Double Hybrid Heat Pump

Installation and Operation Manual

Two-Speed Ground Source Heat Pump

Simultaneous hydronic heating, forced hot air, and domestic hot water

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3-, 4-, 5-, and 6-ton models available

Closed Loop systems only

Vertical or horizontal orientation

ENERGY CATALYST

Table of Contents

Important Safety Information

Safety Symbols Explanation

Warnings, cautions, and notices appear throughout this manual. Read these items carefully before attempting any installation, service, or troubleshooting of the equipment.

WARNING: Indicates a potentially hazardous situation, which if not avoided could result in death or serious injury.

CAUTION: Indicate a potentially hazardous situation or an unsafe practice, which if not avoided could result in minor or moderate injury or product or property damage.

IMPORTANT! Notification of installation, operation, or maintenance information, which is important, but which is not hazard-related.

General Safety Messages

WARNING: DO NOT install, operate, or maintain this equipment before carefully reading this instruction manual.

WARNING: The Heat Pump appliance is not to be used by persons (including children) with reduced physical, sensory, or mental capabilities, or lack of experience and knowledge, unless they have been given supervision or instruction.

WARNING: The Heat Pump is not a toy and children should not play with the appliance.

CAUTION: Never operate the heat pump without an air filter.

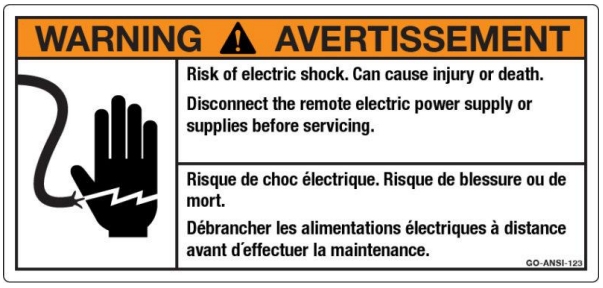
IMPORTANT!

- Save this manual and any other operating instructions for yourself and any future owners of this appliance.
- Additional copies of this manual are available from the installer or by contacting Energy Catalyst Technologies.
- A trained or approved Energy Catalyst Technologies installer must perform all installation practices.
- A licensed refrigeration technician must perform all refrigeration repairs and modifications. Energy Catalyst Technologies must approve all service repairs if the system is covered under manufacturer warranty.
- Unless otherwise noted in the terms outlined in the warranty, you must register your product with Energy Catalyst Technologies in order to receive the full benefit of the warranty.

Electrical Hazard Warnings

DANGER: ELECTRIC SHOCK CAN KILL!!

WARNING: The following is a general warning statement which should be read and understood before installing and/or operating your Double Hybrid Heat Pump.



WARNING: Install a means for disconnection from the main supply across all poles to provide full disconnection if the heat pump is out of line of sight from the main breaker or if the unit is further than 50 ft (15 m) away from the main breaker panel.

WARNING: Always turn off system power before removing panels to reduce the risk of electric shock.
NOTE: Some units may have more than one or two power supplies.

WARNING: DO NOT stick hands into return, supply, or any other opening. There is a sharp, spinning blade that could cause severe injury.

WARNING: The presence of water around the base of the unit constitutes an electrical hazard. Turn off the power to the unit as soon as water leakage is discovered and call a service technician immediately.

WARNING: Never jump any fused circuit to reduce the risk of electric shock and product damage.

CAUTION: The system contains refrigerant under very high pressure. The system must only be serviced by qualified persons only.

CAUTION: Keep all covers and panels in place at all times. Do not leave unattended with covers or panels off during installation or servicing.

CAUTION: All repairs, electrical or mechanical, should be attempted only by trained technicians. In the event of a problem with the unit, do not reset the unit until the problem has been fully corrected.
NOTE: Equipment failure due to resetting without first correcting the problem will not be covered by the warranty.

CAUTION: All breakers and fuses supplying power to this unit should be clearly labeled at the time of installation.

CAUTION: All wiring and plumbing should be done in strict accordance with local and national codes and ordinances.

General Information

Model Nomenclature

DHHP | 036 | TV | HW – R

SERIES
DHHP = Double Hybrid Heat Pump

UNIT SIZE
036
048
060
072

DISCHARGE AND ORIENTATION
TV = Top Discharge Vertical Orientation
TH = Side Discharge Horizontal Orientation

BACKUP TYPE
HW = Hot Water Backup
FA = Forced Air Backup

RETURN AIR CONFIGURATION
R = Right Hand
L = Left Hand

Sample Double Hybrid Heat Pump Configuration

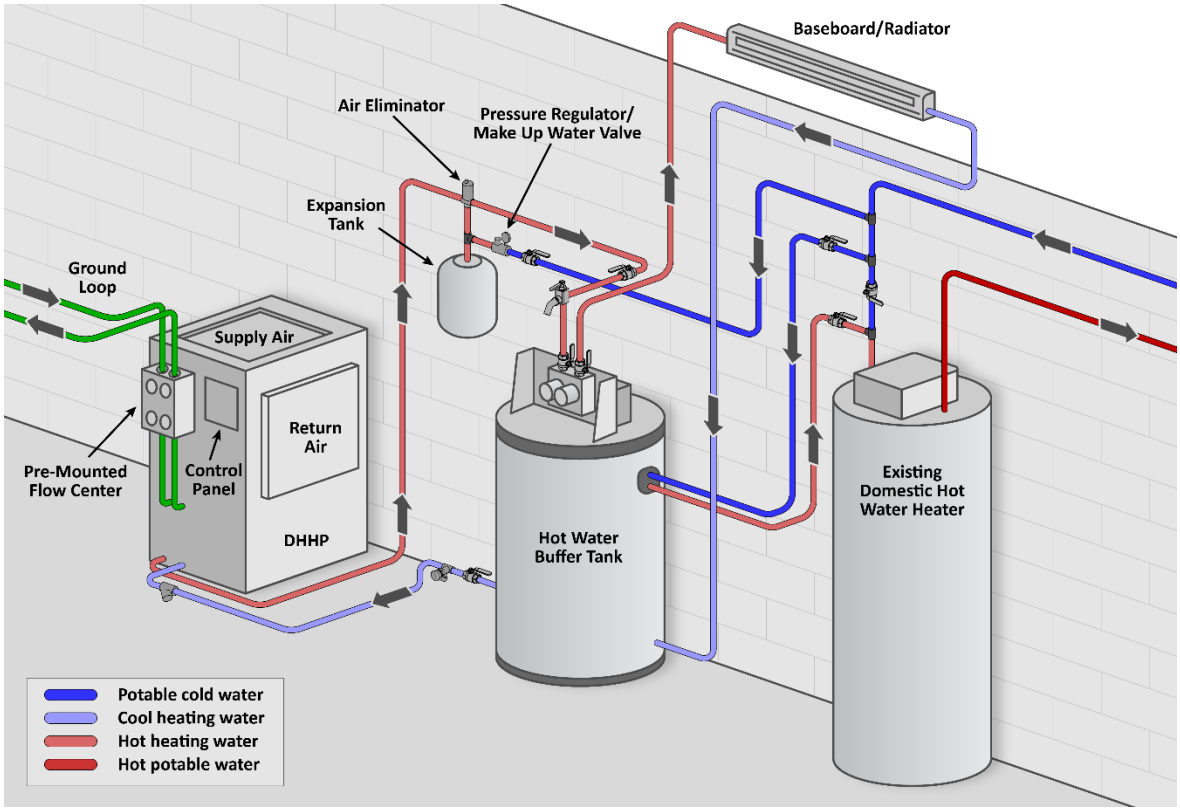


Figure 1: Hybrid Configuration

Performance Ratings

Table 1: Double Hybrid Heat Pump performance ratings

Model	Tons	Capacity Modulation	Ground Loop Flow Rate	CFM	Ground Loop Heat Pump[4]							
					Cooling (Force Air only)[1]		Forced Air Heating[2]		Hybrid Air & Water Heating[3]		Hot Water Only	
					Capacity (BTU/Hr)	EER	Capacity (BTU/Hr)	COP	Capacity (BTU/Hr)	COP	Capacity (BTU/Hr)	COP
36	3	Part	12/11	1200	28,000	27	23,000	4.8	19,600	4.0	17,300	3.4
		Full	12	1400	37,500	17	29,300	4.3	25,000	3.7	22,000	3.2
48	4	Part	14/12	1550	38,500	23	30,800	4.4	26,200	3.8	23,100	3.3
		Full	15	1700	47,500	16.5	38,000	3.9	32,300	3.4	28,500	3.0
60	5	Part	16/14	1700	44,000	20	37,000	3.9	31,500	3.5	27,800	3.2
		Full	18	2100	55,500	15	45,500	3.6	38,700	3.3	34,200	3.1
72	6	Part	17/16	1800	56,000	21.5	46,500	4.2	39,600	3.7	35,000	3.3
		Full	20	2200	69,000	16	56,000	3.8	47,600	3.3	42,000	3.1

[1]Cooling capacities based upon 80.6 °F (27 °C) DB, 66.2 °F (19 °C) WB entering air temperature.
[2]Heating capacities based upon 68°F (20 °C) DB, 59°F (15 °C) WB entering air temperature.
[3]Hybrid Heating Capacity based on 115 °F (56.1 °C) hot water supply, 32 °F/42 °F (0 °C /5.5 °C) ground loop entering water temperature, 68 °F (20 °C) entering air temperature.
[4]All ratings based upon 240V operation.

Table 2: AHRI Ratings

Model	Tons	Capacity Modulation	Ground Loop Flow Rate (cool/heat)	CFM (cool/heat)	Ground Loop Heat Pump[3]			
					Cooling (Force Air only)[1]		Forced Air Heating[2]	
					Capacity (BTU/Hr)	EER	Capacity (BTU/Hr)	COP
36	3	Part	12/11	1200/1150	28,000	27	23,000	4.8
		Full	12	1400/1500	37,500	17	29,300	4.3
48	4	Part	14/12	1550/1500	38,500	23	30,800	4.4
		Full	15	1650/1700	47,500	16.5	38,000	3.9
60	5	Part	16/14	1700/1750	44,000	20	37,000	3.9
		Full	18	2100	55,500	15	45,500	3.6
72	6	Part	17/ 16	1700/2000	56,000	21.5	46,500	4.2
		Full	20	2200	69,000	16	56,000	3.8

[1]Cooling capacities based upon 80.6 °F (27 °C) DB, 66.2 °F (19 °C) WB entering air temperature.
[2]Heating capacities based upon 68°F (20 °C) DB, 59°F (15 °C) WB entering air temperature.
[3] All ratings based upon 240V operation.

Common Acronyms and Measurements

Table 3: Common Acronyms and Measurements

Term	Definition	Term	Definition
BTU/hr	Heating or cooling capacity	EER	Energy Efficient Ratio (Cooling BTU/hr out divided by watts input)
COP	Coefficient of performance (BTU/hr out: BTU/hr in)	GPM	Gallons per minute, water flow
CFM	Cubic feet per minute, airflow	kW	Kilowatt
DHHP	Double Hybrid Heat Pump	V	Volts
DHW	Domestic hot water		

Double Hybrid Heat Pump Description

The Double Hybrid Heat Pump (DHHP) is a plug-and-play geothermal heating system that is designed to be adaptable to a wide variety of existing heating systems, including buildings with hot water radiators, baseboard, radiant floors, forced air, or some combination thereof. During winter operation, it supplies about 80% of its heat as hot water and 20% as hot air. It has automatic controls to help provide the proper amount of heat to the building while optimizing the system for maximum efficiency.

When used as a Hybrid, the unit will automatically maximize the use of the existing hot water heating infrastructure. In general, if an existing building can raise the temperature 5 degrees in 1 hour with their existing boiler during a cold winter day, the building has plenty of capacity. Buildings with undersized heat emitters will receive a higher percentage of their heat from hot air (>20%).

Built into the control panel are ports for an outdoor air sensor that is used for Outdoor Reset Control. This sensor will be used to vary the tank temperature setpoint during the heating season. The temperature range and amount of setback can be adjusted from the control screen.

Figure 2: Double Hybrid Heat Pump (DHHP) with pre-mounted Flow Center

Thermal Buffer Tank Description

Integral to the heat pump is a 65-gallon, hydronic hot water buffer tank (see Figure 3), which is used for thermal storage, thermal buffer, debris removal, hydronic backup heat, and indirect hot water production.

The tank has a 4-inch copper heat exchanger that is used for domestic hot water pre-heat (see Figure 3). It also comes with two 6-kW, 41,000 BTU electric resistance heater elements that can be used for backup heating or used during peak load situations.

The pre-heat coil in the buffer tank can be plumbed to and from the cold-water supply from the existing hot water tank. (See Figure 4) As hot water is used, new water passes through the pre-heat coil and enters the existing hot water tank pre-heated. The performance of the indirect hot water heating coil is provided in Appendix A.

Figure 3: Thermal buffer tank and cut away view

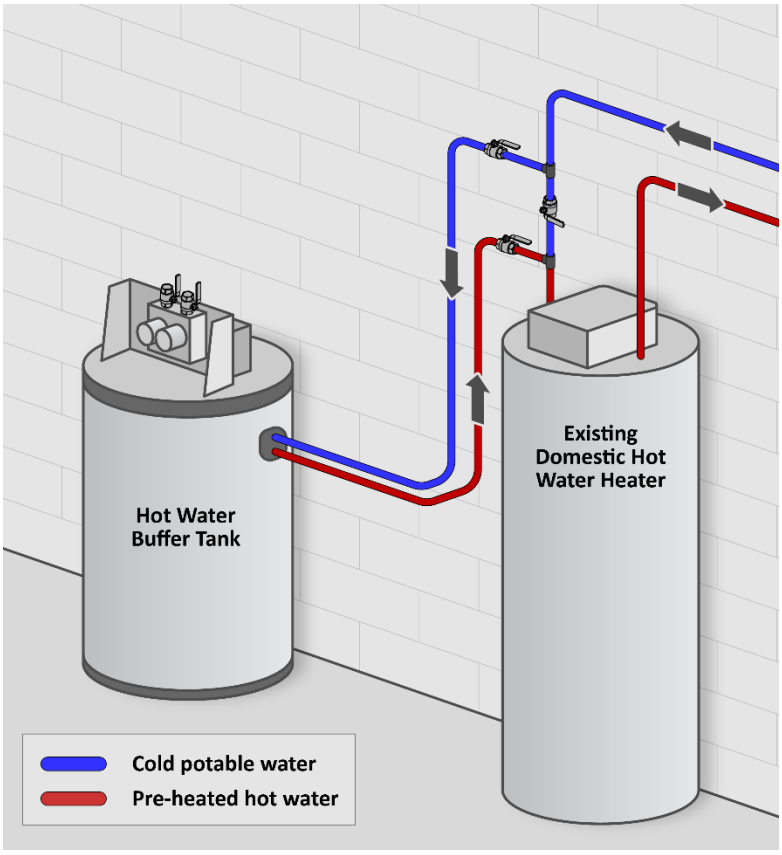


Figure 4: Recommended Domestic Hot Water plumbing arrangement

Modes of Operation

The Double Hybrid is designed to work for a wide variety of types of buildings with two primary modes of heating operation:

1. **Hybrid mode (HY):** operates as a hot water generator that automatically provides supplemental heating by hot air.
   Hot water generator, that also makes supplemental hot air.
2. **Forced Air mode (FA):** operates as a forced air heat pump that will automatically maintain tank temperature for domestic or other hot water uses.
   Hot air generator, that also makes hot water.

Cooling mode and Water-to-Water mode are universal and can be used regardless of which heating mode is selected. There are several options for backup heat, and it is important to select the correct type from the control screen that matches the installation. Free Cooling mode is a site-specific mode that is often used for locations where a large amount of domestic hot water and cooling are required.

Table 4: Selectable Heating Modes

Mode Indicator	Description	Select Heating Mode by	Controlling Parameters
HY	Hybrid mode	Control screen (F10)	Y1, Y2, XX, Tank Temperature (T1)
FA	Forced Air mode	Control screen (F10)	Y1, Y2, XX, Tank Temperature (T1)

Table 4.1: Universal Modes

Mode Indicator	Description	Mode Activated by	Controlling Parameters
C	Cooling mode	Cooling call (O) and Y1 or Y2	Y1, Y2
WW	Water-to-Water mode	Cooling call (O) and an absence of Y1 or Y2	Tank Temperature (T1)

Table 4.2: Backup Heat Modes

Mode Indicator	Description	Select Backup Mode by	Controlling Parameters
EW	Electric Water Heating mode (Same as Hybrid mode except it has turned on backup heat in the buffer tank.)	Control screen (F10)	Y1, Y2, XX, T1
EA	Electric Hot Air mode (Same as Forced Air mode except it has turned on a backup strip heat.)	Control screen (F10)	Y1, Y2, XX, T1
B	Boiler mode (Same as Hybrid mode except it turns the load pump off.)	Control screen (F10)	Y1, Y2, XX, T1

Table 4.3: Site-Specific Modes

Mode Indicator	Description	Select Backup Mode by	Controlling Parameters
FC	Free Cooling mode (Will make chilled air when making hot water if the outside temperature is above a setpoint.)	Control screen (F10)	Outdoor Air Temperature (T8), Tank Temperature (T1)

Table 5: Modes of Operation Signals

Source	Signal	Primary function in Hybrid Mode	Primary Function in Forced Air Mode
Thermostat	Y1	Stage 1 request switch. Turns on Load Pump. Compressor turns on to maintain tank temperature.	Stage 1 request switch. Turns on Compressor and blower to make hot air.
	Y2	Stage 2 request switch. Turns Compressor to stage 2. Automatically makes hot water with supplemental hot air at very low blower speed.	Stage 1 request switch. Turns on Compressor stage 2, blower speed determined by discharge air setpoint.
	O	Cooling/Heating request [1 = cooling, 0 = heating]. Limits operation to cooling (C) or water heating (WW) only.	Cooling/Heating request [1 = cooling, 0 = heating]. Limits operation to cooling (C) or water heating (WW) only.
	E	Electric/Boiler backup request switch [1 = request, 0 = no request]. Activates backup heat and Load Pump if electric hot water backup is selected (default).	Electric/Boiler backup request switch [1 = request, 0 = no request]. Activate backup heat and maintains a minimum blower speed.
Tank Temperature (T1) Sensor	Tank Temperature below setpoint	Turns on Compressor to stage 1. If tank temperature continues to drop, stage 2 will turn on. Blower will turn on very slowly if Y1, Y2, or E signals are also active.	Turns on Compressor to stage 1. If tank temperature continues to drop, stage 2 will turn on. Blower will turn on if Y1, Y2, or E signals are also active.
Zone Control Board	XX	Turns on Load Pump and will run Compressor to maintain tank temperature.	Turns on Load Pump and will run Compressor to maintain tank temperature.

*Ground Loop Pump and Recirculation Pump will automatically turn on whenever the Compressor is on. Respective speeds will modulate automatically.

Hybrid Configuration

Hybrid configuration is often added to existing infrastructure and is the most common configuration. For buildings with existing hot water boilers, we recommend using the DHHP Hybrid configuration.

Figure 5 is an example of that existing infrastructure using a boiler, while Figure 6 shows the same infrastructure with the Heat Pump installed and the Buffer Tank replacing the boiler.

