

ALLIED AIR ENTERPRISES

SERVICE MANUAL

4SCU20LX 4SHP20LX

August 2015

IMPORTANT:

Before applying any power (main or low voltage) to the outdoor unit, confirm the Comfort Sync™ thermostat has software Version 2.13 or higher installed. (Reference the Comfort Sync™ thermostat manual.)

This unit is an integral component of a communicating system that requires a Comfort Sync™ thermostat and communicating air handler or furnace.

⚠ WARNING

Improper installation, adjustment, alteration, service or maintenance can cause personal injury, loss of life, or damage to property. Installation and service must be performed by a licensed professional installer (or equivalent) or a service agency.

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⚠ IMPORTANT

The Clean Air Act of 1990 bans the intentional venting of refrigerant (CFCs, HCFCs AND HFCs) as of July 1, 1992. Approved methods of recovery, recycling or reclaiming must be followed. Fines and/or incarceration may be levied for noncompliance.

I. GENERAL

- Refer to the specification sheet for information regarding electrical ratings, sound ratings, performance ratings, unit dimensions and other technical data.
- See Installation Instructions for unit installation and charging procedures.
- See long line set guidelines for lines exceeding 50 ft. (including risers) and maximum risers of 20 ft.

- Refer to Comfort Sync™ thermostat manual for operation and programming of thermostat.
- Refer to indoor air handler/coil or furnace equipment installation instructions for installation information.
- These instructions are intended as a general guide and do not supersede local codes in any way. Consult authorities who have jurisdiction before installation. The 20LX units are high-efficiency residential split-systems which feature a variable-capacity scroll compressor and use HFC-410A refrigerant. Units are available in 2, 3, 4 and 5-ton sizes. These units are designed for use only with an expansion valve (approved for use with HFC-410A) in the indoor unit.

⚠ WARNING

Electric Shock Hazard. Can cause injury or death. Unit must be grounded in accordance with national and local codes.

Line voltage is present at all components when unit is not in operation on units with single-pole contactors. Disconnect all remote electric power supplies before opening access panel. Unit may have multiple power supplies.

⚠ WARNING



Electrical Hazard
High Voltage
Wait 5 Minutes

Electrical components may hold charge. Do not remove this panel or service this area for 5 minutes after the power has been removed.

Electrical

⚠ IMPORTANT

Connect line voltage power supply wiring to the outdoor unit before connecting low voltage wiring from the main outdoor unit control to the thermostat. Failure to follow this may result in a communication error.

Wiring must conform with current local codes and the current National Electric Code (NEC). In Canada, wiring must conform with current local codes and the current Canadian Electrical Code (CEC).

24VAC TRANSFORMER

Use the transformer provided with the furnace or air handler for low-voltage control power (24VAC - 40 VA minimum).

Load Shedding

Utility Load Shedding Mode ACTIVATED

(Utility Cycled Unit OFF) – The normally closed set of contacts in the utility load shedding control receiver **OPEN**. This removes 24VAC from the coil of the field-provided relay (catalog # 69J79). The relay contacts close (terminal **7** to terminal **2**), completing the circuit between terminals **R** and **L** on the outdoor control. The 24VAC input to terminal **L** activates the load shedding mode in the outdoor control, cycling the outdoor unit **OFF**. The 7-Segment display on the outdoor control displays a load shedding alert code (**E600**) and an alert appears on the display of the Comfort Sync™ thermostat. The customer receives email notifica-

tions when the alert occurs, if the option to receive notifications is selected.

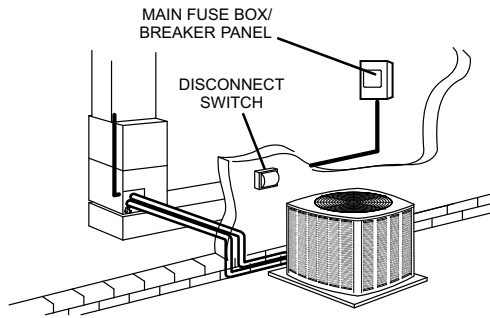
Utility Load Shedding Mode DEACTIVATED

(Normal Equipment Operation) – When load shedding is not required, the contacts in the utility load control receiver are closed. This provides 24VAC to the coil of the field-provided relay (catalog # 69J79). The relay contacts **OPEN** (terminal **7** to terminal **2**) removing 24VAC from the **L** terminal on the outdoor control. This deactivates the load shedding mode in the outdoor control. The outdoor unit returns to normal operation and alert code clears once load shedding mode is deactivated.

For more information, see the Load Shedding Feature on page 22.

1 SIZE CIRCUIT AND INSTALL DISCONNECT SWITCH

REFER TO THE UNIT NAMEPLATE FOR MINIMUM CIRCUIT AMPACITY, AND MAXIMUM FUSE OR CIRCUIT BREAKER (HACR PER NEC). INSTALL POWER WIRING AND PROPERLY SIZED DISCONNECT SWITCH.

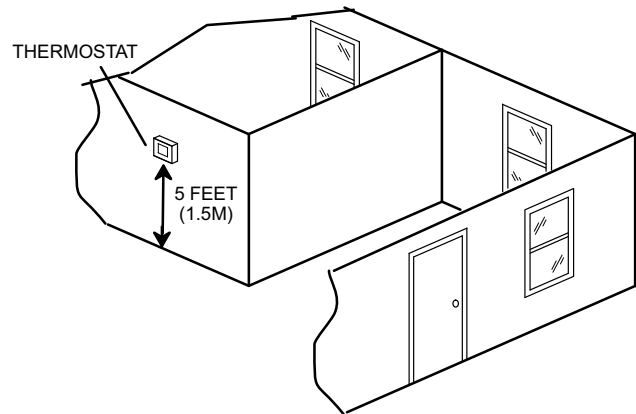


NOTE - UNITS ARE APPROVED FOR USE ONLY WITH COPPER CONDUCTORS. GROUND UNIT AT DISCONNECT SWITCH OR TO AN EARTH GROUND.

Figure 1. Electrical Installation

2 INSTALL THERMOSTAT

INSTALL ROOM THERMOSTAT (ORDERED SEPARATELY) ON AN INSIDE WALL, APPROXIMATELY IN THE CENTER OF THE CONDITIONED AREA AND 5 FEET (1.5M) FROM THE FLOOR. IT SHOULD NOT BE INSTALLED ON AN OUTSIDE WALL OR WHERE IT CAN BE AFFECTED BY SUNLIGHT OR DRAFTS.



NOTE - 24VAC, CLASS II CIRCUIT CONNECTIONS ARE MADE IN THE CONTROL BOX.

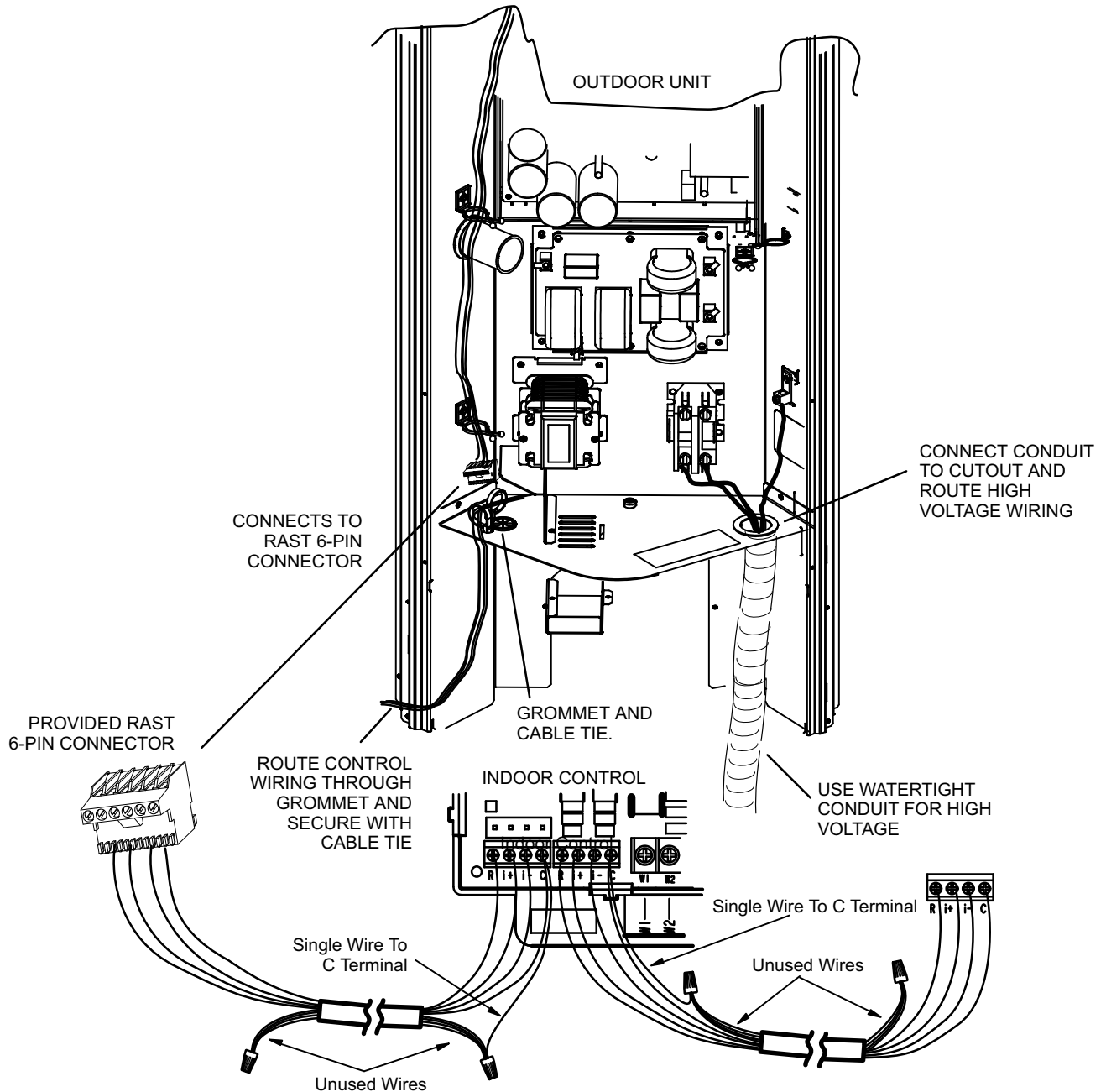
Figure 2. Thermostat Location

3 ROUTE CONTROL WIRES

Maximum length of wiring (18 gauge) for all connections on the RSBus is 1500 feet (457 meters). Wires should be color-coded, with a temperature rating of 95°F (35°C) minimum, and solid-core (Class II Rated Wiring). All low voltage wiring must enter unit through field-provided field-installed grommet installed in electrical inlet.

The Comfort Sync™ thermostat requires four thermostat wires between the thermostat and the furnace / air handler control and four wires between the outdoor unit and the furnace/air handler control. When a thermostat cable with more than four wires is used, the extra wires must be properly connected to avoid electrical noise (see below).

Use a wire nut to bundle the four unused wires at each end of the cable. Each bundle should also include an additional wire that should be connected on each end to the C terminal as shown in the figure below.



4 ROUTE HIGH VOLTAGE AND GROUND WIRES

Any excess high voltage field wiring should be trimmed and secured away from any low voltage field wiring. To facilitate a conduit, a cutout is located on the bottom of the control box. Connect conduit to the control box using a proper conduit fitting.

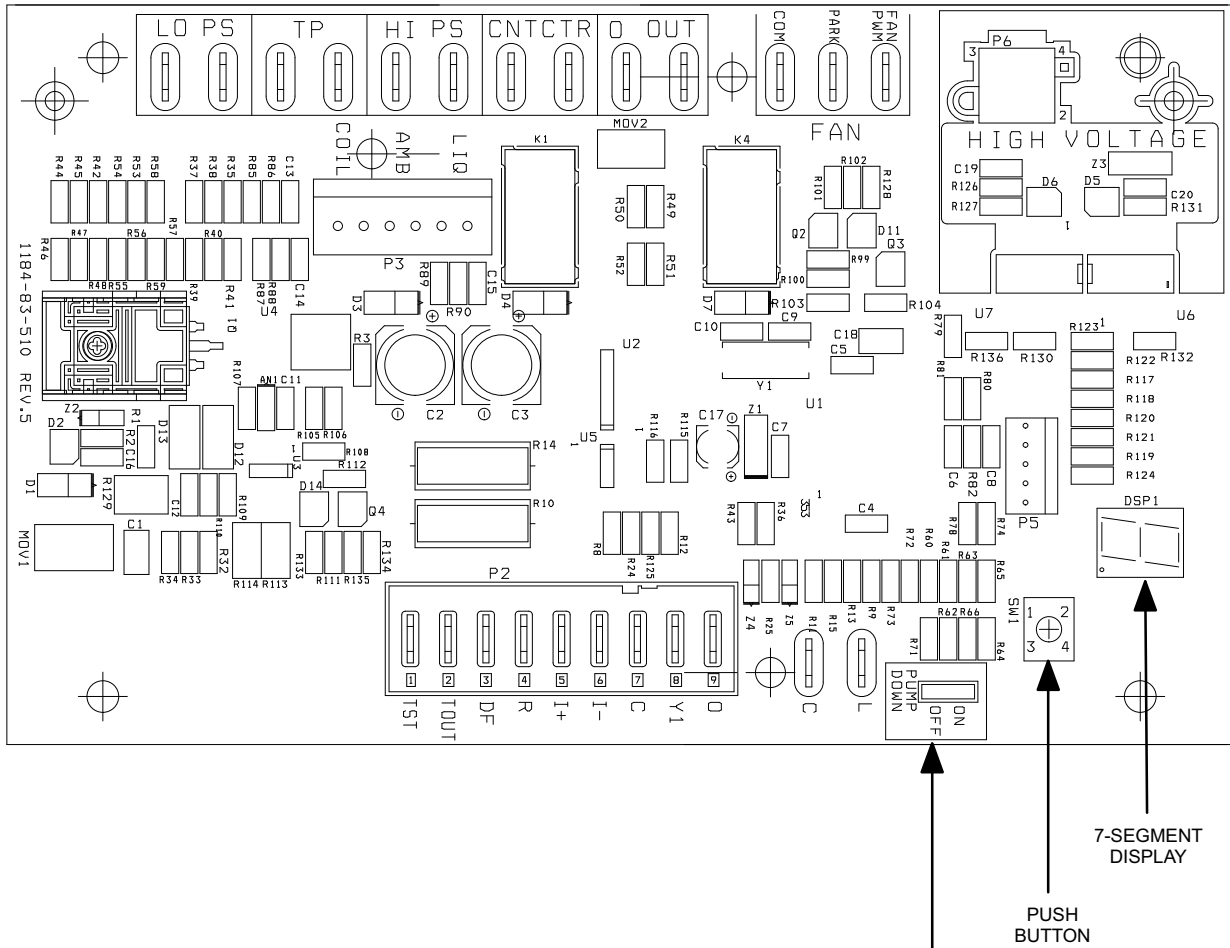
Figure 3. Electrical Installation (Continued)

⚠ CAUTION

ELECTROSTATIC DISCHARGE (ESD) Precautions and Procedures

Electrostatic discharge can affect electronic components. Take precautions during unit installation and service to protect the unit's electronic controls. Precautions will help to avoid control exposure to electrostatic discharge by putting the unit, the control and the technician at the same electrostatic potential. Neutralize electrostatic charge by touching hand and all tools on an unpainted unit surface before performing any service procedure.

STEP 3 -- ELECTRICAL (Continued) -- Outdoor Control Unit



NOTE - The green LED located on the outdoor control flashes when communication occurs between the outdoor control and either the thermostat or the inverter.

PUMP DOWN - WHEN THE UNIT IS IN PUMP DOWN MODE, Pd IS SHOWN ON THE 7-SEGMENT DISPLAY.

TO ACTIVATE PUMP DOWN MODE, REFER TO PUMP DOWN CYCLE SEQUENCE ON PAGE 16.

Figure 4. Outdoor Control Unit

TABLE 1

Outdoor Control Terminal Designations and Input /Outputs (see figure 4 for terminal locations)

Designator	Description	Input	Output	Common
O	For heat pump applications only.	N/A	Switched 24VAC nominal	N/A
O OUT	For heat pump applications only.	N/A	N/A	24VAC common
LO PS	Low pressure switch	N/A	5ma @18VAC	N/A
LO PS	Low pressure switch sensing connection	5ma @18VAC	N/A	N/A
Hi PS	High pressure switch	N/A	24VAC nominal	N/A
Hi PS	High pressure switch sensing connection	24VAC nominal	N/A	N/A
TP	Top cap thermostat switch (in series with the HI PS)	N/A	24VAC nominal	N/A
TP	Top cap thermostat switch sensing connection	24VAC nominal	N/A	N/A
Cntctr	Control (inverter power) contactor switched output (in series with the HI PS and TC)	N/A	Switched 24VAC Nominal	N/A
Cntctr	Contactor common	N/A		24VAC common
Fan PWM	PWM fan output	N/A	10-97% duty cycle, 19-23 VDC peak	N/A
COM	PWM fan common connection	N/A	N/A	Fan PWM common
Fan Park	PWM fan parking spot for unused terminal, not connected.	N/A	N/A	N/A

P2 Terminal Designations (Outdoor Board)

O	For heat pump applications only.	24VAC nominal from thermostat and loaded to draw 17ma at 30VAC	N/A	N/A
Y1	Y1 emergency input	24VAC nominal from thermostat and loaded to draw 17ma at 30VAC	N/A	N/A
C	24VAC nominal power return.	N/A	N/A	24VAC common
i-	Low data line.	Data	Data	N/A
i+	High data line.	Data	Data	N/A
R	24VAC nominal power input.	24VAC nominal board main power input.	N/A	N/A
DF	OEM test	N/A	N/A	N/A
TOUT	26Vdc transistor output to factory tester	N/A	N/A	N/A
TST	OEM test pin. In each terminal box: P2 - Terminal 1 - TEST P2 - Terminal 2 - TOUT P2 - Terminal 3 - DF P2 - Terminal 4 - R	24VAC nominal 17ma @ 30VAC	N/A	N/A

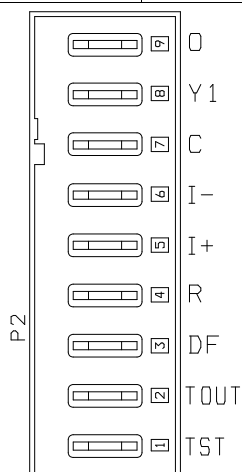


Table 1 continued.

Outdoor Control Terminal Designations and Input /Outputs					
WARNING - Electric Shock Hazard. Can cause injury or death. Unit must be grounded in accordance with national and local codes. The 4 pins in P6 have the potential of transferring up to 250 volts to the unit cabinet ground.					
Designator		Description (Outdoor Board)	Input	Output	Common
P6 - Pin 1	Tx	Transmit data to inverter, connects to Rx of inverter.	Outdoor control communication transmit pin.	<ul style="list-style-type: none"> Pin 1 to pin 2 should read 4.5 to 5.5 VDC when not communicating. Pin 3 to pin 2 should read 4.5 to 5.5 VDC when not communicating. Pin 4 to pin 2 should read 4.5 to 5.5 VDC. NOTE - Communication signals switch off and on rapidly. This may cause volt meter readings to fluctuate. This is normal. Communication signals will switch between this 5V and common (Pin 2).	
P6 - Pin 2	Inverter Common	Inverter common NOTE - This is a signal reference point and not an earth ground.	Inverter common.		
P6 - Pin 3	Rx	Receive data from the inverter. Connects to Tx of inverter.	Outdoor control communication receive pin.		
P6 - Pin 4	Inv 5V	Inverter 5VDC volts.	Inverter 5VDC volts		
LIQ		Liquid line temperature sensor supply.	N/A	N/A	N/A
LIQ		Liquid line temperature sensor return.	N/A	N/A	N/A
AMB		Outdoor ambient temperature sensor supply.	N/A	N/A	N/A
AMB		Outdoor ambient temperature sensor return.	N/A	N/A	N/A
COIL		Outdoor coil temperature sensor supply.	N/A	N/A	N/A
COIL		Outdoor coil temperature sensor return.	N/A	N/A	N/A
Pump Down		<p>To initiate pump down function, place jumper in the ON position. (See PUMP DOWN MODE OPERATION.)</p> <ol style="list-style-type: none"> Place the jumper in the ON position to activate pump down mode. Place the jumper in the OFF position to deactivate pump down mode. <p>NOTE -If the pump down jumper is in the ON position during power-up, it is ignored.</p> <p>NOTE - The outdoor control stays in pump down mode for five minutes, after which the outdoor control initiates a compressor shutdown sequence.</p>			
L		Load shedding input	24VAC input to L energizes load shedding feature.	N/A	N/A
C		Load shedding input reference. Refer to wiring of load shedding terminals located on page 22.	N/A	N/A	24VAC common

II. SYSTEM OPERATION AND SERVICE

Connect line voltage power supply wiring to the outdoor unit before connecting low voltage wiring from the main outdoor unit control to the thermostat. Failure to follow this may result in a communication error.

7-Segment Alert and System Status Codes

Alert codes are displayed using the 7-segment display located on the outdoor control.

NOTE - System fault and lockout codes take precedence over system status codes (cooling, heating operating percentages or defrost/dehumidification).

The 7-segment will display an abnormal condition (error code) when detected in the system. A list of the codes are shown in table 2.

RESETTING ALERT CODES

Alert codes can be reset manually or automatically:

1. Manual Reset

Manual reset can be achieved by one of the following methods:

- Disconnecting R wire from the outdoor control R terminal.
- Turning the indoor unit off and back on again

After power up, all currently displayed codes are cleared.

2. Automatic Reset

After an alert is detected, the outdoor control continues to monitor the unit's system and compressor operations. When/if conditions return to normal, the alert code is turned off automatically.

NOTE - Error codes can be recalled by following information shown in table 3.

Table 2. Outdoor Control 7-Segment Display Alert Codes and Inverter LED Flash Codes

NOTE - System fault and lockout codes take precedence over system status codes (cooling, heating operating percentages or defrost/dehumidification). Only the latest active fault or lockout codes are displayed (if present). If no fault or lockout codes are active, then system status codes are displayed. Alert codes are also displayed on the Wi-Fi® thermostat.

Alert Codes	Inverter Code	Inverter LED Flash Code (number of flashes)		Priority	Alarm Description	Possible Causes and Clearing Alarm
		Red LED	Green LED			
N/A	N/A	ON	OFF	N/A	-024 and -036 only: Indicates inverter is operating normally.	
N/A	N/A	ON	ON	N/A	-048 and -060 only: Indicates inverter is operating normally.	
N/A	N/A	OFF	OFF	N/A	Indicates inverter is NOT energized.	
E 105	N/A	N/A	N/A	Moderate	The outdoor control has lost communication with either the thermostat or indoor unit.	Equipment is unable to communicate. Indicates numerous message errors. In most cases errors are related to electrical noise. Make sure high voltage power is separated from RSBus. Check for mis-wired and/or loose connections between the stat, indoor unit and outdoor unit. Check for a high voltage source of noise close to the system. Fault clears after communication is restored.
E 120	N/A	N/A	N/A	Moderate	There is a delay in the outdoor unit responding to the system.	Typically, this alarm/code does not cause any issues and clears on its own. The alarm/code is usually caused by a delay in the outdoor unit responding to the thermostat. Check all wiring connections. Cleared after unresponsive device responds to any inquiry.
E 124	N/A	N/A	N/A	Critical	The Wi-Fi® thermostat has lost communication with the outdoor unit for more than 3 minutes.	Equipment lost communication with the thermostat. Check the wiring connections and resistance, then cycle the system power. This alarm stops all associated HVAC operations and waits for a signal from the non-communicating unit. The alarm / fault clears after communication is re-established.
E 125	N/A	N/A	N/A	Critical	There is a hardware problem with the outdoor control.	There is a control hardware problem. Replace the outdoor control if the problem prevents operation and is persistent. The alarm / fault is cleared 300 seconds after the fault recovers.
E 131	N/A	N/A	N/A	Critical	The outdoor unit control parameters are corrupted.	Reconfigure the system. Replace the control if heating or cooling is not available.
E 132	N/A	N/A	N/A	Critical	Internal software error.	Replace outdoor control.
E 180	N/A	N/A	N/A	Critical	The outdoor unit ambient temperature sensor has malfunctioned. As a result the outdoor unit control will not perform low ambient cooling.	Valid temperature reading is lost during normal operation and after outdoor control recognized sensors. Compare outdoor sensor resistance to temperature/resistance charts in unit installation instructions. Replace sensor pack if necessary. At the beginning of (any) configuration, furnace or air-handler control detects the presence of the sensor(s). If detected (reading in range), appropriate feature is shown in the thermostat About screen. The alarm / fault clears upon configuration, or when normal values are sensed.

