

OBD II Mode \$06 Case Study

Mode \$06 can assist you with difficult OBD II non-continuous monitor problems.



This issue's case study was contributed by "G" Jerry Truglia.

Most technicians have at least heard of Mode \$06 data, but many still don't understand how it can be utilized in a diagnostic situation. If you are unfamiliar with Mode \$06, what follows is a quick review. The second generation on-board diagnostic standard (OBD II) includes nine diagnostic modes.

Mode \$01 is used to request and display sensor data, open/closed loop status, whether switches are on or off and any other datastream parameter identification data (PIDs) the system or scan tool is capable of displaying.

Mode \$02 is used by your scan tool to request freeze frame data from the PCM. This stored information is captured when a diagnostic trouble code (DTC) is set.

Mode \$03 lists DTCs stored in the PCM's memory. These are the five-digit P0xxx generic OBD II DTC and P1xxx OEM enhanced codes.

Mode \$04 is used by the scan tool to clear codes and freeze frame data and to reset non-continuous monitors.

Mode \$05 is used to display oxygen sensor monitor test results and is not accessible by all scan tools.

Mode \$06 is an advanced diagnostic mode that displays the unfiltered test results from all non-continuous monitors. These results include the evaporative emission control system (EVAP), catalytic converter, air system, PCV and EGR systems, engine thermostat, oxygen sensor and engine misfire on Fords.

Mode \$07 displays test results for all continuous monitors, which include misfires on vehicles other than Fords, oxygen sensor operation and the operation of all engine sensors and other inputs. This mode indicates whether the OBD II system has run all its self-checks, and whether all monitors have passed.

Mode \$08 is only accessible using scan tools with bi-directional capability and allows any self-tests that are available through the PCM to be run.

Mode \$09 is used to display vehicle identification information, such as the VIN and PCM calibration.

Early OBD II vehicles report Mode \$06 data as Test Identification (TID) and Component Identification (CID) data. Later OBD II vehicles equipped with controller area networks (CAN) report Mode \$06 data as Monitor Identification (MID) and Test Identification (TID) data. For example, prior to the new standards, TID\$01 represented catalyst monitor test results for Toyota vehicles, as well as oxygen sensor monitor test results for Ford vehicles. For the sake of uniformity, the newer SAE OBD II standard recommends that vehicle manufacturers utilize MID\$21-\$24 for catalyst monitor data.

If you've never worked with Mode \$06 before, you're probably wondering about all the stray dollar signs on this page. The dollar sign tells you that what's to follow is a hexadecimal value, not a base 10 number. Hexadecimal notation, commonly called "hex," is a base 16 numbering system that uses the digits 0 through 9 and the letters A through F. Base 10, the numbering system you're no doubt familiar with, uses the numbers 0 through 9 only.

Hex code is used in the computer programming language that PCMs understand. Hex code numbers can be converted into regular decimal values using a scientific calculator, or with the calculator built into the Windows operating system.

Open the calculator, click on "View," then select "Scientific." Click "Hex," enter the value in hex code, then click "Dec" to automatically convert the value to a base 10 decimal number you can read and understand. For example, if you convert the hex code \$4D into base 10, the result is 77.

Many recent scan tools automatically perform the hex conversion and scaling of Mode \$06 data into the base 10 numbers you're familiar with. Mode \$06 data is typically displayed by the scan tool in three columns. The first

continued on page 3

Fine Tuning



Fine Tuning questions are answered by Mark Hicks, Technical Services Manager. Please send your questions to: Mark Hicks c/o Wells Manufacturing, L.P., P.O. Box 70, Fond du Lac, WI 54936-0070 or e-mail him at technical@wellsmfgcorp.com. We'll send you a very nice Wells golf shirt if your question is published. So please include your shirt size with your question.

Q: I'm working on a 2004 Dodge Intrepid with a 2.7L engine that has 23,000 miles on it. A diagnostic trouble code (DTC) P0441, indicating insufficient EVAP purge, is stored in memory. The test instructions I have say to check vacuum and the operation of the purge solenoid. I can activate the solenoid with my scan tool with vacuum applied and it works. But that is where my instructions stop. Do you have a more complete test procedure for this DTC?

**Keith Howe
Howe's Auto Repair
Philadelphia, PA**

A: Keith, I'm sure the following test procedure (courtesy of Identifix) will work for you.

First, verify the hoses for the purge solenoid are routed correctly and are not pinched or restricted in any way. This includes verifying no liquid fuel or charcoal are in the lines. Clean or replace the lines as needed.

Next, verify the canister purge solenoid varies its duty cycle when commanded by a scan tool. Replace the solenoid if it's sticking.

