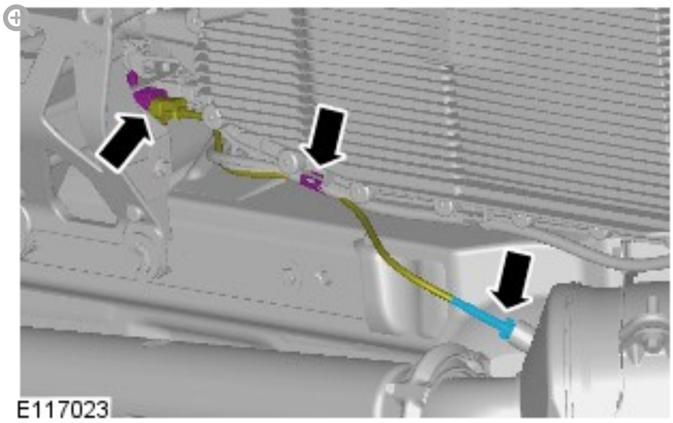
3.

Make sure that the mating faces are clean and free of corrosion and foreign material.



Torque: **35 Nm**

INSTALLATION

1.

- Make sure the anti-seize compound does not contact the catalyst monitor sensor tip.
- If accidentally dropped or knocked install a new sensor.
- Make sure that the wiring harness is not twisted or damaged on installation. Failure to follow this instruction may result in damage to the vehicle.

If the original sensor is to be installed, apply lubricant meeting specification ESE-M12A4-A to the thread of the sensor.

To install, reverse the removal procedure.

ELECTRONIC ENGINE CONTROLS - TDV6 3.0L DIESEL

POST DPF EXHAUST GAS TEMPERATURE SENSOR [G1269247]

+

REMOVAL

Removal steps in this procedure may contain installation details.

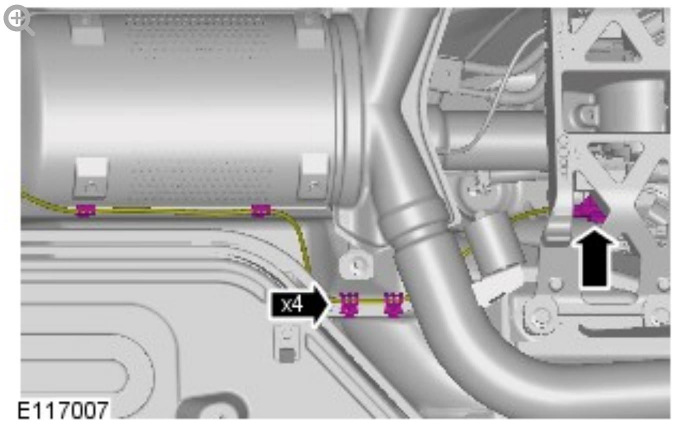
1. Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

2. Refer to: Air Deflector (501-02 Front End Body Panels, Removal and Installation).

3.

> Note the fitted position of the component prior to removal.



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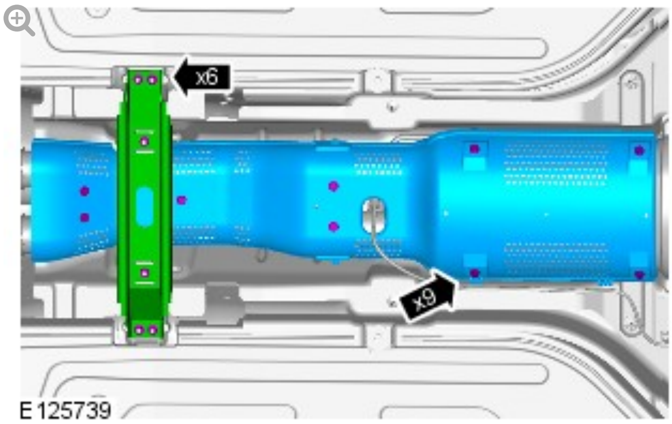
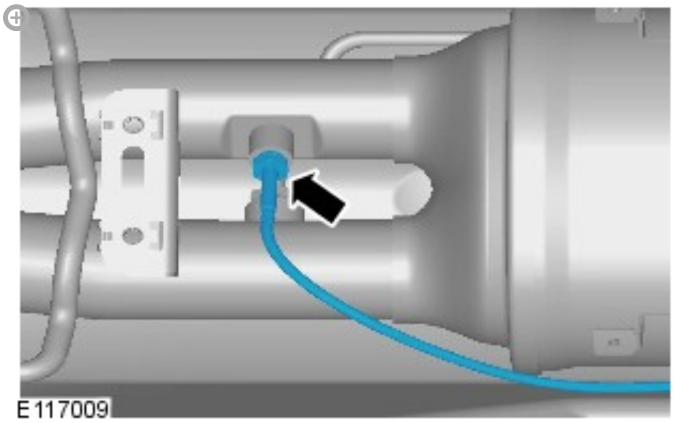


Torque: **9 Nm**

5.

> Make sure that the mating faces are clean and free of corrosion and foreign material.



Torque: **35 Nm**

INSTALLATION

1.

- Make sure the anti-seize compound does not contact the catalyst monitor sensor tip.
- If accidentally dropped or knocked install a new sensor.
- Make sure that the wiring harness is not twisted or damaged on installation. Failure to follow this instruction may result in damage to the vehicle.

If the original sensor is to be installed, apply lubricant meeting specification ESE-M12A4-A to the thread of the sensor.

To install, reverse the removal procedure.

ELECTRONIC ENGINE CONTROLS - TDV6 3.0L DIESEL

PRE CATALYTIC CONVERTER TEMPERATURE SENSOR [G1269248]

REMOVAL

Removal steps in this procedure may contain installation details.

1.

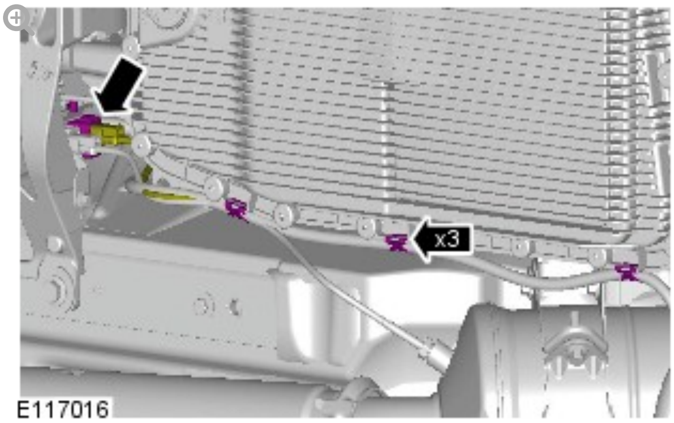
Make sure to support the vehicle with axle stands.

Raise and support the vehicle.

2. Refer to: Air Deflector (501-02 Front End Body Panels, Removal and Installation).

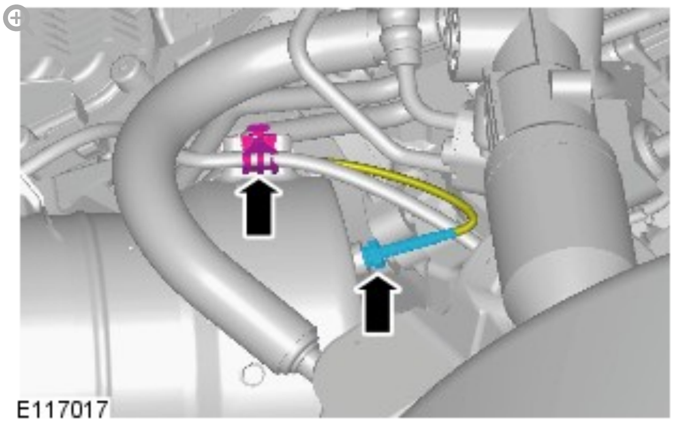
3.

Note the fitted position of the component prior to removal.



4.

Make sure that the mating faces are clean and free of corrosion and foreign material.



Torque: **35 Nm**

INSTALLATION

1.

- Make sure the anti-seize compound does not contact the catalyst monitor sensor tip.
- If accidentally dropped or knocked install a new sensor.
- Make sure that the wiring harness is not twisted or damaged on installation. Failure to follow this instruction may result in damage to the vehicle.

If the original sensor is to be installed, apply lubricant meeting specification ESE-M12A4-A to the thread of the sensor.

To install, reverse the removal procedure.

ELECTRONIC ENGINE CONTROLS - TDV6 3.0L DIESEL

PRE DPF EXHAUST GAS TEMPERATURE SENSOR [G1269249]

+

REMOVAL

Removal steps in this procedure may contain installation details.

1.

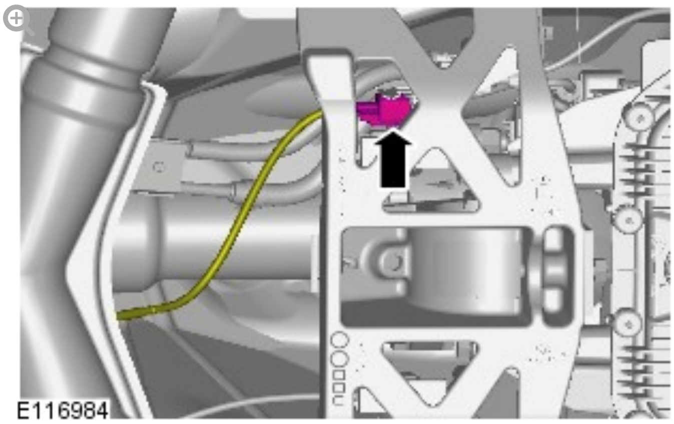
   Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

2. Refer to: Air Deflector (501-02 Front End Body Panels, Removal and Installation).

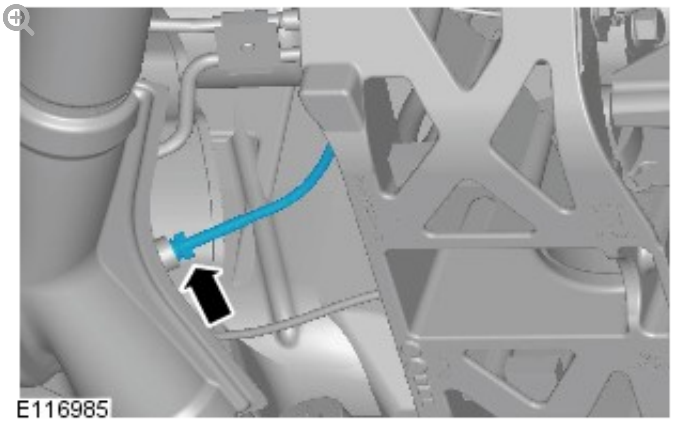
3.