Table 2. Outdoor Control 7-Segment Display Alert Codes and Inverter LED Flash Codes

NOTE - System fault and lockout codes take precedence over system status codes (cooling, heating operating percentages or defrost/dehumidification). Only the latest active fault or lockout codes are displayed (if present). If no fault or lockout codes are active, then system status codes are displayed. Alert codes are also displayed on the Wi-Fi® thermostat.

Alert Codes	Inverter Code	Inverter LED Flash Code (number of flashes)		Priority	Alarm Description	Possible Causes and Clearing Alarm
		Red LED	Green LED			
E 345	N/A	N/A	N/A	Critical	Heat Pump or Air Conditioner Alert Code - The "O" relay on the outdoor board has failed. Either the pilot relay contacts did not close, the relay coil did not energize or the circuit that confirms this operational sequence is not sensing properly.	Issue: Broken R50 will make the control board think reversing valve output is always off regardless of state of relay. (Supplier issue - We have found our functional test fixture can bend over MOV2 and crush it into R50. There are cut-outs in the plate of the fixture to let the two relays pass through as the plate with pogo pins is moved to the board to make contact with the terminals. Corrective Actions: Short term fix: Converted the system back to a 24 volt system to get unit operating. Long term: Replace outdoor control.
E 409	N/A	N/A	N/A	Moderate	Outdoor control secondary voltage is 18VAC or less.	Secondary voltage is below 18VAC. After 10 minutes, operation is discontinued. Check the indoor line voltage and transformer output voltage. The alarm clears after the voltage is higher than 20VAC for 2 seconds or after a power reset.
E 410	N/A	N/A	N/A	Moderate	The outdoor unit cycled off due to low pressure switch opening.	Unit pressure is below the lower limit. The system is shut-down. The low pressure switch closes above 90PSIG and opens below 40PSIG. Confirm that the system is properly charged with refrigerant. Check TXV, indoor unit blower motor, dirty filters or clogged refrigerant filter. Confirm that the evaporator coil is clean. The alarm clears after the pressure switch opens or after a power reset.
E 411	N/A	N/A	N/A	Critical	The low pressure switch has opened 5 times within one hour. As a result, the outdoor unit is locked out.	Low pressure switch error count reached 5 strikes. The low pressure switch opens at 40PSIG and resets at 90PSIG. Confirm that the system is properly charged with refrigerant. Check for clogged TXV, blockage to indoor unit blower motor, dirty filters or clogged refrigerant filter. Confirm that the evaporator coil is clean. The alarm clears after a power reset.
E 412	N/A	N/A	N/A	Moderate	The outdoor unit high pressure switch has opened.	Unit pressure is above the upper limit. System is shut down. The high pressure switch opens at 590PSIG and closes at 418PSIG. Confirm that the system is properly charged with refrigerant. Check for clogged TXV, blockage to indoor unit blower motor, clogged refrigerant filter. Confirm that the outdoor unit is clean. The alarm clears after the pressure switch closes or a power reset. For heating, indoor CFM may be set too low. For zoning system, zone CFM may be set too low.
E 413	N/A	N/A	N/A	Critical	The high pressure switch has opened 5 times within one hour. As a result, the outdoor unit is locked out.	Open high pressure switch error count reached 5 strikes. System is shut down. The high pressure switch for HFC-410A opens at 590PSIG and closes at 418PSIG. Confirm that the system is properly charged with refrigerant. Check condenser fan motor, for clogged TXV, for blockage to indoor unit blower motor, for stuck reversing valve or clogged refrigerant filter. Confirm that the outdoor unit is clean. The alarm clears after a power reset. For heating, indoor CFM may be set too low. For zoning system, zone CFM may be set too low.
E 416	N/A	N/A	N/A	Moderate / Critical	The outdoor coil sensor has malfunctioned. As a result the outdoor unit control will not perform defrost.	Coil sensor being detected open or shorted, or temperature is out of coil sensor range. Outdoor unit control will not perform demand or time/temperature defrost operation. System is still able heat and cool. Check the resistance of the coil sensor and compare to temperature resistance chart. Replace coil sensor if needed. The alarm clears when outdoor unit control detects proper coil sensor readings or after a power reset.

Table 2. Outdoor Control 7-Segment Display Alert Codes and Inverter LED Flash Codes

NOTE - System fault and lockout codes take precedence over system status codes (cooling, heating operating percentages or defrost/dehumidification). Only the latest active fault or lockout codes are displayed (if present). If no fault or lockout codes are active, then system status codes are displayed. Alert codes are also displayed on the Wi-Fi® thermostat.

Alert Codes	Inverter Code	Inverter LED Flash Code (number of flashes)		Priority	Alarm Description	Possible Causes and Clearing Alarm
		Red LED	Green LED			
E 422	N/A	N/A	N/A	Moderate	Compressor top cap switch exceeding thermal limit.	Issue: One of the wires from the top cap switch had pulled off one of the TP terminals on the outdoor control board. Corrective Action: Reconnected wire onto top cap terminal.
E 423	40	4 flashes	OFF	Moderate / Critical	The inverter has detected a circuit problem.	Control locks out after 10 strikes within an hour. To clear, disconnect power to outdoor unit and restart.
E 424	N/A	N/A	N/A	Moderate	The liquid line temperature sensor has malfunctioned.	In normal operation, after outdoor control recognizes sensors, the alarm is sent if valid temperature reading is lost. Compare liquid line sensor resistance to temperature/resistance charts in unit installation instructions. Replace sensor pack if necessary. At the beginning of (any) configuration, furnace or air-handler control detects the presence of the sensor(s). If detected (reading in range), appropriate feature is shown in the thermostat About screen. The alarm / fault clears upon configuration, or when normal values are sensed.
E 425	N/A	N/A	N/A	Minor	Outdoor control has increased minimum compressor speed to allow for proper oil return due to low ambient temperature. NOTE - Minimum speed adjustments begin at 45°F and increase to 100% minimum at 17°F.	Outdoor ambient temperature is below system limit. Control attempts to run at lowest allowed compressor speed to allow for proper oil return. Automatically clears when outdoor ambient temperature rises above limit for more than 5 minutes.
E 426	N/A	N/A	N/A	Critical	Excessive inverter alarms	After ten faults within one hour, control is locked out, indicating poor system operation. Review history of alarms to resolve system setup. Check condenser fan motor, TXV, indoor unit blower motor, over-charge, undercharge, or clogged refrigerant filter. To clear error, disconnect power to outdoor unit and restart. Inverter alarms 12 to 14 and 53 do not count toward this lock out condition.
E 427	21	2 flashes	1 flash	Moderate / Critical	The inverter has detected a DC peak fault condition. If condition (55A or higher) is detected, outdoor unit compressor and fan stop. Anti-short cycle is initiated. If peak current (55A or higher) occurs 10 times within an hour, system is locked out. Indicates high pressure, condenser fan failure, locked compressor rotor or overcharge. To clear, disconnect power to outdoor unit and restart.	
E 428	22	2 flashes	2 flashes	Moderate / Critical	The inverter has detected a high main input current condition.	If condition is detected, is detected, outdoor unit compressor and fan stop. Anti-short cycle is initiated. If condition occurs 5 times within an hour, system is locked out. Indicates high pressure, condenser fan failure or overcharge. To clear, disconnect power to outdoor unit and restart.
E 429	23	2 flashes	3 flashes	Moderate / Critical	On a call for compressor operation, if DC link power in inverter does not rise above 180 VDC for 2 and 3 ton models, 250 VDC for 4 and 5 ton models, within 30 seconds, the control will display a moderate code. If condition is detected, outdoor unit will stop (Compressor and fan). Anti-short cycles is initiated. If condition occurs 10 times within a 60 minute rolling time period, system will lock out and display a critical code.	Issues: (1) If DC link power in inverter does not rise above 180 VDC for 2- and 3-ton models, 250 VDC for 4- and 5-ton models, within 30 seconds, the outdoor control will display a moderate code. (2) Capacitors on inverter do not properly charge. Corrective Actions: (1) check for proper main power to outdoor unit and for any loose electrical connections. (2) Outdoor control boards with part # 103686-03 have software update to delay the de-energizing of the reversing valve by four seconds when coming out of defrost.

Table 2. Outdoor Control 7-Segment Display Alert Codes and Inverter LED Flash Codes

NOTE - System fault and lockout codes take precedence over system status codes (cooling, heating operating percentages or defrost/dehumidification). Only the latest active fault or lockout codes are displayed (if present). If no fault or lockout codes are active, then system status codes are displayed. Alert codes are also displayed on the Wi-Fi® thermostat.

Alert Codes	Inverter Code	Inverter LED Flash Code (number of flashes)		Priority	Alarm Description	Possible Causes and Clearing Alarm
		Red LED	Green LED			
E 430	26	2 flashes	6 flashes	Moderate / Critical	Compressor start failure.	If condition is detected, outdoor unit compressor and fan stop. Anti-short cycle is initiated. If condition occurs 10 times within an hour, system is locked out. Indicates poor connection at compressor harness, improper winding resistance, locked compressor rotor, or flooded compressor. To clear, disconnect power to outdoor unit and restart.
E 431	27	2 flashes	7 flashes	Moderate / Critical	Error occurs when PFC detects an over-current condition of 100A, the control will display a moderate code. If condition is detected, outdoor unit will stop (Compressor and fan). Anti-short cycle is initiated. Inverter is unavailable to communicate with the outdoor control for 3 minutes. If condition occurs 10 times within a 60 minute rolling time period, system will lock out and display a critical code.	Issues: (1) Indicates power interruption, brownout, poor electrical connection or loose inverter input wire. (2) System testing was set up and code was generated when the reversing valve is de-energized coming out of defrost (code appears with or without 30 compressor delay). Corrective Actions: (1) Check for proper main power to outdoor unit and for any loose electrical connections. (2) Outdoor control boards with part # 103686-03 have software update to delay the de-energizing of the reversing valve by four seconds when coming out of defrost.
E 432	28	2 flashes	8 flashes	Moderate / Critical	The inverter has detected a DC link high voltage condition.	Error occurs when the DC link capacitor voltage is greater than 480VDC. If condition is detected, outdoor unit compressor and fan stop. Anti-short cycle is initiated. If condition occurs 10 times within an hour, system is locked out. System stops. To clear, disconnect power to outdoor unit and restart.
E 433	29	2 flashes	9 flashes	Moderate / Critical	The inverter has detected a compressor over-current condition.	Error occurs when compressor peak phase current is greater than 28A. Inverter issues code 14 first and slows down to try to reduce the current. If the current remains high, outdoor unit compressor and fan stop. Anti-short cycle is initiated. If condition occurs five times within an hour, system is locked out. To clear disconnect power to outdoor unit and restart.
E 434	53	5 flashes	3 flashes	Moderate / Critical	Outdoor control has lost communications with the inverter for greater than 3 minutes. Outdoor control will stop all compressor demands, recycle power to the inverter by de-energizing the contactor for 2 minutes. If this occurs 3 time in one thermostat call, the outdoor unit will locked out and display a critical code.	Issues: (1) Loose electrical connections. (2) Interruption of main power to inverter. Corrective Actions: (1) Check all electrical connections. (2) Check for proper main power to inverter.
E 435	60	6 flashes	OFF	Moderate / Critical	Inverter internal error.	When this error occurs, the outdoor control cycles power to the inverter by opening the contactor for two minutes. Check that the EEPROM is properly seated. After power is cycled to the inverter 3 times, the outdoor unit is locked out.

Table 2. Outdoor Control 7-Segment Display Alert Codes and Inverter LED Flash Codes

NOTE - System fault and lockout codes take precedence over system status codes (cooling, heating operating percentages or defrost/dehumidification). Only the latest active fault or lockout codes are displayed (if present). If no fault or lockout codes are active, then system status codes are displayed. Alert codes are also displayed on the Wi-Fi® thermostat.

Alert Codes	Inverter Code	Inverter LED Flash Code (number of flashes)		Priority	Alarm Description	Possible Causes and Clearing Alarm
		Red LED	Green LED			
E 436	62	6 flashes	2 flashes	Moderate / Critical	Inverter heat sink temperature exceeded limit. Occurs when the heat sink temperature exceeds the inverter limit. Inverter issues code 13 first, then slows down to allow the heat sink to cool. If temperature remains high, outdoor unit stops (compressor and fan). Anti-short cycle is initiated. If condition occurs 5 times within an hour, system is locked out. To clear, disconnect power to outdoor unit and restart.	<p>Issue: Feedback from supplier tear down of inverter indicates that the screws that hold the inverter to the inverter board were loose causing poor contact between these two components.</p> <p>Corrective Action: Tighten screws that hold the heat sink to the inverter control board.</p> <p>NOTE: Wait five minutes to all capacitor to discharge before checking screws.</p>
E 437	65	6 flashes	5 flashes	Moderate / Critical	Heat sink temperature sensor fault has occurred (temperature less than 4°F or greater than 264°F after 10 minutes of operation).	Occurs when the temperature sensor detects a temperature less than 0.4°F or greater than 264°F after 10 minutes of operation. If condition is detected, outdoor unit will stop (compressor and fan). Anti-short cycle is initiated. If condition occurs 5 times within an hour, system will lock out. To clear disconnect power to outdoor unit and restart. If problem persists, replace inverter.
E 438	73	7 flashes	3 flashes	Moderate / Critical	The inverter has detected a PFC over current condition. This would be caused by a high load condition, high pressure, or outdoor fan failure. Outdoor control will display the code when the inverter has the error. After 3 minutes, the inverter will reset and the compressor will turn on again. If it happens 10 times within a 60 minute rolling time period, the OD control will lock out operation of the outdoor unit and display a critical code.	<p>Issue: Possible issue is system running at high pressures. Check for high pressure trips or other alert codes in room thermostat and outdoor control.</p>
E 439	12	1 flash	2 flashes	Moderate	Compressor slowdown due to high input current.	Input current is approaching a high limit. Compressor speed automatically slows. The control continues sending the inverter speed demanded by the thermostat. The control sets indoor CFM and outdoor RPM to values according to demand percentage rather than the actual Hz. Alarm is automatically cleared.
E 440	13	1 flash	3 flashes	Moderate	Heat sink temperature is approaching limit. The compressor speed automatically slows to reduce heat sink temperature. The control sets indoor CFM and outdoor RPM to values according to demand percentage rather than the actual Hz. Alarm is automatically cleared.	<p>Issue: Feedback from supplier tear down of inverter indicates that the screws that hold the inverter to the inverter board were loose causing poor contact between these two components.</p> <p>Corrective action: Tighten screws that hold the heat sink to the inverter control board.</p> <p>NOTE: Wait 5 minutes to all capacitor to discharge before checking screws.</p>

Table 2. Outdoor Control 7-Segment Display Alert Codes and Inverter LED Flash Codes

NOTE - System fault and lockout codes take precedence over system status codes (cooling, heating operating percentages or defrost/dehumidification). Only the latest active fault or lockout codes are displayed (if present). If no fault or lockout codes are active, then system status codes are displayed. Alert codes are also displayed on the Wi-Fi® thermostat.

Alert Codes	Inverter Code	Inverter LED Flash Code (number of flashes)		Priority	Alarm Description	Possible Causes and Clearing Alarm
		Red LED	Green LED			
E 441	14	1 flash	4 flashes	Moderate	Compressor slowdown due to high compressor current. Compressor current is approaching limit. The compressor speed automatically slows. The control sets indoor CFM and outdoor RPM to values according to demand percentage rather than the actual Hz. Alarm is automatically cleared..	Issue: Possible issue is system running at high pressures. Check for high pressure trips or other alert codes in room thermostat and outdoor control.
E 442	N/A	N/A	N/A	Critical	The top cap switch has opened five times within one hour. As a result, the outdoor unit is locked out.	When compressor thermal protection sensor opens five times within one hour, outdoor stops working. To clear, disconnect power to outdoor unit and restart.
E 443	N/A	N/A	N/A	Critical	Incorrect appliance unit size code selected.	Check for proper configuring of unit size codes for outdoor unit in configuration guide or in installation instructions. If replacing inverter, verify inverter model matches unit size. The alarm/fault clears after the correct match is detected following a reset. Remove the thermostat from the system while applying power and reprogramming.
E 600	N/A	N/A	N/A	Critical	Compressor has been cycled OFF on utility load shedding.	Load shedding function: Provides a method for a local utility company to limit the maximum power level usage of the outdoor unit. The feature is activated by applying 24 volts AC power to the L and C terminals on the outdoor control.
E 601	N/A	N/A	N/A	Critical	Outdoor unit has been cycled OFF on low temperature protection.	Low temperature protection: Outdoor unit will not operate when the outdoor temperature is at or below -4°F (-20°C). If the unit is operating and the outdoor temperature drops below -4°F (-20°C), the unit continues to operate until the room thermostat is satisfied or the outdoor temperature drops to -15°F (-26°C). Outdoor unit ambient sensor provides temperature readings.

POWER-UP / RESET:

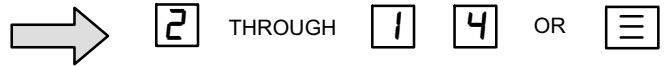
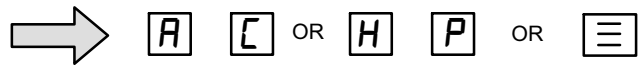
FIRMWARE VERSION: During initial power-up or reset, the first item displayed is the outdoor control firmware version. Example to the right shows firmware version 2.3.

UNIT TYPE: The next item displayed is the self discovery unit type. AC = air conditioner and HP = heat pump. If the unit type cannot be determined, three bars appear.

UNIT NOMINAL CAPACITY: The next item to be displayed is the self-discovery unit nominal capacity. Valid capacities are 24 for 2-ton, 36 for 3-ton, 48 for 4-ton and 60 for 5-ton units. If the unit type cannot be determined, three bars appear.

UNIT CODE: The next item to be displayed is the self discovery unit code. (may be a single character or two characters). If the unit code cannot be determined, three bars appear.

7-SEGMENT POWER-UP DISPLAY STRING



(These are just examples of firmware version, unit type, unit nominal capacity and unit codes.)

UNIT CODE	UNIT TYPE, SIZE AND MODEL
≡	NOT PROGRAMMED
1 7	2-TON HEAT PUMP
1 9	3-TON HEAT PUMP
2 1	4-TON HEAT PUMP
2 2	5-TON HEAT PUMP
2 4	2-TON AIR CONDITIONER
2 6	3-TON AIR CONDITIONER
2 8	4-TON AIR CONDITIONER
2 9	5-TON AIR CONDITIONER

7-SEGMENT POWER-UP DISPLAY STRING EXAMPLE

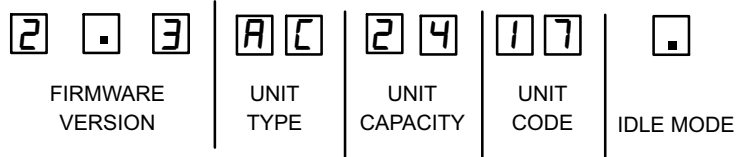


Figure 5. Outdoor Control 7-Segment Unit Status Displays

Table 3. Outdoor Control 7-Segment Unit Status Displays

Description	Example of Display
Idle Mode: Decimal point flashes at 1 Hz.	Idle Mode: Decimal point flashes at 1 Hz (0.5 second on, 0.5 second off). Display OFF.
<p>Soft Disable Mode: Top and bottom horizontal line and decimal point flash at 1 Hz. If indoor or outdoor control displays Soft Disable code: 1) Confirm proper wiring between all devices (thermostat, indoor and outdoor). 2) Cycle power to the control that is displaying the Soft Disable code. 3) Put the room thermostat through Setup. 4) Go to Setup/System Devices/Thermostat/Edit/push Reset. 5) Go to Setup/System Devices/Thermostat/Edit/push Reset All. If the room thermostat detects a new device or a device that is not communicating, it sends a Soft Disable. When this occurs, Alarm 10 is activated and the room thermostat sends a Soft Disable command to the offending device on the bus (outdoor control, IFC, AHC, EIM or Damper Control Module).</p>	<p>Soft Disable Mode: Top and bottom horizontal line and decimal point flash at 1 Hz (0.5 second on, 0.5 second off).</p> <p>The thermostat control in Soft Disable Mode is indicated by the following:</p> <ul style="list-style-type: none"> • On AHC, IFC and outdoor controls, Soft Disable Mode is indicated by flashing double horizontal lines on the 7-segment display. • On the Damper Control Module and EIM, the green LED will blink 3 seconds on and 1 second off.
O.E.M. Test Mode	All segments flashing at 2 Hz (unless error is detected). <i>NOTE - Control should be replaced.</i>
Anti-Short Cycle Delay	The middle line flashes at 1 Hz for 2 seconds, followed by a 2-second display of the number of minutes left on the timer (value is rounded up: 2 min. 1 sec. is displayed as 3). If activated, the anti-short cycle delay time remaining is displayed (default is 300 sec./5 min.).
Cooling Cycle: Shows current percentage of maximum cooling capacity. Example to the right indicates a cooling demand of 50 percent and a outdoor fan speed of 700 RPM.	<p>The demand percentage is displayed first, followed by a pause, then the outdoor fan speed and the ambient temperature.</p> <p><i>C 5 0</i> pause <i>F 7 0 0</i> pause <i>A 7 6</i></p>
Diagnostic recall: Shows the last 10 stored diagnostic error codes.	<p>If first error is <i>E 2 5 0</i>, second <i>E 2 3 1</i> pause <i>E 2 5 0</i> pause <i>E 2 3 1</i></p> <p>Next codes (up to 10) are shown using same method.</p>
Fault memory clears	<p>If there are no error codes stored: <i>E</i> pause <i>0 0 0</i>. After the fault memory is cleared, the following string flashes every 0.5 seconds:</p> <p><i>0 0 0 0</i> pause</p>
Active error in outdoor control Idle mode: Show all active error(s) codes.	Following display string is repeated if Error E 125 and E 201 are present: <i>E 1 2 5</i> pause <i>E 2 0 1</i>
Active error in run mode: Show current status and all active error(s) codes.	Following display string is repeated if Error E 440 is present while outdoor fan speed at 700RPM: <i>F 7 0 0</i> pause <i>E 4 4 0</i>
Outdoor Ambient Temperature (OAT): Any time OAT is within operating range, value is displayed if unit is in diagnostic and non-diagnostic modes.	Following display string is repeated if cooling is active with outdoor fan speed set at 650 RPM and OAT is 104°F: <i>C 3 5</i> pause <i>F 6 5 0</i> pause <i>A 1 0 4</i> pause
Outdoor Coil Temperature (OCT): Any time OCT is sensed in operating range, value is displayed if unit is in diagnostic mode or manually enabled for non-diagnostic modes.	Following display string is repeated if heat is active with outdoor fan speed set at 550 RPM and OCT is 25°F: <i>H 3 5</i> pause <i>F 5 5 0</i> pause <i>c 7 7</i> pause
Liquid Line Temperature (LIQ): Any time LIQ is sensed in operating range, value is displayed if unit is in diagnostic mode or manually enabled for non-diagnostic modes.	Following display string is repeated if cooling is active with outdoor fan speed set at 650 RPM and LIQ is 105°F: <i>C 3 1</i> pause <i>F 6 5 0</i> pause <i>L 1 0 5</i> pause
Pump Down Mode: While the unit is in pump down mode, <i>P d</i> is displayed repeatedly. Errors are shown if they exist.	Following display string is repeated: <i>P d</i> pause <i>P d</i> <i>P d</i> pause <i>E 4 4 0</i> pause <i>P d</i> pause <i>E 4 4 0</i>

