    11. 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.

Cooling Mode:

1. Set the unit to cooling mode and adjust the cooling control setpoints to activate Stage 1 and Stage 2.
2. Monitoring the unit via the PC APP or LCD interface while the unit runs, and record the following after 10 minutes of run time:
    1. Suction pressure (both stages)
    2. Discharge pressure (both stages)
    3. Indoor Loop In temperature
    4. Indoor Loop Out temperature
    5. Indoor Delta T
    6. Outdoor Loop In (Supply In) temperature
    7. Outdoor Loop Out (Supply Out) temperature
    8. Outdoor Delta T

3. Adjust the cooling control setpoints to the desired tank temperature, and allow the unit to 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 in the Indoor Loop piping and ensure the area is clean.
4. Turn the power on to the unit. Set the Setpoints Control (or aquastat) to the final settings and record the values.

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 Sheet - Commercial W/WH-Series

Installation Site		**Startup Date**	**Installer**	
City			**Company**	
Province		**Check boxes unless asked to record data. Circle data units.**	**Model**	
Country			**Serial #**	
Client Name		**Site Owner 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/concentration		% Volume		% Weight			
	Loop static pressure		psig	kPa				
Ground Loop System	All shut-off valve are open (full flow available)							
	Loop is full and purged of air							
	Antifreeze type/concentration		% Volume		% Weight			
	Loop static pressure		psig	kPa				
Ground Water System	Water valve installed in OUT line							
	Flow control installed in OUT line							
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)	Stage 1 Suction Pressure / Discharge Pressure					psig	kPa	
	Stage 2 Suction Pressure / Discharge Pressure					psig	kPa	
	Indoor In (Hot In), Indoor Out (Hot Out), and Delta T		In		Out		°F	°C
	Outdoor In (Supply In), Outdoor Out (Supply Out), and Delta T		In		Out		°F	°C
	Outdoor Flow		igpm	gpm		L/s		
	Compressor L1 (black wire) current		A					
	Heating setpoint and discharge pressure at cycle end		°F	°C		psig	kPa	
Cooling Mode (HAC only) (10 minutes)	Stage 1 Suction Pressure / Discharge Pressure					psig	kPa	
	Stage 2 Suction Pressure / Discharge Pressure					psig	kPa	
	Indoor In (Hot In), Indoor Out (Hot Out), and Delta T		In		Out		°F	°C
	Outdoor In (Supply In), Outdoor Out (Supply Out), and Delta T		In		Out		°F	°C
	Cooling setpoint and suction pressure at cycle end		°F	°C		psig	kPa	
Final Control Settings	Heating S1 Setpoint, S1 Delta			°F	°C			
	Heating S2 Setpoint, S2 Delta			°F	°C			
	Heating S3 Setpoint, S3 Delta, S3 Time Delay			°F	°C		min	
	Cooling S1 Setpoint, S1 Delta			°F	°C			
	Cooling S2 Setpoint, S2 Delta			°F	°C			

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

A total of three copies are required, one for the site, one for the installer/startup and one to be sent to Maritime Geothermal Ltd.

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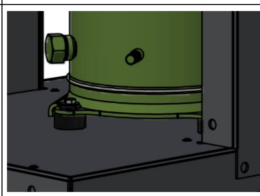
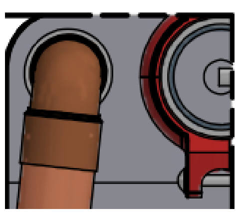
Routine Maintenance

MAINTENANCE SCHEDULE

Item		Interval	Procedure
LCD Interface or **Status Lights** or **PC App via USB**		Weekly (optional, if alarms are not reported through a BACnet system)	Check for alarms and faults. Rectify problem if alarms found. See **Troubleshooting** chapter.
Strainers		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 Contactors		1 year	Inspect for pitted / burned points or loose wires. If necessary, replace contactor or tighten wires.
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/Fault	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 (Stage 1 or Stage 2)	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 (Stage 1 or Stage 2)	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) <<W240+ ONLY>>	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 (Stage 1 or Stage 2)	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 (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).	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 (Stage 1 or Stage 2)	This alarm occurs when the 3-phase monitor detects a fault condition and sends a fault signal to the control board. For three phase units only.	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 (Stage 1 or Stage 2)	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 (Stage 1 or Stage 2)	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] **(Stage 1 or Stage 2)**	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 enclosure.	Locate and fix leak, taking all necessary precautions associated with **A2L** refrigerants. See **Service Procedures** chapter.

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FAULT TROUBLESHOOTING

Alarm/Fault	Description	Recommended Action
Pressure Sensors	The sensor is reading outside of the acceptable range. Check to ensure connector is on securely.	Replace the pressure sensor. If this does not rectify the problem, replace the control board.
Temperature Sensors	The sensor is reading outside of the acceptable range. Check to ensure connector is on securely.	Replace the temperature sensor. If this does not rectify the problem, replace the control board.
Control Board: - *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 board and the Control Board, and then turning the power back on again. If this does not work then either the LDC Display board, the cable, or the driver section of the Control Board may be faulty.
Control Board: - *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** below.
MODBUS: - *Main Comms*	Hardware problem on heat pump control board.	24V**DC** is not present across **24VDC** and **GND** at lower right of control board. Replace board if voltage not correct.
		Remove MODBUS screw terminal connector from board as well as jumper from **TERM** (located just above the MODBUS connector). Using a multimeter set to DC volts with negative probe on **B** and positive probe on **A**, confirm there is **+2.5VDC**. Replace board if voltage not correct.
	MODBUS termination problem.	Verify MODBUS **TERM** jumper is in place on control board. Install jumper if missing.
MODBUS: - *R454b Leak Detector*	Refrigerant detector communications experienced a timeout.	See **LEAK DETECTOR TROUBLESHOOTING** on next 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.
	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.
	Faulty run capacitor (Single phase only)	Check value with capacitance meter. Should match label on capacitor. Compressor will hum while trying to start and then trip its overload.	Replace if faulty.
	Loose or faulty wiring	Check all compressor wiring, including inside compressor electrical box.	Fix any loose connections. Replace any damaged wires.
	Faulty compressor contactor	Voltage on line side with contactor held closed, but no voltage on one or both terminals on the load side. Points pitted or burned. Or, 24VAC across coil but contactor will not engage.	Replace contactor.
	Thermal overload on compressor tripped	Ohmmeter shows reading when placed across R and S terminals and infinity between C & R or C & S. A valid resistance reading is present again after the compressor has cooled down.	Proceed to Operation Troubleshooting (particularly *high suction pressure* and *high discharge pressure*) to determine the cause of the thermal overload trip.
	Burned out motor (open winding)	Remove wires from compressor. Ohmmeter shows infinite resistance between any two terminals Note: Be sure compressor overload has had a chance to reset. If compressor is hot this may take several hours.	Replace the compressor.
	Burned out motor (shorted windings)	Remove wires from compressor. Resistance between any two terminals is below the specified value.	Replace the compressor.
	Motor shorted to ground	Remove wires from compressor. 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	Start capacitor faulty (Single phase only)	Check with capacitance meter. Check for black residue around blowout hole on top of capacitor.	Replace if faulty. Remove black residue in electrical box if any.
	Potential Relay faulty (Single phase only)	Replace with new one and verify compressor starts properly.	Replace if faulty.
	Compressor is “tight” due to damaged mechanism	Compressor attempts to start but trips its internal overload after a few seconds. Run capacitor has been verified already.	Attempt to “rock” compressor free. If normal operation cannot be established, replace compressor.

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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 brazed plate heat exchanger. (typically for open loop, less likely 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 (or TS2) 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 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 brazed plate heat exchanger. (typically for open loop, less likely 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 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 super heat 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 (or TS2) 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).

Tests to determine if an EEV is working

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

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

The EEV can be checked electrically:

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

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

Check with a new EEV:

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

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

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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 CO_2 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 brazed plate 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 (brazed plates) **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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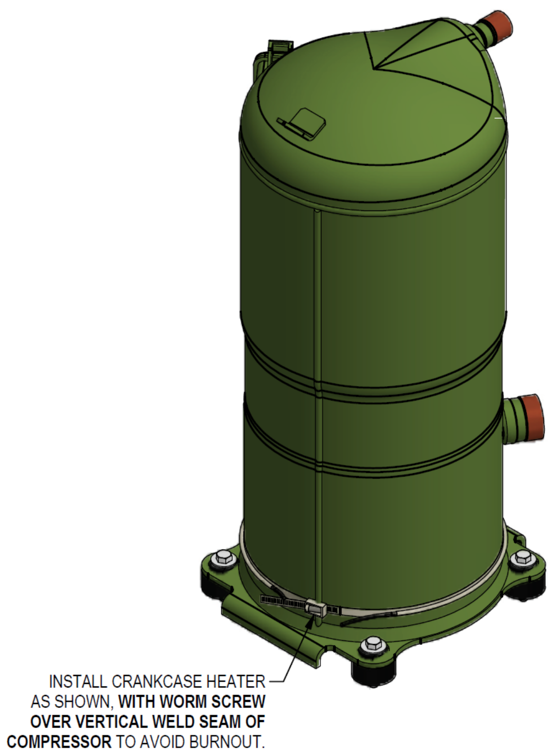
Compressor Replacement Procedure

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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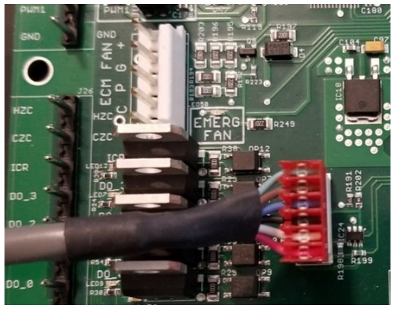
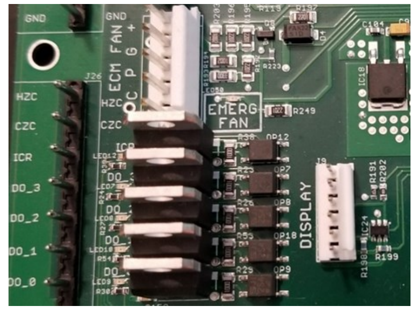
Control Board Replacement Procedure

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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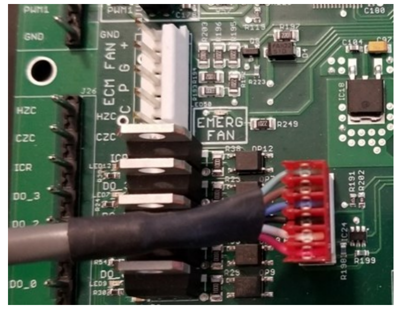
LCD Interface (Display) Board Replacement Procedure

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 21 - Flow Rates & Volumes

MODEL	Nominal Size (60Hz)	Recommended Liquid Flow (Outdoor & Indoor Loops) 100% CAPACITY (2 COMPRESSORS)		Recommended Liquid Flow (Outdoor & Indoor Loops) 50% CAPACITY (1 COMPRESSOR)		Heat Pump's Indoor Loop Holdup Volume		Heat Pump's Outdoor Loop Holdup Volume	
	tons	gpm(US)	*L/s*	gpm(US)	*L/s*	US gal	*L*	US gal	*L*
W/WH-150	12	36	*2.3*	18	*1.2*	1.90	*7.2*	1.90	*7.2*
W/WH-185	17	48	*3.0*	24	*1.5*	2.77	*10.5*	2.77	*10.5*
W/WH-240	20	60	*3.8*	30	*1.9*	3.10	*11.7*	3.10	*11.7*
W/WH-300	23	72	*4.5*	36	*2.3*	3.54	*13.4*	3.54	*13.4*
W/WH-400	30	100	*6.3*	50	*3.2*	4.52	*17.1*	4.52	*17.1*
W/WH-500	40	120	*7.6*	60	*3.8*	5.78	*21.9*	5.78	*21.9*
W/WH-600	50	150	*9.5*	75	*4.8*	6.87	*26.0*	6.87	*26.0*
W/WH-800	65	190	*12.0*	95	*6.0*	8.62	*32.6*	8.62	*32.6*
W-900	70	210	*13.2*	105	*6.6*	9.49	*35.9*	9.49	*35.9*
W-1000	81	225	*14.2*	113	*7.1*	10.6	*40.0*	10.6	*40.0*

A2L

Table 22 - Refrigerant Charge (Per Circuit)

MODEL	TYPE	lb	*kg*	OIL
W-150	R454b	5.5	*2.5*	POE
W-185	R454b	9.5	*4.3*	POE
W-240	R454b	10	*4.5*	PVE-BVC32
W-300	R454b	11	*5.0*	PVE-BVC32
W-400	R454b	13	*5.9*	PVE-BVC32
W-500	R454b	22	*10.0*	PVE-BVC32
W-600	R454b	25	*11.4*	PVE-BVC32
W-800	R454b	29	*13.2*	PVE-BVC32
W-900	R454b	30	*13.6*	PVE-BVC32
W-1000	R454b	33	*15.0*	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-150	R513a (A1)	5.5	*2.5*	POE
WH-185	R513a (A1)	9.5	*4.3*	POE
WH-240	R513a (A1)	10	*4.5*	POE
WH-300	R513a (A1)	11	*5.0*	POE
WH-400	R513a (A1)	13	*5.9*	POE
WH-500	R513a (A1)	22	*10.0*	POE
WH-600	R513a (A1)	25	*11.4*	POE
WH-800	R513a (A1)	29	*13.2*	POE

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

Table 23 - Shipping Information

MODEL	WEIGHT lb (kg)	DIMENSIONS in (cm) L	W	H
W/WH-150	950 (432)	78 (198)	32 (81)	82 (208)
W/WH-185	1207 (549)	78 (198)	32 (81)	82 (208)
W/WH-240	1351 (614)	78 (198)	32 (81)	82 (208)
W/WH-300	1386 (630)	78 (198)	32 (81)	82 (208)
W/WH-400	1440 (655)	78 (198)	32 (81)	82 (208)
W/WH-500	1955 (889)	89 (226)	36 (91)	88 (224)
W/WH-600	2054 (934)	89 (226)	36 (91)	88 (224)
W/WH-800	2192 (996)	89 (226)	36 (91)	88 (224)
W-900	2340 (1064)	89 (226)	36 (91)	88 (224)
W-1000	2488 (1131)	89 (226)	36 (91)	88 (224)

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Table 24a - 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*	
	ICE production	Maximum LLT/LWT	110	*43*	Maximum hot loop temperature during ICE production (specify ICE duty at order).
	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
	ICE production	Minimum LLT	0	*-17*	Minimum cold loop temperature during ice production (specify ICE duty at order).
	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 24b - 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	37	*3*	EWT should normally be 45°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	37	*3*	EWT should normally be 45°F or greater.
		Maximum ELT	90	*32*	0-10VDC modulating water valve required on outdoor loop above this temperature to limit suction pressure *(contact Engineering for firmware revision of this feature)*
	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*	

EWT: Entering Water Temperature
LWT: Leaving Water Temperature

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

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Table 25: Loop Pressure Drop Data			INDOOR (water 130°F)		INDOOR (water 104°F)		OUTDOOR (water 50°F)		OUTDOOR (15% methanol 32°F)		OUTDOOR (35% prop.glycol 32°F)	
	gpm	L/s	psi	kPa	psi	kPa	psi	kPa	psi	kPa	psi	kPa
W/WH-150	24	1.5	0.9	6.2	0.9	6.2	1.0	6.9	1.1	7.6	1.2	8.3
	28	1.8	1.2	8.3	1.2	8.3	1.3	9.0	1.4	9.7	1.7	12
	32	2.0	1.5	10	1.5	10	1.6	11	1.8	12	2.2	15
	36	2.3	1.8	12	1.9	13	2.0	14	2.2	15	2.7	19
	40	2.5	2.2	15	2.3	16	2.4	17	2.6	18	3.2	22
	48	3.0	3.2	22	3.3	23	3.4	23	3.6	25		
W/WH-185	32	2.0	1.0	6.9	1.0	6.9	1.1	7.6	1.2	8.3	2.0	14
	36	2.3	1.2	8.3	1.3	9.0	1.4	9.7	1.6	11	2.2	15
	40	2.5	1.5	10	1.6	11	1.7	12	1.9	13	2.4	17
	48	3.0	2.1	15	2.2	15	2.3	16	2.5	17	2.9	20
	60	3.8	3.3	23	3.4	23	3.5	24	3.6	25	3.7	26
W/WH-240	32	2.0	0.8	5.5	0.8	5.5	0.9	6.2	1.0	6.9	1.7	12
	36	2.3	1.0	6.9	1.0	6.9	1.1	7.6	1.2	8.3	2.0	14
	40	2.5	1.2	8.3	1.2	8.3	1.3	9.0	1.5	10	2.2	15
	48	3.0	1.6	11	1.7	12	1.8	12	2.0	14	2.5	17
	60	3.8	2.5	17	2.6	18	2.7	19	2.9	20	3.3	23
	72	4.5	3.5	24	3.7	26	3.8	26	4.0	28	4.1	28
W/WH-300	36	2.3	0.7	4.8	0.7	4.8	0.8	5.5	0.9	6.2		
	40	2.5	0.9	6.2	0.9	6.2	1.0	6.9	1.1	7.6	2.1	15
	48	3.0	1.2	8.3	1.2	8.3	1.3	9.0	1.4	9.7	2.5	17
	60	3.8	1.7	12	1.8	12	1.9	13	2.1	15	3.1	21
	72	4.5	2.5	17	2.6	18	2.7	19	2.9	20	3.7	26
	90	5.7	3.9	27	4.0	28	4.1	28	4.4	30	4.8	33
W/WH-400	60	3.8	1.0	6.9	1.0	6.9	1.1	7.6	1.2	8.3	1.9	13
	72	4.5	1.4	9.7	1.4	9.7	1.5	10	1.7	12	2.3	16
	90	5.7	2.1	15	2.2	15	2.3	16	2.5	17	3.1	21
	100	6.3	2.6	18	2.7	19	2.8	19	3.0	21	3.5	24
	110	6.9	3.1	21	3.2	22	3.3	23	3.6	25	4.0	28
	120	7.6	3.7	26	3.8	26	3.9	27	4.2	29	4.6	32
W/WH-500	50	3.2	0.8	5	0.8	5	0.8	6	1.0	7	1.3	9
	60	3.8	1.1	7	1.1	7	1.1	8	1.3	9	1.7	12
	70	4.4	1.4	10	1.4	10	1.5	10	1.6	11	2.2	15
	80	5.0	1.8	12	1.8	12	1.9	13	2.0	14	2.8	19
	90	5.7	2.2	15	2.2	15	2.4	16	2.5	17	3.4	23
	100	6.3	2.7	18	2.7	19	2.9	20	3.1	21	4.0	28
	110	6.9	3.2	22	3.2	22	3.4	24	3.7	25	4.7	33
	120	7.6	3.7	26	3.8	26	4.0	28	4.3	30	5.5	38
	130	8.2	4.4	30	4.4	31	4.7	32	5.0	35	6.3	44

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Table 25: (cont'd)	Loop Pressure Drop Data		INDOOR (water 130°F)		INDOOR (water 104°F)		OUTDOOR (water 50°F)		OUTDOOR (15% methanol 32°F)		OUTDOOR (35% prop.glycol 32°F)	
	gpm	***L/s***	**psi**	***kPa***	**psi**	***kPa***	**psi**	***kPa***	**psi**	***kPa***	**psi**	***kPa***
W/WH-600	60	*3.8*	0.8	*5*	0.8	*5*	0.8	*6*	1.0	*7*	1.3	*9*
	75	*4.7*	1.1	*8*	1.2	*8*	1.2	*8*	1.4	*10*	1.8	*13*
	90	*5.7*	1.6	*11*	1.6	*11*	1.7	*12*	1.8	*12*	2.5	*17*
	110	*6.9*	2.3	*16*	2.3	*16*	2.4	*17*	2.6	*18*	3.5	*24*
	130	*8.2*	3.1	*21*	3.2	*22*	3.3	*23*	3.6	*25*	4.6	*32*
	150	*9.5*	4.1	*28*	4.2	*29*	4.4	*30*	4.7	*32*	5.9	*40*
	170	*10.7*	5.1	*35*	5.3	*36*	5.5	*38*	5.9	*41*	7.3	*50*
W/WH-800	80	*5.0*	0.9	*6*	0.9	*6*	0.9	*6*	1.1	*8*	1.4	*10*
	95	*6.0*	1.2	*8*	1.2	*8*	1.3	*9*	1.4	*10*	1.8	*13*
	110	*6.9*	1.5	*11*	1.6	*11*	1.6	*11*	1.8	*12*	2.4	*16*
	130	*8.2*	2.1	*14*	2.1	*15*	2.2	*15*	2.4	*17*	3.2	*22*
	150	*9.5*	2.7	*19*	2.8	*19*	2.9	*20*	3.1	*21*	4.0	*28*
	170	*10.7*	3.5	*24*	3.5	*24*	3.7	*25*	3.9	*27*	5.0	*34*
	190	*12.0*	4.3	*29*	4.4	*30*	4.6	*31*	4.9	*34*	6.0	*42*
	210	*13.2*	5.2	*36*	5.3	*36*	5.5	*38*	5.9	*41*	7.2	*49*
W-900	90	*5.7*	0.9	*6*	1.0	*7*	1.0	*7*	1.2	*8*	1.5	*10*
	105	*6.6*	1.2	*8*	1.3	*9*	1.3	*9*	1.5	*10*	1.9	*13*
	130	*8.2*	1.8	*12*	1.8	*13*	1.9	*13*	2.1	*14*	2.7	*19*
	150	*9.5*	2.4	*16*	2.4	*17*	2.5	*17*	2.7	*18*	3.5	*24*
	170	*10.7*	3.0	*20*	3.0	*21*	3.2	*22*	3.4	*23*	4.3	*29*
	190	*12.0*	3.7	*25*	3.7	*26*	3.9	*27*	4.2	*29*	5.2	*36*
	210	*13.2*	4.4	*31*	4.5	*31*	4.7	*33*	5.0	*35*	6.2	*42*
	230	*14.5*	5.3	*36*	5.4	*37*	5.6	*39*	6.0	*41*	7.2	*50*
W-1000	100	*6.3*	1.0	*7*	1.0	*7*	1.0	*7*	1.2	*8*	1.5	*10*
	113	*7.1*	1.2	*8*	1.2	*8*	1.3	*9*	1.5	*10*	1.8	*13*
	120	*7.6*	1.3	*9*	1.4	*9*	1.4	*10*	1.6	*11*	2.0	*14*
	140	*8.8*	1.8	*12*	1.8	*12*	1.9	*13*	2.0	*14*	2.6	*18*
	160	*10.1*	2.3	*16*	2.3	*16*	2.4	*17*	2.6	*18*	3.3	*23*
	180	*11.4*	2.8	*20*	2.9	*20*	3.0	*21*	3.2	*22*	4.0	*28*
	200	*12.6*	3.5	*24*	3.5	*25*	3.7	*26*	3.9	*27*	4.8	*34*
	220	*13.9*	4.1	*29*	4.2	*29*	4.4	*31*	4.7	*33*	5.7	*40*
	225	*14.2*	4.3	*30*	4.4	*31*	4.6	*32*	4.9	*34*	5.9	*41*
	240	*15.1*	4.9	*34*	5.0	*35*	5.2	*36*	5.5	*38*	6.6	*46*

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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 26 - 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-150	**12**	36	2.3	9,639	**108,700**	**32**	**3.30**
W-185	**15**	48	3.0	12,766	**146,600**	**43**	**3.37**
W-240	**20**	60	3.8	16,398	**194,300**	**57**	**3.47**
W-300	**23**	72	4.5	18,194	**218,100**	**64**	**3.51**
W-400	**30**	100	6.3	23,851	**275,400**	**81**	**3.38**
W-500	**40**	120	7.6	32,049	**367,800**	**108**	**3.36**
W-600	**50**	150	9.5	40,296	**462,000**	**135**	**3.36**
W-800	**65**	190	12.0	51,364	**585,800**	**172**	**3.34**
W-900	**70**	210	13.2	55,886	**638,600**	**187**	**3.35**
W-1000	**81**	225	14.2	66,657	**756,500**	**222**	**3.33**

*** 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-150	**12**	36	2.3	10,053	**151,800**	**44**	**4.43**
W-185	**15**	48	3.0	13,405	**204,600**	**60**	**4.47**
W-240	**20**	60	3.8	17,055	**266,900**	**78**	**4.59**
W-300	**23**	72	4.5	19,340	**312,800**	**92**	**4.74**
W-400	**30**	100	6.3	25,120	**403,300**	**118**	**4.71**
W-500	**40**	120	7.6	32,962	**525,900**	**154**	**4.68**
W-600	**50**	150	9.5	41,152	**654,000**	**192**	**4.66**
W-800	**65**	190	12.0	52,969	**839,500**	**246**	**4.64**
W-900	**70**	210	13.2	57,475	**902,900**	**265**	**4.60**
W-1000	**81**	225	14.2	68,622	**1,053,500**	**309**	**4.50**

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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 26 - W-SERIES Standard Capacity Ratings

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

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-150	**12**	36	2.3	8,623	**135,400**	**40**	**4.60**	**15.7**
W-185	**15**	48	3.0	10,562	**165,800**	**49**	**4.60**	**15.7**
W-240	**20**	60	3.8	13,604	**216,300**	**63**	**4.66**	**15.9**
W-300	**23**	72	4.5	16,180	**262,100**	**77**	**4.75**	**16.2**
W-400	**30**	100	6.3	21,822	**351,400**	**103**	**4.72**	**16.1**
W-500	**40**	120	7.6	28,287	**452,700**	**133**	**4.69**	**16.0**
W-600	**50**	150	9.5	35,186	**556,000**	**163**	**4.63**	**15.8**
W-800	**65**	190	12.0	45,562	**715,500**	**210**	**4.60**	**15.7**
W-900	**70**	210	13.2	49,785	**771,500**	**226**	**4.54**	**15.5**
W-1000	**81**	225	14.2	56,129	**864,500**	**253**	**4.51**	**15.4**

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

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

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-150	**12**	36	2.3	6,833	**148,300**	**43**	**6.36**	**21.7**
W-185	**15**	48	3.0	8,226	**179,300**	**53**	**6.39**	**21.8**
W-240	**20**	60	3.8	10,935	**236,200**	**69**	**6.33**	**21.6**
W-300	**23**	72	4.5	12,918	**282,900**	**83**	**6.42**	**21.9**
W-400	**30**	100	6.3	17,113	**373,000**	**109**	**6.39**	**21.8**
W-500	**40**	120	7.6	22,183	**477,000**	**140**	**6.30**	**21.5**
W-600	**50**	150	9.5	27,493	**588,400**	**172**	**6.27**	**21.4**
W-800	**65**	190	12.0	35,316	**755,800**	**222**	**6.27**	**21.4**
W-900	**70**	210	13.2	39,065	**828,000**	**243**	**6.21**	**21.2**
W-1000	**81**	225	14.2	44,081	**930,200**	**273**	**6.18**	**21.1**

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Performance Tables - W-Series (US UNITS)

W-150-H**-X-*D-PP *R454b, 60 Hz, 2 x YA76K1E-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.

LOW TEMPERATURE — LARGER MODEL SIZES ONLY

	EVAPORATOR LOOP *(50% Propylene Glycol)*							ELECTRICAL		CONDENSER LOOP *(Water)*						
	ELT (°F)	Evap. Temp.	Flow (gpm)	LLT (°F)	Delta T (°F)	**Ice Cooling (Btu/hr)**	**EER**	Compressor Current (A)*	Input Power (W)	EWT (°F)	Cond. Temp.	Flow (gpm)	LWT (°F)	Delta T (°F)	**Heating** (Btu/hr)	**COP_H**
LOW TEMPERATURE	5															
	10															
	15															
	20															
	25															
	30															
	35															
	40															

	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	36	21	-3.8	63,400	16.0	9,464	104	114	36	109	5.3	**95,200**	**2.95**
	30	20	36	26	-4.3	72,400	16.2	9,584	104	115	36	110	5.8	**104,600**	**3.20**
	35	25	36	30	-4.9	82,400	16.3	9,715	104	116	36	110	6.4	**115,000**	**3.47**
	40	29	36	34	-5.6	93,300	16.5	9,831	104	116	36	111	7.1	**126,300**	**3.77**
	45	34	36	39	-6.3	104,900	16.6	9,952	104	117	36	112	7.7	**138,400**	**4.08**
	50	39	36	43	-7.0	118,000	16.8	10,053	104	117	36	113	8.5	**151,800**	**4.43**
	55	43	36	47	-7.9	131,900	16.9	10,143	104	118	36	113	9.3	**166,000**	**4.80**
	60	48	36	51	-8.8	147,300	17.0	10,233	104	119	36	114	10.2	**181,800**	**5.21**
	65	53	36	55	-9.8	164,200	17.1	10,293	104	119	36	115	11.1	**198,900**	**5.66**
	70	57	36	59	-10.8	182,000	17.2	10,350	104	120	36	116	12.1	**216,900**	**6.14**
	25	15	36	22	-3.4	57,300	16.7	10,336	115	124	36	120	5.2	**92,000**	**2.61**
	30	20	36	26	-4.0	66,200	16.9	10,459	114	124	36	120	5.7	**101,400**	**2.84**
	35	25	36	30	-4.6	76,100	17.1	10,572	114	124	36	120	6.3	**111,700**	**3.10**
	40	30	36	35	-5.2	86,900	17.2	10,698	113	125	36	120	6.9	**122,900**	**3.37**
	45	34	36	39	-5.9	98,900	17.4	10,807	112	125	36	120	7.6	**135,300**	**3.67**
	50	39	36	43	-6.7	112,000	17.6	10,923	112	125	36	120	8.3	**148,800**	**3.99**
	55	44	36	47	-7.5	126,200	17.7	11,016	111	125	36	120	9.2	**163,300**	**4.34**
	60	48	36	51	-8.5	142,000	17.9	11,110	110	126	36	120	10.1	**179,400**	**4.73**
	65	53	36	55	-9.5	159,300	18.0	11,175	109	126	36	120	11.1	**197,000**	**5.17**
	70	58	36	59	-10.6	178,100	18.1	11,235	108	126	36	120	12.1	**216,000**	**5.63**

	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	36	36	45	-8.6	154,700	13.9	5,990	50	74	36	60	10.4	**174,800**	**25.8**
	54	37	36	45	-8.4	151,100	14.2	6,458	55	79	36	65	10.3	**172,800**	**23.4**
	54	37	36	45	-8.2	147,600	14.5	6,932	60	84	36	70	10.2	**170,900**	**21.3**
	54	37	36	46	-8.0	144,200	14.8	7,405	65	89	36	75	10.1	**169,100**	**19.5**
	54	38	36	46	-7.8	140,500	15.2	7,901	70	95	36	80	9.9	**167,100**	**17.8**
	54	38	36	46	-7.6	136,800	15.6	8,414	75	100	36	85	9.8	**165,100**	**16.3**
	54	39	36	46	-7.4	133,300	16.0	8,948	80	105	36	90	9.7	**163,500**	**14.9**
	54	39	36	46	-7.2	129,400	16.5	9,498	85	110	36	95	9.6	**161,400**	**13.6**
	54	39	36	47	-7.0	125,500	17.0	10,088	90	116	36	99	9.4	**159,600**	**12.4**
	54	40	36	47	-6.7	121,400	17.6	10,712	95	121	36	104	9.3	**157,600**	**11.3**

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Performance Tables - W-Series (METRIC UNITS)

W-150-H**-X-*D-PP

R454b, 60 Hz, 2 x YA76K1E-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

LOW TEMPERATURE

EVAPORATOR LOOP (50% Propylene Glycol)							ELECTRICAL		CONDENSER LOOP (Water)						
ELT (°C)	Evap. Temp.	Flow (L/s)	LLT (°C)	Delta T (°C)	Ice Cooling (kW)	COP_C	Compressor Current (A)*	Input Power (W)	EWT (°C)	Cond. Temp.	Flow (L/s)	LWT (°C)	Delta T (°C)	Heating (kW)	COP_H
5															
10															
15															
20							LARGER MODEL SIZES ONLY								
25															
30															
35															
40															

HEATING

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
-3.9	-9.3	2.3	-6.0	-2.1	18.6	16.0	9,464	40	45.7	2.3	42.9	2.9	**27.9**	**2.95**
-1.1	-6.7	2.3	-3.5	-2.4	21.2	16.2	9,584		46.0	2.3	43.2	3.2	**30.7**	**3.20**
1.7	-4.1	2.3	-1.0	-2.7	24.1	16.3	9,715		46.4	2.3	43.6	3.6	**33.7**	**3.47**
4.4	-1.5	2.3	1.3	-3.1	27.3	16.5	9,831		46.7	2.3	43.9	3.9	**37.0**	**3.77**
7.2	1.1	2.3	3.7	-3.5	30.7	16.6	9,952		47.1	2.3	44.3	4.3	**40.6**	**4.08**
10.0	3.7	2.3	6.1	-3.9	34.6	16.8	10,053		47.4	2.3	44.7	4.7	**44.5**	**4.43**
12.7	6.2	2.3	8.3	-4.4	38.7	16.9	10,143		47.8	2.3	45.2	5.2	**48.7**	**4.80**
15.6	8.8	2.3	10.7	-4.9	43.2	17.0	10,233		48.2	2.3	45.7	5.7	**53.3**	**5.21**
18.3	11.4	2.3	12.9	-5.4	48.1	17.1	10,293		48.5	2.3	46.2	6.2	**58.3**	**5.66**
21.1	14.0	2.3	15.1	-6.0	53.3	17.2	10,350		48.9	2.3	46.7	6.7	**63.6**	**6.14**
-3.9	-9.2	2.3	-5.8	-1.9	16.8	16.7	10,336	46.0	51.0	2.3	49	2.9	**27.0**	**2.61**
-1.1	-6.6	2.3	-3.3	-2.2	19.4	16.9	10,459	45.7	51.2	2.3		3.2	**29.7**	**2.84**
1.7	-4.0	2.3	-0.9	-2.6	22.3	17.1	10,572	45.4	51.3	2.3		3.5	**32.7**	**3.10**
4.4	-1.4	2.3	1.5	-2.9	25.5	17.2	10,698	45.1	51.4	2.3		3.8	**36.0**	**3.37**
7.2	1.2	2.3	3.9	-3.3	29.0	17.4	10,807	44.7	51.6	2.3		4.2	**39.7**	**3.67**
10.0	3.8	2.3	6.3	-3.7	32.8	17.6	10,923	44.3	51.7	2.3		4.6	**43.6**	**3.99**
12.7	6.4	2.3	8.5	-4.2	37.0	17.7	11,016	43.8	51.8	2.3		5.1	**47.9**	**4.34**
15.5	9.0	2.3	10.8	-4.7	41.6	17.9	11,110	43.3	52.0	2.3		5.6	**52.6**	**4.73**
18.3	11.6	2.3	13.0	-5.3	46.7	18.0	11,175	42.7	52.1	2.3		6.2	**57.7**	**5.17**
21.1	14.2	2.3	15.2	-5.9	52.2	18.1	11,235	42.2	52.3	2.3		6.7	**63.3**	**5.63**

COOLING

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
12	2	2.3	7.2	-4.8	45.3	13.9	5,990	10.0	23	2.3	15.8	5.8	**51.2**	**7.56**
	3	2.3	7.3	-4.7	44.3	14.2	6,458	12.8	26	2.3	18.5	5.7	**50.6**	**6.86**
	3	2.3	7.4	-4.6	43.3	14.5	6,932	15.6	29	2.3	21.3	5.7	**50.1**	**6.24**
	3	2.3	7.6	-4.4	42.3	14.8	7,405	18.3	32	2.3	23.9	5.6	**49.6**	**5.71**
	3	2.3	7.7	-4.3	41.2	15.2	7,901	21.1	35	2.3	26.6	5.5	**49.0**	**5.22**
	3	2.3	7.8	-4.2	40.1	15.6	8,414	23.9	38	2.3	29.3	5.4	**48.4**	**4.78**
	4	2.3	7.9	-4.1	39.1	16.0	8,948	26.7	41	2.3	32.1	5.4	**47.9**	**4.37**
	4	2.3	8.0	-4.0	37.9	16.5	9,498	29.4	44	2.3	34.7	5.3	**47.3**	**3.99**
	4	2.3	8.1	-3.9	36.8	17.0	10,088	32.2	47	2.3	37.4	5.2	**46.8**	**3.63**
	4	2.3	8.3	-3.7	35.6	17.6	10,712	35.0	49	2.3	40.2	5.2	**46.2**	**3.31**

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Performance Tables - W-Series (US UNITS)

W-185-H**-X-*D-PP

R454b, 60 Hz, 2 x YA91K1E-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.

