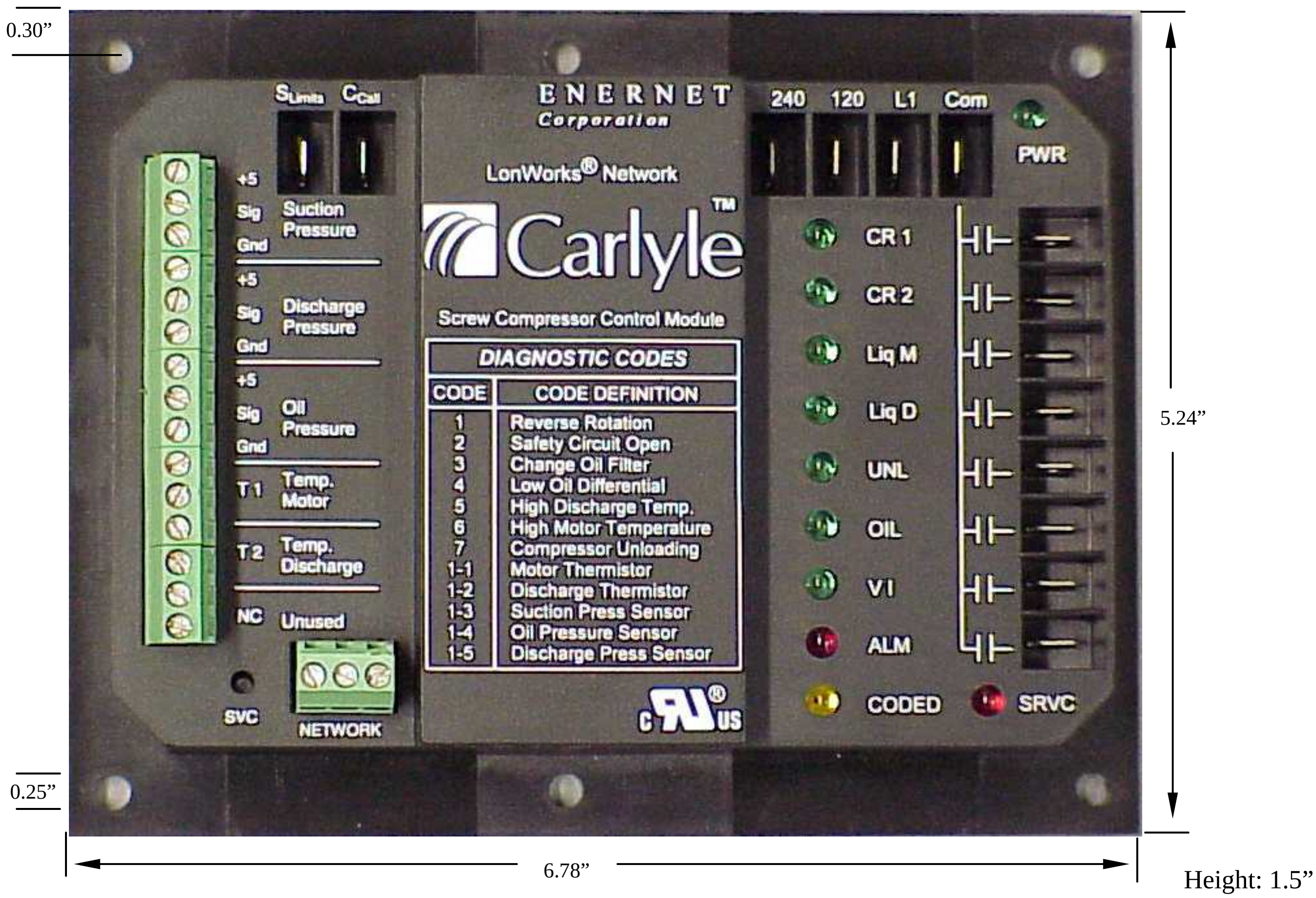
LonCEM®



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1.0 Overview

The LonCEM is a solid state electronic module used as the primary compressor protection for our 74mm screw compressors. It is used on both our semi-hermetic (06T) and open-drive (05T) air conditioning and refrigeration compressors. Special instructions for 05T installations are provided in Section 3.4. The module provides thermal compressor protection by monitoring motor and discharge temperature and providing liquid injection cooling as required. Oil pressure protection is provided by monitoring suction, discharge and oil pressure. Pressure drop through the oil system (oil filters, oil cooler, oil line solenoid etc.) is continuously monitored to insure proper oil flow. Other features include reverse rotation protection, 20 second time-delay between compressor starts, volume index control for refrigeration models, and startup sequencing of the oil and economizer solenoid valves. A functional overview providing details on each module function is presented in Appendix A.

A LonWorks® version of the module is available, allowing communication over a LonWorks® control network. Through the network, the module can be instructed to provide on/off and unloading control. In addition, all module inputs including: suction pressure, discharge pressure, oil pressure, motor temperature, and discharge temperature are available for data logging and/or as input to another controller.

The module will be available as part of a package including all necessary sensors, wiring harnesses, and fittings. The remainder of this document provides a comparison of the old and new protection modules, bill of materials of the LonCEM module packages, installation instructions, trouble shooting and application notes, and a description of the sensor inputs and control outputs. Appendix F summarizes the conversion of the sensor outputs to engineering units, which is helpful when diagnosing sensor and operational problems.

1.1 Old CEM versus New LonCEM

The new LonCEM Packages (see section 2.0 for Bill of Materials) replace the older style CEM (P/N 3TA0796B). The newer style module incorporates 3 pressure transducers (in addition to the motor and discharge thermistor inputs used on the old module), which eliminate many of the previously required electro-mechanical pressure switches. The following items are no longer required when using the new LonCEM packages:

Description	**P/N**
Older Style CEM	3TA0796B
Oil Pressure Protection Switch	HK06ZB006
Reverse Rotation Switch	HK01CB002
Oil Filter Protection Switch	HK06CA051
5k Thermistor*****	HH79NZ065
Electronic Phase Monitor**	P251-0090

* Still required, but is included in LonCEM package (see section 2 for complete BoM)
****** Was never required but offered as an option for reverse rotation protection.

1.2 Other Required System Safeties

The new (or old) **module does not eliminate the need for the Low and/or High Pressure safety switch(es)**. These functions are not included in the module.

A voltage sensing relay with normally open contacts should be wired to the load side of the compressor circuit breaker, with the contacts in series with the mechanical safeties as supplied to the Slimits input on the module. This is to deactivate the module (i.e. shut off oil feed) in case of a breaker trip.

