TomcoTechtips

TM ISSUE 14

Engine Computer Controls

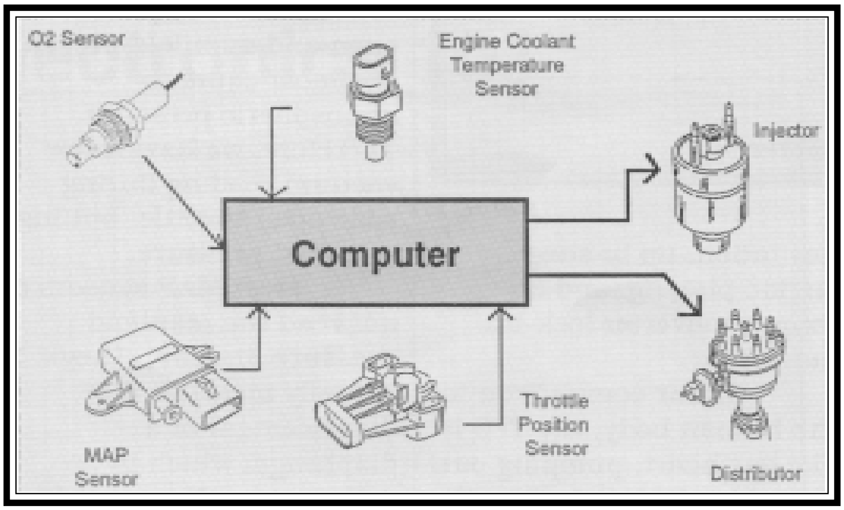
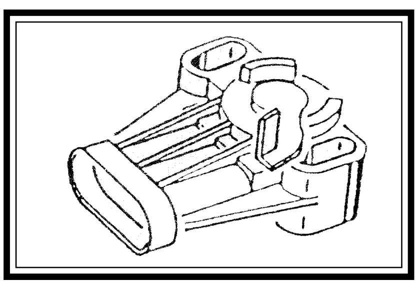


Figure 1



The Throttle Position Sensor (TPS) can be located inside the carburetor or on the side of the carburetor or throttle body. It is in direct contact with the throttle shaft and linkage.

The TPS relays two different pieces of information. First, it lets the computer know the position of the throttle plate, or simply how far down the accelerator is depressed. Second, the TPS lets the computer know how fast the throttle plate is changing.

Lets say you are driving along and you have to come to a sudden stop. The quick release of your foot from the accelerator pedal to the brake would be signaled to the computer by the TPS. The TPS would also signal the computer if you were to bury the accelerator pedal to the floor.

What does the computer do with this information? Lets take a look.

In our first example of a sudden release of the accelerator pedal, we know that when this situation occurs we need less fuel. The computer would read the signal from the TPS and respond by leaning out the air/fuel mixture. The computer may also turn off the AC compressor to prevent stalling or turn on the air pump to burn off hydrocarbons.

In our second example of heavy acceleration, the computer would respond by richening the fuel mixture. It may also turn the AC compressor off, decreasing engine load, thereby giving you more power needed for the acceleration.

Now that we know what the TPS function is, lets see how it works. The TPS is actually a variable resistor or potentiometer.

A **potentiometer** (see Figure 2) is a mechanical device that measures movement. It then converts that movement into a voltage value.

The TPS is a potentiometer that consists of three wires. One wire carries the reference voltage from the computer. This wire is connected to one end of a resistor inside the sensor. Another wire is the sensor's ground and it is connected to

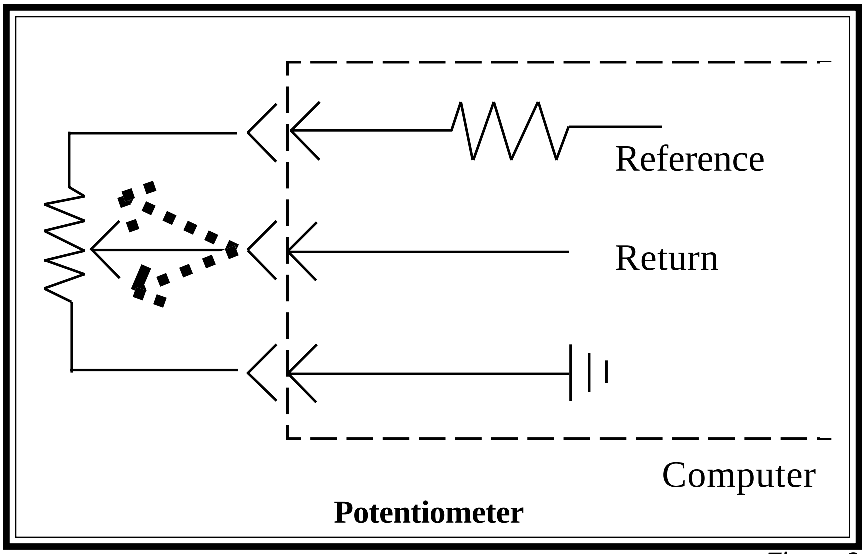


Figure 2

the other end of the resistor. The third wire is attached to a slider or wiper which sweeps across the resistor. This wiper is attached to the throttle shaft. As the position of the throttle changes, so does the position of the wiper on the resistor.