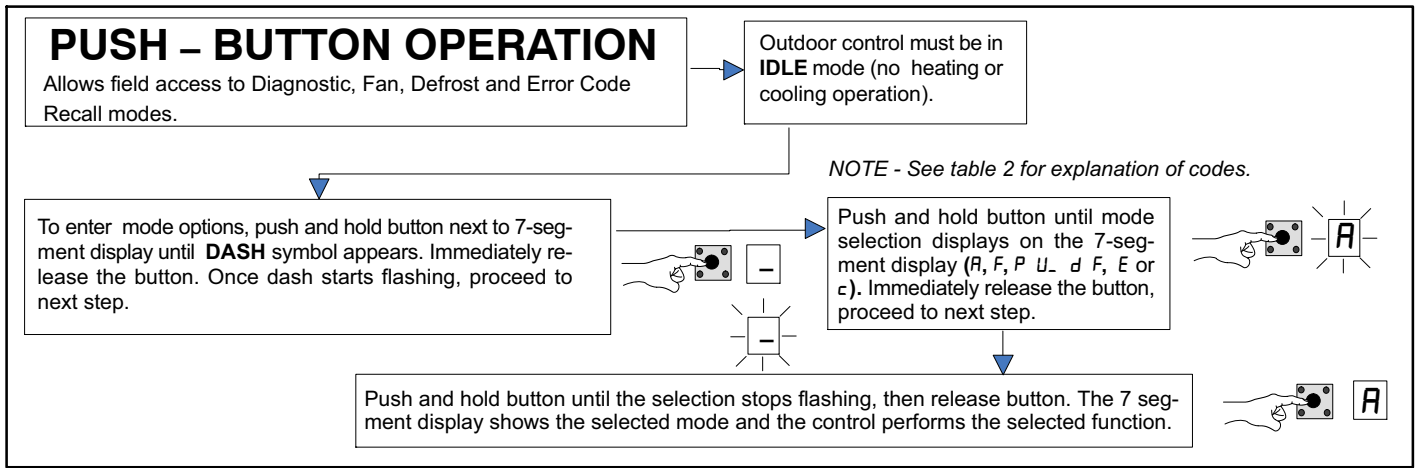


Figure 6. Push-Button Operation

Unit Selection Code for Outdoor Control		
If the single-character display shows three (3) horizontal lines, the unit selection code needs to be programmed. Press and hold the button until the <i>P U</i> menu option is displayed, release button. The single-character display displays the selected mode per example in figure 5. When the desired unit selection code appears, press and hold the button until it stops flashing, then release.		
Unit Code	Unit Type	Unit Model
24	2-ton air conditioner	4SCU20LX124
26	3-ton air conditioner	4SCU20LX136
28	4-ton air conditioner	4SCU20LX148
29	5-ton air conditioner	4SCU20LX160
17	2-ton heat pump	4SHP20LX124
19	3-ton heat pump	4SHP20LX136
21	4-ton heat pump	4SHP20LX148
22	5-ton heat pump	4SHP20LX160
6	2-ton air handler	BCE4M245
7	2.5-ton air handler	BCE4M305
8	3-ton air handler	BCE4M365
9	4-ton air handler	BCE4M485
L	5-ton air handler	BCE4M605

Idle mode — System is energized with no demand — Decimal flashes at 1 Hertz > 0.5 second ON, 0.5 second OFF.		
Display Symbol or Character	Display	Fan Test and Display String Option
Displayed during start-up or power recycling.	Display string shows outdoor control firmware version <i>1 _ 5</i> > pause > <i>R C</i> or <i>H P</i> unit > pause > unit capacity in BTUs > pause > unit code. If 3 horizontal bars are displayed during any sequence of this display string, it indicates that the specific parameter is not configured.	
■	Idle mode — decimal flashes at 1 Hertz > 0.5 second ON, 0.5 second OFF	
<i>C</i> or <i>H</i>	Indicates either cooling (<i>C</i>) or heating (<i>H</i>) mode and demand percentage.	
<i>d F</i>	Code displays when system is in defrost mode. To enter defrost mode, unit must be running in heating mode, outdoor ambient must be below 65°F and outdoor coil temperature must be below defrost termination temperature.	
<i>F</i>	Indicates outdoor fan RPM speed.	Control must be in Idle mode: To enter fan test option - <i>F</i> mode, push and hold button until solid — appears, release button. Display begins flashing. Within 10 seconds, push and hold button until required symbol <i>F</i> displays, release button. Display begins flashing. Within 10 seconds, push and hold button until display stops flashing, release button. Control outputs DC voltage on PWM and COM terminals. Outdoor fan cycles ON for 10 minutes at 490 RPM. To exit test — Push and hold button until three horizontal bars display. Release button, outdoor fan cycles OFF .
<i>R</i>	<i>R</i> in the display string represents the ambient temperature in °F at the sensor on the outdoor unit. In display configuration mode, it also represents the option for enabling both coil and liquid line temperature on the 7-segment display string.	Control can be in Idle or demand mode: To enter display configuration option - <i>R</i> mode, push and hold button until solid — appears, release button. Display begins flashing. Within 10 seconds, push and hold button until required symbol <i>R</i> displays, release button. Display begins flashing. Within 10 seconds, push and hold button until display stops flashing, release button. Display shows error (<i>E</i>) code(s), ambient (<i>R</i>), outdoor coil (<i>c</i>) and liquid (<i>L</i>) temperatures in Fahrenheit. <i>NOTE - If button is not pushed in the 10-second time period, the control exits the test mode. If this occurs, test mode must be repeated.</i>
Error Code Recall Mode (<i>NOTE - control must be in idle mode</i>)		
<i>E</i>	To enter error code recall mode, push and hold button until solid <i>E</i> appears, then release button. Control displays up to 10 error codes stored in memory. If <i>E</i> □ □ □ is displayed, there are no stored error codes.	
— — —	To exit error code recall mode, push and hold button until solid three horizontal bars appear, then release button. <i>Note - Error codes are not cleared.</i>	
<i>c</i>	To clear error codes stored in memory, continue to hold button while the 3 horizontal bars are displayed. Release button when solid <i>c</i> is displayed.	
<i>c</i>	Push and hold for one (1) second, release button. 7-Segment displays □ □ □ □ and exits error recall mode.	

FIELD TEST MODE OPERATION

The field test mode allows the unit to be put into diagnostic mode and allows the installer to perform multiple tests on the control / unit.

Diagnostic Mode

Diagnostic mode is only available when the system is idle or during an active / suspended call for heating or cooling. Diagnostic mode is terminated when the exit command is given, the button is pressed and released without entering the diagnostic menu or 10 minutes has passed, whichever comes first.

When this mode is selected all installed temperature sensor valves (non-open and non-short) are shown on the 7-segment display. The following system status codes are displayed:

- Cooling
- Percentage demand operation
- Outdoor fan RPM
- Active error codes

Outdoor Fan Mode

Diagnostic mode is only available while the system is in idle mode. This mode can be exited with the proper command or after 10 minutes has passed.

In diagnostic mode, the control energizes the outdoor fan at the highest speed. The control continuously displays the fan RPM on the 7-segment display.

PUMP DOWN MODE OPERATION

1. Turn room thermostat **OFF**.
2. Install a set of refrigerant gauges on the system to monitor the pressure.

NOTE - All operation monitoring devices: High pressure switch, low pressure switch and compressor internal vacuum protection remain active in the system. This will prevent the compressor from recovering all the system refrigerant into the outdoor unit.

NOTE - If the pump down jumper is in the ON position during power-up, it is ignored.

3. Move the **Pump Down** jumper (figure 4) from the **OFF** position to the **ON** position.

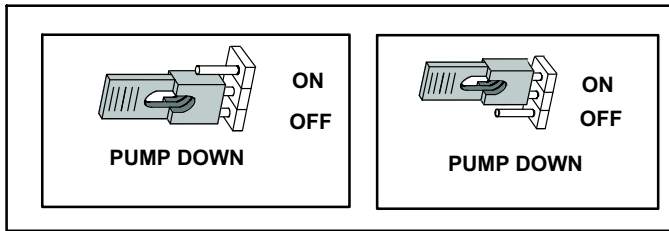


Figure 7. Pump Down Jumper

4. Shut off the liquid line service valve to stop the flow of refrigerant into the indoor coil.
5. After a three-second delay, the compressor and outdoor fan will ramp up to 100% capacity. (Indoor fan will remain **OFF**.)

6. Monitor the low-side pressure at the outdoor unit. The internal vacuum protection in the compressor and/or one of the pressure switches prevents full recovery of the refrigerant into the outdoor unit. When the system reaches this condition, the suction line service valve should be shut off and the **Pump Down Jumper** moved back to the **OFF** position.

NOTE - The outdoor control will stay in pump down mode for five minutes, after which the outdoor control initiates a compressor shutdown sequence.

7. Use a refrigerant recovery machine to recover the remaining refrigerant on the indoor side of the system.

Table 4. Field Test, Diagnostic Recall and Program Menu Options

Display	Display and action (normal operation)
No Change - idle (*)	No Change - idle (*)
Solid .	Enter or exit field test and program mode.
Solid A	Puts unit in diagnostic mode. (Displays ambient, coil, liquid sensor temperatures and any active error codes.)
Solid c	Clears error history (**)
Solid E	Enter diagnostic recall mode. Displays up to 10 error codes in memory.
Solid F	Starts outdoor fan.
String P U	Enter unit code programming.

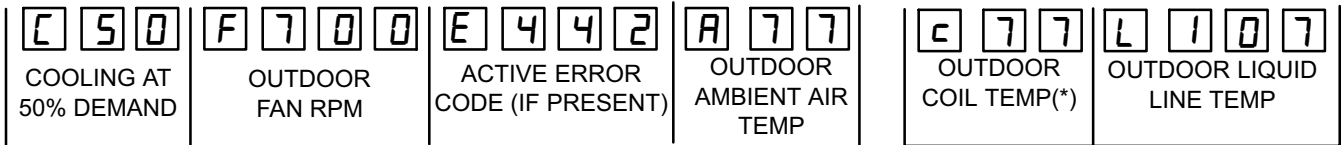
*No change indicates the display will continue to show whatever is currently being displayed for normal operations.

**Note once the error history is deleted it cannot be recovered. After the history is deleted, the unit will reset itself.

Table 5. Normal Operation Character Display String

Display	Display and action (normal operation)	Display and action (configuration and test mode)
.	Idle mode — decimal flashes at 1 Hertz > 0.5 second ON, 0.5 second OFF	
C	Cooling operation. Shows C and the cooling demand percentage. Example: C 5 0 pause F 7 0 0 pause A 7 5	
F	Fan RPM. Shows F and the current fan RPM. Example: H 5 0 pause F 6 0 0 pause A 4 5	
E	E in the display string represents the active error code(s) in the outdoor unit. Example: C 5 0 pause F 7 0 0 pause E 4 4 1 pause E 4 4 2 pause A 7 5 pause	
A	A in the display string represents the outdoor ambient temperature in °F at the outdoor sensor on the outdoor unit. Example: C 5 0 pause F 7 0 0 pause A 7 5	
c	If enabled, c in the display string represents the outdoor coil temperature in °F at the sensor on the outdoor unit. Example: C 5 0 pause F 7 0 0 pause A 7 5 pause c 4 5 pause. Air conditioning units do not require an outdoor coil sensor. A 10K resistor, across pins 5 and 6 on the outdoor control sensor harness, prevents false outdoor coil sensor codes. The 10K resistor causes the 7-segment display to show a constant 77°F coil (c) temperature value.	
L	If enabled, L in the display string represents the outdoor liquid line temperature in °F at the sensor on the outdoor unit. Example: C 5 0 pause F 7 0 0 pause A 7 5 pause c 4 5 pause pause L 1 0 5 pause	
P d	P d displays when system is in pump down mode.	

TYPICAL 7-SEGMENT ACTIVE COOLING OR HEATING DEMAND DISPLAY STRING



BY DEFAULT, COOLING OR HEATING, DEMAND, OUTDOOR FAN RPM, ACTIVE ERROR CODES AND OUTDOOR AMBIENT TEMPERATURE ARE DISPLAYED.

OUTDOOR COIL AND LIQUID LINE TEMPERATURES CAN BE MANUALLY ENABLED. IF SYSTEM POWER IS RECYCLED, DISPLAY STRING REVERTS BACK TO DEFAULT (SEE FIGURE 9 TO ENABLE)

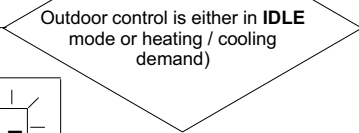
* Air conditioning units do not require an outdoor coil sensor. A 10K resistor, across pins 5 and 6 on the outdoor control sensor harness, prevents false outdoor coil sensor codes. The 10K resistor causes the 7-segment display to show a constant 77°F coil (c) temperature value.

Figure 8. Typical 7-Segment Demand Display String

How to enable liquid line temperature information on a 7-segment display

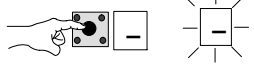
Both coil and liquid line temperatures can be enabled for display either during normal demand operation or while in idle mode.

NOTE - If system power is recycled, display string reverts back to default. Repeat the procedure which enables the outdoor coil and liquid line temperature information. All temperatures are displayed in Fahrenheit.

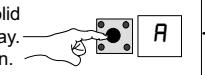


Wait until unit returns to a active demand or idle mode.

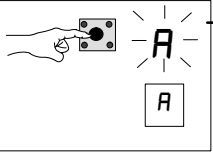
To enable temperature display, push and hold button next to 7-segment display until **dash** symbol appears and immediately release button. Once dash starts flashing, proceed to next step.



Push and hold the button until the solid **A** appears on the 7-segment display. Then, immediately release the button.



Push and hold button until the flashing **A** stops flashing then release button. The display shows the coil and liquid line temperature if there is an active demand running.



During thermostat demand of the outdoor control, the 7-segment display shows the cooling or heating (percent demand), fan RPM, error codes if present, and outdoor ambient, Coil and liquid line temperatures need to be manually enabled to be displayed.



NOTE - The coil and liquid line temperature readings are temporarily shown on the outdoor 7-segment display when the Comfort Sync™ diagnostic screen is accessed.

Figure 9. Enabling Liquid Line Temperature Information

Configuring Unit

When installing a replacement outdoor control, the unit selection code may have to be manually assigned using the 7-segment display and push button on the control. The unit code sets unit type, capacity and outdoor fan RPM.

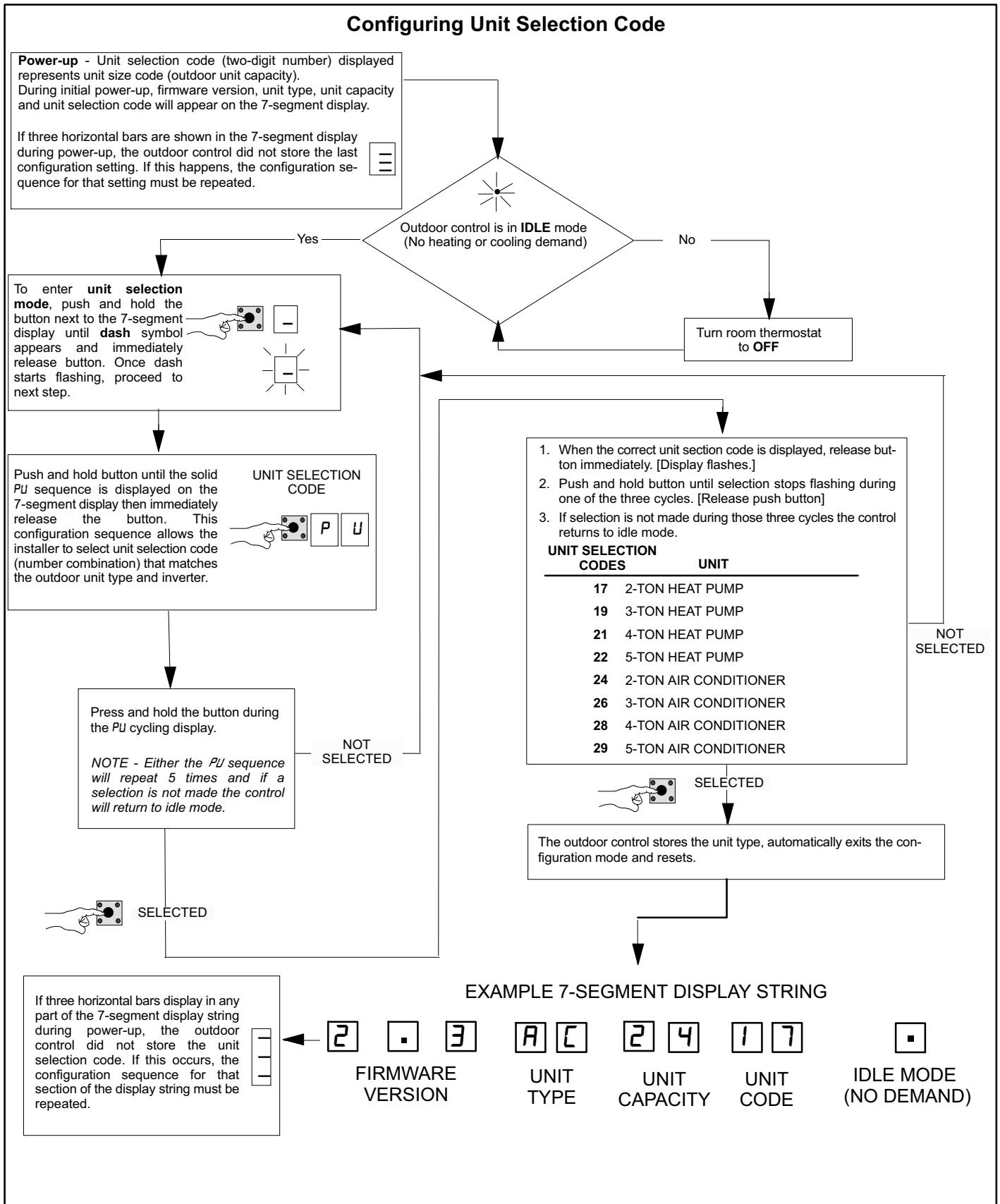


Figure 10. Configuring Unit Selection Code

Reconfiguring Outdoor Control using Comfort Sync Wi-Fi® Thermostat

If any component of the HVAC system is changed, e.g. replacing an outdoor sensor, reconfiguring the system is required. To begin reconfiguring a system, select the **Setup** tab.

System Overview

Refer to the Thermostat Installer Setup Guide for configuration procedures.

IMPORTANT

Some scroll compressors have internal vacuum protector that will unload the scrolls when suction pressure goes below 20 psig. A hissing sound will be heard when the compressor is running unloaded. Protector will reset when low pressure in system is raised above 40 psig. **DO NOT REPLACE COMPRESSOR.**

The outdoor control provides the following functions:

- Internal switching of outputs.
- Compressor anti-short-cycle delay (adjustable through the thermostat interface).
- Five-strike lockout function.
- High (S4) and low (S87) pressure switches.
- Ambient (RT13) and liquid line (RT36) temperatures monitoring and protection.

COMPRESSOR PROTECTION — FIVE-STRIKE LOCKOUT

The five-strike lockout function is designed to protect the compressor from damage. The five-strike feature is used for both high (S4) and low (S87) pressure switches.

Resetting Five-Strike Lockout

Once the condition has been rectified, power to the outdoor control **R** terminal must be cycled OFF.

Diagnostic Information

The following diagnostic information is available through the thermostat's user interface. Refer to the thermostat Installer's System Setup Guide.

- Compressor anti-short-cycle delay timer status
- Cooling rate
- Compressor shift delay timer status
- High pressure switch status
- Low pressure switch status
- Compressor top cap switch status
- Liquid line temperature
- Outdoor ambient temperature
- Outdoor fan RPM
- Compressor active alarm
- Compressor Hz
- Inverter compressor short cycle
- Heat sink temperature

Installer Test

Verify the proper operation of the system by running the Installer Test feature through the thermostat interface. Refer to the Installer System Setup Guide.

COMPRESSOR SHORT CYCLING DELAY

The outdoor control protects the compressor from:

- Short cycling (five minutes) during initial power-up.
- Interruption in power to the unit.
- Pressure or sensor trips.
- Delay after demand is removed.

The delay is set by default for 300 seconds (five minutes) but can be changed through the thermostat interface.

Available settings are 60, 120, 180, 240 and 300 seconds.

CRANKCASE HEATER (HR1)

Compressors in all units are equipped with a 40-watt belly-band-type crankcase heater. HR1 prevents liquid from accumulating in the compressor. HR1 is controlled by the crankcase heater thermostat.

CRANKCASE HEATER THERMOSTAT (S40)

Thermostat S40 controls the crankcase heater in all units. S40 is located on the liquid line. When liquid line temperature drops below 50°F, thermostat S40 closes, energizing HR1. The thermostat opens, de-energizing HR1, once liquid line temperature reaches 70°F.

Maintenance

Outdoor Unit

Maintenance and service must be performed by a qualified installer or service agency. At the beginning of each cooling season, the system should be checked as follows:

1. Clean and inspect outdoor coil (may be flushed with a water hose). Ensure power is off before cleaning.
2. Outdoor unit fan motor is factory-lubricated and sealed. No further lubrication is needed.
3. Visually inspect all connecting lines, joints and coils for evidence of oil leaks.
4. Check all wiring for loose connections.
5. Check for correct voltage at unit (unit operating).
6. Check amp draw on outdoor fan motor.
7. Inspect drain holes in coil compartment base and clean if necessary.

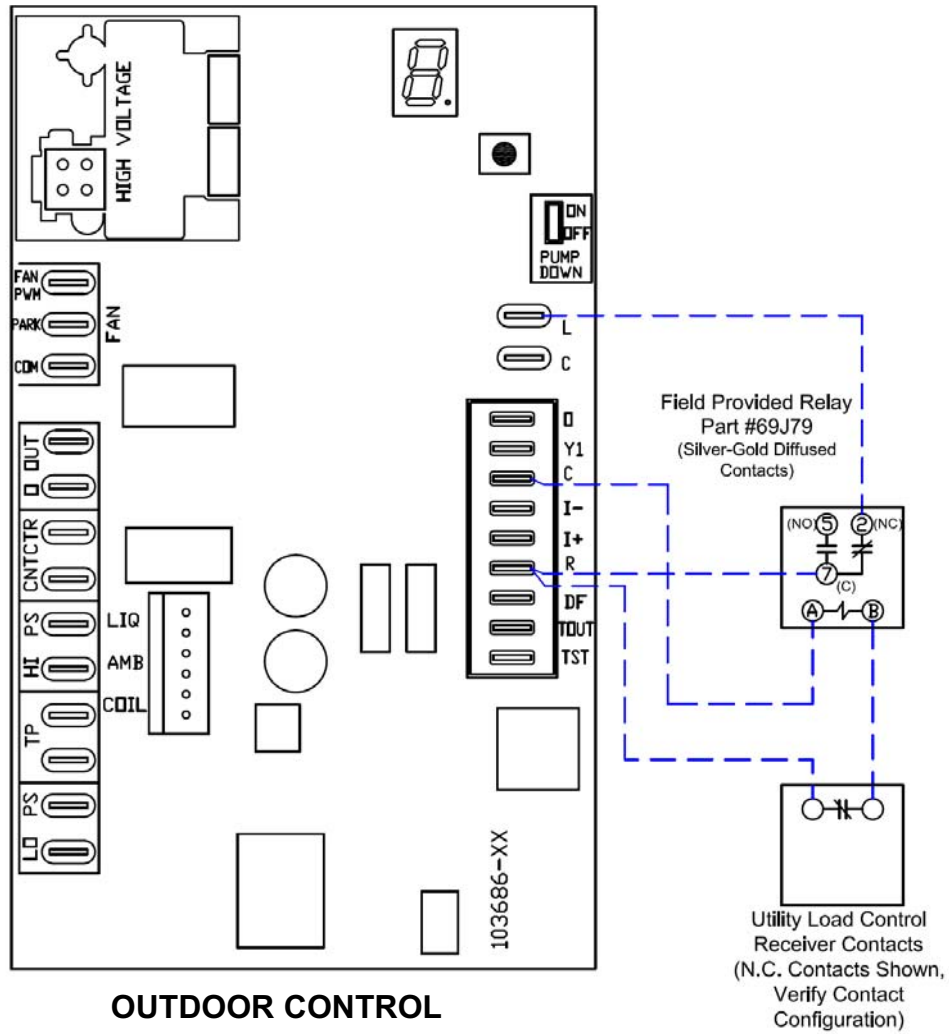
NOTE - If insufficient heating or cooling occurs, the unit should be gauged and refrigerant charge should be checked.

Outdoor Coil

It may be necessary to clean the outdoor coil more frequently if it is exposed to substances which are corrosive or which block airflow across the coil (e.g., pet urine, cottonwood seeds, fertilizers, fluids that may contain high levels of corrosive chemicals such as salts)

- The outdoor coil may be flushed with a water hose.
- Coastal Areas — Moist air in ocean locations can carry salt, which is corrosive to most metal. Units that are located near the ocean require frequent inspections and maintenance. These inspections will determine the necessary need to wash the unit including the outdoor coil. Consult your installing contractor for proper intervals/procedures for your geographic area or service contract.

Utility Load Shedding



NOTE - For more information on Load Shedding, see Electrical section.

Figure 11. Load Shedding Feature Wiring Diagram

Unit Sequence of Operation

The following figures illustrate the overall unit sequence of operation along with the operation of various pressure switches and temperature sensors. The figures also illustrate the use of the compressor anti-short-cycle function in relation to unit Status, unit Fault and lock-out LED Codes and unit system operation interactions.

