Kit #373-25865-000

VARIABLE SPEED MOTOR ANALYZER
INSTRUCTIONS

Motor Analyzer 035-18865-000
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VARIABLE SPEED SYSTEM AND MOTOR ANALYZER

These instructions describe how to use the variable speed Analyzer, 373-25865-000, to troubleshoot variable speed UPG furnaces, air handlers, and single package units employing variable speed motors.

DESCRIPTION

The Analyzer is a test and diagnostic instrument suitable for field and laboratory use. It is a system controller that monitors, generates and simulates all control functions that operate the General Electric ECM™ motor used in UPG equipment and competitors with the noted differences below. The use of the analyzer in conjunction with these instructions allows the Service Technician to very quickly diagnose and trouble shoot UPG variable speed products.

The Analyzer exercises all of the control modes and functions of ECM-driven product. It activates on/off delays and airflow settings, granting full access to torque/airflow control as well as the set-up and delay tables programmed into the motor.

The Analyzer has two operating modes. The first, the “SYSTEM” mode, operates the motor while the motor is in-place, installed in the application, and powered by the system. In this mode, the Analyzer operates while the system is operating, monitoring the system’s status and verifying the continuity of the control functions. It connects between the motor and the system controls using the systems harness and an auxiliary cable in a simple feed-through configuration.

The second mode, the “ANALYZER” mode, independently exercises the motor with or without any connection to the system except for 24 VAC power. By switching between these two modes of operation, with the Analyzer connected in-line with the unit, the technician has a powerful diagnostic tool to determine whether the cfm programming board, the ECM microprocessor, wiring, or the motor is the source of the malfunction.

Analyzer may be use for limited bench testing. Provide external 24vac power to the R and B/C connections on either side of analyzer with pin tip leads such as 525-31464-000 test leads from Source One. NOTE: The motor must be under a load to work so this has limited use.

ANALYZER OVERVIEW

Refer to Fig # 1 for the location of each of the functions described below.

A. Control Mode Selector –
This switch, located on the right side of the case is the heart of troubleshooting and fault diagnosis. With the switch in the “System” mode the analyzer monitors the information being sent from the unit controls to the motor. With the switch in the “Analyzer” mode the Analyzer supplies the information and controls the operation of the motor.
B. Activator Switches -

1. **Control Function Activators** – Seven switches on the face of the Analyzer activate each of the motors control line inputs when the Control Mode Switch is in the “Analyzer” position.

   - **G** - Fan only operation.
   - **Y/Y2** - Compressor operation on a single stage system or second stage operation on a two-stage system.
   - **Y1** - 1\textsuperscript{st} Stage compressor operation on a two-stage system.
   - **O** - Reversing valve operation. Should be in the “on” position for all cooling units and also for heat pumps in the cooling mode.
   - **W1** - 1\textsuperscript{st} Stage of heating for gas furnaces, 2\textsuperscript{nd} stage of heating for an air handler. NOTE: On Non-UPG Boards this may be 2\textsuperscript{nd} stage heat.
   - **W2** - 2\textsuperscript{nd} Stage of heating for gas furnaces, 1\textsuperscript{st} stage of heating for an air handler. NOTE: On Non-UPG Boards this may be 1\textsuperscript{st} stage heat.
   - **HUM** - With the switch in the “off” position the programmed 1\textsuperscript{st} and 2\textsuperscript{nd} stage cooling airflow is reduced 15%. With the switch in the On ‘Up’ position the unit should deliver the programmed airflow.
   - **BK/PWM** - This switch is on the left side of the analyzer. This allows the analyzer to be used with systems using pulse width modulation. This
switch should always be placed in the “BK” position while trouble shooting all current products. (PWM) - To control the airflow. This method of control was used on the Triathlon air handler. All current units employ the continuously variable mode of operation. NOTE: Not used in any current production UPG products.

2. **Airflow Programming Switches** – These switches are identified as **COOL**, **HEAT**, **ADJUST**, and **DELAY**. Their function is the same as the programming pins on the cfm programming board contained in the unit. When the switch is in the “Analyzer” position the unit cfm is determined by the setting of these switches. At the start of the trouble shooting procedure these switches should be adjusted to match the pin setting on the unit cfm programming board.

