

Application Engineering

CoreSense Diagnostics for Copeland Scroll UltraTech Air Conditioning Compressors

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Contents

Safety

Important Safety Information	2
Responsibilities, Qualifications and Training	2
Terminal Venting and Other Pressurized System Hazards	2
Flammable Refrigerant Hazards	3
Electrical Hazards	3
Hot Surface and Fire Hazards	3
Lifting Hazards	3
POE Oil Hazards	3
Precautions	3
Signal Word Definitions	5

Introduction

Overview	6
Application Restrictions and Types	6
Product Specifications	6

Installation

Mounting	6
Terminal Description	6

Operation

Compressor Protection	7
Module LED Description	7
Module Operation/Code Description	7
Resetting Alert Codes	8

Service

Module History Download	8
Warranty Information	9
Support	9

Figures & Tables

Figure 1 Wires Pulled Through Module	8
Figure 2 Module Dimensions in Millimeters	10
Figure 3 Terminal Locations	10

Figure 4 Wiring Diagram	11
Table 1 Flash Code Description	12
Table 2 CoreSense Diagnostics LED Troubleshooting Information	13

Safety

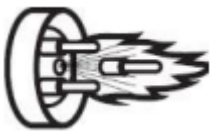
Important Safety Information

Those involved in the design, manufacture, and installation of a system, system purchasers, and service personnel may need to be aware of hazards and precautions discussed in this section and throughout this document. OEMs integrating the compressor into a system should ensure that their own employees follow this bulletin and provide any necessary safety information to those involved in manufacturing, installing, purchasing, and servicing the system.

Responsibilities, Qualifications and Training

- OEMs are responsible for system design, selection of appropriate components, integration of this component into the system, and testing the system. OEMs must ensure that staff involved in these activities are competent and qualified.
- OEMs are also responsible for ensuring that all product, service, and cautionary labels remain visible or are appropriately added in a conspicuous location on the system to ensure they are clear to any personnel involved in the installation, commissioning, troubleshooting or maintenance of this equipment.
- Only qualified and authorized HVAC or refrigeration personnel are permitted to install, commission, troubleshoot and maintain this equipment. Electrical connections must be made by qualified electrical personnel.
- Observe all applicable standards and codes for installing, servicing, and maintaining electrical and refrigeration equipment.

Terminal Venting and Other Pressurized System Hazards



If a compressor's electrical terminal pin loses its seal, pressurized oil, refrigerant, and debris may spray out. This is called "terminal venting".

The ejected debris, oil, and refrigerant can injure people or damage property. The oil and refrigerant spray can be ignited by electrical arcing at the terminal or any nearby ignition source, producing flames that may project a significant distance from the compressor. The distance depends on the pressure and the amount of refrigerant and oil mixture in the system. The flames can cause serious or fatal burns and ignite nearby materials.

Each compressor has a terminal cover or molded plug that covers electrical connections. The cover or plug helps to protect against electric shock and the risks of terminal venting. If terminal venting occurs, the cover or plug helps contain the spray of refrigerant and oil and reduces the risk of ignition. If ignition occurs, the plug or cover helps contain the flames. However, neither the terminal cover nor the molded plug can completely eliminate the risk of venting, ignition, or electric shock.

See [copeland.com/terminal-venting](https://www.copeland.com/terminal-venting) for more details about terminal venting. Additionally, a compressor's refrigerant lines keep refrigerant and oil under pressure. When removing or recharging refrigerant from this component during service, this can pose a pressurized fluid hazard.

Flammable Refrigerant Hazards



If flammable refrigerant is released from a system, an explosive concentration can be present in the air near the system. If there is an ignition source nearby, a release of flammable refrigerant can result in a fire or explosion. While systems using flammable refrigerant are designed to mitigate the risk of ignition if the refrigerant is released, fire and explosion can still occur.

See copeland.com/flammable-refrigerants for more information on flammable refrigerant safety.

Electrical Hazards



Until a system is de-energized, and capacitors have been discharged, the system presents a risk of electric shock.

Hot Surface and Fire Hazards



While the system is energized, and for some time after it is deenergized, the compressor may be hot. Touching the compressor before it has cooled can result in severe burns. When brazing system components during service, the flames can cause severe burns and ignite nearby combustible materials.

Lifting Hazards



Certain system components may be very heavy. Improperly lifting system components or the compressor can result in serious personal injury. Use proper lifting techniques when moving.

