

Electronic Engine Controls - V6 4.0L Petrol -

Lubricants

Item	Land Rover Part No.
* HO2s removal	STC 50545
HO2s threads	Apply suitable high temperature anti-seize compound to threads of sensor

*** Apply to area around sensor threads prior to attempting to remove sensor**

Engine Management System

Item	Description
Engine management system:	
Make	Siemens
Type	PAG EMS - Generation 1

Torque Specifications

Description	Nm	lb-ft
Intake manifold tuning (IMT) valve bolts	10	7
+ Heated oxygen sensor (HO2S)	45	33
* RH catalytic converter to exhaust manifold bolts	22	16
* LH catalytic converter to exhaust manifold bolts	22	16
LH catalyst monitor sensor	45	33
Heat shield bolts	10	7
Mass air flow (MAF) sensor Torx screws	2	1.5
** Camshaft position (CMP) sensor bolt	6	4
Engine coolant temperature (ECT) sensor	18	13
Throttle body bolts	10	7
Crankshaft position (CKP) sensor Torx screw	8	6
Knock sensor (KS) bolt	20	15

+ Apply anti-seize lubricant to threads of sensor - See Lubricants

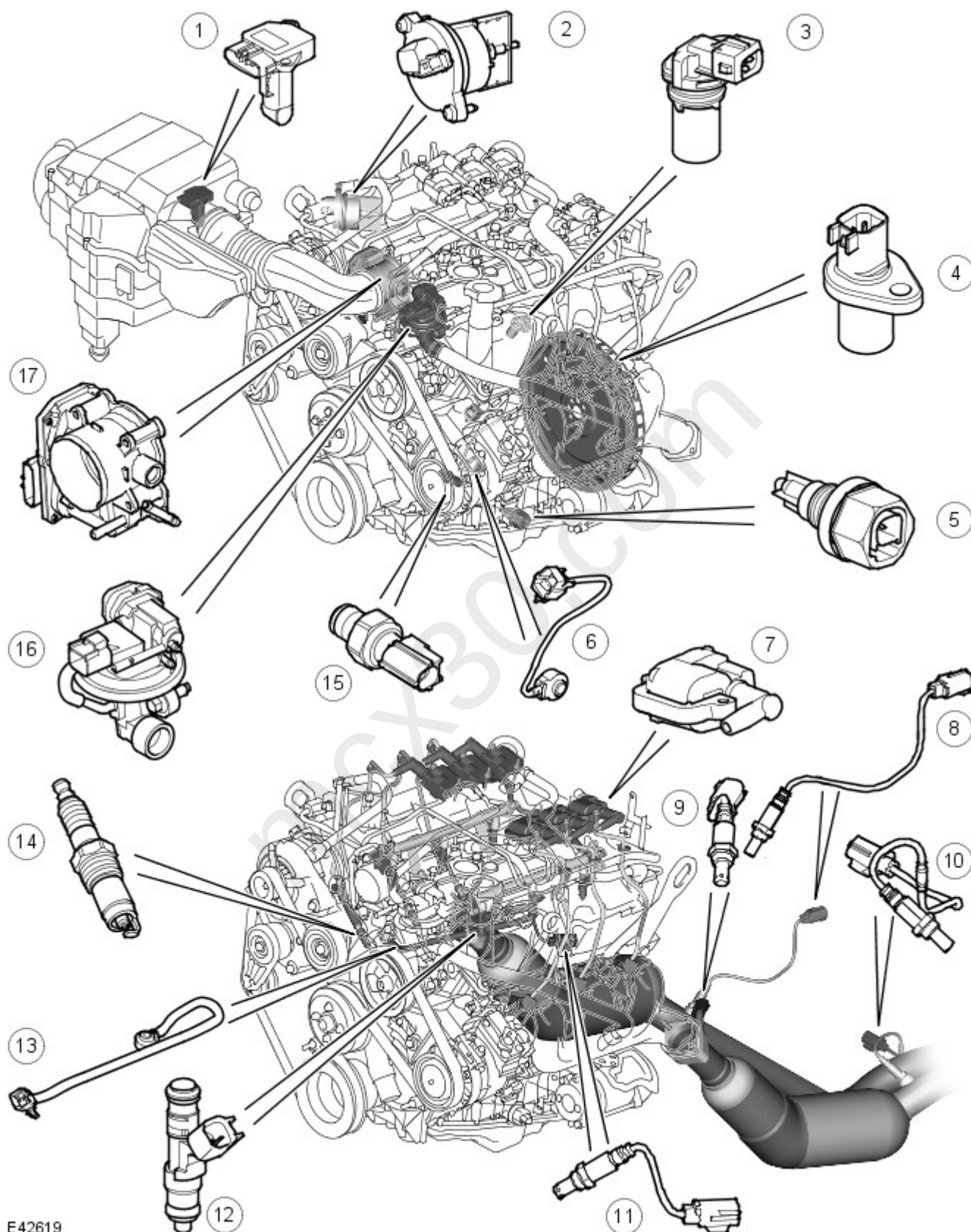
*** New bolts must be fitted**

**** Apply clean engine oil to a new CMP sensor O-ring seal.**

Electronic Engine Controls - V6 4.0L Petrol - Electronic Engine Controls

Description and Operation

4.0 Liter Electronic Engine Controls Component Location Sheet 1 of 2

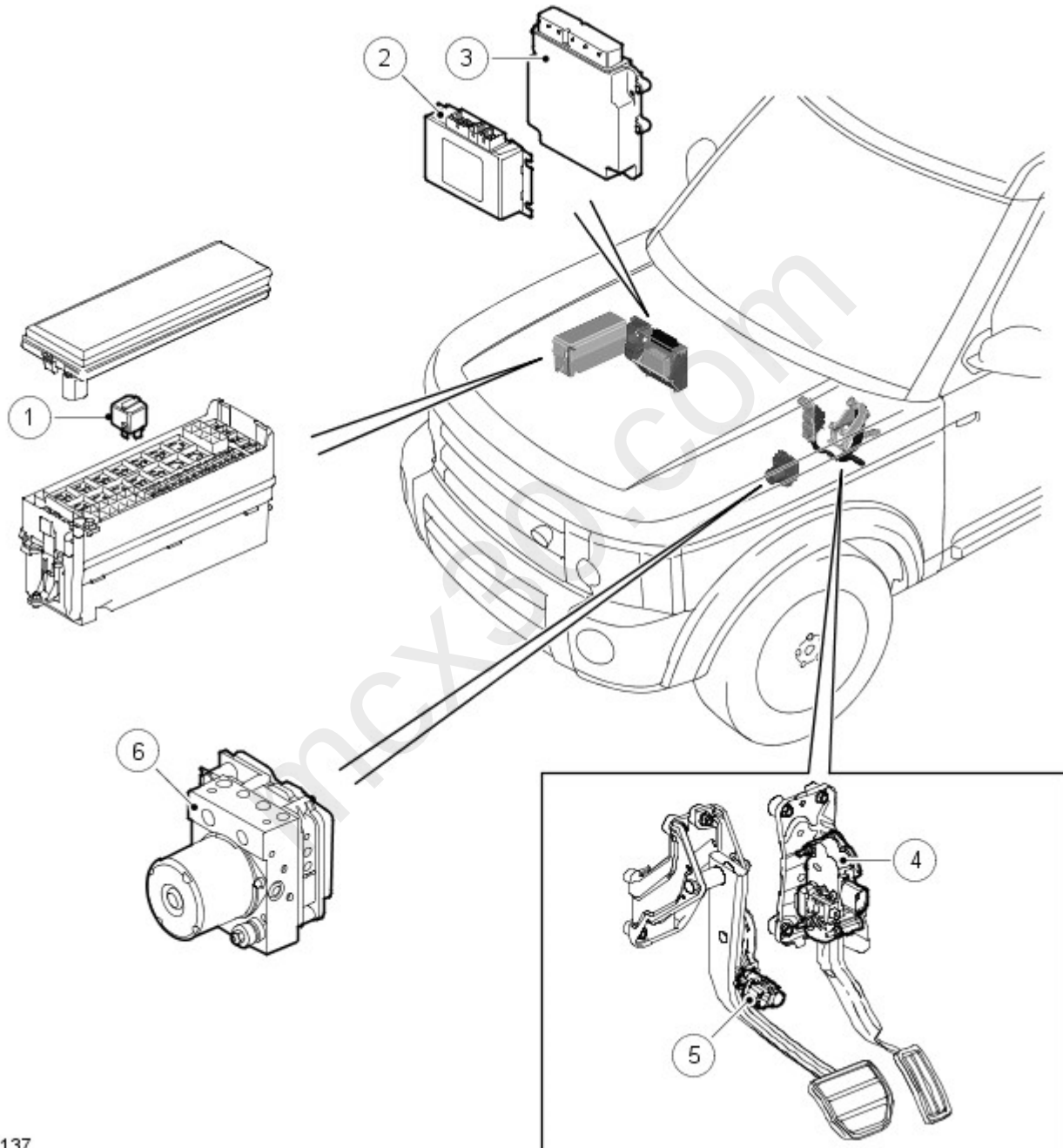


E42619

Item	Part Number	Description
1	-	mass air flow (MAF)/intake air temperature (IAT)
2	-	intake manifold tuning (IMT) valve
3	-	camshaft position (CMP)
4	-	crankshaft position (CKP)

5	-	Engine oil temperature sensor
6	-	Knock sensor
7	-	Ignition coils
8	-	Heated Exhaust Gas Oxygen sensor (HEGO)
9	-	Universal Heated Exhaust Gas Oxygen sensor (UHEGO)
10	-	Heated Exhaust Gas Oxygen sensor (HEGO)
11	-	Universal Heated Exhaust Gas Oxygen sensor (UHEGO)
12	-	Injectors
13	-	Knock sensor
14	-	Spark plugs
15	-	engine oil pressure (EOP) sensor
16	-	exhaust gas recirculation (EGR) valve and pressure differential sensor
17	-	Electric throttle

4.0 Liter Electronic Engine Controls Component Location Sheet 2 of 2

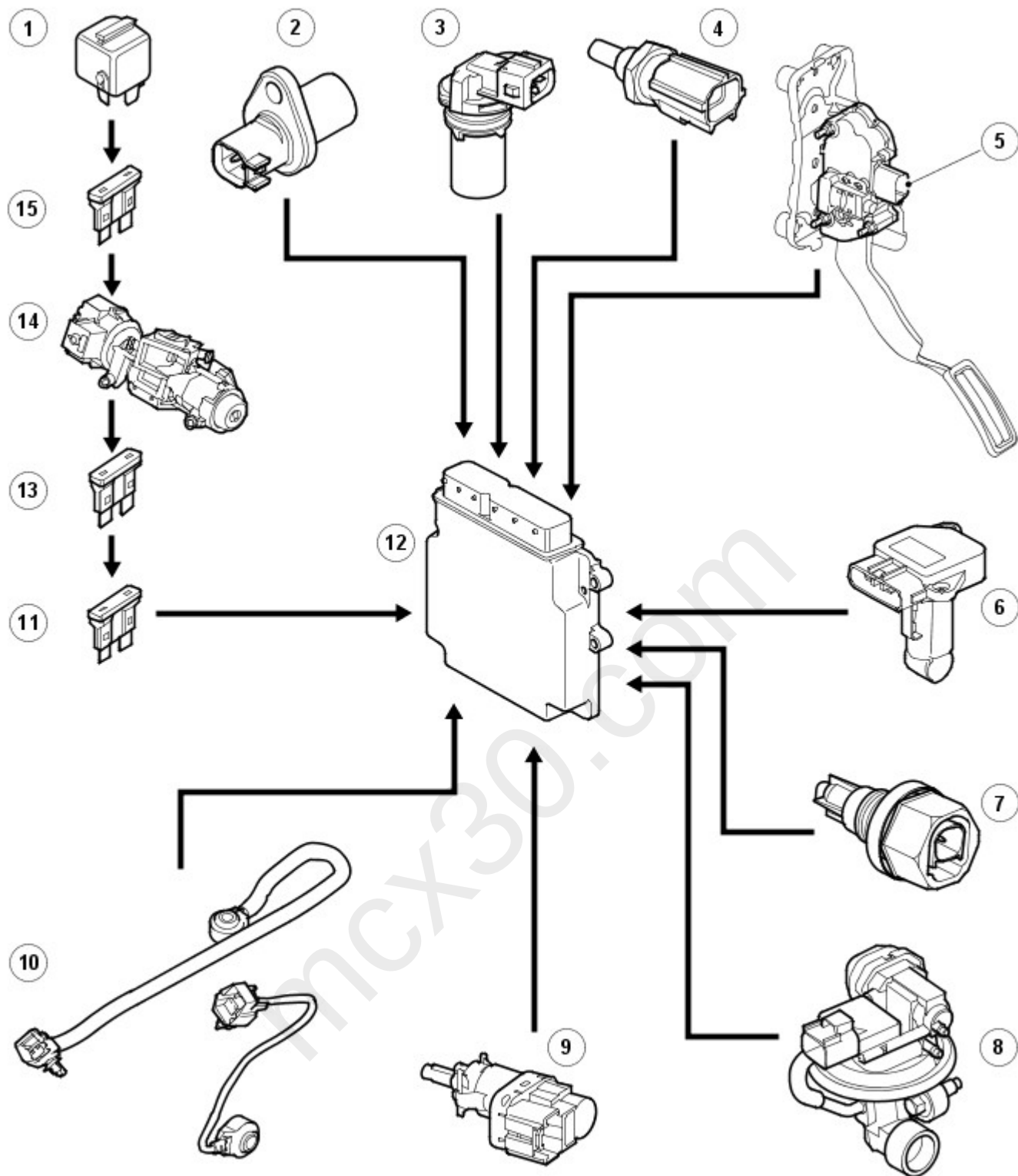


E50137

Item	Part Number	Description
1	-	Main relay
3	-	Transfer box control module
2	-	engine control module (ECM)
4	-	Brake lamp switch
5	-	Clutch switch
6	-	anti-lock brake system (ABS) control module

