2009 ENGINE PERFORMANCE

Engine Control System (1AR-FE) - Highlander

SFI SYSTEM

PRECAUTION

1. INITIALIZATION

NOTE:

- **Perform Reset Memory (AT initialization) when replacing the automatic transaxle assembly, engine assembly or ECM (See PROBLEM SYMPTOMS TABLE).**
- **Perform Registration (VIN registration) when replacing the ECM (See REGISTRATION).**

HINT:

Initialization cannot be completed by only disconnecting and reconnecting the cable of the negative (-) battery terminal.

2. WHEN USING TECHSTREAM

CAUTION: ***Observe the following items for safety reasons:***

- **Read the Techstream instruction manual before using the Techstream.**
- **Prevent the Techstream cable from being caught on the pedals, shift lever and steering wheel when driving with the Techstream connected to the vehicle.**
- **When driving the vehicle for testing purposes while using the Techstream, two persons are required. One person drives the vehicle, and the other operates the Techstream.**

3. DISCONNECT AND RECONNECT CABLE OF NEGATIVE BATTERY TERMINAL

a. Before performing work on electronic components, disconnect the cable from the negative (-) battery terminal in order to prevent damage to the electrical system or components.

b. Before disconnecting and reconnecting the battery cable, turn the ignition switch off and the headlight dimmer switch off. Then loosen the terminal nut completely. Do not damage the cable or terminal.

c. When the battery cable is disconnected, the clock and radio settings and stored DTCs are cleared. Therefore, before disconnecting the cable from the negative (-) battery terminal, make a note of the settings.

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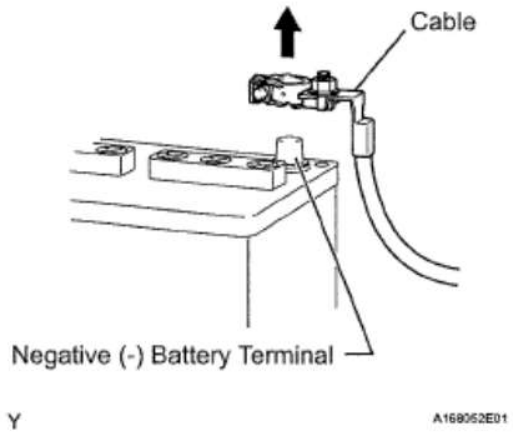


Fig. 1: Disconnecting Battery Cable
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NOTE:

- **When disconnecting the negative (-) battery cable, initialize the following systems after the cable is reconnected.**

SYSTEM NAME CHART

System name	See procedure
Power Back Door System	INITIALIZATION

DEFINITION OF TERMS

DEFINITION OF TERMS

Term	Definition
Monitor Description	Description of what ECM monitors and how it detects malfunctions (monitoring purpose and details).
Related DTCs	Group of diagnostic trouble codes that are output by ECM based on same malfunction detection logic.
Typical Enabling Condition	Preconditions that allow ECM to detect malfunctions. With all preconditions satisfied, ECM stores DTC when monitored value(s) exceeds malfunction threshold(s).
Sequence of Operation	Order of monitor priority, applied if multiple sensors and components are involved in single malfunction detection process. Each sensor and component are monitored in turn, when previous detection operation is completed.
Required Sensor/Components	Sensors and components used by ECM to detect each malfunction.
Frequency of Operation	Number of times ECM checks for each malfunction during each driving cycle. "Once per driving cycle" means ECM only performs checks for that malfunction once during single driving cycle. "Continuous" means ECM performs checks for that malfunction whenever enabling conditions are met.

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Duration	Minimum time for which ECM must detect continuous deviation in monitored value(s) in order to store DTC. Timing begins when Typical Enabling Conditions are met.
Malfunction Thresholds	Value beyond which ECM determines malfunctions exist and stores DTCs.
MIL Operation	Timing of MIL illumination after malfunction is detected. "Immediate" means ECM illuminates MIL as soon as malfunction is detected. "2 driving cycles" means ECM illuminates MIL if same malfunction is detected second time during next sequential driving cycle.

PARTS LOCATION

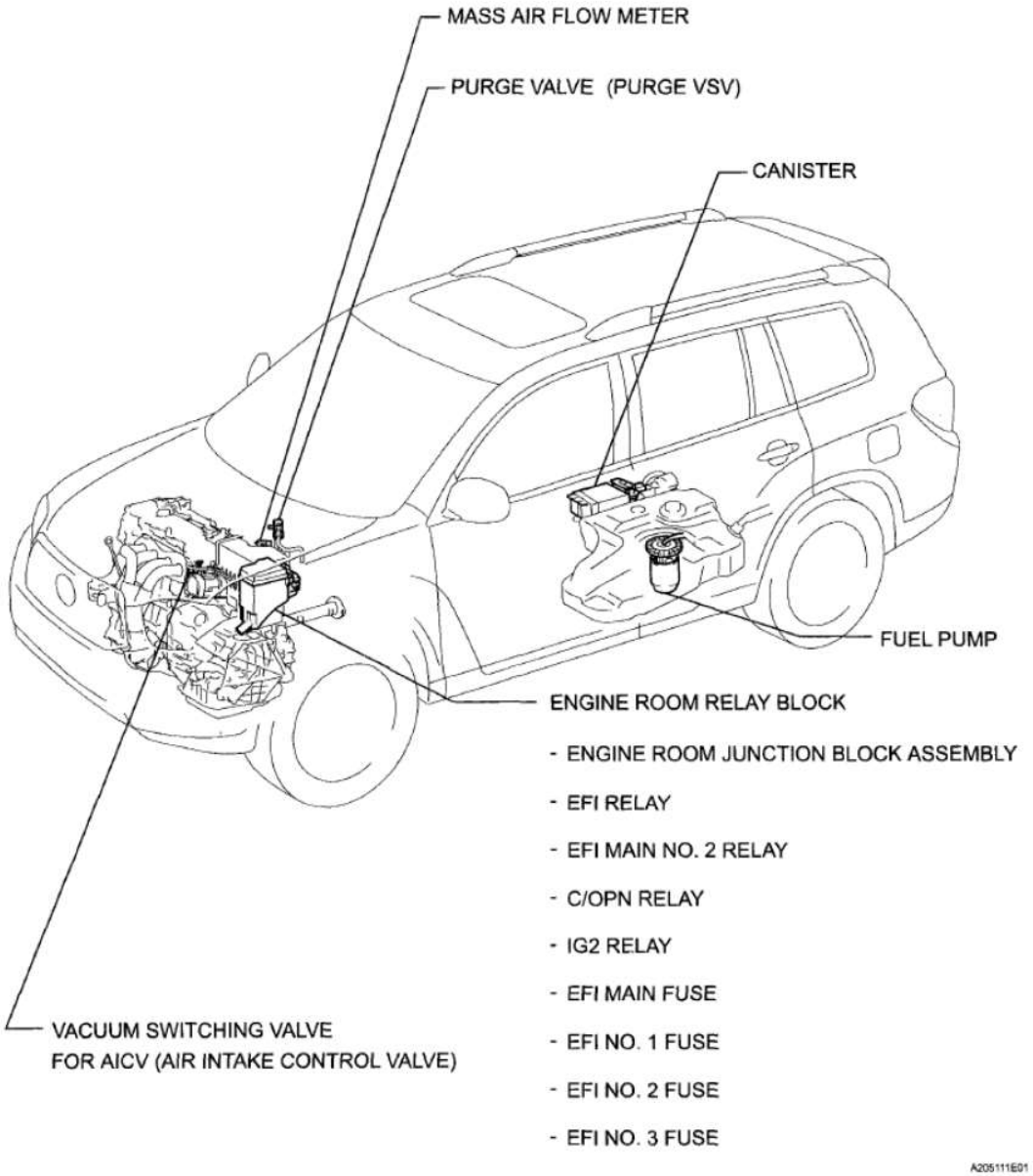


Fig. 2: Identifying SFI System Parts Location (1 Of 4)

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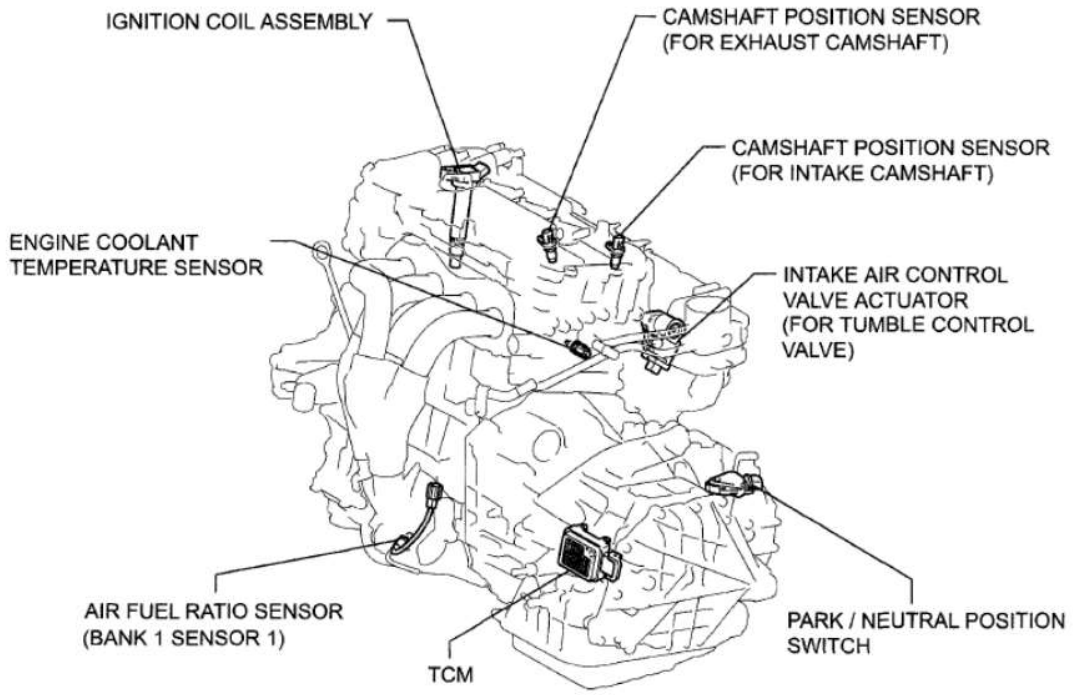


Fig. 3: Identifying SFI System Parts Location (2 Of 4)
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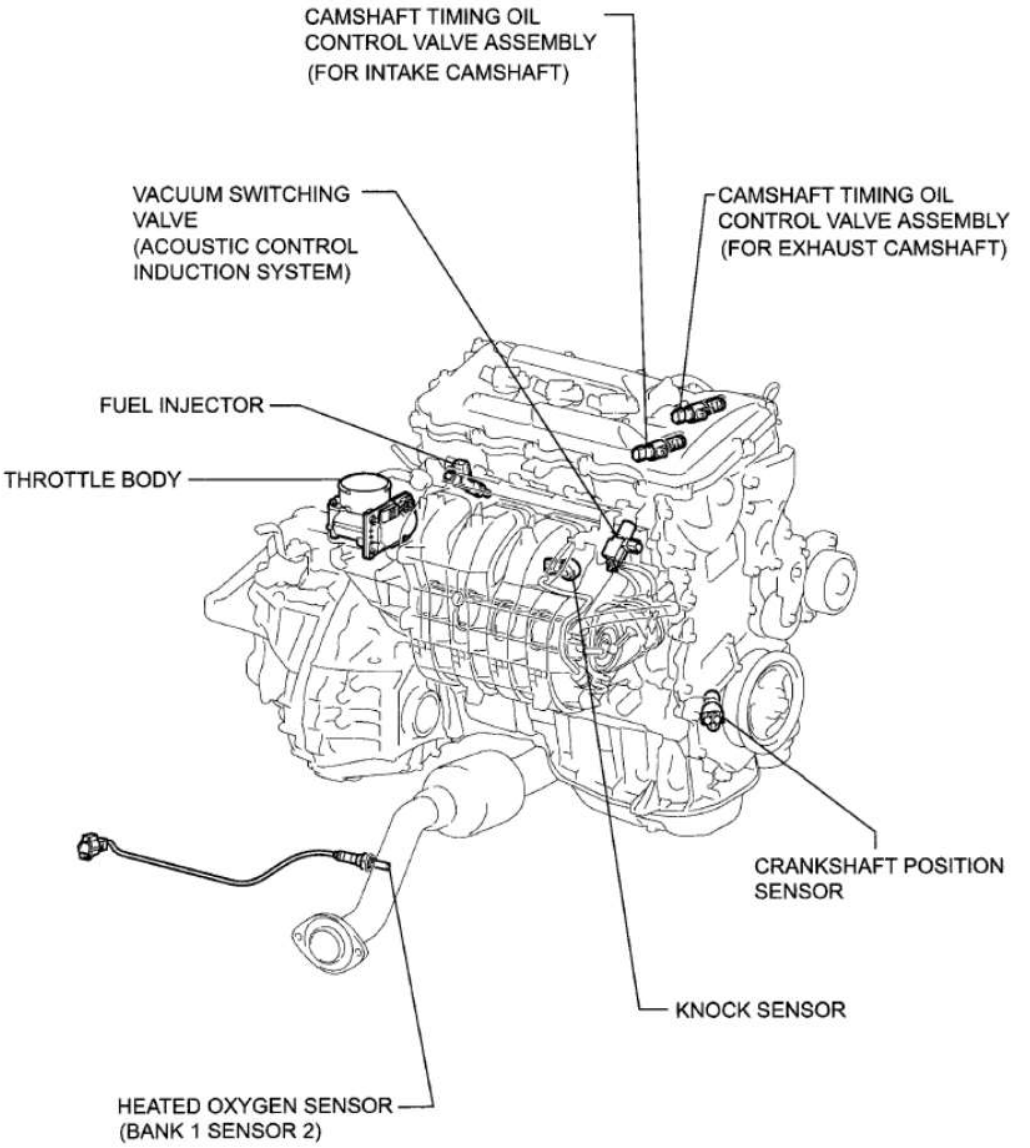


Fig. 4: Identifying SFI System Parts Location (3 Of 4)
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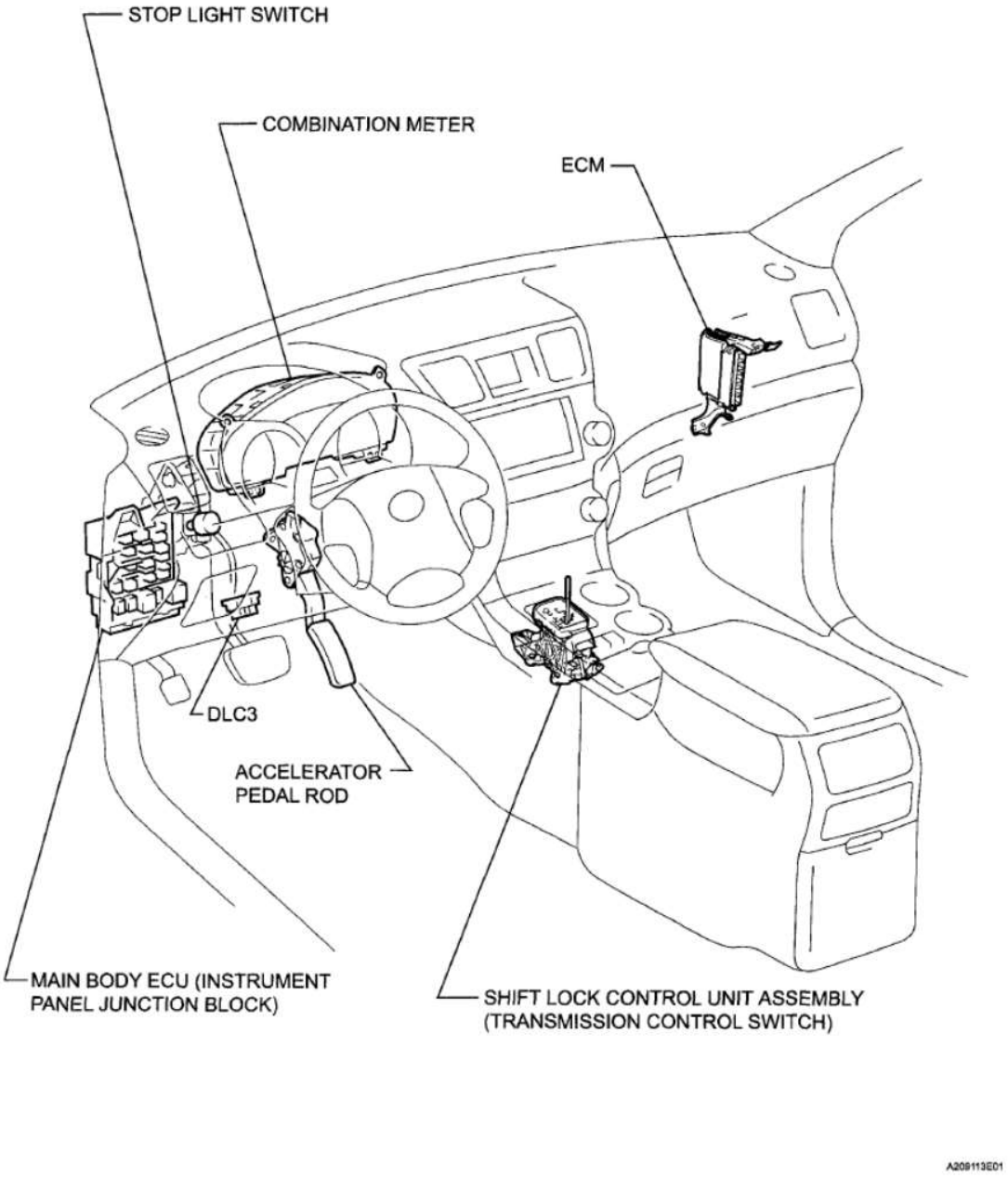


Fig. 5: Identifying SFI System Parts Location (4 Of 4)
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SYSTEM DIAGRAM

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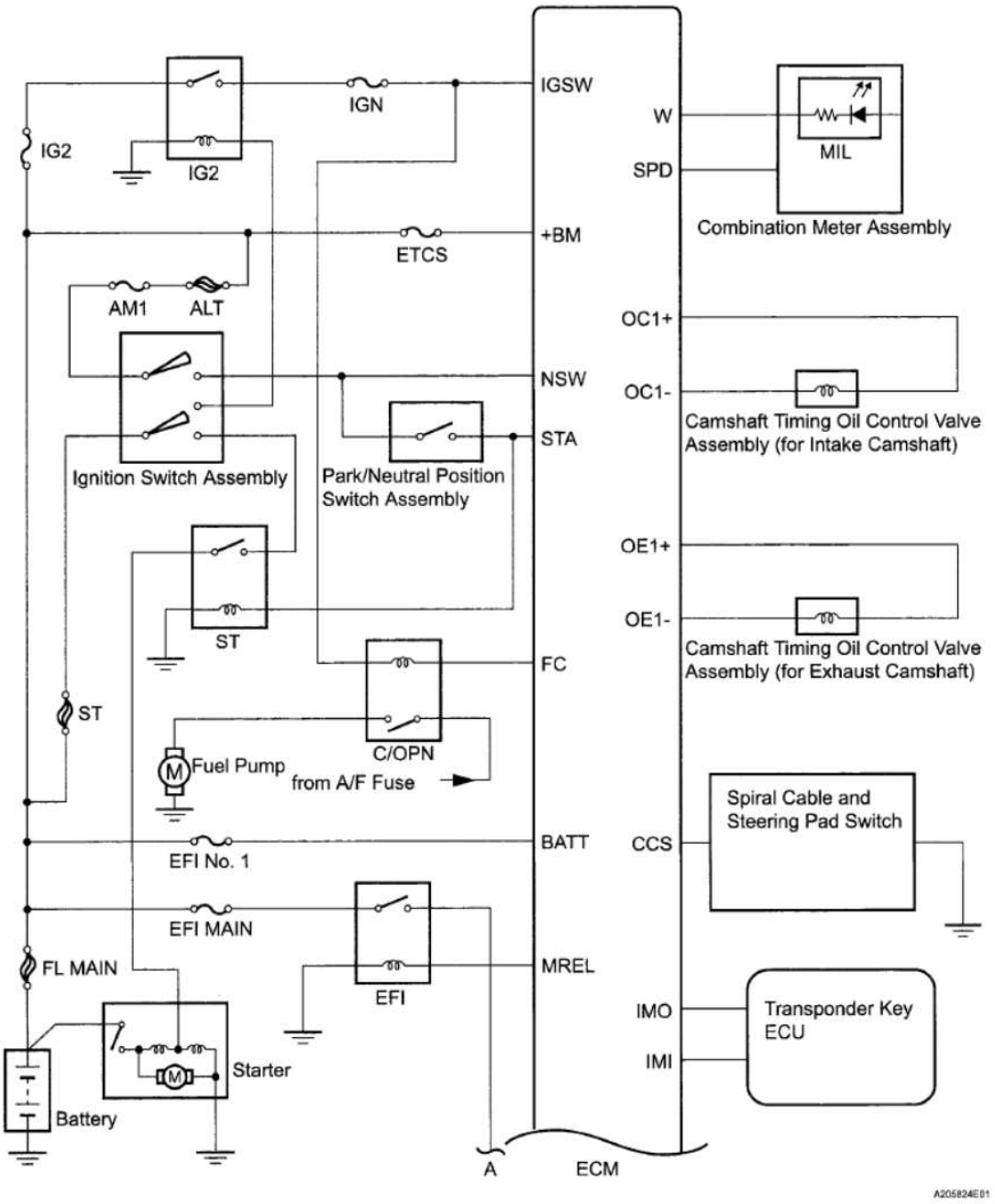


Fig. 6: SFI System - System Diagram (1 Of 4)
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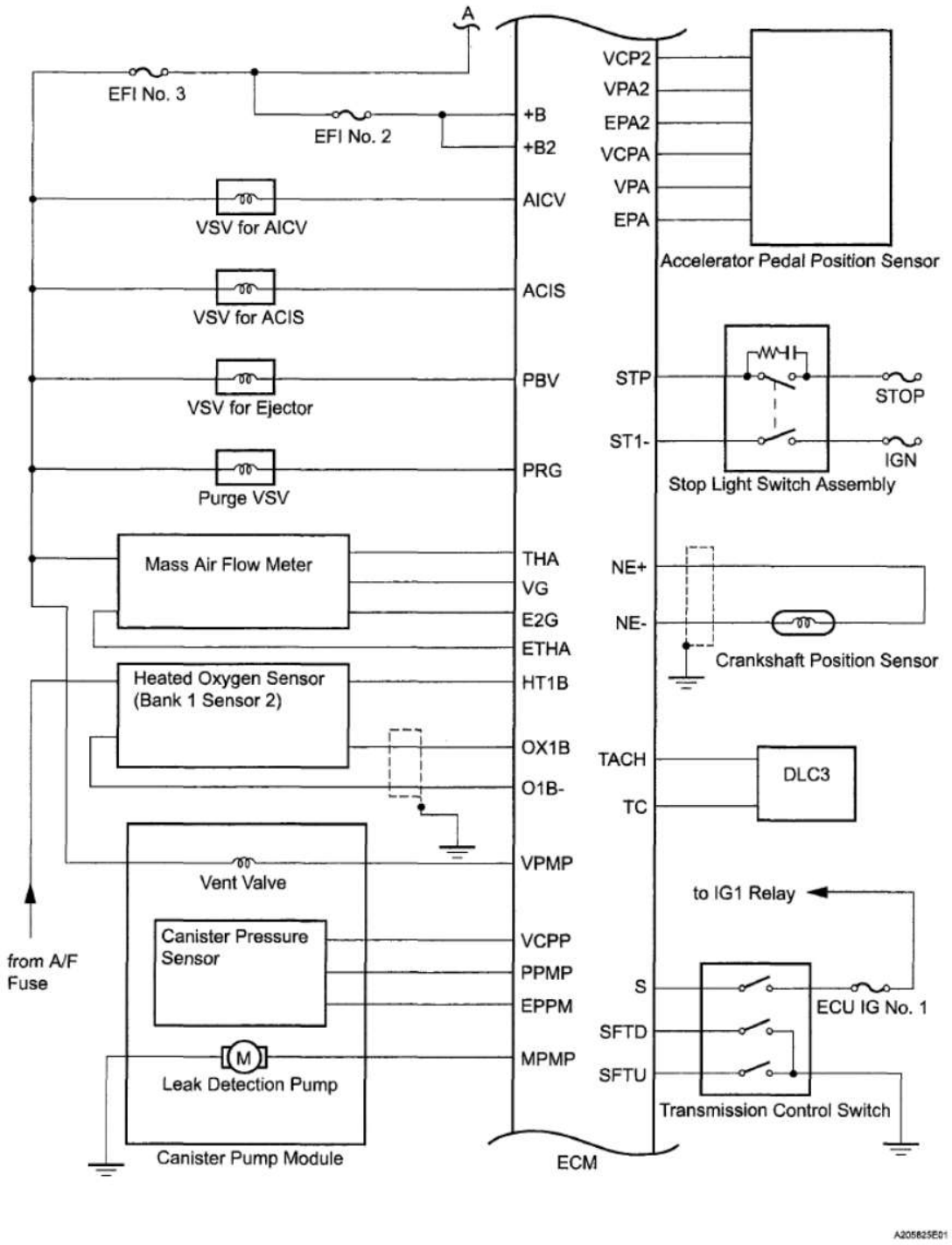


Fig. 7: SFI System - System Diagram (2 Of 4)
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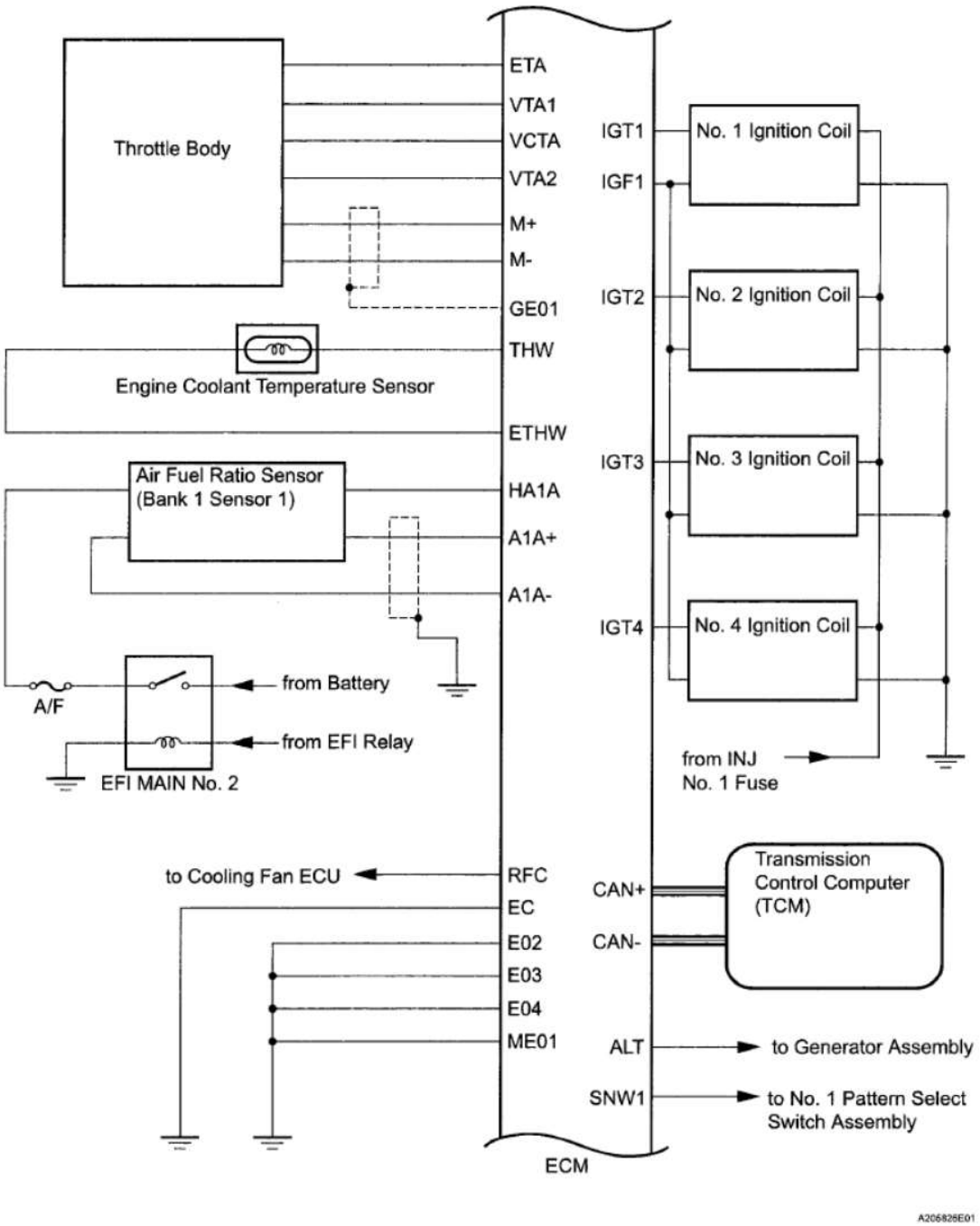


Fig. 8: SFI System - System Diagram (3 Of 4)
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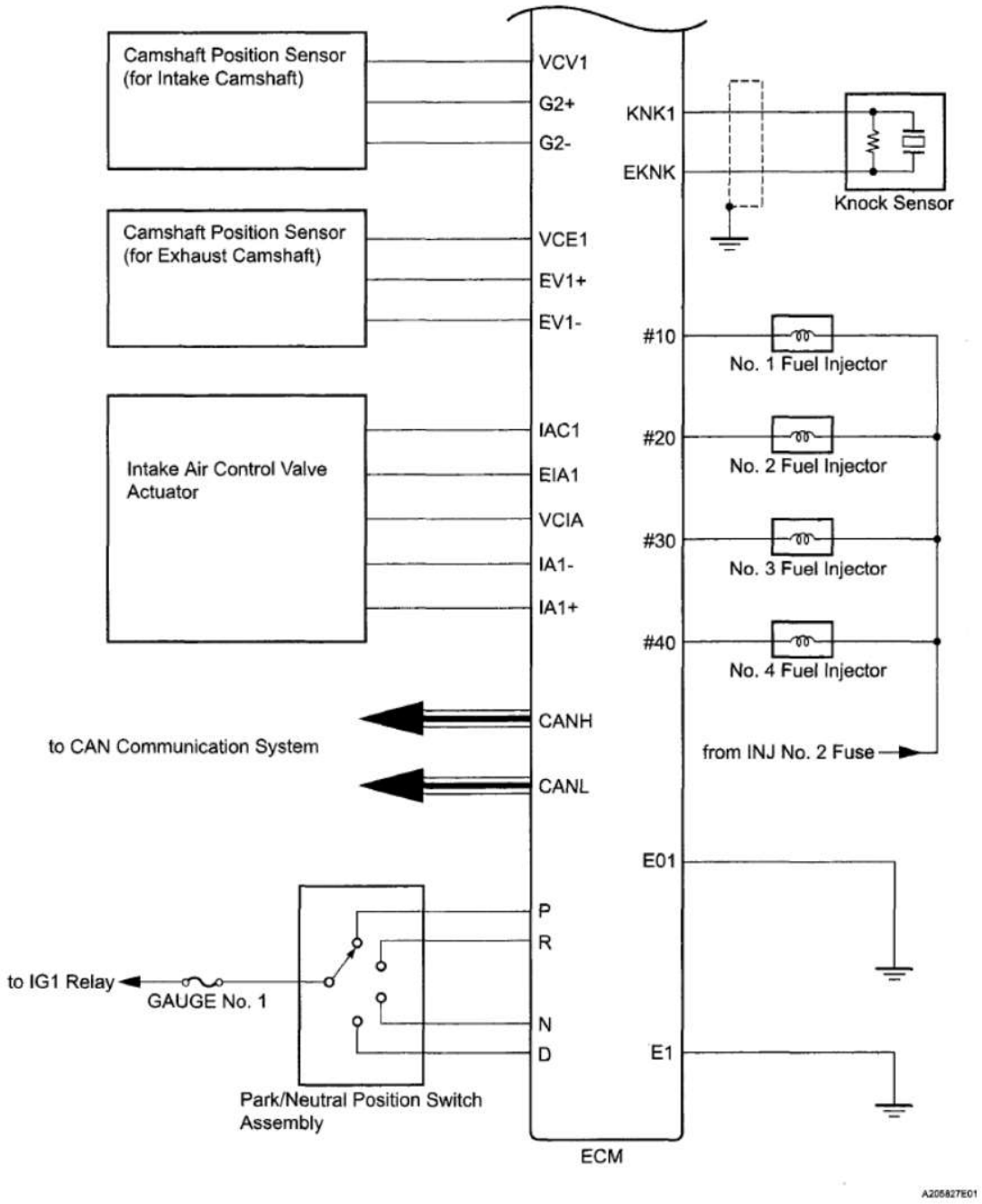


Fig. 9: SFI System - System Diagram (4 Of 4)
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HOW TO PROCEED WITH TROUBLESHOOTING

HINT:

*: Use the Techstream.

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1. **VEHICLE BROUGHT TO WORKSHOP**
2. **CUSTOMER PROBLEM ANALYSIS**
3. **CONNECT TECHSTREAM TO DLC3**

   HINT:

   If the display indicates a communication fault in the Techstream, inspect the DLC3.

   When any CAN communication system DTCs are output, perform troubleshooting on the CAN communication system first.

4. **CHECK DTC AND FREEZE FRAME DATA***

   HINT:

   Record or print DTCs and freeze frame data if necessary.

5. **CLEAR DTC AND FREEZE FRAME DATA***
6. **CONDUCT VISUAL INSPECTION**
7. **SET CHECK MODE DIAGNOSIS***
8. **CONFIRM PROBLEM SYMPTOMS**

   HINT:

   If the engine does not start, first perform the "Check For DTC" procedure and "Conduct Basic Inspection" procedure below.

