



Generation I



Generation II

# Emerson® UltraTech® Variable-Speed Motor

## Troubleshooting Manual

1 HP,  $\frac{3}{4}$  HP,  $\frac{1}{2}$  HP, and  $\frac{1}{3}$  HP



## Table of Contents

About the Emerson® UltraTech® Variable-Speed Motor .....	2
Safety Tips.....	4
Getting Started .....	5
Motor isn't Spinning or Runs Abnormally.....	5
Motor Rattles or Makes Excessive Noise .....	5
Motor and Control Unit Diagnostics.....	6
<b>Check I:</b>	
Diagnosis with Ultracheck-EZ™ Diagnostic Tool.....	7
<b>Check II:</b>	
Electrical Troubleshooting.....	11
<b>Check III:</b>	
Control Unit Verification.....	14
<b>Check IV:</b>	
Motor Verification .....	18
Final Checks .....	21

**This manual is intended as a guide to identifying and diagnosing problems related to the Emerson® UltraTech® variable-speed motor. It is not intended to provide instructions concerning diagnosis of related system components nor the service or replacement of the blower motor.**

**This manual provides troubleshooting instructions for both Generation I and Generation II of the UltraTech variable-speed motor.**

## **About the Emerson® UltraTech® Variable-Speed Motor**

The Emerson® UltraTech® variable-speed motor is a 4-wire electronically controlled motor developed by Emerson Climate Technologies. Its two-way communication provides automatic configuration and checking of system settings to ensure the customer better comfort, efficiency, and higher reliability. The UltraTech® motor provides efficient “soft” start-and-stop and automatically adjusts its speed to precisely match humidity and temperature needs. The end result for homeowners is enhanced energy efficiency and home comfort.

## **About Emerson**

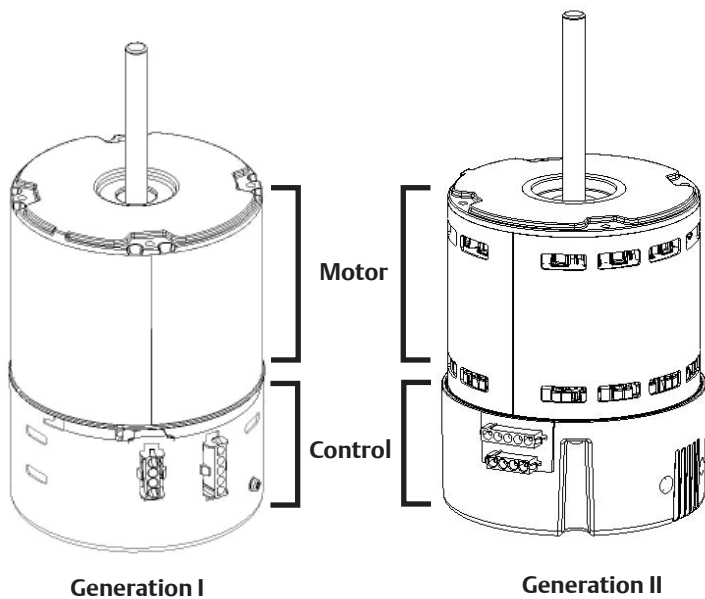
Emerson, based in St. Louis, is a global leader in bringing technology and engineering together to provide innovative solutions to customers through its network power, process management, industrial automation, climate technologies, and appliance and tools businesses. For more information, visit [Emerson.com](http://Emerson.com).

## **About Emerson Climate Technologies**

Emerson Climate Technologies, a business of Emerson, is the world’s leading provider of heating, ventilation, air conditioning and refrigeration solutions for residential, industrial and commercial applications. The group combines best-in-class technology with proven engineering, design, distribution, educational and monitoring services to provide customized, integrated climate-control solutions for customers worldwide. Emerson Climate Technologies’ innovative solutions, which include industry-leading brands such as Copeland Scroll® compressors and White-Rodgers® instruments, improve human comfort, safeguard food and protect the environment.

