MOTOR AGE TRAINING

TST

"Understanding Engine Management"

Presented by Motor Age & TST

Sponsored by

Duralast®

What To Expect From This Webinar

- **A 60 to 90+ Minute Webinar**
- **A solid understanding of vehicle engine management helps you identify and resolve many of the drivability issues you encounter.**
- **A quick overview of PCM functions, covering inputs, outputs, and how sensors and actuators regulate engine performance.**
- **This webinar will discuss sensors, actuators, fuel trim, ignition systems, and O2/Air Fuel sensors essential for efficient engine operation.**
- **Explain the primary functions of the Powertrain Control Module (PCM), including how inputs, outputs, sensors, and actuators interact to control engine performance.**

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What To Expect From This Webinar

- **Identify key engine management components - fuel systems, ignition systems, and describe their role in efficient engine operation.**
- **Apply a foundational understanding of PCM logic to interpret sensor and actuator behavior during real-world diagnostic and performance scenarios.**
- **The Recording Will Be Available at Motor Age Training Account & TSTseminars.org**

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First Things First

1. Listen to the vehicle owner complaint
2. Verify the complaint - this in many cases will require a test drive
3. Perform a good visual
4. Connect a scan tool and check for DTCs & look at Generic OBD II data
5. Perform a complete vehicle scan
6. Use AllData to check for DTC information, TSBs and system understanding

Autel Ultra S2

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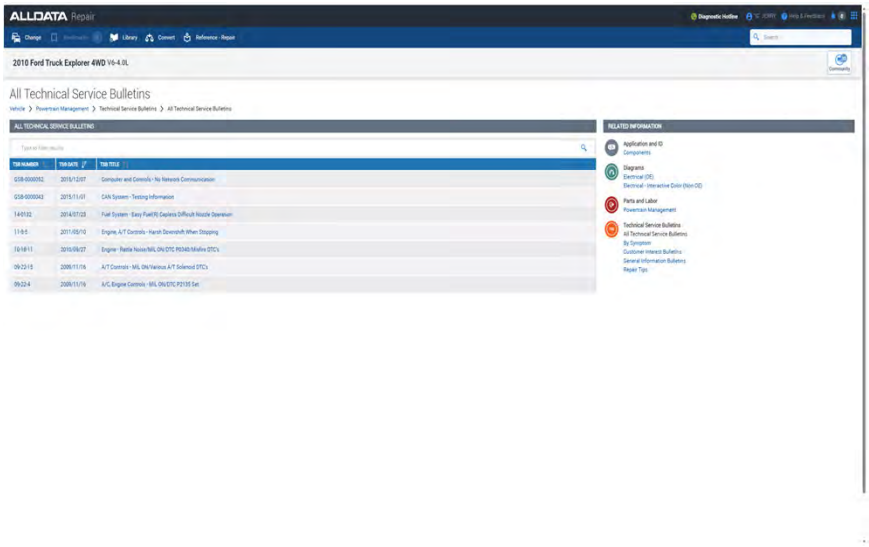
ALLDATA - TSBs



Courtesy of AllData

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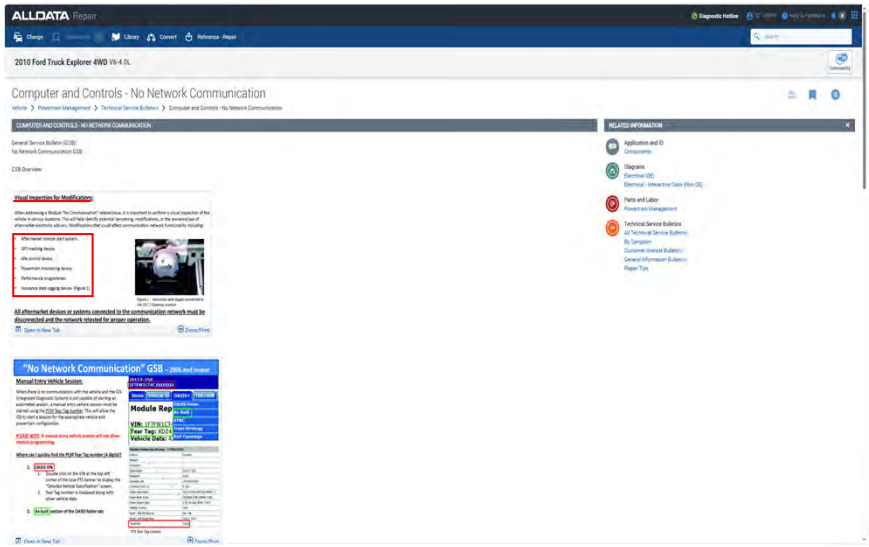