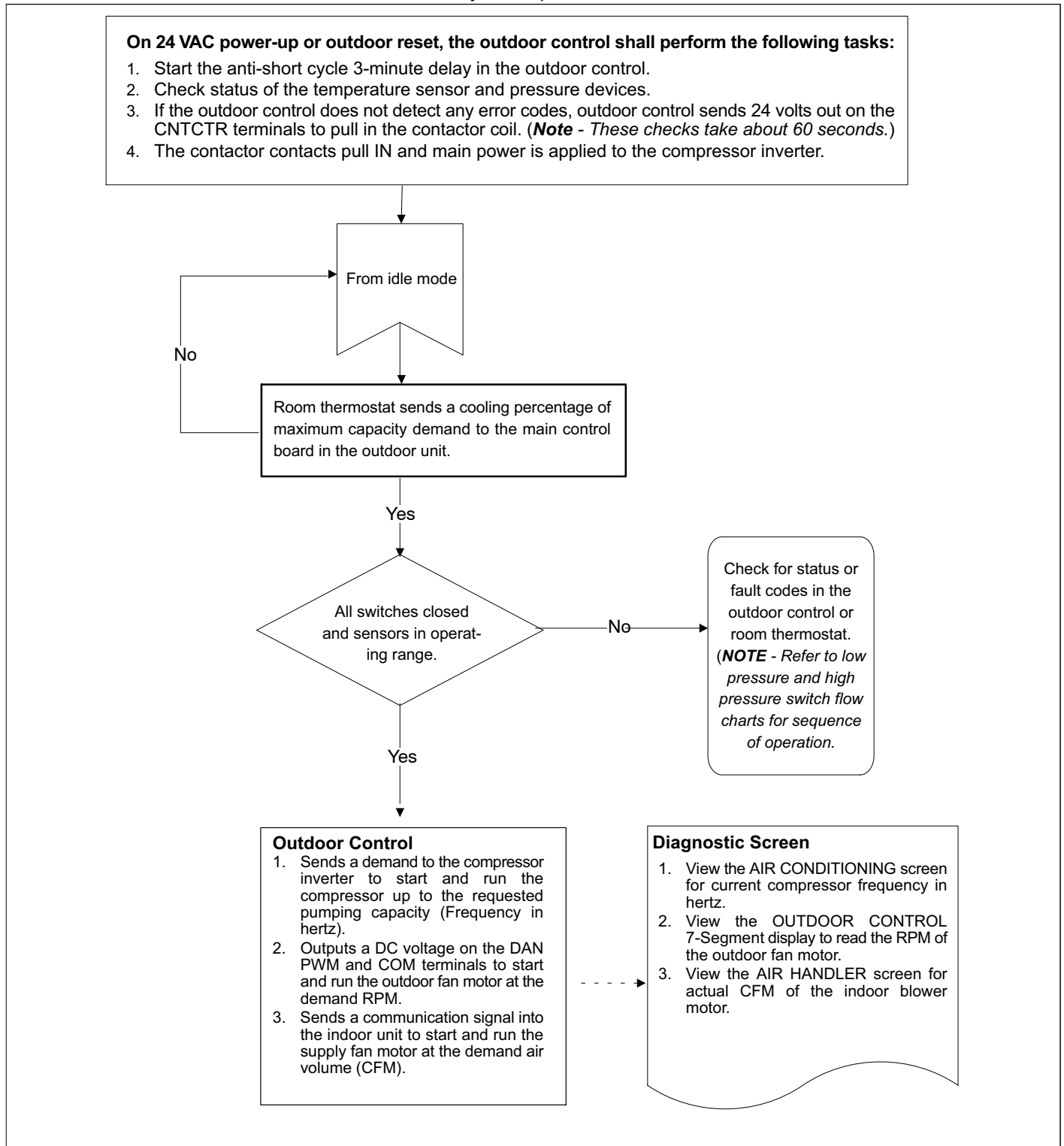


Figure 12. 24 Volt Power-Up or Outdoor Reset

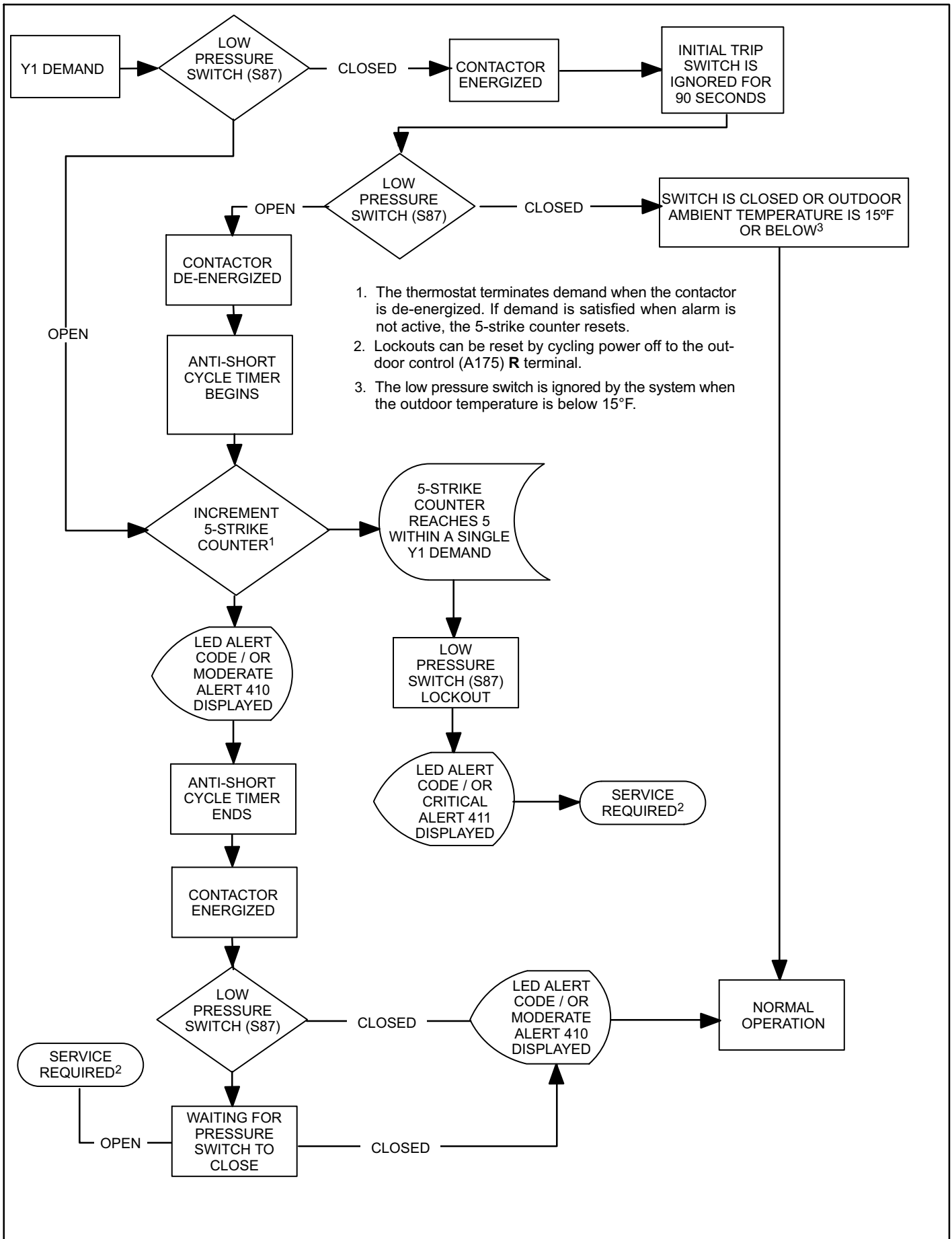


Figure 13. Low Pressure Switch (S87) Sequence of Operation (All Versions)

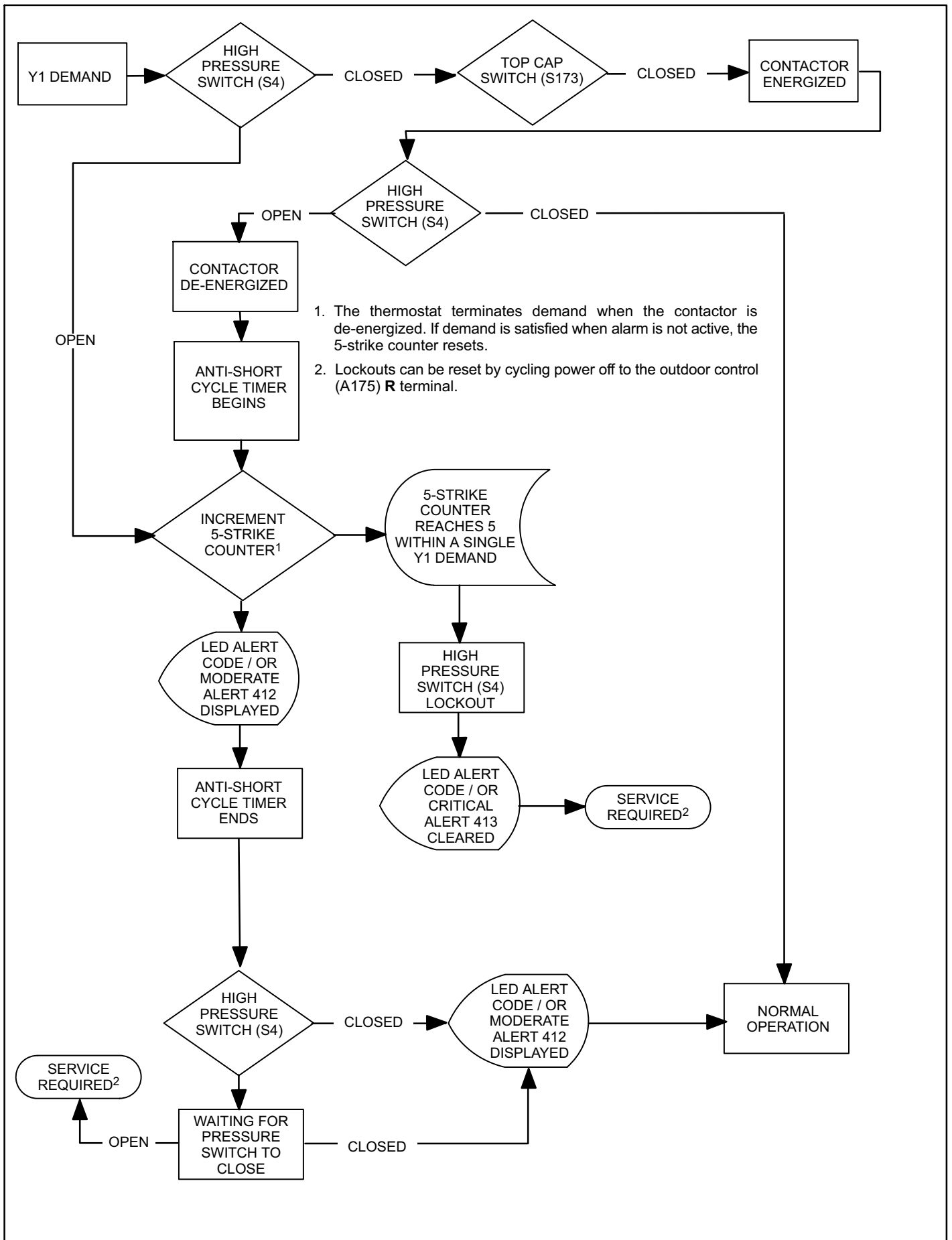


Figure 14. High Pressure Switch (S4) Sequence of Operation (All Versions)

Component Testing Table of Contents

Verifying High Pressure and Low Pressure Switch Operation	Line Filter (Electromagnetic Compatibility Circuit - EMC) Operations, Checkout and Status / Error Codes
Compressor Operation, Checkout and Status / Error Codes	Outdoor Fan Operation and Checkout
Crankcase Heater, Checkout and Status / Error Codes	Ferrites
Top Cap Switch Operation, Checkout and Status / Error Codes	Outdoor Control Operation, Checkout and Status / Error Codes
Reactor Operations, Checkout and Status / Error Codes	Unit Sensor Operations, Checkout and Status / Error Codes
	DC Inverter Control Operation, Checkout and Status / Error Codes
	Emergency 24VAC Operation

Verifying High and Low Pressure Switch Operation

OPERATION :

The unit's pressure switches (LO PS - S87 and HI PS - S4) are factory-wired into the control on the LO-PS and HI-PS terminals, respectively.

Low Pressure Switch (LO-PS) — See figure 13 for low pressure switch sequence of operation.

High Pressure Switch (HI-PS) — See figure 14 for high pressure switch sequence of operation.

Pressure Switch Event Settings

The following pressures are the auto-reset event value triggers for low and high pressure thresholds:

- **High Pressure** (auto-reset) - trip at 590 psig; reset at 418.
- **Low Pressure** (auto-reset) - trip at 40 psig; reset at 90.

TESTING

Using a multimeter set to ohms with the terminals disconnected from the control board, check the resistance between the two terminals of the pressure switch. If the resistance reading is 0 ohms, the switch is closed.

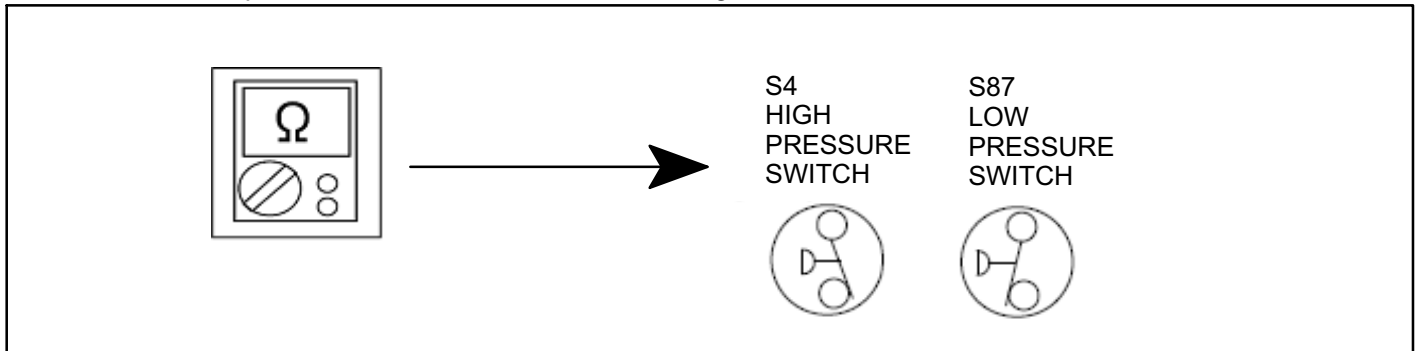


Figure 15. Verifying High Pressure and Low Pressure Switch Operation

High and Low Pressure Switch Errors

Table 6. Outdoor Control 7-Segment Display Alert Codes - High and Low Pressure Switches

System fault and lockout codes take precedence over system status codes (cooling, heating operating percentages or defrost/dehumidification). Only the latest active fault or lockout codes are displayed (if present). If no fault or lockout codes are active, then system status codes are displayed. Alert codes are also displayed on the thermostat.

Alert Codes	Priority	Alarm Description	Possible Causes and Clearing Alarm
E 410	Moderate	The outdoor unit low pressure switch has closed.	Unit pressure is below the lower limit. The system is shut down. The low pressure switch closes above 90PSIG and opens below 40PSIG. Confirm that the system is properly charged with refrigerant. Check TXV, indoor unit blower motor, dirty filters or clogged refrigerant filter. Confirm that the evaporator coil is clean. The alarm clears after the pressure switch opens or after a power reset.
E 411	Critical	The low pressure switch has opened 5 times within one hour. As a result, the outdoor unit is locked out.	Low pressure switch error count reached 5 strikes. The low pressure switch for HFC-410A opens at 40PSIG and resets at 90PSIG. Confirm that the system is properly charged with refrigerant. Check for clogged TXV, blockage to indoor unit blower motor, dirty filters or clogged refrigerant filter. Confirm that the evaporator coil is clean. The alarm clears after a power reset.
E 412	Moderate	The outdoor unit high pressure switch has opened.	Unit pressure is above the upper limit. System is shut down. The high pressure switch opens at 590PSIG and closes at 418PSIG. Confirm that the system is properly charged with refrigerant. Check for clogged TXV, blockage to indoor unit blower motor, clogged refrigerant filter. Confirm that the outdoor unit is clean. The alarm clears after the pressure switch closes or a power reset. For heating, indoor CFM may be set too low. For zoning system, zone CFM may be set too low.
E 413	Critical	The high pressure switch has opened 5 times within one hour. As a result, the outdoor unit is locked out. <i>NOTE - Unused on AC units. Used for heat pump applications only.</i>	Open high pressure switch error count reached 5 strikes. System is shut down. The high pressure switch for HFC-410A will open at 590PSIG and close at 418PSIG. Confirm that the system is properly charged with refrigerant. Check condenser fan motor, clogged TXV, blockage to indoor unit blower motor, stuck reversing valve or clogged refrigerant filter. Confirm that the outdoor unit is clean. The alarm clears after a power reset. For heating, indoor CFM may be set too low. For zoning system, zone CFM may be set too low.

Compressor Operation, Testing and Status / Error Codes

OPERATION:

The compressor is a 380VAC three-phase variable-capacity scroll compressor that is approved for use with HFC-410A refrigerant. The compressor, when connected to an inverter, is capable of operating in a running frequency range from 22 hertz up to a maximum of 70 Hertz (maximum hertz is dependent on compressor size). The compressor speed is determined by demand from the room thermostat.

TESTING:

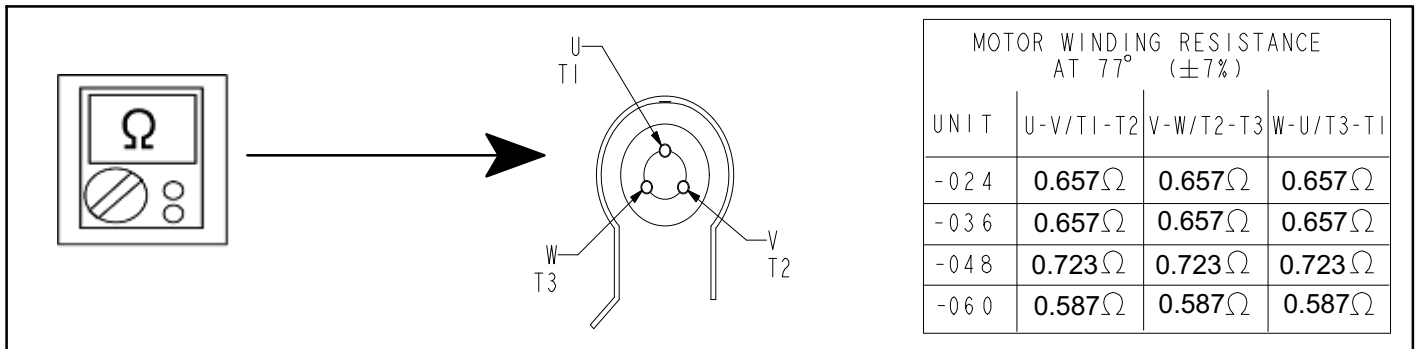


Figure 16. Compressor Operation, Checkout and Status/Error Codes

STATUS CODES:

When the compressor is running, the 7-segment display on the outdoor control sends the current compressor demand (as a percentage) to the room thermostat. (Example: **C 5 0** – compressor is running at 50% of maximum speed.)

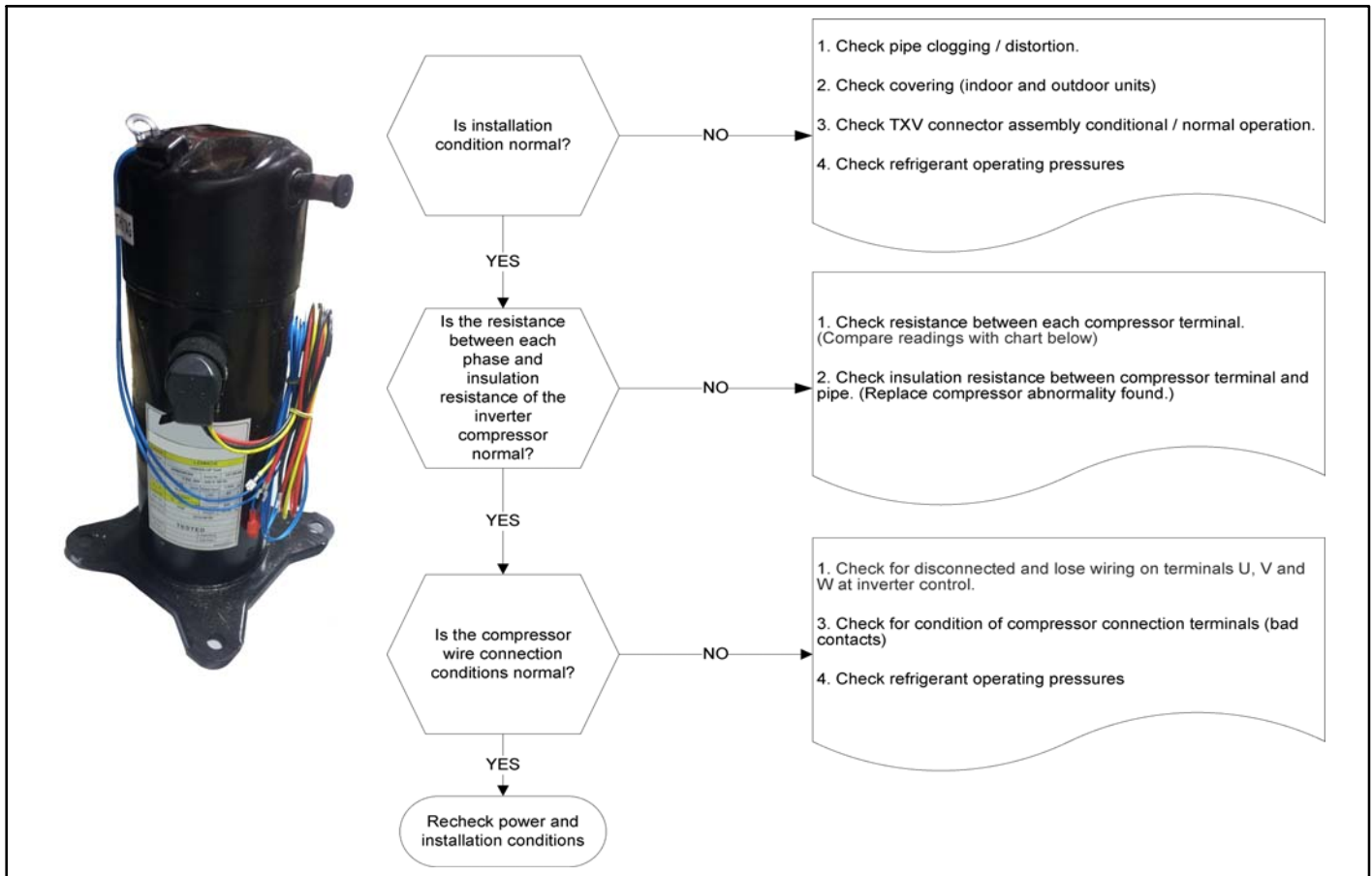


Figure 17. Compressor Operation, Testing and Status/Error Codes

ERROR CODES:

Table 7. Outdoor Control 7-Segment Display Alert Codes - Compressor

System fault and lockout codes take precedence over system status codes (cooling, heating operating percentages or defrost/dehumidification). Only the latest active fault or lockout codes are displayed (if present). If no fault or lockout codes are active, then system status codes are displayed. Alert codes are also displayed on the thermostat..

Alert Codes	Inverter Code	Inverter LED Flash Code (number of flashes)		Priority	Alarm Description	Possible Causes and Clearing Alarm
		Red LED	Green LED			
E 430	26	2 flashes	6 flashes	Moderate / Critical	Compressor start failure.	If condition is detected, outdoor unit compressor and fan stop. Anti-short cycle is initiated. If condition occurs 10 times within an hour, system is locked out. Indicates poor connection at compressor harness, improper winding resistance, locked compressor rotor, or flooded compressor. To clear, disconnect power to outdoor unit and restart.
E 433	29	2 flashes	9 flashes	Moderate / Critical	The inverter has detected a compressor over-current condition.	Error occurs when compressor peak phase current is greater than 28A. Inverter issues code 14 first and slows down to try to reduce the current. If the current remains high, outdoor unit compressor and fan stop. Anti-short cycle is initiated. If condition occurs 5 times within an hour, system is locked out. To clear disconnect power to outdoor unit and restart.
E 439	12	1 flash	2 flashes	Moderate	Compressor slow-down due to high input current.	Input current is approaching a high limit. Compressor speed automatically slows. The control continues sending the inverter speed demanded by the thermostat. The control sets indoor CFM and outdoor RPM to values according to demand percentage rather than the actual Hz. Alarm is automatically clear.

Table 7. Outdoor Control 7-Segment Display Alert Codes - Compressor

System fault and lockout codes take precedence over system status codes (cooling, heating operating percentages or defrost/dehumidification). Only the latest active fault or lockout codes are displayed (if present). If no fault or lockout codes are active, then system status codes are displayed. Alert codes are also displayed on the thermostat..

