Supplement to the ComPac Product Manual for the ASDCA air conditioners

This supplement to the ComPac Product Manual describes:

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48 VDC wiring

The ASDCA air conditioners require a 48 Volt DC power to operate the evaporator air movers and the free cooling damper motor.

1. If the air conditioners are powered, remove AC and DC power to the air conditioners by switching the breakers in the shelter to the OFF position. Size a 2 conductor wire 12 AWG cable per NEC standard. Connect the cable between a DC breaker in the shelter and the DC breaker in the air conditioner. The DC breaker in the air conditioner is located on the right side of the bank of breakers. (See photos on following page.)

2. Size the DC conductor wires per NEC standard. Distances of up to approximately 30 feet (9 meters) require a 12AWG feed. For distances greater than 30 feet (9meters), size the DC wire accordingly. Wire sizes 14AWG thru 10AWG shall be TelcoFlex®III or KS24194®L3 type wiring. Wire sizes 10AWG or larger shall be TelcoFlex®IV or KS24194®L4 telecommunications type wiring. All wire connections to the DC power plant must utilize 2-hole compression lugs sized per the wire being installed. 1-hole lugs are prohibited unless the DC plant cannot accommodate 2-hole lugs. Connect the cable between a DC breaker in the shelter DC power plant and the DC breaker in the air conditioner. The DC breaker in the air conditioner is located on the right side of the bank of breakers. (See photos below).

3. Install a 20A DC breaker in the power plant. Breaker will be supplied by the end user or local market for the applicable DC power plant.
4. **Prior to** turning on the breaker in the DC power plant, ensure the 48VDC polarity is correct.

5. Turn ON the DC breaker in the shelter’s DC power plant.

6. Verify the polarity and the voltage at the air conditioner to make sure the polarity is correct and that there is 48 VDC at the breaker in the air conditioner. If the polarity is not correct, switch the wires.

7. Turn on the DC breaker in the air conditioner.

8. Note that the CoolLinks PLC controller requires a 5A DC breaker in the DC power plant rather than the 20A breaker necessary for each air conditioner. Other than breaker size, the steps for installation and verification of the 48 VDC supply to the CoolLinks PLC controller are similar to the above steps.

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**Installation of the Indoor and Outdoor Sensors**

Shipped in the CoolLinks enclosure are:

- the indoor temperature sensor, part number EE10
- the outdoor temperature and humidity sensor, part number EE060
- the outdoor sensor mounting enclosure and hardware
- 40 ft. of 18 AWG, 4-conductor indoor sensor cable
- 33 ft. of 18 AWG, 4-conductor with M12 female screw connector outside sensor cable
- two 50 ft. long Cat5e Ethernet cables
The indoor temperature sensor should be mounted on the interior wall between the return air grilles. Install the sensor and route the sensor cable from the indoor sensor to the PLC enclosure as required by the customer. Connect the cable to the terminals in the PLC enclosure as indicated in the CoolLinks electrical connection diagram.

The outdoor temperature and humidity sensor is mounted on the exterior of the shelter. Install the sensor, screw the outside cable to the sensor and route the cable to the PLC enclosure as required by the customer. Connect the cable to the terminals in the PLC enclosure as indicated in the CoolLinks electrical connection diagram.

**Connection of PLC controller board in shelter to CoolLinks™ board in the air conditioner**

Route a Cat 5e shielded Ethernet cable from the PC board in each air conditioner to the PLC controller in the shelter. If the cable is routed through the air stream, it must be plenum rated.
Configuration of AC Unit Address on CoolLinks™ board in the air conditioner

Each AC unit must be designated as either AC unit 1 or AC unit 2. The AC unit address is configured with the NET ADDR switches on the CoolLinks™ board. Standing inside the shelter facing the AC return air vents, AC unit 1 is the left-hand unit and AC unit 2 is the right-hand unit. For AC unit 1, set all NET ADDR switches down (default). For AC unit 2, set NET ADDR switch 1 up (ON) and all other switches down. (See photo on page 5).