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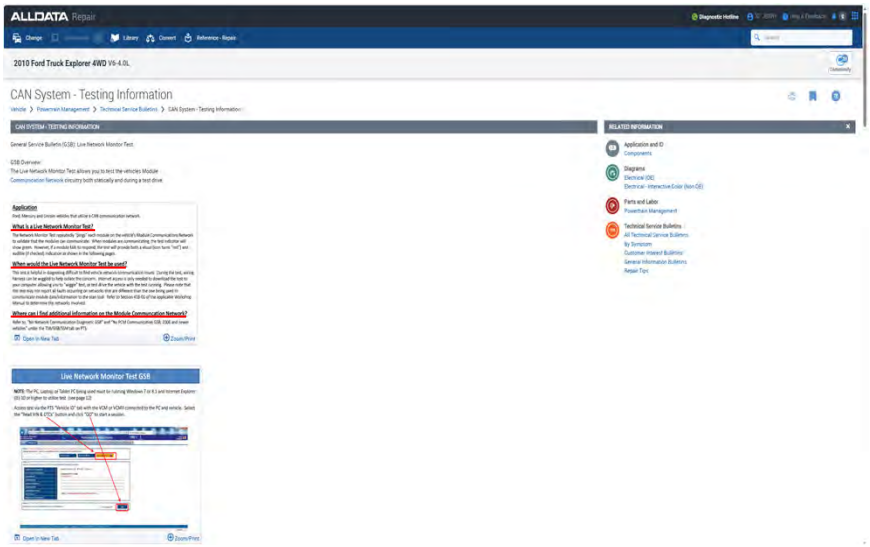

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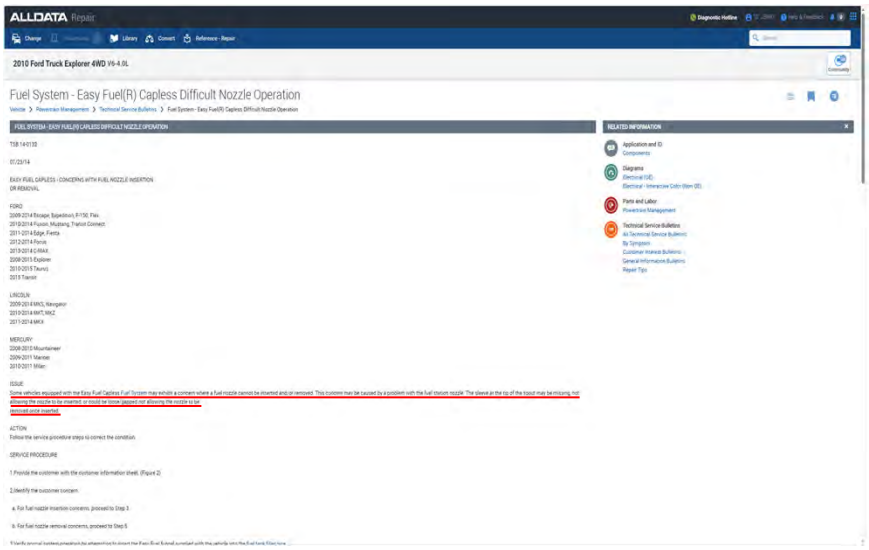

