Combo Geothermal Heat Pump

Installation & Operating Instructions

Model: RU-VE*

Application

- Geo source, loop or ground water fluid
- Forced air vertical cabinet output
- Standard left ducting return, easily field converted to right ducting return
- Matching capacity hydronic, hot water heating, output
- Equipped for optional AUX EL strip heat (controller included)

Domestic Water Heater, Desuperheater

Energy Star promotes the desuperheater and it is standard with this series. However, it only efficiently produces hot water if the tank temperature is less than 115° F (46° C). Thus, for proper and efficient application a hot water buffer tank is suggested, see page 16.

Drawings: **NC604p4, NH601, NR602, UAW601, UAW602, XX029**

DO NOT DESTROY THIS MANUAL. PLEASE READ CAREFULLY AND KEEP IN A SAFE PLACE FOR FUTURE REFERENCE BY A SERVICE TECHNICIAN.

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Table of Contents

Introduction

When used and controlled properly, geothermal heat pumps can save hundreds of dollars per year. NorthStar Series geothermal heat pumps are designed to provide maximum efficiency and reliability. Solid and simple electric controls allow for low maintenance and built in safety protection.

Controller NH-CTR-CMB provides compressor monitor and safety limit interface, internally wired functions for forced air blower, hydronic pump relay, 2-stage compressor, heat/cool reversing, Combo mode selection, fault indicator, PC readout fault codes, etc.

This Combo model series requires a heat pump multi-stage room thermostat, 7 wires minimum. In addition if the room thermostat has dehumidification output, this can activate the BK terminal to reduce blower speed. The hydronic heating mode is activated from an external aquastat contact closure wired between R and HW screw terminals.

The factory default is air stat priority, but by removing a jumper the system can become hydronic priority.

The optional AUX EL strip heat module is activated from roomstat W2 or if the system is in a compressor fault mode. The controller holds off AUX EL upper kW stages for the first 20 minutes after thermostat call.

The loop pump 240-volt output terminals are active whenever the compressor contactor is active, fused at 10A.

The hydronic pump 240 output is active HW input terminal, fused at 10A. Note – if the external hydronic pumps are 120-volt, we suggest the use of a 240 coil relay connected to the internal hydronic pump terminal block.

This Combo series is forced air cooling only, water cooling is not provided.

Forced air humidifier has special terminal block connection for easy field installation.

Hydronic mode is full compressor only; there is no Part Load hydronic mode. However, a field jumper peg can be removed to operate on hydronic Part Load only.

From initial roomstat activation, the controller never turns on all stages of AUX EL immediately (except during a lockout condition or while operating in emergency heat mode). During normal operation, Stage 1 must be active for 20 minutes (factory default, PC download) and another 20 minutes must elapse before stage 3 or stage 4 is activated.

Moving and Storage
Units should be stored in original packaging in a clean dry area. Store and move units in normal upright position. Do not stack units.

Initial Inspection
Be certain to inspect all cartons and crates as units are received before signing the freight bill. Verify that all items received have no physical damage. Report any damages or shortages on the freight bill. The purchaser is responsible for filing the necessary claims with the carrier. Concealed or hidden damages not discovered until removing packaging must be reported to the carrier within 15 days of receipt.

Unit Location and Mounting
Locate the unit in an indoor area where the ambient temperature will remain above 45°F [8°C]. Northern Heat Pump provides 3 removable panels for ease of servicing; front (2), right and left bottom. This unit is zero clearance rated; however, allow enough room to remove panels for service and maintenance. We suggest setting the unit on a sound vibration pad, see accessories price sheet, R-PAD-2735-1-**. Water supply should **not** be hard plumbed directly with copper pipe as this could transfer any vibration to living space.

Please read and understand conditions associated with proper installation, unauthorized changes, and POWER ON procedures.

Warranty Statement
See the last page of this manual for detailed limited warranty coverage explanation.

Safety Considerations

⚠ WARNING

BEFORE PERFORMING SERVICE OR MAINTENANCE OPERATIONS ON A SYSTEM, TURN OFF MAIN POWER SWITCHES TO THE INDOOR UNIT. IF APPLICABLE, TURN OFF THE ACCESSORY HEATER POWER SWITCH. ELECTRICAL SHOCK COULD CAUSE PERSONAL INJURY.

Installing and servicing heating and air conditioning equipment can be hazardous due to system pressure and electrical components. Only trained and qualified service personnel should install, repair or service heating and air conditioning equipment. Untrained personnel can perform the basic maintenance functions of cleaning coils and cleaning and replacing filters. All other operations should be performed by trained service personnel. When working on heating and air conditioning equipment, observe precautions in the literature, tags and labels attached to the unit and other safety precautions that may apply, such as the following safety measures:

- Follow all safety codes.
- Wear safety glasses and work gloves.
- Use a quenching cloth for brazing operations.
- Have a fire extinguisher available for all brazing operations.

Refrigerant Loop Schematic
The block diagrams relating to heat/cool/hydronic may be helpful in diagnosing or understanding the refrigerant component operations.

Northern Heat Pump Configurator

R	A	-	V	E	-	0	2	8	-	1	-	C	L	D	X	1	-	X	X	-	U	S
1	2		3	4		5	6	7		8		9	10	11	12	13		14	15		16	17

Model Number Digits

RA-VE-028-1-CLDX1-XX-US

Geo Source (1)

Unit Type (2)
A = Single Stage
D = Dual Compressor
T = Two Stage
U = Two Stage w/HLHE*
*Hydronic Load Heat Exchanger – for hot water heating applications

Unit Style (3)
S = Split
V = Vertical
W = Hydronic

Refrigerant (4)
E = R-410A

Nominal BTU (5, 6, 7)
028 (Single Stage) 2-ton
032 (Single Stage) 2.5-ton
041 (Single Stage) 3-ton
053 (Single Stage) 4-ton
061 (Single Stage) 5-ton
073 (Single Stage) 6-ton

020 (Two Stage) 1.5-ton
026 (Two Stage) 2-ton
033 (Two Stage) 2.5-ton
040 (Two Stage) 3-ton
045 (Two Stage) 3.5-ton
052 (Two Stage) 4-ton
062 (Two Stage) 5-ton

020 (Hydronic) 1.5-ton
024 (Hydronic) 2-ton
030 (Hydronic) 2.5-ton
036 (Hydronic) 3-ton
050 (Hydronic) 4-ton
057 (Hydronic) 5-ton
070 (Hydronic) 6-ton

072 (Hydronic Dual) 6-ton
100 (Hydronic Dual) 8-ton
114 (Hydronic Dual) 10-ton
140 (Hydronic Dual) 12-ton

Country of Origin (16, 17)
US = United States
CA = Canada

Auxiliary kW Option* (14, 15)
05 = 4.8 kW
10 = 9.6 kW
15 = 14.4 kW
20 = 19.2 kW
XX = None
*Can be factory or field installed

Vintage (13)
1

Miscellaneous Kits (12)
A = Soft Start Kit (Installed)
X = None

Desuperheater Option (11)
D = Desuperheater w/ Factory Installed Pump
X = None

Configuration Option (10)
L = Left Return (Standard)*
R = Right Return
C = Split Air Coil
X = N/A or No Split Air Coil
*Left return can be field converted to right return

Heat Exchanger Option (9)
C = Copper
N = Cupronickel
M = Copper (Load) & Cupronickel (Source)
D = Double Wall (Load) & Copper (Source)
R = Double Wall (Load) & Cupronickel (Source)

Voltage Option (8)
1 = 208/230V, 1 Ph
2 = 208/230V, 3 Ph

Split System Coils

R-AE-030-21-US

R = Geo

Always A

Refrigerant
E = R-410A

Coil Size
21 = 21”
24 = 24”

Coil Capacity
024 = 24k BTU (2-ton)
036 = 36k BTU (3-ton)
048 = 48k BTU (4-ton)
060 = 60k BTU (5-ton)

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Forced Air – Mechanical Specifications – R410A Two-Stage Compressor

MODEL	RU-VE-026 (2 ton)	RU-VE-033 (2.5 ton)	RU-VE-040 (3 ton)	RU-VE-052 (4 ton)	RU-VE-062 (5 ton)
Coax & Piping Water Volume – gal	.43	.65	.65	1.1	1.1
Internal Pressure Drop (feet)	6.2	4.2	5.5	6.2	8.0
Internal Pressure Drop (psi)	2.7	1.8	2.4	2.7	3.5
Source Temperature °F (min/max)	20°/120°	20°/120°	20°/120°	20°/120°	20°/120°
Nominal source differential* ° F (H/C)	3/12°	8/11°	9/11°	6/11°	6/10°
Factory Charge R410A -(oz) *	52	52	72	118	118
Static Pressure – Nominal	0.3	0.3	0.3	0.3	0.3
Static Pressure – Design	0.5	0.5	0.5	0.5	0.5
Air Filter	7/8 X 21 7/8 X 27 1/2	7/8 X 21 7/8 X 27 1/2	7/8 X 28 7/8 X 27 1/2	7/8 X 27 1/2 X 37 7/8	7/8 X 27 1/2 X 37 7/8
Weight– Packaged (lbs)	510	530	550	573	600

*Shown as reference information only, see unit nameplate for the supplied factory charge for each specific unit.

HEATING – ISO 13256-1 SPECIFICATION – ENERGY STAR

Model	Stage	Source GPM	WLHP – Water Loop				GWHP – Ground Water				GLHP – Ground Loop			
			68° F		68° F		50° F		68° F		32° F/41° F		68° F	
			Capacity Btu/h	Blower CFM	Temp Rise	COP	Capacity Btu/h	Blower CFM	Temp Rise	COP	Capacity Btu/h	Blower CFM	Temp Rise	COP
RU-VE-026	FL	7	36.18	900	39	4.71	30.28	900	32	4.42	24.94	900	26	3.98
RU-VE-026	PL	7	24.86	700	33	4.79	22.10	700	29	4.48	19.10	700	26	4.00
RU-VE-033	FL	8	42.16	940	42	4.21	37.00	950	36	4.11	28.39	950	28	3.64
RU-VE-033	PL	8	29.00	720	38	4.85	23.85	700	32	4.19	21.20	714	28	3.89
RU-VE-040	FL	10	53.00	1210	41	4.70	43.55	1205	34	4.45	33.83	1200	27	3.88
RU-VE-040	PL	10	38.20	1020	35	5.70	31.40	1000	30	4.92	27.81	1000	26	4.44
RU-VE-052	FL	13	80.38	1500	41	4.54	57.40	1500	36	3.87	45.80	1500	29	3.45
RU-VE-052	PL	13	48.00	1200	37	4.58	38.48	1200	30	3.87	34.40	1180	27	3.57
RU-VE-062	FL	15	83.46	1840	41	4.19	68.00	1840	35	4.19	54.42	1820	28	3.72
RU-VE-062	PL	15	64.68	1520	40	5.08	51.00	1470	32	4.28	46.28	1475	29	3.98

COOLING – ISO 13256-1 SPECIFICATION – ENERGY STAR

Model	Stage	Source GPM	WLHP – Water Loop				GWHP – Ground Water				GLHP – Ground Loop			
			86° F		80.6° F		59° F		80.6° F		77° F/68° F		80.6° F	
			Capacity Btu/h	Blower CFM	Temp Drop	EER	Capacity Btu/h	Blower CFM	Temp Drop	EER	Capacity Btu/h	Blower CFM	Temp Drop	EER
RU-VE-026	FL	7	33.09	950	20	14.1	37.58	950	22	21.4	30.75	950	20	16.9
RU-VE-026	PL	7	24.82	750	20	15.3	28.20	750	21	23.1	23.10	750	22	20.2
RU-VE-033	FL	8	34.36	1000	20	14.9	39.62	1000	22	21.6	36.76	1000	21	16.7
RU-VE-033	PL	8	25.77	730	22	14.0	29.72	740	25	22.4	27.57	750	24	18.9
RU-VE-040	FL	10	43.10	1260	22	14.6	48.40	1260	23	21.1	45.54	1260	22	16.9
RU-VE-040	PL	10	32.30	1055	21	17.9	36.24	1055	22	28.5	35.60	1060	21	24.3
RU-VE-052	FL	13	56.83	1600	22	13.6	66.21	1600	23	20.1	60.13	1600	22	15.9
RU-VE-052	PL	13	42.50	1300	20	15.6	49.21	1275	22	25.7	47.53	1275	22	22.5
RU-VE-062	FL	15	72.59	1970	21	14.9	78.13	1970	23	19.7	74.00	1970	23	16.4
RU-VE-062	PL	15	55.00	1600	22	17.0	58.61	1630	21	24.3	61.51	1670	22	23.3

1. Capacities are based on temperatures shown in heading, source is left group, return air is right group.
2. Stated Btu/h are the ISO 13256-1 formula adjusted, actual HP supply energy delivered is 2% greater.
3. Temp rise is based on sensible only.
4. All ratings based upon operation at lower voltage of dual voltage rated models.
5. Ground Loop Heat Pump ratings based on 15% antifreeze solution.

Hydronic – Mechanical Specifications – R410A Compressor

MODEL	**RU-VE-026** (2 ton)	**RU-VE-033** (2.5 ton)	**RU-VE-040** (3 ton)	**RU-VE-052** (4 ton)	**RU-VE-062** (5 ton)
Hydronic GPM, min.	7	8	10	13	15
Nominal water rise ° F	6	7	8	7	7
Coax Water Connection (NPT)	1”	1”	1”	1”	1”
Coax & Piping Water Volume – gal	.43	.65	.77	1.1	1.1
Internal Pressure Drop (feet)	11	7	7	7	10

*Shown as reference information only, see unit nameplate for the supplied factory charge for each specific unit. Rated is at 50° F source and 90° F hydronic return water.

ISO 13256-2 Performance – Energy Star

Model	**Capacity Modulation**	**Ground Water Heat Pump**				**Ground Loop Heat Pump**			
		Cooling 59° F		**Heating 50° F**		**Cooling Full Load 77° F**		**Heating Full Load 32° F**	
		Capacity Btu/h	**EER Btu/h/W**	**Capacity Btu/h**	**COP**	**Capacity Btu/h**	**EER Btu/h/W**	**Capacity Btu/h**	**COP**
026	Full	27,000	21.8	24,800	3.8	23,000	16.9	21,500	3.1
033	Full	33,200	21.7	30,500	3.7	28,400	16.4	26,500	3.08
040	Full	40,300	22.9	37,000	4.1	34,500	17.0	32,200	3.12
052	Full	48,300	21.0	44,300	3.5	41,200	16.1	38,500	3.04
062	Full	62,200	22.7	57,000	4.0	54,000	16.7	49,500	3.10

Heating capacities based upon 104° F hydronic return water.
Cooling capacities based upon 53° F hydronic return water.
Ground Loop Heat Pump ratings based on 15% antifreeze solution.
All ratings based upon operation at lower voltage of dual voltage rated models.

