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Variable Speed Troubleshooting Guide

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Variable Speed Troubleshooting Guide

Introduction

This Trouble-Shooting Guide is designed to assist in determining operating difficulties with the ‘Variable Speed’ Air Handler or Furnace. It is not to be used to Trouble-Shoot Single Package equipment employing a Variable Speed Motor.

There are three unique components in Variable Speed units, the General Electric *ECM Motor*, the General Electric *ECM Microprocessor*, and the York *CFM Programming Board*. Before an attempt is made to repair or trouble-shoot; a good understanding of how the motor maintains a specific CFM is required.

The ECM Motor: ECM stands for Electronically Commutated Motor. The motor consists of two components, a DC Volt, Ball Bearing Motor; and an Electronic Control Module. In this Troubleshooting Guide, the Electronic Control Module will be referred to as the ECM Microprocessor. The ECM Microprocessor is designed to store the relationship between “Speed, Torque, and Air Flow” for the Blower Performance of any given unit. The ECM Motor is first programmed at the factory to match the operating characteristics and airflow range of a given model Furnace or Air Handler. At start-up, the installer sets the exact airflow in **Cubic Feet per Minute (CFM)** by choosing the proper speed taps on the CFM Programming Board.

The CFM Programming Board: The main function of the board is to allow the installer a means of choosing a design CFM and to accept input from the Thermostat, Humidistat, and Condensing Unit. Based on these inputs, the motor will vary the airflow to meet the programmed requirement, depending on the Mode of Operation. The CFM Board has a CFM Indicator Light that flashes 1 time for every 100 CFM. i.e.: 10 flashes = 1000 CFM. This is an indication of Actual CFM, not Programmed CFM. There are ‘Jumpers’ on the CFM Board that are used to make the speed selections.

Example: Assume we have a Single Stage, 2.5 Ton Unit, operating in a Cooling Only application in which the installer programs the CFM Board for 1000 CFM. The motor will ramp up to the required RPM to deliver 1000 CFM; based on the Torque it must develop to overcome the Static Resistance of the Duct System. If the resistance increases, causing a corresponding change in Torque, the motor will increase its RPM to maintain the desired airflow. Conversely, if the resistance decreases, the motor will decrease its RPM to maintain the selected CFM.

The ECM Microprocessor: The ECM Microprocessor is mounted on the end of the ECM Motor. It is described in the ECM Motor section above. The ECM Microprocessor is available as a Source One replacement part. See page 29 in Appendix A for the part numbers.

Note: This Guide may instruct you to replace the ECM Microprocessor. If an ECM Microprocessor is not available, you will have to replace the complete ECM Motor assembly, which includes the ECM Microprocessor.

The Motor’s Static Pressure Design Limit is 1” w.c. External Static Pressure. Below 1”, the motor will strive to maintain its set point CFM. If the static pressure exceeds the 1” limitation, the motor will modulate its speed up and down in an effort to maintain the programmed airflow. If left operating in this condition, the motor will be damaged. Generally, residential duct designs are based on Duct Static Pressure of about 0.50” w.c. Refer to the airflow charts in Appendix A for more information.

Note: Do Not connect a humidifier to the HUM terminals on the CFM Board! The HUM terminals on the CFM board allow input from a Humidistat for De-Humidification purposes only.

Operation

The ECM Motor is powered at all times with both High Voltage and Control Voltage. There are two Socket/Plug connectors on the Control end of the motor. A 5-Pin connector providing 120 or 240 volt power to drive the motor armature; and a 16-pin connector providing 24 volt control voltage and inputs.

If the motor is in an Air Handler, it will be set up for 240 Volts. If the motor is in a furnace it will be set up for 120 Volts. There is a jumper between pins 1 & 2 on the 5-pin connector for 120-volt operation. The jumper is absent for 240 volt use.

A 24-volt input to the motor ECM Microprocessor will cause the motor to operate at a programmed speed; or modify a programmed speed to a different speed.

The following will describe the 24-volt inputs and what effect they have on the motor.

Note: Most of the inputs are applied to the CFM Board at the thermostat connection terminal strip, processed, and passed on through the board to the Motor via the 16 pin harness. On furnace applications, 'Heating Speed' inputs are delivered directly to the motor from the 'Furnace Control'.

With 24 Volts present between Common and the following terminals, these will be the results.

G	The motor operates at 63% of its Programmed Cooling Speed.
Y1	The motor operates at 55% of its Programmed Cooling Speed.
Y2	No effect.
Y	The motor operates at its Programmed Cooling Speed.
W1	The motor operates at its Programmed Low Heat Speed.
W2	The motor operates at its Programmed High Heat Speed.
O	This input is always present unless the Heat Pump jumper is removed from the CFM Board. If this input is removed, the motor recognizes the use of a Heat Pump, in the Heating Mode. It operates at the greater of; the Programmed Heating Speed, or the Programmed Cooling Speed.
This action occurs upon the <u>removal</u> of the input 24 volt input.	
HUM	If the motor is operating at a 'Cooling Speed', its speed is reduced by 15%, to 85% of the original speed. This input allows a standard Humidistat to function as a 'De-Humidistat'. The reduced air flow across the evaporator coil allows for greater removal of humidity.
Note:	This is not a 'Speed Input'. It is a 'Speed Modification' input. It only effects the Cooling Speeds.
Important reminder:	Do not connect a Humidifier to this terminal!

Speed Input Examples:

Input on Y1, input removed from HUM: The motor operates at 85% of 55% of the Programmed Cooling Speed. i.e., the motor operates at 47% of the Programmed Cooling Speed.

Inputs on G and Y: The Y input takes precedent, and the motor operates at its Programmed Cooling Speed.

Inputs on Y, G, and W1; input removed from O: A Heat Pump is recognized. It is operating on both stages of heat. The greater of Y or W1 becomes the operating speed.

Reminder: The HUM input does not select a speed, but modifies a cooling speed.

Service Procedures

Steps you will take when troubleshooting the motor.

Voltage Check:

1. Select the 'Voltage Check Diagram' in Section 7 (Pages 9-23), for your mode of operation.
2. Remove power from the unit.
3. Unplug the 16-pin connector from the ECM Microprocessor.
4. Restore power to the unit.
5. Measure and record the voltage on each pin of the connector.
6. Compare the measured voltages to the diagram voltages.
7. If the voltages are correct, replace the ECM Microprocessor.
8. If the voltages are incorrect, verify that the thermostat inputs are correct.
9. If the voltages are still incorrect, replace the CFM Board.

Moisture Check:

1. Remove power from the unit.
2. Look for the presence of moisture on or around the motor.
3. If moisture is found, apply heat with a heat gun to dry the ECM Microprocessor.
4. Locate the source of the moisture and correct the problem.
5. Make sure the harness plugs are below the motor.
6. Rotate the motor if necessary.
7. Form a drip loop in both of the wiring harnesses under the motor.
8. Restore power to the unit.
9. Check operation.
10. If operation is ok, moisture was the problem.

Resistance Check:

1. Remove power from the unit and wait 5 minutes for the electronic components to completely de-energize.
2. Remove the two ¼" hex head bolts attaching the ECM Microprocessor to the end of the Motor.
3. Support the ECM Microprocessor while removing the bolts.
4. The ECM Microprocessor is electrically connected to the ECM Motor with a 3-pin connector.
5. Remove the 3-pin connector from the ECM Microprocessor.
6. Set your Ohmmeter to the 100,000 Ω setting.
7. Check resistance between each of the ECM Motor leads and the case of the motor.
8. The resistance between each lead to case should be greater than 100K Ω .
9. If the resistance is less than 100K Ω , replace the ECM Motor.

Section 1

Symptom: Motor will not start; no movement.

1. Remove power from the unit and remove the 5-Pin connector from the motor.
2. Apply power to the unit.
3. Check for the correct voltage between pins 4 and 5 of the 5-pin wiring harness connector.
 - ✓ Furnaces have a white wire at Pin 4 and a brown wire at Pin 5.
 - ✓ Air Handlers have a yellow wire at Pin 4 and a purple wire at Pin 5.
 - ✓ A furnace operates at 120 Volts AC and should have a black jumper between Pins 1 and 2 of the 5-pin connector.
 - ✓ An Air Handler operates at 240 Volts AC and should not have the jumper.

Is the correct voltage present?

No Determine why and correct.

Yes Remove power, reconnect the 5-pin connector, go to Step 4.

4. Place a jumper between 'R' and 'G' at the low voltage terminal block.

Does the blower run?

No Go to Step 5.

Yes The problem is in the thermostat, thermostat wiring, or connections.
5. Run 'Fan Only' Voltage Check.
 - Refer to Page 3, Voltage Check; and Section 7, Page 10, for Voltage Check Diagram
 - Are the correct voltages present?

No Determine why and correct. (Check the following items.)

 - ✓ Check for loose terminals at the plug connections.
 - ✓ Check for incorrect connections within the harness.

Yes Remove power and reinstall the 16-pin connector to the motor control.

Go to Step 6.
6. With the power off, spin the blower wheel.

Does the blower spin.

No Determine why.

 - ✓ Check for an obstruction in the housing.
 - ✓ Check for a loose blower on the shaft.
 - If the motor can not be made to spin, replace it.

Yes Go to Step 7.
7. Run moisture check. Refer to Page 3.

Did it pass the moisture check?

No Correct the moisture problem.

Yes Go to Step 8.

8. Does the motor run?
 - No Go to Step 9.
 - Yes End of troubleshooting.

9. Run resistance check. Refer to Page 3.
 - Did it pass the resistance check?
 - No Replace the ECM Motor.
 - Yes Replace the ECM Microprocessor.