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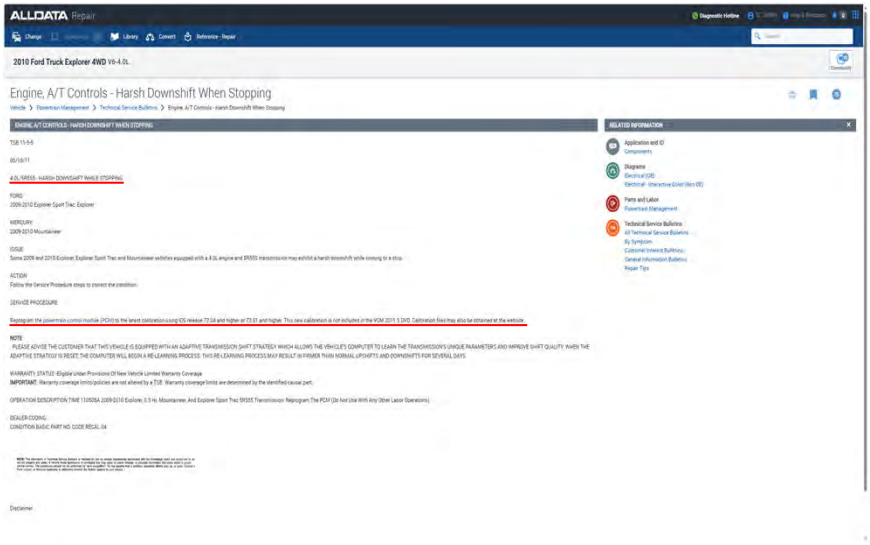

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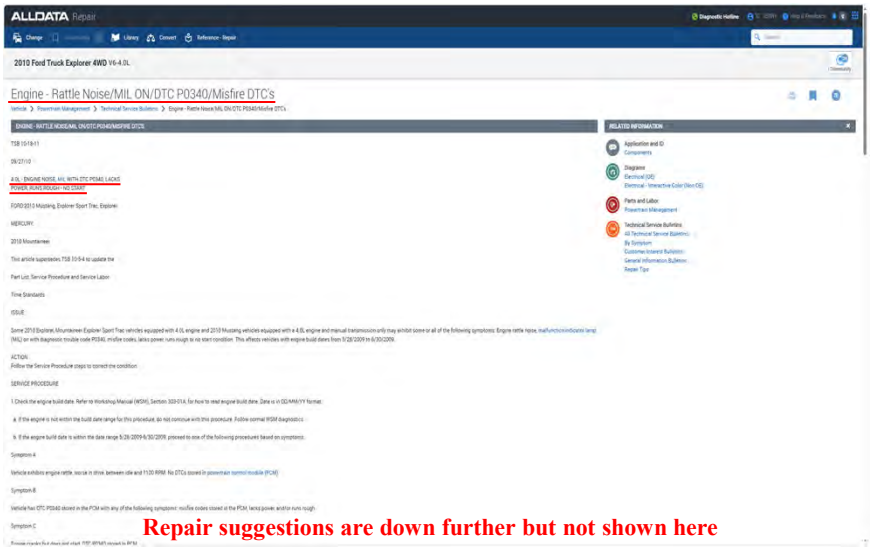
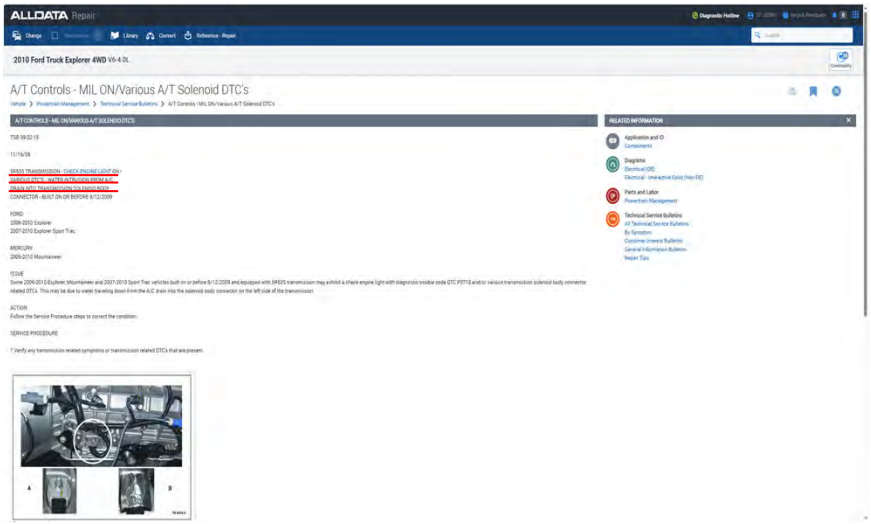


