TomcoTechtips

TM

ISSUE 8

Two Tools Used For Electronic Diagnosis

This and future issues of TOMCO TECH TIPS will refer to ohmmeters and oscilloscopes in relation to solving electronic problems.

Today, most automotive technicians are familiar with these instruments, but sometimes going back to basics is important in understanding certain procedures.

THE OHMMETER

An ohmmeter reads electrical resistance which is measured in ohms. It measures how much an electrical device or an entire circuit resists the electricity flowing through it. The more ohms a circuit or component has, the higher its resistance.

An ohmmeter contains a small battery. When the technician connects the ohmmeter to a component, a test current from the battery flows through the component producing readings.

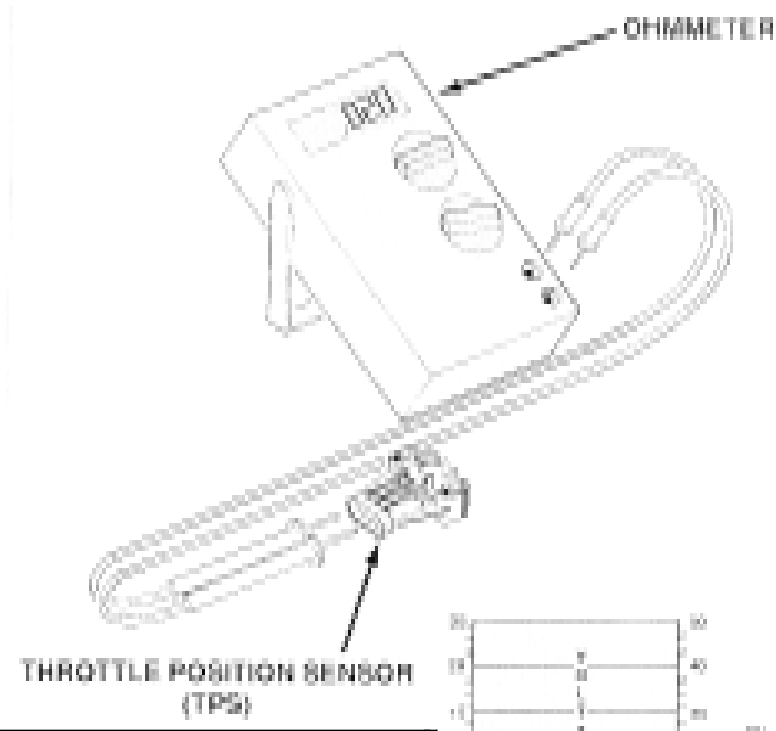
THE OSCILLOSCOPE

An oscilloscope or "scope" is a graphic voltmeter. Instead of showing voltage values in numbers on a scale or meter display, the scope shows them as lines on a monitor screen or TV tube.

The sensors on today's computer-controlled engines send signals back to the control computer or ignition control module. The technician cannot always read these sensor voltages accurately with a voltmeter because the voltages change abruptly.

Analyzing these voltages on the scope is easy because the scope captures all the changes in that signal and all the changes in that signal. It displays them as lines on the TV screen. *Fig. A*

For example, the pattern shown in *Fig. B* is a typical scope pattern created by magnetic RPM pickup in many Ford, Chrysler and GM electronic ignition distributors.



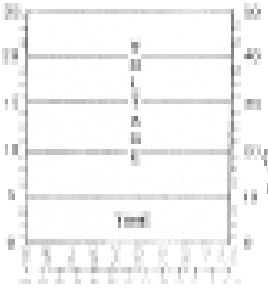


Fig. A
Oscilloscope with voltage and time scales.

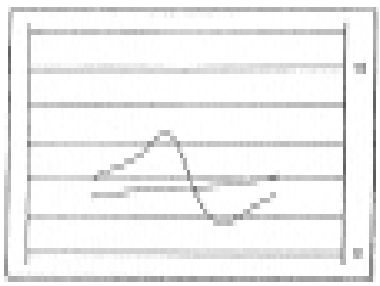
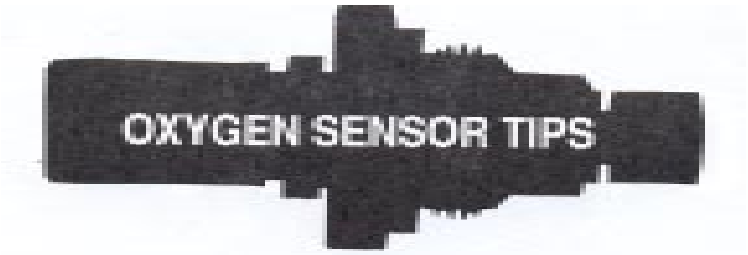


Fig. B
Voltage pattern on oscilloscope.



THE MOST IMPORTANT SENSOR ON TODAY'S COMPUTER CONTROLLED VEHICLES

The oxygen sensor can affect emissions, air/fuel ratio and fuel mileage more than any other sensor on today's vehicle. Most of the carburetor service manuals advise you to fill the bowl before installing on the engine.