Electrical Data – Single Phase

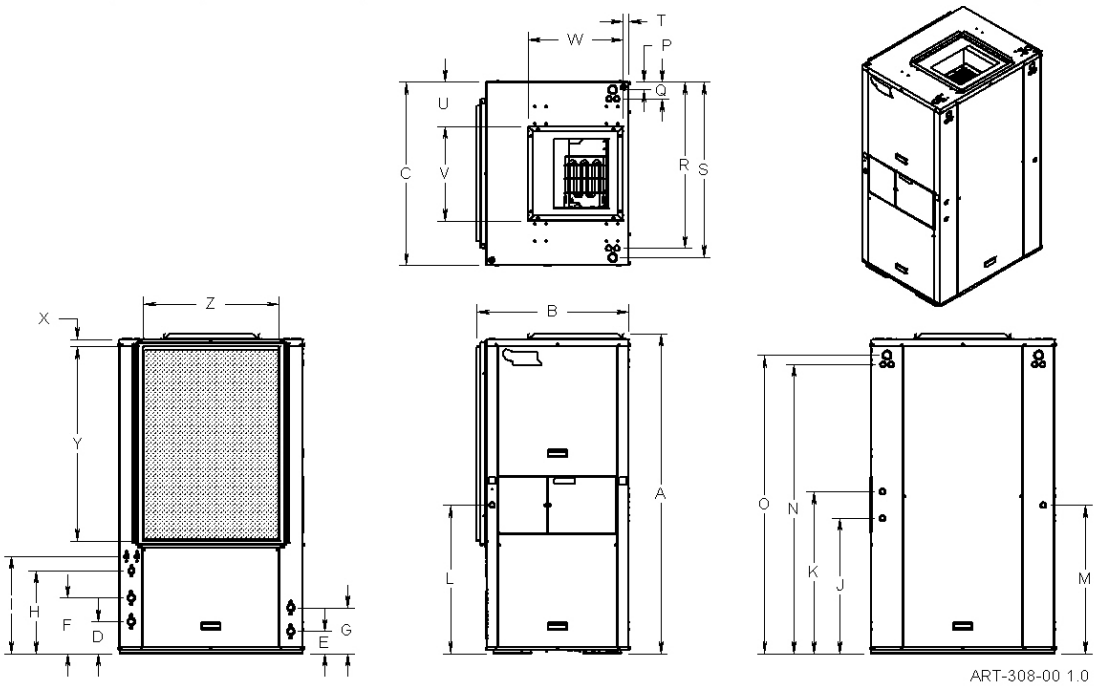
Model	Voltage	Compressor		Blower	Desup. Pump	Loop Pump (Ext)	Total	Min.	Max. Fuse/ HACR
	(60 Hz)	RLA	LRA	FLA	FLA	FLA	FLA	Ampac.	
020	208/230-1	10.3	52	4.5	.15	4.4	19.3	21.9	40
026	208/230-1	14.1	70	4.5	.15	4.4	23.1	26.7	50
033	208/230-1	16.7	82	4.5	.15	4.4	25.7	29.9	50
040	208/230-1	16.7	96	6.1	.15	4.4	27.4	31.5	50
052	208/230-1	25.6	118	6.1	.15	4.4	36.2	42.6	70
062	208/230-1	27.2	150	7.3	.15	4.4	39.1	45.9	80

Electrical Data – Three-Phase

Model	Voltage	Compressor		Blower	Desup. Pump	Loop Pump (Ext)	Total	Min.	Max. Fuse/ HACR
	(60 Hz)	RLA	LRA	FLA	FLA	FLA	FLA	FLA	
020	200/230-3	7.1	59	4.5	.15	4.4	16.1	17.9	30
033	200/230-3	11.2	58	4.5	.15	4.4	20.2	23.0	40
040	200/230-3	13.5	88	6.1	.15	4.4	24.2	27.5	40
052	200/230-3	17.6	123	6.1	.15	4.4	28.2	32.6	60

Product Dimensions

		COMBINATION UNITS					
		RU-VE-062	RU-VE-052	RU-VE-040	RU-VE-033	RU-VE-026	RU-VE-020
OVERALL CABINET	A (Height)	60 5/8" [154cm]					
	B (Width)	28 3/4" [73.1cm]					
	C (Depth)	34 7/8" [88.5cm]					
WATER CONNECTIONS	D (Source In)	6 1/8" [15.4cm]					
	E (Source Out)	4 1/4" [10.6cm]					
	F (Hydronic In)	10 9/16" [26.8cm]					
	G (Hydronic Out)	8 11/16" [22.1cm]					
	H (Drain)	15 3/4" [39.9cm]					
	I (Desuperheater In/Out)	18 1/2" [46.8cm]					
	Source In/Out	1" NPT					
	Source In/Out	1" NPT					
	Drain	1/2" NPT					
	Desuperheater In/Out	1/2" NPT					
ELECTRICAL CONNECTIONS	J	25 3/4" [65.3cm]					
		Ø1.125 X Ø.875 Double Knockout					
	K	30 3/4" [78cm]					
		Ø1.125 X Ø.875 Double Knockout					
	L	28 1/4" [71.6cm]					
		Ø1.125 X Ø.875 Double Knockout					
	M	28 1/8" [71.4cm]					
		Ø1.125 X Ø.875 Double Knockout					
	N	54 7/8" [139.3cm]					
		Ø1.125 X Ø.875 Double Knockout					
	O	56 5/8" [143.8]					
		Ø1.75 X Ø.1.375 Double Knockout					
	P	1 1/2" [3.8cm]					
		Ø1.75 X Ø.1.375 Double Knockout					
	Q	3 1/4" [8.3cm]					
		Ø1.75 X Ø.1.375 Double Knockout					
	R	31 5/8" [80.2cm]					
		Ø1.75 X Ø.1.375 Double Knockout					
	S	33 3/8" [84.7cm]					
		Ø1.75 X Ø.1.375 Double Knockout					
SUPPLY CONN.	T	1 1/8" [2.7cm]					
	U	8 3/8" [21.4cm]					
	V	18" [45.7cm]					
	W	18" [45.7cm]					
RETURN CONN.	X	1 3/8" [3.5cm]					
	Y	36 7/8" [93.7cm]		27 7/8" [70.9cm]		20 7/8" [53.1cm]	
	Z	25 7/8" [65.6cm]					



Installation Requirements

1. All installation work must be performed by trained, qualified contractors or technicians. Northern Heat Pump, sponsors installation and service schools to assist the installer. **Visit our Website at www.electromn.com for upcoming service schools.**

⚠ WARNING

ALL ELECTRICAL WIRING MUST BE IN ACCORDANCE WITH NATIONAL ELECTRIC CODE AND LOCAL ELECTRIC CODES, ORDINANCES, AND REGULATIONS.

⚠ WARNING

OBSERVE ELECTRIC POLARITY AND WIRING COLORS. FAILURE TO OBSERVE COULD CAUSE ELECTRIC SHOCK AND/OR DAMAGE TO THE EQUIPMENT.

⚠ CAUTION

This unit can only be used for its intended design as described in this manual. Any internal wiring changes, modifications to the circuit board, modifications or bypass of any controls, or installation practices not according to the details of this manual will void the product warranty, the safety certification label, and manufacturer product liability. Northern Heat Pump cannot be held responsible for field modifications, incorrect installations, and conditions which may bypass or compromise the built-in safety features and controls.

2. If this is a Dual Heat system, this product relates only to the addition to the furnace ducting system external to the gas or oil force air furnace. The owner/ installer assumes all responsibility and/or liability associated with any needed installation of the gas/oil furnace, fuel system, flue, chimney, etc. Any instructions or comments made within this manual (or factory phone assistance) relating to the gas/oil furnace are provided as comments of assistance and "helps" only.

⚠ CAUTION

This unit shall not be operated (either heating section or blower) until the interior of the structure is completed and cleaned. This also means all duct work must be complete with filter, etc. Manufacturer's warranty is void if this unit is operated during structure construction.

⚠ CAUTION

Hazards or unsafe practices could result in property damage, product damage, severe personal injury and/or death.

3. All removed or discharged refrigerant must be recovered. Local and federal statutes are to be observed. Should a compressor need replacing, the compressor oil is to remain with the compressor. Refrigerant lines on the compressor must be sealed.

4. Remember, safety is the installer's responsibility and the installer must know this product well enough to instruct the end user on its safe use.

At Northern Heat Pump, the safety of the installer and the end user is of highest priority. Remember, safety is the installer's responsibility and the installer must know this product well enough to instruct the end user on its safe use. Professional installers should be trained and experienced in the areas of handling electrical components, sheet metal products, and material handling processes.

Mechanical Installation Overview

As with all geothermal heat pumps, the source loop or fluid is the energy source. The design and installation of the source fluid system is of utmost importance to the proper operation and efficiency of the system the following items should be carefully considered and properly followed for all installations:

Examination of the existing forced air furnace – This NorthStar Series unit cannot correct airflow problems inherent within the duct work system. Prior to starting this installation, examine the total furnace system and make necessary comments or recommendations to the homeowner. Remember, if a marginal condition exists within the existing duct work system, the installation of a geothermal heat pump will not cure PRE-EXISTING conditions. Consider such items as adequate cold air return and adequate supply duct and room register (1 register per 100 CFM) etc.

Heating capacity – Size the geothermal heat pump according to the normal heating requirements as the building exists today. Do not necessarily match to the existing furnace nameplate because it may be oversized. Do not oversize the geothermal heat pump.

Other plenum equipment – Auxiliary equipment such as humidifiers, zone plenum dampers, etc., located within the plenum which may cause a non-uniform airflow issues may have to be removed if they cause excessive reduction to system airflow. Zone dampers within the trunk line at least 12" (30.5 cm) from the coil typically do not pose problems. When horizontal zone dampers are involved, perform all check-out functions with smallest zone open first.

Comment – zone dampers cause back pressure on the blower and overall reduced airflow. Reduced airflow can cause the geothermal unit to perform poorly or in some cases cause icing or freeze ups in the geo loop or air coil.

Insufficient cold air return capacity – Installation experience indicates this is a major concern. In fact, it could represent a problem in as many as 60% of the installations, especially if there is a requirement to increase airflow when the existing cold air return capacity is already undersized or restricted. Check the static pressure within the return cabinet or the suction at the filter cabinet door. Do not assume because there is a register on the wall, the hole behind the register or the passageways are equal to this register. Sharp offsets and transitions in the cold air return system often cause severe restrictions. Expect to add additional registers or a relief register in the main cold air return duct.

Closed Loop Applications – Closed loop system re-circulates the same water/antifreeze solution through a closed system of underground high-density polyethylene pipe. As the solution passes through the pipe it collects heat (in the heating mode) that is being transferred from the relatively warm surrounding soil through the pipe and into the relatively cold solution. The solution is circulated back to the heat pump that extracts its heat and then returns to the ground to absorb more heat from the earth. Earth loops must be sized properly for each particular geographic area and individual capacity requirements. The NorthStar Series heat pumps are designed to operate on either **vertical or horizontal closed loop applications** (Figures 1 & 2)**.** Vertical loops are typically installed with a well drilling rig up to 200 feet (61 meters) deep or more. Horizontal systems are typically installed with excavating or trenching equipment approximately six to eight feet (2-2.5 meters) deep, depending on geographic location and length of pipe used.

Horizontal Closed Loop

Figure 1

Vertical Closed Loop

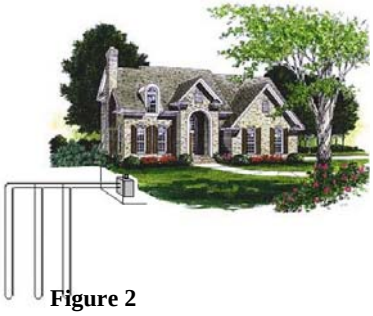


Figure 2

Lake or Pond Loops – Closed loop systems may also be used in lakes or rivers to supply a heat source to the heat pump. Typically a loop consisting of geothermal pipe can be designed and placed in an area not much deeper than 15ft (4.5 meters) with some water currents present. In any lake or pond, municipal and area codes must be observed in regards to a lake or pond loop. The use of an environmentally friendly loop fluid like food grade propylene glycol should be considered in the event damage should ever occur to the loop. Consult an IGSHPA or CGC certified installer for proper lake or pond loop design.

Mechanical Installation Source Water

⚠ WARNING

LOOP DESIGN IS EXTREMELY IMPORTANT FOR PROPER HEAT PUMP OPERATION. INCORRECT LOOP DESIGN WILL REDUCE HEAT PUMP EFFICIENCY, CAUSE POOR PERFORMANCE OR MAY RENDER THE SYSTEM UNUSABLE. CONTACT AN IGSHPA OR CGC CERTIFIED GEOTHERMAL LOOP CONTRACTOR FOR PROPER INSTALLATIONS.

Water Connections General

The following pages outline typical piping arrangements for the most common source water connection options, as well as flushing and filling procedures and antifreeze requirements for closed loop systems. Do **not** connect copper piping directly to the source water connection points on this unit. A section of flexible piping is recommended to reduce and isolate vibrations transmitting from the compressor into other parts of the system.

Once closed loops are completed, they must be pressure tested to at least 60 PSI to ensure integrity. Once pressure is tested, loop must be purged of all foreign debris and filled with fluid. All air must be removed at this time by flushing the system. (Table 2) shows approximate fluid volumes.

Pressure/Temperature (P/T) plugs – Should be installed in the adaptor elbow on the entering and leaving water line of the heat pump on a closed system. (Figures 3 and 4) A thermometer can be inserted into the P/T ports to check entering and leaving water temperatures. A pressure gauge can also be inserted into these P/T ports to determine the pressure differential between the entering and leaving water. This pressure differential can then be compared to the engineering specifications data to determine the flow rate of the system.

P/T Adapter

Figure 3

Flow Center – if selecting non-pressure closed loop design (Figure 5), a flow center is required. Flow center is the key to installation ease and long-term reliability.

Loop Pump Selection – Select a loop circulation pump based upon the GPM required and total system pressure drop. See specification, page 3. Geo heat pump Btu/h capacity and efficiency are directly related to the GPM flow through the unit.

Vibration pad – suggest setting the unit on a sound vibration pad, available from most distributors or accessories price sheet – R-PAD-2735-1-**.

Water quality – models with standard copper heat exchanger coils require the installer to evaluate water quality and meet minimum water properties.

