Application Guide 575-012
Carlyle Control Module (CCM)
Capacity and Protection Control

8/2/2022
Rev 6

Carlyle Controller Part No. 2BSB000928

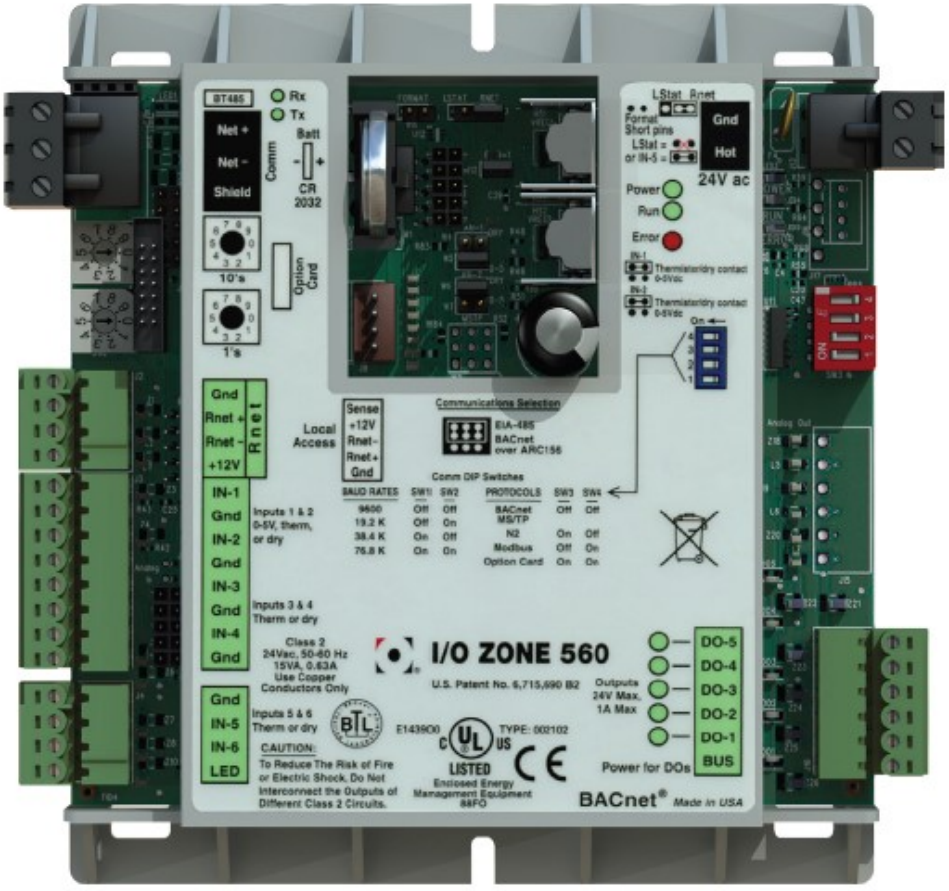


Table of Contents:

General Description

The Carlyle Control Module (CCM) functions to provide screw compressor protection and, in some applications, compressor capacity control. The CCM is designed to work with **ALL** Carlyle screw compressor types: Paragon, 06Z VFD, and the 06TR/TA 74mm compressors.

- Control compressor capacity by operating the compressor's slide valve to maintain the system's control set-point (suction pressure or temperature),
- For 06Z VFD and 06TR/TA compressor models, control the Vi Piston to optimize compressor efficiency.
- In addition, the CCM will have functionality to protect the compressor and provide LED fault status indication for:
    - Oil level and oil flow protection
    - Motor cooling protection
    - Discharge temperature protection
    - Pressure transducer sensor failure indication
    - Temperature thermistor failure indication

The CCM is part of Carlyle compressor control packages 6BSB000929 and 6BSB000930.

Besides this Application Guide, the following manuals, I/O Zone Installation Guide and I/O Zone Integration Guide are necessary for proper installation and Network Protocol configuration. These manuals are located at www.carlylecompressor.com

Motor and discharge temperature control for a screw compressor is critical. Excessive motor and discharge gas temperatures can cause premature compressor failure. Therefore, control of these temperatures is very important. The CCM monitors these temperatures using the factory-installed 5K thermistor in the motor windings and a field-installed 5K thermistor in the compressor discharge temperature thermo-well. When the thermistors indicate an overheated condition, the CCM will perform the following:

- Energize a liquid injection valve, sending cool liquid into the motor compartment.
- Override the Slide Valve and restrict the compressor from unloading and or force the compressor to fully load to reduce motor and or discharge temperature.
- Shut the compressor down.

CCM Configuration

To configure and display the CCM inputs, outputs, and fault codes using your laptop computer, the virtual BacView software must be installed on a laptop. This software can be downloaded from www.carlylecompressor.com. An interface cable, Carlyle P/N USB-L, is required to communicate the laptop to the CCM Controller. Once communication is established, the user can configure to support the following applications.

1. Slide Valve Control and Compressor Protection (06TS/TT/TU/TV models)
2. Vi Piston Control and Compressor Protection (06Z VFD models)
3. Slide Valve Control only (06TS/TT/TU/TV models)
4. Vi Piston Control only (06Z VFD models)
5. Compressor Protection only
6. 06TA / 06TR (74mm models)

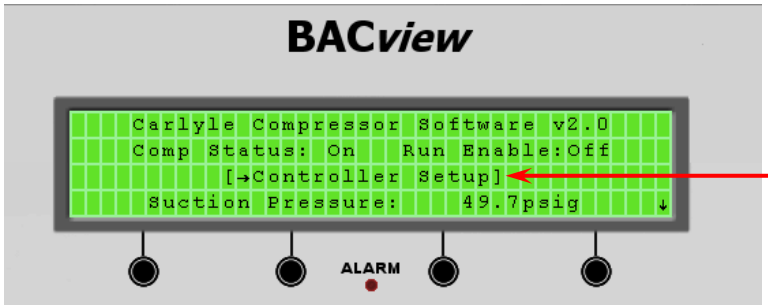
The CCM is preconfigured with the following protocol Networks to allow the ease of data to be transmitted across a network between the CCM and the System Controller.

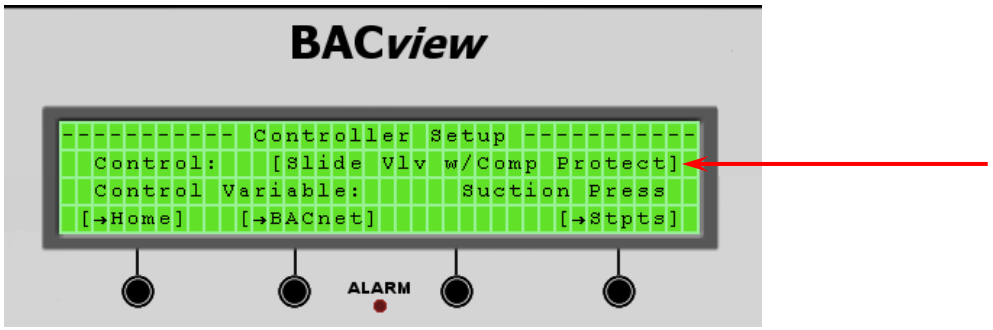
- BACnet, Modbus, or N2 Open
- LonWorks (requires optional card)
- RS485 Communication Port

Controller Configuration Setup for Compressor Models 06TS, 06TT, 06TU, and 06TV:

Configure CCM per the following three options:

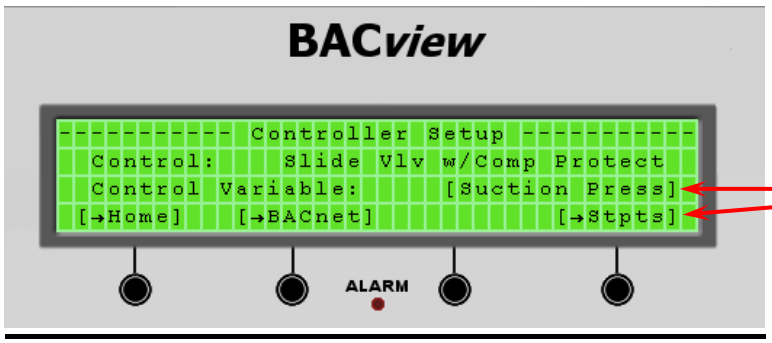
1. Slide Valve Control and Compressor Protection (Default Setting).
2. Slide Valve Control only.
3. Compressor protection only



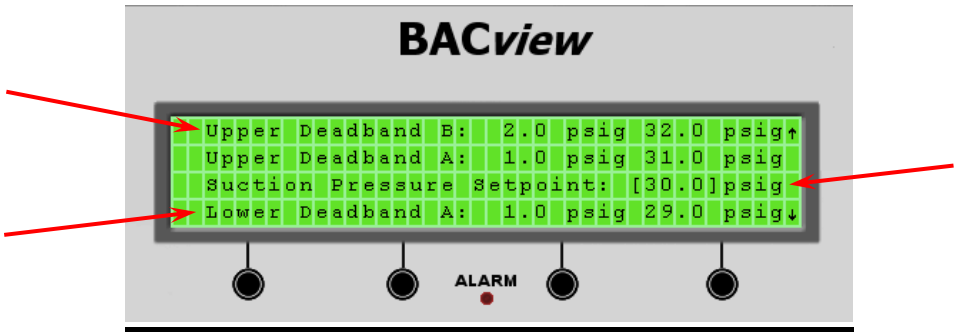


Perform steps 4-6 only if using the slide valve to control compressor capacity.

4. Select your Control Variable parameter – Suction Pressure or Temperature.
5. Input the Control Variable set-point in PSIG or Deg F.



6. Input the process set-point and upper and lower dead-band control range values.

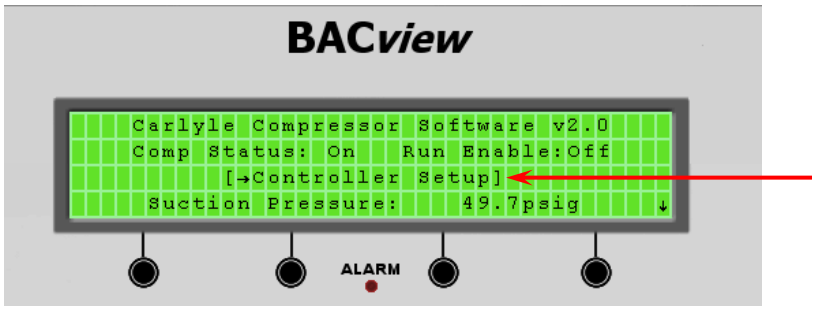


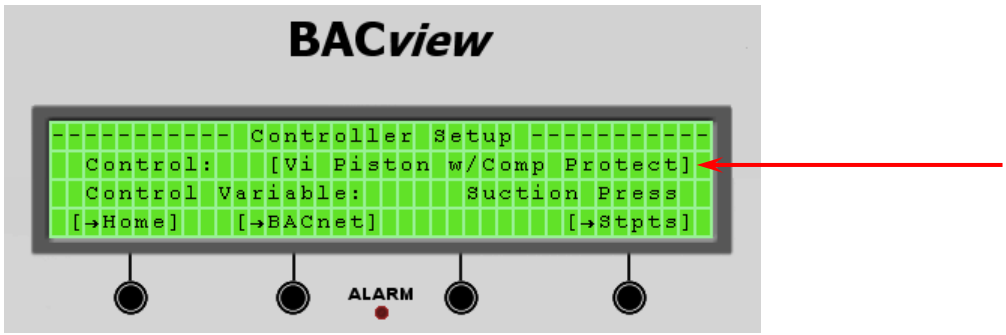
For Compressor Models 06ZC, 06ZF, and 06ZJ (VFD models):

These compressor models will be capacity controlled with an external VFD drive. The VFD will monitor the process control set-point, temperature or pressure, and adjust the compressor speed to maintain system loading. Therefore, the CCM module will be required for compressor protection and Vi control only.

Configure CCM per the following three options:

1. Vi Piston and Compressor Protection.
2. Vi Piston only.
3. Compressor protection only





Configuration is now complete, no need to select a process control set-point or input a set-point and upper and lower dead-band ranges. Capacity control will be externally controlled by the VFD.

Compressor Protection

The CCM will monitor motor and discharge temperatures through a factory installed 5K thermistor in the motor windings (Tm) and field-installed 5K thermistor inserted into a thermo-well on the compressor body (Td) respectively.

NOTE: Motor and Discharge temperature thermistors will not display accurate temperature values until actual sensor conditions are above 130F. The displayed values in the virtual BacView software will appear non-responsive until a reasonable temperature range is achieved.

Motor Temperature (Tm) will have the following functions.

- Control a motor cooling valve to provide liquid injection to the motor compartment.
- Override the compressor slide valve to reduce motor temperature.
- Turn the compressor off on an overheated motor temperature condition.
- **See Table A & B for Tm control points.**

Motor Temperature (Td) will have the following functions.

- Override the compressor slide valve to reduce discharge temperature.
- Turn the compressor off on a high discharge temperature condition.
- **See Table A & B for Td control points.**

Run Recognition Signal

The CCM must have the capability to identify when the compressor is actually operating. A run recognition signal from the System Controller must be received by the CCM via Input #5 and or via the Communication Port. **The Slide Valve and Compressor Protection functionality are not active until the CCM receives the Run Recognition signal from the System Controller.**

LED Fault Indication

The CCM will provide an LED alarm output signal to the System Controller when a compressor fault condition arises. This signal is through Output #4 and or the Communication Port.

Fault indication table for software version 3.0

#	Fault Description	LED Indication (Output #4)	Output #5 (S_{limit})	Compressor	Manual Reset Required
1	High Discharge Temperature Trip	Solid Red	Open/De-energized	OFF	Yes
2	High Motor Temperature Trip	Constant Blinking	Open/De-energized	OFF	Yes
3	Low Oil flow (Po – Ps < 45 psig)	One blink & 2 second pause	Open/De-energized	OFF	Yes
4	Faulty suction or oil pressure transducer/thermistor sensor	Two blinks & 2 second pause	Open/De-energized	OFF	Yes
5	Faulty Motor Temperature Thermistor	Three blinks & 2 second pause	Open/De-energized	OFF	Yes
6	Faulty Discharge Temperature Thermistor	Four blinks & 2 second pause	Open/De-energized	OFF	Yes
7	Faulty Discharge Transducer	Five blinks & 2 second pause	Open/De-energized	OFF	Yes
8	Reverse Rotation	One blinks & 5 second pause	Open/De-energized	OFF	Yes
9	Unloading, motor temperature	Three blinks & 5 second pause	Closed/Energized	ON	No
10A	Change Oil Filter (Pd – Po > 35 psig)	Three blinks & 5 second pause	Closed/Energized	ON	No
10B	High Oil Filter DP (Pd – Po > 50 psig)	Three blinks & 5 second pause	Open/De-Energized	OFF	Yes

Fault indication table for software version 2.0

Fault Description	LED Indication (Output #4)	Output #5	Compressor	Manual Reset Required
High Discharge Temperature Trip	Solid Red	Open/De-energized	OFF	Yes
High Motor Temperature Trip	Constant Blinking	Open/De-energized	OFF	Yes
Compressor Oil Trip	One blink & 2 second pause	Open/De-energized	OFF	Yes
Faulty Suction Transducer/Thermistor Sensor	Two blinks & 2 second pause	Open/De-energized	OFF	Yes
Faulty Motor Temperature Thermistor	Three blinks & 2 second pause	Open/De-energized	OFF	Yes
Faulty Discharge Temperature Thermistor	Four blinks & 2 second pause	Open/De-energized	OFF	Yes
Faulty Discharge Transducer	Five blinks & 2 second pause	Open/De-energized	OFF	Yes

Fault indication table for software version 1.5

Fault Description	LED Indication (Output #4)	Output #5	Compressor	Manual Reset Required
High Discharge Temperature Trip	Solid Red	Open/De-energized	OFF	Yes
High Motor Temperature Trip	Constant Blinking	Open/De-energized	OFF	Yes
Compressor Oil Trip	One blink & 2 second pause	Open/De-energized	OFF	Yes
Faulty Transducer/Thermistor Sensor	Two blinks & 2 second pause	Open/De-energized	OFF	Yes
Faulty Motor Temperature Thermistor	Three blinks & 2 second pause	Open/De-energized	OFF	Yes
Faulty Discharge Temperature Thermistor	Four blinks & 2 second pause	Open/De-energized	OFF	Yes

Table C

Slide Valve Control:

The CCM will have the ability to control the compressor slide valve for capacity control by loading/unloading the compressor to maintain the refrigeration system's process control set-point. The set-point can be defined in one of two ways: refrigerant suction pressure (psig) or a leaving water temperature (deg. F). **The end user will have to configure the CCM in the following way:**

1) Select **Pressure** or **Temperature** for the process control variable (Default is Pressure).
2) Select **Physical Input** or **Network Input** (Network input means the process control variable is not physically wired to the CCM, but the value is being passed via the Network to the CCM as an input).
3) Input the process control set-point value.
   - Allowable pressure range is (-1.5 psig to 70 psig)
   - Allowable temperature range is (-60F to 80F)
4) 1,2, 3 can be accomplished through:
   - The BacView hand-held display unit.
   - Downloadable BacView software to a Laptop.
   - A communication port between the CCM and System Controller.

Once configured, the CCM will default to that specific process control curve (**See Charts E and F**).

For capacity control, the CCM will need to measure the suction pressure (psig) or leaving water temperature (Deg F) of the HVAC/Refrigeration system at CCM Input #1. A pressure transducer or 5K thermistor will need to be installed and wired back to the CCM input #1.

The CCM slide valve control logic works with two upper and two lower dead-bands as defined by this table and graph below.

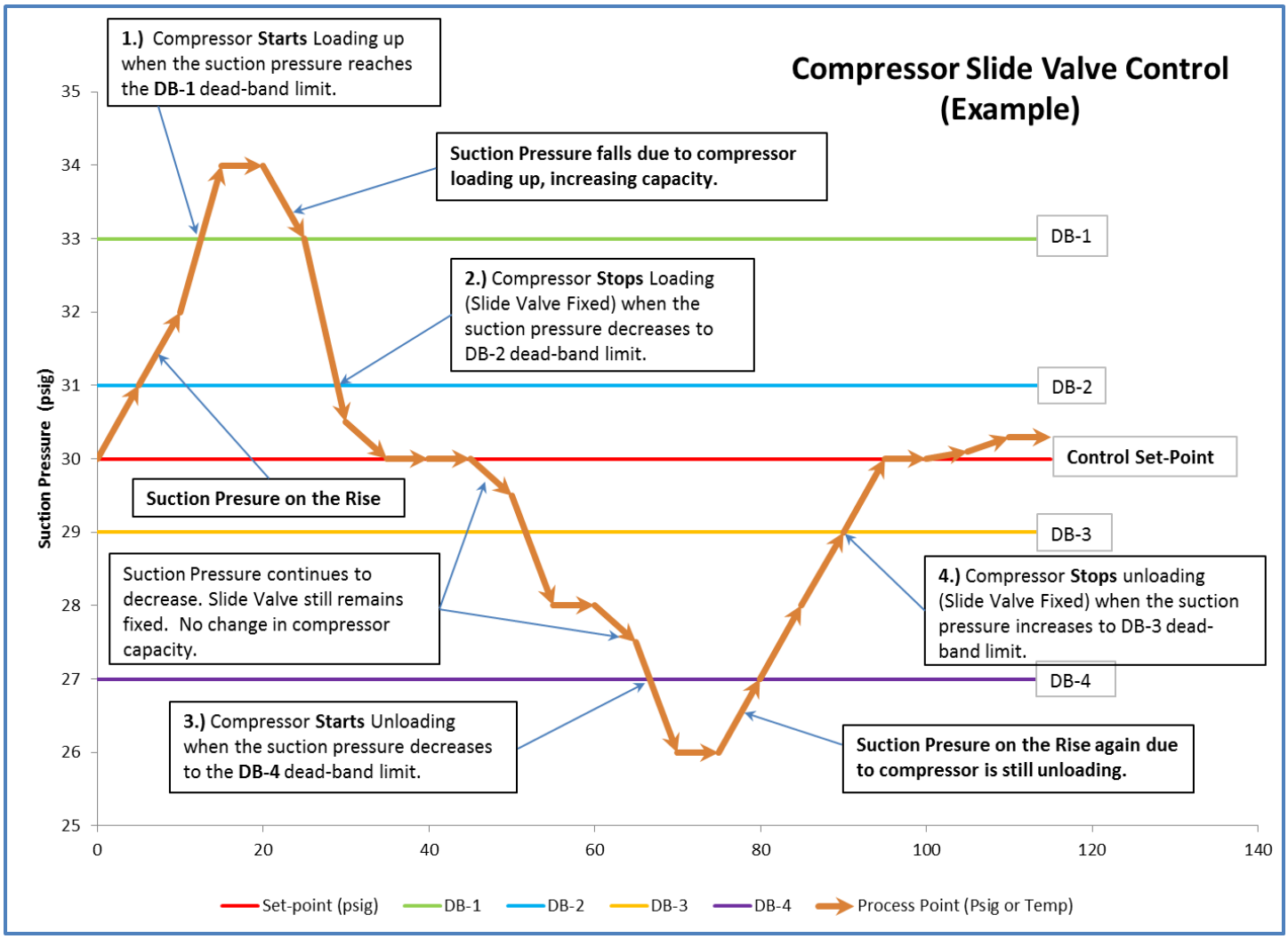
Logic	**1.)** On Process Point rise above the **Upper DB-1** dead-band, the CCM will Energize both unloader coils to load the compressor and increase capacity until the process point falls below **Upper DB-2.**	As long as the Process Point remains between the **Upper DB-2** and **Lower DB-3** dead-band limits, the Slide Valve will not move, but remain fixed. Keeping the compressor capacity constant.	**3.)** If the Process Point continues to fall and reaches the **Lower DB-4** dead-band limit, the CCM will De-energize both unloader coils to unload the compressor and decrease compressor capacity.
Slide Valve Coil #1, Coil #2	Energized, Energized	De-energize, Energized	De-energized, De-energized
Slide Valve Coil #1, Coil #2	De-energize, Energized	De-energize, Energized	De-energize, Energized
Logic	**2.)** If the Process Point decreases to the **Upper DB-2** dead-band limit, the CCM will stop the compressor from loading by de-energize coil #1, fixing the slide valve position. Keeping the compressor capacity constant.	As long as the Process Point remains between the **Upper DB-2** and **Lower DB-3** dead-band limits, the Slide Valve will not move, but remain fixed. Keeping the compressor capacity constant.	**4.)** Both unloader coils will remain De-energized until the suction pressure rises to the **Lower DB-3** dead-band limit. This will stop compressor unloading, stopping the Slide Valve from moving. Keeping the compressor capacity constant.

The **lower and upper dead-bands are adjustable inputs** that can be changed by the User. The Upper/Lower dead-band values bracket the set-point and will activate the slide valve to load, unload, or maintain compressor capacity when the process control point breaches these dead-band values. The allowable dead-band range is from 0.5 to 5.0 in 0.1 increments.

