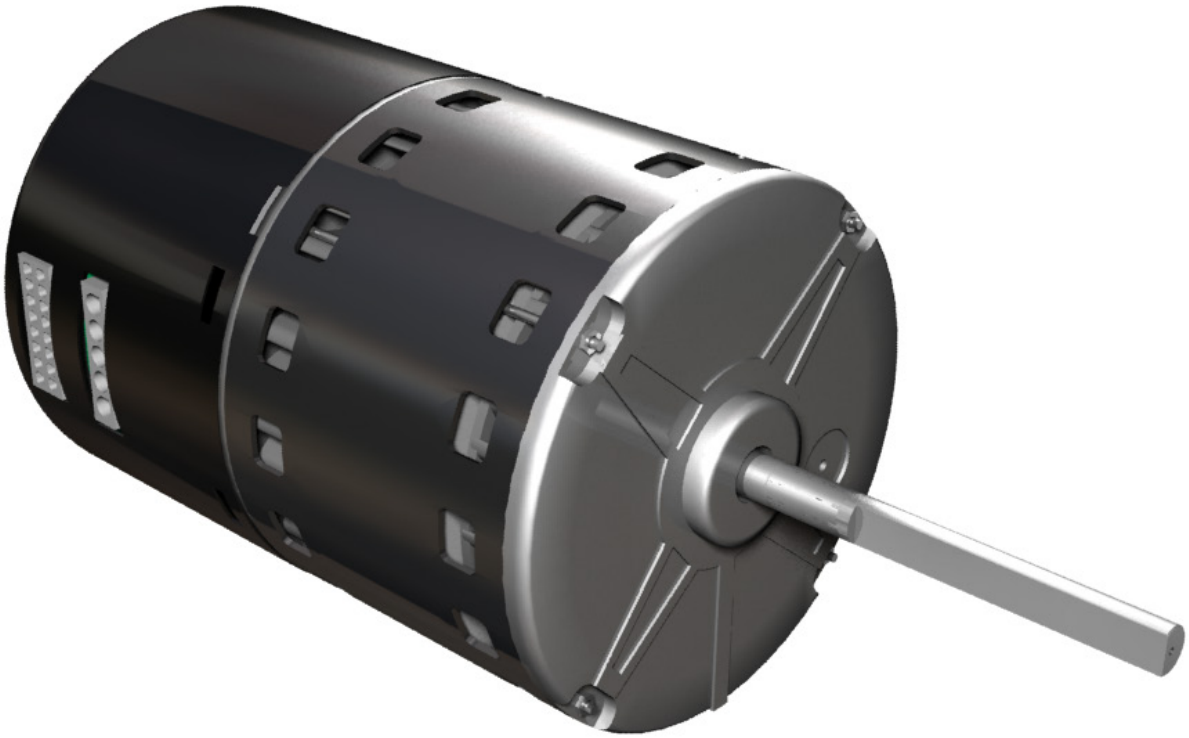


MANUAL – TROUBLESHOOTING

ECM Motor

ECM / ECM-DX Series

v100 – Issue Date: 12/21/20

ECM MOTOR

TABLE OF CONTENTS

ECM MOTOR

TROUBLESHOOTING

ECM Motor Background

The ECM, or Electronically Commutated Motor, is a "smart" motor. Meaning it can be programmed to react to specific conditions.

The ECM is electronically adjustable with an analog signal sent to the speed controller, or in some cases automatically adjusts itself to conditions. The ECM motor uses a quieter soft start when compared to standard AC motors and has much lower power consumption. The design is a combination of a very efficient brushless DC motor, an integrated electronic control and extensive knowledge of the customer's application, which is captured in the control's programming.

Price is currently using the Genteq EON motor in 1/2 HP, 3/4 HP and 1 HP sizes. Voltages for the motors are 120/240/277 VAC single phase AC.

While this motor is more complicated than a standard AC fan motor there are many benefits. This manual will show you how to setup, program and troubleshoot ECM motors.

There are two types of programs Price can load on to an ECM; Constant Volume, which is Price's default, or Constant Torque for special situations (contact application engineering).

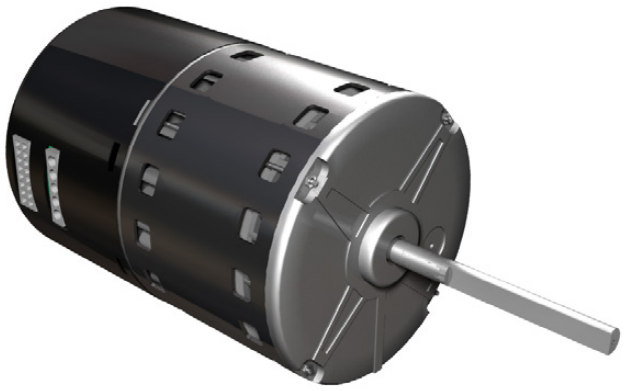
Constant Volume:

This programming strategy has the motor speed up or slowdown in terms of RPM to compensate for changes in system pressure in order to deliver a constant airflow. For instance, on a fan powered terminal equipped with a MERV 13 filter, as the filter begins loading up with dust, the pressure drop increases, and the ECM will speed itself up to maintain the airflow it is set for within 5%. As the primary air valve opens and less and less air is being pulled through the filter, and more air is coming down the valve, the motor slows down to compensate for less pressure drop to deliver the same airflow, within 5%. The ECM does this by measuring its own torque and RPM in real time and uses the application specific program created in Price's lab to either speed up or slow down with any changes to either. Essentially as RPM begins to drop due to increases in system pressure, torque increases to bring the RPM up, and vice versa. This transition happens seamlessly as the motor is running.

