Copeland Scroll

Oil & Gas Compression

Copeland Scroll® Compressor Module

Installation, Operation & Maintenance Manual

Model Family
SZO22
SZV22
400/480VAC,
50/60 Hz,
3-Phase

EMERSON™
Process Management

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FIGURES

TABLES

Compressor Module Nomenclature

Model	Max Delivery Pressure (PSIG)	Max Flow (MCFD)	Drive HP	High Press Switch Setting (PSIG)	Low Press Switch Setting	High Temp Setting °F (°C)	Oil Thermal Bypass Valve Setpoint °F (°C)	Gas Bypass Valve	Module Weight (Lbs.)
Single Scroll Units									
SZO22C3A-EDE-234	125	100	10	215	2" W.C. (5 mbarg)	240 (116)	200	YES	350
SZV22C1A-EDE-140	190	100	15	215	2" W.C. (5 mbarg)	280 (138)	250	NO	356

IMPORTANT SAFETY INFORMATION

This manual contains important instructions for installation, operation and maintenance of your Copeland Scroll® Compressor Module.

WARNING

The Compressor Module must be installed ONLY in systems that have been designed by qualified engineering personnel. The system must conform to all applicable local and national regulations and safety standards.

These instructions are intended to assist in the installation and operation of the Compressor Module and MUST be kept with the Compressor.

Service and maintenance of the Compressor Module must be performed by qualified technicians only. Service and maintenance must conform to all applicable local and national regulations and safety standards.

Thoroughly review this manual, all instructions and hazard warnings before performing any work on the Compressor Module.

Maintain all Compressor Module operation and hazard warning labels.

WARNING

Flammable gas can form explosive mixtures with air. Explosive gases can cause property damage, serious personal injury or death.

WARNING

Failure to disconnect and lockout electrical power from the Compressor Module before attempting maintenance can cause shock, burns, severe personal injury or death.

WARNING

Loosening or removing pressure-containing components from the Compressor Module when it is in operation can cause major property damage, serious personal injury or death.

Failure to relieve system pressure prior to performing service or maintenance on the Compressor Module can cause property damage or serious personal injury.

CAUTION

Extreme heat can cause personal injury or property damage.

CAUTION

Always use a lifting device capable of supporting the full weight of the Compressor Module or component being lifted.

Handling or lifting heavy assemblies can cause personal injury or property damage.

Safety Symbols Used in This Manual

SAFETY ALERT SYMBOL

When you see this symbol on the Compressor Module or in this manual, look for one of the following words and be aware of the potential for personal injury or property damage.

WARNING

A Warning describes hazards that CAN or WILL cause serious personal injury, death or major property damage.

CAUTION

A Caution describes hazards that CAN cause personal injury or property damage.

NOTE

A Note indicates special instructions that are very important and must be followed.

1.0 INTRODUCTION

The Copeland Scroll® SZO22 Compressor Module comes equipped with one Copeland Scroll® Compressor designed for Class I, Division II applications. The Compressor Module is designed for assembly into a Compressor Package ready for service in the field; the completed housing is done by equipment Packagers. This section provides an overview of these components.

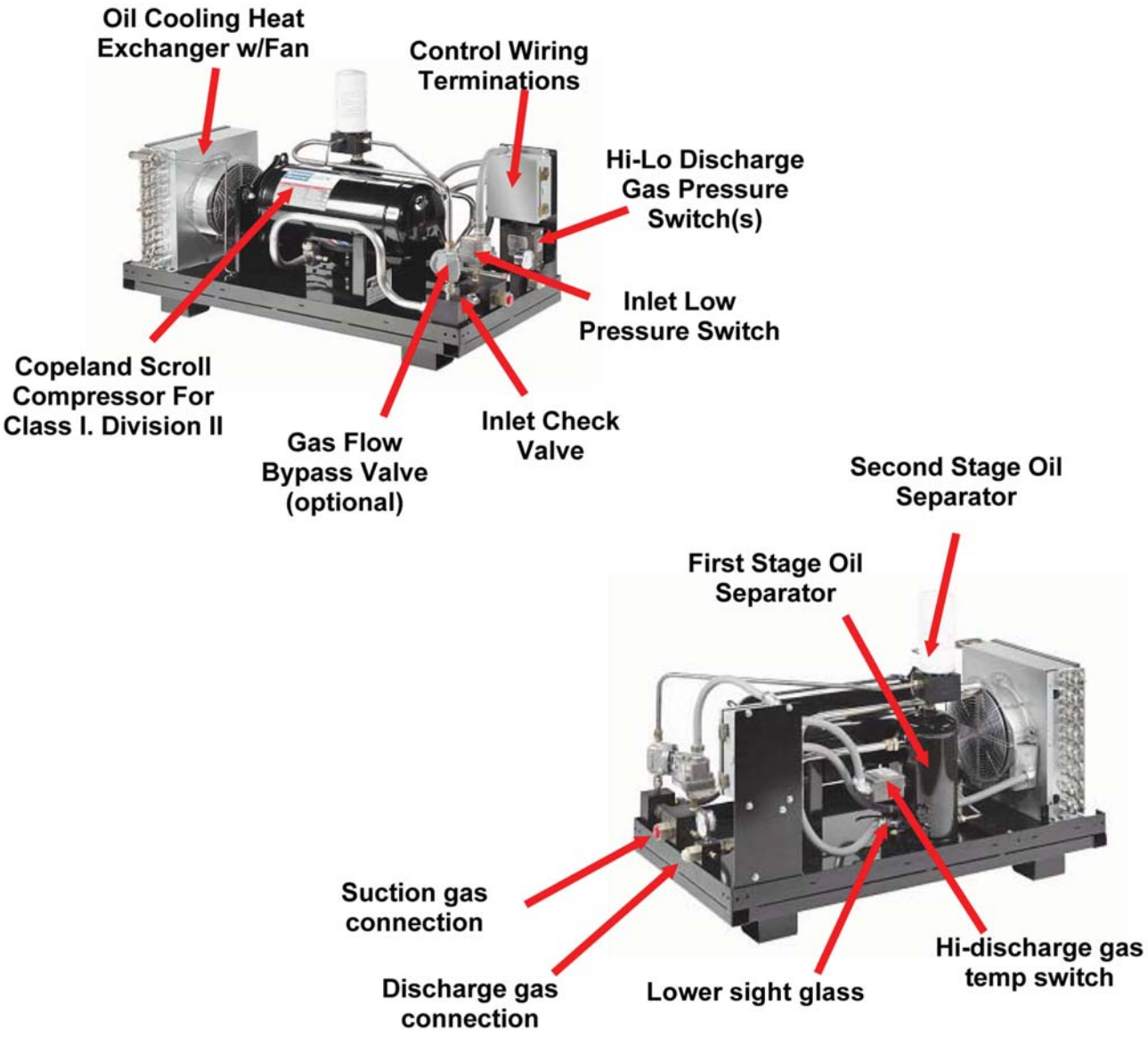
These terms are used throughout this manual:

- **Compressor Module** - the SZO22 Compressor Module shown in **Section 1.1**
- **Compressor** - a Copeland Scroll® Compressor
- **Compressor Package** - the entire assembly, including the Compressor Module, ready for service in the field
- **Packagers** - the company that prepares the Compressor Module for service
- **VFD** - Variable Frequency Drive used to power a variable speed Compressor Module

1.1 The Compressor Module

The **Compressor Module** consists of one Compressor and the other components shown in **Figure 1**.

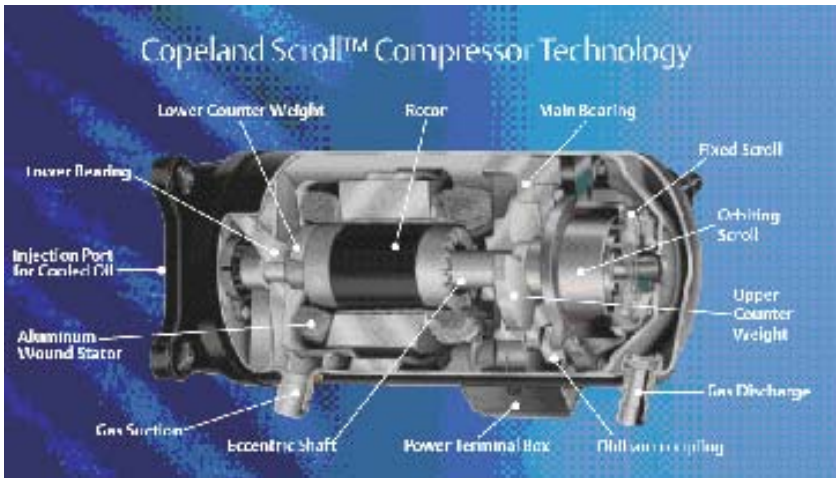
Figure 1 Compressor Module Components



1.2 The Compressor

The **Compressor** refers to the Copeland Scroll® Compressor. Each Compressor Module has two Compressors. **Figure 2** shows a cross-section of a Compressor and its key components.

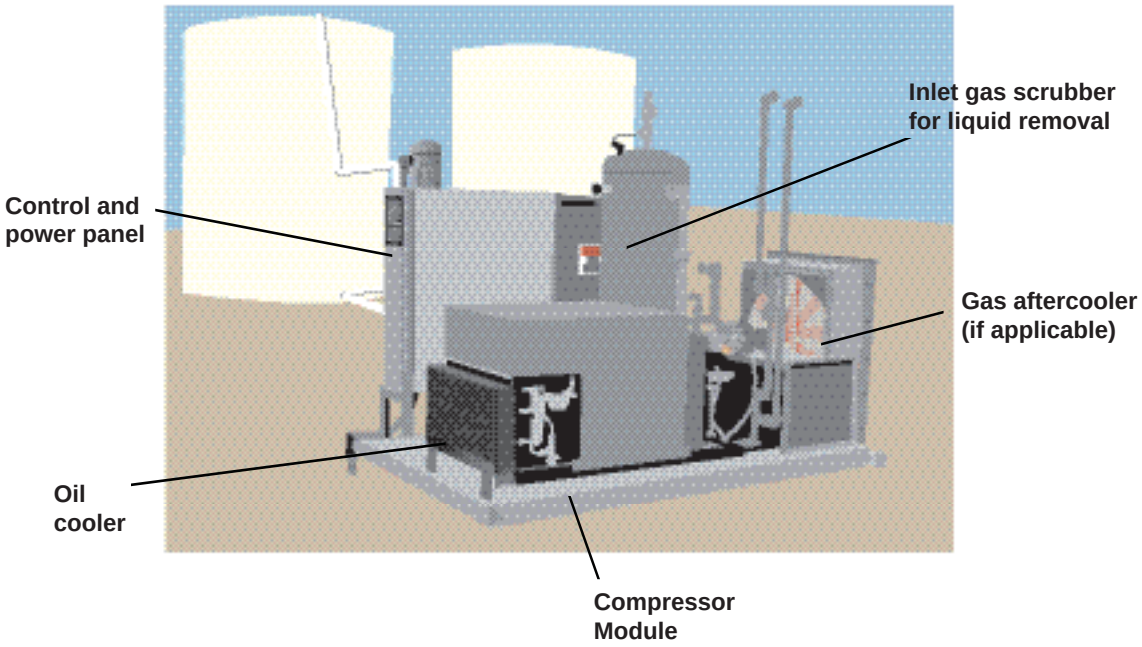
Figure 2 Copeland Scroll® Compressor Cross Section (not shown: Encapsulated Stator)



1.3 The Compressor Package

The **Compressor Package** consists of the Compressor Module housed in an assembly ready for service in the field. Equipment **Packagers** customize the assembly and complete the fabrication for Compressor Modules for each application. **Figure 3** shows a simplified example of a Compressor Package.