Note:

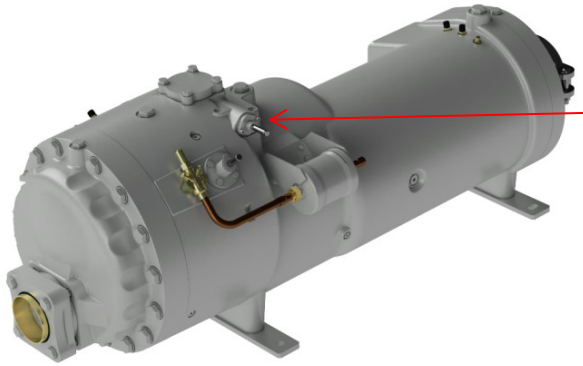
The Upper DB-**1** dead-band value should never be set higher than the Upper DB-**2** dead-band value.
Likewise, the Lower DB-**3** dead-band value should never be set lower than the Lower DB-**4** dead-band value.

The Slide Valve is used to control the process control set-point by loading and unloading the compressor. The graph is an example of how the upper and lower dead-bands facilitate slide valve control to maintain the system set-point.



Vi Piston Control

Compressor models 06ZC, 06ZF, 06ZJ are specifically designed for VFD application ONLY and do not incorporate a slide valve for capacity control. To optimize compressor efficiency, the compressor is equipped with a Vi piston valve to regulate the screw compressor's discharge port volume. The CCM controller will control the Vi piston automatically based on the compressor's suction and discharge pressure ratio.



The Vi piston valve is solenoid controlled and the following coil voltages can be applied….24vac, 120vac, 240 vac.

CCM Module Inputs

The CCM has the ability to monitor up to 5 inputs. These inputs will be processed by the CCM to control the compressor slide valve, protect the compressor from a high temperature condition or loss of compressor supply oil, and control the Vi piston for compressor efficiency.

Input #1: Slide-Valve Capacity Control or Vi Piston Control

- A 5 vdc suction pressure transducer or an NTC temperature thermistor can be installed to measure the process control parameter for slide valve capacity control.
- Or if the Vi piston is enabled for the VFD compressor models, then the 5 vdc suction pressure transducer is required.
- The 5 vdc pressure transducer is Carlyle Part# HK05YZ003 (**See Chart E**).
- Use the transducer wire harness provided in the 6BSB000929 or 930 controller kit.
- NTC Thermistor is Carlyle P/N A1004MS24P1 (see table F), which is part of controller kit P/N 6BSB000929 or 930.
- The process signal received by Input #1 will be compared to the process set-point, based on the deviation, the controller will energize/de-energize the slide valve solenoid coils to load/unload the compressor for maintaining the user defined set-point.
- The end user will have to install a power supply with a 5VDC supply power output for the pressure transducer (recommend TDK Lambda DSP10-5).

Input #2: Discharge Pressure for Vi piston control (VFD Models 06ZC, 06ZF, and 06ZJ)

Note: For this feature to work the Vi Piston Control must be Enabled and the Slide Valve Control must be Disabled under the "Controller Setup" feature.

- Input #2 is only required if controlling the Vi piston solenoid coil for 06Z VFD compressor models.
- The 5 vdc pressure transducer is Carlyle Part# HK05YZ007 (**See Chart G**).
- Use the transducer wire harness provided in the 6BSB000929 or 930 controller kit.
- End User will have to install a power supply with a 5VDC supply power output for the pressure transducer (recommend TDK Lambda DSP10-5).

Input #3: Discharge Temperature Control

- Input defined for a 5K NTC Thermistor (Carlyle Part# 00PPG000008105A).
- The thermistor profile is defined by **Table D**.
- Input monitors discharge temperature and will override slide valve by continuously energizing output #2 if discharge temperature > 200F and will continuously energize both output #1 and output #2 if discharge temperature > 215F.
- Input monitors discharge temperature and will trip the compressor off by de-energizing output #5, if motor temperature > 230F.
- The temperature control points are defined in **Table A & B**.

Input #4: Dry Contact for Compressor Oil Protection

- Input will be used as dry contact for an Oil Flow Switch (P/N 8BSB000475 and 8BSB000605) and Oil Level Switch (P/N 8CCB000742, or 8CCB000743) wired in series.
- Oil flow and Oil level switches should be wired in series. If either component opens due to a loss of oil flow and or level, input #4 will be in an open state, thus de-energizing output #5 and tripping the compressor off.

Input #5: Compressor recognition signal (received from Master Controller)

- Tells the CCM Controller that the compressor is on and running.
- Slide Valve Control and Compressor Protection are activated when the CCM receives the recognition signal that the compressor is on.
- CCM controller initiates a 120 second delay regarding monitoring input#1 (suction pressure or thermistor temperature).
- CCM controller allows for a 15 second delay prior to beginning to monitor inputs and taking action for inputs #2, #3, and #4 (eliminate nuisance trips on startup).
- When the compressor is off, there will be no oil flow. Therefore, the oil flow switch will be open, causing output #5 to open, therefore not allowing the compressor to start. Therefore, the controller must ignore the oil flow switch until the compressor is started and actual compressor oil flow is established, resulting in a closed oil flow switch.

Input #6: Motor Temperature Control

Note: The motor thermistor connection points are located in the compressors electrical box at terminals S1 and C. In the event of a thermistor failure, a spare thermistor is available between S2 and C terminal points.

- Input defined for the 5K NTC Thermistor that is embedded in the compressor motor windings.
- The compressor motor thermistor profile is defined by **Table D**.
- Input monitors the motor temperature and will open/close output #3, energizing/de-energizing a motor cooling solenoid valve for liquid injection if motor temperature > 240F.
- Input monitors motor temperature and will override slide valve by continuously energizing output #2 if motor temperature > 245F and will continuously energize both output #1 and output #2 if motor temperature >260F.
- Input monitors motor temperature and will trip the compressor off by de-energizing output #5, if motor temperature > 275F.
- The temperature control points are defined in **Table A & B.**

NOTE: Motor and Discharge (input #3 and #6) temperature thermistors will not display accurate temperature values until actual sensor conditions are above 130F. The displayed values in the virtual BacView software will appear non-responsive until a reasonable temperature range is achieved.

CCM Module Outputs

NOTE: The CCM outputs each require a SPST 24VAC relay as an interface between the CCM and the slide valve, Vi Piston and motor cooling solenoid coils. These solenoid coils cannot be operated directly from the CCM Outputs.

The CCM has 5 outputs rated for 24VAC, 1 amp continuous current and will be applied to control the following:

- Slide Valve compressor unloader coils
- Vi Piston solenoid coil
- Motor Cooling Valve
- Provides LED fault code indication
- Provides compressor stop/start pilot duty control (enables the compressor to start)

Output #1 & #2: If Slide Valve Control is Enabled (Paragon 06TS, TT, TU, & TV Models)

- Output #1 energizes/de-energizes Slide Valve Coil #1 for compressor capacity control.
- Output #2 energizes/de-energizes Slide Valve Coil #2 for compressor capacity control.
- Outputs #1 and #2 are directed to open/close, via the suction pressure or temperature signal received by Input #1, to maintain the refrigeration system's process control set-point.

Output #1: If Vi Piston Control is Enabled (06ZC, ZF, & ZJ VFD Models)

- Output #1 energizes to activate the Vi Piston. This is based on the pressure ratio between the compressor suction and discharge pressures.
- Output #2 is not used.

Output #3: Open/Close Motor Cooling Valve

- Energizes/de-energizes a motor cooling valve for liquid injection for motor cooling.
- Energizes if Motor Temperature (Input #2) is > 240 and will stay energized until Motor Temperature is < 225F.

Output #4: LED Status indication for a Compressor Trip

- Is normally open when the compressor has no fault conditions (the LED indicator light is off).
- Will close, providing an LED blink code pattern, when a compressor fault condition arises as defined in **Table C.**
- An alternative to the output #4 LED notification is the end user receiving the compressor faults via the CCM's communication port when interfaced to the System Controller.

Output #5: Enables the Compressor to Run

- When output is closed (energized), the compressor is enabled to run and therefore there are no fault conditions.
- Output must be part of Refrigeration System's pilot duty Start/Stop Compressor circuit.
- An alternative to output #5 is the end user receiving this compressor start/stop signal (run enable) via the CCM's communication port to the System Controller.
- Output will open (de-energize), tripping the compressor offline if the following fault conditions arise
    - High Discharge Temperature
    - High Motor Temperature
    - Low oil level
    - Low oil flow
    - Faulty pressure transducer (open or short)
    - Faulty thermistor (open or short)

Controller Default Setting:

The CCM controller comes configured with the following default setting. These setting can be changed by the end user.

CCM Default Setting	
Slide Valve Control: Enabled	**Upper Dead band-B:** 2 F
Compressor Protection: Enabled	**Upper Dead band-A:** 1 F
Upper Dead band-B: 2 psig	**Lower Dead band-A:** 1 F
Upper Dead band-A: 1 psig	**Lower Dead band-B:** 2 F
Lower Dead band-A: 1 psig	**Suction Pressure set-point:** 30 psig
Lower Dead band-B: 2 psig	**Temperature set-point:** 35F

CCM Control Points

Motor and Discharge Temperature Control Points

ALC Controller	Injection On (°F)	Injection Off (°F)	Shutdown Compressor (°F)	Manually Reset Compressor (°F)	Time Delay required before manual reset (sec)
Discharge Temp (Td)	NA	NA	Td > 225	Td < 175	30
Motor Cooling Temp (Tm)	Tm > 240	Tm < 225	Tm > 270	Tm < 225	30

Table A

Slide Valve Override Control Points

ALC Controller	Restrict Further Compressor Unloading Energized SV Coil #2 continuously (°F)	Fully Load Compressor and restrict unloading below 100% Energize SV Coil #1 and Coil #2 continuously (°F)
*SV – Discharge Temp (Td)	200 < Td < 215 (discontinue SV override when Td < 198F)	Td > 215F (discontinue SV override when Td < 213F)
*SV – Motor Cooling Temp (Tm)	245 < Tm < 260 (discontinue SV override when Tm < 243F)	Tm > 260F (discontinue SV override when Tm < 258F)

*SV – Slide Valve

Table B

Sensor Profile

5K NTC Thermistor, Carlyle Part# 00PPG000008105A. The DC voltage can be measure across the thermistor inputs on the CCM, and using the table below, can be converted to a temperature.

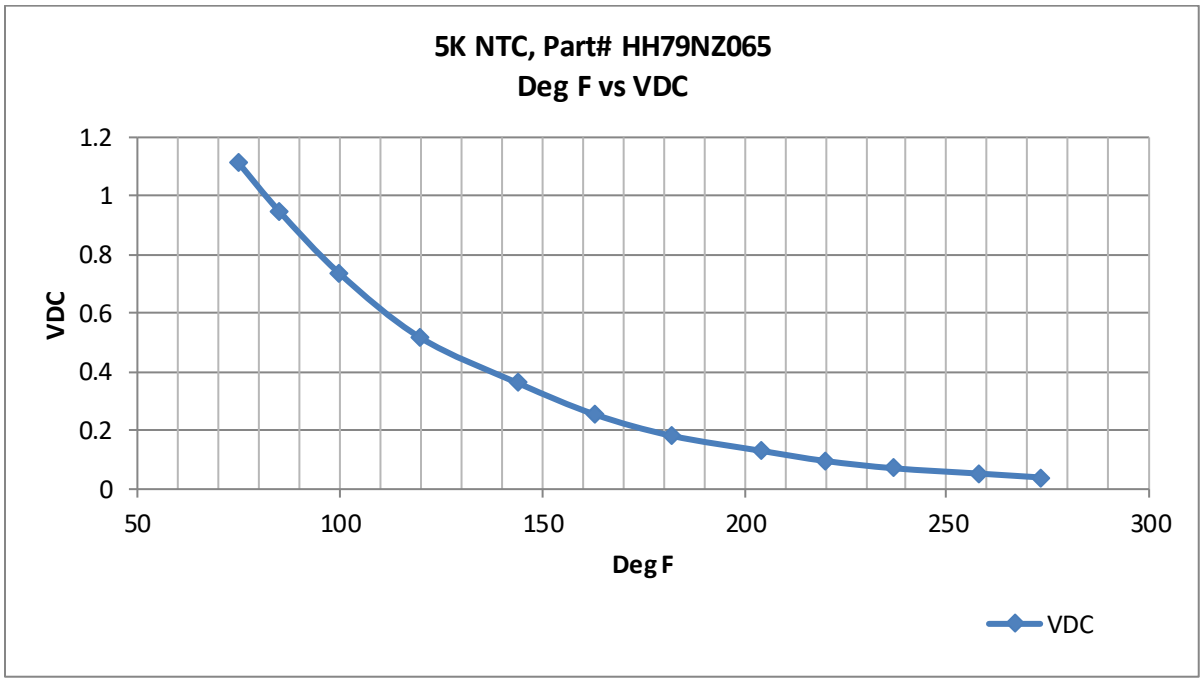


Table D

The 5vdc suction pressure transducer sensor, Carlyle Part# HK05YZ003. The DC voltage can be measured across the **Sig** and **Gnd** terminals, and using the table below, can be converted to a pressure.
PSIG = 33 * VDC – 16.5

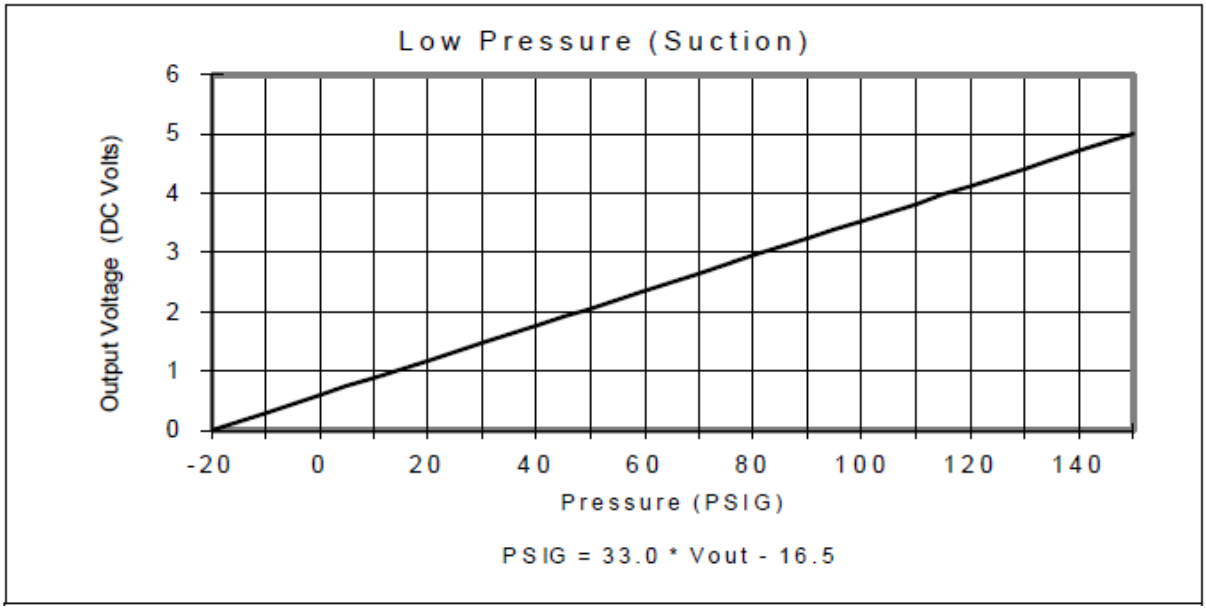


Chart E

The NTC Thermistor Sensor, Carlyle Part# A1004MS24P1. The DC voltage can be measure across the thermistor inputs on the CCM, and using the chart below, can be converted to a temperature.

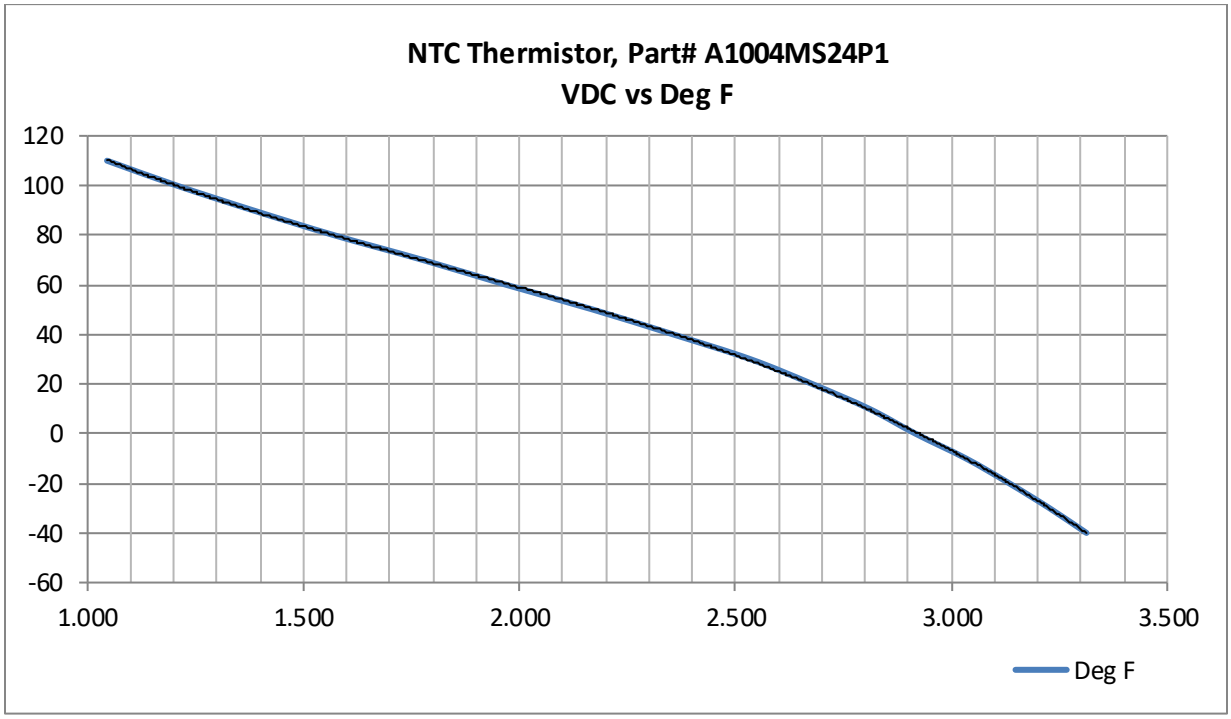


Chart F

The 5vdc discharge pressure transducer sensor, Carlyle Part# HK05YZ007. The DC voltage can be measured across the **Sig** and **Gnd** terminals, and using the table below, can be converted to a pressure.
PSIG = 101.594 * VDC - 47.33

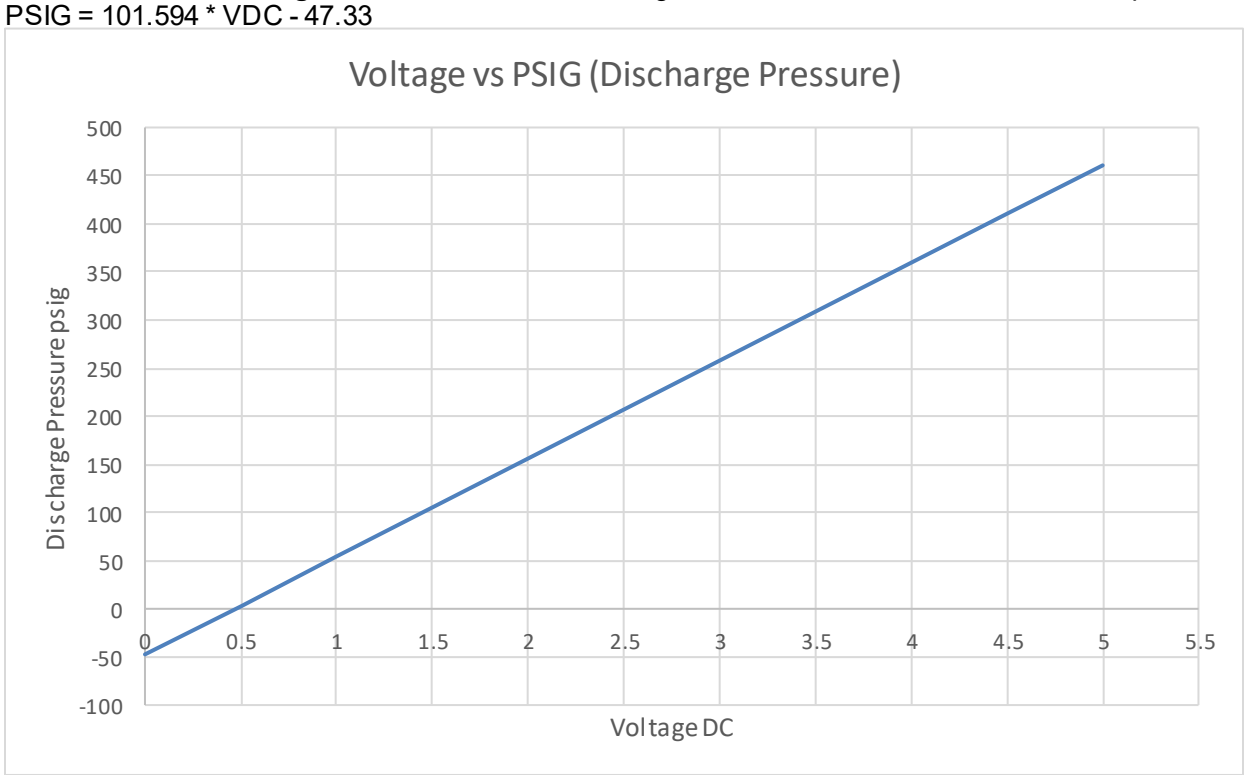


Chart G

CCM Layout and Interface:

Note:

The I/O Zone Installation Guide is for controller specifications, mounting requirements, and electrical requirements and installation.