Alert Codes	Inverter Code	Inverter LED Flash Code (number of flashes)		Priority	Alarm Description	Possible Causes and Clearing Alarm
		Red LED	Green LED			
E 440	13	1 flash	3 flashes	Moderate	Heat sink temperature is approaching limit. The compressor speed automatically slows to reduce heat sink temperature. The control sets indoor CFM and outdoor RPM to values according to demand percentage rather than the actual Hz. Alarm is automatically cleared.	<p>Issue: Feedback from supplier tear down of inverter indicates that the screws that hold the inverter to the inverter board were loose causing poor contact between these two components.</p> <p>Corrective action: Tighten screws that hold the heat sink to the inverter control board.</p> <p>NOTE: Wait 5 minutes to all capacitor to discharge before checking screws.</p>
E 441	14	1 flash	4 flashes	Moderate	Compressor slow-down due to high compressor current. Compressor current is approaching limit. The compressor speed automatically slows. The control sets indoor CFM and outdoor RPM to values according to demand percentage rather than the actual Hz. Alarm is automatically cleared..	<p>Issue: Possible issue is system running at high pressures. Check for high pressure trips or other alert codes in room thermostat and outdoor control.</p>
E 600	N/A	N/A	N/A	Critical	Compressor has been cycled OFF on utility load shedding.	Load shedding function: Provides a method for a local utility company to limit the maximum power level usage of the outdoor unit. The feature is activated by applying 24 volts AC power to the L and C terminals on the outdoor control.

Crankcase Heater, Testing and Status / Error Codes

OPERATION:

CRANKCASE HEATER (HR1)

Compressors in all units are equipped with a 40 watt belly-band type crankcase heater. The heater prevents liquid from accumulating in the compressor. The heater is controlled by the crankcase heater thermostat.

CRANKCASE HEATER THERMOSTAT (S40)

Crankcase heater thermostat S40 controls the crankcase heater in all units and is located on the liquid line.

1. When liquid line temperature drops below 50°F the thermostat closes which results in the heater being energized.
2. When liquid line temperature rises above 70°F the thermostat opens which results in the heater being de-energized.

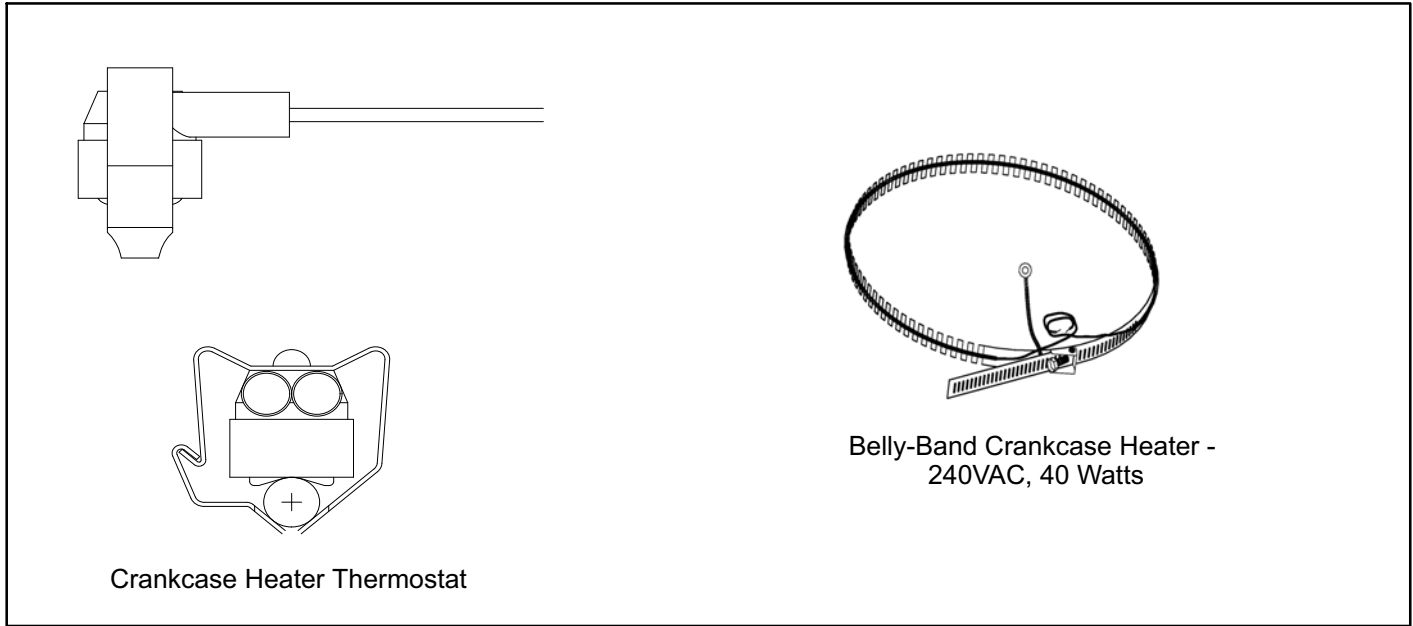


Figure 18. Belly-Band Crankcase Heater Thermostat

TESTING:

Belly-Band Crankcase Heater: Using meter set on ohms, check crankcase heater resistance. If resistance is 0 ohms or infinite, replace the crankcase heater.

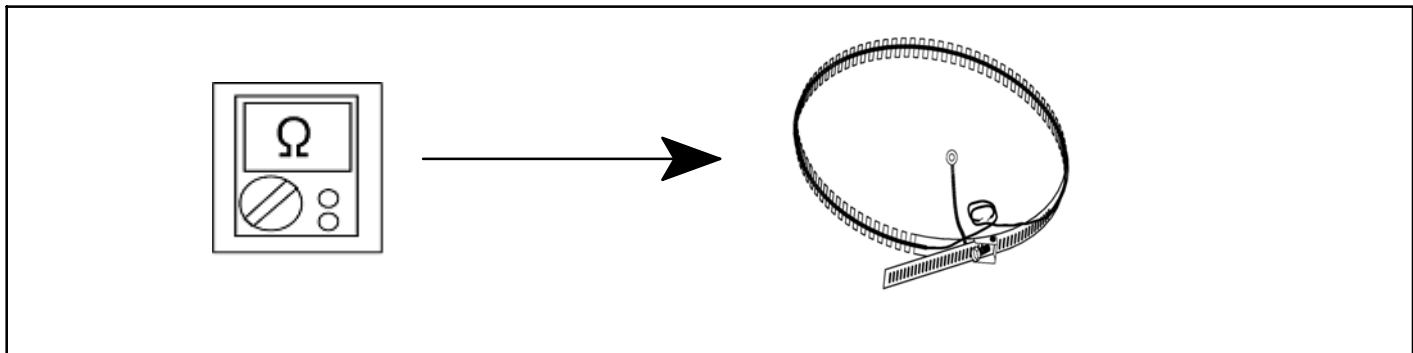


Figure 19. Checking Belly-Band Crankcase Heater

Crankcase Heater Thermostat: As the detected temperature changes, the resistance across the sensor changes. Table 11 shows how the resistance varies as the temperature changes for this sensor.

NOTE - When checking the ohms across a sensor, be aware that a sensor showing a resistance value that is not within the range shown in table 11 may be performing as designed. However, if a shorted or open circuit is detected, the sensor is faulty; the sensor needs to be replaced.

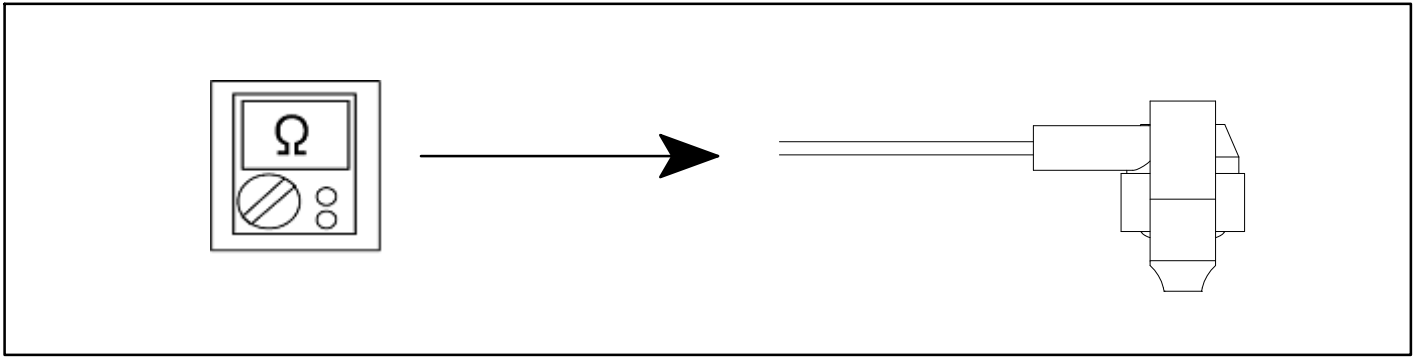


Figure 20. Checking Crankcase Heater Thermostat

STATUS CODE:

None

ERROR CODES:

None

Top Cap Switch Operation, Testing and Status / Error Codes

OPERATION:

Top Cap Thermal Sensor Switch (S173)

Some units are equipped with a compressor-mounted normally closed temperature switch that prevents compressor damage due to overheating caused by internal friction. The switch is located on top of the compressor casing. This switch senses the compressor casing temperature and opens at 239-257°F to shut off compressor operation. The auto-reset switch closes when the compressor casing temperature falls to 151-187°F, and the compressor is re-energized. This single-pole, single-throw (SPST) bi-metallic switch.

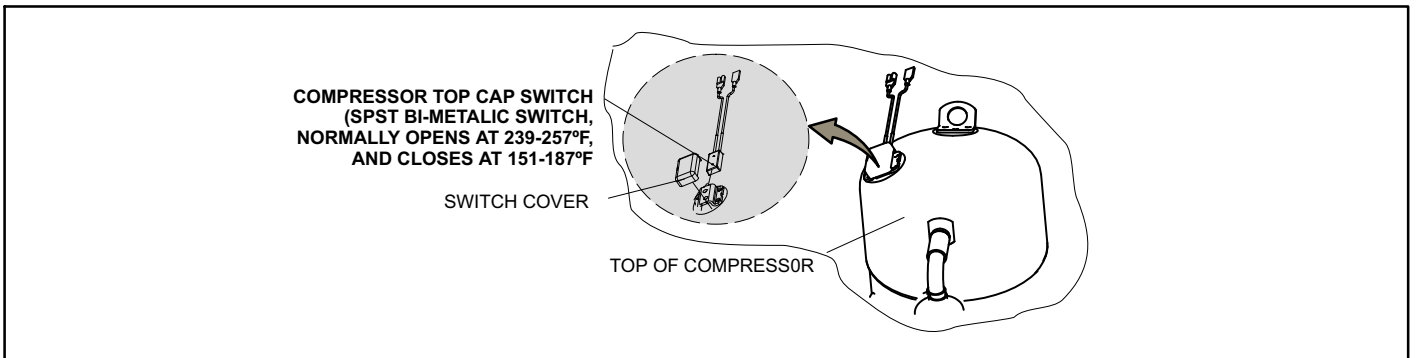


Figure 21. Top Cap Thermal Sensor Switch

TESTING:

Using a multimeter set to ohms, with the terminals disconnected from the system, check the resistance between the two terminals of the top cap switch. If the meter display does not change, the switch is open. If the meter display goes to infinite, the switch is closed.

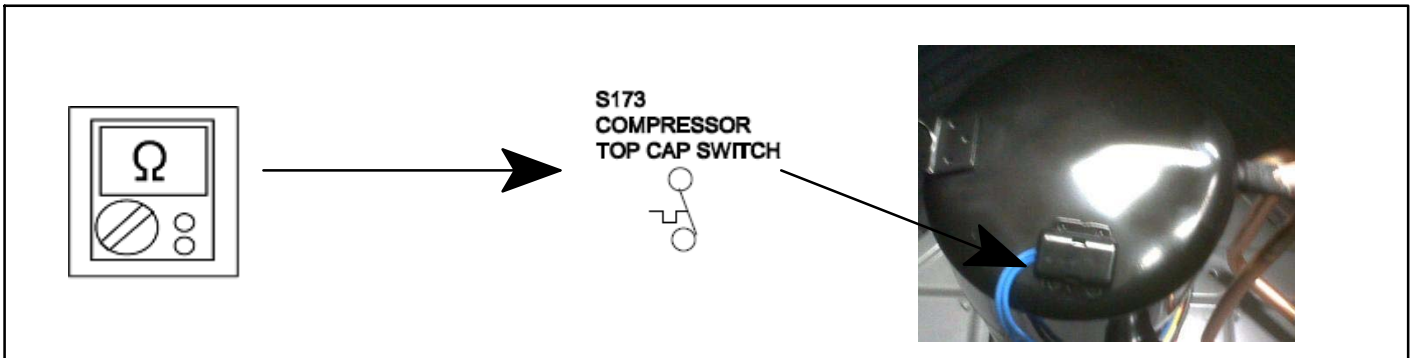


Figure 22. Verifying Top Cap Thermal Sensor Switch

STATUS:

None

ERROR:

Table 8. Outdoor Control 7-Segment Display Alert Codes - Top Cap Switch			
NOTE - System fault and lockout codes take precedence over system status codes (cooling, heating operating percentages or defrost/dehumidification). Only the latest active fault or lockout codes are displayed (if present). If no fault or lockout codes are active, then system status codes are displayed. Alert codes are also displayed on the thermostat.			
Alert Codes	Priority	Alarm Description	Possible Causes and Clearing Alarm
E 422	Moderate	Compressor top cap switch exceeding thermal limit.	Issue: One of the wires from the top cap switch had pulled off one of the TP terminals on the outdoor control board. Corrective Action: Reconnected wire onto top cap terminal.
E 442	Critical	The top cap switch has opened 5 times within one hour. As a result, the outdoor unit is locked out.	When compressor thermal protection sensor opens 5 times within 1 hour, outdoor stops working. To clear, disconnect power to outdoor unit and restart.

Reactor Operations, Testing and Status / Error Codes

OPERATION:

Reactor (Inductor or choke) is a passive two-terminal electrical component that stores energy in its magnetic field. Reactors are one of the basic components used in electronics where current and voltage change with time, due to the ability of inductors to delay and reshape alternating currents.

TESTING::

Main Power **ON** – Voltage **IN** reactor should be the same as the voltage **OUT**. With main power **OFF** and reactor disconnected from system; resistance between leads should be the same (brown **IN** to brown **OUT**, blue **IN** to blue **OUT**).

STATUS CODES:

None

ERROR CODES:

None

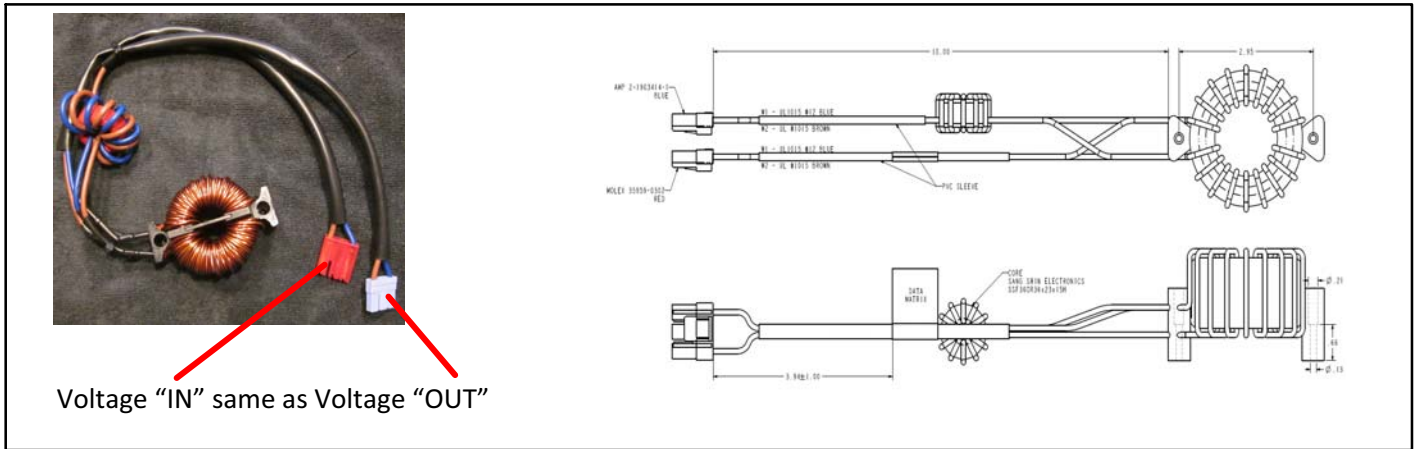


Figure 23. 2- and 3-Ton Reactor

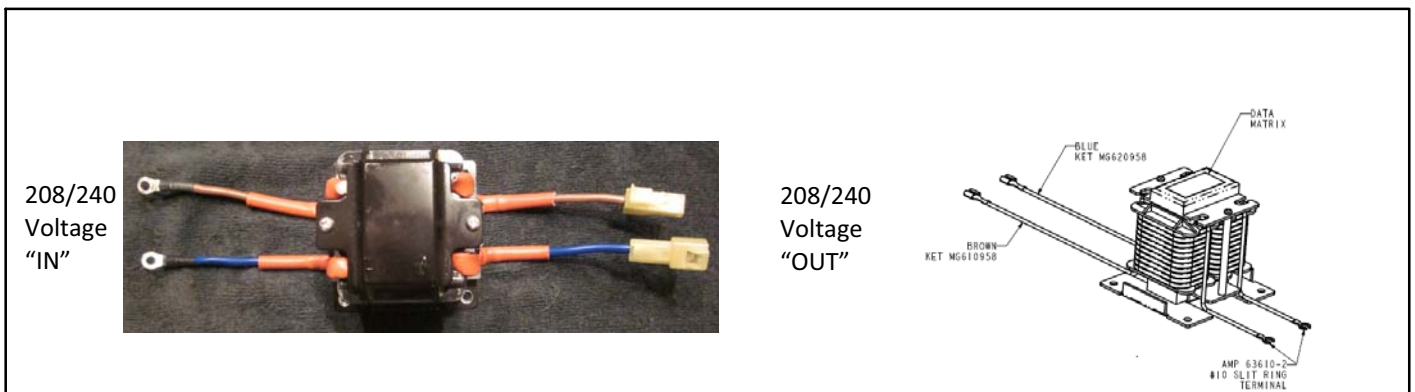


Figure 24. 4- and 5-Ton Reactor

Line Filter (Electromagnetic Compatibility Circuit - EMC) Operations, Testing and Status / Error Codes

OPERATION:

The line filter reduces the unintentional conducted emission from the equipment, to a level sufficient to pass regulatory limits (such as FCC part 15).

The filter is rated at 208/230 volt, 30 amp maximum, 60 Hertz.

NOTE - The 2- and 3-ton inverters have the EMC built-in. The 4- and 5-ton units have an external device (see illustration below).

NOTE - A line filter is an electronic filter which is placed between electronic equipment and an external power source in order to attenuate conducted radio frequency interference (RFI). RFI is also known as electromagnetic interference (EMI).

TESTING:

Voltage **IN** should read the same value as the Voltage **OUT**. With filter isolated from system, resistance between **L1** and **L2** should be the same as resistance between **N1** and **N2**.

STATUS CODES:

None

ERROR CODES:

None

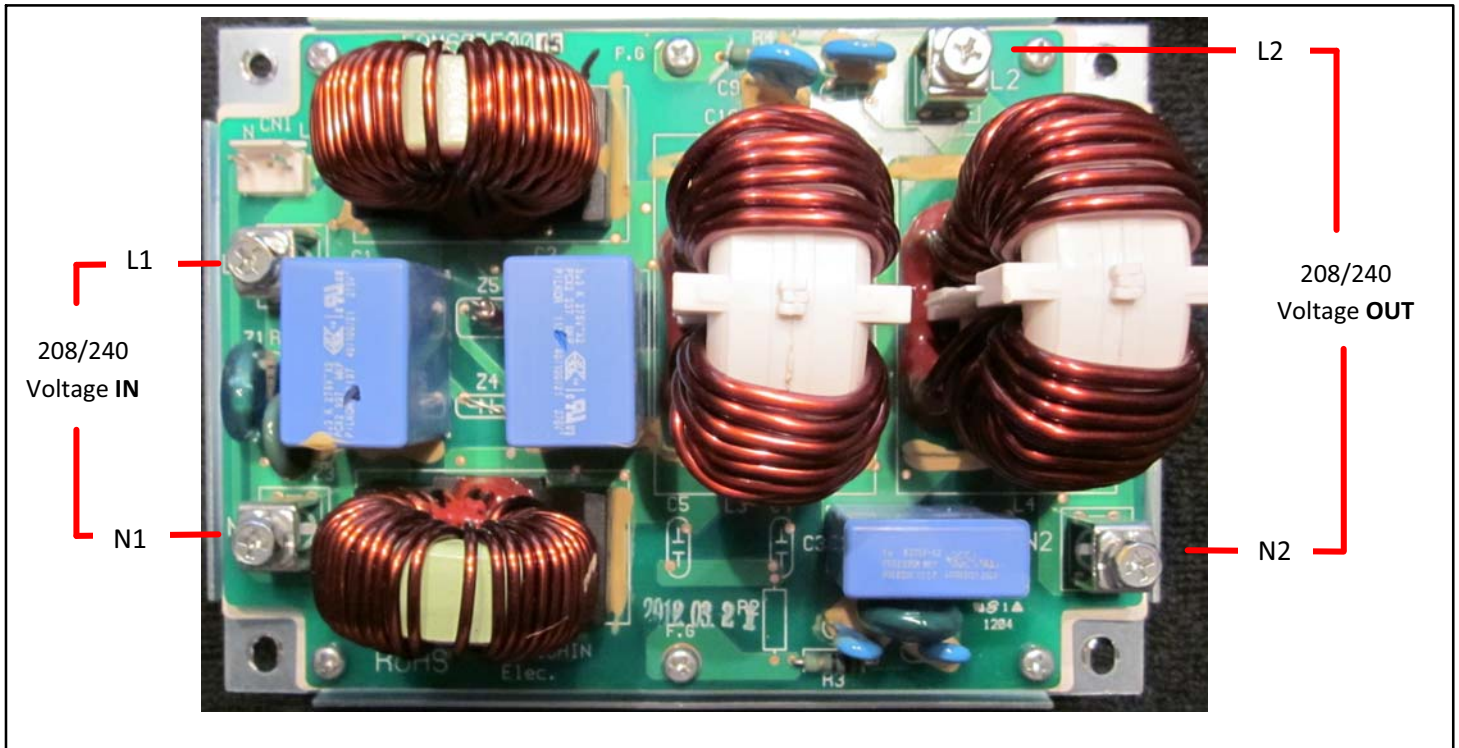


Figure 25. 4- and 5-Ton Filter Board (EMC)

Outdoor Fan Operation and Testing

OPERATION:

These units use an integrated control and motor that is programmed for variable-capacity operation. The fan speed is controlled by the Comfort Sync™ thermostat.

TESTING:

VAC Voltage Check

Check for 208/240 VAC power at inverter contactor (red wires) (see figure 26).