LOW TEMPERATURE*

EVAPORATOR LOOP *(50% Propylene Glycol)*							ELECTRICAL		CONDENSER LOOP *(Water)*						
ELT (°F)	Evap. Temp.	Flow (gpm)	LLT (°F)	Delta T (°F)	**Ice Cooling (Btu/hr)**	**EER**	Compressor Current (A)*	Input Power (W)	EWT (°F)	Cond. Temp.	Flow (gpm)	LWT (°F)	Delta T (°F)	**Heating** (Btu/hr)	**COP_H**
5	-3	48	2	-2.7	**56,400**	**6.6**	15.3	9,554	85	94	48	89	3.6	**86,200**	**2.64**
10	2	48	7	-3.1	**64,400**	**7.2**	15.8	9,761		95	48	89	4.0	**95,300**	**2.86**
15	6	48	12	-3.5	**73,100**	**7.9**	16.3	9,970		95	48	89	4.4	**105,100**	**3.09**
20	10	48	16	-4.0	**82,400**	**8.7**	16.8	10,178		96	48	90	4.8	**115,400**	**3.32**
25	15	48	21	-4.4	**92,500**	**9.4**	17.3	10,372		96	48	90	5.3	**126,500**	**3.57**
30	19	48	25	-4.9	**103,400**	**10.2**	17.8	10,575		96	48	91	5.8	**138,500**	**3.84**
35	24	48	30	-5.5	**115,300**	**11.1**	18.2	10,771		97	48	91	6.3	**151,400**	**4.12**
40	28	48	34	-6.1	**128,000**	**11.9**	18.7	10,959		97	48	92	6.9	**165,100**	**4.42**

*NOTE FOR LOW TEMPERATURE: salt brine, commonly used in arenas, is not an acceptable loop fluid due to its corrosive nature.

HEATING

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**
25	15	48	21	-3.9	86,500	19.6	12,500	104	115	48	109	5.4	**128,400**	**3.01**
30	20	48	26	-4.4	98,500	19.8	12,689		115	48	110	5.9	**141,100**	**3.26**
35	24	48	30	-5.0	111,900	20.1	12,878		116	48	111	6.5	**155,100**	**3.53**
40	29	48	34	-5.7	126,400	20.4	13,061		116	48	111	7.1	**170,300**	**3.82**
45	34	48	39	-6.4	142,100	20.6	13,237		117	48	112	7.8	**186,600**	**4.13**
50	38	48	43	-7.1	159,500	20.8	13,405		117	48	113	8.6	**204,600**	**4.47**
55	43	48	47	-8.0	178,200	21.1	13,563		118	48	113	9.4	**223,800**	**4.84**
60	48	48	51	-8.9	198,900	21.3	13,705		118	48	114	10.3	**245,000**	**5.24**
65	52	48	55	-9.9	221,500	21.5	13,832		119	48	115	11.2	**268,000**	**5.68**
70	57	48	59	-10.9	245,600	21.6	13,942		119	48	116	12.3	**292,500**	**6.15**
25	15	48	22	-3.5	78,200	20.7	13,665	115	124	48	120	5.2	**124,100**	**2.66**
30	20	48	26	-4.1	90,300	21.0	13,855	114	124	48		5.7	**136,900**	**2.90**
35	25	48	30	-4.6	103,500	21.3	14,045	114	124	48		6.3	**150,700**	**3.14**
40	29	48	35	-5.3	117,900	21.6	14,251	113	125	48		7.0	**165,800**	**3.41**
45	34	48	39	-6.0	133,900	21.9	14,432	112	125	48		7.7	**182,500**	**3.71**
50	39	48	43	-6.8	151,300	22.1	14,606	112	125	48		8.4	**200,500**	**4.02**
55	43	48	47	-7.6	170,100	22.4	14,770	111	125	48		9.2	**219,800**	**4.36**
60	48	48	51	-8.5	191,200	22.6	14,921	110	125	48		10.2	**241,500**	**4.74**
65	53	48	55	-9.5	214,000	22.8	15,076	109	126	48		11.1	**264,800**	**5.15**
70	57	48	59	-10.6	239,000	23.0	15,193	108	126	48		12.2	**290,200**	**5.60**

COOLING

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**
54	35	48	46	-7.8	186,200	14.3	7,202	50	73	48	59	9.4	**210,100**	**25.9**
	36	48	46	-7.6	182,400	14.8	7,763	55	78	48	64	9.3	**208,200**	**23.5**
	36	48	46	-7.4	178,700	15.3	8,349	60	83	48	69	9.2	**206,500**	**21.4**
	37	48	46	-7.3	175,000	15.9	8,952	65	88	48	74	9.1	**204,900**	**19.5**
	37	48	47	-7.1	171,200	16.5	9,598	70	94	48	79	9.1	**203,300**	**17.8**
	38	48	47	-7.0	167,300	17.2	10,281	75	99	48	84	9.0	**201,700**	**16.3**
	38	48	47	-6.8	163,400	18.0	11,004	80	104	48	89	8.9	**200,300**	**14.8**
	39	48	47	-6.6	159,400	18.8	11,757	85	109	48	94	8.8	**198,900**	**13.6**
	39	48	47	-6.5	155,200	19.7	12,572	90	115	48	99	8.8	**197,500**	**12.3**
	40	48	47	-6.3	150,800	20.7	13,440	95	120	48	104	8.7	**196,000**	**11.2**

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Performance Tables - W-Series (METRIC UNITS)

W-185-H**-X-*D-PP

R454b, 60 Hz, 2 x YA91K1E-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

LOW TEMPERATURE*

EVAPORATOR LOOP *(50% Propylene Glycol)*							ELECTRICAL		CONDENSER LOOP *(Water)*						
ELT (°C)	Evap. Temp.	Flow (L/s)	LLT (°C)	Delta T (°C)	**Ice Cooling (kW)**	**COP_C**	Compressor Current (A)*	Input Power (W)	EWT (°C)	Cond. Temp.	Flow (L/s)	LWT (°C)	Delta T (°C)	**Heating (kW)**	**COP_H**
-15.0	-19.4	3.0	-16.5	-1.5	**16.5**	**1.92**	15.3	9,554		34.7	3.0	31.4	2.0	**25.3**	**2.64**
-12.2	-16.9	3.0	-13.9	-1.7	**18.9**	**2.12**	15.8	9,761		34.9	3.0	31.6	2.2	**27.9**	**2.86**
-9.4	-14.5	3.0	-11.3	-1.9	**21.4**	**2.32**	16.3	9,970		35.1	3.0	31.8	2.4	**30.8**	**3.09**
-6.7	-12.1	3.0	-8.9	-2.2	**24.1**	**2.54**	16.8	10,178	29.4	35.3	3.0	32.1	2.7	**33.8**	**3.32**
-3.9	-9.6	3.0	-6.3	-2.4	**27.1**	**2.76**	17.3	10,372		35.5	3.0	32.3	2.9	**37.1**	**3.57**
-1.1	-7.2	3.0	-3.8	-2.7	**30.3**	**2.99**	17.8	10,575		35.7	3.0	32.6	3.2	**40.6**	**3.84**
1.7	-4.7	3.0	-1.4	-3.1	**33.8**	**3.24**	18.2	10,771		35.9	3.0	32.9	3.5	**44.4**	**4.12**
4.4	-2.3	3.0	1.0	-3.4	**37.5**	**3.50**	18.7	10,959		36.2	3.0	33.2	3.8	**48.4**	**4.42**

*NOTE FOR LOW TEMPERATURE: salt brine, commonly used in arenas, is not an acceptable loop fluid due to its corrosive nature.

HEATING

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**
-3.9	-9.4	3.0	-6.1	-2.2	25.4	19.6	12,500		45.8	3.0	43.0	3.0	**37.6**	**3.01**
-1.1	-6.8	3.0	-3.5	-2.4	28.9	19.8	12,689		46.1	3.0	43.3	3.3	**41.4**	**3.26**
1.7	-4.2	3.0	-1.1	-2.8	32.8	20.1	12,878		46.4	3.0	43.6	3.6	**45.5**	**3.53**
4.4	-1.6	3.0	1.2	-3.2	37.0	20.4	13,061		46.7	3.0	43.9	3.9	**49.9**	**3.82**
7.2	0.9	3.0	3.6	-3.6	41.7	20.6	13,237	40	46.9	3.0	44.3	4.3	**54.7**	**4.13**
10.0	3.6	3.0	6.1	-3.9	46.7	20.8	13,405		47.2	3.0	44.8	4.8	**60.0**	**4.47**
12.7	6.1	3.0	8.3	-4.4	52.2	21.1	13,563		47.5	3.0	45.2	5.2	**65.6**	**4.84**
15.6	8.7	3.0	10.7	-4.9	58.3	21.3	13,705		47.8	3.0	45.7	5.7	**71.8**	**5.24**
18.3	11.3	3.0	12.8	-5.5	64.9	21.5	13,832		48.1	3.0	46.2	6.2	**78.5**	**5.68**
21.1	13.9	3.0	15.0	-6.1	72.0	21.6	13,942		48.3	3.0	46.8	6.8	**85.7**	**6.15**
-3.9	-9.3	3.0	-5.8	-1.9	22.9	20.7	13,665	46.0	51.0	3.0		2.9	**36.4**	**2.66**
-1.1	-6.7	3.0	-3.4	-2.3	26.5	21.0	13,855	45.7	51.1	3.0		3.2	**40.1**	**2.90**
1.7	-4.1	3.0	-0.9	-2.6	30.3	21.3	14,045	45.4	51.2	3.0		3.5	**44.2**	**3.14**
4.4	-1.5	3.0	1.5	-2.9	34.6	21.6	14,251	45.0	51.4	3.0		3.9	**48.6**	**3.41**
7.2	1.1	3.0	3.9	-3.3	39.2	21.9	14,432	44.6	51.5	3.0	49	4.3	**53.5**	**3.71**
10.0	3.7	3.0	6.2	-3.8	44.3	22.1	14,606	44.2	51.6	3.0		4.7	**58.8**	**4.02**
12.7	6.3	3.0	8.5	-4.2	49.9	22.4	14,770	43.8	51.7	3.0		5.1	**64.4**	**4.36**
15.5	8.9	3.0	10.8	-4.7	56.0	22.6	14,921	43.2	51.8	3.0		5.7	**70.8**	**4.74**
18.3	11.5	3.0	13.0	-5.3	62.7	22.8	15,076	42.7	52.0	3.0		6.2	**77.6**	**5.15**
21.1	14.1	3.0	15.2	-5.9	70.0	23.0	15,193	42.1	52.1	3.0		6.8	**85.1**	**5.60**

COOLING

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**
	2	3.0	7.7	-4.3	54.6	14.3	7,202	10.0	23	3.0	15.2	5.2	**61.6**	**7.59**
	2	3.0	7.8	-4.2	53.5	14.8	7,763	12.8	25	3.0	18.0	5.2	**61.0**	**6.89**
	2	3.0	7.9	-4.1	52.4	15.3	8,349	15.6	28	3.0	20.7	5.1	**60.5**	**6.27**
	3	3.0	7.9	-4.1	51.3	15.9	8,952	18.3	31	3.0	23.4	5.1	**60.1**	**5.71**
	3	3.0	8.1	-3.9	50.2	16.5	9,598	21.1	34	3.0	26.2	5.1	**59.6**	**5.22**
12	3	3.0	8.1	-3.9	49.0	17.2	10,281	23.9	37	3.0	28.9	5.0	**59.1**	**4.78**
	4	3.0	8.2	-3.8	47.9	18.0	11,004	26.7	40	3.0	31.6	4.9	**58.7**	**4.34**
	4	3.0	8.3	-3.7	46.7	18.8	11,757	29.4	43	3.0	34.3	4.9	**58.3**	**3.99**
	4	3.0	8.4	-3.6	45.5	19.7	12,572	32.2	46	3.0	37.1	4.9	**57.9**	**3.60**
	4	3.0	8.5	-3.5	44.2	20.7	13,440	35.0	49	3.0	39.8	4.8	**57.4**	**3.28**

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Performance Tables - W-Series (US UNITS)

W-240-H**-X-*D-PP

R454b, 60 Hz, 2 x 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 *(50% Propylene Glycol)*							ELECTRICAL		CONDENSER LOOP *(Water)*						
	ELT (°F)	Evap. Temp.	Flow (gpm)	LLT (°F)	Delta T (°F)	**Ice Cooling (Btu/hr)**	**EER**	Compressor Current (A)*	Input Power (W)	EWT (°F)	Cond. Temp.	Flow (gpm)	LWT (°F)	Delta T (°F)	**Heating** (Btu/hr)	**COP$_H$**
LOW TEMPERATURE*	5	-3	60	2	-2.9	**75,300**	**6.6**	18.2	12,634	85	95	60	89	3.8	**115,100**	**2.67**
	10	2	60	7	-3.3	**85,600**	**7.2**	18.7	12,915		95	60	89	4.2	**126,800**	**2.88**
	15	6	60	11	-3.7	**96,900**	**7.9**	19.3	13,185		95	60	90	4.6	**139,500**	**3.10**
	20	10	60	16	-4.2	**109,200**	**8.7**	19.9	13,448		96	60	90	5.1	**153,100**	**3.34**
	25	15	60	20	-4.7	**122,700**	**9.4**	20.4	13,696		96	60	91	5.6	**167,900**	**3.59**
	30	19	60	25	-5.3	**137,200**	**10.2**	20.9	13,957		96	60	91	6.1	**183,700**	**3.86**
	35	24	60	29	-5.8	**153,000**	**11.1**	21.5	14,223		97	60	92	6.7	**200,900**	**4.14**
	40	28	60	34	-6.5	**170,000**	**12.0**	22.1	14,500		97	60	92	7.3	**219,300**	**4.43**

*NOTE FOR LOW TEMPERATURE: salt brine, commonly used in arenas, is not an acceptable loop fluid due to its corrosive nature.

	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	-4.2	117,400	23.2	16,208	104	115	60	110	5.7	**171,700**	**3.10**
	30	20	60	25	-4.8	132,600	23.4	16,352		116	60	110	6.3	**187,400**	**3.36**
	35	24	60	30	-5.4	149,500	23.5	16,492		116	60	111	6.9	**204,800**	**3.64**
	40	29	60	34	-6.0	168,000	23.7	16,651		117	60	112	7.5	**223,900**	**3.94**
	45	34	60	38	-6.7	187,800	24.0	16,837		117	60	112	8.2	**244,300**	**4.25**
	50	38	60	43	-7.5	209,600	24.2	17,056		118	60	113	8.9	**266,900**	**4.59**
	55	43	60	47	-8.3	232,800	24.5	17,308		119	60	114	9.7	**291,000**	**4.93**
	60	48	60	51	-9.2	258,400	24.9	17,609		119	60	115	10.6	**317,600**	**5.29**
	65	52	60	55	-10.2	286,100	25.3	17,960		120	60	116	11.6	**346,500**	**5.65**
	70	57	60	59	-11.2	315,300	25.8	18,358		120	60	117	12.6	**377,100**	**6.02**
	25	15	60	21	-3.8	106,200	24.9	17,737	114	124	60	120	5.6	**165,800**	**2.74**
	30	20	60	26	-4.4	121,500	25.0	17,847	114	125	60		6.1	**181,400**	**2.98**
	35	24	60	30	-5.0	138,400	25.2	17,959	113	125	60		6.7	**198,700**	**3.24**
	40	29	60	34	-5.6	156,800	25.4	18,119	113	125	60		7.3	**217,700**	**3.52**
	45	34	60	39	-6.3	177,200	25.6	18,292	112	125	60		8.0	**238,700**	**3.82**
	50	39	60	43	-7.1	199,300	25.9	18,525	111	126	60		8.8	**261,600**	**4.14**
	55	43	60	47	-8.0	223,100	26.3	18,775	110	126	60		9.6	**286,300**	**4.47**
	60	48	60	51	-8.9	249,500	26.7	19,101	109	126	60		10.6	**313,800**	**4.81**
	65	53	60	55	-9.9	278,300	27.1	19,460	108	126	60		11.6	**343,800**	**5.18**
	70	57	60	59	-11.0	309,400	27.7	19,902	107	127	60		12.7	**376,500**	**5.54**

	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	36	60	45	-8.2	246,200	15.9	9,899	50	72	60	60	10.0	**279,000**	**24.9**
		36	60	46	-8.0	240,400	16.5	10,453	55	77	60	65	9.8	**275,100**	**23.0**
		37	60	46	-7.8	235,300	17.2	11,062	60	82	60	70	9.7	**272,100**	**21.3**
		37	60	46	-7.7	229,900	18.0	11,731	65	87	60	75	9.6	**269,000**	**19.6**
		37	60	46	-7.5	224,100	18.8	12,463	70	92	60	80	9.5	**265,700**	**18.0**
		38	60	46	-7.3	218,500	19.8	13,264	75	97	60	84	9.4	**262,900**	**16.5**
		38	60	47	-7.1	212,900	20.8	14,141	80	102	60	89	9.3	**260,300**	**15.1**
		39	60	47	-6.9	207,000	22.0	15,095	85	107	60	94	9.2	**257,600**	**13.7**
		39	60	47	-6.7	200,600	23.2	16,130	90	112	60	99	9.0	**254,800**	**12.4**
		40	60	47	-6.5	194,300	24.6	17,256	95	117	60	104	9.0	**252,300**	**11.3**

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Performance Tables - W-Series (METRIC UNITS)

W-240-H**-X-*D-PP

R454b, 60 Hz, 2 x 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

LOW TEMPERATURE*

EVAPORATOR LOOP *(50% Propylene Glycol)*							ELECTRICAL		CONDENSER LOOP *(Water)*						
ELT (°C)	Evap. Temp.	Flow (L/s)	LLT (°C)	Delta T (°C)	**Ice Cooling (kW)**	**COP_C**	Compressor Current (A)*	Input Power (W)	EWT (°C)	Cond. Temp.	Flow (L/s)	LWT (°C)	Delta T (°C)	**Heating (kW)**	**COP_H**
-15.0	-19.3	3.8	-16.6	-1.6	**22.1**	**1.93**	18.2	12,634	29.4	34.7	3.8	31.5	2.1	**33.7**	**2.67**
-12.2	-16.9	3.8	-14.0	-1.8	**25.1**	**2.12**	18.7	12,915		34.9	3.8	31.7	2.3	**37.2**	**2.88**
-9.4	-14.4	3.8	-11.5	-2.1	**28.4**	**2.32**	19.3	13,185		35.2	3.8	32.0	2.6	**40.9**	**3.10**
-6.7	-12.0	3.8	-9.0	-2.3	**32.0**	**2.54**	19.9	13,448		35.4	3.8	32.2	2.8	**44.9**	**3.34**
-3.9	-9.6	3.8	-6.5	-2.6	**36.0**	**2.76**	20.4	13,696		35.6	3.8	32.5	3.1	**49.2**	**3.59**
-1.1	-7.1	3.8	-4.0	-2.9	**40.2**	**3.00**	20.9	13,957		35.8	3.8	32.8	3.4	**53.8**	**3.86**
1.7	-4.7	3.8	-1.5	-3.2	**44.8**	**3.25**	21.5	14,223		36.0	3.8	33.1	3.7	**58.9**	**4.14**
4.4	-2.2	3.8	0.8	-3.6	**49.8**	**3.51**	22.1	14,500		36.2	3.8	33.5	4.1	**64.3**	**4.43**

*NOTE FOR LOW TEMPERATURE: salt brine, commonly used in arenas, is not an acceptable loop fluid due to its corrosive nature.

HEATING

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**
-3.9	-9.5	3.8	-6.2	-2.3	34.4	23.2	16,208	40	46.0	3.8	43.2	3.2	**50.3**	**3.10**
-1.1	-6.9	3.8	-3.8	-2.7	38.9	23.4	16,352		46.4	3.8	43.5	3.5	**54.9**	**3.36**
1.7	-4.3	3.8	-1.3	-3.0	43.8	23.5	16,492		46.7	3.8	43.8	3.8	**60.0**	**3.64**
4.4	-1.7	3.8	1.1	-3.3	49.2	23.7	16,651		47.1	3.8	44.2	4.2	**65.6**	**3.94**
7.2	0.8	3.8	3.5	-3.7	55.0	24.0	16,837		47.4	3.8	44.6	4.6	**71.6**	**4.25**
10.0	3.4	3.8	5.8	-4.2	61.4	24.2	17,056		47.7	3.8	44.9	4.9	**78.2**	**4.59**
12.7	6.0	3.8	8.1	-4.6	68.2	24.5	17,308		48.1	3.8	45.4	5.4	**85.3**	**4.93**
15.6	8.6	3.8	10.5	-5.1	75.7	24.9	17,609		48.4	3.8	45.9	5.9	**93.1**	**5.29**
18.3	11.2	3.8	12.6	-5.7	83.8	25.3	17,960		48.7	3.8	46.4	6.4	**101.5**	**5.65**
21.1	13.8	3.8	14.9	-6.2	92.4	25.8	18,358		49.1	3.8	47.0	7.0	**110.5**	**6.02**
-3.9	-9.4	3.8	-6.0	-2.1	31.1	24.9	17,737	45.8	51.3	3.8	49	3.1	**48.6**	**2.74**
-1.1	-6.8	3.8	-3.5	-2.4	35.6	25.0	17,847	45.5	51.5	3.8		3.4	**53.2**	**2.98**
1.7	-4.2	3.8	-1.1	-2.8	40.6	25.2	17,959	45.2	51.6	3.8		3.7	**58.2**	**3.24**
4.4	-1.6	3.8	1.3	-3.1	46.0	25.4	18,119	44.8	51.8	3.8		4.1	**63.8**	**3.52**
7.2	1.0	3.8	3.7	-3.5	51.9	25.6	18,292	44.4	51.9	3.8		4.4	**70.0**	**3.82**
10.0	3.6	3.8	6.1	-3.9	58.4	25.9	18,525	44.0	52.1	3.8		4.9	**76.7**	**4.14**
12.7	6.2	3.8	8.3	-4.4	65.4	26.3	18,775	43.6	52.2	3.8		5.3	**83.9**	**4.47**
15.5	8.8	3.8	10.6	-4.9	73.1	26.7	19,101	43.0	52.3	3.8		5.9	**92.0**	**4.81**
18.3	11.4	3.8	12.8	-5.5	81.6	27.1	19,460	42.4	52.4	3.8		6.4	**100.8**	**5.18**
21.1	14.0	3.8	15.0	-6.1	90.7	27.7	19,902	41.8	52.6	3.8		7.1	**110.3**	**5.54**

COOLING

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**
12	2	3.8	7.4	-4.6	72.2	15.9	9,899	10.0	22	3.8	15.6	5.6	**81.8**	**7.30**
	2	3.8	7.6	-4.4	70.5	16.5	10,453	12.8	25	3.8	18.2	5.4	**80.6**	**6.74**
	3	3.8	7.7	-4.3	69.0	17.2	11,062	15.6	28	3.8	21.0	5.4	**79.7**	**6.24**
	3	3.8	7.7	-4.3	67.4	18.0	11,731	18.3	31	3.8	23.6	5.3	**78.8**	**5.74**
	3	3.8	7.8	-4.2	65.7	18.8	12,463	21.1	33	3.8	26.4	5.3	**77.9**	**5.28**
	3	3.8	7.9	-4.1	64.0	19.8	13,264	23.9	36	3.8	29.1	5.2	**77.1**	**4.84**
	4	3.8	8.1	-3.9	62.4	20.8	14,141	26.7	39	3.8	31.9	5.2	**76.3**	**4.43**
	4	3.8	8.2	-3.8	60.7	22.0	15,095	29.4	42	3.8	34.5	5.1	**75.5**	**4.02**
	4	3.8	8.3	-3.7	58.8	23.2	16,130	32.2	44	3.8	37.2	5.0	**74.7**	**3.63**
	4	3.8	8.4	-3.6	56.9	24.6	17,256	35.0	47	3.8	40.0	5.0	**73.9**	**3.31**

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Performance Tables - W-Series (US UNITS)

W-300-H**-X-*D-PP

R454b, 60 Hz, 2 x 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.

LOW TEMPERATURE*

EVAPORATOR LOOP *(50% Propylene Glycol)*							ELECTRICAL		CONDENSER LOOP *(Water)*						
ELT (°F)	Evap. Temp.	Flow (gpm)	LLT (°F)	Delta T (°F)	**Ice Cooling (Btu/hr)**	**EER**	Compressor Current (A)*	Input Power (W)	EWT (°F)	Cond. Temp.	Flow (gpm)	LWT (°F)	Delta T (°F)	**Heating** (Btu/hr)	**COP_H**
5	-3	72	2	-2.7	**84,200**	**6.6**	19.8	14,288	85	95	72	89	3.6	**128,800**	**2.64**
10	2	72	7	-3.1	**96,000**	**7.2**	20.4	14,609		95	72	89	3.9	**142,200**	**2.85**
15	6	72	12	-3.5	**108,900**	**7.9**	21.0	14,905		95	72	89	4.3	**156,600**	**3.08**
20	10	72	16	-3.9	**122,700**	**8.7**	21.6	15,181		96	72	90	4.8	**171,900**	**3.32**
25	15	72	21	-4.4	**137,800**	**9.5**	22.2	15,434		96	72	90	5.2	**188,400**	**3.58**
30	19	72	25	-4.9	**154,000**	**10.3**	22.7	15,700		97	72	91	5.7	**206,000**	**3.85**
35	24	72	30	-5.5	**171,500**	**11.1**	23.3	15,974		97	72	91	6.3	**225,000**	**4.13**
40	28	72	34	-6.0	**190,200**	**12.0**	23.9	16,269		97	72	92	6.8	**245,300**	**4.42**

*NOTE FOR LOW TEMPERATURE: salt brine, commonly used in arenas, is not an acceptable loop fluid due to its corrosive nature.

HEATING

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**
25	15	72	21	-3.9	129,400	25.0	17,813	104	115	72	109	5.3	**188,800**	**3.11**
30	19	72	26	-4.5	149,000	25.3	18,089		115	72	110	5.8	**209,400**	**3.39**
35	24	72	30	-5.1	170,600	25.7	18,353		116	72	111	6.5	**231,900**	**3.70**
40	29	72	34	-5.8	193,800	26.1	18,652		116	72	111	7.1	**256,100**	**4.02**
45	34	72	38	-6.6	219,900	26.5	18,964		117	72	112	7.9	**283,300**	**4.38**
50	38	72	43	-7.4	248,100	27.0	19,340		117	72	113	8.7	**312,800**	**4.74**
55	43	72	47	-8.3	278,300	27.6	19,767		118	72	114	9.6	**344,500**	**5.11**
60	48	72	51	-9.3	312,200	28.2	20,249		118	72	115	10.6	**380,000**	**5.50**
65	53	72	55	-10.4	348,500	28.9	20,836		119	72	116	11.7	**418,300**	**5.88**
70	58	72	59	-11.5	388,300	29.8	21,499		120	72	117	12.9	**460,400**	**6.28**
25	15	72	22	-3.5	117,500	27.0	19,517	115	124	72	120	5.1	**182,700**	**2.74**
30	20	72	26	-4.1	136,800	27.4	19,782	114	124	72		5.7	**203,000**	**3.01**
35	24	72	30	-4.7	158,200	27.8	20,053	114	124	72		6.3	**225,300**	**3.29**
40	29	72	35	-5.4	181,600	28.2	20,366	113	125	72		7.0	**249,800**	**3.59**
45	34	72	39	-6.2	207,500	28.6	20,687	112	125	72		7.8	**276,800**	**3.92**
50	39	72	43	-7.0	236,100	29.1	21,055	111	125	72		8.6	**306,600**	**4.27**
55	44	72	47	-8.0	267,200	29.7	21,480	111	125	72		9.5	**339,200**	**4.63**
60	48	72	51	-9.0	301,500	30.4	21,978	110	125	72		10.5	**375,200**	**5.00**
65	53	72	55	-10.1	338,600	31.2	22,587	108	126	72		11.6	**414,400**	**5.38**
70	58	72	59	-11.3	379,100	32.1	23,275	107	126	72		12.8	**457,200**	**5.76**

COOLING

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**
54	35	72	45	-8.2	294,300	17.7	11,705	50	71	72	60	9.9	**333,000**	**25.1**
	35	72	46	-8.0	288,200	18.5	12,353	55	76	72	65	9.8	**329,100**	**23.3**
	36	72	46	-7.8	281,900	19.3	13,073	60	82	72	70	9.7	**325,300**	**21.6**
	36	72	46	-7.7	276,300	20.3	13,868	65	87	72	75	9.6	**322,400**	**19.9**
	37	72	46	-7.5	270,200	21.4	14,760	70	92	72	80	9.5	**319,400**	**18.3**
	38	72	46	-7.4	264,500	22.7	15,755	75	97	72	84	9.4	**317,100**	**16.8**
	38	72	46	-7.2	258,400	24.1	16,852	80	103	72	89	9.3	**314,700**	**15.3**
	39	72	47	-7.0	252,700	25.6	18,054	85	108	72	94	9.3	**313,200**	**14.0**
	39	72	47	-6.9	246,400	27.3	19,394	90	113	72	99	9.2	**311,400**	**12.7**
	40	72	47	-6.7	240,200	29.2	20,872	95	119	72	104	9.2	**310,300**	**11.5**

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Performance Tables - W-Series (METRIC UNITS)

W-300-H**-X-*D-PP

R454b, 60 Hz, 2 x 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 *(50% Propylene Glycol)*							ELECTRICAL		CONDENSER LOOP *(Water)*						
	ELT (°C)	Evap. Temp.	Flow (L/s)	LLT (°C)	Delta T (°C)	**Ice Cooling (kW)**	**COP_C**	Compressor Current (A)*	Input Power (W)	EWT (°C)	Cond. Temp.	Flow (L/s)	LWT (°C)	Delta T (°C)	**Heating (kW)**	**COP_H**
LOW TEMPERATURE*	-15.0	-19.4	4.5	-16.5	-1.5	**24.7**	**1.93**	19.8	14,288	29.4	34.8	4.5	31.4	2.0	**37.8**	**2.64**
	-12.2	-16.9	4.5	-13.9	-1.7	**28.1**	**2.12**	20.4	14,609		35.0	4.5	31.6	2.2	**41.7**	**2.85**
	-9.4	-14.5	4.5	-11.3	-1.9	**31.9**	**2.32**	21.0	14,905		35.2	4.5	31.8	2.4	**45.9**	**3.08**
	-6.7	-12.1	4.5	-8.9	-2.2	**36.0**	**2.54**	21.6	15,181		35.4	4.5	32.1	2.7	**50.4**	**3.32**
	-3.9	-9.6	4.5	-6.3	-2.4	**40.4**	**2.77**	22.2	15,434		35.6	4.5	32.3	2.9	**55.2**	**3.58**
	-1.1	-7.2	4.5	-3.8	-2.7	**45.1**	**3.01**	22.7	15,700		35.8	4.5	32.6	3.2	**60.4**	**3.85**
	1.7	-4.7	4.5	-1.4	-3.1	**50.3**	**3.26**	23.3	15,974		36.1	4.5	32.9	3.5	**65.9**	**4.13**
	4.4	-2.3	4.5	1.1	-3.3	**55.7**	**3.51**	23.9	16,269		36.3	4.5	33.2	3.8	**71.9**	**4.42**

*NOTE FOR LOW TEMPERATURE: salt brine, commonly used in arenas, is not an acceptable loop fluid due to its corrosive nature.

	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	4.5	-6.1	-2.2	37.9	25.0	17,813	40	45.8	4.5	42.9	2.9	**55.3**	**3.11**
	-1.1	-7.1	4.5	-3.6	-2.5	43.7	25.3	18,089		46.2	4.5	43.2	3.2	**61.4**	**3.39**
	1.7	-4.4	4.5	-1.1	-2.8	50.0	25.7	18,353		46.4	4.5	43.6	3.6	**68.0**	**3.70**
	4.4	-1.8	4.5	1.2	-3.2	56.8	26.1	18,652		46.8	4.5	43.9	3.9	**75.1**	**4.02**
	7.2	0.9	4.5	3.5	-3.7	64.5	26.5	18,964		47.1	4.5	44.4	4.4	**83.0**	**4.38**
	10.0	3.6	4.5	5.9	-4.1	72.7	27.0	19,340		47.4	4.5	44.8	4.8	**91.7**	**4.74**
	12.7	6.2	4.5	8.1	-4.6	81.6	27.6	19,767		47.7	4.5	45.3	5.3	**101.0**	**5.11**
	15.5	8.8	4.5	10.3	-5.2	91.5	28.2	20,249		48.0	4.5	45.9	5.9	**111.4**	**5.50**
	18.3	11.5	4.5	12.5	-5.8	102.1	28.9	20,836		48.3	4.5	46.5	6.5	**122.6**	**5.88**
	21.1	14.2	4.5	14.7	-6.4	113.8	29.8	21,499		48.6	4.5	47.2	7.2	**134.9**	**6.28**
	-3.9	-9.6	4.5	-5.8	-1.9	34.4	27.0	19,517	46.1	51.0	4.5	49	2.8	**53.5**	**2.74**
	-1.1	-6.9	4.5	-3.4	-2.3	40.1	27.4	19,782	45.7	51.1	4.5		3.2	**59.5**	**3.01**
	1.7	-4.3	4.5	-0.9	-2.6	46.4	27.8	20,053	45.4	51.2	4.5		3.5	**66.0**	**3.29**
	4.4	-1.6	4.5	1.4	-3.0	53.2	28.2	20,366	45.0	51.4	4.5		3.9	**73.2**	**3.59**
	7.2	1.1	4.5	3.8	-3.4	60.8	28.6	20,687	44.6	51.5	4.5		4.3	**81.1**	**3.92**
	10.0	3.7	4.5	6.1	-3.9	69.2	29.1	21,055	44.1	51.6	4.5		4.8	**89.9**	**4.27**
	12.8	6.4	4.5	8.4	-4.4	78.3	29.7	21,480	43.6	51.7	4.5		5.3	**99.4**	**4.63**
	15.6	9.1	4.5	10.6	-5.0	88.4	30.4	21,978	43.1	51.8	4.5		5.8	**110.0**	**5.00**
	18.3	11.7	4.5	12.7	-5.6	99.2	31.2	22,587	42.4	52.0	4.5		6.4	**121.4**	**5.38**
	21.1	14.4	4.5	14.8	-6.3	111.1	32.1	23,275	41.8	52.1	4.5		7.1	**134.0**	**5.76**

	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	2	4.5	7.4	-4.6	86.3	17.7	11,705	10.0	22	4.5	15.5	5.5	**97.6**	**7.36**
		2	4.5	7.6	-4.4	84.5	18.5	12,353	12.8	25	4.5	18.2	5.4	**96.5**	**6.83**
		2	4.5	7.7	-4.3	82.6	19.3	13,073	15.6	28	4.5	21.0	5.4	**95.3**	**6.33**
		2	4.5	7.7	-4.3	81.0	20.3	13,868	18.3	30	4.5	23.6	5.3	**94.5**	**5.83**
		3	4.5	7.8	-4.2	79.2	21.4	14,760	21.1	33	4.5	26.4	5.3	**93.6**	**5.36**
		3	4.5	7.9	-4.1	77.5	22.7	15,755	23.9	36	4.5	29.1	5.2	**92.9**	**4.92**
		3	4.5	8.0	-4.0	75.7	24.1	16,852	26.7	39	4.5	31.9	5.2	**92.2**	**4.48**
		4	4.5	8.1	-3.9	74.1	25.6	18,054	29.4	42	4.5	34.6	5.2	**91.8**	**4.10**
		4	4.5	8.2	-3.8	72.2	27.3	19,394	32.2	45	4.5	37.3	5.1	**91.3**	**3.72**
		4	4.5	8.3	-3.7	70.4	29.2	20,872	35.0	48	4.5	40.1	5.1	**90.9**	**3.37**

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Performance Tables - W-Series (US UNITS)

W-400-H**-X-*D-PP

R454b, 60 Hz, 2 x 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.

