Section 6C1-2 Engine Management – V6 Diagnostics

ATTENTION

Before performing any Service Operation or other procedure described in this Section, refer to Section 00 Warnings, Cautions and Notes for correct workshop practices with regard to safety and/or property damage.

1 General Information

1.1 Diagnostic System Check

The engine management diagnostic procedure is organised in a logical structure that begins with the Diagnostic System Check. The Diagnostic System Check directs the diagnostic procedure to the logical steps necessary to diagnose an engine driveability fault condition.

1.2 Diagnostic Trouble Code Tables

The Diagnostic System Check directs the diagnostic procedure to the appropriate diagnostic trouble code (DTC) tables if there is a DTC currently stored in the engine control module (ECM).

The diagnostic tables locate a faulty circuit or component through a logic based on the process of elimination. These diagnostic tables are developed with the following assumptions:

- the vehicle functioned correctly at the time of assembly,
- there are no multiple faults, and
- the problem currently exists.

Understanding and the correct use of the diagnostic trouble code (DTC) tables are essential to reduce diagnostic time and to prevent misdiagnosis.

Multiple DTC Fault Conditions

Some fault conditions trigger multiple component DTCs even if the fault condition exists only on a single component. If there are multiple DTCs stored in the ECM, the service technician must view and record all DTCs logged.

The relationship between the logged DTCs can then be analysed to determine the source of the fault condition. Always begin the diagnostic process with the DTC table of the fault condition that may trigger other DTCs to set.

The following fault conditions may trigger multiple DTCs:

- a fault in the serial data communication circuit,
- a system voltage that is too low may cause incorrect engine management system operation or engine management component malfunction,
- a system voltage that is too high may damage the ECM and / or other engine management components,
- fault condition in the ECM read only memory (ROM) or random access memory (RAM),
- fault condition in the ECM internal circuitry or programming,
- improperly connected sensor or component wiring connector, or
- an electrical fault condition in the following shared ECM electrical circuits trigger DTCs on components or sensors that share in the faulty shared circuit. Test the electrical circuit of the appropriate sensors or components to isolate the fault condition. Refer to 2 Wiring Diagrams and Connector Charts.
  - 5 V Reference Circuit,
  - Low Reference Circuit, or
  - Ignition Control Voltage Circuit.

If there are no obvious faults to begin a multiple DTC fault condition diagnostic procedure, diagnose the DTCs in the following order unless directed otherwise:

1. Always start with the lowest numbered component level DTCs such as:
   - sensor DTCs,
   - solenoid DTCs, or
   - relay DTCs.
2. Then follow with system level DTCs such as:
   - misfire DTCs,
   - fuel trim DTCs, or
   - catalyst DTCs.

1.3 Symptoms Diagnostics

The Diagnostic System Check directs the service technician to the symptoms diagnostics if the following conditions exist:

- a vehicle driveability fault condition exists,
- there is no current diagnostic trouble code presently stored in the ECM, and
- all Tech 2 engine data parameters are within normal operating range.

1.4 Diagnostic Trouble Codes

The ECM constantly performs self-diagnostic tests on the engine management system. When the ECM detects a fault condition in the engine operating parameters, the ECM sets a diagnostic trouble code (DTC) to represent that fault condition. The following are the types of DTCs programmed in the ECM. In addition, DTCs are classified as either a current or history DTC.

- Type A – emission related DTCs,
- Type B – emission related DTCs, and
- Type C – non-emission related DTCs.

NOTE

Depending on the type of DTC set, the ECM may command the ‘Check Powertrain’ icon (MY2005 vehicles) or, for MY2006 vehicles, the Malfunction Indicator Lamp (MIL) to activate and warn the driver there is a fault in the engine management system. Refer to Section 12C Instrumentation for further information on the Check Engine warning display.

Type A – Emission Related DTCs

The ECM takes the following action when a Type A DTC runs and fails:

- sets a current Type A DTC that represents the fault condition,
- illuminates the instrument cluster Multi-Function Display (MFD) Check Powertrain icon, or the Malfunction Indicator Lamp (MIL), and
- records the operating condition at the time the diagnostic fails and stores this information in the freeze frame / failure record.

Type B – Emission Related DTCs

The ECM takes the following action when a Type B DTC runs and fails:

- On the first time a Type B DTC fails, the ECM takes the following actions:
  - sets a current Type B DTC that represents the fault condition, and
  - records the operating conditions at the time the fault sets and stores this information in the failure records.
- On the second consecutive ignition cycle that a Type B DTC fails, the ECM takes the following actions:
  - activates the instrument cluster Multi-Function Display (MFD) Check Powertrain icon, or the Malfunction Indicator Lamp (MIL), and
  - records the operating condition at the time the diagnostic fails and stores this information in the freeze frame / failure record.

Conditions for Clearing Type A or Type B DTCs

- The current DTC clears when there is no fault condition in the current ECM self-diagnostics.
- If there are no DTCs logged after three or four consecutive ignition cycles, the ECM deactivates the Check Powertrain icon, or the Malfunction Indicator Lamp (MIL).
- Type A or Type B History DTC clears when there is no fault condition after 40 consecutive warm-up cycles.
- Use Tech 2 to clear DTC/s.

Type C – Non-Emission Related DTCs

The ECM takes the following action when a Type A DTC runs and fails:

- sets a current Type C DTC that represents the fault condition,
- records the operating conditions at the time the DTC is logged and stores this information in the Failure Record, and:
- the instrument cluster MFD may display a message.

NOTE

The instrument cluster Check Powertrain icon, or the malfunction indicator lamp (MIL) is not activated when a Type C DTC sets.

Conditions for Clearing Type C DTCs

- The current DTC clears when there is no fault condition in the current ECM self-diagnostics.
- Type C History DTC clears when there is no fault condition after 40 consecutive warm-up cycles.
- Use Tech 2 to clear DTCs.

Current DTCs

A DTC is a Current DTC if the fault condition that triggers that DTC is present during the last ECM self-diagnostics.

History DTCs

A DTC is a History DTC if the fault condition that triggers that DTC is not present during the last ECM self-diagnostics.

2 Wiring Diagrams and Connector Charts

2.1 Wiring Diagrams

Serial Data and Data Link Connector

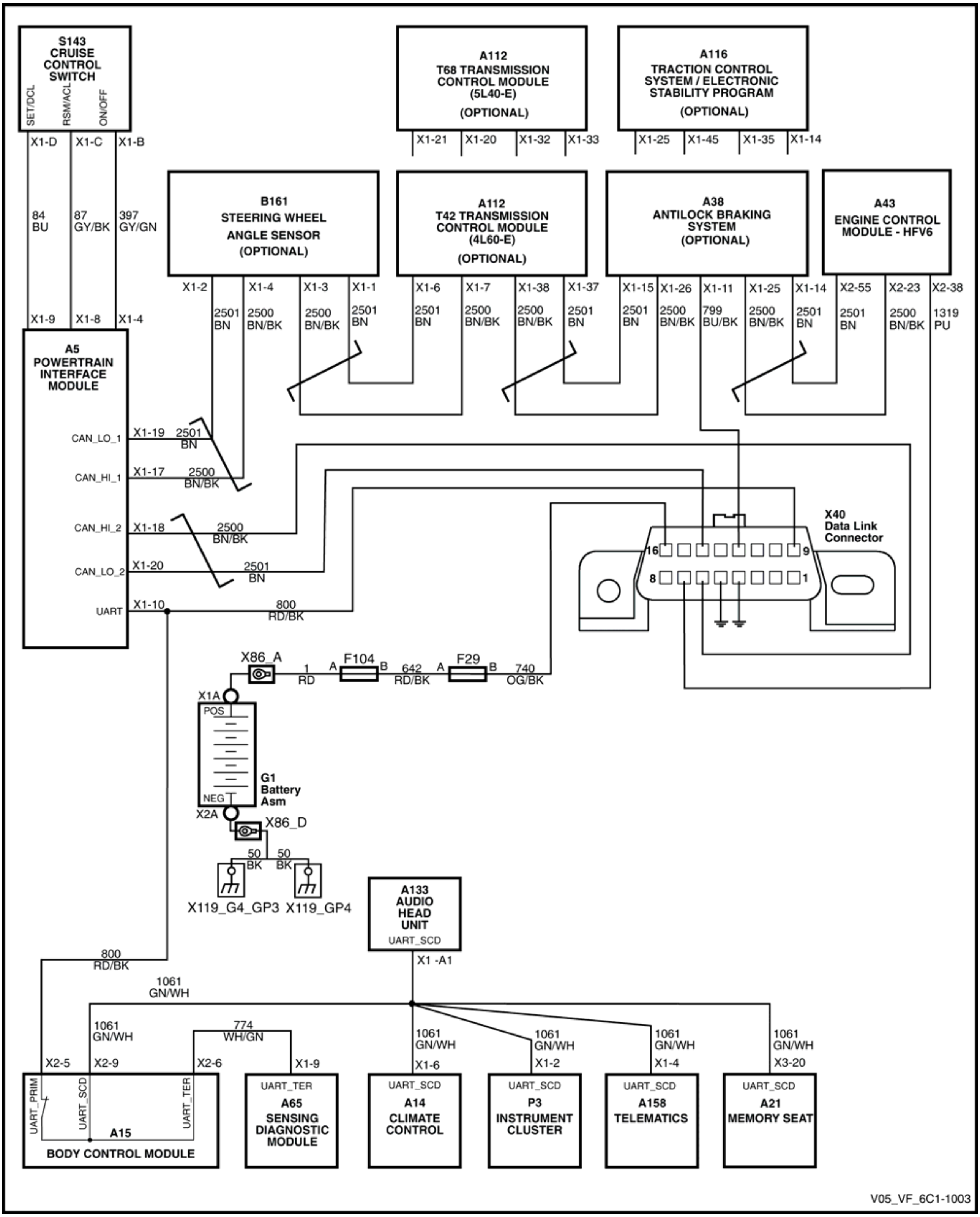


Figure 6C1-2 – 1

Power Supplies and ECM Inputs

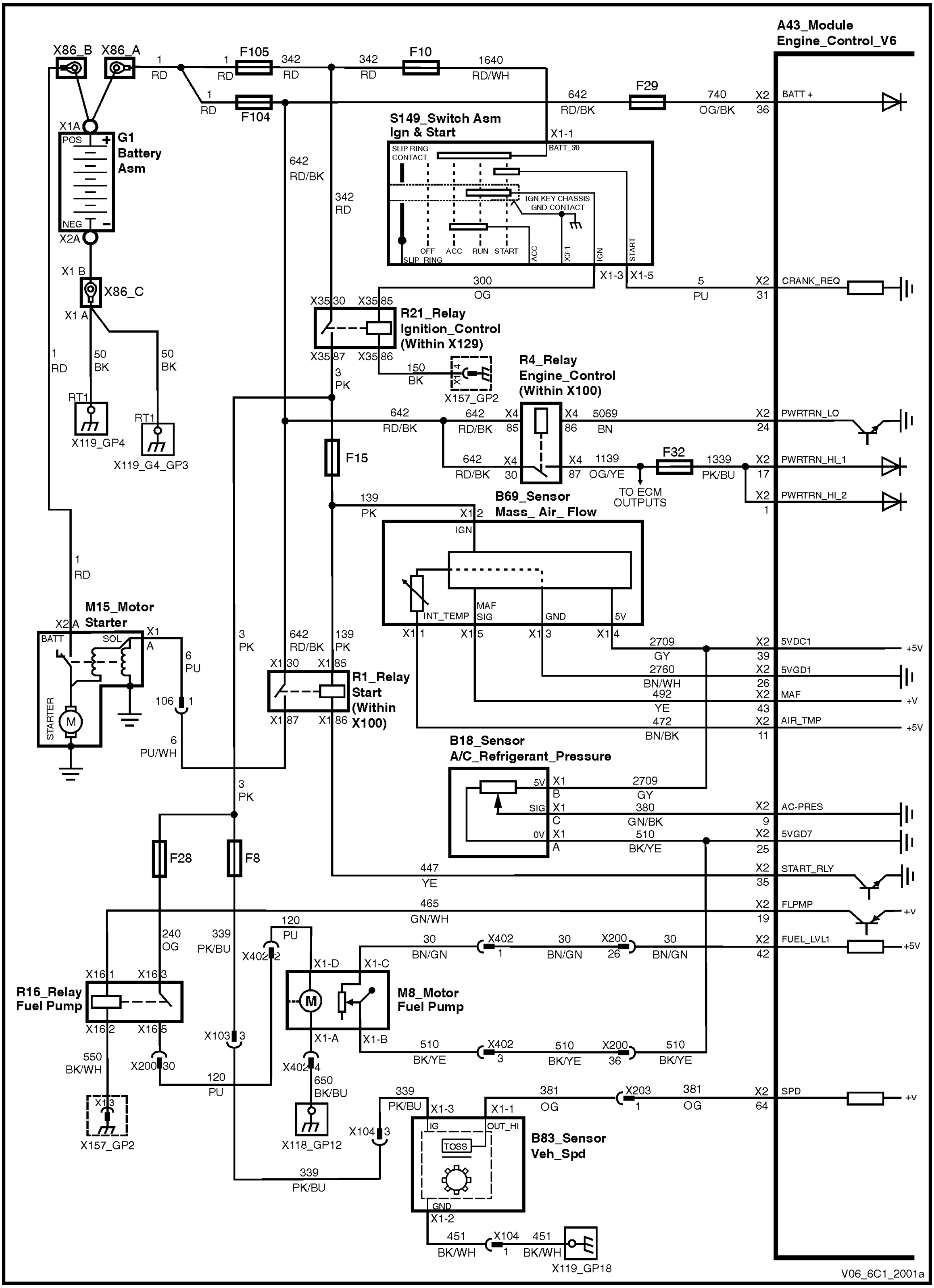


Figure 6C1-2 – 2

Cooling Fans, A/C Clutch & Generator

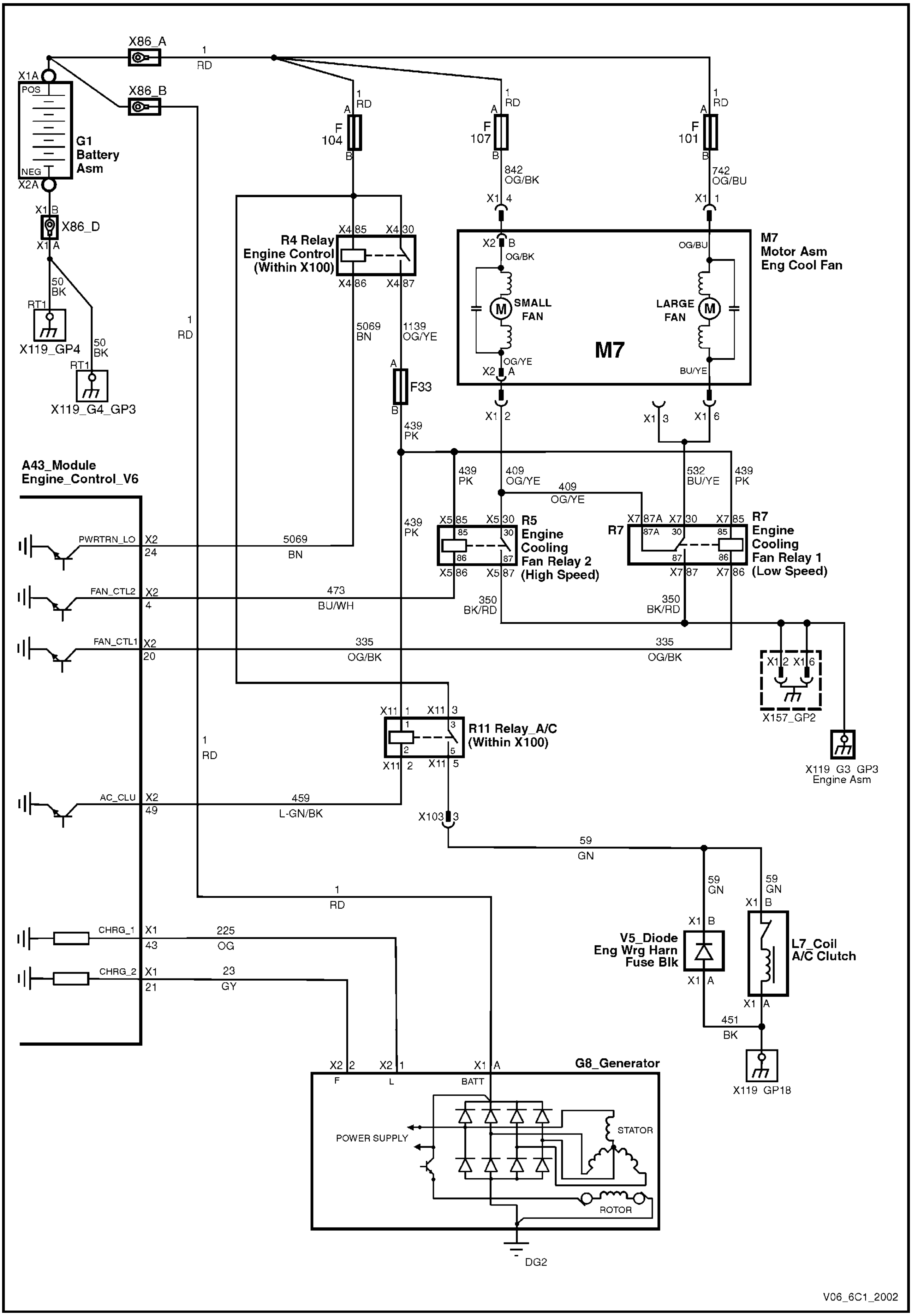


Figure 6C1-2 – 3

Sensors

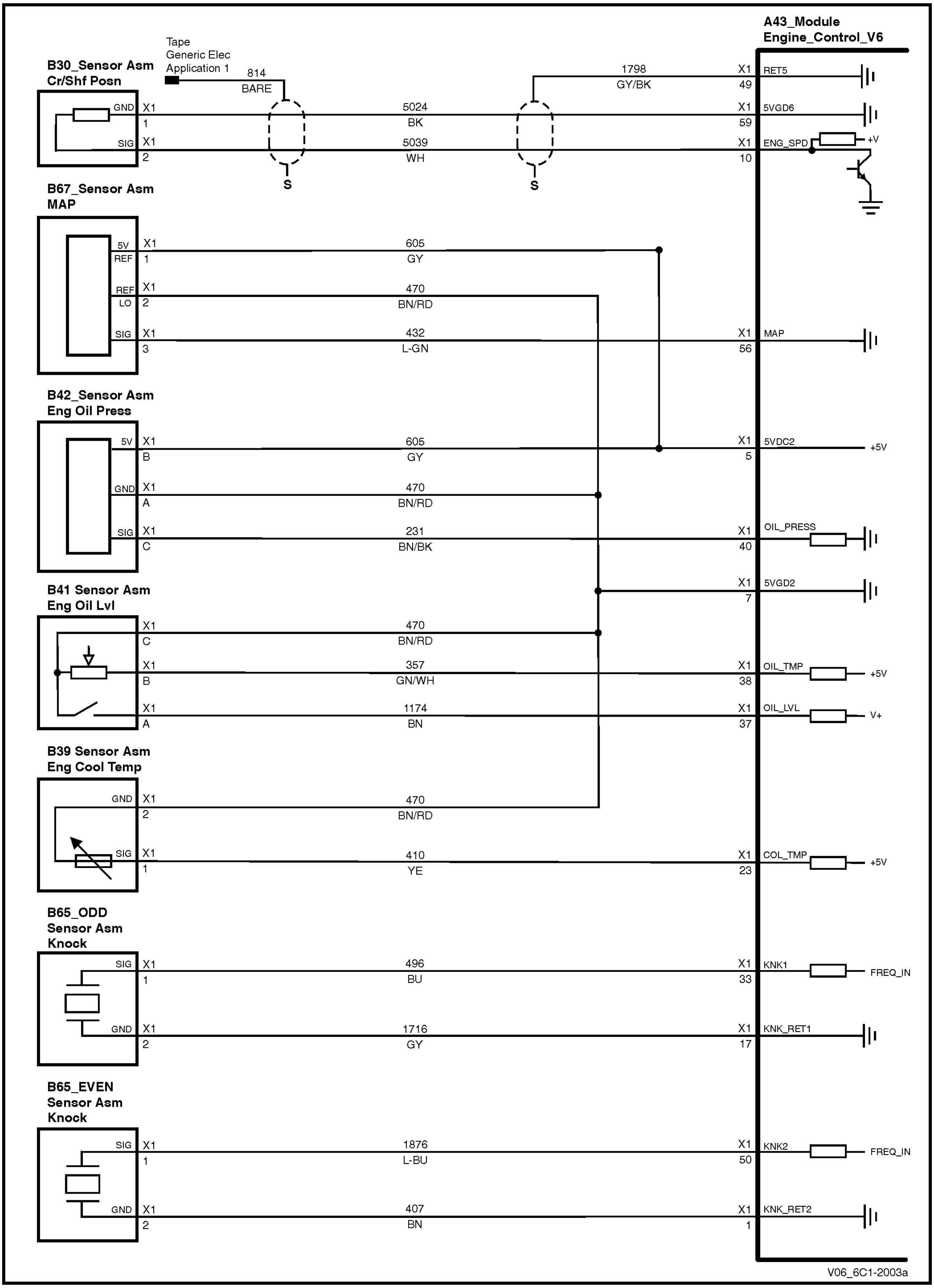


Figure 6C1-2 – 4

Switches & Throttle Control

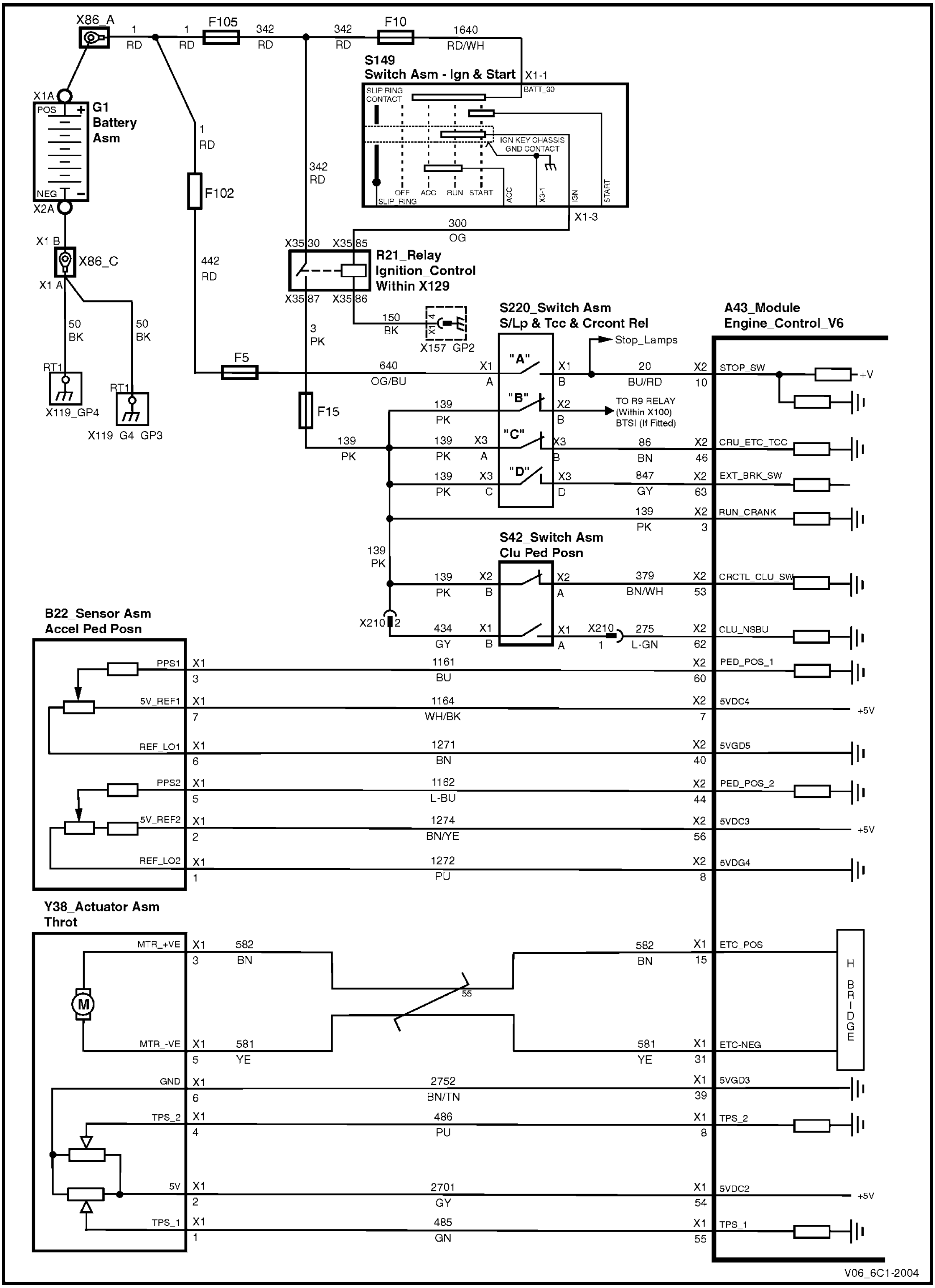


Figure 6C1-2 – 5

Camshaft Control – Alloytec 190 / High Output Engine

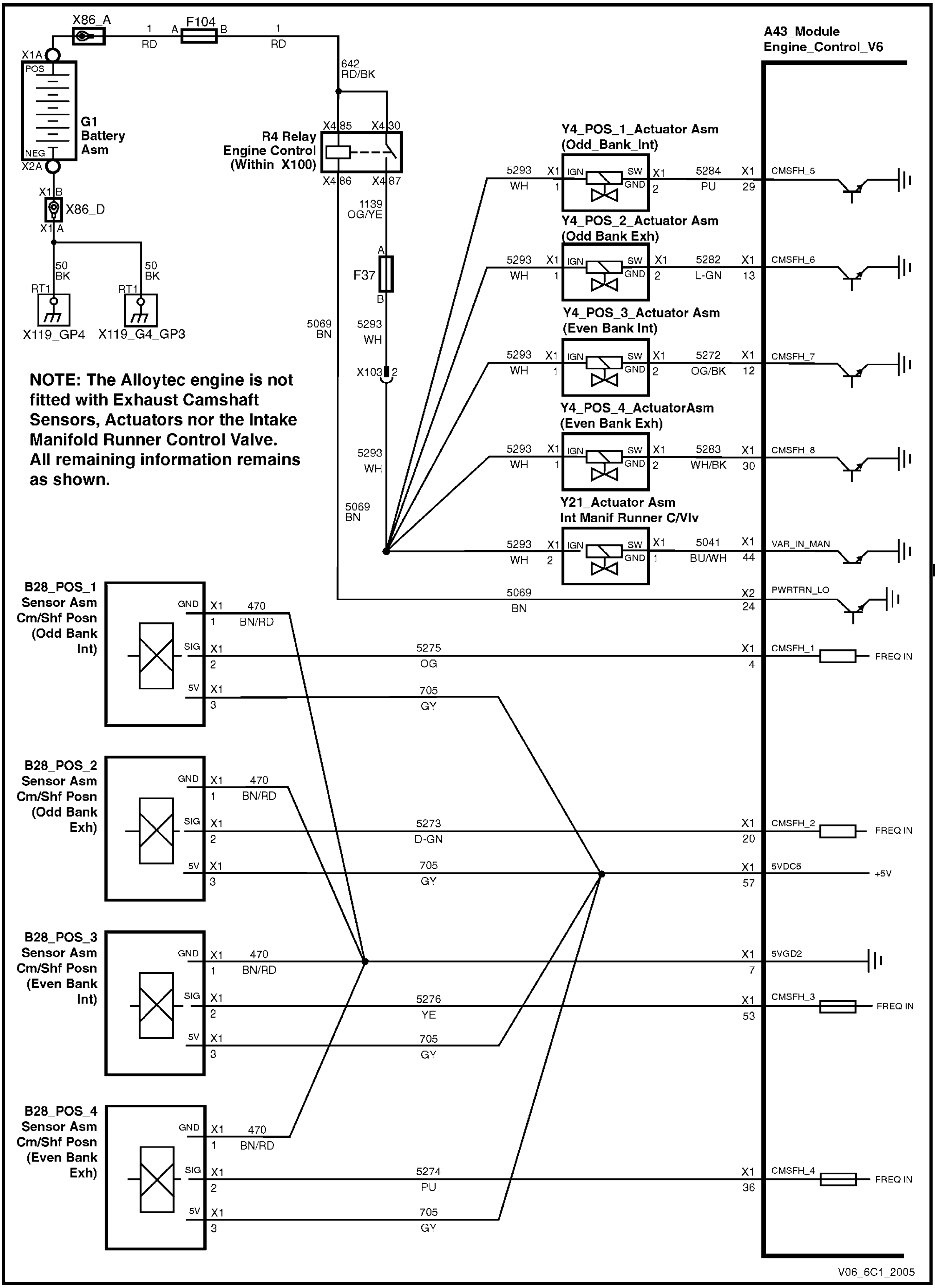


Figure 6C1-2 – 6

HO2S – All Alloytec Engines

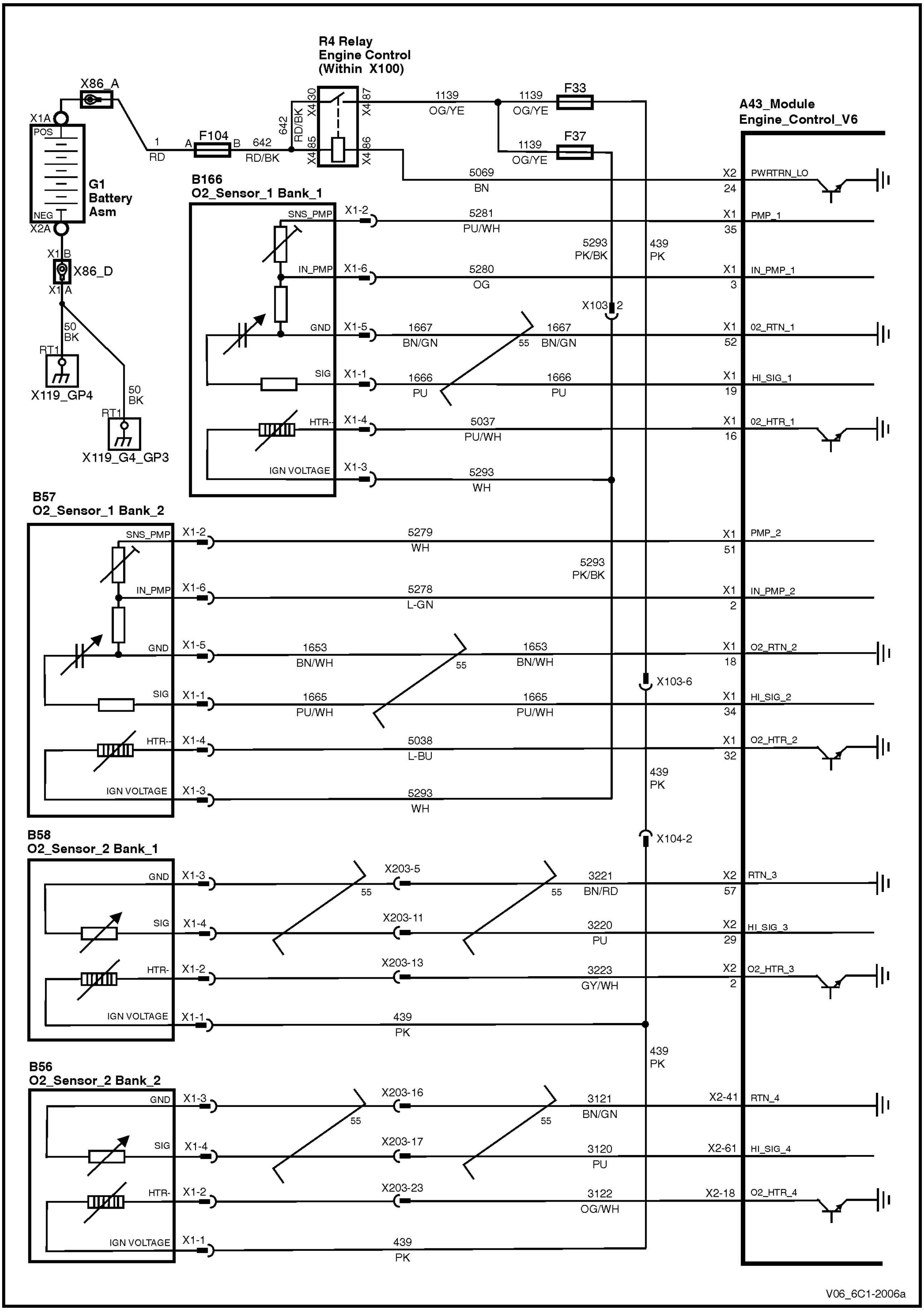


Figure 6C1-2 – 7

Fuel Injectors and EVAP Purge Solenoid

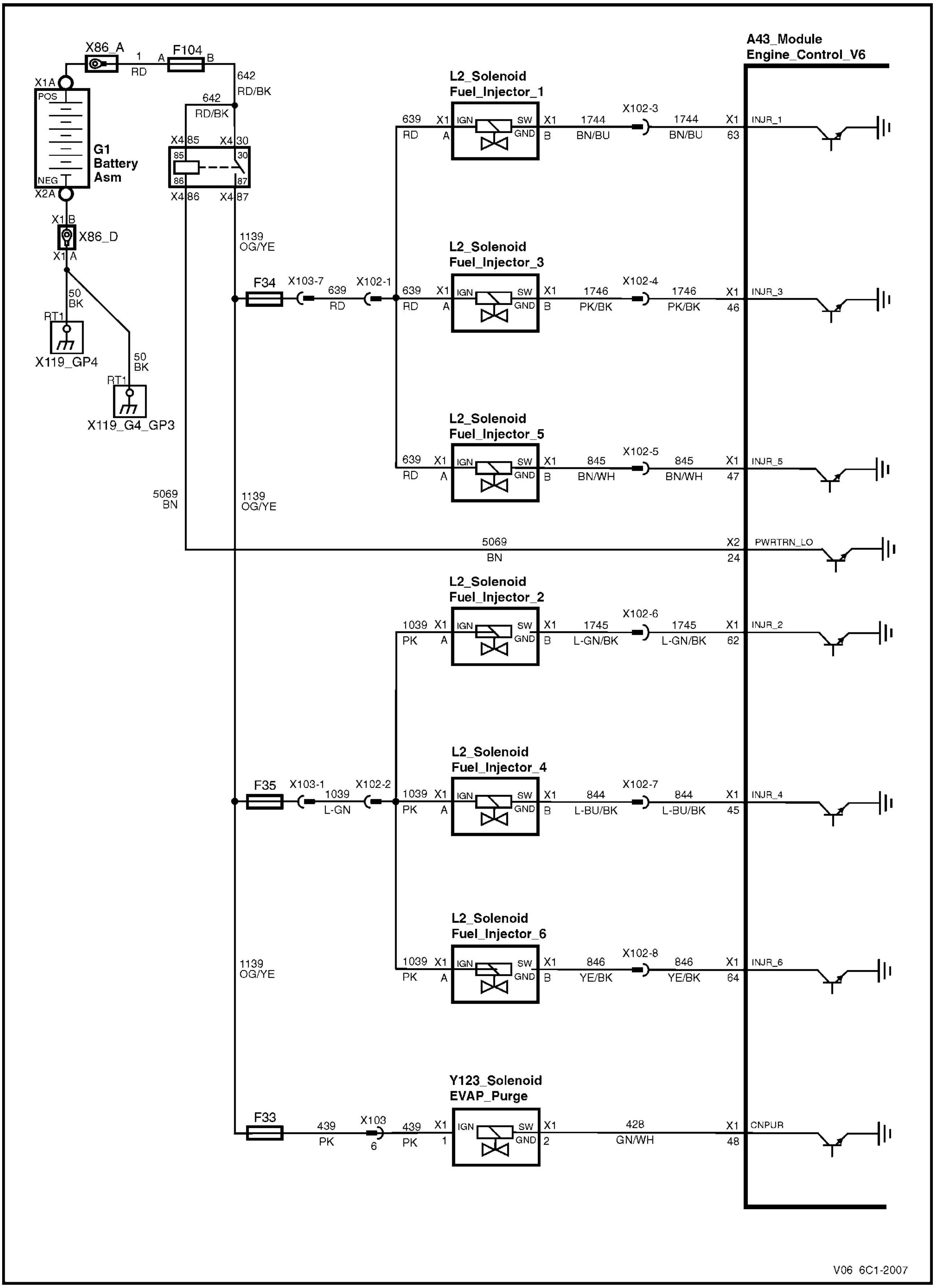


Figure 6C1-2 – 8

Ignition System

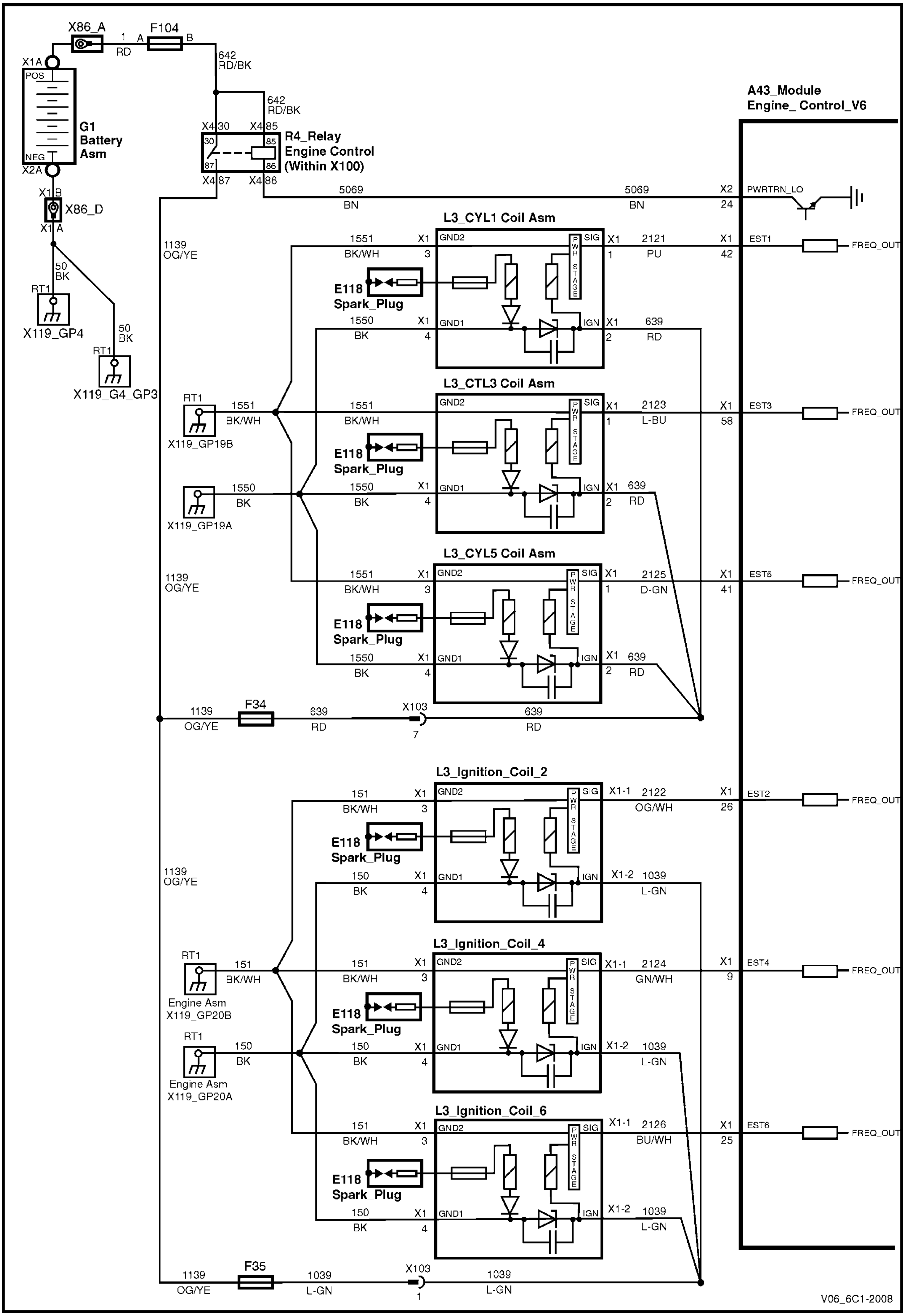


Figure 6C1-2 – 9

2.2 ECM Connector End Views

Engine Control Module A43 V6 – Connector X1

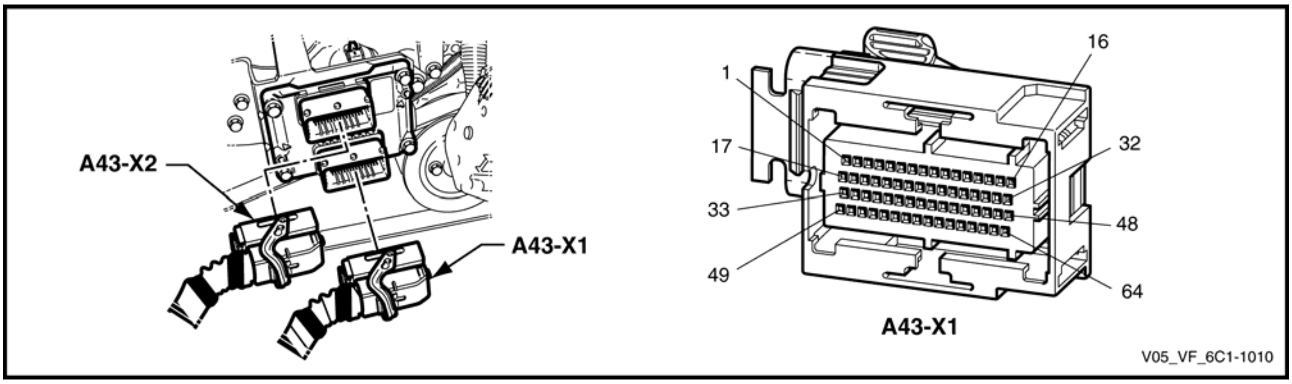


Figure 6C1-2 – 10

Terminal / Pin	Wire Colour	Circuit No.	Function
X1–1	BN	407	Low Reference – Knock Sensor Bank 2
X1–2	L-GN	5278	B2S1 HO2S Input Pump Current (Bank 2 Sensor 1)
X1–3	OG	5280	B1S1 HO2S Input Pump Current (Bank 1 Sensor 1)
X1–4	OG	5275	CMP Sensor Signal – Intake Bank 1
X1–5	GY	605	5 Volt Reference – 6
X1–6	—	—	Not Used
X1–7	BN/RD	470	Low Reference – Ground 2
X1–8	PU	486	TP Sensor 2 Signal
X1–9	GN/WH	2124	EST 4 Control
X1–10	WH	5039	CKP Sensor High
X1–11	—	—	Not Used
X1–12	OG/BK	5272	CMP Actuator Solenoid Control – Intake Bank 2
X1–13	L-GN	5282	CMP Actuator Solenoid Control – Exhaust Bank 1
X1–14	—	—	Not Used
X1–15	BN	582	TAC Motor Control (Positive)
X1–16	PU/WH	5037	B1S1 HO2S Heater Low Reference (Bank 1 Sensor 1)
X1–17	GY	1716	Low Reference – Knock Sensor Bank 1
X1–18	BN/WH	1653	B2S1 HO2S Low Signal (Bank 2 Sensor 1)
X1–19	PU	1666	B1S1 HO2S High Signal (Bank 1 Sensor 1)
X1–20	D-GN	5273	CMP Sensor Signal – Exhaust Bank 1
X1–21	GY	23	Generator Field Duty Cycle Signal (‘F’ Terminal)
X1–22	—	—	Not Used
X1–23	YE	410	ECT Sensor Signal
X1–24	—	—	Not Used
X1–25	BU/WH	2126	EST 6 Control
X1–26	OG/WH	2122	EST 2 Control
X1–27	—	—	Not Used

X1–28	—	—	Not Used
X1–29	PU	5284	CMP Actuator Solenoid Control – Intake Bank 1
X1–30	WH/BK	5283	CMP Actuator Solenoid Control – Exhaust Bank 2
X1–31	YE	581	TAC Motor Control (Negative)
X1–32	L-BU	5038	B2S1 HO2S Heater Low Control (Bank 2 Sensor 1)
X1–33	BU	496	Knock Sensor 1 Signal (Bank 1)
X1–34	PU/WH	1665	B2S1 HO2S High Signal (Bank 2 Sensor 1)
X1–35	PU/WH	5281	B1S1 HO2S Pump Current (Bank 1 Sensor 1)
X1–36	PU	5274	CMP Sensor Signal – Exhaust Bank 2
X1–37	BN	1174	Oil Level Switch Signal
X1–38	GN/WH	357	Oil Temperature Sensor Signal
X1–39	BN/TN	2752	Low Reference – Ground 3
X1–40	BN/BK	231	Oil Pressure Sensor Signal
X1–41	D-GN	2125	EST 5 Control
X1–42	PU	2121	EST 1 Control
X1–43	OG	225	Generator Turn On Signal (‘L’ Terminal)
X1–44	BU/WH	5041	IMRC Solenoid Control
X1–45	L-BU/BK	844	Fuel Injector 4 Control
X1–46	PK/BK	1746	Fuel Injector 3 Control
X1–47	BN/WH	845	Fuel Injector 5 Control
X1–48	GN/WH	428	EVAP Canister Purge Solenoid Control
X1–49	GY/BK	1798	CKP Sensor Shield Return
X1–50	L-BU	1876	Knock Sensor 2 Signal (Bank 2)
X1–51	WH	5279	B2S1 HO2S Pump Current (Bank 2 Sensor 1)
X1–52	BN/GN	1667	B1S1 HO2S Low Signal (Bank 1 Sensor 1)
X1–53	YE	5276	CMP Sensor Signal – Intake Bank 2
X1–54	GY	2701	5 Volt Reference – 2
X1–55	GN	485	TP Sensor 1 Signal
X1–56	L-GN	432	MAP Sensor Signal
X1–57	GY	705	5 Volt Reference – 5
X1–58	L-BU	2123	EST 3 Control
X1–59	BK	5024	CKP Sensor Low – Ground 6
X1–60	—	—	Not Used
X1–61	—	—	Not Used
X1–62	L-GN/BK	1745	Fuel Injector 2 Control
X1–63	BN/BU	1744	Fuel Injector 1 Control
X1–64	YE/BK	846	Fuel Injector 6 Control

Engine Control Module A43 V6 – Connector X2

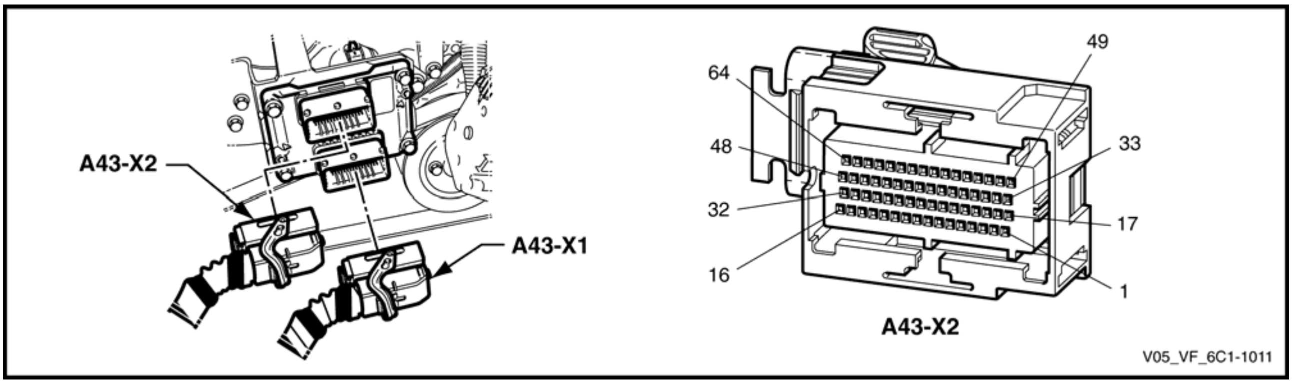


Figure 6C1-2 – 11

Terminal / Pin	Wire Colour	Circuit No.	Function
X2–1	PK/BU	1339	Ignition Voltage 1
X2–2	GY/WH	3223	B1S2 O2 Sensor Heater Control (Bank 1 Sensor 2)
X2–3	PK	139	Ignition Voltage 1
X2–4	BU/WH	473	High Speed Cooling Fan Relay Control
X2–5	BN/RD	121	Engine Speed Signal
X2–6	—	—	Not Used
X2–7	WH/BK	1164	5 Volt Reference 4
X2–8	PU	1272	Low Reference Ground 4
X2–9	GN/BK	380	A/C Refrigerant Pressure Sensor Signal
X2–10	BU/RD	20	Stop Lamp Switch Signal
X2–11	BN/BK	472	IAT Sensor Signal
X2–12	—	—	Not Used
X2–13	—	—	Not Used
X2–14	—	—	Not Used
X2–15	—	—	Not Used
X2–16	—	—	Not Used
X2–17	PK/BU	1339	Ignition Voltage 1
X2–18	OG/WH	3122	B2S2 O2 Sensor Heater Control (Bank 2 Sensor 2)
X2–19	GN/WH	465	Fuel Pump Relay Control
X2–20	OG/BK	335	Low Speed Cooling Fan Control
X2–21	—	—	Not Used
X2–22	PU/WH	5197	Vehicle Speed (from Instrument)
X2–23	BN/BK	2500	GMLAN Serial Data Bus – High
X2–24	BN	5069	Engine Control Relay Control
X2–25	BK/YE	510	Low Reference – Ground 7
X2–26	BN/WH	2760	Low Reference – Ground 1
X2–27	—	—	Not Used
X2–28	—	—	Not Used

X2–29	PU	3220	B1S2 O2 Sensor High Signal (Bank 1 Sensor 2)
X2–30	—	—	Not Used
X2–31	PU	5	Crank Voltage
X2–32	OG/BK	1786	Park/Neutral Switch Signal
X2–33	—	—	Not Used
X2–34	—	—	Not Used
X2–35	YE	447	Starter Relay Coil Control
X2–36	OG/BK	740	Battery Positive Voltage
X2–37	—	—	Not Used
X2–38	PU	1319	Data Link Connector (DLC) Serial Data
X2–39	GY	2709	5 Volt Reference 1
X2–40	BN	1271	Low Reference – Ground 5
X2–41	BN/GN	3121	B2S2 O2 Sensor Low Signal (Bank 2 Sensor 2)
X2–42	BN/GN	30	Fuel Level Sensor Signal
X2–43	YE	492	MAF Sensor Signal
X2–44	L-BU	1162	APP Sensor 2 Signal
X2–45	—	—	Not Used
X2–46	BN	86	Brake Switch (S220 – ‘C’) Cruise Cancel Signal
X2–47	—	—	Not Used
X2–48	—	—	Not Used
X2–49	L-GN/BK	459	A/C Compressor Clutch Relay Control
X2–50	—	—	Not Used
X2–51	—	—	Not Used
X2–52	—	—	Not Used
X2–53	BN/WH	379	Clutch Switch (S42) Cruise Cancel Signal
X2–54	—	—	Not Used
X2–55	BN	2501	GMLAN Serial Data Bus – Low
X2–56	BN/YE	1274	5 Volt Reference 3
X2–57	BN/RD	3221	B1S2 O2 Sensor Low Signal (Bank 1 Sensor 2)
X2–58	BN/WH	4	Accessory Voltage
X2–59	—	—	Not Used
X2–60	BU	1161	APP Sensor 1 Signal
X2–61	PU	3120	B2S2 O2 Sensor High Signal (Bank 2 Sensor 2)
X2–62	L-GN	275	Clutch Switch (S42) Clutch Disengaged Signal
X2–63	GY	847	Extended Travel Brake Switch Signal
X2–64	OG	381	Vehicle Speed Sensor Signal

2.3 Connector End Views

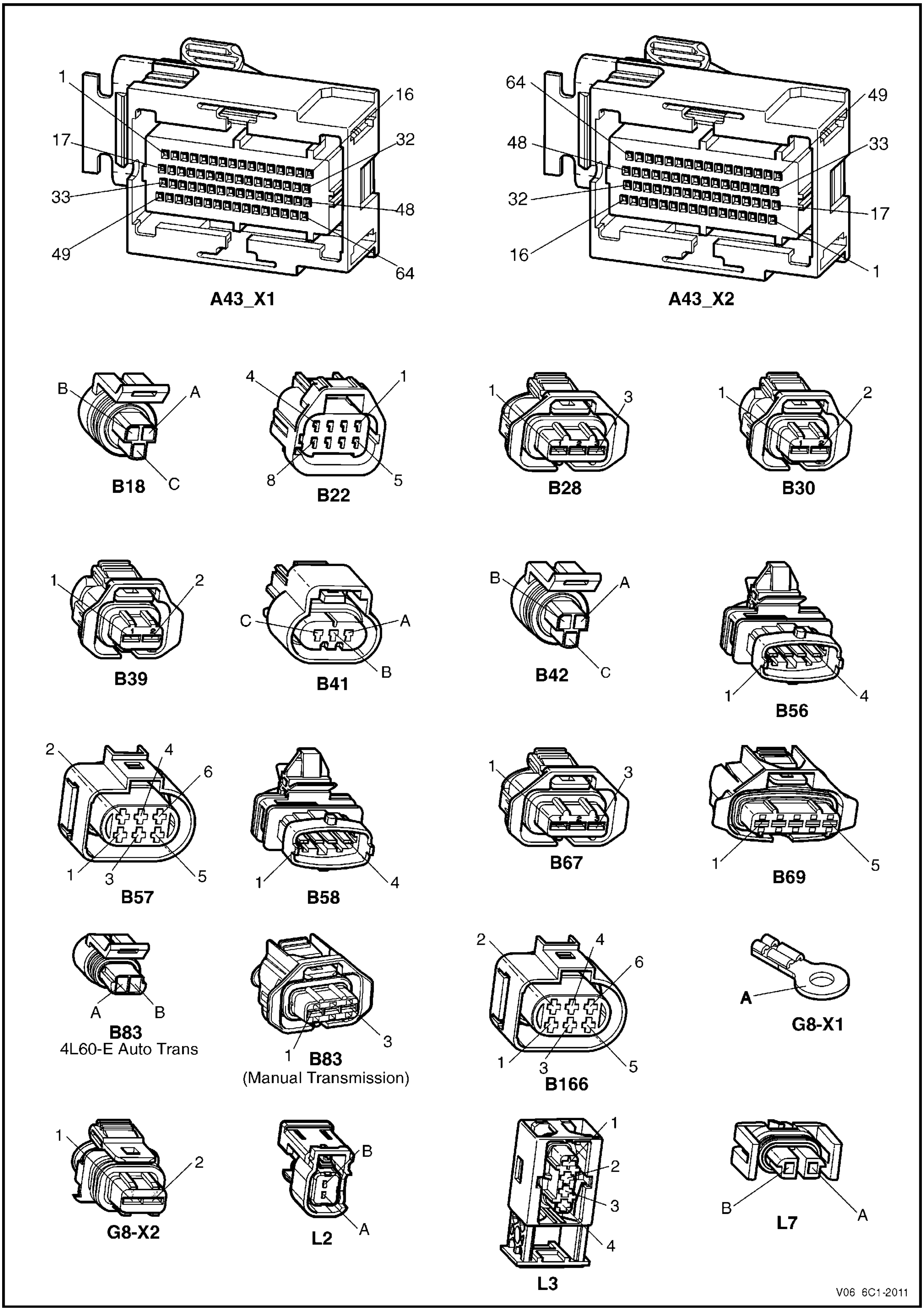


Figure 6C1-2 – 12

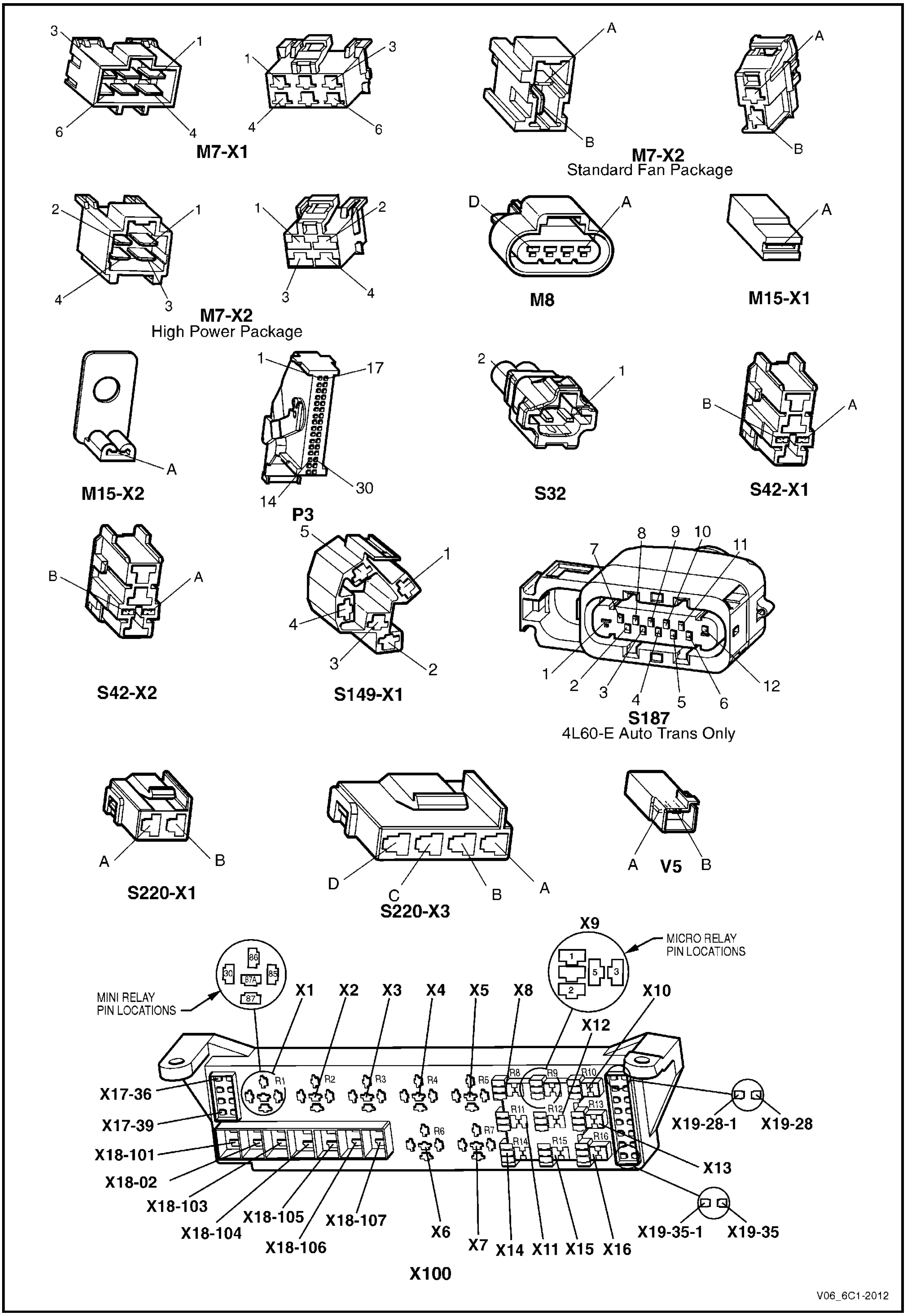
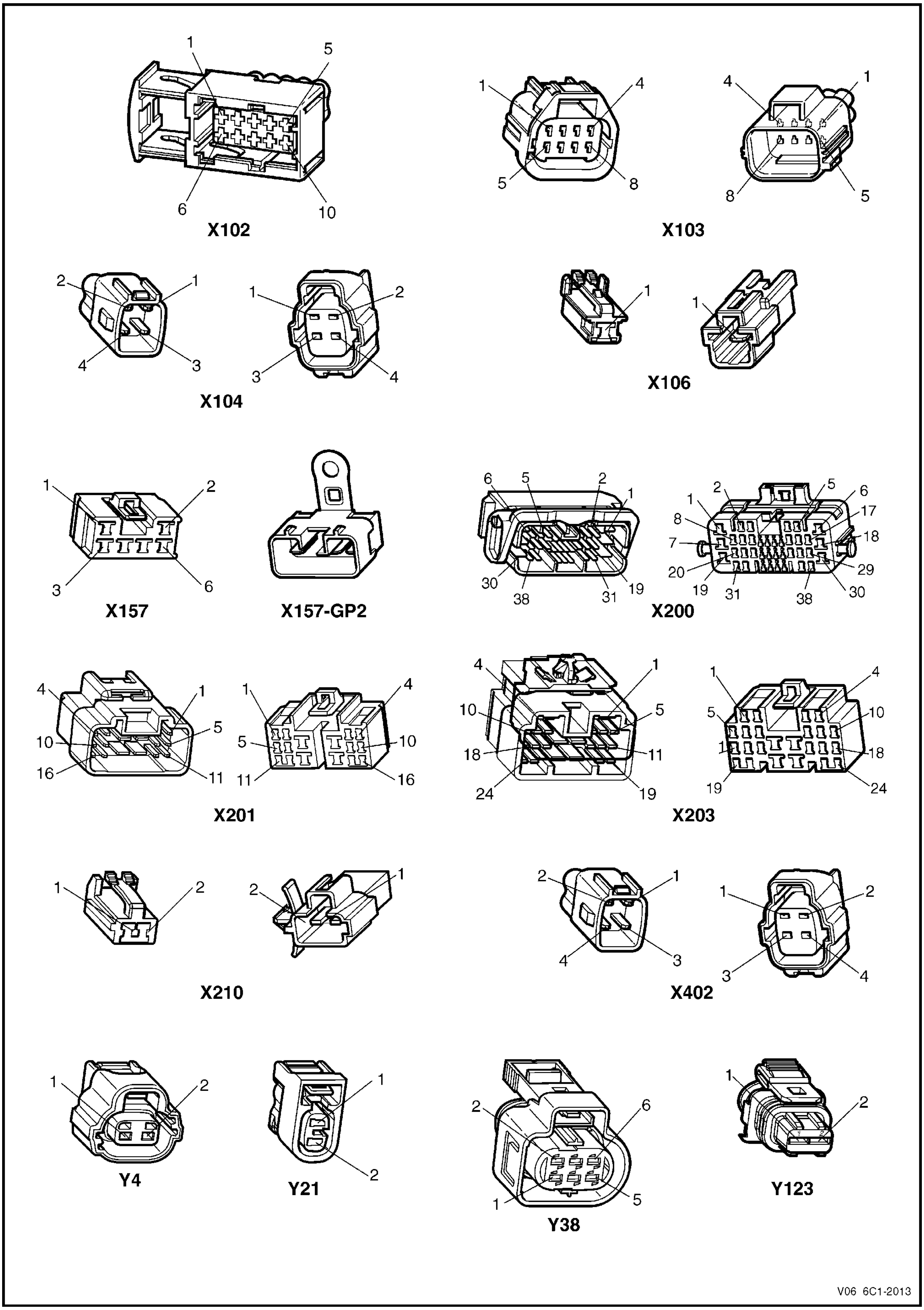


Figure 6C1-2 – 13


X102
X103
X104
X106
X157
X157-GP2
X200
X201
X203
X210
X402
Y4
Y21
Y38
Y123
V06 6C1-2013

3 Diagnostics Starting Point

3.1 Basic Requirements

Basic Knowledge Required

CAUTION

A lack of basic understanding regarding electronics, electrical wiring circuits and use of electrical circuit testing tools when performing an engine management system diagnostic procedure could result in incorrect diagnostic results or damage to engine management system components.

Understanding of the following is required to perform the diagnostic procedures detailed in this Section. Refer to Section 12P Wiring Diagrams and to Basic Tools Required.

- Basic electronics,
- Electrical wiring circuits,
- Electrical circuits testing, and
- Correct use of the basic engine management system diagnostic tools.

In addition, understanding of the engine management system is essential to prevent misdiagnosis and component damage. Refer to Section 6C1-1 Engine Management – V6 – General Information.

Basic Tools Required

CAUTION

Use of incorrect electrical circuit diagnostic tools when performing the engine management diagnostic procedures could result in incorrect diagnostic results or damage to engine management system components.

The following electrical circuit testing tools are required to perform the diagnostic procedures detailed in this Section.

- Tech 2, refer to Section 0C Tech 2,
- Test lamp, refer to Section 12P Wiring Diagrams, and
- Digital multimeter with 10 MΩ impedance, refer to Section 12P Wiring Diagrams.

3.2 Diagnostic Precautions

The following precautions must be observed when performing the powertrain diagnostic procedure, otherwise incorrect diagnostic results or damage to engine management system components will occur:

- Disconnection of the battery affects certain vehicle electronic systems. Refer to Section 00 Cautions and Notes before disconnecting the battery.
- Disconnect the battery negative lead when performing the following procedures:
  - Disconnecting the ECM connectors, or
  - Charging the battery.
- Disconnect the battery terminal lead and the ECM connectors before attempting any electric arc welding on the vehicle.
- Do not start the engine if the battery terminal is not properly secured to the battery.
- Do not disconnect or reconnect the following while the ignition is switched on or when the engine is running:
  - Any engine management system component electrical wiring connector, or
  - Battery terminal leads.
- Ensure the correct procedure for disconnecting and connecting engine management system electrical wiring connectors is always followed. For information on the correct procedure for disconnecting and connecting specific wiring connectors, refer to Section 6C1-3 Engine Management – V6 – Service Operations.
- Ensure that all wiring harness connectors are fitted correctly.
- When steam or pressure cleaning engines, do not direct the cleaning nozzle at engine management system components.
- Do not clear any DTCs unless instructed.
- The fault must be present when using the diagnostic trouble code (DTC) diagnostic tables. Otherwise, misdiagnosis or replacement of good parts may occur.
- Do not touch the ECM connector pins or soldered components on the ECM circuit board to prevent ECM Electrostatic Discharge damage. Refer to Section 12P Wiring Diagrams for information on Electrostatic Discharge.
- Use only the test equipment specified in the diagnostic tables as other test equipment may give incorrect results or damage good components.
- The ECM is designed to withstand normal current draw associated with vehicle operations. However, the following fault conditions or incorrect test procedure may overload the ECM internal circuit and damage the ECM:
  - A short to voltage fault condition in any of the ECM low reference circuits may cause internal ECM and / or sensor damage. Therefore, any short to voltage fault condition in the ECM low reference circuits must be rectified before replacing a faulty component.
  - A short to ground fault condition in any of the ECM 5 V reference circuits may cause internal ECM and / or sensor damage. Therefore, any short to ground fault condition in the ECM 5 V reference circuits must be rectified before replacing a faulty component.
  - When using a test lamp to test an electrical circuit, do not use any of the ECM low reference circuits or 5 V reference circuits as a reference point. Otherwise, excessive current draw from the test lamp may damage the ECM.
- Disregard DTCs that set while performing the following diagnostic Steps:
  - Using Tech 2 actuator tests, or
  - Disconnecting an engine management system sensor connector then switching on the ignition.
- After completing the required diagnostics and service operations, road test the vehicle to ensure correct engine management system operation.

3.3 Preliminary Checks

The preliminary checks are a set of visual and physical checks or inspections that may quickly identify engine management system fault condition.

- Refer to the appropriate Service Techlines for relevant information regarding the fault condition.
- Ensure the battery is fully charged.
- Inspect the battery connections for corrosion or a loose terminal.
- Ensure that all engine management system related fuses are serviceable.
- Inspect for incorrect aftermarket theft deterrent devices, lights or mobile phone installation.
- Ensure there is no speaker magnet positioned too close to any electronic module that contains relays.
- Inspect the engine wiring harness for proper connections, pinches or cuts.
- Ensure that all engine management related electrical wiring connectors are fitted correctly.
- Inspect the ECM ground connections for corrosion, loose terminal or incorrect position.
- Ensure the resistance between the ECM housing and the battery negative cable is less than 0.5 Ω.
- Check the ECM bracket fasteners for correct torque value.
- Check all engine management related components for correct installation.
- Inspect the vacuum hoses for splits, kinks, oil contamination and proper connections, refer to the vehicle emission control information label. Check the hoses thoroughly for any type of leak or restriction.
- Inspect the air intake ducts for being collapsed, split or for having damaged areas.
- Inspect for air leaks at the throttle body mounting area, mass air flow (MAF) sensor, intake manifold and intake manifold sealing surfaces.
- Check for wiring harness routing that may be positioned too close to a high voltage or high current device such as the following:
  - Secondary ignition components, and
  - Motors and generators.

NOTE

High voltage or high current devices may induce electrical noise on a circuit, which can interfere with normal circuit operation.

3.4 Diagnostic System Check

Description

The engine management diagnostic procedure is organised in a logical structure that begins with the Diagnostic System Check. The Diagnostic System Check directs the diagnostic procedure to the logical steps necessary to diagnose an engine driveability fault condition.

Test Description

The following numbers refer to the step numbers in the diagnostic table:

4 Tests the operation of Tech 2.

6 Tests the integrity of the GM LAN serial data communication circuit. A PIM DTC sets if the PIM detects a fault condition in the communication circuit. A fault condition on the serial data communication circuit may trigger multiple DTCs on other sensors and components.

7 Tests for fault conditions on the vehicle theft deterrent system. The BCM is an integral part of the theft deterrent system. Any fault condition on the BCM that may affect the operation of the theft deterrent system must be rectified before proceeding with this diagnostic table.

Step	Action	Yes	No
1	Have you read the basic requirements?	Go to Step 2	Refer to 3.1 Basic Requirements
2	Have you read the diagnostic precautions?	Go to Step 3	Refer to 3.2 Diagnostic Precautions
3	Have you performed the preliminary checks?	Go to Step 4	Refer to 3.3 Preliminary Checks
4	1 Switch off the ignition. 2 Connect Tech 2 to the diagnostic link connector (DLC). 3 Switch on the ignition with the engine not running. 4 Push Tech 2 power button on. Does Tech 2 screen illuminate and display Tech 2?	Go to Step 5	Refer to Section 0C Tech 2
5	Using Tech 2, attempt to communicate with the PIM and the BCM. Does the PIM or the BCM fail to communicate?	Refer to Section 6E1 Powertrain Interface Module – V6	Go to Step 6
6	Does DTC U1064, U2100, U2105, U2106, U2108, B1009, B1013, B1014, B1000, B1019, B3057, B3924, P0633, P1611 or P1678 also set in the PIM?	Refer to Section 6E1 Powertrain Interface Module – V6	Go to Step 7
7	Does DTC 2, DTC 17, DTC 19, DTC 20, DTC 24 DTC 25 also set in the BCM?	Refer to Section 12J Body Control Module	Go to Step 8
8	Using Tech 2, view and record DTCs set at the ECM and TCM. Does Tech 2 display any DTC?	Go to Step 9	Refer to 4.1 Symptoms Diagnosis Table
9	Does Tech 2 display multiple DTCs?	Go to Step 10	Go to the diagnostic table of the DTC displayed. Refer to 6.1 DTC List in Ascending Order.

Step	Action	Yes	No
10	Does Tech 2 display any serial data communication circuit DTC?	Go to the appropriate serial data communication circuit DTC table. Refer to 6.1 DTC List in Ascending Order	Go to Step 11
11	Does Tech 2 display any immobiliser circuit DTC?	Go to the appropriate immobiliser circuit DTC table. Refer to 6.1 DTC List in Ascending Order.	Go to Step 12
12	Refer to the DTC Table of the fault condition that is most likely to trigger multiple DTCs. Refer to 1.2 Diagnostic Trouble Code Tables in this Section.	—	—
When all diagnosis and repairs are completed, check the system for correct operation.			

4 Symptoms Diagnostics

4.1 Symptoms Diagnosis Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been performed?	Go to Step 2	Refer to 3.4 Diagnostic System Check
2	Is the fault intermittent?	Refer to 4.2 Intermittent Fault Conditions	Go to Step 3
3	Does the engine backfire?	Refer to 4.3 Backfire	Go to Step 4
4	Does the engine crank but does not run?	Refer to 4.4 Cranks But Does Not Run	Go to Step 5
5	Does the engine cut-out or miss?	Refer to 4.5 Cuts Out, Misses	Go to Step 6
6	Is there a detonation or spark knock noise coming from the engine?	Refer to 4.6 Detonation / Spark Knock	Go to Step 7
7	Is there an engine dieseling or run-on condition?	Refer to 4.7 Dieseling, Run-on	Go to Step 8
8	Is there an engine hard starting condition?	Refer to 4.8 Hard Start	Go to Step 9
9	Is there an engine hesitation, sag or stumble condition?	Refer to 4.9 Hesitation, Sag and Stumble	Go to Step 10
10	Does the engine suffer from lack of power, sluggishness or sponginess?	Refer to 4.10 Lack of Power, Sluggishness or Sponginess	Go to Step 11
11	Does the engine suffer from poor fuel economy?	Refer to 4.11 Poor Fuel Economy	Go to Step 12
12	Does the engine suffer from rough, unstable or incorrect idle and engine stalling?	Refer to 4.12 Rough, Unstable, Incorrect Idle or Stalling	Go to Step 13
13	Does the engine surge or chuggle?	Refer to 4.13 Surges / Chuggles	Go to Step 14
When all diagnosis and repairs are completed, check the system for correct operation.			

4.2 Intermittent Fault Conditions

Description

A fault condition is intermittent if one of the following conditions exists:

- the fault condition is not always present,
- the fault condition cannot be presently duplicated, or
- there is no Current DTC but a History DTC is stored.

Diagnostic Table

Checks	Actions

Preliminary	• Perform the preliminary checks. Refer to 3.3 Preliminary Checks in this Section .
	• Gather information from the customer regarding the conditions that trigger the intermittent fault such as:
	  • At what engine or ambient temperature range does the fault occur?
	  • Does the fault occur when operating aftermarket electrical equipment inside the vehicle?
	  • Does the fault occur on rough roads or in wet road conditions?
	• If the intermittent fault is a start and then stall condition, check theft deterrent system. Refer to Section 12J Body Control Module.

Tech 2 Tests	The following are lists of Tech 2 diagnostic tests that may be used to diagnose intermittent faults: • Wriggle test the suspected wiring harness and connectors while observing Tech 2 operating parameters. If Tech 2 read-out fluctuates during this procedure, check the tested wiring harness circuit for a loose connection. • Observe the freeze frame / failure records for the suspected history DTC and then operate the vehicle in the conditions that triggers the intermittent fault while an assistant observes the suspected Tech 2 operating parameter data. • Capture and store data in the snapshot mode when the fault occurs. The stored data may be played back at a slower rate to aid diagnostics. Refer to Tech 2 User Instructions for further information on the Snapshot function. • Compare the engine operating parameters of the engine being diagnosed to the engine operating parameters of a known good engine.

Check Powertrain icon or Malfunction Indicator Lamp	The following conditions may cause an intermittent Check Powertrain icon or Malfunction Indicator Lamp (MIL) fault with no DTC listed:
	• Electromagnetic interference (EMI) caused by a faulty relay, ECM controlled solenoid, switch or other external source.
	• Incorrect installation of aftermarket electrical equipment such as the following:
	  • mobile phones,
	  • theft deterrent alarms,
	  • lights, or
	  • radio equipment.
	• ECM grounds are loose.

Checks	Actions

Temperature Related	Temperature related intermittent fault condition occurs only when the engine or ambient temperature is hot, or only when it is cold.
	• If the intermittent fault is heat related, review Tech 2 data in relationship to the following:
	  • high ambient temperature,
	  • engine generated heat,
	  • circuit generated heat due to a poor electrical connection or high electrical load, and
	  • higher than normal load conditions (towing, etc.).
	• If the intermittent fault is related to cold ambient or engine temperature, review Tech 2 data in relationship to the following:
	  • low ambient temperature, and
	  • the fault condition that occurs only on a cold start situation.

Additional Tests	• Incorrect installation of aftermarket electrical equipment such as the following:
	  • mobile phones,
	  • theft deterrent alarms,
	  • lights, or
	  • radio equipment.
	• Electromagnetic interference (EMI) caused by a faulty relay, ECM controlled solenoid or switch. The fault is triggered when the relay or solenoid is activated.
	• Test the A/C compressor clutch and some relays that contain a clamping diode or resistor for an open circuit.
	• Test the generator for a faulty rectifier bridge that may allow the A/C noise into the ECM electrical circuit.

When all diagnosis and repairs are completed, check the system for correct operation.	

4.3 Backfire

Description

The air / fuel mixture in the intake manifold or in the exhaust system ignites which produces a loud popping noise.

Checks	Actions
Preliminary	Perform the Preliminary Checks. Refer to 3.3 Preliminary Checks in this Section.
Sensor / System	• Check the air intake system and crankcase for air leaks. • Check the PCV System for correct operation. Refer to Section 6A1 Engine Mechanical – V6. • Use Tech 2 to monitor the knock sensor system for excessive spark retard activity. Check for items that cause spark retard activity.

Fuel System	• Check the fuel system for the following fault conditions. Refer to Section 8A1 Fuel System.
	  • restricted fuel filter,
	  • incorrect fuel pressure, and
	  • contaminated fuel.
	• Check the operation of the fuel injectors. Refer to Section 6C1-3 Engine Management – V6 – Service Operations.
	• Perform the fuel injector balance test, refer to 5.3 Fuel Injector Balance Test in this Section.
	• Check the items that can cause an engine to run lean.
	• Check the items that cause an engine to run rich.

Ignition System	• Check for an intermittent ignition circuit malfunction. • Inspect for moisture or corrosion around the spark plug / ignition coil area. • Test the ignition coil voltage output. Refer to Section 6C1-3 Engine Management – V6 – Service Operations. • Remove and inspect the spark plugs. Refer to Section 6C1-3 Engine Management – V6 – Service Operations. **NOTE** If the spark plugs are fouled, determine the cause of the fouling before replacing the spark plugs. Refer to Section 6C1-3 Engine Management – V6 – Service Operations. • Check for loose ignition coil ground circuit.
Engine Cooling System	Check the engine for over-heating. Refer to Section 6B1 Engine Cooling – V6.
Engine Mechanical	Check for the following engine fault conditions. Refer to Section 6A1 Engine Mechanical – V6. • low compression, and • worn valve train components.

<table>
<tr><th>Checks</th><th>Actions</th></tr>
<tr><td>Additional Checks</td><td>Check the exhaust system for possible restrictions. Refer to Section 8B Exhaust System.
Electromagnetic interference (EMI) on the crankshaft position (CKP) sensor can cause an engine misfire condition.

Using Tech 2, monitor the engine speed parameter. A sudden increase in the engine speed parameters without moving the throttle position indicates that an Electromagnetic Interference fault may be present.

Wiring harness routing which may be positioned very close to a high voltage or high current device such as the following may induce EMI:
secondary ignition components, or
motors and generators.
Dirty starter motor commutator or brushes can mask the crankshaft position sensor signal.
Check the torque converter clutch (TCC) operation. A TCC that applies too soon can cause engine detonation, which will trigger spark retard activity. Refer to Section 7C1 Automatic Transmission – 4L60E – General Information or Section 7E1 Automatic Transmission – 5L40E – General Information.</td></tr>
<tr><td colspan="2">When all diagnosis and repairs are completed, check the system for correct operation.</td></tr>
</table>

4.4 Cranks But Does Not Run

Definition

The engine cranks normally but does not start.