When the throttle is closed the wiper is furthest from the reference voltage, resulting in a low voltage reading to the computer. When the throttle is wide open, the wiper is closer to reference voltage, resulting in a high voltage reading.

The voltage will vary then, depending where the wiper is located on the resistor. This corresponds directly to how far the accelerator pedal is down. The voltage varies from around .5 volts at idle to 4.5 or 5.0 volts at wide open throttle.

When a throttle position sensor fails, a hesitation, tip in surge, engine pinging, and no torque converter lock-up may occur.

In our comparison to the human body, the TPS is like our heart, pumping out more blood when body functions increase, such as exercise.

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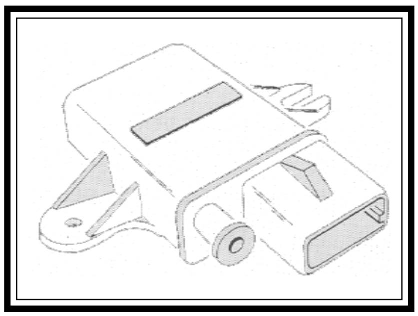


The Manifold Absolute Pressure Sensor (MAP) can be located on the firewall, or engine. It is connected by a vacuum hose to the intake manifold. It is used to measure changes in intake manifold pressure.

When the engine is at an idle, the manifold pressure is the lowest. This is due to the fact that the throttle plate is closed, thereby causing a partial vacuum inside the manifold. Stated another way, the pressure inside the manifold is lower than atmospheric pressure. This is why our vacuum reading at an idle is high.

When the engine is at wide open throttle, the manifold pressure is higher. This results from the fact that the throttle plate is open and manifold pressure is almost equal to atmospheric pressure. Therefore, we have a low vacuum reading during wide open throttle, but high manifold pressure.

Most MAP sensors do not read the manifold pressure directly. They actually measure the displacement of a diaphragm which is deflected by the manifold pressure. This diaphragm is connected to a set of sensing resistors. These sensing resistors change resistance in proportion to manifold pressure. This change in resistance results in a change in the voltage. This voltage is sent through an amplifier before it goes to the computer.

The MAP sensor has three wire connectors like the TPS sensor. Once again, one wire is the five volt reference from the computer. Another wire supplies a ground inside the computer. The third line is the return signal to the computer.

As the resistance changes in the MAP sensor due to a change in manifold pressure, it sends a varying voltage to the computer.
When the manifold pressure is low, as at an idle, the voltage signal to the computer will be low.
Conversely, when the manifold pressure is high, the signal the computer receives will be high voltage. This voltage will vary from about 1 to 1.5 volts at idle to about 4 to 4.5 volts at wide open throttle.

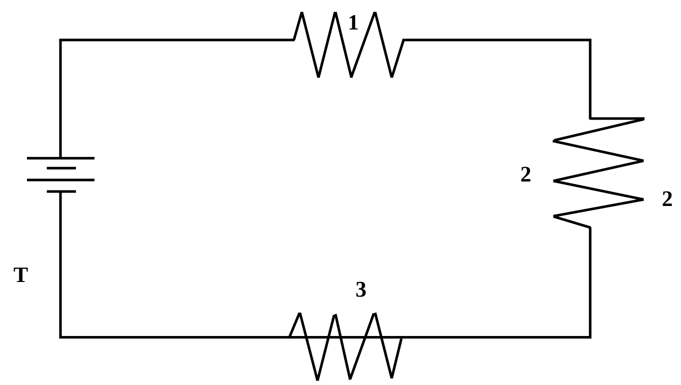
The computer uses this

information to control fuel delivery and ignition timing. When the engine is at idle, low manifold pressure is read, and the computer will lean the fuel mixture and advance timing. This provides better fuel economy.

When the engine is under load, a high manifold pressure is read and the computer richens the fuel mixture to meet the greater engine demand.

Ford MAP Sensors have a varying frequency, not a change in voltage. They will be discussed in a future issue.

Electronics 101



3 **Series Circuit**

A **Series Circuit** is a circuit that has only one path for the current to flow on. The current flows from the power source, through any number of electrical devices having a resist-ance, then returns to the other side of the power source. If a break or opening occurs in this type of circuit, the circuit will be rendered inoperative.

