REPAIR PART INSTALLATION INSTRUCTIONS

CONTROL REPAIR KIT FOR (S1-37323868001) MODELS E4TS030S06 THRU 060

GENERAL

This repair kit is a replacement for the controls used in the E4TS heat pumps. This kit replaces the TS control (part number 18386 / 031-01913-000), YorkGuard V control (part number 18392 / 031-01957-000), and TS interface control (part number 18387 / 031-01927-000) in the E4TS models.

INSTALLATION PROCEDURE

1. Remove control from packaging and configure the control as follows.
   a. Specify the desired Low Temperature Cut Out (LTCO) using the jumper on the control.
   b. Specify the desired Balance Point (BP) using the jumper on the control.
   c. Select Defrost Curve 3 using the jumper on the control.

IMPORTANT - The control will not energize the compressor if the Defrost Curve Jumper is in the 5, 6, or PRGM positions. Power must be removed from the Y1, Y2, and W thermostat inputs for jumper setting changes to be applied.

   d. Specify the desired Y2 Lock functionality. If Y2 LOCK is in the ON position, the control will function as the original E4TS control and stay in second stage until the thermostat is satisfied. If Y2 LOCK is in the OFF position, the control will allow the unit to switch from second stage heating or cooling back to first stage heating or cooling according to the room thermostat call.
   e. Specify if the E4TS unit is installed with a fossil fuel furnace using the FUEL jumper. The jumper should be ON for a fossil fuel furnace installation and OFF for an air handler installation.
   f. Specify the desired Switch Point.
   g. Specify the desired HOT HEAT PUMP setting. If the jumper is in the ON position, the control will be allowed to reduce the indoor airflow during second stage heating operation to increase indoor air outlet temperatures. If the jumper is in the OFF position, the control will always deliver high indoor airflow when the compressor is operating in second stage.
2. Disconnect electrical power (high voltage) from unit.
3. Remove power from indoor unit to remove low voltage (24VAC) power being supplied to outdoor unit.
4. Remove control panel access cover.
5. Remove all three control boards from the control box by removing the screws. Leave the wires attached to the controls.
6. If the unit is equipped with a fossil fuel relay kit, do the following.
   a. Remove fossil fuel relay from control box by removing mounting screws.
   b. Remove the following fossil fuel relay wires (if equipped) from the YorkGuard V control.
      •Black wire at B/C terminal
      •Yellow with green stripe wire at Y terminal
      •White wire at W terminal
   c. Remove the yellow fossil fuel relay wire from the wire nut connecting this wire to the yellow wire from the low voltage connection terminal block.
   d. Connect the yellow wire contained in the repair kit to the yellow wire from the low voltage connection terminal block using the provided wire nut.
   e. Set aside the fossil fuel relay and the wires attached to it since they are now disconnected from the control box and the existing controls.
7. Cut the large wire tie that is securing a large bundle of wires. Take care to not cut any wires.
8. Align the mounting holes of the new control template with the left two YorkGuard V mounting holes in the control panel. The thermostat inputs of the new control should be to the left.
9. Mark the locations for the six control mounting holes using the supplied template.
10. Drill 7/64” holes at the locations marked in the previous step.
11. Mount the new control using the provided screws and the six mounting holes (two existing and four created in previous step). The control should be mounted so the thermostat inputs are to the left and the input jumpers are at the lower right.
12. Move the thermistor leads from the YorkGuard V control terminals to the new control terminals.
    a. Move white outdoor ambient thermistor leads from the OD terminals of the YorkGuard V control to the AMB and AMBG terminals of the new control.
    b. Move the red discharge temperature thermistor leads from the DIS terminals of the YorkGuard V control to the DIS and DISG terminals of the new control. The leads can be connected to either terminal.
    c. Move the blue liquid line temperature thermistor leads from the LL terminals of the YorkGuard V control to the LL and LLG terminals of the new control. The leads can be connected to either terminal.
13. Remove the black wire that is connected to COND FAN on the YorkGuard V from the L1 terminal block connection. The wire tie securing this wire with other wires in the wire harness (373-24255-009) must be removed.

14. Connect the black wire that is factory installed to the L1 terminal of the new control to the L1 terminal block connection.
15. Move the black outdoor fan motor lead that is connected to the COND FAN terminal of the YorkGuard V control to the ODF terminal of the new control.
16. Move the black wires from the COM and REV VAL terminals of the YorkGuard V to the black wire extension harness connected to the RVG and RV terminals of the new control.
17. Move the yellow wires from the PS terminals of the YorkGuard V control to the yellow wire extension harness connected to the HPS terminals of the new control.
18. Cut the lower and upper wire ties on the thermostat wire harness (373-24255-001).
19. Remove the blue wire connected to the Y2 terminal of the small interface control and connect to the blue wire extension that is factory installed to the Y2 terminal of the new control.
20. Remove the white wire connected to the W terminal of the YorkGuard V control and connect to the white wire extension that is factory installed to the W terminal of the new control.
21. Move the green wire from the Y2 Out terminal of the small interface control to the Y2 Out terminal of the new control.
22. Cut the terminations from the thermostat wires shown in the table below and terminate each wire with an insulated 1/4" female quick connect terminal. Maintain as much length as possible to allow for connection to the new control. Move the wires from the YorkGuard V control terminals to the new control terminals as shown in Table 1. The other thermostat wires moved in previous steps are also shown in the table.

NOTE: If a fossil fuel relay is installed, the yellow wire will have been terminated already in an earlier step.

TABLE 1: Control Wiring

Wire Color	Old Control Terminal	New Control Terminal
Purple	L/X	X/L
Black	B/C	C (near Y1)
Yellow	Y	Y1
Red	R	R
Gray	W2/60	W2 OUT
Orange	O	O
Brown	W1/66	W1 OUT
White	W	W
Green	Y2 OUT	Y2 OUT
Blue	Y2	Y2

23. Remove the black wire on contactor B (right) coil terminal. The black wire to be removed is connected to the YorkGuard V C terminal by the M contactor output. It shares a terminal with another wire.
24. Remove the white wire on contactor A (left) coil terminal.
25. Remove the brown wire on contactor B (right) coil terminal.
26. Connect the three-wire harness that is factory installed to the new control and the low voltage contactor wires as shown in Table 2.

TABLE 2: Contactor Wiring

Wire Color	Contactor Connection	New Control Terminal
Black	Common coil terminal of contactor B. The common coil terminals of contactor A and B are connected with an existing black wire.	C (near M1)
Brown	Coil terminal of contactor B (right)	M2
White	Coil terminal of contactor A (left)	M1

27. Remove the orange crankcase heater wire from the C terminal of the dual run capacitor.
28. Cut the terminal from the orange wire and strip ½".
29. Attach the orange extension wire provided in the kit to the orange crankcase heater wire using a supplied wire nut.
30. Attach the orange crankcase heater wire to the orange extension harness that is factory installed to the CCH terminal of the new control.
31. Separate the blue wire connected to the right relay of the TS control from the wire harness (373-24255-007). Remove the blue wire from the TS control relay and place it on the L1 terminal of contactor A. The blue wire should now connect L1 of contactor A to the C terminal of the dual run capacitor.
32. Remove the red and yellow wires connected to the TS control right relay from the terminals of the contactors. Remove wire ties as necessary. The three control boards should now be disconnected from the heat pump and can be set aside.

33. If the indoor unit is a fossil fuel furnace and is equipped with the optional bonnet sensor kit, attach the yellow/black two-wire harness supplied with the repair kit to the BS and BSG terminals of the new control. Attach the field-supplied bonnet sensor wires to the pink wires using the supplied wire nuts.
34. Route and bundle wires neatly. Separate high and low voltage wiring if possible.
35. Replace the wiring diagram with the new diagram supplied with the repair kit.
36. Install the control fault code label on the inside of the control panel access cover.
37. Reapply power to indoor and outdoor unit.
38. Test operation of unit.
39. Verify that the control has no fault codes and system is operating properly.
40. When proper system operation is verified, depress the LAST ERROR button on the control for more than five seconds to clear any faults from memory. The control will flash both LED's three times when the memory is cleared. The control will flash both LED's twice when the LAST ERROR button is depressed and there are no faults stored in memory.
41. Install control panel access cover.

SYSTEM OPERATION

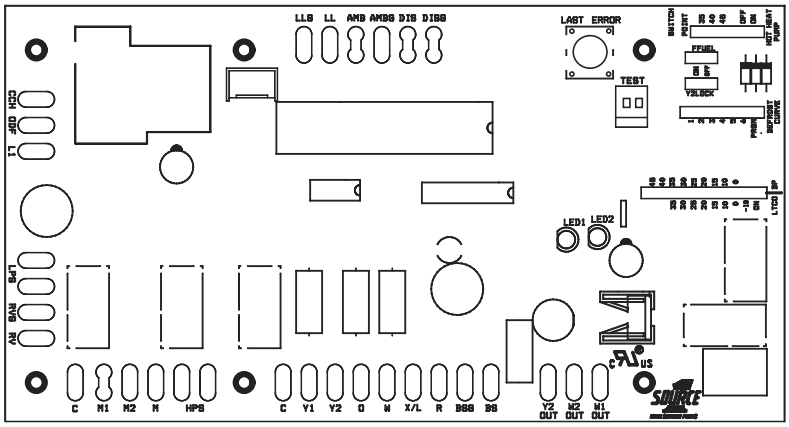

FIGURE 1: Demand Defrost Control Module

REQUIRED CONTROL SETUP

IMPORTANT - The following steps must be taken at the time of installation to insure proper system operation.

