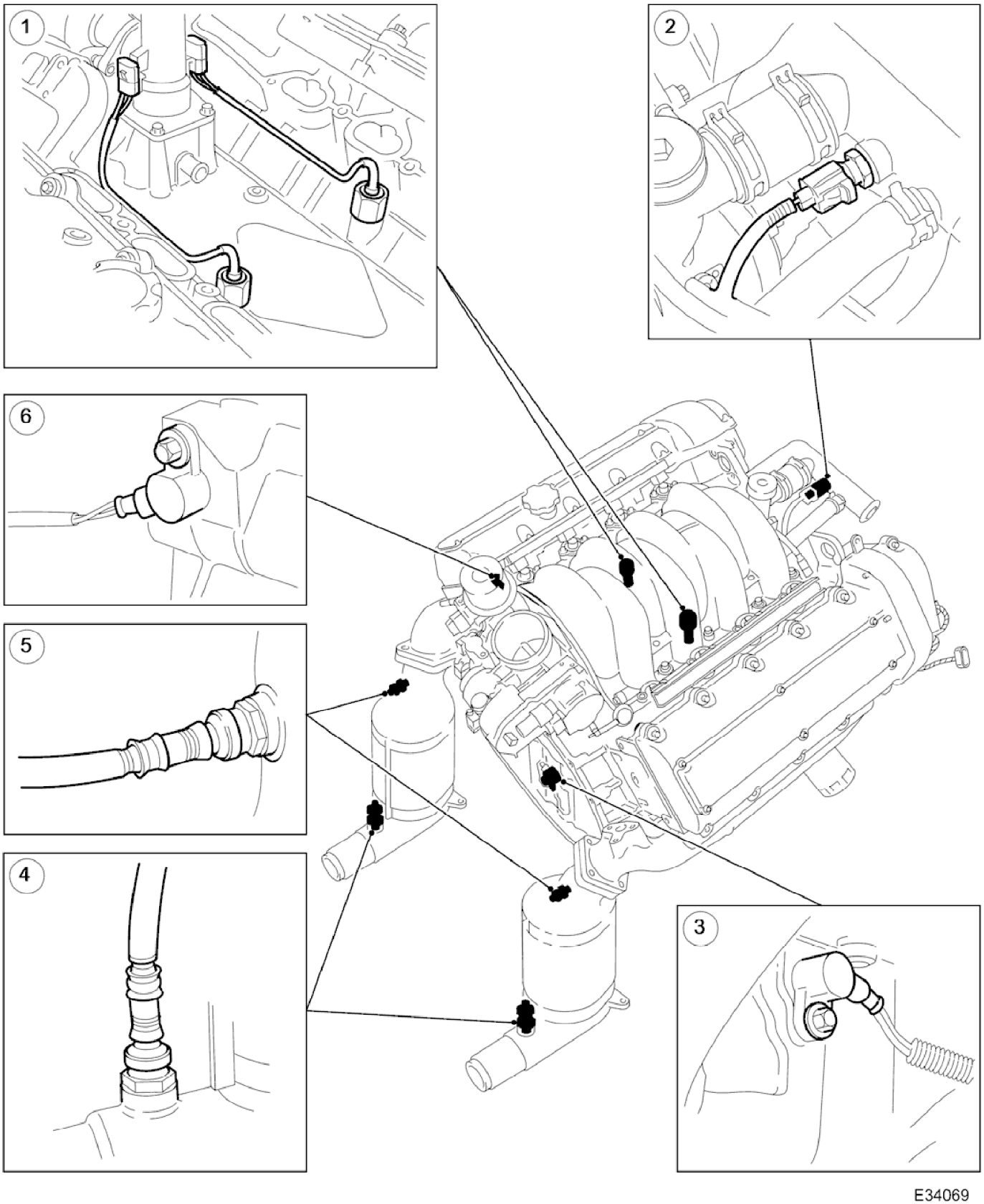


Parts List

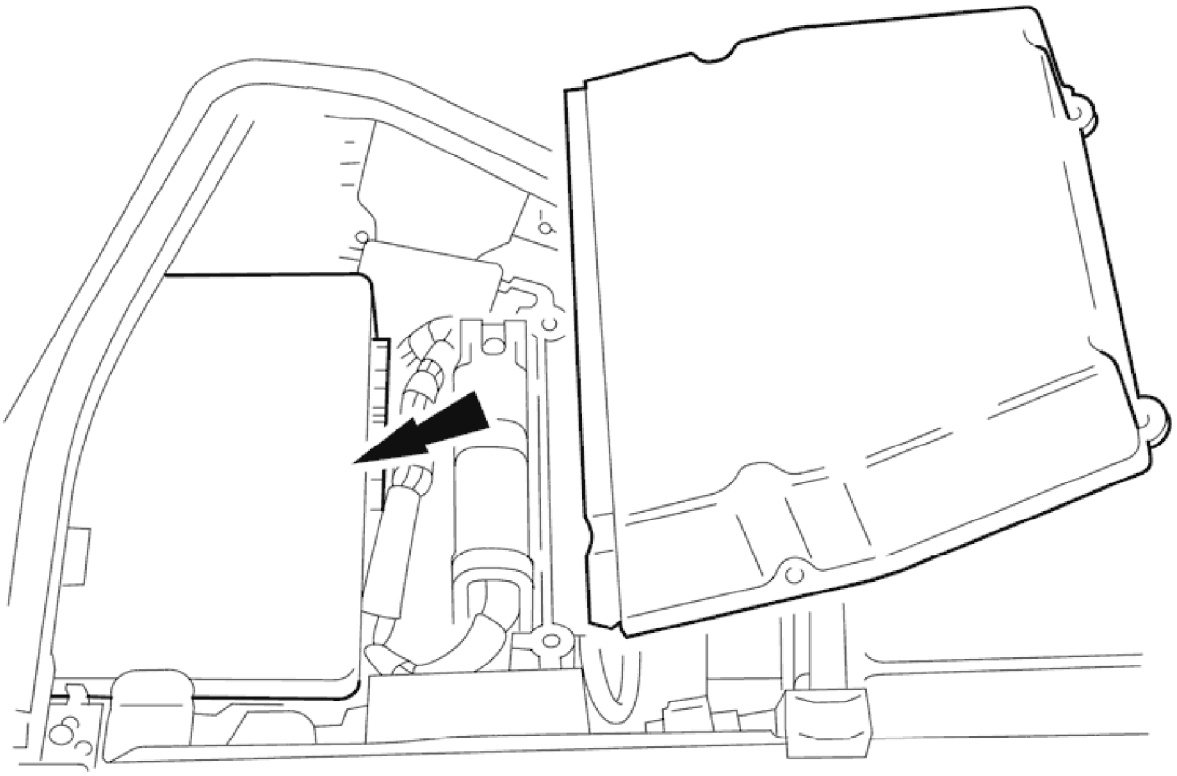
Item	Description
1	Knock sensor
2	Engine coolant temperature sensor
3	Crankshaft position sensor
4	Downstream oxygen sensor
5	Upstream oxygen sensor
6	Camshaft position sensor