4.0L EMS Control Diagram Sheet 1 of 2

• NOTE: A= Hardwired



A →

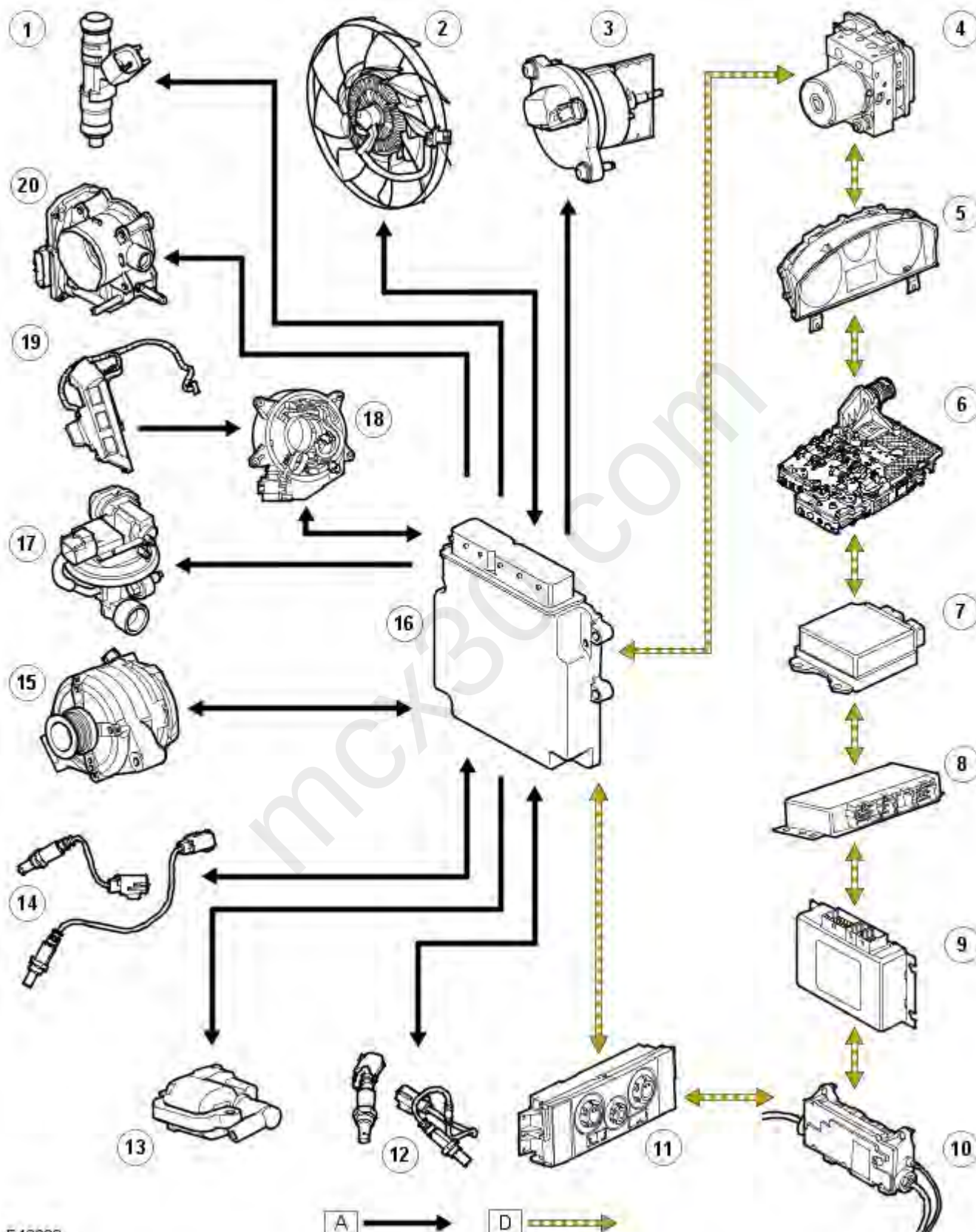
E50136

Item	Part Number	Description
1	-	Main relay
2	-	CKP
3	-	CMP
4	-	engine coolant temperature (ECT) sensor
5	-	accelerator pedal position (APP)
6	-	MAF
7	-	Engine oil temperature sensor
8	-	manifold absolute pressure (MAP)
9	-	Brake light switch
10	-	Knock sensor
11	-	Fuse No 25P

12	-	ECM
13	-	Fuse 60P
14	-	Ignition switch
15	-	Fuseable link 11E

4.0L EMS Control Diagram Sheet 2 of 2

• NOTE: A= Hardwired D= controller area network (CAN) Bus



E42638

Item	Part Number	Description
1	-	Injectors
2	-	Engine cooling fan

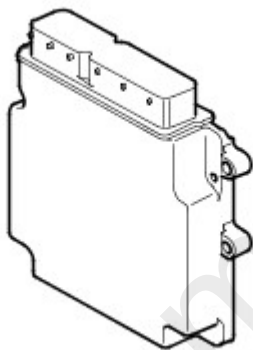
3	-	IMT valve
4	-	ABS control module
5	-	Instrument cluster
6	-	transmission control module (TCM)
7	-	restraints control module (RCM)
8	-	Differential control module
9	-	Transfer box control module
10	-	Electric park brake control module
11	-	automatic temperature control (ATC) module
12	-	Universal Heated Exhaust Gas Oxygen sensor (UHEGO) and Heated Exhaust Gas Oxygen sensor (HEGO)
13	-	Ignition coils
14	-	Universal Heated Exhaust Gas Oxygen sensor (UHEGO) and Heated Exhaust Gas Oxygen sensor (HEGO)
15	-	Generator
16	-	ECM
17	-	EGR valve/differential pressure sensor
18	-	Clock spring
19	-	Speed control switches
20	-	Electric throttle body

GENERAL

The V6 4.0 Liter engine is controlled by an ECM manufactured by DENSO. The Engine Management System (EMS) controls the following:

- Engine fueling
- Ignition timing
- Closed loop fueling
- Knock control
- Idle speed control
- Emission control
- On board diagnostic
- Interface with the immobilization system
- Speed control

ENGINE CONTROL MODULE (ECM)



E42610

The ECM is located in the E-Box in the plenum area on the passenger side of the engine compartment attached to the bulkhead.

Inputs

The ECM has the following inputs:

- Central Junction Box
- Engine Coolant Temperature
- Brake Switch
- Manifold Absolute Pressure
- Accelerator Pedal Position 1
- Accelerator Pedal Position 2
- Throttle Position 1
- Throttle Position 2
- Engine cooling fan Speed
- Engine speed and position sensor (crankshaft sensor)
- Camshaft position sensor
- Engine Oil Temperature
- IAT sensor (integrated into MAF)
- MAF
- Knock sensors (2)
- Speed Control Switches (resistive ladders)
- Oxygen sensors (4)
- Vehicle Speed (via CAN)
- EGR Differential Pressure

- EGRMAP
- Generator Monitor

Outputs

The ECM outputs to the following:

- Throttle Actuator
- Ignition coils (6)
- Oxygen sensor heaters (4)
- Fuel injectors (6)
- EGR Valve
- IMT valve
- Purge Valve
- Fuel pump relay
- Starter Relay
- Air conditioning condenser fan module (CAN)
- EMS Main Relay
- Viscous Fan Control
- Generator Control

The ECM controls the engine fueling by providing sequential fuel injection to all cylinders. Ignition is controlled by a direct ignition system, provided by six plug top coils. The ECM is able to detect and correct for ignition knock on each cylinder and adjust the ignition timing for each cylinder to achieve optimum performance.

The ECM uses a torque-based strategy to generate the torque required by the driver and other vehicle ECU's. The EMS uses various sensors to determine the torque required from the engine. These include:

- Mass Air Flow meter
- Accelerator Pedal Position sensor
- Engine temperatures
- Oxygen sensors

The EMS processes these signals and decides how much torque to generate. Torque is then generated by using various actuators to supply air, fuel and spark to the engine (electronic throttle, injectors, coils, etc.)The EMS also interfaces with other vehicle ECU's, via CAN, to obtain additional information, these include

- ABS control module
- TCM
- Transfer box control module

Pin No	Description	Input/Output
1	CAN	Input/Output
2	CAN	Input/Output
3	Generator monitor	Input
4	UHEGO Bank A ground	-
5	UHEGO Bank B ground	-
6	Crank sensor -	Input
7	Cam sensor ground	-
8	Not used	-
9	Not used	-
10	Sensor ground 3	-
11	Sensor ground 4	-
12	Sensor ground 5	-
13	Not used	-
14	Spare ground	-
15	Sensor ground 6	-
16	Not used	-
17	Not used	-
18	MAF ground	-
19	Knock sensor bank A ground	-
20	Knock sensor bank B ground	-
21	Not used	-
22	Not used	-
23	Oil temperature sensor	Input
24	Sensor power 6	Output
25	LIN A	Output
26	UHEGO B +	Input
27	UHEGO B -	-
28	UHEGO A +	+
29	UHEGO A -	-
30	Crank sensor +	Input
31	Not used	-
32	Not used	-
33	Not used	-
34	CMP signal bank A	Input
35	Not used	-
36	Not used	-
37	Not used	-
38	Differential pressure sensor	Input
39	Not used	-

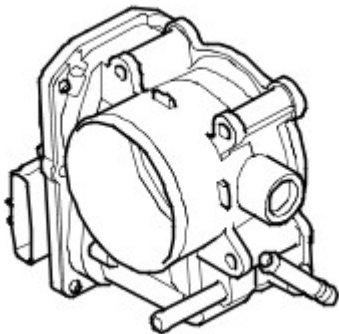
Pin No	Description	Input / Output
40	Fuel pressure sensor	Input
41	Not used	-
42	Knock sensor A +	Input
43	Knock sensor B +	Input
44	Not used	-
45	Not used	-
46	Fuel temperature sensor	Input
47	Sensor power 5	Output
48	Sensor power 4	Output
49	Not used	-
50	Not used	-
51	Not used	-
52	Not used	-
53	Not used	-
54	Not used	-
55	Not used	-
56	Ignition coil cylinder 3 B	Output
57	Ignition coil cylinder 3 A	Output
58	Ignition coil cylinder 2 B	Output
59	Ignition coil cylinder 2 A	Output
60	Ignition coil cylinder 1 B	Output
61	Ignition coil cylinder 1 A	Output
62	Ignition coil ground bank A	-
63	Viscous fan monitor	Input
64	Ignition coil ground bank B	-
65	Throttle position sensor 1	-I
66	Air temperature sensor	Input
67	Throttle position sensor 2	Input
68	Coolant temperature sensor	Input
69	MAP	Input
70	MAF	Input
71	Not used	-
72	Sensor power 3	Output
73	Not used	-
74	Throttle valve open direction -	Output
75	Throttle valve open direction +	Output
76	UHEGO Heater bank A	Output
77	UHEGO Heater bank B	Output
78	Injector cylinder 1 B	Output
79	Injector cylinder 1 B	Output
80	Injector cylinder 2 A	Output
81	Injector cylinder 2 B	Output
82	Injector cylinder 3 A	Output
83	Injector cylinder 3 B	Output
84	Inlet manifold tuning valve 1	Output
85	Not used	-
86	Not used	Output
87	Not used	Output
88	Not used	Output
89	Not used	-
90	EGR	Input
91	Not used	-
92	Purge valve	Output
93	Viscous fan request	Output
94	Not used	-
95	Fuel pump relay	Output
96	Alternator control	Output

ECM Connector C0635 Pin Out Table

Pin No	Description	Input / Output
1	Signal ground 1	-
2	Power ground 1	-
3	Power ground 2	-
4	ECM power	Input
5	Power ground 3	-
6	APP sensor ground 1	-
7	APP sensor ground 2	-
8	Not used	-
9	Not used	-
10	Not used	-
11	Not used	-
12	Park/Neutral signal	Input
13	Not used	-
14	Not used	-
15	Not used	-
16	EMS relay	Output

Pin No	Description	Input / Output
17	Crank request	Output
18	CAN +	Output
19	APP sensor 2 power	Output
20	Fuel pump control	Output
21	Not used	-
22	Not used	-
23	Not used	-
24	APP sensor 1 signal	Output
25		
26	Brake light switch	Input
27	Not used	-
28	Not used	-
29	Not used	-
30	Ignition switch	Input
31	CAN +	Input
32	APP sensor 1 power	Output
33	DMTL	Output
34	Not used	-
35	Speed switch -	Output

ELECTRONIC THROTTLE



E42611

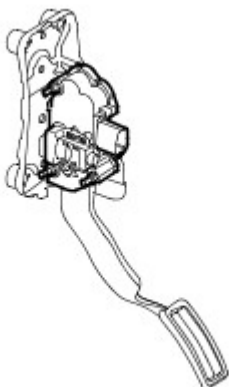
The V6 engine torque is regulated via an electronic throttle body which is located on the intake manifold in the engine compartment. An APP determines the driver demand to control throttle opening. This value is input into the EMS and the throttle is opened to the correct angle by means of an electric motor integrated into the throttle body. Sensors in the throttle body are used to determine the position of the throttle plate and the rate of change in its angle. A software strategy within the ECM enables the throttle position to be calibrated each ignition cycle. When the ignition is turned 'ON', the ECM opens and closes the throttle fully, thus performing a self-diagnostic and calibration. The throttle body is connected to the ECM via a pair of twisted wires to avoid electrical interference.

For additional information, refer to: [Acceleration Control](#) (310-02B Acceleration Control - V6 4.0L Petrol, Description and Operation).

C0175 Electronic Throttle Pin Out Table

Pin No	Description	Input / Output
1	Signal 1	Output
2	5 volt supply	Input
3	Signal 2	Output
4	Ground	-
5	Actuator +	Input
6	Actuator -	-

ACCELERATOR PEDAL POSITION SENSOR (APP)



E42612

The APP is used in conjunction with the electronic throttle body to provide a drive-by-wire system. The sensor is a resistive

type. Sensors in the accelerator pedal are used to determine the driver's request for vehicle speed, acceleration and deceleration. This value is input into the EMS and the throttle is opened to the correct angle by means of an electric motor integrated into the throttle body.

The APP sensor signals are checked for range, and for plausibility. Two separate reference voltages are supplied to the pedal. If one sensor fails, the other can be used as a 'limp – home' input.

The wires that connect the ground and signal from both potentiometers to the EMS are twisted together into two pairs, avoiding having to use a screen wire.