Section 2

Symptom: Motor runs when it should be off

1. Wait 5 minutes for any time delay to time out.
 - Did the motor shut off?
 - No Go to Step 2.
 - Yes There is not a problem. It was in 'Blower Off Delay' Mode.

2. Is the unit an Air Handler or Furnace?
 - Air Handler Go to Step 3.
 - Furnace Go to Step 5.

3. Does the Air Handler have electric heat?
 - No Check for the presence of a jumper wire, between Pin 2 and Pin 3, at the 6-pin connector on the Air Handler Control Board.
 - If one is not present, install one.
 - Yes Check for an open limit switch.
 - ✓ 24 Volts DC should be present between the 'Orange' wire at the limit and 'C' at the 24-Volt Terminal Board.
 - Go to Step 4.

4. Is the limit open?
 - No Go to Step 5.
 - Yes Check for low airflow and correct the problem.
 - ✓ Verify that the correct CFM has been selected on the CFM Board.

5. Remove all of the thermostat wiring from the low voltage terminal block.
 - Does the motor shut off?
 - No Go to Step 6.
 - Yes The problem is in the thermostat or thermostat wiring. Determine where the signal is coming from and correct the problem.

6. Run voltage check for a unit in the 'Stand-by Mode'. (Section 7, Page 9)
 - Does it pass the Voltage Check?
 - No Replace the CFM Board.
 - Yes Replace the ECM Microprocessor.

Section 3

Symptom: Motor runs Backwards

1. Verify that the part number of the ECM Microprocessor and /or the ECM Motor is correct.
 - Refer to Page 29 for Part Numbers.
2. Reversed rotation is usually a sign that the wrong ECM Motor is being used or that the ECM Microprocessor has been programmed incorrectly.
3. Replace the ECM Motor and /or ECM Microprocessor with the correct one.

Section 4

Symptom: The motor speed modulates up and down

1. Remove the blower door from the unit.
 - Does the blower still modulate?
 - No The duct static is too great. The motor can not achieve its programmed airflow. Correct the problems causing high static pressure in the duct.
 - Yes Go to Step 2.
2. Remove the thermostat wiring from the unit. Place a jumper between 'R' and 'G' on the low voltage terminal block.
 - Does the motor still modulate?
 - No Check the following.
 - ✓ The problem is in the thermostat wiring, or
 - ✓ The problem is an intermittent call from the thermostat, or
 - ✓ The problem is an intermittent call from the humidistat.
 - An intermittent call may be caused by short-cycling of the thermostat or humidistat. You will need to determine what is causing the short-cycle to occur.
 - Yes Run moisture check, see page 3.
3. Does the motor still modulate?
 - No End of troubleshooting.
 - Yes Go to Step 4.
4. Run voltage check for a unit in the 'Stand-by Mode'. (Section 7, Page 9)
 - Do any of the voltage readings modulate?
 - No Replace the ECM Microprocessor.
 - Yes Replace the CFM Board.

Section 5

Symptom: Motor does not operate at the Programmed Speed

1. Let the motor operate for 5 minutes to make sure it is not in a delay period.
2. Compare the number of flashes of the Green LED on the CFM Board to the programmed CFM.
3. The light should flash 1 time for every 100 CFM.
4. Keep in mind that the CFM will change, based on the Mode of Operation. Refer to the Voltage Input Section on page 2 to determine what the 'Actual' airflow should be for your Mode of Operation.
5. Refer to Appendix A, Pages 25-28, for the air flow tables.
6. Run Voltage Check.
Are the voltages correct for the Mode of Operation you are in?
No Check the following.
 - ✓ Make sure the pins are fully inserted and tight in their sockets.
 - ✓ Check the harness wiring against the diagram to ensure correct connections.
 - ✓ Verify that the correct inputs are present at the thermostat terminals of the CFM Board.Yes Go to Step 7.
7. Run Moisture Check
Was moisture the problem?
No Go to Step 8.
Yes End of troubleshooting.
8. The motor is either programmed incorrectly or defective. Replace the ECM Microprocessor.

Section 6

Furnaces Only

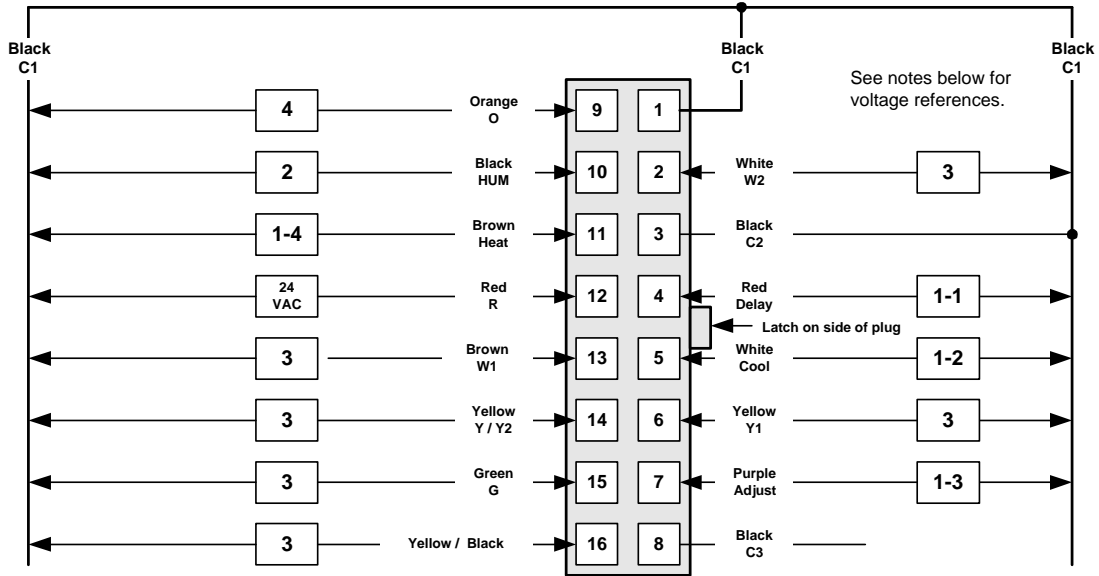
Symptom: Motor runs on Cool; Will not run on Heat

- The Cool Speed Inputs are sent to the ECM Microprocessor from the CFM Board.
 - The Heat Speed Inputs do not go to the CFM Board. They are sent directly to the ECM Microprocessor from the Furnace Control Module.
 - The 16-Pin plug is the same at the CFM Board and the ECM Microprocessor. They can be mistakenly interchanged.
 - Therefore, it is possible to get the harness installed 'backwards'.
 - If the Heat Speed Inputs from the Furnace Control go to the CFM Board instead of the ECM Microprocessor, the motor will not run on a call for heat.
1. Compare the wiring connections between the Furnace Control and the ECM Microprocessor to the Wiring Diagram.
 - ✓ The *White Wire* should run from Heat High on the furnace control to pin 2 of the ECM Microprocessor.
 - ✓ The *Brown Wire* should run from Heat Low on the furnace control to pin 13 of the ECM Microprocessor.Are they correct?
 - ✓ The plug at the CFM Board should contain 14 wires.
 - ✓ The plug at the ECM Microprocessor should contain 16 wires.No Reverse the harness.
 - Remove the two 16-pin connectors from the CFM Board and the ECM Microprocessor.
 - Attach the connector with 14 wires to the CFM Board.
 - Attach the connector with 16 wires to the ECM Microprocessor.Yes Go to Step 2.
 2. Check for 24 volts AC at the 'Circ In' terminal on the Furnace Control.
Is voltage present?
 - No Determine why and correct the problem.
 - Yes Go to Step 3.
 3. Check for 24 volts AC at the Heat Low or Heat High terminal of the Furnace Control.
 - 1st stage operation = 24 volts AC on Heat Low.
 - 2nd stage operation = 24 volts AC on Heat High.Is voltage present?
 - No Replace the Furnace Control.
 - Yes Refer to Section 1.

Section 7

Voltage Check Stand-By Mode

Note: When running this voltage check, all of the thermostat wires must be disconnected.