1. Consult system wiring diagram to determine proper thermostat wiring for your system.
2. If hot heat pump configuration is desired, change HOT HEAT PUMP jumper to ON position.
3. If installation includes a fossil fuel furnace, change FFUEL jumper to ON position.
4. Set low temperature cutout (LTCO), balance point (BP), switch point (SP), and Y2 Lock jumpers as desired.
5. Verify proper system functionality. Confirm room thermostat operation including fault code display capability.
6. Upon completion of installation, verify that no fault codes are stored in memory. Clear the fault code memory if necessary.

ANTI-SHORT CYCLE DELAY

The control includes a five-minute anti-short cycle delay (ASCD) timer to prevent the compressor from short cycling after a power or thermostat signal interruption. The ASCD timer is applied when the control is first powered from the indoor unit thermostat and immediately following the completion of a compressor run cycle. The compressor and the outdoor fan will not operate during the five minutes that the timer is active.

The ASCD timer can be bypassed by connecting the TEST terminals for three seconds while the thermostat is calling for compressor operation (Y1 input signal energized).

LOW VOLTAGE DETECTION

The control monitors the transformer secondary (24 VAC) voltage and provides low voltage protection for the heat pump and its components. In particular, the control prevents contactor chatter during low voltage conditions. If the voltage drops below approximately 19 VAC, the control will continue to energize any relays that are already energized but will not energize any additional relays until the voltage level increases. If the voltage drops below approximately 16 VAC, the control will immediately de-energize the relay outputs and will not energize any relays until the voltage level increases. The control will store and display the appropriate fault codes when low voltage conditions occur.

CRANKCASE HEATER

The control energizes the crankcase heater terminal (CCH) whenever line voltage is applied to the control and the outdoor fan is not on. If the compressor is equipped with a crankcase heater, it will be energized from the CCH terminal of the control.

TEST INPUT

The control includes a TEST input connector that can be used for various testing functions during installation and service. The TEST input connector is shown in Figures 1and 4. The following table summarizes the behavior of the control when the two TEST pins are connected. More detailed descriptions of the various functions are included in other sections of this document.

TABLE 3:TEST Input Functionality

Duration of connection (seconds)	Control behavior with no thermostat signals present	Control behavior with thermostat signals present
Less than 2	No response	No response
2-6	Display operational mode	Bypass ASCD. If Y1 is present and high-pressure switch is closed, contactors will be energized.
	Clear soft lockout	Clear soft lockout
	Clear hard lockout	Clear hard lockout
More than 6	Display operational mode. Energize X/L with active defrost curve flash code.	Initiate defrost cycle ignoring the liquid line and outdoor ambient temp. Energize X/L with active defrost curve flash code
Connection removed	Resume normal LED display	Terminate defrost as normal or until O signal is energized.
Connection not removed	Display operational mode. Energize X/L with active defrost curve flash code.	Continue defrost cycle and X/L flash code until TEST connection removed.

LED DIAGNOSTIC INDICATORS

The control includes two LED's that display various types of diagnostic information. LED1 is red and LED2 is green. The location of the LED's is shown in Figures 1and 4. These LED's are used to display operational mode, status, and fault information.

OPERATIONAL MODE DETECTION

The control can be used in a variety of applications including heat pumps and air conditioners with modulating compressors. The control uses various inputs to determine the proper mode of operation.

It looks for the presence of a reversing valve connected to the RV and RVG terminals to determine if it should operate as a heat pump or an air conditioner. If the reversing valve is not connected, the control will not operate in the heat pump mode. The control senses the reversing valve loads and determines the operational mode each time power to the control is cycled.

The control also senses the connections that are made to the M, M1, and M2 terminals and determines the correct operational mode for the control. This is done each time power to the control is cycled.

OPERATIONAL MODE DISPLAY

The control will display its active operational mode using the onboard LED's when the TEST pins are connected while no thermostat signals are energized. See Table 4. The control will display the operational mode as long as the TEST pins are shorted and no thermostat signals are energized. When the TEST pin short is removed, the control will return to normal LED displays. The X/L output will be energized (with the number of flashes corresponding to the active defrost curve) while the operational mode is displayed. For example, if defrost curve 2 is active, the X/L output will be energized with two flashes while the operational mode is being displayed on the LED's.

TABLE 4: Operational Mode Display

Operational Mode	LED1 (Red)	LED2 (Green)
Heat Pump		ON
Air Conditioner		OFF
Single-Stage Compressor	1	
Reciprocating Two-Stage Compressor	2	
Scroll Two-Stage Compressor	3	

STATUS MODE DISPLAY

The control also provides status codes using the LED's. Status codes indicate the state of operation of the unit but do not represent a fault. Table 5 describes the LED displays during status codes. Status codes will not be displayed when a fault code is present.

During the following conditions, the control will not energize the X/L output.

TABLE 5: Status Code Display

Description	LED1 (Red)	LED2 (Green)
No power to control	OFF	OFF
First-stage compressor operation – not applicable to single stage compressor	OFF	ON
Second-stage or full capacity compressor operation	ON	ON
Control normal operation – no call for compressor	OFF	2 sec ON 2 sec OFF
Control normal operation – call for compressor and ASCD timer (5 min.) is active	OFF	Rapid Flash
No fault codes in memory – Initiated by LAST ERROR push button	2	2
Fault code memory cleared – Initiated by LAST ERROR push button	3	3

FAULT CODE DISPLAY

X/L Output

The X/L terminal of the heat pump control is typically connected to the X/L input of the room thermostat. The thermostat uses this signal to notify the homeowner of a problem with the heat pump using an LED or LCD display. When the control energizes the X/L terminal, the thermostat displays the flash code so the homeowner can see it.

The heat pump control informs the homeowner of the type of condition that is present using flash codes. Table 6 shows the condition categories and the corresponding X/L flash codes.

The control will continue to energize the X/L output for fault codes having an X/L code of 4 flashes even after the thermostat calls are removed. The control does this to notify the installer or homeowner that a significant problem with the wiring or system configuration is present and needs to be corrected.

The control will continue to energize the X/L output until the condition that caused the fault condition no longer exists.

TABLE 6:X/L Output Categories

Condition Category	X/L
Soft Lockout – Reset with interruption of thermostat call following correction of fault condition	2 flashes
Hard Lockout – Reset by cycling power to system	3 flashes
Wiring, sensor or control setting related error	4 flashes

LED Display

The control will display any fault code that is currently active using the LED's. The control will display the fault code, pause two seconds, and display the fault again. The control will continue the fault code display until the condition that caused the fault code no longer exists. If multiple fault codes are present at the same time, the control will display only the most recent fault. The other active errors may be accessed from memory using the LAST ERROR pushbutton.

Operational Fault Codes

Table 7 shows the operational faults that the control can detect. The control displays this type of error by flashing LED1 (Red) only. LED1 (Green) is not energized. These faults typically occur when the heat pump has been operating and a problem occurs.

TABLE 7: Operational Fault Codes

Description	LED1 (Red)	LED2 (Green)	X/L
Operational Faults			
Control Failure that still allows fault code output	ON	OFF	4 if possible
High-pressure switch fault (not in lockout yet)	1	OFF	OFF
High-pressure switch lockout (last mode of operation was heat pump)	2	OFF	2 (soft) 3 (hard)
High-pressure switch lockout (last mode of operation was defrost)	3	OFF	2 (soft) 3 (hard)
Low-pressure switch lockout	4	OFF	2 (soft) 3 (hard)
Low Voltage (< 19 VAC) preventing further relay outputs	5	OFF	OFF
Low Voltage (< 16 VAC) stopped current relay outputs	6	OFF	OFF
Pipe Freeze Protection Timer expiration	7	OFF	4

Sensor or Switch Fault Codes

Table 8 shows the faults that the control can detect when a problem is present with a sensor or switch. The control displays this type of error by energizing LED1 (Red) constantly and flashing LED2 (Green). These faults typically occur when the heat pump has been operating and a problem occurs with a sensor or its wiring. These faults could also occur during installation as the heat pump is configured.

