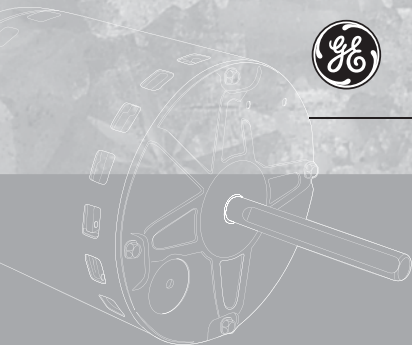


# ECM | SERVICE GUIDE



***GE ECM***

By REGAL-BELOIT



**⚠ WARNING**

Working on the motor with power connected may result in electrical shock or other conditions that may cause personal injury, death or property damage.

**⚠ WARNING**

On models 2.0/ 2.3/ 2.5 always disconnect the power from the HVAC system and wait at least 5 minutes before opening the motor, i.e. removing the two bolts from the motor control (end bell) and disconnecting the 3-pin plug to the motor. This is to allow the capacitors to dissipate for safety.

**⚠ WARNING**

Always disconnect the power from the HVAC system before removing or replacing connectors, servicing the motor, removing the high voltage plug, and before reconnecting.

**⚠ WARNING**

Disconnect AC power from the system and make sure the blower wheel has come to a complete stop.

**⚠ WARNING**

Do not operate motor without blower wheel attached. Such operation will cause the motor to oscillate up and down.

**⚠ WARNING**

You must have the correct replacement module from the manufacturer that is a direct replacement for the failed module. **USING THE WRONG MODULE VOIDS ALL PRODUCT WARRANTIES AND MAY PRODUCE UNEXPECTED RESULTS.**

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Read this section before using  
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## **START HERE:** **Using the ECM Service Guide**

The purpose of this guide is to help you accurately and efficiently troubleshoot GE ECM-driven systems. For ease of troubleshooting and to avoid misdiagnosis, it is strongly recommended that each step of this guide be used in the following order:

1. Begin with the “HVAC System Troubleshooting Basics” section on the opposite page.
2. If the answer to the problem is not solved there, read all of the Tech Tips on pages 4-5.
3. After reading all of the Tech Tips, go to the “Motor ID” section of this guide on page 6 to be sure you use the procedures for the correct motor.
4. After determining which motor you are working on from the “Motor ID” chart on page 6, go to the section in this guide for the motor model you are working on and follow the instructions listed there.

# HVAC System Troubleshooting Basics

**Before troubleshooting the ECM motor, check these system basics:**

1. Confirm that the correct thermostat input and **ONLY** the correct input voltage is present at the interface or main control board on the furnace/air handler. Loose or broken low-voltage wires are also potential problem areas **and** can cause intermittent problems.
  - ➔ For the heating and/or cooling systems, use the manufacturers guide to confirm proper demands (heat or cool), especially on multi-stage systems. Use the “Sequence of Operation” charts and the “Thermostat Wiring Diagrams”, found in these guides to confirm proper wiring and operation.
2. When checking low-voltage connections, always use the C terminal on the board, never ground.
3. Check the setting of the jumper pins or DIP switches on the manufacturer’s control board. Do not assume they are correct; use the manufacturer’s guide to select the proper airflow, delays, and profiles. **Always disconnect the main power to the unit when making these adjustments.**

4. Check all terminal/plug connections both at the furnace/air-handler control board and at the motor.  
**Always disconnect power to the system before disconnecting and reconnecting plugs.** Look for:
  - ➔ Loose plugs and/ or loose pin connections in the plug.
  - ➔ Burnt, bent or loose pins or seats.
5. Confirm there are no limits, rollouts or safeties tripped. Also check for any fault codes present on the furnace/air-handler control boards.
  - ➔ If fault codes are present, follow the manufacturer's recommendations to resolve the problem.
6. If these checks do not solve the problem, or if a fault code reveals a motor problem, read the Tech Tips on pages 4-5, and go to the "Motor ID" section on page 6 to identify the motor. Then go to the corresponding motor section in this guide for additional diagnostics.