Note the fitted position of the component prior to removal.



4.

Make sure that the mating faces are clean and free of corrosion and foreign material.



Torque: **35 Nm**

INSTALLATION

1.

- Make sure the anti-seize compound does not contact the catalyst monitor sensor tip.
- If accidentally dropped or knocked install a new sensor.
- Make sure that the wiring harness is not twisted or damaged on installation. Failure to follow this instruction may result in damage to the vehicle.

If the original sensor is to be installed, apply lubricant meeting specification ESE-M12A4-A to the thread of the sensor.

To install, reverse the removal procedure.

ELECTRONIC ENGINE CONTROLS - TDV6 3.0L DIESEL

RIGHT EXHAUST GAS TEMPERATURE SENSOR [G1269243]

REMOVAL

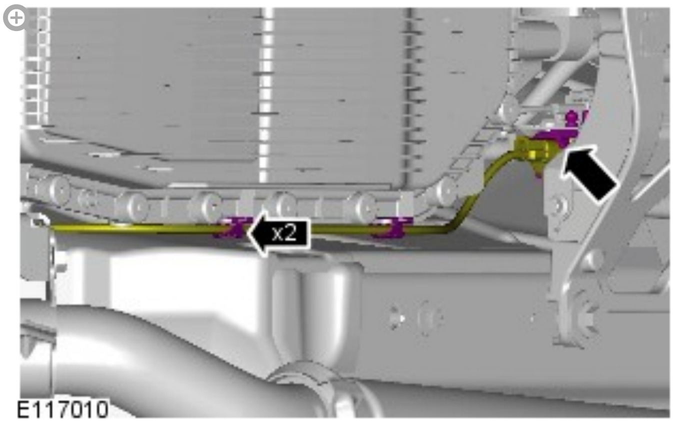
Removal steps in this procedure may contain installation details.

1. Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

2. Refer to: Air Deflector (501-02 Front End Body Panels, Removal and Installation).

3. Note the fitted position of the component prior to removal.



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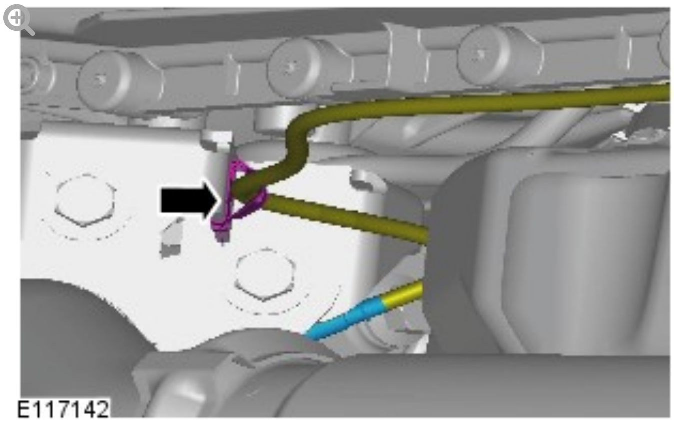
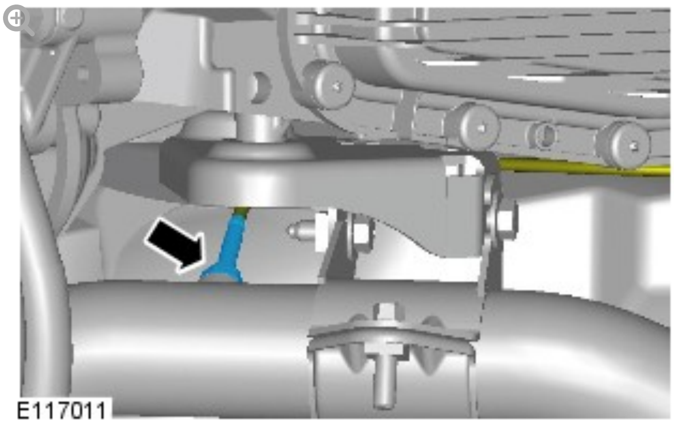


5.

Make sure that the mating faces are clean and free of corrosion and foreign material.



Torque: **35 Nm**

INSTALLATION

1.

- Make sure the anti-seize compound does not contact the catalyst monitor sensor tip.
- If accidentally dropped or knocked install a new sensor.
- Make sure that the wiring harness is not twisted or damaged on installation. Failure to follow this instruction may result in damage to the vehicle.

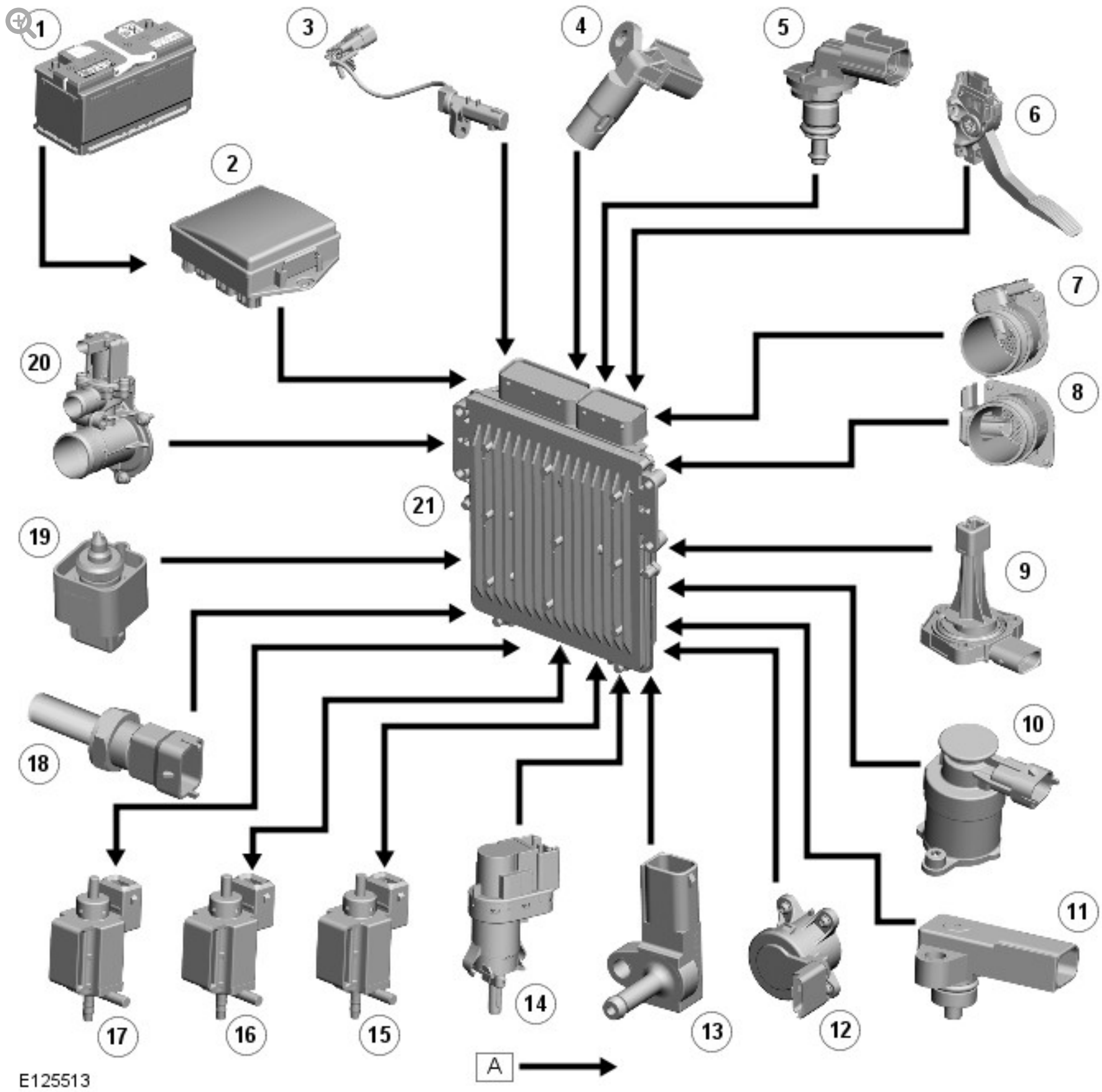
If the original sensor is to be installed, apply lubricant meeting specification ESE-M12A4-A to the thread of the sensor.

To install, reverse the removal procedure.