LOW TEMPERATURE*

EVAPORATOR LOOP *(50% Propylene Glycol)*							ELECTRICAL		CONDENSER LOOP *(Water)*						
ELT (°F)	Evap. Temp.	Flow (gpm)	LLT (°F)	Delta T (°F)	**Ice Cooling (Btu/hr)**	**EER**	Compressor Current (A)*	Input Power (W)	EWT (°F)	Cond. Temp.	Flow (gpm)	LWT (°F)	Delta T (°F)	**Heating (Btu/hr)**	**COP$_H$**
5	-3	100	2	-2.6	**112,300**	**6.8**	25.6	18,552		94	100	88	3.4	**169,900**	**2.68**
10	2	100	7	-3.0	**128,000**	**7.5**	26.5	18,976		95	100	89	3.7	**187,800**	**2.90**
15	6	100	12	-3.4	**145,200**	**8.2**	27.4	19,397		95	100	89	4.1	**207,100**	**3.13**
20	11	100	16	-3.8	**163,700**	**8.9**	28.4	19,819	85	96	100	90	4.6	**227,800**	**3.37**
25	15	100	21	-4.2	**183,900**	**9.7**	29.3	20,223		96	100	90	5.0	**250,100**	**3.62**
30	19	100	25	-4.7	**205,500**	**10.4**	30.2	20,659		96	100	91	5.5	**274,000**	**3.89**
35	24	100	30	-5.3	**229,100**	**11.3**	31.2	21,109		97	100	91	6.0	**299,800**	**4.16**
40	28	100	34	-5.8	**254,300**	**12.1**	32.1	21,579		97	100	92	6.6	**327,400**	**4.45**

*NOTE FOR LOW TEMPERATURE: salt brine, commonly used in arenas, is not an acceptable loop fluid due to its corrosive nature.

HEATING

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$_H$**
25	14	100	22	-3.4	158,300	32.8	23,392		115	100	109	4.7	**236,300**	**2.96**
30	19	100	26	-4.0	184,700	33.2	23,726		116	100	109	5.3	**263,900**	**3.26**
35	24	100	30	-4.6	213,500	33.7	24,039		116	100	110	5.9	**293,800**	**3.58**
40	29	100	35	-5.3	245,100	34.1	24,388		117	100	111	6.6	**326,600**	**3.92**
45	34	100	39	-6.0	280,900	34.6	24,729	104	117	100	111	7.3	**363,600**	**4.31**
50	39	100	43	-6.9	319,300	35.1	25,121		118	100	112	8.1	**403,300**	**4.71**
55	43	100	47	-7.7	361,200	35.6	25,540		119	100	113	9.0	**446,700**	**5.13**
60	48	100	51	-8.7	407,700	36.2	25,967		119	100	114	9.9	**494,600**	**5.58**
65	53	100	55	-9.8	458,800	36.8	26,470		120	100	115	11.0	**547,500**	**6.06**
70	58	100	59	-11.0	513,600	37.5	26,986		120	100	116	12.1	**604,100**	**6.56**
25	15	100	22	-3.1	142,900	35.5	25,680	115	124	100		4.6	**228,700**	**2.61**
30	20	100	26	-3.6	168,900	35.9	25,982	115	125	100		5.1	**255,800**	**2.89**
35	24	100	31	-4.3	197,300	36.3	26,284	114	125	100		5.7	**285,200**	**3.18**
40	29	100	35	-4.9	229,200	36.8	26,625	114	125	100		6.4	**318,300**	**3.50**
45	34	100	39	-5.7	264,300	37.2	26,948	113	125	100	120	7.1	**354,500**	**3.86**
50	39	100	44	-6.5	303,800	37.7	27,296	112	126	100		8.0	**395,200**	**4.24**
55	44	100	48	-7.4	346,500	38.2	27,666	111	126	100		8.9	**439,200**	**4.65**
60	49	100	52	-8.5	394,400	38.8	28,073	110	126	100		9.9	**488,500**	**5.10**
65	53	100	55	-9.5	445,800	39.4	28,550	109	126	100		10.9	**541,600**	**5.56**
70	58	100	59	-10.8	503,200	40.1	29,047	108	126	100		12.1	**600,700**	**6.06**

COOLING

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**
	35	100	46	-7.7	382,600	24.0	15,326	50	72	100	59	9.3	**433,200**	**25.0**
	35	100	46	-7.6	377,500	25.1	16,278	55	77	100	64	9.3	**431,400**	**23.2**
	36	100	46	-7.5	372,100	26.3	17,341	60	82	100	69	9.2	**429,600**	**21.5**
	36	100	46	-7.3	366,500	27.7	18,501	65	87	100	74	9.2	**428,000**	**19.8**
54	37	100	46	-7.2	360,500	29.2	19,797	70	93	100	79	9.1	**426,400**	**18.2**
	37	100	47	-7.1	354,000	30.9	21,221	75	98	100	84	9.1	**424,800**	**16.7**
	38	100	47	-7.0	347,300	32.8	22,776	80	103	100	89	9.0	**423,400**	**15.2**
	38	100	47	-6.8	340,300	34.8	24,441	85	108	100	94	9.0	**422,100**	**13.9**
	39	100	47	-6.7	332,900	37.1	26,273	90	114	100	99	9.0	**421,000**	**12.7**
	39	100	47	-6.5	324,900	39.6	28,254	95	119	100	104	8.9	**419,700**	**11.5**

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Performance Tables - W-Series (METRIC UNITS)

W-400-H**-X-*D-PP

R454b, 60 Hz, 2 x 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 (50% Propylene Glycol)							ELECTRICAL		CONDENSER LOOP (Water)						
	ELT (°C)	Evap. Temp.	Flow (L/s)	LLT (°C)	Delta T (°C)	Ice Cooling (kW)	COP$_C$	Compressor Current (A)*	Input Power (W)	EWT (°C)	Cond. Temp.	Flow (L/s)	LWT (°C)	Delta T (°C)	Heating (kW)	COP$_H$
LOW TEMPERATURE*	-15.0	-19.3	6.3	-16.4	-1.4	**32.9**	**2.00**	25.6	18,552	29.4	34.7	6.3	31.3	1.9	**49.8**	**2.68**
	-12.2	-16.8	6.3	-13.9	-1.7	**37.5**	**2.19**	26.5	18,976		34.9	6.3	31.5	2.1	**55.0**	**2.90**
	-9.4	-14.4	6.3	-11.3	-1.9	**42.6**	**2.39**	27.4	19,397		35.1	6.3	31.7	2.3	**60.7**	**3.13**
	-6.7	-11.9	6.3	-8.8	-2.1	**48.0**	**2.61**	28.4	19,819		35.3	6.3	32.0	2.6	**66.8**	**3.37**
	-3.9	-9.5	6.3	-6.2	-2.3	**53.9**	**2.83**	29.3	20,223		35.5	6.3	32.2	2.8	**73.3**	**3.62**
	-1.1	-7.1	6.3	-3.7	-2.6	**60.2**	**3.06**	30.2	20,659		35.7	6.3	32.5	3.1	**80.3**	**3.89**
	1.7	-4.6	6.3	-1.2	-2.9	**67.1**	**3.30**	31.2	21,109		35.9	6.3	32.7	3.3	**87.9**	**4.16**
	4.4	-2.2	6.3	1.2	-3.2	**74.5**	**3.54**	32.1	21,579		36.2	6.3	33.1	3.7	**96.0**	**4.45**

*NOTE FOR LOW TEMPERATURE: salt brine, commonly used in arenas, is not an acceptable loop fluid due to its corrosive nature.

	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	6.3	-5.8	-1.9	46.4	32.8	23,392	40	46.2	6.3	42.6	2.6	**69.3**	**2.96**
	-1.1	-7.1	6.3	-3.3	-2.2	54.1	33.2	23,726		46.6	6.3	42.9	2.9	**77.3**	**3.26**
	1.7	-4.4	6.3	-0.9	-2.6	62.6	33.7	24,039		46.8	6.3	43.3	3.3	**86.1**	**3.58**
	4.4	-1.7	6.3	1.5	-2.9	71.8	34.1	24,388		47.2	6.3	43.7	3.7	**95.7**	**3.92**
	7.2	1.0	6.3	3.9	-3.3	82.3	34.6	24,729		47.4	6.3	44.1	4.1	**106.6**	**4.31**
	10.0	3.7	6.3	6.2	-3.8	93.6	35.1	25,121		47.8	6.3	44.5	4.5	**118.2**	**4.71**
	12.8	6.3	6.3	8.5	-4.3	105.9	35.6	25,540		48.1	6.3	45.0	5.0	**130.9**	**5.13**
	15.5	9.0	6.3	10.7	-4.8	119.5	36.2	25,967		48.4	6.3	45.5	5.5	**145.0**	**5.58**
	18.3	11.7	6.3	12.9	-5.4	134.5	36.8	26,470		48.7	6.3	46.1	6.1	**160.5**	**6.06**
	21.1	14.4	6.3	15.0	-6.1	150.5	37.5	26,986		49.0	6.3	46.7	6.7	**177.0**	**6.56**
	-3.9	-9.7	6.3	-5.6	-1.7	41.9	35.5	25,680	46.3	51.3	6.3	49	2.6	**67.0**	**2.61**
	-1.1	-6.9	6.3	-3.1	-2.0	49.5	35.9	25,982	46.1	51.4	6.3		2.8	**75.0**	**2.89**
	1.7	-4.3	6.3	-0.7	-2.4	57.8	36.3	26,284	45.7	51.6	6.3		3.2	**83.6**	**3.18**
	4.4	-1.6	6.3	1.7	-2.7	67.2	36.8	26,625	45.3	51.7	6.3		3.6	**93.3**	**3.50**
	7.2	1.1	6.3	4.0	-3.2	77.5	37.2	26,948	44.9	51.8	6.3		3.9	**103.9**	**3.86**
	10.0	3.8	6.3	6.4	-3.6	89.0	37.7	27,296	44.4	51.9	6.3		4.4	**115.8**	**4.24**
	12.7	6.5	6.3	8.6	-4.1	101.5	38.2	27,666	43.9	52.1	6.3		4.9	**128.7**	**4.65**
	15.6	9.2	6.3	10.9	-4.7	115.6	38.8	28,073	43.4	52.2	6.3		5.5	**143.2**	**5.10**
	18.3	11.9	6.3	13.0	-5.3	130.7	39.4	28,550	42.8	52.3	6.3		6.1	**158.7**	**5.56**
	21.1	14.6	6.3	15.1	-6.0	147.5	40.1	29,047	42.2	52.4	6.3		6.7	**176.0**	**6.06**

	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	2	6.3	7.7	-4.3	112.1	24.0	15,326	10.0	22	6.3	15.2	5.2	**127.0**	**7.33**
		2	6.3	7.8	-4.2	110.6	25.1	16,278	12.8	25	6.3	18.0	5.2	**126.4**	**6.80**
		2	6.3	7.8	-4.2	109.1	26.3	17,341	15.6	28	6.3	20.7	5.1	**125.9**	**6.30**
		2	6.3	7.9	-4.1	107.4	27.7	18,501	18.3	31	6.3	23.4	5.1	**125.4**	**5.80**
		3	6.3	8.0	-4.0	105.7	29.2	19,797	21.1	34	6.3	26.2	5.1	**125.0**	**5.33**
		3	6.3	8.1	-3.9	103.7	30.9	21,221	23.9	37	6.3	29.0	5.1	**124.5**	**4.89**
		3	6.3	8.1	-3.9	101.8	32.8	22,776	26.7	40	6.3	31.7	5.0	**124.1**	**4.45**
		4	6.3	8.2	-3.8	99.7	34.8	24,441	29.4	42	6.3	34.4	5.0	**123.7**	**4.07**
		4	6.3	8.3	-3.7	97.6	37.1	26,273	32.2	45	6.3	37.2	5.0	**123.4**	**3.72**
		4	6.3	8.4	-3.6	95.2	39.6	28,254	35.0	48	6.3	39.9	4.9	**123.0**	**3.37**

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Performance Tables - W-Series (US UNITS)

W-500-H**-X-*D-PP *R454b, 60 Hz, 2 x GSD60235VL (460-3-60)*

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

	EVAPORATOR LOOP *(50% Propylene Glycol)*							ELECTRICAL		CONDENSER LOOP *(Water)*						
	ELT (°F)	Evap. Temp.	Flow (gpm)	LLT (°F)	Delta T (°F)	**Ice Cooling (Btu/hr)**	**EER**	Compressor Current (A)*	Input Power (W)	EWT (°F)	Cond. Temp.	Flow (gpm)	LWT (°F)	Delta T (°F)	**Heating** (Btu/hr)	**COP$_H$**
LOW TEMPERATURE*	5	-3	120	2	-2.9	**147,300**	**6.9**	35.0	24,530	85	95	120	89	3.7	**222,600**	**2.66**
	10	2	120	7	-3.2	**167,600**	**7.5**	36.2	25,093		95	120	89	4.1	**245,700**	**2.87**
	15	6	120	11	-3.7	**189,800**	**8.3**	37.3	25,623		95	120	90	4.5	**270,600**	**3.10**
	20	10	120	16	-4.1	**213,900**	**9.0**	38.4	26,128		96	120	90	4.9	**297,300**	**3.33**
	25	15	120	20	-4.6	**240,300**	**9.8**	39.5	26,593		96	120	90	5.4	**326,200**	**3.59**
	30	19	120	25	-5.1	**268,800**	**10.6**	40.5	27,080		96	120	91	5.9	**357,300**	**3.87**
	35	24	120	29	-5.7	**299,900**	**11.5**	41.6	27,576		97	120	92	6.5	**390,900**	**4.15**
	40	28	120	34	-6.4	**333,500**	**12.5**	42.7	28,096		97	120	92	7.1	**427,200**	**4.46**

*NOTE FOR LOW TEMPERATURE: salt brine, commonly used in arenas, is not an acceptable loop fluid due to its corrosive nature.

	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	120	21	-3.9	214,700	45.6	31,777	104	115	120	109	5.3	**319,800**	**2.95**
	30	20	120	26	-4.5	247,600	45.8	31,980		116	120	110	5.9	**353,500**	**3.24**
	35	24	120	30	-5.1	283,900	46.1	32,158		116	120	111	6.5	**390,500**	**3.56**
	40	29	120	34	-5.8	323,800	46.4	32,391		117	120	111	7.2	**431,300**	**3.90**
	45	34	120	38	-6.6	368,000	46.7	32,632		117	120	112	8.0	**476,400**	**4.28**
	50	39	120	43	-7.4	416,300	47.1	32,962		118	120	113	8.8	**525,900**	**4.68**
	55	44	120	47	-8.4	468,900	47.6	33,366		119	120	114	9.7	**580,000**	**5.09**
	60	48	120	51	-9.4	526,900	48.1	33,825		119	120	115	10.7	**639,600**	**5.54**
	65	53	120	55	-10.5	589,500	48.8	34,424		120	120	116	11.8	**704,400**	**6.00**
	70	58	120	58	-11.7	657,900	49.7	35,110		120	120	117	13.0	**775,200**	**6.47**
	25	15	120	22	-3.5	193,700	49.3	34,998	115	125	120	120	5.2	**309,800**	**2.59**
	30	20	120	26	-4.1	226,400	49.5	35,081	114	125	120		5.7	**342,800**	**2.86**
	35	25	120	30	-4.7	262,100	49.6	35,172	114	125	120		6.3	**378,900**	**3.16**
	40	29	120	35	-5.4	301,300	49.8	35,326	113	125	120		7.0	**418,800**	**3.47**
	45	34	120	39	-6.2	345,900	50.0	35,489	112	126	120		7.8	**464,000**	**3.83**
	50	39	120	43	-7.1	394,300	50.3	35,709	111	126	120		8.6	**513,300**	**4.21**
	55	44	120	47	-8.0	447,400	50.7	36,004	111	126	120		9.5	**567,500**	**4.62**
	60	49	120	51	-9.0	506,100	51.2	36,389	110	126	120		10.5	**627,600**	**5.05**
	65	54	120	55	-10.2	570,700	51.9	36,932	108	126	120		11.7	**694,100**	**5.51**
	70	58	120	59	-11.4	640,400	52.6	37,551	107	127	120		12.9	**766,000**	**5.98**

	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	120	45	-8.2	488,900	31.8	19,623	50	72	120	60	9.9	**552,700**	**24.9**
		36	120	46	-8.1	482,800	33.4	21,008	55	77	120	65	9.9	**551,300**	**23.0**
		36	120	46	-8.0	476,500	35.1	22,492	60	82	120	70	9.8	**550,100**	**21.2**
		37	120	46	-7.8	469,700	36.9	24,051	65	88	120	75	9.8	**548,600**	**19.5**
		37	120	46	-7.7	463,600	38.9	25,723	70	93	120	80	9.8	**548,300**	**18.0**
		38	120	46	-7.6	455,700	41.0	27,542	75	98	120	85	9.7	**546,600**	**16.5**
		38	120	46	-7.5	447,900	43.4	29,478	80	104	120	90	9.7	**545,400**	**15.2**
		39	120	46	-7.3	439,300	45.9	31,572	85	109	120	95	9.7	**544,000**	**13.9**
		39	120	46	-7.2	431,000	48.8	33,882	90	114	120	100	9.7	**543,600**	**12.7**
		40	120	47	-7.0	421,300	51.8	36,353	95	120	120	105	9.6	**542,400**	**11.6**

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Performance Tables - W-Series (METRIC UNITS)

W-500-H**-X-*D-PP *R454b, 60 Hz, 2 x GSD60235VL (460-3-60)*

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

METRIC

LOW TEMPERATURE*

EVAPORATOR LOOP *(50% Propylene Glycol)*							ELECTRICAL		CONDENSER LOOP *(Water)*						
ELT (°C)	Evap. Temp.	Flow (L/s)	LLT (°C)	Delta T (°C)	**Ice Cooling (kW)**	**COP_C**	Compressor Current (A)*	Input Power (W)	EWT (°C)	Cond. Temp.	Flow (L/s)	LWT (°C)	Delta T (°C)	**Heating (kW)**	**COP_H**
-15.0	-19.3	7.6	-16.6	-1.6	**43.2**	**2.02**	35.0	24,530	29.4	34.7	7.6	31.5	2.1	**65.2**	**2.66**
-12.2	-16.9	7.6	-14.0	-1.8	**49.1**	**2.21**	36.2	25,093		34.9	7.6	31.7	2.3	**72.0**	**2.87**
-9.4	-14.4	7.6	-11.5	-2.1	**55.6**	**2.42**	37.3	25,623		35.2	7.6	31.9	2.5	**79.3**	**3.10**
-6.7	-12.0	7.6	-9.0	-2.3	**62.7**	**2.64**	38.4	26,128		35.4	7.6	32.1	2.7	**87.1**	**3.33**
-3.9	-9.6	7.6	-6.5	-2.6	**70.4**	**2.88**	39.5	26,593		35.6	7.6	32.4	3.0	**95.6**	**3.59**
-1.1	-7.1	7.6	-3.9	-2.8	**78.8**	**3.12**	40.5	27,080		35.8	7.6	32.7	3.3	**104.7**	**3.87**
1.7	-4.7	7.6	-1.5	-3.2	**87.9**	**3.38**	41.6	27,576		36.0	7.6	33.0	3.6	**114.6**	**4.15**
4.4	-2.2	7.6	0.8	-3.6	**97.7**	**3.65**	42.7	28,096		36.2	7.6	33.3	3.9	**125.2**	**4.46**

*NOTE FOR LOW TEMPERATURE: salt brine, commonly used in arenas, is not an acceptable loop fluid due to its corrosive nature.

HEATING

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**
-3.9	-9.6	7.6	-6.1	-2.2	62.9	45.6	31,777	40	46.2	7.6	42.9	2.9	**93.7**	**2.95**
-1.1	-6.9	7.6	-3.6	-2.5	72.6	45.8	31,980		46.6	7.6	43.3	3.3	**103.6**	**3.24**
1.7	-4.3	7.6	-1.1	-2.8	83.2	46.1	32,158		46.8	7.6	43.6	3.6	**114.4**	**3.56**
4.4	-1.6	7.6	1.2	-3.2	94.9	46.4	32,391		47.2	7.6	44.0	4.0	**126.4**	**3.90**
7.2	1.1	7.6	3.5	-3.7	107.9	46.7	32,632		47.4	7.6	44.4	4.4	**139.6**	**4.28**
10.0	3.7	7.6	5.9	-4.1	122.0	47.1	32,962		47.8	7.6	44.9	4.9	**154.1**	**4.68**
12.8	6.4	7.6	8.1	-4.7	137.4	47.6	33,366		48.1	7.6	45.4	5.4	**170.0**	**5.09**
15.6	9.1	7.6	10.4	-5.2	154.4	48.1	33,825		48.4	7.6	45.9	5.9	**187.4**	**5.54**
18.3	11.7	7.6	12.5	-5.8	172.8	48.8	34,424		48.7	7.6	46.6	6.6	**206.4**	**6.00**
21.1	14.4	7.6	14.6	-6.5	192.8	49.7	35,110		49.0	7.6	47.2	7.2	**227.2**	**6.47**
-3.9	-9.6	7.6	-5.8	-1.9	56.8	49.3	34,998	46.0	51.4	7.6	49	2.9	**90.8**	**2.59**
-1.1	-6.8	7.6	-3.4	-2.3	66.4	49.5	35,081	45.7	51.6	7.6		3.2	**100.5**	**2.86**
1.7	-4.2	7.6	-0.9	-2.6	76.8	49.6	35,172	45.4	51.7	7.6		3.5	**111.0**	**3.16**
4.4	-1.5	7.6	1.4	-3.0	88.3	49.8	35,326	45.0	51.8	7.6		3.9	**122.7**	**3.47**
7.2	1.2	7.6	3.8	-3.4	101.4	50.0	35,489	44.6	51.9	7.6		4.3	**136.0**	**3.83**
10.0	3.9	7.6	6.1	-3.9	115.6	50.3	35,709	44.1	52.1	7.6		4.8	**150.4**	**4.21**
12.8	6.6	7.6	8.4	-4.4	131.1	50.7	36,004	43.6	52.2	7.6		5.3	**166.3**	**4.62**
15.5	9.2	7.6	10.5	-5.0	148.3	51.2	36,389	43.1	52.3	7.6		5.8	**183.9**	**5.05**
18.3	11.9	7.6	12.6	-5.7	167.3	51.9	36,932	42.4	52.4	7.6		6.5	**203.4**	**5.51**
21.1	14.6	7.6	14.8	-6.3	187.7	52.6	37,551	41.7	52.6	7.6		7.2	**224.5**	**5.98**

COOLING

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**
12	2	7.6	7.4	-4.6	143.3	31.8	19,623	10.0	22	7.6	15.5	5.5	**162.0**	**7.30**
	2	7.6	7.5	-4.5	141.5	33.4	21,008	12.8	25	7.6	18.3	5.5	**161.6**	**6.74**
	2	7.6	7.6	-4.4	139.6	35.1	22,492	15.6	28	7.6	21.0	5.4	**161.2**	**6.21**
	3	7.6	7.7	-4.3	137.7	36.9	24,051	18.3	31	7.6	23.7	5.4	**160.8**	**5.71**
	3	7.6	7.7	-4.3	135.9	38.9	25,723	21.1	34	7.6	26.5	5.4	**160.7**	**5.28**
	3	7.6	7.8	-4.2	133.6	41.0	27,542	23.9	37	7.6	29.3	5.4	**160.2**	**4.84**
	3	7.6	7.8	-4.2	131.3	43.4	29,478	26.7	40	7.6	32.1	5.4	**159.8**	**4.45**
	4	7.6	7.9	-4.1	128.7	45.9	31,572	29.4	43	7.6	34.8	5.4	**159.4**	**4.07**
	4	7.6	8.0	-4.0	126.3	48.8	33,882	32.2	46	7.6	37.6	5.4	**159.3**	**3.72**
	4	7.6	8.1	-3.9	123.5	51.8	36,353	35.0	49	7.6	40.3	5.3	**159.0**	**3.40**

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Performance Tables - W-Series (US UNITS)

W-600-H**-X-*D-PP *R454b, 60 Hz, 2 x GSD80295VL (460-3-60)*

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

LOW TEMPERATURE*

EVAPORATOR LOOP *(50% Propylene Glycol)*							ELECTRICAL		CONDENSER LOOP *(Water)*						
ELT (°F)	Evap. Temp.	Flow (gpm)	LLT (°F)	Delta T (°F)	**Ice Cooling (Btu/hr)**	**EER**	Compressor Current (A)*	Input Power (W)	EWT (°F)	Cond. Temp.	Flow (gpm)	LWT (°F)	Delta T (°F)	**Heating** (Btu/hr)	**COP_H**
5	-3	150	2	-2.9	**186,100**	**7.0**	36.9	30,773	85	94	150	89	3.7	**280,200**	**2.67**
10	2	150	7	-3.3	**211,300**	**7.6**	38.2	31,415	85	95	150	89	4.1	**308,800**	**2.88**
15	6	150	11	-3.7	**239,100**	**8.4**	39.5	32,050	85	95	150	90	4.5	**339,800**	**3.11**
20	11	150	16	-4.1	**269,200**	**9.1**	40.8	32,682	85	96	150	90	5.0	**373,200**	**3.35**
25	15	150	20	-4.6	**302,500**	**9.9**	42.1	33,283	85	96	150	90	5.4	**409,700**	**3.61**
30	19	150	25	-5.2	**338,300**	**10.8**	43.4	33,933	85	96	150	91	6.0	**448,800**	**3.88**
35	24	150	29	-5.8	**377,400**	**11.6**	44.8	34,603	85	97	150	92	6.5	**491,300**	**4.16**
40	28	150	34	-6.4	**419,700**	**12.5**	46.1	35,302	85	97	150	92	7.2	**537,100**	**4.46**

*NOTE FOR LOW TEMPERATURE: salt brine, commonly used in arenas, is not an acceptable loop fluid due to its corrosive nature.

HEATING

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**
25	15	150	21	-3.9	271,200	51.3	39,965	104	115	150	109	5.4	**403,000**	**2.96**
30	20	150	26	-4.5	311,800	51.7	40,218	104	116	150	110	5.9	**444,600**	**3.24**
35	25	150	30	-5.1	356,100	52.0	40,413	104	116	150	111	6.5	**489,700**	**3.55**
40	29	150	34	-5.8	404,400	52.3	40,662	104	117	150	111	7.2	**539,000**	**3.88**
45	34	150	38	-6.6	459,100	52.7	40,871	104	117	150	112	7.9	**594,500**	**4.26**
50	39	150	43	-7.4	517,500	53.1	41,152	104	118	150	113	8.7	**654,000**	**4.66**
55	44	150	47	-8.3	581,200	53.5	41,463	104	119	150	114	9.6	**718,900**	**5.08**
60	49	150	51	-9.3	651,600	54.0	41,760	104	119	150	115	10.6	**790,400**	**5.55**
65	54	150	55	-10.4	728,800	54.6	42,160	104	120	150	116	11.6	**869,100**	**6.04**
70	58	150	58	-11.6	811,500	55.1	42,562	104	120	150	117	12.8	**953,300**	**6.56**
25	15	150	22	-3.5	245,000	56.3	43,825	115	125	150	120	5.2	**390,000**	**2.61**
30	20	150	26	-4.1	285,100	56.7	44,057	114	125	150	120	5.8	**431,000**	**2.87**
35	25	150	30	-4.7	328,700	57.0	44,267	114	125	150	120	6.4	**475,400**	**3.15**
40	30	150	35	-5.4	378,000	57.2	44,415	113	125	150	120	7.0	**525,400**	**3.47**
45	34	150	39	-6.2	431,700	57.6	44,619	112	126	150	120	7.8	**579,900**	**3.81**
50	39	150	43	-7.0	491,900	57.9	44,836	111	126	150	120	8.6	**641,000**	**4.19**
55	44	150	47	-8.0	556,800	58.3	45,073	111	126	150	120	9.5	**706,800**	**4.60**
60	49	150	51	-9.0	629,400	58.7	45,343	110	127	150	120	10.5	**780,400**	**5.04**
65	54	150	55	-10.1	707,900	59.1	45,597	108	127	150	120	11.6	**859,900**	**5.53**
70	59	150	59	-11.3	794,500	59.6	45,962	107	127	150	120	12.7	**947,900**	**6.04**

COOLING

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**
54	35	150	46	-8.1	604,500	31.8	24,543	50	72	150	60	9.8	**684,000**	**24.6**
54	35	150	46	-8.0	595,800	33.8	26,127	55	77	150	65	9.7	**680,700**	**22.8**
54	36	150	46	-7.9	587,400	35.9	27,864	60	82	150	70	9.7	**678,200**	**21.1**
54	37	150	46	-7.7	578,300	38.4	29,774	65	88	150	75	9.6	**675,700**	**19.4**
54	37	150	46	-7.6	569,200	41.0	31,880	70	93	150	80	9.6	**673,800**	**17.9**
54	38	150	46	-7.5	560,400	44.1	34,206	75	98	150	85	9.6	**673,000**	**16.4**
54	39	150	46	-7.4	550,200	47.4	36,769	80	103	150	90	9.6	**671,600**	**15.0**
54	39	150	46	-7.2	539,000	51.1	39,596	85	109	150	95	9.5	**670,000**	**13.6**
54	40	150	47	-7.1	527,300	55.2	42,711	90	114	150	100	9.5	**669,000**	**12.3**
54	40	150	47	-6.9	514,400	59.7	46,142	95	119	150	105	9.5	**667,800**	**11.1**

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Performance Tables - W-Series (METRIC UNITS)

W-600-H**-X-*D-PP

R454b, 60 Hz, 2 x GSD80295VL (460-3-60)

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

METRIC

LOW TEMPERATURE*

EVAPORATOR LOOP (50% Propylene Glycol)							ELECTRICAL		CONDENSER LOOP (Water)						
ELT (°C)	Evap. Temp.	Flow (L/s)	LLT (°C)	Delta T (°C)	Ice Cooling (kW)	COP_C	Compressor Current (A)*	Input Power (W)	EWT (°C)	Cond. Temp.	Flow (L/s)	LWT (°C)	Delta T (°C)	Heating (kW)	COP_H
-15.0	-19.2	9.5	-16.6	-1.6	**54.5**	**2.04**	36.9	30,773	29.4	34.6	9.5	31.5	2.1	**82.1**	**2.67**
-12.2	-16.8	9.5	-14.0	-1.8	**61.9**	**2.24**	38.2	31,415		34.8	9.5	31.7	2.3	**90.5**	**2.88**
-9.4	-14.3	9.5	-11.5	-2.1	**70.1**	**2.45**	39.5	32,050		35.1	9.5	31.9	2.5	**99.6**	**3.11**
-6.7	-11.9	9.5	-9.0	-2.3	**78.9**	**2.67**	40.8	32,682		35.3	9.5	32.2	2.8	**109.4**	**3.35**
-3.9	-9.4	9.5	-6.5	-2.6	**88.7**	**2.91**	42.1	33,283		35.4	9.5	32.4	3.0	**120.1**	**3.61**
-1.1	-7.0	9.5	-4.0	-2.9	**99.1**	**3.15**	43.4	33,933		35.7	9.5	32.7	3.3	**131.5**	**3.88**
1.7	-4.6	9.5	-1.5	-3.2	**110.6**	**3.41**	44.8	34,603		35.9	9.5	33.0	3.6	**144.0**	**4.16**
4.4	-2.1	9.5	0.8	-3.6	**123.0**	**3.67**	46.1	35,302		36.1	9.5	33.4	4.0	**157.4**	**4.46**

*NOTE FOR LOW TEMPERATURE: salt brine, commonly used in arenas, is not an acceptable loop fluid due to its corrosive nature.

HEATING

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
-3.9	-9.6	9.5	-6.1	-2.2	79.5	51.3	39,965	40	46.2	9.5	43.0	3.0	**118.1**	**2.96**
-1.1	-6.8	9.5	-3.6	-2.5	91.4	51.7	40,218		46.6	9.5	43.3	3.3	**130.3**	**3.24**
1.7	-4.2	9.5	-1.1	-2.8	104.4	52.0	40,413		46.8	9.5	43.6	3.6	**143.5**	**3.55**
4.4	-1.5	9.5	1.2	-3.2	118.5	52.3	40,662		47.2	9.5	44.0	4.0	**158.0**	**3.88**
7.2	1.2	9.5	3.5	-3.7	134.5	52.7	40,871		47.4	9.5	44.4	4.4	**174.2**	**4.26**
10.0	3.9	9.5	5.9	-4.1	151.7	53.1	41,152		47.8	9.5	44.8	4.8	**191.7**	**4.66**
12.8	6.6	9.5	8.2	-4.6	170.3	53.5	41,463		48.1	9.5	45.3	5.3	**210.7**	**5.08**
15.5	9.2	9.5	10.3	-5.2	191.0	54.0	41,760		48.4	9.5	45.9	5.9	**231.6**	**5.55**
18.3	11.9	9.5	12.5	-5.8	213.6	54.6	42,160		48.7	9.5	46.4	6.4	**254.7**	**6.04**
21.1	14.6	9.5	14.7	-6.4	237.8	55.1	42,562		49.0	9.5	47.1	7.1	**279.4**	**6.56**
-3.9	-9.4	9.5	-5.8	-1.9	71.8	56.3	43,825	46.0	51.4	9.5	49	2.9	**114.3**	**2.61**
-1.1	-6.7	9.5	-3.4	-2.3	83.6	56.7	44,057	45.7	51.6	9.5		3.2	**126.3**	**2.87**
1.7	-4.1	9.5	-0.9	-2.6	96.3	57.0	44,267	45.3	51.7	9.5		3.6	**139.3**	**3.15**
4.4	-1.3	9.5	1.4	-3.0	110.8	57.2	44,415	45.0	51.8	9.5		3.9	**154.0**	**3.47**
7.2	1.3	9.5	3.8	-3.4	126.5	57.6	44,619	44.6	52.0	9.5		4.3	**170.0**	**3.81**
10.0	4.1	9.5	6.1	-3.9	144.2	57.9	44,836	44.1	52.2	9.5		4.8	**187.9**	**4.19**
12.7	6.7	9.5	8.3	-4.4	163.2	58.3	45,073	43.6	52.3	9.5		5.3	**207.1**	**4.60**
15.6	9.4	9.5	10.6	-5.0	184.5	58.7	45,343	43.1	52.5	9.5		5.8	**228.7**	**5.04**
18.3	12.1	9.5	12.7	-5.6	207.5	59.1	45,597	42.4	52.6	9.5		6.4	**252.0**	**5.53**
21.1	14.8	9.5	14.8	-6.3	232.8	59.6	45,962	41.8	52.8	9.5		7.1	**277.8**	**6.04**

COOLING

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
12	2	9.5	7.5	-4.5	177.2	31.8	24,543	10.0	22	9.5	15.4	5.4	**200.5**	**7.21**
	2	9.5	7.6	-4.4	174.6	33.8	26,127	12.8	25	9.5	18.2	5.4	**199.5**	**6.68**
	2	9.5	7.6	-4.4	172.2	35.9	27,864	15.6	28	9.5	21.0	5.4	**198.8**	**6.18**
	3	9.5	7.7	-4.3	169.5	38.4	29,774	18.3	31	9.5	23.6	5.3	**198.0**	**5.69**
	3	9.5	7.8	-4.2	166.8	41.0	31,880	21.1	34	9.5	26.4	5.3	**197.5**	**5.25**
	3	9.5	7.8	-4.2	164.2	44.1	34,206	23.9	37	9.5	29.2	5.3	**197.2**	**4.81**
	4	9.5	7.9	-4.1	161.2	47.4	36,769	26.7	40	9.5	32.0	5.3	**196.8**	**4.40**
	4	9.5	8.0	-4.0	158.0	51.1	39,596	29.4	43	9.5	34.7	5.3	**196.4**	**3.99**
	4	9.5	8.1	-3.9	154.5	55.2	42,711	32.2	46	9.5	37.5	5.3	**196.1**	**3.60**
	5	9.5	8.2	-3.8	150.8	59.7	46,142	35.0	49	9.5	40.3	5.3	**195.7**	**3.25**

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Performance Tables - W-Series (US UNITS)

W-800-H**-X-*D-PP *R454b, 60 Hz, 2 x GSD80385VL (460-3-60)*

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

LOW TEMPERATURE*

EVAPORATOR LOOP *(50% Propylene Glycol)*							ELECTRICAL		CONDENSER LOOP *(Water)*						
ELT (°F)	Evap. Temp.	Flow (gpm)	LLT (°F)	Delta T (°F)	**Ice Cooling (Btu/hr)**	**EER**	Compressor Current (A)*	Input Power (W)	EWT (°F)	Cond. Temp.	Flow (gpm)	LWT (°F)	Delta T (°F)	**Heating** (Btu/hr)	**COP_H**
5	-3	190	2	-2.9	**240,700**	**6.9**	54.4	40,360	85	94	190	89	3.8	**364,600**	**2.65**
10	2	190	7	-3.3	**273,700**	**7.5**	56.2	41,150		95	190	89	4.2	**401,700**	**2.86**
15	6	190	11	-3.8	**310,000**	**8.3**	57.9	41,945		95	190	90	4.6	**442,100**	**3.09**
20	10	190	16	-4.2	**349,500**	**9.0**	59.7	42,751		96	190	90	5.1	**485,700**	**3.33**
25	15	190	20	-4.8	**392,900**	**9.8**	61.5	43,530		96	190	91	5.6	**533,200**	**3.59**
30	19	190	25	-5.3	**439,900**	**10.7**	63.3	44,382		96	190	91	6.1	**584,500**	**3.86**
35	24	190	29	-5.9	**491,100**	**11.6**	65.2	45,271		97	190	92	6.7	**640,200**	**4.14**
40	28	190	33	-6.6	**546,500**	**12.5**	67.1	46,204		97	190	92	7.4	**700,200**	**4.44**

*NOTE FOR LOW TEMPERATURE: salt brine, commonly used in arenas, is not an acceptable loop fluid due to its corrosive nature.