TABLE 8: Sensor or Switch Fault Codes

Description	LED1 (Red)	LED2 (Green)	X/L
Required Sensor or Switch Faults			
Outdoor ambient sensor failure (short)	ON	1	2 (soft)
Outdoor ambient sensor failure (open)	ON	2	2 (soft)
Liquid line sensor failure (short)	ON	3	2 (soft)
Liquid line sensor failure (open)	ON	4	2 (soft)
Optional Discharge Line Sensor Faults			
High discharge line temperature	ON	5	2 (soft) 3 (hard)
Low discharge line temperature	ON	6	2 (soft) 3 (hard)
Discharge line sensor failure (short)	ON	7	2 (soft)
Optional Bonnet Sensor Faults			
Bonnet sensor failure (short)	ON	8	4
Fossil Fuel Mode setting error (FFUEL jumper in OFF position but bonnet sensor present)	ON	9	4

Wiring Related Fault Codes

Table 9 shows the faults that the control can detect when a problem is present with the system wiring or jumper configurations. The control displays this type of error by flashing LED1 (Red) and energizing LED2 (Green) constantly. These faults typically occur when the heat pump is first installed or when a system component such as the room thermostat or indoor unit is replaced or rewired.

TABLE 9: Wiring Related Fault Codes

Description	LED1 (Red)	LED2 (Green)	X/L
Wiring Related Faults			
Compressor Contactor Miswire	1	ON	4
Y2 present without Y1	2	ON	4
Y1 and W present without Y2 in two stage mode	3	ON	4
O signal received in AC mode	4	ON	4
W signal received in AC mode	5	ON	4
W and O signal received in AC mode	6	ON	4
W and O signal received in HP mode	7	ON	4
Defrost Curve Jumper Error (Invalid jumper setting preventing compressor operation)	8	ON	4

FAULT CODE MEMORY

Displaying Stored Fault Codes

The control will store up to five fault codes in memory. If more than five faults occur, the five most recent fault codes will remain in memory. The stored faults can be displayed by depressing the LAST ERROR push button for one to five seconds while no thermostat inputs to the control are energized. See Figures 1and 4 for the location of the push button. Since some room thermostats energize the O signal even when not calling for compressor operation, turn the room thermostat to the SYSTEM OFF setting when displaying fault codes.

When the LAST ERROR push button is depressed and released, the control will display the stored fault codes beginning with the most recent. The control will display the most recent fault code, pause two seconds, and display the next fault code. The control will display the stored error codes and then return to the normal LED status display mode. The stored fault codes can be displayed again by depressing the push button again. When the control displays the fault codes with the onboard LED's, it will also energize the X/L output with the corresponding flash code. The X/L output signal can be observed at the room thermostat or at the control using a 24VAC LED test device connected to the X/L terminal.

If the control has no fault codes stored in memory, it will flash both LED's twice simultaneously. If a thermostat signal is energized while the control is displaying the stored error codes, the control will stop displaying the stored error codes and resume normal operation.

Clearing Fault Code Memory

Once the stored fault codes have been displayed and recorded, the installer should clear the stored fault codes from the control's memory. This practice will enable better troubleshooting and diagnosis of system problems. If the stored fault codes are not cleared after the cause of the problem has been resolved, a service technician doing a later service call may not know that the fault codes in the memory were caused by a problem that has already been fixed. The technician may waste time trying to fix a condition that no longer exists. Therefore, it is very important to always clear the fault code memory after the unit is installed and running properly following a service call.

IMPORTANT - Always clear the fault code memory after resolving the condition that caused the fault code.

To clear the fault code memory, depress the LAST ERROR push button for longer than 5 seconds. The control will flash both LED's three times to indicate that the memory has been cleared. To confirm that the memory has been cleared, depress the LAST ERROR push button for one to five seconds. The control will flash both LED's twice to indicate that no faults are stored in memory.

LOCKOUT MODES

Soft Lockout

The control will cause a soft lockout during the following conditions. Detailed descriptions of the conditions required for the control to enter the soft lockout mode are contained in other sections of this document.

1. High-pressure switch
   a. Two openings within six hours
2. Low-pressure switch
   a. One opening of the switch for more than five seconds except under certain conditions.
3. High discharge temperature (with optional discharge sensor)
   a. Temperature reading exceeds 263F
4. Low discharge temperature (with optional discharge sensor)
   a. Temperature reading does not reach 90F following timer expiration under certain conditions.

During the soft lockout mode, the control will do the following.

1. De-energize the compressor
2. If in heating mode, the control will energize auxiliary heat as if the outdoor ambient temperature was below the LTCO setting.
3. Energize the LED and X/L outputs with the appropriate flash codes
4. Store the appropriate fault code in memory.

The control will reset the soft lockout condition when any of the following occur following removal of the fault condition.

1. Power is cycled to the R or Y1 inputs of the control. This will cause the soft lockout condition to be reset when the thermostat is satisfied or when the thermostat is set to SYSTEM OFF and back to HEAT or COOL mode.
2. The TEST terminals are shorted for more than two seconds.

When the soft lockout condition is reset, the control will stop displaying the fault code and will respond to thermostat inputs normally.

Hard Lockout

If four soft lockouts occur within a twelve-hour period, the control shall cause a hard lockout condition. These soft lockouts can be caused by the same or different conditions. The control will function in the same way during soft and hard lockout conditions. The difference is in the requirements for resetting the lockout condition. The control will reset the hard lockout condition when any of the following occur following removal of the fault condition.

1. Power is removed from the R input of the control.
2. The TEST terminals are shorted for more than two seconds.

A hard lockout condition will not be reset when the thermostat is satisfied or when the thermostat is set to SYSTEM OFF and back to HEAT or COOL mode. Power (24 VAC) to the control must be removed and reapplied.

When the hard lockout condition is reset, the control will de-energize the LED and X/L outputs and respond to thermostat inputs normally.

Wiring or Setting Related Lockouts

The control will not operate the compressor when the following faults occur. These faults can be reset using the same methods used to reset a soft lockout. However, two occurrences of these faults will not cause a hard lockout condition.

1. Presence of Y2 thermostat signal without Y1.
2. Shorted discharge sensor input
3. Shorted bonnet sensor
4. Shorted or open liquid line or outdoor ambient sensor
5. Defrost curve jumper error

If a compressor wiring error is detected, the control will not operate the compressor. Once the compressor wiring error has been detected, power (24 VAC) must be cycled to the control for the control to sense the wiring change and clear the lockout condition.

DEFROST OPERATION

General

The control maintains proper airflow through the outdoor coil during heating operation by melting frost and ice that may form on the coil. Frost may accumulate unevenly in different sections of the coil because of the arrangement of the refrigeration circuit within the coil. The control may initiate a defrost cycle even when the coil is not completely covered with frost. This is normal operation.

The control regulates the defrost operation of the heat pump based on accumulated compressor run time, outdoor coil temperature, and outdoor ambient temperature. The control will cause the unit to operate in the normal heating mode until it determines that a defrost cycle is needed.

All defrost timings are based on accumulated compressor run time.

Operation

The defrost mode is equivalent to the cooling mode except that the outdoor fan motor is de-energized. The control shall do the following to initiate a defrost cycle.

- De-energize the outdoor fan
- Energize the crankcase heater
- Energize the reversing valve
- Energize the auxiliary heat outputs based on the system configuration
- Energize Y2 OUT terminal if not already energized
- Begin the maximum defrost cycle length timer

If the call for heating (Y1) is removed from the control during the defrost cycle, it will terminate the defrost cycle and de-energize the compressor. The control will also stop the defrost cycle length timer but not reset it. When the control receives another call for heating, it will restart the defrost cycle and the timer at the point at which the call for heating was removed. This will happen only if the liquid line temperature conditions allow defrost to occur.

Defrost Curves

The control uses a set of defrost curve parameters that are selected using the defrost curve selection jumper. The location of the defrost curve selection jumper is shown in Figures 1and 4. Another section of this document shows the appropriate jumper position. Jumper positions 5, and 6 are not used and the control will not allow the compressor to operate when the jumper is in any of these positions or in the PRGM position.

Defrost Curve Selection

The control will display the proper fault code when a defrost curve jumper error is present. If the jumper is missing, the control will behave as if the jumper was in the PRGM position. The control will display the active defrost curve using the X/L terminal when the heat pump is operating in a defrost cycle that has been forced using the TEST inputs. It will also display the active defrost curve using the X/L terminal when the operational mode is being displayed using the LED's. For instance, the X/L output will be energized with two flashes when defrost curve 2 is active. The control will lock out the compressor if the defrost curve selection jumper is not properly set.

Defrost Cycle Initiation

The control will allow the heat pump to operate in the heating mode until the combination of outdoor ambient and outdoor coil temperatures indicate that a defrost cycle is necessary.

The control will initiate a defrost cycle when the liquid line temperature is below the initiate point for the measured ambient temperature (see Figure 2) continuously for 4-1/2 minutes. This delay eliminates unnecessary defrost cycles caused by refrigeration surges such as those that occur at the start of a heating cycle.

The control will initiate a defrost cycle every 6 hours (accumulated compressor run time) to recirculate refrigerant lubricants. This forced defrost timer will be reset and restarted following the completion or termination of a defrost cycle.