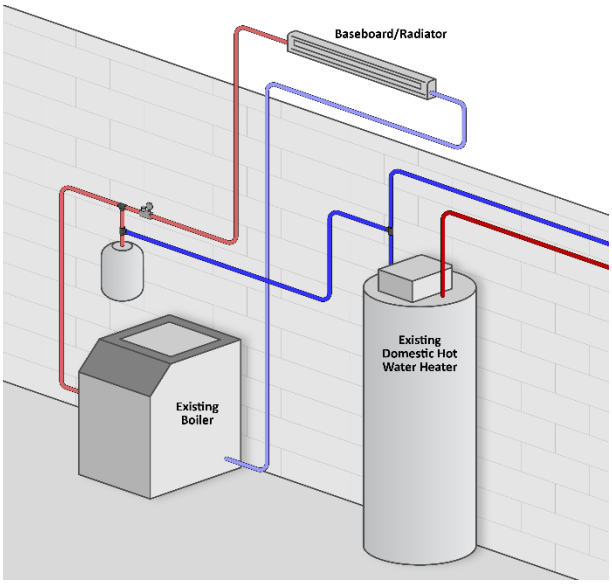


Figure 5: Existing infrastructure before DHHP Hybrid configuration installation

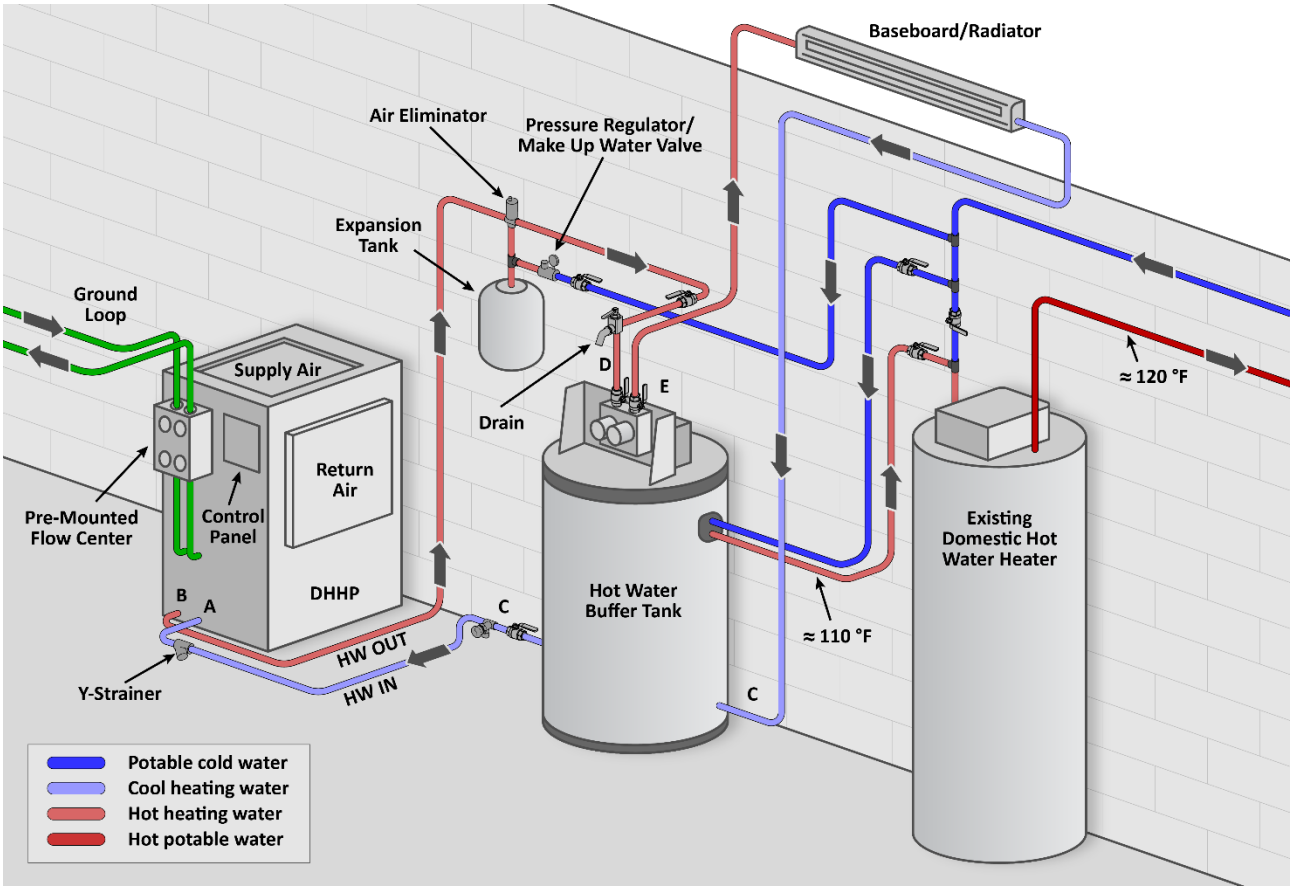


Figure 6: Single-zone Hybrid installation diagram

Hybrid Installation Tips

To properly install the DHHP in a Hybrid configuration, remember the following (see Figure 6):

1. The **HW Out** on the DHHP must always connect into the top of the Buffer Tank **(D)** because the tank temperature is one of several signals that turns the heat pump on and off. See Table 5 for the modes of operation signals.
2. The two ports at the bottom of the Buffer Tank **(C)** are the same and can be inter-changed as needed. One port **C** connects to port **A** and the other connects to the **baseboard/radiator** outlet.
3. The baseboard/radiator inlet connects to the top of the Buffer Tank **(E).**
4. **IMPORTANT: Do not run pumps dry.** The makeup water assembly (expansion tank, pressure regulator, air eliminator) may be in locations other than shown. Regardless, the system must be filled with water and purged of air before operation.
5. Using a pre-mounted pressurized flow center is recommended but not required.
6. Ensure ground loop water is free and clear of all debris.
7. Domestic hot water can be pre-heated by the system, but the system is not intended to be used as the exclusive domestic hot water provider.
8. When producing chilled air, the heat pump will automatically turn off the ground loop pump and reject heat to the buffer tank until it reaches the summer setpoint.
9. If the building contains radiators, they will need to be bled of air after retrofit.
10. Be sure to properly remove air from the system before operating. Drawing water in the opposite direction with a drain and ball valve may help. (See Figure 7.)
11. Refer to Table 6 for minimum duct sizing requirements based on the DHHP model installed.

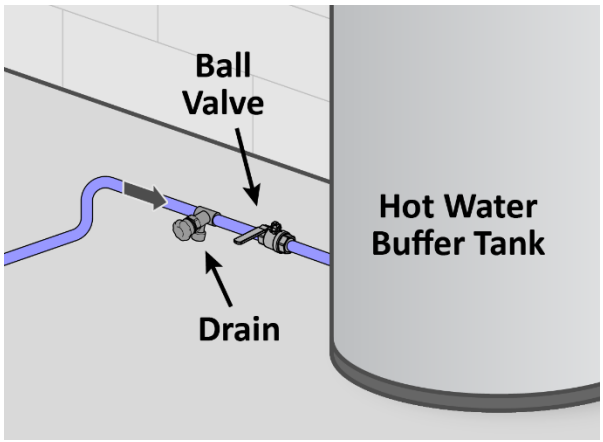


Figure 7: Purge air from the system

Table 6: Minimum duct sizing requirements (CFM) for Hybrid Mode

Model	Tons	Capacity Modulation	Min air volume @ .08" static pressure, for duct sizing (CFM)
36	3	Part	1100
		Full	
48	4	Part	1300
		Full	
60	5	Part	1500
		Full	
72	6	Part	1700
		Full	

Multi-zone Options

If a building has several zones, it may be helpful to have a zone control board. This board does not come with the DHHP system. It may either already be installed as part of the existing heating system or can be purchased separately and installed.

The DHHP is designed to replace a hot water boiler. The DHHP needs to be connected to a main house thermostat, and like a hot water boiler, can accept a signal from an isolated end switch (often designated as X/X). This signal, by default, will be interpreted as a call for hydronic heat. If zoning with circulators, the load pump can be excluded as shown in Figure 8. If zoning with zone valves, the load pump can be used as shown in Figure 9. If a load pump is used, it will activate when the isolated end switch is closed.

In Hybrid Mode, there is a subtle difference between the X/X and Y1 signal. Both will aim to supply hot water to the building, and both will turn the compressor on indirectly by cooling the buffer tank. However, Y1 will also cause the fan to turn on at a very low speed if the compressor is on at the same time as the Y1 signal. By operating the fan at this moment, the system efficiency increases significantly. The X/X signal will not do this because it is assumed that the X/X signal may also be used for other hydronic uses aside from building heating (such as pool heating or snowmelt).

On the second page of the Setup screen (F10), there is an option to make X/X = Y1.

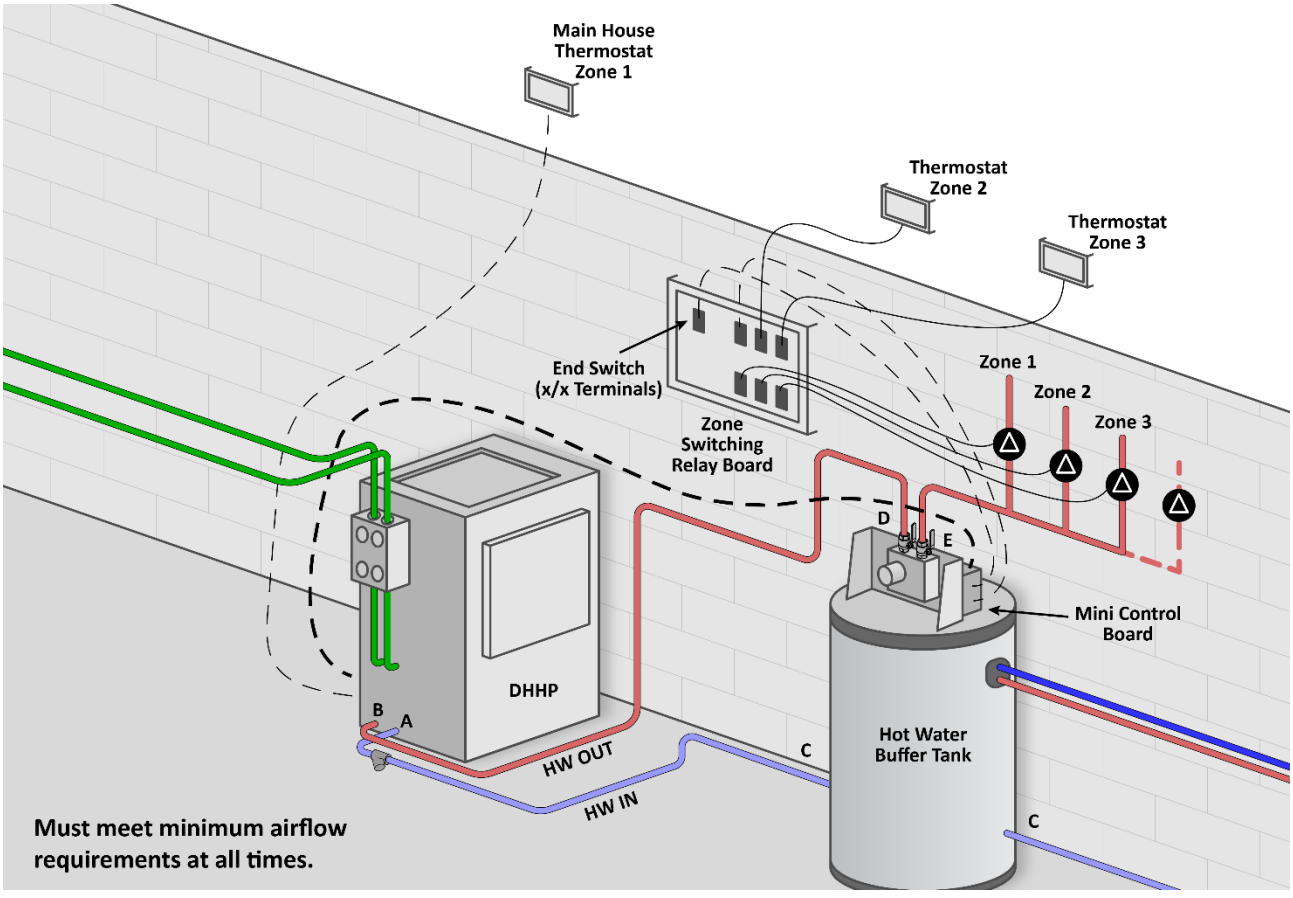


Figure 8: Multi-zone Hybrid configuration with zone pump circulators (Makeup Assembly not shown.)

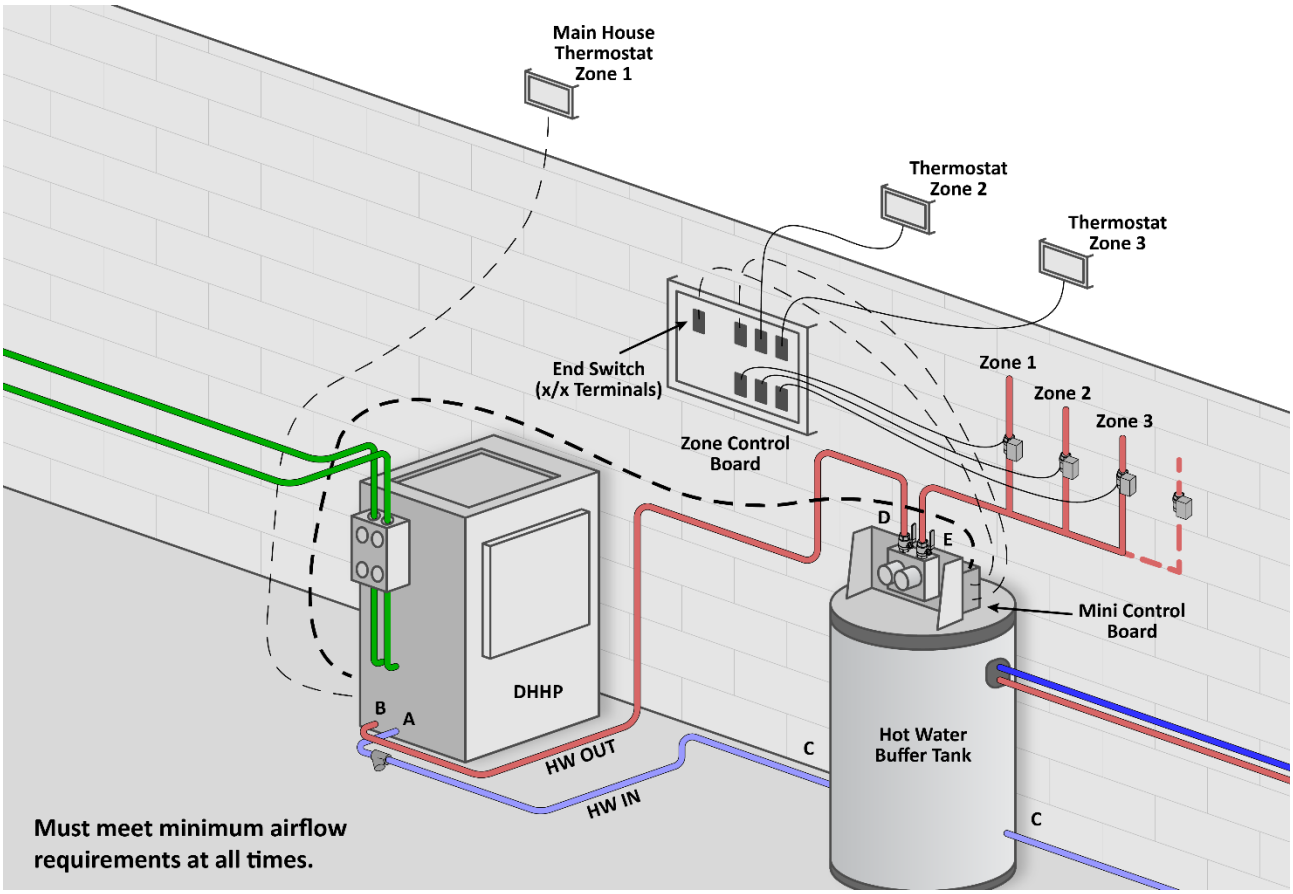


Figure 9: Multi-zone Hybrid configuration with zone valves. (Makeup Assembly not shown.)

Forced Air Configuration

The Forced Air configuration has similar plumbing, but very different operation from a Hybrid configuration. See Table 5 for more information.

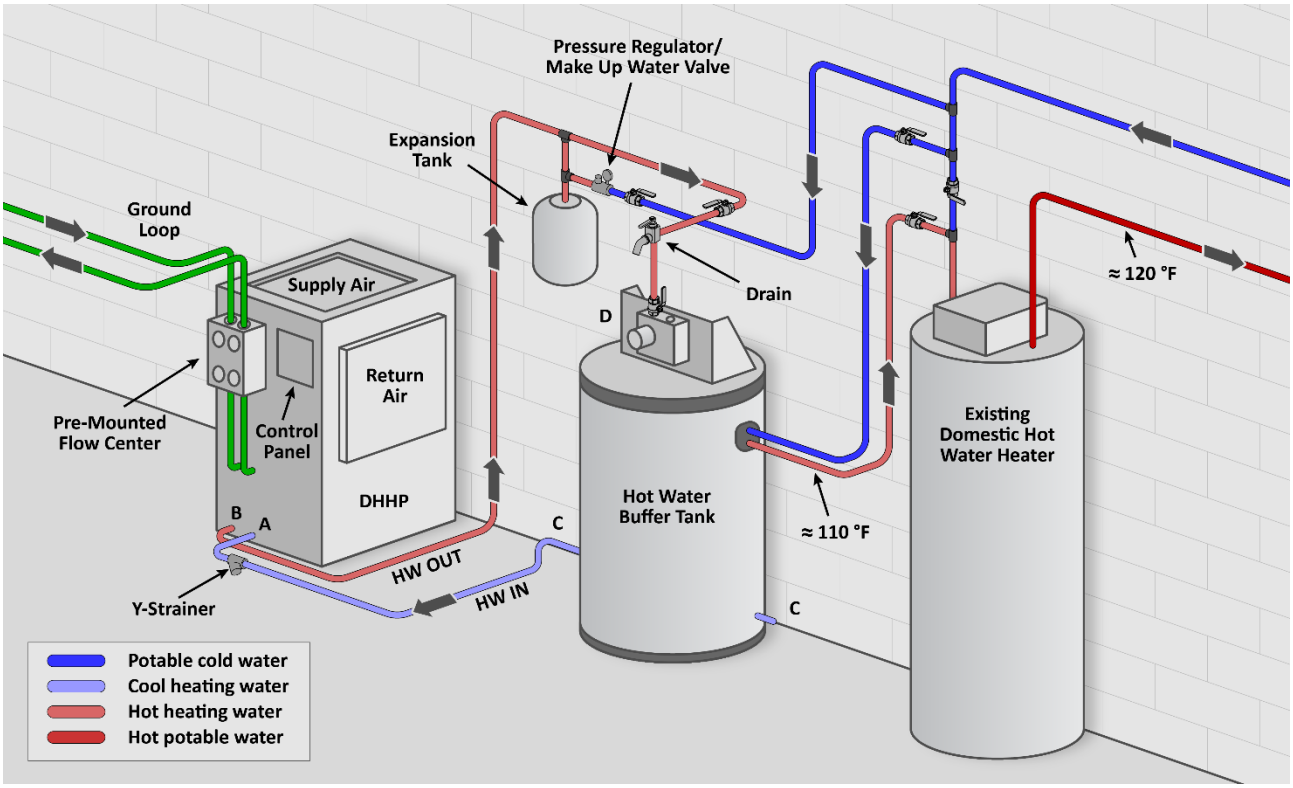


Figure 10: Forced Air Mode Plumbing Diagram

Forced Air Installation Tips

To properly install the DHHP in a Forced Air configuration, remember the following:

1. Ensure proper duct sizing for design airflow at all times. If zone dampers are added, ensure that the smallest zone achieves the required airflow rates (See Table 1).
2. The heat pump will reject heat to the hot water tank while operating in Forced Air heating and cooling modes. It will also maintain tank temperature for domestic hot water pre-heat.
3. The **HW Out** on the DHHP **(B)** must always connect to the top of the Buffer Tank **(D)** because the tank temperature is one of several signals that turns the heat pump on and off. See Table 5 for information on the modes of operation signals.
4. The ports at the bottom of the Buffer Tank **(C)** are the same and can be interchanged as needed. (See Figure 10.) Connect either port **C** to port **A.**
5. **IMORTANT: Do not run pumps dry.** The makeup water assembly (expansion tank, pressure regulator, air eliminator) may be in locations other than shown. Regardless, the system must be filled with water and purged of air before operation.
6. Using a pre-mounted, pressurized flow center is recommended but not required.
7. Ensure ground loop water is free and clear of all debris.

8. Domestic hot water can be pre-heated by the system, but the system is not intended to be used as the exclusive domestic hot water provider.
9. When producing chilled air, the heat pump will automatically turn off the ground loop pump and reject heat to the buffer tank until it reaches setpoint.
10. The heat pump will maintain temperature setpoint in the hot water tank and can produce hot air or chilled air and hot water at the same time.