2.0 Bill of Materials

To simplify installation, all of the required parts are included in a single package. Separate packages were developed for modules with and without the LonWorks® communication option. The following table lists all the components supplied in each package.

Table 1. Bill of Materials

Item	0TA1063 Package with LonWorks (Quantity)	0TA1064[1] Package without LonWorks (Quantity)	Carlyle P/N	Description
1	1		3TA1061	LonCEM (**with LonWorks** Transceiver)
1		1	3TA1062	LonCEM (**without LonWorks** Transceiver)
2	1	1	HK05YZ003	Low Pressure Transducer (suction)
3	2	2	HK05YZ007	High Pressure Transducer (disch and oil)
4	3	3	06TA680007S[2]	Harness for Transducers (15 ft lead wire)
5	1	1	HH79NZ065	Discharge Temperature Thermistor (5 Kohm)
6	1	1	DD08SA051	SAE Discharge Adapter Fitting (1.3"L, 7/16"-20 SAE to ¼" NPT)
7	1	1	DD08SA052	SAE Suction Adapter Fitting (3.7"L, 7/16"-20 SAE to ¼" NPT)
8	2	2	DD17GA051[3]	Cross Fitting (suction and discharge)
9	1		N/A	Zener Diode (see Appendix D)

1. 0TA1064 package is no longer available for new installations.
2. Includes shielded cable for the pressure transducer wiring harness, see Appendix C for proper shielded cable grounding techniques.
3. Parker Part Number: AVC1-4

3.0 Installation Instructions

The following instructions cover mounting the module in the control panel, installing the sensor inputs on the compressor, and a description of the control outputs. A complete wiring diagram is contained in Appendix B which covers the control wiring and the wiring connections to the module.

3.1 Mounting Module

The module should be mounted in a protective environment (typically installed inside the unit electrical control box). Phoenix style screw-down connectors are supplied for all sensor inputs. The transducer harness assembly (Item 4) is equipped with 15 ft of shielded cable, used to connect the pressure transducers to the module. The red wire connects to the **+5** input, the white wire connects to the **Sig** input, and the black wire connects to the **Gnd** input. The remaining six inputs are for the motor temperature thermistor, discharge temperature thermistor, and communications input, all of which are polarity insensitive. Male quick disconnects are provided for all of the power inputs and control outputs.

Grounding Shielded Cable

In order to protect the module from the influence of electrical noise coupled onto the sensor input wires, it is recommended that shielded cable be used **for all of the sensor inputs**. The original pressure transducer wiring harness, which consisted of individual stranded wires, has been replaced with a shielded cable to aid in this effort. See Appendix C for a description of proper shielded cable grounding techniques.

3.2 Sensor Inputs

Suction Pressure (see Figure 1)

1. Install the suction adapter fitting (Item 7) into the compressor's low side port (torque to 10-12 ft. lb, 14-16 NM).
2. Install the cross fitting (Item 8) into the adapter fitting (torque to 20-25 ft lb, 27-34 NM) using Teflon tape or pipe dope. The cross fitting can be oriented as desired.
3. The suction pressure transducer and low pressure switch are connected to the cross fitting. The Schrader port is available for field gauge connections.

   The **suction** pressure transducer (Item 2) can be identified by a **blue dot** located on the black base of the transducer. The oil pressure and discharge pressure transducers (Item 3) do not contain any special markings on the black base.

Discharge Pressure (see Figure 1)

1. Install the discharge adapter fitting (Item 6) into the compressor's high side port.
2. Install the cross fitting (Item 8) into the adapter fitting (torque to 20-25 ft lb, 27-34 NM) using Teflon tape or pipe dope. The cross fitting can be oriented as desired.
3. The discharge pressure transducer[1] (has no color dot identifier) and high pressure switch are connected to the cross fitting. The Schrader port is available for field gauge connections.

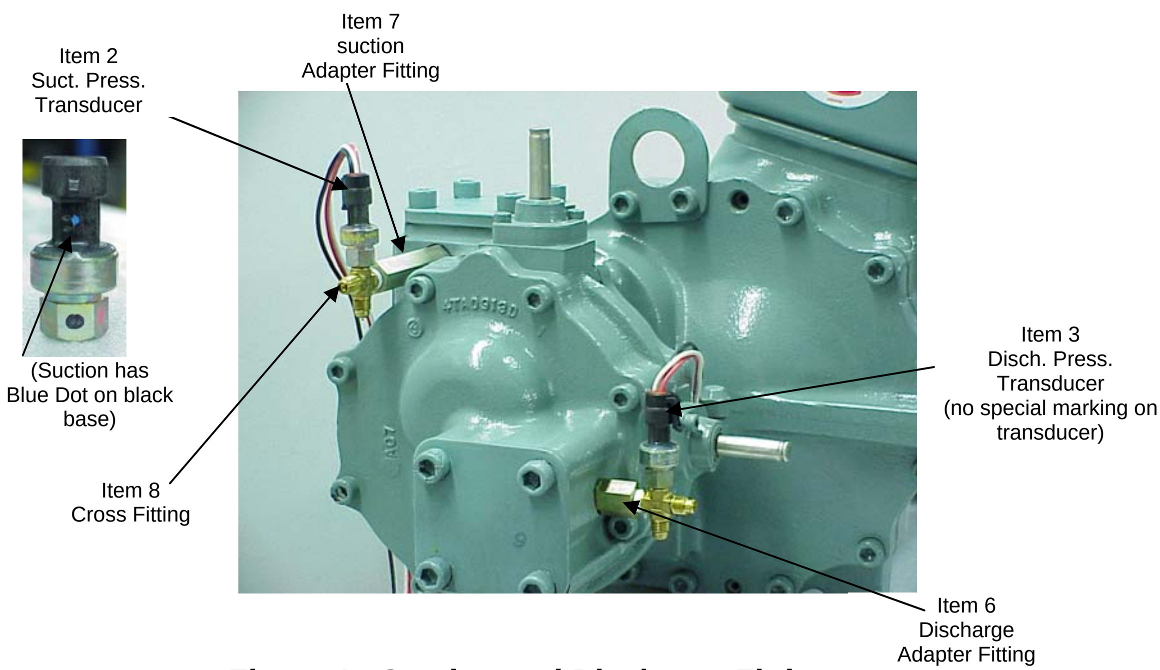

Figure 1. Suction and Discharge Fittings

[1] The same model pressure transducer is used to measure discharge and oil pressure.