ELECTRONIC ENGINE CONTROLS - SYSTEM OPERATION AND COMPONENT DESCRIPTION

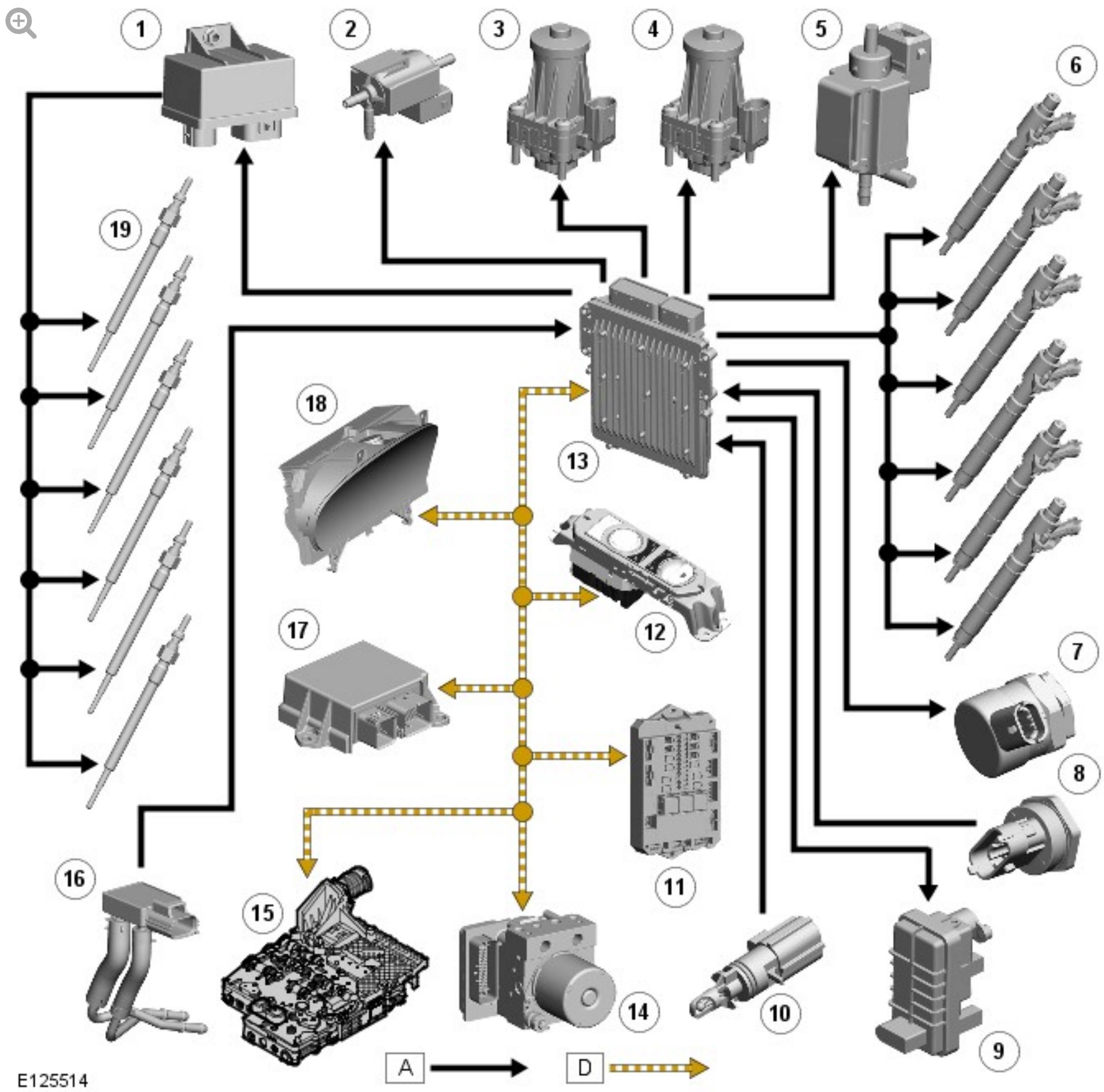
[G1245436]

CONTROL DIAGRAM



NOTE:	**A** = Hardwired
1	Battery
2	Engine Junction Box (EJB)
3	Crankshaft Position (CKP) sensor
4	Camshaft Position (CMP) sensor
5	Engine Coolant Temperature (ECT) sensor
6	Accelerator Pedal Position (APP) sensor
7	Mass Air Flow (MAF)/Intake Air Temperature (IAT) sensor
8	Mass Air Flow (MAF) sensor
9	Engine oil level/temperature sensor

10	Fuel volume control valve
11	Manifold Absolute Pressure (MAP) sensor
12	Throttle actuator
13	Secondary turbocharger boost pressure sensor
14	Brake lamp/brake test switch
15	Exhaust Gas Recirculation (EGR) solenoid valve
16	Secondary turbocharger turbine shut-off solenoid valve
17	Secondary turbine compressor shut-off solenoid valve
18	Fuel temperature sensor
19	Water in fuel sensor
20	Secondary turbocharger recirculation valve
21	Engine Control Module (ECM)



NOTE:	**A** = Hardwired; **D** = High Speed Controller Area Network (CAN) bus
1	Glow plug relay
2	Active engine mounts solenoid valve
3	Left Hand (LH) Exhaust Gas Recirculation (EGR) valve
4	Right Hand (RH) Exhaust Gas Recirculation (EGR) valve
5	EGR cooler bypass vacuum solenoid valve
6	Fuel injector (6 off)
7	Fuel pressure control valve
8	Fuel pressure sensor
9	Primary turbocharger control module

10	Charge air temperature sensor
11	Central Junction Box (CJB)
12	JaguarDrive selector
13	Engine Control Module (ECM)
14	Anti-lock Brake System (ABS) module
15	Transmission Control Module (TCM)
16	Differential pressure sensor
17	Restraints Control Module (RCM)
18	Instrument cluster
19	Glow plug (6 off)

SYSTEM OPERATION

OPERATION

The 3.0L V6 diesel engine management system is controlled by an ECM (engine control module) and is able to monitor, adapt and precisely control the fuel injection. The ECM uses multiple sensor inputs and precision control of actuators to achieve optimum performance during all driving conditions.

The ECM controls fuel delivery to all six cylinders via a common rail injection system. The common rail system uses a fuel rail to accumulate highly pressurized fuel and feed the six, electronically controlled injectors. The fuel rail is located in close proximity to the injectors, which assists in maintaining full system pressure at each injector at all times.

The ECM uses the drive by wire principle for acceleration control. There are no control cables or physical connections between the accelerator pedal and the engine. Accelerator pedal demand is communicated to the ECM by two potentiometers located in an APP (accelerator pedal position) sensor. The ECM uses the two signals to determine the position, rate of movement and direction of movement of the pedal. The ECM then uses this data, along with other engine information from other sensors, to achieve the optimum engine response.

COMPONENT DESCRIPTION

DESCRIPTION

The ECM is located on a bracket on the passenger side of the engine compartment bulkhead.

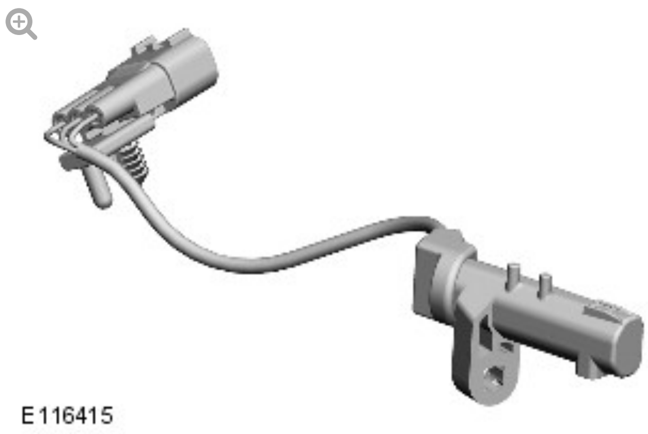
The ECM connected to the vehicle harnesses via 2 connectors. The ECM contains data processors and memory microchips. The output signals to the actuators are in the form of ground paths provided by driver circuits within the ECM. The ECM driver circuits produce heat during normal operation and dissipate this heat via the casing. Some sensors receive a regulated voltage supplied by the ECM. This avoids incorrect signals caused by voltage drop during cranking.

The ECM performs self diagnostic routines and stores fault codes in its memory. These fault codes and diagnostics can be accessed using a Jaguar approved diagnostic system. If the ECM is to be replaced, the new ECM is supplied 'blank' and must be configured to the vehicle using a Jaguar approved diagnostic system. A 'flash' EEPROM (electrically erasable programmable read only memory) allows the ECM to be externally configured, using a Jaguar approved diagnostic system, with market specific or new tune information. The current engine tune data can be accessed and read using a Jaguar approved diagnostic system.

When a new ECM is fitted, it must also be synchronized to other system control modules using a Jaguar approved diagnostic system. ECM's cannot be 'swapped' between vehicles as they must be 'matched' with security information to other system modules.

The ECM is connected to the engine sensors which allow it to monitor the engine operating conditions. The ECM processes these signals and decides the actions necessary to maintain optimum engine performance in terms of drive ability, fuel efficiency and exhaust emissions. The memory of the ECM is programmed with instructions for how to control the engine. The memory also contains data in the form of maps which the ECM uses as a basis for fuelling and emission control. By comparing the information from the sensors to the data in the maps, the ECM is able to calculate the various output requirements. The ECM contains an adaptive strategy which updates the system when components vary due to production tolerances or ageing.

The ECM is connected to other system control modules and receives data from these modules on the high speed CAN (controller area network) bus to enable precise engine control under all vehicle operating conditions.



The CKP (crankshaft position) sensor is located at the rear of the engine block on the LH (left-hand) side. The sensor lead passes through a cover in an aperture on the side of the engine block. The sensor is secured to a bracket on a plate which locates the rear crankshaft oil seal. The sensor tip is aligned with a magnetic trigger reluctor wheel which is attached to the end of the crankshaft. The trigger wheel is a press fit on the end of the crankshaft. The trigger wheel must be carefully aligned to the crankshaft to ensure correct timing. The sensor produces a square wave signal, the frequency of which is proportional to engine speed.

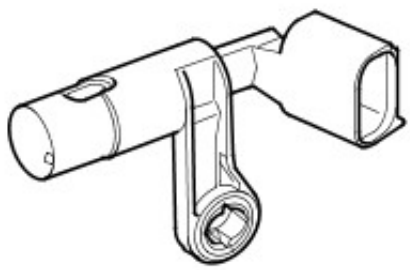
The ECM monitors the CKP sensor signal and can detect engine over-speed. The ECM counteracts engine over-speed by gradually fading out speed synchronized functions. The CKP is a Hall effect sensor. The sensor measures the magnetic field variation induced by the magnetized trigger wheel.