Checks	Actions
Preliminary	• Perform the preliminary checks. Refer to 3.3 Preliminary Checks in this Section. • Check the theft deterrent system for correct operation. Refer to Section 12J Body Control Module.
Sensor / System	• Check the engine coolant temperature (ECT) sensor for an incorrect value. Compare the engine coolant temperature against the intake air temperature (IAT) on a cold engine. The ECT and IAT sensor values should be within ± 3°C of each other. Refer to Section 6C1-3 Engine Management – V6 – Service Operations for details of the Temperature vs. Resistance Table. • Check the mass air flow (MAF) sensor installation. Incorrect installation of the MAF sensor may cause hard start condition. Refer to Section 6C1-3 Engine Management – V6 – Service Operations. • Check for a dirty starter motor commutator or brushes that can mask the crankshaft position sensor signal.

Fuel System	• Check the fuel system for the following fault conditions. Refer to Section 8A1 Fuel System.
	  • restricted fuel filter,
	  • incorrect fuel pressure,
	  • contaminated fuel, and
	  • incorrect fuel pump relay operation.
	• Check the operation of the fuel injectors. Refer to Section 6C1-3 Engine Management – V6 – Service Operations.

Ignition System	• Inspect for moisture or corrosion around the spark plug / ignition coil area. • Test the ignition coil voltage output. Refer to Section 6C1-3 Engine Management – V6 – Service Operations. • Remove and inspect the spark plugs. Refer to Section 6C1-3 Engine Management – V6 – Service Operations. **NOTE** If the spark plugs are fouled, determine the cause of the fouling before replacing the spark plugs. Refer to Section 6C1-3 Engine Management – V6 – Service Operations. Check for loose ignition coil ground circuit.

Engine Mechanical	• Check for excessive oil in combustion chamber. Refer to Section 6A1 Engine Mechanical – V6.
	• Check for the following engine fault conditions. Refer to Section 6A1 Engine Mechanical – V6.
	  • low compression, and
	  • worn valve train components.

When all diagnosis and repairs are completed, check the system for correct operation.	

4.5 Cuts Out, Misses

Description

Steady pulsation or jerking that is usually more severe as the engine load increases. This condition is not normally felt greater than 1500 rpm or 48 km/h. The exhaust has a steady spitting sound at idle or low speed.

Checks	Actions
Preliminary	• Perform the preliminary checks. Refer to 3.3 Preliminary Checks in this Section. • Check the air filter element and intake air ducts for blockages. • Check for intake manifold vacuum leak.
Sensor / System	• Using Tech 2, check the heated oxygen sensor (HO2s) operating parameters. The HO2s should respond quickly to different throttle positions. • Use Tech 2 to monitor the knock sensor system for excessive spark retard activity. Check for items that cause spark retard activity. Refer to 6.21 DTC P0327, P0328, P0332 or P0333 in this Section.

Fuel System	• Check the fuel system for the following fault conditions. Refer to Section 8A1 Fuel System.
	  • restricted fuel filter,
	  • incorrect fuel pressure, and
	  • contaminated fuel.
	• Check the operation of the fuel injectors. Refer to Section 6C1-3 Engine Management – V6 – Service Operations.
	• Perform the fuel injector balance test, refer to 5.3 Fuel Injector Balance Test in this Section.
	• Check for fault conditions that cause an engine to run rich or to run lean.

Ignition System	• Inspect for moisture or corrosion around the spark plug / ignition coil area. • Test the ignition coil voltage output. Refer to Section 6C1-3 Engine Management – V6 – Service Operations. • Remove and inspect the spark plugs. Refer to Section 6C1-3 Engine Management – V6 – Service Operations. **NOTE** If the spark plugs are fouled, determine the cause of the fouling before replacing the spark plugs. Refer to Section 6C1-3 Engine Management – V6 – Service Operations. • Check for loose ignition coil grounds.
Engine Mechanical	Check for the following engine fault conditions. Refer to Section 6A1 Engine Mechanical –V6. • low compression, and • worn valve train components.

Checks	Actions

Additional Checks	• Check the exhaust system for possible restrictions. Refer to Section 8B Exhaust System.
	• Electromagnetic interference (EMI) on the crankshaft position (CKP) sensor can cause an engine misfire condition.
	Using Tech 2, monitor the engine speed parameter. A sudden increase in the engine speed parameters without moving the throttle position indicates that an electromagnetic interference fault may be present.
	• Wiring harness routing which may be positioned very close to a high voltage or high current device such as the following may induce EMI:
	  • secondary ignition components, or
	  • motors and generators.

When all diagnosis and repairs are completed, check the system for correct operation.	

4.6 Detonation / Spark Knock

Description

The engine produces sharp rapid metallic knocks that are more audible during acceleration.

Checks	Actions
Preliminary	Perform the preliminary checks. Refer to 3.3 Preliminary Checks in this Section.
Sensor System	Use Tech 2 to monitor the knock sensor system.

Fuel System	• Check the fuel system for the following fault conditions. Refer to Section 8A1 Fuel System.
	  • restricted fuel filter,
	  • incorrect fuel pressure, and
	  • contaminated fuel.
	• Check the operation of the fuel injectors. Refer to Section 6C1-3 Engine Management – V6 – Service Operations.
	• Perform the fuel injector balance test, refer to 5.3 Fuel Injector Balance Test in this Section.
	• Ensure the fuel tank is filled with petrol that has a minimum octane reading of 92.
	• Check for fault conditions that can cause an engine to run lean.

Ignition System	Check the spark plugs for proper heat range. Refer to Section 6C1-3 Engine Management – V6 – Service Operations.
Engine Mechanical	• Check the combustion chambers for excessive carbon build-up. Refer to Section 6A1 Engine Mechanical – V6. • Check the camshaft timing. Refer to Section 6A1 Engine Mechanical – V6.
Additional Checks	• Check the torque converter clutch (TCC) operation. The TCC applying too soon can cause the engine to spark knock. Refer to Section 7C2 Automatic Transmission – 4L60E – Electrical Diagnosis or Section 7E2 Automatic Transmission – 5L40E – Electrical Diagnosis.
When all diagnosis and repairs are completed, check the system for correct operation.	

4.7 Dieseling, Run-on

Description

The engine continues to run after the ignition is switched off but runs very roughly and then stalls.

Checks	Actions
Preliminary	Perform the preliminary checks. Refer to 3.3 Preliminary Checks in this Section.
Fuel System	Inspect the injectors for leaking condition. Refer to Section 6C1-3 Engine Management – V6 – Service Operations.
Engine Cooling System	• Check for engine overheating. Refer to Section 6B1 Engine Cooling – V6. • Check the engine thermostat for proper operation and correct heat range. Refer to Section 6B1 Engine Cooling – V6.
Engine Mechanical	• Check for build up of carbon deposit in the combustion chamber, which may cause hot spots and increased compression ratio. Refer to Section 6A1 Engine Mechanical – V6. • Using Tech 2, check for incorrect engine idle speed.

Additional	• If the engine continues to run after the ignition is switched off but the engine runs normally, check the following:
	  • ignition switch operation,
	  • voltage feedback from alternator L terminal to ignition switch, and
	  • sticking ignition control relay.

When all diagnosis and repairs are completed, check the system for correct operation.	

4.8 Hard Start

Definition

The engine cranks normally but takes longer to start than usual. As soon as the engine runs, the engine may stall immediately.

Checks	Actions
Preliminary	• Perform the preliminary checks. Refer to 3.3 Preliminary Checks in this Section. • Check the theft deterrent system for correct operation. Refer to Section 12J Body Control Module.
Sensor / System	• Check the engine coolant temperature (ECT) sensor for an incorrect value. Compare the engine coolant temperature against the intake air temperature (IAT) on a cold engine. The ECT and IAT sensor values should be within ± 3°C of each other. Refer to Section 6C1-3 Engine Management – V6 – Service Operations for details of the Temperature vs. Resistance Table. • Check the mass air flow (MAF) sensor installation. Incorrect installation of the MAF sensor may cause hard start condition. Refer to Section 6C1-3 Engine Management – V6 – Service Operations. • Test the resistance of the crankshaft position (CKP) sensor. The CKP sensor resistance must be within 700 – 1,200 Ω at all temperatures. • Check for dirty starter motor commutator or brushes that can mask the crankshaft position sensor signal.

Fuel System	• Check the fuel system for the following fault conditions. Refer to Section 8A1 Fuel System.
	  • restricted fuel filter,
	  • incorrect fuel pressure, and
	  • contaminated fuel.
	• Check the operation of the fuel injectors. Refer to Section 6C1-3 Engine Management – V6 – Service Operations.

Ignition System	• Inspect for moisture or corrosion around the spark plug / ignition coil area. • Test the ignition coil voltage output. Refer to Section 6C1-3 Engine Management – V6 – Service Operations. • Remove and inspect the spark plugs. Refer to Section 6C1-3 Engine Management – V6 – Service Operations. **NOTE** If the spark plugs are fouled, determine the cause of the fouling before replacing the spark plugs. Refer to Section 6C1-3 Engine Management – V6 – Service Operations. • Check for loose ignition coil ground circuit.

Engine Mechanical	• Check for excessive oil in combustion chamber. Refer to Section 6A1 Engine Mechanical – V6.
	• Check for the following engine fault conditions. Refer to Section 6A1 Engine Mechanical – V6.
	  • low compression, and
	  • worn valve train components.

When all diagnosis and repairs are completed, check the system for correct operation.	

4.9 Hesitation, Sag and Stumble

Description

Momentary lack of response or hesitation as the accelerator is depressed. This condition is usually more severe when first trying to make the vehicle move from a standing start but can occur at any vehicle speed.

Checks	Actions
Preliminary	• Perform the preliminary checks. Refer to 3.3 Preliminary Checks in this Section. • Check the air filter element and intake air ducts for blockages.
Sensor / System	• Using Tech 2, check the heated oxygen sensor (HO2s) operating parameters. The HO2s should respond quickly to different throttle positions. • Inspect the accelerator pedal position (APP) sensor harness connector for correct connection. Poor connection of this connector will not set a DTC.

Fuel System	• Check the fuel system for the following fault conditions. Refer to Section 8A1 Fuel System.
	  • restricted fuel filter,
	  • incorrect fuel pressure, and
	  • contaminated fuel.
	• Check the operation of the fuel injectors. Refer to Section 8A1 Fuel System.
	• Perform the fuel injector balance test, refer to 5.3 Fuel Injector Balance Test in this Section.
	• Check for fault conditions that cause an engine to run rich or to run lean.

Ignition System	• Inspect for moisture or corrosion around the spark plug / ignition coil area. • Test the ignition coil voltage output. Refer to Section 6C1-3 Engine Management – V6 – Service Operations. • Remove and inspect the spark plugs. Refer to Section 6C1-3 Engine Management – V6 – Service Operations. **NOTE** If the spark plugs are fouled, determine the cause of the fouling before replacing the spark plugs. Refer to Section 6C1-3 Engine Management – V6 – Service Operations. • Check for loose ignition coil ground circuit.
Engine Cooling System	Check the engine thermostat for correct operation and heat range. Refer to Section 6B1 Engine Cooling – V6.
Additional Checks	• If fitted, check for the correct operation of the intake manifold runner control system. Refer to Section 6C1-3 Engine Management – V6 – Service Operations. • Check the generator output voltage. Refer to Section 6D1-1 Charging System – V6.
When all diagnosis and repairs are completed, check the system for correct operation.	

4.10 Lack of Power, Sluggishness or Sponginess

Description

The engine delivers less than normal power. There is little or no increase in vehicle speed when the accelerator pedal is partially depressed.

Checks	Actions
Preliminary	• Perform the preliminary checks. Refer to 3.3 Preliminary Checks in this Section. • Check the air filter element and intake air ducts for blockages.
Sensor / System	• Use Tech 2 to monitor the knock sensor system for excessive spark retard activity. Check for items that cause spark retard activity. • Inspect the accelerator pedal position (APP) sensor harness connector for correct connection. Poor connection of this connector will not set a DTC.

Fuel System	• Check the fuel system for the following fault conditions. Refer to Section 8A1 Fuel System.
	  • restricted fuel filter,
	  • incorrect fuel pressure, and
	  • contaminated fuel.
	• Check the operation of the fuel injectors. Refer to Section 6C1-3 Engine Management – V6 – Service Operations.
	• Perform the fuel injector balance test, refer to 5.3 Fuel Injector Balance Test in this Section.
	• Check for fault conditions that can cause the engine to run rich or run lean.

Ignition System	• Inspect for moisture or corrosion around the spark plug / ignition coil area. • Test the ignition coil voltage output. Refer to Section 6C1-3 Engine Management – V6 – Service Operations. • Remove and inspect the spark plugs. Refer to Section 6C1-3 Engine Management – V6 – Service Operations. **NOTE** If the spark plugs are fouled, determine the cause of the fouling before replacing the spark plugs. Refer to Section 6C1-3 Engine Management – V6 – Service Operations. • Check for loose ignition coil ground circuit.

Engine Mechanical	• Check for the following engine mechanical fault condition. Refer to Section 6A1 Engine Mechanical – V6.
	  • low engine compression, and
	  • worn valve train components.

Additional Checks	• Check the exhaust system for possible restrictions. Refer to Section 8B Exhaust System. • Test for other TCM related faults that may cause the transmission to operate in the default mode. • Check for transmission mechanical faults that may produce similar symptoms such as slipping clutch. • If fitted, check for the correct operation of the intake manifold runner control system. Refer to Section 6C1-3 Engine Management – V6 – Service Operations.
When all diagnosis and repairs are completed, check the system for correct operation.	

4.11 Poor Fuel Economy

Description

As confirmed by an actual road test, the fuel economy as compared to the previous fuel consumption of the same vehicle is noticeably lower.

Checks	Actions
Preliminary	• Perform the preliminary checks. Refer to 3.3 Preliminary Checks in this Section. • Check the air filter element and intake air ducts for blockages. • Check for correct tyre pressure. Refer to Section 10 Wheels and Tyres. • Check the recent driving conditions are the same compared to the previous when the fuel consumption is normal. The following are list of driving conditions that may affect fuel consumption: – vehicle load, – acceleration rate, – A/C or other electrical equipment use, and – vehicle used for towing.
Sensor / System	• Check the air intake system and crankcase for air leaks. • Check the PCV System for correct operation. Refer to Section 6A1 Engine Mechanical – V6. • Check for the correct calibration of the speedometer. Refer to Section 12C Instrumentation. • Use Tech 2 to monitor the knock sensor system for excessive spark retard activity. Check for items that cause spark retard activity. • Using Tech 2, check the heated oxygen sensor (HO2s) operating parameters. The HO2s should respond quickly to different throttle positions.
Fuel System	• Check the fuel system for the following fault conditions. Refer to Section 8A1 Fuel System. – restricted fuel filter, – incorrect fuel pressure, and – contaminated fuel. • Check the operation of the fuel injectors. Refer to Section 6C1-3 Engine Management – V6 – Service Operations. • Perform the fuel injector balance test, refer to 5.3 Fuel Injector Balance Test in this Section. • Check the items that cause an engine to run rich. • Check for foreign material accumulation in the throttle bore, carbon build-up on the throttle valve or on the throttle shaft. • Check the throttle body for tampering.

Checks	Actions
Ignition System	• Inspect for moisture or corrosion around the spark plug / ignition coil area. • Test the ignition coil voltage output. Refer to Section 6C1-3 Engine Management – V6 – Service Operations. • Remove and inspect the spark plugs. Refer to Section 6C1-3 Engine Management – V6 – Service Operations. **NOTE** If the spark plugs are fouled, determine the cause of the fouling before replacing the spark plugs. Refer to Section 6C1-3 Engine Management – V6 – Service Operations. • Check for loose ignition coil ground circuit.
Engine Cooling System	• Check the engine thermostat for proper operation and correct heat range. Refer to Section 6B1 Engine Cooling – V6.
Engine Mechanical	Check for the following engine fault conditions. Refer to Section 6A1 Engine Mechanical – V6. • low compression, and • worn valve train components.

Additional Checks	• Check the exhaust system for possible restrictions. Refer to Section 8B Exhaust System.
	• Electromagnetic interference (EMI) on the crankshaft position (CKP) sensor can cause an engine misfire condition.
	Using Tech 2, monitor the engine speed parameter. A sudden increase in the engine speed parameters without moving the throttle position indicates that an Electromagnetic Interference fault may be present.
	Wiring harness routing which may be positioned very close to a high voltage or high current device such as the following may induce EMI:
	  • secondary ignition components, and
	  • motors and generators.
	• Check the torque converter clutch (TCC) operation. A TCC that applies too soon can cause engine detonation, which will trigger spark retard activity. Refer to Section 7C2 Automatic Transmission – 4L60E – Electrical Diagnosis or Section 7E2 Automatic Transmission – 5L40E – Electrical Diagnosis.
	• Test for other TCM related faults that may cause the transmission to operate in the default mode. Refer to Section 7C2 Automatic Transmission – 4L60E – Electrical Diagnosis or Section 7E2 Automatic Transmission – 5L40E – Electrical Diagnosis.
	• Check for transmission mechanical faults such as slipping clutch. Refer to Section 7C3 Automatic Transmission – 4L60E – Hydraulic and Mechanical Diagnosis or Section 7E3 Automatic Transmission – 5L40E – Hydraulic and Mechanical Diagnosis.
	• Check the brake system including the parking brake for sticking or incorrect operation. Refer to Section 5A Service and Park Braking System.

When all diagnosis and repairs are completed, check the system for correct operation.	

4.12 Rough, Unstable, Incorrect Idle or Stalling

Description

Engine idle speed fluctuates causing the engine to run unevenly. If the engine idle speed drops too low, the engine may stall.

Checks	Actions
Preliminary	• Perform the preliminary checks. Refer to 3.3 Preliminary Checks in this Section. • Check the air filter element and intake air ducts for blockages.
Sensor / System	• Check the throttle actuator control (TAC) system. Refer to Section 6C1-3 Engine Management – V6 – Service Operations. • Check the air intake system and crankcase for air leaks. Refer to Section 6C1-3 Engine Management – V6 – Service Operations. • Check the PCV System for correct operation. Refer to Section 6A1 Engine Mechanical – V6. • Use Tech 2 to monitor the knock sensor system for excessive spark retard activity. Check for items that cause spark retard activity. • Using Tech 2, check the heated oxygen sensor (HO2s) operating parameters. The HO2s sensor should respond quickly to different throttle positions.
Fuel System	• Check the fuel system for the following fault conditions. Refer to Section 8A1 Fuel System. – restricted fuel filter, – incorrect fuel pressure, and – contaminated fuel. • Check the operation of the fuel injectors. Refer to Section 6C1-3 Engine Management – V6 – Service Operations. • Perform the fuel injector balance test, refer to 5.3 Fuel Injector Balance Test in this Section. • Check the items that cause an engine to run rich.
Ignition System	• Inspect for moisture or corrosion around the spark plug and ignition coil area. • Test the ignition coil voltage output. Refer to Section 6C1-3 Engine Management – V6 – Service Operations. • Remove and inspect the spark plugs. Refer to Section 6C1-3 Engine Management –V6 – Service Operations. **NOTE** If the spark plugs are fouled, determine the cause of the fouling before replacing the spark plugs. Refer to Section 6C1-3 Engine Management – V6 – Service Operations. • Check for loose ignition coil grounds.
Engine Mechanical	• Parasitic load on the engine such as the following: • automatic transmission fault condition, or • a belt driven accessory fault condition. • Check for the following engine fault conditions. Refer to Section 6A1 Engine Mechanical –V6. • low compression, or • worn valve train components.
When all diagnosis and repairs are completed, check the system for correct operation.	

4.13 Surges / Chuggles

Description

With the accelerator pedal in a steady position, the vehicle speeds up and slows down or the engine power fluctuates.

Checks	Actions
Preliminary	Perform the preliminary checks. Refer to 3.3 Preliminary Checks in this Section.
Sensor / System	- Using Tech 2, check the heated oxygen sensor (HO2s) operating parameters. The HO2s should respond quickly to different throttle positions. - Test the resistance of the crankshaft position (CKP) sensor. The CKP sensor resistance must be 700 – 1,200 Ω at all temperatures.
Fuel System	- Check the fuel system for the following fault conditions. Refer to Section 8A1 Fuel System. - restricted fuel filter, - incorrect fuel pressure, and - contaminated fuel. - Check the operation of the fuel injectors. Refer to Section 6C1-3 Engine Management – V6 – Service Operations. - Perform the fuel injector balance test, refer to 5.3 Fuel Injector Balance Test in this Section. - Check the items that cause an engine to run rich. - Check for fault conditions that can cause an engine to run lean.
Ignition System	- Inspect for moisture or corrosion around the spark plug / ignition coil area. - Test the ignition coil voltage output. Refer to Section 6C1-3 Engine Management – V6 – Service Operations. - Remove and inspect the spark plugs. Refer to Section 6C1-3 Engine Management – V6 – Service Operations. **NOTE** If the spark plugs are fouled, determine the cause of the fouling before replacing the spark plugs. Refer to Section 6C1-3 Engine Management – V6 – Service Operations. - Check for loose ignition coil ground circuit.

Checks	Actions
Additional Checks	• Check the torque converter clutch (TCC) operation. A TCC that applies too soon can cause engine detonation, which will trigger spark retard activity. Refer to Section 7C2 Automatic Transmission – 4L60E – Electrical Diagnosis or Section 7E2 Automatic Transmission – 5L40E – Electrical Diagnosis. • Test the A/C clutch for correct operation. Refer to Section 2B HVAC Climate Control – Servicing and Diagnosis. • Check the evaporative emission (EVAP) canister purge solenoid for the following conditions: Refer to Section 6C1-3 Engine Management – V6 – Service Operations. – stuck open condition, and – charcoal contamination. • Check the exhaust system for possible restrictions. Refer to Section 8B Exhaust System. • Electromagnetic interference (EMI) on the crankshaft position (CKP) sensor can cause an engine misfire condition. Using Tech 2, monitor the engine speed parameter. A sudden increase in the engine speed parameters without moving the throttle position indicates that an Electromagnetic Interference fault may be present. Wiring harness routing which may be positioned very close to a high voltage or high current device such as the following may induce EMI: • secondary ignition components, or • motors and generators.
When all diagnosis and repairs are completed, check the system for correct operation.	

5 Functional Checks

5.1 General Information

The items detailed in the following pages are to be used when there is a customer complaint and there are no diagnostic trouble codes set, or one or more of the Tech 2 data values are not within the typical values. They are also to be used when instructed from a DTC table. Before using these tables, you should refer to 4 Symptoms Diagnostics in this Section, which may direct you to using the following functional checks.

The purpose of these tables is to diagnose engine control module (ECM) controlled components or sub-systems that do not have diagnostic trouble codes assigned to them. Another purpose of these tables is for Technicians who feel confident that a particular part of the sub-system is not operating properly and wants only to check that particular item for proper operation without going through lengthy diagnostic procedures.

5.2 Fuel Injector Coil Test

The fuel injector coil test is divided into two parts. Begin by performing the fuel injector coil quick test. Then only perform the Injector Coil Test – With Special Tool J39021 procedure if the quick test determines that there is a faulty fuel injector.

Fuel Injector Coil Quick Test

Test Description

The following numbers refer to the step numbers in the diagnostic table:

1 This step checks if the engine coolant temperature is within the correct range.

2 This step tests each fuel injector resistance within a specific temperature range.

3 This step determines if all of the fuel injectors are within 3 ohms of each other.

Step	Action	Value(s)	Yes	No
1	Using Tech 2, observe the engine coolant temperature (ECT). Refer to Section 0C Tech 2. Is the ECT within the specified range?	10 – 32°C	Go to Step 2	Go to Step 3
2	1 Disconnect the fuel injector harness connector, refer to 2.15 Fuel Rail Assembly, in Section 6C1-3 Engine Management – V6 – Service Operations. 2 Using a digital ohmmeter and connector test adaptor kit J 35616-A, measure the resistance of each fuel injector between the ignition voltage circuit and the fuel injector control circuit. Refer to Section 12P Wiring Diagrams for information on testing for continuity and to Figure 6C1-2 – 15 and Figure 6C1-2 – 16 for the fuel injector harness connector. Do any of the fuel injectors display a resistance outside the specified range?	11 – 14 Ω	Refer to Injector Coil Test – With Special Tool J39021	Injectors OK
3	1 Disconnect the fuel injector harness connector, refer to 2.15 Fuel Rail Assembly, in Section 6C1-3 Engine Management – V6 – Service Operations. 2 Using a digital ohmmeter and connector test adaptor kit J 35616-A, measure the resistance of each fuel injector between the ignition voltage circuit and the fuel injector control circuit. Refer to Section 12P Wiring Diagrams for information on testing for continuity and to Figure 6C1-2 – 15 and Figure 6C1-2 – 16 for the fuel injector harness connector. 3 Record each fuel injector value. 4 Subtract the lowest resistance value from the highest. Is the difference equal to, or less than, the specified value?	3 Ω	Injectors OK	Refer to Injector Coil Test – With Special Tool J39021

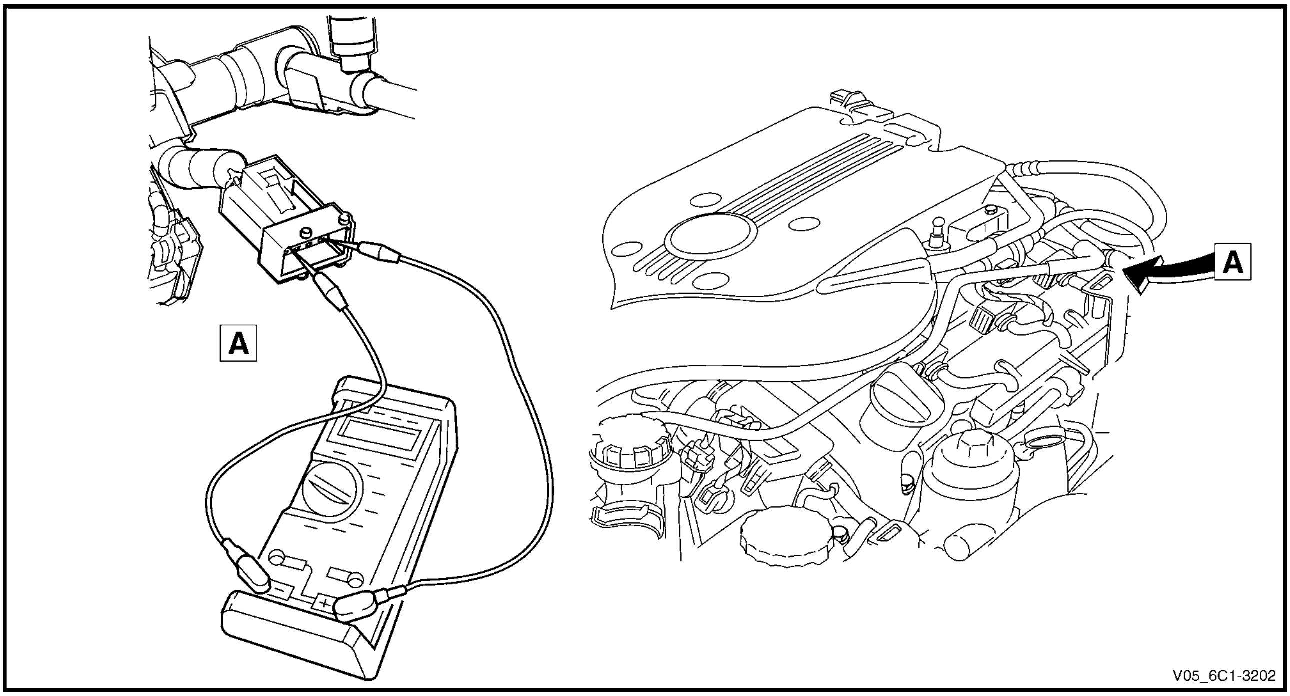


Figure 6C1-2 – 15

Fuel Injector Harness to Engine Harness Connector

Pin Description

Pin	Function	Circuit Number
1	Ignition Voltage Circuit – Cyl. 1, 3, 5	639
2	Ignition Voltage Circuit – Cyl. 2, 4, 6	1039
3	Injector 1 Control Circuit	1744
4	Injector 3 Control Circuit	1746
5	Injector 5 Control Circuit	845
6	Injector 2 Control Circuit	1745
7	Injector 4 Control Circuit	844
8	Injector 6 Control Circuit	846

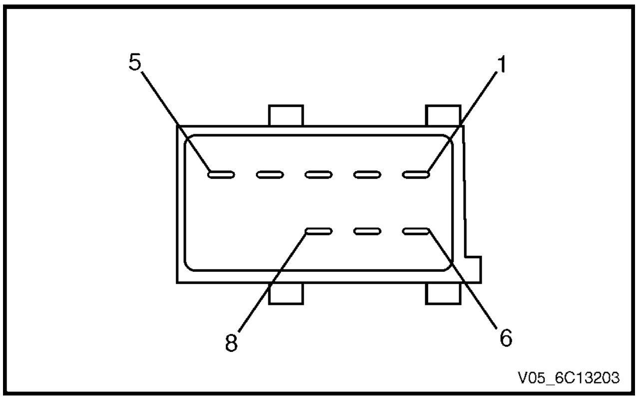


Figure 6C1-2 – 16

Injector Coil Test – With Special Tool J39021

1 Depressurise the fuel system, refer to Section 8A1 Fuel System.

2 Turn the ignition OFF.

NOTE

After removing the upper intake manifold, plug the lower manifold opening to prevent dirt and other contaminants from entering.

3 Remove the upper intake manifold assembly, refer to Section 6A1 Engine Mechanical – V6.

4 Using Tech 2, observe the engine coolant temperature (ECT), refer to Section 0C Tech 2. If the ECT is 10 – 32°C, refer to Engine Coolant Temperature Between 10 – 32(C, or if the ECT is outside this range, refer to Engine Coolant Temperature Outside 10 – 32(C.

Engine Coolant Temperature Between 10 – 32°C

Step	Action	Value(s)	Yes	No
1	1 Set the amperage supply selector switch on the fuel injector tester (1), special tool J 39021 to the Coil Test 0.5 A position. Refer to Figure 6C1-2 – 17. 2 Connect the fuel injector tester leads (4 and 5) to B+ and ground. 3 Connect the digital multimeter (2) positive and negative lead to the fuel injector tester. Set the multimeter to read DC Voltage. 4 Connect the fuel injector tester, using fuel injector harness adapter, special tool J44602 to a fuel injector. 5 Press the Push to Start Test button on the fuel injector tester. 6 Observe and record the voltage reading on the digital multimeter. **NOTE** The voltage reading may rise during the test. Record the voltage reading after one second of the test. 7 Repeat steps 4 through 6 for each fuel injector. **NOTE** The table in Figure 6C1-2 – 18 shows an example of the results from a fuel injector coil test. Did any fuel injector have an erratic voltage reading (large fluctuations in voltage that did not stabilise), or voltage readings outside of the specified value?	5.5 – 6.6 V	Replace the faulty fuel injector/s. Refer to 2.15 Fuel Rail Assembly, in Section 6C1-3 Engine Management – V6 – Service Operations.	System OK
When all repairs are completed, check the system for fuel leaks and correct operation.				

Engine Coolant Temperature Outside 10 – 32°C

Step	Action	Value(s)	Yes	No
1	1 Set the amperage supply selector switch on the fuel injector tester (1), special tool J 39021 to the Coil Test 0.5 A position. Refer to Figure 6C1-2 – 17. 2 Connect the fuel injector tester leads (4 and 5) to B+ and ground. 3 Connect the digital multimeter (2) positive and negative lead to the fuel injector tester. Set the multimeter to read DC Voltage. 4 Connect the fuel injector tester, using injector harness adapter, special tool J44602 to a fuel injector. 5 Press the Push to Start Test button on the fuel injector tester. 6 Observe and record the voltage reading on the digital multimeter. **NOTE** The voltage reading may rise during the test. Record the voltage reading after one second of the test. 7 Repeat steps 4 through 6 for each fuel injector. 8 Identify the highest voltage reading recorded from the six fuel injectors tested that is 9.5 V or less. **NOTE** Disregard those voltage readings that are greater than 9.5 V. Voltage readings greater than 9.5 V indicate a faulty fuel injector. 9 Subtract the remaining voltage readings recorded in Step 8, from the highest voltage reading. Are any of the values recorded in Step 9 greater than the specified value?	0.6 V	Go to Step 2	System OK
2	1 Replace any fuel injector that has any of the following: – a subtracted value exceeding 0.6 V, – an initial reading greater than 9.5 V, and – an erratic reading. **NOTE** The table in Figure 6C1-2 – 19 shows an example of the results from a fuel injector coil test. Has the repair been completed?	–	System OK.	–
When all repairs are completed, check the system for fuel leaks and correct operation.				

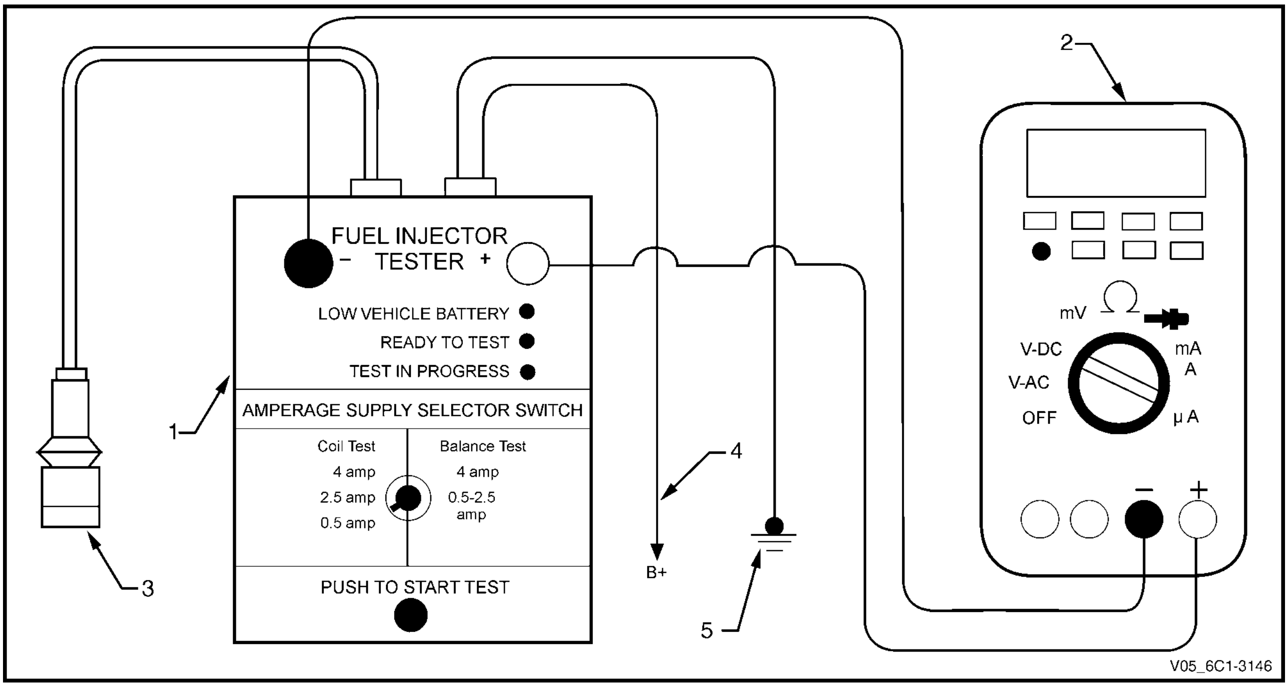


Figure 6C1-2 – 17

Legend

1 Fuel Injector Tester – Special Tool J39021
2 Digital Multimeter
3 Fuel Injector Harness Adapter – Special Tool J44602
4 To Battery Positive Terminal
5 Battery Earth

Fuel Injector Coil Test Example – Engine Coolant Temperature 10 – 32°C (Typical Values Shown)		
Fuel Injector No.	Voltage Reading	Pass / Fail (acceptable range 5.5 - 6.6 V)
1	6.6	Pass
2	5.4	Fail
3	6.2	Pass
4	6.1	Pass
5	6.7	Fail
6	6.0	Pass

Figure 6C1-2 – 18

Fuel Injector Coil Test Example – Engine Coolant Temperature Greater / Less Than 10 – 32°C (Typical Values Shown)				
Fuel Injector No.	Voltage Reading	Highest Voltage Reading (9.5 V or less)	Subtracted Value (acceptable voltage 0.6 V)	Pass / Fail
1	9.8	–	–	Fail
2	6.4	7.0	0.6	Pass
3	6.9	7.0	0.1	Pass
4	5.8	7.0	1.2	Fail
5	7.0	7.0	0.0	Pass
6	6.3	7.0	0.7	Fail

Figure 6C1-2 – 19

5.3 Fuel Injector Balance Test

CAUTION

To avoid irregular fuel pressure readings, do not perform this procedure if the engine coolant temperature is greater than 94° C.

Fuel Injector Balance Test – With Tech 2

1. Check the engine coolant temperature is less than 94°C.
2. Perform the fuel injector coil test and replace any fuel injectors that are not functioning correctly before proceeding. Refer to 5.2 Fuel Injector Coil Test in this Section.
3. Perform the fuel system pressure check and ensure the fuel system is functioning correctly before proceeding with the fuel injector balance test. Refer to Section 8A1 Fuel System.
4. While the fuel pressure gauge is still connected to the fuel pressure test point, pressurise the fuel system. Refer to Section 8A1 Fuel System.
5. When the fuel pressure reading stabilises, record the fuel pressure reading indicated by the fuel pressure gauge.

NOTE

The fuel pressure reading taken in Step 5 is known as the first pressure reading.

6. Connect Tech 2 to the data link connector (DLC) and turn the ignition on.
7. On Tech 2 select **Engine / V6 Engine / Actuator Test / Fuel Injector Balance**.
8. Follow the Tech 2 prompts, recording the fuel pressure gauge reading for each injector.

NOTE

The fuel pressure readings taken in Step 8 are known as the second pressure reading

9. Perform the Fuel Injector Pressure Drop Calculation in this Section.

Fuel Injector Balance Test – Without Tech 2

1. Check the engine coolant temperature is less than 94°C.
2. Perform the fuel injector coil test and replace any fuel injectors that are not functioning correctly before proceeding. Refer to 5.2 Fuel Injector Coil Test in this Section.
3. Perform the fuel system pressure check and ensure the fuel system is functioning correctly before proceeding with the fuel injector balance test. Refer to Section 8A1 Fuel System.
4. While the fuel pressure gauge is still connected to the fuel pressure test point, pressurise the fuel system. Refer to Section 8A1 Fuel System.
5. When the fuel pressure reading stabilises, record the fuel pressure reading indicated by the fuel pressure gauge.

NOTE

The fuel pressure reading taken in Step 5 is known as the first pressure reading.

6. Remove the upper intake manifold assembly, refer to Section 6A1 Engine Mechanical – V6.

NOTE

After removing the upper intake manifold, plug the lower manifold opening to prevent dirt and other contaminants from entering.

7. Connect Tool No. J 39021 Fuel Injector Tester (1), and Tool No. J 44602 (3) to the fuel injector connector. Refer to Figure 6C1-2 – 20.

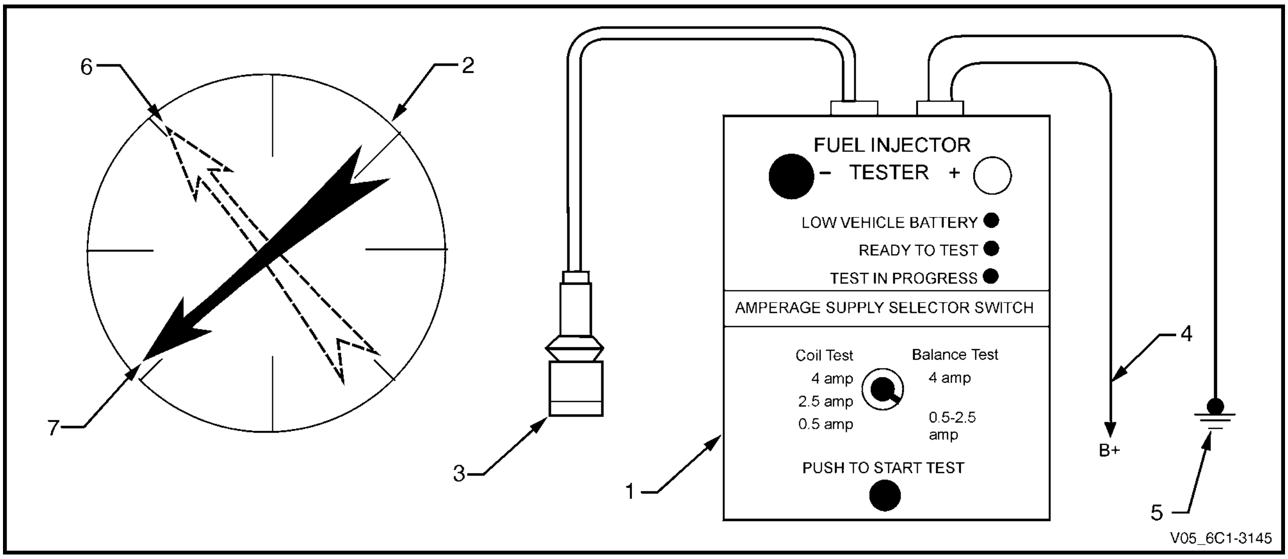


Figure 6C1-2 – 20

Legend

1	Fuel Injector Tester – Special Tool J39021	5	Battery Earth
2	Fuel Pressure Gauge – Special Tool SD28018	6	First Pressure Reading
3	Fuel Injector Harness Adapter – Special Tool J44602	7	Second Pressure Reading
4	To Battery Positive Terminal		

8 Connect the fuel injector tester battery positive lead (4) and battery negative lead (5) to the battery, refer to Figure 6C1-2 – 20.

9 Set the amperage supply selector of the fuel injector tester to the Balance Test 0.5 – 2.5 A position.

CAUTION

As the fuel pressure tends to increase after the fuel injector stops fuel delivery, record the fuel pressure value immediately after the fuel injector stops fuel delivery. Do not record the higher fuel pressure value.

10 Press the Push to Start Test Button on the fuel injector tester to activate the fuel injector.

11 Record the fuel pressure reading indicated by the fuel pressure gauge.

NOTE

The fuel pressure readings taken in Step 10 is known as the second pressure reading

12 Repeat the balance test pressure reading for each fuel injector.

13 Perform the Fuel Injector Pressure Drop Calculation in this Section.

Fuel Injector Pressure Drop Calculation

Fuel Injector Balance Test Example – Typical Values Shown						
Cylinder	1	2	3	4	5	6
1st Pressure Reading	360 kPa	360 kPa	360 kPa	360 kPa	360 kPa	360 kPa
2nd Pressure Reading	155 kPa	131 kPa	155 kPa	200 kPa	146 kPa	150 kPa
Amount of Pressure Drop	205 kPa	229 kPa	205 kPa	160 kPa	214 kPa	210 kPa
Average Range 194 - 214 kPa	Injector OK	Replace fuel injector – too much pressure drop	Injector OK	Replace fuel injector – too little pressure drop	Injector OK	Injector OK

Figure 6C1-2 – 21

1 Subtract the second pressure reading from the first pressure reading to calculate the pressure drop value. Refer to Figure 6C1-2 – 21, typical results.

2 Calculate the pressure drop value for each fuel injector.

3 Add all the individual pressure drop values of each fuel injector to calculate the total pressure drop.

4 Divide the total pressure drop by the number of fuel injectors to calculate the average pressure drop.

Fuel Injector Pressure Drop Analysis

1 A fuel injector is faulty if its pressure drop value deviates from the average pressure drop by more than 10 kPa.

CAUTION

Do not repeat any portion of the test before running the engine to prevent the engine from flooding.

2 Re-test any fuel injector that does not meet the specification.

3 Replace all faulty fuel injectors, refer to 2.15 Fuel Rail Assembly, in Section 6C1-3 Engine Management – V6 – Service Operations.

5.4 Fuel Injector Leak Down Test

1 Turn the ignition switch OFF.

NOTE

After removing the upper intake manifold, plug the lower manifold opening to prevent dirt and other contaminants from entering.

2 Remove the upper intake manifold assembly, refer to Section 6A1 Engine Mechanical – V6.

CAUTION

Clean around the area where the fuel injectors enter the lower intake manifold.

3 Remove the bolt (1), three places, attaching the fuel rail to the lower intake manifold.

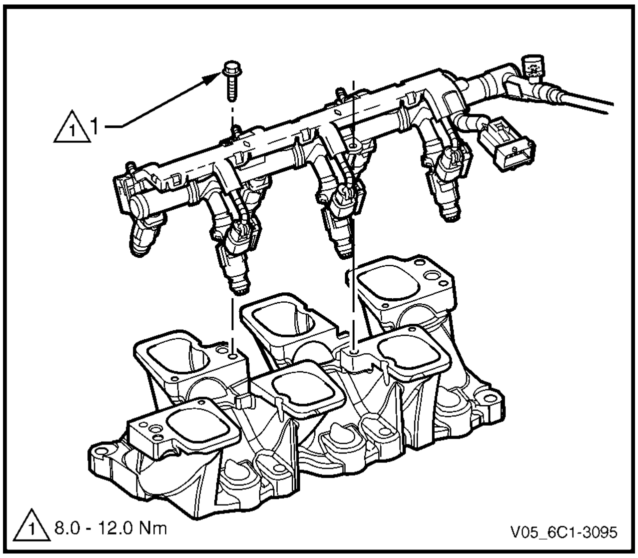


Figure 6C1-2 – 22

CAUTION

Care must be taken when removing the fuel rail and injector assembly to prevent damage to the injector spray tips and injector harness connector terminals.

Support the fuel rail and injector assembly after removal.

4 Lift up and support the fuel rail and injector assembly.

NOTE

Do not disconnect the fuel feed hose from the fuel rail.

5 Place a board (1) with a sheet of clean paper (2), preferably white, onto the lower intake manifold.

6 Using Tech 2, enable the fuel pump to pressurise the fuel system, refer to Section 0C Tech 2 for this procedure.

7 Whilst the fuel system is pressurised, check the following:

- Signs of fuel stains on the paper (3).
- Signs of weeping at the fuel injector spray tips (4).

8 If any of the above conditions are present, replace the leaking fuel injector/s, refer to 2.15 Fuel Rail Assembly, in Section 6C1-3 Engine Management – V6 – Service Operations.

9 Carefully reinstall the fuel rail and injector assembly.

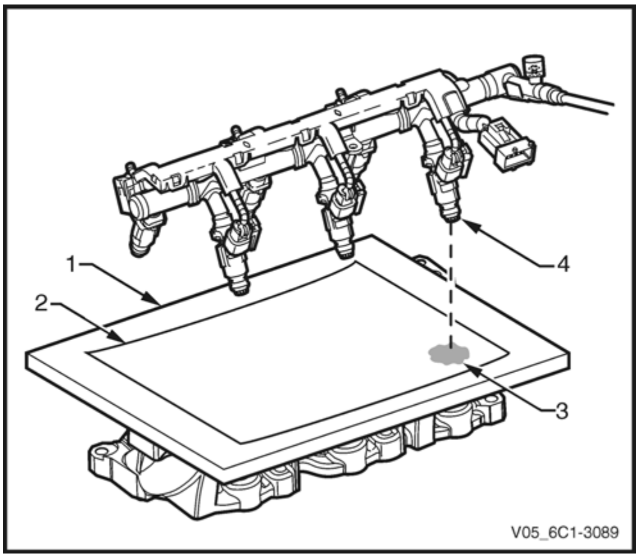


Figure 6C1-2 – 23

CAUTION

Ensure the fuel injectors are correctly seated in the lower intake manifold, and the fuel rail attaching brackets are correctly located prior to tightening the attaching bolts.

10 Tighten the fuel rail bolts to the correct torque specification.

Fuel rail attaching bolt torque specification ....8.0 – 12.0 Nm

11 Reinstall the upper intake manifold assembly, refer to Section 6A1 Engine Mechanical – V6.

12 Inspect the fuel rail and quick connect fitting for leaks, refer to Section 8A1 Fuel System.

13 Road test the vehicle and check for correct operation.

5.5 Alcohol / Contaminants in Fuel Diagnosis

Description

Water contamination in the fuel system may cause driveability conditions such as hesitation, stalling, no start, or misfires in one or more cylinders. Water may collect near a single fuel injector at the lowest point in the fuel rail, and cause a misfire in that cylinder. If the fuel system is contaminated with water, inspect the fuel system components for rust, or deterioration.

Alcohol (e.g. Ethanol) concentrations more than 10% in the fuel can be detrimental to fuel system components. Alcohol contamination may cause fuel system corrosion, deterioration of rubber components, and subsequent fuel filter restriction. Fuel contaminated with alcohol may cause driveability conditions such as hesitation, lack of power, stalling, or no start. Some types of alcohol are more detrimental to fuel system components than others.

Alcohol in Fuel Testing Procedure

NOTE

The procedures detailed are not intended to be accurate but rather, indicative of a contamination situation.

The fuel sample should be drawn from the bottom of the tank so that any water present in the tank will be detected. The sample should be bright and clear. If alcohol contamination is suspected, then use the following procedure to test the fuel quality.

- Using a 100 ml graduated cylinder with 1 ml marks, fill the cylinder with fuel to the 90 ml mark.
- Add 10 ml of water to bring the total fluid volume to 100 ml and install a stopper.
- Shake the cylinder vigorously for 10 – 15 seconds.
- Carefully loosen the stopper to release the pressure.
- Re-install the stopper and shake the cylinder vigorously again for 10 – 15 seconds.
- Put the cylinder on a level surface for approximately 5 minutes to allow adequate liquid separation.

If alcohol is present in the fuel, the volume of the lower layer, that now contains both alcohol and water, will be more than 10 ml. For example, if the volume of the lower layer is increased to 15 ml, this indicates at least 5 percent alcohol in the fuel. The actual amount of alcohol may be somewhat more because this procedure does not extract all of the alcohol from the fuel. To obtain an accurate determination of the amount of alcohol contamination in a given fuel sample, then professional analysis should be sought.

Particulate Contaminants in Fuel Testing Procedure

The fuel sample should be drawn from the bottom of the tank so that any contaminants present in the tank will be detected. The sample should be bright and clear. If the sample appears cloudy or contaminated with water as indicated by a water layer at the bottom of the sample, use the following procedure to diagnose the fuel.

- Using an approved fuel container, draw approximately 0.5 litre of fuel.
- Place the cylinder on a level surface for approximately 5 minutes to allow settling of the particulate contamination.

Particulate contamination will show up in various shapes and colours. Sand will typically be identified by a white or light brown crystals. Rubber will appear as black and irregular particles. If particles are found, clean the entire fuel system thoroughly. Refer to Section 8A1 Fuel Tank.

5.6 Crankshaft Position (CKP) System Variation Learn Procedure

Description

The crankshaft position system variation learn feature is carried out automatically on the HFV6 engine under decel with fuel cut. The road speed and duration of the self-learn process varies with different vehicle equipment levels such as transmission, final drive ratio etc.

The variation learn procedure cannot be over-written, nor can it be accessed with Tech 2.

5.7 Throttle Body Relearn

A throttle body relearn procedure is performed in one of two ways:

- Engine Control Module initiated throttle body relearn, or
- Tech 2 initiated throttle body relearn.

Engine Control Module Throttle Body Relearn

The engine control module (ECM) will automatically perform a throttle body relearn procedure if either of the following conditions exist:

- The battery has been disconnected, or
- The ignition switch is in the ON position for greater than 29 seconds, and the following conditions are met:
  - Engine speed is less than 40 rpm,
  - Vehicle speed is 0 km/h,
  - Engine coolant temperature is 5 – 60°C,
  - Intake air temperature is 5 – 60°C,
  - Accelerator pedal position sensor angle is less than 14.9%, and
  - Ignition voltage is greater than 10 V.

Tech 2 Throttle Body Relearn

To perform a throttle body relearn using Tech 2, complete the following procedure:

NOTE

Tech 2 will not initiate a throttle body relearn if the engine is running.

1. Connect Tech 2 to the data link connector (DLC) and turn the ignition on.
2. On Tech 2 select Engine / Programming / Throttle Body Relearn.
3. When Tech 2 displays ‘Do you really want to Reset?’, press the ‘Yes’ soft key.
4. When Tech 2 displays ‘Programming Completed’, and the electronic throttle control value displayed by Tech 2 is ‘11’, press the ‘Confirm’ soft key to return to the Tech 2 Programming screen.
5. The throttle body relearn is now complete.

5.8 Intake Manifold Runner Control (IMRC) System Diagnosis

Circuit Description

An intake manifold runner control (IMRC) valve is used to change the intake manifold plenum configuration. When the IMRC valve is open, the intake manifold is configured to one large plenum. When the IMRC valve is closed, the intake manifold is configured to 2 smaller plenums. The IMRC valve improves engine performance at low and high engine speeds.

Ignition voltage is supplied directly to the IMRC solenoid. The engine control module (ECM) controls the solenoid by grounding the control circuit with a solid state device called a driver. The driver is equipped with a feedback circuit that is pulled up to a voltage. The ECM can determine if the control circuit is open, shorted to ground, or shorted to a voltage by monitoring the feedback voltage.

Additional Information

Inspect the IMRC solenoid valve for witness marks that indicate that the valve was hitting the intake manifold. This condition may be temperature related.

Test Description

The number below refers to the step number on the diagnostic table.

2 This diagnostic table will only diagnose the mechanical portion of the IMRC solenoid. If there is a DTC set for the IMRC solenoid, refer to the appropriate DTC table. Refer to DTC List in Ascending Order.

Diagnostic Table

Step	Action	Value(s)	Yes	No
1	Has the Diagnostic System Check been completed?	—	Go to Step 2	Refer to 3.4 Diagnostic System Check
2	1 Ignition ON, engine OFF. 2 Use Tech 2 to check the DTC information. Is DTC P2008, P2009, or P2010 set?	—	Go to 6.1 DTC List in Ascending Order	Go to Step 3
3	1 Remove the intake manifold runner control (IMRC) solenoid from the intake manifold, but leave the electrical connector connected. Refer to Intake Manifold Runner Control Solenoid Valve, in Section 6C1-3 Engine Diagnosis – V6 – Service Operations. 2 Use Tech 2 to command the IMRC solenoid ON and OFF. 3 Observe the valve of the IMRC solenoid while you command the IMRC solenoid ON and OFF. Does the valve of the IMRC solenoid move in both directions?	—	Go to Step 4	Go to Step 5

4	1 Inspect the inside of the intake manifold for the following conditions: • Carbon build-up that limits the movement of the IMRC valve. • Casting flash that limits the movement of the IMRC valve. • Foreign material that limits the movement of the IMRC valve. 2 Clean or replace the upper intake manifold as required. Refer to 2.12 Upper Intake Manifold, in Section 6A1 Engine Mechanical – V6 Engine. Did you find and correct the condition?	—	Go to Step 6	Go to Additional Information in this DTC
5	1 Replace the IMRC solenoid. Refer to Intake Manifold Runner Control Solenoid Valve, in Section 6C1-3 Engine Diagnosis – V6 – Service Operations. Did you complete the replacement?	—	Go to Step 6	—
6	1 Connect all disconnected components. 2 Clear the DTCs with Tech 2. 3 Start the engine. 4 Operate the system to verify the repair. Did you correct the condition?	—	Go to Step 7	Go to Step 2
7	1 Using Tech 2, select the DTC display function. Does Tech 2 display any DTCs?	—	Go to the appropriate DTC Table	System OK
When all diagnosis and repairs are completed, clear all DTCs and verify correct operation				

5.9 Electronic Ignition (EI) System Diagnosis

Circuit Description

The engine control module (ECM) controls the ignition coils by pulsing the ignition control (IC) circuits, which triggers an ignition coil and fires the spark plug. The ECM controls the sequencing and the timing of each ignition coil. The ignition system consist of the following components:

- The six ignition coils
- The crankshaft position (CKP) sensor
- The four camshaft position (CMP) sensors
- The ECM

The ignition coils use the following circuits:

- An IC circuit
- An ignition 1 voltage circuit
- Two ground circuits

Additional Information

- Use the J 35616-B Connector Test Adapter Kit for any test that requires probing the ECM harness connector or a component harness connector.
- Inspect the ignition coils for aftermarket devices. An aftermarket device connected to the ignition coil circuits, may cause a condition with the ignition coils.
- For an intermittent fault condition, refer to 4.2 Intermittent Fault Conditions in this Section.
- To assist diagnosis, refer to 2 Wiring Diagrams and Connector Charts in this Section for the system wiring diagram and connector charts.

Test Description

The numbers below refer to the step numbers on the diagnostic table.

4 The ignition coils for each bank are fused separately. If a fuse opens or the ignition 1 voltage circuit opens between the fuse and the splice, all the ignition coils for one bank of the engine would be inoperative. If the ground circuit opens at the engine block, the ignition coils would be inoperative for one bank of the engine.

5 This step tests for an open or a high resistance in the ignition 1 voltage circuit of the ignition coil. If the DMM does not display near battery voltage there is an open or a high resistance in the circuit.

6 This step determines if the ground circuit is open. If the circuit is open, the ignition coils would be inoperative for one bank of the engine.

7 This step determines if the ignition 1 voltage circuit is shorted to ground. If the fuse is open, the ignition coils would be inoperative for one bank of the engine.

Diagnostic Table

Step	Action	Value(s)	Yes	No
1	Has the Diagnostic System Check been performed?	—	Go to Step 2	Refer to 3.4 Diagnostic System Check
2	Were you sent here from DTC P0300 or P0301-P0306?	—	Go to Step 3	Go to 6.18 DTC P0300 or 6.19 DTC P0301, P0302, P0303, P0304, P0305 or P0306

3	1 Start the engine. 2 Allow the engine to reach operating temperature. 3 Operate the engine at 2,000 rpm. 4 Monitor all of the Misfire Current Counters with a scan tool. There are a total of 6 counters, 1 counter per cylinder. Are any of the Misfire Current Counters incrementing?	—	Go to Step 4	Go to 4.2 Intermittent Fault Conditions
4	Are all the misfire counters incrementing for one bank of the engine?	—	Go to Step 7	Go to Step 5
5	1 Ignition OFF. 2 Disconnect the appropriate ignition coil. 3 Ignition ON, engine OFF. 4 Connect a test lamp between the battery voltage circuit of the ignition coil and a good ground. 5 Measure the voltage between the probe of the test lamp and a good ground with a DMM. Refer to Section 12 P Wiring Diagrams for the procedure to measure voltage drop. Is the voltage at the specified value?	B+	Go to Step 6	Go to Step 9
6	1 Connect the test lamp between the battery voltage circuit of the ignition coil and to each ground circuit of the ignition coil. Does the test lamp illuminate at each ground circuit?	—	Go to Step 8	Go to Step 10
7	1 Test the battery voltage circuit for an open or high resistance at the splice of the affected bank of ignition coils. Refer to Section 12P Wiring Diagrams for circuit testing procedures. Did you find and correct the condition?	—	Go to Step 12	Go to Step 10
8	1 Test for an intermittent and for a poor connection at the ignition coil. Refer to Section 12P Wiring Diagrams for circuit testing procedures. Did you find and correct the condition?	—	Go to Step 12	Go to Step 11
9	**NOTE** The battery voltage circuit is shared with other components. Disconnecting a component on the shared battery voltage circuit may isolate a shorted component. Review the electrical schematic and diagnose the shared circuits and components. 1 Repair a short to ground, an open or high resistance in the ignition 1 voltage circuit. Refer to Section 12P Wiring Diagrams for wiring repair procedures. 2 Replace the fuse as necessary. Did you complete the repair?	—	Go to Step 12	—
10	1 Repair the open or high resistance in the ground circuit. Refer to Section 12P Wiring Diagrams for wiring repair procedures. Did you complete the repair?	—	Go to Step 12	—

11	1 Replace the ignition coil. Refer to 2.17 Ignition Coils, in Section 6C1-3 Engine Management – V6 – Service Operations. Did you complete the replacement?	—	Go to Step 12	—
12	1 Connect all disconnected components. 2 Use Tech 2 to clear the DTC/s. 3 Start the engine. 4 Observe the Capture Info with Tech 2. Do any of the misfire counters increment?	—	Go to Step 2	Go to Step 13
13	1 Using Tech 2, select the DTC display function. Does Tech 2 display any DTCs?	—	Go to the appropriate DTC Table	System OK
When all diagnosis and repairs are completed, clear all DTCs and verify correct operation				

6 Diagnostic Trouble Code Tables

6.1 DTC List in Ascending Order

As a number of diagnostic tables cater for multiple DTC numbers, a specific DTC table may be difficult to locate. To make a specific DTC diagnostic table easier to find, the next list is arranged in numerical ascending order. The actual diagnostic table can be located by selecting the link provided.

DTC	Description	Diagnostic Table
P0008	Engine Position System Performance (Bank 1)	6.2 DTC P0008, P0009, P0016, P0017, P0018 or P0019
P0009	Engine Position System Performance (Bank 2)	6.2 DTC P0008, P0009, P0016, P0017, P0018 or P0019
P0010	Intake Camshaft Position Control Solenoid Circuit Malfunction (Bank 1)	6.3 DTC P0010, P0013, P0020, P0023, P2088, P2089, P2090, P2091, P2092, P2093, P2094 or P2095
P0011	Intake Camshaft Position Range / Performance (Bank 1)	6.4 DTC P0011, P0014, P0021, P0024, P1011, P1012, P1013, or P1014
P0013	Exhaust Camshaft Position Control Solenoid Circuit Malfunction (Bank 1)	6.3 DTC P0010, P0013, P0020, P0023, P2088, P2089, P2090, P2091, P2092, P2093, P2094 or P2095
P0014	Exhaust Camshaft Position Range / Performance (Bank 1)	6.4 DTC P0011, P0014, P0021, P0024, P1011, P1012, P1013, or P1014
P0016	Crankshaft / Intake Camshaft Position not Plausible (Bank 1)	6.2 DTC P0008, P0009, P0016, P0017, P0018 or P0019
P0017	Crankshaft / Exhaust Camshaft Position not Plausible (Bank 1)	6.2 DTC P0008, P0009, P0016, P0017, P0018 or P0019
P0018	Crankshaft / Intake Camshaft Position not Plausible (Bank 2)	6.2 DTC P0008, P0009, P0016, P0017, P0018 or P0019
P0019	Crankshaft / Exhaust Camshaft Position not Plausible (Bank 2)	6.2 DTC P0008, P0009, P0016, P0017, P0018 or P0019
P0020	Intake Camshaft Position Control Solenoid Circuit Malfunction (Bank 2)	6.3 DTC P0010, P0013, P0020, P0023, P2088, P2089, P2090, P2091, P2092, P2093, P2094 or P2095
P0021	Intake Camshaft Position Range / Performance (Bank 2)	6.4 DTC P0011, P0014, P0021, P0024, P1011, P1012, P1013, or P1014
P0023	Exhaust Camshaft Position Control Solenoid Circuit Malfunction (Bank 2)	6.3 DTC P0010, P0013, P0020, P0023, P2088, P2089, P2090, P2091, P2092, P2093, P2094 or P2095
P0024	Exhaust Camshaft Position Range / Performance (Bank 2)	6.4 DTC P0011, P0014, P0021, P0024, P1011, P1012, P1013, or P1014
P0030	O2 Sensor Heater Circuit Malfunction (Bank 1, Sensor 1)	6.5 DTC P0030, P0031, P0032, P0036, P0037, P0038, P0050, P0051, P0052, P0056, P0057 or P0058
P0031	O2 Sensor Heater Circuit Low Voltage (Bank 1, Sensor 1)	6.5 DTC P0030, P0031, P0032, P0036, P0037, P0038, P0050, P0051, P0052, P0056, P0057 or P0058
P0032	O2 Sensor Heater Circuit High Voltage (Bank 1, Sensor 1)	6.5 DTC P0030, P0031, P0032, P0036, P0037, P0038, P0050, P0051, P0052, P0056, P0057 or P0058
P0036	O2 Sensor Heater Circuit Malfunction (Bank 1, Sensor 2)	6.5 DTC P0030, P0031, P0032, P0036, P0037, P0038, P0050, P0051, P0052, P0056, P0057 or P0058

DTC	Description	Diagnostic Table
P0037	O2 Sensor Heater Circuit Low Voltage (Bank 1, Sensor 2)	6.5 DTC P0030, P0031, P0032, P0036, P0037, P0038, P0050, P0051, P0052, P0056, P0057 or P0058
P0038	O2 Sensor Heater Circuit High Voltage (Bank 1, Sensor 2)	6.5 DTC P0030, P0031, P0032, P0036, P0037, P0038, P0050, P0051, P0052, P0056, P0057 or P0058
P0040	O2 Sensor Signals Not Plausible (Bank 1, Sensor 1 & Bank 2, Sensor 1)	6.6 DTC P0040 or P0041
P0041	O2 Sensor Signals Not Plausible (Bank 1, Sensor 2 & Bank 2, Sensor 2)	6.6 DTC P0040 or P0041
P0050	O2 Sensor Heater Circuit Malfunction (Bank 2, Sensor 1)	6.5 DTC P0030, P0031, P0032, P0036, P0037, P0038, P0050, P0051, P0052, P0056, P0057 or P0058
P0051	O2 Sensor Heater Circuit Low Voltage (Bank 2, Sensor 1)	6.5 DTC P0030, P0031, P0032, P0036, P0037, P0038, P0050, P0051, P0052, P0056, P0057 or P0058
P0052	O2 Sensor Heater Circuit High Voltage (Bank 2, Sensor 1)	6.5 DTC P0030, P0031, P0032, P0036, P0037, P0038, P0050, P0051, P0052, P0056, P0057 or P0058
P0053	O2 Sensor Heater Resistance Range / Performance (Bank 1, Sensor 1)	6.7 DTC P0053 or P0059
P0056	O2 Sensor Heater Circuit Malfunction (Bank 2, Sensor 2)	6.5 DTC P0030, P0031, P0032, P0036, P0037, P0038, P0050, P0051, P0052, P0056, P0057 or P0058
P0057	O2 Sensor Heater Circuit Low Voltage (Bank 2, Sensor 2)	6.5 DTC P0030, P0031, P0032, P0036, P0037, P0038, P0050, P0051, P0052, P0056, P0057 or P0058
P0058	O2 Sensor Heater Circuit High Voltage (Bank 2, Sensor 2)	6.5 DTC P0030, P0031, P0032, P0036, P0037, P0038, P0050, P0051, P0052, P0056, P0057 or P0058
P0059	O2 Sensor Heater Resistance Range / Performance (Bank 2, Sensor 1)	6.7 DTC P0053 or P0059
P0101	Mass Air Flow Sensor Circuit Range / Performance	6.8 DTC P0101, P0102 or P0103
P0102	Mass Air Flow Sensor Voltage Low	6.8 DTC P0101, P0102 or P0103
P0103	Mass Air Flow Sensor Voltage High	6.8 DTC P0101, P0102 or P0103
P0112	Intake Air Temperature Sensor Circuit Low Voltage	6.9 DTC P0112 or P0113
P0113	Intake Air Temperature Sensor Circuit High Voltage	6.9 DTC P0112 or P0113
P0116	Engine Coolant Temperature Sensor Circuit Range / Performance	6.10 DTC P0116, P0117, P0118, P0125 or P1258
P0117	Engine Coolant Temperature Sensor Circuit Low Voltage	6.10 DTC P0116, P0117, P0118, P0125 or P1258
P0118	Engine Coolant Temperature Sensor Circuit High Voltage	6.10 DTC P0116, P0117, P0118, P0125 or P1258
P0121	Throttle Position Sensor 1 Circuit Range / Performance	6.11 DTC P0121, P0122, P0123, P0221, P0222,or P0223
P0122	Throttle Position Sensor 1 Circuit Low Voltage	6.11 DTC P0121, P0122, P0123, P0221, P0222,or P0223
P0123	Throttle Position Sensor 1 Circuit High Voltage	6.11 DTC P0121, P0122, P0123, P0221, P0222,or P0223

DTC	Description	Diagnostic Table
P0125	Insufficient Engine Coolant Temperature For Closed Loop Fuel Control	6.10 DTC P0116, P0117, P0118, P0125 or P1258
P0130	O2 Sensor Circuit Malfunction (Bank 1, Sensor 1)	6.12 DTC P0130, P0131, P0132, P0135, P0137, P0138, P0140, P0141, P0150 P0151, P0152, P0155, P0157, P0158, P0160, P0161, P2243, P2247, P2270, P2271, P2272, P2273, P2297 or P2298
P0131	O2 Sensor Circuit Low Voltage (Bank 1, Sensor 1)	6.12 DTC P0130, P0131, P0132, P0135, P0137, P0138, P0140, P0141, P0150 P0151, P0152, P0155, P0157, P0158, P0160, P0161, P2243, P2247, P2270, P2271, P2272, P2273, P2297 or P2298
P0132	O2 Sensor Circuit High Voltage (Bank 1 Sensor 1)	6.12 DTC P0130, P0131, P0132, P0135, P0137, P0138, P0140, P0141, P0150 P0151, P0152, P0155, P0157, P0158, P0160, P0161, P2243, P2247, P2270, P2271, P2272, P2273, P2297 or P2298
P0133	O2 Sensor Circuit Slow Response (Bank 1 Sensor 1)	6.13 DTC P0133 or P0153
P0135	O2 Sensor Heater Circuit Range / Performance (Bank 1, Sensor 1)	6.12 DTC P0130, P0131, P0132, P0135, P0137, P0138, P0140, P0141, P0150 P0151, P0152, P0155, P0157, P0158, P0160, P0161, P2243, P2247, P2270, P2271, P2272, P2273, P2297 or P2298
P0137	O2 Sensor Circuit Low Voltage (Bank 1, Sensor 2)	6.12 DTC P0130, P0131, P0132, P0135, P0137, P0138, P0140, P0141, P0150 P0151, P0152, P0155, P0157, P0158, P0160, P0161, P2243, P2247, P2270, P2271, P2272, P2273, P2297 or P2298
P0138	O2 Sensor Circuit High Voltage (Bank 1, Sensor 2)	6.12 DTC P0130, P0131, P0132, P0135, P0137, P0138, P0140, P0141, P0150 P0151, P0152, P0155, P0157, P0158, P0160, P0161, P2243, P2247, P2270, P2271, P2272, P2273, P2297 or P2298
P0139	O2 Sensor Slow Response (Bank1 Sensor 2)	6.14 DTC P0139 or P0159
P0140	O2 Sensor Circuit No Activity Detected (Bank 1 Sensor 2)	6.12 DTC P0130, P0131, P0132, P0135, P0137, P0138, P0140, P0141, P0150 P0151, P0152, P0155, P0157, P0158, P0160, P0161, P2243, P2247, P2270, P2271, P2272, P2273, P2297 or P2298
P0141	O2 Sensor Heater Circuit Range / Performance (Bank 1, Sensor 2)	6.12 DTC P0130, P0131, P0132, P0135, P0137, P0138, P0140, P0141, P0150 P0151, P0152, P0155, P0157, P0158, P0160, P0161, P2243, P2247, P2270, P2271, P2272, P2273, P2297 or P2298
P0150	O2 Sensor Circuit Malfunction (Bank 2, Sensor 1)	6.12 DTC P0130, P0131, P0132, P0135, P0137, P0138, P0140, P0141, P0150 P0151, P0152, P0155, P0157, P0158, P0160, P0161, P2243, P2247, P2270, P2271, P2272, P2273, P2297 or P2298
P0151	O2 Sensor Circuit Low Voltage (Bank 2, Sensor 1)	6.12 DTC P0130, P0131, P0132, P0135, P0137, P0138, P0140, P0141, P0150 P0151, P0152, P0155, P0157, P0158, P0160, P0161, P2243, P2247, P2270, P2271, P2272, P2273, P2297 or P2298

DTC	Description	Diagnostic Table
P0152	O2 Sensor Circuit High Voltage (Bank 2, Sensor 1)	6.12 DTC P0130, P0131, P0132, P0135, P0137, P0138, P0140, P0141, P0150 P0151, P0152, P0155, P0157, P0158, P0160, P0161, P2243, P2247, P2270, P2271, P2272, P2273, P2297 or P2298
P0153	O2 Sensor Circuit Slow Response (Bank 2 Sensor 1)	6.13 DTC P0133 or P0153
P0155	O2 Sensor Heater Circuit Range / Performance (Bank 2, Sensor 1)	6.12 DTC P0130, P0131, P0132, P0135, P0137, P0138, P0140, P0141, P0150 P0151, P0152, P0155, P0157, P0158, P0160, P0161, P2243, P2247, P2270, P2271, P2272, P2273, P2297 or P2298
P0157	O2 Sensor Circuit Low Voltage (Bank 2, Sensor 2)	6.12 DTC P0130, P0131, P0132, P0135, P0137, P0138, P0140, P0141, P0150 P0151, P0152, P0155, P0157, P0158, P0160, P0161, P2243, P2247, P2270, P2271, P2272, P2273, P2297 or P2298
P0158	O2 Sensor Circuit High Voltage (Bank 2, Sensor 2)	6.12 DTC P0130, P0131, P0132, P0135, P0137, P0138, P0140, P0141, P0150 P0151, P0152, P0155, P0157, P0158, P0160, P0161, P2243, P2247, P2270, P2271, P2272, P2273, P2297 or P2298
P0159	O2 Sensor Slow Response (Bank1 Sensor 2)	6.14 DTC P0139 or P0159
P0160	O2 Sensor Circuit No Activity Detected (Bank 2, Sensor 2)	6.12 DTC P0130, P0131, P0132, P0135, P0137, P0138, P0140, P0141, P0150 P0151, P0152, P0155, P0157, P0158, P0160, P0161, P2243, P2247, P2270, P2271, P2272, P2273, P2297 or P2298
P0161	O2 Sensor Heater Circuit Range / Performance (Bank 2, Sensor 2)	6.12 DTC P0130, P0131, P0132, P0135, P0137, P0138, P0140, P0141, P0150 P0151, P0152, P0155, P0157, P0158, P0160, P0161, P2243, P2247, P2270, P2271, P2272, P2273, P2297 or P2298
P0196	Engine Oil Temperature Sensor Range / Performance	6.15 DTC P0196, P0197 or P0198
P0197	Engine Oil Temperature Voltage Low	6.15 DTC P0196, P0197 or P0198
P0198	Engine Oil Temperature Voltage High	6.15 DTC P0196, P0197 or P0198
P0201	Injector 1 Control Circuit Malfunction	6.16 DTC P0201, P0202, P0203, P0204, P0205, P0206, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P0273, P0274, P0276 or P0277
P0202	Injector 2 Control Circuit Malfunction	6.16 DTC P0201, P0202, P0203, P0204, P0205, P0206, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P0273, P0274, P0276 or P0277
P0203	Injector 3 Control Circuit Malfunction	6.16 DTC P0201, P0202, P0203, P0204, P0205, P0206, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P0273, P0274, P0276 or P0277
P0204	Injector 4 Control Circuit Malfunction	6.16 DTC P0201, P0202, P0203, P0204, P0205, P0206, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P0273, P0274, P0276 or P0277
P0205	Injector 5 Control Circuit Malfunction	6.16 DTC P0201, P0202, P0203, P0204, P0205, P0206, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P0273, P0274, P0276 or P0277

DTC	Description	Diagnostic Table
P0206	Injector 6 Control Circuit Malfunction	6.16 DTC P0201, P0202, P0203, P0204, P0205, P0206, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P0273, P0274, P0276 or P0277
P0219	Engine Overspeed Condition	6.17 DTC P0219
P0221	Throttle Position Sensor 2 Circuit Range / Performance	6.11 DTC P0121, P0122, P0123, P0221, P0222,or P0223
P0222	Throttle Position Sensor 2 Circuit Low Voltage	6.11 DTC P0121, P0122, P0123, P0221, P0222,or P0223
P0223	Throttle Position Sensor 2 Circuit High Voltage	6.11 DTC P0121, P0122, P0123, P0221, P0222,or P0223
P0261	Injector 1 Control Circuit Low Voltage	6.16 DTC P0201, P0202, P0203, P0204, P0205, P0206, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P0273, P0274, P0276 or P0277
P0262	Injector 1 Control Circuit High Voltage	6.16 DTC P0201, P0202, P0203, P0204, P0205, P0206, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P0273, P0274, P0276 or P0277
P0264	Injector 2 Control Circuit Low Voltage	6.16 DTC P0201, P0202, P0203, P0204, P0205, P0206, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P0273, P0274, P0276 or P0277
P0265	Injector 2 Control Circuit High Voltage	6.16 DTC P0201, P0202, P0203, P0204, P0205, P0206, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P0273, P0274, P0276 or P0277
P0267	Injector 3 Control Circuit Low Voltage	6.16 DTC P0201, P0202, P0203, P0204, P0205, P0206, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P0273, P0274, P0276 or P0277
P0268	Injector 3 Control Circuit High Voltage	6.16 DTC P0201, P0202, P0203, P0204, P0205, P0206, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P0273, P0274, P0276 or P0277
P0270	Injector 4 Control Circuit Low Voltage	6.16 DTC P0201, P0202, P0203, P0204, P0205, P0206, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P0273, P0274, P0276 or P0277
P0271	Injector 4 Control Circuit High Voltage	6.16 DTC P0201, P0202, P0203, P0204, P0205, P0206, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P0273, P0274, P0276 or P0277
P0273	Injector 5 Control Circuit Low Voltage	6.16 DTC P0201, P0202, P0203, P0204, P0205, P0206, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P0273, P0274, P0276 or P0277
P0274	Injector 5 Control Circuit High Voltage	6.16 DTC P0201, P0202, P0203, P0204, P0205, P0206, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P0273, P0274, P0276 or P0277
P0276	Injector 6 Control Circuit Low Voltage	6.16 DTC P0201, P0202, P0203, P0204, P0205, P0206, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P0273, P0274, P0276 or P0277

DTC	Description	Diagnostic Table
P0277	Injector 6 Control Circuit High Voltage	6.16 DTC P0201, P0202, P0203, P0204, P0205, P0206, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P0273, P0274, P0276 or P0277
P0300	Engine Misfire Detected	6.18 DTC P0300
P0301	Cylinder 1 Misfire Detected	6.19 DTC P0301, P0302, P0303, P0304, P0305 or P0306
P0302	Cylinder 2 Misfire Detected	6.19 DTC P0301, P0302, P0303, P0304, P0305 or P0306
P0303	Cylinder 3 Misfire Detected	6.19 DTC P0301, P0302, P0303, P0304, P0305 or P0306
P0304	Cylinder 4 Misfire Detected	6.19 DTC P0301, P0302, P0303, P0304, P0305 or P0306
P0305	Cylinder 5 Misfire Detected	6.19 DTC P0301, P0302, P0303, P0304, P0305 or P0306
P0306	Cylinder 6 Misfire Detected	6.19 DTC P0301, P0302, P0303, P0304, P0305 or P0306
P0324	Knock Sensor Module Performance	6.20 DTC P0324
P0327	Knock Sensor Circuit Low Frequency (Bank 1)	6.21 DTC P0327, P0328, P0332 or P0333
P0328	Knock Sensor Circuit High Frequency (Bank 1)	6.21 DTC P0327, P0328, P0332 or P0333
P0332	Knock Sensor Circuit Low Frequency (Bank 2)	6.21 DTC P0327, P0328, P0332 or P0333
P0333	Knock Sensor Circuit High Frequency (Bank 2)	6.21 DTC P0327, P0328, P0332 or P0333
P0335	Crankshaft Position Sensor Circuit Malfunction	6.22 DTC P0335, P0336, P0337 or P0338
P0336	Crankshaft Position Sensor Signal Range / Performance	6.22 DTC P0335, P0336, P0337 or P0338
P0337	Crankshaft Position Sensor Circuit Low Duty Cycle	6.22 DTC P0335, P0336, P0337 or P0338
P0338	Crankshaft Position Sensor Circuit High Duty Cycle	6.22 DTC P0335, P0336, P0337 or P0338
P0341	Intake Camshaft Position Sensor Range / Performance (Bank 1)	6.23 DTC P0341, P0342, P0343, P0346, P0347, P0348, P0366, P0367, P0368, P0391, P0392 or P0393
P0342	Intake Camshaft Position Sensor Low Voltage (Bank 1)	6.23 DTC P0341, P0342, P0343, P0346, P0347, P0348, P0366, P0367, P0368, P0391, P0392 or P0393
P0343	Intake Camshaft Position Sensor High Voltage (Bank 1)	6.23 DTC P0341, P0342, P0343, P0346, P0347, P0348, P0366, P0367, P0368, P0391, P0392 or P0393
P0346	Intake Camshaft Position Sensor Range / Performance (Bank 2)	6.23 DTC P0341, P0342, P0343, P0346, P0347, P0348, P0366, P0367, P0368, P0391, P0392 or P0393
P0347	Intake Camshaft Position Sensor Low Voltage (Bank 2)	6.23 DTC P0341, P0342, P0343, P0346, P0347, P0348, P0366, P0367, P0368, P0391, P0392 or P0393
P0348	Intake Camshaft Position Sensor High Voltage (Bank 2)	6.23 DTC P0341, P0342, P0343, P0346, P0347, P0348, P0366, P0367, P0368, P0391, P0392 or P0393
P0351	Ignition Coil Cylinder 1 Circuit Malfunction	6.24 DTC P0351, P0352, P0353, P0354, P0355, P0356, P2300, P2301, P2303, P2304, P2306, P2307, P2309, P2310, P2312, P2313, P2315 or P2316

