2002 ENGINE PERFORMANCE

Self-Diagnostics - RAV4

INTRODUCTION

NOTE: Before performing testing procedures, check for any related Technical Service Bulletins (TSBs).

To properly diagnosis and repair this vehicle, follow **TESTING PROCEDURE** under SELF-DIAGNOSTIC SYSTEM. If no Diagnostic Trouble Codes (DTC) are present and a no start condition exists, proceed to **BASIC DIAGNOSTIC PROCEDURES - 4-CYLINDER** article. If no DTCs are present and a driveability condition exists, proceed to **TROUBLE SHOOTING - NO CODES** article for diagnosis by symptom (i.e., ROUGH IDLE, ENGINE STALLS, etc.).

SELF-DIAGNOSTIC SYSTEM

SYSTEM OVERVIEW

Engine Control Module (ECM) monitors engine operation and contains a self-diagnostic system which stores Diagnostic Trouble Codes (DTC) and complies to On-Board Diagnostics Generation II (OBD-II) standards.

Self-diagnostic system is used to provide vehicle with an on-board diagnostic system which is capable of continuously monitoring efficiency of emission control system, and improving diagnosis and repair when system failures occur.

OBD-II regulations require that Malfunction Indicator Light (MIL) must be illuminated when a malfunction exists in the emission control system which affects vehicle emissions or a malfunction exists in the ECM. MIL may also be illuminated when a DTC is stored in the ECM memory due to a system or component failure. MIL is displayed as an engine icon located just below engine coolant temperature gauge on instrument cluster on instrument panel. MIL may also be referred to as CHECK ENGINE light.

If malfunction does not reoccur in 3 consecutive trips, MIL will turn off, but DTCs remain stored in ECM memory. DTCs may be retrieved using an OBD-II scan tool that complies with SAE standard J-1978 or Toyota hand-held tester connected to Data Link Connector (DLC) No. 3. Scan tool or Toyota hand-held tester may also be used to provide freeze frame data and to clear DTCs from ECM. For additional information on freeze frame data, see **FREEZE FRAME DATA** .

TWO-TRIP DETECTION LOGIC

When a malfunction initially occurs, Diagnostic Trouble Code (DTC) will be temporarily stored in ECM memory but Malfunction Indicator Light (MIL) will not illuminate. The second time malfunction is detected, MIL will illuminate provided ignition is turned off and then back on after first malfunction was detected. This is referred to as "Two-Trip Detection Logic" and only applies to specific DTCs. When road testing vehicle in CHECK mode using Toyota hand-held tester, two-trip detection logic will not function and MIL will illuminate the first time a malfunction is detected.

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DATA LINK CONNECTOR

OBD-II regulations (SAE J-1962) standardizes configuration of Data Link Connector (DLC) No. 3. DLC No. 3 is located at driver's side of instrument panel. See **Fig. 1** .

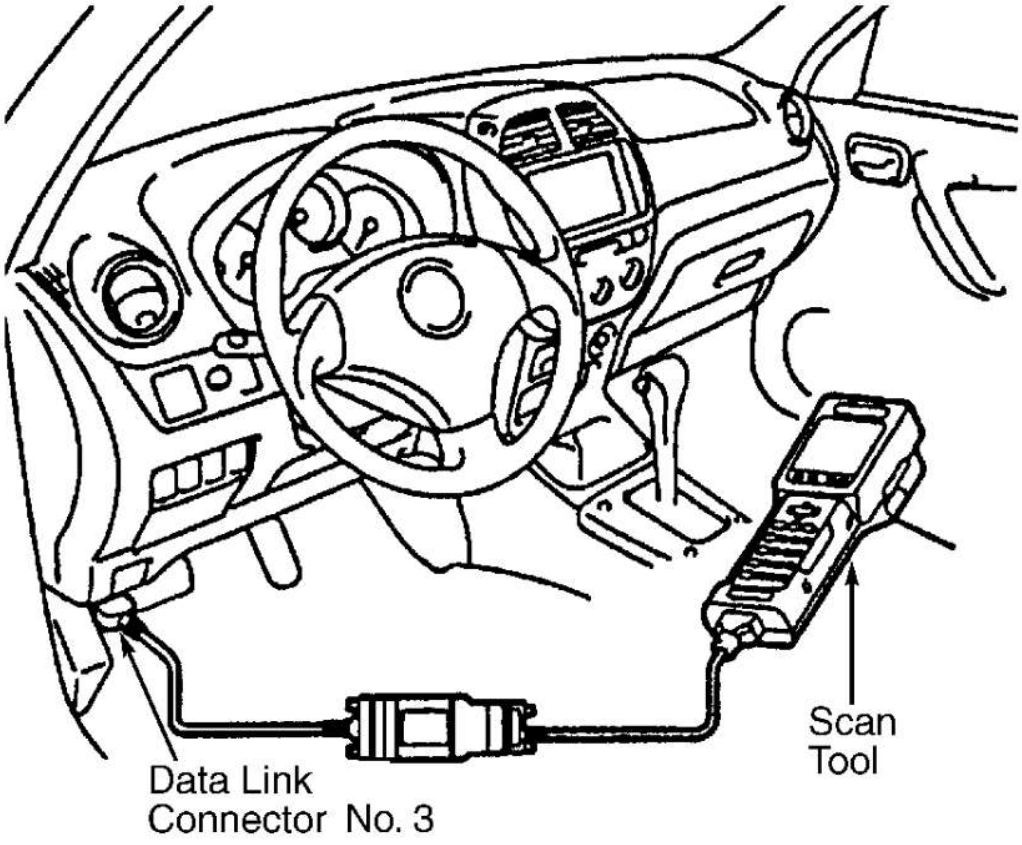


Fig. 1: Locating Data Link Connector No. 3
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

FREEZE FRAME DATA

Engine Control Module (ECM) records engine operating conditions when a misfire or fuel trim (mixture) malfunction or when various other malfunctions exist. ECM records engine operating conditions for the fuel system, calculated load, engine coolant temperature, engine speed, vehicle speed and etc. when a malfunction exists. This information is referred to as freeze frame data. If more than one Diagnostic Trouble Code (DTC) exists, only freeze frame data for the first DTC is recorded. Freeze frame data is useful for determining conditions when a malfunction occurred. OBD-II scan tool or Toyota hand-held tester may by used to read freeze frame data.

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MALFUNCTION INDICATOR LIGHT INSPECTION

NOTE: Malfunction Indicator Light (MIL) may also be referred to as CHECK ENGINE light. Inspect MIL to ensure it is operational and will come on if a Diagnostic Trouble Code (DTC) is set.

1. Turn ignition on. Check that MIL comes on and remains on. MIL is displayed as an engine icon located just below engine coolant temperature gauge on instrument cluster on instrument panel. If MIL comes on and remains on, go to next step. If MIL does not come on, check bulb circuit on instrument cluster and Green/Red or White wire and electrical connectors between MIL and Engine Control Module (ECM). See **WIRING DIAGRAMS** article. There are 2 different wiring harnesses used and wire color varies according to wiring harness used. ECM is located behind passenger's side kick panel, just below instrument panel. See **Fig. 2** .
2. Start engine and ensure MIL goes off. If MIL goes off, no malfunction is detected at this time. If MIL remains on or blinks with engine running, a malfunction is detected. Proceed to **TESTING PROCEDURE** .

TESTING PROCEDURE

To ensure correct diagnosis and repair, testing should be done in the following sequence:

- **Record Customer Complaint**

  Ensure all customer complaints or observations are recorded. Test drive vehicle with customer when necessary for malfunction verification.

- **Retrieve Diagnostic Trouble Codes**

  Using Toyota hand-held tester or scan tool, retrieve Diagnostic Trouble Codes (DTC) from Engine Control Module (ECM) and record any freeze frame data (if applicable). See **RETRIEVING DIAGNOSTIC TROUBLE CODES** .

- **Clear Diagnostic Trouble Codes**

  Using Toyota hand-held tester or scan tool, clear DTCs and freeze frame data from ECM. See **CLEARING DIAGNOSTIC TROUBLE CODES** .

- **Visual Inspection**

  Inspect all electrical connectors and wiring for suspected circuit or component. Ensure all electrical connections are clean and tight.

- **Confirm Symptoms & Diagnostic Trouble Codes**

  Perform road test. Determine if original symptoms still exist. Using scan tool or Toyota hand-held tester, retrieve DTCs from ECM. See **RETRIEVING DIAGNOSTIC TROUBLE CODES** .

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- **Diagnose & Repair Diagnostic Trouble Codes**

  Perform appropriate DTC test listed under DIAGNOSTIC TESTS as necessary. For DTC descriptions, see **DIAGNOSTIC TROUBLE CODE DEFINITIONS** table under DIAGNOSTIC TROUBLE CODE DEFINITIONS. If no DTCs are present and a no start condition exists, proceed to **BASIC DIAGNOSTIC PROCEDURES - 4-CYLINDER** article. If no DTCs are present and a driveability condition exists, proceed to **TROUBLE SHOOTING - NO CODES** article for diagnosis by symptom (i.e., ROUGH IDLE, ENGINE STALLS, etc.).

- **Verification Procedure**

  After repairs have been completed, clear all DTCs from ECM. See **CLEARING DIAGNOSTIC TROUBLE CODES** . Perform road test. Ensure no DTCs exist and all symptoms and/or complaints have been repaired.

RETRIEVING DIAGNOSTIC TROUBLE CODES

NOTE: Diagnostic Trouble Codes (DTC) may be retrieved using Toyota hand-held tester or On-Board Diagnostic (OBD-II) scan tool that complies with SAE standard J-1978. Toyota hand-held tester or OBD-II scan tool may be operated in NORMAL mode when retrieving DTCs. Only Toyota hand-held tester may be used in CHECK mode when retrieving DTCs.

NORMAL mode is used to retrieve DTCs from Engine Control Module (ECM). CHECK mode is used to check for DTCs when operating vehicle to simulate conditions during which DTC was set. CHECK mode contains a higher sensing ability to detect malfunctions. CHECK mode helps determine malfunctions caused by poor electrical connections or intermittent problems which are difficult to determine using NORMAL mode.

NOTE: If using Toyota hand-held tester, when ignition switch is turned from ON to ACC or OFF position during CHECK mode, hand-held tester is switched from NORMAL mode to CHECK mode or from CHECK MODE to NORMAL mode, all DTCs and freeze frame data will be erased from ECM. DO NOT switch modes until all DTCs and freeze frame data have been recorded.

NORMAL Mode Diagnostic Trouble Code Retrieval

1. Connect Toyota hand-held tester or scan tool to Data Link Connector (DLC) No. 3 at driver's side of instrument panel. See **Fig. 1** . Turn ignition on with engine off. Turn hand-held tester or scan tool on. Using hand-held tester or scan tool manufacturer's instructions, check for DTCs and freeze frame data.
2. If hand-held tester or scan tool does not display UNABLE TO CONNECT TO VEHICLE, go to next step. If hand-held tester or scan tool displays UNABLE TO CONNECT TO VEHICLE, check DLC No. 3. See **DATA LINK CONNECTOR NO. 3 INSPECTION** under SCAN TOOL PROBLEMS.
3. Record any DTCs and freeze frame data displayed for system diagnosis. If driveability problem exist and no DTCs are present, go to **TROUBLE SHOOTING - NO CODES** article for diagnosis by symptom.
4. If any DTCs are present, perform appropriate DTC test under **DIAGNOSTIC TESTS** . For DTC

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descriptions, see **DIAGNOSTIC TROUBLE CODE DEFINITIONS** table under DIAGNOSTIC TROUBLE CODE DEFINITIONS. For information on freeze frame data, see **FREEZE FRAME DATA** . For information on two-trip detection logic DTCs, see **TWO-TRIP DETECTION LOGIC** .

5. After repairs for DTC have been completed, DTC must be cleared from ECM. See **CLEARING DIAGNOSTIC TROUBLE CODES** . Road test vehicle to ensure all symptoms and/or complaints have been repaired.

CHECK Mode Diagnostic Trouble Code Retrieval (Toyota Hand-Held Tester Only)

NOTE: If using Toyota hand-held tester, if ignition switch is turned from ON to ACC or OFF position during CHECK mode, all DTCs and freeze frame data will be erased from ECM. DO NOT switch from CHECK mode to NORMAL mode until all DTCs and freeze frame data are recorded.

1. Ensure vehicle battery is fully charged. Apply parking brake. Place transaxle in Park or Neutral. Ensure A/C and ignition are off. Check that throttle valve is fully closed. Connect hand-held tester to Data Link Connector (DLC) No. 3 at driver's side of instrument panel. See **Fig. 1** . Turn ignition on and then turn hand-held tester on.
2. Switch hand-held tester from NORMAL mode to CHECK mode. Ensure Malfunction Indicator Light (MIL) on instrument cluster flashes to indicate CHECK mode operation. Start engine. If no DTCs are present, MIL will turn off. Try to simulate conditions of driveability complaint described by customer.
3. Record any DTCs and freeze frame data displayed for system diagnosis. If driveability problem exist and no DTCs are present, go to **TROUBLE SHOOTING - NO CODES** article for diagnosis by symptom.
4. If any DTCs are present, perform appropriate DTC test under **DIAGNOSTIC TESTS** . For DTC descriptions, see **DIAGNOSTIC TROUBLE CODE DEFINITIONS** table under DIAGNOSTIC TROUBLE CODE DEFINITIONS. For information on freeze frame data, see **FREEZE FRAME DATA** . For information on two-trip detection logic DTCs, see **TWO-TRIP DETECTION LOGIC** .
5. After repairs for DTC have been completed, DTC must be cleared from ECM. See **CLEARING DIAGNOSTIC TROUBLE CODES** . Road test vehicle to ensure all symptoms and/or complaints have been repaired.

CLEARING DIAGNOSTIC TROUBLE CODES

1. After repairs for Diagnostic Trouble Codes (DTC) have been completed, DTCs and freeze frame data should be cleared from Engine Control Module (ECM) memory. Using scan tool or Toyota hand-held tester, follow the manufacturer's instructions and clear DTCs and freeze frame data from ECM.

NOTE: If using Toyota hand-held tester, DTCs and freeze frame data may be cleared from ECM by switching from CHECK mode to NORMAL mode, or from NORMAL mode to CHECK mode, or if ignition switch is turned from ON to ACC or OFF position during CHECK mode.

2. DTCs and freeze frame data may also be cleared by removing EFI1 fuse (20-amp). EFI1 fuse is located in fuse/relay box at driver's side front corner of engine compartment. DTCs and freeze frame data may also be cleared by disconnecting negative battery cable. However, other various memory functions such as the

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clock, radio, alarm, seats, etc. will be cleared and must be reset.

ENGINE CONTROL MODULE LOCATION

Engine Control Module (ECM) is located behind passenger's side kick panel, just below instrument panel. See **Fig. 2** .

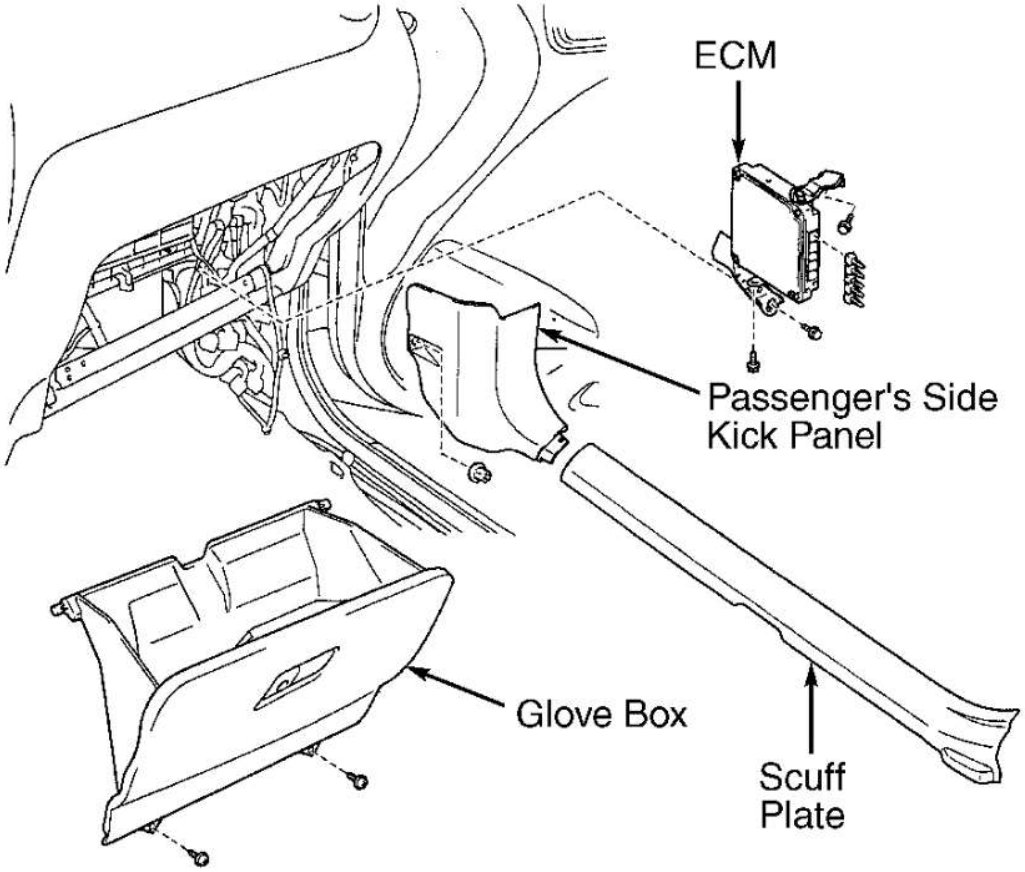


Fig. 2: Locating Engine Control Module
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

TEST DRIVE CONFIRMATION

1. On certain Diagnostic Trouble Codes (DTC), once DTC has been cleared from Engine Control Module (ECM) memory, a test drive confirmation can be performed to verify repairs are made and that DTC does not reset. Test drive confirmation will duplicate conditions required to set specified DTCs.

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2. Test drive confirmation lists the procedure to be performed to check that DTC does not reset. Test drive confirmation applies only to specific DTCs. Test drive confirmation will be included within proper DTC test under DIAGNOSTIC TESTS.

PROGRAMMING

ENGINE CONTROL MODULE PROGRAMMING

An engine immobilizer system may be used. On models equipped with engine immobilizer system, if Engine Control Module (ECM) is replaced, ECM must be programmed with proper ignition key code for engine immobilizer system. Models equipped with engine immobilizer system may be identified by looking at the ignition key. On models equipped with engine immobilizer system, the top of the ignition key is thicker than a standard ignition key, as a transponder chip is incorporated into the top of the ignition key. For programming procedures, see **COMPUTER RELEARN PROCEDURES** article in GENERAL INFORMATION, or appropriate ENGINE IMMOBILIZER SYSTEMS article in ACCESSORIES & EQUIPMENT.

SCAN TOOL PROBLEMS

DATA LINK CONNECTOR NO. 3 INSPECTION

1. If Toyota hand-held tester or scan tool displays UNABLE TO CONNECT TO VEHICLE when hand-held tester or scan tool is connected to Data Link Connector (DLC) No. 3, try hand-held tester or scan tool on another vehicle. If hand-held tester or scan tool operates on another vehicle, go to next step. If hand-held tester or scan tool does not operate on another vehicle, problem is probably with hand-held tester or scan tool.
2. Check voltage and resistance between ground and specified terminal on DLC No. 3. See **DATA LINK CONNECTOR NO. 3 VOLTAGE & RESISTANCE SPECIFICATIONS** table. See **Fig. 3** . If voltage or resistance readings are not within specification, check wiring circuit. See **WIRING DIAGRAMS** article. For full wiring diagram of DLC No. 3, it may be necessary to see DATA LINK CONNECTORS article in WIRING DIAGRAMS.

DATA LINK CONNECTOR NO. 3 VOLTAGE & RESISTANCE SPECIFICATIONS

Terminal No. (Circuit)	Specification
4 (Chassis Ground)	1 Ohm Or Less
5 (Signal Ground)	1 Ohm Or Less
7 (BUS Communication)	(1)
16 (Battery Voltage)	9-14 Volts
(1) Pulse generation should exist during information transmission from Engine Control Module (ECM).	

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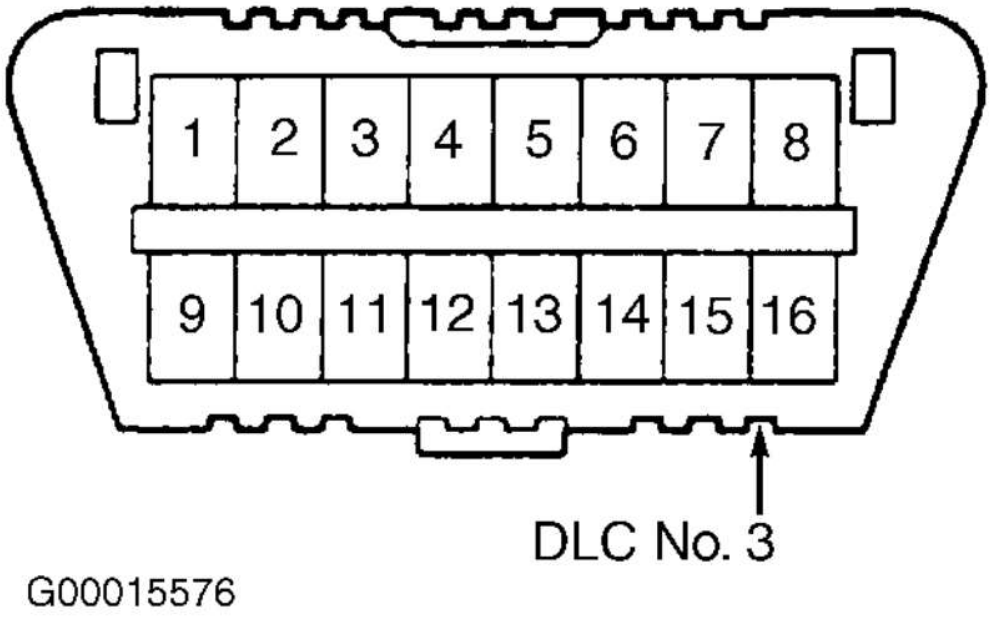


Fig. 3: Identifying Data Link Connector No. 3 Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

SUMMARY

If no Diagnostic Trouble Codes (DTC) are present and a no start condition exists, proceed to **BASIC DIAGNOSTIC PROCEDURES - 4-CYLINDER** article. If no DTCs are present and a driveability condition exists, proceed to **TROUBLE SHOOTING - NO CODES** article for diagnosis by symptom (i.e., ROUGH IDLE, ENGINE STALLS, etc.).

DIAGNOSTIC TROUBLE CODE DEFINITIONS

DIAGNOSTIC TROUBLE CODE DEFINITIONS

DTC (1)	Description
B2795 (2)	Unmatched Key Code
B2796 (2)	No Communication In Immobilizer System
B2797 (2)	Communication Malfunction No. 1
B2798 (2)	Communication Malfunction No. 2
P0100	Mass Airflow Meter Circuit
P0101	Mass Airflow Meter Circuit Range/Performance

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P0110(3)	Intake Air Temperature Sensor Circuit
P0115(3)	Engine Coolant Temperature Sensor Circuit
P0116	Engine Coolant Temperature Sensor Circuit Range/Performance
P0120(3)	Throttle Position Sensor Circuit
P0121	Throttle Position Sensor Circuit Range/Performance
P0125	Insufficient Coolant Temperature For Closed Loop Fuel Control
P0128	Thermostat Malfunction
P0136	Heated Oxygen Sensor Circuit (Bank No. 1 Sensor No. 2)
P0141	Heated Oxygen Sensor Heater Circuit (Bank No. 1 Sensor No. 2)
P0156	Heated Oxygen Sensor Circuit (Bank No. 2 Sensor No. 2)
P0161	Heated Oxygen Sensor Heater Circuit (Bank No. 2 Sensor No. 2)
P0171	System Too Lean (Bank No. 1)
P0172	System Too Rich (Bank No. 1)
P0174	System Too Lean (Bank No. 2)
P0175	System Too Rich (Bank No. 2)
P0300	Random/Multiple Cylinder Misfire Detected
P0301	Cylinder No. 1 Misfire Detected
P0302	Cylinder No. 2 Misfire Detected
P0303	Cylinder No. 3 Misfire Detected
P0304	Cylinder No. 4 Misfire Detected
P0325(3)	Knock Sensor Circuit
P0335	Crankshaft Position Sensor Circuit
P0340	Camshaft Position Sensor Circuit
P0420	Catalyst System Efficiency Below Threshold (Bank No. 1)
P0430	Catalyst System Efficiency Below Threshold (Bank No. 2)
P0440	Evaporative Emission Control System
P0441	Incorrect EVAP Purge Flow
P0446	EVAP Vent Control Malfunction
P0450	EVAP Pressure Sensor Circuit
P0451	EVAP Pressure Sensor Range/Performance
P0500	Vehicle Speed Sensor Circuit
P0505	Idle Control System Malfunction
P0710 (4)	Transmission Fluid Temp. Sensor Malfunction
P0711 (4)	Transmission Fluid Temp. Sensor Range/Performance
P0750 (4)	Shift Solenoid Valve SL1 Malfunction
P0753 (4)	Shift Solenoid Valve SL1 Electrical Malfunction
P0755 (4)	Shift Solenoid Valve SL2 Malfunction
P0758 (4)	Shift Solenoid Valve SL2 Electrical Malfunction
P0765 (4)	Shift Solenoid Valve S4 Malfunction

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P0768 (4)	Shift Solenoid Valve S4 Electrical Malfunction
P0770 (4)	Shift Solenoid Valve DSL Malfunction
P0773 (4)	Shift Solenoid Valve DSL Circuit Electrical Malfunction
P1133	Air/Fuel Sensor Circuit Response Malfunction (Bank No. 1 Sensor No. 1)
P1135	Air/Fuel Sensor Heater Circuit (Bank No. 1 Sensor No. 1)
P1153	Air/Fuel Sensor Circuit Response Malfunction (Bank No. 2 Sensor No. 1)
P1155	Air/Fuel Sensor Heater Circuit (Bank No. 2 Sensor No. 1)
P1300(3)	Ignitor No. 1 Circuit
P1305(3)	Ignitor No. 2 Circuit
P1310(3)	Ignitor No. 3 Circuit
P1315(3)	Ignitor No. 4 Circuit
P1335(5)	Crankshaft Position Sensor Circuit
P1346	Variable Valve Timing Sensor Circuit Range/Performance
P1349	Variable Valve Timing System Malfunction
P1520	Stoplight Switch Signal Circuit
P1600	Engine Control Module BATT Circuit
P1656	Oil Control Valve Circuit Malfunction
P1725 (4)	Input Speed Sensor Circuit
P1730 (4)	Countergear Speed Sensor Circuit
P1760 (4)	Shift Solenoid Valve SLT Malfunction
P1780(6)	Park/Neutral Position Switch Circuit

(1) Some DTCs are two-trip detection logic DTCs. For more information, see **TWO-TRIP DETECTION LOGIC** under SELF-DIAGNOSTIC SYSTEM.

(2) DTC applies to models equipped with engine immobilizer system. MIL will not illuminate if DTC exists. For testing procedures, see appropriate ENGINE IMMOBILIZER SYSTEMS article in ACCESSORIES & EQUIPMENT.

(3) If this DTC is set, Engine Control Module (ECM) will enter fail-safe mode.

(4) DTC applies only to models with electronically controlled automatic transaxle. For testing procedures, see appropriate DIAGNOSIS article in AUTOMATIC TRANSMISSIONS.

(5) MIL will not illuminate.

(6) Test applies only to A/T models.

DIAGNOSTIC TESTS

NOTE: Before performing any diagnostic test, see SELF-DIAGNOSTIC SYSTEM for diagnostic system functions and system diagnostic procedures. Also check for any related Technical Service Bulletins (TSBs).

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NOTE: **When performing diagnostic tests, it may be necessary to identify Engine Control Module (ECM) electrical connector terminals which are referenced to in testing procedure. See Fig. 4 . When wire color is called out at a specified terminal, there may be 2 different wire colors listed, as there are 2 different wiring harnesses used.**

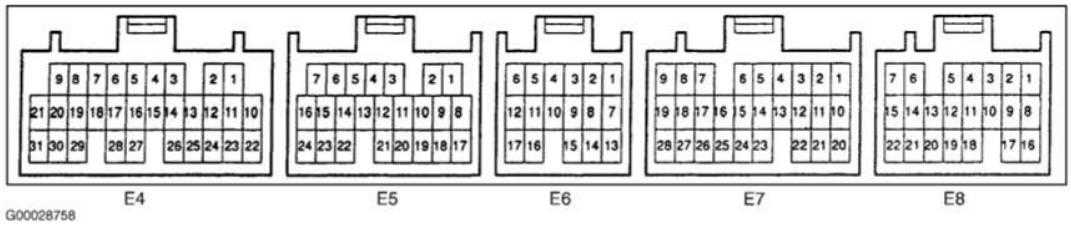


Fig. 4: Identifying Engine Control Module Electrical Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

DTC P0100: MASS AIRFLOW METER CIRCUIT

CAUTION: If Engine Control Module (ECM) replacement is instructed in following test, always ensure ECM electrical connectors and ground circuits are okay. If either are defective, repair and repeat testing to confirm ECM malfunction. On models equipped with engine immobilizer, if ECM is replaced, ECM must be programmed with proper ignition key code for engine immobilizer system. For programming procedures, see COMPUTER RELEARN PROCEDURES article in GENERAL INFORMATION, or appropriate ENGINE IMMOBILIZER SYSTEMS article in ACCESSORIES & EQUIPMENT.

Circuit Description

Mass Airflow (MAF) meter uses a platinum hot wire which is maintained at a constant temperature by controlling the current flow through the hot wire. Current flow is then measured as an output voltage. MAF meter may also be referred to as airflow meter. DTC is set when ECM detects an open or short in MAF meter circuit for more than 3 seconds with engine speed at 4000 RPM or less. Possible causes are:

- MAF meter circuit is open or shorted.
- Defective MAF meter.
- Defective ECM.

Diagnostic Aids

After confirming DTC P0100, use Toyota hand-held tester or scan tool to access CURRENT DATA to confirm MAF meter air flow rate. If MAF meter air flow rate is 0.0 gm/sec., VG circuit may be open or shorted, or power source circuit may be open. If MAF meter air flow rate is 271.0 gm/sec. or more, E2G circuit may be open. Using hand-held tester or scan tool, read FREEZE FRAME data. Freeze frame data records engine

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conditions when malfunction is detected.

Diagnosis & Repair

1. Connect Toyota hand-held tester or scan tool to Data Link Connector (DLC) No. 3 at driver's side of instrument panel. See **Fig. 1** . Turn ignition on and then turn hand-held tester or scan tool on. Start engine and allow engine to idle. Using hand-held tester or scan tool, monitor MAF meter air flow rate. If MAF meter air flow rate is 0.0 gm/sec., go to next step. If MAF meter air flow rate is 271 gm/sec. or more, go to step 5 .
2. Turn ignition off. Disconnect electrical connector at MAF meter. MAF meter is bolted to upper cap on air cleaner assembly and contains a Black 5-pin electrical connector. Turn ignition on. Using voltmeter, check voltage between ground and terminal No. 1 (Black/Red wire) on MAF meter electrical connector. See **Fig. 5** . If voltage is 9-14 volts, go to next step. If voltage is not 9-14 volts, repair open in Black/Red wire between EFI main relay and MAF meter. See **WIRING DIAGRAMS** article. EFI main relay may also be referred to as EFI relay. EFI main relay is located in fuse/relay box at driver's side front corner of engine compartment. If necessary to check EFI3 fuse (10-amp), this fuse is located in fuse/relay box at driver's side front corner of engine compartment.
3. Turn ignition off. Reinstall electrical connector at MAF meter. Remove glove box and passenger's side kick panel (if necessary) for access to ECM with electrical connectors still installed on ECM. See **Fig. 2** . Apply parking brake. Ensure A/C switch is in OFF position and shift lever is in Neutral. Start engine and allow engine to idle. Using voltmeter, check voltage between body ground and terminal No. 12 (Blue/White wire) at ECM electrical connector E5. See **Fig. 4** . This is the VG terminal on ECM. Voltage should be 1.1-1.5 volts. If voltage is not within specification, go to next step. If voltage is within specification, replace ECM.
4. Check for open and short in Blue/White wire and electrical connectors between MAF meter and ECM. See **WIRING DIAGRAMS** article. If wiring harness and electrical connectors are okay, replace MAF meter. See **AIRFLOW METER** under ENGINE SENSORS & SWITCHES in REMOVAL, OVERHAUL & INSTALLATION - 4-CYLINDER article. If wiring harness or electrical connector is defective, repair as necessary.
5. Turn ignition off. Remove glove box and passenger's side kick panel (if necessary) for access to ECM with electrical connectors still installed on ECM. See **Fig. 2** . Using ohmmeter, check resistance between body ground and terminal No. 21 (Blue wire) at ECM electrical connector E5. See **Fig. 4** . The is the E2G terminal on ECM. If resistance is one ohm or less, go to next step. If resistance is greater than one ohm, replace ECM.
6. Check for open in wiring harness and electrical connectors between MAF meter and ECM. See **WIRING DIAGRAMS** article. If wiring harness and electrical connectors are okay, replace MAF meter. See **AIRFLOW METER** under ENGINE SENSORS & SWITCHES in REMOVAL, OVERHAUL & INSTALLATION - 4-CYLINDER article. If wiring harness or electrical connector is defective, repair as necessary.

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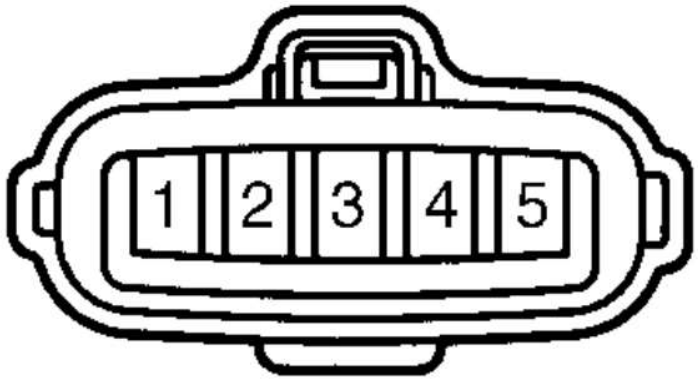


Fig. 5: Identifying Mass Airflow Meter Electrical Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

DTC P0101: MASS AIRFLOW METER CIRCUIT RANGE/PERFORMANCE

Circuit Description

Mass Airflow (MAF) meter uses a platinum hot wire which is maintained at a constant temperature by controlling the current flow through the hot wire. Current flow is then measured as an output voltage. MAF meter may also be referred to as airflow meter. DTC is set when ECM detects MAF meter output is greater than 2.2 volts with throttle valve closed for more than 10 seconds with engine speed of 900 RPM or less, or MAF meter output is less than 1.06 volts with Throttle Position (TP) sensor VTA circuit signal voltage of .63 volt or more for more than 10 seconds with engine speed of 1500 RPM or more. Possible cause is defective MAF meter.

Diagnostic Aids

This DTC uses two-trip detection logic. Using Toyota hand-held tester or scan tool, read FREEZE FRAME data. Freeze frame data records engine conditions when malfunction is detected.

Diagnosis & Repair

Using Toyota hand-held tester or scan tool, check for any other DTCs. If other DTCs exist, diagnose and repair those DTCs first and retest. If only DTC P0101 exists, replace MAF meter. MAF meter is bolted to upper cap on air cleaner assembly and contains a Black 5-pin electrical connector. See **AIRFLOW METER** under ENGINE SENSORS & SWITCHES in REMOVAL, OVERHAUL & INSTALLATION - 4-CYLINDER

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article.

DTC P0110: INTAKE AIR TEMPERATURE SENSOR CIRCUIT

CAUTION: If Engine Control Module (ECM) replacement is instructed in following test, always ensure ECM electrical connectors and ground circuits are okay. If either are defective, repair and repeat testing to confirm ECM malfunction. On models equipped with engine immobilizer, if ECM is replaced, ECM must be programmed with proper ignition key code for engine immobilizer system. For programming procedures, see COMPUTER RELEARN PROCEDURES article in GENERAL INFORMATION, or appropriate ENGINE IMMOBILIZER SYSTEMS article in ACCESSORIES & EQUIPMENT.