C. **Verify Commons** –
This switch is located on the left side of the control. The ECM Microprocessor uses two commons, pin 1 and pin 3 of the 16-pin connector at the motor. In order for the motor to operate properly both of these commons must be connected to the same ground. When the control mode switch is in the “Analyzer” position and the “Verify Commons” is up these two commons are made inside the analyzer. With the “Verify Commons” switch in the down position the connection of the two grounds is determined by the wiring in the unit. NOTE: Not applicable to UPG products but may apply to other manufacturers.

D. **Variable Controls** –
The two knobs in the center of the face of the Analyzer serve the following function.
1. **Pulse Width Modulation Adjust** – the left hand knob on the face of the analyzer controls this feature. This feature is not used with UPG’s furnaces, air handlers or single package units employing variable speed motors. This feature could be used to trouble shoot Triathlon air handler variable speed motors.

The analyzer has an adjustable pulse width modulation generator that is controlled by the knob. As the knob is turned clockwise the on time of the wave increases. This allows the airflow of the motor to be adjusted from no cfm, full off to maximum cfm, fully on. To use this feature set the Analyzer as follows:

a. Place the **Control Mode Selector** on the right side of the Analyzer in the “ANALYZER” position.

b. Place the **BK/PWM** switch on the left side of the Analyzer in the “PWM” position.

c. Turn the **HUM** switch on the lower right hand corner on the front of the Analyzer to the on position.

d. Place the sliding switch next to the knob and the front of the analyzer in the full left position.

In this mode of operation the LCD displays the % of the duty cycle being generated to the motor.
2. **Vth knob** – the right hand knob on the face of the Analyzer controls this feature. This feature can be used to vary the voltage signal to the “G”, “Y/Y2” and “Y1” motor inputs. By varying the voltage the threshold voltage can be determined. The threshold voltage is the voltage level at which the motor starts to operate. The threshold voltage should be between 40% and 60% of the control voltage to the motor. To use this feature set the analyzer as follows:
   a. Place the **Control Mode Selector** on the right side of the Analyzer in the “ANALYZER” position.
   b. Place the sliding switch next to the knob in the full right position.
   c. Place the switch next to the knob in the “on” position. **THIS IS THE ONLY TIME THIS SWITCH SHOULD BE PLACED IN THE ON POSITION!**
   d. Turn the knob to the full counterclockwise position.
   e. Place the “G” switch on the bottom left corner of the face of the Analyzer in the on position.
   f. The LCD will display the voltage being sent to the “G” input to the motor.
   g. Turn the knob clockwise until the motor starts to operate. The voltage at which the motor starts to turn is the threshold voltage.

E. **Data Display** -

1. **LCD And Display Selector** – The 4-position switch located just below the LCD selects the function value that is displayed on the LCD screen.
   a. **Vth** – With the sliding switch located to the left of this marking the LCD will displays the adjustable AC voltage used to measure and test the threshold voltage of the “G”, “Y1”, and “Y/Y2” functions.
   b. **R(VAC)** – With the sliding switch located below this marking the LCD will displays the control voltage being supplied to the analyzer from the unit.
   c. **RPM** – With the sliding switch located below this marking the LCD will display the RPM at which the motor is operating.
   d. **PWM** - With the sliding switch located to the right of this marking the PWM signal generator inside the Analyzer will be turned on and the LCD will display the PWM signal being generated.

2. **Control Function Status Lamps** – These lamps will only be energized when a circuit is completed between the Analyzer and the motor. The “R” lamp should be energized anytime the Analyzer is connected to the unit and the motor and the unit is energized. The “G”, “Y1”, “Y/Y2”, “W1”, “W2”, “O”, and “HUM” lamp will be energized anytime the unit or the Analyzer is calling for the indicated mode of operation. The “OUT” lamp functions the same as the cfm indicator lamp on the cfm programming control in the unit. It will flash one time for the motor delivers every 100 cfm. **NOTE:** On Non-UPG units W-1 & W-2 may be reversed. W-1 may indicate 2nd stage heat and W-2 may be 1st stage heat.
VARIABLE SPEED COMPONENT DESCRIPTION AND OPERATION

There are three unique components in Variable Speed units, the General Electric ECM Motor, the General Electric ECM Microprocessor, and the 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 Assembly:
ECM stands for Electronically Commutated Motor. The motor consists of two components, a DC Volt, Ball Bearing Motor; and an Electronic Control Module, refer to Fig #2. 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, Air Handler, or Packaged Unit. 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 or by the positioning of a wire at a terminal block on the Packaged Units.

