Visoka škola elektrotehnike i računarstva strukovnih studija
Beograd

Dijagnostički kodovi grešaka

OBD i EOBD

Osnovi dijagnostike vozila

- On-board dijagnostika na vozilu (OBD) je pojam koji se odnosi na sposobnost samodijagnostikovanja i izveštavanja o nastaloj grešci.
- OBD sistem daje serviseru ili vlasniku vozila mogućnost pristupa statusu različitih podsistema vozila.
- Količina dijagnostičkih informacija dostupnih preko OBD-a znatno je varirala od uvođenja ranih verzija on-board računara u vozila u 1980-im.
- Rane verzije OBD-a bi jednostavno aktivirale indikator neispravnosti ako bi se detektovao problem, ali ne bi pružile nikakve informacije o prirodi problema.
- Moderne OBD implementacije koriste standardizovani komunikacioni port za pružanje podataka u realnom vremenu kao dodatak standardizovanoj listi dijagnostičkih kodova grešaka, ili DTC-a (Diagnostic Trouble Codes), koji omogućavaju brzo otkrivanje i otklanjanje kvarova u vozilu.

Osnovi dijagnostike vozila

Razvoj OBD-a

ON-BOARD DIAGNOSTIC GENERATION – II (OBD-II) SYSTEMS

During the 1980s, most manufacturers began equipping their vehicles with full-function control systems capable of alerting the driver of a malfunction and of allowing the technician to retrieve codes that identify circuit faults. These early diagnostic systems were meant to reduce emissions and speed up vehicle repair.
The automotive industry calls these systems **On-Board Diagnostics (OBDs)**. The **California Air Resources Board (CARB)** developed the first regulation requiring manufacturers selling vehicles in that state to install OBD. OBD Generation I (OBD I) applies to all vehicles sold in California beginning with the 1988 model year. It carries the following requirements:
1. An instrument panel warning lamp able to alert the driver of certain control system failures, now called a **malfunction indicator lamp (MIL),**
2. The system`s abilityty record and transmit DTC`s for emission-related failures.
3. Electronic system monitoring of the HO_2S, EGR valve, and evaporative purge solenoid. Although not U.S. EPA required during this time most manufacturers also equipped vehicles sold outside of California with OBD I.

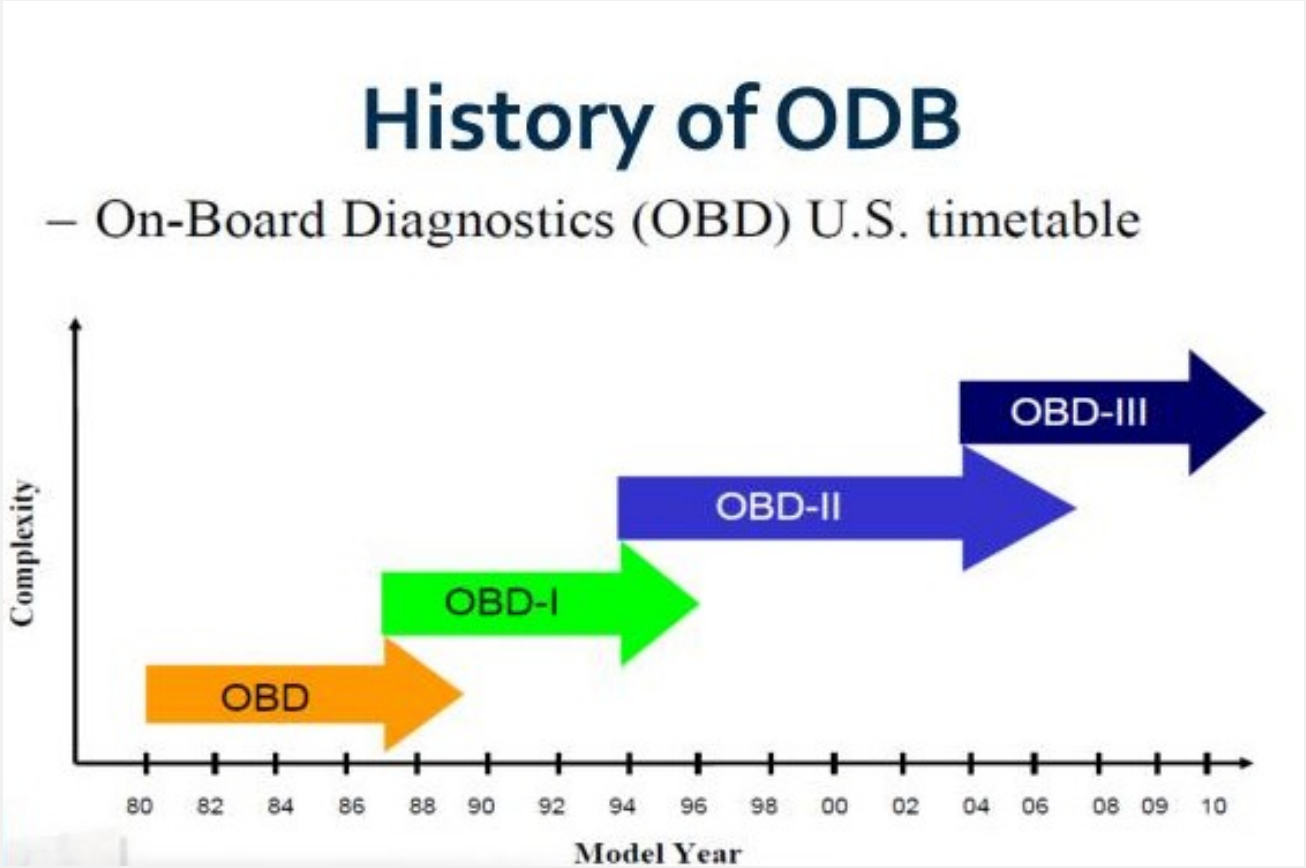
By failing to monitor the catalytic converter, the evaporative systems for leaks and the presence of engine misfire, OBD I did not do enough to lower automotive emissions. This led the CARB and the EPA to develop OBD Generation II (OBD II).

Figure: A typical malfunction indicator lamp (MIL) often labeled "check engine" and "service engine soon"

OBD-II OBJECTIVES. Generally, the CARB defines an OBD-II-equipped vehicle by ability to do the following:
1. Detect component degradation or a faulty emission – related system that prevents compliance with federal emission standards.
2. Alert the driver of needed emission-related repair or maintenance.
3. Use standardized DTSs and accept a generic scan tool.

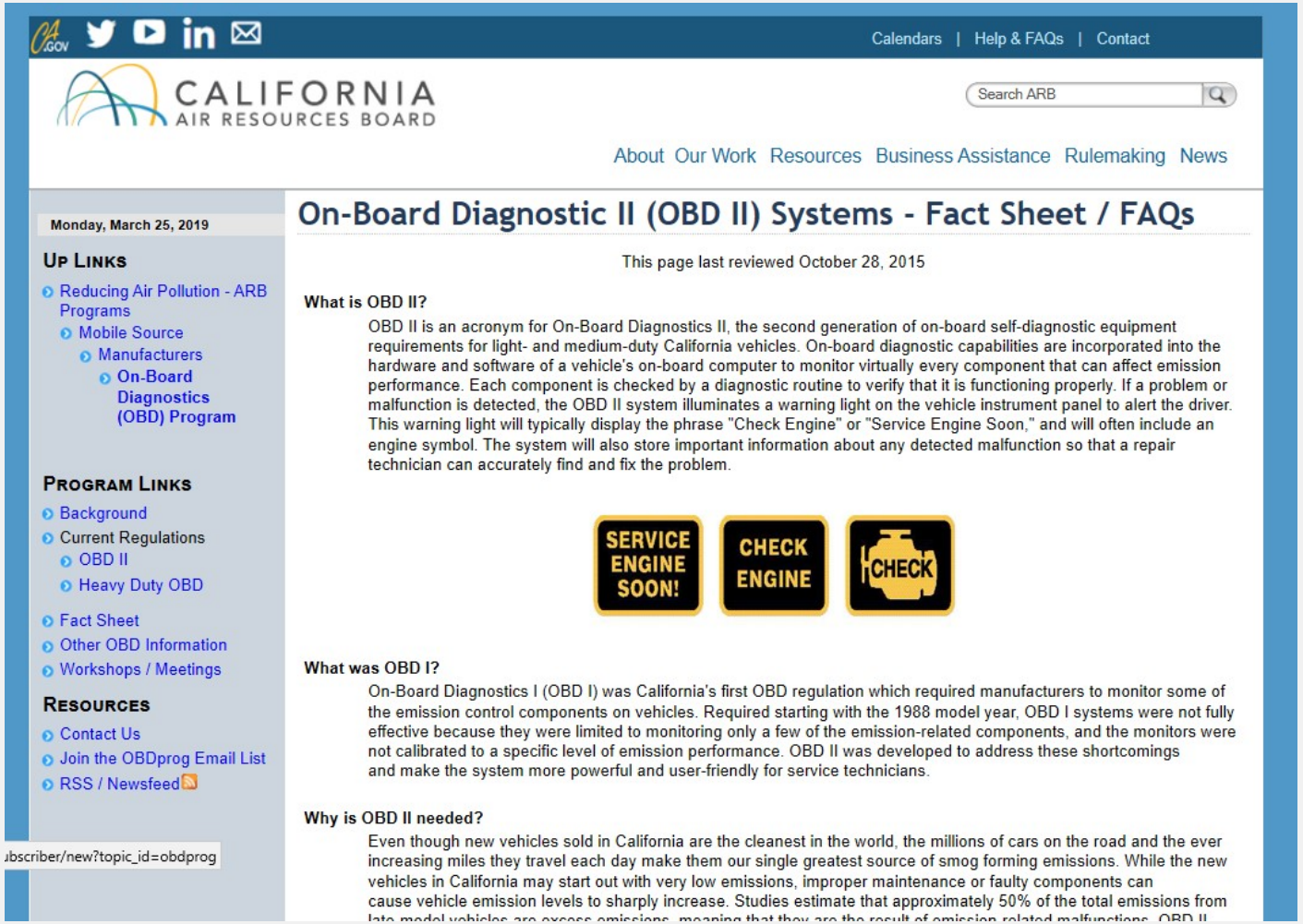
Osnovi dijagnostike vozila

Razvoj OBD-a



Osnovi dijagnostike vozila

Razvoj OBD-a



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On-Board Diagnostic II (OBD II) Systems - Fact Sheet / FAQs

This page last reviewed October 28, 2015

What is OBD II?