This view is of the Harness Plug (looking at the pins) after having been removed from the Motor
All voltages are taken with the Negative Lead of the Volt Meter on Pin 1
All voltages are AC unless otherwise noted



Depends on the position of the Tap on the CFM Board

- A = Less than 2.5 Volts
- B = + 12 Volts DC
- C = - 12 Volts DC
- D = 24 Volts

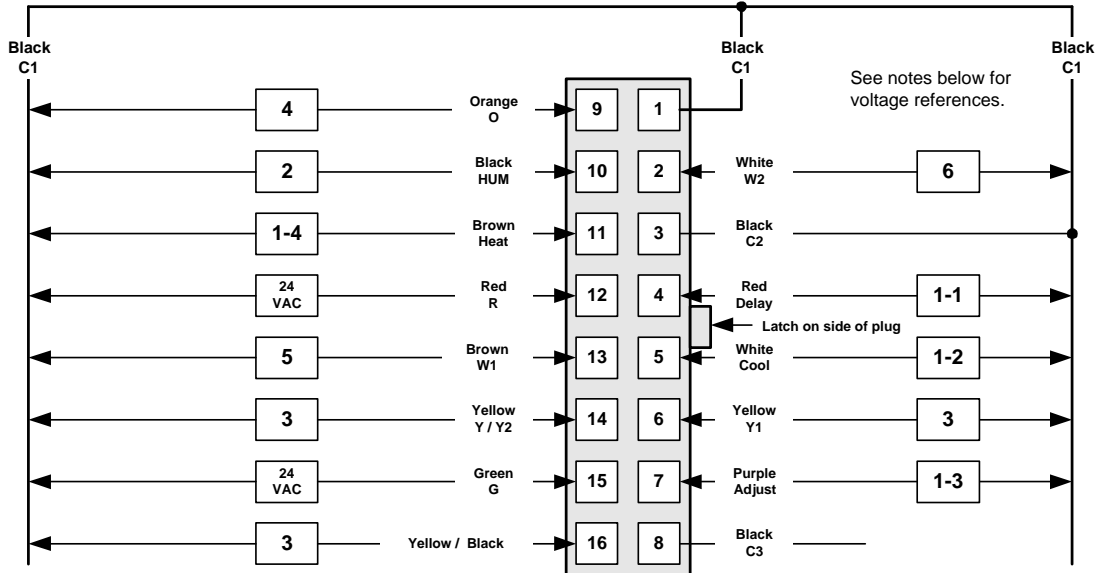
2 Is the HUM circuit energized by a Humidistat, or is the Humidistat Jumper installed on the CFM Board? Yes = 24 Volts No = Less than 2.5 Volts

3 Less than 2.5 Volts

4 Is there a Heat Pump thermostat set to the 'Cool' position or is the 'Heat Pump' jumper installed on the CFM Board? Yes = 24 Volts No = Less than 2.5 Volts

Section 7

Voltage Check Continuous Fan Variable Speed Furnace



This view is of the Harness Plug (looking at the pins) after having been removed from the Motor
All voltages are taken with the Negative Lead of the Volt Meter on Pin 1
All voltages are AC unless otherwise noted



Depends on the position of the Tap on the CFM Board

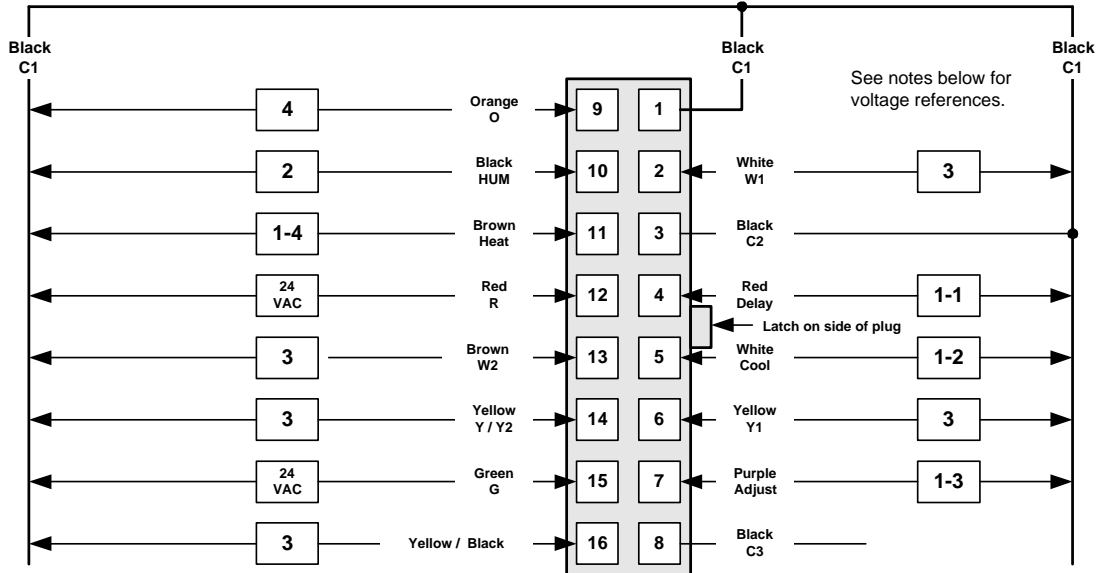
- A = Less than 2.5 Volts
- B = + 12 Volts DC
- C = - 12 Volts DC
- D = 24 Volts

- 2** Is the HUM circuit energized by a Humidistat, or is the Humidistat Jumper installed on the CFM Board? Yes = 24 Volts No = Less than 2.5 Volts
- 3** Less than 2.5 Volts
- 4** Is there a Heat Pump thermostat set to the 'Cool' position or is the 'Heat Pump' jumper installed on the CFM Board? Yes = 24 Volts No = Less than 2.5 Volts
- 5** Is DIP Switch 3 on the Furnace Control Module in the ON position? Yes = 24 Volts No = Less than 2.5 Volts
- 6** Is Dip Switch 3 on the Furnace Control Module in the OFF position? Yes = 24 Volts No = Less than 2.5 Volts

Note: If the Green wire is not attached to the G terminal of the Furnace Control, both 5 and 6 will be less than 2.5 volts.

Section 7

Voltage Check Continuous Fan Variable Speed Air Handler



This view is of the Harness Plug (looking at the pins) after having been removed from the Motor
All voltages are taken with the Negative Lead of the Volt Meter on Pin 1
All voltages are AC unless otherwise noted



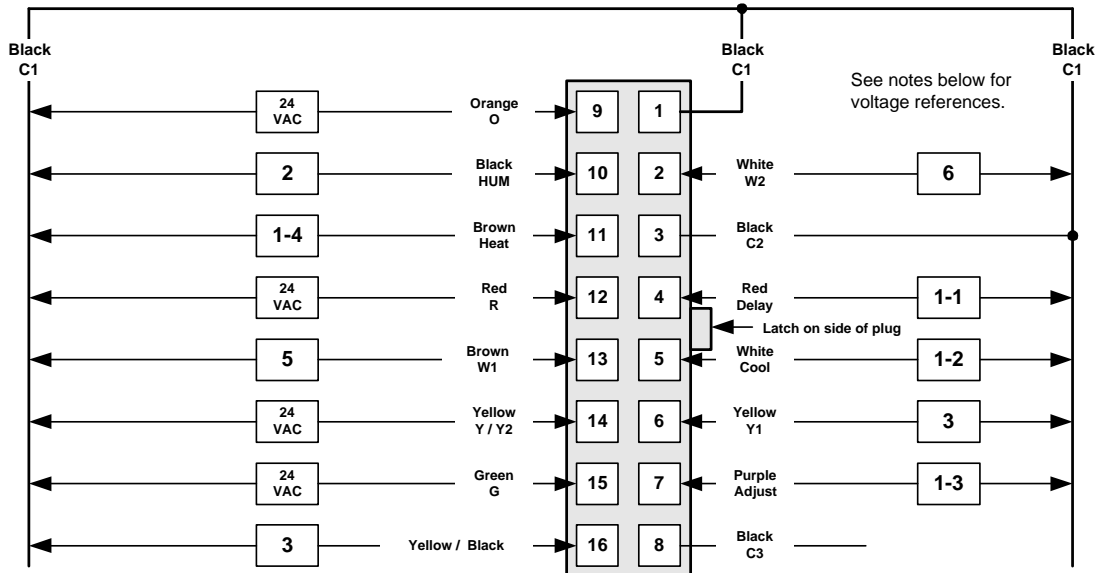
Depends on the position of the Tap on the CFM Board

- A = Less than 2.5 Volts
- B = + 12 Volts DC
- C = - 12 Volts DC
- D = 24 Volts

- | | |
|---|---|
| 2 | Is the HUM circuit energized by a Humidistat, or is the Humidistat Jumper installed on the CFM Board?
Yes = 24 Volts No = Less than 2.5 Volts |
| 3 | Less than 2.5 Volts |
| 4 | Is there a Heat Pump thermostat set to the 'Cool' position or is the 'Heat Pump' jumper installed on the CFM Board?
Yes = 24 Volts No = Less than 2.5 Volts |

Section 7

Voltage Check Single Stage Cooling Variable Speed Furnace



This view is of the Harness Plug (looking at the pins) after having been removed from the Motor
 All voltages are taken with the Negative Lead of the Volt Meter on Pin 1
 All voltages are AC unless otherwise noted



Depends on the position of the Tap on the CFM Board

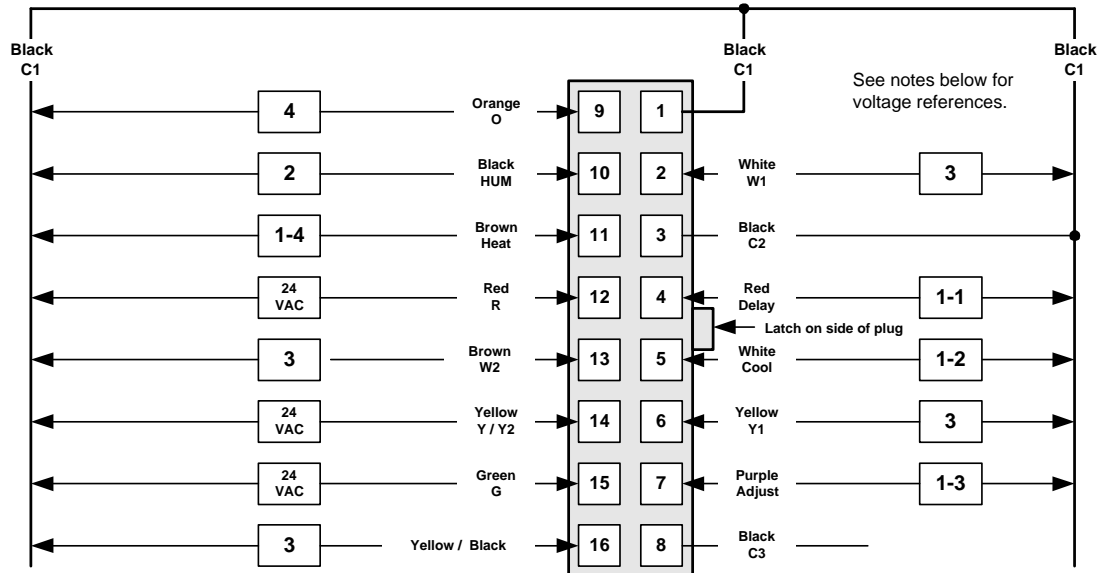
- A = Less than 2.5 Volts
- B = + 12 Volts DC
- C = - 12 Volts DC
- D = 24 Volts

