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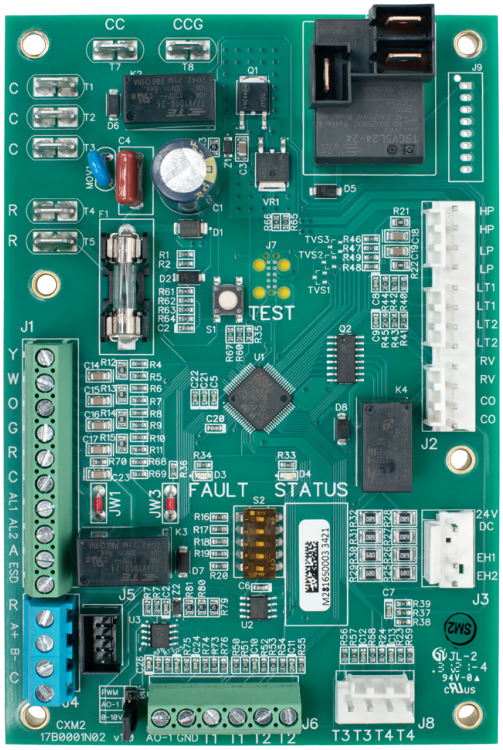
CXM2

Digital Heat Pump Controller



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The CXM2 Electronic Control is a robust, microprocessor based heat pump controller that is advanced and feature-laden for maximum application flexibility. The CXM2 Control has relay outputs for Compressor, Reversing Valve, Alarm Relay, and a configurable relay for Fan. For on board diagnostics, there are 2 LED's to provide status indication.

There are inputs for safety pressure switches, low temperature protection thermistors, condensate overflow sensor, DIP switch selection inputs, thermostat inputs, and emergency shutdown input. Additional configurable temperature sensor inputs are available that may be used for compressor discharge, leaving air, leaving water, and entering water temperature sensors (except for TRL and Water-to-Water products, see product line submittals for details).

The CXM2 has an RS-485 communications port to interface with a communicating thermostat or other communicating controls and tools.

General Operating Parameters: The following are general operating parameters for the CXM2 Control:
- Operating Environment: -40°F to 176°F and up to 95% relative humidity, non-condensing
- Storage Environment: -40°F to 185°F and up to 95% relative humidity, non-condensing

Power Requirements: CXM2 only power draw:
- Normally 5 VA draw at 24VAC
- Maximum 10 VA draw at 24VAC
- A dedicated 24VAC, 50-60Hz, 1Ph, 40VA transformer minimum is required for typical WSHP application

Relay Contact and Connection Ratings: The following relays are mounted on the CXM2 Control:
- Compressor Relay: 40VA at 24VAC
- Alarm Relay: 28VA at 24VAC
- Reversing Valve: 28VA at 24VAC
- Fan Enable / Loop Pump Relay: 1 HP at 240VAC
- 'A' terminal: 20VA at 24VAC

Grounding: The control board must be grounded from one of the C terminals.

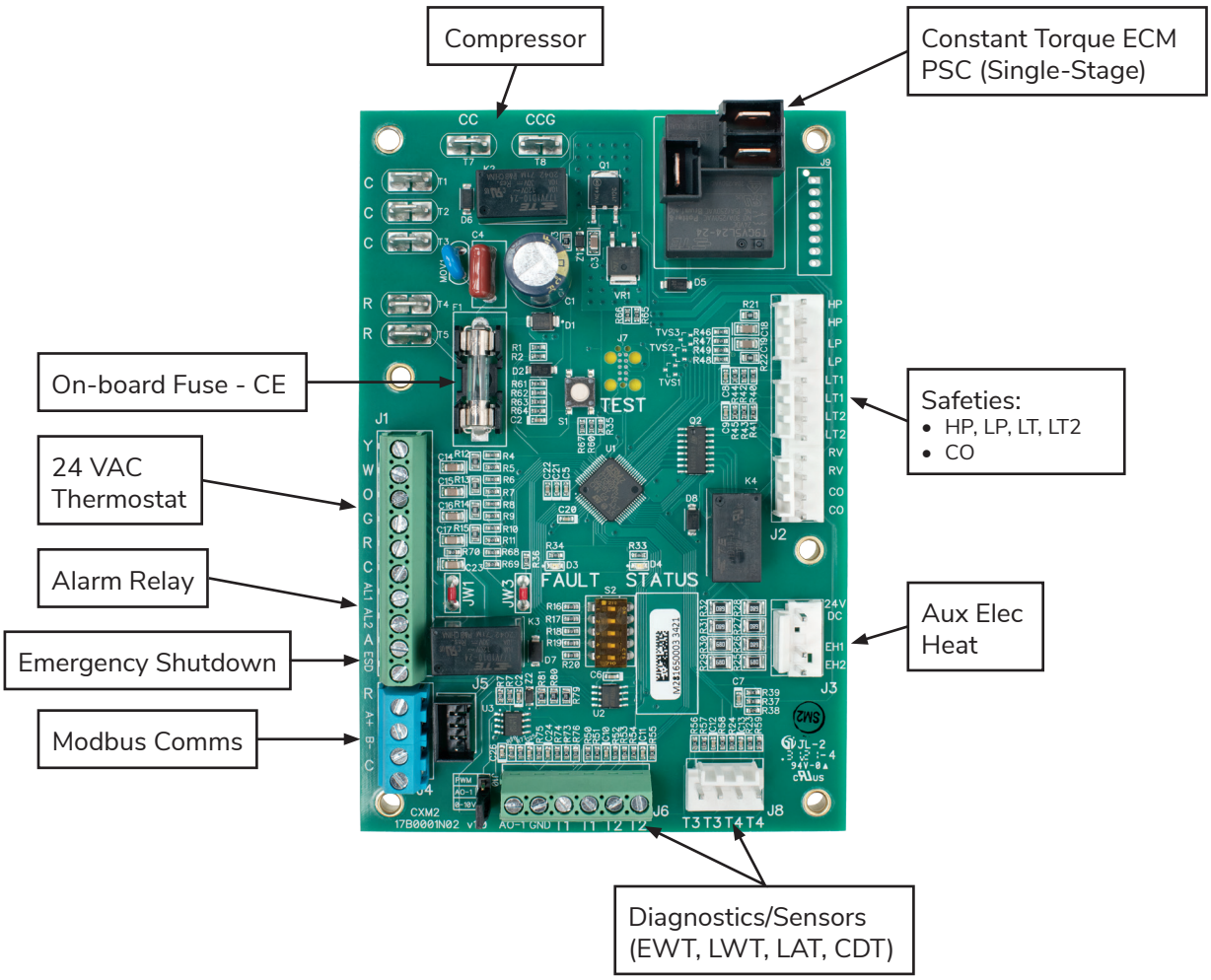
Basic Control Features:
- Single compressor control
- Anti-short cycle protection
- High pressure cut-out
- Low pressure cut-out
- Over and under voltage cut-outs
- Water coil low temperature cut-out
- Air coil low temperature cut-out
- Random start
- Status LED and Fault LED
- Reset lockout at unit or disconnect
- Condensate overflow sensor
- Intelligent fault retry
- Test Mode
- Multiple blower configuration options
- Electric heat outputs
- Unit performance sentinel
- Accessory water valve connection

