

Electronic Engine Controls - V8 5.0L Petrol -**Torque Specifications**

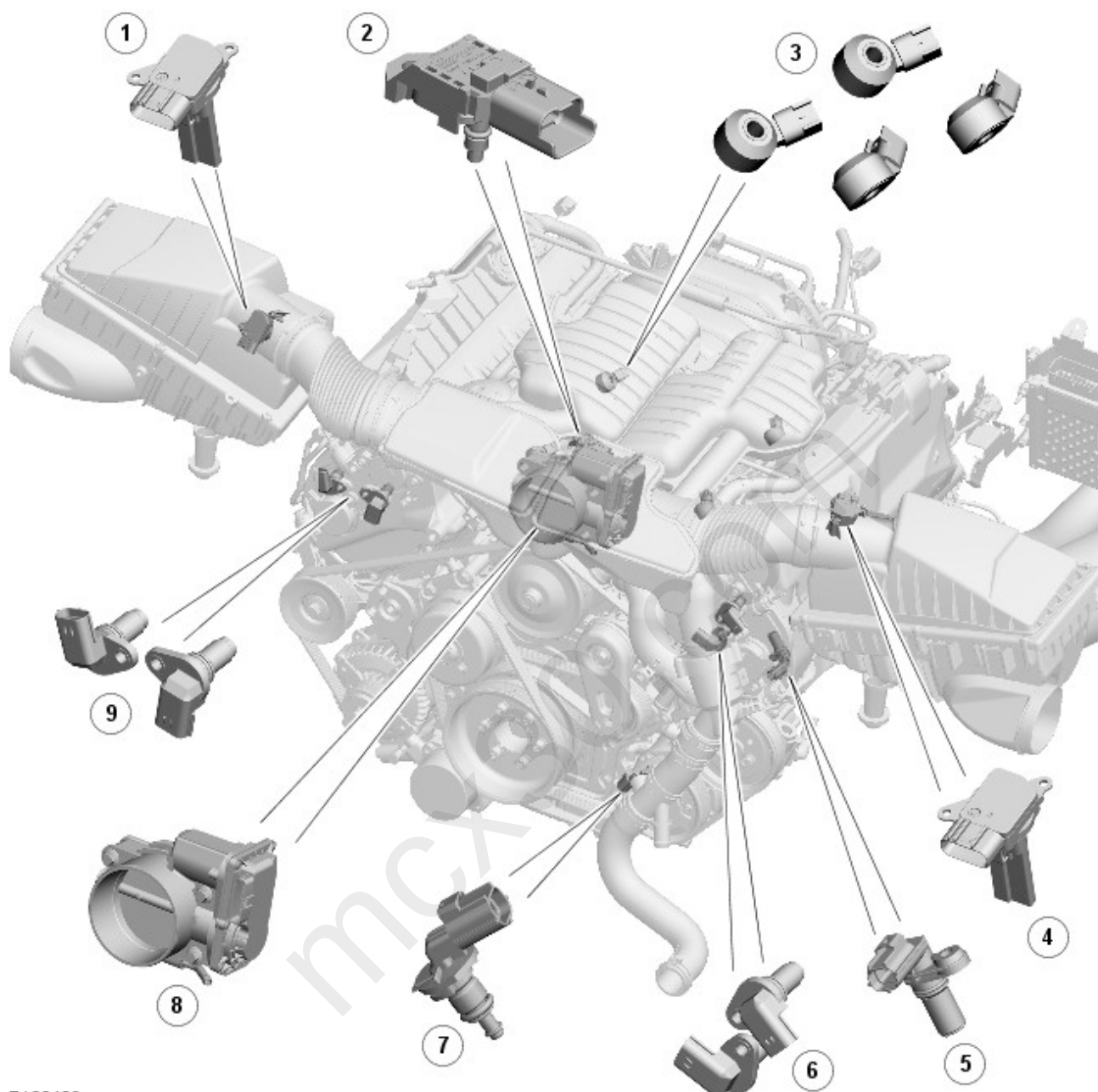
Description	Nm	lb-ft	lb-in
Camshaft position (CMP) sensor(s) retaining bolt	10	7	-
Crankshaft position (CKP) sensor retaining bolt	10	7	-
Heated oxygen sensor(s) (HO2S)	48	35	-
Catalyst monitor sensor(s)	48	35	-
Knock sensor(s) (KS) retaining bolt	20	15	-
Fuel rail pressure (FRP) sensor	32	24	-
Manifold absolute pressure and temperature (MAPT) sensor	5	-	44
Engine oil level sensor retaining bolts	12	8	-
Variable valve timing (VVT) oil control solenoid(s) retaining bolts	10	7	-
Engine control module (ECM) retaining bolts	7	-	62
Engine control module (ECM) retaining nuts	7	-	62
Mass air flow (MAF) sensor retaining bolts	1.2	-	10.6

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Electronic Engine Controls - V8 5.0L Petrol - Electronic Engine Controls

Description and Operation

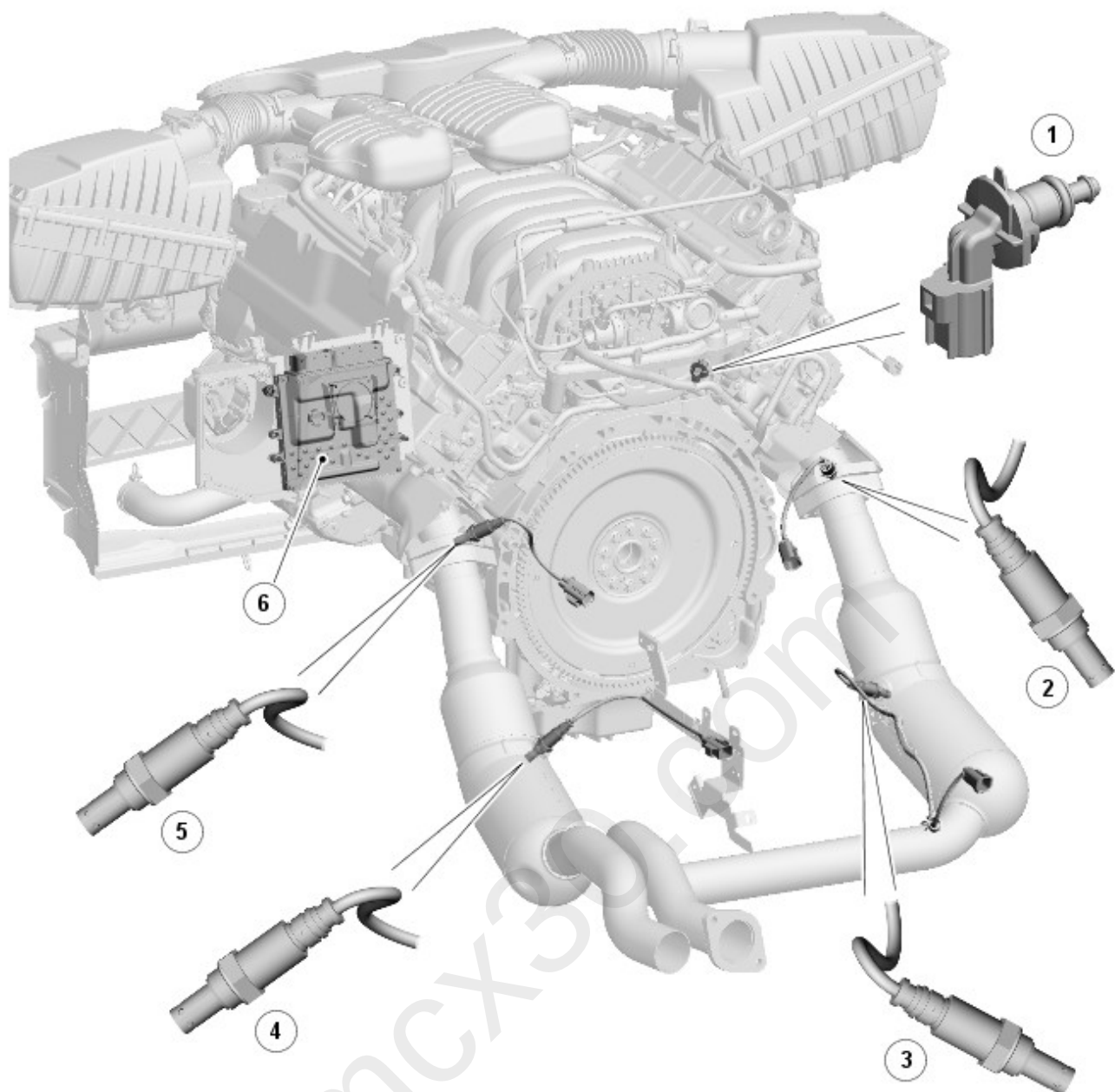
COMPONENT LOCATION - SHEET 1 OF 3



E122439

Item	Part Number	Description
1	-	MAFT (mass air flow and temperature) sensor
2	-	MAP (manifold absolute pressure) sensor
3	-	Knock sensors
4	-	MAFT sensor
5	-	CKP (crankshaft position) sensor
6	-	CMP (camshaft position) sensors
7	-	ECT (engine coolant temperature) sensor (ECT 2)
8	-	Electronic throttle
9	-	CMP sensors

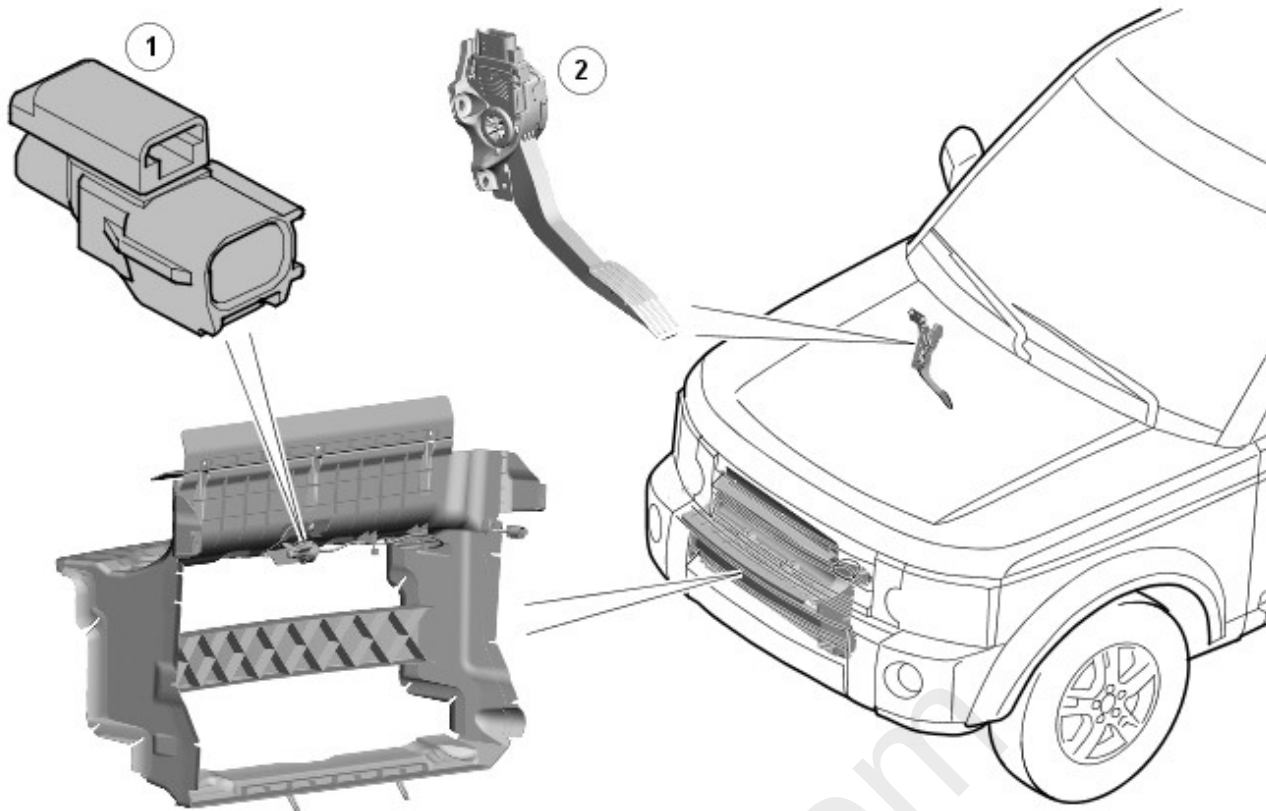
COMPONENT LOCATION - SHEET 2 OF 3



E121379

Item	Part Number	Description
1	-	ECT sensor (ECT 1)
2	-	Upstream HO2S (heated oxygen sensor)
3	-	Downstream HO2S
4	-	Downstream HO2S
5	-	Upstream HO2S
6	-	ECM (engine control module)