Figure 3 Typical Compressor Package



2.0 INSTALLATION

2.1 Installation Guidelines

2.1.1 Required Component—Inlet Gas Scrubber

An appropriate inlet gas scrubber is **REQUIRED** to remove liquids from the gas prior to compression. If there is potential for liquid slugging, a suitable trap must be installed to prevent liquid from flooding and damaging the Compressor.

NOTE
Failing to use an appropriate inlet gas scrubber to remove liquids from the gas prior to compression can cause flooding and damage the Compressor.

2.1.2 General Installation Guidelines

Follow these general guidelines for installation:

- The Compressor Module must be installed and operated in compliance with all applicable codes and regulations.
- The system must be installed on a level surface.
- Install pipe unions or flanges to connect the system to the inlet and discharge piping for ease of service.
- Install isolation valves on the inlet and discharge piping.
- A common ground must be connected between the Compressor Module and the Compressor Package chassis. This ground must comply with the National Electric Code (NEC) and any other applicable codes.
- Solid debris also must be removed from the gas prior to compression. When required, use a 5 to 10-micron inlet filter to remove debris from the gas stream. The degree of filtration required depends on the specific application.

2.2 Inlet and Discharge Pressures

Refer to **Table 1** for acceptable inlet and discharge pressure levels.

Table 1 Inlet and discharge pressure limits

Type	Level	Operating Guidelines
Minimum Inlet Pressure	0.75 psig / 2" water column (model specific)	Consult factory for operations below 0.0 psig.
Maximum Inlet Pressure	10 / 25 psig (model specific)	Operation at pressures above 25 psig will result in: • Excessive oil carryover • Loss of oil from the Compressor Module
Discharge Pressure Range	70 psig to 190 psig (depends on model)	When the discharge pressure of the Compressor Module reaches the maximum, which ranges from 70 to 190 psig, depending on the model (see **Compressor Module Nomenclature** on page **iv**): • The Compressor Module goes into high discharge pressure recycle if equipped. • The Compressor Module's bypass regulator diverts gas from the high-pressure side to the low-pressure side of the module. All Compressor Modules must be equipped with pressure-limiting or relief devices.
Minimum Differential Pressure	70 psi	A minimum pressure differential of 70 psi between inlet and discharge pressure is required for proper operation.

NOTE: Required Component – High Pressure Discharge Gas Bypass Valve

To eliminate redundancy, the high pressure discharge gas bypass (recycle) valve was removed from some of the scroll modules (see table below). Packagers will need to install downstream pressure relief of our module.

Model	Max Delivery Pressure (PSIG)	Max Flow (MCFD)	Drive HP	High Press Switch Setting (PSIG)	Low Press Switch Setting	High Temp Setting °F (°C)	Oil Thermal Bypass Valve Setpoint °F (°C)	Gas Bypass Valve	Module Weight (Lbs.)
Single Scroll Units									
SZO22C3A-EDE-234	125	100	10	215	2" W.C. (5 mbarg)	240 (116)	200	YES	350
SZV22C1A-EDE-140	190	100	15	215	2" W.C. (5 mbarg)	280 (138)	250	NO	356

2.3 Ambient Temperature Range

The Compressor Module operating ambient temperature is 20°F to +122°F (-29° to +50°C). For details on ambient temperatures for VFD startup and Compressor Module operation, see **Table 10** on page **29**.

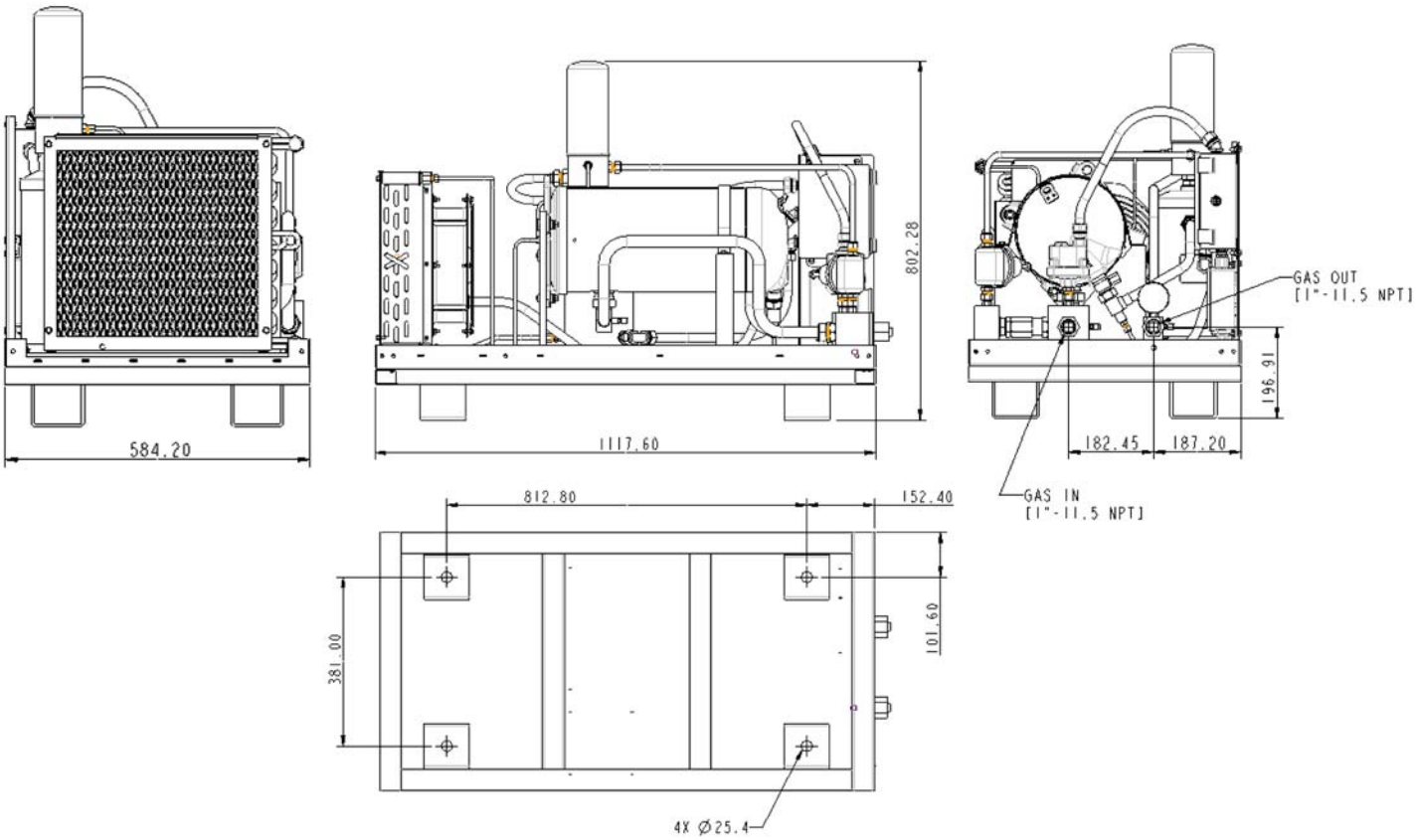
2.4 Installation Clearance and Dimensions

Allow sufficient clearance on all sides for service access, especially for gas and electrical connections at the rear of the Compressor Module. Check applicable national and local electrical codes.

Cooling air flow is back to front—from the gas connection end to the oil cooler end. Do not block or restrict the cooler fans or oil cooler.

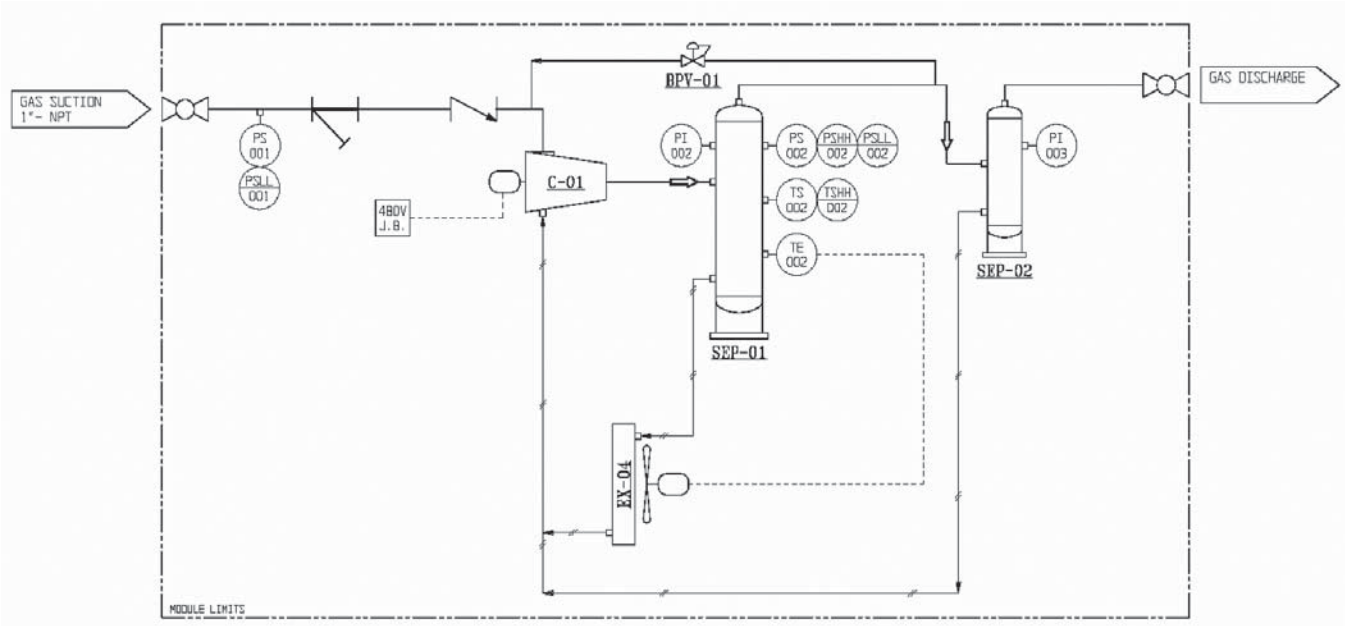
Refer to **Figure 4** for the dimensions of the Compressor Module.

