

ENVISION™

Commercial 30 Ton

Water Source/Geothermal Heat Pump



Water-Furnace.
Commercial Solutions

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AHRI Data

AHRI/ASHRAE/ISO 13256-1
English (IP) Units

Model	Capacity Modulation	Flow Rate		Water Loop Heat Pump				Ground Water Heat Pump				Ground Loop Heat Pump			
				Cooling EWT 86°F		Heating EWT 68°F		Cooling EWT 59°F		Heating EWT 50°F		Cooling EWT 77°F		Heating EWT 32°F	
		gpm	cfm	Capacity Btuh	EER Btuh/W	Capacity Btuh	COP	Capacity Btuh	EER Btuh/W	Capacity Btuh	COP	Capacity Btuh	EER Btuh/W	Capacity Btuh	COP
360*	Full Load	90.0	8800	355,500	12.1	454,600	4.2	401,600	17.0	375,200	3.7	356,800	13.1	290,800	3.2
	Part Load	90.0	8800	186,600	12.7	238,700	4.3	210,800	17.9	197,000	3.9	187,300	13.8	152,700	3.4

7/24/2015

Cooling capacities based upon 80.6°F DB, 66.2°F WB entering air temperature

Heating capacities based upon 68°F DB, 59°F WB entering air temperature

All ratings based upon 208V operation.

* Ratings are outside the scope of the AHRI Water to Air/Brine to Air Heat Pumps Certification Program.



All Envision Series 30 Ton product is safety listed under UL 60335-2-40 thru and performance tested in accordance with AHRI/ISO standard 13256-1.

AHRI Data cont.

The performance standard AHRI/ASHRAE/ISO 13256-1 became effective January 1, 2000 and replaces AHRI Standards 320, 325, and 330. This new standard has three major categories: Water Loop (comparable to ARI 320), Ground Water (ARI 325), and Ground Loop (ARI 330). Although these standards are similar there are some differences:

Unit of Measure: The Cooling COP

The cooling efficiency is measured in EER (US version measured in Btu/h per Watt. The Metric version is measured in a cooling COP (Watt per Watt) similar to the traditional COP measurement.

Water Conditions Differences

Entering water temperatures have changed to reflect the centigrade temperature scale. For instance the water loop heating test is performed with 68°F (20°C) water rounded down from the old 70°F (21.1°C).

Air Conditions Differences

Entering air temperatures have also changed (rounded down) to reflect the centigrade temperature scale. For instance the cooling tests are performed with 80.6°F (27°C) dry bulb and 66.2°F (19°C) wet bulb entering air instead of the traditional 80°F (26.7°C) DB and 67°F (19.4°C) WB entering air temperatures. 80.6/66.2 data may be converted to 80/67 using the entering air correction table. This represents a significantly lower relative humidity than the old 80/67 of 50% and will result in lower latent capacities.

Pump Power Correction Calculation

Within each model, only one water flow rate is specified for all three groups and pumping Watts are calculated using the following formula. This additional power is added onto the existing power consumption.

$$\bullet \text{ Pump power correction} = (\text{gpm} \times 0.0631) \times (\text{Press Drop} \times 2990) / 300$$

Where 'gpm' is waterflow in gpm and 'Press Drop' is the pressure drop through the unit heat exchanger at rated water flow in feet of head.

Blower Power Correction Calculation

Blower power is corrected to zero external static pressure using the following equation. The nominal airflow is rated at a specific external static pressure. This effectively reduces the power consumption of the unit and increases cooling capacity but decreases heating capacity. These Watts are significant enough in most cases to increase EER and COPs fairly dramatically over ARI 320, 325, and 330 ratings.

$$\bullet \text{ Blower Power Correction} = (\text{cfm} \times 0.472) \times (\text{esp} \times 249) / 300$$

Where 'cfm' is airflow in cfm and 'esp' is the external static pressure at rated airflow in inches of water gauge.

ISO Capacity and Efficiency Calculations

The following equations illustrate cooling calculations:

$$\bullet \text{ ISO Cooling Capacity} = \text{Cooling Capacity (Btu/h)} + (\text{Blower Power Correction (Watts)} \times 3.412)$$

$$\bullet \text{ ISO EER Efficiency (W/W)} = \text{ISO Cooling Capacity (Btu/h)} \times 3.412 / [\text{Power Input (Watts)} - \text{Blower Power Correction (Watts)} + \text{Pump Power Correction (Watt)}]$$

The following equations illustrate heating calculations:

$$\bullet \text{ ISO Heating Capacity} = \text{Heating Capacity (Btu/h)} - (\text{Blower Power Correction (Watts)} \times 3.412)$$

$$\bullet \text{ ISO COP Efficiency (W/W)} = \text{ISO Heating Capacity (Btu/h)} \times 3.412 / [\text{Power Input (Watts)} - \text{Blower Power Correction (Watts)} + \text{Pump Power Correction (Watt)}]$$

Comparison of Test Conditions

	ARI 320	ISO/AHRI 13256-1 WLHP	ARI 325	ISO/AHRI 13256-1 GWHP	ARI 330	ISO/AHRI 13256-1 GLHP
Cooling						
Entering Air - DB/WB °F	80/67	80.6/66.2	80/67	80.6/66.2	80/67	80.6/66.2
Entering Water - °F	85	86	50/70	59	77	77
Fluid Flow Rate	*	**	**	**	**	**
Heating						
Entering Air - DB/WB °F	70	68	70	68	70	68
Entering Water - °F	70	68	50/70	50	32	32
Fluid Flow Rate	*	**	**	**	**	**

Note *: Flow rate is set by 10°F rise in standard cooling test
Part load entering water conditions not shown.

Note **: Flow rate is specified by the manufacturer

WLHP = Water Loop Heat Pump; GWHP = Ground Water Heat Pump; GLHP = Ground Loop Heat Pump

Conversions:

$$\text{Airflow (lps)} = \text{cfm} \times 0.472;$$

$$\text{esp (Pascals)} = \text{esp (in wg)} \times 249;$$

$$\text{Water Flow (lps)} = \text{gpm} \times 0.0631;$$

$$\text{Press Drop (Pascals)} = \text{Press Drop (ft hd)} \times 2990$$

The Envision Series 30 Ton

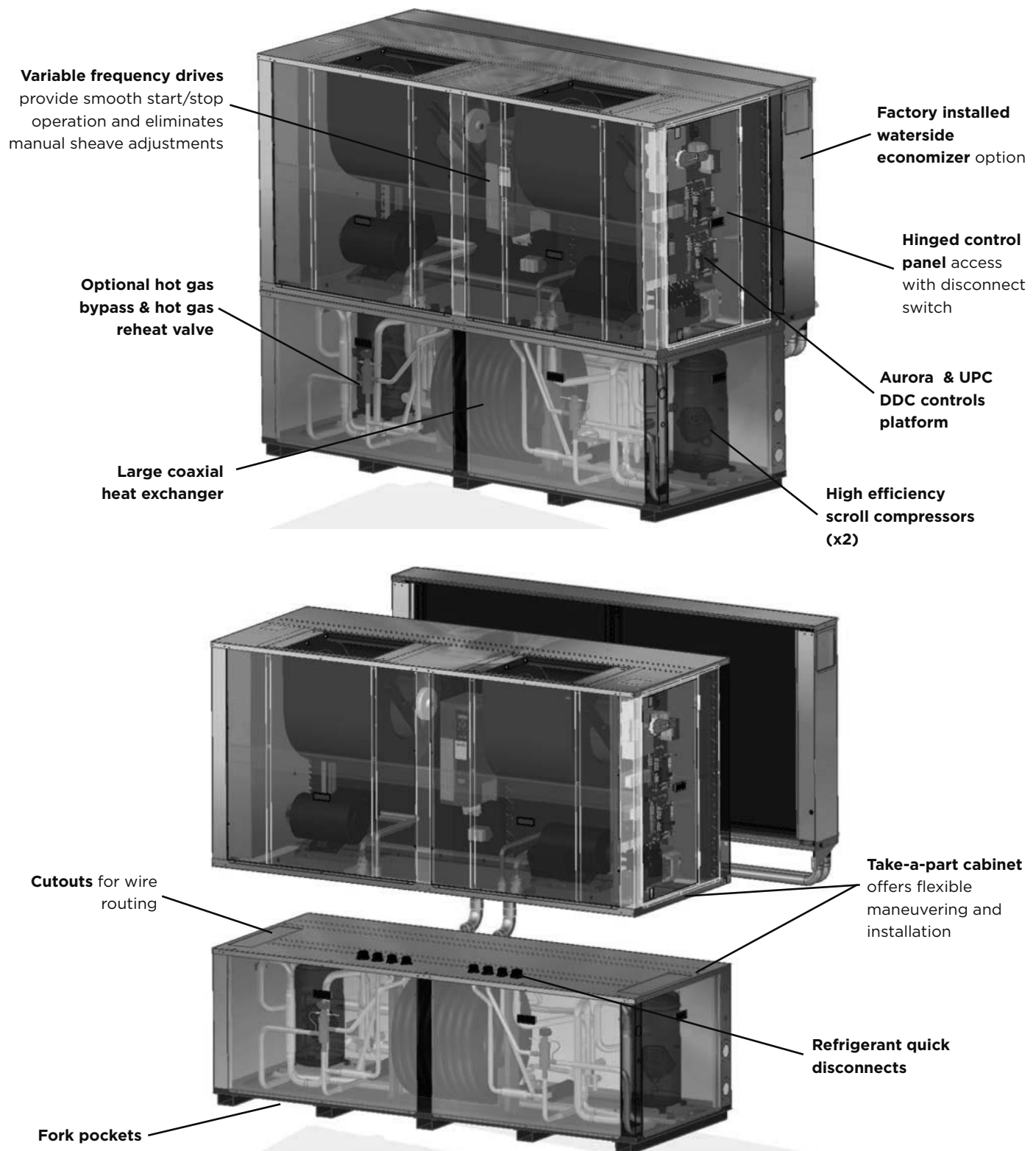
WaterFurnace has expanded large water-to-air packaged heat pumps by introducing the Envision Series 30 Ton that comes with a host of new features. The Envision Series 30 Ton features a take-a-part design that allows the unit to simply be separated in the field for those jobs with not much room to maneuver. By splitting the air handling section from the compressor section, the design can be taken into a building in two different sections which makes it lower weight and smaller footprint. The sections can easily be rejoined. The unit features refrigerant quick disconnects that enable the unit to be factory charged and run tested yet allow separation in the field without touching a refrigerant gauge. Additional new features of the Envision Series 30 Ton is the variable frequency drive (VFD) with an LCD display to adjust blower speeds eliminating manual pulley adjustments. Other advantages of Envision Series 30 Ton is the broad range of factory installed features such as hot gas reheat, internal 2-way water control valves, waterside economizer, electrical disconnects, and many others valuable features that make this product stand in a class of its own.

Envision Series 30 Ton Highlights

- Capacities ranging from 360,000 Btu/h output
- Complete commercial voltage selection of 208-230 V/60 Hz/3ph, 460/60/3, and 575/60/3
- Innovative features such as:
 - Variable frequency drives provide a smooth start/stop operation & LCD touchpad for speed change
 - Optional take-a-part cabinet design featuring refrigerant quick disconnect fittings
 - Optional factory installed waterside economizer reduces installation time and provides minimal piping
 - Short Circuit Current Rating values of 100 kA
 - Aurora DDC controls

The Envision Series 30 Ton cont.

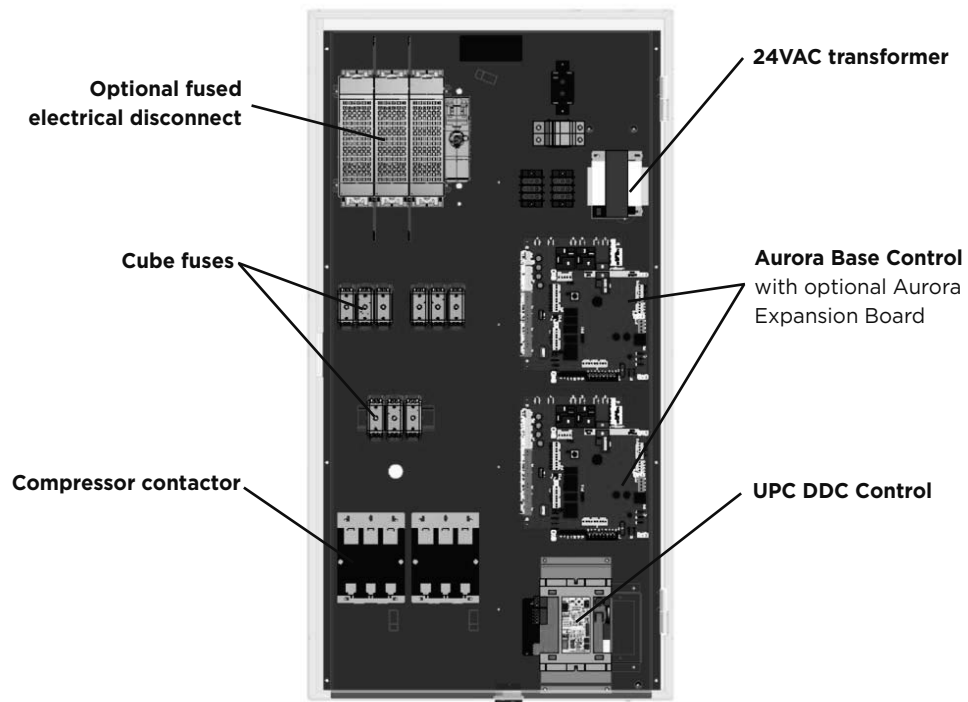
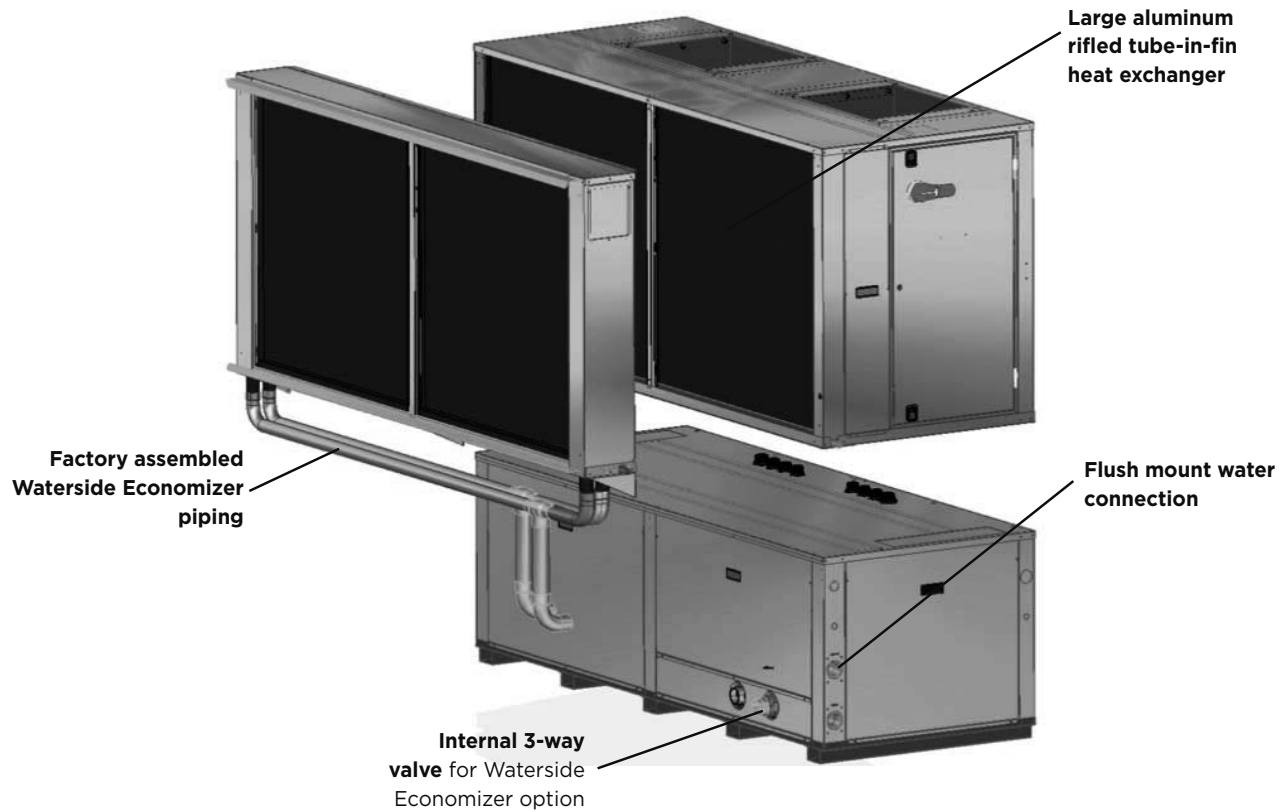
Product Features: Vertical Cabinet



A true left and right return option is available.

The Envision Series 30 Ton cont.

Product Features:



Inside the Envision Series 30 Ton

Compressors

Envision Series 30 Ton water-to-air units use high efficiency R-410A, hermetically sealed; scroll compressors that are mounted on rubber grommets for vibration isolation. Scroll compressors provide high efficiency while providing greater tolerance to liquid refrigerant entering the suction port.



Service Connections and Serviceability

Two Schrader service ports are provided in every refrigerant circuit. The suction side and discharge side ports are for field charging and servicing access. All valves are 7/16 in. SAE connections.



Water-to-Refrigerant Heat Exchanger

Large oversized coaxial refrigerant to water heat exchangers provide unparalleled efficiency. The coaxes are designed for the low pressure drop and low flow rates. All coaxes are pressure rated at 450 psig water side and 600 psig on the refrigerant side. Optional refrigerant and coaxial heat exchanger insulation is available to prevent condensation in low temperature loop operation.



Vibration Absorbers

Vibration absorbers are factory installed on every compressor suction and discharge tube to dampen the vibrations introduced by compressor on the refrigerant piping. These absorbers are constructed from corrugated copper tubing wrapped with stainless steel wire braid to provide strength and flexibility.



Cabinet

All units are constructed of corrosion resistant galvanized sheet metal with polyester powder coat paint rated for more than 1,000 hours of salt spray. Large lift-out access panels provide access to the compressor section from multiple sides. Air handler access panels allow servicing of the blower motor, blower, VFD, and drain pan. Side or top discharge option is available.

All-Aluminum Air Coil

These air coils are constructed of lanced fin and rifled tube aluminum that is not susceptible to formicary corrosion. For additional condensate runoff and meeting project specifications, an optional AlumiSeal e-coating is available.



Hot Gas Bypass/Reheat

The hot gas bypass option is designed to limit the minimum evaporating pressure in the cooling mode to prevent the air coil from icing. Hot gas reheat option provides consistent comfort by removing moisture from the air without over cooling the space. These options are available together or standalone.

Thermostatic Expansion Valve

All units utilize balanced port, bi-directional, thermostatic expansion valves (TXV) for refrigerant metering. These valves have stainless steel capillary tube and bulb for improved robustness over conventional copper sensing capillary lines. The valve consists of a laser-welded power-head, forged brass valve body and diaphragm optimized for R-410A applications. This valve design allows precise refrigerant flow in a wide range of entering water variation geothermal systems.



Internally Mounted Solenoid Valve Option

When variable speed circulating pump systems are designed, low pressure drop (high Cv) solenoid valves are specified at each unit to vary the pump according to flow required. It is important that these valves be low pressure drop to avoid unwanted pump Watts. This option can be factory installed inside the unit.

Water Connections

Flush mount FPT water connection fittings allow one wrench leak-free connections and do not require a backup wrench.

4-Way Reversing Valve

Units feature a reliable all-brass pilot operated refrigerant reversing valve. The reversing valve operation is limited to change of mode by the control to enhance reliability.



Blower Motor and Variable Frequency Drive

Envision Series 30 Ton units are all equipped with a NEMA Premium motor equipped with a variable frequency drive. Variable frequency drives (VFD) provide smooth start/stop operation to eliminate noise and vibration in the cabinet. VFDs also make service and installation easier by eliminating manual sheave adjustments.

Inside the Envision Series 30 Ton cont.

Control Panel

Envision Series 30 Ton control panel features a heavy-duty, hinged service door for ease of service and installation. The keyed service door features a factory mounted disconnect switch. The left interior of the control panel features high voltage components such as the electrical disconnect, fuses, and compressor contactors. The right interior of the panel features the Aurora Base Control (ABC) board, optional expansion board, control transformer, and optional UPC DDC control. The control panel was designed with the technician in mind to provide convenient, clear wiring with plenty of working space.

Electrical Disconnect

A factory mounted, internally wired, disconnect is available to provide electrical isolation from high voltage supply at the heat pump. Separate circuit protection must be field installed in the power wiring and must comply with National Electric Code (NEC) and/or local codes. Disconnect features include:

- Non-fused, rotary disconnect with “on/off” position
- Door interlocked, external pistol handle keeps door closed when disconnect is “on”
- “Lockout/Tagout” feature to keep the unit “off” during service
- Complies with NEC Article 440-14

Short Circuit Current Rating

An optional factory mounted, fused disconnect provides the same benefits as the non-fused version yet increases the short circuit current rating, SCCR to comply with buildings with a high available fault current. Adding the fused disconnect option ensures the equipment will comply with NEC Article 409. Separate circuit protection must be field installed in the power wiring and must comply with National Electric Code (NEC) and/or local codes. Disconnect features include:

- Increases SCCR to 100 kA
- Door interlocked, external pistol handle keeps door closed when disconnect is “on”
- “Lockout/Tagout” feature to keep the unit “off” during service
- Complies with NEC Article 440-14
- Complies with NEC Article 409 for Short Circuit Current Rating

Phase Guard

Factory mounted phase guard device is available to protect the compressor against loss of phase, reverse rotation, or phase imbalance.

Fuses

Envision Series 30 Ton units come with non-indicating CUBEFuse which is a finger-safe, time-delay, power fuse with a small footprint, Class J rating, and have high fault interrupting rating. CUBEFuse includes dual-element fuse construction that can withstand inrush current yet still allow low let-through currents during a fault condition.



Drain Pan

All units feature a stainless steel condensate pan that will not rust or corrode. All condensate connections are made with a 7/8” stainless steel drain tube stubbed from the unit. Units shall be externally trapped and vented according to local and national codes.

Filter Rail

All units come standard with an open filter rail which can accommodate duct connections. For an optional deluxe filter rack, this can be done by special request. Contact a factory representative for availability. Filter options include both MERV 4, 2 in [5.1 cm] or an optional 2 in. [5.1 cm] MERV 13 for LEED certification points and high efficiency filtration.

Refrigerant

Envision Series 30 Ton products all feature zero ozone depletion and low global warming potential refrigerant R-410A.

Air Handler Insulation

Washable air handler insulation surface provides cleanability to further enhance IAQ.



Factory Quality

- All refrigerant brazing is performed in a nitrogen environment.
- Computer controlled deep vacuum and refrigerant charging system.
- All joints are leak detected for maximum leak rate of less than 1/4 oz. per year.
- Computer bar code equipped assembly line ensures all components are correct.
- All units are computer run-tested with water to verify both function and performance.



Controls - Aurora Base Control

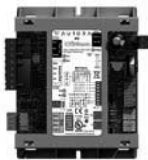
Aurora Base Control

The Aurora Base Control (ABC) System is a complete residential and commercial comfort system that brings all aspects of the HVAC system into one cohesive module network. Aurora uses the Modbus communication protocol to communicate between modules. Each module contains the logic to control all features that are connected to the module. The Aurora Base Control (ABC) has two Modbus channels. The first channel is configured as a master for connecting to devices such as a communicating thermostat, expansion board, or other slave devices. The second channel is configured as a slave for connecting the Aurora Interface Diagnostic (AID) Tool.