Pre-Installation Information

Care should be taken to assure that the installation of the unit is successful. Locate the unit where there is adequate ventilation and room for servicing. Units should be placed on a level surface on a vibration–absorbing pad slightly larger than the base of the unit. Care should be taken to use the proper duct size.

Transportation and Storage

IMPORTANT! During transportation, special consideration must be taken to prevent exposing the unit to freezing conditions, as this can damage the unit. If a unit is taken to the job site or put in storage where it can be exposed to freezing conditions, antifreeze will need to be pumped into the water coils to prevent freezing. **Failure to do this will void the warranty.**

When transporting and storing:

- Move and store units in an upright position.
- Do not stack units.
- Inspect shipment for shipping damage. Any equipment or cartons in question should be removed from the packing and physically inspected. If any damage is detected, the carrier should make a note on the delivery slip acknowledging the damage.
- Check the packing slip for accuracy. In some cases, smaller items (such as temperature sensors) will be packed and shipped inside the unit.

Unit Specifications

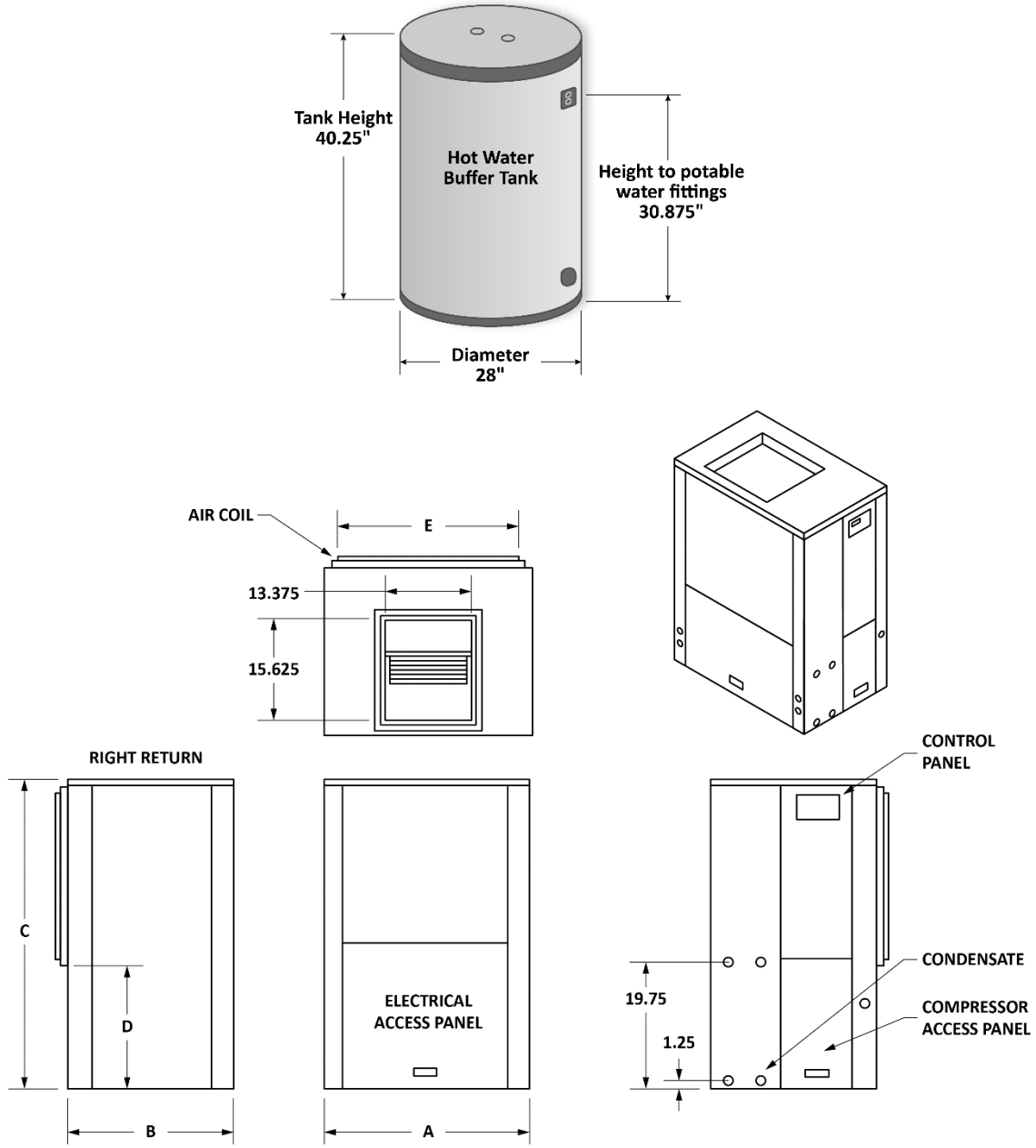


Figure 11: Hot Water Buffer Tank and DHHP unit specifications

Table 7: DHHP unit specifications based on model

Model	A (in.)	B (in.)	C (in.)	Supply Air (W x D) (in.)	Return Air Size (L X W) (in.)	Filter Size (L X W) (in.)	Weight (lb)
36	32	25.75	48	15.625 x 13.375	26 x 28	28 x30	350
48	32	25.75	52	15.625 x 13.375	30 x 28	32 x30	380
60	32	25.75	56	15.625 x 13.375	36 x 30	36 x30	420
72	32	25.75	56	15.625 x 13.375	36 x 30	36 x30	430

Unit Location Considerations

CAUTION: Do not locate the unit in an area that is subject to freezing.

- Locate the unit in an indoor area that allows for easy servicing.
- Make sure that the air filter access and electrical access panels are easily accessible (See Figure 11.)
- Provide sufficient room to make all ground loop, well water, domestic hot water, condensate, and electrical connections as needed.
- A condensate pump will be needed for any system that uses cooling. The pump takes the condensate to a suitable drain location.
- If the unit is placed in a closet, make provision for adequate service access and proper return air flow to the unit.

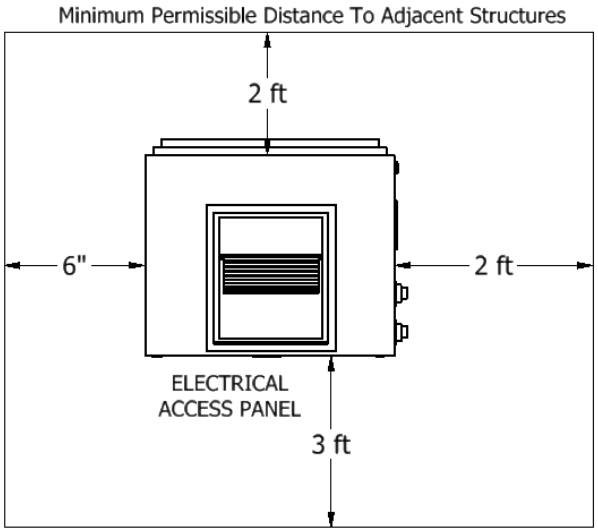


Figure 12: Top view with external clearances to unit.

Air Filtering

To maintain good indoor air quality in a tight building, the air distribution system should have a high-efficiency air filter. To ensure proper unit operation, be sure to inform the building owner of the importance of proper maintenance and the maintenance schedule for checking/changing the filter installed. Most air filters require quarterly attention.

Construction or Remodeling

CAUTION: The unit should NEVER be run during any kind of construction or remodeling that would allow drywall, hard wood, or any kind of dust to be pulled into the system. Running the system during construction or remodeling will void the system warranty. Never operate without an air filter.

Even with extra filtering dust particles can accumulate in the duct system causing unwanted dust for years to come. It can also cause air coil clogging, condensate drain clogging, blower dust accumulation, and many other problems to the system.

If installing this system in a building that is under construction, cover the unit with a plastic bag until the project is complete, especially the air inlet and outlet.

Water Quality Information

Energy Catalyst units use stainless-steel, brazed-plate heat exchangers which have an increased resistance to ground water chemicals, but are still susceptible to fouling and scale. Ensure that all water has been filtered and softened. If needed, install a carbon filter between the loop and the house.

In addition, we strongly recommend using non-ferrous materials, such as plastic, HDPE, copper, or brass when connecting the ground loop to the heat pump. Materials like galvanized iron or black iron will rust over time, and the dissimilar metals could cause a cathodic reaction over time.

Condensate Drain Considerations

Make provisions for a condensate drain connection. Some installations require a condensate pump to take the condensate to a

suitable drain. A condensate pump will be needed for any system that uses cooling.

All Energy Catalyst vertical units have P-traps built internally in the units (see Figure 13). These units require a vent to be installed downstream and outside of the unit. Installation of a second P-Trap is not necessary and if installed, will not allow the unit's condensate pan to drain properly. Excess condensate may trigger the condensate alarm and turn off the unit.

Figure 13: P-trap preinstalled inside the unit

Installation

System Noise and Vibration Isolation

A quality installation should be one where noise is not a complaint. The following are recommendations to achieve a quality install.

Flexible Hose Kit

Installing flexible hose kits to the hot water loop will make for an easy connection to the heat pump and the hot water tank. It will also reduce any noise being transmitted from the heat pump to the indoor plumbing.

Vibration-Absorbing Pad

We recommend that the heat pump and all associated water pumps be installed on a vibration-absorbing pad to isolate the heat pump from a the hard surface floor. This pad will help stop the possibility of the cabinet being rusted out by trapped moisture under the unit.

Basement Installation Recommendations

If installing the heat pump in a basement, we recommend placing the heat pump and tank on blocks (2–4 inches) to give the system some protection against a minor flood. With a vibration dampening pad and blocks, the unit will be approximately 3–6 inches above the floor.

Flexible Duct Connections

Flexible duct connections help to eliminate noise being transmitted from the heat pump through the metal ductwork. This collar also makes the connection of the heat pump to the ductwork a much simpler task.

Closed Loop Systems Plumbing

IMPORTANT! DO NOT use PVC or CPVC piping in any connections to your Energy Catalyst unit. The only exception where PVC or CPVC piping may be used is on the condensate lines.

Do not use ferrous metals in the ground loop piping. These include black iron and galvanized pipe and couplings. These will corrode over time and will foul the heat exchanger.

Min and Max temperatures and pressures:

- Max ground loop operating temperatures: 95 °F (35 °C)
- Min ground loop operating temperatures: 22 °F (-5 °C)
- Max ground loop operating pressures: 100 PSI
- Min ground loop operating pressures: 0 PSI

Closed loop systems will require a minimum of 2.5 G.P.M. per ton and should be designed to maintain a loop temperature above 32 °F (0 °C) and below 90 °F (32 °C). We strongly recommend designing for 3–3.5 G.P.M. per ton. We strongly recommend using a variable speed ground loop circulator as it will automatically adjust flowrate to optimize the system performance.

IMPORTANT! Anti-freeze solutions will impart a higher pressure drop when the temperature of the solution decreases. DO NOT forget to account for this when calculating pumping requirements.

On residential units, a pump is typically required for each unit. The loop pump requirement will depend upon the loop design for a given application. The ground loop piping system must provide suitable access for purging the outside loop and require isolation valves for purging the inside plumbing, including the unit. (See *Purge a Closed Loop System* for purging information.)

Purge a Closed Loop System

Purging of the closed loop and unit should be performed after it has passed the air pressure check.

Purging requires a high velocity pump (flush cart) to purge air and dirt particles from the loop itself. (See Figure 14.) Purging should only be done by a qualified installer.

To properly purge a closed loop system, a minimum velocity of 2 feet per second in every branch of the ground loop must be achieved. The purge ports can also be used for anti-freeze charging.

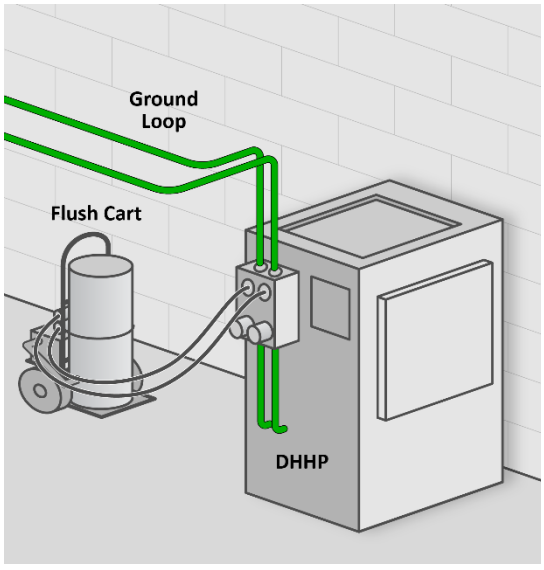


Figure 14: Typical ground loop flushing

Anti-freeze

Anti-freeze should be added for all systems that have a design temperature below 50 °F (10 °C). All Energy Catalyst heat pumps use oversized, brazed-plate heat exchangers that are sensitive to failure by freezing. Placing a unit in an attic or any other cold location without anti-freeze could cause the heat exchanger to freeze when the unit is off. Ensure the anti-freeze solution is well mixed.

IMPORTANT! Units that utilize ground loops must maintain a minimum anti-freeze solution at all times.

IMPORTANT! All Energy Catalyst heat pumps use brazed-plate exchangers that are sensitive to freezing. Failure to use minimum anti-freeze solutions will cause severe damage to the unit. Damage to the unit caused by the failure to maintain proper anti-freeze levels is not covered under the warranty.

Minimum Anti-freeze Solutions (by mass):

- 15% Methanol
- 25% Propylene Glycol
- 25% Ethanol
- 12.5% Methanol and 5% Glycol
- 12.5% Methanol and 5% Ethanol

The anti-freeze solution is added to the system through the flush cart.

IMPORTANT! The Double Hybrid Heat Pump system is not intended for use with an open loop system. Using the DHHP with an open loop system will automatically void the warranty.

If using an open loop system, use an intermediary heat exchanger and connect one side to the unit with an anti-freeze solution.

Install the Ductwork

Caution: Observe the location where your ductwork is being attached to the unit. Ensure that drilling and screws do not penetrate and damage the air coil.

IMPORTANT!

- Always check register CFM requirements against register manufacturer's data for register performance.
- It is extremely important to ensure that duct system return air is not undersized. Undersized return air can cause poor system performance and, in some cases, can cause the blower to "pulse".
- Provide adequately sized supply air plenums and ductwork.
- Make all turns as smooth as possible avoiding any restrictions.
- For residential design, the target static pressure should not be greater than 0.08 inches.
- In many areas in the northeast, code requires that ductwork must be insulated with R-8 insulation. Always install ductwork to local, state, and federal guidelines.

Ductwork should be designed to handle the CFM delivery for the unit while running in high speed. Manufacturer's recommendations for a supply duct are .08 inches of static on the supply and return ducts.

In the USA, ductwork sizing methods should follow Air Conditioning Contractors of America (ACCA) *Manual D* recommendations. Install ductwork within the conditioned space of the building to minimize duct heat loss or gain, wherever possible.

Installing Ductwork in an Attic Area

IMPORTANT! If ductwork is installed in an attic area, the ductwork needs to be built low profile and laid directly on the ceiling joist (code permitting).

After being installed and wrapped in insulation, it is recommended the ductwork be covered with six-to-eight inches of cellulose. If the attic ductwork is not covered with cellulose, it can lose a significant amount of its heating and cooling capacity into the attic area! Ductwork that is inadequately insulated will cause poor system performance and customer dissatisfaction.

Installing in Heating Dominant Climates

For homes in heating dominant climates, where full load cooling is not necessary, installers may opt to select the **Limit the Cooling to First Stage Only** setting on the control panel. (See page 24 for information on how to use the control panel.) Limiting the compressor stage only when cooling will allow the installer to reduce the duct size requirements without reducing comfort in the home.

Install the Plumbing

The DHHP will include a pre-mounted, pre-plumbed, and pre-wired Flow Center to circulate water from the unit to the ground loop. (See Figure 15.) This Flow Center allows a contractor to plumb supply and return lines directly to the unit without needing to mount an external circulator nearby.

See Figure 6 for additional information regarding plumbing in Hybrid configuration. See Figure 10 for additional information regarding plumbing in Forced Air configuration.

Figure 15: Heat Pump with flow center

Install Condensation Piping

The condensate drain should be piped to a drain or condensate pump. The unit has an internal P-trap and can be direct piped. (See Figure 13.)

Electrical Connections

Size all wire in accordance with local electrical code. Connect the incoming line voltage wires to L1 and L2 of the contactor. (See Figure 16 and Figure 17.) A green ground lug will also be provided for the ground wire.

Based on the heat pump size and the current draw, install either 10-, 8-, or 6-gauge wire bundles through the pre-slotted ¾-inch access points. Secure the wires to the unit with non-metallic connectors. See

for electrical requirements.

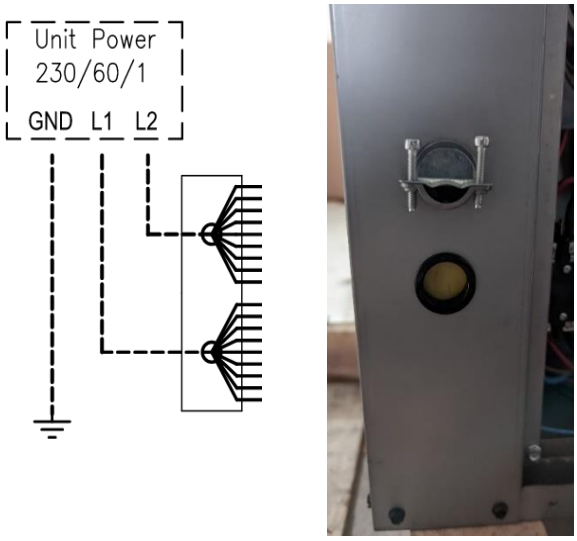


Figure 16: Main High Voltage wiring installation location on Heat Pump

Figure 17: Electrical Main Outlets

Table 8: Electrical Requirements

HP Model	Wire Size (Gauge)	Heat Pump Breaker Size	Pump Fuse Sizes	Backup Heat Breaker Size (12 kW)	Backup Heat Breaker Size (6 kW)
36	10-2	30 A	10 A	70 A	40 A
48	8-2	40 A	10 A	70 A	40 A
60	8-2	40 A	10 A	70 A	40 A
72	6-2	55 A	10 A	70 A	40 A

Control System

The Control system is based on the Simatic family programmable logic controller (PLC).

For communication with the temperature sensors, a 3rd party Modbus TCP I/O is used. The system is not compatible for connectivity through Modbus with outside devices.

Sequence of Operations

There are a total of 11 temperature sensors throughout the system. See Figure 18 and Table 9 for information on sensor locations and function.