   Result

   RESULT CHART

Result	Proceed to
Malfunction does not occur	A
Malfunction occurs	B

   B: GO TO STEP 10

   A: Go to next step

9. **SIMULATE SYMPTOMS**
10. **CHECK FOR DTC***

    Result

    RESULT CHART

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Result	Proceed to
Trouble code output	A
No trouble code output	B

B: GO TO STEP 12

A: Go to next step

11. REFER TO **DTC CHART**
12. **CONDUCT BASIC INSPECTION**

Result

RESULT CHART

Result	Proceed to
Malfunctioning parts not confirmed	A
Malfunctioning parts confirmed	B

B: GO TO STEP 17

A: Go to next step

13. REFER TO **PROBLEM SYMPTOMS TABLE**

Result

RESULT CHART

Result	Proceed to
Malfunctioning circuit confirmed	A
Malfunctioning parts confirmed	B

B: GO TO STEP 17

A: Go to next step

14. **CHECK ECM POWER SOURCE CIRCUIT**
15. **CONDUCT CIRCUIT INSPECTION**

Result

RESULT CHART

Result	Proceed to
Malfunction not confirmed	A
Malfunction confirmed	B

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B: GO TO STEP 18

A: Go to next step

16. **CHECK FOR INTERMITTENT PROBLEMS**
17. **CONDUCT PARTS INSPECTION**
18. **IDENTIFY PROBLEM**
19. **ADJUST AND/OR REPAIR**
20. **CONDUCT CONFIRMATION TEST**

NEXT: END

CHECK FOR INTERMITTENT PROBLEMS

HINT:

Inspect the vehicle ECM using check mode. Intermittent problems are easier to detect with the Techstream when the ECM is in check mode. In check mode, the ECM uses 1 trip detection logic, which is more sensitive to malfunctions than normal mode (default), which uses 2 trip detection logic.

1. Clear the DTCs (See **DTC CHECK/CLEAR**).
2. Switch the ECM from normal mode to check mode using the Techstream (See **CHECK MODE PROCEDURE**).
3. Perform a simulation test (See **HOW TO PROCEED WITH TROUBLESHOOTING**).
4. Check and wiggle the harness(es), connector(s) and terminal(s) (See **HOW TO PROCEED WITH TROUBLESHOOTING**).

BASIC INSPECTION

When a malfunction is not confirmed by the DTC check, troubleshooting should be carried out for all circuits considered to be possible causes of the problem. In many cases, by carrying out the basic engine check shown in the following flowchart, the location of the problem can be found quickly and efficiently. Therefore, using this check is essential when engine troubleshooting.

1. **CHECK BATTERY VOLTAGE**

NOTE: Carry out this check with the engine stopped and the ignition switch off.

Result

RESULT CHART

Result	Proceed to
11 V or higher	OK
Below 11 V	NG

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NG: CHARGE OR REPLACE BATTERY

OK: Go to next step

2. **CHECK WHETHER ENGINE CRANKS**

NG: PROCEED TO PROBLEM SYMPTOMS TABLE

OK: Go to next step

3. **CHECK WHETHER ENGINE STARTS**

NG: GO TO STEP 6

OK: Go to next step

4. **CHECK AIR FILTER**
   a. Visually check that the air filter is not excessively contaminated with dirt or oil.

NG: REPLACE AIR FILTER (See **REMOVAL**)

OK: Go to next step

5. **CHECK IDLING SPEED**

NG: TROUBLESHOOT IDLING SPEED AND PROCEED TO NEXT STEP

OK: Go to next step

6. **CHECK FUEL PRESSURE**

NG: TROUBLESHOOT FUEL PRESSURE AND PROCEED TO NEXT STEP

OK: Go to next step

7. **CHECK FOR SPARK**

NG: TROUBLESHOOT SPARK AND PROCEED TO NEXT STEP

OK: PROCEED TO PROBLEM SYMPTOMS TABLE

REGISTRATION

NOTE: The Vehicle Identification Number (VIN) must be input into the replacement ECM.

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HINT:

The VIN is in the form of a 17-digit alphanumeric vehicle identification number. The Techstream is required to register the VIN.

1. **DESCRIPTION (Using the Techstream)**

   HINT:

   This registration section consists of two parts: Read VIN and Write VIN.

   a. Read VIN: Explains the VIN reading process in a flowchart. This process allows the VIN stored in the ECM to be read in order to confirm that the two VINs, provided with the vehicle and stored in the vehicle ECM, are the same.
   b. Write VIN: Explains the VIN writing process in a flowchart. This process allows the VIN to be input into the ECM. If the ECM is replaced, or the ECM VIN and vehicle VIN do not match, the VIN can be registered, or overwritten in the ECM by following this procedure.

2. **READ VIN**
   a. Confirm the vehicle VIN.
   b. Connect the Techstream to the DLC3.
   c. Turn the ignition switch to ON.
   d. Turn the Techstream on.
   e. Enter the following menus: Powertrain/Engine/Utility/VIN/VIN Read.

3. **WRITE VIN**
   a. Confirm the vehicle VIN.
   b. Connect the Techstream to the DLC3.
   c. Turn the ignition switch to ON.
   d. Turn the Techstream on.
   e. Enter the following menus: Powertrain/Engine/Utility/VIN/VIN Write.

CHECKING MONITOR STATUS

The purpose of the monitor result (mode 06) is to allow access to the results for on-board diagnostic monitoring tests of specific components/systems that are not continuously monitored. Examples are the catalyst, evaporative emission (EVAP) system and thermostat.

The monitor result allows the OBD II scan tool to display the monitor status, test value, minimum test limit and maximum test limit. These data are displayed after the vehicle has been driven to run the monitor.

When the test value is not between the minimum test limit and maximum test limit, the ECM (PCM) interprets this as a malfunction. When the component is not malfunctioning, if the difference of the test value and test limit is very small, the component will malfunction in the near future. Perform the following procedure to view the monitor status. Although this procedure references the Lexus/Toyota diagnostic tester, it can be checked using a generic OBD II scan tool. Refer to your scan tool operator's manual for specific procedures.

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1. **PERFORM MONITOR DRIVE PATTERN**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch to ON and turn the Techstream on.
   c. Clear the DTCs (See **DTC CHECK/CLEAR**).
   d. Drive the vehicle in accordance with the applicable drive pattern described in Readiness Monitor Drive Pattern (See **READINESS MONITOR DRIVE PATTERN**). Do not turn the ignition switch off.

   NOTE: The test results will be lost if the ignition switch is turned off.

2. **ACCESS MONITOR RESULT**
   a. Enter the following menus: Powertrain/Engine/Monitor/Result. The monitor status appears after the component name.
      - Pass: The component is functioning normally.
      - Fail: The component is malfunctioning.
   b. Confirm that Pass or Fail is shown for the component.
   c. Select the component and press ENTER. The accuracy test value appears if the monitor status is either Pass or Fail.
3. **CHECK COMPONENT STATUS**
   a. Compare the test value with the minimum test limit and maximum test limit.
   b. If the test value is between the minimum test limit and maximum test limit, the component is functioning normally. If not, the component is malfunctioning. The test value is usually significantly more or less than the test limit. If the test value is on the borderline of the test limit, the component will malfunction in the near future.

      HINT:

      The monitor result might on rare occasions be Pass even if the Malfunction Indicator Lamp (MIL) is illuminated. This indicates the system malfunctioned on a previous driving cycle. This might be caused by an intermittent problem.

4. **MONITOR RESULT INFORMATION**

   If you use a generic scan tool, multiply the value by the scaling value listed below.

   Air Fuel Ratio Sensor (Sensor 1)

   MONITOR RESULT INFORMATION

Monitor ID	Test ID	Scaling	Unit	Description
$01	$8E	Multiply by 0.001	V	A/F sensor deterioration level
$01	$91	Multiply by 0.004	mA	A/F sensor current

   Heated Oxygen Sensor (Sensor 2)

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MONITOR RESULT INFORMATION

Monitor ID	Test ID	Scaling	Unit	Description
$02	$07	Multiply by 0.001	V	Minimum sensor voltage
$02	$08	Multiply by 0.001	V	Maximum sensor voltage
$02	$8B	Multiply by 0.001	Seconds	0.35 - 0.2 V sensor switch time
$02	$8D	Multiply by 0.001	Seconds	Duration that sensor voltage drops to 0.2 V during fuel cut
$02	$8F	Multiply by 0.0003	9	Maximum oxygen storage capacity

Catalyst

MONITOR RESULT INFORMATION

Monitor ID	Test ID	Scaling	Unit	Description
$21	$A9	Multiply by 0.0003	No dimension	Oxygen storage capacity of catalyst

Advance/Retarded Intake Side

MONITOR RESULT INFORMATION

Monitor ID	Test ID	Scaling	Unit	Description
$35	$81	Multiply by 0.01	Seconds	Forced movement of oil control valve time

Advance/Retarded Exhaust Side

MONITOR RESULT INFORMATION

Monitor ID	Test ID	Scaling	Unit	Description
$35	$85	Multiply by 0.01	Seconds	Forced movement of oil control valve time

EVAP

MONITOR RESULT INFORMATION

Monitor ID	Test ID	Scaling	Unit	Description
$3D	$C9	Multiply by 0.001	kPa	Test value for small leak (P0456)
$3D	$CA	Multiply by 0.001	kPa	Test value for gross leak (P0455)
$3D	$CB	Multiply by 0.001	kPa	Test value for leak detection pump stuck OFF (P2401)
$3D	$CD	Multiply by 0.001	kPa	Test value for leak detection pump stuck ON (P2402)
$3D	$CE	Multiply by 0.001	kPa	Test value for vent valve stuck OFF (P2420)
$3D	$CF	Multiply by 0.001	kPa	Test value for vent valve stuck ON (P2419)
$3D	$D0	Multiply by 0.001	kPa	Test value for reference orifice low flow (P043E)
$3D	$D1	Multiply by 0.001	kPa	Test value for reference orifice high flow (P043F)
$3D	$D4	Multiply by 0.001	kPa	Test value for purge VSV stuck closed (P0441)
$3D	$D5	Multiply by 0.001	kPa	Test value for purge VSV stuck open (P0441)

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$3D	$D7	Multiply by 0.001	kPa	Test value for purge flow insufficient (P0441)

Rear Oxygen Sensor Heater

MONITOR RESULT INFORMATION

Monitor ID	Test ID	Scaling	Unit	Description
$42	$91	Multiply by 0.001	Ohm	Oxygen sensor heater resistance bank 1 sensor 2

Misfire

MONITOR RESULT INFORMATION

Monitor ID	Test ID	Scaling	Unit	Description
$A1	$0B	Multiply by 1	Time	Total EWMA misfire count of all cylinders in last ten driving cycles EWMA: Exponential Weighted Moving Average
$A1	$0C	Multiply by 1	Time	• When ignition switch is ON, total misfire count of all cylinders in last driving cycle is displayed. • While engine is running, total misfire count of all cylinders in current driving cycle is displayed.
$A2	$0B	Multiply by 1	Time	Total EWMA misfire count of cylinder 1 in last ten driving cycles
$A2	$0C	Multiply by 1	Time	• When ignition switch is ON, total misfire count of cylinder 1 in last driving cycle is displayed. • While engine is running, total misfire count of cylinder 1 in current driving cycle is displayed.
$A3	$0B	Multiply by 1	Time	Total EWMA misfire count of cylinder 2 in last ten driving cycles
$A3	$0C	Multiply by 1	Time	• When ignition switch is ON, total misfire count of cylinder 2 in last driving cycle is displayed. • While engine is running, total misfire count of cylinder 2 in current driving cycle is displayed.
$A4	$0B	Multiply by 1	Time	Total EWMA misfire count of cylinder 3 in last ten driving cycles
$A4	$0C	Multiply by 1	Time	• When ignition switch is ON, total misfire count of cylinder 3 in last driving cycle is displayed. • While engine is running, total misfire count of cylinder 3 in current driving cycle is displayed.
$A5	$0B	Multiply by 1	Time	Total EWMA misfire count of cylinder 4 in last ten driving cycles
$A5	$0C	Multiply by 1	Time	• When ignition switch is ON, total misfire count of cylinder 4 in last driving cycle is displayed. • While engine is running, total misfire count of cylinder 4 in

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				current driving cycle is displayed.

READINESS MONITOR DRIVE PATTERN

1. **PURPOSE OF READINESS TESTS**
   - The On-Board Diagnostic (OBD II) system is designed to monitor the performance of emission-related components, and indicate any detected abnormalities with DTCs (Diagnostic Trouble Codes). Since various components need to be monitored during different driving conditions, the OBD II system is designed to run separate monitoring programs called Readiness Monitors.
   - To view the status, enter the following menus: Powertrain/Engine/Monitor/Status2.
   - When the Readiness Monitor status displays Complete, the necessary conditions have been met for running the performance tests for that Readiness Monitor.
   - A generic OBD II scan tool can also be used to view the Readiness Monitor status.

   HINT:

   Many state Inspection and Maintenance (I/M) programs require the vehicle Readiness Monitor status to show Complete before beginning emission tests.

   The Readiness Monitor is reset to Incomplete if:

   - The ECM has lost battery power or blown a fuse.
   - DTCs have been cleared.
   - The conditions for running the Readiness Monitor have not been met.

   If the Readiness Monitor status shows Incomplete, follow the appropriate Readiness Monitor Drive Pattern to change the status to Complete.

   CAUTION: Strictly observe posted speed limits, traffic laws, and road conditions when performing these drive patterns.

   NOTE: These drive patterns represent the fastest method of satisfying all conditions necessary to achieve complete status for each specific Readiness Monitor.
   In the event of a drive pattern being interrupted (possibly due to factors such as traffic conditions), the drive pattern can be resumed. In most cases, the Readiness Monitor will still achieve complete status upon completion of the drive pattern.
   To ensure completion of the Readiness Monitors, avoid sudden changes in vehicle load and speed (driving up and down hills and/or sudden acceleration).

2. **CATALYST MONITOR (ACTIVE AIR FUEL RATIO CONTROL TYPE)**

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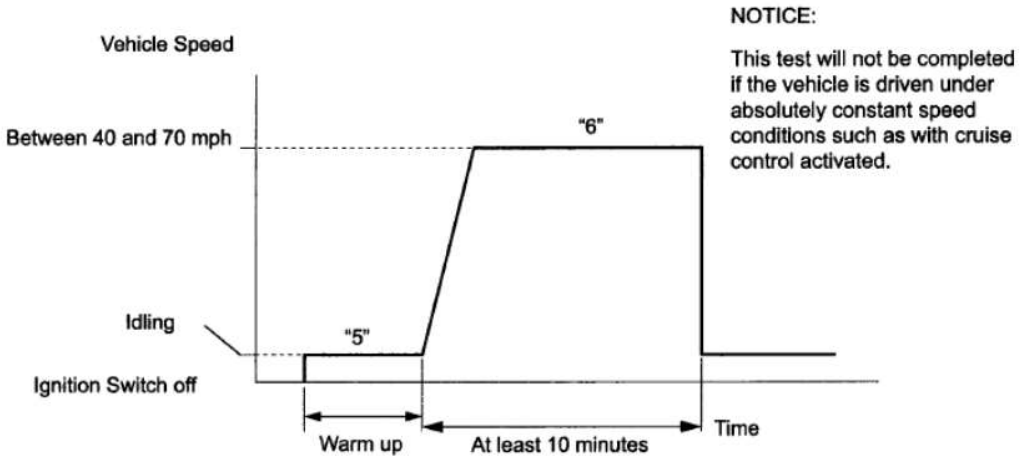


Fig. 10: Vehicle Speed Driving Pattern
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

a. Preconditions

The monitor will not run unless:

- The MIL is off.

b. Drive Pattern

1. Connect the Techstream to the DLC3.
2. Turn the ignition switch to ON.
3. Turn the Techstream on.
4. Clear the DTCs (if output) (See **DTC CHECK/CLEAR**).
5. Start the engine and warm it up.
6. Drive the vehicle at between 40 and 70 mph (64 and 113 km/h) for at least 10 minutes.

c. Monitor Status

Check the Readiness Monitor status displayed on the Techstream.

If the status does not switch to Complete, extend the driving time.

3. **EVAP SYSTEM MONITOR (KEY-OFF TYPE)**

a. Preconditions

The monitor will not run unless:

- The fuel tank is less than 90% full.
- The altitude is less than 8000 ft. (2438 m).

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- The vehicle is stationary.
- The engine coolant temperature is between 4.4 and 35°C (40 and 95°F).
- The intake air temperature is between 4.4 and 35°C (40 and 95°F).
- The vehicle was driven in a city area (or on a free-way) for 10 minutes or more.

b. Monitor Conditions

1. Turn the ignition switch off and wait for 5 to 10 hours depending on certain vehicle conditions.

   HINT:

   Do not start the engine until checking Readiness Monitor status. If the engine is started, the step described above must be repeated.

c. Monitor Status

1. Connect the Techstream to the DLC3.
2. Turn the ignition switch to ON.
3. Turn the Techstream on.
4. Check the Readiness Monitor status displayed on the Techstream.

   If the status does not switch to Complete, restart the engine, make sure that the preconditions have been met, and then perform the Monitor Conditions procedure again.

4. **AIR FUEL RATIO AND HEATED OXYGEN SENSOR MONITORS (ACTIVE AIR FUEL RATIO CONTROL TYPE)**

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Monitor Drive Pattern

Engine Coolant Temperature: 75°C or higher

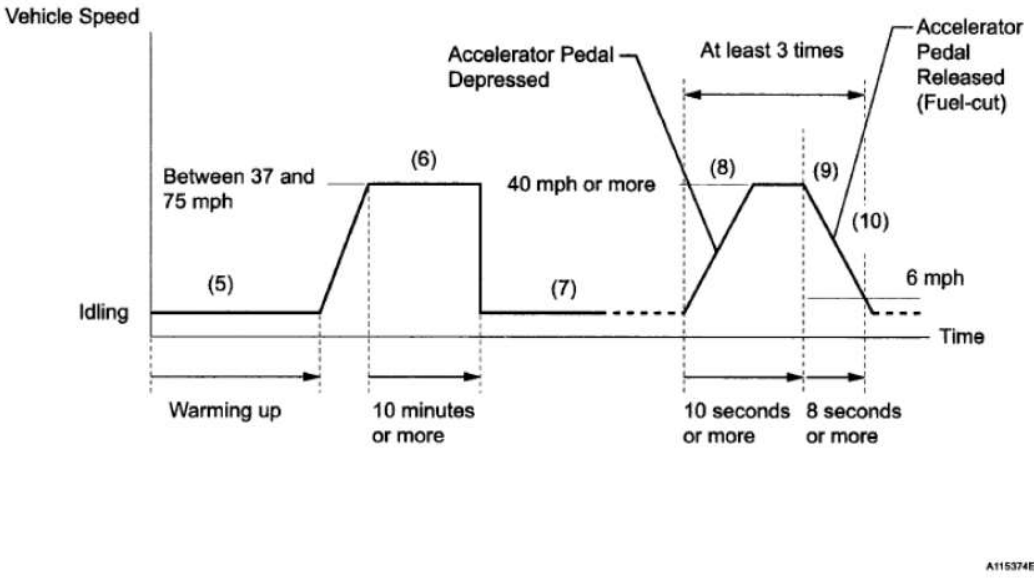


Fig. 11: Vehicle Speed Driving Pattern
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

a. Preconditions

The monitor will not run unless:

- 2 minutes or more have elapsed since the engine was started.
- The engine coolant temperature is 75°C (167°F) or higher.
- Cumulative driving time at a vehicle speed of 30 mph (48 km/h) or more exceeds 6 minutes.
- Air fuel ratio feedback control is performed.

b. Drive Pattern for air fuel ratio sensor and heated oxygen sensor

1. Connect the Techstream to the DLC3.
2. Turn the ignition switch to ON.
3. Turn the Techstream on.
4. Clear the DTCs (See **DTC CHECK/CLEAR**).
5. Start the engine and warm it up until the engine coolant temperature reaches 75°C (167°F) or higher.
6. Drive the vehicle at a speed between 37 mph (60 km/h) and 75 mph (120 km/h) for at least 10 minutes.
7. Change the transmission to 2nd gear.
8. Accelerate the vehicle to 40 mph (64 km/h) or more by depressing the accelerator pedal for at least 10 seconds.

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9. Release the accelerator pedal for at least 8 seconds without depressing the brake pedal in order to execute fuel-cut control.
10. Allow the vehicle to decelerate until the vehicle speed decreases to less than 6 mph (10 km/h).
11. Repeat steps (8) through (10) above at least 3 times in one driving cycle.

c. Monitor Status
   1. Check the Readiness Monitor status displayed on the Techstream.
   2. If the status does not switch to Complete, make sure that the preconditions have been met, and then perform steps (5) through (11) in the Drive Pattern above.

5. **AIR FUEL RATIO AND HEATED OXYGEN SENSOR HEATER MONITORS**

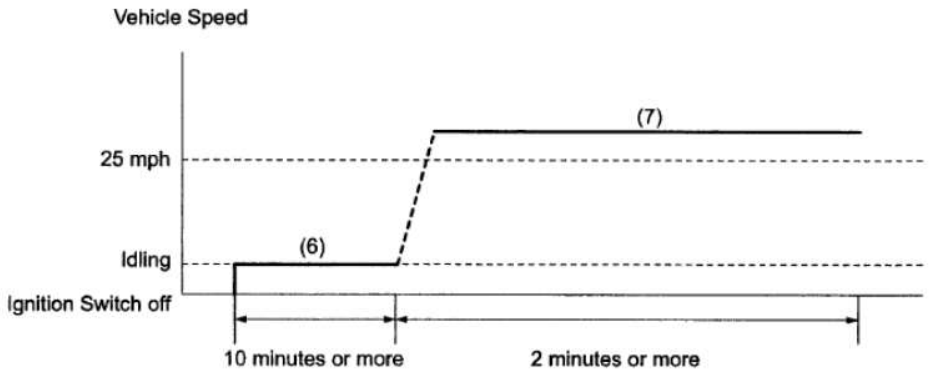


Fig. 12: Vehicle Speed Driving Pattern
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

a. Preconditions

   The monitor will not run unless:

   - The MIL is off.

b. Drive Pattern
   1. Connect the Techstream to the DLC3.
   2. Turn the ignition switch to ON.
   3. Turn the Techstream on.
   4. Clear the DTCs (if output) (See **DTC CHECK/CLEAR**).
   5. Start the engine.
   6. Allow the engine to idle for 10 minutes or more.
   7. Drive the vehicle at 25 mph (40 km/h) or more for at least 2 minutes.

c. Monitor Status
   1. Check the Readiness Monitor status displayed on the Techstream.

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If the status does not switch to Complete, make sure that the preconditions have been met, and repeat steps (5) to (7) described in the Drive Pattern above.

PROBLEM SYMPTOMS TABLE

HINT:

- Use the table below to help determine the cause of problem symptoms. If multiple suspected areas are listed, the potential causes of the symptoms are listed in order of probability in the "Suspected Area" column of the table. Check each symptom by checking the suspected areas in the order they are listed. Replace parts as necessary.
- Inspect the fuses and relays related to this system before inspecting the suspected areas below.

SFI System

PROBLEM SYMPTOMS CHART

Symptom	Suspected Area	See page
Engine does not crank (Does not start)	Battery	**ON-VEHICLE INSPECTION**
	Starter	**INSPECTION**
	Starter relay	**STARTER RELAY**
	Park/neutral position switch assembly	**ADJUSTMENT**
	Starter signal circuit	**STARTER SIGNAL CIRCUIT**
No initial combustion (Does not start)	ECM power source circuit	**ECM POWER SOURCE CIRCUIT**
	Crankshaft position sensor	**CRANKSHAFT POSITION SENSOR**
	Ignition system	**ON-VEHICLE INSPECTION**
	Fuel pump control circuit	**FUEL PUMP CONTROL CIRCUIT**
	Fuel injector circuit	**FUEL INJECTOR CIRCUIT**
	Valve timing	**DTC P0013 CAMSHAFT POSITION "B" ACTUATOR CIRCUIT/OPEN (BANK 1)**
	VC output circuit	**VC OUTPUT CIRCUIT**
	Camshaft position sensor	**CAMSHAFT POSITION SENSOR**
	ECM	**ECM**
	Fuel pump control circuit	**FUEL PUMP CONTROL CIRCUIT**
	Fuel pump	**INSPECTION**
	Fuel injector circuit	**FUEL INJECTOR CIRCUIT**

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Engine cranks normally but difficult to start	ECM power source circuit	**ECM POWER SOURCE CIRCUIT**
	Engine coolant temperature sensor	**ENGINE COOLANT TEMPERATURE SENSOR**
	Intake system	**ON-VEHICLE INSPECTION**
	Ignition system	**ON-VEHICLE INSPECTION**
	Spark plug	**ON-VEHICLE INSPECTION**
	Throttle body	**THROTTLE BODY**
	Compression	**ON-VEHICLE INSPECTION**
Incomplete intermittent combustion occurs (Does not start)	Fuel pump control circuit	**FUEL PUMP CONTROL CIRCUIT**
	Fuel pump	**INSPECTION**
	Ignition circuit	**DTC P0351 IGNITION COIL "A" PRIMARY/SECONDARY CIRCUIT; DTC P0352 IGNITION COIL "B" PRIMARY/SECONDARY CIRCUIT; DTC P0353 IGNITION COIL "C" PRIMARY/SECONDARY CIRCUIT; DTC P0354 IGNITION COIL "D" PRIMARY/SECONDARY CIRCUIT**
	Ignition system	**ON-VEHICLE INSPECTION**
	Fuel injector circuit	**FUEL INJECTOR CIRCUIT**
	ECM power source circuit	**ECM POWER SOURCE CIRCUIT**
	Crankshaft position sensor	**CRANKSHAFT POSITION SENSOR**
	Valve timing	**DTC P0013 CAMSHAFT POSITION "B" ACTUATOR CIRCUIT/OPEN (BANK 1)**
	Camshaft position sensor	**CAMSHAFT POSITION SENSOR**
High engine idle speed	Throttle body	**THROTTLE BODY**
	Intake system	**ON-VEHICLE INSPECTION**
	A/C signal circuit for automatic air conditioning system	**PROBLEM SYMPTOMS TABLE**
	A/C signal circuit for manual air conditioning system	**PROBLEM SYMPTOMS TABLE**
	ECM power source circuit	**ECM POWER SOURCE CIRCUIT**
	Engine coolant temperature	**ENGINE COOLANT TEMPERATURE SENSOR**

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	sensor	
	PCV valve and hose	**INSPECTION**
	Acoustic Control Induction System (ACIS)	**ON-VEHICLE INSPECTION**
Low engine idle speed (Poor idling)	Throttle body	**THROTTLE BODY**
	A/C signal circuit for automatic air conditioning system	**PROBLEM SYMPTOMS TABLE**
	A/C signal circuit for manual air conditioning system	**PROBLEM SYMPTOMS TABLE**
	Fuel pump control circuit	**FUEL PUMP CONTROL CIRCUIT**
	Fuel pump	**INSPECTION**
	Intake system	**ON-VEHICLE INSPECTION**
	PCV valve and hose	**INSPECTION**
	Acoustic Control Induction System (ACIS)	**ON-VEHICLE INSPECTION**
Rough idling	Compression	**ON-VEHICLE INSPECTION**
	Ignition system	**ON-VEHICLE INSPECTION**
	Spark plug	**ON-VEHICLE INSPECTION**
	Fuel injector circuit	**FUEL INJECTOR CIRCUIT**
	ECM power source circuit	**ECM POWER SOURCE CIRCUIT**
	Fuel pump control circuit	**FUEL PUMP CONTROL CIRCUIT**
	Fuel pump	**INSPECTION**
	Throttle body	**THROTTLE BODY**
	Intake system	**ON-VEHICLE INSPECTION**
	PCV valve and hose	**INSPECTION**
	Air fuel ratio sensor	**AIR FUEL RATIO SENSOR**
	Heated oxygen sensor	**HEATED OXYGEN SENSOR**
	Mass air flow meter	**MASS AIR FLOW METER**

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	Acoustic Control Induction System (ACIS)	**ON-VEHICLE INSPECTION**
	Tumble Control Valve (TCV)	**ON-VEHICLE INSPECTION**
Idle hunting	Throttle body	**THROTTLE BODY**
	Intake system	**ON-VEHICLE INSPECTION**
	PCV valve and hose	**INSPECTION**
	Air fuel ratio sensor	**AIR FUEL RATIO SENSOR**
	Mass air flow meter	**MASS AIR FLOW METER**
	Acoustic Control Induction System (ACIS)	**ON-VEHICLE INSPECTION**
	Tumble Control Valve (TCV)	**ON-VEHICLE INSPECTION**
Hesitation/poor acceleration	Fuel pump control circuit	**FUEL PUMP CONTROL CIRCUIT**
	Fuel pump	**INSPECTION**
	Spark plug	**ON-VEHICLE INSPECTION**
	Ignition system	**ON-VEHICLE INSPECTION**
	Fuel injector circuit	**FUEL INJECTOR CIRCUIT**
	ECM power source circuit	**ECM POWER SOURCE CIRCUIT**
	Mass air flow meter	**MASS AIR FLOW METER**
	Throttle body	**THROTTLE BODY**
	Intake system	**ON-VEHICLE INSPECTION**
	Valve timing	**DTC P0013 CAMSHAFT POSITION "B" ACTUATOR CIRCUIT/OPEN (BANK 1)**
	Compression	**ON-VEHICLE INSPECTION**
Surging (Poor driveability)	Spark plug	**ON-VEHICLE INSPECTION**
	Fuel pump control circuit	**FUEL PUMP CONTROL CIRCUIT**
	Fuel pump	**INSPECTION**
	Ignition system	**ON-VEHICLE INSPECTION**
	Fuel injector circuit	**FUEL INJECTOR CIRCUIT**
	ECM power source circuit	**ECM POWER SOURCE CIRCUIT**
	Mass air flow	

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	meter	**MASS AIR FLOW METER**
	Variable Valve Timing (VVT) system	**DTC P0016 CRANKSHAFT POSITION - CAMSHAFT POSITION CORRELATION (BANK 1 SENSOR A); DTC P0017 CRANKSHAFT POSITION - CAMSHAFT POSITION CORRELATION (BANK 1 SENSOR B)**
	Compression	**ON-VEHICLE INSPECTION**
Engine stalls soon after starting	Fuel pump control circuit	**FUEL PUMP CONTROL CIRCUIT**
	Fuel pump	**INSPECTION**
	Spark plug	**ON-VEHICLE INSPECTION**
	Ignition system	**ON-VEHICLE INSPECTION**
	Fuel injector circuit	**FUEL INJECTOR CIRCUIT**
	ECM power source circuit	**ECM POWER SOURCE CIRCUIT**
	Mass air flow meter	**MASS AIR FLOW METER**
	Variable Valve Timing (VVT) system	**DTC P0016 CRANKSHAFT POSITION - CAMSHAFT POSITION CORRELATION (BANK 1 SENSOR A); DTC P0017 CRANKSHAFT POSITION - CAMSHAFT POSITION CORRELATION (BANK 1 SENSOR B)**
	Throttle body	**THROTTLE BODY**
	Intake system	**ON-VEHICLE INSPECTION**
	PCV valve and hose	**INSPECTION**
	Compression	**ON-VEHICLE INSPECTION**
Engine stalls only during A/C operation	A/C signal circuit for automatic air conditioning system	**PROBLEM SYMPTOMS TABLE**
	A/C signal circuit for manual air conditioning system	**PROBLEM SYMPTOMS TABLE**
	ECM	**ECM**
Unable/difficult to refuel	Refueling valve (canister)	**INSPECTION**

TERMINALS OF ECM

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Component without harness connected:
(ECM)

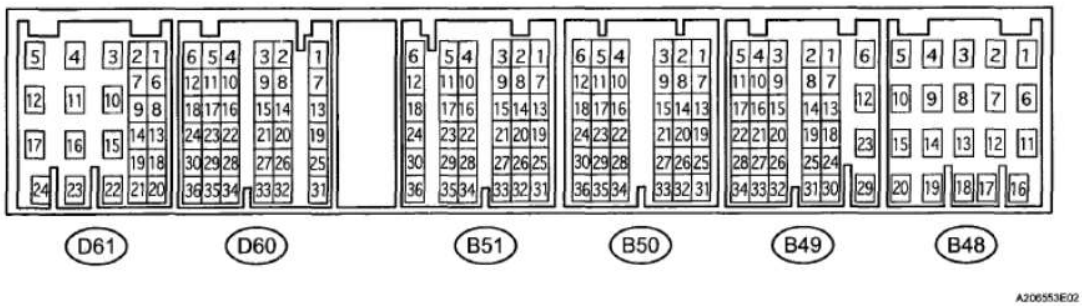


Fig. 13: Identifying ECM Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

HINT:

The standard voltage between each pair of ECM terminals is shown in the table below. The appropriate conditions for checking each pair of terminals are also indicated. The result of checks should be compared with the standard voltage for that pair of terminals, displayed in the Specified Condition column. The illustration above can be used as a reference to identify the ECM terminal locations.