Operator Interface Instructions

System Status
The main screen displays the status of the Marvair CoolLinks system and the two Marvair HVAC units. Standing inside the shelter facing the HVAC return air vents, unit 1 is the left-hand unit and unit 2 is the right-hand unit. The fields on the status screen are as follows:

Indoor Temperature: Indoor temperature from the temperature sensor mounted on the wall between the HVAC return air grilles. This sensor controls the enabling/disabling of the cooling/heating.
IBM Pushbutton: Indicates the status of the Indoor Blower Motor (IBM) as Running or Stopped. If the blower motor is not under automatic control, pressing the pushbutton will turn the motor on and off. Press once to turn on and press again to turn off. The motor is under automatic control whenever the HVAC unit is the lead unit, or in DC Free-Air operation, or in emergency ventilation mode.

Unit Status Panel: Indicates the status of the HVAC unit as follows:
- Lead Yes: unit is lead, No: unit is lag
- Cool Yes: unit cooling, No: unit not cooling
- Heat Yes: unit heating, No: unit not heating
- Filter Ok: filter good, Maint: filter blocked
- Comm Yes: PLC comm ok, No: PLC comm fault

Lead Swap Pushbutton: Swap the lead and lag unit. Note that if the lag unit is in lockout or has a comm fault, the system will not swap. If the lead unit experiences a lockout or comm failure, the system will automatically swap to the lag unit.

Comfort Mode Pushbutton: Drop the first-stage cooling set point to 72°F to allow a service technician to work comfortably inside the shelter. After one hour the set point will return to its previous value.

Reset Lockout Pushbutton: Resets the lockout condition on whichever unit is in lockout. Note that a call for cooling must be active before the lockout can be reset.

Outdoor Air: Outside air temperature (°F).
Humidity: Outside air relative humidity (%).
Dew Point: Dew point temperature (°F). When the calculated dew point is below 60°F, the outside air temperature is below 70°F, and the outside relative humidity is below 80%, enable DC Free-Air cooling.

Alarm Message: Active unit alarms are displayed in the alarm message window between the IBM (Indoor Blower Motor) pushbutton and the unit status panel. If multiple alarms are present the system scrolls through the active alarms with each alarm displayed for five seconds. If no alarms are present, the message window is blank. Thirteen possible alarm messages may be displayed:
- High Pressure Switch Alarm
- Low Pressure Switch Alarm
- High Pressure Switch Lockout Alarm
- Low Pressure Switch Lockout Alarm
- 1st High Indoor Temperature Alarm (> 85°F)
- 2nd High Indoor Temperature Alarm (> 90°F)
- Low Indoor Temperature Alarm (< 45°F)
- Landline Power Alarm
- Damper Alarm
- Smoke Alarm
- Generator Running
- Hydrogen Alarm
- Communications Alarm
The main screen with each of the operator/display fields is presented below.

### Changing Set Points

Set points control the cooling and heating operation of the Marvair CoolLinks system. There are two groups of set points, cooling first and second stage set points, and heating first and second stage set points. The default values for these set points are:

- **Cooling first stage**: 77°F
- **Cooling second stage differential**: 5°F
- **Heating first stage**: 60°F
- **Heating second stage differential**: 2°F

If any of the set points are changed from the operator panel, the default values are restored after a period of one hour. The minimum set point for cooling or heating is 50°F and the maximum set point for cooling or heating is 90°F. To access the set points, simply touch the top or bottom of the Indoor Temperature display. This will then enable the set point control panel. If a new set point value is not entered within ten seconds, the display will revert back to the Indoor Temperature display.

**Cooling First Stage:**
Press the Cooling push-button then press the 1st Stage push-button. Both push buttons

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will turn dark gray with white text and the current cooling first-stage set point value will be displayed. Next, press the set point value to display the numeric entry screen and enter the desired set point. The system will now enable cooling whenever the indoor temperature is 1°F above the set point and disable cooling when the indoor temperature drops to 2°F below the set point.

Cooling Second Stage:
Press the Cooling push-button then press the 2<sup>nd</sup> Stage push-button. Both push buttons will turn dark gray with white text and the current cooling second-stage set point value will be displayed. Next, press the set point value to display the numeric entry screen and enter the differential set point. The system will now enable second-stage cooling whenever the indoor temperature is 1°F higher than the first-stage cooling set point plus the second stage cooling differential and disable second-stage cooling when the indoor temperature drops to 2°F below the first-stage set point. The second-stage cooling differential is set to a default of 5°F to allow the first-stage cooling time to operate fully and to prevent short-cycling of the second unit.