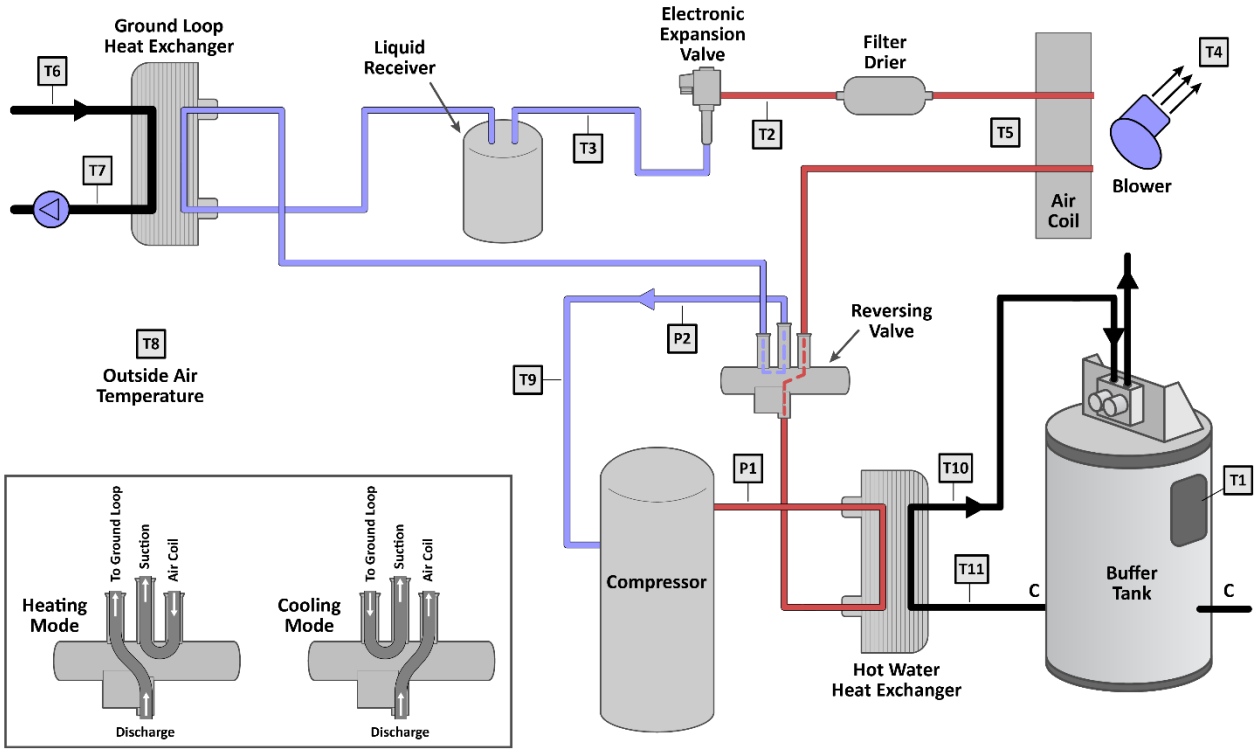


Figure 18: Temperature sensor locations

Table 9: How sensors in system are used

Name	Description	How the Sensor is Used	Included in DHHP Package
T1	Tank temperature [°F]	T1 is used to compare the tank temperature to the tank temperature set point. In most modes, if T1 is below set point, it will turn on the compressor.	Yes
T2	Heating sub temperature [°F]	Service technician parameter.	Yes
T3	Cooling sub temperature [°F]	Service technician parameter.	Yes
T4	Supply air temperature [°F]	Supply air temperature (SAT) is used to adjust the speed of the blower in while producing forced air.	Yes
T5	Return air temperature [°F]	Return air temperature (RAT) is used to compare for measuring differential temperature across the air coil.	Yes

T6	Ground loop inlet temperature [°F]	Ground loop (GL) inlet temperature is used for safety cutouts and for service technicians to determine performance.	Yes
T7	Ground loop outlet temperature [°F]	Ground loop (GL) outlet temperature is used for safety cutouts and for service technicians to determine performance.	Yes
T8	Outside air temperature [°F]	T8 is used to adjust the tank temperature set point to improve efficiency during mild weather conditions. On a mild winter day, the tank temperature set point is decreased. As it gets colder outside, the tank temperature set point increases. (Also known as a hot water reset parameter. See Figure 30.)	Yes
T9	Compressor CP1 suction temperature [°F]	Service technician parameter.	Yes
T10	Hot water supply temperature [°F]	Hot water supply (HWS) temperature is used for a high temperature cutoff, for performance verification, and will raise the fan speed if the building is calling for heat beyond the maximum temperature range of the heat pump.	Yes
T11	Hot water return temperature [°F]	Hot water return (HWR) temperature is used for a high temperature cutoff, for performance verification, and will raise the fan speed if the building is calling for heat beyond the maximum temperature range of the heat pump.	Yes
P1	Condensing pressure	Displays the discharge pressure and will cut off if the pressure gets too high. Useful for service technicians.	Yes
P2	Evaporating pressure	Displays the suction pressure and will cut off if the pressure gets too high. Useful for service technicians.	Yes

NOTE: The Set Point will not cause an action until it reaches hysteresis.

System Wiring

The Double Hybrid Heat Pump is designed to reuse the control wiring often found with boiler systems. For hot water systems that have zones, an isolated end switch from the zone control board will tell a boiler when any zone is calling for heat. The DHHP can accept this same signal (called an X/X signal), and if a thermostat is rewired to go the heat pump instead of the zone control board, the DHHP has an output signal that can replace the thermostat wires on the zone control board. See Figure 19 and Figure 20.

NOTE: If the home has several zones that all have two-wire thermostats, installers may benefit from using a Tekmar 564W, or equivalent, which can reuse the two wires but provide a multitude of signal outputs.

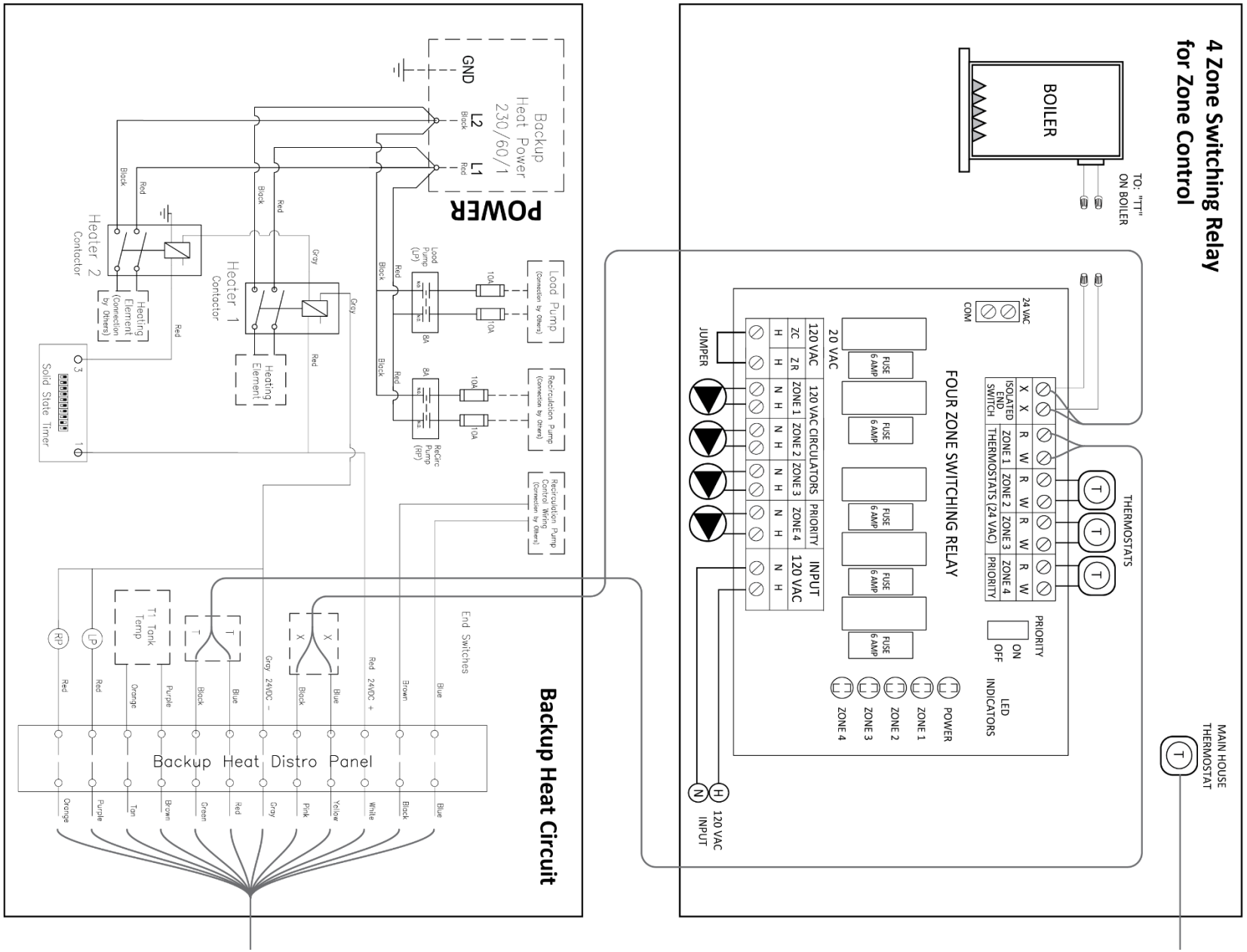


Figure 19: Backup Heat Panel (left) and Zone Switching Relay Panel (right) connect to Main Control Panel (on next page)

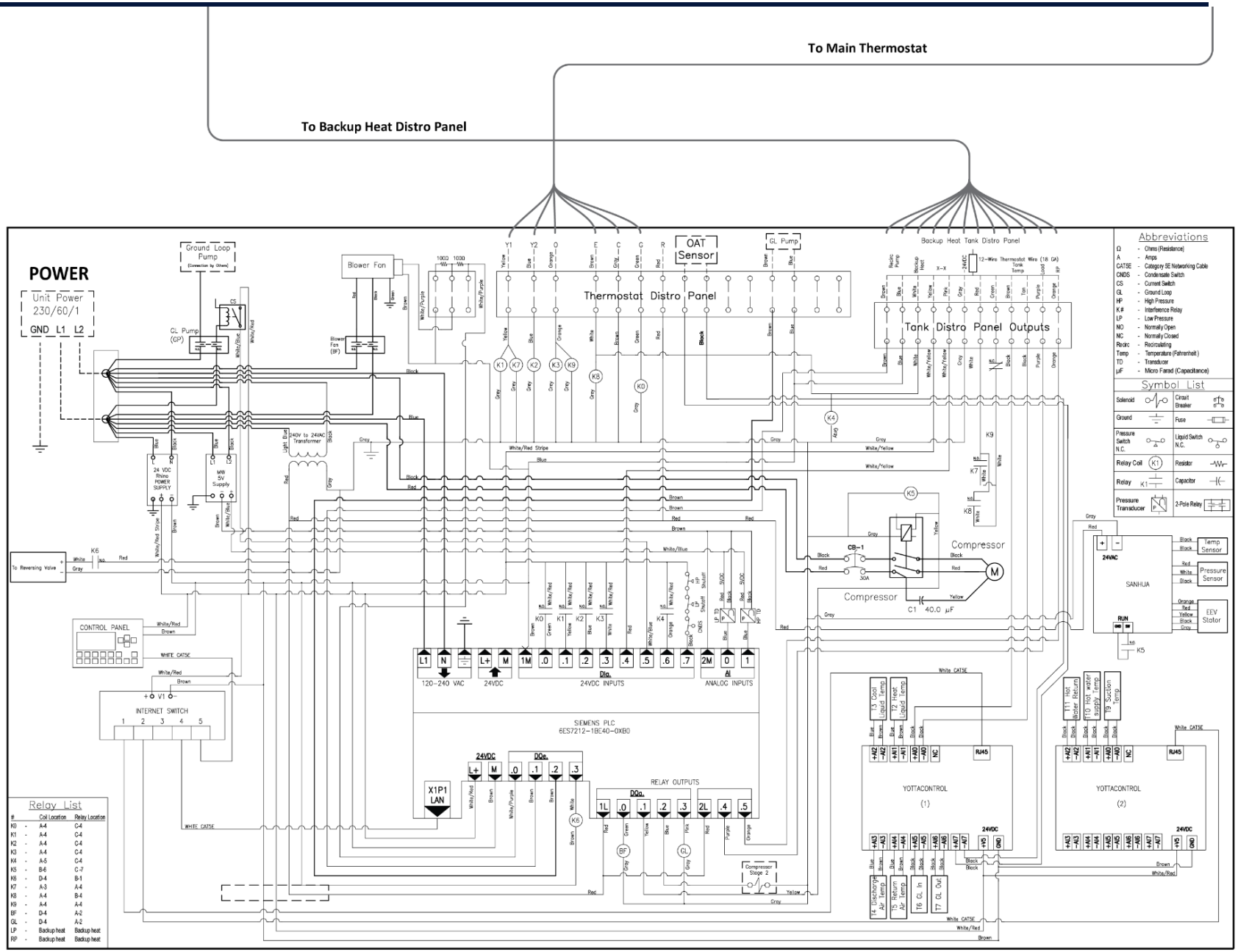


Figure 20: Main Control Panel wiring diagram

Hybrid Mode

For buildings with existing hot water boilers, we recommend using Hybrid Mode. In Hybrid Mode, the system will assume that the primary means of heating will be hot water, with a hot air supplement.

A call for heat (Y1) will turn on a load pump (if used) that will push hot water into the building, and the compressor will turn on as needed to maintain the tank temperature setpoint. A forced air supplement will turn on automatically for a Y2 call, or when there is a Y1 call and the compressor is on.

Table 10: Hybrid Heating Mode control sequence

Thermostat Call				**Tank Temperature**	**Hydronic Call?**	**Heat Pump Reaction**						**Result**
Y1	Y2	O	E	Below setpoint + hysteresis	Isolated end switch (X/X)	Comp stg 1	Comp stg 2	GL	RP	LP	Blower	
No	No	No	No	Yes	No	Yes	No	Yes	Yes	No	No	Raises tank temp if below setpoint
Yes	No	No	No	No	No	No	No	No	No	Yes	No	Y1 turns on load pump
Yes	No	No	No	Yes	No	Yes	varies	Yes	Yes	Yes	Yes	Y1+ tank temp turn on comp and blower
Yes	Yes	No	No	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Y2+ tank temp turn on comp and blower
No	Yes	No	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Y2 holds comp and blower on
No	No	No	No	No	Yes	No	No	No	No	Yes	No	X/X is used to call for hydronic heating
No	No	No	No	Yes	Yes	Yes	varies	Yes	Yes	Yes	No	X/X + tank temp turn on comp
Yes	Yes	No	Yes	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Heat pump will try to avoid high temperature cutout by running fan and backup heat at the same time.
No	No	Yes	No	No	No	No	No	No	No	No	No	Heat pump is now expecting to make either hot water or chilled air. Reversing valve will not engage until Y call.

Yes	No	Yes	No	No	No	Yes	No	Yes	Yes	No	Yes	First stage cooling. Heat rejected to ground loop.
Yes	No	Yes	No	Yes	No	Yes	No	No	Yes	No	Yes	First stage cooling. Heat rejected to buffer tank until setpoint is reached. Ground loop off.

The Hybrid Mode heating control sequence details are as follows:

1. A call for heat (Y1, Y2, X/X, or E) will turn on the hot water supply circulator, providing hot water to the building. A Y2 call will turn on the compressor immediately, but a Y1 or X/X will wait until the tank temperature is below the setpoint to turn the compressor on. X/X is a signal from a zone control end switch or dry contact that can be used to indicate a call for heat from multiple zones.
2. With a call for heat, the compressor will automatically modulate between stage 1 and stage 2 to maintain tank temperature.
3. When the compressor is on and the building is calling for heat, the fan will modulate to provide supplemental heat. Under most cases, it operates at 30% of its maximum speed and about 80% of the heat will still be supplied through hot water.
4. The heat pump will continue to run until there are no more calls for heat. If at any time, Tank Temperature Max1, Hot Water Supply Max 1, or the Hot Water Return Max 1 are exceeded (values are changeable from the control panel), the heat pump will automatically shift its output towards forced air to protect the heat pump without leaving the home without heat.

NOTE: It's important to properly define the Maximum Alarm set point parameters. (See *Alarm* Screens for more information.)

When the Double Hybrid Heat Pump is configured as a Hybrid, the duct sizing can be significantly reduced. (See Table 6.) The forced air volume when heating in Hybrid Mode is typically around 30% of the CFM in Forced Air Mode. The limiting factor, therefore, becomes the minimum required CFM when cooling. On page 2 of the Setup Screen, cooling can be limited to stage 1 only, which reduces the duct size requirements on the system. In most homes in heating dominant areas, stage 1 cooling is suitable to cool the entire building.

Forced Air Mode

By contrast, in Forced Air Mode, the system will assume that the primary means of heating will be hot air. A call for heat (Y1 or Y2) will turn on the compressor and fan to blow hot air into the building. In Forced Air Mode, the compressor will automatically turn on as needed to maintain the tank temperature setpoint.

Table 11: Forced Air Mode control sequence

Thermostat Call				**Tank Temperature**	**Hydronic Call?**	**Heat Pump Reaction**				**Result**		
Y1	Y2	O	E	Below setpoint + hysteresis	Isolated end switch (X/X)	Comp stg 1	Comp stg 2	GL	RP	LP	Blower	
No	No	No	No	Yes	No	Yes	No	Yes	Yes	No	No	Raises tank temp if below setpoint
Yes	No	No	No	No	No	Yes	No	Yes	Yes	Yes	Yes	Y1 turns heat pump to stage 1 forced air heating
Yes	No	No	No	Yes	No	Yes	varies	Yes	Yes	No	Yes	Y1+ tank temp raises the speed of the Recirculation Pump (RP)
Yes	Yes	No	No	No	No	Yes	Yes	Yes	Yes	No	Yes	Y2+ tank temp turn on comp and blower
No	No	No	No	No	Yes	No	No	No	No	Yes	No	X/X is used to call for hydronic heating
No	No	No	No	Yes	Yes	Yes	varies	Yes	Yes	Yes	No	Heat pump will make hot water only, turning on as needed to maintain tank temperature
No	No	Yes	No	No	No	No	No	No	No	No	No	Heat pump is now expecting to make either hot water or chilled air. Reversing valve will not engage until Y call.
Yes	No	Yes	No	No	No	Yes	No	Yes	Yes	No	Yes	First stage cooling. Heat rejected to ground loop
Yes	No	Yes	No	Yes	No	Yes	No	No	Yes	No	Yes	First stage cooling. Heat rejected to buffer tank until setpoint is reached. Ground loop off.

NOTE: In Forced Air mode, backup heat is provided by an electric resistance element on the top of the blower. This element will heat the air as it is being blown into the building.

NOTE: It's important to properly define the Maximum Alarm set point parameters. (See *Alarm* Screens for more information.)

Backup Heat

There are two methods for providing backup heat:

1. Backup heat inside the heat pump unit.
2. Backup heat on the buffer tank.

The wiring for these two methods is different.

In most areas, electrical code requires 1.25 times the wire capacity as the backup power nominal draw. For instance, a backup element that uses 25 amps will need to use a wire capable of at least 31.25 amps and a 40-amp circuit breaker.

Electrical Panel with Backup Heat Inside Unit

In Forced Air models, the contactor for the backup heat will be inside the heat pump.

There will be two sets of power distribution blocks, one for the heat pump and one for the backup heat. Using wire from a second circuit breaker, connect power to the backup heat power blocks.

Backup Heat on Buffer Tank

IMPORTANT!
The buffer tank has two 6-kW, 41,000 BTU electric heating elements pre-installed for backup heat.

Each 6-kW heating element has a pair of pre-installed wires that go to a 4 x 4 electrical box on the side of the buffer tank. (Red and black to the top heating element, and blue and yellow to the bottom heating element.) To utilize both backup heating elements, run two 30-amp, 240VAC wires from the mini control board to the associated heating element wires and junction inside the electrical box. See Figure 21.

NOTE: If you only want to use one backup heat element, a 40-amp wire to the mini control board is sufficient.

NOTE: If you do not want to use either backup heat element, a 15-amp wire is sufficient.

For safety, each wire that goes into the buffer tank goes through a high temperature shut-off switch before going to the heating element.

The buffer tank has a separate power supply from the DHHP. This ensures that the electric heating elements in the buffer tank continue to work in the event of a heat pump failure.

In the configuration settings of the unit, you can select either:

- Boiler backup
- Electric hot water backup

If you select boiler backup, the pump on the boiler will be used to pump backup hot water into the building and the electric heating elements in the buffer tank will not be used. If you select electric hot water backup, the system will use the electric elements in the buffer tank to pump hot water from the tank into the building.