- | | |
|----------|---|
| 2 | Is the HUM circuit energized by a Humidistat, or is the Humidistat Jumper installed on the CFM Board?
Yes = 24 Volts No = Less than 2.5 Volts |
| 3 | Less than 2.5 Volts |
| 4 | Is there a Heat Pump thermostat set to the 'Cool' position or is the 'Heat Pump' jumper installed on the CFM Board?
Yes = 24 Volts No = Less than 2.5 Volts |
| 5 | Is DIP Switch 3 on the Furnace Control Module in the ON position?
Yes = 24 Volts No = Less than 2.5 Volts |
| 6 | Is Dip Switch 3 on the Furnace Control Module in the OFF position?
Yes = 24 Volts No = Less than 2.5 Volts |

Note: If the Green wire is not attached to the G terminal of the Furnace Control, both 5 and 6 will be less than 2.5 volts.

Section 7

Voltage Check Single Stage Cooling Variable Speed Air Handler



This view is of the Harness Plug (looking at the pins) after having been removed from the Motor
 All voltages are taken with the Negative Lead of the Volt Meter on Pin 1
 All voltages are AC unless otherwise noted



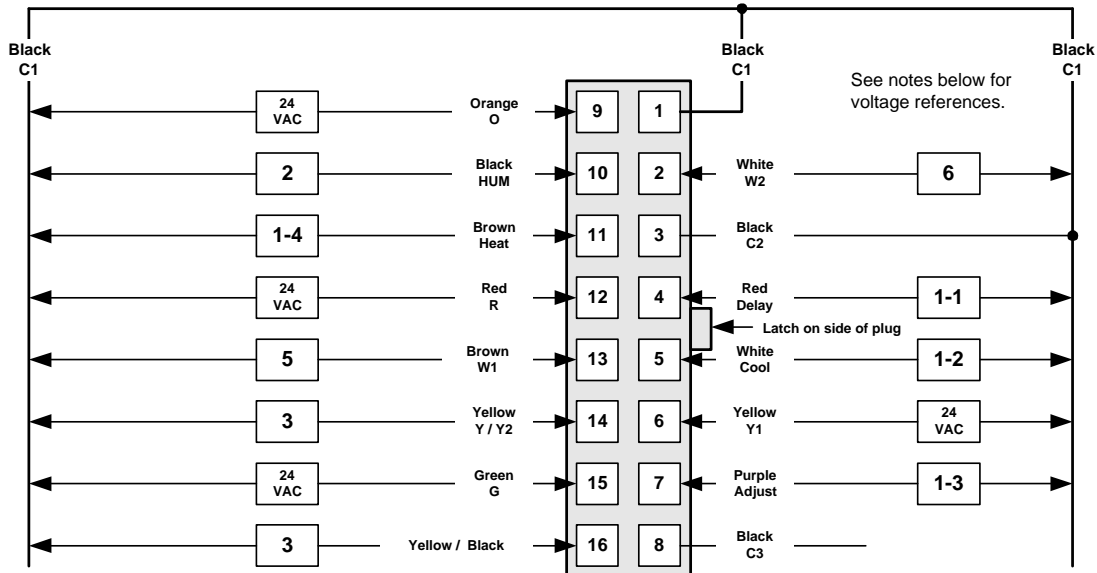
Depends on the position of the Tap on the CFM Board

- A = Less than 2.5 Volts
- B = + 12 Volts DC
- C = - 12 Volts DC
- D = 24 Volts

- | | |
|----------|---|
| 2 | Is the HUM circuit energized by a Humidistat, or is the Humidistat Jumper installed on the CFM Board?
Yes = 24 Volts No = Less than 2.5 Volts |
| 3 | Less than 2.5 Volts |
| 4 | Is there a Heat Pump thermostat set to the 'Cool' position or is the 'Heat Pump' jumper installed on the CFM Board?
Yes = 24 Volts No = Less than 2.5 Volts |

Section 7

Voltage Check 2 Stage Cooling, 1st Stage Operation Variable Speed Furnace



This view is of the Harness Plug (looking at the pins) after having been removed from the Motor
All voltages are taken with the Negative Lead of the Volt Meter on Pin 1
All voltages are AC unless otherwise noted



Depends on the position of the Tap on the CFM Board

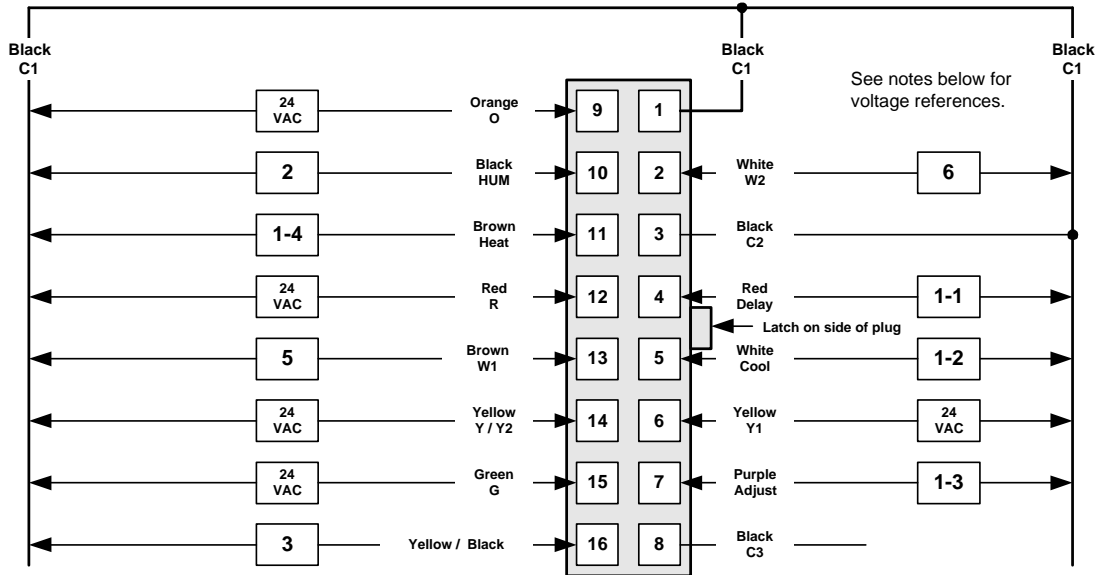
- A = Less than 2.5 Volts
- B = + 12 Volts DC
- C = - 12 Volts DC
- D = 24 Volts

- | | |
|----------|---|
| 2 | Is the HUM circuit energized by a Humidistat, or is the Humidistat Jumper installed on the CFM Board?
Yes = 24 Volts No = Less than 2.5 Volts |
| 3 | Less than 2.5 Volts |
| 4 | Is there a Heat Pump thermostat set to the 'Cool' position or is the 'Heat Pump' jumper installed on the CFM Board? Yes = 24 Volts No = Less than 2.5 Volts |
| 5 | Is DIP Switch 3 on the Furnace Control Module in the ON position?
Yes = 24 Volts No = Less than 2.5 Volts |
| 6 | Is Dip Switch 3 on the Furnace Control Module in the OFF position?
Yes = 24 Volts No = Less than 2.5 Volts |

Note: If the Green wire is not attached to the G terminal of the Furnace Control, both 5 and 6 will be less than 2.5 volts.

Section 7

2 Stage Cooling, 2nd Stage Operation Variable Speed Furnace



This view is of the Harness Plug (looking at the pins) after having been removed from the Motor
 All voltages are taken with the Negative Lead of the Volt Meter on Pin 1
 All voltages are AC unless otherwise noted



Depends on the position of the Tap on the CFM Board

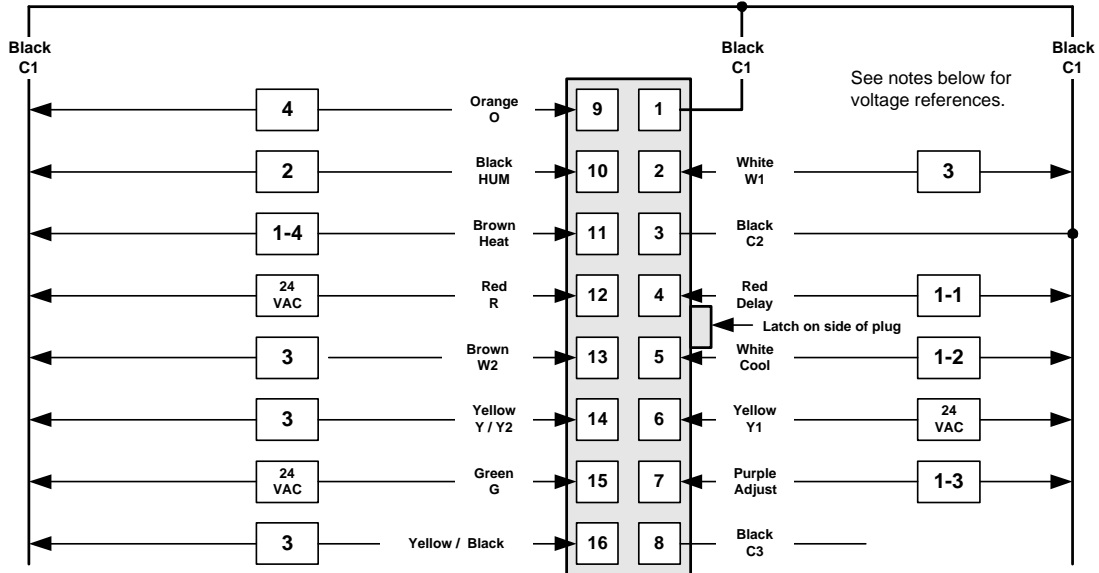
- A = Less than 2.5 Volts
- B = + 12 Volts DC
- C = - 12 Volts DC
- D = 24 Volts

