



Variable Speed Zebra™

**Diagnostics, Control, & Set-Up
for Variable Speed Motors**

“Mini-Manual”



Model: VZ-7

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Specifications

Maximum Input Voltage	29 Volts AC
Overall Circuit Protection	1A. @ 24 VAC
Unit Size	10.75"L x 7.25"W x 3"H
Unit Weight	2.0lb
Warranty	One-Year Limited Warranty

Safety Information

Please read all of these instructions before using your *Variable Speed Zebra*. They have information to protect you, your customers, and their property from harm or damage. Understanding the proper use of this tool will also help you to make more accurate diagnostics on the equipment that you are servicing.

Maximum Input Voltage..... 29 Volts
Maximum Current Through Unit 1 Amp

- **NEVER connect any lead to (nor allow any unconnected lead to touch) Line Voltage, or any voltage higher than 29 Volts.**
- Do not alter the connection plugs. Use only cables supplied by Zebra Instruments. If the 24V Power Supply Cable is used, use only the recommended size fuse and never connect to a voltage source higher than 24 VAC.
- Never allow your *Variable Speed Zebra* to get wet. If it does; dry thoroughly before

To use your VZ-7, follow these steps:

- 1.) Carefully **hook-up** the wire harnesses to equipment.
- 2.) Choose the **mode** you want to operate in.
- 3.) Optionally, **manipulate** the Step switches.

Explanation of steps:

Hook-Up: The VZ-7 receives it's power from the furnace or air handler being tested. Start by disconnecting the power in the equipment. Next, squeeze the ends of the 5-wire power connector on the motor and disconnect it. This gives access to the unlocking tab on the 16-pin motor connector. Press the tab and disconnect that connector from the motor also. (The opposite end of this harness is plugged into the circuit board on your equipment.) Now, carefully plug that same 16-pin connector into the VZ-7's yellow connector. Do it *carefully*, rocking the connector side-to-side instead of applying more pressure. **You can permanently damage the connectors by forcing them!**

Hook-UP (Cont.)

The VZ-7's blue connector should be carefully plugged into the motor's 16-pin receptacle. Finally, re-insert the 5-pin power connector into the motor's socket. (Because of the power surge to charge the motor's capacitors, NEVER plug in the power connector when voltage is on!) The VZ-7's white harness isn't connected at this time. Power up.

Note: A small number of furnace or air handler manufacturers choose not to run a 24V hot wire in their harnesses to the motor. This makes using the VZ-7 more difficult, because an outside source of power must then be used. The red wire with fuse-holder is used for these type of units. It has a special fuse to protect your VZ-7 and the motor from damage that can occur if 24V is applied out of phase with the other wires. *Never modify the connectors to try to get 24V any other way. Your warranty will be void and you may damage the VZ-7 and/or the motor.* Connect the alligator clip ONLY to 24 VAC 'Hot'; the 24 VAC 'Common' is always supplied through the harness.

Your Variable Speed Zebra operates in 4 different modes: **Voltage Check - Observe - Control - and Winding Test**

- **Voltage Check** - Always use this mode first to rule out low voltage as a problem. The AC voltage is shown on the display when this switch is pressed. Additionally, the red *LOW VOLTS LED* will flash if it is below 20 VAC.
- **Observe Mode** - is just that: you are observing the signals that the equipment is sending to the motor's electronics. Use this mode to see if the furnace or air handler is sending the proper signals to the motor.
- **Control Mode** - This mode allows you to generate any command that the equipment would send to the motor, observing the resulting RPM and CFM to see (a) if the motor operates correctly when that setting is being used, and (b) if a tap setting change is desirable to change system performance characteristics.
- **Winding Test** - If you have *concluded* motor failure, this mode determines which section of the motor is not working properly.

Voltage Checking

If the control voltage to the motor is below about 20 volts, the motor may operate erratically. Since this is such an easy test, perform it first. The VZ-7 displays the AC voltage between the **Hot** and **Com** harness wires when the *VOLTAGE* switch is held down. Most units display between 21 and 29 VAC. Voltages outside this range indicate problems that must be investigated. The *LOW VOLTS LED* flashes if the voltage is below 20 volts.

The *SHORT LED* flashes if a short is detected in the motor's electronics unit. **DISCONNECT POWER IMMEDIATELY** to keep damage from occurring. The VZ-7 has an automatic-reset circuit breaker to attempt to minimize damage. If the *SHORT LED* is flashing, this breaker has tripped. You must disconnect power to the VZ-7 to reset this breaker.

Follow the QR Code on page 15 for an online video demonstration on how to test the line voltage to the choke and motor.

OBSERVE mode (Green MODE LED) is meant for you to use when you're diagnosing if the equipment is sending the proper signals to the motor. It is sometimes confusing because a few manufacturers do not follow the suggested uses of the signal lines. For instance, one manufacture sends a signal to the motor down the FAN line when they want the motor to operate at heat speed. Also, some manufacturers choose to require the FAN line to be activated any time the motor should be on; other manufactures don't.

Getting used to the signal patterns that occur on the equipment you service most often will give you experience in this area.

Note: this tool will not display these signals if they are not sent in 2.0/2.3 ECM format. One manufacturer uses special data signals from the thermostat to the motor on a few of it's systems; a future Zebra tool may help diagnose them.

Observe Mode (Cont.)

The OBSERVE mode uses the three upper areas of the VZ-7's control plate to display operation information:

The SETTINGS & OPTIONS area indicates which lines are currently active to the motor.