POE Oil Hazards

This equipment contains polyol ester (POE) oils. Certain polymers (e.g., PVC/CPVC and polycarbonate) can be harmed if they come into contact with POE oils. If POE oil contacts bare skin, it may cause an allergic skin reaction.

Precautions

- Always wear personal protective equipment (gloves, eye protection, etc.).
- Keep a fire extinguisher at the jobsite at all times.
- Keep clear of the compressor when power is applied.
- **IMMEDIATELY GET AWAY if you hear unusual sounds in the compressor. They can indicate that terminal pin ejection may be imminent. This may sound like electrical arcing (sizzling, sputtering or popping). However, terminal venting may still occur even if you do not hear any unusual sounds.**

- Never reset a breaker or replace a blown fuse without performing appropriate electrical testing
 - **A tripped breaker or blown fuse may indicate an electrical fault in the compressor. Energizing a compressor with an electrical fault can cause terminal venting. Perform checks to rule out an electrical fault.**
- Disconnect power and use lock-out/tag-out procedures before servicing.
 - Before removing the terminal cover or molded plug, check that ALL electrical power is disconnected from the unit. Make sure that all power legs are open. (Note: The system may have more than one power supply.)
 - Discharge capacitors for a minimum of two minutes
 - Always use control of hazardous energy (lock-out/tag-out) procedures to ensure that power is not reconnected while the unit is being serviced.
- Allow time for the compressor to cool before servicing.
 - Ensure that materials and wiring do not touch high temperature areas of the compressor.
- Keep all non-essential personnel away from the compressor during service.
 - For A3 refrigerants (R290) remove refrigerant from both the high and low sides of the compressor. Use a recovery machine and cylinder designed for flammable refrigerants. Do not use standard recovery machines because they contain sources of ignition such as switches, high- and low-pressure controls and relays. Only vent the R290 refrigerant into the atmosphere if the system is in a well-ventilated area.
- Never use a torch to remove the compressor. Only tubing cutters should be used for both A2L and A3 refrigerants.
- Use an appropriate lifting device to install or remove the compressor.
- Never install a system and leave it unattended when it has no charge, a holding charge, or with the service valves closed without electrically locking out the system.
- Always wear appropriate safety glasses and gloves when brazing or unbrazing system components.
- Charge the system with only approved refrigerants and refrigeration oils.
- Keep POE oils away from certain polymers (e.g., PVC/CPVC and polycarbonate) and any other surface or material that might be harmed by POE oils. Proper protective equipment (gloves, eye protection, etc.) must be used when handling POE lubricant. Handle POE oil with care. Refer to the Safety Data Sheet (SDS) for further details.
- Before energizing the system:
 1. Securely fasten the protective terminal cover or molded plug to the compressor, and
 2. Check that the compressor is properly grounded per the applicable system and compressor requirements.

Signal Word Definitions

The signal word explained below are used throughout the document to indicate safety messages.



DANGER indicates a hazardous situation which, if not avoided, will result in death or serious injury.



WARNING indicates a hazardous situation which, if not avoided, could result in death or serious injury.



CAUTION, used with the safety alert symbol, indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.

Introduction

Overview

CoreSense Diagnostics is a breakthrough innovation for troubleshooting residential air conditioning and heat pump systems. The CoreSense Diagnostics module is easily installed in the unit electrical panel near the compressor contactor. By using the compressor as a sensor, CoreSense Diagnostics helps the service technician more accurately troubleshoot system and compressor fault conditions.

CoreSense Diagnostics also provides compressor and system protection through its proprietary lockout feature. Depending on the severity and frequency of the fault that caused the trip condition, the CoreSense Diagnostics module can lockout the compressor contactor to prevent damage to the compressor and system components. Less severe fault conditions resulting in an occasional trip will not result in a lockout condition.

Flashing LEDs communicate **ALERT** and **LOCK** codes to the service technician.

Application Restrictions and Types

The CoreSense Diagnostics (571-0072-00) module is designed and qualified for use with ZPS*K5 single phase Copeland Scroll UltraTech compressors.