Constant Torque:

There are instances where a constant airflow program is not desirable, and it would be preferential to have a motor that reacts to changes in system pressure by riding the fan curve as a 'dumb' AC motor would. This is the constant torque program, where torque is held constant and RPM (and airflow) are allowed to vary. The ECM maintains all of its other benefits such as low power consumption compared to regular AC motors, lower noise levels, and the ability to be electronically turned up or down, it just won't respond to pressure changes by increasing or decreasing RPM to maintain airflow for any given speed setting. While this may not be ideal for the balanced fan terminal with filter mentioned above, it is advantageous for any situation where airflow is being varied by another device in series with the ECM fan, and the ECM fan is being used simply as a booster and is expected to react to the other device by delivering the airflow that is provided to it. An example of this might be an application where a cleanroom requires a variable CFM, so a single duct VAV and ECM Fan Filter Unit are used in series. The VAV box will decide what CFM to output to the room and the ECM fan in the Fan Filter Unit is only there to make up the pressure drop of the filter. In this case it is not desirable that the fan speed up as the air valve closes, the intent is for the fan to pass the air supplied to it over the filter. In fact if the ECM were programmed with a constant volume program, the two pressure independent devices in series will usually oppose one another and cause instability where both devises constantly modulate between their upper and lower limits.

ECM MOTOR ▼



ECM MOTOR

TROUBLESHOOTING

ECM Motor Power and Control Connectors

ECM Motor Power Connector (120/240/277 VAC).

ECM Motor Control Connector 16 Wires for programming 4 Wires for basic control.

NOTE: Connectors are keyed to resist the cables being inserted incorrectly.

ECM Motor Power Cable - 120 VAC

Black - Hot Wire (120V)

White - Neutral Wire

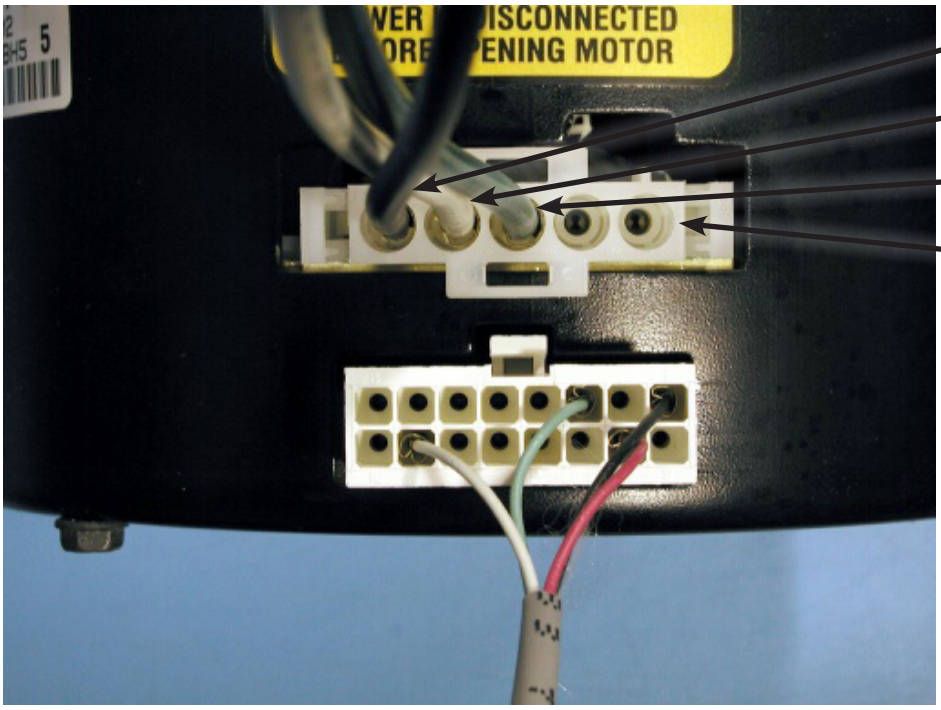
Green - Earth Ground Wire

Jumper Wire - This sets motor to 120V

ECM MOTOR

TROUBLESHOOTING

ECM Motor Power Cable - 240/277 VAC



ECM Motor Troubleshooting Checklist

Problem	Check
Motor doesn't run	• 24 VAC transformer has power (test with AC volt meter) • ECM speed controller has 24 VAC and green light is lit (See ECM Speed Controller Section) • ECM speed controller POT/DIAL is adjusted properly (See ECM Speed Controller Section) • ECM control cable is plugged in correctly and not damaged (See ECM Speed Controller Section) • ECM Motor has proper power 120/240/277 VAC and cable is not damaged **NOTE:** If a motor has a 120 VAC power cable (with a jumper) and 240/277 VAC is supplied to the motor it will be destroyed! • Ensure ECM motor is programmed properly • Check that blower wheel can be spun freely. Motor will go into a locked rotor fault if too much resistance is sensed upon start up and motor will fail to start.
Motor runs, but slowly	• Turn up (Clockwise) POT/DIAL on ECM speed controller (See ECM Speed Controller Section) • ECM motor may have wrong program (example size 20 program, but motor is in a size 40 box) See ECM Programming Section. • Check ECM motor has proper power 120/240/277 VAC and cable is not damaged • ECM motor may be BLANK (not programmed) – ensure motor has a label. If the motor is running slowly and not responding to the speed controller, it's very likely not programmed.
Motor Oscillates (revs fast then slow)	• ECM motor is trying to push too much air, ensure correct program in motor • Turn down ECM speed controller POT/DIAL (See ECM Speed Controller Section) • ECM is trying to push air against too high of an external static pressure
Motor fails HIGH-POT test	• ECM motor has small capacitors that are connected from Line 1 to ground. These capacitors are for filtering out AC line noise; however they will cause a standard AC high test to fail. To properly test a DC high POT tester must be used.