Oil Pressure

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

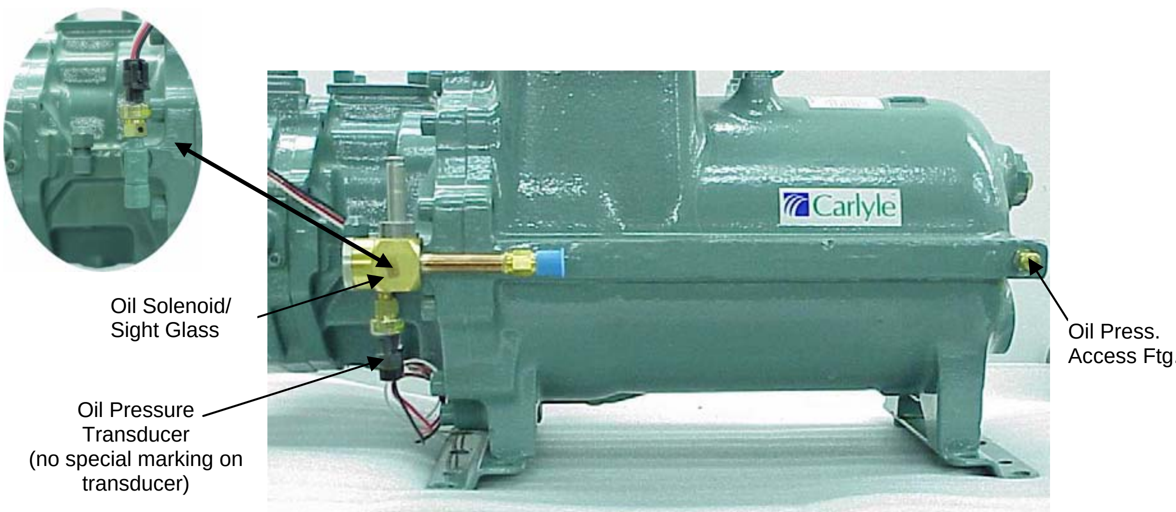

Figure 2. Oil Fittings

Discharge Temperature

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 thermal-conductive 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.

Motor Temperature

A 5 Kohm thermistor is embedded within the motor windings, and is located between S1 and S2 on the compressor electrical terminal plate. Leads should be extended from the terminal plate to the motor temperature inputs on the LonCEM module. In the event of a thermistor failure, a spare thermistor is available between S2 and S3.

Sensor Operating Range

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 Appendix E for a summary of the sensor alarm codes. The inputs are verified both when the compressor is on and off.

	Input Range		Corresponding Signal Range	
Sensor Inputs	Low	High	Low	High
Suction Pressure Transducer	-13.2 psig	140 psig	0.1 VDC	4.74 VDC
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

3.3 Control Outputs

Each of the module outputs is summarized below. Note that each of the corresponding liquid LED lights (one for each output) is lit whenever the output is closed and the output is energized. See Table 2 for a summary of the module temperature control functions.

1CR *Contactor*

This terminal supplies power to the compressor contactor coil/relay. The module uses this output to turn the compressor on or off. Whenever power is supplied to Ccall (compressor call input), 1CR is closed pulling in the contactor and starting the compressor. A 20 second time delay between compressor starts is built into the module. The time delay is active at initial module power-up, or whenever the compressor is called for before 20 seconds of off-time has elapsed.

2CR *Part Wind Contactor*

Supplies power to the compressor part-wind contactor coil/relay, if part-wind start is used. This output is automatically energized 1 second after 1CR during start-up.

Liq M *Liquid Injection (initialized for Motor Cooling)*

Energized whenever the motor temperature limit is exceeded (see Table 2). This output is closed energizing the motor cooling valve and injecting liquid refrigerant into the motor compartment.

Liq D *Liquid Injection (initialized for Discharge Temperature)*

Energized whenever the discharge temperature limit is exceeded (see Table 2). Typically the LiqM and LiqD outputs are wired in parallel with the motor cooling valve. Thus, the motor cooling valve is energized whenever the motor or discharge temperature limits are exceeded (see Appendix B for wiring schematic).

Optionally this output could energize a separate liquid injection valve for discharge temperature control, injecting liquid refrigerant directly into the rotors for discharge temperature control. Typically, a temperature activated liquid injection valve (strapped to discharge line) is used for discharge temperature control.

See the Screw Compressor Application Guide for supplemental (in addition to motor cooling valve) liquid injection requirements.

Table 2. Temperature Control Limits

	Injection On °F (°C)	Injection Off °F (°C)	Shutdown Temp °F (°C)	Reset Temp °F (°C)
Discharge Temperature	205 (96)	190 (88)	230 (110)	200 (93)
Motor Temperature	180 (82)	165 (74)	240 (116)	200 (93)
Unloading (Motor)	N/A	N/A	220 (104)	205 (96)

UNL *Unloader Coil Output*

All 05T and 06T screw compressors are supplied with one step of unloading. Control of the unloading function is not accomplished by the module, but is controlled externally by a rack controller or pressure switch wired in series with the UNL output. The module has a 30 second time delay before energizing the unloader output, insuring the compressor starts unloaded. The compressor is loaded when the unloading coil is energized.

OIL *Oil and Economizer Solenoid Output*

Energized during compressor operation and is de-energized when it is shut off. The oil line and economizer line solenoid valves should be connected in parallel to this output as they are also sequenced on compressor Start/Stop.

It is critical that oil be supplied to the compressor whenever it is running and not supplied when it is off. Similar concerns exist regarding the flow of refrigerant through the economizer line. This output insures this functionality.

VI *VI Coil Output*

All **refrigeration duty** 05TR and 06TR screw compressors are supplied with VI control. The Vi valve (stem located at the 3 o'clock position on the outlet casing) controls the point at which refrigerant exits the rotors. The Vi valve is energized (hi Vi) when the compression ratio is above 5:1, and de-energized (low-Vi) when the compression ratio drops below 5:1. The module continuously monitors the operating pressure ratio and controls the Vi output accordingly. The Vi control effects compressor power only and has no effect on compressor capacity. It is controlled for optimal compressor efficiency.

The module has a 30 second time delay before controlling the Vi output. This insures that the compressor starts in the low Vi (solenoid de-energized) setting.

05TA & 06TA air conditioning screw compressors do not have a Vi valve.