Product Specifications

Operating Temp: - 40° to 150°F (- 40° to 65°C)
Storage Temp: - 40° to 175°F (- 40° to 80°C)
Supply Voltage: 18 to 28VAC, 48 to 62Hz
Module Current Sensing Range: 2 to 30A
Maximum Power Consumption: 2.5 VA (Excluding solenoid load)

Installation

Mounting

Four #8 or #10 self-tapping or sheet metal screws are required for installation of the module. The maximum mounting screw torque is 20 in.lbs. Locate the module near the compressor contactor (wire routing for compressor run, common, and start wires will be easier in this position). The module can be mounted in any orientation and LEDs should be visible for ease of service.

The compressor's run (R), common (C), and start (S) wires are routed through the holes in the CoreSense module marked "R", "C", and "S". See **Figure 1**.

Terminal Description

The terminals for the CoreSense Diagnostics module are ¼" spade terminals.

- **COMMON (C)**
The 24-volt common terminal for module power.
- **DEMAND (Y)**
The demand terminal requires a 24VAC signal measured with respect to the COMMON (C) terminal when there is a call for heating or cooling. A signal above 6VAC indicates the thermostat wants the compressor to be on, while 0-6VAC signal indicates the thermostat wants the compressor to be off.
- **SECOND STAGE DEMAND (Y2)**
The demand (Y) and second stage demand (Y2) terminals require a 24VAC signal measured with respect to the COMMON (C) terminal when there is a call for heating or cooling. A signal above 10VAC indicates the thermostat wants the Ultratech solenoid to be energized, while 0-10VAC signal indicates the thermostat wants the Ultratech solenoid to be deenergized.
- **PROTECTION (PROT)**
The protection terminal is internally connected to the COMMON terminal through a solid-state switch.

- **POWER (R)**
The module requires a constant 24VAC supply power to this terminal. The module must receive an independent power supply in order to operate properly. See **Figure 4**.
- **Thermostat Communication (L)**
Provides a 24V signal to an indoor thermostat indicating the number of ALERT flashes displayed on the module. (Reference thermostat manual for available capability)
- **Solenoid (DC SOL)**
Provides a connection to the Copeland Scroll UltraTech second stage compressor solenoid. This solenoid is internal to the compressor and has a voltage range of 18 to 28VDC. Please refer to bulletin **AE-1311** for information on the Copeland Scroll UltraTech compressor.

Operation

Compressor Protection

The CoreSense Diagnostics module utilizes proprietary algorithms to protect the compressor and system from repeated trips of system pressure controls and the compressor internal overload. The protection terminal of the module should be wired in series with the system low pressure and high-pressure cutouts, as well as the compressor contactor. When the module detects a series of trips as described below, it will activate a lockout feature that opens the solid-state switch in the module, thereby cutting power to the contactor and deenergizing the compressor.

Module LED Description

POWER LED (Green): indicates the module is powered with 18 to 28 volts.

ALERT LED (Yellow): communicates an abnormal system condition through a unique flash code. The ALERT LED will flash a number of times consecutively, pause and then repeat the process. The number of consecutive flashes, defined as the Flash Code, correlates to a particular

abnormal condition. Detailed descriptions of specific **ALERT Flash Codes are shown in Table 1.**

TRIP/LOCK LED (Red): indicates either a TRIP or LOCK condition.

- **TRIP:** is indicated by a solid illumination of the LED. This means the compressor is not running and demand is present at the module.
- **LOCK:** is indicated by a flashing LED correlating to a LOCK condition in which the module will prevent the compressor from starting.

Module Operation/Code Description

Code 1 - Long Run Time

The module will flash yellow one time when the compressor operates for longer than 18 continuous hours. This is an alert code only, and the module will not lockout the compressor for this condition. This code is inactive for heat-pumps.

Code 2 - Compressor (Pressure) Trips

The module will flash yellow two times when the compressor operates from 12 seconds to 15 minutes followed by a trip condition lasting longer than 7 minutes. When four consecutive or ten total Code 2 events are recorded, the module will lockout the compressor and flash red two times.

Code 3 - Pressure Switch Cycling

The module will flash yellow three times when the compressor operates from 12 seconds to 15 minutes followed by a trip condition lasting between 35 seconds to 7 minutes. When four consecutive or ten total Code 3 events are recorded, the module will lockout the compressor and flash red three times.

Code 4 - Locked Rotor Trip

The module will flash yellow four times when the compressor trips within 12 seconds of operation and does not reset and start within 35 seconds. When ten consecutive Code 4 events are recorded the module will lockout the compressor and flash red four times.

