

133 Fuel Injection ME 9.2, ME 9.2.2 (V8 Engine)

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GENERAL

This repair group covers service and repair of engine management systems for 5 Series models with V8 engine and Bosch DME ME 9.2 and ME 9.2.2.

See also:

- **020 Maintenance** for air filter, fuel filter and spark plug replacement
- **100 Engine-General** for engine identification and application
- **120 Ignition System** for ignition coil, camshaft sensor, crankshaft sensor and knock sensor service
- **160 Fuel Tank and Fuel Pump** for fuel pump and fuel pump relay service, fuel pressure tests and fuel pressure regulator replacement
- **180 Exhaust System** for oxygen sensor service
- **ECL Electrical Component Locations**
- **ELE Electrical Wiring Diagrams**
- **OBD On-Board Diagnostics**

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DME applications

DME applications

BMW 5 Series models are equipped with digital motor electronics (DME), also known as Motronic. In these systems, fuel injection and ignition are controlled by an integrated engine control module (ECM). Application information for DME systems is in **Table a**.

Table a. 5 Series engine management applications			
Year, model	Engine code	Engine management	Features
2004-2005			
Sedan: 525i, 530i	M54	Siemens MS 45.1	Double VANOS
Sedan: 545i	N62	Bosch DME ME 9.2 with Valvetronic control module	Valvetronic, VANOS
2006 - 2007			
Sedan, Sports Wagon: 525i, 525xi, 530i, 530xi Sports Wagon	N52	Siemens MSV70	Valvetronic, VANOS
2008 - 2010			
Sedan, Sports Wagon: 528i, 528xi	N52KP	Siemens MSV80	Valvetronic, VANOS
Sedan, Sports Wagon: 535i, 535xi	N54	Siemens MSD80 (to 03 / 2008) MSD81 (from 03 / 2008)	VANOS, turbocharged
2004-2005			
Sedan: 545i	N62	Bosch DME ME 9.2 with Valvetronic control module	Valvetronic, VANOS
2006 - 2010			
Sedan: 550i	N62TU	Bosch DME ME 9.2.2	Valvetronic, VANOS

Warnings and Cautions

WARNING —

- The fuel system is designed to retain pressure even when the ignition is OFF. When working with the fuel system, loosen the fuel lines slowly to allow residual fuel pressure to dissipate. Avoid spraying fuel. Use shop towels to capture leaking fuel.
- Fuel in fuel lines is under pressure (approx. 3 - 5 bar or 45 - 75 psi) and may be expelled forcibly. Do not smoke or work near heaters or other fire hazards. Keep a fire extinguisher handy.
- Unscrew the fuel tank cap to release pressure in the tank before working on fuel lines.
- Plug open fuel lines and fittings.
- Before beginning work on the fuel system, place a fire extinguisher in the vicinity of the work area.
- Work only on the fuel system when engine temperature is below 40°C (104°F).
- Fuel is highly flammable. When working around fuel, do not disconnect wires that could cause electrical sparks. Do not smoke or work near heaters or other fire hazards.
- Wear eye protection and protective clothing to avoid injuries from contact with fuel.
- When working on an open fuel system, wear suitable hand protection, as prolonged contact with fuel can cause illnesses and skin disorders.
- Do not use a work light with an incandescent bulb near fuel. Fuel may spray on the hot bulb causing a fire.
- Make sure the work area is properly ventilated.
- Due to risk of personal injury, be sure the engine is cold before beginning work on engine components.
- The ignition system produces high voltages that can be fatal. Avoid contact with exposed terminals. Use extreme caution when working on a car with the ignition switched ON or the engine running.

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Warnings and Cautions

CAUTION—

- Renew fuel system hoses, clamps and O-rings any time they are removed.
- Prior to disconnecting the battery, read the battery disconnection cautions in **001 Warnings and Cautions**.
- Connect and disconnect the DME system wiring and test equipment leads only when the ignition is switched OFF.
- Wait at least 1 minute after switching the ignition OFF before disconnecting engine control module (ECM) connectors. If the connectors are removed before this time, residual power in the system relay may damage the control module.
- Tests or repair procedures in this section may set fault codes (DTCs) in the ECM and illuminate the MIL. After repairs are completed, access and clear DTC memory using a BMW scan tool. See **On-board diagnostics** in this repair group.
- Fuel system cleaners and other chemical additives other than those specifically recommended by BMW may damage catalytic converters, oxygen sensors or other fuel supply components.
- Do not connect any test equipment that delivers a 12-volt power supply to terminal 15 (+) of the ignition coils. The current flow may damage the ECM. Connect test equipment only as specified by BMW or the equipment maker.
- Relay positions can vary. Be sure to confirm relay location and function by identifying the wiring in the socket using the wiring diagrams found in **ELE Electrical Wiring Diagrams**.
- Use a digital multimeter for electrical tests. Use an LED test light for quick tests.

DRIVEABILITY TROUBLESHOOTING

The self-diagnostic DME engine management systems monitor and store diagnostic trouble codes (DTCs). If the malfunction indicator light (MIL) illuminates, it indicates that an emissions-related fault has occurred and that one or more DTCs are stored in the engine control module (ECM).

- ◀ If faults arise, or if the MIL is illuminated, begin troubleshooting by connecting BMW scan tool to the OBD II plug on left door post.

The capabilities of OBD II software has the potential to save hours of diagnostic time and to help avoid incorrect component replacement and possible damage to system components. See **On-board diagnostics** in this repair group.

Basic engine settings

Idle speed, idle mixture (%CO), and ignition timing are not adjustable. The DME system is adaptive and automatically compensates for changes in the engine due to age, minor wear or small problems such as a disconnected vacuum hose. However, the adaptive range is limited. Once the limits are exceeded, driveability problems become noticeable.

Poor initial driveability may be encountered when the battery is disconnected and reconnected. When the battery is disconnected, ECM adaptive memory may be reset. The system readapts after about ten minutes of driving.

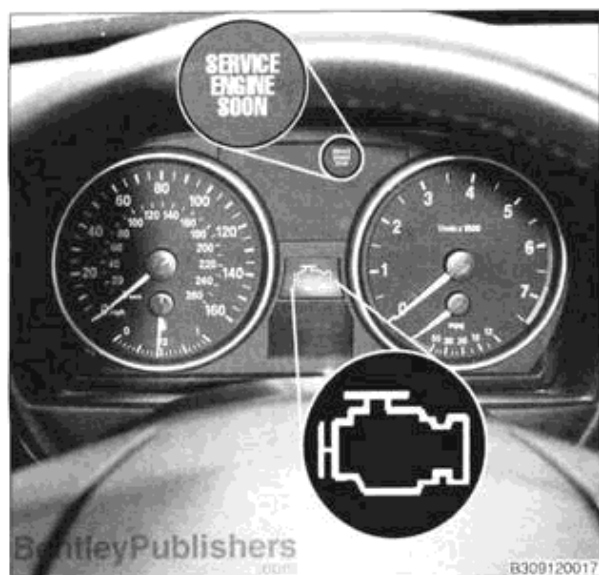
System voltage

Digital motor electronics (DME) requires that the system (battery) voltage be maintained within a narrow range of DC voltage. DC voltage levels beyond or below the operating range, or any AC voltage in the electrical system can cause havoc.

- When troubleshooting an illuminated MIL, make sure the battery is fully charged and capable of delivering all its power to the electrical system. An undercharged battery can amplify AC alternator output ripple.
- To make a quick check of battery charge, measure voltage across battery terminals with all cables attached and ignition OFF. A fully charged battery measures 12.6 volts or slightly more, compared to 12.15 volts for a battery with a 25% charge.

The DME system operates at low voltage and current levels, making it sensitive to small increases in resistance. The electrical system is routinely subject to corrosion, vibration and wear, so faults or corrosion in the wiring harness and connectors are not uncommon.

- Check battery terminals for corrosion or loose cable connections. See **121 Battery, Starter, Alternator**.



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Main grounds

- If a battery cable connection has no visible faults but is still suspect, measure voltage drop across the connection. A large drop indicates excessive resistance, meaning that the connection is corroded, dirty or damaged. Clean or repair and retest. See **600 Electrical System-General** for voltage drop test procedure.
- Visually inspect wiring, connectors, switches and fuses. Loose or damaged connectors can cause intermittent problems, especially small terminals in ECM connectors. Disconnect wiring harness connectors to check for corrosion, and use electrical cleaning spray to remove contaminants.

Main grounds

Good grounds are critical to proper DME operation. If a ground connection has no visible faults but is still suspect, measure the voltage drop across the connection. A large voltage drop means high resistance. Clean or repair the connection and retest.

For voltage drop testing, see **600 Electrical System-General**.

For ground locations, see **ECL Electrical Component Locations**.

On-board diagnostics

Second generation on-board diagnostics (OBD II) software and hardware is incorporated in the engine management systems. The OBD II system monitors components that influence exhaust and evaporative emissions. If a problem is detected, the OBD II system stores the associated diagnostic trouble code (DTC) and condition.

If vehicle emissions levels exceed 1.5 times Federally mandated criteria, the OBD II system illuminates a malfunction indicator light (MIL) in the instrument cluster.

- ◀ Scan tool connected to OBD II plug below left dashboard.

Professional diagnostic scan tools available at the time of this printing include the BMW GT1, ISTA and a small number of aftermarket BMW-specific tools.

In addition to professional scan tools, there are inexpensive generic OBD II scan tool software programs and handheld units available. Although these have limited capabilities as compared to the dedicated tools, they are powerful diagnostic tools.

For the DIY owner, a simple aftermarket DTC reader is available through <http://www.peakresearch.com>. This tool is capable of checking for DTCs as well as switching the illuminated MIL OFF and resetting service indicator lights.

NOTE —

- OBD II DTC memory (including an illuminated MIL) can only be reset using a BMW scan tool or. Removing the connector from the ECM or disconnecting the battery does not erase DTC memory.



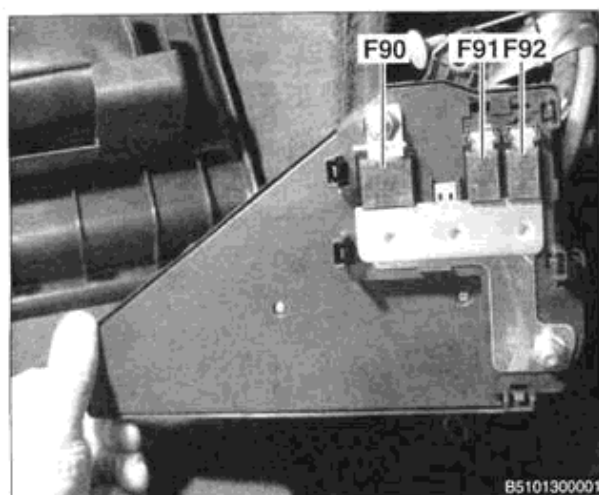
ENGINE MANAGEMENT FUSES AND POWER SUPPLY COMPONENTS

Power supply fuses

See **ECL Electrical Component Locations** for fuse panel access information.