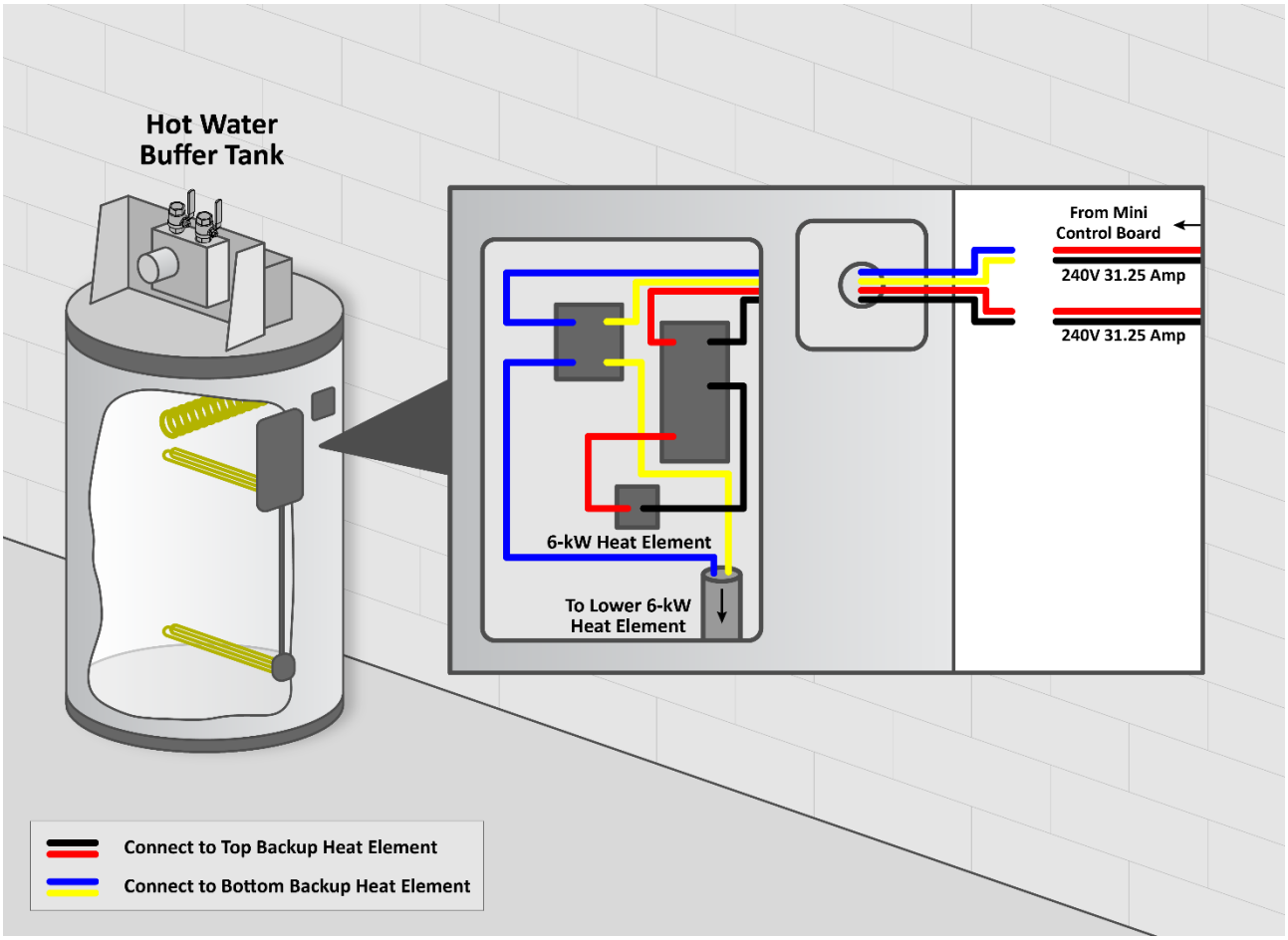


Figure 21: Backup heat wiring on buffer tank

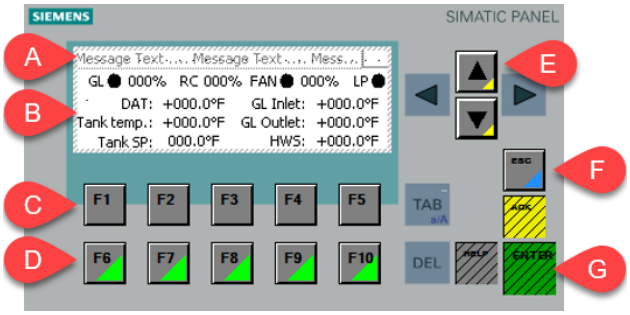
Control Panel and Screens

Control Panel Layout

Application screens are organized so they enable the user to easily access any screen. Using the fixed menu buttons (F6 – F10), the most important screens are easy to access.

Fixed Menu Button	Resulting Screen
F6	Parameters screen
F7	Devices screen
F8	Measurements screen
F9	Alarms screen
F10	Setup screen

See the image below and callout table for a description of the control panel layout and function.



Callout	Description
A	Message line: contains alarm messages. The right side of the message line displays the mode indicator (HY, FA, C, FC, EW, EA, B, or WW)
B	Variable data depending on the selected screen
C	Variable function buttons: accesses the associated option or submenu, depending on the selected screen
D	Fixed menu buttons: provide direct access to a screen
E	Up/Down arrows
F	Escape key: press to delete the input, double-press to go to the Home screen
G	Enter key: press to accept the input

Password Levels

When making a change to any setting on the control panel, you will be prompted to enter a password. The password stays active for about 60 minutes, unless you cycle the power.

- Level 1 password: ADG
- Level 2 password: ECT

NOTE: Only a qualified technician should use the level 2 password.

Start/Home Screens

When the application starts, the Home screen appears.

NOTE: Double press the **Escape** button at any time to come back to the Home screen.

On the Home screen, a number of statuses are shown allowing the operator to perform basic monitoring of the system.

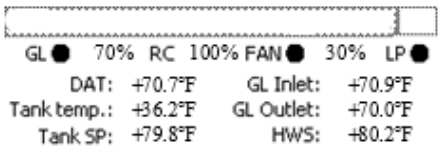


Figure 22: Home screen

Meaning of the statuses/measurements:

Status/ Measurement	Meaning
●	Black indicator means the signal is active (relay is closed); White indicator mean the signal is inactive (relay is open)
GL	C2 (ground loop pump) status and operating speed
RC	C3 (recirculation pump) operating speed
FAN	M1 (motor fan) status and operating speed
LP	C1 (load pump) status and operating speed
DAT	T4 (supply air) temperature
GL Inlet	T6 (ground loop inlet) temperature (into heat exchanger)

Tank temp	T1 (tank) temperature
GL Outlet	T7 (ground loop outlet) temperature (from heat exchanger)
Tank SP	Tank temperature setpoint
HWS	T10 (hot water supply) temperature

Pressing the **Up/Down** arrows on the Home screen, opens the submenu with the Efficiency screen. Pressing the F1 – F5 functional buttons opens the associated Efficiency screen.

Button	Meaning
SH	Opens the Superheating (SH) screen
Subcool	Opens the Subcooling (Subcool) screen
DeltaT	Opens DeltaT screen
%Eff	Opens the Efficiency (%Eff) screen
Setup	Opens the Setup screen

Superheat Screen

Pressing **F1** from the submenu opens the Superheat screen and the relevant measurements display.

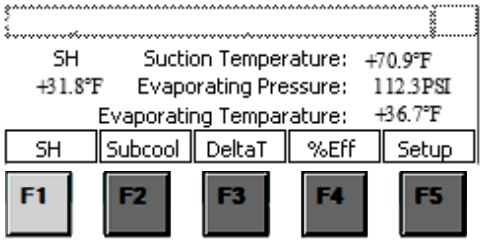


Figure 23: Superheat screen

Meaning of the Superheat screen measurements:

Measurement	Meaning
SH	Superheat value
Suction Temperature	T9 (compressor CP1 suction temperature)
Evaporating Pressure	P2 (suction pressure)
Evaporating Temperature	P2 (suction pressure) converted to temperature

Subcool Screen

Pressing **F2** from the submenu opens the Subcool screen and the relevant measurements display.

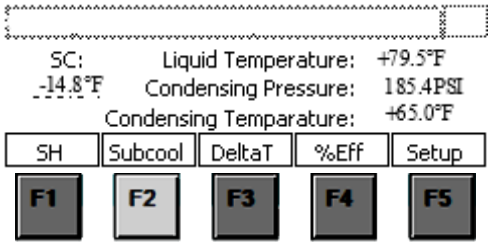


Figure 24: Subcool screen

Meaning of the Subcool screen measurements:

Measurement	Meaning
SC	Subcool value
Liquid Temperature	T2 (heating sub temperature)
Condensing Pressure	P1 (discharge pressure)
Condensing Temperature	P1 (discharge pressure) converted to temperature

DeltaT Screen

Pressing **F3** from the submenu opens the DeltaT screen and the relevant measurements display.

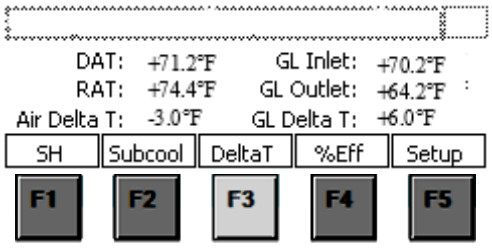


Figure 25: DeltaT screen

Meaning of the DeltaT screen measurements:

Measurement	Meaning
DAT	T4 (supply air) temperature
RAT	T5 (return air) temperature
GL Inlet	T6 (ground loop inlet) temperature (into heat exchanger)
GL Outlet	T7 (ground loop outlet) temperature (from heat exchanger)
Air DeltaT	T4 minus T5 temperature
GL DeltaT	T6 minus T7 temperature

Efficiency Screen

Pressing **F4** from the submenu opens the Efficiency screen and the relevant measurements display.

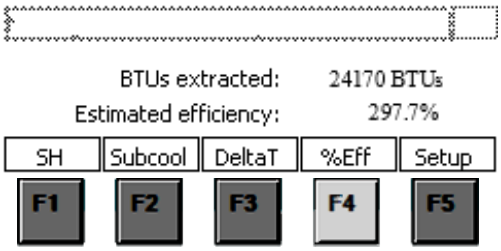


Figure 26: Efficiency screen

NOTE: The % Efficiency is estimated and requires the heat pump size to be input on the second page of the setup screen (F10). The estimate is based on 3 GPM per ton, and the accuracy of the estimate may be low during certain operating conditions.

Meaning of the Efficiency screen measurements:

Measurement	Meaning
BTUs extracted	Number of BTUs extracted
Estimated efficiency	Estimated efficiency as a percentage

Setup Screen

Pressing **F10** opens the Setup screens. There are two pages on the Setup screen where various settings can be made. Press the **Up/Down** arrows to move between the two screens.

Pressing the function button changes the setting for that function. The active function is displayed.

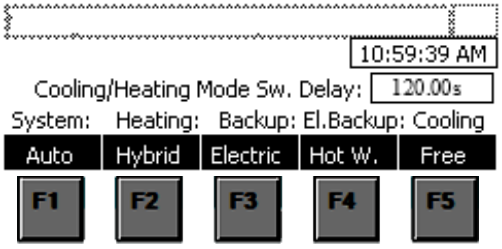


Figure 27: Setup screen page 1

Meaning of function buttons for Setup screen page 1 (pressing the function buttons (F1–F5) toggles the options):

Button	#	Meaning
Auto/ Manual	F1	Manual Mode may be used to manually turn on certain elements, such as fans or pumps, to test them individually. All mechanical devices can be turned on manually from the Device Screen (F7) when in manual mode; however, the compressor will not be allowed to start if operating conditions are not met. Manual Mode will not respond to any thermostat signals.
Hybrid/ Air	F2	Here is where the primary heating mode for the system will be selected (Hybrid or Forced Air). The default is Hybrid.
Electric/ Boiler	F3	Select Electric if the electric elements in the buffer tank or forced air strip heat is used. Select Boiler if the backup heat will be provided by a separate appliance.
Hot W./ Air	F4	Select Hot W. and the backup heat will be provided, either as hot water or hot air.
Free/ Regular	F5	Select Free if the site would like to use air as the source of heat when producing hot water (Free Cooling Mode). This is most commonly used with buildings that have large AC and hot water loads, such as laundromats or commercial restaurants.

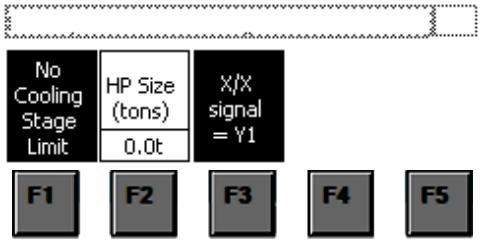


Figure 28: Setup screen page 2

Meaning of function buttons for Setup screen page 2 (pressing the function buttons (F1–F5) toggles the options):

Button	Meaning
F1	No Cooling Stage Limit Limit Cooling to 1st Stage

F2	HP Size tonnage selection (3, 4, 5, or 6 tons)
F3	X/X signal = Y1 X/X signal <> y1

One may decide to have the X/X signal be the same as Y1 in certain situations where forced air may be used across multiple zones in heating mode. For instance, an open concept home with 4 zones and hot water baseboards may choose to have X/X = Y1 to allow for a forced air supplement when any of the 4 zones call for heat.

Parameter Screens

Pressing the **F5** button opens the Parameter screens and displays most of the parameters of the system. Press the **Up/Down** arrows to scroll through the parameters. See *Appendix B*: Parameter Screens for a complete list of the parameter screens.

Table 12: Most commonly used parameters

#	Description	Explanation
1	Summer tank temp setpoint	Tank setpoint when O signal is being received
2	Summer tank temp hysteresis	The amount of temperature below the setpoint at which the tank is considered to be at setpoint (also known as dead band).
3	Winter tank temp setpoint	Tank setpoint whenever O signal is not received
4	Winter tank temp hysteresis - Heating	The amount of temperature below the setpoint at which the tank is considered to be at setpoint (also known as dead band).
5	GL Delta T (T6–T7)	The desired ground loop differential temperature
6	Subcool Setpoint	Target Hybrid Mode subcool value
7	Hot Air Discharge Setpoint	Hot Air target temperature
8	Chilled Air Setpoint	Cooling chilled air target temperature
9	HW reset, max HWS	Peak winter tank temperature
10	HW reset value	Total hot water temperature reset value
11	Outdoor reset Min (T8 Reset)	Outdoor air temperature when tank temperature will be at maximum
12	Outdoor reset Max (T8 Reset Max)	Outdoor air temperature when tank temperature will be at minimum
13	Ground Loop Min allowable temp (T7 Minimum 2)	Minimum allowable ground loop temperature leaving the heat pump.
14	Free Cooling Temperature	The outdoor air temperature at which the building will operate in cooling mode to produce hot water.

Built into the control panel is a port for an outdoor air sensor (T8). This sensor will be used to vary the tank temperature setpoint during the heating season. The temperature range and amount of setback can be adjusted from the control panel. (See Figure 29 and Figure 30.)

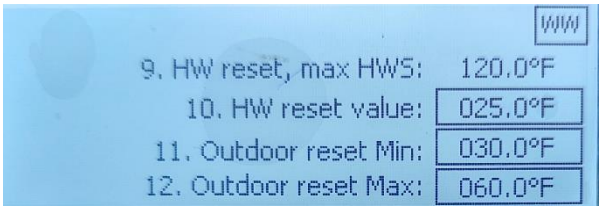


Figure 29: Control Panel

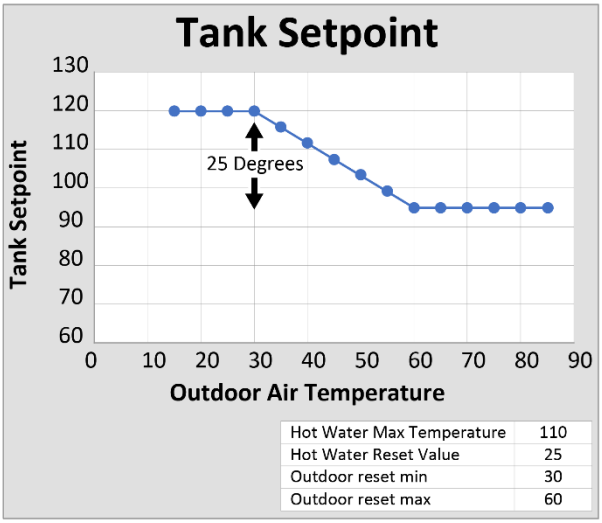


Figure 30: Hot Water Reset

Device/Command Screens

Pressing **F7** opens the Devices screen and thermostat statuses display. The screen displays the signals that the heat pump is currently receiving. Pressing the **F1**–**F5** functional buttons opens the associated Device command screen.

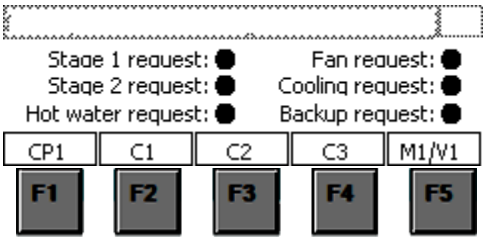


Figure 31: Devices screen

Meaning of functional buttons for Devices screen:

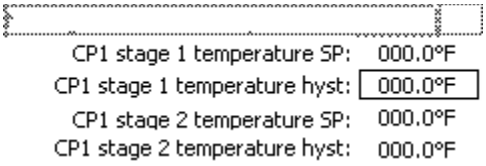
Label	Button	Meaning
CP1	F1	Opens the CP1 – Compressor command screen
C1	F2	Opens the C1 – Load pump command screen
C2	F3	Opens the C2 – Ground loop pump command screen
C3	F4	Opens the C3 – Recirculation pump command screen
M1/V1	F5	Opens the M1/V1 – Blower fan and scroll down 3 pages for Reversing Valve command

Device/Command Screen conventions

On the various device and command screens, the following conventions apply:

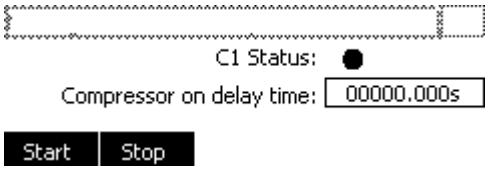
- Parameter values are displayed in a frame, while display/measurements are displayed without a frame.

  Example:



- If there is a permission for any command, the display above the corresponding functional button is colored black, and if there is no permission, the display is colored white.

  Example:



CP1 – Compressor Command/ Parameter/Statistics Screens

Pressing **F1** from the Devices screen opens the CP1 Compressor Command screen. On the CP1 screen, both stages of the compressor CP1 statuses are shown (two dots), as well as the manual compressor commands. Each dot represents a compressor stage. If 1 dot is filled in, the compressor is operating in first stage; 2 dots indicate second stage. Press the **Up/Down** arrows to move between all the compressor screens.

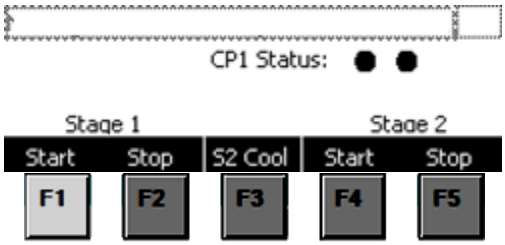


Figure 32: CP1 Compressor command screen

Meaning of functional buttons:

Label	Button	Meaning
Start	F1	CP1 – Compressor Stage 1 start manual command
Stop	F2	CP1 – Compressor Stage 1 stop manual command
S2 Cool	F3	Enable Compressor Stage 2 in the cooling mode (pressing will change the current selection; black if enabled, white if disabled)
Start	F4	CP1 – Compressor Stage 2 start manual command
Stop	F5	CP1 – Compressor Stage 2 stop manual command

Press the **Down arrow** on the Compressor Command screen to open the Compressor Parameters screens.