HERE'S HOW...

As sensor mileage builds up, a natural aging process takes place. With age, the oxygen sensor slows down. As the time needed to switch from 150 to 850 millivolts and back again increases, there is a gradual shift to richer conditions.

Let's take a look at how this typically occurs. If we have a sensor that takes 150 milliseconds to switch form 150 millivolts to 850 millivolts, where as it took 50 milliseconds new, the computer will have 3 times longer to increase injector pulse-width or reduce carburetor dwell readings. Now instead of seeing a peak injector pulse-width of 3 milliseconds, we might find a peak pulse-width of 3.5 or 4 milliseconds. This is before the sensor reaches the computer's 850 millivolts threshold and starts a reduction in pulse-width
to drive the sensor back to 150 millivolts. This gradual change may cause a vehicle to run richer. The result may be an over worked catalyst, air fuel ratios may be 14.3 to 1 instead of 14.7 to 1 (the desired stoichiometric ratio for ideal combustion) and fuel consumption will increase.

This aging of the oxygen sensor starts to occur the day it is installed and may be significant enough to affect fuel mileage in as little as 15,000 to 25,000 miles.

The aging process may be due to a number of factors.
Some of these are...

1. Natural aging of the zirconia material which requires the sensor to get warmer (say 800 degrees Fahrenheit instead of 600 degrees Fahrenheit) before it will produce enough voltage to allow the computer to switch.

2. A buildup of resistance at the interface of the zirconia platinum bond. Think of this condition acting just like corrosion on a connector. This causes false readings in the circuit and is usually due to thermal cycling.

3. Contamination on the outside of the cell reduces the size and number of openings where the exhaust gas can permeate the spinnel coating and react with the platinum-zirconia junction.

So as you can see just from these examples, an oxygen sensor does not have to be dead to need replacement. A sensor begins to degrade almost from the beginning of its life. These factors can cause mileage and performance to deteriorate.

Any vehicle needing a tune-up could benefit from an O2 sensor replacement a swell.

OXYGEN SENSOR SERVICE

RED HOT TIPS for O2 sensor service:

If you have an O2 sensor that is hard to remove from the manifold. **STOP!** Warm up the engine first. Sometimes when the exhaust manifold is heated, the expansion of the metal makes it easier to remove the 'frozen" sensor. Be careful not to get burned using this procedure. The manifold can reach 1000 degrees Fahrenheit.

Another important tip to keep in mind when replacing O2 sensors is to erase the computer memory. Otherwise, when you start the car after the sensor has been replaced, driveability problems will occur for the first few starts and stops. Your customer might be back with problems that could have been avoided.

To erase the computer memory, disconnect the battery or pull ECM (Electronic Control Module) fuse. Wait a few seconds and reconnect. This is a good procedure to follow when any ECM related sensor is replaced.

Finally, did you know that ordinary table salt (sodium chloride) can destroy an oxygen sensor? This is due to a caustic chemical reaction to the exhaust gases and excessive heat. Make sure hands are clean (especially after having a salty snack) before installing an O2 sensor.

Air Temperature Sensor

Air temperature sensors have different names. Ford has Air Charge Temperature (ACT) sensors. General Motors uses Manifold Air Temperature (MAT) sensors and Chrysler has Charge Temperature Sensors (CTS).

All are basically the same. The sensor is located in the intake manifold with its tip exposed to the incoming air. There is a quick response to temperature changes. The sensor reacts to incoming air temperature so the engine computer can adjust the fuel mixture to compensate for changes in air density. Cold air is more dense than warm air. When the air becomes colder, the fuel mixture becomes richer. When the sensor warms up, the mixture leans out.

Air temperature sensor electrical resistance decreases as the temperature increases. The computer applies a reference voltage to the sensor and monitors this voltage for change. The amount of sensor resistance determines the voltage level. When the sensor is cold, resistance is high and voltage is high. As the temperature rises, resistance drops and the voltage decreases.

An air temperature sensor can sometimes be damaged by backfiring in the intake manifold. Carbon and oil can affect the accuracy of the sensor. Also, old age is a factor. Symptoms of a bad sensor are "Check Engine" light on continuously, hesitation, poor mileage or strong exhaust odor.

Trouble codes that indicate an air temperature sensor problem are:

Ford: Codes 24, 54, 64
General Motors: Codes 23, 25
Chrysler: Code 23

An air temperature sensor can be checked with an ohmmeter. Remove the sensor when cold and check the resistance between the sensor's terminals. Use a hair dryer or heat gun (never a flame) to warm the sensor tip. Watch for a drop in resistance. No change means a new sensor is needed. If the tip is coated with carbon, cleaning with a solvent ay solve the problem. If not, replace it.

Don't overtighten the new sensor. Use a sealer on the treads to prevent vacuum leaks.