- pH/calcium hardness — pH < 7.5 and Ca harness < 100 PPM
- Iron fouling — < 0.2 PPM (Ferrous)
< 0.5 PPM of oxygen
- Hydrogen sulfide (H_2S) — < 0.5 PPM
- Chloride levels — < 20 PPM
- Erosion/clogging — < 10 PPM, particles
- Filter, if required — < 800 micron size

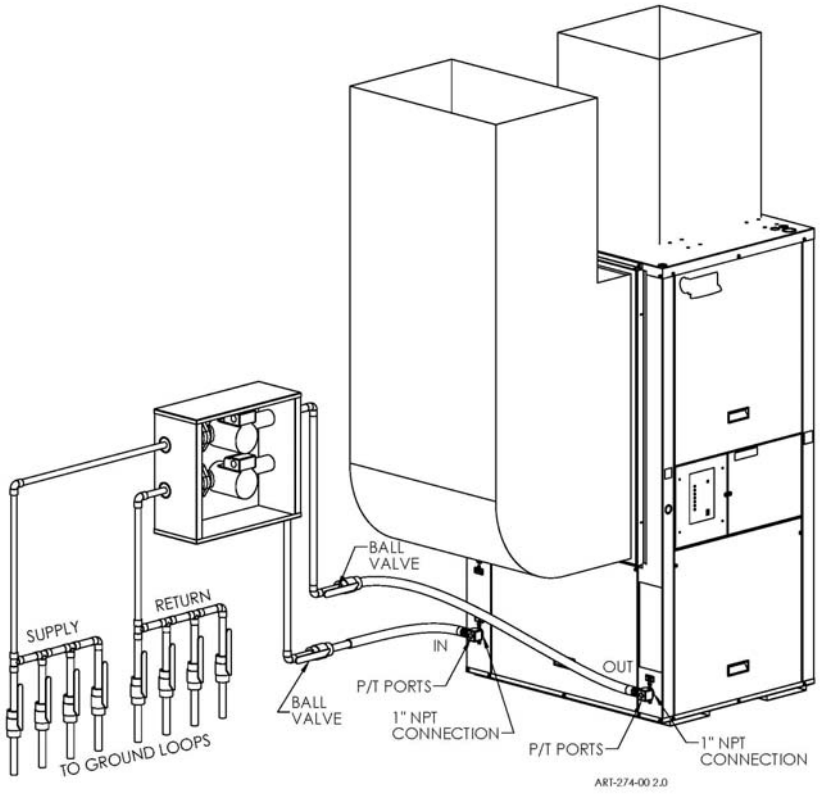


Figure 4 – Pressurized Closed Loop with Flow Center – Typical piping arrangement.

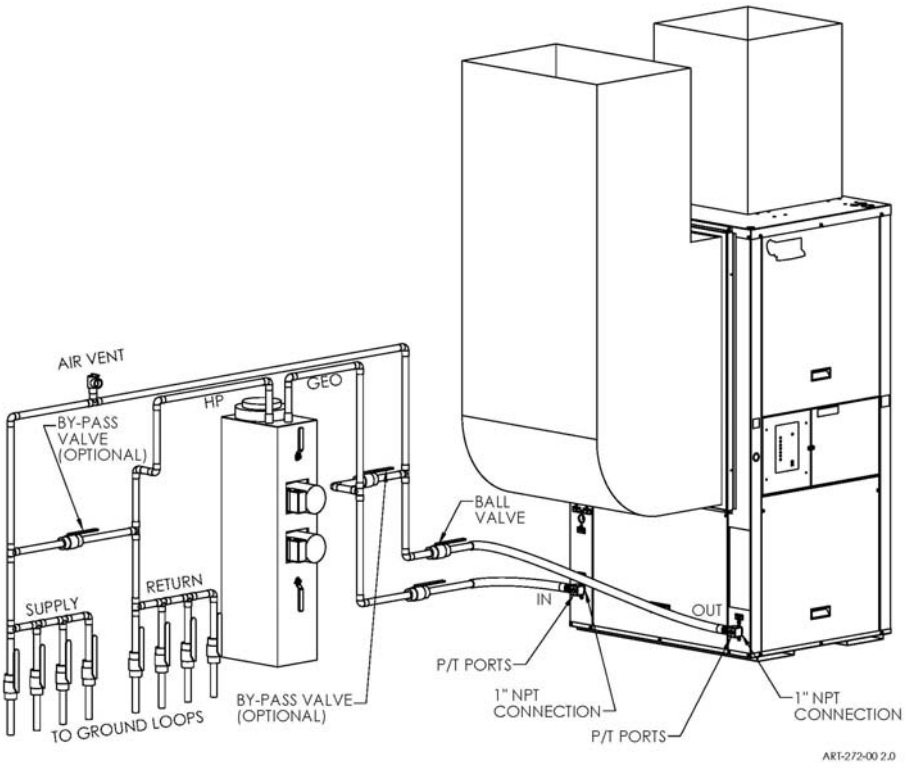


Figure 5 – Non-Pressurized Closed Loop with Flow Center – Typical piping diagram.

Flushing and Filling the System Using 3-Way Valves

Step 1
Use water and a high volume head circulator pump to flush air and debris and to fill the loop system.

- Refer to recommendations provided by IGSHPA or CGC when choosing a pump for the flushing process.
- It is recommended that pump suction be from the bottom of a large volume container. Use a suction line strainer to prevent debris discharged into the container from being recycled to the system.

Step 2
Pump water into the system by connecting the pump discharge hose to one (not both) of the 1.00" NPT water connections located on the sides of the module.
Connect a return hose to the opposite side of the module to discharge debris and air as water is added to the loop.

Step 3
Rotate the module valves as shown in step 3 diagram:

Step 4
Start the pump. Add anti-freeze and water to the container as needed so that no air enters the system. This will push any air out of the loop. If flushing assembly is equipped with valves to reverse flow direction, do so occasionally to help remove trapped air. When bubbles cease in the return hose container, the earth loop has been completely flushed.

Step 5
Flush the heat pump. To do so, simply rotate the valves as shown in step 5 diagram while the pump is running. Flush the heat pump using the same procedure as used to flush the earth loop.

Pressurizing the System (does not apply to Figure 5)

Step 6
After flushing and filling the system, rotate the module valve discharging into the flush container as shown in step 6A diagram to pressurize the loop. Then turn the valves as in step 6B.

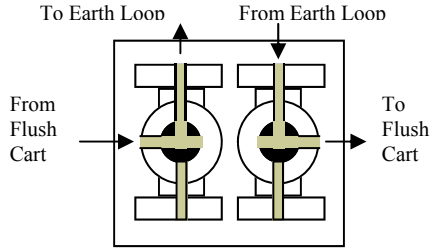
Step 7
Turn off the flush cart pump. The system should remain pressurized. Release excess pressure by rotating either module valve to allow a small amount of water to pass through and out of the system and into the container. Some initial loss of pressure can be expected and is due to the expansion of the earth loop pipe under pressure. The pressure will stabilize if the system has no leaks.

Step 8
Flushing, filling and pressurization should be complete. Start the loop pump module circulators.

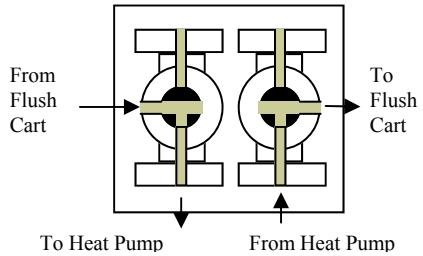
Step 9
Troubleshoot. If for some reason the circulators are not operating, power off and diagnose the problem.

Step 10
Using a single water pressure gauge, measure the pressure drop at the pressure/temperature plugs across the heat pump

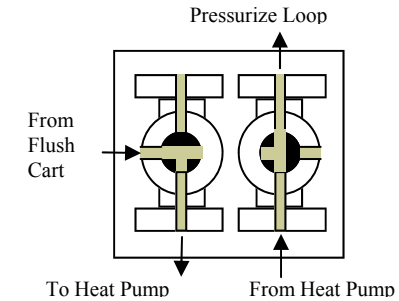
Step 3



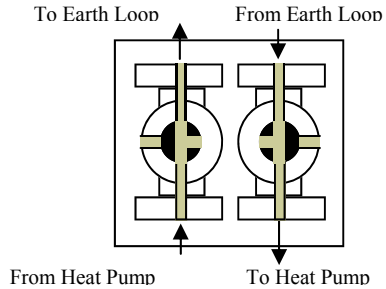
Step 5



Step 6A



Step 6B



heat exchanger. Compare the measurement with the flow versus the pressure drop table (Table#3) and determine the actual flow rate. If the flow rate is low, recheck the selection of the loop pump module model for sufficient capacity. If the model is correct, there is likely trapped air or a restriction in the flow circuit. System pressure should increase rapidly as the flush pump works to force more water into the system. Additional flushing of the loop is needed if the water level in the loop falls. This shows that there is air in the system. System operating pressures should be between 10 to 40 PSI.

Antifreeze

DO NOT mix more than 25% propylene glycol with water to achieve a lower than 15°F [-9°C] freeze protection. (See Table 3) A more concentrated mixture cannot be pumped through the earth loop at low temperatures. Lack of antifreeze will cause unit shutdown problems during cold weather operation (longest unit run time) when the loop temperatures fall below the freeze protection of the antifreeze. Flow rate requirements for closed loop solutions are higher than open loop systems because water temperatures supplied to the heat pump are generally lower. **Typically** 2.0 to 3.0 gallons per minute (GPM) per ton are required for proper operation of the heat pump and the earth coupled heat exchanger.

Table 2 – Approximate Fluid Volume (gal) per 100ft

Pipe	Size	Volume
Polyethylene	¾" IPS SDR 11	2.8
	1" IPS SDR 11	4.5
	1-1/4" IPS SDR 11	8.0
	1-1/2" IPS SDR 11	10.9
	2" IPS SDR 11	18.0
Rubber Hose	1"	3.9
Copper	1"	4.1
	1.25"	6.4
	1.5"	9.2

Table 3 – Antifreeze Percentages by Volume*

Minimum Temperature for Freeze Protection					
	10°F	16°F	17°F	21°F	25°F
	-12°C	-9°C	-8°C	-6°C	-4°C
Type					
Methanol	25%	21%	18%	16%	10%
Propylene Glycol	38%	30%	25%	22%	15%
Ethanol	22%	20%	18%	14%	10%

*Reference information only, see product manufacturer specification for percentage.

⚠ WARNING

DO NOT USE CALCIUM AS ANTI-FREEZE. FOLLOW CGC/IGSHPA RECOMMENDATIONS FOR THE APPROPRIATE TYPE AND AMOUNT OF ANTI-FREEZE.

⚠ WARNING

PREVENTING FREEZE-UP IS INSTALLER/USER RESPONSIBILITY. LEAKING HEAT EXCHANGER OR PIPING (EXTERNAL OR INTERNAL WITHIN THE REFRIGERANT/ COMPRESSOR) ARE NOT COVERED BY WARRANTY.

Open Loop Well – An open system gets its name from the open discharge of water after it has been used by the heat pump. A well must be available that can supply all of the water requirements of the heat pump along with any other water requirements drawing off that same well. The well must be capable of supplying the heat pumps required flow rated for up to 24 hours per day for the coldest winter day.

The discharge water is typically returned to the earth via a properly designed drain field or in a lake.

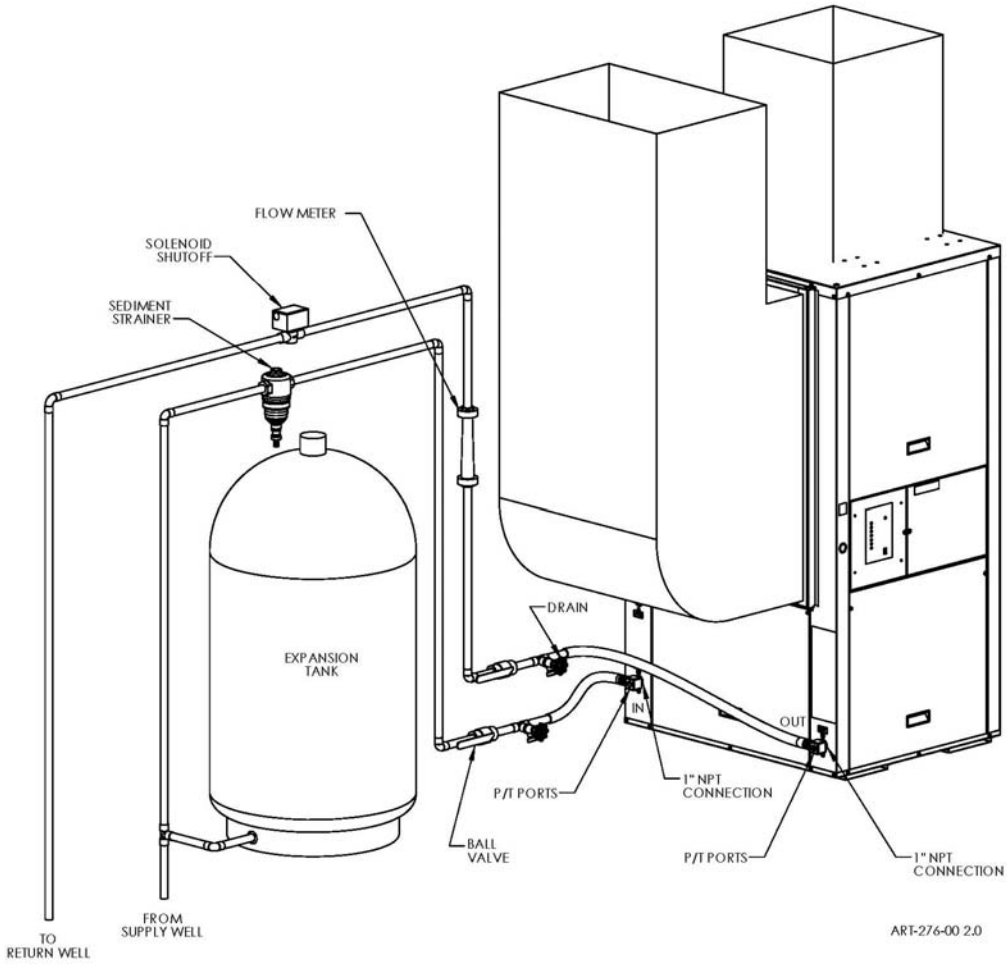
Figure 6 shows the necessary components for water piping of an open system. First a bladder type pressure tank with a "draw down" of at least 1-1/2 to 2 times the well pump capacity must be installed on the supply side of the heat pump to prevent short cycling the well pump. Shut off valves and boiler drains on the entering and leaving water lines are necessary for future maintenance. A screen strainer is placed on the supply line with a mesh size of 40 to 60 and enough surface area to allow for particle buildup between cleanings. Pressure temperature (P/T) plugs are placed in the supply and discharge lines so that thermometers or pressure gauges can be inserted into the water stream. On the well water discharge side of the heat pump a flow control/shut off valve must be mounted to regulate the maximum water flow through the unit. Remove handle to prevent accidental change of flow.