NOTE: If DTCs P0100, P0101, P0110, P0115 and P0120 are output simultaneously, the E2 sensor ground circuit at terminal No. 18 (Brown wire) at ECM electrical connector E5 may be open. See WIRING DIAGRAMS article. For ECM electrical connector terminal identification, see Fig. 4 . It may be necessary to check Brown wire between splice I2 and terminal No. 18 at ECM electrical connector E5. Splice I2 is located behind passenger's side of instrument panel. See Fig. 6 .

Circuit Description

Intake Air Temperature (IAT) sensor is a thermistor built into Mass Airflow (MAF) meter and is used to monitor temperature of intake air flowing through MAF meter. DTC is set when ECM detects an open or short in IAT sensor circuit. If DTC P0110 exists, ECM will operate in fail-safe mode in which intake air temperature is assumed to be 68°F (20°C). Possible causes are:

- IAT sensor circuit is open or shorted.
- Defective IAT sensor.
- Defective ECM.

Diagnostic Aids

After confirming DTC P0110, use Toyota hand-held tester or scan tool to access CURRENT DATA to read the intake air temperature for IAT sensor. If displayed intake air temperature is -40°F (-40°C), IAT sensor circuit may be open. If displayed intake air temperature is 284°F (140°C) or more, IAT sensor circuit may be shorted. Using hand-held tester or scan tool, read FREEZE FRAME data. Freeze frame data records engine conditions when malfunction is detected.

Diagnosis & Repair

1. Connect Toyota hand-held tester or scan tool to Data Link Connector (DLC) No. 3 at driver's side of instrument panel. See **Fig. 1** . Turn ignition on and then turn hand-held tester or scan tool on.
2. Using hand-held tester or scan tool, read intake air temperature for IAT sensor. If displayed intake air temperature is -40°F (-40°C), go to next step. If displayed intake air temperature is 284°F (140°C) or more, go to step 8 . If displayed intake air temperature is the same as actual air intake temperature,

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problem is intermittent. Check for defective connections or intermittent problem in wiring between MAF meter and ECM. MAF meter is bolted to upper cap on air cleaner assembly and contains a Black 5-pin electrical connector. ECM is located behind passenger's side kick panel, just below instrument panel. See **Fig. 2** .

3. Turn ignition off. Disconnect electrical connector at MAF meter. MAF meter is bolted to upper cap on air cleaner assembly and contains a Black 5-pin electrical connector. Connect jumper wire between terminals No. 4 (Red/White wire) and No. 5 (Brown wire) on electrical connector for MAF meter. See **Fig. 5** .
4. Turn ignition on. Using hand-held tester or scan tool, read intake air temperature for IAT sensor. If displayed intake air temperature is less than 284°F (140°C), go to next step. If displayed intake air temperature is 284°F (140°C) or more, check for defective electrical connections at MAF meter and electrical connector. If electrical connections are defective, repair as necessary. If electrical connections are okay, replace MAF meter. See **AIRFLOW METER** under ENGINE SENSORS & SWITCHES in REMOVAL, OVERHAUL & INSTALLATION - 4-CYLINDER article.
5. Turn ignition off. Remove jumper wire. Remove glove box and passenger's side kick panel (if necessary) for access to ECM with electrical connectors still installed on ECM. See **Fig. 2** . Ensure electrical connectors at ECM are securely installed so all terminals in electrical connectors are contacting terminals in ECM.
6. Ensure electrical connector at MAF meter is still disconnected. Connect jumper wire between terminal No. 18 (Brown wire) at ECM electrical connector E5 and No. 23 (Red/White wire) at ECM electrical connector E4 with all electrical connectors installed on ECM. See **Fig. 4** . This is the E2 and THA terminals on ECM.
7. Turn ignition on. Using hand-held tester or scan tool, read intake air temperature for IAT sensor. If displayed intake air temperature is 284°F (140°C) or more, repair open Brown wire or Red/White wire between MAF meter and ECM. See **WIRING DIAGRAMS** article. If displayed intake air temperature is not 284°F (140°C) or more, replace ECM.
8. Turn ignition off. Disconnect electrical connector at MAF meter. MAF meter is bolted to upper cap on air cleaner assembly and contains a Black 5-pin electrical connector. Turn ignition on. Using hand-held tester or scan tool, read intake air temperature for IAT sensor. If displayed intake air temperature is not -40°F (-40°C), go to next step. If displayed intake air temperature is -40°F (-40°C), replace MAF meter. See **AIRFLOW METER** under ENGINE SENSORS & SWITCHES in REMOVAL, OVERHAUL & INSTALLATION - 4-CYLINDER article.
9. Turn ignition off. Remove glove box and passenger's side kick panel (if necessary) for access to ECM with electrical connectors still installed on ECM. See **Fig. 2** . Disconnect ECM electrical connectors E4 and E5. See **Fig. 4** . Ensure electrical connector is still disconnected at MAF meter.
10. Turn ignition on. Using hand-held tester or scan tool, read intake air temperature for IAT sensor. If displayed intake air temperature is -40°F (-40°C), repair short in wiring harness and electrical connectors between MAF meter and ECM. See **WIRING DIAGRAMS** article. If displayed intake air temperature is not -40°F (-40°C), replace ECM.

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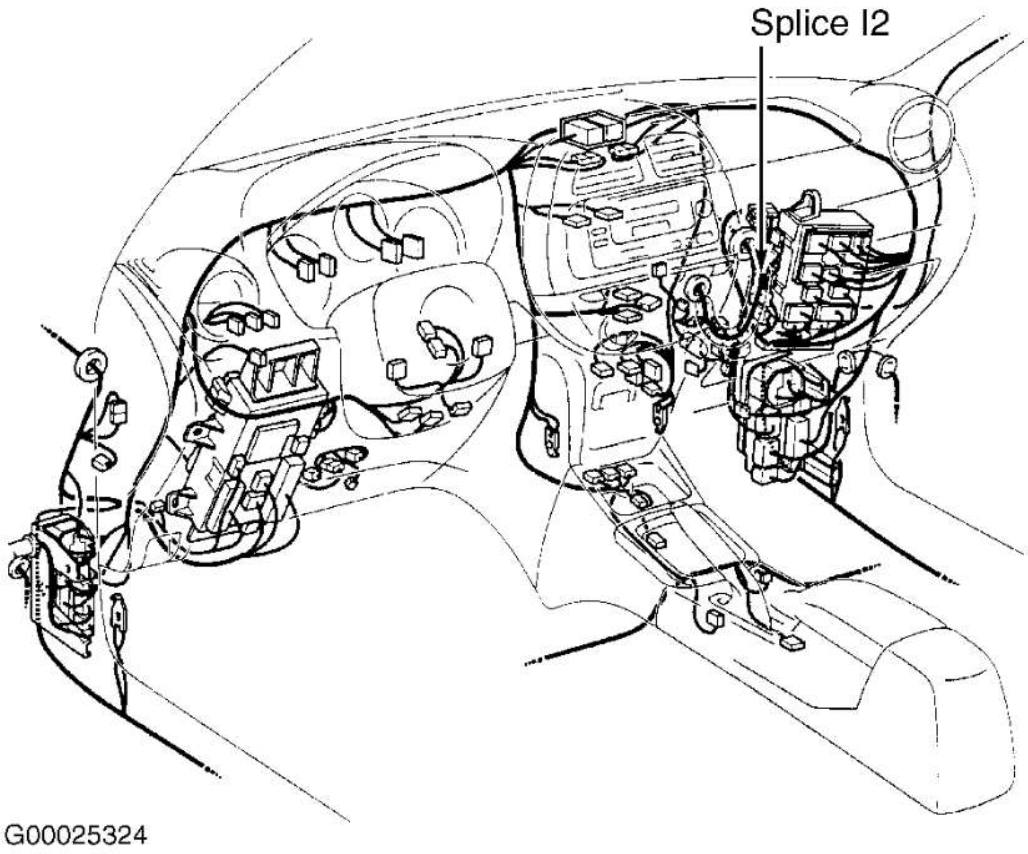


Fig. 6: Locating Splice I2
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

DTC P0115: ENGINE COOLANT TEMPERATURE SENSOR CIRCUIT

CAUTION: If Engine Control Module (ECM) replacement is instructed in following test, always ensure ECM electrical connectors and ground circuits are okay. If either are defective, repair and repeat testing to confirm ECM malfunction. On models equipped with engine immobilizer, if ECM is replaced, ECM must be programmed with proper ignition key code for engine immobilizer system. For programming procedures, see COMPUTER RELEARN PROCEDURES article in GENERAL INFORMATION, or appropriate ENGINE IMMOBILIZER SYSTEMS article in ACCESSORIES & EQUIPMENT.

NOTE: If DTCs P0100, P0101, P0110, P0115 and P0120 are output simultaneously, the E2 sensor ground circuit at terminal No. 18 (Brown wire) at ECM electrical connector E5 may be open. See WIRING DIAGRAMS article. For ECM electrical

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connector terminal identification, see Fig. 4 . It may be necessary to check Brown wire between splice I2 and terminal No. 18 at ECM electrical connector E5. Splice I2 is located behind passenger's side of instrument panel. See Fig. 6 .

Circuit Description

Engine Coolant Temperature (ECT) sensor is a thermistor sensor which monitors engine coolant temperature. DTC is set when ECM detects an open or short in ECT sensor circuit for .5 second. If DTC P0115 exists, ECM will operate in fail-safe mode in which engine coolant temperature is assumed to be 176°F (80°C). Possible causes are:

- ECT sensor circuit is open or shorted.
- Defective ECT sensor.
- Defective ECM.

Diagnostic Aids

After confirming DTC P0115, use Toyota hand-held tester or scan tool to access CURRENT DATA to read the engine coolant temperature for ECT sensor. If displayed engine coolant temperature is -40°F (-40°C), ECT sensor circuit may be open. If displayed engine coolant temperature is 284°F (140°C) or more, ECT sensor circuit may be shorted. Using hand-held tester or scan tool, read FREEZE FRAME data. Freeze frame data records engine conditions when malfunction is detected.

Diagnosis & Repair

1. Connect Toyota hand-held tester or scan tool to Data Link Connector (DLC) No. 3 at driver's side of instrument panel. See **Fig. 1** . Turn ignition on and then turn hand-held tester or scan tool on.
2. Using hand-held tester or scan tool, read engine coolant temperature for ECT sensor. If displayed engine coolant temperature is -40°F (-40°C), go to next step. If displayed engine coolant temperature is 284°F (140°C) or more, go to step 8 . If displayed engine coolant temperature is same as actual engine coolant temperature, problem is intermittent. Check for defective connections or intermittent problem in wiring between ECT sensor and ECM. ECT sensor is located on coolant housing at flywheel end of cylinder head and contains a Dark Gray 2-pin electrical connector with White and Brown wires. ECM is located behind passenger's side kick panel, just below instrument panel. See **Fig. 2** .
3. Turn ignition off. Disconnect electrical connector at ECT sensor. ECT sensor is located on coolant housing at flywheel end of cylinder head and contains a Dark Gray 2-pin electrical connector with White and Brown wires. Connect jumper wire between both terminals on electrical connector for ECT sensor.
4. Turn ignition on. Using hand-held tester or scan tool, read engine coolant temperature for ECT sensor. If displayed engine coolant temperature is less than 284°F (140°C), go to next step. If displayed engine coolant temperature is 284°F (140°C) or more, check for defective electrical connections at ECT sensor and electrical connector. If electrical connections are defective, repair as necessary. If electrical connections are okay, replace ECT sensor. See **ENGINE COOLANT TEMPERATURE SENSOR** under ENGINE SENSORS & SWITCHES in REMOVAL, OVERHAUL & INSTALLATION - 4-CYLINDER article.
5. Turn ignition off. Remove jumper wire. Remove glove box and passenger's side kick panel (if necessary)

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for access to ECM with electrical connectors still installed on ECM. See **Fig. 2** . Ensure electrical connectors at ECM are securely installed so all terminals in electrical connectors are contacting terminals in ECM.

6. Ensure electrical connector at ECT sensor is still disconnected. Connect jumper wire between terminal No. 18 (Brown wire) at ECM electrical connector E5 and No. 22 (White wire) at ECM electrical connector E4 with all electrical connectors installed on ECM. See **Fig. 4** . This is the E2 and THW terminals on ECM.
7. Turn ignition on. Using hand-held tester or scan tool, read engine coolant temperature for ECT sensor. If displayed engine coolant temperature is 284°F (140°C) or more, repair open Brown wire or White wire between ECT sensor and ECM. See **WIRING DIAGRAMS** article. If displayed engine coolant temperature is not 284°F (140°C) or more, replace ECM.
8. Turn ignition off. Disconnect electrical connector at ECT sensor. ECT sensor is located on coolant housing at flywheel end of cylinder head and contains a Dark Gray 2-pin electrical connector with White and Brown wires.
9. Turn ignition on. Using hand-held tester or scan tool, read engine coolant temperature for ECT sensor. If displayed engine coolant temperature is not -40°F (-40°C), go to next step. If displayed engine coolant temperature is -40°F (-40°C), replace ECT sensor. See **ENGINE COOLANT TEMPERATURE SENSOR** under ENGINE SENSORS & SWITCHES in REMOVAL, OVERHAUL & INSTALLATION - 4-CYLINDER article.
10. Turn ignition off. Remove glove box and passenger's side kick panel (if necessary) for access to ECM with electrical connectors still installed on ECM. See **Fig. 2** . Disconnect ECM electrical connectors E4 and E5. See **Fig. 4** . Ensure electrical connector is still disconnected at ECT sensor.
11. Turn ignition on. Using hand-held tester or scan tool, read engine coolant temperature for ECT sensor. If displayed engine coolant temperature is -40°F (-40°C), repair short in wiring harness and electrical connectors between ECT sensor and ECM. See **WIRING DIAGRAMS** article. If displayed engine coolant temperature is not -40°F (-40°C), replace ECM.

DTC P0116: ENGINE COOLANT TEMPERATURE SENSOR CIRCUIT RANGE/PERFORMANCE

NOTE: If DTCs P0115 and P0116 are output simultaneously, an open may exist in wiring between Engine Coolant Temperature (ECT) sensor and Engine Control Module (ECM). Perform DTC P0115: ENGINE COOLANT TEMPERATURE SENSOR CIRCUIT test before performing DTC P0116 test.

Circuit Description

Engine Coolant Temperature (ECT) sensor is a thermistor sensor which monitors engine coolant temperature. DTC is set when ECT sensor signal value is out of range during engine operation. Possible causes are:

- Defective ECT sensor.
- Defective cooling system thermostat.

Diagnostic Aids

This DTC uses two-trip detection logic. Using Toyota hand-held tester or scan tool, read FREEZE FRAME

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data. Freeze frame data records engine conditions when malfunction is detected.

Diagnosis & Repair

1. Using Toyota hand-held tester or scan tool, check for any other DTCs. If only DTC P0116 exists, go to next step. If other DTCs exist, diagnose and repair those DTCs first and retest.
2. Remove and inspect cooling system thermostat for damage and proper operation. Thermostat is located behind thermostat housing which is located just behind the generator. If thermostat is defective, replace thermostat. If thermostat is okay, replace ECT sensor. See **ENGINE COOLANT TEMPERATURE SENSOR** under ENGINE SENSORS & SWITCHES in REMOVAL, OVERHAUL & INSTALLATION - 4-CYLINDER article. ECT sensor is located on coolant housing at flywheel end of cylinder head and contains a Dark Gray 2-pin electrical connector with White and Brown wires.

DTC P0120: THROTTLE POSITION SENSOR CIRCUIT

CAUTION: If Engine Control Module (ECM) replacement is instructed in following test, always ensure ECM electrical connectors and ground circuits are okay. If either are defective, repair and repeat testing to confirm ECM malfunction. On models equipped with engine immobilizer, if ECM is replaced, ECM must be programmed with proper ignition key code for engine immobilizer system. For programming procedures, see COMPUTER RELEARN PROCEDURES article in GENERAL INFORMATION, or appropriate ENGINE IMMOBILIZER SYSTEMS article in ACCESSORIES & EQUIPMENT.

NOTE: If DTCs P0100, P0101, P0110, P0115 and P0120 are output simultaneously, the E2 sensor ground circuit at terminal No. 18 (Brown wire) at ECM electrical connector E5 may be open. See WIRING DIAGRAMS article. For ECM electrical connector terminal identification, see Fig. 4 . It may be necessary to check Brown wire between splice I2 and terminal No. 18 at ECM electrical connector E5. Splice I2 is located behind passenger's side of instrument panel. See Fig. 6 .

Circuit Description

Throttle Position (TP) sensor is a variable resistor located on throttle body which monitors throttle opening and delivers input signal to VTA terminal on ECM. Input signal is about .3-1.0 volt with throttle fully closed and about 3.2-4.9 volts with throttle fully open. ECM uses input signal for determining vehicle driving conditions and adjusts air/fuel mixture accordingly. DTC is set when ECM consistently detects less than .1 volt or more than 4.9 volts on VTA circuit for more than .5 second. If DTC P0120 exists, ECM will operate in fail-safe mode. Possible causes are:

- TP sensor circuit is open or shorted.
- Defective TP sensor.
- Defective ECM.

Diagnostic Aids

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After confirming DTC P0120, use Toyota hand-held tester or scan tool to confirm throttle valve opening percentage with throttle fully closed and fully open to determine probable cause. If percentage displayed is always zero percent, VC circuit may be open or VTA circuit may be open or shorted. If percentage displayed is always approximately 100 percent, E2 circuit may be open. Using hand-held tester or scan tool, read FREEZE FRAME data. Freeze frame data records engine conditions when malfunction is detected.

Diagnosis & Repair

1. Connect Toyota hand-held tester or scan tool to Data Link Connector (DLC) No. 3 at driver's side of instrument panel. See **Fig. 1** . Turn ignition on and then turn hand-held tester or scan tool on.
2. Using hand-held tester or scan tool, read throttle valve opening percentages with throttle fully closed and fully open. Throttle valve opening percentage should be approximately 10 percent with throttle fully closed and approximately 70 percent with throttle fully open. If throttle valve opening percentages are not within specification, go to next step. If throttle valve opening percentages are within specification, problem is intermittent. Check for defective connections or intermittent problem in wiring between TP sensor and ECM. ECM is located behind passenger's side kick panel, just below instrument panel. See **Fig. 2** .
3. Turn ignition off. Disconnect electrical connector at TP sensor. Turn ignition on. Using voltmeter, check voltage between body ground and terminal No. 1 (Yellow wire) at electrical connector for TP. If voltage is 4.5-5.5 volts, go to next step. If voltage is not 4.5-5.5 volts, go to step 6 .
4. Check TP sensor. See **THROTTLE POSITION SENSOR** under ENGINE SENSORS & SWITCHES in SYSTEM & COMPONENT TESTING - 4-CYLINDER article. If TP sensor is okay, go to next step. If TP sensor is defective, replace TP sensor.
5. Remove glove box and passenger's side kick panel (if necessary) for access to ECM with electrical connectors still installed on ECM. See **Fig. 2** . Turn ignition on. Using voltmeter, check voltage between terminals No. 18 (Brown wire) at ECM electrical connector E5 and No. 24 (Blue/Red wire) at ECM electrical connector E4 with all electrical connectors installed on ECM with throttle fully closed and fully open. See **Fig. 4** . This is the E2 and VTA terminals on ECM. Voltage should be .3-1.0 volt with throttle fully closed and 3.2-4.9 volts with throttle fully open. If voltages are within specification, replace ECM. If voltages are not within specification, repair open or short in Brown wire and/or Blue/Red wire and electrical connectors between TP sensor and ECM. See **WIRING DIAGRAMS** article.
6. Remove glove box and passenger's side kick panel (if necessary) for access to ECM with electrical connectors still installed on ECM. See **Fig. 2** . Ensure ignition is on. Using voltmeter, check voltage between terminals No. 2 (Yellow wire) and No. 18 (Brown wire) at ECM electrical connector E5 with all electrical connectors installed on ECM. See **Fig. 4** . This is the VC and E2 terminals on ECM. Voltage should be 4.5-5.5 volts. If voltage is not within specification, replace ECM. If voltage is within specification, repair open or short in Yellow wire and electrical connectors between TP sensor and ECM. See **WIRING DIAGRAMS** article.

DTC P0121: THROTTLE POSITION SENSOR CIRCUIT RANGE/PERFORMANCE

Circuit Description

Throttle Position (TP) sensor is a variable resistor located on throttle body which monitors throttle opening and delivers input signals to Engine Control Module (ECM). ECM uses input signals for determining vehicle driving conditions and adjusts air/fuel mixture accordingly. DTC is set after vehicle speed is more than 19 MPH

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once and TP sensor output voltage is out of range. Possible cause is defective TP sensor.

Diagnostic Aids

This DTC uses two-trip detection logic. Using Toyota hand-held tester or scan tool, read FREEZE FRAME data. Freeze frame data records engine conditions when malfunction is detected.

Diagnosis & Repair

Using Toyota hand-held tester or scan tool, check for any other DTCs. If other DTCs exist, diagnose and repair those DTCs first and retest. If only DTC P0121 exists, replace TP sensor.

DTC P0125: INSUFFICIENT COOLANT TEMPERATURE FOR CLOSED LOOP FUEL CONTROL

NOTE: This DTC may be caused by the vehicle running out of fuel.

CAUTION: If Engine Control Module (ECM) replacement is instructed in following test, always ensure ECM electrical connectors and ground circuits are okay. If either are defective, repair and repeat testing to confirm ECM malfunction. On models equipped with engine immobilizer, if ECM is replaced, ECM must be programmed with proper ignition key code for engine immobilizer system. For programming procedures, see COMPUTER RELEARN PROCEDURES article in GENERAL INFORMATION, or appropriate ENGINE IMMOBILIZER SYSTEMS article in ACCESSORIES & EQUIPMENT.

Circuit Description

Heated Air/Fuel (A/F) sensors monitor exhaust gas oxygen content and deliver input signals to ECM. Heated A/F sensors are located on exhaust manifold above catalytic converters. See **Fig. 7** . A/F sensor for cylinders No. 1 and 4 is referred to as bank No. 1 sensor No. 1. A/F sensor for cylinders No. 2 and 3 is referred to as bank No. 2 sensor No. 1. A/F sensors may also be referred to as A/F ratio sensors. ECM uses input signals to determine fuel injection system operation. DTC is set when A/F sensor output voltage does not change after engine is started with engine at normal operating temperature, engine speed of 1500 RPM or more and with vehicle speed of 25-62 MPH for at least 1.5 minutes. Possible causes are:

- A/F sensor circuit is open or shorted.
- Defective A/F sensor.
- Air induction system malfunction.
- Improper fuel pressure.
- Defective fuel injector.
- Exhaust system leak.
- Vehicle has run out of fuel.
- Defective ECM.

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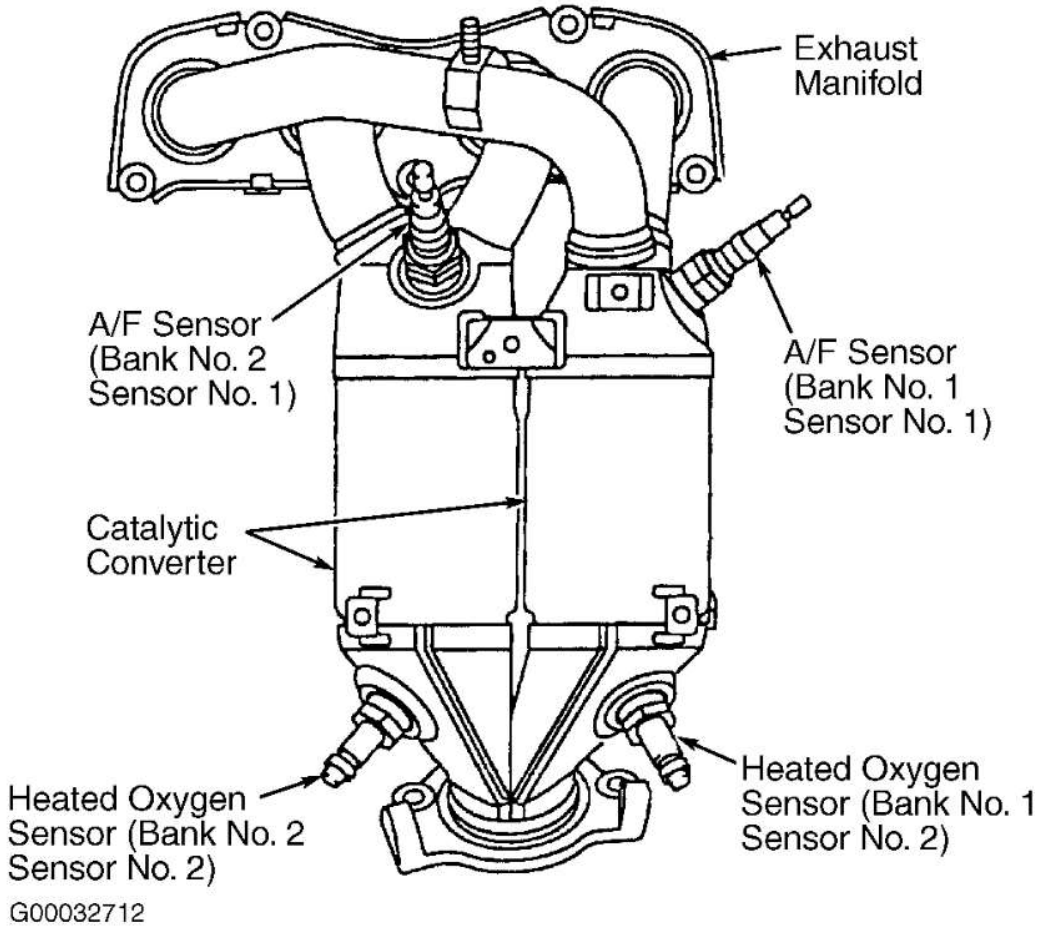


Fig. 7: Locating A/F Sensors & Heated Oxygen Sensors
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Diagnostic Aids

After confirming DTC P0125, use Toyota hand-held tester or scan tool to access CURRENT DATA to read output voltage for A/F sensors. ECM maintains a fixed voltage of 3.3 volts at AFR+ and AFL+ terminals on ECM, and 3.0 volts at AFR- and AFL- terminals on ECM. It is impossible to confirm A/F sensor output voltage without using Toyota hand-held tester or scan tool. A/F sensor output voltage on scan tool is displayed at one fifth the voltage of that displayed on a Toyota hand-held tester. Using hand-held tester or scan tool, read FREEZE FRAME data. Freeze frame data records engine conditions when malfunction is detected.

Test Drive Confirmation

1. Test drive confirmation may be performed to operate vehicle under conditions which may cause DTC to be set. When performing test drive confirmation, procedures must be performed exactly as listed or the

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malfunction may not be detected. If Toyota hand-held tester is available, go to next step. If Toyota hand-held tester is not available, go to step 3 .

2. Connect hand-held tester to Data Link Connector (DLC) No. 3 at driver's side of instrument panel. See **Fig. 1** . Switch hand-held tester from NORMAL mode to CHECK mode.
3. Start engine. Allow engine to idle for at least 60 seconds.
4. Drive vehicle at 24 MPH or more for at least 40 seconds and then allow engine to idle for at least 10 seconds. Repeat this procedure 9 times and then check operation of Malfunction Indicator Light (MIL). If MIL illuminates, malfunction exists and DTC is set. If MIL does not illuminate, malfunction does not exist.

Diagnosis & Repair

1. Using Toyota hand-held tester or scan tool, check for any other DTCs. If only DTC P0125 exists, go to next step. If other DTCs exist, diagnose and repair those DTCs first and retest.
2. With Toyota hand-held tester or scan tool still connected to DLC No. 3, start engine and maintain engine speed at 2500 RPM for about 90 seconds to fully warm the A/F sensor. Allow engine to idle.
3. Using hand-held tester or scan tool, monitor each A/F sensor output voltage with engine idling, engine racing and while driving vehicle at 25 MPH or more with engine speed of 1500 RPM or more while opening and closing the throttle. Ensure A/F sensor output voltage is within specification. See **AIR/FUEL SENSOR OUTPUT VOLTAGE SPECIFICATIONS** table. If A/F sensor output voltage is not within specification, go to next step. If A/F sensor output voltage is within specification, go to step 10 .

NOTE: If A/F sensor output voltage remains 3.30 volts (Toyota hand-held tester) or .66 volt (OBD-II scan tool) during all conditions, A/F sensor circuit may be open. If A/F sensor output voltage remains 3.80 volts or more (Toyota hand-held tester) or .76 volt or more (OBD-II scan tool) during all conditions, A/F sensor circuit may be shorted. If A/F sensor output voltage remains 2.80 volts or less (Toyota hand-held tester) or .56 volt or less (OBD-II scan tool) during all conditions, A/F sensor circuit may be shorted. During fuel enrichment, A/F sensor output voltage may be less than 2.8 volts (Toyota hand-held tester) or .56 volt (OBD-II scan tool) which is normal. During fuel cut, A/F sensor output voltage may be more than 3.8 volts (Toyota hand-held tester) or .76 volt (OBD-II scan tool) which is normal.

AIR/FUEL SENSOR OUTPUT VOLTAGE SPECIFICATIONS

Application & Operating Condition	Specification
Using OBD-II Scan Tool	
Engine Idling, Engine Racing & Driving Vehicle (1)	(2)
Using Toyota Hand-Held Tester	
Engine Idling, Engine Racing & Driving Vehicle (1)	(3)

(1) Drive vehicle at 25 MPH or more with engine speed of 1500 RPM or more while opening and closing the throttle.

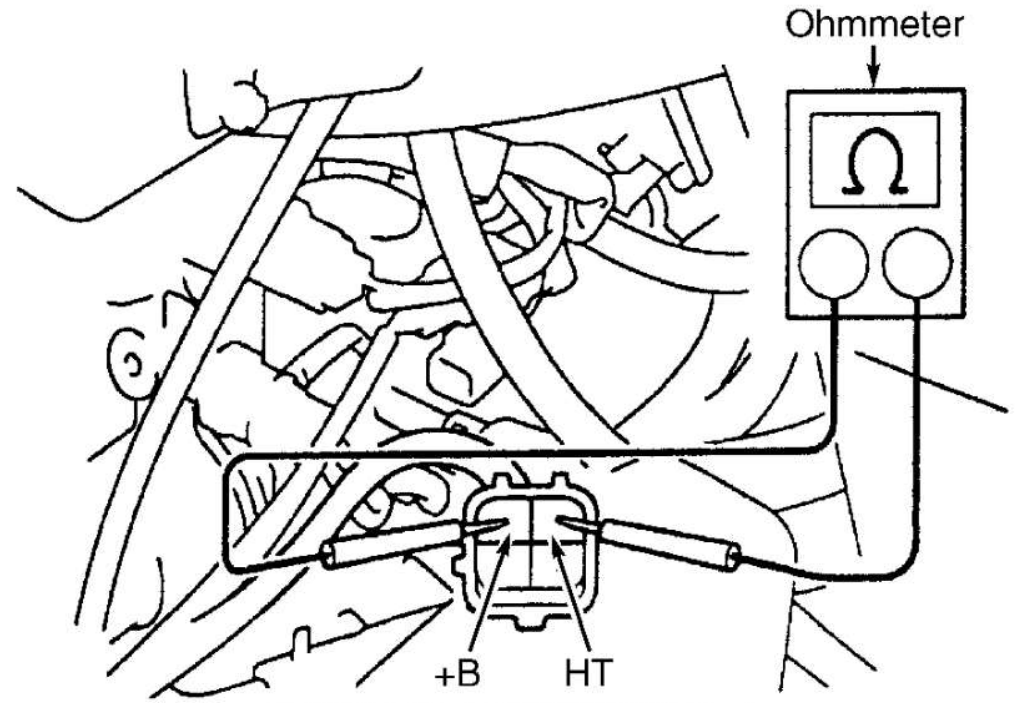
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(2) Voltage should not remain at .56 volt or less, .66 volt, or .76 volt or more.

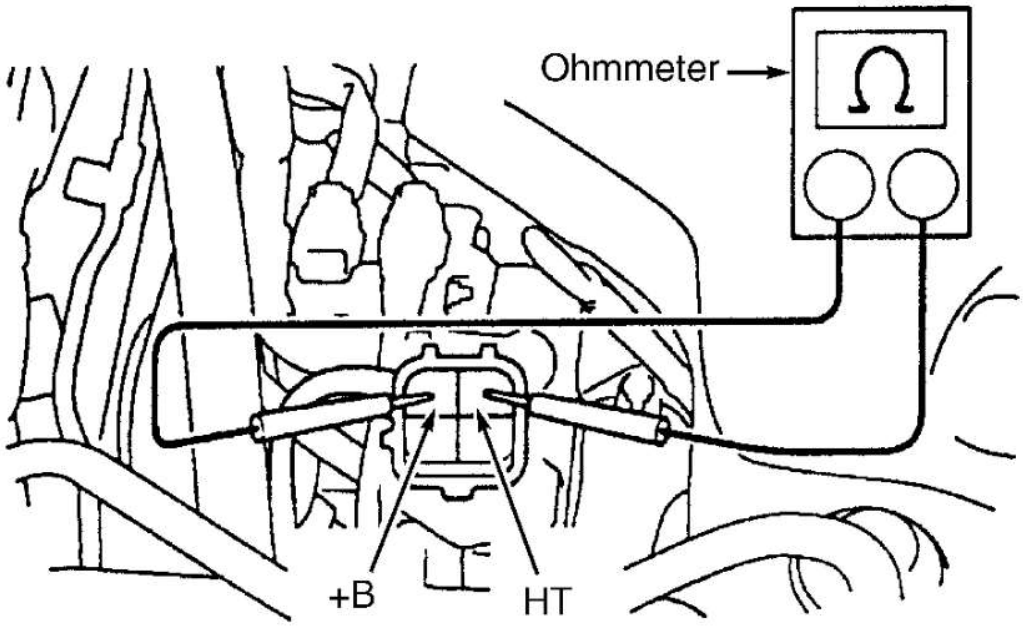
(3) Voltage should not remain at 2.80 volts or less, 3.30 volts, or 3.80 volts or more.

4. Check for open and short in wiring harness and electrical connectors between A/F sensors and ECM. See **WIRING DIAGRAMS** article. A/F sensors are located on exhaust manifold above catalytic converters. See **Fig. 7** . A/F sensor for cylinders No. 1 and 4 is referred to as bank No. 1 sensor No. 1. A/F sensor for cylinders No. 2 and 3 is referred to as bank No. 2 sensor No. 1. ECM is located behind passenger's side kick panel, just below instrument panel. See **Fig. 2** . If wiring harness and electrical connectors are okay, go to next step. If wiring harness or electrical connector is defective, repair as necessary.
5. Disconnect electrical connector for A/F sensor. Using ohmmeter, check resistance for heater on A/F sensor between +B and HT terminals on electrical connector for A/F sensor. See **Fig. 8** . Resistance should be .8-1.4 ohms at 68°F (20°C) and 1.8-3.2 ohms at 1472°F (800°C). If resistance is within specification, go to next step. If resistance is not within specification, replace A/F sensor. See **AIR/FUEL SENSOR** under ENGINE SENSORS & SWITCHES in REMOVAL, OVERHAUL & INSTALLATION - 4-CYLINDER article.

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BANK NO. 1 SENSOR NO. 1



BANK NO. 2 SENSOR NO. 1

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Fig. 8: Testing Heater On A/F Sensor
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6. Ensure engine oil dipstick, oil filler cap, Positive Crankcase Ventilation (PCV) system and all other air induction system components are intact and operating properly. If problem does not exist, go to next step. If problem exists, repair as necessary.
7. Check fuel pressure. See **FUEL PRESSURE** under FUEL SYSTEMS in BASIC DIAGNOSTIC PROCEDURES - 4-CYLINDER article. Fuel pressure should be 44-50 psi (3.1-3.5 kg/cm^2) with engine idling and should remain at least 21 psi (1.5 kg/cm^2) for a minimum of 5 minutes after engine is shut off. If fuel pressure is within specification, go to next step. If fuel pressure is not within specification, repair fuel system as necessary.
8. Check operation of fuel injectors. See **FUEL CONTROL** under FUEL SYSTEMS in SYSTEM & COMPONENT TESTING - 4-CYLINDER article. Fuel injector volume should be 53-65 cc (3.2-3.9 cu. in.) within 15 seconds and difference in volume between each fuel injector should be less than 6 cc (.37 cu. in.). Fuel injectors should not leak more than one drop every 12 minutes. If fuel injectors are okay, go to next step. If fuel injectors are defective, replace fuel injectors as necessary.
9. Check exhaust system for leaks. If no exhaust leak exists, replace A/F sensor. See **AIR/FUEL SENSOR** under ENGINE SENSORS & SWITCHES in REMOVAL, OVERHAUL & INSTALLATION - 4-CYLINDER article. If exhaust leak exists, repair exhaust system as necessary.
10. Using Toyota hand-held tester or scan tool, clear DTCs from ECM. Perform test drive confirmation and then go to next step. See **TEST DRIVE CONFIRMATION** .
11. Recheck for DTCs. If DTC P0125 does not exist, go to next step. If DTC P0125 exists, replace ECM. ECM is located behind passenger's side kick panel, just below instrument panel. See **Fig. 2** .
12. Verify if vehicle ran out of fuel. If vehicle ran out of fuel, DTC P0125 was caused by the vehicle running out of fuel. If vehicle did not run out of fuel, problem is intermittent. Check for defective connections or intermittent problem in wiring. ECM is located behind passenger's side kick panel, just below instrument panel. See **Fig. 2** .