➤ Rear distribution panel (A46) in trunk, installed in right rear fender:

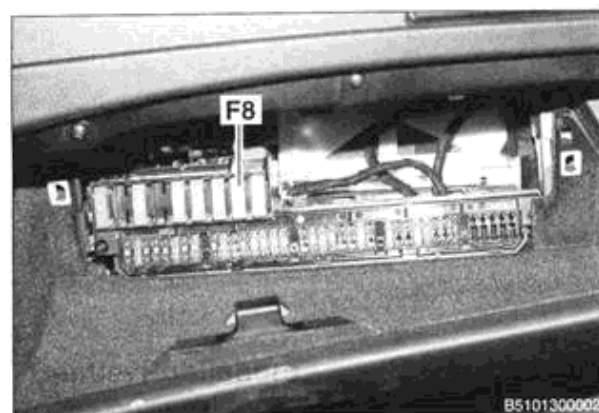
- **F90** 200A: Power supply to fuse and relay panel behind glove compartment (A41a).
- **F91** 100A: Power supply to fuse panel Integrated voltage supply module (IVM) (A6009).



➤ **A41a:** fuse and relay panel behind glove compartment:

- **F8** 60A: Integrated voltage supply module (IVM) (A6009)

See **ECL Electrical Component Locations** for specific vehicle fuse locations.



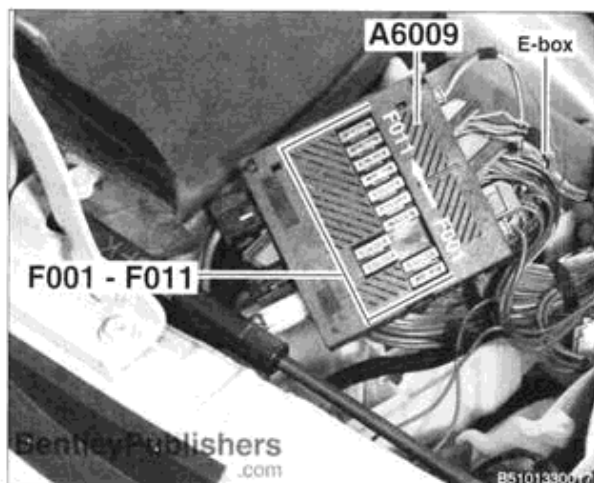
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Integrated voltage supply module (IVM) (A6009)

Integrated voltage supply module (IVM) (A6009)

The integrated voltage supply module (IVM) (A6009) is in the E-box, right rear engine compartment, under the plenum cover. See also:

- **Integrated voltage supply module (IVM) relays** in this repair group for IVM relay information
- **ECL Electrical Component Locations** for E-box access information.



IVM fuse ratings are in **Table b**

Table b. Fuse applications, integrated voltage supply module (IVM) (A6009)

Fuse	Rating in amps	Protected circuits
F001	30	Engine control module (ECM) (A6000) Fuel injectors 5 - 8 (Y6105 - Y6108) Valvetronic control module (A60210) Sequential manual gearbox (SMG) (A70010)
F002	20	Camshaft sensors, left bank (B62241, B62242) Ignition coils 5 - 8 (T6155 - T 6158) VANOS solenoids, left bank (Y6283, Y6284) Fuel tank vent solenoid (Y6120)
F003	20	Ignition coils 1 - 4 (T6151 - T6154)
F004	20	Ignition coils 5 - 8 (T6155 - T6158)
F005	30	Camshaft sensors, right bank (B62141, B62142) Crankshaft sensor (B6203) Thermostat, characteristic map (Y6279) VANOS solenoids, right bank (Y6281, Y6282) Mass air flow sensor (B6207)
F006	20	Fuel injectors 1 - 4 (Y6101 - Y6104)
F007	20	Engine control module (ECM) (A6000) Sequential manual gearbox (SMG) (A70010)
F008	30	Oil quality sensor (B62540) Oxygen sensor heaters
F009	10	Fuel pump relay (K96) Tailpipe flap (Y198) Radiator shutter solenoid (Y13864) E-box fan (M6506) DMTL pump (M119a) Secondary air pump relay (K6304)
F010	40	Valvetronic control module (A60210)
F011	40	Valvetronic control module (A60210)

BOSCH DME ME 9.2, ME 9.2.2

5 series models to 09 / 2005: N62 V8 engine with Valvetronic (4.4 liter) is equipped with Bosch DME ME 9.2 engine management.

5 series models from 09 / 2005: N62TU V8 engine with Valvetronic (4.8 liter) is equipped with Bosch DME ME 9.2.2 engine management.

Both DME engine management systems for N62 and N62TU V8 engine are similar and will be covered together unless otherwise noted.

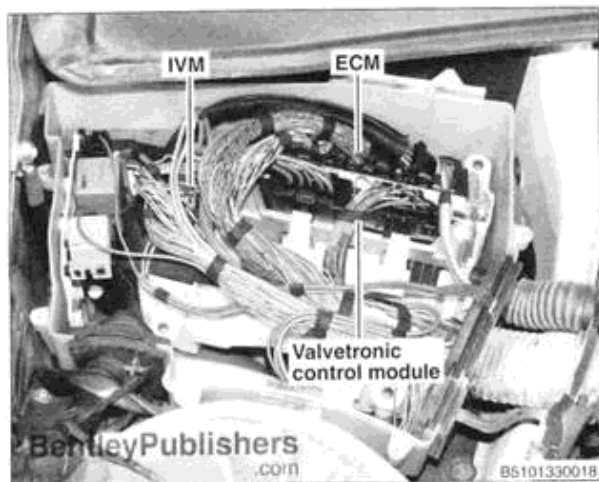
For a description of the N62 engine, see **100 Engine-General**.

Bosch DME introduction

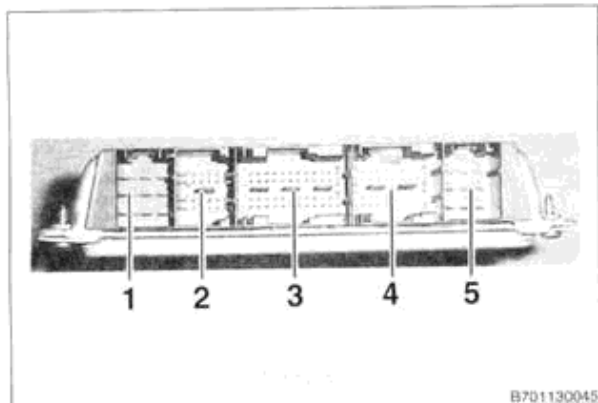
The Bosch DME engine management system meets stringent emission requirements in addition to reducing fuel consumption and increasing driving performance. A flash EEPROM is used as the storage medium for program data, DTC memory and adaptation values. The engine control module (ECM) works in combination with the Valvetronic control module:

- ECM: Overall engine management
- Valvetronic control module: Variable intake valve lift

- The ECM, Valvetronic control module and integrated voltage supply module (IVM) are in the E-box at the right rear of the engine compartment.
- The ECM controls an electric cooling fan (**arrow**) in the base of the E-box to draw in cool air from the passenger compartment.



- The 134 pin ECM is manufactured by Bosch to BMW specifications. The ECM uses the SKE (standard shell construction) housing and has 5 modular connectors.

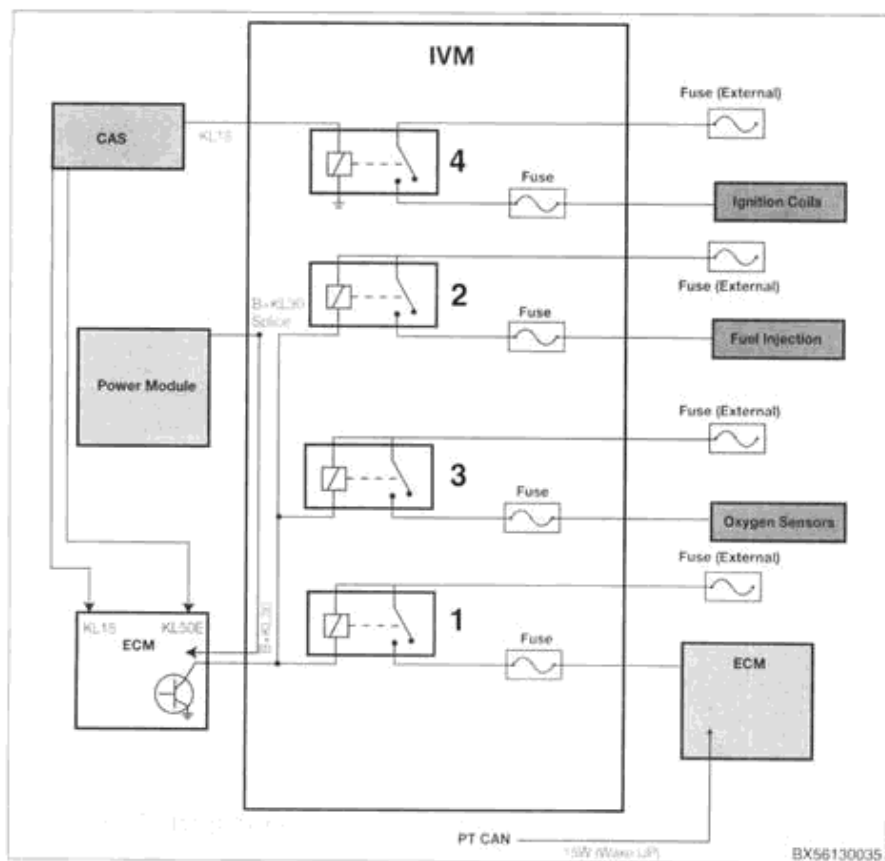


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Integrated voltage supply module (IVM) relays

Integrated voltage supply module (IVM) relays

When ignition is switched ON, the ECM activates a ground path to energize relays 1 - 3 in the IVM.



1. Power to ECM
2. Power to fuel injectors
1. Power to oxygen sensor heaters
 - CAS activates relay 4.
2. Power to ignition coils
 - Additional relays in IVM supply power to the Valvetronic system and automatic transmission control module.

See also **Engine Management Fuses and Power Supply Components** in this repair group.