The control will also initiate a defrost cycle when the TEST terminals are shorted. This feature allows an installer or service technician to start a defrost cycle immediately as required. When the TEST terminals are shorted for more than six seconds with a Y1 input energized and the high-pressure switch closed, the ASCD will be bypassed and the compressor will be energized. If an O signal is present, the control will not initiate a defrost cycle. If the defrost cycle is initiated using the TEST terminals, the control will bypass the normal auxiliary heat timings and will energize the W1 Out and W2 Out terminals immediately when it begins the defrost cycle.

When the TEST inputs are used to force a defrost cycle, the control will ignore the state of the liquid line temperature and outdoor ambient temperature inputs. The coil does not have to be cold and the outdoor temperature does not have to be within a certain range for the heat pump to be forced into a defrost cycle. After the TEST input jumper is removed, the defrost mode will be terminated as normal. The defrost cycle length timer will not be started until the TEST input is removed. If the TEST terminals remain shorted, the control will keep the unit in defrost mode.

Defrost Inhibition

The control will not initiate a defrost cycle if the liquid line temperature is above 40°F unless the defrost cycle is forced using the TEST input.

The control will not initiate a defrost cycle when the outdoor ambient temperature is below –25°F or above 55°F unless the defrost cycle is forced using the TEST input.

The control will also prevent a defrost cycle from being initiated too soon after the initiation of the previous defrost cycle. When power is applied to the control and after the completion or termination of each defrost cycle, the control will start a 40-minute timer. When this timer expires, the control will allow another defrost cycle when needed. The timer is based on accumulated compressor run time.

Defrost Termination

The control will terminate the defrost cycle immediately after the liquid line temperature reaches 80°F or after eight minutes of defrost operation.

The control will also terminate a defrost cycle that has been forced using the TEST input when the O input is energized. The control will not terminate a normal defrost cycle when it receives an O input.

The control will do the following to terminate a defrost cycle.

- Energize the outdoor fan
- De-energize the crankcase heater
- De-energize the reversing valve
- De-energize the auxiliary heat outputs
- Control the Y2 Out terminal based on operating conditions
- Reset and restart the 40-minute defrost inhibit timer

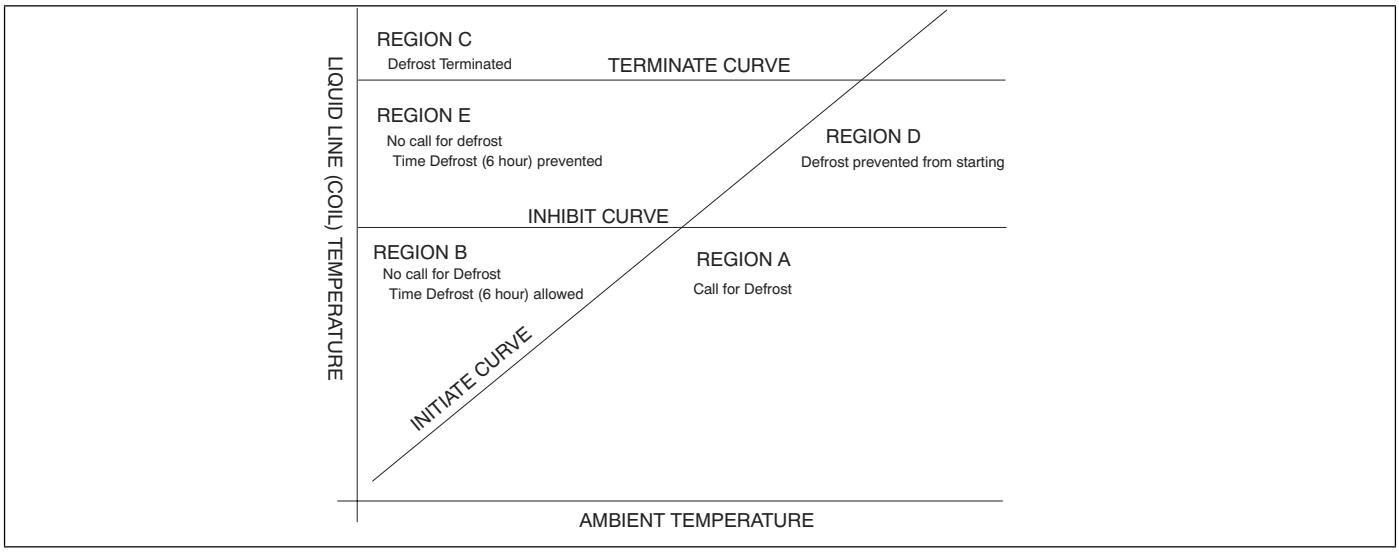

FIGURE 2: Defrost Operation Curves

COOLING OPERATION

First-Stage Cooling Operation

During first-stage cooling operation, the control will receive thermostat signals at the Y1 and O input terminals. The control will energize the M1 compressor output terminal. This signal energizes the coil of compressor contactor A causing the compressor to run in first (low) stage. The control also closes the outdoor fan relay delivering power to the ODF terminal causing the outdoor fan to operate. The control energizes the RV terminal with 24VAC to switch the reversing valve.

Second Stage Cooling Operation

During second-stage cooling operation, the control will receive thermostat signals from Y1, Y2 and O inputs. The control will energize the M2 compressor output terminal. This signal energizes the coil of compressor contactor B causing the compressor to run in second (high) stage. During two-stage cooling operation the control also closes the ODF relay causing the outdoor fan to operate. The control energizes the RV terminal with 24VAC to switch the reversing valve. Additionally, the Y2 OUT terminal is energized with 24VAC. This signal can be used to signal the indoor unit to deliver high air flow.

Two-Stage Cooling Anticipation Mode

The second-stage anticipation mode applies only to cooling operation. It does not apply to heating operation.

The purpose of this mode is to allow the unit to bypass first stage operation under very hot conditions when the unit will most likely require second stage operation anyway.

The factory setting for second-stage cooling anticipation mode is OFF.

If the control receives two consecutive calls for second-stage cooling (Y1+Y2+O), it shall force second stage compressor operation with the next call for first stage cooling (Y1+O). The control shall continue to force second stage cooling operation with thermostat calls for first stage cooling until one of the following conditions occurs.

- A thermostat call for first stage cooling (Y1+O) that has duration of less than 10 minutes.
- Recycling 24VAC to the control
- Shorting the TEST input pins.

If the Y2 LOCK jumper is in the OFF position, the control will not implement second-stage anticipation mode. This results in second-stage operation only when the room thermostat calls for second-stage cooling (Y1 + Y2 + 0).

If the jumper is removed, the control will behave as if the jumper is in the OFF position.

HEATING OPERATION

First-Stage Heating Operation

During first-stage heating operation, the control will receive a thermostat signal at the Y1 input terminal. The control will energize the M1 compressor output terminal. This signal energizes the coil of compressor contactor A causing the compressor to run in first (low) stage. The control also closes the outdoor fan relay delivering power to the ODF terminal causing the outdoor fan to operate. The reversing valve is not energized in heating mode.

Second-Stage Heating Operation

During second-stage heating operation, the control will receive a thermostat signal at the Y1 and Y2 input terminals. The control will energize the M2 compressor output terminal. This signal energizes the coil of compressor contactor B causing the compressor to run in second (high) stage. The control also closes the ODF relay causing the outdoor fan to operate. The Y2 OUT terminal may or may not be energized depending on the HP mode of operation (conventional vs. hot heat pump).

Conventional Heat Pump Mode

The factory setting of the HOT HEAT PUMP jumper on the control is the OFF position. In this configuration the heat pump operates in conventional heat pump mode. If the jumper is not in place, the control will act as if the jumper is in the OFF position.

If the HOT HEAT PUMP jumper is in the OFF position, the control will energize the Y2 OUT terminal whenever the compressor is running in second-stage.

The location of the hot heat pump jumper is shown in Figures 1and 4.

Hot Heat Pump Enable (HOT HEAT PUMP) Settings

The Hot Heat Pump Enable (HOT HEAT PUMP) jumper input does not affect the Forced Second Stage Feature.

Hot Heat Pump Mode

The control will operate in Hot Heat Pump Mode only if the HOT HEAT PUMP jumper on the control is placed in the ON position. The Y2 OUT signal must also be connected to the indoor unit.

Hot Heat Pump Mode only affects the indoor blower motor speed when the unit is operating in second-stage heating.

The control implements the Hot Heat Pump Mode by controlling the indoor airflow level during second-stage heating operation only. Cooling operation is not affected. By reducing the indoor airflow level, the heat pump system will operate with increased indoor discharge air temperatures. The control changes the indoor airflow level using the Y2 OUT signal. This terminal is connected to the high speed cooling input of a variable speed indoor unit. When the heat pump control energizes the Y2 OUT terminal, the indoor blower runs at high speed delivering high airflow. When the control de-energizes the Y2 OUT terminal, the indoor blower runs at a lower speed delivering lower airflow.