Figure 4 Compressor Module Dimensions, in. (mm)



2.5 Process and Instrumentation Diagrams (P&IDs)

Figure 5 Compressor Module Gas and Oil Flow Diagram and Safety Shutdowns



Code	Description
BPV-01	Gas bypass valve (optional)
C-01 / C-02	Compressor and motor
EX-04	Oil cooler, fan controlled by thermistor
FL-05	Oil filter
PI002	Pressure gauge on first-stage oil separator
PI003	Pressure gauge on second-stage oil separator
PS002 / PSHH002	High discharge gas pressure switch
PS001 / PSLL001	Inlet low pressure switch
SEP-01	First-stage oil separator, 6” O.D.
SEP-02	Second-stage oil separator/coalescing element
TCV-03	Thermal bypass valve, 3-way, set @ 200°F (93°C) option for 250F, model specific
TE002	Fan speed thermistor
TS002 / TSHH002	High discharge gas temp switch

2.6 Electrical Controls

2.6.1 General Considerations

All shutdown devices are dry contact switches rated Class I, Division II that are wired to a terminal box for connection to the packager supplied control circuit. The common wires on all switches are connected together. All switches are closed unless a fault condition is detected.

All safety and protective devices must be installed and used in accordance with applicable codes and regulations.

Switches

All switch connections are wired to terminal strips in a junction box on the Compressor Module.

Switch	Status
• Low Inlet Gas Pressure	Normally Open, closes on pressure rise
• High Discharge Gas Pressure	Normally Closed, opens on pressure rise
• High Temperature	Normally Closed, opens on temperature rise

Electrical Considerations - Variable Speed Compressor Module

- Compressor power for a variable speed Compressor Module is the **Variable Frequency Drive (VFD)**.
- Compressor speed control can be either a 4-20 mA or 0-10V signal (transducer supplied by customer) applied to the VFD. Speed can also be manually controlled with a potentiometer or the VFD can be set for a fixed speed.
- The Compressor is protected by the VFD.
- The customer control circuit must supply an **Enable** signal to the VFD before the drive will accept a **Run Fwd** signal.
- The VFD will start when the **Enable** signal is on and a **Run Fwd** signal is applied.
- The VFD will stop if the **Run Fwd** signal is off or the **Enable** signal is removed.

NOTE

*The drive provides 24V for the **Enable** and **Run Fwd** signals.*
*The installer must connect the **Enable** and **Run Forward** terminals to the drive's 24V terminal.*

2.6.2 Oil Cooler Fan Control

The Compressor Module temperature is controlled by managing module oil flow and temperature. The module's precise temperature control is critical to system performance and equipment life. Maintaining proper temperature control also reduces the possibility of gas condensing into liquids during operation.

- Cooling fans require 24VDC, 4.5A (105 Watts) for the Compressor Module. Fan speed is controlled by a 0-10VDC control signal that is applied to the yellow lead on the fan terminal strip. Standard Compressor Modules use a nonlinear PTC thermistor to monitor oil temperature and provide a speed signal.
- High temperature Compressor Modules use a linear NTC thermistor to monitor oil temperature. This signal is available to support a customer-provided fan speed control circuit.
- All power connections are wired to terminal strips in a junction box on the Compressor Module.

Figure 6 Brushless DC Fan

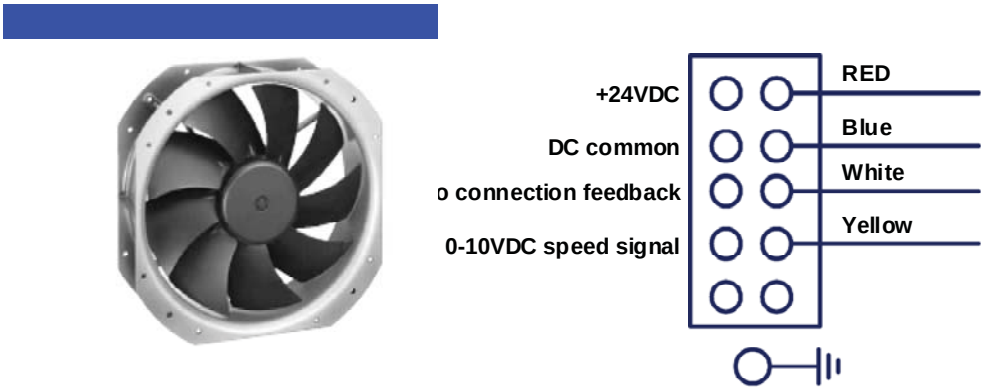


Figure 7 Basic Fan Control System

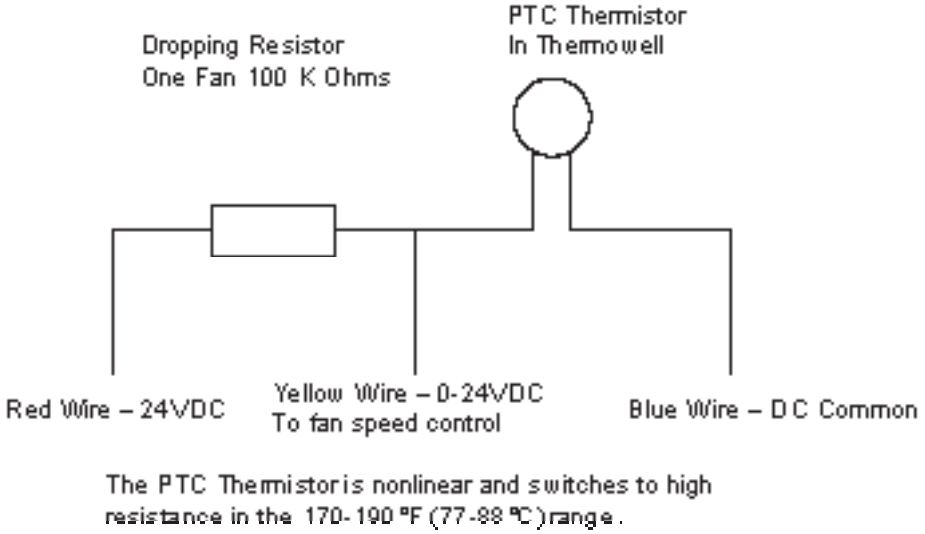
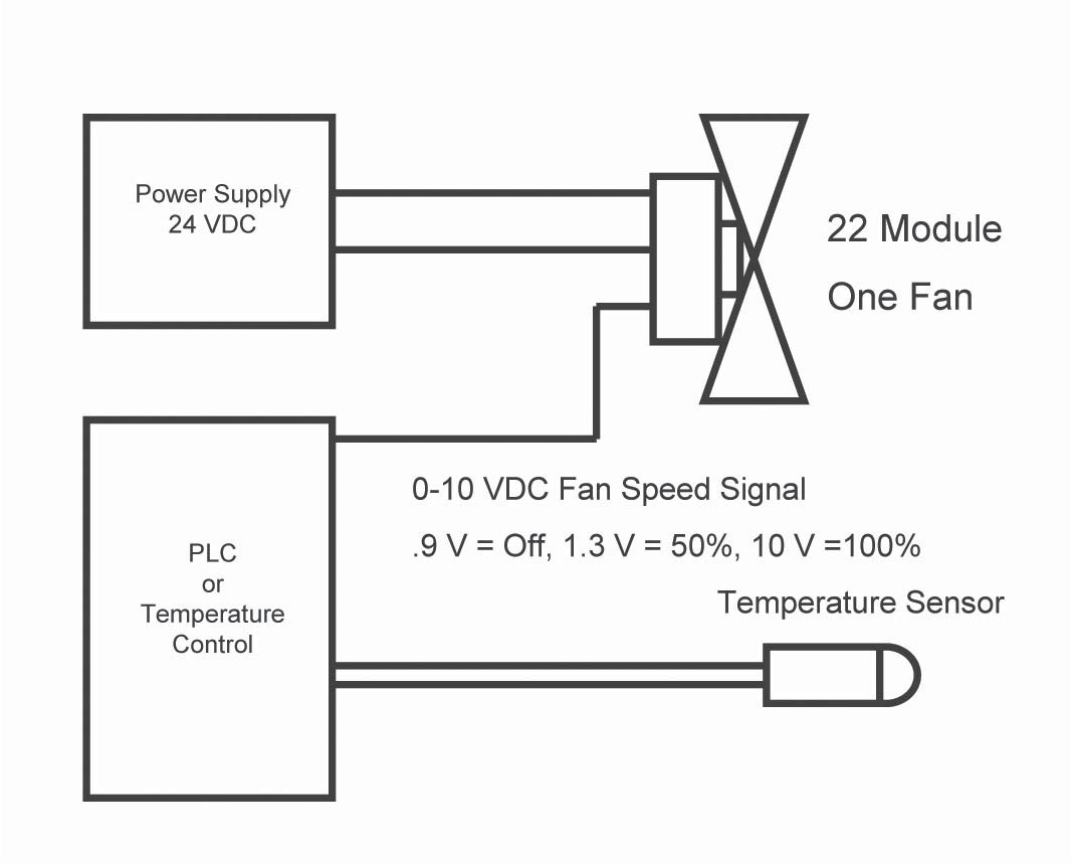
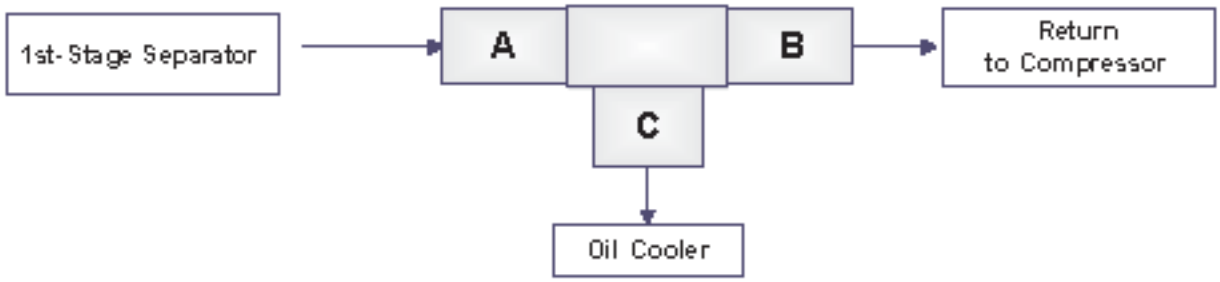


Figure 8 Optional Customer-Installed High Temperature Fan Control System



- Compressor requirements: 0.8 to 2 GPM (3.0-755 LPM) flow rate
- Thermal oil bypass valve, standard setting: 200°F (93°C) / 250F model specific
- Thermal bypass valve operation (valve's purpose is to provide discharge temperature control)
- Oil flow on valve is A to B when the unit is cold and A to C when the heat rises (see **Figure 9**).