Repair suggestions are down further but not shown here

Courtesy of AllData

ALLDATA - TSBs



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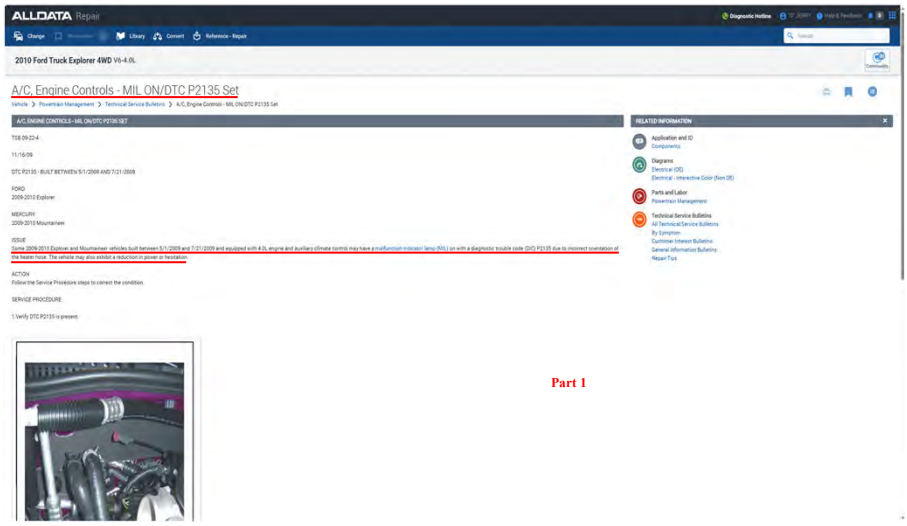


Part 1

Courtesy of AllData

ALLDATA - TSBs

2.Check the clearance between the heater inlet hose and the throttle position sensor (PS) connector and wiring. (Figure 1)

a. If the clearance is more than 3/8" (10 mm), follow normal diagnostics.

b. If the hose is touching the wiring or the clearance is 3/8" (10 mm) or less, proceed to Step 3.

3. Relieve cooling system pressure. Refer to Work Shop Manual (WSM), Section 303-03.

4.Remove the spring clamp at the heater core outlet tube connection and rotate hose clockwise until the hose is oriented as shown in the picture and install the spring clamp. There should be about 13/16" - 1 3/16" (20-30 mm) clearance between the hose and the IPS connector and wiring harness. In addition, the hose must have clearance to all clamps on the other heater hose.

5.Inspect the wires at the IPS connector where the hose was contacting. If the wires are worn, repair as needed.

6.Top off engine coolant as needed.

7.Clear DTC's.

WARRANTY STATUS: Eligible Under Provisions Of New Vehicle Limited Warranty Coverage

IMPORTANT: Warranty coverage limits/policies are not altered by a TSB. Warranty coverage limits are determined by the identified causal part.

OPERATION DESCRIPTION TIME 0922044A 2009-2010 Explorer; 0.4 Hr. Mountaineer 4.0L, Rotate The Heater Hose Following The Service Procedure (Do Not Use With Any Other Labor Operations) 0922045 2009-2010 Explorer; 0.6 Hr. Mountaineer 4.0L, Rotate The Heater Hose Repair Wires At The TPS Connector Following The Service Procedure (Do Not Use With Any Other Labor Operations)