- | | |
|----------|---|
| 2 | Is the HUM circuit energized by a Humidistat, or is the Humidistat Jumper installed on the CFM Board? Yes = 24 Volts No = Less than 2.5 Volts |
| 3 | Less than 2.5 Volts |
| 4 | Is there a Heat Pump thermostat set to the 'Cool' position or is the 'Heat Pump' jumper installed on the CFM Board? Yes = 24 Volts No = Less than 2.5 Volts |
| 5 | Is DIP Switch 3 on the Furnace Control Module in the ON position?
Yes = 24 Volts No = Less than 2.5 Volts |
| 6 | Is Dip Switch 3 on the Furnace Control Module in the OFF position?
Yes = 24 Volts No = Less than 2.5 Volts |

Note: If the Green wire is not attached to the G terminal of the Furnace Control, both 5 and 6 will be less than 2.5 volts.

Section 7

Voltage Check 2 Stage Cooling, 1st Stage Operation Variable Speed Air Handler



This view is of the Harness Plug (looking at the pins) after having been removed from the Motor
All voltages are taken with the Negative Lead of the Volt Meter on Pin 1
All voltages are AC unless otherwise noted



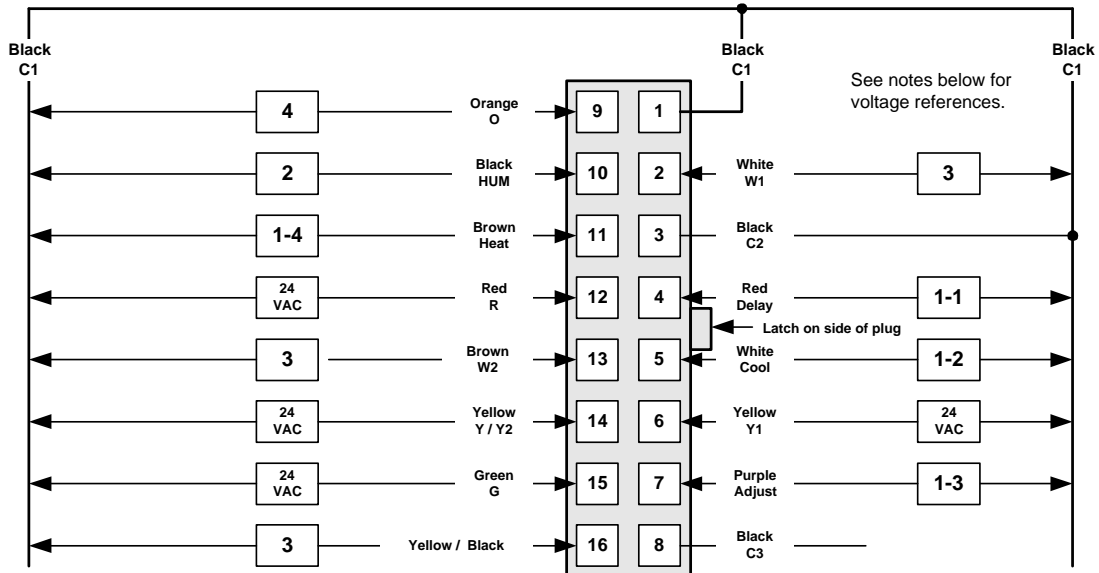
Depends on the position of the Tap on the CFM Board

- A = Less than 2.5 Volts
- B = + 12 Volts DC
- C = - 12 Volts DC
- D = 24 Volts

- | | |
|----------|---|
| 2 | Is the HUM circuit energized by a Humidistat, or is the Humidistat Jumper installed on the CFM Board?
Yes = 24 Volts No = Less than 2.5 Volts |
| 3 | Less than 2.5 Volts |
| 4 | Is there a Heat Pump thermostat set to the 'Cool' position or is the 'Heat Pump' jumper installed on the CFM Board?
Yes = 24 Volts No = Less than 2.5 Volts |

Section 7

Voltage Check 2 Stage Cooling, 2nd Stage Operation Variable Speed Air Handler



This view is of the Harness Plug (looking at the pins) after having been removed from the Motor
All voltages are taken with the Negative Lead of the Volt Meter on Pin 1
All voltages are AC unless otherwise noted



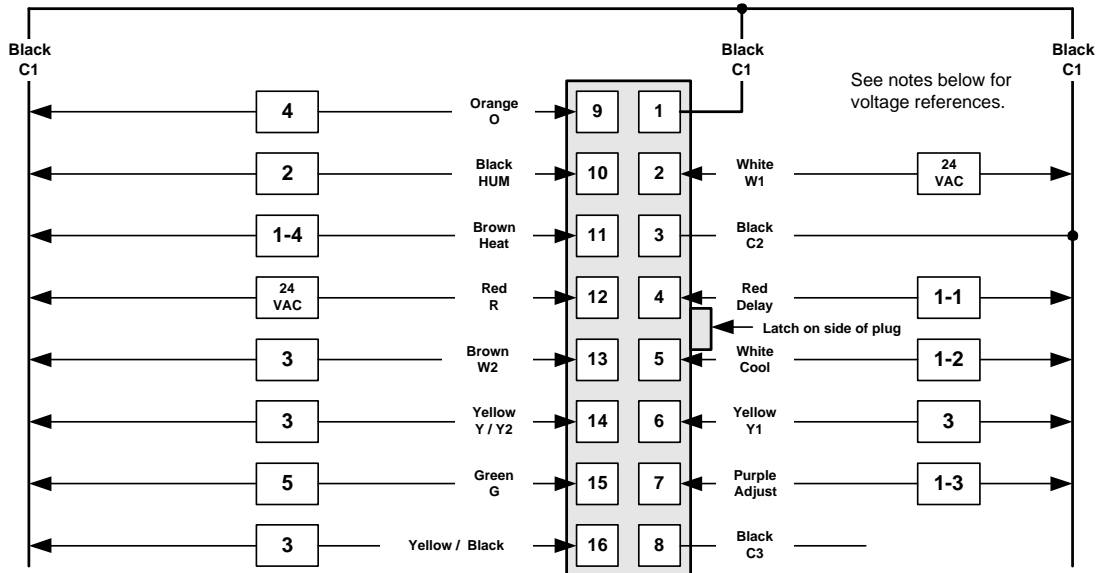
Depends on the position of the Tap on the CFM Board

- A = Less than 2.5 Volts
- B = + 12 Volts DC
- C = - 12 Volts DC
- D = 24 Volts

- | | |
|----------|---|
| 2 | Is the HUM circuit energized by a Humidistat, or is the Humidistat Jumper installed on the CFM Board?
Yes = 24 Volts No = Less than 2.5 Volts |
| 3 | Less than 2.5 Volts |
| 4 | Is there a Heat Pump thermostat set to the 'Cool' position or is the 'Heat Pump' jumper installed on the CFM Board?
Yes = 24 Volts No = Less than 2.5 Volts |

Section 7

Voltage Check 2 Stage Electric Heat, 1st Stage Operation Air Handler without a Heat Pump



This view is of the Harness Plug (looking at the pins) after having been removed from the Motor
All voltages are taken with the Negative Lead of the Volt Meter on Pin 1
All voltages are AC unless otherwise noted



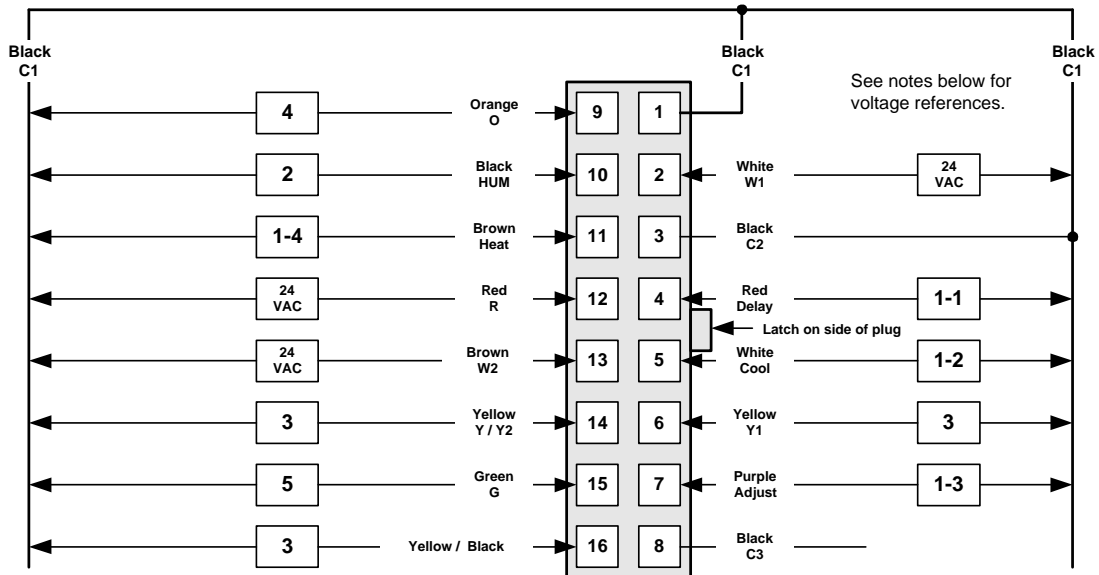
Depends on the position of the Tap on the CFM Board