TERMINAL DESCRIPTION SPECIFIED CONDITION CHART

Terminal No. (Symbol)	Wiring Color	Terminal Description	Condition	Specified Condition
D61-17 (BATT) - B49-6 (E1)	R - W-B	Battery (for measuring battery voltage and for ECM memory)	Always	11 to 14 V
D61-22 (+BM) - B49-6 (E1)	L - W-B	Power source of throttle actuator	Always	11 to 14 V
D60-21 (IG SW) - B49-6 (E1)	W - W-B	Ignition switch	Ignition switch ON	11 to 14 V
D61-23 (+B) - B49-6 (E1)	SB - W-B	Power source of ECM	Ignition switch ON	11 to 14 V
D61-24 (+B2) - B49-6 (E1)	GR - W-B	Power source of ECM	Ignition switch ON	11 to 14 V
B49-28 (OC1+) - B49-22 (OC1-)	V - L	Camshaft timing oil control valve for intake side	Idling	Pulse generation (see waveform 11)
D60-36 (MREL) - B49-6 (E1)	G - W-B	EFI relay	Ignition switch ON	11 to 14 V
B50-11 (VG) - B50-5 (E2G)	R - Y	Mass air flow meter	Idling, shift lever in P or N, A/C switch off	0.5 to 3.0 V

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B50-6 (THA) - B50-12 (ETHA)	P - BR	Intake air temperature sensor (built into mass air flow meter)	Idling, intake air temperature 20°C (68°F)	0.5 to 3.4 V
B51-18 (THW) - B51-17 (ETHW)	W - BR	Engine coolant temperature sensor	Idling, engine coolant temperature 80°C (176°F)	0.2 to 1.0 V
B51-11 (VCTA) - B51-5 (ETA)	R - BR	Power source of throttle position sensor (specific voltage)	Ignition switch ON	4.5 to 5.5 V
B51-9 (VTA1) - B51-5 (ETA)	V - BR	Throttle position sensor (for engine control)	Ignition switch ON, accelerator pedal released	0.5 to 1.1 V
			Ignition switch ON, accelerator pedal fully depressed	3.2 to 4.8 V
B51-10 (VTA2) - B51-5 (ETA)	LG - BR	Throttle position sensor (for sensor malfunction detection)	Ignition switch ON, accelerator pedal released	2.1 to 3.1 V
			Ignition switch ON, accelerator pedal fully depressed	4.6 to 4.9 V
D60-6 (VPA) - D60-2 (EPA)	R-SB	Accelerator pedal position sensor (for engine control)	Ignition switch ON, accelerator pedal released	0.5 to 1.1 V
			Ignition switch ON, accelerator pedal fully depressed	2.6 to 4.5 V
D60-5 (VPA2) - D60-1 (EPA2)	GR-V	Accelerator pedal position sensor (for sensor malfunction detection)	Ignition switch ON, accelerator pedal released	1.2 to 2.0 V
			Ignition switch ON, accelerator pedal fully depressed	3.4 to 5.5 V
D60-4 (VCPA) - D60-2 (EPA)	L-SB	Power source of accelerator pedal position sensor (for VPA)	Ignition switch ON	4.5 to 5.5 V
D60-3 (VCP2) - D60-1 (EPA2)	P-V	Power source of accelerator pedal position sensor (for VPA2)	Ignition switch ON	4.5 to 5.5 V
B49-29 (HA1A) - B48-11 (E04)	L - W-B	Air fuel ratio sensor heater	Idling with warm engine	Pulse generation (see waveform 2 2)
			Ignition switch ON	11 to 14 V
B49-7 (A1A+) - B49-6 (E1)	BR - W-B	Air fuel ratio sensor	Ignition switch ON	3.3 V*
B49-1 (A1A-) - B49-6 (E1)	Y - W-B	Air fuel ratio sensor	Ignition switch ON	3.0 V*
B49-23 (HT1B) - B48-6 (E03)	B - W-B	Heated oxygen sensor heater	Ignition switch ON	11 to 14 V

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B49-2 (OX1B) - B49-8 (O1B-)	BR-Y	Heated oxygen sensor	Engine speed maintained at 2500 rpm for 2 minutes after warming up engine	Pulse generation (see waveform 3 3)
B48-7 (#10) - B48-1 (E01)	L - W	Fuel injector	Ignition switch ON	11 to 14 V
B48-8 (#20) - B48-1 (E01) B48-9 (#30) - B48-1 (E01) B48-10 (#40) - B48-1 (E01)	Y - W B - W W - W		Idling	Pulse generation (see waveform 4 4)
B51-12 (KNK1) - B51-6 (EKNK)	B - W	Knock sensor	Engine speed maintained at 4000 rpm after warming up engine	Pulse generation (see waveform 5 5)
B49-17 (G2+) - B49-5 (G2-)	Y - P	Camshaft position sensor for intake side	Idling	Pulse generation (see waveform 6 6)
B50-14 (NE+) - B50-2 (NE-)	W - B	Crankshaft position sensor	Idling	Pulse generation (see waveform 6 6)
B48-2 (IGT1) - B49-6 (E1) B48-3 (IGT2) - B49-6 (E1) B48-4 (IGT3) - B49-6 (E1) B48-5 (IGT4) - B49-6 (E1)	Y - W-B P - W-B G - W-B L - W-B	Ignition coil (ignition signal)	Idling	Pulse generation (see waveform 7 7)
B48-16 (IGF1) - B49-6 (E1)	W - W-B	Ignition coil (ignition confirmation signal)	Ignition switch ON	4.5 to 5.5 V
			Idling	Pulse generation (see waveform 7 7)
B51-26 (PRG) - B49-6 (E1)	Y - W-B	Purge VSV	Ignition switch ON	11 to 14 V
			Idling	Pulse generation (see waveform 8 8)
D60-29 (SPD) - B49-6 (E1)	LG - W-B	Speed signal from combination meter	Vehicle driven at 12 mph (20 km/h)	Pulse generation (see waveform 9 9)
D60-8 (STA) - B49-6 (E1)	O - W-B	Starter signal	Cranking	5.5 V or higher
B51-24 (NSW) - B49-6 (E1)	GR - W-B	Park/neutral position switch signal	Ignition switch ON, shift lever in P or N	Below 1.5 V
			Ignition switch ON, shift lever not in P or N	6.0 V or higher

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D60-20 (STP) - B49-6 (E1)	R - W-B	Stop light switch assembly	Brake pedal depressed	7.5 to 14 V
			Brake pedal released	Below 1.5 V
D60-15 (ST1-) - B49-6 (E1)	LG - W-B	Stop light switch assembly (opposite to voltage at STP terminal)	Ignition switch ON, brake pedal depressed	Below 1.5 V
			Ignition switch ON, brake pedal released	7.5 to 14 V
B48-18 (M+) - B48-20 (ME01)	R - W-B	Throttle actuator	Idling with warm engine	Pulse generation (see waveform 10 10)
B48-19 (M-) - B48-20 (ME01)	L - W-B	Throttle actuator	Idling with warm engine	Pulse generation (see waveform 11 11)
D60-34 (FC) - B49-6 (E1)	P - W-B	Fuel pump control	Ignition switch ON	11 to 14 V
			Idling	Below 1.5 V
D60-18 (W) - B49-6 (E1)	Y - W-B	MIL	Ignition switch ON (MIL turns on)	Below 1.5 V
			Idling	11 to 14 V
D60-35 (TC) - B49-6 (E1)	Y - W-B	Terminal TC of DLC3	Ignition switch ON	11 to 14 V
D60-23 (TACH) - B49-6 (E1)	GR - W-B	Engine speed	Idling	Pulse generation (see waveform 12 12)
D61-7 (VPMP) - B49-6 (E1)	P - W-B	Vent valve (built into canister pump module)	Ignition switch ON	11 to 14 V
D61-9 (MPMP) - B49-6 (E1)	G - W-B	Leak detection pump (built into canister pump module)	Leak detection pump OFF	Below 3 V
			Leak detection pump ON	11 to 14 V
B51-3 (VCPP) - B51-4 (EPPM)	Y - BR	Power source for canister pressure sensor (specific voltage)	Ignition switch ON	4.5 to 5.5 V
B51-2 (PPMP) - B51-4 (EPPM)	W - BR	Canister pressure sensor (built into canister pump module)	Ignition switch ON	3 to 3.6 V
B49-25 (ALT) - B49-6 (E1)	R - BR	Generator	Ignition switch ON	11 to 14 V
D61-18 (CANH) - B49-6 (E1)	R - W-B	CAN communication line	Ignition switch ON	Pulse generation (see waveform 13 13)
D61-20 (CANL) - B49-6 (E1)	W - W-B	CAN communication line	Ignition switch ON	Pulse generation (see waveform 14 14)
B51-27 (ACIS) - B49-6 (E1)	L - W-B	VSV for Acoustic Control Induction System (ACIS) operation signal	Ignition switch ON	11 to 14 V
B50-25 (OE1+) - B50-19 (OE1-	G-R	Camshaft timing oil control valve for exhaust side	Idling	Pulse generation (see waveform 1

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)				1)
B49-11 (VCV1) - B49-6 (E1)	L - W-B	Power source of camshaft position sensor for intake side (specific voltage)	Ignition switch ON	4.5 to 5.5 V
B50-7 (VCE1) - B49-6 (E1)	B - W-B	Power source of camshaft position sensor for exhaust side (specific voltage)	Ignition switch ON	4.5 to 5.5 V
B50-13 (EV1+) - B50-1 (EV1-)	G - W	Camshaft position sensor for exhaust side	Idling	Pulse generation (see waveform 6 6)
B51-33 (IA1+) - B48-1 (E01)	W - W	DC motor for tumble control valve	Idling with cold engine	Pulse generation (see waveform 15 15)
B51-34 (IA1-) - B48-1 (E01)	B - W	DC motor for tumble control valve	Idling with cold engine	Pulse generation (see waveform 16 16)
B50-18 (IAC1) - B50-17 (EIA1)	GR - BR	Tumble control valve position sensor	Ignition switch ON	3.0 to 4.0 V
B50-16 (VCIA) - B49-6 (E1)	V - W-B	Power source of tumble control valve position sensor (specific voltage)	Ignition switch ON	4.5 to 5.5 V
B51-35 (AICV) - B49-6 (E1)	P - W-B	VSV for air intake control system operation signal	Ignition switch ON	11 to 14 V
B51-30 (CAN+) - B49-6 (E1)	B - W-B	CAN communication line	ignition switch ON	Pulse generation (see waveform 17 17)
B51-36 (CAN-) - B49-6 (E1)	W - W-B	CAN communication line	Ignition switch ON	Pulse generation (see waveform 18 18)
D60-28 (SFTU) - B49-6 (E1)	V - W-B	Up shift switch signal	Ignition switch ON and shift lever in S	11 to 14 V
			Ignition switch ON and shift lever in S, the "+" range (up shift) selected	0 to 1.5 V
D61-4 (SFTD) - B49-6 (E1)	Y - W-B	Down shift switch signal	Ignition switch ON and shift lever in S	11 to 14 V
			Ignition switch ON and shift lever in S, the "-" range (down shift) selected	0 to 1.5 V
D61-10 (RFC) - B49-6 (E1)	BR - W-B	Cooling fan control	Ignition switch ON	Below 1.5 V
B50-28 (P) - B49-6 (E1)	L - W-B	P shift position switch signal	Ignition switch ON and shift lever in P	11 to 14 V
			Ignition switch ON and shift	

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			lever in any position other than P	0 to 1.5 V
B50-27 (R) - B49-6 (E1)	B - W-B	R shift position switch signal	Ignition switch ON and shift lever in R	11 to 14 V
			Ignition switch ON and shift lever in any position other than R	0 to 1.5 V
B50-26 (N) - B49-6 (E1)	LG - W-B	N shift position switch signal	Ignition switch ON and shift lever in N	11 to 14 V
			Ignition switch ON and shift lever in any position other than N	0 to 1.5 V
B50-30 (D) - B49-6 (E1)	G - W-B	D shift position switch signal	Ignition switch ON and shift lever in D	11 to 14 V
			Ignition switch ON and shift lever in any position other than D	0 to 1.5 V
D60-30 (S) - B49-6 (E1)	SB - W-B	S shift position switch signal	Ignition switch ON and shift lever in S	11 to 14 V
			Ignition switch ON and shift lever in any position other than S	0 to 1.5 V
HINT: *: The ECM terminal voltage is constant regardless of the output voltage shown on the Techstream.				

1. **WAVEFORM 1**

Camshaft Timing Oil Control Valve Signal

WAVEFORM REFERENCE

Terminal No. (Symbol)	Tool Setting	Condition
B49-28 (OC1+) - B49-22 (OC1-)	5 V/DIV, 1 ms/DIV	Idling
B50-25 (OE1+) - B50-19 (OE1-)	5 V/DIV, 1 ms/DIV	Idling

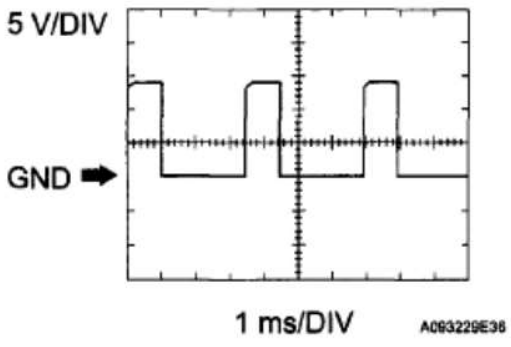


Fig. 14: Identifying Waveform 1

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2. **WAVEFORM 2**

Air Fuel Ratio Sensor (Bank 1 Sensor 1) Heater Signal

WAVEFORM REFERENCE

Terminal No. (Symbol)	Tool Setting	Condition
B49-29 (HA1A) - B48-11 (E04)	5 V/DIV, 10 ms/DIV	Idling with warm engine

HINT:

The wavelength varies in accordance with the engine operating condition.

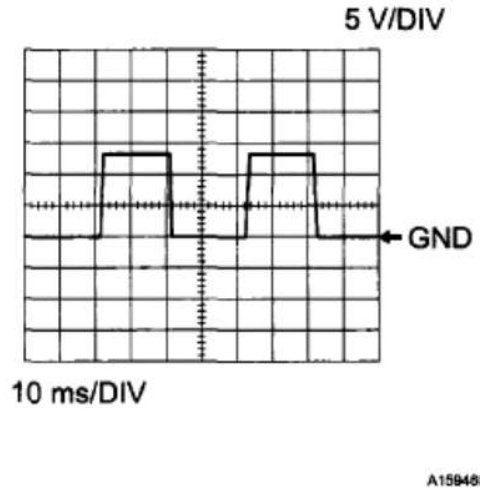


Fig. 15: Identifying Waveform 2
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

3. **WAVEFORM 3**

Heated Oxygen Sensor (Bank 1 Sensor 2) Signal

WAVEFORM REFERENCE

Terminal No. (Symbol)	Tool Setting	Condition
B49-2 (OX1B) - B49-8 (O1B-)	0.2 V/DIV, 200 ms/DIV	Engine speed maintained at 2500 rpm for 2 minutes after warming up engine

HINT:

In the Data List, item O2S B1 S2 shows the ECM input values from the heated oxygen sensor.

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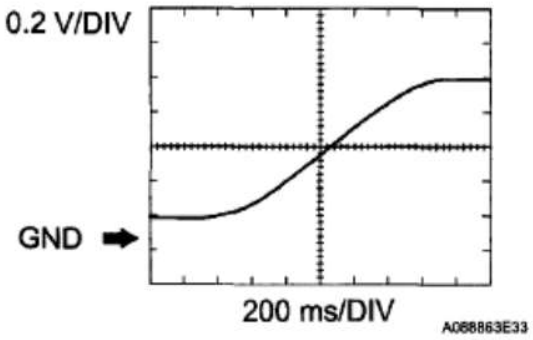


Fig. 16: Identifying Waveform 3
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

4. **WAVEFORM 4**

Injector No. 1 (to No. 4) Injection Signal

WAVEFORM REFERENCE

Terminal No. (Symbol)	Tool Setting	Condition
B48-7 (#10) - B48-1 (E01)	20 V/DIV, 20 ms/DIV	Idling
B48-8 (#20) - B48-1 (E01)	20 V/DIV, 20 ms/DIV	Idling
B48-9 (#30) - B48-1 (E01)	20 V/DIV, 20 ms/DIV	Idling
B48-10 (#40) - B48-1 (E01)	20 V/DIV, 20 ms/DIV	Idling

HINT:

The wavelength becomes shorter as the engine speed increases.

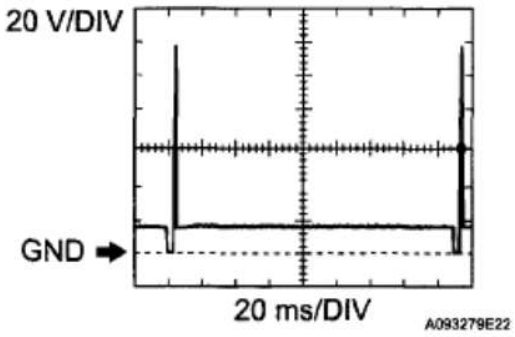


Fig. 17: Identifying Waveform 4
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

5. **WAVEFORM 5**

Knock Sensor Signal

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WAVEFORM REFERENCE

Terminal No. (Symbol)	Tool Setting	Condition
B51-12 (KNK1) - B51-6 (EKNK)	1 V/DIV, 1 ms/DIV	Engine speed maintained at 4000 rpm after warming up engine

HINT:

- The wavelength becomes shorter as the engine speed increases.
- The waveforms and amplitudes displayed differ slightly depending on the vehicle.

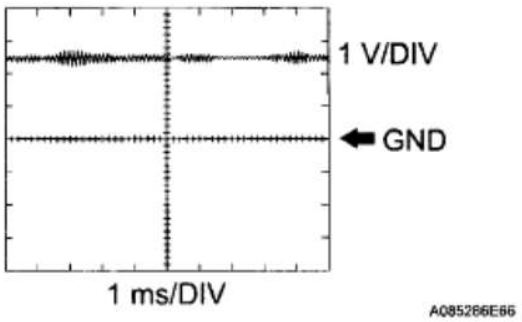


Fig. 18: Identifying Waveform 5
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

6. **WAVEFORM 6**

Crankshaft Position Sensor and Camshaft Position Sensor Signal

WAVEFORM REFERENCE

Terminal No. (Symbol)	Tool Setting	Condition
B50-14 (NE+) - B50-2 (NE-)	5 V/DIV, 20 ms/DIV	idling
B49-17 (G2+) - B49-5 (G2-)	5 V/DIV, 20 ms/DIV	Idling
B50-13 (EV1+) - B50-1 (EV1-)	5 V/DIV, 20 ms/DIV	Idling

HINT:

The wavelength becomes shorter as the engine speed increases.

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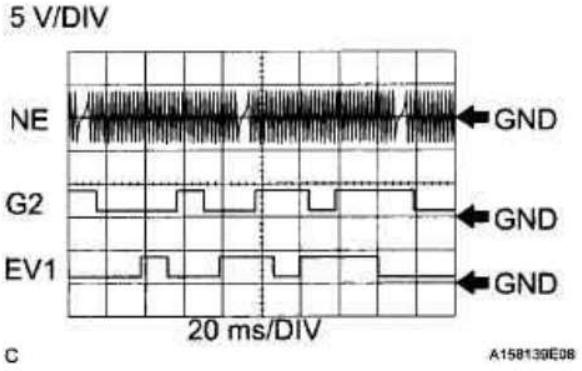


Fig. 19: Identifying Waveform 6
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

7. **WAVEFORM 7**

Ignition Coil IGT Signal (from ECM to Ignition Coil) and Ignition Coil IGF Signal (from Ignition Coil to ECM)

WAVEFORM REFERENCE

Terminal No. (Symbol)	Tool Setting	Condition
B48-2 (IGT1) - B49-6 (E1)	2 V/DIV, 20 ms/DIV	Idling
B48-3 (IGT2) - B49-6 (E1)	2 V/DIV, 20 ms/DIV	Idling
B48-4 (IGT3) - B49-6 (E1)	2 V/DIV, 20 ms/DIV	Idling
B48-5 (IGT4) - B49-6 (E1)	2 V/DIV, 20 ms/DIV	Idling
B48-16 (IGF1) - B49-6 (E1)	2 V/DIV, 20 ms/DIV	Idling

HINT:

The wavelength becomes shorter as the engine speed increases.

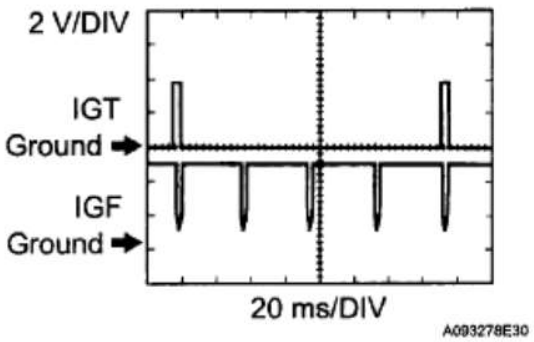


Fig. 20: Identifying Waveform 7
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

8. **WAVEFORM 8**

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Purge VSV Signal

WAVEFORM REFERENCE

Terminal No. (Symbol)	Tool Setting	Condition
B51-26 (PRG) - B49-6 (E1)	10 V/DIV, 20 ms/DIV	Idling

HINT:

If the waveform is not similar to the illustration, check the waveform again after idling for 10 minutes or more.

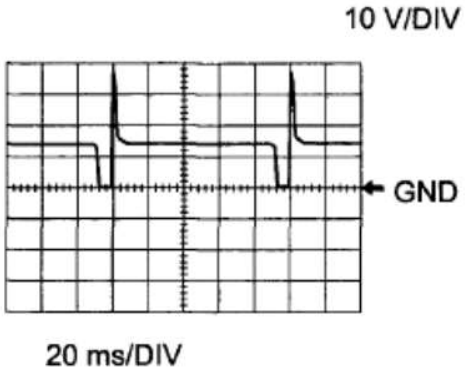


Fig. 21: Identifying Waveform 8
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

9. **WAVEFORM 9**

Vehicle Speed Signal

WAVEFORM REFERENCE

Terminal No. (Symbol)	Tool Setting	Condition
D60-29 (SPD) - B49-6 (E1)	2 V/DIV, 20 ms/DIV	Vehicle driven at 12 mph (20 km/h)

HINT:

The wavelength becomes shorter as the vehicle speed increases.

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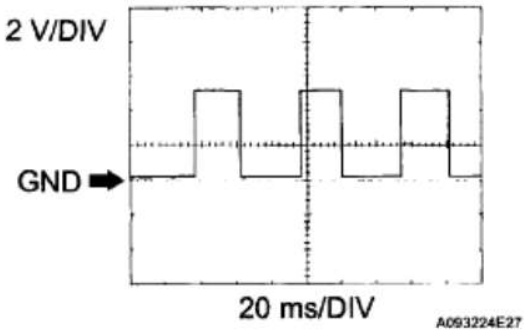


Fig. 22: Identifying Waveform 9
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

10. **WAVEFORM 10**

Throttle Actuator Positive Terminal Signal

WAVEFORM REFERENCE

Terminal No. (Symbol)	Tool Setting	Condition
B48-18 (M+) - B48-20 (ME01)	5 V/DIV, 1 ms/DIV	Idling with warm engine

HINT:

The duty ratio varies depending on the throttle actuator operation.

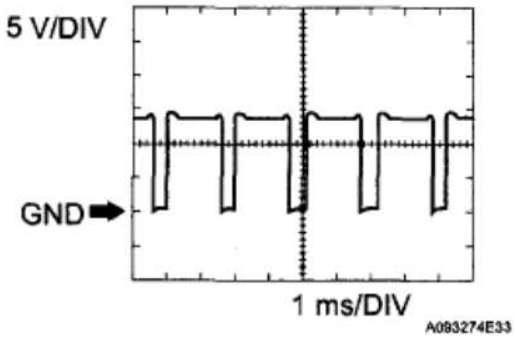


Fig. 23: Identifying Waveform 10
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

11. **WAVEFORM 11**

Throttle Actuator Negative Terminal Signal

WAVEFORM REFERENCE

Terminal No. (Symbol)	Tool Setting	Condition
B48-19 (M-) - B48-20 (ME01)	5 V/DIV, 1 ms/DIV	Idling with warm engine

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HINT:

The duty ratio varies depending on the throttle actuator operation.

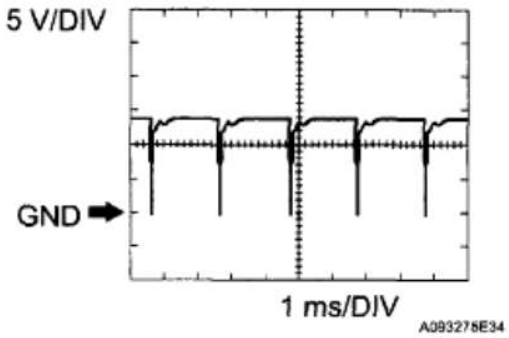


Fig. 24: Identifying Waveform 11
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

12. **WAVEFORM 12**

Engine Speed Signal

WAVEFORM REFERENCE

Terminal No. (Symbol)	Tool Setting	Condition
D60-23 (TACH) - B49-6 (E1)	5 V/DIV, 10 ms/DIV	Idling

HINT:

The wavelength becomes shorter as the engine speed increases.

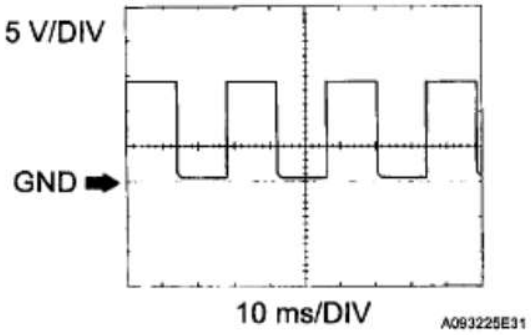


Fig. 25: Identifying Waveform 12
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

13. **WAVEFORM 13**

CAN Communication Signal (Reference)

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WAVEFORM REFERENCE

Terminal No. (Symbol)	Tool Setting	Condition
D61-18 (CANH) - B49-6 (E1)	1 V/DIV, 10 µs/DIV	Ignition switch ON

HINT:

The waveform varies depending on the CAN communication signal.

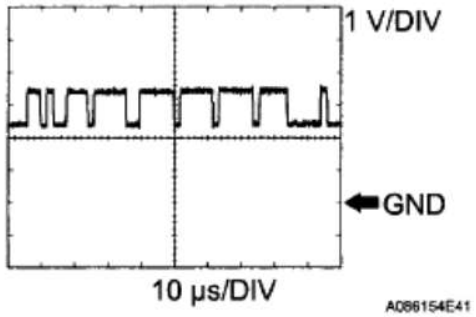


Fig. 26: Identifying Waveform 13
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

14. **WAVEFORM 14**

CAN Communication Signal (Reference)

WAVEFORM REFERENCE

Terminal No. (Symbol)	Tool Setting	Condition
D61-20 (CANL) - B49-6 (E1)	1 V/DIV, 10 µs/DIV	Ignition switch ON

HINT:

The waveform varies depending on the CAN communication signal.

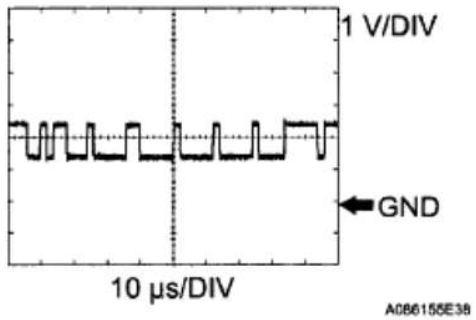


Fig. 27: Identifying Waveform 14
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15. **WAVEFORM 15**

DC Motor for Tumble Control Valve Positive Terminal Signal

WAVEFORM REFERENCE

Terminal No. (Symbol)	Tool Setting	Condition
B51-33 (IA1+) - B48-1 (E01)	5 V/DIV, 1 ms/DIV	Idling with cold engine

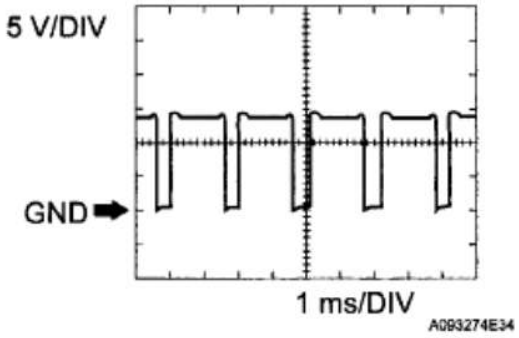


Fig. 28: Identifying Waveform 15
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

16. **WAVEFORM 16**

DC Motor for Tumble Control Valve Negative Terminal Signal

WAVEFORM REFERENCE

Terminal No. (Symbol)	Tool Setting	Condition
B51-34 (IA1-) - B48-1 (E01)	5 V/DIV, 1 ms/DIV	Idling with cold engine

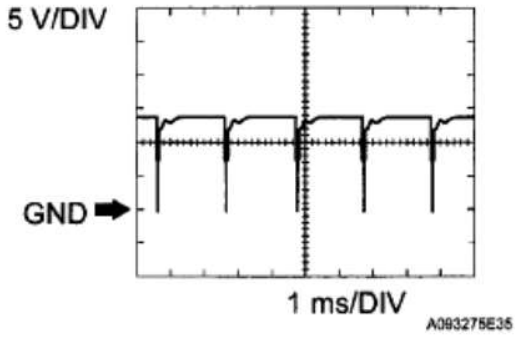


Fig. 29: Identifying Waveform 16
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17. **WAVEFORM 17**

CAN Communication Signal

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WAVEFORM REFERENCE

Terminal No. (Symbol)	Tool Setting	Condition
B51-30 (CAN+) - B49-6 (E1)	1 V/DIV, 10 µsec/DIV	Ignition switch ON

HINT:

The waveform varies depending on the CAN communication signal.

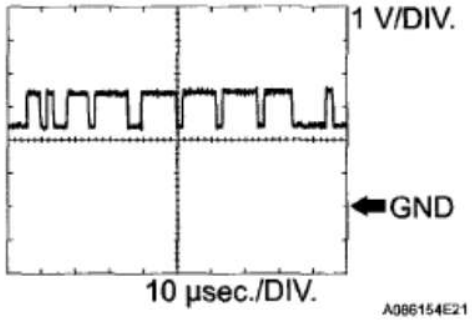


Fig. 30: Identifying Waveform 17
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18. **WAVEFORM 18**

CAN Communication Signal

WAVEFORM REFERENCE

Terminal No. (Symbol)	Tool Setting	Condition
B51-36 (CAN-) - B49-6 (E1)	1 V/DIV, 10 µsec/DIV	Ignition switch ON

HINT:

The waveform varies depending on the CAN communication signal.

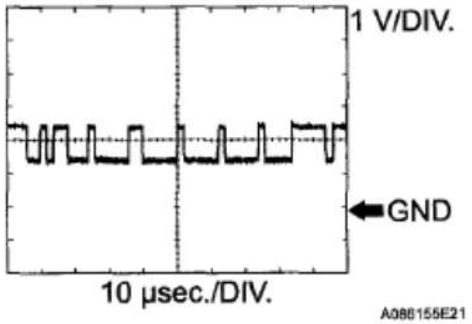


Fig. 31: Identifying Waveform 18
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DIAGNOSIS SYSTEM

1. DESCRIPTION

When troubleshooting OBD II (On-Board Diagnostics) vehicles, the Techstream (complying with SAE J1987) must be connected to the DLC3 (Data Link Connector 3) of the vehicle. Various data in the vehicle's ECM (Engine Control Module) can be then read.

OBD II regulations require that the vehicle's on-board computer illuminates the MIL (Malfunction Indicator Lamp) on the instrument panel when the computer detects a malfunction in:

a. The emission control system and components.
b. The powertrain control components (which affect vehicle emissions).
c. The computer itself.

In addition, the applicable DTCs prescribed by SAE J2012 are stored in the ECM memory. If the malfunction does not recur in 3 consecutive trips, the MIL turns off automatically but the DTCs remain stored in the ECM memory.



Fig. 32: Identifying MIL (Malfunction Indicator Lamp)
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To check the DTCs, connect the Techstream to the DLC3. The Techstream displays output DTCs, freeze frame data, and a variety of engine data. The DTCs and freeze frame data can be cleared with the Techstream. In order to enhance OBD function on vehicles and develop the Off-Board diagnosis system, Controller Area Network (CAN) communication is used in this system. CAN is a network which uses a pair of data transmission lines spanning multiple computers and sensors. It allows for high speed communications between the systems and simplification of the wire harness connections.

2. NORMAL MODE AND CHECK MODE

The diagnosis system operates in normal mode during normal vehicle use. In normal mode, 2 trip detection logic is used to ensure accurate detection of malfunctions. Check mode is also available as an option for technicians. In check mode, 1 trip detection logic is used for simulating malfunction symptoms and increasing the ability of the system to detect malfunctions, including intermittent problems (Techstream only).

3. TRIP DETECTION LOGIC

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When a malfunction is first detected, the malfunction is temporarily stored in the ECM memory (1st trip). If the same malfunction is detected during the next subsequent drive cycle, the MIL is illuminated (2nd trip).

4. **DLC3 (Data Link Connector 3)**
   a. Check the DLC3 (See **HOW TO TROUBLESHOOT ECU CONTROLLED SYSTEMS**).
5. **FREEZE FRAME DATA**

   The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can be helpful in determining whether the vehicle was moving or stationary, whether the engine was warmed up or not, whether the air fuel ratio was lean or rich, as well as other data stored at the time of a malfunction.

6. **BATTERY VOLTAGE**

   Standard voltage:

   11 to 14 V

   If voltage is below 11V, replace or recharge the battery before proceeding.

7. **MIL (Malfunction Indicator Lamp)**
   a. The MIL is illuminated when the ignition switch is first turned to ON (the engine is not running).
   b. The MIL turns off when the engine is started. If the MIL remains illuminated, the diagnosis system has detected a malfunction or abnormality in the system.

      HINT:

      If the MIL is not illuminated when the ignition switch is first turned to ON, check the **MIL CIRCUIT** .

8. **ALL READINESS**

   HINT:

   - With "All Readiness", you can check whether or not the DTC judgment has been completed by using the Techstream.
   - You should check "All Readiness" after simulating malfunction symptoms or for validation after finishing repairs.

   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the Techstream on.
   d. Clear the DTCs (See **DTC CHECK/CLEAR**).
   e. Perform the DTC judgment driving pattern to run the DTC judgment.
   f. Enter the following menus: Powertrain/Engine/Utility/All Readiness.

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g. Input the DTCs to be confirmed.
h. Check the DTC judgment result.

TECHSTREAM DISPLAY DESCRIPTION

Techstream Display	Description
NORMAL	• DTC judgment completed • System normal
ABNORMAL	• DTC judgment complete • System abnormal
INCOMPLETE	• DTC judgment not complete • Driving pattern should be performed after confirming DTC enabling conditions
UNKNOWN	• Unable to perform DTC judgment • Number of DTCs which do not fulfill DTC preconditions has reached ECU memory limit

DTC CHECK/CLEAR

NOTE: When the diagnosis system is changed from normal mode to check mode or vice versa, all DTCs and freeze frame data recorded in normal mode are cleared. Before changing modes, always check and make a note of DTCs and freeze frame data.

HINT:

- DTCs which are stored in the ECM can be displayed on the Techstream. The Techstream can display the current, pending and permanent DTCs.
- If a malfunction is detected during the current driving cycle, current and permanent DTCs are stored.
- Some DTCs are not stored if the ECM does not detect the same malfunction again during a second consecutive driving cycle. However, such malfunctions, detected on only one occasion, are stored as pending DTCs.
- Current and pending DTCs can be cleared by using the Techstream or by disconnecting the cable from the negative battery terminal. However, permanent DTCs cannot be cleared using either of these two methods.
- After clearing current DTCs using the Techstream (or by disconnecting the cable from the negative battery terminal), permanent DTCs can be cleared when the system is determined to be normal for the relevant DTCs and then the universal trip is performed. The driving pattern to obtain a normal judgment is described under the "CONFIRMATION DRIVING PATTERN" for the respective DTC.