The engine management system provides optimum control of the engine under all operating conditions using several strategically placed sensors and any necessary actuators. Electronic engine control consists of:

- engine control module
- throttle position sensor
- engine coolant temperature sensor
- camshaft position sensor
- crankshaft position sensor
- mass air flow sensor
- intake air temperature sensor
- knock sensor
- heated oxygen sensor

Electronic Engine Control

Engine Control Module (ECM)2



E34101

The ECM incorporates a comprehensive monitoring and diagnostic capability including software variations to ensure system compliance with the latest diagnostic and emissions legislation in different markets. The engine control module controls the coil on plug ignition system, electronic fuel system, cruise control and the electronic throttle control system.

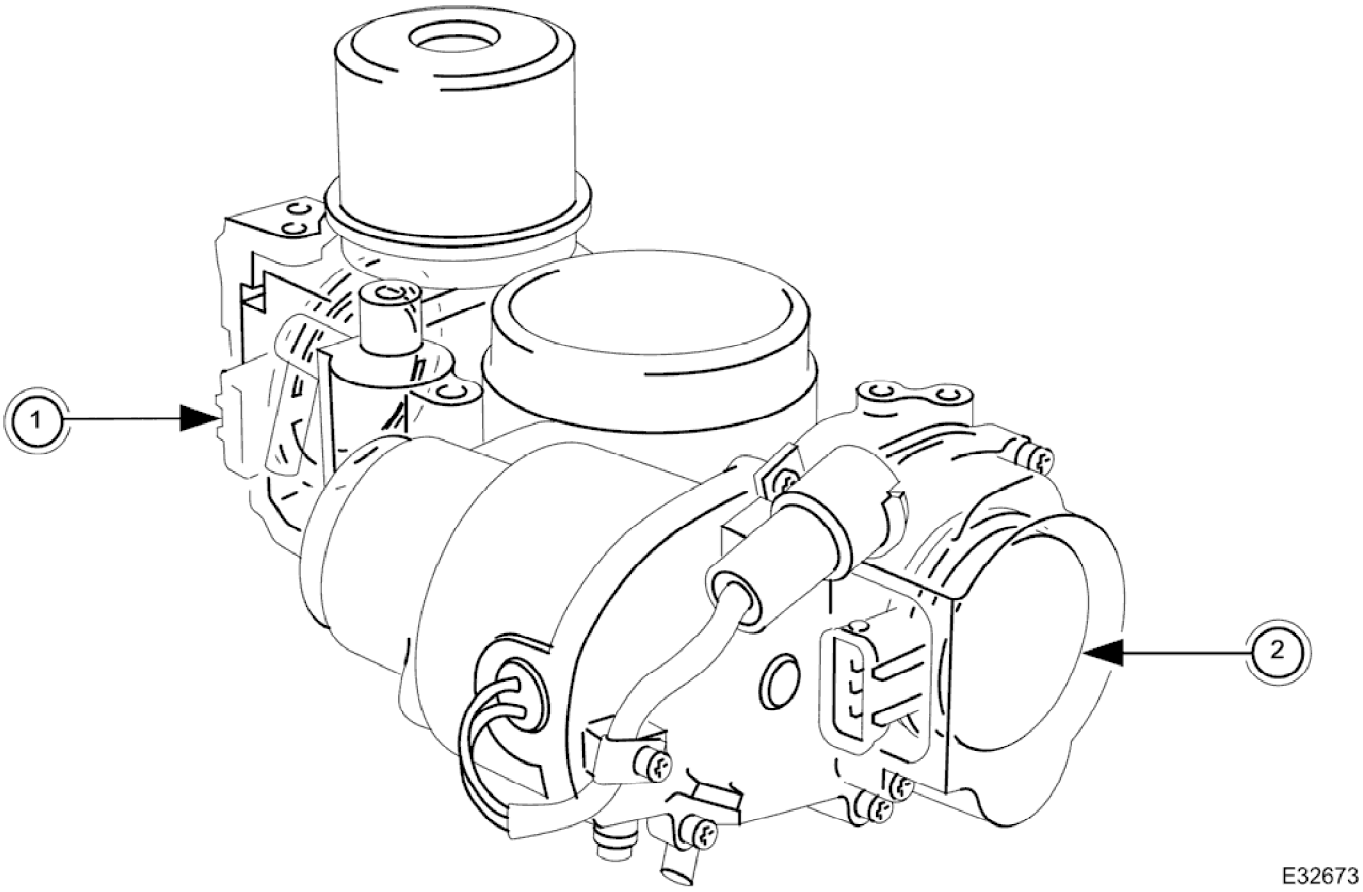
The ECM responds to input signals received from sensors relating to engine operating conditions and provides output signals to the appropriate actuators. These output signals are based on the evaluated input signals which are compared with calibrated data tables or maps held within the ECM before the output signal is generated.