If the HOT HP jumper is in the ON position and the control receives a call for second-stage heating, the control will energize the compressor and measure the outdoor ambient temperature. Second-stage heating operation can result from one of two different control features. One feature is referred to as “Forced Second-Stage” while the other is a response to a Y1 & Y2 thermostat input.

If the outdoor ambient temperature is equal to or greater than 50°F, the control will energize Y2 OUT and keep it energized until the thermostat is satisfied (Y1 signal removed). The higher airflow is required to keep the operating pressures low when the outdoor ambient temperature is 50°F or greater.

If the outdoor ambient temperature is less than 50°F, the control will start a ten-minute timer and keep Y2 OUT de-energized. Therefore, the compressor will be operating and the indoor unit will be operating with reduced airflow. **If the HOT HP jumper is in the ON position and if the outdoor ambient temperature is less than 50°F, the indoor airflow at the beginning of a heating cycle will always be low.**

When the ten-minute timer expires, the control will measure the liquid line temperature and determine whether to energize Y2 OUT and increase the indoor airflow or keep Y2 OUT de-energized and maintain reduced indoor airflow. The control compares the measured liquid line temperature to a pre-programmed indoor airflow curve. It continues to keep Y2 OUT de-energized until the liquid line temperature exceeds the curve for the given outdoor ambient temperature continually for 30 seconds. If the liquid line temperature drops below the curve, the control will reset the 30-second timer and restart it when the liquid line temperature again exceeds the curve. When the liquid line temperature exceeds the indoor airflow control curve continually for 30 seconds, the control will energize Y2 OUT, i.e. cause high indoor airflow, until the thermostat demand is satisfied and the thermostat signal inputs are removed. Figure 3 describes the required behavior.

Once the control energizes Y2 OUT to create high airflow, it will keep Y2 OUT energized until the thermostat is satisfied and the call for heating is removed. It will do this regardless of a change in outdoor ambient or liquid line temperature. Therefore, if the control energizes Y2 OUT because the outdoor ambient temperature is greater than or equal to 50°F or because the liquid line temperature exceeds the curve for the given outdoor ambient temperature (point within region B), it will keep Y2 OUT energized until the thermostat is satisfied even if the liquid line or outdoor ambient temperature falls below the curve (point within region A).

The control of Y2 OUT to generate high indoor airflow as required will prevent the heat pump system pressures and temperatures from becoming too great when the compressor is running at full capacity with low indoor airflow.

As an example, assume that the HOT HP jumper is in the ON position. When the control receives a call for second-stage heating (Y1 & Y2), it checks the outdoor ambient temperature. If the outdoor ambient temperature is 52°F, the control will energize Y2 OUT immediately causing high indoor airflow and keep it energized until the thermostat signal is removed. If the outdoor ambient temperature is 48°F, the control will maintain Y2 OUT in a de-energized state and begin a ten-minute timer. The indoor unit will be running at low airflow because of the thermostat signal being delivered to the Y1 input of the indoor unit.

When the ten-minute timer expires, the control will compare the liquid line temperature to the indoor airflow control curve for the measured outdoor ambient temperature. If the point is within region A (See Figure 3), the control shall maintain Y2 OUT in the de-energized state until the liquid line temperature rises so that region B is entered. While in region A, the indoor unit will continue to run at low airflow. When the liquid line temperature point enters region B, the control will start a 30 second timer. When the timer expires, the control will immediately energize Y2 OUT. If the liquid line temperature drops back into region A before the timer expires, the control will reset the timer and restart it when the liquid line temperature again enters region B. When the liquid line temperature is in region B continually for thirty seconds, the Y2 OUT signal will be delivered to the indoor unit and cause high airflow.

Forced Second-Stage Feature

The control determines the behavior of the forced second stage feature based on the Switch Point jumper input. Based on the Switch Point setting and the liquid line temperature, the control will lock the compressor to second stage operation.

This forced second stage feature insures that the compressor will always be in second stage during a defrost cycle. If the compressor were allowed to be in first stage during defrost, the outdoor coil would not defrost as quickly as it would in second stage. The maximum defrost cycle length timer could expire before the defrost cycle is complete.

The forced second stage feature also prevents first stage heating operation at low temperature and avoids cold indoor discharge air.

Switch Point Settings

The switch point setting affects only the forced second stage feature of the hot heat pump.

The control allows for switch point settings to be 35°F, 40°F or 45° F.

The factory places the switch point jumper in the 35° F position. If the jumper is removed, the control will behave as if the jumper is in the 35°F position.

The minimum switch point temperature option of 35°F insures that the compressor will always be in second stage operation during defrost. If a temperature option below 35°F was allowed, the heat pump might require a defrost cycle (based on liquid line temperature below initiate curve) before the control forced the compressor into second stage operation based on the switch point setting.

Forced Second Stage Feature Operation

The control will force second stage compressor operation when the liquid line temperature is below the switch point even if the thermostat is calling only for first stage. The liquid line temperature must be below the switch point continuously for 30 seconds. If the liquid line temperature exceeds the switch point before 30 seconds has expired, the control will reset the timer and restart the timer when the liquid line falls below the switch point again. The liquid line temperature may be filtered to improve system performance if necessary.

The control shall only implement this behavior during a call for first-stage heating (Y1).

The control will no longer force two-stage compressor when all of the following conditions are true continuously for 30 seconds. If any of the conditions are no longer true before the 30-second timer expires, the control will reset the timer and restart the timer when all of the conditions are again true. That is, if the liquid line temperature exceeds the switch point temperature then falls below the switch point temperature before the 30-second timer expires, the control shall reset the timer when the control falls below the switch point. The control shall restart the 30-second timer when the liquid line temperature exceeds the switch point temperature again.

1. The liquid line temperature exceeds the switch point temperature.
2. The outdoor ambient temperature exceeds the values corresponding to each switch point setting as shown in Table 10.

TABLE 10: Switch Point Exit Temperatures

Switch Point Setting	OD Ambient Exit Temp
35	42
40	47
45	55

1. The unit is not in defrost mode. If the other exit conditions are met while the unit is in defrost mode, the control will complete the defrost cycle and then exit the forced second-stage feature.

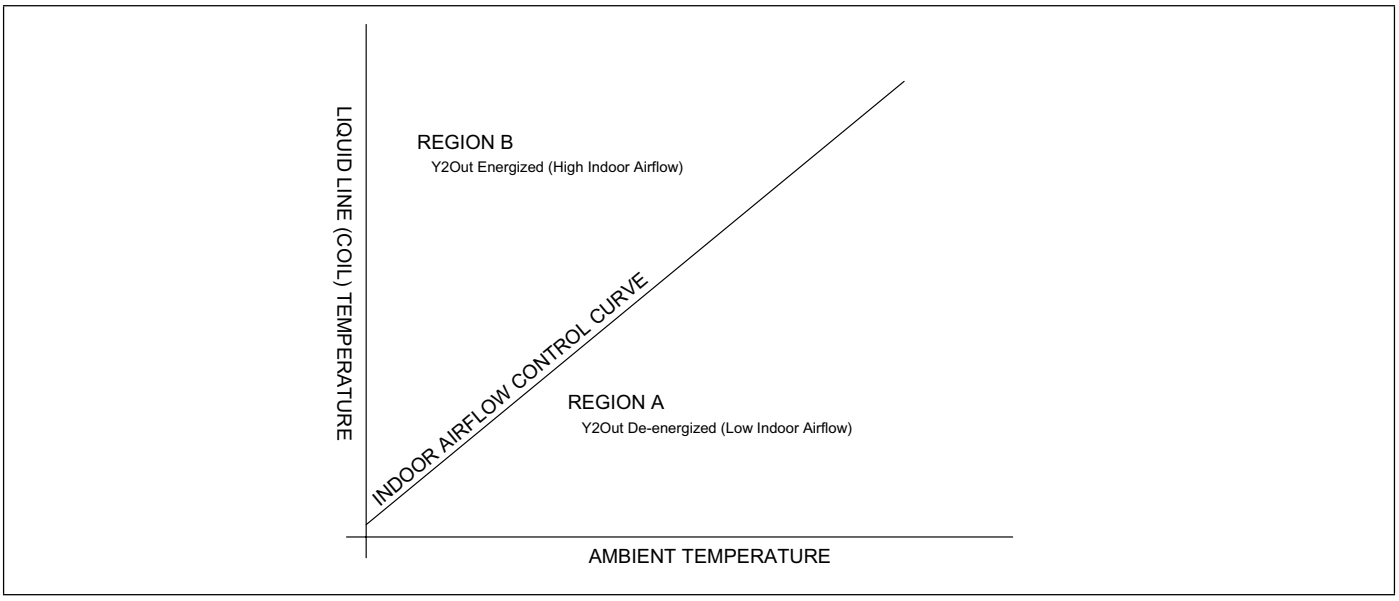

FIGURE 3: Hot Heat Pump Indoor Airflow Control

During defrost operation, the control will ignore the HOT HP jumper setting and energize the Y2 OUT signal to create high indoor airflow. Additionally, if at any point the conditions require a defrost cycle, the control will override the reduced indoor airflow feature and function based on the defrost requirements and conditions.