# Tech Tips

## TECH TIP #1

**Do not automatically assume the ECM motor has failed.** Follow this guide completely before replacing it.

### ⚠ WARNING

Working on the motor with power connected may result in electrical shock or other conditions that may cause personal injury, death or property damage.

### ⚠ WARNING

Always disconnect the power from the HVAC system before removing or replacing connectors or servicing the motor

### ⚠ WARNING

On models 2.0/ 2.3/ 2.5 always disconnect the power from the HVAC system and wait at least 5 minutes before opening the motor, i.e. removing the two bolts from the motor control (end bell) and disconnecting the 3-pin plug to the motor. This is to allow the capacitors to dissipate for safety.

## TECH TIP #2

When it is necessary to disconnect the power from the HVAC system, it is always good practice to **verify that voltage has been disconnected** with a voltmeter.

## TECH TIP #3

A True- RMS meter is not needed to check high voltage or low voltage (communication voltage) to the motor.

## TECH TIP #4

If you must replace the 2.0, 2.3, or 2.5 control module, then be sure to **use a direct replacement** from the manufacturer. ECM control modules are factory programmed for specific manufacturer applications.

**Use of the wrong control module voids all product warranties and may result in improper or no blower operation.**

## TECH TIP #5

If a check of the 2.0, 2.3, or 2.5 control module indicates replacement is required, then **also check the motor module**. Installing a new control on a failed motor will result in the new control also failing.

## TECH TIP #6

**Always pull on the connector and not the wires.** Most connectors are also keyed. Reconnecting a connector the wrong way could damage the motor.

## TECH TIP #7

When checking any plug connector, the meter leads are most likely larger than the terminals or socket. Using thin leads will prevent the terminals from being damaged by voltage checks. Thinner leads are also available in a 90° angle as needed. Go to **theDealerToolbox.com** for part numbers and ordering information if needed.



# Motor Identification Chart

ECM X13



- Identification Sticker
- Heat sink
- Speed taps

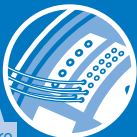
ECM 2.3 / 2.5



2.3  
≥ 10  
wires



2.5  
≤ 5  
wires



■ Identification Sticker

NOTE: Early models do not have identification stickers.

■ Painted, steel motor control

■ 2.3 - 10 or more wires in the 16-pin connector

■ 2.5 - 5 or less wires in the 16-pin connector

MOTOR ID

ECM 2.0



■ Unpainted, cast aluminum motor control

NOTE: ECM 1.0 & 2.0 motors are no longer in production.

ECM 1.0



■ Square motor control

NOTE: See manufacturer's service guide for 1.0 motor diagnostics.

**⚠ WARNING**

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**⚠ WARNING**

On models 2.0/ 2.3/ 2.5 always disconnect the power from the HVAC system and wait at least 5 minutes before opening the motor, i.e. removing the two bolts from the motor control (end bell) and disconnecting the 3-pin plug to the motor. This is to allow the capacitors to dissipate for safety.

**⚠ WARNING**

Always disconnect the power from the HVAC system before removing or replacing connectors, servicing the motor, removing the high voltage plug, and before reconnecting.

**⚠ WARNING**

Disconnect AC power from the system and make sure the blower wheel has come to a complete stop.

**⚠ WARNING**

Do not operate motor without blower wheel attached. Such operation will cause the motor to oscillate up and down.

**⚠ WARNING**

You must have the correct replacement module from the manufacturer that is a direct replacement for the failed module. USING THE WRONG MODULE VOIDS ALL PRODUCT WARRANTIES AND MAY PRODUCE UNEXPECTED RESULTS.

Read **Using the ECM Service Guide** before using this section.

