Hoffman Controls
Installation & Operating Instructions

880-90 Low Ambient Head Pressure Control for ECM Motors

General

CAUTION

Failure to read and understand the accompanying instructions and diagrams or failure to complete the "Checkout Procedure" prior to energizing the Control may result in permanent damage to the Control.

The 880-90 Low Ambient Head Pressure Communicating Control is designed to modulate energy efficient Electrically Commutated condenser fan Motors (ECM) in air conditioning and refrigration systems. The control monitors the head pressure by sensing the sub-cooled liquid line temperature, system pressure or via a 0-10Vdc control signal and varys the air volume through the condenser consequently regulating head pressure for proper heat rejection in low ambient conditions.

Pre-Installation

1. For use with ECM condenser fan motors capable of accepting a 0-10Vdc, 10-0Vdc (fail safe signal) or 13-17Vdc amplitude, 80Hz Pulse Width Modulated (PWM) control signal.
2. The control provides 90mA (typically nine ECM motors) of motor drive capability and works with all motor line voltages.
3. The control can monitor one to three refrigerant circuits with 10K liquid line temperature sensors or 0.5-4.5Vdc, 500psi pressure transducers. When using more than one temperature sensor or pressure transducer, the maximum sensor is in control. The 880-90 is not supplied with temperature sensors or pressure transducers. Temperature sensor p/n 100-0016-001 may be purchased. 0.5-4.5Vdc, 500psi pressure transducers are market available. Additionally, the 880-90 will accept a 0-10Vdc control signal.
4. The 880-90 control is capable of operating as Modbus RTU Serial Interface slave device. Critical parameters can be read and set remotely via Modbus comunication.
5. The control requires an external 24Vac, 3VA power source.
6. Wiring must comply with Local and National Electrical Codes.
7. Refer to 880-90 Product Data (HCC #172-0267-000) to insure a complete understanding of the controllers function before continuing installation.

Installation

WARNING

Disconnect power from the unit and electrically disable the compressor prior to installation.

- Install the 880-90 control in a weatherproof control panel or use a NEMA Series type 2, 3, or 3R enclosure. The control is conformally coated but must be protected from moisture and condensation.
- Determine an appropriate mounting location and attach the control using four sheet metal screws through the circuit board four corner standoffs.
- Dimensions and mounting hole patterns for the control are included in Figure 2, 880-90 Wiring Diagram.
- Make the wiring connections as shown in Figure 2, 880-90 Wiring Diagram.
- Note: Attach the ECM motor speed control signal to the PWM(+) & GND(-) terminals for PWM type motors and attach the 0-10Vdc or 10-0Vdc type motors to the VDC(+) & GND(-) terminals. It is acceptable to use both PWM and VDC type motors at the same time.
- The 24Vac "COM" terminal allows for grounded 24Vac supply if required.

Liquid Line Sensor Installation

- Install the supplied 10K Sensor to the top of liquid line where the line exits the condenser coil as shown in Figure 1, Sensor Installation.

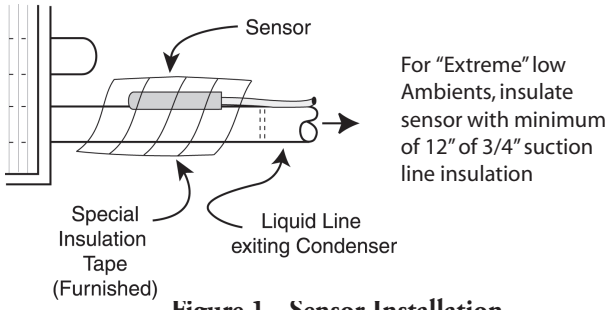


Figure 1 - Sensor Installation

- Use the special tape provided to secure the Sensor to the liquid line. Stretch the tape slightly, as you wrap Sensor around the liquid line. Use all the tape, lapping the Sensor. Firm contact is required between the metal tab of the Sensor and the liquid line.
- Connect the 1st sensor to the control's input terminals S1 & GND (minimum of 1 sensor required). Note that it doesn't matter which of the two sensor wires is attached to GND.
- If monitoring two refrigerant circuits, install the 2nd sensor to the 2nd condensor coil as shown above and connect it to the controls' input terminals S2 & GND.
- Additional insulation of the taped sensor and adjacent refrigerant line back to condenser header may be required in extremely cold ambients (+20°F).
- Refrigeration applications or extremely low ambient environments may require additional consideration. See Engineering Bulletin (HCC #81XEB02REVA) for "Low Ambient Considerations".

