If the MAF sensor fails the ECM implements a back up strategy, which is based on engine speed. In the event of a MAF sensor signal failure any of the following symptoms may be observed:

- Difficult starting.
- Engine stalls after starting.
- Delayed engine response.
- Emissions control inoperative.
- Idle speed control inoperative.
- Reduced engine performance.

Should the IAT sensor fail the ECM defaults to an assumed air temperature of -5 °C (23 °F).

In the event of an IAT sensor signal failure any of the following symptoms may be observed:

- Over fuelling resulting in black smoke.
- Idle speed control inoperative.

Boost Pressure (BP) Sensor

The BP sensor is located on the front side of the intake manifold and has a three pin connector. It provides a voltage signal relative to intake manifold pressure to the ECM. The BP sensor works on the piezo ceramic crystal principal. Piezo ceramic crystals are pressure sensitive and, in the BP sensor, oscillate at a rate dependent on air pressure. The BP sensor produces a voltage between 0 and 5 volts proportional to the pressure level of the air in the intake manifold. A reading of 0 volts indicates low pressure and a reading of 5 volts indicates high pressure. The ECM uses the signal from the BP sensor for the following functions:

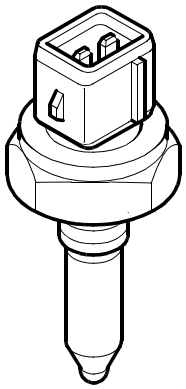
- To maintain manifold boost pressure.
- To reduce exhaust smoke emissions while driving at high altitude.
- Control of the EGR system.
- Control of the vacuum control module

ECM supplies the BP sensor with a 5 volt power supply. The output from the BP sensor is measured at the ECM. The earth path is supplied via the ECM.

In the event of a BP sensor signal failure any of the following symptoms may be observed:

- Altitude compensation inoperative (engine will produce black smoke).
- Active boost control inoperative.
- The ECM assumes a default pressure of 0.9 bar (13 lbf/in^2).

Engine Coolant Temperature (ECT) Sensor



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The ECT sensor is located in the engine block at the front of the engine. It provides the ECM with engine coolant temperature information. The ECM uses this ECT information for the following functions:

- Fuelling calculations.
- Temperature gauge.
- To limit engine operation if coolant temperature is too high.
- Cooling fan operation.
- Glow plug operating time.

The ECM ECT sensor circuit consists of an internal voltage divider circuit incorporating an external negative temperature coefficient thermistor. As temperature rises, the resistance in the thermistor decreases, as temperature decreases, the resistance in the sensor increases. The output of the sensor is the change in voltage as the thermistor allows more current to pass to earth according to the temperature of the coolant. The ECM compares the signal voltage to stored values and compensates fuel delivery to ensure optimum driveability at all times. The engine will require more fuel when it is cold to overcome fuel condensing onto the cold metal surfaces inside the combustion chamber. To achieve a richer air/fuel ratio the ECM extends the injector opening time. As the engine warms up the air/fuel ratio is leaned off.

The inputs and outputs for the ECT are a reference voltage and an earth return circuit, both provided by the ECM. The ECT signal is measured at the ECM.

ECT Sensor Resistance

Temperature, °C (°F)	Resistance, kΩ
-30 (-22)	4.916
-20 (-4)	4.853
-10 (14)	4.745
0 (32)	4.584
10 (50)	4.354
20 (68)	4.046
30 (86)	3.660
40 (104)	3.220
50 (122)	2.751
60 (140)	2.267
70 (158)	1.862
80 (176)	1.490
90 (194)	1.182
100 (212)	0.938
110 (230)	0.738
120 (248)	0.581
130 (266)	0.464

In the event of an ECT sensor signal failure any of the following symptoms may be observed:

- Difficult cold start.
- Difficult hot start.
- Driveability concerns.
- Temperature gauge reading does not accurately represent the coolant temperature.

In the event of ECT signal failure the ECM applies a default value of 80 °C (176 °F) coolant temperature for fuelling purposes. The ECM will also run the cooling fan when the ignition is switched on to protect the engine from overheating.