DTC P0128: THERMOSTAT MALFUNCTION

CAUTION: If Engine Control Module (ECM) replacement is instructed in following test, always ensure ECM electrical connectors and ground circuits are okay. If either are defective, repair and repeat testing to confirm ECM malfunction. On models equipped with engine immobilizer, if ECM is replaced, ECM must be programmed with proper ignition key code for engine immobilizer system. For programming procedures, see COMPUTER RELEARN PROCEDURES article in GENERAL INFORMATION, or appropriate ENGINE IMMOBILIZER SYSTEMS article in ACCESSORIES & EQUIPMENT.

Circuit Description

DTC is set when ECM detects engine coolant temperature is less than 167°F (75°C) when engine should be at normal operating temperature. Possible causes are:

- Defective cooling system thermostat.

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- Defective ECM.

Diagnostic Aids

Using Toyota hand-held tester or scan tool, read FREEZE FRAME data. Freeze frame data records engine conditions when malfunction is detected.

Diagnosis & Repair

1. Remove and inspect cooling system thermostat for damage and proper operation. Thermostat is located behind thermostat housing which is located just behind the generator. If thermostat is okay, go to next step. If thermostat is defective, replace thermostat.
2. Using Toyota hand-held tester or scan tool, check for any other DTCs. If other DTCs exist, diagnose and repair those DTCs first and retest. If only DTC P0128 exists, replace ECM. ECM is located behind passenger's side kick panel, just below instrument panel. See **Fig. 2** .

DTC P0136: HEATED OXYGEN SENSOR CIRCUIT (BANK NO. 1 SENSOR NO. 2)

Circuit Description

Heated oxygen sensors monitor exhaust gas oxygen content and deliver input signals to Engine Control Module (ECM). Heated oxygen sensors are located on exhaust manifold below catalytic converters. See **Fig. 7** . Heated oxygen sensor for cylinders No. 1 and 4 is referred to as bank No. 1 sensor No. 2. ECM uses input signals to determine fuel injection system operation. DTC is set when heated oxygen sensor (bank No. 1 sensor No. 2) output voltage remains at .40 volt or more, or .50 volt or less when vehicle is driven at 25 MPH with engine at normal operating temperature. Possible causes are:

- Heated oxygen sensor (bank No. 1 sensor No. 2) circuit is open or shorted.
- Defective heated oxygen sensor (bank No. 1 sensor No. 2).

Diagnostic Aids

This DTC uses two-trip detection logic. Using Toyota hand-held tester or scan tool, read FREEZE FRAME data. Freeze frame data records engine conditions when malfunction is detected.

Test Drive Confirmation

1. Test drive confirmation may be performed to operate vehicle under conditions which may cause DTC to be set. When performing test drive confirmation, procedures must be performed exactly as listed or the malfunction may not be detected. If Toyota hand-held tester is available, go to next step. If Toyota hand-held tester is not available, go to step 3 .
2. Connect hand-held tester to Data Link Connector (DLC) No. 3 at driver's side of instrument panel. See **Fig. 1** . Switch hand-held tester from NORMAL mode to CHECK mode.
3. Start engine. Allow engine to idle for at least 60 seconds.
4. Drive vehicle at 24 MPH or more for at least 40 seconds and then allow engine to idle for at least 10 seconds. Repeat this procedure 9 times and then check operation of Malfunction Indicator Light (MIL). If

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MIL illuminates, malfunction exists and DTC is set. If MIL does not illuminate, malfunction does not exist.

Diagnosis & Repair

1. Using Toyota hand-held tester or scan tool, check for any other DTCs. If only DTC P0136 exists, go to next step. If other DTCs exist, diagnose and repair those DTCs first and retest.
2. Check for open and short in wiring harness and electrical connectors between heated oxygen sensor (bank No. 1 sensor No. 2) and ECM. See **WIRING DIAGRAMS** article. Heated oxygen sensor (bank No. 1 sensor No. 2) is located on exhaust manifold below catalytic converters. See **Fig. 7** . ECM is located behind passenger's side kick panel, just below instrument panel. See **Fig. 2** . If wiring harness and electrical connectors are okay, go to next step. If wiring harness or electrical connector is defective, repair as necessary.
3. With hand-held tester or scan tool still connected to DLC No. 3, start engine and warm engine to normal operating temperature. Monitor heated oxygen sensor (bank No. 1 sensor No. 2) output voltage while quickly accelerating engine to 4000 RPM 3 consecutive times. Output voltage should fluctuate from .40 volt or less to .55 volt or more. If output voltage is not within specification, replace heated oxygen sensor (bank No. 1 sensor No. 2). See **HEATED OXYGEN SENSOR** under ENGINE SENSORS & SWITCHES in REMOVAL, OVERHAUL & INSTALLATION - 4-CYLINDER article. If output voltage is within specification, problem is intermittent. Check for defective connections or intermittent problem in wiring between heated oxygen sensor (bank No. 1 sensor No. 2) and ECM.

DTC P0141: HEATED OXYGEN SENSOR HEATER CIRCUIT (BANK NO. 1 SENSOR NO. 2)

CAUTION: If Engine Control Module (ECM) replacement is instructed in following test, always ensure ECM electrical connectors and ground circuits are okay. If either are defective, repair and repeat testing to confirm ECM malfunction. On models equipped with engine immobilizer, if ECM is replaced, ECM must be programmed with proper ignition key code for engine immobilizer system. For programming procedures, see COMPUTER RELEARN PROCEDURES article in GENERAL INFORMATION, or appropriate ENGINE IMMOBILIZER SYSTEMS article in ACCESSORIES & EQUIPMENT.

Circuit Description

Heated oxygen sensors monitor exhaust gas oxygen content and deliver input signals to ECM. Heated oxygen sensors are located on exhaust manifold below catalytic converters. See **Fig. 7** . Heated oxygen sensor for cylinders No. 1 and 4 is referred to as bank No. 1 sensor No. 2. ECM uses input signals to determine fuel injection system operation. DTC is set when heated oxygen sensor (bank No. 1 sensor No. 2) heater current draw exceeds 2 amps or is .2 amp or less when heater operates. Possible causes are:

- Heated oxygen sensor (bank No. 1 sensor No. 2) circuit is open or shorted.
- Defective heated oxygen sensor (bank No. 1 sensor No. 2).
- Defective ECM.

Diagnostic Aids

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This DTC uses two-trip detection logic. Using Toyota hand-held tester or scan tool, read FREEZE FRAME data. Freeze frame data records engine conditions when malfunction is detected.

Diagnosis & Repair

1. Remove glove box and passenger's side kick panel (if necessary) for access to ECM with electrical connectors still installed on ECM. See **Fig. 2** . Turn ignition on. Using voltmeter, check voltage between body ground and terminal No. 3 (Red/Black wire) at ECM electrical connector E5. See **Fig. 4** . This is the HT1B terminal on ECM. Voltage should be 9-14 volts. If voltage is not within specification, go to next step. If voltage is within specification, replace ECM.
2. Disconnect electrical connector for heated oxygen sensor (bank No. 1 sensor No. 2). See **Fig. 7** . Using ohmmeter, check resistance between +B and HT terminals on electrical connector for heater on heated oxygen sensor (bank No. 1 sensor No. 2). See **Fig. 9** .
3. Resistance should be 11-16 ohms at 68°F (20°C) and 23-32 ohms at 1472°F (800°C). If resistance is within specification, go to next step. If resistance is not within specification, replace heated oxygen sensor (bank No. 1 sensor No. 2). See **HEATED OXYGEN SENSOR** under ENGINE SENSORS & SWITCHES in REMOVAL, OVERHAUL & INSTALLATION - 4-CYLINDER article.
4. Check wiring harness and electrical connectors between ECM and heated oxygen sensor (bank No. 1 sensor No. 2), and between heated oxygen sensor (bank No. 1 sensor No. 2), EFI3 fuse (10-amp) and EFI main relay. See **WIRING DIAGRAMS** article. EFI main relay may also be referred to as EFI relay. EFI3 fuse and EFI main relay are located in fuse/relay box at driver's side front corner of engine compartment.

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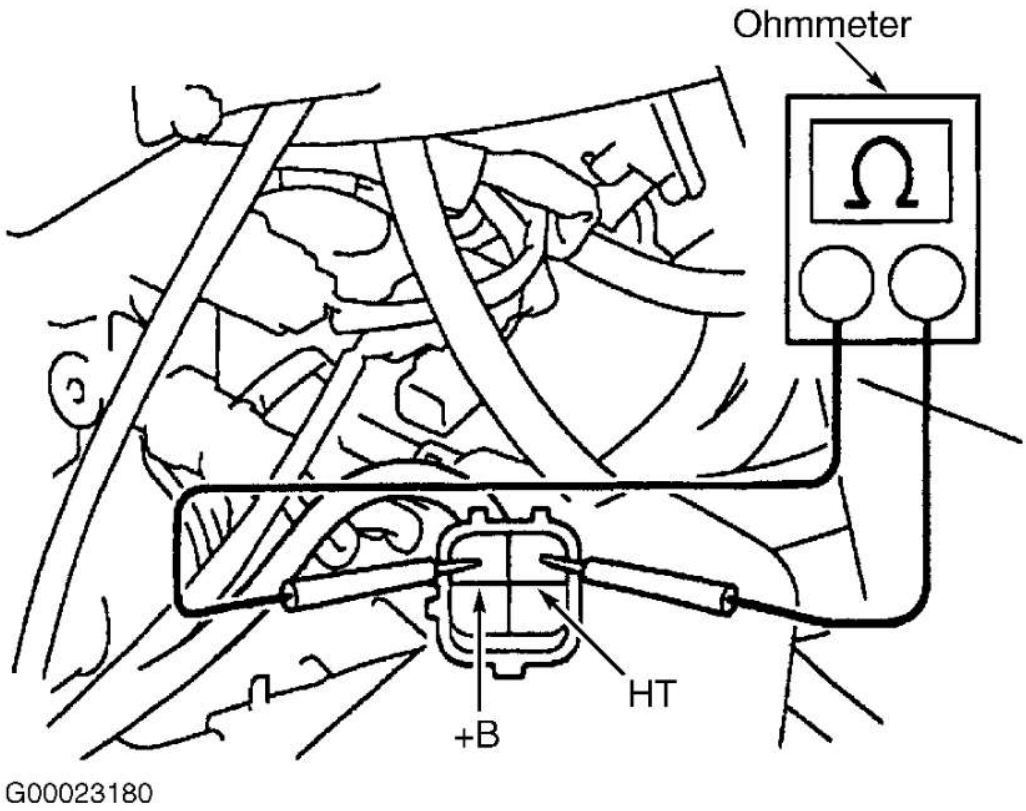


Fig. 9: Testing Heater On Heated Oxygen Sensor (Bank No. 1 Sensor No. 2)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

DTC P0156: HEATED OXYGEN SENSOR CIRCUIT (BANK NO. 2 SENSOR NO. 2)

Circuit Description

Heated oxygen sensors monitor exhaust gas oxygen content and deliver input signals to Engine Control Module (ECM). Heated oxygen sensors are located on exhaust manifold below catalytic converters. See **Fig. 7** . Heated oxygen sensor for cylinders No. 2 and 3 is referred to as bank No. 2 sensor No. 2. ECM uses input signals to determine fuel injection system operation. DTC is set when heated oxygen sensor (bank No. 2 sensor No. 2) output voltage remains at .40 volt or more, or .50 volt or less when vehicle is driven at 25 MPH with engine at normal operating temperature. Possible causes are:

- Heated oxygen sensor (bank No. 2 sensor No. 2) circuit is open or shorted.
- Defective heated oxygen sensor (bank No. 2 sensor No. 2).

Diagnostic Aids

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This DTC uses two-trip detection logic. Using Toyota hand-held tester or scan tool, read FREEZE FRAME data. Freeze frame data records engine conditions when malfunction is detected.

Test Drive Confirmation

1. Test drive confirmation may be performed to operate vehicle under the conditions which may cause DTC to be set. When performing test drive confirmation, procedures must be performed exactly as listed or the malfunction may not be detected. If Toyota hand-held tester is available, go to next step. If Toyota hand-held tester is not available, go to step 3 .
2. Connect hand-held tester to Data Link Connector (DLC) No. 3 at driver's side of instrument panel. See **Fig. 1** . Switch hand-held tester from NORMAL mode to CHECK mode.
3. Start engine. Allow engine to idle for at least 60 seconds.
4. Drive vehicle at 24 MPH or more for at least 40 seconds and then allow engine to idle for at least 10 seconds. Repeat this procedure 9 times and then check operation of Malfunction Indicator Light (MIL). If MIL illuminates, malfunction exists and DTC is set. If MIL does not illuminate, malfunction does not exist.

Diagnosis & Repair

1. Using Toyota hand-held tester or scan tool, check for any other DTCs. If only DTC P0156 exists, go to next step. If other DTCs exist, diagnose and repair those DTCs first and retest.
2. Check for open and short in wiring harness and electrical connectors between heated oxygen sensor (bank No. 2 sensor No. 2) and ECM. See **WIRING DIAGRAMS** article. Heated oxygen sensor (bank No. 2 sensor No. 2) is located on exhaust manifold. See **Fig. 7** . ECM is located behind passenger's side kick panel, just below instrument panel. See **Fig. 2** . If wiring harness and electrical connectors are okay, go to next step. If wiring harness or electrical connector is defective, repair as necessary.
3. With hand-held tester or scan tool still connected to DLC No. 3, start engine and warm engine to normal operating temperature. Monitor heated oxygen sensor (bank No. 2 sensor No. 2) output voltage while quickly accelerating engine to 4000 RPM 3 consecutive times. Output voltage should fluctuate from .40 volt or less to .55 volt or more. If output voltage is not within specification, replace heated oxygen sensor (bank No. 2 sensor No. 2). See **HEATED OXYGEN SENSOR** under ENGINE SENSORS & SWITCHES in REMOVAL, OVERHAUL & INSTALLATION - 4-CYLINDER article. If output voltage is within specification, problem is intermittent. Check for defective connections or intermittent problem in wiring between heated oxygen sensor (bank No. 2 sensor No. 2) and ECM.

DTC P0161: HEATED OXYGEN SENSOR HEATER CIRCUIT (BANK NO. 2 SENSOR NO. 2)

CAUTION: If Engine Control Module (ECM) replacement is instructed in following test, always ensure ECM electrical connectors and ground circuits are okay. If either are defective, repair and repeat testing to confirm ECM malfunction. On models equipped with engine immobilizer, if ECM is replaced, ECM must be programmed with proper ignition key code for engine immobilizer system. For programming procedures, see COMPUTER RELEARN PROCEDURES article in GENERAL INFORMATION, or appropriate ENGINE IMMOBILIZER SYSTEMS article in ACCESSORIES & EQUIPMENT.

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Circuit Description

Heated oxygen sensors monitor exhaust gas oxygen content and deliver input signals to ECM. Heated oxygen sensors are located on exhaust manifold below catalytic converters. See **Fig. 7** . Heated oxygen sensor for cylinders No. 2 and 3 is referred to as bank No. 2 sensor No. 2. ECM uses input signals to determine fuel injection system operation. DTC is set when heated oxygen sensor (bank No. 2 sensor No. 2) heater current draw exceeds 2 amps or is .2 amp or less when heater operates. Possible causes are:

- Heated oxygen sensor (bank No. 2 sensor No. 2) circuit is open or shorted.
- Defective heated oxygen sensor (bank No. 2 sensor No. 2).
- Defective ECM.

Diagnostic Aids

This DTC uses two-trip detection logic. Using Toyota hand-held tester or scan tool, read FREEZE FRAME data. Freeze frame data records engine conditions when malfunction is detected.

Diagnosis & Repair

1. Remove glove box and passenger's side kick panel (if necessary) for access to ECM with electrical connectors still installed on ECM. See **Fig. 2** . Turn ignition on. Using voltmeter, check voltage between body ground and terminal No. 14 (Red/Yellow wire) at ECM electrical connector E6. See **Fig. 4** . This is the HT2B terminal on ECM. Voltage should be 9-14 volts. If voltage is not within specification, go to next step. If voltage is within specification, replace ECM.
2. Disconnect electrical connector for heated oxygen sensor (bank No. 2 sensor No. 2). See **Fig. 7** . Using ohmmeter, check resistance between +B and HT terminals on electrical connector for heater on heated oxygen sensor (bank No. 2 sensor No. 2). See **Fig. 10** .
3. Resistance should be 11-16 ohms at 68°F (20°C) and 23-32 ohms at 1472°F (800°C). If resistance is within specification, go to next step. If resistance is not within specification, replace heated oxygen sensor (bank No. 2 sensor No. 2). See **HEATED OXYGEN SENSOR** under ENGINE SENSORS & SWITCHES in REMOVAL, OVERHAUL & INSTALLATION - 4-CYLINDER article.
4. Check wiring harness and electrical connectors between ECM and heated oxygen sensor (bank No. 2 sensor No. 2), and between heated oxygen sensor (bank No. 2 sensor No. 2), EFI3 fuse (10-amp) and EFI main relay. See **WIRING DIAGRAMS** article. EFI main relay may also be referred to as EFI relay. EFI3 fuse and EFI main relay are located in fuse/relay box at driver's side front corner of engine compartment.

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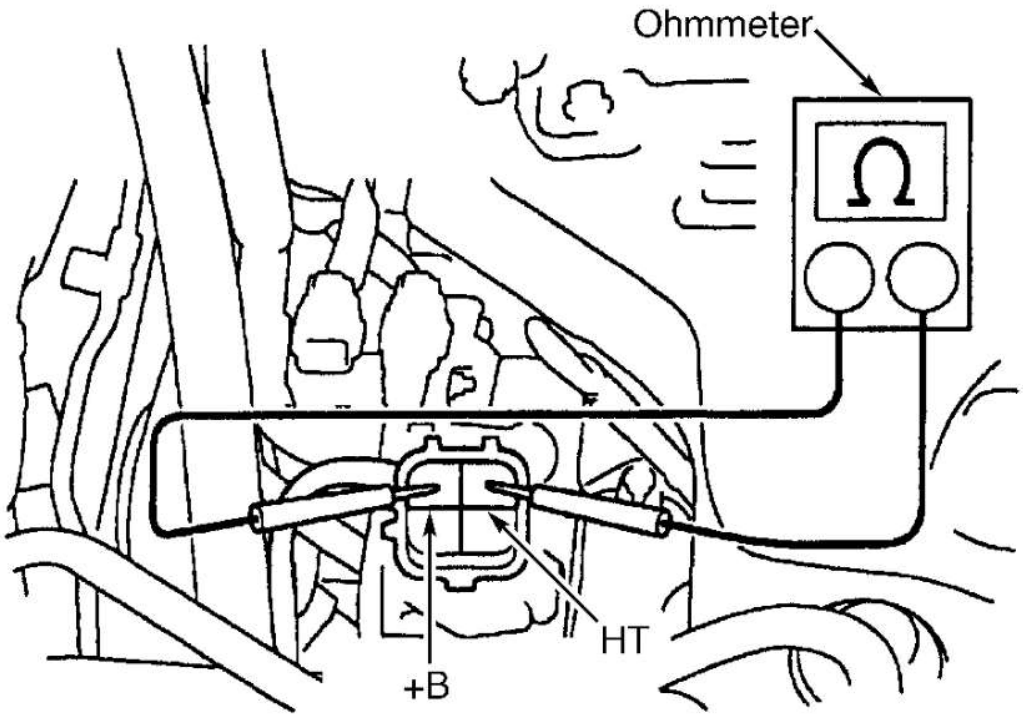


Fig. 10: Testing Heater On Heated Oxygen Sensor (Bank No. 2 Sensor No. 2)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

DTC P0171: SYSTEM TOO LEAN (BANK NO. 1), OR P0172: SYSTEM TOO RICH (BANK NO. 1)

NOTE: These DTCs may be caused by the vehicle running out of fuel.

CAUTION: If Engine Control Module (ECM) replacement is instructed in following test, always ensure ECM electrical connectors and ground circuits are okay. If either are defective, repair and repeat testing to confirm ECM malfunction. On models equipped with engine immobilizer, if ECM is replaced, ECM must be programmed with proper ignition key code for engine immobilizer system. For programming procedures, see COMPUTER RELEARN PROCEDURES article in GENERAL INFORMATION, or appropriate ENGINE IMMOBILIZER SYSTEMS article in ACCESSORIES & EQUIPMENT.

Circuit Description

Fuel trim refers to feedback compensation value compared against basic injection time. Fuel trim includes short-term and long-term fuel trim.

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DTC P0171 is set when fuel trim is driven rich beyond a certain value with engine at normal operating temperature and the actual air/fuel ratio is lean. Possible causes are:

- Air induction system malfunction.
- Fuel injector restricted.
- Defective Mass Airflow (MAF) meter.
- Defective Engine Coolant Temperature (ECT) sensor.
- Ignition system malfunction.
- Improper fuel pressure.
- Exhaust system leak.
- Air/Fuel (A/F) sensor (bank No. 1 sensor No. 1) circuit is open or shorted.
- Defective A/F sensor (bank No. 1 sensor No. 1).
- Defective ECM.
- Vehicle ran out of fuel.

DTC P0172 is set when fuel trim is driven lean beyond a certain value with engine at normal operating temperature and the actual air/fuel ratio is rich. Possible causes are:

- Air induction system malfunction.
- Fuel injector restricted or leaking.
- Defective Mass Airflow (MAF) meter.
- Defective Engine Coolant Temperature (ECT) sensor.
- Ignition system malfunction.
- Improper fuel pressure.
- Exhaust system leak.
- Air/Fuel (A/F) sensor (bank No. 1 sensor No. 1) circuit is open or shorted.
- Defective A/F sensor (bank No. 1 sensor No. 1).
- Defective ECM.
- Vehicle ran out of fuel.

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Diagnostic Aids

These DTCs use two-trip detection logic. When DTC P0171 exists, the actual air/fuel ratio is to lean. When DTC P0172 exists, the actual air/fuel ratio is to rich. If total of short-term fuel trim value and long-term fuel trim value is within plus or minus 38 percent, the system is functioning normally. Using Toyota hand-held tester or scan tool, read FREEZE FRAME data. Freeze frame data records engine conditions when malfunction is detected.

Test Drive Confirmation

1. Test drive confirmation may be performed to operate vehicle under conditions which may cause DTC to be set. When performing test drive confirmation, procedures must be performed exactly as listed or the

malfunction may not be detected. If Toyota hand-held tester is available, go to next step. If Toyota hand-held tester is not available, go to step 3 .

2. Connect hand-held tester to Data Link Connector (DLC) No. 3 at driver's side of instrument panel. See **Fig. 1** . Switch hand-held tester from NORMAL mode to CHECK mode.
3. Start engine. Allow engine to idle for at least 60 seconds.
4. Drive vehicle at 24 MPH or more for at least 40 seconds and then allow engine to idle for at least 10 seconds. Repeat this procedure 9 times and then check operation of Malfunction Indicator Light (MIL). If MIL illuminates, malfunction exists and DTC is set. If MIL does not illuminate, malfunction does not exist.

Diagnosis & Repair

1. Ensure engine oil dipstick, oil filler cap, Positive Crankcase Ventilation (PCV) system and all other air induction system components are intact and operating properly. If problem does not exist, go to next step. If problem exists, repair as necessary.
2. Check operation of fuel injectors. See **FUEL CONTROL** under FUEL SYSTEMS in SYSTEM & COMPONENT TESTING - 4-CYLINDER article. Fuel injector volume should be 53-65 cc (.18-.22 oz.) within 15 seconds and difference in volume between each fuel injector should be less than 6 cc (.02 oz.). Fuel injectors should not leak more than one drop every 12 minutes. If fuel injectors are okay, go to next step. If fuel injectors are defective, replace fuel injectors as necessary.
3. Check Mass Airflow (MAF) meter and Engine Coolant Temperature (ECT) sensor. MAF meter may also be referred to as airflow meter. See **AIRFLOW METER** and **ENGINE COOLANT TEMPERATURE SENSOR** under ENGINE SENSORS & SWITCHES in SYSTEM & COMPONENT TESTING - 4-CYLINDER article. If MAF meter and ECT sensor are okay, go to next step. If MAF meter or ECT sensor is defective, replace components as necessary. See **AIRFLOW METER** or **ENGINE COOLANT TEMPERATURE SENSOR** under ENGINE SENSORS & SWITCHES in REMOVAL, OVERHAUL & INSTALLATION - 4-CYLINDER article.
4. Check ignition system by performing spark test. See **SPARK TEST** under IGNITION SYSTEMS in BASIC DIAGNOSTIC PROCEDURES - 4-CYLINDER article. If ignition system operates properly and spark exist, go to next step. If ignition system does not operate properly and spark does not exist, repair ignition system as necessary.
5. Check fuel pressure. See **FUEL PRESSURE** under FUEL SYSTEMS in BASIC DIAGNOSTIC PROCEDURES - 4-CYLINDER article. Fuel pressure should be 44-50 psi (3.1-3.5 kg/cm^2) with engine idling and should remain at least 21 psi (1.5 kg/cm^2) for a minimum of 5 minutes after engine is shut off. If fuel pressure is within specification, go to next step. If fuel pressure is not within specification, repair fuel system as necessary.
6. Check exhaust system for leaks. If no exhaust leak exists, go to next step. If exhaust leak exists, repair exhaust system as necessary.
7. Connect Toyota hand-held tester or scan tool to Data Link Connector (DLC) No. 3 at driver's side of instrument panel. See **Fig. 1** . Start engine and maintain engine speed at 2500 RPM for about 90 seconds to fully warm the A/F sensor. Allow engine to idle.

NOTE: ECM maintains a fixed voltage of 3.3 volts at AFR+ and AFL+ terminals on ECM, and 3.0 volts at AFR- and AFL- terminal on ECM. It is impossible to

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confirm A/F sensor output voltage without using Toyota hand-held tester or scan tool. A/F sensor output voltage on scan tool is displayed at one fifth the voltage of that displayed on a Toyota hand-held tester.

NOTE: **If A/F sensor output voltage remains 3.30 volts (Toyota hand-held tester) or .66 volt (OBD-II scan tool) during all conditions, A/F sensor circuit may be open. If A/F sensor output voltage remains 3.80 volts or more (Toyota hand-held tester) or .76 volt or more (OBD-II scan tool) during all conditions, A/F sensor circuit may be shorted. If A/F sensor output voltage remains 2.80 volts or less (Toyota hand-held tester) or .56 volt or less (OBD-II scan tool) during all conditions, A/F sensor circuit may be shorted. During fuel enrichment, A/F sensor output voltage may be less than 2.8 volts (Toyota hand-held tester) or .56 volt (OBD-II scan tool) which is normal. During fuel cut, A/F sensor output voltage may be more than 3.8 volts (Toyota hand-held tester) or .76 volt (OBD-II scan tool) which is normal.**

8. Using hand-held tester or scan tool, monitor A/F sensor (bank No. 1 sensor No. 1) output voltage with engine idling, engine racing and while driving vehicle at 25 MPH or more with engine speed of 1500 RPM or more while opening and closing the throttle. Ensure A/F sensor output voltage is as specified. See **AIR/FUEL SENSOR OUTPUT VOLTAGE SPECIFICATIONS** table. If A/F sensor output voltage is not within specification, go to next step. If A/F sensor output voltage is within specification, go to step 10 .

AIR/FUEL SENSOR OUTPUT VOLTAGE SPECIFICATIONS

Application & Operating Condition	Specification
Using OBD-II Scan Tool	
Engine Idling, Engine Racing & Driving Vehicle (1)	(2)
Using Toyota Hand-Held Tester	
Engine Idling, Engine Racing & Driving Vehicle (1)	(3)

(1) Drive vehicle at 25 MPH or more with engine speed of 1500 RPM or more while opening and closing the throttle.

(2) Voltage should not remain at .56 volt or less, .66 volt, or .76 volt or more.

(3) Voltage should not remain at 2.80 volts or less, 3.30 volts, or 3.80 volts or more.

9. Check for open and short in wiring harness and electrical connectors between A/F sensor (bank No. 1 sensor No. 1) and ECM. See **WIRING DIAGRAMS** article. A/F sensor (bank No. 1 sensor No. 1) is located on exhaust manifold above catalytic converters. See **Fig. 7** . ECM is located behind passenger's side kick panel, just below instrument panel. See **Fig. 2** . If wiring harness and electrical connectors are okay, replace A/F sensor (bank No. 1 sensor No. 1). See **AIR/FUEL SENSOR** under ENGINE SENSORS & SWITCHES in REMOVAL, OVERHAUL & INSTALLATION - 4-CYLINDER article. If wiring harness or electrical connector is defective, repair as necessary.
10. Using Toyota hand-held tester or scan tool, clear DTCs from ECM. Perform test drive confirmation and

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then go to next step. See **TEST DRIVE CONFIRMATION** .

11. Recheck for DTCs. If DTC P0171 or P0172 does not exist, go to next step. If DTC P0171 and/or P0172 exist, replace ECM. ECM is located behind passenger's side kick panel, just below instrument panel. See **Fig. 2** .
12. Verify if vehicle ran out of fuel. If vehicle ran out of fuel, DTC P0171 and/or P0172 was caused by the vehicle running out of fuel. If vehicle did not run out of fuel, problem is intermittent. Check for defective connections or intermittent problem in wiring. ECM is located behind passenger's side kick panel, just below instrument panel. See **Fig. 2** .

DTC P0174: SYSTEM TOO LEAN (BANK NO. 2), OR P0175: SYSTEM TOO RICH (BANK NO. 2)

NOTE: These DTCs may be caused by the vehicle running out of fuel.

CAUTION: If Engine Control Module (ECM) replacement is instructed in following test, always ensure ECM electrical connectors and ground circuits are okay. If either are defective, repair and repeat testing to confirm ECM malfunction. On models equipped with engine immobilizer, if ECM is replaced, ECM must be programmed with proper ignition key code for engine immobilizer system. For programming procedures, see COMPUTER RELEARN PROCEDURES article in GENERAL INFORMATION, or appropriate ENGINE IMMOBILIZER SYSTEMS article in ACCESSORIES & EQUIPMENT.

Circuit Description

Fuel trim refers to feedback compensation value compared against basic injection time. Fuel trim includes short-term and long-term fuel trim.

DTC P0174 is set when fuel trim is driven rich beyond a certain value with engine at normal operating temperature and the actual air/fuel ratio is lean. Possible causes are:

- Air induction system malfunction.
- Fuel injector restricted.
- Defective Mass Airflow (MAF) meter.
- Defective Engine Coolant Temperature (ECT) sensor.
- Ignition system malfunction.
- Improper fuel pressure.
- Exhaust system leak.
- Air/Fuel (A/F) sensor (bank No. 2 sensor No. 1) circuit is open or shorted.
- Defective A/F sensor (bank No. 2 sensor No. 1).
- Defective ECM.
- Vehicle ran out of fuel.

DTC P0175 is set when fuel trim is driven lean beyond a certain value with engine at normal operating

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temperature and the actual air/fuel ratio is rich. Possible causes are:

- Air induction system malfunction.
- Fuel injector restricted or leaking.
- Defective Mass Airflow (MAF) meter.
- Defective Engine Coolant Temperature (ECT) sensor.
- Ignition system malfunction.
- Improper fuel pressure.
- Exhaust system leak.
- Air/Fuel (A/F) sensor (bank No. 2 sensor No. 1) circuit is open or shorted.
- Defective A/F sensor (bank No. 2 sensor No. 1).
- Defective ECM.
- Vehicle ran out of fuel.

Diagnostic Aids

These DTCs use two-trip detection logic. When DTC P0174 exists, the actual air/fuel ratio is to lean. When DTC P0175 exists, the actual air/fuel ratio is to rich. If total of short-term fuel trim value and long-term fuel trim value is within plus or minus 38 percent, the system is functioning normally. Using Toyota hand-held tester or scan tool, read FREEZE FRAME data. Freeze frame data records engine conditions when malfunction is detected.

Test Drive Confirmation

1. Test drive confirmation may be performed to operate vehicle under conditions which may cause DTC to be set. When performing test drive confirmation, procedures must be performed exactly as listed or the malfunction may not be detected. If Toyota hand-held tester is available, go to next step. If Toyota hand-held tester is not available, go to step 3 .
2. Connect hand-held tester to Data Link Connector (DLC) No. 3 at driver's side of instrument panel. See **Fig. 1** . Switch hand-held tester from NORMAL mode to CHECK mode.
3. Start engine. Allow engine to idle for at least 60 seconds.
4. Drive vehicle at 24 MPH or more for at least 40 seconds and then allow engine to idle for at least 10 seconds. Repeat this procedure 9 times and then check operation of Malfunction Indicator Light (MIL). If MIL illuminates, malfunction exists and DTC is set. If MIL does not illuminate, malfunction does not exist.

Diagnosis & Repair

1. Ensure engine oil dipstick, oil filler cap, Positive Crankcase Ventilation (PCV) system and all other air induction system components are intact and operating properly. If problem does not exist, go to next step. If problem exists, repair as necessary.
2. Check operation of fuel injectors. See **FUEL CONTROL** under FUEL SYSTEMS in SYSTEM & COMPONENT TESTING - 4-CYLINDER article. Fuel injector volume should be 53-65 cc (.18-.22 oz.) within 15 seconds and difference in volume between each fuel injector should be less than 6 cc (.02 oz.).

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Fuel injectors should not leak more than one drop every 12 minutes. If fuel injectors are okay, go to next step. If fuel injectors are defective, replace fuel injectors as necessary.

3. Check Mass Airflow (MAF) meter and Engine Coolant Temperature (ECT) sensor. MAF meter may also be referred to as airflow meter. See **AIRFLOW METER** and **ENGINE COOLANT TEMPERATURE SENSOR** under ENGINE SENSORS & SWITCHES in SYSTEM & COMPONENT TESTING - 4-CYLINDER article. If MAF meter and ECT sensor are okay, go to next step. If MAF meter or ECT sensor is defective, replace components as necessary. See **AIRFLOW METER** or **ENGINE COOLANT TEMPERATURE SENSOR** under ENGINE SENSORS & SWITCHES in REMOVAL, OVERHAUL & INSTALLATION - 4-CYLINDER article.
4. Check ignition system by performing spark test. See **SPARK TEST** under IGNITION SYSTEMS in BASIC DIAGNOSTIC PROCEDURES - 4-CYLINDER article. If ignition system operates properly and spark exist, go to next step. If ignition system does not operate properly and spark does not exist, repair ignition system as necessary.
5. Check fuel pressure. See **FUEL PRESSURE** under FUEL SYSTEMS in BASIC DIAGNOSTIC PROCEDURES - 4-CYLINDER article. Fuel pressure should be 44-50 psi (3.1-3.5 kg/cm^2) with engine idling and should remain at least 21 psi (1.5 kg/cm^2) for a minimum of 5 minutes after engine is shut off. If fuel pressure is within specification, go to next step. If fuel pressure is not within specification, repair fuel system as necessary.
6. Check exhaust system for leaks. If no exhaust leak exists, go to next step. If exhaust leak exists, repair exhaust system as necessary.
7. Connect Toyota hand-held tester or scan tool to Data Link Connector (DLC) No. 3 at driver's side of instrument panel. See **Fig. 1** . Start engine and maintain engine speed at 2500 RPM for about 90 seconds to fully warm the A/F sensor. Allow engine to idle.