DTC	Description	Diagnostic Table
P0352	Ignition Coil Cylinder 2 Circuit Malfunction	6.24 DTC P0351, P0352, P0353, P0354, P0355, P0356, P2300, P2301, P2303, P2304, P2306, P2307, P2309, P2310, P2312, P2313, P2315 or P2316
P0353	Ignition Coil Cylinder 3 Circuit Malfunction	6.24 DTC P0351, P0352, P0353, P0354, P0355, P0356, P2300, P2301, P2303, P2304, P2306, P2307, P2309, P2310, P2312, P2313, P2315 or P2316
P0354	Ignition Coil Cylinder 4 Circuit Malfunction	6.24 DTC P0351, P0352, P0353, P0354, P0355, P0356, P2300, P2301, P2303, P2304, P2306, P2307, P2309, P2310, P2312, P2313, P2315 or P2316
P0355	Ignition Coil Cylinder 5 Circuit Malfunction	6.24 DTC P0351, P0352, P0353, P0354, P0355, P0356, P2300, P2301, P2303, P2304, P2306, P2307, P2309, P2310, P2312, P2313, P2315 or P2316
P0356	Ignition Coil Cylinder 6 Circuit Malfunction	6.24 DTC P0351, P0352, P0353, P0354, P0355, P0356, P2300, P2301, P2303, P2304, P2306, P2307, P2309, P2310, P2312, P2313, P2315 or P2316
P0366	Exhaust Camshaft Position Sensor Range / Performance (Bank 1)	6.23 DTC P0341, P0342, P0343, P0346, P0347, P0348, P0366, P0367, P0368, P0391, P0392 or P0393
P0367	Exhaust Camshaft Position Sensor Low Voltage (Bank 1)	6.23 DTC P0341, P0342, P0343, P0346, P0347, P0348, P0366, P0367, P0368, P0391, P0392 or P0393
P0368	Exhaust Camshaft Position Sensor High Voltage (Bank 1)	6.23 DTC P0341, P0342, P0343, P0346, P0347, P0348, P0366, P0367, P0368, P0391, P0392 or P0393
P0391	Exhaust Camshaft Position Sensor Range / Performance (Bank 2)	6.23 DTC P0341, P0342, P0343, P0346, P0347, P0348, P0366, P0367, P0368, P0391, P0392 or P0393
P0392	Exhaust Camshaft Position Sensor Low Voltage (Bank 2)	6.23 DTC P0341, P0342, P0343, P0346, P0347, P0348, P0366, P0367, P0368, P0391, P0392 or P0393
P0393	Exhaust Camshaft Position Sensor High Voltage (Bank 2)	6.23 DTC P0341, P0342, P0343, P0346, P0347, P0348, P0366, P0367, P0368, P0391, P0392 or P0393
P0420	Catalytic System – Low Efficiency (Bank 1)	6.25 DTC P0420 or P0430
P0430	Catalytic System – Low Efficiency (Bank 2)	6.25 DTC P0420 or P0430
P0443	Evaporative Emission Control System Purge Solenoid Circuit Malfunction	6.26 DTC P0443, P0458 or P0459
P0458	Evaporative Emission Control System Purge Solenoid Circuit Low Voltage	6.26 DTC P0443, P0458 or P0459
P0459	Evaporative Emission Control System Purge Solenoid Circuit High Voltage	6.26 DTC P0443, P0458 or P0459
P0460	Fuel Level Sensor Range / Performance	6.27 DTC P0460, P0461, P0462 or P0463
P0461	Fuel Level Sensor Range / Performance	6.27 DTC P0460, P0461, P0462 or P0463
P0462	Fuel Level Sensor Low Voltage	6.27 DTC P0460, P0461, P0462 or P0463
P0463	Fuel Level Sensor High Voltage	6.27 DTC P0460, P0461, P0462 or P0463
P0480	Cooling Fan Relay 1 Circuit Malfunction	6.28 DTC P0480, P0481, P0691, P0692, P0693 or P0694

DTC	Description	Diagnostic Table
P0481	Cooling Fan Relay 2 and 3 Circuit Malfunction	6.28 DTC P0480, P0481, P0691, P0692, P0693 or P0694
P0500	Vehicle Speed Sensor Circuit Malfunction	6.29 DTC P0500
P0504	Brake Switch Circuit Malfunction	6.30 DTC P0504 or P0571
P0506	Idle Speed Control rpm Too Low	6.31 DTC P0506, P0507, P0638, P1551, P2100, P2101, P2119 or P2176
P0507	Idle Speed Control rpm Too High	6.31 DTC P0506, P0507, P0638, P1551, P2100, P2101, P2119 or P2176
P0513	Wrong Transponder Key	6.32 DTC P0513, P0633, P1629, P1632, P1677, P1678 or P1679
P0521	Oil Pressure Sensor Range / Performance	6.33 DTC P0521, P0522 or P0523
P0522	Oil Pressure Sensor Voltage Low	6.33 DTC P0521, P0522 or P0523
P0523	Oil Pressure Sensor Voltage High	6.33 DTC P0521, P0522 or P0523
P0532	A/C Pressure Sensor Voltage Low	6.34 DTC P0532 or P0533
P0533	A/C Pressure Sensor Voltage High	6.34 DTC P0532 or P0533
P0560	System Voltage Malfunction	6.35 DTC P0560, P0562 or P0563
P0562	System Voltage Low Voltage	6.35 DTC P0560, P0562 or P0563
P0563	System Voltage High Voltage	6.35 DTC P0560, P0562 or P0563
P0571	Brake Switch Circuit Malfunction	6.30 DTC P0504 or P0571
P0601	Replace Electronic Control Unit (ECU)	6.36 DTC P0601, P0602, P0604 or P0606
P0602	Program Electronic Control Unit (ECU)	6.36 DTC P0601, P0602, P0604 or P0606
P0604	Replace Electronic Control Unit (ECU)	6.36 DTC P0601, P0602, P0604 or P0606
P0606	Replace Electronic Control Unit (ECU)	6.36 DTC P0601, P0602, P0604 or P0606
P0615	Starter Relay Circuit Malfunction	6.37 DTC P0615, P0616 or P0617
P0616	Starter Relay Circuit Low Voltage	6.37 DTC P0615, P0616 or P0617
P0617	Starter Relay Circuit High Voltage	6.37 DTC P0615, P0616 or P0617
P0625	Alternator F Terminal Low Voltage	6.38 DTC P0625 or P0626
P0626	Alternator F Terminal High Voltage	6.38 DTC P0625 or P0626
P0627	Fuel Pump Relay Circuit Malfunction	6.39 DTC P0627, P0628 or P0629
P0628	Fuel Pump Relay Voltage Low	6.39 DTC P0627, P0628 or P0629
P0629	Fuel Pump Relay Voltage High	6.39 DTC P0627, P0628 or P0629
P0633	Immobiliser Function Not Programmed	6.32 DTC P0513, P0633, P1629, P1632, P1677, P1678 or P1679
P0638	Commanded Versus Actual Throttle Position Correlation	6.31 DTC P0506, P0507, P0638, P1551, P2100, P2101, P2119 or P2176
P0645	A/C Relay Circuit Malfunction	6.39 DTC P0645, P0646 or P0647
P0646	A/C Relay Voltage Low	6.39 DTC P0645, P0646 or P0647
P0647	A/C Relay Voltage High	6.39 DTC P0645, P0646 or P0647
P0685	Engine Control Ignition Relay Circuit Malfunction	6.41 DTC P0685, P0686 or P0687
P0686	Engine Control Ignition Relay Circuit Low Voltage	6.41 DTC P0685, P0686 or P0687

DTC	Description	Diagnostic Table
P0687	Engine Control Ignition Relay Circuit High Voltage	6.41 DTC P0685, P0686 or P0687
P0691	Cooling Fan Relay 1 Circuit Low Voltage	6.27 DTC P0480, P0481, P0691, P0692, P0693 or P0694
P0692	Cooling Fan Relay 1 Circuit High Voltage	6.27 DTC P0480, P0481, P0691, P0692, P0693 or P0694
P0693	Cooling Fan Relay 2 and 3 Circuit Low Voltage	6.27 DTC P0480, P0481, P0691, P0692, P0693 or P0694
P0694	Cooling Fan Relay 2 and 3 Circuit High Voltage	6.27 DTC P0480, P0481, P0691, P0692, P0693 or P0694
P0700	Malfunction Indicator (MI) Request from Transmission Control Module (TCM)	6.42 DTC P0700
P0704	Clutch Switch Input Circuit Malfunction	6.43 DTC P0704
P0850	Park / Neutral Signal Circuit Incorrect Signal	6.44 DTC P0850
P0864	Invalid Signal from TCM (Transmission Control Module)	6.45 DTC 864
P1011	Intake Camshaft Actuator Park Position (Bank 1)	6.4 DTC P0011, P0014, P0021, P0024, P1011, P1012, P1013, or P1014
P1012	Exhaust Camshaft Actuator Park Position (Bank 1)	6.4 DTC P0011, P0014, P0021, P0024, P1011, P1012, P1013, or P1014
P1013	Intake Camshaft Actuator Park Position (Bank 2)	6.4 DTC P0011, P0014, P0021, P0024, P1011, P1012, P1013, or P1014
P1014	Exhaust Camshaft Actuator Park Position (Bank 2)	6.4 DTC P0011, P0014, P0021, P0024, P1011, P1012, P1013, or P1014
P1258	Engine Coolant Over Temperature – Protection Mode Active	6.10 DTC P0116, P0117, P0118, P0125 or P1258
P1551	Throttle Control Lower Position Not Reached during Learning Mode	6.31 DTC P0506, P0507, P0638, P1551, P2100, P2101, P2119 or P2176
P1629	Immobiliser Fuel Enable Signal Not Received	6.32 DTC P0513, P0633, P1629, P1632, P1677, P1678 or P1679
P1632	Immobiliser Fuel Disable Signal Received	6.32 DTC P0513, P0633, P1629, P1632, P1677, P1678 or P1679
P1648	Wrong Security Code Entered	6.45 DTC P1648
P1668	Alternator L Terminal Circuit Malfunction	6.47 DTC P1668, P2500 or P2501
P1677	Immobiliser Function not Enabled	6.32 DTC P0513, P0633, P1629, P1632, P1677, P1678 or P1679
P1678	Engine Control Module Identification Failed	6.32 DTC P0513, P0633, P1629, P1632, P1677, P1678 or P1679
P1679	Immobiliser Environment Identification Failed	6.32 DTC P0513, P0633, P1629, P1632, P1677, P1678 or P1679
P1845	Engine Torque Reduction Malfunction	6.48 DTC P1845
P2008	Intake Manifold Runner Control Solenoid Circuit Malfunction	6.49 DTC P2008, P2009 or P2010
P2009	Intake Manifold Runner Control Solenoid Circuit Low Voltage	6.49 DTC P2008, P2009 or P2010
P2010	Intake Manifold Runner Control Solenoid Circuit High Voltage	6.49 DTC P2008, P2009 or P2010
P2088	Intake Camshaft Position Control Solenoid Circuit Low Voltage (Bank 1)	6.3 DTC P0010, P0013, P0020, P0023, P2088, P2089, P2090, P2091, P2092, P2093, P2094 or P2095

DTC	Description	Diagnostic Table
P2089	Intake Camshaft Position Control Solenoid Circuit High Voltage (Bank 1)	6.3 DTC P0010, P0013, P0020, P0023, P2088, P2089, P2090, P2091, P2092, P2093, P2094 or P2095
P2090	Exhaust Camshaft Position Control Solenoid Circuit Low Voltage (Bank 1)	6.3 DTC P0010, P0013, P0020, P0023, P2088, P2089, P2090, P2091, P2092, P2093, P2094 or P2095
P2091	Exhaust Camshaft Position Control Solenoid Circuit High Voltage (Bank 1)	6.3 DTC P0010, P0013, P0020, P0023, P2088, P2089, P2090, P2091, P2092, P2093, P2094 or P2095
P2092	Intake Camshaft Position Control Solenoid Circuit Low Voltage (Bank 2)	6.3 DTC P0010, P0013, P0020, P0023, P2088, P2089, P2090, P2091, P2092, P2093, P2094 or P2095
P2093	Intake Camshaft Position Control Solenoid Circuit High Voltage (Bank 2)	6.3 DTC P0010, P0013, P0020, P0023, P2088, P2089, P2090, P2091, P2092, P2093, P2094 or P2095
P2094	Exhaust Camshaft Position Control Solenoid Low Voltage (Bank 2)	6.3 DTC P0010, P0013, P0020, P0023, P2088, P2089, P2090, P2091, P2092, P2093, P2094 or P2095
P2095	Exhaust Camshaft Position Control Solenoid Circuit High Voltage (Bank 2)	6.3 DTC P0010, P0013, P0020, P0023, P2088, P2089, P2090, P2091, P2092, P2093, P2094 or P2095
P2096	Post Catalyst O2 Sensor Fuel Trim Below Lower Limit (Bank 1)	6.50 DTC P2096 or P2098
P2097	Post Catalyst O2 Sensor Fuel Trim Above Upper Limit (Bank 1)	6.51 DTC P2097 or P2099
P2098	Post Catalyst O2 Sensor Fuel Trim Below Lower Limit (Bank 2)	6.50 DTC P2096 or P2098
P2099	Post Catalyst O2 Sensor Fuel Trim Above Upper Limit (Bank 2)	6.51 DTC P2097 or P2099
P2100	Throttle Control Motor Malfunction	6.31 DTC P0506, P0507, P0638, P1551, P2100, P2101, P2119 or P2176
P2101	Throttle Control Position Range / Performance	6.31 DTC P0506, P0507, P0638, P1551, P2100, P2101, P2119 or P2176
P2105	Throttle Control Forced Engine Shutdown	6.52 DTC P2105
P2107	Throttle Control Malfunction	6.53 DTC P2107
P2119	Closed Throttle Position Range / Performance	6.31 DTC P0506, P0507, P0638, P1551, P2100, P2101, P2119 or P2176
P2122	Accelerator Pedal Position Sensor 1 Voltage Low	6.54 P2122, P2123, P2127, P2128 or P2138
P2123	Accelerator Pedal Position Sensor 1 Voltage High	6.54 P2122, P2123, P2127, P2128 or P2138
P2127	Accelerator Pedal Position Sensor 2 Voltage Low	6.54 P2122, P2123, P2127, P2128 or P2138
P2128	Accelerator Pedal Position Sensor 2 Voltage High	6.54 P2122, P2123, P2127, P2128 or P2138
P2138	Accelerator Pedal Position Sensor 1-2 Correlation	6.54 P2122, P2123, P2127, P2128 or P2138
P2176	Throttle Control Lower Position not Learned	6.31 DTC P0506, P0507, P0638, P1551, P2100, P2101, P2119 or P2176
P2177	Fuel Trim Lean during Cruising / Acceleration (Bank 1)	6.55 DTC P2177 or P2179
P2178	Fuel Trim Rich during Cruising / Acceleration (Bank 1)	6.56 DTC P2178 or P2180
P2179	Fuel Trim Lean during Cruising / Acceleration (Bank 2)	6.55 DTC P2177 or P2179
P2180	Fuel Trim Rich during Cruising / Acceleration (Bank 2	6.56 DTC P2178 or P2180

DTC	Description	Diagnostic Table
P2187	Fuel Trim Lean during Idling / Deceleration (Bank 1)	6.57 DTC P2187 or P2189
P2188	Fuel Trim Rich during Idling / Deceleration (Bank 1)	6.58 DTC P2188 or P2190
P2189	Fuel Trim Lean during Idling / Deceleration (Bank 2)	6.57 DTC P2187 or P2189
P2190	Fuel Trim Rich during Idling / Deceleration (Bank 2)	6.58 DTC P2188 or P2190
P2195	B1S1 O2 Sensor – System Too Lean (Bank 1 Sensor 1)	6.59 DTC P2195 or P2197
P2196	B1S1 O2 Sensor – System Too Rich (Bank 1 Sensor 1)	6.60 DTC P2196 or P2198
P2197	B2S1 O2 Sensor – System Too Lean (Bank 2 Sensor 1)	6.59 DTC P2195 or P2197
P2198	B2S1 O2 Sensor – System Too Rich (Bank 2 Sensor 1)	6.60 DTC P2196 or P2198
P2227	Barometric Pressure Sensor Range / Performance	6.61 DTC P2227, P2228 or P2229
P2228	Barometric Pressure Sensor Voltage Low	6.61 DTC P2227, P2228 or P2229
P2229	Barometric Pressure Sensor Voltage High	6.61 DTC P2227, P2228 or P2229
P2231	O2 Sensor Signal Short to Heater Circuit (Bank 1, Sensor 1)	6.61 DTC P2231, P2232, P2234, P2235, P2251 or P2254
P2232	O2 Sensor Signal Short to Heater Circuit (Bank 1 Sensor 2)	6.62 DTC P2231, P2232, P2234, P2235, P2251 or P2254
P2234	O2 Sensor Signal Short to Heater Circuit (Bank 2, Sensor 1)	6.62 DTC P2231, P2232, P2234, P2235, P2251 or P2254
P2235	O2 Sensor Signal Short to Heater Circuit (Bank 2 Sensor 2)	6.62 DTC P2231, P2232, P2234, P2235, P2251 or P2254
P2237	O2 Sensor Pump Current Circuit Malfunction (Bank 1, Sensor 1)	6.63 DTC P2237, P2238, P2239, P2240, P2241 or P2242
P2238	O2 Sensor Pump Current Circuit Low Voltage (Bank 1, Sensor 1)	6.63 DTC P2237, P2238, P2239, P2240, P2241 or P2242
P2239	O2 Sensor Pump Current Circuit High Voltage (Bank 1, Sensor 1)	6.63 DTC P2237, P2238, P2239, P2240, P2241 or P2242
P2240	O2 Sensor Pump Current Circuit Malfunction (Bank 2, Sensor 1)	6.63 DTC P2237, P2238, P2239, P2240, P2241, P2242, P2626 or P02629
P2241	O2 Sensor Pump Current Circuit Low Voltage (Bank 2, Sensor 1)	6.63 DTC P2237, P2238, P2239, P2240, P2241, P2242, P2626 or P02629
P2242	O2 Sensor Pump Current Circuit High Voltage (Bank 2, Sensor 1)	6.63 DTC P2237, P2238, P2239, P2240, P2241, P2242, P2626 or P02629
P2243	O2 Sensor Voltage Signal Circuit Malfunction (Bank 1, Sensor 1)	6.12 DTC P0130, P0131, P0132, P0135, P0137, P0138, P0140, P0141, P0150 P0151, P0152, P0155, P0157, P0158, P0160, P0161, P2243, P2247, P2270, P2271, P2272, P2273, P2297 or P2298
P2247	O2 Sensor Voltage Signal Circuit Malfunction (Bank 2, Sensor 1)	6.12 DTC P0130, P0131, P0132, P0135, P0137, P0138, P0140, P0141, P0150 P0151, P0152, P0155, P0157, P0158, P0160, P0161, P2243, P2247, P2270, P2271, P2272, P2273, P2297 or P2298
P2251	O2 Sensor Ground Circuit Malfunction (Bank 1, Sensor 1)	6.62 DTC P2231, P2232, P2234, P2235, P2251 or P2254
P2254	O2 Sensor Ground Circuit Malfunction (Bank 2, Sensor 1)	6.62 DTC P2231, P2232, P2234, P2235, P2251 or P2254

DTC	Description	Diagnostic Table
P2270	O2 Sensor Lean / Rich Switch Signal Malfunction (Bank 1, Sensor 2)	6.12 DTC P0130, P0131, P0132, P0135, P0137, P0138, P0140, P0141, P0150 P0151, P0152, P0155, P0157, P0158, P0160, P0161, P2243, P2247, P2270, P2271, P2272, P2273, P2297 or P2298
P2271	O2 Sensor Rich / Lean Switch Signal Malfunction (Bank 1, Sensor 2)	6.12 DTC P0130, P0131, P0132, P0135, P0137, P0138, P0140, P0141, P0150 P0151, P0152, P0155, P0157, P0158, P0160, P0161, P2243, P2247, P2270, P2271, P2272, P2273, P2297 or P2298
P2272	O2 Sensor Lean / Rich Switch Signal Malfunction (Bank 2, Sensor 2)	6.12 DTC P0130, P0131, P0132, P0135, P0137, P0138, P0140, P0141, P0150 P0151, P0152, P0155, P0157, P0158, P0160, P0161, P2243, P2247, P2270, P2271, P2272, P2273, P2297 or P2298
P2273	O2 Sensor Rich / Lean Switch Signal Malfunction (Bank 2, Sensor 2)	6.12 DTC P0130, P0131, P0132, P0135, P0137, P0138, P0140, P0141, P0150 P0151, P0152, P0155, P0157, P0158, P0160, P0161, P2243, P2247, P2270, P2271, P2272, P2273, P2297 or P2298
P2297	O2 Sensor Range / Performance During Deceleration Fuel Cutoff (Bank 1, Sensor 1)	6.12 DTC P0130, P0131, P0132, P0135, P0137, P0138, P0140, P0141, P0150 P0151, P0152, P0155, P0157, P0158, P0160, P0161, P2243, P2247, P2270, P2271, P2272, P2273, P2297 or P2298
P2298	O2 Sensor Range / Performance During Deceleration Fuel Cutoff (Bank 2, Sensor 1)	6.12 DTC P0130, P0131, P0132, P0135, P0137, P0138, P0140, P0141, P0150 P0151, P0152, P0155, P0157, P0158, P0160, P0161, P2243, P2247, P2270, P2271, P2272, P2273, P2297 or P2298
P2300	Ignition Coil Cylinder 1 Circuit Low Voltage	6.24 DTC P0351, P0352, P0353, P0354, P0355, P0356, P2300, P2301, P2303, P2304, P2306, P2307, P2309, P2310, P2312, P2313, P2315 or P2316
P2301	Ignition Coil Cylinder 1 Circuit High Voltage	6.24 DTC P0351, P0352, P0353, P0354, P0355, P0356, P2300, P2301, P2303, P2304, P2306, P2307, P2309, P2310, P2312, P2313, P2315 or P2316
P2303	Ignition Coil Cylinder 2 Circuit Low Voltage	6.24 DTC P0351, P0352, P0353, P0354, P0355, P0356, P2300, P2301, P2303, P2304, P2306, P2307, P2309, P2310, P2312, P2313, P2315 or P2316
P2304	Ignition Coil Cylinder 2 Circuit High Voltage	6.24 DTC P0351, P0352, P0353, P0354, P0355, P0356, P2300, P2301, P2303, P2304, P2306, P2307, P2309, P2310, P2312, P2313, P2315 or P2316
P2306	Ignition Coil Cylinder 3 Circuit Low Voltage	6.24 DTC P0351, P0352, P0353, P0354, P0355, P0356, P2300, P2301, P2303, P2304, P2306, P2307, P2309, P2310, P2312, P2313, P2315 or P2316
P2307	Ignition Coil Cylinder 3 Circuit High Voltage	6.24 DTC P0351, P0352, P0353, P0354, P0355, P0356, P2300, P2301, P2303, P2304, P2306, P2307, P2309, P2310, P2312, P2313, P2315 or P2316
P2309	Ignition Coil Cylinder 4 Circuit Low Voltage	6.24 DTC P0351, P0352, P0353, P0354, P0355, P0356, P2300, P2301, P2303, P2304, P2306, P2307, P2309, P2310, P2312, P2313, P2315 or P2316

DTC	Description	Diagnostic Table
P2310	Ignition Coil Cylinder 4 Circuit High Voltage	6.24 DTC P0351, P0352, P0353, P0354, P0355, P0356, P2300, P2301, P2303, P2304, P2306, P2307, P2309, P2310, P2312, P2313, P2315 or P2316
P2312	Ignition Coil Cylinder 5 Circuit Low Voltage	6.24 DTC P0351, P0352, P0353, P0354, P0355, P0356, P2300, P2301, P2303, P2304, P2306, P2307, P2309, P2310, P2312, P2313, P2315 or P2316
P2313	Ignition Coil Cylinder 5 Circuit High Voltage	6.24 DTC P0351, P0352, P0353, P0354, P0355, P0356, P2300, P2301, P2303, P2304, P2306, P2307, P2309, P2310, P2312, P2313, P2315 or P2316
P2315	Ignition Coil Cylinder 6 Circuit Low Voltage	6.24 DTC P0351, P0352, P0353, P0354, P0355, P0356, P2300, P2301, P2303, P2304, P2306, P2307, P2309, P2310, P2312, P2313, P2315 or P2316
P2316	Ignition Coil Cylinder 6 Circuit High Voltage	6.24 DTC P0351, P0352, P0353, P0354, P0355, P0356, P2300, P2301, P2303, P2304, P2306, P2307, P2309, P2310, P2312, P2313, P2315 or P2316
P2500	Alternator L Terminal Low Voltage	6.47 DTC P1668, P2500 or P2501
P2501	Alternator L Terminal High Voltage	6.47 DTC P1668, P2500 or P2501
P2626	O2 Sensor Pump Current Trim Circuit Malfunction (Bank 1, Sensor 1)	6.64 DTC P2626, P2627, P2628, P2629, P2630 or P2631
P2627	O2 Sensor Pump Current Trim Circuit Low Voltage (Bank 1, Sensor 1)	6.64 DTC P2626, P2627, P2628, P2629, P2630 or P2631
P2628	O2 Sensor Pump Current Trim Circuit High Voltage (Bank 1, Sensor 1)	6.64 DTC P2626, P2627, P2628, P2629, P2630 or P2631
P2629	O2 Sensor Pump Current Trim Circuit Malfunction (Bank 2, Sensor 1)	6.64 DTC P2626, P2627, P2628, P2629, P2630 or P2631
P2630	O2 Sensor Pump Current Trim Circuit Low Voltage (Bank 2, Sensor 1)	6.64 DTC P2626, P2627, P2628, P2629, P2630 or P2631
P2631	O2 Sensor Pump Current Trim Circuit High Voltage (Bank 2, Sensor 1)	6.64 DTC P2626, P2627, P2628, P2629, P2630 or P2631
U0001	No Communication with CAN-Bus (High Speed)	6.65 DTC U0001
U0101	CAN-Bus No Communication With TCM (Transmission Control Module)	6.66 DTC U0101
U0121	CAN-Bus No Communication With ABS / TC / ESP	6.67 DTC U0121 or U0415
U0155	CAN-Bus No Communication With Gateway	6.68 DTC U0155 or U 0423
U0415	CAN-Bus Invalid Data ABS / TC / ESP	6.66 U0121 or U0415
U0423	CAN-Bus Invalid Data From Gateway	6.67 DTC U0155 or U 0423

6.2 DTC P0008, P0009, P0016, P0017, P0018 or P0019

DTC Descriptor

This diagnostic procedure supports the following DTCs:

- DTC P0008 – Engine Position System Performance (Bank 1)
- DTC P0009 – Engine Position System Performance (Bank 2)
- DTC P0016 – Crankshaft / Intake Camshaft Position Not Plausible (Bank 1)
- DTC P0017 – Crankshaft / Exhaust Camshaft Position Not Plausible (Bank 1)
- DTC P0018 – Crankshaft / Intake Camshaft Position Not Plausible (Bank 2)
- DTC P0019 – Crankshaft / Exhaust Camshaft Position Not Plausible (Bank 2)

Circuit Description

The engine control relay applies ignition positive battery voltage to the camshaft position (CMP) actuator solenoids through the ignition voltage circuit.

Using a device called a driver, the ECM applies a pulse width modulated (PWM) ground to the individual CMP solenoid control circuit. This controls the oil pressure that advances or retards each camshaft position.

The ECM compares the camshaft position to the crankshaft position to detect CMP system malfunction. A CKP / CMP sensor correlation DTC sets if the ECM detects a deviation between the target position of the camshaft and the crankshaft position.

Conditions for Running the DTC

DTC P0008 or P0009

Run continuously once the following conditions are met.

- DTCs P0010, P0011, P0013, P0014, P0020, P0021, P0023, P0024, P0341, P0342, P0343, P0346, P0347, P0348, P0366, P0367, P0368, P0391, P0392, P0393, P2088, P2089, P2090, P2091, P2092, P2093, P2094 and P2095 ran and passed:
- The engine is running.
- The ECM has learned the camshafts position.

DTC P0016, P0017, P0018 or P0019

Run continuously once the following conditions are met.

- DTCs P0010, P0011, P0013, P0014, P0020, P0021, P0023, P0024, P0335, P0336, P0338, P0341, P0342, P0343, P0346, P0347, P0348, P0366, P0367, P0368, P0391, P0392, P0393, P2088, P2089, P2090, P2091, P2092, P2093, P2094 and P2095 ran and passed:
- The calculated engine oil temperature is less than 95°C.
- The engine coolant temperature is 20 – 90°C.
- The engine is running for greater than 5 seconds.

Conditions for Setting the DTC

DTC P0008

The ECM detects that both camshafts on Bank 1 of the engine are misaligned with the crankshaft.

DTC P0009

The ECM detects that both camshafts on Bank 2 of the engine are misaligned with the crankshaft.

DTC P0016, P0017, P0018 or P0019

The ECM detects the following deviation in the correlation between the camshaft position and the crankshaft position for greater than 10 minutes:

- a camshaft position is too advanced in relationship to the crankshaft, or
- a camshaft position is too retarded in relationship to the crankshaft.

Conditions for Clearing DTC

The CKP / CMP sensor correlation DTCs are Type B DTCs. Refer to 1.4 Diagnostic Trouble Codes in this Section for action taken when Type B DTCs set and conditions for clearing Type B DTCs.

Additional Information

- Refer to Section 6C1-1 Engine Management – V6 – General Information for details of the CMP system operation.
- Inspect the engine for recent engine mechanical repairs. Incorrect camshaft, camshaft actuator or timing chain installation will trigger these DTCs.
- The engine oil condition has a major impact on the operation of the camshaft actuator.
- A low oil level may set these DTCs.
- For an intermittent fault condition, refer to 4.2 Intermittent Fault Conditions in this Section.
- Since fault condition in a wiring connector may trigger DTCs, always test the connectors related to this diagnostic procedure for shorted terminals or poor wiring connection before replacing any component. Refer to Section 12P Wiring Diagrams for information on electrical fault diagnosis.
- To assist diagnosis, refer to 2 Wiring Diagrams and Connector Charts in this Section for the system wiring diagram and connector charts.

Test Description

The following numbers refer to the step numbers in the diagnostic table:

3 A fault condition in any of the listed sensors will trigger these DTCs.

5 Incorrect camshaft, camshaft actuator or timing chain installation will trigger these DTCs.

DTC P0008, P0009, P0016 to P0019 Diagnostic Table

Step	Action	Yes	No
1	1 Has the Diagnostic System Check been performed?	Go to Step 2	Refer to 3.4 Diagnostic System Check
2	1 Switch off the ignition for 30 seconds. 2 Start the engine. 3 Allow the engine to reach the normal operating temperature. 4 Increase the engine speed to 2,000 rpm for 10 seconds. 5 Using Tech 2, select the DTC display function. Does DTC P0008, P0009, P0016, P0017, P0018 or P0019 fail this ignition cycle?	Go to Step 3	Refer to Additional Information in this DTC
3	1 Are DTCs relating to the following DTCs also set: • Camshaft actuator circuit • CMP sensor circuit • CKP sensor circuit	Go to the appropriate DTC Table in this Section	Go to Step 4

Step	Action	Yes	No
4	1 Inspect the engine for the following fault conditions. Refer to 6A1 Engine Mechanical – V6: • incorrect installation of the CMP sensor, • incorrect installation of the CKP sensor, • timing chain tensioner fault condition, • incorrectly installed timing chain, • excessive play in the timing chain, and • timing chain that jumped teeth. Was any fault found and rectified?	Go to Step 5	Refer to Additional Information in this DTC
5	1 Using Tech 2, clear the DTCs. 2 Switch off the ignition for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the conditions for running the DTC. Does any of the crankshaft / camshaft position correlation DTCs fail this ignition cycle?	Go to Step 2	Go to Step 6
6	Using Tech 2, select the DTC display function. Does Tech 2 display any DTCs?	Go to the appropriate DTC Table in this Section	System OK
When all diagnosis and repairs are completed, check the system for correct operation.			

6.3 DTC P0010, P0013, P0020, P0023, P2088, P2089, P2090, P2091, P2092, P2093, P2094 or P2095

DTC Descriptor

This diagnostic procedure supports the following DTCs:

- DTC P0010 – Intake Camshaft Position Control Solenoid Circuit Malfunction (Bank 1)
- DTC P0013 – Exhaust Camshaft Position Control Solenoid Circuit Malfunction (Bank 1)
- DTC P0020 – Intake Camshaft Position Control Solenoid Circuit Malfunction (Bank 2)
- DTC P0023 – Exhaust Camshaft Position Control Solenoid Circuit Malfunction (Bank 2)
- DTC P2088 – Intake Camshaft Position Control Solenoid Circuit Low Voltage (Bank 1)
- DTC P2089 – Intake Camshaft Position Control Solenoid Circuit High Voltage (Bank 1)
- DTC P2090 – Exhaust Camshaft Position Control Solenoid Circuit Low Voltage (Bank 1)
- DTC P2091 – Exhaust Camshaft Position Control Solenoid Circuit High Voltage (Bank 1)
- DTC P2092 – Intake Camshaft Position Control Solenoid Circuit Low Voltage (Bank 2)
- DTC P2093 – Intake Camshaft Position Control Solenoid Circuit High Voltage (Bank 2)
- DTC P2094 – Exhaust Camshaft Position Control Solenoid Circuit Low Voltage (Bank 2)
- DTC P2095 – Exhaust Camshaft Position Control Solenoid Circuit High Voltage (Bank 2)

Circuit Description

The engine control relay applies ignition positive battery voltage to the camshaft position (CMP) actuator solenoids through the ignition voltage circuit.

Using a device called a driver, the ECM applies pulse width modulated (PWM) ground to the individual CMP solenoid control circuit to control the oil pressure that advances or retards each camshaft position.

The driver has a feedback circuit that is pulled-up to a voltage. The ECM monitors the driver feedback circuit to determine an open, short to ground or short to a positive voltage fault condition in the control circuit.

A CMP actuator solenoid control circuit DTC sets if the ECM detects an open circuit fault condition in a CMP solenoid control circuit when the solenoid is commanded off.

Conditions for Running the DTC

DTC P0010, P0013, P0020, P0023, P2088, P2090, P2092 or P2094

Run continuously once the following conditions are met:

- The engine speed is greater than 80 rpm
- The ignition voltage is 10.0 – 16.0 V.
- The ECM has commanded the CMP actuator on and off at least once during the ignition cycle.

DTC P2089, P2091, P2093, or P2095

Run continuously once the following conditions are met:

- The engine speed is greater than 80 rpm
- The ignition voltage is 10.0 – 16.0 V.

Conditions for Setting the DTC

DTC P0010, P0013, P0020 or P0023

The ECM detects an open circuit fault condition in a CMP solenoid control circuit when the solenoid is commanded off.

DTC P2088, P2090, P2092 or P2094

The ECM detects a short to ground fault condition in a CMP solenoid control circuit.

DTC P2089, P2091, P2093 or P2095

The ECM detects a short to voltage fault condition in a CMP solenoid control circuit.

Conditions for Clearing DTC

The CMP actuator solenoid control circuit DTCs are Type B DTCs. Refer to 1.4 Diagnostic Trouble Codes in this Section for action taken when Type B DTCs set and conditions for clearing Type B DTCs.

Additional Information

- Refer to Section 6C1-1 Engine Management – V6 – General Information for details of the intake CMP actuator operation.
- For an intermittent fault condition, refer to 4.2 Intermittent Fault Conditions in this Section.
- Since fault condition in a wiring connector may trigger DTCs, always test the connectors related to this diagnostic procedure for shorted terminals or poor wiring connection before replacing any component. Refer to Section 12P Wiring Diagrams for information on electrical fault diagnosis.
- To assist diagnosis, refer to 2 Wiring Diagrams and Connector Charts in this Section for the system wiring diagram and connector charts.

Test Description

The following number refers to the step number in the diagnostic table:

4 The ECM monitors the driver feedback circuit to determine if the CMP actuator control circuit is open, shorted to ground or shorted to a positive voltage. If the voltage is outside the specified range, there is a fault condition with the control circuit.

DTC P0010, P0013, P0020, P0023, P2088 to P2095 Diagnostic Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been performed?	Go to Step 2	Refer to 3.4 Diagnostic System Check
2	1 Switch off the ignition for 30 seconds. 2 Start the engine. 3 Allow the engine to reach the normal operating temperature. 4 Increase the engine speed to 2,000 rpm for 10 seconds or operate the vehicle within the conditions for running the DTC. 5 Using Tech 2, select the DTC display function. Does P0010, P0013, P0020, P0023, P2088, P2089, P2090, P2091, P2092, P2093, P2094 or P2095 fail this ignition cycle?	Go to Step 3	Refer to Additional Information in this DTC
3	1 Disconnect the appropriate CMP actuator wiring connector. 2 Switch on the ignition with the engine not running. 3 Connect a test lamp between the CMP actuator ignition voltage circuit and a good ground. Does the test lamp illuminate?	Go to Step 4	Go to Step 5

Step	Action	Yes	No
4	1 Switch on the ignition with the engine not running. 2 Using a digital multimeter, measure the voltage between the appropriate CMP solenoid control circuit and a good ground. Does the multimeter display 2.0 – 3.0 V?	Go to Step 7	Go to Step 6
5	Repair the open circuit fault condition at the CMP solenoid ignition voltage circuit. Refer to Section 12P Wiring Diagrams for information on electrical wiring repair procedures. Was the repair completed?	Go to Step 9	—
6	Test the appropriate CMP control circuit for a high resistance or open circuit fault condition. Refer to Section 12P Wiring Diagrams for information on electrical fault diagnosis. Was any fault found and rectified?	Go to Step 9	Go to Step 8
7	Replace the appropriate CMP solenoid. Refer to Section 6C1-3 Engine Management V6 – Service Operations. Was the repair completed?	Go to Step 9	—
8	Replace the ECM. Refer to Section 6C1-3 Engine Management – V6 – Service Operations. Was the repair completed?	Go to Step 9	—
9	1 Using Tech 2, clear the DTCs. 2 Switch off the ignition for 30 seconds. 3 Operate the vehicle within the conditions for running the DTC. Does any of the CMP actuator solenoid control circuit DTCs fail this ignition cycle?	Go to Step 2	Go to Step 10
10	Using Tech 2, select the DTC display function. Does Tech 2 display any DTCs?	Go to the appropriate DTC Table in this Section	System OK
When all diagnosis and repairs are completed, check the system for correct operation.			

6.4 DTC P0011, P0014, P0021, P0024, P1011, P1012, P1013, or P1014

DTC Descriptors

This diagnostic procedure supports the following DTCs:

- DTC P0011 – Intake Camshaft Position Range / Performance (Bank 1)
- DTC P0014 – Exhaust Camshaft Position Range / Performance (Bank 1)
- DTC P0021 – Intake Camshaft Position Range / Performance (Bank 2)
- DTC P0024 – Exhaust Camshaft Position Range / Performance (Bank 2)
- DTC P1011 – Intake Camshaft Actuator Park Position (Bank 1)
- DTC P1012 – Exhaust Camshaft Actuator Park Position (Bank 1)
- DTC P1013 – Intake Camshaft Actuator Park Position (Bank 2)
- DTC P1014 – Exhaust Camshaft Actuator Park Position (Bank 2)

Circuit Description

The engine control relay applies ignition positive battery voltage to the camshaft position (CMP) actuator solenoids through the ignition voltage circuit.

Using a device called a driver, the ECM applies a pulse width modulated (PWM) ground to the individual CMP solenoid control circuit. This controls the oil pressure that advances or retards each camshaft position.

The ECM compares the camshaft position to the crankshaft position to detect CMP system malfunction. A CMP system performance or park position DTC sets if the ECM detects a deviation between the camshafts actual position and the ECM calculated camshaft position.

Conditions for Running the DTC

DTC P0011, P0014, P0021 and P0024

Run continuously once the following conditions are met.

- DTCs P0010, P0013, P0020, P0023, P0342, P0343, P0347, P0348, P0367, P0368, P0392, P0393, P2088, P2089, P2090, P2091, P2092, P2093, P2094 and P2095 ran and passed:
- The ECM has commanded the CMP actuator from the park position to the phased position 5 times in 10 seconds.
- The engine speed is greater than 1,000 rpm
- The engine is operating for approximately 5 minutes.

DTC P1011, P1012, P1013 and P1014

Run continuously once the following conditions are met.

- DTCs P0010, P0013, P0020, P0023, P2088, P2089, P2090, P2091, P2092, P2093, P2094 and P2095 ran and passed:
- The ECM has completed the CMP actuator solenoid output driver test.
- The engine speed is greater than 1,000 rpm

Conditions for Setting the DTC

DTC P0011, P0014, P0021 or P0024

The ECM detects the following conditions:

- The target position (ECM calculated position of the camshaft) and the actual position of the camshaft deviates by greater than 5 degrees.
- The difference between the actual camshaft angle and the locked position angle deviates by greater than 1 degree.
- The above conditions exists for 7 seconds.

DTC P1011, P1012, P1013 and P1014

The ECM detects that a CMP actuator is not in the parked position on engine start-up.

Conditions for Clearing DTC

DTC P0011, P0014, P0021 and P0024

The CMP system performance DTCs are Type B DTCs. Refer to 1.4 Diagnostic Trouble Codes in this Section for action taken when Type B DTCs set and conditions for clearing Type B DTCs.

DTC P1011, P1012, P1013 and P1014

The CMP system park position DTCs are Type C DTCs. Refer to 1.4 Diagnostic Trouble Codes in this Section for action taken when Type C DTCs set and conditions for clearing Type C DTCs.

Additional Information

- Refer to Section 6C1-1 Engine Management – V6 – General Information for details of the CMP system operation.
- The following conditions may trigger the camshaft position system performance or park position DTCs:
  - Mechanical fault condition in the CMP actuator assembly. Refer to Section 6A1 Engine Mechanical – V6.
  - Switching off the engine while the accelerator pedal is depressed.
  - Switching off the engine while driving.
  - Pressing the accelerator pedal while cranking the engine.
  - An engine idle flare during start-up.
- The engine oil condition has a major impact on the operation of the camshaft actuator.
- A low oil level may set these DTCs.
- For an intermittent fault condition, refer to 4.2 Intermittent Fault Conditions in this Section.
- Since fault condition in a wiring connector may trigger DTCs, always test the connectors related to this diagnostic procedure for shorted terminals or poor wiring connection before replacing any component. Refer to Section 12P Wiring Diagrams for information on electrical fault diagnosis.
- To assist diagnosis, refer to 2 Wiring Diagrams and Connector Charts in this Section for the system wiring diagram and connector charts.

Test Description

The following numbers refer to the step numbers in the diagnostic table:

3 A fault condition in any of the listed sensors will trigger these DTCs.

5 Isolates the fault condition. The CMP actuator is faulty if the DTC moves with the suspected sensor.

DTC P0011, P0014, P0021, P0024, P1011 to P1014 Diagnostic Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been performed?	Go to Step 2	Refer to 3.4 Diagnostic System Check
2	1 Switch off the ignition for 30 seconds. 2 Start the engine. 3 Allow the engine to reach the normal operating temperature. 4 Increase the engine speed to 2,000 rpm for 10 seconds. 5 Using Tech 2, select the DTC display function. Does DTC P0011, P0014, P0021, P0024, P1011, P1012, P1013 or P1014 fail this ignition cycle?	Go to Step 3	Refer to Additional Information
3	Are DTCs relating to the following sensors also set: • CMP sensor circuit or performance • CMP actuator circuit or performance • CKP sensor circuit or performance • Oil pressure sensor	Go to the appropriate DTC Table in this Section	Go to Step 4
4	Remove and inspect the CMP actuator solenoid. Refer to Section 6C1-3 Engine Management – V6 – Service Operations. Was any fault found and rectified?	Go to Step 7	Go to Step 5
5	1 Swap the suspected the CMP actuator solenoid with the CMP actuator solenoid that is operating correctly. 2 Operate the vehicle within the conditions for running the DTC. 3 Using Tech 2, select the DTC display function. Does the suspected CMP actuator solenoid trigger a DTC in its new location?	Go to Step 6	Refer to Additional Information in this DTC
6	Replace the suspected CMP solenoid. Refer to Section 6C1-3 Engine Management – V6 – Service Operations. Was the repair completed?	Go to Step 7	—
7	1 Using Tech 2, clear the DTCs. 2 Switch off the ignition for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the conditions for running the DTC. Does any of the camshaft position system performance or park DTCs position fail this ignition cycle?	Go to Step 2	Go to Step 8
8	Using Tech 2, select the DTC display function. Are there any DTCs displayed?	Go to the appropriate DTC Table in this Section	System OK
When all diagnosis and repairs are completed, check the system for correct operation.			

6.5 DTC P0030, P0031, P0032, P0036, P0037, P0038, P0050, P0051, P0052, P0056, P0057 or P0058

DTC Descriptor

This diagnostic procedure supports the following DTCs:

- DTC P0030 – O2 Sensor Heater Circuit Malfunction (Bank 1, Sensor 1)
- DTC P0031 – O2 Sensor Heater Circuit Low Voltage (Bank 1, Sensor 1)
- DTC P0032 – O2 Sensor Heater Circuit High Voltage (Bank 1, Sensor 1)
- DTC P0036 – O2 Sensor Heater Circuit Malfunction (Bank 1, Sensor 2)
- DTC P0037 – O2 Sensor Heater Circuit Low Voltage (Bank 1, Sensor 2)
- DTC P0038 – O2 Sensor Heater Circuit High Voltage (Bank 1, Sensor 2)
- DTC P0050 – O2 Sensor Heater Circuit Malfunction (Bank 2, Sensor 1)
- DTC P0051 – O2 Sensor Heater Circuit Low Voltage (Bank 2, Sensor 1)
- DTC P0052 – O2 Sensor Heater Circuit High Voltage (Bank 2, Sensor 1)
- DTC P0056 – O2 Sensor Heater Circuit Malfunction (Bank 2, Sensor 2)
- DTC P0057 – O2 Sensor Heater Circuit Low Voltage (Bank 2, Sensor 2)
- DTC P0058 – O2 Sensor Heater Circuit High Voltage (Bank 2, Sensor 2)

Circuit Description

The engine control relay applies positive voltage to the heater ignition voltage circuits of the HO2S. The ECM applies a pulse width modulated (PWM) ground to the heater control circuit of the HO2S through a device within the ECM called a driver, to control the HO2S rate of heating.

The driver has a feedback circuit that is pulled-up when the voltage is approximately 3.3 V. The ECM monitors the Driver feedback circuit to determine if the control circuit is open, shorted to ground or shorted to a positive voltage.

An HO2S heater control circuit DTC sets if the ECM detects a high resistance, open circuit, short to ground or short to voltage fault condition in the HO2S heater control circuit.

Conditions for Running the DTC

Runs continuously once the following conditions are met:

- The ignition voltage is 10.0 – 16.0 V.
- Engine speed is greater than 80 rpm

Conditions for Setting the DTC

DTC P0030, P0036, P0050 or P0056

The ECM detects an open circuit fault condition in the HO2S heater control circuit when the HO2S heater is commanded off.

DTC P0031, P0037, P0051 or P0057

The ECM detects a short to ground fault condition in the HO2S heater control circuit when the HO2S heater is commanded off.

DTC P0032, P0038, P0052 or P0058

The ECM detects a short to voltage fault condition in the HO2S heater control circuit for five seconds when the HO2S heater is commanded on.

Conditions for Clearing the DTC

The HO2S heater control circuit DTCs are Type B DTCs. Refer to 1.4 Diagnostic Trouble Codes in this Section for action taken when Type B DTC sets and conditions for clearing Type B DTCs.

Additional Information

- Refer to Section 6C1-1 Engine Management – V6 – General Information for details of the HO2S system operation.
- For an intermittent fault condition, refer to 4.2 Intermittent Fault Conditions in this Section.
- A faulty HO2S heater element may cause an open heater circuit condition. This fault may be intermittent or only show up after the sensor has operated for a period.
- Inspect the HO2S wiring harness for contact with the exhaust system.
- The front and the rear HO2Ss have a separate fuse connection. If both front or both rear DTCs are set, the appropriate HO2S ignition voltage circuit may be open.
- Since fault condition in a wiring connector may trigger DTCs, always test the connectors related to this diagnostic procedure for shorted terminals or poor wiring connection before replacing any component. Refer to Section 12P Wiring Diagrams for information on electrical fault diagnosis.
- To assist diagnosis, refer to 2 Wiring Diagrams and Connector Charts in this Section for the system wiring diagram and connector charts.

Test Description

The following number refers to the step number in the diagnostic table:

4 The ECM monitors the driver feedback circuit to determine if the heater control circuit is open, shorted to ground or shorted to a positive voltage. If the voltage is outside the specified range, there is a fault condition with the heater control circuit.

DTC P0030 to P0032, P0036 to P0038, P0050 to P0052 and P0056 to P0058 Diagnostic Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been performed?	Go to Step 2	Refer to 3.4 Diagnostic System Check
2	1 Switch off the ignition for 30 seconds. 2 Start the engine. 3 Allow the engine to run at idle speed for at least 30 seconds. 4 Increase the engine speed to 2,000 rpm for 10 seconds. 5 Using Tech 2, select the DTC display function. Does DTC P0030, P0031, P0032, P0036, P0037, P0038, P0050, P0051, P0052, P0056, P0057 or P0058 fail this ignition cycle?	Go to Step 3	Refer to Additional Information in this DTC
3	1 Disconnect the appropriate HO2S wiring connector. 2 Switch on the ignition with the engine not running. 3 Connect a test lamp between the HO2S heater ignition voltage circuit and the ECM housing. Does the test lamp illuminate?	Go to Step 4	Go to Step 5

Step	Action	Yes	No
4	Using a digital multimeter, measure the voltage between the HO2S heater control circuit and a good ground. Does the multimeter display: For Euro 2 emissions (MY2005 vehicles) • Alloytec 190 HO2S 1: 4.6 – 5.2 V? • Alloytec 190 HO2S 2: 2.8 – 4.2 V? • Alloytec HO2S 1: 2.8 – 4.2 V? For Euro 3 emissions (MY2006 vehicles) • All Alloytec Engines HO2S 1: 4.6 – 5.2 V? • All Alloytec Engines HO2S 2: 2.8 – 4.2 V?	Go to Step 7	Go to Step 6
5	**NOTE** The HO2S ignition voltage circuit is shared with other sensors. Ensure that all circuits and components that share this ignition voltage circuit are tested for a short to ground. Repair the high resistance open circuit or short to ground fault condition in the HO2S heater ignition voltage circuit. Refer to Section 12P Wiring Diagrams for information on electrical wiring repair procedures. Was the repair completed?	Go to Step 9	—
6	Test the HO2S heater control circuit for a high resistance, open circuit, short to ground or short to voltage fault condition. Refer to 12P Wiring Diagrams for information on electrical fault diagnosis. Was any fault found and rectified?	Go to Step 9	Go to Step 8
7	Replace the appropriate HO2S. Refer to Section 6C1-3 Engine Management – V6 – Service Operations. Was the repair completed?	Go to Step 9	—
8	Replace the ECM. Refer to Section 6C1-3 Engine Management – V6 – Service Operations. Was the repair completed?	Go to Step 9	—
9	1 Using Tech 2, clear the DTCs. 2 Switch off the ignition for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the conditions for running the DTC. Does any of the HO2S heater control circuit DTCs fail this ignition cycle?	Go to Step 2	Go to Step 10
10	Using Tech 2, select the DTC display function. Does Tech 2 display any DTCs?	Go to the appropriate DTC Table in this Section	System OK
When all diagnosis and repairs are completed, check the system for correct operation.			

6.6 DTC P0040 or P0041

DTC Descriptor

This diagnostic procedure supports the following DTCs:

- DTC P0040 – O2 Sensor Signals Not Plausible (Bank 1, Sensor 1 & Bank 2, Sensor 1)
- DTC P0041 – O2 Sensor Signals Not Plausible (Bank 1, Sensor 2 & Bank 2, Sensor 2)

Circuit Description

The engine control relay applies positive voltage to the heater ignition voltage circuits of the HO2S. The ECM applies a pulse width modulated (PWM) ground to the heater control circuit of the HO2S through a device within the ECM called a driver, to control the HO2S rate of heating.

The ECM applies a voltage of approximately 450 mV between the reference signal circuit and low reference circuit of the HO2S while the sensor temperature is less than the operating range.

Once the HO2S reaches operating temperature, the sensor varies this reference signal voltage, which constantly fluctuates between the high voltage output and the low voltage output.

- The low voltage output is 0 – 450 mV, which occurs if the air fuel mixture is lean.
- The high voltage output is 450 – 1,000 mV, which occurs if the air fuel mixture is rich.

The ECM monitors, stores and evaluates the HO2S voltage fluctuation information to determine the level of oxygen concentration in the exhaust.

An HO2S signal not plausible or wire connector swapped DTC sets if the ECM detects the HO2S signal voltages are heading in the opposite direction of what was commanded.

Additional Information

- Refer to Section 6C1-1 Engine Management – V6 – General Information in this Section for details of the HO2S system operation.
- For an intermittent fault condition, refer to 4.2 Intermittent Fault Conditions in this Section.
- The HO2S must be tightened correctly. A loose HO2S will trigger these DTCs.
- Since fault condition in a wiring connector may trigger DTCs, always test the connectors related to this diagnostic procedure for shorted terminals or poor wiring connection before replacing any component. Refer to Section 12P Wiring Diagrams for information on electrical fault diagnosis.
- To assist diagnosis, refer to 2 Wiring Diagrams and Connector Charts in this Section for the system wiring diagram and connector charts.

Conditions for Running the DTC

Run continuously once the following conditions are met:

- The ignition voltage is 10.0 – 16.0 V.
- The engine is running.
- The O2 sensors are in closed loop.
- The ECM is commanding the HO2Ss fuel trim.

Conditions for Setting the DTC

The ECM detects the HO2S signal voltages are heading in the opposite direction of what was commanded.

Conditions for Clearing the DTC

The HO2S signal not plausible DTCs are Type B DTCs. Refer to 1.4 Diagnostic Trouble Codes in this Section for action taken when Type B DTC sets and conditions for clearing Type B DTCs.

DTC P0040 and P0041 Diagnostic Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been performed?	Go to Step 2	Refer to 3.4 Diagnostic System Check
2	1 Switch off the ignition for 30 seconds. 2 Start the engine. 3 Allow the engine to reach the normal operating temperature. 4 Increase the engine speed to 2,000 rpm for 10 seconds. 5 Using Tech 2, select the DTC display function. Does P0040 or P0041 fail this ignition cycle?	Go to Step 3	Refer to Additional Information in this DTC
3	Check the HO2S 2 wiring connectors for a swapped connector fault condition. Was any fault found and rectified?	Go to Step 5	Go to Step 4
4	Are DTCs relating to other circuits of the HO2S also set?	Go to the appropriate DTC Table in this Section	Refer to Additional Information in this DTC
5	1 Using Tech 2, clear the DTCs. 2 Switch off the ignition for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the conditions for running the DTC. Does any of the HO2S signal not plausible or wire connector swapped DTCs fail this ignition cycle?	Go to Step 2	Go to Step 6
6	Using Tech 2, select the DTC display function. Does Tech 2 display any DTCs?	Go to the appropriate DTC Table in this Section	System OK
When all diagnosis and repairs are completed, check the system for correct operation.			

6.7 DTC P0053 or P0059

DTC Descriptor

This diagnostic procedure supports the following DTCs:

- DTC P0053 – O2 Sensor Heater Resistance Range / Performance (Bank 1, Sensor 1)
- DTC P0059 – O2 Sensor Heater Resistance Range / Performance (Bank 2, Sensor 1)

Circuit Description

The engine control relay applies positive voltage to the heater ignition voltage circuits of the HO2S. The ECM applies a pulse width modulated (PWM) ground to the heater control circuit of the HO2S through a device within the ECM called a driver, to control the HO2S rate of heating.

The ECM maintains the voltage between the reference signal circuit and low reference circuit of the HO2S 1 to about 450 mV by increasing or decreasing the oxygen content in the HO2S diffusion gap. To achieve this, the ECM controls the current applied to the oxygen pumping cell in the HO2S.

- If the air / fuel mixture in the exhaust is balanced (lambda = 1), the oxygen pumping cell current is zero.
- If the exhaust gas in the HO2S 1 diffusion gap is lean, the ECM applies a positive current to the oxygen pumping cell to discharge oxygen from the diffusion gap.
- If the exhaust gas in the HO2S 1 diffusion gap is rich, the ECM applies a negative current to the oxygen pumping cell to draw oxygen into the diffusion gap.

The pumping current required to maintain the HO2S 1 signal circuit voltage to about 450 mV is proportional to the level of oxygen concentration in the exhaust gas. The ECM monitors and evaluates the oxygen pumping current to determine the level of oxygen concentration in the exhaust.

An HO2S internal heater resistance performance DTC sets if the ECM detects an internal fault condition in the ECM HO2S heater circuit.

Conditions for Running the DTC

Run continuously once the following conditions are met:

- DTCs P0030, P0031, P0032, P0101, P0121, P012, P0123, P0131, P0132, P0133, P0221, P0222, P0223, P0336, P0338, P2237, P2243 and P2626 ran and passed.
- The calculated exhaust temperature is greater than 400ºC.
- The engine does not misfire.
- The ignition voltage is 10.0 – 16.0 V.
- The HO2S is commanded on.
- The engine is running at speed greater than 25 rpm

Conditions for Setting the DTC

There is an internal fault condition in the ECM HO2S heater circuit.

Conditions for Clearing the DTC

The HO2S internal heater resistance performance DTCs are Type B DTCs. Refer to 1.4 Diagnostic Trouble Codes in this Section for action taken when Type B DTC sets and conditions for clearing Type B DTCs.

Additional Information

- Refer to Section 6C1-1 Engine Management – V6 – General Information for details of the HO2S system operation.
- For an intermittent fault condition, refer to 4.2 Intermittent Fault Conditions in this Section.
- The HO2S must be tightened correctly. A loose HO2S will trigger these DTCs.
- Since fault condition in a wiring connector may trigger DTCs, always test the connectors related to this diagnostic procedure for shorted terminals or poor wiring connection before replacing any component. Refer to Section 12P Wiring Diagrams for information on electrical fault diagnosis.
- To assist diagnosis, refer to 2 Wiring Diagrams and Connector Charts in this Section for the system wiring diagram and connector charts.

DTC P0053 and P0059 Diagnostic Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been performed?	Go to Step 2	Refer to 3.4 Diagnostic System Check
2	1 Switch off the ignition for 30 seconds. 2 Start the engine. 3 Allow the engine to reach the normal operating temperature. 4 Increase the engine speed to 2,000 rpm for 10 seconds. 5 Using Tech 2, select the DTC display function. Does P0053 or P0059 fail this ignition cycle?	Go to Step 3	Refer to Additional Information in this DTC
3	Are DTCs relating to other circuits of the HO2S also set?	Go to the appropriate DTC Table in this Section	Go to Step 4
4	Replace the ECM. Refer to Section 6C1-3 Engine Management – V6 – Service Operations. Was the repair completed?	Go to Step 5	—
5	1 Using Tech 2, clear the DTCs. 2 Switch off the ignition for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the conditions for running the DTC. Does any of the HO2S internal heater resistance performance DTCs fail this ignition cycle?	Go to Step 2	Go to Step 6
6	Using Tech 2, select the DTC display function. Does Tech 2 display any DTCs?	Go to the appropriate DTC Table in this Section	System OK
When all diagnosis and repairs are completed, check the system for correct operation.			

6.8 DTC P0101, P0102 or P0103

DTC Descriptors

This diagnostic procedure supports the following DTCs:

- DTC P0101 – Mass Air Flow Sensor Circuit Range / Performance
- DTC P0102 – Mass Air Flow Sensor Voltage Low
- DTC P0103 – Mass Air Flow Sensor Voltage High

Circuit Description

The ignition control relay applies ignition positive voltage to the mass airflow (MAF) sensor. The ECM applies 5 V reference voltage and ground through the low reference circuit.

A heater resistor on the MAF sensor heats a micro-mechanical sensor diaphragm at a constant temperature. Two temperature dependent resistors positioned at each side of the heater resistor measure the intake air temperature:

- The first is located at a position before the intake air passes through the heater resistor. This temperature dependent resistor measures the temperature of the intake air before the air is heated.
- The second is located at a position after the intake air has passed through the heater resistor. This sensor measures the temperature of the intake air after the air is heated.

The evaluation circuit on the MAF sensor converts the difference in the resistance value of these two temperature dependent resistors into an analogue signal voltage. The ECM monitors this signal voltage through the MAF sensor signal to calculate the engine intake air mass.

A MAF sensor circuit DTC sets if the ECM detects the actual MAF sensor signal is not within the predetermined range of the calculated MAF sensor value.

Conditions for Running the DTC

DTC P0101

Runs continuously once the following conditions are met:

- DTCs P0121, P0122, P0123, P0221, P0222 and P0223 ran and passed.
- The engine is running.
- The ignition voltage is 10.0 – 16.0 V.
- The MAF sensor signal is -11.6 to +295 grams per second.
- The ECM detects greater than 150 crankshaft revolutions.

DTC P0102

Runs continuously once the following conditions are met:

- DTCs P0121, P0122, P0123, P0221, P0222 and P0223 ran and passed.
- The engine is running.
- The ignition voltage is 10.0 – 16.0 V.

DTC P0103

Runs continuously once the following conditions are met:

- DTCs P0121, P0122, P0123, P0221, P0222 and P0223 ran and passed.
- The engine is running at speed greater than 320 rpm
- The ignition voltage is 10.0 – 16.0 V.

Conditions for Setting the DTC

DTC P0101

The ECM detects the MAF sensor signal is not within the predetermined range of the calculated MAF value for 2 seconds.

DTC P0102

The ECM detects the MAF sensor signal is less than -11.7 grams per second.

DTC P0103

The ECM detects the MAF sensor signal is greater than 294 grams per second.

Additional Information

- The MAF sensor circuit DTCs is a Type B DTC. Refer to 1.4 Diagnostic Trouble Codes in this Section for action taken when a Type B DTC sets and conditions for clearing Type B DTC.
- Refer to Section 6C1-1 Engine Management – V6 – General Information for details of the MAF sensor operation.
- For an intermittent fault condition, refer to 4.2 Intermittent Fault Conditions in this Section.
- Inspect the MAF sensor for an incorrectly routed harness or if the harness is too close to the following:
  - ignition coil,
  - solenoids,
  - relays, and
  - motors.
- A low minimum air rate may cause this DTC to set during deceleration. Inspect for the following conditions:
  - a plugged or a collapsed intake air duct, or a dirty air filter element,
  - objects that block the MAF sensor air inlet screen, and
  - sticking or dirty throttle plate or throttle bore.
- Any un-metered air that enters the engine may cause this DTC to set. Inspect for vacuum leaks in the following:
  - intake manifold,
  - throttle body,
  - barometric pressure (BARO) sensor seal,
  - EVAP canister purge valve seal,
  - brake booster system,
  - air induction system, and
  - crankcase ventilation system.
- Since fault condition in a wiring connector may trigger DTCs, always test the connectors related to this diagnostic procedure for shorted terminals or poor wiring connection before replacing any component. Refer to Section 12P Wiring Diagrams for information on electrical fault diagnosis.
- To assist diagnosis, refer to 2 Wiring Diagrams and Connector Charts in this Section for the system wiring diagram and connector charts.

DTC P0101, P0102 or P0103 Diagnostic Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been performed?	Go to Step 2	Refer to 3.4 Diagnostic System Check
2	1 Switch off the ignition for 30 seconds. 2 Operate the vehicle within the conditions for running the DTC. 3 Using Tech 2, select the DTC display function. Does DTC P0101, P0102 or P0103 fail this ignition cycle?	Go to Step 3	Refer to Additional Information in this DTC
3	Inspect for the following fault conditions: • engine vacuum leak, • air leak in the intake air duct between the MAF sensor and the throttle body, • plugged or collapsed intake air duct, • objects that block the MAF sensor inlet screen, • restricted air filter element, • restricted throttle plate or carbon build-up around the throttle plate, • unseated engine oil dipstick, • loose or missing engine oil cap, and • over filled crankcase. Was any fault found and rectified?	Go to Step 14	Go to Step 4
4	1 Disconnect the MAF sensor wiring connector. 2 Connect a test lamp between the MAF sensor ignition voltage circuit and the ECM housing. 3 Switch on the ignition with the engine not running. Does the test lamp illuminate?	Go to Step 5	Go to Step 11
5	1 Switch on the ignition with the engine not running. 2 Using a digital multimeter, measure the voltage between the MAF sensor 5 V reference circuit and the ECM housing. Does the multimeter display 4.8 – 5.2 V?	Go to Step 6	Go to Step 8
6	1 Switch off the ignition. 2 Connect a 3 A fused jumper wire between the MAF sensor 5 V reference circuit and signal circuit. 3 Switch on the ignition with the engine not running. 4 Using Tech 2, observe the MAF sensor voltage parameter. Does Tech 2 display 4.8 – 5.2 V?	Go to Step 7	Go to Step 9

Step	Action	Yes	No
7	1 Switch off the ignition. 2 Remove ECM Fuse 29 from the engine compartment fuse and relay panel assembly. 3 Using a digital multimeter, measure the resistance between the MAF sensor low reference circuit and the ECM housing. **NOTE** Install ECM Fuse 29 to the engine compartment fuse and relay panel assembly after completing the test. Does the multimeter display 5 Ω?	Go to Step 12	Go to Step 10
8	Test the MAF sensor 5 V reference circuit for a high resistance, open circuit or short to voltage fault condition. Refer to Section 12P Wiring Diagrams for information on electrical fault diagnosis. **NOTE** The MAF sensor shares the 5 V reference circuit with other sensors. A fault condition in the 5 V reference circuit will trigger DTCs on sensors that share this circuit. Was any fault found and rectified?	Go to Step 14	Go to Step 13
9	Test the MAF sensor signal circuit for a high resistance, open circuit, short to ground or short to voltage fault condition. Refer to Section 12P Wiring Diagrams for information on electrical fault diagnosis. Was any fault found and rectified?	Go to Step 14	Go to Step 13
10	Test the MAF sensor low reference circuit for a high resistance or an open circuit fault condition. Refer to Section 12P Wiring Diagrams for information on electrical fault diagnosis. Was any fault found and rectified?	Go to Step 14	Go to Step 13
11	Repair the high resistance or open circuit fault condition in the MAF sensor circuit ignition voltage. Refer to Section 12P Wiring Diagrams for information on electrical wiring repair procedures. Was the repair completed?	Go to Step 14	—
12	Replace the MAF sensor. Refer to Section 6C1-3 Engine Management – V6 – Service Operations. Was the repair completed?	Go to Step 14	—
13	Replace the ECM. Refer to Section 6C1-3 Engine Management – V6 – Service Operations. Was the repair completed?	Go to Step 14	—
14	1 Using Tech 2, clear the DTCs. 2 Switch off the ignition for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the conditions for running the DTC. Does any of the MAF Sensor Circuit DTCs fail this ignition cycle?	Go to Step 2	Go to Step 15
15	Using Tech 2, select the DTC display function. Does Tech 2 display any DTCs?	Go to the appropriate DTC Table in this Section	System OK
When all diagnosis and repairs are completed, check the system for correct operation.			

6.9 DTC P0112 or P0113

DTC Descriptors

This diagnostic procedure supports the following DTCs:

- DTC P0112 – Intake Air Temperature Sensor Circuit Low Voltage
- DTC P0113 – Intake Air Temperature Sensor Circuit High Voltage

Circuit Description

The ECM applies a reference 5 V to the intake air temperature (IAT) sensor signal circuit and ground through the low reference circuit. The IAT sensor is a variable resistor that measures the engine intake air temperature.

- Increased temperature in the intake air decreases the resistance value of the IAT sensor. This increases the IAT sensor pull-down rate to ground. Therefore, the higher the intake air temperature, the lower the signal voltage output of the IAT sensor.
- Decreased temperature in the intake air increases the resistance value of the IAT sensor. This reduces the IAT sensor pull-down rate to ground. Therefore, the lower the intake air temperature, the higher the signal voltage output of the IAT sensor.

An IAT sensor circuit DTC sets if the ECM detects the intake air temperature is outside the specified range.

Conditions for Running the DTC

Runs continuously once the following conditions are met:

- The engine is running for longer than 3.0 minutes.
- The engine is idling for longer than 10.0 seconds

Conditions for Setting the DTC

DTC P0112

The ECM detects the intake air temperature is greater than 132°C for longer than 3.0 seconds.

DTC P0113

The ECM detects the intake air temperature is less than - 38°C for longer than 3.0 seconds.

Conditions for Clearing the DTC

The IAT sensor DTCs are Type B DTCs. Refer to 1.4 Diagnostic Trouble Codes in this Section for action taken when a Type B DTC sets and conditions for clearing Type B DTC.

Additional Information

- Refer to Section 6C1-1 Engine Management – V6 – General Information for details of the IAT Sensor operation.
- For an intermittent fault condition, refer to 4.2 Intermittent Fault Conditions in this Section.
- Test the IAT sensor using the IAT Temperature vs. Resistance in Section 6C1-3 Engine Management – V6 – Service Operations. If the engine has sat overnight, the IAT sensor should display within 3°C of the ECT sensor values.
- Since fault condition in a wiring connector may trigger DTCs, always test the connectors related to this diagnostic procedure for shorted terminals or poor wiring connection before replacing any component. Refer to Section 12P Wiring Diagrams for information on electrical fault diagnosis.
- To assist diagnosis, refer to 2 Wiring Diagrams and Connector Charts in this Section for the system wiring diagram and connector charts.

Test Description

The following numbers refer to the step numbers in the diagnostic table:

3 Tests the signal circuit of the IAT sensor.

4 Measures the integrity of the IAT sensor low reference circuit. Removal of the ECM Fuse 29 enables the ECM to power down completely prior to the test procedure.

DTC P0112 or P0113 Diagnostic Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been performed?	Go to Step 2	Refer to 3.4 Diagnostic System Check
2	1 Switch off the ignition for 30 seconds. 2 Start the engine. 3 Allow the engine to reach the normal operating temperature. 4 Using Tech 2, select the DTC display function. Does DTC P0112 or P0113 fail this ignition cycle?	Go to Step 3	Refer to Additional Information in this DTC
3	1 Switch off the ignition. 2 Disconnect the IAT sensor wiring connector. 3 Switch on the ignition with the engine not running. 4 Using a digital multimeter, measure the voltage between the IAT sensor signal circuit and the ECM housing. Does the multimeter display 4.8 – 5.2 V?	Go to Step 4	Go to Step 5
4	1 Switch off the ignition. 2 Remove ECM Fuse 29 from the engine compartment fuse and relay panel assembly. 3 Using a digital multimeter, measure the resistance between the IAT sensor low reference circuit and the ECM housing. **NOTE** Install the ECM Fuse 29 to the engine compartment fuse and relay panel assembly after completing this test. Does the multimeter display 5 Ω?	Go to Step 7	Go to Step 6
5	Test the IAT sensor signal circuit for a high resistance, open circuit, short to ground or short to voltage fault condition. Refer to Section 12P Wiring Diagrams for information on electrical fault diagnosis. Was any fault found and rectified?	Go to Step 9	Go to Step 8
6	Test the IAT sensor low reference circuit for a high resistance, open circuit, short to ground or short to voltage fault condition. Refer to Section 12P Wiring Diagrams for information on electrical fault diagnosis. **NOTE** The IAT sensor shares the low reference circuit with other sensors. A fault condition in the low reference circuit may trigger DTCs on sensors that share this circuit. Refer to 2 Wiring Diagrams and Connector Charts to assist diagnosis. Was any fault found and rectified?	Go to Step 9	Go to Step 8

Step	Action	Yes	No
7	Replace the IAT sensor. Refer to Section 6C1-3 Engine Management – V6 – Service Operations. Was the repair completed?	Go to Step 9	—
8	Replace the ECM. Refer to Section 6C1-3 Engine Management – V6 – Service Operations. Was the repair completed?	Go to Step 9	—
9	1 Using Tech 2, clear the DTCs. 2 Switch off the ignition for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the conditions for running the DTC. Does any of the IAT sensor DTCs fail this ignition cycle?	Go to Step 2	Go to Step 10
10	Using Tech 2, select the DTC display function. Does Tech 2 display any DTCs?	Go to the appropriate DTC Table in this Section	System OK
When all diagnosis and repairs are completed, check the system for correct operation.			

6.10 DTC P0116, P0117, P0118, P0125 or P1258

DTC Descriptors

This diagnostic procedure supports the following DTCs:

- DTC P0116 – Engine Coolant Temperature Sensor Circuit Range / Performance
- DTC P0117 – Engine Coolant Temperature Sensor Circuit Low Voltage
- DTC P0118 – Engine Coolant Temperature Sensor Circuit High Voltage
- DTC P0125 – Insufficient Engine Coolant Temperature For Closed Loop Fuel Control
- DTC P1258 – Engine Coolant Over Temperature - Protection Mode Active

Circuit Description

The ECM applies a reference 5 V to the engine coolant temperature (ECT) sensor signal circuit and ground through the low reference circuit. The ECT sensor is a variable resistor that measures the temperature of the engine coolant.

- Increased temperature in the engine coolant decreases the resistance value of the ECT sensor. This increases the ECT sensor pull-down rate to ground. Therefore, the higher the engine coolant, the lower the signal voltage output of the ECT sensor.
- Decreased temperature in the engine coolant increases the resistance value of the ECT sensor. This reduces the ECT sensor pull-down rate to ground. Therefore, the lower the engine coolant temperature, the higher the signal voltage output of the ECT sensor.

An ECT sensor DTC sets if the ECM detects the engine coolant temperature is outside the predetermined range.

Conditions for Running the DTC

DTC P0116

Runs continuously when the engine is running.

DTC P0117, P0118 and P1258

Runs continuously when the ignition is switched on.

DTC P00125

Runs continuously once the following conditions are met:

- DTCs P0112, P0113, P0117, P0118, P0480, P0481, P0691, P0692, P0693, and P0694 are not set.
- The engine is running.

Conditions for Setting the DTC

DTC P0116

The ECM detects the engine coolant temperature sensor value is 10°C less than the minimum calculated engine temperature.

DTC P0117

The ECM detects the engine coolant temperature is greater than 140°C for longer than 3 seconds.

DTC P0118

The ECM detects the engine coolant temperature is less than -39°C for longer than 3 seconds.

DTC P0125

The ECM determines the calculated engine temperature by measuring the amount of airflow into the engine. This DTC sets if the ECM detects the actual ECT sensor is not within 10ºC of the calculated engine temperature for approximately 2 – 5 minutes.

DTC P1258

The ECM detects the engine coolant temperature is greater than 131°C for longer than 2 seconds.

Conditions for Clearing the DTC

The ECT sensor DTCs are Type B DTCs. Refer to 1.4 Diagnostic Trouble Codes in this Section for action taken when a Type B DTC sets and conditions for clearing Type B DTC.

Additional Information

- Refer to Section 6C1-1 Engine Management – V6 – General Information for details of the ECT sensor operation.
- For an intermittent fault condition, refer to 4.2 Intermittent Fault Conditions in this Section.
- DTCs P0116, P0117, P0118 and P0125 diagnostic table is developed with the assumption the engine cooling system is functioning correctly. Therefore, rectify any engine cooling system fault conditions before proceeding with this diagnostic table.
- Test the ECT sensor using the ECT Temperature vs. Resistance in Section 6C1-3 Engine Management –V6 – Service Operations. If the engine has sat overnight, the ECT sensor should display within 3°C of the IAT sensor values. When the engine is first started, the ECT should rise steadily to about 90°C then stabilise when thermostat opens.
- Since fault condition in a wiring connector may trigger DTCs, always test the connectors related to this diagnostic procedure for shorted terminals or poor wiring connection before replacing any component. Refer to Section 12P Wiring Diagrams for information on electrical fault diagnosis.
- To assist diagnosis, refer to 2 Wiring Diagrams and Connector Charts in this Section for the system wiring diagram and connector charts.

Test Description

The following numbers refer to the step numbers in the diagnostic table:

2 A fault condition in the engine cooling system may trigger these DTCs.

7 The ECT sensor low reference circuit is shared with other components. DTC P0118 may set if the shared low reference circuit is shorted to voltage. Test the low reference circuit of all components that share this circuit to find the source of the fault condition.

DTC P0116, P0117, P0118, P0125 and P1258 Diagnostic Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been performed?	Go to Step 2	Refer to 3.4 Diagnostic System Check
2	Test the engine cooling system for correct operation. Refer to Section 6B1 Engine Cooling – V6. Was any fault found and rectified?	Go to Step 10	Go to Step 3
3	1 Switch off the ignition for 30 seconds. 2 Operate the vehicle within the conditions for running the DTC. 3 Using Tech 2, select the DTC display function. Does DTC P0116, P0117, P0118, P0125 or P1258 fail this ignition cycle?	Go to Step 4	Refer to Additional Information in this DTC

Step	Action	Yes	No
4	1 Switch off the ignition. 2 Disconnect the ECT sensor wiring connector. 3 Switch on the ignition with the engine not running. 4 Using a digital multimeter, measure the voltage between the ECT sensor signal circuit and the ECM housing. Does the multimeter display 4.8 – 5.2 V?	Go to Step 5	Go to Step 6
5	1 Switch off the ignition. 2 Remove ECM Fuse 29 from the engine compartment fuse and relay panel assembly. 3 Using a digital multimeter, measure the resistance between the ECT sensor low reference circuit and the ECM housing. **NOTE** Install the ECM Fuse 29 to the engine compartment fuse and relay panel assembly after completing this test. Does the multimeter display 5 Ω?	Go to Step 8	Go to Step 7
6	Test the IAT sensor signal circuit for a high resistance, open circuit, short to ground or short to voltage fault condition. Refer to Section 12P Wiring Diagrams for information on electrical fault diagnosis. Was any fault found and rectified?	Go to Step 10	Go to Step 9
7	Test the ECT sensor low reference circuit for a high resistance, open circuit, short to ground or short to voltage fault condition. Refer to Section 12P Wiring Diagrams for information on electrical fault diagnosis. **NOTE** The ECT sensor shares the low reference circuit with other sensors. A fault condition in the low reference circuit may trigger DTCs on sensors that share this circuit. Refer to 2 Wiring Diagrams and Connector Charts in this Section to assist diagnosis. Was any fault found and rectified?	Go to Step 10	Go to Step 9
8	Replace the ECT sensor. Refer to Section 6C1-3 Engine Management – V6 – Service Operations. Was the repair completed?	Go to Step 10	—
9	Replace the ECM. Refer to Section 6C1-3 Engine Management – V6 – Service Operations. Was the repair completed?	Go to Step 10	—
10	1 Using Tech 2, clear the DTCs. 2 Switch off the ignition for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the conditions for running the DTC. Does any of the ECT sensor DTCs fail this ignition cycle?	Go to Step 2	Go to Step 11
11	Using Tech 2, select the DTC display function. Does Tech 2 display any DTCs?	Go to the appropriate DTC Table in this Section	System OK
When all diagnosis and repairs are completed, check the system for correct operation.			