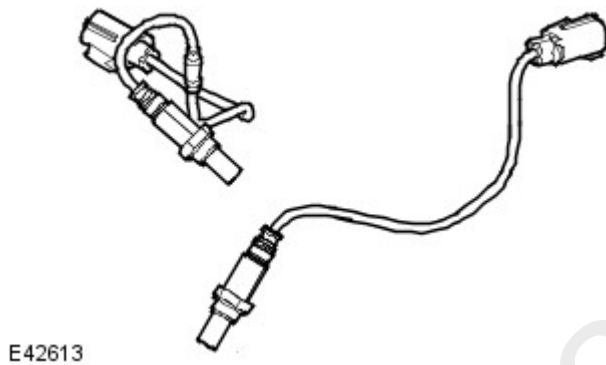
If signal failure occurs, the ECM enters limp home mode. The APP Sensor is located at the accelerator pedal .

C0787 APP Sensor Connector Pin Out Table

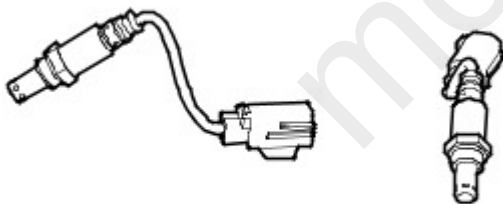
Pin No	Description	Input / Output
1	Sensor 2 ground	-
2	Sensor 1 demand	Output
3	Sensor 1 ground	-
4	Not used	-
5	Sensor 2 demand	Output
6	Supply 2 5 volt	Input
7	Supply 1 5 volt	Input
8	Not used	-

OXYGEN SENSORS

Oxygen Sensor-Upstream



Oxygen Sensor-Downstream



There are four oxygen sensors located in the exhaust system. Two upstream (UHEGO) before the catalytic converter and two down stream (HEGO) after the catalytic converter. The sensors monitor the level of oxygen in the exhaust gases and is used to control the fuel/air mixture. Positioning a sensor in the stream of exhaust gasses from each bank enables the ECM to control the fueling on each bank independently of the other, allowing much closer control of the air/fuel ratio and catalyst conversion efficiency.

The Oxygen Sensor needs to operate at high temperatures in order to function correctly. To achieve the high temperatures required, the sensors are fitted with heater elements that are controlled by a pulse width modulation (PWM) signal from the ECM. The heater elements are operated immediately following engine start and also during low load conditions when the temperature of the exhaust gases is insufficient to maintain the required sensor temperatures. A non-functioning heater delays the sensor's readiness for closed loop control and influences emissions. The PWM duty cycle is carefully controlled to prevent thermal shock to cold sensors.

UHEGO (Universal Heated Exhaust Gas Oxygen) sensors also known as Linear or "Wide Band" sensors produces a constant voltage, with a variable current that is proportional to the oxygen content. This allows closed loop fueling control to a target lambda, i.e. during engine warm up (after the sensor has reached operating temperature and is ready for operation). This improves emission control.

The HEGO sensor uses Zirconium technology that produces an output voltage dependant upon the ratio of exhaust gas

oxygen to the ambient oxygen. The device contains a Galvanic cell surrounded by a gas permeable ceramic, the voltage of which depends upon the level of O₂ diffusing through. Nominal output voltage of the device for $\lambda = 1$ is 300 to 500m volts. As the fuel mixture becomes richer ($\lambda < 1$) the voltage tends towards 900m volts and as it becomes leaner ($\lambda > 1$) the voltage tends towards 0 volts. Maximum tip temperature is 1,000 Degrees Celsius for a maximum of 100 hours.

Sensors age with mileage, increasing their response time to switch from rich to lean and lean to rich. This increase in response time influences the ECM closed loop control and leads to progressively increased emissions. Measuring the period of rich to lean and lean to rich switching monitors the response rate of the upstream sensors.

Diagnosis of electrical faults is continually monitored in both the upstream and downstream sensors. This is achieved by checking the signal against maximum and minimum threshold, for open and short circuit conditions.

Oxygen sensors must be treated with the utmost care before and during the fitting process. The sensors have ceramic material within them that can easily crack if dropped/banged or over-torqued. The sensors must be torqued to the required figure, (40-50Nm), with a calibrated torque wrench. Care should be taken not to contaminate the sensor tip when anti-seize compound is used on the thread.

Failure Modes

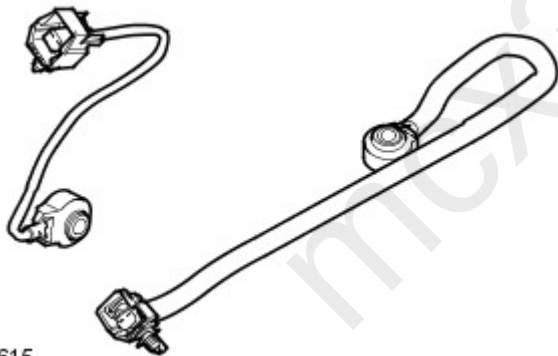
- Mechanical fitting & integrity of the sensor.
- Sensor open circuit/disconnected.
- Short circuit to vehicle supply or ground.
- Lambda ratio outside operating band.
- Crossed sensors Bank A & B.
- Contamination from leaded fuel or other sources.
- Change in sensor characteristic.
- Harness damage.
- Air leak into exhaust system.

Failure Symptoms

- Default to Open Loop fueling for the particular cylinder bank
- High CO reading.
- Strong smell of H₂S (rotten eggs) till default condition.
- Excess emissions.

It is possible to fit front and rear sensors in their opposite location. However the harness connections are of different gender and color to ensure that the sensors cannot be incorrectly connected. In addition to this the upstream sensors have two holes in the sensor tip, whereas the down stream sensors have four holes in the sensor tip for the gas to pass through.

KNOCK SENSORS



The ECM uses active knock control, which serves to prevent engine damaging pre-ignition or detonation under all operating conditions enabling the engine to operate without additional safety margins. For the ECM to be able to determine the point at which a cylinder is pre-detonating, 2 piezo-ceramic sensors are mounted on the engine block. Each sensor monitors engine knock by converting the engine block noise into a suitable electrical signal, which is then transmitted back to the ECM via a twisted pair cable. The signal is then processed within the ECM to identify the data that characterizes knocking.

This information is compared to known signal profiles to determine whether knock is present. If so, the closed loop control system then retards the ignition on that cylinder, for a number of cycles, after which it gradually moves back towards its original setting.

Failure Symptoms

The following describes the failure symptoms of the knock sensors:

- Knock control disabled and a default "safe ignition map" are used.
- Possible rough running and reduced engine performance.

One sensor is located in the center of the engine valley and the other is located on the front RH side of the cylinder block.

CRANKSHAFT SPEED AND POSITION SENSOR



E42616

The CKP is located on the top of the transmission bell housing just to the left of the center line with the sensor tip adjacent to the flywheel rim. The sensor is a variable reluctance type with a resistance of 1100 Ohms $\pm$ 150 Ohms.

The sensor produces the signal which enables the ECM to determine the angle of the crankshaft, and the engine RPM. From this, the point of ignition, fuel injection, etc. is calculated. If the signal wires are reversed a 3° advance in timing will occur, as the ECM uses the falling edge of the signal waveform as its reference/timing point for each tooth.

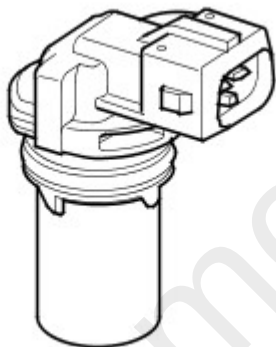
The sensor picks up its signal from a reluctor ring machined into the diameter of the drive plate. The reluctor ring has 36 teeth at 10° intervals and 3° wide. One of the teeth is removed to provide a reference mark which is 60 degrees BTDC No.1 cylinder.

The sensor operates by generating an output voltage caused by the change in magnetic field that occurs as the teeth pass in front of the sensor. The output voltage varies with the speed of the teeth passing the sensor. The higher the engine speed, the higher the output voltage.

The ECM transmits the engine speed over the CAN bus.

If the CKP sensor fails while the engine is running the engine will stall, misfire or run poorly and a relevant fault code will be stored. If the engine is not running when a fault occurs then the engine will not start.

CMP SENSOR

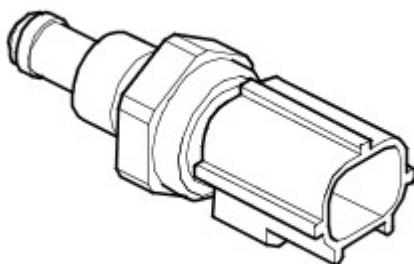


E42617

The CMP is a variable reluctance type sensor located at the front of the engine in the valve cover above number 4 cylinder.

The CMP sensor produces one pulse for every two engine revolutions. The sensor picks up on a reluctor on the LH camshaft.

ECT SENSOR



E42618

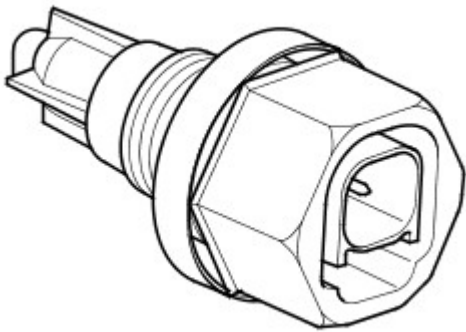
The ECT sensor is a negative temperature coefficient (NTC) type sensor. As coolant temperature rises the resistance of the

sensor falls.

The sensor is located at the front of the engine behind and below the throttle body.

Should the sensor fail the ECM use the oil temperature sensor signal as a backup coolant temperature signal.

ENGINE OIL TEMPERATURE SENSOR

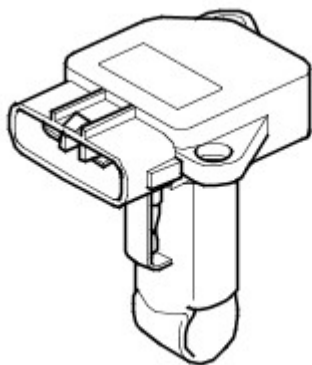


E42632

Oil temperature is monitored through a sensor mounted in the engine sump.

The sensor operates in the range -40 TO 150 degrees Celsius.

MAF / IAT)SENSOR



E42634

The MAF and IAT sensor is located in the air duct between the air filter and throttle body.

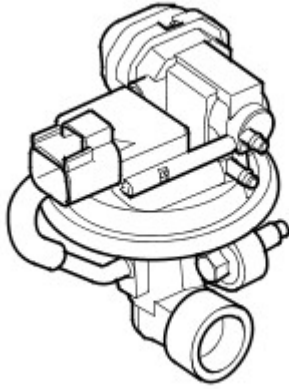
The air mass flow is determined by the cooling effect of inlet air passing over a "hot film" element contained within the device. The higher the air flow the greater the cooling effect and the lower the electrical resistance of the element. The signal from the device is then calculated by the ECM to determine the mass air flow into the engine.

The measured air mass flow is used in determining the fuel quantity to be injected in order to maintain the stoichiometric air/fuel mixture required for correct operation of the engine and exhaust catalysts. Should the device fail there is a software backup strategy that will be evoked once a fault has been diagnosed.

The IAT sensor is integrated into the Mass Air Flow meter. It is a temperature dependent resistor (thermistor), i.e. the resistance of the sensor varies with temperature. This thermistor is a NTC type element meaning that the sensor resistance decreases as the sensor temperature increases. The sensor forms part of a voltage divider chain with an additional resistor in the ECM. The voltage from this network changes as the sensor resistance changes, thus relating the air temperature to the voltage measured by the ECM.

The fixed default value for air temperature is 35°C

MAP SENSOR



E48511

The MAP sensor provides a voltage proportional to the absolute pressure in the intake manifold.

This signal allows the load on the engine to be calculated and used within the internal calculations of the ECM.

The sensor is located in the EGR valve at the front LH side of the engine.

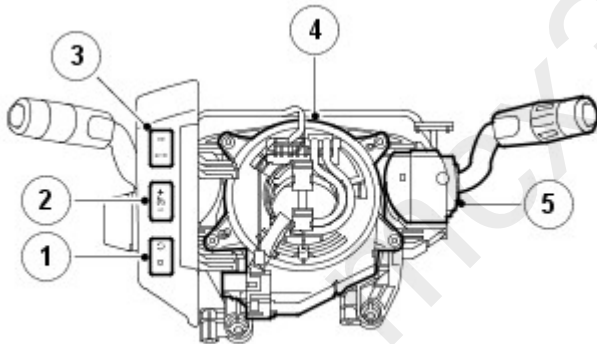
DIFFERENTIAL PRESSURE FEEDBACK-ELECTRONIC/MANIFOLD ABSOLUTE PRESSURE SENSOR (DPFE / MAP)

This pressure transducer monitors the pressure differential on either side of an orifice in the EGR system flow path and transmits that information to the ECM. The pressure drop measured across this orifice is used to estimate the flow rate of recirculated exhaust gas. An Electronic Vacuum Regulator (EVR) is used to control the vacuum signal to the EGR valve based on the electrical signal from the ECM. The ECM monitors the EGR level based on the feedback from the DPFE/MAP transducer, which creates a closed loop system.

EXHAUST GAS RECIRCULATION VALVE (EGR)

The EGR Valve is a PWM controlled valve that allows burned exhaust gas to be recirculated back into the engine. Since exhaust gas has much less oxygen than air, it is basically inert. It takes the place of air in the cylinder and reduces combustion temperature. As the combustion temperature is reduced, so are the oxides of nitrogen (NOx) emissions.

SPEED CONTROL



E47030

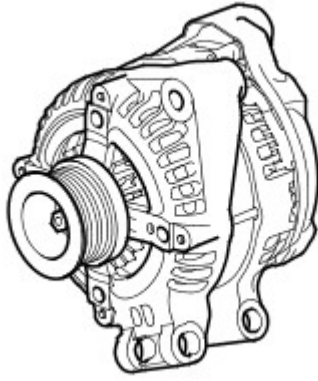
Item	Part Number	Description
1	-	Suspend/resume switch
2	-	Resume/Accelerate/Decelerate (+/-) Switches
3	-	Active speed control time gap switches (for future release)
4	-	Clock spring
5	-	Wiper control column switch

The V6 ECM incorporates a speed control function. The EMS uses a set of resistive ladders to interface with the driver speed control requirements. The speed control is operated from the steering wheel mounted switches. There are three illuminated rocker switches on a resistive ladder.

For additional information, refer to: [Speed Control](#) (310-03C Speed Control - V6 4.0L Petrol, Description and Operation).

The speed control does not have a master switch, it is enabled by pressing the set switch.