The trigger wheel has a 60 minus 2 tooth pattern. The missing teeth represent 12° of crankshaft rotation and provide a reference point for the angular position of the crankshaft at 21° BTDC (before top dead center) on cylinder 1.

When the space with the two missing teeth pass the sensor tip, a gap in the signal is produced which the ECM uses to determine the crankshaft position. The air gap between the sensor tip and the ring is important to ensure correct signals are output to the ECM. The recommended air gap between the CKP and the trigger wheel is 0.4 mm- 1.5 mm.

The ECM uses the signal from the CKP sensor for the following functions:

- Synchronization
- Determine fuel injection timing
- Produce an engine speed signal which is broadcast on the high speed CAN bus for use by other systems.



E46902

The CMP (camshaft position) is located on the front face of the LH cylinder head. The sensor tip protrudes through an aperture in the front face of the cylinder head to pick up on a reluctor behind the camshaft pulley. The CMP sensor is a Hall effect type sensor.

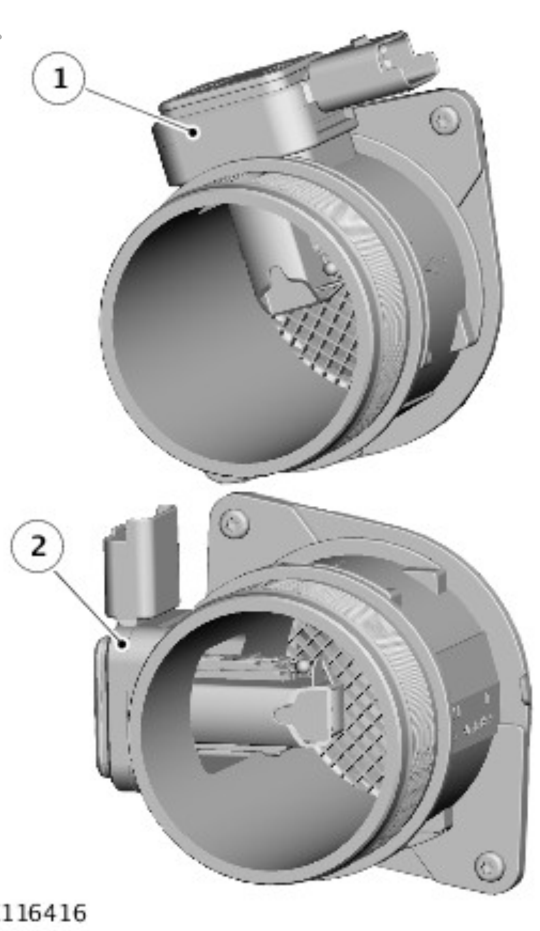
The ECM uses the CMP sensor signal to determine if the piston in No. 1 cylinder is at injection TDC (top dead center) or exhaust TDC. Once this has been established, the ECM can then operate the correct injector to inject fuel into the cylinder when the piston is at injection TDC

The CMP sensor is a Hall effect sensor which used by the ECM at engine start-up to synchronize the ECM with the CKP sensor signal. The ECM does this by using the CMP sensor signal to identify number one cylinder to ensure the correct injector timing. Once the ECM has established the injector timing, the CMP sensor signal is no longer used.

The CMP sensor receives a 5V supply from the ECM. Two further connections to the ECM provide ground and signal output.

If a fault occurs, an error is registered in the ECM. Two types of failure can occur; no CMP sensor signal or a synchronization error of the CMP and CKP sensors. The error recorded by the ECM can also relate to a total failure of the crankshaft signal or crankshaft signal dynamically implausible. Both components should be checked to determine the cause of the fault.

If a fault occurs with the CMP sensor when the engine is running, the engine will continue to run but the ECM will deactivate boost pressure control. Once the engine is switched off, the engine will crank but will not restart while the fault is present.



1	MAF (mass air flow) sensor
2	MAF/IAT (intake air temperature) sensor

The MAF/IAT sensors are located on the inlet air duct directly after the air filter box. Two sensors are fitted; the lower sensor is a combined MAF/IAT sensor and the upper sensor is a MAF sensor only.

The MAF sensors work on the hot film principle. Each sensor has 2 sensing elements which are contained within a film. One element is maintained at ambient (air intake) temperature, e.g. 25°Celsius (77°F). The other element is heated to 200°Celsius (392°F) above the ambient temperature, e.g. 225°Celsius (437°F). Intake air entering the engine passes through the MAF sensors and has a cooling effect on the film. The ECM monitors the current required to maintain the 200°Celsius (392°F) differential between the two elements and uses the differential to provide a precise, non-linear, signal which equates to the volume of air being drawn into the engine.

The MAF sensor output is a digital signal proportional to the mass of the incoming air. The ECM uses this data, in conjunction with signals from other sensors and information from stored fuelling maps, to determine the precise fuel quantity to be injected into the cylinders. The signal is also used as a feedback signal for the EGR (exhaust gas recirculation) system.

The IAT sensor in the lower sensor incorporates a NTC (negative temperature coefficient) thermistor in a voltage divider circuit. The NTC thermistor works on the principle of decreasing resistance in the sensor as the temperature of the intake air increases. As the thermistor allows more current to pass to ground, the voltage sensed by the ECM decreases. The change in voltage is proportional to the temperature change of the intake air. Using the voltage output from the IAT sensor, the ECM can correct the fuelling map for intake air temperature. The correction is an important requirement because hot air contains less oxygen than cold air for any given volume.

The MAF sensor receives a 12V supply from the EJB (engine junction box) and a ground connection via the ECM. Two further connections to the ECM provide a MAF signal and IAT signal.

The IAT sensor receives a 3.3V reference voltage from the ECM and shares a ground with the MAF sensor. The signal output from the IAT sensor is calculated by the ECM by monitoring changes in the supplied reference voltage to the IAT sensor voltage divider circuit.

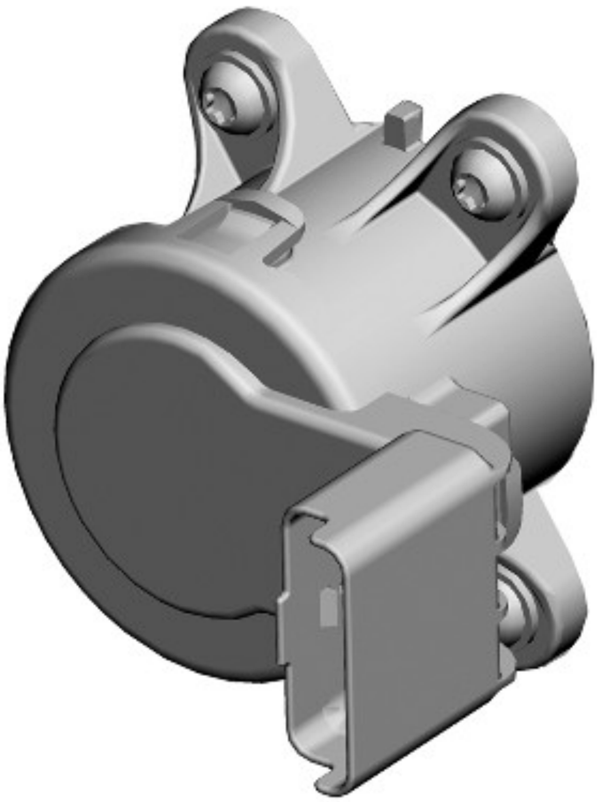
The ECM checks the calculated air mass against the engine speed. If the calculated air mass is not plausible, the ECM uses a default air mass figure which is derived from the average engine speed compared to a stored characteristic map. The air mass value will be corrected using values for boost pressure, atmospheric pressure and air temperature.

If one of the MAF sensor fails the ECM implements the default strategy based on engine speed. In the event of a MAF sensor signal failure, the following symptoms may be observed:

- EGR system off
- Delayed engine response
- Reduced engine performance.

If the IAT sensor fails the ECM uses a default intake air temperature of 40° Celsius (104°F). In the event of an IAT sensor failure, the following symptom may be observed:

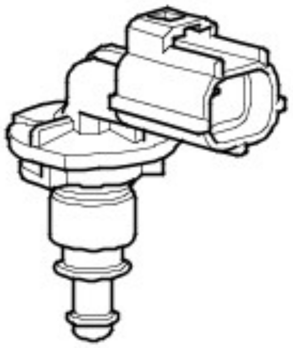
- Under fuelling, resulting in reduced engine performance.



E116417

The electronic throttle actuator is located on the side of the throttle intake manifold.

The electronic throttle actuator controls the volume of air allowed into the inlet manifolds by means of a DC motor which controls a flap in the body of the throttle. The actuator is controlled by the ECM which operates the actuator in response to driver inputs from the APP sensor and other engine related sensors to provide the correct air flow to the intake manifolds.



E46905

The ECT (engine coolant temperature) sensor is located in the LH EGR cooler coolant inlet pipe, at the front of the engine. The ECT sensor provides the ECM and the instrument cluster with engine coolant temperature status.

The ECM uses the temperature information for the following functions:

- Fuelling calculations
- Limit engine operation if engine coolant temperature becomes too high
- Cooling fan operation
- Glow plug activation time.

The instrument cluster uses the temperature information for generation of engine temperature messages. The engine coolant temperature signal is also transmitted on the medium speed CAN bus by the instrument cluster for use by other systems.

The ECT sensor circuit consists of an internal voltage divider circuit which incorporates an NTC thermistor. As the coolant temperature rises the resistance through the sensor decreases and vice versa. The output from the sensor is the change in voltage as the thermistor allows more current to pass to ground relative to the temperature of the coolant.