EMERGENCY HEAT

When the control receives a W signal without a Y signal (emergency heat), the control will de-energize the compressor and energize the W1 OUT and W2 OUT terminals immediately. The balance point setting is ignored during a call for emergency heat. Therefore, W1 OUT and W2 OUT will be energized regardless of the outdoor ambient temperature.

JUMPER INPUTS

The control uses seven jumpers to determine how the heat pump should operate. These jumpers are shown in Figures 1and 4. The jumpers that affect this heat pump are the following. The effects of these jumper settings on the operation of the heat pump are described in other sections of this document.

- LTCO – Low Temperature Cutout
- BP – Balance Point
- Defrost Curve
- FFUEL – Specifies fossil fuel furnace application
- HOT HEAT PUMP – Enables indoor airflow control for hot heat pump application
- Y2 LOCK – Determines compressor staging
- SWITCH POINT – Specifies liquid temperature at which second-stage compressor operation is forced.

The control only reads the jumper inputs when the Y1, Y2, and W thermostat inputs are de-energized. If a jumper position is changed while any of these inputs are energized, the control will not act upon the jumper changes until all three of these thermostat calls are de-energized or power (24 VAC) to the control is cycled.

IMPORTANT - Changes to the jumper inputs do not take affect until Y1, Y2, and W thermostat signals are de-energized.

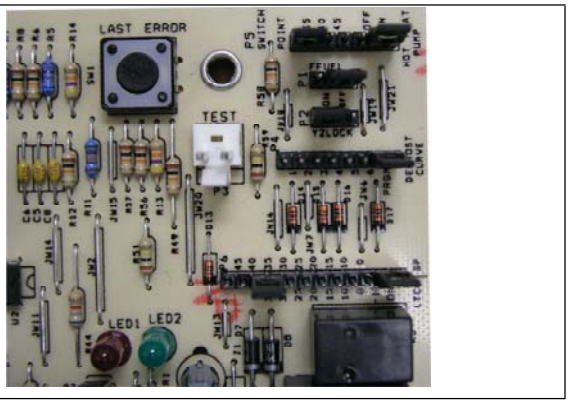

FIGURE 4: Jumper Inputs

LOW TEMPERATURE CUTOUT (LTCO) AND BALANCE POINT (BP)

The control includes a low temperature cutout (LTCO) feature that prevents compressor operation below a specified temperature during heat pump heating operation only. The LTCO setting does not apply to compressor operation during cooling or defrost operation.

The control also includes a balance point feature that prevents the operation of auxiliary heat above a specified temperature.

Setting

The LTCO and BP jumpers on the control are shown in Figures 1 and 4. Both jumpers are placed on the same connector. The control will consider the lowest jumper pin setting to be the LTCO and the highest jumper pin setting to be the BP. The use of the same connector forces the BP and the LTCO to always be separated by at least 10 degrees.

The temperatures shown on the side of the connector labeled LTCO are the LTCO temperature options. The values shown are in degrees F. The control allows the LTCO to be set to any of the following temperatures: -10, 0, 10, 15, 20, 25, 30, 35 degrees F or ON. Placing the jumper in the ON position will allow the control to operate the compressor at any temperature during heating operation.

The factory places the LTCO jumper in the ON position. The jumper must be changed in the field to implement the LTCO feature. If the jumper is removed, the control will behave as if the jumper is in the ON position.

The temperatures shown on the side of the connector labeled BP are the BP temperature options. The values are shown in degrees F. The control allows the balance point to be set to any of the following temperatures: 0, 10, 15, 20, 25, 30, 35, 40, or 45 degrees F.

The factory places the BP jumper in the 35°F position. The jumper may be changed in the field as desired. If the jumper is removed, the control will behave as if the jumper is in the 35 position.

If only one jumper is in place, the control will set the balance point based on the jumper position and will set the LTCO to ON. If only one jumper is in place and it is below the valid BP settings (in the –10 or ON position), the control will set the BP to the default value for no jumper in place (35F) and set the LTCO based on the jumper position (-10 or ON).

Low Temperature Cutout (LTCO) Operation

The control will not operate the compressor in heating mode when the outdoor ambient temperature is below the selected LTCO. The LTCO applies only to air handler mode operation. In fossil fuel mode the balance point (BP) restricts the operation of the compressor so the LTCO setting has no effect.

Balance Point (BP) Operation

If the measured outdoor ambient temperature is greater than the balance point setting, the control will not energize the auxiliary heat outputs. However, the control shall ignore the balance point setting and energize auxiliary heat under some conditions as described in the auxiliary heat sections of this document.

FOSSIL FUEL JUMPER (FFUEL)

Setting

The control includes a FFUEL jumper to specify whether the control is installed with a fossil fuel furnace or an air handler (electric heat). This jumper is shown in Figures 1 and 4. The factory places the FFUEL jumper in the OFF position which is the correct position for an air handler installation. The jumper must be changed to the ON position in the field if the heat pump is installed with a fossil fuel furnace. If the jumper is removed, the control will behave as if the jumper is in the OFF position.

IMPORTANT - If the heat pump is being installed with a fossil fuel furnace, the FFUEL jumper must be placed in the ON position during installation for proper system operation.

Operation

The control operates the auxiliary heat outputs, W1 OUT and W2 OUT, based on the position of the FFUEL jumper. If the FFUEL jumper is in the ON position, the control will function in fossil fuel mode. If the jumper is in the OFF position, the control will function in air handler mode. The FFUEL jumper has no effect on cooling operation.

AUXILIARY HEAT - AIR HANDLER MODE

The heat pump control energizes the auxiliary electric heat in air handler mode using the W1 OUT and W2 OUT signals. The control receives the room thermostat call for auxiliary heat at the W input terminal.

Standard Operation

If the outdoor ambient temperature is less than ten degrees F below the balance point setting and a W input is received with a Y1 or Y1 + Y2 input, the control will energize the M compressor contactor output based on the Y1 input and will energize the W1 OUT immediately when the W input is received. When the W input is received, the control will start a fifteen-minute timer. If the call for Y1 + W or Y1 + Y2 + W is still present after the fifteen-minute timer expires, the control will then energize W2 OUT along with W1 OUT. If the W input is removed but the Y1 or Y1 + Y2 signal remains, the control will de-energize W1 OUT and W2 OUT (if energized) and reset and restart the timer. If the W input is received again without a loss of the Y1 or Y1 + Y2, the same functionality will be repeated.

If the outdoor ambient temperature is ten degrees F or more below the balance point setting and a W input is received with a Y1 or Y1 + Y2 input, the control will energize W1 OUT and W2 OUT immediately.

If the outdoor ambient temperature is below the low temperature cutout (LTCO) setting, the control will de-energize the compressor and energize W1 Out immediately when a Y1 input is received and W2 out immediately when the Y2 input is received. If the outdoor ambient temperature rises above the LTCO setting before the thermostat is satisfied, the control will continue to keep the compressor outputs de-energized until the thermostat is satisfied. In other words, the control will use auxiliary heat to satisfy the thermostat demand and not turn the compressor back on even if the outdoor ambient temperature rises above the LTCO setting during a call for heating.

TABLE 11: Air Handler Auxiliary Heat Functionality

Outdoor Ambient Temperature	**CONTROL INPUTS**			
	Y1	**Y1 + Y2**	**Y1 + W OR Y1 + Y2 + W**	**OR**
Ambient above BP	Heat Pump Operation		Heat Pump Operation (then + W1 OUT + W2 OUT after pipe freeze protection timer expires)	W1 OUT + W2 OUT
Ambient below BP and above BP-10F	Heat Pump Operation		Heat Pump Operation + W1 OUT (immediate) + W2 OUT (after 15 minutes)	W1 OUT + W2 OUT
Ambient below BP-10F and above LTCO	Heat Pump Operation		Heat Pump Operation + W1 OUT (immediate) + W2 OUT (immediate)	W1 OUT + W2 OUT
Ambient below LTCO	W1 OUT	W1 OUT + W2 OUT	W1 OUT + W2 OUT	W1 OUT + W2 OUT

Auxiliary Heat Defrost Operation – Air Handler Mode

The control will energize W1 OUT and W2 OUT 45 seconds prior to and during defrost operation. If a call for heating (Y1 or Y1 + Y2) is still present after the defrost cycle has terminated, the control will continue to energize W1 OUT and W2 OUT for 180 seconds after the defrost cycle has been terminated. The control will begin normal heat pump heating mode operation upon termination of the defrost cycle.