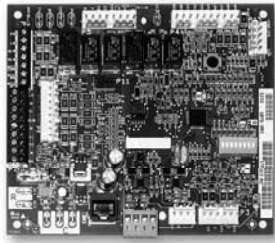
Aurora Unitary Protocol Converter (UPC)

The optional Aurora UPC control provides unparalleled capability in several areas including energy, refrigerant, and performance monitoring, humidity, energy management, and service diagnostics, and then communicates it all thru standard DDC protocols like N2, Lon and BACnet MS/TP. The most unique feature is integration of the Aurora Base Control and UPC into the Envision Series 30 Ton as an integrated heat Pump and DDC controller providing both a cost advantage and providing features not typically found on WSHP controls. This integration allows heat pump monitoring sensors, status and service diagnosis faults to be communicated thru the DDC direct to the building automation system (BAS), giving building supervisors detailed and accurate information on every piece of equipment without removing an access panel!

Control	General Description	Application	Display/Interface	Protocol
Aurora Base Control 	The ABC microprocessor provides all the features necessary to operate today's standard WSHPs that utilize dual capacity compressors and variable speed ECM/5 speed ECM blower motors with hot gas reheat. This control can communicate to a handheld diagnostic tool to help the installing contractor or service technician with equipment setup and service. By utilizing Modbus RTU communication protocol, the ABC board can communicate with additional devices on the Aurora network	Used for residential and commercial applications that use single or dual capacity compressors with PSC, 5-speed ECM, or variable speed ECM blower motors. This base control can also communicate to the AID Tool to display faults, inputs/outputs, and software revision. Commercial features such as hot gas reheat, slow opening water valve, and random start are also capable with the ABC board.	Optional AID tool can be used for field service.	Standalone
Aurora Base Control w/UPC BACnet or N2 	The Aurora Unitary Protocol Converter (UPC) is an integrated solution and communicates directly with the Aurora Heat Pump Controls and allows access/control of a variety of internal Aurora heat pump operations such as sensors, relay operation, faults and other information. In turn, the UPC then converts internal Aurora Modbus protocol to BACnet MS/TP, or N2 protocols and communicates to the BAS system. This provides the great benefit of complete control integration and a myriad of information available to the BAS from the heat pump control. Plus it also allows individual unit configuration such as ECM fan speeds or freeze protection setting directly over the BAS without the need for access to the actual heat pump.	The Aurora UPC is implemented with the Aurora Base Controller (ABC) heat pump control into our latest water source heat pumps. All Internal Aurora points are accessible to the UPC via firmware providing an integrated solution. All zone temperatures and zone sensors are connected to the UPC on an RNet bus, simplifying hook up at the unit. RNet sensors can include a combination of zone temperature and humidity, CO2, and VOC sensors. The UPC includes built-in support for a custom configurable keypad/display unit.	Optional Equipment Touch display	BACnet MS/TP or N2 Open (DIP selectable)
Aurora Base Control w/UPC LonWorks 	The Aurora Unitary Protocol Converter (UPC) is an integrated solution and communicates directly with the Aurora Heat Pump Controls and allows access/control of a variety of internal Aurora heat pump operations such as sensors, relay operation, faults and other information. In turn, the UPC then converts internal Aurora Modbus protocol to LONWorks protocol and communicates to the BAS system.	The Aurora UPC is implemented with the Aurora Base Controller (ABC) heat pump control into our latest water source heat pumps. All Internal Aurora points are accessible to the UPC via firmware providing an integrated solution. All zone temperatures and zone sensors are connected to the UPC on an RNet bus, simplifying hook up at the unit. RNet sensors can include a combination of zone temperature and humidity, CO2, and VOC sensors. The UPC includes built-in support for a custom configurable keypad/display unit.	Optional Equipment Touch display	LonWorks
AXB Expansion Board (Future Availability)	Aurora Advanced Control adds the Aurora AXB expansion board and provides added I/O and standard features. AXB can be added to any of the above packages to enhance the I/O of the controls.	Refrigeration Monitoring - provides Suction and discharge pressure, Suction, liquid line temps and superheat and subcooling. Performance Monitoring - provides entering and leaving loop water temperatures, loop flow rate as well as heat of extraction or rejection rate into the loop. Energy Monitoring - provides real-time power measurement (Watt) of compressor, fan, auxiliary heat and zone pump. - Plus many more I/O options		

Controls - Aurora Base Control cont.

Aurora 'Base' Control



NOTE: Refer to the Aurora Base Control Application and Troubleshooting Guide and the Instruction Guide: Aurora Interface and Diagnostics (AID) Tool for additional information.

Control Features

Software ABC Standard Version 3.0

Single or Dual Capacity Compressors

Either single or dual capacity compressors can be operated.

Variable Speed ECM

Blower Motor Option (If Applicable)

A Variable Speed ECM blower motor can be driven directly using the onboard PWM output. Four blower speeds are available based upon the G, Y1, Y2, and W input signals to the board. The blower speeds can be changed either by the ECM manual configurations mode method or by using the Aurora AID Tool directly. All four blower speeds can be set to the same speed if desired.

5-Speed ECM Blower Motor Option (If Applicable)

A 5-Speed ECM blower motor will be driven directly using the thermostat connections. Any of the G, Y1, or Y2/W signals can drive any of the 5 available pre-programmed blower speeds on the motor. All 5 Series "G" vintage units will be wired this way at the factory.

Other Control Features

- Random start at power up
- Anti-short cycle protection
- High and low pressure cutouts
- Loss of charge
- Water coil freeze detection
- Air coil freeze detection
- Over/under voltage protection
- Condensate overflow sensor
- Load shed
- Dehumidification (where applicable)
- Emergency shutdown
- Hot gas reheat operation (where applicable)
- Diagnostic LED
- Test mode push button switch
- Two auxiliary electric heat outputs
- Alarm output
- Accessory output with N.O. and N.C.
- Modbus communication (master)
- Modbus communication (slave)

Field Selectable Options via Hardware

DIP Switch (SW1) – Test/Configuration Button (See SW1 Operation Table)

Test Mode

The control is placed in the test mode by holding the push button switch SW1 for 2 - 5 seconds. In test mode most of the control timings will be shortened by a factor of sixteen (16). LED3 (green) will flash at 1 second on and 1 second off. Additionally, when entering test mode LED1 (red) will flash the last lockout one time. Test mode will automatically time out after 30 minutes. Test mode can be exited by pressing and holding the SW1 button for 2 to 5 seconds or by cycling the power. **NOTE:** Test mode will automatically be exited after 30 minutes.

Variable Speed ECM Configuration Mode (If Applicable)

The control is placed in the ECM configuration mode by holding the pushbutton switch SW1 for 5 to 10 seconds, the high, low, and "G" ECM speeds can be selected by following the LED display lights. LED2 (yellow) will fast flash when entering the ECM configuration. When setting "G" speed LED3 (green) will be continuously lit, for low speed LED1 (red) will be continuously lit, and for high speed both LED3 (green) and LED1 (red) will be continuously lit. During the ECM configuration mode LED2 (yellow) will flash each of the 12 possible blower speeds 3 times. When the desired speed is flashed press SW1, LED2 will fast flash until SW1 is released. "G" speed has now been selected. Next select low speed, and high speed blower selections following the same process above. After third selection has been made, the control will exit the ECM configuration mode. Aux fan speed will remain at default or current setting and requires the AID Tool for adjustment.

Reset Configuration Mode

The control is placed in reset configuration mode by holding the push button switch SW1 for 50 to 60 seconds. This will reset all configuration settings and the EEPROM back to the factory default settings. LED3 (green) will turn off when entering reset configuration mode. Once LED3 (green) turns off, release SW1 and the control will reset.

DIP Switch (SW2)

- SW2-1** FP1 Selection – Low water coil temperature limit setting for freeze detection. On = 30°F; Off = 15°F.
- SW2-2** FP2 Selection – On = 30°F; Off = N/A
- SW2-3** RV – O/B - thermostat type. Heat pump thermostats with "O" output in cooling or "B" output in Heating can be selected. On = O; Off = B.
- SW2-4** Access Relay Operation (P2)
- and 2-5**

Access Relay Operation	SW2-4	SW2-5
Cycle with Blower	ON	ON
Cycle with Compressor	OFF	OFF
Water Valve Slow Opening	ON	OFF
Cycle with Comm. T-stat Hum Cmd	OFF	ON

Controls - Aurora Base Control cont.

Cycle with Blower - The accessory relay will cycle with the blower output.

Cycle with Compressor - The accessory relay will cycle with the compressor output.

Water Valve Slow Opening - The accessory relay will cycle and delay both the blower and compressor output for 90 seconds.

SW2-6 CC Operation - selection of single or dual capacity compressor. On = Single Stage; Off = Dual Capacity

SW2-7 Lockout and Alarm Outputs (P2) - selection of a continuous or pulsed output for both the LO and ALM Outputs. On = Continuous; Off = Pulsed

SW2-8 Future Use

Alarm Jumper Clip Selection

From the factory, ALM is connected to 24 VAC via JW2. By cutting JW2, ALM becomes a dry contact connected to ALG.

Variable Speed ECM Blower Speeds

The blower speeds can be changed either by using the ECM manual configurations mode method or by using the Aurora AID Tool directly (see Instruction Guide: Aurora Interface and Diagnostics (AID) Tool topic).

Field Selectable Options via Software

(Selectable via the Aurora AID Tool)

ECM Blower Speeds

An ECM blower motor can be driven directly using the onboard PWM output. Four blower speeds are available, based upon the "G", Y1 (low), Y2 (high), and Aux input signals to the board. The blower speeds can be changed either by the ECM manual configurations mode method (see ECM Configuration Mode topic) or by using the Aurora AID Tool directly. All four blower speeds can be set to the same speed if desired. Aux blower speed will remain at default or current setting and requires the AID Tool for adjustment.

Safety Features

The following safety features are provided to protect the compressor, heat exchangers, wiring and other components from damage caused by operation outside of design conditions.

Fuse - a 3 amp automotive type plug-in fuse provides protection against short circuit or overload conditions.

Anti-Short Cycle Protection - 4 minute anti-short cycle protection for the compressor.

Random Start - 5 to 80 second random start upon power up.

Fault Retry - in the fault condition, the control will stage off the outputs and then "try again" to satisfy the thermostat Y input call. Once the thermostat input calls are satisfied, the control will continue on as if no fault occurred. If 3 consecutive faults occur without satisfying the thermostat Y input call, then the control will go to Lockout mode.

Lockout - when locked out, the blower will operate continuously in "G" speed, and PSC blower motor output will remain on. The Alarm output (ALM) and Lockout output (L) will be turned on. The fault type identification display LED1 (Red) shall flash the fault code. To reset lockout conditions with SW2-8 On, thermostat inputs "Y1", "Y2", and "W" must be removed for at least 3 seconds. To reset lockout conditions with SW2-8 Off, thermostat inputs "Y1", "Y2", "W", and "DH" must be removed for at least 3 seconds. Lockout may also be reset by turning power off for at least 30 seconds or by enabling the emergency shutdown input for at least 3 seconds.

Lockout With Emergency Heat - if the control is locked out in the heating mode, and a Y2 or W input is received, the control will operate in the emergency heat mode while the compressor is locked out. The first emergency heat output will be energized 10 seconds after the W input is received, and the blower will shift to high speed. If the control remains locked out, and the W input is present, additional stage of emergency heat will stage on after 2 minutes. When the W input is removed, all of the emergency heat outputs will turn off, and the ECM blower will shift to "G" speed and PSC blower motor output will remain on.

High Pressure - fault is recognized when the Normally Closed High Pressure Switch, P4-9/10 opens, no matter how momentarily. The High Pressure Switch is electrically in series with the Compressor Contactor and serves as a hard-wired limit switch if an overpressure condition should occur.

Low Pressure - fault is recognized when the Normally Closed Low Pressure Switch, P4-7/8 is continuously open for 30 seconds. Closure of the LPS any time during the 30 second recognition time restarts the 30 second continuous open requirement. A continuously open LPS shall not be recognized during the 2 minute startup bypass time.

Loss of Charge - fault is recognized when the Normally Closed Low Pressure Switch, P4-7/8 is open prior to the compressor starting.

Condensate Overflow - fault is recognized when the impedance between this line and 24 VAC common or chassis ground drops below 100K ohms for 30 seconds continuously.

Freeze Detection (Coax) - set points shall be either 30°F or 15°F. When the thermistor temperature drops below the selected set point, the control shall begin counting down the 30 seconds delay. If the thermistor value rises above the selected set point, then the count should reset. The resistance value must remain below the selected set point for the entire length of the appropriate delay to be recognized as a fault. This fault will be ignored for the initial 2 minutes of the compressor run time.

Freeze Detection (Air Coil) - uses the FP2 input to protect against ice formation on the air coil. The FP2 input will operate exactly like FP1 except that the set point is 30 degrees and is not field adjustable.

Controls - Aurora Base Control cont.

Over/Under Voltage Shutdown - An over/under voltage condition exists when the control voltage is outside the range of 18 VAC to 30 VAC. If the over/under voltage shutdown lasts for 15 minutes, the lockout and alarm relay will be energized. Over/under voltage shutdown is self-resetting in that if the voltage comes back within range of 18 VAC to 30 VAC for at least 0.5 seconds, then normal operation is restored.

Operation Description

Power Up - The unit will not operate until all the inputs and safety controls are checked for normal conditions. The unit has a 5 to 80 second random start delay at power up. Then the compressor has a 4 minute anti-short cycle delay after the random start delay.

Standby In standby mode, Y1, Y2, W, DH, and G are not active. Input O may be active. The blower and compressor will be off.

Heating Operation

Single Compressor Heating, 2nd Stage (Y1, Y2)

The compressor will be staged to full capacity 20 seconds after Y2 input is received. The ECM blower will shift to high speed seconds after the Y2 input is received.

Dual Compressor Heating, 2nd Stage (Y1, Y2)

In dual compressor operation, two ABC boards used in 24 VAC operation, there will be a Y2 call to the Y1 input on the second ABC. The compressor will stage to full capacity 30 seconds after Y1 input is received to the second board.

Single Compressor Heating, 3rd Stage (Y1, Y2, W)

The hot water pump is de-energized and the first stage of electric heat is energized 10 seconds after the W command is received. If the demand continues the second stage of electric heat will be energized after 5 minutes.

Dual Compressor Heating, 3rd Stage (Y1, Y2, W) -

The first stage of electric heat is energized 10 seconds after the W command is received. If the demand continues the second stage of electric heat will be energized after 5 minutes

Emergency Heat (W) - The blower will be started on "G" speed, 10 seconds later the first stage of electric heat will be turned on. 5 seconds after the first stage of electric heat is energized the blower will shift to Aux speed. If the emergency heat demand is not satisfied after 2 minutes the second electric heat stage will be energized.

Blower (G) - The blower will start immediately upon receiving a thermostat G command. If there are no other commands from the thermostat the ECM will run on "G" speed until the G command is removed. Regardless of blower input (G) from the thermostat, the blower will remain on for 30 seconds at the end of each heating cycle.

Cooling Operation

In all cooling operations, the reversing valve directly tracks the O input. Thus, anytime the O input is present, the reversing valve will be energized.

Single Compressor Cooling, 2nd Stage (Y1, Y2, O)

The compressor will be staged to full capacity 20 seconds after Y2 input was received. The ECM blower will shift to high speed 15 seconds after the Y2 input was received.

Dual Compressor Cooling, 2nd Stage (Y1, Y2, O)

In dual compressor operation, two ABC boards used in 24 VAC operation, there will be a Y2 call to the Y1 input on the second ABC. The compressor will stage to full capacity 30 seconds after Y1 input is received to the second board.

Blower (G) - The blower will start immediately upon receiving a thermostat G command. If there are no other commands from the thermostat the ECM will run on "G" speed until the G command is removed. Regardless of blower input (G) from the thermostat, the blower will remain on for 30 seconds at the end of each heating, cooling, and emergency heat cycle.

Dehumidification (Y1, O, DH or Y1, Y2, O, DH) - When a DH command is received from the thermostat during a compressor call for cooling the ECM blower speed will be reduced by 15% to increase dehumidification.

Emergency Shutdown - Four (4) seconds after a valid ES input, P2-7 is present, all control outputs will be turned off and remain off until the emergency shutdown input is no longer present. The first time that the compressor is started after the control exits the emergency shutdown mode, there will be an anti-short cycle delay followed by a random start delay. Input must be tied to common to activate.

Continuous Blower Operation - The blower output will be energized any time the control has a G input present, unless the control has an emergency shutdown input present. The blower output will be turned off when G input is removed.

Load Shed - The LS input disables all outputs with the exception of the blower output. When the LS input has been cleared, the anti-short cycle timer and random start timer will be initiated. Input must be tied to common to activate.

Controls - Aurora Base Control cont.

Aurora 'Base' Control LED Displays

These three LEDs display the status, configuration, and fault codes for the control. These can also be read in plain English via the Aurora AID Tool.

Status LED (LED3, Green)

Description of Operation	Fault LED, Green
Normal Mode	ON
Control is Non-functional	OFF
Test Mode	Slow Flash
Lockout Active	Fast Flash
Dehumidification Mode	Flash Code 2
(Future Use)	Flash Code 3
(Future Use)	Flash Code 4
Load Shed	Flash Code 5
ESD	Flash Code 6
(Future Use)	Flash Code 7

Configuration LED (LED2, Yellow)

Description of Operation	Configuration LED, Yellow
No Software Overwritten	Flashing ECM Setting
DIP Switch was Overwritten	Slow Flash
ECM Configuration Mode	Fast Flash

Fault LED (LED1, Red)

Red Fault LED	LED Flash Code*	Lockout	Reset/Remove
Normal - No Faults	OFF	-	
Fault - Input	1	No	Auto
Fault - High Pressure	2	Yes	Hard or Soft
Fault - Low Pressure	3	Yes	Hard or Soft
Fault - Freeze Detection FP2	4	Yes	Hard or Soft
Fault - Freeze Detection FP1	5	Yes	Hard or Soft
Fault - Condensate Overflow	7	Yes	Hard or Soft
Fault - Over/Under Voltage	8	No	Auto
Fault - FP1 & FP2 Sensor Error	11	Yes	Hard or Soft

NOTE: All codes >11 use long flash for tens digit and short flash for the ones digit. 20, 30, 40, 50, etc. are skipped.

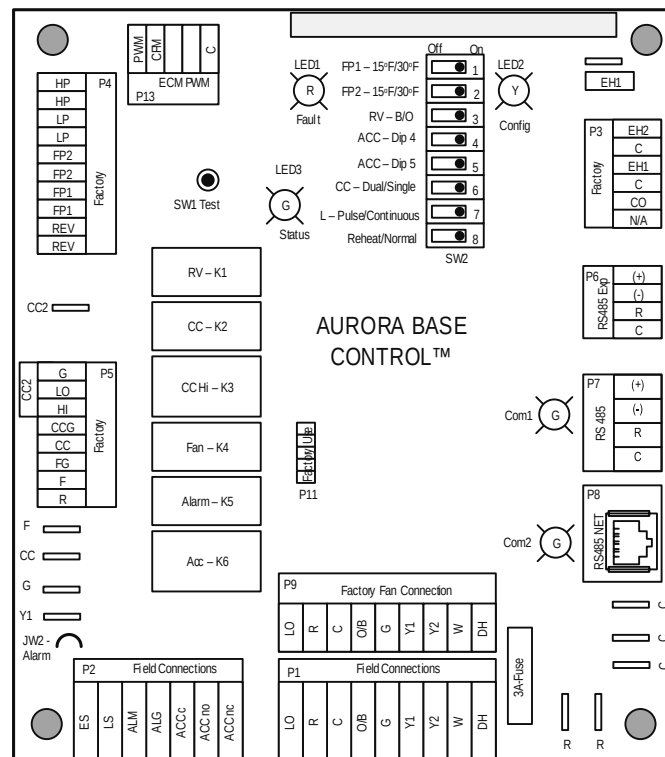
Aurora Interface and Diagnostics (AID) Tool

The Aurora Interface and Diagnostics (AID) Tool is a device that is a member of the Aurora network.

The AID Tool is used to troubleshoot equipment which uses the Aurora control via Modbus RTU communication. The AID Tool provides diagnostics, fault management, ECM setup, and system configuration capabilities to the Aurora family of controls. An AID Tool is recommended, although not required, for ECM airflow settings. The AID Tool simply plugs into the exterior of the cabinet in the AID Tool port.



ABC Control Board Layout



Controls - UPC DDC Control (optional)



Aurora UPC Controller

The Aurora Unitary Protocol Converter (UPC) is designed to add-on to any Aurora based heat pump control. The Aurora Unitary Protocol Converter (UPC) is designed to allow water source heat pumps to be integrated into Building Automation Systems (BAS) with ease. The Aurora UPC is an integrated solution and communicates directly with the Aurora Heat Pump Controls and allows access/control of a variety of internal Aurora heat pump operations such as sensors, relay operation, faults and other information. In turn, the UPC then converts internal Aurora Modbus protocol to BACnet MS/TP, LON, or N2 protocols and communicates to the BAS system. This provides the great benefit of complete control integration and a myriad of information available to the BAS from the heat pump control. Plus it also allows individual unit configuration such as ECM fan speeds or freeze protection setting directly over the BAS without the need for access to the actual heat pump. The Aurora UPC is programmed using the powerful Eikon object oriented.

The Aurora UPC is implemented with the Aurora Base Controller (ABC) heat pump control into our latest water source heat pumps. This will allow for a BAS to integrate

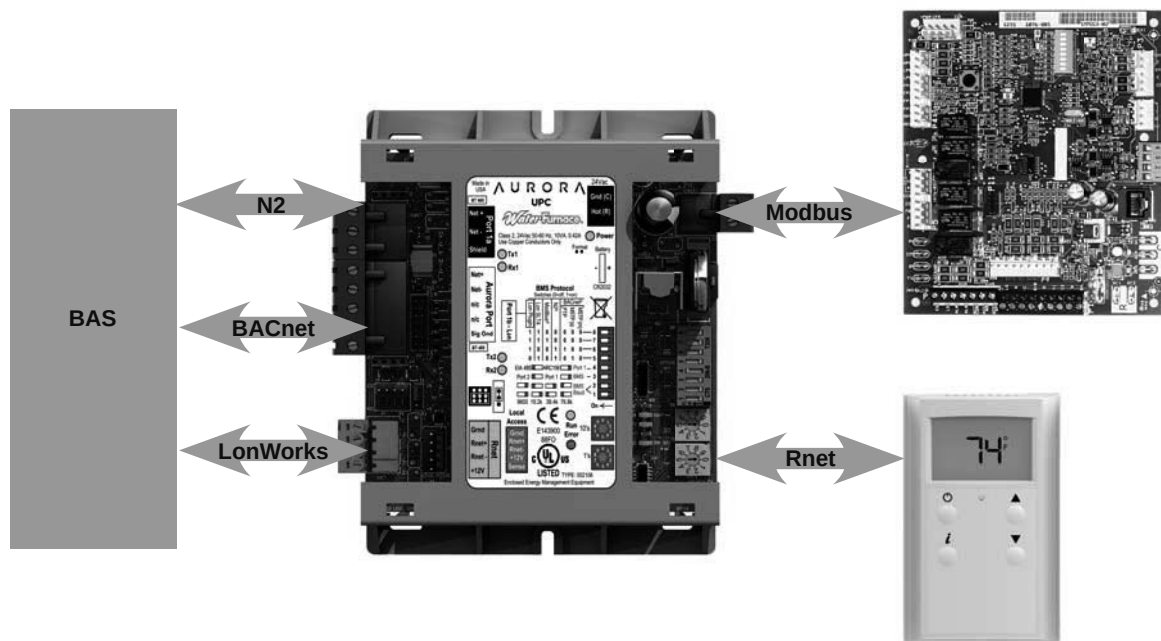


ZS Series Sensors

and communicate to the heat pump thru a choice of 3 different communication protocols. The Aurora UPC has the ability to communicate BACnet MS/TP, N2 open, or LonWorks (requires LON Plugin card). This flexibility is possible due to the onboard dipswitches which allow for the desired protocol and baud rate to be selected in the field. All zone temperatures and zone sensors are connected to the UPC on an RNet bus, simplifying hook up at the unit. RNet sensors can include a combination of zone temperature and humidity, CO2, and VOC sensors. The UPC includes built-in support for a custom configurable keypad/display unit - BACview6 (4-line by 40 character per line display) or BACview5 (2-line by 16 character per line display). Up to 2 Keypad/display units can be mounted remotely for configuration and troubleshooting.