2 Trip Detection Examples

2 TRIP DETECTION REFERENCE

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Pending DTC	Store condition	Malfunction detected
	Clear condition	System determined to be normal or DTCs cleared using Techstream or Cable disconnected from negative battery terminal
Current DTC	Store condition	Malfunction detected (2nd trip)
	Clear condition	No malfunctions in 40 driving cycles or DTCs cleared using Techstream or Cable disconnected from negative battery terminal
Permanent DTC	Store condition	Malfunction detected (2nd trip)
	Clear condition	Ignition switch turned to ON after normal judgment obtained in 3 consecutive driving cycles or After DTCs cleared using Techstream or cable disconnected from negative battery terminal, normal judgment obtained and universal trip performed (not for misfire and fuel system DTCs) or After DTCs cleared using Techstream or cable disconnected from negative battery terminal, malfunction not detected when universal trip driving performed (misfire and fuel system DTCs)
MIL	ON	Malfunction detected (2nd trip)
	OFF	Ignition switch turned to ON after normal judgment obtained in 3 consecutive driving cycles or DTCs cleared using Techstream or Cable disconnected from negative battery terminal

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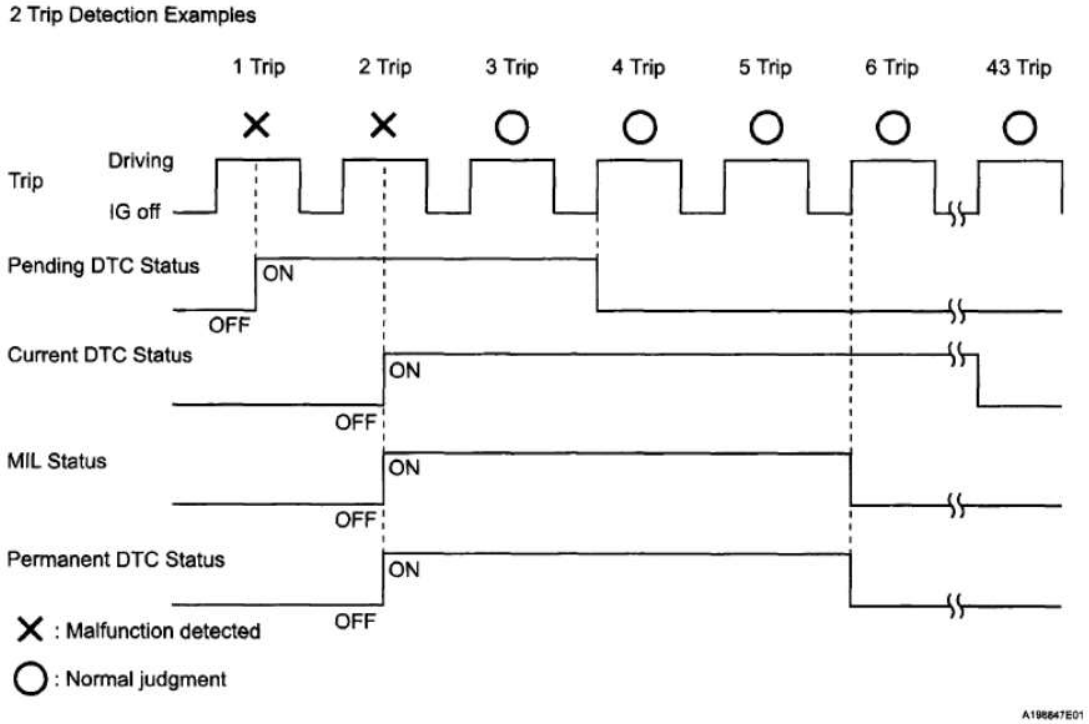


Fig. 33: 2 Trip Detection Malfunction Chart (1 Of 2)
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2 Trip Detection Examples (Instance when DTCs were cleared midway through by using the Techstream or by disconnecting the cable from the negative battery terminal)

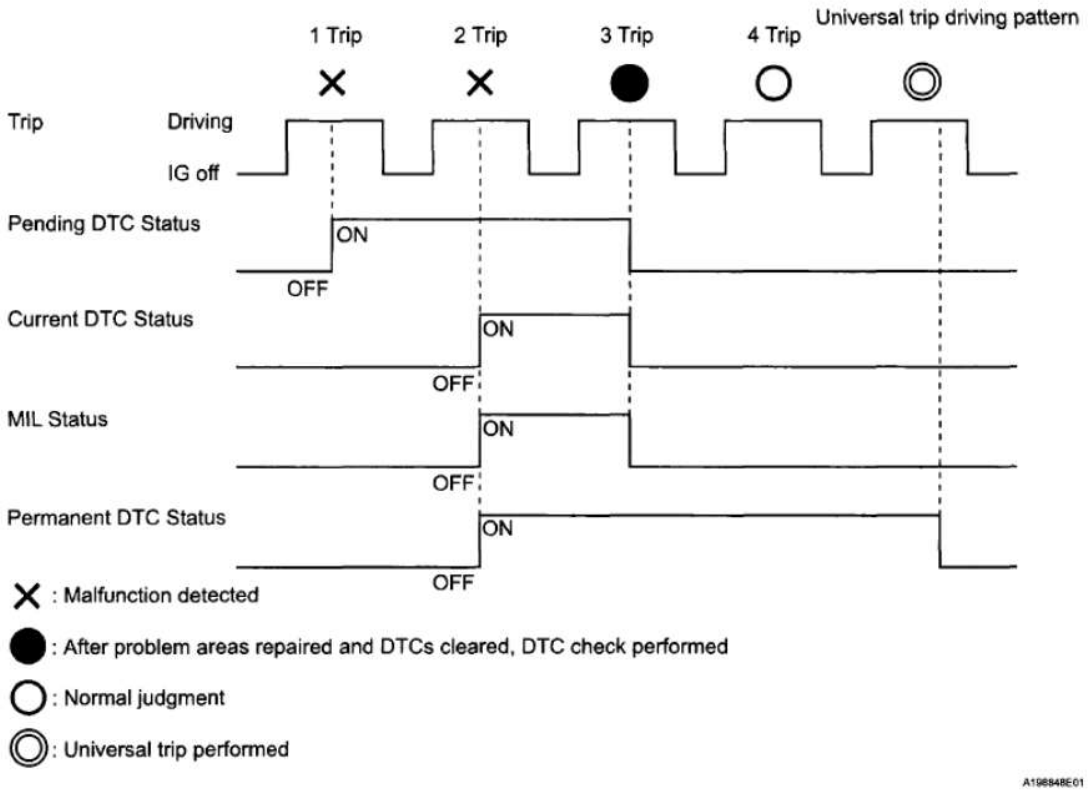


Fig. 34: 2 Trip Detection Malfunction Chart (2 Of 2)
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HINT:

- Obtaining a normal judgment and performing a universal trip driving pattern can be done in the same driving cycle or in different driving cycles.
- It is unnecessary to obtain a normal judgment if the DTCs are misfire or fuel system DTCs.

1. **CHECK DTC**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the Techstream on.
   d. Enter the following menus: Powertrain/Engine/Trouble Codes.
   e. Check the DTC (s) and freeze frame data, and then write them down.
   f. Check the details of the DTC (s) (See **DIAGNOSTIC TROUBLE CODE CHART**).
2. **CLEAR DTC (Pending and Current DTC)**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch to ON.

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c. Turn the Techstream on.
d. Enter the following menus: Powertrain/Engine/Trouble Codes.
e. Clear the DTCs.

3. **CLEAR DTC (Pending and Current DTC without using Techstream)**
   a. Perform either of the following operations:
      1. Disconnect the cable from the negative (-) battery terminal for more than 1 minute.
      2. Remove the EFI NO. 1 and ETCS fuses from the engine room relay block located inside the engine compartment for more than 1 minute.
4. **CLEAR PERMANENT DTC**

HINT:

Even if the following procedure is not performed, permanent DTCs are cleared by obtaining a normal judgment during 3 consecutive driving cycles.

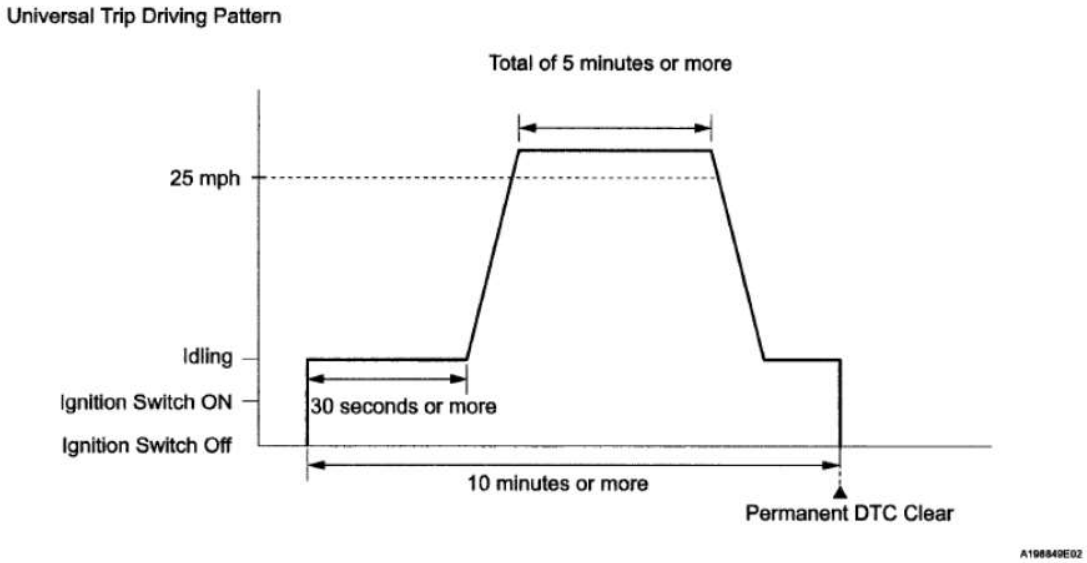


Fig. 35: Vehicle Speed Driving Pattern
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a. Connect the Techstream to the DLC3.
b. Turn the ignition switch to ON.
c. Turn the Techstream on.
d. Enter the following menus: Powertrain/Engine/Trouble Codes.
e. Check if permanent DTCs are stored.

HINT:

If permanent DTCs are not output, it is not necessary to continue this procedure.

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f. Clear the DTCs.

g. Perform the respective confirmation driving patterns in order to obtain a normal judgment for the output DTCs.

HINT:

- Confirmation driving patterns do not need to be performed for misfire and fuel system DTCs.
- For the confirmation driving pattern, refer to the procedures for the relevant DTC (See **DIAGNOSTIC TROUBLE CODE CHART**).

h. Perform the universal trip.

HINT:

The driving pattern to obtain a normal judgment and the universal trip driving can be performed consecutively in the same driving cycle.

1. Idle the engine for 30 seconds or more.
2. Drive the vehicle at 25 mph (40 km/h) or more for a total of 5 minutes or more.

   HINT:

   It is possible to complete the drive pattern even if the vehicle decelerates to less than 25 mph (40 km/h) during the driving cycle provided that the vehicle is driven at 25 mph (40 km/h) or more for a total of 5 minutes.

3. Allow 10 minutes or more to elapse from the time the engine is started.

i. Enter the following menus: Powertrain/Engine/Trouble Codes.

j. Check that the permanent DTCs have been cleared.

HINT:

The permanent DTCs are cleared when the universal trip is completed.

FREEZE FRAME DATA

1. DESCRIPTION

The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can be helpful in determining whether the vehicle was moving or stationary, whether the engine was warmed up or not, whether the air fuel ratio was lean or rich, as well as other data recorded at the time of a malfunction.

HINT:

If it is impossible to replicate the problem even though a DTC is output, confirm the freeze frame data.

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The ECM records engine conditions in the form of freeze frame data every 0.5 seconds. Using the Techstream, 5 separate sets of freeze frame data, including the data values at the time when the DTC is stored, can be checked.

- 3 data sets before the DTC is stored.
- 1 data set when the DTC is stored.
- 1 data set after the DTC is stored.

These data sets can be used to simulate the condition of the vehicle around the time of the occurrence of the malfunction. The data may assist in identifying the cause of the malfunction, and in judging whether it was temporary or not.

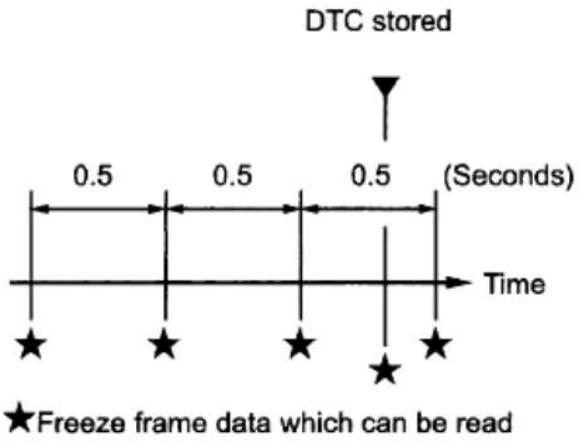


Fig. 36: Identifying Freeze Frame Data
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2. **LIST OF FREEZE FRAME DATA**

LIST OF FREEZE FRAME DATA

Techstream Display	Measurement item	Diagnostic Note
Vehicle Speed	Vehicle speed	The speed indicated on the speedometer.
Engine Speed	Engine speed	-
Calculate Load	Calculated load	The load calculated by the ECM.
Vehicle Load	Vehicle load	The load percentage in terms of the maximum intake air flow amount.
		If the value is approximately 0.0 gm/sec: • The mass air flow meter power source circuit is open.

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MAF	Air flow rate from mass air flow meter	• The VG circuit is open or shorted. If 0.71 gm/sec. or more when 30 seconds after ignition switch turned to ON: • The E2G circuit is open.
Atmosphere Pressure	Atmospheric pressure	-
Coolant Temp	Engine coolant temperature	• If the value is -40°C (-40°F), the sensor circuit is open. • If the value is 140°C (284°F) or higher, the sensor circuit is shorted.
Intake Air	Intake air temperature	• If the value is -40°C (-40°F), the sensor circuit is open. • If the value is 140°C (284°F) or higher, the sensor circuit is shorted.
Ambient Temperature	Ambient temperature	-
Engine Run Time	Accumulated engine running time	-
Initial Engine Coolant Temp	Engine coolant temperature at engine start	-
Initial Intake Air Temp	Initial intake air temperature	-
Battery Voltage	Battery voltage	-
Accel Sens. No. 1 Volt %	Absolute accelerator pedal position No. 1	-
Accel Sens. No. 2 Volt %	Absolute accelerator pedal position No. 2	-
Throttle Sensor Volt %	Absolute throttle position sensor	The throttle opening angle recognized by the ECM. Read the value with the ignition switch ON.
Throttl Sensor #2 Volt %	Absolute throttle position sensor #2	The throttle opening angle recognized by the ECM. Read the value with the ignition switch ON.
Throttle Sensor Position	Throttle sensor positioning	The calculated value based on VTA1. Read the value with the ignition switch ON.
Throttle Motor DUTY	Throttle actuator	-
Injector (Port)	Injection period of No. 1 cylinder	-
Injection Volum (Cylinder1)	Injection volume (cylinder 1)	The quantity of fuel injection volume for 10 times.
Fuel Pump/Speed Status	Fuel pump/status	-

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Vacuum Pump	Key-off EVAP system leak detection pump status	-
TCV Status	Tumble control valve status	-
EVAP (Purge) VSV	EVAP (purge) VSV control duty	The order signal from the ECM.
Evap Purge Flow	Ratio of evaporative purge flow to intake air volume	-
Purge Density Learn Value	Learned value of purge density	-
EVAP System Vent Valve	Key-off EVAP system vent valve status	-
EVAP Purge VSV	VSV status for EVAP control	-
Purge Cut VSV Duty	Purge cut VSV duty	-
Target Air-Fuel Ratio	Ratio compared to stoichiometric level	-
AF Lambda B1 S1	Fuel trim at air fuel ratio sensor	-
AF FT B1 S1	Fuel trim at air fuel ratio sensor	-
AFS Voltage B1 S1	Air fuel ratio sensor output voltage for bank 1 sensor 1	Performing the Control the Injection Volume or Control the Injection Volume for A/F Sensor function of the Active Test enables the technician to check the output voltage of the sensor.
AFS Current B1 S1	Air fuel ratio sensor output current for bank 1 sensor 1	-
A/F Heater Duty #1	Air fuel ratio heater duty ratio	-
O2S B1 S2	Heated oxygen sensor output voltage for bank 1 sensor 2	Performing the Control the Injection Volume or Control the Injection Volume for A/F Sensor function of the Active Test enables the technician to check the output voltage of the sensor.
O2S Impedance B1 S2	Heated oxygen sensor impedance for bank 1 sensor 2	-
O2 Heater B1 S2	Heated oxygen sensor heater	-
O2 Heater Curr Val B1 S2	Heated oxygen sensor current for bank 1 sensor 2	-
Short FT #1	Short-term fuel trim of bank 1	Short-term fuel compensation is used to maintain the air fuel ratio at the stoichiometric level.
Long FT #1	Long-term fuel trim of bank 1	Overall fuel compensation is carried out in the long-term to compensate for a continual deviation of the short-term fuel trim from the central value.
Total FT #1	Total fuel trim of bank 1	-
		• OL (Open Loop): Has not yet satisfied the

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Fuel System Status #1	Fuel system status (bank 1)	conditions to go to closed loop. • CL (Closed Loop): Using the air fuel ratio sensor as feedback for fuel control. • OLDrive: Open loop due to driving conditions (fuel enrichment). • OLFault: Open loop due to a detected system fault. • CLFault: Closed loop but the air fuel ratio sensor, which is used for fuel control, is malfunctioning.
Fuel System Status #2	Fuel system status (bank 2)	
IGN Advance	Ignition timing advance for No. 1 cylinder	-
Knock Feedback Value	Feedback value of knocking	-
Knock Correct Learn Value	Learned knocking correction value	-
ACIS VSV	VSV for acoustic control induction system (ACIS)	-
AICV VSV	VSV for air intake control system (AICV)	-
IAC Sensor Voltage	Intake air control valve position sensor output voltage	-
Intake Air Control Position	Intake air control valve position	-
VVT Control Status #1	VVT control (bank 1) status	-
Catalyst Temp B1 S1	Estimated catalyst temperature (for sensor 1)	-
Catalyst Temp B1 S2	Estimated catalyst temperature (for sensor 2)	-
Starter Signal	Starter signal (STA terminal input status)	-
Power Steering Signal Record	Power steering switch status	-
Neutral Position SW Signal	Park/neutral position switch status	-
Stop Light Switch	Stop light switch status	-
A/C Signal	A/C switch status	-
Idle Up Signal	Idle up signal	-
Closed Throttle Position SW	Closed throttle position switch	-
Fuel Cut Condition	Fuel-cut condition	-
Immobiliser		

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Communication	Immobiliser communication	-
TC Terminal	TC terminal status	-
Time after DTC Cleared	Cumulative time after DTC cleared	-
Distance from DTC Cleared	Total distance vehicle driven after DTC cleared	-
Warmup Cycle Cleared DTC	Warm-up cycle after DTC cleared	-
Dist Batt Cable Disconnect	Total distance vehicle driven after battery cable disconnected	-
IG OFF Elapsed Time	Cumulative time after ignition switch off	-
TC and TE1	TC and TE1 terminals of DLC3	-
Ignition Trig. Count	Ignition counter to calculated misfire count	-
Cylinder #1 Misfire Count	Misfire count of cylinder 1	-
Cylinder #2 Misfire Count	Misfire count of cylinder 2	-
Cylinder #3 Misfire Count	Misfire count of cylinder 3	-
Cylinder #4 Misfire Count	Misfire count of cylinder 4	-
All Cylinders Misfire Count	All cylinders misfire count	-
Misfire RPM	Average engine speed when misfire occurs	-
Misfire Load	Average engine load when misfire occurred	-
Misfire Margin	Margin to detect engine misfire	-
Catalyst OT MF F/C	Catalyst over temperature misfire prevention F/C	-
Cat OT MF F/C History	Catalyst over temperature misfire prevention F/C history	-
Cat OT MF F/C Cylinder#1	Display of fuel cut operation in No. 1 cylinder (if certain level of misfire malfunction is detected)	-
Cat OT MF F/C Cylinder#2	Display of fuel cut operation in No. 2 cylinder (if certain level of misfire malfunction is detected)	-

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Cat OT MF F/C Cylinder#3	Display of fuel cut operation in No. 3 cylinder (if certain level of misfire malfunction is detected)	-
Cat OT MF F/C Cylinder#4	Display of fuel cut operation in No. 4 cylinder (if certain level of misfire malfunction is detected)	-
Tumble C.V Duty Ratio	Intake air control valve duty ratio	-
Electric Fan Motor	Electric fan motor status	-
Idle Fuel Cut Prohibit	Prohibition of fuel cut at idle	-
Idle Fuel Cut	Fuel cut idle	ON: When the throttle valve is fully closed and the engine speed is more than 2800 rpm.
FC TAU	Fuel cut during very light load	The fuel cut is being performed under a very light load to prevent incomplete engine combustion.
Brake Ejector VSV	VSV for brake ejector system	-
Electrical Load Signal 1	Electrical load signal	-
Electrical Load Signal 2	Electrical load signal	-
Electrical Load Signal 3	Electrical load signal	-
Received MIL from ECT	MIL status from ECT	-
Shift Position Sig from ECT	Shift position signal from ECT	-
A/T Oil Temp from ECT	ATF temperature from ECT	-
SPD (NO)	Output shaft speed	-
ECT Lock Up	ECT lock up status	-
Shift SW Status (P Range)	Park/neutral position switch assembly status	-
Shift SW Status (R Range)	Park/neutral position switch assembly status	-
Shift SW Status (N Range)	Park/neutral position switch assembly status	-
Sports Shift Up SW	Sport shift up switch status	-
Sports Shift Down SW	Sport shift down switch status	-

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Sports Mode Selection SW	Sport mode select switch status	-
Snow Switch Status	Snow switch status	-
Shift SW Status (D Range)	Park/neutral position switch assembly status	-

CHECK MODE PROCEDURE

HINT:

Techstream only:

Compared to normal mode, check mode is more sensitive to malfunctions. Therefore, check mode can detect malfunctions that cannot be detected in normal mode.

NOTE: All the stored DTCs and freeze frame data are cleared if: 1) the ECM is changed from normal mode to check mode or vice versa; or 2) the ignition switch is turned from ON to ACC or off while in check mode. Before changing modes, always check and note any DTCs and freeze frame data.

1. **CHECK MODE PROCEDURE**
   a. Check and ensure the following conditions:
      1. Battery voltage is 11 V or higher.
      2. Throttle valve is fully closed.
      3. Shift lever is in P or N.
      4. A/C switch is off.
   b. Turn the ignition switch off.
   c. Connect the Techstream to the DLC3.
   d. Turn the ignition switch to ON.
   e. Turn the Techstream on.
   f. Enter the following menus: Powertrain/Engine/Utility/Check Mode.
   g. Switch the ECM from normal mode to check mode.
   h. Check that the MIL flashes as shown in the illustration.
   i. Start the engine.
   j. Check that the MIL turns off.
   k. Simulate the conditions of the malfunction described by the customer.
   l. Check DTCs and freeze frame data using the Techstream.

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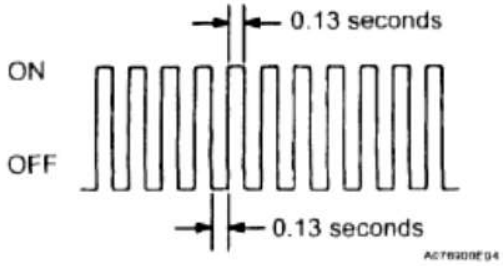


Fig. 37: Identifying Blinking Pattern
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

FAIL-SAFE CHART

If any of the following DTCs are stored, the ECM enters failsafe mode to allow the vehicle to be driven temporarily or stops fuel injection.

FAIL-SAFE CHART

DTC Code	Component	Fail-Safe Operation	Fail-Safe Deactivation Condition
P0031 P0032 P101D	Air fuel ratio sensor heater	The ECM turns off the air fuel ratio sensor heater.	Ignition switch off
P0037 P0038 P102D	Heated oxygen sensor heater	The ECM turns off the heated oxygen sensor heater.	Ignition switch off
P0102 P0103	Mass air flow meter	The ECM calculates ignition timing according to the engine speed and throttle valve position.	Pass condition detected
P0112 P0113	Intake air temperature sensor	The ECM estimates the intake air temperature to be 20°C (68°F).	Pass condition detected
P0115 P0117 P0118	Engine coolant temperature sensor	The ECM estimates the engine coolant temperature to be 80°C (176°F).	Pass condition detected
P0120 P0121 P0122 P0123 P0220 P0222 P0223 P0604 P0606 P0607 P060A P060B P060D	Electronic throttle control system	The ECM cuts off throttle actuator current and the throttle valve is returned to a 6° throttle position by the return spring. The ECM then adjusts the engine output by controlling fuel injection (intermittent fuel-cut) and ignition timing in accordance with the accelerator	Pass condition detected and then ignition switch turned off

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P060E P0657 P1607 P2102 P2103 P2111 P2112 P2118 P2119 P2135		pedal angle to allow the vehicle to continue at minimal speed*1.	
P0300 P0301 P0302 P0303 P0304*2	• Fuel injector • Electronic throttle control system	When a catalyst-damaging misfire occurs (MIL blinking), the following fail-safe operation is performed for catalyst overheat malfunction prevention. 1. Under a low load and at a low engine speed: ○ Fuel cut is performed on the malfunctioning cylinder. 2. Under a high load and at a high engine speed: ○ Throttle valve opening angle control is performed. ○ Fuel cut is performed on all cylinders or the malfunction cylinder.	Pass condition detected and then ignition switch turned off
P0327 P0328	Knock sensor	The ECM sets the ignition timing to maximum retard.	Ignition switch off
P0351 to P0354	Ignition coil	The ECM cuts the fuel.	Pass condition detected
P2120 P2121 P2122 P2123 P2125 P2127 P2128 P2138	Accelerator pedal position sensor	The accelerator pedal position sensor has 2 sensor circuits: Main and Sub. If either circuit malfunctions, the ECM controls the engine using the other circuit. If both circuits malfunction, the ECM regards the accelerator pedal as being released. As a result, the throttle valve is closed and the engine idles.	Pass condition detected and then ignition switch turned off
HINT: • *1: The vehicle can be driven slowly when the accelerator pedal is depressed firmly and slowly. If the accelerator pedal is depressed quickly, the vehicle may speed up and slow down erratically. • *2: Misfire-related fail-safe operations occur when catalyst overheat malfunctions occur.			

DATA LIST/ACTIVE TEST

1. **DATA LIST**

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HINT:

Using the Techstream to read the Data List allows the values or states of switches, sensors, actuators and other items to be read without removing any parts. This non-intrusive inspection can be very useful because intermittent conditions or signals may be discovered before parts or wiring is disturbed. Reading the Data List information early in troubleshooting is one way to save diagnostic time.

NOTE: In the table below, the values listed under "Normal Condition" are reference values. Do not depend solely on these reference values when deciding whether a part is faulty or not.

a. Warm up the engine.
b. Turn the ignition switch off.
c. Connect the Techstream to the DLC3.
d. Turn the ignition switch to ON.
e. Turn the Techstream on.
f. Enter the following menus: Powertrain/Engine/Data List.
g. According to the display on the Techstream, read the Data List.

DIAGNOSTIC NOTE

Tester Display	Measurement Item/Range	Normal Condition	Diagnostic Note
Vehicle Speed	Vehicle speed/ Min.: 0 km/h (0 mph), Max.: 255 km/h (159 mph)	Actual vehicle speed	The speed indicated on the speedometer.
Engine Speed	Engine speed/ Min.: 0 rpm, Max.: 16383 rpm	600 to 700 rpm: Idling	-
Calculate Load	Load calculated by ECM/ Min.: 0%, Max.: 100%	10 to 40%: Idling 10 to 40%: Running without load (2500 rpm)	-
Vehicle Load	Vehicle load/ Min.: 0%, Max.: 25700%	Actual vehicle load	-
MAF	Air flow rate from mass air flow meter/ Min.: 0 gm/sec, Max.: 655.35	1 to 3 gm/sec: Idling	If the value is approximately 0.0 gm/sec: • The mass air flow meter power source circuit is open. • VG circuit is open or shorted.

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	gm/sec.		If 0.71 gm/sec. or more when 30 seconds after ignition switch turned to ON: • The E2G circuit is open.
Atmosphere Pressure	Atmospheric pressure/ Min.: 0 kPa (0 mmHg), Max.: 255 kPa (1912.5 mmHg)	Equivalent to atmospheric pressure (absolute pressure)	-
Coolant Temp	Engine coolant temperature/ Min.: -40°C (-40°F), Max.: 140°C (284°F)	80 to 100°C (176 to 212°F): After warming up	If the value is -40°C (-40°F), the sensor circuit is open. If the value is 140°C (284°F) or higher, the sensor circuit is shorted.
Intake Air	Intake air temperature/ Min.: -40°C (-40°F), Max.: 140°C (284°F)	Equivalent to ambient air temperature	If the value is -40°C (-40°F), the sensor circuit is open. If the value is 140°C (284°F) or higher, the sensor circuit is shorted.
Ambient Temperature	Ambient temperature/ Min.: -40°C (-40°F), Max.: 215°C (419°F)	Actual ambient temperature	-
Engine Run Time	Engine run time/ Min.: 0 s, Max.: 65535 s	Time after engine start	Service data
Initial Engine Coolant Temp	Initial engine coolant temperature/ Min.: -40°C (-40°F), Max.: 119.3°C (246.8°F)	Close to ambient air temperature	Service data
Initial Intake Air Temp	Initial intake air temperature/ Min.: -40°C (-40°F), Max.: 119.3°C (246.8°F)	Close to ambient air temperature	Service data
Battery Voltage	Battery voltage/ Min.: 0V, Max.: 65.5 V	11 to 14 V: Idling	-
Accelerator Position	Accelerator pedal position/ Min.: 0%, Max.: 399.9%	Actual accelerator pedal position	-
	Absolute accelerator	10 to 22%: Accelerator	

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Accel Sens. No. 1 Volt %	pedal position No. 1/ Min.: 0%, Max.: 100%	pedal released 52 to 90%: Accelerator pedal fully depressed	-
Accel Sens. No. 2 Volt %	Absolute accelerator pedal position No. 2/ Min.: 0%, Max.: 100%	24 to 40%: Accelerator pedal released 68 to 100%: Accelerator pedal fully depressed	-
Accel Sensor Out No. 1	Accelerator pedal position sensor No. 1 voltage/ Min.: 0 V, Max.: 4.98 V	-	-
Accel Sensor Out No. 2	Accelerator pedal position sensor No. 2 voltage/ Min.: 0 V, Max.: 4,98 V	-	-
Accel Sensor Out No, 1	Accelerator pedal position sensor No. 1 voltage/ Min.: 0 V, Max.: 4.98 V	0.5 to 1.1 V: Accelerator pedal released 2.6 to 4.5 V: Accelerator pedal fully depressed	-
Accel Sensor Out No. 2	Accelerator pedal position sensor No. 2 voltage/ Min.: 0 V, Max.: 4.98 V	1.2 to 2.0 V: Accelerator pedal released 3.4 to 4.98 V: Accelerator pedal fully depressed	-
Accelerator Idle Position	Whether or not accelerator pedal position sensor detecting idle/ON or OFF	ON: Idling	-
Accel Fully Close Learn #1	Accelerator fully closed learned value No. 1/ Min.: 0 deg, Max.: 124.5 deg	-	ETCS service data
Accel Fully Close Learn #2	Accelerator fully closed learned value No. 2/ Min.: 0 deg, Max.: 124.5 deg	-	ETCS service data
Throttle Sensor Volt %	Throttle valve opening percentage according to throttle position sensor/	• 10 to 22%: Accelerator pedal released • 64 to 96%:	Value calculated based on the voltage at terminal VTA1

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	Min.: 0%, Max.: 100%	Accelerator pedal fully depressed	
Throttl Sensor #2 Volt %	Throttle valve opening percentage according to throttle position sensor No. 2/ Min.: 0%, Max.; 100%	• 42 to 62%: Accelerator pedal released • 92 to 100%: Accelerator pedal fully depressed	Value calculated based on the voltage at terminal VTA2
ST1	Brake pedal signal/ ON or OFF	ON: Brake pedal released	-
System Guard	System guard/ ON or OFF	-	ETCS service data
Open Side Malfunction	Open side malfunction/ ON or OFF	-	ETCS service data
Throttle Idle Position	Whether or not throttle position sensor detecting idle/ ON or OFF	• ON: Accelerator pedal released • OFF: Accelerator pedal fully depressed	-
Throttle Require Position	Throttle requirement position/ Min.: 0 V, Max.: 4.98 V	0.5 to 1.1 V: Idling	-
Throttle Sensor Position*1	Absolute throttle position sensor/ Min.: 0%, Max.: 100%	• 0%: Accelerator pedal released • 50 to 80%: Accelerator pedal fully depressed	Recognition value for throttle opening angle on ECM
Throttle Position No. 1	Throttle position No. 1/ Min.: 0 V, Max.: 4.98 V	-	-
Throttle Position No. 2	Throttle position No. 2/ Min.: 0 V, Max.: 4.98 V	-	-
Throttle Position No. 1	Throttle position No. 1/ Min.: 0 V, Max.: 4.98 V	• 0.5 to 1.1 V: Accelerator pedal released • 3.2 to 4.8 V: Accelerator pedal fully depressed	-

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		• 0.6 to 1.4 V: Fail-safe operating	
Throttle Position No. 2	Throttle position No. 2/ Min.: 0 V, Max.: 4.98 V	• 2.1 to 3.1 V: Accelerator pedal released • 4.6 to 5.0 V: Accelerator pedal fully depressed • 2.1 to 3.1 V: Fail-safe operating	-
Throttle Position Command	Throttle position command value/ Min.: 0 V, Max.: 4.98 V	0.5 to 4.8 V	-
Throttle Sens Open Pos#1	Throttle position sensor No. 1/ Min.: 0 V, Max.: 4.98 V	0.6 to 1.4 V	ETCS service data
Throttle Sens Open Pos#2	Throttle position sensor No. 2/ Min.: 0 V, Max.: 4.98 V	1.7 to 2.5 V	ETCS service data
Throttle Motor Current	Throttle actuator current/ Min.: 0 A, Max.: 19.9 A	0 to 3.0 A: Idling	ETCS service data
Throttle Motor DUTY	Throttle actuator/ Min.: 0%, Max.: 100%	10 to 22%: Idling after engine warmed up	ETCS service data
Throttle Motor Duty (Open)	Throttle actuator duty ratio (open)/ Min.: 0%, Max.: 100%	0 to 40%: Idling	ETCS service data
Throttle Motor Duty (Close)	Throttle actuator duty ratio (close)/ Min.: 0%, Max.: 100%	0 to 40%: Idling	ETCS service data
Throttle Fully Close Learn	Throttle valve fully closed (learned value)/ Min.: 0 V, Max.: 4.98 V	0.4 to 1.0 V: Accelerator pedal released	-
+BM Voltage	+BM voltage/ Min.: 0 V, Max.: 19.9 V	11 to 14 V: Ignition switch ON and system normal	-

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Actuator Power Supply	Actuator power supply/ ON or OFF	ON: Idling	ETCS service data
Injector (Port)	Injection period of the No. 1 cylinder/ Min.: 0 us, Max.: 65535 us	1000 to 3000 us: Idling	-
Injection Volum (Cylinder 1)	Injection volume (cylinder 1)/ Min.: 0 ml, Max.: 2.048 ml	0.05 to 0.15 ml: Idling	The quantity of fuel injection volume for 10 times
Fuel Pump/Speed Status	Fuel pump/speed status/ ON or OFF	-	The Active Test support data
Vacuum Pump	Key-off EVAP system pump status/ ON or OFF	-	The Active Test support data
TCV Status	Tumble control valve status/ ON or OFF	ON: Cold engine start	-
EVAP (Purge) VSV	Purge VSV control duty/ Min.: 0%, Max.: 100%	0 to 50%: Idling, under purge control	The order signal from the ECM
Evap Purge Flow	Purge flow/ Min.: 0%, Max.: 102.3%	0 to 10%: Idling	-
Purge Density Learn Value	Learned value of purge density/ Min.: -50, Max.: 350.000	-40 to 0: Idling	Service data
Vapor Pressure Pump	Vapor pressure/ Min.: 0 kPa (0 mmHg), Max.: 1441.77 kPa (10813 mmHg)	Approximately 100 kPa (750 mmHg): Ignition switch ON	The EVAP system pressure is monitored by the canister pressure sensor.
Vapor Pressure (calculated)	Calculated EVAP system pressure/ Min.: -720.896 kPa (-5407 mmHg), Max.: 720.874 kPa (5407 mmHg)	Approximately 100 kPa (750 mmHg): Ignition switch ON	-
EVAP System Vent Valve	Key-off EVAP system vent valve status/ ON or OFF	-	The Active Test support data

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EVAP Purge VSV	VSV status for EVAP control/ ON or OFF	-	The Active Test support data
Purge Cut VSV Duty	Purge cut VSV duty/ Min.: 0%, Max.: 399.9%	-	-
Target Air-Fuel Ratio	Air fuel ratio/ Min.: 0, Max.: 1.999	0.8 to 1.2: During idling	-
AF Lambda B1 S1	Short-term fuel trim (for bank 1 sensor 1)/ Min.: 0, Max.: 1.999	• Value less than 1 (0.000 to 0.999) = Rich • 1 = Stoichiometric air fuel ratio • Value more than 1 (1.001 to 1.999) = Lean	-
AFS Voltage B1 S1	Air fuel ratio sensor output voltage (for bank 1 sensor 1)/ Min.: 0 V, Max.: 7.999 V	2.6 to 3.8 V: Idling	Performing the Control the Injection Volume or Control the Injection Volume for A/F Sensor function of the Active Test enables the technician to check voltage output of the sensor.
AFS Current B1 S1	Air fuel ratio sensor current (for bank 1 sensor 1)/ Min.: -128 mA, Max.: 127.99 mA	-0.5 to 0.5 mA: Idling	Performing the Control the Injection Volume or Control the Injection Volume for A/F Sensor function of the Active Test enables the technician to check the output voltage of the sensor.
A/F Heater Duty #1	A/F heater duty ratio Min.: 0%, Max.: 399.9%	0 to 100%	-
O2S B1 S2	Heated oxygen sensor output voltage (for bank 1 sensor 2)/ Min.: 0 V, Max.: 1.275 V	0.0 to 0.9 V: Vehicle driven at 44 mph (70 km/h)	Performing the Control the Injection Volume or Control the Injection Volume for A/F Sensor function of the Active Test enables the technician to check voltage output of the sensor.
O2S Impedance B1S2	Sub heated oxygen sensor impedance (for bank 1 sensor 2)/ Min.: 0 ohm, Max.:	5 to 15000 ohm	After driving for approx. 10 min. in an urban area.