A = Less than 2.5 Volts
B = + 12 Volts DC
C = - 12 Volts DC
D = 24 Volts

- | | |
|----------|---|
| 2 | Is the HUM circuit energized by a Humidistat, or is the Humidistat Jumper installed on the CFM Board?
Yes = 24 Volts No = Less than 2.5 Volts |
| 3 | Less than 2.5 Volts |
| 4 | Is there a Heat Pump thermostat set to the 'Cool' position or is the 'Heat Pump' jumper installed on the CFM Board?
Yes = 24 Volts No = Less than 2.5 Volts |
| 5 | Is the Thermostat Fan Switch set to the ON position?
Yes = 24 Volts No = Less than 2.5 Volts |

Section 7

Voltage Check 2 Stage Electric Heat, 2nd Stage Operation Air Handler without a Heat Pump



This view is of the Harness Plug (looking at the pins) after having been removed from the Motor
All voltages are taken with the Negative Lead of the Volt Meter on Pin 1
All voltages are AC unless otherwise noted



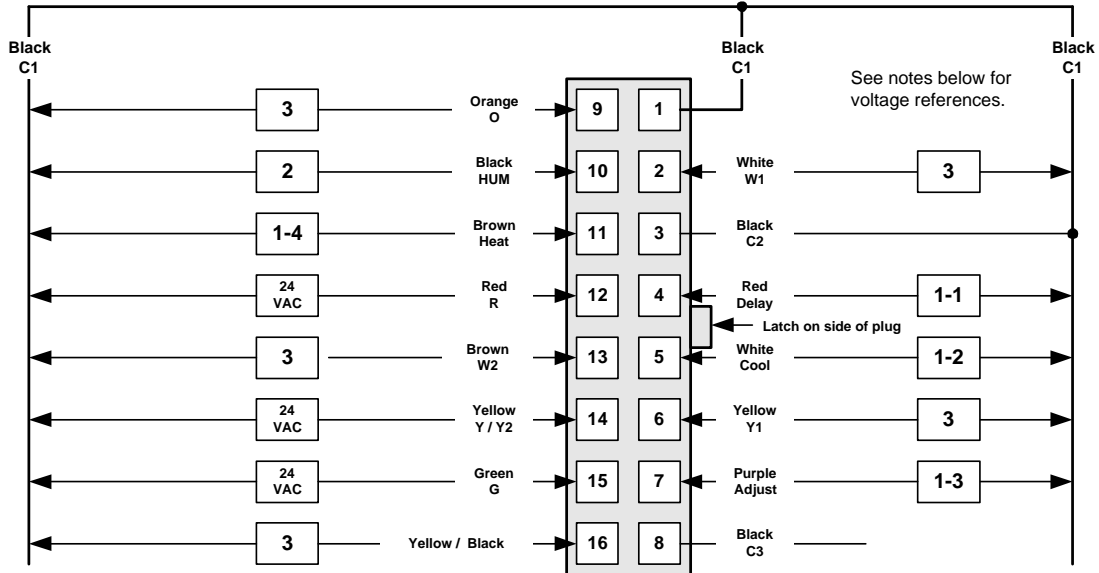
Depends on the position of the Tap on the CFM Board

- A = Less than 2.5 Volts
- B = + 12 Volts DC
- C = - 12 Volts DC
- D = 24 Volts

- | | |
|----------|---|
| 2 | Is the HUM circuit energized by a Humidistat, or is the Humidistat Jumper installed on the CFM Board? Yes = 24 Volts No = Less than 2.5 Volts |
| 3 | Less than 2.5 Volts |
| 4 | Is there a Heat Pump thermostat set to the 'Cool' position or is the 'Heat Pump' jumper installed on the CFM Board? Yes = 24 Volts No = Less than 2.5 Volts |
| 5 | Is the Thermostat Fan Switch set to the ON position?
Yes = 24 Volts No = Less than 2.5 Volts |

Section 7

Voltage Check 2 Stage Electric Heat, 1st Stage Operation Air Handler with a Heat Pump



This view is of the Harness Plug (looking at the pins) after having been removed from the Motor
All voltages are taken with the Negative Lead of the Volt Meter on Pin 1
All voltages are AC unless otherwise noted



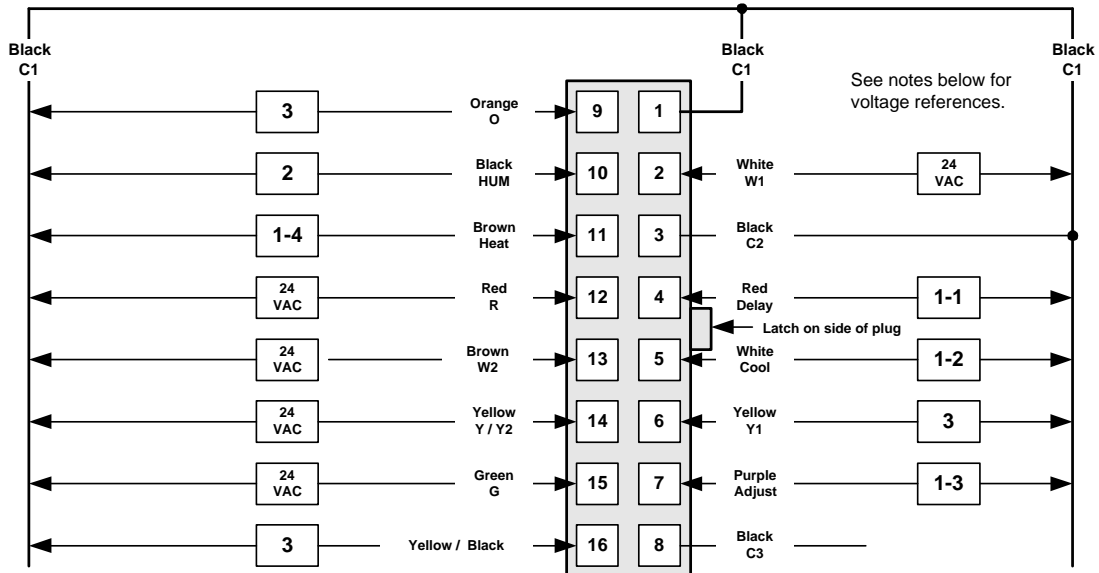
Depends on the position of the Tap on the CFM Board

- A = Less than 2.5 Volts
- B = + 12 Volts DC
- C = - 12 Volts DC
- D = 24 Volts

- | | |
|----------|---|
| 2 | Is the HUM circuit energized by a Humidistat, or is the Humidistat Jumper installed on the CFM Board?
Yes = 24 Volts No = Less than 2.5 Volts |
| 3 | Less than 2.5 Volts |
| 4 | Is there a Heat Pump thermostat set to the 'Cool' position or is the 'Heat Pump' jumper installed on the CFM Board?
Yes = 24 Volts No = Less than 2.5 Volts |

Section 7

Voltage Check 2 Stage Electric Heat, 2nd Stage Operation Air Handler with a Heat Pump



This view is of the Harness Plug (looking at the pins) after having been removed from the Motor
All voltages are taken with the Negative Lead of the Volt Meter on Pin 1
All voltages are AC unless otherwise noted



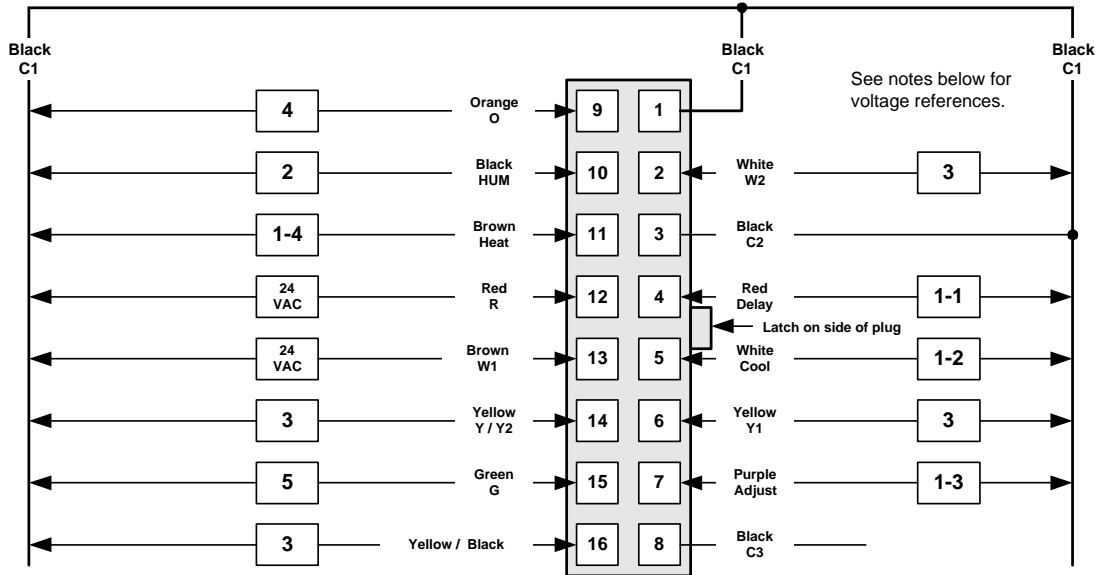
Depends on the position of the Tap on the CFM Board