For more information, visit [EmersonClimate.com](http://EmersonClimate.com).

## UltraTech® Variable-Speed Motor Assembly



## Safety Tips



### WARNING



#### **SHOCK HAZARD!**

Do not expose the motor or control unit to rain or moisture.

**DO NOT** separate the motor and control unit while the motor is in operation.

### CAUTION

Motor and control unit are assembled and calibrated as a set. Mismatching the motor or control unit with other unsuitable parts will drastically affect performance tolerance.

To prevent permanent damage to the unit **DO NOT** apply 240Vac to the motor with the jumper positions 1 and 2.

### NOTICE

The motor and control unit connectors are keyed to prevent misconnecting. **DO NOT** force the connectors together.

To service the motor, disconnect power cable and wait 30 seconds before handling the power cord. This allows the bus capacitor to fully discharge.

## Getting Started

This troubleshooting guide provides field technicians a step by step process for accurately diagnosing and troubleshooting certain problems experienced by Emerson® UltraTech® motors. It does not override or replace instructions suggested by the manufacturer of the HVAC system.

To prevent misdiagnosis and unneeded repairs, operators should try the steps listed in the Basic Troubleshooting section first. If the problem still exists or does not resolve the ongoing issue, go to the Motor and Control Unit Diagnostic section on page 6.

## Basic Troubleshooting

### Motor isn't spinning or runs abnormally.

- Verify thermostat is issuing call for activity.
- Check circuit breaker for trips or accidental shutoff.
- Verify communication cable and power cord are securely connected to control unit connectors. Inspect for shorts, detached wiring, or loose connections.
- Inspect control unit for broken or loose connectors, moisture, excessive dirt or other damage.

### Motor rattles or makes excessive noise.

- Inspect motor and blower for accumulated dirt, internal debris or other signs of damage.
- Inspect blower fan for bent or missing blades, misaligned shaft, or unsecured mounting to shaft.
- Inspect motor shaft for damaged bearings.
- Inspect blower housing for cracks, dents, or corrosion.
- Inspect blower housing for secure mounting to system chassis.
- Verify motor shaft spins freely without effort, by hand, in both directions.

## Motor And Control Unit Diagnostics



### WARNING

- Only trained and qualified professionals familiar with UltraTech® motors should service the motor and control unit.
- Before connecting or disconnecting cables or other electrical connections, verify power is shut off to the system. Failure to comply may cause serious damage to the motor, HVAC system or injury to personnel.
- Because of the risk of electric shock, only individuals thoroughly trained in the use of multimeters should conduct voltage tests.
- Never touch the metal contacts on the multimeter during a test.
- Always check testing equipment for proper operation before use.
- Do not operate the motor without blower wheel attached. Without the blower wheel, the motor will run continuously to a maximum speed and then stop.
- Voltage symbols vary among different multimeters and may be displayed as: VAC, AC, V, or a V beneath a wavy line. Select the correct symbol and set the multimeter to the voltage closest to the voltage that is being measured.

## Check I: Diagnosis with Ultracheck-EZ™ Diagnostic Tool

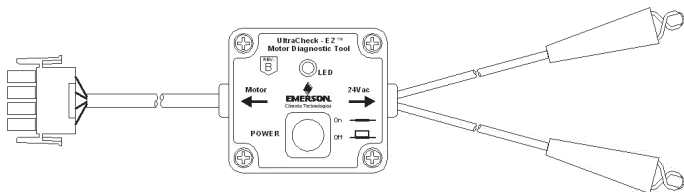
If the Ultracheck-EZ™ diagnostic tool is not available, please proceed to page 13 and complete Checks II through IV in order.



### NOTE

Only trained and qualified professionals familiar with UltraTech® motors should service the motor and control unit.

## Connecting the Ultracheck - EZ Diagnostic Tool



1. Disconnect or turn off AC power to the furnace, air handler, or equipment being serviced.
2. Disconnect the four wire communication cable from the control unit connector [Figure 1].

