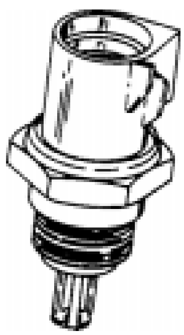
TomcoTechtips

TM

ISSUE 16

Air Charge Temperature Sensors



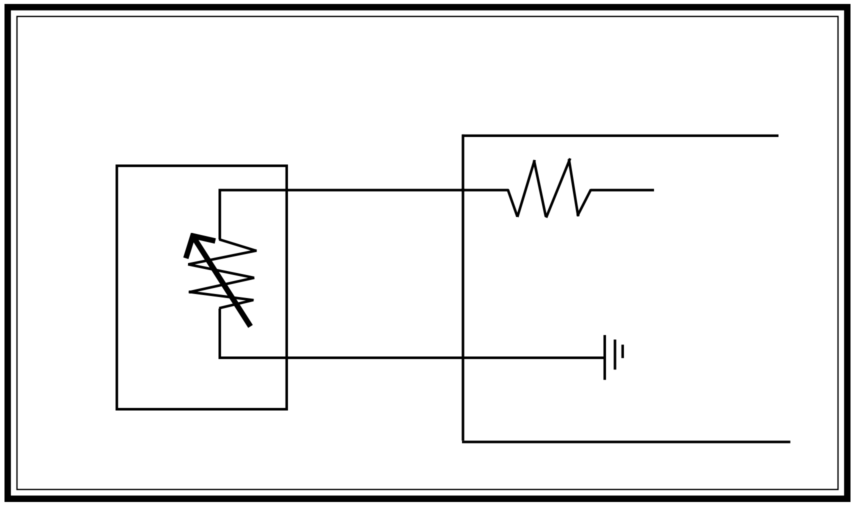


Figure A

In this issue let's continue our sensor coverage by looking at the air charge temperature sensor (ACT). Some manufacturers call this a manifold air temperature sensor (MAT). This sensor is much like the engine coolant temperature sensor we looked at a few issues ago.

The ACT is located in the air filter housing, in the intake manifold, or mass air flow sensor. Its function is to measure the intake air temperature.

The ACT is a thermistor. A thermistor is made of a semiconductive material that changes resistance in relationship to temperature.

There are two different types of thermistors: negative temperature coefficient (NTC) and positive temperature coefficient (PTC) thermistors.

A PTC thermistor's resistance increases as temperature increases.

A NTC thermistor's resistance decreases as temperature increases. Most thermistors used in automotive sensors are of the NTC type.

The ACT is a NTC thermistor. So a low intake air temperature produces a high resistance value, and a high temperature produces a low resistance value.

The typical electrical circuit for the ACT is show in Figure A. The computer supplies a reference signal (usually 5.0 volts) to the ACT sensor through a fixed resistor in the computer. The computer reads the voltage drop across the variable resistor in the ACT. The voltage reading is high when the intake air temperature is cold. This is because the ACT sensor's resistance is high and most of the voltage will drop across the sensor.

Air Charge Temperature Sensors

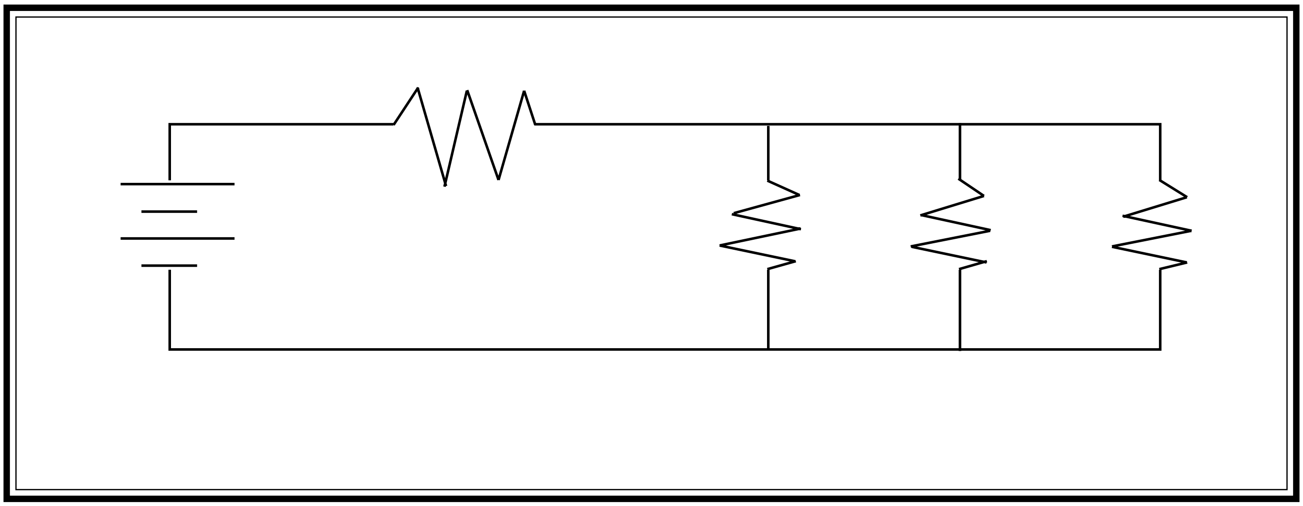
The voltage reading is low when the intake air temperature is hot. This is because the ACT sensor's resistance is low and only a small amount of the voltage will drop across the resistor.