GENERATOR



E47591

The Generator has a multi function voltage regulator for use in a 14V charging system with 6÷12 zener diode bridge rectifiers.

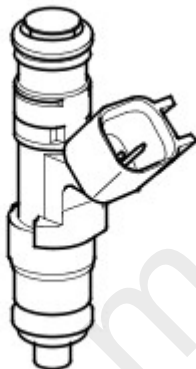
The ECM monitors the load on the electrical system via PWM signal and adjusts the generator output to match the required load. The ECM also monitors the battery temperature to determine the generator regulator set point. This characteristic is necessary to protect the battery; at low temperatures battery charge acceptance is very poor so the voltage needs to be high to maximize any recharge ability, but at high temperatures the charge voltage must be restricted to prevent excessive gassing of the battery with consequent water loss.

For additional information, refer to: Generator (414-02A Generator and Regulator - 4.0L, Description and Operation).

The Generator has a smart charge capability that will reduce the electrical load on the Generator reducing torque requirements, this is implemented to utilize the engine torque for other purposes. This is achieved by monitoring three signals to the ECM:

- Generator sense (A sense), measures the battery voltage at the central junction box (CJB).
- Generator communication (Alt Com) communicates desired Generator voltage set point from ECM to Generator.
- Generator monitor (Alt Mon) communicates the extent of Generator current draw to ECM. This signal also transmits faults to the ECM which will then sends a message to the instrument pack on the CAN bus to illuminate the charge warning lamp.

FUEL INJECTORS



E42640

The ECM controls six fuel injectors located on the cylinder head. The injectors are fed from a common fuel rail as part of a 'returnless' fuel system.

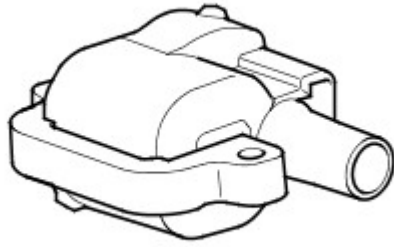
Fuel rail pressure is constant at 4.5 bar (59 psi) and is regulated by a regulator that is integral to the fuel pump module. The ECM monitors the output power stages of the injector drivers for electrical faults. The injector has a default resistance of 14.5 Ohms at 20 Degrees Celsius.

For additional information, refer to: Fuel Charging and Controls (303-04A Fuel Charging and Controls - 4.0L, Description and Operation).

SPARK PLUGS

It is essential that only factory-approved spark plugs be used in service. DO NOT attempt to use 'equivalent' spark plugs. Use of unapproved spark plugs may cause the misfire detection system to malfunction, and the ECM to store misfire faults.

IGNITION COILS



E42644

The Land Rover V6 engine is fitted with ignition coils that are driven directly by the ECM. The coils are mounted on top of the inlet manifold and are connected to the spark plugs by High Tension (HT) leads. The positive supply to the coil is fed from fuse 19 in the battery junction box (BJB). Each coil contains a power stage to trigger the primary current. The ECM sends a signal to each of the coils power stage to trigger the power stage switching. Each bank has a feedback signal that is connected to each power stage. If the coil power stage fails the feedback signal is not sent, causing the ECM to store a fault code.

FUEL PUMP RELAY

The V6 engine has a return less fuel system. The system pressure is maintained at a constant 4.5 bar , with no reference to intake manifold pressure. The fuel is supplied to the injectors from a fuel pump located within the fuel tank. The electrical supply to this fuel pump is controlled by the ECM via the fuel pump relay, in the event of a vehicle impact the ECM will receive a crash signal from the restraints control module and will cut the power supply to the fuel pump relay. The fuel system is pressurized as soon as the ECM is powered up, the pump is then switched off until engine start has been achieved.

The fuel pump relay is located in the CJB. The Fuel pump is contained within the fuel tank.

For additional information, refer to: [Fuel Tank and Lines](#) (310-01C Fuel Tank and Lines - V6 4.0L Petrol, Description and Operation).

VISCOUS FAN CONTROL

The ECM controls an electronically controlled viscous coupled fan to provide engine cooling. The ECM supplies the fan with a PWM signal that controls the amount of slippage of the fan, thus providing the correct amount of cooling fan speed and airflow. The EMS uses a Hall Effect sensor to determine the fan speed.

STARTER RELAY

The starter relay is supplied with power from fuseable link 19 in the Battery Junction Box.

The ECM controls the starter relay by supplying a 12 volt signal to the relay coil when the ignition is in crank position. This relies on the transmission gear position being either P or N.

CONDENSER FAN CONTROL

The ECM receives CAN messages from the ATC control module for idle speed adjustment and for cooling fan.

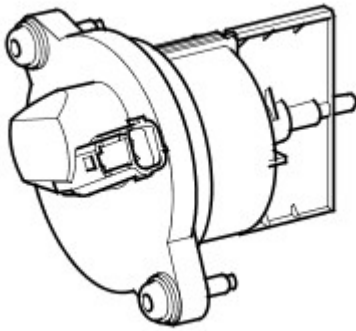
AirConCoolingRequest

This signal defines the level of cooling (from engine cooling fan(s)) required by the ATC system. Calibration within the EMS determines the fan speed required, and which fans will be used, at each requested level.

AirConIdleSpeedRequest

This signal defines whether or not an increase in the engine idle speed is required by the ATC system. The amount of idle speed increase is defined in the EMS calibration.

IMT valve



E42646

The IMT valve moves a plate within the inlet manifold to allow or block sonic pulses between the split manifold halves. This, in effect, extends the inlet tracts for better low rpm torque. The IMT valve is a two position valve and is either fully open or fully closed.
For additional information, refer to: [Intake Air Distribution and Filtering](#) (303-12C Intake Air Distribution and Filtering - V6 4.0L Petrol, Description and Operation).

ECM ADAPTIONS

The ECM has the ability to adapt the values it uses to control certain outputs. This capability ensures the EMS can meet emissions legislation and improve the refinement of the engine throughout its operating range.

The components which have adaptions associated with them are:

- The APP sensor
- The HO2S
- The MAF/IAT sensor
- The CKP sensor
- Electric throttle body.

UHEGO/HEGO and MAF/IAT Sensor

There are several adaptive maps associated with the fueling strategy. Within the fueling strategy the ECM calculates short-term adaptions and long term adaptions. The ECM will monitor the deterioration of the HO2S over a period of time. It will also monitor the current correction associated with the sensors.

The ECM will store a fault code in circumstances where an adaption is forced to exceed its operating parameters. At the same time, the ECM will record the engine speed, engine load and intake air temperature.

CKP Sensor

The characteristics of the signal supplied by the CKP sensor are learned by the ECM. This enables the ECM to set an adaption and support the engine misfire detection function. Due to the small variation between different flywheels and different CKP sensors, the adaption must be reset if either component is renewed, or removed and refitted. It is also necessary to reset the flywheel adaption if the ECM is renewed or replaced. The ECM supports four flywheel adaptions for the CKP sensor. Each adaption relates to a specific engine speed range. The engine speed ranges are detailed in the table below:

Adaptions	Engine Speed, rev / min
1	1800 - 3000
2	3001 - 3800
3	3801 - 4600
4	4601 - 5400

Misfire Detection

Legislation requires that the ECM must be able to detect the presence of an engine misfire. It must be able to detect misfires at two separate levels. The first level is a misfire that could lead to the vehicle emissions exceeding 1.5 times the Federal Test Procedure (FTP) requirements for the engine. The second level is a misfire that may cause catalyst damage.

The ECM monitors the number of misfire occurrences within two engine speed ranges. If the ECM detects more than a predetermined number of misfire occurrences within either of these two ranges, over two consecutive journeys, the ECM will record a fault code and details of the engine speed, engine load and engine coolant temperature. In addition, the ECM monitors the number of misfire occurrences that happen in a 'window' of 200 engine revolutions. The misfire occurrences are assigned a weighting according to their likely impact on the catalysts. If the number of misfires exceeds a certain value, the ECM stores catalyst-damaging fault codes, along with the engine speed, engine load and engine coolant temperature.

The signal from the crankshaft position sensor indicates how fast the poles on the flywheel are passing the sensor tip. A sine wave is generated each time a pole passes the sensor tip. The ECM can detect variations in flywheel speed by monitoring the sine wave signal supplied by the crankshaft position sensor.

By assessing this signal, the ECM can detect the presence of an engine misfire. At this time, the ECM will assess the amount of variation in the signal received from the crankshaft position sensor and assigns a roughness value to it. This roughness value can be viewed within the real time monitoring feature, using T4. The ECM will evaluate the signal against a number of factors and will decide whether to count the occurrence or ignore it. The ECM can assign a roughness and misfire signal for each cylinder, (i.e. identify which cylinder is misfiring).

T4 Diagnostics

The ECM stores faults as diagnostic trouble code (DTC), referred to as 'P' codes. The 'P' codes are defined by on-board diagnostic (OBD) legislation and, together with their associated environmental and freeze frame data, can be read using a third party scan tool or T4. T4 can also read real time data from each sensor, the adaptive values currently being employed and the current fueling, ignition and idle settings.

P Code No	Component / Signal	Fault Description
P0011	CMP/CKP/VVT	Bank A CMP/CKP Position error high , VVT retard position high
P0012	CMP/CKP/VVT	Bank A CMP/CKP Position error low, VVT retard position low
P0021	CMP/CKP/VVT	Bank B CMP/CKP Position error, VVT retard position high
P0022	CMP/CKP/VVT	Bank B CMP/CKP Position error low , VVT retard position low
P0026	VVT	Bank A circuit malfunction range high/low
P0028	VVT	Bank B circuit malfunction range high/low
P0031	UHEGO	Bank A heater control circuit low
P0032	UHEGO	Bank A heater control circuit high
P0051	UHEGO	Bank B heater control circuit low
P0052	UHEGO	Bank B heater control circuit high
P0069	HAC	Sensor circuit/range performance
P0071	Ambient air temperature sensor	Range performance
P0072	Ambient air temperature sensor	Circuit low input
P0073	Ambient air temperature sensor	Circuit high input
P0075	VVT	Bank A open circuit
P0076	VVT	Bank A short to ground
P0077	VVT	Bank A short to battery
P0081	VVT	Bank B open circuit
P0082	VVT	Bank B short to ground
P0083	VVT	Bank B short to battery
P0087	Fuel pressure system	Low fault
P0088	Fuel pressure system	High fault
P0089	Fuel pressure system	Noise fault
P0093	Fuel pressure system	Large leak
P0096	IAT	Sensor range performance
P0101	AFM	Circuit range performance
P102	AFM	Circuit low input
P103	AFM	Circuit high input
P0106	MAP	Sensor range performance
P0107	MAP	Circuit low input
P0108	MAP	Circuit high input
P0111	IAT	Stuck high/low at engine start, stuck high
P0112	IAT	Sensor 1 circuit low input
P0113	IAT	Sensor 1 circuit high input
P0116	ECT	Implausible signal
P0117	ECT	Circuit low input
P0118	ECT	Circuit high input
P0121	Throttle circuit 1 and 2	Range/performance
P0122	Throttle circuit 1	Low input
P0123	Throttle circuit 1	High input
P0125	ECT	Insufficient coolant temperature for closed loop control
P0128	Thermostat monitor	Low coolant temperature - thermostat stuck open
P0131	UHEGO	Bank A short circuit to ground
P0132	UHEGO	Bank A Short circuit to battery
P0133	UHEGO	Bank A slow response
P0136	HEGO	Bank A adaptations
P0137	HEGO	Bank A short circuit to ground
P0138	HEGO	Bank A short circuit to battery
P0139	HEGO	Bank A slow response
P0140	HEGO	Bank A no activity
P0141	HEGO	Bank A heater control circuit malfunction
P0150-1A	HEGO	Bank A element impedance low
P0151	UHEGO	Bank B short circuit to ground
P0152	UHEGO	Bank B short circuit to battery
P0153	UHEGO	Bank B slow response
P0154-00	UHEGO	Bank B slow activation
P0156	HEGO	Bank B adaptations
P0157	HEGO	Bank B short circuit to ground
P0158	HEGO	Bank B short circuit to battery
P0159	HEGO	Bank B slow response
P0160	HEGO	Bank B no activity
P0161	HEGO	Bank B heater control circuit malfunction
P00171	lambda control	Bank A too lean
P0172	lambda control	Bank A too rich
P0174	lambda control	Bank B too lean
P0175	lambda control	Bank B too rich
P0181	Fuel rail temperature sensor	Temperature signal implausible
P0182	Fuel rail temperature sensor	Circuit low input
P0183	Fuel rail temperature sensor	Circuit high input