A solenoid valve is then installed and wired to compressor contactor terminal on the heat pump. (Refer to UAW601) This valve will open when the unit is running and close when the unit stops. A visual flow meter is then installed to allow visual inspection of the flow requirements. The flow meter can also be useful in determining when maintenance is required. Schedule 40 PVC piping, copper tubing, polyethylene or rubber hose can be used for supply and discharge water lines. Limit rubber hose to 10ft. (3m) to prevent excessive pressure drop. Make sure line sizes are large enough to supply the required flow with a reasonable pressure drop (generally 1.00" diameter). Water discharge is generally made to a drain field, stream, pond, surface discharge, tile line, or storm sewer.

⚠ CAUTION

Using a drain field requires soil conditions and adequate sizing to assure rapid percolation or the required flow rates will not be achieved. Consult local codes and ordinances to assure compliance. Do not discharge water to a septic system. The heat pump should never be operated with flow rates (GPM) less than specified. Operation of the unit with less than required flow rate or no flow may result in freezing water in the water to refrigerant heat exchanger. This will cause the unit to shut down on low-pressure lockout. If the unit locks out, verify that the unit has the required flow and reset the unit by shutting off power to the unit for one minute. Do not continually reset the unit; if the unit locks out more than once, call your service professional. Continued reset of the unit can freeze water inside the water coil to the point of rupturing the water coil (no warranty for frozen coils).

Figure 6: **Open Loop Well** – Typical piping diagram.



Open Loop Freeze Protection Switch – Heat pump installations on open loop systems, using a non-antifreeze protected water source during the heating mode require the use of a water coil freeze protection switch. If the water supply to the heat pump is interrupted for any reason, continued operation of the compressor will cause the water remaining in the water-to-refrigerant heat exchanger to freeze and rupture. The freeze protection switch will shut the unit down before freezing can occur and protect the heat pump against flow loss and damage.

Option – 39° F (3.9°C) pipe clamp-on, part number 6047. Connect in series with low limit.

Water Coil Maintenance – Water quality is a major concern for open systems. Problems can occur from scaling, particle buildup, suspended solids, corrosion, pH levels outside the 7-9 ranges, or biological growth. If poor water quality is known to exist in your area a **cupronickel** water coil may be required when ordering the system, or installing a closed loop system may be the best alternative. Water coil cleaning on an open loop system may be necessary on a regular basis.

Depending on the specific water quality issue, the water coil can be cleaned by the following methods:

Chlorine Cleaning (Bacterial Growth)

1. Turn thermostat to "Off" position.
2. Connect a circulating pump to hose bibs on entering water and leaving waterside of heat exchanger.
3. Using a five-gallon pail of water add chlorine bleach mixture. The chlorine should be strong enough to kill the bacteria. Suggested initial mixture is 1 part chlorine bleach to 4 parts water.
4. Close shut off valves upstream and downstream of heat exchanger.
5. Open hose bibs to allow circulation of bleach solution.
6. Start pump and circulate solution through heat exchanger for 15 minutes to one hour. Solution should change color to indicate the chlorine is killing the bacteria and removing it from the heat exchanger.
7. Flush used solution down the drain by adding fresh water supply. Flush until leaving water is clear.
8. Repeat procedure until solution runs clear through the chlorine circulation process.
9. Flush entire heat pump system with water. This procedure can be repeated annually, semiannually, or as often as it takes to keep bacteria out of the heat exchanger, or when bacteria appears in a visual flow meter to the point the flow cannot be read.

Muriatic Acid Cleaning

Difficult Scaling and Particle Buildup Problems

Consult installer due to dangerous nature of acids.

"Iron out" solutions and de-scaling products are also useful.

Desuperheater, Domestic Hot Water

General
All NHP NorthStar Series units are equipped with a desuperheater and an integrated circulating pump (can be a price deduct) that can provide Supplemental Domestic hot Water (SDW). This is done by stripping heat from the superheated gas leaving the compressor.

Fuses – 3-amp fuses are installed in series with the desuperheater pump. The fuses are located in the line voltage control box, upper right. Remove the fuses (turn 230 power source off) to disable the pump whenever the system is not in operation.

General Plumbing and Installation Suggestions

1. Insulated ½" copper piping should be used from the hot water tank to the desuperheater connections on the left side of the unit. The copper tubing should be straight to maintain good water velocity and prevent pockets from forming at the pump inlet.

⚠ CAUTION

Due to high water temperatures generated by the desuperheater, pex or poly pipe may rupture if coupled directly to heat pump outlet.

2. Shut off valves should also be used to service the desuperheater pump without draining the entire hot water tank. Note: Always be sure these valves are open when pump is running.
3. Pump problems develop by running the pump dry or with air in the system. All air must be purged from the desuperheater plumbing before the pump is engaged.
4. To purge air from the lines, loosen the desuperheater pump from its housing by turning the brass collar. Let water drip out of the housing until flow is established and re-tighten the brass collar.
5. Never operate the system without the high temperature switch (normally factory installed) otherwise tank temperatures could become dangerously high.
6. Poor water quality may restrict the effectiveness of using the desuperheater pump and will not allow the pump to circulate.
7. Desuperheater maintenance includes periodically opening the drain on the hot water tank to remove any deposits. Hard water may cause scale buildup in the desuperheater coil reducing its effectiveness.
8. The temperature difference between the water entering and leaving the desuperheater should be 5° F (-15° C) to 15°F (-9° C). The water flow should be approximately 0.4 GPM per ton of nominal cooling.
9. Northern Heat Pump strongly suggests a water heater buffer tank, Figure 7, for the maximum efficiency from the provided desuperheater module. The Figure 7A single tank plumbing and application is shown for information only.

There are a number of ways the desuperheater/pump can be plumbed with and into the building/household water heater tank. **However**, many common methods used **are not** very effective because they simply circulate already heated water from the water heater tank through the desuperheater. The heat pump desuperheater cannot effectively produce hot water energy if the temperature of the water entering the desuperheater is close to or beyond the compressor gas capability to transfer energy into this circulated water – typically 110° F (43° C) to 130° F. Note: Health codes require 130° F (54° C) minimum.

- Example – if the water heater electric element thermostat is set at 140° F (60° C), it will maintain the tank at 140° (60° C). There is no point in circulating 140° (60° C) water through the desuperheater because it is picking up very little or no energy from the compressor hot gas.
- In fact, the energy flow may even be negative if the Geo HP loop temperature is too low, it is possible for a **single tank** hot water heater to actually flow energy into the Geo HP system with a negative effect on energy system efficiency.

Figure 7 – Desuperheater Piping, Buffer Tank
This is the most effective and efficient arrangement and the recommended installation. The buffer tank need not be as big as the standard water heater; 40-gallon size can be very effective. With this two tank system the desuperheater will always act as a city/well water **pre-heater** and the standard water heater (electric elements or gas) only requires tempering energy which is a very small percentage of domestic water heater energy required.

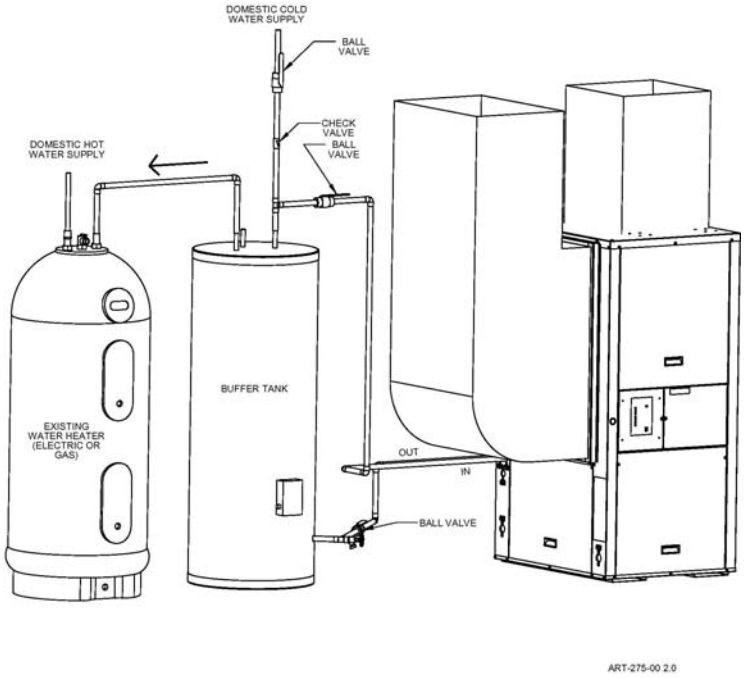
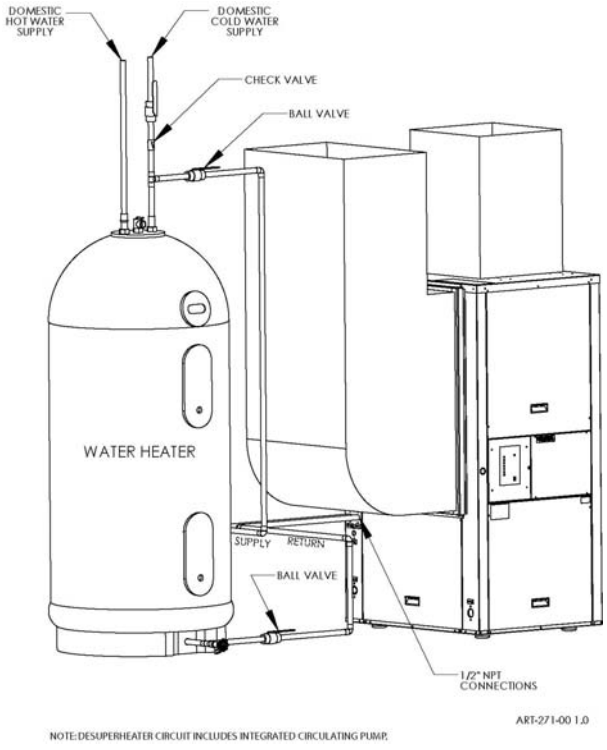


Figure 7A – Desuperheater, Single Tank Concept
Draw water from the bottom drain and returning it to the cold water supply line. This method requires a check valve in the cold water supply to prevent water from flowing into the building or household cold water supply. A spring-type check valve with a pressure rating of 1/2 PSI or less is recommended.

Inspect the dip tube in the water heater cold inlet for a check valve. If a check valve is present it must be removed or damage to the desuperheater circulator will occur.

Before restoring electrical supply to the water heater, adjust the temperature setting on the tank.

- On tanks with both upper and lower elements, the lower element should be turned down to the lowest setting, approximately 100° F (38° C). The upper element should be adjusted to 120°F (49° C) to 130°F (54° C). Depending upon the specific needs of the customer, you may want to adjust the upper element differently.
- On tanks with a single element, lower the thermostat setting to 120° F (49° C).



⚠ CAUTION

Do not run desuperheater pump without supply from water heater. This will damage the pump.

Forced Air Duct System
This Geo heat pump can only perform to its design and certified efficiency if the input and output "components"

of the total heat/cool system are designed and installed to meet the rated requirements. On the input side this is the proper installation and sizing of the loop fluid system, flow center pumps, etc. On the output side this is the ducting system and its ability to handle the necessary airflow during all of the heat pump operating modes.

Compared to a typical gas furnace, heat pump systems always required additional airflow capacity for the same BTU output ratings. If provisions and installation techniques are not provided to handle this larger blower size, the heat pump internal blower will simply load down, pull additional blower motor current, raise the static pressure, and overwork the compressor with increased electric power needs and could be a long-term reliability issue for the compressor and blower motor.

Page 3 specification page and nameplate specify minimum CFM flow through this unit (as produced by the internal blower if the ducting system is proper) at the stated static pressure (SP). Static pressure is controlled and basically determined by the airflow ducting system.

The ducting system "components" start at the unit cabinet output collar, all of the distribution trunks and runs, room registers, return air registers, return air ducts/trunks, and filter.

In applications using galvanized metal ductwork, a flexible duct connector is recommended on both the supply and return air plenums to minimize vibration from the blower. To maximize sound attenuation of the unit blower, the supply and return plenums should include an internal duct liner of 1-inch (2.5 cm) thick glass fiber or be constructed of duct board. Insulation is usually not installed in the supply branch ducts.

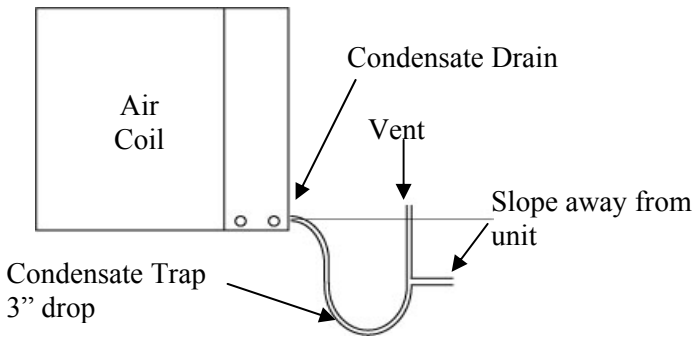
Ducts in unconditioned areas should be wrapped with a minimum of 1-inch duct insulation. Application of the unit to un-insulated ductwork in an unconditioned space is not recommended as the unit's performance will be adversely affected.

All existing ductwork should be checked for leaks and repairs made accordingly.

Condensate Drain

Typical condensate drain installation, shown below.

If there is no nearby floor drain, a condensate drain pump must be used.



Hydronic, Space Water Heating, Installation

Plumbing
The Geo unit hydronics loop is basically a heat exchanger with piping ports for out and in flow. There are no pumps within the unit. Use standard water heating loop parts/components and piping/plumbing best practices as if this Geo unit is a "boiler". The minimum GPM flow requirement and pressure drop within the Geo unit heat exchanger is shown on the page 3 specification chart, for the appropriate model size. The internal feet of head resistance or pumping requirement is at the nominal GPM shown.

Depending upon the installation/heating zone concept, plumbing will depend upon decision for closed loop pressure or non-pressure system. If the vertical lift is less than approximately 15 feet (4.5 meters), buffer tank with non-pressure concept is recommended.

Pressure Hydronic Pumping Loop
If the design involves a pressure system, expansion tank is required with an external safety valve ASME stamp and rated for 30 psi maximum. The necessary air relief and air separation components are strongly recommended for long-term continuous operations.

Call for aquastat heating (HW terminal) assumes the minimum, continuous, flow through the Geo unit heat exchanger is always greater than the minimum GPM shown on the mechanical specification chart, for the appropriate model. This Geo unit **does not** include a flow switch for the hydronics loop, if the flow is less than the specified minimum GPM or if there is no flow due to air locks, pump failure or hydronic water loop issues, the compressor will immediately lockout with high pressure. After the second reset compressor cycle, the compressor will be on permanent lockout with no further action until service or troubleshooting takes place.