NOTE: **ECM maintains a fixed voltage of 3.3 volts at AFR+ and AFL+ terminals on ECM, and 3.0 volts at AFR- and AFL- terminal on ECM. It is impossible to confirm A/F sensor output voltage without using Toyota hand-held tester or scan tool. A/F sensor output voltage on scan tool is displayed at one fifth the voltage of that displayed on a Toyota hand-held tester.**

NOTE: **If A/F sensor output voltage remains 3.30 volts (Toyota hand-held tester) or .66 volt (OBD-II scan tool) during all conditions, A/F sensor circuit may be open. If A/F sensor output voltage remains 3.80 volts or more (Toyota hand-held tester) or .76 volt or more (OBD-II scan tool) during all conditions, A/F sensor circuit may be shorted. If A/F sensor output voltage remains 2.80 volts or less (Toyota hand-held tester) or .56 volt or less (OBD-II scan tool) during all conditions, A/F sensor circuit may be shorted. During fuel enrichment, A/F sensor output voltage may be less than 2.8 volts (Toyota hand-held tester) or .56 volt (OBD-II scan tool) which is normal. During fuel cut, A/F sensor output voltage may be more than 3.8 volts (Toyota hand-held tester) or .76 volt (OBD-II scan tool) which is normal.**

8. Using hand-held tester or scan tool, monitor A/F sensor (bank No. 2 sensor No. 1) output voltage with engine idling, engine racing and while driving vehicle at 25 MPH or more with engine speed of 1500

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RPM or more while opening and closing the throttle. Ensure A/F sensor output voltage is as specified. See **AIR/FUEL SENSOR OUTPUT VOLTAGE SPECIFICATIONS** table. If A/F sensor output voltage is not within specification, go to next step. If A/F sensor output voltage is within specification, go to step 10 .

AIR/FUEL SENSOR OUTPUT VOLTAGE SPECIFICATIONS

Application & Operating Condition	Specification
Using OBD-II Scan Tool	
Engine Idling, Engine Racing & Driving Vehicle (1)	(2)
Using Toyota Hand-Held Tester	
Engine Idling, Engine Racing & Driving Vehicle (1)	(3)

(1) Drive vehicle at 25 MPH or more with engine speed of 1500 RPM or more while opening and closing the throttle.

(2) Voltage should not remain at .56 volt or less, .66 volt, or .76 volt or more.

(3) Voltage should not remain at 2.80 volts or less, 3.30 volts, or 3.80 volts or more.

9. Check for open and short in wiring harness and electrical connectors between A/F sensor (bank No. 2 sensor No. 1) and ECM. See **WIRING DIAGRAMS** article. A/F sensor (bank No. 2 sensor No. 1) is located on exhaust manifold above catalytic converters. See **Fig. 7** . ECM is located behind passenger's side kick panel, just below instrument panel. See **Fig. 2** . If wiring harness and electrical connectors are okay, replace A/F sensor (bank No. 2 sensor No. 1). See **AIR/FUEL SENSOR** under ENGINE SENSORS & SWITCHES in REMOVAL, OVERHAUL & INSTALLATION - 4-CYLINDER article. If wiring harness or electrical connector is defective, repair as necessary.
10. Using Toyota hand-held tester or scan tool, clear DTCs from ECM. Perform test drive confirmation and then go to next step. See **TEST DRIVE CONFIRMATION** .
11. Recheck for DTCs. If DTC P0174 or P0175 does not exist, go to next step. If DTC P0174 and/or P0175 exist, replace ECM. ECM is located behind passenger's side kick panel, just below instrument panel. See **Fig. 2** .
12. Verify if vehicle ran out of fuel. If vehicle ran out of fuel, DTC P0174 and/or P0175 was caused by the vehicle running out of fuel. If vehicle did not run out of fuel, problem is intermittent. Check for defective connections or intermittent problem in wiring. ECM is located behind passenger's side kick panel, just below instrument panel. See **Fig. 2** .

DTC P0300: RANDOM/MULTIPLE CYLINDER MISFIRE DETECTED

Circuit Description

Engine Control Module (ECM) uses input signals provided by crankshaft and camshaft position sensors to monitor the changes in crankshaft rotation. If engine speed rate changes enough to equal a preset number, a misfire is detected and Malfunction Indicator Light (MIL) is illuminated. If misfire rate is great enough and driving conditions will cause catalytic converter damage or overheating, the MIL will blink when misfire is occurring. DTC is set when misfiring of random cylinders is detected during any particular 200 or 1000 revolutions. Possible causes are:

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- Open or short in engine wiring harness.
- Defective connections at ECM or component.
- Disconnected, restricted or damaged vacuum hose(s).
- Ignition system malfunction.
- Defective fuel injector(s).
- Improper fuel pressure.
- Defective Mass Airflow (MAF) meter.
- Defective Engine Coolant Temperature (ECT) sensor.
- Improper engine compression.
- Improper valve clearance.
- Improper valve timing.

Diagnostic Aids

When 2 or more DTCs for misfiring cylinder are recorded repeatedly and DTC P0300 does not exist, it indicates misfires were detected and recorded at different times. If misfire cannot be reproduced, the reason may be because vehicle was driven with a lack of fuel, improper fuel, fouled spark plug or etc. Using Toyota hand-held tester or scan tool, read FREEZE FRAME data. Freeze frame data records engine conditions when malfunction is detected. If COOLANT TEMP displayed in freeze frame data is less than 176°F (80°C), there is a possibility that misfire only exists during warm-up.

If oscilloscope is available, fuel injector operation on misfiring cylinder may be checked by reading fuel injector signal waveform pattern and fuel injector duration signal waveform pattern by connecting oscilloscope between terminal No. 21 (White/Black wire) at ECM electrical connector E4 and fuel injector driver terminal at ECM with engine idling. Terminal No. 21 is the E01 terminal at ECM. For ECM electrical connector terminal identification, see **Fig. 4** . For fuel injector driver identification, see **IDENTIFYING ECM FUEL INJECTOR DRIVER TERMINALS** table. Fuel injector signal waveform pattern and fuel injector duration signal waveform pattern should be properly displayed within proper intervals. See **Fig. 11** .

Test Drive Confirmation

1. Test drive confirmation may be performed to operate vehicle under conditions which may cause DTC to be set. When performing test drive confirmation, procedures must be performed exactly as listed or the malfunction may not be detected. Connect Toyota hand-held tester or scan tool to Data Link Connector (DLC) No. 3 at driver's side of instrument panel. See **Fig. 1** . Check for any DTCs and read FREEZE FRAME data. Record DTCs and freeze frame data. If using hand-held tester, switch hand-held tester to CHECK mode.
2. Drive vehicle several times with engine speed, load and its surrounding range shown with ENGINE SPD, CALC LOAD in freeze frame data or MISFIRE RPM and MISFIRE LOAD in the data list on hand-held tester or scan tool.
3. Allow engine to idle for at least 5 3/4 minutes and then drive vehicle at specified engine speeds for specified amount of time. See **DRIVING PATTERN** table. If using scan tool, turn ignition off after symptom is simulated the first time, then repeat test drive again. If using hand-held tester or scan tool, if a misfire is detected, a DTC will set and misfire will be indicated in freeze frame data. Turn ignition off

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and wait a minimum of 5 seconds.

DRIVING PATTERN

Engine RPM	Specified Time
1000	4 Minutes Or More
2000	2 1/2 Minutes Or More
3000	1 1/2 Minutes Or More

Diagnosis & Repair

1. Check vacuum hoses for leaks, restrictions and proper routing. See **VACUUM DIAGRAMS** article for proper vacuum hose routing. Also, check engine wiring harness and electrical connectors for damage or poor connections. If no problems exist, go to next step. If problem exists, repair as necessary and perform **TEST DRIVE CONFIRMATION** .
2. Remove spark plug for misfiring cylinder. Ensure no carbon deposits exist, spark plug is not fouled and spark plug gap is .039-.047" (1.00-1.20 mm). Check ignition system by performing spark test. See **SPARK TEST** under IGNITION SYSTEMS in BASIC DIAGNOSTIC PROCEDURES - 4-CYLINDER article. If ignition system operates properly and spark exist, go to next step. If ignition system does not operate properly and spark does not exist, repair ignition system as necessary.
3. Remove glove box and passenger's side kick panel (if necessary) for access to ECM with electrical connectors still installed on ECM. See **Fig. 2** . Turn ignition on. Using voltmeter, check voltage between body ground and fuel injector driver terminal for misfiring cylinder at appropriate ECM electrical connector. See **IDENTIFYING ECM FUEL INJECTOR DRIVER TERMINALS** table. For ECM electrical connector terminal identification, see **Fig. 4** . If voltage is not 9-14 volts at fuel injector driver terminal, go to next step. If voltage is 9-14 volts at fuel injector driver terminal, go to step 6 .

IDENTIFYING ECM FUEL INJECTOR DRIVER TERMINALS

Fuel Injector No. (1)	ECM Electrical Connector & Terminal (2)	Wire Color
1	E4 Terminal No. 1	Black/Red
2	E4 Terminal No. 2	Black
3	E4 Terminal No. 3	White
4	E4 Terminal No. 4	Red

(1) Fuel injector No. 1 is at timing chain end of engine and fuel injector No. 4 is at flywheel end of engine.

(2) For ECM electrical connector terminal identification, see **Fig. 4** .

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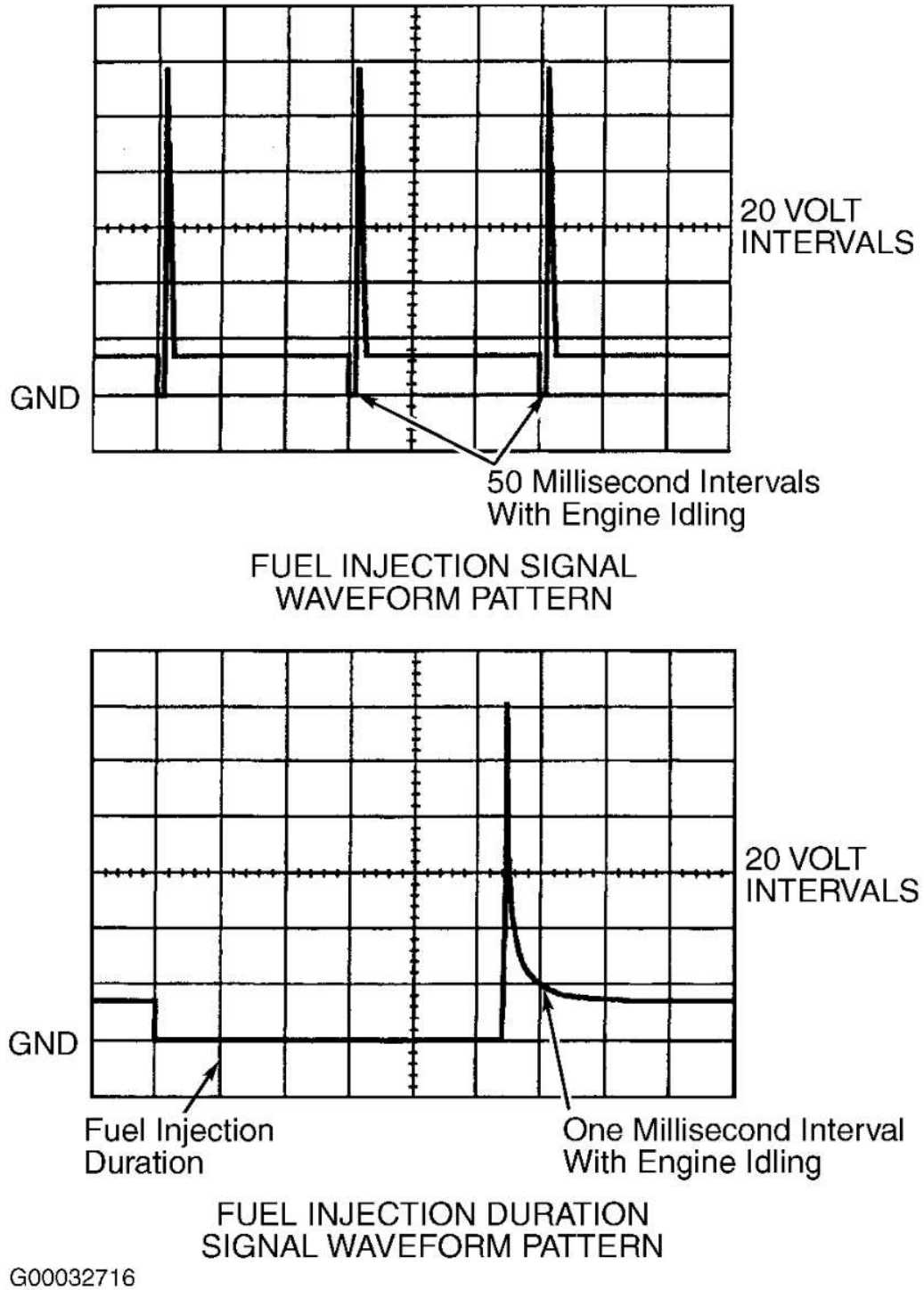


Fig. 11: Identifying Fuel Injector Signal Waveform Pattern & Fuel Injector Duration Signal

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Waveform Pattern
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

4. Disconnect electrical connector at fuel injector on misfiring cylinder. Using ohmmeter, check resistance between electrical terminals on fuel injector. Resistance should be 13.40-14.20 ohms at 68°F (20°C). If resistance is within specification, go to next step. If resistance is not within specification, replace fuel injector. See **FUEL RAILS & FUEL INJECTORS** under FUEL SYSTEMS in REMOVAL, OVERHAUL & INSTALLATION - 4-CYLINDER article.
5. Check for open and short in wiring harness and electrical connectors between fuel injector on misfiring cylinder and ECM. See **WIRING DIAGRAMS** article. If wiring harness or electrical connector is defective, repair as necessary. If wiring harness and electrical connectors are okay, it may be necessary to check for open and short in wiring harness and electrical connectors in fuel injector power supply circuit. See **WIRING DIAGRAMS** article.
6. Check fuel pressure. See **FUEL PRESSURE** under FUEL SYSTEMS in BASIC DIAGNOSTIC PROCEDURES - 4-CYLINDER article. Fuel pressure should be 44-50 psi (3.1-3.5 kg/cm^2) with engine idling and should remain at least 21 psi (1.5 kg/cm^2) for a minimum of 5 minutes after engine is shut off. If fuel pressure is within specification, go to next step. If fuel pressure is not within specification, repair fuel system as necessary.
7. Check operation of fuel injector on misfiring cylinder. See **FUEL CONTROL** under FUEL SYSTEMS in SYSTEM & COMPONENT TESTING - 4-CYLINDER article. Fuel injector volume should be 53-65 cc (.18-.22 oz.) within 15 seconds and difference in volume between each fuel injector should be less than 6 cc (.02 oz.). Fuel injectors should not leak more than one drop every 12 minutes. If fuel injectors are okay, go to next step. If fuel injectors are defective, replace fuel injectors as necessary.
8. Check Mass Airflow (MAF) meter and Engine Coolant Temperature (ECT) sensor. MAF meter may also be referred to as airflow meter. See **AIRFLOW METER** and **ENGINE COOLANT TEMPERATURE SENSOR** under ENGINE SENSORS & SWITCHES in SYSTEM & COMPONENT TESTING - 4-CYLINDER article. If MAF meter and ECT sensor are okay, go to next step. If MAF meter or ECT sensor is defective, replace components as necessary. See **AIRFLOW METER** or **ENGINE COOLANT TEMPERATURE SENSOR** under ENGINE SENSORS & SWITCHES in REMOVAL, OVERHAUL & INSTALLATION - 4-CYLINDER article.
9. Check engine compression on misfiring cylinder. See **MECHANICAL INSPECTION** under PRELIMINARY INSPECTION & ADJUSTMENTS in BASIC DIAGNOSTIC PROCEDURES - 4-CYLINDER article. Check valve clearance on misfiring cylinder. See **VALVE CLEARANCE** under ENGINE MECHANICAL in ON-VEHICLE ADJUSTMENTS - 4-CYLINDER article. Check valve timing. See appropriate article in ENGINES. Repair engine as necessary.

DTC P0301: CYLINDER NO. 1 MISFIRE DETECTED, DTC P0302: CYLINDER NO. 2 MISFIRE DETECTED, DTC P0303: CYLINDER NO. 3 MISFIRE DETECTED &/OR DTC P0304: CYLINDER NO. 4 MISFIRE DETECTED

NOTE: Cylinder No. 1 is at timing chain end of engine and cylinder No. 4 is at flywheel end of engine.

NOTE: When 2 or more DTCs for a misfiring cylinder are recorded repeatedly, but DTC P0300 is not recorded, it indicates that misfires were detected and stored into

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ECM memory at different times.

Circuit Description

Engine Control Module (ECM) uses input signals provided by crankshaft and camshaft position sensors to monitor the changes in crankshaft rotation. If engine speed rate changes enough to equal a preset number, a misfire is detected and Malfunction Indicator Light (MIL) is illuminated. If misfire rate is great enough and driving conditions will cause catalytic converter damage or overheating, the MIL will blink when misfire is occurring. DTC is set when misfiring cylinders is detected during any particular 200 or 1000 revolutions. Possible causes are:

- Open or short in engine wiring harness.
- Defective connections at ECM or component.
- Disconnected, restricted or damaged vacuum hose(s).
- Ignition system malfunction.
- Defective fuel injector(s).
- Improper fuel pressure.
- Defective Mass Airflow (MAF) meter.
- Defective Engine Coolant Temperature (ECT) sensor.
- Improper engine compression.
- Improper valve clearance.
- Improper valve timing.

Diagnostic Aids

These DTCs use two-trip detection logic. If misfire cannot be reproduced, reason may be because of driving with lack of fuel, improper fuel, fouled spark plug, etc. Using Toyota hand-held tester or scan tool, read freeze frame data. Freeze frame data records engine conditions when malfunction is detected.

Diagnosis & Repair

For diagnosis and repair procedure, see **DTC P0300: RANDOM/MULTIPLE CYLINDER MISFIRE DETECTED** .

DTC P0325: KNOCK SENSOR CIRCUIT

CAUTION: If Engine Control Module (ECM) replacement is instructed in following test, always ensure ECM electrical connectors and ground circuits are okay. If either are defective, repair and repeat testing to confirm ECM malfunction. On models equipped with engine immobilizer, if ECM is replaced, ECM must be programmed with proper ignition key code for engine immobilizer system. For programming procedures, see COMPUTER RELEARN PROCEDURES article in GENERAL INFORMATION, or appropriate ENGINE IMMOBILIZER SYSTEMS article in ACCESSORIES & EQUIPMENT.

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Circuit Description

Knock sensor generates voltage when engine block vibrates due to knocking. DTC is set when there is no knock sensor signal to ECM with engine speed is 2000 RPM or more. If DTC P0325 exists, ECM will operate in fail-safe mode which retards the ignition timing to a maximum setting. Possible causes are:

- Knock sensor circuit is open or shorted.
- Defective or loose knock sensor.
- Defective ECM.

Diagnostic Aids

Using Toyota hand-held tester or scan tool, read FREEZE FRAME data. Freeze frame data records engine conditions when malfunction is detected.

Normal mode vibration frequency of knock sensor is 7.6 kHz. If oscilloscope is available, knock sensor operation may be checked by reading knock sensor waveform patterns with engine at 4000 RPM by connecting oscilloscope between body ground and terminal No. 27 (White wire) at ECM electrical connector E4. This is the KNK1 terminal on ECM. ECM is located behind passenger's side kick panel, just below instrument panel. See **Fig. 2** . For ECM electrical connector terminal identification, see **Fig. 4** . Knock sensor waveform patterns should be properly displayed. See **Fig. 12** .

Diagnosis & Repair

1. Ensure ignition is off. Remove glove box and passenger's side kick panel (if necessary) for access to ECM with electrical connectors still installed on ECM. See **Fig. 2** . Disconnect ECM electrical connector E4. See **Fig. 4** .
2. Using ohmmeter, check resistance between body ground and terminal No. 27 (White wire) at ECM electrical connector E4. This is the KNK1 terminal on ECM. Resistance should be one megohm or more. If resistance is not within specification, go to next step. If resistance is within specification, go to step 4 .
3. Check knock sensor. See **KNOCK SENSOR** under ENGINE SENSORS & SWITCHES in SYSTEM & COMPONENT TESTING - 4-CYLINDER article. If knock sensor is okay, go to next step. If knock sensor is defective, replace knock sensor.
4. Check for open and short in White wire and electrical connectors between knock sensor and ECM. See **WIRING DIAGRAMS** article. If wiring and electrical connectors are okay, go to next step. If wiring or electrical connector is defective, repair as necessary.
5. Replace knock sensor with a known-good knock sensor. For servicing of knock sensor, see **KNOCK SENSOR** under ENGINE SENSORS & SWITCHES in REMOVAL, OVERHAUL & INSTALLATION - 4-CYLINDER article. Using Toyota hand-held tester or scan tool, clear DTCs from ECM. Recheck for DTCs. If DTC P0325 still exists, replace ECM. If DTC P0325 does not exist, the original knock sensor was defective.

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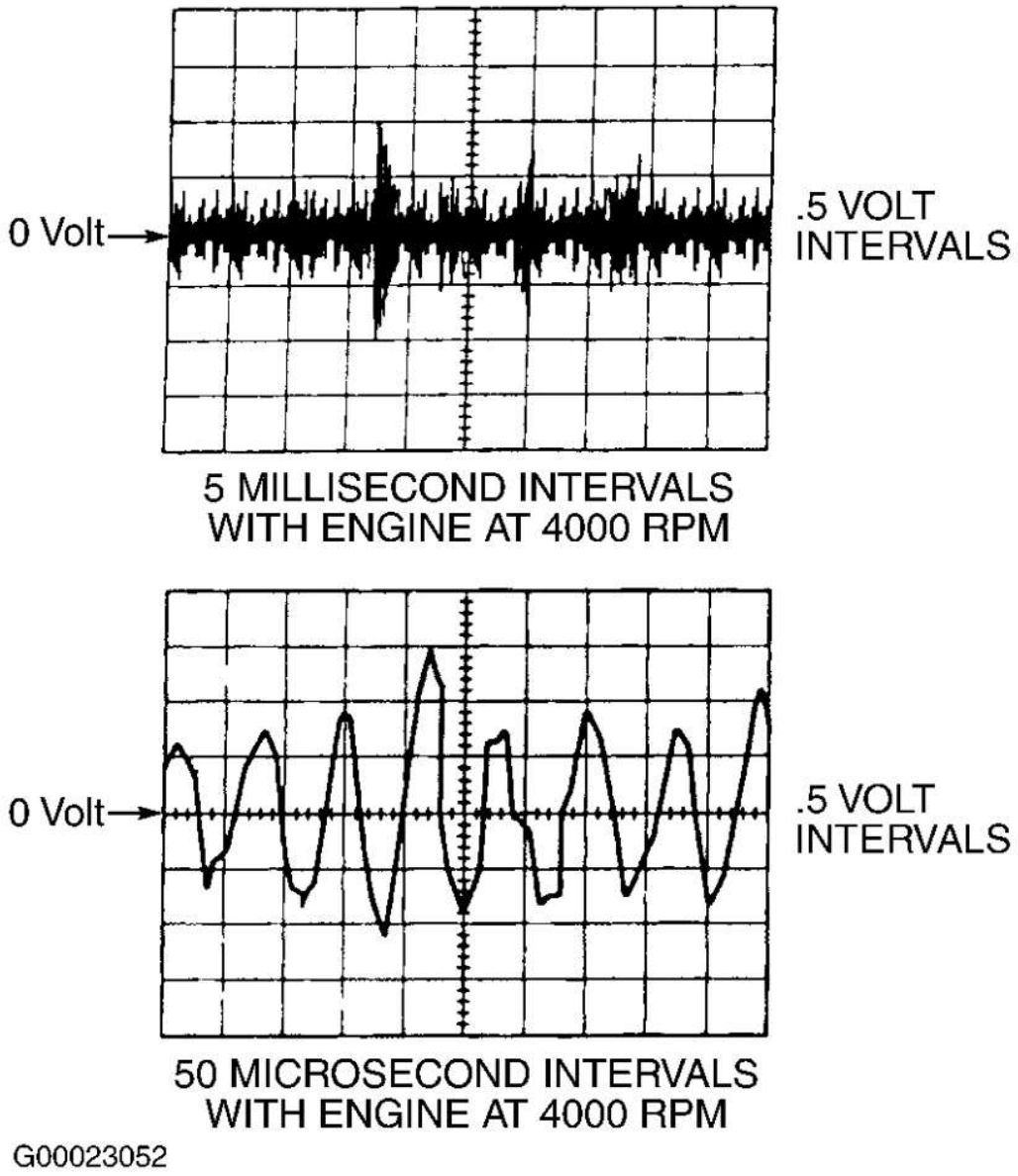


Fig. 12: Identifying Knock Sensor Waveform Patterns
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

DTC P0335 OR P1335: CRANKSHAFT POSITION SENSOR CIRCUIT

CAUTION: If Engine Control Module (ECM) replacement is instructed in following test, always ensure ECM electrical connectors and ground circuits are okay. If either are defective, repair and repeat testing to confirm ECM malfunction.

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On models equipped with engine immobilizer, if ECM is replaced, ECM must be programmed with proper ignition key code for engine immobilizer system. For programming procedures, see COMPUTER RELEARN PROCEDURES article in GENERAL INFORMATION, or appropriate ENGINE IMMOBILIZER SYSTEMS article in ACCESSORIES & EQUIPMENT.

Circuit Description

Crankshaft position sensor is a pick-up coil located on front of engine, near crankshaft pulley and uses a 34-tooth signal plate located on the crankshaft. ECM uses input signals from crankshaft position sensor to determine crankshaft angle and engine speed. DTC P0335 is set when ECM does not receive input signal from crankshaft position sensor when engine is cranking or with engine speed 600 RPM or more. DTC P1335 is set when ECM does not receive input signal from crankshaft position sensor when engine is running. Possible causes are:

- Crankshaft position sensor circuit is open or shorted.
- Defective crankshaft position sensor.
- Defective signal plate.
- Defective ECM.

Diagnostic Aids

DTC P0335 uses two-trip detection logic. Using Toyota hand-held tester or scan tool, read FREEZE FRAME data. Freeze frame data records engine conditions when malfunction is detected.

If oscilloscope is available, crankshaft position sensor operation may be checked by reading crankshaft position sensor waveform pattern with engine idling. This may be done by monitoring the crankshaft position sensor signal which may be referred to as the NE signal. Crankshaft position sensor waveform pattern may be checked by connecting oscilloscope between terminals No. 16 (Red wire) and No. 24 (Pink wire) at ECM electrical connector E5. This is the NE+ and NE- terminals on ECM. ECM is located behind passenger's side kick panel, just below instrument panel. See **Fig. 2** . For ECM electrical connector terminal identification, see **Fig. 4** . Crankshaft position sensor waveform pattern should be properly displayed. See **Fig. 13** .

Diagnosis & Repair

1. Disconnect electrical connector for crankshaft position sensor. Crankshaft position sensor is located on front of engine, near crankshaft pulley. See **Fig. 14** .
2. Using ohmmeter, check resistance between electrical terminals on crankshaft position sensor. Resistance should be 985-1600 ohms with sensor temperature of 14-122°F (-10-50°C) and 1265-1890 ohms with sensor temperature of 122-212°F (50-100°C). If resistance is within specification, go to next step. If resistance is not within specification, replace crankshaft position sensor. See **CRANKSHAFT POSITION SENSOR** under IGNITION SYSTEMS in REMOVAL, OVERHAUL & INSTALLATION - 4-CYLINDER article.
3. Check for open and short in wiring harness and electrical connectors between crankshaft position sensor and ECM. See **WIRING DIAGRAMS** article. ECM is located behind passenger's side kick panel, just below instrument panel. See **Fig. 2** . If wiring harness and electrical connectors are okay, go to next step.

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If wiring harness or electrical connector is defective, repair as necessary.

4. Remove crankshaft position sensor. See **CRANKSHAFT POSITION SENSOR** under IGNITION SYSTEMS in REMOVAL, OVERHAUL & INSTALLATION - 4-CYLINDER article. Inspect crankshaft position sensor and teeth on signal plate located on the crankshaft for damage. If crankshaft position sensor or signal plate is damaged, replace components as necessary. If crankshaft position sensor and signal plate are okay, replace ECM.

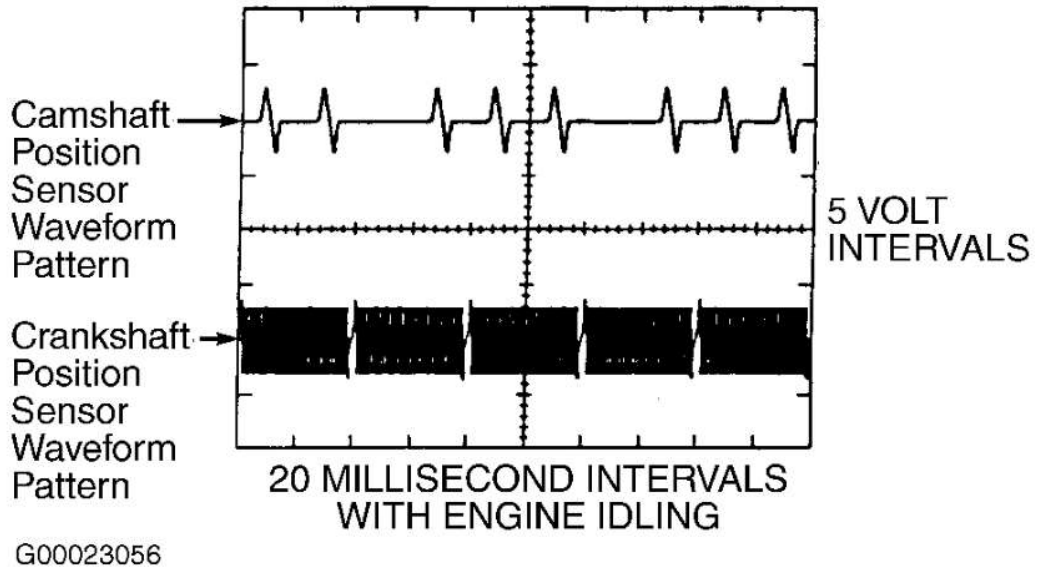


Fig. 13: Identifying Crankshaft Position Sensor & Camshaft Position Sensor Waveform Patterns
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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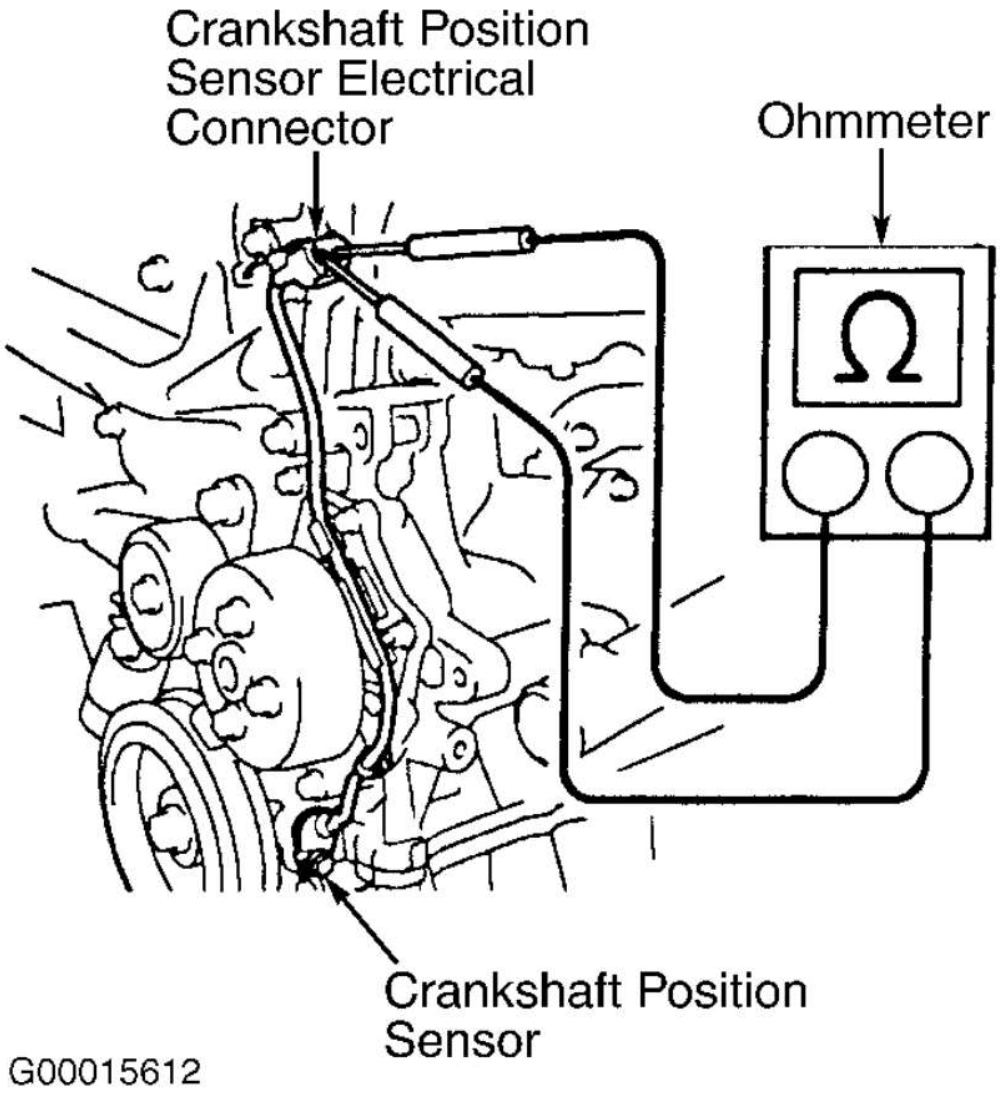


Fig. 14: Locating & Checking Crankshaft Position Sensor
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

DTC P0340: CAMSHAFT POSITION SENSOR CIRCUIT

CAUTION: If Engine Control Module (ECM) replacement is instructed in following test, always ensure ECM electrical connectors and ground circuits are okay. If either are defective, repair and repeat testing to confirm ECM malfunction. On models equipped with engine immobilizer, if ECM is replaced, ECM

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must be programmed with proper ignition key code for engine immobilizer system. For programming procedures, see COMPUTER RELEARN PROCEDURES article in GENERAL INFORMATION, or appropriate ENGINE IMMOBILIZER SYSTEMS article in ACCESSORIES & EQUIPMENT.

Circuit Description

Camshaft position sensor is a pick-up coil located on end of cylinder head at flywheel end of engine and uses a signal plate on outer circumference of intake camshaft. ECM uses input signals from camshaft position sensor to determine the standard crankshaft angle. DTC is set when ECM does not receive input signal from camshaft position sensor with engine cranking or with engine speed 600 RPM or more. Possible causes are:

- Camshaft position sensor circuit is open or shorted.
- Defective camshaft position sensor.
- Defective signal plate.
- Defective ECM.

Diagnostic Aids

This DTC uses two-trip detection logic. Using Toyota hand-held tester or scan tool, read FREEZE FRAME data. Freeze frame data records engine conditions when malfunction is detected.

If oscilloscope is available, camshaft position sensor operation may be checked by reading camshaft position sensor waveform pattern with engine idling. This may be done by monitoring the camshaft position sensor signal which may be referred to as the G2 signal. Camshaft position sensor waveform pattern may be checked by connecting oscilloscope between terminals No. 15 (Yellow wire) and No. 24 (Pink wire) at ECM electrical connector E5. This is the G22+ and NE- terminals on ECM. ECM is located behind passenger's side kick panel, just below instrument panel. See **Fig. 2** . For ECM electrical connector terminal identification, see **Fig. 4** . Camshaft position sensor waveform pattern should be properly displayed. See **Fig. 13** .

Diagnosis & Repair

1. Disconnect electrical connector at camshaft position sensor. Camshaft position sensor is located on end of cylinder head at flywheel end of engine and contains a Black 2-pin electrical connector with Yellow and Blue wires.
2. Using ohmmeter, check resistance between electrical terminals on camshaft position sensor. Resistance should be 835-1400 ohms with sensor temperature of 14-122°F (-10-50°C) and 1060-1645 ohms with sensor temperature of 122-212°F (50-100°C). If resistance is within specification, go to next step. If resistance is not within specification, replace camshaft position sensor. See **CAMSHAFT POSITION SENSOR** under IGNITION SYSTEMS in REMOVAL, OVERHAUL & INSTALLATION - 4-CYLINDER article.
3. Check for open and short in wiring harness and electrical connectors between camshaft position sensor and ECM. See **WIRING DIAGRAMS** article. ECM is located behind passenger's side kick panel, just below instrument panel. See **Fig. 2** . If wiring harness and electrical connectors are okay, go to next step. If wiring harness or electrical connector is defective, repair as necessary.

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4. Remove camshaft position sensor. See **CAMSHAFT POSITION SENSOR** under IGNITION SYSTEMS in REMOVAL, OVERHAUL & INSTALLATION - 4-CYLINDER article. Inspect camshaft position sensor and teeth of signal plate on outer circumference of intake camshaft. If camshaft position sensor or signal plate is damaged, replace components as necessary. If camshaft position sensor and signal plate are okay, replace ECM.