Finally, locate the Natural Vacuum Leak Detection (NVLD) assembly. You'll find it on top of the charcoal canister, above the fuel tank. Back-probe the orange wire and connect a voltmeter. Locate the vacuum line going to the canister (from the purge solenoid) and remove it. Using a hand vacuum pump, apply vacuum to the port going to the canister/NVLD assembly and block the other two lines at the canister. While doing this, observe the voltage on the orange wire. The voltage should change at approximately 1 in. Hg vacuum. Try testing this switch several times to verify that it isn't sticking. Replace the NVLD if the switch is sticking.

In the previous *Counter Point* issue, Sigurd Peterson was working on a 2002 Chevrolet Suburban K1500 with a 5.3 VIN T engine. The problem was multiple transmission troubles codes and intermittent operation of the instrument panel (IP). My initial thought when a problem like this occurs is either the PCM has an issue or there is a power/grounding problem. When numerous codes are stored in the computer's memory, I like to clear them first, then drive the vehicle to see which one comes back first. In most

cases, the first code to reset is the primary problem. But after clearing these codes, they all came back at the same time after 15 minutes of driving.

Intermittent problems are especially difficult to diagnose, because it is nearly impossible to find the cause until the problem occurs. Being prepared to perform the most conclusive test at that time is the key to an accurate repair. After examining the wiring diagram (a portion of which is reproduced below), it is noted the IGN 0 fuse feeds both the IP and transmission solenoids. The IGN C feeds the entire circuit from the battery, and the ignition switch controls distribution of the available current.

When the problem occurs, checking the voltage at the IGN 0 fuse is only part of a conclusive test. To be sure the voltage supply is present, check for voltage at the crank fuse. Also check for a voltage drop between the IGN C and IGN 0 fuses. Either one of these tests will take only a few minutes and will confirm the most probable cause (a defective ignition switch) and might save you some time and a customer.

Results: After the problem occurred, Sigurd checked the circuit and found the ignition switch was defective. This design puts an excessive current load on the ignition switch. It has been brought to my attention that an aftermarket ignition switch relay assistance device is available. If you have a vehicle with persistent ignition switch failures, you may want to check into this.

Diagnose The Problem Win A Shirt

We are working on a 2002 Volkswagen Beetle with a 1.9L turbodiesel engine. It has a surging problem while driving and the idle speed is higher than normal. The engine RPM will surge up and down from the desired speed by 200 RPM or more. A small amount of surge is normal, but it has gotten to the point where it is impossible for my customer to drive the car. I have replaced or tested the mass airflow sensor, the fuel filter, fuel pressure, fuel integrity, timing belt and they are all perfect. What else could be causing this?

**John Huber & Phillip Flusche
Flusche Auto Repair
Decatur, TX**

If you have the answer, please use the following contact information:

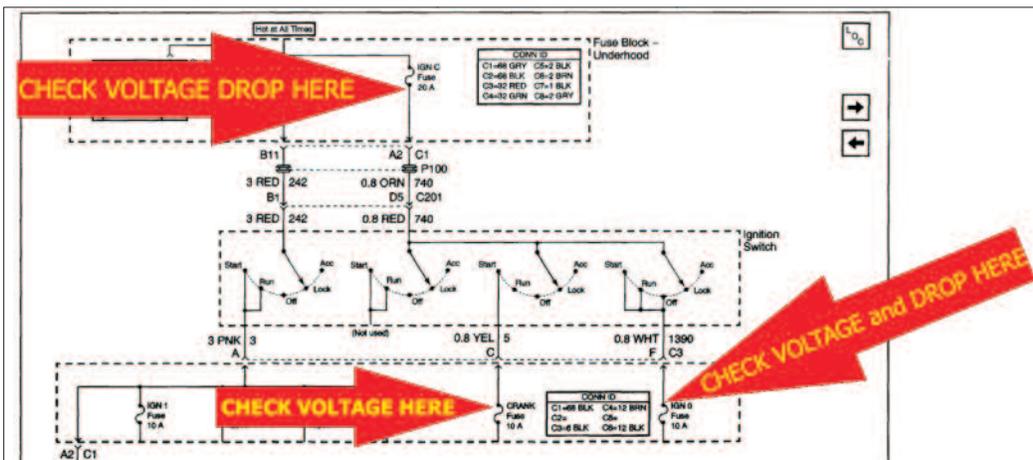
E-mail: technical@wellsmfgcorp.com
Fax: (920) 922-3585
Postal: *Counter Point* Editor
c/o Wells Manufacturing, L.P.
P.O. Box 70
Fond du Lac, WI 54936-0070

For certified (no fee) diagnostic assistance, call 1-800-558-9770 between 7:00 AM and 7:00 PM CST.