6.11 DTC P0121, P0122, P0123, P0221, P0222,or P0223

DTC Descriptors

This diagnostic procedure supports the following DTCs:

- DTC P0121 – Throttle Position Sensor 1 Circuit Range / Performance
- DTC P0122 – Throttle Position Sensor 1 Circuit Low Voltage
- DTC P0123 – Throttle Position Sensor 1 Circuit High Voltage
- DTC P0221 – Throttle Position Sensor 2 Circuit Range / Performance
- DTC P0222 – Throttle Position Sensor 2 Circuit Low Voltage
- DTC P0223 – Throttle Position Sensor 2 Circuit High Voltage

Circuit Description

The ECM applies 5 V to the throttle position (TP) sensor 1 through the 5 V reference circuit and the ground through the low reference circuit. TP sensor 1 and TP sensor 2 share common 5 V reference circuit and low reference circuit.

The TP sensor 1 and TP sensor 2 have individual signal circuits with opposite functionality. These signal circuits provide the ECM with a signal voltage that is proportional to the throttle plate movement.

- The TP sensor 1 signal voltage is less than 1 V when the throttle plate is in closed position, which increases to greater than 4 V when the throttle plate is moved to wide-open throttle.
- The TP sensor 2 signal voltage is greater than 4 V when the throttle plate is in closed position, which decreases to less than 1 V when the throttle plate is moved to wide-open throttle.

The ECM monitors and compares the TP sensor 1 signal voltage to the TP sensor signal voltage 2. In addition, the ECM compares the TP sensor signal to the MAF sensor signal to determine a calculated TP sensor signal.

A TP sensor DTC sets if the ECM detects a fault condition in the TP sensor signal output.

Conditions for Running the DTC

DTC P0121 runs continuously once the following conditions are met:

- The ignition voltage is greater than 7 V.
- The TP sensor 1 signal voltage is 0.17 – 4.6 V.

DTC P0122, P0123, P0222 and P0223 runs continuously once the following conditions are met:

- The ignition voltage is greater than 7 V.
- The ignition is switched on.

DTC P0221 runs continuously once the following conditions are met:

- The battery voltage is greater than 7 V.
- The TP sensor 2 signal voltage is 0.15 – 4.8 V.

DTC P0222 runs continuously once the following conditions are met:

- The battery voltage is greater than 7 V.
- The ignition is switched on.

Conditions for Setting the DTC

DTC P0121

The following conditions exist:

- The TP sensor 1 signal voltage and the TP sensor 2 signal voltage have a difference of greater than 9 percent.
- The TP sensor signal voltage has a difference of greater than 9 percent from the calculated TP sensor signal voltage.

DTC P0122

The ECM detects the TP sensor 1 signal voltage is less than 0.18 volt.

DTC P0123

The ECM detects the TP sensor 1 signal voltage is greater than 4.6 V.

DTC P0221

The following conditions exist:

- The TP sensor 2 signal voltage and the TP sensor 1 signal voltage have a difference of greater than 9 percent.
- The TP sensor 2 signal voltage has a difference of greater than 9 percent from the calculated TP sensor signal voltage.

DTC P0222

The ECM detects the TP sensor 2 signal voltage is less than 0.16 volt.

DTC P0223

The ECM detects the TP sensor 2 signal voltage is greater than 4.8 V.

Conditions for Clearing the DTC

DTCs P0121, P0122, P0123, P0221, P0222 are P0223 are Type B DTCs. Refer to 1.4 Diagnostic Trouble Codes in this Section for action taken when a Type B DTC sets and conditions for clearing Type B DTCs.

Additional Information

- Refer to Section 6C1-1 Engine Management – V6 – General Information for details of the TP sensor operation.
- The ECM defaults to a reduced power mode if there is a fault condition in the TP sensor circuits for the entire ignition cycle, even if the fault condition is corrected.
- For an intermittent fault condition, refer to 4.2 Intermittent Fault Conditions in this Section.
- The TP sensors share a common 5 V reference circuit, test for a fault condition in the 5 V reference circuit if both DTCs P0122 and P0222 are set.
- Since fault condition in a wiring connector may trigger DTCs, always test the connectors related to this diagnostic procedure for shorted terminals or poor wiring connection before replacing any component. Refer to Section 12P Wiring Diagrams for information on electrical fault diagnosis.
- To assist diagnosis, refer to 2 Wiring Diagrams and Connector Charts in this Section for the system wiring diagram and connector charts.

Test Description

The following number refers to the step number in the diagnostic table:

6 Measures the integrity of the TP sensor low reference circuit. Removal of the ECM Fuse 29 enables the ECM to power down completely prior to the test procedure.

DTC P0121, P0122, P0123, P0221, P0222 or P0223 Diagnostic Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been performed?	Go to Step 2	Refer to 3.4 Diagnostic System Check
2	1 Switch off the ignition for 30 seconds. 2 Start the engine. 3 Quickly depress the accelerator pedal to wide-open throttle then release pedal. Repeat this procedure several times or operate the vehicle within the conditions for running the DTC. 4 Using Tech 2, select the DTC display function. Does DTC P0121, P0122, P0123, P0221, P0222 or P0223 fail this ignition cycle?	Go to Step 3	Refer to Additional Information in this DTC
3	1 Disconnect the throttle actuator wiring connector. 2 Switch on the ignition with the engine not running. 3 Using a digital multimeter, measure the voltage between the TP sensor 5 V reference circuit and the ECM housing. Does the multimeter display 4.8 – 5.2 V?	Go to Step 4	Go to Step 7
4	1 Connect a 3 A fused jumper wire between the TP sensor 5 V reference circuit and the TP sensor 1 signal circuit. 2 Switch on the ignition with the engine not running. 3 Using Tech 2, observe the TP sensor 1 voltage parameter. Does Tech 2 display **4.8 – 5.2 V**?	Go to Step 5	Go to Step 8
5	1 Connect a 3 A fused jumper wire between the TP sensor 5 V reference circuit and the TP sensor 2 signal circuit. 2 Using Tech 2, observe the TP sensor 2 voltage parameter. Does Tech 2 display **4.8 – 5.2 V**?	Go to Step 6	Go to Step 9
6	1 Switch off the ignition. 2 Remove ECM Fuse 29 from the engine compartment fuse and relay panel assembly. 3 Using a digital multimeter, measure the resistance between the TP sensor low reference circuit and the ECM housing. **NOTE** Install the ECM Fuse 29 to the engine compartment fuse and relay panel assembly after completing the test. Does the multimeter display 5 Ω?	Go to Step 11	Go to Step 10
7	**NOTE** TP sensor 1 share the 5 V reference circuit with TP sensor 2. A fault condition in the TP sensor 5 V reference circuit may trigger DTCs on both sensors. Test the TP sensor 5 V reference circuit for a high resistance, open circuit, short to ground or short to voltage fault condition. Refer to Section 12P Wiring Diagrams for information on electrical fault diagnosis. Was any fault found and rectified?	Go to Step 13	Go to Step 12

Step	Action	Yes	No
8	Test the TP sensor 1 signal circuit for a high resistance, open circuit, short to ground or short to voltage fault condition. Refer to Section 12P Wiring Diagrams for information on electrical fault diagnosis. Was any fault found and rectified?	Go to Step 13	Go to Step 12
9	Test the TP sensor 2 signal circuit for a high resistance, open circuit, short to ground or short to voltage fault condition. Refer to Section 12P Wiring Diagrams for information on electrical fault diagnosis. Was any fault found and rectified?	Go to Step 13	Go to Step 12
10	Test the TP sensor low reference circuit for a high resistance or an open circuit fault condition. Refer to Section 12P Wiring Diagrams for information on electrical fault diagnosis. Was any fault found and rectified?	Go to Step 13	Go to Step 12
11	Replace the throttle body assembly. Refer to Section 6C1-3 Engine Management – V6 – Service Operations. Was the repair completed?	Go to Step 13	—
12	Replace the ECM. Refer to Section 6C1-3 Engine Management – V6 – Service Operations. Was the repair completed?	Go to Step 13	—
13	1 Using Tech 2, clear the DTCs. 2 Switch off the ignition for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the conditions for running the DTC. Does any of the TP Sensor Circuit DTCs fail this ignition cycle?	Go to Step 2	Go to Step 14
14	Using Tech 2, select the DTC display function. Does Tech 2 display any DTCs?	Go to the appropriate DTC Table in this Section	System OK
When all diagnosis and repairs are completed, check the system for correct operation.			

6.12 DTC P0130, P0131, P0132, P0135, P0137, P0138, P0140, P0141, P0150 P0151, P0152, P0155, P0157, P0158, P0160, P0161, P2243, P2247, P2270, P2271, P2272, P2273, P2297 or P2298

DTC Descriptors

This diagnostic procedure supports the following DTCs:

- DTC P0130 – O2 Sensor Circuit Malfunction (Bank 1, Sensor 1)
- DTC P0131 – O2 Sensor Circuit Low Voltage (Bank 1, Sensor 1)
- DTC P0132 – O2 Sensor Circuit High Voltage (Bank 1, Sensor 1)
- DTC P0135 – O2 Sensor Heater Circuit Range / Performance (Bank 1, Sensor 1)
- DTC P0137 – O2 Sensor Circuit Low Voltage (Bank 1, Sensor 2)
- DTC P0138 – O2 Sensor Circuit High Voltage (Bank 1, Sensor 2)
- DTC P0140 – O2 Sensor Circuit No Activity Detected (Bank 1, Sensor 2)
- DTC P0141 – O2 Sensor Heater Circuit Range / Performance (Bank 1, Sensor 2)
- DTC P0150 – O2 Sensor Circuit Malfunction (Bank 2, Sensor 1)
- DTC P0151 – O2 Sensor Circuit Low Voltage (Bank 2, Sensor 1)
- DTC P0152 – O2 Sensor Circuit High Voltage (Bank 2, Sensor 1)
- DTC P0155 –O2 Sensor Heater Circuit Range / Performance (Bank 2, Sensor 1)
- DTC P0157 – O2 Sensor Circuit Low Voltage (Bank 2, Sensor 2)
- DTC P0158 – O2 Sensor Circuit High Voltage (Bank 2, Sensor 2)
- DTC P0160 – O2 Sensor Circuit No Activity Detected (Bank 2, Sensor 2)
- DTC P0161 – O2 Sensor Heater Circuit Range / Performance (Bank 2, Sensor 2)
- DTC P2243 – O2 Sensor Voltage Signal Circuit Malfunction (Bank 1, Sensor 1)
- DTC P2247 – O2 Sensor Voltage Signal Circuit Malfunction (Bank 2, Sensor 1)
- DTC P2270 – O2 Sensor Lean / Rich Switch Signal Malfunction (Bank 1, Sensor 2)
- DTC P2271 – O2 Sensor Rich / Lean Switch Signal Malfunction (Bank 1, Sensor 2)
- DTC P2272 – O2 Sensor Lean / Rich Switch Signal Malfunction (Bank 2, Sensor 2)
- DTC P2273 – O2 Sensor Rich / Lean Switch Signal Malfunction (Bank 2, Sensor 2)
- DTC P2297 – O2 Sensor Range / Performance During Deceleration Fuel Cutoff (Bank 1, Sensor 1)
- DTC P2298 – O2 Sensor Range / Performance During Deceleration Fuel Cutoff (Bank 2, Sensor 1)

Circuit Description

The engine control relay applies positive voltage to the heater ignition voltage circuits of the HO2S. The ECM applies a pulse width modulated (PWM) ground to the heater control circuit of the HO2S through a device within the ECM called a driver, to control the HO2S rate of heating.

HO2 Sensor 2

The ECM applies a voltage of approximately 450 mV between the reference signal circuit and low reference circuit of the HO2S while the sensor temperature is less than the operating range.

Once the HO2S reaches operating temperature, the sensor varies this reference signal voltage, which constantly fluctuates between the high voltage output and the low voltage output.

- The low voltage output is 0 – 450 mV, which occurs if the air fuel mixture is lean.
- The high voltage output is 450 – 1,000 mV, which occurs if the air fuel mixture is rich.

The ECM monitors, stores and evaluates the HO2S voltage fluctuation information to determine the level of oxygen concentration in the exhaust.

HO2 Sensor 1

The ECM maintains the voltage between the reference signal circuit and low reference circuit of the HO2S 1 to about 450 mV by increasing or decreasing the oxygen content in the HO2S diffusion gap. To achieve this, the ECM controls the current applied to the oxygen pumping cell in the HO2S

The pumping current required to maintain the HO2S 1 signal circuit voltage to about 450 mV is proportional to the level of oxygen concentration in the exhaust gas.

- If the air / fuel mixture in the exhaust is balanced (lambda = 1), the oxygen pumping cell current is zero.
- If the exhaust gas in the HO2S 1 diffusion gap is lean, the ECM applies a positive current to the oxygen pumping cell to discharge oxygen from the diffusion gap.
- If the exhaust gas in the HO2S 1 diffusion gap is rich, the ECM applies a negative current to the oxygen pumping cell to draw oxygen into the diffusion gap.

The ECM monitors and evaluates the oxygen pumping current to determine the level of oxygen concentration in the exhaust.

An HO2S reference circuit DTC sets if the ECM detects the HO2S signal voltage is outside the predetermined range for a specified period.

Conditions for Running the DTC

DTC P0130, P0131, P0132, P0137, P0138, P0140, P0150, P0151 or P0152

Run continuously once the following conditions are met:

- The ignition voltage is 10.0 – 16.0 V.
- The engine is running.

DTC P0135 and P0155

Condition 1

Run continuously once the following conditions are met:

- DTCs P0030, P0031, P0032, P0050, P0051, P0052, P0101, P103, P0121, P0122, P0123, P0131, P0132, P0151, P0152, P0221, P0222, P0223, P0335, P0336, P0338, P2237, P2240, P2243, P2247, P2251 and P2254 ran and passed.
- The ignition voltage is 10.0 – 16.0 V.
- The HO2S is at operating temperature.
- The ECM internal sensing element resistance test is enabled.

Condition 2

Run continuously once the following conditions are met:

- DTCs P0030, P0031, P0032, P0050, P0051, P0052, P0101, P103, P0121, P0122, P0123, P0131, P0132, P0151, P0152, P0221, P0222, P0223, P0335, P0336, P0338, P2237, P2240, P2243, P2247, P2251 and P2254 ran and passed.
- The ignition voltage is 10.0 – 16.0 V.
- The HO2S is at operating temperature.
- The ECM internal sensing element resistance test is enabled.
- The fuel injectors are not disabled.
- If the engine is operating and the ignition is turned off, the engine must be off for at least 5 minutes for this DTC to run.

DTC P0137 and P0157

Run continuously once the following conditions are met:

- DTCs P0117, P0118, P0125 and P0128 ran and passed.
- The engine is operating for longer than two minutes.
- The ignition voltage is 10.0 – 16.0 V.
- The HO2S is at operating temperature.
- The calculated exhaust temperature is 250ºC – 800ºC.
- The engine coolant temperature is less than 40ºC at start-up and greater than 60ºC when the ignition was turned off last ignition cycle.
- The fuel tank level is greater than 25 percent.

DTC P0138 and P0158

Run continuously once the following conditions are met:

- The engine is operating for longer than two minutes.
- The ignition voltage is 10.0 – 16.0 V.
- The HO2S is at operating temperature.
- The calculated exhaust temperature is 250ºC – 800ºC.

DTC P0140 and P0160

Run continuously once the following conditions are met for longer than 90 seconds:

- The engine is operating.
- The ignition voltage is 10.0 – 16.0 V.
- The calculated exhaust temperature is 250º C – 800º C.

DTC P0141 and P0161

Run continuously once the following conditions are met:

- DTCs P0036, P0037, P0038, P0056, P0057, and P0058 ran and passed.
- DTCs P0137, P0138, P0140, P0157, P0158, or P0160 are not set.
- The engine is operating.
- The ECM internal sensing element resistance is valid.
- The fuel system is not in decel fuel shut-off.
- The intake air temperature is greater than -7ºC.
- If the engine is operating and the ignition is turned off, the engine must be off for at least 5 minutes for this DTC to run.
- The ignition voltage is 10.0 – 16.0 V.
- The calculated exhaust temperature is 360ºC – 500ºC.

DTC P2243 and P2247

Run continuously once the following conditions are met:

- DTCs P0030, P0031, P0032, P0050, P0051 and P0052 ran and passed.
- The ECM internal sensing element resistance is greater than 570 Ω.
- The HO2S is at operating temperature.

DTC P2270 and P2272

Run continuously once the following conditions are met:

- DTCs P0036, P0037, P0038, P0056, P0057, P0058, P0137, P0138, P0140, P0141, P0157, P0158, P0160, P0161, P0342, P0343, P0366, P0367, P0368, P0443, P0451, P0452, P0453, P0458 and P0459 ran and passed.
- The engine is running.
- The HO2S 2 are at operating temperature for longer than 10 seconds.
- The long term fuel control is enabled.
- The MAF sensor is greater than 10 g/s.

DTC P2297 and P2298

Condition 1

Run continuously once the following conditions are met:

- DTCs P0130 and P0150 ran and passed.
- The HO2S 1 are at operating temperature.
- The desired HO2S 1 signal is less than 1.6 lambda.
- The internal ECM HO2S 1 signal voltage is less than 4.81 V.
- The fuel injectors are enabled.

Condition 2

Run continuously once a decel fuel cut-off has occurred 11 times with successful adjustments

Conditions for Setting the DTC

DTC P0130 and P0150

The ECM detects the HO2S signal voltage is out of range.

DTC P0131 and P0151

The ECM internal HO2S voltage is less than the specified threshold.

DTC P0132 and P0152

The ECM internal HO2S voltage is less than the specified threshold.

DTC P0135 and P0155

Condition 1

The ECM internal HO2S sensing element resistance is less than the specified threshold for longer than 15 seconds.

Condition 2

The ECM detects the calculated HO2S temperature is greater than a predetermined threshold.

DTC P0137 and P0157

The ECM detects the HO2S signal voltage is less than 60 mV.

DTC P0138 and P0158

The ECM detects the HO2S signal voltage is greater than 1050 mV.

DTC P0140 and P0160

The ECM detects one of the following conditions:

- The HO2S signal voltage is 400 – 500 mV for longer than 5 minutes, or
- the internal resistance of the HO2S is greater than 40,000 Ω when the calculated exhaust temperature is greater than 600ºC.

DTC P0141 and P0161

The ECM detects the HO2S internal resistance is not within the expected range for longer than 6 seconds.

DTC P2243 and P2247

The ECM detects the internal HO2S signal voltage is not 0.2 – 4.7 V.

DTC P2270 and P2272

When the ECM detects the HO2S 2 is less than 650 mV for 100 seconds, the ECM enriches the fuel mixture up to 30 percent for 10 seconds. This DTC sets if the ECM detects the HO2S 2 is still less than 650 mV.

DTC P2271 and P2273

When the ECM detects the HO2S 2 is greater than 650 mV for 100 seconds, the ECM leans the fuel mixture up to -7 percent for 10 seconds. If this signal voltage is still greater than 650 mV, the ECM tests the HO2S at the next decel fuel cut-off. This DTC sets if the ECM detects the HO2S 2 signal voltage is greater than 200 mV after 4 seconds in decel fuel cu-off mode.

DTC P2297 and P2298

The ECM detects the internal HO2S 1 signal voltage is greater than 3.7 V for longer than 10 seconds.

Conditions for Clearing the DTC

The HO2S reference circuit DTCs are Type B DTCs. Refer to 1.4 Diagnostic Trouble Codes in this Section for action taken when Type B DTC sets and conditions for clearing Type B DTCs.

Additional Information

- Refer to Section 6C1-1 Engine Management – V6 – General Information for details of the HO2S system operation.
- For an intermittent fault condition, refer to 4.2 Intermittent Fault Conditions in this Section.
- The HO2S must be tightened correctly. A loose HO2S will trigger these DTCs.
- A fault condition in the fuel delivery system, air intake system or exhaust system may trigger these DTCs.
- Since fault condition in a wiring connector may trigger DTCs, always test the connectors related to this diagnostic procedure for shorted terminals or poor wiring connection before replacing any component. Refer to Section 12P Wiring Diagrams for information on electrical fault diagnosis.
- To assist diagnosis, refer to 2 Wiring Diagrams and Connector Charts in this Section for the system wiring diagram and connector charts.

DTC P0130 to P0132, P0135 to P0138, P0140, P0141, P0150 to P0152, P0155, P0157, P0158, P0160, P0161, P2243, P2247, P2270 to P2273, P2297 or P2298 Diagnostic Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been performed?	Go to Step 2	Refer to 3.4 Diagnostic System Check
2	1 Switch off the ignition for 30 seconds. 2 Start the engine. 3 Allow the engine to reach the normal operating temperature. 4 Increase the engine speed to 2,000 rpm for 10 seconds or operate the vehicle within the conditions for setting the DTC. 5 Using Tech 2, select the DTC display function. Does DTC P0130, P0131, P0132, P0135, P0137, P0138, P0140, P0141, P0150, P0151, P0152, P0155, P0160, P0161, P2243, P2247, P2270, P2271, P2272, P2273, P2297 or P2298 fail this ignition cycle?	Go to Step 3	Refer to Additional Information in this DTC
3	Are DTCs relating to the heater circuit of the O2 sensor, also set? (e.g. P0030, P0031, P0032, P0036, P0037, P0038, P0050, P0051, P0052, P0056, P0057 or P0058)	Go to the appropriate DTC Table in this Section	Go to Step 4
4	1 Disconnect the appropriate HO2S wiring connector. 2 Switch on the ignition with the engine not running. 3 Using a digital multimeter, measure the voltage between the HO2S reference signal circuit and low reference circuit. Does the multimeter display 350 – 550 mV?	Go to Step 7	Go to Step 5
5	1 Test the reference signal circuit of the HO2S for a high resistance, open circuit, short to ground or short to voltage fault condition. Refer to Section 12P Wiring Diagrams for information on electrical fault diagnosis. Was any fault found and rectified?	Go to Step 10	Go to Step 6
6	1 Test the low reference circuit of the HO2S for a high resistance, open circuit, short to ground or short to voltage fault condition. Refer to Section 12P Wiring Diagrams for information on electrical fault diagnosis. Was any fault found and rectified?	Go to Step 10	Go to Step 9
7	1 Test or inspect for the following conditions that may cause the HO2S to detect an incorrect air / fuel mixture: – lean or rich fuel injector fuel delivery, – restricted air intake system, – contaminated fuel, – low fuel line pressure, – exhaust leak near the HO2S, and – leak in the crankcase or vacuum line. Was any fault found and rectified?	Go to Step 10	Go to Step 8
8	1 Replace the appropriate HO2S. Refer to Section 6C1-3 Engine Management – V6 – Service Operations. Was the repair completed?	Go to Step 10	—

Step	Action	Yes	No
9	1 Replace the ECM. Refer to Section 6C1-3 Engine Management – V6 – Service Operations. Was the repair completed?	Go to Step 10	—
10	1 Using Tech 2, clear the DTCs. 2 Switch off the ignition for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the conditions for running the DTC. Does any HO2S reference circuit DTC fail this ignition cycle?	Go to Step 2	Go to Step 11
11	1 Using Tech 2, select the DTC display function. Does Tech 2 display any DTCs?	Go to the appropriate DTC Table in this Section	System OK
When all diagnosis and repairs are completed, check the system for correct operation.			

6.13 DTC P0133 or P0153

DTC Descriptors

This diagnostic procedure supports the following DTCs:

- DTC P0133 – HO2S Circuit Slow Response – Bank 1 Sensor 1
- DTC P0153 – HO2S Circuit Slow Response – Bank 2 Sensor 1

Circuit Description

The wide band heated oxygen sensor (HO2S) measures the amount of oxygen in the exhaust system and provides more information than the switching style HO2S. The wide band sensor consists of an oxygen sensing cell, an oxygen pumping cell, and a heater.

The exhaust gas sample passes through a diffusion gap between the sensing cell and the pumping cell. The engine control module (ECM) supplies a voltage to the HO2S and uses this voltage as a reference to the amount of oxygen in the exhaust system. An electronic circuit within the ECM controls the pump current through the oxygen pumping cell to maintain a constant voltage in the oxygen sensing cell. The ECM monitors the voltage variation in the sensing cell and attempts to keep the voltage constant by increasing or decreasing the amount of current flow, or oxygen ion flow, to the pumping cell.

By measuring the amount of current required to maintain the voltage in the sensing cell, the ECM can determine the concentration of oxygen in the exhaust. The HO2S voltage is displayed as a lambda value. A lambda value of 1 is equal to a stoichiometric air fuel ratio of 14.7:1. Under normal operating conditions, the lambda value will remain around 1. When the fuel system is lean, the oxygen level will be high and the lambda signal will be high or more than 1. When the fuel system is rich, the oxygen level will be low, and the lambda signal will be low or less than 1. The ECM uses this information to maintain the correct air / fuel ratio.

Conditions for Running the DTC

- Before the ECM can report DTC P0133 or P0153 failed, DTCs P0121, P0122, P0123, P0221, P0222, P0223, P0336, P0338, P2237, and P2240 must run and pass.
- DTCs P0030, P0031, P0032, P0050, P0051, P0052, P0053, P0059, P0130, P0131, P0132, P0135, P0150, P0151, P0151, P0152, P0155, P0442, P0443, P0446, P0455, P0458, P0459, P0496, P167A, P167B, P2096, P2097, P2098, P2099, P2231, P2234, P2243, P2247, P2251, P2254, P2297, P2298, P2626, and P2629 are not set.
- The HO2S is at operating temperature.
- The HO2S is between 0.94 – 1.06 lambda.
- The engine speed is between 1,480 – 2,040 rpm.
- The volumetric efficiency is between 16.5 – 38.3 percent.
- The change in volumetric efficiency is less than 3 percent.
- The evaporative emission (EVAP) purge is not active, or the ECM determines the EVAP hydrocarbon (HC) concentration is less than a predetermined amount when EVAP purge is active.
- The long term fuel trim correction is active.
- DTCs P0133 and P0153 run continuously once the above conditions are met for 10 minutes.

Conditions for Setting the DTC

- The ECM has determined that the dynamic value of the affected HO2S is less than a predetermined threshold.
- The above condition is met for more than 4 seconds.

Action Taken When the DTC Sets

- The ECM illuminates the Check Powertrain icon, or the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The ECM turns OFF the Check Powertrain icon, or the malfunction indicator lamp (MIL) after four consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Use Tech 2 to clear the MIL/DTC.

Additional Information

- Use the J 35616 Connector Test Adapter Kit for any test that requires probing the ECM harness connector or a component harness connector.
- The lower connector of the ECM is connector A43-X1 and the upper connector of the ECM is connector A43-X2. Refer to 2.2 ECM Connector End Views in this Section.
- The front wide band sensors do not toggle or switch like a switching HO2S. The front HO2S signals will be relatively stable for an idling engine.
- For an intermittent fault condition, refer to 4.2 Intermittent Fault Conditions in this Section.
- Since fault condition in a wiring connector may trigger DTCs, always test the connectors related to this diagnostic procedure for shorted terminals or poor wiring connection before replacing any component. Refer to Section 12P Wiring Diagrams for information on electrical fault diagnosis.
- To assist diagnosis, refer to 2 Wiring Diagrams and Connector Charts in this Section for the system wiring diagram and connector charts.
- The following table illustrates the typical voltages for the HO2S circuits:

HO2S Voltages	
Conditions: • Ignition ON, Engine OFF • HO2S Disconnected	
HO2S Circuit	**Voltage**
Heater Control	4.6 – 5.0 V
Heater Supply Voltage	B+
Reference Voltage	2.6 – 3.1 V
Low Reference	2.2 – 2.7 V
Pump Current	Less than 0.5 A
Input Pump Current	Less than 0.5 A

Test Description

The numbers below refer to the step numbers on the diagnostic table.

2 This step determines if the condition exists.

4 This step determines if the fuel system is contaminated.

DTC P0133 or P0153 Diagnostic Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been completed?	Go to Step 2	Refer to 3.4 Diagnostic System Check
2	**NOTE** • DTC P0133 is for Bank 1 sensor 1 and DTC P0153 is for bank 2 sensor 1. • DTC P0132 causes DTC P0153 to set. If DTC P0132 is set with DTC P0153, refer to 6.12 DTC P0132 or P0152 in this Section. • Inspect the heated oxygen sensor (HO2S) for being secure before proceeding with this DTC. A sensor that is loose could cause this DTC to set. 1 Start engine and allow to reach operating temperature. 2 Observe the diagnostic trouble code (DTC) information with Tech 2. Did DTC P0133 and / or DTC P0153 fail this ignition cycle?	Go to Step 4	Go to Step 3
3	1 Observe the Freeze Frame / Failure Records for this DTC. 2 Turn OFF the ignition for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame / Failure Records. Did the DTC fail this ignition?	Go to Step 4	Go to Additional Information in this DTC
4	Did DTC P0133 and DTC P0153 fail this ignition cycle?	Go to Step 7	Go to Step 5
5	1 Inspect for an exhaust leak near the HO2S. Refer to Section 8B Exhaust System. After you inspect the exhaust system, return to this diagnostic. Did you find and correct the condition?	Go to Step 8	Go to Step 6
6	1 Inspect or test for the following conditions: • Inspect that the HO2S is securely installed. • Inspect for corrosion on the HO2S terminals. • Inspect the terminal tension at the HO2S and at the engine control module (ECM). Refer to Section 12 Wiring Diagrams. • Inspect the HO2S wiring for damage. Did you find and correct the condition?	Go to Step 8	Go to Step 7

Step	Action	Yes	No
7	**NOTE** If both DTCs are set, determine and correct the cause of the contamination before replacing a sensor. 1 Inspect for the following conditions: • Fuel contamination – refer to 5.5 Alcohol / Contaminants in Fuel Diagnosis in this Section. • The correct RTV sealant. • Engine oil consumption – refer to Section 6A1 Engine Mechanical – V6. • Engine coolant consumption – refer to Section 6B1 Engine Cooling – V6. 2 Replace the HO2S. Refer to Section 6C1-3 Engine Management – V6 – Service Operations. Did you complete the replacement?	Go to Step 8	—
8	1 Use Tech 2 to Clear the DTCs. 2 Turn OFF the ignition for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame / Failure Records. Did the DTC fail this ignition?	Go to Step 2	Go to Step 9
9	1 Using Tech 2, select the DTC display function. Does Tech 2 display any DTCs?	Go to the appropriate DTC Table in this Section	System OK
When all diagnosis and repairs are completed, clear all DTCs and verify correct operation			

6.14 DTC P0139 or P0159

DTC Descriptors

This diagnostic procedure supports the following DTCs:

- DTC P0139 – O2 Sensor Circuit Slow Response (Bank 1 Sensor 2)
- DTC P0159 – O2 Sensor Circuit Slow Response (Bank 2 Sensor 2)

Circuit Description

The post catalytic converter heated oxygen sensor (HO2S) produces a voltage that varies between 100 – 900 mV under normal operating conditions. The engine control module (ECM) produces a bias voltage on the HO2S signal circuit of 420 – -480 mV. The reference ground for the sensor is provided through the ECM.

The ECM monitors the signal voltage to determine if the exhaust is lean or rich. The oxygen sensor voltage is high when the exhaust is rich, and low when the exhaust is lean. The ECM constantly monitors the HO2S signal during the Closed Loop operation. If the ECM detects that the decel fuel cut-off rich-to-lean transition time is too long, DTC P0139 will set for Bank 1 sensor 2, or DTC P0159 will set for bank 2 sensor 2.

Conditions for Running the DTC

- DTCs P0021, P0024, P0030, P0031, P0032, P0036, P0037, P0038, P0050, P0051, P0052, P0056, P0057, P0058, P0101, P0102, P0103, P0106, P0107, P0108, P0116, P0117, P0118, P0121, P0122, P0123, P0125, P0128, P0131, P0132, P0135, P0137, P0138, P0139, P0140, P0141, P0151, P0152, P0155, P0157, P0158, P0159, P0160, P0161, P0201-P0208, P0221, P0222, P0223, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P0273, P0274, P0276, P0277, P0279, P0280, P0282, P0283, P0300, P0301-P0308, P0335, P0336, P0340, P0341, P0345, P0346, P0351-P0358, P0365, P0366, P0390, P0391, P0442, P0443, P0446, P0449, P0453, P0454, P0455, P0458, P0459, and P0496 are not set.
- The ECT Sensor parameter is more than 66° C.
- The Vehicle Speed Sensor parameter is between 5 – 180 km/h.
- The calculated catalytic converter temperature is more than 520° C.
- DTC P0139 or P0159 runs continuously once the above conditions are met.

Conditions for Setting the DTC

- The ECM detects that the decel fuel cut-off and rich-to-lean transition time has exceeded 1 second.

Action Taken When the DTC Sets

- The ECM illuminates the Check Powertrain icon, or the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
- The ECM records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure.
- The ECM writes the operating conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The ECM turns OFF the Check Powertrain icon, or the malfunction indicator lamp (MIL) after three consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Use Tech 2 to clear the MIL and the DTC.

DTC P0139 or P0159 Diagnostic Table

Step	Action	Value(s)	Yes	No
1	Has the Diagnostic System Check been completed?	—	Go to Step 2	Refer to 3.4 Diagnostic System Check
2	1 Start and run the engine until normal operating temperature is reached. 2 Quickly cycle the throttle from closed throttle to wide open throttle (WOT) 3 times within 5 seconds while observing the HO2S Bank 1 Sensor 2 or HO2S Bank 2 Sensor 2 voltage parameter with Tech 2. Does the voltage react immediately when performing the above action?	—	Go to Step 3	Go to Step 4
3	1 Observe the Freeze Frame / Failure Records for this DTC. 2 Turn OFF the ignition for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame / Failure Records. Did the DTC fail this ignition?	—	Go to Step 4	Go to 4.2 Intermittent Fault Conditions.
4	1 Ignition OFF. 2 Disconnect the affected heated oxygen sensor (HO2S) 2 3 Connect a 3 Amp fused jumper wire between the HO2S high signal circuit, on the engine harness side connector, and a good ground. 4 Ignition ON, engine OFF. 5 Use Tech 2 to observe the affected HO2S 2 parameter Is the voltage less than the specified value?	25 mV	Go to Step 5	Go to Step 7
5	1 Remove the jumper wire from the previous step. 2 Connect a 3 Amp fused jumper wire between the HO2S high signal circuit and the HO2S low signal circuit, on the engine harness side connector. 3 Use Tech 2 to observe the HO2S 2 parameter. Is the voltage less than the specified value?	25 mV	Go to Step 6	Go to Step 8
6	1 Remove the jumper wire from the previous step. 2 Measure the resistance of the following circuits with a DMM: • The HO2S heater low control circuit. • The ignition voltage circuit Refer to Section 12P Wiring Diagrams. Is the resistance of either circuit more than the specified value?	5 Ω	Go to Step 12	Go to Step 9

7	1 Test the HO2S high signal circuit for an open or high resistance. Refer to Section 12P Wiring Diagrams. Did you find and correct the condition?	—	Go to Step 15	Go to Step 11
8	1 Test the HO2S low signal circuit for an open or high resistance. Refer to Section 12P Wiring Diagrams. Did you find and correct the condition?	—	Go to Step 15	Go to Step 11
9	1 The HO2S is detecting a rich or lean exhaust condition or may be contaminated. Inspect for one of the following conditions: • HO2S connector water intrusion. • A silicon-contaminated HO2S. • Fuel-contaminated engine oil – refer to 5.5 Alcohol / Contaminants in Fuel Diagnosis in this Section. • Rich fuel injectors. • Lean fuel injectors. Refer to Section 8A1 Fuel System • An exhaust leak between the HO2S and the engine. Refer to Section 8B Exhaust System. • Vacuum leaks. • Fuel contamination. Water, even in small amounts, can be delivered to the fuel injectors, causing a lean exhaust to be indicated. Excessive alcohol in the fuel can also cause this condition. Refer to 5.5 Alcohol / Contaminants in Fuel Diagnosis in this Section. • An inaccurate mass air flow (MAF) sensor. 2 Repair any of the above or similar engine conditions, as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 10
10	1 Test for intermittent and poor connections at the HO2S. Refer to Section 12P Wiring Diagrams. Did you find and correct the condition?	—	Go to Step 15	Go to Step 13
11	1 Test for intermittent and poor connections at the engine control module (ECM). Refer to Section 6C1-3 Engine Management – V6 – Service Operations. Did you find and correct the condition?	—	Go to Step 15	Go to Step 14
12	1 Repair the circuit with high resistance. Refer to 12P Wiring Diagrams. Did you complete the repair?	—	Go to Step 15	—
13	1 Replace the affected HO2S. Refer to Section 6C1-3 Engine Management – V6 – Service Operations. Did you complete the replacement?	—	Go to Step 15	—

14	1 Replace the ECM. Refer to Section 6C1-3 Engine Management – V6 – Service Operations. Did you complete the replacement?	—	Go to Step 15	—
15	1 Use Tech 2 to clear the DTCs. 2 Turn OFF the ignition for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame / Failure Records. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 16
16	1 Using Tech 2, select the DTC display function. Does Tech 2 display any DTCs?	—	Go to the appropriate DTC Table in this Section	System OK
When all diagnosis and repairs are completed, clear all DTCs and verify correct operation				

6.15 DTC P0196, P0197 or P0198

DTC Descriptors

This diagnostic procedure supports the following DTCs:

- DTC P0196 – Engine Oil Temperature Sensor Range / Performance
- DTC P0197 – Engine Oil Temperature Voltage Low
- DTC P0198 – Engine Oil Temperature Voltage High

Circuit Description

The ECM applies a positive 5 V reference voltage to the engine oil temperature (EOT) sensor through the 5 V reference circuit and the ground through the low reference circuit.

The EOT sensor is a variable resistor that measures the temperature of the engine oil. This sensor provides signal voltage to the ECM that is proportional to the oil temperature off the engine.

The ECM monitors and compares the EOT sensor signal voltage against a specified range. An EOT sensor circuit DTC sets if the ECM detects the EOT sensor signal voltage is outside the specified range.

Conditions for Running the DTC

DTC P0196, P0197 and P0198 run continuously when the engine is running.

Conditions for Setting the DTC

DTC P0196

The ECM detects the engine oil temperature sensor is not within 100°C of the modelled temperature

NOTE

The modelled temperature is the temperature that the ECM expects to see given current engine operating conditions.

DTC P0197

The ECM detects the engine oil temperature is less than -35°C for longer than 3 seconds.

DTC P0198

The ECM detects the engine oil temperature is greater than 170°C for longer than 3 seconds.

Conditions for Clearing DTC

The EOT sensor circuit DTCs are Type C DTCs. Refer to 1.4 Diagnostic Trouble Codes in this Section for action taken when a Type C DTC sets and conditions for clearing Type C DTCs.

Additional Information

- Refer to Section 6C1-1 Engine Management – V6 – General Information for details of the EOT sensor operation.
- For an intermittent fault condition, refer to 4.2 Intermittent Fault Conditions in this Section.
- Since fault condition in a wiring connector may trigger DTCs, always test the connectors related to this diagnostic procedure for shorted terminals or poor wiring connection before replacing any component. Refer to Section 12P Wiring Diagrams for information on electrical fault diagnosis.
- To assist diagnosis, refer to 2 Wiring Diagrams and Connector Charts in this Section for the system wiring diagram and connector charts.

Test Description

The following numbers refer to the step numbers in the diagnostic table:

5 Test signal circuit of the EOT sensor. This circuit should display a voltage within the specified range.

6 Measures the integrity of the EOT sensor low reference circuit. Removal of the Fuse 29 enables the ECM to power down completely prior to the test procedure.

DTC P0196, P0197 or P0198 Diagnostic Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been performed?	Go to Step 2	Refer to 3.4 Diagnostic System Check
2	Test the engine cooling system for correct operation. Refer to Section 6B1 Engine Cooling – V6. Was any fault found and rectified?	Go to Step 11	Go to Step 3
3	Inspect the engine oil condition. Refer to Section 6A1 Engine Mechanical – V6. Was any fault found and rectified?	Go to Step 11	Go to Step 4
4	1 Switch off the ignition for 30 seconds. 2 Operate the vehicle within the conditions for running the DTC. 3 Using Tech 2, select the DTC display function. Does DTC P0196, P0197 or P0198 fail this ignition cycle?	Go to Step 5	Refer to Additional Information in this DTC
5	1 Switch off the ignition. 2 Disconnect the EOT sensor wiring connector. 3 Switch on the ignition with the engine not running. 4 Using a digital multimeter, measure the voltage between the EOT sensor signal circuit and the ECM housing. Does the multimeter display 4.8 – 5.2 V?	Go to Step 6	Go to Step 7
6	1 Switch off the ignition. 2 Remove ECM / TCM Fuse 29 from the engine compartment fuse and relay panel assembly. 3 Using a digital multimeter, measure the resistance between the EOT sensor low reference circuit and the ECM housing. **NOTE** Install the ECM Fuse 29 to the engine compartment fuse and relay panel assembly after completing this test. Does the multimeter display 5 Ω?	Go to Step 9	Go to Step 8
7	Test EOT sensor signal circuit for a high resistance, open circuit, short to ground or short to voltage fault condition. Refer to Section 12P Wiring Diagrams for information on electrical fault diagnosis. Was any fault found and rectified?	Go to Step 11	Go to Step 10

Step	Action	Yes	No
8	Test the EOT sensor low reference circuit for a high resistance and open circuit fault condition. Refer to Section 12P Wiring Diagrams for information on electrical fault diagnosis. **NOTE** The EOT sensor shares the low reference circuit with other sensors. A fault condition in the low reference circuit may trigger DTCs on sensors that share this circuit. Refer to 2 Wiring Diagrams and Connector Charts in this Section to assist diagnosis. Was any fault found and rectified?	Go to Step 11	Go to Step 10
9	Replace the EOT sensor. Refer to Section 6C1-3 Engine Management – V6 – Service Operations. Was the repair completed?	Go to Step 11	—
10	Replace the ECM. Refer to Section 6C1-3 Engine Management – V6 – Service Operations. Was the repair completed?	Go to Step 11	—
11	1 Using Tech 2, clear the DTCs. 2 Switch off the ignition for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the conditions for running the DTC. Does any of the conditions for the engine oil pressure sensor circuit DTCs fail this ignition cycle?	Go to Step 2	Go to Step 12
12	Using Tech 2, select the DTC display function. Does Tech 2 display any DTCs?	Go to the appropriate DTC Table in this Section	System OK
When all diagnosis and repairs are completed, check the system for correct operation.			

6.16 DTC P0201, P0202, P0203, P0204, P0205, P0206, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P0273, P0274, P0276 or P0277

DTC Descriptors

This diagnostic procedure supports the following DTCs:

- DTC P0201 – Injector 1 Control Circuit Malfunction
- DTC P0202 – Injector 2 Control Circuit Malfunction
- DTC P0203 – Injector 3 Control Circuit Malfunction
- DTC P0204 – Injector 4 Control Circuit Malfunction
- DTC P0205 – Injector 5 Control Circuit Malfunction
- DTC P0206 – Injector 6 Control Circuit Malfunction
- DTC P0261 – Injector 1 Control Circuit Low Voltage
- DTC P0262 – Injector 1 Control Circuit High Voltage
- DTC P0264 – Injector 2 Control Circuit Low Voltage
- DTC P0265 – Injector 2 Control Circuit High Voltage
- DTC P0267 – Injector 3 Control Circuit Low Voltage
- DTC P0268 – Injector 3 Control Circuit High Voltage
- DTC P0270 – Injector 4 Control Circuit Low Voltage
- DTC P0271 – Injector 4 Control Circuit High Voltage
- DTC P0273 – Injector 5 Control Circuit Low Voltage
- DTC P0274 – Injector 5 Control Circuit High Voltage
- DTC P0276 – Injector 6 Control Circuit Low Voltage
- DTC P0277 – Injector 6 Control Circuit High Voltage

Circuit Description

The engine control relay applies ignition positive voltage to the fuel injector ignition circuit. The ECM applies a pulse width modulated (PWM) ground to the injector control circuit through a device within the ECM called a driver to control each fuel injector on time.

The driver has a feedback circuit that is pulled-up when the voltage is approximately 3.3 V. The ECM monitors the driver feedback circuit to determine if the control circuit is open, shorted to ground or shorted to a positive voltage.

A fuel injector control circuit DTC sets if the ECM detects a fault condition in a fuel injector control circuit.

Conditions for Running the DTC

Run continuously once the following conditions are met:

- the battery voltage is 10.0 – 16.0 V, and
- engine speed is greater than 80 rpm

Conditions for Setting the DTC

DTC P0201, P0202, P0203, P0204, P0205 or P0206

The ECM detects an open circuit fault condition in a fuel injector circuit.

DTC P0261, P0264, P0267, P0270, P0273 and P0276

The ECM detects a short to ground fault condition in the control circuit a fuel injector.

DTC P0262, P0265, P0268, P0271, P0274 and P0277

The ECM detects a short to voltage fault condition in the control circuit of a fuel injector.

Conditions for Clearing the DTC

The fuel injector control circuit DTCs are Type B DTCs. Refer to 1.4 Diagnostic Trouble Codes in this Section for action taken when Type B DTC sets and conditions for clearing Type B DTCs.

Additional Information

- Refer to Section 6C1-1 Engine Management – V6 – General Information for details of the fuel injector operation.
- Using Tech 2, observe the appropriate fuel injector status parameter while wriggle testing related harness and connectors. Tech 2 reading will change from Ok to Fault if there is an intermittent fault condition in the harness or connector being tested.
- Perform the fuel injector coil test to help isolate an intermittent condition. Refer to 5.2 Fuel Injector Coil Test in this Section.
- For an intermittent fault condition, refer to 4.2 Intermittent Fault Conditions in this Section.
- Since fault condition in a wiring connector may trigger DTCs, always test the connectors related to this diagnostic procedure for shorted terminals or poor wiring connection before replacing any component. Refer to Section 12P Wiring Diagrams for information on electrical fault diagnosis.
- To assist diagnosis, refer to 2 Wiring Diagrams and Connector Charts in this Section for the system wiring diagram and connector charts.

Test Description

The following numbers refer to the step numbers in the diagnostic table:

3 Determines if there is a fault condition in the ignition voltage supply circuit. The fuel injectors for each bank of the engine are fused separately. If all DTCs for a single bank are set, there may be a fault in one of the ignition supply circuits.

5 Verifies the ECM is sending control voltage to the fuel injector.

6 Tests if the feed back voltage circuit within the ECM is providing the correct voltage.

DTC P0201 to P0206, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P0273, P0274, P0276 and P0277 Diagnostic Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been performed?	Go to Step 2	Refer to 3.4 Diagnostic System Check
2	1 Switch off the ignition for 30 seconds. 2 Start the engine. 3 Using Tech 2, select the DTC display function. Does DTC P0201, P0202, P0203, P0204, P0205, P0206, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P0273, P0274, P0276 or P0277 set?	Go to Step 3	Refer to Additional Information in this DTC

Step	Action	Yes	No
3	1 Disconnect the fuel injector interconnect harness connector. Refer to Section 6C1-3 Engine Management – V6 – Service Operations. 2 Switch on the ignition with the engine not running. 3 Connect a test lamp between the ignition voltage circuit of the appropriate fuel injector, ECM side of the interconnect connector, and the ECM housing. Does the test lamp illuminate?	Go to Step 4	Go to Step 5
4	1 Switch on the ignition with the engine not running. 2 Using a digital multimeter, measure the voltage between the appropriate fuel injector control circuit, ECM side of the interconnect connector, and the ECM housing. Does the multimeter display 2.6 – 4.6 mV?	Go to Step 7	Go to Step 6
5	Repair the open circuit or short to ground fault condition in the ignition voltage circuit of the appropriate fuel injector. Refer to Section 12P Wiring Diagrams for information on electrical wiring repair procedures. Was the repair completed?	Go to Step 10	—
6	Test the control circuit of the appropriate fuel injector, between the interconnect connector and the ECM, for a high resistance, open circuit, short to ground or short to voltage fault condition. Refer to Section 12P Wiring Diagrams for information on electrical fault diagnosis. Was any fault found and rectified?	Go to Step 10	Go to Step 9
7	1 Remove the upper intake manifold. Refer to Section 6A1-Engine Mechanical – V6. 2 Test the control circuit and the ignition voltage circuit of the appropriate fuel injector, between the interconnect connector and the appropriate fuel injector connector, for a high resistance, open circuit, short to ground or short to voltage fault condition. Refer to Section 12P Wiring Diagrams for information on electrical fault diagnosis. Was any fault found and rectified?	Go to Step 10	Go to Step 8
8	Replace the appropriate fuel injector. Refer to Section 6C1-3 Engine Management – V6 – Service Operations. Was the repair completed?	Go to Step 10	—
9	Replace the ECM. Refer to Section 6C1-3 Engine Management – V6 – Service Operations. Was the repair completed?	Go to Step 10	—
10	1 Using Tech 2, clear the DTCs. 2 Switch off the ignition for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the conditions for running the DTC. Does any of the fuel injector control circuit DTCs fail this ignition cycle?	Go to Step 2	Go to Step 11
11	Using Tech 2, select the DTC display function. Does Tech 2 display any DTCs?	Go to the appropriate DTC Table in this Section	System OK
When all diagnosis and repairs are completed, check the system for correct operation.			

6.17 DTC P0219

DTC Descriptor

This diagnostic procedure supports DTC P0219 – Engine Overspeed Condition.

Circuit Description

The ECM continually monitors the engines operating environment. A engine over-speed condition DTC sets if the ECM detects an engine speed in excess of 7200 RPM.

NOTE

An over-speed condition will occur when a low gear on a manual transmission vehicle has been selected whilst the vehicle is travelling at high road speed. This DTC will not set if the engine is free-revved as the ECM will limit engine speed.

Conditions for Running the DTC

DTC P0219 runs continuously when the following conditions are met:

- The vehicle is fitted with a manual transmission
- The engine is running.
- The ignition voltage is between 10.0 – 16.0 V.

Conditions for Setting the DTC

The ECM detects an engine speed in excess of 7200 RPM for 1 second or longer.

Conditions for Clearing the DTC

The engine over-speed DTC is a Type C DTC. Refer to 1.4 Diagnostic Trouble Codes in this Section for action taken when Type C DTCs set and conditions for clearing Type C DTCs.

Additional Information

- For an intermittent fault condition, refer to 4.2 Intermittent Fault Conditions in this Section.
- Since fault condition in a wiring connector may trigger DTCs, always test the connectors related to this diagnostic procedure for shorted terminals or poor wiring connection before replacing any component. Refer to Section 12P Wiring Diagrams for information on electrical fault diagnosis.
- To assist diagnosis, refer to 2 Wiring Diagrams and Connector Charts in this Section for the system wiring diagram and connector charts.

DTC P0219 Diagnostic Table

Step	Action	Yes	No
1	Has the diagnostic system check been performed?	Go to Step 2	Refer to 3.4 Diagnostic System Check
2	1 Switch off the ignition for 30 seconds. 2 Operate the vehicle within the conditions for running the DTC. 5 Using Tech 2, select the DTC display function. Does DTC P0219 fail this ignition cycle?	Go to Step 3	Refer to Additional Information in this DTC

3	Replace the ECM. Refer to Section 6C1-3 Engine Management – V6 – Service Operations. Was the repair completed?	Go to Step 4	—
4	1 Using Tech 2, clear the DTCs. 2 Switch off the ignition for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the conditions for running the DTC. Does DTC P0219 fail this ignition cycle?	Go to Step 2	Go to Step 5
5	Using Tech 2, select the DTC display function. Are there any DTCs displayed?	Go to the appropriate DTC Table in this Section	System OK
When all diagnosis and repairs are completed, check the system for correct operation.			

6.18 DTC P0300

DTC Descriptor

This diagnostic procedure supports the following DTC:

DTC P0300 Engine Misfire Detected.

Circuit Description

The engine control module (ECM) uses information from the crankshaft position (CKP) sensor and the camshaft position (CMP) sensors to determine when an engine misfire is occurring. By monitoring variations in the crankshaft rotation speed for each cylinder, the ECM is able to detect individual misfire events. A misfire rate that is high enough can cause 3-way catalytic converter damage. The Check Powertrain icon, or the malfunction indicator lamp (MIL) will flash ON and OFF when the conditions for catalytic converter damage are present. DTCs P0301 through P0306 correspond to cylinders 1 through 6. If the ECM is able to determine that a specific cylinder is misfiring, the DTC for that cylinder will set. If the misfire rate is sufficient to cause emission levels to exceed a predetermined value, this DTC sets.

Conditions for Running the DTC

- DTCs P0121, P0122, P0123, P0221, P0222, P0223, P0335, P0336, or P0338 are not set.
- The engine speed is between 400 – 7,000 rpm and steady.
- The delivered torque signal is more than 10 percent at idle.
- The delivered torque signal is between 9 – 30 percent with the transmission in drive.
- The intake air temperature (IAT) is more than –30° C.
- The fuel level is more than 12 percent.
- The torque management is not active.
- The antilock brake system / traction control system (ABS / TCS) is not active.
- The fuel cut-off is not active, including the traction control, the deceleration, the high vehicle speed, and the high engine speed.
- DTC P0300 runs continuously when the above conditions exist for at least 1,000 engine revolutions.

Conditions for Setting the DTC

- The ECM detects a crankshaft rotation speed variation indicating a misfire rate sufficient to cause emissions levels to exceed mandated standards.
- The condition above exists for more than 4 seconds.

Action Taken When the DTC Sets

- The control module activates the Check Powertrain icon, or the MIL on the second ignition cycle that the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The ECM turns OFF the Check Powertrain icon, or the malfunction indicator lamp (MIL) after four consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Use Tech 2 to clear the Check Powertrain icon, or MIL and the DTC.

Additional Information

- A misfire DTC could be caused by an excessive vibration from sources other than the engine. Inspect for the following possible sources:
  - A tyre or wheel that is out of round or out of balance
  - Variable thickness brake rotors
  - An unbalanced drive shaft
  - Certain rough road conditions
  - A damaged accessory drive component or belt
- A misfire DTC could be caused by a camshaft actuator stuck in the full advance or retard position.
- For an intermittent condition, refer to 4.2 Intermittent Fault Conditions in this Section.

Test Description

The numbers below refer to the step numbers on the diagnostic table.

2 This step determines if there is a current condition.

4 If the Misfire Current Counters are incrementing, but the engine is NOT misfiring, this indicates a mechanical condition. For example, an accessory drive belt could cause this condition.

DTC P0300 - Engine Misfire Detected

Step	Action	Yes	No
1	Has the Diagnostic System Check been completed?	Go to Step 2	Refer to 3.4 Diagnostic System Check
2	**NOTE** The engine may only misfire when the engine is under a load. An engine load may be necessary to verify the condition. 1 Start the engine. 2 Use Tech 2 to monitor the Misfire Current Cyl 1 – 6 parameters. Are any of the Misfire Current Counters incrementing?	Go to Step 4.	Go to Step 3
3	1 Clear the DTC. 1 Switch off the ignition for 30 seconds. 2 Operate the vehicle within the conditions for running the DTC. 3 Using Tech 2, select the DTC display function. Does DTC P0300 fail this ignition cycle?	Go to Step 4	Refer to Additional Information in this DTC
4	Is the engine misfiring?	Go to Step 5	Go to Symptoms Diagnostics
5	1 Observe the DTC information using Tech 2. Is DTC P0011, P0014, P0021, P0024, P0201-P0206, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P0273, P0274, P0276, P0277, P0335, P0336, P0338, P0351-P0356, P2088, P2090, P2092, P2094, P2300, P2301, P2303, P2304, P2306, P2307, P2309, P2310, P2312, P2313, P2315, or P2316 also set?	Go to the appropriate DTC Table in this Section	Go to Step 6
6	Is there an engine mechanical noise?	Go to Symptoms in 6A1 Engine Mechanical	Go to Step 7

Step	Action	Yes	No
7	Is there more than one cylinder specific misfire DTC set?	Go to Step 8	Go to 6.19 DTC P0301, P0302, P0303, P0304, P0305 or P0306
8	Are there any heated oxygen sensor (HO2S) DTCs set?	Go to the appropriate DTC Table in this Section	Go to Step 9
9	1 Inspect or test for the following conditions: • Inspect the vacuum hoses for splits, kinks, and proper connections. • Inspect the throttle body and the intake manifold for vacuum leaks. • Inspect the crankcase ventilation valve and / or system for any vacuum leaks. • Test for the correct fuel pressure. Refer to Section 8A1 Fuel Tank. • Inspect the fuel system for any restrictions, leaks or fuel contamination. Refer to Section 8A1 Fuel Tank. • Inspect for fouled or damaged spark plugs. Determine what caused the spark plugs to foul. Refer to Section 6C1-3 Engine Management – Service Operations. • Inspect the exhaust system for restrictions. Refer to Section 8B Exhaust System. • Inspect the engine control grounds for being clean, tight, and in the correct location. • Inspect for a camshaft actuator stuck in the full advance or retard position. 2 Repair as required. Did you find and correct the condition?	Go to Step 10	Go to Symptoms in 6A1 Engine Mechanical
10	1 Use Tech 2 to clear the DTCs. 2 Switch off the ignition for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the Conditions for Running DTC 300. Did the DTC fail this ignition?	Go to Step 2	Go to Step 11
11	1 Using Tech 2, select the DTC display function. Does Tech display any DTCs?	Go to the appropriate DTC Table in this Section	System OK
When all diagnosis and repairs are completed, clear all DTCs and verify correct operation			

6.19 DTC P0301, P0302, P0303, P0304, P0305 or P0306

DTC Descriptor

This diagnostic procedure supports the following DTCs:

- DTC P0301 – Cylinder 1 Misfire Detected
- DTC P0302 – Cylinder 2 Misfire Detected
- DTC P0303 – Cylinder 3 Misfire Detected
- DTC P0304 – Cylinder 4 Misfire Detected
- DTC P0305 – Cylinder 5 Misfire Detected
- DTC P0306 – Cylinder 6 Misfire Detected

Circuit Description

The engine control module (ECM) uses information from the crankshaft position (CKP) sensor and the camshaft position (CMP) sensor to determine when an engine misfire is occurring. By monitoring variations in the crankshaft rotation speed for each cylinder, the ECM is able to detect individual misfire events. A misfire rate that is high enough can cause 3-way catalytic converter damage. The Check Powertrain icon, or the malfunction indicator lamp (MIL) will flash ON and OFF when the conditions for catalytic converter damage are preset. DTCs P0301 – P0306 correspond to cylinders 1 to 6. If the ECM is able to determine that a specific cylinder is misfiring, the DTC for that cylinder sets.

Conditions for Running the DTC

- DTCs P0121, P0122, P0123, P0221, P0222, P0223, P0335, P0336, or P0338 are not set.
- The engine speed is between 400 – 7,000 rpm and steady.
- The delivered torque signal is more than 10 percent at idle with the transmission in neutral.
- The delivered torque signal is between 10 – 30 percent with the transmission in drive.
- The intake air temperature (IAT) is more than –30° C.
- The engine run time is more than 45 seconds.
- The fuel level is more than 12 percent.
- The torque management is not active.
- The antilock brake / traction control (ABS / TC) system is not active.
- The fuel cut-off is not active, including the traction control, the deceleration, the high vehicle speed, and the high engine speed.

DTCs P0301, P0302, P0303, P0304, P0305, and P0306 run continuously when the above conditions exist for at least 1,000 engine revolutions.

Conditions for Setting the DTC

- The ECM detects a crankshaft rotation speed variation indicating a single cylinder misfire rate sufficient to cause emissions levels to exceed mandated standards.
- The condition exists for more than 4 seconds.

Action Taken When the DTC Sets

- The control module activates the Check Powertrain icon, or the MIL on the second ignition cycle that the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The ECM turns OFF the Check Powertrain icon, or the malfunction indicator lamp (MIL) after four consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Use Tech 2 to clear the Check Powertrain icon, or the MIL and the DTC.

Additional Information

- A misfire DTC could be caused by an excessive vibration from sources other than the engine. Check for the following possible sources:
  - Tyre or wheel out of round or balance
  - Variable thickness brake rotor or drum
  - Drive shaft not balanced
  - Certain rough road conditions
  - Damaged accessory drive belt
- For an intermittent condition, refer to 4.2 Intermittent Fault Conditions in this Section.
- Since a fault condition in a wiring connector may trigger DTCs, always test the connectors related to this diagnostic procedure for shorted terminals or poor wiring connection before replacing any component. Refer to Section 12P Wiring Diagrams for information on electrical fault diagnosis.
- To assist diagnosis, refer to 2 Wiring Diagrams and Connector Charts in this Section for the system wiring diagram and connector charts.

DTC P0301, P0302, P0303, P0304, P0305 or P0306 Diagnostic Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been completed?	Go to Step 2	Refer to 3.4 Diagnostic System Check
2	Were you sent here from DTC P0300?	Go to Step 3	Go to 6.18 DTC P0300
3	1 Ignition OFF. 2 Remove the ignition coil of the misfiring cylinder, but leave the electrical connector connected. Refer to 2.17 Ignition Coil, in Section 6C1-3 Engine Management – V6 – Service Operations. 3 Inspect the ignition coil boot for the following conditions: – Holes. – Tears. – Carbon tracking. – Oil contamination or water intrusion. Did you find a condition with the ignition coil boot?	Go to Step 12	Go to Step 4
4	1 Remove the fuel pump fuse from the under-hood fuse and relay centre. 2 Install the J 26792 Spark Tester to the ignition coil boot and a good ground. 3 Crank the engine while observing J 26792. Does the spark tester spark and is the spark consistent?	Go to Step 5	Go to 5.9 Electronic Ignition (EI) System Diagnosis

Step	Action	Yes	No
5	1 Ignition OFF. 2 Remove the spark plug from the cylinder that indicated a misfire. 3 Inspect the spark plug. Refer to 2.25 Spark Plugs – Inspect, in Section 6C1-3 Engine Management – V6 – Service Operations. Does the spark plug appear to be OK?	Go to Step 9	Go to Step 6
6	Is the spark plug oil or coolant fouled?	Go to 2.25 Spark Plugs – Inspect, in Section 6C1-3 Engine Management – V6 – Service Operations	Go to Step 7
7	Is the spark plug gas fouled?	Go to Step 10	Go to Step 9
8	Does the spark plug show any signs of being cracked, worn, or incorrectly gap?	Go to Step 11	Go to Step 9
9	1 Swap the suspected spark plug with another cylinder that is operating correctly. 2 Start the engine. 3 Operate the engine within the conditions that the misfire occurred. 4 Use Tech 2 to monitor the Misfire Current Counters. Did the misfire move with the spark plug?	Go to Step 11	Go to Step 10
10	**NOTE** • Make sure all the fuel injectors operate. High resistance in a fuel injector circuit causes the fuel injector to be inoperative without setting a fuel injector DTC. • Return to this diagnostic after you complete the Fuel Injector Coil Test. 1 Perform the fuel injector coil test. Refer to 5.2 Fuel Injector Coil Test in this Section. Did you find and correct the condition?	Go to Step 13	Go to 4 Symptoms Diagnostics
11	1 Replace the spark plug. Refer to 2.25 Spark Plugs, in Section 6C1-3 Engine Management – V6 – Service Operations. Did you complete the replacement?	Go to Step 13	—
12	1 Replace the ignition coil. Refer to 2.17 Ignition Coils, in Section 6C1-3 Engine Management – V6 – Service Operations. Did you complete the replacement?	Go to Step 13	—
13	1 Using Tech 2, clear the DTCs. 2 Switch off the ignition for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the conditions for running DTC P0301 to P0306. Do any Cylinder Engine Misfire DTCs fail this ignition cycle?	Go to Step 2	Go to Step 14
14	Using Tech 2, select the DTC display function. Does Tech 2 display any DTCs?	Go to the appropriate DTC Table in this Section	System OK
When all diagnosis and repairs are completed, clear all DTCs and verify correct operation			

6.20 DTC P0324

DTC Descriptor

This diagnostic procedure supports DTC P0324 – Knock Sensor Module Performance

Circuit Description

The ECM supplies the ground to the knock sensor (KS) low reference circuit. The KS produces a signal voltage, which is proportional to the level of the engine vibration or spark knock.

When the ECM detects an excessive spark knock, it retards the ignition timing until the spark knock stops.

The KS circuitry within the ECM receives, amplifies, filters and evaluates the KS signal voltage. The ECM performs the following tests to determine if the ECM internal KS circuitry is functioning correctly.

Test One

The ECM performs the following:

1 Turns off the knock sensor signal circuits.

2 Applies different test signals to the ECM internal KS circuitry.

3 Verifies each test signal output response is within range.

4 If the ECM detects any of the tested signals are not within the normal range, DTC P0324 sets.

Test Two

The ECM performs the following:

1 Turns off the knock sensor signal circuits.

2 Tests for any output response when no test signals are applied.

3 If the ECM detects an output response, DTC P0324 sets.

Test Three

1 Turns off the knock sensor signal circuits.

2 Generates an internal test pulse then monitors the return signal.

3 If the return test pulse is less than a calibrated threshold, DTC P0324 sets.

DTC P0324 sets if the ECM detects an incorrect response to the ECM internal KS circuitry tests.

Conditions for Running the DTC

Condition One

Runs continuously once the following conditions are met:

- The ECM is controlling the ignition spark.
- The engine speed is less than 2,300 rpm and steady.
- The volumetric efficiency is steady.

Condition Two

Runs continuously once the following conditions are met:

- The ECM is controlling the ignition spark.
- The engine speed is 1,000 – 4,000 rpm
- The engine coolant temperature is greater than 60° C.
- The volumetric efficiency is steady.

Condition Three

Runs continuously once the following conditions are met:

- The ECM is controlling the ignition spark.
- The engine speed is less than 2,300 rpm and steady.
- The engine coolant temperature is greater than 40° C.
- The volumetric efficiency is steady.

Conditions for Setting the DTC

The ECM detects an incorrect response to an internal ECM KS circuitry test.

Conditions for Clearing the DTC

DTC P0324 – Knock Sensor (KS) Module Performance is a Type B DTC. Refer to 1.4 Diagnostic Trouble Codes in this Section for action taken when a Type B DTC sets and conditions for clearing Type B DTC.

Additional Information

- Refer to Section 6C1-1 Engine Management – V6 – General Information for details of the knock sensor (KS) system operation.
- The ECM turns off the KS signal circuits when performing the ECM internal KS circuitry tests. DTC P0324 sets if there is a fault condition in the internal ECM KS circuitry. Therefore, the KS and the KS signal circuits are not tested in DTC P0324 Diagnostic Table.
- For an intermittent fault condition, refer to 4.2 Intermittent Fault Conditions in this Section.
- Since fault condition in a wiring connector may trigger DTCs, always test the connectors related to this diagnostic procedure for shorted terminals or poor wiring connection before replacing any component. Refer to Section 12P Wiring Diagrams for information on electrical fault diagnosis.
- To assist diagnosis, refer to 2 Wiring Diagrams and Connector Charts in this Section for the system wiring diagram and connector charts.

Test Description

The following number refers to the step number in the diagnostic table:

3 A crankshaft sensor DTC may trigger DTC P0324.

DTC P0324 Diagnostic Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been performed?	Go to Step 2	Refer to 3.4 Diagnostic System Check
2	1 Switch off the ignition for 30 seconds. 2 Operate the vehicle within the conditions for running the DTC. 3 Using Tech 2, select the DTC display function. Does DTC P0324 fail this ignition cycle?	Go to Step 3	Refer to Additional Information in this DTC
3	Are DTCs relating to the CKP Sensor Circuit also set?	Refer to 6.22 DTC P0335, P0336, P0337 or P0338	Go to Step 4
4	Replace the ECM. Refer to Section 6C1-3 Engine Management – V6 – Service Operations. Was the repair completed?	Go to Step 5	—
5	1 Using Tech 2, clear the DTCs. 2 Switch off the ignition for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the conditions for running DTC P0324. Does DTC P0324 fail this ignition cycle?	Go to Step 2	Go to Step 6
6	Using Tech 2, select the DTC display function. Does Tech 2 display any DTCs?	Go to the appropriate DTC Table in this Section	System OK
When all diagnosis and repairs are completed, check the system for correct operation.			

6.21 DTC P0327, P0328, P0332 or P0333

DTC Descriptor

This diagnostic procedure supports the following DTCs:

- DTC P0327 – Knock Sensor Circuit Low Frequency (Bank 1)
- DTC P0328 – Knock Sensor Circuit High Frequency (Bank 1)
- DTC P0332 – Knock Sensor Circuit Low Frequency (Bank 2)
- DTC P0333 – Knock Sensor Circuit High Frequency (Bank 2)

Circuit Description

The ECM supplies the ground to the knock sensor (KS) low reference circuit. The KS produces a signal voltage, which is proportional to the level of the engine vibration or spark knock.

When the ECM detects an excessive spark knock, it retards the ignition timing until the spark knock stops.

To differentiate between a normal engine vibration and the vibration created by a spark knock, the ECM samples the KS signal under different engine speeds and load condition. The ECM uses this samples to determine maximum and minimum KS signal voltage produced when the engine is running under normal conditions.

A knock sensor circuit DTC sets if the ECM detects the KS signal voltage is outside the normal range.

Conditions for Running the DTC

DTC P0327 and P0332

Run continuously once the following conditions are met:

- DTCs P0324, P0335, P0342, P0343, P0347, P0348, P0367, P0368, P0392, and P0393 ran and passed.
- The ECM controls the ignition spark.
- Engine speed is greater than 2000 rpm and steady.
- The engine coolant temperature is greater than 60ºC.
- The volumetric efficiency is steady.

DTC P0328 or P0333

Run continuously once the following conditions are met:

- The ECM controls the ignition spark.
- Engine speed is greater than 2,000 rpm and steady.
- The engine coolant temperature is greater than 60°C.
- The volumetric efficiency is steady.

Conditions for Setting the DTC

DTC P0327 and P0332

The ECM detects the KS signal voltage is less than the minimum KS signal normal range for at least 10 seconds.

DTC P0328 and P0333

The ECM detects the KS signal voltage is greater than the maximum KS signal normal range.

Conditions for Clearing DTC

The knock sensor circuit DTCs are Type B DTCs. Refer to 1.4 Diagnostic Trouble Codes in this Section for action taken when Type B DTC sets and conditions for clearing Type B DTCs.

Additional Information

- Refer to Section 6C1-1 Engine Management – V6 – General Information for details of the knock sensor (KS) system operation.
- Preconditions for running knock sensor circuit DTCs requires that DTC P0324 has ran and passed. Therefore, the diagnostic table for the knock sensor circuit DTCs is developed with the assumption the ECM internal KS circuitry is functioning correctly.
- Excessive engine mechanical noise or engine knocking condition may trigger knock sensor circuit DTCs.
- The knock sensor must be tightened correctly. Refer to Section 6C1-3 Engine Management – V6 – Service Operations.
- The mounting between the knock sensor and engine must be free of burrs, casting flash and foreign material.
- The knock sensor head must be clear from hoses, brackets and engine wiring.
- If the knock sensor lead is damaged in any way, the sensor must be replaced.
- Since fault condition in a wiring connector may trigger DTCs, always test the connectors related to this diagnostic procedure for shorted terminals or poor wiring connection before replacing any component. Refer to Section 12P Wiring Diagrams for information on electrical fault diagnosis.
- To assist diagnosis, refer to 2 Wiring Diagrams and Connector Charts in this Section for the system wiring diagram and connector charts.

Test Description

The following numbers refer to the step numbers in the diagnostic table:

3 Identifies engine mechanical fault conditions that may trigger knock sensor circuit DTCs.

4 Identifies KS fault conditions that may trigger knock sensor circuit DTCs.

DTC P0327, P0328, P0332 and P0333 Diagnostic Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been performed?	Go to Step 2	Refer to 3.4 Diagnostic System Check
2	1 Switch off the ignition for 30 seconds. 2 Operate the vehicle within the conditions for running the DTC. 3 Using Tech 2, select the DTC display function. Does DTC P0327, P0328, P0332 or P0333 fail this ignition cycle?	Go to Step 3	Refer to Additional Information in this DTC
3	Check the engine for excessive mechanical engine noise or engine knocking fault condition. Refer to Section 6A1 Engine Mechanical – V6. Was any fault found and rectified?	Go to Step 7	Go to Step 4

Step	Action	Yes	No
4	Inspect the appropriate KS for the following fault condition. Refer to Section 6C1-3 Engine Management – V6 – Service Operations. • incorrect KS attaching bolt torque value, • burrs, casting flash or foreign material between the knock sensor and engine, • hoses, brackets or engine wiring touching the KS, and • damaged KS wiring harness. • sensor wiring harness for conditions that may induce electromagnetic interference. Refer to 4.2 Intermittent Fault Conditions in this Section. Was any fault found and rectified?	Go to Step 7	Go to Step 5
5	Test the appropriate KS signal circuit and low reference circuit for a high resistance, open circuit, short to ground or short to voltage or shorted together fault condition. Refer to Section 12P Wiring Diagrams for information on electrical fault diagnosis. Was any fault found and rectified?	Go to Step 7	Go to Step 6
6	Replace the faulty KS. Refer to 6C1-3 Engine Management – V6 – Service Operations. Was the repair completed?	Go to Step 7	—
7	1 Using Tech 2, clear the DTCs. 2 Switch off the ignition for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the conditions for running the DTC. Does any of the knock sensor circuit DTCs fail this ignition cycle?	Go to Step 2	Go to Step 8
8	Using Tech 2, select the DTC display function. Does Tech 2 display any DTCs?	Go to the appropriate DTC Table in this Section	System OK
When all diagnosis and repairs are completed, check the system for correct operation.			

6.22 DTC P0335, P0336, P0337 or P0338

DTC Descriptors

This diagnostic procedure supports the following DTCs:

- DTC P0335 – Crankshaft Position Sensor Circuit Malfunction
- DTC P0336 – Crankshaft Position Sensor Signal Range / Performance
- DTC P0337 – Crankshaft Position Sensor Circuit Low Duty Cycle
- DTC P0338 – Crankshaft Position Sensor Circuit High Duty Cycle

Circuit Description

The ECM applies the ground to the crankshaft position (CKP) sensor low reference circuit.

The CKP sensor in conjunction with the 58X reluctor wheel generates an AC signal voltage. The amplitude and frequency of the signal generated is proportional to the engine speed. The ECM uses this signal from the CKP sensor signal circuit to determine the engine rpm

In addition, the CKP sensor sends a signal to the ECM when piston No. 1 and piston No. 4 are at the top dead centre position. The ECM monitors both the CKP signal and the camshaft position (CMP) sensor signal to determine the compression stroke of piston No. 1.

A CKP sensor DTC sets if the ECM detects a fault condition in the CKP sensor signal circuit.

Conditions for Running the DTC

DTC P0335

Runs continuously once the following conditions are met:

- The engine is cranking or running.
- The ECM detects greater than 8 CMP sensor pulses.

DTC P0336

Runs continuously once the following conditions are met:

- DTCs P0341, P0342 and P0343 ran and passed.
- The engine is cranking or running.
- The ECM detects a valid CMP signal.

DTC P0337 and P0338

Runs continuously once the following conditions are met:

- DTCs P0341, P0342 and P0343 ran and passed.
- The engine is cranking or running.
- The ECM detects a valid CMP signal.

Conditions for Setting the DTC

DTC P0335

The ECM does not detect a signal from the CKP sensor for 5 seconds.

DTC P0336

The ECM loses the crankshaft reference position and has to re-synchronise the crankshaft to camshaft one or more times during six consecutive crankshaft revolutions.

DTC P0337

The ECM detects less than 58 reference signal pulses from the CKP sensor in the last eight consecutive crankshaft revolutions.

DTC P0338

The ECM detects more than 58 reference signal pulses from the CKP sensor in the last eight consecutive crankshaft revolutions.

Conditions for Clearing DTC

The CKP sensor circuit DTCs are Type B DTCs. Refer to 1.4 Diagnostic Trouble Codes in this Section for action taken when a Type B DTC sets and conditions for clearing Type B DTCs.

Additional Information

- Refer to Section 6C1-1 Engine Management – V6 – General Information for details of the CKP sensor operation.
- For an intermittent fault condition, refer to 4.2 Intermittent Fault Conditions in this Section.
- If the ECM has stored and learned the camshafts reference position, the ECM will utilise the camshaft position (CMP) sensor signal in place of the CKP signal when there is fault condition in the CKP circuit. This will enable the engine to operate in a limp mode when there is a CKP circuit fault condition.
- During a limp mode, the following DTCs may set and should be ignored.
  - DTC P0324 – Knock Sensor Module Performance
  - DTC P01011 – Intake Camshaft Position Actuator Park Position Bank 1
- The following fault condition may trigger DTC P0338:
  - Fault condition in the CMP sensor circuits.
  - Misaligned CKP sensor reluctor wheel or incorrect reluctor wheel installation.
  - Excessive crankshaft end play that alters the alignment of the reluctor wheel.
  - Obstruction between the CKP sensor and the reluctor wheel.
- Since fault condition in a wiring connector may trigger DTCs, always test the connectors related to this diagnostic procedure for shorted terminals or poor wiring connection before replacing any component. Refer to Section 12P Wiring Diagrams for information on electrical fault diagnosis.
- To assist diagnosis, refer to 2 Wiring Diagrams and Connector Charts in this Section for the system wiring diagram and connector charts.

Test Description

The following numbers refer to the step numbers in the diagnostic table:

3 The ECM supplies 2.5 V to signal circuit of the CKP sensor circuit to reduce the electro-magnetic interference (EMI). If the voltage is not within range, this indicates there is an ECM or an ECM circuit fault condition.

4 The ECM supplies 2.5 V to low reference circuit of the CKP sensor circuit to reduce the electro-magnetic interference (EMI). If the voltage is not within range, this indicates there is an ECM or an ECM circuit fault condition.