ECM MOTOR

TROUBLESHOOTING

NOTE: If a motor has a 120 VAC power cable (with a jumper) and 240/277 VAC is supplied to the motor it will be destroyed!

SAMPLE LABEL applied to factory programmed motor

ECM Standard Speed Controller

All ECM Speed Controllers are manufactured by Price Electronics in Winnipeg. It allows for ON/OFF and 0-100% speed control of any ECM motor (120/240/277 VAC, all HPs).

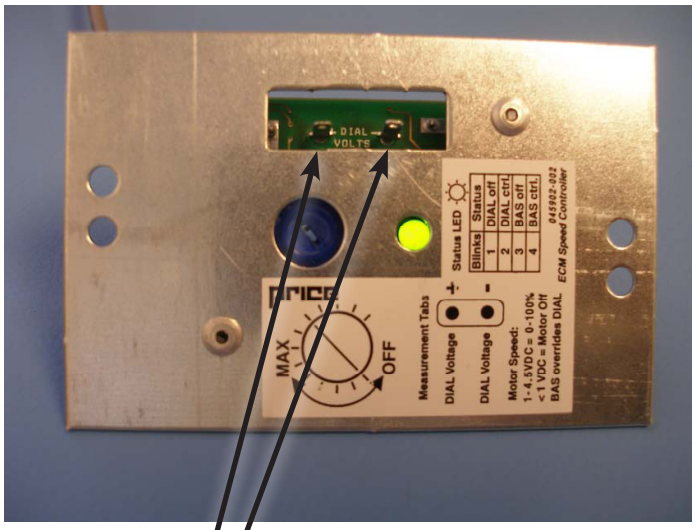
ECM Speed Controllers have 2 modes. Manual adjust and BAS (BAS stands for Building Automation System).

Manual Mode

On a standard ECM speed controller, manual mode the speed is controlled by adjusting the potentiometer (POT). The POT can adjusted from 0-100%. To set the POT precisely the voltage output must be measured. Using a standard multimeter on a DC voltage setting the (+) and (-) tabs on the board can be measured. The output is 0-5 VDC.

POT Voltage	Motor
0 - 1 VDC	Off
1 - 4.5 VDC	0-100% Control
4.5 - 5 VDC	100%

FIGURE 1 - ECM SPEED CONTROLLER (MANUAL SETTING) ▼



Measure (+) VDC

Measure (-) VDC

Range is 0-5 VDC

For each type of terminal unit and fan coil, there are equations in the unit's service and installation manual that will relate the airflow in CFM to the voltage measured across the taps on the fan speed controller. For example:

A size 50 FDCA2 terminal unit with 277 volt ECM equation is as follows: CFM = 672.29 (VDC) – 572.45

So, in order to get 1400 CFM, we would need to rearrange the equation to get: (CFM+572.45) / 672.29 = VDC

The POT would have to be turned up until the voltage measured at the taps is 2.94 VDC

ECM MOTOR

TROUBLESHOOTING

In Building Automation Mode the speed controller reads a 2-10 VDC signal from a controller/computer to adjust the motor speed.

NOTE: Speed Controller will automatically ignore the POT/DIAL when a BAS signal is detected!

The 2-10 VDC signal is connected to the BAS Signal and BAS Common tabs. (**NOTE:** A 4-20 mA signal can be used as well. (series/current signal) However a jumper on the board must be relocated. Default is voltage input signal.)

BAS Input Signal	Motor
0 - 1 VDC	Manual Mode (responds to POT/DIAL)
1 - 2 VDC	Off
2 - 9 VDC	0-100% Control
9-10 VDC	100%

For BAS control, the same volts vs. CFM equations apply, but since the POT operates on a 1-5 volt scale, and the BAS operates on a 2-10 volt scale, the BAS scale is double the POT scale. Therefore whatever voltage is calculated for a specific CFM using the equations, the voltage must be doubled in order to get that CFM by sending a BAS signal.

For example:

Size 50 FDCA2 with 277 volt ECM whose volts vs. CFM equation is:

CFM = 672.29 (VDC) – 572.45

If the fan powered terminal requires a fan flow controlled by the BAS of 2000 CFM, rearranging the equation we get:

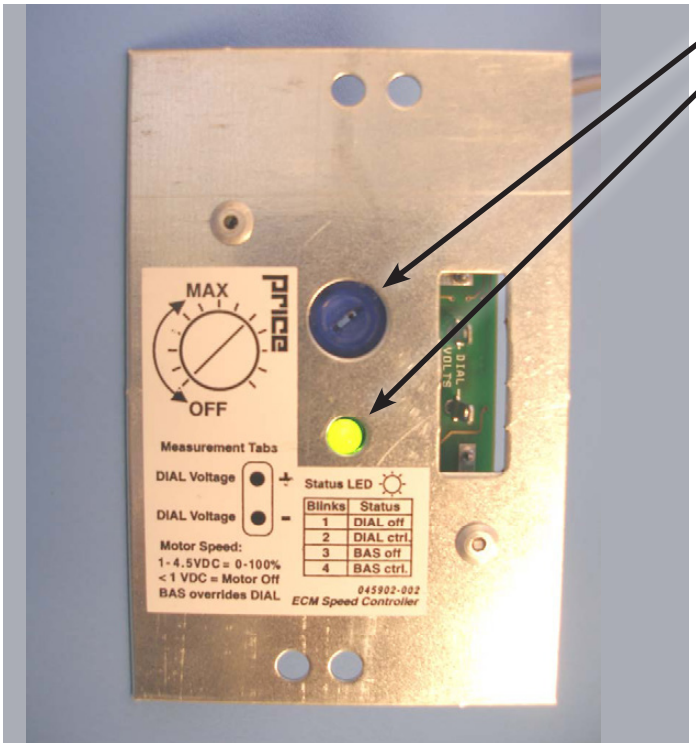
(CFM+572.45) / 672.29 = VDC

The VDC is for the POT however, so to get a CFM using the BAS input, the left side of the equation would need to be multiplied by 2. Now we get:

((CFM+572.45) / 672.29)) * 2 = VDC

Therefore, 2000 CFM would require a BAS voltage of 7.65 VDC.

