Haynes shows you how

BMW 3-Series and Z4 (99-05) Includes 2006 325ci/330ci Coupe and Convertible models Haynes Online Manual.

2 On Board Diagnostic (OBD) system and trouble codes

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Caution:
This video is for familiarization purposes only. Read below for specific information on your vehicle.

Scan tool information

1 Hand-held scanners are the most powerful and versatile tools for analyzing engine management systems used on later model vehicles **(see illustration)** . Early model scanners handle codes and some diagnostics for many systems. Each brand scan tool must be examined carefully to match the year, make and model of the vehicle you are working on. Often, interchangeable cartridges are available to access the particular manufacturer (Chrysler, Ford, GM, Honda, Toyota etc.). Some manufacturers will specify by continent (Asia, Europe, USA, etc.). **Note:** *An aftermarket generic scanner should work with any model covered by this manual. Before purchasing a generic scan tool, make sure that it will work properly with the OBD-II system you want to scan. If necessary, of course, you can always have the codes extracted by a dealer service department or an independent repair shop* .

2.1 Scan-tools like these from Actron and AutoXray can provide advanced diagnostic assistance and information regarding your vehicle's engine management system

OBD system general description

2 All models are equipped with the second generation OBD-II system. This system consists of an on-board computer known as an Electronic Control Module (ECM) or a Powertrain Control Module (PCM), and information sensors, which monitor various functions of the engine and send data to the ECM. This system incorporates a series of diagnostic monitors that detect and identify fuel injection and emissions control system faults and store the information in the computer memory. This updated system also tests sensors and output actuators, diagnoses drive cycles, freezes data and clears codes.

3 This powerful diagnostic computer must be accessed using an OBD-II scan tool and the 16-pin Data Link Connector (DLC) located under the driver's dash area. The ECM is located in a protected area of the engine compartment mounted to the firewall. The ECM is the brain of the electronically controlled fuel and emissions systems. It receives data from a number of sensors and other electronic components (switches, relays, etc.). Based on the information it receives, the ECM generates output signals to control various relays, solenoids (i.e. fuel injectors) and other actuators. The ECM is specifically calibrated to optimize the emissions, fuel economy and driveability of the vehicle.

4 It isn't a good idea to attempt diagnosis or replacement of the ECM or emission control components at home while the vehicle is under warranty. Because of a Federally mandated warranty which covers the emissions system components and because any owner-induced damage to the ECM, the sensors and/or the control devices may void this warranty, take the vehicle to a dealer service department if the ECM or a system component malfunctions.

Information sensors

5 **Brake Pedal Position (BPP) switch** - The BPP switch is located at the top of the brake pedal. It's a normally open switch that closes when the brake pedal is applied and sends a signal to the ECM, which interprets this signal as its cue to disengage the torque converter clutch. The BPP switch is also used to disengage the brake/shift interlock. For information regarding the replacement and adjustment of the BPP switch, refer to Chapter 9 .

6 Camshaft **Position (CMP)** sensor - The CMP sensor produces a signal that the ECM uses to identify the number 1 cylinder and to time the firing sequence of the fuel injectors.

7 Crankshaft **Position (CKP)** sensor - The CKP sensor produces a signal that the ECM uses to determine the position of the crankshaft.

8 Engine Coolant Temperature (ECT) sensor - The ECT sensor is a thermistor (temperature-sensitive variable resistor) that sends a voltage signal to the ECM, which uses this data to determine the temperature of the engine coolant. The ECT sensor helps the ECM control the air/fuel mixture ratio and ignition timing.

9 **Fuel tank pressure** sensor - The fuel tank pressure sensor measures the fuel tank pressure when the ECM tests the EVAP system, and it's also used to control fuel tank pressure by signaling the EVAP system to purge the tank when the pressure becomes excessive.

10 Input shaft **(mainshaft) speed** sensor - The input shaft speed sensor is located inside the transmission. The ECM uses the signal produced by this sensor for many functions involving the powertrain.

11 **Intake Air Temperature (IAT)** sensor - The IAT sensor monitors the temperature of the air entering the engine and sends a signal to the ECM. The IAT sensor is located at the top of the intake manifold near the center.