OBD II is an acronym for On-Board Diagnostics II, the second generation of on-board self-diagnostic equipment requirements for light- and medium-duty California vehicles. On-board diagnostic capabilities are incorporated into the hardware and software of a vehicle's on-board computer to monitor virtually every component that can affect emission performance. Each component is checked by a diagnostic routine to verify that it is functioning properly. If a problem or malfunction is detected, the OBD II system illuminates a warning light on the vehicle instrument panel to alert the driver. This warning light will typically display the phrase "Check Engine" or "Service Engine Soon," and will often include an engine symbol. The system will also store important information about any detected malfunction so that a repair technician can accurately find and fix the problem.

What was OBD I?

On-Board Diagnostics I (OBD I) was California's first OBD regulation which required manufacturers to monitor some of the emission control components on vehicles. Required starting with the 1988 model year, OBD I systems were not fully effective because they were limited to monitoring only a few of the emission-related components, and the monitors were not calibrated to a specific level of emission performance. OBD II was developed to address these shortcomings and make the system more powerful and user-friendly for service technicians.

Why is OBD II needed?

Even though new vehicles sold in California are the cleanest in the world, the millions of cars on the road and the ever increasing miles they travel each day make them our single greatest source of smog forming emissions. While the new vehicles in California may start out with very low emissions, improper maintenance or faulty components can cause vehicle emission levels to sharply increase. Studies estimate that approximately 50% of the total emissions from

Osnovi dijagnostike vozila

Razvoj OBD-a

- OBD(OBD I): Samodijagnostika sistema upravljanja motorom sa indikatorom na instrument tabli (MIL)
- Detekcija i snimanje kodova grešaka vezanih za neispravnost sistema za prečišćavanje izduvnih gasova (emisije)
- Praćenje rada O2 senzora, EGR ventila, EVAP ventila
- OBD II: Detekcija curenja u EVAP sistemu, detekcija izostanka paljenja, praćenje rada katalitičkog konvertora

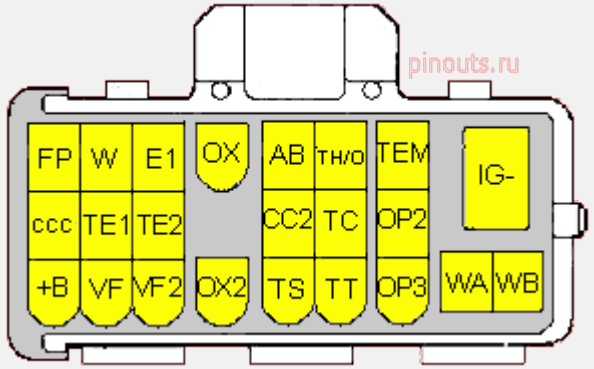
Osnovi dijagnostike vozila

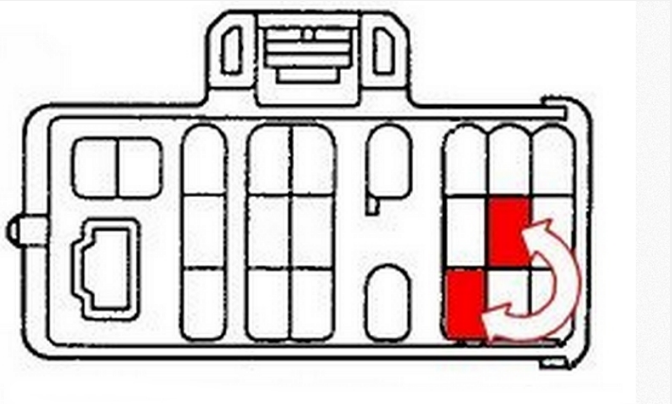
Razvoj OBD-a

- Standard zahteva ne samo detekciju neispravnosti senzora ili ožičenja već i ispitivanje svih uređaja u sistemu za prečišćavanje štetnih gasova
- Osim snimanja kodova grešaka, snimaju se i trenutne vrednosti radnih parametara u vezi sa greškom
- Ispitivanje vozila se vrši po standardizovanom ciklusu
- Naročita pažnja je usmerena na katalitički konvertor i sprečavanje njegovog oštećenja
- Standardizovana utičnica za povezivanje ispitnih uređaja

Osnovi dijagnostike vozila

OBD1 primeri utičnica i očitavanja detektovanih grešaka





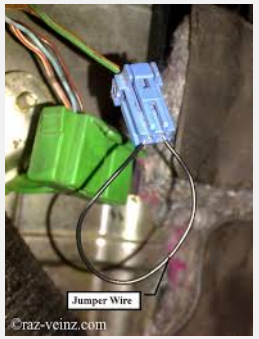
1992 Toyota Camry LE
Fig. 15: Identifying Diagnostic Codes
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Code No.	Blink Pattern	Diagnosis	Trouble Area
(Normal)		• System normal	–
		• Source voltage drop	• Battery • Center airbag sensor assembly
11		• Short in squib circuit or front airbag sensor circuit (to ground)	• Steering wheel pad (squib) • Front airbag sensor • Spiral cable • Center airbag sensor assembly • Wire harness
12		• Short in squib circuit or front airbag sensor circuit (to +B)	• Steering wheel pad (squib) • Front airbag sensor • Spiral cable • Center airbag sensor assembly • Wire harness
13		• Short in squib circuit (between D⁺ wire harness and D⁻ wire harness)	• Steering wheel pad (squib) • Spiral cable • Center airbag sensor assembly • Wire harness

SELF-DIAGNOSIS INDICATOR BLINKS	SYSTEM INDICATED
0	ECU
1	OXYGEN SENSOR (D15B8, D15B7, D16Z1 engine)
3	MANIFOLD ABSOLUTE PRESSURE (MAP SENSOR)
5	
4	CRANK ANGLE (CRANK SENSOR)
6	COOLANT TEMPERATURE (TW SENSOR)
7	THROTTLE ANGLE
8	TDC POSITION (TDC SENSOR)
9	No. 1 CYLINDER POSITION (CYL SENSOR)
10	INTAKE AIR TEMPERATURE (TA SENSOR)
12	EXHAUST GAS RECIRCULATION SYSTEM (EGR)
13	ATMOSPHERIC PRESSURE (PA SENSOR)
14	ELECTRONIC AIR CONTROL (EACV)
15	IGNITION OUTPUT SIGNAL
16	FUEL INJECTOR
17	VEHICLE SPEED SENSOR
19	A/T LOCK-UP CONTROL SOLENOID VALVE A/B
20	ELECTRIC LOAD DETECTOR (ELD)
21	SPOOL SOLENOID VALVE
22	VALVE TIMING OIL PRESSURE SWITCH
41	OXYGEN SENSOR HEATER
43	FUEL SUPPLY SYSTEM (except D15Z1 engine)
48	LAF SENSOR (D15Z1 engine)

Toyota

Honda



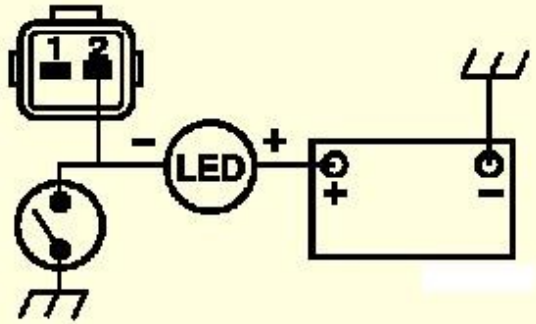
Osnovi dijagnostike vozila

OBD1 primeri utičnica i očitavanja detektovanih grešaka

Diagnostic trouble codes - Engine management

Peugeot 205 1990-96
Engine code: TU3M (KDY/Z)

1



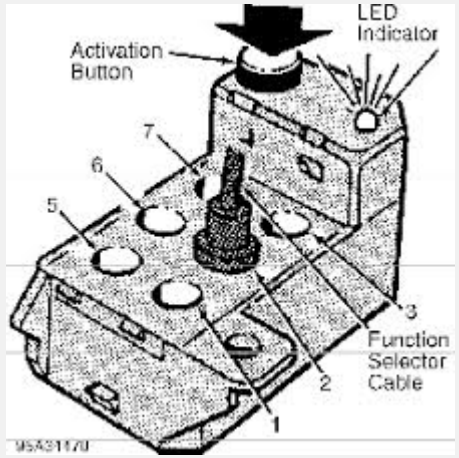
Accessing

- Switch ignition ON.
- Check that MIL illuminates.
- Connect LED test lamp between green data link connector (DLC) terminal 2 and battery positive Fig. 1 .
- Bridge data link connector (DLC) terminal 2 and earth with a switched lead - contacts normally open Fig. 1 .
- Operate switch for 2,5-5 seconds.
- LED or MIL will now flash trouble code 12.
- Each trouble code consists of two groups of one or more flashes
- Long flashes indicate the 'tens' of the trouble code
- Short flashes indicate the 'units' of the trouble code
- A short pause separates each flash
- A long pause separates each trouble code
- For example: Trouble code 12 displayed
- Repeat operation.