COMPONENT LOCATION - SHEET 3 OF 3



E122440

Item	Part Number	Description
1	-	AAT (ambient air temperature) sensor
2	-	APP (accelerator pedal position) sensor

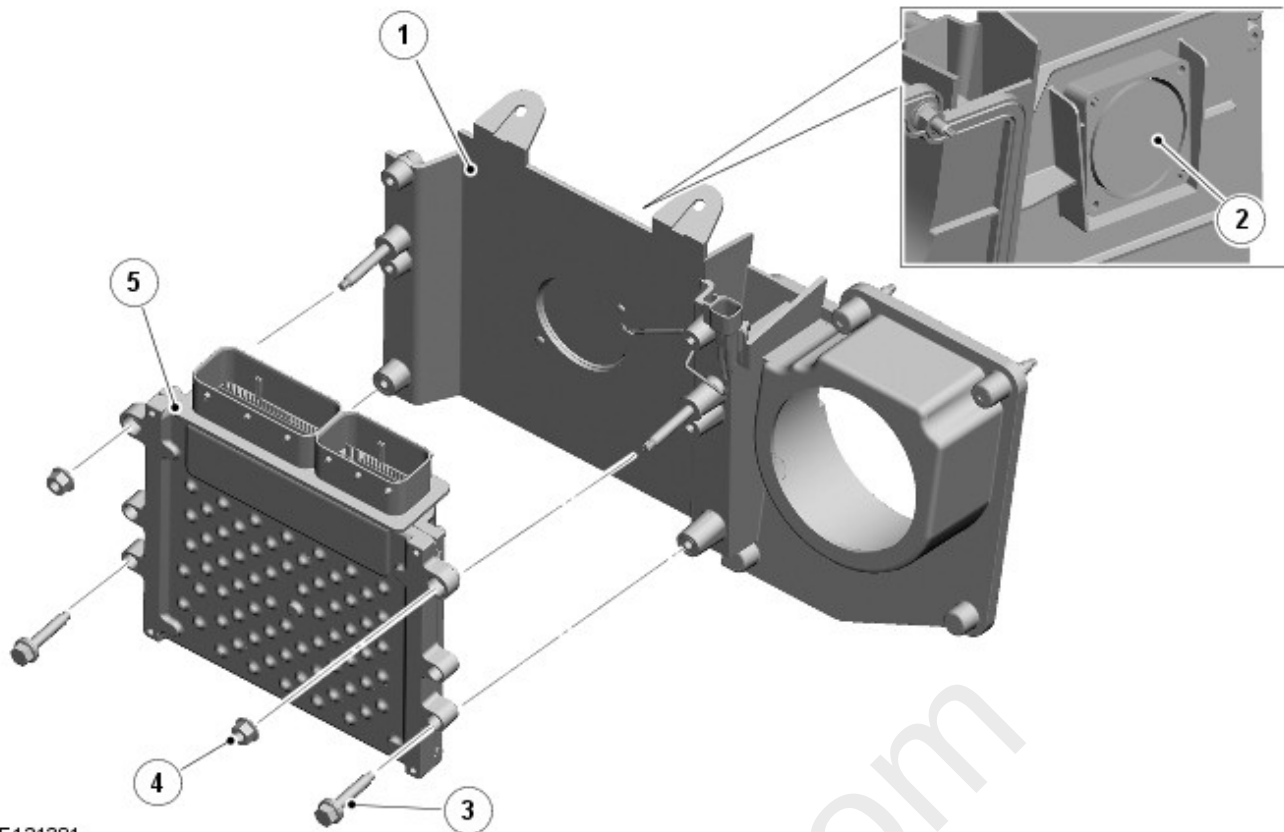
INTRODUCTION

The **EEC (electronic engine control)** system operates the engine to generate the output demanded by the accelerator pedal and loads imposed by other systems. The **EEC** system has an **ECM (engine control module)** that uses a torque-based strategy to evaluate inputs from sensors and other systems, then produces outputs to engine actuators to produce the required torque.

The **EEC** system controls the following:

- Charge air
- Fueling
- Ignition timing
- Valve timing
- Cylinder knock
- Idle speed
- Engine cooling fan
- Evaporative emissions
- On-board diagnostics
- Immobilization system interface
- Speed control.

ENGINE CONTROL MODULE



E121381

Item	Part Number	Description
1	-	ECM and cooling fan mounting bracket
2	-	Cooling fan
3	-	Screw (2 off)
4	-	Nut (2 off)
5	-	ECM

The [ECM](#) is installed in the passenger side protective box in the engine compartment, on a bracket attached to the engine bulkhead. The bracket also contains an electric cooling fan. The [ECM](#), which has an internal temperature sensor, controls the operation of the cooling fan. While the ignition is on, the cooling fan receives a power supply from the [ECM](#) relay in the [EJB \(engine junction box\)](#). When cooling is required, the [ECM](#) connects the cooling fan to ground.

The [ECM](#) has the capability of adapting its fuel and ignition control outputs in response to several sensor inputs.

The [ECM](#) receives inputs from the following:

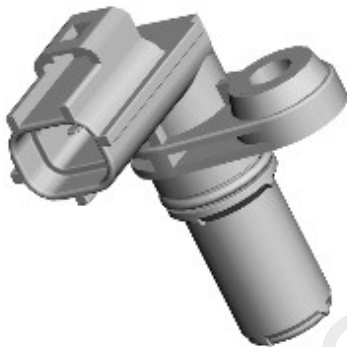
- [CKP \(crankshaft position\)](#) sensor.
- [CMP \(camshaft position\)](#) sensors (4 off).
- [ECT \(engine coolant temperature\)](#) sensors (2 off).
- Knock sensors (4 off).
- [MAP \(manifold absolute pressure\)](#) sensor.
- [MAFT \(mass air flow and temperature\)](#) sensors (2 off).
- Throttle position sensor.
- Heated oxygen sensors (4 off).
- [APP \(accelerator pedal position\)](#) sensor.
- Ambient air temperature sensor.
- [FRP \(fuel rail pressure\)](#) sensor.
- For additional information, refer to: [Fuel Charging and Controls](#) (303-04F Fuel Charging and Controls - V8 5.0L Petrol, Description and Operation).
- Engine cooling fan.
- For additional information, refer to: [Engine Cooling](#) (303-03D Engine Cooling - V8 5.0L Petrol, Description and Operation).
- Stoplamp switch.
- For additional information, refer to: [Anti-Lock Control - Traction Control](#) (206-09A Anti-Lock Control - Traction Control, Description and Operation).
- Speed control cancel/suspend switch.
- For additional information, refer to: [Speed Control](#) (310-03D Speed Control - V8 5.0L Petrol, Description and Operation).
- Oil level and temperature sensor.
- For additional information, refer to: [Engine](#) (303-01D Engine - V8 5.0L Petrol, Description and Operation).
- Fuel LP (low pressure) sensor.
- For additional information, refer to: [Fuel Tank and Lines](#) (310-01D Fuel Tank and Lines - V8 5.0L Petrol, Description and Operation).
- Fuel pump driver module.
- For additional information, refer to: [Fuel Tank and Lines](#) (310-01D Fuel Tank and Lines - V8 5.0L Petrol, Description and Operation).

The [ECM](#) provides outputs to the following:

- Electronic throttle.

- Main relay.
- Heaters elements of the heated oxygen sensors (4 off).
- Fuel injectors (8 off).
For additional information, refer to: [Fuel Charging and Controls](#) (303-04F Fuel Charging and Controls - V8 5.0L Petrol, Description and Operation).
- Ignition coils (8 off).
For additional information, refer to: [Engine Ignition](#) (303-07B Engine Ignition - V8 5.0L Petrol, Description and Operation).
- **VCT (variable camshaft timing)** solenoids (4 off).
For additional information, refer to: [Engine](#) (303-01D Engine - V8 5.0L Petrol, Description and Operation).
- Camshaft profile switching solenoids (2 off).
For additional information, refer to: [Engine](#) (303-01D Engine - V8 5.0L Petrol, Description and Operation).
- Variable intake system tuning valve.
For additional information, refer to: [Intake Air Distribution and Filtering](#) (303-12D Intake Air Distribution and Filtering - V8 5.0L Petrol, Description and Operation).
- **EVAP (evaporative emission)** canister purge valve.
For additional information, refer to: [Evaporative Emissions](#) (303-13B Evaporative Emissions - V8 5.0L Petrol, Description and Operation).
- Engine starter relay. For additional information, refer to: Starting System (303-06D, Description and Operation).
- Engine cooling fan.
For additional information, refer to: [Engine Cooling](#) (303-03D Engine Cooling - V8 5.0L Petrol, Description and Operation).
- Generator. For additional information, refer to: Generator and Regulator (414-02D, Description and Operation).
- HP fuel pumps.
For additional information, refer to: [Fuel Tank and Lines](#) (310-01D Fuel Tank and Lines - V8 5.0L Petrol, Description and Operation).
- Fuel pump driver module.
For additional information, refer to: [Fuel Tank and Lines](#) (310-01D Fuel Tank and Lines - V8 5.0L Petrol, Description and Operation).
- DMTL (diagnostic module - tank leakage) (NAS only).
For additional information, refer to: [Evaporative Emissions](#) (303-13B Evaporative Emissions - V8 5.0L Petrol, Description and Operation).

CRANKSHAFT POSITION SENSOR



E116086

The [CKP](#) sensor is an inductive sensor that allows the [ECM](#) to determine the angular position of the crankshaft and the engine speed.

The [CKP](#) sensor is installed in the rear left side of the sump body, in line with the engine drive plate. The sensor is secured with a single screw and sealed with an O-ring. A two pin electrical connector provides the interface with the engine harness.

The head of the [CKP](#) sensor faces a reluctor ring pressed into the outer circumference of the engine drive plate. The reluctor ring has a 60 minus 2 tooth pattern. There are 58 teeth at 6° intervals, with two teeth removed to provide a reference point with a centerline that is 21° **BTDC (before top dead center)** on cylinder 1 of bank A.