Cooling Example:
First-Stage Set Point: 77°F
Second-Stage Differential: 5°F

First-stage cooling will start when the indoor temperature reaches 78°F and will stop when the indoor temperature reaches 75°F.

Second-stage cooling will start when the indoor temperature reaches 83°F and will stop when the indoor temperature reaches 75°F.

Note that once first-stage cooling is enabled, the unit will run for at least <u>five minutes</u> even if the indoor temperature reaches the disable temperature. This is to prevent short-cycling of the unit and to allow the compressor sufficient time to remove moisture from the air as well as cool the shelter.

Cooling Sequence:

<table>
<thead>
<tr>
<th>Shelter Temperature</th>
<th>Mechanical Cooling Operation</th>
<th>DC Free-Air Cooling Operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt;77°F</td>
<td>DX Cooling Lead Unit</td>
<td>DC Free-Air Cooling Lead Unit</td>
</tr>
<tr>
<td>&gt;79°F</td>
<td>DX Cooling Lead Unit</td>
<td>DC Free-Air Cooling Lead &amp; Lag Unit</td>
</tr>
<tr>
<td>&gt;80°F</td>
<td>DX Cooling Lead Unit</td>
<td>DX Cooling Lead Unit</td>
</tr>
<tr>
<td>&gt;82°F</td>
<td>DX Cooling Lead &amp; Lag Unit</td>
<td>DX Cooling Lead &amp; Lag Unit</td>
</tr>
<tr>
<td>&lt;77°F</td>
<td>DX Cooling Off IBM runs on Lead Unit</td>
<td>DX &amp; DC Free-Air Cooling Off IBM runs on Lead Unit</td>
</tr>
</tbody>
</table>

Heating First Stage:
Press the Heating push-button then press the 1<sup>st</sup> Stage push-button. Both push buttons will turn dark gray with white text and the current heating first-stage set point value will be displayed. Next, press the set point value to display the numeric entry screen and enter the desired set point. The system will now enable heating whenever the indoor temperature is 1°F below the set point and disable heating when the indoor temperature rises to 1°F above the set point.
**Heating Second Stage:**

Press the Heating push-button then press the 2nd Stage push-button. Both push buttons will turn dark gray with white text and the current heating second-stage set point value will be displayed. Next, press the set point value to display the numeric entry screen and enter the differential set point. The system will now enable second-stage heating whenever the indoor temperature is 1°F lower than the first-stage heating set point minus the second stage heating differential and disable second-stage heating when the indoor temperature rises to 1°F above the first-stage set point. The second-stage heating differential is set to a default of 2°F to allow the first-stage heating time to operate fully and to prevent short-cycling of the second unit.

**Heating Example:**

- **First-Stage Set Point:** 60°F
- **Second-Stage Differential:** 2°F

First-stage heating will start when the indoor temperature reaches 59°F and will stop when the indoor temperature reaches 61°F.

Second-stage heating will start when the indoor temperature reaches 57°F and will stop when the indoor temperature reaches 61°F.

**Heating Sequence:**

<table>
<thead>
<tr>
<th>Shelter Temperature</th>
<th>Mechanical Heating Operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;60°F</td>
<td>Energize Heating Element Lead Unit</td>
</tr>
<tr>
<td>&lt;58°F</td>
<td>Energize Heating Element Lead &amp; Lag Unit</td>
</tr>
<tr>
<td>&gt;60°F</td>
<td>De-Energize Heating Element(s) IBM runs on Lead Unit</td>
</tr>
</tbody>
</table>
The main screen with the set point control panel is presented below. Note that if the cooling and heating temperature set points overlap, the system will select cooling.

### DC Free-Air Cooling
When the calculated outside air dew point is less than 60°F, the outside air temperature is less than 70°F, and the outside air relative humidity is less than 80%, mechanical cooling is disabled and outside air is introduced to cool the shelter. All three conditions must be satisfied before DC Free-Air cooling is enabled. In DC Free-Air cooling the damper is opened and its position regulated to mix outside air with internal shelter air. Every twenty-four hours, the damper is opened to 50% to verify the operation of damper motor, damper fault switch, and damper actuator linkage.