HEATING

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**
25	15	190	21	-3.9	341,300	70.1	50,761	104	115	190	109	5.3	**508,500**	**2.94**
30	20	190	26	-4.5	393,800	70.7	51,209		115	190	110	5.9	**562,600**	**3.22**
35	25	190	30	-5.1	452,200	71.2	51,598		116	190	111	6.6	**622,500**	**3.54**
40	29	190	34	-5.8	515,200	71.9	52,053		116	190	111	7.2	**687,200**	**3.87**
45	34	190	38	-6.6	586,500	72.4	52,468		117	190	112	8.0	**760,000**	**4.25**
50	39	190	43	-7.5	664,100	73.1	52,969		118	190	113	8.9	**839,500**	**4.64**
55	44	190	47	-8.4	747,500	73.8	53,502		118	190	114	9.8	**924,800**	**5.07**
60	49	190	50	-9.5	841,300	74.5	54,022		119	190	115	10.8	**1,020,500**	**5.54**
65	53	190	54	-10.6	942,200	75.4	54,656		119	190	116	11.9	**1,123,700**	**6.03**
70	58	190	58	-11.9	1,053,100	76.2	55,291		120	190	117	13.1	**1,236,900**	**6.56**
25	15	190	22	-3.5	308,800	75.6	55,417	115	124	190	120	5.2	**491,900**	**2.60**
30	20	190	26	-4.1	360,400	76.3	55,910	114	124	190		5.8	**545,300**	**2.86**
35	25	190	30	-4.7	418,100	76.9	56,321	114	125	190		6.4	**604,500**	**3.15**
40	30	190	35	-5.5	481,800	77.6	56,794	113	125	190		7.1	**670,000**	**3.46**
45	35	190	39	-6.3	553,000	78.2	57,206	112	125	190		7.9	**742,700**	**3.80**
50	39	190	43	-7.1	631,300	78.9	57,704	111	125	190		8.7	**822,800**	**4.18**
55	44	190	47	-8.1	717,700	79.6	58,157	110	126	190		9.7	**910,900**	**4.59**
60	49	190	51	-9.2	812,600	80.4	58,715	109	126	190		10.7	**1,007,800**	**5.03**
65	54	190	55	-10.3	916,700	81.2	59,253	108	126	190		11.8	**1,113,900**	**5.51**
70	59	190	58	-11.6	1,030,000	82.1	59,915	107	126	190		13.0	**1,229,600**	**6.01**

COOLING

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**
54	35	190	45	-8.2	774,300	47.2	31,423	50	72	190	60	9.9	**876,300**	**24.6**
	36	190	46	-8.1	763,700	49.8	33,483	55	77	190	65	9.9	**872,900**	**22.8**
	36	190	46	-8.0	754,000	52.7	35,803	60	83	190	70	9.8	**871,300**	**21.1**
	37	190	46	-7.9	743,600	55.9	38,335	65	88	190	75	9.8	**869,800**	**19.4**
	38	190	46	-7.7	732,900	59.5	41,133	70	93	190	80	9.8	**868,900**	**17.8**
	38	190	46	-7.6	720,700	63.5	44,266	75	99	190	85	9.8	**867,600**	**16.3**
	39	190	46	-7.5	708,500	67.9	47,678	80	104	190	90	9.7	**867,300**	**14.9**
	39	190	46	-7.3	693,800	72.7	51,432	85	109	190	95	9.7	**865,600**	**13.5**
	40	190	46	-7.2	679,400	78.2	55,630	90	115	190	100	9.7	**865,700**	**12.2**
	40	190	47	-7.0	664,200	84.1	60,179	95	120	190	105	9.7	**866,300**	**11.0**

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Performance Tables - W-Series (METRIC UNITS)

W-800-H**-X-*D-PP

R454b, 60 Hz, 2 x GSD80385VL (460-3-60)

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

METRIC

LOW TEMPERATURE*

EVAPORATOR LOOP *(50% Propylene Glycol)*							ELECTRICAL		CONDENSER LOOP *(Water)*						
ELT (°C)	Evap. Temp.	Flow (L/s)	LLT (°C)	Delta T (°C)	**Ice Cooling (kW)**	**COPC**	Compressor Current (A)*	Input Power (W)	EWT (°C)	Cond. Temp.	Flow (L/s)	LWT (°C)	Delta T (°C)	**Heating (kW)**	**COPH**
-15.0	-19.3	12.0	-16.6	-1.6	**70.5**	**2.01**	54.4	40,360	29.4	34.7	12.0	31.5	2.1	**106.9**	**2.65**
-12.2	-16.9	12.0	-14.0	-1.8	**80.2**	**2.21**	56.2	41,150		34.9	12.0	31.7	2.3	**117.7**	**2.86**
-9.4	-14.4	12.0	-11.5	-2.1	**90.9**	**2.42**	57.9	41,945		35.1	12.0	32.0	2.6	**129.6**	**3.09**
-6.7	-12.0	12.0	-9.0	-2.3	**102.4**	**2.64**	59.7	42,751		35.3	12.0	32.2	2.8	**142.3**	**3.33**
-3.9	-9.6	12.0	-6.6	-2.7	**115.1**	**2.88**	61.5	43,530		35.5	12.0	32.5	3.1	**156.3**	**3.59**
-1.1	-7.1	12.0	-4.0	-2.9	**128.9**	**3.13**	63.3	44,382		35.7	12.0	32.8	3.4	**171.3**	**3.86**
1.7	-4.7	12.0	-1.6	-3.3	**143.9**	**3.39**	65.2	45,271		35.9	12.0	33.1	3.7	**187.6**	**4.14**
4.4	-2.2	12.0	0.7	-3.7	**160.2**	**3.65**	67.1	46,204		36.2	12.0	33.5	4.1	**205.2**	**4.44**

*NOTE FOR LOW TEMPERATURE: salt brine, commonly used in arenas, is not an acceptable loop fluid due to its corrosive nature.

HEATING

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)**	**COPH**
-3.9	-9.4	12.0	-6.1	-2.2	100.0	70.1	50,761	40	45.9	12.0	42.9	2.9	**149.0**	**2.94**
-1.1	-6.7	12.0	-3.6	-2.5	115.4	70.7	51,209		46.3	12.0	43.3	3.3	**164.9**	**3.22**
1.7	-4.1	12.0	-1.1	-2.8	132.5	71.2	51,598		46.6	12.0	43.7	3.7	**182.4**	**3.54**
4.4	-1.4	12.0	1.2	-3.2	151.0	71.9	52,053		46.9	12.0	44.0	4.0	**201.4**	**3.87**
7.2	1.2	12.0	3.5	-3.7	171.9	72.4	52,468		47.2	12.0	44.4	4.4	**222.7**	**4.25**
10.0	3.9	12.0	5.8	-4.2	194.6	73.1	52,969		47.5	12.0	44.9	4.9	**246.0**	**4.64**
12.7	6.5	12.0	8.0	-4.7	219.1	73.8	53,502		47.8	12.0	45.4	5.4	**271.0**	**5.07**
15.5	9.2	12.0	10.2	-5.3	246.6	74.5	54,022		48.1	12.0	46.0	6.0	**299.1**	**5.54**
18.3	11.8	12.0	12.4	-5.9	276.1	75.4	54,656		48.4	12.0	46.6	6.6	**329.3**	**6.03**
21.1	14.5	12.0	14.5	-6.6	308.6	76.2	55,291		48.7	12.0	47.3	7.3	**362.5**	**6.56**
-3.9	-9.3	12.0	-5.8	-1.9	90.5	75.6	55,417	46.0	51.1	12.0	49	2.9	**144.2**	**2.60**
-1.1	-6.6	12.0	-3.4	-2.3	105.6	76.3	55,910	45.7	51.3	12.0		3.2	**159.8**	**2.86**
1.7	-3.9	12.0	-0.9	-2.6	122.5	76.9	56,321	45.3	51.4	12.0		3.6	**177.2**	**3.15**
4.4	-1.3	12.0	1.3	-3.1	141.2	77.6	56,794	44.9	51.6	12.0		3.9	**196.4**	**3.46**
7.2	1.4	12.0	3.7	-3.5	162.1	78.2	57,206	44.5	51.7	12.0		4.4	**217.7**	**3.80**
10.0	4.1	12.0	6.1	-3.9	185.0	78.9	57,704	44.1	51.8	12.0		4.8	**241.1**	**4.18**
12.8	6.7	12.0	8.3	-4.5	210.3	79.6	58,157	43.5	51.9	12.0		5.4	**267.0**	**4.59**
15.6	9.4	12.0	10.5	-5.1	238.1	80.4	58,715	42.9	52.1	12.0		5.9	**295.4**	**5.03**
18.3	12.1	12.0	12.6	-5.7	268.7	81.2	59,253	42.3	52.2	12.0		6.6	**326.5**	**5.51**
21.1	14.7	12.0	14.7	-6.4	301.9	82.1	59,915	41.7	52.4	12.0		7.2	**360.4**	**6.01**

COOLING

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)	**COPC**
12	2	12.0	7.4	-4.6	226.9	47.2	31,423	10.0	22	12.0	15.5	5.5	**256.8**	**7.21**
	2	12.0	7.5	-4.5	223.8	49.8	33,483	12.8	25	12.0	18.3	5.5	**255.8**	**6.68**
	2	12.0	7.6	-4.4	221.0	52.7	35,803	15.6	28	12.0	21.0	5.4	**255.4**	**6.18**
	3	12.0	7.6	-4.4	217.9	55.9	38,335	18.3	31	12.0	23.7	5.4	**254.9**	**5.69**
	3	12.0	7.7	-4.3	214.8	59.5	41,133	21.1	34	12.0	26.5	5.4	**254.6**	**5.22**
	3	12.0	7.8	-4.2	211.2	63.5	44,266	23.9	37	12.0	29.3	5.4	**254.3**	**4.78**
	4	12.0	7.8	-4.2	207.6	67.9	47,678	26.7	40	12.0	32.1	5.4	**254.2**	**4.37**
	4	12.0	7.9	-4.1	203.3	72.7	51,432	29.4	43	12.0	34.8	5.4	**253.7**	**3.96**
	4	12.0	8.0	-4.0	199.1	78.2	55,630	32.2	46	12.0	37.6	5.4	**253.7**	**3.58**
	5	12.0	8.1	-3.9	194.7	84.1	60,179	35.0	49	12.0	40.4	5.4	**253.9**	**3.22**

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Performance Tables - W-Series (US UNITS)

W-900-H**-X-*D-PP

R454b, 60 Hz, 2 x GSD80421VL (460-3-60)

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

	EVAPORATOR LOOP *(50% Propylene Glycol)*							ELECTRICAL		CONDENSER LOOP *(Water)*						
	ELT (°F)	Evap. Temp.	Flow (gpm)	LLT (°F)	Delta T (°F)	**Ice Cooling (Btu/hr)**	**EER**	Compressor Current (A)*	Input Power (W)	EWT (°F)	Cond. Temp.	Flow (gpm)	LWT (°F)	Delta T (°F)	**Heating** (Btu/hr)	**COP_H**
LOW TEMPERATURE*	5	-3	210	2	-2.9	**262,900**	**7.0**	57.5	43,665	85	94	210	89	3.7	**396,600**	**2.66**
	10	2	210	7	-3.3	**298,900**	**7.6**	59.6	44,669		95	210	89	4.1	**437,600**	**2.87**
	15	6	210	11	-3.7	**338,400**	**8.3**	61.7	45,645		95	210	90	4.6	**482,000**	**3.09**
	20	10	210	16	-4.2	**381,400**	**9.1**	63.8	46,607		96	210	90	5.0	**529,900**	**3.33**
	25	15	210	20	-4.7	**428,700**	**9.9**	65.8	47,516		96	210	91	5.5	**581,800**	**3.59**
	30	19	210	25	-5.2	**479,800**	**10.7**	67.9	48,490		96	210	91	6.1	**637,800**	**3.85**
	35	24	210	29	-5.8	**535,600**	**11.6**	70.0	49,497		97	210	92	6.6	**698,600**	**4.14**
	40	28	210	34	-6.5	**595,900**	**12.4**	72.2	50,557		97	210	92	7.3	**764,100**	**4.43**

*NOTE FOR LOW TEMPERATURE: salt brine, commonly used in arenas, is not an acceptable loop fluid due to its corrosive nature.

	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	210	21	-3.9	375,500	75.4	55,280	104	115	210	109	5.3	**557,500**	**2.96**
	30	20	210	26	-4.4	430,700	76.0	55,735		115	210	110	5.9	**614,400**	**3.23**
	35	25	210	30	-5.0	491,900	76.6	56,111		116	210	111	6.5	**677,000**	**3.54**
	40	29	210	34	-5.7	557,600	77.2	56,556		116	210	111	7.1	**744,400**	**3.86**
	45	34	210	39	-6.5	631,900	77.8	56,960		117	210	112	7.8	**820,300**	**4.22**
	50	39	210	43	-7.3	712,600	78.5	57,475		118	210	113	8.6	**902,900**	**4.60**
	55	44	210	47	-8.2	799,000	79.3	58,049		118	210	114	9.5	**991,400**	**5.01**
	60	48	210	51	-9.1	896,200	80.2	58,642		119	210	114	10.4	**1,090,800**	**5.45**
	65	53	210	55	-10.2	1,000,400	81.2	59,403		119	210	115	11.4	**1,197,700**	**5.91**
	70	58	210	59	-11.4	1,114,800	82.3	60,222		120	210	117	12.6	**1,315,100**	**6.40**
	25	15	210	22	-3.5	340,100	81.5	60,360	115	124	210	120	5.2	**539,400**	**2.62**
	30	20	210	26	-4.1	394,400	82.2	60,841	114	124	210		5.7	**595,500**	**2.87**
	35	25	210	30	-4.7	454,600	82.9	61,284	114	125	210		6.3	**657,400**	**3.14**
	40	30	210	35	-5.3	521,700	83.4	61,634	113	125	210		6.9	**725,800**	**3.45**
	45	34	210	39	-6.1	595,700	84.1	62,063	112	125	210		7.7	**801,500**	**3.78**
	50	39	210	43	-6.9	677,300	84.8	62,519	112	125	210		8.5	**884,800**	**4.15**
	55	44	210	47	-7.8	766,700	85.5	63,018	111	126	210		9.4	**976,100**	**4.54**
	60	49	210	51	-8.8	865,100	86.3	63,586	110	126	210		10.3	**1,076,600**	**4.96**
	65	54	210	55	-9.9	973,000	87.2	64,166	109	126	210		11.4	**1,186,600**	**5.42**
	70	58	210	59	-11.1	1,090,100	88.3	64,936	108	127	210		12.5	**1,306,500**	**5.90**

	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	210	45	-8.2	859,300	51.3	35,087	50	72	210	60	9.9	**972,600**	**24.5**
		35	210	46	-8.0	841,300	53.9	37,202	55	77	210	65	9.8	**961,900**	**22.6**
		36	210	46	-7.9	825,800	56.8	39,570	60	82	210	70	9.7	**954,600**	**20.9**
		37	210	46	-7.7	810,000	60.0	42,206	65	88	210	75	9.7	**947,800**	**19.2**
		37	210	46	-7.6	794,600	63.7	45,137	70	93	210	80	9.6	**942,500**	**17.6**
		38	210	46	-7.4	778,400	67.8	48,390	75	98	210	85	9.5	**937,500**	**16.1**
		38	210	46	-7.3	762,200	72.4	51,995	80	104	210	90	9.5	**933,600**	**14.7**
		39	210	47	-7.1	743,500	77.5	55,980	85	109	210	94	9.4	**928,600**	**13.3**
		40	210	47	-6.9	725,800	83.1	60,383	90	114	210	99	9.4	**926,000**	**12.0**
		40	210	47	-6.8	706,700	89.4	65,235	95	119	210	104	9.4	**923,500**	**10.8**

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Performance Tables - W-Series (METRIC UNITS)

W-900-H**-X-*D-PP *R454b, 60 Hz, 2 x GSD80421VL (460-3-60)*

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

METRIC

	EVAPORATOR LOOP *(50% Propylene Glycol)*							ELECTRICAL		CONDENSER LOOP *(Water)*						
	ELT (°C)	Evap. Temp.	Flow (L/s)	LLT (°C)	Delta T (°C)	**Ice Cooling (kW)**	**COP_C**	Compressor Current (A)*	Input Power (W)	EWT (°C)	Cond. Temp.	Flow (L/s)	LWT (°C)	Delta T (°C)	**Heating (kW)**	**COP_H**
LOW TEMPERATURE*	-15.0	-19.4	13.2	-16.6	-1.6	**77.0**	**2.04**	57.5	43,665	29.4	34.7	13.2	31.5	2.1	**116.2**	**2.66**
	-12.2	-16.9	13.2	-14.0	-1.8	**87.6**	**2.23**	59.6	44,669		34.9	13.2	31.7	2.3	**128.2**	**2.87**
	-9.4	-14.5	13.2	-11.5	-2.1	**99.2**	**2.44**	61.7	45,645		35.1	13.2	32.0	2.6	**141.3**	**3.09**
	-6.7	-12.1	13.2	-9.0	-2.3	**111.8**	**2.65**	63.8	46,607		35.3	13.2	32.2	2.8	**155.3**	**3.33**
	-3.9	-9.6	13.2	-6.5	-2.6	**125.6**	**2.89**	65.8	47,516		35.5	13.2	32.5	3.1	**170.5**	**3.59**
	-1.1	-7.2	13.2	-4.0	-2.9	**140.6**	**3.13**	67.9	48,490		35.7	13.2	32.8	3.4	**186.9**	**3.85**
	1.7	-4.7	13.2	-1.5	-3.2	**157.0**	**3.38**	70.0	49,497		35.9	13.2	33.1	3.7	**204.7**	**4.14**
	4.4	-2.3	13.2	0.8	-3.6	**174.6**	**3.65**	72.2	50,557		36.2	13.2	33.5	4.1	**223.9**	**4.43**

*NOTE FOR LOW TEMPERATURE: salt brine, commonly used in arenas, is not an acceptable loop fluid due to its corrosive nature.

	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	-9.5	13.2	-6.1	-2.2	110.0	75.4	55,280	40	45.9	13.2	42.9	2.9	**163.4**	**2.96**
	-1.1	-6.8	13.2	-3.5	-2.4	126.2	76.0	55,735		46.3	13.2	43.3	3.3	**180.1**	**3.23**
	1.7	-4.2	13.2	-1.1	-2.8	144.2	76.6	56,111		46.6	13.2	43.6	3.6	**198.4**	**3.54**
	4.4	-1.6	13.2	1.2	-3.2	163.4	77.2	56,556		46.9	13.2	43.9	3.9	**218.2**	**3.86**
	7.2	1.1	13.2	3.6	-3.6	185.2	77.8	56,960		47.2	13.2	44.3	4.3	**240.4**	**4.22**
	10.0	3.8	13.2	5.9	-4.1	208.8	78.5	57,475		47.5	13.2	44.8	4.8	**264.6**	**4.60**
	12.7	6.4	13.2	8.1	-4.6	234.2	79.3	58,049		47.8	13.2	45.3	5.3	**290.6**	**5.01**
	15.5	9.1	13.2	10.4	-5.1	262.7	80.2	58,642		48.1	13.2	45.8	5.8	**319.7**	**5.45**
	18.3	11.7	13.2	12.6	-5.7	293.2	81.2	59,403		48.4	13.2	46.3	6.3	**351.0**	**5.91**
	21.1	14.4	13.2	14.8	-6.3	326.7	82.3	60,222		48.7	13.2	47.0	7.0	**385.4**	**6.40**
	-3.9	-9.4	13.2	-5.8	-1.9	99.7	81.5	60,360	46.0	51.1	13.2	49	2.9	**158.1**	**2.62**
	-1.1	-6.7	13.2	-3.4	-2.3	115.6	82.2	60,841	45.7	51.3	13.2		3.2	**174.5**	**2.87**
	1.7	-4.1	13.2	-0.9	-2.6	133.2	82.9	61,284	45.4	51.4	13.2		3.5	**192.7**	**3.14**
	4.4	-1.4	13.2	1.5	-2.9	152.9	83.4	61,634	45.1	51.6	13.2		3.8	**212.7**	**3.45**
	7.2	1.3	13.2	3.8	-3.4	174.6	84.1	62,063	44.6	51.7	13.2		4.3	**234.9**	**3.78**
	10.0	3.9	13.2	6.2	-3.8	198.5	84.8	62,519	44.2	51.9	13.2		4.7	**259.3**	**4.15**
	12.8	6.6	13.2	8.5	-4.3	224.7	85.5	63,018	43.7	52.1	13.2		5.2	**286.1**	**4.54**
	15.6	9.3	13.2	10.7	-4.9	253.5	86.3	63,586	43.2	52.2	13.2		5.7	**315.5**	**4.96**
	18.3	11.9	13.2	12.8	-5.5	285.2	87.2	64,166	42.6	52.3	13.2		6.3	**347.8**	**5.42**
	21.1	14.6	13.2	14.9	-6.2	319.5	88.3	64,936	41.9	52.5	13.2		6.9	**382.9**	**5.90**

	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	2	13.2	7.4	-4.6	251.8	51.3	35,087	10.0	22	13.2	15.5	5.5	**285.0**	**7.18**
		2	13.2	7.6	-4.4	246.6	53.9	37,202	12.8	25	13.2	18.2	5.4	**281.9**	**6.62**
		2	13.2	7.6	-4.4	242.0	56.8	39,570	15.6	28	13.2	21.0	5.4	**279.8**	**6.13**
		3	13.2	7.7	-4.3	237.4	60.0	42,206	18.3	31	13.2	23.7	5.4	**277.8**	**5.63**
		3	13.2	7.8	-4.2	232.9	63.7	45,137	21.1	34	13.2	26.4	5.3	**276.2**	**5.16**
		3	13.2	7.9	-4.1	228.1	67.8	48,390	23.9	37	13.2	29.2	5.3	**274.8**	**4.72**
		4	13.2	7.9	-4.1	223.4	72.4	51,995	26.7	40	13.2	32.0	5.3	**273.6**	**4.31**
		4	13.2	8.1	-3.9	217.9	77.5	55,980	29.4	43	13.2	34.6	5.2	**272.1**	**3.90**
		4	13.2	8.2	-3.8	212.7	83.1	60,383	32.2	46	13.2	37.4	5.2	**271.4**	**3.52**
		5	13.2	8.2	-3.8	207.1	89.4	65,235	35.0	49	13.2	40.2	5.2	**270.7**	**3.17**

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Performance Tables - W-Series (US UNITS)

W-1000-H**-X-*D-PP *R454b, 60 Hz, 2 x GSD80485VL (460-3-60)*

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

	EVAPORATOR LOOP *(50% Propylene Glycol)*							ELECTRICAL		CONDENSER LOOP *(Water)*						
	ELT (°F)	Evap. Temp.	Flow (gpm)	LLT (°F)	Delta T (°F)	**Ice Cooling (Btu/hr)**	**EER**	Compressor Current (A)*	Input Power (W)	EWT (°F)	Cond. Temp.	Flow (gpm)	LWT (°F)	Delta T (°F)	**Heating** (Btu/hr)	**COP_H**
LOW TEMPERATURE*	5	-3	225	2	-3.1	**300,300**	**6.7**	65.0	50,695	85	95	225	89	4.0	**457,400**	**2.64**
	10	2	225	7	-3.5	**341,400**	**7.4**	67.1	51,697		95	225	90	4.5	**503,600**	**2.85**
	15	6	225	11	-4.0	**386,700**	**8.1**	69.2	52,719		95	225	90	4.9	**554,000**	**3.08**
	20	10	225	16	-4.5	**436,100**	**8.9**	71.4	53,766		96	225	90	5.4	**608,600**	**3.32**
	25	15	225	20	-5.0	**490,400**	**9.7**	73.5	54,785		96	225	91	5.9	**668,100**	**3.57**
	30	19	225	24	-5.6	**549,300**	**10.5**	75.7	55,902		97	225	92	6.5	**732,400**	**3.84**
	35	24	225	29	-6.3	**613,600**	**11.4**	78.0	57,063		97	225	92	7.1	**802,400**	**4.12**
	40	28	225	33	-6.9	**683,200**	**12.3**	80.3	58,280		97	225	93	7.8	**877,800**	**4.41**

*NOTE FOR LOW TEMPERATURE: salt brine, commonly used in arenas, is not an acceptable loop fluid due to its corrosive nature.

	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	225	21	-4.3	446,600	88.4	65,941	104	114	225	110	5.9	**664,900**	**2.96**
	30	19	225	25	-4.9	508,900	89.1	66,474		115	225	111	6.5	**729,100**	**3.21**
	35	24	225	30	-5.5	577,900	89.7	66,940		116	225	111	7.1	**799,800**	**3.50**
	40	29	225	34	-6.2	651,800	90.5	67,497		116	225	112	7.8	**875,700**	**3.80**
	45	34	225	38	-7.0	735,200	91.2	68,005		117	225	113	8.6	**961,000**	**4.14**
	50	38	225	42	-7.9	825,500	92.0	68,622		117	225	113	9.4	**1,053,500**	**4.50**
	55	43	225	46	-8.8	922,000	92.9	69,273		118	225	114	10.3	**1,152,300**	**4.88**
	60	48	225	50	-9.8	1,030,300	93.8	69,896		118	225	115	11.3	**1,262,900**	**5.30**
	65	53	225	54	-10.9	1,146,500	94.8	70,650		119	225	116	12.3	**1,381,800**	**5.73**
	70	58	225	58	-12.1	1,273,500	95.8	71,384		119	225	118	13.5	**1,511,400**	**6.21**
	25	15	225	21	-3.9	404,500	96.2	71,981	114	124	225	120	5.7	**643,400**	**2.62**
	30	20	225	26	-4.5	466,100	96.9	72,501	114	124	225		6.3	**706,900**	**2.86**
	35	24	225	30	-5.1	534,100	97.6	73,023	113	124	225		6.9	**776,800**	**3.12**
	40	29	225	34	-5.8	608,800	98.5	73,643	112	125	225		7.6	**853,700**	**3.40**
	45	34	225	38	-6.6	692,000	99.3	74,193	112	125	225		8.4	**938,900**	**3.71**
	50	39	225	43	-7.5	783,500	100.1	74,770	111	125	225		9.2	**1,032,500**	**4.05**
	55	44	225	47	-8.4	883,600	101.0	75,381	110	125	225		10.2	**1,134,800**	**4.41**
	60	48	225	51	-9.5	993,800	102.0	76,035	109	125	225		11.2	**1,247,300**	**4.81**
	65	53	225	54	-10.6	1,112,900	103.1	76,828	108	126	225		12.3	**1,369,300**	**5.22**
	70	58	225	58	-11.8	1,243,400	104.2	77,594	107	126	225		13.5	**1,502,500**	**5.67**

	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	225	45	-8.6	968,400	54.5	39,219	50	72	225	61	10.5	**1,095,700**	**24.7**
		36	225	45	-8.4	946,400	57.7	41,832	55	77	225	65	10.3	**1,082,700**	**22.6**
		36	225	45	-8.3	927,200	61.3	44,682	60	82	225	70	10.2	**1,073,200**	**20.8**
		37	225	46	-8.1	908,600	65.0	47,709	65	88	225	75	10.1	**1,065,000**	**19.0**
		37	225	46	-7.9	890,400	69.3	51,037	70	93	225	80	10.1	**1,058,200**	**17.4**
		38	225	46	-7.8	872,300	73.8	54,603	75	98	225	85	10.0	**1,052,300**	**16.0**
		39	225	46	-7.6	854,000	78.9	58,555	80	103	225	90	9.9	**1,047,600**	**14.6**
		39	225	46	-7.4	833,700	84.5	62,803	85	109	225	95	9.9	**1,041,800**	**13.3**
		40	225	46	-7.3	814,200	90.7	67,535	90	114	225	100	9.8	**1,038,500**	**12.1**
		40	225	47	-7.1	793,800	97.5	72,642	95	119	225	105	9.8	**1,035,600**	**10.9**

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Performance Tables - W-Series (METRIC UNITS)

W-1000-H**-X-*D-PP

R454b, 60 Hz, 2 x GSD80485VL (460-3-60)

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

METRIC

LOW TEMPERATURE*

EVAPORATOR LOOP (50% Propylene Glycol)							ELECTRICAL		CONDENSER LOOP (Water)						
ELT (°C)	Evap. Temp.	Flow (L/s)	LLT (°C)	Delta T (°C)	**Ice Cooling (kW)**	**COP_C**	Compressor Current (A)*	Input Power (W)	EWT (°C)	Cond. Temp.	Flow (L/s)	LWT (°C)	Delta T (°C)	**Heating (kW)**	**COP_H**
-15.0	-19.4	14.2	-16.7	-1.7	**88.0**	**1.97**	65.0	50,695	29.4	34.8	14.2	31.6	2.2	**134.1**	**2.64**
-12.2	-16.9	14.2	-14.1	-1.9	**100.1**	**2.17**	67.1	51,697		35.0	14.2	31.9	2.5	**147.6**	**2.85**
-9.4	-14.5	14.2	-11.6	-2.2	**113.3**	**2.38**	69.2	52,719		35.2	14.2	32.1	2.7	**162.4**	**3.08**
-6.7	-12.1	14.2	-9.2	-2.5	**127.8**	**2.60**	71.4	53,766		35.4	14.2	32.4	3.0	**178.4**	**3.32**
-3.9	-9.6	14.2	-6.7	-2.8	**143.7**	**2.84**	73.5	54,785		35.6	14.2	32.7	3.3	**195.8**	**3.57**
-1.1	-7.2	14.2	-4.2	-3.1	**161.0**	**3.08**	75.7	55,902		35.8	14.2	33.0	3.6	**214.6**	**3.84**
1.7	-4.7	14.2	-1.8	-3.5	**179.8**	**3.34**	78.0	57,063		36.1	14.2	33.3	3.9	**235.2**	**4.12**
4.4	-2.3	14.2	0.6	-3.8	**200.2**	**3.60**	80.3	58,280		36.3	14.2	33.7	4.3	**257.3**	**4.41**

*NOTE FOR LOW TEMPERATURE: salt brine, commonly used in arenas, is not an acceptable loop fluid due to its corrosive nature.

HEATING

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**
-3.9	-9.7	14.2	-6.3	-2.4	130.9	88.4	65,941	40	45.8	14.2	43.3	3.3	**194.9**	**2.96**
-1.1	-7.1	14.2	-3.8	-2.7	149.1	89.1	66,474		46.1	14.2	43.6	3.6	**213.7**	**3.21**
1.7	-4.4	14.2	-1.4	-3.1	169.4	89.7	66,940		46.4	14.2	43.9	3.9	**234.4**	**3.50**
4.4	-1.8	14.2	1.0	-3.4	191.0	90.5	67,497		46.7	14.2	44.3	4.3	**256.6**	**3.80**
7.2	0.9	14.2	3.3	-3.9	215.5	91.2	68,005		47.0	14.2	44.8	4.8	**281.6**	**4.14**
10.0	3.6	14.2	5.6	-4.4	241.9	92.0	68,622		47.3	14.2	45.2	5.2	**308.8**	**4.50**
12.7	6.2	14.2	7.8	-4.9	270.2	92.9	69,273		47.7	14.2	45.7	5.7	**337.7**	**4.88**
15.5	8.8	14.2	10.1	-5.4	302.0	93.8	69,896		47.9	14.2	46.3	6.3	**370.1**	**5.30**
18.3	11.5	14.2	12.2	-6.1	336.0	94.8	70,650		48.3	14.2	46.8	6.8	**405.0**	**5.73**
21.1	14.2	14.2	14.4	-6.7	373.2	95.8	71,384		48.6	14.2	47.5	7.5	**443.0**	**6.21**
-3.9	-9.6	14.2	-6.1	-2.2	118.5	96.2	71,981	45.7	51.0	14.2	49	3.2	**188.6**	**2.62**
-1.1	-6.9	14.2	-3.6	-2.5	136.6	96.9	72,501	45.4	51.1	14.2		3.5	**207.2**	**2.86**
1.7	-4.3	14.2	-1.1	-2.8	156.5	97.6	73,023	45.1	51.2	14.2		3.8	**227.7**	**3.12**
4.4	-1.6	14.2	1.2	-3.2	178.4	98.5	73,643	44.7	51.4	14.2		4.2	**250.2**	**3.40**
7.2	1.1	14.2	3.5	-3.7	202.8	99.3	74,193	44.2	51.5	14.2		4.7	**275.2**	**3.71**
10.0	3.7	14.2	5.8	-4.2	229.6	100.1	74,770	43.8	51.6	14.2		5.1	**302.6**	**4.05**
12.8	6.4	14.2	8.1	-4.7	259.0	101.0	75,381	43.2	51.7	14.2		5.7	**332.6**	**4.41**
15.6	9.1	14.2	10.3	-5.3	291.3	102.0	76,035	42.7	51.8	14.2		6.2	**365.6**	**4.81**
18.3	11.7	14.2	12.4	-5.9	326.2	103.1	76,828	42.1	52.0	14.2		6.8	**401.3**	**5.22**
21.1	14.4	14.2	14.5	-6.6	364.4	104.2	77,594	41.4	52.1	14.2		7.5	**440.3**	**5.67**

COOLING

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**
12	2	14.2	7.2	-4.8	283.8	54.5	39,219	10.0	22	14.2	15.8	5.8	**321.1**	**7.24**
	2	14.2	7.3	-4.7	277.4	57.7	41,832	12.8	25	14.2	18.5	5.7	**317.3**	**6.62**
	2	14.2	7.4	-4.6	271.7	61.3	44,682	15.6	28	14.2	21.3	5.7	**314.5**	**6.10**
	3	14.2	7.5	-4.5	266.3	65.0	47,709	18.3	31	14.2	23.9	5.6	**312.1**	**5.57**
	3	14.2	7.6	-4.4	261.0	69.3	51,037	21.1	34	14.2	26.7	5.6	**310.1**	**5.10**
	3	14.2	7.7	-4.3	255.6	73.8	54,603	23.9	37	14.2	29.5	5.6	**308.4**	**4.69**
	4	14.2	7.8	-4.2	250.3	78.9	58,555	26.7	40	14.2	32.2	5.5	**307.0**	**4.28**
	4	14.2	7.9	-4.1	244.3	84.5	62,803	29.4	43	14.2	34.9	5.5	**305.3**	**3.90**
	4	14.2	7.9	-4.1	238.6	90.7	67,535	32.2	46	14.2	37.6	5.4	**304.4**	**3.55**
	5	14.2	8.1	-3.9	232.6	97.5	72,642	35.0	48	14.2	40.4	5.4	**303.5**	**3.19**

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Performance Tables - WH-Series

WH-150-H**-Y-*D-PP

R513a, 60 Hz, 2 x ZR68KCE-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	36	46	-4.3	78,100	13.4	8,286	114	126	36	120	5.9	**106,000**	**3.75**
	60	48	36	55	-5.3	94,900	13.8	8,604	113	126	36		6.9	**123,900**	**4.22**
	70	57	36	64	-6.4	114,400	14.3	8,946	112	126	36		8.1	**144,600**	**4.74**
	80	65	36	72	-7.6	137,000	14.8	9,320	111	127	36		9.4	**168,400**	**5.30**
	90	74	36	81	-9.1	163,100	15.4	9,731	109	127	36		11.0	**195,900**	**5.90**
	50	41	36	46	-3.8	68,200	15.0	9,993	134	145	36	140	5.7	**101,900**	**2.99**
	60	50	36	55	-4.6	82,600	15.5	10,315	133	146	36		6.6	**117,400**	**3.34**
	70	58	36	65	-5.5	99,000	15.9	10,649	132	146	36		7.6	**135,000**	**3.72**
	80	67	36	73	-6.6	117,900	16.5	11,026	131	146	36		8.7	**155,200**	**4.13**
	90	75	36	82	-7.8	139,500	17.0	11,423	130	146	36		10.0	**178,100**	**4.57**
	50	42	36	47	-3.1	56,400	16.9	11,836	155	166	36	160	5.4	**96,400**	**2.39**
	60	51	36	56	-3.8	68,500	17.4	12,194	154	166	36		6.2	**109,700**	**2.64**
	70	60	36	65	-4.6	82,200	18.0	12,591	153	166	36		7.1	**124,800**	**2.90**
	80	68	36	75	-5.5	97,800	18.5	13,001	152	167	36		8.0	**141,800**	**3.20**
	90	77	36	84	-6.5	115,800	19.1	13,447	151	167	36		9.1	**161,300**	**3.52**