DTC P0420: CATALYST SYSTEM EFFICIENCY BELOW THRESHOLD (BANK NO. 1)

Circuit Description

Engine Control Module (ECM) compares waveform pattern of Air/Fuel (A/F) sensor (bank No. 1 sensor No. 1) with waveform pattern of heated oxygen sensor (bank No. 1 sensor No. 2) below catalytic converter to determine if catalytic converter performance has deteriorated. A/F sensor and heated oxygen sensor are located on exhaust manifold above catalytic converter. See **Fig. 7** . Air/fuel ratio compensation keeps the waveform pattern of A/F sensor repeatedly switching back and forth from rich to lean. If catalytic converter is functioning properly, the waveform pattern for heated oxygen sensor (bank No. 1 sensor No. 2) should switch back and forth from rich to lean more slowly than A/F sensor (bank No. 1 sensor No. 1). If both waveform patterns switch at a similar rate, catalytic converter performance has deteriorated. DTC is set when A/F sensor (bank No. 1 sensor No. 1) and heated oxygen sensor (bank No. 1 sensor No. 2) have nearly the same waveform pattern after engine and catalytic converter are at normal operating temperature and vehicle is driven. Possible causes are:

- Exhaust system leak.
- Defective A/F sensor.
- Defective heated oxygen sensor.
- Defective catalytic converter.

Diagnostic Aids

This DTC uses two-trip detection logic. Using Toyota hand-held tester or scan tool, read FREEZE FRAME data. Freeze frame data records engine conditions when malfunction is detected.

If oscilloscope is available, switching rate of heated oxygen sensor (bank No. 1 sensor No. 2) may compared to that of the A/F sensor (bank No. 1 sensor No. 1) by reading the waveform pattern to determine if malfunction exists. To check heated oxygen sensor waveform pattern, the A/F sensor (bank No. 1 sensor No. 1) must first be checked.

Connect oscilloscope between terminals No. 14 (Green wire) and No. 17 (Brown wire) at ECM electrical connector E5. This is the AF1A+ terminal at ECM for A/F sensor (bank No. 1 sensor No. 1) and E1 terminal on ECM. ECM is located behind passenger's side kick panel, just below instrument panel. See **Fig. 2** . For ECM electrical connector terminal identification, see **Fig. 4** .

Start engine and warm engine to normal operating temperature. Ensure all accessories are off. Increase engine speed to 2500-3000 RPM for 3 minutes. Confirm that waveform pattern for A/F sensor (bank No. 1 sensor No. 1) oscillates at about .5 volt during feedback to ECM. See **Fig. 15** . Disconnect oscilloscope and reconnect between terminals No. 11 (Black wire) and No. 17 (Brown wire) at ECM electrical connector E5. This is the

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OX1B terminal for heated oxygen sensor (bank No. 1 sensor No. 2) and E1 terminal on ECM. Read heated oxygen sensor (bank No. 1 sensor No. 2) waveform pattern. If malfunction exists, the heated oxygen sensor waveform pattern will be almost the same as that for the A/F sensor. See **Fig. 15** .

Diagnosis & Repair

1. Using Toyota hand-held tester or scan tool, check for any other DTCs. If only DTC P0420 exists, go to next step. If other DTCs exist, diagnose and repair those DTCs first and then retest.
2. Check exhaust system for leaks. If no exhaust leak exists, go to next step. If exhaust leak exists, repair exhaust system as necessary.
3. Disconnect electrical connector for A/F sensor (bank No. 1 sensor No. 1) located on exhaust manifold above catalytic converter. See **Fig. 7** . Using ohmmeter, check resistance for heater on A/F sensor between +B and HT terminals on electrical connector for A/F sensor. See **Fig. 8** . Resistance should be .8-1.4 ohms at 68°F (20°C) and 1.8-3.2 ohms at 1472°F (800°C). If resistance is within specification, go to next step. If resistance is not within specification, replace A/F sensor (bank No. 1 sensor No. 1). See **AIR/FUEL SENSOR** under ENGINE SENSORS & SWITCHES in REMOVAL, OVERHAUL & INSTALLATION - 4-CYLINDER article.
4. Disconnect electrical connector for heated oxygen sensor (bank No. 1 sensor No. 2) located on exhaust manifold below catalytic converter. See **Fig. 7** . Using ohmmeter, check resistance between +B and HT terminals on electrical connector for heater on heated oxygen sensor (bank No. 1 sensor No. 2). See **Fig. 9** . Resistance should be 11-16 ohms at 68°F (20°C) and 23-32 ohms at 1472°F (800°C). If resistance is within specification, replace catalytic converters along with exhaust manifold. If resistance is not within specification, replace heated oxygen sensor (bank No. 1 sensor No. 2). See **HEATED OXYGEN SENSOR** under ENGINE SENSORS & SWITCHES in REMOVAL, OVERHAUL & INSTALLATION - 4-CYLINDER article.

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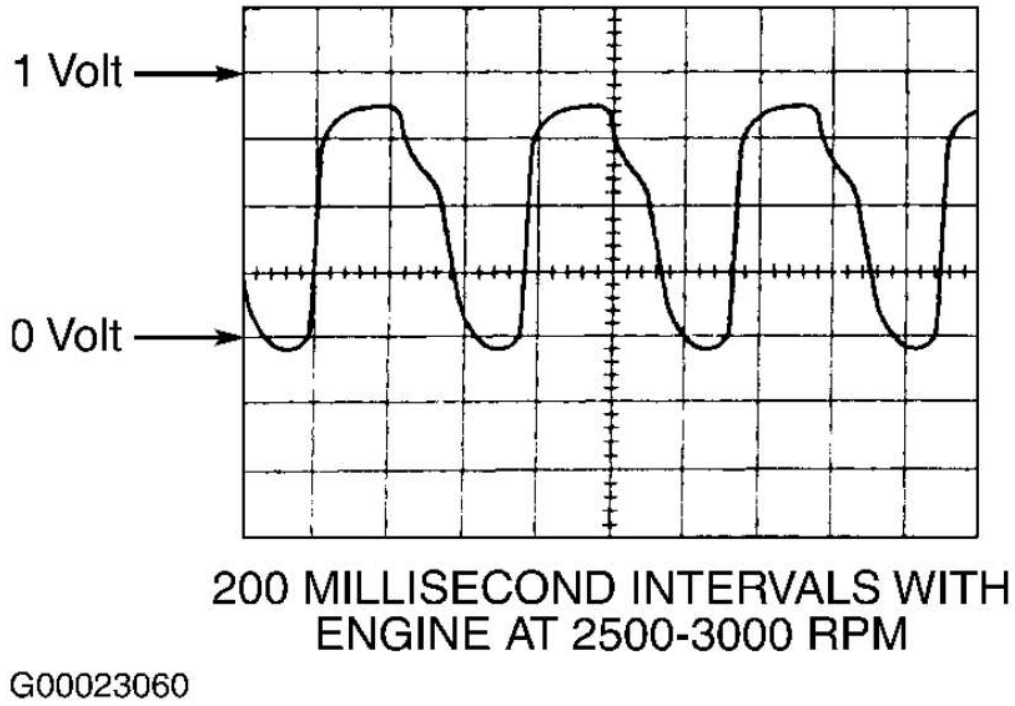


Fig. 15: Identifying Waveform Pattern For A/F Sensors
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

DTC P0430: CATALYST SYSTEM EFFICIENCY BELOW THRESHOLD (BANK NO. 2)

Circuit Description

Engine Control Module (ECM) compares waveform pattern of Air/Fuel (A/F) sensor (bank No. 2 sensor No. 1) with waveform pattern of heated oxygen sensor (bank No. 2 sensor No. 2) below catalytic converter to determine if catalytic converter performance has deteriorated. A/F sensor and heated oxygen sensor are located on exhaust manifold above catalytic converter. See **Fig. 7** . Air/fuel ratio compensation keeps the waveform pattern of A/F sensor repeatedly switching back and forth from rich to lean. If catalytic converter is functioning properly, the waveform pattern for heated oxygen sensor (bank No. 2 sensor No. 2) should switch back and forth from rich to lean more slowly than A/F sensor (bank No. 2 sensor No. 1). If both waveform patterns switch at a similar rate, catalytic converter performance has deteriorated. DTC is set when A/F sensor (bank No. 2 sensor No. 1) and heated oxygen sensor (bank No. 2 sensor No. 2) have nearly the same waveform pattern after engine and catalytic converter are at normal operating temperature and vehicle is driven. Possible causes are:

- Exhaust system leak.
- Defective A/F sensor.

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- Defective heated oxygen sensor.
- Defective catalytic converter.

Diagnostic Aids

This DTC uses two-trip detection logic. Using Toyota hand-held tester or scan tool, read FREEZE FRAME data. Freeze frame data records engine conditions when malfunction is detected.

If oscilloscope is available, switching rate of heated oxygen sensor (bank No. 2 sensor No. 2) may compared to that of the A/F sensor (bank No. 2 sensor No. 1) by reading the waveform pattern to determine if malfunction exists. To check heated oxygen sensor waveform pattern, the A/F sensor (bank No. 2 sensor No. 1) must first be checked.

Connect oscilloscope between terminals No. 13 (White wire) and No. 17 (Brown wire) at ECM electrical connector E5. This is the AF2A+ terminal at ECM for A/F sensor (bank No. 2, sensor No. 1) and E1 terminal on ECM. ECM is located behind passenger's side kick panel, just below instrument panel. See **Fig. 2** . For ECM electrical connector terminal identification, see **Fig. 4** .

Start engine and warm engine to normal operating temperature. Ensure all accessories are off. Increase engine speed to 2500-3000 RPM for 3 minutes. Confirm that waveform pattern for A/F sensor (bank No. 2 sensor No. 1) oscillates at about .5 volt during feedback to ECM. See **Fig. 15** . Disconnect oscilloscope and reconnect between terminals No. 15 (White wire) and No. 17 (Brown wire) at ECM electrical connector E5. This is the OX2B terminal for heated oxygen sensor (bank No. 2 sensor No. 2) and E1 terminal on ECM. Read heated oxygen sensor (bank No. 2 sensor No. 2) waveform pattern. If malfunction exists, the heated oxygen sensor waveform pattern will be almost the same as that for the A/F sensor. See **Fig. 15** .

Diagnosis & Repair

1. Using Toyota hand-held tester or scan tool, check for any other DTCs. If only DTC P0430 exists, go to next step. If other DTCs exist, diagnose and repair those DTCs first and then retest.
2. Check exhaust system for leaks. If no exhaust leak exists, go to next step. If exhaust leak exists, repair exhaust system as necessary.
3. Disconnect electrical connector for A/F sensor (bank No. 2 sensor No. 1) located on exhaust manifold above catalytic converter. See **Fig. 7** . Using ohmmeter, check resistance for heater on A/F sensor between +B and HT terminals on electrical connector for A/F sensor. See **Fig. 8** . Resistance should be .8-1.4 ohms at 68°F (20°C) and 1.8-3.2 ohms at 1472°F (800°C). If resistance is within specification, go to next step. If resistance is not within specification, replace A/F sensor (bank No. 2 sensor No. 1). See **AIR/FUEL SENSOR** under ENGINE SENSORS & SWITCHES in REMOVAL, OVERHAUL & INSTALLATION - 4-CYLINDER article.
4. Disconnect electrical connector for heated oxygen sensor (bank No. 2 sensor No. 2) located on exhaust manifold below catalytic converter. See **Fig. 7** . Using ohmmeter, check resistance between +B and HT terminals on electrical connector for heater on heated oxygen sensor (bank No. 2 sensor No. 2). See **Fig. 10** . Resistance should be 11-16 ohms at 68°F (20°C) and 23-32 ohms at 1472°F (800°C). If resistance is within specification, replace catalytic converters along with exhaust manifold. If resistance is not within specification, replace heated oxygen sensor (bank No. 2 sensor No. 2). See **HEATED OXYGEN SENSOR** under ENGINE SENSORS & SWITCHES in REMOVAL, OVERHAUL & INSTALLATION

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- 4-CYLINDER article.

DTC P0440: EVAPORATIVE EMISSION CONTROL SYSTEM

CAUTION: If Engine Control Module (ECM) replacement is instructed in following test, always ensure ECM electrical connectors and ground circuits are okay. If either are defective, repair and repeat testing to confirm ECM malfunction. On models equipped with engine immobilizer, if ECM is replaced, ECM must be programmed with proper ignition key code for engine immobilizer system. For programming procedures, see COMPUTER RELEARN PROCEDURES article in GENERAL INFORMATION, or appropriate ENGINE IMMOBILIZER SYSTEMS article in ACCESSORIES & EQUIPMENT.

NOTE: This DTC may be caused by a loose or improperly installed fuel tank cap. If DTC P0441, P0446, P0450 or P0451 is output after DTC P0440, perform appropriate test for these DTCs first before performing test for DTC P0440.

Circuit Description

Vapor pressure sensor, canister closed valve Vacuum Switching Valve (VSV) and pressure switching valve Vacuum Switching Valve (VSV) are used to detect abnormalities in the EVAP system. DTC is set if a leak is detected in EVAP system or vapor pressure sensor malfunctions. Canister closed valve VSV may also be referred to as CCV VSV. Possible causes are:

- Damaged, disconnected or restricted vacuum hose(s) or tubes.
- Fuel tank cap is loose or improperly installed.
- Defective fuel tank cap.
- Damaged fuel inlet pipe or fuel tank.
- Defective charcoal canister.
- Vapor pressure sensor circuit is open or shorted.
- Defective vapor pressure sensor.
- Defective overfill check valve on fuel tank.
- Defective ECM.

Diagnostic Aids

This DTC uses two-trip detection logic. Verify with customer if fuel tank cap has been left off or not completely tightened recently. This may cause DTC to be set. Using Toyota hand-held tester or scan tool, read FREEZE FRAME data. Freeze frame data records engine conditions when malfunction is detected.

Diagnosis & Repair

1. Check for cracks and deformations in fuel tank, charcoal canister and fuel inlet pipe. Fuel inlet pipe may also be referred to as fuel filler pipe. Charcoal canister is located near fuel tank. See **Fig. 16** . Check for

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loose connections and disconnected hoses and tubes around fuel tank and charcoal canister. If no problems exist, go to next step. If any problem exists, repair as necessary.

2. Check fuel tank cap to ensure fuel tank cap is a Original Equipment Manufacturer (OEM) fuel tank cap. If fuel tank cap is an OEM fuel tank cap, go to next step. If fuel tank cap is not an OEM fuel tank cap, replace fuel tank cap with an OEM fuel tank cap.
3. Ensure fuel tank cap is properly installed and tightened. If fuel tank cap is properly installed and tightened, go to next step. If fuel tank cap is not properly installed or tightened, reinstall and tighten as necessary.
4. Check fuel tank cap for damage and damaged gasket. If fuel tank cap is not damaged and gasket is okay, go to next step. If fuel tank cap or gasket is damaged, replace fuel tank cap with an OEM fuel tank cap.
5. Visually inspect fuel inlet pipe for damage. See **Fig. 16** . If fuel inlet pipe is not damaged, go to next step. If fuel inlet pipe is damaged, replace fuel inlet pipe.
6. Check vapor pressure sensor connection at fuel pump. See **Fig. 16** . Check vacuum hoses to charcoal canister, EVAP VSV and pressure switching valve VSV for correct installation, loose connections, disconnected hoses and damage. See **Fig. 16** for component location. If no problems exist, go to next step. If any problem exists, repair or replace components as necessary.
7. Check hoses and tubes between fuel tank, fuel inlet pipe and charcoal canister for correct installation, loose connections, being disconnected and damage. See **Fig. 16** . If no problems exist, go to next step. If any problem exists, repair or replace components as necessary.
8. Check charcoal canister for cracks or damage. If charcoal canister is okay, go to next step. If charcoal canister is cracked or damaged, replace charcoal canister. See **CHARCOAL CANISTER** under EMISSION SYSTEMS & SUB-SYSTEMS in REMOVAL, OVERHAUL & INSTALLATION - 4-CYLINDER article.
9. Remove glove box and passenger's side kick panel (if necessary) for access to ECM with electrical connectors still installed on ECM. See **Fig. 2** . Turn ignition on. Using voltmeter, check voltage between terminals No. 2 (Yellow wire) and No. 18 (Brown wire) at ECM electrical connector E5. See **Fig. 4** . This is the VC and E2 terminals on ECM. Voltage should be 4.5-5.5 volts. If voltage is within specification, go to next step. If voltage is not within specification, replace ECM.
10. Turn ignition off. Connect voltmeter between terminals No. 18 (Brown wire) at ECM electrical connector E5 and No. 21 (Blue/Black or White wire) at ECM electrical connector E7. See **Fig. 4** . This is the E2 and PTNK terminals on ECM. There are 2 different wiring harnesses used and wire color varies according to wiring harness used. Remove fuel tank cap. Turn ignition on and note voltage. Voltage should be 3.0-3.6 volts. If voltage is not within specification, go to next step. If voltage is within specification, go to step 12 .
11. Check for open and short in wiring harness and electrical connectors between vapor pressure sensor and ECM. See **WIRING DIAGRAMS** article. If wiring harness and electrical connectors are okay, replace vapor pressure sensor. See **VAPOR PRESSURE SENSOR** under EMISSION SYSTEMS & SUB-SYSTEMS in REMOVAL, OVERHAUL & INSTALLATION - 4-CYLINDER article. If wiring harness or electrical connector is defective, repair as necessary.
12. Inspect fuel tank and overfill check valve for cracks and damage. If fuel tank or overfill check valve are defective, repair or replace components as necessary. If fuel tank and overfill check valve are okay, it is likely that DTC was caused by fuel tank cap not being fully tightened or was improperly installed.

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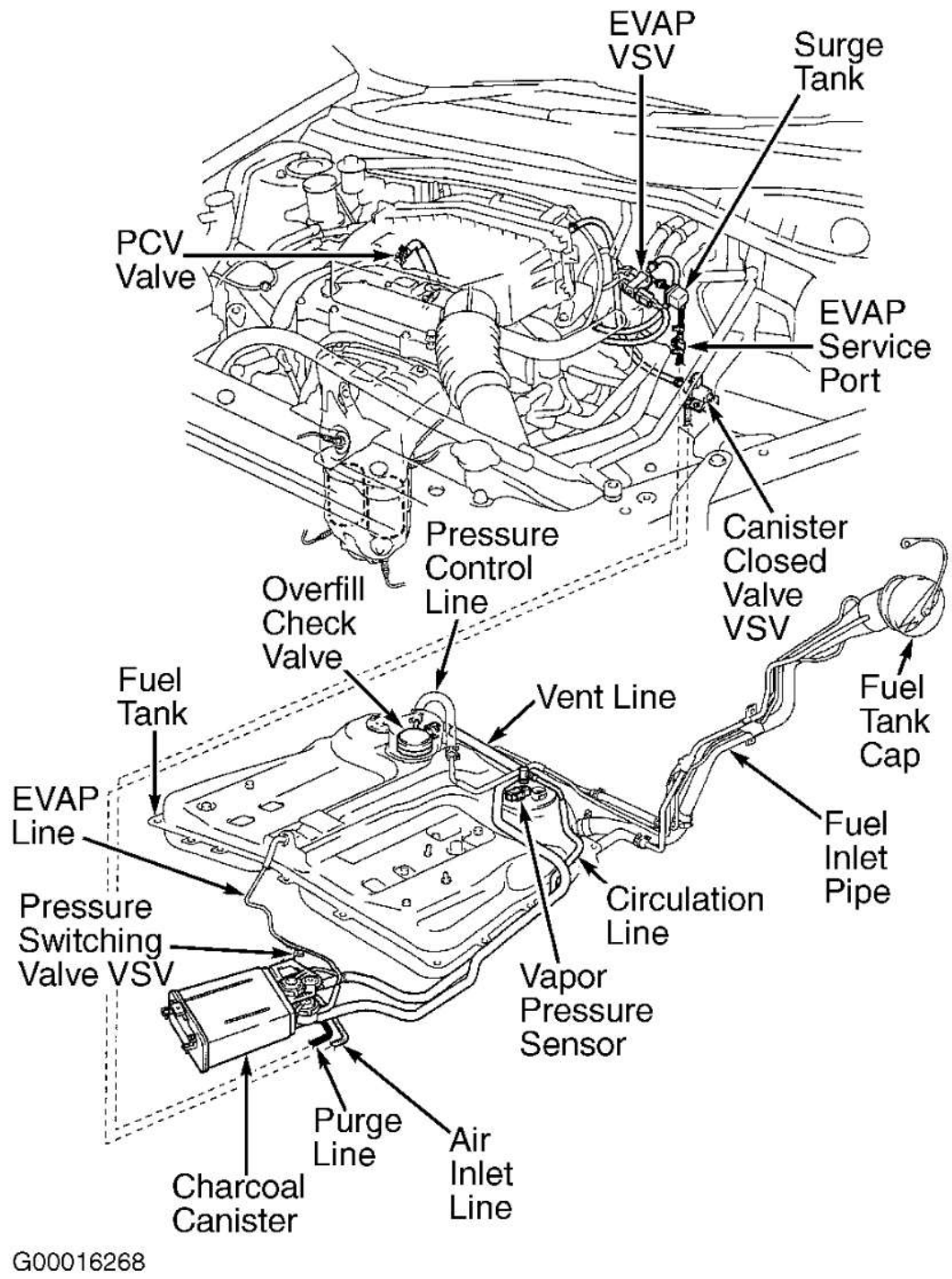


Fig. 16: Locating Emission System Components
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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DTC P0441: INCORRECT EVAP PURGE FLOW, OR DTC P0446: EVAP VENT CONTROL MALFUNCTION

CAUTION: If Engine Control Module (ECM) replacement is instructed in following test, always ensure ECM electrical connectors and ground circuits are okay. If either are defective, repair and repeat testing to confirm ECM malfunction. On models equipped with engine immobilizer, if ECM is replaced, ECM must be programmed with proper ignition key code for engine immobilizer system. For programming procedures, see COMPUTER RELEARN PROCEDURES article in GENERAL INFORMATION, or appropriate ENGINE IMMOBILIZER SYSTEMS article in ACCESSORIES & EQUIPMENT.

NOTE: If DTC P0441, P0446, P0450 or P0451 is output after DTC P0440, perform appropriate test for these DTCs first before performing test for DTC P0440.

Circuit Description

Vapor pressure sensor, canister closed valve Vacuum Switching Valve (VSV) and pressure switching valve Vacuum Switching Valve (VSV) are used to detect abnormalities in the EVAP system. DTC is set if a leak is detected in EVAP system, or when malfunction exists with the canister closed valve VSV, EVAP VSV, pressure switching valve VSV or vapor pressure sensor. Canister closed valve VSV may also be referred to as CCV VSV. Possible causes are:

- Vapor pressure sensor circuit is open or shorted.
- Defective vapor pressure sensor.
- EVAP VSV circuit is open or shorted.
- Defective EVAP VSV.
- Pressure switching valve VSV circuit is open or shorted.
- Defective pressure switching valve VSV.
- Canister closed valve VSV circuit is open or shorted.
- Defective canister closed valve VSV.
- Damaged, disconnected or restricted vacuum hose(s) or tubes.
- Fuel tank cap is loose or improperly installed.
- Defective fuel tank cap.
- Damaged fuel inlet pipe or fuel tank.
- Defective charcoal canister.
- Defective overfill check valve.
- Defective ECM.

Diagnostic Aids

These DTCs use two-trip detection logic. Using Toyota hand-held tester or scan tool, read FREEZE FRAME data. Freeze frame data records engine conditions when malfunction is detected.

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Diagnosis & Repair

1. If Toyota hand-held tester is available, go to next step. If Toyota hand-held tester is not available, go to step, 36 .
2. Check for any signs of hoses near fuel tank for modification and for signs of an accident which may have damaged the fuel tank or charcoal canister. Charcoal canister is located near fuel tank. See **Fig. 16** . If no problems exist, go to next step. If any problems exist, repair or replace components as necessary.
3. Check fuel tank cap to ensure fuel tank cap is a Original Equipment Manufacturer (OEM) fuel tank cap. If fuel tank cap is an OEM fuel tank cap, go to next step. If fuel tank cap is not an OEM fuel tank cap, replace fuel tank cap with an OEM fuel tank cap.
4. Ensure fuel tank cap is properly installed and tightened. If fuel tank cap is properly installed and tightened, go to next step. If fuel tank cap is not properly installed or tightened, reinstall and tighten as necessary.
5. Check fuel tank cap for damage and damaged gasket. If fuel tank cap is not damaged and gasket is okay, go to next step. If fuel tank cap or gasket is damaged, replace fuel tank cap with an OEM fuel tank cap.
6. Remove fuel tank cap. Visually inspect fuel inlet pipe for damage. See **Fig. 16** . If fuel inlet pipe is not damaged, go to next step. If fuel inlet pipe is damaged, replace fuel inlet pipe.
7. Check vapor pressure sensor connection at fuel pump. See **Fig. 16** . Check vacuum hoses to charcoal canister, EVAP VSV and pressure switching valve VSV for correct installation, loose connections, disconnected hoses and damage. See **Fig. 16** for component location. If no problems exist, go to next step. If any problem exists, repair or replace components as necessary.
8. Check hoses and tubes between fuel tank and charcoal canister for correct installation, loose connections, being disconnected and damage. See **Fig. 16** . If no problems exist, go to next step. If any problem exists, repair or replace components as necessary.
9. Check electrical connectors at EVAP VSV, canister closed valve VSV, pressure switching valve VSV and vapor pressure sensor for looseness, poor contact or for being disconnected. See **Fig. 16** . If all electrical connectors are okay, go to next step. If any problem exists, repair or reconnect electrical connector as necessary.
10. Check vacuum hoses and tubes between fuel tank, fuel inlet pipe, overfill check valve and charcoal canister for correct installation, loose connections, being disconnected, restricted or damaged. See **Fig. 16** . If no problems exist, go to next step. If any problem exists, repair or replace components as necessary.
11. Remove glove box and passenger's side kick panel (if necessary) for access to ECM with electrical connectors still installed on ECM. See **Fig. 2** . Turn ignition on. Using voltmeter, check voltage between terminals No. 2 (Yellow wire) and No. 18 (Brown wire) at ECM electrical connector E5. See **Fig. 4** . This is the VC and E2 terminals on ECM. Voltage should be 4.5-5.5 volts. If voltage is within specification, go to next step. If voltage is not within specification, replace ECM.
12. Turn ignition off. Connect voltmeter between terminals No. 18 (Brown wire) at ECM electrical connector E5 and No. 21 (Blue/Black or White wire) at ECM electrical connector E7. See**Fig. 4** . This is the E2 and PTNK terminals on ECM. There are 2 different wiring harnesses used and wire color varies according to wiring harness used. Remove fuel tank cap. Turn ignition on and note voltage. Voltage should be 3.0-3.6 volts. If voltage is not within specification, go to next step. If voltage is within specification, go to step 14 .
13. Check for open and short in wiring harness and electrical connectors between vapor pressure sensor and

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ECM. See **WIRING DIAGRAMS** article. If wiring harness and electrical connectors are okay, replace vapor pressure sensor. See **VAPOR PRESSURE SENSOR** under EMISSION SYSTEMS & SUB-SYSTEMS in REMOVAL, OVERHAUL & INSTALLATION - 4-CYLINDER article. If wiring harness or electrical connector is defective, repair as necessary.

14. Connect hand-held tester to Data Link Connector (DLC) No. 3 at driver's side of instrument panel. See **Fig. 1** . Turn ignition on and then turn hand-held tester on. Select ACTIVE TEST mode on hand-held tester. Note location of EVAP VSV on air intake hose, near air cleaner assembly and contains Black 2-pin electrical connector with Black/Red and Pink wires. See **Fig. 16** .
15. Disconnect vacuum hose at EVAP VSV that goes back to the charcoal canister. See **Fig. 16** . Start engine and allow engine to idle. Using hand-held tester, operate EVAP VSV and check for vacuum at vacuum port on EVAP VSV. When EVAP VSV is on, vacuum should exist and when EVAP VSV is off, no vacuum should exist if EVAP VSV is operating properly. If EVAP VSV operates properly, shut engine off and leave hand-held tester connected to DLC No. 3. Go to next step. If EVAP VSV does not operate properly, shut engine off. Go to step 17 .
16. Check for damaged, disconnected or restricted vacuum hose between EVAP VSV and charcoal canister. If vacuum hose is okay, go to step 21 . If vacuum hose is damaged, disconnected or restricted, repair or replace vacuum hose as necessary and go to step 21 .
17. Check for damaged, disconnected or restricted vacuum hose between intake manifold and EVAP VSV. If vacuum hose is okay, go to next step. If vacuum hose is damaged, disconnected or restricted, repair or replace vacuum hose as necessary.
18. Remove EVAP VSV. Using ohmmeter, ensure continuity exists between electrical terminals on EVAP VSV and resistance is 30-34 ohms at 68°F (20°C). Using ohmmeter, ensure no continuity exists between each electrical terminal and body of EVAP VSV. If EVAP VSV resistance is within specification and no continuity exists between electrical terminal and body of EVAP VSV, go to next step. If resistance is not within specification or if continuity exists between electrical terminal and body of EVAP VSV, replace EVAP VSV along with charcoal canister. Clean vacuum hoses between intake manifold and EVAP VSV, and between EVAP VSV and charcoal canister.
19. To test EVAP VSV operation, apply air pressure to port "E" on EVAP VSV. See **Fig. 17** . Ensure air does not flow from port "F". Apply battery voltage and ground to electrical terminals on EVAP VSV. Apply air pressure to port "E" on EVAP VSV. Ensure air flows from port "F". If EVAP VSV operates properly, go to next step. If EVAP VSV does not operate properly, replace EVAP VSV along with charcoal canister. Clean vacuum hoses between intake manifold and EVAP VSV, and between EVAP VSV and charcoal canister.

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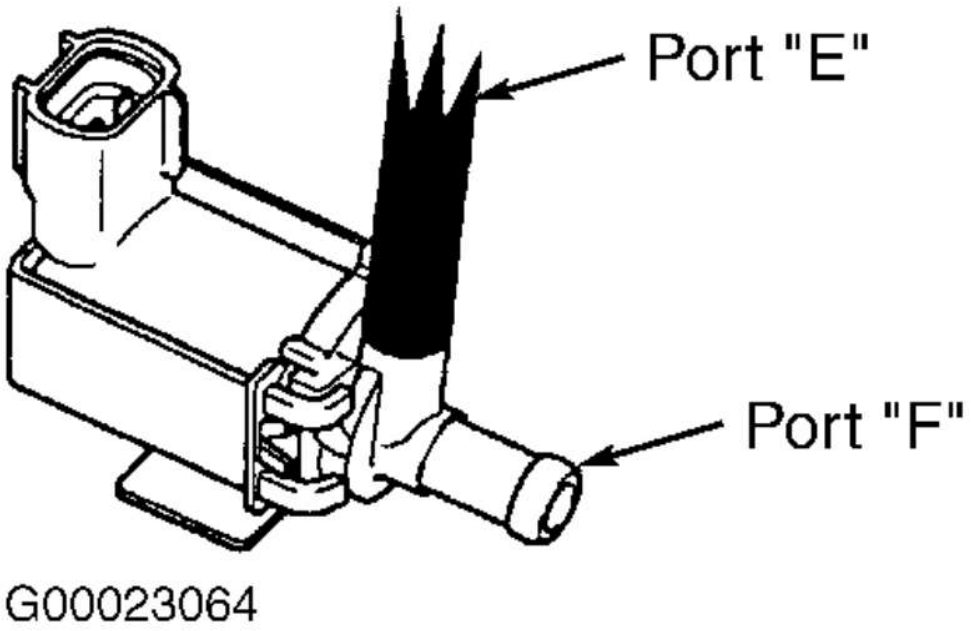


Fig. 17: Identifying EVAP Vacuum Switching Valve Ports
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

20. Check for open and short in wiring harness and electrical connectors between EFI main relay, EFI3 fuse (10-amp) and EVAP VSV, and between EVAP VSV and ECM. See **WIRING DIAGRAMS** article. EFI main relay may also be referred to as EFI relay. EFI3 fuse and EFI main relay are located in fuse/relay box at driver's side front corner of engine compartment. ECM is located behind passenger's side kick panel, just below instrument panel. See **Fig. 2** . If wiring harness and electrical connectors are okay, replace ECM. If wiring harness or electrical connector is defective, repair as necessary.
21. Remove canister closed valve VSV. Canister closed valve VSV is located near driver's side strut tower and contains Black 2-pin electrical connector with Black/Red and Yellow/Green wires. See **Fig. 16** . Reinstall electrical connector on canister closed valve VSV.
22. Turn ignition on and then turn hand-held tester on. Select ACTIVE TEST mode on hand-held tester. Note ports on canister closed valve VSV. See **Fig. 18** . Using hand-held tester, operate canister closed valve VSV while applying air pressure to port "E" on canister closed valve VSV. When canister closed valve VSV is on, air should not flow from port "F", and when canister closed valve VSV is off, air should flow from port "F". If canister closed valve VSV does not operate as specified, turn ignition off. Go to next step. If canister closed valve VSV operates as specified, turn ignition off and leave hand-held tester connected to DLC No. 3. Go to step 27 .

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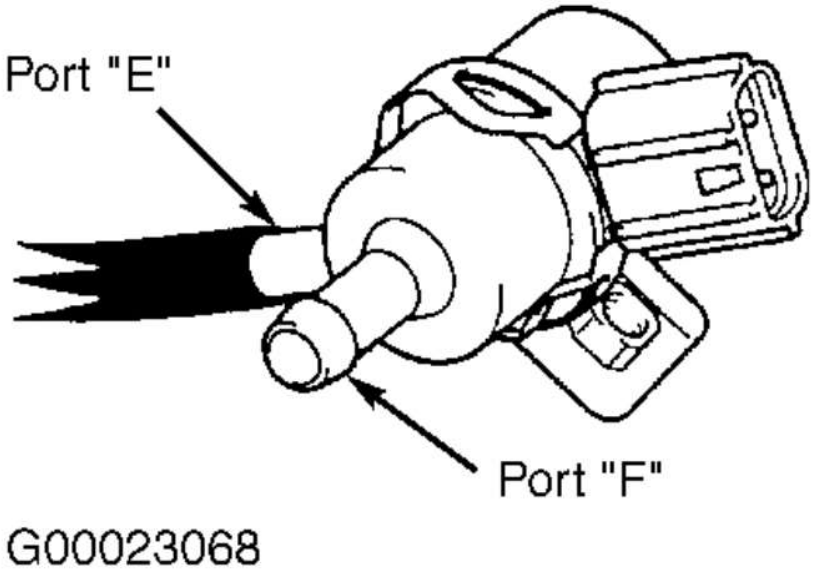


Fig. 18: Identifying Canister Closed Valve Vacuum Switching Valve Ports
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

23. Check vacuum hose between canister closed valve VSV and charcoal canister for correct installation, loose connections, being disconnected and damaged. See **Fig. 16** . If no problems exist, go to next step. If any problem exists, repair or replace components as necessary.
24. Disconnect electrical connector at canister closed valve VSV. Using ohmmeter, ensure continuity exists between electrical terminals on canister closed valve VSV and resistance is 25-30 ohms at 68°F (20°C). Using ohmmeter, ensure no continuity exists between each electrical terminal and body of canister closed valve VSV. If canister closed valve VSV resistance is within specification and no continuity exists between electrical terminal and body of canister closed valve VSV, go to next step. If resistance is not within specification or if continuity exists between electrical terminal and body of canister closed valve VSV, replace canister closed valve VSV along with charcoal canister. Clean vacuum hose between canister closed valve VSV and charcoal canister.
25. To test canister closed valve VSV operation, apply air pressure to port "E" on canister closed valve VSV. See **Fig. 18** . Ensure air flows from port "F". Apply battery voltage and ground to electrical terminals on canister closed valve VSV. Apply air pressure to port "E" on canister closed valve VSV. Ensure air does not flow from port "F". If canister closed valve VSV operates as specified, go to next step. If canister closed valve VSV does not operate as specified, replace canister closed valve VSV along with charcoal canister. Clean vacuum hose between canister closed valve VSV and charcoal canister.
26. Check for open and short in wiring harness and electrical connectors between EFI main relay, EFI3 fuse (10-amp) and canister closed valve VSV, and between canister closed valve VSV and ECM. See

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WIRING DIAGRAMS article. EFI main relay may also be referred to as EFI relay. EFI3 fuse and EFI main relay are located in fuse/relay box at driver's side front corner of engine compartment. ECM is located behind passenger's side kick panel, just below instrument panel. See **Fig. 2** . If wiring harness and electrical connectors are okay, replace ECM. If wiring harness or electrical connector is defective, repair as necessary.