Figure 9 Oil Cooling and Thermal Valve

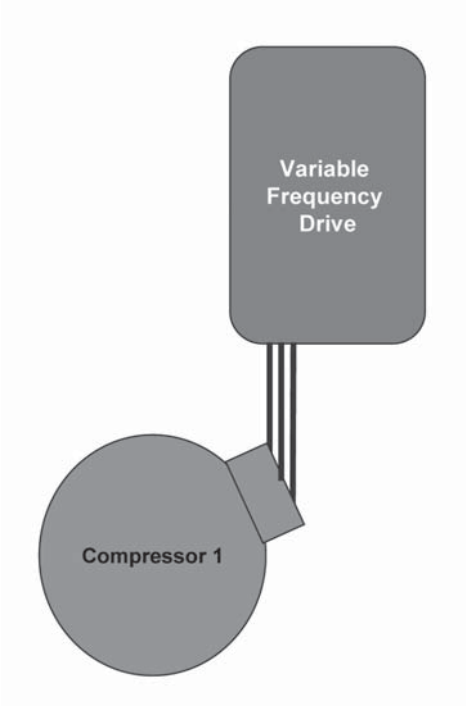


2.6.3 Compressor Module Motor Protection

Variable Speed Compressor Module Protection

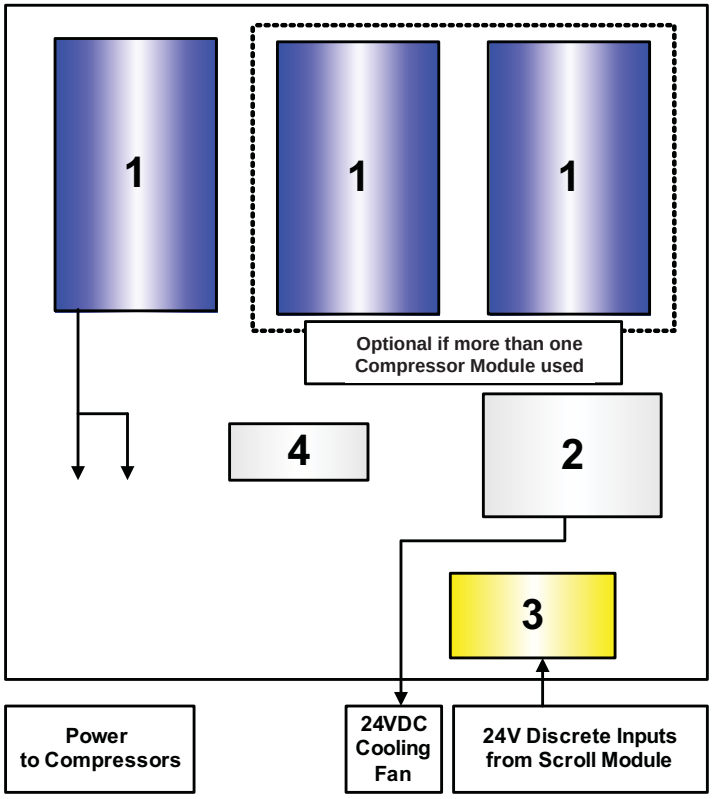
- The VFD provides overload protection for the compressor.
- Module capacity can be changed by varying the typical Compressor speed, ranging from 2400 to 4800 rpm.

Figure 10 Motor Control



2.6.4 Electrical Requirements

Figure 11 Typical Compressor Module Electrical Requirements



Code	Description
1	Control Techniques VFD,* 10 or 15 HP model specific
2	24VDC power supply **
3	PLC or other control for inputs from Compressor Module
4	480V 3-phase input ***

Notes

* VFD on Variable Speed Drive models.

** All other components supplied by Packagers.

*** Contact factory for information about single-phase and other voltage applications.

Table 2 Typical Compressor Module power supply requirements

Compressor Power (data based on 480VAC)	Variable Speed
Module horsepower	10 or 15 HP
VFD voltage supply range	342-528VAC
Phase	3-phase*
Frequency	50/60 Hz
Low Voltage DC Specifications - Oil Cooler Fan Voltage and Power	
Fan motor voltage	24VDC
Total fan motor current	4.5A

Additional power may be required to support customer logic and control circuits.

* Contact factory for information about single-phase applications.

** Reduced capacity at 50 Hz.

2.6.5 Wiring

Figure 12 Control Circuit Terminations

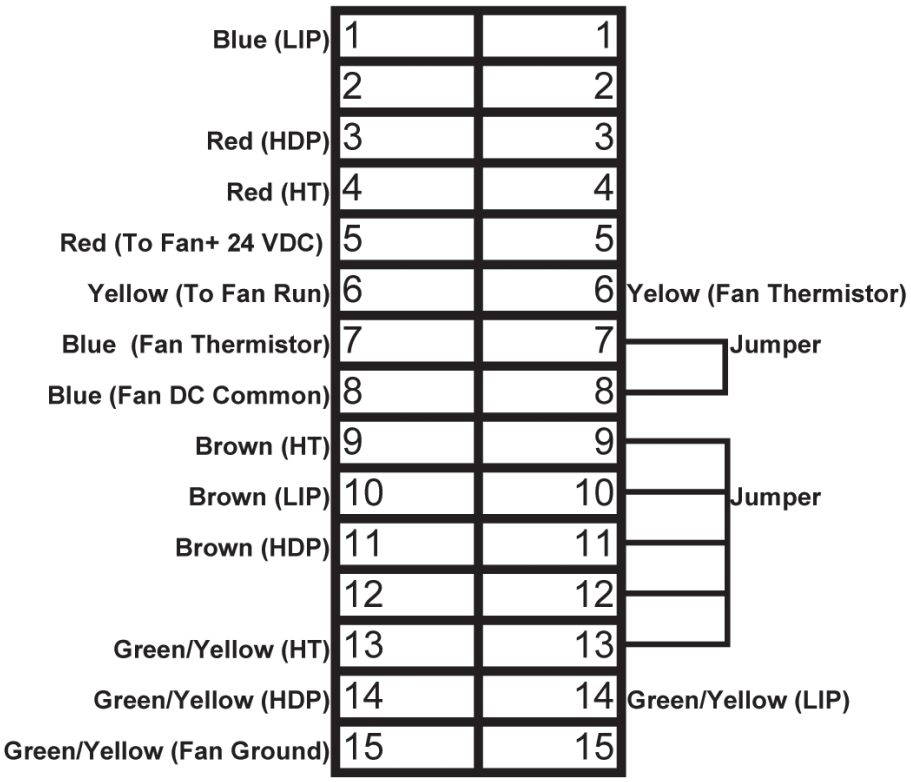
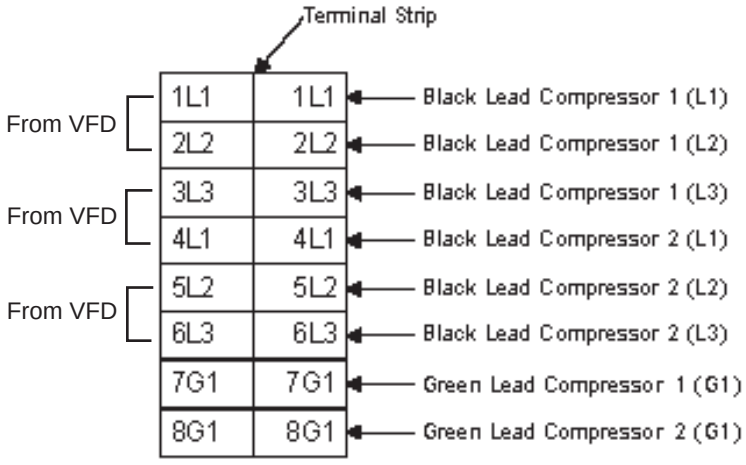


Figure 13 Power Terminations



2.6.6 Variable Frequency Drive (VFD) Terminations

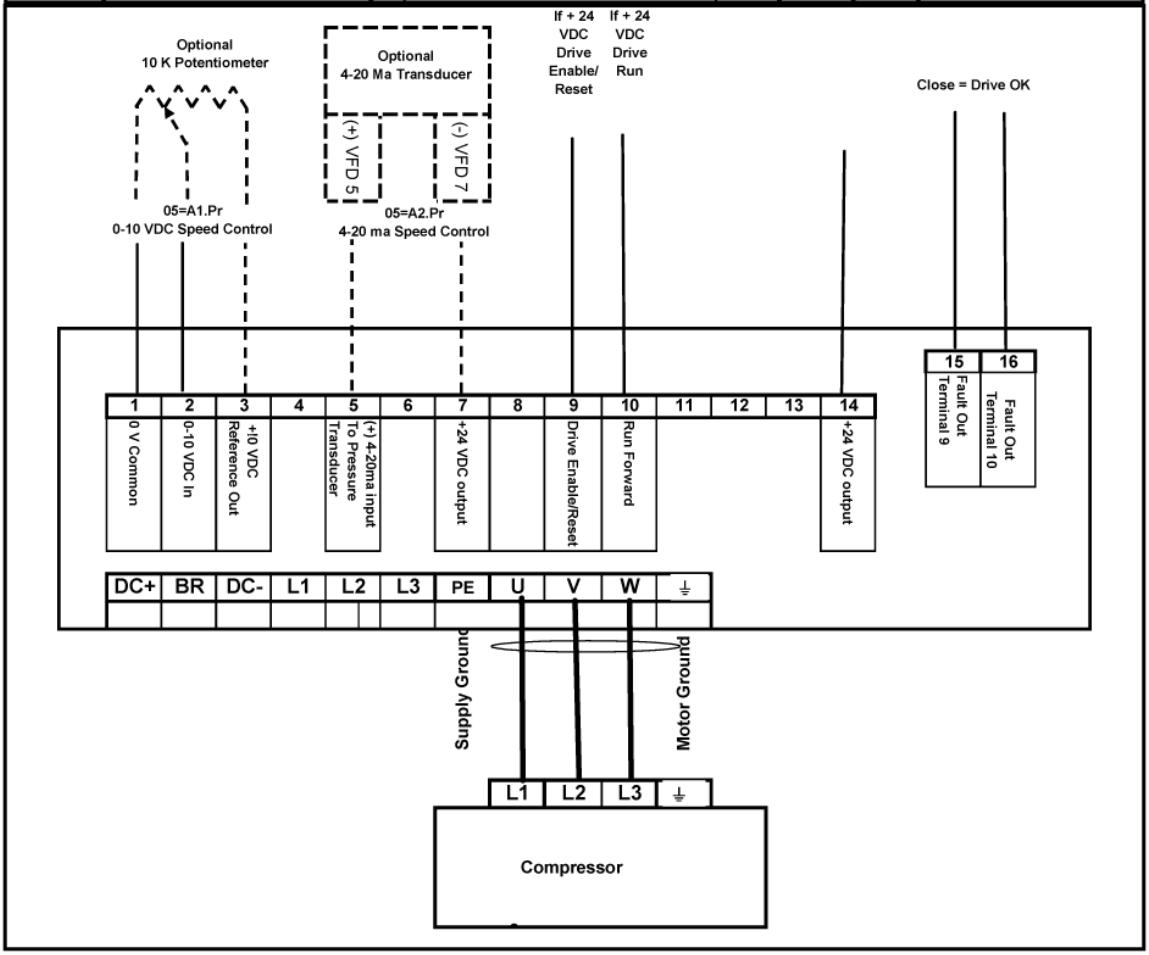
Figure 14 shows VFD terminations. See **Table 3** on page **15** for default and optional VFD terminal configurations. The VFD is shipped configured for a 0-10V speed control input on Terminal 2.