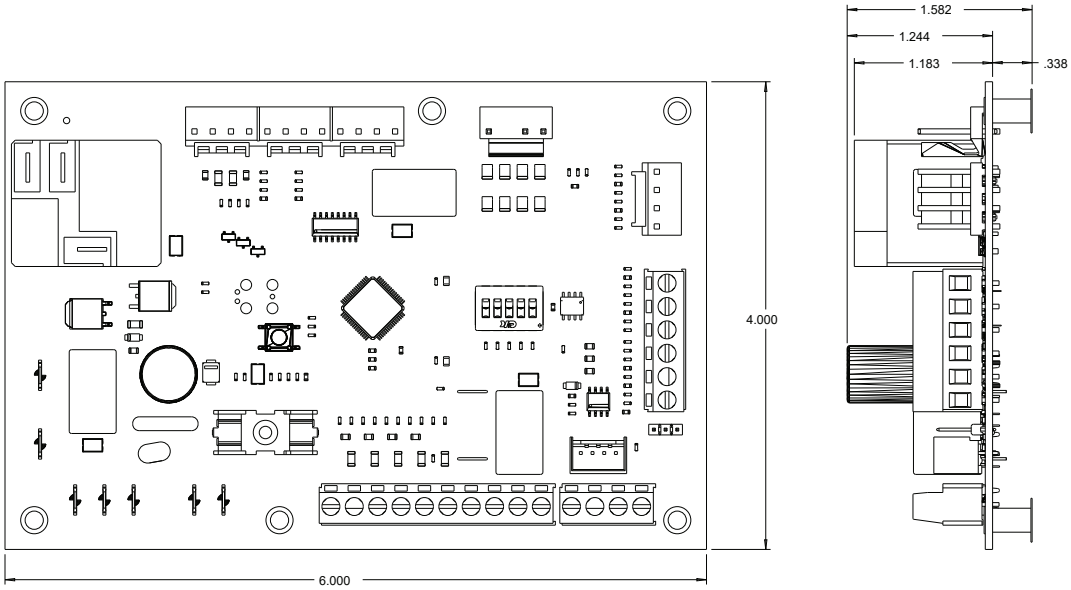
Advanced Control Features:
- Emergency shutdown capability
- Accepts conventional heat pump (Y, O) thermostat types
- RS–485 port to interface with a communicating thermostat or other communicating controls and tools
- Configurable inputs and outputs for advanced functions
- Stores operating conditions history during last 5 faults and offers possible reasons for faults
- Master/Slave thermostat control of up to 3 units

Legend and Glossary of Abbreviations

Abbreviations	Descriptions
BTUH	BTU (British Thermal Unit) per hour
CDT	Compressor discharge temperature
CFM	Airflow, cubic feet per minute
COP	Coefficient of performance = BTUH output/BTUH input
CT ECM	Electronic commutated constant torque fan motor
CV ECM	Electronic commutated constant volume fan motor
DB	Dry bulb temperature, °F
EAT	Entering air temperature
EER	Energy efficient ratio = BTUH output/Watt input
ESP	External static pressure, inches w.g.
EWT	Entering water temperature
FPT	Female pipe thread
GPM	Water flow in U.S., gallons per minute
HC	Air heating capacity, BTUH
HE	Total heat of extraction, BTUH
HR	Total heat of rejection, BTUH
HWC	Hot water generator (desuperheater) capacity, Mbtuh
KW	Total power unit input, kilowatts
LAT	Leaving air temperature, °F
LC	Latent cooling capacity, BTUH
LOC	Loss of charge
LWT	Leaving water temperature, °F
MBTUH	1,000 BTU per hour
MPT	Male pipe thread
MWV	Motorized water valve
PSC	Permanent split capacitor
SC	Sensible cooling capacity, BTUH
S/T	Sensible to total cooling ratio
TC	Total cooling capacity, BTUH
TD or delta T	Temperature differential
VFD	Variable frequency drive
WB	Wet bulb temperature, °F
WPD	Waterside pressure drop, psi or feet of head
WSE	Waterside economizer

Physical Dimensions and Layout





CXM2 Controls

FIELD SELECTABLE INPUTS

Test Mode: Test mode allows the service technician to check the operation of the control in a timely manner. By **momentarily** pressing the TEST push button, the CXM2 control enters a 20 minute test mode period in which all time delays are sped up 15 times. Upon entering test mode, the Status and Fault LED displays will change. The Status LED will flash rapidly to indicate the control is in the test mode. The Fault LED will display the most recent fault condition in memory. **NOTE: A flash code of 1 indicates there have been no faults stored in memory.**

For diagnostic ease at conventional thermostats, the alarm relay will also cycle during test mode. The alarm relay will cycle on and off in sync with Fault LED to indicate a code representing the last fault, at the thermostat.

The test mode can be exited by pressing the TEST push button for 3 seconds. The test mode can also be entered and exited by cycling the G input, 3 times within 60 seconds.

During test mode, the control monitors to see if the LT1 and LT2 thermistors are connected and operating properly. If the control is in test mode, the control will lockout, with Code 9, after 60 seconds if:

a) the compressor is On in Cooling Mode and the LT1 sensor is colder than the LT2 sensor. Or,

b) the compressor is On in Heating Mode and the LT2 sensor is colder than the LT1 sensor.

Retry Mode: If the control is attempting a retry of a fault, the Fault LED will slow flash (slow flash = one flash every 2 seconds) to indicate the control is in the process of retrying.

FIELD CONFIGURATION OPTIONS

NOTE: In the following field configuration options, jumper wires should be clipped ONLY when power is removed from the CXM2 control.

NOTE: Jumper 3 must not be clipped prior to adding antifreeze to the water loop. Antifreeze protection to 10°F required. Clipping JW3 without antifreeze may result in freeze damage and will void the unit warranty.

Water Coil Low Temperature Limit Setting: Jumper 3 (JW3-LT1 Low Temp) provides field selection of temperature limit setting for LT1 of 30°F or 10°F [-1°F or -12°C] (refrigerant temperature).

Not Clipped = 30°F. Clipped = 10°F.

Alarm Relay Setting: Jumper 1 (JW1-AL2 Dry) provides field selection of alarm function when Alarm Relay is energized.

Not Clipped = AL1 connected to R (24VAC) with Alarm Relay active.

Clipped = Dry contact connection between AL1 and AL2 with Alarm Relay active.

DIP SWITCHES

NOTE: In the following field configuration options, DIP switches should only be moved when power is removed from the CXM2 control to ensure proper operation.

DIP Package S2: DIP Package #2 is 5 position and provides the following setup selections.