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	21247.67 ohm		
O2 Heater B1 S2	Heated oxygen sensor heater/ Not Act or Active	-	-
O2 Heater Curr Val B1 S2	Heated oxygen sensor current (for bank 1 sensor 2)/ Min.: 0A, Max.: 4.9 A	-	-
Short FT #1	Short-term fuel trim of bank 1/ Min.:-100%, Max.: 99.2%	-20 to 20%	This item refers to the short-term fuel compensation used to maintain the air fuel ratio at the stoichiometric level.
Long FT #1	Long-term fuel trim of bank 1/ Min.:-100%, Max.: 99.2%	-20 to 20%	This item refers to the overall fuel compensation carried out in the long-term to compensate a continual deviation of the short-term fuel trim from the central value.
Total FT #1	Total fuel trim of bank 1 Average value for fuel trim system of bank 1/ Min.: -0.5, Max.: 0.496	-0.28 to 0.2: Idling	-
Fuel System Status #1	Fuel system status (bank 1)/OL, CL, OLDrive, OLFault or CLFault	CL: Idling after warming up	• OL (Open Loop): Has not yet satisfied the conditions to go to closed loop. • CL (Closed Loop): Using the air fuel ratio sensor as feedback for fuel control. • OLDrive: Open loop due to driving conditions (fuel enrichment). • OLFault: Open loop due to a detected system fault. • CLFault: Closed loop but the air fuel ratio sensor, which is used for fuel control, is malfunctioning.
Fuel System Status #2	Fuel system status (bank 2)/OL, CL, OLDrive, OLFault or	Unused	-

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	CLFault		
IGN Advance	Ignition timing advance for No. 1 cylinder/ Min.: -64 deg., Max.: 63.5 deg.	BTDC 5 to 15 deg.: Idling	-
Knock Feedback Value	Feedback value of knocking/ Min.: -1024 CA, Max.: 1023.9 CA	-20 to 0 CA: Vehicle driven at 44 mph (70 km/h)	Service data
Knock Correct Learn Value	Correction learned value of knocking/ Min.: -1024 CA, Max.: 1023.9 CA	0 to 20 CA: Vehicle driven at 44 mph (70 km/h)	Service data
ACIS VSV	VSV status for ACIS control/ ON or OFF	-	-
AICV VSV	VSV status for AICV control/ ON or OFF	-	-
IAC Sensor Voltage	Intake air control valve position sensor output voltage/ Min.: 0 V, Max.: 4.99 V	-	If valve is 0.2 V or less • IAC1 circuit shorted • VCIA circuit open If valve is 4.8 V or higher • VCIA and IAC1 circuit shorted • IAC1 circuit open • EIA1 circuit open
Intake Air Control Position	Intake air control valve position/ Min.: -250 deg, Max.: 249.99 deg	-	-
VVT Control Status #1*2	Variable valve timing (VVT) control status (bank 1)/ ON or OFF	-	The Active Test support data
VVT Aim Angle #1*2	VVT aim angle (bank 1)/ Min.: 0%, Max.: 399.9%	0 to 100%	VVT duty signal value during forced operation

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VVT Change Angle #1*2	VVT change angle (bank 1)/ Min.: 0 DegFR, Max.: 639.9 DegFR	0 to 55 DegFR: Idling	Displacement angle during forced operation
VVT OCV Duty #1*2	VVT camshaft timing oil control valve operation duty (bank 1)/ Min.: 0%, Max.: 399.9%	0 to 100%	Requested duty value for forced operation
VVT Ex Hold Lrn Val #1*2	VVT exhaust hold duty ratio learned value (bank 1)/ Min.: 0%, Max.: 399.9%	0 to 80%: Idling	-
VVT Ex Chg Angle #1*2	VVT exhaust change angle (for bank 1)/ Min.: 0 DegFR, Max.: 639.9 DegFR	0 to 45 DegFR: Idling	Displacement angle during forced operation
VVT Ex OCV Duty #1*2	VVT exhaust camshaft timing oil control valve duty (for bank 1)/ Min.: 0%, Max.: 399.9%	0 to 100%: Idling	Requested duty value for forced operation
VN Turbo type	Variable Nozzle (VN) turbo type/ Not Avl or Commo or Vacuumor CAN Com	Not Avl	-
Catalyst Temp B1 S1	Catalyst temperature (for bank 1 sensor 1)/ Min.: -40°C (-40°F), Max.: 6513.5°C (11756°F)	-	-
Catalyst Temp B1 S2	Catalyst temperature (for bank 1 sensor 2)/ Min.: -40°C (-40°F), Max.: 6513.5°C (11756°F)	-	-
Starter Signal	Starter signal/ Open or Close	Open: Starter signal ON Close: Starter signal OFF	-
Power Steering	Power steering		

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Signal Record	switch signal/ ON or OFF	-	-
Neutral Position SW Signal	Park/neutral position switch status/ ON or OFF	ON: Shift lever in P or N	-
Stop Light Switch	Stop light switch/ ON or OFF	ON: Brake pedal depressed	-
A/C Signal	A/C switch status/ ON or OFF	ON: A/C ON	-
Idle Up Signal	Idle up signal/ ON or OFF	-	-
Closed Throttle Position SW	Closed throttle position switch/ ON or OFF	• ON: Throttle valve fully closed • OFF: Throttle valve open	-
Fuel Cut Condition	Fuel cut condition/ ON or OFF	ON: Fuel cut operating	-
Immobiliser Communication	Immobiliser communication/ ON or OFF	ON: Normal	-
Check Mode	Check mode/ ON or OFF	ON: Check mode ON	Refer to **CHECK MODE PROCEDURE** .
SPD Test Result	Check mode result for vehicle speed sensor/ Compl or Incmpl	-	-
Misfire Test Result	Check mode result for misfire monitor/ Compl or Incmpl	-	-
OXS1 Test Result	Check mode result for heated oxygen sensor (bank 1 sensor 1)/ Compl or Incmpl	-	-
A/F Test Results #1	Check mode result for air fuel ratio sensor/ Compl or Incmpl	-	-
Complete Parts Monitor	Comprehensive component monitor/ Not Avl or Avail	-	-
Fuel System Monitor	Fuel system monitor/ Not Avl or Avail	-	-
Misfire Monitor	Misfire monitor/ Not Avl or Avail	-	-

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EGRA/VT Monitor	EGR/VVT monitor/ Not Avl or Avail	-	-
EGRA/VT Monitor	EGR/VVT monitor/ Compl or Incmpl	-	-
O2S(A/FS) Heater Monitor	O2S (A/FS) heater monitor/ Not Avl or Avail	-	-
O2S(A/FS) Heater Monitor	O2S (A/FS) heater monitor/ Compl or Incmpl	-	-
O2S(A/FS) Monitor	O2S (A/FS) monitor/ Not Avl or Avail	-	-
O2S(A/FS) Monitor	O2S (A/FS) monitor/ Compl or Incmpl	-	-
A/C Monitor	A/C monitor/ Not Avl or Avail	-	-
A/C Monitor	A/C monitor/ Compl or Incmpl	-	-
2nd Air Monitor	2nd air monitor/ Not Avl or Avail	-	-
2nd Air Monitor	2nd air monitor/ Compl or Incmpl	-	-
EVAP Monitor	EVAP monitor/ Not Avl or Avail	-	-
EVAP Monitor	EVAP monitor/ Compl or Incmpl	-	-
Heated Catalyst Monitor	Heated catalyst monitor/ Not Avl or Avail	-	-
Heated Catalyst Monitor	Heated catalyst monitor/ Compl or Incmpl	-	-
Catalyst Monitor	Catalyst monitor/ Not Avl or Avail	-	-
Catalyst Monitor	Catalyst monitor/ Compl or Incmpl	-	-
Component Monitor ENA	Comprehensive component monitor/ Unable or Enable	-	-
Component Monitor CMPL	Comprehensive component monitor/ Compl or Incmpl	-	-
Fuel System Monitor ENA	Fuel system monitor/ Unable or Enable	-	-
Fuel System	Fuel system monitor/		

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Monitor CMPL	Compl or Incmpl	-	-
Misfire Monitor ENA	Misfire monitor/ Unable or Enable	-	-
Misfire Monitor CMPL	Misfire monitor/ Compl or Incmpl	-	-
EGR/VVT Monitor ENA	EGR/VVT monitor/ Unable or Enable	-	-
EGR/VVT Monitor CMPL	EGR/VVT monitor/ Compl or Incmpl	-	-
Heater Monitor ENA	O2S (A/FS) heater monitor/ Unable or Enable	-	-
Heater Monitor CMPL	O2S (A/FS) heater monitor/ Compl or Incmpl	-	-
O2S(A/FS) Monitor ENA	O2S (A/FS) monitor/ Unable or Enable	-	-
O2S(A/FS) Monitor CMPL	O2S (A/FS) monitor/ Compl or Incmpl	-	-
A/C Monitor ENA	A/C monitor/ Unable or Enable	-	-
A/C Monitor CMPL	A/C monitor/ Compl or Incmpl	-	-
2nd Air Monitor ENA	2nd air monitor/ Unable or Enable	-	-
2nd Air Monitor CMPL	2nd air monitor/ Compl or Incmpl	-	-
EVAP Monitor ENA	EVAP monitor/ Unable or Enable	-	-
EVAP Monitor CMPL	EVAP monitor/ Compl or Incmpl	-	-
Heated Cat Monitor ENA	Heated catalyst monitor/ Unable or Enable	-	-
Heated Cat Monitor CMPL	Heated catalyst monitor/ Compl or Incmpl	-	-
Catalyst Monitor ENA	Catalyst monitor/ Unable or Enable	-	-
Catalyst Monitor CMPL	Catalyst monitor/ Compl or Incmpl	-	-
TC Terminal	TC terminal status/ ON or OFF	-	-
# Codes (Include History)	Number of codes/ Min.: 0, Max.: 255	-	The number of stored DTCs

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MIL	MIL status/ ON or OFF	ON: MIL on	-
MIL ON Run Distance	MIL on run distance/ Min.: 0 km, Max.: 65535 km	Distance after DTC stored	-
Running Time from MIL ON	Running time from MIL on/ Min.: 0 min, Max.: 65535 min	Equivalent to running time after MIL on	-
Time after DTC Cleared	Time after DTC cleared/ Min.: 0 min, Max.: 65535 min	Equivalent to time after DTCs cleared	-
Distance from DTC Cleared	Distance after DTC cleared/ Min.: 0 km, Max.: 65535 km	Equivalent to driven distance after DTCs cleared	-
Warmup Cycle Cleared DTC	Warm-up cycle after DTC cleared/ Min.: 0, Max.: 255	-	The number of warm-up cycles after the DTC is cleared
Dist Batt Cable Disconnect	Distance after battery cable disconnected/ Min.: 0 km, Max.: 65535 km	Total distance vehicle driven after battery cable disconnected	-
IG OFF Elapsed Time	Time after ignition switch off/ Min.: 0 min, Max.: 655350 min	Cumulative time after ignition switch off	-
OBD Requirements	OBD requirement	OBD2	-
Number of Emission DTC	Emission-related DTCs/ Min.: 0, Max.: 127	-	The number of emission-related DTCs
TC and TE1	TC and TE1 terminals of DLC3/ ON or OFF	-	-
Ignition Trig. Count	Ignition counter/ Min.: 0, Max.: 800	0 to 800	-
Cylinder #1 Misfire Count to Cylinder #4 Misfire Count	Misfire counter of cylinder 1 to 4/ Min.: 0, Max.: 255	0 to 16	-
All Cylinders Misfire Count	All cylinders misfire counter/ Min.: 0, Max.: 255	0 to 16	-

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Misfire RPM	Engine speed for first misfire range/ Min.: 0 rpm, Max.: 6375 rpm	0 rpm: Misfire 0	-
Misfire Load	Engine load for first misfire range/ Min.: 0 g/rev, Max.: 3.98 g/rev	0 g/rev: Misfire 0	-
Misfire Margin	Misfire monitoring/ Min.: -128%, Max.: 127%	-100 to 99.2%	The misfire detecting margin
Catalyst OT MF F/C	Catalyst over temperature misfire prevention F/C/ Not Avl or Avail	Avail: Catalyst OT MF F/C available Not Avl: Catalyst OT MF F/C not available	-
Cat OT MF F/C History	Catalyst over temperature misfire prevention F/C history/ ON or OFF	ON: Fuel cut operation history exists	-
Cat OT MF F/C Cylinder #1	Display of fuel cut operation in No. 1 cylinder (if certain level of misfire malfunction is detected)/ ON or OFF	ON: Fuel cut operating	-
Cat OT MF F/C Cylinder #2	Display of fuel cut operation in No. 2 cylinder (if certain level of misfire malfunction is detected)/ ON or OFF	ON: Fuel cut operating	-
Cat OT MF F/C Cylinder #3	Display of fuel cut operation in No. 3 cylinder (if certain level of misfire malfunction is detected)/ ON or OFF	ON: Fuel cut operating	-
Cat OT MF F/C Cylinder #4	Display of fuel cut operation in No. 4 cylinder (if certain level of misfire malfunction is detected)/	ON: Fuel cut operating	-

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	ON or OFF		
Tumble C.V Duty Ratio	Intake air control valve duty ratio/ Min.:-128%, Max.: 127%	-	-
Electric Fan Motor	Electric fan motor status/ ON or OFF	-	-
Idle Fuel Cut Prohibit	Prohibition of fuel cut at idle/ ON or OFF	-	-
Idle Fuel Cut	Fuel cut idle/ ON or OFF	ON: Fuel cut operating	Idle Fuel Cut is "ON" when the throttle valve is fully closed and the engine speed is more than 2800 rpm.
FC TAU	Fuel cut TAU: Fuel cut during very light load/ ON or OFF	ON: Fuel cut operating	The fuel cut being performed under a very light load to prevent incomplete engine combustion.
Brake Ejector VSV	VSV status for brake ejector system/ OPEN or CLOSE	-	-
Communication with ECT	Status of the communication with the ECT/ Comm or No Comm	-	-
Electrical Load Signal 1	Electrical load signal/ ON or OFF	-	-
Electrical Load Signal 2	Electrical load signal/ ON or OFF	-	-
Electrical Load Signal 3	Electrical load signal/ ON or OFF	-	-
Model Code	Model code	-	The identifying model code: ASU4#
Engine Type	Engine type	-	The identifying engine type: 1ARFE
Cylinder Number	Number of cylinders/ Min.: 0, Max.: 255	-	The identifying number of cylinders: 4
Transmission Type	Transmission type	-	The identifying transmission type: ECT 6th
Destination	Destination	-	The identifying destination: A (America)

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Model Year	Model year/ Min.: 1900, Max.: 2155	-	The identifying model year: 200#
System Identification	System identification	-	The identifying engine system: Gasoline (gasoline engine)
Engine Speed of Cyl #1	Engine speed for cylinder 1/ Min.: 0 rpm, Max.: 51199 rpm	-	Output only when Check the Cylinder Compression is performed using the Active Test. 51199 rpm: Active Test not performed
Engine Speed of Cyl #2	Engine speed for cylinder 2/ Min.: 0 rpm, Max.: 51199 rpm	-	Output only when Check the Cylinder Compression is performed using the Active Test. 51199 rpm: Active Test not performed
Engine Speed of Cyl #3	Engine speed for cylinder 3/ Min.: 0 rpm, Max.: 51199 rpm	-	Output only when Check the Cylinder Compression is performed using the Active Test. 51199 rpm: Active Test not performed
Engine Speed of Cyl #4	Engine speed for cylinder 4/ Min.: 0 rpm, Max.: 51199 rpm	-	Output only when Check the Cylinder Compression is performed using the Active Test. 51199 rpm: Active Test not performed
Av Engine Speed of All Cyl	Engine speed for all cylinders/ Min.: 0 rpm, Max.: 51199 rpm	-	Output only when Check the Cylinder Compression is performed using the Active Test. 51199 rpm: Active Test not performed
Received MIL from ECT	Received MIL from ECT/ ON or OFF	MIL illuminate instruction ON signal from ECT: ON	-
Shift Position Sig from ECT	Received shift position signal from ECT/	Actual shift position	-
A/T Oil Temp from ECT	Received ATF temperature sensor value from ECT/ Min.: -40°C (-40°F), Max.: 215°C (419°F)	• After stall test: Approx. 80°C (176°F) • Equal to ambient temperature when	If the value is -40°C (-40°F) or 215°C (419°F), ATF temperature sensor circuit is open or shorted

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		cold soak	
SPD (NO)	Output shaft speed/ Min.: 0 rpm, Max.: 12750 rpm	0 rpm: Vehicle stopped	-
ECT Lock up	Lock up/ ON or OFF	ON: Lock up operating	-
Shift SW Status (P Range)	Park/neutral position switch assembly status/ ON or OFF	• ON: Shift lever in P • OFF: Shift lever not in P	When shift lever position displayed on the Techstream differs from actual position, adjustment of park/neutral position switch assembly or shift cable may be incorrect
Shift SW Status (R Range)	Park/neutral position switch assembly status/ ON or OFF	• ON: Shift lever in R • OFF: Shift lever not in R	When shift lever position displayed on the Techstream differs from actual position, adjustment of park/neutral position switch assembly or shift cable may be incorrect
Shift SW Status (N Range)	Park/neutral position switch assembly status/ ON or OFF	• ON: Shift lever in N • OFF: Shift lever not in N	When shift lever position displayed on the Techstream differs from actual position, adjustment of park/neutral position switch assembly or shift cable may be incorrect
Sports Shift Up SW	Sport shift up switch status/ ON or OFF	• ON: Continuously shift to "+" (upshift) • OFF: "+" (up-shift) released	-
Sports Shift Down SW	Sport shift down switch status/ ON or OFF	• ON: Continuously shift to "-" (down-shift) • OFF: "-" (down-shift) released	-
Sports Mode Selection SW	Sport mode select switch status/ ON or OFF	• ON: Shift lever in S, "+" or "-" • OFF: Shift lever not in S, "+" and	-
Snow Switch Status	Snow switch status/ ON or OFF	• ON: Snow mode switch on • OFF: Snow mode switch off	-
	Park/neutral position	• ON: Shift lever in	When shift lever position displayed on the Techstream

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Shift SW Status (D Range)	switch assembly status/ ON or OFF	D or S • OFF: Shift lever not in D or S	differs from actual position, adjustment of park/neutral position switch assembly or shift cable may be incorrect
HINT: • *1: Excluding throttle valve opening percentage due to idle speed control. • *2: Data List values are only displayed when performing the following Active Test: Control the VVT System (Bank 1), Control the VVT Linear (Bank 1). For other Active Test, the Data List value will be 0.			

2. **ACTIVE TEST**

HINT:

Using the Techstream to perform Active Tests allows relays, VSVs, actuators and other items to be operated without removing any parts. This non-intrusive functional inspection can be very useful because intermittent operation may be discovered before parts or wiring is disturbed. Performing Active Tests early in troubleshooting is one way to save diagnostic time. Data List information can be displayed while performing Active Tests.

a. Warm up the engine.
b. Turn the ignition switch off.
c. Connect the Techstream to the DLC3.
d. Turn the ignition switch to ON.
e. Turn the Techstream on.
f. Enter the following menus: Powertrain/Engine/Active Test.
g. According to the display on the Techstream, perform the Active Test.

DIAGNOSTIC NOTE

Tester Display	Test Part	Control Range	Diagnostic Note
Control the Injection Volume	Change injection volume	-12.5 to 24.8%	• All the injectors are tested at the same time. • Perform the test at less than 3000 rpm. • The injection volume can be changed in 0.1 or 0.2% graduations within the control range.
			• Perform the test at less than 3000 rpm. • Control the Injection Volume for A/F Sensor enables the checking

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Control the Injection Volume for A/F Sensor	Change injection volume	Lower by -12.5% or increase by 25%	and graphing of the air fuel ratio sensor and heated oxygen sensor voltage outputs. • To conduct the test, enter the following menus: Active Test/Control the Injection Volume for A/F Sensor/Data List/All Data/AFS Voltage B1S1 and O2S B1 S2.
Activate the VSV for Intake Control	Activate the VSV for intake control	ON/OFF	• ON: Acoustic Control Induction System (ACIS) VSV is on. • OFF: ACIS VSV is off.
Activate the VSV for Evap Control	Activate purge VSV control	ON/OFF	• ON: Purge VSV on. • OFF: Purge VSV off.
Control the Fuel Pump/Speed	Activate fuel pump (C/OPN relay)	ON/OFF	The test is possible when the following conditions are met: • The ignition switch is ON. • The engine is stopped.
Connect the TC and TE1	Turn on and off TC and CG (TE1) connection	ON/OFF	• ON: TC and TE1 are connected. • OFF: TC and TE1 are disconnected.
Control the Idle Fuel Cut Prohibit	Prohibit idling fuel cut control	ON/OFF	The idling fuel-cut is turned ON when the throttle valve is fully closed and the engine speed is more than 2800 rpm.
Prohibit the Catalyst OT Misfire prevent F/C	Prohibit catalyst overheat malfunction prevention fuel cut operation during misfire	ON/OFF ON: Fuel cut prohibited	Confirm that the vehicle is stopped and the engine speed is 3000 rpm or less.
Control the Electric Cooling Fan	Control electric cooling fan motor	ON/OFF	-
Control the ETCS Open/Close Slow Speed	Throttle actuator	Close/Open	The test is possible when the following conditions are met: • The ignition switch is ON. • The engine is stopped. • The accelerator pedal is fully depressed (Accelerator pedal position: 58 degrees or more).
Control the ETCS Open/Close Fast Speed	Throttle actuator	Close/Open	
Control the VVT		Between -128 and	• The engine stalls or idles roughly when the camshaft timing gear is

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Linear (Bank 1)	Control VVT (bank1)	127%	operated at 100%. • The test is possible during idle.
Control the VVT System (Bank 1)	Control VVT (bank1)	ON/OFF	• The engine stalls or idles roughly when the camshaft timing oil control valve is turned on. • The engine is running and idles normally when the camshaft timing oil control valve is off. • The test is possible during idle.
Control the VVT Exhaust Linear (Bank 1)	Control VVT for exhaust camshaft (bank1)	Between-128 and 127%	• The engine stalls or idles roughly when the camshaft timing gear is operated at 100%. • The test is possible during idle.
Activate the Vacuum Pump	Leak detection pump	ON/OFF	-
Activate the VSV for Vent Valve	Vent valve	ON/OFF	-
Activate the VSV for AICS	Activate vacuum switching valve for air intake control system	ON/OFF	-
Control the IAC Duty Ratio	Control intake air control valve (tumble control valve) duty ratio	Between -100 and 100%	-
Activate the Brake Ejector VSV	Brake ejector VSV	OPEN/CLOSE	Confirm that the intake air temperature is above 5°C (41°F) and intake air temperature sensor is normal
Control the Cylinder #1 Fuel Cut	Cylinder #1 injector fuel cut	ON/OFF	The test is possible while the vehicle is stopped and the engine is idling.*1
Control the Cylinder #2 Fuel Cut	Cylinder #2 injector fuel cut	ON/OFF	
Control the Cylinder #3 Fuel Cut	Cylinder #3 injector fuel cut	ON/OFF	
Control the Cylinder #4 Fuel Cut	Cylinder #4 injector fuel cut	ON/OFF	
Control the All Cylinder Fuel Cut	All cylinder fuel cut	ON/OFF	

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Check the Cylinder Compression *2	Check the cylinder compression pressure (measuring engine speed for each cylinder)	ON/OFF	Fuel injection and ignition stop in all the cylinders.

NOTE:

***1: If the display of the Catalyst OT MF F/C item of the Data List is Not Avl, perform this Active Test with the vehicle stopped and the engine idling. If the display of the Catalyst OT MF F/C item of the Data List is Avail, perform this Active Test as described below.**

1. **Stop the engine and turn the ignition switch to ON to turn Control the Cylinder #1 Fuel Cut (to Control the Cylinder #4 Fuel Cut) ON.**
2. **Start the engine.**

HINT:*2: When performing the Active Test item "Check the Cylinder Compression" and then cranking the engine, the ECM stops the fuel injection and ignition, and measures the engine speed for each cylinder.If the speed of one cylinder is higher than the others, the compression pressure of that cylinder can be concluded to be less than the others.

1. Warm up the engine.
2. Turn the ignition switch off.
3. Connect the Techstream to the DLC3.
4. Turn the ignition switch to ON.
5. Turn the Techstream on.
6. Enter the following menus: Powertrain/Engine/Active Test/Check the Cylinder Compression.
7. Enter the following menus: Compression/Engine Speed of Cyl #1 to Engine Speed of Cyl #4, Av Engine Speed of All Cyl.
8. Press the RIGHT or LEFT button to change Check the Cylinder Compression to ON.

   HINT:

   Fuel injection and ignition for all the cylinders are prohibited at this time, and the engine speed measurement of each cylinder will enter standby mode.

9. Crank the engine until the monitor item values "Engine speed of Cyl #1 to Engine Speed of Cyl #4" and "Av Engine Speed of All Cyl" change.
10. Monitor the engine speed (Engine Speed of Cyl #1 to Engine Speed of Cyl #4, Av Engine Speed of All Cyl) displayed on the Techstream.

    HINT:

    The Techstream displays extremely high values before cranking the engine. The engine speed of each cylinder is measured while cranking the engine and then the Techstream displays the actual engine speed values.

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NOTE:

- **The Active Test item "Check the Cylinder Compression" will automatically turn off 255 seconds after the Active Test is turned on.**
- **When the "Check the Cylinder Compression" is OFF and the engine is cranked, the engine will start.**
- **If the "Check the Cylinder Compression" test needs to be performed again after the engine speed measurement of each cylinder has been performed once, press EXIT to return to the Active Test menu screen. Then perform the Check the Cylinder Compression test again.**
- **Use a fully-charged battery.**

3. **SYSTEM CHECK (Only for Techstream)**

HINT:

Performing a System Check in the Utility menu enables the system, which consists of multiple actuators, to be operated without removing any parts. In addition, it can show whether or not any DTCs are stored, and can detect potential malfunctions in the system.

a. Connect the Techstream to the DLC3.
b. Turn the ignition switch to ON.
c. Turn the Techstream on.
d. Enter the following menus: Powertrain/Engine/Utility.
e. Perform the System Check by referring to the table below.

DIAGNOSTIC NOTE

Tester Display	Test Part	Control Range	Diagnostic Note
Evaporative System Check (Automatic Mode)	Perform 5 steps in order to operate EVAP key-off monitor automatically	35°C (95° F) or less	• If no pending DTCs are detected after performing this test, system functioning normally • Refer to **EVAP SYSTEM**
Evaporative System Check (Manual Mode)	Perform 5 steps in order to operate EVAP key-off monitor manually	35°C (95° F) or less	• Used to detect malfunctioning parts • Refer to **EVAP SYSTEM**

DIAGNOSTIC TROUBLE CODE CHART

HINT:

Parameters listed in the chart may not be exactly the same as yours depending on the type of instrument or other

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factors. If a trouble code is displayed during the DTC check, inspect the trouble areas listed for that code. For details of the code, follow the "Refer to" reference.