If a 4-20 mA input is required, Parameter 05—and possibly Parameter 16—will need to be changed. See **Table 4** on page **16** and the Control Techniques VFD manual (Commander SE model) for details.

Tables 3 and **4** provide terminal and parameter details corresponding to **Figure 14** on page **15**.

10/15 Hp Commander SE VFD

Configuration						Display	
Terminals		#	Parameters	10 Hp	15 Hp		
Terminal		01	Minimum speed (Hz)	40.0	40.0	rD	Drive Ready
1	0V Common	02	Maximum speed (Hz)	80.0	80.0	iH	Drive inhibited
2	**0-10 V input if #05=A1.Pr**	03	Acceleration rate (s/100Hz)	1.0	1.0	tr	Drive tripped
3	10 VDC reference out	04	Deceleration rate (s/100Hz)	10.0	10.0	SP	Motor Speed RPM
4	0V Common	05	Speed Reference select 0-10 VDC	A1.Pr	A1.Pr	A	Output current AMPS
5	**4-20 ma input if #05=A2.Pr**		or			**Faults**	
6	Analog output speed	05	Speed Reference select 4-20 ma	A2.Pr	A2.Pr		
7	24 VDC output	06	Motor rated current	16	24	UU	Under Voltage
8	No Connection	07	Motor rated Speed (RPM)	4800	4800	OU	Over voltage
9	Driven enable/reset if 24V	08	Motor rated voltage	367	367	PH	Phase loss
10	Run forward if 24 V	09	Power factor	0.94	0.94	OI.AC	>150% over current
11	No Connection	10	Parameter access	L2	L2	It.AC	105-150% overc current
12	No Connection	16	Current input mode	4-20	4-20	cL	4-20ma<3ma
13	No Connection	31	Stopping mode	0	0	O.cL	4-20ma>25ma
14	+24 VDC output	35	Start/stop logic	4	4	O.ld1	+24VDC Load >100ma
15	Drive OK =Closed to 16	39	Rated frequency (Hz0	80.0	80.0	Et	External trip
16	Drive OK = closed to 15	48	Voltage mode select	2	2	Oh	Over heat



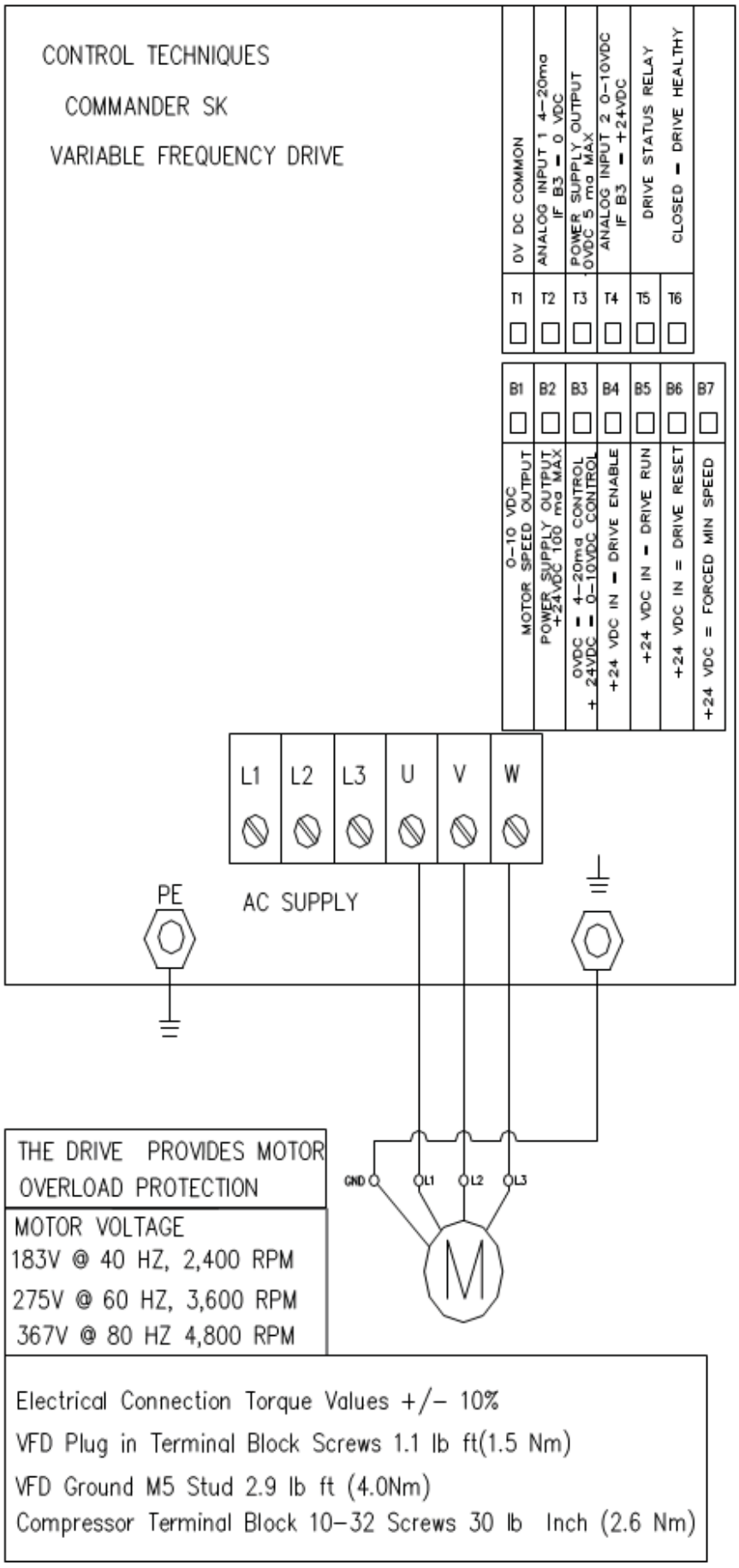

CONTROL TECHNIQUES
COMMANDER SK
VARIABLE FREQUENCY DRIVE
T1 0V DC COMMON
T2 ANALOG INPUT 1 4–20ma IF B3 = 0 VDC
T3 POWER SUPPLY OUTPUT 0VDC 5 ma MAX
T4 ANALOG INPUT 2 0–10VDC IF B3 = +24VDC
T5 T6 DRIVE STATUS RELAY CLOSED = DRIVE HEALTHY
B1 0–10 VDC MOTOR SPEED OUTPUT
B2 POWER SUPPLY OUTPUT +24VDC 100 ma MAX
B3 0VDC = 4–20ma CONTROL +24VDC = 0–10VDC CONTROL
B4 +24 VDC IN = DRIVE ENABLE
B5 +24 VDC IN = DRIVE RUN
B6 +24 VDC IN = DRIVE RESET
B7 +24 VDC = FORCED MIN SPEED
L1 L2 L3 U V W
PE
AC SUPPLY
GND L1 L2 L3
M
THE DRIVE PROVIDES MOTOR OVERLOAD PROTECTION
MOTOR VOLTAGE
183V @ 40 HZ, 2,400 RPM
275V @ 60 HZ, 3,600 RPM
367V @ 80 HZ 4,800 RPM
Electrical Connection Torque Values +/– 10%
VFD Plug in Terminal Block Screws 1.1 lb ft(1.5 Nm)
VFD Ground M5 Stud 2.9 lb ft (4.0Nm)
Compressor Terminal Block 10–32 Screws 30 lb Inch (2.6 Nm)

Table 4 Typical VFD parameters		
Parameter	**Description**	**Typical Value**
01	Minimum speed (Hz)	40.0
02	Maximum speed (Hz)	80.0
03	Acceleration rate (s/100 Hz)	1.0
04	Deceleration rate (s/100 Hz)	10.0
05	Speed reference select	A1.A2
06	Motor rated current	23
07	Motor rated speed (rpm)	4800
08	Motor rated voltage	367
09	Power factor	0.94
10	Parameter access	L2
16	Current input mode	4-20
31	Stopping mode	0
35	Start/stop logic	4
39	Rated frequency (Hz)	80.0
48	Voltage mode select	2

3.0 OPERATION

3.1 Initial Startup - Compressor Module

The following inspections should be made on initial startup—-typically, by the Packager—and after long periods of storage.

- Verify acceptable pre-startup conditions using the checklist in **3.1.1 - Pre-Startup Checklist**.
- Start the Compressor Module, then perform the checks in **3.1.2 - Post-Startup Checklist**.

3.1.1 Pre-Startup Checklist

Perform these checks BEFORE starting the Compressor Module:

MAIN POWER

Check for the following conditions:

___ 1. Motor type is correct for the application, either Variable Speed C3A or C2A motor.

___ 2. Power phasing to the terminal strip and Compressors is correct.

___ 3. Supply voltage to the Variable Frequency Drive (VFD) or Fixed Speed Compressor motors is correct.

___ 4. All chassis, earth grounds are connected.

___ 5. A load reactor or other approved filter is installed for systems with power lead lengths in excess of 200 ft. (61m) between the VFD and Compressor Module terminal box.

LOW VOLTAGE DEVICES

Verify these conditions for low voltage devices:

___ 1. DC polarity is correct.

___ 2. Temperature control device—if other than standard thermistor control—is working properly.

SAFETY AND CONTROL DEVICES

Make sure that all safety and control switches and devices are configured to inhibit Compressor operation if a fault condition is detected, including:

___ 1. Low inlet pressure switch

___ 2. High discharge pressure switch

___ 3. High temperature switch

___ 4. Variable Frequency Drive (VFD) fault

___ 5. Motor overload trip

___ 6. Other safety and control switches and devices

MECHANICAL SYSTEMS

Inspect for these conditions:

___ 1. **(Required)** Compressor inlet is protected from water slugging.

___ 2. **(Recommended)** Gas filtration and treatment is appropriate for the application.

___ 3. Packager configuration applies back pressure to the Compressors.

___ 4. Inlet and discharge valves allow the module to be isolated.

___ 5. All guards and protective covers are installed.

___ 6. Protection from freezing is provided if needed for the application and location.

___ 7. A suitable enclosure providing protection from the elements is appropriate for the application and location.

3.1.2 Post-Startup Checklist

Perform these checks AFTER starting the Compressor Module:

DURING INITIAL OPERATION, PERFORM THESE CHECKS:

___ 1. Compressor Module builds pressure on initial startup; no unusual mechanical noise.

___ 2. Oil level is correct at minimum and maximum speeds.

___ 3. No gas leaks are present.

___ 4. No oil leaks are present.

___ 5. Oil cooler fan turn on and run at the appropriate temperature.

___ 6. Oil cooler fan speed varies with temperature.

___ 7. Compressor motor speed varies appropriately for the Packager configuration.

___ 8. Compressor continues to operate in bypass when the Compressor Module discharge is blocked.

___ 9. Compressor Module is leak tight (maintains approximately 30 psig or more when the Compressors are initially turned off).