There are an extensive number of points that the UPC has available over the network for integration into the BAS. Control programmers need to carefully determine which points they want to add into the BAS database. A list of the BACnet points, N2 points, and LON SNVTs are available along with their individual point descriptions by contacting the Commercial Solutions Group at 1-877-677-4420.

Controls - UPC DDC Control (optional) cont.



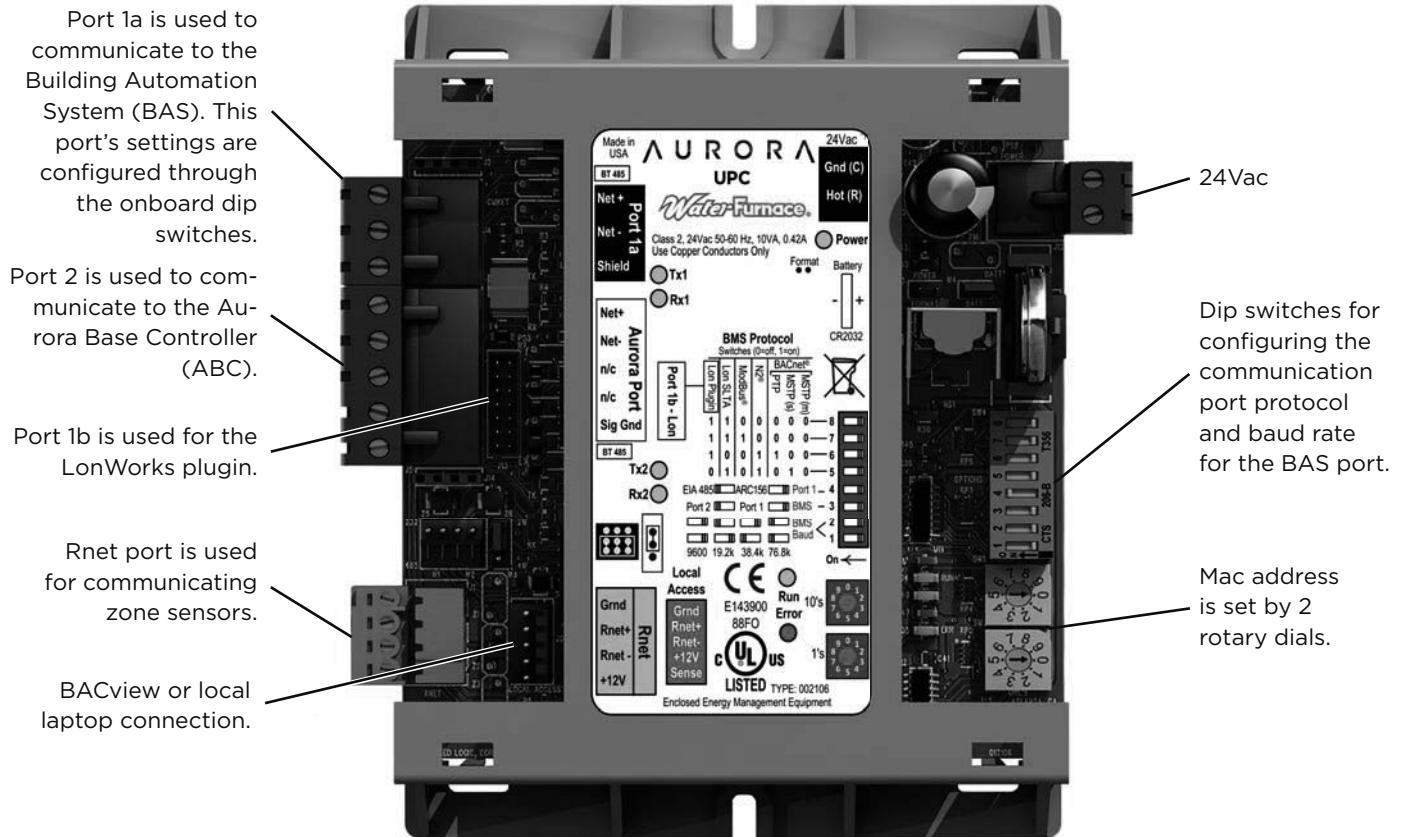
Aurora UPC Features

- Rugged enclosure made of GE C2950 Cylcoloy plastic
- Built-in surge transient protection circuitry
- Operating range of -20° to 140°F; 10 to 95% relative humidity, non-condensing
- Onboard CR123A battery has a life of 10 years with 720 hours of cumulative power outage
- Multi-Protocol field selectable communication port that supports:
 - EIA-485 BACnet MS/TP @ 9600, 19.2k, 38.4k, 76.8k baud
 - Metasys N2 Open
 - LonWorks TP/FT-10 (Requires optional LON plug-in communication card)
- Status of all unit operating conditions and fault lockouts
- Visual LED's for status of power, network communication, processor operation, and errors
- Provides gateway into Aurora heat pump controls for unsurpassed control flexibility
 - Network point for commanding unit into load shed
 - Network point for commanding unit into emergency shutdown
 - Network points to assist in fan speed selection
 - Network points for freeze protection settings
- Heating and cooling control from a remotely located zone sensor
- Rnet communication port which allows for multiple Rnet zone sensors (5) to be connected for space temperature averaging if desired.
- Local laptop or BACview connection for field service
- FCC, UL and CE listed. BTL Certification is pending

Aurora UPC Optional Features

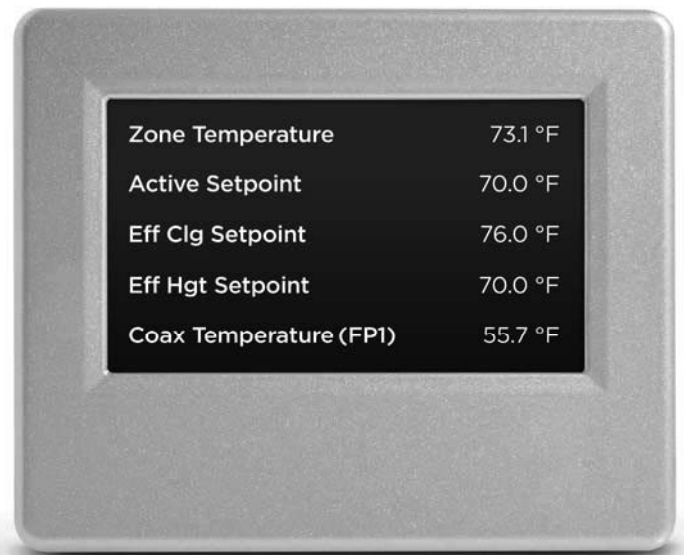
- BACview handheld display, needed for field configuration of fan speeds, set points, etc.
- AID Tool for Aurora ABC configuration and troubleshooting.
- Aurora Advanced Control adds the Aurora AXB expansion board and provides added I/O and standard features
- Optional Sensor Kits (requires Aurora Advanced Control with AXB - Future Availability on Select Models/Configurations)
 - **Refrigeration Monitoring** - provides Suction and discharge pressure, Suction, liquid line temps and superheat and subcooling.
 - **Performance Monitoring** - provides entering and leaving loop water temperatures, loop flow rate as well as heat of extraction or rejection rate into the loop.
 - **Energy Monitoring** - provides real-time power measurement (Watt) of compressor, fan, auxiliary heat and zone pump.
- Graphics packages available in the future

Controls - UPC DDC Control (optional) cont.



Aurora Touch Interface

Utilizing a touch-screen interface, the UPC provides a technician the ability to configure and diagnose equipment at the unit or from any room sensor for added accessibility and simpler troubleshooting. The technician will have full access to equipment status, parameter values, temperature, and humidity sensing as well as access to alarm and trend history. With website-like navigation, the Aurora Touch Interface is easy to use and provides important insight into the system so your building can operate as efficiently as possible.



Controls - UPC DDC Control (optional) cont.

- Leaving Air Temperature (LAT) Sensor** - This 10 kOhm NTC sensor is factory installed on all UPC equipped heat pumps. It typically is attached to wiring inside the blower cabinet on the suction side of the blower. This sensor is attached on ABC FP2 pins available as LAT AU-30.
- Compressor Proving Sensors** - This optional factory installed current sensor is connected to confirm compressor operation via the power wires. The sensor is attached at ABC Y1 and available at point BV-65.
- Valve End Switch** - This optional input is setup for a field installed flow valve end switch. This end switch input is attached at ABC Y2 and available at point BV-67.
- Fan Proving Sensors** - This optional factory installed current sensor is connected to confirm fan operation via the power wires. The sensor is attached at ABC G and available at point BV-33.
- Occupancy Sensor** - This standard feature includes a field installed and wired room sensor with occupancy sensor typically found in DDC systems. The RNet room sensors can be found thru your commercial representative. The occupancy Sensors are attached at ABC O and can be found at point BV-49.

- Dirty Filter Switch** - This optional field installed switch is connected to confirm dirty filter operation. The dirty filter switch can be found thru your commercial representative. The sensor is attached at ABC W and available at point BV-63.
- Fault, Configuration, and Status Codes** - The codes can be visible to the BAS if desired

Aurora Base Fault Codes (ABC Only)

Fault LED (LED1, Red)

	Red Fault LED	LED Flash Code*	Lockout	Reset/Remove
ABC Basic Faults	Normal - No Faults	OFF	-	
	Fault - Input	1	No	Auto
	Fault - High Pressure	2	Yes	Hard or Soft
	Fault - Low Pressure	3	Yes	Hard or Soft
	Fault - Freeze Detection FP2	4	Yes	Hard or Soft
	Fault - Freeze Detection FP1	5	Yes	Hard or Soft
	Fault - Condensate Overflow	7	Yes	Hard or Soft
	Fault - Over/Under Voltage	8	No	Auto
	Fault - FP1 & FP2 Sensor Error	11	Yes	Hard or Soft

NOTE: All codes >11 use long flash for tens digit and short flash for the ones digit. 20, 30, 40, 50, etc. are skipped.

Aurora Advanced Fault Codes (ABC + AXB Expansion Board)

Fault LED (LED1, Red)

	Red Fault LED	LED Flash Code *	Lockout	Reset/Remove	Fault Condition Summary
ABC Basic Faults	Normal - No Faults	Off	-		
	Fault-Input	1	No	Auto	Tstat input error. Autoreset upon condition removal.
	Fault-High Pressure	2	Yes	Hard or Soft	HP switch has tripped (>600 psi)
	Fault-Low Pressure	3	Yes	Hard or Soft	Low Pressure Switch has tripped (<40 psi for 30 continuous sec.)
	Fault-Freeze Detection FP2	4	Yes	Hard or Soft	Freeze protection sensor has tripped (<15 or 30 degF for 30 continuous sec.)
	Fault-Freeze Detection FP1	5	Yes	Hard or Soft	Freeze protection sensor has tripped (<15 or 30 degF for 30 continuous sec.)
	Fault-Condensate Overflow	7	Yes	Hard or Soft	Condensate switch has shown continuity for 30 continuous sec.
	Fault-Over/Under Voltage	8	No	Auto	Instantaneous voltage is out of range. **Controls shut down until resolved.
ABC & AXB Advanced Faults	Fault-FP1 & 2 Snsr Error	11	Yes	Hard or Soft	If FP1 or 2 Sensor Error
	Fault-Compressor Monitor	10	Yes	Hard or Soft	Open Crkt, Run, Start or welded cont
	Non-CriticAXBSnsrErr	13	No	Auto	Any Other Sensor Error
	CriticAXBSnsrErr	14	Yes	Hard or Soft	Sensor Error for EEV or HW
	Alert-HotWtr	15	No	Auto	HW over limit or logic lockout. HW pump deactivated.
	Fault-VarSpdPump	16	No	Auto	Alert is read from PWM feedback.
	Not Used	17	No	Auto	IZ2 Com Fault. Autoreset upon condition removal.
	Non-CritComErr	18	No	Auto	Any non-critical com error
	Fault-CritComErr	19	No	Auto	Any critical com error. Auto reset upon condition removal
	Alarm - Low Loop Pressure	21	No	Auto	Loop pressure is below 3 psi for more than 3 minutes
	Alarm - Home Automation 1	23	No	Auto	Closed contact input is present on Dig 2 input - Text is configurable
	Alarm - Home Automation 2	24	No	Auto	Closed contact input is present on Dig 3 input - Text is configurable

NOTES:

*All codes >11 use long flash for tens digit and short flash for the ones digit. 20, 30, 40, 50 etc. are skipped!

Alert' is a noncritical sensor or function that has failed. Normal operation of the heat pump is maintained but service is desired at some point.

Controls - UPC DDC Control (optional) cont.

Aurora Base or Advanced Control Configuration and Status Codes

Status LED (LED3, Green)

Description of Operation	Fault LED, Green
Normal Mode	ON
Control is Non-functional	OFF
Test Mode	Slow Flash
Lockout Active	Fast Flash
Dehumidification Mode	Flash Code 2
Load Shed	Flash Code 5
Emergency Shutdown	Flash Code 6
On Peak Mode	Flash Code 7
(Future Use)	Flash Code 8
(Future Use)	Flash Code 9

Configuration LED (LED2, Yellow)

Description of Operation	Configuration LED, Yellow
No Software Overwritten	ECM Setting
DIP Switch Overwritten	Slow Flash
ECM Configuration Mode	Fast Flash
Reset Configuration Mode	OFF

- 9. Alarm Relay** - The Alarm relay (ALM) is factory connected to 24 VAC via jumper JW2. By cutting JW2, ABC ALM becomes a dry contact connected to ABC ALG. The Relay is field switchable between Factory setting as an Alarm output or available for other uses.
- 10. Accessory Relay1** - A configurable, accessory relay on the ABC is provided that can be cycled with the compressor, blower, or the Dehumidifier (DH) input. A third (factory) setting cycles the relay with the compressor but delays the compressor and blower output for 90 sec. Source pump or slow opening solenoid valves in well systems or variable speed primary pumping systems would be a prime use of this feature.

Access Relay Operation	SW2-4	SW2-5
Cycle with Blower	ON	ON
Cycle with Compressor	OFF	OFF
Water Valve Slow Opening	ON	OFF
Cycle with Comm. T-stat Hum Cmd	OFF	ON

- 11. Electric Heat EH1** - A digital 24VDC output is provided for electric heat powering. UPC's Default programming has EH1 set for AUX/ELEC Heat operation and will be controlled using the UPC's internal P.I.D. logic. However it can be changed by the BAS to be network controlled.
- 12. Electric Heat EH2** - A digital VDC output is provided for field options converted from the original EH2 output. Default UPC program has the EH2 output set for Network Control but can be changed by the BAS to be controlled by the UPC's internal P.I.D. logic.

Controls - UPC DDC Control (optional) cont.

Aurora Advanced Control Configuration and Options (Future Availability on Select Models/Configurations)

1. **Accessory Relay2** - A second, configurable, accessory relay on the AXB is provided that can be cycled with the compressor 1 or 2, blower, or the Dehumidifier (DH) input. This is to complement the Accessory 1 Relay on the ABC board.

Position	DIP 4	DIP 5	Description
1	ON	ON	Cycles with Fan or ECM (or G)
2	OFF	ON	Cycles with CC1 first stage of compressor or compressor spd 1-12
3	ON	OFF	Cycles with CC2 second stage of compressor or compressor spd 7-12
4	OFF	OFF	Cycles with DH input from ABC board

2. **Analog Out** - A standard 0-10VDC analog output is provided. This output can be used to drive modulating dampers etc.
3. **Variable Speed Pump or Modulating Water Valve (If applicable)** - This input and output are provided to drive and monitor a variable speed pump. The VS pump output is a PWM signal to drive the variable speed pump. The minimum and maximum level are set using the AID Tool. 75% and 100% are the default settings respectively. The VS data input allows a separate PWM signal to return from the pump giving fault and performance information. Fault received from the variable speed pump will be displayed as E16. **Modulating Water Valve** - This Variable speed PWM output is provided to optionally drive a modulating water valve. Through advanced design a 0-10VDC valve can be driven directly from the VS pump output. The minimum and maximum level are set in the same way as the VS pump using the AID Tool. 75% and 100% are the default settings respectively.
4. **Loop Pump Slaving (If applicable)** - This input and output are provided so that two units can be slaved together with a common flow center. When either unit has a call for loop pump, both unit's loop pump relays and variable speed pumps are energized. The flow center then can simply be wired to either unit. The output from one unit should be routed to the input of the other. If daisy chained up to 16 heat pumps can be wired and slaved together in this fashion.

Controls - UPC DDC Control (optional) cont.

Aurora Advanced Control Optional Sensor Kits (Future Availability on Select Models/Configurations)

1. **Energy Monitoring (Standard Sensor Kit on 'Advanced' models)** - The Energy Monitoring Kit includes two current transducers (blower and electric heat) added to the existing two compressor sensors so that the complete power usage of the heat pump can be measured. The BACview Tool provides configuration detail for the type of blower motor and a line voltage calibration procedure to improve the accuracy. This real time power usage information can be displayed on the AID Tool and is available thru network points when using BACnet or N2 Open.
 - Compressor Current 1
 - Compressor Current 2
 - Fan Current
 - Aux Heat Current
 - Pump Selection
 - Voltage
 - Compressor Watts
 - Fan Watts
 - Aux Heat Watts
 - Pump Watts (VS Only)
2. **Refrigerant Monitoring (optional sensor kit)** - The optional Refrigerant Monitoring Kit includes two pressure transducers, and three temperature sensors, heating liquid line, suction temperature and existing cooling liquid line (FP1). These sensors allow the measurement of discharge and suction pressures, suction and liquid line temperatures as well as superheat and subcooling. This information can be displayed on the BACview Tool, or the network when using BACnet and N2.
 - Htg Liquid Line
 - Clg Liquid Line
 - Discharge pressure
 - Suction Pressure
 - Discharge Saturated Temp
 - Suction Saturated Temperature
 - Superheat
 - SubCooling
3. **Performance Monitoring (optional sensor kit)** - The optional Performance Monitoring Kit includes: three temperature sensors, entering and leaving water, leaving air temperature and a water flow rate sensor. With this kit, heat of extraction and rejection will be calculated. This requires configuration using the BACview Tool for selection of water or antifreeze.
 - Leaving Air Temperature (supply)
 - Alt Leaving Air Temperature (Supply)
 - Entering Water Temperature
 - Leaving Water Temperature
 - Water Flow Meter
 - Entering Air Temperature (from zone sensor)
 - Brine Selection (water/antifreeze)
 - Heat of Extraction/Rejection

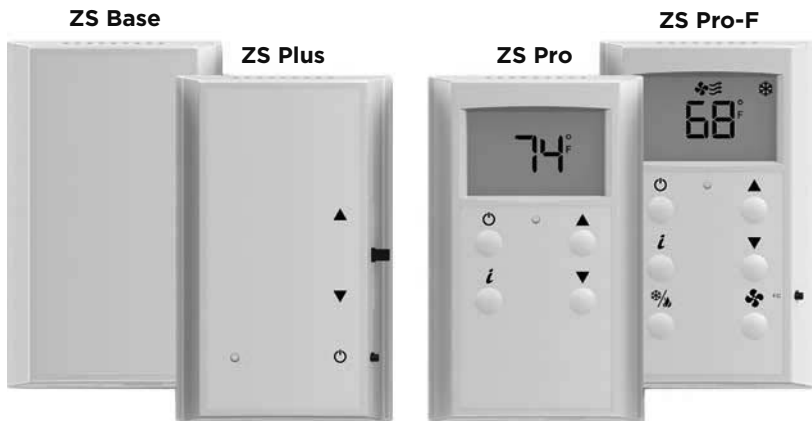
Controls - UPC DDC Control (optional) cont.

ZS Series RNet Sensor Overview

The ZS Series line of intelligent zone sensors provides the function and flexibility you need to manage the conditions important to the comfort and productivity of the zone occupants. The ZS sensors are available in a variety of zone sensing combinations to address your application needs. These combinations include temperature, relative humidity, and indoor air quality (carbon dioxide or VOCs (Volatile Organic Compounds)). They are built to be flexible allowing for easy customization of what the user/technician sees. Designed to work with the Aurora UPC controllers the ZS sensor line includes the ZS Base, ZS Plus, ZS Pro and ZS Pro-F.

The UPC uses a proprietary communication called Rnet to receive the space temperature from the zone sensor.

This is done using (2) 18 AWG twisted pair unshielded cables for a total of 4 wires connected to the Rnet port. The sensor gets its power from the UPC controller and connecting multiple sensors to one UPC will allow for space temperature averaging. The UPC can support one ZS Pro or ZS Pro F with up to four ZS standard sensors wired to the Rnet port on the UPC for a total of 5 zone sensors. The sensors use a precise 10k ohm thermistor with less than 0.18°F drift over a ten year span, this allows for less maintenance or re-calibration after installation. The sensors also have a hidden communication port for connecting a BACview or local laptop that provides access to the equipment for commissioning and maintenance. The table below shows the features of each of the four sensors that are currently available.



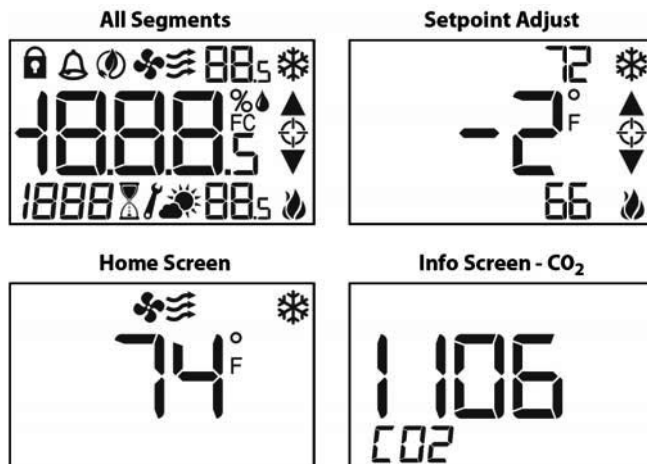
Features	ZS Base	ZS Plus	ZS Pro	ZS Pro-F
Temp, CO ² , Humidity, and VOC Options	✓	✓	✓	✓
Neutral Color	✓	✓	✓	✓
Addressable/supports daisy chaining	✓	✓	✓	✓
Hidden communication port	✓	✓	✓	✓
Mounts on a standard 2" by 4" electrical box	✓	✓	✓	✓
Occupancy Status indicator LED		✓	✓	✓
Push button occupancy override		✓	✓	✓
Setpoint adjust		✓	✓	✓
Large, easy to read LCD			✓	✓
Alarm indicator			✓	✓
°F to °C conversion button				✓

Options	Part Number	Part Number	Part Number	Part Number
Temperature Only	ZSU	ZSUPL	ZSUP	ZSUPF
Temp with CO ²	ZSU-C	ZSUPL-C	ZSUP-C	ZSUPF-C
Temp with Humidity	ZSU-H	ZSUPL-H	ZSUP-H	ZSUPF-H
Temp with Humidity, CO ²	ZSU-HC	ZSUPL-HC	ZSUP-HC	ZSUPF-HC
Temp, Humidity, VOC	ZSU-HV	ZSUPL-HV	ZSUP-HV	ZSUPF-HV
Temp with VOC	ZSU-V	ZSUPL-V	ZSUP-V	ZSUPF-V

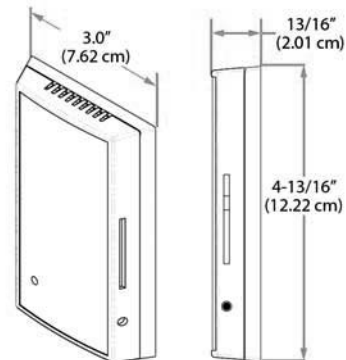
Controls - UPC DDC Control (optional) cont.