## Motor Diagnostics & Replacement Table of Contents

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# Models 2.0 / 2.3 / 2.5

## Premium ECM Motor Diagnostics

### IF THE MOTOR IS RUNNING

- 1. It is normal for the motor to rock back and forth on start up. Do not replace the motor if this is the only symptom identified.**
- 2.** If the system is excessively noisy, does not appear to change speeds in response to a demand (Heat or Cool), or is having symptoms during the cycle such as a tripping limit or freezing coil, check the following:
  - ➔ Wait for programmed delays to time out. If delays are too long, then reset them using the manufacturer's charts.
  - ➔ Ensure the airflow settings are correct for the installed system using the manufacturer's charts. Remember that the change in airflow between continuous-fan speed and low stages of operation may be very slight depending on the size of the system. If the system is operating normally in each stage, then there is no problem.
  - ➔ Remove the filter and check that all of the dampers, registers, and grills are open and free flowing. If removing the filter corrects the problem, clean or replace with a less restrictive filter.

Also check and clean as needed the blower wheel, secondary heat exchanger (if applicable) and evaporator coil (if applicable).

**If this does not correct the problem then:**

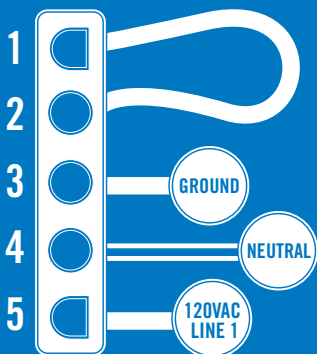
- ➔ Check the external static pressure. If it is higher than the manufacturer's recommendations, correct the airflow restriction.
- 3. If the motor does not shut off at the end of the cycle, check the delay times and wait for the delays to time out. Also, make sure that there is no call for "Continuous fan" on the "G" terminal. This motor may take a while to come to a complete stop with selected delays and the normal ramp down.
- 4. **If the 2.0 / 2.3 motor** has proper high voltage and ground at the 5-pin connector, go to the "Troubleshooting with the TECMate" section on page 20. **If the 2.5 motor** has proper high voltage and ground at the 5-pin connector, the equipment manufacturer's checks, located in their service manuals, must be referenced. This guide cannot troubleshoot the communication to the 2.5 motor. **The TECMate is not designed for use on the 2.5 motor.**
  - ➔ Checking the high voltage on the 5-pin connector is outlined in step 1 on page 11.

## IF THE MOTOR IS NOT RUNNING

1. Check for proper high voltage and ground at the 5-pin connector at the motor. Correct any voltage issues before proceeding to the next step. These are dual voltage motors capable of operating in 120 or 240VAC systems. On 120VAC systems there should be a jumper between terminals 1 and 2 (see Figure 1). On 240VAC systems the jumper should be removed (see Figure 2). If a motor is operating at 240VAC with the jumper in place, the motor will be permanently damaged. Input voltage within plus or minus 10% of the nominal 120VAC or 240VAC is acceptable.
2. **If the 2.0 / 2.3 motor** has proper high voltage and ground at the 5-pin connector, go to the “Troubleshooting with the TECMate” section on page 20. **If the 2.5 motor** has proper high voltage and ground at the 5-pin connector, the equipment manufacturer’s checks, located in their service manuals, must be referenced. This guide cannot troubleshoot the communication to the 2.5 motor.  
**The TECMate is not designed for use on the 2.5 motor.**
3. If further troubleshooting identifies a failed control module, go to “Replacing the ECM Control Module” section on page 23 of this guide for replacement steps.

## Models 2.0 / 2.3 / 2.5

Figure 1



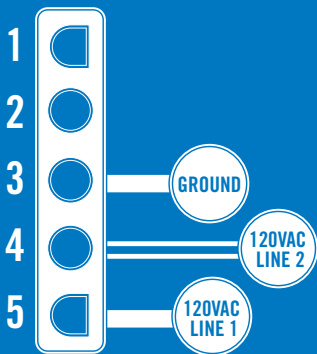
### 120VAC SYSTEM

#### **⚠ WARNING**

Always disconnect power from the system before removing the high voltage plug and before reconnecting.