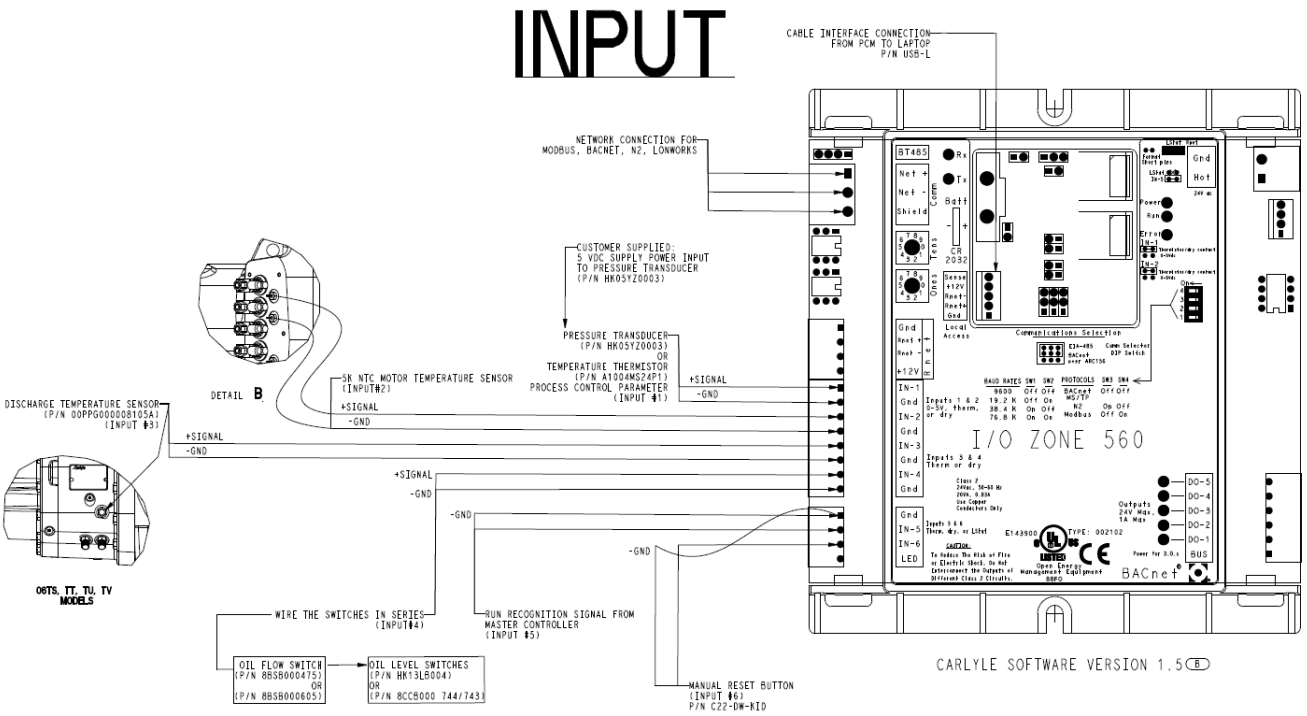
The I/O Zone Integration guide is for instruction regarding using the CCM with Network Protocols.

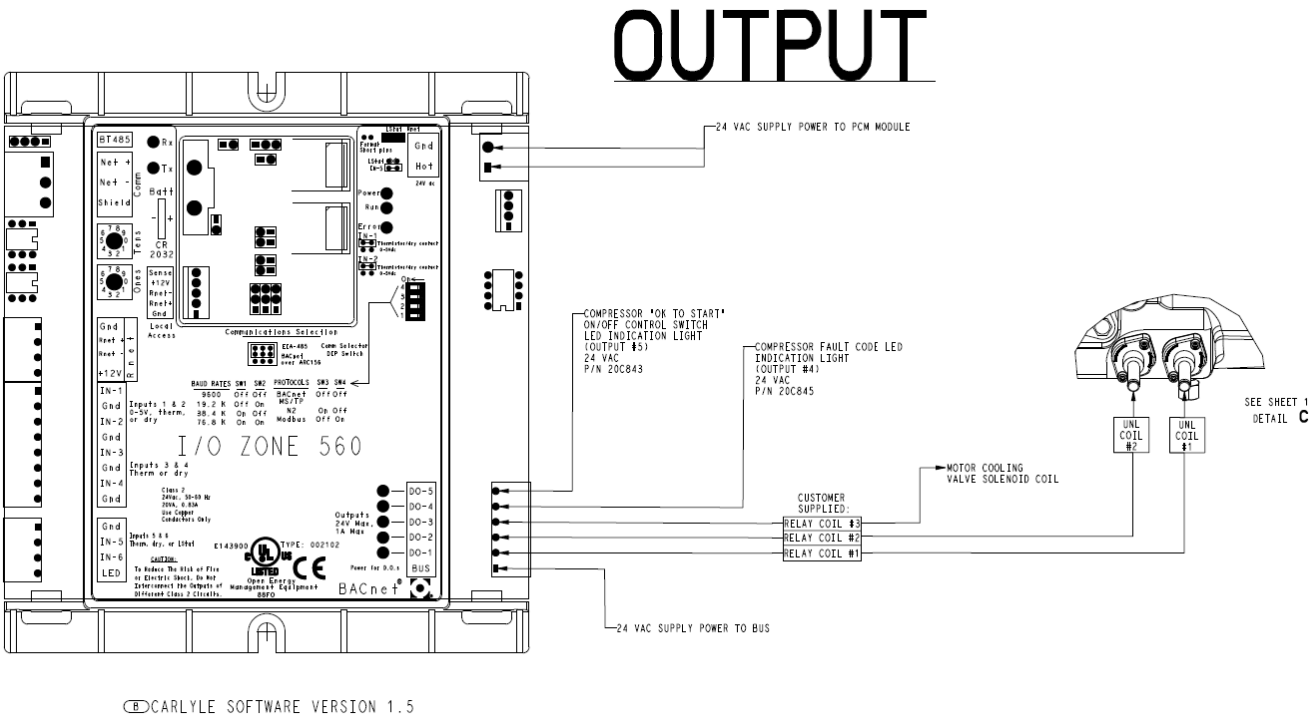
- The CCM comes with Carlyle software pre downloaded to the module. This software is configured specifically for the Paragon and 06Z VFD screw compressors models and the module inputs/outputs have been designated and assigned to work with and operate Carlyle control components only.

- The CCM module should be mounted in a protective environment, typically installed inside the refrigeration system main electrical control box.

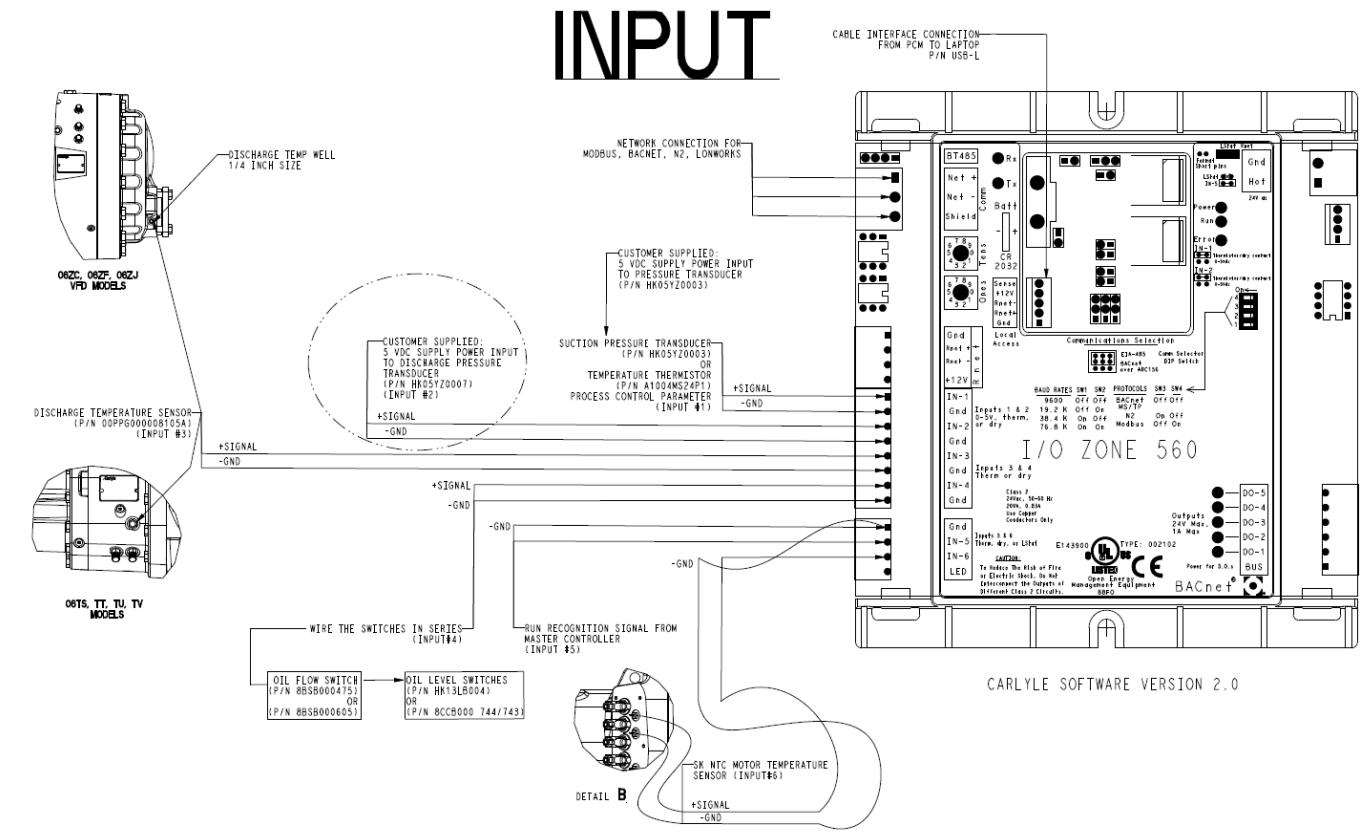
- Review the IO Zone Installation Guide prior to installing the I/O 560 Controller.

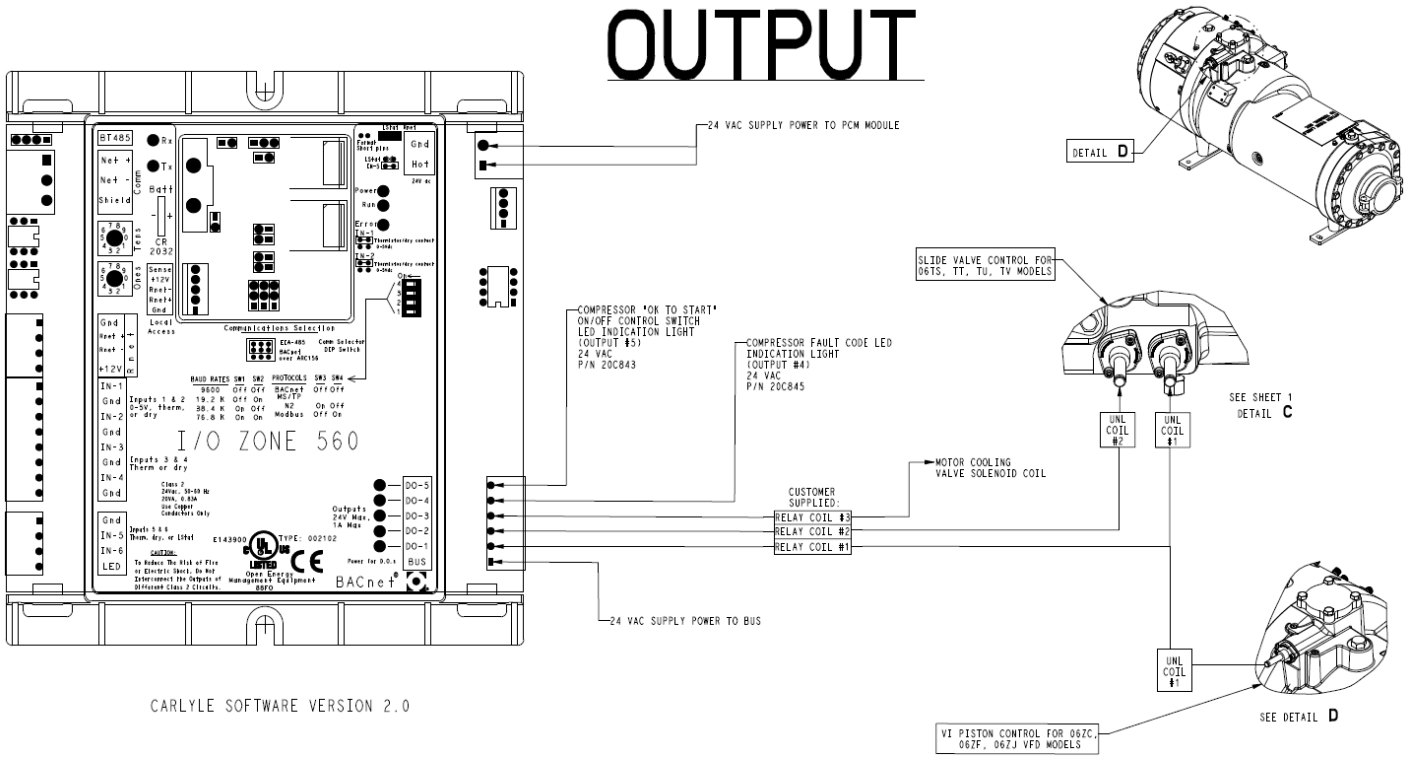
CCM Software version 1.5 (for TS/TT/TU/TV models only)





CCM Software version 2.0 (for TS/TT/TU/TV & 06ZC, ZF, ZJ models)



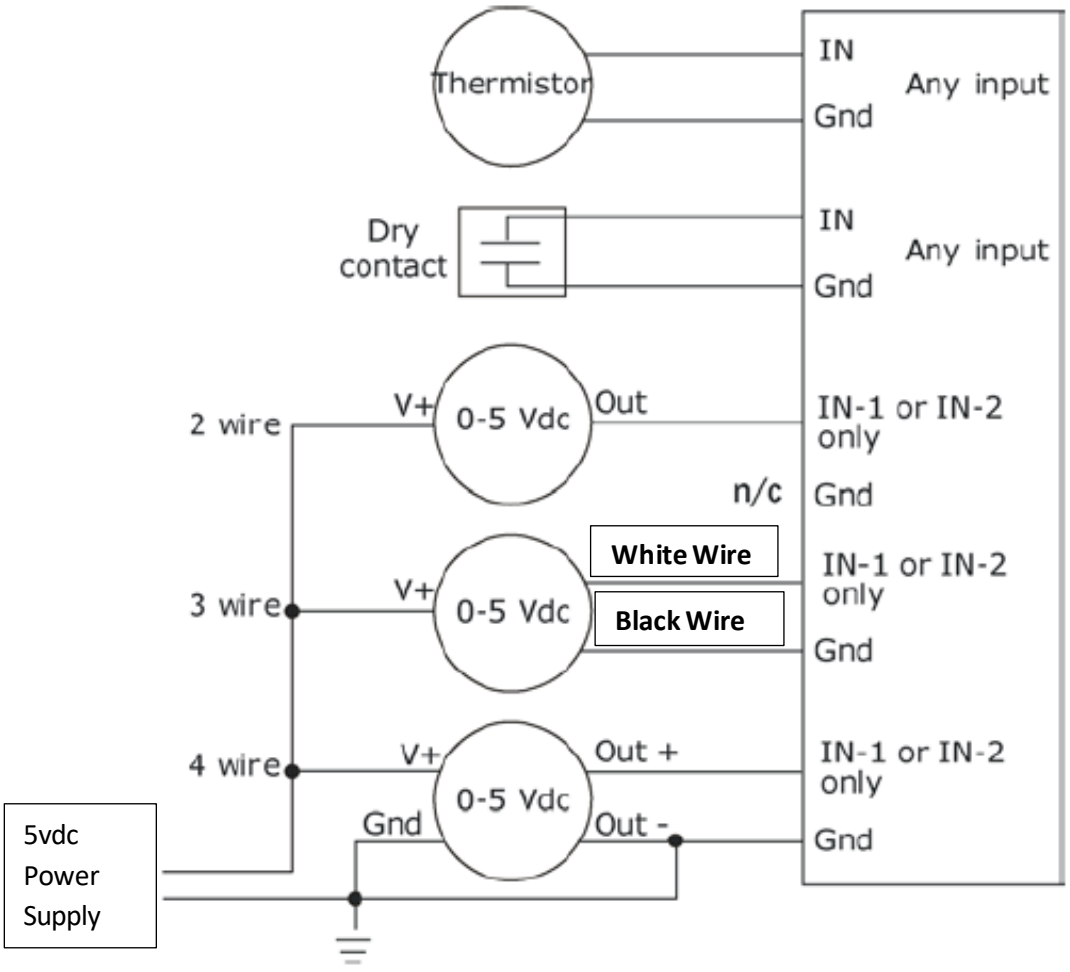


How to Wire the Inputs for Pressure Transducer, Thermistor, or Dry Contact

1. Verify that the I/O Zone's power and communications connections work properly.
2. Pull the screw terminal connector from the controller's power terminals labeled **Gnd** and **Hot**.
3. Connect the input wiring to the screw terminals on the I/O Zone.

NOTES

- Connect the shield wire to the **Gnd** terminal with the ground wire.



CCM Input #1 installation:

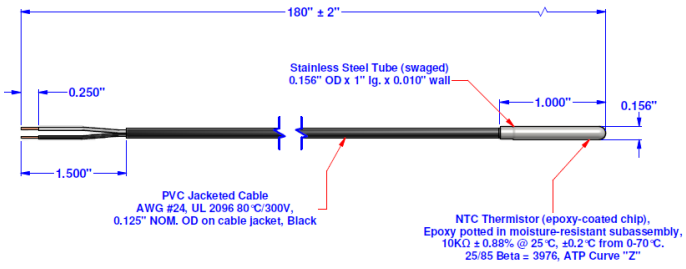
The CCM is designed to work with the Carlyle suction pressure transducer (Part# HK05YZ003) or 5K NTC thermistor (Part# A1004MS24P1). See charts E & F.

To connect the **(3 WIRE)** pressure transducers to the module a transducer harness assembly, equipped with 15ft of shielded cable is available under **Carlyle kit 6BSB000929 & 930**. The wire harness will plug directly in the transducer and has the following wire designations:

- The **RED** wire connects to the +5 vdc supply power (power supply not provided, recommend TDK Lambda, p/n: DSP10-5).
- The **WHITE** wire is the signal wire and connects to the IN-1 terminal location on the CCM controller.
- The **BLACK** wire connects to the GND input on the CCM controller.

Carlyle Part# HK05YZ003
Pressure Transducer

Carlyle Part# A1004MS24P1
5K NTC Thermistor



The NTC temperature thermistor, A1004MS24P1, input is NOT polarity sensitive and will connect to the IN-1 and GND (use if the process control set-point is “Temperature” based).

Set the configuration jumper for input #1 depending on if the control set-point will be measured via Pressure or Temperature. The jumper comes installed on the CCM and may already be in the correct position.

Place the configuration jumper to this position if the Process Control Variable is a thermistor sensor for Input #1.

OR

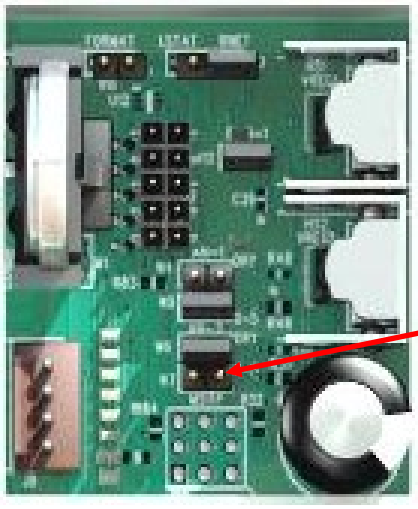
Place the configuration jumper to this position if the Process Control Variable is a 0-5 vdc Pressure Transducer sensor for Input #1.

CCM Input #2 (Discharge Pressure):

This input is only used/required if the CCM controller is being applied with 06ZC, 06ZF, and 06ZJ VFD compressor models. The Vi Piston Control must be enabled in the controller configuration setup.

To connect the **(3 WIRE)** pressure transducers to the module a transducer harness assembly, equipped with 15ft of shielded cable is available under **Carlyle kit 6BSB000929 & 930** The wire harness will plug directly in the transducer and has the following wire designations:

- The **RED** wire connects to the +5 vdc supply power (power supply not provided, recommend TDK Lambda, p/n: DSP10-5).
- The **WHITE** wire is the signal wire and connects to the IN-1 terminal location on the CCM controller.
- The **BLACK** wire connects to the GND input on the CCM controller.

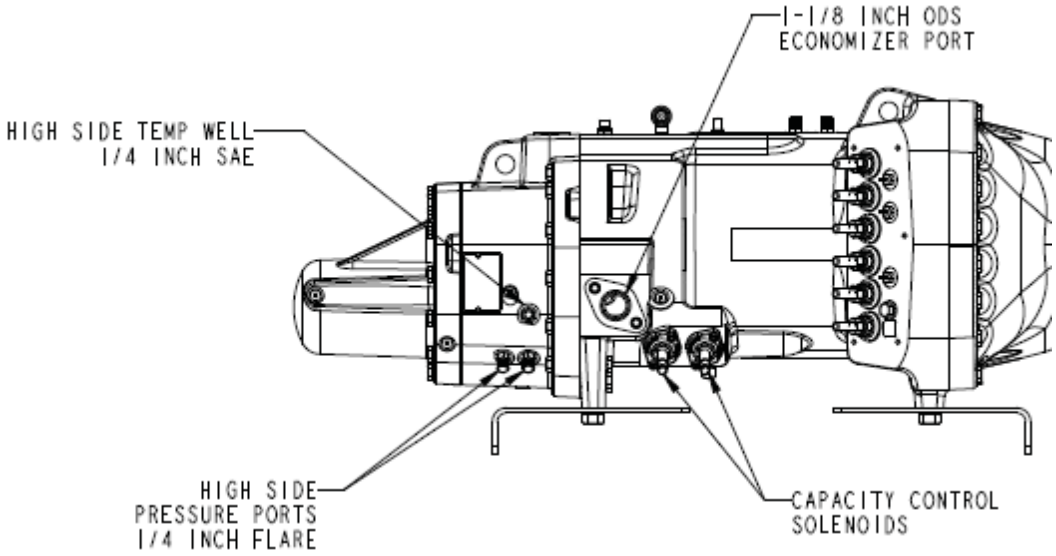


Place the configuration jumper to this position if a 0-5 vdc pressure transducer is used for Vi piston control.

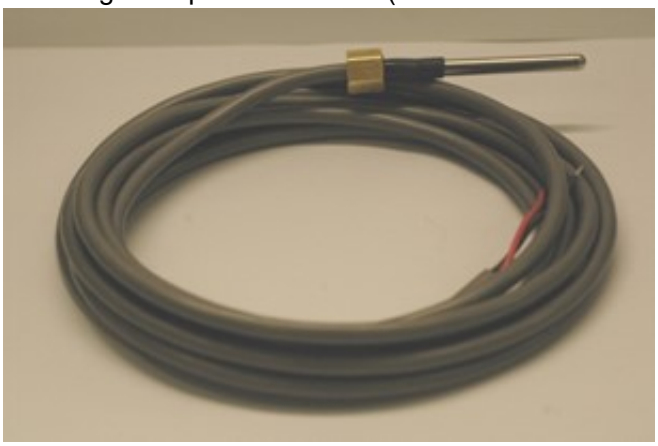
Carlyle Part# HK05YZ007
Discharge Pressure Transducer

CCM Input #3:

This input monitors the compressor discharge temperature and uses the 5K NTC thermistor (Part# 00PPG000008105A) which should install in the compressor's High Side Discharge Temperature Well as shown below. The sensor's control and trip set-points are defined in **Tables A & B.**



Discharge Temperature Sensor (Part# 00PPG000008105A)



CCM Input #4:

The CCM dry contact input #4 is designed to work with the following Carlyle Oil Protection devices to protect the compressor from a loss of oil condition. The Carlyle Oil Level Switch and Oil flow Switch should be wired in series to the CCM Controller at input #4 dry contacts. If either switch opens, the CCM will trip the compressor off-line in 15 seconds.