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. This component is not used on Packaged Units.
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. On furnaces the ECM Microprocessor is available as a Source One replacement part. See Appendix C 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.
**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 or Packaged Unit, 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 not needed 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 Ignition Control’.

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

<table>
<thead>
<tr>
<th>Terminal</th>
<th>Description</th>
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<tbody>
<tr>
<td>G</td>
<td>The motor operates at 63% of its Programmed Cooling Speed.</td>
</tr>
<tr>
<td>Y1</td>
<td>The motor operates at 55% of its Programmed Cooling Speed.</td>
</tr>
<tr>
<td>Y2</td>
<td>No effect.</td>
</tr>
<tr>
<td>Y</td>
<td>The motor operates at its Programmed Cooling Speed.</td>
</tr>
<tr>
<td>W1</td>
<td>The motor operates at its Programmed Low Heat Speed.</td>
</tr>
<tr>
<td>W2</td>
<td>The motor operates at its Programmed High Heat Speed.</td>
</tr>
<tr>
<td>O</td>
<td>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.</td>
</tr>
</tbody>
</table>

This action occurs upon the removal 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 airflow 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.

**ECM Motor Analyzer Interface 035-20257-000**

**For Next Generation 031-09118-000 CFM Board**

![Interface diagram](image)

# 1. Disconnect All Power To System

![Cable image](image)

Figure 1. 12 Wire communications Cable
#2. Identify the system 12-wire communication cable from the 12 Pin connector at the CFM Board to the 16 Pin Connector on the ECM Motor, refer to X in Fig #1.

#3. Disconnect the 16 Pin Connector From The ECM Motor, refer to Fig #2

![Figure 2. ECM Motor 16 Pin Connector](image)

#4. Plug the System Cable 16 Pin connector into ‘System’ end of Analyzer Interface and then plug kit cable harness, 16 Pin Connector-16 Wire, into Analyzer end of the Interface, refer to Fig #3.

![Figure 3. Interface connected to Analyzer](image)

#5. Follow the Analyzer Kit Instructions from this point.
SECTION 1

SYMPTOM: MOTOR WILL NOT START; NO MOVEMENT

1. Remove power from the unit.

2. Try and spin the blower wheel. Does the blower spin?
   NO   Determine why and repair.
   ✓    Check for an obstruction in the housing.
   ✓    Check for a loose blower on the shaft
   ➢ If the motor cannot be made to spin, replace it.
   YES   Go to Step 3.

3. Remove the 5 – pin connector from the motor.

4. Apply power to the unit.

5. Check for correct voltages 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.
   ✓    Single Package units have a purple wire at Pin 4 and a black wire at Pin 5.
   ✓    A furnace operates on 120 volts and should have between 108 and 132 volts present between Pin 4 and Pin 5. There should also be a black jumper between Pin 1 and Pin 2.
   ✓    An Air Handler and Single Package unit operates on 240 volts and should have between 187 and 253 volts present between Pin 4 and Pin 5. There should be NO jumper present between Pin 1 and Pin 2.
   Is the correct voltage present?
   NO   – Determine why and correct.
   YES   – Remove power from the unit, reconnect the 5-pin connector, and go to step 6.

6. Remove the 16-pin connector from the motor. Connect the 16-pin connector to the left-hand side of the Analyzer at the “System Connection”. Connect the harness supplied with the Analyzer to the right side of the Analyzer at the “Motor Connection”. Connect the other end of the harness to the motor. Set the switches on the Analyzer as follows, refer to Figure 1 for location of switches:
   a. Place the “Verify Commons” switch on the left side of the Analyzer in the down position.
   b. Place the “BK PWM” switch on the left side of the Analyzer in the “BK” position.
   c. Set the Vth switch next to the adjustment knob on the right hand center of the Analyzer in the off position.
d. Place the sliding switch between the two knobs on the front of the Analyzer in the “R (Vac) position.

e. Place the “System/Analyzer” switch on the right hand side of the Analyzer in the “Analyzer” position.