Code 5 - Compressor (Moderate Run) Trip

The module will flash yellow five times when the compressor has operated between 15 minutes and 18 hours, followed by a compressor trip lasting longer than 7 minutes. When four consecutive or ten total Code 5 events are recorded, the module will lockout the compressor and flash red five times.

Code 6 - Open Start Circuit

The module will lockout the compressor and flash red six times if the module detects a demand signal in the “Y” terminal and current in the “R” winding of the compressor, but no current is detected in the “S” winding of the compressor for 2 seconds.

Code 7 - Open Run Circuit

The module will lockout the compressor and flash red seven times if the module detects a demand signal in the “Y” terminal and current in the “S” winding of the compressor, but no current is detected in the “R” winding of the compressor for 2 seconds.

Code 8 - Welded Contactor

The module will flash yellow eight times if it has detected line currents in the “S” and “R” windings and demand is absent for 15 seconds.

Code 9 - Low Voltage

The module will flash nine times if the module supply voltage drops below 17VAC for 2 seconds. The module will prevent the compressor from starting until adequate voltage is established.

Code 10 - Over-Current Protection

When the current at the PROT terminal is greater than 2A for 40ms, the module will flash a Code 10. The red LED will flash 10 times with the yellow LED remaining off. This event will cause a lockout of the compressor and indicates that the module is mis-wired, or the contactor coil is shorted to ground.

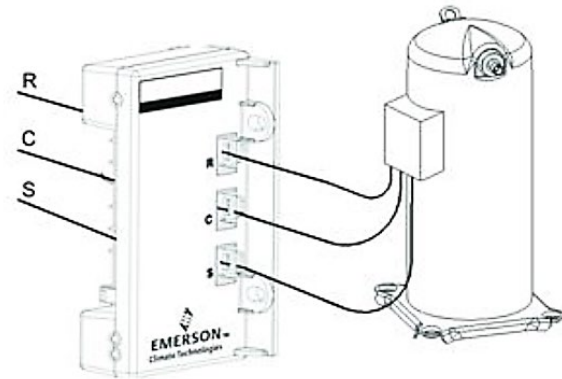
NOTICE

Code 10 is not specified on the module label.

Resetting Alert Codes

When the CoreSense Diagnostics module has detected a series of adverse conditions that have caused it to lockout the compressor, and after the issue has been resolved, it is necessary to manually reset the module in order to clear the present alert code.

The primary way of clearing the code and resetting the ALERT or TRIP/LOCK is to cycle the power to the module by disengaging the COMMON (C) Terminal. This will not clear the seven-day operating history contained in the module memory. It will only clear the present ALERT or TRIP/LOCK and allow for normal operation.



*Figure 1
Wires Pulled Through Module*

Service

Always disconnect and lockout the power supply before beginning electrical troubleshooting.

Module History Download

The CoreSense Diagnostics module is capable of communicating with a personal computer, tablet, or laptop, via Copeland computer software interface (HVACR Fault Finder PC Edition) and USB connection (TTL-232R-5V-WE), in order to download and store fault history and module operation time. This information can be used to

help diagnose and review data from troubled systems in the field. HVACR Fault Finder PC Edition kit (9989-0099-01) with software and cable. For more information, please contact your Copeland Application Engineer.

Warranty Information

Copeland warrants its diagnostic module to be free from defects in materials and workmanship under normal use for a period of one year from the date of purchase or twenty months from manufacture, whichever comes first. During this period, Copeland will replace any defective diagnostic module without charge.

For more information on product warranty please visit www.copeland.com.

Support

For more information visit www.copeland.com, or contact Copeland at [1-844-529-7943](tel:1-844-529-7943).