## Models 2.0 / 2.3 / 2.5

Figure 2



### 240VAC SYSTEM

# Model X13

## Standard ECM Motor Diagnostics

### IF THE MOTOR IS RUNNING

- 1. It is normal for the motor to rock back and forth on start up. Do not replace the motor if this is the only problem identified.**
- 2.** If the system is excessively noisy, does not appear to change speeds in response to a demand (Heat or Cool), or is having symptoms during the cycle such as a tripping limit or freezing coil, check the following:
  - ➔ Wait for programmed delays to time out. If delays are too long, reset them using the manufacturer's charts.
  - ➔ Ensure the airflow settings are correct for the installed system using the manufacturer's charts. If the system is operating normally in each mode, there is no problem.
  - ➔ Remove the filter and check that all of the dampers, registers, and grills are open and free flowing. If removing the filter corrects the problem, clean or replace with a less restrictive filter. Also check and clean as needed the blower wheel, secondary heat exchanger (if applicable) and evaporator coil (if applicable).



### If this does not correct the problem then:

- ➔ Check the external static pressure. If it is higher than the manufacturer's recommendations, correct the airflow restriction.
- 3. If the motor does not shut off at the end of the cycle, check the delay times and wait for the delays to time out. Also make sure that there is no call for "Continuous fan" on the "G" terminal. This motor may take a while to come to a complete stop with selected delays.
- 4. If the above diagnostics do not solve the problem, confirm the voltage checks in the next section below, then continue diagnostics in the section, "Model X13 Standard ECM Motor Communication Diagnostics."  
**The TECMate is not designed for use on this motor.**

#### WARNING

Always disconnect power from the system before removing the high voltage connection(s) and before reconnecting.

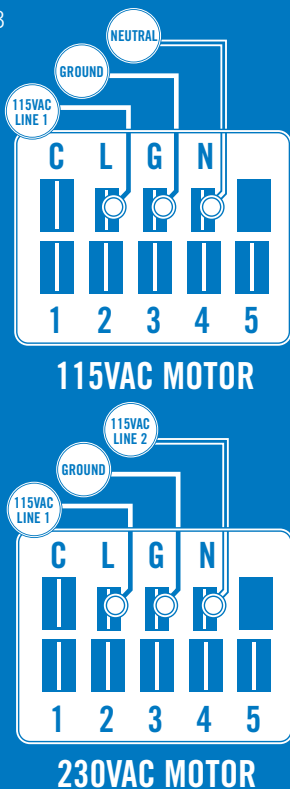
## IF THE MOTOR IS NOT RUNNING

1. Check for proper high voltage and ground at the (L)(G)(N) connections at the motor (see Figure 3 on the next page). Correct any voltage issues before proceeding to the next step. The X13 motor is voltage specific. Only the correct voltage should be applied to the proper motor. Input

voltage within plus or minus 10% of the nominal 115VAC or 230VAC is acceptable.

- The TECMate is not designed for use on this motor.** If the motor has proper high voltage and ground at the (L)(G)(N) connections, continue diagnostics in the next section, “Model X13 Standard ECM Motor Communication Diagnostics.”

Figure 3



# Model X13

## Standard ECM

### Motor Communication Diagnostics

The X13 motor can be communicated through AC or DC low voltage. AC voltage is typically 24VAC and DC voltage can be between 9-23VDC (see Figures 4 and 5 on the next page).

1. Start with the manufacturer's literature to confirm proper set-up, connections and voltage. It is not required that all terminals on the motor have a program. If the low-voltage communication is applied to an unprogrammed terminal, the motor will not operate, which is normal.
2. Initiate a demand from the thermostat and check the voltage between the common and the appropriate motor terminal 1- 5. Confirm the meter is set to the voltage identified from the manufacturer's literature (see Figures 4 and 5 on the next page).