The ECM needs the following inputs to calibrate the engine properly:

- camshaft position
- engine rpm
- engine coolant temperature
- amount of engine detonation

Throttle Position (TP) Sensor

Location



Parts List

Item	Description
1	Accelerator pedal and mechanical guard position sensors
2	Throttle (blade) position sensor

- sends the ECM a signal indicating throttle plate angle
- is the main input to the ECM from the driver
- is a dual Hall effect device mounted on the motor end of the throttle body

Two additional sensors are attached to the throttle body to provide additional feedback to the ECM: a mechanical guard position sensor and an accelerator pedal position sensor.

Camshaft Position (CMP) Sensor

- sends the ECM a signal indicating camshaft position for fuel synchronization purposes
- is a variable reluctance device mounted on bank 2 cylinder side face
- generates a signal when the ring fitted to the bank 2 inlet camshaft passes the sensor

Crankshaft Position (CKP) Sensor

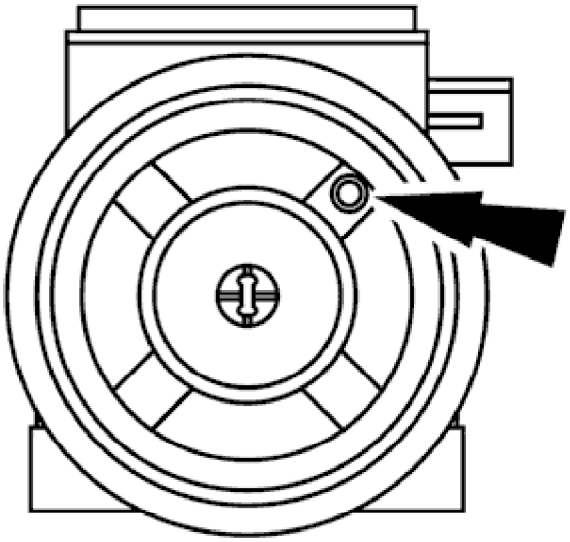
- is a variable reluctance device mounted on the engine oil pan
- generates a signal when the drive plate passes the sensor

- sends the ECM signals indicating crankshaft position and engine speed
- is essential for calculating spark timing

Engine Coolant Temperature (ECT) Sensor

- sends the ECM a signal indicating the temperature of the engine coolant
- is a temperature dependent resistor with a negative temperature coefficient (resistance changes inversely with respect to temperature) and is constantly monitored by the ECM

Intake Air Temperature (IAT) Sensor



E34025

- is mounted in the same housing as the MAF sensor but is not a serviceable item
- sends the ECM a signal indicating the temperature of the air entering the engine
- is a temperature dependent resistor which has a negative temperature coefficient (its resistance changes inversely with respect to ambient temperature).

Knock Sensor (KS)

- is a piezo-electric device which sends a signal to the ECM indicating engine detonation

Between 700 and 6800 rpm, the ECM will retard individual cylinder ignition timing when detonation occurs while allowing the other cylinders to continue operating normally.

During acceleration, at critical load and speed conditions, the ECM retards ignition timing to prevent the onset of detonation.

Heated Oxygen Sensor (HO2S)

- are positioned upstream of the catalytic convertor
- is equipped with a heating element which improves the response time of the sensors during engine warm-up
- has the ability to generate a voltage signal proportional to the oxygen content of the exhaust gases leaving

the engine

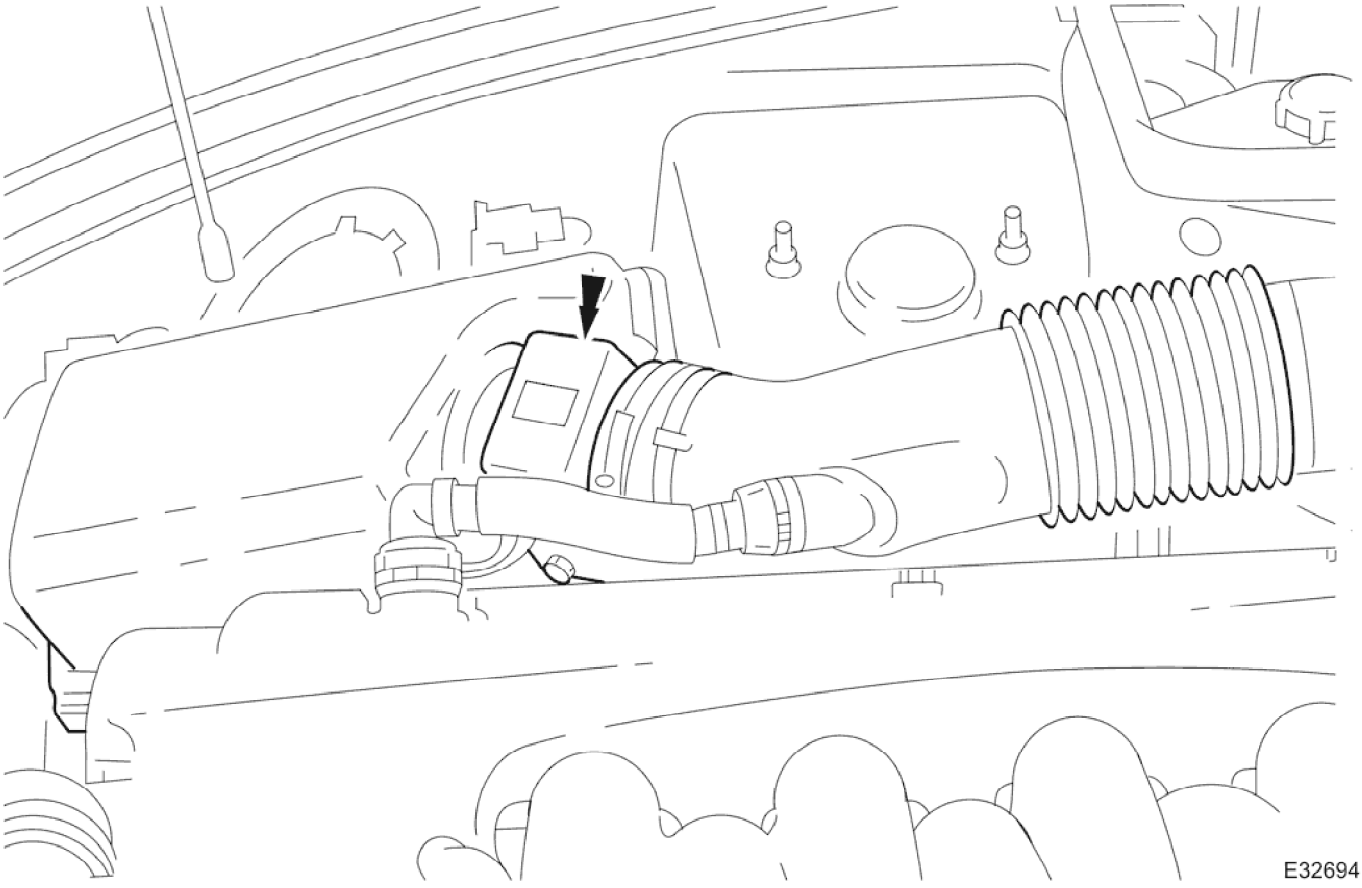
- provides feedback information to the ECM used to calculate fuel delivery and provide optimum gas emissions