The ECM compares the signal voltage to stored values and adjusts fuel delivery to ensure optimum drive ability at all times. The engine will require more fuel when it is cold to overcome fuel condensing on the cold metal surfaces inside the combustion chamber. To achieve a richer air/fuel ratio, the ECM extends the injector opening time. As the engine warms up the air/fuel ratio is leaned off.

The input to the sensor is a 3.3V reference voltage supplied from the voltage divider circuit within the ECM. The ground from the sensor is also connected to the ECM which measures the returned current and calculates a resistance figure for the sensor which relates to the coolant temperature.

If the ECT sensor fails, the following symptoms may be observed:

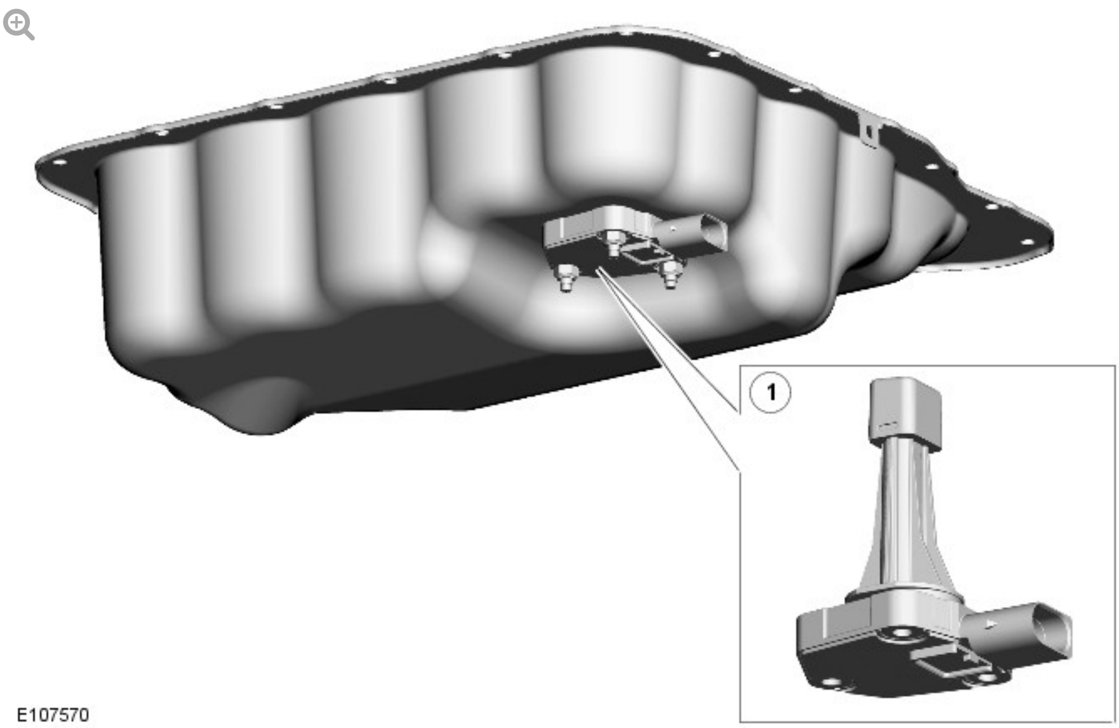
- Difficult cold start
- Difficult hot start
- Engine performance compromised
- Temperature gauge inoperative or inaccurate reading.

In the event of ECT sensor signal failure, the ECM applies a default value of 80°Celsius (176°F) coolant temperature for fuelling purposes. The ECM will also permanently operate the cooling fan at all times when the ignition is switched on, to protect the engine from overheating.

The table that follows shows ECT sensor values and the corresponding sensor resistance and voltage values.

- 40	925	3.23
- 30	496	3.16
- 20	277	3.06
- 10	160	2.91
-0	96	2.70
10	59	2.42

20	37	2.09
30	24	1.75
40	16	1.41
50	11	1.11
60	7.55	0.86
70	5.34	0.66
80	3.84	0.50
90	2.80	0.38
100	2.08	0.29
110	1.56	0.22
120	1.19	0.17
130	0.918	0.14
140	0.715	0.11
150	0.563	0.08



1	Engine oil level and temperature sensor

The 3.0L V6 diesel engine is not fitted with a conventional dipstick. The dipstick is replaced with an ultrasonic oil level and temperature sensor which is located on 3 studs in the underside of the oil pan and secured with 3 locknuts.

The sensor uses ultrasonic pulses to determine the oil level in the oil pan. The level sensor sends an ultrasonic pulse vertically upward and measures the time taken for the pulse to be reflected back to the sensor from the upper surface of the oil. A second reference pulse is also transmitted across a reference distance. The time periods of the first and second pulses are compared and the sensor calculates the oil height in the oil pan. The sensor then converts the results into a PWM (pulse width modulation) signal to the ECM which converts the frequency of the signal into a oil level height.

The sensor uses an NTC type sensor to determine the oil temperature. The sensor measures the oil temperature and converts the sensor signal into a PWM signal to the ECM which converts the frequency of the signal into an oil temperature.

If the oil level is incorrect or a system fault occurs, a warning message is displayed in the instrument cluster message center. The messages that follow can be displayed in the message center:

ENGINE OIL LOW (Amber warning triangle displayed)	The oil is at the minimum level for safe operation. Top-up with 1 liter (1.8 pints) of oil.
ENGINE OIL HIGH (Amber warning triangle displayed)	This warning is displayed when the engine is started, if the oil is above the maximum level for safe operation. Stop the vehicle as soon as safety permits and seek qualified assistance to have the engine oil drained, before driving the vehicle.
ENGINE OIL CRITICALLY LOW	The oil is below the minimum level for safe operation. Stop the vehicle as soon as safety permits and top-up with 1.5 liters (2.6 pints)

(Red warning triangle displayed)	of oil. Wait for 10 minutes, re-check the oil level reading and top-up again if necessary.
ENGINE OIL LEVEL MONITOR SYSTEM FAULT (Amber warning triangle displayed)	A fault with the oil level monitoring system is indicated. Seek qualified assistance as soon as possible.

Oil Level Check

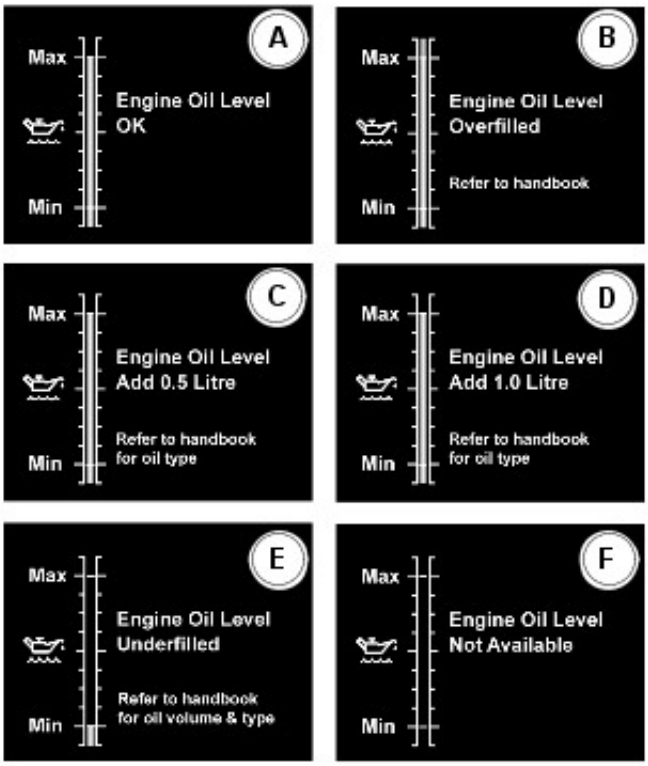
The engine oil level is automatically monitored and is displayed in the trip computer area of the message center.

The steps that follow allow the driver to view the current 'average' engine oil level providing the following parameters are met:

- It is recommended that a reading is taken after a journey (when the oil is hot)
- The engine is stopped and the transmission is in park
- The vehicle is parked on level ground
- 10 minutes has passed after stopping the engine (to allow the oil level to stabilize)

Press the 'TRIP' button on the end of the LH steering column multifunction switch repeatedly, until the oil can icon is displayed at the bottom of the message center.

The system will not give a reading until the oil level has stabilized.



E127152

A	Oil at recommended level. No top-up required.
B	Add 0.5 litres (0.9 pint) of oil.
C	Add 1 litre (1.8 pints) of oil.
D	Oil above maximum for safe operation. Do not drive vehicle. Seek qualified assistance.
E	Oil level below minimum for safe operation. Add 1.5 litre (2.6 pints) of oil, then recheck level.
F1	Oil level stabilizing, oil level not available. Wait ten minutes and then recheck the oil level display.
F2	If this display is accompanied by the warning message 'ENGINE OIL LEVEL MONITOR SYSTEM FAULT', a fault with the oil level monitor is indicated. Seek qualified assistance.

Engine Oil Top-Up

- Failure to use an oil that meets the required specification, could cause excessive engine wear, a build-up of sludge and deposits and increase pollution. It could also lead to engine failure and invalidation of vehicle warranty.
- Overfilling with oil could result in severe engine damage.

Use the procedure that follows to replenish the engine oil level:

- With the ignition on, but the engine not running, unscrew the oil filler cap.
- Add the appropriate quantity of oil (as indicated by the message center oil level display). Wait 10 minutes to allow the oil level stabilize and re-check the level. Clean up any oil spilled during topping up.
- Once the correct level is achieved, refit the filler cap and hand-tighten securely until one click is heard.