Figures & Tables

Figure 2 Module Dimensions in Millimeters

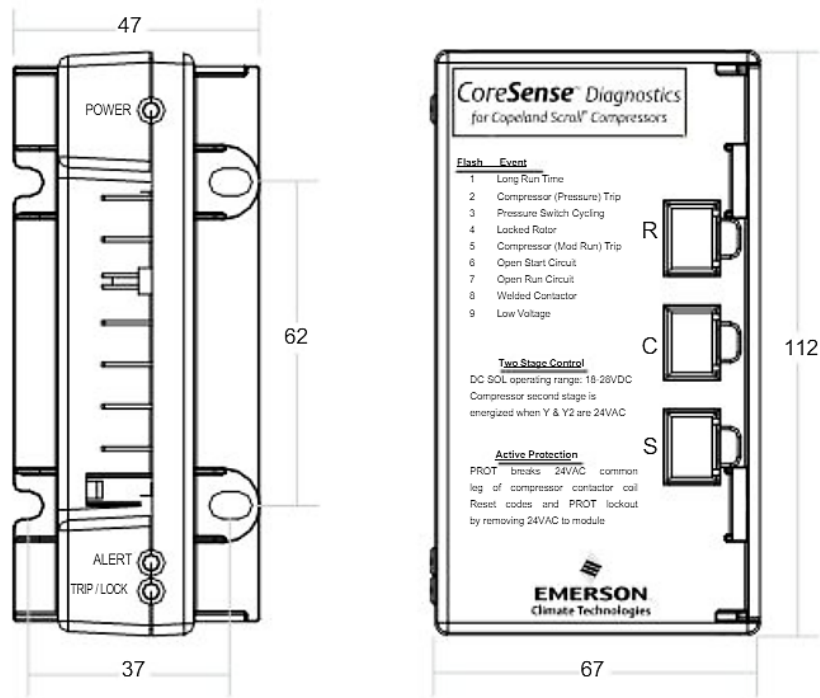


Figure 3 Terminal Locations

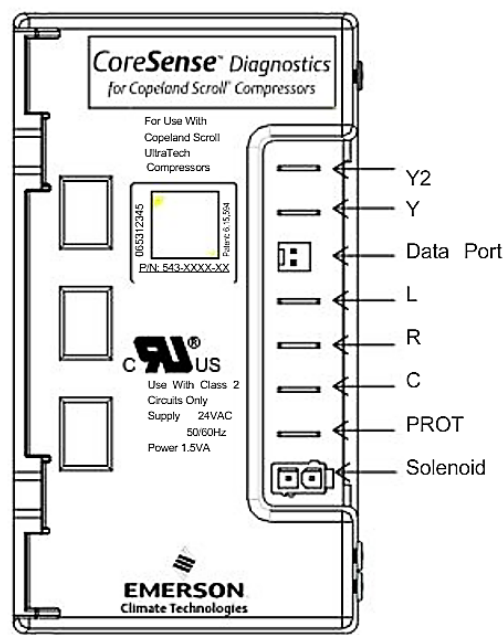


Figure 4 Wiring Diagram

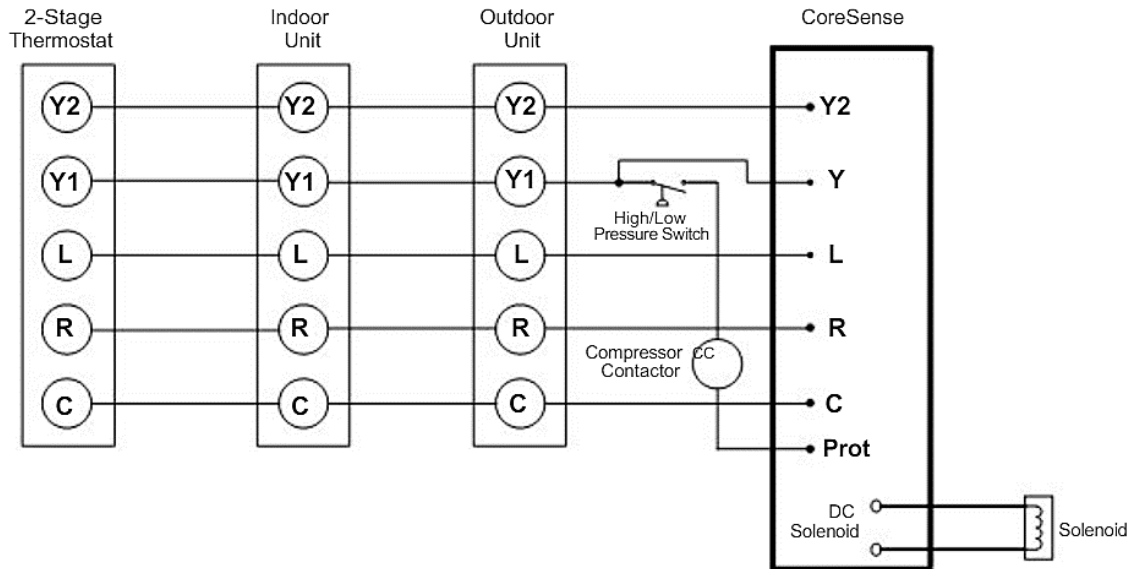


Table 1 Flash Code Description

Alert Code	Alert Condition	Lockout Level	Lockout Indication
Normal Run Solid Green	Normal operation, no trip.	N/A	N/A
Code1 Yellow Flash 1	Long run time. Compressor is running for more than 18 hours at full load. (Code1 is disabled in Heat Pump mode.)	N/A	N/A
Code2 Yellow Flash 2	Compressor Pressure trip. Compressor runs for 12sec to 15min followed by a compressor trip condition lasting longer than 7min.	4x consecutive, 10x total	Red: Flash 2
Code 3 Yellow Flash 3	Pressure switch cycling. Compressor runs for 12sec to 15min followed by a compressor trip lasting between 35sec to 7min	4x consecutive, 10x total	Red: Flash 3
Code 4 Yellow Flash 4	Locked rotor. Compressor trips within a compressor run time of 12sec and does not start within 35sec.	10x consecutive	Red: Flash 4
Code 5 Yellow Flash 5	Compressor moderate run trip. Compressor runs for 15min to 18hrs followed by a compressor trip lasting longer than 7min.	4x consecutive, 10x total	Red: Flash 5
Code 6 Red Flash 6	Open start circuit. Module has detected Y or Y1, and current in the R winding of the compressor and no current in the S winding of the compressor for 2 seconds.	1 occurrence	Red: Flash 6
Code 7 Red Flash 7	Open run circuit. Module has detected Y or Y1, and current in the S winding of the compressor and no current in the R winding of the compressor for 2 seconds.	1 occurrence	Red: Flash 7
Code 8 Yellow Flash 8	Welded Contactor. Module has detected line currents in R and S windings, and Y or Y1 is at 0 VAC for 15 seconds.	N/A	N/A
Code 9 Yellow Flash 9	Low Voltage. Module has detected a 24 VAC supply voltage below 17 VAC +/- 1 VAC for 2 seconds	N/A	N/A
Code10 Red Flash 10	Over Current Protection. PROT terminal has above a 2A input for more than 40 milliseconds.	1 occurrence	Red: Flash 10

Table 2 CoreSense Diagnostics LED Troubleshooting Information