If the [CKP](#) sensor fails, the [ECM](#):

- Uses signals from the [CMP](#) sensors to determine the angular position of the crankshaft and the engine speed
- Adopts a limp home mode where engine speed is limited to a maximum of 3000 rev/min.

With a failed [CKP](#) sensor, engine starts will require a long crank time while the [ECM](#) determines the angular position of the crankshaft.

CAMSHAFT POSITION SENSORS



E116087

The [CMP](#) sensors are MRE (magneto resistive element) sensors that allow the [ECM](#) to determine the angular position of the camshafts. MRE sensors produce a digital output which allows the [ECM](#) to detect speeds down to zero.

The four [CMP](#) sensors are installed in the front upper timing covers, one for each camshaft.

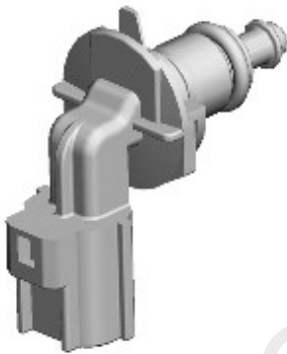
Each [CMP](#) sensor is secured with a single screw and sealed with an O-ring. On each [CMP](#) sensor, a three pin electrical connector provides the interface with the engine harness.

The head of each [CMP](#) sensor faces a sensor wheel attached to the front of the related [VCT](#) unit.

If an exhaust [CMP](#) sensor fails, the [ECM](#) disables the [VCT](#) of both exhaust camshafts.

If an intake [CMP](#) sensor fails, the [ECM](#) disables the [VCT](#) of both intake camshafts. This can result in the engine being slow, or failing, to start.

ENGINE COOLANT TEMPERATURE SENSORS



E108397

The [ECT](#) sensors are [NTC \(negative temperature coefficient\)](#) thermistors that allow the [ECM](#) to monitor the engine coolant temperature.

There are two identical [ECT](#) sensors installed, which are identified as ECT 1 and ECT 2. Each sensor is secured with a twist-lock and latch mechanism, and is sealed with an O-ring. A two pin electrical connector provides the interface between the sensor and the engine harness.

ECT 1

ECT 1 is installed in the heater manifold, at the rear of the [RH \(right-hand\)](#) cylinder head. The input from this sensor is used in calibration tables and by other systems.

If there is an ECT 1 fault, the [ECM](#) adopts an estimated coolant temperature. On the second consecutive trip with an ECT 1 fault, the [ECM](#) illuminates the [MIL \(malfunction indicator lamp\)](#).

ECT 2

ECT 2 is installed in the lower hose connector which attaches to the bottom of the thermostat. The input from this sensor is used for [OBD \(on-board diagnostic\)](#) 2 diagnostics and, in conjunction with the input from ECT 1, to confirm that the thermostat is functional.

If there is an ECT 2 fault, the [ECM](#) illuminates the [MIL](#) on the second consecutive trip.

KNOCK SENSORS



E108400

The knock sensors are piezo-ceramic sensors that allow the [ECM](#) to employ active knock control and prevent engine damage from pre-ignition or detonation.

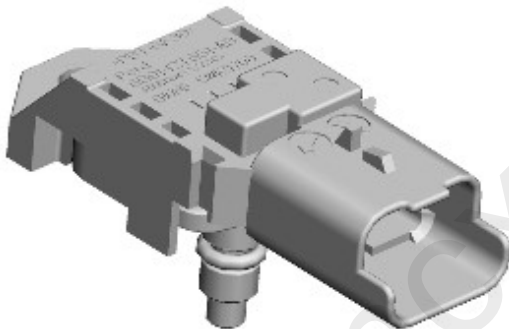
Two knock sensors are installed on the inboard side of each cylinder head, one mid-way between cylinders 1 and 2, and one mid-way between cylinders 3 and 4. Each knock sensor is secured with a single screw. On each knock sensor, a two pin electrical connector provides the interface with the engine harness.

The [ECM](#) compares the signals from the knock sensors with mapped values stored in memory to determine when detonation occurs on individual cylinders. When detonation is detected, the [ECM](#) retards the ignition timing on that cylinder for a number of engine cycles, then gradually returns it to the original setting.

The [ECM](#) cancels closed loop control of the ignition system if the signal received from a knock sensor becomes implausible. In these circumstances the [ECM](#) defaults to base mapping for the ignition timing. This ensures the engine will not become damaged if low quality fuel is used. The [MIL](#) will not illuminate, although the driver may notice that the engine 'pinks' in some driving conditions and displays a drop in performance and smoothness.

The ECM calculates the default value if one sensor fails on each bank of cylinders.

MANIFOLD ABSOLUTE PRESSURE SENSOR



E108402

The [MAP](#) sensor allows the [ECM](#) to calculate the load on the engine, which is used in the calculation of fuel injection time.

The [MAP](#) sensor is installed in the air inlet of the intake manifold. The sensor is secured with a single screw and sealed with an O-ring. A three pin electrical connector provides the interface with the engine harness.

If the [MAP](#) sensor fails, the [ECM](#) adopts a default value of 1 bar (14.5 lbf/in.²).

With a failed [MAP](#) sensor, the engine will suffer from poor starting, rough running and poor driveability.

MASS AIR FLOW AND TEMPERATURE SENSORS



E116091

The [MAFT](#) sensors allow the [ECM](#) to measure the mass flow and the temperature of the air flow into the engine. The mass air flow is measured with a hot film element in the sensor. The temperature of the air flow is measured with a [NTC](#) thermistor in the sensor. The mass air flow is used to determine the fuel quantity to be injected in order to maintain the target air/fuel mixture required for correct operation of the engine and the catalytic converters.

There are two [MAFT](#) sensors installed, one in each air cleaner outlet duct. Each [MAFT](#) sensor is secured with two screws and sealed with an O-ring. On each [MAFT](#) sensor, a five pin electrical connector provides the interface with the engine harness.

If the hot film element signal fails the [ECM](#) invokes a software backup strategy to calculate the mass air flow from other inputs. Closed loop fuel control, closed loop idle speed control and evaporative emissions control are discontinued. The engine will suffer from poor starting, poor throttle response and, if the failure occurs while driving, the engine speed may dip and surging may occur before recovering.

If the [NTC](#) thermistor signal fails the [ECM](#) adopts a default value of 25 °C (77 °F) for the intake air temperature.

THROTTLE POSITION SENSORS

The [TP](#) (throttle position) sensors allow the [ECM](#) to determine the position and angular rate of change of the throttle blade.

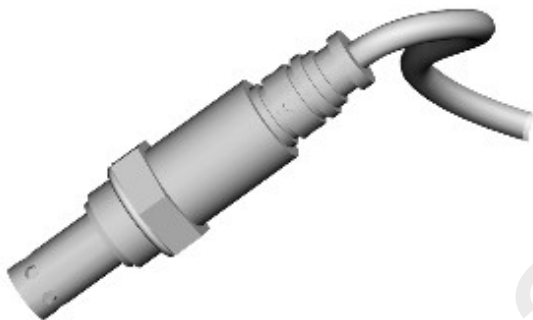
There are two [TP](#) sensors located in the electronic throttle. See below for details of the electronic throttle.

If a [TP](#) sensor fails, the [ECM](#):

- Adopts a limp home mode where engine speed is limited to a maximum of approximately 2000 rev/min
- Discontinues evaporative emissions control
- Discontinues closed loop control of engine idle speed.

With a failed [TP](#) sensor, the engine will suffer from poor running and throttle response.

HEATED OXYGEN SENSORS



E119261

The heated oxygen sensors allow the [ECM](#) to measure the oxygen content of the exhaust gases, for closed loop control of the fuel:air mixture and for catalytic converter monitoring.

An upstream heated oxygen sensor is installed in the outlet of each exhaust manifold, which enables independent control of the fuel:air mixture for each cylinder bank. A downstream heated oxygen sensor is installed in each catalytic converter, which enables the performance of the catalytic converters to be optimized and monitored.

Oxygen sensors need 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 [PWM](#) (pulse width modulation) signal from the [ECM](#). The heater elements are operated after each engine start, once it has been calculated that there is no moisture in the exhaust (between 0 and 2 minutes delay), and also during low load conditions when the temperature of the exhaust gases is insufficient to maintain the required sensor temperature. The [PWM](#) duty cycle is carefully controlled to prevent thermal shock to cold sensors. A non-functioning heater delays the sensor's readiness for closed loop control and increases emissions.

The upstream heated oxygen sensors produce a constant voltage, with a variable current that is proportional to the lambda ratio. The downstream heated oxygen sensors produce an output voltage dependant on the ratio of the exhaust gas oxygen to the ambient oxygen.

The heated oxygen 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.

If a heated oxygen sensor fails:

- The [ECM](#) defaults to open loop fueling for the related cylinder bank
- The CO (carbon monoxide) and emissions content of the exhaust gases may increase
- The exhaust may smell of rotten eggs (hydrogen sulphide).

With a failed heated oxygen sensor, the engine will suffer from reduced refinement and performance.

ACCELERATOR PEDAL POSITION SENSOR



E118973

The [APP](#) sensor allows the [ECM](#) to determine the driver requests for vehicle speed, acceleration and deceleration. The [ECM](#) uses this information, together with information from the [ABS \(anti-lock brake system\)](#) module and the [TCM \(transmission control module\)](#), to determine the setting of the electronic throttle.

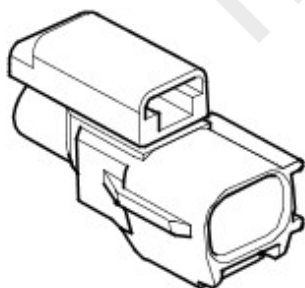
Three screws attach the [APP](#) sensor and integrated accelerator pedal to a bracket on the lower dash panel. A six pin electrical connector provides the interface with the vehicle harness.

The [APP](#) sensor is a twin track potentiometer. Each track receives an independent power supply from the [ECM](#) and returns an independent analog signal to the [ECM](#). Both signals contain the same positional information, but the signal from track 2 is half the voltage of the signal from track 1 at all positions.

If both signals have a fault, the [ECM](#) adopts a limp home mode, which limits the engine speed to 2000 rev/min maximum.

The [ECM](#) constantly checks the range and plausibility of the two signals and stores a fault code if it detects a fault.

AMBIENT AIR TEMPERATURE SENSOR



E43580

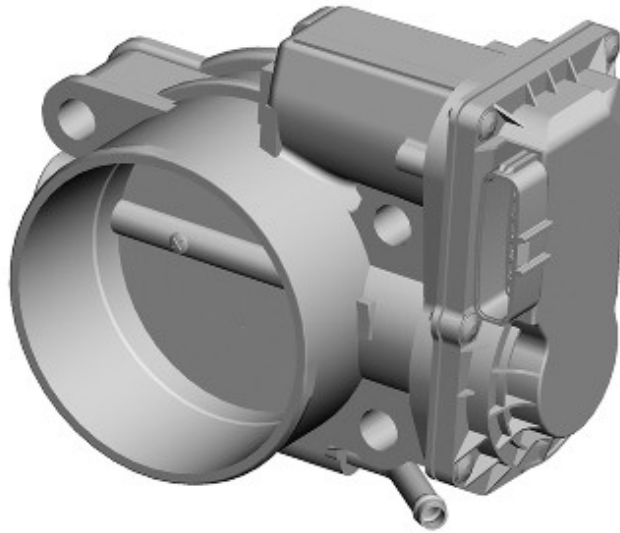
The AAT (ambient air temperature) sensor is a [NTC](#) thermistor that allows the [ECM](#) to monitor the temperature of the air around the vehicle. The [ECM](#) uses the AAT input for a number of functions, including engine cooling fan control. The [ECM](#) also transmits the ambient temperature on the high speed [CAN \(controller area network\)](#) bus for use by other control modules.