SFI System

DIAGNOSTIC TROUBLE CODE CHART

DTC Code	Detection Item	Trouble Area	MIL	Memory
P0010	Camshaft Position "A" Actuator Circuit (Bank 1)	1. Open or short in camshaft timing oil control valve assembly (for intake camshaft) circuit 2. Camshaft timing oil control valve assembly (for intake camshaft) 3. ECM	Comes on	DTC stored
P0011	Camshaft Position "A" - Timing Over-Advanced or System Performance (Bank 1)	1. Valve timing 2. Camshaft timing oil control valve assembly (for intake camshaft) 3. Oil control valve filter 4. Camshaft timing gear assembly 5. ECM	Comes on	DTC stored
P0012	Camshaft Position "A" - Timing Over-Retarded (Bank 1)	1. Valve timing 2. Camshaft timing oil control valve assembly (for intake camshaft) 3. Oil control valve filter	Comes on	DTC stored

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		4. Camshaft timing gear assembly 5. ECM		
P0013	Camshaft Position "B" Actuator Circuit/Open (Bank 1)	1. Open or short in camshaft timing oil control valve assembly (for exhaust camshaft) circuit 2. Camshaft timing oil control valve assembly (for exhaust camshaft) 3. ECM	Comes on	DTC stored
P0014	Camshaft Position "B" - Timing Over-Advanced or System Performance (Bank 1)	1. Valve timing 2. Camshaft timing oil control valve assembly (for exhaust camshaft) 3. Oil control valve filter 4. Camshaft timing gear assembly (for exhaust camshaft) 5. ECM	Comes on	DTC stored
P0015	Camshaft Position "B" - Timing Over-Retarded (Bank 1)	1. Valve timing 2. Camshaft timing oil control valve assembly (for exhaust camshaft) 3. Oil control valve filter	Comes on	DTC stored

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		4. Camshaft timing gear assembly (for exhaust camshaft) 5. ECM		
P0016	Crankshaft Position - Camshaft Position Correlation (Bank 1 Sensor A)	1. Valve timing 2. Camshaft timing oil control valve assembly (for intake camshaft) 3. Oil control valve filter 4. Camshaft timing gear assembly (for intake camshaft) 5. ECM	Comes on	DTC stored
P0017	Crankshaft Position - Camshaft Position Correlation (Bank 1 Sensor B)	1. Valve timing 2. Camshaft timing oil control valve assembly (for exhaust camshaft) 3. Oil control valve filter 4. Camshaft timing gear assembly (for exhaust camshaft) 5. ECM	Comes on	DTC stored
P0031	Oxygen (A/F) Sensor Heater Control Circuit Low (Bank 1 Sensor 1)	1. Open in air fuel ratio sensor heater circuit 2. Air fuel ratio sensor heater (bank 1 sensor 1)	Comes on	DTC stored

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		3. EFI MAIN No. 2 relay 4. ECM		
P0032	Oxygen (A/F) Sensor Heater Control Circuit High (Bank 1 Sensor 1)	1. Short in air fuel ratio sensor heater circuit 2. Air fuel ratio sensor heater (bank 1 sensor 1) 3. EFI MAIN No. 2 relay 4. ECM	Comes on	DTC stored
P0037	Oxygen Sensor Heater Control Circuit Low (Bank 1 Sensor 2)	1. Open in heated oxygen sensor (bank 1 sensor 2) heater circuit 2. Heated oxygen sensor (bank 1 sensor 2) heater 3. EFI MAIN No. 2 relay 4. ECM	Comes on	DTC stored
P0038	Oxygen Sensor Heater Control Circuit High (Bank 1 Sensor 2)	1. Short in heated oxygen sensor (bank 1 sensor 2) heater circuit 2. Heated oxygen sensor (bank 1 sensor 2) heater 3. EFI MAIN No. 2 relay 4. ECM	Comes on	DTC stored
P0101	Mass Air Flow Circuit Range/Performance Problem	1. Mass air flow meter 2. Intake system 3. PCV hose connections	Comes on	DTC stored

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P0102	Mass or Volume Air Flow Circuit Low Input	1. Open or short in mass air flow meter circuit 2. Mass air flow meter 3. ECM	Comes on	DTC stored
P0103	Mass or Volume Air Flow Circuit High Input	1. Open or short in mass air flow meter circuit 2. Mass air flow meter 3. ECM	Comes on	DTC stored
P0111	Intake Air Temperature Sensor Gradient Too High	Mass air flow meter	Comes on	DTC stored
P0112	Intake Air Temperature Circuit Low Input	1. Short in intake air temperature sensor circuit 2. Intake air temperature sensor (built into mass air flow meter) 3. ECM	Comes on	DTC stored
P0113	Intake Air Temperature Circuit High Input	1. Open in intake air temperature sensor circuit 2. Intake air temperature sensor (built into mass air flow meter) 3. ECM	Comes on	DTC stored
P0115	Engine Coolant Temperature Circuit Malfunction	1. Open or short in engine coolant temperature sensor circuit 2. Engine coolant temperature sensor	Comes on	DTC stored

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		3. ECM		
P0116	Engine Coolant Temperature Circuit Range/Performance Problem	1. Thermostat 2. Engine coolant temperature sensor	Comes on	DTC stored
P0117	Engine Coolant Temperature Circuit Low Input	1. Short in engine coolant temperature sensor circuit 2. Engine coolant temperature sensor 3. ECM	Comes on	DTC stored
P0118	Engine Coolant Temperature Circuit High Input	1. Open in engine coolant temperature sensor circuit 2. Engine coolant temperature sensor 3. ECM	Comes on	DTC stored
P011B	Engine Coolant Temperature/Intake Air Temperature Correlation	1. Intake air temperature sensor 2. Engine coolant temperature sensor 3. ECM	Comes on	DTC stored
P0120	Throttle/Pedal Position Sensor/Switch "A" Circuit Malfunction	1. Throttle position sensor (built into throttle body) 2. ECM	Comes on	DTC stored
P0121	Throttle/Pedal Position Sensor/Switch "A" Circuit Range/Performance Problem	1. Throttle position sensor (built into throttle body) 2. Throttle position sensor circuit 3. ECM	Comes on	DTC stored
P0122	Throttle/Pedal	1. Throttle	Comes on	DTC stored

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	Position Sensor/Switch "A" Circuit Low Input	position sensor (built into throttle body) 2. Short in VTA1 circuit 3. Open in VC circuit 4. ECM		
P0123	Throttle/Pedal Position Sensor/Switch "A" Circuit High Input	1. Throttle position sensor (built into throttle body) 2. Open in VTA1 circuit 3. Open in E2 circuit 4. Short between VC and VTA1 circuits 5. ECM	Comes on	DTC stored
P0125	Insufficient Coolant Temperature for Closed Loop Fuel Control	1. Cooling system 2. Engine coolant temperature sensor 3. Thermostat	Comes on	DTC stored
P0128	Coolant Thermostat (Coolant Temperature Below Thermostat Regulating Temperature)	1. Thermostat 2. Cooling system 3. Engine coolant temperature sensor 4. ECM	Comes on	DTC stored
P0136	Oxygen Sensor Circuit Malfunction (Bank 1 Sensor 2)	1. Open or short in heated oxygen sensor (bank 1 sensor 2) circuit 2. Heated oxygen sensor (bank 1 sensor 2) 3. Heated oxygen sensor heater (bank 1 sensor	Comes on	DTC stored

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		2) 4. Air fuel ratio sensor (bank 1 sensor 1) 5. Gas leak from exhaust system		
P0137	Oxygen Sensor Circuit Low Voltage (Bank 1 Sensor 2)	1. Open in heated oxygen sensor (bank 1 sensor 2) circuit 2. Heated oxygen sensor (bank 1 sensor 2) 3. Heated oxygen sensor heater (bank 1 sensor 2) 4. Gas leak from exhaust system	Comes on	DTC stored
P0138	Oxygen Sensor Circuit High Voltage (Bank 1 Sensor 2)	1. Short in heated oxygen sensor (bank 1 sensor 2) circuit 2. Heated oxygen sensor (bank 1 sensor 2) 3. ECM 4. Air fuel ratio sensor (bank 1 sensor 1)	Comes on	DTC stored
P0139	Oxygen Sensor Circuit Slow Response (Bank 1 Sensor 2)	1. Short in heated oxygen sensor (bank 1 sensor 2) circuit 2. Heated oxygen sensor (bank 1 sensor 2) 3. ECM	Comes on	DTC stored
P0141	Oxygen Sensor Heater Circuit Malfunction (Bank 1 Sensor 2)	1. Open or short in heated oxygen sensor (bank 1 sensor 2) heater	Comes on	DTC stored

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		circuit 2. Heated oxygen sensor (bank 1 sensor 2) heater 3. EFI MAIN No. 2 relay 4. ECM		
P0171	System Too Lean (Bank 1)	1. Intake system 2. Injector blockage 3. Mass air flow meter 4. Engine coolant temperature sensor 5. Fuel pressure 6. Gas leak from exhaust system 7. Open or short in air fuel ratio sensor (bank 1 sensor 1) circuit 8. Air fuel ratio sensor (bank 1 sensor 1) 9. PCV valve and hose 10. PCV hose connections 11. ECM	Comes on	DTC stored
P0172	System Too Rich (Bank 1)	1. Injector leak or blockage 2. Mass air flow meter 3. Engine coolant temperature sensor 4. Ignition system 5. Fuel pressure 6. Gas leak from	Comes on	DTC stored

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		exhaust system 7. Open or short in air fuel ratio sensor (bank 1 sensor 1) circuit 8. Air fuel ratio sensor (bank 1 sensor 1) 9. ECM		
P0220	Throttle/Pedal Position Sensor/Switch "B" Circuit	1. Throttle position sensor (built into throttle body) 2. ECM	Comes on	DTC stored
P0222	Throttle/Pedal Position Sensor/Switch "B" Circuit Low Input	1. Throttle position sensor (built into throttle body) 2. Short in VTA2 circuit 3. Open in VC circuit 4. ECM	Comes on	DTC stored
P0223	Throttle/Pedal Position Sensor/Switch "B" Circuit High Input	1. Throttle position sensor (built into throttle body) 2. Open in VTA2 circuit 3. Open in E2 circuit 4. Short between VC and VTA2 circuits 5. ECM	Comes on	DTC stored
P0300	Random/Multiple Cylinder Misfire Detected	1. Open or short in engine wire harness 2. Connector connection 3. Vacuum hose	Comes on/Blinks(1)	DTC stored

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		connections 4. Ignition system 5. Fuel injector 6. Fuel pressure 7. Mass air flow meter 8. Engine coolant temperature sensor 9. Compression pressure 10. Valve timing 11. PCV valve and hose 12. PCV hose connections 13. Intake system 14. Tumble Control Valve (TCV) 15. ECM		
P0301	Cylinder 1 Misfire Detected	Same as DTC P0300	Comes on/Blinks(1)	DTC stored
P0302	Cylinder 2 Misfire Detected	Same as DTC P0300	Comes on/Blinks(1)	DTC stored
P0303	Cylinder 3 Misfire Detected	Same as DTC P0300	Comes on/Blinks(1)	DTC stored
P0304	Cylinder 4 Misfire Detected	Same as DTC P0300	Comes on/Blinks(1)	DTC stored
P0327	Knock Sensor 1 Circuit Low Input (Bank 1 or Single Sensor)	1. Short in knock sensor circuit 2. Knock sensor 3. ECM	Comes on	DTC stored
P0328	Knock Sensor 1 Circuit High Input (Bank 1 or Single Sensor)	1. Open in knock sensor circuit 2. Knock sensor 3. ECM	Comes on	DTC stored
P0335	Crankshaft Position Sensor "A" Circuit	1. Open or short in crankshaft position sensor circuit	Comes on	DTC stored

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		2. Crankshaft position sensor 3. Crankshaft (crank angle sensor plate) 4. ECM		
P0339	Crankshaft Position Sensor "A" Circuit Intermittent	1. Open or short in crankshaft position sensor circuit 2. Crankshaft position sensor 3. Crankshaft (crank angle sensor plate) 4. ECM	Does not come on	DTC stored
P0340	Camshaft Position Sensor Circuit Malfunction	1. Open or short in camshaft position sensor circuit for intake camshaft 2. Camshaft position sensor for intake camshaft 3. Intake camshaft 4. Timing chain jumped tooth 5. ECM	Comes on	DTC stored
P0342	Camshaft Position Sensor "A" Circuit Low Input (Bank 1 or Single Sensor)	1. Open or short in camshaft position sensor circuit for intake camshaft 2. Camshaft position sensor for intake camshaft 3. Intake camshaft 4. Timing chain jumped tooth	Comes on	DTC stored

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		5. ECM		
P0343	Camshaft Position Sensor "A" Circuit High Input (Bank 1 or Single Sensor)	1. Open or short in camshaft position sensor circuit for intake camshaft 2. Camshaft position sensor for intake camshaft 3. Intake camshaft 4. Timing chain jumped tooth 5. ECM	Comes on	DTC stored
P0351	Ignition Coil "A" Primary/Secondary Circuit	1. Ignition system 2. Open or short in IGF1 or IGT1 circuit between ignition coil and ECM 3. No. 1 ignition coil 4. ECM	Comes on	DTC stored
P0352	Ignition Coil "B" Primary/Secondary Circuit	1. Ignition system 2. Open or short in IGF1 or IGT2 circuit between ignition coil and ECM 3. No. 2 ignition coil 4. ECM	Comes on	DTC stored
P0353	Ignition Coil "C" Primary/Secondary Circuit	1. Ignition system 2. Open or short in IGF1 or IGT3 circuit between ignition coil and ECM	Comes on	DTC stored

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		3. No. 3 ignition coil 4. ECM		
P0354	Ignition Coil "D" Primary/Secondary Circuit	1. Ignition system 2. Open or short in IGF1 or IGT4 circuit between ignition coil and ECM 3. No. 4 ignition coil 4. ECM	Comes on	DTC stored
P0365	Camshaft Position Sensor "B" Circuit (Bank 1)	1. Open or short in exhaust camshaft position sensor circuit 2. Exhaust camshaft position sensor 3. Exhaust camshaft 4. Timing chain jumped tooth 5. ECM	Comes on	DTC stored
P0367	Camshaft Position Sensor "B" Circuit Low Input (Bank 1)	1. Open or short in exhaust camshaft position sensor circuit 2. Exhaust camshaft position sensor 3. Exhaust camshaft 4. Timing chain jumped tooth 5. ECM	Comes on	DTC stored
P0368	Camshaft Position Sensor "B" Circuit High Input (Bank 1)	1. Open or short in exhaust camshaft	Comes on	DTC stored

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		position sensor circuit 2. Exhaust camshaft position sensor 3. Exhaust camshaft 4. Timing chain jumped tooth 5. ECM		
P0420	Catalyst System Efficiency Below Threshold (Bank 1)	1. Gas leak from exhaust system 2. Air fuel ratio sensor (bank 1 sensor 1) 3. Heated oxygen sensor (bank 1 sensor 2) 4. Front exhaust pipe assembly (TWC: Front catalyst) 5. Exhaust center pipe assembly (TWC: Rear catalyst)	Comes on	DTC stored
P043E	Evaporative Emission System Leak Detection Reference Orifice Low Flow	1. Canister pump module (Reference orifice, leak detection pump, vent valve) 2. Connector/wire harness (Canister pump module - ECM) 3. EVAP system hose (pipe from air inlet port to canister pump module, canister filter,	Comes on	DTC stored

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		fuel tank vent hose) 4. ECM		
P043F	Evaporative Emission System Reference Orifice High Flow	1. Canister pump module (Reference orifice, leak detection pump, vent valve) 2. Connector/wire harness (Canister pump module - ECM) 3. EVAP system hose (pipe from air inlet port to canister pump module, canister filter, fuel tank vent hose) 4. ECM	Comes on	DTC stored
P0441	Evaporative Emission Control System Incorrect Purge Flow	1. Purge VSV 2. Connector/wire harness (Purge VSV - ECM) 3. ECM 4. Canister pump module 5. Leak from EVAP system 6. Leak from EVAP line (Purge VSV - Intake manifold)	Comes on	DTC stored
P0451	Evaporative Emission Control System Pressure Sensor Range/Performance	1. Canister pump module 2. Connector/wire harness (Canister pump module -	Comes on	DTC stored

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		ECM) 3. EVAP system hose (pipe from air inlet port to canister pump module, canister filter, fuel tank vent hose) 4. ECM		
P0452	Evaporative Emission Control System Pressure Sensor/Switch Low Input	1. Canister pump module 2. Connector/wire harness (Canister pump module - ECM) 3. EVAP system hose (pipe from air inlet port to canister pump module, canister filter, fuel tank vent hose) 4. ECM	Comes on	DTC stored
P0453	Evaporative Emission Control System Pressure Sensor/Switch High Input	1. Canister pump module 2. Connector/wire harness (Canister pump module - ECM) 3. EVAP system hose (pipe from air inlet port to canister pump module, canister filter, fuel tank vent hose) 4. ECM	Comes on	DTC stored
P0455	Evaporative Emission Control System Leak	1. Fuel cap (loose)	Comes on	DTC stored

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	Detected (Gross Leak)	2. Leak from EVAP line (Canister - Fuel tank) 3. Leak from EVAP line (Purge VSV - Canister) 4. Canister pump module 5. Leak from fuel tank 6. Leak from canister		
P0456	Evaporative Emission Control System Leak Detected (Very Small Leak)	1. Fuel cap (loose) 2. Leak from EVAP line (Canister - Fuel tank) 3. Leak from EVAP line (Purge VSV - Canister) 4. Canister pump module 5. Leak from fuel tank 6. Leak from canister	Comes on	DTC stored
P0500	Vehicle Speed Sensor "A"	1. Open or short in speed sensor circuit 2. Speed sensor 3. Combination meter 4. Skid control ECU 5. Main body ECU(2) 6. TCM 7. ECM	Comes on	DTC stored

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		8. Radio receiver assembly 9. Navigation receiver assembly(3) 10. Tire pressure warning ECLT (4) 11. Stereo component amplifier(5)		
P0504	Brake Switch "A"/"B" Correlation	1. Short in stop light switch signal circuit 2. STOP fuse 3. Stop light switch assembly 4. ECM	Does not come on	DTC stored
P0505	Idle Control System Malfunction	1. Electronic throttle control system 2. Intake system 3. PCV hose connections 4. ECM	Comes on	DTC stored
P050A	Cold Start Idle Air Control System Performance	1. Throttle body 2. Mass air flow meter 3. PCV system 4. Air cleaner filter element 5. Intake system 6. VVT system 7. ECM	Comes on	DTC stored
P050B	Cold Start Ignition Timing Performance	1. Throttle body 2. Mass air flow meter 3. PCV system 4. Air cleaner	Comes on	DTC stored

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		filter element 5. Intake system 6. VVT system 7. ECM		
P0560	System Voltage	1. Open in back up power source circuit 2. Battery 3. Battery terminals 4. ECM	Comes on	DTC stored
P0604	Random Access Memory (RAM)	ECM	Comes on	DTC stored
P0606	ECM/PCM Processor	ECM	Comes on	DTC stored
P0607	Control Module Performance	1. ECM 2. Heated oxygen sensor (bank 1 sensor 2) 3. Exhaust gas leak	Comes on	DTC stored
P060A	Internal Control Module Monitoring Processor Performance	ECM	Comes on	DTC stored
P060B	Internal Control Module A/D Processing Performance	ECM	Comes on	DTC stored
P060D	Internal Control Module Accelerator Pedal Position Performance	ECM	Comes on	DTC stored
P060E	Internal Control Module Throttle Position Performance	ECM	Comes on	DTC stored
P0617	Starter Relay Circuit High	1. Park/neutral position switch assembly 2. ST relay circuit 3. Ignition switch assembly	Comes on	DTC stored

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		4. ECM		
P062F	Internal Control Module EEPROM Error	ECM	Comes on	DTC stored
P0630	VIN not Programmed or Mismatch - ECM/PCM	ECM	Comes on	DTC stored
P0657	Actuator Supply Voltage Circuit/Open	ECM	Comes on	DTC stored
P0705	Transmission Range Sensor Circuit Malfunction (PRNDL Input)	1. Open or short in park/neutral position switch circuit 2. Short in park/neutral position switch assembly 3. Open or short in transmission control switch circuit 4. Shift lock control unit assembly 5. ECM	Comes on	DTC stored
P0724	Brake Switch "B" Circuit High	1. Short in stop light switch signal circuit 2. Stop light switch assembly 3. ECM	Comes on	DTC stored
P101D	A/F Sensor Heater Circuit Performance Bank 1 Sensor 1 Stuck ON	ECM	Comes on	DTC stored
P102D	O2 Sensor Heater Circuit Performance Bank 1 Sensor 2 Stuck ON	ECM	Comes on	DTC stored
P1607	Cruise Control Input Processor	ECM	Comes on	DTC stored

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P2004	Intake Manifold Runner Control Stuck Open (Bank 1)	1. DC Motor for tumble control valve circuit 2. DC Motor for tumble control valve 3. Tumble control valve position sensor 4. Tumble control valve 5. ECM	Comes on	DTC stored
P2006	Intake Manifold Runner Control Stuck Closed (Bank 1)	1. DC Motor for tumble control valve circuit 2. DC Motor for tumble control valve 3. Tumble control valve position sensor 4. Tumble control valve 5. ECM	Comes on	DTC stored
P2009	Intake Manifold Runner Control Circuit Low (Bank 1)	1. Open or short in DC motor for tumble control valve circuit 2. Intake manifold (DC motor for tumble control valve) 3. ECM	Comes on	DTC stored
P2010	Intake Manifold Runner Control Circuit High (Bank 1)	1. Open or short in DC motor for tumble control valve circuit 2. Intake manifold (DC motor for	Comes on	DTC stored

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		tumble control valve) 3. ECM		
P2014	Intake Manifold Runner Position Sensor/Switch Circuit (Bank 1)	1. Open or short in tumble control valve position sensor circuit 2. Tumble control valve position sensor 3. ECM	Comes on	DTC stored
P2016	Intake Manifold Runner Position Sensor/Switch Circuit Low (Bank 1)	1. Open or short in tumble control valve position sensor circuit 2. Tumble control valve position sensor 3. ECM	Comes on	DTC stored
P2017	Intake Manifold Runner Position Sensor/Switch Circuit High (Bank 1)	1. Open or short in tumble control valve position sensor circuit 2. Tumble control valve position sensor 3. ECM	Comes on	DTC stored
P2102	Throttle Actuator Control Motor Circuit Low	1. Open in throttle actuator circuit 2. Throttle actuator 3. ECM	Comes on	DTC stored
P2103	Throttle Actuator Control Motor Circuit High	1. Short in throttle actuator circuit 2. Throttle actuator 3. Throttle valve	Comes on	DTC stored

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		4. Throttle body 5. ECM		
P2111	Throttle Actuator Control System - Stuck Open	1. Throttle actuator 2. Throttle body 3. Throttle valve 4. ECM	Comes on	DTC stored
P2112	Throttle Actuator Control System - Stuck Closed	1. Throttle actuator 2. Throttle body 3. Throttle valve 4. ECM	Comes on	DTC stored
P2118	Throttle Actuator Control Motor Current Range/Performance	1. Open in electronic throttle control system power source circuit 2. Battery 3. Battery terminals 4. ETCS fuse 5. ECM	Comes on	DTC stored
P2119	Throttle Actuator Control Throttle Body Range/Performance	1. Electronic throttle control system 2. ECM	Comes on	DTC stored
P2120	Throttle/Pedal Position Sensor/Switch "D" Circuit	1. Accelerator pedal position sensor 2. ECM	Comes on	DTC stored
P2121	Throttle/Pedal Position Sensor/Switch "D" Circuit Range/Performance	1. Accelerator pedal position sensor 2. ECM	Comes on	DTC stored
P2122	Throttle/Pedal Position Sensor/Switch "D" Circuit Low Input	1. Accelerator pedal position sensor 2. Open in VCP1 circuit 3. Open or	Comes on	DTC stored

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		ground short in VPA circuit 4. ECM		
P2123	Throttle/Pedal Position Sensor/Switch "D" Circuit High Input	1. Accelerator pedal position sensor 2. Open in EPA circuit 3. ECM	Comes on	DTC stored
P2125	Throttle/Pedal Position Sensor/Switch "E" Circuit	1. Accelerator pedal position sensor 2. ECM	Comes on	DTC stored
P2127	Throttle/Pedal Position Sensor/Switch "E" Circuit Low Input	1. Accelerator pedal position sensor 2. Open in VCP2 circuit 3. Open or ground short in VPA2 circuit 4. ECM	Comes on	DTC stored
P2128	Throttle/Pedal Position Sensor/Switch "E" Circuit High Input	1. Accelerator pedal position sensor 2. Open in EPA2 circuit 3. ECM	Comes on	DTC stored
P2135	Throttle/Pedal Position Sensor/Switch "A"/"B" Voltage Correlation	1. Short between VTA1 and VTA2 circuits 2. Throttle position sensor (built into throttle body) 3. ECM	Comes on	DTC stored
P2138	Throttle/Pedal Position Sensor/Switch "D"/"E" Voltage Correlation	1. Short between VPA and VPA2 circuits 2. Accelerator pedal position sensor	Comes on	DTC stored

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		3. ECM		
P2195	Oxygen (A/F) Sensor Signal Stuck Lean (Bank 1 Sensor 1)	1. Open or short in air fuel ratio sensor (bank 1 sensor 1) circuit 2. Air fuel ratio sensor (bank 1 sensor 1) 3. Air fuel ratio sensor (bank 1 sensor 1) heater 4. Air fuel ratio sensor heater circuit 5. Intake system 6. Fuel pressure 7. Fuel injector assembly 8. ECM	Comes on	DTC stored
P2196	Oxygen (A/F) Sensor Signal Stuck Rich (Bank 1 Sensor 1)	1. Open or short in air fuel ratio sensor (bank 1 sensor 1) circuit 2. Air fuel ratio sensor (bank 1 sensor 1) 3. Air fuel ratio sensor (bank 1 sensor 1) heater 4. Air fuel ratio sensor heater circuit 5. Intake system 6. Fuel pressure 7. Fuel injector assembly 8. ECM	Comes on	DTC stored
P2237	Oxygen (A/F) Sensor Pumping	1. Open in air fuel	Comes on	DTC stored

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	Current Circuit/Open (Bank 1 Sensor 1)	ratio sensor (bank 1 sensor 1) circuit 2. Air fuel ratio sensor (bank 1 sensor 1) 3. ECM		
P2238	Oxygen (A/F) Sensor Pumping Current Circuit Low (Bank 1 Sensor 1)	1. Open in air fuel ratio sensor (bank 1 sensor 1) circuit 2. Air fuel ratio sensor (bank 1 sensor 1) 3. ECM	Comes on	DTC stored
P2239	Oxygen (A/F) Sensor Pumping Current Circuit High (Bank 1 Sensor 1)	1. Open in air fuel ratio sensor (bank 1 sensor 1) circuit 2. Air fuel ratio sensor (bank 1 sensor 1) 3. ECM	Comes on	DTC stored
P2252	Oxygen (A/F) Sensor Reference Ground Circuit Low (Bank 1 Sensor 1)	1. Open in air fuel ratio sensor (bank 1 sensor 1) circuit 2. Air fuel ratio sensor (bank 1 sensor 1) 3. ECM	Comes on	DTC stored
P2253	Oxygen (A/F) Sensor Reference Ground Circuit High (Bank 1 Sensor 1)	1. Open or short in air fuel ratio sensor (bank 1 sensor 1) circuit 2. Air fuel ratio sensor (bank 1 sensor 1) 3. ECM	Comes on	DTC stored
P2401	Evaporative Emission Leak Detection Pump	1. Canister pump module (Reference	Comes on	DTC stored

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	Stuck OFF	orifice, leak detection pump, vent valve) 2. Connector/wire harness (Canister pump module - ECM) 3. EVAP system hose (pipe from air inlet port to canister pump module, canister filter, fuel tank vent hose) 4. ECM		
P2402	Evaporative Emission Leak Detection Pump Stuck ON	1. Canister pump module (Reference orifice, leak detection pump, vent valve) 2. Connector/wire harness (Canister pump module - ECM) 3. EVAP system hose (pipe from air inlet port to canister pump module, canister filter, fuel tank vent hose) 4. ECM	Comes on	DTC stored
P2419	Evaporative Emission System Switching Valve Control Circuit Low	1. Canister pump module (Reference orifice, leak detection pump, vent	Comes on	DTC stored

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		valve) 2. Connector/wire harness (Canister pump module - ECM) 3. EVAP system hose (pipe from air inlet port to canister pump module, canister filter, fuel tank vent hose) 4. ECM		
P2420	Evaporative Emission System Switching Valve Control Circuit High	1. Canister pump module (Reference orifice, leak detection pump, vent valve) 2. Connector/wire harness (Canister pump module - ECM) 3. ECM	Comes on	DTC stored
P2610	ECM/PCM Internal Engine Off Timer Performance	ECM	Comes on	DTC stored
P2A00	A/F Sensor Circuit Slow Response (Bank 1 Sensor 1)	1. Air fuel ratio sensor (bank 1 sensor 1) 2. Air fuel ratio sensor heater (bank 1 sensor 1) 3. ECM	Comes on	DTC stored
U0101	Lost Communication with TCM	1. ECM to TCM circuit 2. TCM 3. ECM	Comes on	DTC stored

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(1) The MIL flashes when a catalyst-damaging misfire is detected.

(2) w/smart key system

(3) w/navigation system

(4) w/tire pressure warning system

(5) for separate type amplifier system

DTC P0010 CAMSHAFT POSITION "A" ACTUATOR CIRCUIT (BANK 1)

DESCRIPTION

The Variable Valve Timing (VVT) system adjusts the intake valve timing to improve driveability. The engine oil pressure turns the VVT controller to adjust the valve timing.

The camshaft timing oil control valve assembly is a solenoid valve and switches the engine oil line. The valve moves when the ECM applies 12 V to the solenoid. The ECM changes the energizing time to the solenoid (duty-cycle) in accordance with the camshaft position, crankshaft position, throttle position, etc.

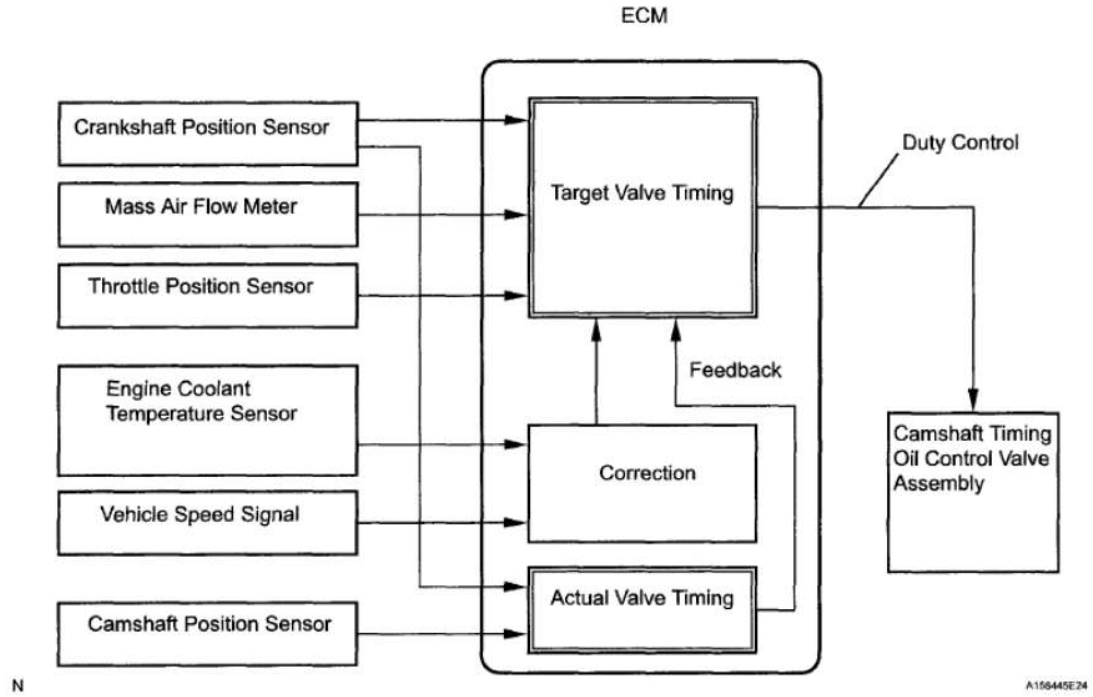


Fig. 38: Variable Valve Timing (VVT) System - Communication Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

DTC DETECTION CONDITION CHART

DTC No.	DTC Detection Condition	Trouble Area

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P0010	Open or short in camshaft timing oil control valve (for intake camshaft) circuit (1 trip detection logic)	• Open or short in camshaft timing oil control valve assembly (for intake camshaft) circuit • Camshaft timing oil control valve assembly (for intake camshaft) • ECM

MONITOR DESCRIPTION

This DTC is designed to detect open or short in the camshaft timing oil control valve assembly (for intake camshaft) circuit. If the camshaft timing oil control valve's duty-cycle is excessively high or low while the engine is running, the ECM will illuminate the MIL and set the DTC.

MONITOR STRATEGY

MONITOR STRATEGY CHART

Related DTCs	P0010 Camshaft Timing Oil Control Valve Range Check
Required Sensors/Components (Main)	Camshaft timing oil control valve assembly
Required Sensors/Components (Related)	-
Frequency of Operation	Continuous
Duration	1 second
MIL Operation	Immediate
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

TYPICAL ENABLING CONDITIONS CHART

All of the following conditions are met	-
Starter	OFF
Ignition switch	ON
Time after ignition switch OFF to ON	0.5 seconds or more
One of the following conditions is met	-
A. All of the following conditions are met	-
(a). Battery voltage	13 to 11 V
(b). CPU commanded Duty	70% or more
(c). Current cut status	Not cut
B. All of the following conditions are met	-
(a). Battery voltage	13 V or more
(b). CPU commanded Duty	80%
(c). Current cut status	Not cut

TYPICAL MALFUNCTION THRESHOLDS

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TYPICAL MALFUNCTION THRESHOLDS CHART

VVT oil control valve condition	Not operation record

COMPONENT OPERATING RANGE

COMPONENT OPERATING RANGE CHART

VVT oil control valve condition	Operation record

CONFIRMATION DRIVING PATTERN

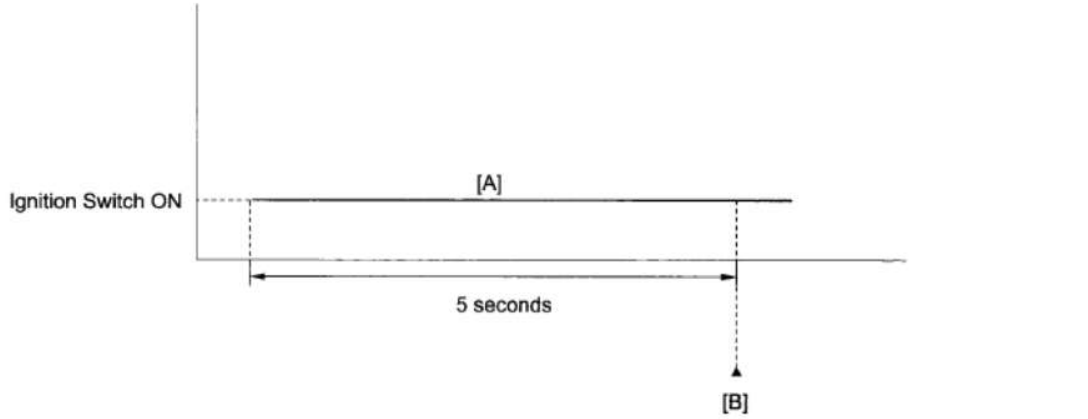


Fig. 39: Confirmation Driving Pattern
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

1. Connect the Techstream to the DLC3.
2. Turn the ignition switch to ON and turn the Techstream on.
3. Clear the DTCs (even if no DTCs are stored, perform the clear DTC procedure)
4. Turn the ignition switch off.
5. Turn the ignition switch to ON and turn the Techstream on.
6. Wait 5 seconds [A].
7. Enter the following menus: Powertrain/Engine/Utility/All Readiness.
8. Input the DTC: P0010.
9. Check the DTC judgment result [B].

TECHSTREAM DISPLAY DESCRIPTION

Techstream Display	Description
NORMAL	• DTC judgment completed • System normal

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ABNORMAL	• DTC judgment completed • System abnormal
INCOMPLETE	• DTC judgment not completed • Perform driving pattern after confirming DTC enabling conditions
UNKNOWN	• Unable to perform DTC judgment • Number of DTCs which do not fulfill DTC preconditions has reached ECU memory limit

10. If the test result is UNKNOWN, enter the following menus: Powertrain/Engine/Trouble Codes/Pending.
11. Read Pending DTCs.

    HINT:

    If a pending DTC is output, the system is malfunctioning.

12. If the test result is INCOMPLETE or UNKNOWN and no pending DTC is output, perform a universal trip and check for permanent DTCs (See **DTC CHECK/CLEAR**).

    HINT:

    - If a permanent DTC is output, the system is malfunctioning.
    - If no permanent DTC is output, the system is normal.

WIRING DIAGRAM

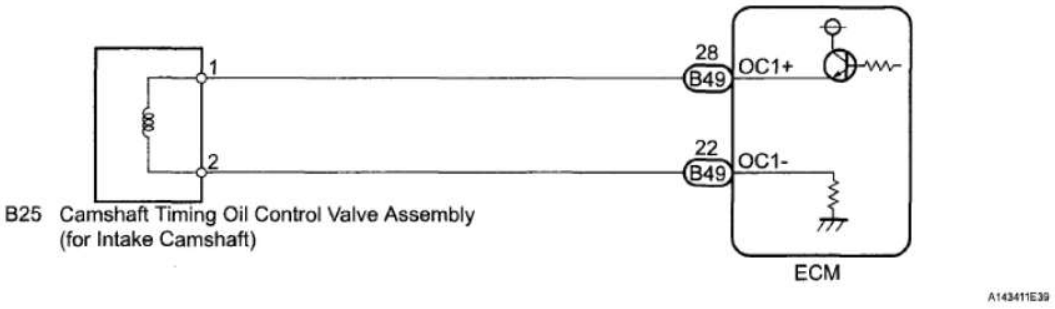


Fig. 40: Camshaft Position "A" Actuator Circuit (Bank 1) - Wiring Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSPECTION PROCEDURE

HINT:

Read freeze frame data using the Techstream. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich,

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and other data from the time the malfunction occurred.

1. **PERFORM ACTIVE TEST USING TECHSTREAM (OPERATE CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY)**
   a. Connect the Techstream to the DLC3.
   b. Start the engine.
   c. Turn the Techstream on.
   d. Turn the A/C switch on.
   e. Enter the following menus: Powertrain/Engine/Active Test/Control the VVT System (Bank 1).
   f. Check the engine speed while operating the camshaft timing oil control valve assembly (for intake camshaft) using the Techstream.

