WELLS Counter Point
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THE ELECTRONIC, DIAGNOSTIC AND DRIVEABILITY RESOURCE.

# Keeping Up With Vehicle Speed Sensors

The Vehicle Speed Sensor (VSS) is more than a digital version of the speedometer cable. In fact, using the VSS to generate digital speedometer readings is a relatively recent application for the VSS.

Before powering a digital dashboard, the VSS was used to regulate the cruise control and control transmission shifts. Now, depending upon vehicle equipment, the VSS may influence or control more systems than any other single sensor.

• With OBD-II, vehicle speed is considered as part of overall engine operating strategies, while the Power Control Module (PCM) controls fuel delivery and ignition timing. The operation of the idle-air-control valve and canister-purge cycle are regulated, in part, by the VSS.

• Automatic transmissions need VSS data to provide the best performance and mileage. Torque converter clutch operation is controlled by the VSS. In an electronically-shifted transmission, VSS signals, instead of hydraulic pressure in the valve body, are used to determine shift points.

• VSS signals may be used by the vehicle's engine management computer to determine when to run electric cooling fans.

• Vehicle speed data is critical to the operation of the assorted variable steering, smart suspension, and smart handling systems. VSS signals may also regulate ABS, disengaging the system below a certain speed so the wheels can completely stop rotating.

• On some vehicles, the car makers use the VSS output as a safety device to limit top speed. When the signal reaches the speed the manufacturer determines is "too fast," the computer regulates fuel flow to control the maximum vehicle speed.

Unlike most sensors, the VSS is a counting, not a measuring sensor. Speed is determined by counting a certain number of units over a fixed period of time. Specifically, the VSS counts the revolutions of the transmission or transaxle output shaft. The higher the count that the VSS sees, the higher its output signal. The VSS is only responsible for the counting portion of the formula. Inside the vehicle's engine management computer an extremely accurate digital clock is used to measure time. The computer is programmed to continually compare the count, or signal, received from the VSS against its internal clock to determine actual vehicle speed. In theory, the VSS should send a signal whenever the vehicle is moving forward. At very low speeds, vehicle movement is not significant to engine performance. Typically, below a threshold speed of about 3 to 5 mph, the VSS either doesn't generate a signal strong enough to be picked up by the computer, or the computer is programmed to ignore the signal.

## TWO TYPES

Two different types of VSS are used. The optical VSS, which first appeared on General Motors vehicles in the 1980s, works off a conventional speedometer cable. The later style is the permanent magnet or "magnetic impulse" design.

An optical VSS is located inside the speedometer head at the back of the instrument panel. It uses a photo cell, light-emitting diode (LED), and a two-blade, mirrored reflector to generate an electrical signal. The LED is powered and emits light whenever the ignition switch is on. When the vehicle is in motion, the speedometer cable spins the two-bladed reflector. The reflector rotates through the LED light beam, breaking the beam two times for each revolution of the reflector. Each time a mirror passes through the LED beam, the light is reflected to the photo cell. When the mirror isn't breaking the beam, no light reaches the photo cell. Whenever light hits a photo cell an electric signal is generated.

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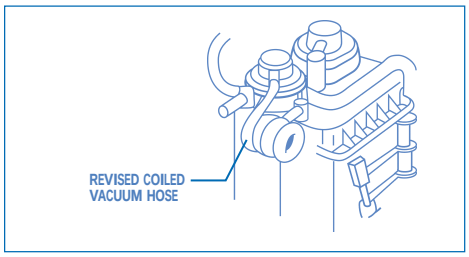
# Fine Tuning

***Fine* Tuning** *questions are answered by Jim Bates, Technical Services Director. Please send your questions to: Jim Bates c/o* ***Wells Manufacturing Corp., P.O. Box 70, Fond du Lac, WI 54936-0070*** *or e-mail him at* ***technical@wellsmfgcorp.com.*** *We'll send you a Wells' shirt if your question is published. So please include your shirt size with your question.*