3.2 Initial Startup - Compressor Package

Refer to your Packager's user manual for information on procedures to start up the Compressor Package, which includes equipment added to the Compressor Module by the Packager.

3.3 Normal Operation Checklist

Observe the following conditions after startup—when power is applied to the VFD and the VFD receives the signal from the Compressor Package control system to run:

CHECK FOR THESE CONDITIONS UNDER NORMAL OPERATION:

___ 1. Compressor speed should range from 2400 to 4800 rpm during normal operation.

___ 2. Suction pressure range is model specific.

___ 3. Discharge pressure should range from 70 psig to 190 psig, depending on the model (see **Compressor Module Nomenclature** on page **iv**).

___ 4. Pressure differential between suction and discharge is at least 70 psi.

___ 5. First-stage separator temperature should be between 170°F and 220°F (77-104°C) model specific.

___ 6. Oil cooler fans should either run continuously or cycle periodically under normal conditions.

If any of these conditions are not met during normal operation, shut down the unit and refer to **5.0 - Troubleshooting** on page **27**.

4.0 MAINTENANCE

4.1 Routine Maintenance

Perform the maintenance procedures in **Table 5** at least once per year or more often if needed.

Oil consumption varies by application and during initial operation. Monitor the oil level routinely to determine a consistent pattern of actual consumption.

Table 5 Maintenance summary

Components	Maintenance	Reason	For details, see:
Lubrication & Cooling System	• Monitor and check the oil level.	A low oil level or loss of oil in the system will result in overheating or mechanical failure. A high oil level may result in excessive oil carryover and oil discharge from the Compressor Module when the Compressors are turned off.	**4.3 - Checking the Oil Level (page 20)**
	• Add oil as needed.		**4.5.1 - Topping Off the Oil Level (page 21)**
	• Change oil annually. **Note:** Some applications may require more frequent service.		**4.5.2 - Changing the Oil (page 22)**
	• Check the condition of the lubricant periodically. Normal color is clear or light gray.		—
	• Change the oil filter (if equipped) annually or as required.		—
Gas Inlet System	• Inspect and clean the inlet screen annually or more often as needed.	A restricted inlet screen will result in reduced flow.	**4.6 - Cleaning the Inlet Screen (page 24)**
Second-Stage Separator System	• Inspect and clean the scavenge line orifice annually or more often as needed.	A restricted scavenge line orifice will result in excessive oil carryover.	**4.7 - Servicing the Scavenge Line Orifice (page 24)**
	• Change the second-stage oil separator element annually or more often if contaminated. **Note:** Some applications may require more frequent service.	A dirty or plugged separator element will result in excessive oil carryover.	**4.8 - Changing the Second-Stage Separator Element (page 25)**
Oil Heat Exchanger	• Ensure heat exchanger cooling fins are clear of dust and debris. • Verify that the fans run freely.	—	—

See **5.0 - Troubleshooting** on page **27** for additional details.

4.2 Maintenance Tools

Figure 15 shows the tools needed for maintenance of the Compressor Module. Contact the Packager to obtain a maintenance tool kit. These are typical air conditioning and refrigeration service tools.

Figure 15 Maintenance Tools

Back-seating control valve

Oil pump, piston type, high pressure
Designed to operate up to 250 psig

Filter wrench
Alternate product: Strap filter wrench

Charging hose 60" (1524mm)

Extension hose with valve 6" (152mm)

CAUTION

When pressure is applied to the oil pump, the handle may extend rapidly.

Verify the Compressor Module pressure is 0 psig before removing the second-stage oil separator.

NOTE
One full stroke oil pump of the handle dispenses 1.6 oz. (47ml) of oil. Move the pump handle slowly using long, slow, full strokes.

NOTE
The hose fittings contain a core depressor that opens the Schrader valve when the fittings are attached. A backseating control valve can be used to open the Schrader valves on the Compressor Module.

When the knob is turned fully counterclockwise, the core depressor is retracted and the backseating control valve can be installed on a Schrader valve without loss of oil.

When the knob is turned clockwise, the core retractor is extended, opening the Schrader valve.

4.3 Checking the Oil Level

The proper oil level varies according to the Compressor Module's operating speed. To check the oil level on the first-stage oil separator level gauge, use the following guidelines based on operating speed.

NOTE - THIS PROCEDURE REFERS TO COMPRESSOR MODULES WITH A SIGHT TUBE. FOR DUAL-SIGHT GLASS SEPARATORS, CONSULT THE FACTORY.

The oil level indicated on the first-stage oil separator sight tube varies with inlet and discharge pressures as well as operating speed. Check the oil level when the compressor is running.

4.3.1 Oil Level Guidelines - Minimum Speed

When operating the Compressor Module at minimum speed—2400 rpm, 40 Hz—check the oil level in the oil level sight tube, shown at right, then refer to the following suggested maintenance actions.

If the oil level is:	Take this action:
• 1"– 3" from the **bottom** of the oil level gauge	No action is required.
• Lower than 1" from the bottom	Add factory-supplied PAO oil to this level (see **4.5.1 - Topping Off the Oil Level** on page **22**).
• Higher than 3" from the bottom	Remove excess oil (see **4.5.2 - Changing the Oil** on page **23**).

4.3.2 Oil Level Guidelines - Maximum Speed

When operating the Compressor Module at maximum speed—4800 rpm, 80 Hz—check the oil level in the oil level sight tube, shown at right, then refer to the following suggested maintenance actions.

If the oil level is:	Take this action:
• 1"– 3" from the **top** of the oil level gauge	No action is required.
• Lower than 3" from the top	Add factory-supplied PAO oil to this level (see **4.5.1 - Topping Off the Oil Level** on page **22**).
• Higher than 1" from the top	Remove excess oil (see **4.5.2 - Changing the Oil** on page **23**).

4.4 Oil Capacity and Type

The factory oil charge of the SZO Compressor Module is 380 fluid ounces (11.25 liters).

Use the special Poly-Alpha-Olefin (PAO) blend available from the Packager. Refer to **Appendix A - Material Data Safety Sheet** on page **32** for details.

CAUTION

The Compressor Module **REQUIRES** a special PAO blend available from your Packager.

Do NOT substitute other types of oil. Using other types of oil will damage the equipment and void the warranty.

4.5 Adding and Removing Oil

Oil is drained from the system through the Schrader valves on the Compressor suction fittings, first-stage oil separator and oil cooler (see **Figure 16** on page **23**).

4.5.1 Topping Off the Oil Level

See **4.4 - Oil Capacity and Type** on page **20** before adding oil. Also refer to **4.2 - Maintenance Tools** on page **19** for information about the tools used in this procedure.

NOTE
Adding oil through the Schrader valve on either compressor suction fitting permits adding the oil with the compressor running.

Adding Oil

RIGHT SIDE VIEW

1. Turn the knob on the backseating control valve fully counterclockwise.
2. Remove the protective cap from the Schrader valve on either compressor suction fitting and connect the backseating control valve.
3. Connect one end of the oil transfer hose to the back-seating control valve.
4. Connect the opposite end of the hose to the oil transfer pump.
5. Pour PAO oil into a clean container and attach the extension hose to the threaded neck of the container.
6. Turn the knob on the backseating control valve clockwise to open the Schrader valve and slowly open the oil transfer hose ball valve.

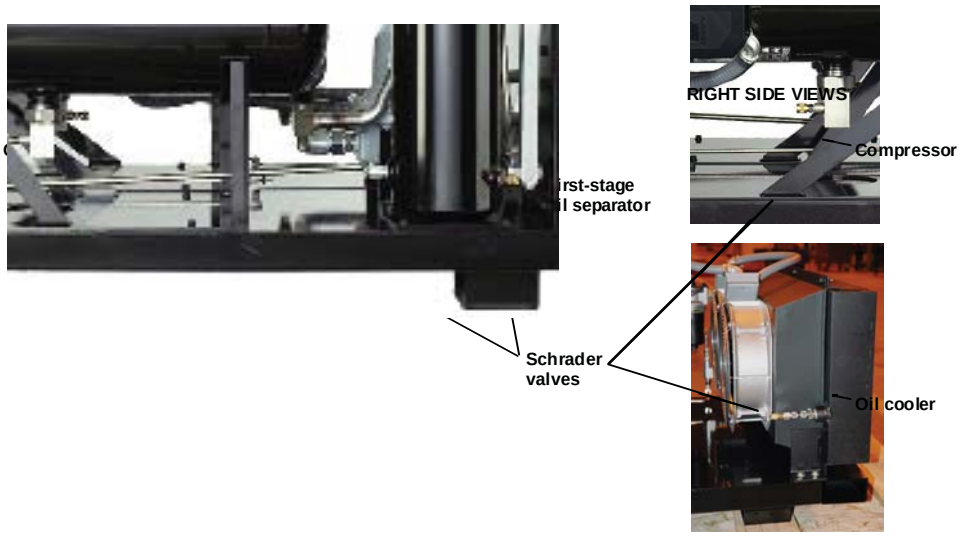
CAUTION
When pressure is applied to the oil pump, the handle may extend rapidly.

7. Move the pump handle slowly using long, slow, full strokes on the pump handle to transfer oil into the Compressor until the desired oil level is reached. One full pump stroke dispenses 1.6 oz. (47ml) of oil (see **4.3 - Checking the Oil Level** on page **21**).
8. Turn the knob on the backseating control valve counterclockwise to close the Schrader valve and remove the control valve.
9. Replace the protective cap on the Schrader valve.
10. Return the Compressor Package to service.
11. Check for leaks at all fittings that have been disturbed.

4.5.2 Changing the Oil

These procedures describe how to drain oil from the system and to replace the oil after draining.

Figure 16 Adding or Draining Oil



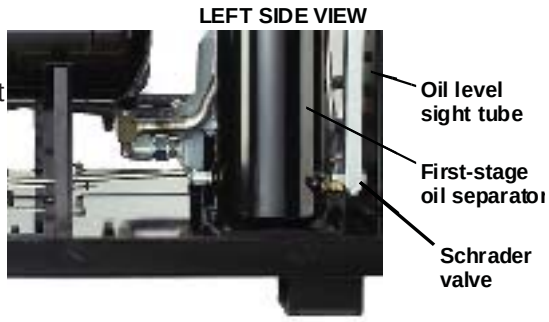
Draining Oil

Under normal operation, the Compressor and oil circuit remain under pressure when the Compressor is turned off. This pressure can be used to drain most of the oil. It is also possible to use the gas supply pressure to force oil out of the Compressor Module. In some cases it may necessary to pressurize the module with an inert gas to remove the oil.