➡ If the low voltage communication is not present, check the demand from the thermostat. Also check the output terminal and wire(s) from the manufacturer's control board or relays to the motor.

➡ If the motor has proper high voltage as identified in the previous section, and proper low voltage to a programmed terminal, and is not operating, the motor is failed. Go to "Replacing the X13 Motor" section on page 29 of this guide.

Figure 4

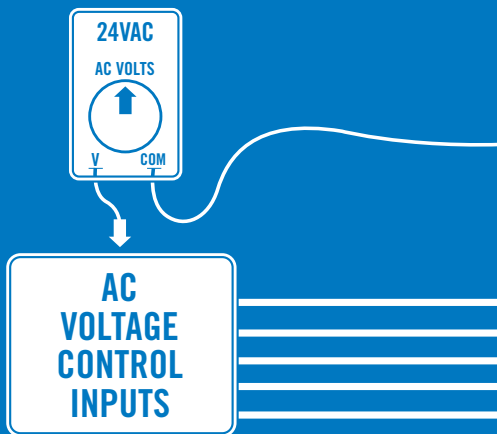
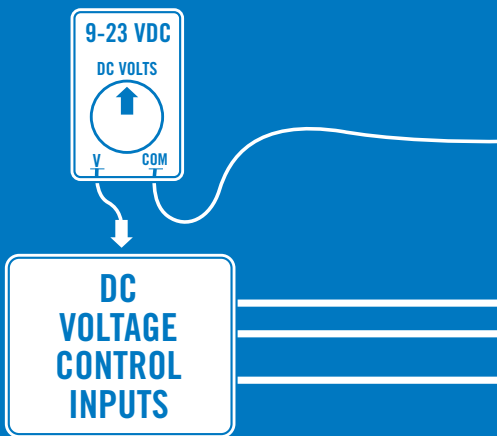
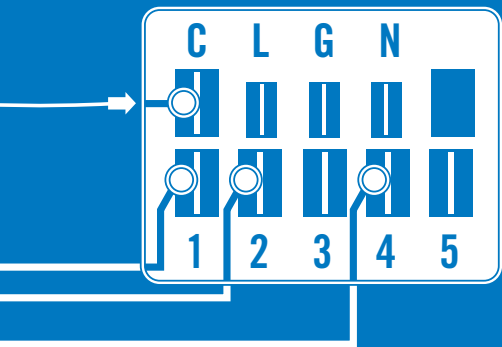
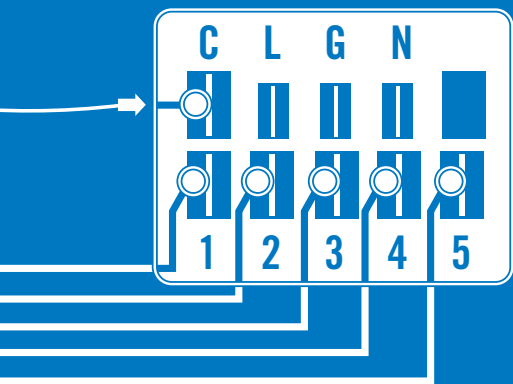


Figure 5





# TECMate

## USAGE CHART

### INDOOR BLOWER MOTORS

**GE ECM Troubleshooter**  
4 button  
w/three position  
(G) switch \*\*



**TECMate XL \***  
4 button



**TECMate Pro**  
1 button



ALL MANUFACTURERS 1.0 / 2.5 / X13	N/A	N/A	N/A
ALL MANUFACTURERS 2.0 / 2.3	Y	Y***	Y

**Y** | This tool will accurately diagnose this motor

**N/A** | This tool is not applicable to this motor

\* The TECMate XL is no longer available. It has been replaced with the TECMate Pro. \*\* The GE ECM Troubleshooter contains its own instructions for use and is available only from Carrier/Bryant distributors. part number (P/N HK50EA001)

**Note: These tools are not for use on GE ECM condensing fan or draft inducer motors.**

## Troubleshooting with the TECMate (Models 2.0 / 2.3 only)

See Motor ID Chart on page 6, if needed.