Peugeot 205

Osnovi dijagnostike vozila

OBD1 primeri utičnica i očitavanja detektovanih grešaka



Volvo

1993–95 850 Series ABS Diagnostic Trouble Code Chart

DTC	Fault text	Notes
1-1-1	No faults detected by diagnostic system	
1-2-1	LH front wheel sensor, faulty signal at speed less than 40 km/h (25 mph)	Switches ABS warning indicator on Switches TRACS warning indicator on
1-2-2	RH front wheel sensor, faulty signal at speed less than 40 km/h (25 mph)	Switches ABS warning indicator on Switches TRACS warning indicator on
1-2-3	LH rear wheel sensor, faulty signal at speed less than 40 km/h (25 mph)	Switches ABS warning indicator on Switches TRACS warning indicator on
1-2-4	RH rear wheel sensor, faulty signal at speed less than 40 km/h (25 mph)	Switches ABS warning indicator on Switches TRACS warning indicator on
1-4-1	Faulty pedal sensor, shorted to ground or supply	Switches ABS warning indicator on Switches TRACS warning indicator on
1-4-2	Faulty brake light switch, open circuit or short circuit	
1-4-3	Fault in control module	
1-4-4	Brake discs overheated	Cars with TRACS only Switches TRACS warning indicator on
2-1-1	LH front wheel sensor, no signal on moving off	Switches ABS warning indicator on Switches TRACS warning indicator on
2-1-2	RH front wheel sensor, no signal on moving off	Switches ABS warning indicator on Switches TRACS warning indicator on
2-1-3	LH rear wheel sensor, no signal on moving off	Switches ABS warning indicator on Switches TRACS warning indicator on
2-1-4	RH rear wheel sensor, no signal on moving off	Switches ABS warning indicator on Switches TRACS warning indicator on
2-2-1	LH front wheel sensor, no signal from ABS system	Switches ABS warning indicator on Switches TRACS warning indicator on
2-2-2	RH front wheel sensor, no signal from ABS system	Switches ABS warning indicator on Switches TRACS warning indicator on
2-2-3	LH rear wheel sensor, no signal from ABS system	Switches ABS warning indicator on Switches TRACS warning indicator on
2-2-4	RH rear wheel sensor, no signal from ABS system	Switches ABS warning indicator on Switches TRACS warning indicator on
3-1-1	LH front wheel sensor, open circuit or short circuit	Switches ABS warning indicator on Switches TRACS warning indicator on
3-1-2	RH front wheel sensor, open circuit or short circuit	Switches ABS warning indicator on Switches TRACS warning indicator on
3-1-3	LH rear wheel sensor, open circuit or short circuit	Switches ABS warning indicator on Switches TRACS warning indicator on
3-1-4	RH rear wheel sensor, open circuit or short circuit	Switches ABS warning indicator on Switches TRACS warning indicator on

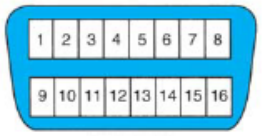
Osnovi dijagnostike vozila

OBD 2

These requirements apply to all 1996 and later model light-duty vehicles. The Clean Air Act of 1990 directed the EPA to develop new regulations for OBD. The primary purpose of OBD II is emission-related, whereas the primary purpose of OBD I (1988) was to detect faults in sensors or sensor circuits. OBD-II regulations require that not only sensors be tested but also all exhaust emission control devices, and that they be verified for proper operation.
All new vehicles must pass the Federal Test Procedure (FTP) for exhaust emissions while being tested for 1874 seconds on dynamometer rollers that simulate the urban drive cycle around downtown Los Angeles.

NOTE: IM 240 is simply a shorter 240-second version of the federal test procedure.

The regulations for OBD-II vehicles state that the vehicle computer must be capable of testing for, and determining, if the exhaust emissions are within 1,5 times the FTP limits. To achieve this goal, the computer must do the following:
1. Test all exhaust emission system components for correct operation.
2. Actively operate the system and measure the results.
3. Continuously monitor all aspects of the engine operation to be certain that the exhaust emissions do not exceed 1,5 times the FTP.
4. Check engine operation for misfire.
5.Turn on MIL if the computer senses a fault in a circuit or system.
6. Record a **freeze-frame**, which is a snapshot of important engine data at the time the DTC was set.
7. Flash the MIL if an engine misfire occurs that could damage catalytic converter.



OBD-II DLC

PIN NO.	ASSIGNMENTS
1.	MANUFACTURER'S DISCRETION
2.	BUS + LINE, SAE J1850
3.	MANUFACTURER'S DISCRETION
4.	CHASSIS GROUND
5.	SIGNAL GROUND
6.	MANUFACTURER'S DISCRETION
7.	K LINE, ISO 9141
8.	MANUFACTURER'S DISCRETION
9.	MANUFACTURER'S DISCRETION
10.	BUS–LINE, SAE J1850
11.	MANUFACTURER'S DISCRETION
12.	MANUFACTURER'S DISCRETION
13.	MANUFACTURER'S DISCRETION
14.	MANUFACTURER'S DISCRETION
15.	L LINE, ISO 9141
16.	VEHICLE BATTERY POSITIVE (4A MAX)

Figure Sixteen-pin OBD-II DLC with terminals identified. Scan tools use the power pin (16) and ground pin (4) for power so that a separate cigarette lighter plug is not necessary on OBD-II vehicles.

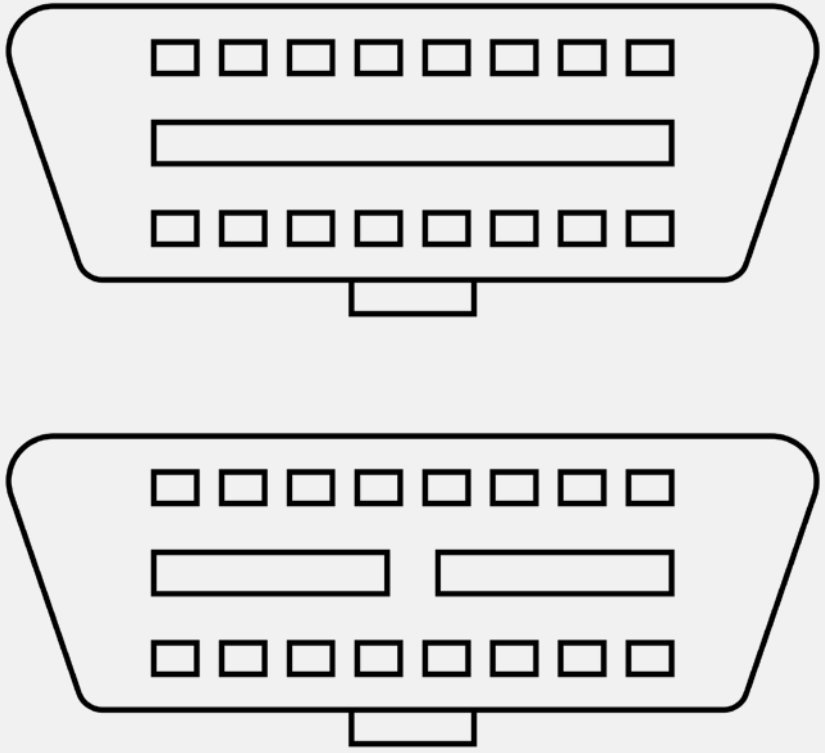
DIAGNOSTIC EXECUTIVE AND TASK MANAGER

On OBD-II Systems, the PCM incorporates a special segment of software. On Ford and GM systems, this software is called the **diagnostic executive**. On Chrysler systems, it is called the **task manager**.
This software program is designed to manage the operation of all OBD-II monitors by controlling the sequence of steps necessary to execute the diagnostic tests and monitors.

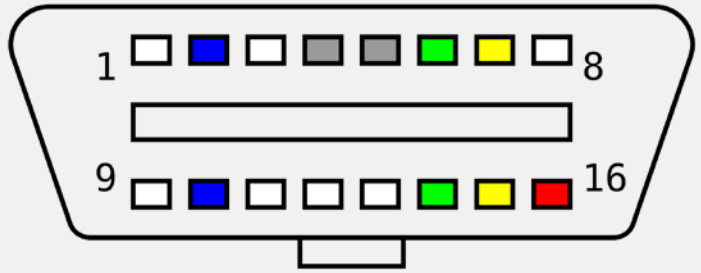
Osnovi dijagnostike vozila

OBD 2 dijagnostički konektor

- SAE J1962 konektor (ekvivalent ISO/DIS 15031-3) po specifikaciji pruža dva moguća hardverska interfejsa, tip A i tip B.
- Obadva tipa konektora su “ženska”, 16pin (2x8pin) u obliku slova D i oba imaju žleb (usek) između gornjeg i donjeg reda pinova, pri čemu tip A ima neprekidan usek, dok tip B ima prekid useka na sredini
- Tip A se koristi za vozila koji koriste napajanje od 12V dok se tip B koristi kod vozila čije je napajanje 24V, pa se na ovaj način onemogućava da se “muški” konektor tipa A ubode u priključak tipa B, dok je obrnuto moguće. (Tip B bi trebalo da bude obeležen plavo sa prednje strane)



Osnovi dijagnostike vozila

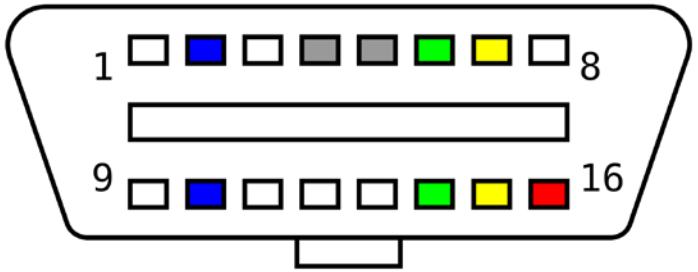


OBD 2 dijagnostički konektor

- Pin16 - Battery voltage:
  - Type "A" 12V/4A
  - Type "B" 24V/2A
- Pin4 - Chassis ground
- Pin5 - Signal ground

Osnovi dijagnostike vozila

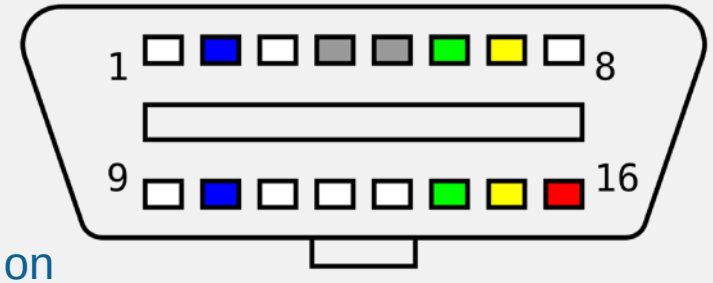
OBD 2 dijagnostički konektor



- Pin7 - K-Line of ISO 9141-2 and ISO 14230-4
- Pin15 - L-Line of ISO 9141-2 and ISO 14230-4
- Pin2 - Bus Positive Line of SAE J1850 PWM and VPW
- Pin10 - Bus Negative Line of SAE J1850 PWM only (not SAE J1850 VPW)
- Pin6 - CAN-High (ISO 15765-4 and SAE J2284)
- Pin14 - CAN-Low (ISO 15765-4 and SAE J2284)