ALM *Alarm Output*

Energized whenever the module enters an alarm state (compressor may or may not be operating depending on the severity of the alarm). The coded alarm light (amber) on the module is flashed at the respective rate in order to indicate the compressor alarm. The flashing is repeated after a short pause. Each of the sensor failure alarms is preceded by a long dash. A comprehensive explanation of the alarm states, including the operational criteria and which alarms require a power reset to clear, is presented in Appendix E.

3.4 Special Instructions for 05T Installations

The only module application differences between 05T and 06T compressors are:

1. Since the 5K motor thermistor is not available for the open drive 05T compressors, a 5.1Kohm resistor (simulating a 76 F temperature reading) should be placed across the motor temperature input. Any ¼ watt carbon film 5.1 Kohm +/-5% resistor, available from many electronic part stores, is acceptable.
2. The oil pressure access fitting on the 06T compressor is not available on the 05T compressors. Therefore, a T-fitting should be supplied at the oil pressure transducer fitting for field gauge readings.

3.5 LonWorks® Communication/Control Summary

Modules are available with and without the LonWorks® communications (see section 2). LonWorks® modules include an FTT10A transceiver allowing them to be connected to other devices over a LonWorks® control network. This allows additional control functionality as well as access to sensor input values and memory storage. A detailed summary of the network variables is included in the "LonCEM Network Interface Notes" document available from Carlyle Application Engineering. Additional information on LonWorks® can be found at www.echelon.com. Following is an overview of the LonWorks® Communication / Control functions:

Additional Control Functions

- Compressor ON/OFF Control
- Compressor Unloader Control
- Module Reset

Available Inputs
All of the modules sensor inputs can be polled over the network including:

- Suction Pressure
- Discharge Pressure
- Oil Pressure
- Motor Temperature
- Discharge Temperature

Memory Storage

The following information is stored in the modules permanent memory.

- All sensor readings recorded prior to the last compressor alarm
- Number of Compressor Cycles
- Compressor Run-Time
- Cumulative Alarm Trips for each Compressor Alarm

3.6 Troubleshooting / Application Notes

Appendix G contains a detailed troubleshooting guide for common problems that may be encountered which should be reviewed before condemning a module to be defective. Common application issues are noted below.

3.6.1 Electrical Noise

As with any electronic device that contains a microprocessor, operation of the module can be effected by electrical noise on any of the input wires (power or sensor) or even the power output wiring. Below are wiring recommendations that should be followed for all installations. Special attention should be made on installations where a variable frequency (inverter) drive is used.

The sensor input wires should never run adjacent (in free air or in conduit) to high voltage wiring. Electromagnetic and capacitive coupling from high voltage wiring to the sensor wires can corrupt the sensor readings possibly resulting in operational problems. The module and all module wiring should be kept away from high voltage components such as power transformers, relays, contactors, etc.

If an inverter is used, precautions should be made to insure that the wires to or from the module are not closely coupled with inverter power wiring, especially the wiring from the inverter to the compressor motor. Inverters can emit a significant amount of electrical noise, which is normal on the output side of the inverter (between inverter and motor).

3.6.2 Pressure Transducer Readings

The cross fitting supplied in the LonCEM package (see Item 8 in Figure 1) for the suction and discharge access fittings, is supplied with one Schrader fitting (intended for field gauge measurements). We do not recommend adding a Schrader fitting to any of the pressure transducer fittings. However, if a Schrader valve is used, precautions should be made to insure that the Schrader valve is fully engaged. A partially engaged Schrader valve can lead to false pressure readings.

3.6.2 Service LED Lamp

The service lamp (red LED located in lower right hand corner of module) is used in conjunction with the LonWorks® network (i.e. will light when being installed as a node on the network). If blinks while the module is installed on a network try re-installing the module on the network. If it is lit steady during module operation this indicates that the module software is not functioning properly. This most likely indicates a hardware problem with the module and it should be replaced.

Appendix A - Functional Overview

LonCEM FUNCTIONAL LOGIC

START-UP SEQUENCE

- A 20 second time delay between compressor starts is built into the module. The time delay is active at initial module power-up, or whenever the compressor is called for before 20 seconds of off-time has elapsed.
- CEM supplies power to the contactor and Oil Solenoid
- 1.25 seconds after startup, the CEM checks for reverse rotation
- 30 seconds after startup, compressor is loaded
- 30 seconds after startup, safeties and VI control begins
- 180 seconds after startup, CEM begins to monitor oil system pressure drop

MOTOR COOLING CONTROL

- The motor cooling valve will be energized when the motor temperature reaches 180F and will de-energize when the temperature drops below 165F
- When the motor temperature reaches 220F the CEM will unload the compressor until the temperature drops below 205F
- If the motor temperature reaches 240F the CEM will shut off the compressor until the temperature drops below 200F

INPUT DEVICE FAILURES

- The module will shut off the compressor if it detects any failure of an input device (thermistors, pressure transducers)

DISCHARGE TEMPERATURE CONTROL

- The motor cooling valve will be energized when the discharge temperature reaches 205F and will de-energize when the temperature drops below 190F
- If the discharge temperature reaches 230F the CEM will shut off the compressor until the temperature drops below 200F

OIL PRESSURE DIFFERENTIAL PROTECTION

- If the pressure differential between oil and suction drops below 45 psi for 90 continuous seconds, the compressor will be shut off

OIL SYSTEM PRESSURE DROP SAFETY

- If the pressure differential between discharge and oil increases to 35 psi for 15 continuous seconds an alarm code will flash
- If the pressure differential between the discharge and oil increases to 50 psi for 15 continuous seconds the compressor will be shut off

VI CONTROL

- The VI coil is energized when the pressure ratio is greater than 4.9:1 and will de-energize when the pressure ratio drops below 5.1:1