FIGURE 2 - ECM SPEED CONTROLLER FACE ▼



Potentiometer/Dial Adjust

Green Status LED must be blinking. (Code 1 thru 4)

ECM MOTOR

TROUBLESHOOTING

LED blink Sequence Chart

The Diagnostic LED will blink out the current status used to determine if the speed control is operating in manual/BAS mode, and if current setting is OFF or CONTROL.

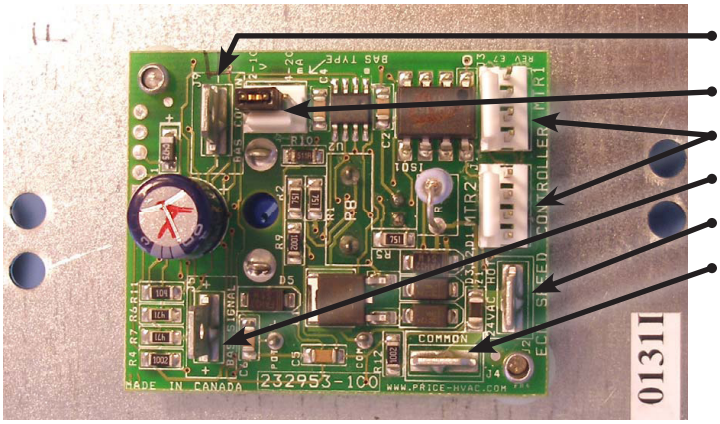
Blink	Mode	Voltage
1	Manual Mode (POT adjust) - OFF	0 - 1 VDC (at POT taps)
2	Manual Mode (POT adjust) - Control 0-100%	1 - 5 VDC (at POT taps)
3	BAS Mode (1-2 VDC signal) - OFF	1 - 2 VDC (at BAS taps)
4	BAS Mode (2-10 VDC signal) - Control 0-100%	2 - 10 VDC (at BAS taps)
LED On Steady of stays OFF	Fault Mode • Measure input voltage – ensure 24 VAC +/- 10% • Check wiring to speed control (ensure 24 VAC HOT and Common are not reversed) • Cycle 24 VAC power to unit • Check BAS input wiring – **NOTE:** 'BAS –' and 24 VAC Common are connected – observe polarity when interfacing to other systems	

*__NOTE:__ BAS input of less than 1 volt means controller is in manual (POT adjust) mode.

Standard Speed Controller Hardware Specifications

Power	24 VAC +/- 10% @ 50/60 Hz (2 VA)
Operating Conditions	0°C to 50°C (32°F - 122°F) 0% - 95% R.H. Noncondensing
Storage Conditions	-30°C - 50°C (-22°F - 122°F) 0% - 95% R.H. Noncondensing
Processor	8-bit flash microcontroller with on board Analog to Digital Converter
Inputs	2 Analog (1 manual adjust dial and 1 BAS 0-10 VDC)
Outputs	3 Digital (GO signal to ECM and Vspd PWM signal @80.0 Hz) and LED
Connections	¼" Spade Terminals – Recommend 18-22 AWG copper wire
Dimensions	53.3 mm by 43.2 mm (2.1" by 1.7")
Weight	45.4 grams (0.1 lbs)

FIGURE 3 - ECM STANDARD SPEED CONTROLLER ▼



__NOTE:__ BAS Common is connected to 24 VAC Common. If 24 VAC is earth grounded then BAS Common will be earth ground as well. Polarity must be observed when connecting multiple speed controllers and transformers.

ECM MOTOR

TROUBLESHOOTING

ECM Deluxe Speed Controller

The Price Deluxe ECM speed controller works with a high efficiency ECM motor. This low voltage (24 VAC) speed control allows full manual (push button adjust) or BAS (2-10 VDC signal) control of the ECM motor. The deluxe speed controller also has a digital screen and BAS RPM feedback (2-10 VDC) which is proportional to motor RPM.

NOTE: 24 VAC COM, BAS COM, ANALOG OUTPUT COM are all connected together. Please observe 24 VAC polarity

The Digital Display shows the user several modes of operation. This allows for easier and more precise field adjustment and troubleshooting. To change modes press both up and down buttons at the same time.

NOTE: Local setpoints are stored to EEPROM and will remain set after power failures.

WARNING: Do not switch 120/208/240/277 VAC power to turn ECM motor on and off. Instead control the 24 VAC signal or BAS signal to turn the ECM motor on and off. The ECM motor has large capacitors that charge quickly on mains power up. Switching on several motors frequently could reduce building power quality

ECM DELUXE SPEED CONTROLLER ▼

BAS Input Signal

The BAS input signal overrides the local setpoint using a remote 0 – 10 VDC signal. If the BAS signal drops below 1 VDC local control (via the push buttons) is restored.