### Emergency Ventilation
The Marvair CoolLinks system will enable emergency ventilation if landline power is lost or if both HVAC units are in lockout. If the outside air temperature is lower than the inside air temperature, the system will open the damper and run the Indoor Blower Motor on each HVAC unit. The system again modulates the damper position to mix outside air with internal shelter air.

### Smoke Detection
If the smoke sensor input to the CoolLinks system is active, the Compressor, Heater, and Indoor Blower Motor on both HVAC units will be shut down and the damper will be fully closed. This is to halt the flow of air within the shelter.
Hydrogen Detection
If the hydrogen sensor input to the CoolLinks system is active, the damper(s) on units that are not currently mechanically cooling will be fully opened and the Indoor Blower Motor(s) will be turned on. The intention here is to expel noxious gases and to introduce outside air into the shelter.

Generator Running
If the generator running input to the CoolLinks system is active, only one HVAC unit will be permitted to run mechanical cooling. As the generator is sized to run only one HVAC unit, this ensures that the generator load is not exceeded. Note: When in generator run mode, the HVAC unit is **not** allowed to operate in the DC Free-Air Cooling mode. This prevents “wet stacking” of the generator because the engine would be running at a small percentage of its capacity.

HVAC Standalone Operation
If the CoolLinks™ board in the HVAC unit is unable to communicate with the PLC in the shelter for a period of sixty seconds the HVAC unit will select standalone mode. Here, the HVAC unit will run mechanical cooling and cool the shelter to a set point of 75°F. The mixed air sensor inside the HVAC unit functions as the shelter temperature sensor. When communications with the PLC is restored, the CoolLinks™ board will automatically drop out of standalone mode and return to PLC-controlled operation.

**CoolLinks Function Test Procedure**

- Ensure all cables and connections are properly installed from each HVAC unit to the CoolLinks control panel.
- Switch the AC and DC breakers to the ON position in each connected HVAC.
- Switch the DC breaker powering the CoolLinks control panel to the ON position. This breaker is located inside the shelter and provides power to the CoolLinks PLC.
- Wait for the CoolLinks control panel to display the home screen. (Approx. 30 sec.)
- Observe the home screen for any active alarms (allow 1 minute) and address any issues at this time.
- Observe the Indoor air temperature, Outdoor air temperature, Dew point and Relative Humidity at this time. Make sure all values are within reason to actual conditions.

**Mechanical Cooling Test**
NOTE: The Indoor Blower will always operate continuously on the Lead unit.

- Set the Cooling first stage set point 3°F below the Indoor air temperature displayed on the screen.
- The Lead unit will start in the Mechanical cooling mode if the outdoor conditions are not favorable for DC free cooling.
- Allow the Lead unit to operate in mechanical cooling.
- Press the Lead Swap button on the screen to swap the Lead unit to the Lag unit.
- The former Lag unit will now become the Lead unit and the mechanical cooling will start.
- Allow the now Lead unit to operate in mechanical cooling.
- To allow both HVAC units to operate in the mechanical cooling mode simultaneously, set the Cooling first stage set point 10°F below the Indoor temperature displayed on the screen. The Lag unit will start in the mechanical cooling mode. The anti-short cycle timer of the compressor circuit may be active.

Note: The HVAC units have a minimum runtime of 5 minutes in mechanical cooling mode regardless of the temperature set point being met.
Electric Heater Test

- Set the Cooling first stage set point to 90°F.
- Set the Heating first stage set point 2°F above the indoor air temperature displayed on the screen.
- The Lead unit will start in the heating mode.
- Allow the heater to operate for a minute to verify heating.
- Press the Lead Swap button on the screen to swap the Lead unit to the Lag unit.
- The former Lag unit will now become the Lead unit and the heating mode will start.
- Allow the now Lead unit to operate in the heating mode.
- Change the heating and cooling set points back to the default values.

Emergency Ventilation and Exercising the Damper

- Switch “ALL” AC voltage breakers to the OFF position and keep the DC voltage breakers in the ON position in ALL connected HVAC units.
- The CoolLinks control panel will activate the Land Line power fail sequence after approximately 30 seconds.
- The indoor air temperature must be equal to or greater than the outdoor air temperature to activate the Emergency ventilation mode. The DC free air damper will open at this time.
- If the indoor air temperature is less than the outdoor air temperature, gradually warm the indoor air temperature sensor until it is greater than the outdoor air temperature.