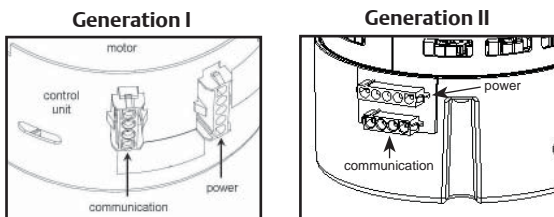


Figure 1

3. Connect the four wire connector of the Ultracheck-EZ diagnostic tool [Figure 2] to the control unit communication connector [Figure 1].

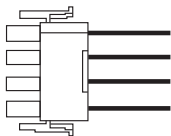


Figure 2

4. Attach one of the alligator clips of the Ultracheck-EZ diagnostic tool [Figure 3] to a proper ground source.



Figure 3

5. Attach the other alligator clip [Figure 3] to a proper 24VAC source.



## NOTE

There is no polarity on the alligator clips.

The UltraCheck-EZ diagnostic tool is equipped with a nonreplaceable fuse. **DO NOT** connect the UltraCheck-EZ diagnostic tool to a power supply over 24Vac. Applying more than 24Vac will make the UltraCheck-EZ diagnostic tool inoperable.

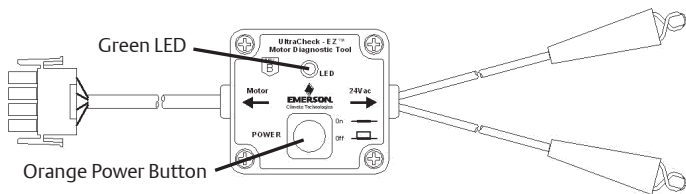


Figure 4

6. Reestablish power to the furnace, air handler or system being serviced.



## NOTE

The **orange button** on the UltraCheck-EZ™ diagnostic tool sends a signal to the UltraTech® motor to rotate when pressed. There may be a five second delay between the time the button is pushed and the motor begins to rotate. **If the orange button doesn't illuminate when pressed, the UltraCheck-EZ diagnostic tool is not connected to a 24Vac supply or is inoperable.**

The **green LED** is an indicating signal that the UltraTech motor is communicating with the UltraCheck-EZ diagnostic tool. **If the green LED doesn't blink, the control unit should be replaced.**

- Use the scenarios below to determine needed action. Complete steps 8-11 before proceeding to the next check. Press the orange button [Figure 4] on the Ultracheck-EZ diagnostic tool and wait five seconds for the blower to spin.

Orange Power Button	Green LED	Motor Blower	Comments
Not Lit	Not Lit	Not Rotating	If button does not illuminate when power button is depressed, verify 24Vac is available at alligator clips. If 24Vac is verified, the UltraCheck-EZ diagnostic tool is inoperable.
Lit	Blinking	Rotating	Motor and control unit are functioning properly.
Lit	Not Lit	Rotating	Control unit should be replaced.
Lit	Blinking	Not Rotating	Further investigation required. Proceed to Check IV to verify motor operation.
Lit	Not Lit	Not Rotating	Control unit should be replaced, proceed to Check IV to verify the motor is still operational.

- Press the orange button [Figure 4] again to stop the blower and turn off the Ultracheck-EZ™ diagnostic tool.
- Disconnect or turn off AC power to the furnace, air handler, or system being serviced.

10. Remove both alligator clips [Figure 3] from the 24Vac and ground connections.
11. Reconnect the four wire communication connector to the control unit connector [Figure 1, page 7].
12. Reestablish power to the furnace, air handler or system being serviced.

## Check II: Electrical Troubleshooting

1. Disconnect or turn off power to the furnace, air handler, or system being serviced and wait 5 minutes. This allows the capacitors in the control unit to fully discharge.
2. Check the rotation and speed of the blower fan. Determine if blower fan can spin freely manually, without effort or assisted means. If binding occurs, the motor needs to be replaced.
3. Determine if HVAC system is wired for 120VAC power or 240 VAC power.
  - If system is wired for 120VAC power, verify a jumper wire is installed between positions 1 and 2 of the power cord connector. On systems wired for 240 VAC, the jumper wire should be removed [Figure 5].