BAS Voltage	Response	Notes
0 - 1 VDC	Local control mode using push buttons	Local setpoint can be adjusted from 0 - 100% using push buttons
1 - 2 VDC	Motor Off	Recommended sending a 1.5 VDC signal to command motor off
2 - 9 VDC	Modulating Control	2 - 9 VDC modulates motor from 0 - 100%
9 - 10 VDC	Maximum Speed	Motor is running at maximum speed (100%)

BAS equations exist in each fan powered terminal product service and installation manual to relate CFM to volts DC. The VDC in the equations however are for the 1-5 volt scale of voltage measured across the manual mode POT taps. The BAS input voltage is a 2-10 VDC scale, and therefore VDC calculated for a given CFM using the equation must be doubled to achieve that CFM using the BAS input. See standard speed controller BAS section for an example of calculating the voltage required for a specific CFM.

LCD Display

Display	Mode	Range
L.SEt	Local Setpoint – Manual speed adjust mode (use UP / DOWN to adjust)	0 - 100%
rPn	RPM – Shows current RPM of motor 1 If E001 – no RPM pulses are being read, check 6 position cable If E002 – RPM reading is above 2000 RPM, check primary air	0 - 2500 RPM
bAS.r	BAS Remote – BAS Mode – Voltage signal (Max reading is 9.99 VDC)	0 - 9.99 VDC
bAS.S	BAS Setpoint – Current BAS setpoint	0 - 100%

ECM MOTOR

TROUBLESHOOTING

Analog RPM Feedback

A two wire connection supplies an analog (0-10 VDC) signal that is directly proportional to the MOTOR 1 RPM. The range is 0 – 2500 RPM and it will output a proportional 0 – 10 VDC signal. If a dual blower system is used, only the RPM of motor 1 can be read.

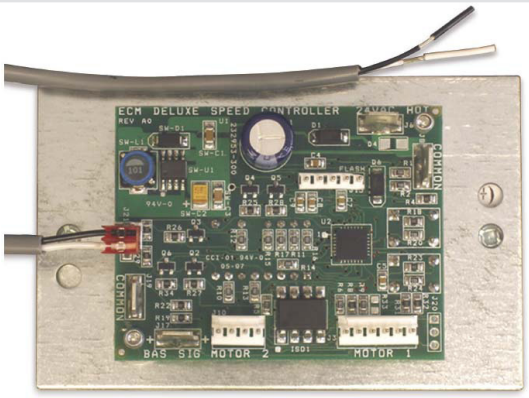
NOTE: The minimum speed of an ECM is approximately 250 RPM. Formula for outputs below (tolerance +/- 5%):

- VDC output = (RPM /250)
- RPM = (VDC * 250)

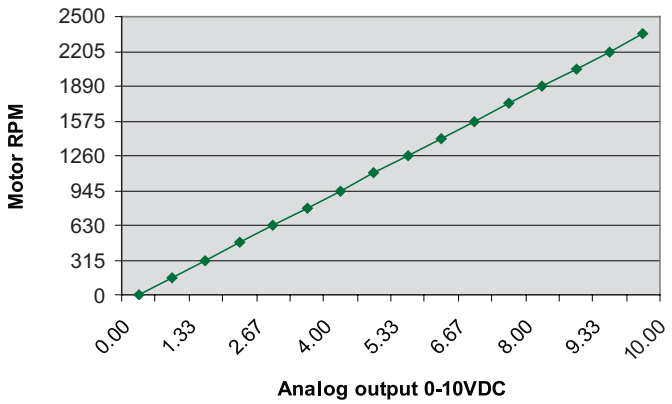
Output signal: 0 – 10 VDC @ 20 k ohm minimum input impedance and is short circuit protected (output impedance is 511 ohm to protect against incorrect wiring).

- Black Wire – Analog RPM output COM (-)
- White Wire – Analog RPM output signal (+)

BACK OF ECMDX ▼



RPM VS. VOLTAGE ▼



ECM Deluxe Speed Controller Hardware Specs

Power	24 VAC +/- 10% 50/60 Hz (2VA)
Operating Conditions	0°C to 50°C (32°F to 122°F) 0% - 95% RH non-condensing
Storage Conditions	-30°C to 50°C (-22°F to 122°F) 0% - 95% RH non-condensing
Processor	8-bit enhanced flash microcontroller
Inputs	1 Analog (BAS) and 3 digital inputs (Push buttons and RPM)
Outputs	2 Digital (GO signal to ECM, and Vspd PWM signal @ 80 Hz), Display, and aux analog output
Connections	¼" Spade Terminals – Recommend 16 – 22 AWG copper wire
Dimensions	71 mm by 96 mm (2.8" by 3.8") (includes mounting plate)
Shipping Weight	100 grams (0.220 lbs)

ECM MOTOR

TROUBLESHOOTING

Wiring and Cables

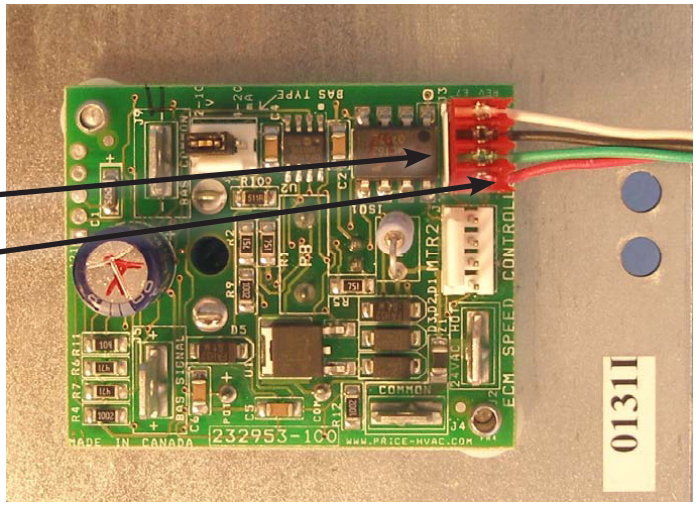
The ECM speed controller requires 24 VAC power from a transformer and outputs control signals to the ECM motor on dual MTA-100 jacks. Either jack or both jacks can be used (for dual fan systems).