DME engine management system description

The DME manages and monitors the following functions:

Air

- Electronic throttle
- Mass air flow
- Variable intake manifold
- Valvetronic

Fuel

- Fuel supply
- Fuel injection

Ignition

- Direct ignition
- Knock control
- Primary and secondary ignition monitoring

Emissions

- OBD II compliance
- Pre- and post-catalyst oxygen sensors
- Electrically heated DME-mapped thermostat
- Misfire detection
- Evaporative emission control and leak detection
- Secondary air injection system (to 03 / 2005)
- Malfunction indicator light (MIL)

Performance controls

- Dual VANOS control
- Output of injection signal (TI) for fuel economy gauge
- Output of engine rpm (TD) for tachometer
- A/C compressor control
- Electric radiator cooling fan
- CAN-bus communication
- Dynamic stability control (DSC) interface
- CAS (car access system) with EWS 3.3
- Cruise control
- ECM programming

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DME engine management system description

Fuel metering

The ECM meters pressurized fuel by changing the opening time (pulse width) of the fuel injectors. The exact amount of fuel injected is determined by the amount of time the injectors are open. To ensure that injector pulse width is the only factor that determines fuel metering, fuel pump pressure is maintained by a pressure regulator.

The fuel injectors are positioned close to the intake valves resulting in large injection spray angles. Greater fuel spray atomization leads to optimum fuel mixing and thereby reduces fuel consumption and exhaust emissions.

- ◀ A service port (**arrow**) in the non-return fuel rail is for fuel pressure tests.

The Siemens fuel injectors have a coil resistance of approximately 12 Ω each.

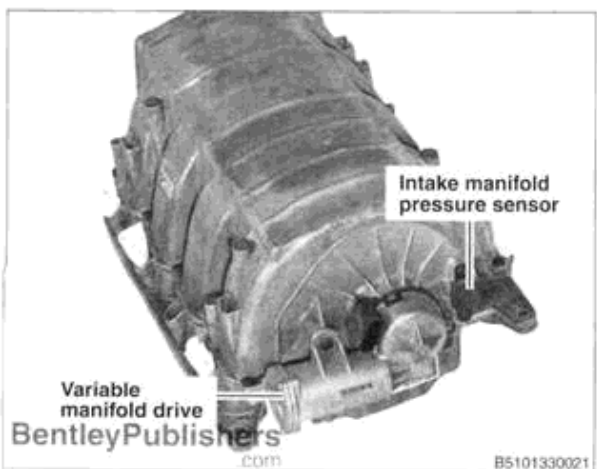
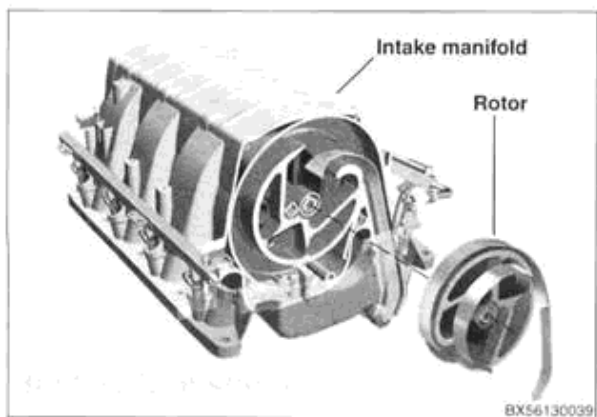
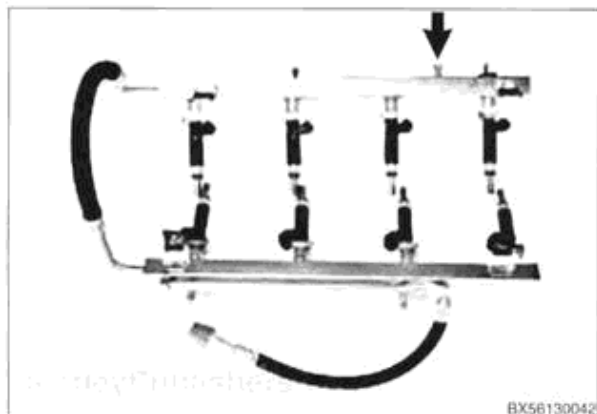
The Bosch DME system uses 8 individual fuel injector circuits so that any one or multiple injectors can be deactivated, if needed. If the ECM detects a catalyst-damaging fault, it deactivates all the injectors.

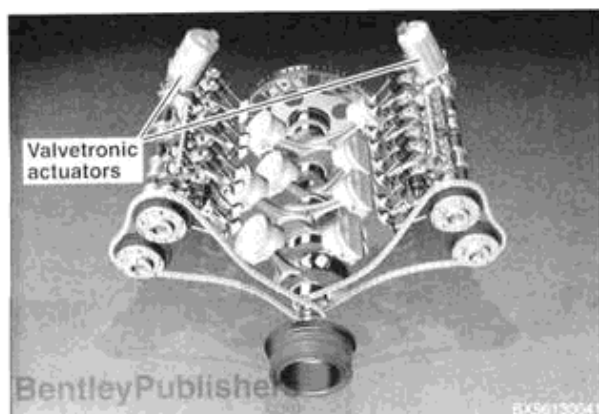
Variable intake manifold

- ◀ The variable intake manifold is operated by turning a rotor.

- ◀ Adjustments to the intake manifold are carried out by the ECM controlling a drive unit. The drive unit is mounted on the rear of the intake manifold.

The drive unit consists of a 12 V electric motor with worm gears and an integral potentiometer for intake manifold position feedback. If the drive unit fails, the system remains in its current position. The driver may notice a loss in power and a fault code may be stored in the ECM.





Valvetronic system

- The Valvetronic control system varies intake valve opening time and valve lift according to engine speed and load. Extent of valve lift is based on a request from the ECM. Two Valvetronic actuators adjust the two eccentric shafts in the cylinder heads, affecting valve lift. See **100 Engine-General** for additional information.

Faults in the Valvetronic system are detected by the Valvetronic control module and transmitted via CAN-bus to the ECM where they are stored for diagnostics.

Idle speed control

- The ECM controls idle speed by varying intake valve lift via the Valvetronic system.

1. Valvetronic motor
2. Return spring
3. Intake camshaft
4. Intermediate lever
5. Intake rocker arm
6. Intake valve

Idle speed is not adjustable. The basic functions and parameters of idle speed control are as follows:

- Control of cold air intake volume.
- Smooth idle speeds regardless of load and inputs.
- Smooth transition from acceleration to deceleration.

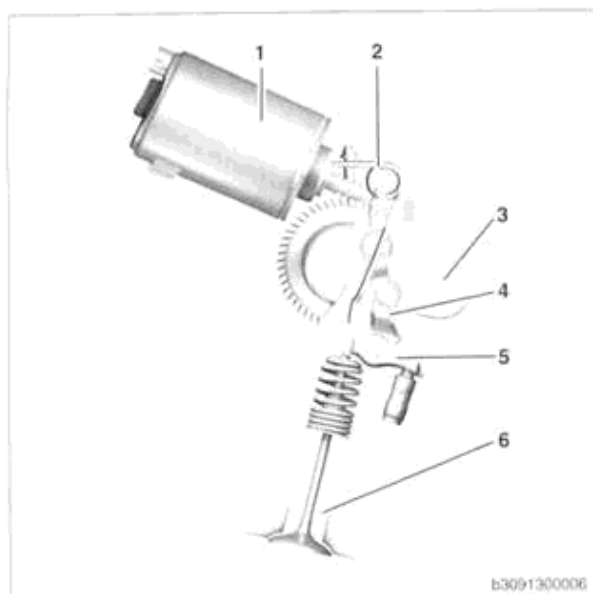
Idle speed stabilization is active during the following conditions:

- Engine warm up
- Heating or A/C activation
- Drive gear selected (automatic transmission)
- Varying cooling fan speeds

Throttle control

- The throttle module (EDK) is not needed for engine load control. Which is carried out by the Valvetronic function of the ECM. However, the throttle may be slightly closed to allow sufficient manifold vacuum for crankcase ventilation and canister purge systems.

The ECM provides operating voltage and ground to the throttle valve for opening and closing the throttle plate.



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DME engine management system description



Knock (detonation) control

Knock sensors monitor and control ignition knock through the ECM. The knock sensors function like microphones and are able to convert mechanical vibration (knock) into electrical signals. The ECM is programmed to react to frequencies that are characteristic of engine knock and adapt the ignition timing point accordingly.

- Four knock sensors (**arrows**) are bolted to the cylinder heads between cylinders 1 & 2, 3 & 4, 5 & 6 and 7 & 8. If the signal value exceeds the programmed threshold, the ECM identifies knock and retards the ignition timing for that cylinder.

If a fault is detected with the sensor(s), the ECM deactivates knock control. Then the ignition timing is set to a conservative basic setting based on intake air temperature and a DTC is stored.

Knock sensor replacement is covered in **120 Ignition System**.

Evaporative emissions

Control of evaporative fuel vapors from the fuel tank continues through tighter controls of fuel tank venting and refinements in the leak detection system (DM-TL).

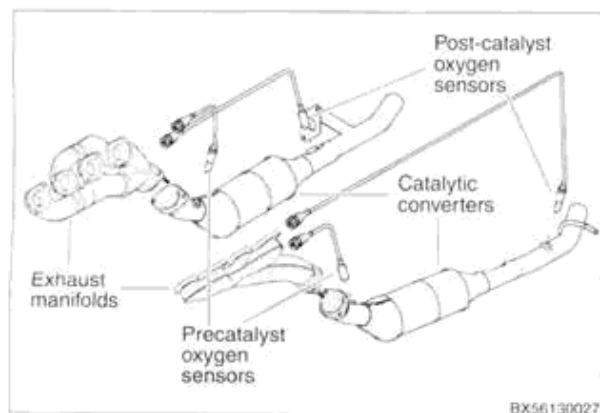
On-board refueling vapor recovery (ORVR)

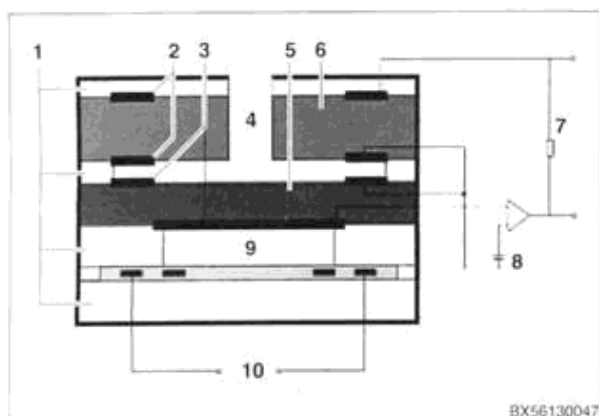
The ORVR system recovers and stores hydrocarbon (fuel) vapors during refueling. When refueling, the pressure of the fuel entering the tank forces hydrocarbon vapors through the tank refuelling breather hose to the liquid / vapor expansion tank and into the activated charcoal canister. The vapors are stored in the canister and the system can then breathe through the DM-TL and the air filter.

Oxygen sensors

- In order to control exhaust emissions, 4 oxygen sensors are utilized, 2 before and 2 after the converters.