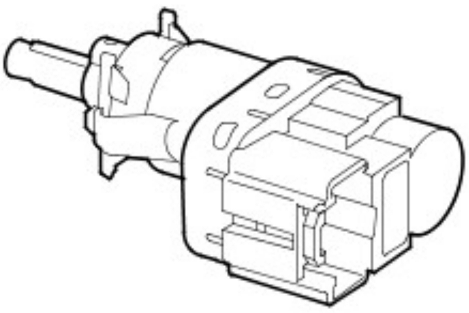
- The approximate quantity of oil required to raise the level from the minimum level of safe operation to the maximum, is 1.5 litres (2.6 pints).
- The ignition must be left on during the top-up, so that the electronic dipstick can register and display the new oil level. This enables an accurate level re-check.

Live Reading/Average Reset

A procedure is available to allow the technician to access the actual engine oil level, rather than the average engine oil level which is available to the driver. An additional procedure is also available to reset the average engine oil level.

Refer to Engine - 3.0L Diesel - General Procedures -

Refer to: Engine Oil Draining and Filling (303-01A Engine - TDV6 3.0L Diesel, General Procedures).



E46910

The brake lamp/brake test switch is located on the pedal box and is operated by the brake pedal. The 2 pole switch has a normally open circuit switch connected to battery voltage which closes the circuit when the driver has depressed the brake pedal and a normally closed circuit which is connected to ground when the driver depresses the brake pedal. The switch contacts are connected directly to the ECM and the ECM also receives a brake pressure signal on the high speed CAN bus from the ABS (anti-lock brake system) module.

The ECM uses the brake signal for the following:

- To limit fuelling during braking
- To inhibit/cancel Speed control if the brakes are applied.

In the event of a brake switch failure, the following symptoms may be observed:

- Speed control inactive
- Increased fuel consumption.

E116419

The fuel pressure control valve is incorporated into the forward end of the common fuel rail for the LH cylinder bank. The control valve regulates the fuel pressure within the fuel rails and is controlled by the ECM. The control valve is a PWM controlled solenoid valve.

When the solenoid is de-energized, an internal spring holds an internal valve closed. At fuel pressure of 100 bar (1450 lbf/in^2) or higher, the force of the spring is overcome, opening the valve and allowing fuel pressure to decay into the fuel return pipe. When the pressure in the fuel rail decays to approximately 100 bar (1450 lbf/in^2) or less, the spring force overcomes the fuel pressure and closes the valve. When the ECM energizes the solenoid, the valve is closed allowing the fuel pressure to build. The pressure in the fuel rail in this condition can reach approximately 2000 bar (29000 lbf/in^2).

The ECM constantly monitors the fuel pressure and activates the fuel pressure control valve accordingly to control the fuel rail pressure within the require parameters. Relieved fuel from the fuel rails is directed through the fuel rail leak-off pipe to the fuel filter return circuit.

The ECM controls the fuel rail pressure by operating the control valve solenoid using a PWM signal. By varying the duty cycle of the PWM signal, the ECM can accurately control the fuel rail pressure and hence the pressure delivered to the injectors according to engine load. This is achieved by the control valve allowing a greater or lesser volume of fuel to pass from the high pressure side of the pump to the un-pressurized fuel return line, regulating the pressure on the high pressure side.

The fuel pressure control valve receives a PWM signal from the ECM of between 0 and 12V. The ECM controls the operation of the control valve using the following information to determine the required fuel pressure:

- Fuel rail pressure
- Engine load
- APP sensor position
- Engine coolant temperature
- Engine speed.

In the event of a total failure of the fuel pressure control valve, the engine will not start. In the event of a partial failure of the fuel pressure control valve, the ECM will activate the solenoid with the minimum duty cycle which results in the injection quantity being limited.

E116418

The fuel pressure sensor is located in the forward end of the common fuel rail for the RH (right-hand) cylinder bank. The sensor is screwed into a threaded port in the end of the fuel rail.

The fuel pressure sensor is a piezo-resistive type sensor containing an actuating diaphragm. Deflection of the diaphragm provides a proportional signal (output) voltage to the ECM, dependant on the fuel pressure within the fuel rails.

E116420

The APP sensor allows the ECM to determine the driver requests for vehicle speed, acceleration and deceleration. The ECM uses this information to determine the torque demand from the engine via injection control.

The APP sensor is installed on the pedal box and secured to a bracket with 3 screws.

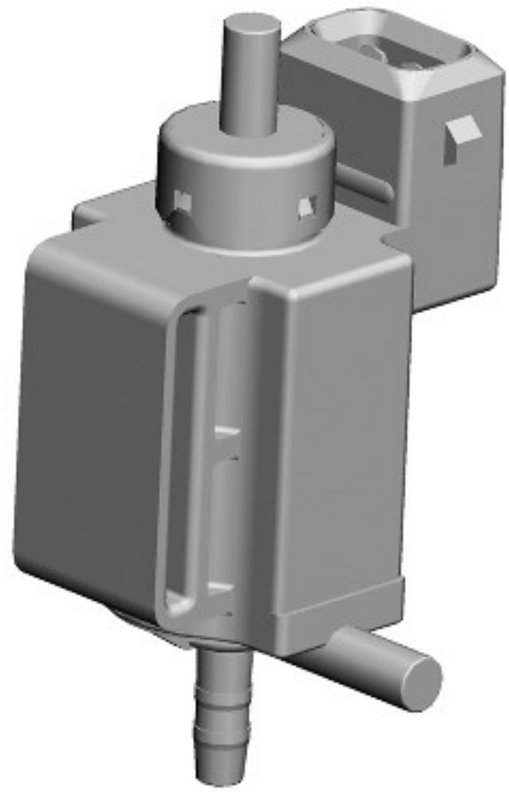
The APP sensor is incorporated into the pedal box assembly. The APP sensor is a twin track rotary potentiometer type sensor which is integral with the throttle pedal housing.

A six pin electrical connector provides the interface with the vehicle harness. The accelerator pedal is connected to a spindle on the RH side of the APP sensor. The APP sensor receives two separate electrical supplies and generates two different outputs.

Both tracks are analogue output signals connected to the ECM. Both signals contain the same positional information, but the secondary track has half the voltage output of the primary track.

If there is a fault with the primary track, the secondary track is used and the vehicle/engine response to pedal demand will be sluggish. If both analogue signals have a fault, the engine adopts a constant high speed of 1300 rpm to allow the vehicle to move. Torque application and reduction of engine speed back to normal idle speed can be subsequently controlled via brake lamp/brake test switch operation.

The ECM constantly checks the range and plausibility of the two signals and stored a fault code if it detects a fault.



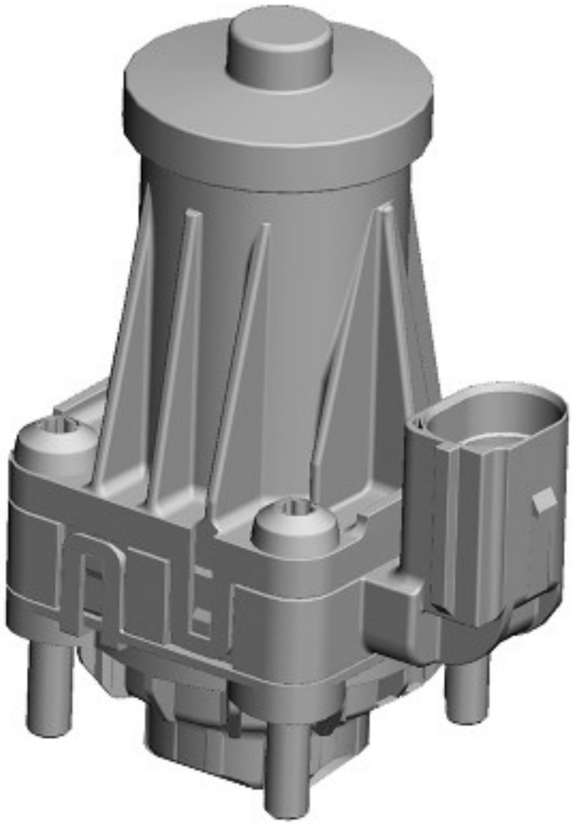
E116421

The EGR cooler bypass solenoid valve is located on a bracket at the rear of the engine, adjacent to the vacuum pump.

The solenoid valve has a vacuum pipe connection to the vacuum pump which provides the vacuum when the engine is running. Two outlets from the solenoid valve each connect to an EGR bypass vacuum actuator.

When the EGR cooler bypass solenoid valve is energized, vacuum created by the vacuum pump is applied to each EGR bypass vacuum actuator and exhaust gasses by-pass the EGR cooler. The default position is for exhaust gas cooling. The actuators move under the influence of the vacuum and move a valve within the EGR cooler to divert the exhaust gasses straight through the cooler. This system is used when the engine management system determines that exhaust gas cooling is not required.

The EGR cooler bypass solenoid valve receives a 12 volt supply from the EJB. The ECM controls the operation of the solenoid valve by controlling the ground path for the solenoid.



E116422

The EGR valve motors each receive a 12 volt supply and ground from the ECM.