P Code No	Component / Signal	Fault Description
P0191	Fuel rail pressure sensor	Range/performance
P0192	Fuel Rail Pressure Sensor	Low Input
P0193	Fuel Rail Pressure Sensor	High Input
P0196	Oil temperature sensor	Range/performance
P0197	Oil temperature sensor	Low input
P0198	Oil temperature sensor	High input
P0201	Injector Circuit	Malfunction - Cylinder 1
P0202	Injector Circuit	Malfunction - Cylinder 2
P0203	Injector Circuit	Malfunction - Cylinder 3
P0204	Injector Circuit	Malfunction - Cylinder 4
P0205	Injector Circuit	Malfunction - Cylinder 5
P0206	Injector Circuit	Malfunction - Cylinder 6
P0207	Injector Circuit	Malfunction - Cylinder 7
P0208	Injector Circuit	Malfunction - Cylinder 8
P0222	APP sensor 2	Low input
P0223	APP sensor 2	High input
P0227	APP sensor 1	Low input
P0228	APP sensor 1	High input
P0229	APP sensor	Intermittent fault
P0297	Active speed control	Vehicle over speed condition
P0300	Misfire	Random/multiple cylinder misfire
P0301	Misfire	Cylinder 1
P0302	Misfire	Cylinder 2
P0303	Misfire	Cylinder 3
P0304	Misfire	Cylinder 4
P0305	Misfire	Cylinder 5
P0306	Misfire	Cylinder 6
P0307	Misfire	Cylinder 7
P0308	Misfire	Cylinder 8
P0313	Misfire	Misfire under low fuel condition
P0316	Misfire	Misfire detected in first 1000 revs
P0326	Knock sensor	Sensor 1 high/low performance error
P0327	Knock sensor	Bank A sensor low input fault
P0328	Knock sensor	Bank A high input fault
P0331	Knock sensor	Sensor 2 high/low performance error
P0332	Knock sensor	Bank B sensor low input fault
P0333	Knock sensor	Bank A high input fault
P0335	Crank sensor	Sensor circuit malfunction during crank/running
P0336	Crank sensor	Range/performance fault
P0340	Intake CMP sensor bank A	Fault during cranking/running
P0341	Intake CMP sensor bank A	Range/performance fault
P0345	Intake CMP sensor bank B	Fault during cranking/running
P0346	Intake CMP sensor bank B	Range/performance fault
P0351	Ignition coil	Circuit malfunction cylinder 1
P0352	Ignition coil	Circuit malfunction cylinder 2
P0353	Ignition coil	Circuit malfunction cylinder 3
P0354	Ignition coil	Circuit malfunction cylinder 4
P0355	Ignition coil	Circuit malfunction cylinder 5
P0356	Ignition coil	Circuit malfunction cylinder 6
P0357	Ignition coil	Circuit malfunction cylinder 7
P0358	Ignition coil	Circuit malfunction cylinder 8
P0365	Exhaust CMP sensor bank A	Fault during cranking/running
P0366	Exhaust CMP sensor bank A	Range/performance fault
P0390	Exhaust CMP sensor bank B	Fault during cranking/running
P0391	Exhaust CMP sensor bank B	Range/performance fault
P0401	EGR system	Insufficient flow detected
P0403	EGR system	Valve circuit high/low input
P0405	Differential pressure sensor	Short to ground
P0406	Differential pressure sensor	Short to battery
P0409	Differential pressure sensor	Range performance
P0420	Catalyst system bank A	Efficiency below threshold
P0430	Catalyst system bank	Efficiency below threshold
P0441	Purge valve	Range performance
P0442	DMTL	Medium leak detected
P0447	DMTL	Short to ground
P0448	DMTL	Short to battery
P0455	DMTL	Large leak detected
P0456	DMTL	Small leak detected
P0458	Purge valve	Short to ground
P0459	Purge valve	Short to battery
P0461	Fuel level sensor	Range/performance fault
P0480	Radiator fan module	Control circuit malfunction
P0493	Viscous fan	Speed Out of range
P0501	Vehicle speed	Range/performance malfunction
P0504	Brake switch	Circuit malfunction

P Code No	Component / Signal	Fault Description
P0506	Idle Control System	RPM Lower Than Expected
P0507	Idle Control System	RPM higher Than Expected
P0512	Crank request circuit	High/low input
P0513	Security key	Key invalid
P0532	Air conditioning refrigerant pressure sensor	Low input
P0533	Air conditioning refrigerant pressure sensor	High input
P0560	Battery back up	Malfunction
P0562	Sensor power supply	Low input
P0563	Sensor power supply	High input
P0566	Speed control cancel switch	ON fault
P0567	Speed control resume switch	ON fault
P0568	Speed control	Low/high input
P0569	Decelerate/set/inch switch	ON fault
P0570	Accelerate/set/inch switch	On fault
P0574	Speed control	Speed monitoring
P0576	Speed control	Low input
P0577	Speed control	High input
P0604	ECM self test	RAM error
P0605	ECM self test	ROM error
P0606	ECM self test	Processor error
P0616	Starter relay	Low input
P0617	Starter relay	High input
P0627	Primary fuel pump	no commands received
P0628	Fuel pump	Electrical low
P0629	Fuel pump	Electrical high
P0633	Security	No ID in ECM
P0634	ECM temperature	Internal temperature too high
P0646	Air conditioning clutch relay	Low input
P0647	Air conditioning clutch relay	High input
P0661	Manifold valve output drive 1	Open circuit or short circuit to ground
P0662	Manifold valve output drive 1	Short circuit to battery
P0664	Manifold valve output drive 2	Open circuit or short circuit to ground
P0665	Manifold valve output drive 2	Short circuit to battery
P0668	ECM temperature sensor	Short to ground
P0669	ECM temperature sensor	Short to battery
P0687	EMS control relay	Relay malfunction
P0831	Clutch switch circuit A	Low input
P0832	Clutch switch circuit A	High input
P0834	Clutch switch circuit B	Low input
P0835	Clutch switch circuit B	High input
P0851	Park/Neutral Switch	Input Circuit Low
P0852	Park/Neutral Switch	Input Circuit High
P1136	E Box fan	Fan malfunction
P1146	Generator command line	Low input/communication error
P1155	HEGO Heater bank A	
P1160	UHEGO Bank A	Slow activation
P1197	UHEGO Bank A	Slow activation/open shorted
P1198	UHEGO Bank B	Slow activation/open shorted
P1233	Secondary fuel pump	Output circuit open
P1234	Primary fuel pump	No commands received
P1236	Primary fuel pump	Pump not working when requested
P1244	Alternator command line	High input
P1260	Security limited start	Theft attempt
P1339	Secondary fuel pump	Driver circuit output low/high
P1367	Ignition coil bank A	
P1368	Ignition coil bank A	
P1452	DMTL	Reference current too low
P1453	DMTL	Reference current too high
P1482	DMTL heater control circuit	Low
P1483	DMTL heater control circuit	High
P1582	Flight recorder	Data stored
P1624	Security ID	ID transfer process failed
P1629	Generator	FR line failure
P1632	Generator	Charge system failure
P1646	UHEGO sensor bank A	Slow activation/control module open shorted
P1647	UHEGO sensor bank B	Slow activation/control module open shorted
P1670	E Box fan	Malfunction low
P1671	E Box fan	Malfunction high
P1697	Speed control	Shorter/Longer switch ON fault
P1700	Low gear ratio	plausibility check
P2066	Secondary fuel pump	Range check
P2070	Manifold valve output drive 1	Performance check stuck open/closed
P2071	Manifold valve output drive 2	Performance check stuck open/closed
P2101	Electric throttle	Range performance
P2103	Electric throttle	Throttle duty at 100% continuously

P Code No	Component / Signal	Fault Description
P2105	Electric throttle	malfunction indicator lamp (MIL) request dual fuel cut off
P2106	Intended reduced availability	Re-configuration failure
P2118	Electric throttle system	Over current detection by hardware
P2119	Electric throttle	Throttle stuck open
P2122	APP sensor	Circuit 2 low input
P2123	App sensor	Circuit 2 high input
P2228	HAC sensor	Circuit low
P2229	HAC sensor	Circuit high
P2299	Accelerator pedal	Brake override
P2401	DMTL Pump	Ground short
P2402	DMTL Pump	Battery short
P2404	DMTL Pump	Noise/reference leak fault
P2450	DMTL	COV stuck open
P2451	DMTL	COV stuck closed
P2503	Charging system	Voltage low
P2504	Charging system	Voltage high
P2601	Water pump	Performance fault
P2610	Engine off timer	Timer malfunction
P2632	Secondary fuel pump driver circuit	Output circuit open
P2633	Secondary fuel pump driver circuit	Output low
P2634	Secondary fuel pump driver circuit	High input
P6365	Primary fuel pump	Pump not working when requested
P2636	Secondary fuel pump	Low flow/performance

CENTRAL JUNCTION BOX

The Central Junction box is used to initiate the power up and power down routines within the ECM. When the ignition is turned on, 12V is applied to the Ignition Sense input to pin 30 of connector C0635. The ECM then starts its power up routines and turns on the ECM main relay.

When the ignition is turned OFF the ECM will maintain its powered up state for several seconds (this may be up to 20 minutes in extreme cases when cooling fans are required) while it initiates its power down routine and on completion will turn off the ECM main relay.

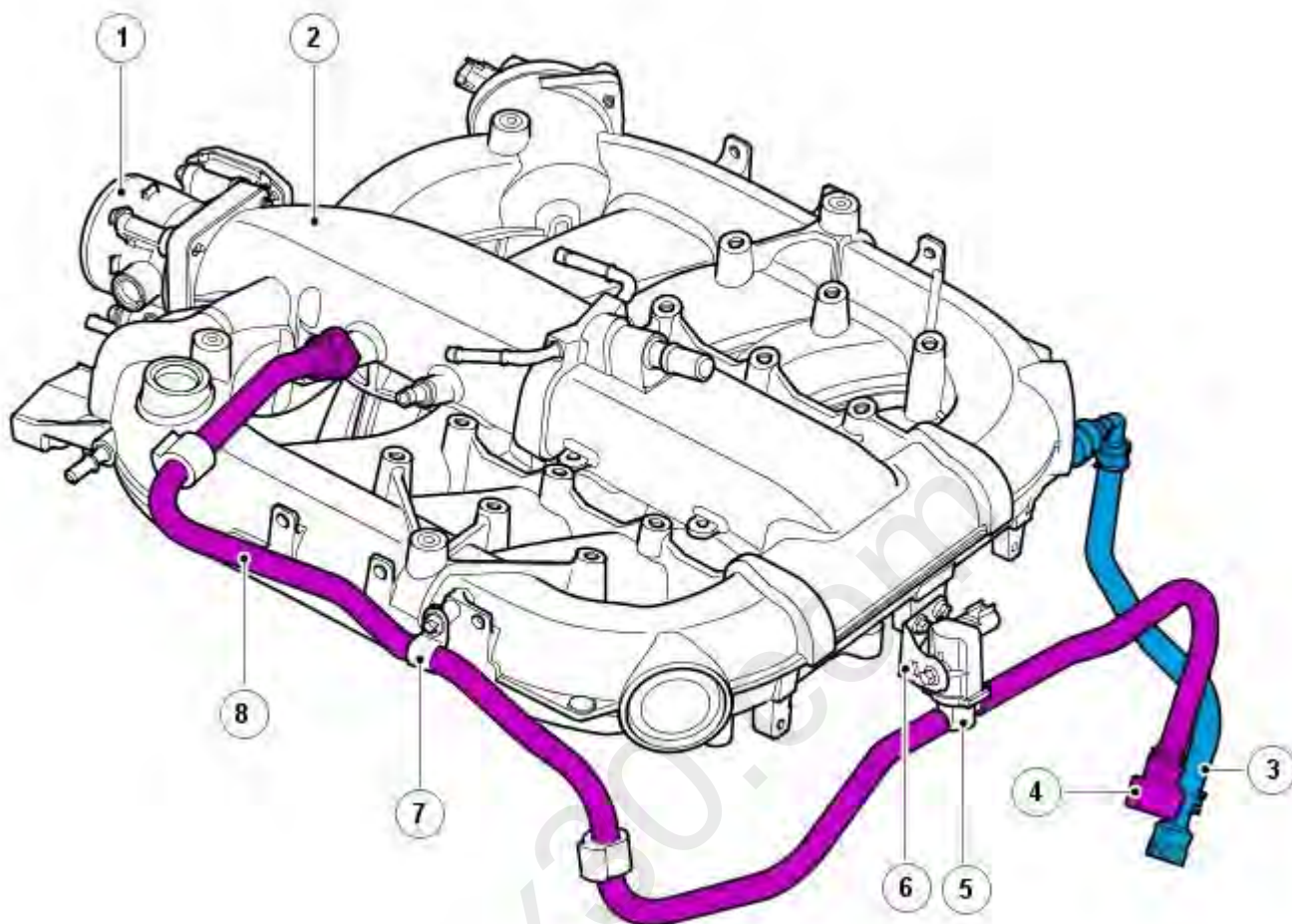
POWER SUPPLIES

The ECM requires a permanent battery level voltage supply and a switched battery level voltage supply. The switched voltage supply is controlled by the ECM via a relay based on the condition of the Central Junction Box input (key position 2).

At key "OFF", the ECM will maintain the switched supply active until internal self checks have been completed. The Main Supply fuse is located in the engine compartment fuse box.

PURGE VALVE

Purge Valve and Hoses



E44559

Item	Part Number	Description
1	-	Electric throttle
2	-	Air intake manifold
3	-	Fuel feed jump hose
4	-	Purge hose connector
5	-	Purge valve
6	-	Purge valve bracket
7	-	Hose clamp
8	-	Manifold to purge valve hose

To meet increasing legislation in fuel evaporative loss the Evaporative Emissions Loss Control System has been introduced to minimize the evaporative loss of fuel vapor from the fuel system to the atmosphere. This is achieved by venting the fuel system through a vapor trap (charcoal canister). The charcoal acts like a sponge and stores the vapor until the canister is purged under the control of the ECM.

The charcoal canister is connected with the inlet manifold, after the throttle body, via a purge valve. This valve is opened and closed according to a PWM signal from the ECM. The canister is purged by drawing clean air through the charcoal, which carries the hydrocarbons into the engine where they are burnt. To maintain drivability and emission control purging must be closely controlled as a 1% concentration of fuel vapor from the canister in the air intake may shift the air/fuel ratio by as much as 20%. Purging must be carried out at regular intervals, to regenerate the charcoal, as its storage capacity is limited, and is cycled with the Fueling Adaption, as both cannot be active at the same time.

The ECM alters the PWM signal to the purge valve to control the rate of purging of the canister. The purging of the canister is done in a controlled manner in order to maintain the correct Stoichiometric air/fuel mixture for the engine. It also ensures the canister itself is purged frequently enough to prevent fuel saturation of the charcoal leading to an excessive build up of fuel vapor (and hence vapor pressure) in the system which could increase the likelihood of vapor leaks. For additional information, refer to: [Evaporative Emissions](#) (303-13A Evaporative Emissions - V6 4.0L Petrol, Description and Operation).

Electronic Engine Controls - V6 4.0L Petrol - Electronic Engine Controls

Diagnosis and Testing

Principles of Operation

For a detailed description of the electronic engine control system and operation, refer to the relevant Description and Operation section of the workshop manual. REFER to: [Electronic Engine Controls](#) (303-14C Electronic Engine Controls - V6 4.0L Petrol, Description and Operation).

Inspection and Verification



CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault and may also cause additional faults in the vehicle being checked and/or the donor vehicle.

- **NOTE:** Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

1. Verify the customer concern.
2. Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection

Mechanical	Electrical
• Engine oil level • Cooling system coolant level • Fuel level • Fuel contamination/grade/quality • Fuel leaks • Accessory drive belt • Sensor installation/condition • Viscous fan and solenoid • Air cleaner condition	• Fuses • Wiring harness • Electrical connector(s) • 5 volt sensor supply • Sensor(s) • Engine Control Module (ECM) • Transmission Control Module (TCM)

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. If the cause is not visually evident, verify the symptom and refer to the Symptom Chart, alternatively check for Diagnostic Trouble Codes (DTCs) and refer to the DTC Index.