Oil Level Switch, Electrical Rating is 20VA, P/N 8CCB000743 (115vac) & 8CCB000744 (230vac). The oil level switch will wire to the CCM Controller input #4 dry contacts and will wire in series with the Carlyle Oil flow Switch.

Oil Level Switch
P/N 8CCB000743 & 8CCB000744
P/N 8CCB000742 (sensor fitting)

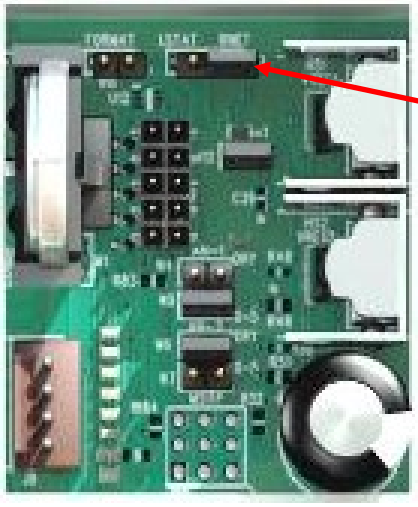
Oil Level Switch/Sensor
P/N 8BTB000311 or HK13LB004
P/N 00PPG000011400A (06Z models only)

The Carlyle oil flow switch is P/N 8BSB000475 for R134a applications or P/N 8BSB000605 for R404a applications. The oil flow switch will wire to the CCM Controller input #4 dry contacts and will wire in series with the Carlyle Oil level Switch.

Flow Switch Ratings			
VA	**Volts**	**AMPS AC**	**AMPS DC**
20	0 - 30	0.4	0.3
	120	0.17	0.13
	240	0.08	0.06

CCM Input #5:

Input #5 is a dry contact circuit which is a Run Recognition signal input for the CCM. A Run Recognition signal from the System Controller to the CCM is required. Upon a compressor start, the System Controller must close input circuit #5 to activate the Slide Valve and Compressor Protection programs. If the compressor trips off or is manually turned off, the Run Recognition signal will open, identifying to the CCM the compressor is not operating, thus deactivating the Slide Valve and Compressor Protection programs.



User must set the configuration jumper to this position for Input #5. This configures Input #5 as a Dry Contact. Failure to do so will result in input #5 not working correctly.

CCM Input #6

Two 5K NTC motor thermistors are embedded in the compressor motor windings. The motor thermistor connection points are in the compressors electrical box at terminals S1 and C. Wire S1 and C terminals to CCM Input #2. In the event of a thermistor failure, a spare thermistor is available between S2 and C terminal points.

CCM outputs #1 & #2:

CCM Output #1 and #2 will control unloader coil #1 and #2 for slide valve capacity control for all Paragon compressor models 06TS, TT, TU, and TV if slide valve capacity control is selected during the controller configuration setup.

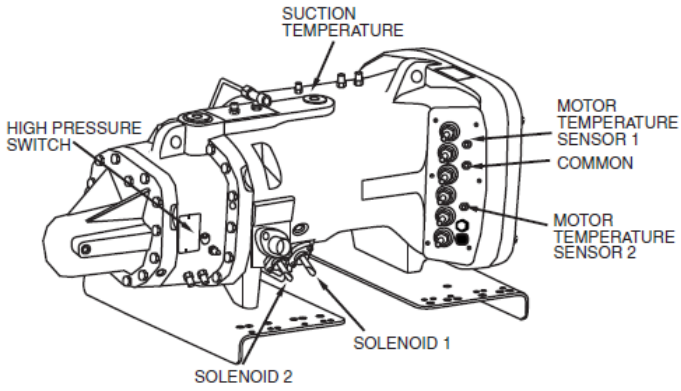
OR

If the CCM controller is being applied with 06ZC, 06ZF, and 06ZJ VFD compressor models, then CCM Output #1 will control the Vi Piston solenoid coil. The Vi piston control feature must be selected in the controller configuration setup.

CCM output #2 will not be required if Vi piston control is enabled and active.

Note: All CCM outputs are rated for 24vac @ 1 amp.

CCM outputs #1 and #2 are not capable to drive the Carlyle unloader solenoid coils directly (see table for available Carlyle solenoid coils). A SPST or DPDT 24vac relay must be installed to interface between the CCM and the solenoid coils. CCM output #1 and #2 must go with Solenoid #1 and Solenoid #2 respectively as shown in the compressor detail below.



	Loads Comp	Unloads Comp	Freezes Unloading
	INCREASE CAPACITY	DECREASE CAPACITY	PARTIAL*
SOLENOID #1	Energized	De-Energized	De-Energized
SOLENOID #2	Energized	De-Energized	Energized

CCM output #3:

CCM output #3 controls the compressor's motor cooling valve for liquid injection into the compressor's suction line for motor cooling (see Table A). CCM output #3 is not capable to drive the Carlyle motor cooling solenoid coil directly, but a 24vac relay is required in the same way as noted for Outputs #1 and #2 for Slide Valve control.

CCM output #4:

CCM output #4 provides LED fault indication for a compressor trip and or sensor fault. The Carlyle controls package provides a Red LED indicator light that the installer should wire directly into output #4 and GND. Panel-mount the LED indicator to the control panel or somewhere accessible/visible to provide fault status of the CCM as noted in the table below.

NOTE: A manual RESET must be initiated in the CCM Controller following clearing of any fault condition noted in the table below. A manual reset can only be accomplished via connecting a laptop to the CCM module via the Carlyle interface cable P/N USB-L and the Virtual BacView software.

Fault indication table for software version 2.0

Fault Description	LED Indication (Output #4)	Output #5	Compressor	Manual Reset Required
High Discharge Temperature Trip	Solid Red	Open/De-energized	OFF	Yes
High Motor Temperature Trip	Constant Blinking	Open/De-energized	OFF	Yes
Compressor Oil Trip	One blink & 2 second pause	Open/De-energized	OFF	Yes
Faulty Suction Transducer/Thermistor Sensor	Two blinks & 2 second pause	Open/De-energized	OFF	Yes
Faulty Motor Temperature Thermistor	Three blinks & 2 second pause	Open/De-energized	OFF	Yes
Faulty Discharge Temperature Thermistor	Four blinks & 2 second pause	Open/De-energized	OFF	Yes
Faulty Discharge Transducer	Five blinks & 2 second pause	Open/De-energized	OFF	Yes

Fault indication table for software version 1.5

Fault Description	LED Indication (Output #4)	Output #5	Compressor	Manual Reset Required
High Discharge Temperature Trip	Solid Red	Open/De-energized	OFF	Yes
High Motor Temperature Trip	Constant Blinking	Open/De-energized	OFF	Yes
Compressor Oil Trip	One blink & 2 second pause	Open/De-energized	OFF	Yes
Faulty Transducer/Thermistor Sensor	Two blinks & 2 second pause	Open/De-energized	OFF	Yes
Faulty Motor Temperature Thermistor	Three blinks & 2 second pause	Open/De-energized	OFF	Yes
Faulty Discharge Temperature Thermistor	Four blinks & 2 second pause	Open/De-energized	OFF	Yes

CCM output #5:

CCM output #5 is closed when there are no compressor fault conditions in and the compressor is operational and ready to start. This output **must** be part of the pilot duty refrigeration system start/stop circuit. The Output will open (de-energize), tripping the compressor offline, for the following fault conditions:

- High Discharge Temperature
- High Motor Temperature
- Low oil level
- Low oil flow
- Faulty pressure transducer (open or short)
- Faulty thermistor (open or short)

The Carlyle controls package provides a Green LED indicator light that the installer should wire directly into output #5 and GND, panel-mount the LED indicator to the control panel or somewhere accessible/visible for easy identification. When the LED light is lit, this indicates the compressor has no fault codes and is ready to be operated/started.

24vac Indicator Light

Slide Valve Override

If the end user prefers to use the System Controller and not the Carlyle CCM to operate the compressor's slide valve for capacity control, the CCM must still be intergrade in with the Slide Valve unloader coils to provide compressor override protection in-case the motor and or discharge temperatures elevate above the allow limits defined in **Table B. See wiring diagram below.**

Slide Valve Override Control Points

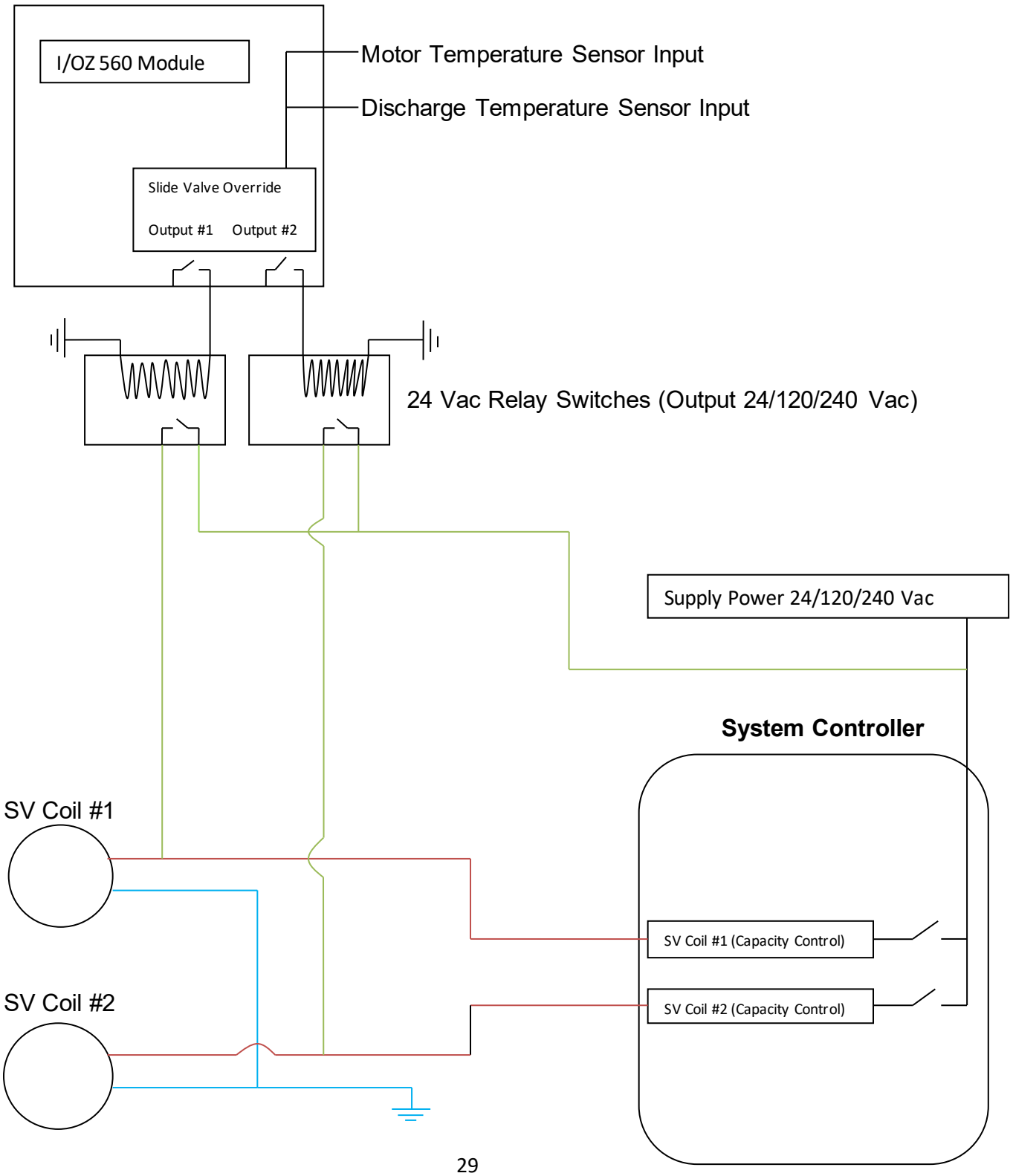
ALC Controller	Restrict Further Compressor Unloading Energized SV Coil #2 continuously (°F)	Fully Load Compressor and restrict unloading below 100% Energize SV Coil #1 and Coil #2 continuously (°F)
*SV – Discharge Temp (Td)	200 < Td < 215 (discontinue SV override when Td < 198F)	Td > 215F (discontinue SV override when Td < 213F)
*SV – Motor Cooling Temp ™	245 < Tm < 260 (discontinue SV override when Tm < 243F)	Tm > 260F (discontinue SV override when Tm < 258F)

*SV – Slide Valve

Table B

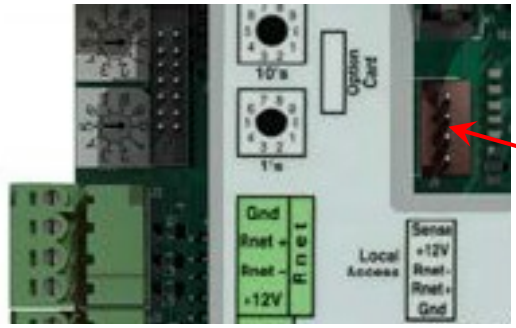
Slide Valve Wiring Diagram with System Controller

This diagram only applies if the CCM will not be used to control the Compressor Slide Valve for capacity control, but the System's Master Controller will perform slide valve control function. This diagram still allows for the CCM to override the slide valve coils #1and #2 for motor and discharge temperature protection.



CCM Controller Display Features

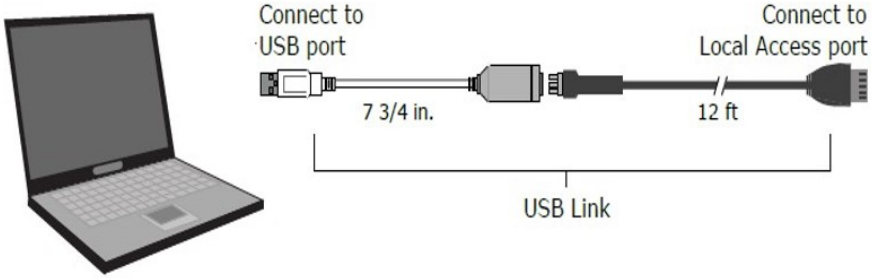
To configure and display the CCM inputs, outputs, and fault codes using your laptop computer, the virtual BacView software must be installed. This software can be downloaded from www.carlylecompressor.com website. An interface cable, Carlyle P/N USB-L, is required to communicate the laptop to the CCM Controller.



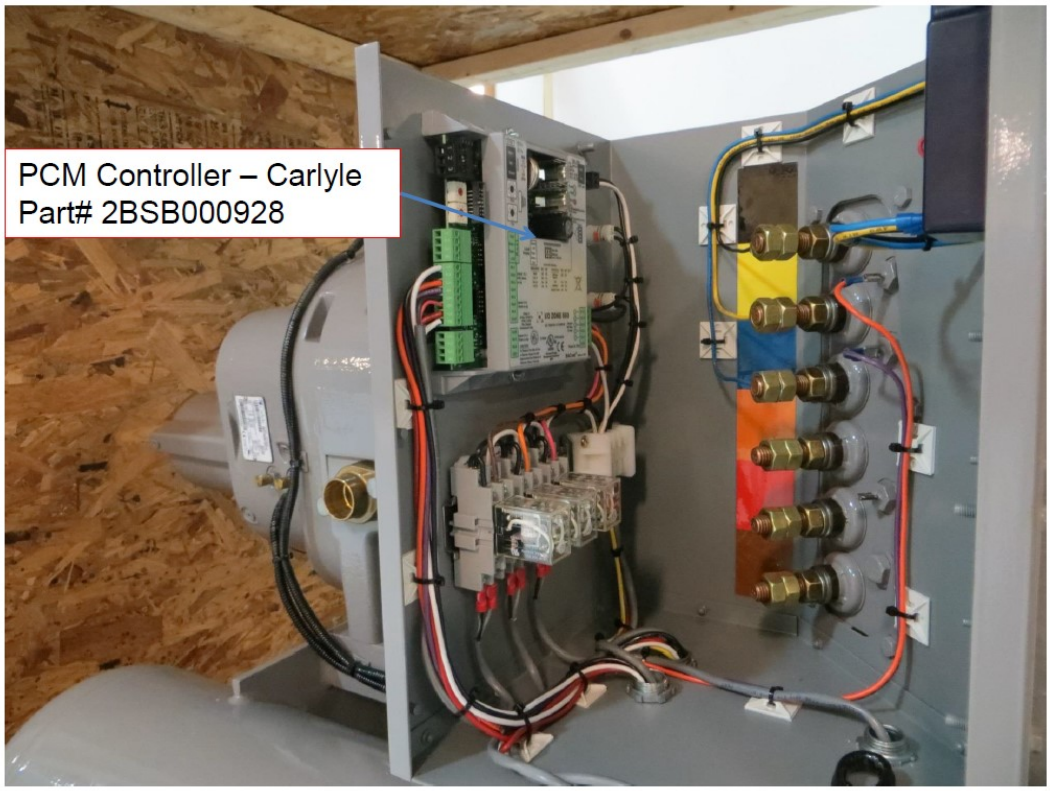
4-pin connection port for the USB-L interface cable.

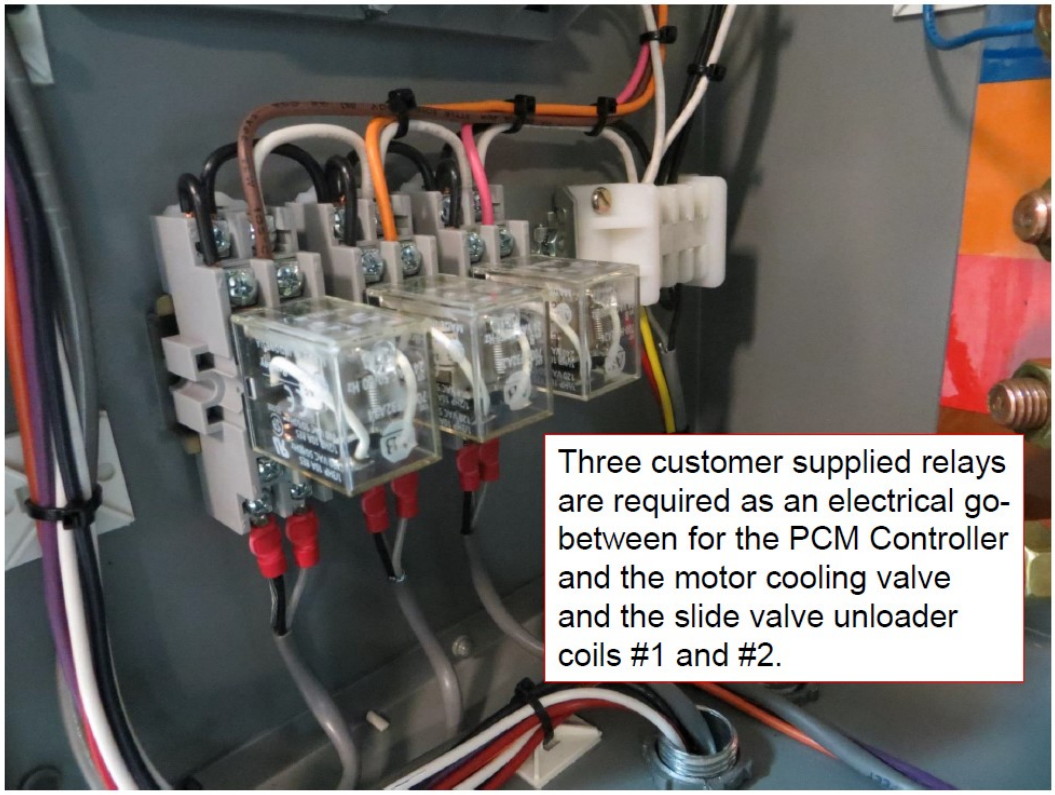
The Virtual BAC*view*® application simulates the BAC*view*®[6] Handheld keypad/display device. Run the Virtual BAC*view*® application on a laptop that is connected to the controller.

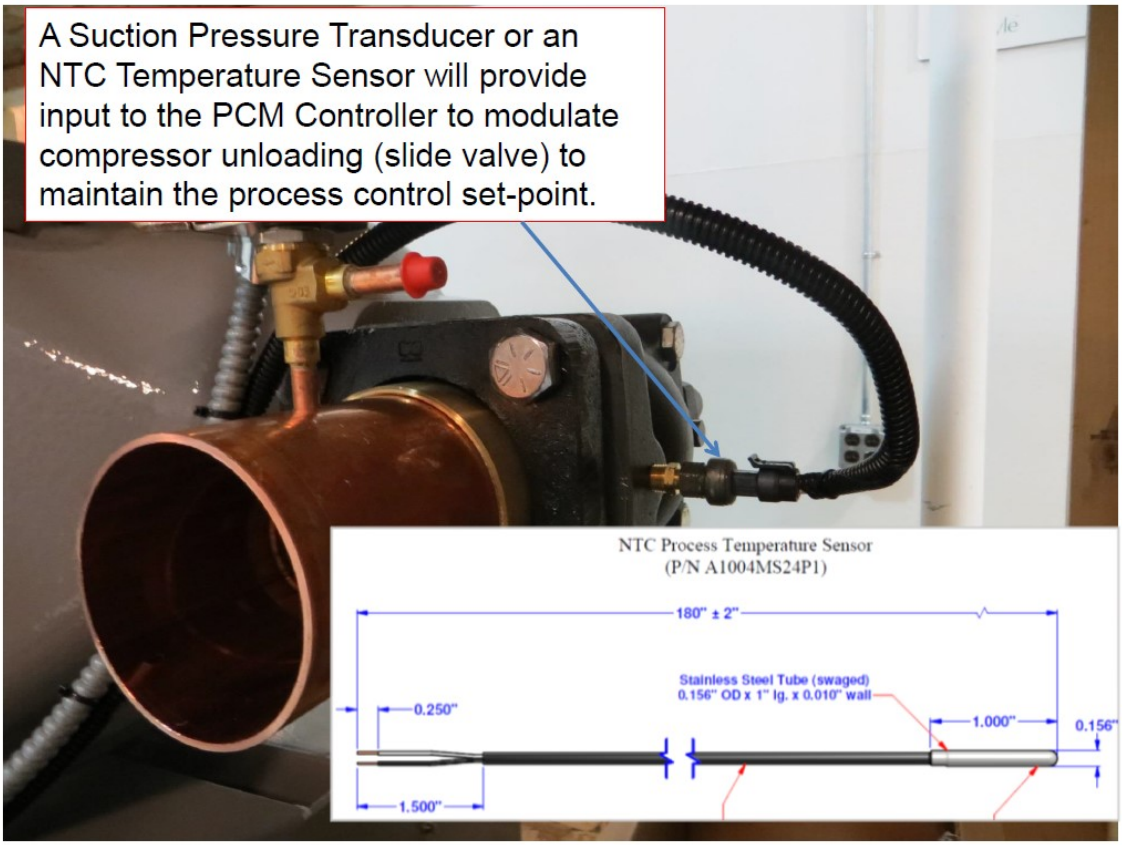
Connect the USB-Link to the computer and to the controller's **Local Access** port.