27. Disconnect vacuum hoses at pressure switching valve VSV. Pressure switching valve VSV is located on bracket at charcoal canister near fuel tank and contains Blue 2-pin electrical connector with Black/Red and Green/Orange or White wires. See **Fig. 16** . There are 2 different wiring harnesses used and wire color varies according to wiring harness used. Ensure electrical connector is installed on pressure switching valve VSV.
28. Turn ignition on and then turn hand-held tester on. Select ACTIVE TEST mode on hand-held tester. Note ports on pressure switching valve VSV. See **Fig. 19** . Using hand-held tester, operate pressure switching valve VSV while applying air pressure to port "E" on pressure switching valve VSV. When pressure switching valve VSV is on, air should flow from port "F", and when pressure switching valve VSV is off, air should not flow from port "F". If pressure switching valve VSV does not operate as specified, turn ignition off. Go to next step. If pressure switching valve VSV operates as specified, turn ignition off and leave hand-held tester connected to DLC No. 3. Go to step 32 .

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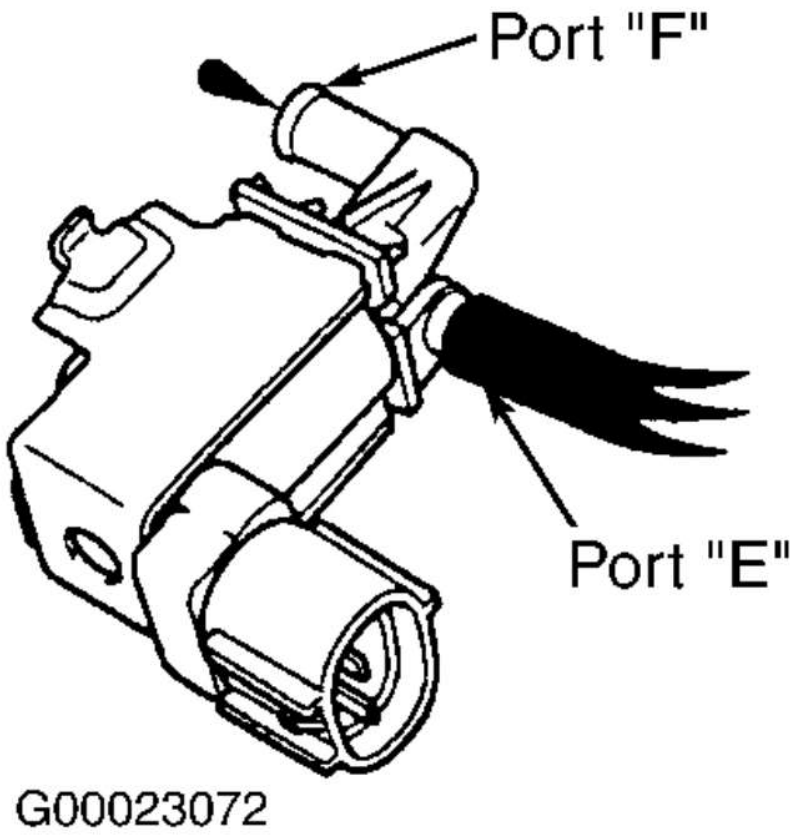


Fig. 19: Identifying Pressure Switching Valve Vacuum Switching Valve Ports
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

29. Disconnect electrical connector at pressure switching valve VSV. Using ohmmeter, ensure continuity exists between electrical terminals on pressure switching valve VSV and resistance is 30-36 ohms at 68°F (20°C). Using ohmmeter, ensure no continuity exists between each electrical terminal and body of pressure switching valve VSV. If pressure switching valve VSV resistance is within specification and no continuity exists between electrical terminal and body of pressure switching valve VSV, go to next step. If resistance is not within specification or if continuity exists between electrical terminal and body of pressure switching valve VSV, replace pressure switching valve VSV along with charcoal canister. Clean vacuum hoses located between pressure switching valve VSV and charcoal canister, and between charcoal canister and fuel tank.
30. To test pressure switching valve VSV operation, apply air pressure to port "E" on pressure switching valve VSV. See **Fig. 19** . Ensure air does not flow from port "F". Apply battery voltage and ground to electrical terminals on pressure switching valve VSV. Apply air pressure to port "E" on pressure

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switching valve VSV. Ensure air flows from port "F". If pressure switching valve VSV operates as specified, go to next step. If pressure switching valve VSV does not operate as specified, replace pressure switching valve VSV along with charcoal canister. Clean vacuum hoses located between pressure switching valve VSV and charcoal canister, and between charcoal canister and fuel tank.

31. Check for open and short in wiring harness and electrical connectors between EFI main relay, EFI3 fuse (10-amp) and pressure switching valve VSV, and between pressure switching valve VSV and ECM. See **WIRING DIAGRAMS** article. EFI main relay may also be referred to as EFI relay. EFI3 fuse and EFI main relay are located in fuse/relay box at driver's side front corner of engine compartment. ECM is located behind passenger's side kick panel, just below instrument panel. See **Fig. 2** . If wiring harness and electrical connectors are okay, replace ECM. If wiring harness or electrical connector is defective, repair as necessary.
32. Remove glove box and passenger's side kick panel (if necessary) for access to ECM with electrical connectors still installed on ECM. See **Fig. 2** . Connect voltmeter between terminals No. 18 (Brown wire) at ECM electrical connector E5 and No. 21 (Blue/Black or White wire) at ECM electrical connector E7. See **Fig. 4** . This is the E2 and PTNK terminals on ECM. There are 2 different wiring harnesses used and wire color varies according to wiring harness used.
33. Turn ignition on. Select ACTIVE TEST mode on hand-held tester. Start engine and allow engine to idle. Using hand-held tester, turn canister closed valve VSV on, EVAP VSV off and pressure switching valve VSV on. Ensure pressure switching valve VSV is on for at least 30 seconds. Note voltage reading after switching EVAP VSV from off to on and pressure switching valve from on to off. Voltage should be 2.5 volts or less. If voltage is within specification, leave voltmeter connected with engine idling and go to next step. If voltage is not within specification, shut engine off and remove voltmeter. Replace fuel tank.
34. Using hand-held tester, ensure canister closed valve VSV is on, EVAP VSV is off and pressure switching valve VSV is on. Ensure pressure switching valve VSV is on for at least 30 seconds. Note voltage reading between E2 and PTNK terminals on ECM after switching EVAP VSV from off to on. Voltage should be 2.5 volts or less. If voltage is within specification, shut engine off. Remove voltmeter and go to next step. If voltage is not within specification, shut engine off and remove voltmeter. Replace charcoal canister.
35. Charcoal canister or overfill check valve may be defective. Check fuel evaporative system. See appropriate FUEL EVAP SYSTEM TEST under FUEL EVAPORATIVE SYSTEM under EMISSION SYSTEMS & SUB-SYSTEMS in SYSTEM & COMPONENT TESTING - 4-CYLINDER article.
36. Check for any signs of hoses near fuel tank for modification and for signs of an accident which may have damaged the fuel tank or charcoal canister. Charcoal canister is located near fuel tank. See **Fig. 16** . If no problems exist, go to next step. If any problems exist, repair or replace components as necessary.
37. Check fuel tank cap to ensure fuel tank cap is a Original Equipment Manufacturer (OEM) fuel tank cap. If fuel tank cap is an OEM fuel tank cap, go to next step. If fuel tank cap is not an OEM fuel tank cap, replace fuel tank cap with an OEM fuel tank cap.
38. Ensure fuel tank cap is properly installed and tightened. If fuel tank cap is properly installed and tightened, go to next step. If fuel tank cap is not properly installed or tightened, reinstall and tighten as necessary.
39. Check fuel tank cap for damage and damaged gasket. If fuel tank cap is not damaged and gasket is okay, go to next step. If fuel tank cap or gasket is damaged, replace fuel tank cap with an OEM fuel tank cap.
40. Remove fuel tank cap. Visually inspect fuel inlet pipe for damage. See **Fig. 16** . If fuel inlet pipe is not damaged, go to next step. If fuel inlet pipe is damaged, replace fuel inlet pipe.
41. Check vapor pressure sensor connection at fuel pump. See **Fig. 16** . Check vacuum hoses to charcoal canister, EVAP VSV and pressure switching valve VSV for correct installation, loose connections,

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disconnected hoses and damage. See **Fig. 16** for component location. If no problems exist, go to next step. If any problem exists, repair or replace components as necessary.

42. Check hoses and tubes between fuel tank and charcoal canister for correct installation, loose connections, being disconnected and damage. See **Fig. 16** . If no problems exist, go to next step. If any problem exists, repair or replace components as necessary.
43. Check electrical connector s at EVAP VSV, canister closed valve Vacuum Switching Valve (VSV), pressure switching valve VSV and vapor pressure sensor for looseness, poor contact or for being disconnected. See **Fig. 16** . If all electrical connectors are okay, go to next step. If any problem exists, repair or reconnect electrical connector as necessary.
44. Check vacuum hoses and tubes between fuel tank, fuel inlet pipe, overfill check valve and charcoal canister for correct installation, loose connections, being disconnected, restricted or damaged. See **Fig. 16** . If no problems exist, go to next step. If any problem exists, repair or replace components as necessary.
45. Remove glove box and passenger's side kick panel (if necessary) for access to ECM with electrical connectors still installed on ECM. See **Fig. 2** . Turn ignition on. Using voltmeter, check voltage between terminals No. 2 (Yellow wire) and No. 18 (Brown wire) at ECM electrical connector E5. See **Fig. 4** . This is the VC and E2 terminals on ECM. Voltage should be 4.5-5.5 volts. If voltage is within specification, go to next step. If voltage is not within specification, replace ECM.
46. Turn ignition off. Connect voltmeter between terminals No. 18 (Brown wire) at ECM electrical connector E5 and No. 21 (Blue/Black or White wire) at ECM electrical connector E7. See **Fig. 4** . This is the E2 and PTNK terminals on ECM. There are 2 different wiring harnesses used and wire color varies according to wiring harness used. Remove fuel tank cap. Turn ignition on and note voltage. Voltage should be 3.0-3.6 volts. If voltage is not within specification, go to next step. If voltage is within specification, go to step 48 .
47. Check for open and short in wiring harness and electrical connectors between vapor pressure sensor and ECM. See **WIRING DIAGRAMS** article. If wiring harness and electrical connectors are okay, replace vapor pressure sensor. See **VAPOR PRESSURE SENSOR** under EMISSION SYSTEMS & SUB-SYSTEMS in REMOVAL, OVERHAUL & INSTALLATION - 4-CYLINDER article. If wiring harness or electrical connector is defective, repair as necessary.
48. Disconnect vacuum hoses at EVAP VSV. EVAP VSV is located on air intake hose, near air cleaner assembly and contains Black 2-pin electrical connector with Black/Red and Pink wires. See **Fig. 16** .
49. Turn ignition on. Connect jumper wire between body ground and terminal No. 6 (Pink wire) at ECM electrical connector E5 to operate EVAP VSV. See **Fig. 4** . This is the EVP1 terminal on ECM. With jumper wire connected so EVAP VSV is on, apply air pressure to port "E" on EVAP VSV. See **Fig. 17** . Ensure air flows from port "F". Disconnect jumper wire so EVAP VSV is off. Apply air pressure to port "E" on EVAP VSV. Ensure air does not flow from port "F". If EVAP VSV does not operate as specified, turn ignition off. Go to next step. If EVAP VSV operates as specified, turn ignition off. Go to step 53 .
50. Remove EVAP VSV. Using ohmmeter, ensure continuity exists between electrical terminals on EVAP VSV and resistance is 30-34 ohms at 68°F (20°C). Using ohmmeter, ensure no continuity exists between each electrical terminal and body of EVAP VSV. If EVAP VSV resistance is within specification and no continuity exists between electrical terminal and body of EVAP VSV, go to next step. If resistance is not within specification or if continuity exists between electrical terminal and body of EVAP VSV, replace EVAP VSV along with charcoal canister. Clean vacuum hoses between intake manifold and EVAP VSV, and between EVAP VSV and charcoal canister.
51. To test EVAP VSV operation, apply air pressure to port "E" on EVAP VSV. See **Fig. 17** . Ensure air does

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not flow from port "F". Apply battery voltage and ground to electrical terminals on EVAP VSV. Apply air pressure to port "E" on EVAP VSV. Ensure air flows from port "F". If EVAP VSV operates properly, go to next step. If EVAP VSV does not operate properly, replace EVAP VSV along with charcoal canister. Clean vacuum hoses between intake manifold and EVAP VSV, and between EVAP VSV and charcoal canister.

52. Check for open and short in wiring harness and electrical connectors between EFI main relay, EFI3 fuse (10-amp) and EVAP VSV, and between EVAP VSV and ECM. See **WIRING DIAGRAMS** article. EFI main relay may also be referred to as EFI relay. EFI3 fuse and EFI main relay are located in fuse/relay box at driver's side front corner of engine compartment. If wiring harness and electrical connectors are okay, replace ECM. If wiring harness or electrical connector is defective, repair as necessary.
53. Disconnect vacuum hoses at canister closed valve VSV. Canister closed valve is located near driver's side strut tower and contains Black 2-pin electrical connector with Black/Red and Yellow/Green wires. See **Fig. 16** .
54. Turn ignition on. Connect jumper wire between body ground and terminal No. 2 (Yellow/Green wire) at ECM electrical connector E6 to operate canister closed valve VSV. See **Fig. 4** . This is the CCV terminal on ECM. With jumper wire connected so canister closed valve VSV is on, apply air pressure to port "E" on canister closed valve VSV. See **Fig. 18** . Ensure air does not flow from port "F". Disconnect jumper wire so canister closed valve VSV is off. Apply air pressure to port "E" on canister closed valve VSV. Ensure air flows from port "F". If canister closed valve VSV does not operate as specified, turn ignition off. Go to next step. If canister closed valve VSV operates as specified, turn ignition off. Go to step 58 .
55. Disconnect electrical connector at canister closed valve VSV. Using ohmmeter, ensure continuity exists between electrical terminals on canister closed valve VSV and resistance is 25-30 ohms at 68°F (20°C). Using ohmmeter, ensure no continuity exists between each electrical terminal and body of canister closed valve VSV. If canister closed valve VSV resistance is within specification and no continuity exists between electrical terminal and body of canister closed valve VSV, go to next step. If resistance is not within specification or if continuity exists between electrical terminal and body of canister closed valve VSV, replace canister closed valve VSV along with charcoal canister. Clean vacuum hose between canister closed valve VSV and charcoal canister.
56. To test canister closed valve VSV operation, apply air pressure to port "E" on canister closed valve VSV. See **Fig. 18** . Ensure air flows from port "F". Apply battery voltage and ground to electrical terminals on canister closed valve VSV. Apply air pressure to port "E" on canister closed valve VSV. Ensure air does not flow from port "F". If canister closed valve VSV operates as specified, go to next step. If canister closed valve VSV does not operate as specified, replace canister closed valve VSV along with charcoal canister. Clean vacuum hose between canister closed valve VSV and charcoal canister.
57. Check for open and short in wiring harness and electrical connectors between EFI main relay, EFI3 fuse (10-amp) and canister closed valve VSV, and between canister closed valve VSV and ECM. See **WIRING DIAGRAMS** article. EFI main relay may also be referred to as EFI relay. EFI3 fuse and EFI main relay are located in fuse/relay box at driver's side front corner of engine compartment. If wiring harness and electrical connectors are okay, replace ECM. If wiring harness or electrical connector is defective, repair as necessary.
58. Disconnect vacuum hoses at pressure switching valve VSV. Pressure switching valve VSV is located on bracket at charcoal canister near fuel tank and contains Blue 2-pin electrical connector with Black/Red and Green/Orange or White wires. See **Fig. 16** . There are 2 different wiring harnesses used and wire color varies according to wiring harness used. Ensure electrical connector is installed on pressure switching valve VSV.

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59. Turn ignition on. Connect jumper wire between body ground and terminal No. 3 (Green/Orange or White wire) at ECM electrical connector E6 to operate pressure switching valve VSV. See **Fig. 4** . This is the TBP terminal on ECM. With jumper wire connected so pressure switching valve VSV is on, apply air pressure to port "E" on pressure switching valve VSV. See **Fig. 19** . Ensure air flows from port "F". Disconnect jumper wire so pressure switching valve VSV is off. Apply air pressure to port "E" on purge flow switching valve VSV. Ensure air does not flow from port "F". If pressure switching valve VSV does not operate as specified, turn ignition off. Go to next step. If pressure switching valve VSV operates as specified, go to step 63 .
60. Disconnect electrical connector at pressure switching valve VSV. Using ohmmeter, ensure continuity exists between electrical terminals on pressure switching valve VSV and resistance is 30-36 ohms at 68°F (20°C). Using ohmmeter, ensure no continuity exists between each electrical terminal and body of pressure switching valve VSV. If pressure switching valve VSV resistance is within specification and no continuity exists between electrical terminal and body of pressure switching valve VSV, go to next step. If resistance is not within specification or if continuity exists between electrical terminal and body of pressure switching valve VSV, replace pressure switching valve VSV along with charcoal canister. Clean vacuum hoses located between pressure switching valve VSV and charcoal canister, and between charcoal canister and fuel tank.
61. To test pressure switching valve VSV operation, apply air pressure to port "E" on pressure switching valve VSV. See **Fig. 19** . Ensure air does not flow from port "F". Apply battery voltage and ground to electrical terminals on pressure switching valve VSV. Apply air pressure to port "E" on pressure switching valve VSV. Ensure air flows from port "F". If pressure switching valve VSV operates as specified, go to next step. If pressure switching valve VSV does not operate as specified, replace pressure switching valve VSV along with charcoal canister. Clean vacuum hoses located between pressure switching valve VSV and charcoal canister, and between charcoal canister and fuel tank.
62. Check for open and short in wiring harness and electrical connectors between EFI main relay, EFI3 fuse (10-amp) and pressure switching valve VSV, and between pressure switching valve VSV and ECM. See **WIRING DIAGRAMS** article. EFI main relay may also be referred to as EFI relay. EFI3 fuse and EFI main relay are located in fuse/relay box at driver's side front corner of engine compartment. If wiring harness and electrical connectors are okay, replace ECM. If wiring harness or electrical connector is defective, repair as necessary.
63. Charcoal canister or overfill check valve may be defective. Check fuel evaporative system. See appropriate FUEL EVAP SYSTEM TEST under FUEL EVAPORATIVE SYSTEM under EMISSION SYSTEMS & SUB-SYSTEMS in SYSTEM & COMPONENT TESTING - 4-CYLINDER article.

DTC P0450: EVAP PRESSURE SENSOR CIRCUIT OR DTC P0451: EVAP PRESSURE SENSOR RANGE/PERFORMANCE

CAUTION: If Engine Control Module (ECM) replacement is instructed in following test, always ensure ECM electrical connectors and ground circuits are okay. If either are defective, repair and repeat testing to confirm ECM malfunction. On models equipped with engine immobilizer, if ECM is replaced, ECM must be programmed with proper ignition key code for engine immobilizer system. For programming procedures, see COMPUTER RELEARN PROCEDURES article in GENERAL INFORMATION, or appropriate ENGINE IMMOBILIZER SYSTEMS article in ACCESSORIES & EQUIPMENT.

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NOTE: If DTC P0441, P0446, P0450 or P0451 is output after DTC P0440, perform appropriate test for these DTCs first before performing test for DTC P0440.

Circuit Description

Vapor pressure sensor, canister closed valve Vacuum Switching Valve (VSV) and pressure switching valve Vacuum Switching Valve (VSV) are used to detect abnormalities in the EVAP system. DTC is set if vapor pressure sensor malfunctions. Possible causes are:

- Vapor pressure sensor circuit is open or shorted.
- Defective vapor pressure sensor.
- Defective ECM.

Diagnostic Aids

These DTCs use two-trip detection logic. Using Toyota hand-held tester or scan tool, read FREEZE FRAME data. Freeze frame data records engine conditions when malfunction is detected.

Diagnosis & Repair

1. Remove glove box and passenger's side kick panel (if necessary) for access to ECM with electrical connectors still installed on ECM. See **Fig. 2** . Turn ignition on. Using voltmeter, check voltage between terminals No. 2 (Yellow wire) and No. 18 (Brown wire) at ECM electrical connector E5. See **Fig. 4** . This is the VC and E2 terminals on ECM. Voltage should be 4.5-5.5 volts. If voltage is within specification, go to next step. If voltage is not within specification, replace ECM.
2. Turn ignition off. Connect voltmeter between terminals No. 18 (Brown wire) at ECM electrical connector E5 and No. 21 (Blue/Black or White wire) at ECM electrical connector E7. See **Fig. 4** . This is the E2 and PTNK terminals on ECM. There are 2 different wiring harnesses used and wire color varies according to wiring harness used. Remove fuel tank cap. Turn ignition on and note voltage. Voltage should be 3.0-3.6 volts. If voltage is not within specification, go to next step. If voltage is within specification, replace ECM.
3. Check for open and short in wiring harness and electrical connectors between vapor pressure sensor and ECM. See **WIRING DIAGRAMS** article. Vapor pressure sensor is located on top of fuel tank. See **Fig. 16** . If wiring harness and electrical connectors are okay, replace vapor pressure sensor. See **VAPOR PRESSURE SENSOR** under EMISSION SYSTEMS & SUB-SYSTEMS in REMOVAL, OVERHAUL & INSTALLATION - 4-CYLINDER article. If wiring harness or electrical connector is defective, repair as necessary.

DTC P0500: VEHICLE SPEED SENSOR CIRCUIT

CAUTION: If Engine Control Module (ECM) replacement is instructed in following test, always ensure ECM electrical connectors and ground circuits are okay. If either are defective, repair and repeat testing to confirm ECM malfunction. On models equipped with engine immobilizer, if ECM is replaced, ECM must be programmed with proper ignition key code for engine immobilizer system. For programming procedures, see COMPUTER RELEARN

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PROCEDURES article in GENERAL INFORMATION, or appropriate ENGINE IMMOBILIZER SYSTEMS article in ACCESSORIES & EQUIPMENT.

Circuit Description

Vehicle speed sensor is located near rear of transaxle. Vehicle speed sensor outputs a 4-pulse input signal for every revolution of the drive gear in transaxle to the instrument cluster where input signal is converted to a rectangular waveform and then sent to the to ECM. DTC is set if there is no vehicle speed signal to ECM while vehicle is being driven. Possible causes are:

- Vehicle speed circuit is open or shorted between instrument cluster and ECM.
- Defective instrument cluster.
- Defective vehicle speed sensor.
- Defective ECM.

Diagnostic Aids

This DTC uses two-trip detection logic. Using Toyota hand-held tester or scan tool, read FREEZE FRAME data. Freeze frame data records engine conditions when malfunction is detected.

Diagnosis & Repair

1. Test drive vehicle and check operation of speedometer. If speedometer operates properly, go to next step. If speedometer does not operate properly, repair speedometer as necessary. See appropriate INSTRUMENT PANELS article in ACCESSORIES & EQUIPMENT. Speedometer may not operate, as input signal from vehicle speed sensor may not be input to instrument cluster.
2. Remove glove box and passenger's side kick panel (if necessary) for access to ECM with electrical connectors still installed on ECM. See **Fig. 2** . Using ohmmeter, check for continuity between body ground and terminal No. 22 (Violet/White or White wire) at ECM electrical connector E7. See **Fig. 4** . This is the SPD terminal on ECM. There are 2 different wiring harnesses used and wire color varies according to wiring harness used. If no continuity exists, go to next step. If continuity exists, repair short to ground in Violet/White or White and electrical connectors between ECM and instrument cluster. See **WIRING DIAGRAMS** article.
3. Raise and support vehicle so front wheels may be rotated. Place transaxle in Neutral. Turn ignition on. Using voltmeter, check voltage between body ground and terminal No. 22 (Violet/White or White wire) at ECM electrical connector E7 while slowly rotating front wheel. See **Fig. 4** . This is the SPD terminal on ECM. Voltage should pulse between 0-5.0 volts. If voltage is within specification, replace ECM. If voltage is not within specification, repair open in Violet/White or White wire and electrical connectors between ECM and instrument cluster. See **WIRING DIAGRAMS** article.

DTC P0505: IDLE CONTROL SYSTEM MALFUNCTION

CAUTION: If Engine Control Module (ECM) replacement is instructed in following test, always ensure ECM electrical connectors and ground circuits are okay. If either are defective, repair and repeat testing to confirm ECM malfunction.

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On models equipped with engine immobilizer, if ECM is replaced, ECM must be programmed with proper ignition key code for engine immobilizer system. For programming procedures, see COMPUTER RELEARN PROCEDURES article in GENERAL INFORMATION, or appropriate ENGINE IMMOBILIZER SYSTEMS article in ACCESSORIES & EQUIPMENT.

Circuit Description

ECM operates Idle Air Control (IAC) valve to perform idle-up and provide feedback for target idling speed. DTC is set when idle speed continues to vary greatly from target speed. Possible causes are:

- IAC valve is stuck or remains closed.
- IAC valve circuit is open or shorted.
- A/C switch circuit is open or shorted.
- Air induction system malfunction.
- Defective ECM.

Diagnostic Aids

This DTC uses two-trip detection logic. Using Toyota hand-held tester or scan tool, read FREEZE FRAME data. Freeze frame data records engine conditions when malfunction is detected.

Diagnosis & Repair

1. Start engine and warm to engine to normal operating temperature. Ensure A/C and all accessories are off. Apply parking brake. Place transaxle in Neutral. Connect Toyota hand-held tester or scan tool to Data Link Connector (DLC) No. 3 at driver's side of instrument panel. See **Fig. 1** . Note engine speed in less than 5 seconds and at more than 5 seconds. If difference in engine speed is 100 RPM or less, shut engine off. Go to next step. If difference in engine speed is more than 100 RPM, shut engine off. Go to step 7 .
2. Ensure ignition is off. Remove glove box and passenger's side kick panel (if necessary) for access to ECM with electrical connectors still installed on ECM. See **Fig. 2** . Disconnect ECM electrical connector E4. See **Fig. 4** .
3. Turn ignition on. Using voltmeter, check voltage between body ground and terminal No. 18 (Black/Blue wire) at ECM electrical connector E4. See **Fig. 4** . This is the RSD terminal on ECM. Voltage should be 9-14 volts.
4. If voltage is within specification, go to next step. If voltage is not within specification, check IAC valve operation. See **IDLE AIR CONTROL VALVE** under IDLE CONTROL SYSTEMS in SYSTEM & COMPONENT TESTING - 4-CYLINDER article. If IAC valve is defective, replace IAC valve. If IAC valve is okay, check for open and short in wiring harness and electrical connectors between IAC valve and ECM. See **WIRING DIAGRAMS** article. Repair wiring as necessary.
5. Check IAC valve operation. See **IDLE AIR CONTROL VALVE** under IDLE CONTROL SYSTEMS in SYSTEM & COMPONENT TESTING - 4-CYLINDER article. If IAC valve is okay, go to next step. If IAC valve is defective, replace IAC valve.
6. Remove IAC valve from throttle body. Inspect IAC valve and passages for carbon build-up and blockage. If a problem exist, repair as necessary. If problem does not exist, replace ECM.

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7. Ensure engine oil dipstick, oil filler cap, Positive Crankcase Ventilation (PCV) system and all other air induction system components are intact and operating properly. If problem exists, repair as necessary. If problem does not exist, an open or short in A/C switch signal circuit may exist. Check A/C amplifier. See appropriate MANUAL A/C-HEATER SYSTEMS article in AIR CONDITIONING & HEATING. Repair as necessary.

DTC P1133: AIR/FUEL SENSOR CIRCUIT RESPONSE MALFUNCTION (BANK NO. 1 SENSOR NO. 1)

NOTE: This DTC may be caused by the vehicle running out of fuel.

CAUTION: If Engine Control Module (ECM) replacement is instructed in following test, always ensure ECM electrical connectors and ground circuits are okay. If either are defective, repair and repeat testing to confirm ECM malfunction. On models equipped with engine immobilizer, if ECM is replaced, ECM must be programmed with proper ignition key code for engine immobilizer system. For programming procedures, see COMPUTER RELEARN PROCEDURES article in GENERAL INFORMATION, or appropriate ENGINE IMMOBILIZER SYSTEMS article in ACCESSORIES & EQUIPMENT.

Circuit Description

Heated Air/Fuel (A/F) sensor (bank No. 1 sensor No. 1) monitors exhaust gas oxygen content and delivers input signals to ECM. Heated A/F sensor (bank No. 1 sensor No. 1) is located on exhaust manifold above catalytic converters. See **Fig. 20** . A/F sensor may also be referred to as A/F ratio sensor. ECM uses input signals to determine fuel injection system operation. DTC is set when A/F sensor (bank No. 1 sensor No. 1) output voltage does not change after engine is started with engine at normal operating temperature, engine speed of 1400 RPM or more and with vehicle speed of 38 MPH or more. Possible causes are:

- A/F sensor (bank No. 1 sensor No. 1) circuit is open or shorted.
- Defective A/F sensor (bank No. 1 sensor No. 1).
- Air induction system malfunction.
- Improper fuel pressure.
- Defective fuel injector.
- Vehicle has run out of fuel.
- Defective ECM.

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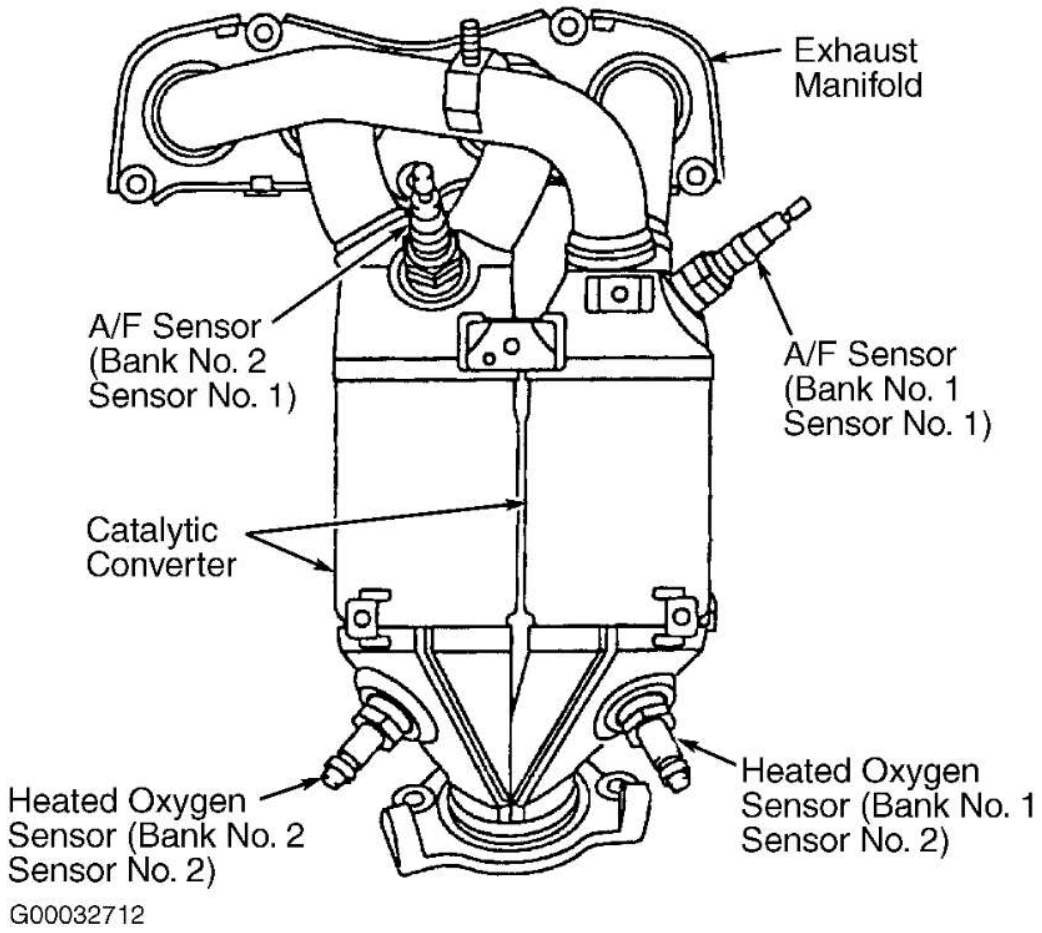


Fig. 20: Locating A/F Sensors & Heated Oxygen Sensors
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Diagnostic Aids

This DTC uses two-trip detection logic. ECM maintains a fixed voltage of 3.3 volts at AFR+ and AFL+ terminals on ECM, and 3.0 volts at AFR- and AFL- terminal on ECM. It is impossible to confirm A/F sensor output voltage without using Toyota hand-held tester or scan tool. A/F sensor output voltage on scan tool is displayed at one fifth the voltage of that displayed on a Toyota hand-held tester. Using hand-held tester or scan tool, read FREEZE FRAME data. Freeze frame data records engine conditions when malfunction is detected.

Test Drive Confirmation

1. Test drive confirmation may be performed to operate vehicle under conditions which may cause DTC to be set. When performing test drive confirmation, procedures must be performed exactly as listed or the malfunction may not be detected. If Toyota hand-held tester is available, go to next step. If Toyota hand-

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held tester is not available, go to step 3 .

2. Connect hand-held tester to Data Link Connector (DLC) No. 3 at driver's side of instrument panel. See **Fig. 1** . Switch hand-held tester from NORMAL mode to CHECK mode.
3. Start engine. Allow engine to idle for at least 60 seconds.
4. Drive vehicle at 24 MPH or more for at least 40 seconds and then allow engine to idle for at least 10 seconds. Repeat this procedure 9 times and then check operation of Malfunction Indicator Light (MIL). If MIL illuminates, malfunction exists and DTC is set. If MIL does not illuminate, malfunction does not exist.

Diagnosis & Repair

1. Using Toyota hand-held tester or scan tool, check for any other DTCs. If only DTC P1133 exists, go to next step. If other DTCs exist, diagnose and repair those DTCs first and retest.
2. With Toyota hand-held tester or scan tool still connected to DLC No. 3, start engine and maintain engine speed at 2500 RPM for about 90 seconds to fully warm the A/F sensors. Allow engine to idle.
3. Using hand-held tester or scan tool, monitor A/F sensor (bank No. 1 sensor No. 1) output voltage with engine idling, engine racing and while driving vehicle at 25 MPH or more with engine speed of 1500 RPM or more while opening and closing the throttle. Ensure A/F sensor output voltage is as specified. See **AIR/FUEL SENSOR OUTPUT VOLTAGE SPECIFICATIONS** table. If A/F sensor output voltage is not within specification, go to next step. If A/F sensor output voltage is within specification, go to step 9 .

NOTE: If A/F sensor output voltage remains 3.30 volts (Toyota hand-held tester) or .66 volt (OBD-II scan tool) during all conditions, A/F sensor circuit may be open. If A/F sensor output voltage remains 3.80 volts or more (Toyota hand-held tester) or .76 volt or more (OBD-II scan tool) during all conditions, A/F sensor circuit may be shorted. If A/F sensor output voltage remains 2.80 volts or less (Toyota hand-held tester) or .56 volt or less (OBD-II scan tool) during all conditions, A/F sensor circuit may be shorted. During fuel enrichment, A/F sensor output voltage may be less than 2.8 volts (Toyota hand-held tester) or .56 volt (OBD-II scan tool) which is normal. During fuel cut, A/F sensor output voltage may be more than 3.8 volts (Toyota hand-held tester) or .76 volt (OBD-II scan tool) which is normal.

AIR/FUEL SENSOR OUTPUT VOLTAGE SPECIFICATIONS

Application & Operating Condition	Specification
Using OBD-II Scan Tool	
Engine Idling, Engine Racing & Driving Vehicle (1)	(2)
Using Toyota Hand-Held Tester	
Engine Idling, Engine Racing & Driving Vehicle (1)	(3)

(1) Drive vehicle at 25 MPH or more with engine speed of 1500 RPM or more while opening and closing the throttle.