DEALER CODING

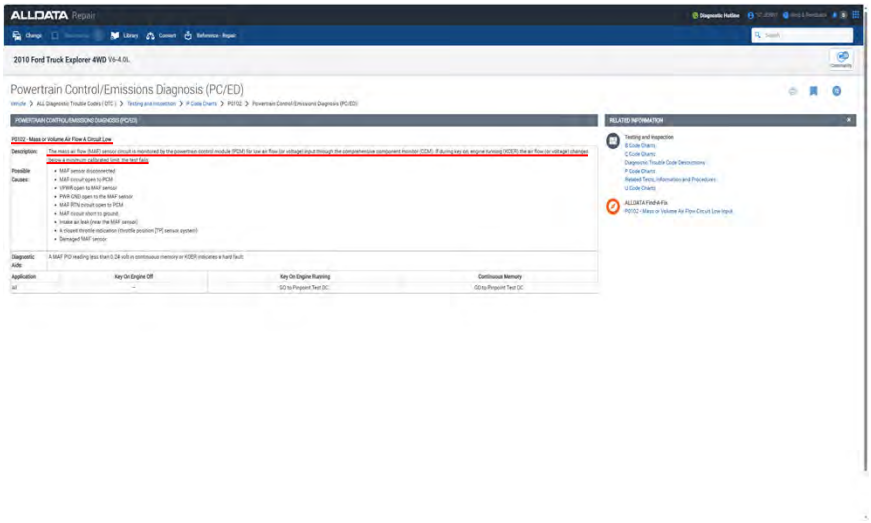
CONDITION BASIC PART NO. CODE 19472 12

Part 2

Figure 1

Courtesy of AllData

ALLDATA - DTC Diagnosis

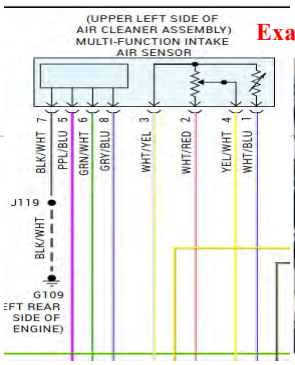


Courtesy of AllData

ALLDATA - System Description & Operation

Circuit/System Description from AllData

Component	Description
B74 Manifold Absolute Pressure Sensor	The sensor is a capacitive pressure transducer. Electronics in the sensor convert pressure into an analog voltage signal. The sensor measures the pressure in the intake manifold between the throttle valve and the intake valves. When the engine is idling or decelerating, the sensor pressure should be low. When the engine is off or under wide-open throttle conditions the pressure should be the same or close to the barometric pressure.
B75C Multifunction Intake Air Sensor	The assembly has several functions: • The mass air flow sensor is a hot film type sensor that measures the mass of air (not the volume) entering the engine. The signal varies with engine load and is displayed by the scan tool in Hertz (Hz) and grams per second (g/s). • The component houses the following sensors: ◦ BARO Sensor 1 ◦ BARO Sensor 2 ◦ IAT Sensor 1 ◦ IAT Sensor 2 ◦ Intake Air Humidity Sensor



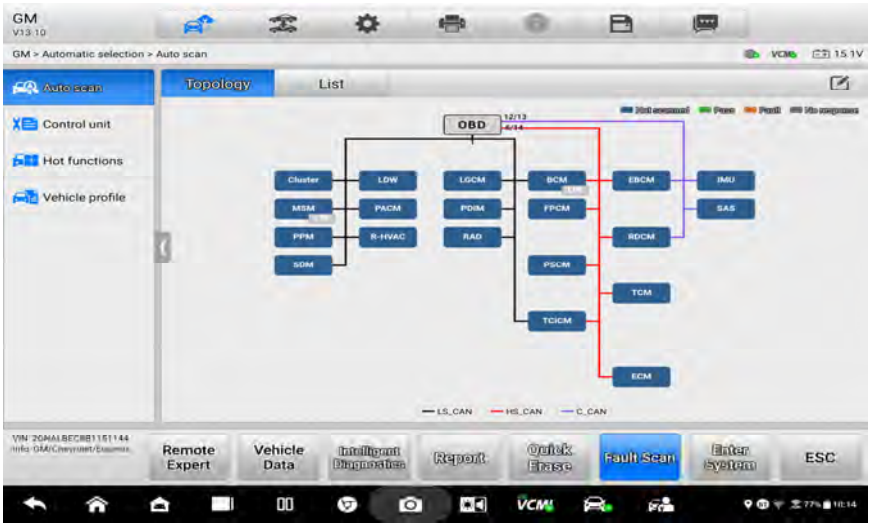
Example of a GM MAF Sensor

Courtesy of AllData

On To The Vehicle

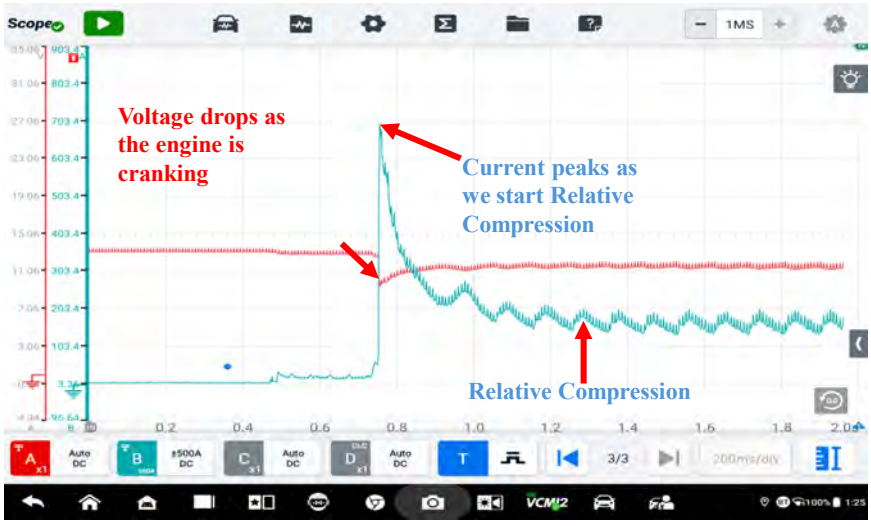
Check Generic Scan Data & Complete Vehicle Scan