DTC P0335 to P0338 Diagnostic Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been performed?	Go to Step 2	Refer to 3.4 Diagnostic System Check
2	1 Switch off the ignition for 30 seconds. 2 Start the engine. 3 Increase the engine speed to 1000 rpm for 30 seconds. 4 Using Tech 2, select the DTC display function. Does DTC P0335, P0336, P0337 or P0338 fail this ignition cycle?	Go to Step 3	Refer to Additional Information in this DTC
3	1 Disconnect the CKP sensor connector. 2 Switch on the ignition with the engine not running. 3 Using a digital multimeter, measure the voltage between the signal circuit of the sensor connector and a good ground. Does the multimeter display 2 – 3 V?	Go to Step 4	Go to Step 7
4	Using a digital multimeter, measure the voltage between the CKP sensor low reference circuit and a good ground. Does the multimeter display 2 – 3 V?	Go to Step 5	Go to Step 7
5	Using a digital multimeter, measure the resistance between the ground shield circuit of the CKP sensor at the ECM connector and the ECM housing. Does the multimeter display 5 Ω?	Go to Step 6	Go to Step 7
6	Perform the following CKP sensor inspection: • Inspect the sensor wiring harness for conditions that may induce electromagnetic interference. Refer to 4.2 Intermittent Fault Conditions in this Section. • Inspect the sensor for incorrect sensor installation or incorrect attaching bolt torque value. Refer to Section 6C1-3 Engine Management – V6 – Service Operations. Was any fault found and rectified?	Go to Step 11	Go to Step 9
7	Test the CKP sensor signal circuit and low reference circuit for a high resistance, open circuit, short to ground, short to voltage or shorted together fault condition. Refer to Section 12P Wiring Diagrams for information on electrical fault diagnosis. Was any fault found and rectified?	Go to Step 11	Go to Step 10
8	Repair the open or high resistance fault condition in the CKP sensor ground shield circuit. Refer to Section 12P Wiring Diagrams for information on electrical repair procedures. Was the repair completed?	Go to Step 11	—
9	Replace CKP sensor. Refer to Section 6C1-3 Engine Management – V6 – Service Operations. Was the repair completed?	Go to Step 11	—
10	Replace the ECM. Refer to Section 6C1-3 Engine Management – V6 – Service Operations. Was the repair completed?	Go to Step 11	—

Step	Action	Yes	No
11	1 Using Tech 2, clear the DTCs. 2 Switch off the ignition for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the conditions for running the DTC. Does any of the CKP sensor circuit DTCs fail this ignition cycle?	Go to Step 2	Go to Step 12
12	Using Tech 2, select the DTC display function. Does Tech 2 display any DTCs?	Go to the appropriate DTC Table in this Section	System OK
When all diagnosis and repairs are completed, check the system for correct operation.			

6.23 DTC P0341, P0342, P0343, P0346, P0347, P0348, P0366, P0367, P0368, P0391, P0392 or P0393

DTC Descriptors

This diagnostic procedure supports the following DTCs:

- DTC P0341 – Intake Camshaft Position Sensor Range / Performance (Bank 1)
- DTC P0342 – Intake Camshaft Position Sensor Low Voltage (Bank 1)
- DTC P0343 – Intake Camshaft Position Sensor High Voltage (Bank 1)
- DTC P0346 – Intake Camshaft Position Sensor Range / Performance (Bank 2)
- DTC P0347 – Intake Camshaft Position Sensor Low Voltage (Bank 2)
- DTC P0348 – Intake Camshaft Position Sensor High Voltage (Bank 2)
- DTC P0366 – Exhaust Camshaft Position Sensor Range / Performance (Bank 1)
- DTC P0367 – Exhaust Camshaft Position Sensor Low Voltage (Bank 1)
- DTC P0368 – Exhaust Camshaft Position Sensor High Voltage (Bank 1)
- DTC P0391 – Exhaust Camshaft Position Sensor Range / Performance (Bank 2)
- DTC P0392 – Exhaust Camshaft Position Sensor Low Voltage (Bank 2)
- DTC P0393 – Exhaust Camshaft Position Sensor High Voltage (Bank 2)

Circuit Description

The ECM applies 5 V to the camshaft position (CMP) sensors through the 5 V reference and ground through the low reference circuit.

The CMP sensor is a Hall effect switch. In conjunction with a 4X reluctor wheel, the CMP sensors provide a signal voltage to the ECM. The ECM uses this signal voltage to determine the position of the camshafts.

The ECM compares the CMP signal voltage to the number of crankshaft revolutions. A CMP sensor DTC sets if the ECM detects a fault condition in the CMP sensor circuits.

Conditions for Running the DTC

The engine is running.

Conditions for Setting the DTC

DTC P0342 or P0347

The ECM detects no pulses from the CMP sensor signal circuit and the CMP sensor signal voltage is low in correlation with the number of crankshaft revolutions.

DTC P0367 or P0392

The ECM detects no pulses from the CMP sensor signal circuit and the CMP sensor signal voltage is low in correlation with the number of crankshaft revolutions.

DTC P0341, P0346, P0366 or P0391

The ECM detects a signal from the CMP sensor signal circuit and the sensor signal range is not within the predetermined parameter or the when the CMP sensor does not correlate with the crankshaft position.

DTC P0343 or P0348

The ECM detects no pulses from the CMP sensor signal circuit and the CMP sensor signal voltage is always high.

DTC P0368 or P0393

The ECM detects no pulses from the CMP sensor signal circuit and the CMP sensor signal voltage is always high.

Conditions for Clearing the DTC

The CMP sensor circuit DTCs are Type B DTCs. Refer to 1.4 Diagnostic Trouble Codes in this Section for action taken when Type B DTCs set and conditions for clearing Type B DTCs.

Additional Information

- Refer to Section 6C1-1 Engine Management – V6 – General Information for details of the CMP sensor operation.
- For an intermittent fault condition, refer to 4.2 Intermittent Fault Conditions in this Section.
- Since fault condition in a wiring connector may trigger DTCs, always test the connectors related to this diagnostic procedure for shorted terminals or poor wiring connection before replacing any component. Refer to Section 12P Wiring Diagrams for information on electrical fault diagnosis.
- To assist diagnosis, refer to 2 Wiring Diagrams and Connector Charts in this Section for the system wiring diagram and connector charts.

Test Description

The following numbers refer to the step numbers in the diagnostic table:

3 Tests the signal circuit of the CMP sensor. This circuit is pulled-up to about 5 V.

4 Measures the integrity of the CMP sensor low reference circuit. Removal of the ECM Fuse 29 enables the ECM to power down completely prior to the test procedure.

DTC P0341 to P0343, P0346 to P0348, P0366 to P0368, P0391 to P0393 Diagnostic Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been performed?	Go to Step 2	Refer to 3.4 Diagnostic System Check
2	1 Switch off the ignition for 30 seconds. 2 Start the engine. 3 Increase the engine speed to 1000 rpm for 30 seconds. 4 Using Tech 2, select the DTC display function. Does P0341, P0342, P0343, P0346, P0347, P0348, P0366, P0367, P0368, P0391, P0392 or P0393 fail this ignition cycle?	Go to Step 3	Refer to Additional Information in this DTC
3	1 Switch off the ignition. 2 Disconnect the appropriate CMP sensor wiring connector. 3 Switch on the ignition with the engine not running. 4 Using a digital multimeter, measure the voltage between the signal circuit of the appropriate CMP sensor and the ECM housing. Does the multimeter display 4.8 – 5.2 V?	Go to Step 4	Go to Step 7
4	1 Switch off the ignition. 2 Remove ECM Fuse 29 from the engine compartment fuse and relay panel assembly. 3 Using a digital multimeter, measure the resistance between the CMP sensor low reference circuit and the ECM housing. **NOTE** Install the ECM Fuse 29 to the engine compartment fuse and relay panel assembly after completing this test. Does the multimeter display 5 Ω?	Go to Step 5	Go to Step 8

Step	Action	Yes	No
5	Test the signal circuit of the CMP sensor for a high resistance, open circuit, short to ground or short to voltage fault condition. Refer to Section 12P Wiring Diagrams for information on electrical fault diagnosis. Was any fault found and rectified?	Go to Step 11	Go to Step 6
6	Perform the following CMP sensor inspection: • Inspect the sensor wiring harness for conditions that may induce electromagnetic interference. Refer to 4.2 Intermittent Fault Conditions in this Section. • Inspect the sensor for incorrect sensor installation or incorrect attaching bolt torque value. Refer to Section 6C1-3 Engine Management – V6 – Service Operations. • Inspect the CMP sensor reluctor wheel for damage or conditions that causes misalignment. Was any fault found and rectified?	Go to Step 11	Go to Step 9
7	Test the CMP sensor 5 V reference circuit for a high resistance, open circuit, short to voltage or short to ground fault condition. Refer to Section 12P Wiring Diagrams for information on electrical fault diagnosis. **NOTE** Each CMP sensor shares a common 5 V reference circuit. A fault condition in the 5 V reference circuit may trigger DTCs on all CMP sensors. Refer to 2 Wiring Diagrams and Connector Charts in this Section to assist diagnosis. Was any fault found and rectified?	Go to Step 11	Go to Step 10
8	Test the CMP sensor low reference circuit for a high resistance or an open circuit fault condition. Refer to Section 12P Wiring Diagrams for information on electrical fault diagnosis. **NOTE** The CMP sensor shares the low reference circuit with other sensors. A fault condition in the low reference circuit may trigger DTCs on sensors that share this circuit. Refer to 2 Wiring Diagrams and Connector Charts in this Section to aid diagnosis. Was any fault found and rectified?	Go to Step 11	Go to Step 10
9	Replace the appropriate CMP sensor. Refer to Section 6C1-3 Engine Management – V6 – Service Operations. Was the repair completed?	Go to Step 11	—
10	Replace the ECM. Refer to Section 6C1-3 Engine Management – V6 – Service Operations. Was the repair completed?	Go to Step 11	—
11	1 Using Tech 2, clear the DTCs. 2 Switch off the ignition for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the conditions for running the DTC. Does any of the CMP Sensor Circuit DTCs fail this ignition cycle?	Go to Step 2	Go to Step 12
12	Using Tech 2, select the DTC display function. Does Tech 2 display any DTCs?	Go to the appropriate DTC Table in this Section	System OK
When all diagnosis and repairs are completed, check the system for correct operation.			

6.24 DTC P0351, P0352, P0353, P0354, P0355, P0356, P2300, P2301, P2303, P2304, P2306, P2307, P2309, P2310, P2312, P2313, P2315 or P2316

DTC Descriptors

This diagnostic procedure supports the following DTCs:

- DTC P0351 – Ignition Coil Cylinder 1 Circuit Malfunction
- DTC P0352 – Ignition Coil Cylinder 2 Circuit Malfunction
- DTC P0353 – Ignition Coil Cylinder 3 Circuit Malfunction
- DTC P0354 – Ignition Coil Cylinder 4 Circuit Malfunction
- DTC P0355 – Ignition Coil Cylinder 5 Circuit Malfunction
- DTC P0356 – Ignition Coil Cylinder 6 Circuit Malfunction
- DTC P2300 – Ignition Coil Cylinder 1 Circuit Low Voltage
- DTC P2301 – Ignition Coil Cylinder 1 Circuit High Voltage
- DTC P2303 – Ignition Coil Cylinder 2 Circuit Low Voltage
- DTC P2304 – Ignition Coil Cylinder 2 Circuit High Voltage
- DTC P2306 – Ignition Coil Cylinder 3 Circuit Low Voltage
- DTC P2307 – Ignition Coil Cylinder 3 Circuit High Voltage
- DTC P2309 – Ignition Coil Cylinder 4 Circuit Low Voltage
- DTC P2310 – Ignition Coil Cylinder 4 Circuit High Voltage
- DTC P2312 – Ignition Coil Cylinder 5 Circuit Low Voltage
- DTC P2313 – Ignition Coil Cylinder 5 Circuit High Voltage
- DTC P2315 – Ignition Coil Cylinder 6 Circuit Low Voltage
- DTC P2316 – Ignition Coil Cylinder 6 Circuit High Voltage

Circuit Description

The engine control relay applies positive voltage to the ignition voltage circuit of the ignition coil and the ignition coil dual line ground circuits are directly connected to ground.

The ECM applies control voltage to the control circuit of the ignition coil during the calculated dwell period that allows current flow to the ignition coil primary winding to generate a magnetic flux field. At the appropriate firing point, the ECM interrupts the control voltage applied to the ignition coil.

Interruption of voltage applied to the control circuit of the ignition coil primary winding induces the transfer of electrical energy from the ignition coil primary winding to the ignition coil secondary winding, which triggers the ignition coil to produce a spark at the spark plug.

An ignition coil control circuit DTC sets if the ECM detects a fault condition in the control circuit of an ignition coil.

Conditions for Running the DTC

Run continuously once the following conditions are met:

- The engine is running.
- The engine speed is 480 – 5,000 rpm
- The battery voltage is 10.0 – 16.0 V.

Conditions for Setting the DTC

DTC P0351, P0352, P0353, P0354, P0355 or P0356

The ECM detects an open circuit fault condition in the ignition coil control circuit.

DTC P2300, P2303, P2306, P2309, P2312 or P2315

The ECM detects a short to ground fault condition in the ignition coil control circuit.

DTC P2301, P2304, P2307, P2310, P2313 and P2316

The ECM detects a short to voltage fault condition in the ignition coil control circuit.

Conditions for Clearing the DTC

The ignition coil control circuit DTCs are Type B DTCs. Refer to 1.4 Diagnostic Trouble Codes in this Section for action taken when Type B DTC sets and conditions for clearing Type B DTCs.

Additional Information

- Refer to Section 6C1-1 Engine Management – V6 – General Information for details of the ignition coil operation.
- A short to voltage fault condition damages the ignition coil. Do not replace the ignition until this fault condition is rectified.
- The ignition coils for each bank of the engine are fused separately. If all DTCs for a single bank are set, there may be a fault in one of the ignition supply circuits.
- The ignition coils for each bank of the engine have a separate ground connections. If all DTCs for a single bank are set, there may be a fault in one of the ground circuits.
- For an intermittent fault condition, refer to 4.2 Intermittent Fault Conditions in this Section.
- Since fault condition in a wiring connector may trigger DTCs, always test the connectors related to this diagnostic procedure for shorted terminals or poor wiring connection before replacing any component. Refer to Section 12P Wiring Diagrams for information on electrical fault diagnosis.
- To assist diagnosis, refer to 2 Wiring Diagrams and Connector Charts in this Section for the system wiring diagram and connector charts.

Test Description

The following numbers refer to the step numbers in the diagnostic table:

3 Determines if there is a fault condition in the ignition voltage supply circuit.

5 Determines if there is a fault condition in the ground circuits of the ignition coil.

6 Tests if the ECM is commanding the ignition coil on and off.

DTC P0351 to P0356, P2300, P2301, P2303, P2304, P2306, P2307, P2309, P2310, P2312, P2313, P2315 or P2316 Diagnostic Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been performed?	Go to Step 2	Refer to 3.4 Diagnostic System Check
2	1 Switch off the ignition for 30 seconds. 2 Start the engine. 3 Using Tech 2, select the DTC display function. Does DTC P0351, P0352, P0353, P0354, P0355, P0356, P2300, P2301, P2303, P2304, P2306, P2037, P2309, P2310, P2312, P2313, P2315 or P2316 fail this ignition cycle?	Go to Step 3	Refer to Additional Information in this DTC

Step	Action	Yes	No
3	1 Disconnect the wiring connector of the appropriate ignition coil. 2 Switch on the ignition with the engine not running. 3 Connect a test lamp between the ignition voltage circuit of the appropriate ignition coil connector and the ECM housing. Does the test lamp illuminate?	Go to Step 4	Go to Step 6
4	Connect a test lamp between a 12 V and each of the ground circuits of the ignition coil connector. Does the test lamp illuminate?	Go to Step 5	Go to Step 7
5	1 Start the engine. 2 Using a digital multimeter, measure the frequency at the control circuit of the ignition coil. Does the multimeter display 3 – 20 Hz?	Go to Step 9	Go to Step 8
6	Repair the high resistance or open circuit fault condition at the ignition voltage circuit of the ignition coil. Refer to Section 12P Wiring Diagrams for information on electrical wiring repair procedures. Was the repair completed?	Go to Step 11	—
7	Repair the high resistance or open circuit fault condition at the ignition coil ground circuits. Refer to Section 12P Wiring Diagrams for information on electrical wiring repair procedures. Was the repair completed?	Go to Step 11	—
8	Test the appropriate ignition coil control circuit for a high resistance, open circuit, short to ground or short to voltage fault condition. Refer to Section 12P Wiring Diagrams for information on electrical fault diagnosis. Was any fault found and rectified?	Go to Step 11	Go to Step 10
9	**CAUTION** **A short to voltage fault condition damages the ignition coil. Do not replace the ignition until this fault condition is rectified.** Replace the faulty ignition coil. Refer to Section 6C1-3 Engine Management – V6 – Service Operations. Was the repair completed?	Go to Step 11	—
10	Replace the ECM. Refer to Section 6C1-3 Engine Management – V6 – Service Operations. Was the repair completed?	Go to Step 11	—
11	1 Using Tech 2, clear the DTCs. 2 Switch off the ignition for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the conditions for running the DTC. Does any of the ignition coil control circuit DTCs fail this ignition cycle?	Go to Step 2	Go to Step 12
12	Using Tech 2, select the DTC display function. Does Tech 2 display any DTCs?	Go to the appropriate DTC Table in this Section	System OK
When all diagnosis and repairs are completed, check the system for correct operation.			

6.25 DTC P0420 or P0430

DTC Descriptors

This diagnostic procedure supports the following DTCs:

- DTC P0420 Catalyst System Low Efficiency Bank 1
- DTC P0430 Catalyst System Low Efficiency Bank 2

Circuit Description

To maintain a reasonably low emission level of hydrocarbons (HC), carbon monoxide (CO), and oxides of nitrogen (NOx) a 3-way catalytic converter (TWC) is used. The catalyst within the converter promotes a chemical reaction that oxidizes the HC and CO present in the exhaust gas. This reaction converts the gases into harmless water vapour and carbon dioxide. The catalyst also reduces the NOx, converting the NOx into nitrogen. The engine control module (ECM) monitors this process using the post catalyst heated oxygen sensor (HO2S) signal. The post-catalyst HO2S located in the exhaust stream after the TWC, produces an output signal that indicates the oxygen storage capacity of the catalyst. The oxygen storage capacity (OSC) determines the ability of the catalyst to convert the exhaust emissions effectively. If the catalyst is functioning correctly, the post-catalyst HO2S signal will be far less active than the signal produced by the pre-catalyst HO2S.

To determine OSC, the ECM commands a rich air / fuel mixture until all oxygen is removed from the catalyst. The ECM then commands a lean air / fuel mixture and monitors the rear heated oxygen sensors to calculate the oxygen storage capacity. The catalyst is operated in this mode until one of the following conditions occur:

- The oxygen stored in the catalyst exceeds a calibrated threshold, which is determined from the rear HO2S signal.
- The rear HO2S indicates the catalyst to be completely saturated with oxygen, which is determined from the rear HO2S signal.

If the ECM detects the average OSC is less than a threshold, this DTC sets. This indicates that the TWC oxygen storage capacity is below a threshold considered acceptable.

Conditions for Running the DTC

- Before the ECM can report, the following DTCs must run and pass:
  DTC P0420 or P0430 failed, DTCs P0030, P0031, P0032, P0036, P0037, P0038, P0050, P0051, P0052, P0053, P0056, P0057, P0058, P0059, P0101, P0102, P0103, P0121, P0122, P0123, P0130, P0131, P0132, P0133, P0135, P0137, P0138, P0139, P0140, P0141, P0150, P0151, P0152, P0153, P0155, P0157, P0158, P0159, P0160, P0161, P0221, P0222, P0223, P0335, P0336, P0338, P167A, P167B, P2096, P2097, P2098, P2099, P2195, P2196, P2197, P2198, P2232, P2235, P2237, P2240, P2243, P2247, P2251, P2254, P2270, P2271, P2272, P2273, P2297, P2298, P2626, and P2629.
- The following DTCs are not set:
  DTCs P0010, P0011, P0013, P0014, P0020, P0021, P0023, P0024, P0030, P0031, P0032, P0036, P0037, P0038, P0050, P0051, P0052, P0053, P0056, P0057, P0058, P0059, P0101, P0102, P0103, P0116, P0117, P0118, P0119, P0121, P0122, P0123, P0125, P0130, P0131, P0132, P0133, P0135, P0137, P0138, P0139, P0140, P0141, P0150, P0151, P0152, P0153, P0155, P0157, P0158, P0159, P0160, P0161, P0221, P0222, P0223, P0300, P0301-P0306, P0443, P0458, P0459, P0496, P167A, P167B, P2088, P2089, P2090, P2091, P2092, P2093, P2094, P2095, P2096, P2097, P2098, P2099, P2100, P2101, P2107, P2119, P2122, P2123, P2127, P2128, P2138, P2176, P2177, P2178, P2179, P2180, P2187, P2188, P2189, P2190, P2195, P2196, P2197, P2198, P2232, P2235, P2237, P2240, P2243, P2247, P2251, P2254, P2270, P2271, P2272, P2273, P2297, P2298, P2626, and P2629.
- The engine speed is 1,040 – 3,000 rpm.
- The air flow into the engine is between 7.0 – 16.0 g/s and not changing more than 3.0 g/s
- The engine intake air temperature (IAT) at engine start-up is more than –30° C.
- The engine is operating for more than 7 minutes.
- The engine is operating in closed loop.
- The calculated TWC temperature is between 500 – 750° C and steady.
- The above conditions exist for approximately 17 minutes.
- DTCs P0420 and P0430 run once a drive cycle. The ECM will attempt to run this diagnostic up to three times a drive cycle.

Conditions for Setting the DTC

The ECM determines that the catalyst efficiency has degraded below a calibrated threshold for more than 4 seconds.

Action Taken When the DTC Sets

- The control module activates the Check Powertrain icon, or the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the DTC

The EVAP Purge Solenoid Valve Control Circuit DTCs are Type B DTCs. Refer to 1.4 Diagnostic Trouble Codes in this Section for action taken when a Type B DTC sets and conditions for clearing Type B DTCs.

P0420 or P0430 Diagnostic Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been completed?	Go to Step 2	Refer to 3.4 Diagnostic System Check
2	Are any other DTCs set?	Go to the appropriate DTC Table in this Section	Go to Step 3
3	1 Inspect for the following conditions: • The catalytic converter is an original equipment part. • Inspect the exhaust system for leaks, damage, loose or missing hardware in the area from the converter to the heated oxygen sensor 2. • The HO2S 2 is secure and the wiring is not damaged or contacting the exhaust. Did you find and correct the condition?	Go to Step 5	Go to Step 4
4	**NOTE** Before replacing the 3-way catalytic converter (TWC), correct any conditions that may have damaged the converter. 1 Replace the catalytic converter. Refer to the appropriate procedure in 8B Exhaust System. Did you complete the replacement?	Go to Step 5	—
5	1 Using Tech 2, clear the DTC/s. 2 Switch off the ignition for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the conditions for running the DTC. Does any of the EVAP purge solenoid valve control circuit DTCs fail this ignition cycle?	Go to Step 2	Go to Step 6
6	Using Tech 2, select the DTC display function. Does Tech 2 display any DTCs?	Go to the appropriate DTC Table in this Section	System OK
When all diagnosis and repairs are completed, clear all DTCs and verify correct operation			

6.26 DTC P0443, P0458 or P0459

DTC Descriptors

This diagnostic procedure supports the following DTCs:

- DTC P0443 – Evaporative Emission Control System Purge Solenoid Circuit Malfunction
- DTC P0458 – Evaporative Emission Control System Purge Solenoid Circuit Low Voltage
- DTC P0459 – Evaporative Emission Control System Purge Solenoid Circuit High Voltage

Circuit Description

The Engine control relay applies ignition positive battery voltage to the evaporative emission (EVAP) purge solenoid.

Using a device called a driver, the ECM applies a pulse width modulated (PWM) ground to the EVAP solenoid control circuit to purge the fuel vapour from the EVAP canister into the intake manifold.

The driver has a feedback circuit that is pulled-up to a voltage. The ECM monitors the driver feedback circuit to determine if the control circuit is open, shorted to ground or shorted to a positive voltage.

An EVAP purge solenoid valve control circuit DTC sets if the ECM detects the voltage on the EVAP solenoid control circuit outside the predetermined range when the solenoid is commanded off.

Conditions for Running the DTC

DTC P0443 and P0458

Runs continuously once the following conditions are met:

- The engine speed is greater than 80 rpm
- The ignition voltage is 10.0 – 16.0 V.
- The ECM has commanded the EVAP Purge Solenoid Valve on and off at least once during the ignition cycle.

DTC P0459

Runs continuously once the following conditions are met:

- The engine speed is greater than 80 rpm
- The ignition voltage is 10.0 – 16.0 V.
- The fuel system is in closed loop.
- The engine speed is above idle.
- The engine is at operating temperature.
- The ECM has commanded the EVAP Purge Solenoid Valve on and off with a duty cycle of greater than 2.5%.

Conditions for Setting the DTC

DTC P0443

The ECM detects the voltage on the EVAP solenoid control circuit is not within the predetermined range when the solenoid is commanded off.

DTC P0458

The ECM detects the voltage on the EVAP solenoid control circuit is less than 2.6 V when the solenoid is commanded off.

DTC P0459

The ECM detects the voltage on the EVAP solenoid control circuit is greater than 4.6 V when the solenoid is commanded on.

Conditions for Clearing the DTC

The EVAP Purge Solenoid Valve Control Circuit DTCs are Type B DTCs. Refer to 1.4 Diagnostic Trouble Codes in this Section for action taken when a Type B DTC sets and conditions for clearing Type B DTCs.

Additional Information

- Refer to Section 6C1-1 Engine Management – V6 – General Information for details of the EVAP Purge Solenoid Valve operation.
- For an intermittent fault condition, refer to 4.2 Intermittent Fault Conditions in this Section.
- Since fault condition in a wiring connector may trigger DTCs, always test the connectors related to this diagnostic procedure for shorted terminals or poor wiring connection before replacing any component. Refer to Section 12P Wiring Diagrams for information on electrical fault diagnosis.
- To assist diagnosis, refer to 2 Wiring Diagrams and Connector Charts in this Section for the system wiring diagram and connector charts.

Test Description

The following number refers to the step number in the diagnostic table:

4 Tests the feedback voltage from the ECM.

DTC P0443, P0458 or P0459 Diagnostic Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been performed?	Go to Step 2	Refer to 3.4 Diagnostic System Check
2	1 Switch off the ignition for 30 seconds. 2 Allow the engine to reach the normal operating temperature or operate the vehicle within the conditions for running the DTC. 3 Using Tech 2, select the DTC display function. Does DTC P0443, P0458 or P0459 fail this ignition cycle?	Go to Step 3	Refer to Additional Information in this DTC
3	1 Disconnect the EVAP solenoid valve wiring connector. 2 Switch on the ignition with the engine not running. 3 Connect a test lamp between the EVAP solenoid valve ignition voltage circuit and the ECM housing. Does the test lamp illuminate?	Go to Step 4	Go to Step 5
4	1 Switch on the ignition with the engine not running. 2 Using a digital multimeter, measure the voltage between the EVAP solenoid valve control circuit and the ECM housing. Does the multimeter display 2.6 – 4.6 V?	Go to Step 7	Go to Step 6
5	Repair the high resistance, open circuit or short to ground fault condition at the EVAP solenoid valve ignition voltage circuit. Refer to Section 12P Wiring Diagrams for information on electrical wiring repair procedures Was the repair completed?	Go to Step 9	—
6	Test the control circuit of the EVAP solenoid valve for a high resistance, open circuit, short to ground or short to voltage fault condition. Refer to Section 12P Wiring Diagrams for information on electrical fault diagnosis. Was any fault found and rectified?	Go to Step 9	Go to Step 8

Step	Action	Yes	No
7	Replace the EVAP solenoid valve. Refer to Section 6C1-3 Engine Management – V6 – Service Operations. Was the repair completed?	Go to Step 9	—
8	Replace the ECM. Refer to Section 6C1-3 Engine Management – V6 – Service Operations. Was the repair completed?	Go to Step 9	—
9	1 Using Tech 2, clear the DTCs. 2 Switch off the ignition for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the conditions for running the DTC. Does any of the EVAP purge solenoid valve control circuit DTCs fail this ignition cycle?	Go to Step 2	Go to Step 10
10	Using Tech 2, select the DTC display function. Does Tech 2 display any DTCs?	Go to the appropriate DTC Table in this Section	System OK
When all diagnosis and repairs are completed, check the system for correct operation.			

6.27 DTC P0460, P0461, P0462 or P0463

DTC Descriptors

This diagnostic procedure supports the following DTCs:

- DTC P0460 – Fuel Level Sensor Range / Performance
- DTC P0461 – Fuel Level Sensor Range / Performance
- DTC P0462 – Fuel Level Sensor Low Voltage
- DTC P0463 – Fuel Level Sensor High Voltage

Circuit Description

The fuel level sensor changes resistance based on the fuel level in the fuel tank. The engine control module (ECM) monitors changes in the resistance of the sensor to determine the fuel level. This information is then sent to the instrument cluster via the GM LAN serial data circuit.

When the fuel tank is full, the sensor resistance is high and the ECM senses high signal voltage. When the fuel tank is empty, the sensor resistance is low and the ECM senses a low signal voltage.

When the ECM senses a signal voltage outside the normal operating range of the sensor, a fuel level sensor DTC will set.

Conditions for Running the DTC

The ignition is on.

Conditions for Setting the DTC

DTC P0461

The ECM detects that greater than 170 km have been accumulated and the fuel level in the fuel tank has not changed by at least 3.0 litres.

DTC P0462

The ECM detects the fuel level signal voltage is less than 0.5 V for 20 seconds.

DTC P0463

The ECM detects the fuel level signal voltage is greater than 4.5 V for 20 seconds.

Conditions for Clearing the DTC

The fuel level sensor circuit DTCs are Type C DTCs. Refer to 1.4 Diagnostic Trouble Codes in this Section for action taken when Type C DTCs set and conditions for clearing Type C DTCs.

Additional Information

- Refer to Section 12C Instrumentation for further information on the fuel gauge system.
- Depending on the current fuel level, it may be difficult to locate a malfunctioning sending unit. The malfunction may only occur when the fuel level is full or near empty. The fuel sender unit may need to be removed for further diagnosis. A fuel level sensor that has an intermittent condition may cause a DTC to set. Remove the fuel level sensor to test the resistance of the sensor, refer to Section 8A1 Fuel System for this procedure. Replace the sensor if the resistance is not within the specified range.
- The following may occur with a fuel level sensor DTC set:
  - The vehicle fuel gauge displays empty.
  - The Instrument Multi-function Display (MFD) displays a fuel condition message.
- Since a fault condition in a wiring connector may trigger DTCs, always test the connectors related to this diagnostic procedure for shorted terminals or poor wiring connection before replacing any component. Refer to Section 12P Wiring Diagrams for information on electrical fault diagnosis.
- For an intermittent fault condition, refer to 4.2 Intermittent Fault Conditions in this Section.
- To assist diagnosis, refer to 2 Wiring Diagrams and Connector Charts in this Section for the system wiring diagram and connector charts.

DTC P0461, P0462 or P0463 Diagnostic Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been performed?	Go to Step 2	Refer to 3.4 Diagnostic System Check
2	1 Switch off the ignition for 30 seconds. 2 Operate the vehicle within the conditions for running the DTC or road test the vehicle under various driving condition. 3 Using Tech 2, select the DTC display function. Does DTC P0461, P0462, P0463 fail this ignition cycle?	Go to Step 3	Refer to Additional Information in this DTC
3	1 Switch off the ignition. 2 Disconnect the fuel level sensor wiring connector. 3 Switch on the ignition with the engine not running. 4 Using a digital multimeter, measure the voltage between the fuel level signal circuit and the ECM housing. Does the multimeter indicate 4.8 – 5.2 V?	Go to Step 4	Go to Step 5
4	1 Switch off the ignition. 2 Remove ECM Fuse F29 from the engine compartment fuse and relay panel assembly. 3 Using a digital multimeter, measure the resistance between the fuel level sensor low reference circuit and the ECM housing. **NOTE** Install the ECM Fuse F29 to the engine compartment fuse and relay panel assembly after completing this test. Does the multimeter indicate less than 5 Ω?	Go to Step 7	Go to Step 6
5	Test the fuel level sensor signal circuit for a high resistance, open circuit, short to ground or short to voltage fault condition. Refer to Section 12P Wiring Diagrams for information on electrical fault diagnosis. Was any fault found and rectified?	Go to Step 9	Go to Step 8
6	Test the fuel level sensor low reference circuit for a high resistance, open circuit, short to ground or short to voltage fault condition. Refer to Section 12P Wiring Diagrams for information on electrical fault diagnosis. Was any fault found and rectified?	Go to Step 9	Go to Step 8
7	Replace the fuel level sensor. Refer to Section 8A1 Fuel Systems. Was the repair completed?	Go to Step 9	–
8	Replace the ECM. Refer to Section 6C1-3 Engine Management – V6 – Service Operations. Was the repair completed?	Go to Step 9	–
9	1 Using Tech 2, clear the DTCs. 2 Switch off the ignition for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the conditions for running the DTC. Do any fuel level sensor DTCs fail this ignition cycle?	Go to Step 2	Go to Step 10
10	Using Tech 2, select the DTC display function. Does Tech 2 display any DTCs?	Go to the appropriate DTC Table in this Section	System OK
When all diagnosis and repairs are completed, check the system for correct operation.			

6.28 DTC P0480, P0481, P0691, P0692, P0693 or P0694

DTC Descriptors

This diagnostic procedure supports the following DTCs:

- DTC P0480 – Cooling Fan Relay 1 Circuit Malfunction
- DTC P0481 – Cooling Fan Relay 2 and 3 Circuit Malfunction
- DTC P0691 – Cooling Fan Relay 1 Circuit Low Voltage
- DTC P0692 – Cooling Fan Relay 1 Circuit High Voltage
- DTC P0693 – Cooling Fan Relay 2 and 3 Circuit Low Voltage
- DTC P0694 – Cooling Fan Relay 2 and 3 Circuit High Voltage

Circuit Description

The engine control relay applies ignition positive battery voltage to the ignition circuit of the engine cooling fan relay 1 and relay 2. Using a device called a driver, the ECM performs the following tasks:

- grounds the engine cooling fan relay 1 control signal circuit to operate the small engine cooling fan, or
- grounds the engine cooling fan relay 2 control signal circuit to operate both the small engine cooling fan and the large engine cooling fan.

The driver has a feedback circuit that is pulled-up to a voltage. The ECM monitors the driver feedback circuit to determine if the control circuit is open, shorted to ground or shorted to a positive voltage.

A cooling fan relay control circuit DTC sets if the ECM detects a fault condition in the engine cooling fan relay control circuit.

Conditions for Running the DTC

Run continuously once the following conditions are met:

- the ignition voltage is 10 – 16 V,
- the engine speed is greater than 40 rpm, and
- the ECM driver transitions from on to off or from off to on.

Conditions for Setting the DTC

DTC P0480

The ECM detects an open circuit fault condition in the control circuit of the engine cooling fan relay 1.

DTC P0481

The ECM detects an open circuit fault condition in the control circuit of the engine cooling fan relay 2.

DTC P0691

The ECM detects a short to ground fault condition in the control circuit of the engine cooling fan relay 1.

DTC P0692

The ECM detects a short to voltage fault condition in the control circuit of the engine cooling fan relay 1.

DTC P0693

The ECM detects a short to ground fault condition in the control circuit of the engine cooling fan relay 2.

DTC P0694

The ECM detects a short to voltage fault condition in the control circuit of the engine cooling fan relay 2.

Conditions for Clearing DTC

The cooling fan relay control circuit DTCs are Type B DTCs. Refer to 1.4 Diagnostic Trouble Codes in this Section for action taken when Type B DTCs set and conditions for clearing Type B DTCs.

Additional Information

- Refer to Section 6B1 – Engine Cooling – V6 for details of the engine cooling fan operation.
- For an intermittent fault condition, refer to 4.2 Intermittent Fault Conditions in this Section.
- Since fault condition in a wiring connector may trigger DTCs, always test the connectors related to this diagnostic procedure for shorted terminals or poor wiring connection before replacing any component. Refer to Section 12P Wiring Diagrams for information on electrical fault diagnosis.
- To assist diagnosis, refer to 2 Wiring Diagrams and Connector Charts in this Section for the system wiring diagram and connector charts.

DTC P0480, P0481, P0691 to P0694 Diagnostic Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been performed?	Go to Step 2	Refer to 3.4 Diagnostic System Check
2	1 Switch off the ignition for 30 seconds. 2 Start the engine. 3 Allow the engine to reach the normal operating temperature. 4 Increase the engine speed to 2,000 rpm for 10 seconds or operate the vehicle within the conditions for setting the DTC. 5 Using Tech 2, select the DTC display function. Does DTC P0480, P0481, P0691, P0692, P0693 or P0694 fail this ignition cycle?	Go to Step 3	Refer to Additional Information in this DTC
3	1 Remove the appropriate engine cooling fan relay. Refer to Section 12O Fuses, Relays and Wiring Harnesses. 2 Connect a test lamp between the ignition voltage circuit of the engine cooling fan relay and the ECM housing. 3 Switch on the ignition with the engine not running. Does the test lamp illuminate?	Go to Step 4	Go to Step 5
4	1 Switch off the ignition. 2 Connect a test lamp between the control circuit of the appropriate engine cooling fan relay and a 12 V. 3 Switch on the ignition with the engine not running. 4 Using Tech 2, command the appropriate engine cooling fan relay on and then off. Does the test lamp turn on and off when the engine cooling fan relay is commanded on and off?	Go to Step 7	Go to Step 6
5	Repair the high resistance or open circuit fault condition in the ignition voltage circuit of the engine cooling fan relay. Refer to Section 12P Wiring Diagrams for information on electrical wiring repair procedures. Was the repair completed?	Go to Step 9	—

Step	Action	Yes	No
6	Test the engine cooling fan relay control circuit for a high resistance, open circuit, short to ground or short to voltage fault condition. Refer to Section 12P Wiring Diagrams for information on electrical fault diagnosis. Was any fault found and rectified?	Go to Step 9	Go to Step 8
7	Replace the faulty engine cooling fan relay. Refer to Section 12O Fuses, Relays and Wiring Harnesses. Was the repair completed?	Go to Step 9	—
8	Replace the ECM. Refer to Section 6C1-3 Engine Management – V6 – Service Operations. Was the repair completed?	Go to Step 9	—
9	1 Using Tech 2, clear the DTCs. 2 Switch off the ignition for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the conditions for running the DTC. Does any of the cooling fan relay control circuit DTCs fail this ignition cycle?	Go to Step 2	Go to Step 10
10	Using Tech 2, select the DTC display function. Does Tech 2 display any DTCs?	Go to the appropriate DTC Table in this Section	System OK
When all diagnosis and repairs are completed, check the system for correct operation.			

6.29 DTC P0500

DTC Descriptor

This diagnostic procedure supports DTC P0500 – Vehicle Speed Sensor Circuit Malfunction (Manual Transmission).

Circuit Description

Vehicle speed information is provided to the engine control module (ECM) by the vehicle speed sensor (VSS). The ignition control relay applies ignition positive voltage to the VSS, and the ground circuit of the VSS is directly connected to ground.

The VSS is a Hall effect switch. In conjunction with an 18 tooth reluctor wheel, the VSS provide a signal voltage to the ECM. The ECM uses this signal voltage to determine vehicle speed.

If the ECM detects no vehicle speed, while other sensors indicate that the vehicle is moving, then DTC P0500 sets.

Conditions for Running the DTC

Runs once the following conditions are met:

- The engine coolant temperature is greater than 40º C,
- the ECM is in fuel shut-off mode, and
- the engine speed is between 1,520 and 3,520 rpm

Conditions for Setting the DTC

The ECM detects a speed of less than 0 km/h for 8 seconds continuously, or 50 seconds cumulative.

Conditions for Clearing the DTC

The vehicle speed sensor circuit malfunction DTC is a Type C DTC. Refer to 1.4 Diagnostic Trouble Codes in this Section for action taken when Type C DTCs set and conditions for clearing Type C DTCs.

Additional Information

- For an intermittent fault condition, refer to 4.2 Intermittent Fault Conditions in this Section.
- Refer to Section 6C1-1 Engine Management – V6 – General Information for details on:
  - VSS operation, and
  - fuel shut-off mode.
- Refer to Section 7B1 Manual Transmission for VSS replacement procedures.
- Since a fault condition in a wiring connector may trigger DTCs, always test the connectors related to this diagnostic procedure for shorted terminals or poor wiring connection before replacing any component. Refer to Section 12P Wiring Diagrams for information on electrical fault diagnosis.
- To assist diagnosis, refer to 2 Wiring Diagrams and Connector Charts in this Section for the system wiring diagram and connector charts.

DTC P0500 Diagnostic Table

Step	Action	Yes	No
1	Has the diagnostic system check been performed?	Go to Step 2	Refer to 3.4 Diagnostic System Check
2	1 Switch off the ignition for 30 seconds. 2 Operate the vehicle within the conditions for running the DTC. 3 Using Tech 2, select the DTC display function. Does DTC P0500 fail this ignition cycle?	Go to Step 3	Refer to Additional Information in this DTC
3	1 Switch off the ignition. 2 Disconnect the wiring connector from the VSS. 3 Connect a test lamp between the ignition circuit of the VSS and ground. 4 Switch on the ignition with the engine not running. Does the test lamp illuminate?	Go to Step 5	Go to Step 4
4	Repair the high resistance or open circuit fault condition in the ignition circuit of the VSS. Refer to Section 12P Wiring Diagrams for information on electrical wiring repair procedures. Was the repair completed?	Go to Step 12	—
5	1 Connect a test lamp between the ground circuit and ignition circuit of the VSS. 2 Switch on the ignition with the engine not running. Does the test lamp illuminate?	Go to Step 7	Go to Step 6
6	Repair the high resistance or open circuit fault condition in the ground circuit of the VSS. Refer to Section 12P Wiring Diagrams for information on electrical wiring repair procedures. Was the repair completed?	Go to Step 12	—
7	CAUTION **To avoid damage to the drive axles, support the lower control arms in the normal horizontal position. Do not run the vehicle in gear with the wheels hanging down at full travel.** 1 Raise the vehicle and support the drive axles with safety stands. Refer to Section 0A General Information for the location of jacking and support points. 2 Connect a fused jumper wire between the ground circuit of the connector and the ground circuit of the VSS. 3 Connect a fused jumper wire between the ignition circuit of the connector and the ignition circuit of the VSS. 4 Using connector test adaptor kit J 35616-A, connect a digital multimeter between the VSS signal circuit and ground. 5 Place the transmission in neutral. 6 Rotate the rear wheels by hand while observing the multimeter. Does the multimeter indicate greater than 0.15 V AC?	Go to Step 10	Go to Step 8

Step	Action	Yes	No
8	Perform the following VSS inspection: • Inspect the VSS wiring harness for conditions that may induce electromagnetic interference. Refer to 4.2 Intermittent Fault Conditions in this Section. • Inspect the VSS for incorrect installation or incorrect attaching bolt torque value. Refer to Section 6C1-3 Engine Management – V6 – Service Operations. • Inspect the VSS sensor reluctor wheel for damage or conditions that causes misalignment. Was any fault found and rectified?	Go to Step 12	Go to Step 9
9	Replace the VSS. Refer to Section 7B1 Manual Transmission – V6. Was the repair completed?	Go to Step 12	—
10	Test the VSS signal circuit for a high resistance, open circuit, short to ground or short to voltage fault condition. Refer to Section 12P Wiring Diagrams for information on electrical fault diagnosis. Was any fault found and rectified?	Go to Step 12	Go to Step 11
11	Replace the ECM. Refer to Section 6C1-3 Engine Management – V6 – Service Operations. Was the repair completed?	Go to Step 12	—
12	1 Using Tech 2, clear the DTCs. 2 Switch off the ignition for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the conditions for running the DTC. Does DTC P0500 fail this ignition cycle?	Go to Step 2	Go to Step 13
13	Using Tech 2, select the DTC display function. Are there any DTCs displayed?	Go to the appropriate DTC Table in this Section	System OK
When all diagnosis and repairs are completed, check the system for correct operation.			

6.30 DTC P0504 or P0571

DTC Descriptor

This diagnostic procedure supports:

- DTC P0504 – Brake Switch Circuit Malfunction.
- DTC P0571 – Cruise Control Brake Switch Circuit

Circuit Description

There are two stop lamp switch assemblies which comprise two individual switches within each assembly. The ECM uses inputs from stop lamp switches ‘A’, ‘C’ and ‘D’.

Stop lamp switch ‘A’ is the stop lamp switch, stop lamp switch ‘B’ is the BTSI relay power supply (where fitted), ‘C’ is the cruise control cancel switch, and stop lamp switch ‘D’ is the extended brake travel switch. DTC P0504 will not set if there is a fault with switch ‘D’.

Switch ‘A’ is a normally open switch that closes when the brake pedal is depressed. When the brake pedal is depressed, the stop lamp switch supplies signal voltage to the stop lamp signal circuit.

Switches ‘C’ and ‘D’ are normally closed switches that open when the brake pedal is depressed. For further information on the brake switch assemblies, refer to Section 6C1-1 Engine Management – V6 – General Information.

The ECM monitors brake pedal ‘A’ and ‘C’ stop lamp switch signals, and if the signals do not correlate, DTC P0504 will set. If the ECM determines that a fault exists in the cruise cancel switch circuit, DTC 571 will set.

Conditions for Running the DTC

Run continuously once the following conditions are met:

- The ignition is switched on.
- The ignition voltage is 10.0 – 16.0 V.

Conditions for Setting the DTC

The ECM detects one of the following conditions:

- Only one switch signal is present when the vehicle accelerates or decelerates rapidly ten times.

NOTE

The ECM will count over several drive cycles.

- A signal is seen from stop lamp switches ‘A’ and / or ‘C’ when the vehicle accelerates rapidly.
- The ECM does not detect a signal from the switches during braking.

Conditions for Clearing the DTC

The brake switch circuit DTC is a Type B DTC. Refer to 1.4 Diagnostic Trouble Codes in this Section for action taken when Type B DTCs set and conditions for clearing Type C DTCs.

Additional Information

- For an intermittent fault condition, refer to 4.2 Intermittent Fault Conditions in this Section.
- Refer to Section 6C1-1 Engine Management – V6 – General Information for details of the brake switch operation.
- Refer to Section 12E Cruise Control for brake pedal switch operation and testing.
- Since a fault condition in a wiring connector may trigger DTCs, always test the connectors related to this diagnostic procedure for shorted terminals or poor wiring connection before replacing any component. Refer to Section 12P Wiring Diagrams for information on electrical fault diagnosis.
- To assist diagnosis, refer to 2 Wiring Diagrams and Connector Charts in this Section for the system wiring diagram and connector charts.

Test Description

The following number refers to the step numbers in the diagnostic table:

3 A fault condition in stop lamp switches ‘A’ and / or ‘C’ may trigger these DTCs.

DTC P0504 or P0571 Diagnostic Table

Step	Action	Yes	No
1	Has the diagnostic system check been performed?	Go to Step 2	Refer to 3.4 Diagnostic System Check
2	1 Switch off the ignition for 30 seconds. 2 Operate the vehicle within the conditions for running the DTC. 3 Using Tech 2, select the DTC display function. Does DTC P0504 or DTC P0571 fail this ignition cycle?	Go to Step 3	Refer to Additional Information in this DTC
3	1 Ignition ON, engine OFF. 2 On Tech 2 select: **Engine / V6 Engine / Data Display / Cruise / Traction Data**. 3 Observe the status of the brake lamp switch, initial brake apply signal and the extended travel brake pedal switch. 4 Fully depress the brake pedal. **NOTE** Full brake pedal travel must be achieved to test the activation of the extended brake travel switch assembly. Does Tech 2 display change from **Inactive** to **Active** in all switches when the pedal is pressed?	Refer to Additional Information in this DTC	Go to Step 4
4	Did the brake lamp switch Tech 2 status fail to change?	Go to Step 5	Go to Step 9
5	1 Disconnect the wiring connector from stop lamp switch ‘A’. Refer to Section 12E Cruise Control. 2 Ignition ON. 3 Connect a test lamp between the voltage circuit of stop lamp switch ‘A’ and a good ground. Does the test lamp illuminate?	Go to Step 7	Go to Step 6
6	1 Repair the high resistance or open circuit fault condition in the voltage circuit of stop lamp switch ‘A’. Refer to Section 12P Wiring Diagrams for information on electrical wiring repair procedures. Was the repair completed?	Go to Step 14	—
7	1 Test stop lamp switch ‘A’. Refer to Section 12E Cruise Control. Was any fault found and rectified?	Go to Step 14	Go to Step 8
8	1 Test the control circuit of the stop lamp switch ‘A’ for a high resistance, open circuit, short to ground or short to voltage fault condition. Refer to Section 12P Wiring Diagrams for information on electrical fault diagnosis. Was the repair completed?	Go to Step 14	Go to Step 13

Step	Action	Yes	No
9	1 Disconnect the wiring connectors from stop lamp switches ‘C’ and ‘D’. Refer to Section 12E Cruise Control. 2 Ignition ON. 3 Connect a test lamp between the voltage circuit of stop lamp switches ‘C’ and ‘D’ and a good ground. Does the test lamp illuminate?	Go to Step 11	Go to Step 10
10	1 Repair the high resistance or open circuit fault condition in the voltage circuit of stop lamp switch ‘C’ and ‘D’. Refer to Section 12P Wiring Diagrams for information on electrical wiring repair procedures. Was the repair completed?	Go to Step 14	—
11	1 Test stop lamp switches ‘C’ and ‘D’. Refer to Section 12E Cruise Control. Was any fault found and rectified?	Go to Step 14	Go to Step 12
12	1 Test the control circuits of stop lamp switches ‘C’ and ‘D’ for a high resistance, open circuit, short to ground or short to voltage fault condition. Refer to Section 12P Wiring Diagrams for information on electrical fault diagnosis. Was the repair completed?	Go to Step 14	Go to Step 13
13	1 Replace the ECM. Refer to Section 6C1-3 Engine Management – V6 – Service Operations. Was the repair completed?	Go to Step 14	—
14	1 Using Tech 2, clear the DTCs. 2 Switch off the ignition for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the conditions for running the DTC. Does DTC P0504 or P571 fail this ignition cycle?	Go to Step 2	Go to Step 2
15	1 Using Tech 2, select the DTC display function. Are there any DTCs displayed?	Go to the appropriate DTC Table in this Section	System OK
When all diagnosis and repairs are completed, check the system for correct operation.			

6.31 DTC P0506, P0507, P0638, P1551, P2100, P2101, P2119 or P2176

DTC Descriptors

This diagnostic procedure supports the following DTCs:

- DTC P0506 – Idle Speed Control rpm Too Low
- DTC P0507 – Idle Speed Control rpm Too High
- DTC P0638 – Commanded Versus Actual Throttle Position Correlation
- DTC P1551 – Throttle Control Lower Position Not Reached During Learning Mode
- DTC P2100 – Throttle Control Motor Malfunction
- DTC P2101 – Throttle Control Position Range / Performance
- DTC P2119 – Closed Throttle Position Range / Performance
- DTC P2176 – Throttle Control Lower Position not Learned

Circuit Description

The ECM monitors and evaluates the accelerator pedal position (APP) sensors signal voltage along with other sensor inputs to determine the desired throttle opening. To control the throttle plate movement, the ECM applies a pulse width modulated (PWM) signal voltage to the throttle actuator motor through the throttle actuator motor control circuits.

- At engine idle speed or when no current is flowing into the throttle actuator motor, a constant force return spring holds the throttle plate at a constant seven percent throttle opening position.
- To control the throttle opening, the ECM applies PWM voltage to the throttle actuator motor. The ECM increases this PWM voltage duty cycle to increase the throttle opening.
- To decrease the throttle opening from the seven percent rest position, the ECM reverses the polarity of the throttle actuator motor control circuit then applies a PWM voltage to the throttle actuator motor.

In addition, the ECM monitors the signal voltage applied to the throttle actuator motor control circuit. A TAC motor control circuit DTC sets if the ECM detects a fault condition in the TAC circuits or motor performance.

Conditions for Running the DTC

DTC P0506 and P0507

Runs continuously once the following conditions are met:

- DTCs P0112, P0113, P0117, P0118, P0121, P0122, P0123, P0221, P0222, P0223, P0443, P0446, P0455, P0458 and P0459 are not set.
- The ignition is switched on.
- The vehicle speed is 0 km/h.
- The engine coolant temperature is greater than 60°C.
- The intake air temperature is greater than -10.5°C.
- The volumetric efficiency is less than 35 percent.
- The EVAP purge solenoid is off.

DTC P0638

Runs continuously once the following conditions are met:

- The ignition is switched on.
- The ignition voltage is greater than 7 V.

DTC P2100

Runs continuously once the following conditions are met:

- DTC P2101 ran and passed.
- The ignition is switched on.

DTC P2101

Runs continuously once the following conditions are met:

- The battery voltage is greater than 7 V.
- The ignition is switched on.

DTC P1551, P2119 and P2176

Runs continuously once the following conditions are met:

- The ignition is switched on.
- The vehicle speed is 0 km/h.
- The engine speed is less than 40 rpm
- The engine coolant temperature is 5 – 60°C.
- The intake air temperature is 5 – 60°C.
- The ignition voltage is greater than 10 V.
- The APP is less than 15 percent.

Conditions for Setting the DTC

DTC P0506

The actual engine speed is less than the desired idle speed by at least 100 rpm for 10 seconds.

DTC P0507

The actual engine speed is greater than the desired idle speed by at least 200 rpm for 10 seconds or the ECM detects three fuel cut-offs due to an engine over speed condition while the engine is idling.

DTC P0638

The ECM detects the commanded duty cycle is greater than 80 percent for longer than 0.6 second.

DTC P1551

The ECM detects the TP sensor angle is outside the predetermined range of 1.8 – 13.0 percent when the TAC motor is deactivated.

DTC 2100

The ECM detects that its internal TAC motor output driver does not deactivate when commanded off.

DTC P2101

The ECM detects the difference between the commanded and the actual throttle opening is greater than 10 percent.

DTC P2119

The ECM determines the throttle plate didn't return to the rest position within 720 milliseconds.

DTC P2176

One of the following conditions exist:

- The TP sensor 1 voltage is outside the range of 0.2 – 0.9 V during the throttle learn procedure.
- The TP sensor 2 voltage is outside the range of 4.2 – 4.8 V during the throttle learn procedure.
- The throttle learn procedure is not learned after an ECM replacement.

Conditions for Clearing DTC

The TAC motor control circuit DTCs are Type A DTCs. Refer to 1.4 Diagnostic Trouble Codes in this Section for action taken when a Type A DTC sets and conditions for clearing Type A DTCs.

Additional Information

- Refer to Section 6C1-1 Engine Management – V6 – General Information for details of the Throttle Actuator Control System operation.
- For an intermittent fault condition, refer to 4.2 Intermittent Fault Conditions in this Section.
- Since fault condition in a wiring connector may trigger DTCs, always test the connectors related to this diagnostic procedure for shorted terminals or poor wiring connection before replacing any component. Refer to Section 12P Wiring Diagrams for information on electrical fault diagnosis.
- To assist diagnosis, refer to 2 Wiring Diagrams and Connector Charts in this Section for the system wiring diagram and connector charts.

Test Description

The following numbers refer to the step numbers in the diagnostic table:

4 A constant force return spring holds the throttle plate at a constant seven percent throttle opening position and should move in either direction under spring pressure and without binding.

8 When the ignition is switched on, the ECM operates the throttle actuator motor to verify the integrity of the TAC system prior to start up. This can be seen by the momentary flash of the test lamp as the ignition is switched on.

P0506, P0507, P0638, P1551, P2100, P2101, P2119 or P2176 Diagnostic Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been performed?	Go to Step 2	Refer to 3.4 Diagnostic System Check
2	1 Switch off the ignition for 30 seconds. 2 Operate the vehicle within the conditions for running the DTC. 3 Start the engine. 4 Quickly depress the accelerator pedal to wide-open throttle then release pedal. Repeat this procedure several times. 5 Using Tech 2, select the DTC display function. Does DTC P0506, P0507, P0638, P1551, P2100, P2101, P2119 or P2176 fail this ignition cycle?	Go to Step 3	Refer to Additional Information in this DTC
3	Is DTC P0121, P0122, P0123, P0221, P0222 or P0223 also set?	Go to the appropriate DTC Table in this Section	Go to Step 4

Step	Action	Yes	No
4	1 Disconnect the throttle actuator wiring connector. **WARNING** **Accidental operation of the TAC motor while performing throttle plate inspection may cause severe personal injury. Refer to Section 6C1-3 Engine Management – V6 – Service Operations for additional precautions on throttle body service procedure.** 2 Inspect the throttle plate for the following: • excessive dirt build-up in the throttle body, • not in rest position, • binding open or binding close, • binding when moving from open to close or close to open position, and • free to move open or close without spring pressure. Was any fault found and rectified?	Go to Step 13	Go to Step 5
5	Inspect the engine for fault conditions that causes incorrect idle speed. Refer to 4.12 Rough, Unstable, Incorrect Idle or Stalling in this Section. Was any fault found and rectified?	Go to Step 13	Go to Step 6
6	1 Switch on the ignition with the engine not running. 2 Using a digital multimeter, measure the voltage between the TAC positive circuit and the ECM housing. Does the multimeter display 2 – 4 V?	Go to Step 7	Go to Step 9
7	1 Switch on the ignition with the engine not running. 2 Using a digital multimeter, measure the voltage between the TAC negative control circuit and the ECM housing. Does the multimeter display 2 – 4 V?	Go to Step 8	Go to Step 9
8	1 Switch off the ignition. 2 Connect Tool No. J34730-405 injector test lamp between the positive and negative control circuit of the TAC. 3 Switch on the ignition for about 5 seconds then switch off while observing the test lamp. Does the test lamp illuminate briefly each time the ignition cycles?	Go to Step 11	Go to Step 10
9	Test the TAC control circuit that measured outside the specified value for a high resistance, open circuit, short to ground or short to voltage fault condition. Refer to Section 12P Wiring Diagrams for information on electrical fault diagnosis. Was any fault found and rectified?	Go to Step 13	Go to Step 12
10	Test the positive and negative control circuits of the TAC for a shorted together fault condition. Refer to Section 12P Wiring Diagrams for information on electrical fault diagnosis. Was any fault found and rectified?	Go to Step 13	Go to Step 12
11	Replace the throttle body assembly. Refer to Section 6C1-3 Engine Management – V6 – Service Operations. Was the repair completed?	Go to Step 13	—

Step	Action	Yes	No
12	Replace the ECM. Refer to Section 6C1-3 Engine Management – V6 – Service Operations. Was the repair completed?	Go to Step 13	—
13	1 Using Tech 2, clear the DTCs. 2 Switch off the ignition for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the conditions for running the DTC. Does any of the TAC motor control circuit DTCs fail this ignition cycle?	Go to Step 2	Go to Step 14
14	Using Tech 2, select the DTC display function. Does Tech 2 display any DTCs?	Go to the appropriate DTC Table in this Section	System OK
When all diagnosis and repairs are completed, check the system for correct operation.			

6.32 DTC P0513, P0633, P1629, P1632, P1677, P1678 or P1679

DTC Descriptors

This diagnostic procedure supports the following DTCs:

- DTC P0513 – Wrong Transponder Key
- DTC P0633 – Immobiliser Function Not Programmed
- DTC P1629 – Immobiliser Fuel Enable Signal Not Received
- DTC P1632 – Immobiliser Fuel Disable Signal Received
- DTC P1677 – Immobiliser Function Not Enabled
- DTC P1678 – Engine Control Module Identification Failed
- DTC P1679 – Immobiliser Environment Identification Failed

Circuit Description

The engine control module (ECM), the powertrain interface module (PIM) and the body control module (BCM) are integral parts of the vehicle theft deterrent system. The theft deterrent system authenticates the security code programmed into each of these modules to prevent unauthorised vehicle operation. This authentication process includes the following steps:

1. At predetermined situations, the BCM sends a security code to the PIM.
2. When the ignition is switched ON, the PIM receives and compares this security code from the BCM against the security code programmed into the PIM.
3. Once the PIM receives the correct security code from the BCM, it sends a security code to the ECM.
4. The ECM receives and compares this security code from the PIM against the security code programmed into the ECM.
5. The authentication process is complete once the ECM receives the correct security code from the PIM within the specified time frame.
6. The ECM allows normal vehicle operation.

NOTE

If any of these authentication processes fail, the vehicle will not start and DTCs will set. For further information on the theft deterrent system, refer to Section 12J Body Control Module.

Conditions for Running the DTC

Conditions for running the DTC are:

- The ignition is switched on.
- The ignition voltage is 10.0 – 16.0 V.

Conditions for Setting the DTC

P0513

The ECM receives an incorrect response from the PIM during the theft deterrent security authentication process.

P0633

An attempt is made to start the engine before the immobiliser function has been programmed into a new PIM.

P1629

The ECM has not received a fuel enable password from the body control module (BCM).

P1632

The ECM receives an incorrect response from the PIM during the theft deterrent security authentication process.

P1677

An attempt is made to start the vehicle after the ECM was reset.

P1678

The ECM does not receive a valid response from the PIM when an attempt is made to start the engine.

P1679

The ECM receives a message from the PIM stating that it can't authenticate to the BCM.

Conditions for Clearing the DTC

Refer to 1.4 Diagnostic Trouble Codes in this Section for action taken when a Type B DTC sets and conditions for clearing Type B DTCs.

Additional Information

- Refer to Section 6C1-1 Engine Management –V6 – General Information for details of the ECM operation.
- Refer to Section 12J Body Control Module for the following information:
  - BCM link to PIM, and
  - Theft Deterrent System.
- Since a fault condition in a wiring connector may trigger DTCs, always test the connectors related to this diagnostic procedure for shorted terminals or poor wiring connection before replacing any component. Refer to Section 12P Wiring Diagrams for information on electrical fault diagnosis.
- For an intermittent fault condition, refer to 4.2 Intermittent Fault Conditions in this Section.
- To assist diagnosis, refer to 2 Wiring Diagrams and Connector Charts in this Section for the system wiring diagram and connector charts.

DTC P0513, P0633, P1629, P1632, P0633, P1677, P1678, P1679 Diagnostic Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been performed?	Go to Step 2	Refer to 3.4 Diagnostic System Check
2	1 Switch off the ignition for 30 seconds. 2 Operate the vehicle within the conditions for setting the DTC. 3 Using Tech 2, select the DTC display function. Does DTC P0513, P1629, P1632, P0633, P1677, P1678 or P1679 fail this ignition cycle?	Go to Step 3	Refer to Additional Information in this DTC
3	Using Tech 2, perform the BCM Link to ECM / PIM procedure. Refer to Section 6E1 Powertrain Interface Module – V6. Has the linking procedure been performed correctly?	Go to Step 7	Go to Step 4
4	Test the BCM system. Refer to Section 12J Body Control Module. Has any fault been found and rectified?	Go to Step 7	Go to Step 5

Step	Action	Yes	No
5	1 Test all ground circuits of the PIM for a high resistance or an open circuit fault condition. Refer to Section 12P Wiring Diagrams for information on electrical fault diagnosis. 2 Test the PIM ignition supply voltage circuit for a high resistance, open circuit or short to ground fault condition. Refer to Section 12P Wiring Diagrams for information on electrical fault diagnosis. Has any fault been found and rectified?	Go to Step 7	Go to Step 6
6	Replace the PIM. Refer to Section 6E1 Powertrain Interface Module – V6. Has the repair been completed?	Go to Step 7	—
7	1 Using Tech 2, clear the DTCs. 2 Switch off the ignition for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the conditions for running the DTC. Do any of the immobiliser DTCs fail this ignition cycle?	Go to Step 2	Go to Step 8
8	Using Tech 2, select the DTC display function. Does Tech 2 display any DTCs?	Go to the appropriate DTC Table in this Section	System OK
When all diagnosis and repairs are completed, clear all DTCs and check the system for correct operation.			

6.33 DTC P0521, P0522 or P0523

DTC Descriptors

This diagnostic procedure supports the following DTCs:

- DTC P0521 – Oil Pressure Sensor Range / Performance
- DTC P0522 – Oil Pressure Sensor Voltage Low
- DTC P0523 – Oil Pressure Sensor Voltage High

Circuit Description

The ECM applies a positive 5 V reference voltage to the engine oil pressure (EOP) sensor through the 5 V reference circuit and the ground through the low reference circuit.

The EOP sensor provides signal voltage to the ECM that is proportional to the oil pressure generated by the engine oil pump. The ECM monitors the EOP sensor signal voltage. If the ECM detects a low oil pressure condition, it sends a serial data communication signal to the instrument cluster to illuminate the check oil warning icon.

The ECM monitors and compares the EOP sensor signal voltage against a specified range. An EOP sensor circuit DTC sets if the ECM detects the EOP sensor signal voltage is outside the specified range.

Conditions for Running the DTC

DTC P0521, P0522 and P0523 run continuously when the engine is running.

Conditions for Setting the DTC

P0521

The ECM detects engine oil pressure is:

- greater than 800 kPa at idle, or
- engine rpm is greater than 2000 rpm and oil pressure is less than 8 kPa.

P0522

The oil pressure sensor signal voltage is less than 0.2 V for more than 10 seconds.

P0523

The oil pressure sensor signal voltage is more than 4.9 V for more than 10 seconds.

Conditions for Clearing DTC

The EOP sensor circuit DTCs are Type B DTC. Refer to 1.4 Diagnostic Trouble Codes in this Section for action taken when a Type B DTC sets and conditions for clearing Type B DTCs.

Additional Information

- Refer to Section 6C1-1 Engine Management – V6 – General Information for details of the EOP sensor operation.
- For an intermittent fault condition, refer to 4.2 Intermittent Fault Conditions in this Section.
- Since fault condition in a wiring connector may trigger DTCs, always test the connectors related to this diagnostic procedure for shorted terminals or poor wiring connection before replacing any component. Refer to Section 12P Wiring Diagrams for information on electrical fault diagnosis.
- To assist diagnosis, refer to 2 Wiring Diagrams and Connector Charts in this Section for the system wiring diagram and connector charts.

Test Description

The following numbers refer to the step numbers in the diagnostic table:

4 Test signal circuit of the EOP sensor. This circuit should display a voltage within the specified range.

5 Measures the integrity of the EOP sensor low reference circuit. Removal of the ECM Fuse 29 enables the ECM to power down completely prior to the test procedure.

P0521 to P0523 Diagnostic Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been performed?	Go to Step 2	Refer to 3.4 Diagnostic System Check
2	1 Switch off the ignition for 30 seconds. 2 Operate the vehicle within the conditions for running the DTC. 3 Using Tech 2, select the DTC display function. Does DTC P0521, P0522 or P0523 fail this ignition cycle?	Go to Step 3	Refer to Additional Information in this DTC
3	1 Switch off the ignition. 2 Disconnect the EOP sensor wiring connector. 3 Switch on the ignition with the engine not running. 4 Using a digital multimeter, measure the voltage between the EOP sensor 5 V reference circuit and the ECM housing. Does the multimeter display 4.8 – 5.2 V?	Go to Step 4	Go to Step 6
4	1 Connect a 3 A fused jumper wire between the EOP sensor 5 V reference circuit and the EOP sensor signal circuit. 2 Switch on the ignition with the engine not running. 3 Using Tech 2, observe the EOP sensor parameter. Does Tech 2 display 780 – 980 kPa?	Go to Step 5	Go to Step 7
5	1 Switch off the ignition. 2 Remove ECM / TCM Fuse 29 from the engine compartment fuse and relay panel assembly. 3 Using a digital multimeter, measure the resistance between the EOP sensor low reference circuit and the ECM housing. **NOTE** Install the ECM Fuse 29 to the engine compartment fuse and relay panel assembly after completing this test. Does the multimeter display 5 Ω?	Go to Step 9	Go to Step 8
6	Test the EOP sensor 5 V reference circuit for an open, short to ground or high resistance fault condition. Refer to Section 12P Wiring Diagrams for information on electrical fault diagnosis. Was any fault found and rectified?	Go to Step 11	Go to Step 10
7	Test EOP sensor signal circuit for short to ground fault condition. Refer to Section 12P Wiring Diagrams for information on electrical fault diagnosis. Was any fault found and rectified?	Go to Step 11	Go to Step 10

Step	Action	Yes	No
8	1 Disconnect the ECM wiring connector. 2 Test the EOP sensor low reference circuit for a high resistance and open circuit fault condition. Refer to Section 12P Wiring Diagrams for information on electrical fault diagnosis. **NOTE** The EOP sensor shares the low reference circuit with other sensors. A fault condition in the low reference circuit may trigger DTCs on sensors that share this circuit. Refer to 2 Wiring Diagrams and Connector Charts in this Section to assist diagnosis. Was any fault found and rectified?	Go to Step 11	Go to Step 10
9	Replace the EOP sensor. Refer to Section 6C1-3 Engine Management – V6 – Service Operations. Was the repair completed?	Go to Step 11	—
10	Replace the ECM. Refer to Section 6C1-3 Engine Management – V6 – Service Operations. Was the repair completed?	Go to Step 11	—
11	1 Using Tech 2, clear the DTCs. 2 Switch off the ignition for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the conditions for running the DTC. Does any of the engine oil pressure sensor circuit DTCs s fail this ignition cycle?	Go to Step 2	Go to Step 12
12	Using Tech 2, select the DTC display function. Does Tech 2 display any DTCs?	Go to the appropriate DTC Table in this Section	System OK
When all diagnosis and repairs are completed, check the system for correct operation.			

6.34 DTC P0532 or P0533

DTC Descriptors

This diagnostic procedure supports the following DTCs:

- DTC P0532 – A/C Pressure Sensor Voltage Low
- DTC P0533 – A/C Pressure Sensor Voltage High

Circuit Description

The ECM supplies a positive 5 V reference voltage to the air-conditioning (A/C) refrigerant pressure sensor through reference circuit and the ground through the low reference circuit.

The A/C pressure sensor provides signal voltage to the ECM through the signal circuit that is proportional to the A/C refrigerant pressure. The ECM monitors the signal voltage of the A/C pressure sensor to determine the refrigerant pressure.

- The A/C pressure sensor voltage increases as the refrigerant pressure increases.
- When the ECM detects the refrigerant pressure exceeds a predetermined value, the ECM activates the cooling fans to reduce the refrigerant pressure.
- When the ECM detects the refrigerant pressure is too high or too low, the ECM disables the A/C clutch to protect the A/C compressor from damage.

An A/C refrigerant pressure sensor circuit DTC sets if the ECM detects the A/C pressure sensor signal is not within the specified range for 3 seconds.

Conditions for Running the DTC

DTC P0532 and P0533 run continuously when the engine is running or when the A/C is switched on.

Conditions for Setting the DTC

DTC P0532

The A/C refrigerant pressure signal voltage is less than 0.2 V for longer than 3 seconds.

DTC P0533

The A/C refrigerant pressure signal voltage is greater than 4.9 V for longer than 3 seconds.

Conditions for Clearing the DTC

The A/C refrigerant pressure sensor circuit DTCs are Type C DTCs. Refer to 1.4 Diagnostic Trouble Codes in this Section for action taken when Type C DTC sets and conditions for clearing Type C DTCs.

Additional Information

- Refer to Section 6C1-1 Engine Management – V6 – General Information for details of the A/C Refrigerant Pressure Sensor operation.
- For an intermittent fault condition, refer to 4.2 Intermittent Fault Conditions in this Section.
- The A/C refrigerant pressure sensor circuit diagnostic table is developed with the assumption the A/C refrigerant system is functioning correctly. Therefore, rectify any A/C refrigerant system fault conditions before proceeding with this diagnostic procedure.
  - An A/C refrigerant low-pressure fault condition may cause DTC P0532 to set.
  - An A/C refrigerant high-pressure fault condition may cause DTC P0533 to set.
- Since fault condition in a wiring connector may trigger DTCs, always test the connectors related to this diagnostic procedure for shorted terminals or poor wiring connection before replacing any component. Refer to Section 12P Wiring Diagrams for information on electrical fault diagnosis.
- To assist diagnosis, refer to 2 Wiring Diagrams and Connector Charts in this Section for the system wiring diagram and connector charts.

Test Description

The following numbers refer to the step numbers in the diagnostic table:

2 Determines if there is an A/C refrigerant system fault condition.

6 Measures the integrity of the A/C Refrigerant Pressure Sensor low reference circuit. Removal of the ECM Fuse 29 enables the ECM to power down completely prior to the test procedure.

DTC P0532 or P0533 Diagnostic Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been performed?	Go to Step 2	Refer to 3.4 Diagnostic System Check
2	Test the A/C refrigerant system. Refer to Section 2B HVAC Climate Control – Servicing and Diagnosis. Was any fault found and rectified?	Go to Step 12	Go to Step 3
3	1 Switch off the ignition for 30 seconds. 2 Operate the vehicle within the conditions for running the DTC. 3 Using Tech 2, select the DTC display function. Does DTC P0532 or P0533 fail this ignition cycle?	Go to Step 4	Refer to Additional Information in this DTC
4	1 Switch off the ignition. 2 Disconnect the A/C pressure sensor connector. 3 Switch on the ignition with the engine not running. 4 Using a digital multimeter, measure the voltage between the A/C pressure sensor 5 V reference circuit and the ECM housing. Does the multimeter display 4.8 – 5.2 V?	Go to Step 5	Go to Step 7
5	1 Connect a 3 A fused jumper wire between the A/C pressure sensor 5 V reference circuit and signal circuit. 2 Switch on the ignition with the engine not running. 3 Using Tech 2, observe the ECM A/C pressure voltage parameter. Does Tech 2 display **4.8 – 5.2 V**?	Go to Step 6	Go to Step 8
6	1 Switch off the ignition. 2 Remove ECM Fuse 29 from the engine compartment fuse and relay panel assembly. 3 Using a digital multimeter, measure the resistance between the A/C refrigerant pressure low reference circuit and the ECM housing. **NOTE** Install the ECM Fuse 29 to the engine compartment fuse and relay panel assembly after completing the test. Does the multimeter display 5Ω?	Go to Step 10	Go to Step 9
7	Test the A/C pressure sensor 5 V reference circuit for a high resistance, open circuit, short to ground, or short to voltage fault condition. Refer to Section 12P Wiring Diagrams for information on electrical fault diagnosis. Was any fault found and rectified?	Go to Step 12	Go to Step 11

Step	Action	Yes	No
8	Test the A/C pressure sensor signal circuit for a high resistance, open circuit, short to ground, or short to voltage fault condition. Refer to Section 12P Wiring Diagrams for information on electrical fault diagnosis. Was any fault found and rectified?	Go to Step 12	Go to Step 11
9	Test the A/C pressure sensor low reference circuit for a high resistance or open circuit condition. Refer to Section 12P Wiring Diagrams for information on electrical fault diagnosis. Was any fault found and rectified?	Go to Step 12	Go to Step 11
10	Replace the A/C pressure sensor. Refer to Section 6C1-3 Engine Management – V6 – Service Operations. Was the repair completed?	Go to Step 12	—
11	Replace the ECM. Refer to Section 6C1-3 Engine Management – V6 – Service Operations. Was the repair completed?	Go to Step 12	—
12	1 Using Tech 2, clear the DTCs. 2 Switch off the ignition for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the conditions for running the DTC. Does any of the A/C refrigerant pressure sensor circuit DTCs fail this ignition cycle?	Go to Step 2	Go to Step 13
13	Using Tech 2, select the DTC display function. Does Tech 2 display any DTCs?	Go to the appropriate DTC Table in this Section	System OK
When all diagnosis and repairs are completed, check the system for correct operation.			

6.35 DTC P0560, P0562 or P0563

DTC Descriptors

This diagnostic procedure supports the following DTCs:

- DTC P0560 – System Voltage Malfunction
- DTC P0562 – System Voltage Low Voltage
- DTC P0563 – System Voltage High Voltage

Circuit Description

Battery voltage is supplied continuously to the engine control module (ECM) through the continuous battery supply circuit and the ground through the ground connection of the ECM housing to the engine.

Turning the ignition switch on activates the ignition control relay, which directs ignition positive voltage from the battery to the ECM switched battery supply circuit which activates the ECM. The ECM then applies control voltage to the control circuit of the engine control relay to activate the engine control relay. The engine control relay supplies ignition voltage to the various engine management system components.

The ECM monitors the battery voltage circuits to ensure the voltage available to the engine management system stays within the specified range. Incorrect system voltage may cause incorrect engine management system operation or component malfunction.

An ECM system voltage DTC sets if the ECM detects the voltage available to any of the ECM voltage supply circuit is outside the specified range.

Conditions for Running the DTC

DTCs P0560, P0563 and P0563 runs continuously when the engine is running at speeds greater than 1500 rpm

Conditions for Setting the DTC

DTC P0560

The ECM detects the ignition 1, ignition 2 or switched battery supply voltage is out of the specified range for 30 seconds.

DTC P0562

The ECM detects the ECM system voltage is less than 11 V for 5 seconds.

DTC P0563

The ECM detects the ECM system voltage is greater than 16 V.

Conditions for Clearing the DTC

The ECM system voltage DTCs are Type C DTCs. Refer to 1.4 Diagnostic Trouble Codes in this Section for action taken when a Type C DTC sets and conditions for clearing Type C DTCs.

Additional Information

- For an intermittent fault condition, refer to 4.2 Intermittent Fault Conditions in this Section.
- Refer to Section 6C1-1 Engine Management – V6 – General Information for details of the ECM operation.
- Since fault condition in a wiring connector may trigger DTCs, always test the connectors related to this diagnostic procedure for shorted terminals or poor wiring connection before replacing any component. Refer to Section 12P Wiring Diagrams for information on electrical fault diagnosis.
- To assist diagnosis, refer to 2 Wiring Diagrams and Connector Charts in this Section for the system wiring diagram and connector charts.

DTC P0560, P0562 or P0563 Diagnostic Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been performed?	Go to Step 2	Refer to 3.4 Diagnostic System Check
2	1 Switch off the ignition for 30 seconds. 2 Increase the engine speed to 1500 rpm or operate the vehicle within the conditions for running the DTC. 3 Using Tech 2, select the DTC display function. Does DTC P0560, P0562, or P0563 fail this ignition cycle?	Go to Step 3	Refer to Additional Information in this DTC
3	Test the battery condition. Refer to Section 12A Battery. Was any fault found and rectified?	Go to Step 9	Go to Step 4
4	Test the charging system operation. Refer to Section 6D1-1 Charging System – V6. Was any fault found and rectified?	Go to Step 9	Go to Step 5
5	Test all the ECM fuses. Refer to Section 12O Relays, Fuses and Wiring Harnesses. Was any fault found and rectified?	Go to Step 9	Go to Step 6
6	Check the ECM ground connections for corrosion, loose terminal or incorrect position. Refer to Section 12P Wiring Diagrams for information on electrical fault diagnosis. Was any fault found and rectified?	Go to Step 9	Go to Step 7
7	Test the following circuits for a high resistance or open circuit fault condition. • Continuous battery supply circuit, • switched battery supply circuit, • ignition 1 circuit, and • ignition 2 circuit. Refer to Section 12P Wiring Diagrams for information on electrical fault diagnosis. Was any fault found and rectified?	Go to Step 9	Go to Step 8
8	Replace the ECM. Refer to Section 6C1-3 Engine Management – V6 – Service Operations. Was the repair completed?	Go to Step 9	—
9	1 Using Tech 2, clear the DTCs. 2 Switch off the ignition for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the conditions for running the DTC. Does any of the ECM system voltage DTCs fail this ignition cycle?	Go to Step 2	Go to Step 10
10	Using Tech 2, select the DTC display function. Does Tech 2 display any DTCs?	Go to the appropriate DTC Table in this Section	System OK
When all diagnosis and repairs are completed, check the system for correct operation.			

6.36 DTC P0601, P0602, P0604 or P0606

DTC Description

This diagnostic procedure supports the following DTCs:

- DTC P0601 – Replace Electronic Control Unit (ECU)
- DTC P0602 – Program Electronic Control Unit (ECU)
- DTC P0604 – Replace Electronic Control Unit (ECU)
- DTC P0606 – Replace Electronic Control Unit (ECU)

Circuit Description

The engine control module (ECM) is the control centre of the engine management system. The programming and calibration needed by the ECM to control the functionality of the engine management system are stored in the ECM read only memory (ROM).

An ECM internal circuit, programming or memory fault DTC sets if there is an internal microprocessor integrity fault condition with the ECM or if the ECM is not programmed.

Conditions for Running the DTC

DTC P0601

Runs once when the checksum calculation at power down is completed in the last ignition cycle.

DTC P0602 and P0606

Runs continuously when the ignition is switched on with the engine not running.

DTC P0604

Runs once when the read / write test at power-down is completed in the last ignition cycle.