	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**	75	36	56	6.2	**104,100**	8.2	3,916	54	37	36	49	-5.1	**91,200**	**23.3**
	55**	80	36	61	6.1	**102,900**	8.4	4,132		37	36	49	-5.0	**89,200**	**21.6**
	60**	85	36	66	6.1	**101,700**	8.5	4,357		38	36	49	-4.9	**87,200**	**20.0**
	65**	90	36	71	6.0	**100,400**	8.7	4,588		38	36	49	-4.7	**85,100**	**18.5**
	70	96	36	76	5.9	**99,200**	8.9	4,835		39	36	49	-4.6	**83,100**	**17.2**
	75	101	36	81	5.8	**97,900**	9.1	5,095		39	36	49	-4.5	**80,900**	**15.9**
	80	106	36	86	5.7	**96,700**	9.3	5,369		40	36	49	-4.4	**78,800**	**14.7**
	85	111	36	91	5.7	**95,500**	9.6	5,654		40	36	49	-4.3	**76,600**	**13.5**
	90	117	36	96	5.6	**94,400**	9.9	5,962		41	36	50	-4.1	**74,400**	**12.5**
	95	122	36	101	5.5	**93,300**	10.2	6,288		41	36	50	-4.0	**72,200**	**11.5**

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	2.3	7.6	-2.4	22.9	13.4	8,286	45.6	52.0	2.3	49	3.3	**31.1**	**3.75**
	15.6	9.0	2.3	12.7	-2.9	27.8	13.8	8,604	45.1	52.2	2.3		3.8	**36.3**	**4.22**
	21.1	13.7	2.3	17.5	-3.6	33.5	14.3	8,946	44.4	52.3	2.3		4.5	**42.4**	**4.74**
	26.7	18.4	2.3	22.5	-4.2	40.2	14.8	9,320	43.7	52.5	2.3		5.2	**49.4**	**5.30**
	32.2	23.2	2.3	27.1	-5.1	47.8	15.4	9,731	42.8	52.7	2.3		6.1	**57.4**	**5.90**
	10.0	5.0	2.3	7.9	-2.1	20.0	15.0	9,993	56.8	62.9	2.3	60	3.2	**29.9**	**2.99**
	15.6	9.8	2.3	13.0	-2.6	24.2	15.5	10,315	56.3	63.1	2.3		3.7	**34.4**	**3.34**
	21.1	14.5	2.3	18.0	-3.1	29.0	15.9	10,649	55.8	63.2	2.3		4.2	**39.6**	**3.72**
	26.7	19.3	2.3	23.0	-3.7	34.6	16.5	11,026	55.2	63.4	2.3		4.8	**45.5**	**4.13**
	32.2	24.0	2.3	27.9	-4.3	40.9	17.0	11,423	54.4	63.5	2.3		5.6	**52.2**	**4.57**
	10.0	5.7	2.3	8.3	-1.7	16.5	16.9	11,836	68.1	74.2	2.3	71	3.0	**28.3**	**2.39**
	15.6	10.5	2.3	13.5	-2.1	20.1	17.4	12,194	67.7	74.3	2.3		3.4	**32.2**	**2.64**
	21.1	15.3	2.3	18.5	-2.6	24.1	18.0	12,591	67.2	74.6	2.3		3.9	**36.6**	**2.90**
	26.7	20.1	2.3	23.6	-3.1	28.7	18.5	13,001	66.7	74.7	2.3		4.4	**41.6**	**3.20**
	32.2	24.9	2.3	28.6	-3.6	33.9	19.1	13,447	66.1	74.9	2.3		5.1	**47.3**	**3.52**

	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**	24	2.3	13.4	3.4	**30.5**	8.2	3,916	12	3	2.3	9.2	-2.8	**26.7**	**6.83**
	12.8**	27	2.3	16.2	3.4	**30.2**	8.4	4,132		3	2.3	9.2	-2.8	**26.1**	**6.33**
	15.6**	30	2.3	19.0	3.4	**29.8**	8.5	4,357		3	2.3	9.3	-2.7	**25.6**	**5.86**
	18.3**	32	2.3	21.6	3.3	**29.4**	8.7	4,588		3	2.3	9.4	-2.6	**24.9**	**5.42**
	21.1	35	2.3	24.4	3.3	**29.1**	8.9	4,835		4	2.3	9.4	-2.6	**24.4**	**5.04**
	23.9	38	2.3	27.1	3.2	**28.7**	9.1	5,095		4	2.3	9.5	-2.5	**23.7**	**4.66**
	26.7	41	2.3	29.9	3.2	**28.3**	9.3	5,369		4	2.3	9.6	-2.4	**23.1**	**4.31**
	29.4	44	2.3	32.6	3.2	**28.0**	9.6	5,654		5	2.3	9.6	-2.4	**22.4**	**3.96**
	32.2	47	2.3	35.3	3.1	**27.7**	9.9	5,962		5	2.3	9.7	-2.3	**21.8**	**3.66**
	35.0	50	2.3	38.1	3.1	**27.3**	10.2	6,288		5	2.3	9.8	-2.2	**21.2**	**3.37**

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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-185-H**-Y-*D-PP *R513a, 60 Hz, 2 x ZH40KCE-TFD (460-3-60)*

HEATING

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**
50	40	48	46	-4.0	96,800	16.8	10,123	115	125	48		5.5	**130,800**	**3.79**
60	48	48	55	-4.9	118,300	17.4	10,527	114	126	48		6.5	**153,700**	**4.28**
70	57	48	64	-5.9	142,400	18.1	10,951	113	126	48	120	7.5	**179,200**	**4.80**
80	65	48	73	-7.1	169,400	18.8	11,411	111	126	48		8.7	**207,800**	**5.34**
90	74	48	82	-8.4	199,500	19.6	11,925	110	127	48		10.1	**239,700**	**5.89**
50	41	48	47	-3.5	85,000	18.4	12,171	135	145	48		5.3	**126,000**	**3.03**
60	50	48	56	-4.3	104,100	19.0	12,523	134	145	48		6.2	**146,300**	**3.42**
70	58	48	65	-5.2	124,900	19.5	12,873	133	146	48	140	7.1	**168,300**	**3.83**
80	67	48	74	-6.2	147,600	20.1	13,261	132	146	48		8.1	**192,300**	**4.25**
90	75	48	83	-7.2	172,100	20.8	13,675	131	146	48		9.2	**218,200**	**4.68**
50	42	48	47	-2.9	70,300	20.6	14,517	155	165	48		5.1	**119,300**	**2.41**
60	51	48	56	-3.6	87,400	21.1	14,866	154	166	48		5.8	**137,600**	**2.71**
70	60	48	66	-4.4	105,200	21.7	15,234	153	166	48	160	6.6	**156,600**	**3.01**
80	68	48	75	-5.2	123,900	22.2	15,601	153	166	48		7.5	**176,600**	**3.32**
90	77	48	84	-6.0	143,500	22.8	15,996	152	167	48		8.4	**197,600**	**3.62**

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	74	48	57	6.5	**145,500**	13.7	6,154		36	48	48	-5.2	**125,200**	**20.3**
55	79	48	61	6.4	**144,300**	13.9	6,456		37	48	49	-5.1	**123,000**	**19.1**
60	84	48	66	6.4	**142,900**	14.1	6,783		37	48	49	-5.0	**120,500**	**17.8**
65	89	48	71	6.3	**141,300**	14.4	7,129		38	48	49	-4.9	**117,700**	**16.5**
70	95	48	76	6.2	**139,700**	14.7	7,511	54	38	48	49	-4.8	**114,700**	**15.3**
75	100	48	81	6.1	**137,800**	15.0	7,924		39	48	49	-4.7	**111,400**	**14.1**
80	105	48	86	6.0	**135,900**	15.4	8,371		39	48	49	-4.5	**108,000**	**12.9**
85	110	48	91	5.9	**133,900**	15.8	8,846		40	48	49	-4.4	**104,400**	**11.8**
90	116	48	96	5.9	**131,800**	16.3	9,368		40	48	49	-4.2	**100,500**	**10.7**
95	121	48	101	5.8	**129,700**	16.8	9,932		41	48	50	-4.0	**96,400**	**9.7**

METRIC

HEATING

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**
10.0	4.2	3.0	7.8	-2.2	28.4	16.8	10,123	45.8	51.8	3.0		3.1	**38.3**	**3.79**
15.6	8.9	3.0	12.9	-2.7	34.7	17.4	10,527	45.3	52.0	3.0		3.6	**45.1**	**4.28**
21.1	13.7	3.0	17.8	-3.3	41.7	18.1	10,951	44.7	52.2	3.0	49	4.2	**52.5**	**4.80**
26.7	18.4	3.0	22.8	-3.9	49.7	18.8	11,411	44.1	52.3	3.0		4.8	**60.9**	**5.34**
32.2	23.1	3.0	27.5	-4.7	58.5	19.6	11,925	43.3	52.5	3.0		5.6	**70.3**	**5.89**
10.0	4.9	3.0	8.1	-1.9	24.9	18.4	12,171	57.1	62.8	3.0		2.9	**36.9**	**3.03**
15.6	9.7	3.0	13.2	-2.4	30.5	19.0	12,523	56.6	62.9	3.0		3.4	**42.9**	**3.42**
21.1	14.4	3.0	18.2	-2.9	36.6	19.5	12,873	56.1	63.1	3.0	60	3.9	**49.3**	**3.83**
26.7	19.2	3.0	23.3	-3.4	43.3	20.1	13,261	55.5	63.2	3.0		4.5	**56.4**	**4.25**
32.2	23.9	3.0	28.2	-4.0	50.4	20.8	13,675	54.9	63.3	3.0		5.1	**64.0**	**4.68**
10.0	5.6	3.0	8.4	-1.6	20.6	20.6	14,517	68.3	74.0	3.0		2.8	**35.0**	**2.41**
15.6	10.4	3.0	13.6	-2.0	25.6	21.1	14,866	67.9	74.2	3.0		3.2	**40.3**	**2.71**
21.1	15.3	3.0	18.7	-2.4	30.8	21.7	15,234	67.4	74.4	3.0	71	3.7	**45.9**	**3.01**
26.7	20.1	3.0	23.8	-2.9	36.3	22.2	15,601	66.9	74.6	3.0		4.2	**51.8**	**3.32**
32.2	24.9	3.0	28.9	-3.3	42.1	22.8	15,996	66.4	74.7	3.0		4.7	**57.9**	**3.62**

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	3.0	13.6	3.6	**42.6**	13.7	6,154		2	3.0	9.1	-2.9	**36.7**	**5.95**
12.8	26	3.0	16.4	3.6	**42.3**	13.9	6,456		3	3.0	9.2	-2.8	**36.1**	**5.60**
15.6	29	3.0	19.2	3.6	**41.9**	14.1	6,783		3	3.0	9.2	-2.8	**35.3**	**5.22**
18.3	32	3.0	21.8	3.5	**41.4**	14.4	7,129		3	3.0	9.3	-2.7	**34.5**	**4.84**
21.1	35	3.0	24.5	3.4	**40.9**	14.7	7,511	12	4	3.0	9.3	-2.7	**33.6**	**4.48**
23.9	38	3.0	27.3	3.4	**40.4**	15.0	7,924		4	3.0	9.4	-2.6	**32.7**	**4.13**
26.7	41	3.0	30.0	3.3	**39.8**	15.4	8,371		4	3.0	9.5	-2.5	**31.7**	**3.78**
29.4	44	3.0	32.7	3.3	**39.2**	15.8	8,846		4	3.0	9.6	-2.4	**30.6**	**3.46**
32.2	47	3.0	35.5	3.3	**38.6**	16.3	9,368		5	3.0	9.7	-2.3	**29.5**	**3.14**
35.0	49	3.0	38.2	3.2	**38.0**	16.8	9,932		5	3.0	9.8	-2.2	**28.3**	**2.84**

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Performance Tables - WH-Series

WH-240-H**-Y-*D-PP

R513a, 60 Hz, 2 x 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	60	46	-4.2	127,000	24.1	13,656	114	125	60	120	5.8	**172,800**	**3.71**
	60	48	60	55	-5.1	153,900	24.9	14,134	113	126	60		6.8	**201,300**	**4.17**
	70	57	60	64	-6.2	185,200	25.8	14,634	112	126	60		7.9	**234,300**	**4.69**
	80	65	60	73	-7.4	221,500	26.7	15,190	111	126	60		9.2	**272,500**	**5.26**
	90	74	60	81	-8.8	263,700	27.7	15,838	109	126	60		10.7	**316,900**	**5.86**
	50	41	60	46	-3.7	112,200	26.1	16,108	134	145	60	140	5.6	**166,300**	**3.03**
	60	49	60	56	-4.5	135,500	26.8	16,576	134	145	60		6.5	**191,200**	**3.38**
	70	58	60	65	-5.4	161,900	27.6	17,018	133	145	60		7.4	**219,100**	**3.77**
	80	67	60	74	-6.4	192,500	28.3	17,500	132	146	60		8.5	**251,400**	**4.21**
	90	75	60	82	-7.6	227,200	29.1	18,016	130	146	60		9.7	**287,900**	**4.68**
	50	42	60	47	-3.0	91,400	29.8	19,587	155	165	60	160	5.3	**157,400**	**2.36**
	60	51	60	56	-3.7	111,500	30.5	20,090	154	165	60		6.1	**179,200**	**2.61**
	70	59	60	66	-4.5	134,100	31.2	20,557	153	166	60		6.9	**203,400**	**2.90**
	80	68	60	75	-5.3	159,200	31.9	21,015	152	166	60		7.8	**230,100**	**3.21**
	90	77	60	84	-6.3	188,200	32.6	21,493	151	166	60		8.8	**260,700**	**3.55**

	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	73	60	57	7.4	**207,400**	18.5	7,849	54	37	60	48	-6.1	**181,600**	**23.1**
	55	78	60	62	7.3	**204,800**	19.1	8,313		37	60	48	-5.9	**177,400**	**21.3**
	60	83	60	67	7.2	**202,600**	19.6	8,813		38	60	48	-5.8	**173,500**	**19.7**
	65	88	60	72	7.2	**200,500**	20.2	9,354		38	60	48	-5.7	**169,500**	**18.1**
	70	93	60	77	7.1	**198,100**	20.8	9,935		38	60	48	-5.5	**165,100**	**16.6**
	75	98	60	82	7.0	**195,900**	21.5	10,561		39	60	48	-5.4	**160,800**	**15.2**
	80	103	60	87	6.9	**194,000**	22.3	11,236		39	60	48	-5.2	**156,500**	**13.9**
	85	108	60	92	6.8	**191,900**	23.0	11,960		40	60	49	-5.1	**152,000**	**12.7**
	90	113	60	97	6.7	**189,700**	23.9	12,738		40	60	49	-4.9	**147,100**	**11.5**
	95	118	60	102	6.7	**187,800**	24.8	13,572		41	60	49	-4.8	**142,300**	**10.5**

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	4.2	3.8	7.7	-2.3	37.2	24.1	13,656	45.7	51.8	3.8	49	3.2	**50.6**	**3.71**
	15.6	8.9	3.8	12.8	-2.8	45.1	24.9	14,134	45.1	51.9	3.8		3.8	**59.0**	**4.17**
	21.1	13.6	3.8	17.7	-3.4	54.3	25.8	14,634	44.5	52.1	3.8		4.4	**68.7**	**4.69**
	26.7	18.3	3.8	22.6	-4.1	64.9	26.7	15,190	43.8	52.3	3.8		5.1	**79.9**	**5.26**
	32.2	23.1	3.8	27.3	-4.9	77.3	27.7	15,838	42.9	52.4	3.8		5.9	**92.9**	**5.86**
	10.0	4.9	3.8	7.9	-2.1	32.9	26.1	16,108	56.9	62.7	3.8	60	3.1	**48.7**	**3.03**
	15.6	9.7	3.8	13.1	-2.5	39.7	26.8	16,576	56.4	62.9	3.8		3.6	**56.0**	**3.38**
	21.1	14.4	3.8	18.1	-3.0	47.5	27.6	17,018	55.9	63.0	3.8		4.1	**64.2**	**3.77**
	26.7	19.2	3.8	23.1	-3.6	56.4	28.3	17,500	55.3	63.2	3.8		4.7	**73.7**	**4.21**
	32.2	23.9	3.8	28.0	-4.2	66.6	29.1	18,016	54.6	63.3	3.8		5.4	**84.4**	**4.68**
	10.0	5.6	3.8	8.3	-1.7	26.8	29.8	19,587	68.2	73.9	3.8	71	2.9	**46.1**	**2.36**
	15.6	10.4	3.8	13.5	-2.1	32.7	30.5	20,090	67.7	74.1	3.8		3.4	**52.5**	**2.61**
	21.1	15.2	3.8	18.6	-2.5	39.3	31.2	20,557	67.3	74.3	3.8		3.8	**59.6**	**2.90**
	26.7	20.0	3.8	23.8	-2.9	46.7	31.9	21,015	66.8	74.4	3.8		4.3	**67.4**	**3.21**
	32.2	24.8	3.8	28.7	-3.5	55.2	32.6	21,493	66.2	74.6	3.8		4.9	**76.4**	**3.55**

	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	14.1	4.1	**60.8**	18.5	7,849	12	3	3.8	8.6	-3.4	**53.2**	**6.77**
	12.8	26	3.8	16.9	4.1	**60.0**	19.1	8,313		3	3.8	8.7	-3.3	**52.0**	**6.24**
	15.6	28	3.8	19.6	4.0	**59.4**	19.6	8,813		3	3.8	8.8	-3.2	**50.9**	**5.77**
	18.3	31	3.8	22.3	4.0	**58.8**	20.2	9,354		3	3.8	8.8	-3.2	**49.7**	**5.30**
	21.1	34	3.8	25.0	3.9	**58.1**	20.8	9,935		4	3.8	8.9	-3.1	**48.4**	**4.86**
	23.9	37	3.8	27.8	3.9	**57.4**	21.5	10,561		4	3.8	9.0	-3.0	**47.1**	**4.45**
	26.7	39	3.8	30.5	3.8	**56.9**	22.3	11,236		4	3.8	9.1	-2.9	**45.9**	**4.07**
	29.4	42	3.8	33.2	3.8	**56.2**	23.0	11,960		4	3.8	9.2	-2.8	**44.6**	**3.72**
	32.2	45	3.8	35.9	3.7	**55.6**	23.9	12,738		5	3.8	9.3	-2.7	**43.1**	**3.37**
	35.0	48	3.8	38.7	3.7	**55.0**	24.8	13,572		5	3.8	9.3	-2.7	**41.7**	**3.08**

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Performance Tables - WH-Series

WH-300-H**-Y-*D-PP

R513a, 60 Hz, 2 x 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.]

HEATING

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**
50	40	72	46	-4.1	148,500	26.1	15,813	114	126	72		5.6	**201,500**	**3.73**
60	48	72	55	-5.0	179,300	26.8	16,273	114	126	72		6.5	**233,900**	**4.21**
70	57	72	64	-6.0	214,900	27.6	16,784	112	126	72	120	7.6	**271,200**	**4.74**
80	65	72	73	-7.1	255,600	28.4	17,357	111	126	72		8.8	**313,900**	**5.30**
90	74	72	82	-8.5	302,700	29.4	18,063	110	127	72		10.2	**363,400**	**5.90**
50	41	72	46	-3.8	137,200	30.8	19,878	134	145	72		5.7	**204,100**	**3.01**
60	50	72	55	-4.6	166,600	31.7	20,487	133	146	72		6.6	**235,600**	**3.37**
70	58	72	64	-5.6	199,900	32.7	21,115	132	146	72	140	7.6	**271,000**	**3.76**
80	67	72	73	-6.6	238,400	33.8	21,841	131	146	72		8.8	**312,000**	**4.19**
90	75	72	82	-7.9	282,300	35.0	22,655	130	146	72		10.1	**358,700**	**4.64**
50	42	72	47	-3.1	112,400	35.1	23,916	155	166	72		5.4	**193,100**	**2.37**
60	51	72	56	-3.8	137,900	35.9	24,402	154	166	72		6.2	**220,200**	**2.64**
70	60	72	65	-4.6	166,700	36.7	24,916	153	166	72	160	7.1	**250,800**	**2.95**
80	68	72	75	-5.5	198,900	37.5	25,489	152	166	72		8.1	**284,900**	**3.28**
90	77	72	83	-6.6	236,100	38.5	26,156	151	167	72		9.2	**324,400**	**3.63**

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	72	72	58	7.8	**260,500**	20.8	9,546		36	72	47	-6.4	**229,200**	**24.0**
55	77	72	63	7.7	**258,600**	21.6	10,319		36	72	47	-6.3	**224,600**	**21.8**
60	83	72	68	7.6	**256,100**	22.5	11,124		37	72	48	-6.1	**219,400**	**19.7**
65	88	72	73	7.6	**254,200**	23.5	11,958		37	72	48	-6.0	**214,600**	**17.9**
70	93	72	78	7.5	**251,700**	24.5	12,849	54	38	72	48	-5.8	**209,100**	**16.3**
75	98	72	82	7.4	**249,700**	25.6	13,798		39	72	48	-5.7	**203,800**	**14.8**
80	104	72	87	7.3	**247,300**	26.8	14,808		39	72	48	-5.5	**197,900**	**13.4**
85	109	72	92	7.3	**245,300**	28.1	15,876		40	72	48	-5.4	**192,300**	**12.1**
90	114	72	97	7.2	**243,100**	29.5	17,038		40	72	48	-5.2	**186,100**	**10.9**
95	120	72	102	7.1	**241,200**	31.0	18,291		41	72	49	-5.0	**179,900**	**9.8**

METRIC

HEATING

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**
10.0	4.3	4.5	7.7	-2.3	43.5	26.1	15,813	45.8	52.0	4.5		3.1	**59.1**	**3.73**
15.6	9.0	4.5	12.8	-2.8	52.6	26.8	16,273	45.3	52.2	4.5		3.6	**68.6**	**4.21**
21.1	13.7	4.5	17.8	-3.3	63.0	27.6	16,784	44.7	52.3	4.5	49	4.2	**79.5**	**4.74**
26.7	18.4	4.5	22.8	-3.9	74.9	28.4	17,357	44.0	52.4	4.5		4.9	**92.0**	**5.30**
32.2	23.1	4.5	27.5	-4.7	88.7	29.4	18,063	43.2	52.6	4.5		5.7	**106.5**	**5.90**
10.0	5.0	4.5	7.9	-2.1	40.2	30.8	19,878	56.8	62.9	4.5		3.2	**59.8**	**3.01**
15.6	9.8	4.5	13.0	-2.6	48.8	31.7	20,487	56.3	63.1	4.5		3.7	**69.1**	**3.37**
21.1	14.5	4.5	18.0	-3.1	58.6	32.7	21,115	55.8	63.2	4.5	60	4.2	**79.4**	**3.76**
26.7	19.3	4.5	23.0	-3.7	69.9	33.8	21,841	55.1	63.4	4.5		4.9	**91.4**	**4.19**
32.2	24.0	4.5	27.8	-4.4	82.7	35.0	22,655	54.4	63.5	4.5		5.6	**105.1**	**4.64**
10.0	5.7	4.5	8.3	-1.7	32.9	35.1	23,916	68.1	74.2	4.5		3.0	**56.6**	**2.37**
15.6	10.5	4.5	13.5	-2.1	40.4	35.9	24,402	67.7	74.3	4.5		3.4	**64.5**	**2.64**
21.1	15.3	4.5	18.5	-2.6	48.9	36.7	24,916	67.2	74.5	4.5	71	3.9	**73.5**	**2.95**
26.7	20.1	4.5	23.6	-3.1	58.3	37.5	25,489	66.6	74.7	4.5		4.5	**83.5**	**3.28**
32.2	24.9	4.5	28.5	-3.7	69.2	38.5	26,156	66.0	74.8	4.5		5.1	**95.1**	**3.63**

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	22	4.5	14.3	4.3	**76.4**	20.8	9,546		2	4.5	8.4	-3.6	**67.2**	**7.03**
12.8	25	4.5	17.1	4.3	**75.8**	21.6	10,319		2	4.5	8.5	-3.5	**65.8**	**6.39**
15.6	28	4.5	19.8	4.2	**75.1**	22.5	11,124		3	4.5	8.6	-3.4	**64.3**	**5.77**
18.3	31	4.5	22.5	4.2	**74.5**	23.5	11,958		3	4.5	8.7	-3.3	**62.9**	**5.25**
21.1	34	4.5	25.3	4.2	**73.8**	24.5	12,849	12	3	4.5	8.8	-3.2	**61.3**	**4.78**
23.9	37	4.5	28.0	4.1	**73.2**	25.6	13,798		4	4.5	8.8	-3.2	**59.7**	**4.34**
26.7	40	4.5	30.8	4.1	**72.5**	26.8	14,808		4	4.5	8.9	-3.1	**58.0**	**3.93**
29.4	43	4.5	33.5	4.1	**71.9**	28.1	15,876		4	4.5	9.0	-3.0	**56.4**	**3.55**
32.2	46	4.5	36.2	4.0	**71.3**	29.5	17,038		5	4.5	9.1	-2.9	**54.5**	**3.19**
35.0	49	4.5	38.9	3.9	**70.7**	31.0	18,291		5	4.5	9.2	-2.8	**52.7**	**2.87**

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Performance Tables - WH-Series

WH-400-H**-Y-*D-PP

R513a, 60 Hz, 2 x ZH76KCE-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)						
	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	100	46	-3.8	191,900	37.2	20,382	115	125	100		5.2	**260,100**	**3.74**
	60	48	100	55	-4.7	233,200	38.3	21,035	114	126	100		6.1	**303,600**	**4.23**
	70	57	100	64	-5.6	281,000	39.5	21,784	113	126	100	120	7.1	**354,000**	**4.76**
	80	65	100	73	-6.8	336,500	40.7	22,658	112	126	100		8.3	**412,500**	**5.34**
	90	74	100	82	-8.0	400,000	42.2	23,753	110	127	100		9.7	**479,700**	**5.92**
	50	41	100	47	-3.3	167,000	41.4	24,778	135	145	100		5.1	**250,200**	**2.96**
	60	50	100	56	-4.1	202,600	42.3	25,352	134	145	100		5.8	**287,700**	**3.33**
	70	58	100	65	-4.9	243,200	43.4	26,027	133	146	100	140	6.7	**330,700**	**3.72**
	80	67	100	74	-5.8	289,600	44.5	26,793	132	146	100		7.7	**379,700**	**4.15**
	90	76	100	83	-6.9	343,200	45.7	27,734	131	146	100		8.8	**436,500**	**4.61**
	50	42	100	47	-2.7	136,600	46.1	29,795	155	165	100		4.8	**236,900**	**2.33**
	60	51	100	57	-3.3	166,700	47.0	30,362	155	166	100		5.5	**268,900**	**2.60**
	70	60	100	66	-4.0	200,800	48.0	30,980	154	166	100	160	6.2	**305,200**	**2.89**
	80	68	100	75	-4.8	240,900	48.9	31,656	153	166	100		7.1	**347,600**	**3.22**
	90	77	100	84	-5.7	285,900	50.1	32,508	152	166	100		8.0	**395,500**	**3.57**

	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	73	100	57	6.7	**310,000**	31.0	12,124		36	100	48	-5.4	**270,300**	**22.3**
	55	78	100	62	6.6	**309,000**	32.0	13,086		36	100	48	-5.3	**266,000**	**20.3**
	60	83	100	67	6.6	**307,800**	33.1	14,075		37	100	48	-5.2	**261,400**	**18.6**
	65	88	100	72	6.6	**306,200**	34.1	15,083		37	100	49	-5.1	**256,400**	**17.0**
	70	94	100	77	6.5	**304,600**	35.3	16,150	54	38	100	49	-5.0	**251,100**	**15.5**
	75	99	100	82	6.5	**302,600**	36.5	17,271		38	100	49	-4.9	**245,300**	**14.2**
	80	104	100	86	6.4	**300,600**	37.8	18,455		39	100	49	-4.8	**239,200**	**13.0**
	85	109	100	91	6.4	**298,400**	39.2	19,695		39	100	49	-4.7	**232,800**	**11.8**
	90	115	100	96	6.3	**296,200**	40.7	21,038		40	100	49	-4.5	**226,000**	**10.7**
	95	120	100	101	6.3	**293,900**	42.3	22,478		40	100	49	-4.4	**218,800**	**9.7**

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	6.3	7.9	-2.1	56.2	37.2	20,382	46.0	51.9	6.3		2.9	**76.2**	**3.74**
	15.6	9.1	6.3	13.0	-2.6	68.3	38.3	21,035	45.5	52.1	6.3		3.4	**89.0**	**4.23**
	21.1	13.8	6.3	18.0	-3.1	82.4	39.5	21,784	44.9	52.2	6.3	49	3.9	**103.7**	**4.76**
	26.7	18.6	6.3	22.9	-3.8	98.6	40.7	22,658	44.3	52.3	6.3		4.6	**120.9**	**5.34**
	32.2	23.3	6.3	27.8	-4.4	117.2	42.2	23,753	43.5	52.5	6.3		5.4	**140.6**	**5.92**
	10.0	5.1	6.3	8.2	-1.8	48.9	41.4	24,778	57.2	62.8	6.3		2.8	**73.3**	**2.96**
	15.6	9.9	6.3	13.3	-2.3	59.4	42.3	25,352	56.8	62.9	6.3		3.2	**84.3**	**3.33**
	21.1	14.7	6.3	18.4	-2.7	71.3	43.4	26,027	56.3	63.1	6.3	60	3.7	**96.9**	**3.72**
	26.7	19.4	6.3	23.5	-3.2	84.9	44.5	26,793	55.7	63.2	6.3		4.3	**111.3**	**4.15**
	32.2	24.2	6.3	28.4	-3.8	100.6	45.7	27,734	55.1	63.3	6.3		4.9	**127.9**	**4.61**
	10.0	5.8	6.3	8.5	-1.5	40.0	46.1	29,795	68.4	74.1	6.3		2.7	**69.4**	**2.33**
	15.6	10.6	6.3	13.8	-1.8	48.9	47.0	30,362	68.1	74.2	6.3		3.1	**78.8**	**2.60**
	21.1	15.4	6.3	18.9	-2.2	58.9	48.0	30,980	67.7	74.4	6.3	71	3.4	**89.5**	**2.89**
	26.7	20.2	6.3	24.0	-2.7	70.6	48.9	31,656	67.2	74.5	6.3		3.9	**101.9**	**3.22**
	32.2	25.0	6.3	29.0	-3.2	83.8	50.1	32,508	66.7	74.7	6.3		4.4	**115.9**	**3.57**

	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	6.3	13.7	3.7	**90.9**	31.0	12,124		2	6.3	9.0	-3.0	**79.2**	**6.54**
	12.8	25	6.3	16.5	3.7	**90.6**	32.0	13,086		2	6.3	9.1	-2.9	**78.0**	**5.95**
	15.6	28	6.3	19.3	3.7	**90.2**	33.1	14,075		3	6.3	9.1	-2.9	**76.6**	**5.45**
	18.3	31	6.3	22.0	3.7	**89.7**	34.1	15,083		3	6.3	9.2	-2.8	**75.1**	**4.98**
	21.1	34	6.3	24.7	3.6	**89.3**	35.3	16,150	12	3	6.3	9.2	-2.8	**73.6**	**4.54**
	23.9	37	6.3	27.5	3.6	**88.7**	36.5	17,271		4	6.3	9.3	-2.7	**71.9**	**4.16**
	26.7	40	6.3	30.3	3.6	**88.1**	37.8	18,455		4	6.3	9.3	-2.7	**70.1**	**3.81**
	29.4	43	6.3	33.0	3.6	**87.5**	39.2	19,695		4	6.3	9.4	-2.6	**68.2**	**3.46**
	32.2	46	6.3	35.7	3.5	**86.8**	40.7	21,038		4	6.3	9.5	-2.5	**66.2**	**3.14**
	35.0	49	6.3	38.5	3.5	**86.1**	42.3	22,478		5	6.3	9.6	-2.4	**64.1**	**2.84**

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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 0.8 for 575-3-60.]*

WH-500-H**-Y-*D-PP *R513a, 60 Hz, 2 x ZH101KCE-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	120	46	-4.2	252,500	41.1	26,948	114	126	120	120	5.7	**342,100**	**3.72**
	60	48	120	55	-5.1	306,700	42.4	27,885	113	126	120		6.7	**399,500**	**4.20**
	70	57	120	64	-6.2	369,600	43.8	28,902	112	126	120		7.8	**465,900**	**4.72**
	80	65	120	73	-7.4	442,000	45.3	30,000	111	126	120		9.1	**542,100**	**5.30**
	90	74	120	81	-8.8	525,700	47.0	31,280	109	127	120		10.6	**630,200**	**5.90**
	50	41	120	46	-3.7	220,500	48.0	33,019	134	145	120	140	5.6	**330,800**	**2.94**
	60	50	120	56	-4.4	266,900	49.1	33,813	134	145	120		6.4	**379,900**	**3.29**
	70	58	120	65	-5.3	319,300	50.2	34,674	133	146	120		7.3	**435,300**	**3.68**
	80	67	120	74	-6.4	380,700	51.5	35,573	132	146	120		8.4	**499,800**	**4.12**
	90	75	120	83	-7.5	450,000	52.8	36,566	130	146	120		9.7	**572,500**	**4.59**
	50	42	120	47	-3.0	179,900	55.9	39,835	155	165	120	160	5.3	**313,500**	**2.31**
	60	51	120	56	-3.7	219,200	56.9	40,546	154	166	120		6.0	**355,200**	**2.57**
	70	60	120	66	-4.4	263,700	57.8	41,248	153	166	120		6.8	**402,100**	**2.86**
	80	68	120	75	-5.3	315,800	58.8	41,976	152	166	120		7.7	**456,700**	**3.19**
	90	77	120	84	-6.3	374,800	59.9	42,752	151	167	120		8.8	**518,400**	**3.55**

	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	73	120	57	7.2	**401,800**	28.4	15,484	54	36	120	48	-5.9	**352,200**	**22.7**
	55	78	120	62	7.1	**399,500**	29.7	16,554		37	120	48	-5.8	**346,200**	**20.9**
	60	83	120	67	7.1	**397,300**	31.1	17,705		37	120	48	-5.7	**340,000**	**19.2**
	65	89	120	72	7.0	**394,900**	32.5	18,914		38	120	48	-5.6	**333,500**	**17.6**
	70	94	120	77	7.0	**393,500**	34.0	20,211		38	120	48	-5.5	**327,600**	**16.2**
	75	99	120	82	7.0	**390,900**	35.7	21,615		39	120	48	-5.4	**320,200**	**14.8**
	80	105	120	87	6.9	**388,700**	37.4	23,104		39	120	48	-5.2	**312,900**	**13.5**
	85	110	120	92	6.9	**386,400**	39.3	24,704		40	120	49	-5.1	**305,100**	**12.4**
	90	115	120	97	6.8	**384,800**	41.4	26,457		40	120	49	-5.0	**297,500**	**11.2**
	95	121	120	102	6.8	**382,500**	43.7	28,319		41	120	49	-4.8	**288,800**	**10.2**

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	7.6	7.7	-2.3	74.0	41.1	26,948	45.7	51.9	7.6	49	3.2	**100.3**	**3.72**
	15.6	9.1	7.6	12.8	-2.8	89.9	42.4	27,885	45.2	52.1	7.6		3.7	**117.1**	**4.20**
	21.1	13.8	7.6	17.7	-3.4	108.3	43.8	28,902	44.6	52.3	7.6		4.3	**136.5**	**4.72**
	26.7	18.4	7.6	22.6	-4.1	129.5	45.3	30,000	43.8	52.4	7.6		5.1	**158.9**	**5.30**
	32.2	23.2	7.6	27.3	-4.9	154.1	47.0	31,280	43.0	52.6	7.6		5.9	**184.7**	**5.90**
	10.0	5.1	7.6	7.9	-2.1	64.6	48.0	33,019	56.9	62.9	7.6	60	3.1	**97.0**	**2.94**
	15.6	9.8	7.6	13.2	-2.4	78.2	49.1	33,813	56.4	63.0	7.6		3.6	**111.3**	**3.29**
	21.1	14.6	7.6	18.2	-2.9	93.6	50.2	34,674	55.9	63.2	7.6		4.1	**127.6**	**3.68**
	26.7	19.3	7.6	23.1	-3.6	111.6	51.5	35,573	55.3	63.3	7.6		4.7	**146.5**	**4.12**
	32.2	24.1	7.6	28.0	-4.2	131.9	52.8	36,566	54.6	63.4	7.6		5.4	**167.8**	**4.59**
	10.0	5.7	7.6	8.3	-1.7	52.7	55.9	39,835	68.2	74.1	7.6	71	2.9	**91.9**	**2.31**
	15.6	10.6	7.6	13.5	-2.1	64.2	56.9	40,546	67.8	74.3	7.6		3.3	**104.1**	**2.57**
	21.1	15.3	7.6	18.7	-2.4	77.3	57.8	41,248	67.3	74.4	7.6		3.8	**117.8**	**2.86**
	26.7	20.2	7.6	23.8	-2.9	92.6	58.8	41,976	66.8	74.6	7.6		4.3	**133.8**	**3.19**
	32.2	24.9	7.6	28.7	-3.5	109.8	59.9	42,752	66.2	74.8	7.6		4.9	**151.9**	**3.55**