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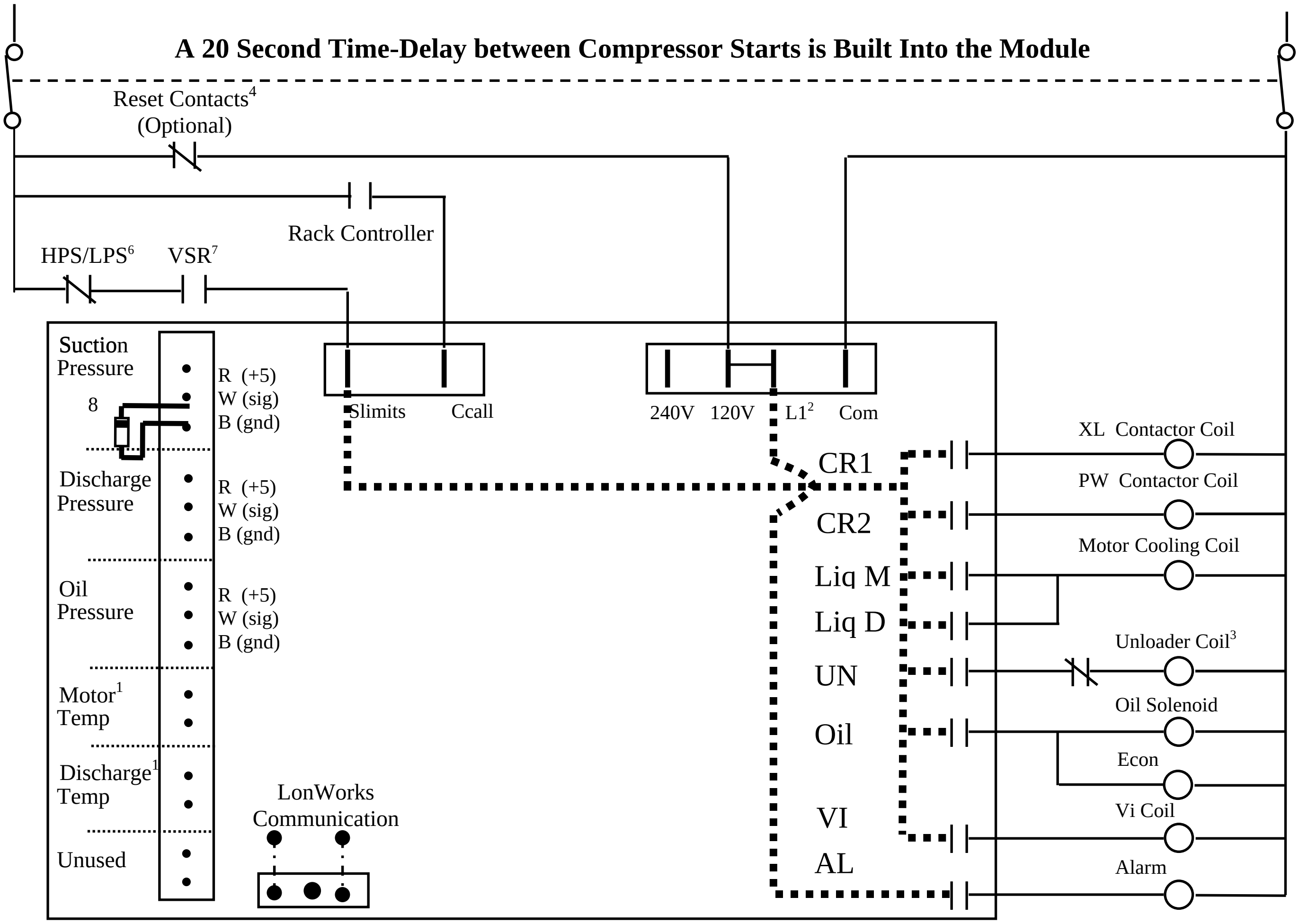

Notes:
1. Connections for Motor Temp, Discharge Temp, and echelon communications are all polarity insensitive.
2. L1 must be jumpered to 240V or 120V depending on line voltage. The drawing shows wiring for 120V. The L1 input is used to power the alarm output.
3. The compressor is *loaded* when the solenoid 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). Contacts will be closed whenever the circuit breaker has power and is not tripped.
8. A Zener Diode (see Appendix D) must be added between the Sig & Gnd input of the Suction Pressure Transducer Input. Zener Diode and installation instructions are included as part of the LonCEM package.

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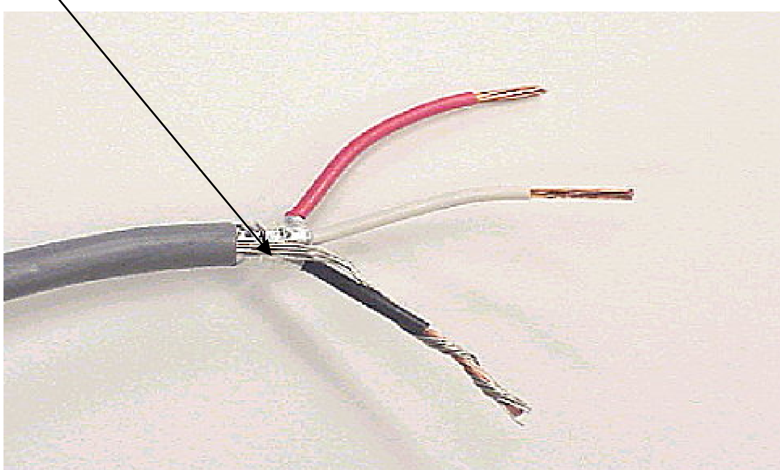
Appendix C – Sensor Wire Grounding

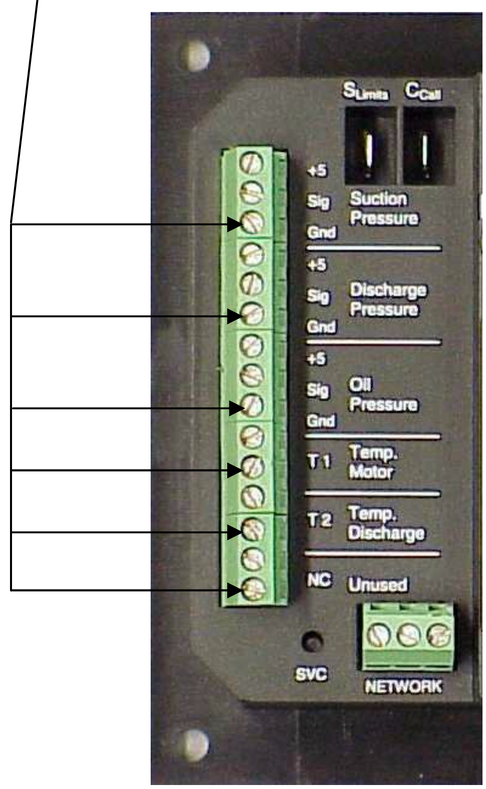
In order to avoid electrical noise on the signal input wires it is important to use shielded cable (pressure transducer harnesses included in the module package are shielded) for all of the pressure and temperature sensor inputs, and to properly ground them as discussed below.

The picture below shows the wiring for the 3 wire pressure transducers. The same procedure should be used with the 2 wire temperature inputs with the drain wire being wrapped around the ground wire, which is the bottom wire for the temperature inputs.