Osnovi dijagnostike vozila

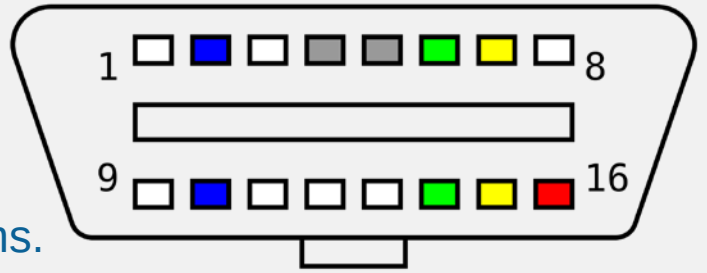
OBD 2 dijagnostički konektor



- Pin1 - Manufacturer discretion:
  - GM: J2411 GMLAN/SWC/Single-Wire CAN
  - VW/Audi/BMW: Switched +12V to tell a scan tool whether the ignition is on
  - Ford, FIAT: Infotainment CAN High
  - DoIP Option #2 Ethernet RX+
- Pin3 - Manufacturer discretion:
  - GM: Object Detection CAN bus (+)
  - Ford: DCL(+) Argentina, Brazil (pre OBD-II) 1997–2000, USA, Europe, etc.
  - Ford: Medium Speed CAN-High
  - Chrysler: CCD Bus(+)
  - BMW: Ethernet RX+
  - DoIP Option #1 Ethernet RX+

Osnovi dijagnostike vozila

OBD 2 dijagnostički konektor

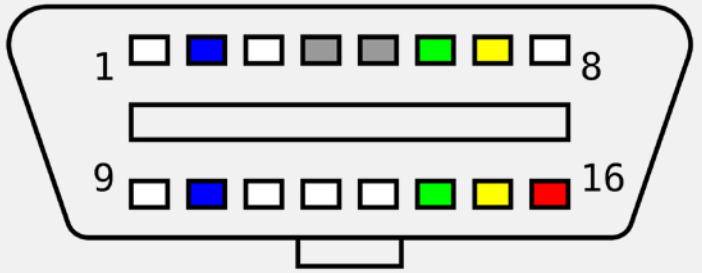


- Pin8 - Manufacturer discretion:
  - BMW: Second K-Line for non OBD-II (Body/Chassis/Infotainment) systems.
  - Ford, FIAT: Infotainment CAN-Low.
  - BMW: Ethernet Enable via 510 Ohm, 0,6 Watt resistance to battery voltage (pin 16)
  - DoIP: Ethernet Activate
  - Subaru: Ignition+
- Pin9 - Manufacturer discretion:
  - BMW: TD (Tachometer Display) signal aka engine RPM signal
  - GM: 8192 bit/s ALDL where fitted
  - DoIP Option #2 Ethernet RX-

Osnovi dijagnostike vozila

OBD 2 dijagnostički konektor

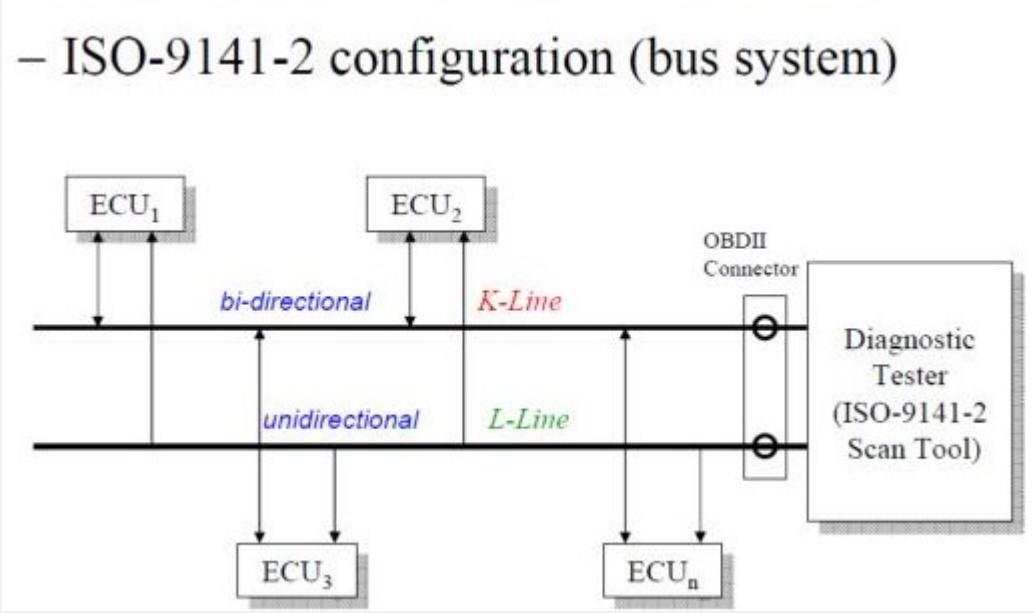
- Pin11 - Manufacturer discretion:
  - GM: Object Detection CAN bus (-)
  - Ford: DCL(-) Argentina, Brazil (pre OBD-II) 1997–2000, USA, Europe, etc.
  - Ford: Medium Speed CAN-Low Chrysler: CCD Bus(-)
  - BMW: Ethernet RX-
  - DoIP Option #1 Ethernet RX-
- Pin12 - Manufacturer discretion:
  - GM: Chassis high-speed CAN bus (+)
  - GM: Diagnostic codes to DIC (1994–2004 Corvette)
  - BMW: Ethernet TX+
  - DoIP Ethernet TX+
- Pin13 - Manufacturer discretion:
  - GM: Chassis high-speed CAN bus (-)
  - Ford: FEPS – Programming PCM voltage
  - BMW: Ethernet TX-
  - DoIP Ethernet TX-



Osnovi dijagnostike vozila

OBD 2 – ISO 9141-2

- Pin7: K- linija je **bidirekciona** za komunikaciju!
- Pin 15: L- linija je **unidirekciona** (samo jedan smer) za "buđenje" EUJ-a
- Koristi UART signaliziranje sa brzinom od 10.4kbaud (baud=simbol/s)
- Maksimalna dužina poruke je 12 bajta (uključujući CRC)
- *High state* je Vbatt (9.60-13.5V)
- *Low state* je 0V (0-2.40V)
- U periodu kada nema signaliziranja *idle signal* je Vbatt



Osnovi dijagnostike vozila

OBD 2

- Kontinualno ispitivanje započinje kada se steknu uslovi i traje do isključenja kontakt brave
- Tri kontinualna “nadzornika”
- **Detaljno (obimno) ispitivanje komponenti**
- **Detekcija izostanka paljenja**
- **Praćenje koncentracije sastava smeše**
- Detaljno ispitivanje komponenti – *comprehensive component monitor* prati rad bitnih komponenti i otkriva neispravnost u njihovom radu ili ožičenju

Osnovi dijagnostike vozila

OBD 2

MONITORS

CONTINUOUS MONITORS As required conditions are met, continuous monitors begin to run. These continuous monitors will run for the remainder of the vehicle drive cycle. The three continuous monitors are as follows:

1. Comprehensive component monitor (CCM).

This monitor watches the sensors and actuators in the OBD-II system. Sensor values are constantly compared with known-good values stored in the PCM`s memory.

The CCM is an internal program in the PCM designed to monitor a failure in any electronic component or circuit (including emission-related and non-emission-related circuits) that provide input or output signals to the PCM. The PCM considers that an input or output signal is inoperative when a failure exists due to an open circuit, out-of-range value, or if an onboard rationality check fails. If an emission-related fault is detected, the PCM will set a code and activate the MIL (requires two consecutive trips).

Many PCM sensors and output devices are tested at key-on or immediately after engine start-up. However, some devices, such as the IAC, are only tested by the CCM after the engine meets certain engine conditions. The number of times the CCM must detect a fault before it will activate the MIL depends upon the manufacturer, but most require two consecutive trips to activate the MIL. The components tested by the CCM include:

-Four-wheel-drive low switch
-Brake switch
-Camshaft (CMP) and crankshaft (CKP) sensors
-Clutch switch (manual transmissions/transaxles only)
-Cruise servo switch
-Engine coolant temperature (ECT) sensor
-EVAP purge sensor or switch

-EVAP purge sensor or switch
-Fuel composition sensor
-Intake air temperature (IAT) sensor
-Knock sensor (KS)
-Manifold absolute pressure (MAP) sensor
-Mass air-flow (MAF) sensor
-Throttle-position (TP) sensor
-Transmission temperature sensor
-Transmission turbine speed sensor
-Vacuum sensor
-Vehicle speed (VS) sensor
-EVAP canister purge and EVAP purge vent solenoid
-Idle air control (IAC) solenoid
-Ignition control system
-Transmission torque converter clutch solenoid
-Transmission shift solenoids

Osnovi dijagnostike vozila

OBD2

- Detekcija izostanka paljenja – *misfire* otkriva izostanak paljenja smeše praćenjem ubrzanja radilice
- Izostanak paljenja tip A – između 200 i 1000 izostanaka, može oštiti konvertor, lampica trepće
- Izostanak paljenja tip B – preko 1000 izostanaka, vozilo ne ispunjava normu, lampica sija, greška je snimljena
- Praćenje korekcija sastava smeše određuje da li su korekcije u granicama i uključuje lampicu ako nisu, greška je snimljena
- Nekontinulani “nadzornici” su oni koji rade ciklički – jednom po ciklusu vožnje ako su svi uslovi ispunjeni

Osnovi dijagnostike vozila

OBD 2

2. Misfire monitor.

This monitor watches for engine misfire. The PCM uses the information received from the crankshaft position sensor (CKP) to calculate time between the edges of the reluctor, as well as the rotational speed and acceleration. By comparing the acceleration of each firing event, the PCM can determine if a cylinder is not firing correctly.

Misfire type A. Upon detection of a misfire type A (200 revolutions), which would cause catalyst damage, the MIL will blink once per second during the actual misfire, and DTC will be stored.

Misfire type B. Upon detection of a misfire type B (1000 revolutions), which will exceed 1,5 times the EPA federal test procedure (FTP) standard or cause vehicle to fail an inspection and maintenance tailpipe emissions test, the MIL will illuminate and a DTC will be stored.

The DTC associated with multiple cylinder misfire for a type A or type B misfire is DTC P0300. The DTCs associated with an individual cylinder misfire for a type A or B misfire are DTCs P0301-P0310.

3. Fuel trim monitor.

The PCM continuously monitors short- and long-term fuel trim. Constantly updated adaptive fuel tables are stored in long-term memory (KAM), and used by the PCM for compensation due to wear and aging of the fuel system components. The MIL will illuminate when the PCM determines the fuel trim values have reached and stayed at their limits.

NONCONTINUOUS MONITORS

Noncontinuous monitors run (at most) once per vehicle drive cycle. The noncontinuous monitors are as follows:

- O2S monitor
- O2S heater monitor
- Catalyst monitor
- EGR monitor
- EVAP monitor
- Secondary AIR monitor
- Transmission monitor
- PCV system monitor
- Thermostat monitor.