Symptom Chart

Symptom	Possible Causes	Action
Engine cranks, but does not fire	• Engine breather system disconnected/restricted • Ignition system • Fuel system • Electronic engine control	Ensure the engine breather system is free from restriction and is correctly installed. Check for ignition system, fuel system and electronic engine control DTCs and refer to the relevant DTC Index
Engine cranks and fires, but will not start	• Evaporative emissions purge valve • Fuel pump • Spark plugs • HT short to ground (tracking) check rubber boots for cracks/damage • Ignition system	Check for evaporative emissions, fuel system and ignition system related DTCs and refer to the relevant DTC Index
Difficult cold start	• Engine coolant level/anti-freeze content • Battery • Electronic engine controls • Exhaust Gas Recirculation (EGR) valve stuck open • Fuel pump • Purge valve	Check the engine coolant level and condition. Ensure the battery is in a fully charged and serviceable condition. Check for electronic engine controls, engine emissions, fuel system and evaporative emissions system related DTCs and refer to the relevant DTC Index
Difficult hot start	• Injector leak • Electronic engine control • Purge valve • Fuel pump • Ignition system • EGR valve stuck open	Check for injector leak, install new injector as required. Check for electronic engine controls, evaporative emissions, fuel system, ignition system and engine emission system related DTCs and refer to the relevant DTC Index
Difficult to start after hot engine off, after engine has reached operating temperature	• Injector leak • Electronic engine control • Purge valve • Fuel pump • Ignition system • EGR valve stuck open	Check for injector leak, install new injector as required. Check for electronic engine controls, evaporative emissions, fuel system, ignition system and engine emission system related DTCs and refer to the relevant DTC Index

DTC Index

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to section 100-00 General Information, [Diagnostic Trouble Code \(DTC\) Index](#) (PCM) 4.0L V6 (100-00 General Information, Description and Operation).

Electronic Engine Controls - V6 4.0L Petrol - Brake Pedal Position (BPP)

Switch Adjustment

General Procedures

Check

1. Remove the brake pedal rubber.

2. NOTE: Make sure that the dial test indicator (DTI) gauge is in line with the brake pedal movement.

Position the DTI gauge on a suitable mounting block, as illustrated.



3. With the aid of another technician, gently press the brake pedal until the stoplamps illuminate.

4. NOTE: The specification is that the stoplamps should illuminate at between 5.5mm and 8.5mm brake pedal travel.

Note the measurement of the brake pedal travel from rest position until the stoplamps illuminated.

Adjust

1. CAUTIONS:



The brake pedal **must not** be pressed during this operation. Failure to follow this instruction may result in damage to the component.



Remove the stoplamp switch.

For additional information, refer to: [Stoplamp Switch](#) (417-01 Exterior Lighting, Removal and Installation).

2. CAUTIONS:



The brake pedal **must not** be pressed during this operation. Failure to follow this instruction may result in damage to the component.



Only use light finger pressure when installing the stoplamp switch. Failure to follow this instruction may result in an incorrectly adjusted stoplamp switch.

Install the stoplamp switch.

For additional information, refer to: [Stoplamp Switch](#) (417-01 Exterior Lighting, Removal and Installation).

3. Check the adjustment of the stoplamp switch by following the **Check** procedure in this procedure and carry out the **Adjust** procedure if required.

Electronic Engine Controls - V6 4.0L Petrol - Engine Oil Pressure (EOP)

Sensor

Removal and Installation

Removal

1. Raise and support the vehicle.

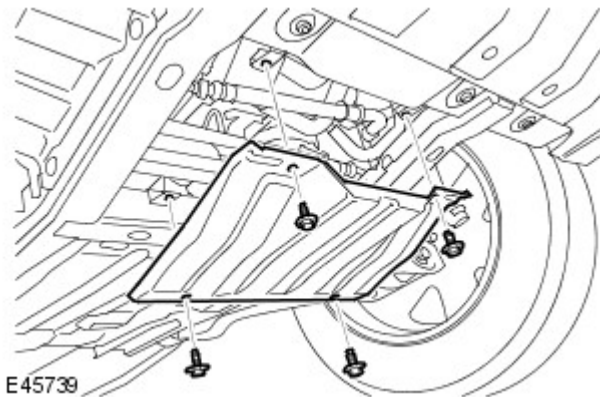
2.  **CAUTION:** Before the disconnection or removal of any components, ensure the area around joint faces and connections are clean. Plug any open connections to prevent contamination.

Disconnect the battery ground cable.

For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

3. Remove the radiator access panel.

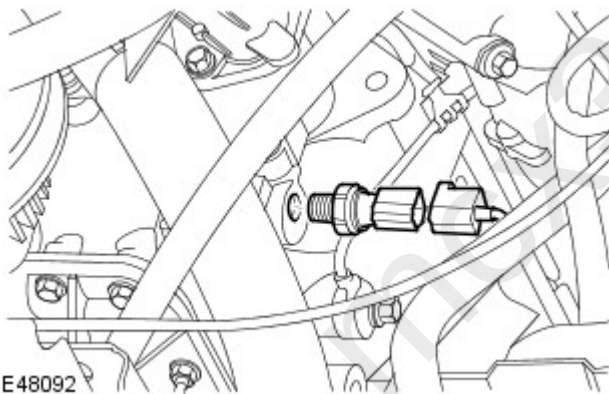
- Remove the 4 bolts.



E45739

4. Remove the EOP sensor.

- Disconnect the electrical connector.
- Position a container to collect the fluid.



E48092

Installation

1. To install, reverse the removal procedure.

- Clean the component mating faces.
- Tighten the oil pressure sensor to 13 Nm (10 lb.ft).

2. Check and top-up the engine oil.

Electronic Engine Controls - V6 4.0L Petrol - Oil Temperature Sensor

Removal and Installation

Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

3. Remove the engine undershield.
For additional information, refer to: [Engine Undershield](#) (501-02 Front End Body Panels, Removal and Installation).



4.  **CAUTION:** Before disconnecting or removing the components, ensure the area around the joint faces and connections are clean. Plug open connections to prevent contamination.

Remove the oil temperature sensor.

- Disconnect the electrical connector.
- Position a container to collect spillage.
- Remove and discard the O-ring seal.

Installation

1. **NOTE:** Lubricate new seals with clean engine oil.

Install the oil temperature sensor.

- Clean the component mating faces.
- Install a new O-ring seal.
- Tighten the oil temperature sensor to 20 Nm (15 lb.ft).
- Connect the electrical connector.

2. Install the engine undershield.
For additional information, refer to: [Engine Undershield](#) (501-02 Front End Body Panels, Removal and Installation).
3. Connect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
4. Check and top-up the engine oil.

Electronic Engine Controls - V6 4.0L Petrol - Engine Control Module (ECM)

Removal and Installation

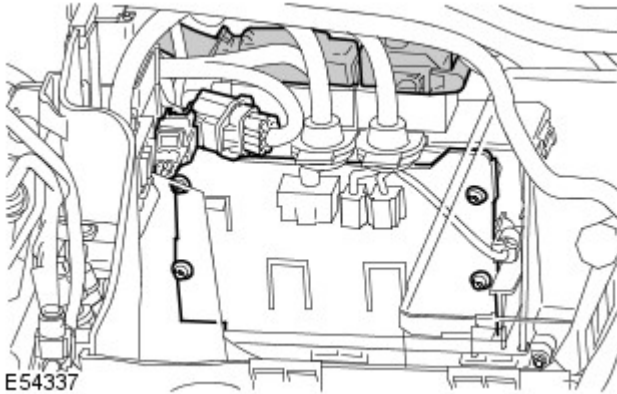
Removal

• **NOTE:** If the ECM is to be replaced, the T4 must be connected prior to battery disconnection and on-screen instructions must be followed.

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the four-wheel drive control module.
For additional information, refer to: [Four-Wheel Drive \(4WD\) Control Module](#) (308-07A Four-Wheel Drive Systems, Removal and Installation).

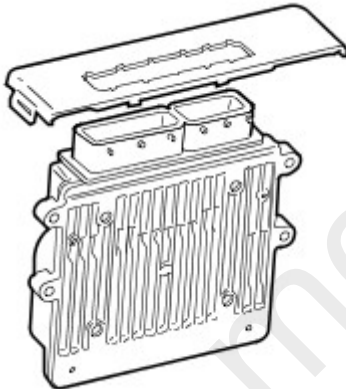
3. Remove the ECM cover.

- Disconnect 2 electrical connectors for access.
- Disconnect the 2 ECM electrical connectors.
- Remove the 4 Torx screws.



4. Remove the ECM.

- Remove the ECM top cover.



Installation

1. Install the ECM.
 - Install the ECM cover and secure with Torx screws.
 - Install the ECM upper cover.
2. Connect the ECM electrical connectors.
3. Connect the 2 electrical connectors disconnected for access.
4. Install the four-wheel drive control module.
For additional information, refer to: [Four-Wheel Drive \(4WD\) Control Module](#) (308-07A Four-Wheel Drive Systems, Removal and Installation).
5. Connect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
6. Connect T4 to calibrate a new ECM.

Electronic Engine Controls - V6 4.0L Petrol - Engine Coolant Temperature (ECT) Sensor

Removal and Installation

Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the throttle body gasket.
For additional information, refer to: [Throttle Body Gasket](#) (303-04E Fuel Charging and Controls - V6 4.0L Petrol, Removal and Installation).
3. Remove the ECT sensor.

- Position an absorbent cloth to collect fluid spillage.
- Disconnect the electrical connector.
- Remove and discard the O-ring seal.



Installation

1. To install, reverse the removal procedure.
 - Clean the components.
 - Tighten the ECT sensor to 18 Nm (13 lb.ft).
 - Top-up the coolant.

Electronic Engine Controls - V6 4.0L Petrol - Crankshaft Position (CKP) Sensor

Removal and Installation

Removal

- NOTE: The CKP sensor is located on the LH side of the torque converter housing.

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

2.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

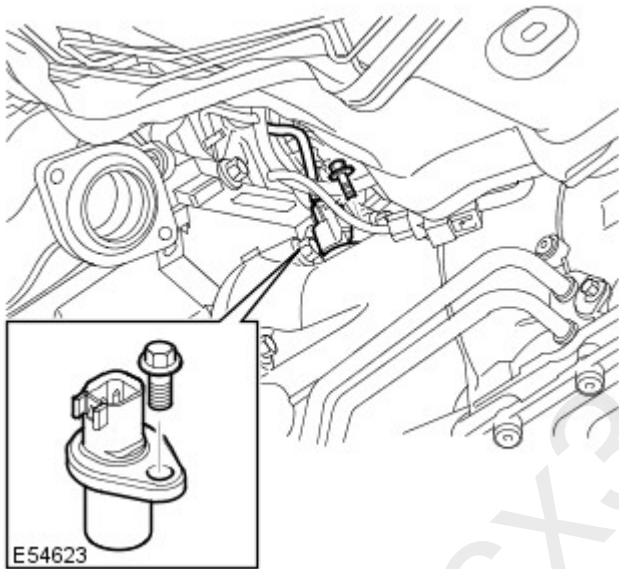
Raise and support the vehicle.

3. Remove the exhaust system.
For additional information, refer to: [Exhaust System](#) (309-00C Exhaust System - V6 4.0L Petrol, Removal and Installation).

4.  **CAUTION:** Before the disconnection or removal of any components, make sure the area around joint faces and connections are clean. Plug any open connections to prevent contamination.

Remove the CKP sensor.

- Disconnect the electrical connector.
- Remove the bolt.



Installation

1. To install, reverse the removal procedure.
 - Clean the component mating faces.
 - Tighten the Torx screw to 8 Nm (6 lb.ft).
2. Install the exhaust system.
For additional information, refer to: [Exhaust System](#) (309-00C Exhaust System - V6 4.0L Petrol, Removal and Installation).
3. Connect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
4. Using the approved diagnostic equipment, clear the powertrain control module (PCM) adaptations.

Electronic Engine Controls - V6 4.0L Petrol - Throttle Position (TP) Sensor

Removal and Installation

Removal

- NOTE: The TP sensor is part of the throttle body and cannot be serviced separately.

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the engine cover.
For additional information, refer to: [Engine Cover - V6 4.0L Petrol](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
3. Remove the air intake resonator.
For additional information, refer to: Resonator (303-12, Removal and Installation).
4. Disconnect the TP sensor electrical connector.



E 44423

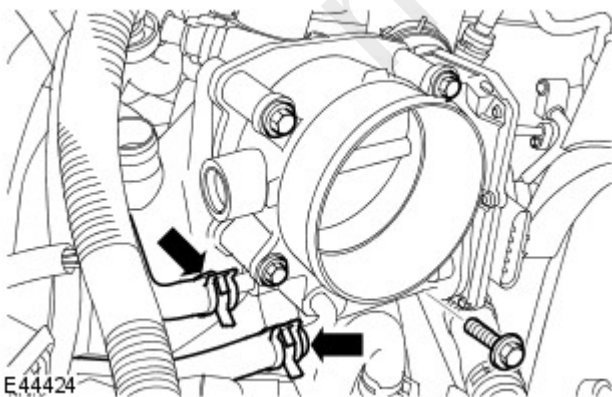
5.  **WARNING:** Since injury such as scalding could be caused by escaping steam or coolant, do not remove the filler cap from the coolant expansion tank while the system is hot.

Disconnect the coolant hoses from the throttle body.

- Clamp the throttle body coolant hoses to minimize coolant loss.
- Release the throttle body hose clips

6. Remove the throttle body.

- Remove the 4 bolts.
- Remove and discard the throttle body gasket.



E 44424

Installation

1. Install the throttle body.
 - Clean the component mating faces.
 - Install a new gasket.
 - Tighten the 4 bolts to 10 Nm (7 lb.ft).
2. Connect the coolant hoses to the throttle body.

- Secure the throttle body hoses clips.
 - Remove the hose clamps from the throttle body hoses.
3. Install the TP sensor electrical connector.
 4. Install the air intake resonator.
For additional information, refer to: Resonator (303-12, Removal and Installation).
 5. Install the engine cover.
For additional information, refer to: [Engine Cover - V6 4.0L Petrol](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
 6. Connect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
 7. Check and top-up the coolant.
 8. Use T4 to re-calibrate a new TP sensor.