The control cable (with RED connector) must be plugged into the circuit board correctly (See Figure 4 and Figure 5).

MTR1 Jack

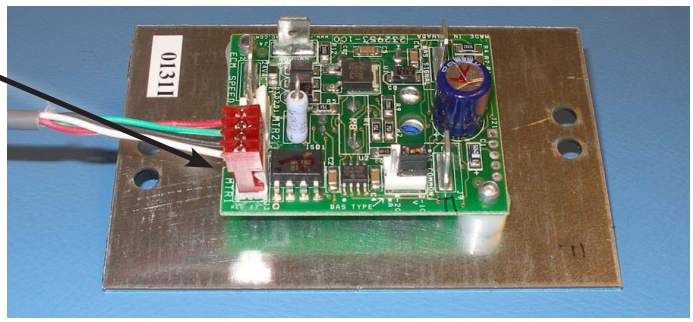
ECM Control Cable (**NOTE:** Orientation)

FIGURE 4 - ECM STANDARD SPEED CONTROLLER WITH CONTROL CABLE PLUGGED INTO MTR1



NOTE: Connector Orientation

FIGURE 5 - ECM STANDARD SPEED CONTROLLER WITH CONTROL CABLE PROPERLY CONNECTED



The red connector is an AMP MTA connected. It is keyed to only go in one way however it can (and has) been forced in backwards.

Ensure connector is inserted correctly.

NOTE: if connector is inserted backwards the motor will run erratically when the speed is adjusted with the speed controller.

ECM MOTOR

TROUBLESHOOTING

Wiring and Cables

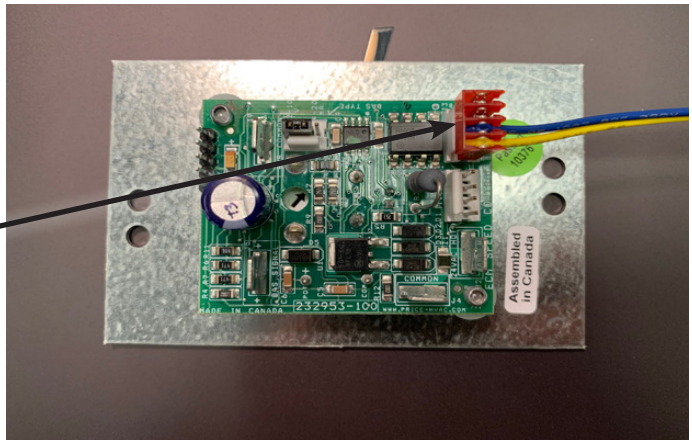
The ECM speed controller requires 24 VAC power from a transformer and outputs control signals to the ECM motor on dual MTA-100 jacks. Either jack or both jacks can be used (for dual fan systems).

The control cable (with RED connector) must be plugged into the circuit board correctly (See Figure 4 and Figure 5).

MTR1 Jack

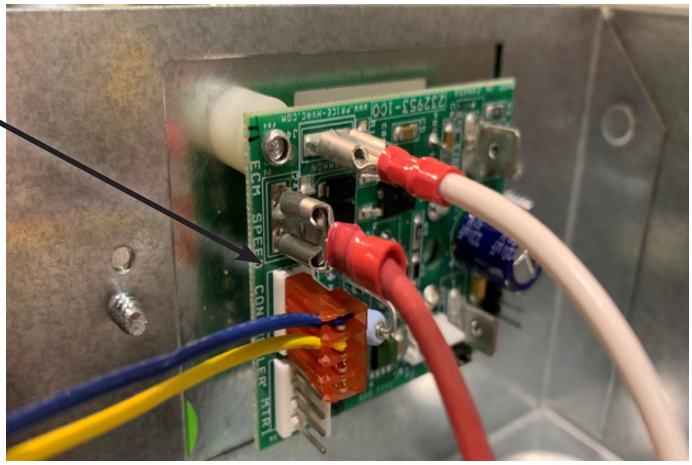
ECM Control Cable (**NOTE:** Orientation)

FIGURE 4 - ECM STANDARD SPEED CONTROLLER WITH CONTROL CABLE PLUGGED INTO MTR1



NOTE: Connector Orientation

FIGURE 5 - ECM STANDARD SPEED CONTROLLER WITH CONTROL CABLE PROPERLY CONNECTED



The red connector is an AMP MTA connected. It is keyed to only go in one way however it can (and has) been forced in backwards.

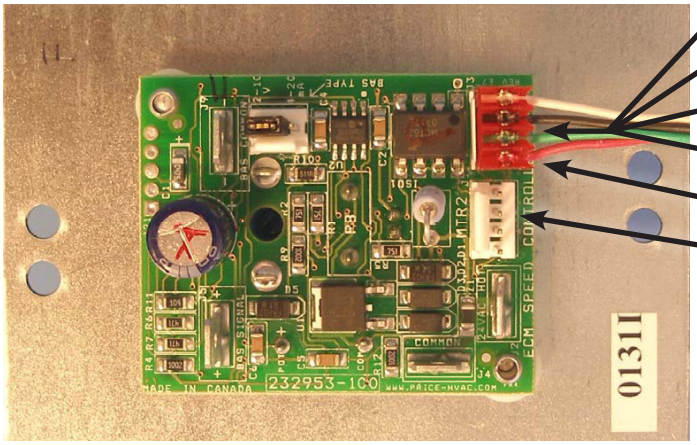
Ensure connector is inserted correctly.