Variable Valve Timing (VVT) Solenoid

Refer to section **<<303-01>>**.

Mass Air Flow (MAF) Sensor

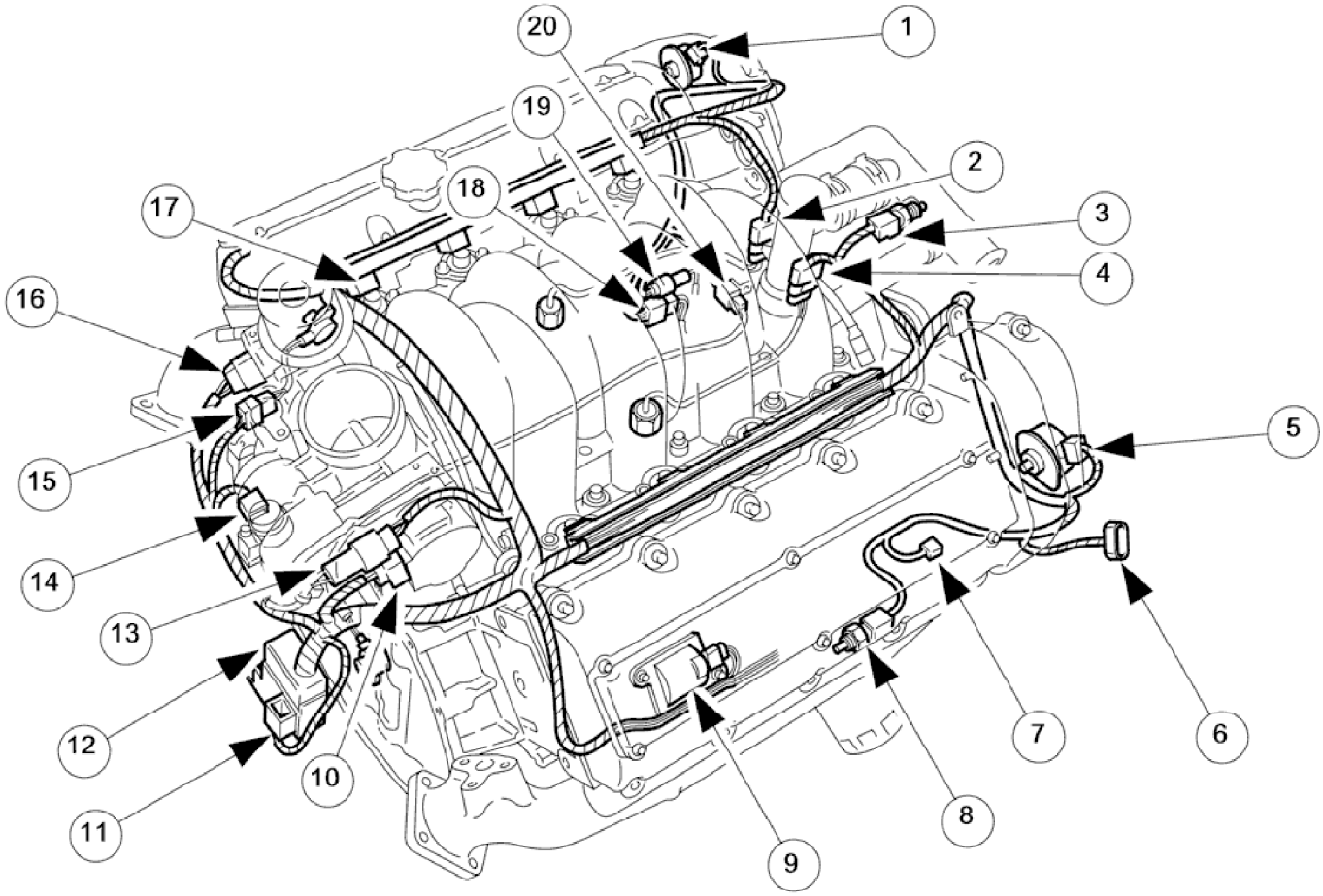
Location



- is of the 'hot-wire' type (the resistance of the wire varies as incoming air passing over it has a cooling effect)
- provides feedback to the ECM to permit monitoring of mass air flow
- is NOT serviceable, necessitating its renewal should a fault occur