**Q: "I have a customer with a 97 Toyota Camry 3.0 DOHC MPI that makes a humming noise at idle that seems to be coming from the area of the charcoal canister. Everything seems to be tight and the car runs fine. Do you know what could be causing this noise?"**

*Steve Lang, Newark, NJ*

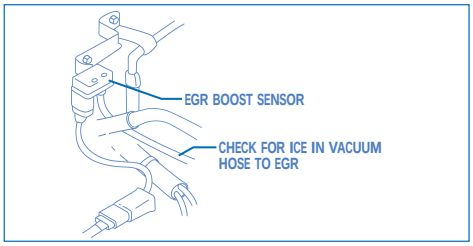
The humming may be coming from the vacuum hose connected between the check valve and the canister. Replacing this hose should solve the problem.




**Q: "We have a 1996 Miata 1.8L 4-cylinder that has an EGR problem with DTC P0470. Following our troubleshooting information, we have determined that there are no disconnected or leaking hoses. The EGR valve seems to be clean and functional. A new EGR boost sensor was no help. What else can cause this?"**

*Robert Miller, Washington, DC*

One area to check, especially during the winter months, is for the formation of ice inside the vacuum line between the EGR Booster Sensor and the EGR Valve. Cleaning out or replacing the vacuum line should solve the problem.




**Q: "I have a 1997 VW Passat VR6 with 60,000 miles on it that has been setting the Malfunction Indicator Lamp (MIL) recently. The DTC is an EVAP code P0440. If I reset the code, it's OK for a few weeks and then comes back. The gas cap is tight and I have been checking for other EVAP system leaks, but haven't found any. Is there anything else that will set this code?"**

*Pat Shearer, Cleveland, OH*

Basically, you are looking for a vacuum leak or a purge-regulator valve problem. The EVAP canister regulator valve is located behind the coolant reservoir on the firewall. It has a two-pin connector and two vacuum lines. First, check the vacuum lines at both ends for brittleness. To check the solenoid, disconnect it and energize it with jumper wires.

**Q: "I have been working on a 1995 Astro Van with the 4.3L engine. It runs fine for awhile and then all of a sudden it cuts out and dies. Sometimes it will restart fine, other times it won't. Sometimes it runs fine for days at a time. This is a very random problem. Scan data, fuel pressure, and timing are all OK. Is there something I should look at more closely?"**

*Art Bensel, Denver, CO*

I would like to suggest that you take a closer look at fuel delivery, especially the fuel pump circuit. Monitoring the fuel pump current will provide additional information about fuel pump condition and wear, as well as corrosion and loose connections in the fuel pump's power and ground circuits.

**New Feature**

## Diagnose The Problem Win A Shirt

A 1998 Ford E-350 4.2L SEFI V6 continuously turns the MIL on with a DTC P0306. You can feel the miss. It also pings under load! Power balance and secondary ignition tests point to cylinder number six. The spark plugs, spark plug wires and number six fuel injector have been replaced. There are no vacuum leaks. Fuel pressure and injector spray patterns look good. Number six injector, as well as the others, look good on the scope too. Compression and cylinder head gasket are OK. Where would you go next?

***The first reader to respond with the most accurate answer via e-mail or fax, and the first reader to respond with the most accurate answer via snail-mail, each will receive a Wells golf shirt. Answer will appear in next issue.***

# Quality Points

## Wells Diagnostic Seminars

When technicians do business with a parts supplier that carries the Wells brand, they get more than quality engine management parts. They also have access to the Wells Advanced Engine Management Diagnostics Seminars. These three-hour programs cover diagnosing ignition, fuel, and emission problems on both OBD I and OBD II systems.

The seminars include demonstrations using common Digital Volt/Ohm meters (DVOM), Digital Storage Oscilloscopes (DSO), Power Graphing meters and Scan Tools that you are probably already using in your shop. The use of the 5-Gas Exhaust Analyzer as a diagnostic tool is also discussed. You are encouraged to bring your own meters, scopes and other diagnostic equipment to use during the hands-on portions of the program.