RNet Sensor Physical and Electrical Data

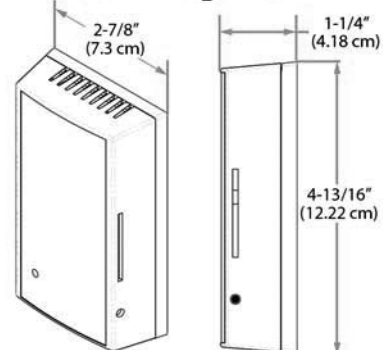
Sensing Element	Range	Accuracy
Temperature (on non-Humidity models)	-4° to 122° F (-20° C to 50° C)	30.35° F (0.2° C)
Temperature (on Humidity models)	50° F to 104° F (10° C to 40° C)	30.5° F (0.3° C)
Humidity	10% to 90%	31.8% typical
CO2	400 to 1250 PPM 1250 to 2000 PPM	330PPM or +/-3% of reading (greater of two) 35% of reading plus 30 PPM
VOC	0 to 2,000 PPM	3100 PPM
Power Requirements	Sensor Type	Power Required
Temperature Only	All Models	12 Vdc @ 8 mA
Temperature with Humidity	All Models	12 Vdc @ 15 mA (idle) to 190 mA (CO2 measurement cycle)
Temp with VOC, or Temp/VOC/Humidity	All Models	12 Vdc @ 60 mA
Temp with CO2 , or Temp/ CO2/Humidity	All Models	12 Vdc @ 15 mA (idle) to 190 mA (CO2 measurement cycle)
Power Supply	A controller supplies the Rnet sensor network with 12 Vdc @ 210 mA. Additional power may be required for your application. See sensor ZS Installation Guide	
Communication	115 kbps Rnet connection between sensor(s) and controller 15 sensors max per Rnet network; 5 sensors max per control program	
Local Access Port	For connecting a laptop computer to the local equipment for maintenance and commissioning	
Environmental Operating Range	32° to 122° F (0° - 50° C), 10% to 90% relative humidity, non-condensing	
Mounting Dimensions	Standard 4"x 2" electrical box using provided 6/32" x 1/2" mounting screws	



Temperature Only or Temperature with Humidity



Sensor with CO2 or VOC



Hot Gas Reheat/Hot Gas Bypass

Hot Gas Reheat Description

The refrigerant flows in normal heat pump path in heating and cooling mode. During the Reheat mode, the operation begins with superheated vapor leaving the compressor going through the reheat valve to the reheat air coil. In the reheat coil the high temperature high pressure gas reheats the air exiting the unit to near neutral. Next, the refrigerant exits the reheat coil and passes through a check valve, which is used to prevent refrigerant flow into the reheat coil during normal heating and cooling operation. The refrigerant passes through the check valve and is then diverted to the coaxial heat exchanger by the four way reversing valve. The hot gas enters the coaxial heat exchanger which will condense the gas to a high pressure liquid due to heat being rejected to the loop fluid. The high pressure liquid leaves the coax and enters the inlet of the TXV. After passing through the TXV the low pressure mixture of liquid/vapor refrigerant expands in the air coil evaporating into a low pressure low temperature gas and moves back through the reversing valve and into the compressor suction. The cycle then starts again by compressing the low pressure low temperature gas into a superheated vapor. A small copper bleed line is located on the reheat/reclaim valve to allow refrigerant that has migrated to the reheat coil to escape.

Hot Gas Bypass Description

The hot gas bypass (HGB) option is designed to limit the minimum evaporating pressure in the cooling mode to prevent the air coil from icing. The HGB valve senses pressure at the outlet of the evaporator by an external equalizer. If the evaporator pressure decreases to 115 psig the HGB valve will begin to open and bypass hot discharge gas into the inlet of the evaporator. The valve will continue to open as needed until it reaches its maximum capacity. Upon a rise of suction pressure, the valve will begin to close back off and normal cooling operation will resume.

Hot Gas Reheat/Hot Gas Bypass cont.

Hot Gas Reheat Dehumidification Overview

Dehumidification - The Need for Reheat

With tighter construction and more and more ventilation air being introduced into buildings, there is more need now than ever for proper humidity control. Ensuring dehumidification can provide consistent employee comfort, a reduction in mold liability, a reduction in cooling costs. Reduced humidity also provides an improvement in indoor air quality (IAQ) thru lower humidity levels which can reduce allergen levels, inhibit mold and bacterial growth, and provide an improved computer environment. ASHRAE 90.1 speaks of an acceptable humidity range in all commercial buildings.

Typical Reheat Applications

Reheat can be used wherever moisture is a problem. Schools, high latent auditorium and theaters, makeup air units*, and computer rooms are typical applications. Although reheat equipped water source heat pumps (wshp's) can condition limited amounts of outdoor air, the percentage of this outdoor air should never exceed 50% of the return air to the unit limiting the mixed return air temperature to a minimum of 50°F. When cold entering air conditions are anticipated, hot gas bypass option should be considered to prevent air coil freeze up.

*A dedicated outdoor air system (DOAS) should be investigated for 100% outdoor air applications.

The Design of Reheat Equipment

Hot gas reheat can help maintain specific humidity levels and neutral air in a building. ASHRAE recommends a relative humidity range of 30-60% with levels greater than 65% making mold growth a possibility. The dehumidification relative humidity set points of 57% (on) and 52% (off) are recommended. During reheat the leaving air temperature (LAT) will approximate neutral air. The included chart (Leaving Air Temperature vs. Entering Water and Air Conditions Chart) shows the LAT vs entering water temperature (EWT) to the unit at differing entering air conditions. At 86-90°F EWT the unit will provide nearly neutral air.

Moisture Removal Capacity

The amount of moisture removal may be calculated by subtracting the sensible cooling capacity from the total cooling capacity in the equipment performance data of the specifications catalog or submittal data. An example is shown below:

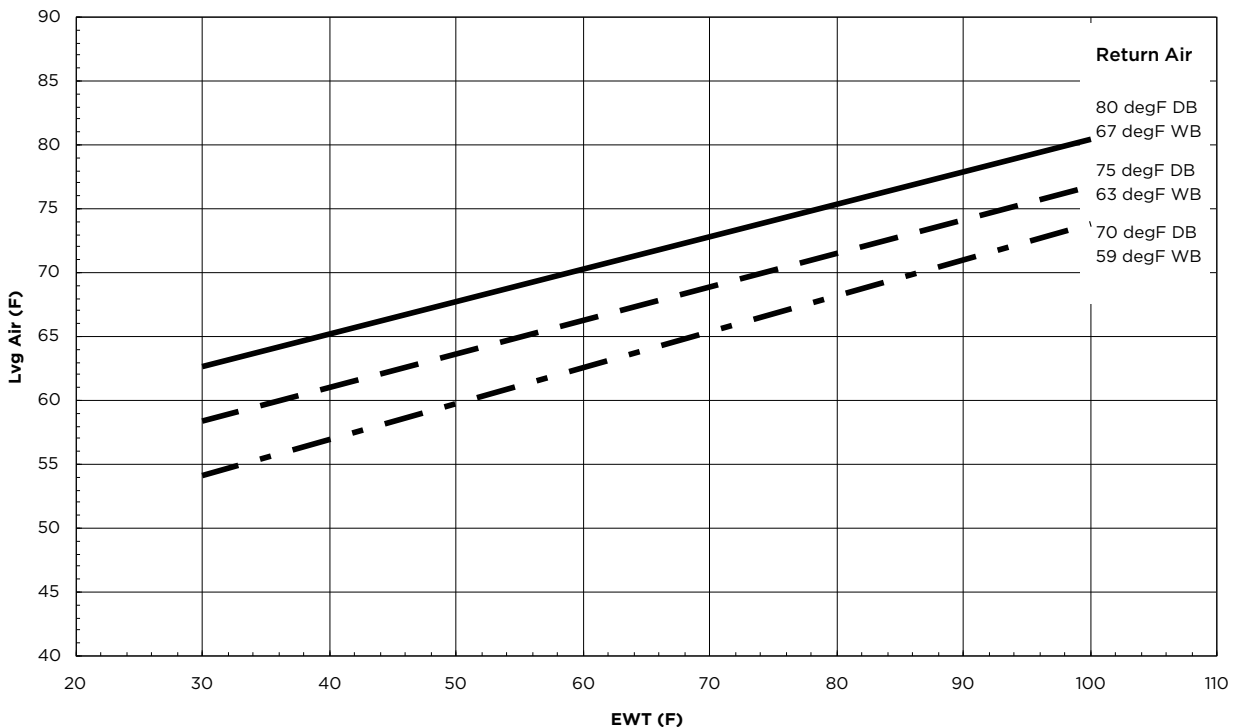
Model WA5D*360, 8800 cfm, 90 gpm, 90°F EWT

$$TC - SC = LC$$

$$316.5 - 221.9 \text{ MBtu/h} = 94.6 \text{ MBtu/h}$$

Where TC = total cooling capacity, SC=sensible capacity, LC=latent capacity

Leaving Air Temperature vs. Entering Water and Air Conditions Chart



Hot Gas Reheat/Hot Gas Bypass cont.

Hot Gas Reheat Dehumidification Overview cont.

Btu/hr may be converted to lbs/hr or grains per hour as shown in the equations below.

$$94,600 \text{ Btu/h} / 1,069 \text{ Btu/lb of water vapor at } 80/67 \text{ DB/WB}^\circ\text{F} = 88.49 \text{ lbs/hr}$$

$$88.49 \text{ lbs/hr} \times 7,000 \text{ grains/lb} = 619,457 \text{ grains/hr}$$

External Static Pressure Adjustment

With a reheat coil option installed an adjustment for external static pressure (ESP) needs to be made. The following table will show the reduction in ESP for any model relating coil air velocity and ESP.

ESP vs. Coil Velocity Table

Coil Velocity (fpm)	250	300	350	400
ESP Increase (in. wg.)	0.10	0.14	0.17	0.20

Model WA5D*360, 8800 cfm,

$$H \times W = SA$$
$$40 \times 40 \times 2 = 3200 \text{ in.}^2 = 22.22 \text{ ft.}^2$$

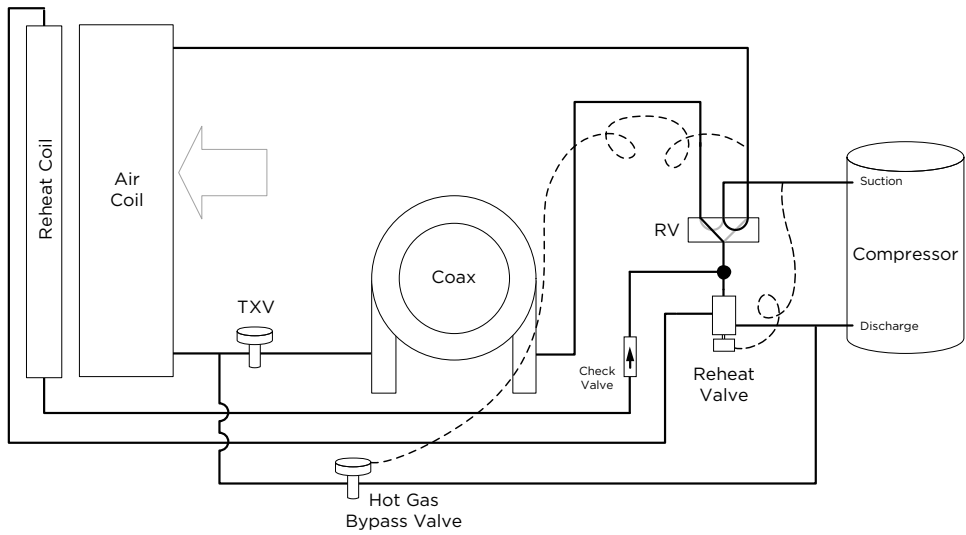
Where H=fin height of air coil, W=fin length of air coil, SA=fin surface area

Calculate air velocity, fpm, cfm / SA

$$8800 \text{ cfm} / 22.22 \text{ ft.}^2 = 396 \text{ fpm}$$

Refer to the ESP vs. Coil Velocity Table and look up the fpm to find ESP increase. If air velocity is below 250 cfm assume 0.10 increase in ESP. Interpolation of data within the table is permitted.

Hot Gas Bypass with Hot Gas Reheat Layout



Hot Gas Reheat - Controls

Hot Gas Reheat Controls

The reheat option is available with the Aurora control. The following schemes are available:

Room wall dehumidistat

An optional room wall dehumidistat that controls the reheat mode thru a 24VAC 'Hum' input (On or Off). Setpoint and deadband is determined by the dehumidistat.

Duct humidity sensor (UPC only)

An optional duct humidity sensor is installed. The UPC control reads the humidity from the sensor and determines operation mode. Setpoint and deadband are internally set by the UPC control and are adjustable. Continuous blower operation is a requirement for this mode to accurately measure relative humidity during the off cycle.

Room wall humidity sensor (UPC only)

An optional wall humidity sensor is installed. The UPC control reads the humidity from the sensor and determines operation mode. Setpoint and deadband are internally set by the UPC control and are adjustable. Continuous blower operation is NOT a requirement for this mode.

The unit will cycle thru a 'flush cycle' to purge refrigerant and oil from the idle heat exchanger once every 24 hours when in cooling mode. The UPC control will provide an option to set back reheat to an adjustable unoccupied humidity set point during unoccupied time periods. This option is factory set to "OFF" so reheat will control to one set point at all times. If set back is required during unoccupied times the option must be set to "ON" in the field by the building automation system or a user interface. The dehumidification set back will only work when using a duct humidity sensor or room wall humidity sensor.

Mode of Operation

Please refer to the refrigeration circuit diagram (Hot Gas Reheat - Refrigerant section) and the hot gas reheat wiring schematic.

Heating Mode Operation

Upon a call for heating (Y), blower relay is energized immediately, and the compressor contactor will be energized after a 90 second delay.

Cooling Mode Operation

Upon a call for cooling (Y, O), blower relay and reversing valve coil are energized immediately, and the compressor contactor is energized after a 90 second delay. If there is a call from the de-humidistat or the internal control logic see the humidity sensor has reached set point the blower cfm will be reduced by 15% to increase the unit's latent capacity.

Dehumidification Mode Operation

Upon a call for dehumidification, the blower relay and reversing valve coil are energized immediately, and the compressor contactor will energize after a 90 second delay. The reheat valve coil will energize once the compressor has been operational for 30 seconds.

If a call for space heating is received during reheat operation the compressor will shut down for 5 minutes and the unit will restart in the heating mode. Once the requirement for space heating has been satisfied the unit will shut down for 5 minutes and re-start in reheat mode.

If a call for space cooling is received during reheat operation the reheat valve coil will be disabled until the space cooling requirements have been satisfied. Once the space cooling requirements have been satisfied the reheat valve coil will be energized with out shutting down the compressor.

Dehumidification Set Point (used only with a humidity sensor)

The factory default set point for dehumidification is 52% this is field adjustable from 30% to 60%. In addition there is a factory default differential of 5% field adjustable from 5% to 15%. The control will enable re-heat when the space humidity rises above the set point plus the differential. Depending upon the environmental conditions within the building and the operating parameters of the water source heat pump, the unit may not be capable of maintaining the lower control limit of 30% relative humidity over extended periods of time.

Reheat operation during periods of unoccupancy

This unoccupied set point is useful to reduce energy use in dehumidification. Many system designs greatly reduce or even eliminate fresh air makeup during the unoccupied hours and the need for reheat is lessened. The control logic contains an unoccupied set point that can be used for the unoccupied mode if desired. The factory default for the set point is 60% and is adjustable from 30% to 60%. The unoccupied setback must be enabled either through a building automation system or with a user interface. Factory default for unoccupied setback is off.

Space Humidity High and Low Alarm Limit (building automation system only)

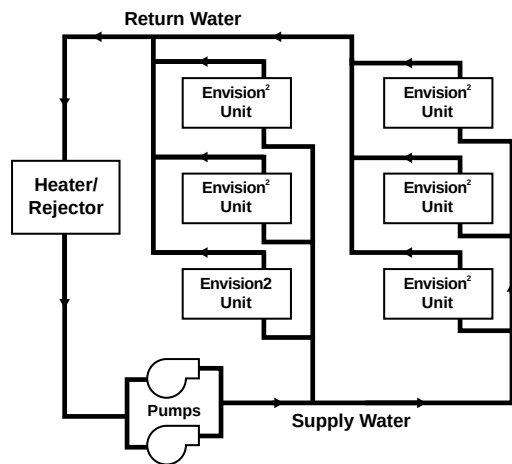
The control has a high and low alarm limit that can be enumerated over a building automation system. The factory default set point for these alarm limits is 0% for the low alarm and 100% for the high alarm limit. These limits can be adjusted though a building automation system. Caution should be used in selecting these limits so as not to cause nuisance alarms.

Application Notes

The Closed Loop Heat Pump Concept

The basic principle of a water source heat pump is the transfer of heat into water from the space during cooling, or the transfer of heat from water into the space during heating. Extremely high levels of energy efficiency are achieved as electricity is used only to move heat, not to produce it. Using a typical WaterFurnace Envision Series 30 Ton, one unit of electricity will move four to five units of heat.

When multiple water source heat pumps are combined on a common circulating loop, the ultimate in energy efficiency is created: The WaterFurnace units on cooling mode are adding heat to the loop which the units in heating mode can absorb, thus removing heat from the area where cooling is needed, recovering and redistributing that heat for possible utilization elsewhere in the system. In modern commercial structures, this characteristic of heat recovery from core area heat generated by lighting, office equipment, computers, solar radiation, people or other sources, is an important factor in the high efficiency and low operating costs of WaterFurnace closed source heat



pump systems.

In the event that a building's net heating and cooling requirements create loop temperature extremes, Envision Series 30 Ton units have the extended range capacity and versatility to maintain a comfortable environment for all building areas. Excess heat can be stored for later utilization or be added or removed in one of three ways; by ground-source heat exchanger loops: plate heat exchangers connected to other water sources, or conventional cooler/boiler configurations. Your WaterFurnace representative has the expertise and computer software to assist in determining optimum system type for specific applications.

The Closed Loop Advantage

A properly applied water source heat pump system offers many advantages over other systems. First costs are low because units can be added to the loop on an "as needed basis"- perfect for speculative buildings. Installed costs are low since units are self-contained and can be located adjacent to the occupied space, requiring minimal ductwork. Maintenance can be done on individual units without system shut-down. Conditions remain comfortable since each unit operates separately, allowing cooling in one area and heating in another. Tenant spaces can be finished and added as needed. Power billing to tenants is also convenient since each unit can be individually metered: each pays for what each uses. Nighttime and/or weekend uses of certain areas are possible without heating or cooling the entire facility. A decentralized system also means if one unit should fault, the rest of the system will continue to operate normally, as well as eliminating air cross-contamination problems and expensive high pressure duct systems requiring an inefficient electric resistance reheat mode.

The Envision Series 30 Ton Approach

Vertical - Closed Loop/Ground Source



There are a number of proven choices in the type of Envision Series 30 Ton system which would be best for any given application. Most often considered are:

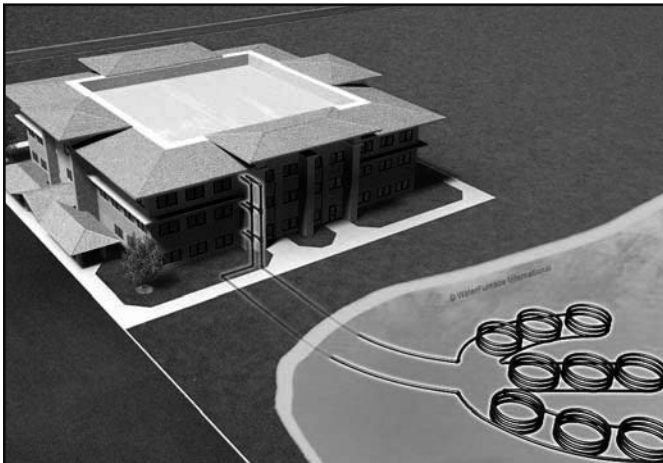
- **Closed Loop/Ground-Source Systems** utilize the stable temperatures of the earth to maintain proper water source temperatures (via vertical or horizontal closed loop heat exchangers) for Envision Series 30 Ton extended range heat pump system. Sizes range from a single unit through many hundreds of units. When net cooling requirements cause closed loop water temperatures to rise, heat is dissipated into the cooler earth through buried high strength plastic pipe "heat exchangers." Conversely if net space heating demands cause loop heat absorption beyond that heat recovered from building core areas, the

Application Notes cont.

loop temperature will fall causing heat to be extracted from the earth. Due to the extended loop temperatures, AHRI/ISO 13256-1 Ground Loop Heat Pumps are required for this application. Because auxiliary equipment such as a fossil fuel boiler and cooling tower are not required to maintain the loop temperature, operating and maintenance costs are very low.

Ground-source systems are most applicable in residential and light commercial buildings where both heating and cooling are desired, and on larger envelope dominated structures where core heat recovery will not meet overall heating loads. Both vertical and horizontally installed closed-loops can be used. The land space required for the “heat exchangers” is 100-250 sq. ft./ton on vertical (drilled) installations and 750-1500 sq. ft./ton for horizontal (trenched) installations. Closed loop heat exchangers can be located under parking areas or even under the building itself.

Surface Water - Closed Loop/Ground Source



On large multi-unit systems, sizing the closed loop heat exchanger to meet only the net heating loads and assisting cooling loads with a closed circuit cooling tower may be the most cost effective choice.

• ***Closed Loop/Ground-Source Surface Water Systems*** also utilize the stable temperatures of Surface Water to maintain proper water source temperatures for Envision Series 30 Ton extended range heat pump systems. These systems have all of the advantages of horizontal and vertical closed loop systems. Due to the extended loop temperatures, AHRI/ISO 13256-1 Ground Water or Ground Loop Heat Pumps are required for this application.

In cooling dominated structures, the ground-source surface water systems can be very cost effective especially where local building codes require water retention ponds for short term storage of surface run-off. Sizing requirements for the surface water is a minimum of 500 sq. ft./ton of surface area at a minimum depth of 8 feet. WaterFurnace should be

Plate Heat Exchanger - Closed Loop/Ground Water



contacted when designs for heating dominated structures are required.

Application Notes cont.

Cooler/Boiler - Closed Loop



• **Closed Loop /Cooler-Boiler Systems** utilize a closed heat recovering loop with multiple water source heat pumps in the more conventional manner. Typically a boiler is employed to maintain closed loop temperatures above 60°F and a cooling tower to maintain loop temperatures below 90°F. These systems are applicable in medium to large buildings regardless of whether the load is heating or cooling dominated. Due to the moderate loop temperatures, AHRI/ISO 13256-1 Water Loop Heat Pumps are required for this application.