- A = Less than 2.5 Volts
- B = + 12 Volts DC
- C = - 12 Volts DC
- D = 24 Volts

- | | |
|----------|---|
| 2 | Is the HUM circuit energized by a Humidistat, or is the Humidistat Jumper installed on the CFM Board? Yes = 24 Volts No = Less than 2.5 Volts |
| 3 | Less than 2.5 Volts |
| 4 | Is there a Heat Pump thermostat set to the 'Cool' position or is the 'Heat Pump' jumper installed on the CFM Board? Yes = 24 Volts No = Less than 2.5 Volts |

Section 7

Voltage Check 2 Stage Furnace, 1st Stage Heat



This view is of the Harness Plug (looking at the pins) after having been removed from the Motor
 All voltages are taken with the Negative Lead of the Volt Meter on Pin 1
 All voltages are AC unless otherwise noted



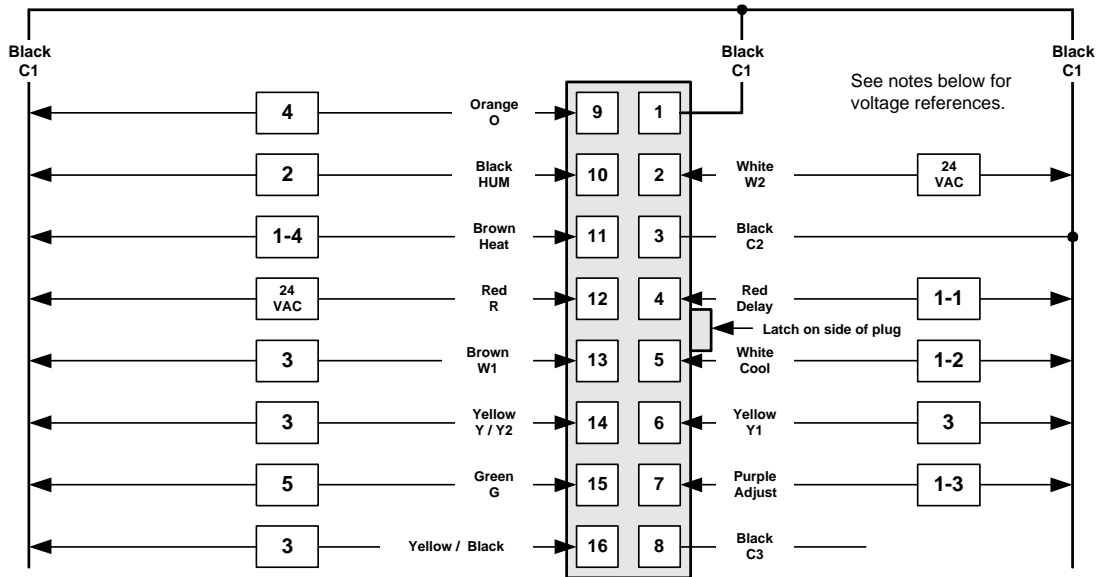
Depends on the position of the Tap on the CFM Board

- A = Less than 2.5 Volts
- B = + 12 Volts DC
- C = - 12 Volts DC
- D = 24 Volts

- | | |
|----------|---|
| 2 | Is the HUM circuit energized by a Humidistat, or is the Humidistat Jumper installed on the CFM Board? Yes = 24 Volts No = Less than 2.5 Volts |
| 3 | Less than 2.5 Volts |
| 4 | Is there a Heat Pump thermostat set to the 'Cool' position or is the 'Heat Pump' jumper installed on the CFM Board? Yes = 24 Volts No = Less than 2.5 Volts |
| 5 | Is the Thermostat Fan Switch set to the ON position?
Yes = 24 Volts No = Less than 2.5 Volts |

Section 7

Voltage Check 2 Stage Furnace, 2nd Stage Heat



This view is of the Harness Plug (looking at the pins) after having been removed from the Motor
 All voltages are taken with the Negative Lead of the Volt Meter on Pin 1
 All voltages are AC unless otherwise noted



Depends on the position of the Tap on the CFM Board

- A = Less than 2.5 Volts
- B = + 12 Volts DC
- C = - 12 Volts DC
- D = 24 Volts

- | | |
|----------|---|
| 2 | Is the HUM circuit energized by a Humidistat, or is the Humidistat Jumper installed on the CFM Board? Yes = 24 Volts No = Less than 2.5 Volts |
| 3 | Less than 2.5 Volts |
| 4 | Is there a Heat Pump thermostat set to the 'Cool' position or is the 'Heat Pump' jumper installed on the CFM Board? Yes = 24 Volts No = Less than 2.5 Volts |
| 5 | Is the Thermostat Fan Switch set to the ON position?
Yes = 24 Volts No = Less than 2.5 Volts |

Appendix A

CFM Selection

Cooling Selection

Use the attached tables to determine the position of the selector on the 'Cool' and 'ADJ' Pins. The position of these selectors controls both 1st Stage Cooling and 2nd Stage Cooling CFM. On a single stage unit, the CFM will be as indicated in the table. On a two stage unit, 1st Stage cfm will be approximately 63% of the selected cooling CFM.

Heating Selection

Use the attached tables to determine the position of the selector on the 'Heat' Pins. The position of this selector controls both 1st and 2nd stage Heating CFM. When applied with Electric Heat, the CFM is the same for either 1st or 2nd stage. On a furnace the CFM will vary between 1st and 2nd stage as indicated in the furnace tables.

Humidistat

This jumper is removed when a humidistat is installed. The humidistat is connected between R and the HUM terminal on the terminal board. When the Humidistat circuit is open, the Cooling CFM is decreased to 85% of the Cooling Selection. If it is a 2 stage unit, operating on 1st stage, the airflow will be 85% of 55% of the selected CFM; or 47% of the selected cooling CFM.

Heat Pump

This jumper is removed when a Variable Speed unit is installed with a Heat Pump. In the Heat Pump mode, with 2nd stage operation, (the compressor and electric heat operating at the same time), the Motor will operate at the higher of the Cooling or Heating Speed Selection.

Caution:

There is a 'Break Out' tab on the edge of the Control Board for all Air Handlers. For proper operation, the 'Break Out' tab must be removed when used with an ECM Motor! If this is not done, the life of the Motor will be shortened. Also, if electric heat is installed, and the limit opens, the blower will not be energized.

Note: Do not break out the tab if it is not a Variable Speed Air Handler.

Airflow Selections Variable Speed Air Handlers

High Speed Cooling and Heat Pump CFM				
Model			Tap Selections	
N-VSB12	N-VSC16	N-VSD20 / F-FV060	Cool Tap	ADJ Tap
1250	1650	2100	A	B
1230	1570	1980	B	B
1150	1500	1860	A	A
1070	1425	1750	B	A
1035	1350	1675	A	C
1000	1305	1605	C	B
965	1285	1575	B	C
820	1220	1510	D	B
870	1185	1420	C	A
715	1110	1335	D	A
785	1065	1280	C	C
645	1000	1200	D	C
Electric Heat CFM				
Model			Tap Selections	
N-VSB12	N-VSC16	N-VSD20 / F-FV060	Heat	
1150	1500	1860	A	
1070	1425	1750	B	
870	1185	1420	C	
715	1110	1330	D	
Delay Profile				
Delay Tap	Unit Type			
Jumper at A	N / A			
Jumper at B	Two Stage Condenser			
Jumper at C	System with TXV or Solenoid Valve			
Jumper at D	System without TXV or without Solenoid Valve			

Airflow Selections 80% Variable Speed Furnaces

High / Low Speed Cooling and Heat Pump CFM								Jumper Settings	
Model									
P*DUA12V06401		P*DUB16V08001		P*DUC20V08001		P*DUC20V09601		Cool Tap	Adj Tap
G8V08012UHA11		G8V10016UHB11		G8V10020UHC11		G8V12020UHC11			
High	Low	High	Low	High	Low	High	Low		
1340	740	1675	920	2050	1135	2020	1130	A	B
1155	635	1555	850	1860	980	1855	960	B	B
1220	671	1525	830	1945	1035	1920	1010	A	A
1050	578	1410	795	1665	910	1680	850	B	A
1100	605	1355	760	1740	950	1765	910	A	C
913	502	1330	750	1575	880	1630	820	C	B
945	520	1280	710	1440	830	1485	760	B	C
726	400	1145	625	1325	760	1355	720	D	B
830	456	1235	680	1410	820	1465	745	C	A
660	400	1035	555	1190	725	1210	650	D	A
747	411	1105	600	1245	745	1260	695	C	C
594	400	920	495	1065	690	1080	595	D	C
High / Low Heat CFM								Jumper Settings	
Model									
P*DUA12V06401		P*DUB16V08001		P*DUC20V08001		P*DUC20V09601		Heat Tap	Adj Tap
G8V08012UHA11		G8V10016UHB11		G8V10020UHC11		G8V12020UHC11			
High	Low	High	Low	High	Low	High	Low		
1315	880	1490	990	1480	975	1950	1330	A	Any
1185	795	1350	900	1350	900	1840	1165	B	Any
1075	720	1240	820	1235	815	1705	1055	C	Any
990	665	1140	760	1140	770	1535	960	D	Any
Delay Profile									
Delay Tap				Unit Type					
Jumper at A				N / A					
Jumper at B				Two Stage Condenser					
Jumper at C				System with TXV or Solenoid Valve					
Jumper at D				System without TXV or without Solenoid Valve					

All CFM's are shown at 0.5" w.c. external static pressure. These units have variable speed motors that automatically adjust to provide constant CFM from 0.0" to 0.6" w.c. static pressure. Between 0.6" and 1.0" w.c., CFM is reduced by 2% per 0.1" increase in static. Operation on duct systems with greater than 1.0" w.c. static pressure is not recommended.