See the Usage Chart on the opposite page for motors applicable to the TECMate.

The TECMate is capable of identifying a motor control failure versus another HVAC system controller or wiring failures.

### WARNING

Disconnect AC power from the system and make sure the blower wheel has come to a complete stop.

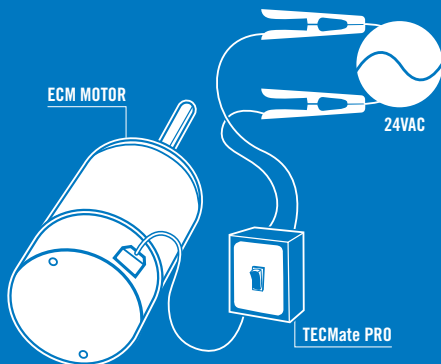
### WARNING

Do not operate motor without blower wheel attached. Such operation will cause the motor to oscillate up and down.

1. Remove the 16-pin connector from the motor, and connect the 16-pin connector from the TECMate. Remove the 5-pin AC power connector first to make accessing the 16-pin locking tab easier. **Reconnect the 5-pin AC power connector.**
2. Connect the two alligator clips from the TECMate to a constant 24VAC (**24VAC terminal and Common terminal**) source such as the transformer low-voltage terminals or terminal strip on the manufacturer's control board

(see Figure 6 below). These connections are not polarity sensitive.

Figure 6



**NOTE: The high voltage 5-Pin connector must be connected to the motor for TECMate tests.**

3. Place the TECMate switch(es) in the OFF position.
4. Reconnect the AC power to the system. The green LED light on the TECMate should be on when connected properly to 24VAC.
5. **Refer to the table on the back of the TECMate for operation guidelines.** Observe the motor for a minimum of 15 seconds.



➡ **If using a TECMate XL or the GE ECM Troubleshooter**, make sure to set the switches according to the instructions on the back for each demand test to eliminate misdiagnosing the problem.

6. When testing is finished, place the TECMate switch(es) in the OFF position and wait for the motor to completely stop. (Based on the manufacturer's program, the motor may not shut off immediately after a test; this is normal).

➡ **If the motor operates with the TECMate**, the motor is ok. Confirm the proper demand call from the thermostat is present at the manufacturer's control board. Check the 16-pin harness for broken wires or bad pin connectors. Troubleshoot the communication with the manufacturer's troubleshooting guide.

➡ **If the motor does not operate with the TECMate**, confirm high voltage (pages 11-12) is present before replacing the control module. Follow the next section on "Replacing the ECM Control Module" on page 23.

## Replacing the ECM Control Module (Models 2.0 / 2.3 / 2.5 Only)

**Before replacing the electronic-control module, you must test the motor module to ensure it is not also damaged.**

Installing a new control on a failed motor will result in the new control failing as well. Procedures for testing the motor module are included below.

### WARNING

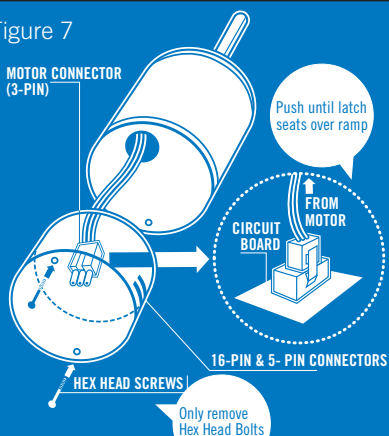
You must have the correct replacement module from the manufacturer that is a direct replacement for the failed module. **USING THE WRONG MODULE VOIDS ALL PRODUCT WARRANTIES AND MAY PRODUCE UNEXPECTED RESULTS.**

### WARNING

Disconnect AC power from HVAC system and wait 5 minutes before opening the motor to avoid electrical shock from motor's capacitors

1. After the system AC power has been off for 5 minutes, unplug the 16-pin connector and the 5-pin connector from the motor control.
2. Remove the blower assembly from the HVAC system.
3. Remove the two (2) hex-head screws from the back of the control.
4. Unplug the 3-pin connector from the inside the control by squeezing the latch and gently pulling on the connector (see Figure 7 on the next page). Now you're ready to test the motor.