Drain wire - should be wrapped around the ground wire and inserted into the signal ground input (see right)



Pins: 3, 6, 9, 11, 13 and 15 (counting from the top) are all **Ground Inputs**

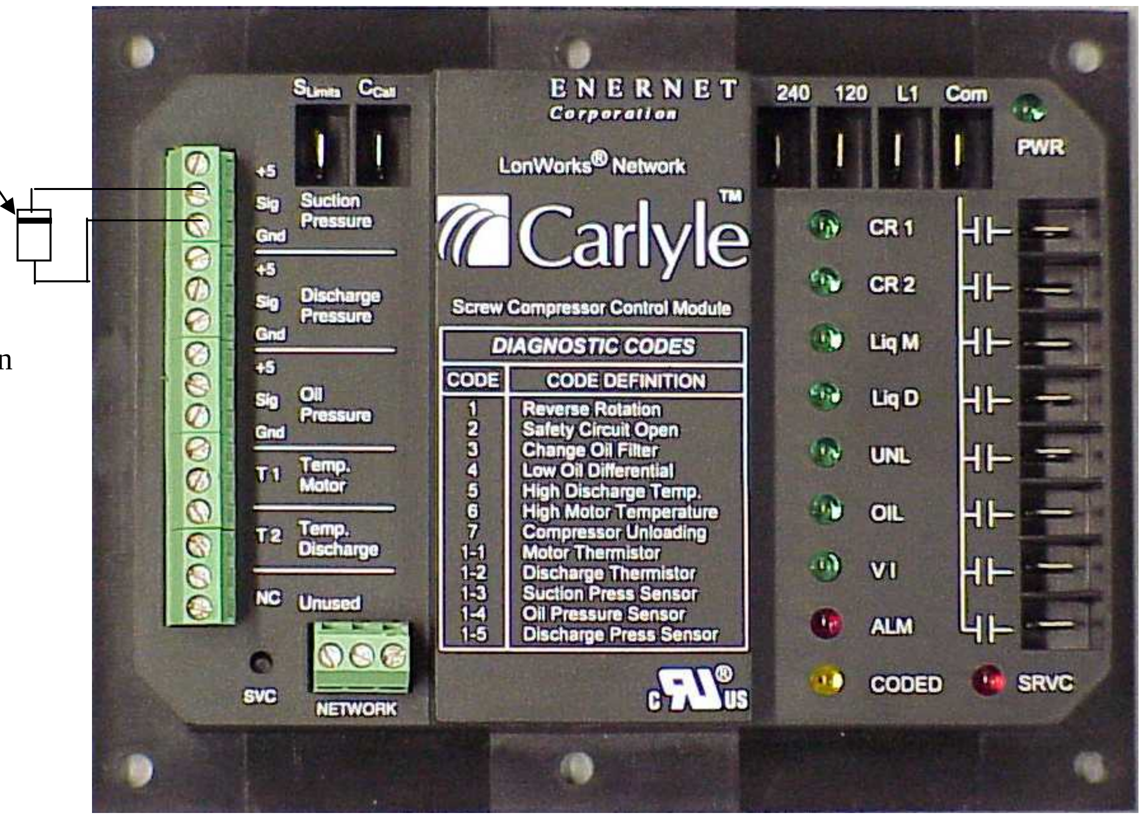


Additional Notes

1. Each sensor (pressure transducers and thermistors) should be run in separate shielded cables, with the drain wire wrapped around the ground* wire and both connected to the ground input.
2. The shielded cable drain wire should **only** be connected at the module end (i.e. not grounded at the sensor end).

* The ground wire is the black wire for the pressure transducer's and is whatever wire is connected to the ground input (bottom input) for the thermistors.

Appendix D – Application of Zener Diode to LonCEM Module



In any applications where the compressor suction pressure is capable of exceeding 140psig (saturation temperatures of 79F w/ R22, 66F with R404A and 64F with R507, may occur during extended off periods) a Zener Diode should be placed in parallel with the suction pressure transducer input.

The module interprets any voltage above 4.7VDC from the suction pressure transducer to be a failed sensor and will lock the compressor out on a suction pressure transducer fault. The diode limits the voltage input to the module below the lockout level, but will not interfere with the operation of the transducer at operating pressures below 140psig.

The diode is to be placed between the suction pressure transducer Signal and Ground inputs in parallel with the sensor (i.e. with the sensor wiring installed). The **cathode band should be installed closet to the Signal input** as shown in the above figure.

Contact Carlyle Application Engineering for Zener Diodes or any Additional Application Questions.

(1) Zener Diode - Motorola Part Number: 1N4732A (4.7VDC; 1W) is included in this packet.

It is also generally stocked at electronic specialty stores.

Appendix E - Alarm Summary

ALARM	Alarm Code	Manual Reset
Reverse Rotation If at any point between 1.25 and 15 seconds after startup a decrease in the discharge pressure of over 10 psig is detected, a shutdown sequence[2] is initiated. Reverse rotation is only checked during the first 15 seconds of compressor operation. Pd1 – Pd2 > 10 psig, where Pd2 is recorded 1.25 sec after Pd1	1	Yes
Safety Circuit Open If at any point the line connecting the Slimits input to L1 is broken (i.e. one of the safeties trips), the compressor is shut down and this alarm code is flashed.	2	No
Oil System Pressure Drop If the pressure drop across the oil system is greater than 35 psig for more than 15 seconds, this alarm code is flashed. Pd – Po > 35 psig for 15 continuous seconds	3	No
If the pressure drop across the oil system is greater than 50 psig for more than 15 seconds, a shutdown sequence is initiated. Pd – Po > 50 psig for 15 continuous seconds	3	Yes
Oil Pressure Differential If the difference between oil pressure and suction pressure is less than 45 psig for more than 90 seconds, a shutdown sequence is initiated. Po – Ps < 45 psig for 90 continuous seconds	4	Yes
Discharge Temperature If the discharge temperature rises above 230F, a shutdown sequence is initiated. Once the discharge temperature drops below 200F for 30 continuous seconds the module will automatically reset.	5	No
Motor Temperature If the motor temperature rises above 220F, the unloader is de-energized and this alarm code is flashed until the temperature drops to 205F.	7	No
If the motor temperature rises above 240F, a shutdown sequence is initiated. Once the motor temperature drops below 200F for 30 continuous seconds	6	No

[2] All outputs are de-energized (except for alarm) and the appropriate alarm code is flashed.

the module will automatically reset.