Engine Harness Connectors

Location



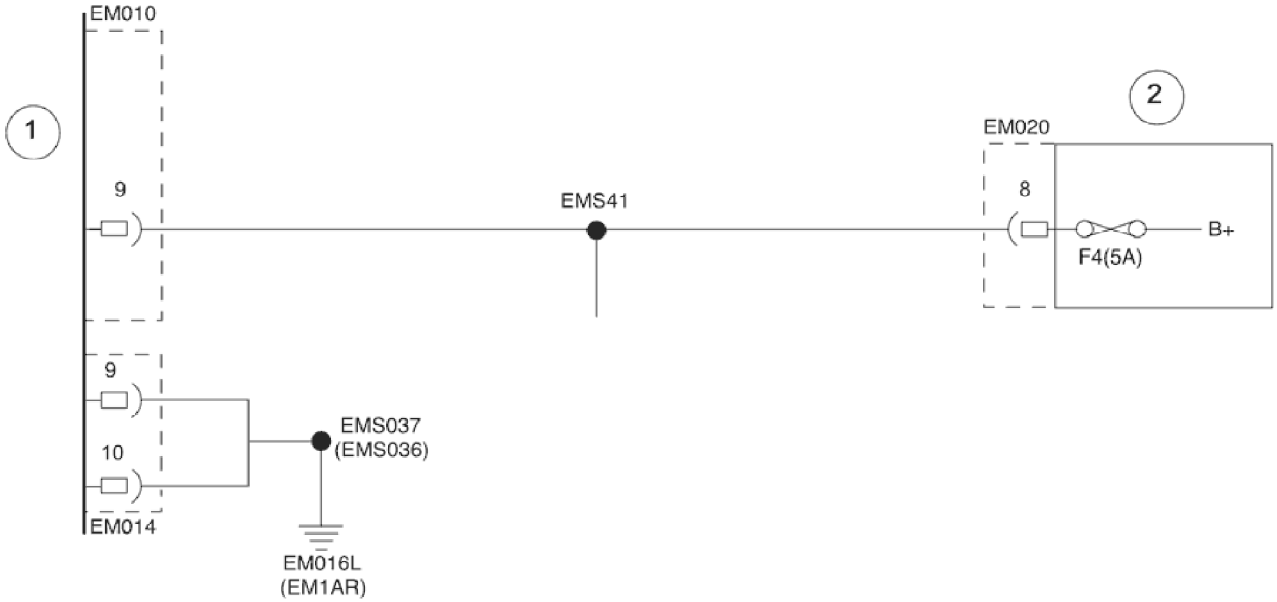
E34083

Parts List

Item	Description
1	PI032 VVT solenoid 2
2	PI027 KS 2
3	PI004 ECT sensor
4	PI026 KS 1
5	PI031 VVT solenoid 1
6	PI035 MAFS (on vehicle)
7	PI050 Generator
8	PI040 Oil pressure switch
9	PI018 to PI021 Bank 1 Ignition coils 1 to 4 PI022 to PI025 Bank 2 Ignition coils 1 to 4
10	PI006 Throttle valve position sensor
11	PI002 Engine management harness (on vehicle)
12	PI001 Engine management harness (on vehicle)
13	PI033 Throttle valve motor
14	PI034 EGR valve (where fitted)
15	PI015 CMP sensor
16	PI042 Accelerator pedal and mechanical guard sensors
17	PI007 to PI010 Bank 1 Injectors 1 to 4 PI011 to PI014 Bank 2 Injectors 1 to 4
18	PI037 Compressor lock sensor (where fitted)
19	PI036 Compressor clutch
20	PI017 CKP sensor

Circuit Diagrams (extracts only)

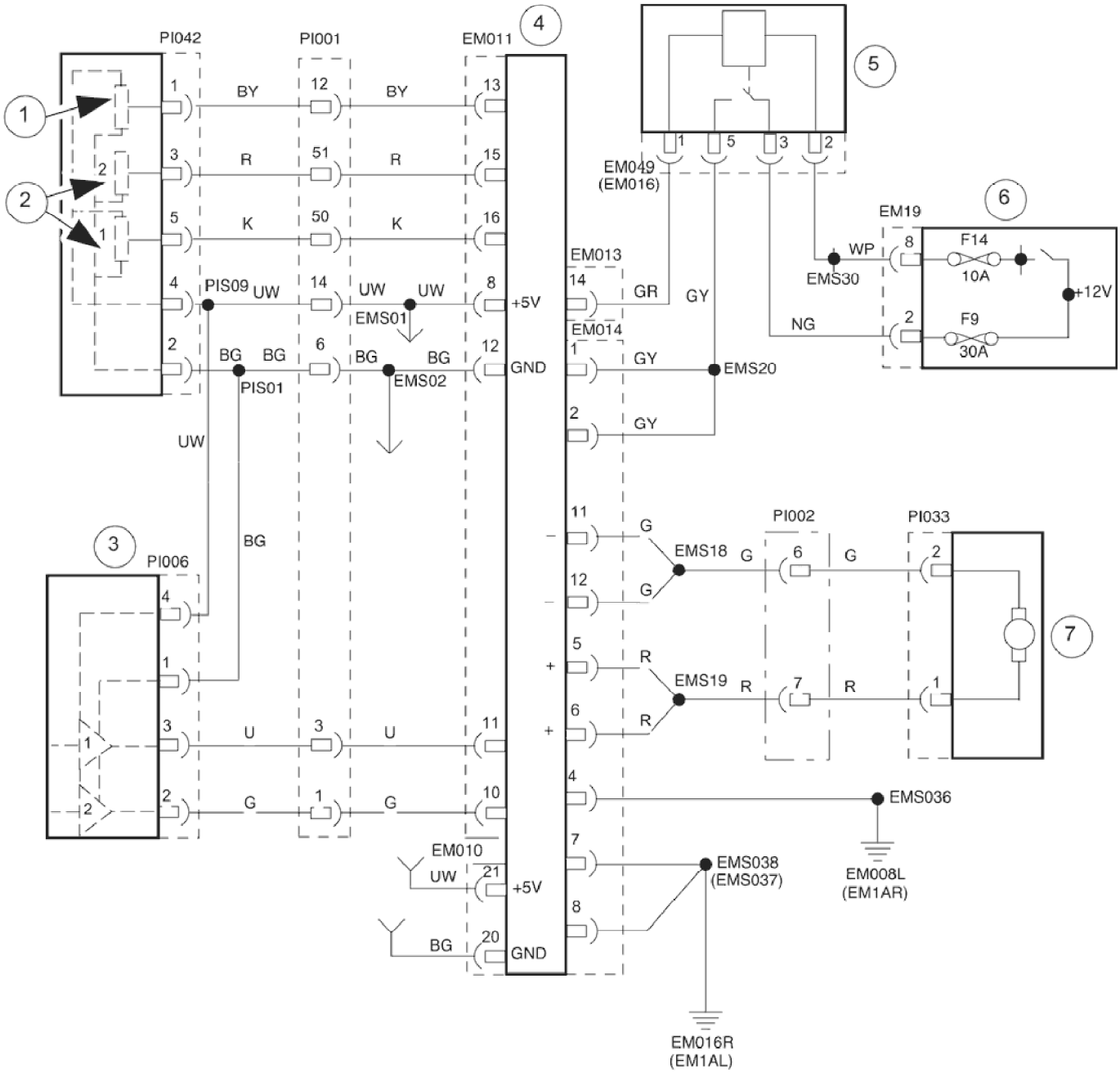
ECM Supply Voltage



E34072

Item	Description
1	Engine management fuse box
2	Engine control module (ECM)