PWM ADJ Potentiometer

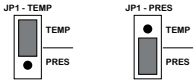
It may be necessary to adjust the PWM ADJ poteniometer when using an ECM condensor fan motor(s) that use a PWM type motor speed control signal. It will be necessary for the installer to have the motor manufacturers' specifications for the amplitude of the PWM signal.

Example: If the manufacturers' PWM amplitude specification is 9-15Vdc, set the PWM ADJ poteniometer below 15Vdc. If the manufacturers' PWM amplitude specification is 15-30Vdc, set the PWM ADJ poteniometer above 15Vdc. The PWM ADJ potentiometer is set at 15Vdc from the factory and this setting will work with most PWM type ECM condenser fan motors.

LOW & HIGH SET Potentiometers

The LOW SET point and HIGH SET point adjustments are critical settings for proper heat rejection in low ambient conditions. The 880-90 control maintains the pressure differential at the expansion valve for proper superheat. The LOW SET and HIGH SET point potentiometers have three scales that provide settings for temperature, pressure and Vdc. Use the scale that is appropriate for the application.

The set point scales are as follows:



When temperature (TEMP) is selected using the JP1 jumper tab, the LOW SET point range is 40°F to 80°F in 1°F increments. The HIGH SET point range is 60°F to 140°F in 1°F increments.

When pressure (PRES) is selected using the JP1 jumper tab, the LOW SET point range is 40psi to 200psi in 2psi increments. The HIGH SET point range is 100psi to 420psi in 2psi increments.

When there is a signal on the 0-10Vdc input and no signal present on the other inputs, the LOW SET point range is 0.5Vdc to 8.0Vdc in 0.1Vdc increments. The HIGH SET point range is 2.0Vdc to 10.0Vdc in 0.1Vdc increments.

This wide range of adjustment provides head pressure contol for a wide range of typical and unique applications.

The **factory setting** is for the typical temperature sensed application with the JP1 jumper in the TEMP position and a LOW SET point of 50°F and a HIGH SET point of 80°F providing a 30°F range (span) of ECM condenser fan motor modulation for the typical Thermal Expansion Valve (TXV) type systems. In this example, the condenser fan motor(s) modulation from full motor speed occurs at 80°F liqiud line (ambients above 60°F) and modulates motor(s) to minimum speed at 50°F liquid line (ambients below 30°F). The motor(s)cycles "OFF" at liquid line temperatures below 50°F and cycles back "ON" first with a 2.5 second full speed hard start then to minimum speed at 53°F liquid line temperature providing 3°F of hysteresis between motor "OFF" and "ON".

A 25°F span (settings of 55°F to 80°F) is recommended for High Efficiency systems. Settings of 70°F to 100°F are recommended for Capillary Tube or Orifice type systems.

Operation with Hysteresis

When the sensed input drops below the LOW SET point, the motor will turn off. When the input rises above the set point by the hysteresis value, the motor will turn back on. The hysteresis value for temperature is 3°F, pressure is 6psi and voltage is 0.8Vdc.

CAUTION: These various set point adjustments are provided only to ensure proper ambient control when the system is properly charged (no vapor in the sight glass), filters, condenser and evaporator coils are clean, and the system is properly charged.

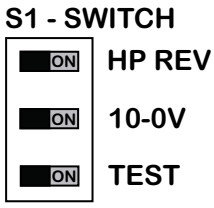
LED Set Point Indicator

When either of the LOW or HIGH set point potentiometers is turned, the LED will flash the new reading. A sequence of flashes indicates a digit from 1-9. A "zero" is indicated by a low-brightness pulse. For example, if the set point is 105°F, the LED will flash once, then pause, then display a dim glow, then pause, then flash five times. If the input type is changed, the set point indication will display the new set point.The LED set point indicator provides the installer with the assurance that the set points have been entered exactly as desired.

During normal operation the LED intensity will increase with the fan motor speed.

S1 SWITCH SELECTIONS

When the heat pump is operating, the fan motor(s) run at high speed. The heat pump is sensed as ON when the 24Vac signal is present on the heat pump (HP24V) input line and the heat pump (HP REV) switch is OFF. The heat pump is also sensed as ON when the 24Vac signal is not present on the heat pump (HP24V) line and the heat pump (HP REV) switch is in the ON position.



When using an ECM condenser fan motor(s) that accepts a 10-0Vdc (fail safe) speed control signal, the S1 10-0V switch should be in the ON position. For 0-10Vdc operation, the switch should be OFF.

When performing a self-test checkout procedure, put the TEST switch in the ON position. This will cause the ECM condenser fan motor(s) to ramp up and down with a period of 15 seconds. Once testing is completed, the switch should be in the OFF position.