Water Quality

In ground water situations where scaling could be heavy or where biological growth such as iron bacteria will be present, a closed loop system is recommended. The heat exchanger coils in ground water systems may, over a period of time, lose heat exchange capabilities due to a buildup of mineral deposits inside. These can be cleaned, but only by a qualified service mechanic, as special solutions and pumping equipment are required. Hot water generator coils can likewise become scaled and possibly plugged. In areas

with extremely hard water, the owner should be informed that the heat exchanger may require occasional flushing. Failure to adhere to the guidelines in the water quality table could result in loss of warranty.

Units with cupronickel heat exchangers are recommended for open loop applications due to the increased resistance to build-up and corrosion, along with reduced wear caused by acid cleaning.

Material		Copper	90/10 Cupronickel	316 Stainless Steel
pH	Acidity/Alkalinity	7 - 9	7 - 9	7 - 9
Scaling	Calcium and Magnesium Carbonate	(Total Hardness) less than 350 ppm	(Total Hardness) less than 350 ppm	(Total Hardness) less than 350 ppm
Corrosion	Hydrogen Sulfide	Less than 0.5 ppm (rotten egg smell appears at 0.5 ppm)	10 - 50 ppm	Less than 1 ppm
	Sulfates	Less than 125 ppm	Less than 125 ppm	Less than 200 ppm
	Chlorine	Less than 0.5 ppm	Less than 0.5 ppm	Less than 0.5 ppm
	Chlorides	Less than 20 ppm	Less than 125 ppm	Less than 300 ppm
	Carbon Dioxide	Less than 50 ppm	10 - 50 ppm	10 - 50 ppm
	Ammonia	Less than 2 ppm	Less than 2 ppm	Less than 20 ppm
	Ammonia Chloride	Less than 0.5 ppm	Less than 0.5 ppm	Less than 0.5 ppm
	Ammonia Nitrate	Less than 0.5 ppm	Less than 0.5 ppm	Less than 0.5 ppm
	Ammonia Hydroxide	Less than 0.5 ppm	Less than 0.5 ppm	Less than 0.5 ppm
	Ammonia Sulfate	Less than 0.5 ppm	Less than 0.5 ppm	Less than 0.5 ppm
Iron Fouling (Biological Growth)	Total Dissolved Solids (TDS)	Less than 1000 ppm	1000 - 1500 ppm	1000 - 1500 ppm
	LSI Index	+0.5 to -0.5	+0.5 to -0.5	+0.5 to -0.5
	Iron, FE ²⁺ (Ferrous) Bacterial Iron Potential	< 0.2 ppm	< 0.2 ppm	< 0.2 ppm
Erosion	Iron Oxide	Less than 1 ppm, above this level deposition will occur	Less than 1 ppm, above this level deposition will occur	Less than 1 ppm, above this level deposition will occur
	Suspended Solids	Less than 10 ppm and filtered for max. of 600 micron size	Less than 10 ppm and filtered for max. of 600 micron size	Less than 10 ppm and filtered for max. of 600 micron size
	Threshold Velocity (Fresh Water)	< 6 ft/sec	< 6 ft/sec	< 6 ft/sec

NOTES: Grains = ppm divided by 17
mg/L is equivalent to ppm

2/22/12

Installation Notes

Typical Unit Installation

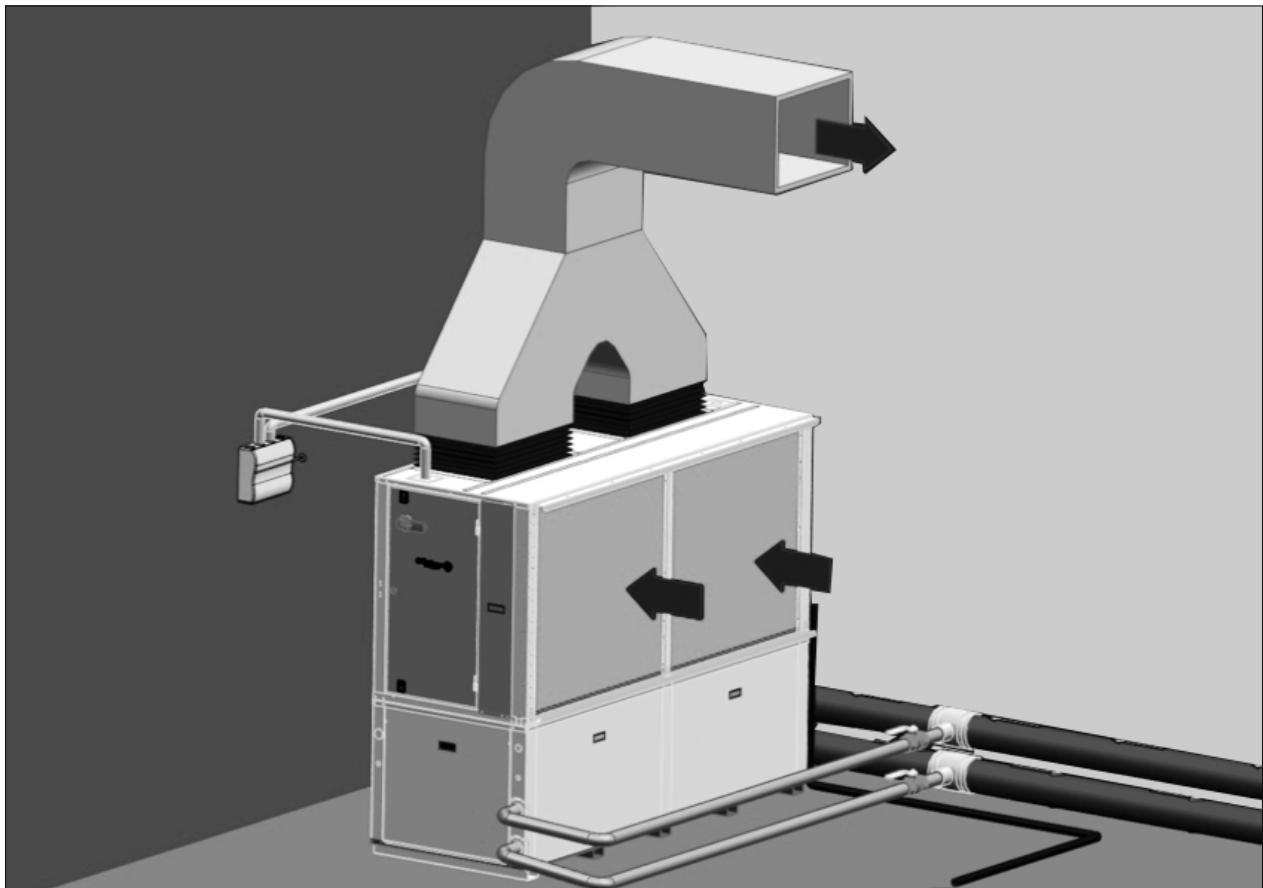
Unit Location

Locate the unit in an indoor area that allows for easy removal of the filter and access panels. Location should have enough space for service personnel to perform maintenance or repair. Provide sufficient room to make water, electrical and duct connection(s). If the unit is located in a confined space, such as a closet, provisions must be made for return air to freely enter the space by means of louvered door, etc. Any access panel screws that would be difficult to remove after the unit is installed should be removed prior to setting the unit.

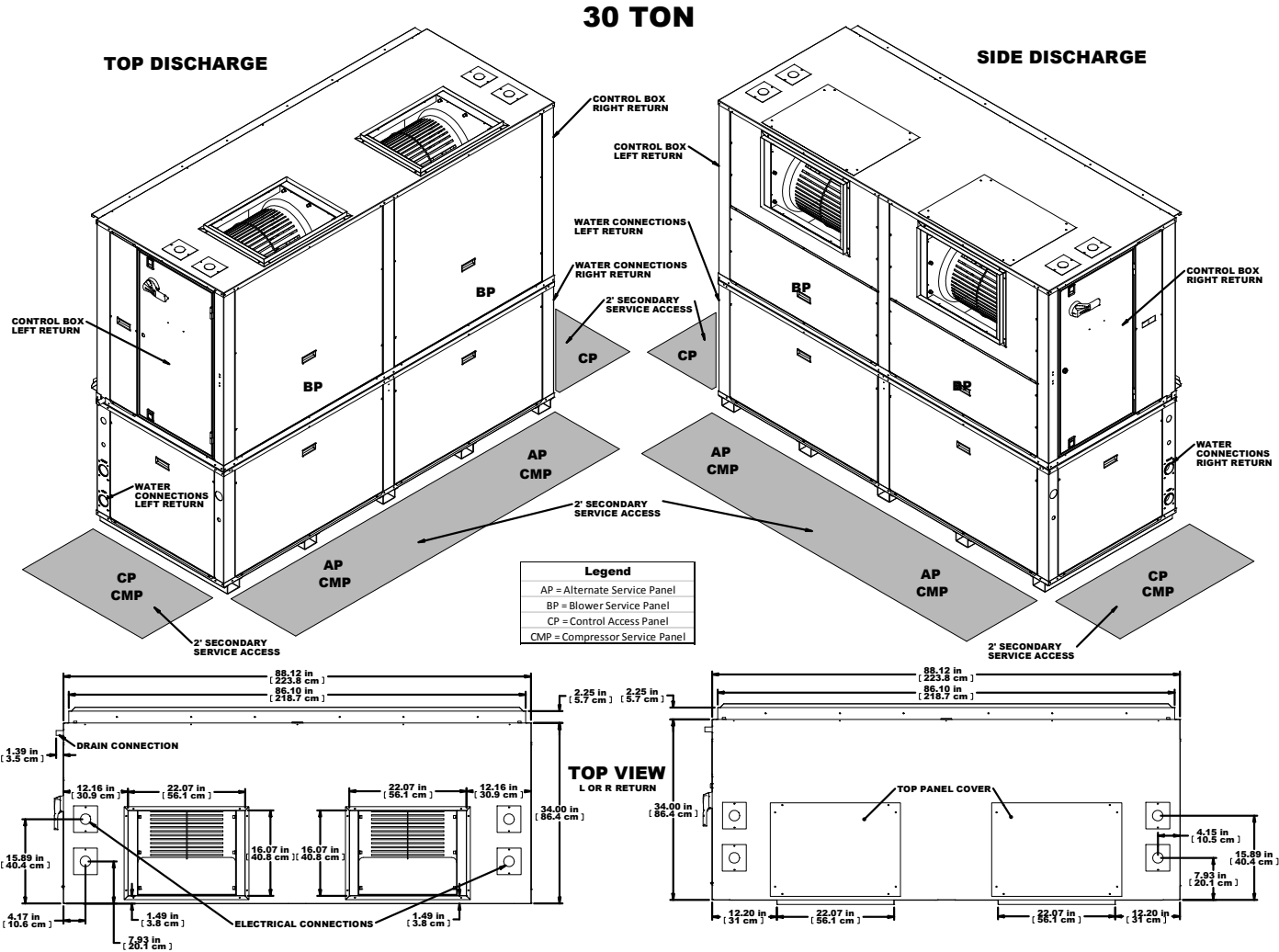
Water Piping

Piping is usually designed as 'reverse return' to equalize flow paths through each unit. A short flexible pressure rated hose is used to make connection to the fixed building piping system. This hose is typically stainless steel braid and includes a swivel fitting on one end for easy removal and is flexible to help isolate the unit for quieter operation. Isolation valves for servicing, y-strainers for filtering and memory-stop flow valve or a balancing valve can be provided for consistent water flow through the unit.

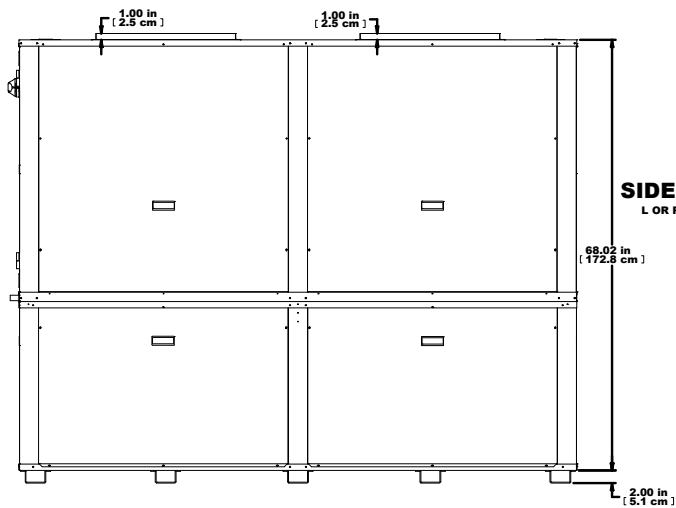
All unit source water connections are fittings that accept a male pipe thread (MPT). Insert the connectors by hand, then tighten the fitting with a wrench to provide a leakproof joint. The open and closed loop piping system should include pressure/temperature ports for serviceability. The proper water flow must be provided to each unit whenever the unit operates. To assure proper flow, use pressure/temperature ports to determine the flow rate. These ports should be located at the supply and return water connections on the unit. The proper flow rate cannot be accurately set without measuring the water pressure drop through the refrigerant-to-water heat exchanger. Limit hose length to 10 feet per connection. Check carefully for water leaks.



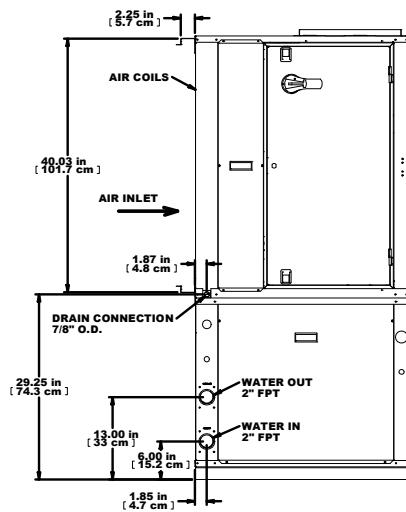
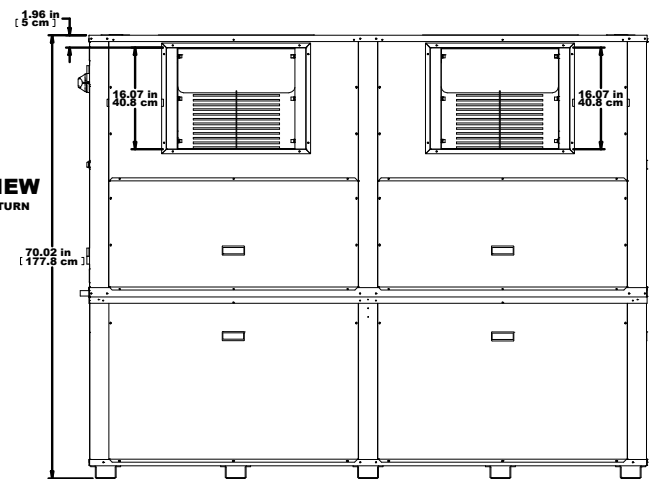
Dimensional Data



Dimensional Data cont.



