Digital Compressor Controller
Copeland Scroll Digital Controller

• Simple Controller That Enables OEM’s To Use Digital Scrolls

• Relieves OEM From Developing Special Controllers
  • Faster Time To Market

• Copeland Controller Functions
  Controls
    - Compressor Contactor
    - Capacity Modulation Solenoid

Protection
  - Excessive Discharge Temperature
  - Low Flow Conditions
  - Operation Under Fault Conditions

Diagnostics
  - 8 Codes Indicating Faults

• Module Is Installed In System Cabinet
Copeland Scroll™ Digital Compressor Diagnostics

- Patented Copeland Diagnostics
- Green “POWER” LED
  - 24VAC Indicator
  - Flashes During Anti-Short Cycle Timer
- Yellow “UNLOADER” LED
  - Indicates Solenoid Is Energized
- Red “ALERT” LED
  - Flash Code Indicating Which ALERT Code Is Active
  - Code Interpreted By Counting Number Of Flashes (1-9)
Copeland Digital Scroll Controller

- **Capacity Solenoid Control**
  - Controller “Modulates” Solenoid Based On Capacity Demand
  - Demand Is Read Once Every 20 Seconds
- **Minor Alert** ➔ Display Appropriate Alarm
- **Major Alert** ➔ De-energize Contactor To Lock Out Compressor

* ppt 11/2/2009 12:48 PM 4
Digital Controller Can Provide Suction Pressure Feedback
- 5 VDC Suction Pressure Transducer Required
- Algorithm “Filters” Suction Pressure Swings
Copeland Scroll™ Digital – Demand Signal vs. Modulation

![Graph showing the relationship between Demand Signal (VDC) and Unloader Modulation (%). The graph includes a shaded area labeled "Compressor Off" and points marked at 1.4, 3.0, and 5.0 on the Demand Signal axis.](image-url)
Copeland Scroll Digital Controller –
Key Specifications

• Size
  - Depth 6” x Height 4” x Width 2”
  - Designed To Minimize Footprint In System Electrical Panel

• Voltages
  - Controller Supply: 19-28VAC, 48-62Hz, 2VA Max
  - Pilot Voltage Capability: AC Voltages 24, 120, 240

• Inputs
  - Minimum: Capacity Signal 1-5VDC, Discharge Thermistor (100K NTC)
  - Optional: Suction Pressure Sensor (Controller Will Source 5VDC To Sensor)

• Outputs
  - Minimum: Digital Solenoid, Compressor Contactor
  - Optional: Suction Pressure, Alarm, Vapor Injection

• Operator Interface
  - 3 LED’s: Green Indicating Module Health
    Amber Indicating Digital Solenoid Operation
    Red - Up To 8 Flash Codes Indicating Operation Status
Copeland Scroll Digital Controller – Key Operational Features

Operation Rules
- Digital duty cycle of 15 seconds
- Min Capacity limited to 10%
- Scrolls unloaded for 0.5 sec on start up
- Scrolls unloaded for 1 sec on shut down to prevent reverse rotation
- 2 Min anti short cycle enforced on all shutdown
- 30 minute “no start” enforced on all high temperature shutdown
- Digital solenoid turned OFF on protector trip

Status Codes
1 Future
2 High Discharge Temperature Td >268F, Reset Td<250, Lockout on 5th
3 Compressor Protector Tripped Detect using current
4 Locked Rotor Lockout on 4th successive locked rotor trip
5 Demand Signal Loss Capacity Req < 0.5VDC, shut down
6 Discharge Thermistor Fault Wires broken, Capacity forced to max 50%
7 Future
8 Welded Contactor Detect using current
9 Low Supply Voltage Supply voltage < 19VAC, shut down
**Copeland Scroll™ Digital Fault Codes**

*“Alert” Light Blinks When Any Of 7 Harmful System Conditions Is Detected*

<table>
<thead>
<tr>
<th>Alert Code</th>
<th>System Condition</th>
<th>Diagnostic Alert Light</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Code 2</td>
<td>High Discharge Temp Trip</td>
<td>Blinks 2 Times</td>
<td>Lockout</td>
</tr>
<tr>
<td>Code 3</td>
<td>Compressor Protector Trip</td>
<td>Blinks 3 Times</td>
<td>Lockout</td>
</tr>
<tr>
<td>Code 4</td>
<td>Locked Rotor</td>
<td>Blinks 4 Times</td>
<td>Lockout</td>
</tr>
<tr>
<td>Code 5</td>
<td>Demand Signal Loss</td>
<td>Blinks 5 Times</td>
<td>Lockout</td>
</tr>
<tr>
<td>Code 6</td>
<td>Discharge Thermistor Fault</td>
<td>Blinks 6 Times</td>
<td>Reduce Capacity</td>
</tr>
<tr>
<td>Code 7</td>
<td>Future</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Code 8</td>
<td>Welded Contactor</td>
<td>Blinks 8 Times</td>
<td>Unload Compressor</td>
</tr>
<tr>
<td>Code 9</td>
<td>Low Voltage</td>
<td>Blinks 9 Times</td>
<td>Trip Compressor</td>
</tr>
</tbody>
</table>