DIP 2.1 – Unit Performance Sentinel Disable: Provides field selection to disable the UPS feature.

On = Enabled. Off = Disabled.

DIP 2.2 – Compressor Relay Staging Operation: Provides selection of Compressor Relay staging operation. The Compressor Relay can be selected to turn on with Stage 1 or Stage 2 call from the thermostat. This is used with Dual Stage units (2 compressors where 2 CXM2 Controls are being used) or with master/slave applications. In master/slave applications, each compressor and fan will stage according to its appropriate DIP 2.2. If set to stage 2, the compressor will have a 3 second on-delay before energizing during a Stage 2 demand. Also, if set for stage 2, the Alarm Relay will NOT cycle during test mode.

On = Stage 1. Off = Stage 2.

DIP 2.3 – Communications Configuration: Provides selection of the CXM2 operation in a communicating system. The CXM2 may operate as a communicating master or slave device depending on the network configuration. In most configurations, the CXM2 will operate as a leader device.

On = Communicating Master device (default).

Off = Communicating Slave device

DIP 2.4 – DDC Output at EH2: Provides selection for DDC operation. If set to DDC Output at EH2, the EH2 terminal will continuously output the last fault code of the controller. If set to EH2 normal, then the EH2 will operate as standard electric heat output.

On = EH2 Normal. Off = DDC Output at EH2

CXM2 Controls, Cont'd.

Table 1: DIP Switch Settings

DIP Switch	Description	Options	Default
DIP 2.1	Unit Performance Sentinel	Enable, Disable	Enable
DIP 2.2	Compressor Staging	Stage 1, Stage 2	--
DIP 2.3	Modbus Communications	Modbus Master, Modbus Slave	Modbus Master
DIP 2.4	EH2/DDC Operation	EH2 Normal, DDC Output at EH2	--
DIP 2.5	Factory Setting	--	ON

DIP 2.5 – Factory Setting: Normal position is On. Do not change selection unless instructed to do so by the Factory.

SAFETY FEATURES

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

Anti-Short Cycle Protection: The control features a 5 minute anti-short cycle protection for the compressor. The anti-short cycle time begins when a call for the compressor ends.

NOTE: The 5 minute anti-short cycle also occurs at power up.

Random Start: The control features a 5-80 second random start upon power up. The random start delay will be present after a control power up and after returning from Emergency Shutdown mode.

Extended Compressor Operation Monitoring: If the compressor relay has been on for 4 continuous hours, then the control will automatically turn off the compressor relay and wait the anti-short cycle protection time. All appropriate safeties will be monitored during the off time. If all operation is normal, and if the compressor demand is still present, the control will turn the compressor back on.

Fault Retry: In Fault Retry Mode, the Fault LED begins slow flashing to signal that the control is trying to recover from a fault input. The CXM2 Control will stage off the outputs and then "try again" to satisfy the thermostat call for compressor. Once the thermostat input calls are satisfied, the control will continue as if no fault occurred. If 3 consecutive faults occur without satisfying the thermostat call for compressor, then the control will go to Lockout Mode. The last fault causing the lockout will be stored in memory and is displayed at the Fault LED by entering the test mode.

NOTE: LT1 and LT2 faults are factory set for one try, so there will be no "retries" for LT1 and LT2 faults. The control is factory configured to enter lockout mode after first LT1 or LT2 fault.

FAULT CODES

Lockout: In Lockout Mode, the Fault LED will begin flashing fast. The compressor relay is turned off immediately. The fan output will be turned off after the current blower off delay unless auxiliary heat is active. The Lockout Mode can be "soft" reset via the thermostat by removing the call for compressor, or by a "hard" reset (disconnecting power to the control). The fault code will be stored in non-volatile memory that can be displayed by the Fault LED by entering the test mode, even if power was removed from the control.

Fault Code 2 – High Pressure Switch: When the High Pressure switch (HP) opens due to high refrigerant pressures, the compressor relay is de–energized immediately. The High Pressure fault recognition is immediate (does not delay for 30 continuous seconds before de–energizing the compressor). When the test mode is activated, the Fault LED will display a fault code of 2 for a High Pressure fault.

Fault Code 3 – Low Pressure Switch: The Low Pressure Switch (LP) must be open and remain open for 30 continuous seconds during a compressor "on" cycle to be recognized as a Low Pressure fault. If the Low Pressure switch is open for 30 seconds prior to compressor power up it will be considered a Low Pressure fault. The Low Pressure switch input is bypassed for the initial 120 seconds of a compressor run cycle. When the test mode is active, the Fault LED will display a fault code of 3 for a Low Pressure fault.

CXM2 Controls, Cont'd.

Fault Code 4 – Water Coil Low Temperature Cut-Out Limit (LT1): The control will recognize an LT1 fault, during a compressor run cycle if:

a) the LT1 thermistor temperature is below the selected low temperature protection limit setting for at least 50 seconds, AND

b) the LT1 thermistor temperature is rising (getting warmer) at a rate LESS than 2°F every 30 seconds

The LT1 input is bypassed for the initial 120 seconds of a compressor run cycle. When the test mode is active, the Fault LED will display a fault code of 4 for a LT1 fault.

Fault Code 5 – Air Coil Low Temperature Cut-Out (LT2): The control will recognize an LT2 fault, during a compressor run cycle if:

a) the LT2 thermistor temperature is below the low temperature protection limit setting for at least 50 seconds, AND

b) the LT2 thermistor temperature is rising (getting warmer) at a rate LESS than 2°F every 30 seconds

The LT2 input is bypassed for the initial 120 seconds of a compressor run cycle. When the test mode is active, the Fault LED will display a fault code of 5 for a LT2 fault.

Fault Code 6 – Condensate Overflow: The Condensate Overflow sensor must sense overflow levels for 30 continuous seconds to be recognized as a CO fault. Condensate Overflow will be monitored continuously during the compressor run cycle. When the test mode is active, the Fault LED will display a fault code of 6 for a Condensate Overflow fault.

Fault Code 7 – Over/Under Voltage Shutdown: An Over/Under Voltage condition exists when the control voltage is outside the range of 18VAC to 31.5VAC. Over/Under Voltage Shutdown is self-resetting in that if the voltage comes back within range of 18.5VAC to 31VAC for at least 0.5 seconds, then normal operation is restored. This is not considered a fault or lockout. If the CXM2 is in Over/Under Voltage Shutdown for 15 minutes, the Alarm Relay will close. When the test mode is active, the Fault LED will display a fault code of 7 for an Over/Under Voltage Shutdown.

⚠ CAUTION! ⚠

CAUTION! Do not restart units without inspection and remedy of faulting condition. Equipment damage may occur.

Fault Code 8 – Unit Performance Sentinel - UPS: The UPS feature warns when the heat pump is operating inefficiently. A UPS condition exists when:

a) In Heating Mode with compressor energized, if LT2 is greater than 125°F for 30 continuous seconds, Or

b) In Cooling Mode with compressor energized, if LT1 is greater than 125°F for 30 continuous seconds, OR LT2 is less than 40°F for 30 continuous seconds.