NOTE: if connector is inserted backwards the motor will run erratically when the speed is adjusted with the speed controller.

ECM MOTOR

TROUBLESHOOTING

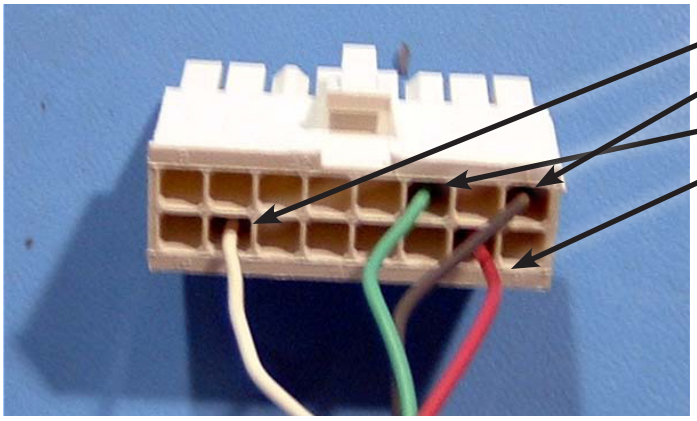
FIGURE 6 - ECM STANDARD SPEED CONTROLLER - CONTROL CABLE PINOUT ▼



- Pin 1 – 9 - 30 VDC “GO” SIG (White)
- Pin 2 – Common (Black)
- Pin 3 – Common (Green)
- Pin 4 – 9 - 30 VDC “PWM” SIG (Red)
- MTR1
- MTR2

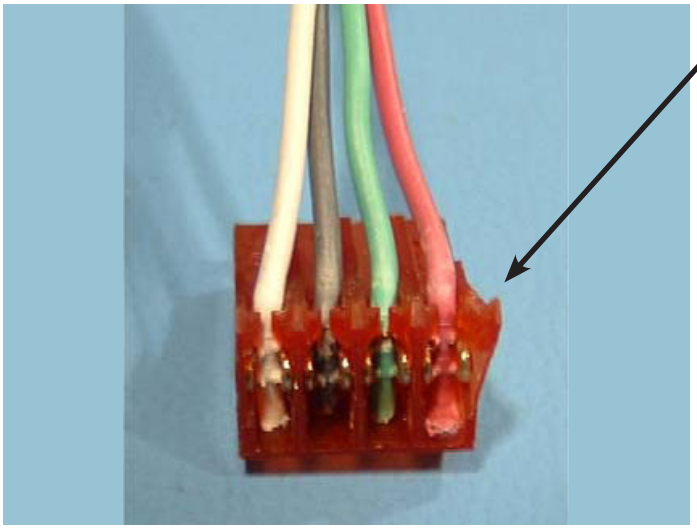
NOTE: There are two motor output jacks (MTR1 & MTR2). They are in parallel so either one can be used. Both jacks are used on dual blower units.

MOTOR END OF CONTROL CABLE ▼



- White (1)
- Black (2)
- Green (3)
- Red (4)

SPEED CONTROLLER END OF CONTROL CABLE ▼



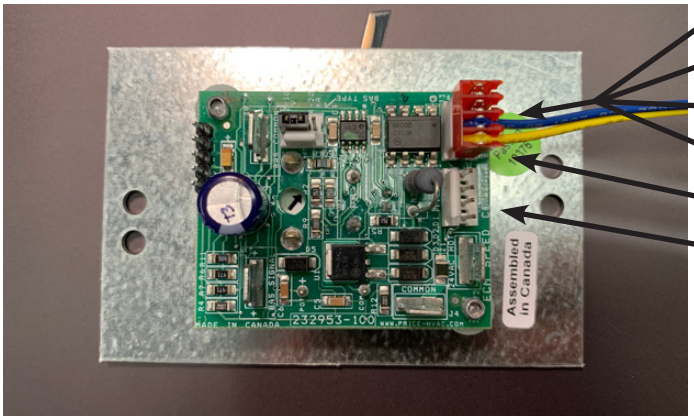
- Left to right, 1, 2, 3, 4

NOTE: If colors are different than shown here, ensure wires are still going to correct position.

ECM MOTOR

TROUBLESHOOTING

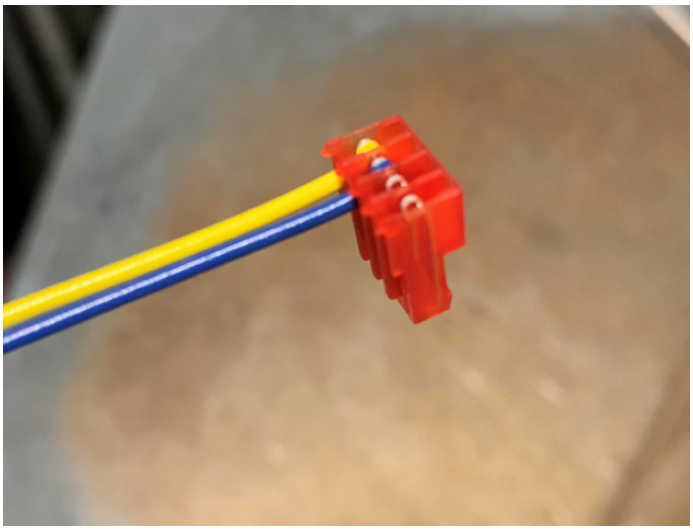
FIGURE 6 - ECM STANDARD SPEED CONTROLLER - CONTROL CABLE PINOUT ▼



- Pin 1 – Unused
- Pin 2 – Unused
- Pin 3 – Common (Blue)
- Pin 4 – 9 - 30 VDC “PWM” SIG (Yellow)
- MTR1
- MTR2

NOTE: There are two motor output jacks (MTR1 & MTR2). They are in parallel so either one can be used. Both jacks are used on dual blower units.