The computer uses the ACT readings to help in determining air/fuel mixture, spark timing and idle control.

Since the ACT is located in the air filter or intake manifold, any buildup on the sensor's tip can cause the sensor to read incorrectly.

A bad ACT sensor can cause poor performance, hard starting, hesitation, or poor fuel mileage.

Electronics 101



A series-parallel circuit has a combination of series and parallel circuits (Fig. B). Series-parallel circuits are commonly used in automotive circuits. The best way to calculate the total resistance of these circuits is to look at both circuit parts individually. In this way you can apply the laws of series circuits to the series portion of the circuit and the laws of parallel circuits to the parallel portion.

Looking at Figure B, we will calculate the total resistance (R_T) for this circuit. We will treat each circuit separately. Calculating the total resistance for the parallel circuits, we have:

$$R_{parallel} = \frac{1}{{}^1/_{R_2} + {}^1/_{R_3} + {}^1/_{R_4}}$$

$$= \frac{1}{{}^1/_{10} + {}^1/_{20} + {}^1/_{10}}$$

$$= \frac{1}{{}^1/_4} = 4 \text{ ohms}$$

Adding this to the resistance of our series circuit we have:

$$R_{Total} = R_{Series} + R_{Parallel}$$

$$R_T = 8 + 4$$

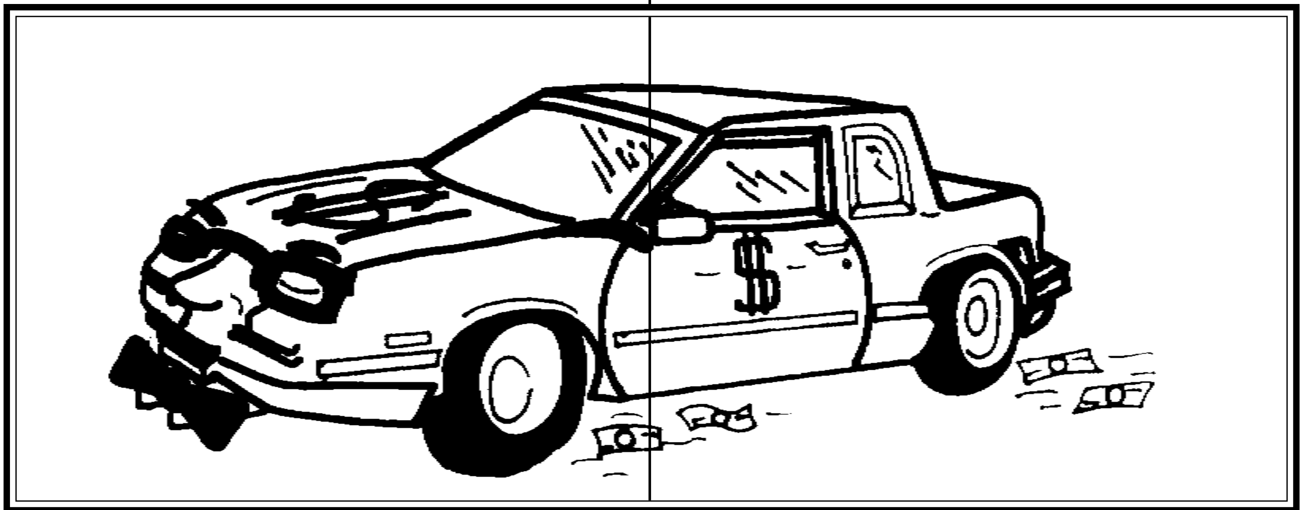
$$R_T = 12 \text{ ohms}$$

Now we can use Ohms Law to calculate the total current:

$$\text{I (amps)} = \frac{\text{E (voltage)}}{\text{R (resistance)}}$$

Continued on Page 4

Too Rich & Stuffy Caddy



A 1982 Cadillac Eldorado with a 4.1 DFI engine died on the road. The owner said the car had not been running well before it finally quit. On a quick inspection, the technician found that an A.I.R. tube on top of the engine had blown out. Hot exhaust gases from this tube melted the main wiring harness. This resulted in completing the ground circuit, allowing the injectors to spray all the time.

The car was towed back to the shop for repairs. The technician repaired the wires to the injectors and drove the car into the shop. There he completed the wiring repairs and replaced the A.I.R. tube. With the repairs completed, he tried to start the car, but it would not start. The injectors were still dumping fuel into the throttle body. On further investigation the technician found some other places where the injector wiring had burned and shorted. This wiring was also repaired, but the car would still not start. He scanned for codes and found a host of codes. Some of these had already been corrected by repairing the wiring. He also had a MAP/BARO code and replaced both the MAP and BARO sensors, just to be on the safe side. He cleared the codes and tried to restart the car. The car would still not start.

Since the injector wiring had shorted, he thought that the quad drivers in the computer may have been damaged. He replaced the wiring harness to be sure that he had corrected all shorts. He also replaced the computer. Unfortunately, the car would still not start.

Using a more up-to-date scan tool, he ran through the data stream to check all his sensor values. All of these were within normal parameters.

After some days of wrestling with this problem, his thoughts turned to other possibilities associated with the no-start symptoms. Could the blown A.I.R. tube just be a symptom of another problem? He decided to drop the catalytic converter (cat). One hit of the key after the cat was removed, and the car ran like a dream.

What happened? The catalytic converter was probably in the process of clogging up for some time. The excessive backpressure caused by this condition blew out the already old, rusted air tube. This in turn melted the wiring harness. The injectors shorted to ground, which caused a constant fuel spray. The extra fuel aided in overheating the cat and stopping it up even more. The clogged cat resulted in an

Continued on Page 4

Electronics 101

Continued from Page 2

$$I = \frac{12}{12}$$

$$I = 1 \text{ amp}$$

Since we know the current value we can measure the voltage drops across each path by once again using Ohms Law.

For our series circuit:

$$E_{(drop)} = I \bullet R$$

$$E = 1 \bullet 8$$

$$E = 8 \text{ volts}$$

In parallel circuits, the voltage drops across each path are the same. So by subtracting the series circuit voltage drop from the total voltage we can calculate the voltage drops in the parallel circuits.

$$E_{Total} - E_{Series} = E_{Parallel}$$

$$12 - 8 = 4 \text{ volts}$$

To figure out the individual currents in each parallel path we need only to divide the voltage drop across each load by the resistance value.

$$I_2 = {}^{V_2}/{}^{R_2} \quad = I_2 \quad = {}^{4}/{}_{10} \text{ amps}$$

$$I_3 = {}^{V_3}/{}^{R_3} \quad = I_3 \quad = {}^{4}/{}_{20} \text{ amps}$$

$$I_4 = {}^{V_4}/{}^{R_4} \quad = I_4 \quad = {}^{4}/{}_{10} \text{ amps}$$

If we want to check to see if our calculations are correct we can add all these currents together. The total should equal the total current value we figured earlier.

$$I_T = I_2 + I_3 + I_4$$

$$= {}^{4}/{}_{10} + {}^{4}/{}_{20} + {}^{4}/{}_{10}$$

$$= {}^{20}/{}_{20} = 1 \text{ amp}$$

This one amp is the same answer we calculated earlier so our computations have been correct.

Too Rich & Stuffy Caddy

Continued from Page 2

exhaust restriction. This caused low engine vacuum and an inability for the engine to breathe. (This low vacuum was responsible for the MAP/BARO code). When the A.I.R. tube was replaced, it cut off the only breathing path for the engine so it could not start.

Replacement of the clogged cat took care of the problems. **Remember to replace the oxygen sensor when replacing a cat!**