If a UPS condition occurs, the control will immediately go to UPS warning. The status LED will remain on as if the control is in Normal Mode. (See "Table 2: LED and Alarm Relay Output".) Outputs of the control, excluding Fault LED and Alarm Relay, will NOT be affected by UPS. The UPS condition cannot occur during a compressor off cycle. During UPS warning, the Alarm Relay will cycle on and off. The cycle rate will be On for 5 seconds, Off for 25 seconds, On for 5 seconds, Off for 25 seconds, etc. When the test mode is active, the Fault LED will display a fault code of 8 for an UPS condition.

Fault Code 9 – Unit Performance Test-UPT/Swapped LT1 & LT2 Thermistors: During test mode, the control monitors to see if the LT1 and LT2 thermistors are connected and operating properly. If the control is in test mode, the control will lockout, with Code 9, after 60 seconds if:

a) the compressor is On in Cooling Mode and the LT1 sensor is colder than the LT2 sensor. Or,

b) the compressor is On in Heating Mode and the LT2 sensor is colder than the LT1 sensor.

When the test mode is active, the Fault LED will display a fault code of 9 for a Swapped Thermistor fault.

Emergency Shutdown – ESD: The ESD Mode can be enabled from an external common signal to terminal ESD. For WSHP rooftop products, ESD Mode is utilized when the ERV (Energy Recovery Ventilator) option is applied to a TRE series rooftop unit to indicate an ERV fault. A contact closure at the ERV unit will connect common to the ESD terminal, which will shut down the rooftop/ERV units. The green Status LED will flash code 3 when the unit is in ESD Mode. (See "Thermostat Inputs" section for details.)

CXM2 Controls, Cont'd.

Diagnostic Features: The green Status LED and red Fault LED on the CXM2 Control advise service personnel of the current status of the CXM2 Control. The LED's will indicate the current operating status of the CXM2, as well as the LAST fault in memory. If there is no fault in memory and the fault display is selected, the Fault LED will flash Code 1. See Table 2 for a complete listing of codes.

UNIT OPERATION DESCRIPTIONS

Power Up: The unit will not operate until all the inputs and safety controls are checked for normal conditions.

NOTE: The compressor will have a 5-minute anti-short cycle delay at power-up.

Standby/Fan Only: In Standby Mode, the compressor will be off. The fan output and RV relay may be on if appropriate inputs are present. If there is demand for constant fan, the fan output will be activated for constant fan airflow.

The RV relay will not directly track the input demands for RV, the CXM2 Control will employ "smart RV" control. This ensures that the RV will only switch positions if the thermostat has called for a Heating/Cooling Mode change.

Compressor Heating: In Compressor Heating Mode, the selected Fan output and the Compressor relay are turned on immediately. If configured as Stage 2 (DIP 2.2 = off), then the Compressor and Fan will not turn on until there is Stage 2 demand. The Compressor relay is turned off immediately when the Compressor Heating demand is removed. The selected Fan output will turn off after the selected heating blower off delay, and the control then reverts to Standby Mode. If there is a Master/Slave configuration or a Dual Compressor configuration, all Compressor relays and related functions will track with their associated DIP 2.2.

Table 2: LED and Alarm Relay Output

CXM2 CONTROLLER FAULT CODES			
CXM2 Fault and Status LED Operation with Test Mode Not Active	**Fault LED (Red)**	**Status LED (Green)**	**Alarm Relay**
CXM2 is non-functional	Off	Off	Open
Normal operation - No active communication	On	On	Open
Normal operation - With active communication	Very Slow Flash	On	Open
Control is currently in fault retry mode	Slow Flash	–	Open
Control is currently locked out	Fast Flash	–	Closed
(ESD) Emergency shutdown condition recognized	–	Flashing Code 3	–
Invalid thermostat input combination	–	Flashing Code 4	–
CXM2 Fault LED and Status Operation with Test Mode Active	**Fault LED (Red)**	**Status LED (Green)**	**Alarm Relay**
No fault since power up in memory	Flashing Code 1	–	Cycling Code 1
High pressure fault in memory	Flashing Code 2	–	Cycling Code 2
Low pressure fault in memory	Flashing Code 3	–	Cycling Code 3
Low temperature protection 1 fault in memory	Flashing Code 4	–	Cycling Code 4
Low temperature protection 2 fault in memory	Flashing Code 5	–	Cycling Code 5
Condensate overflow fault in memory	Flashing Code 6	–	Cycling Code 6
Over / Under voltage shutdown in memory	Flashing Code 7	–	Cycling Code 7
UPS warning in memory	Flashing Code 8	–	Cycling Code 8
UPT fault in memory / swapped LT1 and LT2 thermistors	Flashing Code 9	–	Cycling Code 9

- Fast Flash = 2 flashes every 1 second
- Slow Flash = 1 flash every 2 seconds
- Very Slow Flash = 1 flash every 5 seconds
- Numeric Codes = On pulse 1/3 second; Off pulse 1/3 second followed by a 10 second delay
- Alarm Relay Open = alarm signal off; Alarm Relay Closed = alarm signal on

CXM2 Controls, Cont'd.

Supplemental Heating: In Supplemental Heating Mode, the selected Fan output and Compressor relays will remain on. The EH1 output will turn on immediately. With continuing Supplemental Heating demand, EH2 will turn on after 10 minutes. EH1 and EH2 are turned off immediately when the Supplemental Heating demand is removed, and the control reverts to Compressor Heating Mode. During Supplemental Heating Mode, EH2 will be off (or will turn off if already on) if a) LT1 is greater than 45°F AND b) LT2 is greater than 110°F (LT2 greater than 110°F includes the condition that LT2 is shorted). This condition will have a 30-second recognition time.

Emergency Heat: In Emergency Heat Mode, the selected fan output will be activated and EH1 is turned on immediately. With continuing Emergency Heat demand, EH2 will turn on after 5 minutes. EH1 and EH2 are turned off immediately when the Emergency Heat demand is removed. The selected fan output will turn off after the selected heating blower off delay and the control reverts to Standby Mode.

Cooling: In Cooling Mode, the selected fan output, Compressor, and RV relays are turned on immediately. If configured as Stage 2 (DIP 2.2 = off), then the compressor and fan will not turn on until there is Stage 2 demand. The Compressor relay is turned off immediately when the Cooling demand is removed. The selected Fan output will turn off after the selected cooling blower off delay, and the control then reverts to Standby Mode. The RV relay will remain on until there is a Heating demand. If there is a Master/Slave configuration or a Dual Compressor configuration, all Compressor relays and related functions will track with their associated DIP 2.2.

Blower Configurations: The CXM2 may be configured to operate several different blowers and blower configurations. The configurations include:

a) Single Speed Blower: If the CXM2 is configured for a single speed PSC blower, the K1 relay will operate as the blower relay.

b) No Blower: If the CXM2 is configured for no blower (split system compressor sections), the K1 relay will operate as a loop pump relay.