Once a noncontinuous monitor has run to completion it will not be run again until the conditions are met during the next vehicle drive cycle. Also after a noncontinuous monitor has run to completion, the readiness status on your scan tool will show "complete" or "done" for that monitor. Monitors that have not run to completion will show up on your scanner as "incomplete".

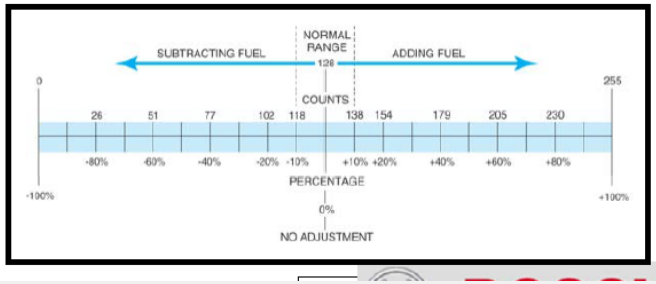


Figure: Both short-term fuel trim and long-term fuel trim use a percentage (%) of adding or subtracting fuel from normal values based on oxygen sensor activity. Many General Motors vehicles display counts instead of percentages. This chart plots both together so that a comparison can be made.

Osnovi dijagnostike vozila

OBD 2

OBD-II MONITOR INFORMATION

COMPREHENSIVE COMPONENT MONITOR

The circuits and components covered by the comprehensive component monitor (CCM) do not include those directly monitored by another monitor.
However, OBD II also requires that inputs from powertrain components to the PCM be tested for rationality, and that outputs to powertrain components from the PCM be tested for functionality. Both inputs and outputs are to be checked electrically. Rationality checks refer to a PCM comparison of input value to values.
Example:
TPS=3 V, MAP=18 in/Hg, RPM=700 rpm, PRNDL=Park
NOTE: Comprehensive component monitors are continuous. Therefore enabling conditions do not apply.
-Monitor runs continuously
-Monitor includes sensors, switches, relays, solenoids, and PCM hardware
-All are checked for opens, shorts-to-ground, and shorts-to-voltage
-Inputs are checked for rationality
-Outputs are checked for functionality
-Most are one-trip DTCs
-Freeze-frame is priority 3
-Three consecutive good trips are used to extinguish the MIL
-Forty warm up cycles are necessary to self erase the DTC and freeze frame.
-Two minutes run time without reoccurrence of the fault constitutes a “good trip”.

CONTINUOUS RUUNING MONITORS
-Monitors run continuously, only stop if they fall
-Fuel system: rich/lean
-Misfire: catalyst damaging/FTP (emissions)
-Two-trip faults (except early generation catalyst damaging misfire)
-MIL, DTC, freeze-frame after two consecutive faults
-Freeze-frame is priority 2 on first trip
-Freeze-frame is priority 4 on maturing (second) trip
-Three consecutive good trips in a similar condition window are used to extinguish the MIL
-Forty warm-up cycles are used to erase DTC and freeze-frame (80 to erase one-trip failure if similar conditions cannot be met).

ONCE PER TRIP MONITORS
-Monitor runs once per trip, pass or fail
-O_2 response, O_2 heaters, EGR, purge flow EVAP leak, secondary air, catalyst
-Two-trip DTCs
-MIL, DTC, freeze-frame after two consecutive faults.
- Freeze-frame is priority 1 on first trip
- Freeze-frame is priority 3 on maturing trip
- Three consecutive good trips are used to extinguish the MIL
-Forty warm-up cycles are used to erase DTC and freeze-frame

EXPONENTIALLY WEIGHTED MOVINH AVERAGE MONITORS (EWMA)= a mathematical method used to determine performance:
- Catalyst monitor; EGR monitor; PCM runs six consecutive failed tests-fails in one trip; Three consecutive failed test on next trip, then falls; Freeze-frame is priority 3; Three consecutive good trips are used to extinguish the MIL; Forty warm-up cycles are used to erase DTC and freeze-frame.

Osnovi dijagnostike vozila

OBD 2

- Upravljač zadacima – *task manager* rukovodi prioritetima izvršenja testovima
- Takođe, određuje da li će se neki test uopšte vršiti u skladu sa ispunjenjem neophodnih uslova: kriterijumi dozvole, kriterijumi zabrane
- *Trip* – jedno “putovanje”, period između uključene i isključene kontakt brave
- Indikator spremnosti – postoje indikatorski bitovi (*flag*) u radnoj memoriji u kojoj se smešta vrednost 1 (ili 0) kada je moguće izvršiti test
- Ciklus zagrevanja je jedno putovanje kod kojeg je motor počeo da radi hladan i dostigao radnu temperaturu

Osnovi dijagnostike vozila

OBD 2

ENABLING CRITERIA

With so many different tests (monitors) to run, the PCM needs an internal director to keep track of when each monitor should run. As mentioned, different manufacturers have different names for this director, such as the diagnostic executive or the task manager. Each monitor has enabling criteria. These criteria are a set of conditions that must be met before the task manager will give the go-ahead for each monitor to run. Most enabling criteria follow simple logic, for example:

- The task manager will not authorize the start of the O2S monitor until the engine has reached operating temperature and the system has entered closed loop.
- The task manager will not authorize the start of the EGR monitor when the engine is at idle, because the EGR is always closed at this time.

There may be a conflict if two monitors were to run at the same time. The results of one monitor might also be tainted if a second monitor were to run simultaneously. In such cases, the task manager decides which monitor has a high priority. Some monitors also depend on the results of other monitors before they can run.

A monitor may be classified as pending if a failed sensor or other system fault is keeping it from running on schedule.

The task manager may suspend a monitor if the conditions are not correct to continue. For example, if the catalyst monitor is running during a road test and the PCM detects a misfire, the catalyst monitor will suspended for the duration of the misfire.

TRIP A trip is defined as a key-on condition that contains the necessary conditions for a particular test to be performed followed by a key-off. These conditions are called the enable criteria. For example, for the EGR test to be performed, the engine must be at normal operating temperature and decelerating for a minimum amount of time. Some tests are performed when the engine is cold, whereas others require that the vehicle be cruising at a steady highway speed.

READINESS INDICATORS Indicators of monitors running or not, are used by most states as an emission test along with a MIL check. Readiness indicators stay in PCM memory until power or ground is interrupted or until DTCs are cleared using a scan tool.

WARM-UP CYCLE Once a MIL is deactivated, the original code will remain in memory until 40 warm-up cycles are completed without the fault reappearing. A warm-up cycle is defined as a trip with an engine temperature increase of at least 40 ^{0}F and where engine temperature reaches at least 160 ^{0}F (71 ^{0}C).

MIL CONDITION: OFF This condition indicates that the PCM has detected any faults in an emissions related component or system, or that the MIL circuit is not working.

MIL CONDITION: ON STEADY This condition indicates a fault in an emissions-related component or system that could affect the vehicle emission levels. The MIL is also turned on at key on, engine off (KOEO) for at least 20 seconds as a bulb check.

Osnovi dijagnostike vozila

OBD 2

- Status indikator lampice može biti: isključena, stalno svetli i treperi
- Lampicu je moguće kod nekih grešaka isključiti, a i obrisati grešku ukidanjem napajanja računaru
- Kod određenog broja kvarova nakon 3 “putovanja” bez ponovne indikacije lampica se sama isključuje (greška ostaje snimljena)
- Tipovi i oznake grešaka su podeljeni po vrsti greške

Osnovi dijagnostike vozila

OBD 2

MIL CONDITION: FLASHING This condition indicates a misfire or fuel control system fault that could damage the catalytic converter.

NOTE: In a misfire condition with the MIL on steady, if the driver reaches a vehicle speed and load condition with the engine misfiring at a level that could cause catalyst damage, the MIL would start flashing. It would continue to flash until engine speed and load conditions caused the level of misfire to subside. Then the MIL would go back to the on-steady condition. This situation might result in a customer complaint of a MIL with an intermittent flashing condition.

MILL: OFF The PCM will turn off the MIL if any of the following actions or conditions occur:
-The codes are cleared with a scan tool.
-Power to the PCM is removed at the battery or with the PCM power fuse for an extended period of time (may be up to several hours or longer).
-A vehicle is driven on three consecutive trips with a warm-up cycle and meets all code set conditions without the PCM detecting any faults.

The PCM will record a failure if a fault is detected that could cause tailpipe emissions to exceed 1,5 times the FTP standard. For one trip failures the MIL is immediately illuminated and a DTC stored. For two trip faults, the MIL is not illuminated nor is the DTC matured until the component has been tested and failed on the next trip. Many failures require that the vehicle be driven under similar RPM, temperature, and load conditions to be given a good trip. Without entering a similar conditions window (SCW) the MIL will remain illuminated.

OBD-II DTC NUMBERING DESIGNATION

A scan tool is required to retrieve DTCs from an OBD-II vehicle. Every OBD-II scan tool will be able to read all generic **Society of Automotive Engineers (SAE)** DTCs from any vehicle. See figure for definitons and explanations of OBD alphanumeric DTCs. The diagnostic trouble codes are grouped into major categories, depending on the location of the fault on the system involved.

Pxxxx codes – powertrain DTCs (engine, transmission -related faults)
Bxxxx codes – body DTCs (accessories, interior-related faults)
Cxxxx codes – chassis DTCs (suspension and steering -related faults)
Uxxxx codes – network DTCs (module communication -related faults)

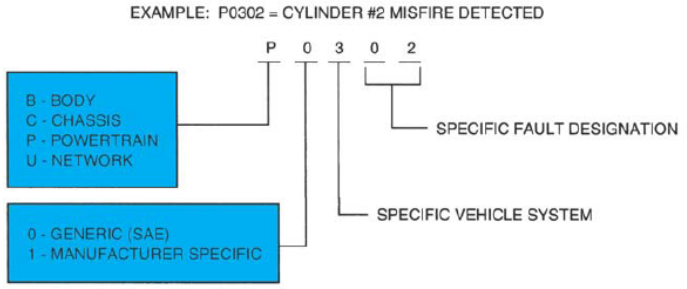


Figure: OBD-II DTC identification format

Osnovi dijagnostike vozila

OBD 2

- Greške mogu biti tipa A, B, C i D
- **Tip A:** greške vezane za emisiju i aktiviraju se nakon samo jednog putovanja – izostanak paljenja, prebogata ili presiromašna smeša
- **Tip B:** greške koje se odnose na neko od kontinualnih ispitivanja u vezi sa emisijom, ako se greška javi na dva uzastopna putovanja
- **Tip C i D:** greške koje nemaju veze sa emisijom
- Tekuće – *pending* greške su one koje su se javile, ali nisu se ispoljile dovoljan broj puta da greška bude snimljena u memoriju. Ponekad je moguće očitati i ovakve greške.