The post-catalyst sensors are conventional heated zirconia units which produce a low and relatively stable voltage (approx. 700 - 800 mV) when the system is stable and operating normally.





The precatlyst units are Bosch LSU planar wideband oxygen sensors. This compact sensor uses thin layers of zirconium dioxide (ZrO_2) ceramic films. The laminate structure allows the integration of several functions including the heating element which ensures that the minimum operating temperature ($750^{\circ}C / 1382^{\circ}F$) is reached rapidly.

1. Zirconium ceramic film
2. Platinum electrode, pump cell
3. Platinum electrode, reference cell
4. Exhaust gas port
5. Reference cell
6. Pump cell
7. Pump current (I_p)
8. Reference voltage (U_{ref})
9. Reference air channel
10. Heating voltage (U_H)

The wideband oxygen sensor can measure mixture in a wide range, from rich to extremely lean, very rapidly.

To operate effectively, the oxygen sensor requires ambient air as the reference gas inside. This ambient air reaches the inside of the sensor through the harness connector and the electrical harness. In case of oxygen sensor malfunction, check the connector and clean contamination as necessary. Also, disconnect and reconnect the harness connector to remove oxidation from the connector pins.

Secondary air injection

5 series V8 engine models manufactured to 03 / 2005 (545i): The secondary air system pumps ambient air into the exhaust stream after a cold engine start to reduce catalytic converter warm-up time and to reduce HC and CO emissions. The ECM controls and monitors the secondary air injection system.

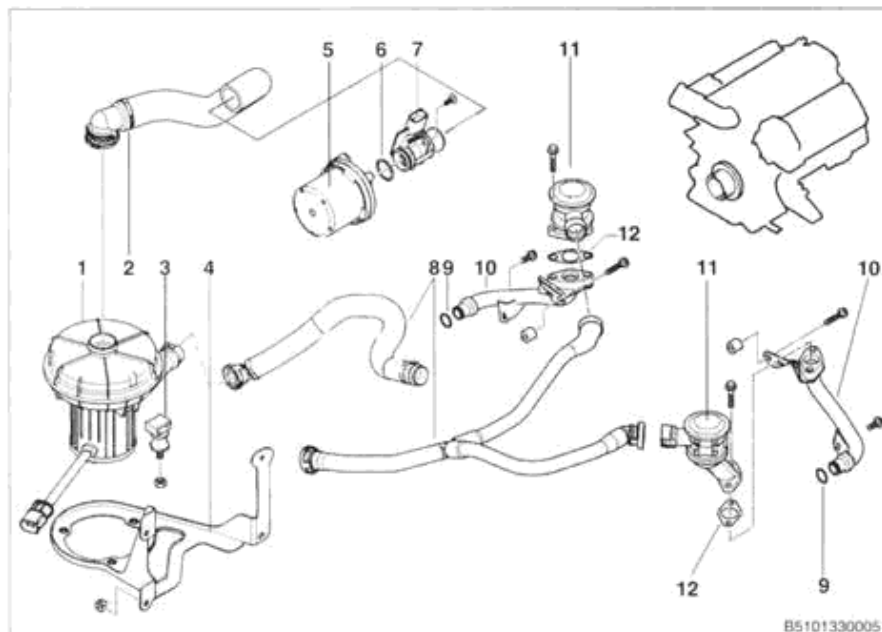
The electric air pump draws in ambient air and supplies it to the secondary air valve. The air injection valve is opened by a solenoid using engine vacuum and is closed by an internal spring.

The secondary air valve is bolted to the right front of the cylinder head. Cast passageways within the cylinder head duct the secondary air directly into the cylinder head exhaust ports.

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Secondary air injection system components

Secondary air injection system components



1. Air pump
2. Filter air duct
3. Air pump mount
4. Air pump bracket
5. Air pump filter
6. O-ring
7. Air pump mini mass air flow sensor
8. Pressure hose
9. O-ring
10. Cylinder head air intake tube
11. Secondary air valve
12. Gasket

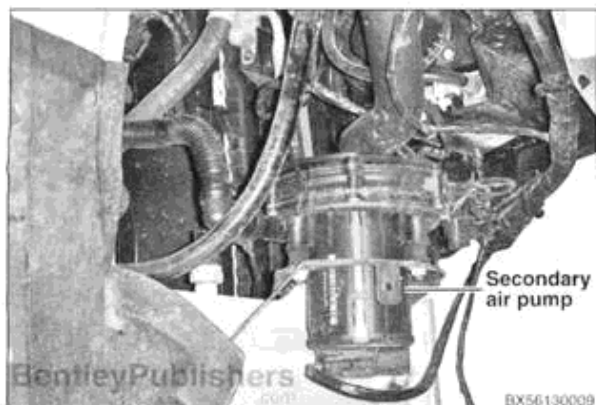


➤ A miniature mass air flow sensor in the secondary air system detects the air mass supplied by the secondary air pump. This function monitors the secondary air system for OBD II compliance.

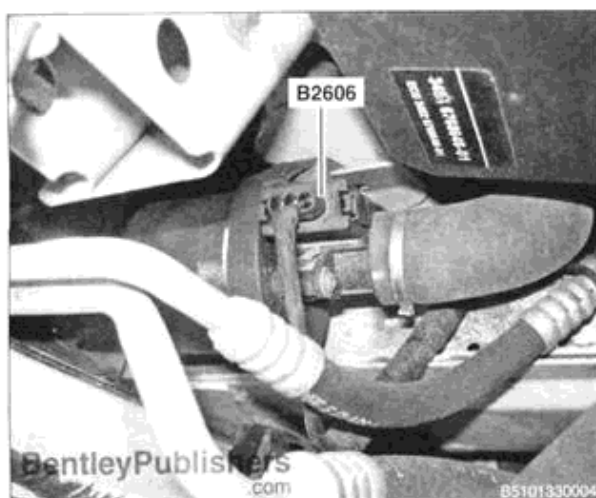
When the mini mass air flow sensor detects no or insufficient air flow, a fault is stored in the ECM and the malfunction indicator light (MIL) is illuminated.

Secondary air injection illustrations

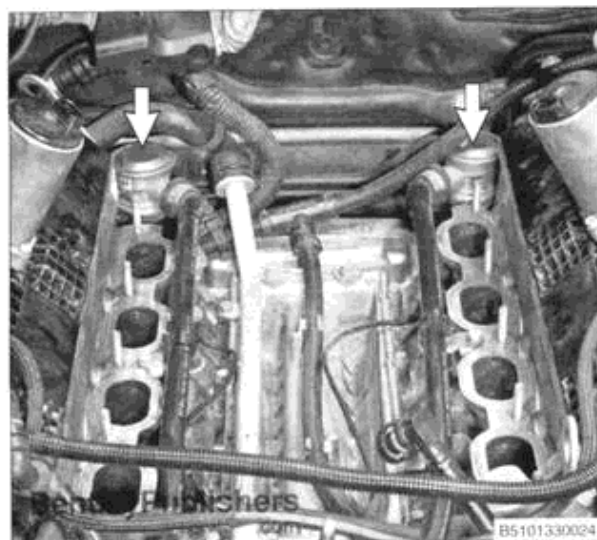
➤ Secondary air pump is in right front fender behind wheel well liner.



➤ B2606 Mini mass air flow sensor.



➤ Secondary air valves (**arrows**) are bolted to the rear of each of cylinder head.



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Air filter housing and duct, removing and installing

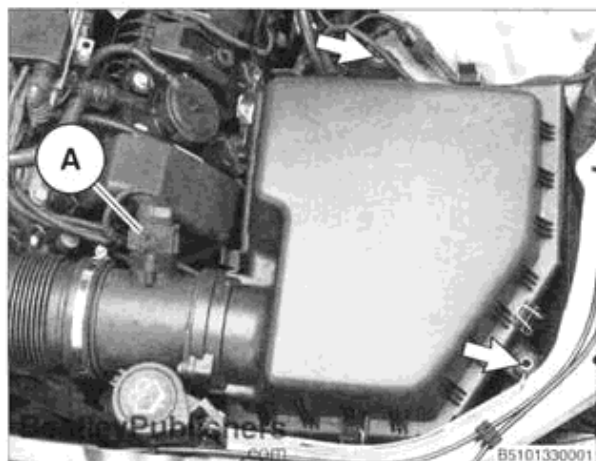
Air filter housing and duct, removing and installing

For air filter element replacement, see **020 Maintenance**.

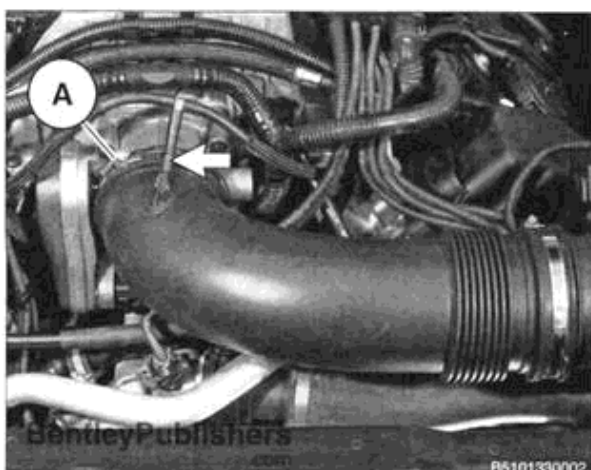
- Remove upper engine covers. See **020 Maintenance**.

Working at air filter housing:

- Disconnect mass air flow sensor electrical connector (**A**).
- Remove filter housing mounting bolts (**arrows**).



- Loosen hose clamp (**A**) at throttle housing and detach vacuum line (**arrow**) from air intake duct.



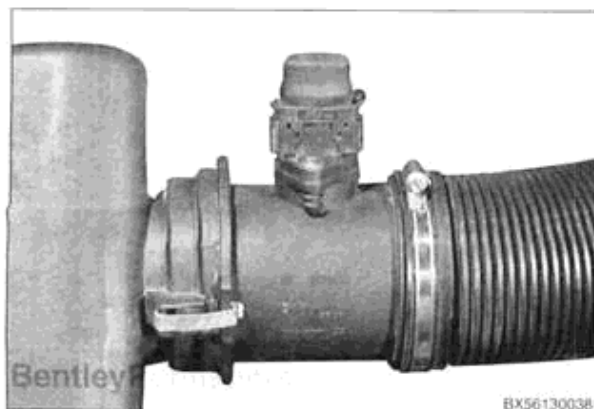
- Remove air filter housing and duct from vehicle.
- Installation is reverse of removal.
- After reinstalling, check and clear fault codes from ECM memory.

Mass air flow, measurement

- The air volume input signal is produced electronically by the hot film mass air flow sensor which uses a heated metal film in the air flow stream to detect the mass of the air flowing past.