SPECIAL CXM2 APPLICATION NOTES

ESD: ESD is the input for Emergency Shutdown Mode. When the ESD input is connected to Ground "C", all inputs are ignored and all outputs are turned off. There will be a random start timer when coming back from ESD.

NOTE: For 3-phase applications, the power input for all controls with daisy-chained "ESD" input signals must be in-phase (i.e. control transformers across L1 & L2 with same polarity) for each control to correctly recognize the state of the "ESD" signal. If the power phasing cannot be matched between units sharing the external signal, a shared external signal can be used to control an added relay that connects the "ESD and "C" terminals on each control.

OTHER OUTPUTS

Electric Heat: Outputs EH1 and EH2 turn on whenever the CXM2 Control is in the following modes: Heating Stage 2 and Emergency Heat.

Status LED: The Status LED is green. The Status LED indicates the operating status of the CXM2 Control. See Table 2: "LED and Alarm Relay Operation".

Fault LED: The Fault LED is red. The Fault LED displays the current operating status of the control, or flashes the corresponding code for the last fault that has occurred if the test mode is active. If there is no fault in memory, then the Fault LED will flash Code 1. If the Fault type is "Primary" (HP, LP, LT1, LT2, or CO) then the Fault type will always be retained in memory (Primary faults will overwrite Secondary faults). If the Fault type is "Secondary" (Over/Under Voltage, UPS or Swapped LT1/LT2) then the Fault type will only be retained if there are no "Primary" faults in memory. The Secondary Fault types will not "overwrite" the Primary fault memory. See Table 2: "LED and Alarm Relay Operation".

Communications: The CXM2 has a single RS-485 communications port that provides communication capabilities for communicating thermostats or connecting with other communicating controls.

Pressure Switches: All pressure switches are designed to be normally closed during normal operating conditions, and to open upon fault.

CXM2 Controls, Cont'd.

Condensate Sensor: The Condensate Sensor input will fault upon sensing impedance less than 100,000 Ohms for 30 continuous seconds. The recommended design uses a single wire terminated with a male 1/4" quick connect located in the drain pan at desired trip level. Upon a high condensate level the water will short between the air coil and the quick connect producing a resistance less than 100,000 Ohms. Since condensate is free of impurities, it has no conductivity. Only the impurities from the drain pan and coil dust or dirt create the conductance. A second ground wire with appropriate terminal to the drain pan can be used with the control to replace the air coil ground path. The Condensate Sensor can also essentially be any open contact that closes upon a fault condition.

Thermistor Temperature Sensors: The thermistors used with the CXM2 are NTC (negative temperature coefficient) type. The sensors have a 1% tolerance and follow the characteristics shown in Table 4. Table 5 shows the nominal resistance at any given temperature and can be used for field service reference. The sensor will use a minimum of 24 AWG wire.

Table 3: Thermostat Inputs with Resulting Demands

Thermostat Operating Modes								
Mode	Input				Output			
	O	G	Y	W	RV	Fan	H/C	AUX
No Demand	ON/OFF	OFF	OFF	OFF	ON/OFF	OFF	OFF	OFF
Fan Only	ON/OFF	ON	OFF	OFF	ON/OFF	ON	OFF	OFF
Cooling	ON	ON	ON	OFF	ON	ON	ON	OFF
Heating	OFF	ON	ON	OFF	OFF	ON	ON	OFF
Heating 2nd Stage	OFF	ON	ON	ON	OFF	ON	ON	ON
Emergency Heat	OFF	ON	OFF	ON	OFF	ON	OFF	ON

[1] ON/OFF = Either ON or OFF; H/C = Either Heating or Cooling.

CXM2 Controls, Cont'd.

Table 4: 1% Sensor Calibration Points

Temp (°F)	Minimum Resistance (Ohm)	Maximum Resistance (Ohm)	Nominal Resistance (Ohm)
78.5	9523	9715	9619
77.5	9650	9843	9746
76.5	10035	10236	10135
75.5	10282	10489	10385
33.5	30975	31598	31285
32.5	31871	32512	32190
31.5	32653	33310	32980
30.5	33728	34406	34065
1.5	80624	82244	81430
0.5	83327	85002	84160
0.0	84564	86264	85410

Table 5: Nominal Resistance at Various Temperatures

Temp (ºC)	Temp (ºF)	Resistance (kOhm)
-17.8	0.0	85.34
-17.5	0.5	84.00
-16.9	1.5	81.38
-12	10.4	61.70
-11	12.2	58.40
-10	14.0	55.30
-9	15.8	52.38
-8	17.6	49.64
-7	19.4	47.05
-6	21.2	44.61
-5	23.0	42.32
-4	24.8	40.15
-3	26.6	38.11
-2	28.4	36.18
-1	30.2	34.37
0	32.0	32.65
1	33.8	31.03
2	35.6	29.50
3	37.4	28.05
4	39.2	26.69
5	41.0	25.39
6	42.8	24.17
7	44.6	23.02
8	46.4	21.92
9	48.2	20.88
10	50.0	19.90
11	51.8	18.97
12	53.6	18.09
13	55.4	17.26
14	57.2	16.46
15	59.0	15.71
16	60.8	15.00
17	62.6	14.32
18	64.4	13.68
19	66.2	13.07
20	68.0	12.49
21	69.8	11.94
22	71.6	11.42
23	73.4	10.92
24	75.2	10.45
25	77.0	10.00
26	78.8	9.57
27	80.6	9.16
28	82.4	8.78
29	84.2	8.41
30	86.0	8.06
31	87.8	7.72
32	89.6	7.40
33	91.4	7.10
34	93.2	6.81
35	95.0	6.53
36	96.8	6.27
37	98.6	6.01
38	100.4	5.77
39	102.2	5.54
40	104.0	5.33
41	105.8	5.12
42	107.6	4.92
43	109.4	4.72
44	111.2	4.54
45	113.0	4.37
46	114.8	4.20
47	116.6	4.04
48	118.4	3.89
49	120.2	3.74
50	122.0	3.60
51	123.8	3.47
52	125.6	3.34
53	127.4	3.22
54	129.2	3.10
55	131.0	2.99
56	132.8	2.88
57	134.6	2.77
58	136.4	2.67
59	138.2	2.58
60	140.0	2.49
61	141.8	2.40
62	143.6	2.32
63	145.4	2.23
64	147.2	2.16
65	149.0	2.08
66	150.8	2.01
67	152.6	1.94
68	154.4	1.88
69	156.2	1.81
70	158.0	1.75
71	159.8	1.69
72	161.6	1.64
73	163.4	1.58
74	165.2	1.53
75	167.0	1.48
76	168.8	1.43
77	170.6	1.39
78	172.4	1.34
79	174.2	1.30
80	176.0	1.26
81	177.8	1.22
82	179.6	1.18
83	181.4	1.14
84	183.2	1.10
85	185.0	1.07
86	186.8	1.04
87	188.6	1.01
88	190.4	0.97
89	192.2	0.94
90	194.0	0.92
91	195.8	0.89
92	197.6	0.86
93	199.4	0.84
94	201.2	0.81
95	203.0	0.79
96	204.8	0.76
97	206.6	0.74
98	208.4	0.72
99	210.2	0.70
100	212.0	0.68
101	213.8	0.66
102	215.6	0.64
103	217.4	0.62
104	219.2	0.60
105	221.0	0.59
106	222.8	0.57
107	224.6	0.55
108	226.4	0.54
109	228.2	0.52
110	230.0	0.51
111	231.8	0.50
112	233.6	0.48
113	235.4	0.47
114	237.2	0.46
115	239.0	0.44
116	240.8	0.43
117	242.6	0.42
118	244.4	0.41
119	246.2	0.40
120	248.0	0.39
121	249.8	0.38
122	251.6	0.37
123	253.4	0.36