The AAT sensor is installed on a bracket in the front bumper ducting, on the vehicle centerline.

The [ECM](#) supplies the sensor with a 5 V reference voltage and a ground, and translates the return signal voltage into a temperature.

If there is a fault with the AAT sensor, the [ECM](#) calculates the AAT from the temperature inputs of the [MAFT](#) sensors. If the AAT sensor and the temperature inputs of the [MAFT](#) sensors are all faulty, the [ECM](#) adopts a default ambient temperature of 25 °C (77 °F).

ELECTRONIC THROTTLE



E116090

The [ECM](#) uses the electronic throttle to help regulate engine torque.

The electronic throttle is attached to the intake manifold.

For additional information, refer to: [Intake Air Distribution and Filtering](#) (303-12D Intake Air Distribution and Filtering - V8 5.0L Petrol, Description and Operation).

The throttle plate is operated by an electric DC (direct current) motor integrated into the throttle body. The [ECM](#) uses a [PWM](#) signal to control the DC motor. The [ECM](#) compares the [APP](#) sensor inputs against an electronic request or value to determine the required position of the throttle plate. The [ECM](#) and electronic throttle are also required to:

- Monitor requests for cruise control operation
- Automatically operate the electronic throttle for accurate cruise control
- Perform all dynamic stability control engine interventions
- Monitor and carry out maximum engine speed and road speed cut outs
- Provide different engine maps for the ride and handling optimization system.

A software strategy within the [ECM](#) calibrates the position of the throttle plate at the beginning of each ignition cycle. When the ignition is turned on, the [ECM](#) performs a self test and calibration routine by fully closing the throttle plate and then opening it again. This tests the default position springs and allows the [ECM](#) to learn the fully closed position.

ECM RELAY

The [ECM](#) relay is used to initiate the power up and power down routines within the [ECM](#). The [ECM](#) relay is installed in the [EJB](#).

When the ignition is turned on, battery voltage is applied to the ignition sense input. The [ECM](#) then starts its power up routines and energizes the [ECM](#) relay.

When the ignition is turned off, the [ECM](#) maintains its powered up state while it conducts the power down routines. This can be for:

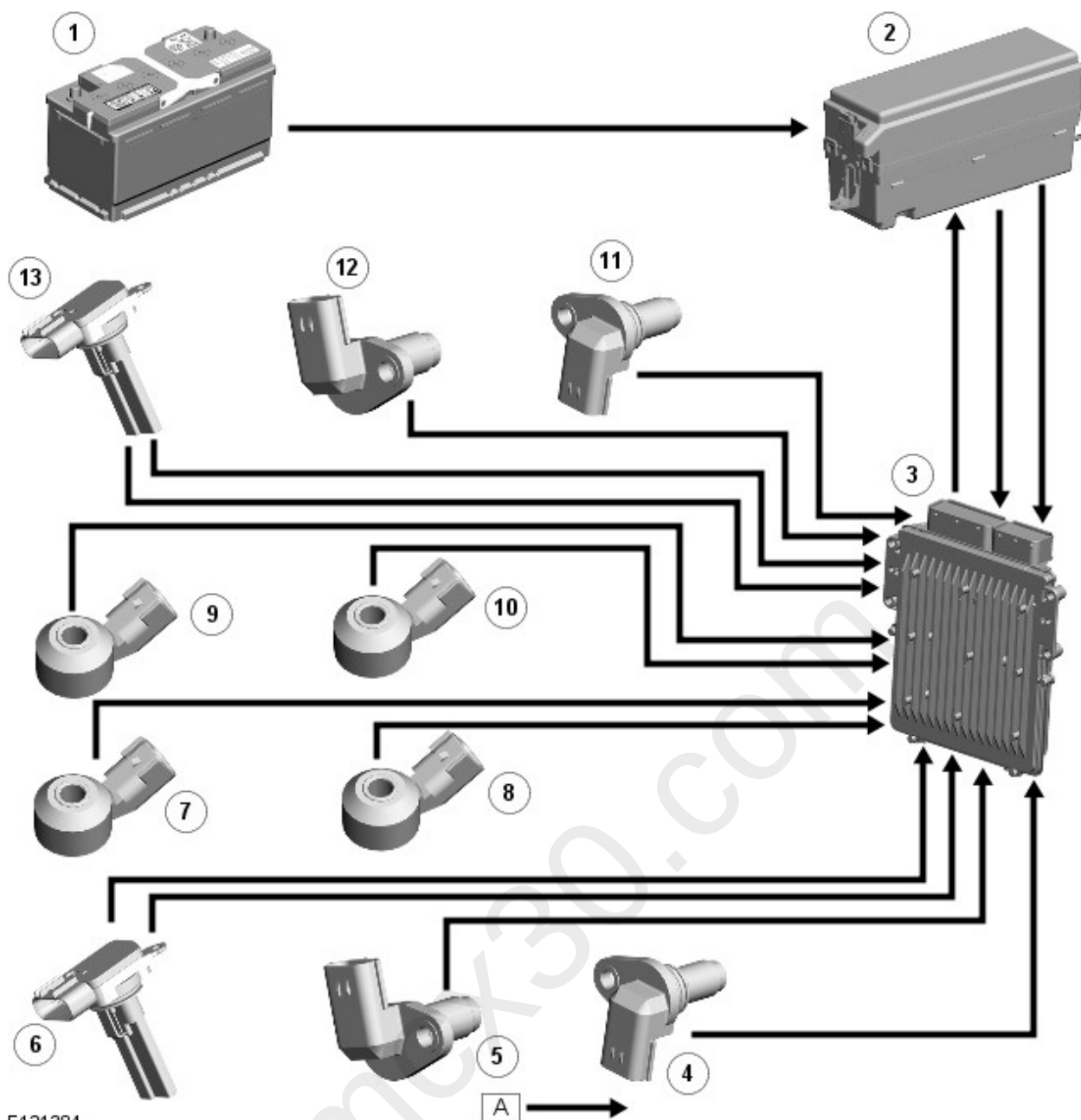
- Up to 20 minutes in extreme cases, when the DMTL system is running (NAS markets) or the [TCM](#) is 'kept awake' because of a 'not in park' condition
- Up to 5 minutes when cooling fans are required.

On completion of the power down routines the [ECM](#) de-energizes the [ECM](#) relay.

CONTROL DIAGRAM

Sheet 1 of 2

- NOTE: A = Hardwired.

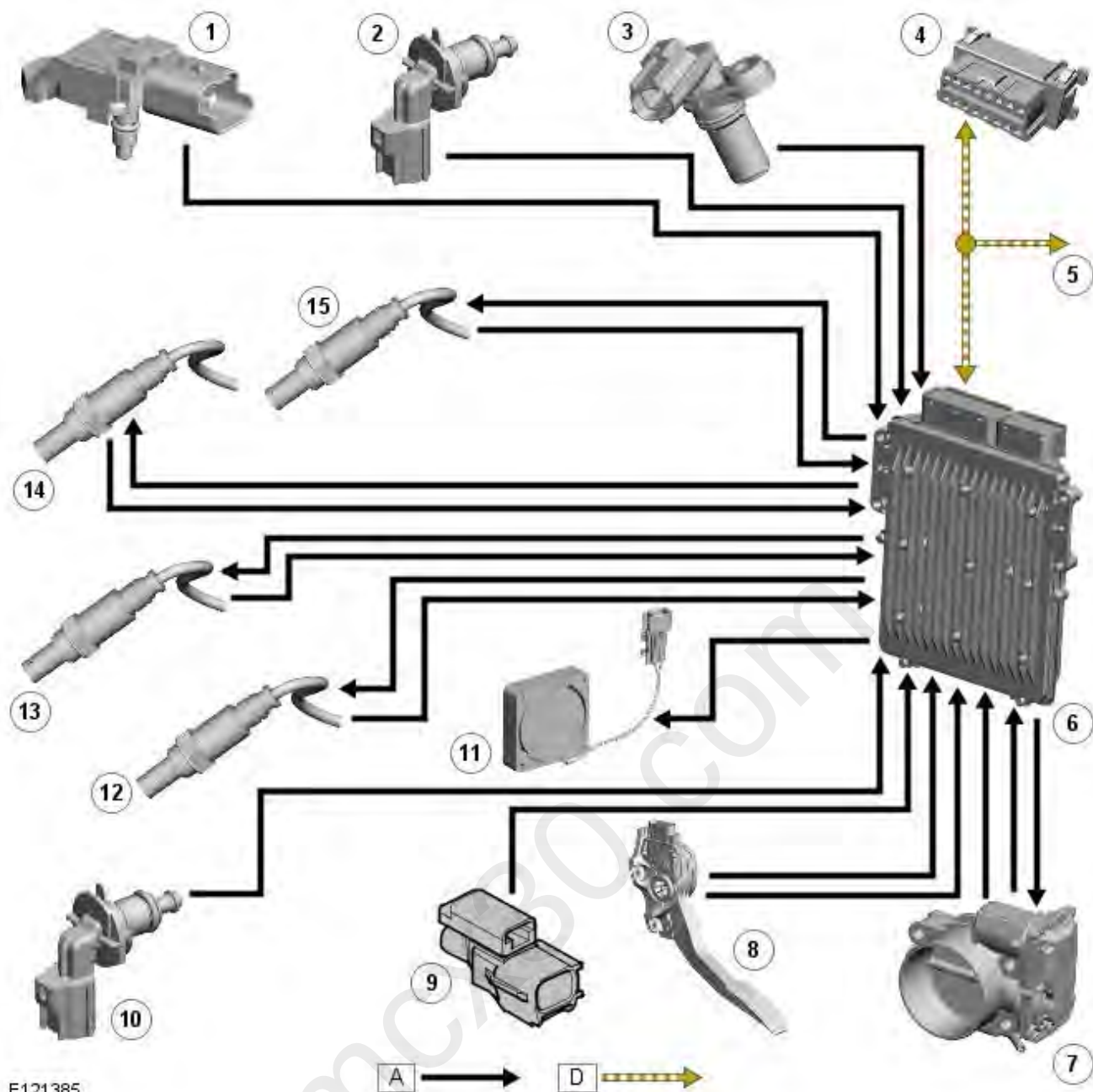


E121384

Item	Part Number	Description
1	-	Battery
2	-	EJB (engine junction box)
3	-	ECM
4	-	LH (left hand) intake CMP sensor
5	-	LH exhaust CMP sensor
6	-	LH MAFT sensor
7	-	LH front knock sensor
8	-	LH rear knock sensor
9	-	RH (right hand) front knock sensor
10	-	RH rear knock sensor
11	-	RH intake CMP sensor
12	-	RH exhaust CMP sensor
13	-	RH MAFT sensor

Sheet 2 of 2

• NOTE: A = Hardwired; D = High speed CAN bus.