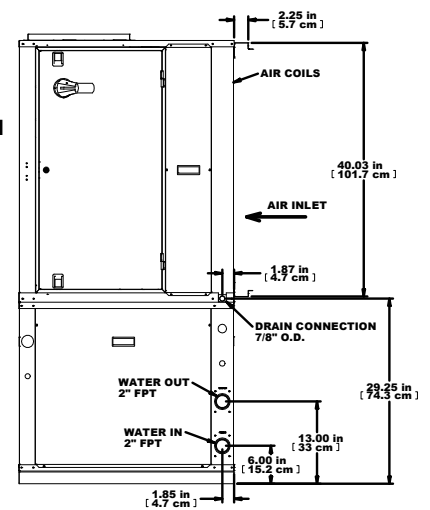
SIDE VIEW
L OR R RETURN



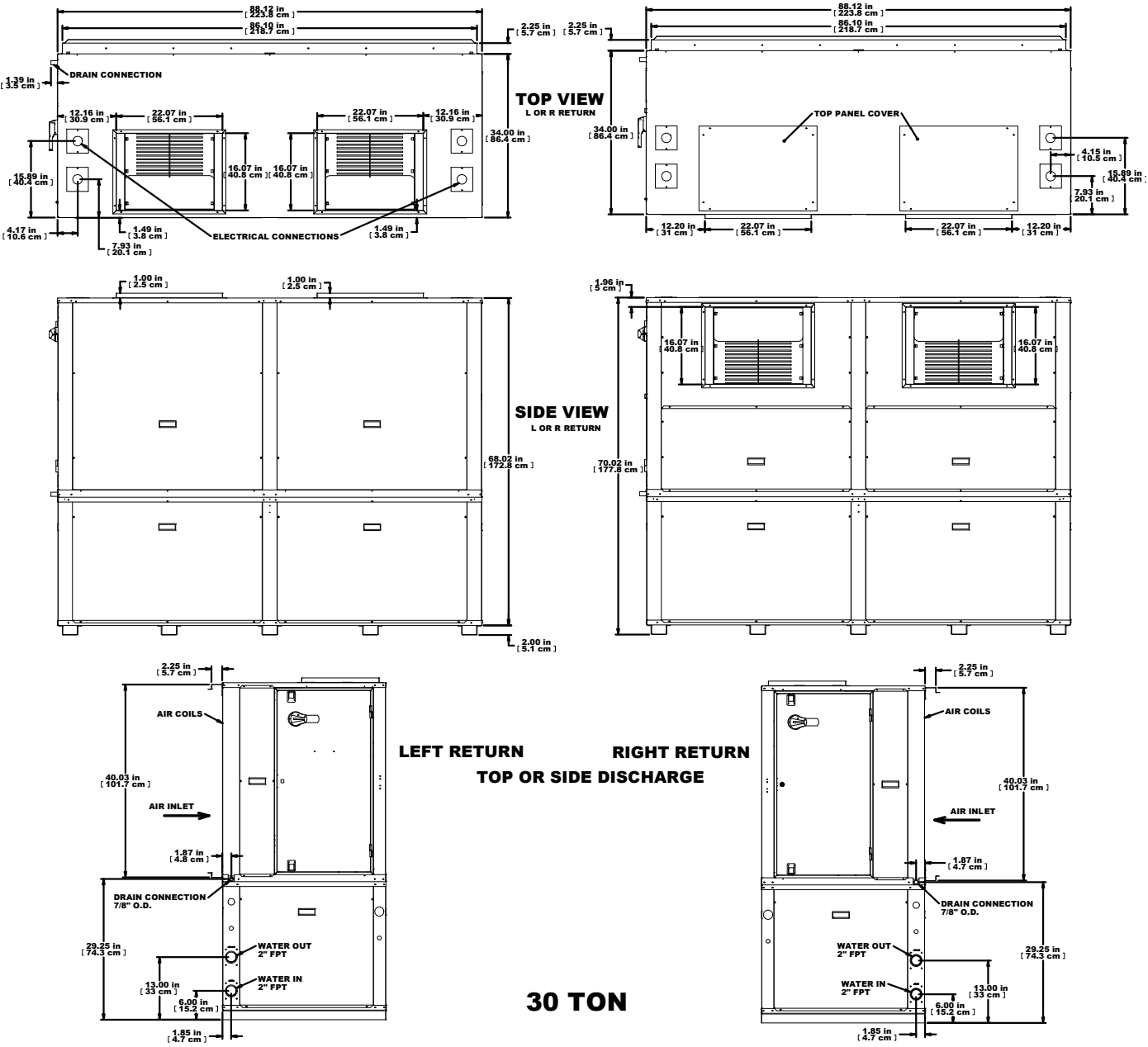
LEFT RETURN

RIGHT RETURN

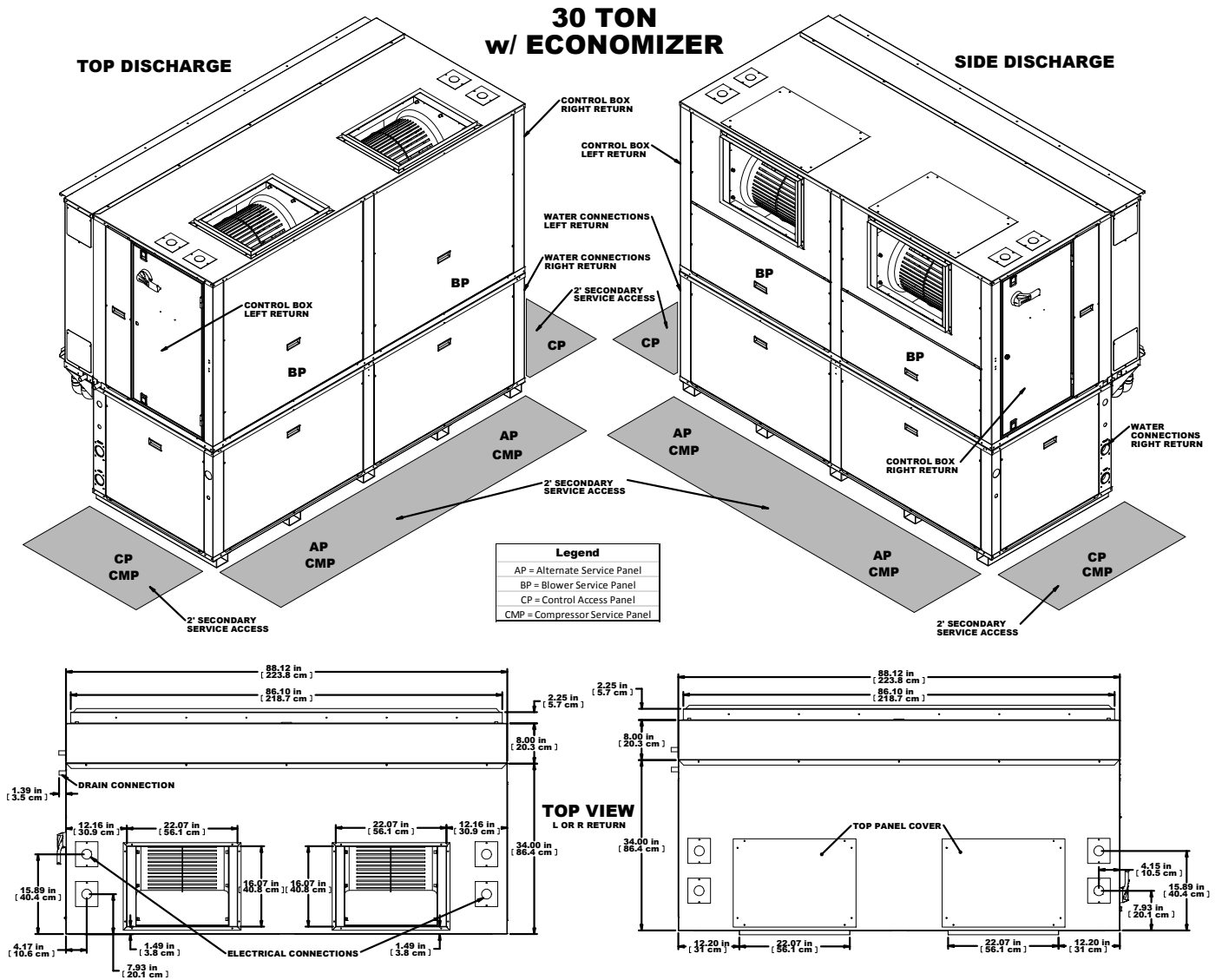
TOP OR SIDE DISCHARGE



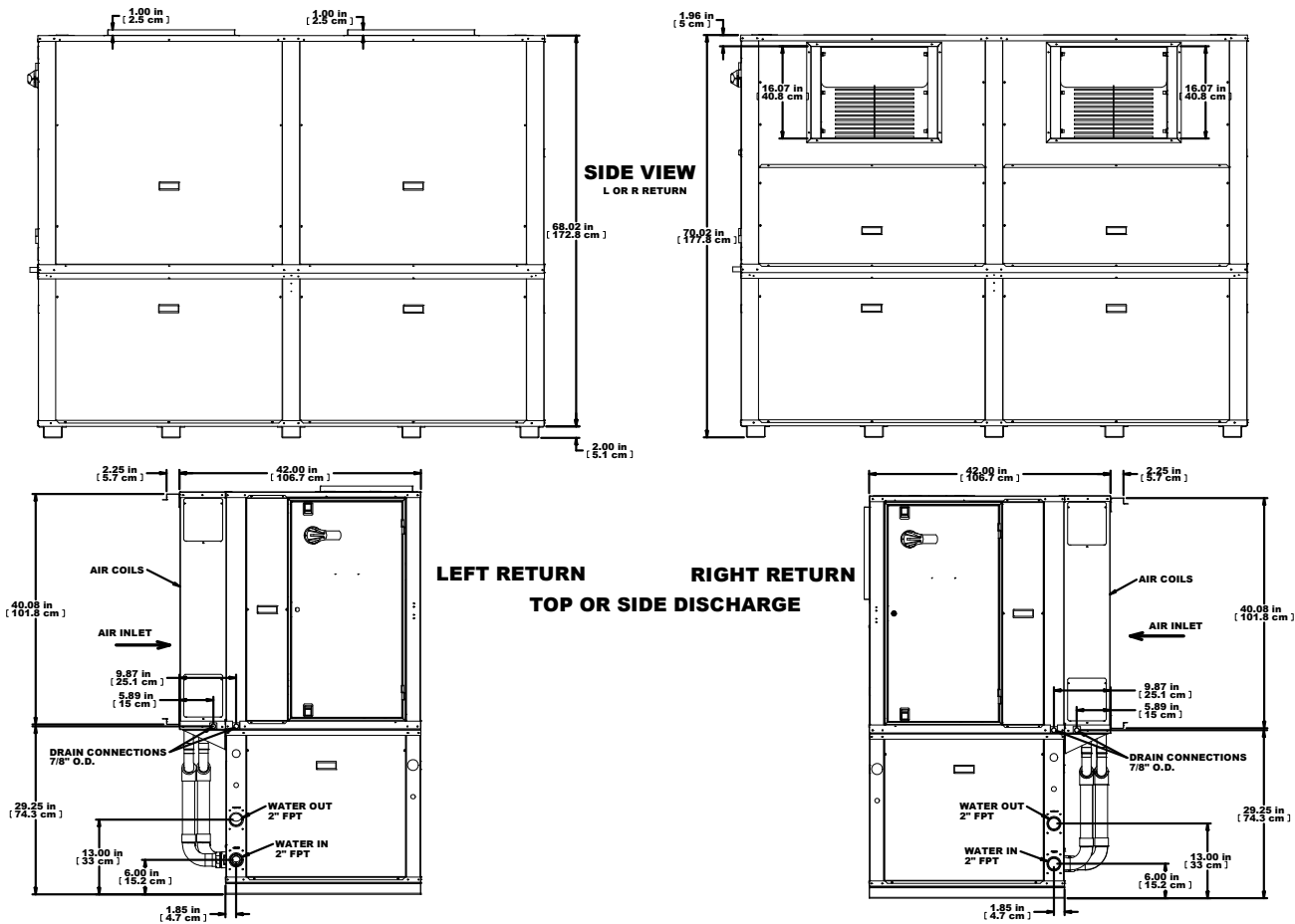
Dimensional Data cont.



Dimensional Data with Waterside Economizer



Dimensional Data with Waterside Economizer cont.



Physical Data

Compressor (2 each)	Scroll
Factory Charge R410A, oz [kg] (per circuit)	236 [6.70]
Fan Motor & Blower (2 each)	
Fan Motor- hp [W]	5 [3729]
Blower Wheel Size (Dia x W), in. [mm]	15x15 [381x381]
Coax and Water Piping	
Water Connections Size - FPT - in [mm]	2 [50.8]
HWG Connection Size - FPT - in [mm]	N/A
Coax & Piping Water Volume - gal [l]	7.4 [28.0]
Air Coil & Filters	
Air Coil Dimensions (H x W), in. [mm]	40x40 (2) [1016x1016]
Air Coil Total Face Area, ft ² [m ²]	22.22 [2.06]
Air Coil Tube Size, in [mm]	3/8 [9.52]
Air Coil Number of rows	3
Filter Standard - 2" [50.8], in [mm]	40x42 (2) [1016x1067]
Weight - Operating, lb [kg]	2410 [1095]
Weight - Packaged, lb [kg]	2793 [1270]

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Electrical Data

Model	Rated	Voltage Min/Max	Compressor*			Fan Motor FLA*	Fan HP	Total Unit FLA***	Min Circ Amp****	Max Fuse / HACR
			MCC	RLA	LRA					
360	208-230/60/3	187/253	75.0	48.1	351	13.6	5.0	137.2	153.3	175.0
	460/60/3	414/506	38.6	24.7	197	6.3	5.0	67.9	75.9	80.0
	575/60/3	518/632	35.0	22.4	135	5.1	5.0	60.6	67.8	70.0

* Ratings per each compressor - unit supplied with two

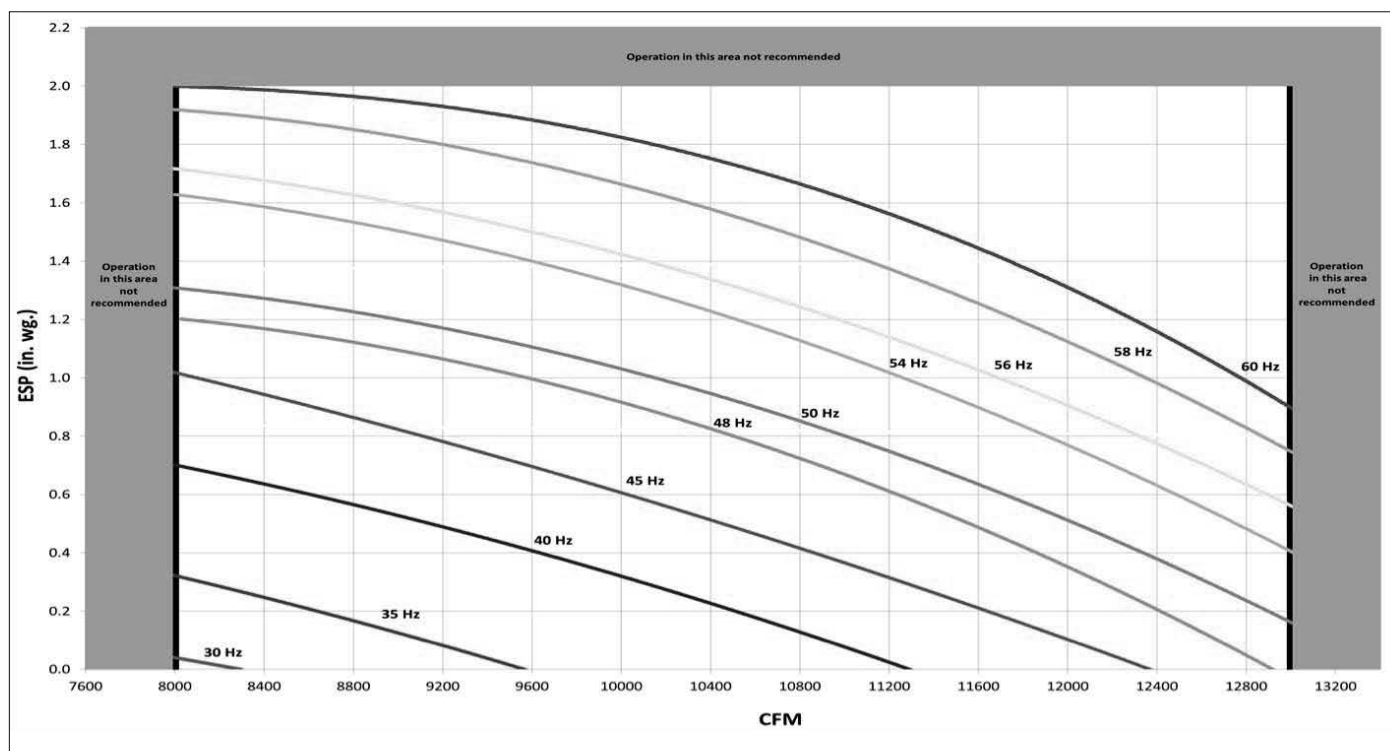
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** Ratings per each fan motor - unit supplied with two.

*** Based on compressor RLA and maximum continuous input current of VFD

**** Based on compressor RLA and VFD maximum continuous input current
HACR circuit breaker in USA only

Blower Performance Data



Airflow in CFM with dry coil and clean air filter.

For applications requiring higher static pressures, contact your local representative.

Performance data does not include drive losses and is based on sea level conditions.

Do not operate in gray region. "na" = information not available at time of printing.

All airflow is rated at lowest Voltage if unit is dual Voltage rated, i.e. 208V for 208-230V units.

For wet coil performance first calculate the face velocity of the air coil (Face Velocity [fpm] = Airflow [cfm] / Face Area [sq ft]).

Then for velocities of 200 fpm reduce the static capability by 0.03 in. wg, 300 fpm by 0.08 in. wg, and 400 fpm by 0.12 in. wg.

AntiFreeze Corrections

Antifreeze Corrections

Catalog performance can be corrected for antifreeze use. Please use the following table and note the example given.

Antifreeze Type	Antifreeze % by wt	Cooling Capacity	Heating Capacity	Pressure Drop
EWT - degF [DegC]		90 [32.2]	30 [-1.1]	30 [-1.1]
Water	0	1.000	1.000	1.000
Ethylene Glycol	10	0.991	0.973	1.075
	20	0.979	0.943	1.163
	30	0.965	0.917	1.225
	40	0.955	0.890	1.324
	50	0.943	0.865	1.419
Propylene Glycol	10	0.981	0.958	1.130
	20	0.969	0.913	1.270
	30	0.950	0.854	1.433
	40	0.937	0.813	1.614
	50	0.922	0.770	1.816
Ethanol	10	0.991	0.927	1.242
	20	0.972	0.887	1.343
	30	0.947	0.856	1.383
	40	0.930	0.815	1.523
	50	0.911	0.779	1.639
Methanol	10	0.986	0.957	1.127
	20	0.970	0.924	1.197
	30	0.951	0.895	1.235
	40	0.936	0.863	1.323
	50	0.920	0.833	1.399

Warning: Gray area represents antifreeze concentrations greater than 35% by weight and should be avoided due to the extreme performance penalty they represent.

Antifreeze Correction Example

Antifreeze solution is Propylene Glycol 20% by weight. Determine the corrected heating and cooling performance at 30°F and 90°F respectively as well as pressure drop at 30°F for an WA5D*360.

The corrected cooling capacity at 90°F would be: 316.5 MBtu/h x 0.969 = 306.7 MBtu/h

The corrected heating capacity at 30°F would be: 217.1 MBtu/h x 0.913 = 198.2 MBtu/h

The corrected pressure drop at 30°F and 90 gpm would be: 34.1 ft. hd x 1.270 = 43.31 ft. hd.

Reference Calculations

Heating Calculations:	Cooling Calculations:
$\text{LWT} = \text{EWT} - \frac{\text{HE}}{\text{gpm} \times 500}$	$\text{LWT} = \text{EWT} + \frac{\text{HR}}{\text{gpm} \times 500}$
$\text{LAT} = \text{EAT} + \frac{\text{HC}}{\text{cfm} \times 1.08}$	$\text{LAT(DB)} = \text{EAT(DB)} - \frac{\text{SC}}{\text{cfm} \times 1.08}$
$\text{TH} = \text{HC} + \text{HWC}$	$\text{LC} = \text{TC} - \text{SC}$
	$\text{S/T} = \frac{\text{SC}}{\text{TC}}$

Legend and Notes

ABBREVIATIONS AND DEFINITIONS:

cfm = airflow, cubic feet/minute
 EWT = entering water temperature, Fahrenheit
 gpm = water flow in gallons/minute
 WPD = water pressure drop, psi and feet of water
 EAT = entering air temperature, Fahrenheit
 (dry bulb/wet bulb)
 HC = air heating capacity, MBtu/h
 TC = total cooling capacity, MBtu/h
 SC = sensible cooling capacity, MBtu/h
 kW = total power unit input, kilowatts
 HR = total heat of rejection, MBtu/h

HE = total heat of extraction, MBtu/h
 HWC = hot water generator capacity, MBtu/h
 EER = Energy Efficient Ratio
 = BTU output/Watt input
 COP = Coefficient of Performance
 = Btu output/Btu input
 LWT = leaving water temperature, °F
 LAT = leaving air temperature, °F
 TH = total heating capacity, MBtu/h
 LC = latent cooling capacity, MBtu/h
 S/T = sensible to total cooling ratio

Notes (Refer to Performance Data tables)

- Performance ratings are based on 80°F DB / 67°F WB EAT for cooling and 70°F DB EAT for heating.
- Three flow rates are shown for each unit. The lowest flow rate shown is used for geothermal open loop/well water systems with a minimum of 50°F EWT. The middle flow rate shown is the minimum geothermal closed loop flow rate. The highest flow rate shown is optimum for geothermal closed loop systems and the suggested flow rate for boiler/tower applications.
- Entering water temperatures below 40°F assumes 15% antifreeze solution.
- For non-standard EAT conditions, apply the appropriate correction factors on (Refer to Correction Factor Tables).
- Interpolation between EWT, gpm, and cfm data is permissible.

Operating Limits

Operating Limits	Cooling		Heating	
	(°F)	(°C)	(°F)	(°C)
Air Limits				
Min. Ambient Air	45	7.2	45	7.2
Rated Ambient Air	80	26.7	70	21.1
Max. Ambient Air	100	37.8	85	29.4
Min. Entering Air	50	10.0	40	4.4
Rated Entering Air db/wb	80.6/66.2	27/19	68	20.0
Max. Entering Air db/wb	110/83	43/28.3	80	26.7
Water Limits				
Min. Entering Water	30	-1.1	20	-6.7
Normal Entering Water	50-110	10-43.3	30-70	-1.1
Max. Entering Water	120	48.9	90	32.2

Notes:

Minimum/maximum limits are only for start-up conditions, and are meant for bringing the space up to occupancy temperature. Units are not designed to operate at the minimum/maximum conditions on a regular basis. The operating limits are dependant upon three primary factors: 1) water temperature, 2) return air temperature, and 3) ambient temperature. When any of the factors are at the minimum or maximum levels, the other two factors must be at the normal level for proper and reliable unit operation.

05/21/15

Correction Factor Tables

Cooling Capacity Corrections

Entering Air WB °F	Total Clg Cap	Sensible Cooling Capacity Multipliers - Entering DB °F										Power Input	Heat of Rejection
		60	65	70	75	80	80.6	85	90	95	100		
55	0.898	0.723	0.866	1.048	1.185	*	*	*	*	*	*	0.985	0.913
60	0.912		0.632	0.880	1.078	1.244	1.260	*	*	*	*	0.994	0.927
65	0.967			0.694	0.881	1.079	1.085	1.270	*	*	*	0.997	0.972
66.2	0.983			0.655	0.842	1.040	1.060	1.232	*	*	*	0.999	0.986
67	1.000			0.616	0.806	1.000	1.023	1.193	1.330	*	*	1.000	1.000
70	1.053				0.693	0.879	0.900	1.075	1.250	1.404	*	1.003	1.044
75	1.168					0.687	0.715	0.875	1.040	1.261	1.476	1.007	1.141

Note: * Sensible capacity equals total capacity at conditions shown.

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Heating Capacity Corrections

Ent Air DB °F	Heating Corrections		
	Htg Cap	Power	Heat of Ext
45	1.062	0.739	1.158
50	1.050	0.790	1.130
55	1.037	0.842	1.096
60	1.025	0.893	1.064
65	1.012	0.945	1.030
68	1.005	0.976	1.012
70	1.000	1.000	1.000
75	0.987	1.048	0.970
80	0.975	1.099	0.930

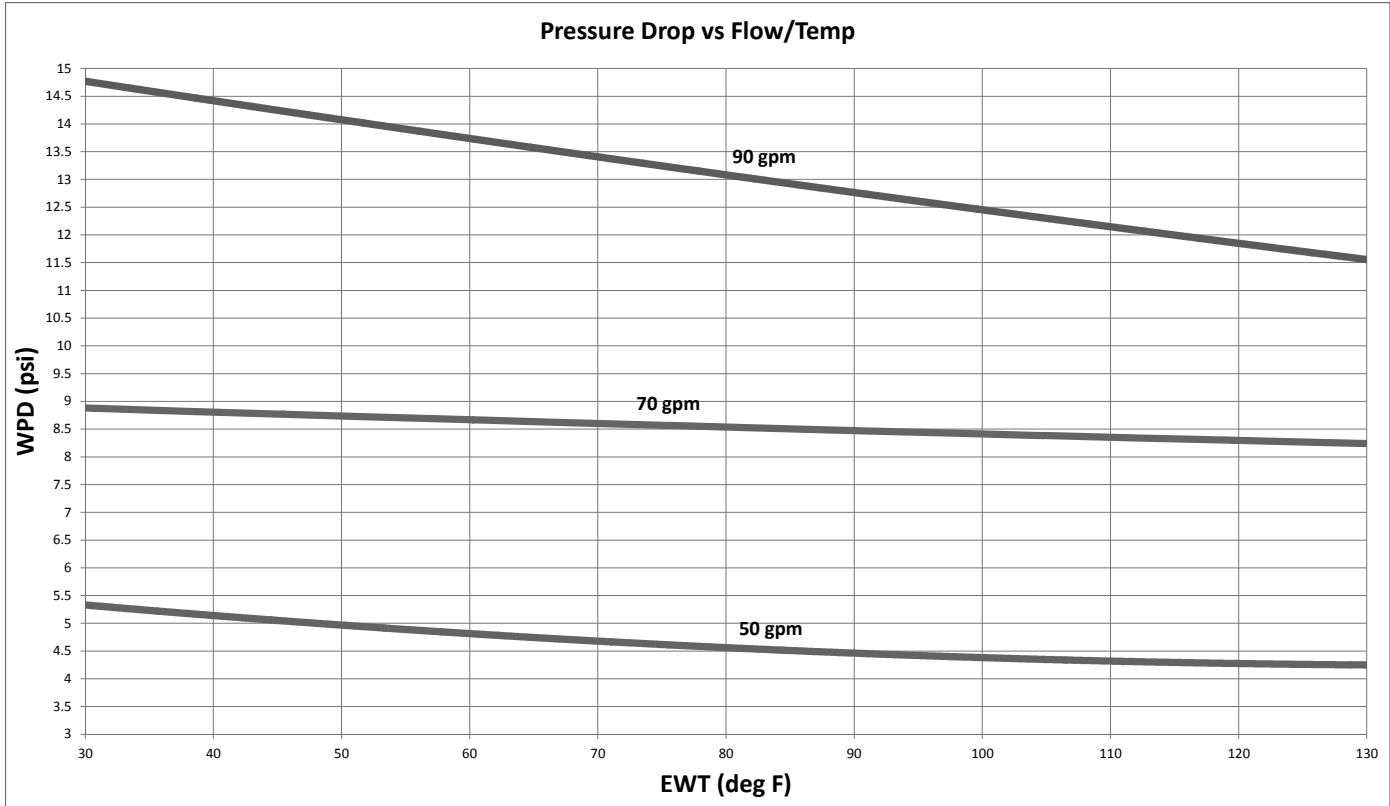
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Air Flow Corrections (Dual Circuit)

Airflow		Cooling				Heating		
CFM Per Ton of Clg	% of Nominal	Total Cap	Sens Cap	Power	Heat of Rej	Htg Cap	Power	Heat of Ext
281	75%	0.981	0.910	0.956	0.976	0.956	1.049	0.947
299	80%	0.985	0.928	0.965	0.981	0.970	1.034	0.959
318	85%	0.988	0.947	0.975	0.986	0.977	1.027	0.968
337	90%	0.990	0.965	0.990	0.990	0.985	1.021	0.977
355	95%	0.996	0.985	0.995	0.997	0.992	1.014	0.986
374	100%	1.000	1.000	1.000	1.000	1.000	1.000	1.000
393	105%	1.005	1.030	1.012	1.014	1.010	0.993	1.005
412	110%	1.007	1.044	1.025	1.013	1.014	0.991	1.014
430	115%	1.010	1.065	1.035	1.018	1.021	0.987	1.024
449	120%	1.014	1.086	1.046	1.024	1.029	0.981	1.033
468	125%	1.017	1.106	1.059	1.027	1.040	0.980	1.039

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Pressure Drop



Performance Data

Capacity Data (8800 CFM)

EWT °F	WATER FLOW GPM	WPD		HEATING - EAT 70 °F					COOLING - EAT 80/67 °F					
		PSI	FT	HC	KW	HE	LAT	COP	TC	SC	S/T	KW	HR	EER
20	50.0	5.5	12.7	Operation not recommended					Operation not recommended					
	70.0	9.0	20.8											
	90.0	15.0	34.6											
30	50.0	5.3	12.2	Operation not recommended					Operation not recommended					
	70.0	8.9	20.5											
	90.0	14.8	34.1											
40	50.0	5.1	11.8	269.9	28.20	173.7	96.3	2.81	390.6	247.5	0.63	26.47	480.9	14.8
	70.0	8.8	20.3	318.1	30.80	213.0	101.9	3.03	401.5	252.7	0.63	24.91	486.5	16.1
	90.0	14.4	33.2	339.4	32.30	229.2	103.5	3.08	403.0	262.0	0.65	23.94	484.7	16.8
50	50.0	5.0	11.5	318.1	30.28	214.8	101.3	3.08	370.4	246.9	0.67	27.80	465.3	13.3
	70.0	8.7	20.1	370.9	33.16	257.8	105.3	3.28	385.4	247.4	0.64	26.30	475.1	14.7
	90.0	14.0	32.3	387.6	33.93	271.8	106.8	3.35	389.7	253.6	0.65	25.40	476.4	15.3
60	50.0	4.8	11.1	385.6	33.68	270.7	107.2	3.36	352.6	231.1	0.66	29.70	453.9	11.9
	70.0	8.6	19.8	417.5	35.23	297.3	111.2	3.47	360.0	241.2	0.67	28.10	455.9	12.8
	90.0	13.7	31.6	431.4	35.81	309.2	111.6	3.53	365.7	243.2	0.67	26.90	457.5	13.6
70	50.0	4.6	10.6	430.8	35.41	310.0	110.6	3.57	336.4	229.0	0.68	31.97	445.5	10.5
	70.0	8.6	19.8	460.0	36.84	334.3	114.4	3.66	342.8	234.4	0.68	29.87	444.7	11.5
	90.0	13.4	30.9	477.5	37.75	348.7	116.3	3.71	345.8	237.4	0.69	28.90	444.4	12.0
80	50.0	4.5	10.4	463.8	36.93	337.8	114.2	3.68	321.4	221.4	0.69	34.40	438.8	9.3
	70.0	8.5	19.6	500.7	38.67	368.8	118.1	3.80	329.2	225.0	0.68	32.14	438.8	10.2
	90.0	13.1	30.2	520.1	39.54	385.2	121.1	3.86	334.0	228.2	0.68	31.02	439.8	10.8
90	50.0	4.5	10.4	501.8	38.58	370.2	118.1	3.81	303.0	216.5	0.71	37.10	429.6	8.2
	70.0	8.5	19.6	541.6	40.53	403.3	122.6	3.92	312.0	219.9	0.70	34.80	430.7	9.0
	90.0	12.8	29.5	565.4	41.57	423.6	125.2	3.99	316.5	221.9	0.70	33.42	430.5	9.5
100	50.0	4.4	10.2	Operation not recommended					Operation not recommended					
	70.0	8.4	19.4						293.8	211.4	0.72	37.39	421.4	7.9
	90.0	12.4	28.6						298.9	213.3	0.71	36.12	422.1	8.3
110	50.0	4.3	9.9	Operation not recommended					Operation not recommended					
	70.0	8.3	19.1						276.4	190.9	0.69	40.66	415.2	6.8
	90.0	12.2	28.1						279.7	192.5	0.69	39.19	413.4	7.1
120	50.0	4.3	9.9	Operation not recommended					Operation not recommended					
	70.0	8.3	19.1						242.2	186.2	0.77	43.82	391.7	5.5
	90.0	11.8	27.2						253.7	194.7	0.77	42.30	398.0	6.0

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Interpolation is permissible, extrapolation is not.