Basic Troubleshooting Information/ Service & Application Notes

General Troubleshooting: Basic CXM2 Control troubleshooting in general is best summarized as simply verifying inputs and outputs. After this process has been verified, confidence in board operation is confirmed and the trouble must be elsewhere. Below are some general guidelines required for developing training materials and procedures when applying the CXM2 Control.

CXM2 Field Inputs: All conventional inputs are 24VAC from the thermostat and can be verified using a voltmeter between C and Y, W, O, and G.

Sensor Inputs: All sensor inputs are 'paired wires' connecting each component with the board; therefore, continuity on pressure switches can be checked at the board connector.

The thermistor resistance should be measured with the connector removed so that only the impedance of the thermistor is measured. If desired, this reading can be compared to the chart shown in the thermistor section of this manual based upon the actual temperature of the thermistor clip (See Tables 4 and 5 for thermistor temperature and resistance values). An ice bath can be used to check calibration of a thermistor if needed.

CXM2 Outputs: The compressor relay is 24VAC and can be verified using a voltmeter. The Alarm Relay can either be 24VAC as shipped or dry contacts (measure continuity during fault) for use with DDC by clipping the JW1 jumper. Electric heat outputs are 24VDC and require a voltmeter set for VDC to verify operation. When troubleshooting, measure from 24VDC terminal to EH1 or EH2 terminals.

Test Mode: Test mode can be entered for 20 minutes by pressing the Test button. For Diagnostic ease at a conventional thermostat, the Alarm Relay will also cycle during test mode. The Alarm Relay will cycle on and off in sync with the Fault LED to indicate a code representing the last fault, at the thermostat. Test mode can also be entered and exited by cycling the G input, 3 times within 60 seconds.

CXM2 THERMOSTAT DETAILS

Anticipation Leakage Current: Maximum leakage current for "Y" is 50mA and for "W" is 20mA. Triacs can be used if leakage current is less than above. Thermostats with anticipators can be used if anticipation current is less than that specified above.

Thermostat Signals:

- "Y", "W", "O", and "G" have a 1 second recognition time when being activated or being removed.
- "R" and "C" are from the transformer.
- "AL1" and "AL2" originate from the Alarm Relay.
- "A" is paralleled with the compressor output for use with motorized water valves.

Safety Listing: The CXM2 Control is listed under UL 60730, and is CE listed under IEC 60730.

Configuration and Advanced Troubleshooting Information

GENERAL

To properly configure and troubleshoot advanced control features, and to aid in troubleshooting basic control features, a communicating thermostat or diagnostic tool with similar capabilities should be used.

SYSTEM CONFIGURATION

All factory installed CXM2 controls have their basic configuration parameters set as part of the factory manufacturing and test process. The System Configuration option provides the installer with the ability to set control options, setup the loop configuration and parameters, and configure field replacement controls.

NOTE: A communicating thermostat or a Configuration/ Diagnostic tool is required to configure systems. For CXM2 applications and CXM replacements, configuring the product series, size, and options is not required for functionality. The system will function without being configured from a communicating device.

Heating / Cooling Off Delays: The heating and cooling mode blower off delay times may be independently adjusted by the user. Each delay time may be set between 0 and 255 seconds.

Option Selection: The Option Selection menu allows the installer to set selected control options.

LT2 Setpoint: The LT2 setpoint should be set to ANTI-FREEZE ONLY when the unit is configured as a water-to-water unit with anti–freeze in the load side loop. For ALL other unit configurations, the LT2 setpoint should be set to WATER.

Motorized Valve: The Motorized Valve option should be set to ON when a motorized water valve with end switch wired to the CXM2 Y is used with a communicating thermostat. For all other system configurations, the Motorized Valve option should be set to OFF.

Unit Configuration: Selections under the Unit Configuration menu are set at the factory as a normal part of the manufacturing and test process. This menu allows the configuration to be modified for special applications, or to configure field replacement controls. The Unit Configuration menu provides the ability to select the Heat Pump Family, Unit Size, Blower Type, and Loop Type. Making these selection configurations is not required. This is an optional step only.

Heat Pump Family: When replacing a control in the field, the Heat Pump Family can be selected. The valid unit family values are available for the user to scroll through to select the proper value. This step is not required.

Heat Pump Size: When replacing a control in the field, the Heat Pump Size can be selected. The valid Heat Pump Size values will be available for the user to scroll through to select the proper value. This step is not required.

Blower Type: When replacing a control in the field, the Blower Type can be selected. The valid Blower Type values will be available for the user to scroll through to select the appropriate value for No Blower or Single Speed configurations. This step is not required.

Configuration and Advanced Troubleshooting Information, Cont'd.

SERVICE MODE

The Service Mode provides the installer with several functions for troubleshooting, including Manual Operation, Control Diagnostics, Control Configuration, and Fault History.

Manual Operation: The Manual Operation mode allows the installer to bypass normal thermostat timings and operating modes, to directly activate the thermostat inputs to the CXM2, activate the CXM2 Test mode, and directly control the internal flow center and proportional valve.

Control Diagnostics: The Control Diagnostics menus allow the installer to see the current status of all CXM2 control switch inputs, values of all temperature sensor inputs, control voltage, internal flow center, and proportional valve operating status and parameters.

DIP Switch Configuration: The DIP Switch Configuration menu allows the installer to easily see the current CXM2 control configuration.

Fault History: In addition to the fault code, the CXM2 stores the status of all control inputs and outputs when a fault condition is detected. The fault history covering the last five lockout conditions is stored and may be retrieved from the CXM2. After a specific fault in the fault history is selected, the operating mode and time when the fault occurred are displayed, with options to select specific control status values when the lockout occurred.

Fault Temp Conditions: This option displays the CXM2 temperature and voltage values when the lockout occurred.

Fault I/O Conditions: This option displays the status of the CXM2 physical and communicated inputs and the relay outputs when the lockout occurred.