Item	Part Number	Description
1	-	MAP sensor
2	-	ECT sensor (ECT 2)
3	-	CKP sensor
4	-	Diagnostic socket
5	-	To other system control modules
6	-	ECM
7	-	Electronic throttle
8	-	APP sensor
9	-	AAT sensor
10	-	ECT sensor (ECT 1)
11	-	ECM cooling fan
12	-	LH upstream HO2S
13	-	LH downstream HO2S
14	-	RH downstream HO2S
15	-	RH upstream HO2S

OPERATION

ECM Adaptions

The [ECM](#) has the ability to adapt the input values it uses to control certain outputs. This capability maintains engine refinement and ensures the engine emissions remain within the legislated limits. The components which have adaptions associated with them are:

- The [APP](#) sensor
- The heated oxygen sensors

- The [MAFT](#) sensors
- The [CKP](#) sensor
- Electronic throttle
- Knock sensors.

Oxygen and MAFT Sensors

There are several adaptive maps associated with the fueling strategy. Within the fueling strategy the [ECM](#) calculates short-term adaptations and long term adaptations. The [ECM](#) will monitor the deterioration of the heated oxygen sensors 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.

Crankshaft Position 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 drive plates 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 drive plate adaption if the [ECM](#) is renewed or replaced. The [ECM](#) supports four drive plate adaptations for the [CKP](#) sensor. Each adaption relates to a specific engine speed range. The engine speed ranges are detailed in the table below:

Adaption	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 an amount of misfire that could lead to the legislated emissions limit being exceeded by a given amount. The second level is a misfire rate that causes degradation in catalytic converter efficiency.

The [ECM](#) monitors the number of misfire occurrences within two engine revolution ranges. If the [ECM](#) determines a misfire failure within either of these two ranges, over two consecutive journeys, it will record a fault code and details of the engine speed, engine load and engine coolant temperature. In addition, if the second level of misfire occurs, on any trip, the [ECM](#) flashes the [MIL](#) while the fault is occurring.

The signal from the [CKP](#) sensor indicates how fast the poles on the drive plate are passing the sensor tip. A sine wave is generated each time a pole passes the sensor tip. The [ECM](#) can detect variations in drive plate 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. The [ECM](#) will evaluate the signal against a number of factors and will decide whether to record the occurrence or ignore it. The [ECM](#) can assign a misfire judgement to an individual cylinder, which can be viewed on Land Rover approved diagnostic equipment.

Diagnostics

The [ECM](#) stores each fault as a [DTC \(diagnostic trouble code\)](#). The [DTC](#) and associated environmental and freeze frame data can be read using Land Rover approved diagnostic equipment, which can also read real time data from each sensor, the adaption values currently being employed and the current fueling, ignition and idle speed settings.

Electronic Engine Controls - V8 5.0L 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](#) (303-14D Electronic Engine Controls - V8 5.0L 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 the relevant Diagnostic Trouble Code (DTC) Index section for the V8 5.0L Petrol, DTC Engine Control Module (PCM) (100-00 General Information, Description and Operation).

Electronic Engine Controls - V8 5.0L Petrol - Powertrain Control Module (PCM) Long Drive Cycle Self-Test

General Procedures



WARNING: Where possible, all road tests should be on well surfaced and dry roads. Always comply with speed limits and local traffic regulations.

- **NOTE:** This procedure is an overcheck only. If fault codes are found, interrogation of the relevant system must be carried out and claimed against.

- **NOTE:** The vehicle must exceed 50mph (80 km/h) during the road test.

1. Connect the diagnostic equipment to the vehicle.
2. Follow on screen prompts and check for engine management fault codes.
3. Clear the fault codes following the on screen procedure.
4. Disconnect the diagnostic equipment from the vehicle.

5. NOTE: Make sure cruise control is not engaged.

Make sure the engine temperature is above 60 °C (140 °F).

Carry out a road test and perform the following operations.

1. Accelerate to 55 mph (88 km/h) in 5th gear and cruise for 2 minutes with the engine speed at or above 1800rpm.
2. Lift off the throttle and allow the vehicle to decelerate until the engine speed is less than 1000 rpm.
3. Stop the vehicle.
4. Release brake, allow the vehicle to move with no throttle for 1 minute.
5. Road test is now complete.

6. Connect the diagnostic equipment to the vehicle.

7. NOTE: If fault codes are found, interrogation of the relevant system must be carried out and claimed against.

Follow on screen prompts and check for engine management fault codes.

8. Disconnect the diagnostic equipment from the vehicle.

Electronic Engine Controls - V8 5.0L Petrol - Powertrain Control Module (PCM) Short Drive Cycle Self-Test

General Procedures

• NOTE: This procedure is an overcheck only. If fault codes are found, interrogation of the relevant system must be carried out and claimed against.

1. Connect the diagnostic equipment to the vehicle.
2. Follow on screen prompts and check for engine management fault codes.
3. Clear the fault codes following the on screen procedure.
4. Start the engine.
 - Allow the engine to idle for 30 seconds.
 - Raise the engine speed to 1500 rpm and hold for 3 minutes until a temperature of 70°C (158 °F) is achieved.
 - Allow the engine to idle for 30 seconds.
 - Switch off the engine.

5. NOTE: If fault codes are found, interrogation of the relevant system must be carried out and claimed against.

Follow on screen prompts and check for engine management fault codes.

6. Disconnect the diagnostic equipment from the vehicle.

Electronic Engine Controls - V8 5.0L 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 - V8 5.0L Petrol - Camshaft Position (CMP)

Sensor LH

Removal and Installation

Removal

- NOTE: Removal steps in this procedure may contain installation details.

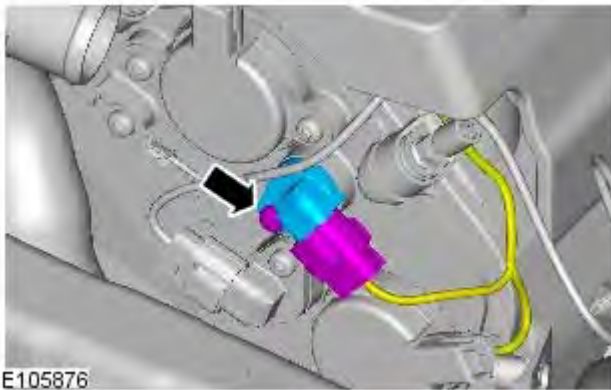
1.  WARNING: Make sure to support the vehicle with axle stands.

Raise and support the vehicle.

2. Refer to: [Thermostat Housing](#) (303-03D Engine Cooling - V8 5.0L Petrol, Removal and Installation).

3.

- Torque: 10 Nm



Installation

1. CAUTIONS:



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



Make sure that the sensor tip is clean and free of foreign material.

- NOTE: Lubricate the O-ring seal with clean engine oil.

To install, reverse the removal procedure.

Electronic Engine Controls - V8 5.0L Petrol - Camshaft Position (CMP)

Sensor RH

Removal and Installation

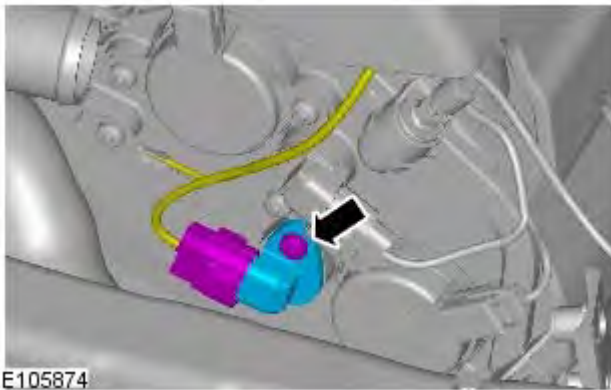
Removal

- NOTE: Removal steps in this procedure may contain installation details.

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

Raise and support the vehicle.

2. Refer to: [Thermostat Housing](#) (303-03D Engine Cooling - V8 5.0L Petrol, Removal and Installation).



3.
 - Torque: 10 Nm

Installation

1. CAUTIONS:



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



Make sure that the sensor tip is clean and free of foreign material.

- NOTE: Lubricate the O-ring seal with clean engine oil.

To install, reverse the removal procedure.

Electronic Engine Controls - V8 5.0L Petrol - Catalyst Monitor Sensor LH

Removal and Installation

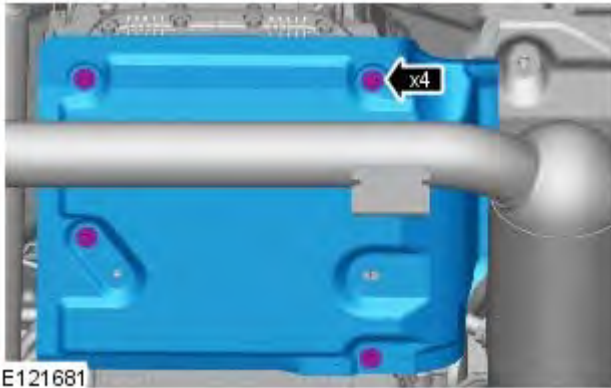
Removal

- NOTE: Removal steps in this procedure may contain installation details.

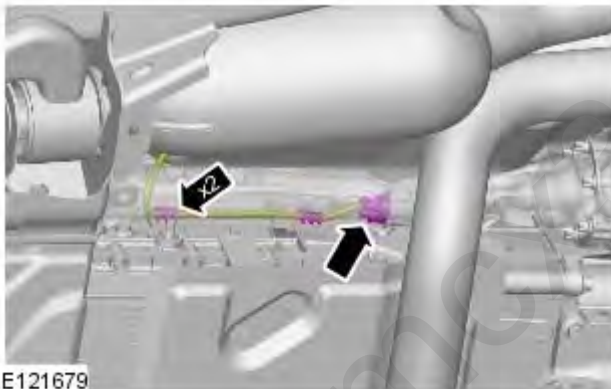
1.  **WARNING:** Make sure to support the vehicle with axle stands.

Raise and support the vehicle.

2. Torque: 10 Nm

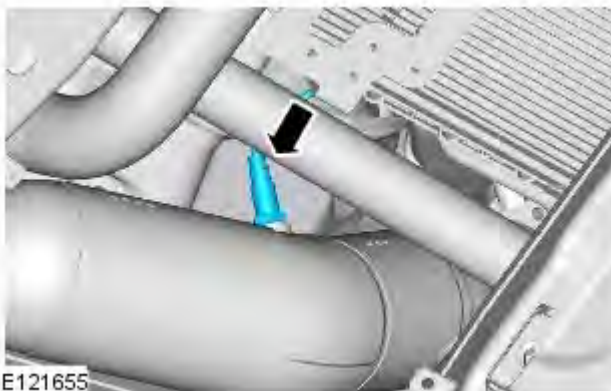


- 3.



4.  **CAUTION:** Make sure that the mating faces are clean and free of foreign material.

Torque: 48 Nm



Installation

1. **CAUTIONS:**



If accidentally dropped or knocked install a new sensor.



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

- NOTE: If the original sensor is to be installed, apply lubricant meeting specification ESE-M12A4-A to the thread of the sensor.
- NOTE: Make sure the anti-seize compound does not contact the HO2S tip.

To install, reverse the removal procedure.