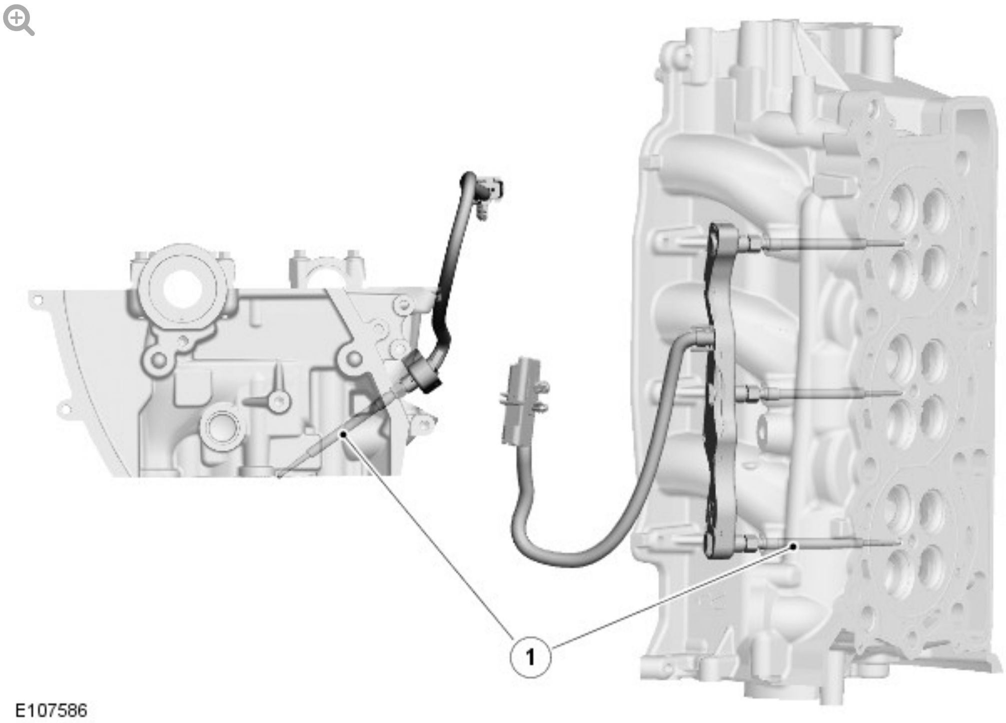
The 12 volt power supply from the ECM operates the EGR valve motor. Three further wires connect the EGR valve to the ECM a 5 volt reference voltage, a ground and a position signal feedback.

The valve is used to direct a calculated proportion of exhaust gas back into the combustion chamber.

E116423

The oil pressure sensor is located in a threaded port in the LH cylinder head. The sensor is connected directly to the instrument cluster.

The sensor is not connected to the ECM but is supplied with a reference voltage from the instrument cluster. The sensor ground is through the sensor body and the engine. When the oil pressure falls to below a predetermined threshold, the sensor internal switch contacts close, completing a circuit from the instrument cluster. This circuit is sensed by the instrument cluster which displays and appropriate warning message and warning lamp to alert the driver.



1	Glow plug

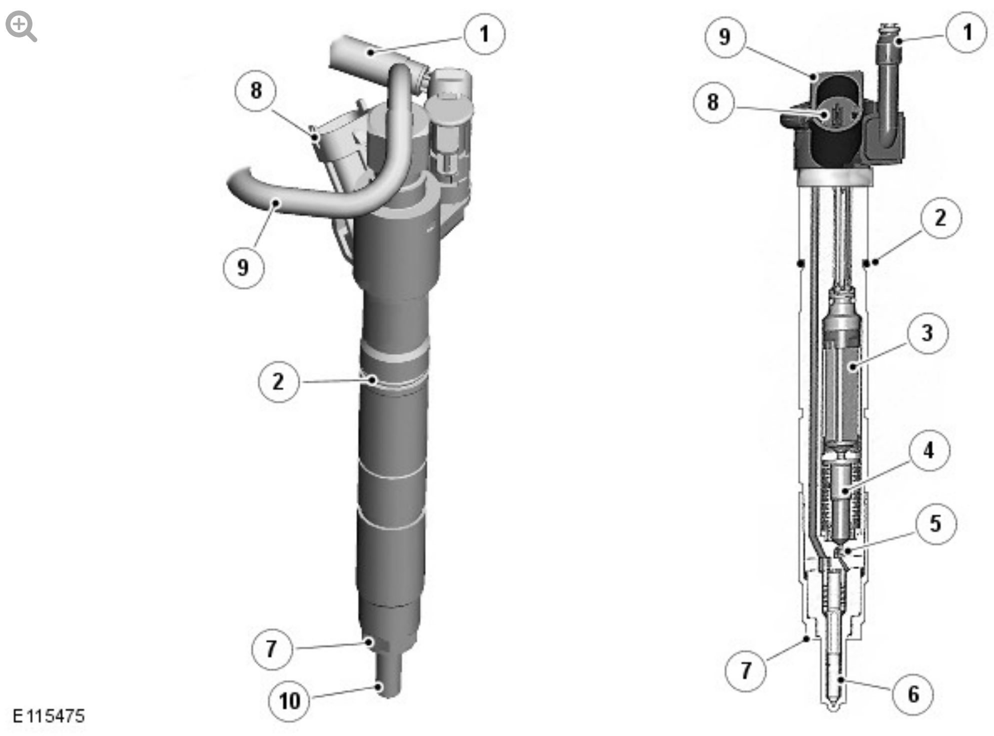
Three glow plugs are located in each of the cylinder heads, on the inlet side. The glow plugs and the glow plug module are a vital part of the engine starting strategy. The glow plugs heat the air inside the cylinder during cold starts to assist combustion. The use of glow plugs helps reduce the amount of additional fuel required on start-up, and consequently reduces the emission of black smoke. The use of glow plugs also reduces the amount of injection advance required, which reduces engine noise, particularly when idling with a cold engine.

There are three phases of glow plug activity:

- Pre-heat
- During crank
- Post heat.

The ceramic sheathed element glow plugs are made from a heat-resistant, electrically conductive ceramic material. The ceramic sheathed-element glow plugs outer layer is heated directly and is self regulating. The self regulation allows the resistance of the sheathed element to automatically increase as the heat increases preventing the glow plug from overheating. In addition, during the heating process and under the control of the glow plug module, the glow plugs can be operated above their nominal voltages. This permits heat-up speeds of 1000°C per second. The sheathed-element glow plugs reach a maximum glow temperature of 1300°C and can hold a temperature of 1150°C for several minutes after the first-start glow or at intervening times.

The glow plugs are controlled by the ECM using the glow plug module and external sensor values to control the glow plug operation via internal software.



1	Fuel return
2	O-ring seal
3	Piezo stack actuator
4	Hydraulic coupler

5	Control valve
6	Nozzle body
7	Copper sealing washer
8	Electrical connector
9	High pressure feed
10	Nozzle

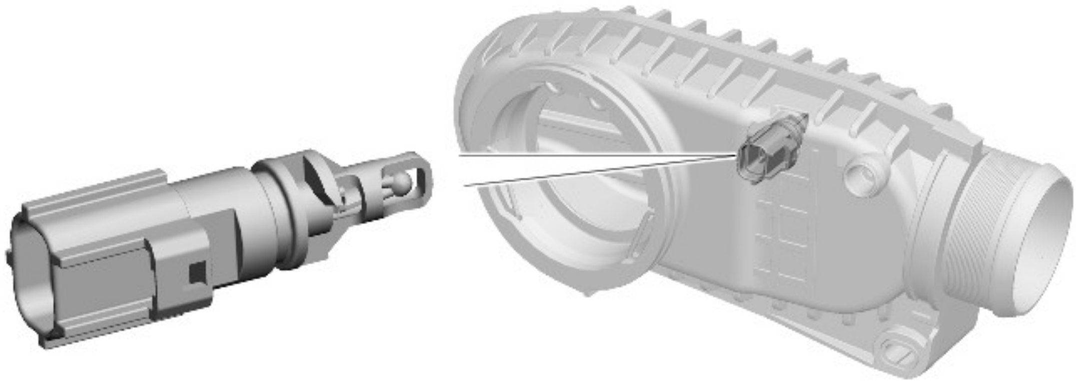
Six fuel injectors are used in the fuel system. A piezo actuator in each injector is electronically controlled by the ECM to operate the injector in response to engine speed and load conditions.

Each injector is calibrated to the ECM and applicable the cylinder to which it is fitted. Therefore, if an injector is removed it must be refitted to the cylinder from which it was removed. If a new injector is fitted, a calibration routine using a Jaguar approved diagnostic system must be performed to calibrate the injector unique code to the ECM

The operating voltage of the injector is between 110 and 163 volts depending on engine speed and load and care must be taken when working in the vicinity of the injectors. The voltage increases linearly with the injector operating pressure from 200 to 2000 bar (2900 to 29000 lbf/in^2).

Each injector has an electrical resistance value of between 150 - 250 kOhms.

Each injector operation is controlled by a charge and discharge cycle allowing energy to dissipate in, and recover from the injector. Never disconnect the wiring connection when the engine is running. The injector can remain open causing engine damage.



E116759

The is charge air temperature sensor is located in the rear of the intake chamber immediately preceding the throttle intake manifold. The sensor is used to measure the intake air temperature from the turbochargers in order to calculate the required amount of fuelling.

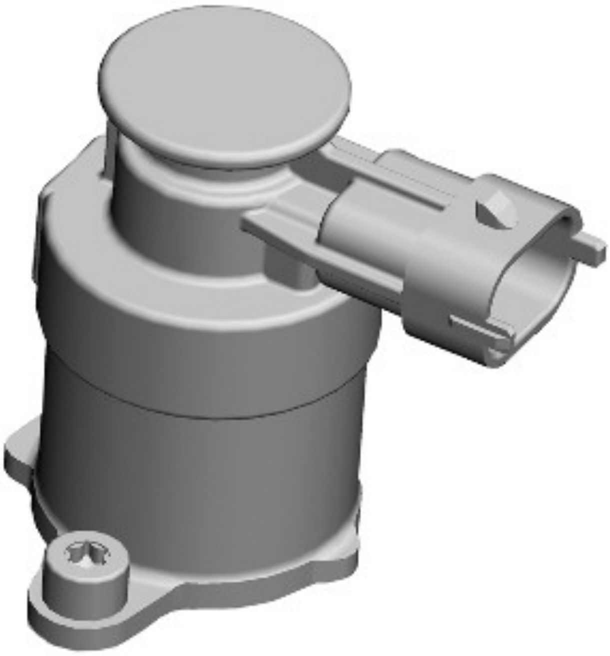
The charge air temperature sensor incorporates a NTC thermistor in a voltage divider circuit. The NTC thermistor works on the principle of decreasing resistance in the sensor as the temperature of the charge air increases. As the thermistor allows more current to pass to ground, the voltage sensed by the ECM decreases. The change in voltage is proportional to the temperature change of the charge air. Using the voltage output from the charge air temperature sensor, the ECM can correct the fuelling map for charge air temperature. The correction is an important requirement because hot air contains less oxygen than cold air for any given volume.