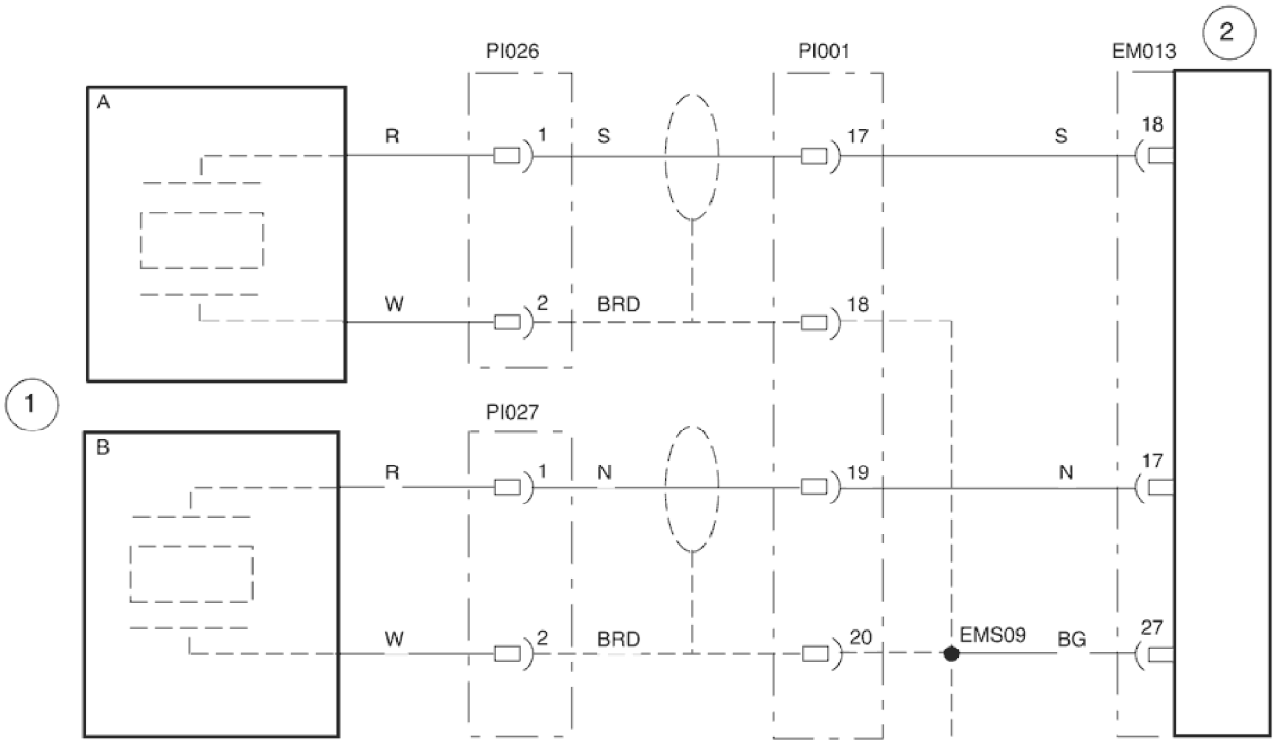
Throttle Sensors and Control



E34073

Item	Description
1	Mechanical guard position sensor (potentiometer)
2	Pedal demand sensors (potentiometers)
3	Throttle position sensor
4	Engine control module (ECM)
5	Throttle motor power relay
6	EMS fuse box
7	Throttle motor

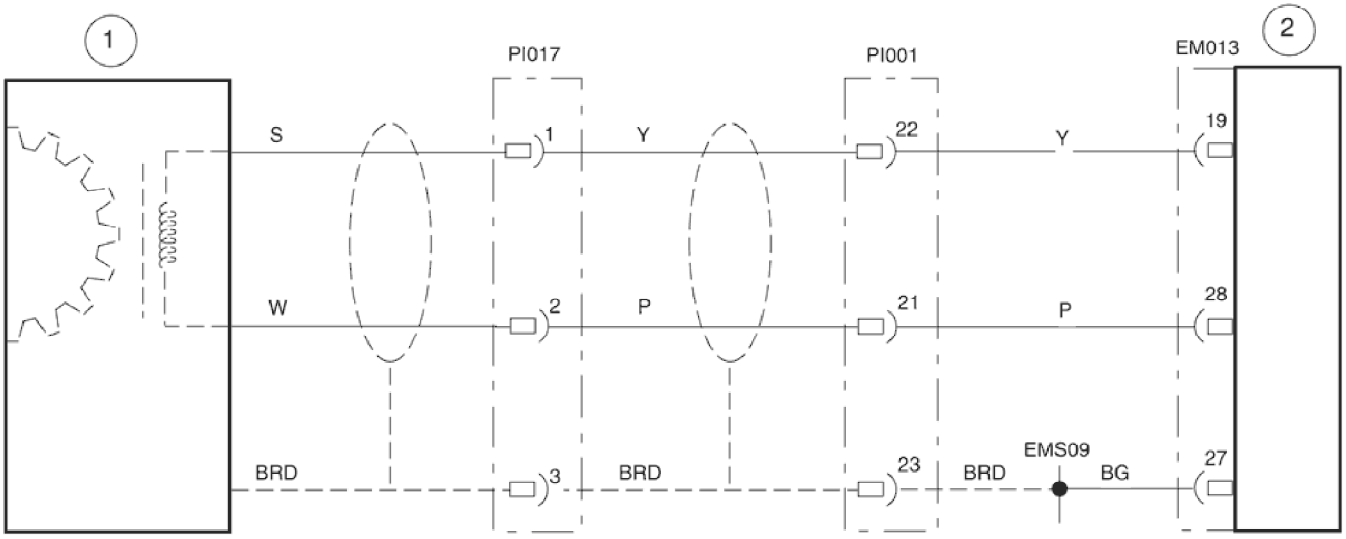
Knock Sensor



E32966

Item	Description
1	Knock sensors, banks 1 and 2
2	Engine control module (ECM)