1. Turn the knob on the backseating control valve fully counterclockwise.
2. Connect the backseating control valve to the Schrader valve near the bottom of the first-stage oil separator, shown in **Figure 16**.
3. Connect one end of the oil transfer hose to the backseating control valve.
4. Place the free end of the hose into a suitable container and turn the knob on the backseating control valve clockwise to open the Schrader valve and open the oil transfer hose ball valve.
5. Leave the valves open until the oil stops flowing and gas comes out of the hose; close the valves.
6. Relocate the hose to the Schrader valve on the inlet of one Compressor and repeat **Steps 5** and **6**. Repeat for the other Compressor on the Compressor Module.
7. Move the hose to the Schrader valve on the oil cooler and repeat **Steps 5** and **6**.
8. Close the valves, remove the service hose and replace the protective caps on all Schrader valves.
9. Note the volume of oil that has been drained from the Compressor Module; replace the oil as described in the next section, **Replacing Oil** on page **24**.

Replacing Oil

1. Turn the knob on the backseating control valve fully counterclockwise.
2. Remove the protective cap from the Schrader valve on the first-stage oil separator (shown at right) and connect the backseating control valve.
3. Connect one end of the oil transfer hose to the back-seating control valve.
4. Connect the opposite end of the hose to the oil transfer pump.
5. Connect the 6” (152mm) extension hose to the oil transfer pump.



6. Pour PAO oil into a clean container and install the oil transfer pump.
7. Turn the knob on the backseating control valve clockwise to open the Schrader valve.

CAUTION
When pressure is applied to the oil pump, the handle may extend rapidly.

8. Move the pump handle slowly using long, slow, full strokes on the pump handle to transfer oil into the Compressor until the desired oil level is reached. One full pump stroke dispenses 1.6 oz. (47ml) of oil (see **4.3 - Checking the Oil Level** on page **21**).
9. After adding the same amount of oil that was drained from the Compressor Module, start the Compressors and verify that the operating oil level is correct (see **4.3 - Checking the Oil Level** on page **2**). If necessary, adjust the oil level (see **4.5.1 - Topping the Oil Level** on page **22**).
10. Turn the knob on the backseating control valve counterclockwise to close the Schrader valve.
11. Replace the protective cap on the Schrader valve.
12. Return the Compressor Package to service.
13. Check for leaks at all fittings that have been disturbed.

4.6 Cleaning the Inlet Screen

The 30-mesh screen in the inlet block must remain unobstructed for optimal flow rate. If the flow rate is lower than expected even when the Compressor is running properly, this screen may be obstructed.

Figure 17 Gas Inlet Block and Screen

To inspect and clean the inlet screen:

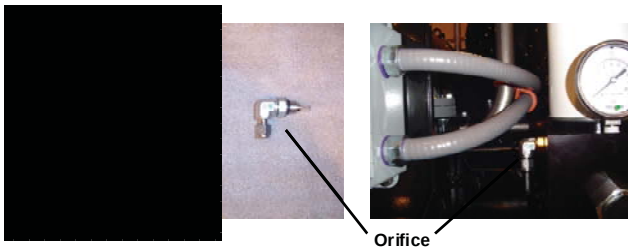
1. Turn off and isolate the Compressor from all power sources.
2. Turn off the gas supply.
3. Vent the system to 0 psig.
4. Remove the SAE plug on the side of the inlet block.
5. Remove the screen.
6. Inspect the screen and inside of the block. Clean or replace if necessary.
7. Replace SAE nut.
8. Return the Compressor Package to service.
9. Check for leaks at all fittings that have been disturbed.

4.7 Servicing the Scavenge Line Orifice

The scavenge line orifice in the oil separator block must remain clear of obstruction. If this orifice is restricted, the secondstage oil separator can become saturated, increasing oil consumption.

Note: image shown is 90 degree orifice. Procedure is the same for straight orifice.

Figure 18 Scavenge Line Orifice



To inspect and clean the orifice:

1. Turn off and isolate the Compressor from all power sources.
2. Turn off the gas supply.
3. Vent the system to 0 psig.
4. Disconnect the tube and remove the fitting.
5. Inspect the screen. Clean or replace the fitting assembly if necessary.
6. Replace the fitting and reconnect the tube. Tighten the swage nut hand tight plus 1/4 turn.
7. Return the Compressor Package to service.
8. Check for leaks at all fittings that have been disturbed.

4.8 Changing the Second-Stage Separator Element

To replace the second-stage separator element:

1. Turn off and isolate the Compressor from all power sources.
2. Turn off the gas supply.
3. Vent the system to 0 psig. Follow applicable safety procedures and codes.
4. Loosen the separator element by turning it counterclockwise with a strap wrench.
5. Remove the separator element. Verify the gasket is removed with the separator.
6. Inspect the separator block for contaminants and remove any debris.
7. Apply a small amount of oil to the gasket and internal "O" ring on the new separator element.
8. Install the element on the separator block; turn clockwise to tighten.
9. Return the Compressor Package to service.
10. Check for leaks at all fittings that have been disturbed

5.0 TROUBLESHOOTING

This section offers tips for troubleshooting.

5.1 Troubleshooting Guide

Refer to **Table 6** for recommended solutions to typical problems.

Table 6 Troubleshooting

Problem	Recommended Actions
Low Inlet Gas Pressure Fault	• Closed gas inlet valve. • Restricted or insufficient gas supply. • Blocked inlet filter/screen (located internally on the Compressor Module inlet block).
High Oil Temperature Fault	• Blocked air flow across oil cooler. • Ensure cooling fans are operating when the unit is running and up to temperature; at approximately 180°F (82°C), fans should start to run at minimum speed. • Ensure adequate oil level in first-stage separator (see **4.3 - Checking the Oil Level** on page **20**).
High Discharge Pressure Fault	• Restricted discharge and bypass valve fault.
VFD Fault	• The drive LED will display the specific fault (see **Table 7**).

Table 7 VFD fault codes and descriptions

Code	Description
UU	Insufficient voltage
OU	Excessive voltage
OI.AC	Excessive motor current (instantaneous condition)
It.AC	Excessive motor current (overload condition)
Oh1, Oh2	Excessive heat sink temperature
Ph	Loss of AC supply phase

5.2 Platform Symptoms Diagnosis

Use the following guidelines to troubleshoot operating problems.

Table 9 Platform troubleshooting guidelines

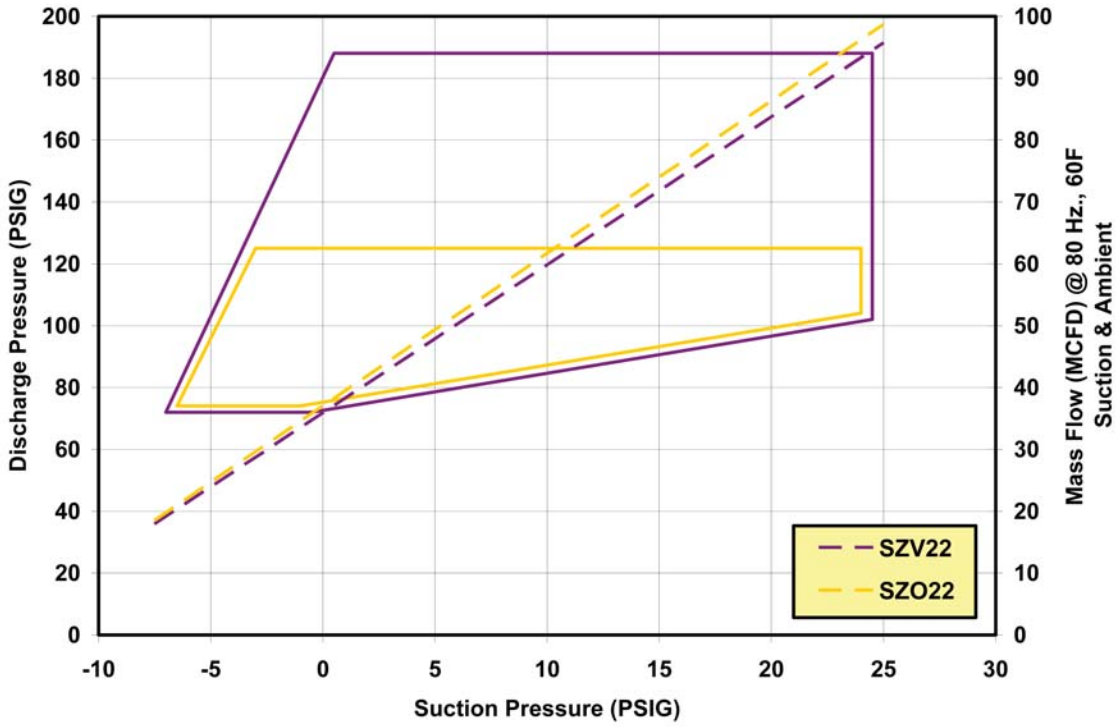
Problem	Recommended Actions
Low Gas Flow	• Low inlet pressure • Insufficient gas supply • High temperature • Bypass valve open • Low Compressor speed • Restricted inlet screen
High Oil Carryover	• Saturated or dirty secondstage oil separator • High oil level • Restricted scavenge orifice • Insufficient back pressure • Oil dilution
Compressors Won't Run	• Determine drive status. • Is inhibit circuit closed? • Is run signal present? • Does the VFD indicate a fault code?
Incorrect Compressor Speed	• Low inlet pressure • High discharge pressure • High temperature, fan, low oil, oil cooler • Problem with speed control sensor and related components
High Temperature	• Low oil level • Restricted oil filter • Blocked oil cooler air flow • Oil cooler fan not operating • Operation conditions outside of Compressor Module specifications

6.0 SPECIFICATIONS

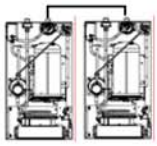
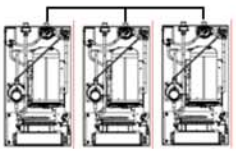
Table 10 Compressor Module Specifications

General Information	
Inlet pressure range	Model specific - refer to application envelope
Outlet pressure range	70 to 275 psig (depends on model—see page **iv**)
Mechanical Description	
Module weight	Approximately 350 lb. (160kg)
Suction connection	1.0” NPT
Discharge connection	0.75” NPT
Sound level	Approximately 72 dBA @ 1 m, 58 dBA @ 10 m
Vibration	3 mil at 60 Hz
Minimum cold start ambient temperature [1,4]	Compressor -20°F (-29°C) VFD power 14°F (-10°C)
Ambient operating temperature range [1,4]	0 to 122°F (-18 to 50°C)
Module dimensions	See **Figure 4** on page **6**
Materials of Construction	
Compressor - general	Cold rolled steel, aluminum, cast iron as required
Compressor bearings	Self-lubricated, sleeve type, steel backed
Oil heat exchanger	Aluminum
Oil/gas separator tank	Cold rolled steel
Tubes/fittings/skid structure	Stainless/carbon steel
Lubrication	
Oil type	Synthetic, 15 or 32 weight, PAO (special factory-supplied blend)
System oil capacity, oz. (ml)	170 fluid ounces (5.0 liters)
Projected oil consumption [2]	Approximately 40 oz. (0.9 l) / 8,000 hours at 0.25 psig suction (<5 ppm)
System Electrical (Standard)	
Minimum VFD ambient startup temperature[3,4]	+14°F (-10°C)
Power supply to inverter • Voltage range • Input frequency range	380 to 480VAC (50/60 Hz)
Overpressure detection (outlet)	215 psig open
Underpressure detection (inlet)	0.75 psig open (low pressure system) / 2" water column
Oil overtemperature detection	240°F (110°C) open (280°F for SZV) model specific
Fault output to customer	Packager to establish
Run input from customer	Dry contact
Gas Medium	
Natural gas	
H_2S maximum content [5]	25 ppm
Moisture content [5]	100% saturated, no free liquids
Inlet temperature [5]	-20 to 115°F (-28 to 46°C); protection from freezing if water is present

1. If the Compressors are started at temperatures above the listed minimums and continue to run, the minimum operating temperature is 20°F (-29°C).
2. Based on sweet gas wellhead gas. Results may vary due to gas quality and site conditions.
3. Do not apply power to the VFD if ambient temperature is below this level.
4. If power is continuously supplied to the VFD when the Compressor is off, the minimum starting temperature is -4°F (-20°C).
5. Consult factory for more details and applications guidelines.