The sensor is mounted in the air inlet pipe between the air filter and the throttle valve. As air flows through the sensor, the hot film is cooled, changing the resistance which affects current flow (voltage drop) through the circuit. The ECM monitors this change and regulates the amount of fuel injected.

The mass air flow sensor contains an integral air temperature sensor. The signal from this negative temperature coefficient (NTC) sensor is needed by the ECM to correct the air volume input signal. Changes in intake air temperature (air density) affect the amount of fuel injected, ignition timing and secondary air injection activation.



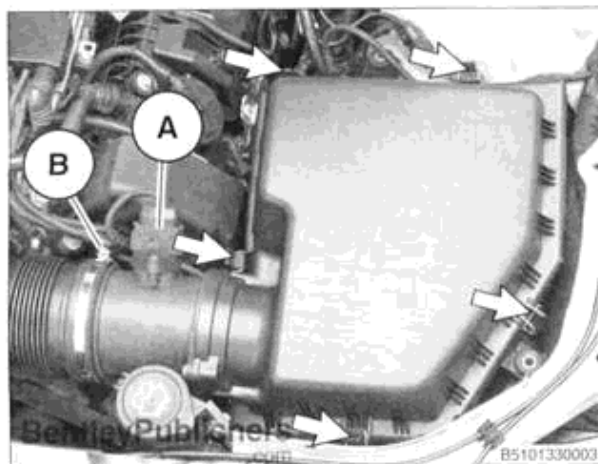
Mass air flow sensor, replacing

- Switch ignition OFF and remove key.



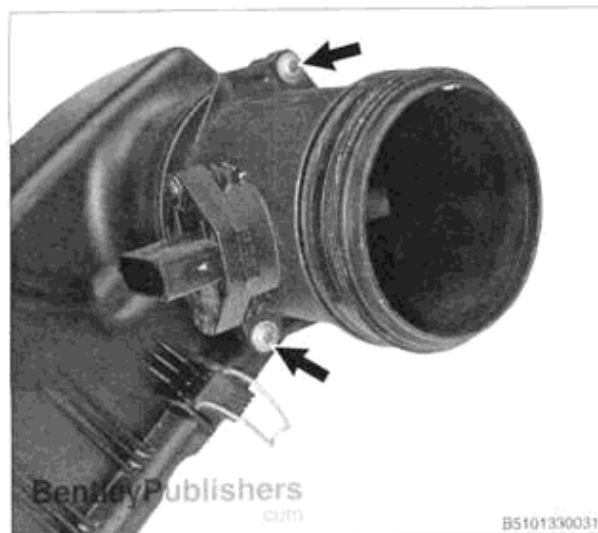
Working at air filter housing:

- Disconnect mass air flow sensor electrical connector (A).
- Unclip filter housing lid (arrows).
- Loosen air duct clamp (A) and remove air filter housing lid from vehicle.



Remove fasteners (arrows) and remove mass air flow sensor from air filter housing.

- Check intake ducts for cracks and vacuum leaks.
- Installation is reverse of removal.
 - Inspect O-ring and replace if necessary.
- After reinstalling, check and clear fault codes from ECM memory.



Throttle housing (EDK), replacing

Accelerator pedal position module (PWG)



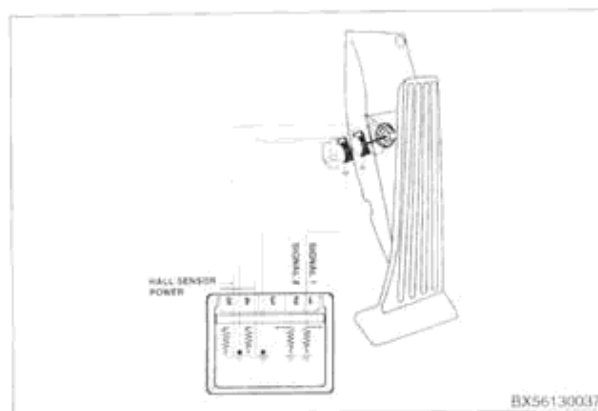
The accelerator pedal position module (PWG) provides two variable voltage signals to the ECM that represent accelerator pedal position and rate of movement. The ECM activates the Valvetronic system based on this input.

Dual Hall sensors are used in the PWG. The ECM compares the values from the two for plausibility. If the signals are not within the plausible range, the ECM uses the lower of the two signals as the driver request input. Acceleration response in that case is slower because maximum Valvetronic opening is reduced.

After replacing the throttle housing, use BMW scan tool to reset adaptation values.

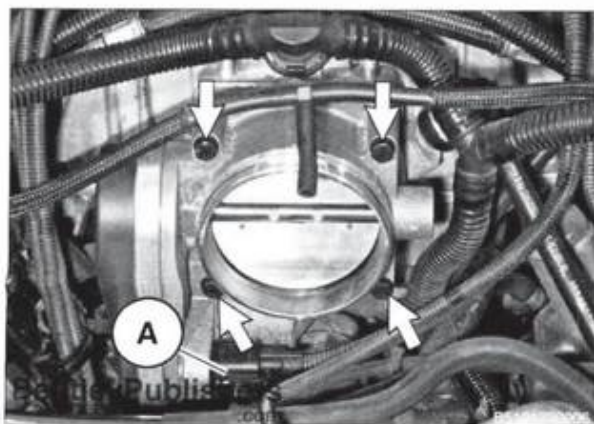
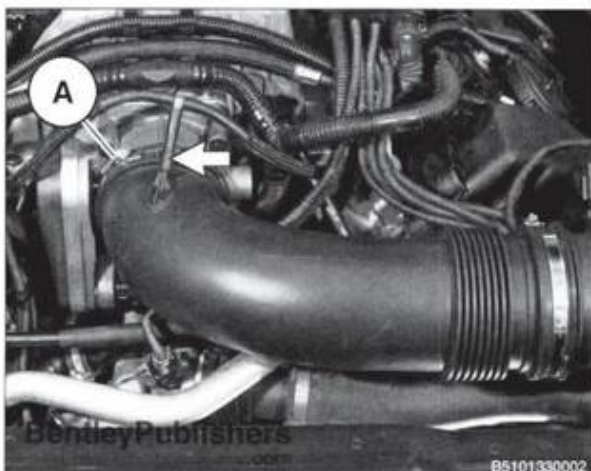
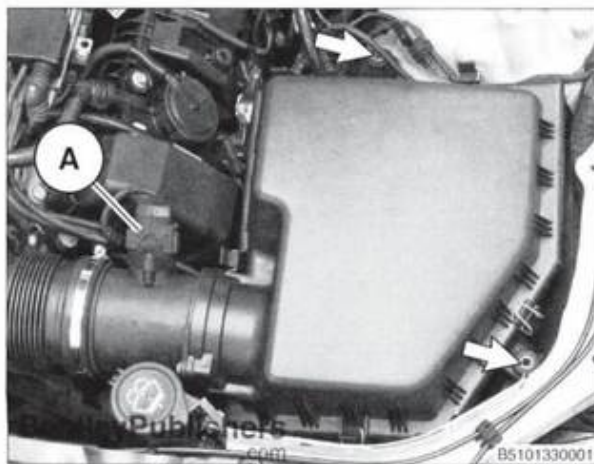
CAUTION—

- If the adaptation process is not completed correctly, the engine does not start.



133-20 Fuel Injection ME 9.2, ME 9.2.2 (V8 Engine)

Throttle housing (EDK), replacing



— Switch ignition OFF and remove key.

— Remove upper engine covers. See **020 Maintenance**.

➤ Working at air filter housing:

- Disconnect mass air flow sensor electrical connector (A).
- Remove filter housing mounting bolts (arrows).

➤ Loosen hose clamp (A) at throttle housing and detach vacuum line (arrow) from air intake duct.

— Remove air filter housing and duct from vehicle.

➤ Working at left side of intake manifold:

- Disconnect electrical connector (A).
- Remove fasteners (arrows) and remove throttle housing.

— Installation is reverse of removal.

— Replace profile gasket (sealing O-ring) between throttle assembly and intake manifold.

— After reinstalling, check and clear fault codes from ECM memory. Reset throttle plate adaptation values following scan tool on-screen instructions.

Valvetronic motor, removing and installing

Right side valvetronic motor shown. Left side is similar.

- Switch ignition OFF and remove key.
- Remove upper engine covers. See **020 Maintenance**.
- Disconnect battery negative (-) cable.

CAUTION—

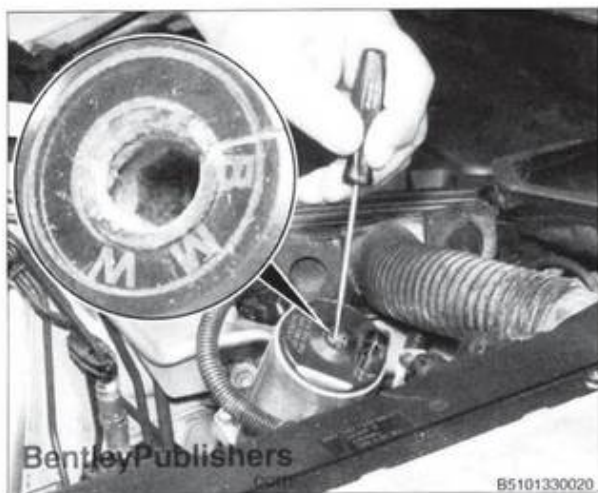
- Prior to disconnecting the battery, read the battery disconnection cautions in **001 Warnings and Cautions**.

- ◀ Disconnect valvetronic motor electrical connector (**arrow**).

- ◀ Locate BMW roundel (logo) at back of valvetronic motor. Using a small pick, chisel center area of roundel to expose Allen head (**inset**).

- ◀ Remove valvetronic motor fasteners (**arrows**).

- Using a 4 mm Allen, gently rotate valvetronic motor shaft counterclockwise until released from eccentric shaft splines.
- Remove valvetronic motor in direction of **arrow**.
- Installation is reverse of removal. Remember to:
 - Route ignition harness correctly
- After reinstalling, check and clear fault codes from ECM memory.



133-22 Fuel Injection ME 9.2, ME 9.2.2 (V8 Engine)

Fuel rail and injectors, removing and installing

Fuel rail and injectors, removing and installing

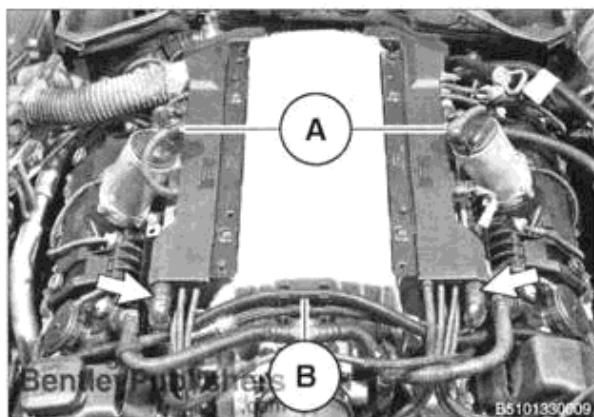
Fuel injectors are electrically controlled solenoid valves that provide precisely metered and atomized fuel into the engine intake ports.