NOTE: At some settings, Low Cool and/or Low Heat air flow may be lower than what is required to operate an airflow switch on certain models of electronic air cleaners. Consult the instructions for the electronic air cleaner for further details.

Airflow Selections 94% Upflow Variable Speed Furnaces

High / Low Speed Cooling and Heat Pump CFM								Jumper Settings	
Model									
P1XUB12V05501		P1XUC16V07501		P1XUC20V09501		P1XUD20V11201		Cool Tap	Adj Tap
G9V06012UPB11		G9V08016UPC11		G9V10020UPC11		G9V12020UPD11			
High	Low	High	Low	High	Low	High	Low		
1315	720	1655	930	2030	1090	2180	1210	A	B
1095	610	1555	855	1780	945	1760	970	B	B
1200	655	1510	830	1890	1000	2000	1100	A	A
1010	545	1440	790	1630	850	1600	910	B	A
1065	595	1375	755	1685	895	1780	990	A	C
870	500	1350	745	1555	830	1540	860	C	B
885	505	1280	700	1430	785	1410	820	B	C
655	450	1150	620	1310	740	1300	770	D	B
870	460	1230	670	1400	770	1400	800	C	A
610	445	1030	555	1220	665	1220	710	D	A
715	450	1120	600	1245	700	1230	740	C	C
545	450	915	495	1075	605	1060	660	D	C
High / Low Heat CFM								Jumper Settings	
Model									
P1XUB12V05501		P1XUC16V07501		P1XUC20V09501		P1XUD20V11201		Heat Tap	Adj Tap
G9V06012UPB11		G9V08016UPC11		G9V10020UPC11		G9V12020UPD11			
High	Low	High	Low	High	Low	High	Low		
1020	665	1635	1065	1940	1225	1870	1205	A	Any
925	610	1540	990	1745	1105	1715	1105	B	Any
850	555	1400	890	1595	1010	1590	1020	C	Any
785	515	1265	805	1475	930	1480	950	D	Any
Delay Profile									
Delay Tap				Unit Type					
Jumper at A				N / A					
Jumper at B				Two Stage Condenser					
Jumper at C				System with TXV or Solenoid Valve					
Jumper at D				System without TXV or without Solenoid Valve					

All CFM's are shown at 0.5" w.c. external static pressure. These units have variable speed motors that automatically adjust to provide constant CFM from 0.0" to 0.6" w.c. static pressure. Between 0.6" and 1.0" w.c., CFM is reduced by 2% per 0.1" increase in static. Operation on duct systems with greater than 1.0" w.c. static pressure is not recommended.

NOTE: At some settings, Low Cool and/or Low Heat air flow may be lower than what is required to operate an airflow switch on certain models of electronic air cleaners. Consult the instructions for the electronic air cleaner for further details.

Airflow Selections

92% Downflow / Horizontal Variable Speed Furnaces

High / Low Speed Cooling and Heat Pump CFM				Jumper Settings	
Model					
P1XDB12V07501		P1XDD20V11201		Cool Tap	Adj Tap
G9V08012DHB11		G9V12020DHD11			
High	Low	High	Low		
1345	740	2230	1290	A	B
1120	620	1810	1025	B	B
1225	675	2100	1150	A	A
1020	560	1680	950	B	A
1100	605	1850	1045	A	C
880	490	1600	900	C	B
920	505	1500	840	B	C
660	450	1410	770	D	B
800	450	1510	825	C	A
600	420	1265	700	D	A
720	440	1320	740	C	C
545	420	1120	625	D	C

Model				Jumper Settings	
P1XDB12V07501		P1XDD20V11201		Heat Tap	Adj Tap
G9V08012DHB11		G9V12020DHD11			
High	Low	High	Low		
1380	900	1925	1260	A	Any
1260	820	1750	1165	B	Any
1150	750	1600	1055	C	Any
1075	700	1475	985	D	Any

Delay Profile	
Delay Tap	Unit Type
Jumper at A	N / A
Jumper at B	Two Stage Condenser
Jumper at C	System with TXV or Solenoid Valve
Jumper at D	System without TXV or without Solenoid Valve

All CFM's are shown at 0.5" w.c. external static pressure. These units have variable speed motors that automatically adjust to provide constant CFM from 0.0" to 0.6" w.c. static pressure. Between 0.6" and 1.0" w.c., CFM is reduced by 2% per 0.1" increase in static. Operation on duct systems with greater than 1.0" w.c. static pressure is not recommended.

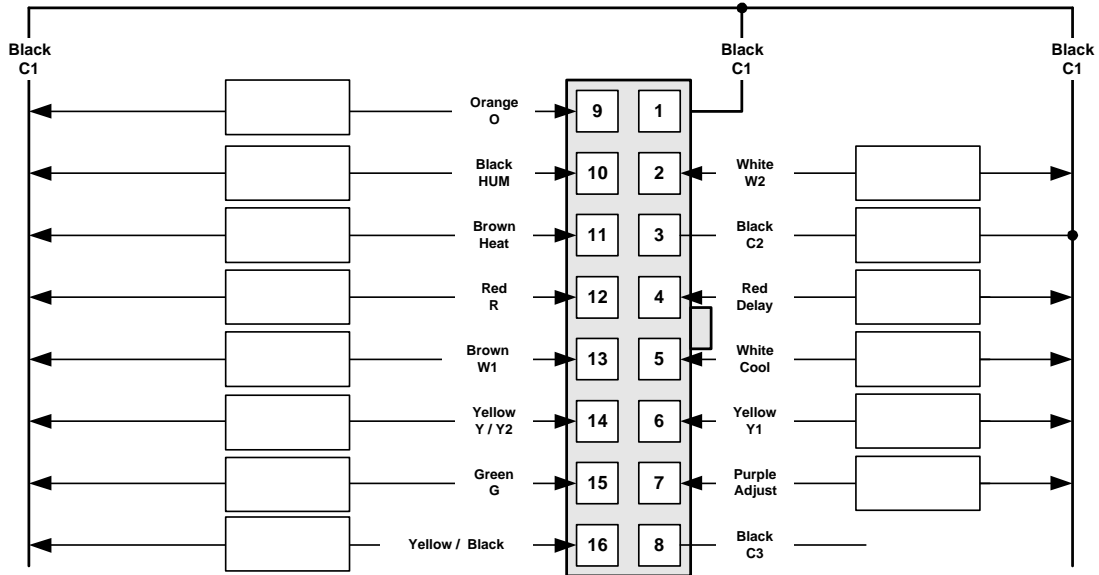
NOTE: At some settings, Low Cool and/or Low Heat air flow may be lower than what is required to operate an airflow switch on certain models of electronic air cleaners. Consult the instructions for the electronic air cleaner for further details.

Motor Control Modules (ECM Microprocessor)

Variable Speed Motor Modules (ECM Microprocessor)			
Furnace Model	Module Number	HP	Motor Number
P1XDB12V07501A G9V08012DHB11	324-32013-014	1/2	024-31904-014
P1DUA12V06401C P2DUA12V06401LA G8V08012UHA12A	324-32013-022	1/2	024-31940-022
P1XUB12V05501D G9V06012UPB11B	324-32013-024	1/2	024-31940-024
P1DUB16V08001C P2DUB16V08001LA G8V10016UHB11C	324-32014-022	3/4	024-31947-022
PIXUC16V07501D G9V08016UPC11B	324-32014-024	3/4	024-31747-024
P1XDD20V11201A G9V12020DHD11A	324-32015-010	1	024-31941-010
P1DUC20V08001C P2DUC20V08001LA G8V10020UHC11C	324-32015-022	1	024-31941-022
P1DUC20V09601C P2DUC20V09601LA G8V12020UHC11C	324-32015-023	1	024-31941-023
P1XUC20V09501D G9V10020UPC11B	324-32015-024	1	024-31941-024
P1XUD20V11201D G9V12020UPD11B	324-32015-025	1	024-31941-025

Appendix A

Voltage Check Diagram for Recording Voltages



This view is of the Harness Plug (looking at the pins) after having been removed from the Motor. All voltages are taken with the Negative Lead of the Volt Meter on Pin 1. All voltages are AC unless otherwise noted.

Copy this sheet and use it to record your voltages.

1. Measure the voltage on each pin and record the value in the appropriate box. Keep the Negative Lead of your meter on Pin 1 for all voltage measurements.
Keep in mind that some of the voltages may be DC Volts.
2. Compare the measured values to those in the 'Voltage Check' Diagram describing your 'Mode of Operation'.
3. Follow the guidelines in the Voltage Check section on page 3 of the Troubleshooting Guide.

Model: _____	Tap Positions
Serial: _____	
Customer: _____	
Address: _____	

Phone: _____	
Install Date: _____	Cool _____
	Adjust _____
	Heat _____
	Delay _____
	Heat Pump _____
	Humidistat _____