Protective Faults That Require Manual Reset
**Code 2 – High Discharge Temperature Trip**

- **Event Trigger**
  - Discharge temperature is above 268°F OR discharge thermistor input is short circuited

- **Action**
  - Deenergize compressor contactor ➔ Take Compressor Offline
  - Close alarm relay contacts ➔ Display Code 2 Alert
  - Unloader solenoid deenergized

- **Event Reset For Restarting Compressor**
  - 30 minute cool down timer AND discharge temperature below 250°F

- **Flash Code Clear/Alarm Relay Contact Open**
  - Compressor must have 60 non-interrupted, ALERT free minutes of run time
**Code 2 – High Discharge Temperature Lockout**

- **Event Trigger**
  - 5 High Discharge Temperature trips within 4 hours

- **Action**
  - Deenergize compressor contactor ➔ Take Compressor Offline
  - Close alarm relay contacts ➔ Display Code 2 Alert
  - Unloader solenoid deenergized

- **Event Reset For Restarting Compressor**
  - Controller 24VAC power must be cycled on and off

- **Flash Code Clear/Alarm Relay Contact Open**
  - Controller 24VAC power must be cycled on and off
Code 3 – Compressor Protector Trip

- **Event Trigger**
  - Demand 1.4VDC or higher AND
  - Compressor internal overload protector open OR
  - Power disconnected to compressor (fuse, breaker, loose wire)

- **Action**
  - Deenergize compressor contactor ➔ Take Compressor Offline
  - Close alarm relay contacts ➔ Display Code 3 Alert
  - Unloader solenoid deenergized

- **Event Reset For Restarting Compressor**
  - Wait anti-short cycle timer delay (2 minutes)

- **Flash Code Clear/Alarm Relay Contact Open**
  - Demand 1.4VDC or higher AND compressor current detected
Code 4 – Locked Rotor

- Event Trigger
  - Controller senses a locked rotor condition in compressor

- Action
  - Deenergize compressor contactor ➔ Take Compressor Offline
  - Close alarm relay contacts ➔ Display Code 4 Alert
  - Unloader solenoid deenergized

- Event Reset For Restarting Compressor
  - Controller 24VAC power must be cycled on and off

- Flash Code Clear/Alarm Relay Contact Open
  - Controller 24VAC power must be cycled on and off
**Code 5 – Demand Signal Loss**

- **Event Trigger**
  - Demand signal below 0.5 VDC

- **Action**
  - Deenergize compressor contactor ➔ Take Compressor Offline
  - Close alarm relay contacts ➔ Display Code 5 Alert
  - Unloader solenoid deenergized

- **Event Reset For Restarting Compressor**
  - Demand signal above 0.5 VDC AND anti-short cycle timer complete

- **Flash Code Clear/Alarm Relay Contact Open**
  - Demand signal above 0.5 VDC
Code 6 – Discharge Thermistor Fault

- Event Trigger
  - Discharge thermistor is not connected to Compressor Controller

- Action
  - Limit maximum capacity of compressor to 50% unloader modulation
  - Close alarm relay contacts ➔ Display Code 6 Alert

- Event Reset For Restarting Compressor
  - Thermistor reconnected

- Flash Code Clear/Alarm Relay Contact Open
  - Thermistor reconnected
**Code 8 – Compressor Contactor Fault**

- **Event Trigger**
  - Compressor current is detected when demand is below 1.4VDC

- **Action**
  - Reenergizes compressor contactor
  - Close alarm relay contacts ➔ Displays Code 8 Alert
  - Unloader solenoid energized
    - Net effect is to run compressor unloaded until demand rises above 1.4VDC again

- **Event Reset For Restarting Compressor**
  - Compressor continues to run

- **Flash Code Clear/Alarm Relay Contact Open**
  - Demand above 1.4VDC OR no compressor current detected
Code 9 – Low 24VAC Supply

- Event Trigger
  - Compressor Controller 24VAC supply below 18.5VAC

- Action
  - Trip compressor
  - Close alarm relay contacts ➔ Display Code 9 Alert

- Event Reset For Restarting Compressor
  - 24VAC supply above 19.5VAC AND anti-short cycle timer complete

- Flash Code Clear/Alarm Relay Contact Open
  - 24VAC supply above 19.5VAC AND anti-short cycle timer complete