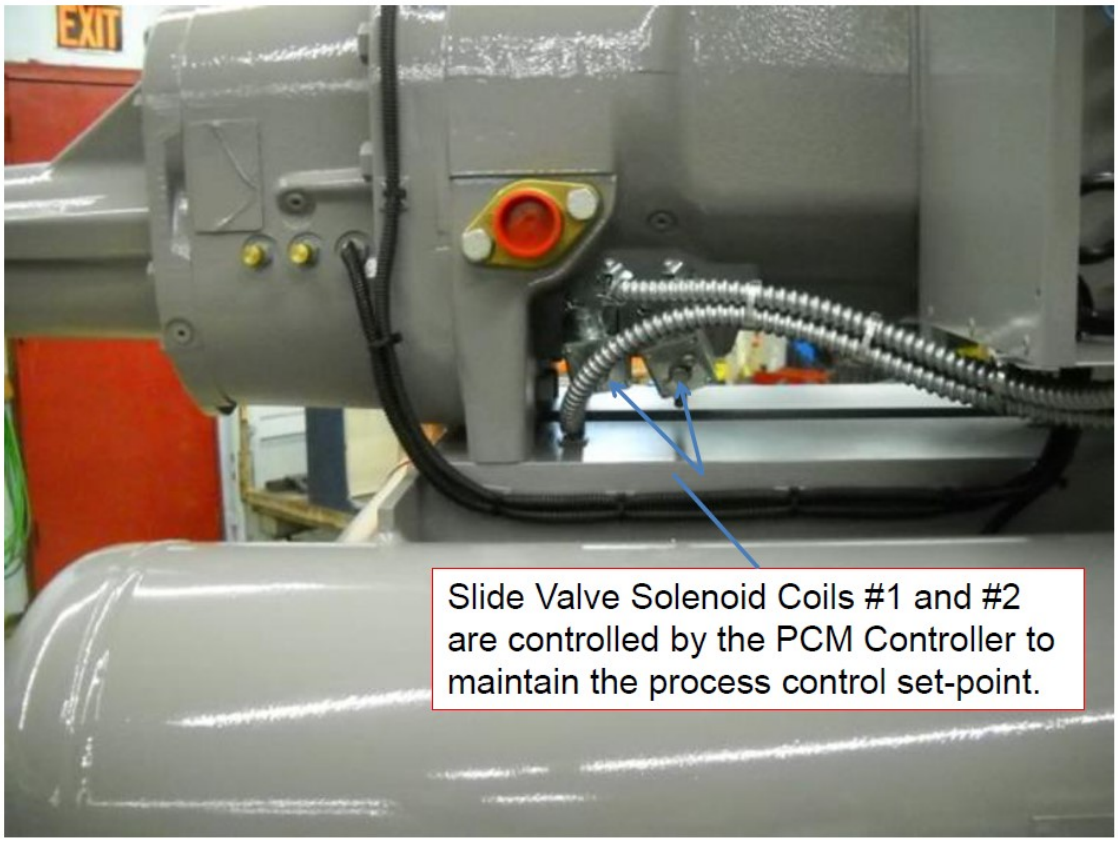


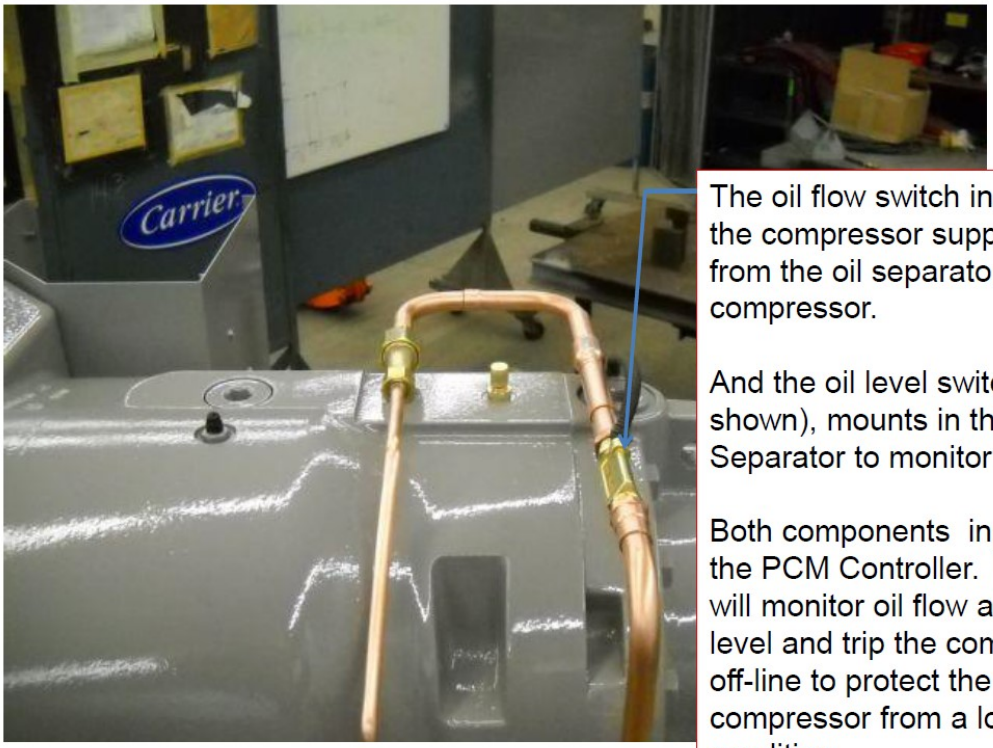
General Installation Pictorials (for example only)






A Suction Pressure Transducer or an NTC Temperature Sensor will provide input to the PCM Controller to modulate compressor unloading (slide valve) to maintain the process control set-point.
NTC Process Temperature Sensor
(P/N A1004MS24P1)
180" ± 2"
Stainless Steel Tube (swaged)
0.156" OD x 1" lg. x 0.010" wall
0.250"
1.000"
0.156"
1.500"


EXIT
Slide Valve Solenoid Coils #1 and #2 are controlled by the PCM Controller to maintain the process control set-point.

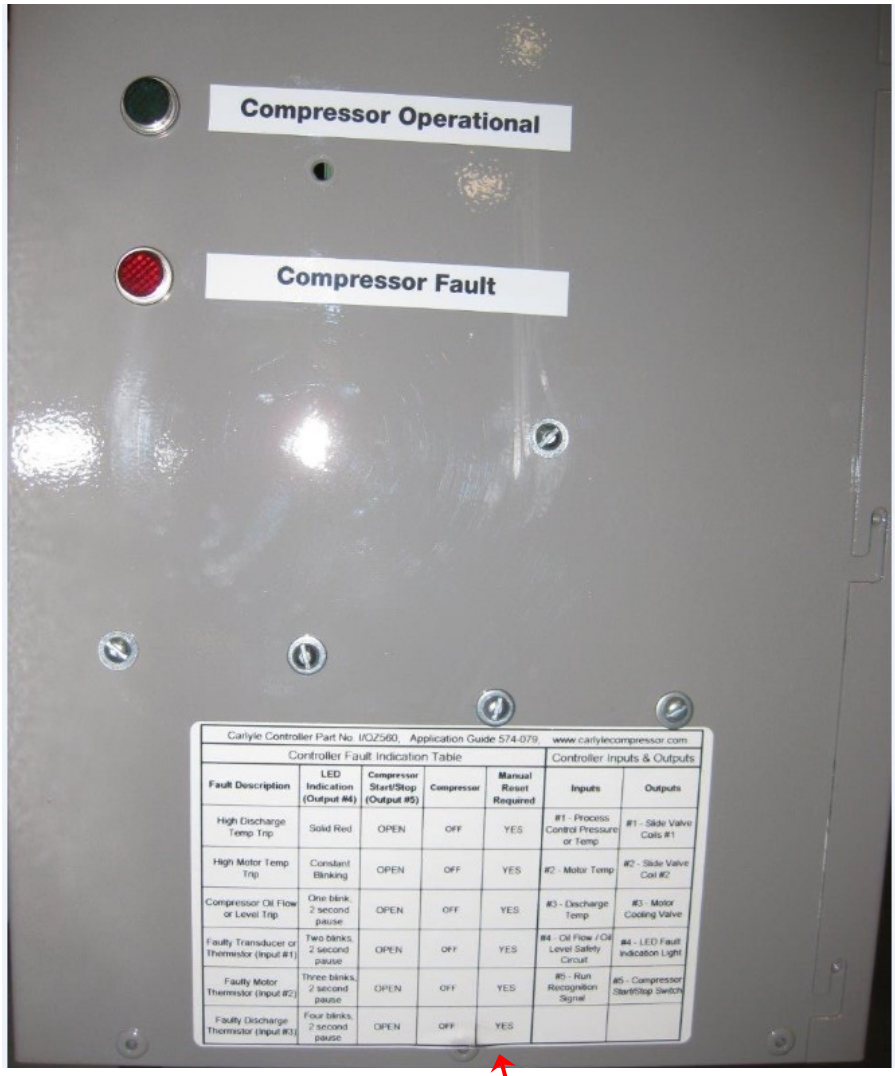


The oil flow switch installs in the compressor supply line from the oil separator to the compressor.

And the oil level switch, (not shown), mounts in the Oil Separator to monitor oil level.

Both components input into the PCM Controller. The PCM will monitor oil flow and oil level and trip the compressor off-line to protect the compressor from a loss of oil condition.

LED Indicators are provided in the CCM Controller Kit. Install labels next to each LED light identifying the indication.



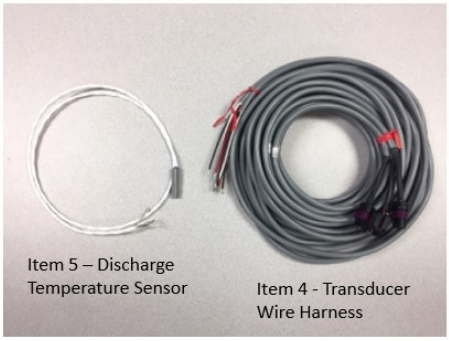
Place adhesive label in a location next to the CCM Controller so it is visible for Field Service and Refrigeration Technicians.

CCM Controller, LonCEM Replacement Section
Software Version 3.0

The LonCEM package consists of the following items:

Item	Description	LonCEM Kit P/N	QTY
1	Controller	3TA1061	1
2	Suction Transducer	HK05YZ003	1
3	Discharge & Oil Pressure Transducer	HK05YZ007	2
4	Transducer Wire Harness	06TA680007S	3
5	Discharge Temperature Thermistor	HH79NZ065	1
6	Discharge fitting 7/16"-20 to 1/4" NPT x 1.3" L	DD08SA051	1
7	Suction fitting 7/16"-20 to 1/4" NPT x 3.7" L	DD08SA052	1
8	Cross fitting (Suction & Discharge)	DD17SA051	2

Item 1 – Controller



Item 5 – Discharge Temperature Sensor

Item 4 - Transducer Wire Harness

74mm Compressor Installation

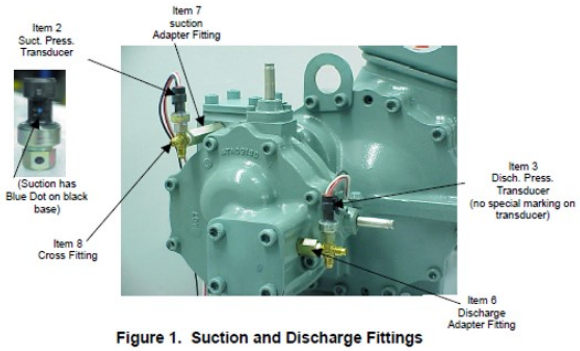
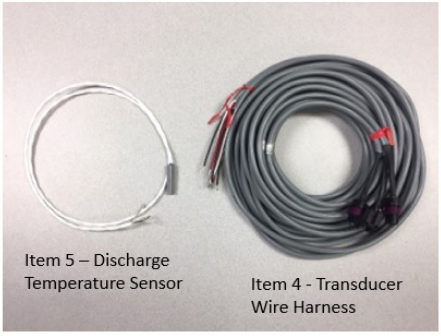


Figure 1. Suction and Discharge Fittings

The LonCEM Kit compared to the CCM Kit:

Item	Description	LonCEM Kit P/N	QTY		CCM kit P/N	QTY
1	Controller	3TA1061	1		6BSB000928	1
2	Suction Transducer	HK05YZ003	1		Not Required	0
3	Discharge & Oil Pressure Transducer	HK05YZ007	2		HK05YZ007	2
4	Transducer Wire Harness	06TA680007S	3		06TA680007S	2
5	Discharge Temperature Thermistor	HH79NZ065	1		HH79NZ065	1
6	Discharge fitting 7/16"-20 to 1/4" NPT x 1.3" L	DD08SA051	1		DD08SA051	1
7	Suction fitting 7/16"-20 to 1/4" NPT x 3.7" L	DD08SA052	1		Not Required	0
8	Cross fitting (Suction & Discharge)	DD17SA051	2		DD17SA051	1

Item 1 - Controller



Item 5 – Discharge Temperature Sensor

Item 4 - Transducer Wire Harness

74mm Compressor Installation

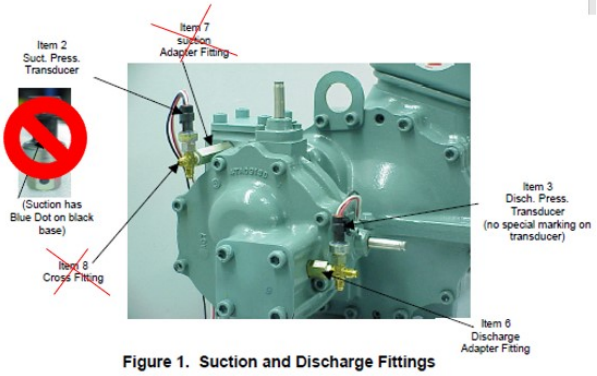


Figure 1. Suction and Discharge Fittings

Inputs and Outputs of the LonCEM Module:

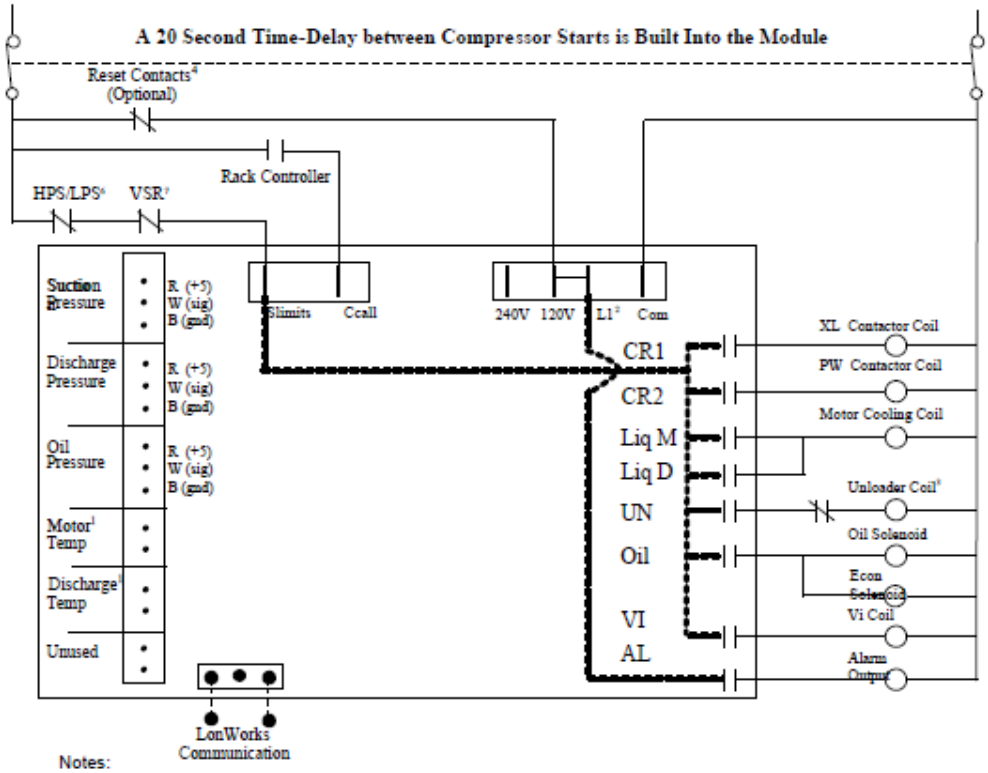
- Supply power input voltage (240, 120, L1 and Com)
- Slimits – System safety control loop. Must be closed to allow compressor to start via CR1, CR2
- Ccall – Call for cooling input signal from System Controller

INPUTS

- **Suction, Oil, and Discharge Pressure**
- **Motor Temperature**
- **Discharge Temperature**
- **Pd – Po > 50...change oil filter**
- **Po – Ps < 45...oil flow rate too low.**
- **Shutdown on high motor or discharge temp**

OUTPUTS

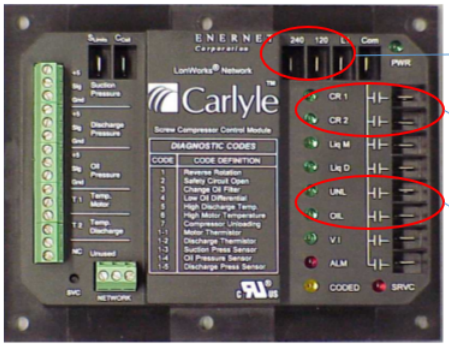
- **CR1/CR2 start compressor switches.**
- **Liq M & Liq D liquid Injection**
- **UNL – Unload to reduce motor temperature....only function.**
- **OIL – energize oil and economizer solenoid valves upon a compressor start**
- **VI energized automatically if pressure ratio PR > 5.0**

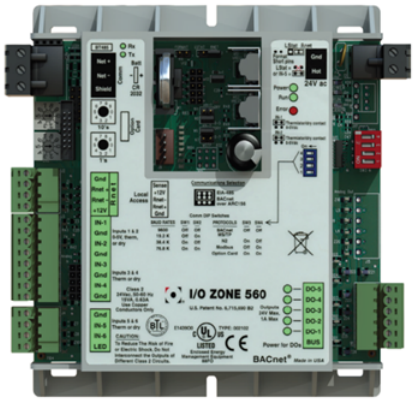


Notes:

1. Connections for Motor Temp, Discharge Temp, and echelon communications are all polarity insensitive.
2. L1 must be jumpered to 240V or 120V depending on line voltage. The drawing shows wiring for 120V. The L1 input is used to power the alarm output.
3. The compressor is *loaded* when the solenoid is energized and *unloaded* when de-energized.
4. A normally closed set of contacts can be added to reset power to the module. Useful for remotely resetting a module out on an Alarm Failure
5. The diagnostic alarm code is flashed by the yellow alarm light during a compressor alarm.
6. The system safeties are monitored on the Slimits Input. This input actually powers the contactor output and is switched through the module. See section 1.2 for details on the additional required system safeties.
7. A voltage sensing relay (VSR) (or an equivalent method) should be used to detect if power is lost to the line side of the contactor (i.e. circuit breaker has tripped).

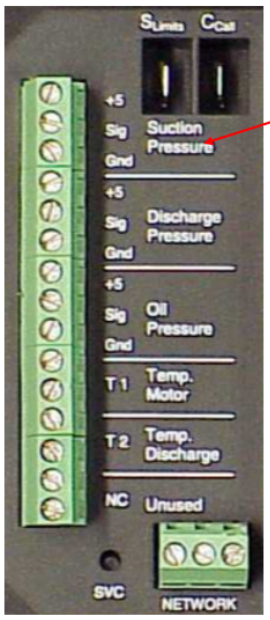
Controller Functionality Differences:





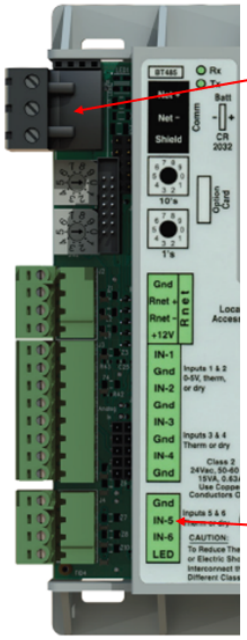
- **Supply voltage to power the CCM is 24vac only. All outputs are 24vac. CCM controller does not have 120/240 vac input/output.**
- **The CCM does not have internal CR1/CR2 compressor start contactors to start the compressor.**
- **The CCM does not have available outputs to energize the isolation solenoid valves, upon a compressor start, for the oil line, economizer line, and the liquid injection line. The System Controller will have to energize these isolation solenoid valves upon a compressor start.**
- **No suction pressure transducer required. Suction pressure will be a fixed set-point inputted by the user.**
- **A separate 5 vdc power supply will be required for the pressure transducers.**
- **An intermediate relay will be required to be installed between the CCM and solenoid coils for Vi Valve, Unloader, and liquid injection valve if their coil voltages are 120vac or 240vac.**

Comparing Inputs (LonCEM and CCM Module):



Suction pressure will be a user defined Input for the CCM, and a physical pressure transducer is not required.

Input #1: Oil Pressure
Input #2: Discharge Pressure
Input #3: Motor Temperature
Input #4: Dry Contact for oil flow switch
Input #5: Run Recognition signal (Ccall)
Input #6: Discharge Temperature



If using the Network, will have to re-configure to ModBus, BacNet. Or purchase LonWorks hardware to interface with PCM module.

The LonCem module uses Ccall input (Call for Cooling). The CCM module Input #5 is a Run Recognition signal. Rack Controller closes this dry input when a Call for Cooling and the compressors starts. Let's the CCM Module know the compressor is running and to start monitoring the inputs/outputs.

Comparing Outputs (LonCEM and CCM Module):

CR1 – Supplies power to the compressor contactor. CCM Module does not have this compressor XL start contactor.

CR2 - Supplies power to the compressor contactor for PW Start. CCM Module does not have this compressor PW start contactor.

Liquid M & Liq D are typically wired in parallel to energize an injection cooling valve into economizer port to reduce **Motor** and **Discharge** temperature. CCM Module Output #3 will perform this same function. Motor and Discharge temp control limits will be in the software.

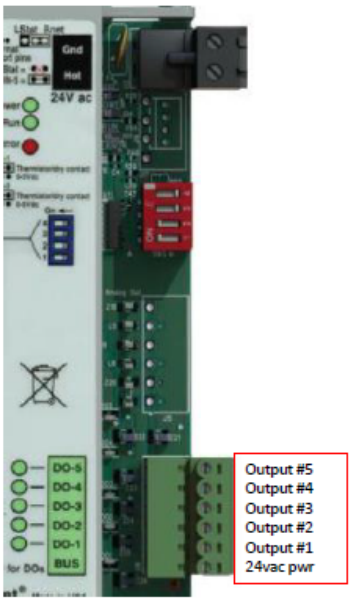
UNL – The LonCEM module will control the unloader to help maintain motor temperature. De-energizes the unloader if motor temp > 220F. The CCM performs this function via Output #2

Oil – The LonCEM Oil and Economizer isolation solenoid coils will energize upon a compressor start. The CCM controller does not have this capability. The Rack Controller will have to perform.