With unit operating, check for main VAC to motor and outdoor control VDC output to motor:

1. No voltage present – Check main power
2. Voltage present – Perform DC volt checks (19 -23 VDC between FAN PWM and COM)

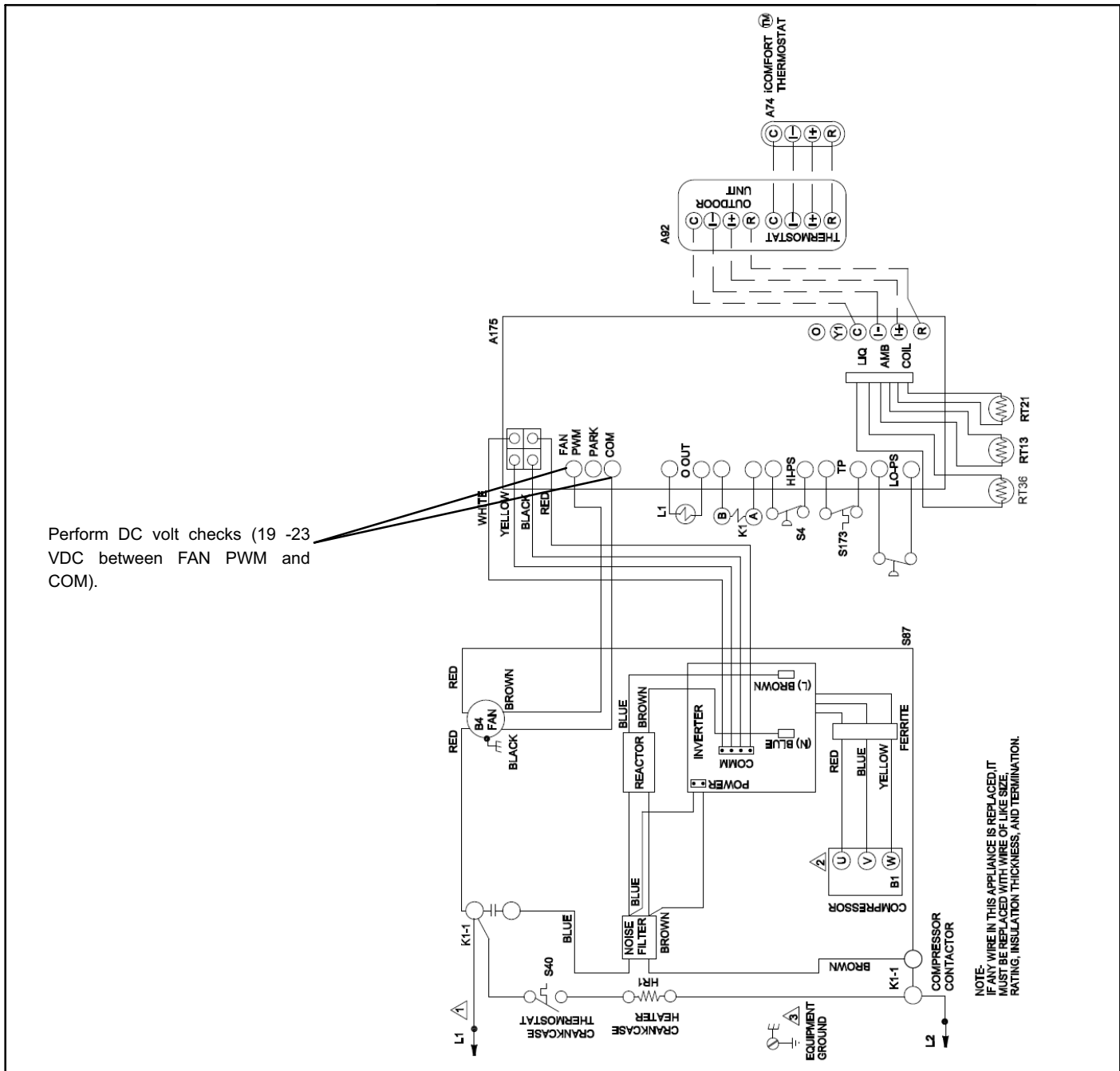


Figure 26. VAC Voltage Check

VDC Voltage Check:

Check for VDC out of Fan PWM and COM. VDC output reading is determined by the percentage of room thermostat demand.

1. No voltage present – Remove wires from control and check for VDC. If there is no voltage present, then replace outdoor control.
2. Voltage present – Perform a 9-volt battery test on motor (see figure 27).

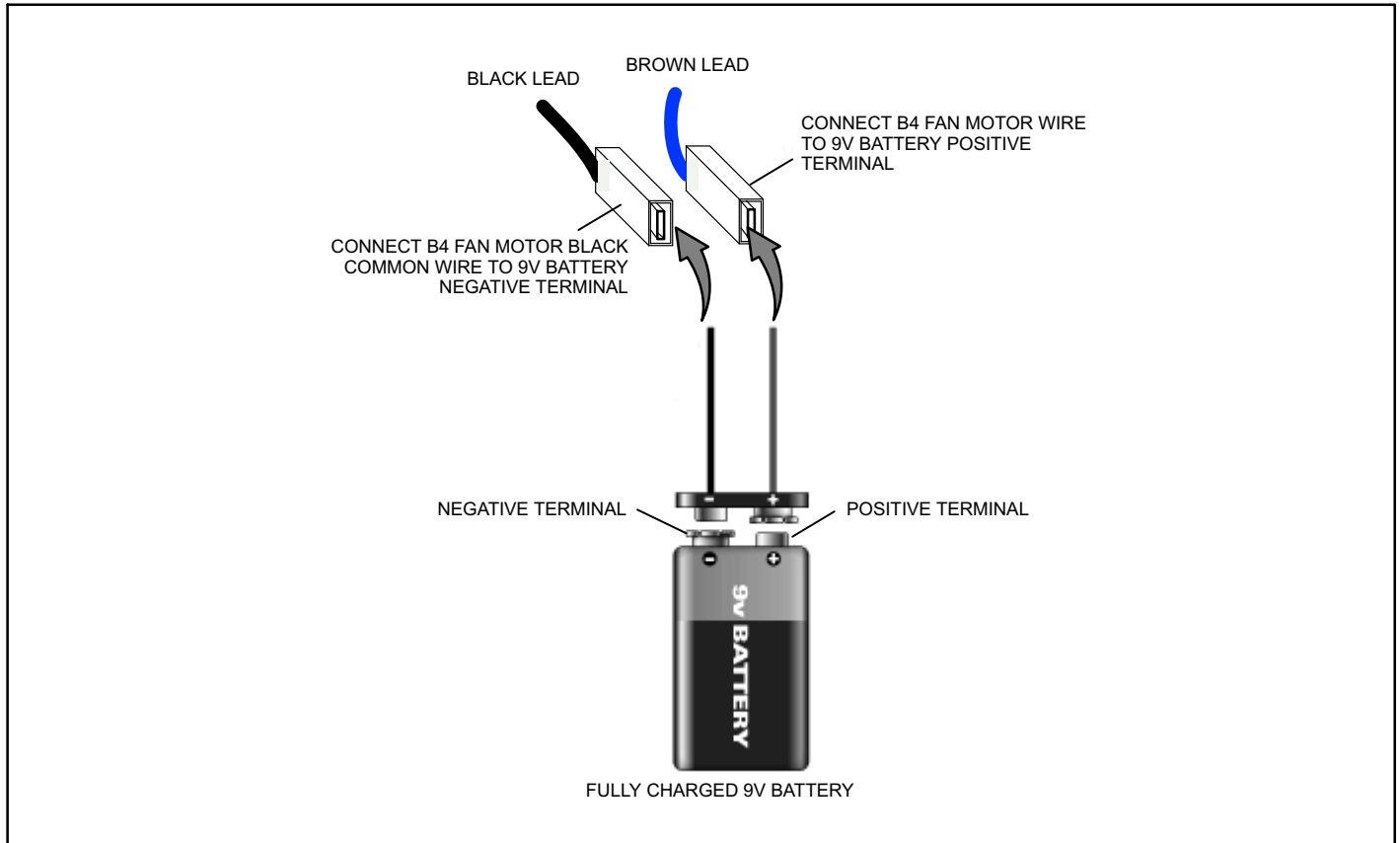


Figure 27. VDC Voltage Check

STATUS OR ERROR CODES:

There is no feedback from the outdoor fan motor to the outdoor control therefore no status or error codes are displayed on either the outdoor control or room thermostat.

NOTE - If the outdoor fan does not operate at the correct RPM, or does not start, the system will shut be down by other protection components such as the high and low pressure switches which will generate error code(s).

Ferrites

Electronic cabling and wires, by virtue of their length-to-width ratios, are perfect natural antennas. In the presence of high-speed microprocessor signals, cables will conduct, radiate, and receive unwanted high-frequency signals. Use an insertion-loss device, such as a ferrite suppressor as shown below, to control radio-frequency (RF) interference.

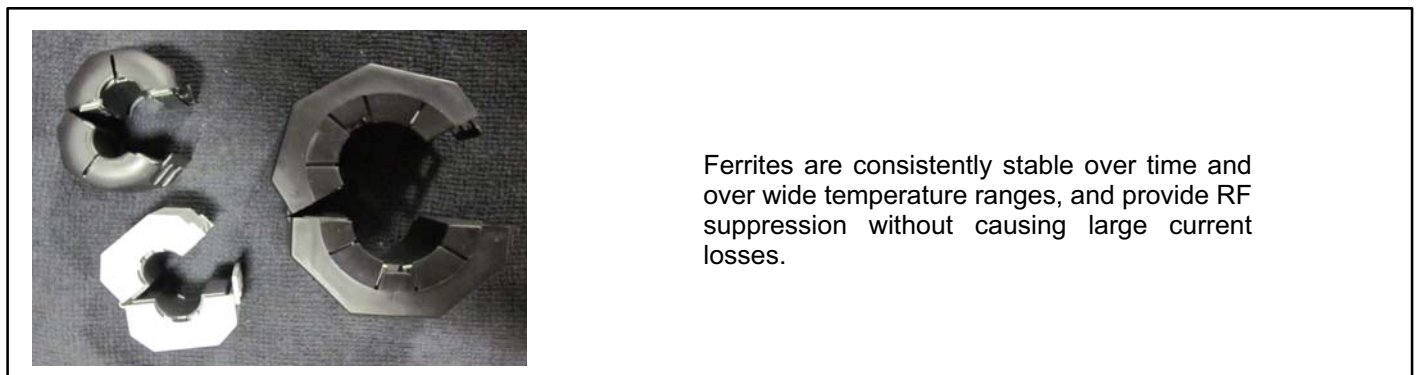


Figure 28. Ferrites

Outdoor Control Operation, Testing and Status / Error Codes

OPERATION:

The outdoor control is a microprocessor-based device for use with variable-capacity compressors up to 5-tons in capacity operating on 24VAC residential power. The outdoor control integrates the functionality of maintaining compressor speed, demand, defrost and fan PWM controls. The outdoor control is self-configuring. During start-up the outdoor control selects one of two configurations - variable-capacity air conditioner or variable-capacity heat pump.

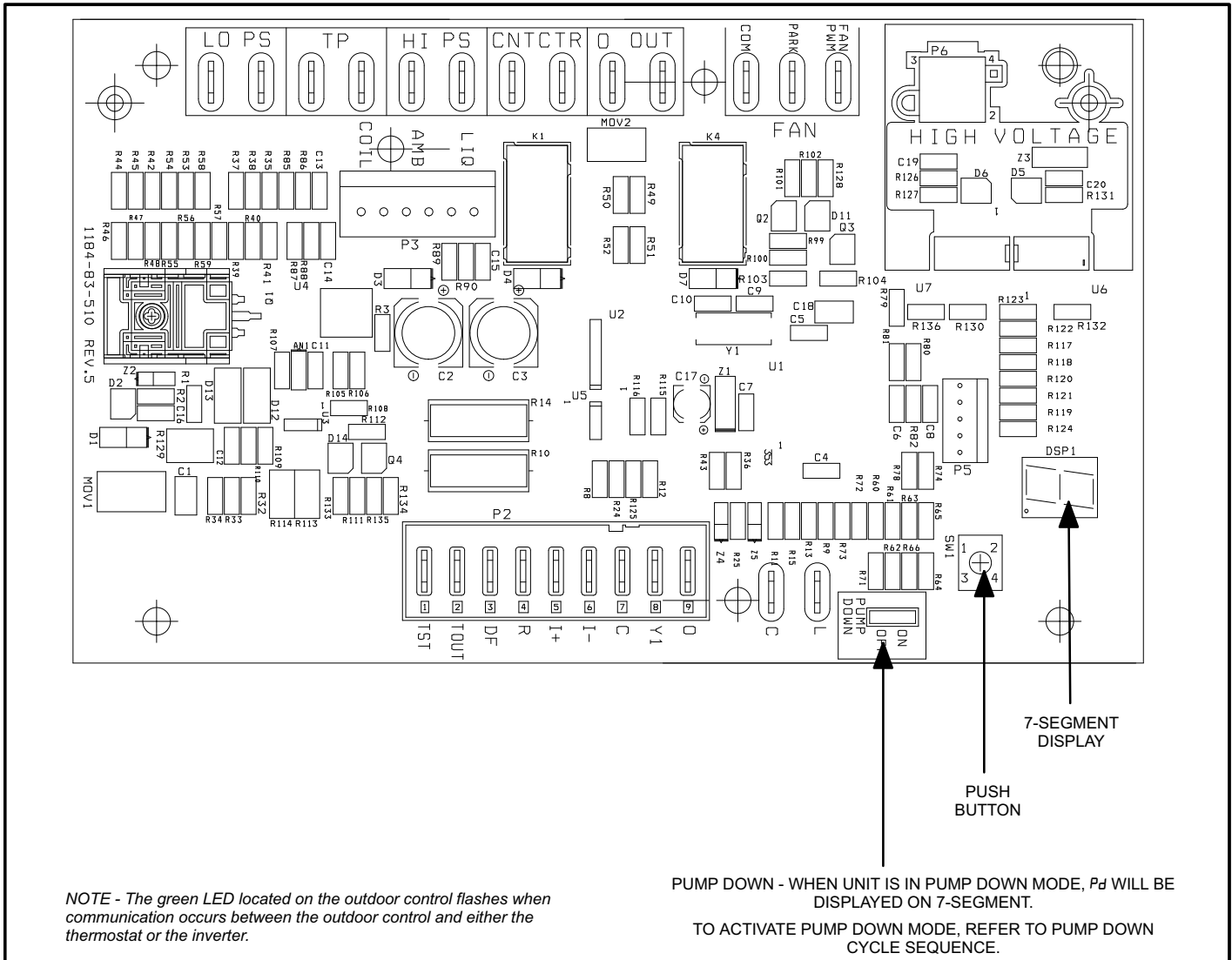


Figure 29. Outdoor Control Unit

STATUS CODES:

Table 9. Outdoor Control 7-Segment Display Alert Codes - Outdoor Control Status			
NOTE - System fault and lockout codes take precedence over system status codes (cooling, heating operating percentages or defrost/dehumidification). Only the latest active fault or lockout codes are displayed (if present). If no fault or lockout codes are active, then system status codes are displayed. Alert codes are also displayed on the thermostat.			
Alert Codes	Priority	Alarm Description	Possible Causes and Clearing Alarm
E 600	Critical	Compressor has been cycled OFF on utility load shedding.	Load shedding function: Provides a method for a local utility company to limit the maximum power level usage of the outdoor unit. The feature is activated by applying 24 volts AC power to the L and C terminals on the outdoor control.
E 601	Critical	Outdoor unit has been cycled OFF on low temperature protection.	Low temperature Protection: Outdoor unit will not operate when the outdoor temperature is at or below -4°F (-20°C). If the unit is operating and the outdoor temperature drops below -4°F (-20°C), the unit will continue to operate until the room thermostat is satisfied or the outdoor temperature drops to -15°F (-26°C). (Outdoor unit ambient sensor provides temperature readings.)

ERROR CODES:

Table 10. Outdoor Control 7-Segment Display Alert Codes - Outdoor Control Errors

NOTE - System fault and lockout codes take precedence over system status codes (cooling, heating operating percentages or defrost/dehumidification). Only the latest active fault or lockout codes are displayed (if present). If no fault or lockout codes are active, then system status codes are displayed. Alert codes are also displayed on the thermostat.

Alert Codes	Priority	Alarm Description	Possible Causes and Clearing Alarm
E 105	Moderate	The outdoor control has lost communication with either the thermostat or indoor unit.	Equipment is unable to communicate. Indicates numerous message errors. In most cases errors are related to electrical noise. Make sure high voltage power is separated from RSBus. Check for mis-wired and/or loose connections between the stat, indoor unit and outdoor unit. Check for a high voltage source of noise close to the system. Fault clears after communication is restored.
E 120	Moderate	There is a delay in the outdoor unit responding to the system.	Typically, this alarm/code does not cause any issues and will clear on its own. The alarm / code is usually caused by a delay in the outdoor unit responding to the thermostat. Check all wiring connections. Cleared after unresponsive device responds to any inquiry.
E 124	Critical	The thermostat has lost communication with the outdoor unit for more than 3 minutes.	Equipment lost communication with the thermostat. Check the wiring connections, ohm wires and cycle power. The alarm stops all associated HVAC operations and waits for a heartbeat message from the unit that's not communicating. The alarm / fault clears after communication is re-established.
E 125	Critical	There is a hardware problem with the outdoor control.	There is a control hardware problem. Replace the outdoor control if the problem prevents operation and is persistent. The alarm / fault is cleared 300 seconds after the fault recovers.
E 131	Critical	The outdoor unit control parameters are corrupted	Reconfigure the system. Replace the control if heating or cooling is not available.
E 132	Critical	Internal software error.	Replace outdoor control.

Unit Sensor Operations, Testing and Status / Error Codes

OPERATION

Pins 5 and 6 (No Sensor)

There is no sensor located on positions 5 and 6 of the connector. A resistor installed between pins 5 and 6 on the cable harness provides continuity for this circuit. This resistor (location shown in figure 31) provides resistance value between 314669 and 3779 ohms. If the resistor becomes damaged or lost, the outdoor control generates a false error code indicating the coil temperature sensor is out of range or faulty (see table 11). If resistor is damaged or missing, order replacement harness assembly (101334-05).

Ambient Temperature Sensor (RT13)

Ambient temperatures, as read by the ambient temperature sensor (shown in figure 31) which are below -35°F (-37°C) or above 120°F (48°C) trigger a fault condition. If the ambient sensor is open, shorted, or out of the temperature range of the sensor, the control does not perform demand defrost operation. The control reverts to time/temperature defrost operation and displays the appropriate alert code (see table 11). Heating and cooling operation is allowed in this fault condition.

Liquid Line Temperature Sensor (RT36)

Liquid line temperatures below -40°F (-40°C) or above 140°F (60°C) trigger a fault condition and result in the appropriate alarm code (see table 11). The outdoor control uses the liquid line sensor to change the fan speed, allowing cooling operation at lowered ambient temperatures.

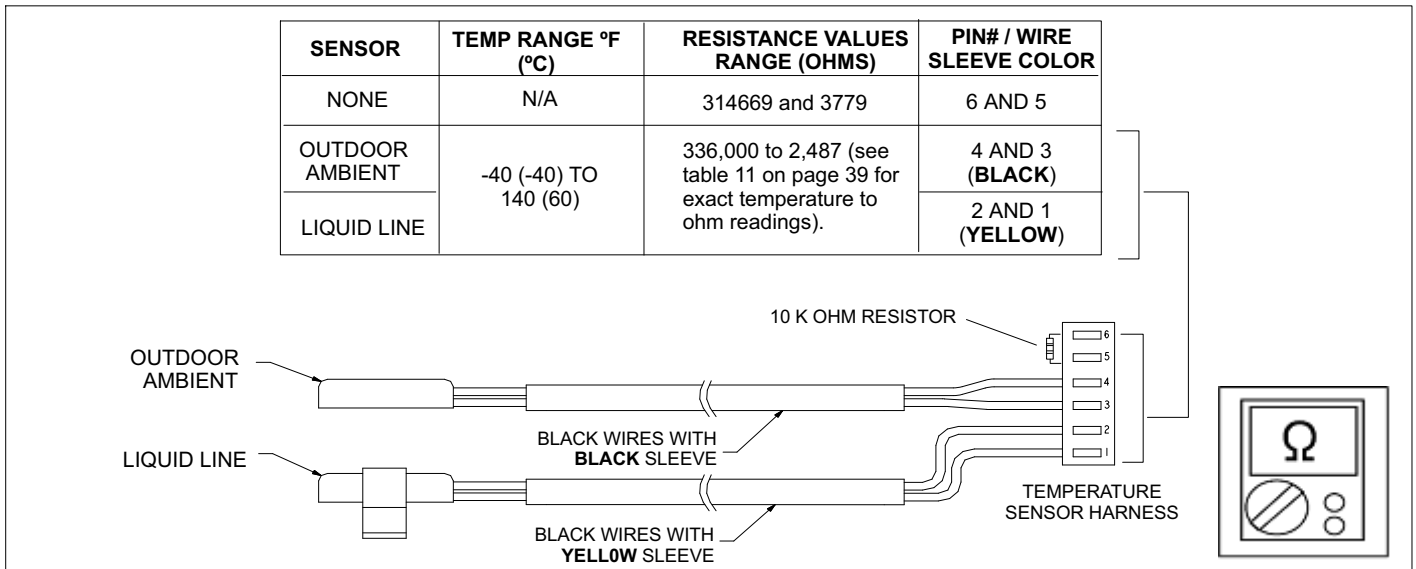


Figure 30. Temperature Sensor Specifications

TESTING

Sensors connect to the outdoor control through a field-replaceable harness assembly that plugs into the outdoor control. Through the sensors, the control detects outdoor ambient, coil and liquid temperature fault conditions. As the detected temperature changes, the resistance across the sensor changes. Check sensor operation by reading ohms across pins shown in figure 30.

NOTE - When checking the ohms across a sensor, be aware that a sensor showing a resistance value that is not within the range shown in figure 30, may be performing as designed. However, if a shorted or open circuit is detected, then the sensor may be faulty and the sensor harness will need to be replaced.