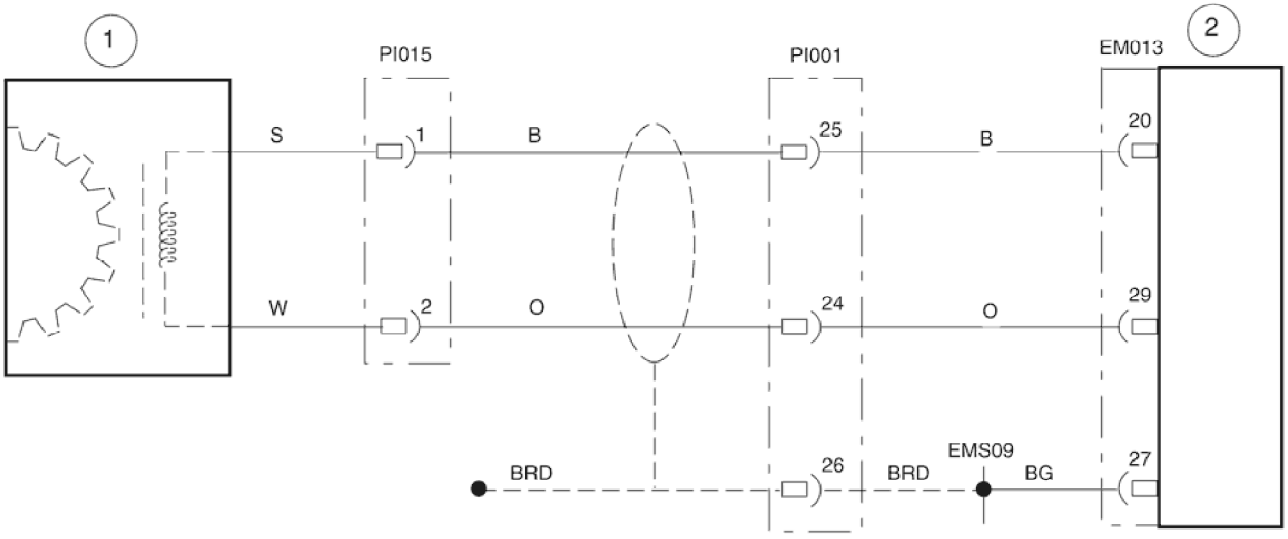
Crankshaft Position sensor



E32968

Item	Description
1	Crankshaft position sensor
2	Engine control module (ECM)