The charge air temperature sensor receives a 3.3V reference voltage from the ECM. The signal output from the charge air temperature sensor is calculated by the ECM by monitoring changes in the supplied reference voltage to the charge air temperature sensor voltage divider circuit.

If the charge air temperature sensor fails the ECM uses a default charge air temperature of -5°C (23°F). In the event of an charge air temperature sensor failure, any of the following symptoms may be observed:

- Over fuelling, resulting black smoke emitting from the exhaust

- Idle speed control inoperative.

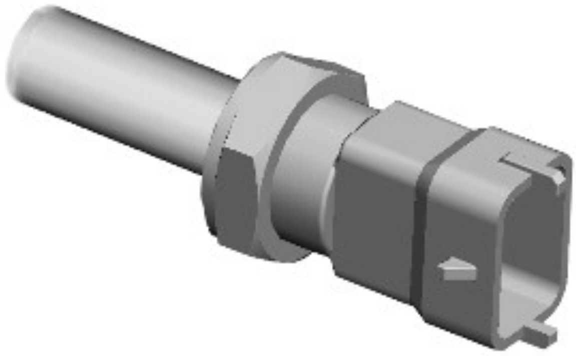


E116761

The volume control valve is mounted on the high pressure pump, and located in the feed port between the high-pressure pump elements and the internal transfer pump. The volume control valve is a variable position solenoid-operated valve that is controlled by the ECM.

The volume control valve is controlled by a PWM signal from the ECM to allow a defined amount of 'leak off' from the high pressure fuel pump. The leak off fuel provides cooling and lubrication for the high-pressure pump internal components. The fuel is returned through a leak off pipe to the fuel filter, where it cools and is returned into the fuel filter via the low pressure return line.

The volume control valve determines the amount of fuel that is delivered from the internal transfer pump to the high pressure pumping elements. When there is no signal to the volume control valve, the valve is closed and there is no fuel delivery. The ECM applies a varying PWM signal of between 0 to 100% to control the required fuel volume.

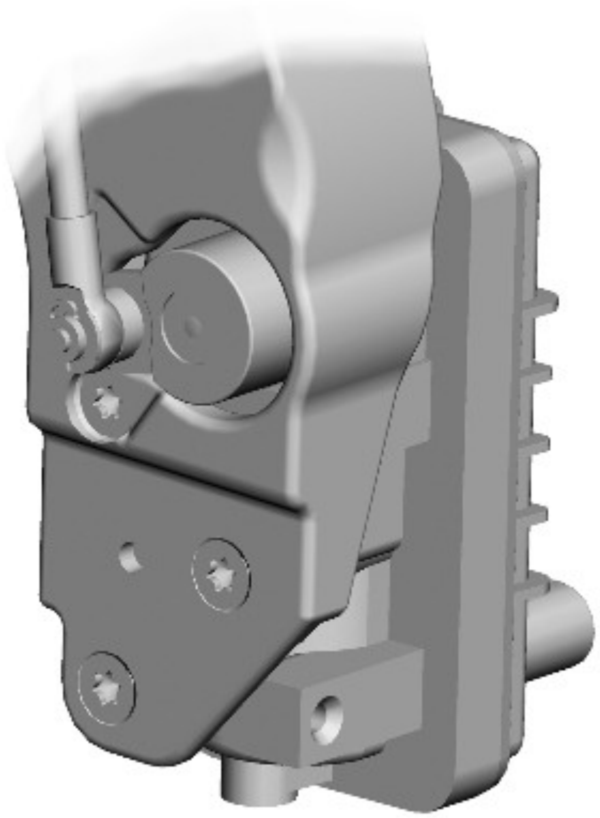


E116762

The fuel temperature sensor is located on the rear of the high pressure fuel pump. It measures the fuel temperature in the low-pressure side of the high pressure fuel pump.

The ECM continually monitors this signal to determine the fuel temperature to prevent overheating of the fuel system. The ECM will also make fine adjustments to fuel injection quantity to adjust for fuel temperature.

The inlet temperature sensor is an NTC thermistor. As the fuel temperature rises the resistance through the sensor decreases and visa versa. The ECM measures the change in voltage as the thermistor allows more current to pass to ground relative to the fuel temperature.



E116424

The primary turbocharger control module is attached to a bracket which is an extension of the turbocharger body.

The primary turbocharger control module comprises a stepper motor which electronically controls the primary turbocharger variable vanes by moving an actuating lever. When the stepper motor drive shaft turns, a position signal is created. The ECM receives the position signal to determine the angular position of the vanes.

The stepper motor is connected to an output shaft. The output shaft has a connecting rod attached eccentrically which converts the rotary motion of the shaft into linear motion of the connecting rod. The opposite end of the connecting rod is attached to an actuating lever. The actuating lever moves with the connecting rod and adjusts the variable vanes mechanically.

The ECM provides the stepper motor with a power and ground for stepper motor operation and also a reference voltage, ground and position signal connections for variable vane position control.

E116425

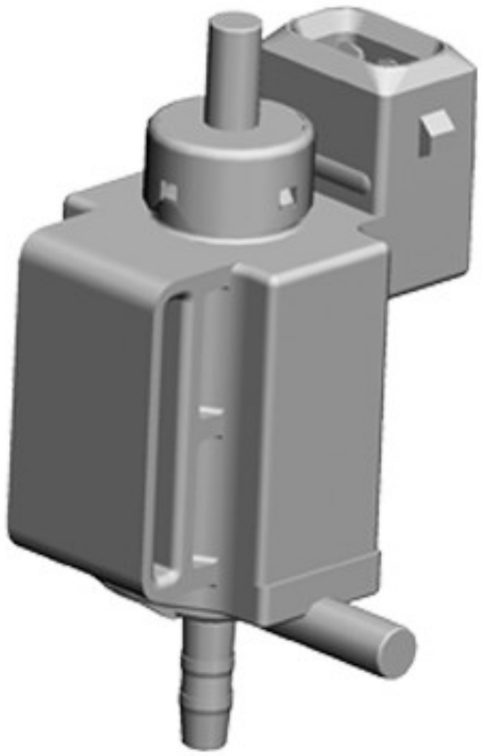
The secondary turbocharger boost pressure sensor is located on the steering pump mounting bracket on the RH side of the engine. The sensor is connected via a hose to the charge air outlet pipe from the primary turbocharger compressor.

The sensor provides a voltage signal to the ECM relative to the output charge air pressure from the secondary turbocharger. The boost pressure sensor has a 3 pin connector which is connected to the ECM and provides a 5V reference supply from the ECM, a signal input to the ECM and a ground for the sensor.

The boost pressure sensor uses a diaphragm transducer to measure pressure. The ECM uses the boost pressure sensor signal for the following functions:

- Maintain manifold boost pressure
- Reduce exhaust smoke emissions when driving at high altitude
- Control of the EGR system

- To help smooth control of the mono to bi and bi to mono turbo transitions
- To aid the air path diagnostics.

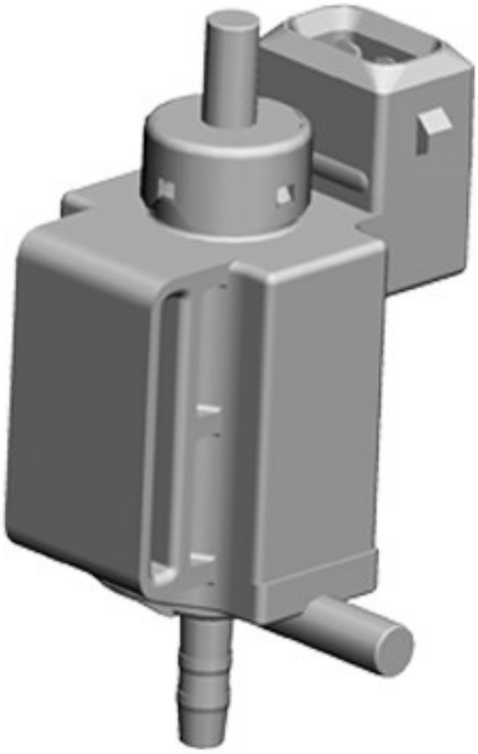


E123687

The secondary turbine shut-off solenoid valve is located on a bracket at the front of the engine, above the LH front cylinder cover assembly. The bracket is shared with the secondary turbocharger recirculation solenoid valve. The secondary turbine shut-off solenoid valve is the innermost of the two solenoid valves.

The secondary turbine shut-off solenoid receives a vacuum supply from the vacuum pump. The valve is connected by a pipe to the turbine shut-off valve vacuum actuator which is located on the rear of the secondary turbocharger. A position sensor is attached to the turbine shut-off valve vacuum actuator to inform the ECM of the turbine shut-off position.

Operation of the valve vacuum actuator is controlled by a PWM signal from the ECM and the secondary turbocharger turbine shut-off valve solenoid. When the shut-off solenoid is energized by the ECM a 4.5V PWM current is applied to operate the solenoid, vacuum is then applied to the shut-off valve vacuum actuator. The valve is opened allowing the secondary turbocharger turbine to be driven by the exhaust gasses for as long as the valve is open. When the valve is to be closed the ECM applies a 0.5V PWM current to the solenoid.



E123687

The secondary turbocharger compressor shut-off solenoid valve is located on a bracket at the front of the engine, above the LH front cylinder cover assembly. The bracket is shared with the secondary turbocharger turbine shut-off solenoid valve. The secondary turbocharger compressor shut-off solenoid valve is the outermost of the two solenoid valves.

The secondary turbocharger compressor shut-off solenoid valve receives a vacuum supply from the vacuum pump. The valve is connected by a pipe to