Vi – CCM controller will control the Vi solenoid coil same as the LonCEM (CCM Output #1).

ALM– for LonCEM module. The PCM Output #4 is the alarm output indicator light. Will blink a set flash code to indicate the type of fault.

SRVC – Is an induction light that the Network/Software is not functioning and LonCem module should be replaced. CCM Module does not require this fault condition.

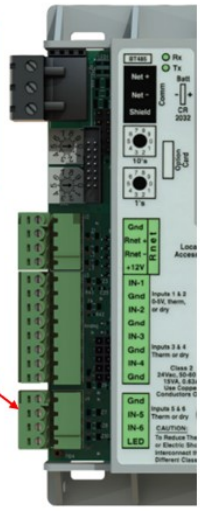


Power, Ccall and Slimit:

•Ccall - Power from RMCC Board #1 Output #1.....CCM Module has a run recognition signal, Input #5 Dry Contact. System controller closes this dry contact upon a call for cooling to start the compressor. The closure of this dry contact tell the CCM that the compressor is ON and to start monitoring the CCM inputs, outputs, alarm limits . For the LonCem, the 120/240 power jumpers to Ccall, but has a Rack Controller make/break switch in-line.

Input #1: Oil Pressure
Input #2: Discharge Pressure
Input #3: Motor Temperature
Input #4: Dry Contact for oil flow switch
Input #5: Run Recognition signal (Ccall)
Input #6: Discharge Temperature

The LonCem module uses Ccall input (Call for Cooling). The CCM module Input #5 is a Run Recognition signal. Rack Controller closes this dry input when a Call for Cooling and the compressors starts. Let's the CCM Module know the compressor is running and to start monitoring the inputs/outputs.



Safety permissive string to allow compressor to start.

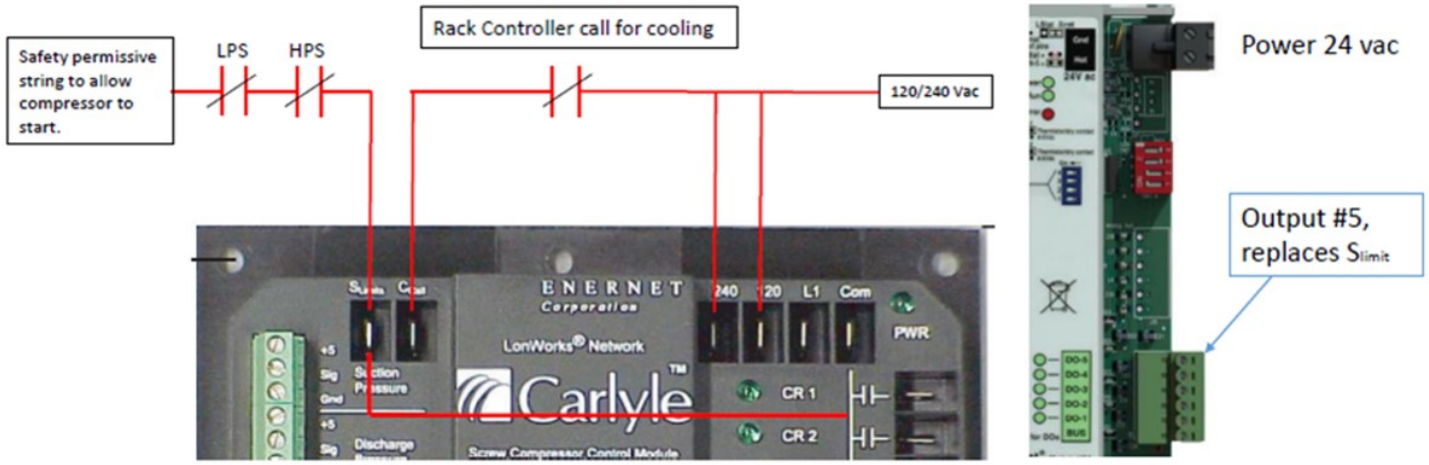
LPS HPS

Rack Controller call for cooling

120/240 Vac

•Power input voltage (240, 120, L1 and Com).....CCM module supply power is 24VAC only.

•Slimits - Power input through mechanical Hi and Low Pressure switches.....Permissive Control String to trip the compressor off from external safeties and CCM module internal safeties. If CCM has an internal alarm it will open output #5, tripping the compressor.



Comparing Alarm Codes (LonCEM versus CCM Module):

LonCEM Alarm Codes

CCM Alarm Codes

#	Fault Description	LED Indication (Output #4)	Output #5 (Slimit)	Compressor	Manual Reset Required
1	High Discharge Temperature Trip	Solid Red	Open/De-energized	OFF	no
2	High Motor Temperature Trip	Constant Blinking	Open/De-energized	OFF	
3	Low Oil flow (Po – Ps < 45 psig)	One blink & 2 second pause	Open/De-energized	OFF	Yes
4	Faulty suction or oil pressure transducer/thermistor sensor	Two blinks & 2 second pause	Open/De-energized	OFF	Yes
5	Faulty Motor Temperature Thermistor	Three blinks & 2 second pause	Open/De-energized	OFF	Yes
6	Faulty Discharge Temperature Thermistor	Four blinks & 2 second pause	Open/De-energized	OFF	Yes
7	Faulty Discharge Transducer	Five blinks & 2 second pause	Open/De-energized	OFF	Yes
8	Reverse Rotation	One blinks & 5 second pause	Open/De-energized	OFF	Yes
9	Unloading, motor temperature	Three blinks & 5 second pause	Closed/Energized	ON	No
10A	Change Oil Filter (Pd – Po > 35 psig)	Three blinks & 5 second pause	Closed/Energized	ON	No
10B	High Oil Filter DP (Pd – Po > 50 psig)	Three blinks & 5 second pause	Open/De-Energized	OFF	Yes

- No faulty suction pressure transducer alarm
- No Software alarm code

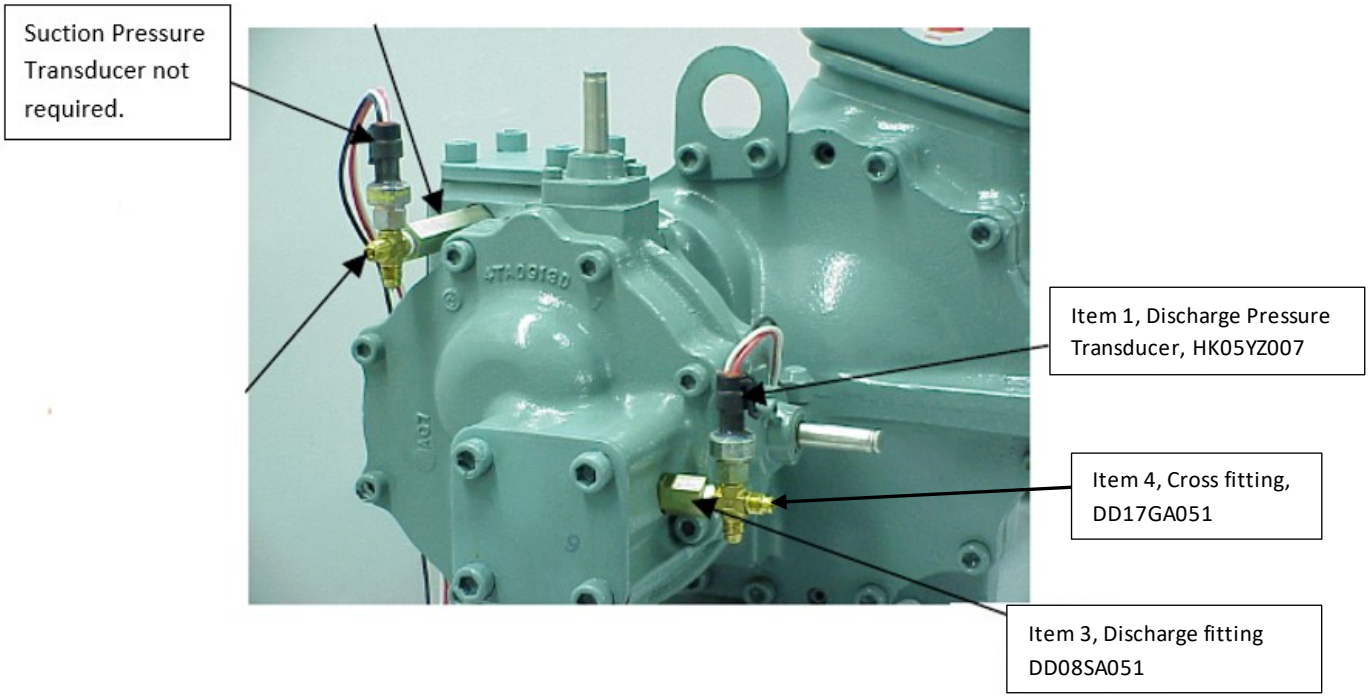
Setup of the CCM Controller and Accessories

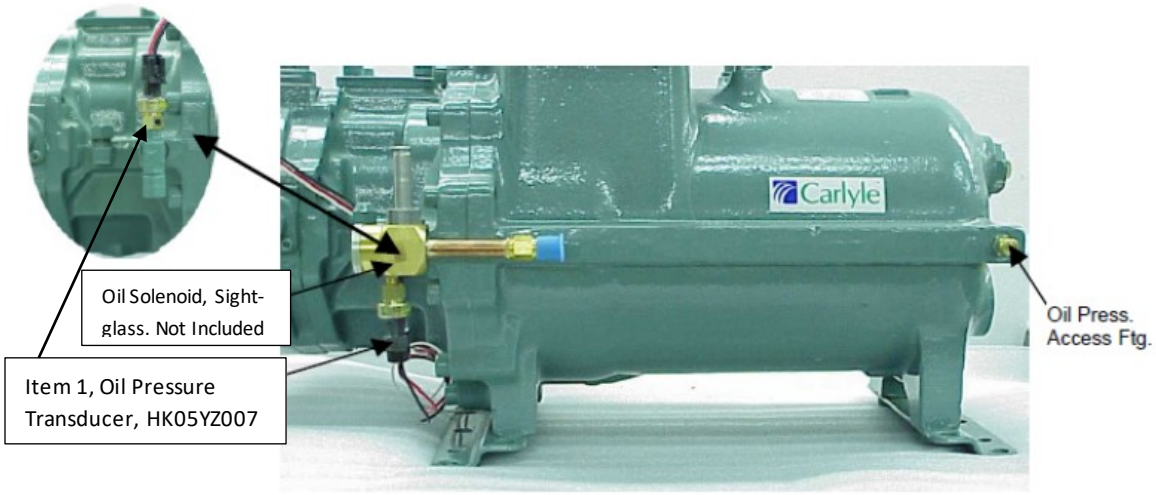
To apply the CCM controller to the 06TA/06TR 74mm screw compressor, the following items are required:

- CCM Controller, p/n 2BSB000928 (Qty 1)
- Accessory hardware kit, p/n 6BAB001611 (Qty 1)
- Transducer wire harness, p/n 06TA680007S (Qty 2)
- CCM to laptop interface cable, p/n USB-L

The 6BAB001611 accessory kit consists of the following parts:

- Item 1, p/n HK05YZ007, 5 vdc pressure transducer, discharge & oil pressure, qty 2
- Item 2, p/n HH79NZ065, Discharge temperature sensor, qty 1
- Item 3, p/n DD08SA051, Discharge fitting 7-16"-20 x 1/4" NPT x 1.3" LG, qty 1
- Item 4, p/n DD17GA051, Cross fitting, qty 1





The Carlyle Control Module (CCM) functions to provide screw compressor protection and, in some applications, compressor capacity control. The CCM is designed to work with **ALL** Carlyle screw compressor types: Paragon, 06Z VFD, and the 06TR/TA 74mm compressors.

This section of the application guide will primarily focus on the setup and installation of the CCM as it relates to the **06TR / 06TA screw 74mm screw compressor** and will function in the following manner:

- CCM will control the Vi valve to optimize compressor efficiency.
- In addition, the CCM will have functionality to protect the compressor and provide LED fault status indication for:
  - Oil Filter and Oil flow protection
  - Liquid injection for motor temperature protection
  - Liquid Injection for discharge temperature protection
  - Unloader control for motor temperature protection
  - Compressor reserve rotation protection
  - Pressure transducer sensor failure indication
  - Temperature thermistor failure indication

CCM Alarm Table 1 (Software version 3.0)

#	Fault Description	LED Indication (Output #4)	Output #5 (S_{limit})	Compressor	Manual Reset Required
1	High Discharge Temperature Trip	Solid Red	Open/De-energized	OFF	No
2	High Motor Temperature Trip	Constant Blinking	Open/De-energized	OFF	No
3	Low Oil flow (Po – Ps < 45 psig)	One blink & 2 second pause	Open/De-energized	OFF	Yes
4	Faulty suction or oil pressure transducer/thermistor sensor	Two blinks & 2 second pause	Open/De-energized	OFF	Yes
5	Faulty Motor Temperature Thermistor	Three blinks & 2 second pause	Open/De-energized	OFF	Yes
6	Faulty Discharge Temperature Thermistor	Four blinks & 2 second pause	Open/De-energized	OFF	Yes
7	Faulty Discharge Transducer	Five blinks & 2 second pause	Open/De-energized	OFF	Yes
8	Reverse Rotation	One blinks & 5 second pause	Open/De-energized	OFF	Yes
9	Unloading, motor temperature	Three blinks & 5 second pause	Closed/Energized	ON	No
10A	Change Oil Filter (Pd – Po > 35 psig)	Three blinks & 5 second pause	Closed/Energized	ON	No
10B	High Oil Filter DP (Pd – Po > 50 psig)	Three blinks & 5 second pause	Open/De-Energized	OFF	Yes

06TR / 06TA CCM Temperature Setpoints

Motor and Discharge Temperature Control Points

CCM Controller	Injection On (°F) Energize Output #3	Injection Off (°F) De-energize Output #3	Shutdown Compressor (°F)	Auto Reset Compressor (°F)	Time Delay required before manual reset (sec)
Discharge Temp (Td)	Td> 205	Td < 190	Td > 230	Td < 200	none
Motor Cooling Temp (Tm)	Tm > 180	Tm < 165	Tm > 240	Tm < 200	none

06TR / 06TA Configuration Setup

The Network Communication Port for BACnet, Modbus, N2, and LonWorks.

LonWorks requires the user to install an additional Network Card (not provide by Carlyle.

Interface connection port to communicate a laptop to the CCM. The Carlyle interface cable P/N USB-L is required.

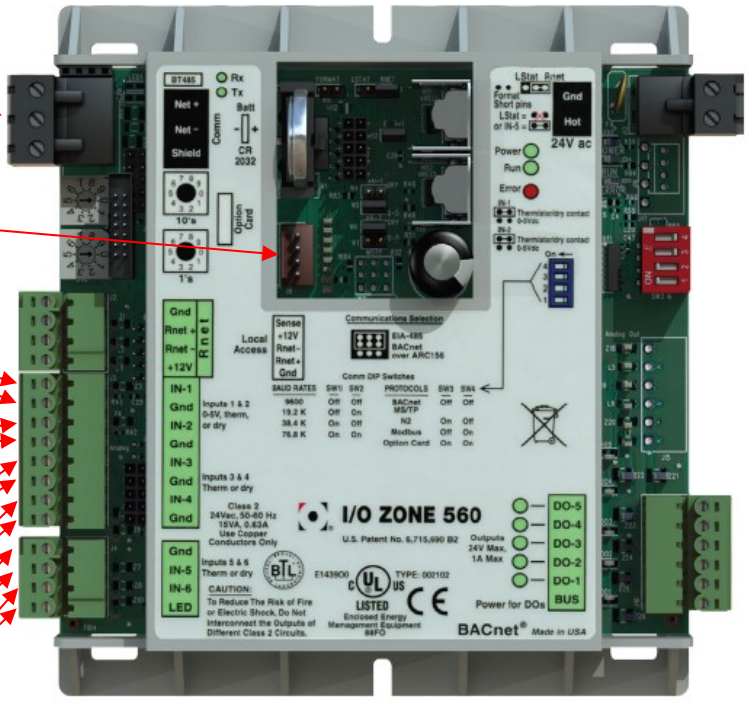
Input #1: 5 vdc Pressure Transducer for Oil Pressure Transducer for 06TR & 06TA

Input #2: 5 vdc pressure transducer for discharge pressure. CCM will monitor compressor discharge to control Vi valve.

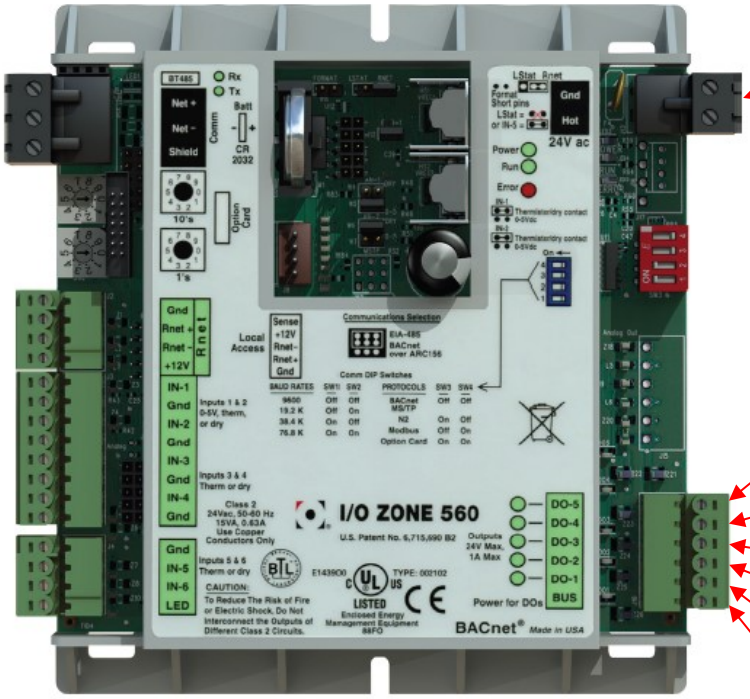
Input #3: 5K NTC Discharge Temperature Thermistor. Field installed on compressor discharge line

Input #4: Install Jumper. Not used

Input #5: System Controller closes this Dry Contact upon a compressor start. Let's the CCM know the compressor has started.



Input #6: Motor Temperature Thermistor. Wire this input to Terminals S1 and C in the compressor electrical box. S2 and C is a spare thermistor.



24 VAC Supply Power Input required.

Output #5: Compressor Start/Stop control circuit switch. **End User interface for pilot duty compressor on/off control circuit.**

Output #4: LED alarm output Indication. Install a 24VAC red indicator light to this output for alarm blink code indications.

Output #3 for Motor Cooling & Discharge liquid injection solenoid coil.

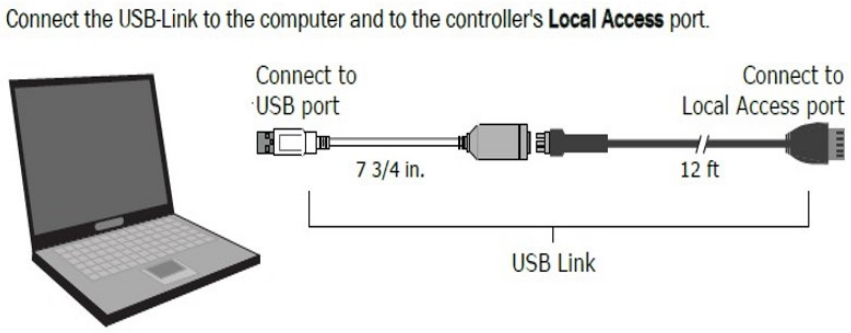
Output #2 will control the unloader solenoid coil for motor temperature control only.

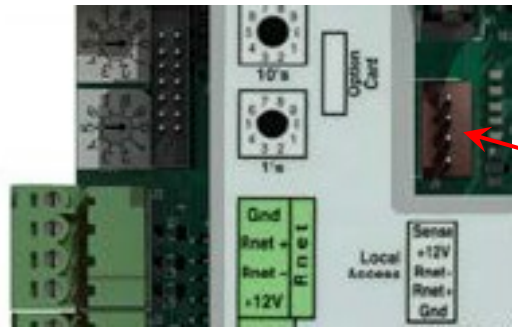
Output #1 will control the Vi valve solenoid coil.

24VAC Supply Power Input required for BUS Outputs. 24 VAC input Supply Power required to the BUS.

06TR / 06TA CCM Configuration and Setup

To configure and display the controller inputs, outputs, and fault codes using your laptop computer, the virtual BacView software must be installed on a laptop. This software can be downloaded from www.carlylecompressor.com. An interface cable, Carlyle P/N USB-L, is required to communicate the laptop to the CCM Controller. Once communication is established, the user can configure the CCM for the 06TR/TA 74mm screw compressor.

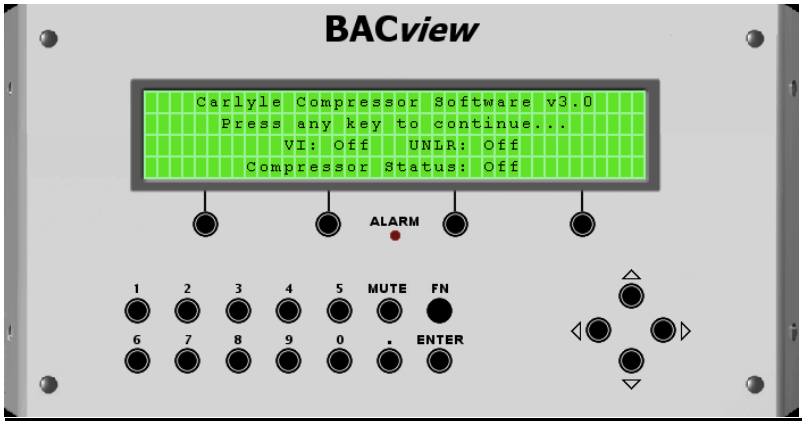




4-pin connection port for the USB-L interface cable.

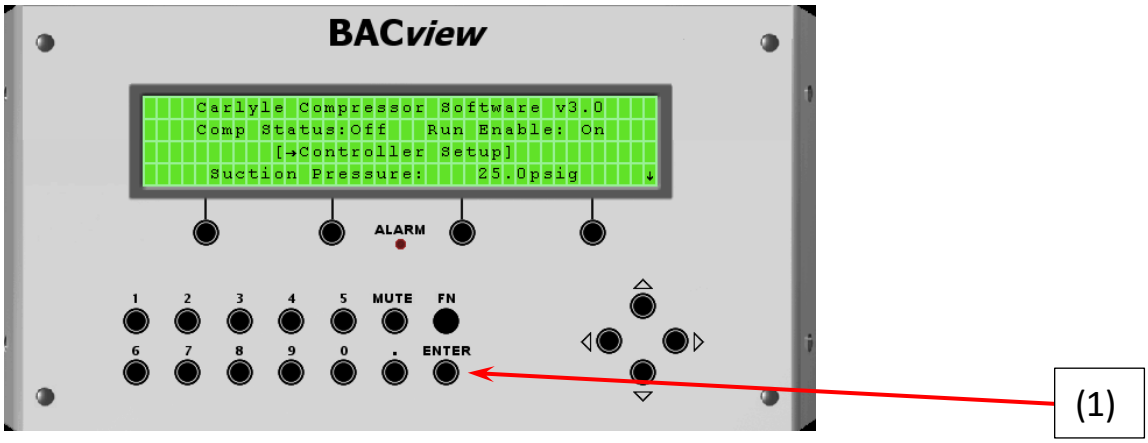
Steps prior to setting up the CCM:

1.) Download the virtual BACview software to your laptop from the Carlyle website.
2.) Install the USB-Link interface cable from the laptop to the CCM.
3.) Power up the CCM and open the virtual BACview software.
4.) The virtual BACview display will open (shown below).
5.) Hit any key to continue.