Injectors receive voltage from the DME main relay. The engine control module (ECM) controls injector opening by activating the ground circuit for the injector valve solenoids. The ECM varies the duration (in milliseconds) of injector opening to regulate air / fuel ratio.

- Switch ignition OFF and remove key.
- Remove upper engine covers. See **020 Maintenance**.
- For a quick check of injectors, run engine and touch each injector with a screwdriver or stethoscope. You should feel a vibration or hear a buzzing. Switch engine OFF.
- Disconnect battery negative (-) cable.

CAUTION—

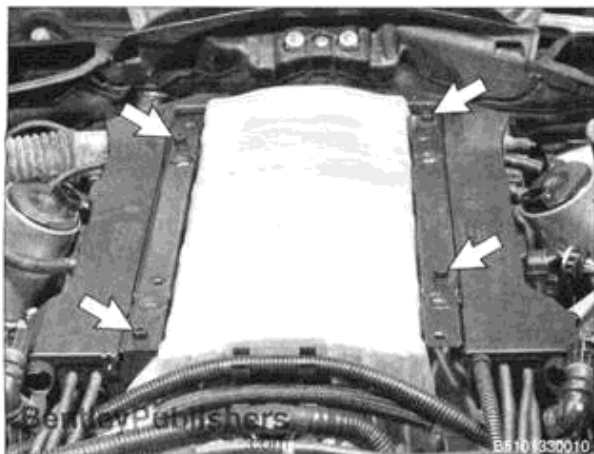
- Prior to disconnecting the battery, read the battery disconnection cautions in **001 Warnings and Cautions**.



- Working above engine, disconnect valvetronic motor electrical connectors (A). Disconnect knock sensor electrical connectors (arrows) and unclip wiring harness from holder (B).

CAUTION—

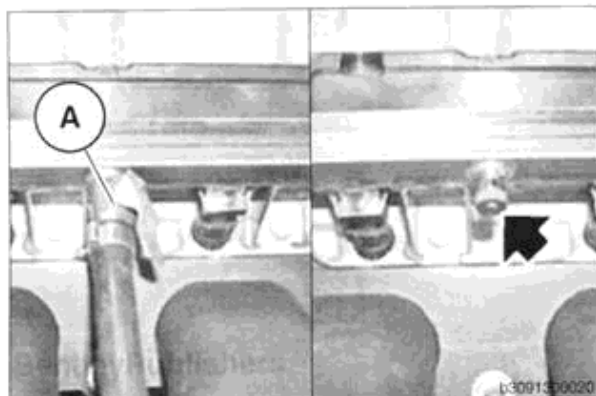
- Be sure to mark oxygen sensor connectors so that they can be reassembled as before.



- Disconnect the following electrical connectors:
 1. Fuel injector electrical connectors at fuel rail, left and right side.
 2. Throttle housing.
 3. Both temperature sensors.
 4. All electrical solenoids.
 5. Alternator.
 6. Manifold pressure sensor.
 7. Intake manifold drive unit.
 8. Camshaft position sensors, left and right side.
 9. Left eccentric shaft sensor.
- Remove wiring harness bracket fasteners (arrows). Lift up and lay wiring harness aside.

Fuel Injection ME 9.2, ME 9.2.2 (V8 Engine) 133-23

Fuel rail and injectors, removing and installing

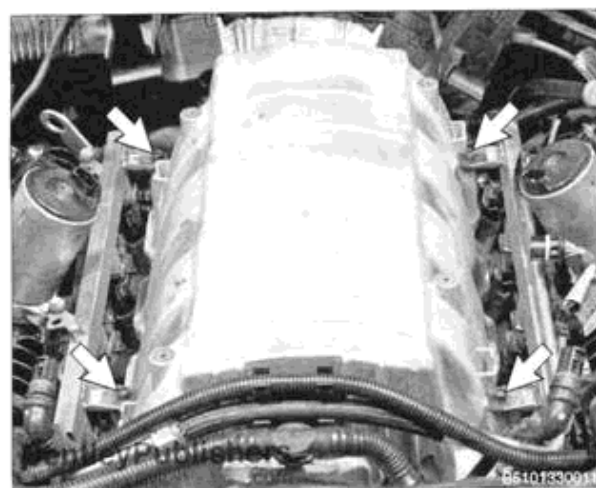


- Unscrew Schrader valve cap (**arrow**) from fuel rail. Connect air line adapter (**A**) to fitting.

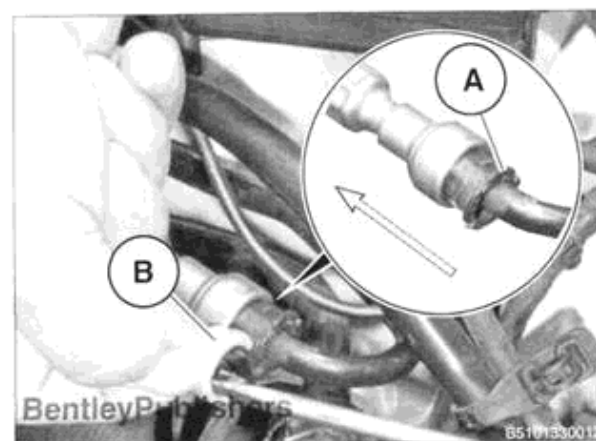
- Unscrew fuel tank cap to release pressure.
- Using a brief burst of compressed air (maximum of 3 bar or 43.5 psi), blow fuel back into fuel tank.

WARNING—

- Fuel in the fuel line is under pressure (approx. 3 - 5 bar or 45 - 75 psi) and may be expelled forcibly. Do not smoke or work near heaters or other fire hazards. Keep a fire extinguisher handy.
- Unscrew the fuel tank cap to release pressure in the tank before working on the fuel line.
- Plug open fuel lines and fittings.



- Working above engine:
 - Remove fuel rail fasteners (**arrows**).
 - Lift left and right side fuel rail up and off engine.



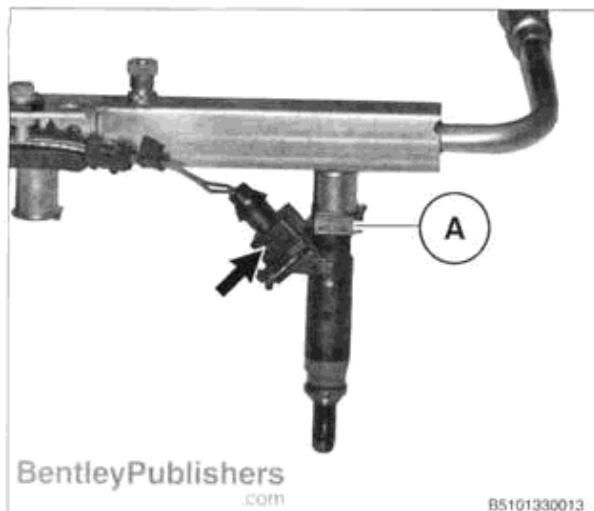
- Using a small flat blade screwdriver, remove fuel line locking collar (**B**). Unlock fuel line by pushing coupler (**A**) in direction of **arrow**. Remove fuel line with from fuel rail from vehicle.

WARNING—

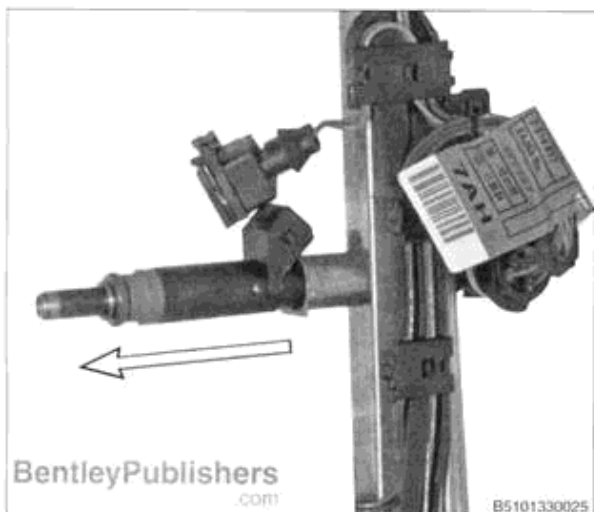
- Wrap a clean shop towel around fitting before disconnecting. Residual fuel pressure is present in the fuel line.

133-24 Fuel Injection ME 9.2, ME 9.2.2 (V8 Engine)

Intake manifold, removing and installing



- Disconnect fuel injector electrical connectors (arrow). Pry retaining clip from injector (A).



- Remove individual injectors:
 - Pull injector from rail (arrow).
- Installation is reverse of removal. Remember to:
 - Fit new sealing O-rings when installing injectors. For ease of installation, lightly lubricate O-rings with assembly lubricant.
 - Check that injector electrical connections are correctly fitted and that injectors are fully seated prior to installing fuel rail mounting bolts.
 - Replace wire ties.

Tightening torque

Fuel rail to cylinder head	10 Nm (7 ft-lb)
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- After reinstalling, check and clear fault codes from ECM memory.

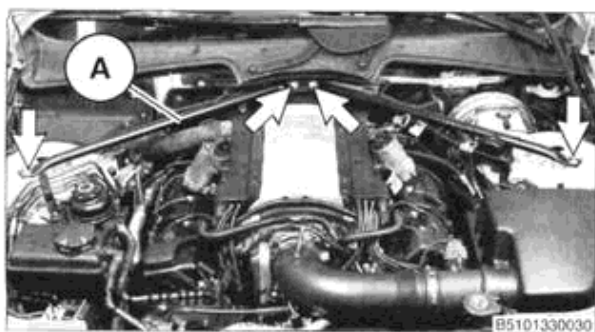
Intake manifold, removing and installing

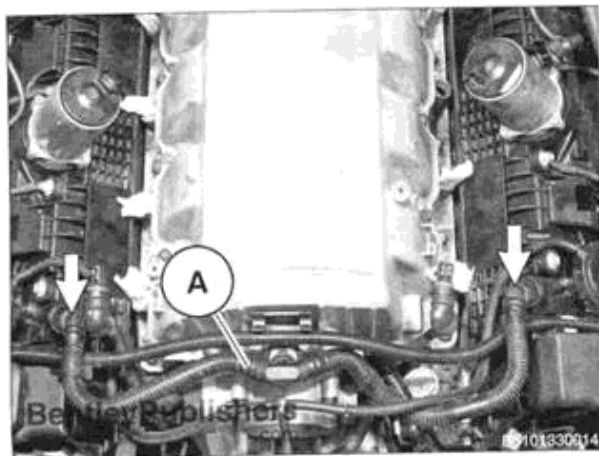
- Disconnect battery negative (-) cable in cargo compartment.