7. Turn on the power to the unit. Is the “R” lamp at the top of the analyzer energized?
   NO – The 24 volt power supply in the unit is not supplying voltage to the motor.
   ✓ Check at 24 volts on the secondary side of the transformer.
   ✓ Check for a blown fuse on the unit control board on the air handler or single package unit. The fuse is located in the red wire between the transformer and the control board in the furnace.
   ✓ Check for miswiring of the hot side of the control circuit, red wire.
   YES – Go to Step 8

8. On all furnaces, air handlers and single package heat pumps and electric/electric units turn the “G” switch on the bottom of the Analyzer to the on position. On gas heat single package units turn the “W2” switch on the bottom of the analyzer to the on position. Does the motor run?
   NO – Go to Step 9
   YES – Go to Step 11

9. Perform the resistance check described in Appendix A. Is the resistance greater than 100,000 ohms?
   NO – Replace the ECM Motor.
   YES – Go to step 10.

10. Perform the moisture check described in Appendix A. Does the motor run?
    NO – Replace the ECM Microprocessor.
    YES – End of troubleshooting.

11. Place the “System/Analyzer” switch on the right hand side of the Analyzer in the “System” position. Remove the thermostat wires and place a jumper between “R” and “G” of the low voltage terminal strip on the unit. Does the motor run?
    NO – Go to step 12.
    YES – The problem is with the thermostat wiring or the thermostat.

12. Remove the sixteen pin connector from the “System Connection” of the analyzer and check the following:
    ✓ Check for loose terminals at the plug connections.
    ✓ Check for incorrect wiring at the sixteen-pin connector.
    ✓ Verify the wiring within the unit matches the wiring diagram

13. Is the wiring okay?
    NO – Correct
    YES – Replace the cfm programming control.
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 no problem. The motor was running in the “Off Delay” mode.

2. Is the unit an Air Handler, Package Unit, or Furnace?
   - Air Handler, Single Package Heat Pump, Single Package Cooling/Electric, Single Package Cooling  Go to Step 3
   - Single Package Gas Heat  Go to Step 5
   - Furnace  Go to Step 6

3. Does the unit have electric heat?
   NO  Check for the presence of a jumper between Pin2 and Pin3, at the 6-pin connector on the Blower 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 of the Air Handler Control Board
        Go to Step 4.

4. Is the limit open?
   NO  Go to Step 7
   YES  Check for low airflow and correct the problem.
        ✓ Verify that the correct CFM has been selected on the CFM programming board.

5. Check for 24 volts between 1 (orange wire) of the 6-pin connector and ground.
   Is 24 volts present?
   NO  The limit circuit is open. Check for low airflow and correct the problem.
        ✓ Verify the correct CFM has been selected on the CFM programming board.
   YES  Go to Step 7

6. Is the ignition control flashing a fault code
NO - Go to Step 7
YES - The limit circuit is open. Check for low airflow and correct the problem.
✓ Verify the correct CFM has been selected on the CFM programming board.

7. Remove the 16-pin connector from the motor. Connect the 16-pin connector to the left-hand side of the Analyzer at the “System Connection”. Connect the harness supplied with the Analyzer to the right side of the Analyzer at the “Motor Connection”. Connect the other end of the harness to the motor. Set the switches on the Analyzer as follows, refer to Figure 1 for location of switches:

   a. Place the “Verify Commons” switch on the left side of the Analyzer in the down position.
   b. Place the “BK PWM” switch on the left side of the Analyzer in the “BK” position.
   c. Set the Vth switch next to the adjustment knob on the right hand center of the Analyzer in the off position.
   d. Place the sliding switch between the two knobs on the front of the Analyzer in the “R (Vac)” position.
   e. Place the “System/Analyzer” switch on the right hand side of the Analyzer in the “Analyzer” position.

8. Place the “Control Function Activator Switches” “G”, “Y/Y2”, “Y1”, “W1”, and “W2” in the off position.
   Does the “R” “Control Function Status Light” come on?
   YES – Go to step 9
   NO – The 24-volt power supply in the unit is not supplying voltage to the motor.
   ✓ Check at 24 volts on the secondary side of the transformer.
   ✓ Check for a blown fuse on the unit control board on the air handler or single package unit. The fuse is located in the red wire between the transformer and the control board in the furnace.
   ✓ Check for miswiring of the hot side of the control circuit, red wire.