   Result

   TECHSTREAM OPERATION CHART

Techstream Operation	Specified Condition
OFF	Normal engine speed
ON	Engine idles roughly or stalls (soon after camshaft timing oil control valve assembly switched from OFF to ON)

   HINT:

   If the result is not acceptable, cool the engine and perform the Active Test again.

   g. Start the engine when the engine coolant temperature is 30°C (86°F) or less.
   h. Turn the Techstream on.
   i. Turn the A/C switch on.
   j. Enter the following menus: Powertrain/Engine/Active Test/Control the VVT System (Bank 1).
   k. Check the engine speed while operating the camshaft timing oil control valve assembly (for intake camshaft) using the Techstream when the engine coolant temperature is 50°C (122°F) or less.

   Result

   TECHSTREAM OPERATION CHART

Techstream Operation	Specified Condition
OFF	Normal engine speed
ON	Engine idles roughly or stalls (soon after camshaft timing oil control valve assembly switched from OFF to ON)

   NG: Go to step 2

   OK: CHECK FOR INTERMITTENT PROBLEMS (See **CHECK FOR INTERMITTENT**

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PROBLEMS)

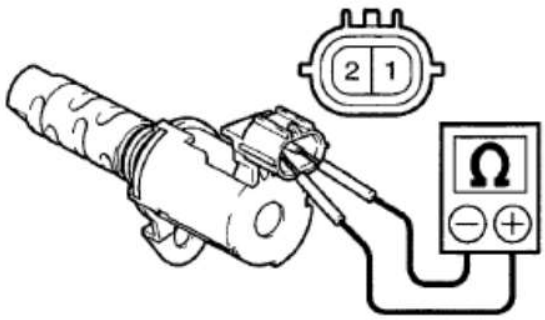
2. **INSPECT CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY (FOR INTAKE CAMSHAFT)**
   a. Remove the camshaft timing oil control valve assembly (for intake camshaft).
   b. Measure the resistance according to the value(s) in the table below.

Standard Resistance

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
1 - 2	20°C (68°F)	6.9 to 7.9 ohms

Component without harness connected:
(Camshaft Timing Oil Control Valve Assembly (for Intake Camshaft))



A207567E02

Fig. 41: Inspecting Camshaft Timing Oil Control Valve Assembly
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

   c. Connect the positive (+) battery terminal to terminal 1 and connect the negative (-) battery terminal to terminal 2. Check the valve operation.

OK:

Valve moves quickly.

   d. Reinstall the camshaft timing oil control valve assembly (for intake camshaft).

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NG: REPLACE CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY (FOR INTAKE CAMSHAFT) (See **REMOVAL**)

Component without harness connected:
(Camshaft Timing Oil Control Valve Assembly (for Intake Camshaft))

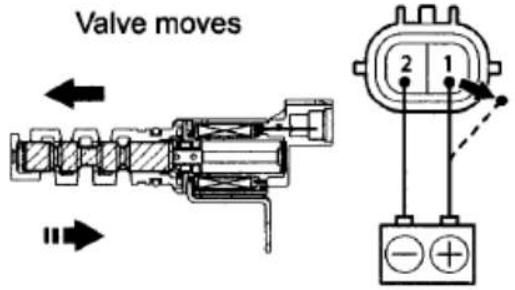


Fig. 42: Connecting Battery Terminals To Camshaft Timing Oil Control Valve Assembly
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

3. **CHECK HARNESS AND CONNECTOR (CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY - ECM)**
   a. Disconnect the camshaft timing oil control valve assembly (for intake camshaft) connector.
   b. Disconnect the ECM connector.
   c. Measure the resistance according to the value(s) in the table below.

Standard Resistance (Check for Open)

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
B25-1 - B49-28 (OC1+)	Always	Below 1 ohms
B25-2 - B49-22 (OC1-)	Always	Below 1 ohms

Standard Resistance (Check for Short)

TESTER CONNECTION SPECIFIED CONDITION CHART

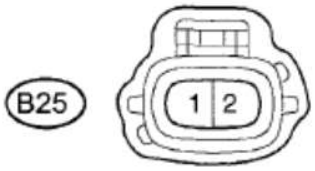
Tester Connection	Condition	Specified Condition
B25-1 or B49-28 (OC1+) - Body ground	Always	10 kohms or higher
B25-2 or B49-22 (OC1-) - Body ground	Always	10 kohms or higher

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d. Reconnect the camshaft timing oil control valve assembly (for intake camshaft) connector.
e. Reconnect the ECM connector.

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR

Front view of wire harness connector:
(to Camshaft Timing Oil Control Valve Assembly (for Intake Camshaft))



Rear view of wire harness connector:
(to ECM)

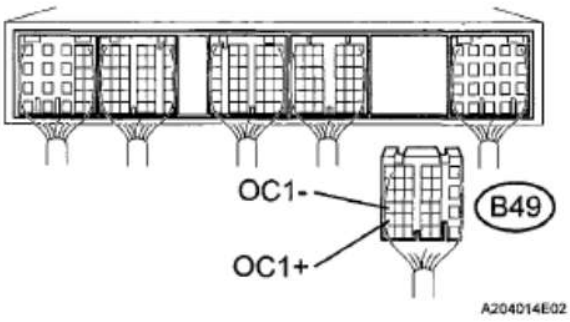


Fig. 43: Identifying Camshaft Timing Oil Control Valve Assembly And ECM Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: REPLACE ECM (See **REMOVAL**)

DTC P0011 CAMSHAFT POSITION "A" - TIMING OVER-ADVANCED OR SYSTEM PERFORMANCE (BANK 1); DTC P0012 CAMSHAFT POSITION "A" - TIMING OVER-RETARDED (BANK 1)

DESCRIPTION

Refer to **DTC P0010** .

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DTC DETECTION CONDITION CHART

DTC No.	DTC Detection Condition	Trouble Area
P0011	The valve timing is not adjusted in the valve timing advance range (1 trip detection logic).	• Valve timing • Camshaft timing oil control valve assembly (for intake camshaft) • Oil control valve filter • Camshaft timing gear assembly • ECM
P0012	The valve timing is not adjusted in the valve timing retard range (2 trip detection logic).	

MONITOR DESCRIPTION

The ECM optimizes the intake valve timing using the Variable Valve Timing (VVT) system to control the intake camshaft. The VVT system includes the ECM, the camshaft timing oil control valve assembly and the VVT controller (camshaft timing gear assembly). The ECM sends a target duty-cycle control signal to the camshaft timing oil control valve assembly. This control signal regulates the oil pressure supplied to the VVT controller. The VVT controller can advance or retard the intake camshaft.

If the difference between the target and actual intake valve timings is large, and changes in the actual intake valve timing are small, the ECM interprets this as the VVT controller stuck malfunction and stores a DTC.

Example:

A DTC is set when the following conditions "A" and "B" are met:

a. It takes 5 seconds or more to change the valve timing by 5°CA (Condition "A").
b. After the above condition is met, the camshaft timing oil control valve assembly is forcibly activated 10 seconds (Condition "B").

DTC P0011 (Advanced Cam Timing) is subject to 1 trip detection logic.

DTC P0012 (Retarded Cam Timing) is subject to 2 trip detection logic.

These DTCs indicate that the VVT controller cannot operate properly due to camshaft timing oil control valve assembly malfunctions or the presence of foreign objects in the camshaft timing oil control valve assembly.

The monitor will run if all of the following conditions are met:

- The engine is warm (the engine coolant temperature is 75°C [167°F] or higher).
- The vehicle has been driven at more than 40 mph (64 km/h) for 3 minutes.
- The engine has idled for 3 minutes.

MONITOR STRATEGY

MONITOR STRATEGY CHART

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Related DTCs	P0011: Advanced Camshaft Timing P0012: Retarded Camshaft Timing
Required Sensors/Components (Main)	Camshaft timing oil control valve assembly and VVT controller
Required Sensors/Components (Related)	Crankshaft position sensor Camshaft position sensor Engine coolant temperature sensor
Frequency of Operation	Once per driving cycle
Duration	Within 10 seconds
MIL Operation	Advanced camshaft timing: Immediate Retarded camshaft timing: 2 driving cycles
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

TYPICAL ENABLING CONDITIONS CHART

Monitor runs whenever following DTCs not stored	P0010 (Camshaft Timing Oil Control Valve) P0016 (VVT System - Misalignment) P0102, P0103 (Mass Air Flow Meter) P0115, P0117, P0118 (Engine Coolant Temperature Sensor) P0125 (Insufficient Coolant Temperature for Closed Loop Fuel Control) P0335 (Crankshaft Position Sensor) P0340 (Camshaft Position Sensor)
Battery voltage	11 V or higher
Engine speed	400 to 4000 rpm
Engine coolant temperature	75 to 100°C (167 to 212°F)

TYPICAL MALFUNCTION THRESHOLDS

TYPICAL MALFUNCTION THRESHOLDS CHART

All of following conditions are met	-
Deviation of actual valve timing and target valve timing	More than 5°CA (Crankshaft angle)
Valve timing	No change at advanced (retarded) valve timing

CONFIRMATION DRIVING PATTERN

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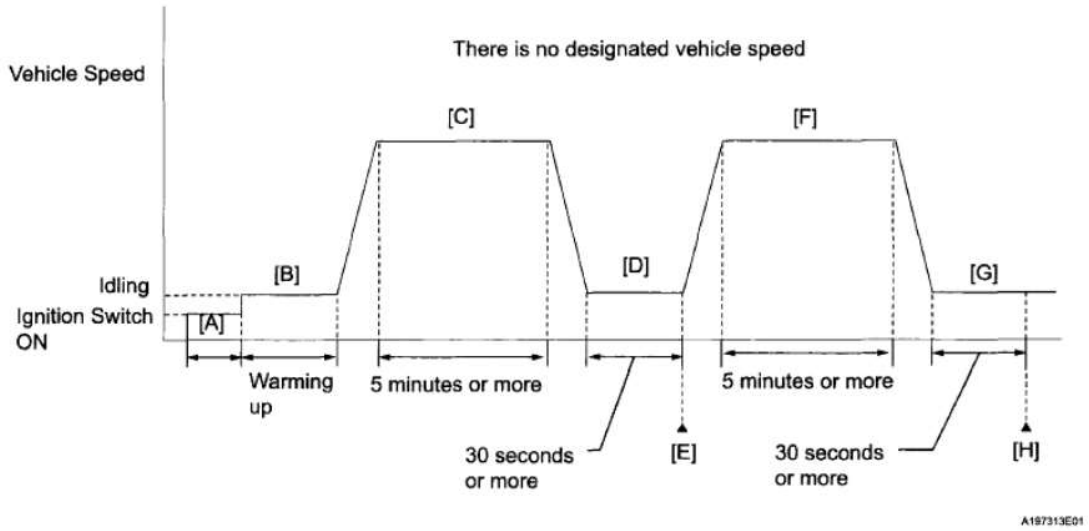


Fig. 44: Vehicle Speed Driving Pattern
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

1. Connect the Techstream to the DLC3.
2. Turn the ignition switch to ON and turn the Techstream on.
3. Clear the DTCs (even if no DTCs are stored, perform the clear DTC procedure).
4. Turn the ignition switch off.
5. Turn the ignition switch to ON and turn the Techstream on [A].
6. Start the engine and warm it up until the engine coolant temperature reaches 75°C (167°F) or higher [B];
7. Drive the vehicle for 5 minutes or more [C].
8. Idle the engine for 30 seconds or more [D].
9. Enter the following menus: Powertrain/Engine/Utility/All Readiness.
10. Input the DTC: P0011 or P0012.
11. Check the DTC judgment result [E].

TECHSTREAM DISPLAY DESCRIPTION

Techstream Display	Description
NORMAL	• DTC judgment completed • System normal
ABNORMAL	• DTC judgment completed • System abnormal
INCOMPLETE	• DTC judgment not completed Perform driving pattern after confirming • DTC enabling conditions
UNKNOWN	• Unable to perform DTC judgment • Number of DTCs which do not fulfill DTC preconditions has reached ECU

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	memory limit

CAUTION: When performing the confirmation driving pattern, obey all speed limits and traffic laws.

HINT:

- If the judgment result shows ABNORMAL, the system has a malfunction.
- If the judgment result shows INCOMPLETE or UNKNOWN, perform steps [F] through [H].

12. Drive the vehicle for 5 minutes or more [F].
13. Idle the engine for 30 seconds or more [G].
14. Enter the following menus: Powertrain/Engine/Utility/All Readiness.
15. Input the DTC: P0011 or P0012.
16. Check the DTC judgment result again [H].
17. If the test result is UNKNOWN, enter the following menus: Powertrain/Engine/Trouble Codes/Pending.
18. Read Pending DTCs [H].

    HINT:

    If a pending DTC is output, the system is malfunctioning.

19. If the test result is INCOMPLETE or UNKNOWN and no pending DTC is output, perform a universal trip and check for permanent DTCs (See **DTC CHECK/CLEAR**).

    HINT:

    - If a permanent DTC is output, the system is malfunctioning.
    - If no permanent DTC is output, the system is normal.

WIRING DIAGRAM

Refer to **DTC P0010** .

INSPECTION PROCEDURE

HINT:

- DTC P0011 or P0012 may be stored when foreign objects in the engine oil are caught in some parts of the system. The DTC will remain set even if the system returns to normal after a short time. Those foreign objects may then be captured by the oil filter.
- Read freeze frame data using the Techstream. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.

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1. **CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P0011 OR P0012)**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the Techstream on.
   d. Enter the following menus: Powertrain/Engine/Trouble Codes.
   e. Read the DTCs.

   Result

   RESULT CHART

Result	Proceed to
DTC P0011 or P0012 is output	A
DTC P0011 or P0012 and other DTCs are output	B

   HINT:

   If any DTCs other than P0011 or P0012 are output, troubleshoot those DTCs first.

   B: GO TO **DTC CHART**

   A: Go to next step

2. **PERFORM ACTIVE TEST USING TECHSTREAM (OPERATE CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY)**
   a. Connect the Techstream to the DLC3.
   b. Start the engine.
   c. Turn the Techstream on.
   d. Turn the A/C switch on.
   e. Enter the following menus: Powertrain/Engine/Active Test/Control the VVT System (Bank 1).
   f. Check the engine speed while operating the camshaft timing oil control valve assembly (for intake camshaft) using the Techstream.

   Result

   TECHSTREAM OPERATION CHART

Techstream Operation	Specified Condition
OFF	Normal engine speed
ON	Engine idles roughly or stalls (soon after camshaft timing oil control valve assembly switched from OFF to ON)

   HINT:

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If the result is not acceptable, cool the engine and perform the Active Test again.

g. Start the engine when the engine coolant temperature is 30°C (86°F) or less.
h. Turn the Techstream on.
i. Turn the A/C switch on.
j. Enter the following menus: Powertrain/Engine/Active Test/Control the VVT System (Bank 1).
k. Check the engine speed while operating the camshaft timing oil control valve assembly (for intake camshaft) using the Techstream when the engine coolant temperature is 50°C (122°F) or less.

Result

TECHSTREAM OPERATION CHART

Techstream Operation	Specified Condition
OFF	Normal engine speed
ON	Engine idles roughly or stalls (soon after camshaft timing oil control valve assembly switched from OFF to ON)

NG: Go to step 4

OK: Go to next step

3. **CHECK WHETHER DTC OUTPUT RECURS (DTC P0011 OR P0012)**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the Techstream on.
   d. Clear the DTCs (See **DTC CHECK/CLEAR**).
   e. Turn the ignition switch off.
   f. Turn the ignition switch to ON and turn the Techstream on.
   g. Start the engine and warm it up.
   h. Drive the vehicle in accordance with the driving pattern described in the **CONFIRMATION DRIVING PATTERN**.
   i. Enter the following menus: Powertrain/Engine/Utility/All Readiness.
   j. Input the DTC: P0011 or P0012.
   k. Check the DTC judgment result.

Result

RESULT CHART

Result	Proceed to
NORMAL (DTC is not output)	A
ABNORMAL (DTC P0011 or P0012 is output)	B

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HINT:

DTC P0011 or P0012 may be stored when foreign objects in the engine oil are caught in some parts of the system. The DTC will remain stored even if the system returns to normal after a short time. These foreign objects may then be captured by the oil filter.

B: Go to step 4

A: CHECK FOR INTERMITTENT PROBLEMS (See **CHECK FOR INTERMITTENT PROBLEMS**)

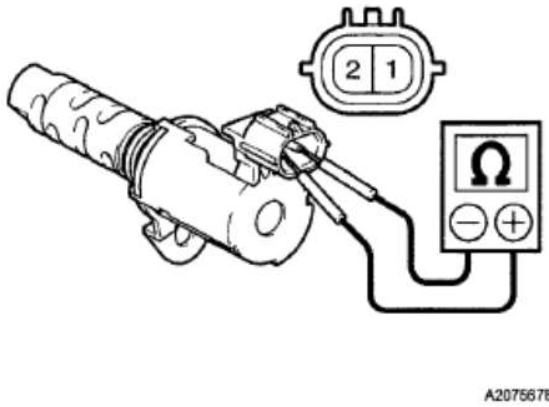
4. **INSPECT CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY**
   a. Remove the camshaft timing oil control valve assembly (for intake camshaft).
   b. Measure the resistance according to the value(s) in the table below.

Standard Resistance

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
1 - 2	20°C (68°F)	6.9 to 7.9 ohms

Component without harness connected:
(Camshaft Timing Oil Control Valve Assembly (for Intake Camshaft))



A207567E02

Fig. 45: Inspecting Camshaft Timing Oil Control Valve Assembly
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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c. Connect the positive (+) battery terminal to terminal 1 and connect the negative (-) battery terminal to terminal 2. Check the valve operation.

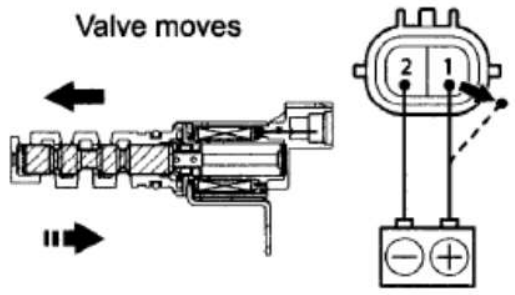
OK:

Valve moves quickly.

d. Reinstall the camshaft timing oil control valve assembly (for intake camshaft).

NG: REPLACE CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY (See **REMOVAL**)

Component without harness connected:
(Camshaft Timing Oil Control Valve Assembly (for Intake Camshaft))



Y A183795E04

Fig. 46: Connecting Battery Terminals To Camshaft Timing Oil Control Valve Assembly
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

5. **CHECK VALVE TIMING (CHECK FOR LOOSE TIMING CHAIN AND JUMPED TEETH)**
   a. Remove the cylinder head cover (See **REMOVAL**).

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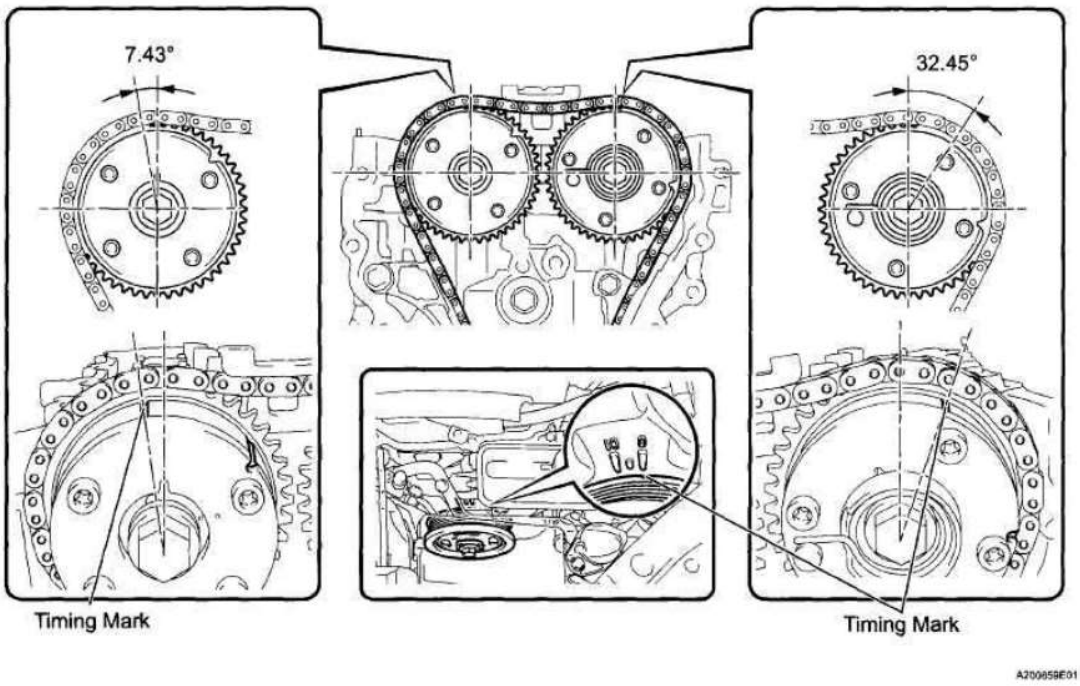


Fig. 47: Identifying Timing Marks
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. Turn the crankshaft pulley, and align its groove with the timing mark "0" of the timing chain cover.
c. Check that the timing marks of the camshaft timing gears are aligned with the timing marks as shown in the illustration.

OK:

Timing marks on camshaft timing gears are aligned as shown in the illustration.

d. Reinstall the cylinder head cover (See **INSTALLATION**).

NG: ADJUST VALVE TIMING (See **REMOVAL**)

OK: Go to next step

6. **INSPECT CAMSHAFT TIMING GEAR ASSEMBLY**
   a. Inspect the camshaft timing gear assembly (See **INSPECTION**).

NG: REPLACE CAMSHAFT TIMING GEAR ASSEMBLY (See **DISASSEMBLY**)

OK: Go to next step

7. **INSPECT OIL CONTROL VALVE FILTER**
   a. Remove the oil control valve filter (See **DISASSEMBLY**).

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b. Check that the filter is not clogged.

OK:

Filter is not clogged.

c. Reinstall the oil control valve filter (See **REASSEMBLY**).

NG: REPLACE OIL CONTROL VALVE FILTER (See **DISASSEMBLY**)

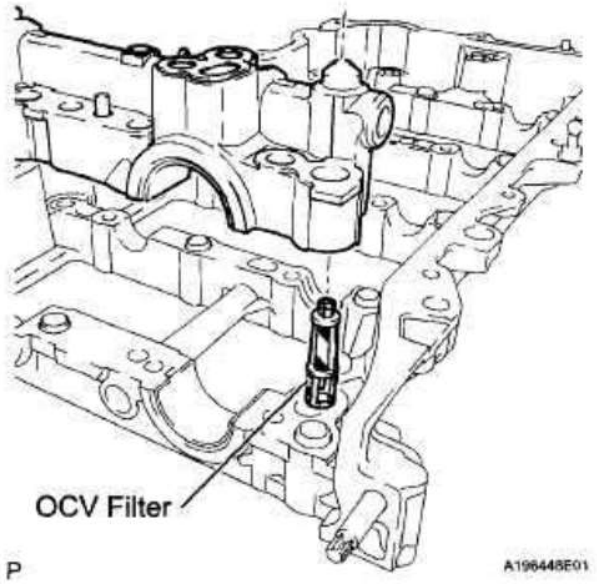


Fig. 48: Identifying Oil Control Valve Filter
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

8. **CHECK WHETHER DTC OUTPUT RECURS (DTC P0011 OR P0012)**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the Techstream on.
   d. Clear the DTCs (See **DTC CHECK/CLEAR**).
   e. Turn the ignition switch off.
   f. Turn the ignition switch to ON and turn the Techstream on.
   g. Start the engine and warm it up.
   h. Drive the vehicle in accordance with the driving pattern described in the **CONFIRMATION DRIVING PATTERN**.
   i. Enter the following menus: Powertrain/Engine/Utility/All Readiness.
   j. Input the DTC: P0011 or P0012.

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k. Check the DTC judgment result.

Result

RESULT CHART

Result	Proceed to
NORMAL (DTC is not output)	A
ABNORMAL (DTC P0011 or P0012 is output)	B

HINT:

DTC P0011 or P0012 may be stored when foreign objects in the engine oil are caught in some parts of the system. The DTC will remain stored even if the system returns to normal after a short time. These foreign objects may then be captured by the oil filter.

B: REPLACE ECM (See **REMOVAL**)

A: CHECK FOR INTERMITTENT PROBLEMS (See **CHECK FOR INTERMITTENT PROBLEMS**)

DTC P0013 CAMSHAFT POSITION "B" ACTUATOR CIRCUIT/OPEN (BANK 1)

DESCRIPTION

The Variable Valve Timing (VVT) system adjusts the exhaust valve timing to improve driveability. The engine oil pressure turns the VVT controller to adjust the valve timing.

The camshaft timing oil control valve is a solenoid valve and switches the engine oil line. The valve moves when the ECM applies 12 V to the solenoid. The ECM changes the energizing time to the solenoid (duty-cycle) in accordance with the camshaft position, crankshaft position, throttle position, etc.

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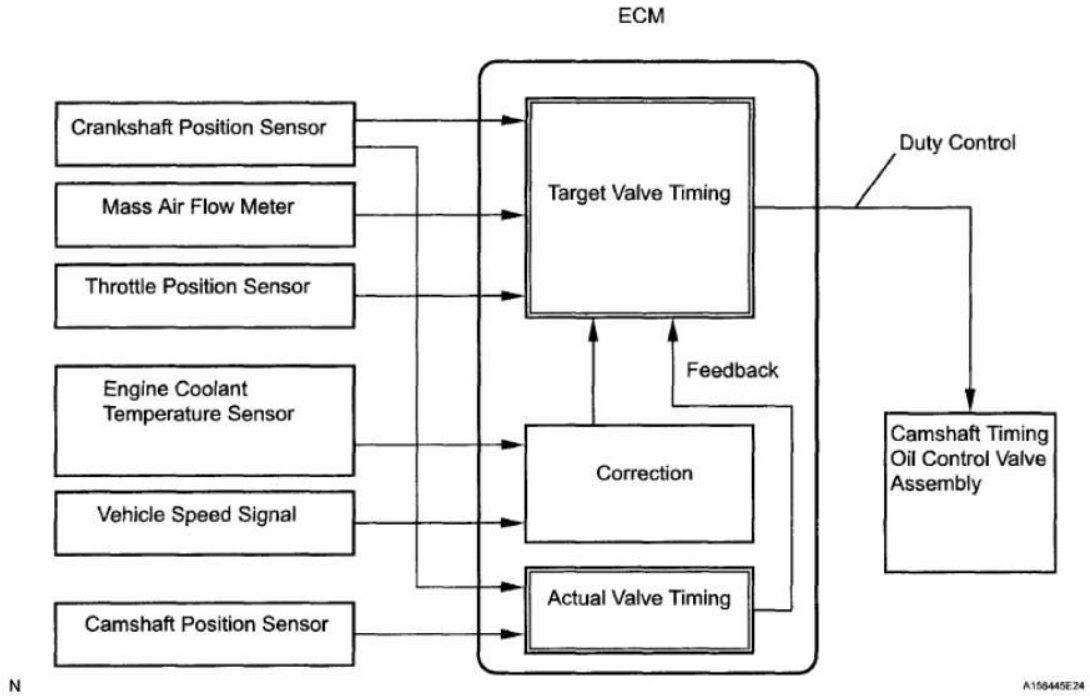


Fig. 49: Variable Valve Timing (VVT) System - Communication Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

DTC DETECTION CONDITION CHART

DTC No.	DTC Detection Condition	Trouble Area
P0013	Open or short in camshaft timing oil control valve (for exhaust camshaft) circuit (1 trip detection logic)	• Open or short in camshaft timing oil control valve assembly (for exhaust camshaft) circuit • Camshaft timing oil control valve assembly (for exhaust camshaft) • ECM

MONITOR DESCRIPTION

This DTC is designed to detect open or short in the camshaft timing oil control valve (for exhaust camshaft) circuit. If the camshaft timing oil control valve assembly's duty-cycle is excessively high or low while the engine is running, the ECM will illuminate the MIL and set the DTC.

MONITOR STRATEGY

MONITOR STRATEGY CHART

Related DTCs	P0013. Exhaust Camshaft Timing Oil Control Valve Range Check
Required Sensors/Components (Main)	Exhaust camshaft timing oil control valve

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Required Sensors/Components (Related)	-
Frequency of Operation	Continuous
Duration	1 second
MIL Operation	Immediate
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

TYPICAL ENABLING CONDITIONS CHART

Monitor runs whenever following DTCs not present	None
All of following conditions met	-
Starter	OFF
Ignition switch	ON
Time after ignition switch off to ON	0.5 seconds or more

TYPICAL MALFUNCTION THRESHOLDS

TYPICAL MALFUNCTION THRESHOLDS CHART

One of following conditions met	-
A. All of following conditions met	-
Battery voltage	11 to 13 V
Target duty ratio	Less than 70%
Output signal duty ratio	100% or more
B. All of following conditions met	-
Battery voltage	13 V or more
Target duty ratio	Less than 80%
Current cut status	Not cut
Output signal duty	3% or less

COMPONENT OPERATING RANGE

COMPONENT OPERATING RANGE CHART

Camshaft timing oil control valve duty ratio	3 to 100%

CONFIRMATION DRIVING PATTERN

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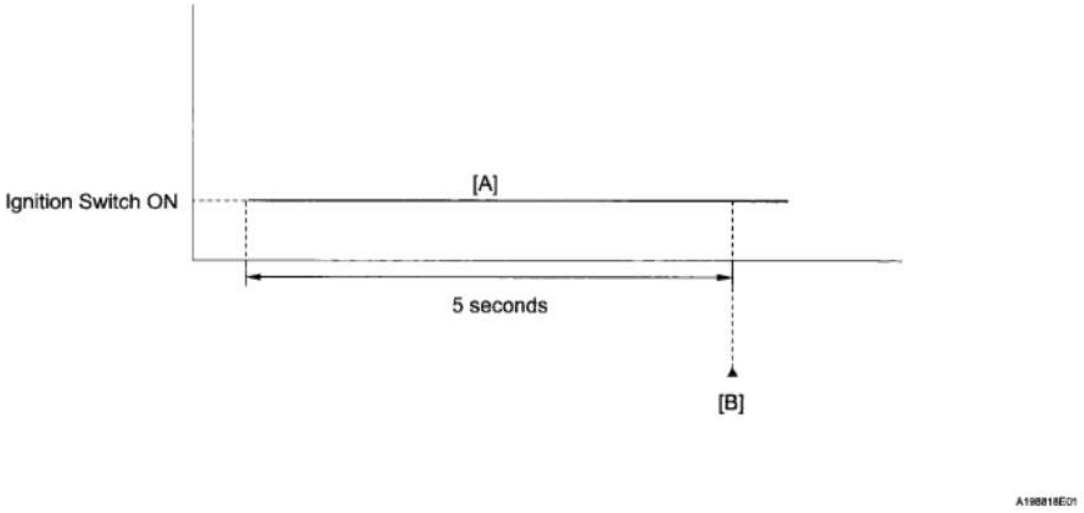


Fig. 50: Confirmation Driving Pattern
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

1. Connect the Techstream to the DLC3.
2. Turn the ignition switch to ON and turn the Techstream on.
3. Clear the DTCs (even if no DTCs are stored, perform the clear DTC procedure).
4. Turn the ignition switch off.
5. Turn the ignition switch to ON and turn the Techstream on.
6. Wait 5 seconds [A].
7. Enter the following menus: Powertrain/Engine/Utility/All Readiness.
8. Input the DTC: P0013.
9. Check the DTC judgment result [B].

TECHSTREAM DISPLAY DESCRIPTION

Techstream Display	Description
NORMAL	• DTC judgment completed • System normal
ABNORMAL	• DTC judgment completed • System abnormal
INCOMPLETE	• DTC judgment not completed • Perform driving pattern after confirming DTC enabling conditions
UNKNOWN	• Unable to perform DTC judgment • Number of DTCs which do not fulfill DTC preconditions has reached ECU memory limit

10. If the test result is UNKNOWN, enter the following menus: Powertrain/Engine/Trouble Codes/Pending.

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11. Read Pending DTCs.

    HINT:

    If a pending DTC is output, the system is malfunctioning.

12. If the test result is INCOMPLETE or UNKNOWN and no pending DTC is output, perform a universal trip and check for permanent DTCs (See **DTC CHECK/CLEAR**).

    HINT:

    - If a permanent DTC is output, the system is malfunctioning.
    - If no permanent DTC is output, the system is normal.

WIRING DIAGRAM

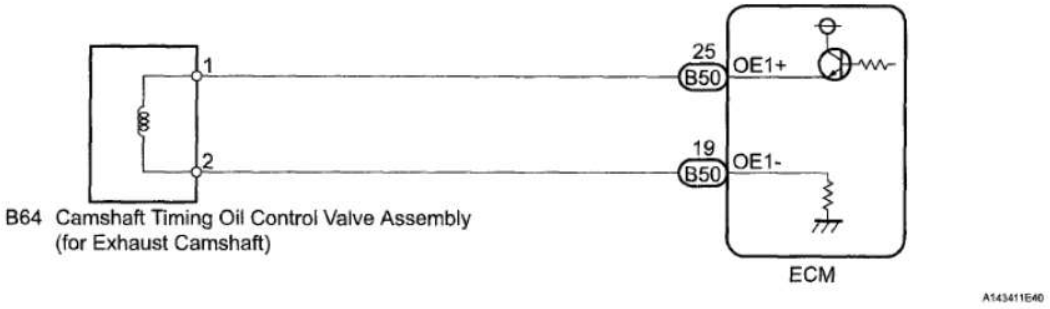


Fig. 51: Camshaft Position "B" Actuator Circuit/Open (Bank 1) - Wiring Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSPECTION PROCEDURE

HINT:

- If DTC P0013 is output, check the VVT system (for exhaust camshaft) circuit.
- Read freeze frame data using the Techstream. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can be helpful in determining whether the vehicle was running or stopped, whether the engine was warmed up or not, whether the air fuel ratio was lean or rich, as well as other data recorded at the time of a malfunction.

1. **PERFORM ACTIVE TEST USING USING TECHSTREAM (OPERATE CAMSHAFT TIMING OIL CONTROL VALVE)**
    a. Connect the Techstream to the DLC3.
    b. Start the engine.
    c. Turn the Techstream on.
    d. Turn the A/C switch on.

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e. Enter the following menus: Powertrain/Engine/Active Test/Control the VVT Exhaust Linear (Bank 1).
f. Check the engine speed while operating the camshaft timing oil control valve assembly (for exhaust camshaft) using the Techstream.