## CAUTION

Operating the motor at 240VAC with jumper wire installed will cause significant damage to the motor.

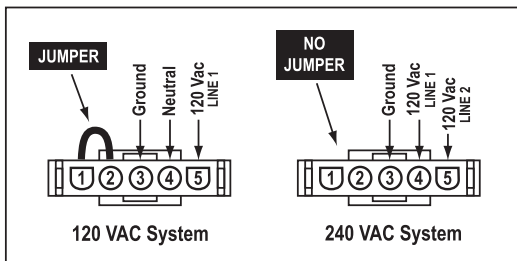


Figure5

4. Disconnect power cord from connector on control unit. Inspect power cord connector for bent, damaged, or recessed wires and terminals [Figure 5].
  - Contact HVAC manufacturer if power cord contains bent, damaged, or recessed wires and terminals.



**Figure 6**

5. Disconnect four wire communication cable from connector on control unit. Inspect communication cable connector for bent, damaged, or recessed wires and terminals [Figure 6].
  - Contact HVAC manufacturer if communication cable contains bent, damaged, or recessed wires and terminals.
6. Reconnect or turn on power to the furnace, air handler, or system being serviced.
7. Check the voltage between positions 4 and 5 of the power cord connector [Figure 5].
  - Contact HVAC manufacturer if system is rated for 120VAC power, and the measured voltage between positions 4 and 5 is not 120VAC.
  - Contact HVAC manufacturer if system is rated for 240VAC power, and the measured voltage between positions 4 and 5 is not 240VAC.
  - If the measured voltages are correct between positions 4 and 5 for the 120VAC or 240 VAC system, go to step 8.
8. Check the voltage between positions 1 and 4 of the communication cable connector [Figure 6].
  - Contact HVAC manufacturer if the measured voltage between positions 1 and 4 is not 9-15VDC.
  - If the measured voltage between positions 1 and 4 is 9-15VDC, go to step 9.
  - If all electrical checks are ok, go to step 9.

9. Disconnect or turn off AC power to the furnace, air handler, or system being serviced. Wait 5 minutes to allow the capacitors to fully discharge.
10. Proceed to Check III.

## Check III: Control Unit Verification

### Generation I

1. Disconnect or turn off AC power to the furnace, air handler, or system being serviced. Wait 5 minutes to allow the capacitors to fully discharge.

### Removing Control Unit

2. Loosen two screws securing the motor and control unit together. Twist the control unit and pull away from motor until both units are separated [Figure 7a].

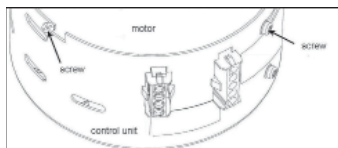


Figure 7a

### Generation II

1. Disconnect or turn off AC power to the furnace, air handler, or system being serviced. Wait 5 minutes to allow the capacitors to fully discharge.

### Removing Control Unit

2. Remove three screws securing the motor and control unit together. Grasp the control unit and pull away from motor until both units are separated [Figure 7b].

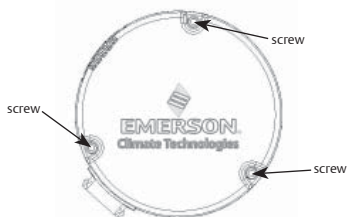
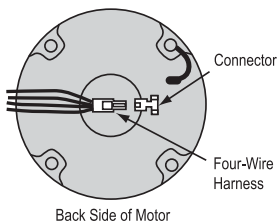


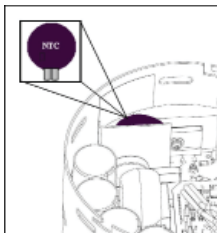
Figure 7b

3. Disconnect the four-wire motor-to-control harness from the motor end shield [Figure 8a] and remove control unit. Inspect for bent, damaged, or recessed wires and terminals inside of connector.
  - Replace control unit if four-wire harness contains bent, damaged or recessed wires and terminals.



