Application Engineering

Diagnostics Module for Copeland Scroll Air Conditioning Compressors

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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

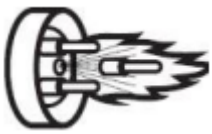
• OEMs are responsible for system design, selection of appropriate components, integration of this component into the system, and testing the system. OEMs must ensure that staff involved in these activities are competent and qualified.

• 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 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.

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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.**

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• 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.

• 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.

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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.

Revision Tracking R7
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 update.

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Introduction

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

Diagnostics Module 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 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.

Diagnostics Part Numbers

Version	OEM Part Number	Service P/N
Two Wire AC:	571-0066-00	971-0066-00
Three Wire HP	571-0067-00	971-0067-00

Application Restrictions and Types

This module is designed for universal compatibility across all single stage scroll compressors used in residential air conditioning applications. Diagnostics Module is not designed for use with Copeland Scroll Variable Speed or 2 Stage scroll compressors.

The Diagnostics module is available in two-wire and three-wire configurations. The two-wire module (571-0066-00) uses the demand signal (Y) to power the module. The two-wire module is used primarily in split system cooling applications where 24 volts may not be available at the outdoor unit to power the module. The three-wire module (571-0067-00) is powered continuously by (R) and (C) and is ideal for all packaged unit applications, and for split systems applications where (R) and (C) are available at the outdoor unit. See Figures 1 and 2.

Product Specifications

Operating Temp: - 40° to 150°F (- 40° to 65°C) Storage Temp: - 60° to 175°F (- 49° to 80°C) Supply Voltage: 19 to 28VAC , 48 to 62Hz
Working amperage for module: 2 to 30A Maximum Power Consumption: 1.5 VA

Installation

The top cover of the module is not designed to be removed.

The current sensor is capable of measuring a minimum of 2 amps. If the compressor current is less than 2 amps during normal operation, then loop the compressor COMMON lead wire through the current sensing port two times.

⚠CAUTION

The terminals of the module are in close proximity to each other and care must be used to prevent terminal to terminal shorting. Shorting the terminals may destroy the module and/or the transformer used to power the module.

For module dimensions and terminal identification, refer to Figure 4.

Terminal Description

The terminals for the 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.
- PROTECTION (PROT)
  The protection terminal is internally wired to the COMMON terminal through a normally closed set of contacts.
- POWER (R)
  This terminal is only on the 571-0067-00 three wire version. The module requires a constant 24VAC power supply to this terminal.

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Compressor Protection

The 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 normally closed protection contacts in the module, thereby cutting power to the contactor and shutting off the compressor.

Module LED Description

RUN/ALERT LED (Yellow)

A solid yellow LED indicates the module is powered and the compressor/system is running normally. Abnormal system conditions are indicated through a unique yellow flash code. The Yellow RUN/ALERT LED will flash consecutively, pause and then repeat when adverse conditions are detected within the compressor or system. The number of consecutive flashes, defined as the flash code, correlate to a particular abnormal condition. See Tables 1 and 2.

TRIP/LOCK LED (Red)

A solid red LED indicates the compressor is in a TRIP state where the module detects the presence of a demand signal from the thermostat, however no current to the compressor is detected by the module. A compressor trip typically indicates the compressor's internal overload is open or may indicate missing supply power to the compressor. The Red TRIP/LOCK LED will flash consecutively, pause and then repeat when the compressor lockout feature is active. The number of consecutive flashes, defined as the flash code, correlate to a particular lock condition. See Table 2. (Note: The Yellow Run/Alert LED will be turned off)

Module Operation/Code Description

The following is a description of the protection coding of the Diagnostics module:

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.

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 seven minutes. When four consecutive 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 Code 3 events are recorded, the module will lockout the compressor and flash red three times. A lockout will also occur in the case that 10 events have been recorded without resetting the alert.

Code 4 - Locked Rotor Trips

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 10 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 Code 5 events are recorded, the module will lockout the compressor and flash red five times. A lockout will also occur if ten Code 5 events are recorded without resetting the alert (see Resetting Alert Codes below).