Osnovi dijagnostike vozila

OBD 2

DTC NUMBERING EXPLANATION The number in the hundredth position indicates the specific vehicle system or subgroup that failed. This position should be consistent for P0xxx and P1xxx type codes. The following numbers and systems were established by SAE:

- **P0100 – Air metering and fuel system fault**
- **P0200 – Fuel system (fuel injector only) fault**
- **P0300 – Ignition system or misfire fault**
- **P0400 – Emission control system fault**
- **P0500 – Idle speed control, vehicle speed (VS) sensor fault**
- **P0600 – Computer output circuit (relay, solenoid, etc.) fault**
- **P0700 – Transaxle, transmission faults**

NOTE: The number of the last two digits indicate the specific fault within the vehicle system.

TYPES OF DTCS Not all OBD-II DTCs are of the same importance for exhaust emissions. Each type of DTC has different requirements for it to set, and the computer will only turn on the MIL for emissions-related DTCs.

TYPE A CODES. A type A DTC is emission-related and will cause the MIL to be turned on the ***first trip*** if the computer has detected a problem. Engine misfire or a very rich or lean air-fuel ratio, for example, would cause a type A DTC. These codes alert the driver to an emission problem that may cause damage to the catalytic converter.

TYPE B CODES. A type B code will be stored and the MIL will be turned on during the ***second consecutive trip***, alerting the driver to the fact that a diagnostic test was performed and failed.

TYPE C AND CODES. Type C and D codes are for use with non-emission-related diagnostic tests; they will cause the lighting of a "service" lamp if the vehicle is so equipped). Type C codes are also called type C1 codes and D codes are also called type C0 codes.

FREQUENTLY ASKED QUESTION
What Are Pending Codes?

Pending codes are set when operating conditions are met and the component or circuit is not within the normal range, yet the conditions have not yet been met to set a DTC. For example, a sensor may require two consecutive faults before a DTC is set. If a scan tool displays a pending code or a failure a driveability concern could also be present. The pending code help the technician to determine the root cause before the customer complains of a check engine light indication.

Osnovi dijagnostike vozila

OBD 2

- Greške se dele i po prioritetu
- Ako je memorija grešaka puna, greške višeg prioriteta će prebrisati grešku manjem prioriteta
- Greška višeg prioriteta upisuje svoj *freeze frame* preko greške nižeg prioriteta
- Serviser ne sme da obriše grešku ako nije otklonjen uzrok, a preporučuje se da dopusti da računar sam obriše grešku
- Brisanje grešaka od strane računara se dešava nakon 40 ciklusa zagrevanja za upisane i 80 ciklusa zagrevanja za tekuće greške.

Osnovi dijagnostike vozila

OBD 2

DIAGNOSTIC TROUBLE CODE PRIORITY

CARB has also mandated that all diagnostic trouble (DTCs) be stored according to individual priority. DTCs with higher priority overwrite those with a lower priority. The OBD-II System DTC Priority is listed below:

- **Priority 0 – Non-emission-related codes**
- **Priority 1 – One-trip failure of two-trip fault for non-fuel, non-misfire codes**
- **Priority 2 – One-trip failure of two-trip fault for fuel or misfire codes**
- **Priority 3 – Two-trip failure or matured fault of non-fuel, non misfire codes**
- **Priority 4 – Two-trip failure or matured fault for fuel or misfire codes**

OBD-II FREEZE-FRAME To assist the service technician, OBD II requires the computer to take a "snapshot" or freeze-frame of all data at the instant an emission-related DTC is set. A scan tool is required to retrieve this data.

NOTE: Although OBD II requires that just one freeze-frame of data be stored, the instant an emission-related DTC is set, vehicle manufacturers usually provide expanded data about the DTC beyond that required such as General Motors failure recorders. However, retrieving this enhanced data usually requires the use of vehicle-specific scan tool.

Freeze-frame items include:

- **Calculated load value**
- **Engine speed**
- **Short-term and long-term fuel trim percent**
- **Fuel system pressure (on some vehicles)**
- **Vehicle speed**
- **Engine coolant temperature**
- **Intake manifold pressure**
- **Closed/open-loop status**
- **Fault code that triggered the freeze-frame**
- **If a misfire code is set, identify which cylinder is misfiring.**

A DTC should not be cleared from the vehicle computer memory unless the fault has been corrected and the technician is so directed by the diagnostic procedure. If the problem that caused the DTC to be set has been corrected, the ***computer will automatically clear the DTC after 40 consecutive warm-up cycles with no further faults detected***. It requires 80 warm-up cycles to erase the **pending fault** if similar conditions window cannot be met. The codes can also be erased by using a scan tool or by disconnecting the battery or PCM in most cases.

NOTE: Disconnecting the battery may not erase OBD II DTCs or freeze-frame data. Most vehicle manufacturers recommend using a scan tool to erase DTCs rather than disconnecting the battery, because the memory for the radio, seats and learned engine operating parameters is lost if the battery is disconnected.

Osnovi dijagnostike vozila

OBD 2

- Kriterijumi dozvole predstavljaju određeni set vrednosti radnih parametara za koje je moguće izvršiti određeno ispitivanje – npr. određen broj obrtaja motora, temperatura, pritisak u usisnom vodu, položaj pedale i klapne gasa itd.
- Kriterijumi zabrane predstavljaju uslove pod kojima nije moguće vršiti određeni test – npr. kada je neispravna lambda sonda posle konvertora nije moguće ispitati njegovu ispravnost
- Zabrana ispitivanja je moguća i kada je u toku neko drugo ispitivanje, pri čemu bi efekti ispitivanja ometali jedno drugo
- Može se desiti da uključenje greške u vezi sa neuspelim ispitivanjem pokrene i sačeka rezultate nekog drugog ispitivanja da ne bi došlo do lažne greške

Osnovi dijagnostike vozila

OBD 2

ENABLING CONDITIONS OR CRITERIA

These are the exact engine operating conditions required for a diagnostic monitor to run.
Example: Specific RPM, ECT, MAP, run times, VSS, etc.

PENDING Under some situations the PCM will not run a monitor if the MIL is illuminated and a fault is stored from another monitor. In these situations, the PCM postpones monitors pending a resolution of the original fault. The PCM does not run the test until the problem is remedied.
For example, when the MIL is illuminated for an oxygen sensor fault, the PCM does not run the catalyst monitor until the oxygen sensor fault is remedied. Since the catalyst monitor is based on signals from the oxygen sensor, running the test would produce inaccurate results.

CONFLICT There are also situations when the PCM does not run a monitor if another monitor is in progress. In these situations, the effects of another monitor running could result in an erroneous failure. If this conflict is present, the monitor is not run until the conflicting condition passes. Most likely, the monitor will run later after the conflicting monitor has passed.
For example, if the fuel system monitor is in progress, the PCM does not run the EGR monitor. Since both tests monitor changes in air-fuel ratio and adaptive fuel compensation, the monitors conflict with each other.

SUSPEND Occasionally, the PCM may not allow a two-trip fault to mature. The PCM will suspend the maturing fault if a condition exists that may induce erroneous failure. This prevents illuminating the MIL for the wrong fault and allows more precise diagnosis.
For example, if the PCM is storing a one-trip fault for the oxygen sensor and the EGR monitor, the PCM may still run the EGR monitor but will suspend the results until the oxygen sensor monitor either passes or fails. At that point, the PCM can determine if the EGR system is actually failing or if an oxygen sensor is failing

RATIONALITY TEST While input signals to the PCM are constantly being monitored for electrical opens and shorts, they are also tested for rationality. This means hat the input signal is compared against other inputs and information to see if it makes sense under the current conditions.
PCM sensor inputs that are checked for rationality include:

- **MAP sensor**
- **O_2 sensor**
- **ECT**
- **Camshaft position sensor (CMP)**
- **VS sensor**
- **Crankshaft position sensor (CKP)**
- **IAT sensor**
- **TP sensor**
- **Ambient air temperature sensor**
- **Power steering switch**
- **O_2 sensor heater**
- **Engine controller**
- **Brake switch**
- **P/N switch**
- **Transmission controls**

Monitors Have to Run to Set a DTC
Sometimes a vehicle will be running terrible yet there are no stored DTCs. Always check to see that all of the monitors have run. If not, check service information for the enable criteria needed to allow the monitors to run. ***For example, if a thermostat is defective, the engine temperature may never get high enough for a monitor to run. Once the monitor has run, then one or more diagnostic trouble codes may be set making diagnosis easier.***

Osnovi dijagnostike vozila

OBD 2

- Prilikom ispitivanja senzora i aktuatora motorni računar proverava njihove električne spojeve različitim metodama
- Ispituje se da li je došlo do prekida u instalaciji ili kratkog spoja
- Osim detekcije otvorene veze i kratkog spoja, proverava se da li su vrednosti u opsegu očekivanih
- Kod spregnutih senzora i aktuatora vrši se ispitivanje funkcionalnosti, odnosno da li određeno upravljanje izaziva adekvatan efekat

Osnovi dijagnostike vozila

OBD 2

FUNCTIONALITY TEST A functionality rest refers to PCM inputs checking the operation of the outputs.

Example:

PCM commands the IAC open, expected charge in engine

RPM is not seen

IAC 60 counts (example of commanded position)

RPM 700 RPM (example of the desired engine speed)

PCM outputs that are checked for functionality include:

-EVAP canister purge solenoid
-EVAP purge vent solenoid
-Cooling fan
-Idle air control solenoid
-Ignition control system
-Transmission torque converter clutch solenoid
-Transmission shift solenoids (A,B,1-2, etc.)

ELECTRICAL TEST Refers to the PCM check of both inputs and outputs for the following:

-Open
-Shorts
-Ground

Example:

ECT

Shorted high (input to PCM) above capable voltage, i.e., 5V sensor with 12V input to PCM would indicate a short to voltage or a short high.