Important Dates To Remember



The National Institute for Automotive Service Excellence (ASE) is introducing a new addition to the Automobile Technician certification test series — the Light Vehicle Diesel Engines Test (A9). The first A9 tests will be offered during the May 2009 ASE test administration. Spring paper and pencil testing for all ASE tests (regular and recertification) will be held May 7th, 12th and 14th at 700+ test centers. **WELLS**



Power Distribution Schematic (Ignition, Run and Start Bus Bar)

OBID II Mode \$06 Case Study

column is the TID that indicates what system monitor is involved. The second column is the CID, which corresponds to the component being tested and its test value. The third column is PASS/FAIL that tells you if the test value is in or out of predetermined limits.

It's still a good idea to familiarize yourself with the differences between base 10 and base 16, simply because it will help you understand Mode \$06 and will make the data it contains seem less unusual.

Try this simple quiz. Decode \$DE from base 16 into base 10. Did you answer 27 (13 + 14)? The correct answer is 222 (16 x 13) + (1 x 14) = 222. Just like (10 x 7) + (1 x 7) = 77 in base 10 math.

Mode \$06 can be useful for diagnosing faults when the vehicle has an emissions or driveability issue, but hasn't set any codes. It can also be used to spot other pending problems that have not set a code and to verify repairs by making sure all monitored systems pass OBID II diagnostic self-tests. For example, if a vehicle has a bad oxygen sensor heater circuit and a bad catalytic converter, you'd probably only find a DTC for the sensor heater. Replacing the oxygen sensor would allow the catalyst monitor to run, possibly setting a second DTC.

Mode \$06 data was used in the following case study, which concerns a 2001 Infiniti with 79,137 miles on the odometer. The MIL would illuminate intermittently, but it could take as many as 7000 miles between occurrences.

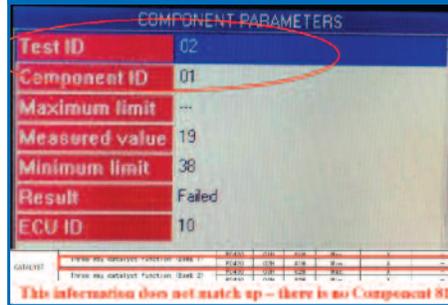
After a visual inspection, I decided to check for relevant technical service bulletins (TSBs). I found a few bulletins that referenced PCM reprogramming, replacing the front HO2S and replacing the catalytic converter.

Even though the MIL was off, my next step was to connect my scan tool. I wanted to determine if the monitors were "Ready." None were, so I decided to check Mode \$06 for component failures. Mode \$06 failure info for this vehicle is shown in Figure 1.

The scan tool I was using for Mode \$06 did not convert the raw data into numbers or system components that I could use for diagnosis. I needed to acquire the Mode \$06 hexadecimal data, and the only place it is available is the Nissan/Infiniti service information website.

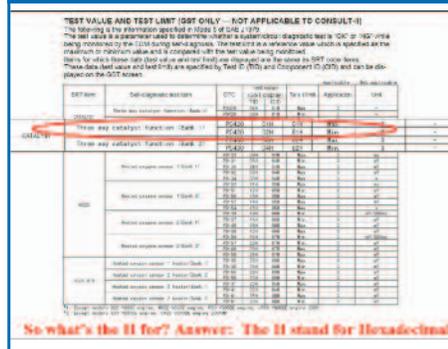
The easiest way to get to this site and other OE service information websites is via the National Automotive Service Taskforce website (www.nastf.org), where the addresses for all manufacturers' service information websites are listed.

Figure 1 Some scan tools do not provide Mode \$06 data. Others do, but only in hexadecimal format. To further complicate matters, available service information may not match up with the TID and CID data you see on your scan tool.



After paying the Infiniti service information website's access fee, I was able to search and find the needed records to decode the Mode \$06 raw data (Figure 2).

Figure 2 Most Mode \$06 tests will give a minimum and maximum acceptable test result. There's no need to convert from hexadecimal if you know the accepted hex values for a specific TID.

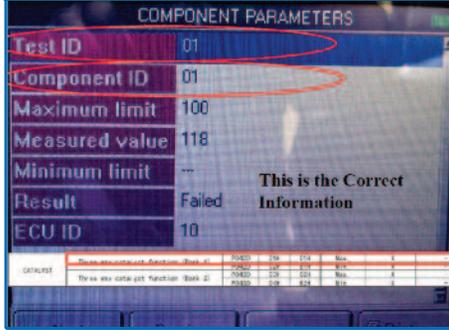


Because the DTCs and monitors had already been reset during a previous repair attempt, Mode \$06 was my only place to look for pending information. I decided to proceed with the assumption that since the MIL was staying off for increments of 7000 miles, there was an issue with the catalyst monitor failing to run, preventing that monitor from completing.

After a careful review of the Infiniti service information, I found the information in Figure 1 was not correct. The data was not matching up with the correct CID. CID 01, not CID 81, should have been displayed. The correct information is shown in Figure 3.