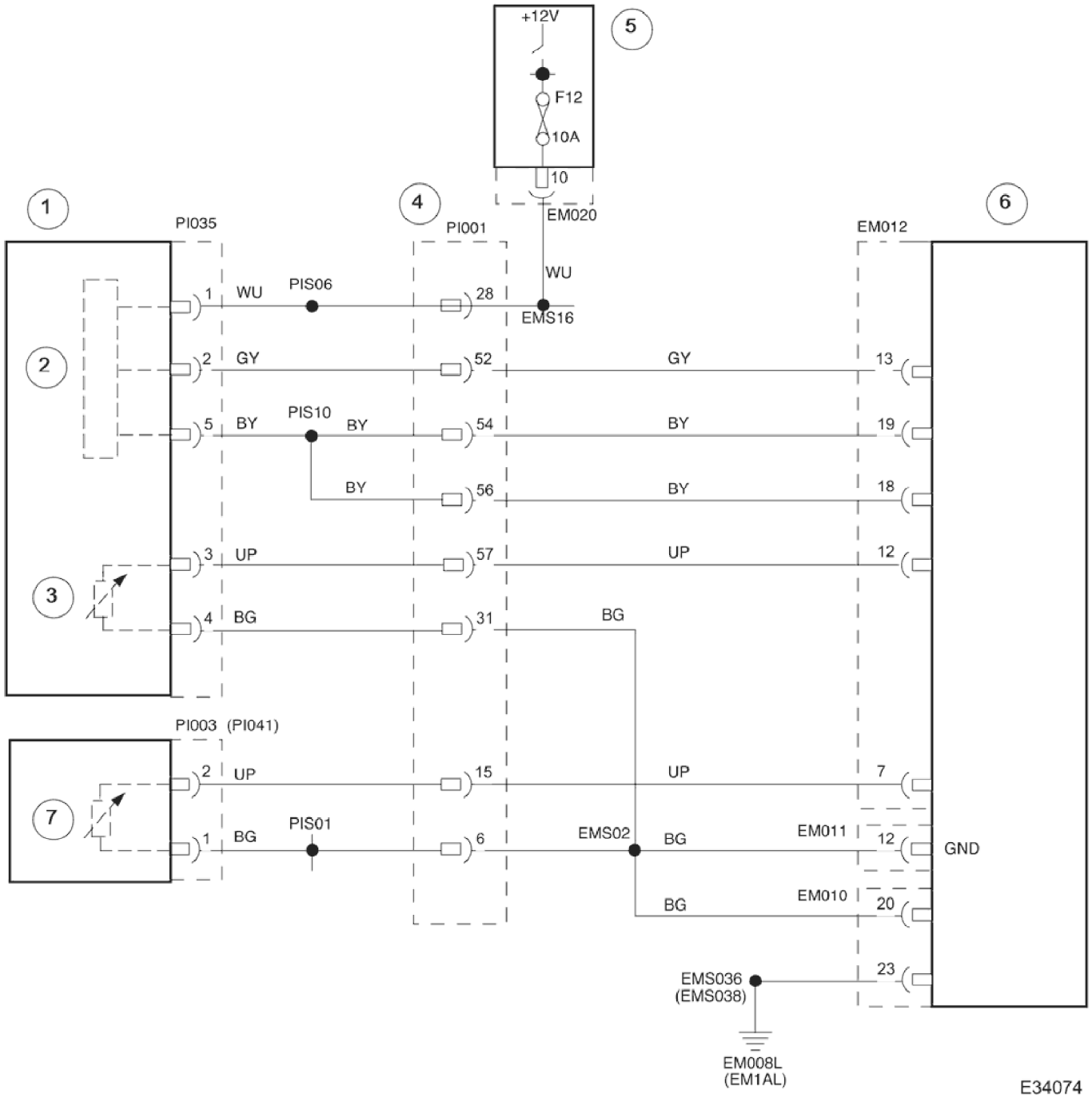
Camshaft Position sensor



E32967

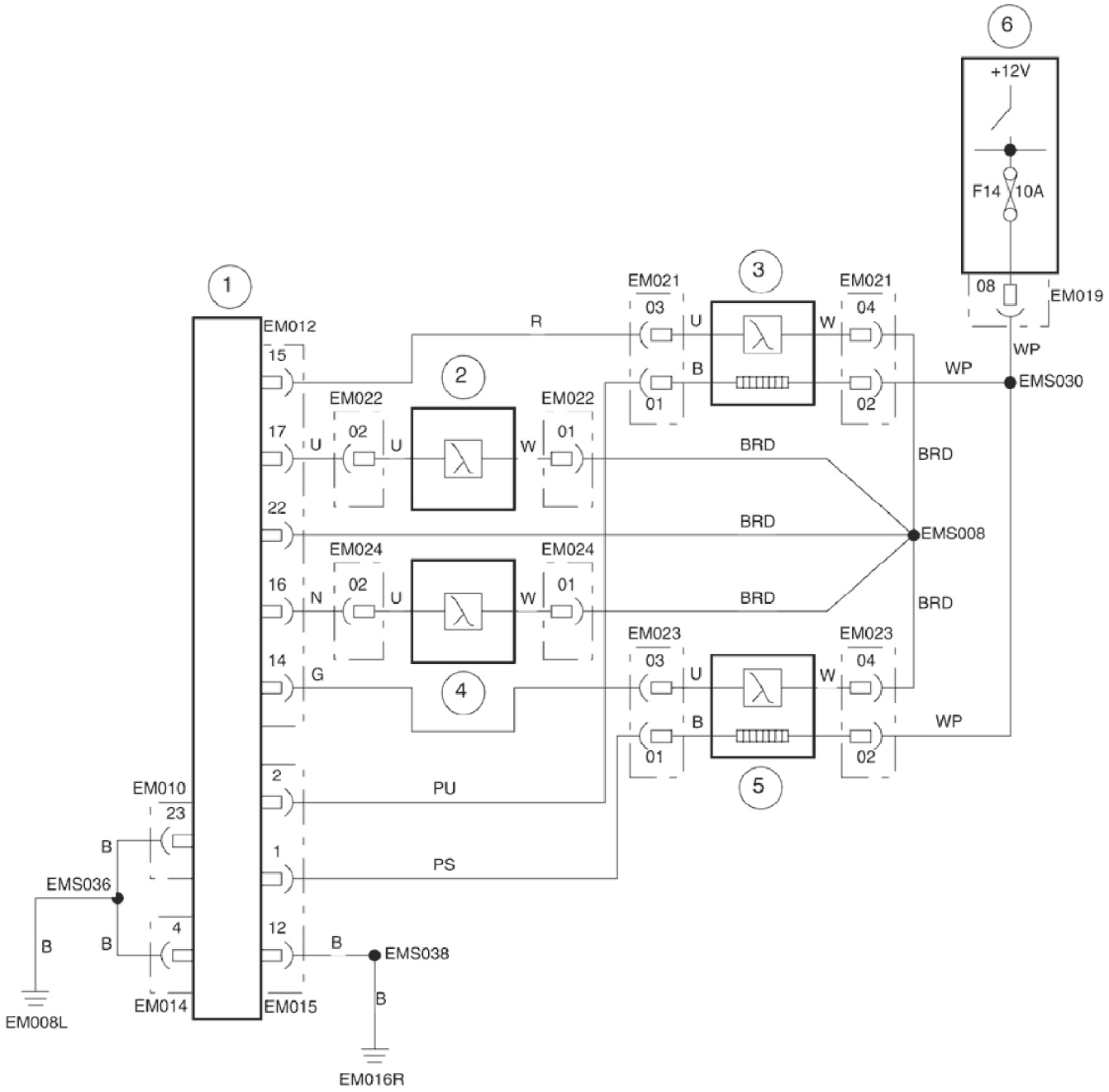
Item	Description
1	Camshaft position sensor
2	Engine control module (ECM)

MAF and IAT Sensors



Item	Description
1	MAF assembly
2	MAF sensor
3	IAT sensor
4	Engine to vehicle harness connector
5	EMS fuse box
6	Engine control module (ECM)
7	Charge air cooler - IAT sensor (supercharged engines only)

Oxygen Sensors


6
+12V
F14 10A
08
EM019
WP
EMS030
1
EM012
15
17
22
16
14
2
12
EM010
23
4
EM014
EM015
EMS036
EMS038
EM008L
EM016R
2
EM022
02
01
U
W
EM024
N
G
3
EM021
03
04
R
B
WP
BRD
EMS008
4
EM023
PU
PS
5
E33917

Item	Description
1	Engine control module (ECM)
2	Downstream oxygen sensor (A)
3	Upstream heated oxygen sensor (A)
4	Downstream oxygen sensor (B)
5	Upstream heated oxygen sensor (B)
6	Engine management fuse box