Discharge Pressure (PSIG)
200
180
160
140
120
100
80
60
40
20
0
-10
-5
0
5
10
15
20
25
30
Suction Pressure (PSIG)
100
90
80
70
60
50
40
30
20
10
0
Mass Flow (MCFD) @ 80 Hz., 60F Suction & Ambient
SZV22
SZO22

2

Packaging Configuration *(1-3 modules in parallel to achieve required flow rate)*	Suction Press (PSIG)	Max Flow & HP	Discharge Pressure (PSIG) 70	80	90	100	110	120	130	140	150	160	170	180	190
One Module Package (15-100 MCFD) 	-7.5	MCFD	16	16											
		HP	7	8											
	0	MCFD	37	37	37	36	36	36	36	36	36	35	35	35	35
		HP	7	8	9	9	10	10	11	11	12	13	13	14	14
	5	MCFD	50	50	50	50	49	49	49	49	49	48	48	48	48
		HP	8	9	9	10	10	11	11	12	12	13	13	14	15
	10	MCFD	63	63	63	63	63	62	62	62	61	61	61	61	60
		HP	9	9	10	10	11	11	12	12	13	13	14	14	15
	15	MCFD		76	76	76	76	75	75	75	75	74	74	74	73
		HP		10	10	11	11	12	12	13	13	14	14	15	15
	20	MCFD		89	89	89	89	88	88	88	88	87	87	87	86
		HP		10	11	11	12	12	12	13	14	14	15	15	16
	25	MCFD				102	102	102	101	101	101	100	100	100	99
		HP				12	12	12	12	13	14	15	15	16	16
Two Module Package (30-200 MCFD) 	-7.5	MCFD	33	32											
		HP	14	15											
	0	MCFD	75	74	74	73	72	72	72	72	71	71	70	70	70
		HP	15	16	18	19	20	21	22	23	24	25	26	27	28
	5	MCFD	101	100	100	99	99	98	98	97	97	97	96	96	95
		HP	16	17	19	20	21	22	23	24	25	26	27	28	29
	10	MCFD	127	126	126	126	125	124	124	123	123	122	122	121	121
		HP	17	18	19	20	22	23	24	25	26	27	28	29	30
	15	MCFD		152	152	152	152	151	150	150	149	148	148	147	147
		HP		19	20	21	23	23	24	25	27	28	29	30	31
	20	MCFD		179	179	178	178	177	176	176	175	175	174	173	173
		HP		20	21	22	24	24	24	26	28	29	30	31	32
	25	MCFD				203	203	203	203	202	202	201	200	199	199
		HP				23	24	24	25	27	28	30	31	32	33
Three Module Package (50-300 MCFD) 	-7.5	MCFD	49	48											
		HP	21	23											
	0	MCFD	112	111	110	109	108	108	108	108	107	106	105	105	104
		HP	22	24	26	28	29	31	33	34	36	38	39	41	42
	5	MCFD	151	150	150	149	148	147	147	146	146	145	144	143	143
		HP	24	26	28	29	31	32	34	36	37	39	40	42	44
	10	MCFD	190	190	189	188	188	187	185	185	184	183	183	182	181
		HP	26	27	29	31	32	34	36	37	39	40	42	43	45
	15	MCFD		229	229	228	227	226	225	224	224	223	222	221	220
		HP		29	31	32	34	35	36	38	40	41	43	45	46
	20	MCFD		268	268	267	267	265	265	264	263	262	261	260	259
		HP		30	32	34	35	36	37	39	41	43	44	46	48
	25	MCFD				305	305	305	304	303	302	301	300	299	298
		HP				35	36	36	37	40	43	44	46	47	49

NOTES:

1. Max flow at 4800 rpm, 80Hz. For 3600 rpm, 60Hz (fixed speed) performance, multiply maximum flow and horsepower values by 0.75
2. All modules capable of continous 100% flow bypass of discharge gas back to suction without shutting down on high temperature
3. Standard test conditions: 60° F suction gas, 60° F ambient, 0.6 SG gas, 14.7 psia = 0 psig
4. Performance data to be used as an estimation guide only and is subject to change without notice
5. Contact factory for operation below atmospheric pressure

Technical Support and Service

For product and support information on Copeland® Brand Gas Compressors, visit the Web site listed in **Table 12** or contact the factory by mail, phone or fax.

Table 12 Contact information

Web Site	**EmersonProcess.com/copelandscroll**
Factory Location	Emerson Climate Technologies, Inc. 1675 W. Campbell Rd. Sidney, OH 45365 USA
Phone	800-996-4660
Fax	937-493-2447

APPENDIX A - MATERIAL DATA SAFETY SHEET

The information in this material safety data sheet should be provided to all who use, handle, store, transport or are otherwise exposed to this product. CPI believes the information in this document to be reliable and up to date as of the date of publication, but makes no guarantee that it is.

CAUTION

This oil is intended for use only in the Copeland Scroll® Compressor used in natural gas applications.

Use of any other oil may result in failure and is not covered by warranty.

DISPOSE WASTE OIL PROPERLY:

- If the oil has not been contaminated, it can be disposed the same as a synthetic motor oil.
- If the oil is contaminated, the end user must comply with all applicable regulations for disposal of hazardous materials.

A.1 SUPPLIER

CPI Engineering Services Inc.
2300 James Savage Rd.
Midland, MI 48642
Emergency Number: (989) 496-3780

A.2 PRODUCT NAME AND INFORMATION

Product (Trade name and synonyms)	CP-6006 Series
Chemical Name	Poly-Alpha-Olefin (PAO)
Chemical Family	Synthetic Hydrocarbon
Formula	$C_{10n}H_{20n}+2$
CAS#	Proprietary

A.3 COMPONENTS AND HAZARD STATEMENT

This product is non-hazardous. The product contains no known carcinogens. No special warning labels are required under OSHA 29 CFR 1910.1200.

FDA Statement. This product complies with FDA 21 CFR 178.3570 regarding lubricants for incidental food contact.

A.4 SAFE HANDLING AND STORAGE

Handling. Do not take internally. Avoid contact with skin, eyes, and clothing. Upon contact with skin, wash with soap and water. Flush eyes with water for 15 minutes and consult physician. Wash contaminated clothing before reuse.

Storage. Keep container tightly sealed when not in use.

A.5 PHYSICAL DATA

Appearance	Clear, water-white liquid
Boiling Point	>300°F (149°C)
Vapor Pressure	<0.01mm Hg @ 20°C (0.00039 in.Hg @ 68°F)
Specific Gravity (water=1)	0.79-0.85
Volatiles, Percent by Volume	0%
Odor	None
Solubility in Water	Insoluble
Evaporation Rate (butyl acetate=1)	Nil

A.6 Fire and Explosion Hazards

Flash Point (by Cleveland Open Cup)		320-530°F (160-276°C)
Flammable Limits		Not established
Auto-Ignition Temperature		No data
HMIS Ratings	Health	0
	Flammability	1
	Reactivity	0
NFPA Ratings		Not established
Extinguishing Media		Dry chemical; CO_2 foam; water spray (fog)
Unusual Fire and Explosion Hazards		None
Special Fire Fighting Techniques		Burning fluid may evolve irritating/noxious fumes. Firefighters should use NIOSH/MNSA-approved self-contained breathing apparatus. Use water to cool fire-exposed containers. Use water carefully near exposed liquid to avoid frothing and splashing of hot liquid.

A.7 Reactivity Data

Stability	Stable
Hazardous Polymerization	Will not occur
Incompatible Materials	Strong oxidizers
Conditions to Avoid	Excessive heat
Hazardous Decomposition Products	Analogous compounds evolve carbon monoxide, carbon dioxide, and other unidentified fragments when burned. See **A.6 - Fire and Explosion Hazards**.

A.8 Health Hazard Data

Threshold Limit Value		5mg/m^3 ACGIH
Situations to Avoid		Avoid breathing oil mists.
First Aid Procedures	Ingestion	Consult physician at once. DO NOT INDUCE VOMITING. May cause nausea and diarrhea.
	Inhalation	Product is not toxic by inhalation. If oil mist is inhaled, remove to fresh air and consult physician.

To the best of our knowledge the toxicity of this product has not been fully investigated. Analogous compounds are considered to be essentially non-toxic.

A.9 Personal Protection Information

Respiratory Protection	Use in well ventilated area.
Ventilation	Local exhaust
Protective Gloves	Not required, but recommended, especially for prolonged exposure
Eye/Face Protection	Goggles

A.10 Spill or Leak Procedures

In case of spill:

- Wear suitable protective equipment, especially goggles.
- Stop source of spill.
- Dike spill area.
- Use absorbent materials to soak up fluid (e.g., sand, sawdust, commercially available materials).
- Wash spill area with large amounts of water.
- Properly dispose of all materials.

A.11 Waste Disposal Methods

Incinerate this product and all associated wastes in a licensed facility in accordance with federal, state, and local regulations.

Oil & Gas Compression

Copeland Scroll® Compressor Module

Installation, Operation & Maintenance Manual

The Company Behind the Products

Printed in the USA.

SZ022 Model Family

2008SSD-34 (5/08)

Technical Support/Service

Web Site

www.emersonprocess.com/copelandscroll

Emerson Climate Technologies, Inc.

1675 W. Campbell Rd.

P.O.Box 669

Sidney, OH 453650-0669

USA

Phone: 800-966-4660

Fax: 937-493-2447