- If an external flow switch is added, wire in series with the internal loop flow switch.

Hydronic Heating Zones
If there are small zones or zones which cannot handle the Btu/h capacity of the appropriate installed model (specification chart Btu/h) or if these zones reduce the GPM water flow, there must be external controls or a buffer tank within the system to make sure the compressor does not short cycle or the system does not overheat. For a Geo water to water unit the most effective and easiest method of handling multiple zones is with a buffer tank system.

⚠ WARNING

THE SYSTEM MUST BE DESIGNED FOR A MINIMUM 10 TO 15 MINUTE COMPRESSOR RUN TIME ON EACH AQUASTAT CALL. IF, DURING THE LIFE OF THE WARRANTY, THERE ARE COMPRESSOR FAILURE ISSUES AND AN EVALUATION OF THE INSTALLATION DETERMINES THERE WAS NO PROVISION FOR TAKING CARE OF COMPRESSOR SHORT CYCLING OR COMPRESSOR HIGH DISCHARGE PRESSURE REPEATED OPERATION, WARRANTY MAY BE REJECTED.

Hydronic Buffer Tank Consideration
Buffer tank is ideal for non-pressure concept and is the simplest pumping/plumbing approach. The number and size of heating zones has no immediate consideration, the Geo unit has its own external main pump which simply "pumps into" a buffer tank circulating loop. If all pumps are installed below the lower half of the buffer tank, non-pressure tank is the ideal installation, no purging or air lock issue will develop.

Each heating zone pump has its own thermostat control device which simply causes its pump to pull energy from the buffer tank as required. An aquastat type device on the buffer tank controls or determines the Geo unit HW call.

Buffer tank sizing is typically 6 to 10 gallons (23-38 liters) per ton. If it is a heating only installation, larger buffer tank should be considered and suggested. See typical diagram, Figure 8.

Zone Controller
Electro Industries has an optional, easy to install and simplified zone controller, up to 8 pumping zones. See accessories page for ordering model number.

Forced Air Fan Coil
The water coil can be one zone from a buffer tank. When the zone controller is used, this is typically the priority zone and with priority on the other hydronic zones are held off. The water coil should operate from the tank's highest temperature.

If cooling is desired or planned for the forced air water coil, the forced air room thermostat (1H/1C) will control the Geo unit reversing valve as well as the call for heat/cool controls the air handler blower. The buffer tank aquastat will need to function as a heat/cool device to activate the Geo unit.

Hydronics Loop Temperature Operating Point Consideration
The efficiency of this water to water Geo unit directly relates to the hydronics aquastat set point or operating water temperature. Even though this unit is specified or rated at 110° F (43° C) outlet temperature, the efficiency COP can change as much as 0.8 or 1.0 from 110° F (43° C) to 90° F (32° C) (COP 2.4 versus COP 3.2). The higher the hydronics return water temperature, the higher the compressor discharge pressure and the higher compressor motor current draw or watts.

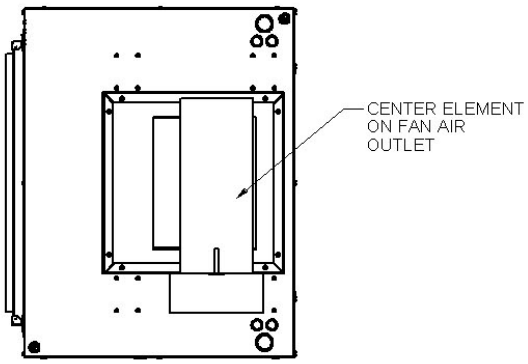
Optional Auxiliary Electric Heat Installation

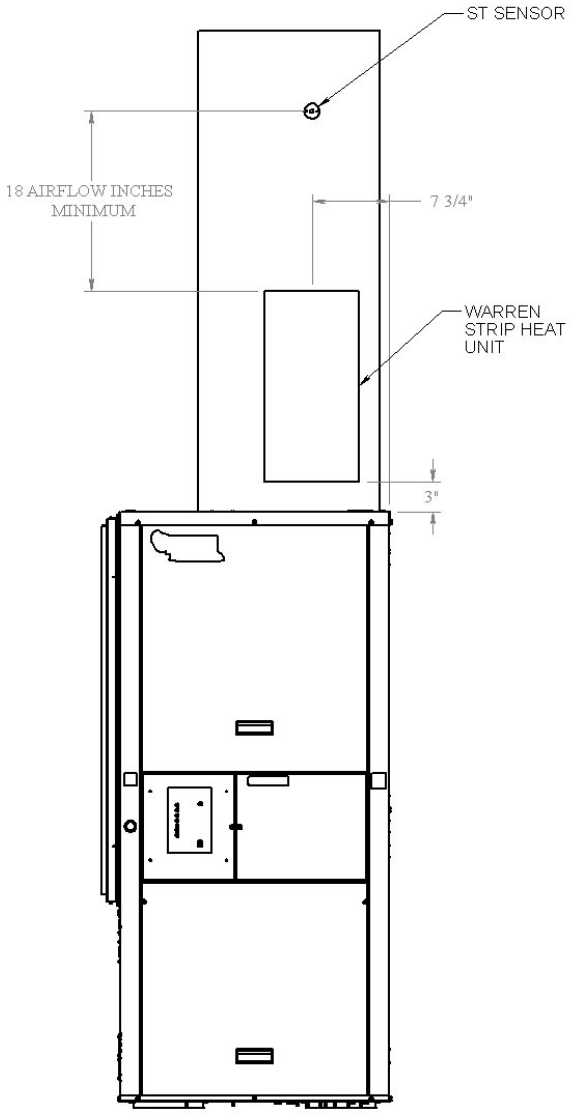
Electrical auxiliary strip heat unit (AUX EL) is offered as an option on all NHP Combination models. This option provides an extra "boost" of heat during the coldest days of the year should the heat pump be unable to meet your BTU demands. It also elevates output temperature, adding to the comfort level of your home or building.

AUX EL for applications in the United States
If your NHP heat pump is ordered with an electrical auxiliary strip heat unit, the AUX EL unit will come factory pre-installed inside the heat pump. No plenum alterations are necessary with the exception of the installation of the supply sensor (ST).

AUX EL for Canadian applications
We offer a custom pre-wired, plenum installed AUX EL unit for the Canadian market. This unit is shipped in a separate container and must be installed in the ductwork as shown in the diagram on page 22. The cables for the ST temperature sensor and the AUX EL should be routed through the NHP heat pump. The AUX EL cable should be plugged into J2 and the ST sensor cable attached to the location labeled "SENSOR" on the control board. Following installation of these units, a power cycle will allow the NHP heat pump to recognize the installed units.

Canadian installations only;


CENTER ELEMENT
ON FAN AIR
OUTLET


ST SENSOR
18 AIRFLOW INCHES
MINIMUM
7 3/4"
WARREN
STRIP HEAT
UNIT
3"

ART-306-00 1.0

Electrical Hookup

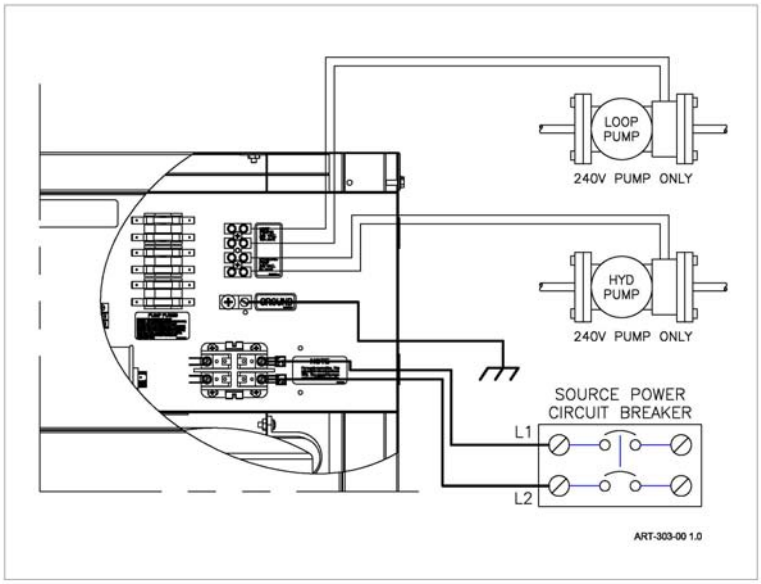
⚠ WARNING

DISCONNECT ALL ELECTRICAL POWER BEFORE ELECTRICALLY CONNECTING OR SERVICING THE UNIT. FAILURE TO DISCONNECT THE ELECTRICAL POWER BEFORE WORKING ON THIS PRODUCT CAN CREATE A HAZARD LEADING TO PERSONAL INJURY OR DEATH.

Line Voltage
The nameplate and/or Installation and Operating Manual specification page provides RLA, LRA, and total amps requirement. Select the proper wire size to comply with your type of wire routing and NEC field wiring requirements.

- If this unit includes AUX EL module, its own nameplate provides kW and current/voltage requirement.

The field power supply connection is at the compressor contactor, at the end of the line voltage control box.



Disconnect – field provided external safety disconnect is required, see nameplate max amps.

Loop pumps – the loop pump station can be powered at the TB above the contactor. 10-amp fusing is included, left of terminal block.

Hydronic pump – the appropriate terminal block provides 240-volt output when the control board determines hydronic heating mode. 10A fusing is included. If the main hydronic pump is 120V, must use a 240V coil interposing relay at this terminal block.

Buffer Tank Zone Controller
See the appropriate zone controller installation manual/diagrams as required. Electro Industries' model EB-ZXA-* installation is BI010.

Forced Air Handler/Water Coil
The room thermostat for the forced air coil and its appropriate control mechanism must operate the air handler and the pump for the water coil. Also, if it is to be used for cooling, the thermostat must provide the O terminal reversing valve O function to this Geo unit and appropriately control the compressor HW terminal.

> **Note:**
> Once the roomstat is set for COOL it must remain in COOL for the summer season. If it is turned off or switched back and forth, the buffer tank could actually heat up in summer.

Grounding – route and install the proper size ground conductor between the ground lug above the compressor contactor and the building service entrance panel ground bus. This must be a conductor wire size according to NEC code for the total amp rating of the installed model. The conduit is not sufficient ground conductor.

Duct Sensor (ST) – install in the Geo supply air plenum, at least 18 inches (61cm) above the strip heat element (airflow inches). The ST sensor does not have an end cap; the small black electronic part just within the tube end is the actual temperature sensor. It is desirable for the air coming out of the coil to pass as closely as possible to the black tip without warm-up or dampening delay. Best results are obtained when this sensor is in the maximum warm air stream.

⚠ WARNING

USE ONLY COPPER WIRE FOR CONNECTION TO THE CIRCUIT BREAKER TERMINALS AND INSIDE THIS PRODUCT'S CABINET.

⚠ WARNING

TO AVOID THE RISK OF ELECTRIC SHOCK OR DEATH, WIRING TO THE UNIT MUST BE PROPERLY GROUNDED. FAILURE TO PROPERLY GROUND THE UNIT CAN RESULT IN A HAZARD LEADING TO PERSONAL INJURY OR DEATH.

Low Voltage Hookup

Room Thermostat, Forced Air Mode
A multi-wire **heat pump** thermostat is required for the NH-CTR-CMB controller. The primary connections are:

R – R
C – C
G – G
O – O
Y1 – Y1
Y2 – Y2
W2 – W2

Additional stat connections:

L – heat pump fault light, permanent hold after three faults during the same power cycle
BK – if roomstat has dehumidification function, connect to BK **and** remove J11 BK pin jumper

Hydronic mode, external:

R – R
HW – call for heat

Comment – factory default is set up for HW (hot water) to activate the compressor at Full Load. If sizing is such that Part Load compressor (first stage) only is required for the hydronics mode, remove the jumper peg from the control board in the location labeled "FL" as shown here . If there is an external aquastat with stage 1 and stage 2 capability, call factory for wiring instructions.

Humidifier
There are two connection arrangements:

- Humidifier active, heating function only – 24V available at W (C is common)
- Humidifier active with continuous blower (roomstat fan – on) and heating – 24V available at G (C is common)

Well or Lake Water Source
As a deterrent to possible loop/source coil freeze-up in case of water source failure, suggest adding 39° F (4° C) freeze stat in addition to the flow switch. See Accessories/Options for ordering part number. Wire 39° F (4° C) freeze stat in series with flow switch.

Operation Indicators

LED Indications

- Main board, green – main 24-volt power
- Top board, red – indicates no loop fluid flow
- External LED, green – 24-volt power on, fuse okay
- External LED, red – in fault mode
    - Pulsing represents the automatic reset mode. PC download is set where the third fault in 72 hours forces a hard hold.
    - Hard hold means compressor off, LED solid red, only resettable by power down. W2 is active with AUX EL.
- External LED, pulsing – in a 30-second cycle there is a short pause, then the count, then return to solid until the next pause, etc.
    - 1 = high pressure limit
    - 2 = low pressure limit
    - 3 = no water flow

Operational Tips

Combo, operating priority – factory default for air source priority.

Optional installed AUX EL strip heat module – This unit can operate in one of two modes; one with supply temperature sensing and one without.

MODE ONE; without temperature sensing. In this mode, the AUX EL will activate as a result of roomstat temperature and timing.

1. Stage 1 is immediately active, blower is at Y2 speed.
2. After 20 minutes of Stage 1 heat, (PC download setup), stage 2 (and 3 on 15kw and 20kw models) is active with appropriate blower speed.
3. During any lockout condition, weather it be a fault condition or an ACD (anti-cycle delay) condition, the roomstat W2 output may activate full AUX EL heat with full blower speed.
4. If so equipped, AUX EL will act as your roomstat's "emergency" heat. By utilizing this capability, the user can elect to use AUX EL to provide forced air heat while utilizing the heat pump's hydronic (HW) ability to heat water. By switching the roomstat to the "emergency heat" mode, AUX EL will activate with the appropriate blower speed. Hydronic heating can then proceed by using the heat pump's compressor.

MODE TWO; with temperature sensing. In this mode, the AUX EL will activate as a result of roomstat W2 call to maintain a plenum temperature set point.