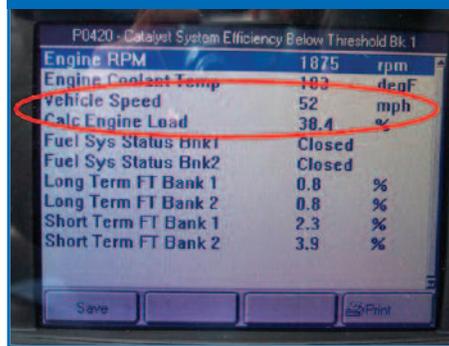
After driving the generic drive cycle, all of the monitors were now "Ready," except for EVAP. This is because the vehicle was already hot and the enabling criteria for most EVAP systems require the engine temperature to start from cold, or the monitor will be suspended.

Figure 3 In this screen capture we can see that the scanner's Mode \$06 TID and CID information matches our service information, and that the converter has failed the non-continuous monitor test.



With the catalyst monitor "Ready," it only took a few thousand miles before the MIL illuminated, setting a DTC P0420 (Figure 4). Mode \$06 provided an advance warning that the catalytic converter was not functioning as designed.

Figure 4 A non-continuous monitor won't set a DTC if it never gets the chance to run. Once the enabling criteria were met, the catalyst monitor ran on this vehicle, and a DTC P0420 was stored.



This vehicle was under an 8-year/80,000-mile federal emissions warranty, but the owner had previously been told no parts would be replaced until a DTC set. The DTC did not set until the vehicle had exceeded 80,000 miles. But because the owner was able to provide the recorded Mode \$06 data, the dealership agreed to replace both oxygen sensors and the catalytic converter under warranty.

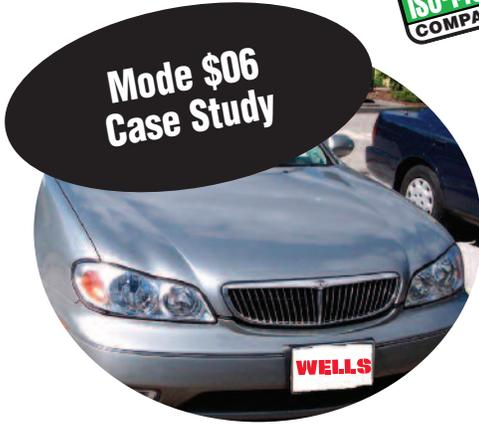
As you can see, Mode \$06 can be a big help in providing the test results needed to confirm a defective converter. Imagine how using Mode \$06 can assist you in solving OBID II monitor and other problems. **WELLS**

"G" Jerry Truglia is an experienced automotive instructor with Automotive Technician Training Services, Inc. His new book, "Understanding and Diagnosing Hybrid Vehicles," is now available. He also provides training programs and materials on many other topics. You can reach "G" at gt@attstraining.com or (845) 628-1062.

WELLS

WELLS MANUFACTURING, L.P.
P.O. Box 70
Fond du Lac, WI 54936-0070

Return Service Requested



Quality Points

Eco-Friendly Substrates

Are you among the 77% of Americans who currently buy organic products, look for energy-saving stickers on appliances or are simply seeking ways to reduce your carbon footprint? If so, one way to tread more lightly on the Earth is to consciously purchase “green” products from companies that have made a commitment to protecting our environment.

A common reason given for not buying green is the perception of added cost. In some cases it is true that green products are more expensive. But as more and more companies convert to environmentally-conscious production methods, cost has been proven to remain the same or actually improve. The following is just one example.



Modules, showing environmentally-friendly aluminum nitride substrates (in green).

Removing the heat from an internal high-powered ignition control module transistor can be a challenge. For years the best method was to use a beryllium oxide substrate. This type of substrate has been found to be unfriendly to the environment in the long term. Our engineering team devoted more than a year of research and testing to find a replacement substrate, with qualities of longevity and function that were the same or better. Today, Wells utilizes environmentally-friendly and cost-effective aluminum nitride substrates in every ignition control module we manufacture.

Wells — a place where originality is an everyday occurrence. **WELLS**

Publisher's Information

Wells President.....David Peace
V.P. Marketing & Sales.....Steve Hildebrand
Technical Services Manager Mark Hicks
Newsletter EditorKarl Seyfert

Counter Point is a quarterly publication of Wells Manufacturing, L.P., P.O. Box 70, Fond du Lac, WI 54936-0070. Letters and comments should be directed to: **Counter Point** Editor, c/o Wells Manufacturing, L.P., P.O. Box 70, Fond du Lac, WI 54936-0070.

© COPYRIGHT 2008 WELLS MANUFACTURING, L.P.
All rights reserved. No reproduction in whole or part is permitted without the written consent of Wells Manufacturing, L.P.