880-90 Control Input Signals

The 880-90 control provides one to three temperature sensor or one to three pressure transducer inputs. Whichever line is giving a valid reading is used. If more than one line is valid, the maximum of the valid lines is used. If none of the lines are valid, the VDC IN input line is used. If this line has a signal less than 0.3Vdc, then the 880-90 control assumes that there are no valid inputs, the LED will flash continously and the motor(s) will run at full speed.

880-90 Control Output

The 880-90 control PWM and 0-10Vdc motor maximum speed output is 97% duty cycle PWM and 9.7Vdc. The minimum speed output is 20% duty cycle PWM and 2.0Vdc. Motor off is 0% duty cycle PWM and 0.0Vdc. If using 10-0Vdc (fail safe) mode, the motor maximum speed output is 0.0Vdc and the minimum speed output is 8.0Vdc. Motor off is 9.7Vdc. Note: if using Modbus communication, motor speed constants can be changed.

Checkout Procedure

CAUTION

Verify all ECM motor connections & configurations before applying power.

1. Verify line voltage is correctly applied to the motor(s) terminals.
2. Verify motor(s) has been programmed for correct rotation (CW/CCW) and is selected for the reccommended propeller blade.

Prepare for Operation

1. It is recommended that the compressor be disabled prior to control and condenser fan motor(s) operation checkout.
2. Motor speed control can be tested by putting the TEST S1 switch in the ON position. The motor(s) speed will ramp up and down over a period of 15 seconds. Put the switch in the OFF position for normal operation..
3. An alternate test method is to disconnect one lead off all temperature or pressure sensors and if used , disconnect the VDC IN lead from the control. The LED will flash continuously and the motor(s) will run at full speed if all wiring is correct.
4. Once the control and motor(s) wiring is verified, reconnect the sensors/VDC IN inputs and the compressor power may be restored.
5. Set thermostat for cooling demand and apply voltage to the unit. Condenser fan(s) will hard start if the liquid line is 3°F (if temperture sense is being used) above the LOW SET point value and modulate over the span of the range selected.
6. Verify that the motor is operating properly for temperature sensed. Depending on the LOW & HIGH set points, when the sensor temperature at "start up" is:
   a. **Below Selected Range,** the motor(s) will not start.
   b. **Within Selected Range,** the motor(s) will first hard start and then modulate to a reduced speed proportional to the temperature sensed.
   c. **Above Selected Range, t**he motor(s) will start and remain at full speed.
7. Verify operation as described above by monitoring liquid line temperature and observing motor speed.
8. If using pressure or Vdc inputs, monitor the control signals for proper operation.