Figure 7



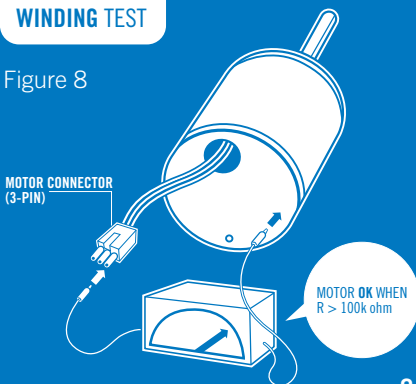
## MOTOR MODULE TESTS

### A. The Winding Test (see Figure 8)

Set ohm meter to the highest possible setting and measure resistance between each of the three motor leads to the unpainted part of the end shield. The motor passes the test if the meter indicates greater than 100k ohms.

## WINDING TEST

Figure 8



## B. The Phase-to-Phase Test (see Figure 9 below)

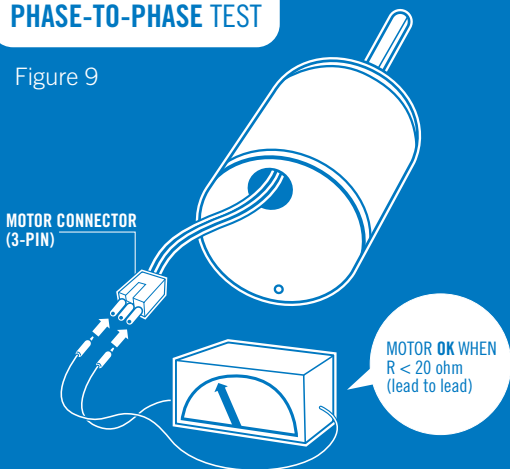
Set ohm meter to lowest possible setting and measure the motor phase to phase resistance by checking these combinations of the 3-pin motor connector with an ohm meter:

- Lead 1 to lead 2
- Lead 1 to lead 3
- Lead 2 to lead 3

For the purpose of this test, either end of the 3-pin plug is lead 1. Resistance values should be less than 20 ohms and each of the three values should be the same (plus or minus 10%). If the measured resistance is outside of these parameters, the motor fails the test.

### PHASE-TO-PHASE TEST

Figure 9



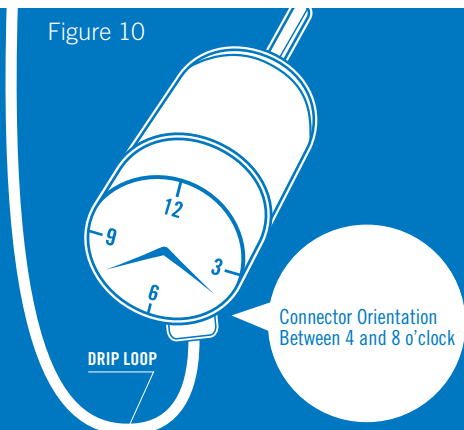
**C. If the motor passes** both of these tests, then the motor is ok and only the control must be replaced. Continue with replacing the ECM control module in step 5.

**D. If the motor fails** either of these tests, replace the motor module following the guidelines on page 28. When finished installing the motor module, continue with the replacement of the ECM control module, in step 5 below.