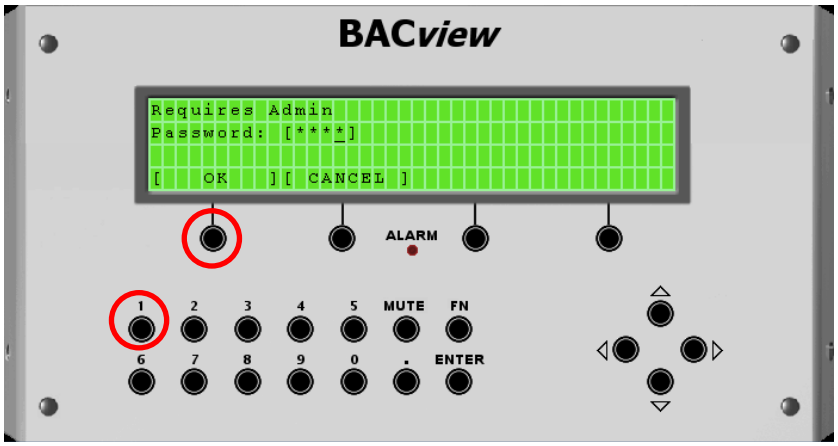


1.) The BACview virtual display is interactive and the user can interact via mouse clicks on the black circle dots to make selections.
2.) On the home screen below, select [Controller Setup] by clicking on "**ENTER**".

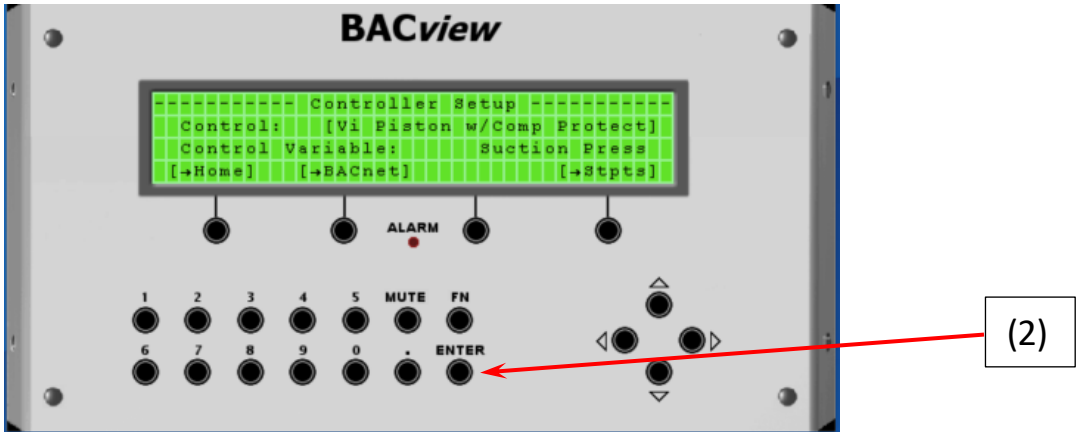
The home screen has brackets around **[Controller Setup]**. Click on "**ENTER**" (1)



3.) An Admin screen will appear requesting a password. Type in 1111 by clicking on the #1 on the virtual BACview or typing it in from the laptop. Then select "**OK**" (Black Dot under "OK") or hit enter.

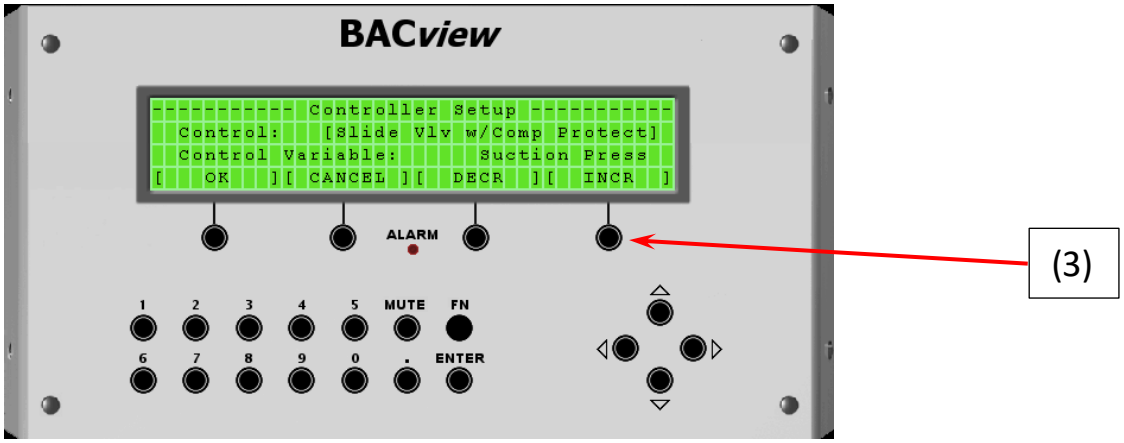


The following controller setup screen will appear. From this screen the user will select the 06TA/06TR compressor. From this setup screen click "**Enter**" (2) to activate "**Control: [Vi Piston w/Comp Protect]**" field.

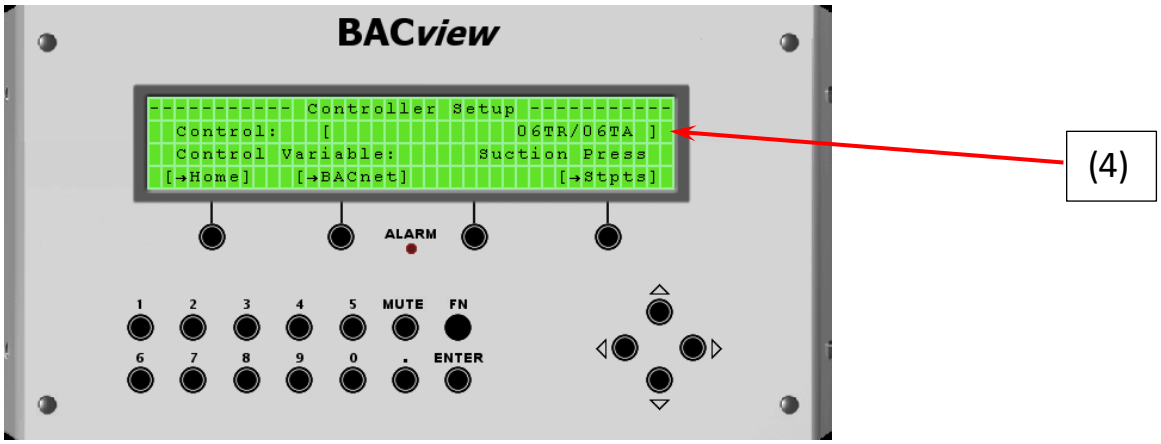


The following screen will appear.

- Click on "**INCR**" (3) repeatedly until you see "**Control: [06TR / 06TA]**" (4). Then Click on "**Enter**"
- The CCM is now setup for the 06TR/06TA 74mm compressor.



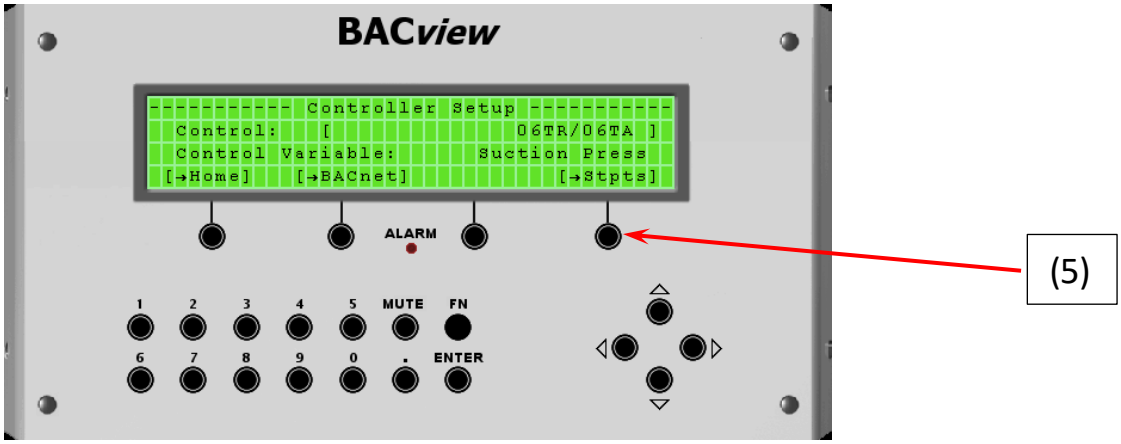
Controller is setup for the 06TR/06TA 74mm screw compressor



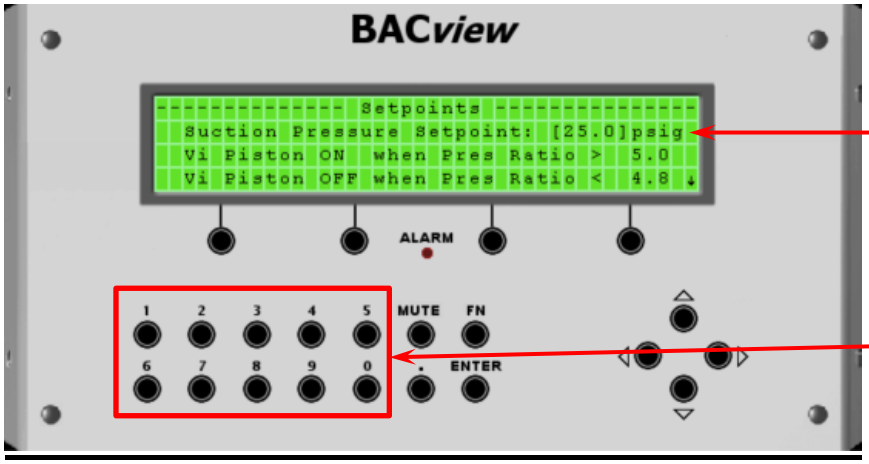
Setup the suction pressure set point by selecting **[Stpts]** (5).

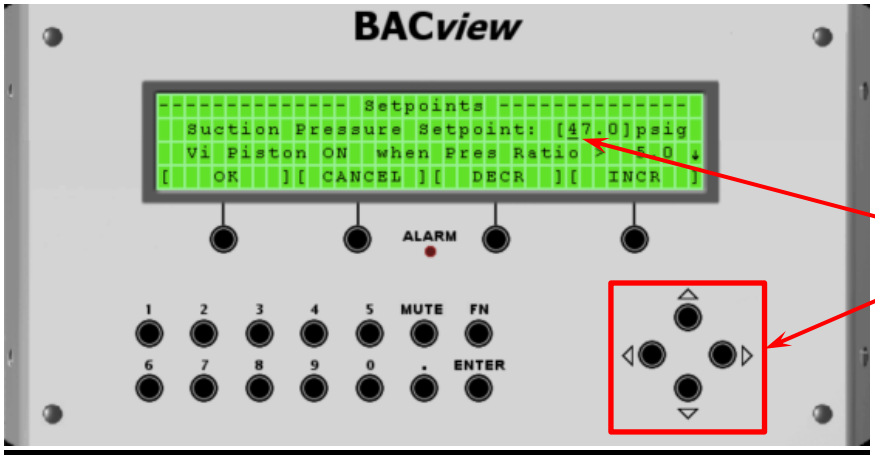
The suction pressure set point is a fixed value inputted by the User and should be set to the same value as the refrigeration rack or system suction pressure controlling set point. The CCM will use this suction pressure set point:

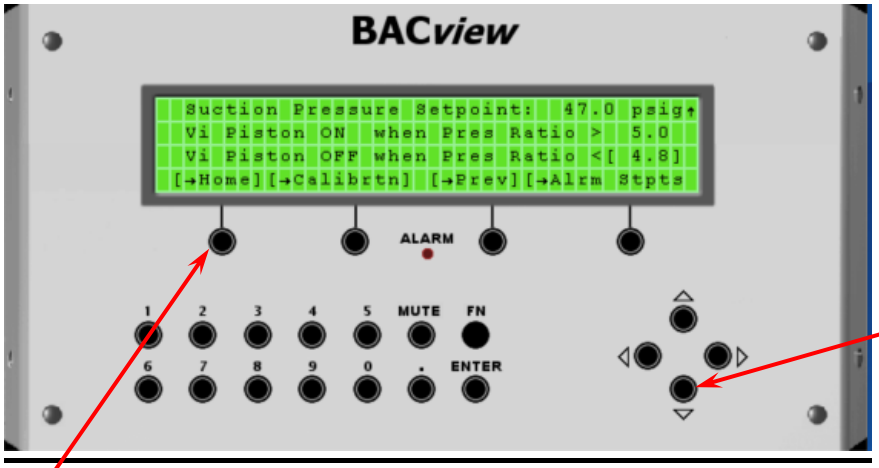
- To active the compressor's Vi valve (ratio between discharge and suction pressure set point).
- To trip the compressor on low oil flow if oil pressure minus suction pressure set point is < 35 psig.



Adjust the Suction Pressure Setpoint (6) by selecting "**Enter**". This will activate the numerical field **[25.0] psig,** allowing the user to change the value using the keypad on the virtual display (7) or the laptop. Use the arrow keys to move the cursor to the numerical number you wish to change (8). Use the up/down arrows (8) to change the numerical value. Once done, click "**OK**". **The suction setpoint is now set**. Click on the down arrow button (9) until you see **[Home].** Click "**Home**" (10) to return to the home screen.

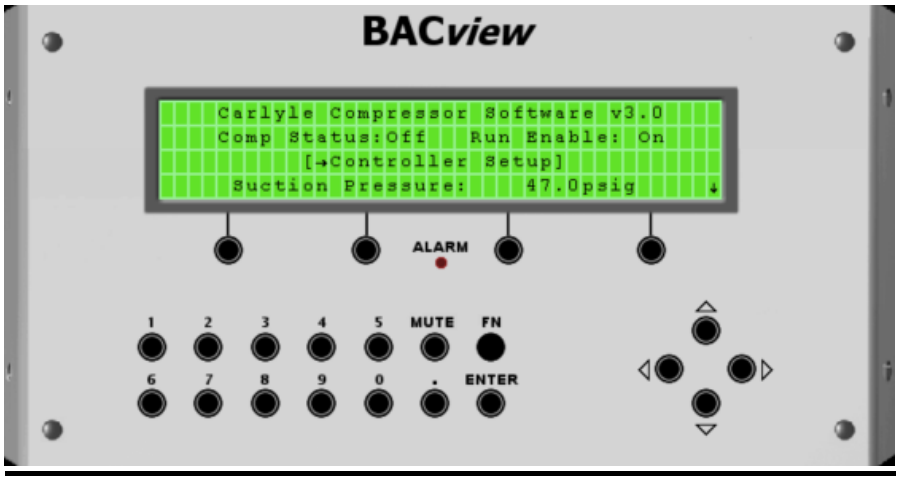






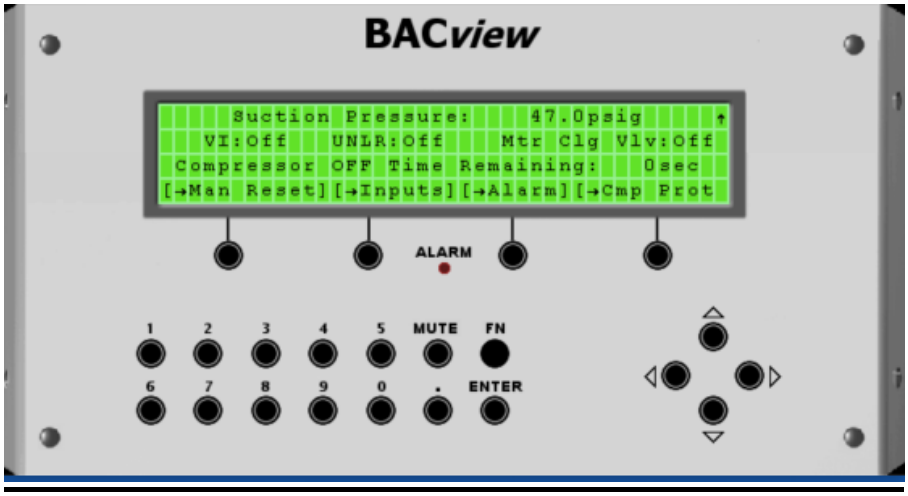
Home Screen

- The home screen notes the latest Carlyle software version.
- Provide **ON/OFF** status of the compressor.
- Run Enable "**ON**" means there are no compressor alarms and the compressor can and will start if a start sequence is initiated. If "**OFF**" the compressor will not start.
- The [Controller Setup] input for configuring the CCM.
- The User defined suction pressure input is shown.
- Provides **ON/OFF** status of the compressor's Vi, Unloader, and the Motor Cooling valve (liquid injection **ON/OFF**).



Hit the down arrow key a few time until you see the selection of fields in brackets. [Man Reset], [Inputs], [Alarm], [Cmp Prot].

- **Vi: OFF**, means the compressor's vi solenoid valve is de-energized (06TR model)
- **UNLR: OFF**, means the compressor's unloader solenoid is de-energized
- **Mtr Clg Vlv: OFF**, means the compressor's liquid injection valve is closed.



- **[Man Reset]** is selected when a manual reset is required. For example, following the clearing of an alarm a manual reset is always required.
- **[Inputs]** is selected to allow the user to see oil and discharge pressure, motor and discharge temperature, oil status, compressor status.
- **[Alarm]** allows the user to view the active alarms.
- **[Cmp Prot]** allows the user to view the compressor motor, discharge, and shutdown temperature set points.

Compressor Protection for 06TR/TA

The CCM will monitor motor and discharge temperatures through a factory installed 5K thermistor in the motor windings (Tm) and field-installed 5K thermistor installed on the discharge line of the compressor (Td) respectively.

NOTE: Motor and Discharge temperature thermistors will not display accurate temperature values until actual sensor conditions are above 130F. The displayed values in the virtual BacView software will appear non-responsive until a reasonable temperature range is achieved.

Motor Temperature (Tm) will have the following functions.

- Control a motor cooling valve to provide liquid injection to the motor compartment.
- Override the compressor slide valve to reduce motor temperature.
- Turn the compressor off on an overheated motor temperature condition.
- **See Table A for (Tm) control points.**

Motor Temperature (Td) will have the following functions.

- Override the compressor slide valve to reduce discharge temperature.
- Turn the compressor off on a high discharge temperature condition.
- **See Table A for (Td) control points.**

Table A - Motor and Discharge Temperature Control Points

CCM Controller	Injection On (°F) Energize Output #3	Injection Off (°F) De-energize Output #3	Shutdown Compressor (°F)	Automatic Reset Compressor (°F)	Time Delay required before manual reset (sec)
Discharge Temp (Td)	Td> 205	Td < 190	Td > 230	Td < 200	30
Motor Cooling Temp (Tm)	Tm > 180	Tm < 165	Tm > 240	Tm < 200	30

CCM Output #2, Unloader Override Control:

If Motor Temperature Tm rises above 220F, then override unloader control of **Output #2** and keep **Output #2** de-energized until Tm < 205F.

When override is active, CCM will issue alarm ode #9 (see table 1) where **Output #4** LED light flash 3 blinks, 5 second pause continuously while the compressor is running.

CCM Controller	De-energize Output #2 continuously	Discontinue override
Motor Temp (Tm)	**Tm > 220F**	**Tm < 205F**

Network

The CCM is preconfigured with the following protocol Networks to allow the ease of data to be transmitted across a network between the CCM and the System Controller.

- BACnet, Modbus, or N2 Open
- LonWorks (requires optional card)
- RS485 Communication Port

CCM Module Inputs

The CCM has the ability to monitor up to 6 inputs. These inputs will be processed by the CCM to control the compressor unloader, protect the compressor from a high temperature condition or loss of compressor supply oil, and control the Vi valve for compressor efficiency.

CCM Input #1 and #2 setup:

The CCM is designed to work with the Carlyle pressure transducer (Part# HK05YZ007) for compressor oil and discharge pressure.

To connect the **(3 WIRE)** pressure transducers to the module a transducer harness assembly, equipped with 15ft of shielded cable. The wire harness will plug directly in the transducer and has the following wire designations:

- The **RED** wire connects to the +5 vdc supply power (power supply not provided, recommend TDK Lambda, p/n: DSP10-5).
- The **WHITE** wire is the signal wire and connects to the IN-1 terminal location on the CCM controller.
- The **BLACK** wire connects to the GND input on the CCM controller.

Set the configuration jumper for input #1 to the following position. The jumper comes installed on the CCM and may already be in the correct position.

Place the configuration jumper to this position for a 5 vdc pressure transducer sensor for **Input #1.**

Place the configuration jumper to this position for a 5 vdc pressure transducer sensor for **Input #2.**

Input #1: Oil Pressure

- A 5 vdc, 3 wire pressure transducer input to monitor compressor oil pressure.
- The 5 vdc pressure transducer is Carlyle Part P/N HK05YZ007 (**See Chart E**).
- Use the provided 15' transducer wire harness. Carlyle P/N 06TA680007S.
- The end user will have to install a power supply with a 5VDC supply power output for the pressure transducer (recommend TDK Lambda DSP10-5).
- If Discharge Pressure minus Oil Pressure is > 35 psig for 15 continuous seconds, the CCM will initiate alarm 10A, "Change Oil Filter". The compressor will not trip off.
- If Discharge Pressure minus Oil Pressure is > 50 psig for 15 continuous seconds, the CCM will initiate alarm 10B "High Oil Filter DP" and trip the compressor off.
- If Oil Pressure minus suction pressure setpoint is < 45 psig for 90 continuous seconds, the CCM will initiate alarm 3, "Low oil flow" and trip the compressor off.