12 **Knock** sensor**(s)** - The knock sensor is a piezoelectric crystal that oscillates in proportion to engine vibration. (The term piezoelectric refers to the property of certain crystals that produce a voltage when subjected to shock.) The oscillation of the piezoelectric crystal produces a voltage output that is monitored by the ECM, which retards the ignition timing when the oscillation exceeds a certain threshold. When the engine is operating normally, the knock sensor oscillates consistently and its voltage signal is steady. When detonation occurs, engine vibration increases, and the oscillation of the knock sensor exceeds a design threshold. (Detonation is an uncontrolled explosion, after the spark occurs at the spark plug, which spontaneously combusts the remaining air/fuel mixture, resulting in a pinging or slapping sound.) If allowed to continue, detonation can damage the engine. The knock sensor is bolted to the engine block.

13 Manifold Absolute Pressure (MAP) sensor - The MAP sensor, monitors the pressure or vacuum downstream from the throttle plate, inside the intake manifold. The MAP sensor measures intake manifold pressure and vacuum on the absolute scale, i.e. from zero instead of from sea-level atmospheric pressure (14.7 psi). The MAP sensor converts the absolute pressure into a variable voltage signal that changes with the pressure. The ECM uses this data to determine engine load so that it can alter the ignition advance and fuel enrichment.

14 **Output shaft (countershaft) speed** sensor - The output shaft speed sensor is located inside the transmission. The ECM uses the signal produced by this sensor for many functions involving the powertrain.

15 **Oxygen sensors** - An oxygen sensor generates a small variable voltage signal in proportion to the difference between the oxygen content in the exhaust stream and the oxygen content in the ambient air. The ECM uses this voltage signal to maintain a stoichiometric air/fuel ratio of 14.7:1 by constantly adjusting the on-time of the fuel injectors. There are four oxygen sensors: two upstream sensors (ahead of the catalytic converter) and two downstream oxygen sensors (after the catalyst).

16 Throttle **Position (TP)** sensor - The TP sensor is a potentiometer that receives a constant voltage input from the ECM and sends back a voltage signal that varies in relation to the opening angle of the throttle plate inside the throttle body. This voltage signal tells the ECM when the throttle is closed, half-open, wide open or anywhere in between. The ECM uses this data, along with information from other sensors, to calculate injector pulse width (the interval of time during which an injector solenoid is energized by the ECM). The TP sensor is located on the

throttle body, on the end of the throttle plate shaft. The TP sensor is not removable on any model. If it's defective, replace the throttle body.

17 **Transmission range switch** - The transmission range switch is located inside the transmission. It is used only on automatics and functions like a conventional Park/Neutral Position (PNP) switch: it prevents the engine from starting in any gear other than Park or Neutral, and it closes the circuit for the back-up lights when the shift lever is moved to Reverse. The ECM monitors the voltage output signal from the switch, which corresponds to the position of the shift lever. Thus the ECM is able to determine the gear selected and is able to control the operation of the transmission.

18 **Vehicle Speed Input** - The speed signal is obtained by the ABS system and used by the Electronic Control Module (ECM) for various functions in the engine management system.

Output actuators

19 **EVAP** canister purge valve - The purge valve is normally closed. But when ordered to do so by the ECM, it allows the fuel vapors that are stored in the EVAP canister to be drawn into the intake manifold, where they're mixed with intake air, then burned along with the normal air/fuel mixture, under certain operating conditions.

20 **Three/two-way valve** - The three/two-way valve is located just ahead of the fuel filter underneath the vehicle and covered by a shield. It is controlled by the ECM and regulates fuel volume going to the fuel rail and injectors.

21 **Fuel injectors** - The fuel injectors spray a very fine mist of fuel into the intake ports where it is mixed with incoming air. The injectors operate like solenoids and are controlled by the ECM. For more information about the injectors, see Chapter 4 .

22 **Idle Air Control (IAC) valve** - The IAC valve controls the amount of air allowed to bypass the throttle plate when the throttle plate is at its (nearly closed) idle position. The IAC valve is controlled by the ECM. When the engine is placed under an additional load at idle (running the air conditioning compressor during low-speed maneuvers, for example), the engine can run roughly, stumble and even stall. To prevent this from happening, the ECM opens the IAC valve to increase the idle speed enough to overcome the extra load imposed on the engine. The IAC valve is mounted on the throttle body.

23 **Ignition coils** - There is one ignition coil per spark plug. The coils are located on top of the valve cover, directly over the spark plugs. The ignition coils are under the control of the Electronic Control Module (ECM). There is no separate ignition control module. Instead, coil drivers inside the ECM turn the primary side of the coils on and off. For more information about the ignition coils, see Chapter 5 .