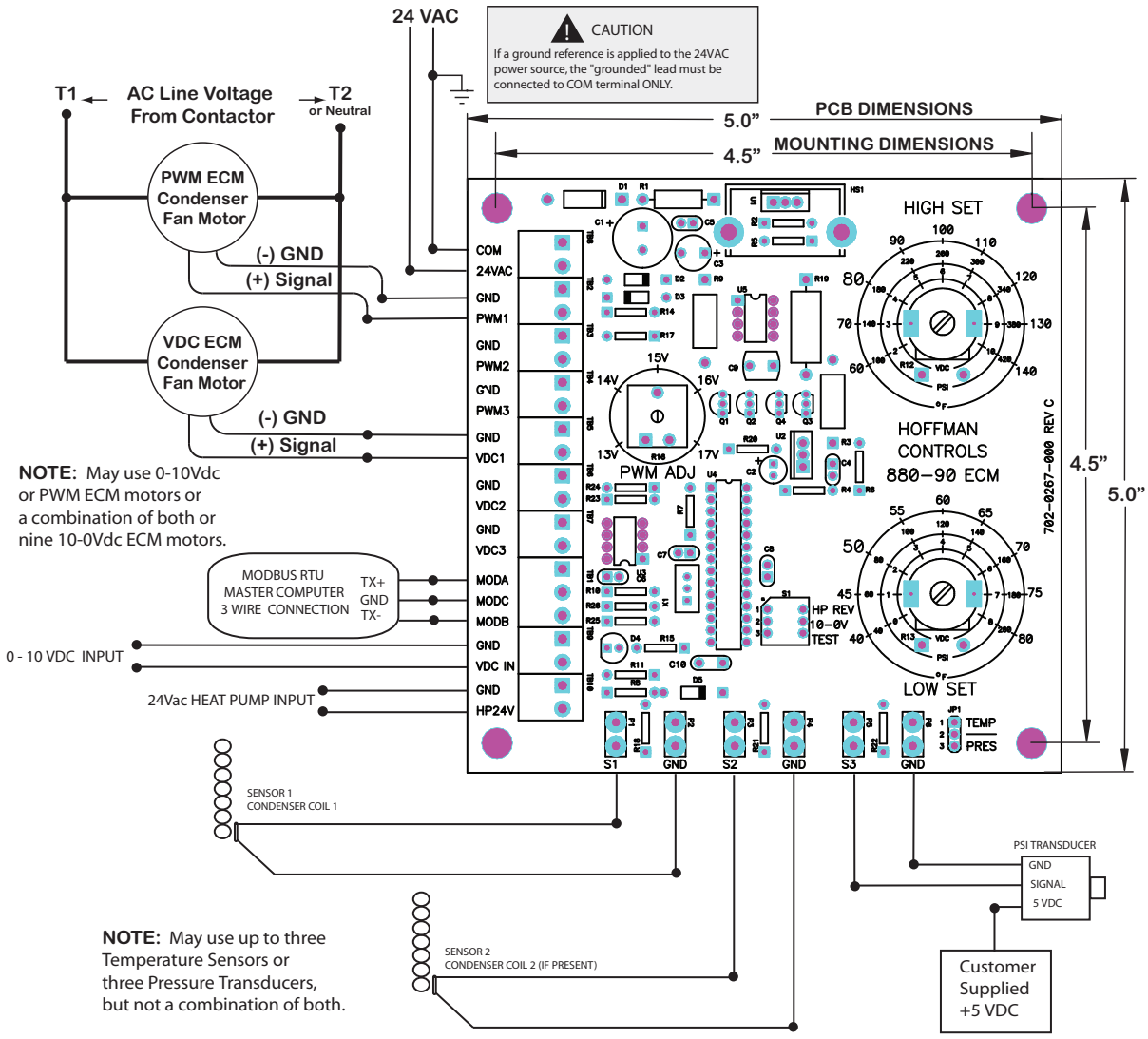


Figure 2 - Wiring Diagram for the 880-90 Control

Modbus Operation

The 880-90 control operates as a slave device when connected to a Modbus master device over a standard Modbus RTU RS-485 three wire serial interface. The Modbus communication can be used to set several different parameters on the 880-90 control. Even if power is lost and the processor is rebooted, the values set over Modbus are retained.

The default Baud Rate is 19200, the default Slave Address is 1 and the default Parity Code is 38. These defaults can be changed as shown below in registers 18, 19 and 20 once connected to the Modbus master. The following parameters can be read and set remotely via Modbus:

Modbus Read/Write Parameters

Register	Description
0	Temp/Pressure Input Line 1 (degrees F or psi) reading x 10 (read only) if the reading is not valid, a value of 10000 is used
1	Temp/Pressure Input Line 2 (read only)
2	Temp/Pressure Input Line 3 (read only)
3	0-10 VDC Input (read only) volts x10 – If there is a valid temp or pressure or if this reading is less than 0.3 volts, a value of 10000 is used
4	PWM Duty Cycle current value in % (read only)
5	Pressure Sensor Jumper (read only) 1 if Yes, 0 if no (temp position)
6	Heat Pump 24 VAC Present (read only) 1 if yes, 0 if no
7	Heat Pump Reverse Acting (read only) 1 if yes, 0 if no
8	Reverse Output (read only) low output for high speed, 1 if yes, 0 if no
9	Low Set Point (x10 degF, x10 psi, x10 volts) note: if this is changed over Modbus, the change will be retained until the pot is turned on the board.
10	High Set Point
11	Use Modbus Low Set Point (0 for no, 1 for yes) note: this is set to a one when the Modbus overrides the pot set point. It is set to 0 when the pot is turned on the board. If it is set to 0 over the Modbus, then the control will revert to the current pot setting.
12	Use Modbus High Set Point
13	Hard Start Time (in milliseconds) default is 2500 (2.5 seconds)
14	Motor Output High (% duty cycle) default is 97
15	Motor Output Low (% duty cycle) default is 20
16	Motor Off (% duty cycle) default is 0
17	Pressure Sensor Max – default is 500 psi
18	Modbus Slave Address – default is 1
19	Modbus Baud Rate Code – default is 4 which is 19200 (codes 0-7 represent: 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200)
20	Modbus Parity Code – default is 38 (38 is even, 54 is odd and 14 is no parity with 2 stop bits)
21	Hysteresis Temperature (degrees x 10) default is 25, or 2.5 degrees F
22	Hysteresis Pressure (psi x 10) default is 60, or 6.0 psi
23	Hysteresis Voltage (volts x 10) default is 8, or 0.8 volts
24	Reset Control to Factory Defaults (set to 1 to reset the control)