ALARM	Alarm Code	Manual Reset
Sensor Failure If at any point the module detects a failure of an input device (thermistor, pressure transducer), the module will initiate a shutdown sequence.		
Motor Thermistor Failure	1-1	No
Discharge Thermistor Failure	1-2	No
Suction Pressure Transducer Failure	1-3	No
Oil Pressure Sensor Failure	1-4	No
Discharge Pressure Sensor Failure	1-5	No

Alarm Code Summary

Following is a summary of the diagnostic alarm codes flashed by the yellow alarm light during a compressor alarm.

DIAGNOSTIC CODES

CODE	Definition
1	Reverse Rotation
2	Safety Circuit Open
3	Change Oil Filter
4	Low Oil Differential
5	High Discharge Temperature
6	High Motor Temperature
7	Compressor Unloading
1-1	Motor Thermistor Failure
1-2	Discharge Thermistor Failure
1-3	Suction Press Sensor Failure
1-4	Oil Pressure Sensor Failure
1-5	Discharge Press Sensor Failure

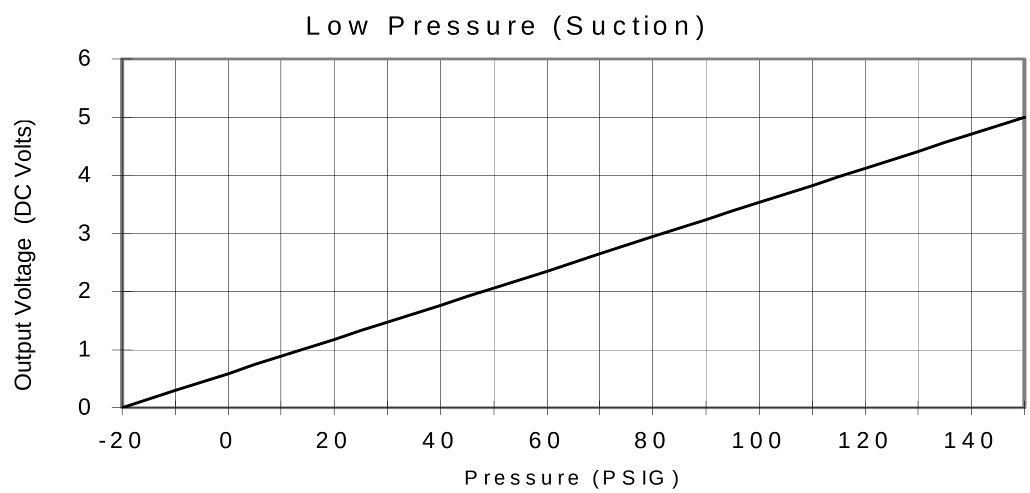
Notes:

- The alarm code is flashed out by the amber alarm lamp
- A pause is present after each code is flashed out
- The sensor failure codes (1-1:1-5) are preceded by a long steady lamp to distinguish them from the other alarm codes

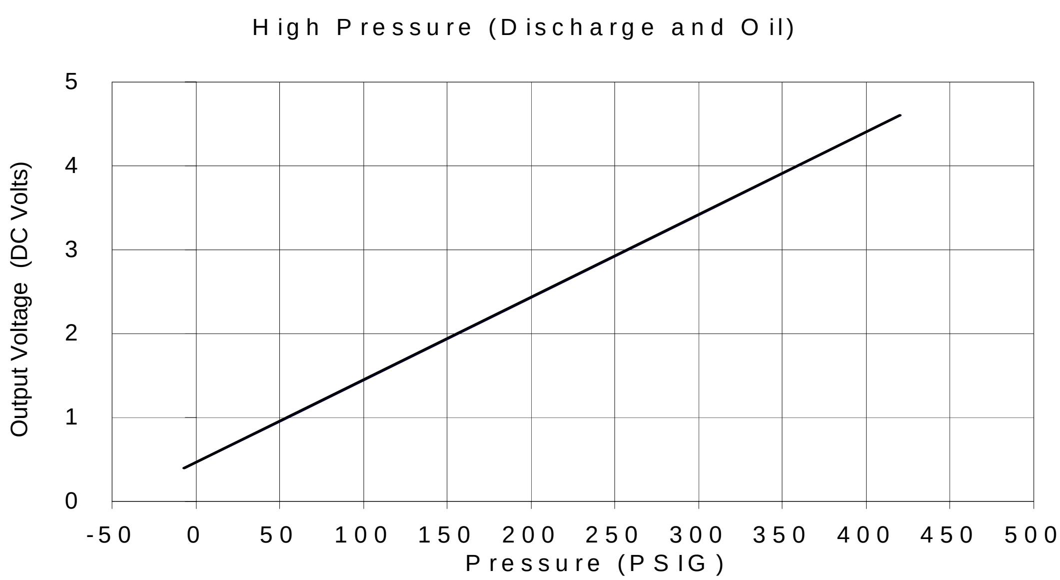
Appendix F - Converting Sensor Inputs to Engineering Units

Pressure Transducers

The following graphs show the sensor output voltage, as measured across the **Sig** and **Gnd** terminals, versus the operating pressure. Separate graphs are shown for the low side (suction) and high side (discharge and oil) transducers. The equations shown in the graphs give approximate values as they assume a perfect +5 power supply.



PSIG = 33.0 * Vout - 16.5



PSIG = 101.59 * Vout - 47.33

Motor and Discharge Thermistors

The following table shows conversion of module voltage (as measured across the modules input terminals) and thermistor resistance (as measured across the thermistor leads when not connected to the module) to temperature.