QUICK CHECK FOR GM MASS AIR FLOW SENSORS

Ever get stumped by a phantom stall?

You are driving down the road just fine. When you hit a bump or stop at a light, the engine quits. A check of the service engine light reveals no codes. The trouble might be the mass air flow sensor. A quick check we have found is to restart the engine and let it idle until fully warmed up. Rap on the top of the sensor with your knuckles while the engine is running. BINGO! The car dies.

Replace the mass air flow sensor.

RICH CONDITION ON TOYOTA COROLLAS

On late model carbureted 4 cylinder Corollas, we have seen a rich running condition sometimes followed by a fouled spark plug on the number 3 cylinder. This could be caused by a leaking accelerator pump diaphragm. The vacuum operated accelerator pump is actuated by a vacuum hose fed into the number 3 intake manifold runner. The pump diaphragm can rupture allowing raw fuel to be sucked down the vacuum hose.

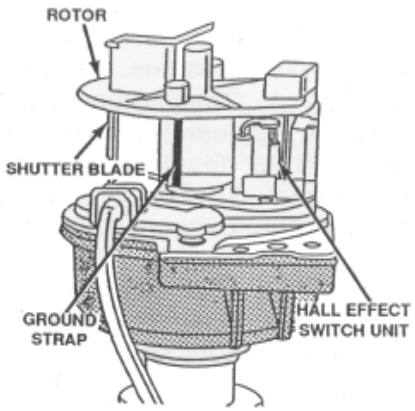
Replacing the diaphragm will eliminate this problem

CHRYSLER IGNITION PROBLEMS

Ever have a problem with a Chrysler 2.2 liter Turbo showing a trouble code 54? This means there is a problem-in the synchronization pick -up circuit. The service procedure is to check for an 8-volt or greater reference signal at the connector to the distributor. If this voltage is good, you should then check for an 8-volt signal at the power module.

You are now at the point where you are told the pickup in the distributor may be bad and to replace it. To make sure the pickup isn't working, it can be tested by using an oscilloscope. This is done by tapping into the distributor sync wire that feeds the power module. Start the motor and adjust the oscilloscope to get a steady pattern on the screen. If the pickup is good, there should be a square wave on the screen (fig 1). When you have a bad pickup, you will not have a square wave (fig.2). There may also be an intermittent failure in which you will see a square wave for awhile and then it will change to a straight line for a short time.

The distributor reference pickup can be tested in the same way. It should produce a square wave as in fig 1. In addition, use an ohmmeter to look for continuity from the shutter blades of the rotor to the engine block. If not good, the rotor should be removed and the distributor shaft cleaned in the area where the rotor ground strap makes contact. Continuity should then be checked on the rotor ground strap to the shutter blades. If this is bad, the rotor should be replaced.



CHRYSLER 2.2 LITER TURBO DISTRIBUTOR

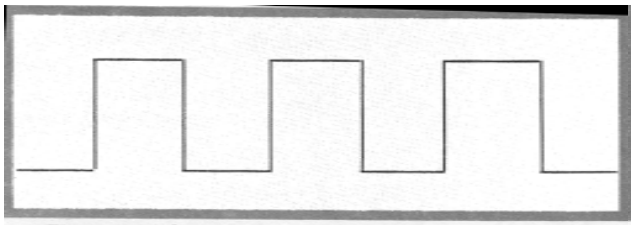


Figure 1 - Good Pattern From Pick - up Circuit
(Square Wave)

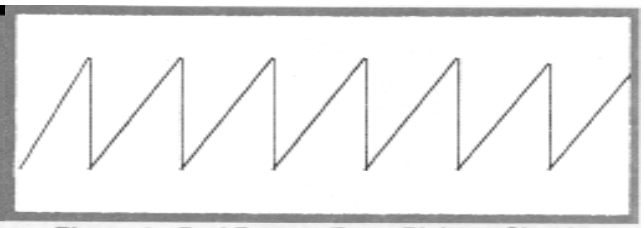


Figure 2 - Bad Pattern From Pick-up Circuit
(Typical)

HIGH IDEAL SPEED ON GM 2.0L "J" CARS

Early model throttle body injected GM "J" cars may develop as extremely high idle condition. This is common on high mileage vehicles with air conditioning. When the A/C compressor goes bad and locks up, the usual "quick fix" is to disconnect the compressor clutch wires to keep from throwing the belt. This is often followed by a constant high idle. Strangely, this is related to the idle up controller.

The power steering pressure switch is also used to increase idle speed when the power steering is engaged. It is normally a closed switch. Its ground is completed through the compressor clutch coil. Therefore, if the clutch is disconnected, the circuit is always open to the power steering switch. The computer thinks the power steering and the A/C compressor is in use and increases the I.A.C. (idle air control) opening to raise the idle speed.

A fix we have found, short of repairing the air conditioner, is to install a 10-ohm 20-watt resister between the clutch wire harness connector terminals. This simulates the clutch coil load and completes the ground circuit.

TOMCO INC.