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Electronic Engine Controls - V8 5.0L Petrol - Catalyst Monitor Sensor RH

Removal and Installation

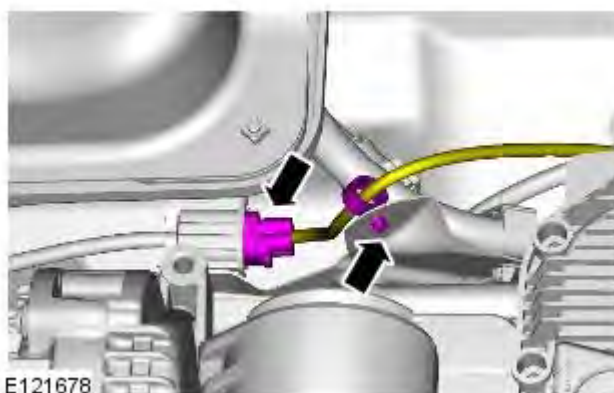
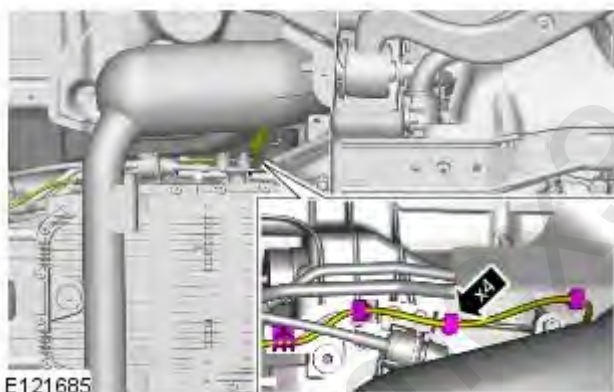
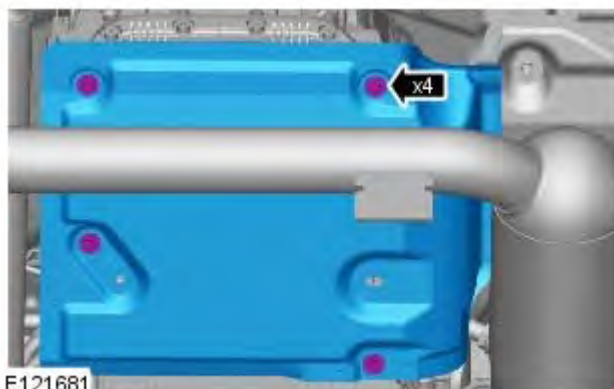
Removal

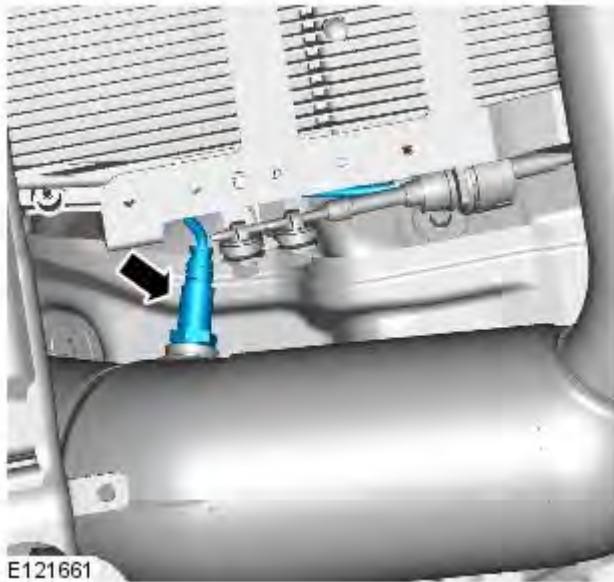
- NOTE: Removal steps in this procedure may contain installation details.

1.  **WARNING:** Make sure to support the vehicle with axle stands.

Raise and support the vehicle.

2. Torque: 10 Nm





5.  **CAUTION:** Make sure that the mating faces are clean and free of foreign material.

Torque: 48 Nm

Installation

1. **1. CAUTIONS:**



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



If accidentally dropped or knocked install a new sensor.



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

- **NOTE:** 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 - V8 5.0L Petrol - Crankshaft Position (CKP) Sensor

Removal and Installation

Removal

- NOTE: Removal steps in this procedure may contain installation details.

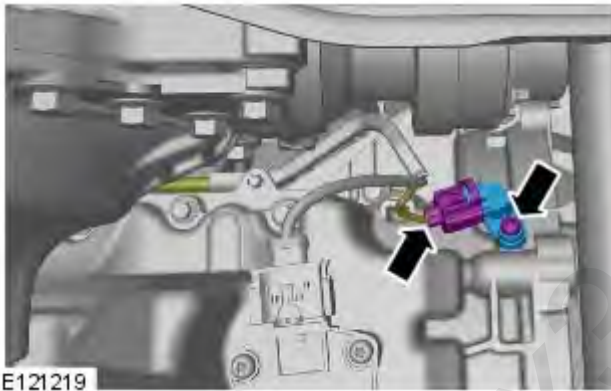
1. Disconnect the battery ground cable.

Refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

2.  **WARNING:** Make sure to support the vehicle with axle stands.

Raise and support the vehicle.

3. Refer to: [Engine Undershield](#) (501-02 Front End Body Panels, 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.

Torque: 10 Nm

Installation

1. **CAUTIONS:**



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



Make sure that the component is clean, free of foreign material and lubricant.

To install, reverse the removal procedure.

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

Electronic Engine Controls - V8 5.0L Petrol - Engine Control Module (ECM)

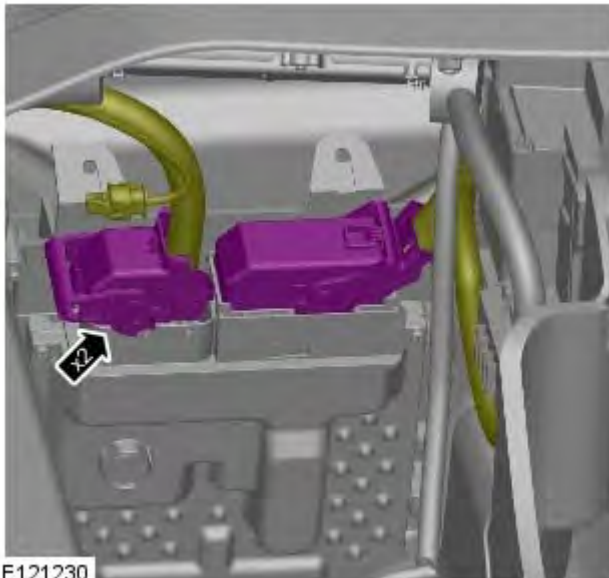
Removal and Installation

Removal

- NOTE: Removal steps in this procedure may contain installation details.

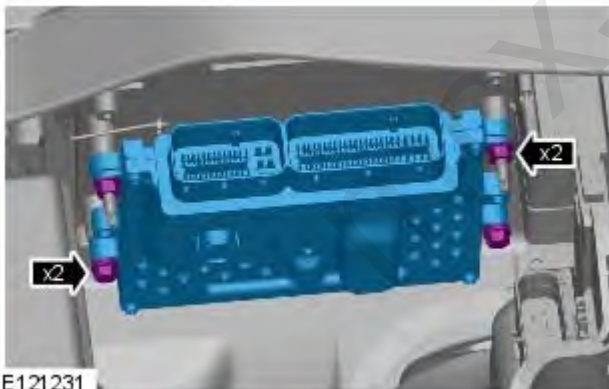
1. Remove the battery.

Refer to: [Battery](#) (414-01 Battery, Mounting and Cables, Removal and Installation).



E121230

2.  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.



E121231

3. Torque: 7 Nm

Installation

1. To install, reverse the removal procedure.

Electronic Engine Controls - V8 5.0L Petrol - Engine Coolant Temperature (ECT) Sensor

Removal and Installation

Removal

- NOTE: Removal steps in this procedure may contain installation details.

1.  **WARNING:** Make sure to support the vehicle with axle stands.

Raise and support the vehicle.

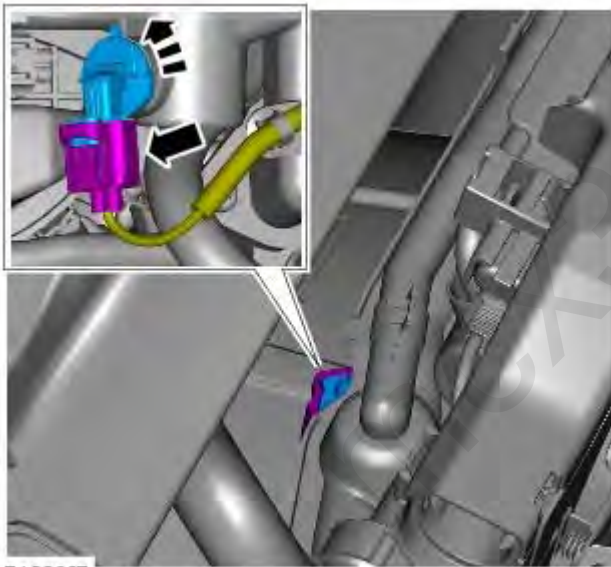
2. Disconnect the battery ground cable.

Refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

3. Refer to: [Engine Cover - V8 5.0L Petrol](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).

4. Refer to: [Cooling System Draining, Filling and Bleeding](#) (303-03D Engine Cooling - V8 5.0L Petrol, General Procedures).

5. **NOTE:** Some variation in the illustrations may occur, but the essential information is always correct.



E108667

Installation

1. To install, reverse the removal procedure.

Electronic Engine Controls - V8 5.0L Petrol - Engine Oil Level Sensor

Removal and Installation

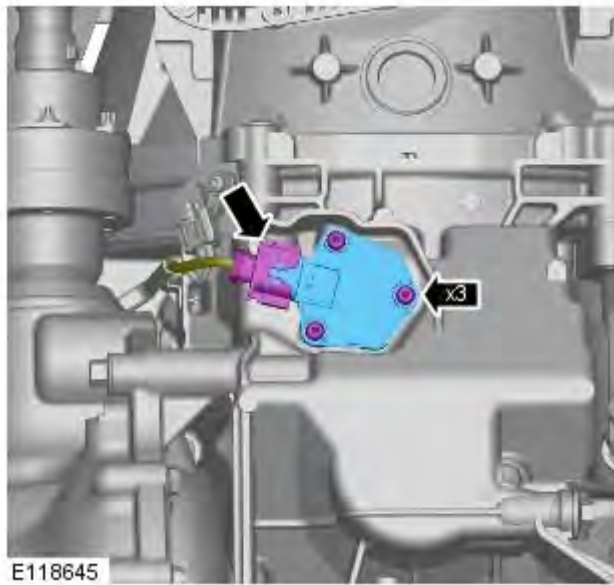
Removal

- NOTE: Removal steps in this procedure may contain installation details.

1.  **WARNING:** Make sure to support the vehicle with axle stands.

Raise and support the vehicle.

2. Refer to: [Engine Oil Draining and Filling](#) (303-01D Engine - V8 5.0L Petrol, General Procedures).



3. **CAUTIONS:**



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 and discard the O-ring seal.

- NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

Torque: 12 Nm

Installation

1. To install, reverse the removal procedure.

Electronic Engine Controls - V8 5.0L Petrol - Front Knock Sensor (KS) LH

Removal and Installation

Removal

- NOTE: Removal steps in this procedure may contain installation details.

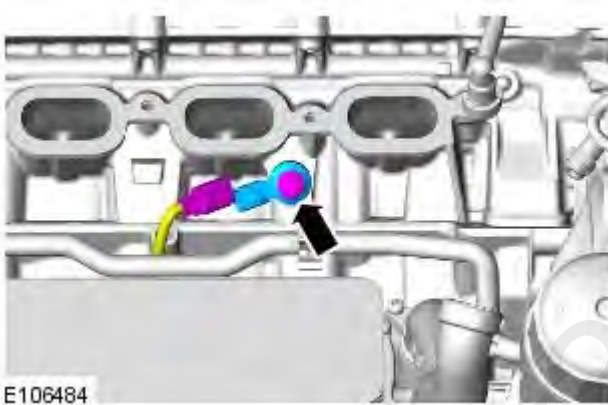
1. Disconnect the battery ground cable.

Refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

2.  **WARNING:** Make sure to support the vehicle with axle stands.

Raise and support the vehicle.

3. Refer to: [Intake Manifold](#) (303-01D Engine - V8 5.0L Petrol, Removal and Installation).



4. Torque: 20 Nm

Installation

1. To install, reverse the removal procedure.

Electronic Engine Controls - V8 5.0L Petrol - Front Knock Sensor (KS) RH

Removal and Installation

Removal

- NOTE: Removal steps in this procedure may contain installation details.

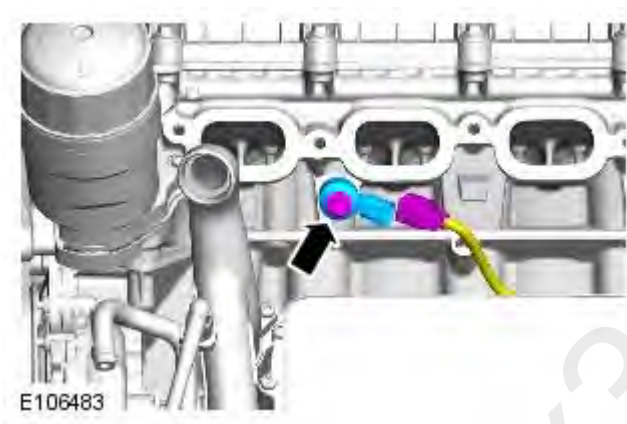
1. Disconnect the battery ground cable.

Refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

2.  **WARNING:** Make sure to support the vehicle with axle stands.

Raise and support the vehicle.

3. Refer to: [Intake Manifold](#) (303-01D Engine - V8 5.0L Petrol, Removal and Installation).



4. Torque: 20 Nm

Installation

1. To install, reverse the removal procedure.

Electronic Engine Controls - V8 5.0L Petrol - Fuel Rail Pressure (FRP)

Sensor

Removal and Installation

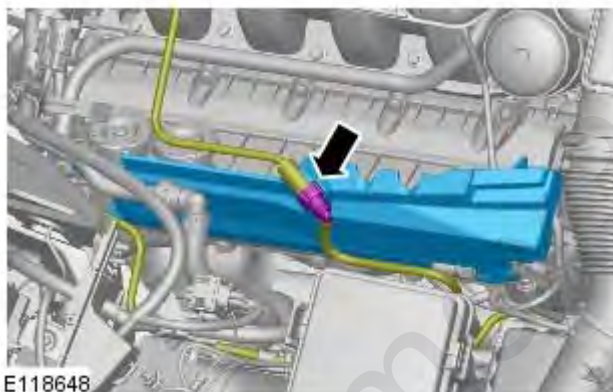
Removal

- NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: [Petrol and Petrol-Ethanol Fuel Systems Health and Safety Precautions](#) (100-00 General Information, Description and Operation).
2. Refer to: [Fuel System Pressure Release - V8 5.0L Petrol](#) (310-00 Fuel System - General Information, General Procedures).
3. Disconnect the battery ground cable.

Refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

4. Refer to: [Fuel Injection Component Cleaning](#) (303-04F Fuel Charging and Controls - V8 5.0L Petrol, General Procedures).
5. Refer to: [Engine Cover - V8 5.0L Petrol](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).



6. 6. NOTE: Some variation in the illustrations may occur, but the essential information is always correct.



7. 7. CAUTIONS:



Be prepared to collect escaping fluids.



Make sure that all openings are sealed. Use new blanking caps.

- Torque: 32 Nm

Installation

1. To install, reverse the removal procedure.

Electronic Engine Controls - V8 5.0L Petrol - Heated Oxygen Sensor (HO2S)

LH

Removal and Installation

Special Tool(s)

 310-121 Wrench, HO2S E53465	
---	--

Removal

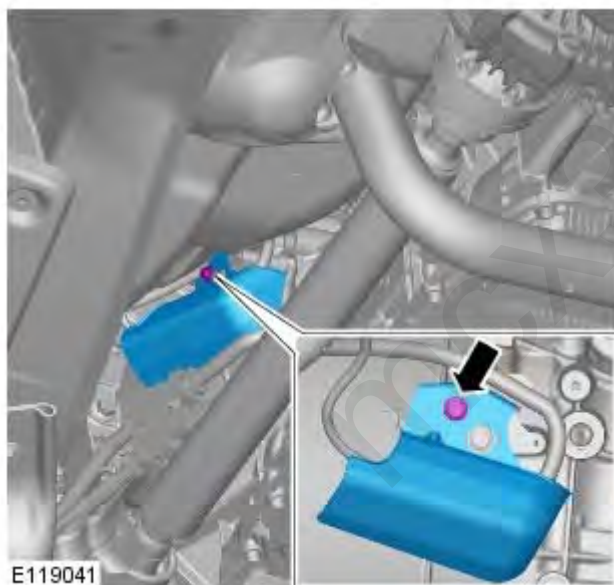
- NOTE: Removal steps in this procedure may contain installation details.

1.  **WARNING:** Make sure to support the vehicle with axle stands.

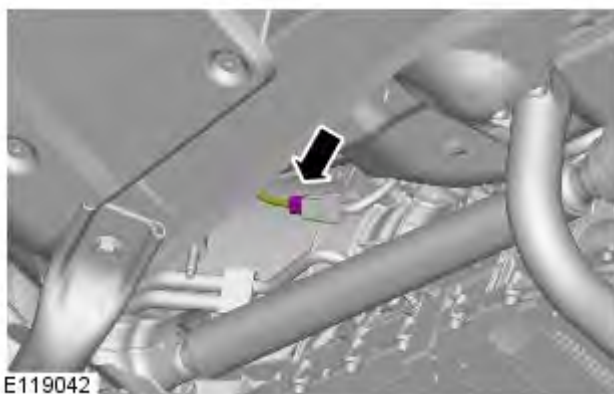
Raise and support the vehicle.

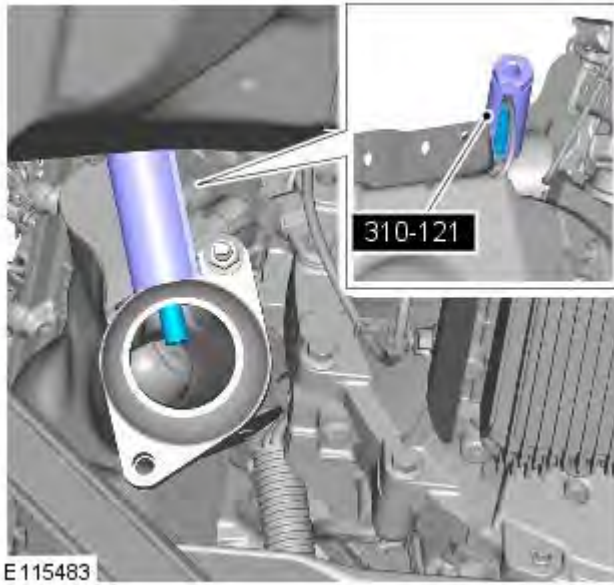
2. Refer to: [Exhaust System](#) (309-00D Exhaust System - V8 5.0L Petrol, Removal and Installation).

3. Torque: 11 Nm



- 4.





5.  **CAUTION:** Make sure that the mating faces are clean and free of foreign material.

Special Tool(s): [310-121](#)

Torque: 48 Nm

Installation

1. **1. CAUTIONS:**



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



If accidentally dropped or knocked install a new sensor.



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

- **NOTE:** 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.

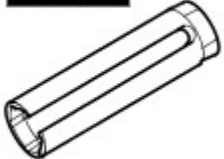
2. Using the approved diagnostic equipment, clear the powertrain control module (PCM) adaptations.

Electronic Engine Controls - V8 5.0L Petrol - Heated Oxygen Sensor (HO2S)

RH

Removal and Installation

Special Tool(s)

 310-121 Wrench, H02S E53465	
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Removal

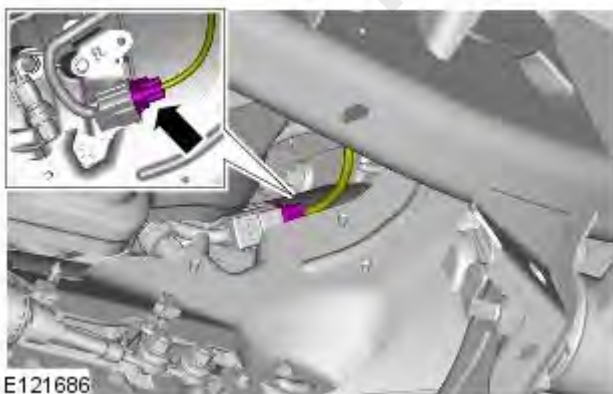
- NOTE: Removal steps in this procedure may contain installation details.

1.  **WARNING:** Make sure to support the vehicle with axle stands.

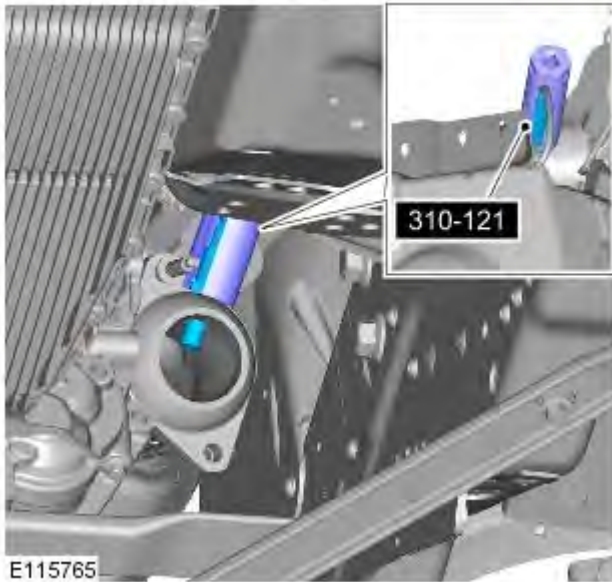
Raise and support the vehicle.

2. Refer to: [Exhaust System](#) (309-00D Exhaust System - V8 5.0L Petrol, Removal and Installation).

3. Torque: 9 Nm



- 4.



5.  **CAUTION:** Make sure that the mating faces are clean and free of foreign material.

Special Tool(s): [310-121](#)

Torque: 48 Nm

Installation

1. **1. CAUTIONS:**



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



If accidentally dropped or knocked install a new sensor.



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

- **NOTE:** 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 - V8 5.0L Petrol - Manifold Absolute Pressure (MAP) Sensor

Removal and Installation

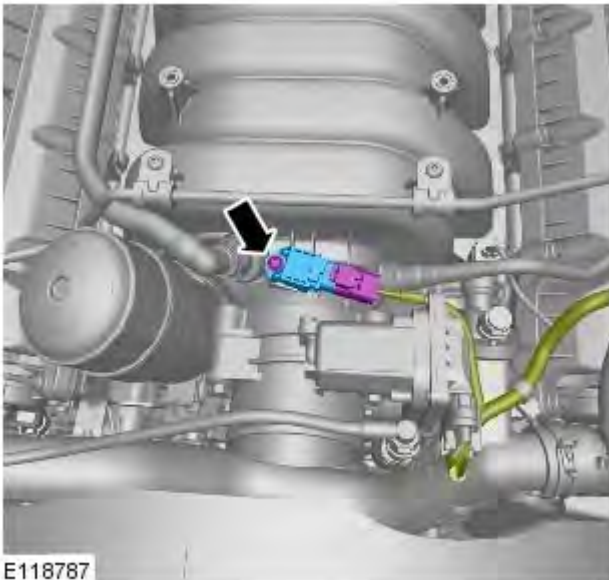
Removal

- NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: [Air Cleaner Outlet Pipe T-Connector](#) (303-12D Intake Air Distribution and Filtering - V8 5.0L Petrol, Removal and Installation).