All entering air conditions are 80°F DB and 67°F WB in Cooling and 70°F DB in Heating.

All performance data is based upon the lower voltage of dual voltage units.

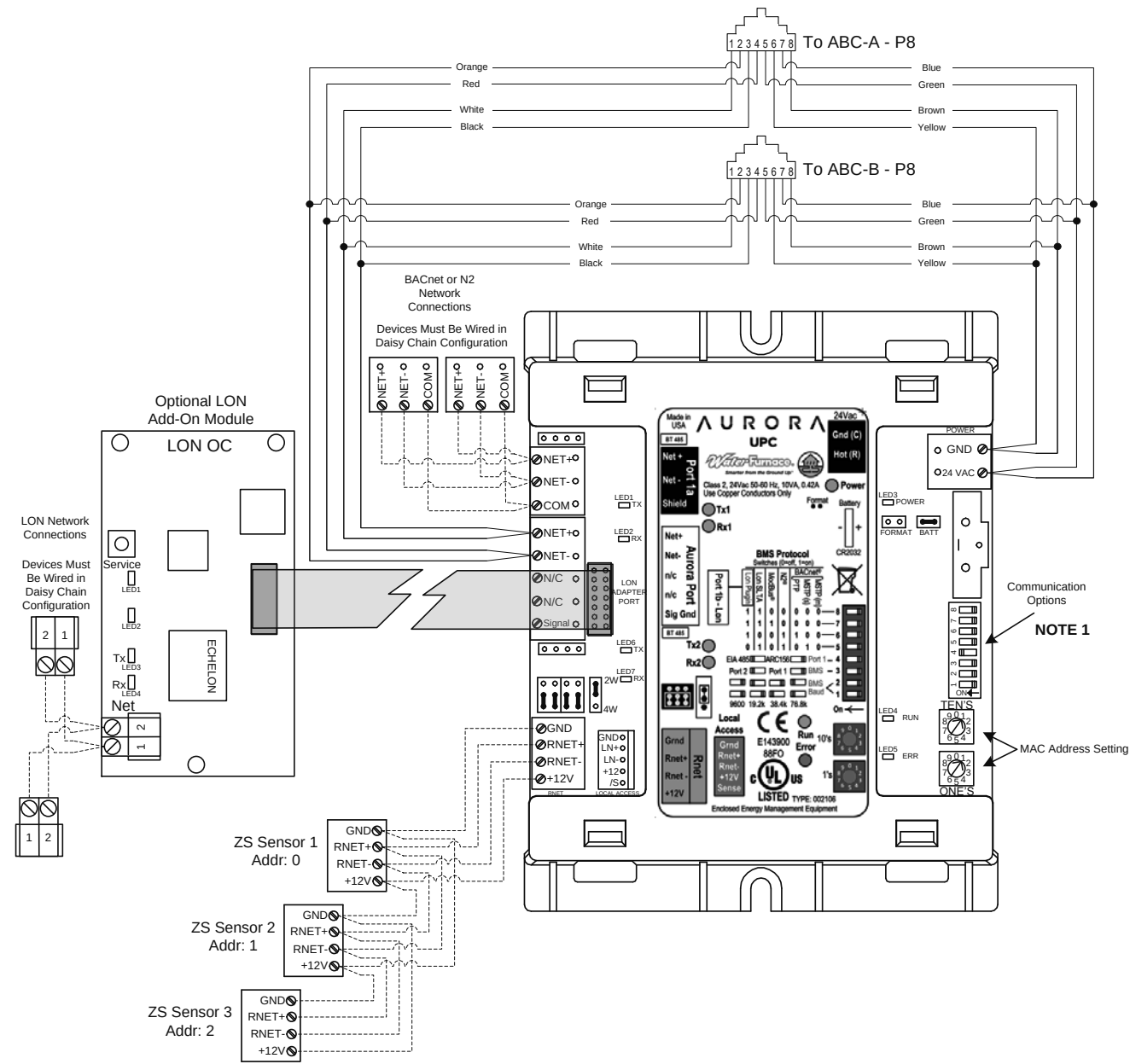
Operation below 60°F EWT requires optional insulated water/refrigerant circuit.

Operation below 40°F EWT is based upon 15% antifreeze solution.

See performance correction tables for operating conditions other than those listed above.

Wiring Schematics

Aurora Control with UPC - Dual Compressor



ZS Sensor Information

Zone Sensors can be wired in daisy chain as show or in a star or hybrid configuration. Maximum of 5 sensors per UPC. Maximum allowable load 210mA. See the UPC install manual for possible sensor combinations.

DIP Switch Value

1	1	ON
2	2	ON
4	3	ON
8	4	ON

Each ZS sensor must have a unique address, but the addresses do not need to be sequential. Use the DIP switches on the back of the ZS sensor to set an address from 0 to 4. (0 is the factory default.) Each DIP switch has the value shown in the figure to the left. Turn on as many DIP switches as you need so that their total value equals the address.

Notes

1. Use DIP Switches 5 – 8 to change communication protocol and DIP switches 1 – 2 to change BACnet baud rate

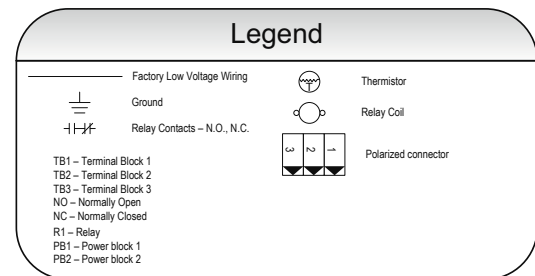
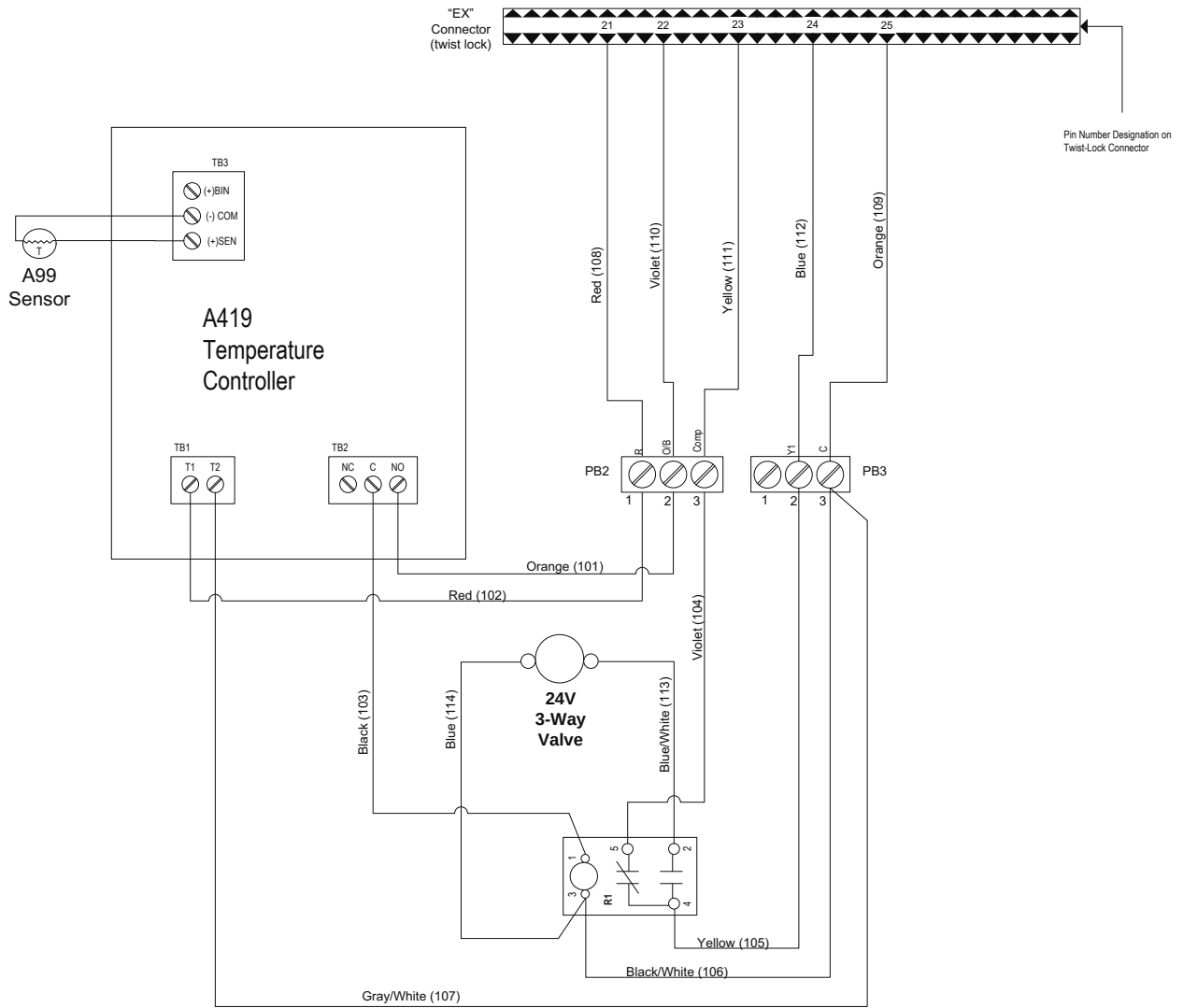
Legend

— Factory Low Voltage Wiring
- - - Field Low Voltage Wiring

RJ45 Connector

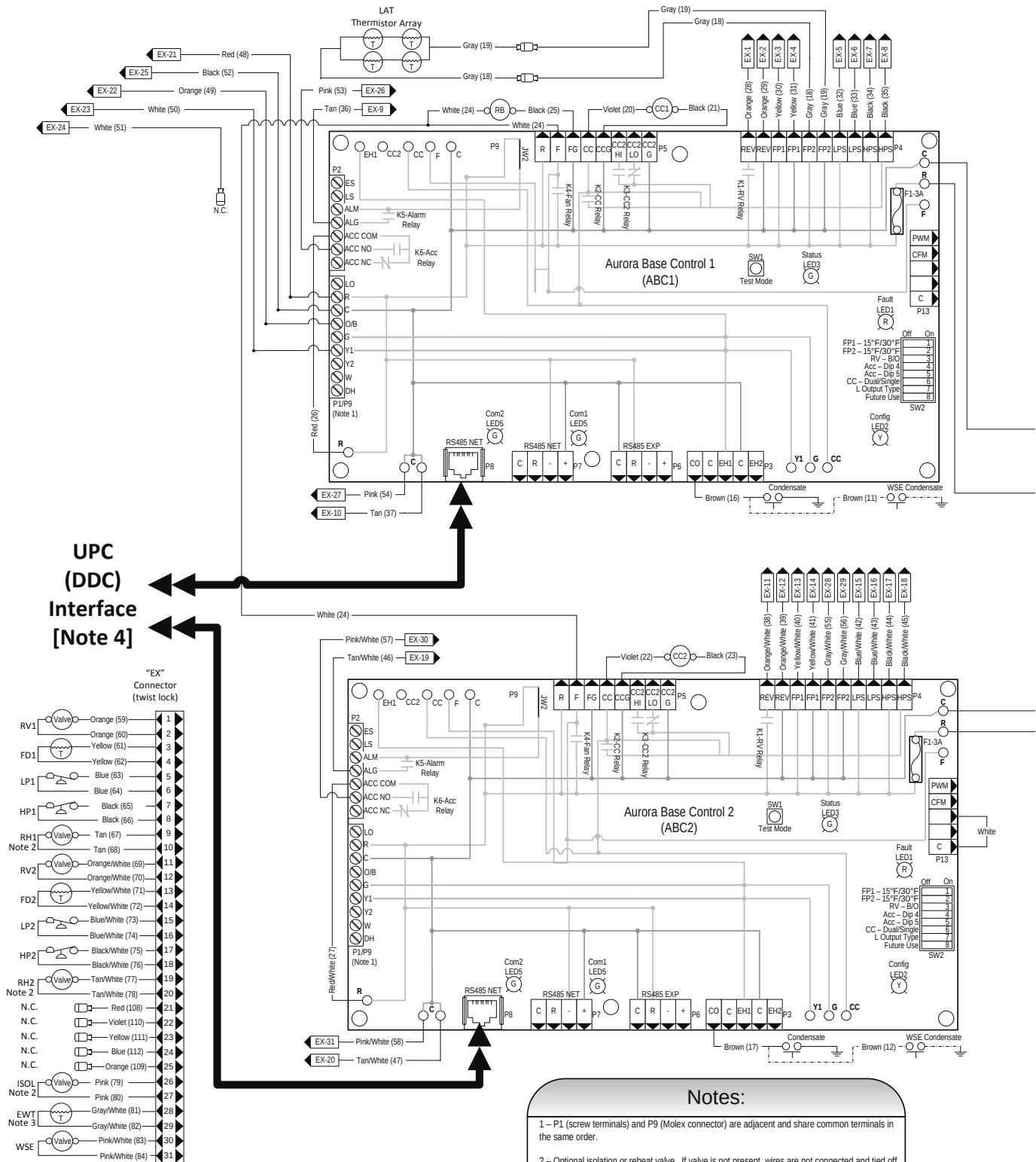
Wiring Schematics

Aurora Control with Waterside Economizer without UPC - Dual Compressor



Wiring Schematics cont.

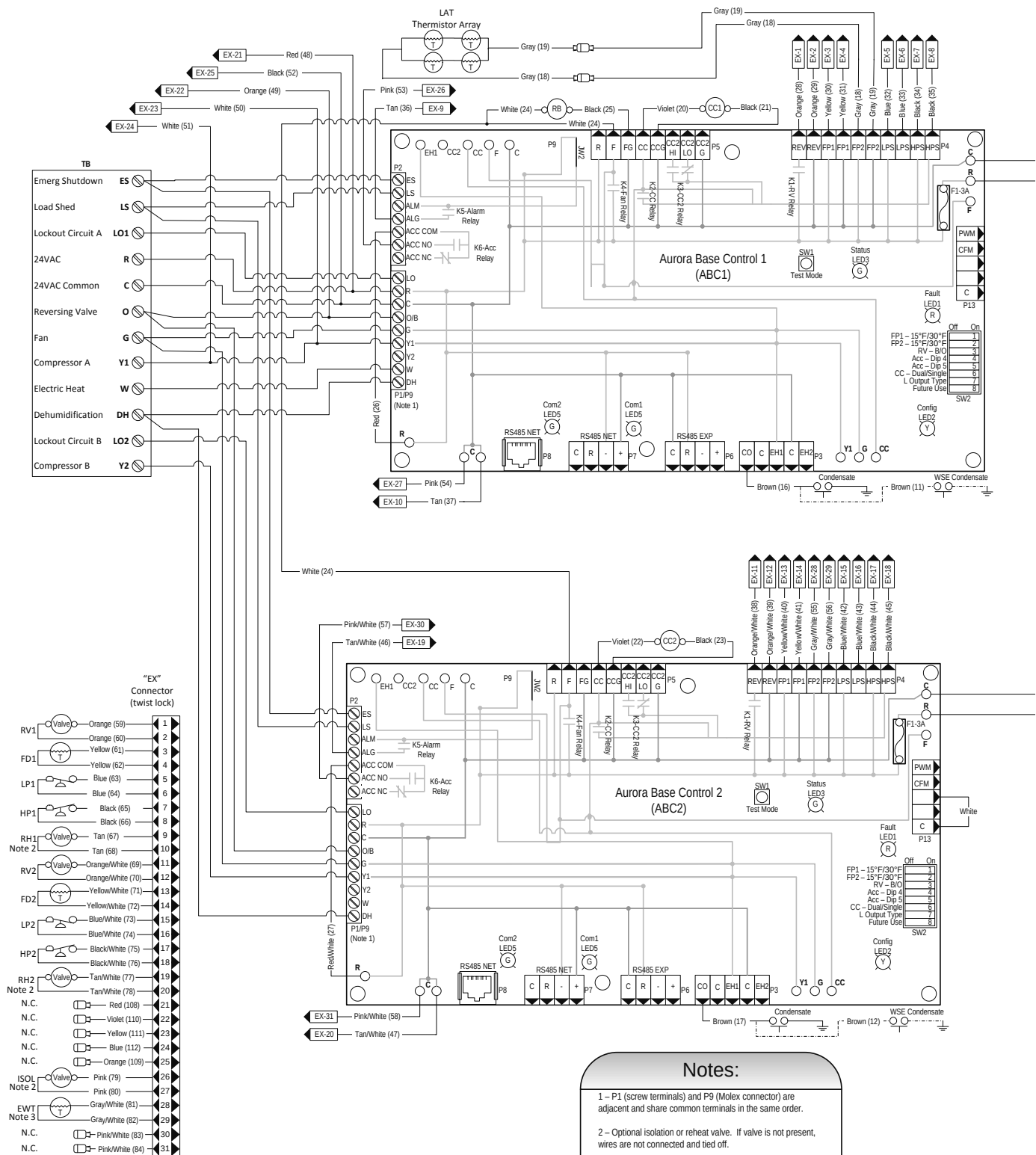
With UPC and Waterside Economizer



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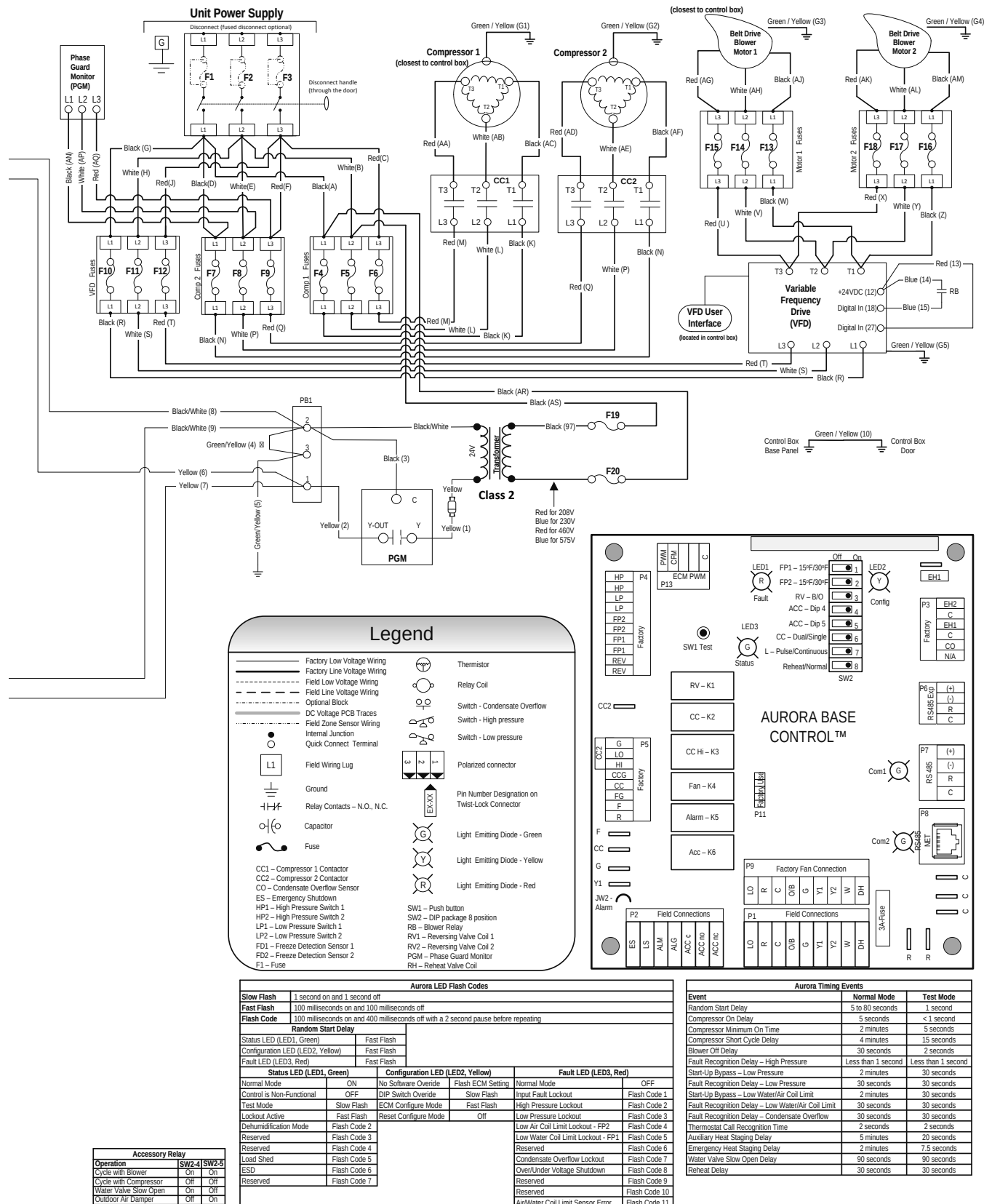
Wiring Schematics cont.