24 **Variable** Valve Timing **(VANOS)** - Variable valve timing is achieved by the use of solenoids and actuators allowing oil pressure to act upon both camshafts (intake and exhaust) to provide a dynamic range of valve timing adjustment. The system is controlled by the ECM and offers many benefits including an increase in performance and fuel economy, lowered emissions (NOx), and smoother idle.

Obtaining and clearing Diagnostic Trouble Codes (DTCs)

25 All models covered by this manual are equipped with on-board diagnostics. When the ECM recognizes a malfunction in a monitored emission control system, component or circuit, it turns on the Malfunction Indicator Light (MIL) on the dash. This light may read, Check Engine or Service Engine Soon or may just be a symbol depending on when the vehicle was made. The ECM will continue to display the MIL until the problem is fixed and the Diagnostic Trouble Code (DTC) is cleared from the ECM's memory. You'll need a scan tool to access any DTCs stored in the ECM.

26 Before accessing any DTCs stored in the ECM, thoroughly inspect ALL electrical connectors and hoses. Make sure that all electrical connections are tight, clean and free of corrosion. And make sure that all hoses are correctly connected, fit tightly and are in good condition (no cracks or tears). Also, make sure that the engine is tuned up. A poorly running engine is probably one of the biggest causes of emission-related malfunctions. Often, simply giving the engine a good tune-up will correct the problem.

Accessing the DTCs

27 On these models, all of which are equipped with On-Board Diagnostic II (OBD-II) systems, the Diagnostic Trouble Codes (DTCs) can only be accessed with a scan tool. Professional scan tools are expensive, but relatively inexpensive generic scan tools **(see illustration 2.1)** are available at most auto parts stores. Simply plug the connector of the scan tool into the vehicle's diagnostic connector **(see illustration)** . Follow the instructions included with the scan tool to extract the DTCs.

2.27 The Data Link Connector (DLC) is located under the dash near the left kick panel

28 Once you have obtained (and written down) all of the stored DTCs, look them up on the accompanying DTC chart.

29 After troubleshooting the source of each DTC make any necessary repairs or replace the defective component(s).

Clearing the DTCs

30 Clear the DTCs with the scan tool in accordance with the instructions provided by the scan tool's manufacturer.

Diagnostic Trouble Codes

31 The accompanying tables list several Diagnostic Trouble Codes (DTCs) that can be accessed by the home mechanic. More codes exist for the vehicle by the manufacturer but only a professional scan tool and software (which is quite expensive) can get them.

OBD-II trouble codes

Note:
Not all trouble codes apply to all models.

Code	Probable cause
P0011	Camshaft (A) position timing over-advanced or performance problem (Bank 1)
P0012	Camshaft (A) position timing over-retarded or performance problem (Bank 1)
P0014	Camshaft (B) position timing over-advanced or performance problem (Bank 1)
P0015	Camshaft (B) position timing over-retarded or performance problem (Bank 1)
P0030	Upstream oxygen sensor, heater circuit malfunction (Bank 1 Sensor 1)
P0031	Upstream oxygen sensor heater circuit, low voltage input (Bank 1 Sensor 1)
P0032	Upstream oxygen sensor heater circuit, high voltage input (Bank 1 Sensor 2)
P0036	Downstream oxygen sensor, heater circuit malfunction (Bank 1 Sensor 2)
P0037	Downstream oxygen sensor heater circuit, low voltage input (Bank 1 Sensor 2)
P0038	Downstream oxygen sensor heater circuit, high voltage input (Bank 1 Sensor 1)
P0040	Oxygen sensor signal Bank 1 Sensor 1 is crossed with Bank 2 Sensor 1
P0041	Oxygen sensor signal Bank 1 Sensor 2 is crossed with Bank 2 Sensor 2
P0050	Upstream oxygen sensor, heater circuit malfunction (Bank 2 Sensor 1)
P0051	Upstream oxygen sensor heater circuit, low voltage input (Bank 2 Sensor 1)
P0052	Upstream oxygen sensor heater circuit, high voltage input (Bank 2 Sensor 2)
P0056	Downstream oxygen sensor, heater circuit malfunction (Bank 2 Sensor 2)
P0057	Downstream oxygen sensor heater circuit, low voltage input (Bank 2 Sensor 2)
P0058	Downstream oxygen sensor heater circuit, high voltage input (Bank 2 Sensor 1)
P0101	Mass Air Flow (MAF) sensor circuit range or performance problem