Do not use an open flame or lighter to heat the sensor. This will damage the sensor. A hairdryer may be used to warm the sensor to prevent damage to the sensor

Note: This test will also trigger HVAC unit #1 and unit #2 Land Line power fail.

Smoke Alarm Test

- Install a temporary jumper inside the CoolLinks PLC panel from +24VDC terminal block to PLC Smoke Alarm input.
- When the Smoke Alarm input of the PLC is powered, all functions of each connected HVAC will shut down to prevent air movement in the shelter.
- Remove the temporary jumper to deactivate the Smoke alarm and allow HVAC operation to resume.

Hydrogen Alarm Test

- Install a temporary jumper inside the CoolLinks PLC panel from +24VDC terminal block to PLC Hydrogen Alarm input.
- When the Hydrogen Alarm input of the PLC is powered, the damper(s) on units that are not currently mechanically cooling will open fully and the Indoor Blower will operate. This will expel the noxious gases and induce outside air into the shelter.
- Remove the temporary jumper to deactivate the Hydrogen alarm and allow HVAC operation to resume.
- The damper(s) will close at this time and resume normal operation.
Generator Running Testing

- Install a temporary jumper inside the CoolLinks PLC panel from +24VDC terminal block to PLC Generator Running input.
- When the Generator Running input of the PLC is powered, only one HVAC is allowed to operate in the mechanical cooling mode based on the cooling set points.
- The Lag unit will not operate at any time during the Generator Running mode.
- The DC free air damper is also inoperable during the Generator Running mode. This is to prevent the wet stacking effect on the generator due to insufficient load.
- Remove the temporary jumper to deactivate the Generator Running mode and allow HVAC operation to resume.

FAQ’s and Troubleshooting Guide for the Marvair CoolLinks™ HVAC System

Temperature and Humidity Sensors:

Q. Why is the indoor temperature reading not correct?
Answer:
1. If the indoor sensor is reading 32F-38F degrees on the display, the red wire or +V connection is disconnected. The electric heat on both HVAC’s will operate when this condition is present.
2. If the indoor sensor is reading 139F degrees on the display, the green wire or GND connection is disconnected. The mechanical cooling on both HVAC’s will operate when this condition is present.
3. If the indoor sensor is reading 47F degrees on the display, the white wire or T connection is disconnected or the red and green wires are reversed. The electric heat on both HVAC’s will operate when this condition is present.

Q. Why is the outdoor temperature and humidity reading not correct?
Answers:
1. If the outdoor temperature and dew point are reading a negative value on the display, the black wire or connection to the PLC analog input (1) from the sensor is disconnected.
2. If the dew point and humidity are reading a ### or 0% value on the display, the white wire or connection to the PLC analog input (0) from the sensor is disconnected.
3. If the outdoor temperature, dew point and humidity are reading a very high value on the display, the blue wire or connection to the -24vdc terminal block from the sensor is disconnected. If the blue and brown wires are reversed at the -24vdc and +24vdc terminal block these values will also read very high. The red ERROR light on the PLC will also flash indicating improper connection.
4. If the outdoor temperature is reading -40F degrees, the dew point is reading ### and the humidity is reading 0%. The brown wire or connection to the +24vdc terminal block is disconnected. These values will also appear if the sensor is disconnected from the sensor cable on the outside of the shelter or if the sensor is not connected to the CoolLinks™ controller.

Q. Why does the CoolLinks™ display show (###) in the areas where a number should be displayed?
Answer:
1. The Ethernet cable from the HMI to the 8 port hub is disconnected or the Ethernet cable from the PLC to the 8 port hub is disconnected. When connected, an LED at each connection point should flash to indicate a connection.

CoolLinks™ Controller HMI Display and Power:

Q. Why will the CoolLinks™ Controller HMI display not power up?
Answers:
1. The power connector at the bottom of the display is disconnected.
2. The polarity of the DC power supply is reversed (Phoenix Contact). Source power should be +48vdc.
3. The DC breaker in the DC power bay is OFF.
Q. Why does the DC breaker for the CoolLinks™ Controller trip in the DC power bay?

