

# Diagnostic Dilemmas

## Cause: Fuel Trim

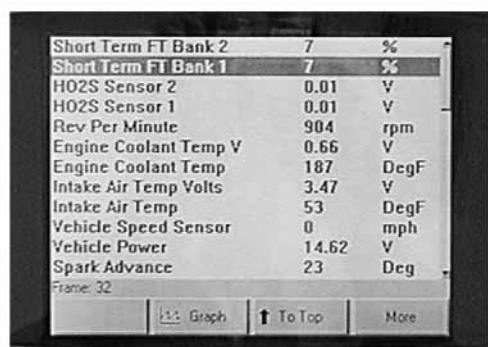
## Effect: A4LD No Lockup Hot

By: Brian Workman

You just installed an A4LD, took it for a road test and it works perfectly! Then, as you return to the shop you lose lockup.

You break out your scan tool and there are no codes. No codes, no lockup. Why? The first thing you need to do is determine whether you have a control problem or a transmission problem. So, it's off for another road test, this time to monitor whether the computer is commanding lockup or not. Sure enough, the computer is not commanding lockup.

**FIGURE 1**



**Scan tool fuel trim less than 10:**

Both O2 sensors read lean, low voltage and the fuel trim is above 0, so the computer is starting to richen up the mixture by increase the injector on time.

Just to put your curiosity at rest, you override the lockup command and the transmission does have lockup. That's a relief, huh? So why isn't the computer sending a signal for lockup?

To start off, computers, as I always say, are "stupid." Don't give them any information and you get nothing in return. Give them limited or wrong information, and that's what you will get back. Computers don't think: They are processors, which mean they process information and perform tasks. Lockup is one of those tasks. So why did we lose the command?

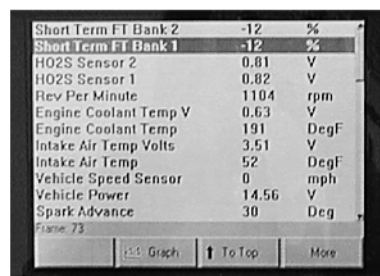
For a computer to perform a task, it must receive information from the sensors. Mass airflow (MAF), oxygen (O2),

knock, manifold absolute pressure (MAP), air intake temperature (AIT), crank and camshaft, vehicle speed, gear position, coolant temperature (CTS) and throttle position (TPS) are just some of these sensors. They send information on to the computer, which can then command the actuators to perform their tasks. Actuators are solenoids, lockup, shift, EGR valves, fuel injectors, etc.

So what does fuel trim have to do with lockup? It has nothing to do with lockup BUT it has everything to do with driveability.

So what is fuel trim? Fuel trim is rebalancing the fuel mixture for reduced emissions. It is a number that represents the computer's learned amount of total fuel need. That number is derived from the time the fuel injectors are pulsed on and off. The higher the fuel trim number, the more fuel is being commanded, the more injector pulse on time. The lower the number, the less fuel is commanded, the less the injector is pulsed on. The fuel trim command is a result of what the oxygen sensor tells the computer. You don't want to see short-term fuel trim over 10

**FIGURE 2**



**Sensor rich:**

Both O2 sensors read rich and the fuel trim is well below 0, meaning the computer is leaning out the mixture by reducing the injectors on time.

on your scan tool. Fuel trim starts at 0 and can go positive, more fuel, or negative, less fuel.

The oxygen sensor's job is to tell the computer how much unburned oxygen is in the exhaust. When the O2 sensor reads a high amount of oxygen, the voltage will be low, around 100 mv. This is a lean condition. The computer will add fuel to richen up the fuel mixture by increasing the amount of time the injector is turned on.

When the O2 sensor reads a small amount of oxygen, the voltage will be high, around 900mv. This is a rich condition. The computer will reduce the amount of fuel by decreasing the injector on time.

Watching the O2 sensors on your scan tool, you'll see the voltage switching constantly between high and low, from 100 mv to 900 mv. If the O2 sensors are working correctly and everything is normal with the engine, the switching voltage will cross 500 mv rapidly. Every time the O2 sensors cross the 500mv threshold, the computer makes adjustments to the amount of fuel it either adds or reduces to the engine. Fuel trim.