9. Is the motor running?
   YES – Replace the ECM microprocessor.
   NO – Go to Step 10.

10. Remove all the thermostat wiring from the unit. Place the “System/Analyzer” switch on the right hand side of the Analyzer in the “System” position. Turn on the power. The “R” “Control Function Light” should be on and the “O” and “HUM” “Control Function Light” may be on.

11. Are there any other “Control Function Lights” on?
   NO – Replace the cfm programming control.
   YES – The light that is energized will identify which circuit is initiating blower operation. Example – if the “G” light is energized the “G” circuit is the problem.
   ✓ Use the wiring diagram to trace the wiring and determine why the circuit is energized and correct.
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 APPENDIX C for listing of correct part numbers for each model.

2. Remove the 16-pin connector from the motor. Connect the 16-pin connector to the left-hand side of the Analyzer at the “System Connection”. Connect the harness supplied with the Analyzer to the right side of the Analyzer at the “Motor Connection”. Connect the other end of the harness to the motor. Set the switches on the Analyzer as follows; refer to Figure 1 for location of switches:

a. Place the “Verify Commons” switch on the left side of the Analyzer in the down position.
b. Place the “BK PWM” switch on the left side of the Analyzer in the “BK” position.
c. Set the Vth switch next to the adjustment knob on the right hand center of the Analyzer in the off position.
d. Place the sliding switch between the two knobs on the front of the Analyzer in the “R (Vac) position.
e. Place the “System/Analyzer” switch on the right hand side of the Analyzer in the “Analyzer” position.

3. Turn the “G” “Activator Switch” on the bottom of the Analyzer to the on position. Does the motor run in the correct direction? NO – Replace the ECM Microprocessor
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 problem causing the high static pressure in the duct or reprogram to a lower airflow.
   YES go to Step 2.

2. Remove the 16-pin connector from the motor. Connect the 16-pin connector to the left-hand side of the Analyzer at the “System Connection”. Connect the harness supplied with the Analyzer to the right side of the Analyzer at the “Motor Connection”. Connect the other end of the harness to the motor. Set the switches on the Analyzer as follows; refer to Figure 1 for location of switches:
   a. Place the “Verify Commons” switch on the left side of the Analyzer in the down position.
   b. Place the “BK PWM” switch on the left side of the Analyzer in the “BK” position.
   c. Set the Vth switch next to the adjustment knob on the right hand center of the Analyzer in the off position.
   d. Place the sliding switch between the two knobs on the front of the Analyzer in the “R (Vac) position.
   e. Place the “System/Analyzer” switch on the right hand side of the Analyzer in the “Analyzer” position.

3. On all furnaces, air handlers and single package heat pumps and electric/electric units turn the “G” switch on the bottom of the Analyzer to the on position. On gas heat single package units turn the “W2” switch on the bottom of the analyzer to the on position. Does the motor still modulate?
   NO – Check the following.
   ✓ The problem may be the thermostat wiring, or
   ✓ The problem may be an intermittent call from the thermostat, or
   ✓ The problem may be an intermittent call from the humidistat, or
   ✓ The problem may be in the CFM programming board.
   ➢ 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. If the wiring, of the thermostat, and humidistat check out OK, replace the CFM programming board.
   YES – Run a moisture check, See Appendix A.

4. Does the motor still modulate?
   NO – End of troubleshooting.
   YES – Replace the ECM Microprocessor
SECTION 5

SYMPTOM: MOTOR DOES NOT OPERATE AT THE PROGRAMMED SPEED
(This section applies to furnaces and air handler only)

1. Let the motor operate for 5 minutes to make sure it is not in a delay period.

2. Verify that the part number of the ECM Microprocessor and/or the ECM Motor is correct.
   ➢ Refer to APPENDIX C for listing of correct part numbers for each model.

3. Compare the number of flashes of the Green LED on the CFM Board to the programmed CFM. Reference Appendix B for the appropriate programming tables.

4. The light should flash 1 time for every 100 CFM.

5. Keep in mind that the CFM will change, based on the Mode of Operation. Refer to Appendix D for description of airflow in different operating modes.

6. Does the number of flashes match the programming and mode of operation?
   YES – End of troubleshooting.
   NO – Go to step 6.