Answer:
1. If the polarity of the CoolLinks™ DC power supply to the DC converter is reversed (-48vdc) the DC converter will be damaged (black CUI converter). The converter will need to be replaced in order to operate.  
   (Reference: Marvair ASDCA Polarity Check Bulletin 104)

CoolLinks™ Controller Alarms:

Q. What do these alarms mean?

Communications Alarm- The CoolLinks™ controller is not communicating with the HVAC control board.  

Troubleshooting:
1. The Ethernet cable from the CoolLinks™ Controller to the HVAC is disconnected or damaged.  
2. The NET ADDRESS dip switches 1-4 on the control board need to be properly set. Unit #1 should be set with all 4 dip switches in the OFF or down position. Unit #2 should be set with the number 1 dip switch in the ON or up position and dip switches 2,3 and 4 in the OFF or down position.

Damper Alarm- The actuator damper in the HVAC has failed to open when economizer mode is available.  
   (Reference: Marvair CoolLinks™ Damper Alarm Bulletin 103)

HVAC Troubleshooting:

Q. Why does the DC breaker for the HVAC trip in the DC power bay?

Answers:
1. The DC breaker may be undersized. The correct breaker sizing is 20amps for each HVAC.  
2. The polarity of the DC power supply is reversed (-48vdc) and the DC converter is damaged as a result. The polarity must be corrected to (+48vdc) and the DC converter inside the HVAC must be replaced.  
   Note: The DC converter can be disconnected from the (+48vdc) source to allow the HVAC to operate until the DC converter is replaced. With the DC converter disconnected, the actuator damper will not operate.  
   (Reference: Marvair ASDCA Polarity Check Bulletin 104)

Q. Why does the blower run continuously?

Answer:
1. The blower of the LEAD unit will operate continuously by default. This is to keep air moving in the shelter at all times and aid in preventing hot spots.

Q. Can I disable the continuous blower?

Answer:
1. This function cannot be disabled and is programmed into the PLC firmware.

Q. Why does the HVAC continue to operate in mechanical cooling when the cooling set-point has been reached?

Answer:
1. The CoolLinks™ Controller is programmed by default to operate in the mechanical cooling mode for a minimum of 5 minutes. This is to prevent short-cycling of the unit and to allow the compressor sufficient time to remove moisture from the air as well cool the shelter.

Q. When do the HVAC’s swap Lead unit operation?

Answer:
1. The CoolLinks™ Controller will swap the lead unit on each call for cooling and the blower will run continuously on the lead unit.
Q. How do I connect the HVAC fail alarm to the CoolLinks™ controller?  
(Reference: Marvair Fail Alarm Bulletin 101 REV 1)

Q. How do I get both HVAC’s to operate simultaneously?  
Answer:
1. Press the button in the center of the CoolLinks™ controller touchscreen where the indoor temperature is displayed and enter a new cooling set-point and press the enter arrow at the lower right of the screen. This set-point should be at least 10 degrees lower than the indoor temperature displayed. Once operation is confirmed, return the cooling set-point back to the previous value. The default cooling set-point is 77 degrees.

Q. How can I test the damper in the HVAC’s?  
Answer:
1. Switch the AC breakers OFF in both HVAC’s and keep the DC breakers ON. Wait for the inside shelter temperature to rise greater than the outdoor temperature. When the inside temperature is greater than the outside temperature the dampers will begin to open in both HVAC’S. This is referred to as emergency ventilation.
**CoolLinks™ Control board points of interest**

- **DC power (+)**
- **DC power (-)**
- **Lockout Alarm Contacts**
- **Ethernet port**
- **Thermocouple sensor**
- **Yellow wire +**
- **Red wire -**
- **Dirty Filter Input**
- **High press switch**
- **Low press switch**

**Additional Points of Interest**

- **Electric heat contactor output**
- **Spare blower dry contacts not used**
- **Indoor blower 10vdc output sign**
- **Damper output signal 0 to 10vdc**
- **Compressor contactor output**

**Network Address Dip Switches**

- Unit #1, ALL set to OFF
- Unit #2, 1 is ON, 2, 3, 4 is OFF

**Additional Notes**

- When blower is running the output will be between 9 and 10vdc from GND to OUT
- When damper is operating the output will have a range from 0 to 10vdc between GND and OUT

10 to 12vdc should always be present at TP5 (+12v) to TP4 (GND)