Flash Code number corresponds to the number of LED flashes, followed by a pause, and then repeated. TRIP and ALERT LEDs flashing at same time means control circuit voltage is too low for operation (brown-out conditions).

Status	Description	Troubleshooting Information
Solid Green "RUN"	Module has power and operating normally	Supply voltage is present at module terminals
Solid Red "TRIP"	Thermostat demand signal Y is present, but the compressor is not running	- Compressor protector is open - Check for high head pressure - Check compressor supply voltage - Outdoor unit power disconnect is open - Compressor circuit breaker or fuse(s) is open - Broken wire or connector is not making contact - High pressure switch open if present in system - Compressor contactor has failed open
"ALERT" Flash Codes		
Yellow "ALERT" Flash Code 1	Long Run Time Low Refrigerant Charge Compressor is running extremely long run cycles	- Low refrigerant charge - Evaporator blower is not running - Check blower relay coil and contacts - Check blower motor capacitor - Check blower motor for failure or blockage - Check evaporator blower wiring and connectors - Check indoor blower control board - Check thermostat wiring for open circuit long run cycles - Evaporator coil is frozen - Check for low suction pressure - Check for excessively low thermostat setting - Check evaporator airflow (coil blockages or return air filter) - Check ductwork or registers for blockage - Faulty metering device - Check TXV bulb installation (size, location, and contact) - Check if TXV/fixed orifice is stuck closed or defective - Liquid line restriction (filter drier blocked if present in system) - Thermostat is malfunctioning - Check thermostat sub-base or wiring for short circuit - Check thermostat installation (location, level)
Yellow "ALERT" Flash Code 2	Compressor (Pressure) Trip High Refrigerant Charge Discharge pressure out of limits or compressor overloaded	- Condenser fan is not running - Check fan capacitor - Check fan wiring and connectors - Check fan motor for failure or blockage - High head pressure - Check high pressure switch if present in system - Check if system is overcharged with refrigerant - Check for non-condensable in system - Condenser coil poor air circulation (dirty, blocked, damaged) - Return air duct has substantial leakage