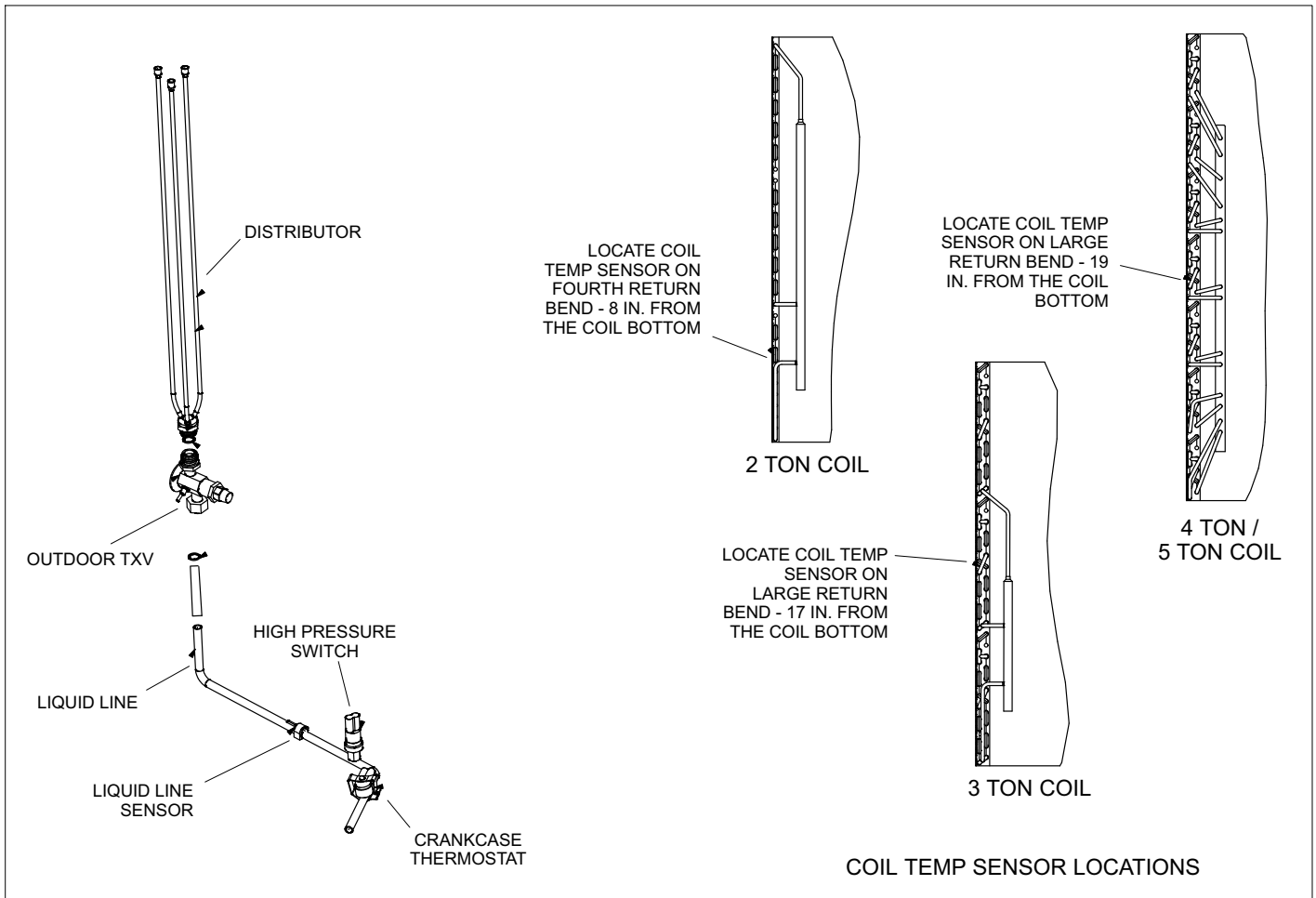


Figure 31. Temperature Sensor Locations

Table 11. Ambient and Liquid Line Sensors Temperature / Resistance Range

Degrees Fahr- enheit	Resistance	Degrees Fahr- enheit	Resistance	Degrees Fahr- enheit	Resistance	Degrees Fahr- enheit	Resistance
136.3	2680	56.8	16657	21.6	44154	-11.3	123152
133.1	2859	56.0	16973	21.0	44851	-11.9	125787
130.1	3040	55.3	17293	20.5	45560	-12.6	128508
127.3	3223	54.6	17616	20.0	46281	-13.2	131320
124.7	3407	53.9	17942	19.4	47014	-13.9	134227
122.1	3592	53.2	18273	18.9	47759	-14.5	137234
119.7	3779	52.5	18607	18.4	48517	-15.2	140347
117.5	3968	51.9	18945	17.8	49289	-15.9	143571
115.3	4159	51.2	19287	17.3	50074	-16.5	146913
113.2	4351	50.5	19633	16.8	50873	-17.2	150378
111.2	4544	49.9	19982	16.3	51686	-17.9	153974
109.3	4740	49.2	20336	15.7	52514	-18.6	157708
107.4	4937	48.5	20695	15.2	53356	-19.3	161588
105.6	5136	47.9	21057	14.7	54215	-20.1	165624
103.9	5336	47.3	21424	14.1	55089	-20.8	169824
102.3	5539	46.6	21795	13.6	55979	-21.5	174200
100.6	5743	46.0	22171	13.1	56887	-22.3	178762
99.1	5949	45.4	22551	12.5	57811	-23.0	183522
97.6	6157	44.7	22936	12.0	58754	-23.8	188493
96.1	6367	44.1	23326	11.5	59715	-24.6	193691
94.7	6578	43.5	23720	11.0	60694	-25.4	199130
93.3	6792	42.9	24120	10.4	61693	-26.2	204829
92.0	7007	42.3	24525	9.9	62712	-27.0	210805
90.6	7225	41.7	24934	9.3	63752	-27.8	217080
89.4	7444	41.1	25349	8.8	64812	-28.7	223677
88.1	7666	40.5	25769	8.3	65895	-29.5	230621
86.9	7890	39.9	26195	7.7	67000	-30.4	237941
85.7	8115	39.3	26626	7.2	68128	-31.3	245667
84.5	8343	38.7	27063	6.7	69281	-32.2	253834
83.4	8573	38.1	27505	6.1	70458	-33.2	262482
82.3	8806	37.5	27954	5.6	71661	-34.1	271655
81.2	9040	37.0	28408	5.0	72890	-35.1	281400
80.1	9277	36.4	28868	4.5	74147	-36.1	291774
79.0	9516	35.8	29335	3.9	75431	-37.1	302840
78.0	9757	35.2	29808	3.4	76745	-38.2	314669
77.0	10001	34.7	30288	2.8	78090	-39.2	327343
76.0	10247	34.1	30774	2.3	79465		
75.0	10496	33.5	31267	1.7	80873		
74.1	10747	33.0	31766	1.2	82314		
73.1	11000	32.4	32273	0.6	83790		
72.2	11256	31.9	32787	0.0	85302		
71.3	11515	31.3	33309	-0.5	86852		
70.4	11776	30.7	33837	-1.1	88440		
69.5	12040	30.2	34374	-1.7	90068		
68.6	12306	29.6	34918	-2.2	91738		
67.7	12575	29.1	35471	-2.8	93452		
66.9	12847	28.6	36031	-3.4	95211		
66.0	13122	28.0	36600	-4.0	97016		
65.2	13400	27.5	37177	-4.6	98870		
64.4	13681	26.9	37764	-5.2	100775		
63.6	13964	26.4	38359	-5.7	102733		
62.8	14251	25.8	38963	-6.3	104746		
62.0	14540	25.3	39577	-6.9	106817		
61.2	14833	24.8	40200	-7.5	108948		
60.5	15129	24.2	40833	-8.2	111141		
59.7	15428	23.7	41476	-8.8	113400		
59.0	15730	23.2	42130	-9.4	115727		
58.2	16036	22.6	42794	-10.0	118126		
57.5	16345	22.1	43468	-10.6	120600		

ERROR CODES:

Table 12. Outdoor Control 7-Segment Display Alert Codes - Outdoor Control Errors

NOTE - System fault and lockout codes take precedence over system status codes (cooling, heating operating percentages or defrost/dehumidification). Only the latest active fault or lockout codes are displayed (if present). If no fault or lockout codes are active, then system status codes are displayed. Alert codes are also displayed on the thermostat.

Alert Codes	Priority	Alarm Description	Possible Causes and Clearing Alarm
E 180	Critical	The thermostat has found a problem with the outdoor unit's ambient temperature sensor.	During normal operation, after the outdoor control recognizes sensors, the alarm will be sent only if valid temperature reading is lost. Compare outdoor sensor resistance to temperature/resistance charts in unit installation instructions. Replace sensor pack if necessary. At the beginning of (any) configuration, furnace or air-handler control will detect the presence of the sensor(s). If detected (reading in range), appropriate feature will be set as 'installed' and shown in the thermostat 'About' screen. The alarm / fault will clear upon configuration, or sensing normal values.
E 416	Moderate / Critical	The outdoor coil sensor is either open, short-circuited or the temperature is out of sensor range. As a result the outdoor unit control will not perform defrost.	Coil sensor is detected as open or shorted, or temperature is out of coil sensor range. Outdoor unit control will not perform demand or time/temperature defrost operation. System will still heat or cool. Check the resistance of the coil sensor and compare to temperature resistance chart. Replace coil sensor if needed. The alarm clears when outdoor unit control detects proper coil sensor readings or after a power reset.
E 424	Moderate	Faulty outdoor liquid line sensor	Sensor is open or shorted. Replace the sensor.

DC Inverter Control Operation, Testing, Status / Error Codes

OPERATION OF COMPONENTS:

Electromagnetic compatibility circuit (EMC): EMC ensures the correct operation of different equipment items which use or respond to electromagnetic phenomena. It also helps to negate the effects of interference. *NOTE - The 2- and 3-ton inverter has an EMC built-in. The 4- and 5-ton units have an external inverter.*

CONVERTER:

Converts AC (alternating current) to DC (direct current).

POWER FACTOR CORRECTION (PFC) CIRCUIT:

The PFC module is an integrated part of the outdoor inverter that monitors the DC bus for high, low and abnormal voltage conditions. If any of these conditions are detected, the PFC function and compressor will stop.

INTELLIGENT (INVERTER) POWER MODULE (IPM):

The IPM converts DC power into AC power. The control method is known as pulse width modulation (PWM). This means the DC is switched on and off very quickly (chopped) by the transistor switches to make simulated AC at required frequency and voltage.

COMMUNICATION CONTROL CIRCUIT:

Receives and sends message between the inverter and the outdoor control.

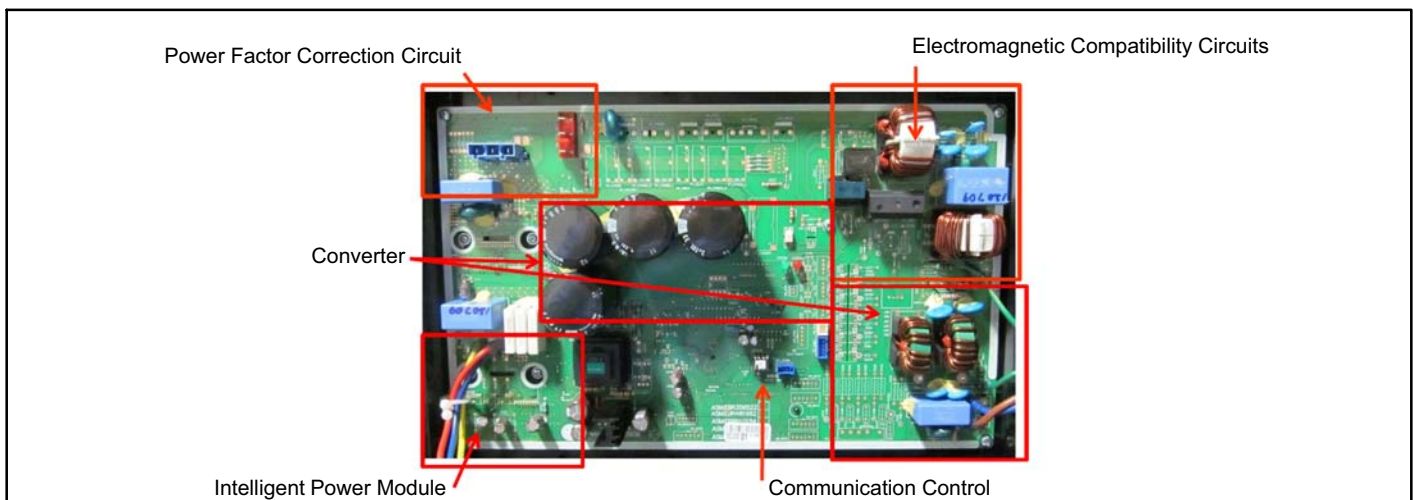


Figure 32. 2- and 3-Ton Unit Inverter

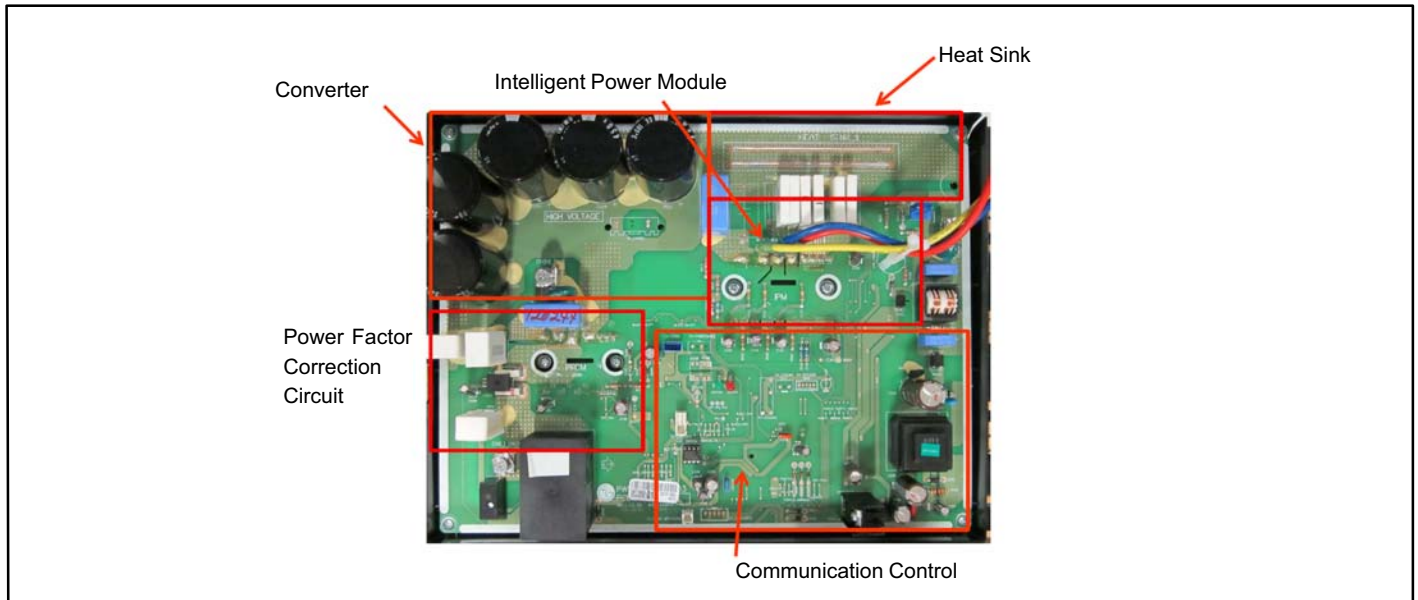


Figure 33. 4- and 5-Ton Unit Inverter

STATUS CODES:

Table 13. Outdoor Control 7-Segment Display Alert Codes and Inverter LED Flash Codes

NOTE - System fault and lockout codes take precedence over system status codes (cooling, heating operating percentages or defrost/dehumidification). Only the latest active fault or lockout codes are displayed (if present). If no fault or lockout codes are active, then system status codes are displayed. Alert codes are also displayed on the thermostat.

Alert Codes	Inverter LED Flash Code (number of flashes)		Priority	Alarm Description	Possible Causes and Clearing Alarm
	Red LED	Green LED			
N/A	ON	OFF	N/A	2- and 3-ton only: Indicates inverter is operating normally.	
N/A	ON	ON	N/A	4- and 5-ton only: Indicates inverter is operating normally.	
N/A	OFF	OFF	N/A	Indicates inverter is NOT energized.	

ERROR CODES:

Table 14. Outdoor Control 7-Segment Display Alert Codes and Inverter LED Flash Codes

NOTE - System fault and lockout codes take precedence over system status codes (cooling, heating operating percentages or defrost/dehumidification). Only the latest active fault or lockout codes are displayed (if present). If no fault or lockout codes are active, then system status codes are displayed. Alert codes are also displayed on the thermostat.

Alert Codes	Inverter Code	Inverter LED Flash Code (number of flashes)		Priority	Alarm Description	Possible Causes and Clearing Alarm
		Red LED	Green LED			
E 423	40	4 flashes	OFF	Moderate / Critical	The inverter has detected a circuit problem.	Control will lock out after 10 strikes within an hour. To clear disconnect power to outdoor unit and restart.
E 426	N/A	N/A	N/A	Critical	Excessive inverter alarms	<p>After ten faults within one hour, control will lock out.</p> <p>Indicates poor system operation. Review history of alarms to resolve system setup. Check condenser fan motor, TXV, indoor unit blower motor, stuck reversing valve, over-charge, undercharge, and clogged refrigerant filter.</p> <p>To clear error, disconnect power to outdoor unit and restart. Inverter alarms 12 to 14 and 53 do not count towards this lock out condition.</p>

Table 14. Outdoor Control 7-Segment Display Alert Codes and Inverter LED Flash Codes

NOTE - System fault and lockout codes take precedence over system status codes (cooling, heating operating percentages or defrost/dehumidification). Only the latest active fault or lockout codes are displayed (if present). If no fault or lockout codes are active, then system status codes are displayed. Alert codes are also displayed on the thermostat.

Alert Codes	Inverter Code	Inverter LED Flash Code (number of flashes)		Priority	Alarm Description	Possible Causes and Clearing Alarm
		Red LED	Green LED			
E 427	21	2 flashes	1 flash	Moderate / Critical	The inverter has detected a DC peak fault condition.	If condition (55A or higher) is detected, outdoor unit will stop (compressor and fan). Anti-short cycle is initiated. If peak current (55A or higher) occurs 10 times within an hour, system will lock out. Indicates high pressure, condenser fan failure, locked compressor rotor or overcharge. To clear, disconnect power to outdoor unit and restart.
E 428	22	2 flashes	2 flashes	Moderate / Critical	The inverter has detected a high main input current condition.	If condition is detected, outdoor unit will stop (compressor and fan). Anti-short cycle is initiated. If condition occurs 5 times within an hour, system will lock out. Indicates high pressure, condenser fan failure or overcharge. To clear, disconnect power to outdoor unit and restart.
E 429	23	2 flashes	3 flashes	Moderate / Critical	On a call for compressor operation, if DC link power in inverter does not rise above 180 VDC for 2 and 3 ton models, 250 VDC for 4 and 5 ton models, within 30 seconds, the control will display a moderate code. If condition is detected, outdoor unit will stop (Compressor and fan). Anti-short cycles is initiated. If condition occurs 10 times within a 60 minute rolling time period, system will lock out and display a critical code.	Issues: (1) If DC link power in inverter does not rise above 180 VDC for 2- and 3-ton models, 250 VDC for 4- and 5-ton models, within 30 seconds, the outdoor control will display a moderate code. (2) Capacitors on inverter do not properly charge. Corrective Actions: (1) check for proper main power to outdoor unit and for any loose electrical connections. (2) Outdoor control boards with part # 103686-03 have software update to delay the de-energizing of the reversing valve by four seconds when coming out of defrost.
E 430	26	2 flashes	6 flashes	Moderate / Critical	Compressor start failure.	If condition is detected, outdoor unit will stop (compressor and fan). Anti-short cycle is initiated. If condition occurs 10 times within an hour, system will lock out. Indicates poor connection at compressor harness, improper winding resistance, locked compressor rotor, or flooded compressor. To clear, disconnect power to outdoor unit and restart.
E 431	27	2 flashes	7 flashes	Moderate / Critical	Error occurs when PFC detects an over-current condition of 100A, the control will display a moderate code. If condition is detected, outdoor unit will stop (Compressor and fan). Anti-short cycle is initiated. Inverter is unavailable to communicate with the outdoor control for 3 minutes. If condition occurs 10 times within a 60 minute rolling time period, system will lock out and display a critical code.	Issues: (1) Indicates power interruption, brownout, poor electrical connection or loose inverter input wire. (2) System testing was set up and code was generated when the reversing valve is de-energized coming out of defrost (code appears with or without 30 compressor delay). Corrective Actions: (1) Check for proper main power to outdoor unit and for any loose electrical connections. (2) Outdoor control boards with part # 103686-03 have software update to delay the de-energizing of the reversing valve by four seconds when coming out of defrost.
E 432	28	2 flashes	8 flashes	Moderate / Critical	The inverter has detected a DC link high voltage condition.	Error occurs when the DC link capacitor voltage is greater than 480VDC. If condition is detected, outdoor unit will stop (compressor and fan). Anti-short cycle is initiated. If condition occurs 10 times within an hour, system will lock out. System will stop. To clear, disconnect power to outdoor unit and restart.

Table 14. Outdoor Control 7-Segment Display Alert Codes and Inverter LED Flash Codes

NOTE - System fault and lockout codes take precedence over system status codes (cooling, heating operating percentages or defrost/dehumidification). Only the latest active fault or lockout codes are displayed (if present). If no fault or lockout codes are active, then system status codes are displayed. Alert codes are also displayed on the thermostat.

Alert Codes	Inverter Code	Inverter LED Flash Code (number of flashes)		Priority	Alarm Description	Possible Causes and Clearing Alarm
		Red LED	Green LED			
E 433	29	2 flashes	9 flashes	Moderate / Critical	The inverter has detected a compressor over-current condition.	Error occurs when compressor peak phase current is greater than 28A. Inverter will issue code 14 first and slow down to try to reduce the current. If the current remains high, outdoor unit will stop (compressor and fan). Anti-short cycle is initiated. If condition occurs 5 times within an hour, system will lock out. To clear disconnect power to outdoor unit and restart.
E 434	53	5 flashes	3 flashes	Moderate / Critical	Outdoor control has lost communications with the inverter for greater than 3 minutes. Outdoor control will stop all compressor demands, re-cycle power to the inverter by de-energizing the contactor for 2 minutes. If this occurs 3 time in one thermostat call, the outdoor unit will locked out and display a critical code.	<p>Issues:</p> <p>(1) Loose electrical connections. (2) Interruption of main power to inverter.</p> <p>Corrective Actions:</p> <p>(1) Check all electrical connections. (2) Check for proper main power to inverter.</p>
E 435	60	6 flashes	OFF	Moderate / Critical	Inverter internal error.	When this error occurs, the outdoor control will cycle power to the inverter by opening the contactor for 2 minutes. Check that the EEPROM is properly seated. After power is cycled to the inverter 3 times, the outdoor unit is locked out.
E 436	62	6 flashes	2 flashes	Moderate / Critical	Inverter heat sink temperature exceeded limit. Occurs when the heat sink temperature exceeds the inverter limit. Inverter issues code 13 first, then slows down to allow the heat sink to cool. If temperature remains high, outdoor unit stops (compressor and fan). Anti-short cycle is initiated. If condition occurs 5 times within an hour, system is locked out. To clear, disconnect power to outdoor unit and restart.	<p>Issue: Feedback from supplier tear down of inverter indicates that the screws that hold the inverter to the inverter board were loose causing poor contact between these two components.</p> <p>Corrective Action: Tighten screws that hold the heat sink to the inverter control board.</p> <p>NOTE: Wait five minutes to all capacitor to discharge before checking screws.</p>
E 437	65	6 flashes	5 flashes	Moderate / Critical	Heat sink temperature sensor fault has occurred (temperature less than 4 °F or greater than 264°F after 10 minutes of operation).	This occurs when the temperature sensor detects a temperature less than 0.4°F or greater than 264°F after 10 minutes of operation. If condition is detected, outdoor unit will stop (compressor and fan). Anti-short cycle is initiated. If condition occurs 5 times within an hour, system will lock out. To clear disconnect power to outdoor unit and restart. If problem persists, replace inverter.
E 438	73	7 flashes	3 flashes	Moderate / Critical	The inverter has detected a PFC over current condition. This would be caused by a high load condition, high pressure, or outdoor fan failure. Outdoor control will display the code when the inverter has the error. After 3 minutes, the inverter will reset and the compressor will turn on again. If it happens 10 times within a 60 minute rolling time period, the OD control will lock out operation of the outdoor unit and display a critical code.	<p>Issue: Possible issue is system running at high pressures. Check for high pressure trips or other alert codes in room thermostat and outdoor control.</p>

Table 14. Outdoor Control 7-Segment Display Alert Codes and Inverter LED Flash Codes

NOTE - System fault and lockout codes take precedence over system status codes (cooling, heating operating percentages or defrost/dehumidification). Only the latest active fault or lockout codes are displayed (if present). If no fault or lockout codes are active, then system status codes are displayed. Alert codes are also displayed on the thermostat.

Alert Codes	Inverter Code	Inverter LED Flash Code (number of flashes)		Priority	Alarm Description	Possible Causes and Clearing Alarm
		Red LED	Green LED			
E 439	12	1 flash	2 flashes	Moderate	Compressor slowdown due to high input current.	Input current is approaching a high limit. Compressor speed will automatically slow down. The control continues sending the inverter speed demanded by the thermostat. The control will set indoor CFM and outdoor RPM to values according to demand percentage rather than the actual Hz. Alarm is automatically clear.
E 440	13	1 flash	3 flashes	Moderate	Heat sink temperature is approaching limit. The compressor speed automatically slows to reduce heat sink temperature. The control sets indoor CFM and outdoor RPM to values according to demand percentage rather than the actual Hz. Alarm is automatically cleared.	<p>Issue: Feedback from supplier tear down of inverter indicates that the screws that hold the inverter to the inverter board were loose causing poor contact between these two components.</p> <p>Corrective action: Tighten screws that hold the heat sink to the inverter control board.</p> <p>NOTE: Wait 5 minutes to all capacitor to discharge before checking screws.</p>
E 441	14	1 flash	4 flashes	Moderate	Compressor slowdown due to high compressor current. Compressor current is approaching limit. The compressor speed automatically slows. The control sets indoor CFM and outdoor RPM to values according to demand percentage rather than the actual Hz. Alarm is automatically cleared..	<p>Issue: Possible issue is system running at high pressures. Check for high pressure trips or other alert codes in room thermostat and outdoor control.</p>

Emergency 24VAC System Operation

The Y terminal located on the outdoor control allows the outdoor unit to be cycled ON and OFF using 24VAC inputs. The outdoor unit will operate at 100% capacity in this configuration.

The following wiring diagrams display the wiring changes needed to switch a full communicating system to a non-communicating system with the unit running in emergency mode (24VAC inputs to outdoor unit).

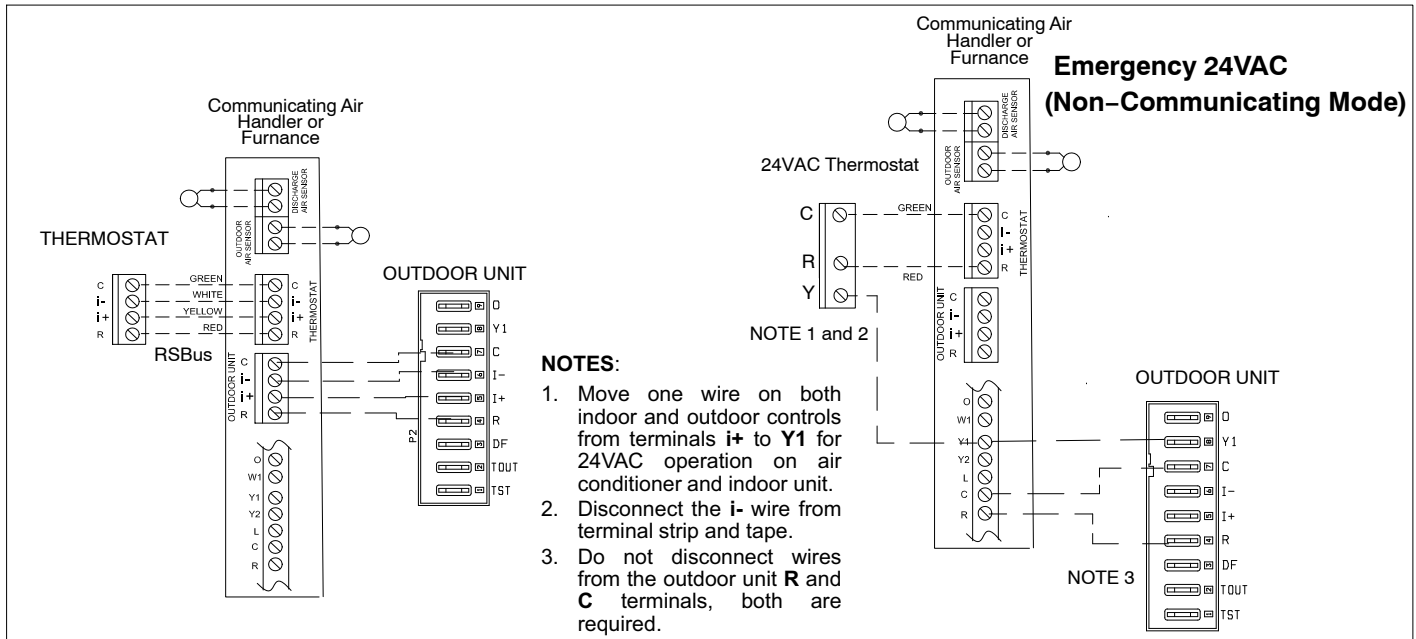


Figure 34. Emergency 24VAC System Operation

System Refrigerant

IMPORTANT !