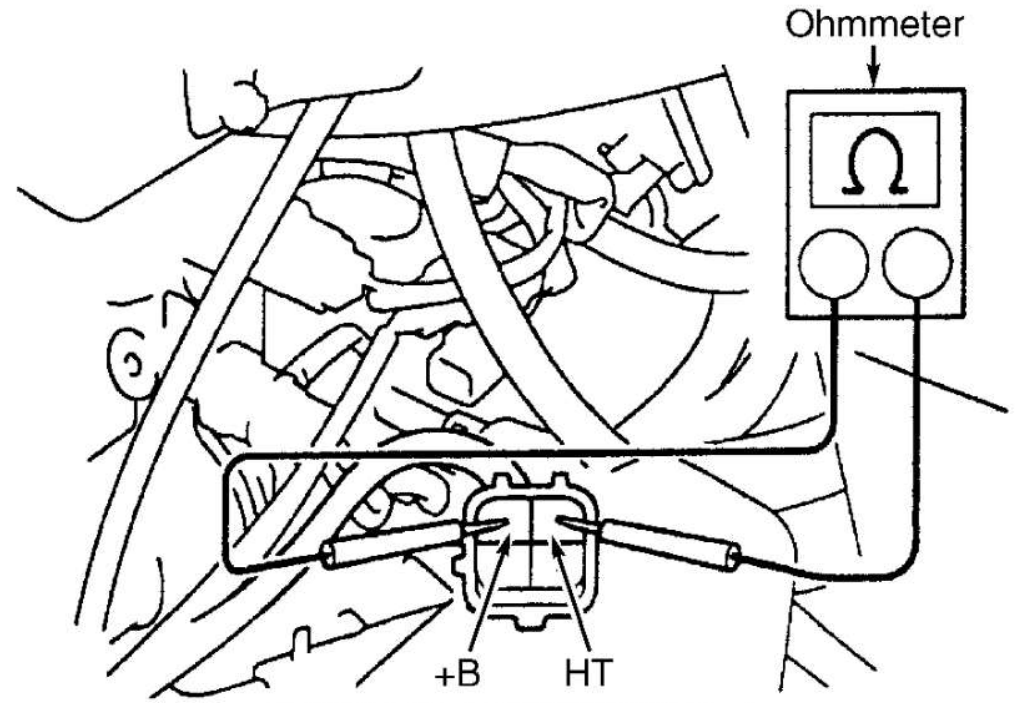
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(2) Voltage should not remain at .56 volt or less, .66 volt, or .76 volt or more.

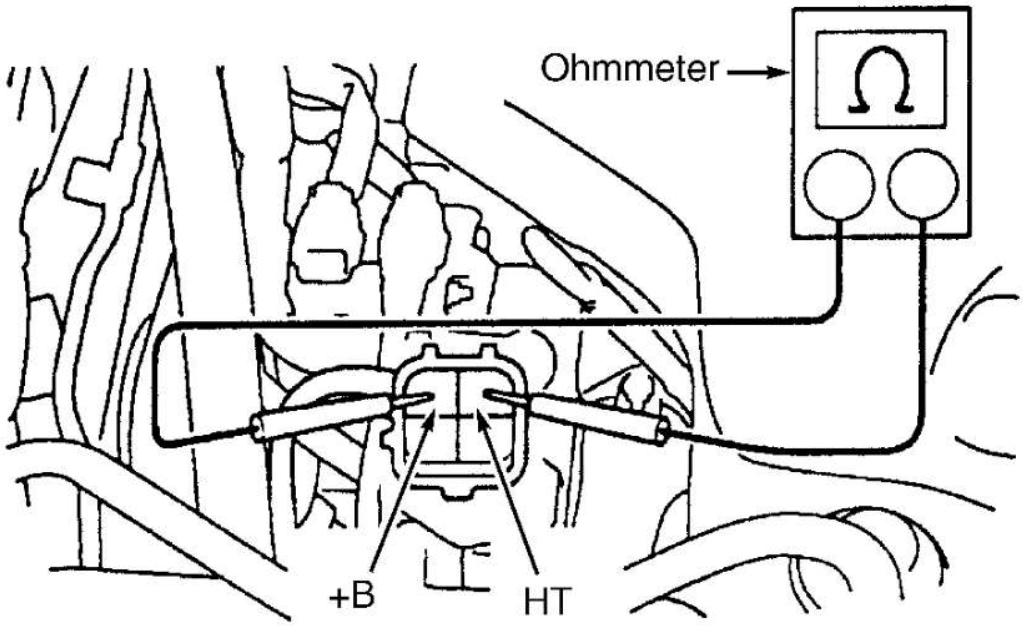
(3) Voltage should not remain at 2.80 volts or less, 3.30 volts, or 3.80 volts or more.

4. Check for open and short in wiring harness and electrical connectors between A/F sensor (bank No. 1 sensor No. 1) and ECM. See **WIRING DIAGRAMS** article. A/F sensor (bank No. 1 sensor No. 1) is located on exhaust manifold above catalytic converters. See **Fig. 20** . ECM is located behind passenger's side kick panel, just below instrument panel. See **Fig. 2** . If wiring harness and electrical connectors are okay, go to next step. If wiring harness or electrical connector is defective, repair as necessary.
5. Disconnect electrical connector for A/F sensor (bank No. 1 sensor No. 1). Using ohmmeter, check resistance for heater on A/F sensor between +B and HT terminals on electrical connector for A/F sensor. See **Fig. 21** . Resistance should be .8-1.4 ohms at 68°F (20°C) and 1.8-3.2 ohms at 1472°F (800°C). If resistance is within specification, go to next step. If resistance is not within specification, replace A/F sensor (bank No. 1 sensor No. 1). See **AIR/FUEL SENSOR** under ENGINE SENSORS & SWITCHES in REMOVAL, OVERHAUL & INSTALLATION - 4-CYLINDER article.

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BANK NO. 1 SENSOR NO. 1



BANK NO. 2 SENSOR NO. 1

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Fig. 21: Testing Heater On A/F Sensor
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6. Ensure engine oil dipstick, oil filler cap, Positive Crankcase Ventilation (PCV) system and all other air induction system components are intact and operating properly. If problem does not exist, go to next step. If problem exists, repair as necessary.
7. Check fuel pressure. See **FUEL PRESSURE** under FUEL SYSTEMS in BASIC DIAGNOSTIC PROCEDURES - 4-CYLINDER article. Fuel pressure should be 44-50 psi (3.1-3.5 kg/cm^2) with engine idling and should remain at least 21 psi (1.5 kg/cm^2) for a minimum of 5 minutes after engine is shut off. If fuel pressure is within specification, go to next step. If fuel pressure is not within specification, repair fuel system as necessary.
8. Check operation of fuel injectors. See **FUEL CONTROL** under FUEL SYSTEMS in SYSTEM & COMPONENT TESTING - 4-CYLINDER article. Fuel injector volume should be 53-65 cc (.18-.22 oz.) within 15 seconds and difference in volume between each fuel injector should be less than 6 cc (.02 oz.). Fuel injectors should not leak more than one drop every 12 minutes. If fuel injectors are okay, replace A/F sensor (bank No. 1 sensor No. 1). See **AIR/FUEL SENSOR** under ENGINE SENSORS & SWITCHES in REMOVAL, OVERHAUL & INSTALLATION - 4-CYLINDER article. If fuel injectors are defective, replace fuel injectors as necessary.
9. Using Toyota hand-held tester or scan tool, clear DTCs from ECM. Perform test drive confirmation and then go to next step. See **TEST DRIVE CONFIRMATION** .
10. Recheck for DTCs. If DTC P1133 does not exist, go to next step. If DTC P1133 exists, replace ECM. ECM is located behind passenger's side kick panel, just below instrument panel. See **Fig. 2** .
11. Verify if vehicle ran out of fuel. If vehicle ran out of fuel, DTC P1133 was caused by the vehicle running out of fuel. If vehicle did not run out of fuel, problem is intermittent. Check for defective connections or intermittent problem in wiring. ECM is located behind passenger's side kick panel, just below instrument panel. See **Fig. 2** .

DTC P1135: AIR/FUEL SENSOR HEATER CIRCUIT (BANK NO. 1 SENSOR NO. 1)

CAUTION: If Engine Control Module (ECM) replacement is instructed in following test, always ensure ECM electrical connectors and ground circuits are okay. If either are defective, repair and repeat testing to confirm ECM malfunction. On models equipped with engine immobilizer, if ECM is replaced, ECM must be programmed with proper ignition key code for engine immobilizer system. For programming procedures, see COMPUTER RELEARN PROCEDURES article in GENERAL INFORMATION, or appropriate ENGINE IMMOBILIZER SYSTEMS article in ACCESSORIES & EQUIPMENT.

Circuit Description

Heated Air/Fuel (A/F) sensor (bank No. 1 sensor No. 1) monitors exhaust gas oxygen content and delivers input signals to ECM. Heated A/F sensor (bank No. 1 sensor No. 1) is located on exhaust manifold above catalytic converters. See **Fig. 20** . A/F sensor may also be referred to as A/F ratio sensor. ECM uses input signals to determine fuel injection system operation. DTC is set when A/F sensor (bank No. 1 sensor No. 1) heater current draw exceeds 8 amps or is .25 amp or less when heater operates. Possible causes are:

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- A/F sensor (bank No. 1 sensor No. 1) circuit is open or shorted.
- Defective A/F sensor (bank No. 1 sensor No. 1).
- Defective A/F heater relay.
- Defective ECM.

Diagnostic Aids

This DTC uses two-trip detection logic. Using Toyota hand-held tester or scan tool, read FREEZE FRAME data. Freeze frame data records engine conditions when malfunction is detected.

Diagnosis & Repair

1. Remove glove box and passenger's side kick panel (if necessary) for access to ECM with electrical connectors still installed on ECM. See **Fig. 2** . Turn ignition on. Using voltmeter, check voltage between body ground and terminal No. 5 (White/Blue wire) at ECM electrical connector E5. See **Fig. 4** . This is the HAF1A terminal on ECM. Voltage should be 9-14 volts. If voltage is not within specification, go to next step. If voltage is within specification, replace ECM.
2. Disconnect electrical connector for A/F sensor (bank No. 1 sensor No. 1). See **Fig. 20** . Using ohmmeter, check resistance for heater on A/F sensor between +B and HT terminals on electrical connector for A/F sensor. See **Fig. 21** . Resistance should be .8-1.4 ohms at 68°F (20°C) and 1.8-3.2 ohms at 1472°F (800° C). If resistance is within specification, go to next step. If resistance is not within specification, replace A/F sensor (bank No. 1 sensor No. 1). See **AIR/FUEL SENSOR** under ENGINE SENSORS & SWITCHES in REMOVAL, OVERHAUL & INSTALLATION - 4-CYLINDER article.
3. Check A/F heater relay. A/F heater relay may also be referred to as A/F HTR relay, A/F sensor relay or A/F relay. See **A/F HEATER RELAY** under MODULES, MOTORS, RELAYS & SOLENOIDS in SYSTEM & COMPONENT TESTING - 4-CYLINDER article. If A/F heater relay is okay, go to next step. If A/F heater relay is defective, replace A/F heater relay.
4. Check wiring harness and electrical connectors between A/F heater relay and A/F sensor (bank No. 1 sensor No. 1), and between A/F sensor (bank No. 1 sensor No. 1) and ECM. See **WIRING DIAGRAMS** article. It may be necessary to check A/F fuse (20-amp) which is located in fuse/relay box at driver's side front corner of engine compartment.

DTC P1153: AIR/FUEL SENSOR CIRCUIT RESPONSE MALFUNCTION (BANK NO. 2 SENSOR NO. 1)

NOTE: This DTC may be caused by the vehicle running out of fuel.

CAUTION: If Engine Control Module (ECM) replacement is instructed in following test, always ensure ECM electrical connectors and ground circuits are okay. If either are defective, repair and repeat testing to confirm ECM malfunction. On models equipped with engine immobilizer, if ECM is replaced, ECM must be programmed with proper ignition key code for engine immobilizer system. For programming procedures, see COMPUTER RELEARN PROCEDURES article in GENERAL INFORMATION, or appropriate ENGINE IMMOBILIZER SYSTEMS article in ACCESSORIES & EQUIPMENT.

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Circuit Description

Heated Air/Fuel (A/F) sensor (bank No. 2 sensor No. 1) monitors exhaust gas oxygen content and delivers input signals to ECM. Heated A/F sensor (bank No. 2 sensor No. 1) is located on exhaust manifold above catalytic converters. See **Fig. 20** . A/F sensor may also be referred to as A/F ratio sensor. ECM uses input signals to determine fuel injection system operation. DTC is set when A/F sensor (bank No. 2 sensor No. 1) output voltage does not change after engine is started with engine at normal operating temperature, engine speed of 1400 RPM or more and with vehicle speed of 38 MPH or more. Possible causes are:

- A/F sensor (bank No. 2 sensor No. 1) circuit is open or shorted.
- Defective A/F sensor (bank No. 2 sensor No. 1).
- Air induction system malfunction.
- Improper fuel pressure.
- Defective fuel injector.
- Vehicle has run out of fuel.
- Defective ECM.

Diagnostic Aids

This DTC uses two-trip detection logic. ECM maintains a fixed voltage of 3.3 volts at AFR+ and AFL+ terminals on ECM, and 3.0 volts at AFR- and AFL- terminal on ECM. It is impossible to confirm A/F sensor output voltage without using Toyota hand-held tester or scan tool. A/F sensor output voltage on scan tool is displayed at one fifth the voltage of that displayed on a Toyota hand-held tester. Using hand-held tester or scan tool, read FREEZE FRAME data. Freeze frame data records engine conditions when malfunction is detected.

Test Drive Confirmation

1. Test drive confirmation may be performed to operate vehicle under conditions which may cause DTC to be set. When performing test drive confirmation, procedures must be performed exactly as listed or the malfunction may not be detected. If Toyota hand-held tester is available, go to next step. If Toyota hand-held tester is not available, go to step 3 .
2. Connect hand-held tester to Data Link Connector (DLC) No. 3 at driver's side of instrument panel. See **Fig. 1** . Switch hand-held tester from NORMAL mode to CHECK mode.
3. Start engine. Allow engine to idle for at least 60 seconds.
4. Drive vehicle at 24 MPH or more for at least 40 seconds and then allow engine to idle for at least 10 seconds. Repeat this procedure 9 times and then check operation of Malfunction Indicator Light (MIL). If MIL illuminates, malfunction exists and DTC is set. If MIL does not illuminate, malfunction does not exist.

Diagnosis & Repair

1. Using Toyota hand-held tester or scan tool, check for any other DTCs. If only DTC P1153 exists, go to next step. If other DTCs exist, diagnose and repair those DTCs first and retest.
2. With Toyota hand-held tester or scan tool still connected to DLC No. 3, start engine and maintain engine speed at 2500 RPM for about 90 seconds to fully warm the A/F sensors. Allow engine to idle.

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3. Using hand-held tester or scan tool, monitor A/F sensor (bank No. 2 sensor No. 1) output voltage with engine idling, engine racing and while driving vehicle at 25 MPH or more with engine speed of 1500 RPM or more while opening and closing the throttle. Ensure A/F sensor output voltage is as specified. See **AIR/FUEL SENSOR OUTPUT VOLTAGE SPECIFICATIONS** table. If A/F sensor output voltage is not within specification, go to next step. If A/F sensor output voltage is within specification, go to step 9 .

NOTE: **If A/F sensor output voltage remains 3.30 volts (Toyota hand-held tester) or .66 volt (OBD-II scan tool) during all conditions, A/F sensor circuit may be open. If A/F sensor output voltage remains 3.80 volts or more (Toyota hand-held tester) or .76 volt or more (OBD-II scan tool) during all conditions, A/F sensor circuit may be shorted. If A/F sensor output voltage remains 2.80 volts or less (Toyota hand-held tester) or .56 volt or less (OBD-II scan tool) during all conditions, A/F sensor circuit may be shorted. During fuel enrichment, A/F sensor output voltage may be less than 2.8 volts (Toyota hand-held tester) or .56 volt (OBD-II scan tool) which is normal. During fuel cut, A/F sensor output voltage may be more than 3.8 volts (Toyota hand-held tester) or .76 volt (OBD-II scan tool) which is normal.**

AIR/FUEL SENSOR OUTPUT VOLTAGE SPECIFICATIONS

Application & Operating Condition	Specification
Using OBD-II Scan Tool	
Engine Idling, Engine Racing & Driving Vehicle (1)	(2)
Using Toyota Hand-Held Tester	
Engine Idling, Engine Racing & Driving Vehicle (1)	(3)

(1) Drive vehicle at 25 MPH or more with engine speed of 1500 RPM or more while opening and closing the throttle.

(2) Voltage should not remain at .56 volt or less, .66 volt, or .76 volt or more.

(3) Voltage should not remain at 2.80 volts or less, 3.30 volts, or 3.80 volts or more.

4. Check for open and short in wiring harness and electrical connectors between A/F sensor (bank No. 2 sensor No. 1) and ECM. See **WIRING DIAGRAMS** article. A/F sensor (bank No. 2 sensor No. 1) is located on exhaust manifold above catalytic converters. See **Fig. 20** . ECM is located behind passenger's side kick panel, just below instrument panel. See **Fig. 2** . If wiring harness and electrical connectors are okay, go to next step. If wiring harness or electrical connector is defective, repair as necessary.
5. Disconnect electrical connector for A/F sensor (bank No. 2 sensor No. 1). Using ohmmeter, check resistance for heater on A/F sensor between +B and HT terminals on electrical connector for A/F sensor. See **Fig. 21** . Resistance should be .8-1.4 ohms at 68°F (20°C) and 1.8-3.2 ohms at 1472°F (800°C). If resistance is within specification, go to next step. If resistance is not within specification, replace A/F sensor (bank No. 2 sensor No. 1). See **AIR/FUEL SENSOR** under ENGINE SENSORS & SWITCHES in REMOVAL, OVERHAUL & INSTALLATION - 4-CYLINDER article.
6. Ensure engine oil dipstick, oil filler cap, Positive Crankcase Ventilation (PCV) system and all other air

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induction system components are intact and operating properly. If problem does not exist, go to next step. If problem exists, repair as necessary.

7. Check fuel pressure. See **FUEL PRESSURE** under FUEL SYSTEMS in BASIC DIAGNOSTIC PROCEDURES - 4-CYLINDER article. Fuel pressure should be 44-50 psi (3.1-3.5 kg/cm^2) with engine idling and should remain at least 21 psi (1.5 kg/cm^2) for a minimum of 5 minutes after engine is shut off. If fuel pressure is within specification, go to next step. If fuel pressure is not within specification, repair fuel system as necessary.
8. Check operation of fuel injectors. See **FUEL CONTROL** under FUEL SYSTEMS in SYSTEM & COMPONENT TESTING - 4-CYLINDER article. Fuel injector volume should be 53-65 cc (.18-.22 oz.) within 15 seconds and difference in volume between each fuel injector should be less than 6 cc (.02 oz). Fuel injectors should not leak more than one drop every 12 minutes. If fuel injectors are okay, replace A/F sensor (bank No. 2 sensor No. 1). See **AIR/FUEL SENSOR** under ENGINE SENSORS & SWITCHES in REMOVAL, OVERHAUL & INSTALLATION - 4-CYLINDER article. If fuel injectors are defective, replace fuel injectors as necessary.
9. Using Toyota hand-held tester or scan tool, clear DTCs from ECM. Perform test drive confirmation and then go to next step. See **TEST DRIVE CONFIRMATION** .
10. Recheck for DTCs. If DTC P1153 does not exist, go to next step. If DTC P1153 exists, replace ECM. ECM is located behind passenger's side kick panel, just below instrument panel. See **Fig. 2** .
11. Verify if vehicle ran out of fuel. If vehicle ran out of fuel, DTC P1153 was caused by the vehicle running out of fuel. If vehicle did not run out of fuel, problem is intermittent. Check for defective connections or intermittent problem in wiring. ECM is located behind passenger's side kick panel, just below instrument panel. See **Fig. 2** .

DTC P1155: AIR/FUEL SENSOR HEATER CIRCUIT (BANK NO. 2 SENSOR NO. 1)

CAUTION: If Engine Control Module (ECM) replacement is instructed in following test, always ensure ECM electrical connectors and ground circuits are okay. If either are defective, repair and repeat testing to confirm ECM malfunction. On models equipped with engine immobilizer, if ECM is replaced, ECM must be programmed with proper ignition key code for engine immobilizer system. For programming procedures, see COMPUTER RELEARN PROCEDURES article in GENERAL INFORMATION, or appropriate ENGINE IMMOBILIZER SYSTEMS article in ACCESSORIES & EQUIPMENT.

Circuit Description

Heated Air/Fuel (A/F) sensor (bank No. 2 sensor No. 1) monitors exhaust gas oxygen content and delivers input signals to ECM. Heated A/F sensor (bank No. 2 sensor No. 1) is located on exhaust manifold above catalytic converters. See **Fig. 20** . A/F sensor may also be referred to as A/F ratio sensor. ECM uses input signals to determine fuel injection system operation. DTC is set when A/F sensor (bank No. 2 sensor No. 1) heater current draw exceeds 8 amps or is .25 amp or less when heater operates. Possible causes are:

- A/F sensor (bank No. 2 sensor No. 1) circuit is open or shorted.
- Defective A/F sensor (bank No. 2 sensor No. 1).
- Defective A/F heater relay.

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- Defective ECM.

Diagnostic Aids

This DTC uses two-trip detection logic. Using Toyota hand-held tester or scan tool, read FREEZE FRAME data. Freeze frame data records engine conditions when malfunction is detected.

Diagnosis & Repair

1. Remove glove box and passenger's side kick panel (if necessary) for access to ECM with electrical connectors still installed on ECM. See **Fig. 2** . Turn ignition on. Using voltmeter, check voltage between body ground and terminal No. 4 (White/Red wire) at ECM electrical connector E5. See **Fig. 4** . This is the HAF2A terminal on ECM. Voltage should be 9-14 volts. If voltage is not within specification, go to next step. If voltage is within specification, replace ECM.
2. Disconnect electrical connector for A/F sensor (bank No. 2 sensor No. 1). See **Fig. 20** . Using ohmmeter, check resistance for heater on A/F sensor between +B and HT terminals on electrical connector for A/F sensor. See **Fig. 21** . Resistance should be .8-1.4 ohms at 68°F (20°C) and 1.8-3.2 ohms at 1472°F (800° C). If resistance is within specification, go to next step. If resistance is not within specification, replace A/F sensor (bank No. 2 sensor No. 1). See **AIR/FUEL SENSOR** under ENGINE SENSORS & SWITCHES in REMOVAL, OVERHAUL & INSTALLATION - 4-CYLINDER article.
3. Check A/F heater relay. A/F heater relay may also be referred to as A/F HTR relay, A/F sensor relay or A/F relay. See **A/F HEATER RELAY** under MODULES, MOTORS, RELAYS & SOLENOIDS in SYSTEM & COMPONENT TESTING - 4-CYLINDER article. If A/F heater relay is okay, go to next step. If A/F heater relay is defective, replace A/F heater relay.
4. Check wiring harness and electrical connectors between A/F heater relay and A/F sensor (bank No. 2 sensor No. 1), and between A/F sensor (bank No. 2 sensor No. 1) and ECM. See **WIRING DIAGRAMS** article. It may be necessary to check A/F fuse (20-amp) which is located in fuse/relay box at driver's side front corner of engine compartment.

DTC P1300: IGNITOR NO. 1 CIRCUIT

CAUTION: If Engine Control Module (ECM) replacement is instructed in following test, always ensure ECM electrical connectors and ground circuits are okay. If either are defective, repair and repeat testing to confirm ECM malfunction. On models equipped with engine immobilizer, if ECM is replaced, ECM must be programmed with proper ignition key code for engine immobilizer system. For programming procedures, see COMPUTER RELEARN PROCEDURES article in GENERAL INFORMATION, or appropriate ENGINE IMMOBILIZER SYSTEMS article in ACCESSORIES & EQUIPMENT.

Circuit Description

Direct Ignition System (DIS) ignites one cylinder with one ignition coil. Ignitor is integral to ignition coil. Direct ignition system may also be referred to as distributorless ignition system. ECM determines ignition timing and outputs an ignition signal (IGT signal) for each cylinder. Based on IGT signals, power transistors in ignitor cut off current to primary coil in ignition coil, causing ignition coil to fire the spark plug. At the same

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time, the ignitor delivers an ignition confirmation signal (IGF signal) to ECM to verify ignition coil has fired. DTC P1300 is for ignitor on ignition coil No. 1 and is set when there is no IGF signal to ECM when engine is running. If DTC P1300 exists, ECM will operate in fail-safe mode. Possible causes are:

- Ignition system malfunction.
- IGF or IGT1 circuit from ignition coil to ECM is open or shorted.
- Defective ignition coil with ignitor.
- Defective ECM.

Diagnostic Aids

Using Toyota hand-held tester or scan tool, read FREEZE FRAME data. Freeze frame data records engine conditions when malfunction is detected.

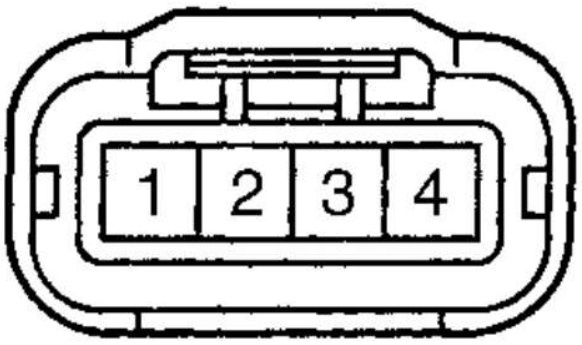
Diagnosis & Repair

1. Check for spark at cylinder No. 1 by performing spark test. See **SPARK TEST** under IGNITION SYSTEMS in BASIC DIAGNOSTIC PROCEDURES - 4-CYLINDER article. Cylinder No. 1 is the front cylinder at timing chain end of engine and uses the ignition coil No. 1. If spark exists, go to next step. If spark does not exist, go to step 4 .
2. Check for open and short in Green/Black and Red wires and electrical connectors between ECM and ignition coil No. 1. See **WIRING DIAGRAMS** article. ECM is located behind passenger's side kick panel, just below instrument panel. See **Fig. 2** . If wiring harness and electrical connectors are okay, go to next step. If wiring harness or electrical connector is defective, repair as necessary.
3. Disconnect electrical connector at ignition coil No. 1. Remove glove box and passenger's side kick panel (if necessary) for access to ECM with electrical connectors still installed on ECM. See **Fig. 2** . Turn ignition on. Using voltmeter, check voltage between body ground and terminal No. 25 (Red wire) at ECM electrical connector E4. See **Fig. 4** . This is the IGF terminal on ECM. Voltage should 4.5-5.5 volts. If voltage is within specification, replace ignition coil No. 1. If voltage is not within specification, replace ECM.
4. Check for open and short in Green/Black wire and electrical connectors between ECM and ignition coil No. 1. See **WIRING DIAGRAMS** article. ECM is located behind passenger's side kick panel, just below instrument panel. See **Fig. 2** . If wiring harness and electrical connectors are okay, go to next step. If wiring harness or electrical connector is defective, repair as necessary.
5. Remove glove box and passenger's side kick panel (if necessary) for access to ECM with electrical connectors still installed on ECM. See **Fig. 2** . Using voltmeter, check voltage between body ground and terminal No. 10 (Green/Black wire) at ECM electrical connector E4 while cranking engine. See **Fig. 4** . This is the IGT1 terminal on ECM. Voltage should be more than .1 volt and less than 4.5 volts. If voltage is not within specification, go to next step. If voltage is within specification, go to step 7 .
6. Disconnect electrical connector at ignition coil No. 1. Using voltmeter, check voltage between body ground and terminal No. 10 (Green/Black wire) at ECM electrical connector E4 while cranking engine. See **Fig. 4** . Voltage should be more than .1 volt and less than 4.5 volts. If voltage is within specification, replace ignition coil No. 1. If voltage is not within specification, replace ECM.
7. Using voltmeter, check voltage between body ground and terminal No. 1 (Black/White wire) at electrical connector for ignition coil No. 1 with ignition switch in ON and START positions. See **Fig. 22** . Voltage

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should be 9-14 volts. If voltage is within specification, go to next step. If voltage is not within specification, check power supply circuit between ignition switch, IG2 relay and ignition coil No. 1. See **WIRING DIAGRAMS** article. IG2 relay provides voltage for power supply circuit to ignition coil No. 1. IG2 relay is located in fuse/relay box at driver's side front corner of engine compartment.

8. Check for open in White/Black wire and electrical connectors between ground and ignition coil No. 1. See **WIRING DIAGRAMS** article. If wiring harness and electrical connectors are okay, replace ignition coil No. 1. If wiring harness or electrical connector is defective, repair as necessary.



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Fig. 22: Identifying Ignition Coil Electrical Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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DTC P1305: IGNITOR NO. 2 CIRCUIT

CAUTION: If Engine Control Module (ECM) replacement is instructed in following test, always ensure ECM electrical connectors and ground circuits are okay. If either are defective, repair and repeat testing to confirm ECM malfunction. On models equipped with engine immobilizer, if ECM is replaced, ECM must be programmed with proper ignition key code for engine immobilizer system. For programming procedures, see COMPUTER RELEARN PROCEDURES article in GENERAL INFORMATION, or appropriate ENGINE IMMOBILIZER SYSTEMS article in ACCESSORIES & EQUIPMENT.

Circuit Description

Direct Ignition System (DIS) ignites one cylinder with one ignition coil. Ignitor is integral to ignition coil. Direct ignition system may also be referred to as distributorless ignition system. ECM determines ignition timing and outputs an ignition signal (IGT signal) for each cylinder. Based on IGT signals, power transistors in

ignitor cut off current to primary coil in ignition coil, causing ignition coil to fire the spark plug. At the same time, the ignitor delivers an ignition confirmation signal (IGF signal) to ECM to verify ignition coil has fired. DTC P1305 is for ignitor on ignition coil No. 2 and is set when there is no IGF signal to ECM when engine is running. If DTC P1305 exists, ECM will operate in fail-safe mode. Possible causes are:

- Ignition system malfunction.
- IGF or IGT2 circuit from ignition coil to ECM is open or shorted.
- Defective ignition coil with ignitor.
- Defective ECM.

Diagnostic Aids

Using Toyota hand-held tester or scan tool, read FREEZE FRAME data. Freeze frame data records engine conditions when malfunction is detected.

Diagnosis & Repair

1. Check for spark at cylinder No. 2 by performing spark test. See **SPARK TEST** under IGNITION SYSTEMS in BASIC DIAGNOSTIC PROCEDURES - 4-CYLINDER article. Cylinder No. 2 is second cylinder from timing chain end of engine and uses the ignition coil No. 2. If spark exists, go to next step. If spark does not exist, go to step 4 .
2. Check for open and short in Blue/Black and Red wires and electrical connectors between ECM and ignition coil No. 2. See **WIRING DIAGRAMS** article. ECM is located behind passenger's side kick panel, just below instrument panel. See **Fig. 2** . If wiring harness and electrical connectors are okay, go to next step. If wiring harness or electrical connector is defective, repair as necessary.
3. Disconnect electrical connector at ignition coil No. 2. Remove glove box and passenger's side kick panel (if necessary) for access to ECM with electrical connectors still installed on ECM. See **Fig. 2** . Turn ignition on. Using voltmeter, check voltage between body ground and terminal No. 25 (Red wire) at ECM electrical connector E4. See **Fig. 4** . This is the IGF terminal on ECM. Voltage should 4.5-5.5 volts. If voltage is within specification, replace ignition coil No. 2. If voltage is not within specification, replace ECM.
4. Check for open and short in Blue/Black wire and electrical connectors between ECM and ignition coil No. 2. See **WIRING DIAGRAMS** article. ECM is located behind passenger's side kick panel, just below instrument panel. See **Fig. 2** . If wiring harness and electrical connectors are okay, go to next step. If wiring harness or electrical connector is defective, repair as necessary.
5. Remove glove box and passenger's side kick panel (if necessary) for access to ECM with electrical connectors still installed on ECM. See **Fig. 2** . Using voltmeter, check voltage between body ground and terminal No. 11 (Blue/Black wire) at ECM electrical connector E4 while cranking engine. See **Fig. 4** . This is the IGT2 terminal on ECM. Voltage should be more than .1 volt and less than 4.5 volts. If voltage is not within specification, go to next step. If voltage is within specification, go to step 7 .
6. Disconnect electrical connector at ignition coil No. 2. Using voltmeter, check voltage between body ground and terminal No. 11 (Blue/Black wire) at ECM electrical connector E4 while cranking engine. See **Fig. 4** . Voltage should be more than .1 volt and less than 4.5 volts. If voltage is within specification, replace ignition coil No. 2. If voltage is not within specification, replace ECM.
7. Using voltmeter, check voltage between body ground and terminal No. 1 (Black/White wire) at electrical

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connector for ignition coil No. 2 with ignition switch in ON and START positions. See **Fig. 22** . Voltage should be 9-14 volts. If voltage is within specification, go to next step. If voltage is not within specification, check power supply circuit between ignition switch, IG2 relay and ignition coil No. 2. See **WIRING DIAGRAMS** article. IG2 relay provides voltage for power supply circuit to ignition coil No. 2. IG2 relay is located in fuse/relay box at driver's side front corner of engine compartment.

8. Check for open in White/Black wire and electrical connectors between ground and ignition coil No. 2. See **WIRING DIAGRAMS** article. If wiring harness and electrical connectors are okay, replace ignition coil No. 2. If wiring harness or electrical connector is defective, repair as necessary.

DTC P1310: IGNITOR NO. 3 CIRCUIT

CAUTION: If Engine Control Module (ECM) replacement is instructed in following test, always ensure ECM electrical connectors and ground circuits are okay. If either are defective, repair and repeat testing to confirm ECM malfunction. On models equipped with engine immobilizer, if ECM is replaced, ECM must be programmed with proper ignition key code for engine immobilizer system. For programming procedures, see COMPUTER RELEARN PROCEDURES article in GENERAL INFORMATION, or appropriate ENGINE IMMOBILIZER SYSTEMS article in ACCESSORIES & EQUIPMENT.

Circuit Description

Direct Ignition System (DIS) ignites one cylinder with one ignition coil. Ignitor is integral to ignition coil. Direct ignition system may also be referred to as distributorless ignition system. ECM determines ignition timing and outputs an ignition signal (IGT signal) for each cylinder. Based on IGT signals, power transistors in ignitor cut off current to primary coil in ignition coil, causing ignition coil to fire the spark plug. At the same time, the ignitor delivers an ignition confirmation signal (IGF signal) to ECM to verify ignition coil has fired. DTC P1310 is for ignitor on ignition coil No. 3 and is set when there is no IGF signal to ECM when engine is running. If DTC P1310 exists, ECM will operate in fail-safe mode. Possible causes are:

- Ignition system malfunction.
- IGF or IGT3 circuit from ignition coil to ECM is open or shorted.
- Defective ignition coil with ignitor.
- Defective ECM.

Diagnostic Aids

Using Toyota hand-held tester or scan tool, read FREEZE FRAME data. Freeze frame data records engine conditions when malfunction is detected.

Diagnosis & Repair

1. Check for spark at cylinder No. 3 by performing spark test. See **SPARK TEST** under IGNITION SYSTEMS in BASIC DIAGNOSTIC PROCEDURES - 4-CYLINDER article. Cylinder No. 3 is third cylinder from timing chain end of engine and uses the ignition coil No. 3. If spark exists, go to next step. If spark does not exist, go to step 4 .

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2. Check for open and short in Green and Red wires and electrical connectors between ECM and ignition coil No. 3. See **WIRING DIAGRAMS** article. ECM is located behind passenger's side kick panel, just below instrument panel. See **Fig. 2** . If wiring harness and electrical connectors are okay, go to next step. If wiring harness or electrical connector is defective, repair as necessary.
3. Disconnect electrical connector at ignition coil No. 3. Remove glove box and passenger's side kick panel (if necessary) for access to ECM with electrical connectors still installed on ECM. See **Fig. 2** . Turn ignition on. Using voltmeter, check voltage between body ground and terminal No. 25 (Red wire) at ECM electrical connector E4. See **Fig. 4** . This is the IGF terminal on ECM. Voltage should 4.5-5.5 volts. If voltage is within specification, replace ignition coil No. 3. If voltage is not within specification, replace ECM.
4. Check for open and short in Green wire and electrical connectors between ECM and ignition coil No. 3. See **WIRING DIAGRAMS** article. ECM is located behind passenger's side kick panel, just below instrument panel. See **Fig. 2** . If wiring harness and electrical connectors are okay, go to next step. If wiring harness or electrical connector is defective, repair as necessary.
5. Remove glove box and passenger's side kick panel (if necessary) for access to ECM with electrical connectors still installed on ECM. See **Fig. 2** . Using voltmeter, check voltage between body ground and terminal No. 12 (Green wire) at ECM electrical connector E4 while cranking engine. See **Fig. 4** . This is the IGT3 terminal on ECM. Voltage should be more than .1 volt and less than 4.5 volts. If voltage is not within specification, go to next step. If voltage is within specification, go to step 7 .
6. Disconnect electrical connector at ignition coil No. 3. Using voltmeter, check voltage between body ground and terminal No. 12 (Green wire) at ECM electrical connector E4 while cranking engine. See **Fig. 4** . Voltage should be more than .1 volt and less than 4.5 volts. If voltage is within specification, replace ignition coil No. 3. If voltage is not within specification, replace ECM.
7. Using voltmeter, check voltage between body ground and terminal No. 1 (Black/White wire) at electrical connector for ignition coil No. 3 with ignition switch in ON and START positions. See **Fig. 22** . Voltage should be 9-14 volts. If voltage is within specification, go to next step. If voltage is not within specification, check power supply circuit between ignition switch, IG2 relay and ignition coil No. 3. See **WIRING DIAGRAMS** article. IG2 relay provides voltage for power supply circuit to ignition coil No. 3. IG2 relay is located in fuse/relay box at driver's side front corner of engine compartment.
8. Check for open in White/Black wire and electrical connectors between ground and ignition coil No. 3. See **WIRING DIAGRAMS** article. If wiring harness and electrical connectors are okay, replace ignition coil No. 3. If wiring harness or electrical connector is defective, repair as necessary.