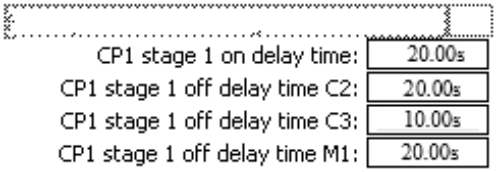


Figure 33: CP1 Compressor parameters screen page 1

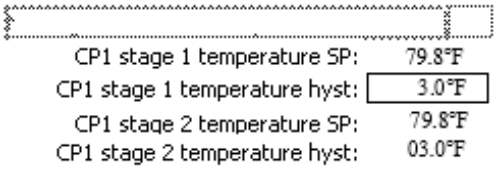


Figure 34: CP1 Compressor parameters screen page 2

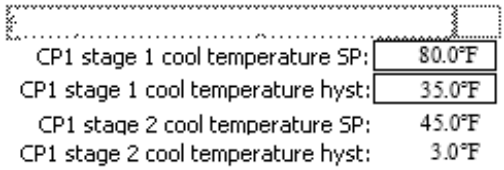


Figure 35: CP1 Compressor parameters screen page 3

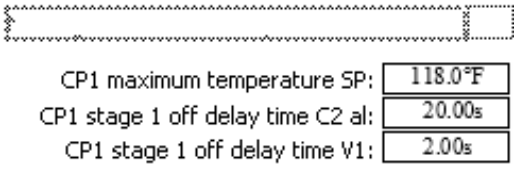


Figure 36: CP1 Compressor parameters screen page 4

Meaning of the parameters:

Parameter	Meaning
15	CP1 stage 1 on delay time – defines the delay time after the start of compressor stage 1 after which the start of compressor stage 2 is allowed, both in automatic and manual mode
16	CP1 stage 1 off delay time C2 – defines the delay time after the stop of compressor stage 1 after which the stop of C2 pump is allowed, both in automatic and manual mode
17	CP1 stage 1 off delay time C3 – defines the delay time after the stop of compressor stage 1 after which the stop of C3 pump is allowed, both in automatic and manual mode
18	CP1 stage 1 off delay time M1 – defines the delay time after the stop of compressor stage 1 after which the stop of M1 fan is allowed, both in automatic and manual mode
19	CP1 stage 1 temperature SP – displays the stage 1 temperature setpoint, based on T1 tank temperature, in heating operating modes, calculated, in the limits between the HW reset, max HWS (T1 Max) and the HW reset, max HWS (T1 Max) minus the HW reset value (T1 reset)
20	CP1 stage 1 temperature hyst– defines the compressor stage 1 temperature setpoint hysteresis, based on T1 tank temperature, in heating operating modes
21	CP1 stage 2 temperature SP – displays the stage 1 temperature setpoint, based on T1 tank temperature, in heating operating modes, calculated
22	CP1 stage 2 temperature hyst– displays the compressor stage 2 temperature setpoint hysteresis, based on T1 tank temperature, in heating operating modes
23	CP1 stage 1 cool temperature SP – displays the stage 1 temperature setpoint, based on T1 tank temperature, in cooling operating modes, calculated
24	CP1 stage 1 cool temperature hyst– defines the compressor stage 1 temperature setpoint hysteresis, based on T1 tank temperature, in cooling operating modes
25	CP1 stage 2 cool temperature SP – displays the stage 1 temperature setpoint, based on T1 tank temperature, in cooling operating modes, calculated

26	CP1 stage 2 cool temperature hyst – displays the compressor stage 2 temperature setpoint hysteresis, based on T1 tank temperature, in cooling operating modes
27	CP1 maximum temperature SP – defines the maximum allowed setpoint, both in cooling and heating modes
29	CP1 stage 1 off delay time V1 – defines the delay time after the stop of compressor stage 1 after which the stop of V1 valve is allowed, both in automatic and manual mode, but only in cooling and free cooling mode

Press the **Down arrow** on the Compressor Parameter Screens to open the Compressor Statistics screens.

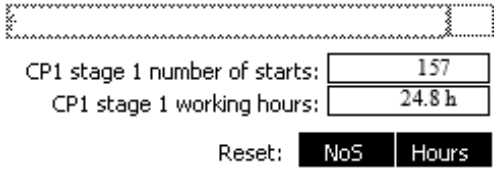


Figure 37: CP1 Compressor statistics screen page 1

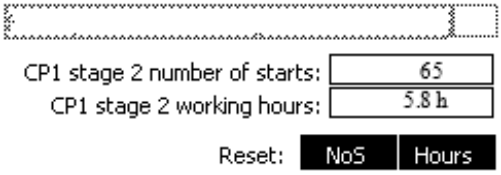


Figure 38: CP1 Compressor statistics screen page 2

Meaning of the statistics:

- CP1 stage 1 number of starts – displays the compressor (CP1) stage 1 number of starts
- CP1 stage 1 working hours – displays the compressor (CP1) stage 1 working hours
- CP1 stage 2 number of starts – displays the compressor (CP1) stage 2 number of starts
- CP1 stage 2 working hours – displays the compressor (CP1) stage 2 working hours

Meaning of functional buttons:

Label	Button	Meaning
NoS	F4	Reset the number of starts
Hours	F5	Reset the operating hours counter

C1 – Load Pump Command/Parameter/Statistics Screens

Press the **F2** button from the Devices screen (F7) to open the C1 – Load Pump Command Screen. The status of the load pump displays, as well as the manual pump commands and various parameters, measurements, and statistical values. Press the **Up/Down** arrows to move between all the pump screens. If there is a permission for any command, the display above the corresponding functional button is colored black, and if there is no permission, the display is colored white.

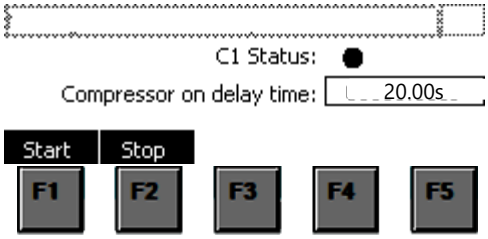


Figure 39: Load pump command screen

Meaning of functional buttons:

Label	Button	Meaning
Start	F1	Load pump start manual command
Stop	F2	Load pump stop manual command

Press the **Down** arrow on the Load Pump Command Screen to open the Load Pump Statistics screen.

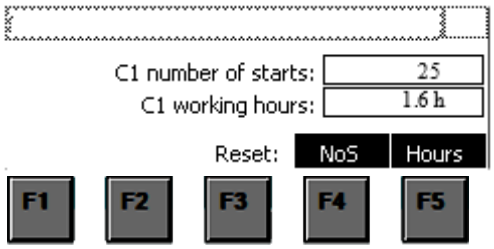


Figure 40: C1 Load pump statistics screen

C2 – Ground Loop Pump Command/Parameter/Statistics Screens

Press the **F3** button from the Devices screen to open the C2 – Ground Loop Pump Command Screen. The status of the Ground Loop pump displays with the C2 actual speed, as well as the manual pump commands and various parameters, measurements, and statistical values. Press the **Up/Down** arrows to move between all the pump screens.

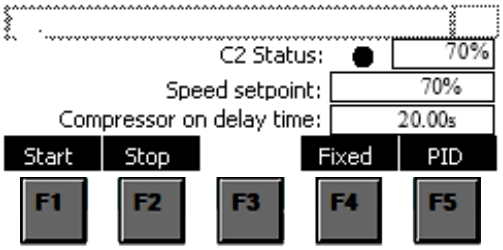


Figure 41: C2 Ground Loop command screen

Label	Button	Meaning
Start	F1	C2 – Ground Loop pump start manual command
Stop	F2	C2 – Ground Loop pump stop manual command
Fixed	F4	C2 – Ground Loop pump Fixed speed (if the fixed speed mode is enabled, the display is black and the C2 pump is running with 100% speed; if fixed speed is not enabled, the display is white.
PID	F5	Open the C2 PID screen

Meaning of the parameters:

Parameter	Meaning
31	C2 speed setpoint – defines the C2 speed setpoint, based on the control value received from the PID loop
32	Compressor on delay time – Defines the time after C2 start, after which the compressor has a permission to start, except in regular cooling mode (when there is a request for cooling, either stage 1 or stage 2) or in free cooling mode

Press the **Down** arrow on the Ground Loop Pump Command screen to open the Ground Loop Pump Statistics screen.

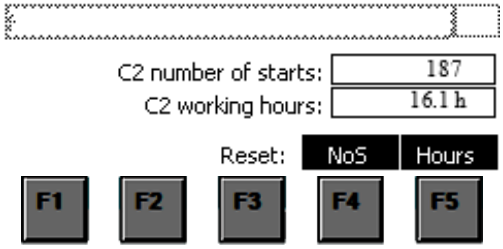


Figure 42: C2 Ground Loop pump statistics screen

Press the **F5** button from the Ground Loop Pump Command screen to open the PID screen. We strongly advise customers do not modify any of these PID settings!

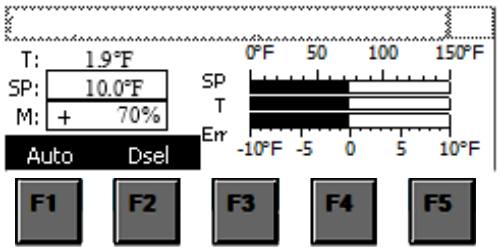


Figure 43: C2 Ground Loop pump PID screen

Meaning of functional buttons:

Label	Button	Meaning
Auto	F1	Auto/Manual switch (if the Automatic mode is enabled, the display is black; if not, the display is white)
Dsel	F2	Differential constant enable (if the Differential constant is enabled, the display is black; if not, the display is white)

Meaning of the measurements:

Label	Meaning
T	PID measurement and controlled value (T6–T7 in all the heating modes and T3 in all the cooling modes)
SP	PID setpoint
M	PID Manual value (C2 speed setpoint)
Err	PID regulation error (PID setpoint – PID measurement)

Press the **Down** arrow on the Ground Loop Pump PID screen to open the Ground Loop Pump Parameters screen.

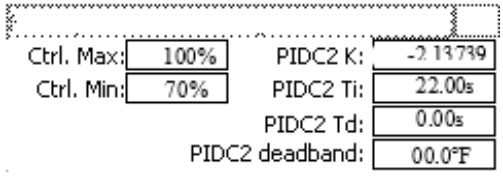


Figure 44: C2 Ground Loop Pump PID parameters screen page 1

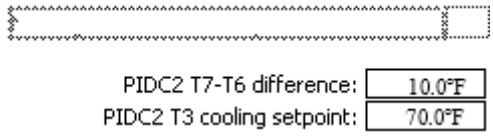


Figure 45: C2 Ground Loop Pump PID parameters screen page 2

Meaning of the parameters:

Parameter	Meaning
121	Ctrl. Max – Defines the maximum allowed control value (C2 speed)
122	Ctrl. Min – Defines the minimum allowed control value (C2 speed)
117	PIDC2 K – PID proportional gain
118	PIDC2 Ti – PID integrative time constant
119	PIDC2 Td – PID differential time constant
120	PIDC2 deadband – defines the PID deadband (the range around the setpoint in which the PID doesn't react)
123	T7–T6 difference – defines the PID setpoint at T6–T7 difference
124	PIDC2/3 cooling setpoint – defines the PID T3 cooling setpoint

C3 – Recirculation Pump Command/Parameter/Statistics Screens

Press the **F4** button from the Devices screen to open the C3 Recirculation Pump Command Screen. The status of the recirculation pump displays, as well as the manual pump commands and various parameters, measurements, and statistical values. Press the **Up/Down** arrows to move between all the pump screens. The recirculation pump relay turns on anytime a speed setpoint of greater than 0% is given.

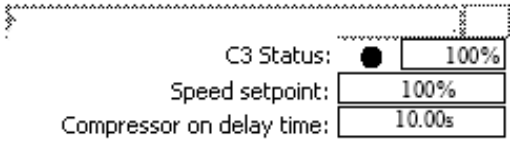


Figure 46: C3 Recirculation pump command screen

Meaning of the parameters:

Parameter	Meaning
33	C3 speed setpoint – defines the C3 speed setpoint, based on the control value received from the PID loop
34	Compressor on delay time – Defines the time after C3 start, after which the compressor has a permission to start in all the modes

Press the **Down** arrow on the C3 Recirculation Pump Command screen to open the Recirculation Pump Parameters screen.

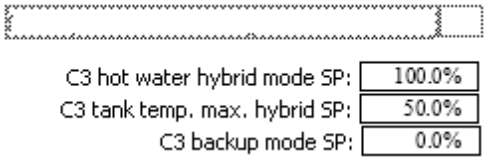


Figure 47: C3 Recirculation pump parameters screen page 1

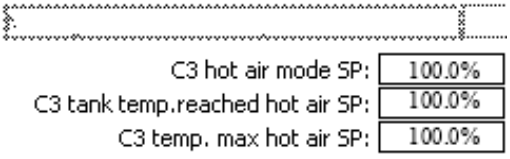


Figure 48: C3 Recirculation pump parameters screen page 2

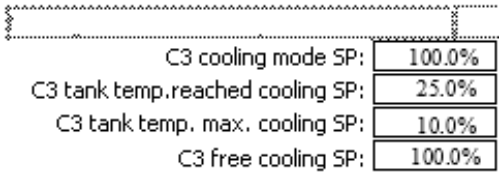


Figure 49: C3 Recirculation pump parameters screen page 3

Meaning of the parameters:

Parameter	Meaning
35	C3 hot water hybrid mode SP – defines C3 speed setpoint during regular operation in the hot water hybrid mode
36	C3 tank temp. max. hybrid SP – defines C3 speed setpoint in the hot water hybrid mode, electric hot water backup mode and boiler backup mode, when there is T1, T10 or T11 Maximum 1 alarm and the Stage 1 or Stage 2 request for heating
38	C3 hot air mode SP – defines C3 speed setpoint in the hot air and electric hot air backup mode
39	C3 tank temp. reach. hot air SP – defines C3 speed setpoint in the hot air mode and electric hot air backup mode, when T1 is above the setpoint and there is a heating request (Stage 1 or Stage 2)
41	C3 cooling mode SP – defines C3 speed setpoint in the cooling and water to water mode
42	C3 tank temp. reach. Cooling SP – defines C3 speed setpoint in the cooling mode, when T1 is above the setpoint and there is a cooling request (Stage 1 or Stage 2)
43	C3 tank temp. max cooling SP – defines C3 speed setpoint in the cooling mode, when there is T1 Maximum 2 alarm and the Stage 1 or Stage 2 request for cooling
44	C3 free cooling SP - defines C3 speed setpoint in the free cooling mode

Press the **Down** arrow on the C3 Recirculation Pump Parameter 3 screen to open the Recirculation Pump Statistics screen.

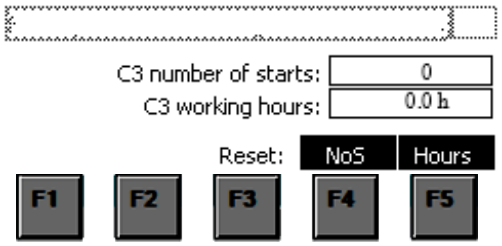


Figure 50: C3 Recirculation pump statistics screen

BL/RV – Blower and Reversing Valve Command/Parameter/Statistics Screens

Press the **F5** button from the Devices screen to open the M1 Fan Command screen. The status of the M1 Fan displays, as well as the manual fan commands and various parameters, measurements, and statistical values. Press the **Up/Down** arrows to move between all the fan screens. If there is a permission for any command, the display above the corresponding functional button is colored black, and if there is no permission, the display is colored white.

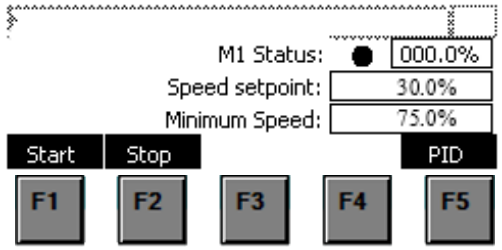


Figure 51: M1 Fan command screen

Meaning of functional buttons:

Label	Button	Meaning
Start	F1	Fan start manual command
Stop	F2	Fan stop manual command
PID	F5	Open the M1 PID screen

Meaning of the parameters:

Parameter	Meaning
45	M1 speed setpoint – defines the M1 speed setpoint, based on the control value received from the PID loop
46	Compressor on delay time – Defines the time after C3 start, after which the compressor has a permission to start in all the modes

Press the **Down** arrow on the M1 Fan Command screen to open the M1 Fan Parameters screen.

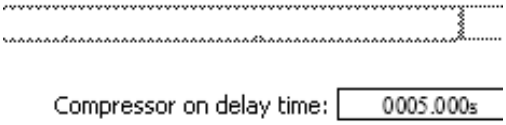


Figure 52: M1 Fan parameters screen

Meaning of the parameters:

Parameter	Meaning
47	Compressor on delay time – Defines the time after M1 start, after which the compressor has a permission to start in all the modes

Press the **Down** arrow on the M1 Fan Parameter screen to open the M1 Fan Statistics screen.

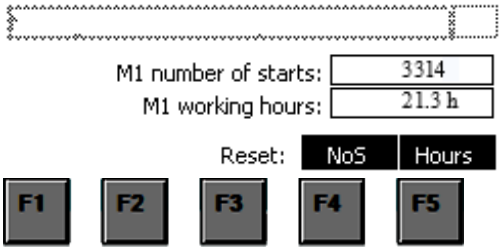


Figure 53: M1 Fan statistics screen

Press the **F5** button on the M1 Fan Command screen to open the M1 PID screen. We strongly advise that customers do not modify any of these PID settings!

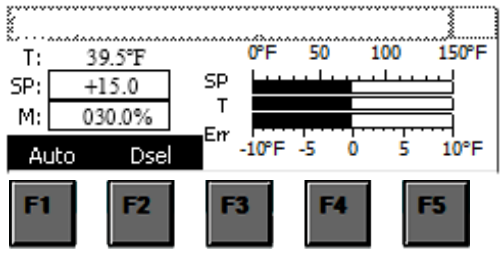


Figure 54: M1 Fan PID screen

Meaning of the measurements:

Label	Meaning
T	PID measurement and controlled value (p1T [pressure converted to temperature] -T10 in the Electric hot water backup mode, Boiler backup mode, Heating mode with hot water hybrid; T4 in the Electric hot air backup mode, Hot Air mode, Water to Water mode, Cooling mode, Free Cooling mode at all times, Electric hot water backup mode, Boiler backup mode, Heating mode with hot water hybrid if T1, T10 or T11 Maximum 1 alarm appears and the compressor is in the stage 1 or stage 2)
SP	PID setpoint
M	PID Manual value (M1 speed setpoint)
Err	PID regulation error (PID setpoint – PID measurement)

Meaning of functional buttons:

Label	Button	Meaning
Auto	F1	Auto/Manual switch – if the Automatic mode is enabled, the display is black; if not, the display is white
Dsel	F2	Differential constant enable – if the Differential constant is enabled, the display is black; if not, the display is white

Press the **Down** arrow on the M1 Fan PID screen to open the M1 Fan Parameters screen.

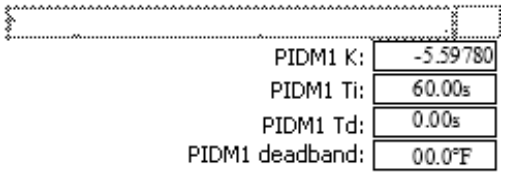


Figure 55: M1 Fan PID parameters screen page 1

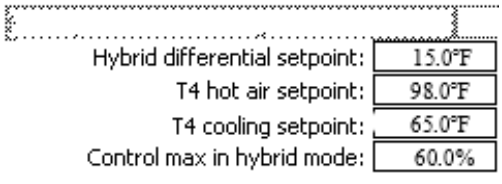


Figure 56: M1 Fan PID parameters screen page 2

Meaning of the parameters:

Parameter	Meaning
125	Compressor on delay time – Defines the time after M1 start, after which

	the compressor has a permission to start in all the modes
126	PIDM1 K – PID proportional gain
127	PIDM1 K – PID proportional gain
128	PIDM1 deadband – defines the PID deadband (the range around the setpoint in which the PID doesn't react)
129	Hybrid differential setpoint – defines the PID setpoint in the Electric hot water backup mode, Boiler backup mode, Heating mode with hot water hybrid
130	T4 hot air setpoint – defines the PID T4 hot air setpoint, hardcoded limited to 110 °F
131	T4 cooling setpoint – defines the PID T4 cooling setpoint
132	Control max in hybrid mode – defines the maximum fan speed in heating mode with hot water hybrid

V1 – Reversing Valve Command/Parameter/Statistics Screens

Press the **Down** button from the in the M1 Fan Statistic screen to open the V1 Reversing Valve Command screen. The V1 Command screen is the fourth page down. The status of the V1 Reversing Valve displays, as well as various parameters, measurements, and statistical values. Press the **Up/Down** arrows to move between all the valve screens. The default position of the reversing valve will operate the heat pump in a heating mode. Pressing Open (F1) will activate the reversing valve and turn it to a cooling mode.