Code 9 - Over-Current Protection

When the current at the PROT terminal is greater than 2A for 40ms, the module will flash a Code 9. The red LED will flash 9 times with the yellow LED remaining off. This alert indicates that the module is mis-wired or the contactor coil is shorted to ground.

NOTICE

Code 9 is not specified on the module label.

Low Supply Voltage

If the 24 VAC supply voltage to the module drops below the required amount to power the processors, the processor will be continuously reset. Both LEDs may flicker, and the alerts on the module will be reset.

Resetting Alert Codes

When the 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 is to press the reset button located on the module. Note: Pressing the reset will require a pin or mini/electronics screwdriver. This button must be pressed and held for a minimum of one second for the module to be reset. Pressing the reset button clears the immediate lock code and the seven day operating history. It will not clear the permanent module history. In the case of the three-wire module, the codes can be reset or cleared by cycling power to the module. This can be done by disengaging the Common (C) terminal. This will not clear the seven day operating history.

Note: For the 571-0066-00 module, if a fault is present, it is expected that the thermostat demand will remain present and the module will stay powered and function similar to the 571-0067-00 module. If the thermostat demand cycles off, then the 571-0066-00 module will reset and alert will clear.

Module History Download

The Diagnostics module is capable of communicating with a personal computer, tablet, or laptop, via Copeland computer software interfaces (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.

Copeland LP. 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 LP. will replace any defective diagnostic module without charge.

For more information on product warranty please visit Copeland.com

Support

For more information visit Copeland.com

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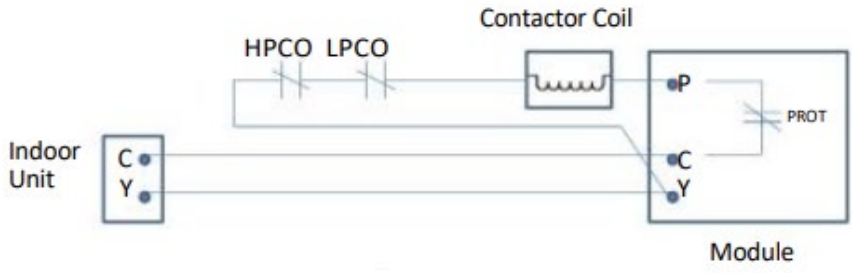