DTC P1315: IGNITOR NO. 4 CIRCUIT

CAUTION: If Engine Control Module (ECM) replacement is instructed in following test, always ensure ECM electrical connectors and ground circuits are okay. If either are defective, repair and repeat testing to confirm ECM malfunction. On models equipped with engine immobilizer, if ECM is replaced, ECM must be programmed with proper ignition key code for engine immobilizer system. For programming procedures, see COMPUTER RELEARN PROCEDURES article in GENERAL INFORMATION, or appropriate ENGINE IMMOBILIZER SYSTEMS article in ACCESSORIES & EQUIPMENT.

Circuit Description

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Direct Ignition System (DIS) ignites one cylinder with one ignition coil. Ignitor is integral to ignition coil. Direct ignition system may also be referred to as distributorless ignition system. ECM determines ignition timing and outputs an ignition signal (IGT signal) for each cylinder. Based on IGT signals, power transistors in ignitor cut off current to primary coil in ignition coil, causing ignition coil to fire the spark plug. At the same time, the ignitor delivers an ignition confirmation signal (IGF signal) to ECM to verify ignition coil has fired. DTC P1315 is for ignitor on ignition coil No. 4 and is set when there is no IGF signal to ECM when engine is running. If DTC P1315 exists, ECM will operate in fail-safe mode. Possible causes are:

- Ignition system malfunction.
- IGF or IGT4 circuit from ignition coil to ECM is open or shorted.
- Defective ignition coil with ignitor.
- Defective ECM.

Diagnostic Aids

Using Toyota hand-held tester or scan tool, read FREEZE FRAME data. Freeze frame data records engine conditions when malfunction is detected.

Diagnosis & Repair

1. Check for spark at cylinder No. 4 by performing spark test. See **SPARK TEST** under IGNITION SYSTEMS in BASIC DIAGNOSTIC PROCEDURES - 4-CYLINDER article. Cylinder No. 4 is fourth cylinder from timing chain end of engine and uses the ignition coil No. 4. If spark exists, go to next step. If spark does not exist, go to step 4 .
2. Check for open and short in Black and Red wires and electrical connectors between ECM and ignition coil No. 4. See **WIRING DIAGRAMS** article. ECM is located behind passenger's side kick panel, just below instrument panel. See **Fig. 2** . If wiring harness and electrical connectors are okay, go to next step. If wiring harness or electrical connector is defective, repair as necessary.
3. Disconnect electrical connector at ignition coil No. 4. Remove glove box and passenger's side kick panel (if necessary) for access to ECM with electrical connectors still installed on ECM. See **Fig. 2** . Turn ignition on. Using voltmeter, check voltage between body ground and terminal No. 25 (Red wire) at ECM electrical connector E4. See **Fig. 4** . This is the IGF terminal on ECM. Voltage should 4.5-5.5 volts. If voltage is within specification, replace ignition coil No. 4. If voltage is not within specification, replace ECM.
4. Check for open and short in Black wire and electrical connectors between ECM and ignition coil No. 4. See **WIRING DIAGRAMS** article. ECM is located behind passenger's side kick panel, just below instrument panel. See **Fig. 2** . If wiring harness and electrical connectors are okay, go to next step. If wiring harness or electrical connector is defective, repair as necessary.
5. Remove glove box and passenger's side kick panel (if necessary) for access to ECM with electrical connectors still installed on ECM. See **Fig. 2** . Using voltmeter, check voltage between body ground and terminal No. 13 (Black wire) at ECM electrical connector E4 while cranking engine. See **Fig. 4** . This is the IGT4 terminal on ECM. Voltage should be more than .1 volt and less than 4.5 volts. If voltage is not within specification, go to next step. If voltage is within specification, go to step 7 .
6. Disconnect electrical connector at ignition coil No. 4. Using voltmeter, check voltage between body ground and terminal No. 13 (Black wire) at ECM electrical connector E4 while cranking engine. See **Fig.**

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4 . Voltage should be more than .1 volt and less than 4.5 volts. If voltage is within specification, replace ignition coil No. 4. If voltage is not within specification, replace ECM.

7. Using voltmeter, check voltage between body ground and terminal No. 1 (Black/White wire) at electrical connector for ignition coil No. 4 with ignition switch in ON and START positions. See **Fig. 22** . Voltage should be 9-14 volts. If voltage is within specification, go to next step. If voltage is not within specification, check power supply circuit between ignition switch, IG2 relay and ignition coil No. 4. See **WIRING DIAGRAMS** article. IG2 relay provides voltage for power supply circuit to ignition coil No. 4. IG2 relay is located in fuse/relay box at driver's side front corner of engine compartment.
8. Check for open in White/Black wire and electrical connectors between ground and ignition coil No. 4. See **WIRING DIAGRAMS** article. If wiring harness and electrical connectors are okay, replace ignition coil No. 4. If wiring harness or electrical connector is defective, repair as necessary.

DTC P1335: CRANKSHAFT POSITION SENSOR CIRCUIT

For diagnosis and repair procedures, see **DTC P0335 OR P1335: CRANKSHAFT POSITION SENSOR CIRCUIT.**

DTC P1346: VARIABLE VALVE TIMING SENSOR CIRCUIT RANGE/PERFORMANCE

CAUTION: If Engine Control Module (ECM) replacement is instructed in following test, always ensure ECM electrical connectors and ground circuits are okay. If either are defective, repair and repeat testing to confirm ECM malfunction. On models equipped with engine immobilizer, if ECM is replaced, ECM must be programmed with proper ignition key code for engine immobilizer system. For programming procedures, see COMPUTER RELEARN PROCEDURES article in GENERAL INFORMATION, or appropriate ENGINE IMMOBILIZER SYSTEMS article in ACCESSORIES & EQUIPMENT.

Circuit Description

The Variable Valve Timing (VVT) sensor is a pick-up coil located on end of cylinder head at flywheel end of engine and uses a signal plate on outer circumference of intake camshaft. VVT sensor may also be referred to as camshaft position sensor. The ECM uses input signal from VVT sensor to determine the standard crankshaft angle for controlling the intake valve timing. DTC is set when ECM detects a deviation in crankshaft position sensor and VVT sensor signals. Possible causes are:

- Mechanical system malfunction such as the timing chain stretched or jumped teeth.
- Defective ECM.

Diagnostic Aids

This DTC uses two-trip detection logic. Using Toyota hand-held tester or scan tool, read FREEZE FRAME data. Freeze frame data records engine conditions when malfunction is detected.

Diagnosis & Repair

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Check valve timing while checking for loose, stretched or jumped teeth on timing chain. See appropriate article in ENGINES. If no problem exist, replace ECM. ECM is located behind passenger's side kick panel, just below instrument panel. See **Fig. 2** . If problem exists, repair or replace components as necessary.

DTC P1349: VARIABLE VALVE TIMING SYSTEM MALFUNCTION

CAUTION: If Engine Control Module (ECM) replacement is instructed in following test, always ensure ECM electrical connectors and ground circuits are okay. If either are defective, repair and repeat testing to confirm ECM malfunction. On models equipped with engine immobilizer, if ECM is replaced, ECM must be programmed with proper ignition key code for engine immobilizer system. For programming procedures, see COMPUTER RELEARN PROCEDURES article in GENERAL INFORMATION, or appropriate ENGINE IMMOBILIZER SYSTEMS article in ACCESSORIES & EQUIPMENT.

Circuit Description

The Variable Valve Timing (VVT) system controls intake valve timing in response to driving conditions. ECM controls Variable Valve Timing (VVT) Oil Control Valve (OCV) to ensure correct intake valve timing. Engine oil pressure which is controlled by VVT OCV is supplied to VVT controller on front of intake camshaft. VVT controller changes relative position between camshaft and crankshaft. VVT OCV may also be referred to as VVT camshaft timing oil control valve. DTC is set if ECM detects valve timing remains fixed and does not change when engine is at normal operating temperature and engine speed is 400-4000 RPM. Possible causes are:

- Incorrect valve timing.
- Defective VVT OCV.
- Defective VVT controller.
- Defective ECM.

Diagnostic Aids

Using Toyota hand-held tester or scan tool, read FREEZE FRAME data. Freeze frame data records engine conditions when malfunction is detected.

Diagnosis & Repair

1. Check valve timing. See appropriate article in ENGINES. If no problem exist, go to next step. If problem exists, repair or replace components as necessary.
2. If Toyota hand-held tester is available, go to next step. If Toyota hand-held tester is not available, go to step 11 .
3. Connect hand-held tester to Data Link Connector (DLC) No. 3 at driver's side of instrument panel. See **Fig. 1** . Start engine and warm engine to normal operating temperature. Allow engine to idle.
4. Select ACTIVE TEST mode and then VVT on hand-held tester to operate the VVT OCV. Note engine idle when VVT OCV is operated by hand-held tester. Engine idle should be normal with VVT OCV off

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and should become rough or engine may stall when VVT OCV is on. If engine idle does not function as specified, shut engine off. Go to next step. If engine idle is as specified, VVT OCV is functioning properly at this time. DTC may have been set because of a foreign object that was temporarily caught in engine oil system but after a short time system returned to normal.

5. Remove glove box and passenger's side kick panel (if necessary) for access to ECM with electrical connectors still installed on ECM. See **Fig. 2** . Connect oscilloscope between terminals No. 19 (White/Red wire) and No. 29 (White wire) at ECM electrical connector E4. See **Fig. 4** . This is the OCV+ and OCV- terminals on ECM.
6. Start engine and allow engine to idle. Ensure VVT OCV signal waveform pattern is as shown in illustration. See **Fig. 23** . As engine speed is increased, waveform pattern frequency "A" should lengthen. If signal waveform pattern is as shown, shut engine off. Go to next step. If signal waveform pattern is not as shown, shut engine off. Replace ECM.
7. Check VVT controller assembly for proper operation. See appropriate article in ENGINES. If VVT controller assembly operates properly, go to next step. If VVT controller assembly does not operate properly, replace VVT controller assembly and go to next step.
8. Check VVT OCV resistance and operation. See **VARIABLE VALVE TIMING CAMSHAFT TIMING OIL CONTROL VALVE** under VARIABLE VALVE TIMING SYSTEM in SYSTEM & COMPONENT TESTING - 4-CYLINDER article. If VVT OCV is okay, go to next step. If VVT OCV is defective, replace VVT OCV and go to next step.
9. Check for restrictions in VVT OCV and oil passage. If no problem exist, go to next step. If problem exists, repair or replace components as necessary.
10. Using hand-held tester, clear DTCs from ECM. Start engine and allow engine to idle. Shut engine off. Turn ignition on. Using hand-held tester, check for DTCs. If DTC P1349 exists, replace ECM. If DTC P1349 does not exist, no problem is indicated at this time. DTC may have been set because of a foreign object that was temporarily caught in engine oil system but after a short time system returned to normal.
11. Start engine and warm engine to normal operating temperature. Allow engine to idle. Note engine idle while disconnecting electrical connector at VVT OCV. VVT OCV is located at intake manifold side of cylinder head, near timing chain end of engine. See **Fig. 24** . Engine idle should not change. Using jumper wires, apply battery voltage and ground to electrical terminals on VVT OCV. Engine should idle rough or stall. If VVT OCV operates as specified, shut engine off. Go to next step. If VVT OCV does not operate as specified, shut engine off. Go to step 14 .
12. Reinstall electrical connector on VVT OCV. Remove glove box and passenger's side kick panel (if necessary) for access to ECM with electrical connectors still installed on ECM. See **Fig. 2** . Connect oscilloscope between terminals No. 19 (White/Red wire) and No. 29 (White wire) at ECM electrical connector E4. See **Fig. 4** . This is the OCV+ and OCV- terminals on ECM.
13. Start engine and allow engine to idle. Ensure VVT OCV signal waveform pattern is as shown in illustration. See **Fig. 23** . As engine speed is increased, waveform pattern frequency "A" should lengthen. If signal waveform pattern is not as shown, shut engine off. Replace ECM. If signal waveform pattern is as shown, shut engine off. VVT OCV is functioning properly at this time. DTC may have been set because of a foreign object that was temporarily caught in engine oil system but after a short time system returned to normal.
14. Check VVT controller assembly for proper operation. See appropriate article in ENGINES. If VVT controller assembly operates properly, go to next step. If VVT controller assembly does not operate properly, replace VVT controller assembly and go to next step.
15. Check VVT OCV resistance and operation. See **VARIABLE VALVE TIMING CAMSHAFT**

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TIMING OIL CONTROL VALVE under VARIABLE VALVE TIMING SYSTEM in SYSTEM & COMPONENT TESTING - 4-CYLINDER article. If VVT OCV is okay, go to next step. If VVT OCV is defective, replace VVT OCV. and go to next step.

16. Check for blockage in VVT OCV and oil passage. If no problem exist, go to next step. If problem exists, repair or replace components as necessary.
17. Using scan tool, clear DTCs from ECM. Start engine and allow engine to idle. Shut engine off. Turn ignition on. Using scan tool, check for DTCs. If DTC P1349 exists, replace ECM. If DTC P1349 does not exist, no problem is indicated at this time. DTC may have been set because of a foreign object that was temporarily caught in engine oil system but after a short time system returned to normal.

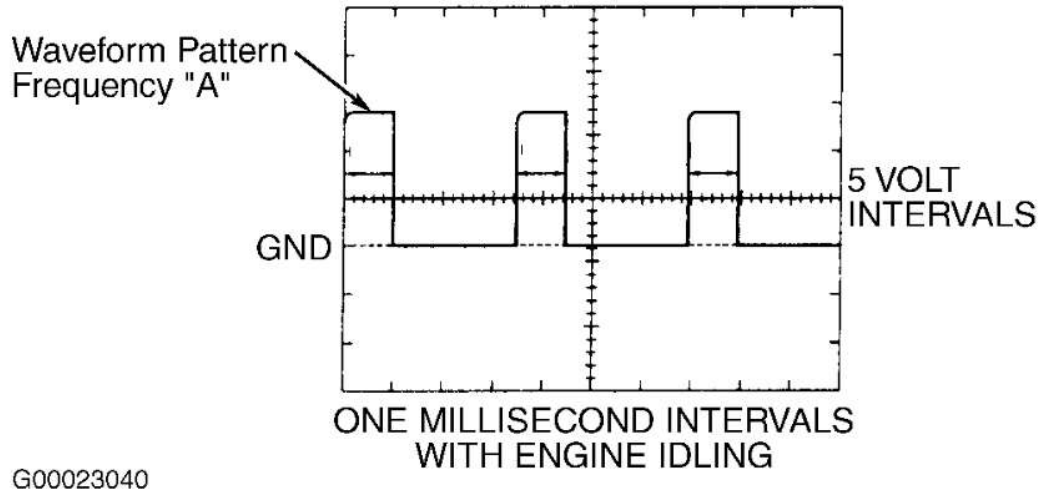


Fig. 23: Identifying Variable Valve Timing Oil Control Valve Signal Waveform Pattern
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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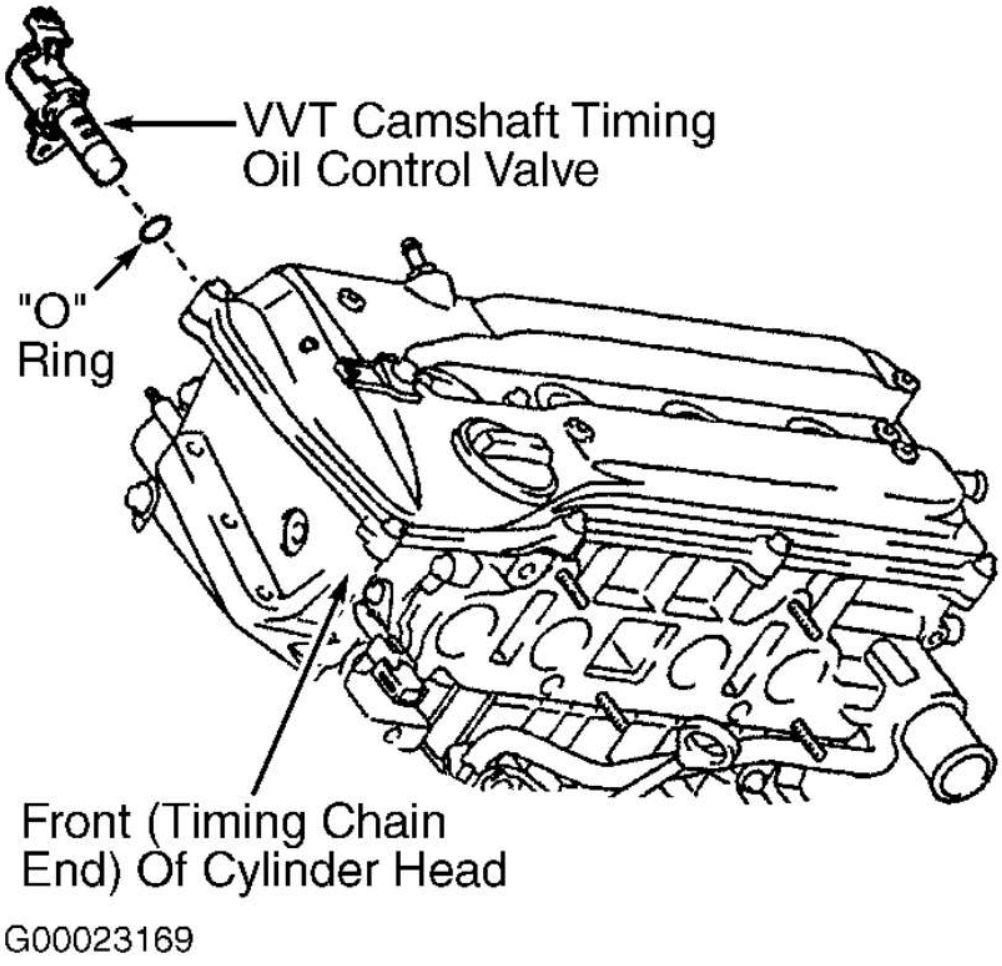


Fig. 24: Locating Variable Valve Timing Oil Control Valve
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

DTC P1520: STOPLIGHT SWITCH SIGNAL CIRCUIT

CAUTION: If Engine Control Module (ECM) replacement is instructed in following test, always ensure ECM electrical connectors and ground circuits are okay. If either are defective, repair and repeat testing to confirm ECM malfunction. On models equipped with engine immobilizer, if ECM is replaced, ECM must be programmed with proper ignition key code for engine immobilizer system. For programming procedures, see COMPUTER RELEARN PROCEDURES article in GENERAL INFORMATION, or appropriate ENGINE IMMOBILIZER SYSTEMS article in ACCESSORIES & EQUIPMENT.

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Circuit Description

Stoplight switch may also be referred to as brake switch. Stoplight switch signal is used to detect when brakes have been applied. ECM uses this signal to control fuel cut-off engine speed. DTC is set if stoplight switch does not turn off when vehicle is being driven. Possible causes are:

- Stoplight switch signal circuit is shorted.
- Defective stoplight switch.
- Defective ECM.

Diagnostic Aids

This DTC uses two-trip detection logic. Using Toyota hand-held tester or scan tool, read FREEZE FRAME data. Freeze frame data records engine conditions when malfunction is detected.

Diagnosis & Repair

1. If Toyota hand-held tester is available, go to next step. If Toyota hand-held tester is not available, go to step 6 .
2. Check stoplight operation. If stoplights operate properly, go to next step. If stoplights do not operate properly, repair as necessary and retest system. See EXTERIOR LIGHTS article in ACCESSORIES & EQUIPMENT.
3. Connect hand-held tester to Data Link Connector (DLC) No. 3 at driver's side of instrument panel. See **Fig. 1** . Turn ignition on and then turn hand-held tester on.
4. Monitor STP signal on hand-held tester while depressing and releasing brake pedal. STP signal should indicate ON with brake pedal depressed and OFF with brake pedal released. If STP signal is not as specified, go to next step. If STP signal is as specified, problem is intermittent. Check for defective connections or intermittent problem in wiring between stoplight switch and ECM. See **WIRING DIAGRAMS** article. Stoplight switch is located near top of brake pedal. ECM is located behind passenger's side kick panel, just below instrument panel. See **Fig. 2** .
5. Check wiring harness and electrical connectors between stoplight switch and ECM. See **WIRING DIAGRAMS** article. Stoplight switch is located near top of brake pedal. ECM is located behind passenger's side kick panel, just below instrument panel. See **Fig. 2** . If wiring harness and electrical connectors are okay, replace ECM. If wiring harness or electrical connectors are defective, repair as necessary.
6. Check stoplight operation. If stoplights operate properly, go to next step. If stoplights do not operate properly, repair as necessary and retest system. See EXTERIOR LIGHTS article in ACCESSORIES & EQUIPMENT.
7. Remove glove box and passenger's side kick panel (if necessary) for access to ECM with electrical connectors still installed on ECM. See **Fig. 2** .
8. Turn ignition on. Using voltmeter, check voltage between body ground and terminal No. 15 (Green/White or White wire) at ECM electrical connector E8 while depressing and releasing brake pedal. See **Fig. 4** . This is the STP terminal on ECM. There are 2 different wiring harnesses used and wire color varies according to wiring harness used.
9. With brake pedal depressed, voltage should be 7.5-14.0 volts. With brake pedal released, voltage should

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be less than 1.5 volts. If voltage is not within specification, go to next step. If voltage is within specification, problem is intermittent. Check for defective connections or intermittent problem in wiring harness and electrical connectors between stoplight switch and ECM and for intermittent problem with stoplight switch. See **WIRING DIAGRAMS** article. Stoplight switch is located near top of brake pedal.

10. Check wiring harness and electrical connectors between stoplight switch and ECM. See **WIRING DIAGRAMS** article. Stoplight switch is located near top of brake pedal. If wiring harness and electrical connectors are okay, replace ECM. If wiring harness or electrical connectors are defective, repair as necessary.

DTC P1600: ENGINE CONTROL MODULE BATT CIRCUIT

CAUTION: If Engine Control Module (ECM) replacement is instructed in following test, always ensure ECM electrical connectors and ground circuits are okay. If either are defective, repair and repeat testing to confirm ECM malfunction. On models equipped with engine immobilizer, if ECM is replaced, ECM must be programmed with proper ignition key code for engine immobilizer system. For programming procedures, see COMPUTER RELEARN PROCEDURES article in GENERAL INFORMATION, or appropriate ENGINE IMMOBILIZER SYSTEMS article in ACCESSORIES & EQUIPMENT.

Circuit Description

Constant battery voltage is supplied to BATT terminal at ECM as the back-up power source. DTC is set when open in back-up power source is detected. Possible causes are:

- Back-up power source circuit is open.
- Defective ECM.

Diagnostic Aids

If DTC P1600 exists, the ECM will not store any other DTCs. Using Toyota hand-held tester or scan tool, read FREEZE FRAME data. Freeze frame data records engine conditions when malfunction is detected.

Diagnosis & Repair

1. Remove glove box and passenger's side kick panel (if necessary) for access to ECM with electrical connectors still installed on ECM. See **Fig. 2** .
2. Using voltmeter, check voltage between body ground and terminal No. 1 (Red/White or Light Blue wire) at ECM electrical connector E8. See **Fig. 4** . Light Blue wire may also be referred to as Sky Blue wire. This is the BATT terminal on ECM. Sky Blue wire may also be referred to as Light Blue wire. There are 2 different wiring harnesses used and wire color varies according to wiring harness used. Voltage should be 9-14 volts. If voltage is not within specification, go to next step. If voltage is within specification, replace ECM.
3. Remove EFI1 fuse (20-amp) and EFI2 fuse (5-amp) from fuse/relay box at driver's side front corner of engine compartment. Check both fuses. If fuses are okay, reinstall fuses. Check wiring harness and electrical connectors between EFI1 fuse and ECM. See **WIRING DIAGRAMS** article. It may be

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necessary to check wiring between battery and EFI1 fuse. For additional wiring for EFI1 fuse to the battery, see POWER DISTRIBUTION article in WIRING DIAGRAMS. If fuses are defective, replace fuse and check for short in wiring harness and components connected to EFI1 and EFI2 fuses. See **WIRING DIAGRAMS** article. Repair wiring as necessary.

DTC P1656: OIL CONTROL VALVE CIRCUIT MALFUNCTION

CAUTION: If Engine Control Module (ECM) replacement is instructed in following test, always ensure ECM electrical connectors and ground circuits are okay. If either are defective, repair and repeat testing to confirm ECM malfunction. On models equipped with engine immobilizer, if ECM is replaced, ECM must be programmed with proper ignition key code for engine immobilizer system. For programming procedures, see COMPUTER RELEARN PROCEDURES article in GENERAL INFORMATION, or appropriate ENGINE IMMOBILIZER SYSTEMS article in ACCESSORIES & EQUIPMENT.

Circuit Description

The Variable Valve Timing (VVT) system controls intake valve timing in response to driving conditions. ECM controls Variable Valve Timing (VVT) Oil Control Valve (OCV) to ensure correct intake valve timing. Engine oil pressure which is controlled by VVT OCV is supplied to VVT controller on front of intake camshaft. VVT controller changes relative position between camshaft and crankshaft. VVT OCV may also be referred to as VVT camshaft timing oil control valve. DTC is set if ECM detects an open or short in VVT OCV circuit. Possible causes are:

- VVT OCV circuit is open or shorted.
- Defective VVT OCV.
- Defective ECM.

Diagnostic Aids

Using Toyota hand-held tester or scan tool, read FREEZE FRAME data. Freeze frame data records engine conditions when malfunction is detected.

Diagnosis & Repair

1. If Toyota hand-held tester is available, go to next step. If Toyota hand-held tester is not available, go to step 4 .
2. Connect hand-held tester to Data Link Connector (DLC) No. 3 at driver's side of instrument panel. See **Fig. 1** . Start engine and warm engine to normal operating temperature. Allow engine to idle.
3. Select ACTIVE TEST mode and then VVT on hand-held tester to operate the VVT OCV. Note engine idle when VVT OCV is operated by hand-held tester. Engine idle should be normal with VVT OCV off and should become rough or engine may stall when VVT OCV is on. If engine idle does not function as specified, shut engine off. Go to next step. If engine idle is as specified, VVT OCV is functioning properly at this time. DTC may have been set due to intermittent problem in wiring harness or electrical connectors between ECM and VVT OCV. VVT OCV is located at intake manifold side of cylinder head,

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near timing chain end of engine. See **Fig. 24** . ECM is located behind glove box. See **Fig. 2** .

4. Disconnect electrical connector at VVT OCV. VVT OCV is located at intake manifold side of cylinder head, near timing chain end of engine. See **Fig. 24** . Start engine and allow engine to idle. With engine idling, using jumper wires, apply battery voltage and ground to electrical terminals on VVT OCV. Engine should idle rough or stall. If VVT OCV operates as specified, shut engine off. Go to next step. If VVT OCV does not operate as specified, shut engine off. Replace VVT OCV. See **VARIABLE VALVE TIMING CAMSHAFT TIMING OIL CONTROL VALVE** under VARIABLE VALVE TIMING SYSTEM in REMOVAL, OVERHAUL & INSTALLATION - 4-CYLINDER article.
5. Reinstall electrical connector on VVT OCV. Remove glove box and passenger's side kick panel (if necessary) for access to ECM with electrical connectors still installed on ECM. See **Fig. 2** . Connect oscilloscope between terminals No. 19 (White/Red wire) and No. 29 (White wire) at ECM electrical connector E4. See **Fig. 4** . This is the OCV+ and OCV- terminals on ECM.
6. Start engine and allow engine to idle. Ensure VVT OCV signal waveform pattern is as shown in illustration. See **Fig. 23** . As engine speed is increased, waveform pattern frequency "A" should lengthen. If signal waveform pattern is as shown, shut engine off. Go to next step. If signal waveform pattern is not as shown, shut engine off. Replace ECM.
7. Check for open and short in wiring harness and electrical connectors between VVT OCV and ECM. See **WIRING DIAGRAMS** article. If wiring harness and electrical connectors are okay, problem is intermittent. Check for defective connections or intermittent problem in wiring between VVT OCV and ECM. If wiring harness or electrical connector is defective, repair as necessary.

DTC P1780: PARK/NEUTRAL POSITION SWITCH CIRCUIT

CAUTION: If Engine Control Module (ECM) replacement is instructed in following test, always ensure ECM electrical connectors and ground circuits are okay. If either are defective, repair and repeat testing to confirm ECM malfunction. On models equipped with engine immobilizer, if ECM is replaced, ECM must be programmed with proper ignition key code for engine immobilizer system. For programming procedures, see COMPUTER RELEARN PROCEDURES article in GENERAL INFORMATION, or appropriate ENGINE IMMOBILIZER SYSTEMS article in ACCESSORIES & EQUIPMENT.

Circuit Description

Test applies only to A/T models. Park/Neutral Position (PNP) switch delivers input signals to ECM. Input signals are used for air/fuel correction and for idle speed control. DTC is set when 2 or more switches are on simultaneously for "R", "N", "2" and "L" position or when ECM is receiving an ON signal from PNP switch when vehicle is being operated for more than 30 seconds at 44 MPH or more with engine speed of 1500-2500 RPM. Possible causes are:

- PNP switch circuit is shorted.
- Defective PNP switch.
- Defective ECM.

Diagnostic Aids

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This DTC uses two-trip detection logic. After confirming DTC P1780, use Toyota hand-held tester to access CURRENT DATA to confirm PNP switch signal. Using hand-held tester or scan tool, read FREEZE FRAME data. Freeze frame data records engine conditions when malfunction is detected.

Diagnosis & Repair

1. If Toyota hand-held tester is available, go to next step. If Toyota hand-held tester is not available, go to step 6 .
2. Connect hand-held tester to Data Link Connector (DLC) No. 3 at driver's side of instrument panel. See **Fig. 1** . Turn ignition on and then turn hand-held tester on. Using hand-held tester, monitor NSW, REVERSE, 2ND and LOW signals while moving shift lever into Park, Reverse, Neutral, "2" and Low. Ensure signals are properly displayed in relation to shift lever position. See **INPUT SIGNAL DISPLAYS** table. If signals are not properly displayed, go to next step. If signals are properly displayed, replace ECM. ECM is located behind passenger's side kick panel, just below instrument panel. See **Fig. 2** .

INPUT SIGNAL DISPLAYS

Shift Lever Position	Signal Display
Park & Netural	NSW OFF-ON
Reverse	REVERSE OFF-ON
Low	LOW OFF-ON
2	2ND OFF-ON

3. Disconnect electrical connector from PNP switch. PNP switch is located on side of transaxle. Note PNP switch terminal identification. See **Fig. 25** . Using ohmmeter, check for continuity between specified terminals with shift lever in proper positions. See **PARK/NEUTRAL POSITION SWITCH SPECIFICATIONS** table.
4. If proper continuity exists, go to next step. If proper continuity does not exist, adjust or replace switch as necessary. For adjustment or replacement procedures for PNP switch, see **PARK/NEUTRAL POSITION SWITCH** under ENGINE SENSORS & SWITCHES in REMOVAL, OVERHAUL & INSTALLATION - 4-CYLINDER article.

PARK/NEUTRAL POSITION SWITCH SPECIFICATIONS

Shift Lever Position	Continuity Between Terminals No.
Park	1 & 3; 6 & 9
Reverse	2 & 3
Neutral	3 & 5; 6 & 9
Drive	3 & 7
2	3 & 4
Low	3 & 8

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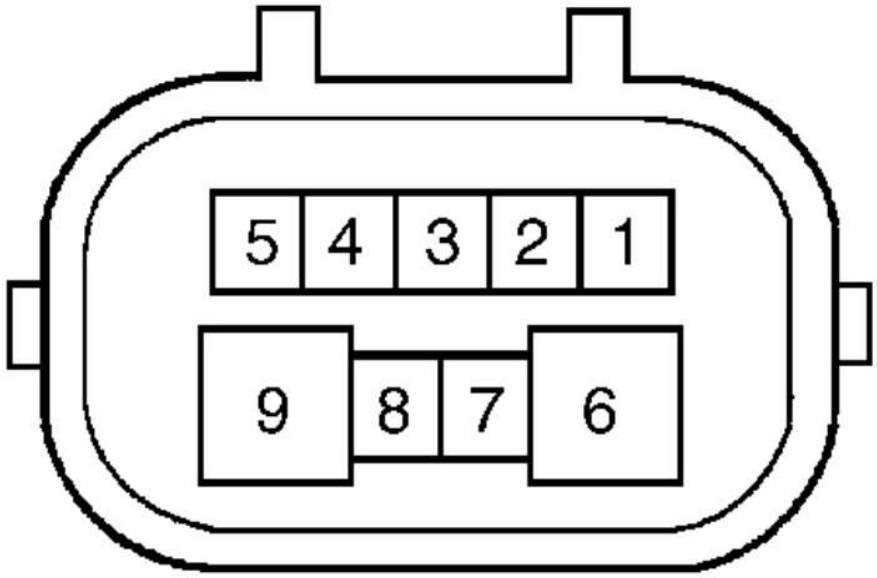


Fig. 25: Identifying Park/Neutral Position Switch Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

5. Check wiring harness and electrical connectors between PNP switch and ECM, and between battery and PNP switch. See **WIRING DIAGRAMS** article. It may be necessary to consult wiring diagram in appropriate STARTERS article in STARTING & CHARGING SYSTEMS for additional PNP switch wiring. ECM is located behind passenger's side kick panel, just below instrument panel. See **Fig. 2** . If wiring harness and electrical connectors are okay, replace ECM. If wiring harness or electrical connectors are defective, repair as necessary.
6. Remove glove box and passenger's side kick panel (if necessary) for access to ECM with electrical connectors still installed on ECM. See **Fig. 2** . Turn ignition on. Using voltmeter, check voltage between body ground and specified terminal at ECM electrical connector E7 in relation to shift lever position. See **PARK/NEUTRAL POSITION SWITCH VOLTAGE** table. See **Fig. 4** . If voltage is not within specification, go to next step. If voltage is within specification, replace ECM.

PARK/NEUTRAL POSITION SWITCH VOLTAGE

Shift Lever Position	(1) Terminal No.	Volts
Reverse	1	0
	2	(2) 10-14

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3		0
12		0
Drive	1	10-14
2		0
3		0
12		0
2	1	0
2		0
3		10-14
12		0
Low	1	0
2		0
3		0
12		10-14

(1) Measure voltage between ground and terminal listed at ECM electrical connector E7. See **Fig. 4** .

(2) Voltage may be slightly less due to illumination of back-up lights.

7. Disconnect electrical connector from PNP switch. PNP switch is located on side of transaxle. Note PNP switch terminal identification. See **Fig. 25** . Using ohmmeter, check for continuity between specified terminals with shift lever in proper positions. See **PARK/NEUTRAL POSITION SWITCH SPECIFICATIONS** table.
8. If proper continuity exists, go to next step. If proper continuity does not exist, adjust or replace PNP switch as necessary. For adjustment or replacement procedures for PNP switch, see **PARK/NEUTRAL POSITION SWITCH** under ENGINE SENSORS & SWITCHES in REMOVAL, OVERHAUL & INSTALLATION - 4-CYLINDER article.
9. Check wiring harness and electrical connectors between PNP switch and ECM, and between battery and PNP switch. See **WIRING DIAGRAMS** article. It may be necessary to consult wiring diagram in appropriate STARTERS article in STARTING & CHARGING SYSTEMS for additional PNP switch wiring. Repair wiring harness or electrical connectors as necessary.

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