PCM Determination of Faults Chart

Monitor Name	Monitor Type (How Often It Completes)	Number of Faults on Separate Trips to Set a Pending DTC	Number of Separate Consecutive Trips to Light MIL, Store a DTC	Number of Trips with No Faults to Erase a pending DTC	Number of Trips with No Fault to Turn the MIL Off	Number of Warm-Up Cycles to Erase DTC after MIL Is Turned Off
CCM	Continuous (when trip conditions allow it)	1	2	-	3–Trips	40
Catalyst	Once per drive cycle	1	3	-	3–Trips	40
Misfire Type A	Continuous		1		3–Similar conditions	40
Misfire Type B	Continuous	1	2	-	3–Similar conditions	40
Fuel System	Continuous	1	2	-	3–Similar conditions	40
Oxygen Sensor	Once per trip	1	2	-	3–Trips	40
EGR	Once per trip	1	2	-	3–Trips	40
EVAP	Once per trip	1	1	-	3–Trips	40
AIR	Once per trip	1	2	-	3–Trips	40

	Monitor Type	Conditions to Set DTC and Illuminate MIL	Extinguish MIL	Clear DTC Criteria	Applicable DTC
Comprehensive Monitor	Continuous 1-trip monitor	Input and output failure—rationally, functionally, electrically	3 consecutive pass trips	40 warm-up cycles	P0123

Osnovi dijagnostike vozila

OBD 2

- OBD 2 standard podrazumeva tehničke procedure u nekoliko modova
  - Mod 1 – Očitavanje radnih parametara
  - Mod 2 – freeze frame podaci
  - Mod 3 – Očitavanje memorije grešaka
  - Mod 4 – Brisanje memorije grešaka, freeze time podataka i rezultata nekontinualnih ispitivanja
  - Mod 5 – Ispitivanje lambda sondi
  - Mod 6 – Rezultati nekontinualnih ispitivanja
  - Mod 7 – Rezultati kontinualnih ispitivanja
  - Mod 8 – Test aktuatora (bidirekcioni)
  - Mod 9 – Identifikacija računara (modula)

Osnovi dijagnostike vozila

OBD 2

GLOBAL OBD II AND MODE $06

Global OBD II, also called **generic OBD II**, is the a standardized format of on-board diagnostic, following SAE standard J1962. Global OBD II was designed for engineers: when OBD II was first introduced it was not intended to be used by service technicians.

PURPOSES AND FUNCTIONS The purposes and functions Global OBD include:

1. It can check the powertrain control module (PCM) to determine what it das detected about a failure.

2. It can be used by service technicians to verify a repair.

3. It can check the test results performed by the PCM to see if the results are close to a failure level. This information will show what is a fault, even though no diagnostic trouble codes are set.

4. Since the data displayed is very technical, it often needs to be converted to give the service technician usable information.

5. An estimated 80 % of the PCM DTCs can be diagnosed using the global OBD function of the scan tool.

6. At global OBD II functions are standardized, which is not the case when looking at original equipment manufacturer (OEM) data.

7. Some DTCs may be displayed using the global OBD II function of the scan tool that is not displayed on an OEM, or by using the enhanced mode OBD II function of the scan tool.

GLOBAL OBD II MODES

All OBD II vehicles must be able to display data on a global (generic) scan tool under nine different modes of operation. These modes include:

MODE ONE. Current powertrain data (parameter identification display or PID)

MODE TWO. Freeze-frame data

MODE THREE. Diagnostic trouble codes

MODE FOUR. Clear and reset DTCs, freeze-frame data, an readiness status monitors for noncontinuous monitors only

MODE FIVE. Oxygen sensor monitor test results.

MODE SIX. Onboard monitoring of test results for noncontinuous monitored systems.

MODE SEVEN. Onboard monitoring of test results for continuously monitored systems

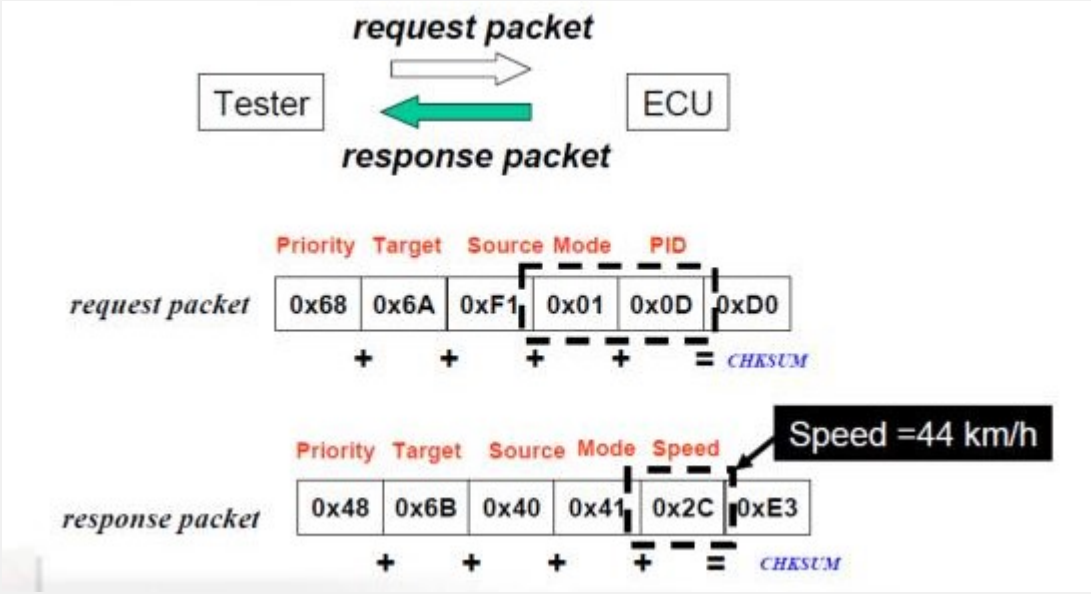
MODE EIGHT. Bidirectional control of onboard systems

MODE NINE. Module identification

Osnovi dijagnostike vozila

OBD 2

- Zbog jednostavnosti rada motornog računara i smanjenja njegovog opterećenja, kao i smanjenja zauzeća memorije identifikatori u OBD standardu su dati kao heksadecimalne, a ne decimalne vrednosti.
- OBD standard i sistem za samodijagnostiku se po pravilu razlikuje od fabričkog i pristupa mu se kroz odvojene procedure i sa standardizovanim komunikacionim protokolom
- Mod 6 je izuzetna ispomoć za servisere, nažalost EOBD standard ne zahteva podršku od strane poizvođača, pa je na našem tržištu ovaj mod neupotrebljiv
- Međutim, principi testiranja koji se koriste u ovom modu su dobre dijagnostičke procedure i mogu se samostalno primeniti



Osnovi dijagnostike vozila

OBD 2

READING MODE $06 DATA Some scan tools translate the raw hexadecimal data into English, such as **Auto Enginuity** scan tool software, which is used with a PC. However, the data is difficult to read. In addition, data from Ford vehicles needs to be multiplied by a conversion factor to achieve a usable valve.

SELECT MONITOR The first step is to select the monitor (fuel trim, misfire, catalyst, etc.). There could be three results:

-**Incomplete**. This means that the computer has not yet completed the test for the selected monitor.

-**Pass**. This means that the monitor was tested to completion and that the test passed. This pass could have been close to failing; looking at the test results will indicate how close it cam to failing.

-**Fall**. The monitor test failed. Checking the test results will help the service technician determine why it failed and by how much, which will help in diagnosing the root cause.

DATA DISPLAY. The test data displayed often includes upper limit and/or lower limit (often not both), test results and units. The "unit" may be just a number. However, by looking at the upper and lower limits, the technician can judge how close the test results were to failing the test. Many scan tools display component and test information in plain English while others just display the hexadecimal number. If just the hexadecimal number is shown, it has to be translated into English to show which component or test is being displayed. Check service information for the exact translation or refer to the following charts for a typical example.

Chart 1

$03	Fuel System 1
$03	Fuel System 2
$04	Calculated Load Percentage
$05	Engine Coolant Temp Sensor (Celsius)
$06	Short-Term Fuel Trim Bank 1 (%)
$07	Long-Term Fuel Trim Bank 1 (%)
$08	Short-Term Fuel Trim Bank 2 (%)
$09	Long-Term Fuel Trim Bank 2 (%)
$0A	Fuel Pressure Gauge (KPA)
$0B	Intake MAP (KPA)
$0C	Engine Speed (1/min)
$0D	Vehicle Speed (km/h)
$0E	Ignition Timing Advance (degrees)
$0F	Intake Air Temperature (Celsius)
$10	Air Flow Rate (g/s)
$11	Absolute Throttle Position (%)

$12	Commanded Secondary AIR Status
$13	O2S Bank 1-Sensor 1
$13	O2S Bank 1-Sensor 2
$13	O2S Bank 1-Sensor 3
$13	O2S Bank 1-Sensor 4
$13	O2S Bank 2-Sensor 1
$13	O2S Bank 2-Sensor 2
$13	O2S Bank 2-Sensor 3
$13	O2S Bank 2-Sensor 4
$14	O2S Voltage Bank 1-Sensor 1 (V)
$14	Short-Term Fuel Trim Bank 1-Sensor 1 (%)
$15	O2S Voltage Bank 1-Sensor 2 (V)
$15	Short-Term Fuel Trim Bank 1-Sensor 2 (%)
$16	O2S Voltage Bank 1-Sensor 3 (V)
$16	Short-Term Fuel Trim Bank 1-Sensor 3 (%)
$17	O2S Voltage Bank 1-Sensor 4 (V)
$17	Short-Term Fuel Trim Bank 1-Sensor 4 (%)
$18	O2S Voltage Bank 2-Sensor 1 (V)
$18	O2S Voltage Bank 3-Sensor 1 (V)
$18	Short-Term Fuel Trim Bank 2-Sensor 1 (%)
$18	Short-Term Fuel Trim Bank 3-Sensor 1 (%)
$19	O2S Voltage Bank 2-Sensor 2 (V)
$19	O2S Voltage Bank 3-Sensor 2 (V)
$19	Short-Term Fuel Trim Bank 2-Sensor 2 (%)
$19	Short-Term Fuel Trim Bank 3-Sensor 2 (%)
$1A	O2S Voltage Bank 2-Sensor 3 (V)
$1A	O2S Voltage Bank 4-Sensor 1 (V)
$1A	Short-Term Fuel Trim Bank 2-Sensor 3 (%)
$1A	Short-Term Fuel Trim Bank 4-Sensor 1 (%)
$1B	O2S Voltage Bank 2-Sensor 4 (V)
$1B	O2S Voltage Bank 4-Sensor 2 (V)