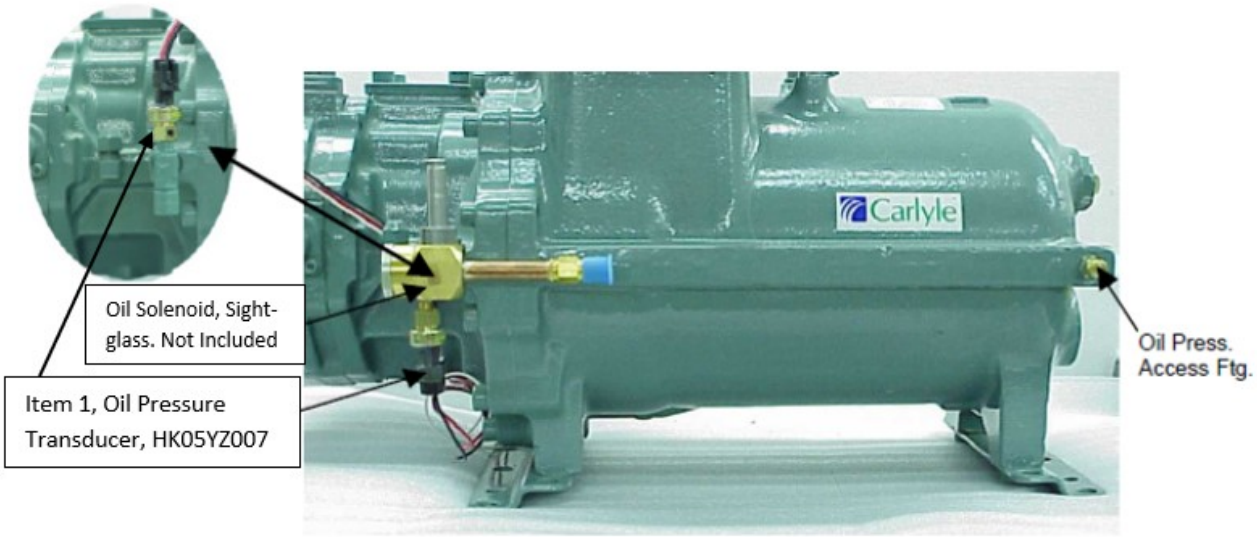


Figure 2

Figure 2 shows the compressor oil connections.

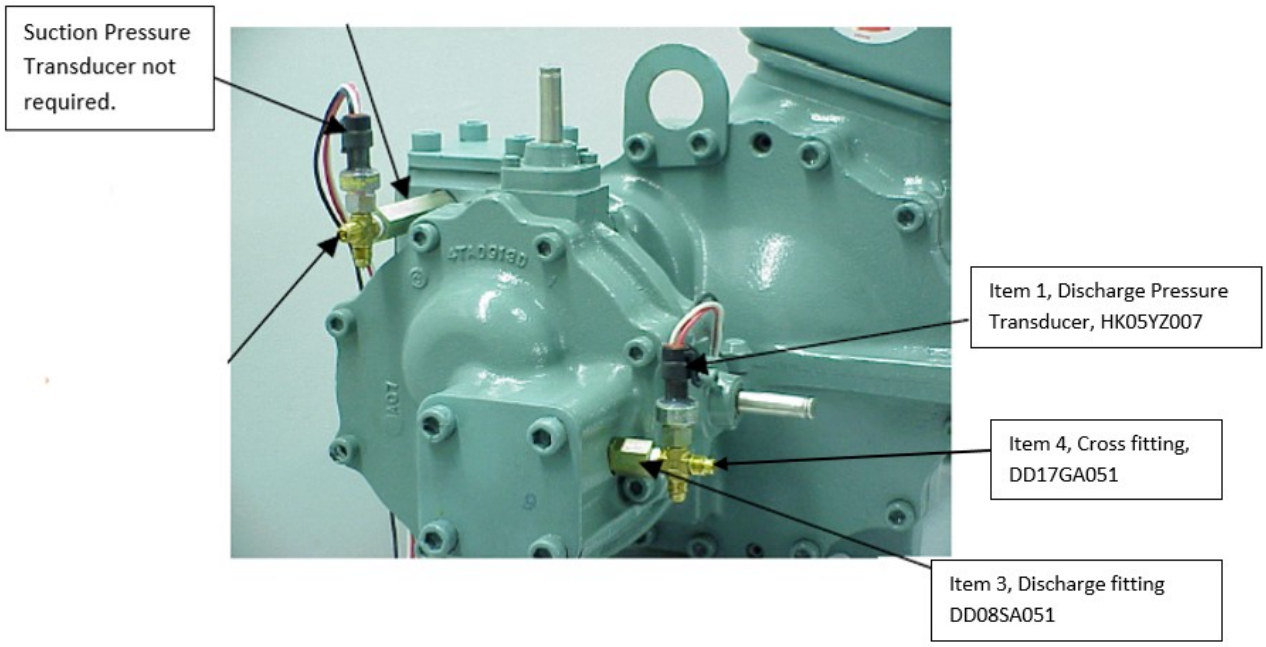
1. The oil pressure transducer is connected at the bottom of the oil solenoid sight glass assembly (optional assembly shown in main diagram) or alternatively at the top of the oil Tee fitting supplied on the compressor (shown in the exploded view to the upper left of main diagram).

   The oil solenoid sight glass assembly shown in Figure 2 is an optional item (P/N EF12ZZ025), which can be purchased directly from Carlyle. The standard Oil Tee fitting supplied on the compressor is also shown.

2. One of the compressor schraeder fittings (removed from either suction or discharge access ports) should be installed at the end of the oil galley for oil pressure field measurements.

Input #2: Discharge Pressure

- A 5 vdc, 3 wire pressure transducer input to monitor compressor oil pressure.
- The 5 vdc pressure transducer is Carlyle Part P/N HK05YZ007 (**See Chart E**).
- Use the provided 15' transducer wire harness. Carlyle P/N 06TA680007S.
- The end user will have to install a power supply with a 5VDC supply power output for the pressure transducer (recommend TDK Lambda DSP10-5).
- Discharge pressure input is used to calculate compressor pressure ratio. If the ratio is > 5.0 the CCM will energize the Vi valve. And will reset once the pressure ratio drops below 4.8.



- Install item 3 (Discharge Fitting) into the high side port.
- Install item 4(Cross Fitting) into item 3, torque 20-25 ft. lb, using Teflon tape or pipe dope
- Install item 1 (Pressure Transducer) to the cross fitting.

Input #3: Discharge Temperature

- Input is a 5 Kohm NTC Thermistor (Carlyle P/N HH79NZ065).
- The thermistor profile is defined by **Table D**.
- Input monitors the discharge temperature and will open/close output #3, energizing/de-energizing a liquid injection valve if discharge temperature > 205F, injection off at 190F.
- Compressor shut down if the temperature > 230F, reset 200F.
- The temperature control points are defined in **Table A.**

The discharge temperature sensor (Item 5) should be strapped to the discharge line as close to the discharge service valve as possible (within 6" or less is optimal). Carlyle recommends using thermoconductive grease to help insure accurate temperature readings. The thermistor must then be wrapped with high temperature insulation such as high temperature foam or cork insulation.

Input #4: Dry Contact not used with 06TR / 06TA compressor

- This dry contact input must be closed and therefore a jumper needs to be installed between IN-4 and GND.

Input #5: Ccall - Compressor recognition signal (received from Master Controller)

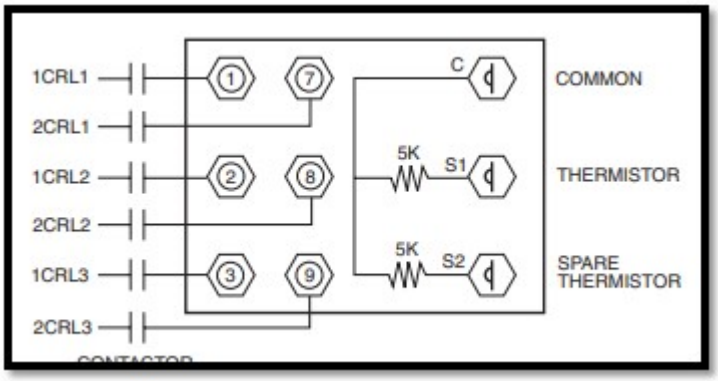
- A Ccall signal for cooling from the system controller will initiate a compressor start and close input #5 dry contact.
- Input #5 is a dry contact that must be closed by the system controller upon a compressor start. The closure of this dry contact activates the CCM to start performing it functions because a compressor has started.
- If this dry contact remains open and a compressor is started. The CCM will not be performing compressor protection for it thinks the compressor is off.
- The system controller should open this dry contact every time the compressor is automatically/manually turned off or trips off due to a fault condition.

Input #5 is a dry contact circuit which is a Run Recognition signal input for the CCM. A Run Recognition signal must be provided from the System Controller to the CCM. Upon a compressor start, the System Controller must close this circuit for the CCM to know the compressor is operating and will activate the compressor protection programs. If the compressor trips off or is manually turned off, the Run Recognition signal will open, identifying to the CCM the compressor is not operating, thus deactivating the compressor protection programs.

User must set the configuration jumper to this position for Input #5. This configures Input #5 as a Dry Contact. Failure to do so will result in input #5 not working correctly.

Input #6: Motor Temperature

- Two 5 Kohm NTC Thermistors (S1 and S2) are embedded within the compressor's motor windings and lead wire connections are located in the compressor's electrical terminal plate.
- Wire CCM input 6 to S1 and C (common). In the event of a thermistor failure, a spare thermistor is available between S2 and C (common).
- The compressor motor thermistor profile is defined by **Table D**.
- Input monitors the motor temperature and will open/close output #3, energizing/de-energizing a liquid injection valve if motor temperature is > 180F, injection off at 165F.
- This input will shut down the compressor if the temperature is >240F, reset 200F.
- Input will override the unloader output #2 if motor temperature is > 220F, reset 205F.
- The temperature control points are defined in **Table A.**



NOTE: Motor and Discharge (input #3 and #6) temperature thermistors will not display accurate temperature values until actual sensor conditions are above 130F. The displayed values in the virtual BacView software will appear non-responsive until a reasonable temperature range is achieved.

CCM Module Outputs

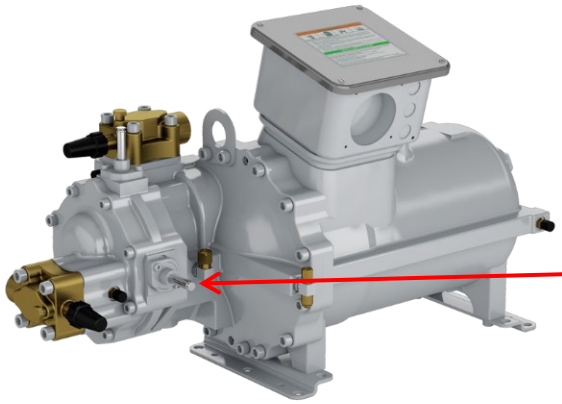
NOTE: The CCM outputs #1, #2, and #3 will each require a SPST 24VAC relay as an interface between the CCM and unloader, Vi valve and motor cooling solenoid coils if solenoid coil voltage is not 24vac.

The CCM has 5 outputs rated for 24VAC, 1 amp continuous current and will be applied to control the following:

- **Output #1**: Compressor Vi valve
- **Output #2**: Unloader
- **Output #3**: Liquid injection valve for motor and discharge
- **Output #4**: Provides LED alarm/fault code indication
- **Output #5**: Provides compressor stop/start pilot duty control (enables the compressor to start)

Output #1:

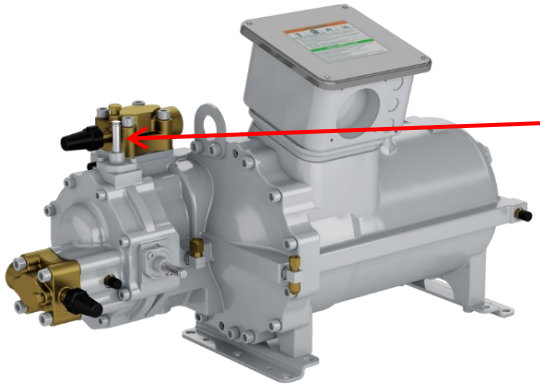
- Output #1 energizes to activate the Vi valve if the pressure ratio between the discharge pressure (input #2) and suction pressure setpoint is > 5.0. Will reset (de-energize) when the pressure ratio is < 4.8.
- To optimize compressor efficiency, low temperature 06TR models are equipped with a Vi valve to regulate the screw compressor's discharge port volume to improve compressor efficiency. 06TA models do not have a Vi valve.



The Vi valve is solenoid controlled and the following coil voltages can be applied….24vac, 120vac, 240 vac.

Output #2:

- The system/rack controller will control compressor unloading for capacity control. But the CCM will override/de-energize the unloader valve if the motor temperature is > 220F.
- Output #2 should be wired in series with the system/rack controller compressor unloading circuit. If motor temperature is > 220F, output#2 will de-energize, not allowing the compressor to load until motor temperature is < 205F.



The unloader valve is solenoid controlled and the following coil voltages can be applied….24vac, 120vac, 240 vac.

Output #3: Motor & Discharge liquid injection

- Energizes/de-energizes the liquid injection valve.
- If motor temperature (Input #6) is > 180F, output #3 will stay energized until motor temperature is < 160F.
- If discharge temperature (Input #3) is > 205F, output #3 will stay energized until discharge temperature is < 190F.

Output #4: Alarm fault code LED Status indication

- Output #4 is normally de-energized when the compressor has no fault conditions / active alarms (the LED indicator light is off).
- Once an alarm / fault condition arises as defined in **Table 1.** Output #4 will close (energize) and will flash the fault code indication pattern defined in table 1 to identify the fault condition
- Output #5 (safety circuit, Slimit) will automatically open an will not close until the alarm code is cleared and output #4 de-energizes.
- It is recommended a red 24 vac LED indicator light be installed to output #4 to provide visible identification of alarm codes. When the LED light is lit, this indicates the compressor has a fault code.

Output #5: Enables the Compressor to Run

- Output #5 should be part of the system/compressor safety loop (Slimit). The compressor should not be permitted to start if this safety loop is open due to a system fault or compressor fault.
- When output #5 is closed (energized), the CCM will provide indication via the virtual BacView **Home Screen "Run Enabled: On"**. The compressor is enabled to run and therefore there are no compressor fault conditions noted by the CCM.
- Output #5 must be part of Refrigeration System's pilot duty Start/Stop Compressor circuit.
- And therefore when (de-energize), will trip the compressor off for the following compressor fault conditions.
    - High Discharge Temperature
    - High Motor Temperature
    - Low oil level flow
    - High oil filter DP
    - Faulty pressure transducer (open or short)
    - Faulty thermistor (open or short)
    - Reverse rotation

It is recommended a Green 24 vac LED indicator light be installed to output #5 to provide visible identification. When the LED light is lit, this indicates the compressor has no fault codes and is ready to be operated/started.

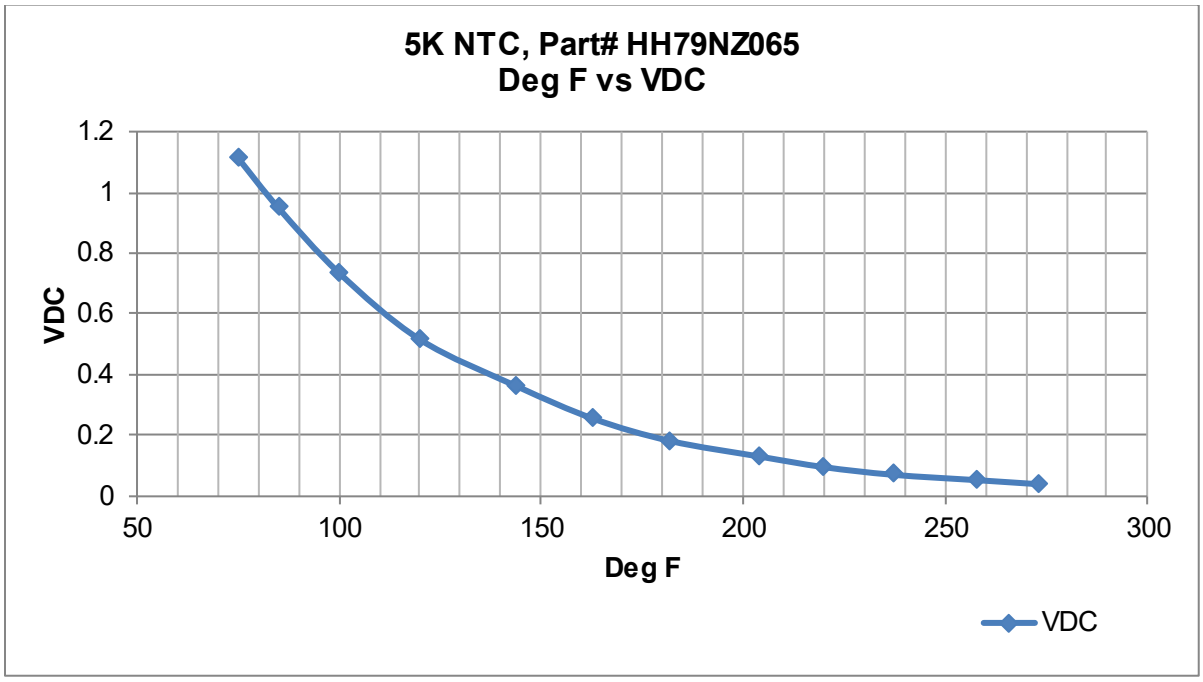


Table D

The 5vdc discharge and oil pressure transducer sensor, Carlyle Part# HK05YZ007. The DC voltage can be measured across the **Sig** and **Gnd** terminals, and using the table below, can be converted to a pressure. PSIG = 101.594 * VDC - 47.33

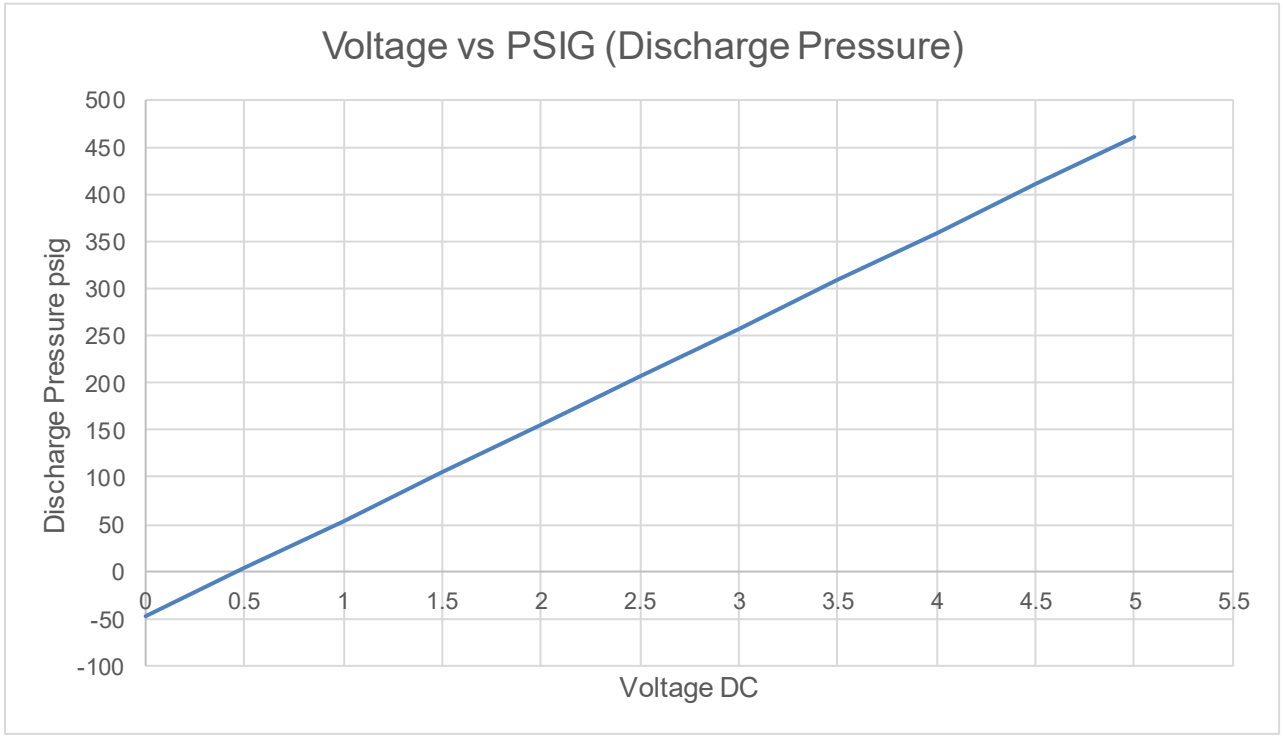


Chart E

The table shown below shows the allowable operating range for each of the sensor inputs. Values measured outside these Limits will result in a sensor failure alarm. See Table 1.

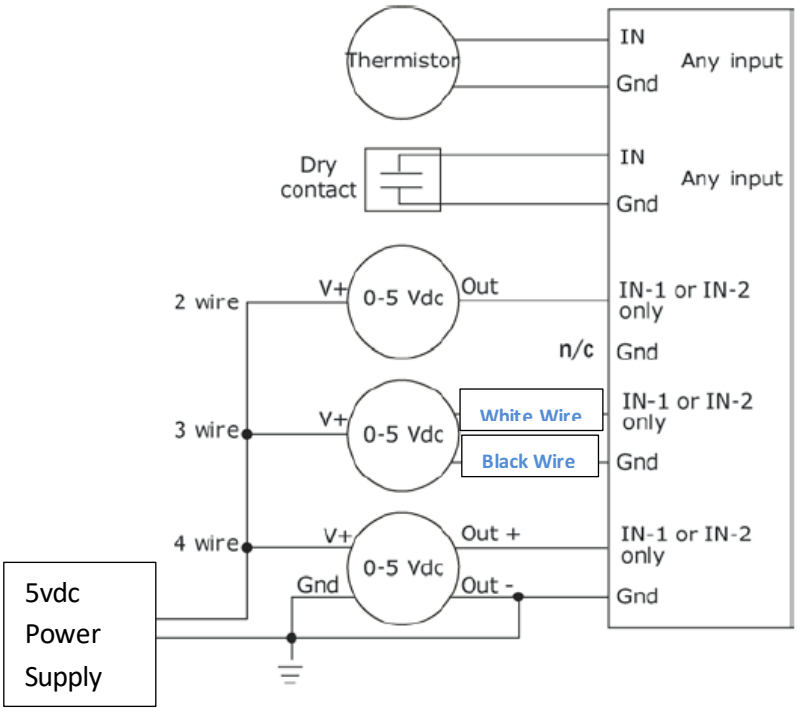
Sensor Inputs	Input Range Low	Input Range High	Corresponding Signal Range Low	Corresponding Signal Range High
Discharge Pressure Transducer	-6.6 psig	450 psig	0.4 VDC	4.9 VDC
Oil Pressure Transducer	-6.6 psig	450 psig	0.4 VDC	4.9 VDC
Motor Temp Thermistor	-32°F	312°F	88,480 Ohms	195 Ohms
Discharge Temp Thermistor	-32°F	312°F	88,480 Ohms	195 Ohms

How to Wire the Inputs for Pressure Transducer, Thermistor, or Dry Contact

1. Verify that the I/O Zone's power and communications connections work properly.
2. Pull the screw terminal connector from the controller's power terminals labeled **Gnd** and **Hot**.
3. Connect the input wiring to the screw terminals on the I/O Zone.

NOTES

- Connect the shield wire to the **Gnd** terminal with the ground wire.



CCM Software version 3.0 (for TS/TT/TU/TV & 06ZC, ZF, ZJ & 06TR/TA models)