Figure 1
571-0066-00 Two-Wire Diagram

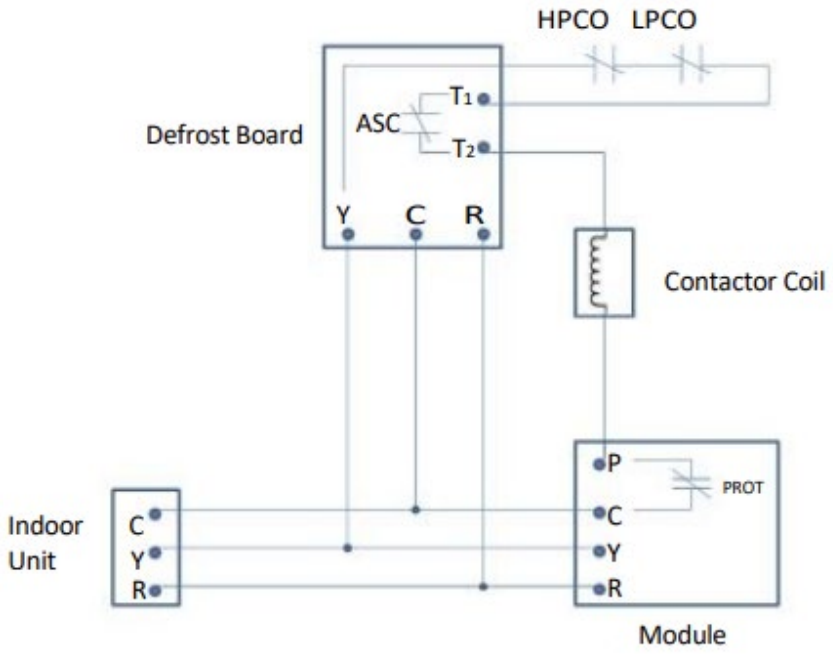


Figure 2
571-0067-00 Three-Wire Diagram

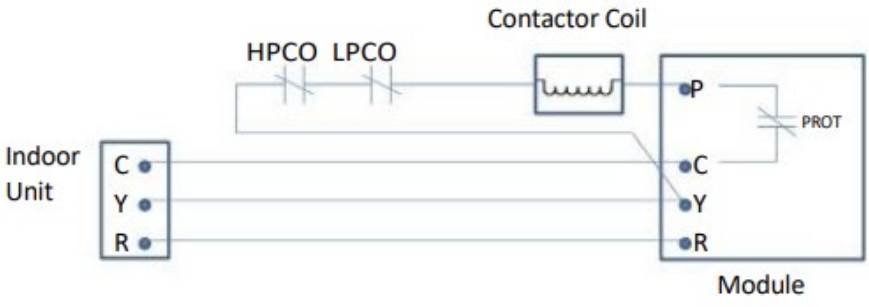


Figure 3
571-0067-00 Three-Wire Diagram

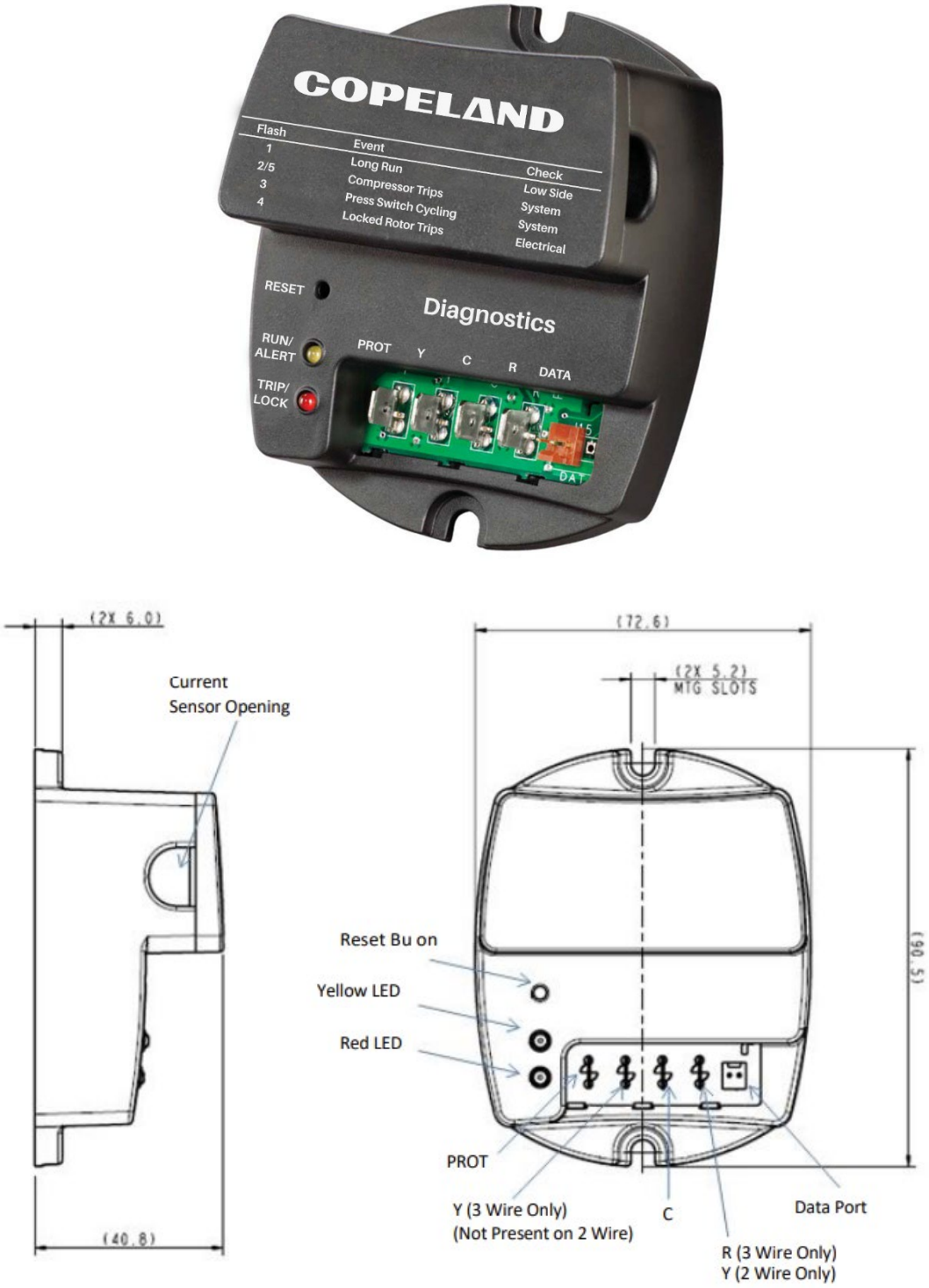


Figure 4
Dimensions are in Millimeters.

Tables

Table 1 - Quick Reference Table

Alert Code	Alert Condition	Lock Level	Lock Indication
Normal Run Solid Yellow	Normal operation, no trip.	N/A	N/A
Code1 Yellow Flash 1	Long run time. Compressor is on running for more than 18 hours. (Code1 is disabled in Heat Pump mode.)	N/A	N/A
Code2 Yellow Flash 2	Compressor (pressure) trip. Compressor runs for 12 sec to 15 min followed by a compressor trip condition lasting longer than 7 min.	4x consecutive	Red: Flash 2 Yellow: Off
Code3 Yellow Flash 3	Pressure switch cycling. Compressor runs for 12 sec to 15 min followed by a compressor trip lasting between 35 sec to 7 min.	4x consecutive or 10x total	Red: Flash 3 Yellow: Off
Code4 Yellow Flash 4	Locked rotor. Compressor trips within a compressor run time of 12 sec and does not start within 35 sec.	10x consecutive	Red: Flash 4 Yellow: Off
Code5 Yellow Flash 5	Compressor (moderate run) trip. Compressor runs for 15 min to 18 hrs followed by a compressor trip lasting longer than 7 min.	4x consecutive or 10x total	Red: Flash 5 Yellow: Off
Code9 Red Flash 9	The current to the PROT terminal is greater than 2A	Current >2A for 40ms	Red: Flash 9 Yellow: Off
Trip Solid Red	Demand is present, but compressor is not running	N/A	N/A

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Table 2

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

Status	Description	Troubleshooting Information