LonCEM 5K Thermistor Output Conversion to Temperature

Voltage[1] (VDC)	Resistance[2] (ohms)	Temp (C)	Temp (F)	Voltage[1] (VDC)	Resistance[2] (ohms)	Temp (C)	Temp (F)
4	6480.0	19.2	66.5	2.1	1173.1	61.6	142.9
3.9	5743.6	21.9	71.4	2	1080.0	64.0	147.1
3.8	5130.0	24.4	75.9	1.9	992.9	66.4	151.4
3.7	4610.8	26.9	80.3	1.8	911.2	68.8	155.9
3.6	4165.7	29.2	84.6	1.7	834.5	71.4	160.6
3.5	3780.0	31.5	88.7	1.6	762.4	74.1	165.4
3.4	3442.5	33.7	92.7	1.5	694.3	76.9	170.5
3.3	3144.7	35.9	96.6	1.4	630.0	79.9	175.8
3.2	2880.0	38.1	100.5	1.3	569.2	83.1	181.5
3.1	2643.2	40.2	104.3	1.2	511.6	86.4	187.6
3	2430.0	42.3	108.1	1.1	456.9	90.1	194.1
2.9	2237.1	44.4	111.9	1	405.0	94.0	201.3
2.8	2061.8	46.5	115.6	0.9	355.6	98.4	209.1
2.7	1901.7	48.6	119.4	0.8	308.6	103.3	217.9
2.6	1755.0	50.7	123.2	0.7	263.7	108.8	227.8
2.5	1620.0	52.8	127.0	0.6	220.9	115.2	239.4
2.4	1495.4	54.9	130.9	0.5	180.0	122.9	253.2
2.3	1380.0	57.1	134.8	0.4	140.9	132.5	270.4
2.2	1272.9	59.4	138.8	0.3	103.4	145.2	293.3

Notes

1. Voltage measured between thermistor input pins on module sensor terminal block.
2. Resistance measured across the Thermistor Leads when **not** connected to module.

Appendix G – LonCEM Module Troubleshooting Guide

This guide provides Trouble Shooting tips for the LonCEM module which may be useful if the module does not appear to be functioning properly. The Installation and Application Instructions should be reviewed first to insure that the module is correctly installed and wired.

Each module does go through a complete functional test, completed only after a 24 hour burn in period, where all inputs and outputs are tested at the factory before shipment. This insures that each module is fully functional before it is shipped to our customer.

Following are several troubleshooting tips for common problems that may be encountered.

What if the green power LED does not light up when the module is powered?
Without a call for compressor (i.e. CCALL), all lights should be OFF except for the main Green power light. If it is not lit, this could mean that:

a) One of the +5 signals outputs is shorted out. One by one each of the RED +5V wires should be removed from the module (suction, discharge and oil). If one is shorted, the power led will light again shortly after the power wire is removed.

b) The power transformer may be damaged (i.e. 115 input was powered w/ 240V)

What does it mean when Red Service LED is Lit?
a) The service lamp will light if the service pin (lower left on module) is depressed. Sometimes when the module covers are placed on the module the service pin will be caught by the plastic and will not protrude through the hole in the housing. Centering the pin through the hole can rectify this problem.

b) It could also mean that the module board has been damaged as the RED service led will light if the module is not functional.

What if one of the outputs will not energize the load (contactor or solenoid valve)?
a) It is possible to burn out the output if there is a short at the load. The outputs are fired by triac's which are electronic switches. If they are shorted they will burn out. The module would have to be replaced at this point.

It is important to note that in general it is not possible to test the triac outputs with a standard voltage meter as the triac's will leak current through them and give you false readings on your meter. The only way to test the functionality of the triac is to put a load on them.

What if pressure sensors are not reading properly?

The voltage (DC) input to the module between the signal and ground inputs should be proportional to the sensed pressure. The accuracy of the sensor can be checked by comparing the measured pressure to the pressure as converted over from the measured voltage. The conversion chart and formulas are contained in the Installation Instructions. If there is a discrepancy between pressures (i.e. gauge and module), the following items should be examined:

a) Check to make sure that all of the wire connections are all good and tight at the module.

Be sure to back the Phoenix screw back far enough to get the wires properly placed in the holding box and then tighten down until the wires are firmly in place. Gently pulling on the wires will help to insure that they are secured down properly.

Be sure that strands of wire to not protrude into one of the neighboring connectors.

b) Make sure that the sensors are grounded properly, we recommend taking the drain wire and wrapping it around the black ground wire and then inserting this pair into the GND input. The module is designed to have a floating ground. No ground wire (not from the module and not from the sensors) is to be tied to panel or earth ground.

c) Make sure all sensor wire is run clear of any high voltage power. This includes:

> compressor power wiring
> control power (i.e. 115/208/230V) wiring
> any high voltage device (transformer, contactor, relay etc.)

If the module mounted too close to a power transformer, contactor etc. that could be corrupting the power signals.

d) Check to make sure that debris has not worked its way between the pressure transducer and wiring harness at the connection clip. If suspicious, the area should be blow out with nitrogen or dry air.

e) Check to make sure that the correct model transducer is used on each input.

> The part number will be marked on the transducer,
HK05YZ003 For suction (suction has blue dot on transducer)
HK05YZ007 For discharge & oil
> Unclip the harness from the transducer to insure that you get the correct module code

f) Make sure that the transducer is not installed on a fitting with a Schrader valve Although handy when changing out a transducer in the field, we have experienced problems when the Schrader depressor on the module would not fully depress the Schrader valve causing the module to not to read the proper pressure.

g) Make sure the Zener Diode on the suction pressure transducer input is installed properly. If the Diode is installed upside-down (i.e. with cathode band facing down and not up) the pressure will not be read properly.

h) Are the transducers are powered with 5V from the module (required voltage between +5 output of module (RED wire) and the Ground (GND). Check to make sure the supplied voltage is 5V (+/- 0.2V)

What if the Temperature sensors do not read properly?

As with the pressure transducers, the measured voltage between the two thermistor leads (motor or discharge) should also be proportional to the sensed temperature. A table is also available in the Installation Instructions which can be used to convert the resistance across the thermistors or more practically (sense it can be measured with the wires connected to the module) the DC voltage across the wires. If there is suspicion that the correct temperatures are not being recorded by the module, the following items should be investigated.

The motor and discharge thermistors are made of the same material and as such have the same conversion from resistance and/or voltage to temperature.

a) Are the wires properly secured (see notes under pressure transducer wiring discussed above).

c) Is the motor thermistor run inside the same conduit as the high voltage compressor power wires? It should be run outside of the power conduits.

b) Is the thermistor bad?
There is a spare thermistor in the motor windings with the connections available at the terminal plate. Try relocating the thermistor leads from the main to the spare thermistor if it is suspected that the motor thermistor is bad.

Is the module short cycling the compressor?

It is possible if enough electrical noise enters the module for the energy to cause the microprocessor to reset which will cause the module to cycle the compressor on the built in 20 second time delay. If excessive cycling of the compressor is observed:

a) Check to make sure the compressor is not being cycled on one of the compressor safeties (i.e. Slimits is always powered) and that the controller is not short cycling the compressor (i.e. CCALL input is powered up all the time)?

b) If these items have been checked, the commons sources of electrical noise (see discussion under pressure transducer readings above) should be investigated.

If the module continues to short cycle after addressing the items above, contact Carlyle Application Engineering for further remedies.