P0102	Mass or Volume Air Flow (MAF) sensor circuit, low input voltage
P0103	Mass or Volume Air Flow (MAF) sensor circuit, high input voltage
P0107	MAP or Barometric pressure sensor circuit, low input voltage
P0108	MAP or Barometric pressure sensor circuit, high input voltage
P0111	Intake Air Temperature (IAT) sensor, range or performance problem
P0112	Intake Air Temperature (IAT) sensor, low input voltage
P0113	Intake Air Temperature (IAT) sensor, high input voltage
P0116	Engine Coolant Temperature (ECT) sensor circuit, range or performance problem
P0117	Engine Coolant Temperature (ECT) sensor circuit, low input voltage
P0118	Engine Coolant Temperature (ECT) sensor circuit, high input voltage
P0120	Throttle Position (TP) sensor, circuit “A” malfunction
P0121	Throttle/pedal position sensor, “A” circuit range or performance problem
P0122	Throttle/pedal position sensor, “A” circuit low voltage input
P0123	Throttle/pedal position sensor, “A” circuit high voltage input
P0125	Insufficient coolant temperature for closed loop fuel control
P0128	Engine Coolant Temperature, insufficient coolant temperature for closed loop
P0130	Upstream oxygen sensor, circuit malfunction (Bank 1 Sensor 1)
P0131	Upstream oxygen sensor circuit, low voltage input (Bank 1 Sensor 1)
P0132	Upstream oxygen sensor circuit, high voltage input (Bank 1 Sensor 1)
P0133	Upstream oxygen sensor circuit, slow response (Bank 1 Sensor 1)
P0134	Upstream oxygen sensor circuit, no activity detected (Bank 1 Sensor 1)
P0135	Upstream oxygen sensor heater, circuit malfunction (Bank 1 Sensor 1)
P0136	Downstream oxygen sensor, circuit malfunction (Bank 1 Sensor 2)
P0137	Downstream oxygen sensor circuit, low voltage input (Bank 1 Sensor 2)
P0138	Downstream oxygen sensor circuit, high voltage input (Bank 1 Sensor 2)
P0139	Downstream oxygen sensor circuit, slow response (Bank 1 Sensor 2)

P0140	Downstream oxygen sensor circuit, no activity detected (Bank 1 Sensor 2)
P0141	Downstream oxygen sensor heater, circuit malfunction (Bank 1 Sensor 2)
P0150	Upstream oxygen sensor, circuit malfunction (Bank 2 Sensor 1)
P0151	Upstream oxygen sensor circuit, low voltage input (Bank 2 Sensor 1)
P0152	Upstream oxygen sensor circuit, high voltage input (Bank 2 Sensor 1)
P0153	Upstream oxygen sensor circuit, slow response (Bank 2 Sensor 1)
P0154	Upstream oxygen sensor circuit, no activity detected (Bank 2 Sensor 1)
P0155	Upstream oxygen sensor heater, circuit malfunction (Bank 2 Sensor 1)
P0156	Downstream oxygen sensor, circuit malfunction (Bank 2 Sensor 2)
P0157	Downstream oxygen sensor circuit, low voltage input (Bank 2 Sensor 2)
P0158	Downstream oxygen sensor circuit, high voltage input (Bank 2 Sensor 2)
P0159	Downstream oxygen sensor circuit, slow response (Bank 2 Sensor 2)
P0160	Downstream oxygen sensor circuit, no activity detected (Bank 2 Sensor 2)
P0161	Downstream oxygen sensor heater, circuit malfunction (Bank 2 Sensor 2)
P0170	Fuel trim malfunction (Bank 1)
P0171	Fuel system too lean (Bank1)
P0172	Fuel system too rich (Bank 1)
P0173	Fuel trim malfunction (Bank 2)
P0174	Fuel system too lean (Bank 2)
P0175	Fuel system too rich (Bank 1)
P0197	Engine oil temperature sensor, low input voltage
P0198	Engine oil temperature sensor, high input voltage
P0201	Cylinder No. 1 fuel injector, circuit malfunction
P0202	Cylinder No. 2 fuel injector, circuit malfunction
P0203	Cylinder No. 3 fuel injector, circuit malfunction
P0204	Cylinder No. 4 fuel injector, circuit malfunction
P0205	Cylinder No. 5 fuel injector, circuit malfunction
P0206	Cylinder No. 6 fuel injector, circuit malfunction
P0221	Throttle/pedal position sensor, “B” circuit range or performance problem
P0222	Throttle/pedal position sensor, “B” circuit low voltage input