Solid Yellow "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	1. Compressor protector is open • Check for high head pressure • Check compressor supply voltage 2. Outdoor unit power disconnect is open 3. Compressor circuit breaker or fuse(s) is open 4. Broken wire or connector is not making contact 5. High pressure switch open if present in system 6. Compressor contactor has failed open
"ALERT" Flash Codes		
Yellow "ALERT" Flash Code 1	Long Run Time; Compressor is running extremely long run cycles indicative of low capacity due to a system low-side fault	1. Low refrigerant charge 2. 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 3. 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 4. Faulty metering device • Check TXV bulb installation (size, location and contact) • Check if TXV/fixed orifice is stuck closed or defective 5. Liquid line restriction (filter drier blocked if present in system) 6. 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; Discharge pressure out of limits or compressor overloaded	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)
Yellow "ALERT" Flash Code 3	Short Cycling; Compressor is running only briefly	1. Thermostat demand signal is intermittent 2. Time delay relay or control board defective 3. Low or high pressure switch is cycling

Status	Description	Troubleshooting 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
"LOCK" Flash Codes		
Red "LOCK" 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)
Red "LOCK" Flash Code 3 Yellow Off	Short Cycling; Compressor is locked out after 10 consecutive short cycling events	1. Thermostat demand signal is intermittent 2. Time delay relay or control board defective 3. If high pressure switch present go to Flash Code 2 information
Red "LOCK" 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 "LOCK" 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