The **current flow or amps** in a series circuit will be the same at every point in the circuit. In Figure 3, we can figure out the amperage by using Ohm's Law. As we learned in Tech Tip Number 13, Ohm's Law states that "One volt of pressure (E) is required to push one ampere of current (I) through one ohm of resistance (R)." **I = E/R**. Plugging in our number, we can solve for I. I = 12/12 or I = 1 amp. The amperage for this circuit would be 1 amp.

The **total resistance** of a series circuit is equal to the sum of the total of each resistance in the circuit. If a resistance is increased in a series circuit the total resistance of that circuit increases. The total resistance of Figure 3 would be the sum of the resistances, $R_T=R_1+R_2+R_3$.

The total resistance in Figure 3 would be computed as follows:

$R_T = R_1+R_2+R_3$

$R_T = 2+4+6$

$R_T = 12$

The total resistance would be 12 ohms.

When voltage pushes current through a resistance in a series circuit, a loss of voltage or what is known as a **voltage drop** occurs. This voltage drop can be measured across each resistance in the circuit. The sum total of these voltage drops is equal to the total applied voltage, or in equation form:

$E_T = E_1+E_2+E_{3.}$

Lets figure the voltage drops in our example.

$E_1 = I \bullet R$
$E_1 = 1 \bullet 2$
$E_1 = 2$

$E_2 = I \bullet R$
$E_2 = 1 \bullet 4$
$E_2 = 4$

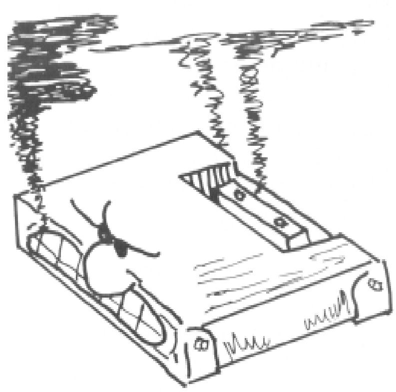
$E_3 = I \bullet R$
$E_3 = 1 \bullet 6$
$E_3 = 6$

$E_T = 2+4+6$
$E_{T-} = 12$

As you can see, the sum of all the voltage drops is equal to our total applied voltage.

Parallel circuits will be covered in our next issue.

Hot Headed Computer

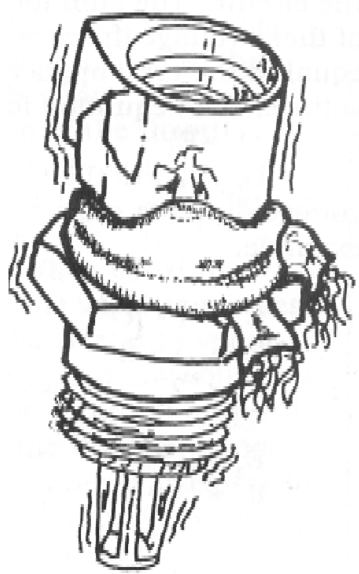


A 1989 Pontiac Bonneville with a 3.8(c) engine was brought into our shop for a cold running problem. When the car was warm it seemed to run all right. But it ran extremely poor when it was cold.

A check with the scan tool revealed no codes present in the computer's memory. Scanning through the information, we found a coolant temperature reading of 240° F. We disconnected the engine coolant temperature sensor, increasing the resistance and simulating a cold engine condition. The temperature reading dropped to 140°F.

We then traced the wires back to the computer and disconnected the coolant input wire and checked for shorts or bad grounds. We found no problems in the wiring. The coolant temperature was still reading 140°F. The only suspect left was the computer. Replacement of the computer returned the readings to normal. A computer chip had gone bad, causing a false reading.

Chilled Out ACT



1991 Chevrolet Caprice was experiencing a starting problem in cold weather. When the car did start, it would sputter, idle unevenly, and seem ready to die at any moment. There was also a lot of smoke coming from the exhaust. After warm-up, the car ran fine.

Diagnostic computer checks found nothing wrong. The dealer installed a new PROM, plugs, and did a tune-up. The symptoms remained.

After hearing the cold weather symptoms described, a Tomco technician decided the Air Charge Temperature Sensor (ACT) must be malfunctioning. The ACT measures air temperature and adjusts the air/fuel mixture accordingly.

A Tomco ACT Sensor was installed, and the problem was corrected.

When diagnosing a driveability problem, be sure you get *all* the information you can from the customer. Pool together all the customer has told you with your knowledge of computer controls to make a logical diagnosis. After all, the computer uses logic.

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