P0223	Throttle/pedal position sensor, “B” circuit high voltage input
P0261	Cylinder No. 1 fuel injector circuit, low voltage input
P0262	Cylinder No. 1 fuel injector circuit, high voltage input
P0264	Cylinder No. 2 fuel injector circuit, low voltage input
P0265	Cylinder No. 2 fuel injector circuit, high voltage input
P0267	Cylinder No. 3 fuel injector circuit, low voltage input
P0268	Cylinder No. 3 fuel injector circuit, high voltage input
P0270	Cylinder No. 4 fuel injector circuit, low voltage input
P0271	Cylinder No. 4 fuel injector circuit, high voltage input
P0273	Cylinder No. 5 fuel injector circuit, low voltage input
P0274	Cylinder No. 5 fuel injector circuit, high voltage input
P0276	Cylinder No. 6 fuel injector circuit, low voltage input
P0277	Cylinder No. 6 fuel injector circuit, high voltage input
P0300	Random or multiple cylinder misfires detected
P0301	Cylinder no. 1 misfire detected
P0302	Cylinder no. 2 misfire detected
P0303	Cylinder no. 3 misfire detected
P0304	Cylinder no. 4 misfire detected
P0305	Cylinder no. 5 misfire detected
P0306	Cylinder no. 6 misfire detected
P0313	Misfire detected with low fuel
P0316	Misfire detected at start up (within first 1000 revolutions)
P0325	Knock sensor 1, circuit malfunction (Bank 1)
P0327	Knock sensor 1, low voltage input (Bank 1)
P0328	Knock sensor 1, high voltage input (Bank 1)
P0330	Knock sensor 2, circuit malfunction (Bank 2)
P0332	Knock sensor 2, low voltage input (Bank 2)
P0335	Crankshaft Position (CKP) sensor, circuit “A” malfunction
P0339	Crankshaft Position (CKP) sensor, intermittent “A” circuit
P0340	Camshaft Position (CMP) sensor, circuit “A” malfunction (Bank 1)
P0344	Camshaft Position (CMP) sensor, intermittent “A” circuit (Bank 1)
P0363	Misfire detected ñ fueling disabled
P0365	Camshaft Position (CMP) sensor, “B” circuit malfunction (Bank 1)
P0369	Camshaft Position (CMP) sensor, intermittent “B” circuit (Bank 1)

P0370	Timing Reference High Resolution Signal A
P0385	Crankshaft Position (CKP) sensor, circuit “B” malfunction
P0411	Secondary Air Injection System incorrect flow detected
P0412	Secondary Air Injection switching valve circuit “A” malfunction
P0413	Secondary Air Injection System switching valve open circuit “A”
P0414	Secondary Air Injection System switching valve shorted circuit “A”
P0420	Catalyst system efficiency below threshold (Bank 1)
P0430	Catalyst system efficiency below threshold (Bank 2)
P0440	Evaporative Emission Control (EVAP) system malfunction
P0441 (pre-2002)	Evaporative Emission Control (EVAP) system, incorrect purge flow
P0441 (2002 and later)	Evaporative Emission Control (EVAP) system purge control valve stuck open
P0442	Evaporative Emission Control (EVAP) system, small leak detected
P0443	Evaporative Emission Control (EVAP) system purge control valve, circuit malfunction
P0444	Evaporative Emission Control (EVAP) system, purge control valve circuit open
P0445	Evaporative Emission Control (EVAP) system, purge control valve circuit shorted
P0455	Evaporative Emission Control (EVAP) system, large leak detected
P0456	Evaporative Emission Control (EVAP) system, very small leak detected
P0491	Secondary Air Injection System insufficient flow
P0492	Secondary Air Injection System insufficient flow (Bank 2)
P0500	Vehicle Speed Sensor (VSS), circuit “A” malfunction
P0505	Idle control system malfunction
P0600	Serial Communication Link malfunction
P0601	Powertrain Control Module (PCM), memory checksum error
P0604	PCM Random Access Memory (RAM) error
P0700	Transmission Control Request (MIL Request)