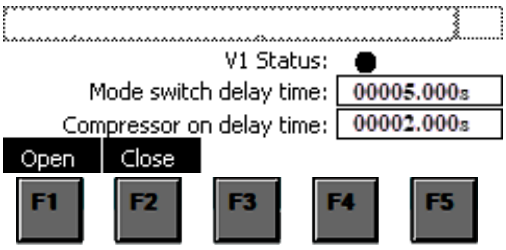


Figure 57: V1 Reversing Valve command screen

Meaning of functional buttons:

Label	Button	Meaning
Open	F1	Reversing Valve start manual command
Close	F2	Reversing Valve stop manual command

Meaning of the parameters:

Parameter	Meaning
49	Compressor on delay time – Defines the time after V1 start, after which the compressor has a permission to start, in regular cooling mode or in free cooling mode.

Press the **Down** arrow on the V1 Reverse Valve Command screen to open the V1 Reverse Valse Statistics screen.

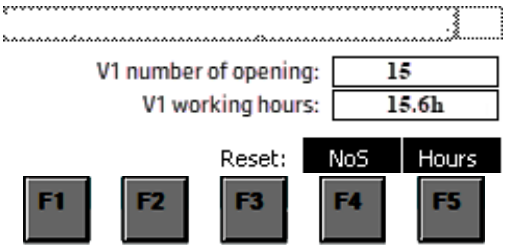


Figure 58: V1 Reversing Valve statistics screen

Measurement Screens

Press the **F8** button to open the Measurements screens and display the thermostat statuses. Press the **F1–F5** functional buttons to open the associated device command screen.

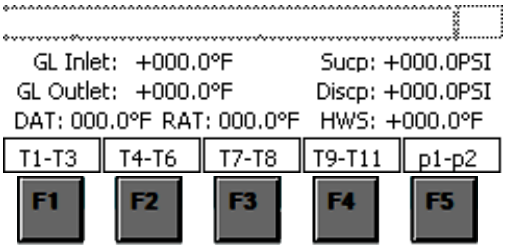


Figure 59: Measurements screen page 1

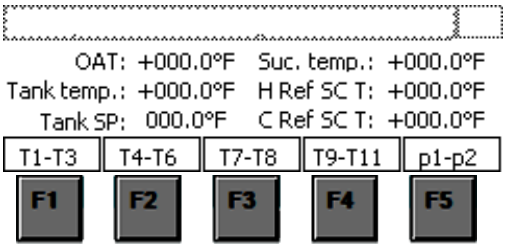


Figure 60: Measurements screen page 2

Meaning of the measurements:

Label	Meaning
GL Inlet	Ground loop inlet (T6)
GL Outlet	Ground loop outlet (T7)
DAT	Air temperature (T4)
HWS	Hot water supply (T10)
Sucp	Suction pressure (P2)
Discp	Discharge pressure (P1)

Meaning of functional buttons:

Label	Button	Meaning
T1–T3	F1	Opens the T1–T3 measurement screens
T4–T6	F2	Opens the T4–T6 measurement screens
T7–T8	F3	Opens the T7–T8 measurement screens
T9–T11	F4	Opens the T9–T11 measurement screens
P1–P2	F5	Opens the P1–P2 measurement screens

Press the **F1–F5** functional buttons on the Measurement screen to open the associated measurement parameter screen.

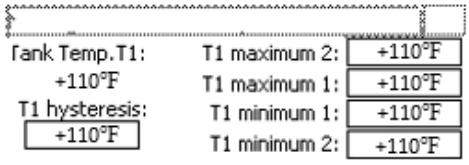


Figure 61: Measurement parameter screen

Meaning of the alarm parameters:

Parameter	Meaning
T1 hysteresis	The temperature change required before the Warning/Cutoff expires
T1 maximum 2	Tank temperature maximum 2 alarm setting
T1 maximum 1	Tank temperature maximum 1 alarm setting
T1 minimum 1	Tank temperature minimum 1 alarm setting
T1 minimum 2	Tank temperature minimum 2 alarm setting

Press the **Down** arrow on the Measurement Parameter screen to open the Measurement Trend screen.

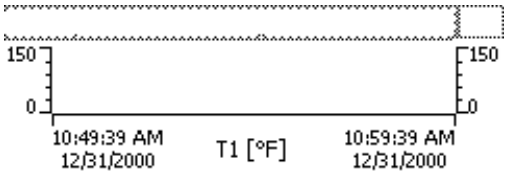


Figure 62: Measurement trend screen

The P2 pressure measurement has an additional screen where the user can set the maximum number of times of a Maximum 2 alarm in a 24-hour period, after which the C3 pump is blocked. The user with the appropriate password has the option to reset the 24-hour counter by pressing the **F1** button.

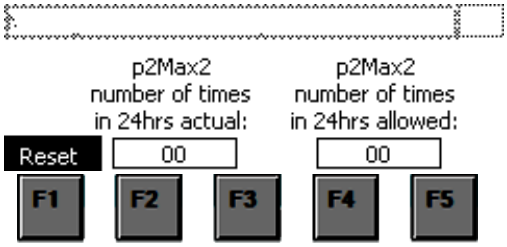


Figure 63: P2 pressure 24-hour alarm parameter screen

Alarm Screens

Press the **F9** button to reach the Alarm screen. This will display any active alarms. An alarm can

only be cleared by removing the cause of the alarm.

In total there are 60 alarms, and each one will display a unique text that explains the source of the alarm.

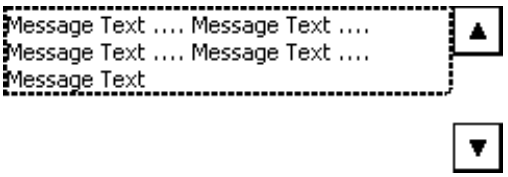


Figure 64: Alarm screen

Each temperature sensor (T1–T11) and pressure sensor (P1 and P2) have a series of alarm messages. For each sensor, the alarm message on the control panel displays the sensor name and one of the following to indicate the issue:

- Maximum Cut off (2)
- Maximum Alarm (1)
- Minimum Cut off (2)
- Minimum Alarm (1)
- Wire break
- Overflow
- Communication fault

For example:

For the tank temperature (T1) maximum alarm, you will see the message:

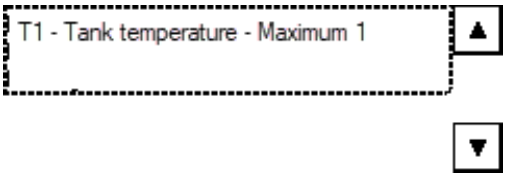


Figure 65: Sample Alarm screen

The maximum 1 alarm for T1, T10, T11 impacts the way the system runs in Hybrid mode. When the measured temperatures hit the alarm parameter, the unit will increase fan speed to divert a greater percentage of its heat production to forced air to avoid reaching a cutout temperature limit.

If the system reaches the maximum cutoff, maximum alarm, minimum cutoff, or minimum alarm, the system will shut itself down automatically and will go into a safety-protection mode.

There are some additional alarms that have special purposes.

Alarm	Purpose
Emergency Cutoff - High/Low Pressure, Condensate	These are three cutoffs that are in the series. If any of them are triggered, power will be disconnected to the compressor. High- and low-pressure cutoff use pressure switches, and the condensate cutoff uses a float switch to detect blockage.
Communication Fault	A communication fault usually happens from a loose wire. Check that the ethernet cables and the wire brackets on the Yotta Control modules are tightly affixed. To clear this fault, cycling power is often the best way.
C2 - Ground loop pump - Start timeout	The heat pump has a current switch on the ground loop wires. If this switch does not detect current when the heat pump is turned on, the switch will not allow the compressor to start.
Compressor CP1 liquid line pressure - Cut off - too many in 24 hrs	To prevent potential damage to the unit, the system will not allow the compressor to run if the high- or low-pressure cutoff has been triggered more than 1 time in 24 hours. This can be manually cleared.

Troubleshooting

Problem	Possible Cause	Checks and Corrections
Compressor won't start	1. Compressor circuit breaker (integrated into heat pump control board) is OFF. 2. Ground loop pump is OFF. A current switch will prevent compressor from starting if the ground loop pump isn't running. 3. Incorrect signal. 4. Temperature setpoint has been reached.	1. Validate that circuit breaker is ON. 2. Verify proper fluid flow through ground loop. Ensure that ground loop does not have entrapped air. 3. Press F7 to see which signals are received by the heat pump. 4. In Hybrid Mode (HY), the compressor will not start until the temperature is below the setpoint + hysteresis value. See Table 5 for details.
Issues with display screen	1. Incorrect operation. See *Control Panel and Screens* Section for additional information. 2. Password Required. Password can be found in the Control Panel and Screen Section.	1. Be sure to press ENTER to select a box and then use ARROWS to move around. Once a change is made, press ENTER again to confirm change. 2. In the password screen, scroll over the box, press ENTER, type in the password, then press ENTER again to confirm. The display will add extra stars. Then scroll down to Accept and press ENTER.
Unit is turning off too soon	1. Check for any error codes. Check whether the unit is shutting down on low ground temperature. 2. Tank temperature setpoint too low.	1. Installers must change the ground loop temperature minimum cutoff values (T6, T7) to match the level of anti-freeeze protection that was used. 2. The error code displays the sensor that caused the error. Check the high and low temperature warning and cutout temperatures by pushing F8 and then finding the corresponding temperature sensor. 3. Check tank temperature setpoint (F6). Summer setpoint will be used anytime that the system is in a cooling mode.
Unit was running, but now won't turn back on	1. Check for any error codes.	1. The unit requires a manual reset for certain safety limits.
Error Code: Wire Break or Communication fault	1. Check for loose wires on the Yotta Control modules.	1. Turning off power for a moment may help to clear this fault.

Maintenance

Refer to the following for maintenance tasks:

- This system is designed for closed loops only. If using an unpressurized flow center, check the water level every three months and anti-freeze level annually.
- If using a pre-mounted, pressurize flow center, as long as the system is operating properly, we do not recommend probing the water lines. Feel the pumps and connected piping to verify water movement.
- Replace filters as needed. In most homes, this is either quarterly or semi-annually. Ensure that filter rack is properly reattached.
- It is recommended to fill out a *Startup Worksheet* every 2 years to track any variations in performance. (See Appendix C.)

Unit Startup Checklist

Before powering on the unit, check the following:

- ☐ Fuses, breakers, and wire size correct.
- ☐ Low voltage wiring complete.
- ☐ Piping completed and water system cleaned and flushed.
- ☐ Air is purged from closed loop system.
- ☐ Isolation valves are open; water control valves or loop pumps wired.
- ☐ Condensate line open and correctly pitched.
- ☐ Blower rotates freely.
- ☐ Air filter is clean and in position. Filter rack cover is tightly attached.
- ☐ Service/access panels are in place. This is especially important for any panels that cover the airside of the unit.
- ☐ The hot water buffer tank (if used) is properly plumbed to the unit and purged of all air.
- ☐ Ensure that the outdoor air temperature sensor is wired into the unit. The sensor should be placed in a location that receives minimal direct sun exposure.
- ☐ Verify that the water flow rate is correct by measuring the pressure drop through the heat exchanger using the P/T plugs and comparing to unit performance data.
- ☐ Check the temperature of both the supply and discharge water against the measurements shown on the display screen.
- ☐ Typically, the heat pump should heat or cool air by 20–30 degrees and heat water by 4–8 degrees.
- ☐ During all testing, check for excessive vibration, noise, or water leaks. Correct or repair as required.
- ☐ Fill out the *Startup Worksheet*. (See Appendix C.)

Program the Control Panel Display

- Set the summer and winter tank setpoint temperatures by pressing F6. Scroll down to adjust other parameters.
- If anti-freeze was added, update the ground loop minimum cutoff temperature values (T6 and T7) to match the level of anti-freeze protection that was provided. By changing these values, the installer takes full responsibility for the anti-freeze.
- Select the proper operating mode and backup method in the setup page (F10). Scroll down to the second setup page for additional selections.

Customer Care

Frequency and How to Replace the Filter

- Air filters must be clean to obtain maximum performance. They should be inspected quarterly under normal operating conditions and be replaced when necessary.
- Units should never be operated without a filter.
- The heat pump can accept filters with ratings up to MERV 13. We recommend using a 2-inch-thick filter if using a MERV rating above 9.

Annual/Bi-Annual Check

It is good practice to have a service technician check the system and sensors at least once every 2 years. Be sure to fill out a copy of the *Startup Worksheet* (Appendix C: Startup Worksheets) with temperature and pressure values to keep a historical record.

Additional *Startup Worksheets* are provided for record keeping.

Appendix A: Indirect Hot Water Heating Coil Performance

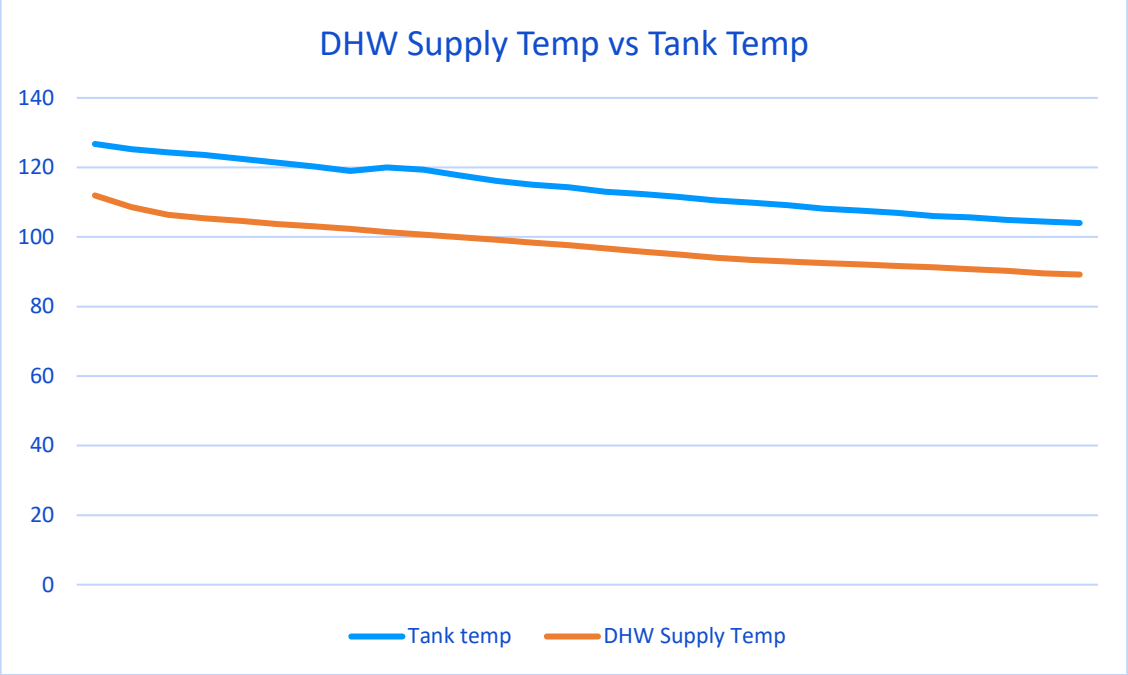


Figure 66: Domestic Hot Water supply temperature versus tank temperature. Performance based on steady 1 GPM with 51 °F (10 °C) entering Domestic Water Temperature.

Appendix B: Parameter Screens

List of parameter screens accessed through the **F5** button on the control panel.

#	Description
1	Summer tank temp setpoint - Cooling
2	Summer tank temp hysteresis - Cooling
3	Winter tank temp setpoint – Heating (T1Max)
4	Winter tank temp hysteresis - Heating
5	GL Delta T (T6–T7)
6	Subcool Setpoint (T3 Setpoint Cooling)
7	Hot Air Discharge Setpoint (T4 Hot Air Setpoint)
8	Chilled Air Setpoint (T4 Setpoint Cooling)
9	HW reset, max HWS (not adjustable – T1 Max)
10	HW reset value (T1 reset)
11	Outdoor reset Min (T8 Reset)
12	Outdoor reset Max (T8 Reset Max)
13	Ground Loop Min allowable temp (T7 Minimum 2)
14	Free Cooling Temperature
15	CP1 stage 1 on delay time – defines the delay time after the start of compressor stage 1 after which the start of compressor stage 2 is allowed, both in automatic and manual mode
16	CP1 stage 1 off delay time C2 – defines the delay time after the stop of compressor stage 1 after which the stop of C2 pump is allowed, both in automatic and manual mode
17	CP1 stage 1 off delay time C3 – defines the delay time after the stop of compressor stage 1 after which the stop of C3 pump is allowed, both in automatic and manual mode
18	CP1 stage 1 off delay time M1 – defines the delay time after the stop of compressor stage 1 after which the stop of M1 fan is allowed, both in automatic and manual mode
19	CP1 stage 1 temperature SP – displays the stage 1 temperature setpoint, based on T1 tank temperature, in heating operating modes, calculated
20	CP1 stage 1 temperature hyst– defines the compressor stage 1 temperature setpoint hysteresis, based on T1 tank temperature, in heating operating modes
21	CP1 stage 2 temperature SP – displays the stage 1 temperature setpoint, based on T1 tank temperature, in heating operating modes, calculated
22	CP1 stage 2 temperature hyst– displays the compressor stage 2 temperature setpoint hysteresis, based on T1 tank temperature, in heating operating modes
23	CP1 stage 1 cool temperature SP – displays the stage 1 temperature setpoint, based on T1 tank temperature, in cooling operating modes, calculated
24	CP1 stage 1 cool temperature hyst– defines the compressor stage 1 temperature setpoint hysteresis, based on T1 tank temperature, in cooling operating modes
25	CP1 stage 2 cool temperature SP – displays the stage 1 temperature setpoint, based on T1 tank temperature, in cooling operating modes, calculated
26	CP1 stage 2 cool temperature hyst– displays the compressor stage 2 temperature setpoint hysteresis, based on T1 tank temperature, in cooling operating modes
27	CP1 maximum temperature SP – defines the maximum allowed setpoint, both in cooling and heating modes

#	Description
29	CP1 stage 1 off delay time V1 – defines the delay time after the stop of compressor stage 1 after which the stop of V1 valve is allowed, both in automatic and manual mode, but only in cooling and free cooling mode
31	C2 speed setpoint – defines the C2 speed setpoint, based on the control value received from the PID loop
32	Compressor on delay time – Defines the time after C2 start, after which the compressor has a permission to start, except in regular cooling mode (when there is a request for cooling, either stage 1 or stage 2) or in free cooling mode
33	C3 speed setpoint – defines the C3 speed setpoint, based on the control value received from the PID loop
34.	Compressor on delay time – Defines the time after C3 start, after which the compressor has a permission to start in all the modes
35	C3 hot water hybrid mode SP – defines C3 speed setpoint in the hot water hybrid mode
36	C3 tank temp. max. hybrid SP – defines C3 speed setpoint in the hot water hybrid mode, electric hot water backup mode and boiler backup mode, when there is T1, T10 or T11 Maximum 1 alarm and the Stage 1 or Stage 2 request for heating
38	C3 hot air mode SP – defines C3 speed setpoint in the hot air and electric hot air backup mode
39	C3 tank temp. reach. hot air SP – defines C3 speed setpoint in the hot air mode and electric hot air backup mode, when T1 is above the setpoint and there is a heating request (Stage 1 or Stage 2)
41	C3 cooling mode SP – defines C3 speed setpoint in the cooling and water to water mode
42	C3 tank temp. reach. Cooling SP – defines C3 speed setpoint in the cooling mode, when T1 is above the setpoint and there is a cooling request (Stage 1 or Stage 2)
43	C3 tank temp. max cooling SP – defines C3 speed setpoint in the cooling mode, when there is T1 Maximum 2 alarm and the Stage 1 or Stage 2 request for cooling
44	C3 free cooling SP - defines C3 speed setpoint in the free cooling mode
45	M1 speed setpoint – defines the M1 speed setpoint, based on the control value received from the PID loop
46	Compressor on delay time – Defines the time after C3 start, after which the compressor has a permission to start in all the modes
47	Compressor on delay time – Defines the time after M1 start, after which the compressor has a permission to start in all the modes
49	Compressor on delay time – Defines the time after V1 start, after which the compressor has a permission to start, in regular cooling mode or in free cooling mode
115	p2 Maximum 2 number of times in 24 hours (actual value)
116	p2 Maximum 2 number of times in 24 hours allowed
117	PIDC2 K – PID proportional gain
118	PIDC2 Ti – PID integrative time constant
119	PIDC2 Td – PID differential time constant
120	PIDC2 deadband – defines the PID deadband (the range around the setpoint in which the PID doesn’t react)
121	Ctrl. Max – Defines the maximum allowed control value (C2 speed)
122	Ctrl. Min – Defines the minimum allowed control value (C2 speed)
123	T7-T6 difference – defines the PID setpoint as T6-T7 difference
124	PIDC2 /3 cooling setpoint – defines the PID T3 cooling setpoint
125	PIDM1 K – PID proportional gain