Without UPC, Without Waterside Economizer



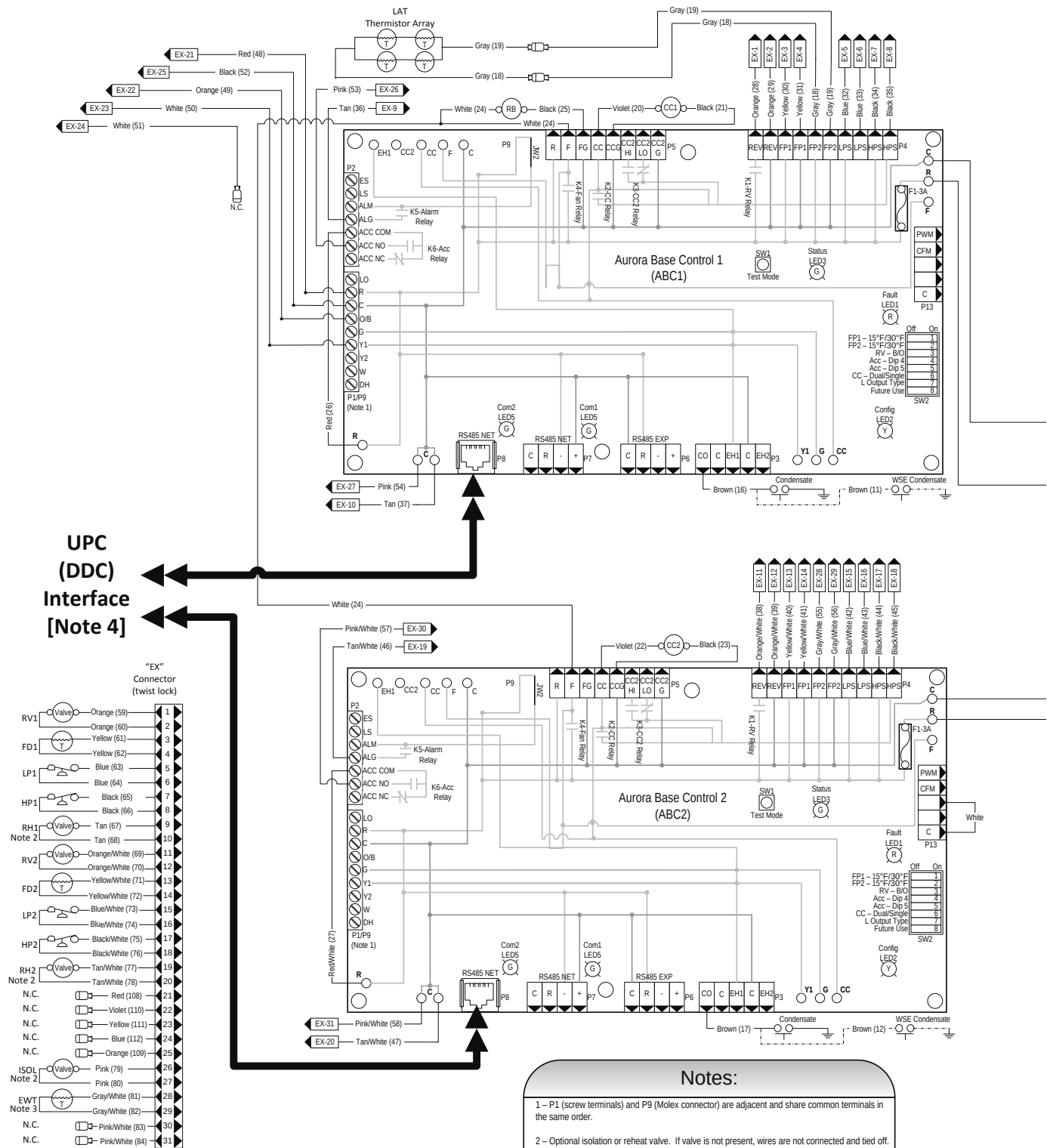
Wiring Schematics cont.

Without UPC, Without Waterside Economizer



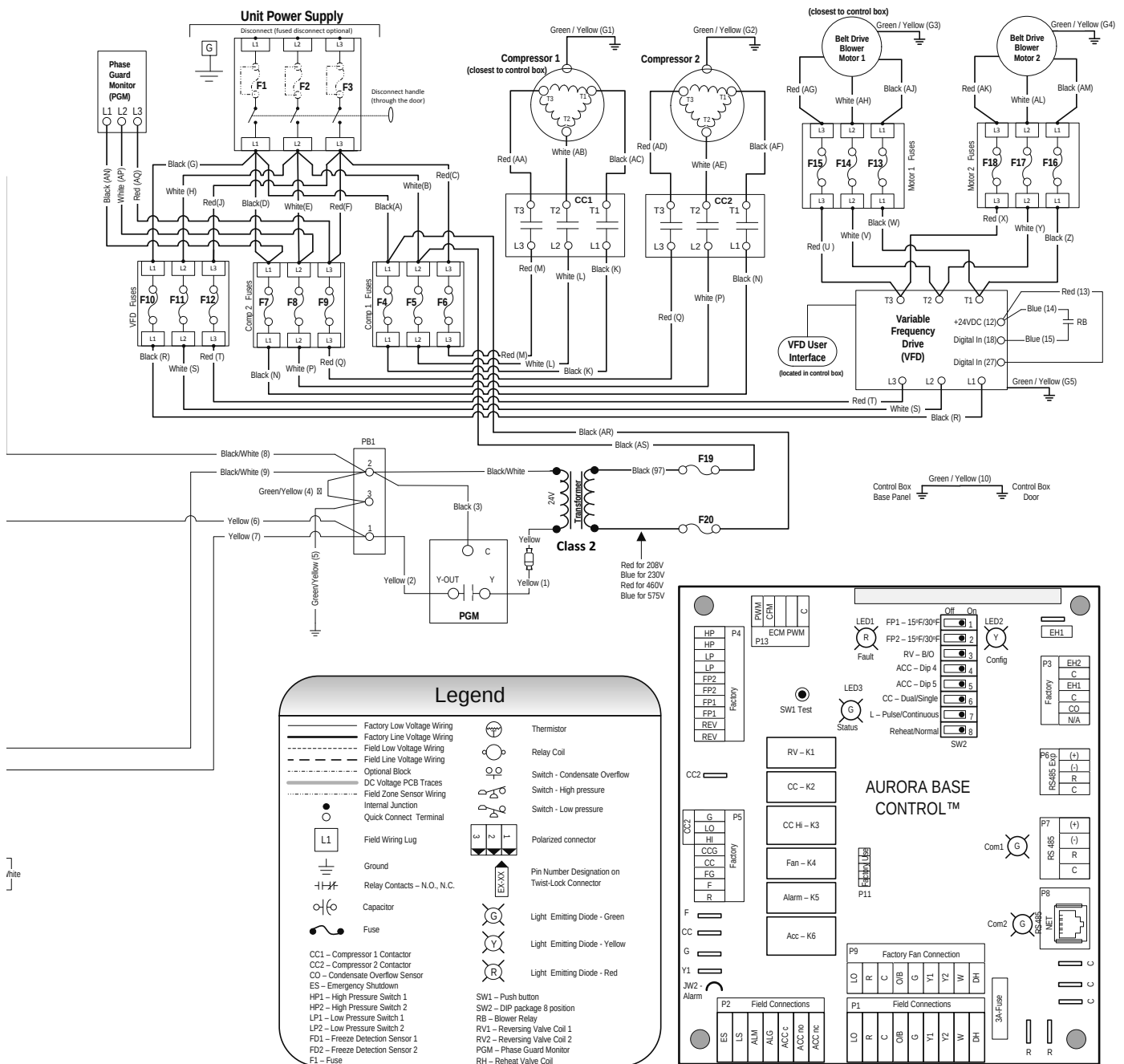
Wiring Schematics cont.

With UPC, Without Waterside Economizer



Wiring Schematics cont.

With UPC, Without Waterside Economizer

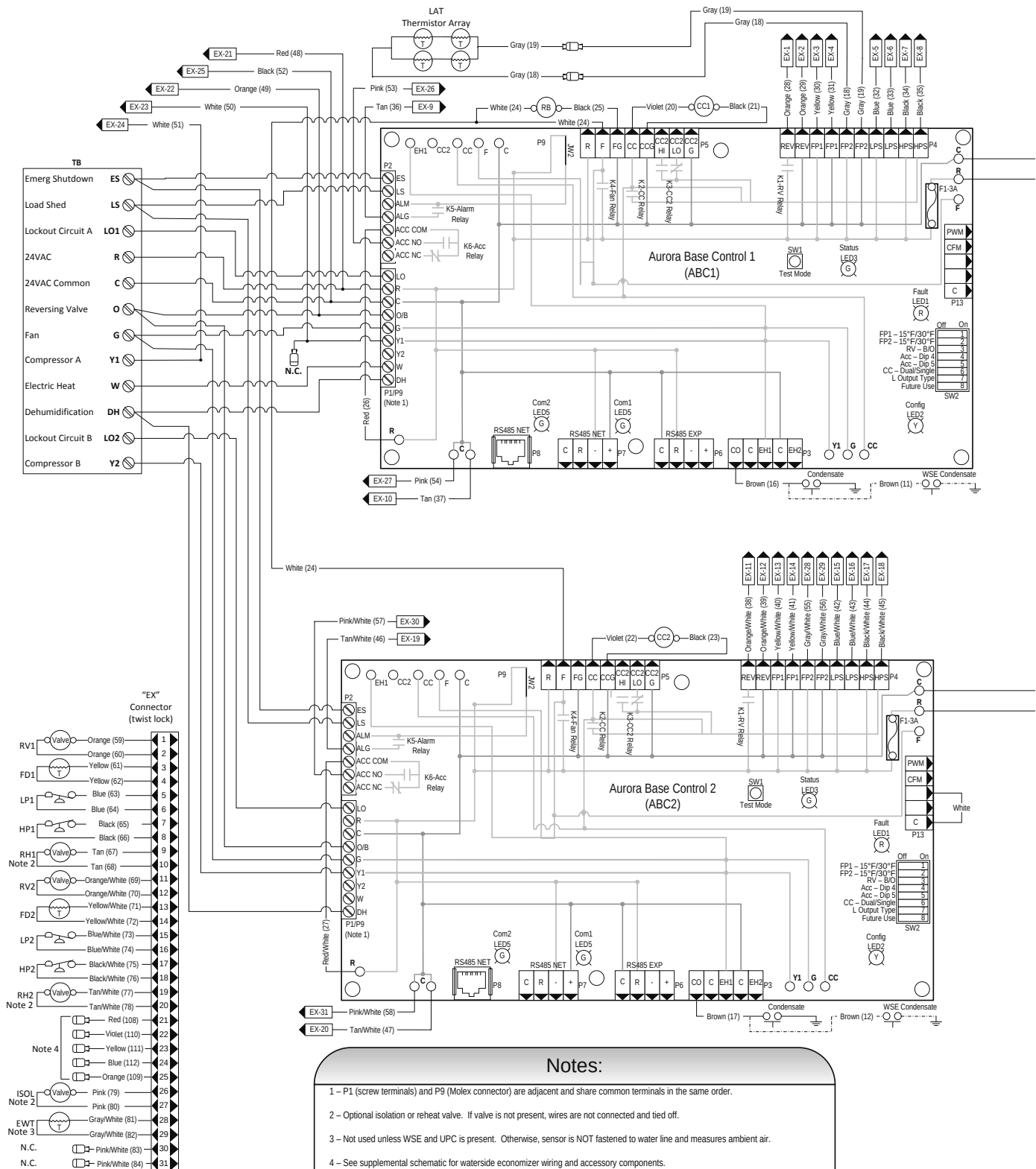


Aurora LED Flash Codes							
Slow Flash	1 second on and 1 second off						
Fast Flash	100 milliseconds on and 100 milliseconds off						
Flash Code	100 milliseconds on and 400 milliseconds off with a 2 second pause before repeating						
Random Start Delay							
Status LED (LED1, Green)							
Configuration LED (LED2, Yellow)						Fast Flash	
Fault LED (LED3, Red)						Fast Flash	
Status LED (LED1, Green)		Configuration LED (LED2, Yellow)			Fault LED (LED3, Red)		
Normal Mode	ON	No Software Override		Flash ECM Setting	Normal Mode		OFF
Control is Non-Functional	OFF	DIP Switch Override		Slow Flash	Input Fault Lockout		Flash Code 1
Test Mode	Slow Flash	ECM Configure Mode		Fast Flash	High Pressure Lockout		Flash Code 2
Lockout Active	Fast Flash	Reset Configure Mode		Off	Low Pressure Lockout		Flash Code 3
Dehumidification Mode	Flash Code 2				Low Air Coil Limit Lockout - FP2		Flash Code 4
Reserved	Flash Code 3				Low Water Coil Limit Lockout - FP1		Flash Code 5
Reserved	Flash Code 4				Reserved		Flash Code 6
Load Shed	Flash Code 5				Condensate Overflow Lockout		Flash Code 7
ESD	Flash Code 6				Over/Under Flow Shutdown		Flash Code 8
Reserved	Flash Code 7				Reserved		Flash Code 9
					Reserved		Flash Code 10
					Ag/Mag/Cool Limit Sensor Error		Flash Code 11

Event	Normal Mode	Test Mode
Random Start Delay	5 to 80 seconds	1 second
Compressor On Delay	5 seconds	< 1 second
Compressor Minimum On Time	4 minutes	5 seconds
Compressor Short Cycle Delay	4 minutes	15 seconds
Blower Off Delay	30 seconds	2 seconds
Fault Recognition Delay – High Pressure	Less than 2 seconds	Less than 2 seconds
Start-Up Bypass – Low Pressure	2 minutes	30 seconds
Fault Recognition Delay – Low Pressure	30 seconds	30 seconds
Start-Up Bypass – Low Water/Fair Coil Limit	2 minutes	30 seconds
Fault Recognition Delay – Low Water/Fair Coil Limit	30 seconds	30 seconds
Fault Recognition Delay – Condensate Overflow	30 seconds	30 seconds
Thermostat Call Recognition Time	2 seconds	2 seconds
Auxiliary Heat Staging Delay	5 minutes	20 seconds
Emergency Heat Staging Delay	2 minutes	7.5 seconds
Water Valve Slow Open Delay	90 seconds	90 seconds
Reheat Delay	30 seconds	30 seconds

Wiring Schematics cont.

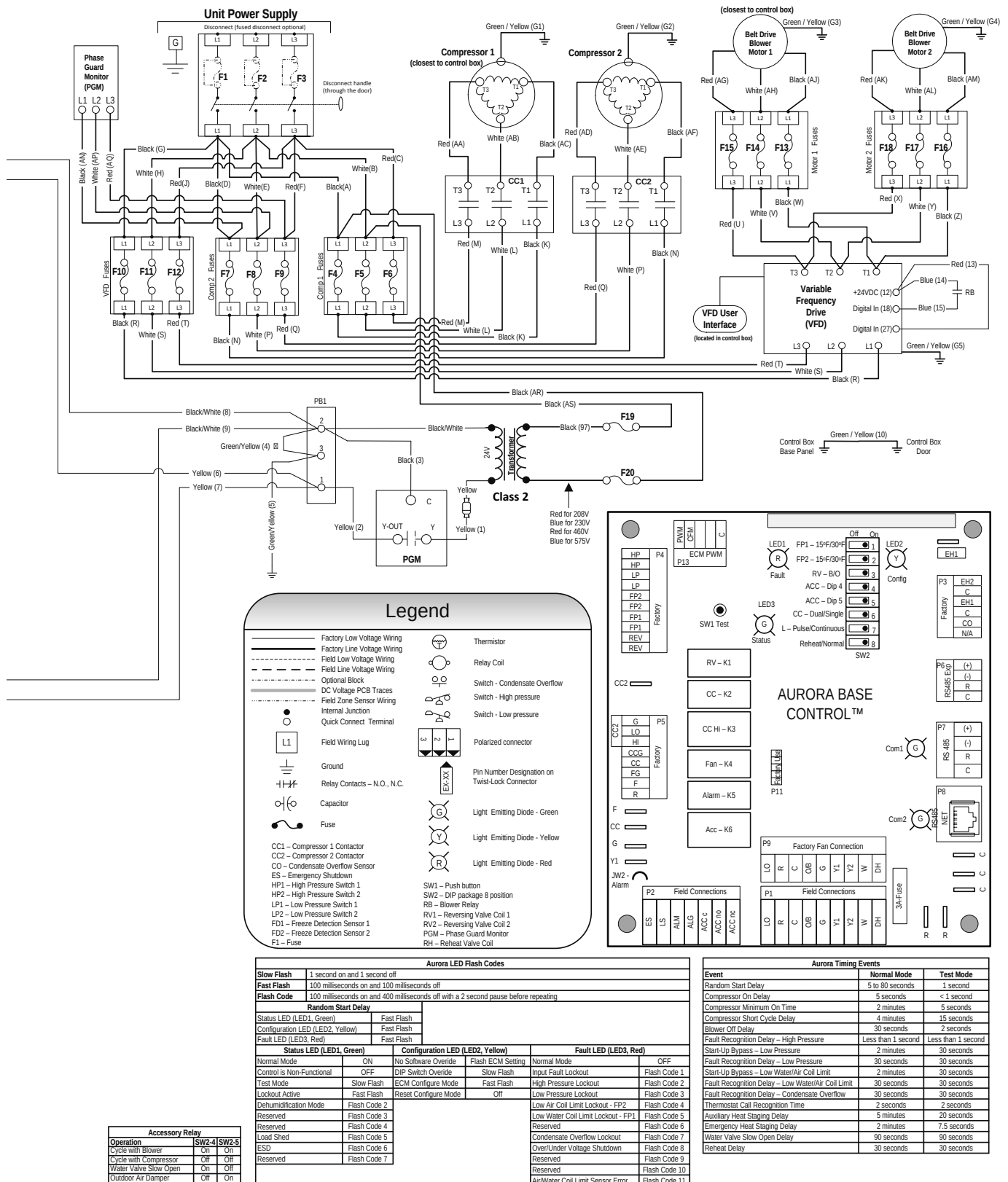
Without UPC, With Waterside Economizer



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Wiring Schematics cont.

Without UPC, With Waterside Economizer



Engineering Guide Specifications

General

Furnish and install WaterFurnace Water Source Heat Pumps as indicated on the plans. Equipment shall be completely assembled, piped and internally wired. Capacities and characteristics as listed in the schedule and the specifications that follow. The reverse cycle heating/cooling units shall be either suspended type with horizontal air inlet and discharge or floor mounted type with horizontal air inlet and vertical upflow air discharge. Units shall be AHRI/ISO 13256-1 certified and listed by a nationally recognized safety-testing laboratory or agency, such as ETL Testing Laboratory. Each unit shall be computer run-tested at the factory with conditioned water and operation verified to catalog data. Each unit shall be mounted on a pallet and shipped in a corrugated box or stretch-wrapped. The units shall be designed to operate with entering liquid temperature between 30°F and 120°F [-1.1°C and 48.9°C].

Casing and Cabinet

The cabinet shall be fabricated from heavy-gauge galvanized steel and finished with corrosion-resistant powder coating. This corrosion protection system shall meet the stringent 1000 hour salt spray test per ASTM B117. The interior shall be insulated with 1/2 in. thick, multi-density, cleanable aluminum foil coated glass fiber with edges sealed or tucked under flanges to prevent the introduction of glass fibers into the discharge air. Standard cabinet panel insulation must meet NFPA 90A requirements, air erosion and mold growth limits of UL-181, stringent fungal resistance test per ASTM-C1071 and ASTM G21, and shall meet zero level bacteria growth per ASTM G22. Unit insulation must meet these stringent requirements or unit(s) will not be accepted.

A duct collar shall be provided on the supply air opening. Standard size 2 in. [5.1 cm] MERV 4 filters shall be provided with each unit. The units shall have an insulated divider panel between the air handling section and the compressor section to minimize the transmission of compressor noise. Vertical units shall be supplied with left or right horizontal air inlet and top vertical air discharge.

The compressor shall be double isolation mounted using selected durometer grommets to provide vibration free compressor mounting. The compressor mounting bracket shall be acoustically deadened galvanized steel to prevent vibration transmission to the cabinet.

Option: AlpinePure MERV 13 filter - A 2 in. thick [51 mm] MERV 13 filter can help fulfill a credit under the LEED Rating System. Its low initial resistance promotes low energy consumption (0.21 in. w.g. @ 300 fpm) and provides nearly twice the life of a standard filter (300 fpm vs. standard 500 fpm application).

Option: A Super Quiet Sound package shall include multi-density full coverage compressor blanket.

Option: An internally mounted low pressure drop (high Cv) water solenoid valve shall be factory installed for use in variable speed pumping applications.

Refrigerant Circuit

All units shall utilize the non-ozone depleting and low global warming potential refrigerant R-410A. All units shall contain a sealed refrigerant circuit including a hermetic motor-compressor, bidirectional thermostatic expansion valve, finned tube air-to-refrigerant heat exchanger, reversing valve, coaxial tube water-to-refrigerant heat exchanger, and service ports.

Compressors shall be high-efficiency single speed rotary or scroll type designed for heat pump duty and mounted on vibration isolators. The compressor shall be double isolation mounted using selected durometer grommets to provide vibration free compressor mounting.

The coaxial water-to-refrigerant heat exchanger shall be designed for low water pressure drop and constructed of a convoluted copper (cupronickel option) inner tube and a steel outer tube. Refrigerant to air heat exchangers shall utilize enhanced corrugated lanced aluminum fins and rifled aluminum tube construction rated to withstand 600 psig (4135 kPa) refrigerant working pressure. Refrigerant to water heat exchangers shall be of copper inner water tube and steel refrigerant outer tube design, rated to withstand 600 psig (4135 kPa) working refrigerant pressure and 450 psig (3101 kPa) working water pressure.

Option: AlumiSeal electro-coated air coil.

The thermostatic expansion valve shall provide proper superheat over the entire liquid temperature range with minimal "hunting." The valve shall operate bidirectionally without the use of check valves.

Engineering Guide Specifications cont.

Option: Cupronickel refrigerant to water heat exchanger shall be of copper-nickel inner water tube and steel refrigerant outer tube design, rated to withstand 600 psig (4135 kPa) working refrigerant pressure and 450 psig (3101 kPa) working water pressure. Water lines shall also be of cupronickel construction.

Option: ThermaShield coated water-to-refrigerant heat exchanger, water lines and refrigerant suction lines shall be insulated to prevent condensation at low liquid temperatures below 50°F.

Option: AlpinePure hot gas bypass

Option: AlpinePure hot gas reheat

Blower Motor and Assembly

All units shall have belt-driven centrifugal blowers. Blower motors shall be permanently lubricated with speed control via a variable frequency drive. Variable frequency drives eliminate manual sheave adjustment for testing and balancing of airflow. LCD type display shall be located in the control box for easy adjustment of motor speed. The blower shall be double-width double inlet forward curved with dynamically balanced wheels. Blower motors shall be nominal 1725 rpm, sealed ball bearing type with NEMA premium efficiency rating. The drive shall include fixed pitch blower sheave and fixed pitch motor sheave sized for 115% of the blower brake horsepower. The blower and motor assembly must be capable of overcoming the external static pressures as shown on the schedule.

Electrical

A control box shall be located within the unit compressor compartment and shall contain a 100VA transformer, 24 volt activated, 2 pole compressor contactor, terminal block for thermostat wiring and solid-state controller for complete unit operation. Electromechanical operation WILL NOT be accepted. Units shall be name-plated for use with time delay fuses or HACR circuit breakers. Unit controls shall be 24 volt and provide heating or cooling as required by the remote thermostat/sensor.

An Aurora microprocessor-based controller that interfaces with a multi-stage electronic thermostat to monitor and control unit operation shall be provided. The control shall provide operational sequencing, blower speed control, high and low pressure switch monitoring, freeze detection, condensate overflow sensing, lockout mode control, LED status and fault indicators, fault memory, field selectable options and accessory output. The control shall provide fault retry three times before locking out to limit nuisance trips.

A detachable terminal block with screw terminals will be provided for field control wiring. All units shall have knockouts for entrance of low and line voltage wiring. The blower motor and control box shall be harness plug wired for easy removal.

Option: An Aurora Unitary Protocol Converter (UPC) shall be included that communicates directly with the Aurora Heat Pump Controls and allows access/control of a variety of internal Aurora heat pump operations such as sensors, relay operation, faults and other information. In turn, the UPC shall convert the internal Aurora Modbus protocol to BACnet MS/TP, or N2 protocols for communication over a BAS system. Additional individual unit configuration items such as ECM fan speeds or freeze protection settings shall be directly available over the BAS without the need for access to the actual heat pump.

Option: Aurora UPC DDC communication protocols: LonWorks

Piping

Supply and return water connections shall be FPT copper fittings fixed to the corner post, which eliminate the need for backup pipe wrenches.

Notes

Revision Guide

Pages:	Description:	Date:	By:
All	First published	Oct 2015	MA



Manufactured by
WaterFurnace International, Inc.
9000 Conservation Way
Fort Wayne, IN 46809
www.waterfurnace.com

Product:	Envision Series 30 Ton
Type:	Water Source/Geothermal Heat Pump
Size:	Commercial 30 Ton
Document:	Specification Catalog

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