CAUTION—

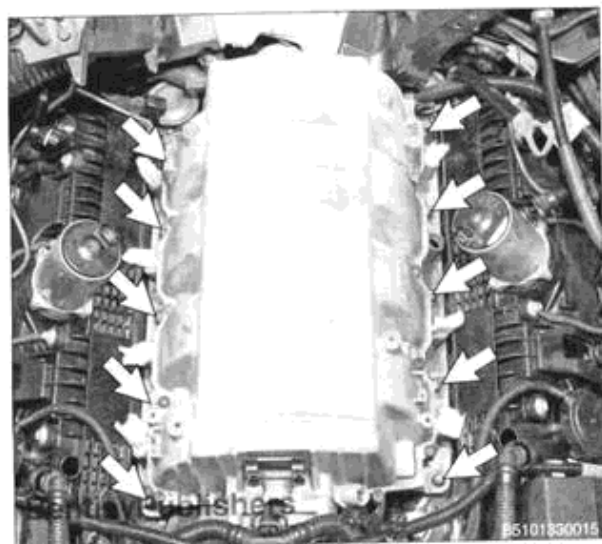
- Prior to disconnecting the battery, read the battery disconnection cautions in 001 Warnings and Cautions.

- Remove upper engine covers. See 020 Maintenance.
- Remove air filter housing and air intake ducts. See Air filter housing and ducts, removing and installing in this repair group.
- Remove and discard tension strut fasteners (arrows). Remove strut brace (A).
- Remove fuel rail. See Fuel injectors, removing and installing in this repair group.





- Disconnect crankcase vent hose (A) from valve covers (arrows). Remove from intake manifold.



- Remove intake manifold fasteners (arrows). With help from an assistant, lift intake manifold up and off engine.
- Installation is reverse of removal. Remember to:
 - Install new gaskets to intake manifold before installing.
 - Clean sealing surfaces.
 - Replace all seals.

Tightening torque

Manifold to cylinder head	
• M6	10 Nm (7.3 ft-lb)
• M7	15 Nm (11 ft-lb)
• M8	22 Nm (16.2 ft-lb)
Tension strut to body (replace fasteners)	30.5 Nm (22.4 ft-lb)

Engine coolant temperature (ECT) sensor, replacing

The engine coolant temperature (ECT) sensor is an NTC (negative temperature coefficient) sensor. As coolant temperature rises, resistance through the sensor decreases.

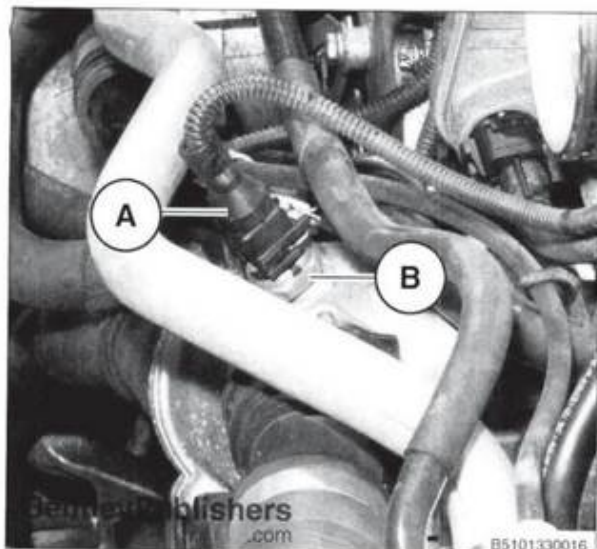
The ECM varies ignition timing and air / fuel mixture based on engine coolant temperature. The ECT sensor is supplied a 5 volt reference voltage. The voltage drop across the sensor varies as the coolant temperature (sensor resistance) changes.

If the ECT sensor input is faulty or not plausible, the MIL is illuminated when OBD II fault criteria are exceeded. The ECM assumes a substitute value (80°C / 176°F) to maintain engine operation. The ignition timing is set to a safely conservative basic setting.

The ECT sensor is located on the front of the engine near thermostat housing.

133-26 Fuel Injection ME 9.2, ME 9.2.2 (V8 Engine)

Radiator outlet coolant temperature sensor



➤ With engine fully cooled off, disconnect ECT sensor connector (A).

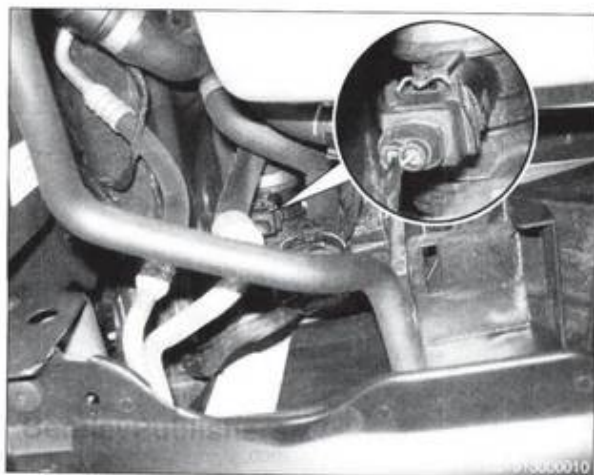
- Unscrew ECT sensor (B) from cylinder head. Be prepared to catch small amount of coolant.
- Installation is reverse of removal:
 - Use new copper sealing washer when installing sensor.
 - Replace lost coolant.

Tightening torque

Temperature sensor to cylinder head	13 Nm (9.5 ft-lb)
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- After reinstalling, check and clear fault codes from ECM memory.

Radiator outlet coolant temperature sensor

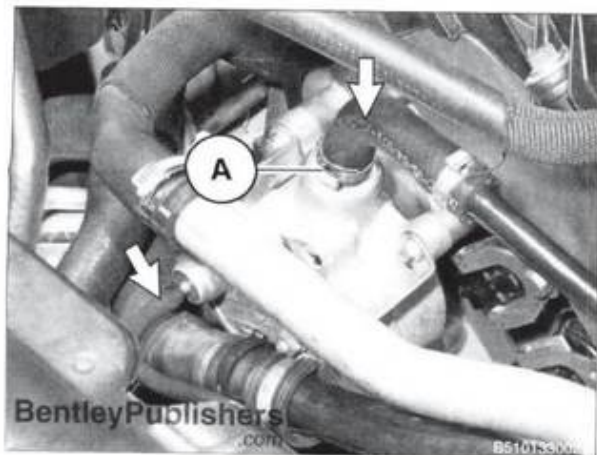


➤ The radiator outlet temperature sensor (**inset**) is an NTC (negative temperature coefficient) sensor. As coolant temperature rises, resistance through the sensor decreases.

The ECM varies cooling fan speed based on radiator outlet coolant temperature. The radiator outlet coolant temperature sensor is supplied a 5 volt reference voltage. Voltage drop across the sensor varies as coolant temperature (sensor resistance) changes.

Vacuum pump, removing and installing

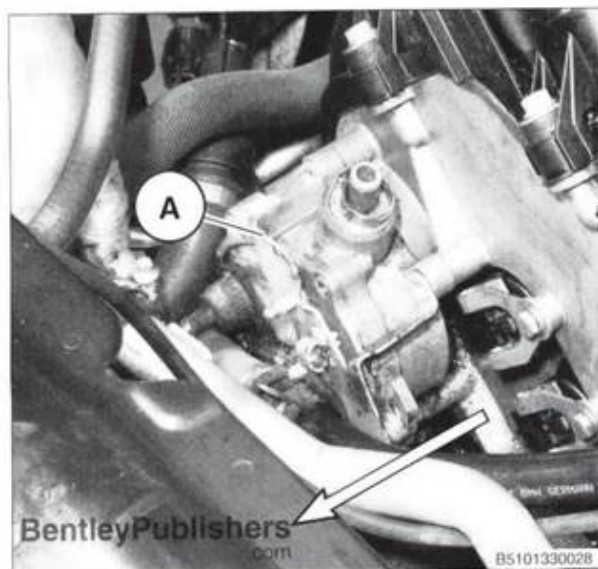
- Pump brake pedal 10 times to reduce vacuum pressure in brake booster.
 - Remove upper engine covers. See **020 Maintenance**.
 - Remove intake air ducts. See **Air filter housing and ducts, removing and installing** in this repair group.
- Remove clamp (A) and vacuum line from pump (arrows).



Remove vacuum pump fasteners (**arrows**).

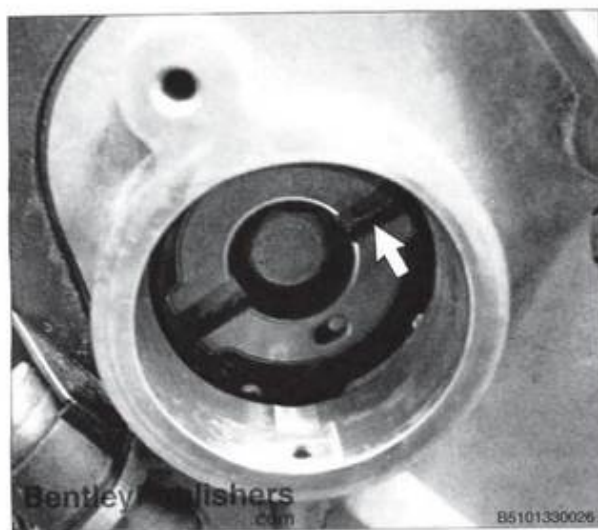


Remove vacuum pump (**A**) from engine.



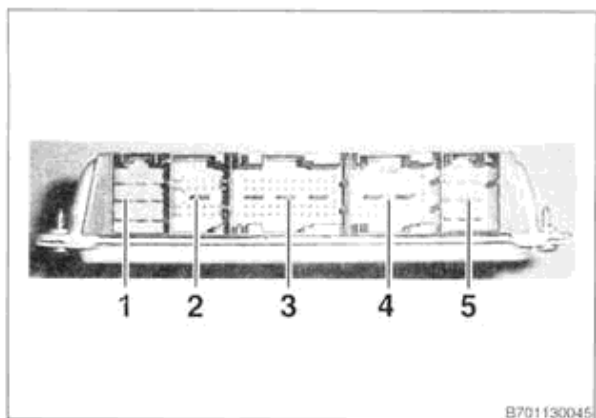
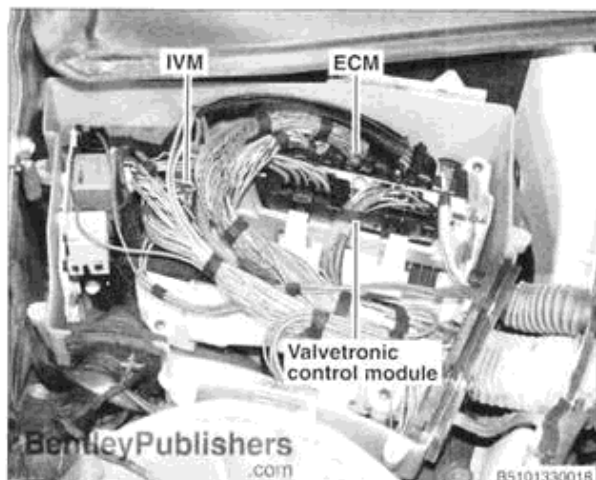
Installation is reverse of removal. Remember to:

- Replace vacuum pump O-ring.
- Properly align pump to camshaft slot (**arrow**).