1. Stage 1 immediately active, blower is at the heat pump blower speed (Y1 and Y2).
2. Stages 2 and 3 are activated after 2 minutes of a roomstat W2 call if (1) the supply temperature (ST) is below the setting labeled "Electro Heat Stage 2 & 3 decision" in the PC software and (2) below the AUX MAX temperature (both of these variables are PC software adjustable).
3. Once ST reaches AUX MAX temperature, stage 2 is deactivated.
4. If ST remains above AUX MAX temperature for 5 minutes, stage 3 is deactivated.
5. During any lockout condition, weather it be a fault condition or an ACD (anti-cycle delay) condition, the roomstat W2 output may activate full AUX EL heat high full blower speed.
6. If so equipped, AUX EL will act as your roomstat's "emergency" heat. By utilizing this capability, the user can elect to use AUX EL to provide forced air heat while utilizing the heat pump's hydronic (HW) ability to heat water. By switching the roomstat to the "emergency heat" mode, AUX EL will activate with the appropriate blower speed. Hydronic heating can then proceed by using the heat pump's compressor.

PC download (software disc and special cable required) – factory setup shown in Figure 1. Values can be changed with PC and WRITE function.

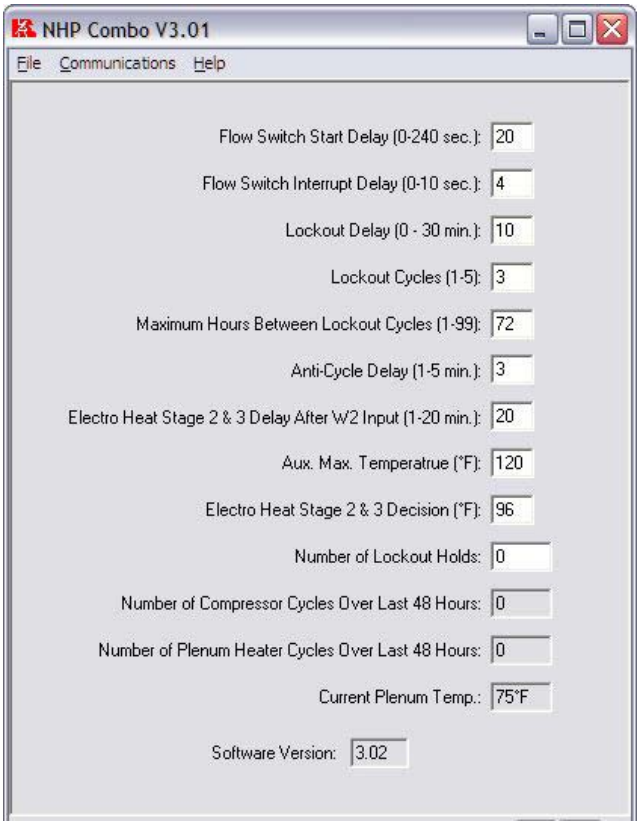


Figure 1

Refrigerant cycle – for troubleshooting or reference purposes attached are one-line sketches of the three operating modes.

Troubleshooting sequence – the NH-CTR-CMB controller is programmed to follow various functions relating to the air stat, aquastat, compressor staging, AUX EL, blower, pumps, etc. NC604 page 4 provides the sequence information relating to various combinations of action within the heat pump. Some of this action also includes various detected compressor out of tolerance limit conditions, etc.

Accessories/Options

	Part Number
Fault/alarm external annunciator	R-AL-RS-1
Fuse – source loop pump, 10A	UFUSE1799
Fuse – desuperheater pump, 3A	UFUSE1796
Open loop, freeze limit, 39° F (4° C), pipe mounted	6047
Sound vibration pad	R-PAD-2735-1
Zone interface controller, 1 to 4 zones	EB-ZXA-1
Zone interface controller, additional 4 zones	EB-ZEA-2
Return air filter ▪ 21-⅞ x 27-½ ▪ 28-⅞ x 27-½ ▪ 37-⅞ x 27-½	 5864 5865 5863

Loop Flow Center
Contact your distributor or Electro Industries for non-pressure recommendation, QT flow center (5050?).

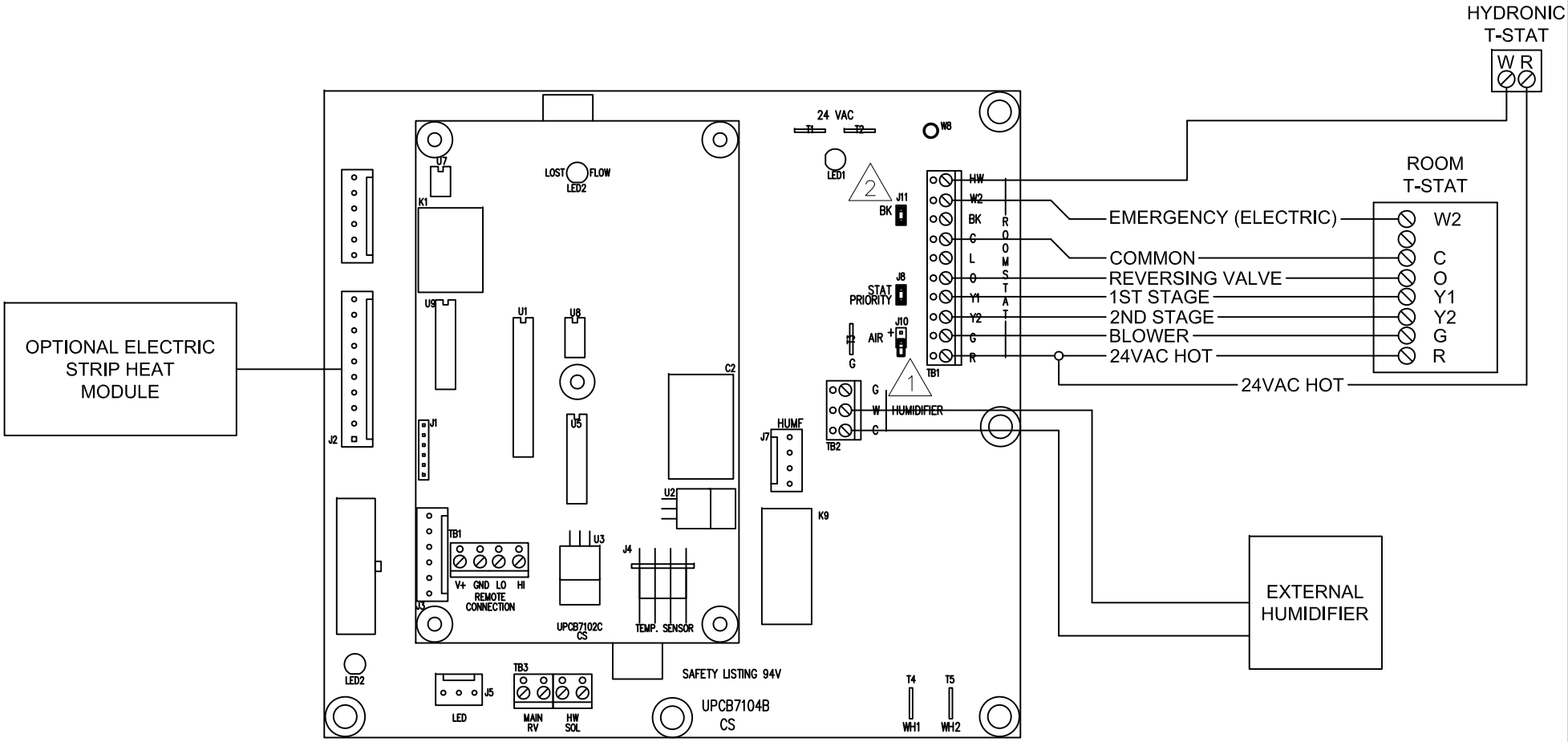
Hydronics Buffer Tank
Contact Electro Industries with your zone, sizing, and hydronic system diagram for recommended buffer tank system.

Figure 2 – Geo HP Controller – Sequence Information

		Air Stat	W Stat	COMP		LED	ACD	AUX EL	ECM	Pin	W Pump	HW DV	Notes
				PL	FL								
1	Power > 3 minutes	G				G			Lo	15			
2		Y1		✓		G	OK		M	6			
3	Add	Y2		✓	✓	G	"		Hi	14 & 6			
4		-											
5	Then Y2 off	-				G	T		-				
6	Flow open	Y1		✓		G	OK		M	6			①
7	20 seconds	Y1				P-R	T		M	6			
8	Auto reset (3)	-				G	OK		-				
9													
10		Y1		✓		G	OK		M	6			
11		Y2		✓	✓	G	"		Hi	14 & 6			
12		W2		✓	✓	G	"	1	Hi	14 & 6			
13	W2 off	-		✓	✓	G	"	-	Hi	14 & 6			
14	Y1 and Y2 still on	Y1		✓	✓	G	"		Hi	14 & 6			
15	Add HW	Y1	HW	✓	✓	G	"		Hi	14 & 6			
16	Y1 and Y2 off	-	HW			G	T				✓	✓	④
17	3-minute ACD		HW	✓	✓	G	OK				✓	✓	
18	Roomstat in emergency	W2	HW	✓	✓	G	OK	1	E	13	✓	✓	②
19	W2 off	-	HW	✓	✓	G	OK	-	-	-	✓	✓	
20	HW off		-			G	T				-	-	
21	Before ACD timeout, add HW		HW			G	T				✓	✓	
22	Then 3 minutes, ACD		HW	✓	✓	G	OK				✓	✓	
23	Add Y1	Y1	HW			G	T		M	6			
24	3 minutes, ACD	Y1	HW	✓		G	OK		M	"			
25	Add Y2	Y2	HW	✓	✓	G	"		Hi	14 & 6			
26	Add W2	W2	HW	✓	✓	G	"	1	Hi	14 & 6			
27	Y1, Y2, W2 off	-	HW			G	T				✓	✓	
28	3 minutes, ACD		HW	✓	✓	G	OK				✓	✓	④
29													
30	Hi press		HW			P-R	T				✓	✓	
31	Auto reset (3), after ACD delays		HW	✓	✓	G	OK				✓	✓	
32	Later Y1	Y1	HW			G	T		M	6			
33	3 minutes, ACD	Y1	HW	✓		G	OK		M	"			
34	Y1 and HW off	-	-			G	T						
35	Later, after normal ACD		HW	✓	✓	G	OK				✓	✓	
36	Any time low press		HW			P-R	T				✓	✓	
37	3 minutes, ACD		HW	✓	✓	G	OK				✓	✓	
38	3rd – hard		HW			R	T						③

ELECTRO INDUSTRIES, INC.
2150 West River Street, PO Box 538, Monticello, MN 55362
763.295.4138 • 800.922.4138 • fax 763.295.4434
sales@electromn.com • www.electromn.com

PACKAGED COMBINATION UNIT R(B,U)-(H,V)E SERIES HOOKUP
STANDARD HEAT PUMP STAT & HYDRONIC STAT

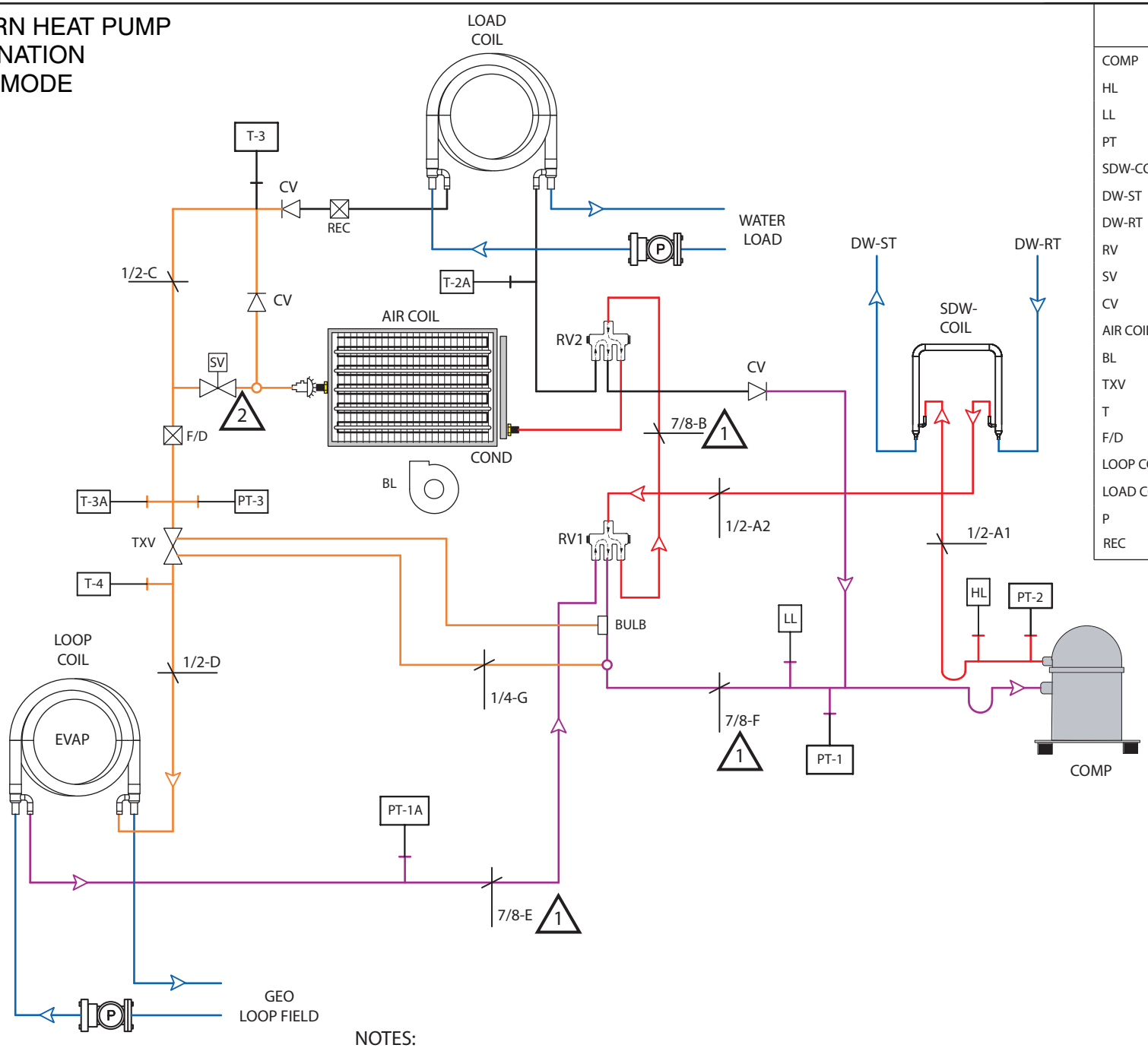


NOTES:

1. W & G ENERGIZED ON HEATING CALL.
2. REMOVE BK JUMPER WHEN USING STAT (BK) WITH DEHUMIDIFICATION CONTROL.

ELECTRO INDUSTRIES, INC.
MONTICELLO, MN 55362

NORTHERN HEAT PUMP
COMBINATION
- HEAT MODE



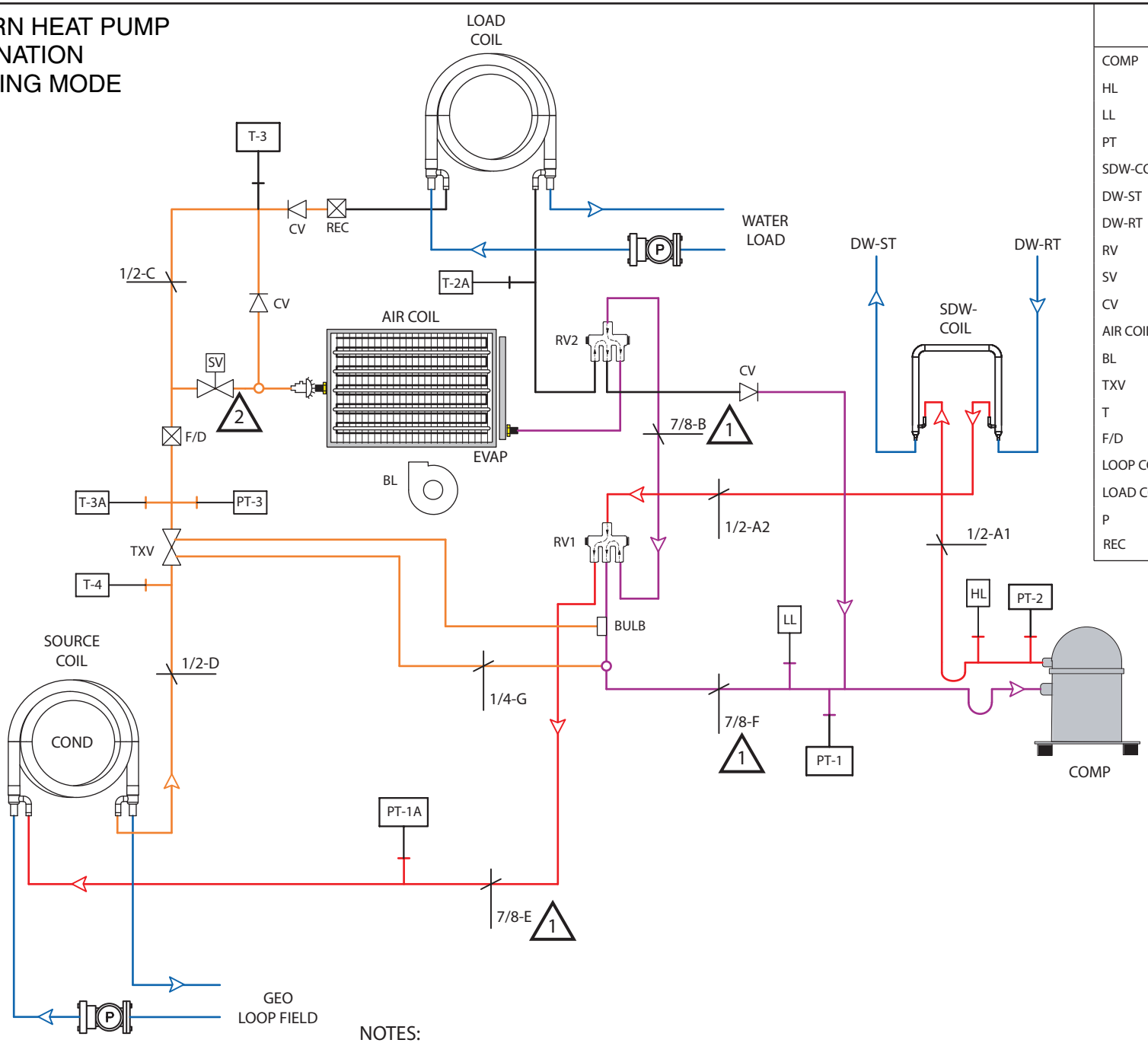
Name	
COMP	Compressor
HL	Pressure high limit
LL	Pressure low limit
PT	Pressure test port
SDW-COIL	Supplementary heat exchanger
DW-ST	Ref: DW supply
DW-RT	Ref: DW return
RV	Reversing valve
SV	Solenoid valve
CV	Check valve
AIR COIL	Air heat exchanger
BL	Ref: Blower
TXV	Expansion valve
T	Temperature test point
F/D	Filter/dryer
LOOP COIL	Source heat exchanger
LOAD COIL	Water heat exchanger
P	Ref: Loop pump
REC	Receiver

NOTES:

1. 4.0 TON TO 5.0 TON UNITS USE 7/8" PIPE, 1.5 TON TO 3.0 TON USE 3/4" PIPE.
2. SV - NO SOLENOID, FLOW THROUGH FROM AIR COIL.

NORTHERN HEATPUMP

NORTHERN HEAT PUMP
COMBINATION
- COOLING MODE



Name	
COMP	Compressor
HL	Pressure high limit
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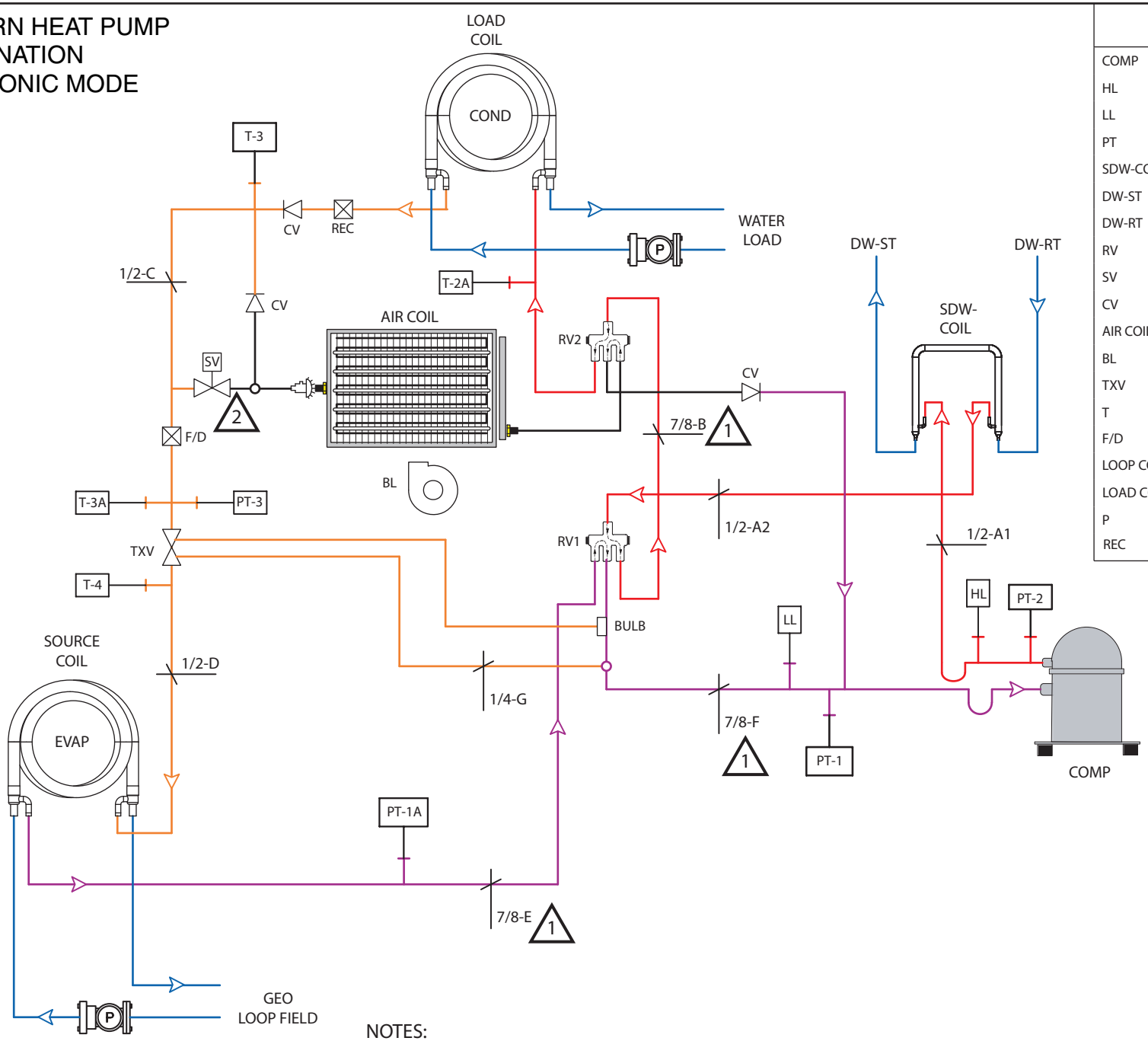
SDW-COIL	Supplementary heat exchanger
DW-ST	Ref: DW supply
DW-RT	Ref: DW return
RV	Reversing valve
SV	Solenoid valve
CV	Check valve
AIR COIL	Air heat exchanger
BL	Ref: Blower
TXV	Expansion valve
T	Temperature test point
F/D	Filter/dryer
LOOP COIL	Source heat exchanger
LOAD COIL	Water heat exchanger
P	Ref: Loop pump
REC	Receiver

NOTES:

1. 4.0 TON TO 5.0 TON UNITS USE 7/8" PIPE, 1.5 TON TO 3.0 TON USE 3/4" PIPE.
2. SV - NO SOLENOID, FLOW THROUGH TO AIR COIL DISTRIBUTOR.