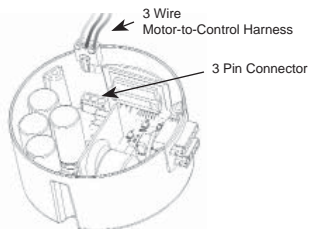
**Figure 8a**

4. Inspect the NTC thermistor inside of control unit for any cracks or breakage [Figure 9a].
  - Replace control unit if NTC thermistor is cracked or broken.



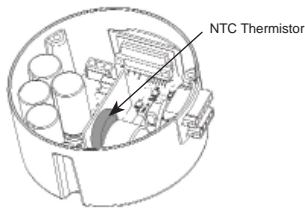
**Figure 9a**

3. Disconnect the three-wire motor-to-control harness from the control [Figure 8b] and remove control unit. Inspect for bent, damaged, or recessed terminals inside of connector.
  - Replace control unit if the three pin connector contains bent damaged or recessed terminals.



**Figure 8b**

4. Inspect the NTC thermistor inside of control unit for any cracks or breakage [Figure 9b].
  - Replace control unit if NTC thermistor is cracked or broken.



**Figure 9b**

5. Inspect capacitors inside of control unit for bulging or swelling caps [Figure 10a].
- Replace control unit if capacitors are bulging or swollen.

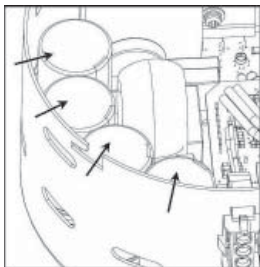


Figure 10a

6. Check phase to phase resistance between each of the three phase wires (red, blue, and yellow) in the 4-wire harness connector [Figure 11a]. Resistance levels between any two wires should be greater than 100K.

**Do not check the green wire during this test.**

- If multimeter indicates resistance levels greater than 100K, the control unit is functioning properly. Next, to verify motor functionality, proceed to Check IV.
- Replace control unit if multimeter indicates resistance levels lower than 100K.

5. Inspect capacitors inside of control unit for bulging or swelling caps [Figure 10b].
- Replace control unit if capacitors are bulging or swollen.

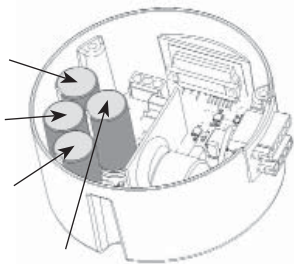
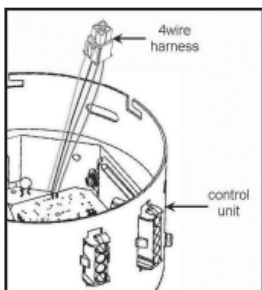


Figure 10b

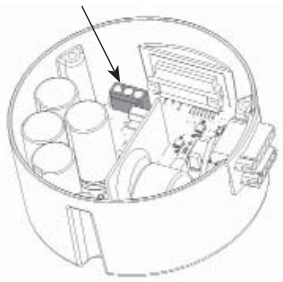
6. Check phase to phase resistance between each of the three phase pins in the 3-pin motor connector [Figure 11b]. Resistance levels between any two **pins** should be greater than 100K.

- If multimeter indicates resistance levels greater than 100K, the control unit is functioning properly. Next, to verify motor functionality, proceed to Check IV.
- Replace control unit if multimeter indicates resistance levels lower than 100K.



**Figure 11a**

3 Pin Motor Connector



**Figure 11b**

## Check IV: Motor Verification

- 1 Disconnect or turn off AC power to the furnace, air handler, or system being serviced. Wait 5 minutes to allow the capacitors to fully discharge.
- 2 Make sure the motor shaft spins freely without effort manually in both directions [Figure 12].
  - If motor shaft spins freely, go to step 3.
  - Replace motor if the shaft does not spin freely without effort manually.