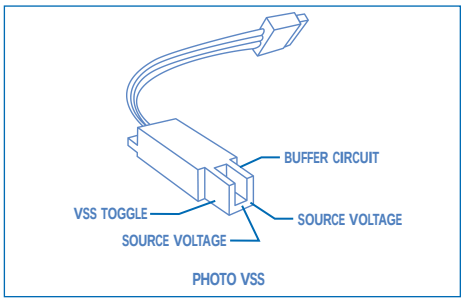
You'll also learn how to use the Wells toll-free tech hotline and other services when you run into those tough diagnostic problems.

Ask your Wells supplier to contact us to coordinate a seminar in your area.

*continued from page 1*

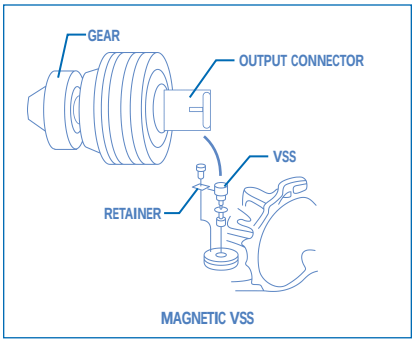
## Keeping Up With Vehicle Speed Sensors

The on-and-off reflection of the LED beam into the photocell produces a pulsating current. The faster the mirror rotates, the more times the light beam is broken and reflected to the photocell, generating more electrical pulses. The computer is programmed to convert the number of pulses from the photo cell to an electronic measurement of vehicle speed.




The permanent magnet VSS is like an ABS wheel-speed sensor. The permanent magnet VSS is mounted on the transmission or transaxle case in the speedometer cable opening. If the vehicle has a digital speedometer, the VSS replaces the cable. If the vehicle uses a conventional speedometer, the VSS will be placed in series with the cable. The rotation of the VSS permanent magnet past the sensing coil generates a pulsating voltage. The faster the rotation, the greater the pulse frequency and the greater the voltage output.

The pulsating signal from a VSS creates an alternating current (AC) voltage. Computers cannot handle AC signals, so early VSS circuits also included a buffer module that converted the VSS output to a digital output that can be read by the computer. Later model computers convert the VSS signal internally, eliminating the need for the buffer module, or circuit, between the VSS and the computer.




## SYMPTOMS

The VSS is usually a very reliable unit with a long service life. Although any component can fail all by itself, permanent magnet VSS problems often are linked to physical damage caused when the transmission or transaxle was removed during major service. Extremely high underhood or internal transmission temperatures may also cause the VSS to fail. Dusty mirrors in the optical units also can cause problems.

Because the VSS is tied into several systems on the vehicle, a VSS failure is relatively easy to identify. No signal from the VSS to the computer should set a code. Obvious signs that the VSS isn't producing a signal include the digital speedometer/odometer not working, the cruise control can't be set, and transmission shifting is rough and erratic. Other possible problems from a failed VSS include rough idling and an increase in fuel consumption.

A more difficult problem to identify is a VSS that works, but sends out the wrong signal for a given vehicle speed. In some cases, a wrong reading from the VSS may still cause a code to be set. For example, if the VSS signal tells the computer the vehicle is traveling 60 miles an hour, but the throttle position sensor and MAP sensor tell the computer that the engine is idling, the computer will be confused. And a confused computer should set any of the following codes:

| | |
|---|---|
| GM | 24 |
| Ford | 27, 29, 452 |
| Chrysler | 28, 15 |

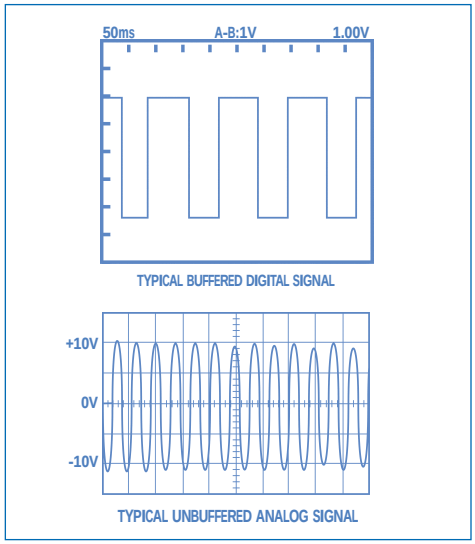
Typical OBD-II codes for a malfunctioning VSS are:

| | |
|---|---|
| P0500 | Vehicle Speed Sensor Malfunction |
| P0501 | Vehicle Speed Sensor Range/Performance |
| P0502 | Vehicle Speed Sensor Low Input |
| P0503 | Vehicle Speed Sensor Intermittent/Erratic/High |
| P0716 | Speed Sensor Circuit Input Intermittent |
| P0718 | Speed Sensor Input Circuit Input low |

On a vehicle that uses the VSS as a safety device, a defective sensor may send out a wrong "too fast" signal, shutting down fuel flow at the wrong time. Although this doesn't happen often, it can be a difficult problem to identify. The customer will probably describe it as a random or intermittent sudden loss of power and poor performance, only to have the engine resume normal operation. Routine diagnostic checks of the engine in the shop won't show any problem because there isn't a problem with the engine or the ECM.

## TESTING

The VSS can be tested using a scan tool or a lab scope, however vehicle manufacturers' test procedures vary widely. A road test with the scan tool and/or lab scope hooked up is often the most effective way to test a VSS. Compare your scan tool readings with the manufacturer's specifications. When using the lab scope, you may see either a square-wave pattern if the VSS has an integrated buffer circuit or an AC sine wave if the buffering and conversion are done within the computer.




In some cases, you can even count VSS cycles with a DVOM. Use the analog bar because the digital display usually won't be fast enough or accurate enough to give reliable readings.

If the readings on your scan tool or lab scope match the manufacturer's specifications, then the VSS is working properly and the problem is most likely in the computer. If the readings don't match the specs, check the sensor wiring harness and connectors for damage, corrosion, and high resistance. If the wiring and connections are good, the sensor is bad and must be replaced.

One final note on VSS, changing to a different tire size than the original equipment may cause problems, especially if the change is excessive, and the buffer has not been recalibrated. The speedometer readings will be wrong and there is a chance other vehicle systems may be affected because the VSS signals will no longer show actual vehicle speed.

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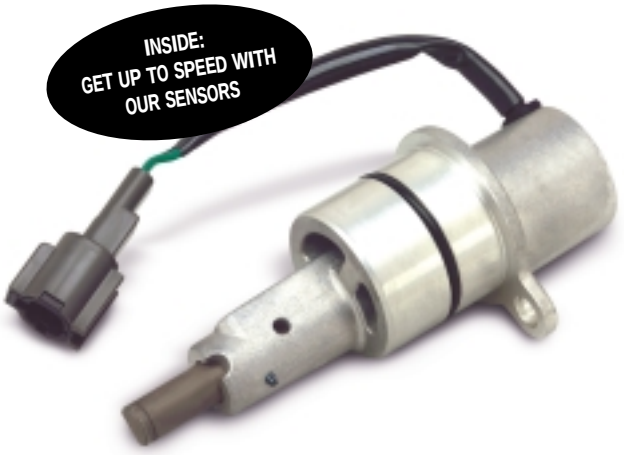


# Hot off the Wire

## Register Now For ASE Tests

Isn't it time you showed your customers you are qualified to join the ranks of the more than 425,000 automotive service professionals who are ASE certified?

You can still register for the Spring 2000 ASE certification tests, but you must act quickly. The registration deadline is March 31, 2000. The tests will be given May 2, 4, and 9. Testing will be done at more than 800 locations across the country; you pick the test site most convenient for you.

ASE offers certification in many areas including automotive technician, engine machinist, and parts specialist.

To register, or for more information, contact ASE, 13505 Dulles Technology Drive, Suite 2, Herndon, VA, 20171. Phone 703-713-3800. You can also register at their ASE web site: www.asecert.org.

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