Check Topology - Complete Vehicle Scan



Check The Battery - Starter - Alternator / Generator

Check The Engine Health - Relative Compression

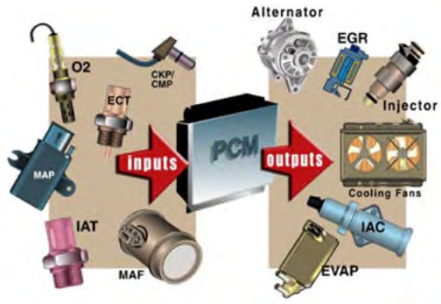


How Vehicle Computer Work

The PCM is the brain of the vehicle comparing engine data to what it would like things to be. *Sensors* in a vehicle are the eyes, ears, nose, and hands that God gave you to know what's going on. The PCM knowing what is going on might want to do something, like firing the fuel injectors for a certain period of time, uses *actuators* to get this done.

How Vehicle Computer Work

Sensors tell the PCM what is going on by transferring voltage signals that reflect what is going on in the engine such as load, throttle position, temperature, and more. So, to summarize, what vehicle computers do is Sense, Compare and Adjust.



On To Component Testing

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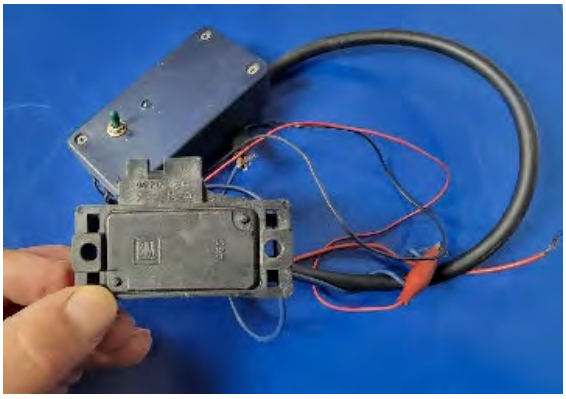
Testing Vehicle Sensors - Off Vehicle



Testing Vehicle Actuators - Off Vehicle



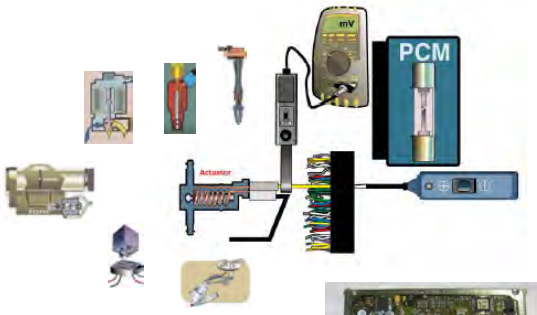

Testing Vehicle Actuators - Off Vehicle

Use CAUTION when replacing PCMs, they just don't happen to burn out. The sensitive circuits inside the PCM are easily damaged by actuators that have shorted out due to low electrical resistance or high mechanical resistance.

Use proper diagnostic procedures to test all solenoids before replacing a PCM.

Damage to PCMs are commonly caused by shorted solenoids.