#	Description
126	PIDM1 Ti – PID integrative time constant
127	PIDM1 Td – PID differential time constant
128	PIDM1 deadband – defines the PID deadband (the range around the setpoint in which the PID doesn't react)
129	Hybrid differential setpoint – defines the PID setpoint in the Electric hot water backup mode, Boiler backup mode, Heating mode with hot water hybrid
130	T4 hot air setpoint – defines the PID T4 hot air setpoint
131	T4 cooling setpoint – defines the PID T4 cooling setpoint
132	Control max in hybrid mode – defines the maximum fan speed in heating mode with hot water hybrid

Appendix C: Startup Worksheets

STARTUP WORKSHEET

DHHP Startup/Check Worksheet (Circle Startup or Check)

Date: _____

Service Tech: _____

Location: _____

City and Zip: _____

Mode of Operation (Check one)

HY – Heating Mode with HW Hybrid selected ☐

FA – Heating Mode with Hot Air selected ☐

C – Regular Cooling Mode ☐

Purpose of Visit:

_____

_____

SYSTEM TEMPERATURES & PRESSURES

Home Screen (Esc x2)

DAT (Supply Air Temperature, T4) _____ °F

RAT (Return Air Temperature, T5) _____ °F

Air-side Delta T (DAT-RAT) _____ **°F**

GL Inlet (Ground Loop Inlet, T6) _____ °F

GL Outlet (T7 Ground Loop Outlet) _____ °F

Ground Loop Delta T (GL Inlet-Outlet) _____ **°F**

Tank temp (T1 Tank Temperature) _____ °F

HWS (Hot Water Supply, T10) _____ °F

HWR (Hot Water Return, T11) _____ °F

Hot Water Delta T (HW Inlet-Outlet) _____ **°F**

Heat of Extraction:
(GL Delta T x 475 x Flow Rate (GPM) _____

Electrical Input: _____ Amps _____ Volts

Heat of Rejection (BTU/Hr):
(Heat of extraction + Electrical Input x 3.41) _____

EFFICIENCY

Condensing temperature _____ **°F**

Hot water supply/ Discharge Air Temperature _____ **°F**

Approach Temperature (Condensing – Hot Water/Discharge Air temperature) _____ **°F**

Superheat (Should be around 10°F) _____ **°F**

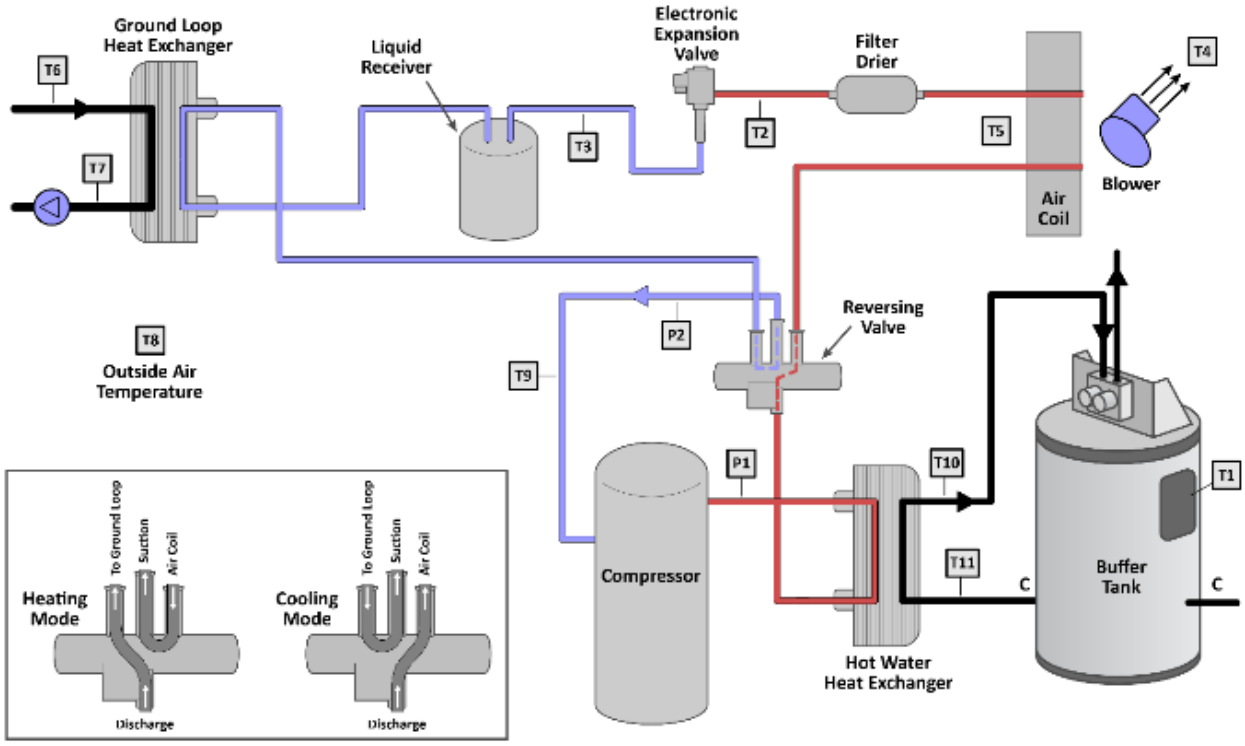
SPEEDS

RC Speed (%) _____

FAN Speed (%) _____

Estimated Flow rate (GPM) _____

Ground Loop Speed (%) _____



STARTUP WORKSHEET

DHHP Startup/Check Worksheet (Circle Startup or Check)

Date: _____

Service Tech: _____

Location: _____

City and Zip: _____

Mode of Operation (Check one)

HY – Heating Mode with HW Hybrid selected ☐

FA – Heating Mode with Hot Air selected ☐

C – Regular Cooling Mode ☐

Purpose of Visit:

_____

_____

SYSTEM TEMPERATURES & PRESSURES

Home Screen (Esc x2)

DAT (Supply Air Temperature, T4) _____ °F

RAT (Return Air Temperature, T5) _____ °F

Air-side Delta T (DAT-RAT) _____ **°F**

GL Inlet (Ground Loop Inlet, T6) _____ °F

GL Outlet (T7 Ground Loop Outlet) _____ °F

Ground Loop Delta T (GL Inlet-Outlet) _____ **°F**

Tank temp (T1 Tank Temperature) _____ °F

HWS (Hot Water Supply, T10) _____ °F

HWR (Hot Water Return, T11) _____ °F

Hot Water Delta T (HW Inlet-Outlet) _____ **°F**

Heat of Extraction:
(GL Delta T x 475 x Flow Rate (GPM) _____

Electrical Input: _____ Amps _____ Volts

Heat of Rejection (BTU/Hr):
(Heat of extraction + Electrical Input x 3.41) _____

EFFICIENCY

Condensing temperature _____ **°F**

Hot water supply/ Discharge Air Temperature _____ **°F**

Approach Temperature (Condensing – Hot Water/Discharge Air temperature) _____ **°F**

Superheat (Should be around 10°F) _____ **°F**

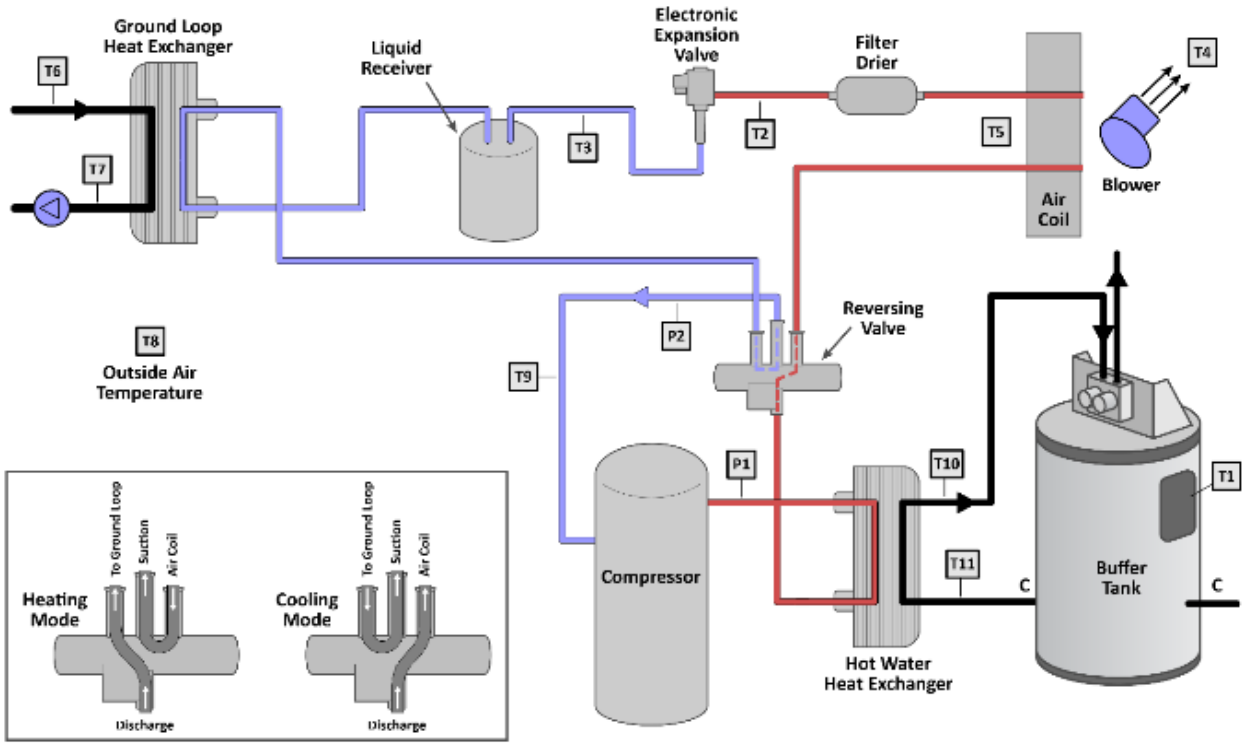
SPEEDS

RC Speed (%) _____

FAN Speed (%) _____

Estimated Flow rate (GPM) _____

Ground Loop Speed (%) _____



STARTUP WORKSHEET

DHHP Startup/Check Worksheet (Circle Startup or Check)

Date: _____

Service Tech: _____

Location: _____

City and Zip: _____

Mode of Operation (Check one)

HY – Heating Mode with HW Hybrid selected ☐

FA – Heating Mode with Hot Air selected ☐

C – Regular Cooling Mode ☐

Purpose of Visit:

_____

_____

SYSTEM TEMPERATURES & PRESSURES

Home Screen (Esc x2)

DAT (Supply Air Temperature, T4) _____ °F

RAT (Return Air Temperature, T5) _____ °F

Air-side Delta T (DAT-RAT) _____ **°F**

GL Inlet (Ground Loop Inlet, T6) _____ °F

GL Outlet (T7 Ground Loop Outlet) _____ °F

Ground Loop Delta T (GL Inlet-Outlet) _____ **°F**

Tank temp (T1 Tank Temperature) _____ °F

HWS (Hot Water Supply, T10) _____ °F

HWR (Hot Water Return, T11) _____ °F

Hot Water Delta T (HW Inlet-Outlet) _____ **°F**

Heat of Extraction:
(GL Delta T x 475 x Flow Rate (GPM) _____

Electrical Input: _____ Amps _____Volts

Heat of Rejection (BTU/Hr):
(Heat of extraction + Electrical Input x 3.41) _____

EFFICIENCY

Condensing temperature _____ **°F**

Hot water supply/ Discharge Air Temperature _____ **°F**

Approach Temperature (Condensing – Hot Water/Discharge Air temperature) _____ **°F**

Superheat (Should be around 10°F) _____ **°F**

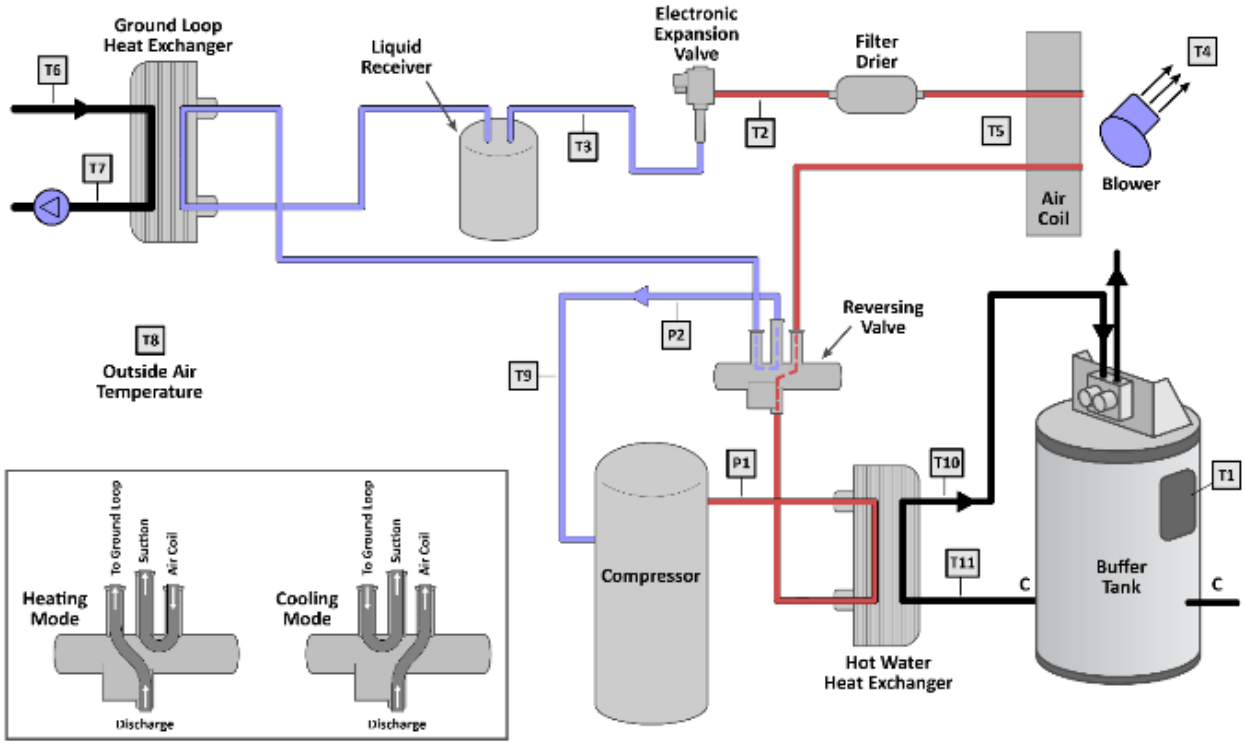
SPEEDS

RC Speed (%) _____

FAN Speed (%) _____

Estimated Flow rate (GPM) _____

Ground Loop Speed (%) _____



STARTUP WORKSHEET

DHHP Startup/Check Worksheet (Circle Startup or Check)

Date: _____

Service Tech: _____

Location: _____

City and Zip: _____

Mode of Operation (Check one)

HY – Heating Mode with HW Hybrid selected ☐

FA – Heating Mode with Hot Air selected ☐

C – Regular Cooling Mode ☐

Purpose of Visit:

_____

_____

SYSTEM TEMPERATURES & PRESSURES

Home Screen (Esc x2)

DAT (Supply Air Temperature, T4) _____ °F

RAT (Return Air Temperature, T5) _____ °F

Air-side Delta T (DAT-RAT) _____ **°F**

GL Inlet (Ground Loop Inlet, T6) _____ °F

GL Outlet (T7 Ground Loop Outlet) _____ °F

Ground Loop Delta T (GL Inlet-Outlet) _____ **°F**

Tank temp (T1 Tank Temperature) _____ °F

HWS (Hot Water Supply, T10) _____ °F

HWR (Hot Water Return, T11) _____ °F

Hot Water Delta T (HW Inlet-Outlet) _____ **°F**

Heat of Extraction:
(GL Delta T x 475 x Flow Rate (GPM) _____

Electrical Input: _____ Amps _____ Volts

Heat of Rejection (BTU/Hr):
(Heat of extraction + Electrical Input x 3.41) _____

EFFICIENCY

Condensing temperature _____ **°F**

Hot water supply/ Discharge Air Temperature _____ **°F**

Approach Temperature (Condensing – Hot Water/Discharge Air temperature) _____ **°F**

Superheat (Should be around 10°F) _____ **°F**

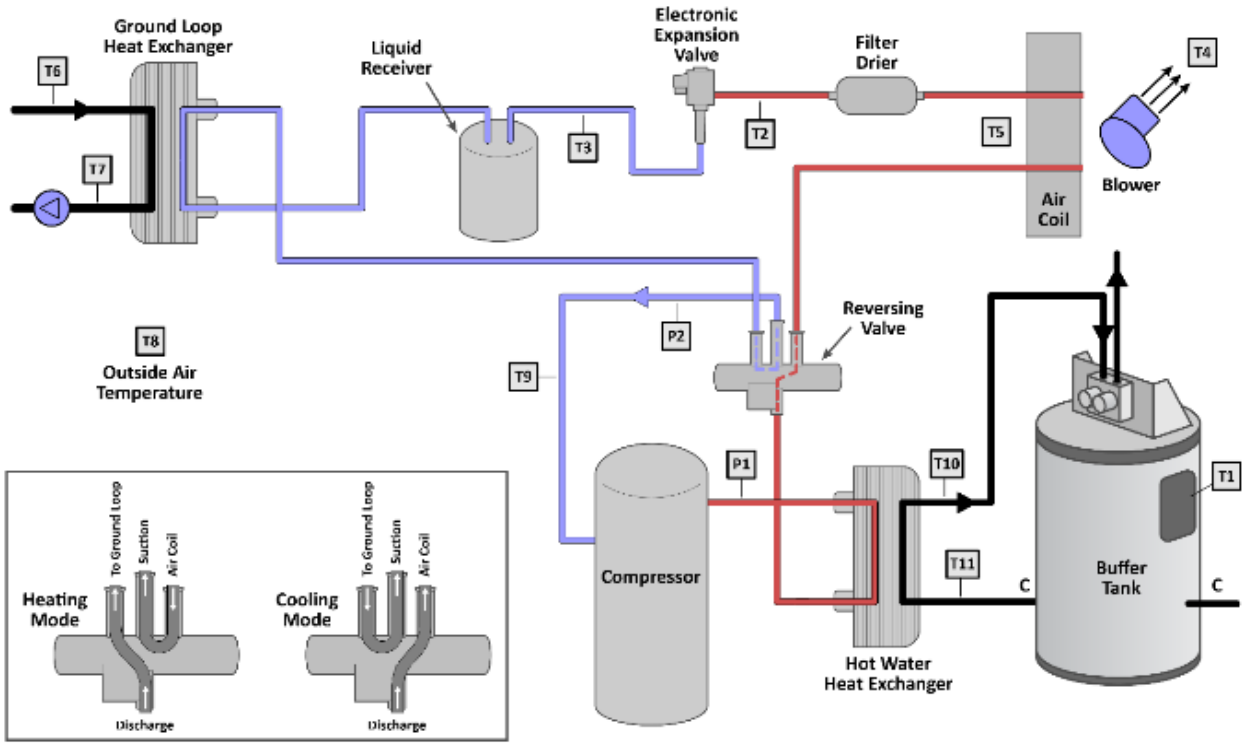
SPEEDS

RC Speed (%) _____

FAN Speed (%) _____

Estimated Flow rate (GPM) _____

Ground Loop Speed (%) _____



Revision History

Revision	Date	Page(s)	Description	Revised By
A	9/7/2023	All	Total redesign of the manual	Matt Desmarais

Contact Information:
Energy Catalyst Technologies
513 25th Street
Watervliet, NY 12189
802-793-0863
Energycatalyst.org
mattd@energycatalysttech.com