Fault Configuration Conditions: This option displays the status of the CXM2 option selections when the lockout occurred.

Fault Possible Causes: This option displays a list of potential causes of the stored fault.

Clear Fault History: The Clear Fault History option allows the fault history stored in the non-volatile memory of the CXM2 to be cleared.

CXM2 Master/Slave Addressing

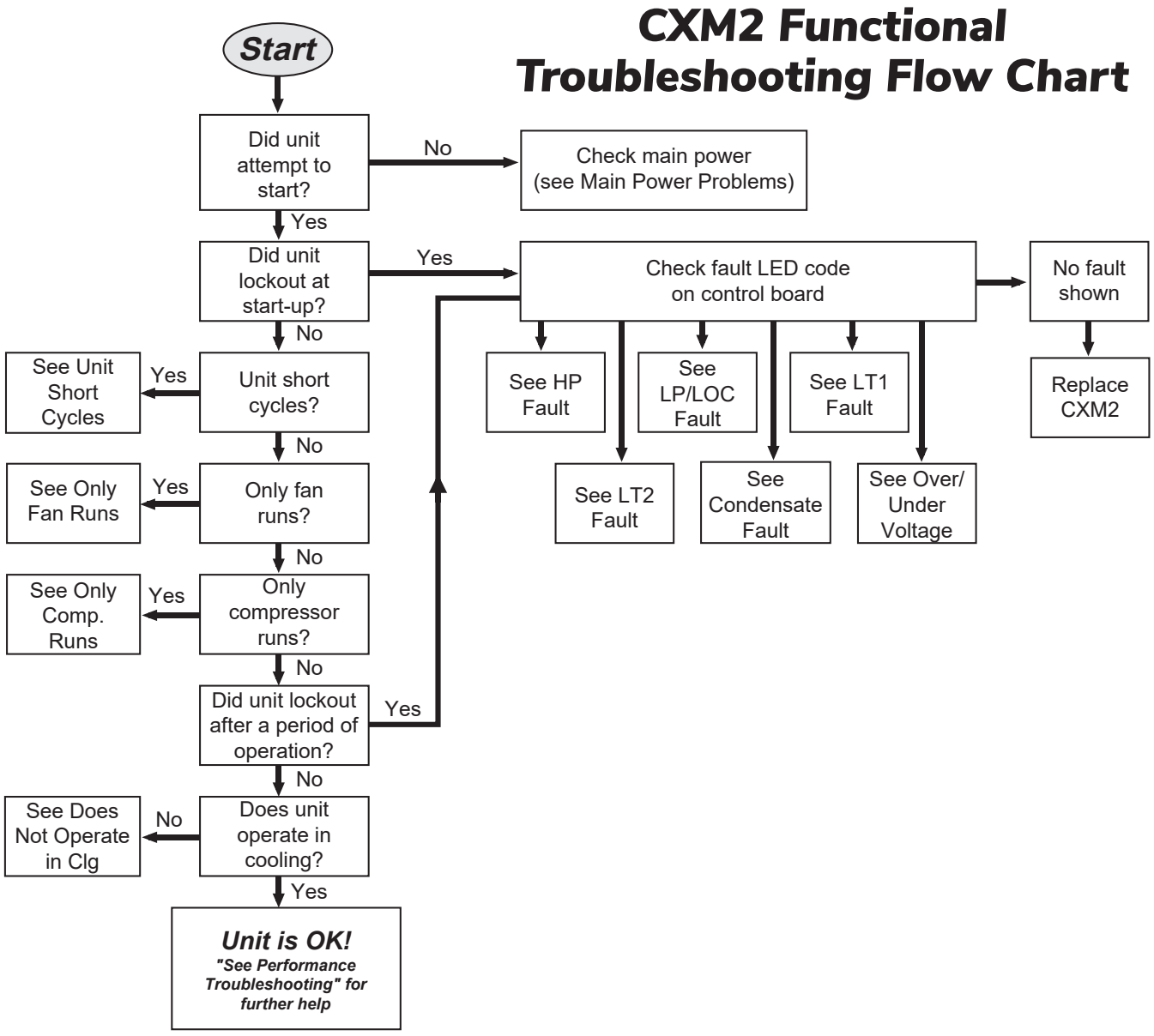
Multiple CXM2 controls may be controlled from a single communicating thermostat; up to 3 controls may be controlled from the same communicating thermostat.

When configuring multiple units for control by the same thermostat, before applying power:

1. Connect the thermostat to each CXM2 control normally, using the A+ & B- connections (daisy chain wiring so all CXM2 controls share the communication port).
2. Next, insure that DIP switch S2-3 is in the ON position for only the master CXM2, and S2-3 is in the OFF position for all slave CXM2 controls.
3. Apply power to the master unit and one (1) of the unaddressed slave units that is to be controlled by the same thermostat.
4. After applying unit power, press and hold the TEST button on the CXM2 control of the slave unit. After several seconds, the Fault and Status LEDs will begin to flash, and the TEST button may be released. When both LEDs are flashing rapidly, the slave has been assigned an address and will be controlled by the same thermostat demand messages as the master CXM2 control.
5. Repeat steps 3 and 4 for each additional unit to be added to the system (the master CXM2 unit and addressed slaves should remain powered).

Functional Troubleshooting Flow Chart

Use the following troubleshooting flow chart and tables on the following pages to find the appropriate troubleshooting strategies for the CXM2 control and most water source heat pump applications.



Functional Troubleshooting

⚠ CAUTION! ⚠

CAUTION! Do not restart units without inspection and remedy of faulting condition. Equipment damage may occur.

Fault	Htg	Clg	Possible Cause	Solution
Main Power Problems	X	X	Green Status LED Off	Check line voltage circuit breaker and disconnect.
				Check for correct line voltage between L1 and L2 on the contactor.
				Check for 24VAC between R and C on CXM2.
				Check primary/secondary voltage on transformer.
				Check the fuse continuity (remove from circuit and measure resistance).
HP Fault – Code 2 High Pressure		X	Reduced or no water flow in cooling	Check voltage to pump or valve, pump operation or valve operation/setting.
				Check water flow adjust to proper flow rate.
		X	Water temperature out of range in cooling	Bring water temp within design parameters.
	X		Reduced or no air flow in heating	Check for dirty air filter and clean or replace.
				Check fan motor operation and/or airflow restrictions.
				Check air coil for dirt/debris buildup. Clean if needed.
				Check external static pressure. Check static vs. blower table.
	X		Air temperature out of range in heating	Bring return air temp within design parameters.
	X	X	Overcharged with refrigerant	Check superheat/subcooling vs. typical operating condition table.
	X	X	Bad HP Switch	Check switch continuity and operation. Replace as needed.
	X		Frozen water heat exchanger	Thaw heat exchanger.
	X	X	Bad HPWS Switch	Check switch continuity and operation. Replace if needed.
LP/LOC Fault – Code 3 Low Pressure / Loss of Charge	X	X	Insufficient charge	Check for refrigerant leaks.
	X		Compressor pump down at start-up	Check refrigerant charge and start-up water flow.
LT1 Fault – Code 4 Water Low Temperature	X		Reduced or no water flow in heating	Check voltage to pump or valve, pump operation or water valve operation/setting.
				Check for plugged strainer or filter. Clean or replace.
				Check water flow. Adjust to proper flow rate.
	X		Inadequate antifreeze level	Check antifreeze density with hydrometer.
	X		Improper low temperature setting (30°F vs. 10°F)	Clip JW3 jumper for antifreeze (10°F) use.
	X		Water temperature out of range	Bring water temp within design parameters.
	X	X	Bad thermistor	Check temp and impedance correlation per chart. Replace if needed.
LT2 Fault – Code 5 Low Air Temperature		X	Reduced or no airflow in cooling	Check for dirty air filter and clean or replace.
				Check fan motor operation and airflow restrictions.
				Check external static pressure. Check static vs. blower table.
		X	Air temperature out of range	Check vent air temperature. Bring entering air temp within design parameters.
		X	Improper low temperature setting (30°F vs. 10°F)	Normal airside applications will require 30°F only.
	X	X	Bad thermistor	Check temp and impedance correlation per chart. Replace if needed.