133-28 Fuel Injection ME 9.2, ME 9.2.2 (V8 Engine)

Bosch ME 9.2, ME 9.2.2 ECM pin assignments



Bosch ME 9.2, ME 9.2.2 ECM pin assignments

➤ The engine control module (ECM) (arrow) is located in the right rear of the engine compartment in the E-box.

➤ The ECM has 5 main electrical harness connectors, for a total 134 pins.

- 1: X60001 (voltage, ground supply)
- 2: X60002 (oxygen sensors)
- 3: X60003 (signals)
- 4: X60004 (signals)
- 5: X60005 (ignition coils)

ECM pin assignments for V8 engines are given in **Table c**. This information can be helpful when diagnosing faults to or from the ECM.

Generally, absence of voltage or continuity means there is a wiring or connector problem. Test results with incorrect values do not necessarily mean that a component is faulty. Check for loose, broken or corroded connections and wiring before replacing components. For engine management system electrical schematics, see **ELE Electrical Wiring Diagrams**.

When making checks at the ECM, use a break-out box to allow tests to be made with the connector attached to the ECM. This prevents damage to the small terminals in the connector. As an alternative, the connector housing can be separated so that electrical checks can be made from the back of the connector.

CAUTION—

- Wait at least one minute after switching the ignition OFF before removing the connector from the ECM. If the connector is removed before this time, residual power in the system relay may damage the ECM.
- Connect or disconnect the control module connector and meter probes with the ignition OFF.

Fuel Injection ME 9.2, ME 9.2.2 (V8 Engine) 133-29

Bosch ME 9.2, ME 9.2.2 ECM pin assignments

Table c. Bosch ME 9.2 ME 9.2.2 ECM pin assignments

Connector X60001 9-pin (signals)

Pin	Type	Component or function	Note
1	-	Not used	
2	-	Not used	
3	input/output	TXD signal	Integrated voltage supply module (IVM)
4	ground	ECM ground	Integrated voltage supply module (IVM)
5	-	Not used	
6	ground	ECM ground	Integrated voltage supply module (IVM)
7	input	Terminal 30	Integrated voltage supply module (IVM)
8	input	Terminal 87	Integrated voltage supply module (IVM)
9	-	Not used	

Connector X60002 24-pin (signals)

Pin	Type	Component or function	Note
1	output	Signal, oxygen sensor heating	Bank 1 sensor 1
2	output	Signal, oxygen sensor heating	Bank 2 sensor 1
3	-	Not used	
4	-	Not used	
5	-	Not used	
6	output	Oxygen sensor heating	Bank 1 sensor 2
7	ground	Oxygen sensor	Bank 1 sensor 1
8	ground	Oxygen sensor	Bank 2 sensor 2
9	ground	Oxygen sensor	Bank 2 sensor 1
10	ground	Oxygen sensor	Bank 1 sensor 2
11	-	Not used	
12	output	Oxygen sensor heating	Bank 2 sensor 2
13	input	Oxygen sensor signal	Bank 1 sensor 1
14	input	Oxygen sensor signal	Bank 2 sensor 2
15	input	Oxygen sensor signal	Bank 2 sensor 1
16	input	Oxygen sensor signal	Bank 1 sensor 2
17	-	Not used	
18	-	Not used	
19	input	Oxygen sensor signal	Bank 1 sensor 1
20	input	Oxygen sensor signal	Bank 1 sensor 1
21	input	Oxygen sensor signal	Bank 2 sensor 1
22	input	Oxygen sensor signal	Bank 2 sensor 1
23	input	Terminal 87	Integrated voltage supply module (IVM)
24	-	Not used	

133-30 Fuel Injection ME 9.2, ME 9.2.2 (V8 Engine)

Bosch ME 9.2, ME 9.2.2 ECM pin assignments

Connector X60003 52-pin (signals)

Pin	Type	Component or function	Note
1	input	Mass air flow sensor signal	Mass air flow sensor
2	input	Intake pipe pressure sensor signal	Intake pipe pressure sensor
3	input	Mass air flow sensor signal	Mass air flow sensor
4	output	5 volt reference voltage	Mass air flow sensor
5	-		
6	output	Fuel injector signal	Fuel injector signal 4
7	output	Fuel injector signal	Fuel injector signal 5
8	output	Fuel injector signal	Fuel injector signal 6
9	output	VANOS solenoid signal	VANOS solenoid intake, bank 2
10	output	VANOS solenoid signal	VANOS solenoid intake, bank 1
11	output	Fuel injector signal	Fuel injector signal 7
12	output	Thermostat heating	Characteristic MAP thermostat
13	output	Fuel injector signal	Fuel injector signal 1
14	ground	Ground	Connector X6460
15	-	Not used	
16	input	Camshaft position sensor signal	Camshaft position sensor, exhaust bank 1
17	input	Camshaft position sensor signal	Camshaft position sensor, exhaust bank 2
18	input / output	Valvetronic control module	Valvetronic control module
19	input / output	BSD signal	Connector X6038
20	output	VANOS solenoid signal	VANOS solenoid, bank 1
21	output	Fuel tank vent valve signal	Fuel tank vent valve
22	-	Not used	
23	output	VANOS solenoid signal	VANOS solenoid exhaust, bank 2
24	output	Fuel injector signal	Fuel injector signal 2
25	output	Fuel injector signal	Fuel injector signal 8
26	output	Fuel injector signal	Fuel injector signal 3
27	output	Crankshaft position sensor signal	Crankshaft position sensor
28	input	Engine coolant temperature sensor signal	Engine coolant temperature sensor
29	input	Camshaft position sensor signal	Camshaft position sensor, intake bank 1
30	input	Camshaft position sensor signal	Camshaft position sensor, intake bank 2
31	input	Throttle valve signal	Throttle valve
32	input	Throttle valve signal	Throttle valve
33	input	Knock sensor signal	Knock sensor 1
34	input	Knock sensor signal	Knock sensor 1
35	input	Knock sensor signal	Knock sensor 2
36	input	Knock sensor signal	Knock sensor 2
37	ground	Ground	Connector X6450

Fuel Injection ME 9.2, ME 9.2.2 (V8 Engine) 133-31

Bosch ME 9.2, ME 9.2.2 ECM pin assignments

Connector X60003 52-pin (signals) (continued)			
Pin	Type	Component or function	Note
38	input / output	Signal PT-CAN high	Valvetronic control module
39	-	Not used	
40	output	Variable intake manifold changeover valve signal	
41	output	Variable intake manifold changeover valve signal	Knock sensor
42	output	Throttle valve signal	Throttle valve
43	output	Throttle valve signal	Throttle valve
44	-	Not used	
45	input	Variable intake manifold changeover valve signal	
46	input	Knock sensor signal	Knock sensor 1
47	input	Knock sensor signal	Knock sensor 1
48	input	Knock sensor signal	Knock sensor 2
49	input	Knock sensor signal	Knock sensor 2
50	output	Throttle valve signal	Throttle valve
51	input / output	Signal PT-CAN high	Valvetronic control module
52	ground	Throttle valve signal	Throttle valve

Connector X60004 40-pin (signals)			
Pin	Type	Component or function	Note
1	-	Not used	
2	input	DMTL signal	Diagnostic module for fuel tank leakage
3	output	Secondary air pump relay	Secondary air pump
4	output	Engine cooling fan signal	Engine cooling fan
5	input	Secondary air mass air flow signal	Secondary air mass air flow sensor
6	-	Not used	
7	ground	Accelerator pedal module	Accelerator pedal module
8	input	Accelerator pedal module signal	Accelerator pedal module
9	output	Accelerator pedal module	Accelerator pedal module
10	output	Fuel pump relay activation	Fuel pump relay
11	-	Not used	
12	ground	Accelerator pedal module	Accelerator pedal module
13	input	Accelerator pedal module	Accelerator pedal module
14	output	Accelerator pedal module	Accelerator pedal module
15	ground	Secondary air mass air flow sensor	Secondary air mass air flow sensor
16	output	Tailpipe flap signal	Tailpipe flap
17	output	TD signal	Connector X243
18	output	Tailpipe flap signal	Tailpipe flap
19	output	E-box cooling fan signal	E-box cooling fan

133-32 Fuel Injection ME 9.2, ME 9.2.2 (V8 Engine)

Bosch ME 9.2, ME 9.2.2 ECM pin assignments

Connector X60004 40-pin (signals) (continued)

Pin	Type	Component or function	Note
20	input	DMTL signal	Diagnostic module for fuel tank leakage
21	output	Radiator shutter signal	Radiator shutter
22	input	Processed wheel speed	Right rear wheel
23	input	Clutch switch signal	Clutch switch
24	input	Brake light switch	Connector X181
25	input	Oil pressure switch signal	Oil pressure switch
26	input	Terminal 15	Wake up signal
27	-	Not used	
28	input	Brake light switch signal	Test signal
29	-	Not used	
30	input	DMTL signal	Diagnostic module for fuel tank leakage
31	-	Not used	
32	-	Not used	
33	input	EWS signal	Car access system (CAS)
34	-	Not used	
35	-	Not used	
36	input / output	Signal PT-CAN high	CAN bus connector
37	input / output	Signal PT-CAN high	CAN bus connector
38	input	Engine coolant temperature sensor signal	Engine coolant temperature sensor, radiator outlet
39	input	Engine coolant temperature sensor signal	Engine coolant temperature sensor, radiator outlet
40	input	Start signal	Car access system (CAS)

Connector X60005 9-pin (ignition coils)

Pin	Type	Component or function	Note
1	output	Ignition coil signal	Ignition coil signal 3
2	output	Ignition coil signal	Ignition coil signal 4
3	output	Ignition coil signal	Ignition coil signal 1
4	output	Ignition coil signal	Ignition coil signal 7
5	ground	Ground	
6	output	Ignition coil signal	Ignition coil signal 8
7	output	Ignition coil signal	Ignition coil signal 2
8	output	Ignition coil signal	Ignition coil signal 6
9	output	Ignition coil signal	Ignition coil signal 5