	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	7.6	14.0	4.0	**117.8**	28.4	15,484	12	2	7.6	8.7	-3.3	**103.2**	**6.65**
	12.8	26	7.6	16.7	3.9	**117.1**	29.7	16,554		3	7.6	8.8	-3.2	**101.5**	**6.13**
	15.6	29	7.6	19.5	3.9	**116.4**	31.1	17,705		3	7.6	8.8	-3.2	**99.6**	**5.63**
	18.3	31	7.6	22.2	3.9	**115.7**	32.5	18,914		3	7.6	8.9	-3.1	**97.7**	**5.16**
	21.1	34	7.6	25.0	3.9	**115.3**	34.0	20,211		3	7.6	8.9	-3.1	**96.0**	**4.75**
	23.9	37	7.6	27.8	3.9	**114.6**	35.7	21,615		4	7.6	9.0	-3.0	**93.8**	**4.34**
	26.7	40	7.6	30.5	3.8	**113.9**	37.4	23,104		4	7.6	9.1	-2.9	**91.7**	**3.96**
	29.4	43	7.6	33.2	3.8	**113.2**	39.3	24,704		4	7.6	9.2	-2.8	**89.4**	**3.63**
	32.2	46	7.6	36.0	3.8	**112.8**	41.4	26,457		5	7.6	9.2	-2.8	**87.2**	**3.28**
	35.0	49	7.6	38.8	3.8	**112.1**	43.7	28,319		5	7.6	9.3	-2.7	**84.6**	**2.99**

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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 0.8 for 575-3-60.]*

WH-600-H**-Y-*D-PP *R513a, 60 Hz, 2 x ZH125KCE-TED (460-3-60)*

HEATING

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
50	40	150	46	-4.2	312,200	44.6	33,507	114	126	150		5.7	**423,200**	**3.70**
60	48	150	55	-5.1	379,700	46.2	34,769	113	126	150		6.6	**495,100**	**4.17**
70	57	150	64	-6.1	458,100	47.9	36,100	112	126	150	120	7.8	**578,000**	**4.69**
80	65	150	73	-7.3	548,200	49.6	37,484	111	127	150		9.0	**672,900**	**5.26**
90	74	150	81	-8.8	652,800	51.5	39,026	110	127	150		10.5	**782,800**	**5.88**
50	41	150	46	-3.6	271,400	52.0	40,650	135	145	150		5.5	**406,800**	**2.93**
60	50	150	56	-4.4	329,600	53.5	41,852	134	146	150		6.3	**469,100**	**3.28**
70	58	150	65	-5.3	395,300	55.1	43,100	133	146	150	140	7.3	**539,100**	**3.67**
80	67	150	74	-6.3	472,100	56.7	44,333	132	146	150		8.4	**620,200**	**4.10**
90	75	150	83	-7.5	559,000	58.3	45,611	130	146	150		9.6	**711,500**	**4.57**
50	42	150	47	-2.9	221,200	61.3	49,173	155	166	150		5.2	**385,700**	**2.30**
60	51	150	56	-3.6	271,200	62.7	50,322	154	166	150		5.9	**439,600**	**2.56**
70	59	150	66	-4.4	327,700	64.1	51,413	153	166	150	160	6.8	**499,900**	**2.85**
80	68	150	75	-5.3	393,200	65.4	52,466	152	167	150		7.7	**569,000**	**3.18**
90	77	150	84	-6.3	467,400	66.7	53,498	151	167	150		8.8	**646,800**	**3.54**

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	150	57	7.0	**486,200**	32.1	20,572		36	150	48	-5.6	**420,300**	**20.4**
55	78	150	62	6.9	**483,300**	33.5	21,867		36	150	48	-5.5	**412,900**	**18.9**
60	83	150	67	6.9	**480,800**	34.9	23,251		37	150	48	-5.4	**405,700**	**17.4**
65	89	150	72	6.8	**478,200**	36.5	24,734		38	150	48	-5.3	**398,000**	**16.1**
70	94	150	77	6.8	**476,000**	38.1	26,326	54	38	150	48	-5.2	**390,300**	**14.8**
75	99	150	82	6.8	**474,700**	40.0	28,045		39	150	49	-5.1	**383,100**	**13.7**
80	104	150	87	6.7	**472,700**	41.9	29,889		40	150	49	-5.0	**374,800**	**12.5**
85	110	150	92	6.7	**470,700**	44.1	31,878		40	150	49	-4.9	**366,000**	**11.5**
90	115	150	97	6.7	**468,900**	46.4	34,023		41	150	49	-4.8	**356,900**	**10.5**
95	120	150	102	6.6	**467,200**	48.9	36,337		41	150	49	-4.7	**347,200**	**9.6**

METRIC

HEATING

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
10.0	4.2	9.5	7.7	-2.3	91.5	44.6	33,507	45.7	52.1	9.5		3.2	**124.0**	**3.70**
15.6	8.9	9.5	12.8	-2.8	111.3	46.2	34,769	45.2	52.2	9.5		3.7	**145.1**	**4.17**
21.1	13.7	9.5	17.7	-3.4	134.3	47.9	36,100	44.6	52.4	9.5	49	4.3	**169.4**	**4.69**
26.7	18.3	9.5	22.6	-4.1	160.7	49.6	37,484	43.9	52.5	9.5		5.0	**197.2**	**5.26**
32.2	23.1	9.5	27.3	-4.9	191.3	51.5	39,026	43.1	52.7	9.5		5.8	**229.4**	**5.88**
10.0	4.9	9.5	8.0	-2.0	79.5	52.0	40,650	56.9	63.0	9.5		3.1	**119.2**	**2.93**
15.6	9.7	9.5	13.2	-2.4	96.6	53.5	41,852	56.5	63.1	9.5		3.5	**137.5**	**3.28**
21.1	14.4	9.5	18.2	-2.9	115.9	55.1	43,100	55.9	63.3	9.5	60	4.1	**158.0**	**3.67**
26.7	19.2	9.5	23.2	-3.5	138.4	56.7	44,333	55.3	63.4	9.5		4.7	**181.8**	**4.10**
32.2	23.9	9.5	28.0	-4.2	163.8	58.3	45,611	54.7	63.5	9.5		5.3	**208.5**	**4.57**
10.0	5.6	9.5	8.4	-1.6	64.8	61.3	49,173	68.2	74.2	9.5		2.9	**113.0**	**2.30**
15.6	10.4	9.5	13.6	-2.0	79.5	62.7	50,322	67.8	74.4	9.5		3.3	**128.8**	**2.56**
21.1	15.2	9.5	18.7	-2.4	96.0	64.1	51,413	67.3	74.6	9.5	71	3.8	**146.5**	**2.85**
26.7	20.1	9.5	23.8	-2.9	115.2	65.4	52,466	66.8	74.7	9.5		4.3	**166.8**	**3.18**
32.2	24.8	9.5	28.7	-3.5	137.0	66.7	53,498	66.2	74.9	9.5		4.9	**189.6**	**3.54**

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	9.5	13.9	3.9	**142.5**	32.1	20,572		2	9.5	8.9	-3.1	**123.2**	**5.98**
12.8	26	9.5	16.6	3.8	**141.6**	33.5	21,867		2	9.5	8.9	-3.1	**121.0**	**5.54**
15.6	28	9.5	19.4	3.8	**140.9**	34.9	23,251		3	9.5	9.0	-3.0	**118.9**	**5.10**
18.3	31	9.5	22.1	3.8	**140.1**	36.5	24,734		3	9.5	9.1	-2.9	**116.6**	**4.72**
21.1	34	9.5	24.9	3.8	**139.5**	38.1	26,326	12	3	9.5	9.1	-2.9	**114.4**	**4.34**
23.9	37	9.5	27.7	3.8	**139.1**	40.0	28,045		4	9.5	9.2	-2.8	**112.3**	**4.02**
26.7	40	9.5	30.4	3.7	**138.5**	41.9	29,889		4	9.5	9.2	-2.8	**109.8**	**3.66**
29.4	43	9.5	33.1	3.7	**137.9**	44.1	31,878		5	9.5	9.3	-2.7	**107.3**	**3.37**
32.2	46	9.5	35.9	3.7	**137.4**	46.4	34,023		5	9.5	9.3	-2.7	**104.6**	**3.08**
35.0	49	9.5	38.7	3.7	**136.9**	48.9	36,337		5	9.5	9.4	-2.6	**101.8**	**2.81**

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Performance Tables - WH-Series

WH-800-H**-Y-*D-PP

R513a, 60 Hz, 2 x ZH150KCE-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.]*

HEATING

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**
50	40	190	46	-4.0	380,600	57.7	41,048	115	125	190	120	5.5	**516,300**	**3.69**
60	48	190	55	-4.9	461,100	59.4	42,482	114	126	190		6.4	**601,700**	**4.15**
70	57	190	64	-5.9	554,800	61.1	44,018	113	126	190		7.4	**700,700**	**4.67**
80	65	190	73	-7.0	663,100	63.0	45,655	111	126	190		8.6	**814,700**	**5.23**
90	74	190	82	-8.3	788,700	65.1	47,540	110	127	190		10.0	**946,700**	**5.84**
50	41	190	47	-3.5	331,000	65.4	49,776	135	145	190	140	5.3	**496,500**	**2.92**
60	50	190	56	-4.2	400,100	67.0	51,153	134	145	190		6.1	**570,300**	**3.27**
70	58	190	65	-5.0	478,700	68.6	52,585	133	146	190		6.9	**653,900**	**3.64**
80	67	190	74	-6.0	571,400	70.3	54,031	132	146	190		8.0	**751,500**	**4.08**
90	75	190	83	-7.2	676,800	72.0	55,571	131	146	190		9.2	**862,200**	**4.55**
50	42	190	47	-2.8	270,400	74.6	59,872	155	165	190	160	5.0	**470,300**	**2.30**
60	51	190	57	-3.5	327,900	75.8	61,083	154	166	190		5.7	**532,000**	**2.55**
70	60	190	66	-4.2	393,800	77.0	62,199	154	166	190		6.4	**601,800**	**2.84**
80	68	190	75	-5.0	471,500	78.2	63,276	153	166	190		7.3	**683,200**	**3.16**
90	77	190	84	-5.9	560,100	79.3	64,343	152	167	190		8.3	**775,500**	**3.53**

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	190	56	6.4	**566,400**	42.2	24,652	54	36	190	48	-5.2	**487,500**	**19.8**
55	78	190	61	6.4	**563,100**	43.9	26,069		37	190	49	-5.1	**479,200**	**18.4**
60	84	190	66	6.3	**561,200**	45.8	27,669		37	190	49	-5.0	**471,600**	**17.0**
65	89	190	71	6.3	**559,300**	47.8	29,407		38	190	49	-4.9	**463,600**	**15.8**
70	94	190	76	6.3	**557,900**	49.9	31,309		39	190	49	-4.8	**455,400**	**14.5**
75	100	190	81	6.3	**556,100**	52.2	33,413		39	190	49	-4.7	**446,200**	**13.4**
80	105	190	86	6.2	**554,900**	54.7	35,672		40	190	49	-4.6	**437,100**	**12.3**
85	110	190	91	6.2	**552,600**	57.3	38,111		40	190	49	-4.5	**426,300**	**11.2**
90	116	190	96	6.2	**551,600**	60.1	40,797		41	190	49	-4.4	**415,900**	**10.2**
95	121	190	101	6.2	**550,600**	63.1	43,656		41	190	49	-4.3	**404,900**	**9.3**

METRIC

HEATING

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**
10.0	4.3	12.0	7.8	-2.2	111.5	57.7	41,048	45.8	51.9	12.0	49	3.1	**151.3**	**3.69**
15.6	9.0	12.0	12.9	-2.7	135.1	59.4	42,482	45.3	52.1	12.0		3.6	**176.3**	**4.15**
21.1	13.7	12.0	17.8	-3.3	162.6	61.1	44,018	44.8	52.2	12.0		4.1	**205.4**	**4.67**
26.7	18.4	12.0	22.8	-3.9	194.3	63.0	45,655	44.1	52.3	12.0		4.8	**238.8**	**5.23**
32.2	23.1	12.0	27.6	-4.6	231.1	65.1	47,540	43.3	52.5	12.0		5.6	**277.5**	**5.84**
10.0	5.0	12.0	8.1	-1.9	97.0	65.4	49,776	57.1	62.8	12.0	60	2.9	**145.5**	**2.92**
15.6	9.8	12.0	13.3	-2.3	117.3	67.0	51,153	56.6	62.9	12.0		3.4	**167.1**	**3.27**
21.1	14.5	12.0	18.3	-2.8	140.3	68.6	52,585	56.2	63.1	12.0		3.8	**191.6**	**3.64**
26.7	19.3	12.0	23.4	-3.3	167.5	70.3	54,031	55.6	63.2	12.0		4.4	**220.2**	**4.08**
32.2	24.0	12.0	28.2	-4.0	198.4	72.0	55,571	54.9	63.3	12.0		5.1	**252.7**	**4.55**
10.0	5.7	12.0	8.4	-1.6	79.2	74.6	59,872	68.3	74.1	12.0	71	2.8	**137.8**	**2.30**
15.6	10.5	12.0	13.7	-1.9	96.1	75.8	61,083	67.9	74.2	12.0		3.2	**155.9**	**2.55**
21.1	15.3	12.0	18.8	-2.3	115.4	77.0	62,199	67.6	74.4	12.0		3.6	**176.4**	**2.84**
26.7	20.1	12.0	23.9	-2.8	138.2	78.2	63,276	67.1	74.6	12.0		4.1	**200.2**	**3.16**
32.2	24.9	12.0	28.9	-3.3	164.1	79.3	64,343	66.5	74.7	12.0		4.6	**227.3**	**3.53**

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	12.0	13.6	3.6	**166.0**	42.2	24,652	12	2	12.0	9.1	-2.9	**142.9**	**5.80**
12.8	26	12.0	16.4	3.6	**165.0**	43.9	26,069		3	12.0	9.2	-2.8	**140.4**	**5.39**
15.6	29	12.0	19.1	3.5	**164.5**	45.8	27,669		3	12.0	9.2	-2.8	**138.2**	**4.98**
18.3	32	12.0	21.8	3.5	**163.9**	47.8	29,407		3	12.0	9.3	-2.7	**135.9**	**4.63**
21.1	35	12.0	24.6	3.5	**163.5**	49.9	31,309		4	12.0	9.3	-2.7	**133.5**	**4.25**
23.9	38	12.0	27.4	3.5	**163.0**	52.2	33,413		4	12.0	9.4	-2.6	**130.8**	**3.93**
26.7	41	12.0	30.1	3.4	**162.6**	54.7	35,672		4	12.0	9.4	-2.6	**128.1**	**3.60**
29.4	44	12.0	32.8	3.4	**162.0**	57.3	38,111		5	12.0	9.5	-2.5	**124.9**	**3.28**
32.2	47	12.0	35.6	3.4	**161.7**	60.1	40,797		5	12.0	9.6	-2.4	**121.9**	**2.99**
35.0	49	12.0	38.4	3.4	**161.4**	63.1	43,656		5	12.0	9.6	-2.4	**118.7**	**2.73**

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Electrical Specifications - W-Series

Table 27 - W-Series (R454b) Electrical Specifications

	Elec. Code	Power Supply			Compressors (each)		FLA	MCA	Maximum Fuse/Breaker	Minimum Wire Size
		V-ø-Hz	MIN	MAX	RLA	LRA	Amps	Amps	Amps	ga
W-150	1	208/230-1-60	187	253	32.8	184	66.5	74.7	100	#3-2
	2	208-3-60	187	229	24.4	200	49.7	55.8	80	#4-3
	4	460-3-60	414	506	11.9	103	24.3	27.3	40	#8-3
	5	575-3-60	518	632	9.4	78	19.3	21.7	30	#10-3
W-185	2	208-3-60	187	229	28.7	208	58.3	65.5	80	#4-3
	4	460-3-60	414	506	12.4	100	25.3	28.4	40	#8-3
	5	575-3-60	518	632	9.0	78	18.5	20.8	30	#10-3
W-240	2	208-3-60	187	229	40.4	217	81.7	91.8	125	#2-3
	4	460-3-60	414	506	21.2	122	42.9	48.2	60	#6-3
	5	575-3-60	518	632	15.4	97	31.3	35.2	50	#8-3
W-300	2	208-3-60	187	229	44.2	252	89.3	100.4	125	#2-3
	4	460-3-60	414	506	22.6	137	45.7	51.4	60	#6-3
	5	575-3-60	518	632	19.2	103	38.9	43.7	60	#6-3
W-400	2	208-3-60	187	229	57.7	330	116.3	130.7	150	#0-3
	4	460-3-60	414	506	26.9	180	54.3	61.0	80	#4-3
	5	575-3-60	518	632	21.5	132	43.5	48.9	60	#6-3
W-500	4	460-3-60	414	506	32.1	211	64.4	72.4	100	#3-3
	5	575-3-60	518	632	27.8	162	55.8	62.8	80	#4-3
W-600	4	460-3-60	414	506	40.7	212	81.6	91.8	125	#2-3
	5	575-3-60	518	632	32.6	168	65.4	73.6	100	#3-3
W-800	4	460-3-60	414	506	53.1	316	106.4	119.7	150	#0-3
	5	575-3-60	518	632	42.5	255	85.2	95.8	125	#2-3
W-900	4	460-3-60	414	506	51.4	316	103.0	115.9	150	#0-3
	5	575-3-60	518	632	41.2	258	82.6	92.9	125	#2-3
W-1000	4	460-3-60	414	506	64.1	299	128.4	144.4	200	#000-3
	5	575-3-60	518	632	51.3	229	102.8	115.6	150	#0-3

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Electrical Specifications - WH-Series

Table 28 - WH-Series (R513a) Electrical Specifications

	Elec. Code	Power Supply			Compressors (each)		FLA	MCA	Maximum Fuse/Breaker	Minimum Wire Size
		V-ø-Hz	MIN	MAX	RLA	LRA	Amps	Amps	Amps	ga
WH-150	1	208/230-1-60	187	253	28.8	176	58.5	65.7	80	#4-2
	2	208-3-60	187	229	18.6	156	38.1	42.8	60	#6-3
	4	460-3-60	414	506	9.0	75	18.5	20.8	30	#10-3
	5	575-3-60	518	632	7.4	54	15.3	17.2	20	#12-3
WH-185	2	208-3-60	187	229	29.5	195	59.9	67.3	80	#4-3
	4	460-3-60	414	506	13.1	95	26.7	30.0	40	#8-3
	5	575-3-60	518	632	12.5	80	25.5	28.6	40	#8-3
WH-240	2	208-3-60	187	229	37.2	239	75.3	84.6	125	#2-3
	4	460-3-60	414	506	20.1	125	40.7	45.7	60	#6-3
	5	575-3-60	518	632	12.8	80	26.1	29.3	40	#8-3
WH-300	2	208-3-60	187	229	57.1	300	115.1	129.4	150	#0-3
	4	460-3-60	414	506	23.7	150	47.9	53.8	80	#4-3
	5	575-3-60	518	632	20.5	109	41.5	46.6	60	#6-3
WH-400	2	208-3-60	187	229	64.2	340	129.3	145.4	200	#000-3
	4	460-3-60	414	506	28.6	179	57.7	64.9	80	#4-3
	5	575-3-60	518	632	25.8	132	52.1	58.6	80	#4-3
WH-500	4	460-3-60	414	506	34.9	225	70.0	78.7	100	#3-3
	5	575-3-60	518	632	28.7	180	57.6	64.8	80	#4-3
WH-600	4	460-3-60	414	506	40.8	272	81.8	92.0	125	#2-3
	5	575-3-60	518	632	28.4	238	57.0	64.1	80	#4-3
WH-800	4	460-3-60	414	506	50.1	310	100.4	112.9	150	#0-3
	5	575-3-60	518	632	47.4	239	95.0	106.9	150	#0-3

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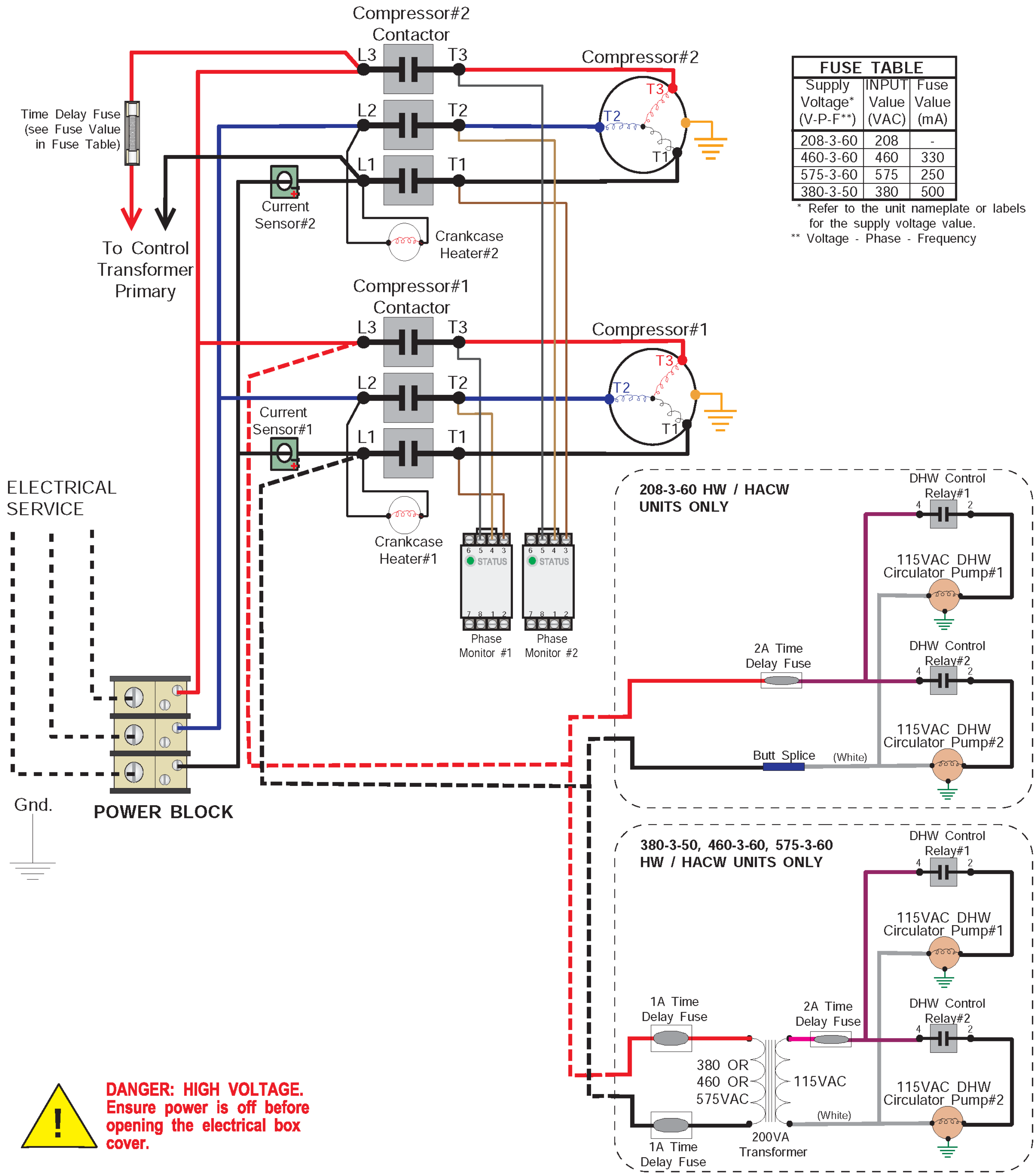
W/WH-150 to 1000 High Voltage Schematic Diagram

Dual Circuit Scroll / Optional Domestic Hot Water



FUSE TABLE		
Supply Voltage* (V-P-F**)	INPUT Value (VAC)	Fuse Value (mA)
208-3-60	208	-
460-3-60	460	330
575-3-60	575	250
380-3-50	380	500

* Refer to the unit nameplate or labels for the supply voltage value.
** Voltage - Phase - Frequency

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

REV	ECO #	IMPL BY	APVD BY	DATE
02	ISSUE 03	D. RHEAULT	D. RHEAULT	24-Jun-2022
02	ISSUE 02	D. RHEAULT	D. RHEAULT	15-Mar-2022
02	Reformatted	D. RHEAULT	D. RHEAULT	01-Nov-2017
01	Initial Release	C. GEDDES	C. GEDDES	18-Oct-2012

Drawn By: Chris Geddes		Date: 18-Oct-2012
Checked By: Chris Geddes		Date: 18-Oct-2012
Approved By: Chris Geddes	(ENG)	Date: 18-Oct-2012
Approved By	(MFG)	Date
Approved By		Date

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

Drawing Name	W/WH-150 to W/WH-1000-H***-**-*D-PP High Voltage Schematic Diagram		
Size: A	Drawing Number: 001717SCH	Drawing Rev: 02(i3)	SHEET: 1 of 1

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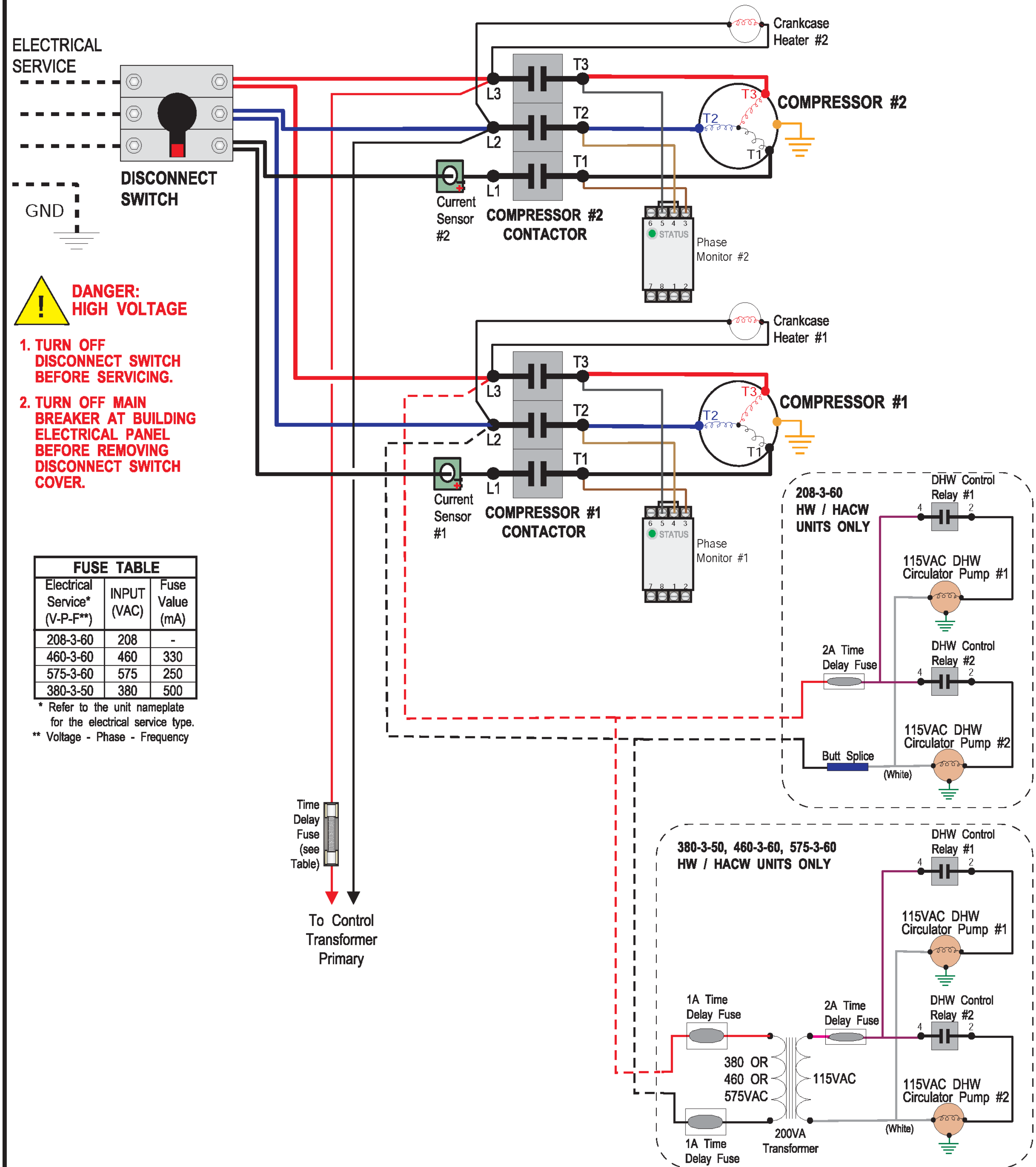
W/WH-150 to 1000 High Voltage Schematic Diagram

Dual Circuit Scroll / Optional Domestic Hot Water / with Unit Mounted Disconnect



FUSE TABLE		
Electrical Service* (V-P-F**)	INPUT (VAC)	Fuse Value (mA)
208-3-60	208	-
460-3-60	460	330
575-3-60	575	250
380-3-50	380	500

* Refer to the unit nameplate for the electrical service type.
** Voltage - Phase - Frequency

REV	ECO #	IMPL BY	APVD BY	DATE
01	ISSUE 03	D. RHEAULT	D. RHEAULT	24-Jun-2022
01	ISSUE 02	D. RHEAULT	D. RHEAULT	15-Mar-2022
01	Initial Release	D. RHEAULT	D. RHEAULT	4-Dec-2019

Drawn By	Dan Rheault	Date 4-Dec-2019
Checked By	Dan Rheault	Date 4-Dec-2019
Approved By (ENG)	Dan Rheault	Date 4-Dec-2019
Approved By (MFG)		Date
Approved By		Date

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

Drawing Name: W/WH-150 to W/WH-1000-H***-**-*D-PP w/Disconnect High Voltage Schematic Diagram

Size	Drawing Number	Drawing Rev	SHEET
A	002414SCH	01(i3)	1 of 1

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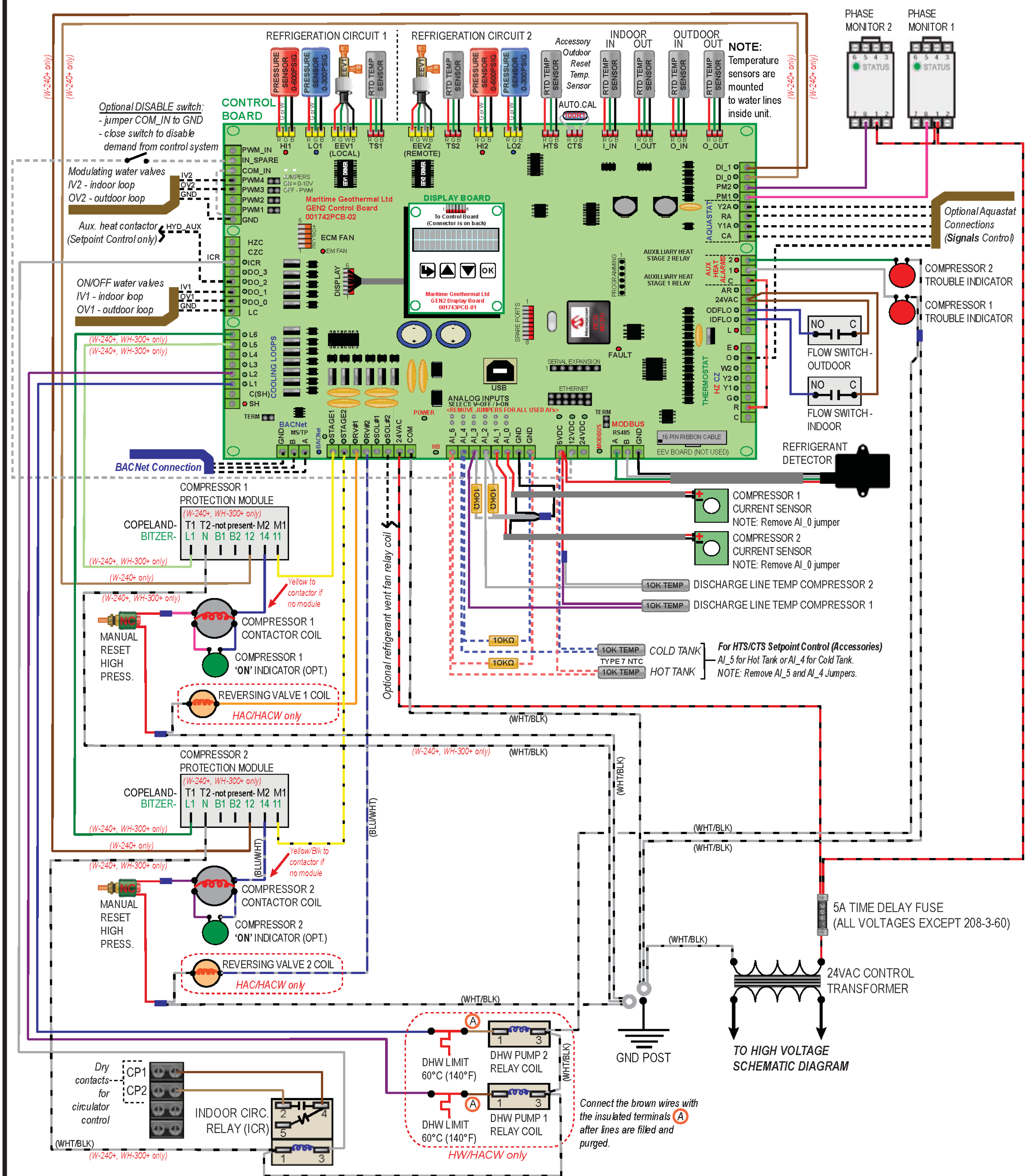
W/WH-150 to 1000 Low Voltage Schematic Diagram - Dual Circuit / Dual Compressor



Drawn By	Date
D. RHEAULT	12-MAR-2025
Checked By	Date
D. RHEAULT	12-MAR-2025
Eng. Approved By	Date
Mfg. Approved By	Date
Approved By	Date

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

Drawing Name: W/WH-150~1000-H***-X/Y-*D-PP Low Voltage Schematic Diagram

Size	Drawing Number	Drawing Rev	Sheet
LET	002752SCH	01	1 / 1

REV	ECO#	IMPL BY	APVD BY	DATE
01	Initial Release	D. RHEAULT	D. RHEAULT	12-MAR-2025

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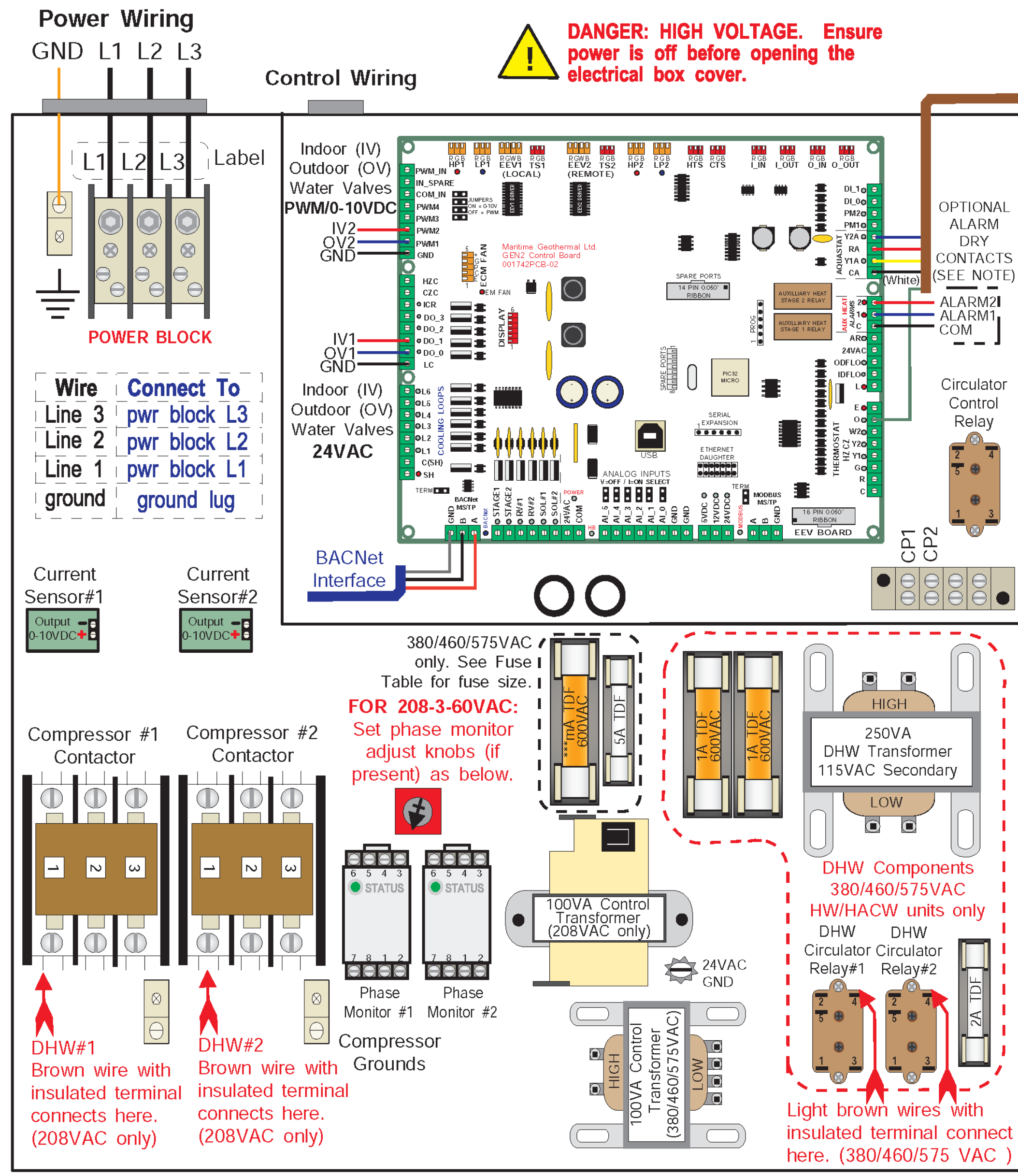
W/WH-150 to 1000 Electrical Box Diagram

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_Y2A: Stage 2 (compr.2)
SYSTEM_O: Htg/Cooling Mode (active in cooling)

2. Hardwired (24VAC)

Use an 18-4 or 18-5 cable.