Low Resistance = High Amperage



Most Expensive Fuse On The Vehicle

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Generic OBD II

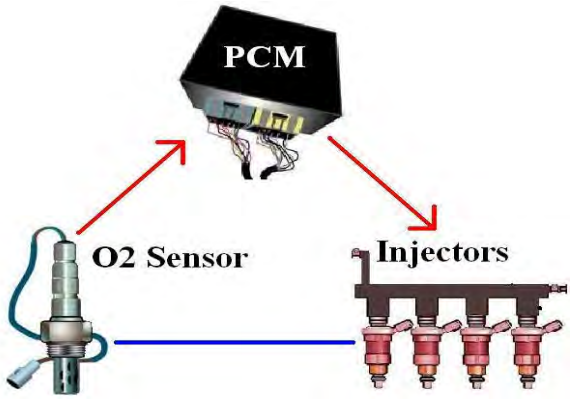
MODES	GENERIC TITLE
Mode 1	Powertrain Diagnostic Data
Mode 2	Powertrain Freeze Frame Data
Mode 3	Emission Related Powertrain DTCs
Mode 4	Clear/Reset Emission Related Diagnostic Information
Mode 5	Oxygen Sensor Monitoring Test Results
Mode 6	Test Results for Non-Continuously Monitoring Systems
Mode 7	Test Results for Continuously Monitored Systems
Mode 8	Request Control of On-Board System Test or Component
Mode 9	Request Vehicle Information
Mode 0A/10	Permanent Diagnostic Trouble Codes (DTCs) (Cleared DTCs)

The 10 Modes of OBD II are something you have been using for years. When you connect your scan tool collecting information for DTCs, hey that's Mode 3. When you look at scan data PIDS your using Mode 1. So, see you know some of the 10 Modes of OBD II. Mode 0A/ 10 is Permanent DTCs that started in 2010.

How Vehicle Computer Work

Think of a vehicle computer (PCM) system as the human body. A sensor (a sensor such as the HO2S) is like your fingertips touching something hot, sending the signal to your brain (the PCM) then sending the signal to your arm muscles (an actuator like injectors) to pull away.

Sense, Compare & Adjust



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On To The Vehicle

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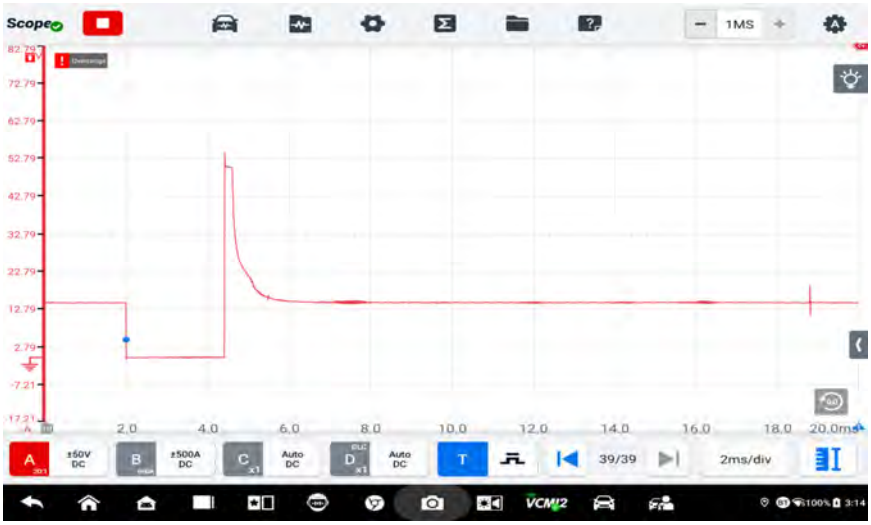
Ignition Test Using Labscope

Fuel Injector Test Using Labscope



Review -Helpful Sensor Information On The Most Common Sensors

- **CTS about 1.5 volts on a normal operating engine.**
- **HO2S (Oxygen Sensor) the voltage should switch from 150 mV or less to 850 mV or higher, at 2000 RPMs, within 100 milliseconds or less.**
- **IAT about 1 volts or so on a normal operating engine at idle.**
- **MAP should be about 1 volt on an engine that has 18 to 20 inches of vacuum at idle.**
- **MAF at least 1 gram per liter of the engine, tested at idle.**
- **TP (Throttle Position) voltage should be tested with a meter on Min/Max or better yet with a labscope. At closed throttle, the voltage typically is 300 mV to 1200 mV (1 volt, 200 mV) and approximately 5 volts at wide open throttle.**

TIP: When a new or good running vehicle enters your shop, check for DTCs and Pending DTCs. If there are NONE present, make a printout or write down the scan data at idle and 2500 RPM. This becomes very helpful information that you can use to compare a known good against what you are working on. The information will assist you in finding a PID that is out of specification. Make sure it's the same engine with similar conditions, cold, hot, and 2500 RPM.

Thank you to our partner!

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THANK YOU

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