Conditions for Setting the DTC

DTC P0601

The ECM detects an incorrect ROM checksum for greater than 30 seconds.

DTC P0602

The ECM programming is incomplete.

DTC P0604

The ECM detects an error in the RAM for 6 seconds.

DTC P0606

There is an internal ECM circuit fault condition for 6 seconds.

Conditions for Clearing the DTC

The ECM Internal Circuit, Programming or Memory Fault DTCs are Type A DTCs. Refer to 1.4 Diagnostic Trouble Codes in this Section for action taken when a Type A DTC sets and conditions for clearing Type A DTCs.

Additional Information

- Refer to Section 6C1-1 Engine Management – V6 – General Information for details of the ECM operation.
- Since fault condition in a wiring connector may trigger DTCs, always test the connectors related to this diagnostic procedure for shorted terminals or poor wiring connection before replacing any component. Refer to Section 12P Wiring Diagrams for information on electrical fault diagnosis.
- For an intermittent fault condition, refer to 4.2 Intermittent Fault Conditions in this Section.
- To assist diagnosis, refer to 2 Wiring Diagrams and Connector Charts in this Section for the system wiring diagram and connector charts.

DTC P0601, P0602, P0604 and P0606 Diagnostic Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been performed?	Go to Step 2	Refer to 3.4 Diagnostic System Check
2	1 Switch off the ignition for 30 seconds. 2 Operate the vehicle within the conditions for running the DTC. 3 Using Tech 2, select the DTC display function. Does DTC P0601, P0602, P0604 or P0606 fail this ignition cycle?	Go to Step 3	Refer to Additional Information in this DTC
3	Test all ECM fuses and ground connections. Refer to Section 12O Relays, Fuses and Wiring Harnesses. Was any fault found and rectified?	Go to Step 6	Go to Step 4
4	Attempt to program the ECM. Refer to Section 0C Tech 2. Was the programming successful?	Go to Step 6	Go to Step 5
5	Replace the ECM. Refer to Section 6C1-3 Engine Management – V6 – Service Operations. Was the repair completed?	Go to Step 6	—
6	1 Using Tech 2, clear the DTCs. 2 Switch off the ignition for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the conditions for running the DTC. Does any of the ECM internal circuit, programming or memory fault DTCs fail this ignition cycle?	Go to Step 2	Go to Step 7
7	Using Tech 2, select the DTC display function. Does Tech 2 display any DTCs?	Go to the appropriate DTC Table in this Section	System OK
When all diagnosis and repairs are completed, check the system for correct operation.			

6.37 DTC P0615, P0616 or P0617

DTC Descriptors

This diagnostic procedure supports the following DTCs:

- DTC P0615 – Starter Relay Circuit Malfunction
- DTC P0616 – Starter Relay Circuit Low Voltage
- DTC P0617 – Starter Relay Circuit High Voltage

Circuit Description

The engine control relay applies battery voltage to the coil circuit of the starter relay through the ignition circuit. When the ignition switched is turned to the Start position and all the conditions required to enable an engine cranking is met, the ECM grounds the starter relay control circuit to activate the starter relay. When active, the starter relay applies battery voltage to the starter motor solenoid control circuit to operate the starter motor. Refer to Section 6D1-2 Starting System – V6 for information on the cranking system operation.

The ECM monitors the control circuit of the starter relay for conditions that are incorrect for the commanded state. A starter relay control circuit DTC sets if the ECM detects a fault condition in the starter relay control circuit.

Conditions for Running the DTC

DTCs P0615, P0616 and P0617 run continuously once the following conditions are met:

- The ignition is switched on
- The ignition voltage is 10.0 – 16.0 V.

Conditions for Setting the DTC

The ECM detects a condition that is incorrect for the starter relay commanded state.

Conditions for Clearing the DTC

The starter relay control circuit DTCs are Type C DTCs. Refer to 1.4 Diagnostic Trouble Codes in this Section for action taken when Type C DTCs set and conditions for clearing Type C DTCs.

Additional Information

- Refer to Section 6D1-2 Starting System – V6 for information on the cranking system operation.
- For an intermittent fault condition, refer to 4.2 Intermittent Fault Conditions in this Section.
- Since fault condition in a wiring connector may trigger DTCs, always test the connectors related to this diagnostic procedure for shorted terminals or poor wiring connection before replacing any component. Refer to Section 12P Wiring Diagrams for information on electrical fault diagnosis.
- To assist diagnosis, refer to 2 Wiring Diagrams and Connector Charts in this Section for the system wiring diagram and connector charts.

Test Description

The following number refers to the step number in the diagnostic table:

3 A fault condition in the starting system or theft deterrent system may trigger this DTC.

DTC P0615, P0616 or P0617 Diagnostic Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been performed?	Go to Step 2	Refer to 3.4 Diagnostic System Check

Step	Action	Yes	No
2	1 Switch off the ignition for 30 seconds. 2 Turn the ignition switch to the Start position or operate the vehicle within the conditions for running the DTC. 3 Using Tech 2, select the DTC display function. Does DTC P0615, P0616 and P0617 fail this ignition cycle?	Go to Step 3	Refer to Additional Information in this DTC
3	Check for a fault condition in the following systems which can disable the starting system: • Starting System, refer to Section 6D1-2 Starting System – V6. • Theft Deterrent System, refer to Section 12J Body Control Module. Was any fault found and rectified?	Go to Step 10	Go to Step 4
4	1 Remove the starter relay. Refer to Section 12O Fuses, Relays and Wiring Harnesses. 2 Connect a test lamp between the ignition circuit of the starter relay and a good ground. 3 Switch on the ignition. Does the test lamp illuminate when the ignition switch is turned to the on position?	Go to Step 5	Go to Step 6
5	1 Connect a test lamp between the control circuit of the starter relay and a 12 V. 2 Turn the ignition switch to the Start position and then release it back to the on position. Does the test lamp turn on when the ignition switch is turned to the Start position and then turn off when the ignition switch returns to the on position?	Go to Step 8	Go to Step 7
6	Repair the ignition voltage circuit of the starter relay for a high resistance or open circuit fault condition. Refer to Section 12P Wiring Diagrams for information on electrical wiring repair procedures. Was the repair completed?	Go to Step 10	—
7	Test the control circuit of the starter relay for a high resistance, open circuit, short to ground or a short to voltage fault condition. Refer to Section 12P Wiring Diagrams for information on electrical fault diagnosis. Was any fault found and rectified?	Go to Step 10	Go to Step 9
8	Replace the starter relay. Refer to Section 12O Fuses, Relays and Wiring Harnesses. Was the repair completed?	Go to Step 10	—
9	Replace the ECM. Refer to Section 6C1-3 Engine Management – V6 – Service Operations. Was the repair completed?	Go to Step 10	—
10	1 Using Tech 2, clear the DTCs. 2 Switch off the ignition for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the conditions for running the DTC. Does the starter relay control circuit DTCs fail this ignition cycle?	Go to Step 2	Go to Step 11
11	Using Tech 2, select the DTC display function. Does Tech 2 display any DTCs?	Go to the appropriate DTC Table in this Section	System OK
When all diagnosis and repairs are completed, check the system for correct operation.			

6.38 DTC P0625 or P0626

DTC Descriptors

This diagnostic procedure supports the following DTCs:

- DTC P0625 – Alternator F Terminal Low Voltage
- DTC P0626 – Alternator F Terminal High Voltage

Circuit Description

The voltage regulator within the generator regulates the generator charge output by increasing or decreasing the generator on time. The generator field (Gen F) duty cycle output signal represents the generator on time. Refer to Section 6D1-1 Charging System – V6 for details of the charging system operation.

The ECM monitors the Gen F terminal output signal to calculate Gen F duty cycle percentage. This enables the ECM to provide engine idle compensation based on electrical loads and to detect a fault condition in the generator operation.

A Generator F-terminal circuit DTC sets if the ECM detects the Gen F duty cycle is outside the specified range for a predetermined set of parameters.

Conditions for Running the DTC

DTC P0625

Runs continuously when the following conditions are met:

- There is no generator, CKP sensor or CMP sensor DTC set.
- The engine speed is less than 3000 rpm
- The generator is not commanded off.

DTC P0626

Runs continuously when the following conditions are met:

- There is no generator, CKP sensor or CMP sensor DTC set.
- The ignition is switched on with the engine not running

Conditions for Setting the DTC

DTC P0625

The ECM detects the Gen F Terminal Signal parameter is less than five percent for 15 seconds.

DTC P0626

The ECM detects the Gen F Terminal Signal parameter is greater than five percent for 15 seconds.

Conditions for Clearing DTC

The Generator F-terminal circuit are Type C DTCs. Refer to 1.4 Diagnostic Trouble Codes in this Section for action taken when a Type C DTC sets and conditions for clearing Type C DTCs.

Additional Information

- For an intermittent fault condition, refer to 4.2 Intermittent Fault Conditions in this Section.
- Refer to Section 6C1-1 Engine Management – V6 – General Information for details of the ECM operation.
- Refer to Section 6D1-1 Charging System – V6 for details of the charging system operation.
- Since fault condition in a wiring connector may trigger DTCs, always test the connectors related to this diagnostic procedure for shorted terminals or poor wiring connection before replacing any component. Refer to Section 12P Wiring Diagrams for information on electrical fault diagnosis.
- To assist diagnosis, refer to 2 Wiring Diagrams and Connector Charts in this Section for the system wiring diagram and connector charts.

DTC P0625 or P0626 Diagnostic Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been performed?	Go to Step 2	Refer to 3.4 Diagnostic System Check
2	1 Switch off the ignition for 30 seconds. 2 Operate the vehicle within the conditions for running the DTC. 3 Using Tech 2, select the DTC display function. Does DTC P0625 or P0626 fail this ignition cycle?	Go to Step 3	Refer to Additional Information in this DTC
3	Test the charging system for any fault condition that may cause incorrect generator operation. Refer to Section 6D1-1 Charging System – V6. Was any fault found and rectified?	Go to Step 6	Go to Step 4
4	Test the Gen F signal circuit for a high resistance, open circuit, short to ground or short to voltage fault condition. Refer to Section 12P Wiring Diagrams for information on electrical fault diagnosis. Was any fault found and rectified?	Go to Step 6	Go to Step 5
5	Replace the ECM. Refer to Refer to Section 6C1-3 Engine Management – V6 – Service Operations. Was the repair completed?	Go to Step 7	—
6	1 Using Tech 2, clear the DTCs. 2 Switch off the ignition for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the conditions for running the DTC. Does any of the Generator F-terminal circuit DTCs fail this ignition cycle?	Go to Step 2	Go to Step 8
7	Using Tech 2, select the DTC display function. Does Tech 2 display any DTCs?	Go to the appropriate DTC Table in this Section	System OK
When all diagnosis and repairs are completed, check the system for correct operation.			

6.39 DTC P0627, P0628 or P0629

DTC Descriptors

This diagnostic procedure supports the following DTCs:

- DTC P0627 – Fuel Pump Relay Circuit Malfunction
- DTC P0628 – Fuel Pump Relay Voltage Low
- DTC P0629 – Fuel Pump Relay Voltage High

Circuit Description

The ground circuit of the fuel pump relay coil is directly connected to ground. When the ignition switch is turned on and all the conditions required to enable fuel pump operation are met, the ECM applies battery voltage to the fuel pump relay control circuit to operate the fuel pump. Refer to Section 8A1 Fuel System for further information.

The ECM monitors the control circuit of the fuel pump relay for conditions that are incorrect for the commanded state. A fuel pump relay control circuit DTC sets if the ECM detects a fault condition in this circuit.

NOTE

If activated, the engine immobilisation system will disable the operation of the fuel pump relay. Refer to Section 12K Telematics for further information.

Conditions for Running the DTC

Run continuously once the following conditions are met:

- the ignition is switched on, and
- the ignition voltage is 10.0 – 16.0 V.

Conditions for Setting the DTC

The ECM detects a condition that are incorrect for the fuel pump relay commanded state.

Conditions for Clearing the DTC

The fuel pump relay control circuit DTCs are Type C DTCs. Refer to 1.4 Diagnostic Trouble Codes in this Section for action taken when Type C DTCs set and conditions for clearing Type C DTCs.

Additional Information

- Refer to Section 8A1 Fuel System for details of the fuel pump operation.
- Refer to Section 12K Telematics for details of the Immediate Engine Immobilisation System.
- For an intermittent fault condition, refer to 4.2 Intermittent Fault Conditions in this Section.
- Since fault condition in a wiring connector may trigger DTCs, always test the connectors related to this diagnostic procedure for shorted terminals or poor wiring connection before replacing any component. Refer to Section 12P Wiring Diagrams for information on electrical fault diagnosis.
- To assist diagnosis, refer to 2 Wiring Diagrams and Connector Charts in this Section for the system wiring diagram and connector charts.

Test Description

The following number refers to the step number in the diagnostic table:

7 A fault condition in the vehicle Telematics may trigger a fault condition in the fuel pump relay control circuit.

DTC P0627 to P0629 Diagnostic Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been performed?	Go to Step 2	Refer to 3.4 Diagnostic System Check
2	1 Switch off the ignition for 30 seconds. 2 Turn the ignition switch to the Start position or operate the vehicle within the conditions for running the DTC. 3 Using Tech 2, select the DTC display function. Does DTC P0627, P0628 and P0629 fail this ignition cycle?	Go to Step 3	Refer to Additional Information in this DTC
3	1 Remove the fuel pump relay. Refer to Section 12O Fuses, Relays and Wiring Harnesses. 2 Connect a test lamp between the ground circuit of the fuel pump relay and a 12 V. Does the test lamp illuminate?	Go to Step 4	Go to Step 5
4	1 Connect a test lamp between the control circuit and ground circuit of the fuel pump relay. 2 Using Tech 2, command the fuel pump relay on. Does the test lamp switch from off to on as Tech 2 commands the fuel pump relay from off to on?	Go to Step 7	Go to Step 6
5	Repair the high resistance or open circuit fault condition in the ground circuit of the fuel pump relay. Refer to Section 12P Wiring Diagrams for information on electrical wiring repair procedures. Was the repair completed?	Go to Step 9	—
6	Test the control circuit of the fuel pump relay for a high resistance, open circuit, short to ground or a short to voltage fault condition. Refer to Section 12P Wiring Diagrams for information on electrical fault diagnosis. **NOTE** If the vehicle is equipped with an Immediate Engine Immobilisation System, test this system for a fault condition that may trigger a fuel pump relay control circuit DTC, before proceeding to the next step. Refer to Section 12K Telematics for further information. Was any fault found and rectified?	Go to Step 9	Go to Step 8
7	Replace the fuel pump relay. Refer to Section 12O Fuses, Relays and Wiring Harnesses. Was the repair completed?	Go to Step 9	—
8	Replace the ECM. Refer to Section 6C1-3 Engine Management – V6 – Service Operations. Was the repair completed?	Go to Step 9	—
9	1 Using Tech 2, clear the DTCs. 2 Switch off the ignition for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the conditions for running the DTC. Does the fuel pump relay control circuit DTCs fail this ignition cycle?	Go to Step 2	Go to Step 10
10	Using Tech 2, select the DTC display function. Does Tech 2 display any DTCs?	Go to the appropriate DTC Table in this Section	System OK
When all diagnosis and repairs are completed, check the system for correct operation.			

6.40 DTC P0645, P0646 or P0647

DTC Descriptors

This diagnostic procedure supports the following DTCs:

- DTC P0645 – A/C Relay Circuit Malfunction.
- DTC P0646 – A/C Relay Voltage Low.
- DTC P0647 – A/C Relay Voltage High.

Circuit Description

The engine control relay applies battery voltage to the coil circuit of the air-conditioning (A/C) clutch relay through the ignition circuit. Using a device called a driver, the ECM grounds control circuit of the A/C relay to activate the A/C clutch and operate the A/C compressor. Refer to Section 2A HVAC Climate Control – Description and Operation for details of the A/C compressor operation.

The driver has a feedback circuit that is pulled-up to a voltage. The ECM monitors the driver feedback circuit to determine if the control circuit is open, shorted to ground or shorted to a positive voltage.

An A/C relay control circuit DTC sets if the ECM detects a fault condition in the A/C relay control circuit.

Conditions for Running the DTC

DTC P0645, P0646 or P0647 runs continuously once the following conditions are met:

- The ignition voltage is 10 – 16 V.
- The engine speed is greater than 80 rpm

Conditions for Setting the DTC

Conditions for Setting DTC P0645

The ECM detects an open circuit fault condition in the A/C relay control circuit.

Conditions for Setting DTC P0646

The ECM detects a short to ground fault condition in the A/C relay control circuit.

Conditions for Setting DTC P0647

The ECM detects a short to voltage fault condition in the A/C relay control circuit.

Conditions for Clearing the DTC

The A/C relay control circuit DTCs are Type C DTCs. Refer to 1.4 Diagnostic Trouble Codes in this Section for action taken when Type C DTCs set and conditions for clearing Type C DTCs.

Additional Information

- For an intermittent fault condition, refer to 4.2 Intermittent Fault Conditions in this Section.
- Refer to Section 2A HVAC Climate Control – Description and Operation for details of the A/C system operation.
- Since a fault condition in a wiring connector may trigger DTCs, always test the connectors related to this diagnostic procedure for shorted terminals or poor wiring connection before replacing any component. Refer to Section 12P Wiring Diagrams for information on electrical fault diagnosis.
- To assist diagnosis, refer to 2 Wiring Diagrams and Connector Charts for the system wiring diagram and connector charts.

Test Description

The following number refers to the step numbers in the diagnostic table:

3 A fault condition in the HVAC system may trigger this DTC.

DTC P0645, P0646 or P0647 Diagnostic Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been performed?	Go to Step 2	Refer to 3.4 Diagnostic System Check
2	1 Switch off the ignition for 30 seconds. 2 Switch on the A/C system or operate the vehicle within the conditions for running the DTC. 3 Using Tech 2, select the DTC display function. Does DTC P0645 P0646 or P0647 fail this ignition cycle?	Go to Step 3	Refer to Additional Information in this DTC
3	Check for a fault condition in the HVAC system, which can disable the AC compressor clutch. Refer to Section 2A HVAC Climate Control – Description and Operation for details of the A/C compressor operation. Was any fault found and rectified?	Go to Step 10	Go to Step 4
4	1 Remove the A/C relay. Refer to Section 12O Fuses, Relays and Wiring Harnesses. 2 Connect a test lamp between the ignition circuit of the A/C relay coil and the ECM housing. 3 Switch on the ignition with the engine not running. Does the test lamp illuminate?	Go to Step 5	Go to Step 6
5	1 Connect a test lamp between the control circuit of the A/C relay and a 12 V. 2 Switch on the ignition with the engine not running. 3 Using Tech 2, command the A/C relay on and then off. Does the test lamp turn on and off when the A/C relay is commanded on and off?	Go to Step 8	Go to Step 7
6	Repair the high resistance or open circuit fault condition in the ignition voltage circuit of the A/C relay. Refer to Section 12P Wiring Diagrams for information on electrical wiring repair procedures. Was the repair completed?	Go to Step 10	—
7	Test the control circuit of the A/C relay for a high resistance, open circuit, short to ground or short to voltage fault condition. Refer to Section 12P Wiring Diagrams for information on electrical fault diagnosis. Was any fault found and rectified?	Go to Step 10	Go to Step 9
8	Replace the A/C relay. Refer to Section 12O Fuses, Relays and Wiring Harnesses. Was the repair completed?	Go to Step 10	—
9	Replace the ECM. Refer to Section 6C1-3 Engine Management – V6 – Service Operations. Was the repair completed?	Go to Step 10	—
10	1 Using Tech 2, clear the DTCs. 2 Switch off the ignition for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the conditions for running the DTC. Does any of the A/C relay control circuit DTCs fail this ignition cycle?	Go to Step 2	Go to Step 11
11	Using Tech 2, select the DTC display function. Does Tech 2 display any DTCs?	Go to the appropriate DTC Table in this Section	System OK
When all diagnosis and repairs are completed, check the system for correct operation.			

6.41 DTC P0685, P0686 or P0687

DTC Descriptors

This diagnostic procedure supports the following DTCs:

- DTC P0685 – Engine Control Ignition Relay Circuit Malfunction
- DTC P0686 – Engine Control Ignition Relay Circuit Low Voltage
- DTC P0687 – Engine Control Ignition Relay Circuit High Voltage

Circuit Description

The supply voltage circuit of the engine control relay is directly connected to battery voltage. When the ignition switch is turned on, the ECM grounds the relay control circuit to provide ignition voltage to various sensors and components that controls the engine operation.

The ECM monitors the control circuit of the engine control relay for conditions that are incorrect for the commanded state. An engine control relay circuit DTC sets if the ECM detects a fault condition in this circuit.

Conditions for Running the DTC

DTCs P0685, P0686 and P0687 run continuously once the following conditions are met:

- The ignition is switched on
- The ignition voltage is 10.0 – 16.0 V.

Conditions for Setting the DTC

The ECM detects a condition that is incorrect for the engine control relay commanded state.

Conditions for Clearing the DTC

The engine control relay control circuit DTCs are Type C DTCs. Refer to 1.4 Diagnostic Trouble Codes in this Section for action taken when Type C DTCs set and conditions for clearing Type C DTCs.

Additional Information

- For an intermittent fault condition, refer to 4.2 Intermittent Fault Conditions in this Section.
- Since fault condition in a wiring connector may trigger DTCs, always test the connectors related to this diagnostic procedure for shorted terminals or poor wiring connection before replacing any component. Refer to Section 12P Wiring Diagrams for information on electrical fault diagnosis.
- To assist diagnosis, refer to 2 Wiring Diagrams and Connector Charts in this Section for the system wiring diagram and connector charts.

Test Description

The following number refers to the step number in the diagnostic table:

4 Removal of the ECM Fuse 29 enables the ECM to power down completely prior to the test procedure.

DTC P0685, P0686 or P0687 Diagnostic Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been performed?	Go to Step 2	Refer to 3.4 Diagnostic System Check
2	1 Switch off the ignition for 30 seconds. 2 Turn the ignition switch to the Start position or operate the vehicle within the conditions for running the DTC. 3 Using Tech 2, select the DTC display function. Does DTC P0685, P0686 and P0687 fail this ignition cycle?	Go to Step 3	Refer to Additional Information in this DTC
3	1 Remove the engine control relay. Refer to Section 12O Fuses, Relays and Wiring Harnesses. 2 Connect a test lamp between the battery voltage circuit of the engine control relay and a good ground. Does the test lamp illuminate?	Go to Step 4	Go to Step 5
4	1 Switch off the ignition. 2 Remove and reinstall the ECM fuse 29 from the engine compartment fuse and relay panel assembly. 3 Connect a test lamp between the control circuit and the battery voltage circuit of the engine control relay. 4 Switch on the ignition. Does the test lamp switches from off to on when the ignition switch is turned form off to on?	Go to Step 7	Go to Step 6
5	Repair the high resistance or open circuit fault condition in the battery voltage circuit of the engine control relay. Refer to Section 12P Wiring Diagrams for information on electrical wiring repair procedures. Was the repair completed?	Go to Step 9	—
6	Test the control circuit of the engine control relay for a high resistance, open circuit, short to ground or a short to voltage fault condition. Refer to Section 12P Wiring Diagrams for information on electrical fault diagnosis. Was any fault found and rectified?	Go to Step 9	Go to Step 8
7	Replace the engine control relay. Refer to Section 12O Fuses, Relays and Wiring Harnesses. Was the repair completed?	Go to Step 9	—
8	Replace the ECM. Refer to Section 6C1-3 Engine Management – V6 – Service Operations. Was the repair completed?	Go to Step 9	—
9	1 Using Tech 2, clear the DTCs. 2 Switch off the ignition for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the conditions for running the DTC. Does the engine control relay control circuit DTCs fail this ignition cycle?	Go to Step 2	Go to Step 10
10	Using Tech 2, select the DTC display function. Does Tech 2 display any DTCs?	Go to the appropriate DTC Table in this Section	System OK
When all diagnosis and repairs are completed, check the system for correct operation.			

6.42 DTC P0700

DTC Descriptor

This diagnostic procedure supports DTC P0700 – Malfunction Indicator (MI) Request from Transmission Control Module (TCM).

Circuit Description

The engine control module (ECM) communicates directly with the transmission control module (TCM) and other control modules connected to the GM LAN serial data communication circuit through the GM LAN protocol.

DTC P0700 – Malfunction Indicator Request from TCM sets if the following condition exists:

- The TCM detects an emission related fault condition and sets a TCM DTC that represent the fault condition.
- The ECM receives a serial data signal from the TCM requesting the illumination of the malfunction indicator.

Conditions for Running the DTC

DTC P0700 runs continuously when the ignition is switched on.

Conditions for Setting the DTC

The ECM receives a serial data signal from the TCM requesting the illumination of the Check Powertrain icon, or the malfunction indicator lamp (MIL).

Conditions for Clearing the DTC

DTC P0700 – Malfunction Indicator Request from TCM is a Type A DTCs. Refer to 1.4 Diagnostic Trouble Codes in this Section for action taken when a Type A DTC sets and conditions for clearing Type A DTCs.

Additional Information

- Refer to Section 6C1-1 Engine Management – V6 – General Information for details of the ECM operation.
- For an intermittent fault condition, refer to 4.2 Intermittent Fault Conditions in this Section.
- To assist diagnosis, refer to 2 Wiring Diagrams and Connector Charts in this Section for the system wiring diagram and connector charts.

DTC P0700 Diagnostic Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been performed?	Go to Step 2	Refer to 3.4 Diagnostic System Check
2	1 Switch off the ignition for 30 seconds. 2 Operate the vehicle within the conditions for running the DTC. 3 Using Tech 2, select the DTC display function. Does DTC P0700 fail this ignition cycle?	Go to Step 3	Refer to Additional Information in this DTC
3	Are other powertrain DTCs also set?	Go to the appropriate DTC Table in this Section	Refer to Section 7C2 Automatic Transmission – 4L60E – Electrical Diagnosis or Section 7E4 Automatic Transmission – 5L40E – Electrical Diagnosis
When all diagnosis and repairs are completed, check the system for correct operation.			

6.43 DTC P0704

DTC Descriptor

This diagnostic procedure supports DTC P0704 – Clutch Switch Input Circuit Malfunction.

Circuit Description

There are two clutch pedal switch assemblies. One switch is a pedal travel switch that ensures the engine can only be cranked with the clutch pedal fully depressed. The second switch disengages the cruise control when the clutch is depressed, in much the same way that the brake pedal switch is used to disengage the cruise control feature.

The cruise control cancel switch is normally closed when the clutch pedal is at rest, opening when the pedal is pressed. Activation of this switch removes the signal to the ECM which will then deactivate the cruise control.

Conditions for Running the DTC

Runs continuously when the ignition is switched and the engine is running.

Conditions for Setting the DTC

The ECM detects 15 gear changes with less than three clutch switch inputs.

NOTE

The ECM determines that a gear change has been performed by the engine speed / vehicle speed ratio.

Conditions for Clearing the DTC

The clutch switch circuit DTC is a Type C DTC. Refer to 1.4 Diagnostic Trouble Codes in this Section for action taken when Type C DTCs set and conditions for clearing Type C DTCs.

Additional Information

- For an intermittent fault condition, refer to 4.2 Intermittent Fault Conditions in this Section.
- Refer to Section 6C1-1 Engine Management – V6 – General Information for details of the clutch switch operation.
- Refer to Section 12E Cruise Control for clutch pedal switch operation and testing.
- Since fault condition in a wiring connector may trigger DTCs, always test the connectors related to this diagnostic procedure for shorted terminals or poor wiring connection before replacing any component. Refer to Section 12P Wiring Diagrams for information on electrical fault diagnosis.
- To assist diagnosis, refer to 2 Wiring Diagrams and Connector Charts in this Section for the system wiring diagram and connector charts.

DTC P0704 Diagnostic Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been performed?	Go to Step 2	Refer to 3.4 Diagnostic System Check
2	1 Switch off the ignition for 30 seconds. 2 Operate the vehicle within the conditions for running the DTC. 3 Using Tech 2, select the DTC display function. Does DTC P0704 fail this ignition cycle?	Go to Step 3	Refer to Additional Information in this DTC

3	1 Switch on the ignition with the engine not running. 2 On Tech 2 select: **Engine / V6 Engine / Data Display / Engine Data 1**. 3 Observe the status of the cruise control cancel switch. 4 Depress the clutch pedal. Does Tech 2 display change from Inactive to Active when the pedal is pressed?	Refer to Additional Information in this DTC	Go to Step 4
4	1 Disconnect the wiring connector from the cruise control cancel switch. Refer to Section 12E Cruise Control. 2 Switch on the ignition. 3 Connect a test lamp between the voltage circuit of cruise control cancel clutch switch and a ground. Does the test lamp illuminate?	Go to Step 6	Go to Step 5
5	Repair the high resistance or open circuit fault condition in the voltage circuit of the clutch switch. Refer to Section 12P Wiring Diagrams for information on electrical wiring repair procedures. Was the repair completed?	Go to Step 9	—
6	Test the cruise control cancel clutch switch. Refer to Section 12E Cruise Control. Was any fault found and rectified?	Go to Step 9	Go to Step 7
7	Test the control circuit of the cruise control clutch switch, which failed for a high resistance, open circuit, short to ground or short to voltage fault condition. Refer to Section 12P Wiring Diagrams for information on electrical fault diagnosis. Was any fault found and rectified?	Go to Step 9	Go to Step 8
8	Replace the ECM. Refer to Section 6C1-3 Engine Management – V6 – Service Operations. Was the repair completed?	Go to Step 9	—
9	1 Using Tech 2, clear the DTCs. 2 Switch off the ignition for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the conditions for running the DTC. Does DTC P0704 fail this ignition cycle?	Go to Step 2	Go to Step 11
10	Using Tech 2, select the DTC display function. Does Tech 2 display any DTCs?	Go to the appropriate DTC Table in this Section	System OK
When all diagnosis and repairs are completed, check the system for correct operation.			

6.44 DTC P0850

DTC Descriptor

This diagnostic procedure supports DTC P0850 – Park / Neutral Signal Circuit Incorrect Signal.

Circuit Description

The Park / Neutral (P / N) switch is a part of the automatic transmission gear selector position switch assembly. This DTC applies to all automatic transmissions fitted to the MY2005 / MY2006 range of vehicles, however the Park / Neutral (P / N) switch on the 5L40-E Automatic Transmission is a part of the Internal Mode Switch (IMS) assembly. Therefore, access to the IMS is only possible after lowering the transmission oil pan.

The P / N switch is a normally open switch that closes when the transmission is shifted to Park or Neutral position. The ECM applies a reference 12 V to the signal circuit of the P / N switch when it is open. When the transmission is shifted to the Park or Neutral position, the P / N switch closes and pulls the P / N switch signal circuit to ground.

DTC P0850 sets when the ECM detects a fault condition in the P / N switch circuit.

Conditions for Running the DTC

DTC P0850 runs continuously when the ignition voltage is 10.0 – 16.0 V.

Conditions for Setting the DTC

DTC P0850 sets when the ECM detects one of the following fault conditions:

- The P / N switch signal circuit is pulled to ground for 100 seconds while the TCM sends a signal that the transmission is in gear.
- The P / N switch signal circuit is 12 V for 100 seconds while the TCM sends a signal the transmission is in park or neutral.

Conditions for Clearing the DTC

DTC P0850 is a Type ‘C’ DTC. Refer to 1.4 Diagnostic Trouble Codes in this Section for action taken when Type ‘C’ DTCs set and conditions for clearing Type ‘C’ DTCs.

Additional Information

- The ECM uses the transmission range data to enable engine cranking when DTC P0850 sets.
- For an intermittent fault condition, refer to 4.2 Intermittent Fault Conditions in this Section.
- Refer to Section 6C1-1 Engine Management – V6 – General Information for details of the park / neutral switch operation.
- Since fault condition in a wiring connector may trigger DTCs, always test the connectors related to this diagnostic procedure for shorted terminals or poor wiring connection before replacing any component. Refer to Section 12P Wiring Diagrams for information on electrical fault diagnosis.
- To assist diagnosis, refer to 2 Wiring Diagrams and Connector Charts in this Section for the system wiring diagram and connector charts.

DTC P0850 Diagnostic Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been performed?	Go to Step 2	Refer to 3.4 Diagnostic System Check
2	1 Switch on the ignition. 2 Using Tech 2, observe the status of the automatic transmission gear position. 3 Shift the transmission lever across all gear levels. Does Tech 2 display **P/N** when the transmission is in park or neutral and **In Gear** when the transmission lever is in other positions?	Go to Step 3	Go to Step 4

Step	Action	Yes	No
3	1 Switch off the ignition for 30 seconds. 2 Switch on the ignition. 3 Shift the transmission lever across all gear levels. Does DTC P0850 fail this ignition cycle?	Go to Step 4	Refer to Additional Information in this DTC
4	1 Remove the transmission position switch wiring connector. Refer to Section 7C4 Automatic Transmission_4L60E – On-vehicle Servicing or Section 7E4 Automatic Transmission_5L40E – On-vehicle Servicing. 2 Connect a test lamp between the ground circuit of the transmission switch and a 12 V source. Does the test lamp illuminate?	Go to Step 5	Go to Step 6
5	1 Connect a 3 A jumper wire between the signal circuit of the park / neutral signal circuit and a good ground. 2 Using Tech 2, observe the status of the transmission gear. Does Tech 2 display a change from **In Gear** to **P/N** when the jumper wire is connected?	Go to Step 8	Go to Step 7
6	Repair the high resistance or open circuit fault condition in the ground circuit of the transmission position switch. Refer to Section 12P Wiring Diagrams for information on electrical wiring repair procedures. Was the repair completed?	Go to Step 10	—
7	Test the signal circuit of the park / neutral switch for a high resistance, open circuit, short to ground or short to voltage fault condition. Refer to 12P Wiring Diagrams for information on electrical fault diagnosis. Was any fault found and rectified?	Go to Step 10	Go to Step 9
8	Replace the transmission position switch. Refer to Section 7C4 Automatic Transmission – 4L60E – On-vehicle Servicing, or Section 7E4 Automatic Transmission_5L40E – On-vehicle Servicing. Was the repair completed?	Go to Step 10	—
9	Replace the ECM. Refer to Section 6C1-3 Engine Management – V6 – Service Operations. Was the repair completed?	Go to Step 10	—
10	1 Using Tech 2, clear the DTCs. 2 Switch off the ignition for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the conditions for running the DTC. Does DTC P0850 fail this ignition cycle?	Go to Step 2	Go to Step 11
11	Using Tech 2, select the DTC display function. Does Tech 2 display any DTCs?	Go to the appropriate DTC Table in this Section	System OK
When all diagnosis and repairs are completed, check the system for correct operation.			

6.45 DTC P0864

DTC Descriptor

This diagnostic procedure supports the DTC P0864 TCM Communication Circuit Performance

Circuit Description

The transmission control module (TCM) sends vehicle speed data to the engine control module (ECM). The data is sent to the ECM through a communication network called the GM local area network (LAN). Two circuits are used to communicate LAN data between the ECM and TCM. A fault in the LAN will not cause DTC P0864 to set by itself. If a LAN fault occurs, other DTCs will set in addition to DTC P0864.

If the ECM receives invalid vehicle speed data from the TCM, this DTC sets.

Conditions for Running the DTC

- The ignition is on for more than 3 seconds.
- The ignition voltage is between 10.5 – 18 volts.
- No other LAN errors are present.
- DTC P0864 runs continuously once the above conditions are met for more than 2.5 seconds.

Conditions for Setting the DTC

- The ECM receives no valid vehicle speed data from the TCM for more than 4 seconds.

Action Taken When the DTC Sets

- The control module stores the DTC information into memory when the diagnostic runs and fails.
- The Check Powertrain icon, or the malfunction indicator lamp (MIL) will not illuminate.
- The control module records the operating conditions at the time the diagnostic fails. The control module stores this information in the Failure Records.

Conditions for Clearing the DTC

- A current DTC Last Test Failed clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other non-emission related diagnostic.
- Use Tech 2 to clear the DTC.

Additional Information

- Since fault condition in a wiring connector may trigger DTCs, always test the connectors related to this diagnostic procedure for shorted terminals or poor wiring connection before replacing any component. Refer to Section 12P Wiring Diagrams for information on electrical fault diagnosis.
- For an intermittent fault condition, refer to 4.2 Intermittent Fault Conditions in this Section.
- To assist diagnosis, refer to 2 Wiring Diagrams and Connector Charts in this Section for the system wiring diagram and connector charts.

DTC P0864 Diagnostic Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been performed?	Go to Step 2	Refer to 3.4 Diagnostic System Check
2	1 Ignition ON, engine OFF. **NOTE** Record all Failure Records before clearing the DTC. Using Clear Info erases the Failure Records from the engine control module (ECM) and transmission control module (TCM). 2 Record the DTC Freeze Frame / Failure Records. Did you record any TCM Freeze Frame / Failure Records?	Go to Diagnostic Trouble Code (DTC) List – Vehicle in 0D Vehicle Diagnostics	Go to Step 3
3	1 Use Tech 2 to clear the DTC. 2 Turn the ignition off for at least 30 seconds. 3 Start engine and allow to idle. Did DTC P0864 reset?	Go to Step 4	Go to 4.2 Intermittent Fault Conditions.
4	Did any TCM DTCs or any other "U" DTC also set?	Go to Diagnostic Trouble Code (DTC) List – Vehicle in 0D Vehicle Diagnostics	Go to Step 5
5	1 Test the LAN circuits in the wiring harness between TCM and the ECM for a high resistance, or for a poor connection at the module connectors, refer to Section 12P Wiring Diagrams. Did you find and correct the condition?	Go to Step 7	Go to Step 6
6	1 Replace the ECM. Refer to Section 6C1-3 Engine Management –V6 – Service Operations for details on replacing the ECM. Did you complete the replacement?	Go to Step 7	—
7	1 Use Tech 2 to clear the DTCs. 2 Ignition OFF for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame / Failure Records. Does DTC P0864 fail this ignition cycle?	Go to Step 2	Go to Step 8
8	1 Using Tech 2, select the DTC display function. Does Tech 2 display any DTCs?	Go to the appropriate DTC Table in this Section	System OK
When all diagnosis and repairs are completed, clear all DTCs and verify correct operation			

6.46 DTC P1648

DTC Descriptor

This diagnostic procedure supports DTC P1648 – Wrong Security Code Entered.

Circuit Description

Tech 2 is used to program the engine control module (ECM). Before any programming, a security code must be entered into Tech 2. The ECM will check if the code entered is correct before continuing. If the security code is incorrect, DTC P1648 sets.

Conditions for Running the DTC

Conditions for running the DTC are:

- The ignition is switched on.
- The ignition voltage is 10.0 – 16.0 V.

Conditions for Setting the DTC

An incorrect security code is entered into Tech 2 when attempting to program the ECM.

Action Taken When the DTC Sets

When the DTC sets, the Check Powertrain icon, or the malfunction indicator lamp (MIL) is not displayed.

Conditions for Clearing the DTC

The immobiliser security code is a Type ‘C’ DTC. Refer to 1.4 Diagnostic Trouble Codes in this Section for action taken when a Type ‘C’ DTC sets and conditions for clearing Type ‘C’ DTCs.

Additional Information

- Refer to Section 6C1-1 Engine Management –V6 – General Information for details of the ECM operation.
- Refer to Section 6C1-3 Engine Management –V6 – Service Operations for details on resetting the ECM.
- Since fault condition in a wiring connector may trigger DTCs, always test the connectors related to this diagnostic procedure for shorted terminals or poor wiring connection before replacing any component. Refer to Section 12P Wiring Diagrams for information on electrical fault diagnosis.
- For an intermittent fault condition, refer to 4.2 Intermittent Fault Conditions in this Section.
- To assist diagnosis, refer to 2 Wiring Diagrams and Connector Charts in this Section for the system wiring diagram and connector charts.

Test Description

The following numbers refer to the step numbers in the diagnostic table:

4 This step tests the ECM ground circuits and supply voltage.

DTC P1648 Diagnostic Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been performed?	Go to Step 2	Refer to 3.4 Diagnostic System Check
2	1 Switch off the ignition for 30 seconds. 2 Using Tech 2, select the DTC display function. **NOTE** Do not attempt to perform any Tech 2 function that requires the ECM security code to be entered. Does DTC P1648 fail this ignition cycle?	Go to Step 4	Go to Step 3
3	Using Tech 2, attempt a programming function that requires the ECM security code to be entered. Refer to Section 6C1-3 Engine Management –V6 – Service Operations for details on resetting the ECM. Has the programming function been successfully performed?	System OK	Go to Step 4
4	1 Test all ECM ground circuits for a high resistance or an open circuit fault condition. Refer to Section 12P Wiring Diagrams for information on electrical fault diagnosis. 2 Test the ECM ignition supply voltage circuit for a high resistance, open circuit or short to ground fault condition. Refer to 12P Wiring Diagrams for information on electrical fault diagnosis. Has any fault been found and rectified?	Go to Step 6	Go to Step 5
5	Replace the ECM. Refer to Section 6C1-3 Engine Management –V6 – Service Operations for details on replacing the ECM. Has the repair been completed?	Go to Step 6	—
6	1 Using Tech 2, clear the DTCs. 2 Switch off the ignition for 30 seconds. Does DTC P1648 fail this ignition cycle?	Go to Step 2	Go to Step 7
7	Using Tech 2, select the DTC display function. Does Tech 2 display any DTCs?	Go to the appropriate DTC Table in this Section	System OK
When all diagnosis and repairs are completed, clear all DTCs and check the system for correct operation.			

6.47 DTC P1668, P2500 or P2501

DTC Descriptors

This diagnostic procedure supports the following DTCs:

- DTC P1668 – Generator L Terminal Circuit Malfunction
- DTC P2500 – Generator L Terminal Low Voltage
- DTC P2501 – Generator L Terminal High Voltage

Circuit Description

The engine control module (ECM) applies a signal voltage to the Generator L (GEN L) terminal circuit to control the load of the generator on the engine. Refer to Section 6D1-1 Charging System for details of the charging system operation.

A GEN L terminal circuit DTC sets if the ECM detects the Gen L circuit voltage is outside the specified range for a predetermined set of parameters.

Conditions for Running the DTC

DTC P1668

Runs continuously when one of the following conditions are met:

- Ignition on Test – The ignition is switched on with the engine not running for 5 seconds.
- Engine Run Test – The engine is running at speed less than 3,000 rpm

DTC P2500

Runs continuously when the following conditions are met:

- There is no generator, CKP sensor or CMP sensor DTC set.
- The engine is running.
- The generator is not commanded off.

DTC P2501

Runs continuously when the following conditions are met:

- There is no generator, CKP sensor or CMP sensor DTC set.
- The ignition is switched on with the engine not running.

Conditions for Setting the DTC

DTC P1668

- Ignition on Test – the ECM detects a high signal voltage on the Gen L for 5 seconds.
- Engine Run Test – the ECM detects a low signal voltage on the Gen L for 5 seconds.

DTC P2500

The ECM detects a low signal voltage on the Gen L for 15 seconds.

DTC P2501

The ECM detects a high signal voltage on the Gen L for 5 seconds.

Conditions for Clearing DTC

The Generator L-terminal circuit are Type C DTCs. Refer to 1.4 Diagnostic Trouble Codes in this Section for action taken when a Type C DTC sets and conditions for clearing Type C DTCs.

Additional Information

- For an intermittent fault condition, refer to 4.2 Intermittent Fault Conditions in this Section.
- Refer to Section 6C1-1 Engine Management – V6 – General Information for details of the ECM operation.
- Refer to Section 6D1-1 Charging System – V6 for details of the charging system operation.
- Since fault condition in a wiring connector may trigger DTCs, always test the connectors related to this diagnostic procedure for shorted terminals or poor wiring connection before replacing any component. Refer to Section 12P Wiring Diagrams for information on electrical fault diagnosis.
- To assist diagnosis, refer to 2 Wiring Diagrams and Connector Charts in this Section for the system wiring diagram and connector charts.

DTC P1668, P2500 or P2501 Diagnostic Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been performed?	Go to Step 2	Refer to 3.4 Diagnostic System Check
2	1 Switch off the ignition for 30 seconds. 2 Operate the vehicle within the conditions for running the DTC. 3 Using Tech 2, select the DTC display function. Does DTC P1668, P2500 or P2501 fail this ignition cycle?	Go to Step 3	Refer to Additional Information in this DTC
3	Test the charging system for any fault condition that may cause incorrect generator operation. Refer to Section 6D1-1 Charging System – V6. Was any fault found and rectified?	Go to Step 6	Go to Step 4
4	Test the Gen L signal circuit for a high resistance, open circuit, short to ground or short to voltage fault condition. Refer to Section 12P Wiring Diagrams for information on electrical fault diagnosis. Was any fault found and rectified?	Go to Step 6	Go to Step 5
5	Replace the ECM. Refer to Section 6C1-3 Engine Management – V6 – Service Operations. Was the repair completed?	Go to Step 6	—
6	1 Using Tech 2, clear the DTCs. 2 Switch off the ignition for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the conditions for running the DTC. Does any of the Generator L terminal circuit DTCs fail this ignition cycle?	Go to Step 2	Go to Step 7
7	Using Tech 2, select the DTC display function. Does Tech 2 display any DTCs?	Go to the appropriate DTC Table in this Section	System OK
When all diagnosis and repairs are completed, check the system for correct operation.			

6.48 DTC P1845

DTC Descriptor

This diagnostic procedure supports DTC P1845 – Engine Torque Reduction Malfunction

Circuit Description

The ECM monitors and compares the engine torque output against the maximum allowable engine torque. Refer to Section 6C1-1 Engine Management – V6 – General Information for details of the engine torque limit management operation.

If the requested torque is higher than the maximum allowable torque, the ECM applies engine torque limitation and DTC P1845 – Engine Torque Reduction Malfunction sets.

Conditions for Running the DTC

DTC P1845 runs continuously when the engine is running at speeds greater than 40 rpm.

Conditions for Setting the DTC

The engine torque output exceeds the maximum allowable torque output for 10 minutes.

Conditions for Clearing the DTC

DTC P1845 – Engine Torque Reduction Malfunction is a Type ‘C’ DTC. Refer to 1.4 Diagnostic Trouble Codes in this Section for action taken when a Type ‘C’ DTC sets and conditions for clearing Type ‘C’ DTC.

Additional Information

- Refer to Section 6C1-1 Engine Management – V6 – General Information for details of the Engine Torque Limit Management operation.
- For an intermittent fault condition, refer to 4.2 Intermittent Fault Conditions in this Section.
- Since fault condition in a wiring connector may trigger DTCs, always test the connectors related to this diagnostic procedure for shorted terminals or poor wiring connection before replacing any component. Refer to Section 12P Wiring Diagrams for information on electrical fault diagnosis.
- To assist diagnosis, refer to 2 Wiring Diagrams and Connector Charts in this Section for the system wiring diagram and connector charts.

Test Description

The following number refers to the step number in the diagnostic table:

4 Fault conditions that apply excessive load on the engine may trigger this DTC.

DTC P1845 Diagnostic Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been performed?	Go to Step 2	Refer to 3.4 Diagnostic System Check
2	1 Switch off the ignition for 30 seconds. 2 Operate the vehicle within the conditions for running the DTC or road test the vehicle under various driving condition. 3 Using Tech 2, select the DTC display function. Does DTC P1845 fail this ignition cycle?	Go to Step 3	Refer to Additional Information in this DTC
3	Are there any other ECM or TCM DTCs set?	Go to the appropriate DTC Table in this Section	Go to Step 4
4	Inspect for fault conditions in the engine or transmission that applies excessive load on the engine. Was any fault found and rectified?	Go to Step 6	Go to Step 5
5	Replace the ECM. Refer to Section 6C1-3 Engine Management – V6 – Service Operations. Was the repair completed?	Go to Step 6	—
6	1 Using Tech 2, clear the DTCs. 2 Switch off the ignition for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the conditions for running the DTC. Does DTC P1845 fail this ignition cycle?	Go to Step 2	Go to Step 7
7	Using Tech 2, select the DTC display function. Does Tech 2 display any DTCs?	Go to the appropriate DTC Table in this Section	System OK
When all diagnosis and repairs are completed, check the system for correct operation.			

6.49 DTC P2008, P2009 or P2010

DTC Descriptor

This diagnostic procedure supports the following DTCs:

- DTC P2008 – Intake Manifold Runner Control Solenoid Circuit Malfunction
- DTC P2009 – Intake Manifold Runner Control Solenoid Circuit Low Voltage
- DTC P2010 – Intake Manifold Runner Control Solenoid Circuit High Voltage

Circuit Description

The engine control relay applies ignition positive battery voltage to the intake manifold runner control (IMRC) solenoid through the ignition voltage circuit.

Using a device called a driver, the ECM applies a pulse width modulated (PWM) ground to the IMRC solenoid control circuit to alter the length and volume of the intake manifold runners.

The driver has a feedback circuit that is pulled-up to a voltage. The ECM monitors the driver feedback circuit to determine if the control circuit is open, shorted to ground or shorted to a positive voltage.

An IMRC solenoid circuit DTC sets if the ECM detects the voltage on the IMRC solenoid control circuit outside the predetermined range when the solenoid is commanded OFF.

Conditions for Running the DTC

Each DTC runs continuously once the following conditions are met:

- The engine speed is greater than 80 rpm
- The ignition voltage is 10.0 – 16.0 V.
- The ECM has commanded the IMRC Solenoid ON and OFF at least once during the ignition cycle.

Conditions for Setting the DTC

DTC P2008

The ECM detects the voltage on the IMRC solenoid control circuit is between 2.6 – 4.6 V when the solenoid is commanded off.

DTC P2009

The ECM detects the voltage on the IMRC solenoid control circuit is less than 2.6 V when the solenoid is commanded off.

DTC P2010

The ECM detects the voltage on the IMRC solenoid control circuit is greater than 4.6 V when the solenoid is commanded ON.

Conditions for Clearing the DTC

The IMRC solenoid control circuit DTCs are Type ‘C’ DTCs. Refer to 1.4 Diagnostic Trouble Codes in this Section for action taken when a Type ‘C’ DTC sets and conditions for clearing Type ‘C’ DTCs.

Additional Information

- Refer to Section 6C1-1 Engine Management – V6 – General Information for details of the IMRC solenoid operation.
- For an intermittent fault condition, refer to 4.2 Intermittent Fault Conditions in this Section.
- Since a fault condition in a wiring connector may trigger DTCs, always test the connectors related to this diagnostic procedure for shorted terminals or poor wiring connection before replacing any component. Refer to Section 12P Wiring Diagrams for information on electrical fault diagnosis.
- To assist diagnosis, refer to 2 Wiring Diagrams and Connector Charts in this Section for the system wiring diagram and connector charts.

Test Description

The following number refers to the step number in the diagnostic table:

4 Tests the feedback voltage from the ECM.

DTC P2008, P2009 or P2010 Diagnostic Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been performed?	Go to Step 2	Refer to 3.4 Diagnostic System Check
2	1 Switch off the ignition for 30 seconds. 2 Operate the vehicle within the conditions for running the DTC. 3 Using Tech 2, select the DTC display function. Does DTC P2008, P2009 or P2010 fail this ignition cycle?	Go to Step 3	Refer to Additional Information in this DTC
3	1 Disconnect the IMRC solenoid wiring connector. 2 Ignition ON, engine OFF. 3 Connect a test lamp between the IMRC solenoid ignition voltage circuit and the ECM housing. Does the test lamp illuminate?	Go to Step 4	Go to Step 5
4	1 Ignition ON, engine OFF. 2 Using a DMM, measure the voltage between the IMRC solenoid control circuit and the ECM housing. Does the multimeter display 2.6 – 4.6 V?	Go to Step 7	Go to Step 6
5	Repair the high resistance, open circuit or short to ground fault condition at the IMRC solenoid ignition voltage circuit. Refer to Section 12P Wiring Diagrams for information on electrical wiring repair procedures Was the repair completed?	Go to Step 9	—
6	Test the control circuit of the IMRC solenoid for a high resistance, open circuit, short to ground or short to voltage fault condition. Refer to Section 12P Wiring Diagrams for information on electrical fault diagnosis. Was any fault found and rectified?	Go to Step 9	Go to Step 8
7	Replace the IMRC solenoid. Refer to Section 6C1-3 Engine Management – V6 – Service Operations. Was the repair completed?	Go to Step 9	—
8	Replace the ECM. Refer to Section 6C1-3 Engine Management – V6 – Service Operations. Was the repair completed?	Go to Step 9	—
9	1 Using Tech 2, clear the DTCs. 2 Switch off the ignition for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the conditions for running the DTC. Does any of the IMRC solenoid control circuit DTCs fail this ignition cycle?	Go to Step 2	Go to Step 10
10	Using Tech 2, select the DTC display function. Does Tech 2 display any DTCs?	Go to the appropriate DTC Table in this Section	System OK
When all diagnosis and repairs are completed, check the system for correct operation.			

6.50 DTC P2096 or P2098

DTC Descriptors

This diagnostic procedure supports the following DTCs:

- DTC P2096 Post Catalyst O2 Sensor Fuel Trim Below Lower Limit (Bank 1)
- DTC P2098 Post Catalyst O2 Sensor Fuel Trim Below Lower Limit (Bank 2)

Circuit Description

The wide band heated oxygen sensor 1 measures the amount of oxygen in the exhaust system and provides more information than the switching style HO2S2. The wide band sensor consists of an oxygen sensing cell, an oxygen pumping cell, and a heater. The exhaust gas sample passes through a diffusion gap between the sensing cell and the pumping cell. The engine control module (ECM) supplies a voltage to the HO2S and uses this voltage as a reference to the amount of oxygen in the exhaust system. An electronic circuit within the ECM controls the pump current through the oxygen pumping cell, maintaining a constant voltage in the oxygen sensing cell. The ECM monitors the voltage variation in the sensing cell and attempts to keep the voltage constant by increasing or decreasing the amount of current flow, or oxygen ion flow, to the pumping cell. By measuring the amount of current required to maintain the voltage in the sensing cell, the ECM can determine the concentration of oxygen in the exhaust. The HO2S voltage is displayed as a lambda value. A lambda value of 1 is equal to a stoichiometric air fuel ratio of 14.7:1. Under normal operating conditions, the lambda value will remain around 1. When the fuel system is lean, the oxygen level will be high and the lambda signal will be high or more than 1. When the fuel system is rich, the oxygen level will be low, and the lambda signal will be low or less than 1. The ECM uses this information to maintain the correct air / fuel ratio.

Fuel trim biasing is used by the ECM to keep the post catalyst HO2S voltage within a range of 580 – 665 mV as possible. This allows optimal catalyst efficiency under light load conditions, such as at idle or a steady cruise. The ECM constantly monitors how lean or rich the fuel trim bias is commanded. If the ECM detects that the fuel trim bias is commanded lean for more than a calibrated amount, DTC P2096 or P2098 sets.

Conditions for Running the DTC

- Before the ECM can report DTC P2096 or P2098 failed, DTCs P0030, P0031, P0032, P0041, P0050, P0051, P0052, P0101, P0131, P0132, P0135, P0137, P0138, P0140, P0141, P0151, P0152, P0155, P0157, P0158, P0160, P0161, P2231, P2234, P2237, P2240, P2243, P2247, P2251, P2254, P2270, P2271, P2273, P2626, and P2629 must run and pass.
- The engine is operating for more than 2 seconds.
- The post catalyst fuel trim control is enabled.
- The front and rear HO2S are in Closed Loop.
- DTCs P2096and P2098 run continuously once the above conditions are met for more than 40 seconds.

Conditions for Setting the DTC

The post catalyst fuel trim correction factor is biased lean by more than 3 percent of the HO2S lambda value for more than 4 seconds.

Action Taken When the DTC Sets

- The ECM activates the Check Powertrain icon, or the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
- The ECM records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

These post catalyst fuel trim system DTCs are Type ‘B’ DTCs. Refer to 1.4 Diagnostic Trouble Codes in this Section for action taken when a Type ‘C’ DTC sets and conditions for clearing Type ‘B’ DTCs.

Use Tech 2 to clear the Check Powertrain icon, or the MIL and the DTC.

Additional Information

- Refer to Section 6C1-1 Engine Management – V6 – General Information for details of the post catalyst oxygen sensor operation.
- For an intermittent fault condition, refer to 4.2 Intermittent Fault Conditions in this Section.
- Since a fault condition in a wiring connector may trigger DTCs, always test the connectors related to this diagnostic procedure for shorted terminals or poor wiring connection before replacing any component. Refer to Section 12P Wiring Diagrams for information on electrical fault diagnosis.
- To assist diagnosis, refer to 2 Wiring Diagrams and Connector Charts in this Section for the system wiring diagram and connector charts.
- The lower connector of the ECM is connector X1 and the upper connector of the ECM is connector X2. Refer to 2.2 Connector Chart in this Section for pin and circuit identification.

Test Description

The numbers below refer to the step numbers on the diagnostic table.

2 This step determines if a condition exists.

4 This step is testing for a rear HO2S sensor circuit condition. A circuit condition sets this DTC.

7 This step inspects for the rear sensors being connected to the correct bank of the engine. This condition causes this DTC to set.

8 This step is testing for an intermittent circuit condition. Thoroughly inspect the HO2S circuits for an intermittent circuit condition.

9 This step is testing for an intermittent circuit condition. Thoroughly inspect the HO2S circuits for an intermittent circuit condition.

DTC P2096 or P2098 Diagnostic Table

Step	Action	Value(s)	Yes	No
1	Has the Diagnostic System Check been completed?	—	Go to Step 2	Refer to 3.4 Diagnostic System Check
2	**WARNING** **Refer to 4.17 Road-testing, in 00 Warnings Cautions and Notes.** 1 Switch off the ignition for 30 seconds. **NOTE** The rear heated oxygen sensors (HO2S) must be in Closed Loop for this diagnostic to run. A road load condition is necessary to obtain Closed Loop. 2 Operate the vehicle within the conditions for running the DTC. 3 Using Tech 2, select the DTC display function. Does DTC P2096 or P2098 fail this ignition cycle?	—	Go to Step 3	Refer to Additional Information in this DTC
3	Is DTC P0041, P0137, P0138, P0140, P0157, P0158, or P0160 also set?	—	Go to the appropriate DTC Table in this Section	Go to Step 4

4	1 Operate the engine above 1,200 rpm for 30 seconds. 2 Use Tech 2 to observe appropriate rear heated oxygen sensor (HO2S) voltage Is the voltage more or less than the specified value?	60 mV	Go to Step 7	Go to Step 5
5	1 Turn OFF the ignition. 2 Disconnect the appropriate HO2S. 3 Ignition ON, engine OFF. 4 Use Tech 2 to observe the oxygen sensor (HO2S) voltage parameter. Is the voltage within the specified range?	350 – 550 mV	Go to Step 12	Go to Step 6
6	1 Test the appropriate HO2S signal circuit for a short to ground. Refer to Section 12P Wiring Diagrams. Did you find and correct the condition?	—	Go to Step 19	Go to Step 14
7	1 Inspect the rear HO2S for being connected to the correct bank of the engine. If the sensors are connected to the incorrect bank, swap the connectors as necessary. Did you find and correct the condition?	—	Go to Step 19	Go to Step 8
8	1 Shake the related HO2S harnesses for the front sensor between the HO2S harness connector and the engine control module (ECM) while monitoring the appropriate HO2S lambda parameter. Does the HO2S parameter change abruptly while moving the related harnesses?	—	Go to Step 15	Go to Step 9
9	1 Shake the related HO2S harnesses for the rear sensor between the HO2S harness connector and the ECM while monitoring the appropriate HO2S voltage parameter. Does the HO2S parameter change abruptly while moving the related harnesses?	—	Go to Step 15	Go to Step 10
10	1 Ignition OFF. 2 Disconnect the front and rear HO2S. 3 Inspect the front and rear HO2S for the following conditions: – Damaged wiring between the HO2S and the ECM – An intermittent circuit condition causes this DTC to set. – Terminal corrosion or water intrusion in the HO2S harness connectors. – The correct terminal tension. – The HO2S is securely installed. – Any exhaust leaks – Refer to Section 8B Exhaust System. 4 Repair as necessary. Refer to Section 12P Wiring Diagrams. Did you find and correct the condition?	—	Go to Step 19	Go to Step 11

11	1 Disconnect the ECM. 2 Test the appropriate front HO2S circuits for being shorted together between the HO2S connector and the ECM. Refer to Section 12P Wiring Diagrams. Did you find and correct the condition?	—	Go to Step 19	Go to Step 13
12	1 Test for shorted terminals and for poor connections at the HO2S. Refer to Section 12P Wiring Diagrams. Did you find and correct the condition?	—	Go to Step 19	Go to Step 17
13	1 Test for shorted terminals and for poor connections at the ECM. Refer to Section 12P Wiring Diagrams. Did you find and correct the condition?	—	Go to Step 19	Go to Step 16
14	1 Test for shorted terminals and for poor connections at the ECM. Refer to Section 12P Wiring Diagrams. Did you find and correct the condition?	—	Go to Step 19	Go to Step 18
15	1 Repair the circuit as necessary. Refer to Section 12P Wiring Diagrams. Did you complete the repair?	—	Go to Step 19	—
16	1 Replace the appropriate HO2S. Refer to the Oxygen Sensor 1 procedure, in Section 6C1-3 Service Operations. Did you complete the replacement?	—	Go to Step 19	—
17	1 Replace the appropriate HO2S. Refer to the Oxygen Sensor 2 procedure, in Section 6C1-3 Service Operations. Did you complete the replacement?	—	Go to Step 19	—
18	1 Replace the ECM. Refer to Engine Control Module (ECM) Remove, Reinstall and ECM Reset in Section 6C1-3 Service Operations. Did you complete the replacement?	—	Go to Step 19	—
19	1 Using Tech 2, clear the DTCs. 2 Switch off the ignition for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the conditions for running the DTC. Does DTC P2096 or P2098 fail this ignition cycle?	—	Go to Step 2	Go to Step 20
20	Using Tech 2, select the DTC display function. Does Tech 2 display any DTCs?	—	Go to the appropriate DTC Table in this Section	System OK
When all diagnosis and repairs are completed, clear all DTCs and verify correct operation				

6.51 DTC P2097 or P2099

DTC Descriptors

This diagnostic procedure supports the following DTCs:

- DTC P2097 Post Catalyst O2 Sensor Fuel Trim Above Upper Limit (Bank 1)
- DTC P2099 Post Catalyst O2 Sensor Fuel Trim Above Upper Limit (Bank 2)

Circuit Description

The wide band heated oxygen sensor 1 measures the amount of oxygen in the exhaust system and provides more information than the switching style HO2S2. The wide band sensor consists of an oxygen sensing cell, an oxygen pumping cell, and a heater. The exhaust gas sample passes through a diffusion gap between the sensing cell and the pumping cell. The engine control module (ECM) supplies a voltage to the HO2S and uses this voltage as a reference to the amount of oxygen in the exhaust system. An electronic circuit within the ECM controls the pump current through the oxygen pumping cell, maintaining a constant voltage in the oxygen sensing cell. The ECM monitors the voltage variation in the sensing cell and attempts to keep the voltage constant by increasing or decreasing the amount of current flow, or oxygen ion flow, to the pumping cell. By measuring the amount of current required to maintain the voltage in the sensing cell, the ECM can determine the concentration of oxygen in the exhaust. The HO2S voltage is displayed as a lambda value. A lambda value of 1 is equal to a stoichiometric air fuel ratio of 14.7:1. Under normal operating conditions, the lambda value will remain around 1. When the fuel system is lean, the oxygen level will be high and the lambda signal will be high or more than 1. When the fuel system is rich, the oxygen level will be low, and the lambda signal will be low or less than 1. The ECM uses this information to maintain the correct air / fuel ratio.

Fuel trim biasing is used by the ECM to keep the post catalyst HO2S voltage within a range of 580 – 665 mV as possible. This allows optimal catalyst efficiency under light load conditions, such as at idle or a steady cruise. The ECM constantly monitors how lean or rich the fuel trim bias is commanded. If the ECM detects that the fuel trim bias is commanded rich for more than a calibrated amount, DTC P2097 or P2099 sets.

Conditions for Running the DTC

- Before the ECM can report DTC P2096 or P2098 failed, DTCs P0030, P0031, P0032, P0041, P0050, P0051, P0052, P0101, P0131, P0132, P0135, P0137, P0138, P0140, P0141, P0151, P0152, P0155, P0157, P0158, P0160, P0161, P2231, P2234, P2237, P2240, P2243, P2247, P2251, P2254, P2270, P2271, P2273, P2626, and P2629 must run and pass.
- The engine is operating for more than 2 seconds.
- The post catalyst fuel trim control is enabled.
- The front and rear HO2S are in Closed Loop.
- DTCs P2097 and P2099 run continuously once the above conditions are met for more than 40 seconds.

Conditions for Setting the DTC

The post catalyst fuel trim correction factor is biased rich by more than –3 percent of the HO2S lambda value for more than 4 seconds.

Action Taken When the DTC Sets

- The ECM activates the Check Powertrain icon, or the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
- The ECM records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

These post catalyst fuel trim system DTCs are Type ‘B’ DTCs. Refer to 1.4 Diagnostic Trouble Codes in this Section for action taken when a Type ‘C’ DTC sets and conditions for clearing Type ‘B’ DTCs.

Use Tech 2 to clear the Check Powertrain icon, or the MIL and the DTC.

Additional Information

- Refer to Section 6C1-1 Engine Management – V6 – General Information for details of the post catalyst oxygen sensor operation.
- For an intermittent fault condition, refer to 4.2 Intermittent Fault Conditions in this Section.
- Since a fault condition in a wiring connector may trigger DTCs, always test the connectors related to this diagnostic procedure for shorted terminals or poor wiring connection before replacing any component. Refer to Section 12P Wiring Diagrams for information on electrical fault diagnosis.
- To assist diagnosis, refer to 2 Wiring Diagrams and Connector Charts in this Section for the system wiring diagram and connector charts.
- The lower connector of the ECM is connector X1 and the upper connector of the ECM is connector X2. Refer to 2.2 Connector Chart in this Section for pin and circuit identification.

Test Description

The numbers below refer to the step numbers on the diagnostic table.

2 This step determines if a condition exists.

4 This step is testing for a rear HO2S sensor circuit condition. A circuit condition sets this DTC.

7 This step inspects for the rear sensors being connected to the correct bank of the engine. This condition causes this DTC to set.

8 This step is testing for an intermittent circuit condition. Thoroughly inspect the HO2S circuits for an intermittent circuit condition.

9 This step is testing for an intermittent circuit condition. Thoroughly inspect the HO2S circuits for an intermittent circuit condition.

DTC P2096 or P2098 Diagnostic Table

Step	Action	Value(s)	Yes	No
1	Has the Diagnostic System Check been completed?	—	Go to Step 2	Refer to 3.4 Diagnostic System Check
2	**WARNING** **Refer to 4.17 Road-testing, in 00 Warnings Cautions and Notes.** 1 Switch off the ignition for 30 seconds. **NOTE** The rear heated oxygen sensors (HO2S) must be in Closed Loop for this diagnostic to run. A road load condition is necessary to obtain Closed Loop. 2 Operate the vehicle within the conditions for running the DTC. 3 Using Tech 2, select the DTC display function. Does DTC P2097 or P2099 fail this ignition cycle?	—	Go to Step 3	Refer to Additional Information in this DTC
3	Is DTC P0041, P0137, P0138, P0140, P0157, P0158, or P0160 also set?	—	Go to the appropriate DTC Table in this Section	Go to Step 4

4	1 Operate the engine above 1,200 rpm for 30 seconds. 2 Use Tech 2 to observe appropriate rear heated oxygen sensor (HO2S) voltage. Is the voltage less than the specified value?	1,050 mV	Go to Step 7	Go to Step 5
5	1 Ignition OFF. 2 Disconnect the appropriate HO2S. 3 Ignition ON, engine OFF. 4 Use Tech 2 to observe the oxygen sensor (HO2S) voltage parameter. Is the voltage within the specified range?	350 – 550 mV	Go to Step 12	Go to Step 6
6	1 Test the appropriate HO2S signal circuit for a short to voltage. Refer to Section 12P Wiring Diagrams. Did you find and correct the condition?	—	Go to Step 19	Go to Step 14
7	1 Inspect the rear HO2S for being connected to the correct bank of the engine. If the sensors are connected to the incorrect bank, swap the connectors as necessary. Did you find and correct the condition?	—	Go to Step 19	Go to Step 8
8	1 Shake the related HO2S harnesses for the front sensor between the HO2S harness connector and the engine control module (ECM) while monitoring the appropriate HO2S lambda parameter. Does the HO2S parameter change abruptly while moving the related harnesses?	—	Go to Step 15	Go to Step 9
9	1 Shake the related HO2S harnesses for the rear sensor between the HO2S harness connector and the ECM while monitoring the appropriate HO2S voltage parameter. Does the HO2S parameter change abruptly while moving the related harnesses?	—	Go to Step 15	Go to Step 10
10	1 Ignition OFF. 2 Disconnect the front and rear HO2S. 3 Inspect the front and rear HO2S for the following conditions: – Damaged wiring between the HO2S and the ECM. An intermittent circuit condition causes this DTC to set. – Terminal corrosion or water intrusion in the HO2S harness connectors. – The correct terminal tension. – The HO2S is securely installed. – Any exhaust leaks. Refer to Section 8B Exhaust System. 4 Repair as necessary. Refer to Section 12P Wiring Diagrams. Did you find and correct the condition?	—	Go to Step 19	Go to Step 11

11	1 Disconnect the ECM. 2 Test the appropriate front HO2S circuits for being shorted together between the HO2S connector and the ECM. Refer to Section 12P Wiring Diagrams. Did you find and correct the condition?	—	Go to Step 19	Go to Step 13
12	1 Test for shorted terminals and for poor connections at the ECM. Refer to Section 12P Wiring Diagrams. Did you find and correct the condition?	—	Go to Step 19	Go to Step 17
13	1 Test for shorted terminals and for poor connections at the ECM. Refer to Section 12P Wiring Diagrams. Did you find and correct the condition?	—	Go to Step 19	Go to Step 16
14	1 Test for shorted terminals and for poor connections at the ECM. Refer to Section 12P Wiring Diagrams. Did you find and correct the condition?	—	Go to Step 19	Go to Step 18
15	1 Repair the circuit as necessary. Refer to Section 12P Wiring Diagrams. Did you complete the repair?	—	Go to Step 19	—
16	1 Replace the appropriate HO2S. Refer to the Oxygen Sensor 1 procedure, in Section 6C1-3 Service Operations. Did you complete the replacement?	—	Go to Step 19	—
17	1 Replace the appropriate HO2S. Refer to the Oxygen Sensor 2 procedure, in Section 6C1-3 Service Operations. Did you complete the replacement?	—	Go to Step 19	—
18	1 Replace the ECM. Refer to Engine Control Module (ECM) Remove, Reinstall and ECM Reset in Section 6C1-3 Service Operations. Did you complete the replacement?	—	Go to Step 19	—
19	1 Using Tech 2, clear the DTCs. 2 Switch off the ignition for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the conditions for running the DTC. Does DTC P2097 or P2099 fail this ignition cycle?	—	Go to Step 2	Go to Step 20
20	Using Tech 2, select the DTC display function. Does Tech 2 display any DTCs?	—	Go to the appropriate DTC Table in this Section	System OK
When all diagnosis and repairs are completed, clear all DTCs and verify correct operation				

6.52 DTC P2105

DTC Descriptor

This diagnostic procedure supports DTC P2105 – Throttle Control Forced Engine Shutdown.

Circuit Description

The ECM monitors and evaluates the accelerator pedal position (APP) sensors signal voltage along with other sensor inputs to determine the desired throttle opening. To control the throttle plate movement, the ECM applies a pulse width modulated (PWM) signal voltage to the throttle actuator motor through the throttle actuator motor control circuits.

- At engine idle speed or when no current is flowing into the throttle actuator control (TAC) motor, a constant force return spring holds the throttle plate at a constant seven percent throttle opening position.
- To control the throttle opening, the ECM applies PWM voltage to the TAC motor. The ECM increases this PWM voltage duty cycle to increase the throttle opening.

To decrease the throttle opening from the seven percent rest position, the ECM reverses the polarity of the TAC motor control circuit then applies a PWM voltage to the TAC motor.

The ECM monitors the ignition supply voltage to ensure the correct operation of the engine management components and sensors. DTC P2105 sets if the ECM detects an incorrect ignition voltage.

Conditions for Running the DTC

DTC P2105 runs continuously when the ECM completed the power-down process in the last ignition cycle.

Conditions for Setting the DTC

The ECM detects an incorrect voltage level at the ignition supply circuits.

Conditions for Clearing the DTC

DTC P2105 – Throttle Actuator Control (TAC) Module Internal Circuit is a Type A DTC. Refer to 1.4 Diagnostic Trouble Codes in this Section for action taken when a Type A DTC sets and conditions for clearing Type A DTC.

Additional Information

- Refer to Section 6C1-1 Engine Management – V6 – General Information for details of the TP actuator operation.
- Since fault condition in a wiring connector may trigger DTCs, always test the connectors related to this diagnostic procedure for shorted terminals or poor wiring connection before replacing any component. Refer to Section 12P Wiring Diagrams for information on electrical fault diagnosis.
- For an intermittent fault condition, refer to 4.2 Intermittent Fault Conditions in this Section.
- To assist diagnosis, refer to 2 Wiring Diagrams and Connector Charts in this Section for the system wiring diagram and connector charts.

DTC P2105 Diagnostic Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been performed?	Go to Step 2	Refer to 3.4 Diagnostic System Check
2	1 Switch off the ignition for 30 seconds. 2 Operate the vehicle within the conditions for running the DTC. 3 Using Tech 2, select the DTC display function. Does DTC P2105 fail this ignition cycle?	Go to Step 3	Refer to Additional Information in this DTC

Step	Action	Yes	No
3	1 Remove the ECM / TCM Fuse 32 from the engine compartment relay panel assembly. **NOTE** Voltage may be available at both terminals of Fuse 32 because of normal voltage feed back condition. Therefore, the fuse must be removed prior to testing. 2 Inspect the ECM / TCM Fuse 32 for an open circuit fault condition. Was any fault found and rectified?	Go to Step 7	Go to Step 4
4	1 Remove the engine control relay from the engine compartment relay panel assembly. 2 Test the ignition circuit of the ECM, from the fuse terminal to the Engine control relay for a high resistance, open circuit, short to ground or short to voltage fault condition. Refer to Section 12P Wiring Diagrams for information on electrical fault diagnosis. **NOTE** The engine control relay supplies ignition voltage to other components and sensors through the ECM ignition circuit. A fault condition in this ignition circuit may trigger DTCs on components or sensors connected to this circuit. Was any fault found and rectified?	Go to Step 7	Go to Step 5
5	Disconnect the vehicle side wiring connector of the ECM. Refer to Section 6C1-3 Engine Management – V6 – Service Operations. Test both ignition circuits of the ECM, from the fuse terminal to the ECM wiring connector for a high resistance, open circuit, short to ground or short to voltage fault condition. Refer to Section 12P Wiring Diagrams for information on electrical fault diagnosis. Was any fault found and rectified?	Go to Step 7	Go to Step 6
6	Replace the ECM. Refer to Section 6C1-3 Engine Management – V6 – Service Operations. Was the repair completed?	Go to Step 7	—
7	1 Using Tech 2, clear the DTCs. 2 Switch off the ignition for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the conditions for running the DTC. Does DTC P2105 fail this ignition cycle?	Go to Step 2	Go to Step 8
8	Using Tech 2, select the DTC display function. Does Tech 2 display any DTCs?	Go to the appropriate DTC Table in this Section	System OK
When all diagnosis and repairs are completed, check the system for correct operation.			

6.53 DTC P2107

DTC Descriptor

This diagnostic procedure supports DTC P2107 – Throttle Control Malfunction.

Circuit Description

The ECM applies 5 V to the throttle position (TP) sensor 1 through the 5 V reference circuit 2701 and the ground through the low reference circuit 2752. TP sensor 1 and TP sensor 2 share a common 5 V reference circuit and a common low reference circuit.

The TP sensor 1 and TP sensor 2 have individual signal circuits with opposite functionality. These signal circuits provide the ECM with a signal voltage that is proportional to the throttle plate movement.

- The TP sensor 1 signal voltage is less than 1 V when the throttle plate is in closed position, which increases to greater than 4 V when the throttle plate is moved to wide-open throttle.
- The TP sensor 2 signal voltage is greater than 4 V when the throttle plate is in closed position, which decreases to less than 1 V when the throttle plate is moved to wide-open throttle.

The ECM monitors and evaluates the accelerator pedal position (APP) sensors signal voltage along with other sensor inputs to determine the desired throttle opening. To control the throttle plate movement, the ECM applies a pulse width modulated (PWM) signal voltage to the throttle actuator motor through the throttle actuator motor control circuits.

- At engine idle speed or when no current is flowing into the throttle actuator control (TAC) motor, a constant force return spring holds the throttle plate at a constant seven percent throttle opening position.
- To control the throttle opening, the ECM applies PWM voltage to the TAC motor. The ECM increases this PWM voltage duty cycle to increase the throttle opening.

To decrease the throttle opening from the seven percent rest position, the ECM reverses the polarity of the TAC motor control circuit then applies a PWM voltage to the TAC motor.

If the ECM detects the TP sensor 1 amplification output does not correlate with the TP sensor 1 signal voltage during a predetermined sets of conditions, DTC P2107 sets.

Conditions for Running the DTC

DTC P2107 runs continuously once the following conditions are met:

- The vehicle speed is 0 km/h.
- The engine speed is less than 40 rpm
- The engine coolant temperature is 5 – 60° C.
- The intake air temperature is 5 – 60° C.
- The ignition voltage is greater than 10 V.
- The APP is less than 15 percent.
- The ECM is performing the closed throttle test with the ignition switched on and the engine not running.

Conditions for Setting the DTC

The ECM detects that its internal TP sensor 1 amplification output does not correlate with the TP sensor 1 signal voltage.

Conditions for Clearing the DTC

DTC P2107 – Throttle Actuator Control Module Internal Circuit is a Type ‘C’ DTC. Refer to 1.4 Diagnostic Trouble Codes in this Section for action taken when a Type ‘C’ DTC sets and conditions for clearing Type ‘C’ DTC.

Additional Information

- Refer to Section 6C1-1 Engine Management – V6 – General Information for details of the TP sensor operation.
- For an intermittent fault condition, refer to 4.2 Intermittent Fault Conditions in this Section.
- Since fault condition in a wiring connector may trigger DTCs, always test the connectors related to this diagnostic procedure for shorted terminals or poor wiring connection before replacing any component. Refer to Section 12P Wiring Diagrams for information on electrical fault diagnosis.
- To assist diagnosis, refer to 2 Wiring Diagrams and Connector Charts in this Section for the system wiring diagram and connector charts.

DTC P2107 Diagnostic Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been performed?	Go to Step 2	Refer to 3.4 Diagnostic System Check
2	1 Switch off the ignition for 30 seconds. 2 Operate the vehicle within the conditions for running the DTC. 3 Using Tech 2, select the DTC display function. Does DTC P2107 fail this ignition cycle?	Go to Step 3	Refer to Additional Information in this DTC
3	Replace the ECM. Refer to Section 6C1-3 Engine Management – V6 – Service Operations. Was the repair completed?	Go to Step 4	—
4	1 Using Tech 2, clear the DTCs. 2 Switch off the ignition for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the conditions for running the DTC. Does DTC P2107 fail this ignition cycle?	Go to Step 2	Go to Step 5
5	Using Tech 2, select the DTC display function. Does Tech 2 display any DTCs?	Go to the appropriate DTC Table in this Section	System OK
When all diagnosis and repairs are completed, check the system for correct operation.			