NORTHERN HEATPUMP

NORTHERN HEAT PUMP
COMBINATION
- HYDRONIC MODE

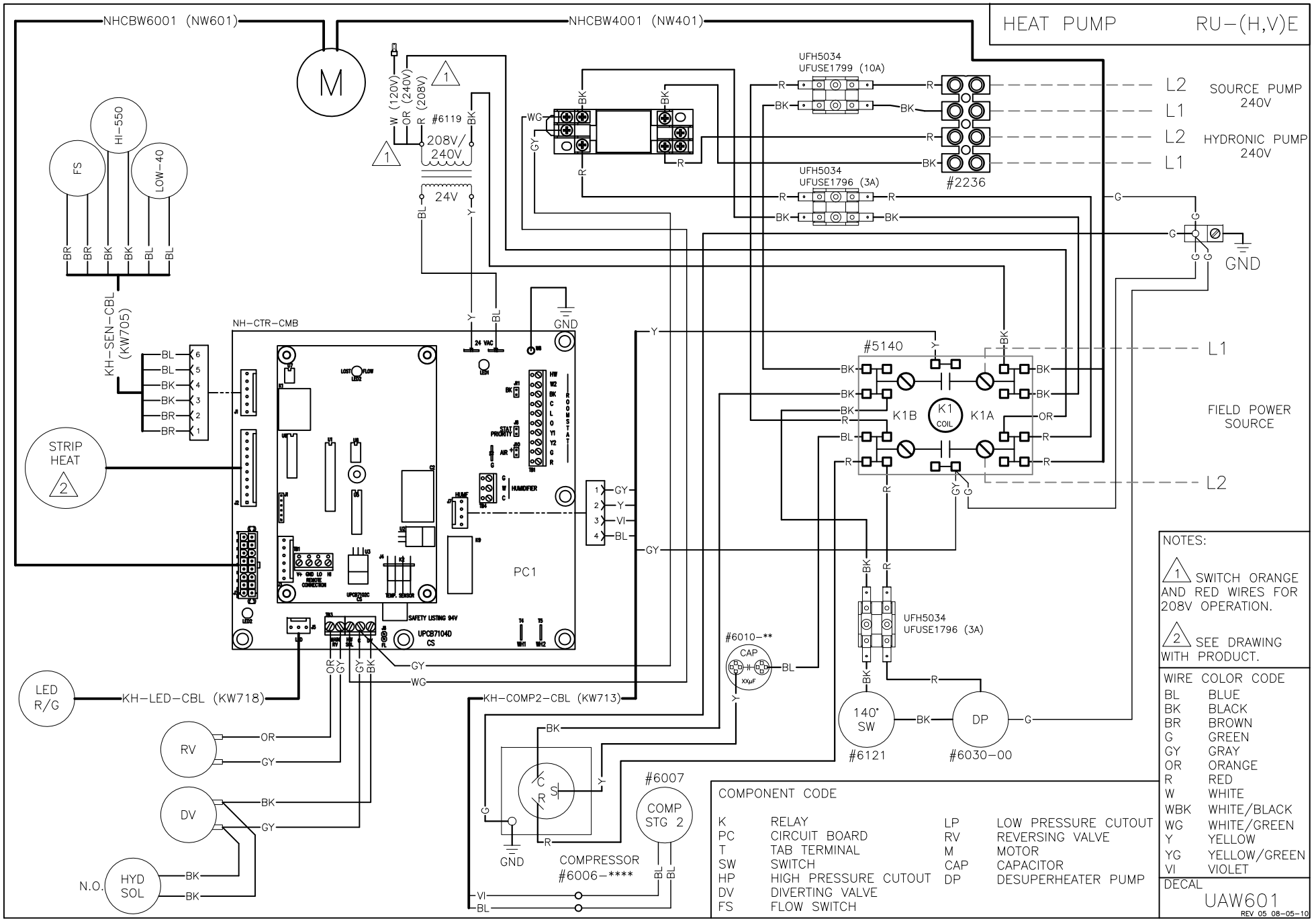


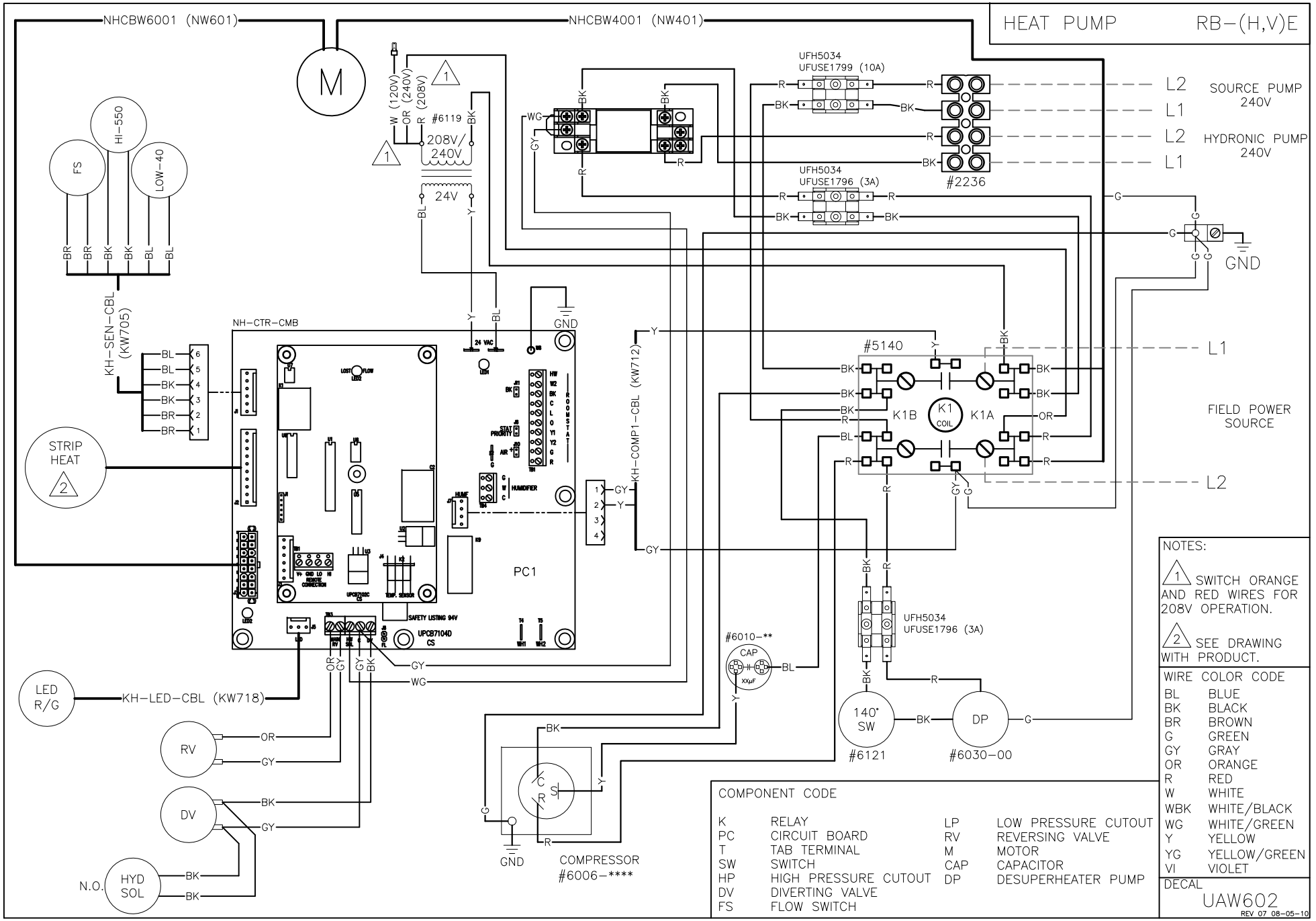
Name	
COMP	Compressor
HL	Pressure high limit
LL	Pressure low limit
PT	Pressure test port
SDW-COIL	Supplementary heat exchanger
DW-ST	Ref: DW supply
DW-RT	Ref: DW return
RV	Reversing valve
SV	Solenoid valve
CV	Check valve
AIR COIL	Air heat exchanger
BL	Ref: Blower
TXV	Expansion valve
T	Temperature test point
F/D	Filter/dryer
LOOP COIL	Source heat exchanger
LOAD COIL	Water heat exchanger
P	Ref: Loop pump
REC	Receiver

NOTES:

1. 4.0 TON TO 5.0 TON UNITS USE 7/8" PIPE, 1.5 TON TO 3.0 TON USE 3/4" PIPE.
2. SV - NO SOLENOID, ENERGIZED PREVENTS FLOW TO AIR COIL.

NORTHERN HEATPUMP


HEAT PUMP RU–(H,V)E
NHCBW6001 (NW601)
NHCBW4001 (NW401)
M
HI–550
FS
LOW–40
BR BR BK BK BL BL
KH–SEN–CBL (KW705)
NH–CTR–CMB
PC1
UPCB7104D CS
W (120V) OR (240V) R (208V)
#6119
208V/ 240V
24V
GND
STRIP HEAT
LED R/G
KH–LED–CBL (KW718)
RV
DV
N.O.
HYD SOL
KH–COMP2–CBL (KW713)
#6007
COMP STG 2
COMPRESSOR #6006–****
UFH5034 UFUSE1799 (10A)
#2236
UFH5034 UFUSE1796 (3A)
#5140
K1B
K1A
K1 COIL
L1
L2
SOURCE PUMP 240V
HYDRONIC PUMP 240V
FIELD POWER SOURCE
#6010–**
CAP
XXuF
140° SW
#6121
DP
#6030–00
NOTES:
1 SWITCH ORANGE AND RED WIRES FOR 208V OPERATION.
2 SEE DRAWING WITH PRODUCT.
WIRE COLOR CODE
BL BLUE
BK BLACK
BR BROWN
G GREEN
GY GRAY
OR ORANGE
R RED
W WHITE
WBK WHITE/BLACK
WG WHITE/GREEN
Y YELLOW
YG YELLOW/GREEN
VI VIOLET
COMPONENT CODE
K RELAY
PC CIRCUIT BOARD
T TAB TERMINAL
SW SWITCH
HP HIGH PRESSURE CUTOUT
DV DIVERTING VALVE
FS FLOW SWITCH
LP LOW PRESSURE CUTOUT
RV REVERSING VALVE
M MOTOR
CAP CAPACITOR
DP DESUPERHEATER PUMP
DECAL
UAW601
REV 05 08–05–10


HEAT PUMP RB–(H,V)E
NHCBW6001 (NW601)
NHCBW4001 (NW401)
M
HI–550
FS
LOW–40
KH–SEN–CBL (KW705)
NH–CTR–CMB
PC1
UPCB7104D CS
STRIP HEAT
2
LED R/G
KH–LED–CBL (KW718)
RV
DV
HYD SOL
N.O.
W (120V)
OR (240V)
R (208V)
#6119
208V/ 240V
24V
UFH5034 UFUSE1799 (10A)
UFH5034 UFUSE1796 (3A)
#2236
L2
L1
SOURCE PUMP 240V
HYDRONIC PUMP 240V
GND
#5140
K1B
K1A
K1 COIL
FIELD POWER SOURCE
KH–COMP1–CBL (KW712)
#6010–**
CAP
XXuF
140° SW
#6121
DP
#6030–00
COMPRESSOR #6006–****
NOTES:
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BK BLACK
BR BROWN
G GREEN
GY GRAY
OR ORANGE
R RED
W WHITE
WBK WHITE/BLACK
WG WHITE/GREEN
Y YELLOW
YG YELLOW/GREEN
VI VIOLET
COMPONENT CODE
K RELAY
PC CIRCUIT BOARD
T TAB TERMINAL
SW SWITCH
HP HIGH PRESSURE CUTOUT
DV DIVERTING VALVE
FS FLOW SWITCH
LP LOW PRESSURE CUTOUT
RV REVERSING VALVE
M MOTOR
CAP CAPACITOR
DP DESUPERHEATER PUMP
DECAL
UAW602
REV 07 08–05–10

Northern Heat Pump Residential Limited Product Warranty

Effective November 1, 2009

Northern Heat Pump, LTD. warrants to the original owner, at the original installation site, for a period of three (3) years from date of original purchase, that the product and product parts manufactured by Northern Heat Pump, LTD. are free from manufacturing defects in materials and workmanship, when used under normal conditions and when such product has not been modified or changed in any manner after leaving the plant of Northern Heat Pump, LTD. If any product or product parts manufactured by Northern Heat Pump, LTD. are found to have manufacturing defects in materials or workmanship, such will be repaired or replaced by Northern Heat Pump, LTD. Northern Heat Pump, LTD., shall have the opportunity to directly, or through its authorized representative, examine and inspect the alleged defective product or product parts. Northern Heat Pump, LTD. may request that the materials be returned to Northern Heat Pump, LTD. at owner's expense for factory inspection. The determination as to whether product or product parts shall be repaired, or in the alternative, replaced, shall be made by Northern Heat Pump, LTD. or its authorized representative.

TEN YEAR (10) LIMITED WARRANTY ON REFRIGERATION COMPONENTS

Northern Heat Pump, LTD. warrants that the compressor, reversing valve, expansion valve and heat exchanger(s) of its products are free from defects in materials and workmanship through the tenth year following date of original purchase. If any compressor, reversing valve, expansion valve or heat exchanger(s) are found to have a manufacturing defect in materials or workmanship, Northern Heat Pump, LTD. will repair or replace them at their discretion.

FIVE YEAR (5) LIMITED WARRANTY ON OPEN WIRE ELEMENTS

Northern Heat Pump, LTD. warrants that the open wire elements of its products are free from defects in materials and workmanship through the fifth year following date of original purchase. If any open wire elements are found to have a manufacturing defect in materials or workmanship, Northern Heat Pump, LTD. will replace them.

Northern Heat Pump, LTD. shall cover labor costs according to the Repair / Replacement Labor Allowance Schedule for a period of three (3) years from the date of original purchase, to the original owner, at the original installation site on all parts excluding the compressor, reversing valve, expansion valve, and heat exchanger(s). Northern Heat Pump, LTD shall cover labor costs according to the Repair / Replacement Labor Allowance Schedule for a period of five (5) years from the date of original purchase, to the original owner, at the original installation site, on parts including the compressor, reversing valve, expansion valve, and heat exchanger(s). The Repair / Replacement Labor Allowance is designed to reduce the cost of repairs. This Repair / Replacement Labor Allowance may not cover the entire labor fee charged by your dealer / contractor.

NORTHERN HEAT PUMP, LTD.
A Subsidiary of Electro Industries, Inc.
2150 West River Street, PO Box 538, Monticello, MN 55362
763-295-4138 • 800-922-4138 • fax 763-295-4434
sales@electromn.com

CONDITIONS AND LIMITATIONS:

1. This warranty is limited to residential, single family dwelling installations only. Any commercial or multi-unit dwelling installations fall under the Northern Heat Pump Commercial Limited Product Warranty.
2. Northern Heat Pump, LTD. shall not be liable for performance related issues resulting from improper installation, improper sizing, improper duct or distribution system, or any other installation deficiencies.
3. If at the time of a request for service the original owner cannot provide an original sales receipt or a warranty card registration then the warranty period for the product will have deemed to begin the date the product is shipped from the factory and **NOT** the date of original purchase.
4. The product must have been sold and installed by a licensed electrician, plumbing, or heating contractor.
5. The application and installation of the product must be in compliance with Northern Heat Pump, LTD. specifications, as stated in the installation and instruction manual, and all state, provincial and federal codes and statutes. If not, the warranty will be null and void.
6. The purchaser shall have maintained the product in accordance with the manual that accompanies the unit. Annually, a qualified and licensed contractor must inspect the product to assure it is in proper working condition.
7. All related heating components must be maintained in good operating condition.
8. All lines must be checked to confirm that all condensation drains properly from the unit.
9. Replacement of a product or product part under this limited warranty does not extend the warranty term or period.
10. Replacement product parts are warranted to be free from defects in material and workmanship for ninety (90) days from the date of installation. All exclusions, conditions, and limitations expressed in this warranty apply.
11. Before warranty claims will be honored, Northern Heat Pump, LTD. shall have the opportunity to directly, or through its authorized representative, examine and inspect the alleged defective product or product parts. Remedies under this warranty are limited to repairing or replacing alleged defective product or product parts. The decision whether to repair or, in the alternative, replace products or product parts shall be made by Northern Heat Pump, LTD. or its authorized representative.

THIS WARRANTY DOES NOT COVER:

1. Costs for labor for diagnosis, removal or reinstallation of an alleged defective product or product part, transportation to Northern Heat Pump, LTD. or Electro Industries, Inc., and any other materials necessary to perform the exchange, except as stated in this warranty. Replacement material will be invoiced to the distributor in the usual manner and will be subject to adjustment upon verification of defect.
2. Any product or product part that has been damaged as a result of being improperly serviced or operated, including, but not limited to, the following: operated during construction phase, with insufficient water or air flow; allowed to freeze; subjected to flood conditions; subjected to improper voltages or power supplies; operated with air flow or water conditions and/or fuels or additives which cause unusual deposits or corrosion in or on the product; chemical or galvanic erosion; improper maintenance or subject to any other abuse or negligence.
3. Any product or product part that has been damaged as a result of natural disasters, including, but not limited to, lightning, fire, earthquake, hurricanes, tornadoes or floods.
4. Any product or product part that has been damaged as a result of shipment or handling by the freight carrier. It is the receiver's responsibility to claim and process freight damage with the carrier.
5. Any product or product part that has been defaced, abused or suffered unusual wear and tear as determined by Northern Heat Pump, LTD. or its authorized representative.
6. Workmanship of any installer of the product or product part. This warranty does not assume any liability of any nature for unsatisfactory performance caused by improper installation.
7. Transportation charges for any replacement product, product part or component, service calls, normal maintenance; replacement of fuses, filters, refrigerant, etc.

THESE WARRANTIES DO NOT EXTEND TO ANYONE EXCEPT THE ORIGINAL PURCHASER AT RETAIL AND ONLY WHEN THE PRODUCT IS IN THE ORIGINAL INSTALLATION SITE. THE REMEDIES SET FORTH HEREIN ARE EXCLUSIVE.

ALL IMPLIED WARRANTIES, INCLUDING WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, ARE HEREBY DISCLAIMED WITH RESPECT TO ALL PURCHASERS OR OWNERS. NORTHERN HEAT PUMP, LTD. IS NOT BOUND BY PROMISES MADE BY OTHERS BEYOND THE TERMS OF THESE WARRANTIES. FAILURE TO RETURN THE WARRANTY CARD SHALL HAVE NO EFFECT ON THE DISCLAIMER OF THESE IMPLIED WARRANTIES.

ALL EXPRESS WARRANTIES SHALL BE LIMITED TO THE DURATION OF THIS EXPRESS LIMITED WARRANTIES SET FORTH HEREIN AND EXCLUDE ANY LIABILITY FOR CONSEQUENTIAL OR INCIDENTAL DAMAGES RESULTING FROM THE BREACH THEREOF. SOME STATES OR PROVINCES DO NOT ALLOW THE EXCLUSION OR LIMITATION OF INCIDENTAL OR CONSEQUENTIAL DAMAGES, SO THE ABOVE LIMITATIONS OR EXCLUSIONS MAY NOT APPLY. PRODUCTS OR PARTS OF OTHER MANUFACTURERS ATTACHED ARE SPECIFICALLY EXCLUDED FROM THE WARRANTY.

THIS WARRANTY GIVES YOU SPECIFIC LEGAL RIGHTS, AND YOU MAY HAVE OTHER RIGHTS WHICH VARY UNDER THE LAWS OF EACH STATE. IF ANY PROVISION OF THIS WARRANTY IS PROHIBITED OR INVALID UNDER APPLICABLE STATE OR PROVINCIAL LAW, THAT PROVISION SHALL BE INEFFECTIVE TO THE EXTENT OF THE PROHIBITION OR INVALIDITY WITHOUT INVALIDATING THE REMAINDER OF THE AFFECTED PROVISION OR THE OTHER PROVISIONS OF THIS WARRANTY.