The DIGITAL DISPLAY area alternates back and forth every 5 seconds or so with the calculated RPM and programmed CFM that the motor is pumping. This display may take up to 30 seconds to stabilize after the motor has reached a constant speed. Note: *not every motor is programmed with this feature.*

The 4-LED **TAP** section has tri-color LED's that indicate the 4 tap settings that can send set-up information to the motor. Their status is reported as 1.) No color mean no option selected on this tap. 2.) Green color means the first option is selected. 3.) Red color mean the second option is selected, and 4.) Yellow color means that both options are selected.

Observe Mode (Cont.)

Usually these tap settings are set with DIP switches or removable shunts. They control the ramp-up and ramp-down speeds, start delays and stop delays, and sometimes, allowing you to set up a unit to run slightly faster or slower; to the customers preference.

We display the settings here so you can spot something that is set incorrectly. Remember that you must remove, then reapply, power to the motor before the new settings are active.

Some manufacturers choose to use other schemes than the standard HEAT, COOL, ADJUST, and DELAY taps, making it confusing for those of us who service these units. Similar to the SETTINGS & OPTIONS displays, getting used to the schemes of the manufacturers you service most frequently will give you experience.

Control Mode

CONTROL mode is similar to OBSERVE mode, except that you decide what signals you would like sent down of the motor electronics. The MODE LED glows RED in this mode.

The CONTROL mode is used for further diagnosis, and also to test various settings for problems without having to reset the system thermostat. Detecting the RPM and CFM of the various modes that a system can be set to is best accomplished here. Please remember that the Digital Display may take, as much as, 30 seconds after the motor has reached a constant speed to stabilize. Be patient.

The OPTION STEP switch selects one or more *options*. It selects the options in a circle; that is, they repeat after the end of the list. Initially OFF, repeatedly pressing the up switch turns the R. VALVE option line on; then the HUMID. line; the both; the back to OFF; and then starts over again. You can use either UP or DOWN to get to your choice quickly.

Control Mode (Cont.)

The SETTING STEP switch operates in the same way, but it's choices are: OFF - h1 - h2 - c1 - c2 - FA - H1 - H2 - C1 - OFF. Selecting the capital letter for H or C will simultaneously make the FAN line active. Alternately, stopping on a choice that has a small h or c will send signals only down those lines, the FAN line will NOT be activated. The 1 or 2 after the Heat or Cool means which stage, when using a multi-stage unit. There is a delay of a few seconds after you stop on your choice, before the lines switch to the choice.

In the CONTROL mode, you will notice that only the middle set of 7 LED's change. The left-hand set keeping displaying what the system is calling for. This allows you to effectively isolate the rest of the system from the motor (assuming the connected line voltage is correct) and positively prove which component is having problems. If you conclude that the motor is defective, go on to the winding test to identify which section to replace.

Winding Test

The WINDING TEST Mode is performed on a motor *that is already shown to be defective*. It is used to identify if the windings section of the motor is defective also, or if you only need to replace the electronics module on the end of the motor. Since the complete motor is quite pricey, and the electronics package is a fraction of the cost, it makes good sense to replace just the pack - if possible.

Hook-Up: Shut off power. Disconnect the Line Power plug at the motor. Disconnect the 16-pin plug at the motor. Remove blower assembly and electrically isolate it from the furnace/airhandler. WAIT 5 MINUTES FOR THE CAPACITORS TO DISCHARGE! Then remove only the two bolts that hold the pack onto the end of the motor. Carefully squeeze the locking tab on the connector inside pack, gently rocking the 3-wire plug to separate it from the motor. Now, connect the white VZ-7 harness to that connector and the alligator clip to a bare area of the motor case; leave the blue harness unconnected.

Winding Test Mode (Cont.)

Now, press and release the WINDING TEST switch; the display will make a circular pattern to remind you that the motor shaft needs to be turned one or two revolutions to test it.

The digital display gives the results of the test:

“00” means connector is not connected.

“02” means motor not spun 1-2 turns in time

“11” means a winding is shorted to the case

“21” means winding phase “A” is open

“22” means winding phase “B” is open

“23” means winding phase “C” is open

“31” means winding phase “A” is shorted

“32” means winding phase “B” is shorted

“33” means winding phase “C” is shorted

“77” means the winding section shows OK.

Display returns to the last mode after 10 seconds.

Of course, there could be problems with the bearings. If motor slows after getting warm, disconnect as above to eliminate EMF back feeding from electronics pack as a possible symptom that acts like bearing seizure, before condemning bearings themselves.

Avoiding Problems & Help

Don't disassemble the VZ-7. IC's inside are sensitive to static charges that might occur if they are touched. Warranty will be void.

Be very gentle when connecting cables; the pins can easily be damaged. Never force connectors together, gently wiggle them. If the VZ-7's cable harnesses are damaged, replacement harnesses are available; follow the instructions carefully to avoid static discharge.

Please follow the QR code below to watch online video training. This is the fastest way to acquaint yourself with the VZ-7, and to learn how to use it to positively identify which component in a Variable Speed System has failed.



One-Year Limited Warranty

For a period of one year from the original end-user's date of purchase, Zebra Instruments warrants that this tool is without manufacturing defects. Should you encounter any problems, please contact us and we will attempt to resolve your problem as quickly as possible. This resolution may include replacement, exchange, or repair of a defective tool; at our option. This warranty does not apply to tools that have been exposed to: voltages and/or currents that are higher than those specified in this manual; abuse or rough handling; any damage to connectors, harnesses, or adapters; or damage from moisture or chemicals. Out-of-warranty repairs are available for nominal charge plus shipping. Please contact us for an RMA (return merchandise authorization) before returning a tool for repair.

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