6.54 DTC P2122, P2123, P2127, P2128 or P2138

DTC Descriptors

This diagnostic procedure supports the following DTCs:

- DTC P2122 – Accelerator Pedal Position Sensor 1 Voltage Low
- DTC P2123 – Accelerator Pedal Position Sensor 1 Voltage High
- DTC P2127 – Accelerator Pedal Position Sensor 2 Voltage Low
- DTC P2128 – Accelerator Pedal Position Sensor 2 Voltage High
- DTC P2138 – Accelerator Pedal Position Sensor 1 – 2 Correlation

Circuit Description

The ECM applies a separate 5 V reference circuit and low reference circuit to the accelerator pedal position (APP) sensor 1 and sensor 2. The APP sensors produce a signal voltage that represents the accelerator pedal position.

- The APP sensor 1 signal voltage increases from 1 V at rest position to greater than 4 V when the accelerator pedal is fully depressed.
- The APP sensor 2 signal voltage increases from 0.5 V at rest position to greater than 2 V when the accelerator pedal is fully depressed.

The ECM monitors and evaluates the APP sensors signal voltage along with other sensor inputs to determine the desired throttle opening. An APP sensor circuit DTC sets if the signal voltage of the APP sensor is outside the predetermined range.

Conditions for Running the DTC

DTC P2122, P2123, P2127, P2128 and P2138 runs continuously once the following conditions are met:

- The ignition is switched on.
- The ignition voltage is greater than 7 V.

Conditions for Setting the DTC

DTC P2122

The ECM determines the APP sensor 1 signal voltage is less than 0.84 V.

DTC P2123

The ECM determines the APP sensor 1 signal voltage is greater than 4.82 V.

DTC P2127

The ECM determines the APP sensor 2 signal voltage is less than 0.66 V.

DTC P2128

The ECM determines the APP sensor 2 signal voltage is greater than 4.82 V.

DTC P2138

The ECM detects the difference between the APP sensor 1 and sensor 2 signal voltage is greater than the predetermined value.

Conditions for Clearing DTC

The APP sensor circuit DTCs are Type ‘A’ DTCs. Refer to 1.4 Diagnostic Trouble Codes in this Section for action taken when a Type ‘A’ DTC sets and conditions for clearing Type ‘A’ DTCs.

Additional Information

- Refer to Section 6C1-1 Engine Management – V6 – General Information for details of the APP sensor operation.
- For an intermittent fault condition, refer to 4.2 Intermittent Fault Conditions in this Section.
- Since fault condition in a wiring connector may trigger DTCs, always test the connectors related to this diagnostic procedure for shorted terminals or poor wiring connection before replacing any component. Refer to Section 12P Wiring Diagrams for information on electrical fault diagnosis.
- To assist diagnosis, refer to 2 Wiring Diagrams and Connector Charts in this Section for the system wiring diagram and connector charts.

Test Description

The following numbers refer to the step numbers in the diagnostic table:

2 Tests the APP sensor internal circuits throughout its range of motion. If the DTC fails while performing this test, there is an internal fault condition in the APP sensor internal circuitry.

5 Measures the integrity of the TP sensor low reference circuit. Removal of the ECM Fuse 29 enables the ECM to power down completely prior to the test procedure.

DTC P2122, P2123, P2127, P2128 or P2138 Diagnostic Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been performed?	Go to Step 2	Refer to 3.4 Diagnostic System Check
2	1 Switch off the ignition for 30 seconds. 2 Start the engine. 3 Quickly depress the accelerator pedal to wide-open throttle then release pedal. Repeat this procedure several times or operate the vehicle within the conditions for running the DTC. 4 Using Tech 2, select the DTC display function. Does DTC P2122, P2123, P2127, P2128 or P2138 fail this ignition cycle?	Go to Step 3	Refer to Additional Information in this DTC
3	1 Disconnect the APP sensor wiring connector. 2 Switch on the ignition with the engine not running. 3 Using a digital multimeter, measure the voltage between the 5 V reference circuit of the appropriate APP sensor and the ECM housing. Does the multimeter display 4.8 – 5.2 V?	Go to Step 4	Go to Step 6
4	1 Connect a 3 A fused jumper wire between the 5 V reference circuit and the signal circuit of the appropriate APP sensor. 2 Switch on the ignition with the engine not running. 3 Using Tech 2, observe the voltage parameter appropriate APP sensor. Does Tech 2 display **4.8 – 5.2 V**?	Go to Step 5	Go to Step 7

Step	Action	Yes	No
5	1 Switch off the ignition. 2 Remove ECM / TCM Fuse 29 from the engine compartment fuse and relay panel assembly. 3 Using a DMM, measure the resistance between the appropriate TP sensor low reference circuit and the ECM housing. **NOTE** Install the ECM Fuse 29 to the engine compartment fuse and relay panel assembly after completing this test. Does the multimeter display 5 Ω?	Go to Step 9	Go to Step 8
6	Test the 5 V reference circuit of the appropriate APP sensor for a high resistance, open circuit, short to ground or short to voltage fault condition. Refer to Section 12P Wiring Diagrams for information on electrical fault diagnosis. Was any fault found and rectified?	Go to Step 11	Go to Step 10
7	Test the signal circuit of the appropriate APP sensor for a high resistance, open circuit, short to ground or short to voltage fault condition. Refer to Section 12P Wiring Diagrams for information on electrical fault diagnosis. Was any fault found and rectified?	Go to Step 11	Go to Step 10
8	Test the low reference circuit of the appropriate APP sensor for a high resistance or an open circuit fault condition. Refer to Section 12P Wiring Diagrams for information on electrical fault diagnosis. Was any fault found and rectified?	Go to Step 11	Go to Step 10
9	Replace the accelerator pedal assembly. Refer to Section 6C1-3 Engine Management – V6 – Service Operations. Was the repair completed?	Go to Step 11	—
10	Replace the ECM. Refer to Section 6C1-3 Engine Management – V6 – Service Operations. Was the repair completed?	Go to Step 11	—
11	1 Using Tech 2, clear the DTCs. 2 Switch off the ignition for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the conditions for running the DTC. Does any of the APP Sensor Circuit DTCs fail this ignition cycle?	Go to Step 2	Go to Step 12
12	Using Tech 2, select the DTC display function. Does Tech 2 display any DTCs?	Go to the appropriate DTC Table in this Section	System OK
When all diagnosis and repairs are completed, check the system for correct operation.			

6.55 DTC P2177 or P2179

DTC Descriptors

This diagnostic procedure supports the following DTCs:

- DTC P2177 Fuel Trim System Lean at Cruise or Accel Bank 1
- DTC P2179 Fuel Trim System Lean at Cruise or Accel Bank 2

Circuit Description

The engine control module (ECM) controls the air / fuel metering system to provide the best possible combination of driveability, fuel economy, and emission control. Fuel delivery is controlled differently during Open and Closed Loop. During Open Loop, the ECM determines fuel delivery based on sensor signals without heated oxygen sensor (HO2S) input. During Closed Loop, the HO2S inputs are added and used by the ECM to calculate short and long term fuel trim fuel delivery adjustments. If the HO2S indicates a lean condition, fuel trim values will be above 0 percent. If the HO2S indicates a rich condition, fuel trim values will be below 0 percent. Short term fuel trim values change rapidly in response to the HO2S signals. Long term fuel trim makes coarse adjustments to maintain an air / fuel ratio of 14.7:1. If the ECM detects an excessively lean condition, this DTC sets.

Conditions for Running the DTC

- Before the ECM can report DTC P2177 or P2179 failed, DTCs P0101, P0121, P0122, P0123, P0133, P0153, P0221, P0222, P0223, P0336, P0338, P0443, P0458, P0459, P0461, P0462, P0463, P2066, P2067, and P2068 must run and pass.
- The fuel system is in closed loop.
- The long fuel trim is active.
- The engine coolant temperature (ECT) is more than 60° C.
- The evaporative emission (EVAP) canister purge solenoid valve is not enabled.
- The intake air temperature (IAT) is less than 60° C.
- The fuel level is more than 11.6 percent.
- The amount of air flow into the engine is more than 7,000 grams.
- DTC P2177 and P2179 runs continuously once the above conditions are met for at least 300 seconds.

Conditions for Setting the DTC

- The Total Fuel Trim Avg. is more than 23 percent.
- The condition exists for 4 seconds.

Action Taken When the DTC Sets

- The control module illuminates the Check Powertrain icon, or the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the Check Powertrain icon, or the malfunction indicator lamp (MIL) after four consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Use Tech 2 to clear the MIL and the DTC.

Additional Information

- A fuel system delivery condition causes this DTC to set. Thoroughly inspect all items that cause a lean condition.
- Any un-metered air into the engine causes this DTC to set. Thoroughly inspect all areas of the engine for vacuum leaks.
- For an intermittent fault condition, refer to 4.2 Intermittent Fault Conditions in this Section.
- To assist diagnosis, refer to 2 Wiring Diagrams and Connector Charts in this Section for the system wiring diagram and connector charts.

Test Description

The numbers below refer to the step numbers on the diagnostic table.

2 This step determines if there is a current condition.

4 If DTC P2177 and P2179 are set at the same time, this indicates that both banks of the engine are operating lean. Inspect for items that would cause both banks of the engine to operate lean.

5 Disconnecting the mass air flow (MAF) sensor determines if the MAF sensor signal is skewed. If the Short Term FT parameter changes more than the specified value, there is a condition with the MAF sensor. A MAF sensor condition can cause this DTC without setting a MAF DTC. If there is a MAF sensor condition, the MAF sensor parameters will appear to be within range.

6 A vacuum leak causes DTC P2177 and P2179 to set at the same time. Inspect all areas of the engine for a vacuum leak. Also inspect the PCV valve for being the correct one for this application. Make sure that the engine oil fill cap is in place and that it is tight. Verify that the engine oil dip stick is fully seated.

DTC P2177 or P2179 Diagnostic Table

Step	Action	Value(s)	Yes	No
1	Has the Diagnostic System Check been completed?	—	Go to Step 2	Refer to 3.4 Diagnostic System Check
2	**NOTE** If any DTCs are set, except P2177 or P2179, refer to those DTCs before proceeding with this diagnostic. 1 Idle the engine at the normal operating temperature. 2 Check that the fuel system is operating in Closed Loop. 3 Observe the Total Fuel Trim Avg. parameter for Bank 1 or bank 2 with a scan tool. Is the Total Fuel Trim Avg. less than the specified value indicated?	23%	Go to Step 3	Go to Step 4
3	1 Use Tech 2 to clear the DTC/s. 2 Ignition OFF for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the Conditions for Running the DTC. Does the DTC fail this ignition cycle?	—	Go to Step 4	Refer to Additional Information in this DTC
4	Are both banks of the engine operating lean?	—	Go to Step 5	Go to Step 7

5	1 Start the engine. **NOTE** Additional DTCs will set when the MAF sensor disconnected. 2 Disconnect the mass air flow (MAF) sensor harness connector while the engine is operating. 3 Observe the Short Term FT parameter for Bank 1 and bank 2, using Tech 2. 4 Reconnect the MAF sensor after completing this step. Does the Short Term FT parameter for both banks of the engine change more than the specified value with the MAF sensor disconnected?	20%	Go to 6.8 DTC P0101, P0102 or P0103	Go to Step 6
6	1 Inspect for the following conditions: – The vacuum hoses for splits, kinks, and proper connections. – The throttle body and the intake manifold for vacuum leaks. – The crankcase ventilation valve and system for leaks. – The air intake system after the MAF sensor for vacuum leaks. – Contaminated fuel. Refer to 5.5 Alcohol / Contaminants in Fuel Diagnosis in this Section. – Lean injectors. Refer to 5.2 Fuel Injector Coil Test in this Section. – The engine control ground points for being clean, tight, and in the correct locations. – A high engine oil level condition. A high engine oil level causes oil residue to form on the mass air flow (MAF) sensor, causing a lean indication. The MAF sensor does not need to be replaced. – An engine mechanical condition. Did you find and correct the condition?	—	Go to Step 8	Refer to Additional Information and Test Description in this DTC
7	1 Inspect for the following conditions: – Vacuum leaks that only affect one bank of the engine – For example, the intake manifold, the injector O-rings. – Lean injectors – refer to 5.2 Fuel Injector Coil Test in this Section. – Exhaust leaks, missing or loose exhaust hardware. Refer to Section 8B Exhaust System. – The heated oxygen sensors (HO2S) are installed securely and the electrical connectors are not contacting the exhaust system. – An engine mechanical condition. Did you find and correct the condition?	—	Go to Step 8	Refer to Additional Information in this DTC

8	Using Tech 2, clear the DTCs. 2 Switch off the ignition for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the conditions for running the DTC. Did DTC P2177 or P2179 fail this ignition cycle?	—	Go to Step 2	Go to Step 9
9	1 Using Tech 2, select the DTC display function. Does Tech 2 display any DTCs?	—	Go to the appropriate DTC Table in this Section	System OK
When all diagnosis and repairs are completed, clear all DTCs and verify correct operation				

6.56 DTC P2178 or P2180

DTC Descriptors

This diagnostic procedure supports the following DTCs:

- DTC P2178 Fuel Trim System Rich at Cruise or Accel Bank 1
- DTC P2180 Fuel Trim System Rich at Cruise or Accel Bank 2

Circuit Description

The engine control module (ECM) controls the air / fuel metering system to provide the best possible combination of driveability, fuel economy, and emission control. Fuel delivery is controlled differently during Open and Closed Loop. During Open Loop, the ECM determines fuel delivery based on sensor signals without heated oxygen sensor (HO2S) input. During Closed Loop, the HO2S inputs are added and used by the ECM to calculate short and long term fuel trim fuel delivery adjustments. If the HO2S indicates a lean condition, fuel trim values will be above 0 percent. If the HO2S indicates a rich condition, fuel trim values will be below 0 percent. Short term fuel trim values change rapidly in response to the HO2S signals. Long term fuel trim makes coarse adjustments to maintain an air / fuel ratio of 14.7:1. If the ECM detects an excessively rich condition, this DTC sets.

Conditions for Running the DTC

- Before the ECM can report DTC P2178 or P2180 failed, DTCs P0101, P0121, P0122, P0123, P0133, P0153, P0221, P0222, P0223, P0336, P0338, P0443, P0458, P0459, P0461, P0462, P0463, P2066, P2067, and P2068 must run and pass.
- The fuel system is in closed loop.
- The long fuel trim is active.
- The engine coolant temperature (ECT) is more than 60° C.
- The evaporative emission (EVAP) canister purge solenoid valve is not enabled.
- The intake air temperature (IAT) is less than 60° C.
- The fuel level is more than 11.6 percent.
- The amount of air flow into the engine is more than 7,000 grams.
- DTC P2178 and P2180 run continuously once the above conditions are met for at least 300 seconds.

Conditions for Setting the DTC

- The Total Fuel Trim Avg. is less than –22 percent.
- The condition exists for 4 seconds.

Action Taken When the DTC Sets

- The control module illuminates the Check Powertrain icon, or the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The Fuel Trim System circuit DTCs are Type ‘B’ DTCs. Refer to 1.4 Diagnostic Trouble Codes in this Section for action taken when a Type ‘B’ DTC sets and conditions for clearing Type ‘B’ DTCs.
- Use Tech 2 to clear the Check Powertrain icon, or the MIL and the DTC.

Additional Information

- A fuel delivery condition causes this DTC to set. Thoroughly inspect all items that could cause a rich condition.
- For an intermittent fault condition, refer to 4.2 Intermittent Fault Conditions in this Section.
- Since fault condition in a wiring connector may trigger DTCs, always test the connectors related to this diagnostic procedure for shorted terminals or poor wiring connection before replacing any component. Refer to Section 12P Wiring Diagrams for information on electrical fault diagnosis.
- To assist diagnosis, refer to 2 Wiring Diagrams and Connector Charts in this Section for the system wiring diagram and connector charts.

Test Description

The numbers below refer to the step numbers on the diagnostic table.

2 This step determines whether the fault is present.

4 If DTC P2178 and DTC P2180 set at the same time, then both banks of the engine are operating rich. Inspect items that would cause both banks of the engine to operate rich.

5 Disconnecting the mass air flow (MAF) sensor determines if the MAF sensor signal is skewed. If the Short Term FT parameter changes more than the specified value, there is a condition with the MAF sensor. A MAF sensor condition can cause this DTC without setting a MAF DTC. If there is a MAF sensor condition, the MAF sensor parameters will appear to be within range.

DTC P2178 or P2180 Diagnostic Table

Step	Action	Value(s)	Yes	No
1	Has the Diagnostic System Check been completed?	—	Go to Step 2	Refer to 3.4 Diagnostic System Check
2	**NOTE** If any DTCs are set, except P2178 and DTC P2180, refer to those DTCs before proceeding with this diagnostic. 1 Idle the engine at the normal operating temperature. 2 Check that the fuel system is in Closed Loop. 3 Observe the Total Fuel Trim Avg. parameter for Bank 1 and / or bank 2 with Tech 2. Is the Total Fuel Trim Avg. less than the specified value?	–22%	Go to Step 3	Go to Step 4
3	1 Observe the Freeze Frame and / or the Failure records data for this DTC. 2 Turn the ignition OFF for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame and / or the Failure records data. Does the DTC fail this ignition cycle?	—	Go to Step 4	Refer to Additional Information in this DTC
4	Are both banks of the engine operating rich?	—	Go to Step 5	Go to Step 7

5	1 Start the engine. **NOTE** Additional DTCs will set when the MAF sensor is disconnected. 2 Disconnect the mass air flow (MAF) sensor harness connector while the engine is operating. 3 Observe the Short Term FT parameter for Bank 1 and bank 2 with Tech 2. 4 Reconnect the MAF sensor after completing this step. Does the Short Term FT parameter for both banks of the engine change more than the specified value with the MAF sensor disconnected?	20%	Go to 6.8 DTC P0101, P0102 or P0103	Go to Step 6
6	1 Inspect for the following conditions: – A collapsed air intake duct – A restricted air filter element – The MAF sensor for foreign objects – Excessive fuel in the crankcase – Change the oil as necessary. – Contaminated fuel. Refer to 5.5 Alcohol / Contaminants in Fuel Diagnosis in this Section. – The ECM grounds for being clean, tight, and in the correct locations – An engine mechanical condition – refer to Section 6A1 – Engine Mechanical V6. Did you find and correct the condition?	—	Go to Step 8	Go to Additional Information in this DTC
7	1 Inspect for the following conditions: – Rich injectors – refer to 5.2 Fuel Injector Coil Test in this Section. – Restricted exhaust system – refer to Section 8B Exhaust System – An engine mechanical condition – refer to Section 6A1 – Engine Mechanical V6. Did you find and correct the condition?	—	Go to Step 8	Go to Additional Information in this DTC
8	1 Switch off the ignition for 30 seconds. 2 Using Tech 2, clear the DTCs and reset the fuel trim system. 3 Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame / Failure Records. Did DTC P2178 and / or P2180 fail this ignition cycle?	—	Go to Step 2	Go to Step 9
9	1 Using Tech 2, select the DTC display function. Does Tech 2 display any DTCs?	—	Go to the appropriate DTC Table in this Section	System OK

6.57 DTC P2187 or P2189

DTC Descriptors

This diagnostic procedure supports the following DTCs:

- DTC P2187 Fuel Trim System Lean at Idle Bank 1
- DTC P2189 Fuel Trim System Lean at Idle Bank 2

Circuit Description

The engine control module (ECM) controls the air / fuel metering system to provide the best possible combination of driveability, fuel economy, and emission control. Fuel delivery is controlled differently during Open and Closed Loop. During Open Loop, the ECM determines fuel delivery based on sensor signals without heated oxygen sensor (HO2S) input. During Closed Loop, the HO2S inputs are added and used by the ECM to calculate short and long term fuel trim fuel delivery adjustments. If the HO2S indicate a lean condition, fuel trim values will be above 0 percent. If the O2S indicate a rich condition, fuel trim values will be below 0 percent. Short term fuel trim values change rapidly in response to the HO2S signals. Long term fuel trim makes coarse adjustments to maintain an air / fuel ratio of 14.7:1. If the ECM detects an excessively lean condition, this DTC sets.

Conditions for Running the DTC

- Before the ECM can report DTC P2187 or P2189 failed, DTCs P0101, P0121, P0122, P0123, P0133, P0153, P0221, P0222, P0223, P0336, P0338, P0443, P0458, P0459, P0461, P0462, P0463, P2066, P2067, and P2068 must run and pass.
- The fuel system is in closed loop.
- The long fuel trim is active.
- The engine coolant temperature (ECT) is more than 60° C.
- The evaporative emission (EVAP) canister purge solenoid valve is not enabled.
- The intake air temperature (IAT) is less than 60° C.
- The fuel level is more than 11.6 percent.
- The amount of air flow into the engine is more than 7000 grams.
- DTC P2187 and P2189 runs continuously once the above conditions are met for at least 300 seconds.

Conditions for Setting the DTC

- The Total Fuel Trim Avg. is more than 40 percent.
- The LT FT Idle / Decel is more than seven percent.
- The condition exists for 4 seconds.

Action Taken When the DTC Sets

The control module illuminates the Check Powertrain icon, or the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.

The control module records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The Fuel Trim System circuit DTCs are Type ‘B’ DTCs. Refer to 1.4 Diagnostic Trouble Codes in this Section for action taken when a Type ‘B’ DTC sets and conditions for clearing Type ‘B’ DTCs.
- Use Tech 2 to clear the Check Powertrain icon, or the MIL and the DTC.

Additional Information

- A fuel delivery condition causes this DTC to set. Thoroughly inspect all items that could cause a rich condition.
- For an intermittent fault condition, refer to 4.2 Intermittent Fault Conditions in this Section.
- Since fault condition in a wiring connector may trigger DTCs, always test the connectors related to this diagnostic procedure for shorted terminals or poor wiring connection before replacing any component. Refer to Section 12P Wiring Diagrams for information on electrical fault diagnosis.
- To assist diagnosis, refer to 2 Wiring Diagrams and Connector Charts in this Section for the system wiring diagram and connector charts.

Test Description

The numbers below refer to the step numbers on the diagnostic table.

2 This step determines if there is a current condition.

4 If DTC P2187 and P2189 are set at the same time, this indicates that both banks of the engine are operating lean. Inspect for items that would cause both banks of the engine to operate lean.

5 Disconnecting the mass air flow (MAF) sensor determines if the MAF sensor signal is skewed. If the Short Term FT parameter changes more than the specified value, there is a condition with the MAF sensor. A MAF sensor condition can cause this DTC without setting a MAF DTC. If there is a MAF sensor condition, the MAF sensor parameters will appear to be within range.

6 A vacuum leak causes DTC P2187 and P2189 to set at the same time. Inspect all areas of the engine for a vacuum leak. Also inspect the positive crankcase ventilation (PCV) valve for being the correct one for this application. Make sure that the engine oil fill cap is in place and that it is tight. Verify that the engine oil dip stick is fully seated.

DTC P2187 or P2189 Diagnostic Table

Step	Action	Value(s)	Yes	No
1	Has the Diagnostic System Check been completed?	—	Go to Step 2	Refer to 3.4 Diagnostic System Check
2	**NOTE** If any DTCs are set, except P2187 and DTC P2189, refer to those DTCs before proceeding with this diagnostic. 1 Idle the engine at the normal operating temperature. 2 The fuel system is in Closed Loop. 3 Observe the Total Fuel Trim Avg. parameter for Bank 1 and / or bank 2 with a scan tool. Is the Total Fuel Trim Avg. less than the specified value?	40%	Go to Step 3	Go to Step 4
3	1 Observe the Freeze Frame and / or the Failure records data for this DTC. 2 Turn the ignition OFF for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame and / or the Failure records data. Does the DTC fail this ignition cycle?	—	Go to Step 4	Refer to Additional Information in this DTC
4	Are both banks of the engine operating lean?	—	Go to Step 5	Go to Step 7

5	1 Start the engine. **NOTE** Additional DTCs will set when the MAF sensor is disconnected. 2 Disconnect the mass air flow (MAF) sensor harness connector while the engine is operating. 3 Observe the Short Term FT parameter for Bank 1 and bank 2 with Tech 2. 4 Reconnect the MAF sensor after completing this step. Does the Short Term FT parameter for both banks of the engine change more than the specified value with the MAF sensor disconnected?	20%	Go to 6.8 DTC P0101, P0102 or P0103	Go to Step 6
6	1 Inspect for the following conditions: – Vacuum hoses for splits, kinks, and proper connections. – The throttle body and the intake manifold for vacuum leaks. – The crankcase ventilation valve and system for leaks. – Air intake system after the MAF sensor for vacuum leaks. – Contaminated fuel – Refer to 5.5 Alcohol / Contaminants in Fuel Diagnosis in this Section. – Lean injectors – Refer to 5.2 Fuel Injector Coil Test in this Section. – The ECM grounds for being clean, tight, and in the correct locations – A high engine oil level condition. A high engine oil level causes oil residue to form on the MAF sensor, causing a lean indication. The MAF sensor does not need to be replaced. – An engine mechanical condition – refer to Section 6A1 – Engine Mechanical V6. Did you find and correct the condition?	—	Go to Step 8	Refer to Additional Information and Test Description in this DTC
7	1 Inspect for the following conditions: – Vacuum leaks that only affect one bank of the engine – For example, the intake manifold, the injector O-rings. – Lean injectors – refer to 5.2 Fuel Injector Coil Test in this Section. – Exhaust leaks, missing or loose exhaust hardware. – The heated oxygen sensor (HO2S) is installed securely and the electrical connector is not contacting the exhaust system. – An engine mechanical condition – Section 6A1 – Engine Mechanical V6. Did you find and correct the condition?	—	Go to Step 8	Refer to Additional Information in this DTC

8	Using Tech 2, clear the DTCs. 2 Switch off the ignition for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the conditions for running the DTC. Did DTC P2179 or P2189 fail this ignition cycle?	—	Go to Step 2	Go to Step 9
9	1 Using Tech 2, select the DTC display function. Does Tech 2 display any DTCs?	—	Go to the appropriate DTC Table in this Section	System OK

6.58 DTC P2188 or P2190

DTC Descriptors

This diagnostic procedure supports the following DTCs:

- DTC P2188 Fuel Trim System Rich at Idle Bank 1
- DTC P2190 Fuel Trim System Rich at Idle Bank 2

Circuit Description

The engine control module (ECM) controls the air / fuel metering system to provide the best possible combination of driveability, fuel economy, and emission control. Fuel delivery is controlled differently during Open and Closed Loop. During Open Loop, the ECM determines fuel delivery based on sensor signals without heated oxygen sensor (HO2S) input. During Closed Loop, the HO2S inputs are added and used by the ECM to calculate short and long term fuel trim fuel delivery adjustments. If the HO2S indicate a lean condition, fuel trim values will be above 0 percent. If the O2S indicate a rich condition, fuel trim values will be below 0 percent. Short term fuel trim values change rapidly in response to the HO2S signals. Long term fuel trim makes coarse adjustments to maintain an air / fuel ratio of 14.7:1. If the ECM detects an excessively rich condition, this DTC sets.

Conditions for Running the DTC

- Before the ECM can report DTC P2188 or P2190 failed, DTCs P0101, P0121, P0122, P0123, P0133, P0153, P0221, P0222, P0223, P0336, P0338, P0443, P0458, P0459, P0461, P0462, P0463, P2066, P2067, and P2068 must run and pass.
- The fuel system is in Closed Loop.
- The long fuel trim is active.
- The engine coolant temperature (ECT) is more than 60°C (140°F).
- The evaporative emission (EVAP) canister purge solenoid valve is not enabled.
- The intake air temperature (IAT) is less than 60°C (140°F).
- The fuel level is more than 11.6 percent.
- The amount of air flow into the engine is more than 7 000 grams.
- DTC P2188 and P2190 runs continuously once the above conditions are met for at least 300 seconds

Conditions for Setting the DTC

- The Total Fuel Trim Avg. is less than –40 percent.
- The LT FT Idle / Decel is less than -7 percent.
- The condition exists for 4 seconds.

Action Taken When the DTC Sets

- The control module activates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the Check Powertrain icon, or the malfunction indicator lamp (MIL) after four consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Use Tech 2 to clear the Check Powertrain icon, or the MIL and the DTC.

Additional Information

- A fuel delivery condition causes this DTC to set. Thoroughly inspect all items that cause a rich condition.
- For an intermittent fault condition, refer to 4.2 Intermittent Fault Conditions in this Section.
- To assist diagnosis, refer to 2 Wiring Diagrams and Connector Charts in this Section for the system wiring diagram and connector charts.

Test Description

The numbers below refer to the step numbers on the diagnostic table.

2 This step determines whether the fault is present.

4 If DTC P2188 and P2190 set at the same time, then both banks of the engine are operating rich. Inspect items that would cause both banks to operate rich.

5 Disconnecting the mass air flow (MAF) sensor determines if the MAF sensor signal is skewed. If the Short Term FT parameter changes more than the specified value, there is a condition with the MAF sensor. A MAF sensor condition can cause this DTC without setting a MAF DTC. If there is a MAF sensor condition, the MAF sensor parameters will appear to be within range.

DTC P2188 or P2190 Diagnostic Table

Step	Action	Value(s)	Yes	No
1	Has the Diagnostic System Check been completed?	—	Go to Step 2	Refer to 3.4 Diagnostic System Check
2	**NOTE** If any DTCs are set, except P2188 and P2190, refer to those DTCs before proceeding with this diagnostic. 1 Idle the engine at the normal operating temperature. 2 Check that the fuel system is in Closed Loop. 3 Observe the Total Fuel Trim Avg. parameter for Bank 1 and / or bank 2 with Tech 2. Is the Total Fuel Trim Avg. less than the specified value?	–40%	Go to Step 3	Go to Step 4
3	1 Observe the Freeze Frame and / or the Failure Records data for this DTC. 2 Turn the ignition OFF for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame and / or the Failure Records data. Does the DTC fail this ignition cycle?	—	Go to Step 4	Go to Additional Information in this DTC
4	Are both banks of the engine operating rich?	—	Go to Step 5	Go to Step

5	1 Start the engine. **NOTE** Additional DTCs will set with the mass air flow (MAF) sensor disconnected. 2 Disconnect the MAF sensor harness connector while the engine is operating. 3 Observe the Short Term FT parameter for Bank 1 and Bank 2 with Tech 2. 4 Connect the MAF sensor after completing this step. Does the Short Term FT parameter for both banks of the engine change more than the specified value with the MAF sensor disconnected?	20%	Go to 6.8 DTC P0101, P0102 or P0103	Go to Step 5
6	1 Inspect for the following conditions: – A collapsed air intake duct – A restricted air filter element – Inspect the MAF sensor for foreign objects. – Excessive fuel in the crankcase – Change the oil as necessary. – Contaminated fuel. Refer to 5.5 Alcohol / Contaminants in Fuel Diagnosis in this Section. – The engine control grounds for being clean, tight, and in the correct locations – An engine mechanical condition – refer to Section 6A1 – Engine Mechanical V6. Did you find and correct the condition?	—	Go to Step 8	Go to Additional Information in this DTC
7	1 Inspect for the following conditions: – Rich injectors – Refer to 5.2 Fuel Injector Coil Test in this Section. – Restricted exhaust system – Refer to Section 8B Exhaust System. – An engine mechanical condition – refer to Section 6A1 – Engine Mechanical V6. Did you find and correct the condition?	—	Go to Step	Go to Additional Information in this DTC
8	1 Turn OFF the ignition for 30 seconds. 2 Using Tech 2, clear the DTCs and reset the fuel trim system. 3 Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame / Failure Records. Did DTC P2188 and / or P2190 fail this ignition cycle?	—	Go to Step 2	Go to Step 9
9	1 Using Tech 2, select the DTC display function. Does Tech 2 display any DTCs?	—	Go to the appropriate DTC Table in this Section	System OK

6.59 DTC P2195 or P2197

DTC Descriptors

This diagnostic procedure supports the following DTCs:

- DTC P2195 – B1S1 O2 Sensor – System Too Lean (Bank 1 Sensor 1)
- DTC P2197 – B2S1 O2 Sensor – System Too Lean (Bank 2 Sensor 1)

Circuit Description

The wide band heated oxygen sensor 1 (HO2S1) measures the amount of oxygen in the exhaust system and provides more information than the switching style HO2S2. The wide band sensor consists of an oxygen sensing cell, an oxygen pumping cell, and a heater. The exhaust gas sample passes through a diffusion gap between the sensing cell and the pumping cell. The engine control module (ECM) supplies a voltage to the HO2S and uses this voltage as a reference to the amount of oxygen in the exhaust system. An electronic circuit within the ECM controls the pump current through the oxygen pumping cell, maintaining a constant voltage in the oxygen sensing cell.

The ECM monitors the voltage variation in the sensing cell and attempts to keep the voltage constant by increasing or decreasing the amount of current flow, or oxygen ion flow, to the pumping cell. By measuring the amount of current required to maintain the voltage in the sensing cell, the ECM can determine the concentration of oxygen in the exhaust. The HO2S voltage is displayed as a lambda value. A lambda value of 1 is equal to a stoichiometric air fuel ratio of 14.7:1.

Under normal operating conditions, the lambda value will remain around 1. When the fuel system is lean, the oxygen level will be high and the lambda signal will be high or more than 1. When the fuel system is rich, the oxygen level will be low, and the lambda signal will be low or less than 1. The ECM uses this information to maintain the correct air / fuel ratio.

Conditions for Running the DTC

- Before the ECM can report DTC P2195 or P2197 failed, DTCs P0137, P0138, P0140, P0141, P0157, P0158, P0160, P0161, P2270, P2271, P2272, and P2273 must run and pass.
- The front and rear heated oxygen sensors are at operating temperature.
- The rear HO2S voltage signal is more than 850 mV.
- The front HO2S is more than 1.08 lambda.
- The Loop Status for both the front and rear sensors is Closed Loop.
- DTCs P2195 and P2197 run continuously once the above conditions are met.

Conditions for Setting the DTC

Condition 1

- The ECM detects that the front HO2S is operating too lean while the rear HO2S is operating too rich and the ECM detects that the fuel trim is at maximum control,

  OR
- The rear fuel trim, long and short term, is more than a threshold.
- This DTC sets after the air flow coming into the engine accumulates to more than 200 grams and the above conditions are met for more than 4 seconds.

Condition 2

- The ECM detects that the rear HO2S is operating too rich while the ECM is commanding a lean air / fuel mixture.
- This DTC sets after the air flow coming into the engine accumulates to more than 800 grams and the above condition is met for more than 4 seconds.

Action Taken When the DTC Sets

- The ECM activates the Check Powertrain icon, or the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
- The ECM records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the Check Powertrain icon, or the malfunction indicator lamp (MIL) after four consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Use Tech 2 to clear the Check Powertrain icon, or the MIL and the DTC.

Additional Information

- A HO2S fault condition may cause this DTC to set. Thoroughly inspect all items that could cause a lean condition.
- For an intermittent fault condition, refer to 4.2 Intermittent Fault Conditions in this Section.
- Since a fault condition in a wiring connector may trigger DTCs, always test the connectors related to this diagnostic procedure for shorted terminals or poor wiring connection before replacing any component. Refer to Section 12P Wiring Diagrams for information on electrical fault diagnosis.
- To assist diagnosis, refer to 2 Wiring Diagrams and Connector Charts in this Section for the system wiring diagram and connector charts.

Test Description

The numbers below refer to the step numbers on the diagnostic table.

2 This step determines if a condition exists.

5 This step is testing for a rear HO2S sensor circuit condition. A circuit condition sets this DTC.

8 This step is testing for an intermittent circuit condition. Thoroughly inspect the HO2S circuits for an intermittent circuit condition.

9 This step is testing for an intermittent circuit condition. Thoroughly inspect the HO2S circuits for an intermittent circuit condition.

DTC P2195 or P2197 Diagnostic Table

Step	Action	Value(s)	Yes	No
1	Has the Diagnostic System Check been completed?	—	Go to Step 2	Refer to 3.4 Diagnostic System Check
2	1 Allow the engine to reach operating temperature. 2 Operate the vehicle within the parameters specified in Conditions for Running the DTC. 3 Observe the diagnostic trouble code (DTC) information, using Tech 2. Did DTC P2195 or DTC P2197 fail this ignition?	—	Go to Step 4	Go to Step 3

3	1 Observe the Freeze Frame and / or the Failure records data for this DTC. 2 Turn the ignition OFF for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame and / or the Failure records data. Does the DTC fail this ignition cycle?	—	Go to Step 4	Refer to Additional Information in this DTC
4	Is DTC P0041, P0137, P0138, P0140, P0157, P0158, or P0160 also set?	—	Go to the appropriate DTC Table in this Section	Go to Step 5
5	1 Operate the engine above 1,200 RPM for 30 seconds. 2 Observe the appropriate rear HO2S voltage, using Tech 2. Is the voltage more than the specified value?	60 mV	Go to Step 8	Go to Step 6
6	1 Ignition OFF. 2 Disconnect the appropriate rear heated oxygen sensor (HO2S). 3 Ignition ON, engine OFF. 4 Observe the appropriate rear HO2S voltage parameter with Tech 2. Is the voltage within the specified range?	350 – 550 mV	Go to Step 12	Go to Step 7
7	1 Test the appropriate rear HO2S signal circuit for a short to ground. Refer to Section 12P Wiring Diagrams. Did you find and correct the condition?	—	Go to Step 19	Go to Step 14
8	1 Shake the related HO2S harnesses for the front sensor between the HO2S harness connector and the engine control module (ECM) while monitoring the appropriate HO2S lambda parameter. Does the HO2S parameter change abruptly while moving the related harnesses?	—	Go to Step 15	Go to Step 9
9	1 Shake the related HO2S harnesses for the rear sensor between the HO2S harness connector and the ECM while monitoring the appropriate HO2S voltage parameter. Does the HO2S parameter change abruptly while moving the related harnesses?	—	Go to Step 15	Go to Step 10

10	1 Ignition OFF. 2 Disconnect the front and rear heated oxygen sensors. 3 Inspect the front and rear heated oxygen sensors for the following conditions: – For damaged wiring between the HO2S and the ECM – An intermittent circuit condition may cause this DTC to set. – For terminal corrosion or water intrusion in the HO2S harness connectors. – For the correct terminal tension. – The HO2S is securely installed and not damaged. – For any exhaust leaks – Refer to Section 8B Exhaust System. 8 Repair as necessary. Refer to Section 12P Wiring diagrams. Did you find and correct the condition?	—	Go to Step 19	Go to Step 11
11	1 Disconnect the ECM. 2 Test the appropriate front heated oxygen sensor circuits for being shorted together between the HO2S connector and the ECM. Refer to Section 12P Wiring Diagrams. Did you find and correct the condition?	—	Go to Step 19	Go to Step 13
12	1 Test for shorted terminals and for poor connections at the HO2S. Refer to Section 12P Wiring Diagrams. Did you find and correct the condition?	—	Go to Step 19	Go to Step 17
13	1 Test for shorted terminals and for poor connections at the ECM. Refer to Section 12P Wiring Diagrams. Did you find and correct the condition?	—	Go to Step 19	Go to Step 16
14	1 Test for shorted terminals and for poor connections at the ECM. Refer to 12P Wiring Diagrams. Did you find and correct the condition?	—	Go to Step 19	Go to Step 18
15	1 Repair the circuit as necessary. Refer to Section 12P Wiring Diagrams. Did you complete the repair?	—	Go to Step 19	—
16	1 Replace the HO2S 1. Refer to the Oxygen Sensor 1 procedure, in Section 6C1-3 Service Operations. Did you complete the replacement?	—	Go to Step 19	—
17	1 Replace the HO2S 2. Refer to the Oxygen Sensor 2 procedure, in Section 6C1-3 Service Operations. Did you complete the replacement?	—	Go to Step 19	—

18	1 Replace the ECM. Refer to Engine Control Module (ECM) Remove, Reinstall and ECM Reset in Section 6C1-3 Service Operations. Did you complete the replacement?	—	Go to Step 19	—
19	1 Clear the DTCs, using Tech 2. 2 Turn OFF the ignition for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the conditions for running the DTC. Does DTC P2195 or P2197 fail this ignition cycle?	—	Go to Step 2	Go to Step 20
20	1 Using Tech 2, select the DTC display function. Does Tech 2 display any DTC?	—	Go to the appropriate DTC Table in this Section	System OK

When all diagnosis and repairs are completed, clear all DTCs and verify correct operation

6.60 DTC 2196 or P2198

DTC Descriptors

This diagnostic procedure supports the following DTCs:

- DTC P2196 – B1S1 O2 Sensor – System Too Rich (Bank 1 Sensor 1)
- DTC P2198 – B2S1 O2 Sensor – System Too Rich (Bank 2 Sensor 1)

Circuit Description

The wide band heated oxygen sensor 1 (HO2S1) measures the amount of oxygen in the exhaust system and provides more information than the switching style HO2S2. The wide band sensor consists of an oxygen sensing cell, an oxygen pumping cell, and a heater. The exhaust gas sample passes through a diffusion gap between the sensing cell and the pumping cell. The engine control module (ECM) supplies a voltage to the HO2S and uses this voltage as a reference to the amount of oxygen in the exhaust system. An electronic circuit within the ECM controls the pump current through the oxygen pumping cell, maintaining a constant voltage in the oxygen sensing cell.

The ECM monitors the voltage variation in the sensing cell and attempts to keep the voltage constant by increasing or decreasing the amount of current flow, or oxygen ion flow, to the pumping cell. By measuring the amount of current required to maintain the voltage in the sensing cell, the ECM can determine the concentration of oxygen in the exhaust. The HO2S voltage is displayed as a lambda value. A lambda value of 1 is equal to a stoichiometric air fuel ratio of 14.7:1.

Under normal operating conditions, the lambda value will remain around 1. When the fuel system is lean, the oxygen level will be high and the lambda signal will be high or more than 1. When the fuel system is rich, the oxygen level will be low, and the lambda signal will be low or less than 1. The ECM uses this information to maintain the correct air / fuel ratio.

Conditions for Running the DTC

- Before the ECM can report DTC P2196 or P2198 failed, DTCs P0137, P0138, P0140, P0141, P0157, P0158, P0160, P0161, P2270, P2271, P2272, and P2273 must run and pass.
- The front and rear heated oxygen sensors are at operating temperature.
- The rear HO2S voltage signal is more than 150 mV.
- The front HO2S is more than 0.92 lambda.
- The Loop Status for both the front and rear sensors is Closed Loop.
- DTCs P2196 and P2198 run continuously once the above conditions are met.

Conditions for Setting the DTC

Condition 1

- The ECM detects that the front HO2S is operating too rich while the rear HO2S is operating too lean and the ECM detects that the fuel trim is at minimum control,

  OR
- The rear fuel trim, long and short term, is less than a threshold.
- This DTC sets after the air flow coming into the engine accumulates to more than 200 grams and the above conditions are met for more than 4 seconds.

Condition 2

- The ECM detects that the rear HO2S is operating too lean while the ECM is commanding a rich air / fuel mixture.
- This DTC sets after the air flow coming into the engine accumulates to more than 800 grams and the above condition is met for more than 4 seconds.

Action Taken When the DTC Sets

- The ECM activates the Check Powertrain icon, or the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
- The ECM records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the Check Powertrain icon, or the malfunction indicator lamp (MIL) after four consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Use Tech 2 to clear the Check Powertrain icon, or the MIL and the DTC.

Additional Information

- A HO2S fault condition may cause this DTC to set. Thoroughly inspect all items that could cause a rich condition.
- For an intermittent fault condition, refer to 4.2 Intermittent Fault Conditions in this Section.
- Since a fault condition in a wiring connector may trigger DTCs, always test the connectors related to this diagnostic procedure for shorted terminals or poor wiring connection before replacing any component. Refer to Section 12P Wiring Diagrams for information on electrical fault diagnosis.
- To assist diagnosis, refer to 2 Wiring Diagrams and Connector Charts in this Section for the system wiring diagram and connector charts.

Test Description

The numbers below refer to the step numbers on the diagnostic table.

2 This step determines if a condition exists.

5 This step is testing for a rear HO2S sensor circuit condition. A circuit condition sets this DTC.

8 This step is testing for an intermittent circuit condition. Thoroughly inspect the HO2S circuits for an intermittent circuit condition.

9 This step is testing for an intermittent circuit condition. Thoroughly inspect the HO2S circuits for an intermittent circuit condition.

DTC P2196 or P2198 Diagnostic Table

Step	Action	Value(s)	Yes	No
1	Has the Diagnostic System Check been completed?	—	Go to Step 2	Refer to 3.4 Diagnostic System Check
2	1 Allow the engine to reach operating temperature. 2 Operate the vehicle within the parameters specified in Conditions for Running the DTC. 3 Observe the diagnostic trouble code (DTC) information, using Tech 2. Did DTC P2196 or DTC P2198 fail this ignition?	—	Go to Step 4	Go to Step 3

3	1 Observe the Freeze Frame and / or the Failure records data for this DTC. 2 Turn the ignition OFF for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame and / or the Failure records data. Does the DTC fail this ignition cycle?	—	Go to Step 4	Refer to Additional Information in this DTC
4	Is DTC P0041, P0137, P0138, P0140, P0157, P0158, or P0160 also set?	—	Go to the appropriate DTC Table in this Section	Go to Step 5
5	1 Operate the engine above 1,200 RPM for 30 seconds. 2 Observe the appropriate rear HO2S voltage, using Tech 2. Is the voltage less than the specified value?	1,050 mV	Go to Step 8	Go to Step 6
6	1 Ignition OFF. 2 Disconnect the appropriate rear heated oxygen sensor (HO2S). 3 Ignition ON, engine OFF. 4 Observe the appropriate rear HO2S voltage parameter with Tech 2. Is the voltage within the specified range?	350 – 550 mV	Go to Step 12	Go to Step 7
7	1 Test the appropriate rear HO2S signal circuit for a short to voltage. Refer to Section 12P Wiring Diagrams. Did you find and correct the condition?	—	Go to Step 19	Go to Step 14
8	1 Shake the related HO2S harnesses for the front sensor between the HO2S harness connector and the engine control module (ECM) while monitoring the appropriate HO2S lambda parameter. Does the HO2S parameter change abruptly while moving the related harnesses?	—	Go to Step 15	Go to Step 9
9	1 Shake the related HO2S harnesses for the rear sensor between the HO2S harness connector and the ECM while monitoring the appropriate HO2S voltage parameter. Does the HO2S parameter change abruptly while moving the related harnesses?	—	Go to Step 15	Go to Step 10

10	1 Ignition OFF. 2 Disconnect the front and rear heated oxygen sensors. 3 Inspect the front and rear heated oxygen sensors for the following conditions: – For damaged wiring between the HO2S and the ECM – An intermittent circuit condition may cause this DTC to set. – For terminal corrosion or water intrusion in the HO2S harness connectors. – For the correct terminal tension. – The HO2S is securely installed and not damaged. – For any exhaust leaks – Refer to Section 8B Exhaust System. 8 Repair as necessary. Refer to Section 12P Wiring diagrams. Did you find and correct the condition?	—	Go to Step 19	Go to Step 11
11	1 Disconnect the ECM. 2 Test the appropriate front heated oxygen sensor circuits for being shorted together between the HO2S connector and the ECM. Refer to Section 12P Wiring Diagrams. Did you find and correct the condition?	—	Go to Step 19	Go to Step 13
12	1 Test for shorted terminals and for poor connections at the HO2S. Refer to Section 12P Wiring Diagrams. Did you find and correct the condition?	—	Go to Step 19	Go to Step 17
13	1 Test for shorted terminals and for poor connections at the ECM. Refer to Section 12P Wiring Diagrams. Did you find and correct the condition?	—	Go to Step 19	Go to Step 16
14	1 Test for shorted terminals and for poor connections at the ECM. Refer to 12P Wiring Diagrams. Did you find and correct the condition?	—	Go to Step 19	Go to Step 18
15	1 Repair the circuit as necessary. Refer to Section 12P Wiring Diagrams. Did you complete the repair?	—	Go to Step 19	—
16	1 Replace the HO2S 1. Refer to the Oxygen Sensor 1 procedure, in Section 6C1-3 Service Operations. Did you complete the replacement?	—	Go to Step 19	—
17	1 Replace the HO2S 2. Refer to the Oxygen Sensor 2 procedure, in Section 6C1-3 Service Operations. Did you complete the replacement?	—	Go to Step 19	—

18	1 Replace the ECM. Refer to Engine Control Module (ECM) Remove, Reinstall and ECM Reset in Section 6C1-3 Service Operations. Did you complete the replacement?	—	Go to Step 19	—
19	1 Clear the DTCs, using Tech 2. 2 Turn OFF the ignition for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the conditions for running the DTC. Does DTC P2196 or P2198 fail this ignition cycle?	—	Go to Step 2	Go to Step 20
20	1 Using Tech 2, select the DTC display function. Does Tech 2 display any DTC?	—	Go to the appropriate DTC Table in this Section	System OK
When all diagnosis and repairs are completed, clear all DTCs and verify correct operation				

6.61 DTC P2227, P2228 or P2229

DTC Descriptor

This diagnostic procedure supports the following DTCs:

- DTC P2227 – Barometric Pressure Sensor Circuit Range / Performance
- DTC P2228 – Barometric Pressure Sensor Voltage Low
- DTC P2229 – Barometric Pressure Sensor Voltage High

Circuit Description

The ECM applies a positive 5 V reference voltage to the barometric pressure (BARO) sensor through the 5 V reference circuit and the ground through the low reference circuit.

The BARO sensor provides signal voltage to the ECM that is proportional to the atmospheric pressure changes through the signal circuit. The ECM uses the BARO signal voltage to maintain the correct fuel delivery at different altitudes.

The ECM monitors and compares the BARO sensor signal voltage against a specified range. A BARO pressure sensor circuit DTC sets if the ECM detects the BARO sensor signal voltage is outside the specified range.

Conditions for Running the DTC

DTC P2227

Runs continuously once the following conditions are met for 3 seconds:

- DTCs P0121, P0122, P0123, P0221, P0222 or P0223 are not set.
- The engine is running.

DTC P2228 and P2229

Runs continuously once the following conditions are met for 3 seconds:

- DTCs P0101, P0102 or P0103 are not set.
- The engine is running.

Conditions for Setting the DTC

DTC P2227

The ECM detects the BARO pressure changed greater than 5 kPa within 20 seconds or the BARO pressure changed greater than 30 kPa since the last ignition cycle.

DTC P2228

The ECM detects the BARO sensor signal voltage is less than 0.20 V.

DTC P2229

The ECM detects the BARO sensor signal voltage is greater than 4.8 V for longer than 2.0 seconds.

Conditions for Clearing DTC

The BARO pressure sensor circuit DTCs are Type ‘B’ DTC. Refer to 1.4 Diagnostic Trouble Codes in this Section for action taken when a Type ‘B’ DTC sets and conditions for clearing Type ‘B’ DTCs.

Additional Information

- Refer to Section 6C1-1 Engine Management – V6 – General Information for details of the BARO Sensor operation.
- For an intermittent fault condition, refer to 4.2 Intermittent Fault Conditions in this Section.
- Since fault condition in a wiring connector may trigger DTCs, always test the connectors related to this diagnostic procedure for shorted terminals or poor wiring connection before replacing any component. Refer to Section 12P Wiring Diagrams for information on electrical fault diagnosis.
- To assist diagnosis, refer to 2 Wiring Diagrams and Connector Charts in this Section for the system wiring diagram and connector charts.

Test Description

The following numbers refer to the step numbers in the diagnostic table:

4 Test signal circuit of the BARO sensor. This circuit should display a voltage within the specified range.

5 Measures the integrity of the TP sensor low reference circuit. Removal of the ECM Fuse 29 enables the ECM to power down completely prior to the test procedure.

DTC P2227 P2228 or P2229 Diagnostic Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been performed?	Go to Step 2	Refer to 3.4 Diagnostic System Check
2	1 Switch off the ignition for 30 seconds. 2 Operate the vehicle within the conditions for running the DTC. 3 Using Tech 2, select the DTC display function. Does DTC P2227, P2228 or P2229 fail this ignition cycle?	Go to Step 3	Refer to Additional Information in this DTC
3	1 Switch off the ignition. 2 Disconnect the BARO sensor wiring connector. 3 Switch on the ignition with the engine not running. 4 Using a digital multimeter, measure the voltage between the BARO sensor signal circuit and the ECM housing. Does the multimeter display 4.5 – 5.5 V?	Go to Step 4	Go to Step 6
4	1 Switch on the ignition with the engine not running. 2 Using a digital multimeter, measure the voltage between the BARO sensor 5 V reference circuit and the ECM housing. Does the multimeter display 4.8 – 5.2 V?	Go to Step 5	Go to Step 7
5	1 Switch off the ignition. 2 Remove ECM / TCM Fuse 29 from the engine compartment fuse and relay panel assembly. 3 Using a digital multimeter, measure the resistance between the BARO sensor low reference circuit and the ECM housing. **NOTE** Install the ECM Fuse 29 to the engine compartment fuse and relay panel assembly after completing this test. Does the multimeter display 5 Ω?	Go to Step 9	Go to Step 8

Step	Action	Yes	No
6	Test BARO sensor signal circuit for a high resistance, open circuit, short to ground or short to voltage fault condition. Refer to Section 12P Wiring Diagrams for information on electrical fault diagnosis. Was any fault found and rectified?	Go to Step 11	Go to Step 10
7	Test the BARO sensor 5 V reference circuit for an open, short to ground or high resistance fault condition. Refer to Section 12P Wiring Diagrams for information on electrical fault diagnosis. **NOTE** The BARO sensor shares the 5 V reference circuit with other sensors. A fault condition in the 5 V reference circuit may trigger DTCs on sensors that share this circuit. Refer to 2 Wiring Diagrams and Connector Charts in this Section to assist diagnosis. Was any fault found and rectified?	Go to Step 11	Go to Step 10
8	1 Disconnect the ECM wiring connector. 2 Test the BARO sensor low reference circuit for a high resistance and open circuit fault condition. Refer to Section 12P Wiring Diagrams for information on electrical fault diagnosis. Was any fault found and rectified?	Go to Step 11	Go to Step 10
9	Replace the BARO sensor. Refer to Section 6C1-3 Engine Management – V6 – Service Operations. Was the repair completed?	Go to Step 11	—
10	Replace the ECM. Refer to Section 6C1-3 Engine Management – V6 – Service Operations. Was the repair completed?	Go to Step 11	—
11	1 Using Tech 2, clear the DTCs. 2 Switch off the ignition for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the conditions for running the DTC. Does any of the BARO pressure sensor circuit DTCs fail this ignition cycle?	Go to Step 2	Go to Step 12
12	Using Tech 2, select the DTC display function. Does Tech 2 display any DTCs?	Go to the appropriate DTC Table in this Section	System OK
When all diagnosis and repairs are completed, check the system for correct operation.			

6.62 DTC P2231, P2232, P2234, P2235, P2251 or P2254

DTC Descriptors

This diagnostic procedure supports the following DTCs:

- DTC P2231 – O2 Sensor Signal Interference by Heater Circuit (Bank 1, Sensor 1)
- DTC P2232 – O2 Sensor Signal Short to Heater Circuit (Bank 1, Sensor 2)
- DTC P2234 – O2 Sensor Signal Interference by Heater Circuit (Bank 2, Sensor 1)
- DTC P2235 – O2 Sensor Signal Short to Heater Circuit (Bank 2, Sensor 2)
- DTC P2251 – O2 Sensor Ground Circuit Malfunction (Bank 1, Sensor 1)
- DTC P2254 – O2 Sensor Ground Circuit Malfunction (Bank 2, Sensor 1)

Circuit Description

The Engine control relay applies positive voltage to the heater ignition voltage circuits of the HO2S. The ECM applies a pulse width modulated (PWM) ground to the heater control circuit of the HO2S through a device within the ECM called a Driver, to control the HO2S rate of heating.

O2 Sensor 1

The ECM maintains the voltage between the reference signal circuit and low reference circuit of the HO2S 1 to about 450 mV by increasing or decreasing the oxygen content in the HO2S diffusion gap. To achieve this, the ECM controls the current applied to the oxygen pumping cell in the HO2S.

- If the air / fuel mixture in the exhaust is balanced (lambda = 1), the oxygen pumping cell current is zero.
- If the exhaust gas in the HO2S 1 diffusion gap is lean, the ECM applies a positive current to the oxygen pumping cell to discharge oxygen from the diffusion gap.
- If the exhaust gas in the HO2S 1 diffusion gap is rich, the ECM applies a negative current to the oxygen pumping cell to draw oxygen into the diffusion gap.

The pumping current required to maintain the HO2S 1 signal circuit voltage to about 450 mV is proportional to the level of oxygen concentration in the exhaust gas. The ECM monitors and evaluates the oxygen pumping current to determine the level of oxygen concentration in the exhaust.

An HO2S signal circuit shorted to heater control circuit DTC sets if the ECM detects the HO2S signal voltage is increasing or decreasing at the same rate as the HO2S heater control circuit.

O2 Sensor 2

The ECM applies a voltage of approximately 450 mV between the reference signal circuit and low reference circuit of the HO2S 2 while the sensor temperature is less than the operating range.

Once the HO2S 2 reaches operating temperature, the sensor varies this reference signal voltage, which constantly fluctuates between the high voltage output and the low voltage output.

The low voltage output is 0 – 450 mV, which occurs if the air fuel mixture is lean.

The high voltage output is 450 – 1,000 mV, which occurs if the air fuel mixture is rich.

The ECM monitors, stores and evaluates the HO2S 2 voltage fluctuation information to determine the level of oxygen concentration in the exhaust.

Conditions for Running the DTC

DTC P2231 or P2234

Run continuously once the following conditions are met:

- DTCs P0030, P0031, P0032, P0050, P0051, P0052, P0053, P0059, P0130, P0135, P0150 or P0155 are not set.
- The HO2S heater control is enabled.
- The HO2S heater duty cycle is greater than 5 percent.
- The HO2S is at operating temperature for 10 seconds.
- The ECM does not detect an engine misfire fault condition.
- The fuel injectors are enabled.
- The ignition voltage is 10.5 – 18 V.
- The calculated exhaust temperature is less than 800°C.
- The MAF sensor signal output is steady within 3 percent of the airflow into the engine.

DTC P2232 and P2235

Run continuously once the following conditions are met:

- The engine is running.
- The HO2S is at operating temperature for longer than 90 seconds.
- The fuel injectors are enabled.
- The ignition voltage is greater than 10.5 V.
- The calculated exhaust temperature is 250 – 800°C.

DTC P2251 and P2254

Run continuously once the following conditions are met:

- DTCs P0030, P0031, P0032, P0050, P0051 and P0052 ran and passed.
- The HO2S heater control is enabled.
- The ECM internal sensing element resistance is greater than 570 Ω.
- The ECM detects the internal HO2S signal voltage is 1.47 – 1.53 V.
- The HO2S is at operating temperature.

Conditions for Setting the DTC

DTC P2231 or P2234

The ECM detects the following conditions:

- The internal HO2S signal voltage changes greater than 100 mV as the heater control switches.
- The above condition occurs 18 times in the last 10 seconds.

DTC P2232 or P2235

The ECM detects the following conditions:

- The internal HO2S signal voltage switches at the same rate as the heater circuit.
- The above condition occurs four times out of six as the heater is turned off.

DTC P2251 or P2254

The ECM detects the following conditions:

- The internal HO2S signal voltage changes greater than 10 mV as the heater control switches.
- The above condition occurs 20 times in the last 10 seconds.

Conditions for Clearing the DTC

The HO2S signal circuit shorted to heater control circuit DTCs are Type 'B' DTCs. Refer to 1.4 Diagnostic Trouble Codes in this Section for action taken when Type 'B' DTC sets and conditions for clearing Type 'B' DTCs.

Additional Information

- Refer to Section 6C1-1 Engine Management – V6 – General Information for details of the HO2S system operation.
- For an intermittent fault condition, refer to 4.2 Intermittent Fault Conditions in this Section.
- The HO2S must be tightened correctly. A loose HO2S will trigger these DTCs.
- Since fault condition in a wiring connector may trigger DTCs, always test the connectors related to this diagnostic procedure for shorted terminals or poor wiring connection before replacing any component. Refer to Section 12P Wiring Diagrams for information on electrical fault diagnosis.
- To assist diagnosis, refer to 2 Wiring Diagrams and Connector Charts in this Section for the system wiring diagram and connector charts.

DTC P2231, P2232, P2234, P2235, P2251or P2254 Diagnostic Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been performed?	Go to Step 2	Refer to 3.4 Diagnostic System Check
2	1 Switch off the ignition for 30 seconds. 2 Start the engine. 3 Allow the engine to reach the normal operating temperature. 4 Increase the engine speed to 2,000 rpm for 10 seconds. 5 Using Tech 2, select the DTC display function. Does DTC P2231, P2232, P2234, P2235, P2251 or P2254 fail this ignition cycle?	Go to Step 3	Refer to Additional Information in this DTC
3	1 Disconnect the appropriate HO2S connector. 2 From the HO2S to the sensor wiring connector, test the following circuit for a shorted to the sensor heater control circuit fault condition: • Reference signal circuit, • low reference circuit, • pump current, • input pump current. Refer to Section 12P Wiring Diagrams for information on electrical fault diagnosis. Was any fault found?	Go to Step 6	Go to Step 4

Step	Action	Yes	No
4	1 Disconnect the ECM and the appropriate HO2S connector. 2 From the HO2S wiring connector to the ECM wiring connector, test the following circuit for a shorted to the sensor heater control circuit fault condition: • Reference signal circuit, • low reference circuit, • pump current, • input pump current. Refer to Section 12P Wiring Diagrams for information on electrical fault diagnosis. Was any fault found and rectified?	Go to Step 8	Go to Step 7
6	Replace the appropriate HO2S. Refer to Section 6C1-3 Engine Management – V6 – Service Operations. Was the repair completed?	Go to Step 8	—
7	Replace the ECM. Refer to Section 6C1-3 Engine Management – V6 – Service Operations. Was the repair completed?	Go to Step 8	—
8	1 Using Tech 2, clear the DTCs. 2 Switch off the ignition for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the conditions for running the DTC. Does any of the O2 Sensor Signal Circuit Shorted to Heater Control Circuit DTCs fail this ignition cycle?	Go to Step 2	Go to Step 9
9	Using Tech 2, select the DTC display function. Does Tech 2 display any DTCs?	Go to the appropriate DTC Table in this Section	System OK
When all diagnosis and repairs are completed, check the system for correct operation.			

6.63 DTC P2237, P2238, P2239, P2240, P2241 or P2242

DTC Descriptors

This diagnostic procedure supports the following DTCs:

- DTC P2237 – O2 Sensor Pump Current Circuit Malfunction (Bank 1, Sensor 1)
- DTC P2238 – O2 Sensor Pump Current Circuit Low Voltage (Bank 1, Sensor 1)
- DTC P2239 – O2 Sensor Pump Current Circuit High Voltage (Bank 1, Sensor 1)
- DTC P2240 – O2 Sensor Pump Current Circuit Malfunction (Bank 2, Sensor 1)
- DTC P2241 – O2 Sensor Pump Current Circuit Low Voltage (Bank 2, Sensor 1)
- DTC P2242 – O2 Sensor Pump Current Circuit High Voltage (Bank 2, Sensor 1)

Circuit Description

The engine control relay applies positive voltage to the heater ignition voltage circuits of the HO2S #1. The ECM applies a pulse width modulated (PWM) ground to the heater control circuit of the HO2S through a device within the ECM called a Driver, to control the HO2S rate of heating.

The ECM maintains the voltage between the reference signal circuit and low reference circuit of the HO2S #1 to about 450 mV by increasing or decreasing the oxygen content in the HO2S diffusion gap. To achieve this, the ECM controls the current applied to the oxygen pumping cell in the HO2S.

- If the air / fuel mixture in the exhaust is balanced (lambda = 1), the oxygen pumping cell current is zero.
- If the exhaust gas in the HO2S #1 diffusion gap is lean, the ECM applies a positive current to the oxygen pumping cell to discharge oxygen from the diffusion gap.
- If the exhaust gas in the HO2S #1 diffusion gap is rich, the ECM applies a negative current to the oxygen pumping cell to draw oxygen into the diffusion gap.

The pumping current required to maintain the HO2S #1 signal circuit voltage to about 450 mV is proportional to the level of oxygen concentration in the exhaust gas. The ECM monitors and evaluates the oxygen pumping current to determine the level of oxygen concentration in the exhaust.

An HO2S pumping current control circuit DTC sets if the ECM detects the HO2S #1 signal voltage is outside the predetermined range.

Conditions for Running the DTC

Condition 1

Run continuously once the following conditions are met:

- DTCs P0101, P0121, P0122, P0123, P0133, P0135, P0153, P0155, P0221, P0222, P0223, P0336 and P0338 ran and passed.
- The ECM is commanding the lambda outside the range of 0.97 – 1.03.
- The engine is operating in closed loop.
- The HO2S heater is at operating temperature.

Condition 2

Run continuously once the following conditions are met:

- DTCs P0101, P0121, P0122, P0123, P0133, P0135, P0153, P0155, P0221, P0222, P0223, P0336 and P0338 ran and passed.
- The ECM is commanding the lambda rich and then lean periodically with a change of greater than 2 percent.
- The ECM detects the internal HO2S signal voltage is 1.48 – 1.52 V.
- The HO2S is 0.97 – 1.03 lambda.
- The engine is operating in closed loop.
- The HO2S heater is at operating temperature.

Condition 3

Run continuously once the following conditions are met:

- DTCs P0133 and P0153 ran and passed.
- The HO2S heater is at operating temperature.

Conditions for Setting the DTC

Condition 1

The ECM detects the following conditions:

- The internal HO2S signal voltage change is 1.52 – 1.48 V.
- The above condition exists and 200 grams of exhausts gas has passed.

Condition 2

The ECM stores the fuel trim control values. This DTC sets if the ECM detects a deviation of greater than 10 percent within 1.5 seconds between the stored value and the current value of the fuel trim.

Condition 3

The ECM detects that 5 seconds after decel fuel shut-off, the internal HO2S signal voltage is less than 1.7 V.

Conditions for Clearing the DTC

The HO2S pumping current control circuit DTCs are Type 'B' DTCs. Refer to 1.4 Diagnostic Trouble Codes in this Section for action taken when Type 'B' DTC sets and conditions for clearing Type 'B' DTCs.

Additional Information

- Refer to Section 6C1-1 Engine Management – V6 – General Information for details of the HO2S system operation.
- For an intermittent fault condition, refer to 4.2 Intermittent Fault Conditions in this Section.
- Inspect the HO2S wiring harness for contact with the exhaust system.
- The HO2S must be tightened correctly. A loose HO2S will trigger these DTCs.
- Since fault condition in a wiring connector may trigger DTCs, always test the connectors related to this diagnostic procedure for shorted terminals or poor wiring connection before replacing any component. Refer to Section 12P Wiring Diagrams for information on electrical fault diagnosis.
- To assist diagnosis, refer to 2 Wiring Diagrams and Connector Charts in this Section for the system wiring diagram and connector charts.
- The following table illustrates the typical voltages for the HO2S circuits:

HO2S Voltages	
Conditions: • Ignition ON, Engine OFF • HO2S Disconnected	
HO2S Circuit	**Voltage**
Heater Control	4.6 – 5.0 V
Heater Supply Voltage	B+
Reference Voltage	2.6 – 3.1 V
Low Reference	2.2 – 2.7 V
Pump Current	Less than 0.5 A
Input Pump Current	Less than 0.5 A

Test Description

The following numbers refer to the step numbers in the diagnostic table:

2 When performing this test, the HO2S should react immediately.

4 Connecting a jumper wire between the HO2S reference signal circuit and the low reference circuit causes the ECM to apply signal voltage to the pumping current and input pumping current.

DTC P2237, P2238, P2239, P2240 or P2242 Diagnostic Table

Step	Action	Value(s)	Yes	No
1	Has the Diagnostic System Check been completed?	—	Go to Step 2	Refer to 3.4 Diagnostic System Check
2	1 Switch off the ignition for 30 seconds. 2 Start the engine. 3 Allow the engine to reach the normal operating temperature. 4 Increase the engine speed to 2,000 rpm for 10 seconds. 5 Using Tech 2, select the DTC display function. Does DTC P2237, P2238, P2239, P2240, P2241, P2242, fail this ignition cycle?	—	Go to Step 3	Refer to 4.2 Intermittent Fault Conditions
3	Are DTCs relating to the reference circuit of the HO2S also set? (e.g. 6.12 DTC P0130, P0131, P0132, P0135, P0137, P0138, P0140, P0141, P0150 P0151, P0152, P0155, P0157, P0158, P0160, P0161, P2243, P2247, P2270, P2271, P2272, P2273, P2297 or P2298)	—	Go to the appropriate DTC Table in this Section	Go to Step 4
4	1 Disconnect the appropriate HO2S wiring connector. 2 Ignition ON, engine OFF. 3 Using a digital multimeter, measure the voltage between the input pump current circuit and a good ground. Is the voltage more than the specified value?	50 mV	Go to Step 8	Go to Step 5
5	1 Ignition ON, engine OFF. 2 Using a digital multimeter, measure the voltage between the pump current circuit and a good ground. is the voltage display more than the specified value?	50 mV	Go to Step 8	Go to Step 6
6	1 Connect a 3 A fused jumper wire between the HO2S reference signal circuit and the low reference circuit. 2 Ignition ON, engine OFF. 3 Using a digital multimeter, measure the voltage between the input pump current circuit and a good ground. Is the voltage reading within the specified range?	4.8 – 5.2 V	Go to Step 7	Go to Step 8

7	1 Connect a 3 A fused jumper wire between the HO2S reference signal circuit and the low reference circuit. 2 Ignition ON, engine OFF. 3 Using a digital multimeter, measure the voltage between the pump current circuit and a good ground. Is the voltage reading within the specified range?	4.8 – 5.2 V	Go to Step 9	Go to Step 10
8	1 Test the input pump current and the pump current circuit of the HO2S for a high resistance, open circuit, short to ground, short to voltage or shorted together fault condition. Refer to Section 12P Wiring Diagrams for information on electrical fault diagnosis. Was any fault found and rectified?	—	Go to Step 12	Go to Step 11
9	1 Test or inspect for the following conditions that may cause the HO2S to detect an incorrect air / fuel mixture: • Lean or rich fuel injector fuel delivery, • Contaminated fuel, • Low fuel line pressure, • Exhaust leak near the HO2S, and • Leak in the crankcase or vacuum line. Was any fault found and rectified?	—	Go to Step 12	Go to Step 10
10	1 Replace the appropriate HO2S. Refer to Section 6C1-3 Engine Management – V6 – Service Operations. Was the repair completed?	—	Go to Step 12	—
11	1 Replace the ECM. Refer to Section 6C1-3 Engine Management – V6 – Service Operations. Was the repair completed?	—	Go to Step 12	—
12	1 Using Tech 2, clear the DTCs. 2 Switch off the ignition for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the conditions for running the DTC. Does any of the HO2S pumping current control circuit DTCs fail this ignition cycle?	—	Go to Step 2	Go to Step 13
12	Using Tech 2, select the DTC display function. Does Tech 2 display any DTCs?	—	Go to the appropriate DTC Table in this Section	System OK
When all diagnosis and repairs are completed, clear all DTCs and verify correct operation				

6.64 DTC P2626, P2627, P2628, P2629, P2630 or P2631

DTC Descriptors

- DTC P2626 – O2 Sensor Pump Current Trim Circuit Malfunction (Bank 1, Sensor 1)
- DTC P2627 – O2 Sensor Pump Current Trim Circuit Low Voltage (Bank 1, Sensor 1)
- DTC P2628 – O2 Sensor Pump Current Trim Circuit High Voltage (Bank 1, Sensor 1)
- DTC P2629 – O2 Sensor Pump Current Trim Circuit Malfunction (Bank 2, Sensor 1)
- DTC P2630 – O2 Sensor Pump Current Trim Circuit Low Voltage (Bank 2, Sensor 1)
- DTC P2631 – O2 Sensor Pump Current Trim Circuit High Voltage (Bank 2, Sensor 1)

Circuit Description

The wide band heated oxygen sensor (HO2S) measures the amount of oxygen in the exhaust system and provides more information than the switching style HO2S. The wide band sensor consists of an oxygen sensing cell, an oxygen pumping cell, and a heater. The exhaust gas sample passes through a diffusion gap between the sensing cell and the pumping cell. The engine control module (ECM) supplies a voltage to the HO2S and uses this voltage as a reference to the amount of oxygen in the exhaust system.

An electronic circuit within the ECM controls the pump current through the oxygen pumping cell in order to maintain a constant voltage in the oxygen sensing cell. The ECM monitors the voltage variation in the sensing cell and attempts to keep the voltage constant by increasing or decreasing the amount of current flow, or oxygen ion flow, to the pumping cell. By measuring the amount of current required to maintain the voltage in the sensing cell, the ECM can determine the concentration of oxygen in the exhaust.

The HO2S voltage is displayed as a lambda value. A lambda value of 1 is equal to a stoichiometric air fuel ratio of 14.7:1. Under normal operating conditions, the lambda value will remain around 1. When the fuel system is lean, the oxygen level will be high and the lambda signal will be high or more than 1. When the fuel system is rich, the oxygen level will be low, and the lambda signal will be low or less than 1. The ECM uses this information to maintain the correct air / fuel ratio.

Conditions for Running the DTC

- Before the ECM can report DTC P2626 or P2629 failed, DTCs P0101, P0121, P0122, P0123, P0221, P0222, P0223, P0336, and P0338 must run and pass.
- The engine is operating.
- The ignition voltage is between 10.7 – 18.0 volts.
- The fuel system is in fuel shut-off mode.
- The calculated exhaust temperature is less than 750°C.
- The heated oxygen sensors are at operating temperature.
- DTC P2626 and P2629 runs continuously once the above conditions are met.

Conditions for Setting the DTC

- The ECM internal HO2S voltage is more than 4.81 volts.
- The condition exists for more than 4 seconds or 600 seconds if the fuel level is less than 12 percent.

Action Taken When the DTC Sets

- The ECM illuminates the Check Powertrain icon, or the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the DTC

- The ECM turns OFF the Check Powertrain icon, or the malfunction indicator lamp (MIL) after four consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Use Tech 2 to clear the Check Powertrain icon, or the MIL and the DTC.

Additional Information

- Use the J 35616 Connector Test Adapter Kit for any test that requires probing the ECM harness connector or a component harness connector.
- The lower connector of the ECM is connector A43-X1 and the upper connector of the ECM is connector A43-X2. Refer to 2.2 ECM Connector End Views in this Section.
- The front wide band sensors do not toggle or switch like a switching HO2S. The front HO2S signals will be relatively stable for an idling engine.
- For an intermittent fault condition, refer to 4.2 Intermittent Fault Conditions in this Section.
- Since fault condition in a wiring connector may trigger DTCs, always test the connectors related to this diagnostic procedure for shorted terminals or poor wiring connection before replacing any component. Refer to Section 12P Wiring Diagrams for information on electrical fault diagnosis.
- To assist diagnosis, refer to 2 Wiring Diagrams and Connector Charts in this Section for the system wiring diagram and connector charts.
- The following table illustrates the typical voltages for the HO2S circuits:

HO2S Voltages	
Conditions: • Ignition ON, Engine OFF • HO2S Disconnected	
HO2S Circuit	**Voltage**
Heater Control	4.6 – 5.0 V
Heater Supply Voltage	B+
Reference Voltage	2.6 – 3.1 V
Low Reference	2.2 – 2.7 V
Pump Current	Less than 0.5 A
Input Pump Current	Less than 0.5 A

Test Description

The numbers below refer to the step numbers on the diagnostic table.

2 This step determines if the condition exists. The HO2S lambda parameter should react immediately to the changes in throttle position when performing this test.

5 This step determines if there is a condition with the pumping current circuit. Connecting a jumper wire between the reference voltage and the low reference circuits causes the ECM to command the pumping current and the input pumping current circuits.

DTC P2626, P2627, P2628, P2629, P2630 or P2631 Diagnostic Table

Step	Action	Value(s)	Yes	No
1	Has the Diagnostic System Check been completed?	—	Go to Step 2	Refer to 3.4 Diagnostic System Check
2	1 Start engine and allow to reach operating temperature. 2 Cycle the throttle from idle to wide open throttle (WOT), 3 times within 5 seconds. 3 Use Tech 2 to observe the affected HO2S lambda value Does the affected HO2S lambda value react immediately to the above action?	—	Go to Step 3	Go to Step 4
3	1 Observe the Freeze Frame / Failure Records for this DTC. 2 Turn OFF the ignition for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame / Failure Records. Does P2626 P2627, P2628, P2629, P2630 or P2631 fail this ignition?	—	Go to Step 4	Go to Additional Information in this DTC
4	Is DTC P0131, P0132, P0151 or P0152 also set?	—	Go to the appropriate DTC Table in this Section	Go to Step 5
5	1 Ignition OFF. 2 Disconnect the appropriate heated oxygen sensor (HO2S). 3 Ignition ON, engine OFF. 4 Connect a 3-amp fused jumper wire between the reference voltage circuit and the low reference circuit of the HO2S. 5 Measure the voltage between the pump current circuit and a good ground. Is the voltage more than the specified value?	1.0 V	Go to Step 7	Go to Step 6
6	1 Test the pump current circuit of the HO2S for an open. Refer to Section 12P Wiring Diagrams. Did you find and correct the condition?	—	Go to Step 11	Go to Step 8
7	1 Test for an intermittent and for a poor connection at the appropriate HO2S. Refer to Section 12P Wiring Diagrams. Did you find and correct the condition?	—	Go to Step 11	Go to Step 9
8	1 Test for an intermittent and for a poor connection at the engine control module (ECM). Refer to Section 12P Wiring Diagrams. Did you find and correct the condition?	—	Go to Step 11	Go to Step 10

9	1 Replace the HO2S. Refer to Refer to Section 6C1-3 Engine Management – V6 – Service Operations. Did you complete the replacement?	—	Go to Step 11	—
10	1 Replace the ECM. Refer to Section 6C1-3 Engine Management –V6 – Service Operations for details on replacing the ECM. Did you complete the replacement?	—	Go to Step 11	—
11	1 Use Tech 2 to clear the DTCs. 2 Turn OFF the ignition for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame / Failure Records. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 12
12	1 Using Tech 2, select the DTC display function. Does Tech 2 display any DTCs?	—	Go to the appropriate DTC Table in this Section	System OK
When all diagnosis and repairs are completed, clear all DTCs and verify correct operation				

6.65 DTC U0001

DTC Descriptor

This diagnostic procedure supports DTC U0001 – No Communication with CAN-Bus (High Speed).

Circuit Description

The engine control module (ECM) communicates directly with the control modules connected to the GM LAN serial data communication circuit through the GM LAN protocol.

However, the body control module (BCM) along with control modules connected to the (UART) serial data communication circuit communicate with each other using the UART protocol. Refer to Section 12J Body Control Module for information on the UART serial data communication circuit.

Since the GM LAN and UART protocols are not compatible, a powertrain interface module (PIM) is integrated into the serial data communication system to serve as a gateway. This gateway allows communication between the two protocols. Refer to Section 6E1 Powertrain Interface Module – V6 for further information on the GM LAN serial data communication circuit.

DTC U0001 sets if the ECM detects a fault condition in the serial data communication circuit.

Conditions for Running the DTC

DTC U0001 runs continuously when the following conditions are met:

The ignition voltage is 10.0 – 16.0 V.

The vehicle power mode requires serial data communication.

Conditions for Setting the DTC

The ECM detects a specified number of transmitted messages are not valid.

Conditions for Clearing the DTC

The Serial Data Communication Circuit DTCs are Type 'C' DTCs. Refer to 1.4 Diagnostic Trouble Codes in this Section for action taken when a Type 'C' DTC sets and conditions for clearing Type 'C' DTCs.