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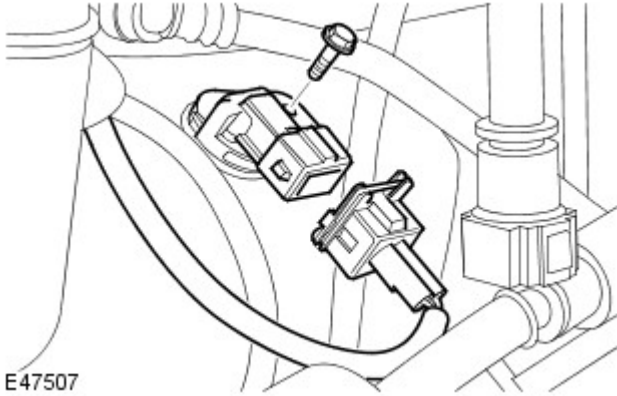
Electronic Engine Controls - V6 4.0L Petrol - Camshaft Position (CMP)

Sensor

Removal and Installation

Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the engine cover.
For additional information, refer to: [Engine Cover - V6 4.0L Petrol](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
3. Remove the CMP sensor.
 - Disconnect the electrical connector.
 - Remove the bolt.



Installation

1. To install, reverse the removal procedure.
 - Clean the component mating faces.
 1. Lubricate a new O-ring seal with clean engine oil.
 - Tighten the bolt to 6 Nm (4 lb.ft)

Electronic Engine Controls - V6 4.0L Petrol - Knock Sensor (KS) LH

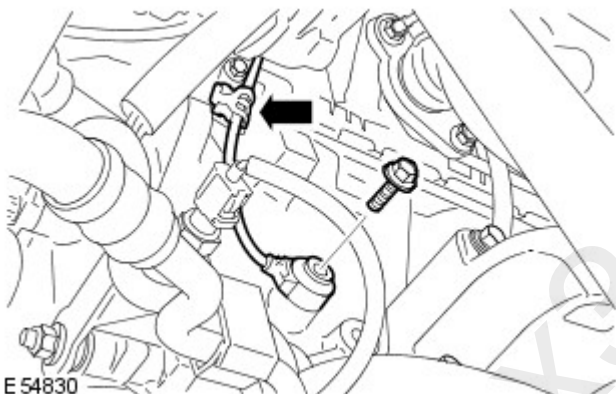
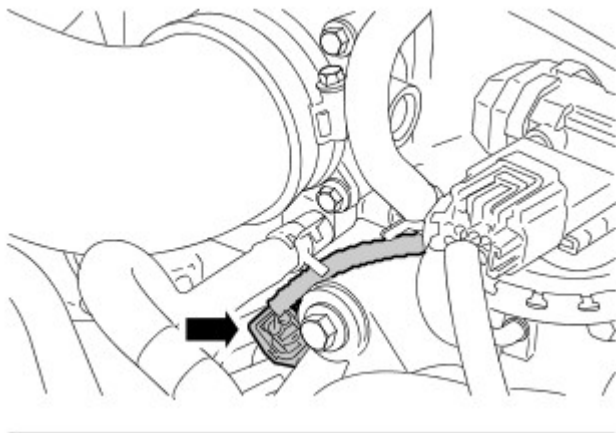
Removal and Installation

Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

2. Remove the KS.

- Disconnect the electrical connector.
- Release the knock sensor electrical connector retaining clips.
- Remove the bolt.



Installation

1. To install, reverse the removal procedure.
 - Clean the component mating faces.
 - Tighten the bolt to 20 Nm (15 lb.ft).

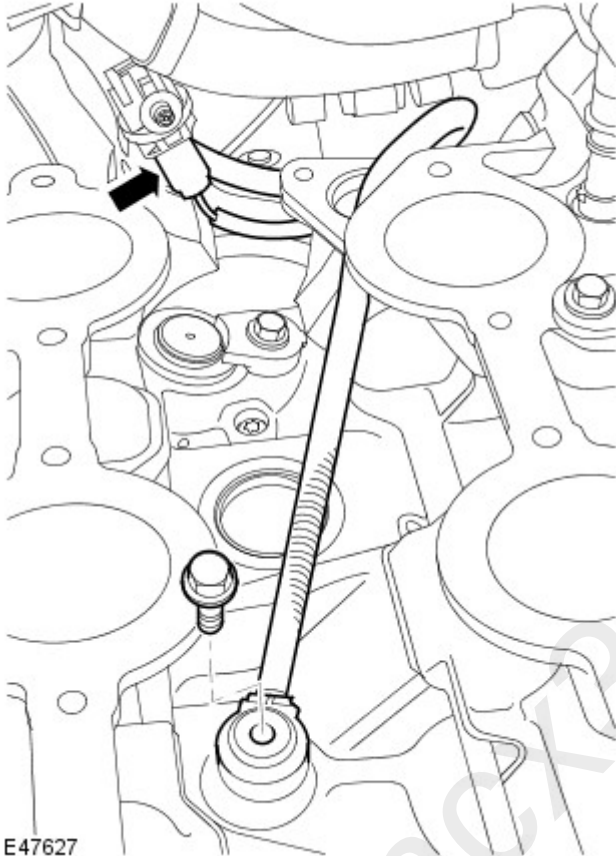
Electronic Engine Controls - V6 4.0L Petrol - Knock Sensor (KS) RH

Removal and Installation

Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the intake manifold.
For additional information, refer to: [Intake Manifold](#) (303-01C Engine - V6 4.0L Petrol, In-vehicle Repair).
3. Remove the KS.

- Disconnect the electrical connector.
- Release the RH KS electrical connector retaining clip.
- Remove the bolt.



Installation

1. To install, reverse the removal procedure.
 - Clean the component mating faces.
 - Tighten the bolt to 20 Nm (15 lb.ft).

Electronic Engine Controls - V6 4.0L Petrol - Heated Oxygen Sensor (HO2S)**LH**

Removal and Installation

Special Tool(s)	
 310-121 E53465	Wrench, HO2S
	310-121(LRT-19-014)

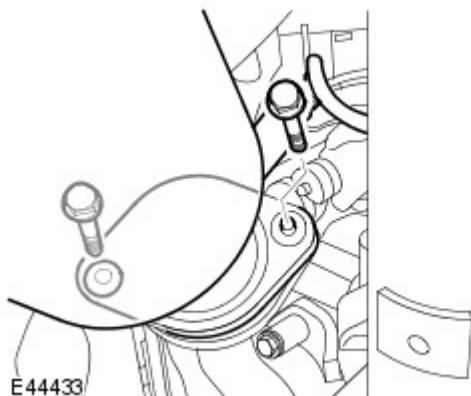
Removal

1.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

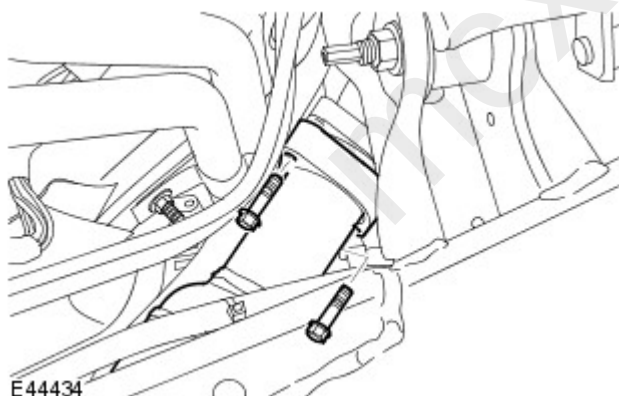
2. Disconnect the LH catalytic converter from the exhaust manifold.

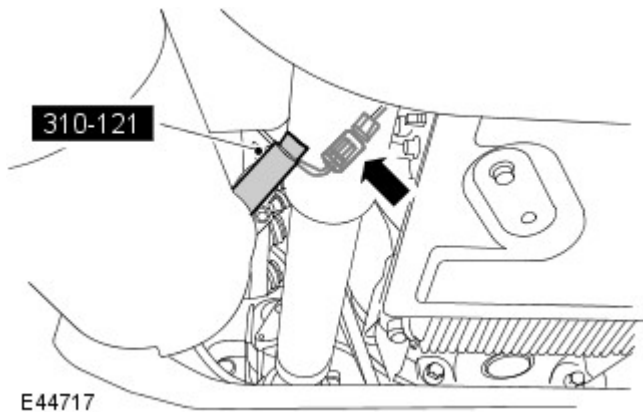
- Remove and discard the 2 bolts.



3. Disconnect the RH catalytic converter from the exhaust manifold.

- Remove and discard the 2 bolts.





4. Using the special tool, remove the HO2S.

- Release the wiring harness.
- Disconnect the electrical connector.

Installation

1. CAUTIONS:

 Make sure the anti-seize compound does not contact the HO2S tip.

 Make sure the HO2S wiring harness is not twisted more than 180 degrees and is not in contact with either the exhaust or driveshaft.

Using the special tool, install the HO2S.

- Clean the components.
- Apply an anti-seize compound to the thread of the sensor.
- Tighten the HO2S to 45 Nm (33 lb.ft).
- Connect the electrical connector.
- Attach the wiring harness.

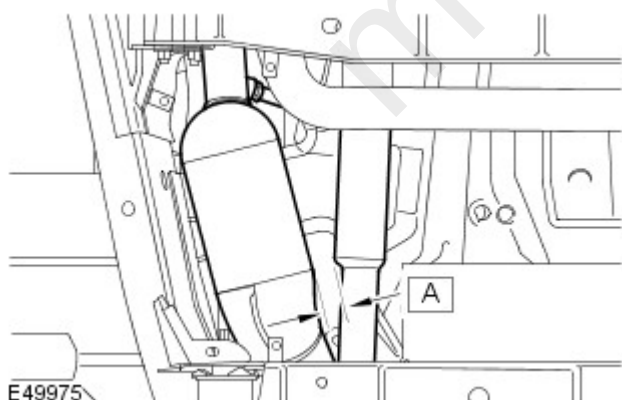
2. Position the RH catalytic converter to the exhaust manifold.

- Clean the components.
- Tighten the new bolts to 22 Nm (16 lb.ft).

3.  CAUTION: Make sure there is a clearance (A) of 25 mm to 30 mm between the closest points of the LH catalytic converter and the front driveshaft.

Position the LH catalytic converter to the exhaust manifold.

- Clean the components.
- Tighten the new bolts to 22 Nm (16 lb.ft).



4. Using the approved diagnostic equipment, clear the powertrain control module (PCM) adaptations.

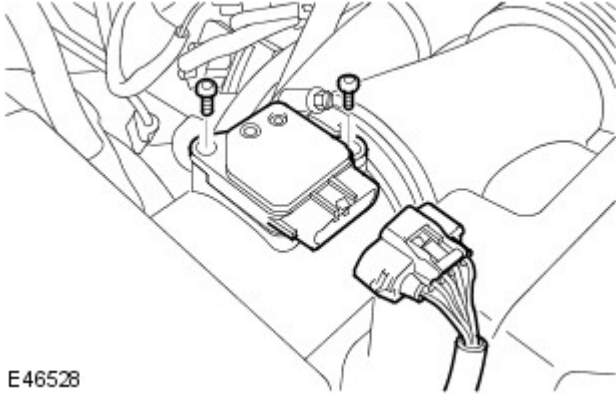
Electronic Engine Controls - V6 4.0L Petrol - Mass Air Flow (MAF) Sensor

Removal and Installation

Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the MAF sensor.

- Remove the 2 Torx screws.
- Disconnect the electrical connector.



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Installation

1. To install, reverse the removal procedure.
 - Tighten Torx screws to 2 Nm (1.5 lb.ft).

2. **NOTE:** Federal market vehicles only.

If required, carry out a short drive cycle.

For additional information, refer to: [Powertrain Control Module \(PCM\) Short Drive Cycle Self-Test](#) (303-14D Electronic Engine Controls - V8 5.0L Petrol, General Procedures).

3. **NOTE:** Non federal market vehicles only.

Using the approved diagnostic equipment, clear the powertrain control module (PCM) adaptations.

Electronic Engine Controls - V6 4.0L Petrol - Intake Manifold Tuning (IMT) Valve

Removal and Installation

Removal

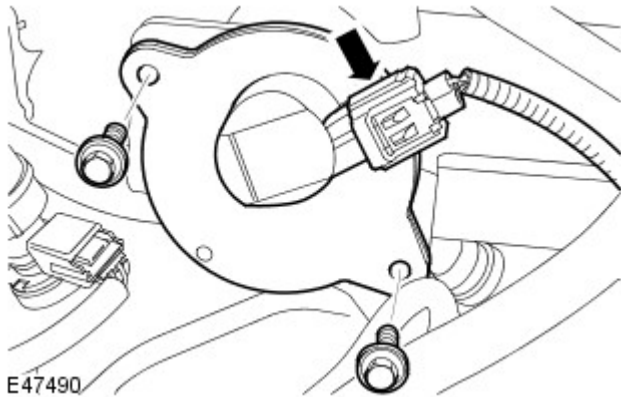
1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the engine cover.
For additional information, refer to: [Engine Cover - V6 4.0L Petrol](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).



CAUTION: Before the disconnection or removal of any components, ensure the area around joint faces and connections are clean. Plug any open connections to prevent contamination.

Remove the intake manifold tuning valve.

- Disconnect the electrical connector.
- Remove the 2 bolts.
- Discard the O-ring seal.