5. Insert the 3-pin connector back into the new control module. A slight click will be heard when inserted properly. This connector is keyed for proper connection.
6. Attach the new control module with connectors facing down:
  - ➔ If replacing an ECM 2.0 control with an ECM 2.3 control, insert plastic tab into perimeter of replacement control and align tab with mating hole in the endshield. Use the new shorter bolts provided to ensure a secure attachment. Orient the control connectors to the endshield between 4 and 8 o'clock (as seen similarly in Figure 10 on the next page), insert bolts and tighten.
  - ➔ If replacing an ECM 2.3 with an ECM 2.3 control, orient the new control to the motor's endshield with connectors facing down, insert bolts and tighten.

- ➔ ECM 2.5 control must be replaced with an ECM 2.5 control. Orient the new control to the motor's endshield with connectors facing down, insert bolts and tighten.
7. Reinstall the blower/ motor assembly into the HVAC system by following the manufacturer's guidelines.
  8. Plug the 16-pin connector and the 5-pin connector back into the motor. The connectors are keyed. Observe proper orientation.
  9. Be certain to form a drip loop so that water cannot enter the motor by draining down the cables (see Figure 10 below).
  10. Go to the "Final Installation Checks" on page 30.

Figure 10

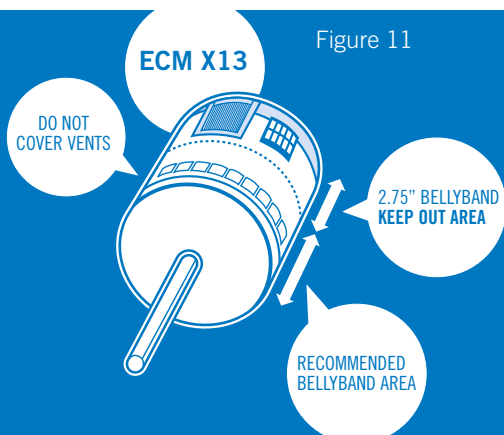


## Replacing the ECM Motor Module (Models 2.0 / 2.3 / 2.5)

- Make sure the belly band is not covering any shell holes.
- The motor module does not have a specified orientation, however, the motor control does.
- Make sure the three-wire plug will reach the motor control when it is oriented properly before tightening down the belly band. Proper orientation is for the connectors to be facing down or at least between 4 and 8 o'clock (as seen similarly in Figure 10 on the opposite page).
- After installing the new motor module, install the motor control starting at step 5 on page 26.

## Replacing the X13 Motor

- The X13 is a one piece motor. Do not open motor to service.
- Motor must be a direct replacement from the manufacturer with respect to voltage and model unit.
- When replacing the X13 motor with a belly band for mounting, the band should not be located in the area identified in Figure 11.
- Reconnect high and low voltage wiring according to the manufacturer's guidelines.
- Proper orientation is for the connectors to be facing down or at least between 4 and 8 o'clock (as seen similarly in Figure 10 on the previous page).





## Final Installation Checks

- Check all wiring and connections, especially those removed while servicing.

### Ensure the system is set up as follows:

- Verify the condensate drain is not plugged or clogged.
- Reconnect the AC power to the HVAC system and verify that the motor is working properly.
- Check and plug leaks in return ducts and equipment cabinet.
- Verify that the system is running quietly and smoothly, in all modes (heating, cooling, and continuous fan) and all stages (if applicable).
- Return all thermostat settings to the customer's preference.

### Note: If this is a repeat failure then it is important that you check the following:

- If any evidence of moisture, then correct the issue.
- If the area is subject to high amounts of lightning strikes, then use of additional transient protection may be helpful.

See “good practices” on next page:

## Good Practices:

- Finish all service calls by checking all safeties, and perform a visual inspection of the overall job to prevent call-backs.
- Check the level of Carbon Monoxide (CO) in the vent(s) and living spaces of all homes with fossil-fuel appliances.
- Recommend annual maintenance.

Visit  
**[www.theDealerToolbox.com](http://www.theDealerToolbox.com)**  
to learn more.



***GE ECM***

By REGAL-BELOIT



GEECM-1002 (5M 11/06)  
Version 1.0

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