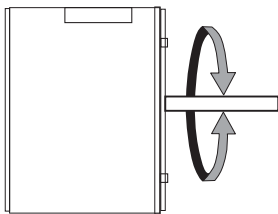


Figure 12

## Removing Control Unit (if still mounted to the motor) Generation I

- Loosen two screws securing the motor and control unit together. Twist the control unit and pull away from motor until both units are separated [Figure 13a].

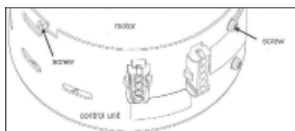


Figure 13a

- Disconnect the four-wire motor-to-control harness from the motor end [Figure 14a] and remove control unit [Figure 13a]. Inspect for bent, damaged, or recessed wires and terminals inside of connector.
  - Replace control unit if four-wire harness contains bent, damaged or recessed wires and terminals.

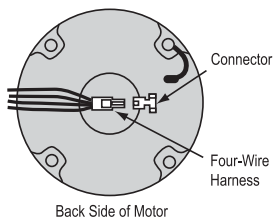


Figure 14a

## Removing Control Unit (if still mounted to the motor) Generation II

- Remove three screws securing the motor and control unit together. Grasp the control unit and pull away from motor until both units are separated [Figure 13b].



Figure 13b

- Disconnect the three-wire motor-to-control harness from the control [Figure 14b] and remove control unit. Inspect for bent, damaged, or recessed wires and terminals inside of control connector.
  - Replace control unit if the three pin connector contains bent damaged or recessed terminals

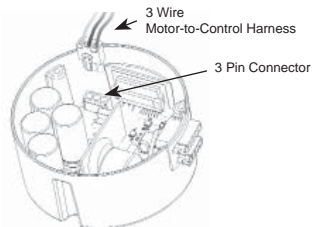


Figure 14b

- 5 Inspect connector on back side of motor for bent, damaged, or recessed terminals [Figure 15].
  - Replace motor if connector contains bent, damaged, or recessed terminals.

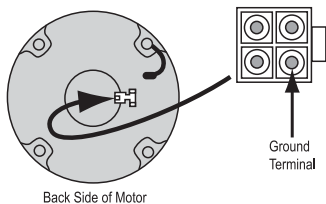


Figure 15

6. Check phase to phase resistance between each of the three phase terminals in the motor connector. **Do not check the ground terminal during this test** [Figure 15].

**Resistance levels between any two contacts should be equal.**

- If resistance levels are equal the motor is functioning properly.
- Replace motor if the resistance levels are not equal.
- Replace motor if the resistance levels are open circuited or short circuited.

If both motor and control unit appear to be functioning correctly, reassemble motor and control unit and contact HVAC system manufacturer.

- 5 Inspect motor-to-control harness connector on back side of motor for bent, damaged, or recessed wires and terminals [Figure 15].
  - Replace motor if connector contains bent, damaged, or recessed wires and terminals.

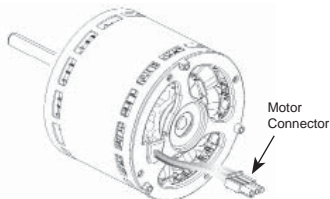


Figure 15

6. Check phase to phase resistance between each of the three phase terminals in the motor connector

**Resistance levels between any two contacts should be equal.**

- If resistance levels are equal the motor is functioning properly.
- Replace motor if the resistance levels are not equal.
- Replace motor if the resistance levels are open circuited or short circuited.

If both motor and control unit appear to be functioning correctly, reassemble motor and control unit and contact HVAC system manufacturer.

## Final Checks

- Check mounting and fastening of motor and control unit. Make sure control unit and motor are securely attached together and mounted tightly in HVAC system.
- Check control unit connectors. Inspect for shorts, detached wiring, or loose connections.
- Check power cord and communication cable connections. Make sure both are securely connected to control unit connectors.
- Check blower motor and verify wheel rotation. Make sure it spins freely manually without effort or assisted means in both directions.
- Check circuit breaker.

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