

We Have a Sensor Code, Is it Really the Sensor?

The check engine light just came on, we scan through the OBD port and we have codes, sensor related codes. Is the MAF, ECT, O2 sensor, etc really bad? We don't know yet. The OBD code system does not give us root cause, it gives us clues because something is out of bounds. If the reported sensor value is out of bounds, is the sensor reporting correctly and the parameter is out of bounds, is the wiring/connector faulty, has the sensor failed, or has the ECM failed? We don't know yet. We only know that something is wrong with the system that the sensor is involved with but for now, that's all we know. Let's start with what a sensor is and how it works in our trucks:

A sensor translates a real world analogue input into an electrical signal to be read by a piece of electronics like an amplifier. This translation can take many forms but usually a changing resistance, voltage, duty cycle or frequency that varies with the parameter being measured. It can be a positive or negative coefficient meaning varies directly or inversely with the changing parameter. A positive coefficient temp sensor for instance goes up in resistance as the temperature goes up. It can also be the opposite. Sensors usually have between 1 and 4 wires going to them. The simplest example is a temp sensor that varies resistance with temperature and has a single lead at the end and the body of the sensor grounded to the engine block through the threads. The computer reads the changing resistance through that sensor with either a constant voltage or constant current source and converts that value to a useable temperature value through a look up table. It's a passive and simple sensor. A sensor can also be active and need power or an accurate reference voltage. It may also need a separate clean ground to work correctly. The convenient practice of just bolting the ground wire to the frame does not work for delicate sensors that need a really clean signal so you will see sensor ground or lo ref as a dedicated wire heading back to the ECM.

So how do you determine if it's really the ECT, MAF or fuel tank pressure sensor? First if it needs power or a 5V reference circuit you verify good clean power, ref voltage and ground at the sensor while connected. If no good at the sensor what does it look like back at the ECM on those wires? Does the passive sensor wire have continuity back to the ECM? You'll need a decent dvm, piercing probes or T pins and some basic knowledge of electrical measurement. Be careful here as some of these voltages are not protected back at the ECM and you can cause damage if you short them. Next you see if the ECM translated sensor value makes sense on live data with your scanner. On a cold or warm engine is the ECT at ambient or 195F, is the MAP at atmospheric pressure, is the IAT at atmospheric temp? Does the TPS change value smoothly all the way through the gas pedal range with proper end values. Do the O2 sensors switch between the proper rail voltages and with the expected frequency and do they peg high/rich at full throttle? Does the MAF read approximately correct at idle and at a full throttle shift change as verified with a VE calculator? You can go one level deeper if you like this stuff such as reading the changing frequency of the MAF sensor output with a scope or proper meter and see if that freq matches the presumed air flow. Or you could put the temp sensor in boiling water and see if the value makes sense, etc.

Of course many people get a sensor code and just replace the sensor to see if the code goes away and that is a matter of dealers choice but I see a great many posts of people listing all the stuff they have already changed using the parts cannon with no improvement yet and in some cases, even more problems now. Many aftermarket parts are inferior to a perfect sensor in the truck now that has not actually failed. If you want to get good at problem solving you need a good diagnostic process. It's interesting if you like this stuff and can save time and money. That said a quick and dirty test would be to swap with a known good part or swap pairs like O2 sensors to see if the problem changes banks for instance. Have I ever swapped a sensor first based on an educated guess without a 3 page flow chart? Yes but not very often.

On a related note you should always check the quality of the power and ground to any sub system module like the ICM before just condemning it. What does the voltage look like on the pink wire to the ICM for instance?

Needless to say, all of this is way easier with a proper electrical schematic and various sources will provide this like shop manuals, alldata or Mitchell1.

So does this code make any "sense"? Is replacing the sensor sensible? I sense some frustration with this problem. Knowledge is power, to the sensor. Enough of these senseless nerdy jokes. LOL.