C - 24VAC Common
R - 24VAC Hot
Y1A - Stage 1 (Compressor 1)
Y2A - Stage 2 (Compressor 2)
O - Heating/Cooling Mode (active for cooling mode)

A dry contact from "R" to "Y1A" will start compressor #1.

A dry contact from "R" to "Y2A" will start compressor #2.

A dry contact from "R" to "O" will activate cooling mode (for both compressors).

3. Setpoint Control

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

DHW NOTE: If the heat pump is to be operated without the hot water circulators 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 pumps are water lubricated and must not be run dry.**

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.

- **Stages Y1A & Y2A** are completely independent (unlike with residential "Ultratech" compressors). Each may be used at any time.
- **Anti-short cycle timer** of 5 minutes exists for each compressor.
- **Alarm1 and Alarm2** signals are dry contacts (NO). Connect the signal source to COM. Alarm1 is for stage 1 (Y1A) and Alarm2 is for stage 2 (Y2A). 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
02	ISSUE 03	D. RHEAULT	D. RHEAULT	24-Jun-2022
02	ISSUE 02	D. RHEAULT	D. RHEAULT	15-Mar-2022
02	Reformatted	D. RHEAULT	D. RHEAULT	01-Nov-2017
01	Initial Release	C. GEDDES	C. GEDDES	18-Oct-2012

Drawn By: Chris Geddes		Date: 18-Oct-2012
Checked By: Chris Geddes		Date: 18-Oct-2012
Approved By: Chris Geddes	(ENG)	Date: 18-Oct-2012
Approved By	(MFG)	Date
Approved By		Date

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

Drawing Name: W/WH-150 to W/WH-1000-H***-*-*D-PP Electrical Box Diagram

Size	Drawing Number	Drawing Rev	SHEET
A	001719ELB	02(i3)	1 of 1

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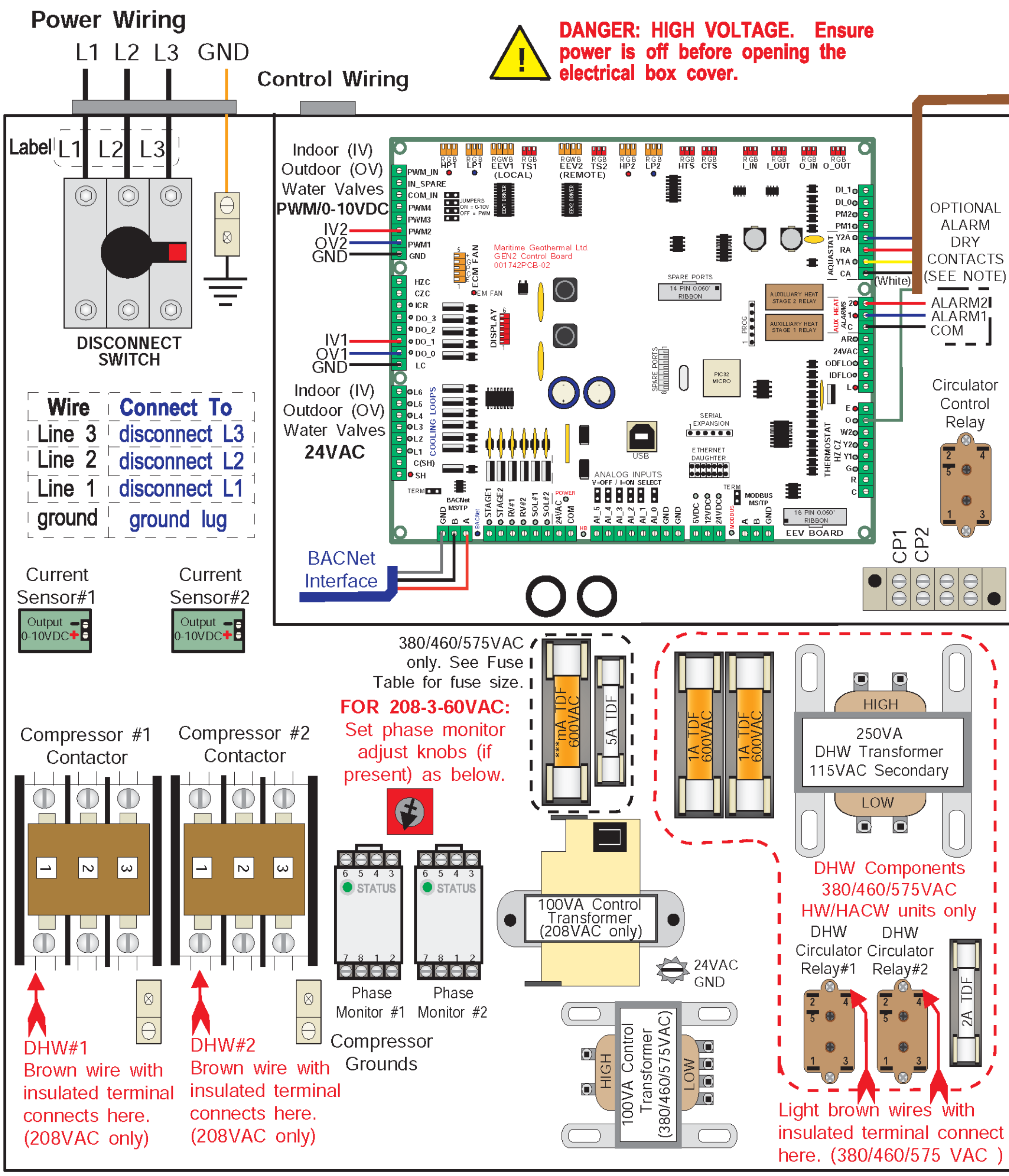
W/WH-150 to 1000 w/Disconnect Electrical Box Diagram



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_Y2A: Stage 2 (compr.2)
SYSTEM_O: Htg/Cooling Mode (active in cooling)

2. Hardwired/Signals (24VAC)

Use an 18-4 or 18-5 cable.

C - 24VAC Common
R - 24VAC Hot
Y1A - Stage 1 (Compressor 1)
Y2A - Stage 2 (Compressor 2)
O - Heating/Cooling Mode (active for cooling mode)

A dry contact from **R** to **Y1A** will start compressor #1.

A dry contact from **R** to **Y2A** will start compressor #2.

A dry contact from **R** to **O** will activate cooling mode (for both compressors).

3. Setpoint Control

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

DHW NOTE: If the heat pump is to be operated without the hot water circulators 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 pumps are water lubricated and must not be run dry.**

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 swap 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.

- **Stages Y1A & Y2A** are completely independent (unlike with residential 2-stage compressors). Each may be used at any time.
- **Anti-short cycle timer** of 5 minutes exists for each compressor.
- **Alarm1 and Alarm2** signals are dry contacts (NO). Connect the signal source to COM. Alarm1 is for stage 1 (Y1A) and Alarm2 is for stage 2 (Y2A). 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 03	D. RHEAULT	D. RHEAULT	24-Jun-2022
01	ISSUE 02	D. RHEAULT	D. RHEAULT	15-Mar-2022
01	Initial Release	D. RHEAULT	D. RHEAULT	4-Dec-2019

Drawn By: Dan Rheault	Date: 4-Dec-2019
Checked By: Dan Rheault	Date: 4-Dec-2019
Approved By (ENG): Dan Rheault	Date: 4-Dec-2019
Approved By (MFG)	Date
Approved By	Date

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

Drawing Name	W/WH-150 to W/WH-1000-H***-*-*D-PP w/Disconnect Electrical Box Diagram		
Size	**Drawing Number**	**Drawing Rev**	**SHEET**
A	002415ELB	01(i3)	1 of 1

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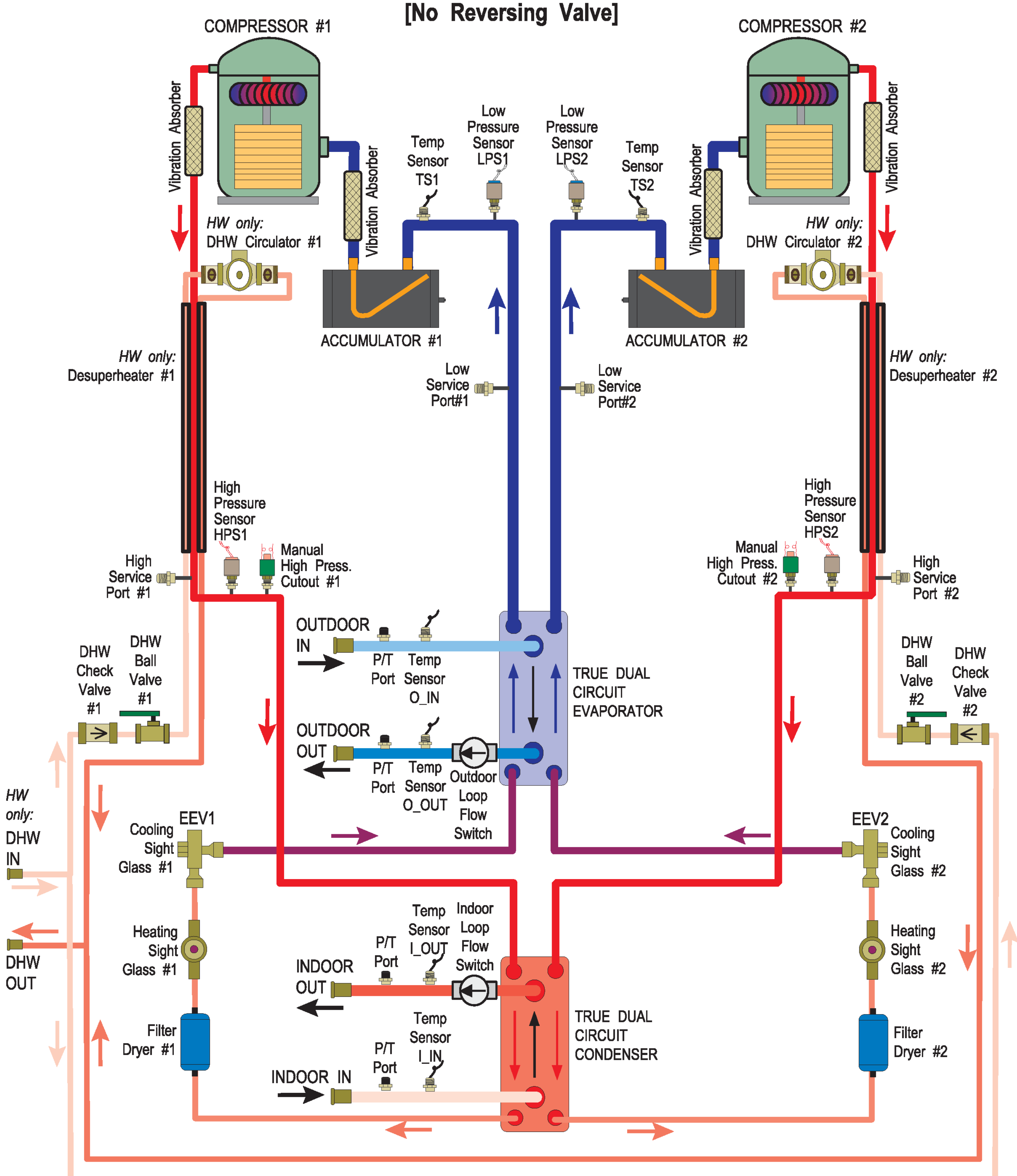
W/WH-150 to 1000-H/HW Refrigeration Circuit
[No Reversing Valve]



01(i2)	ISSUE 02	D. RHEAULT	D. RHEAULT	1-Jun-2022
01	Initial Release	C. GEDDES	C. GEDDES	23-Oct-2012
REV	ECO #	IMPL BY	APVD BY	DATE

Drawn By Chris Geddes	Date 23-Oct-2012
Checked By Chris Geddes	Date 23-Oct-2012
Approved By (ENG) Chris Geddes	Date 23-Oct-2012
Approved By (MFG)	Date
Approved By	Date

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

Drawing Name	W/WH-150 to 1000-H(W) Refrigeration Circuit Diagram		
Size	Drawing Number	Drawing Rev	SHEET
A	001720RCD	01(i2)	1 of 1

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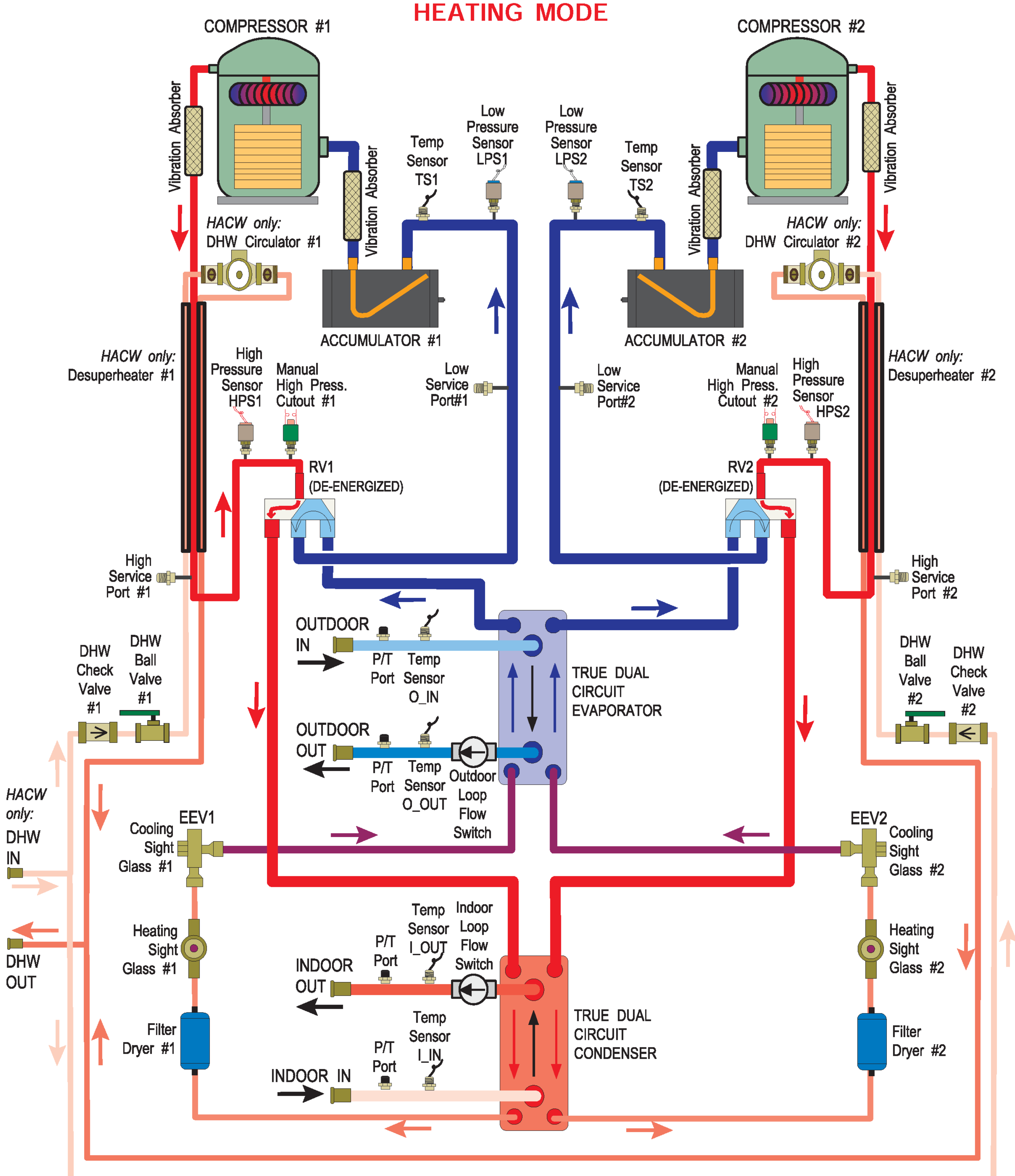
W/WH-150 to 1000-HAC/HACW Refrigeration Circuit

HEATING MODE



					Drawn By Chris Geddes	Date 23-Oct-2012
					Checked By Chris Geddes	Date 23-Oct-2012
					Approved By (ENG) Chris Geddes	Date 23-Oct-2012
02	000303	D. RHEAULT	D. RHEAULT	1-Jun-2022	Approved By (MFG)	Date
01	Initial Release	C. GEDDES	C. GEDDES	23-Oct-2012	Approved By	Date
REV	ECO #	IMPL BY	APVD BY	DATE		

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

Drawing Name	W/WH-150 to 1000-HAC(W) Refrigeration Circuit Diagram - Heating Mode		
Size A	Drawing Number 001721RCD	Drawing Rev 02	SHEET 1 of 1

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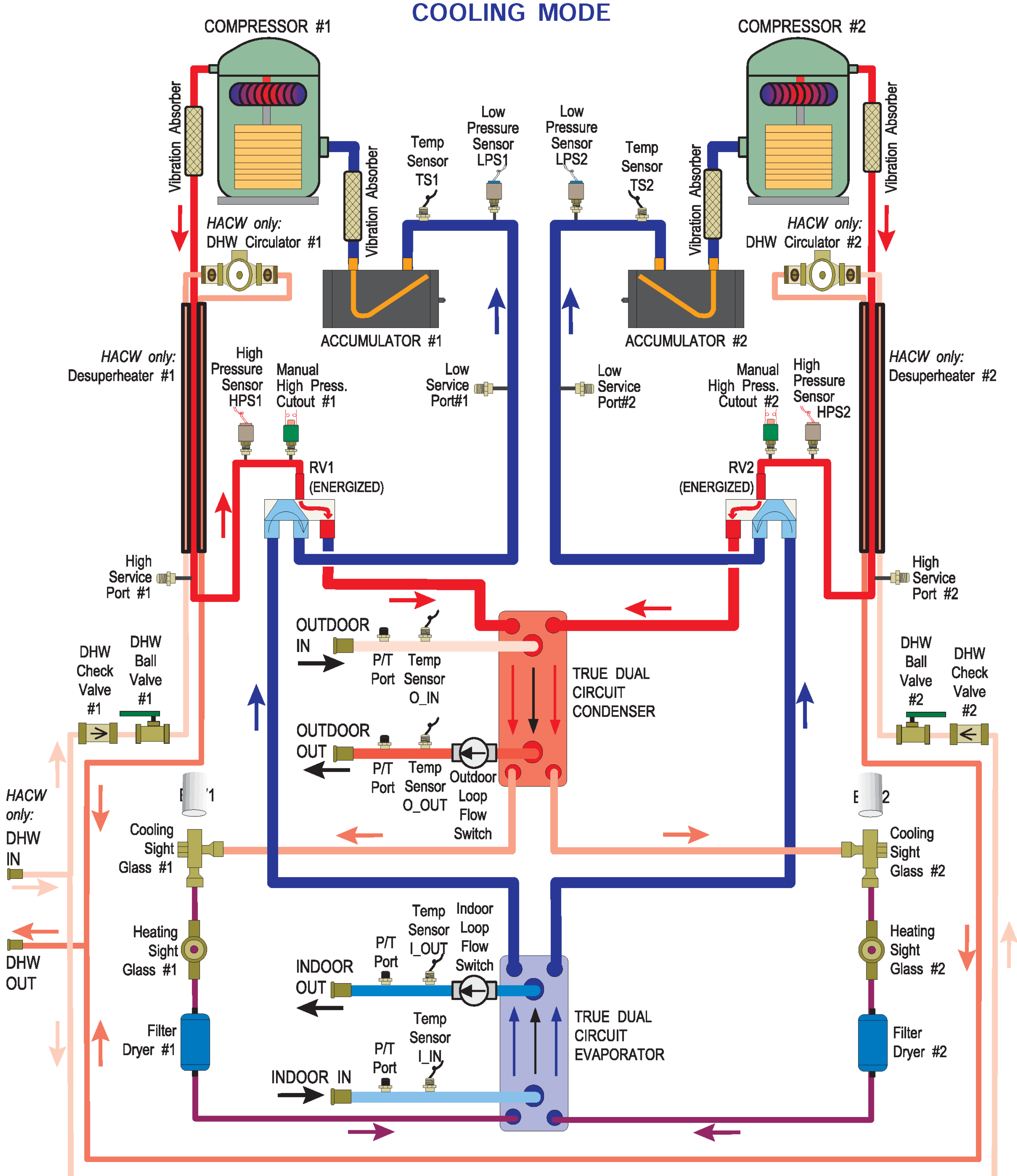
W/WH-150 to 1000-HAC/HACW Refrigeration Circuit

COOLING MODE



02	000303	D. RHEAULT	D. RHEAULT	1-Jun-2022	
01	Initial Release	C. GEDDES	C. GEDDES	23-Oct-2012	
REV	ECO #	IMPL BY	APVD BY	DATE	

Drawn By: Chris Geddes	Date: 23-Oct-2012
Checked By: Chris Geddes	Date: 23-Oct-2012
Approved By (ENG): Chris Geddes	Date: 23-Oct-2012
Approved By (MFG)	Date
Approved By	Date

MARITIME GEOTHERMAL LTD.

170 Plantation Rd, Petitcodiac, NB E4Z 6H4

Drawing Name	W/WH-150 to 1000-HAC(W) Refrigeration Circuit Diagram - Cooling Mode		
Size: A	Drawing Number: 001722RCD	Drawing Rev: 02	SHEET: 1 of 1

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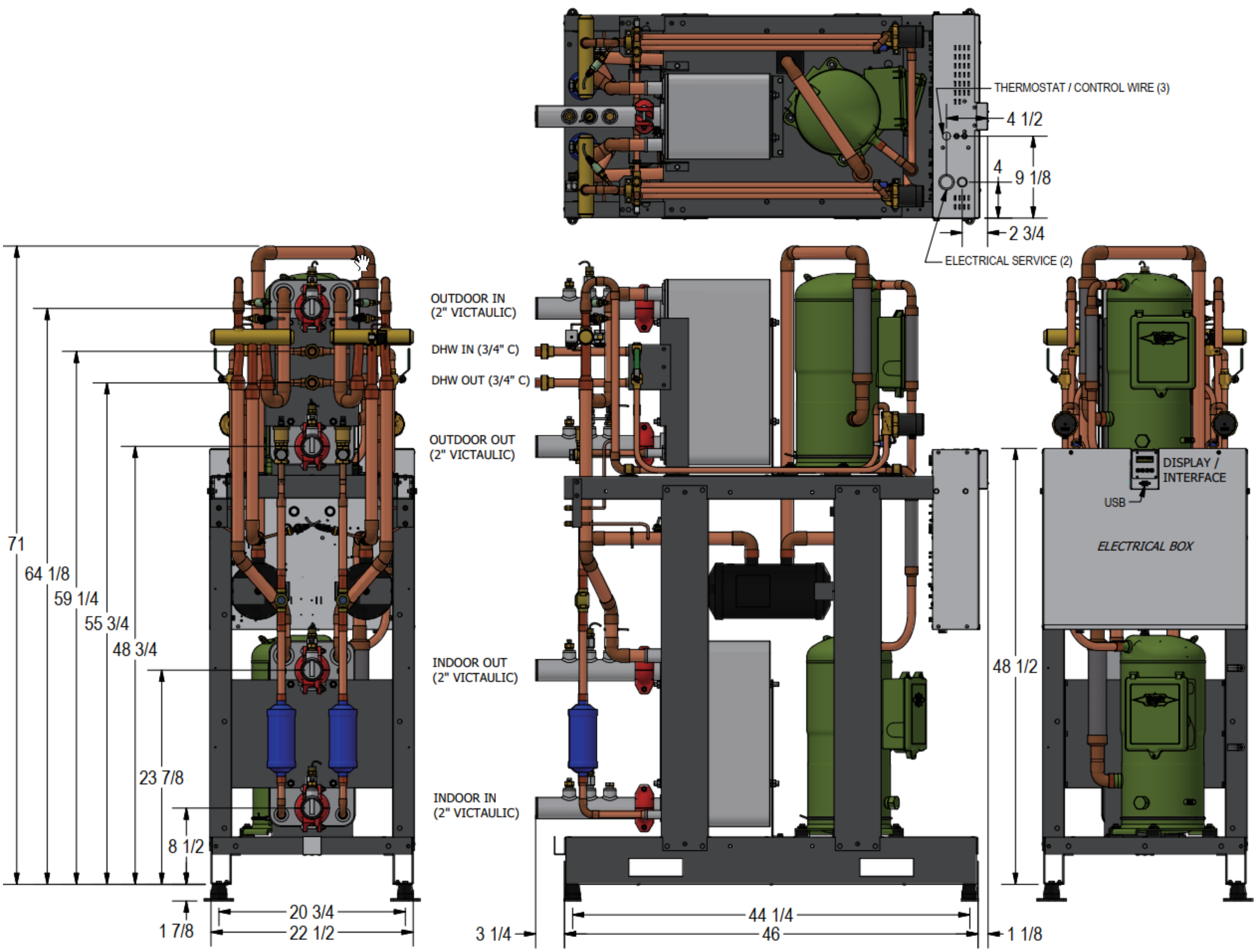
Dimensions: Without Enclosure (Sizes 150-400)



All dimensions in inches.

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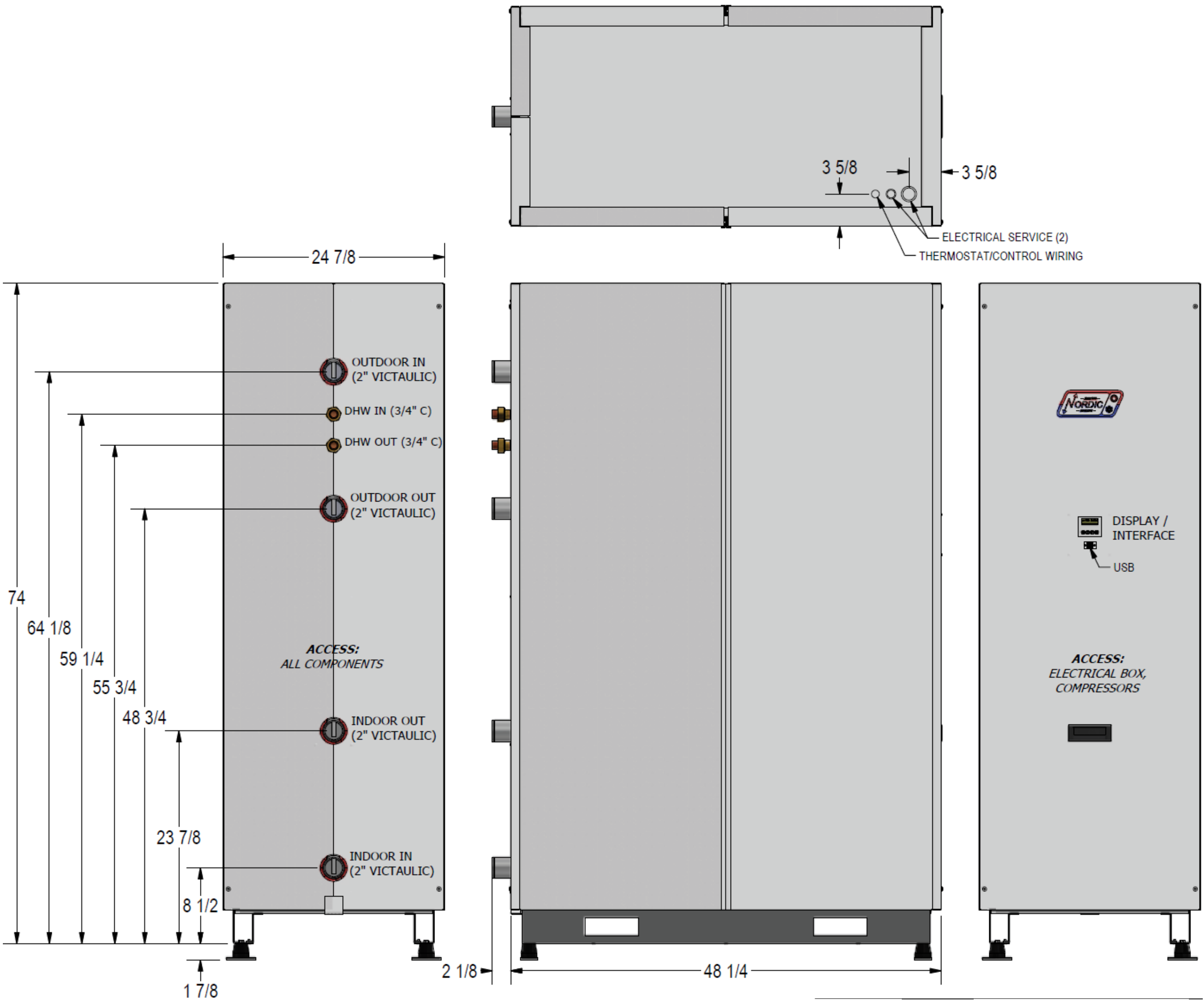
Dimensions: With Enclosure (Sizes 150-400)



RECOMMENDED BACK CLEARANCE:
3 FT + HEADERS

NO SIDE CLEARANCE REQUIRED

RECOMMENDED FRONT CLEARANCE:
3 FT

All dimensions in inches.

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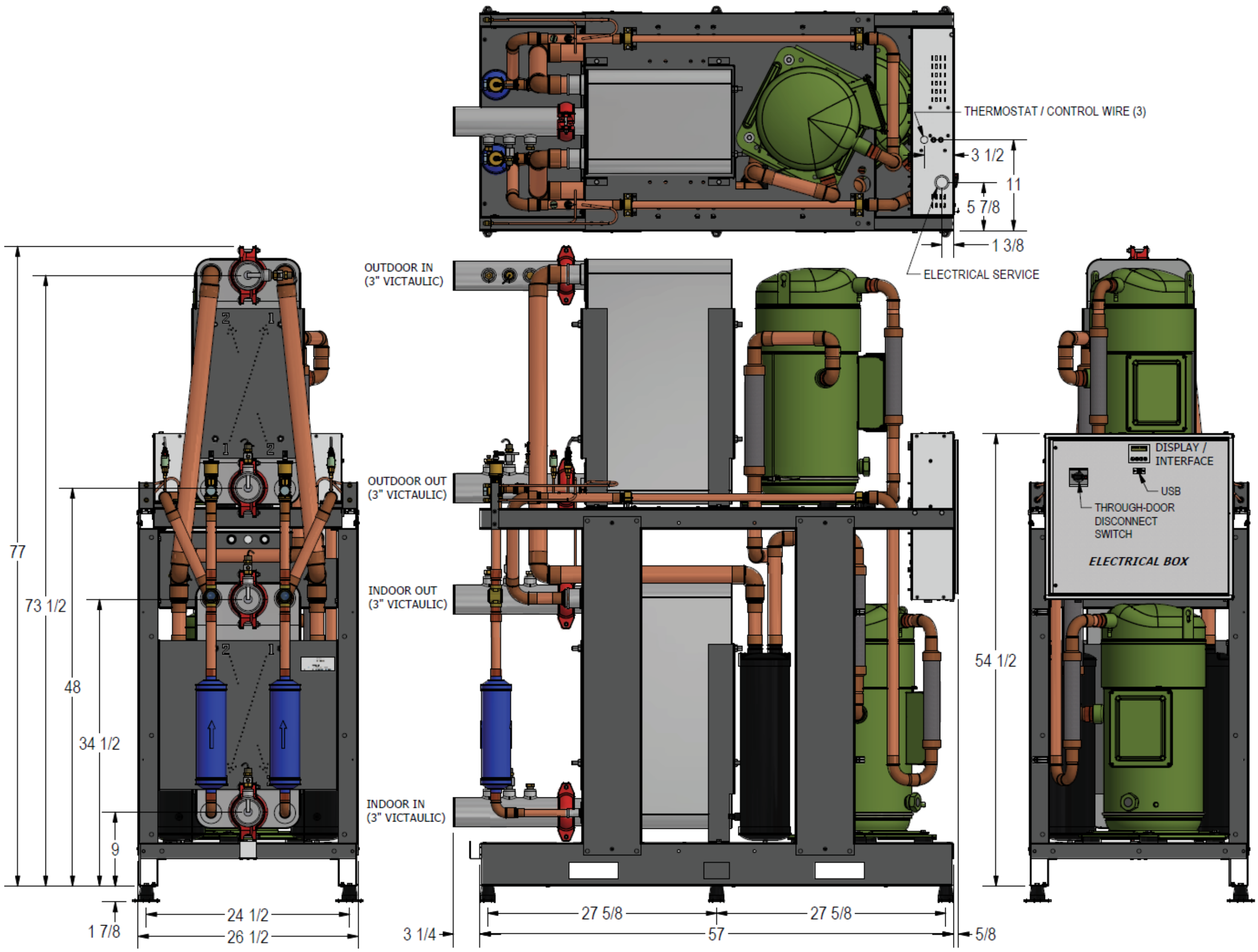
Dimensions: Without Enclosure (Sizes 500-1000)



All dimensions in inches.