Pipe Freeze Protection Timer – Air Handler Mode Operation

The control starts a four-hour timer when a call for compressor operation and auxiliary heat (Y1 + W or Y1 + Y2 + W) is received. If the call for compressor operation and auxiliary heat is still present after the timer expires, the control will energize W1 OUT and W2 OUT in addition to the compressor output regardless of the balance point setting. If the call for auxiliary heat (W) is removed but the call for compressor operation (Y1 or Y1 + Y2) remains, the control will de-energize auxiliary heat (W1 OUT and W2 OUT) and reset and restart the timer. If the timer expires again, the same functionality will be repeated indefinitely. The purpose of this feature is to prevent the pipes in a home from freezing if the balance point is set too low and the heat pump cannot heat the home using compressor operation only. This will be a benefit if a home is not occupied and a compressor problem occurs. The control shall also store and display a fault flash code when the pipe freeze timer has expired.

AUXILIARY HEAT - FOSSIL FUEL MODE

Standard Operation

The LTCO does not have any impact on the operation of auxiliary heat when the control is in fossil fuel mode. Since the compressor is not allowed to come on below the balance point and the balance point is always above the LTCO, the balance point setting effectively becomes the LTCO setting. This is done intentionally to allow the balance point to function as an economic balance point based on the cost of heating with electricity (above the balance point) versus heating with fossil fuel (below the balance point).

If the measured outdoor ambient temperature is below the balance point setting, the control will de-energize compressor outputs and energize W1 OUT immediately when the Y1 input is received and W2 OUT immediately when a Y2 input is received. If the outdoor ambient temperature rises above the balance point setting before the thermostat is satisfied, the control will continue to keep the compressor outputs de-energized until the thermostat is satisfied. In other words, the control will use furnace to satisfy the thermostat demand and not turn the compressor back on even if the outdoor ambient temperature rises above the LTCO setting during the call for heating.

If a W input is received with or without a Y1or Y1 + Y2 input, the control will de-energize the compressor outputs and energize W1 OUT and W2 OUT immediately.

Table 12 describes the auxiliary heat operation for fossil fuel mode.

TABLE 12: Fossil Fuel Furnace Auxiliary Heat Functionality

Outdoor Ambient Temperature	CONTROL INPUTS			
	Y1	Y1 + Y2	Y1 + W OR Y1 + Y2 + W	W
Ambient above BP	Heat Pump Operation		Heat Pump Operation (then W1 OUT + W2 OUT after pipe freeze protection timer expires)	W1 OUT + W2 OUT
Ambient below BP	W1 OUT	W1 OUT + W2 OUT	W1 OUT + W2 OUT	W1 OUT + W2 OUT

Bonnet Sensor – Fossil Fuel Mode

The heat pump may be equipped in the field with an optional indoor air discharge temperature or bonnet sensor. The control does not allow the heat pump and the furnace to operate simultaneously even with a bonnet sensor installed except surrounding a defrost cycle. The control cycles the fossil fuel furnace differently surrounding a defrost cycle depending on whether a bonnet sensor is installed.

The bonnet sensor is installed in the indoor unit and is mounted so that it measures the indoor air temperature after the air exits the furnace. The bonnet sensor is connected to the heat pump control using the BS and BSG terminals. Refer to the bonnet sensor accessory kit for complete installation instructions.

The bonnet sensor only applies to fossil fuel furnace applications and should not be installed with air handlers. If the bonnet sensor is present and the control is set to air handler mode, the indoor unit might be a furnace and the operation mode is incorrectly specified. The control will operate in fossil fuel mode instead of air handler mode so that the furnace and heat pump are not operated simultaneously.

Since the bonnet sensor is an optional accessory, the control cannot detect a bonnet sensor that fails in the open position. If the control senses that the bonnet sensor thermistor is open, it will assume that a bonnet sensor thermistor is not connected and will function without implementing the optional bonnet sensor features. If the control senses that the bonnet sensor thermistor is shorted, it will cause a lockout condition and store and display the appropriate error code.

If the control is in air handler mode and detects that a bonnet sensor input is present, it will control W1 OUT and W2 OUT as required by the fossil fuel mode. It will also cause a fault code to be displayed on the thermostat via the X/L output to notify the homeowner that there is a problem even though the system is operating.

Auxiliary Heat Defrost Operation – Fossil Fuel Mode with Bonnet Sensor

With a bonnet sensor present the control will energize W1 OUT and W2 OUT 45 seconds prior to the initiation of the defrost cycle.

During defrost operation, if the bonnet sensor input reaches 109°F, the control will de-energize W1 OUT and W2 OUT. The control will re-energize W1 OUT and W2 OUT when the bonnet sensor input drops below 90°F again and the defrost cycle is still in process.

If a call for heating (Y1) is still present after the defrost cycle has terminated, the control will continue to energize W1 OUT and W2 OUT after the defrost cycle has been terminated until the bonnet sensor reaches 109°F. When the bonnet sensor reaches 109°F after the defrost cycle has terminated, the control will de-energize W1 OUT and W2 OUT and will not re-energize them during this call for heat. That is, once the defrost cycle has terminated, the control will not cycle W1 OUT and W2 OUT with the bonnet sensor.

The control will begin normal heat pump heating mode operation upon termination of the defrost cycle.

Auxiliary Heat Defrost Operation – Fossil Fuel Mode without Bonnet Sensor

If the control is in fossil fuel mode and senses that no bonnet sensor is present, it will energize W1 OUT and W2 OUT immediately when the defrost cycle is initiated. If a call for heating (Y1) is still present after the defrost cycle has terminated, the control will de-energize W1 OUT and W2 OUT immediately and return to normal heat pump mode operation.

In this mode the control will energize the fossil fuel furnace only during defrost and not provide any comfort enhancements during the transition. The heat pump and furnace will not operate at the same time if the bonnet sensor is not in place.

Pipe Freeze Protection Timer – Fossil Fuel Mode Operation

The control starts a four-hour timer when a call for compressor operation and auxiliary heat (Y1 + W) is received. If the outdoor temperature is above the balance point, the control will energize the compressor instead of the auxiliary heat outputs. If the call for compressor operation and auxiliary heat is still present after the timer expires, the control will energize W1 OUT and W2 OUT and de-energize the compressor regardless of the balance point setting. The control will keep the W1 OUT and W2 OUT signals energized until the Y1 signal is removed. That is, the control will lock into auxiliary heat furnace operation until the room thermostat is satisfied. The purpose of this feature is to prevent the pipes in a home from freezing if the balance point is set too low and the heat pump cannot heat the home using compressor operation only. This will be a benefit if a home is not occupied and a compressor problem occurs. The control will also store and display a fault flash code when the pipe freeze timer has expired.

Y2 LOCK

The control includes a Y2 LOCK feature which allows the unit to anticipate the need for second-stage cooling during high-load conditions. Refer to the “Second-Stage Cooling Anticipation Mode” section of this document for detailed information.

The Y2 Lock jumper on the control is shown in Figures 1 and 4. The factory places the Y2 Lock jumper in the ON position. If the jumper is removed, the control will behave as if the jumper is in the ON position.

SWITCH POINT

The control includes a switch point feature which determines the liquid temperatures at which the compressor will be forced to operate in second-stage. Refer to the “Switch Point Operation” section of this document for detailed information.

Setting

The switch point jumper on the control is shown in Figures 1 and 4. The control allows for switch point settings to be 35, 40 or 45. The valves shown are in degrees F.

The factory places the switch point jumper in the 35°F position. If the jumper is removed, the control will behave as if the jumper is in the 35°F position. The switch point feature is used exclusively for the HP heating operation mode. Cooling operation is not effected by switch point setting.

HIGH-PRESSURE SWITCH FAULT

The heat pump is equipped with a high-pressure switch that is connected to the control at the HPS terminals. If the high-pressure switch opens for more than 40 milliseconds, the control will de-energize the compressor and store and display the appropriate fault code. If the pressure switch closes and a thermostat call for compressor operation is present, the control will apply the five-minute anti-short cycle delay timer and start the compressor when the timer expires.

When the compressor is started following a high-pressure switch fault, the control will start a six-hour timer based on accumulated compressor run time. If the control senses another opening of the high-pressure switch before the timer expires, it will cause a soft lockout condition. The second opening of the high-pressure switch must be greater than 160 milliseconds for the lockout to occur. If the second opening is between 40 and 160 milliseconds, the control will de-energize the compressor but not cause a soft lockout condition. If the control does not sense a second high-pressure switch opening before the six-hour timer expires, the timer and counter will be reset.

LOW-PRESSURE SWITCH

If the heat pump is equipped with a low-pressure switch, it is connected to the control at the LPS terminals. If the low-pressure switch opens for more than five seconds, the control will cause a soft lockout condition and display the appropriate fault codes. However, the control will ignore the low pressure switch input and not cause a soft lockout condition if it opens during the following conditions.

- Defrost operation
- First two minutes of compressor operation
- Two minutes following the completion of a defrost cycle
- TEST input shorted with Y1 input energized

DISCHARGE LINE TEMPERATURE SENSOR

The heat pump may be equipped with an optional discharge line temperature sensor. If a discharge sensor is present, the control will provide the following features.

High Discharge Line Temperature

If the control senses a discharge line temperature reading of 263°F for 30 seconds continually, it will cause a soft lockout condition. If the discharge line temperature drops below 263°F during the 30-second timer, the control will reset the 30-second timer and restart the timer if the discharge line temperature again exceeds 263°F.