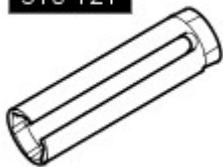


Installation

1. Install the intake manifold tuning valve.
 - Clean the component mating faces.
 - Install a new O-ring seal.
 - Tighten the bolts to 10 Nm (7 lb.ft).
2. Connect the electrical connector.
3. Install the engine cover.
For additional information, refer to: [Engine Cover - V6 4.0L Petrol](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).
4. Connect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Electronic Engine Controls - V6 4.0L Petrol - Catalyst Monitor Sensor LH

Removal and Installation

Special Tool(s)	
 E53465	Wrench, HO2S
	310-121 (LRT-19-014)

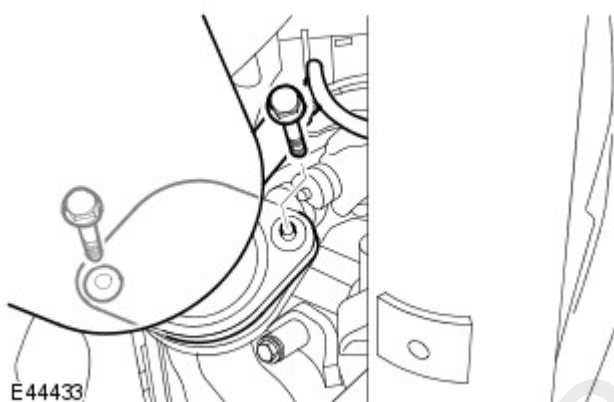
Removal

-  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

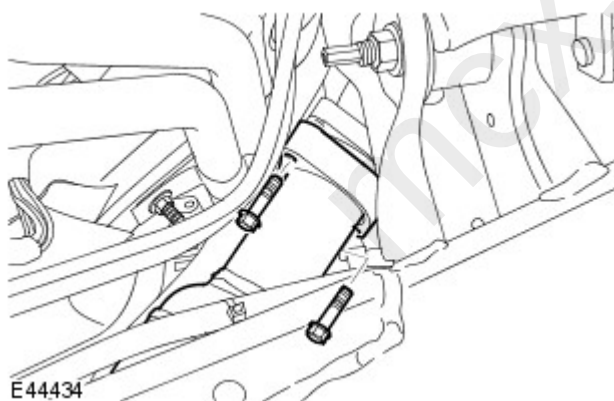
- Disconnect the LH catalytic converter from the exhaust manifold.

- Remove and discard the 2 bolts.



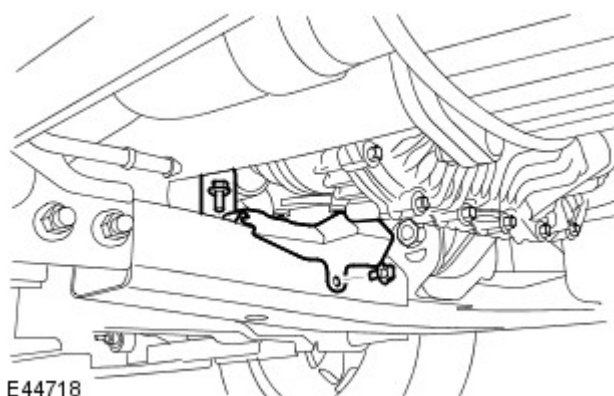
- Disconnect the RH catalytic converter from the exhaust manifold.

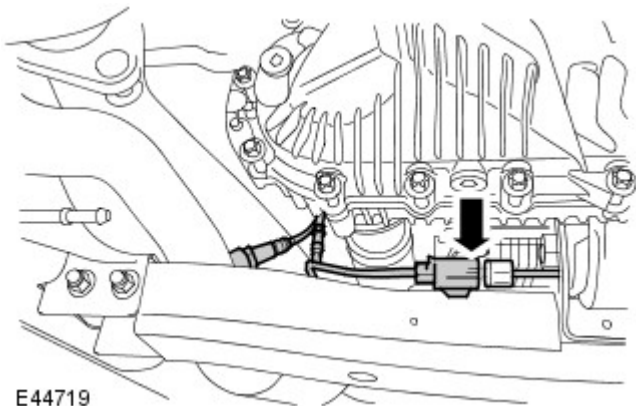
- Remove and discard the 2 bolts.



- Remove the catalyst monitor sensor electrical connector heat shield.

- Remove the 2 bolts.





5. Using the special tool, remove the catalyst monitor sensor.

- Release the wiring harness.
- Disconnect the electrical connector.

Installation

1. CAUTIONS:

 Make sure the anti-seize compound does not contact the catalyst monitor sensor tip.

 Make sure the catalyst monitor sensor wiring harness is not twisted more than 180 degrees and is not in contact with either the exhaust or driveshaft.

Using the special tool, install the catalyst monitor sensor.

- Clean the components.
- Apply an anti-seize compound to the thread of the sensor.
- Tighten the catalyst monitor sensor to 45 Nm (33 lb.ft).
- Connect the electrical connector.
- Attach the wiring harness.

2. Install the heat shield.

- Tighten the bolts to 10 Nm (7 lb.ft).

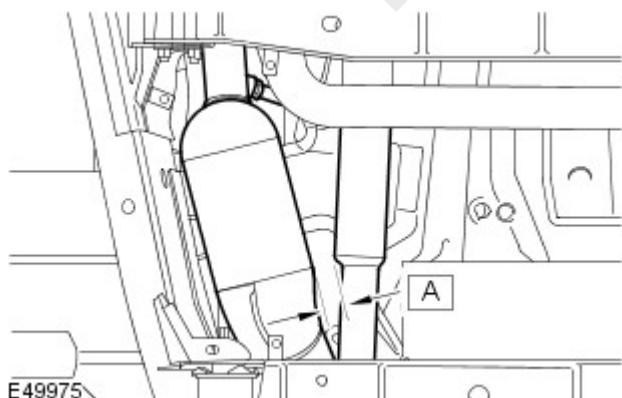
3. Position the RH catalytic converter to the exhaust manifold.

- Clean the components.
- Tighten the new bolts to 22 Nm (16 lb.ft).

4.  CAUTION: Make sure there is a clearance (A) of 25 mm to 30 mm between the closest points of the LH catalytic converter and the front driveshaft.

Position the LH catalytic converter to the exhaust manifold.

- Clean the components.
- Tighten the new bolts to 22 Nm (16 lb.ft).



5. NOTE: For NAS vehicles only.

If required, carry out a long drive cycle.
For additional information, refer to: Powertrain Control Module (PCM) Long Drive Cycle Self-Test (303-14A, General Procedures).

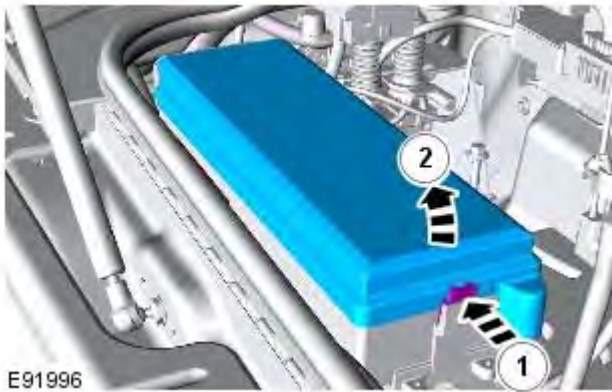
Electronic Engine Controls - V6 4.0L Petrol - Engine Control Module (ECM)

Cooling Fan

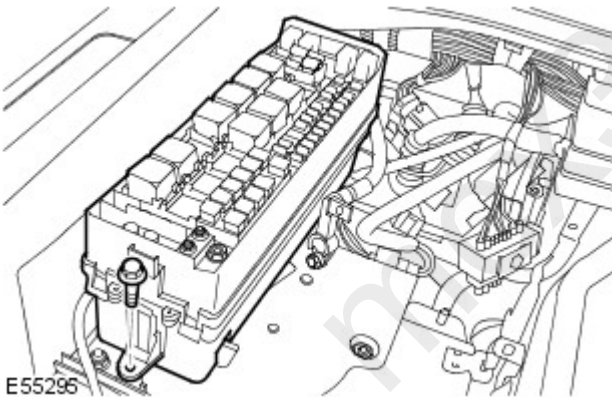
Removal and Installation

Removal

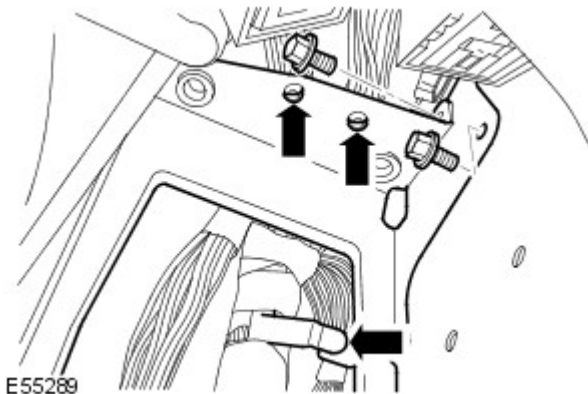
1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the battery tray.
For additional information, refer to: [Battery Tray](#) (414-01 Battery, Mounting and Cables, Removal and Installation).
3. Remove the engine control module (ECM).
For additional information, refer to: [Engine Control Module \(ECM\)](#) (303-14, Removal and Installation).
4. Remove the battery junction box (BJB) cover.
 - Release the clip.

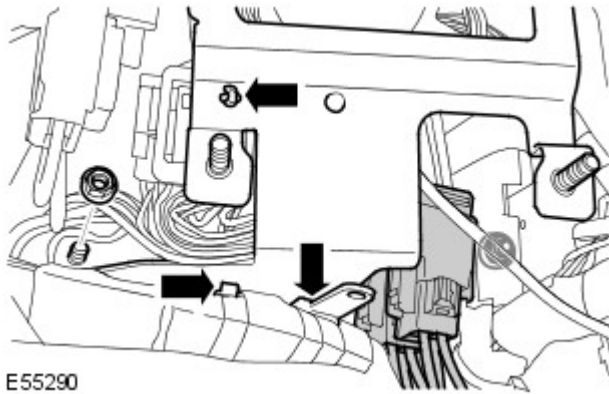


5. Release the BJB from the bracket.
 - Remove the bolt.



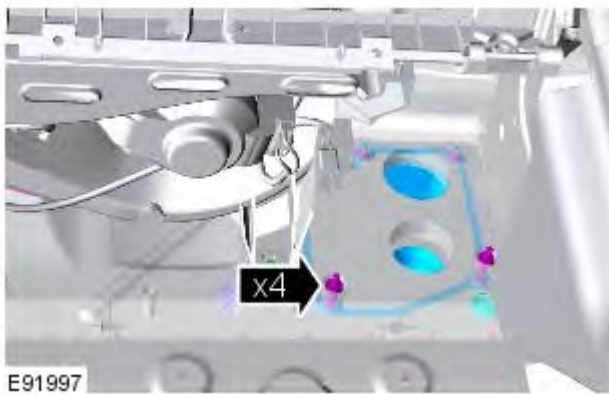
6. Remove the central junction box (CJB).
For additional information, refer to: [Central Junction Box \(CJB\)](#) (418-00 Module Communications Network, Removal and Installation).
7. Release the CJB bracket.
 - Release the 3 upper wiring harness clips.
 - Remove the 2 bolts.





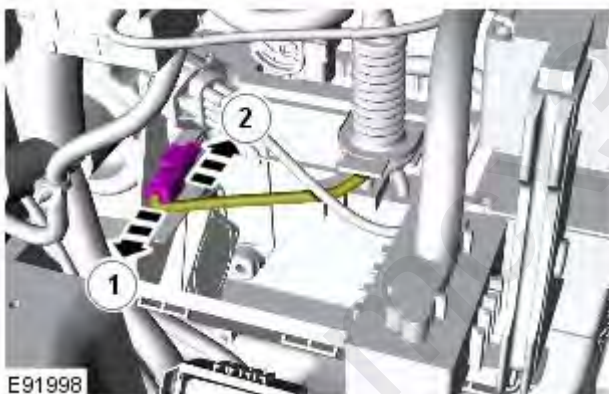
8. Remove the CJB bracket.

- Disconnect the 2 electrical connectors.
- Release the 3 lower wiring harness clips.
- Remove the 2 nuts.



9. Release the ECM housing.

- Release the insulation for access to the nuts.
- Remove the 2 nuts and 2 bolts.

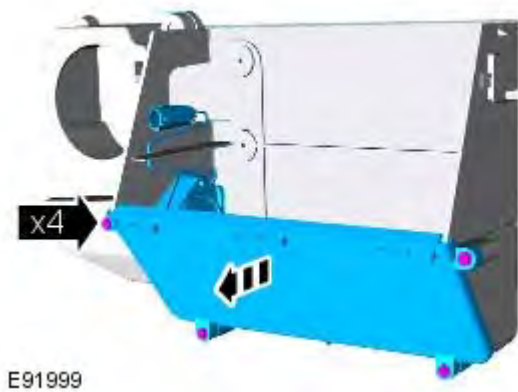


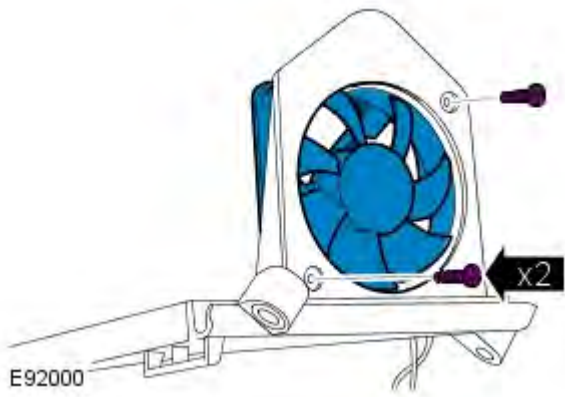
10. ⚠ CAUTION: Note of the routing of the wiring harnesses.

Release and disconnect the ECM cooling fan electrical connector.

11. Remove the ECM housing lower panel.

- Remove the 4 screws.





12.  **CAUTION:** Note the fitted position of the component prior to removal.

Remove the cooling fan.

- Remove the 2 screws.

Installation

1.  **CAUTION:** Make sure that these components are installed to the noted removal position.

Install the cooling fan.

- Install the 2 screws.

2.  **CAUTION:** Make sure the seal is installed correctly.

Install the ECM housing lower panel.

- Install the 4 screws.

3.  **CAUTION:** Make sure that the wiring harnesses are correctly routed.

Connect and secure the cooling fan electrical connector.

4.  **CAUTION:** Make sure that the seal is correctly located.

Secure the ECM housing.

- Tighten the bolts and nuts to 10 Nm (7 lb.ft).

5. Install the CJB bracket.

- Tighten the nuts to 10 Nm (7 lb.ft).
- Secure the clips.
- Connect the electrical connectors.
- Tighten the bolts to 25 Nm (18 lb.ft).

6. Install the CJB.

For additional information, refer to: [Central Junction Box \(CJB\)](#) (418-00 Module Communications Network, Removal and Installation).

7. Secure the BJB to the bracket.

- Tighten the bolt to 6 Nm (4 lb.ft).

8. Install the BJB cover.

- Secure the clip.

9. Install the engine ECM.

For additional information, refer to: Engine Control Module (ECM) (303-14, Removal and Installation).

10. Install the battery tray.

For additional information, refer to: [Battery Tray](#) (414-01 Battery, Mounting and Cables, Removal and Installation).

11. Connect the battery ground cable.

For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