2. **2.** NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

- Torque: 5 Nm



Installation

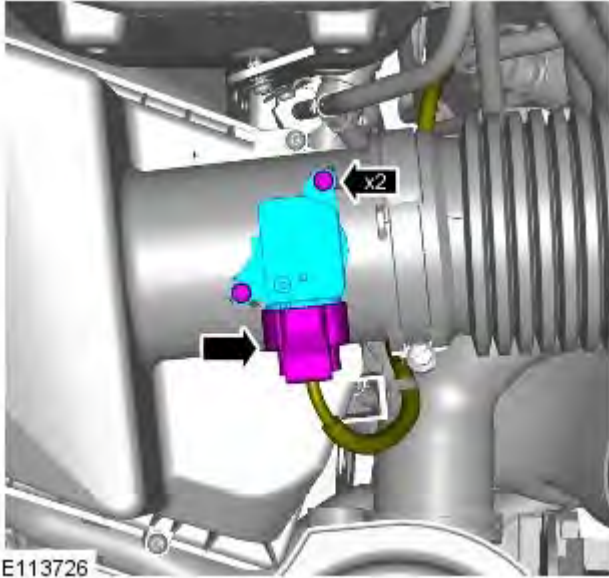
1. To install, reverse the removal procedure.

Electronic Engine Controls - V8 5.0L Petrol - Mass Air Flow (MAF) Sensor

Removal and Installation

Removal

- NOTE: Removal steps in this procedure may contain installation details.



1. 1. NOTE: Right-hand shown, left-hand similar.

- NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

Torque: 1.2 Nm

Installation

1. To install reverse the removal procedure.
2. Using the approved diagnostic equipment, clear the powertrain control module (PCM) adaptations.

Electronic Engine Controls - V8 5.0L Petrol - Rear Knock Sensor (KS) LH

Removal and Installation

Removal

- NOTE: Removal steps in this procedure may contain installation details.

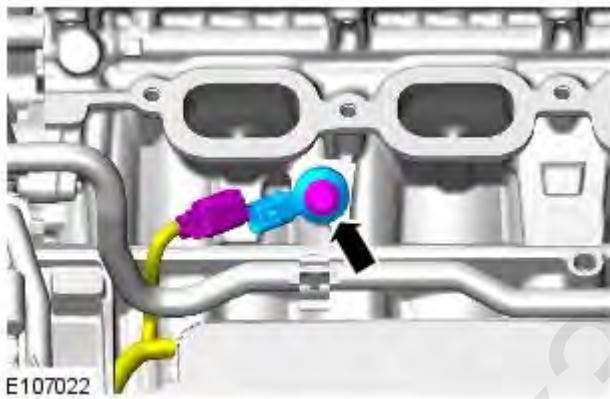
1. Disconnect the battery ground cable.

Refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

2.  **WARNING:** Make sure to support the vehicle with axle stands.

Raise and support the vehicle.

3. Refer to: [Intake Manifold](#) (303-01D Engine - V8 5.0L Petrol, Removal and Installation).



4. Torque: 20 Nm

Installation

1. To install, reverse the removal procedure.

Electronic Engine Controls - V8 5.0L Petrol - Rear Knock Sensor (KS) RH

Removal and Installation

Removal

- NOTE: Removal steps in this procedure may contain installation details.

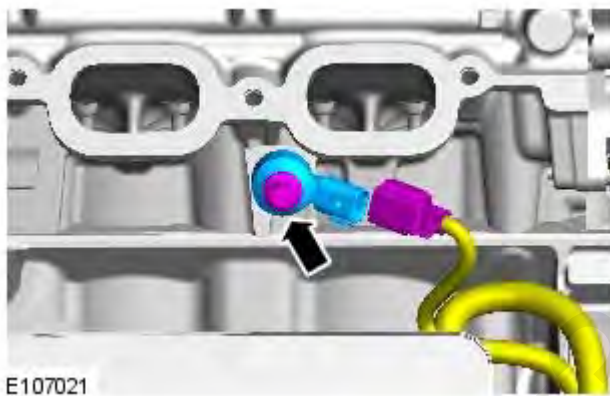
1. Disconnect the battery ground cable.

Refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

2.  **WARNING:** Make sure to support the vehicle with axle stands.

Raise and support the vehicle.

3. Refer to: [Intake Manifold](#) (303-01D Engine - V8 5.0L Petrol, Removal and Installation).



4. Torque: 20 Nm

Installation

1. To install, reverse the removal procedure.

Electronic Engine Controls - V8 5.0L Petrol - Variable Valve Timing (VVT) Oil Control Solenoid LH

Removal and Installation

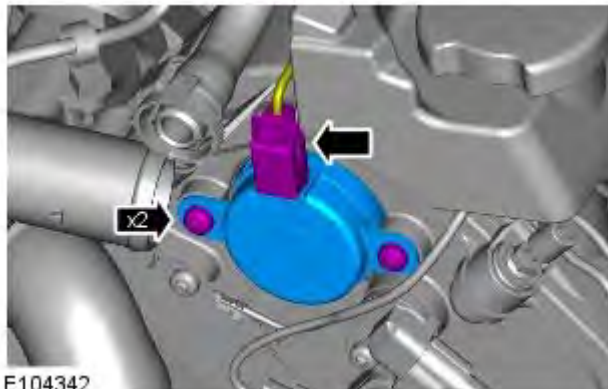
Removal

- NOTE: Removal steps in this procedure may contain installation details.

1.  **WARNING:** Make sure to support the vehicle with axle stands.

Raise and support the vehicle.

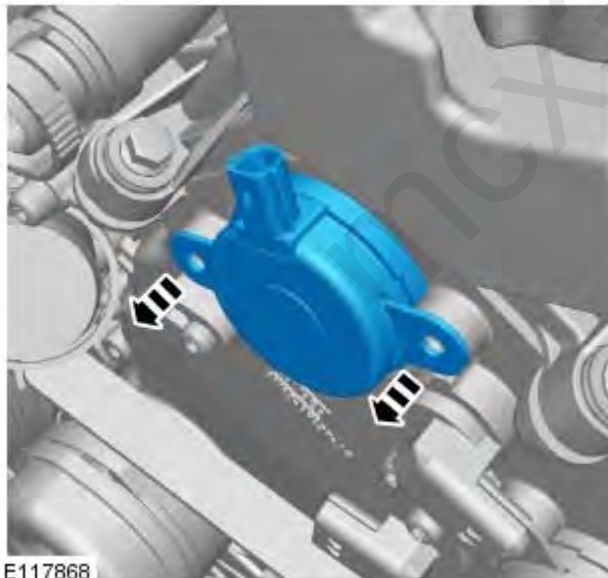
2. Refer to: [Thermostat Housing](#) (303-03D Engine Cooling - V8 5.0L Petrol, Removal and Installation).



E104342

3. **NOTE:** Some variation in the illustrations may occur, but the essential information is always correct.

Torque: 10 Nm



E117868

4.  **CAUTION:** Evenly and progressively, remove the VVT units from each side.

- NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

Installation

1.  **CAUTION:** Make sure that the mating faces are clean and free of foreign material.

- NOTE: Lubricate the O-ring seal with clean engine oil.

To install, reverse the removal procedure.

Electronic Engine Controls - V8 5.0L Petrol - Variable Valve Timing (VVT) Oil Control Solenoid RH

Removal and Installation

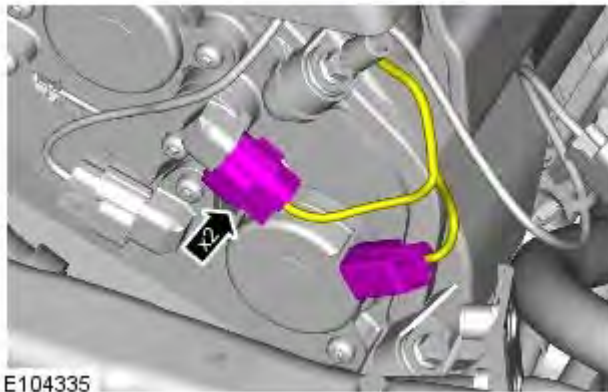
Removal

- NOTE: Removal steps in this procedure may contain installation details.

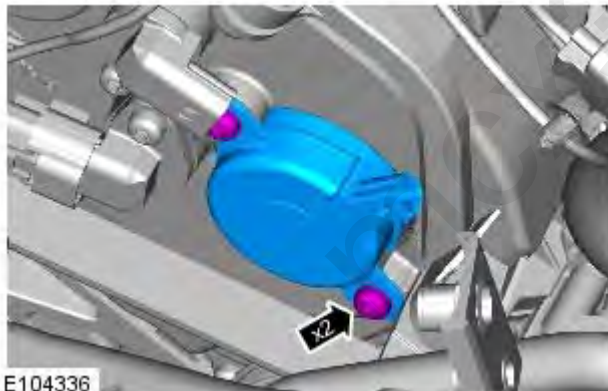
1.  **WARNING:** Make sure to support the vehicle with axle stands.

Raise and support the vehicle.

2. Refer to: [Thermostat Housing](#) (303-03D Engine Cooling - V8 5.0L Petrol, Removal and Installation).

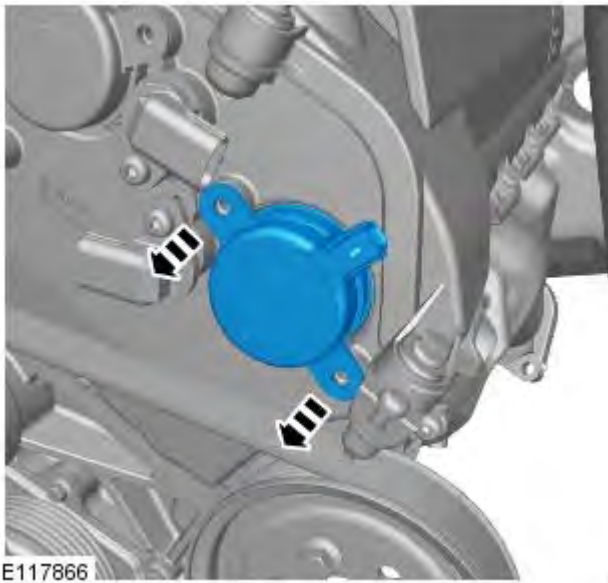


3. **NOTE:** Some variation in the illustrations may occur, but the essential information is always correct.



4. **NOTE:** Some variation in the illustrations may occur, but the essential information is always correct.

Torque: 10 Nm



5. **5.**  **CAUTION:** Evenly and progressively, remove the VVT units from each side.
 - **NOTE:** Some variation in the illustrations may occur, but the essential information is always correct.

Installation

1. **1.**  **CAUTION:** Make sure that the mating faces are clean and free of foreign material.
 - **NOTE:** Lubricate the O-ring seal with clean engine oil.

To install, reverse the removal procedure.