$1B	Short-Term Fuel Trim Bank 2-Sensor 4 (%)
$1B	Short-Term Fuel Trim Bank 4-Sensor 2 (%)
$1C	OBD Requirements
$1D	O2S Bank 1-Sensor 1
$1D	O2S Bank 1-Sensor 2
$1D	O2S Bank 2-Sensor 1
$1D	O2S Bank 2-Sensor 2
$1D	O2S Bank 3-Sensor 1
$1D	O2S Bank 3-Sensor 2
$1D	O2S Bank 4-Sensor 1
$1D	O2S Bank 4-Sensor 2
$1E	Power Take Off Status
$1F	Time Since Engine Start(s)
$21	Distance While MIL Active (km/miles)
$22	Relative Fuel Pressure (kPa)
$23	Fuel Pressure Gauge (kPa)
$24	Equivalence Ratio Bank 1-Sensor 1 (:1)
$25	Equivalence Ratio Bank 1-Sensor 2 (:1)
$26	Equivalence Ratio Bank 1-Sensor 3 (:1)
$27	Equivalence Ratio Bank 1-Sensor 4 (:1)
$28	Equivalence Ratio Bank 2-Sensor 1 (:1)
$28	Equivalence Ratio Bank 3-Sensor 1 (:1)
$29	Equivalence Ratio Bank 2-Sensor 2 (:1)
$29	Equivalence Ratio Bank 3-Sensor 2 (:1)
$2A	Equivalence Ratio Bank 2-Sensor 3 (:1)

Osnovi dijagnostike vozila

OBD 2

Chart 2

Test ID	Numbers (oxygen sensor)
$01	Rich to Lean Sensor Threshold
$02	Lean to Rich Sensor Threshold
$03	Low Sensor Voltage for Switch Time Calculation
$04	High Sensor Voltage for Switch Time Calculation
$05	Rich to Lean Sensor Switch Time
$06	Lean to Rich Sensor Switch Time
$07	Minimum Sensor Voltage for Test Cycle
$08	Maximum Sensor Voltage for Test Cycle
$09	Time Between Sensor Transitions
$0A	Sensor Period
$2A	Equivalence Ratio Bank 3-Sensor 3 (:1)
$2B	Equivalence Ratio Bank 2-Sensor 4 (:1)
$2B	Equivalence Ratio Bank 3-Sensor 4 (:1)
$2C	Commanded EGR (%)
$2D	EGR Error (%)
$2E	Commanded Evaporative Purge (%)
$2F	Fuel Level Input (%)
$30	Number of Warm-Ups Since DTCs Cleared
$31	Distance Since DTCs Cleared
$32	EVAP System Vapor Pressure (Pa)
$33	Barometric Pressure (kPa)
$34	O2S Current Bank 1-Sensor 1 (ma)
$35	O2S Current Bank 1-Sensor 2 (ma)
$36	O2S Current Bank 1-Sensor 3 (ma)
$37	O2S Current Bank 1-Sensor 4 (ma)
$38	O2S Current Bank 2-Sensor 1 (ma)
$38	O2S Current Bank 3-Sensor 1 (ma)
$39	O2S Current Bank 2-Sensor 2 (ma)
$39	O2S Current Bank 3-Sensor 2 (ma)
$3A	O2S Current Bank 2-Sensor 3 (ma)
$3A	O2S Current Bank 3-Sensor 3 (ma)
$3B	O2S Current Bank 2-Sensor 4 (ma)
$3B	O2S Current Bank 3-Sensor 4 (ma)
$3C	Catalyst Temperature Bank 1-Sensor 1°C
$3D	Catalyst Temperature Bank 2-Sensor 1°C
$3E	Catalyst Temperature Bank 1-Sensor 2°C
$3F	Catalyst Temperature Bank 2-Sensor 2°C
$42	Control Module Voltage
$43	Absolute Load Value (%)
$44	Commanded Equivalence Ratio
$45	Relative Throttle Position (%)
$46	Ambient Air Temperature °C
$47	Absolute Throttle Position B (%)
$48	Absolute Throttle Position C (%)
$49	Accelerator Pedal Position D (%)
$4A	Accelerator Pedal Position E (%)
$4B	Accelerator Pedal Position F (%)
$4C	Commanded Throttle ACT. Control (%)
$4D	Engine Run Time with MIL Active (min.)
$4E	Time Since DTCs Cleared (min.)

OXYGEN SENSOR HEATER MODE $06 TEST (GENERAL MOTORS)

This fault can set a P0141 DTC for bank1, sensor 1 (B1S1). Checking service information indicates the following enable criteria for the code to set:

1. Cold engine start
2. Engine at idle speed
3. Engine operating temperature below 66 ^{0}C

The following monitors are suspend:

1. EVAP
2. Oxygen sensor performance
3. Catalyst

Mode $06 data for B1S1 heater circuit in TID-06, CID-41:

1. The maximum limit -186
2. Measure value = 33
3. Minimum limit = -----
4. Result = passed

Note that the technician cannot determine what is being measured nor what the number 186 indicates. Also note that there is no minimum limit and the measured value of 33 is far below the maximum limit of 186. ***This means that the oxygen sensor heater test easily passed.***

OXYGEN SENSOR HEATER MODE $06 TEST (GENERAL MOTORS)

A misfire fault can set a random misfire DTC of P0300 or one or more individual misfire DTCS P0301 for cylinders one through 10. The enable criteria for these codes to set include:

1. Time since engine start 5 seconds
2. Engine coolant temperature (-7 to 121 ^{0}C)
3. RPM range from idle to redline or fuel cutoff.
4. Fuel level 15 % minimum

Test ID is used to identify several related tests including:
$50 – Total engine misfire (updated every 1000 revolutions)
$53 – Cylinder specific misfire
For example, a Ford being checked using mode $06 for TID-50 had the following results:
Maximum limit = 1.180
Measured value = 0
Minimum value = ----
Result = passed
What is the percentage of misfire allowed? The value shown for maximum has to be converted to get the actual percentage. According to service information to get the actual percentage of misfire the value gas to be multiplied by 0,000015. Therefore, the raw value for maximum misfire was 1180 x 0,000015 = 1,75 %. In other words, the maximum allowable misfire before a DTC is set is 1,7 %. By looking at mode $06 data, the technician can determine how close the engine is to failing the misfire monitor.
For individual cylinder misfires, check test ID $53. For example, if a value of 17.482 is displayed, the test failed. Multiplying the test results I(17.482) by conversion factor (0,000015)shows a misfire of 26 %.
Type A misfire codes are those that can cause damage to the catalytic converter. The misfire usually ranges from 40% at idle to about 4% at high engine speeds.
Type B misfire codes are set if the misfire exceeds 2% to 4%, depending on the engine, make, model and year.

Osnovi dijagnostike vozila

OBD 2

FORD OXYGEN SENSOR MODE $06 TEST

Ford and other companies have many tests performed on the oxygen sensor, including voltage amplitude. For example Ford TID $01, CID $21 for HO2S1 shows:
Minimum value = 512
Maximum value = N/A
Current value = 794
According to Ford service information, the numbers have to be converted into volts by multiplying the value 0,00098. Therefore, the current value is 0,778V, which is above the minimum allowable voltage of 0,50 (512 x 0,00098 =0,50).

GENERAL MOTORS CAN OXYGEN SENSOR MODE $06 TEST

One of the oxygen sensor test performed on a GM vehicle with CAN (GMCAN) is the rich-to-lean sensor switch time. Typical test results show:
Monitor ID (MID) $01
Test ID $05
Maximum limit = 0,155 sec
Measured value = 0,030 sec
Minimum value = 0,000 sec
Result = passed
This mode $06 test clearly shows that the oxygen sensor is able to reset very quickly to a change in air-fuel mixture ***from rich to lean by reacting in 30ms***. Normally this information can ***only be determined by a service technician using a scope*** of the waveform who forces the system lean and watches the reaction time on the scope display. ***Using mode $06 and a scan tool, especially on vehicles equipped with CAN, is a fast and easy way to determine oxygen sensor health without having to do time-consuming tests.***

FORD EGR TEST

Ford check many functions of the exhaust gas recirculation (EGR) system, including flow testing and tests of the sensor used to check the flow of exhaust gases. The duty cycle of the EGR solenoid can be checked using mode $06 by looking at the following:
TID $4B
CID $30
Maximum limit = 26214
Measured value = 14358
Minimum value = -------
Test results = passed
These results at the limits, like many other Ford mode $06, must be converted to give usable values. Multiply the measured set limit value by 0.0000305 to get the duty cycle as a percentage (%).
Maximum limit = 26214 x 0,0000305=80 %
Measured value = 14.358 x 0,0000305=43%

FORD DELTA PRESSURE FOR EGR FLOW TEST In this test, the following occurred on a test vehicle:
TID 4A
CID 30
Maximum limit =
Measured value = 2.226
Minimum limit = 768
Result passed
The values shown need to be compared and corrected as follows:
-If the value is greater than 32.767, the value is negative.
-If the value is less than 32.767, the value is positive.
-Multiply the value by 0,0078 to get inches of water.
The value was 2.226 x 0,0078=17,7 inches of water of vacuum (negative pressure)

GENERAL MOTORS CATALYST EFFICIENCY TEST

The scan tool displays data that does not need to be converted, although the units are often unknown. The service technician can, however, see how close the results come to either the maximum or the minimum limits. For example, a GM idle catalyst efficiency test could have the results following:
TIC 0C; CID 60
Maximum limit = 33.234
Measured value =17.708
Minimum limit = -----
Result = passed
What do the numbers represent? The numbers are created as a result of the test and cannot be determined by the technician. However, it is clear by the reading and the maximum limit that the catalyst efficiency test easily passed. This is an excellent test to check if the efficiency of the catalytic converter needs to be determined.

Mode $06 Replaces Scope
Mode $06 data, especially when used on CAN-equipped vehicles, reduces the need to use an oscilloscope to view oxygen sensor reaction time in ms. In the past, the only way to test an oxygen sensor for reaction time was to force the sensor lean or rich while viewing the reaction on a scope. Then, the reaction time could be determined using the cursors. Mode $06 data now includes oxygen sensor reaction time so that all that is needed to determine oxygen sensor condition is a scan tool and mode $06 data.

Hvala na pažnji!