Additional Information

- Refer to Section 6C1-1 Engine Management – V6 – General Information for details of the ECM operation.
- Since fault condition in a wiring connector may trigger DTCs, always test the connectors related to this diagnostic procedure for shorted terminals or poor wiring connection before replacing any component. Refer to Section 12P Wiring Diagrams for information on electrical fault diagnosis.
- For an intermittent fault condition, refer to 4.2 Intermittent Fault Conditions in this Section.
- To assist diagnosis, refer to 2 Wiring Diagrams and Connector Charts in this Section for the system wiring diagram and connector charts.

Test Description

The following number refers to the step numbers in the diagnostic table:

1 The following tests are included in the Diagnostic System Check.

- Tests the integrity of the GM LAN serial data communication circuit.
- Tests for fault conditions on the vehicle theft deterrent system stored in the BCM.

DTC U0001 Diagnostic Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been performed?	Go to Step 2	Refer to 3.4 Diagnostic System Check
2	1 Switch off the ignition for 30 seconds. 2 Operate the vehicle within the conditions for running the DTC. 3 Using Tech 2, select the DTC display function. Does DTC U0001 fail this ignition cycle?	Go to Step 3	Refer to Additional Information in this DTC
3	Replace the ECM. Refer to Section 6C1-3 Engine Management – V6 – Service Operations. Was the repair completed?	Go to Step 4	—
4	1 Using Tech 2, clear the DTCs. 2 Switch off the ignition for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the conditions for running the DTC. Does DTC U0001 fail this ignition cycle?	Go to Step 2	Go to Step 5
5	Using Tech 2, select the DTC display function. Are there any DTCs displayed?	Go to the appropriate DTC Table in this Section	System OK
When all diagnosis and repairs are completed, check the system for correct operation.			

6.66 DTC U0101

DTC Description

This diagnostic procedure supports the following DTC:

- DTC U0101 – CAN-Bus No Communication With TCM (Transmission Control Module)

Circuit Description

The engine control module (ECM) communicates directly with the transmission control module (TCM) and other control modules connected to the GM LAN serial data communication circuit through the GM LAN protocol.

However, the body control module (BCM) along with control modules connected to the universal asynchronous receive and transmit (UART) serial data communication circuit communicates with each other through the UART protocol. Refer to Section 12J Body Control Module for information on the UART serial data communication circuit.

Since the GM LAN and UART protocols are not compatible, a powertrain interface module (PIM) is integrated into serial data communication system to serve as a gateway. This gateway allows communication between the two protocols. Refer to Section 6E1 Powertrain Interface Module – V6 for further information on the GM LAN serial data communication circuit.

A serial data communication circuit – TCM DTC sets if the ECM detects an invalid signal from the TCM.

Conditions for Running the DTC

DTC U0101 runs continuously when the following conditions are met:

- The ignition is on for longer than 3 seconds.
- The ignition voltage is 10.0 – 16.0 V.

Conditions for Setting the DTC

The ECM did not receive a valid signal from the TCM within the specified time frame.

Conditions for Clearing the DTC

This Serial Data Communication Circuit DTC is a Type C DTC. Refer to 1.4 Diagnostic Trouble Codes in this Section for action taken when a Type C DTC sets and the conditions required for clearing Type C DTCs.

Additional Information

- Refer to Section 6C1-1 Engine Management – V6 – General Information for details of the ECM operation.
- Since fault condition in a wiring connector may trigger DTCs, always test the connectors related to this diagnostic procedure for shorted terminals or poor wiring connection before replacing any component. Refer to Section 12P Wiring Diagrams for information on electrical fault diagnosis.
- For an intermittent fault condition, refer to 4.2 Intermittent Fault Conditions in this Section.
- To assist diagnosis, refer to 2 Wiring Diagrams and Connector Charts in this Section for the system wiring diagram and connector charts.

Test Description

The following number refers to the step numbers in the diagnostic table:

1 The following tests are included in the Diagnostic System Check.

   - Tests the integrity of the GM LAN serial data communication circuit.
   - Tests for fault conditions on the vehicle theft deterrent system stored in the BCM.

DTC P0864 and U0101 Diagnostic Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been performed?	Go to Step 2	Refer to 3.4 Diagnostic System Check
2	1 Switch off the ignition for 30 seconds. 2 Operate the vehicle within the conditions for running the DTC. 3 Using Tech 2, select the DTC display function. Does DTC U0101 fail this ignition cycle?	Go to Step 3	Refer to Additional Information in this DTC
3	Using Tech 2, attempt to communicate with the PIM. Does the PIM failed to communicate?	Refer to the Section 6E1 Powertrain Interface Module – V6	Go to Step 4
4	Are DTCs also set in the PIM?	Refer to Section 6E1 Powertrain Interface Module – V6	Go to Step 5
5	Are DTCs that may trigger a fault condition in the serial data communication circuit also set in the TCM?	Refer to Section 7C2 Automatic Transmission – 4L60E – Electrical Diagnosis or Section 7E2 Automatic Transmission – 5L40E – Electrical Diagnosis	Go to Step 6
6	Replace the TCM, refer to Section 7C4 Automatic Transmission – 4L60E – On-vehicle Servicing or Section 7E4 Automatic Transmission – 5L40-E – On-vehicle Servicing. Was the repair completed?	Go to Step 7	—
7	1 Using Tech 2, clear the DTCs. 2 Switch off the ignition for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the conditions for running the DTC. Does any of the serial data communication circuit – TCM DTCs fail this ignition cycle?	Go to Step 2	Go to Step 8
8	Using Tech 2, select the DTC display function. Does Tech 2 display any DTCs?	Go to the appropriate DTC Table in this Section	System OK
When all diagnosis and repairs are completed, check the system for correct operation.			

6.67 DTC U0121 or U0415

DTC Descriptors

This diagnostic procedure supports the following DTCs:

- DTC U0121 – CAN-Bus No Communication With ABS / TC / ESP
- DTC U0415 – CAN-Bus Invalid Data ABS / TC / ESP

Circuit Description

The engine control module (ECM) communicates directly with the ABS / TCS / ESP electronic control unit (ECU) and other control modules connected to the GM LAN serial data communication circuit through the GM LAN protocol.

However, the body control module (BCM) along with control modules connected to the universal asynchronous receive and transmit (UART) serial data communication circuit communicate with each other using the UART protocol. Refer to Section 12J Body Control Module for information on the UART serial data communication circuit.

Since the GM LAN and UART protocols are not compatible, a powertrain interface module (PIM) is integrated into the serial data communication system to serve as a gateway. This gateway allows communication between the two protocols. Refer to Section 6E1 Powertrain Interface Module – V6 for further information on the GM LAN serial data communication circuit.

DTC U0415 – Controller Area Network Invalid Signal from the TCS sets if the ECM detects an invalid signal from the ABS / TCS / ESP ECU.

Conditions for Running the DTC

DTC U0121 and U0415 runs continuously when the following conditions are met:

- The ignition is on for longer than 3 seconds.
- The ignition voltage is 10.0 – 16.0 V.

Conditions for Setting the DTC

The ECM did not receive a valid signal from the ECU of the ABS / TCS / ESP.

Conditions for Clearing the DTC

The Serial Data Communication Circuit DTCs are Type C DTCs. Refer to 1.4 Diagnostic Trouble Codes in this Section for action taken when a Type C DTC sets and conditions for clearing Type C DTCs.

Additional Information

- Refer to Section 6C1-1 Engine Management – V6 – General Information for details of the ECM operation.
- Since fault condition in a wiring connector may trigger DTCs, always test the connectors related to this diagnostic procedure for shorted terminals or poor wiring connection before replacing any component. Refer to Section 12P Wiring Diagrams for information on electrical fault diagnosis.
- For an intermittent fault condition, refer to 4.2 Intermittent Fault Conditions in this Section.
- To assist diagnosis, refer to 2 Wiring Diagrams and Connector Charts in this Section for the system wiring diagram and connector charts.

Test Description

The following number refers to the step numbers in the diagnostic table:

1 The following tests are included in the Diagnostic System Check.
   - Tests the integrity of the GM LAN serial data communication circuit.
   - Tests for fault conditions on the vehicle theft deterrent system stored in the BCM.

DTC U0121 or U0415 Diagnostic Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been performed?	Go to Step 2	Refer to 3.4 Diagnostic System Check
2	1 Switch off the ignition for 30 seconds. 2 Operate the vehicle within the conditions for running the DTC. 3 Using Tech 2, select the DTC display function. Does DTC U0121 and U0415 fail this ignition cycle?	Go to Step 3	Refer to Additional Information in this DTC
3	Using Tech 2, attempt to communicate with the PIM. Does the PIM fail to communicate?	Refer to the Section 6E1 Powertrain Interface Module – V6	Go to Step 4
4	Are DTCs also set in the PIM?	Refer to Section 6E1 Powertrain Interface Module – V6	Go to Step 5
5	Are DTCs that may trigger a fault condition in the serial data communication circuit also set in the ABS / TCS / ESP ECU?	Refer to Section 5 ABS / TCS / ESP General Information	Go to Step 6
6	Replace the ABS / TCS / ESP ECU. Refer to Section 5B ABS / TCS / ESP General Information. Was the repair completed?	Go to Step 7	—
7	1 Using Tech 2, clear the DTCs. 2 Switch off the ignition for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the conditions for running the DTC. Does any of the serial data communication circuit DTCs fail this ignition cycle?	Go to Step 2	Go to Step 8
8	Using Tech 2, select the DTC display function. Does Tech 2 display any DTCs?	Go to the appropriate DTC Table in this Section	System OK
When all diagnosis and repairs are completed, check the system for correct operation.			

6.68 DTC U0155 or U0423

DTC Descriptors

This diagnostic procedure supports the following DTCs:

- DTC U0155 – CAN-Bus No Communication With Gateway
- DTC U0423 – CAN-Bus Invalid Data From Gateway

Circuit Description

The engine control module (ECM) communicates directly with the control modules connected to the GM LAN serial data communication circuit through the GM LAN protocol.

However, the body control module (BCM) along with control modules connected to the universal asynchronous receive and transmit (UART) serial data communication circuit communicate with each other using the UART protocol. Refer to Section 12J Body Control Module for information on the UART serial data communication circuit.

Since the GM LAN and UART protocols are not compatible, a powertrain interface module (PIM) is integrated into the serial data communication system to serve as a gateway. This gateway allows communication between the two protocols. Refer to Section 6E1 Powertrain Interface Module – V6 for further information on the GM LAN serial data communication circuit.

A PIM serial data communication circuit DTC sets if the ECM detects an invalid signal from the PIM.

Conditions for Running the DTC

DTCs U0155 and U0423 run continuously when the following conditions are met:

- The engine is running.
- The ignition voltage is 10.0 – 16.0 V.

Conditions for Setting the DTC

The ECM did not receive a valid signal from the PIM within the specified time frame.

Conditions for Clearing the DTC

The PIM serial data communication circuit DTCs are Type C DTCs. Refer to 1.4 Diagnostic Trouble Codes in this Section for action taken when a Type C DTC sets and conditions for clearing Type C DTCs.

Additional Information

- Refer to Section 6C1-1 Engine Management – V6 – General Information for details of the ECM operation.
- Since fault condition in a wiring connector may trigger DTCs, always test the connectors related to this diagnostic procedure for shorted terminals or poor wiring connection before replacing any component. Refer to Section 12P Wiring Diagrams for information on electrical fault diagnosis.
- For an intermittent fault condition, refer to 4.2 Intermittent Fault Conditions in this Section.
- To assist diagnosis, refer to 2 Wiring Diagrams and Connector Charts in this Section for the system wiring diagram and connector charts.

Test Description

The following number refers to the step numbers in the diagnostic table:

1 The following tests are included in the Diagnostic System Check.

  - Tests the integrity of the GM LAN serial data communication circuit.
  - Tests for fault conditions on the vehicle theft deterrent system stored in the BCM.

DTC U0155 or U0423 Diagnostic Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been performed?	Go to Step 2	Refer to 3.4 Diagnostic System Check
2	1 Switch off the ignition for 30 seconds. 2 Operate the vehicle within the conditions for running the DTC. 3 Using Tech 2, select the DTC display function. Does DTC U0155, or U0423 fail this ignition cycle?	Go to Step 3	Refer to Additional Information in this DTC
3	Replace the PIM. Refer to Section 6E1 Powertrain Interface Module – V6. Was the repair completed?	Go to Step 4	—
4	1 Using Tech 2, clear the DTCs. 2 Switch off the ignition for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the conditions for running the DTC. Does any of the PIM serial data communication circuit DTCs fail this ignition cycle?	Go to Step 2	Go to Step 5
5	Using Tech 2, select the DTC display function. Does Tech 2 display any DTCs?	Go to the appropriate DTC Table in this Section	System OK
When all diagnosis and repairs are completed, check the system for correct operation.			

7 V6 Engine – Tech 2 Functions

7.1 Introduction

CAUTION

Do not use a Tech 2 that displays faulty data; have the Tech 2 repaired. The use of a faulty Tech 2 can result in misdiagnosis and the unnecessary replacement of parts.

From the Main Menu, having selected **Diagnostics / 2006 / VZ and WL Series / Engine**, the Tech 2 functions for the HFV6 engine, include:

F0: Diagnostic Trouble Codes

F1: Data Display

F2: OBD Data

F3: Snapshot

F4: Actuator Test

F5: Additional Functions

F6: Programming

7.2 Tech 2 Functions

F0: Diagnostic Trouble Codes

When this test mode is initiated, DTCs stored by the ECM can be displayed or cleared. When entered, there are three additional modes for selection:

F0: **Read DTC Information**: All DTCs stored in the ECM will be displayed.

F1: **Clear Engine & Transmission DTCs**: Clears all current DTCs in the ECM and TCM memories.

F2: **Freeze Frame / Failure Records**: The ECM records certain vehicle operating conditions when a type 'A' or 'B' (emission related) DTC is stored as a history DTC. Only one Freeze Frame record is stored for the first failed test that sets the DTC and activates the MIL.
Because of the limitations of the Freeze Frame, Failure Records have been created to cater for the situation where multiple DTCS are set or when the DTC is not emission related (type 'C'). Failure Records have similar data parameters to the Freeze Frame record.

Refer to Section 0C TECH 2 for more specific information relating to this selection.

F1: Data Display

- Use the Tech 2 Data List under the following conditions:
- The Diagnostic System Check – V6 Engine has been completed.
- The On-Board Diagnostics are functioning correctly.
- No DTCs are present.

NOTE

- Tech 2 values from an engine that is operating correctly may be used for comparison with the engine you are diagnosing. The Tech 2 engine data lists represent typical values that would be seen on a normal operating engine.
- The Tech 2 Data Definitions list that follows the Data Lists, is arranged in alphabetical order and contains a brief description of all of the engine related parameters that are available.

When 'F1 Data Display' is selected, there are 13 data lists provided, that can save time when diagnosing symptomatic conditions.

Engine Data 1

Engine Data 2

EVAP Data

Fuel Trim Data

O2 Sensor Data

TAC Data (Throttle Actuator Control)

Camshaft Position Actuator Data

Cooling/HVAC Data

Cruise/Traction Data

Electrical/Theft Data

Instrument Data

ODM Data (Output Driver Module)

Misfire Data

F2: OBD Data

In this test mode, Tech 2 displays engine management data parameters relating to the OBD (On Board Diagnostic) for the engine being diagnosed. Refer to 7.5 OBD Data for specific detail.

F3: Snapshot

In this test mode, Tech 2 captures data before and after a snapshot triggering event that may or may not set a DTC. For more specific information relating to the use of this Tech 2 feature, refer to Section 0C TECH 2.

F4: Actuator Test

In this test mode, Tech 2 performs software override commands to the ECM, to assist in problem isolation during diagnostics. When entering this mode, there are 12 actuators that can be tested for operational integrity. The 12 tests available are:

CMP Actuator System

Fan Relays

Fuel Pump Relay Test

Electronic Throttle Control Test

A/C Relay Test

Alternator L Terminal

EVAP Purge Solenoid

Int. Manifold Runner Ctrl. Sol. (available for Alloytec 190 / High Output engine only)

Engine Speed Control

Starter Relay Test

Fuel Injector Balance

F5: Additional Functions

When this selection is made from the Tech 2 screen, an additional two choices are provided:

F0: System Identification: In this mode, Tech 2 will display the engine identification screen and the vehicle VIN.

F1: Security Information: When selected, this mode displays various engine management data parameters relating to the security system.

F6: Programming

Within this selection, there are five programming selections available:

F0: BCM Link to ECM/PIM

F1: Reset ECU

F2: Fuel Trim Reset

F3: Reset Engine Oil Life

F4: Throttle Body Relearn

7.3 HFV6 Engine Data Lists

The following 'typical' Tech 2 values were recorded under the following conditions:

Ignition ON:	**Engine Running**
• Engine stopped, ignition in the ON position.	• Engine running.
• Closed throttle.	• Closed throttle.
• Transmission selector in the Park position (Automatic Transmission) or Neutral (Manual Transmission).	• Transmission selector in the Park position (Automatic Transmission) or Neutral (Manual Transmission).
• Engine, transmission at ambient temperature.	• Engine, transmission at normal operating temperature.
• Accessories are OFF.	• Accessories are OFF.
• Brake pedal not applied.	• Brake pedal not applied.

NOTE

The values quoted in the following data lists are only intended to provide the Technician with an indication of the values to be expected.

Engine Data 1

Tech 2 Display	Units Displayed	Ignition On	Engine Running
Engine Speed	RPM	0	639
Desired Engine Idle Speed	RPM	600	640
Coolant Temperature	°C	50	63
Intake Air Temperature	°C	29	31
Mass Air Flow	g/s	0.00	3.91
Engine Load	%	100	25
Volumetric Efficiency	%	99	17
Calculated Pedal Position	%	0	0
Desired Throttle Position	%	4	1
Calculated Throttle Position	%	5	1
Barometric Pressure	kPa	101	101
Barometric Pressure	V	4.86	4.86
Loop Status B1S1 (Bank 1 Sensor 1)	Open / Closed	Open	Closed
Loop Status B2S1 (Bank 2 Sensor 1)	Open / Closed	Open	Closed
B1S1 O2 Sensor (Bank 1 Sensor 1)	:1 (= Lambda)	0.99	0.99
B1S2 O2 Sensor (Bank 1 Sensor 2)	mV	442	455
B2S1 O2 Sensor (Bank 2 Sensor 1)	:1 (= Lambda)	1.00	0.99
B2S2 O2 Sensor (Bank 2 Sensor 2)	mV	442	451
B1 Short Term Fuel Trim (Bank 1)	%	0	–1
B1 LTFT Idle / Deceleration (Bank 1 Long Term Fuel Trim)	%	2	1
B1 LTFT Cruise / Acceleration (Bank 1 Long Term Fuel Trim)	%	0	0

B2 Short Term Fuel Trim (Bank 2)	%	0	–1
B2 LTFT Idle / Deceleration (Bank 2 Long Term Fuel Trim)	%	2	1
B2 LTFT Cruise / Acceleration (Bank 2 Long Term Fuel Trim)	%	–1	–1
(2) Transmission Gear	P-N / In Gear	P-N	P-N
EVAP Purge Solenoid (Evaporative Emission)	%	0	0
Fuel Level	L	31	31
Spark Advance	°CA	0	9
B1 Knock Sensor Signal (Bank 1)	V	3.6	0.9
B2 Knock Sensor Signal (Bank 2)	V	3.6	0.8
Knock Retard	°CA	0	0
Knock Retard Cylinder 1	°CA	0	0
Knock Retard Cylinder 2	°CA	0	0
Knock Retard Cylinder 3	°CA	0	0
Knock Retard Cylinder 4	°CA	0	0
Knock Retard Cylinder 5	°CA	0	0
Knock Retard Cylinder 6	°CA	0	0
Ignition Accessory Signal	Off / On	On	On
Ignition On Signal	Off / On	On	On
Malfunction Indicator (MI)	Off / On / Flashing	On	Off
Fuel Pump Relay	Off / On	Off	On
(1) IMRC Solenoid (Intake Manifold Runner Control)	Off / On	Off	Off
Engine Control Ignition Relay	Off / On	On	On
Engine Control Ignition Relay Feedback	V	12.4	14.1
(2) Actual Gear – With the ignition ON, only '5' will be displayed in the forward ranges. The display changes to '1' with the engine running, as this is the '*actual*' gear.	-1- / -2- / -3- / -4- / -5- / -P/N- / -R- / -Invalid-	-P/N-	-P/N-
Brake Lamp Switch	Inactive / Active	Inactive	Inactive
Extended Travel Brake Pedal Switch	Inactive / Active	Inactive	Inactive
Reduced Engine Power	Inactive / Active	Inactive	Inactive
DTC Set This Ignition	No DTC / DTC Set	No DTC	No DTC
Vehicle Speed	km/h	0	0
Engine Runtime	h:m:s	00:00:00	00:05:54
(3) Clutch Pedal Switch	Inactive / Active	Inactive	Inactive
(1) Alloytec 190 / High Output Engine Only (2) Automatic Transmission Only (3) Manual Transmission Only			

Engine Data 2

Tech 2 Display	Units Displayed	Ignition On	Engine Running
Engine Speed	RPM	0	601
Desired Engine Idle Speed	RPM	620	600
Coolant Temperature	°C	42	87
Calculated ECT – Closed Loop Fuel Control (Engine Coolant Temperature)	°C	50	49
Calculated ECT – Thermostat Diagnosis (Engine Coolant Temperature)	°C	28	48
Intake Air Temperature	°C	33	29
Start Up ECT (Engine Coolant Temperature)	°C	42	54
Start Up IAT (Intake Air Temperature)	°C	–48	36
Mass Air Flow Sensor	V	1.00	1.2
Mass Air Flow	g/s	0.00	3.45
Engine Load	%	100	23
Volumetric Efficiency	%	99	15
Power Enrichment	No / Yes	No	No
Dec. Fuel Cutoff (Deceleration)	Inactive / Active	Inactive	Inactive
Calculated Pedal Position	%	0	0
Desired Throttle Position	%	4	1
Calculated Throttle Position	%	5	1
Barometric Pressure	kPa	101	101
Barometric Pressure	V	4.86	4.86
Loop Status B1S1 (Bank 1 Sensor 1)	Open / Closed	Open	Closed
Loop Status B2S1 (Bank 2 Sensor 1)	Open / Closed	Open	Closed
B1 Short Term Fuel Trim (Bank 1)	%	0	0
B1 LTFT Idle / Deceleration (Bank 1 Long Term Fuel Trim)	%	2	1
B1 LTFT Cruise / Acceleration (Bank 1 Long Term Fuel Trim)	%	0	0
B2 Short Term Fuel Trim (Bank 2)	%	0	–2
B2 LTFT Idle / Deceleration (Bank 2 Long Term Fuel Trim)	%	2	1
B2 LTFT Cruise / Acceleration (Bank 2 Long Term Fuel Trim)	%	–1	–1
Injection Time Cylinder 1	ms	0.00	2.3
Injection Time Cylinder 2	ms	0.00	2.2
Injection Time Cylinder 3	ms	0.00	2.3
Injection Time Cylinder 4	ms	0.00	2.2
Injection Time Cylinder 5	ms	0.00	2.3
Injection Time Cylinder 6	ms	0.00	2.2
Spark Advance	°CA	0	10

Ignition Accessory Signal	Off / On	On	On
Ignition On Signal	Off / On	On	On
(2) Transmission Gear	P-N / In Gear	P-N	P-N
(2) Actual Gear – With the ignition ON, only '5' will be displayed in the forward ranges. The display changes to '1' with the engine running, as this is the '*actual*' gear.	-1- / -2- / -3- / -4- / -5- / -P/N- / -R- / -Invalid-	-P/N-	-P/N-
Fuel Pump Relay	Off / On	Off	On
Fan Relay 1	Off / On	Off	Off
Fan Relay 2 and 3	Off / On	Off	Off
A/C Relay (Air Conditioning)	Off / On	Off	Off
(2) Transmission Gear Selector Signal	Valid / Invalid	Valid	Valid
Distance Since DTC Cleared	km	1280	1280
Reduced Engine Power	Inactive / Active	Inactive	Inactive
Vehicle Speed	km/h	0	0
Engine Runtime	h:m:s	00:00:00	00:09:58
(1) Alloytec 190 / High Output Engine Only (2) Automatic Transmission Only (3) Manual Transmission Only			

EVAP Data

Tech 2 Display	Units Displayed	Ignition On	Engine Running
EVAP Purge Solenoid (Evaporative Emission)	%	0	9
Fuel Level	L	31	28
Fuel Level Sensor	V	2.20	2.27
Time Since Engine Off	h:m:s	00:12:30	00:12:30
Engine Speed	RPM	0	598
Desired Engine Idle Speed	RPM	620	600
Coolant Temperature	°C	41	92
Start Up ECT (Engine Coolant Temperature)	°C	41	54
Start Up IAT (Intake Air Temperature)	°C	–48	36
Intake Air Temperature	°C	33	29
Mass Air Flow Sensor	V	1.0	1.2
Engine Load	%	100	23
Volumetric Efficiency	%	99	15
Calculated Pedal Position	%	0	0
Desired Throttle Position	%	4	1
Calculated Throttle Position	%	5	1
Barometric Pressure	kPa	101	101
Loop Status B1S1 (Bank 1 Sensor 1)	Open / Closed	Open	Closed
Loop Status B2S1 (Bank 2 Sensor 1)	Open / Closed	Open	Closed
B1S1 O2 Sensor (Bank 1 Sensor 1)	:1 (=Lambda)	0.99	0.99
B2S1 O2 Sensor (Bank 2 Sensor 1)	:1 (=Lambda)	0.99	0.99
B1 Short Term Fuel Trim (Bank 1)	%	0	1
B1 LTFT Idle / Deceleration (Bank 1 Long Term Fuel Trim)	%	2	1
B1 LTFT Cruise / Acceleration (Bank 1 Long Term Fuel Trim)	%	0	0
B1 Total Fuel Trim (Bank 1)	%	1	7
B2 Short Term Fuel Trim (Bank 2)	%	0	–2
B2 LTFT Idle / Deceleration (Bank 2 Long Term Fuel Trim)	%	2	1
B2 LTFT Cruise / Acceleration (Bank 2 Long Term Fuel Trim)	%	–1	–1
B2 Total Fuel Trim (Bank 2)	%	0	3
Fuel Trim Learn	Disabled / Enabled	Disabled	Disabled
Ignition Accessory Signal	Off / On	On	On
Ignition On Signal	Off / On	On	On
DTC Set This Ignition	No DTC / DTC Set	No DTC	No DTC
Vehicle Speed	km/h	0	0
Engine Runtime	h:m:s	00:00:00	00:12:44
Fuel Pump Relay	Off / On	Off	On
(1) Alloytec 190 / High Output Engine Only (2) Automatic Transmission Only (3) Manual Transmission Only			

Fuel Trim Data

Tech 2 Display	Units Displayed	Ignition On	Engine Running
B1 Short Term Fuel Trim (Bank 1)	%	0	0
B1 LTFT Idle / Deceleration (Bank 1 Long Term Fuel Trim)	%	2	1
B1 LTFT Cruise / Acceleration (Bank 1 Long Term Fuel Trim)	%	0	0
B1 Total Fuel Trim (Bank 1)	%	1	6
B2 Short Term Fuel Trim (Bank 2)	%	0	–2
B2 LTFT Idle / Deceleration (Bank 2 Long Term Fuel Trim)	%	2	1
B2 LTFT Cruise / Acceleration (Bank 2 Long Term Fuel Trim)	%	0	–1
B2 Total Fuel Trim (Bank 2)	%	1	2
Fuel Trim Learn	Disabled / Enabled	Disabled	Disabled
Loop Status B1S1 (Bank 1 Sensor 1)	Open / Closed	Open	Closed
Loop Status B2S1 (Bank 2 Sensor 1)	Open / Closed	Open	Closed
Injection Time Cylinder 1	ms	0.0	2.2
Injection Time Cylinder 2	ms	0.0	2.2
Injection Time Cylinder 3	ms	0.0	2.2
Injection Time Cylinder 4	ms	0.0	2.2
Injection Time Cylinder 5	ms	0.0	2.2
Injection Time Cylinder 6	ms	0.0	2.2
Requested Torque	%	99	99
Catalyst Protection Mode	Inactive / Active	Inactive	Inactive
B1 Catalyst Temperature (Bank 1)	°C	300	300
B2 Catalyst Temperature (Bank 2)	°C	300	300
B1S1 O2 Sensor (Bank 1 Sensor 1)	:1 (= Lambda)	0.99	0.99
B1S2 O2 Sensor (Bank 1 Sensor 2)	mV	4442	468
B2S1 O2 Sensor (Bank 2 Sensor 1)	:1 (= Lambda)	1.00	0.99
B2S2 O2 Sensor (Bank 2 Sensor 2)	mV	442	455
B1 Average Injection Time (Bank 1)	ms	0.0	2.1
B2 Average Injection Time (Bank 2)	ms	0.0	2.0
Power Enrichment	No / Yes	No	No
Dec. Fuel Cutoff (Deceleration)	Inactive / Active	Inactive	Inactive
EVAP Purge Solenoid (Evaporative Emission)	%	0	32
Engine Speed	RPM	0	600
Coolant Temperature	°C	39	96
Intake Air Temperature	°C	32	29
Start Up ECT (Engine Coolant Temperature)	°C	39	54
Start Up IAT (Intake Air Temperature)	°C	–48	36
Mass Air Flow Sensor	V	1.0	1.2

Engine Load	%	100	22
Volumetric Efficiency	%	99	15
Calculated Pedal Position	%	0	0
Calculated Throttle Position	%	5	1
Barometric Pressure	kPa	101	101
Barometric Pressure	V	4.86	4.86
Spark Advance	°CA	0	12
Ignition On Signal	Off / On	On	On
(2) Actual Gear – With the ignition ON, only '5' will be displayed in the forward ranges. The display changes to '1' with the engine running, as this is the '*actual*' gear.	-1- / -2- / -3- / -4- / -5- / -P/N- / -R- / -Invalid-	-P/N-	-P/N-
DTC Set This Ignition	No DTC / DTC Set	No DTC	No DTC
Vehicle Speed	km/h	0	0
Engine Runtime	h:m:s	00:00:00	00:17:50
Ignition Accessory Signal	Off / On	On	On
Mass Air Flow	g/s	0.00	3.25
(1) Alloytec 190 / High Output Engine Only (2) Automatic Transmission Only (3) Manual Transmission Only			

O2 Sensor Data

Tech 2 Display	Units Displayed	Ignition On	Engine Running
Loop Status B1S1 (Bank 1 Sensor 1)	Open / Closed	Open	Closed
Loop Status B2S1 (Bank 2 Sensor 1)	Open / Closed	Open	Closed
Commanded B1S1 O2 Sensor Value (Bank 1 Sensor 1)	:1 (= Lambda)	0.99	0.99
Commanded B2S1 O2 Sensor Value (Bank 2 Sensor 1)	:1 (= Lambda)	0.99	0.99
B1S1 O2 Sensor (Bank 1 Sensor 1)	:1 (= Lambda)	0.99	0.99
B1S2 O2 Sensor (Bank 1 Sensor 2)	mV	442	468
B2S1 O2 Sensor (Bank 2 Sensor 1)	:1 (= Lambda)	1.00	0.99
B2S2 O2 Sensor (Bank 2 Sensor 2)	mV	442	460
B1S1 O2 Sensor Heater (Bank 1 Sensor 1)	Ohm	540	78
B2S1 O2 Sensor Heater (Bank 2 Sensor 1)	Ohm	540	78
Commanded B1S1 O2 Sensor Heater (Bank 1 Sensor 1)	%	0.0	40.8
Commanded B2S1 O2 Sensor Heater (Bank 2 Sensor 1)	%	0.0	44.6
B1 Short Term Fuel Trim (Bank 1)	%	0	0
B1 LTFT Idle / Deceleration (Bank 1 Long Term Fuel Trim)	%	2	1
B1 LTFT Cruise / Acceleration (Bank 1 Long Term Fuel Trim)	%	0	0
B1 Total Fuel Trim (Bank 1)	%	1	7
B2 Short Term Fuel Trim (Bank 2)	%	0	–3
B2 LTFT Idle / Deceleration (Bank 2 Long Term Fuel Trim)	%	2	1
B2 LTFT Cruise / Acceleration (Bank 2 Long Term Fuel Trim)	%	–1	–1
B2 Total Fuel Trim (Bank 2)	%	0	2
Fuel Trim Learn	Disabled / Enabled	Disabled	Disabled
Power Enrichment	No / Yes	No	No
Dec. Fuel Cutoff (Deceleration)	Inactive / Active	Inactive	Inactive
Engine Speed	RPM	0	600
Coolant Temperature	°C	39	100
Intake Air Temperature	°C	32	30
Start Up ECT (Engine Coolant Temperature)	°C	39	54
Start Up IAT (Intake Air Temperature)	°C	–48	36
Mass Air Flow Sensor	V	1.0	1.2
Mass Air Flow	g/s	0.00	3.50
Engine Load	%	100	23
Volumetric Efficiency	%	99	15
Calculated Pedal Position	%	0	0
Calculated Throttle Position	%	5	1
Barometric Pressure	kPa	101	101
Barometric Pressure	V	4.86	4.86
Spark Advance	°CA	0	12
DTC Set This Ignition	No DTC / DTC Set	No DTC	No DTC
Vehicle Speed	km/h	0	0
Engine Runtime	h:m:s	00:00:00	00:22:04
(1) Alloytec 190 / High Output Engine Only (2) Automatic Transmission Only (3) Manual Transmission Only			

TAC Data (Throttle Actuator Control)

Tech 2 Display	Units Displayed	Ignition On	Engine Running
Reduced Engine Power	Inactive / Active	Inactive	Inactive
Calculated Pedal Position	%	0	0
Desired Throttle Position	%	4	1
Calculated Throttle Position	%	5	0
APP Sensor 1-2 Correlation (Accelerator Pedal Position Sensor)	Okay / Fault	Okay	Okay
TP Sensor 1-2 Correlation (Throttle Position)	Okay / Fault	Okay	Okay
APP Sensor 1 (Accelerator Pedal Position)	V	1.02	1.02
APP Sensor 2 (Accelerator Pedal Position)	V	0.47	0.49
TP Sensor 1 (Throttle Position)	V	0.71	0.57
TP Sensor 2 (Throttle Position)	V	4.29	4.45
TP Sensor 1 Learned Lower Position (Throttle Position)	V	0.53	0.53
TP Sensor 2 Learned Lower Position (Throttle Position)	V	4.49	4.49
Electronic Throttle Control Learn Counter	Counts	11	11
Brake Lamp Switch	Inactive / Active	Inactive	Inactive
Brake Switch Signal Status	Valid / Invalid	Valid	Valid
Initial Brake Apply Signal	Inactive / Active	Inactive	Inactive
Extended Travel Brake Pedal Switch	Inactive / Active	Inactive	Inactive
Engine Speed	RPM	0	601
Desired Engine Idle Speed	RPM	650	600
Coolant Temperature	°C	38	102
Intake Air Temperature	°C	32	30
Mass Air Flow Sensor	V	1.0	1.1
Mass Air Flow	g/s	0.00	3.22
Barometric Pressure	kPa	101	101
Barometric Pressure	V	4.86	4.86
Engine Load	%	100	22
Volumetric Efficiency	%	99	14
Ignition Accessory Signal	Off / On	On	On
Ignition On Signal	Off / On	On	On
Engine Control Ignition Relay	Off / On	On	On
Engine Control Ignition Relay Feedback	V	12.4	14.2
Traction Control	Active / Inactive	Inactive	Inactive
Requested Torque	%	99	99
DTC Set This Ignition	No DTC / DTC Set	No DTC	No DTC
Vehicle Speed	km/h	0	0
Engine Runtime	h:m:s	00:00:00	00:23:36
(1) Alloytec 190 / High Output Engine Only (2) Automatic Transmission Only (3) Manual Transmission Only			

Camshaft Position Actuator Data

Tech 2 Display	Units Displayed	Ignition On	Engine Running
B1 Commanded Intake Camshaft Position (Bank 1)	%	0	20
B1 Commanded Intake Camshaft Position (Bank 1)	°CA	0.0	0.0
B1 Actual Intake Camshaft Position (Bank 1)	°CA	0.0	0.0
(1) B1 Commanded Exhaust Camshaft Position (Bank 1)	%	0	20
(1) B1 Commanded Exhaust Camshaft Position (Bank 1)	°CA	0.0	0.0
(1) B1 Actual Exhaust Camshaft Position (Bank 1)	°CA	0.0	0.2
B2 Commanded Intake Camshaft Position (Bank 2)	%	0	20
B2 Commanded Intake Camshaft Position (Bank 2)	°CA	0.0	0.0
B2 Actual Intake Camshaft Position (Bank 2)	°CA	0.0	0.0
(1) B2 Commanded Exhaust Camshaft Position (Bank 2)	%	0	20
(1) B2 Commanded Exhaust Camshaft Position (Bank 2)	°CA	0.0	0.0
(1) B2 Actual Exhaust Camshaft Position (Bank2)	°CA	0.0	0.0
Engine Speed	RPM	0	600
Desired Engine Idle Speed	RPM	650	600
Coolant Temperature	°C	37	104
Intake Air Temperature	°C	32	31
Mass Air Flow	g/s	0.00	3.14
Mass Air Flow Sensor	V	1.0	1.1
Engine Load	%	100	21
Volumetric Efficiency	%	99	14
Calculated Pedal Position	%	0	0
Calculated Throttle Position	%	5	0
Barometric Pressure	kPa	101	101
Barometric Pressure	V	4.86	4.86
Ignition On Signal	Off / On	On	On
Oil Level	Normal / Low	Normal	Normal
Engine Oil Pressure	kPa	24	132
DTC Set This Ignition	No DTC / DTC Set	No DTC	No DTC
Vehicle Speed	km/h	0	0
Engine Runtime	h:m:s	00:00:00	00:25:51
Ignition Accessory Signal	Off / On	On	On
(1) Alloytec 190 / High Output Engine Only (2) Automatic Transmission Only (3) Manual Transmission Only			

Cooling/HVAC Data

Tech 2 Display	Units Displayed	Ignition On	Engine Running
Coolant Temperature	°C	37	105
Intake Air Temperature	°C	32	32
Fan Relay 1	Off / On	Off	Off
Fan Relay 2 and 3	Off / On	Off	Off
A/C Request	No / Yes	No	No
A/C Relay (Air Conditioning)	Off / On	Off	Off
A/C Pressure Sensor (Air Conditioning)	V	1.1	1.3
A/C Pressure Sensor (Air Conditioning)	kPa	822.25	1,016.60
A/C Cutoff Mode (Air Conditioning)	Inactive / Pressure / Max. Acceleration / Active	Inactive	Inactive
A/C Disengagement 1st History	Refer List Below	High Pressure	Engine Speed
A/C Disengagement 2nd History	Refer List Below	High Pressure	High Pressure
A/C Disengagement 3rd History	Refer List Below	High Pressure	High Pressure
A/C Disengagement 4th History	Refer List Below	High Pressure	High Pressure
A/C Disengagement 5th History	Refer List Below	High Pressure	High Pressure
A/C Disengagement 6th History	Refer List Below	High Pressure	High Pressure
A/C Disengagement 7th History	Refer List Below	High Pressure	High Pressure
A/C Disengagement 8th History	Refer List Below	High Pressure	High Pressure
Start Up ECT (Engine Coolant Temperature)	°C	37	54
Start Up IAT (Intake Air Temperature)	°C	–48	36
Engine Load	%	100	21
Volumetric Efficiency	%	99	14
Spark Advance	°CA	0	11
Knock Retard	°CA	0	0
Engine Speed	RPM	0	601
Vehicle Speed	km/h	0	0
Engine Runtime	h:m:s	00:00:00	00:27:32
A/C Disengagement History Units			
High Pressure / Engine Speed / Low Battery / Stall Prevention / Full Load / Performance / Engine Temp / Not Present			

Cruise/Traction Data

Tech 2 Display	Units Displayed	Ignition On	Engine Running
Cruise Control Switch	Inactive / Active	Inactive	Inactive
Cruise Control Active	No / Yes	No	No
Cruise Set / Decel Switch	Inactive / Active	Inactive	Inactive
Cruise Resume / Acceleration Switch	Inactive / Active	Inactive	Inactive
Cruise Control Disengagement Reason	Refer List Below	Brake	Brake
CC Disengagement 1st History (Cruise Control)	Refer List Below	Cancel	Cancel
CC Disengagement 2nd History (Cruise Control)	Refer List Below	Cancel	Cancel
CC Disengagement 3rd History (Cruise Control)	Refer List Below	Brake	Brake
CC Disengagement 4th History (Cruise Control)	Refer List Below	Brake	Brake
CC Disengagement 5th History (Cruise Control)	Refer List Below	Cancel	Cancel
CC Disengagement 6th History (Cruise Control)	Refer List Below	Cancel	Cancel
CC Disengagement 7th History (Cruise Control)	Refer List Below	Brake	Brake
CC Disengagement 8th History (Cruise Control)	Refer List Below	Brake	Brake
Vehicle Speed	km/h	0	0
Brake Lamp Switch	Inactive / Active	Inactive	Inactive
Brake Switch Signal Status	Valid / Invalid	Valid	Valid
Initial Brake Apply Signal	Inactive / Active	Inactive	Inactive
Extended Travel Brake Pedal Switch	Inactive / Active	Inactive	Inactive
Calculated Pedal Position	%	0	0
Desired Throttle Position	%	4	1
Calculated Throttle Position	%	5	1
Engine Speed	RPM	0	599
(2) Actual Gear – With the ignition ON, only '5' will be displayed in the forward ranges. The display changes to '1' with the engine running, as this is the '*actual*' gear.	-1- / -2- / -3- / -4- / -5- / -P/N- / -R- / -Invalid-	-P/N-	-P/N-
Spark Advance	°CA	0	10
Traction Control	Active / Inactive	Inactive	Inactive
Requested Torque	%	99	99

Cruise Control Disengagement Reason Units

Brake / Cancel / Clutch Diseng / Coasting / Throttle Control / Max. Acceleration / High Decel / High Speed / Illegal Mode / Low Speed / Not Present / Off / OverSpeed / PCM / Command Error / Traction / Ignition Off / Data Error / System Error / Engine Runtime / Engine Speed / DTCs Set / Injection Stop / First Gear / Accel Pedal Pos / Voltage Low / Manual Neutral / Over Limit

(1) Alloytec 190 / High Output Engine Only (2) Automatic Transmission Only (3) Manual Transmission Only

Electrical/Theft Data

Tech 2 Display	Units Displayed	Ignition On	Engine Running
Ignition On Signal	Off / On	On	On
Ignition Accessory Signal	Off / On	On	On
Engine Control Ignition Relay	Off / On	On	On
Engine Control Ignition Relay Feedback	V	12.4	14.2
Crank Request	Inactive / Active	Inactive	Inactive
Starter Relay	Off / On	Off	Off
(2) Transmission Gear	P/N / In Gear	P-N	P-N
(2) Actual Gear – With the ignition ON, only '5' will be displayed in the forward ranges. The display changes to '1' with the engine running, as this is the '*actual*' gear.	-1- / -2- / -3- / -4- / -5- / -P/N- / -R- / -Invalid-	-P/N-	-P/N-
(2) Actual Gear	Valid / Invalid	Valid	Valid
Alternator L Terminal Duty Cycle	%	0	99
Engine Speed	RPM	0	599
ECM Immobilized	No / Yes	No	No
(1) Alloytec 190 / High Output Engine Only (2) Automatic Transmission Only (3) Manual Transmission Only			

Instrument Data

Tech 2 Display	Units Displayed	Ignition On	Engine Running
Ignition On Signal	Off / On	On	On
Ignition Accessory Signal	Off / On	On	On
Vehicle Speed	km/h	0	0
Engine Speed	RPM	0	593
(2) Actual Gear – With the ignition ON, only '5' will be displayed in the forward ranges. The display changes to '1' with the engine running, as this is the '*actual*' gear.	-1- / -2- / -3- / -4- / -5- / -P/N- / -R- / -Invalid-	-P/N-	-P/N-
Coolant Temperature	°C	36	105
Fuel Level	L	31	31
Fuel Level Sensor	V	2.24	2.24
Engine Oil Pressure Sensor	Low / High	High	High
Engine Oil Pressure	kPa	24	132
Engine Oil Life Remaining	%	81	81
Oil Level	Normal / Low	Normal	Normal
Oil Temperature Sensor	°C	34	89
Malfunction Indicator (MI)	Off / On / Flashing	On	Off
Cruise Control Active	No / Yes	No	No
Reduced Engine Power	Inactive / Active	Inactive	Inactive
ECM Immobilized	No / Yes	No	No
(1) Alloytec 190 / High Output Engine Only (2) Automatic Transmission Only (3) Manual Transmission Only			

ODM Data (Output Driver Module)

Tech 2 Display	Units Displayed	Ignition On	Engine Running
A/C Relay Status	OK / Fault / Undefined Status	Undefined Status	Undefined Status
Cylinder 1 Injector Circuit Status	OK / Fault / Undefined Status	Undefined Status	OK
Cylinder 2 Injector Circuit Status	OK / Fault / Undefined Status	Undefined Status	OK
Cylinder 3 Injector Circuit Status	OK / Fault / Undefined Status	Undefined Status	OK
Cylinder 4 Injector Circuit Status	OK / Fault / Undefined Status	Undefined Status	OK
Cylinder 5 Injector Circuit Status	OK / Fault / Undefined Status	Undefined Status	OK
Cylinder 6 Injector Circuit Status	OK / Fault / Undefined Status	Undefined Status	OK
EVAP Purge Solenoid Valve Circuit Status (Evaporative Emission)	OK / Fault / Undefined Status	Undefined Status	OK
(1) B1 Exhaust Camshaft Position Solenoid Valve Circuit Status (Bank 1)	OK / Fault / Undefined Status	Undefined Status	OK
B1 Intake Camshaft Position Solenoid Valve Circuit Status (Bank 1)	OK / Fault / Undefined Status	Undefined Status	OK
(1) B2 Exhaust Camshaft Position Solenoid Valve Circuit Status (Bank 2)	OK / Fault / Undefined Status	Undefined Status	OK
B2 Intake Camshaft Position Solenoid Valve Circuit Status (Bank 2)	OK / Fault / Undefined Status	Undefined Status	OK
Fan Relay 1 Circuit Status	OK / Fault / Undefined Status	Undefined Status	Undefined Status
Fan Relay 2 and 3 Circuit Status	OK / Fault / Undefined Status	Undefined Status	Undefined Status
Fuel Pump Relay Circuit Status	OK / Fault / Undefined Status	Undefined Status	Undefined Status
B1S1 O2 Sensor Heater Circuit Status (Bank 1 Sensor 1)	OK / Fault / Undefined Status	Undefined Status	Undefined Status
B1S2 O2 Sensor Heater Circuit Status (Bank 1 Sensor 2)	OK / Fault / Undefined Status	Undefined Status	Undefined Status
B2S1 O2 Sensor Heater Circuit Status (Bank 2 Sensor 1)	OK / Fault / Undefined Status	Undefined Status	Undefined Status
B2S2 O2 Sensor Heater Circuit Status (Bank 2 Sensor 2)	OK / Fault / Undefined Status	Undefined Status	Undefined Status
(1) MRC Solenoid Circuit Status (Intake Manifold Runner Control)	OK / Fault / Undefined Status	Undefined Status	Undefined Status
Malfunction Indicator (MI) Circuit Status	OK / Fault / Undefined Status	Undefined Status	Undefined Status
Starter Relay Circuit Status	OK / Fault / Undefined Status	Undefined Status	Undefined Status
Engine Runtime	h:m:s	00:00:00	00:33:07
(1) Alloytec 190 / High Output Engine Only (2) Automatic Transmission Only (3) Manual Transmission Only			

Misfire Data

Tech 2 Display	Units Displayed	Ignition On	Engine Running
Cycles of Misfire	Counts	0	0 – 3000 (Increments)
Total Misfire	Counts	0	0
Misfire Current Cyl. #1	Counts	0	0
Misfire Current Cyl. #2	Counts	0	0
Misfire Current Cyl. #3	Counts	0	0
Misfire Current Cyl. #4	Counts	0	0
Misfire Current Cyl. #5	Counts	0	0
Misfire Current Cyl. #6	Counts	0	0
Misfire History Cyl. #1	Counts	0	0
Misfire History Cyl. #2	Counts	0	0
Misfire History Cyl. #3	Counts	0	0
Misfire History Cyl. #4	Counts	0	0
Misfire History Cyl. #5	Counts	0	0
Misfire History Cyl. #6	Counts	0	0
A/C Relay (Air Conditioning)	Off / On	Off	Off
Barometric Pressure	kPa	101	101
B1 Catalyst Temperature (Bank 1)	°C	300	300
B2 Catalyst Temperature (Bank 2)	°C	300	300
Catalyst Protection Mode	Inactive / Active	Inactive	Inactive
(2) Transmission Gear	P-N / In Gear	P-N	P-N
Coolant Temperature	°C	36	108
Engine Load	%	100	24
Engine Oil Pressure	kPa	24	116
Engine Runtime	h:m:s	00:00:00	00:34:40
Ignition On Signal	Off / On	On	On
Injection Time Cylinder 1	ms	0.0	2.3
Injection Time Cylinder 2	ms	0.0	2.2
Injection Time Cylinder 3	ms	0.0	2.1
Injection Time Cylinder 4	ms	0.0	2.1
Injection Time Cylinder 5	ms	0.0	2.1
Injection Time Cylinder 6	ms	0.0	2.1
B1 Average Injection Time (Bank 1)	ms	0.0	2.1
B2 Average Injection Time (Bank 2)	ms	0.0	2.1
Mass Air Flow Sensor	V	1.0	1.2
Mass Air Flow	g/s	0.00	3.19
Power Enrichment	No / Yes	No	No
Spark Advance	°CA	0	11
Calculated Throttle Position	%	5	1
Vehicle Speed	km/h	0	0
Volumetric Efficiency	%	99	14
(1) Alloytec 190 / High Output Engine Only (2) Automatic Transmission Only (3) Manual Transmission Only			

7.4 Tech 2 Data Definitions

NOTE

This listing is arranged in alphabetical order and defines each parameter shown in the Data Lists.

A/C Cutoff Mode (Air Conditioning): This parameter displays whether the control module is commanding the A/C compressor clutch relay OFF for a number of reasons, among which is; operating pressure outside given parameters or throttle position at wide open throttle (WOT).

A/C Disengagement 1 – 8 History: The parameter displays the last 8 air conditioning (A/C) compressor disengages in order from 1 to 8 with 8 being the most recent. There are 8 possible causes listed for the A/C compressor to disengage; High Pressure, Engine Speed, Battery Voltage, Stall Prevention, Full Load, Performance, Engine Temperature or Signal not Present. Any of these causes need to be outside calibrated values, to cause the A/C to disengage.

A/C Pressure Sensor (Air Conditioning): This parameter displays the voltage from the A/C high side pressure sensor signal circuit to the control module.

A/C Pressure Sensor (Air Conditioning): This parameter displays the pressure in kPa from the A/C high side pressure sensor signal circuit to the control module.

A/C Relay (Air Conditioning): This parameter displays the state of the A/C clutch relay control circuit, either as ‘ON’ or ‘OFF’.

A/C Relay Status: This parameter displays the state of the A/C request input to the control module from the heating, ventilation, and air conditioning (HVAC) controls.

A/C Request: Represents the commanded state of the A/C clutch control relay. Clutch should be engaged when ON is displayed.

Actual Exhaust Camshaft Position (Bank 1 or Bank 2): Only on the Alloytec 190 / High Output engine, this parameter displays the actual exhaust camshaft position in degrees of crankshaft angle.

Actual Gear: This parameter displays the transmission range input to the control module, determined directly from the decoding of the PRNDL – A, B, C, and P inputs from the transmission internal mode switch (IMS).

Actual Gear: Based on the evaluation of the PRNDL – A, B, C, and P inputs, the ECM determines whether the parameter is valid or invalid.

Actual Intake Camshaft Position (Bank 1 or Bank 2): This parameter displays the actual intake camshaft position in degrees of crankshaft angle.

Alternator L Terminal Duty Cycle: This parameter displays the ECM commanded state of the voltage regulator on the alternator, expressed as a percentage from 0 to 100.

APP Sensor 1 (Accelerator Pedal Position): This parameter displays the actual voltage on the APP sensor 1 signal circuit as measured by the ECM, that can range from 0.9 – 4.5 volts.

APP Sensor 2 (Accelerator Pedal Position): This parameter displays the actual voltage on the APP sensor 1 signal circuit as measured by the ECM, that can range from 0.45 – 2.25 volts.

APP Sensor 1 and 2 Correlation (Accelerator Pedal Position): This parameter displays ‘Okay’ under normal operating conditions or ‘Fault’ if the control module detects the signal voltage from APP sensor 1 that is not in the correct relationship to APP sensor 2.

Average Injection Time (Bank 1 or Bank 2): This parameter displays the average pulse width of the fuel injectors for each bank of the engine as determined by the ECM.

B1/B2 S1 O2 Sensor 1 (Bank 1 or Bank 2 Sensor 1): This parameter displays the lambda output from the HO2S to the ECM. A lambda below 1.0 indicates a rich exhaust, while a lambda above 1.0 indicates a lean exhaust.

B1/B2 S2 O2 Sensor 2 (Bank 1 or Bank 2 Sensor 2): This parameter displays the mV output from the HO2S to the ECM. A lower voltage indicates a lean exhaust, while a higher voltage indicates a rich exhaust.

B1/B2 S1 O2 Sensor Heater (Bank 1 or Bank 2 Sensor 1): This parameter displays the resistance of the sensing element within the ECM. The front sensors are normally regulated to 80 ohms.

B1/B2 S1/S2 O2 Sensor Heater Circuit Status (Bank 1 or Bank 2 Sensor 1 or Sensor 2): The parameter displays ‘Fault’ if the oxygen sensor heater control circuit is open, shorted to ground, or shorted to voltage. The parameter displays ‘Undefined’ until the circuit has been commanded ON.

Barometric Pressure: This parameter displays the barometric pressure in kPa. The ECM uses the barometric pressure for fuel control to compensate for altitude differences.

Barometric Pressure: This parameter displays the barometric pressure voltage. The control module uses the barometric pressure for fuel control to compensate for altitude differences.

Brake Lamp Switch: This parameter displays the serial data message of the brake signal from the antilock braking system, control module (ABS). Regardless of the braking variant (ABS / ABS-TCS or ABS-TCS / ESP) fitted to a V6 engined vehicle, the brake lamp switch signal is sent by the ABS control module.

Brake Switch Signal Status: This parameter displays the position of the torque converter clutch (TCC) brake pedal switch input to the ECM.

Calculated ECT – Closed Loop Fuel Control (Engine Coolant Temperature): This parameter displays the modelled temperature that the control module calculates from air entering the engine, coolant temperature, and ambient air temperature. If the actual engine coolant temperature does not reach this calculated temperature within a predetermined amount of time, a DTC will set.

Calculated ECT – Thermostat Diagnosis (Engine Coolant Temperature): This parameter displays the modelled temperature that the control module calculates from air entering the engine, coolant temperature, and ambient air temperature. If the actual engine coolant temperature does not reach this calculated temperature within a predetermined amount of time, a DTC will set.

Calculated Pedal Position: This parameter displays the angle of the accelerator pedal position (APP) as calculated by the ECM, using the signals from the APP sensors, as a percentage of throttle opening.

Calculated Throttle Position: This parameter displays the percentage of throttle opening, based on the two TP sensor inputs to the ECM.

Catalyst Protection Mode: This parameter displays if the control module is commanding catalytic converter protection or not.

Catalyst Temperature (Bank 1 or Bank 2): This parameter displays the catalytic converter temperature as calculated by the control module.

Clutch Pedal Switch: This parameter displays the state of the clutch pedal as determined by the ECM from the clutch start switch position.

Clutch Pedal Switch: This parameter displays the state of the clutch pedal as determined by the ECM from the clutch pedal switch.

Commanded Exhaust Camshaft Position (Bank 1 or Bank 2): This parameter displays the exhaust camshaft position in percent of range as commanded by the control module.

Commanded Exhaust Camshaft Position (Bank 1 or Bank 2): This parameter displays the exhaust camshaft position in crankshaft degrees, as commanded by the ECM.

Commanded Intake Camshaft Position (Bank 1 or Bank 2): This parameter displays the intake camshaft position in crankshaft degrees, as commanded by the ECM.

Commanded B1/B2 S1 O2 Sensor Heater (Bank 1 or Bank 2 Sensor 1): This parameter displays the state of the oxygen sensor heater control circuit, as a percentage.

Commanded B1/B2 S1 O2 Sensor Value (Bank 1 or Bank 2 Sensor 1): This parameter displays the lambda output from the HO2S to the ECM. A lambda below 1.0 indicates a rich exhaust, while a lambda above 1.0 indicates a lean exhaust.

Coolant Temperature: This parameter displays the temperature of the engine coolant based on input to the control module from the engine coolant temperature (ECT) sensor.

Crank Request: This parameter displays whether the ignition switch has been cycled to the crank position, requesting the ECM to activate the starter relay.

Cruise Control Active: This parameter displays the status of the cruise control system as determined by the ECM.

Cruise Control Switch: This parameter displays the state of the cruise control on / off switch input to the control module.

Cruise Control Disengagement Reason: The parameter displays which of a possible 28 causes for the cruise control to disengage.

CC Disengagement 1 – 8 History (Cruise Control): The parameter displays the last 8 cruise control disengages in order from 1 to 8, with 8 being the most recent. There are about 28 possible causes for the cruise control to disengage.

Cruise Resume / Acceleration Switch: This parameter displays the state of the cruise control resume / accel switch position input to the ECM.

Cruise Set / Decel Switch: This parameter displays the state of the cruise controls set / decel. switch position input to the ECM.

Cycles of Misfire: This parameter displays the number of misfire tests during 200 engine revolutions.

Cylinder 1 – 6 Injector Circuit Status: This parameter displays the state of the fuel injector control circuit. The parameter displays ‘Fault’ if the fuel injector control circuit is open, shorted to ground, or shorted to voltage. This parameter displays ‘Undefined Status’ until the control circuit has been commanded ‘On’.

Dec. Fuel Cutoff (Deceleration): This parameter displays the status of the ECM operating mode, used to turn off the fuel injectors and the evaporative emission (EVAP) canister purge valve during certain deceleration conditions.

Desired Engine Idle Speed: This parameter displays the desired engine idle speed as commanded by the ECM.

Desired Throttle Position: This parameter displays the desired throttle position (TP) angle commanded by the ECM.

Distance Since DTC Cleared: This parameter displays the distance (km) travelled since any diagnostic trouble code (DTC) has been cleared from the ECM memory.

DTC Set This Ignition: This parameter displays Yes if a DTC set on the current ignition cycle.

ECM Immobilized: This parameter displays ‘Yes’ when an internal control module reset occurs. Tech 2 will display ‘No’ under normal operating conditions.

Electronic Throttle Control Learn Counter: When the ECM performs a throttle body relearn procedure, the throttle plate is commanded to move from the rest position (7% open) to full closed (0%), then to around 10% open.
At the start of this procedure, the Tech 2 ‘TAC Learn Counter’ parameter should display 0, and then count up to 11 after the procedure is completed. If the counter did not start at 0 or if the counter did not end at 11, a fault has occurred and a DTC should set.

Engine Control Ignition Relay: This parameter displays the state of the control circuit for control module power relay as commanded by the ECM.

Engine Control Ignition Relay Feedback: This parameter displays the voltage available at the engine control ignition relay pin of the control module.

Engine Load: This parameter displays the calculated engine load in percent based on inputs to the control module from various engine sensors.

Engine Oil Life Remaining: This parameter displays the percentage of engine oil life remaining. The controller calculates the engine oil life by monitoring engine load, coolant temperature, and engine speed.

Engine Oil Pressure: This parameter displays the oil pressure in kPa from the ECM, developed from the engine oil pressure (EOP) sensor input.

Engine Oil Pressure Sensor: This parameter displays ‘High’ if the engine oil pressure is within the correct range. If the ECM detects that the engine oil pressure is not within the correct range, Tech 2 will display ‘Low’.

Engine Runtime: This parameter displays the time elapsed since the engine was started.

Engine Speed: This parameter displays the speed of the engine crankshaft rotation from information received from the CKP sensor. If there is a CKP sensor DTC, the ECM calculates the engine speed from one of the camshaft position (CMP) sensors.

EVAP Purge Solenoid (Evaporative Emission): This parameter displays the on-time or duty cycle of the EVAP canister purge solenoid commanded by the ECM. Zero percent indicates no purge. One hundred percent indicates full purge.

EVAP Purge Solenoid Valve Circuit Status (Evaporative Emission): This parameter displays the state of the EVAP purge solenoid control circuit. The parameter displays ‘Fault’ if the EVAP purge solenoid control circuit is open, shorted to ground, or shorted to voltage. The parameter displays ‘Undefined Status’ until the circuit has been established as ‘OK’.

Exhaust Camshaft Position Solenoid Valve Circuit Status (Bank 1 or Bank 2): This parameter displays the state of the exhaust camshaft actuator solenoid control circuit. The parameter displays Fault if the camshaft actuator solenoid control circuit is open, shorted to ground, or shorted to voltage. The parameter displays Indeterminate until the circuit has been commanded ON.

Extended Travel Brake Pedal Switch: This parameter displays the state of the brake pedal as determined by the ECM from the extended travel brake pedal switch position.

Fan Relay 1: This parameter displays the control module commanded state of the fan relay control circuit.

Fan Relay 2 and 3: This parameter displays the control module commanded state of the fan relay control circuit.

Fan Relay 1 Circuit Status: This parameter displays the state of the fan relay control circuit. The parameter displays ‘Fault’ if the fan relay control circuit is open, shorted to ground, or shorted to voltage. The parameter displays ‘Undefined’ until the relay control circuit has been determined as being ‘OK’.

Fan Relay 2 and 3 Circuit Status: This parameter displays the state of the fan relay control circuit. The parameter displays ‘Fault’ if the fan relay control circuit is open, shorted to ground, or shorted to voltage. The parameter displays ‘Undefined’ until the relay control circuit has been determined as being ‘OK’.

Fuel Level: This parameter displays the amount of fuel in the fuel tank in litres, as calculated by the ECM from data received from the fuel level sensor.

Fuel Level Sensor: This parameter displays the voltage received from the fuel level sensor in the fuel tank, by the ECM.

Fuel Pump Relay Circuit Status: This parameter displays the state of the fuel pump relay control circuit. The parameter displays ‘Fault’ if the fuel pump relay control circuit is open, shorted to ground, or shorted to voltage. The parameter displays ‘Undefined’ until the relay control circuit has been determined as being ‘OK’.

Fuel Pump Relay: This parameter displays the ECM commanded state of the fuel pump relay control circuit.

Fuel Trim Learn: This parameter displays ‘Enabled’ when conditions are appropriate for enabling long term fuel trim corrections. This indicates that the long term fuel trim is adapting continuing amounts of short term fuel trim. If Tech 2 displays ‘Disabled’, then long term fuel trim will not respond to changes in short term fuel trim.

Ignition Accessory Signal: This parameter displays ‘On’ when the control module detects a voltage at the ignition ‘ACC’ terminal, X1-4 of the ignition switch.

Ignition On Signal: This parameter displays ‘On’ when the control module detects a voltage at the ignition ‘IGN’ terminal X1-3 of the ignition switch.

IMRC Solenoid (Intake Manifold Runner Control): This parameter displays the ECM’s commanded state of the IMRC solenoid.

IMRC Solenoid Circuit Status (Intake Manifold Runner Control): This parameter displays the state of the intake manifold runner control (IMRC) circuit. The parameter displays ‘Fault’ if the IMRC circuit is open, shorted to ground, or shorted to voltage. The parameter displays ‘Undefined Status’ until the circuit has been determined as being ‘OK’.

Initial Brake Apply Signal: This parameter displays the serial data message of the brake signal from the antilock braking system, control module (ABS). Regardless of the braking variant (ABS / ABS-TCS or ABS-TCS / ESP) fitted to a V6 engined vehicle, the brake lamp switch signal is sent by the ABS control module.

Injection Time Cylinder 1 – 6: This parameter displays the amount of fuel injector On-time or pulse width as commanded by the ECM.

Intake Air Temperature: This parameter displays the temperature of the air entering the air induction system based on input to the ECM from the intake air temperature (IAT) sensor.

Intake Camshaft Position Solenoid Valve Circuit Status (Bank 1 or Bank 2): This parameter displays the state of the intake camshaft actuator solenoid control circuit. The parameter displays ‘Fault’ if the camshaft actuator solenoid control circuit is open, shorted to ground, or shorted to voltage. The parameter displays ‘Undefined Status’ until the circuit has been determined as being ‘OK’. This parameter may not change if Tech 2 is used to command the CMP solenoid ON.

Knock Sensor Signal (Bank 1 or Bank 2): This parameters displays the voltage input to the control module from the knock sensor (KS).

Knock Retard: This parameter indicates the amount of spark advance in crankshaft degrees that the ECM removes from the ignition control (IC) spark advance in response to the signal from the knock sensors.

Knock Retard Cylinder 1 – 6: This parameter displays the knock retard as commanded by the ECM for cylinders 1-6. Each cylinder is controlled individually based on both knock sensor signal inputs.

Loop Status B1S1 / B2S1 (Bank 1 or Bank 2 Sensor 1): This parameter displays the state of the fuel control system as commanded by the ECM. ‘Closed’ Loop operation indicates that the ECM is controlling the fuel delivery based on the oxygen sensors input signal. In ‘Open’ Loop operation the ECM ignores the oxygen sensor input signal and bases the amount of fuel to be delivered on other sensor inputs.

LTFT Idle / Deceleration (Bank 1 or Bank 2) (Long Term Fuel Trim): This parameter displays the commanded Long Term Fuel Trim correction by the ECM for Bank 1 or Bank 2 for idle and deceleration conditions.

LTFT Cruise Acceleration (Bank 1 or Bank 2) (Long Term Fuel Trim): This parameter displays the commanded Long Term Fuel Trim correction by the ECM for Bank 1 or Bank 2 for cruise and acceleration conditions.

Malfunction Indicator (MI): This parameter displays the commanded (‘On, ‘Off’ or ‘Flashing’) state of the malfunction indicator lamp (MIL) control circuit by the ECM.

Malfunction Indicator (MI) Circuit Status: This parameter displays the state of the MIL control circuit. The parameter displays ‘Fault’ if the MIL control circuit is open, shorted to ground, or shorted to voltage. This parameter displays ‘Undefined Status’ until the circuit has been determined as being ‘OK’.

Mass Air Flow: This parameter displays the measured quantity (g/s) of air flowing into the engine during all operating conditions.

Mass Air Flow Sensor: This parameter displays the signal voltage from the mass air flow (MAF) sensor to the ECM.

Misfire Current Cyl. #1 – #6: Tech 2 displays a range of 0 – 200 counts. This parameter displays the number of misfires that have been detected during the last 200 cylinder firing events. The counters may normally display some activity, but the activity should be nearly equal for all of the cylinders, and in low numbers.

Misfire History Cyl. #1 – #6: Tech 2 displays a range of 0 – 65,535 counts. The misfire history counters display the total level of misfire that has been detected on each cylinder. The misfire history counters will not update or show any activity until a misfire DTC P0300 has become active. The misfire history counters will update every 200 cylinder firing events.

Oil Level: When the ECM receives information from the engine oil level switch, where the engine oil level is within preset parameters, Tech 2 will display ‘Normal’. If not within preset parameters, the display will show ‘Low’.

Oil Temperature Sensor: This parameter displays the engine oil temperature in degrees C.

Power Enrichment: This parameter displays the status of the operating mode of the ECM used to increase fuel delivery during certain acceleration conditions.

Reduced Engine Power: This parameter displays when the ECM is commanding reduced engine power due to a throttle actuator control (TAC) system condition.

Requested Torque: This parameter displays the calculated amount torque requested of the ECM by the transmission control module (TCM).

Short Term Fuel Trim (Bank 1 or Bank 2): This parameter displays the short-term correction to the fuel delivery by the ECM in response to oxygen sensor 1 or 2. If the oxygen sensor indicates a lean air / fuel mixture, the control module will add fuel, increasing the short term fuel trim above 0. If the oxygen sensor indicates a rich air / fuel mixture, the control module will reduce fuel decreasing the short term fuel trim below 0.

Spark Advance: This parameter displays the amount of spark advance the ECM is commanding on the ignition control circuits. The ECM determines the desired advance.

Starter Relay: This parameter displays the Em’s commanded state of the starter motor relay control circuit.

Starter Relay Circuit Status: This parameter displays the state of the starter relay control circuit. The parameter displays ‘Fault’ if the starter relay control circuit is open, shorted to ground, or shorted to voltage. The parameter displays Undefined Status’ until the circuit has been determined as being ‘OK’. This parameter may not change if Tech 2 is used to command the relay control circuit ON.

Start Up ECT (Engine Coolant Temperature): This parameter displays the temperature of the engine coolant on start up based on input to the ECM from the ECT sensor.

Start Up IAT (Intake Air Temperature): This parameter displays the temperature of the intake air at start in the air induction system based on input to the ECM from the IAT sensor.

Time Since Engine Off: This parameter displays the amount of time (hours:minutes:seconds) that has elapsed since the engine was last cycled OFF.

Total Fuel Trim (Bank 1 or Bank 2): This parameter displays the overall fuel trim from the idle / decel cell and the cruise / accel cell.

Total Misfire: This parameter displays the total number of cylinder firing events that the control module detected as misfires for the last 200 crankshaft revolution sample period.

TP Sensor 1 (Throttle Position): This parameter displays the actual voltage on the TP sensor 1 signal circuit as measured by the ECM.

TP Sensor 1 Learned Lower Position (Throttle Position): This parameter displays the learned minimum value of TP sensor 1 as recorded by the ECM during the last learn procedure.

TP Sensor 2 (Throttle Position): This parameter displays the actual voltage on the TP sensor 2 signal circuit as measured by the ECM.

TP Sensor 2 Learned Lower Position (Throttle Position): This parameter displays the learned minimum value of TP sensor 2 as recorded by the ECM during the last learn procedure.

TP Sensor 1-2 Correlation (Throttle Position): This parameter displays ‘Fault’ when the ECM detects that TP sensor 1 voltage signal is not within the correct relationship to TP sensor 2. Tech 2 displays ‘Okay’ under normal operating conditions.

Traction Control: This parameter displays ‘Active’ if the ABS / TCS module is commanding traction control.

Transmission Gear: This parameter displays the position of the transmission gear selector that is transmitted over the serial data circuit from the TCM.

Transmission Gear Selector Signal: This parameter displays the position of the transmission gear selector that is transmitted over the serial data circuit from the TCM.

Vehicle Speed: This parameter displays the speed of the vehicle as calculated by the TCM from information received from the vehicle speed sensor (VSS).

Volumetric Efficiency: This parameter displays the volumetric efficiency of the engine as calculated by the control module.

7.5 OBD Data

Tech 2 Display	Units Displayed	Typical Values	
		Ignition On	Engine Running
B1S1 O2 Sensor (Bank 1 Sensor 1)	mA	0.008	0
B1S1 Lambda Value (Bank 1 Sensor 1)	:1 (= Lambda)	1.000	1.003
B1S2 O2 Sensor (Bank 1 Sensor 2)	mV	440	445
B1S2 Short Term Fuel Trim (Bank 1 Sensor 1)	%	99.2%	99.2%
B2S1 O2 Sensor (Bank 1 Sensor 1)	mA	0.000	0.024
B2S1 Lambda Value (Bank 1 Sensor 1)	:1 (= Lambda)	1.003	0.995
B2S2 O2 Sensor (Bank 1 Sensor 2)	mV	440	475
B2S2 Short Term Fuel Trim (Bank 1 Sensor 1)	%	99.2	99.2
Fuel System 1 Automatic Control Loop	—	—	—
Fuel System 2 Automatic Control Loop	—	—	—
Calculated Load	%	100.0	18.8
Engine Coolant Temperature	°C	56	90
B1 Short Term Fuel Trim (Bank 1)	%	0.0	–0.8
B1 Long Term Fuel Trim (Bank 1)	%	0.0	0.0
B2 Short Term Fuel Trim (Bank 2)	%	0.0	0.8
B2 Long Term Fuel Trim (Bank 2)	%	0.0	0.0
Engine Speed	RPM	0	588
Vehicle Speed	km/h	0	0
Ignition Timing Advance for Cylinder 1	°CA	0	13
Intake Air Temperature	°C	47	32
Mass Air Flow	g/s	0.00	2.75
Absolute TP (Throttle Position)	%	14.5	
OBD Requirements to which Vehicle is Designed	EOBD		
Distance While MIL is Activated	km	0	0

7.6 Actuator Test

CMP Actuator System

After selecting this test from the Tech 2, the following four tests are possible:

F0: Intake CMP Actuator Bank 1: This test allows the Technician to control the angle of the Bank 1 Intake Camshaft Position Actuator Solenoid.

F1: Intake CMP Actuator Bank 2: This test allows the Technician to control the angle of the Bank 2 Intake Camshaft Position Actuator Solenoid.

F2: Exhaust CMP Actuator Bank 1: This test allows the Technician to control the angle of the Bank 1 Exhaust Camshaft Position Actuator Solenoid.

F3: Exhaust CMP Actuator Bank 2: This test allows the Technician to control the angle of the Bank 2 Exhaust Camshaft Position Actuator Solenoid.

Preconditions (All Tests): Engine running, coolant temperature above 80 °C, vehicle speed 0 km/h, transmission in Park or Neutral.

NOTE

All four tests are only available for the Alloytec 190 / High Output engine. The Alloytec engine has access to the two intake camshaft actuators only.

Fan Relays

WARNING

Take care that no-one can access the engine compartment during these tests!

F0: Fan Relay 1: This test allows the Technician to turn fan relay 1, on and off.

F1: Fan Relays 2 and 3: This test allows the Technician to turn fan relays 2 and 3, on and off.

F2 Fan Relays 1, 2 and 3: This test allows the Technician to turn fan relays 1, 2 and 3, on and off.

Preconditions (All Tests): Air conditioning is ‘Off’.

NOTE

Three relays are only fitted to those vehicles with the 430 Watt cooling fan package.

Fuel Pump Relay Test

This test allows the Technician to turn the fuel pump on and off.

NOTE

To avoid the possibility of engine flooding and subsequent catalytic converter damage, Tech 2 will deactivate the fuel pump relay after 2 seconds.

Precondition: Ignition ‘On’, engine ‘Off’.

Electronic Throttle Control Test

This selection from the Tech 2 Actuator Test menu, provides two parameters; the Calculated Throttle Position and the Desired Throttle Position. As the Technician increases or decreases the throttle opening in 10% increments, each of the two parameters should be the same.

Preconditions: Ignition 'On', engine 'Off', vehicle speed is 0 km/h, there are no vehicle speed DTCs set and the ECM is not performing a throttle learn procedure.

A/C Relay Test

Allows the Technician to turn the air conditioning relay 'On' and 'Off'.

Precondition: Ignition 'On'.

Alternator L Terminal

This test allows the Technician to turn 'On' and 'Off', the commanded state of the voltage regulator in the alternator. 'On' displays a commanded state of 99%, while 'Off' displays a commanded state of 0%.

Precondition: Engine running.

EVAP Purge Solenoid

This test allows the Technician to control the EVAP purge solenoid valve. The normal commanded state is '0%'. The system will increase or decrease the amount of purge by changing the duty cycle of the purge valve in 10% increments within a range of 0 – 100%. The system will remain in the commanded state until cancelled by Tech 2.

NOTE

The EVAP Purge Solenoid Command parameter may not change states when using this output control.

Precondition: Ignition 'On', engine 'Off'.

Int. Manifold Runner Ctrl. Sol.

This test allows the Technician to turn the IMRC (Intake Manifold Runner Control) ground circuit 'On' or 'Off.

Precondition: Ignition 'On', engine 'Off'.

NOTE

The IMRC is only fitted to the Alloytec 190 / High Output engine.

Engine Speed Control

CAUTION

Other DTCs may set when the Engine Speed Control function is used. Disregard those DTCs that set under this condition.

Allows the increase / decrease of the engine speed in 20 – 30 rpm increments from the base idle speed, up to 1,600 rpm.

NOTE

If the engine coolant temperature is below the prescribed minimum, a message to that effect is displayed and access to engine speed control is blocked.

Preconditions: Engine running, engine temperature above 80°C, transmission in Park or Neutral.

F2: OBD Data

In this test mode, Tech 2 displays engine management data parameters relating to the OBD (On Board Diagnostic) for the engine being diagnosed. Refer to 7.5 OBD Data for specific detail.

F3: Snapshot

In this test mode, Tech 2 captures data before and after a snapshot triggering event that may or may not set a DTC. For more specific information relating to the use of this Tech 2 feature, refer to Section 0C TECH 2.

F4: Actuator Test

In this test mode, Tech 2 performs software override commands to the ECM, to assist in problem isolation during diagnostics. When entering this mode, there are 12 actuators that can be tested for operational integrity. The 12 tests available are:

CMP Actuator System

Fan Relays

Fuel Pump Relay Test

Electronic Throttle Control Test

A/C Relay Test

Alternator L Terminal

EVAP Purge Solenoid

Int. Manifold Runner Ctrl. Sol. (available for Alloytec 190 / High Output engine only)

Engine Speed Control

Starter Relay Test

Fuel Injector Balance

F5: Additional Functions

When this selection is made from the Tech 2 screen, an additional two choices are provided:

F0: System Identification: In this mode, Tech 2 will display the engine identification screen and the vehicle VIN.

F1: Security Information: When selected, this mode displays various engine management data parameters relating to the security system.

F6: Programming

Within this selection, there are five programming selections available:

F0: BCM Link to ECM/PIM

F1: Reset ECU

F2: Fuel Trim Reset

F3: Reset Engine Oil Life

F4: Throttle Body Relearn

7.7 Programming

F0: **BCM Link to ECM / PIM**: Should the ECM, PIM or BCM be replaced, the modules must be security linked to each other. If this linking procedure is not performed, the vehicle will not crank nor run. For additional information relating to Tech 2 and the linking procedure, refer to 12J Body Control Module.

NOTE

After an ECU reset, the ignition switch must be turned Off for at least 10 seconds and then turned On for at least one minute, before attempting communication between Tech 2 and the ECU.

Preconditions: TIS approval (TIS 2000 Security Access) must be obtained, the four digit security number entered into Tech 2 and the theft deterrent system disarmed. Then the ignition must be turned 'On', using a programmed remote coded key.

F1: **Reset ECU**: This function erases the security link between the engine control module (ECM) and the powertrain interface module (PIM). If this procedure is performed, the engine will not crank nor run. A BCM Link to ECM / PIM procedure will need to be performed. For additional information relating to the BCM Link to ECM / PIM procedure, refer to 12J Body Control Module.

NOTE

After an ECU reset, the ignition switch must be turned Off for at least 10 seconds and then turned On for at least one minute, before attempting communication between Tech 2 and the ECU.

Preconditions: The four digit security code must be entered into Tech 2 and the theft deterrent system must be disarmed and the ignition switched 'On' with a programmed remote coded key.

F2: **Fuel Trim Reset**: This function resets the fuel trim data values learned by the ECM.

F3: **Reset Engine Oil Life**: This function resets the engine oil life parameters into the ECM, following an engine oil change.

F4: **Throttle Body Relearn**: In this mode, Tech 2 commands the throttle plate from its rest position to full closed then to about 10% open. This procedure takes approximately 6 – 8 seconds. At the start of this procedure, the Tech 2, 'Electronic Throttle Control Learn Counter' parameter should display '0' then count up to 11, after the procedure is completed. If the counter does not start at '0', nor display a count of '11' at the conclusion of the procedure, a fault has occurred and a DTC will set.