6. Remove the 16-pin connector from the motor. Connect the 16-pin connector to the left-hand side of the Analyzer at the “System Connection”. Connect the harness supplied with the Analyzer to the right side of the Analyzer at the “Motor Connection”. Connect the other end of the harness to the motor. Set the switches on the Analyzer as follows; refer to Figure 1 for location of switches:

   a. Place the “Verify Commons” switch on the left side of the Analyzer in the down position.
   b. Place the “BK PWM” switch on the left side of the Analyzer in the “BK” position.
   c. Set the Vth switch next to the adjustment knob on the right hand center of the Analyzer in the off position.
   d. Place the sliding switch between the two knobs on the front of the Analyzer in the “R (Vac) position.
   e. Place the “System/Analyzer” switch on the right hand side of the Analyzer in the “Analyzer” position.

7. Set the CFM programming switch on the Analyzer to match the position of the jumpers on the CFM programming board.

8. Turn on the either the “G”, “Y1”, “Y2”, “W1”, or “W2” switch at the bottom of the analyzer to the “on” position and count the number of flashes at the green
LED in the upper left hand corner of the analyzer. Is the motor operating at the correct CFM?
NO – Go to Step 9.
YES – Go to Step 10.

9. Perform a moisture check per instruction in Appendix A. Does the motor run at the correct speed?
NO - Replace the ECM Microprocessor.
YES – Go to Step 10.

10. Place the “Analyzer/System” switch on the right hand side on the analyzer in the “System” position. Remove the thermostat wire and place a jumper between “R” and “G”, “Y1”, “Y2”, “W1”, or “W2”. Is the motor operating at the correct CFM?
NO – Replace the CFM programming board.
YES – The problem is in the thermostat or the thermostat wiring.
APPENDIX A - SERVICE PROCEDURES

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 ohm scale.
7. Check resistance between each of the ECM Motor leads and the case of the motor.
8. The resistance between each lead and the case should be greater than 100,000 ohms.
9. If the resistance is less than 100,000 ohms replace the ECM motor.
APPENDIX B - CFM Selection

Cooling Selection

See Installation Instructions to determine the position of the selector on the ‘Cool’ and ‘ADJ’ Pins. The position of these selectors controls both 1\textsuperscript{st} Stage Cooling and 2\textsuperscript{nd} Stage Cooling CFM. On a single stage unit, the CFM will be as indicated in the table. On a two stage unit, 1\textsuperscript{st} Stage cfm will be approximately 65% of the selected cooling CFM for an air handler and 55% of the selected cooling CFM for a furnace.

Heating Selection

See APPENDIX B to determine the position of the selector on the ‘Heat’ Pins. The position of this selector controls both 1\textsuperscript{st} and 2\textsuperscript{nd} stage Heating CFM. When applied with Electric Heat, the CFM is the same for either 1\textsuperscript{st} or 2\textsuperscript{nd} stage. On a furnace the CFM will vary between 1\textsuperscript{st} and 2\textsuperscript{nd} 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 1\textsuperscript{st} stage, the airflow will be 85% of 55% of the selected CFM for a furnace or 85% of 65% of the selected cooling CFM for an air handler resulting in either a 47% or 55% 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 2\textsuperscript{nd} 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.

Continuous Fan

On an air handler, single package electric/electric or a single package heat pump the air flow in the continuous fan mode will be 63% of the programmed cooling airflow on older models and 50% on “Next Generation Models”.

On a single package gas package, the airflow will be the programmed heating CFM

There are three different options on the furnace:
a. With the green wire disconnected from the “G” terminal of the ignition module, the airflow will be 63% of the programmed cooling CFM.
b. With the green wire connected to the “G” terminal of the ignition module and the third dip switch in the “ON” position, the airflow will be the programmed low heat CFM.
c. With the green wire connected to the “G” terminal of the ignition module and the third dip switch in the “OFF” position, the airflow will be the programmed cooling CFM.

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.

We would like to thank Mr. Lou Sulfstede of Sulfstede Consulting Services, Inc for allowing York International, Inc to use copyrighted material in the preparation of this manual.

We would also like to thank Mr. Paul Flora of cfm Distributing, Kansas City, Mo. for his contributions in the preparation of this manual.
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