Yellow "ALERT" Flash Code 3	Pressure Switch Cycling Compressor is running only briefly due to pressure switch cycling	1 Time delay relay or control board defective 2 If high pressure switch present, go to Flash Code 2 information
Yellow "ALERT" Flash Code 4	Locked Rotor	1 Run capacitor has failed 2 Low line voltage (contact utility if voltage at disconnect is low) • Check wiring connections 3 Excessive liquid refrigerant in compressor 4 Compressor bearings are seized • Measure compressor oil level
Yellow "ALERT" Flash Code 5	Compressor (Moderate Run) Trip	1 Evaporator blower is not running • Check blower relay coil and contacts • Check blower motor capacitor • Check blower motor for failure or blockage • Check evaporator blower wiring and connectors • Check indoor blower control board • Check thermostat wiring for open circuit 2 Faulty metering device • Check TXV bulb installation (size, location, and contact) • Check if TXV/fixed orifice is stuck closed or defective 3 Condenser coil poor air circulation (dirty, blocked, damaged) 4 Low refrigerant charge
Yellow "ALERT" Flash Code 8	Welded Contactor Compressor always runs	1 Compressor contactor has failed closed 2 Thermostat demand signal not connected to module
Yellow "ALERT" Flash Code 9	Low Supply Voltage Voltage below 18V	1 Control Circuit transformer is overloaded 2 Low line voltage (contact utility if voltage at disconnect is low)
"LOCKOUT" Flash Codes		
Red "LOCKOUT" Flash Code 2 Yellow Off	Compressor (Pressure) Trip Compressor is locked out after 4 consecutive or 10 total compressor (pressure) trip events	1 Condenser fan is not running • Check fan capacitor • Check fan wiring and connectors • Check fan motor for failure or blockage 2 High head pressure • Check high pressure switch if present in system • Check if system is overcharged with refrigerant • Check for non-condensable in system 3 Condenser coil poor air circulation (dirty, blocked, damaged) 4 Return air duct has substantial leakage
Red "LOCKOUT" Flash Code 3 Yellow Off	Pressure Switch Cycling Compressor is locked out after 4 consecutive or 10 total pressure cycling events	1 Time delay relay or control board defective 2 If high pressure switch present, go to Flash Code 2 information
Red "LOCKOUT" Flash Code 4 Yellow Off	Locked Rotor Compressor is locked out after 10 consecutive locked rotor events	1 Run capacitor has failed 2 Low line voltage (contact utility if voltage at disconnect is low) • Check wiring connections 3 Excessive liquid refrigerant in compressor 4 Compressor bearings are seized • Measure compressor oil level

Red "LOCKOUT" Flash Code 5 Yellow Off	Compressor (Moderate Run) Trip Compressor is locked out after 4 consecutive or 10 total compressor (moderate run) trip events	1 Evaporator blower is not running • Check blower relay coil and contacts • Check blower motor capacitor • Check blower motor for failure or blockage • Check evaporator blower wiring and connectors • Check indoor blower control board • Check thermostat wiring for open circuit 2 Faulty metering device • Check TXV bulb installation (size, location and contact) • Check if TXV/fixed orifice is stuck closed or defective 3 Condenser coil poor air circulation (dirty, blocked, damaged) 4 Low refrigerant charge
Red "LOCKOUT" Flash Code 6 Yellow Off	Open Start Circuit Current only in run circuit	1 Run capacitor has failed 2 Open circuit in compressor start wiring or connections • Check wiring and connectors between supply and the compressor "S" terminal 3 Compressor start winding is damaged • Check compressor motor winding resistance
Red "LOCKOUT" Flash Code 7 Yellow Off	Open Run Circuit Current only in start circuit	1 Open circuit in compressor run wiring or connections • Check wiring and connectors between supply and the compressor "R" terminal. Confirm proper wire routing per Figure 1. 2 Compressor run winding is damaged • Check compressor motor winding resistance
Red "LOCKOUT" Flash Code 10	Over Current Protection Current to PROT is greater than 2 Amps	1 Check for contactor shorted to ground 2 Check for mis-wiring to the PROT terminal

Revision Tracking R2

The document format has been updated to the new Copeland format

All occurrences of "Emerson" have been removed

A note regarding A3 and R290 venting has been updated

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