The system must be operating at full capacity during charging. Increase (heat) or decrease (cooling) the thermostat setting by 5°F to create system demand. Confirm outdoor unit running capacity on the display on the outdoor control. Value should be 100%.

This section outlines the procedures to:

1. Connect a gauge set for testing and charging as illustrated in figure 35.
2. Check and adjust indoor airflow as described in figure 36.
3. Add or remove refrigerant using the weigh-in method shown in figure 37.

4. Verify the charge using the subcooling method described in figure 38.

IMPORTANT: Unit must be operating at 100% input to be charged properly.

ADDING OR REMOVING REFRIGERANT

This system uses HFC-410A refrigerant which operates at much higher pressures than HCFC-22. The liquid line filter drier is approved for use with HFC-410A only. Do not replace it with components designed for use with HCFC-22.

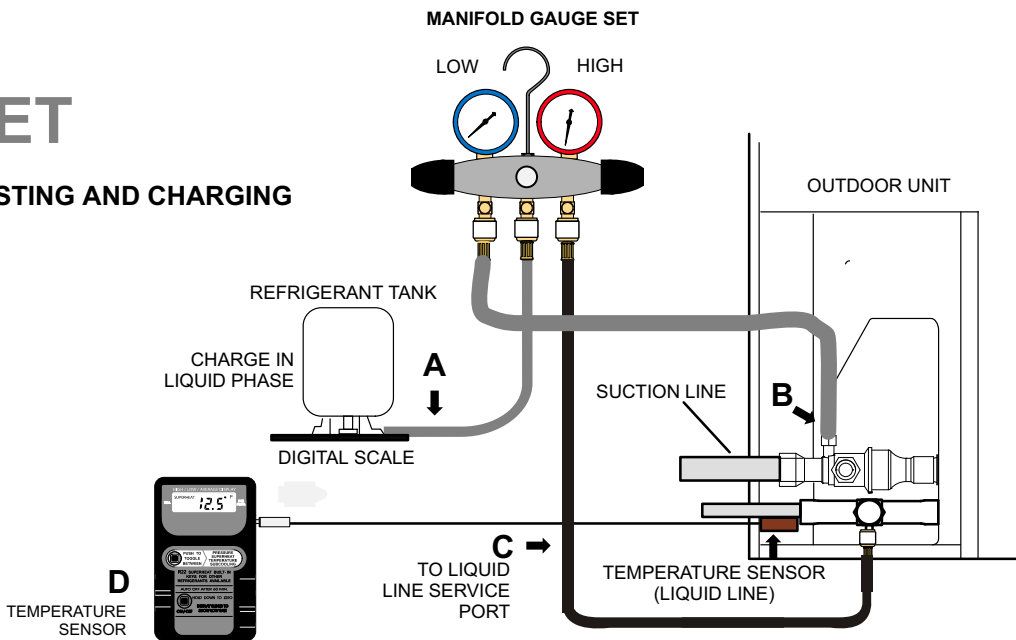
INDOOR AIRFLOW CHECK

Check airflow using the Delta-T (DT) process using the illustration in figure 36.

The diagnostic screen on the thermostat or outdoor control 7-segment display shows indoor and outdoor motor CFMs or RPMs.

GAUGE SET

CONNECTIONS FOR TESTING AND CHARGING



- CLOSE MANIFOLD GAUGE SET VALVES AND CONNECT THE CENTER HOSE TO A CYLINDER OF HFC-410A SET FOR LIQUID PHASE CHARGING.
- CONNECT THE MANIFOLD GAUGE SET'S LOW PRESSURE SIDE TO THE SUCTION LINE SERVICE PORT.
- CONNECT THE MANIFOLD GAUGE SET'S HIGH PRESSURE SIDE TO THE LIQUID LINE SERVICE PORT.
- POSITION TEMPERATURE SENSOR ON LIQUID LINE NEAR LIQUID LINE SERVICE PORT.

Figure 35. Gauge Set Connections

AIRFLOW

INDOOR COIL

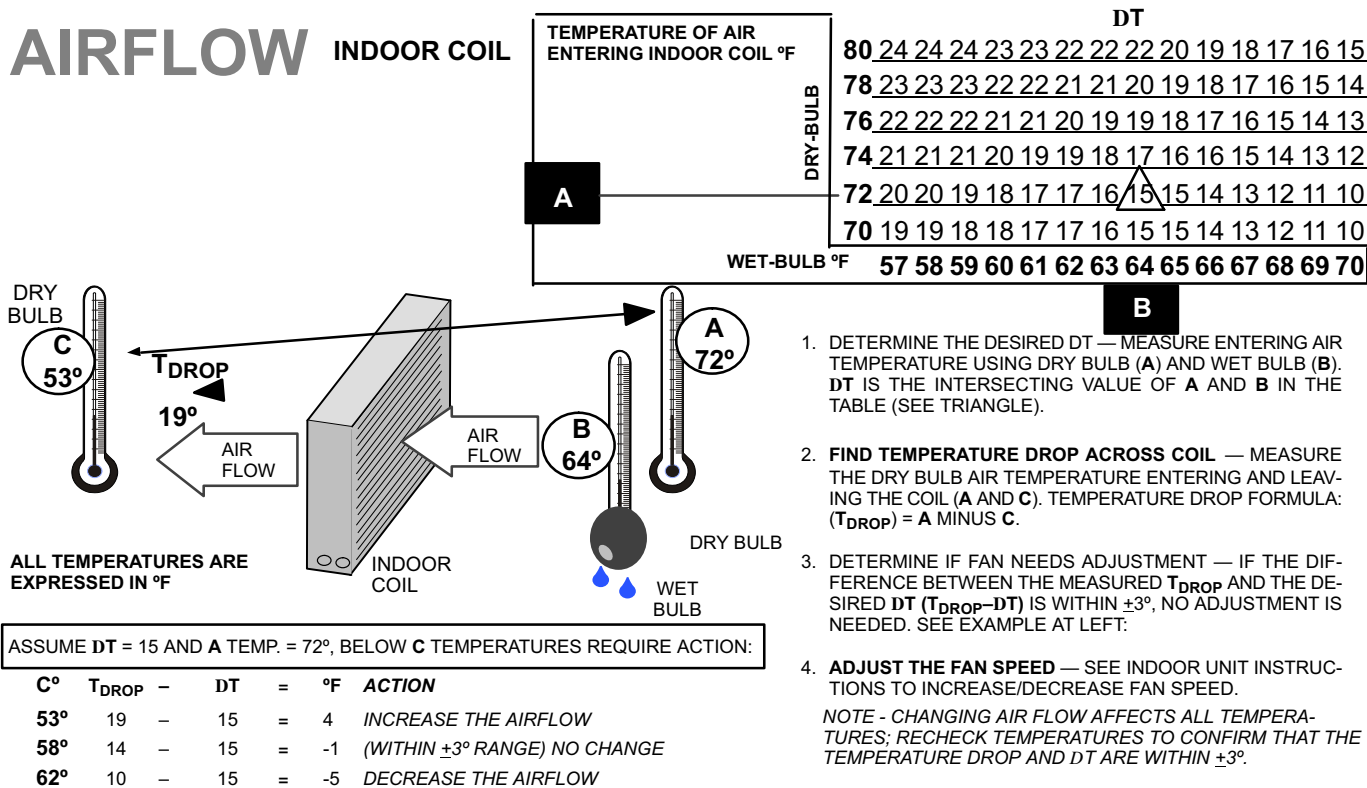


Figure 36. Checking Indoor Airflow over Evaporator Coil using Delta-T Chart

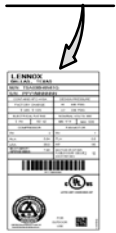
Use the WEIGH-IN method for adding initial refrigerant charge, and then use SUBCOOLING method for for verifying refrigerant charge.

WEIGH-IN CHARGING METHOD

64°F (17.7°C) and Below

Adjust amount for variation in line set length and liquid line diameter using table below.

Amount specified on nameplate \pm _____ = Total charge



Liquid Line Set Diameter	HFC-410A (ounces per foot)
5/16"	0.40
3/8"	0.60
1/2"	1.00

NOTE - Insulate liquid line when it is routed through areas where the surrounding ambient temperature could become higher than the temperature of the liquid line or when pressure drop is equal to or greater than 20 psig.

NOTE - The nameplate is shown for illustration purposes only. Go to actual nameplate on outdoor unit for charge information.

Charging Formula for Liquid Line Charge Adjustments

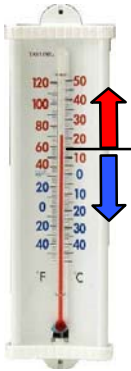
[(Line set oz./ft. x total length) - (factory charge for line set)] = charge adjustment

Example: Units are factory-charged for 15 feet (4.6 meters) of 3/8" line set. Factory charge for 3/8" is 0.60 oz/ft x 15 = 9.0 ounces.

Figure 37. Using HFC-410A Weigh-In Method

SUBCOOLING CHARGING METHOD

*(All charging **MUST** be performed while system is operating either at maximum speed or 100% demand.)*



USE COOLING MODE
60°F (15°C)
USE HEATING MODE

1. THE DIAGNOSTIC SCREEN ON THE THERMOSTAT OR OUTDOOR CONTROL 7-SEGMENT DISPLAY WILL SHOW INDOOR AND OUTDOOR MOTOR CFMS OR RPMs.
2. MEASURE OUTDOOR AMBIENT TEMPERATURE; DETERMINE WHETHER TO USE **COOLING MODE** OR **HEATING MODE** TO CHECK CHARGE.
3. CONNECT GAUGE SET.
4. CHECK LIQUID AND VAPOR LINE PRESSURES. COMPARE PRESSURES WITH EITHER HEAT OR COOLING MODE NORMAL OPERATING PRESSURES IN THE APPLICABLE CHARGING STICKER, NORMAL OPERATING PRESSURES, HIGH STAGE.
NOTE - THE REFERENCE TABLE IS A GENERAL GUIDE. EXPECT MINOR PRESSURE VARIATIONS. SIGNIFICANT DIFFERENCES MAY MEAN IMPROPER CHARGE OR OTHER SYSTEM PROBLEM.
5. SET THERMOSTAT FOR HEAT/COOL DEMAND, DEPENDING ON MODE BEING USED:
 - USING COOLING MODE** — WHEN THE OUTDOOR AMBIENT TEMPERATURE IS 60°F (15°C) AND ABOVE. TARGET SUBCOOLING VALUES (SECOND STAGE - HIGH CAPACITY) IN APPLICABLE CHARGING STICKER ARE BASED ON 70 TO 80°F (21-27°C) INDOOR RETURN AIR TEMPERATURE; IF NECESSARY, OPERATE HEATING TO REACH THAT TEMPERATURE RANGE; THEN SET THERMOSTAT TO COOLING MODE SETPOINT TO 68°F (20°C) WHICH SHOULD CALL FOR SECOND-STAGE (HIGH STAGE) COOLING. WHEN PRESSURES HAVE STABILIZED, CONTINUE WITH STEP 6.
 - USING HEATING MODE** — WHEN THE OUTDOOR AMBIENT TEMPERATURE IS BELOW 60°F (15°C). TARGET SUBCOOLING VALUES (SECOND-STAGE - HIGH CAPACITY) IN APPLICABLE CHARGING STICKER ARE BASED ON 65-75°F (18-24°C) INDOOR RETURN AIR TEMPERATURE; IF NECESSARY, OPERATE COOLING TO REACH THAT TEMPERATURE RANGE; THEN SET THERMOSTAT TO HEATING MODE SETPOINT TO 77°F (25°C) WHICH SHOULD CALL FOR SECOND-STAGE (HIGH STAGE) HEATING. WHEN PRESSURES HAVE STABILIZED, CONTINUE WITH STEP 6.
6. READ THE LIQUID LINE TEMPERATURE; RECORD IN THE LIQ° SPACE.
7. READ THE LIQUID LINE PRESSURE; THEN FIND ITS CORRESPONDING TEMPERATURE IN THE TEMPERATURE/ PRESSURE CHART LISTED IN THE APPLICABLE CHARGING STICKER AND RECORD IT IN THE SAT° SPACE.
8. SUBTRACT LIQ° TEMPERATURE FROM SAT° TEMPERATURE TO DETERMINE SUBCOOLING; RECORD IT IN SC° SPACE.
9. COMPARE SC° RESULTS WITH APPLICABLE CHARGING STICKER, BEING SURE TO NOTE ANY ADDITIONAL CHARGE FOR LINE SET AND/OR MATCH-UP.
10. IF SUBCOOLING VALUE IS GREATER THAN SHOWN IN APPLICABLE CHARGING STICKER FOR THE APPLICABLE UNIT, REMOVE REFRIGERANT; IF LESS THAN SHOWN, ADD REFRIGERANT.
11. IF REFRIGERANT IS ADDED OR REMOVED, REPEAT STEPS 6 THROUGH 10 TO VERIFY CHARGE.
12. DISCONNECT GAUGE SET AND RE-INSTALL BOTH THE LIQUID AND SUCTION SERVICE VALVE CAPS.

SAT° _____

LIQ° - _____

SC° = _____

Figure 38. Using HFC-410A Subcooling Method - High Speed (High Capacity)

Table 15. HFC-410A Temperature (°F) - Pressure (Psig)

°F	Psig	°F	Psig	°F	Psig	°F	Psig	°F	Psig	°F	Psig	°F	Psig	°F	Psig
32	100.8	48	137.1	63	178.5	79	231.6	94	290.8	110	365.0	125	445.9	141	545.6
33	102.9	49	139.6	64	181.6	80	235.3	95	295.1	111	370.0	126	451.8	142	552.3
34	105.0	50	142.2	65	184.3	81	239.0	96	299.4	112	375.1	127	457.6	143	559.1
35	107.1	51	144.8	66	187.7	82	242.7	97	303.8	113	380.2	128	463.5	144	565.9
36	109.2	52	147.4	67	190.9	83	246.5	98	308.2	114	385.4	129	469.5	145	572.8
37	111.4	53	150.1	68	194.1	84	250.3	99	312.7	115	390.7	130	475.6	146	579.8
38	113.6	54	152.8	69	197.3	85	254.1	100	317.2	116	396.0	131	481.6	147	586.8
39	115.8	55	155.5	70	200.6	86	258.0	101	321.8	117	401.3	132	487.8	148	593.8
40	118.0	56	158.2	71	203.9	87	262.0	102	326.4	118	406.7	133	494.0	149	601.0
41	120.3	57	161.0	72	207.2	88	266.0	103	331.0	119	412.2	134	500.2	150	608.1
42	122.6	58	163.9	73	210.6	89	270.0	104	335.7	120	417.7	135	506.5	151	615.4
43	125.0	59	166.7	74	214.0	90	274.1	105	340.5	121	423.2	136	512.9	152	622.7
44	127.3	60	169.6	75	217.4	91	278.2	106	345.3	122	428.8	137	519.3	153	630.1
45	129.7	61	172.6	76	220.9	92	282.3	107	350.1	123	434.5	138	525.8	154	637.5
46	132.2	62	175.4	77	224.4	93	286.5	108	355.0	124	440.2	139	532.4	155	645.0
47	134.6			78	228.0			109	360.0			140	539.0		

LINE SET REQUIREMENT

- Total equivalent length equals 180 feet (all piping and fittings included).

NOTE - This is a general guide. Lengths may be more or less, depending on remaining system design factors.

- Maximum linear (actual) length = 150 feet.
- Maximum linear liquid lift = 60 feet.

NOTE - Maximum lifts are dependent on total length, number of elbows, and other factors that contribute to total pressure drop.

- Maximum linear length of vapor riser = 60 feet.
- Size vertical vapor riser per table below.
- **Line set lengths up to 50 linear feet:** Use rated line sizes listed in table below.

- **Line set lengths between 51 and 150 linear feet:** Crankcase heater and non-bleed port TXV factory-installed. No additional components required. Vertical vapor riser must be sized to the vapor riser listed in tables below.
- **Line set lengths over 150 linear feet:** Not recommended.
- Additional oil is not required for systems with line lengths up to 150 feet.

NOTE - Recommended POE oils are Mobil EAL ARCTIC 22 CC or ICI EMKARATE™ RL32CF.

SUCTION TRAPS

In systems with the outdoor unit 5 to 60 feet above the indoor unit, one trap must be installed at the bottom of the suction riser.

Table 16. Standard Refrigerant Line Set — Up to 50 Linear Feet

Model Number	Line Diameter up to 50 Feet	
	Liquid Line	Suction Line
2 Ton	3/8"	3/4"
3 Ton 4 Ton	3/8"	7/8"
5 Ton	3/8"	1-1/8" *

* Some applications may require a field-provided 1-1/8" to 7/8" adapter.

Table 17. 51 to 150 Linear Feet in Length

Model	Maximum Total Equivalent Length (ft)	Maximum Linear (actual) Length (ft)	Maximum Vapor Riser (ft)	Maximum Liquid Riser (ft)	Preferred Vapor Line Sizes for Horizontal Runs	Required Vapor Riser Size
2 Ton	180	150	60	60	3/4"	5/8"
3 Ton	180	150	60	60	7/8"	3/4"
4 Ton	180	150	60	60	7/8"	7/8"
5 Ton	180	150	60	60	7/8"	7/8"

Table 18. Liquid Line Diameter Selection Table

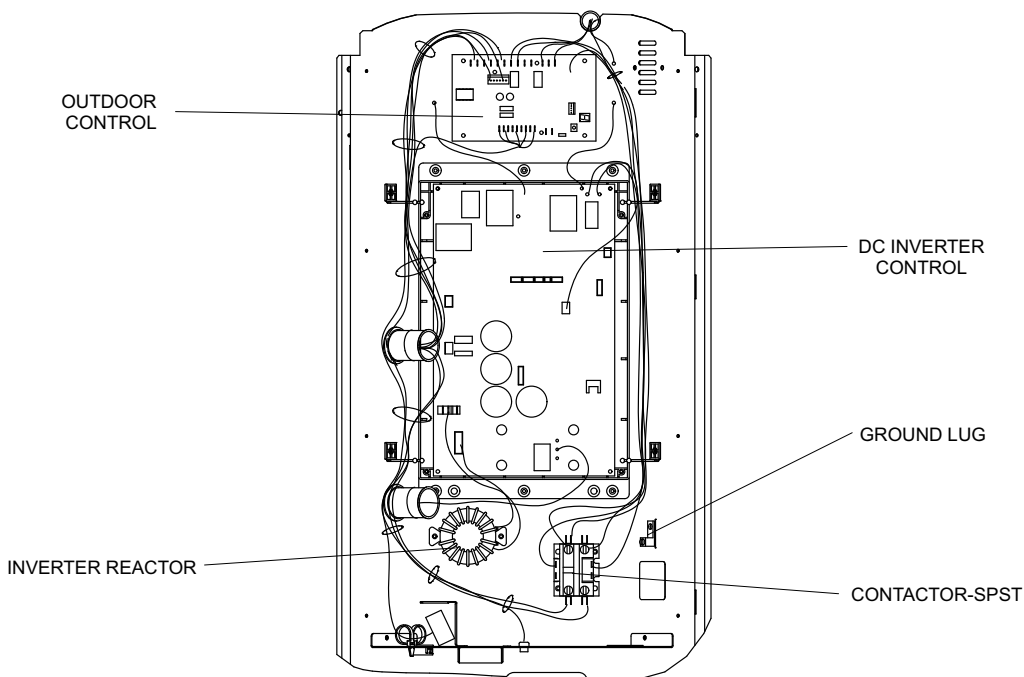
Unit	Line Size	Total Linear Length (feet)						Max. Elevation (ft)
		25	50	75	100	125	150	
2 Ton	5/16"	25	50	55	48	40	33	
	3/8"	25	50	60	60	60	60	
3 Ton	3/8"	25	50	60	56	51	45	
	1/2"	25	50	60	60	60	60	
4 Ton	3/8"	25	50	50	41	31	22	
	1/2"	25	50	60	60	60	60	
5 Ton	3/8"	25	50	36	22	8	NR	
	1/2"	25	50	60	60	60	59	

Note - Shaded rows indicate rated liquid line size.

1. Find your unit on the left side of the table.
2. Start with the rated liquid line size (shaded row) for the outdoor unit.
3. Select the actual total linear length of your system shown at the top of the table.
4. The elevation listed in the table is the maximum allowed for the liquid line listed.
5. Consider the larger liquid line size shown in the table if the elevation does not meet your requirements.

Typical Unit Parts Arrangement

CONTROL PANEL FOR 24 AND 36 MODELS



CONTROL PANEL FOR 48 AND 60 MODELS

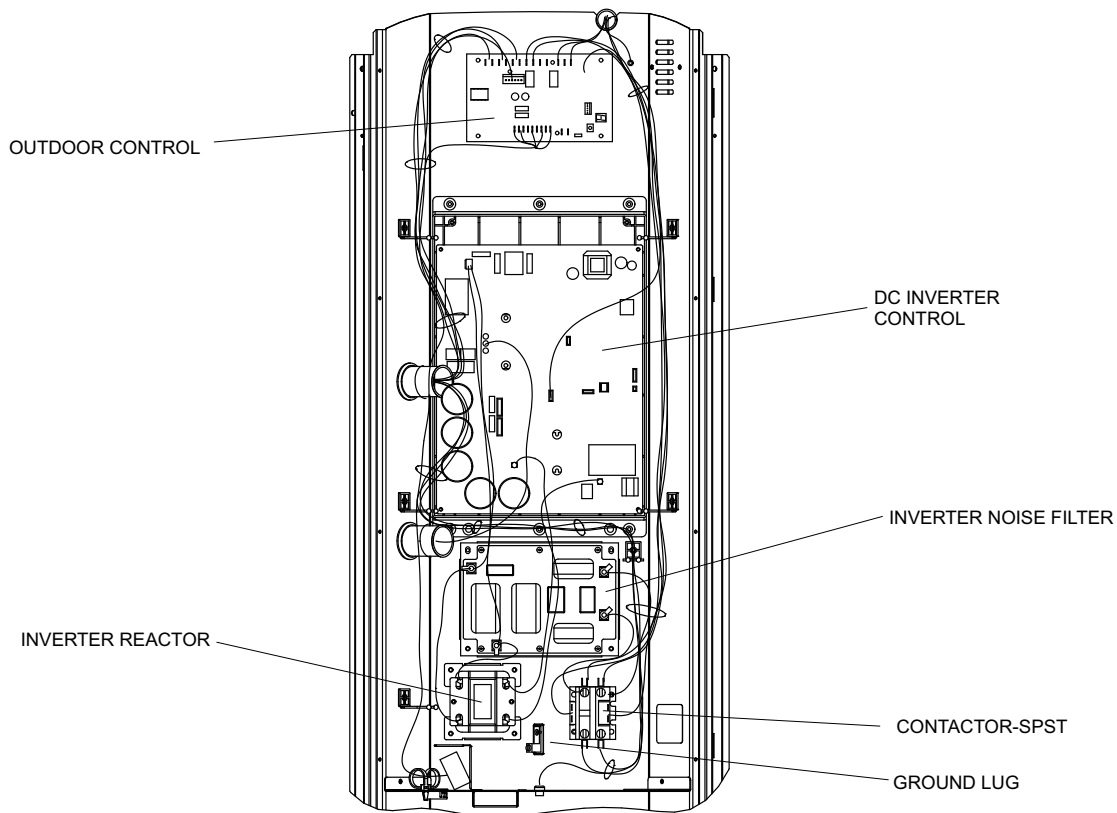


Figure 39. Control Panel Components