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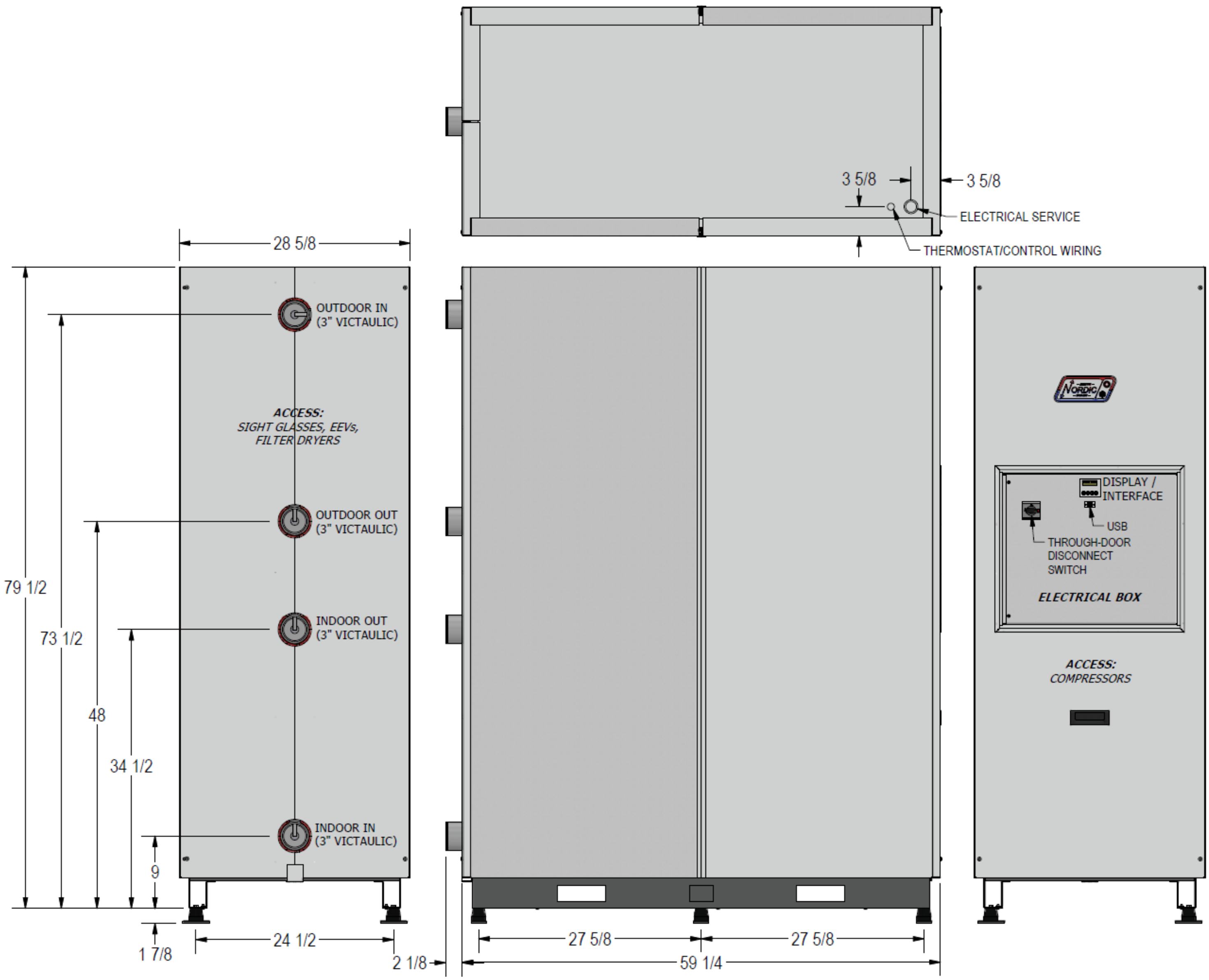
Dimensions: With Enclosure (Sizes 500-1000)



RECOMMENDED
BACK CLEARANCE:
3 FT + HEADERS

NO SIDE CLEARANCE REQUIRED

RECOMMENDED
FRONT CLEARANCE:
3 FT

All dimensions in inches.

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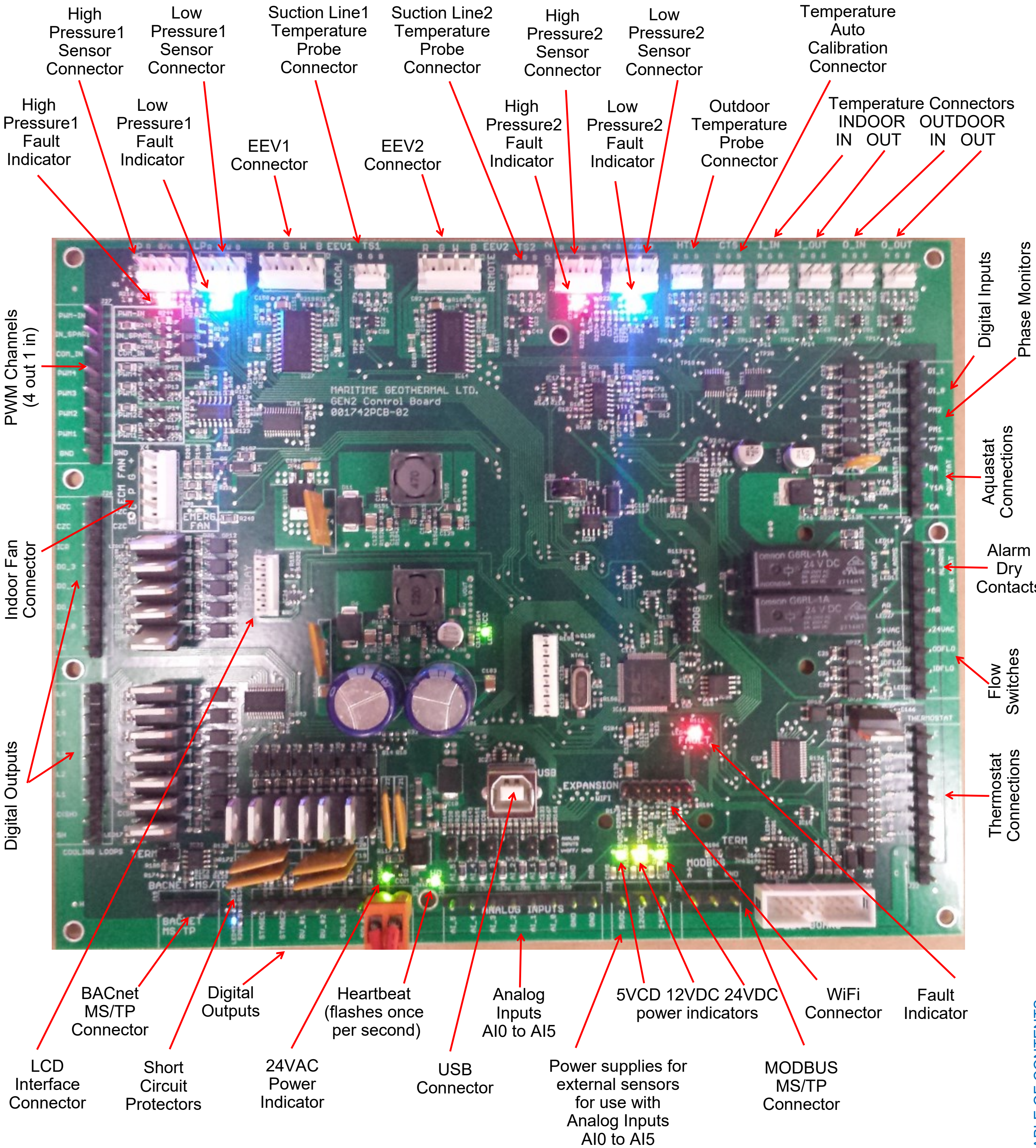
Appendix A - GEN2 Control Board Description

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 refr. circuit 1 compressor discharge pressure
LPS1/LO1	Low Pressure Sensor 1	Measures refr. circuit 1 compressor suction pressure
EEV1	Local EEV	Control of refr. circuit 1 Electronic Expansion Valve
TS1	Suction Line Temperature 1	Mounted to refr. circuit 1 common suction line inside unit
EEV2	Remote EEV	Control of refr. circuit 2 Electronic Expansion Valve
TS2	Suction Line Temperature 2	Mounted to refr. circuit 2 common suction line inside unit
HPS2/HI2	High Pressure Sensor 2	Measures refr. circuit 2 compressor discharge pressure
LPS2/LO2	Low Pressure Sensor 2	Measures refr. circuit 2 compressor suction pressure
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	Compressor 2 protection module 24VAC power (sizes W-240/WH-300 and up)
L5	Loop5	Compressor 1 protection module 24VAC power (sizes W-240/WH-300 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	Desuperheater pump 2 enable (HACW/HW models only)
L1	Loop1	Desuperheater pump 1 enable (HACW/HW models only)
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 1
STAGE2	Compressor Stage 2	Starts / stops compressor 2
RV#1	Reversing Valve#1	Off in heating mode, on in cooling mode (reversing HAC models only)
RV#2	Reversing Valve#2	Off in heating mode, on in cooling mode (reversing HAC models only)
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 1 temperature sensor
AI_2	Analog In Channel 2	Compressor discharge line 2 temperature sensor
AI_1	Analog In Channel 1	Compressor 2 current sensor
AI_0	Analog In Channel 0	Compressor 1 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

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TABLE A4 - Control Board Connector Descriptions (Right Side)		
Signal	**Description**	
DI_1	Digital Input 1	Compressor 2 protection module alarm input (sizes W-240 and up)
DI_0	Digital Input 0	Compressor 1 protection module alarm input (sizes W-240 and up)
PM2	Phase Monitor 2	Phase monitor 2 alarm input
PM1	Phase Monitor 1	Phase monitor 1 alarm input
Y2A*	Aquastat stage 2	Optional water heat stage 2 24VAC input for use with Signals/Hardwired control.
RA*	Aquastat power (24VAC)	Optional 24VAC for aquastat used with Signals/Hardwired control.
Y1A*	Aquastat stage1	Optional water heat stage 1 24VAC input for use with Signals/Hardwired control.
CA*	Aquastat power (ground)	Optional 24VAC ground for aquastat used with Signals/Hardwired control.
2	Stage 2 alarm	Dry contact to indicate refr. circuit 2 alarm, used with C
1	Stage 1 alarm	Dry contact to indicate refr. circuit 1 alarm, used with C
C	Alarm Common	Used with 2 and 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)	Jumpered to C above for alarm indicators 1 and 2.
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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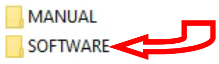
Appendix B - USB Driver Installation (Windows 10 & earlier)

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:

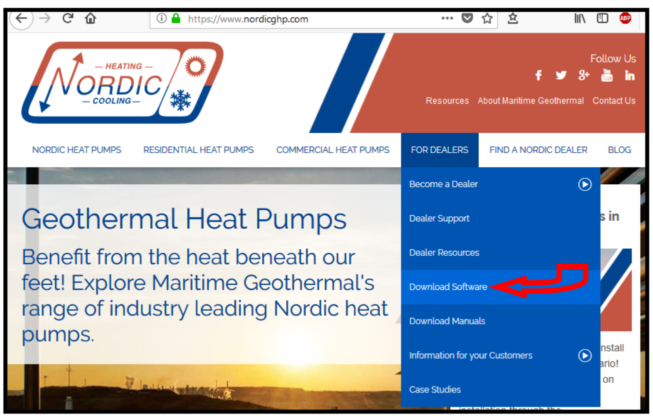


Double click on the SOFTWARE folder to show its contents:

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:



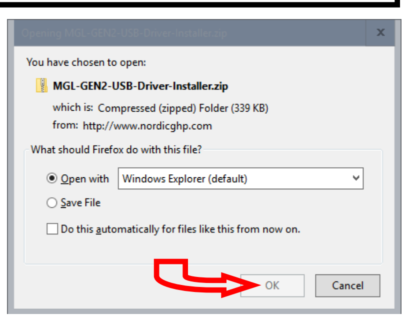
2. Click on **MGL GEN2 USB Driver Installer** to download it:

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

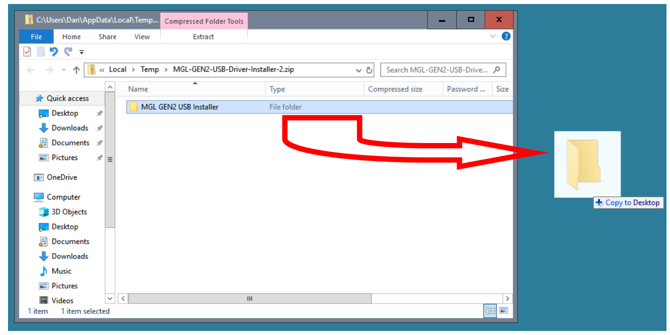
DOWNLOAD PC App (software for Windows laptop):
MGL GEN2 PC APP V2.05

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

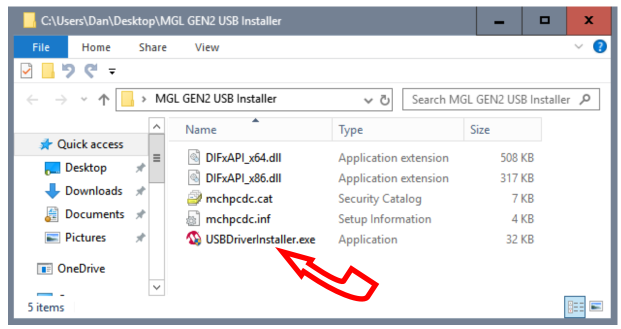
3. Choose "Open with Windows Explorer", and hit "OK".
(If the choice window doesn't pop up, find the downloaded file in your browser downloads and double click on it.)



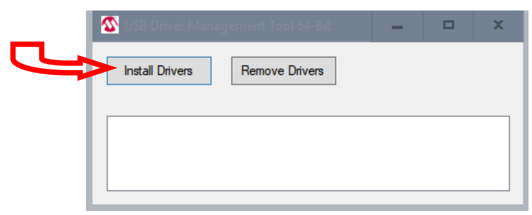
4. In the window that is displayed, click and hold down the mouse button on the folder name, and drag to your desktop:



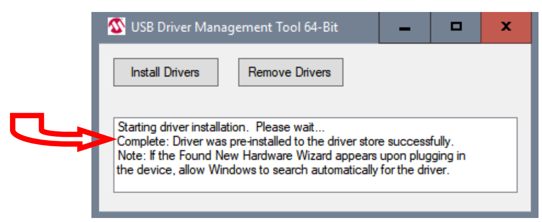
5. Double click on the folder you just dragged onto the desktop, then double click on the "USBDriverInstaller" file:



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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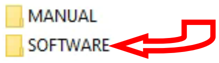
Appendix C - PC App Installation (Windows 11)

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:

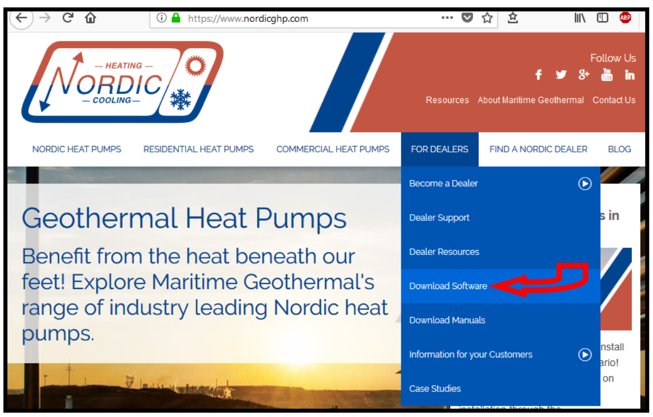


Double click on the SOFTWARE folder to show its contents:

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:



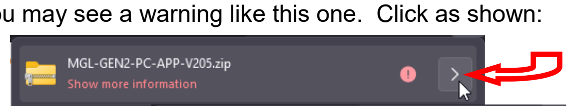
2. Click on **MGL GEN2 PC APP V2__** to download it:

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

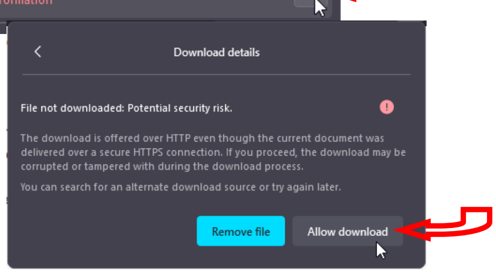
DOWNLOAD PC App (software for Windows laptop):
MGL GEN2 PC APP V2.05

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

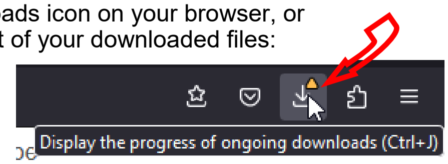
3. You may see a warning like this one. Click as shown:



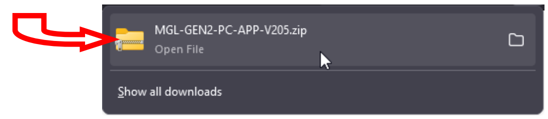
Then:



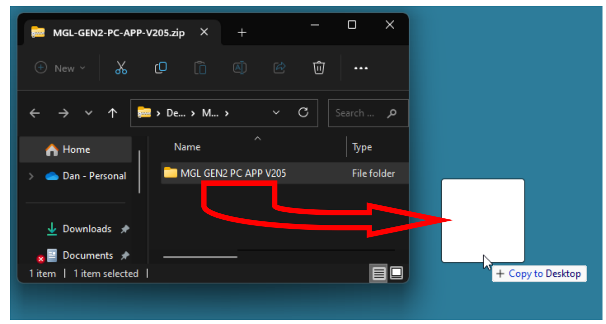
4. Click on the downloads icon on your browser, or otherwise view a list of your downloaded files:



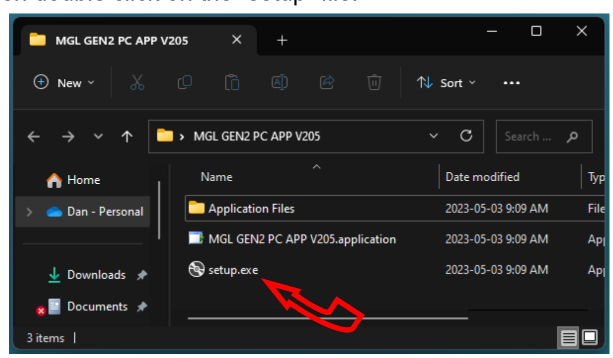
5. Then click on the .zip file to open it in a File Explorer window:



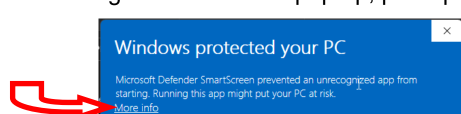
6. In the window that is displayed, click and hold down the mouse button on the folder name, and drag to your desktop:



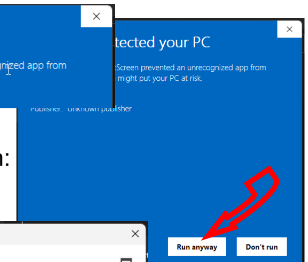
7. Double click on the folder you just dragged onto the desktop, then double click on the “setup” file:



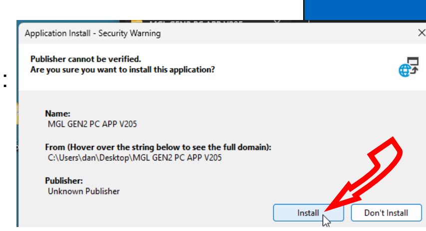
8. Click “More info”, “Run anyway”, “Install”, or similar on any warning windows which pop up, perhaps more than once.



Then:



And:



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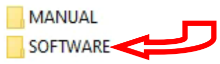
Appendix D - PC App Installation (Windows 10 & earlier)

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:

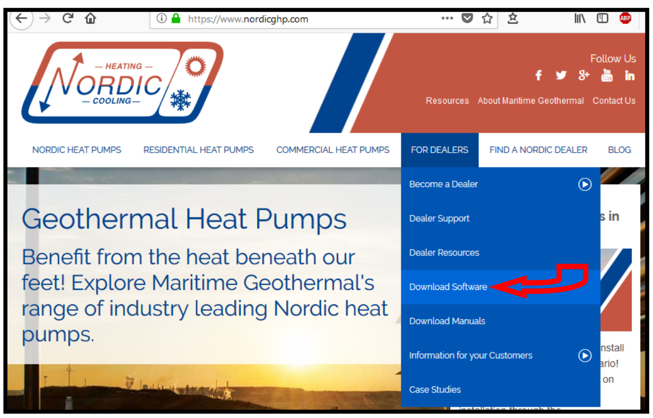


Double click on the SOFTWARE folder to show its contents:

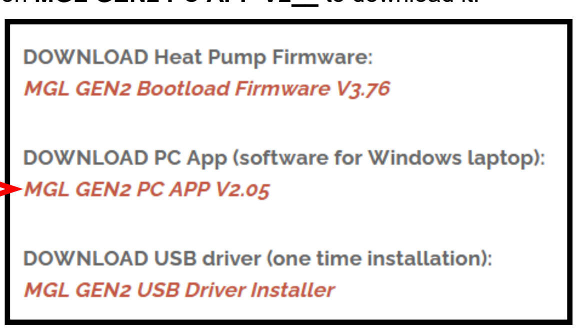
Double click on **Step 2** and follow the prompts, clicking “allow” or “yes” as required. If you get a warning that .NET framework is required, go back and double click on step **z**, then try **Step 2** again.

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:

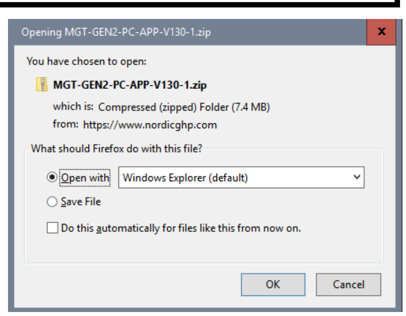


DOWNLOAD Heat Pump Firmware:
MGL GEN2 Bootload Firmware V3.76

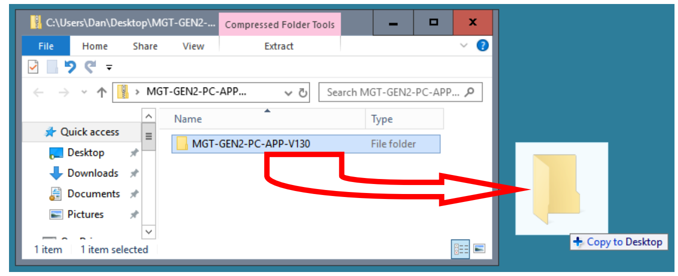
DOWNLOAD PC App (software for Windows laptop):
MGL GEN2 PC APP V2.05

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

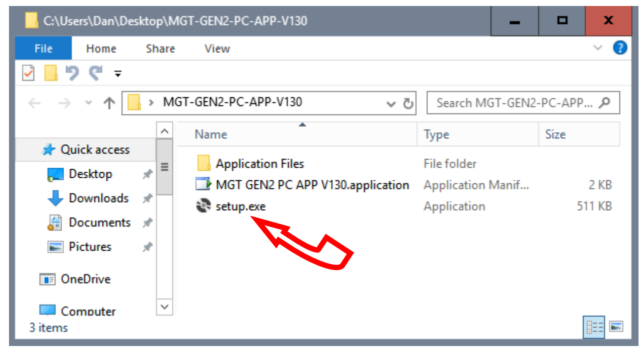
3. Choose “Open with Windows Explorer”, and hit “OK”:



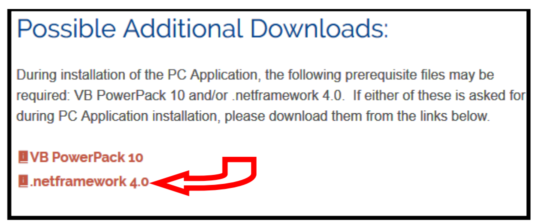
4. In the window that is displayed, click and hold down the mouse button on the folder name, and drag to your desktop:



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:



Possible Additional Downloads:

During installation of the PC Application, the following prerequisite files may be required: VB PowerPack 10 and/or .netframework 4.0. If either of these is asked for during PC Application installation, please download them from the links below.

VB PowerPack 10
.netframework 4.0

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:

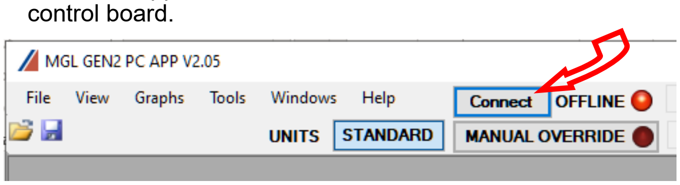
MGL_GEN2_V376.production.hex	(firmware file)
PIC32UBL.exe	(the programmer)
USB Bootloader Instructions.pdf	(these instructions)

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

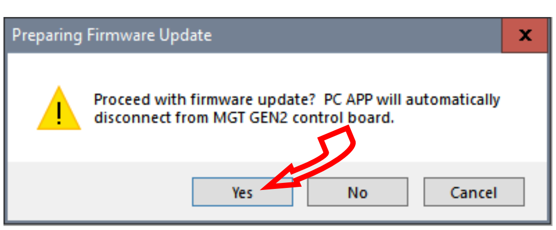
3. Connect a USB (printer) cable between computer and control board.

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.

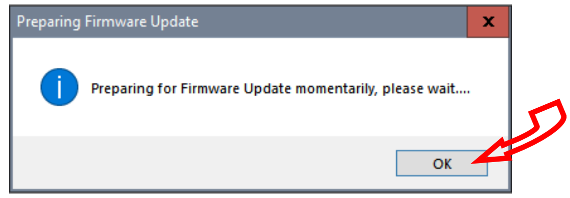
5. In the PC App, click on the **Connect** button to connect to the control board.



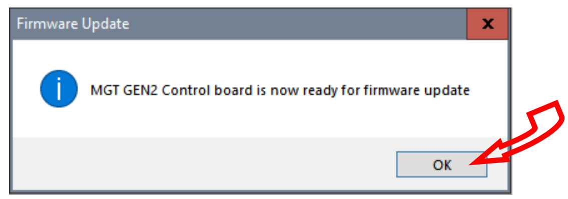
6. Go to menu **Tools --> Update Firmware**. The following message box will appear:



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

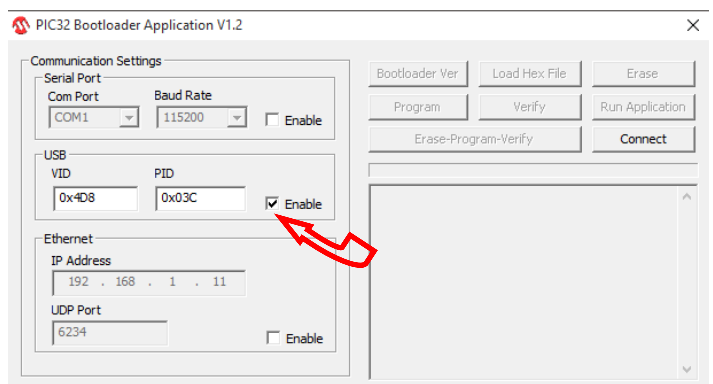


8. Click on **OK**. After a minute, the following message box will appear:

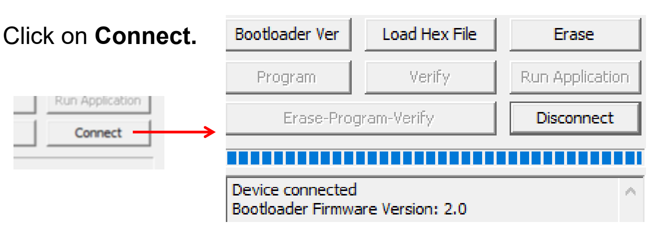


9. Click on **OK**. The control board is now in bootloader mode and is ready to be programmed.

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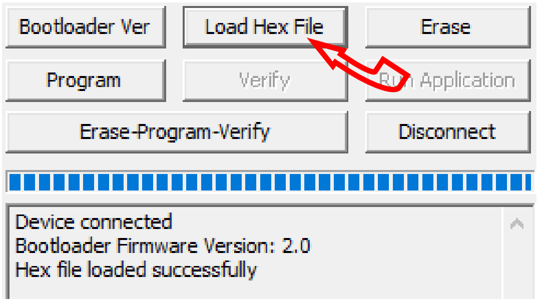
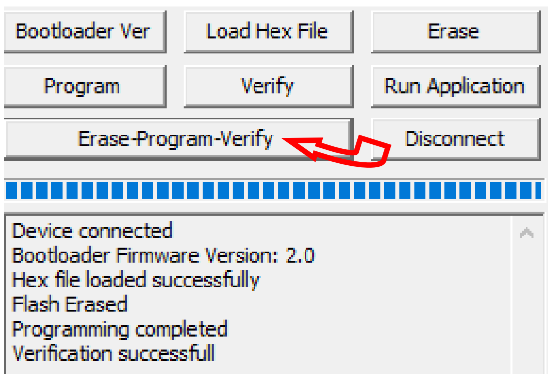
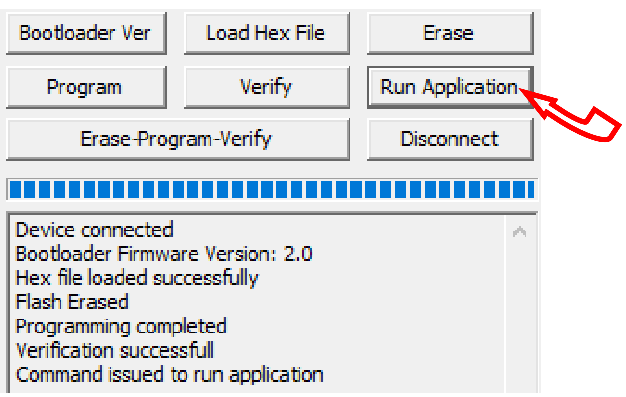
12. Click on **Load Hex File**. Select the *MGL_GEN2_V376.production.hex* (or higher version number) file, which is in the folder you created on the Desktop.



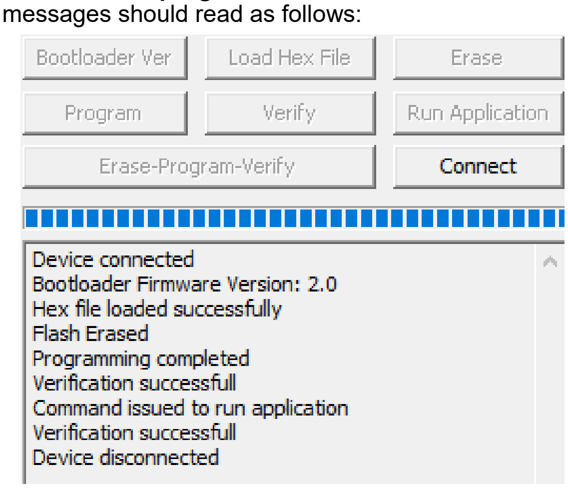
13. Click on **Erase—Program—Verify.** Programming…. Wait while status bar shows progress. The messages should read as below when finished:



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.



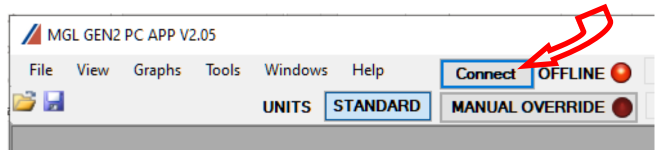
15. **Wait until the programmer disconnects itself.** The messages should read as follows:



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.



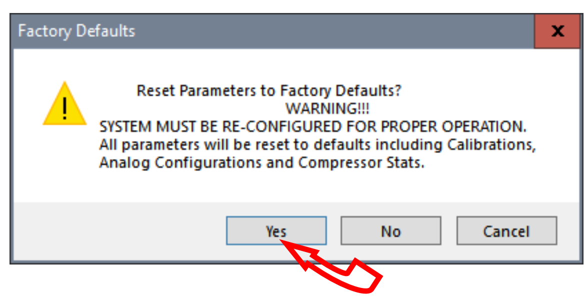
NOTE: Updating the firmware does not affect the configuration settings.

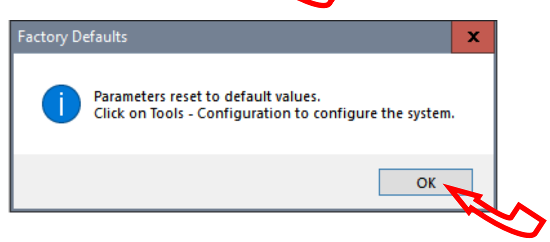
Reset to Defaults?

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

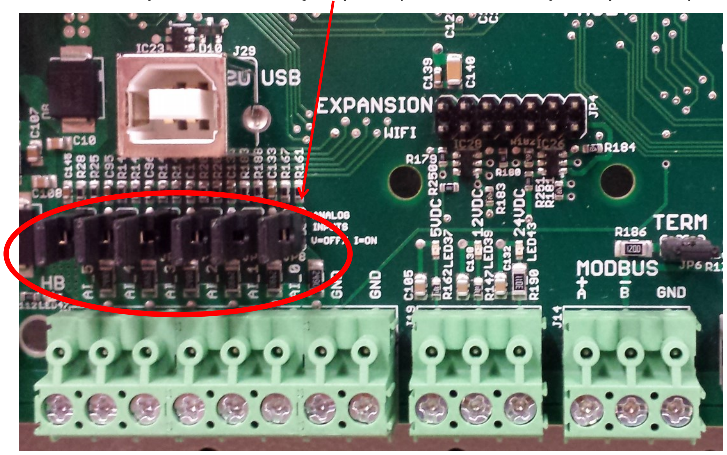
2. In that folder on the Desktop, there will be three files:

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

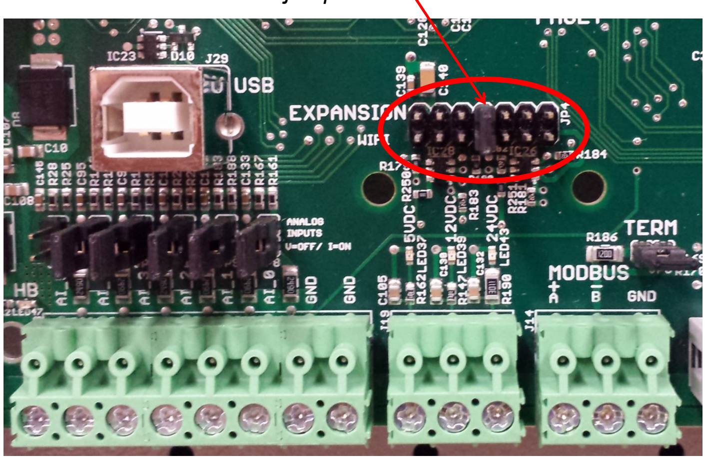
   Note that on most computers, the file extensions (.exe, .pdf) will be hidden.

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.

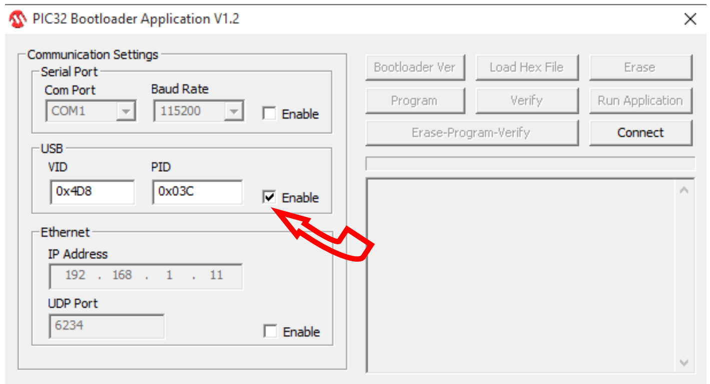
Borrow any one of these jumpers (however many are present)



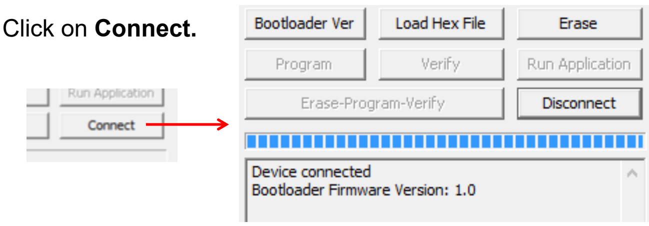
Place jumper here



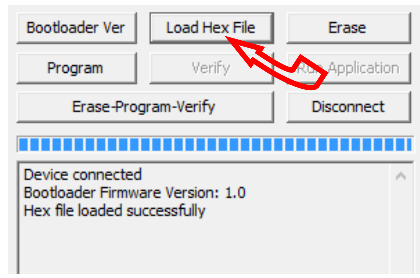
6. Turn the power back on. The control board is now in boot loader mode and is ready to be programmed.
7. Double click on the downloaded PIC32UBL.exe to run it. In the window that opens, click on the USB **Enable** check box.



8. Click on **Connect.**

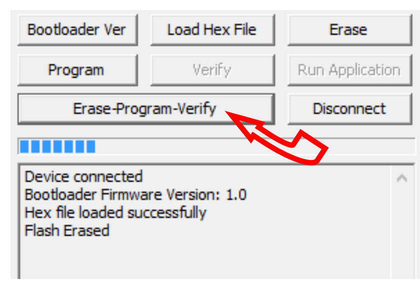


9. Click on **Load Hex File**. Select the *MGL_GEN2_V376. production.hex* (or higher version number) file, which is in the folder you created on the Desktop.

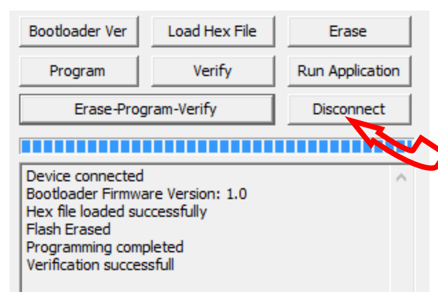


10. Click on **Erase—Program—Verify**

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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