Table continued on next page.

Functional Troubleshooting, Cont'd.

Table continued from previous page.

Fault	Htg	Clg	Possible Cause	Solution
Condensate Fault – Code 6 High Condensate Level	X	X	Blocked drain	Check for blockage and clean drain.
	X	X	Improper trap	Check trap dimensions and location ahead of vent.
		X	Poor drainage	Check for piping slope away from unit.
				Check slope of unit toward drain pan outlet.
				Check for proper size and location of vent drain. Check vent location.
		X	Moisture on sensor	Check for moisture shorting to air coil.
	X	X	Dirty air filter	Check for dirty air filter and clean or replace.
	X	X	Restricted return air flow	Find and eliminate restriction. Increase return duct and/or grille size.
Over/Under Voltage – Code 7 (Auto Resetting)	X	X	Under Voltage	Check line voltage and 24VAC voltage before and during operation.
				Check line voltage wire size.
				Check 24VAC to insure the correct line voltage transformer tap is used.
	X	X	Over Voltage	Check line voltage and 24VAC before and during operation.
				Check 24VAC to insure the correct line voltage transformer tap is used.
Unit Performance Sentinel – Code 8	X		Heating mode LT2>125°F	Check for poor airflow or overcharged unit.
		X	Cooling Mode LT1>125°F OR LT2< 40ºF	Check for poor water flow or air flow.
Unit Performance Test / Swapped Thermistor – Code 9	X	X	LT1 and LT2 swapped	Reverse position of thermistors.
Low Air Coil Pressure Fault (Dedicated Dehumidification Mode) – Code 11		X	Reduced or no airflow in Cooling or Dedicated Dehumidification Mode	Check for dirty air filter and clean or replace.
				Check fan motor operation and airflow restrictions.
				Check external static pressure. Check static vs. blower table.
		X	Air temperature out of range	Check vent air temperature. Bring entering air temp within design parameters.
		X	Bad pressure switch	Check switch continuity and operation. Replace if needed.
Low Air Coil Temperature Fault (Dedicated Dehumidification Mode) – Code 12		X	Reduced airflow in cooling, Dedicated Dehumidification Mode, or Constant Fan Mode	Check for dirty air filter and clean or replace.
				Check fan motor operation and airflow restrictions.
				Check external static pressure. Check static vs. blower table.
		X	Air temperature out of range	Check vent air temperature. Bring entering air temp within design parameters.
		X	Bad thermistor	Check temp and impedance correlation per chart. Replace if needed.
IFC Fault – Code 13 Internal Flow Controller Fault	X	X	No pump output signal	Check DC voltage between A01 and GND. Should be between 0.5 and 10 VDC with pump active.
	X	X	Low pump voltage	Check line voltage to the pump.
	X	X	No pump feedback signal	Check DC voltage between T1 and GND. Voltage should be between 3 and 4 VDC with pump OFF and between 0 and 2 VDC with the pump ON.
	X	X	Bad pump RPM sensor	Replace pump if the line voltage and control signals are present at the pump and the pump does not operate.
TRL Products Only Fault – Code 13 Low Flow Protection	X	X	Reduced or no water flow	Check voltage to pump or valve, pump operation or valve operation/setting.
				Check water flow. Adjust to proper flow rate.
No Fault Code Shown	X	X	No compressor operation	See Fan Only Runs.
	X	X	Compressor overload	Check for overheated compressor and open windings. Replace if necessary.
	X	X	Control board	Reset power and check operation.
Unit Short Cycles	X	X	Dirty air filter	Check for dirty air filter and clean or replace.
	X	X	Unit in Test Mode	Reset power or wait 20 minutes for auto exit.
	X	X	Unit selection oversized	Recheck loads and sizing, Check load calculations and heat pump capacity.
	X	X	Compressor overload	Check for overheated compressor and open windings. Replace as needed.
Only Fan Runs	X	X	Thermostat position	Ensure thermostat set for heating or cooling operation.
	X	X	Unit locked out	Check for lockout codes. Reset power.
	X	X	Compressor overload	Check for overheated compressor and open windings. Replace as needed.
	X	X	Thermostat wiring	Check thermostat wiring at CXM2. Put in Test Mode and jumper Y and R to give call for compressor.

Performance Troubleshooting, Cont'd.

Table continued from previous page.

Symptom	Htg	Clg	Possible Cause	Solution
Only Compressor Runs	X	X	Thermostat wiring	Check thermostat wiring at CXM2.
				Check thermostat wiring at or CXM2. Put in Test Mode and then jumper Y1 and W1 to R to give call for fan, compressor, and electric heat.
	X	X	Fan motor relay	Jumper G and R for fan operation. Check for line voltage across blower relay contacts.
				Check fan power. Enable relay operation (if present).
	X	X	Fan motor	Check line voltage at motor. Check capacitor.
Unit Doesn't Operate in Cooling		X	Reversing valve	Set for cooling demand and check 24VAC on RV coil.
				If RV is stuck, run high pressure up by reducing water flow and, while operating, engage and disengage RV coil voltage to push valve.
		X	Thermostat setup	For CXM2, check for "O" RV setup, not "B".
		X	Thermostat wiring	Check thermostat wiring at CXM2. CXM2 requires a call for the compressor before RV solenoid will energize.
Modulating Valve Troubleshooting	X	X	Improper output setting	Verify the AO-2 jumper is in the 0-10V position.
	X	X	No valve output signal	Check DC voltage between AO2 and GND. Should be 0vdc when valve is off and between 3.3vdc and 10vdc when valve is on.
	X	X	No valve operation	Check voltage to the valve.
				Replace valve if voltage and control signals are present at the valve and it does not operate.

Revision History

Date	Page #	Description
10/18/22	All	First Published

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