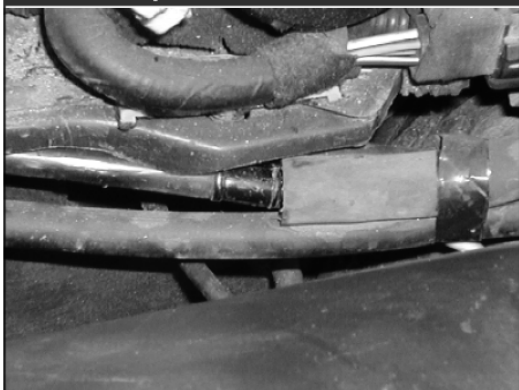
How does this help us in diagnosing a no-lockup condition? Easy!

Drive the vehicle and watch fuel trim. Short-term fuel trim should never go over 10. If it does, start looking at what O2 sensors voltage. If your O2s are reading lean, 100 mv or less, and fuel trim keeps rising over 10 to 20, 25 and more, the computer is telling you that no matter how much fuel it adds, it can't make the system go rich. In these lean conditions, the computer will inhibit lockup to prevent a lean driveability problem. Lean driveability problems show up as lean misses, surges while

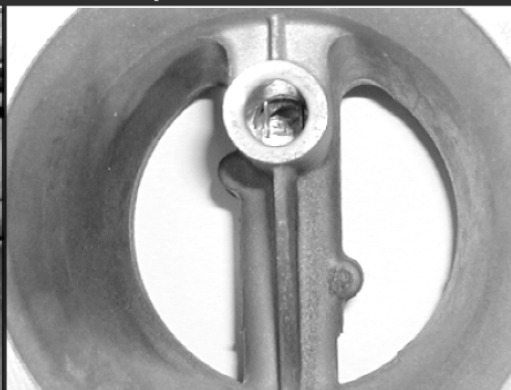
driving. It can feel like a transmission going in and out of lockup.

The most common reason for high fuel trim numbers and a lean O2 sensor is unmetered air. All air entering the engine must pass through the MAF. The computer reads the amount of air entering and controls the fuel injectors on time for a proper mixture. Any air

**FIGURE 4, VACUUM LINE OFF**



**FIGURE 5, FORD MAF SENSOR**



**Cutline for measurement:**

When the air box is removed on some cars to access the transmission, it is not uncommon for vacuum lines to be pulled off, creating leaks commonly known as unmetered air. Contaminated MAF sensors can be caused by turning the air filter box over during a repair, allowing dirt and debris to affect the sensor's ability to meter air. Oil bath filters and poorly designed air filters, and less than premium paper can also contribute to this type of problem. The lesser quality paper has a tendency to be sucked off.

that gets into an engine without being read by the MAF is called unmetered air. Unmetered air can be the result of several things: A dirty or contaminated Mass Airflow Sensor, vacuum leaks, damaged intake tube from the air box to the throttle body or clamps to the intake tube left loose during installation. The MAF can become contaminated simply by turning the air box over with a dirty filter in it. On this particular vehicle, the Mass Airflow Sensor needed to be cleaned and the air cleaner replaced with a new one. Problem fixed.

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**FIGURE 3**

Short Term FT Bank 2	25	%
Short Term FT Bank 1	25	%
H02S Sensor 2	0.04	V
H02S Sensor 1	0.04	V
Rev Per Minute	1332	rpm
Engine Coolant Temp V	0.65	V
Engine Coolant Temp	189	DegF
Intake Air Temp Volts	3.44	V
Intake Air Temp	54	DegF
Vehicle Speed Sensor	0	mph
Vehicle Power	14.50	V
Spark Advance	32	Deg
Frame: 42		
Graph To Top More		

**Fuel trim is at 25:**

When unmetered air is introduced into the engine, both O2 sensors go full lean, low voltage, fuel trim is at its maximum 25 and the computer is trying to richen up the mixture by increasing the injector on time to its maximum.