Low Discharge Line Temperature

The control will begin a sixty-minute timer when either of the following conditions are met.

- The discharge line temperature has not reached 90°F after eight minutes of accumulated compressor run time.
- The discharge temperature has not reached 90°F after fifteen minutes of accumulated compressor run time following the exit of a defrost cycle.

If the discharge line temperature has not reached 90°F after the sixty-minute timer has expired, the control will cause a soft lockout condition. The control will reset the sixty-minute timer upon expiration and when the compressor starts. The timer is reset when the compressor starts and is only restarted if one of the two conditions shown above are met.

The low discharge temperature fault indicates that the outdoor coil is too cold during heating operation. The lockout is intended to prevent refrigerant flooding back to the compressor.

IMPORTANT - The discharge sensor must be well insulated and installed properly to prevent nuisance lockouts from occurring.

INDICATIONS OF PROPER OPERATION

Cooling

Cooling operation is the same as any conventional air conditioning unit.

1. The outdoor fan should be running, with warm air being discharged from the top of the unit.
2. The indoor blower (furnace or air handler) will be operating, discharging cool air from the ducts. Coils or other parts in the air circuit should be cleaned as often as necessary to keep the unit clean. Use a brush, vacuum cleaner attachment, or other suitable means.
3. The vapor line at the outdoor unit will feel cool to the touch.
4. The liquid line at the outdoor unit will feel warm to the touch.

Heating

Indications of proper Heating operation is as follows:

1. The outdoor fan should be running, with cool air being discharged from the top of the unit.
2. The indoor blower (furnace or air handler) will be operating, discharging warm air from the ducts.
3. The vapor line at the outdoor unit will feel warm to the touch.
4. The liquid line at the outdoor unit will feel cool to the touch.

TEMPLATE

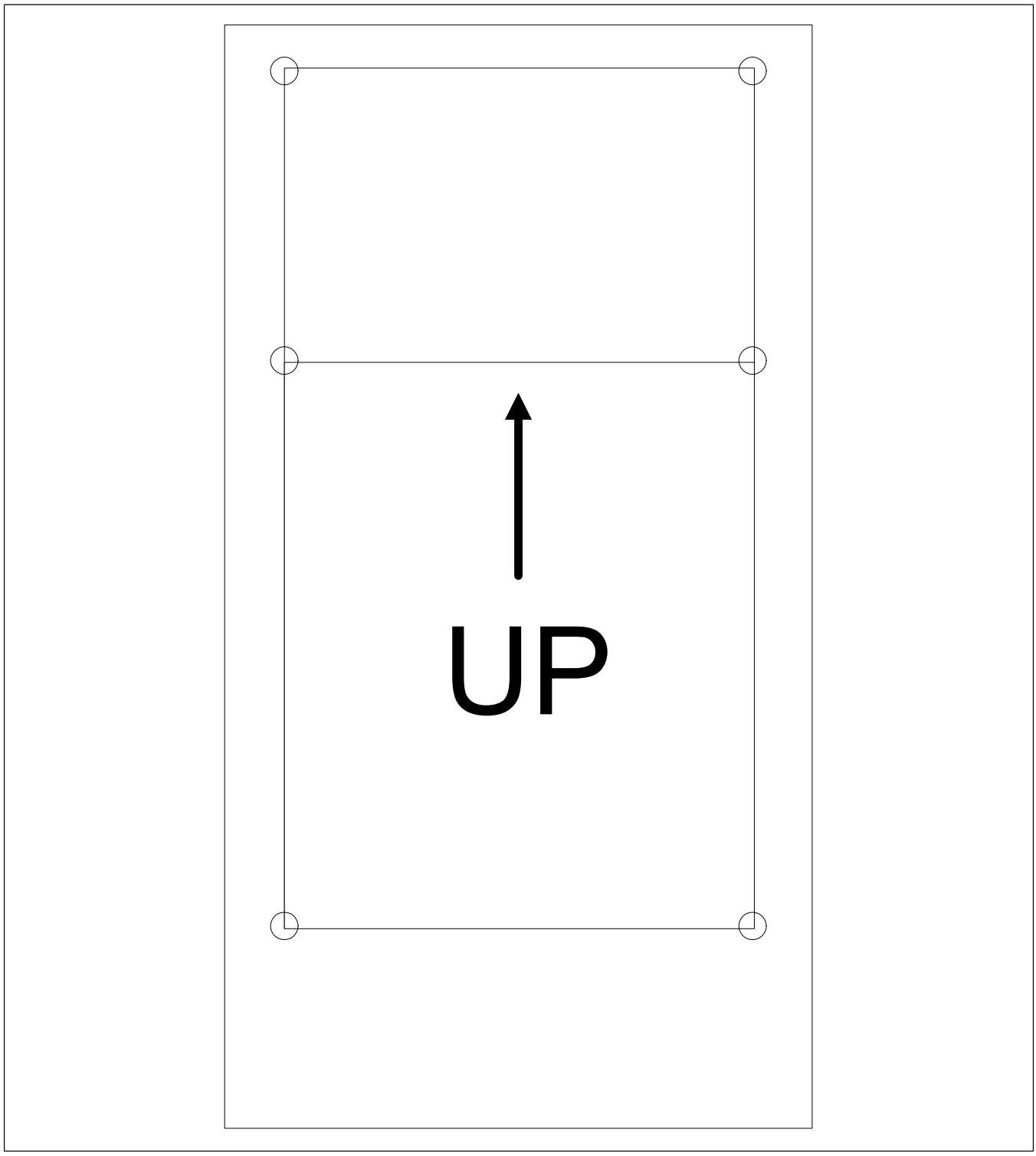

FIGURE 5: Control Mounting Template

WIRING DIAGRAM

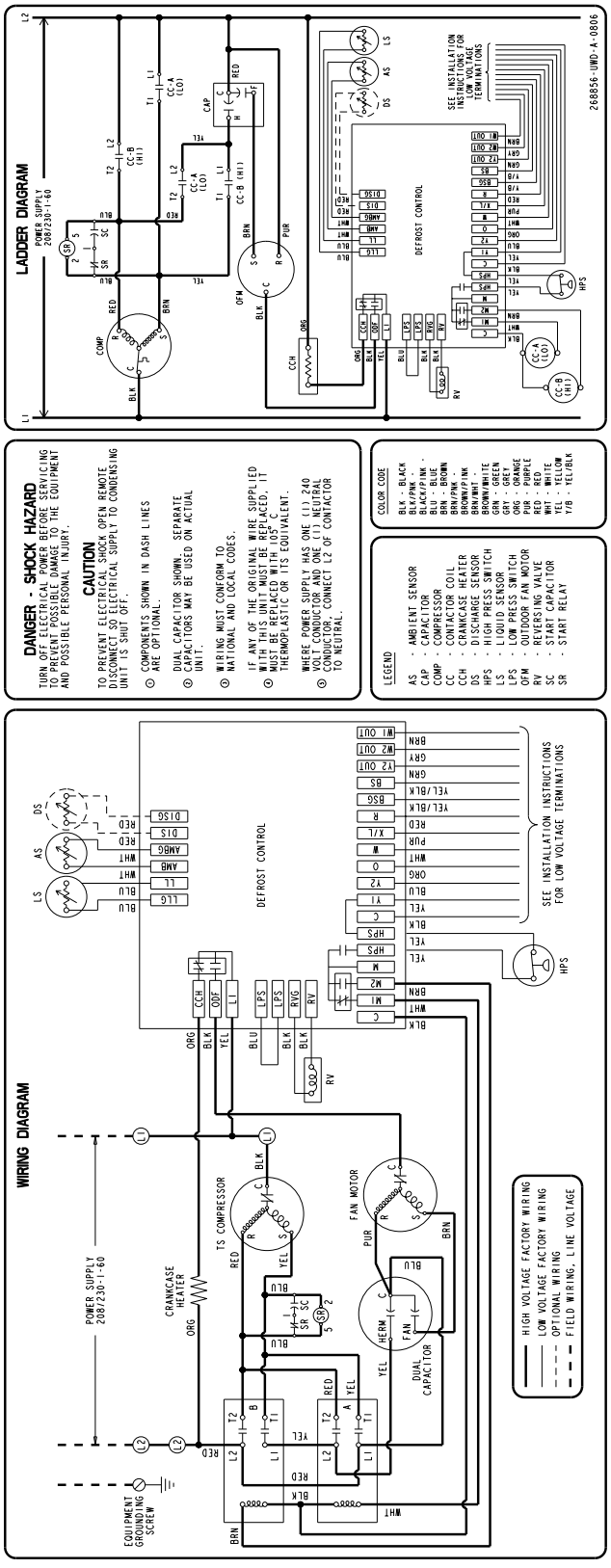

FIGURE 6: Wiring Diagram

NOTES

276249-UAI-A-0107
Supersedes: Nothing