SPEED CONTROLLER END OF CONTROL CABLE ▼



NOTE: If colors are different than shown here, ensure wires are still going to correct position.

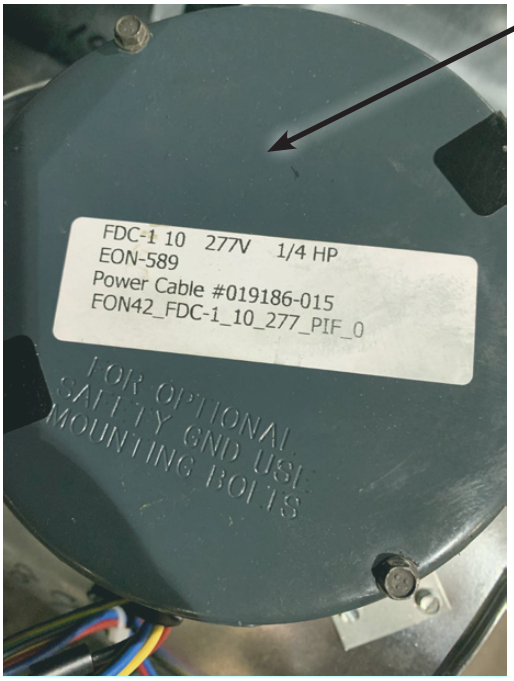
ECM MOTOR

TROUBLESHOOTING

CONTROL CABLE - MOTOR CONNECTION ▼

Accessible behind removable panel on external casing (fastened by 4 screws)

CONTROL CABLE - MOTOR CONNECTION ▼

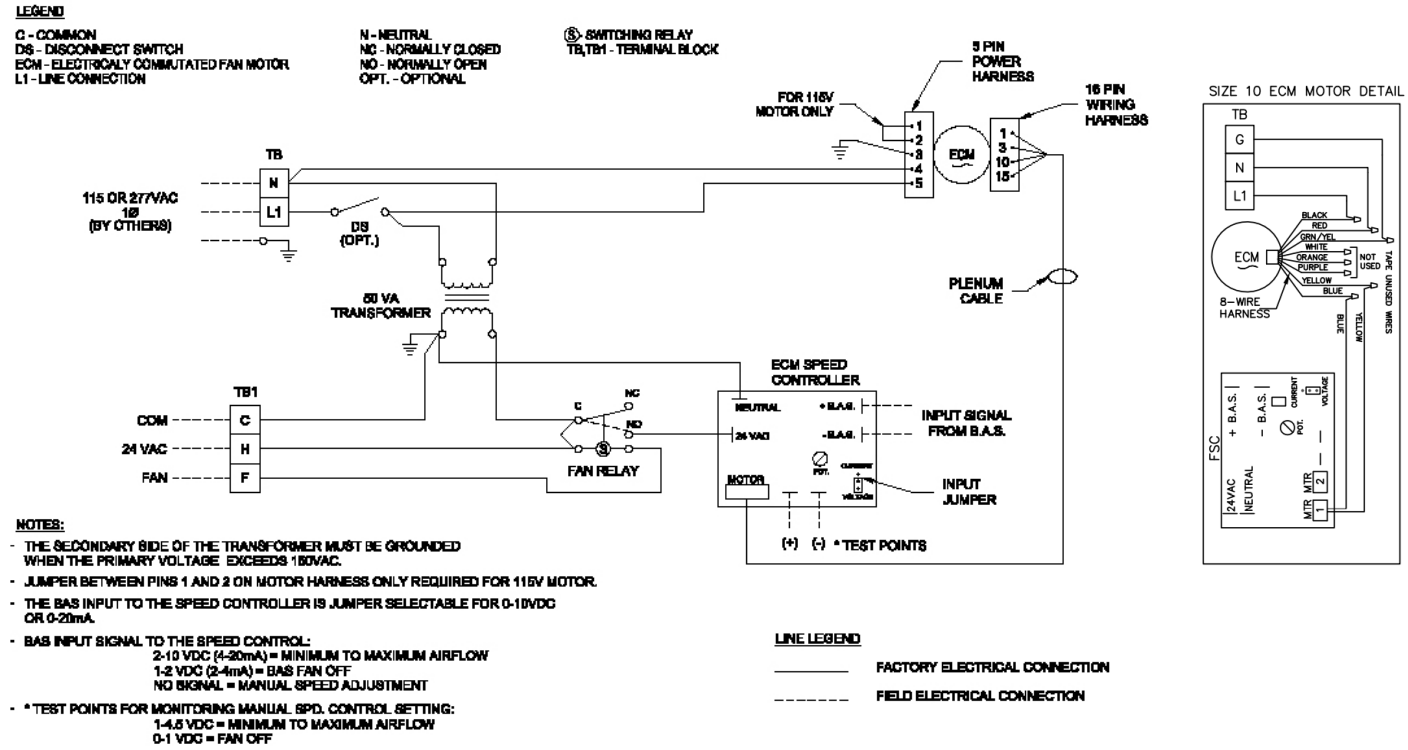


Motor specification displayed on cover of external casing

ECM MOTOR

TROUBLESHOOTING

Typical Wiring Diagram



NOTE: The ECM motor is turned ON/OFF by switching 24 VAC power to the ECM speed controller. It is not recommended to switch the main (120/240/277 VAC) power on and off. This is because the ECM motor has large capacitors that cause a current surge when turned on. This could cause a significant power spike if many units are turned on at once.

This document contains the most current product information as of this printing.
For the most up-to-date product information, please go to priceindustries.com