Result

TECHSTREAM OPERATION CHART

Techstream Operation	Specified Condition
0% (OFF)	Normal engine speed
127% (ON)	Engine idles roughly or stalls (soon after camshaft timing oil control valve assembly switched from OFF to ON)

HINT:

If the result is not acceptable, cool the engine and perform the Active Test again.

g. Start the engine when the engine coolant temperature is 30°C (86°F) or less.
h. Turn the Techstream on.
i. Turn the A/C switch on.
j. Enter the following menus: Powertrain/Engine/Active Test/Control the VVT Exhaust Linear (Bank 1).
k. Check the engine speed while operating the camshaft timing oil control valve assembly (for exhaust camshaft) using the Techstream when the engine coolant temperature is 50°C (122°F) or less.

Result

TECHSTREAM OPERATION CHART

Techstream Operation	Specified Condition
0% (OFF)	Normal engine speed
127% (ON)	Engine idles roughly or stalls (soon after camshaft timing oil control valve assembly switched from OFF to ON)

NG: Go to step 2

OK: CHECK FOR INTERMITTENT PROBLEMS (See **CHECK FOR INTERMITTENT PROBLEMS**)

2. **INSPECT CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY (FOR EXHAUST CAMSHAFT)**
   a. Remove the camshaft timing oil control valve assembly (for exhaust camshaft).
   b. Measure the resistance according to the value(s) in the table below.

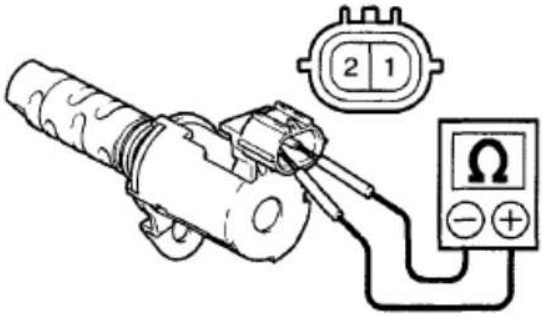
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Standard Resistance

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
1 - 2	20°C (68°F)	6.9 to 7.9 ohms

Component without harness connected:
(Camshaft Timing Oil Control Valve Assembly (for Exhaust Camshaft))



A207567E03

Fig. 52: Inspecting Camshaft Timing Oil Control Valve Assembly
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

c. Connect the positive (+) battery terminal to terminal 1 and connect the negative (-) battery terminal to terminal 2. Check the valve operation.

OK:

Valve moves quickly.

d. Reinstall the camshaft timing oil control valve assembly (for exhaust camshaft).

NG: REPLACE CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY (FOR EXHAUST CAMSHAFT) (See **REMOVAL**)

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Component without harness connected:
(Camshaft Timing Oil Control Valve Assembly (for Exhaust Camshaft))

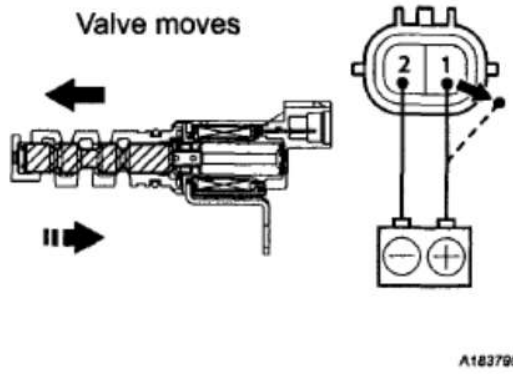


Fig. 53: Connecting Battery Terminals To Camshaft Timing Oil Control Valve Assembly
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

3. **CHECK HARNESS AND CONNECTOR (CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY - ECM)**
   a. Disconnect the camshaft timing oil control valve assembly (for exhaust camshaft) connector.
   b. Disconnect the ECM connector.
   c. Measure the resistance according to the value(s) in the table below.

Standard Resistance (Check for Open)

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
B64-1 - B50-25 (OE1+)	Always	Below 1 ohms
B64-2 - B50-19 (OE1-)	Always	Below 1 ohms

Standard Resistance (Check for Short)

TESTER CONNECTION SPECIFIED CONDITION CHART

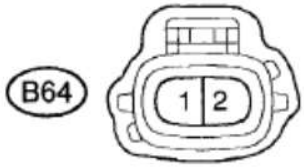
Tester Connection	Condition	Specified Condition
B64-1 or B50-25 (OE1+) - Body ground	Always	10 kohms or higher
B64-2 or B50-19 (OE1-) - Body ground	Always	10 kohms or higher

   d. Reconnect the camshaft timing oil control valve assembly (for exhaust camshaft) connector.
   e. Reconnect the ECM connector.

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NG: REPAIR OR REPLACE HARNESS OR CONNECTOR (CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY - ECM)

Front view of wire harness connector:
(to Camshaft Timing Oil Control Valve Assembly (for Exhaust Camshaft))



Rear view of wire harness connector:
(to ECM)

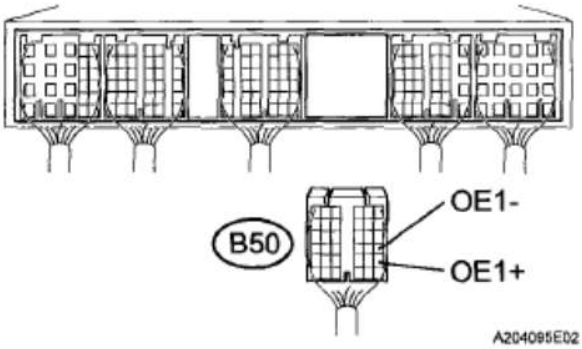


Fig. 54: Identifying Camshaft Timing Oil Control Valve Assembly And ECM Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: REPLACE ECM (See **REMOVAL**)

DTC P0014 CAMSHAFT POSITION "B" - TIMING OVER-ADVANCED OR SYSTEM PERFORMANCE (BANK 1); DTC P0015 CAMSHAFT POSITION "B" - TIMING OVER-RETARDED (BANK 1)

DESCRIPTION

Refer to **DTC P0013** .

DTC DETECTION CONDITION CHART

DTC	DTC Detection Condition	Trouble Area

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No.		
P0014	The valve timing is not adjusted in the exhaust valve timing advance range (3 trip detection logic).	• Valve timing • Camshaft timing oil control valve assembly (for exhaust camshaft) • Oil control valve filter • Camshaft timing gear assembly (for exhaust camshaft) • ECM
P0015	The valve timing is not adjusted in the exhaust valve timing retard range (1 trip detection logic).	

MONITOR DESCRIPTION

The ECM optimizes the exhaust valve timing using the Variable Valve Timing (VVT) system to control the exhaust camshaft. The VVT system includes the ECM, the camshaft timing oil control valve assembly and the VVT controller (camshaft timing gear assembly). The ECM sends a target duty-cycle control signal to the camshaft timing oil control valve assembly. This control signal regulates the oil pressure supplied to the VVT controller. The VVT controller can advance or retard the exhaust camshaft.

If the difference between the target and actual exhaust valve timing is large, and changes in the actual exhaust valve timing are small, the ECM interprets this as a VVT controller stuck malfunction and stores a DTC.

Example:

A DTC is set when the following conditions "A" and "B" are met:

a. It takes 5 seconds or more to change the valve timing by 5°CA (Condition "A").
b. After the above condition is met, the camshaft timing oil control valve assembly is forcibly activated 10 seconds (Condition "B").

DTC P0014 (Advanced Cam Timing) is subject to 3 trip detection logic.

DTC P0015 (Retarded Cam Timing) is subject to 1 trip detection logic.

These DTCs indicate that the VVT controller cannot operate properly due to camshaft timing oil control valve assembly malfunctions or the presence of foreign objects in the camshaft timing oil control valve assembly.

The monitor will run if all of the following conditions are met:

- The engine is warm (the engine coolant temperature is 75°C [167°F] or more).
- The vehicle has been driven at more than 40 mph (64 km/h) for 3 minutes.
- The engine has idled for 3 minutes.

MONITOR STRATEGY

MONITOR STRATEGY CHART

	P0014: Advanced Camshaft Timing

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Related DTCs	P0015: Retarded Camshaft Timing
Required Sensors/Components (Main)	Camshaft timing oil control valve and VVT controller
Required Sensors/Components (Related)	Crankshaft position sensor Camshaft position sensor Engine coolant temperature sensor
Frequency of Operation	Once per driving cycle
Duration	Within 10 seconds
MIL Operation	Advanced camshaft timing: 3 driving cycles Retarded camshaft timing: Immediate
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

TYPICAL ENABLING CONDITIONS CHART

Monitor runs whenever following DTCs not stored	P0013 (Exhaust Camshaft Timing Oil Control Valve) P0017 (Exhaust VVT System - Misalignment) P0102, P0103 (Mass Air Flow Meter) P0115, P0117, P0118 (Engine Coolant Temperature Sensor) P0125 (Insufficient Coolant Temperature for Closed Loop Fuel Control) P0335 (Crankshaft Position Sensor) P0340 (Camshaft Position Sensor) Battery voltage 11 V or higher
Engine speed	500 to 4000 rpm
Engine coolant temperature	75 to 100°C (167 to 212°F)

TYPICAL MALFUNCTION THRESHOLDS

Advanced Camshaft Timing

TYPICAL MALFUNCTION THRESHOLDS CHART

Valve timing	No change
Valve timing	Advance position

Retarded Camshaft Timing

TYPICAL MALFUNCTION THRESHOLDS CHART

Valve timing	No change
Valve timing	Retarded position

CONFIRMATION DRIVING PATTERN

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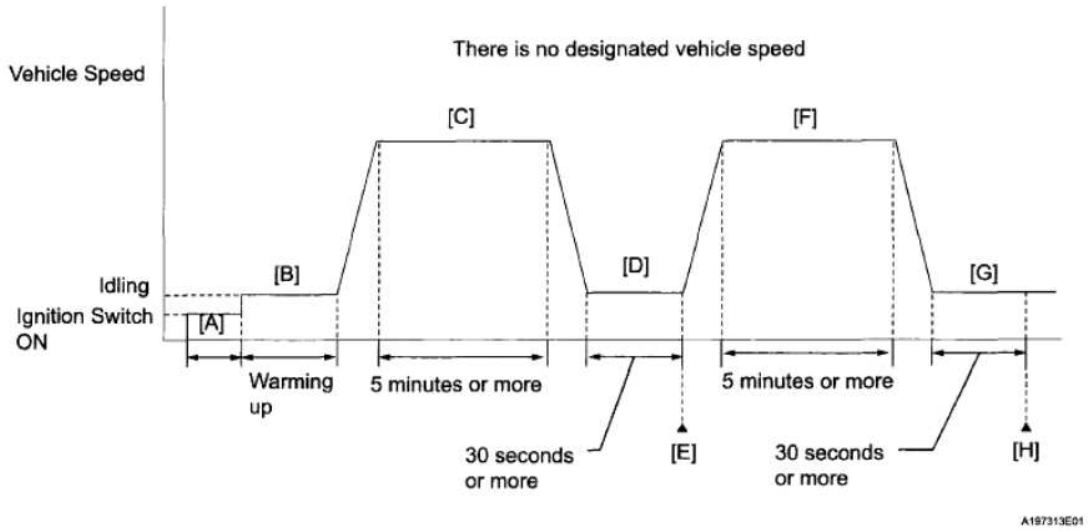


Fig. 55: Vehicle Speed Driving Pattern
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

1. Connect the Techstream to the DLC3.
2. Turn the ignition switch to ON and turn the Techstream on.
3. Clear the DTCs (even if no DTCs are stored, perform the clear DTC procedure).
4. Turn the ignition switch off.
5. Turn the ignition switch to ON and turn the Techstream on [A].
6. Start the engine and warm it up until the engine coolant temperature reaches 75°C (167°F) or higher [B].
7. Drive the vehicle for 5 minutes or more [C].
8. Idle the engine for 30 seconds or more [D].
9. Enter the following menus: Powertrain/Engine/Utility/All Readiness.
10. Input the DTC: P0014 or P0015.
11. Check the DTC judgment result [E].

TECHSTREAM DISPLAY DESCRIPTION

Techstream Display	Description
NORMAL	• DTC judgment completed • System normal
ABNORMAL	• DTC judgment completed • System abnormal
INCOMPLETE	• DTC judgment not completed Perform driving pattern after confirming • DTC enabling conditions
UNKNOWN	• Unable to perform DTC judgment • Number of DTCs which do not fulfill DTC preconditions has reached ECU

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	memory limit

CAUTION: When performing the confirmation driving pattern, obey all speed limits and traffic laws.

HINT:

- If the judgment result shows ABNORMAL, the system has a malfunction.
- If the judgment result shows INCOMPLETE or UNKNOWN, perform steps [F] through [H].

12. Drive the vehicle for 5 minutes or more [F].
13. Idle the engine for 30 seconds or more [G].
14. Enter the following menus: Powertrain/Engine/Utility/All Readiness.
15. Input the DTC: P0014 or P0015.
16. Check the DTC judgment result again [H].
17. If the test result is UNKNOWN, enter the following menus: Powertrain/Engine/Trouble Codes/Pending.
18. Read Pending DTCs [H].

    HINT:

    If a pending DTC is output, the system is malfunctioning.

19. If the test result is INCOMPLETE or UNKNOWN and no pending DTC is output, perform a universal trip and check for permanent DTCs (See **DTC CHECK/CLEAR**).

    HINT:

    - If a permanent DTC is output, the system is malfunctioning.
    - If no permanent DTC is output, the system is normal.

WIRING DIAGRAM

Refer to **DTC P0013** .

INSPECTION PROCEDURE

HINT:

- DTC P0014 or P0015 may be stored when foreign objects in the engine oil are caught in some parts of the system. The DTC will remain set even if the system returns to normal after a short time. Those foreign objects may then be captured by the oil filter.
- Read freeze frame data using the Techstream. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.

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1. **CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P0014 OR P0015)**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the Techstream on.
   d. Enter the following menus: Powertrain/Engine/Trouble Codes.
   e. Read the DTCs.

   Result

   RESULT CHART

Result	Proceed to
DTC P0014 or P0015 is output	A
DTC P0014 or P0015 and other DTCs are output	B

   HINT:

   If any DTCs other than P0014 or P0015 are output, troubleshoot those DTCs first.

   B: GO TO **DTC CHART**

   A: Go to next step

2. **PERFORM ACTIVE TEST USING TECHSTREAM (OPERATE CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY)**
   a. Connect the Techstream to the DLC3.
   b. Start the engine.
   c. Turn the Techstream on.
   d. Turn the A/C switch on.
   e. Enter the following menus: Powertrain/Engine/Active Test/Control the VVT Exhaust Linear (Bank 1).
   f. Check the engine speed while operating the camshaft timing oil control valve assembly (for exhaust camshaft) using the Techstream.

   Result

   TECHSTREAM OPERATION CHART

Techstream Operation	Specified Condition
0% (OFF)	Normal engine speed
127% (ON)	Engine idles roughly or stalls (soon after camshaft timing oil control valve assembly switched from OFF to ON)

   HINT:

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If the result is not acceptable, cool the engine and perform the Active Test again.

g. Start the engine when the engine coolant temperature is 30°C (86°F) or less.
h. Turn the Techstream on.
i. Turn the A/C switch on.
j. Enter the following menus: Powertrain/Engine/Active Test/Control the VVT Exhaust Linear (Bank 1).
k. Check the engine speed while operating the camshaft timing oil control valve assembly (for exhaust camshaft) using the Techstream when the engine coolant temperature is 50°C (122°F) or less.

Result

TECHSTREAM OPERATION CHART

Techstream Operation	Specified Condition
0% (OFF)	Normal engine speed
127% (ON)	Engine idles roughly or stalls (soon after camshaft timing oil control valve assembly switched from OFF to ON)

NG: Go to step 4

OK: Go to next step

3. **CHECK WHETHER DTC OUTPUT RECURS (DTC P0014 OR P0015)**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the Techstream on.
   d. Clear the DTCs (See **DTC CHECK/CLEAR**).
   e. Turn the ignition switch off.
   f. Turn the ignition switch to ON and turn the Techstream on.
   g. Start the engine and warm it up.
   h. Drive the vehicle in accordance with the driving pattern described in the **CONFIRMATION DRIVING PATTERN**.
   i. Enter the following menus: Powertrain/Engine/Utility/All Readiness.
   j. Input the DTC: P0014 or P0015.
   k. Check the DTC judgment result.

Result

RESULT CHART

Result	Proceed to
NORMAL (DTC is not output)	A

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ABNORMAL (DTC P0014 or P0015 is output)	B

HINT:

DTC P0014 or P0015 may be stored when foreign objects in the engine oil are caught in some parts of the system. The DTC will remain stored even if the system returns to normal after a short time. These foreign objects may then be captured by the oil filter.

B: Go to step 4

A: CHECK FOR INTERMITTENT PROBLEMS (See **CHECK FOR INTERMITTENT PROBLEMS**)

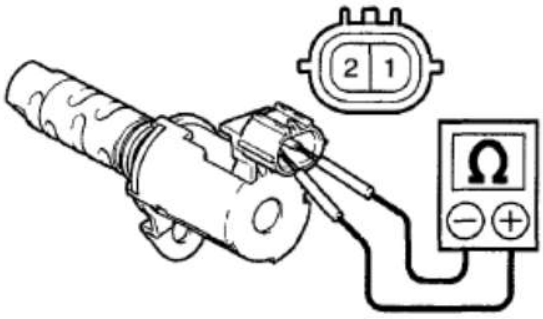
4. **INSPECT CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY (FOR EXHAUST CAMSHAFT)**
   a. Remove the camshaft timing oil control valve assembly (for exhaust camshaft).
   b. Measure the resistance according to the value(s) in the table below.

Standard Resistance

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
1 - 2	20°C (68°F)	6.9 to 7.9 ohms

Component without harness connected:
(Camshaft Timing Oil Control Valve Assembly (for Exhaust Camshaft))



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Fig. 56: Inspecting Camshaft Timing Oil Control Valve Assembly
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

c. Connect the positive (+) battery terminal to terminal 1 and connect the negative (-) battery terminal to terminal 2. Check the valve operation.

OK:

Valve moves quickly.

d. Reinstall the camshaft timing oil control valve assembly (for exhaust camshaft).

NG: REPLACE CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY (FOR EXHAUST CAMSHAFT) (See **REMOVAL**)

Component without harness connected:
(Camshaft Timing Oil Control Valve Assembly (for Exhaust Camshaft))

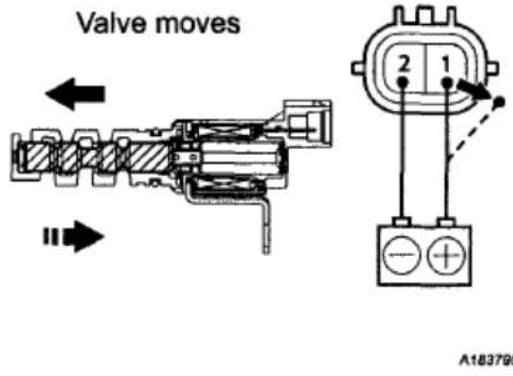


Fig. 57: Connecting Battery Terminals To Camshaft Timing Oil Control Valve Assembly
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

5. **CHECK VALVE TIMING (CHECK FOR LOOSE TIMING CHAIN AND JUMPED TEETH)** (See **INSPECTION PROCEDURE**)

NG: ADJUST VALVE TIMING (See **DISASSEMBLY**)

OK: Go to next step

6. **INSPECT CAMSHAFT TIMING GEAR ASSEMBLY (FOR EXHAUST CAMSHAFT)**
   a. Inspect the camshaft timing gear assembly (for exhaust camshaft) (See **INSPECTION**).

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NG: REPLACE CAMSHAFT TIMING GEAR ASSEMBLY (FOR EXHAUST CAMSHAFT) (See **REMOVAL**)

OK: Go to next step

7. **INSPECT OIL CONTROL VALVE FILTER**
   a. Remove the oil control valve filter (See **DISASSEMBLY**).
   b. Check that the filter is not clogged.

   OK:

   Filter is not clogged.

   c. Reinstall the oil control valve filter (See **REASSEMBLY**).

   NG: REPLACE OIL CONTROL VALVE FILTER (See **DISASSEMBLY**)

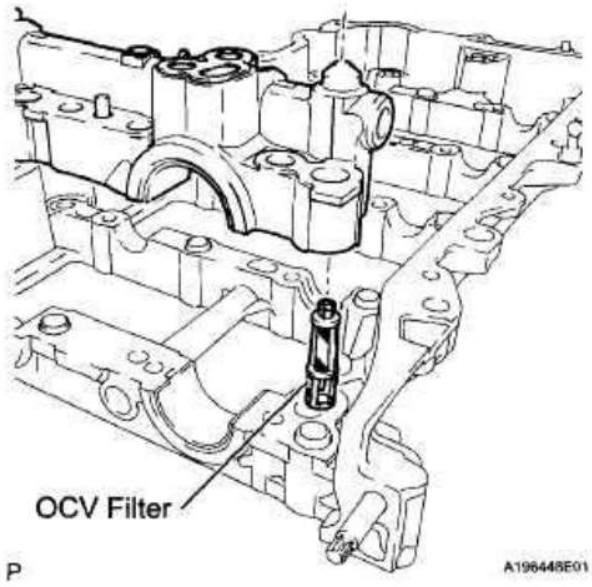


Fig. 58: Identifying Oil Control Valve Filter
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

8. **CHECK WHETHER DTC OUTPUT RECURS (DTC P0014 OR P0015)**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the Techstream on.
   d. Clear the DTCs (See **DTC CHECK/CLEAR**).
   e. Turn the ignition switch off.

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f. Turn the ignition switch to ON and turn the Techstream on.
g. Start the engine and warm it up.
h. Drive the vehicle in accordance with the driving pattern described in the **CONFIRMATION DRIVING PATTERN**.
i. Enter the following menus: Powertrain/Engine/Utility/All Readiness.
j. Input the DTC: P0014 or P0015.
k. Check the DTC judgment result.

Result

RESULT CHART

Result	Proceed to
NORMAL (DTC is not output)	A
ABNORMAL (DTC P0014 or P0015 is output)	B

HINT:

DTC P0014 or P0015 may be stored when foreign objects in the engine oil are caught in some parts of the system. The DTC will remain stored even if the system returns to normal after a short time. These foreign objects may then be captured by the oil filter.

B: REPLACE ECM (See **REMOVAL**)

A: CHECK FOR INTERMITTENT PROBLEMS (See **REMOVAL**)

DTC P0016 CRANKSHAFT POSITION - CAMSHAFT POSITION CORRELATION (BANK 1 SENSOR A); DTC P0017 CRANKSHAFT POSITION - CAMSHAFT POSITION CORRELATION (BANK 1 SENSOR B)

DESCRIPTION

The ECM optimizes the valve timing by using the Variable Valve Timing (VVT) system to control the intake and exhaust camshafts. The VVT system includes the ECM, the camshaft timing oil control valve assembly and the VVT controller (camshaft timing gear assembly). The ECM sends a target duty-cycle control signal to the camshaft timing oil control valve assembly.

This control signal regulates the oil pressure supplied to the VVT controller. The VVT controller can advance or retard the intake and exhaust camshafts.

DTC DETECTION CONDITION CHART

DTC No.	Detection Condition	Trouble Area
		• Valve timing • Camshaft timing oil control

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		valve assembly (for intake camshaft) • Oil control valve filter • Camshaft timing gear assembly (for intake camshaft) • ECM
P0016	Deviation in crankshaft position sensor signal and camshaft position sensor (for intake camshaft) signal (2 trip detection logic)	
P0017	Deviation in crankshaft position sensor signal and camshaft position sensor (for exhaust camshaft) signal (2 trip detection logic)	• Valve timing • Camshaft timing oil control valve assembly (for exhaust camshaft) • Oil control valve filter • Camshaft timing gear assembly (for exhaust camshaft) • ECM

MONITOR DESCRIPTION

To monitor the correlation of the intake and exhaust camshaft positions and crankshaft position, the ECM checks the VVT learned value while the engine is idling. The VVT learned value is calibrated based on the camshaft positions and crankshaft position. The intake valve timing is set to the most retarded angle while the engine is idling. If the VVT learned value is out of the specified range in consecutive driving cycles, the ECM illuminates the MIL and stores the DTC.

This DTC indicates that the intake and exhaust camshaft timing positions are incorrect with respect to the crankshaft, caused by factors such as the timing chain having jumped a tooth. This monitor begins to run after the engine has idled for 5 minutes.

MONITOR STRATEGY

MONITOR STRATEGY CHART

Related DTCs	P0016: Camshaft Timing Misalignment at Idling (for Intake Side) P0017: Camshaft Timing Misalignment at Idling (for Exhaust Side)
Required Sensors/Components (Main)	VVT controller (camshaft timing gear assembly)
Required Sensors/Components (Related)	Camshaft position sensor Crankshaft position sensor
Frequency of Operation	Once per driving cycle
Duration	Less than 1 minute
MIL Operation	2 driving cycles
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

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Intake Side

TYPICAL ENABLING CONDITIONS CHART

Monitor runs whenever following DTCs not stored	P0010 (Camshaft Timing Oil Control Valve) P0102, P0103 (Mass Air Flow Meter) P0115, P0117, P0118 (Engine Coolant Temperature Sensor) P0125 (Insufficient Coolant Temperature for Closed Loop Fuel Control) P0335 (Crankshaft Position Sensor) P0340 (Camshaft Position Sensor)
Engine speed	500 to 1000 rpm

Exhaust Side

TYPICAL ENABLING CONDITIONS CHART

Monitor runs whenever following DTCs not stored	P0013 (Exhaust Camshaft Timing Oil Control Valve) P0102, P0103 (Mass Air Flow Meter) P0115, P0117, P0118 (Engine Coolant Temperature Sensor) P0125 (Insufficient Coolant Temperature for Closed Loop Fuel Control) P0335 (Crankshaft Position Sensor) P0340 (Camshaft Position Sensor)
Engine speed	500 to 1000 rpm

TYPICAL MALFUNCTION THRESHOLDS

Intake Side

TYPICAL MALFUNCTION THRESHOLDS CHART

One of following conditions is met	-
VVT learned value at maximum retarded valve timing	Less than 22°CA (crankshaft angle)
VVT learned value at maximum retarded valve timing	More than 47°CA (crankshaft angle)

Exhaust Side

TYPICAL MALFUNCTION THRESHOLDS CHART

One of following conditions is met	-
VVT learned value at maximum advanced valve timing	Less than 82.5°CA (crankshaft angle)
VVT learned value at maximum advanced valve timing	More than 107.5°CA (crankshaft angle)

CONFIRMATION DRIVING PATTERN

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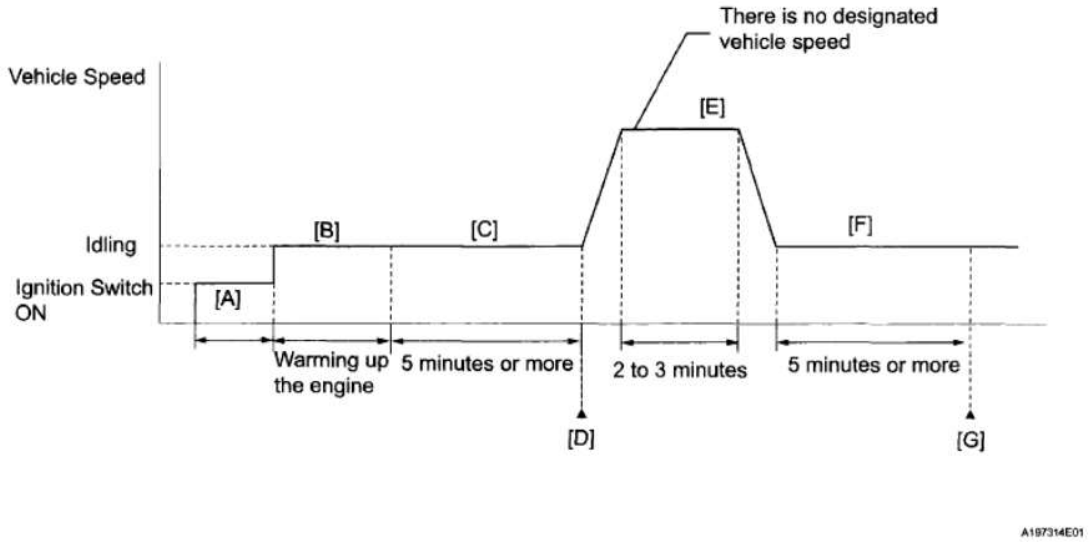


Fig. 59: Vehicle Speed Driving Pattern
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

1. Connect the Techstream to the DLC3.
2. Turn the ignition switch to ON and turn the Techstream on.
3. Clear the DTCs (even if no DTCs are stored, perform the clear DTC procedure).
4. Turn the ignition switch off.
5. Turn the ignition switch to ON and turn the Techstream on [A].
6. Start the engine and warm it up until the engine coolant temperature reaches 75°C (167°F) or higher [B].
7. Idle the engine for 5 minutes or more [C].
8. Enter the following menus: Powertrain/Engine/Utility/All Readiness.
9. Input the DTC: P0016 or P0017.
10. Check the DTC judgment result [D].

TECHSTREAM DISPLAY DESCRIPTION

Techstream Display	Description
NORMAL	• DTC judgment completed • System normal
ABNORMAL	• DTC judgment completed • System abnormal
INCOMPLETE	• DTC judgment not completed • Perform driving pattern after confirming DTC enabling conditions
UNKNOWN	• Unable to perform DTC judgment • Number of DTCs which do not fulfill DTC preconditions has reached ECU memory limit

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CAUTION: When performing the confirmation driving pattern, obey all speed limits and traffic laws.

HINT:

- If the judgment result shows ABNORMAL, the system has a malfunction.
- If the judgment result shows INCOMPLETE or UNKNOWN, perform steps [E] through [G].

11. Drive the vehicle for 2 to 3 minutes [E].
12. Idle the engine for 5 minutes or more [F].
13. Check the DTC judgment result [G].
14. If the test result is UNKNOWN, enter the following menus: Powertrain/Engine/Trouble Codes/Pending.
15. Read Pending DTCs [G].

    HINT:

    If a pending DTC is output, the system is malfunctioning.

16. If the test result is INCOMPLETE or UNKNOWN and no pending DTC is output, perform a universal trip and check for permanent DTCs (See **DTC CHECK/CLEAR**).

    HINT:

    - If a permanent DTC is output, the system is malfunctioning.
    - If no permanent DTC is output, the system is normal.

INSPECTION PROCEDURE

HINT:

- DTC P0016 or P0017 may be stored when foreign objects in the engine oil are caught in some parts of the system. The DTC will remain set even if the system returns to normal after a short time. Those foreign objects may then be captured by the oil filter.
- Read freeze frame data using the Techstream. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1. **CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P0016 AND P0017)**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the Techstream on.
   d. Enter the following menus: Powertrain/Engine/Trouble Codes.
   e. Read the DTCs.

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Result

RESULT CHART

Result	Proceed to
DTC P0016 or P0017 is output	A
DTC P0016 or P0017 and other DTCs are output	B

HINT:

If any DTCs other than P0016 or P0017 are output, troubleshoot those DTCs first.

B: GO TO **DTC CHART**

A: Go to next step

2. **PERFORM ACTIVE TEST USING TECHSTREAM (OPERATE CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY)**
   a. Connect the Techstream to the DLC3.
   b. Start the engine.
   c. Turn the Techstream on.
   d. Check the camshaft timing oil control valve assembly for intake camshaft.
      1. Enter the following menus: Powertrain/Engine/Active Test/Control the VVT System (Bank 1).
      2. Check the engine speed while operating the camshaft timing oil control valve assembly (for intake camshaft) using the Techstream.

         Result

         TECHSTREAM OPERATION CHART

Techstream Operation	Specified Condition
OFF	Normal engine speed
ON	Engine idles roughly or stalls (soon after camshaft timing oil control valve assembly switched from OFF to ON)

   e. Check the camshaft timing oil control valve assembly for exhaust camshaft.
      1. Enter the following menus: Powertrain/Engine/Active Test/Control the VVT Exhaust Linear (Bank 1).
      2. Check the engine speed while operating the camshaft timing oil control valve assembly (for exhaust camshaft) using the Techstream.

         Result

         TECHSTREAM OPERATION CHART

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Techstream Operation	Specified Condition
0% (OFF)	Normal engine speed
127% (ON)	Engine idles roughly or stalls (soon after camshaft timing oil control valve assembly switched from OFF to ON)

HINT:

If the VVT system can be operated using the Active Test, it can be assumed that the VVT system is operating normally.

NG: Go to step 4

OK: Go to next step

3. **CHECK WHETHER DTC OUTPUT RECURS (DTC P0016 OR P0017)**
   a. Connect the Techstream to the DLC 3.
   b. Turn the ignition switch to ON.
   c. Turn the Techstream on.
   d. Clear the DTCs (See **DTC CHECK/CLEAR**).
   e. Turn the ignition switch off.
   f. Turn the ignition switch to ON and turn the Techstream on.
   g. Start the engine and warm it up.
   h. Drive the vehicle in accordance with the driving pattern described in the **CONFIRMATION DRIVING PATTERN**.
   i. Enter the following menus: Powertrain/Engine/Utility/All Readiness.
   j. Input the DTC: P0016 or P0017.
   k. Check the DTC judgment result.

Result

RESULT CHART

Result	Proceed to
NORMAL (DTC is not output)	A
ABNORMAL (DTC P0016 or P0017 is output)	B

HINT:

DTC P0016 or P0017 may be stored when foreign objects in the engine oil are caught in some parts of the system. The DTC will remain stored even if the system returns to normal after a short time. These foreign objects may then be captured by the oil filter.

B: Go to step 4

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A: CHECK FOR INTERMITTENT PROBLEMS (See **CHECK FOR INTERMITTENT PROBLEMS**)

4. **INSPECT CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY (FOR INTAKE OR EXHAUST CAMSHAFT)**

HINT:

Inspect the specified camshaft timing oil control valve assembly (for intake or exhaust camshaft) in accordance with the inspection result of step 2.

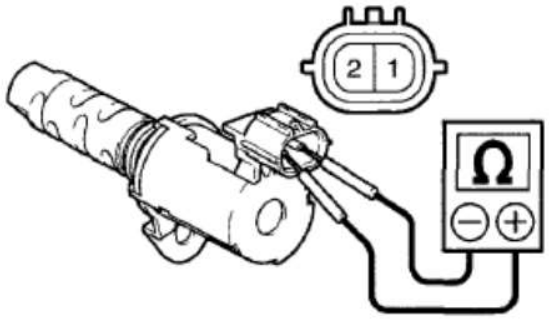
a. Remove the camshaft timing oil control valve assembly (for intake or exhaust camshaft).
b. Measure the resistance according to the value(s) in the table below.

Standard Resistance

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
1 - 2	20°C (68°F)	6.9 to 7.9 ohms

Component without harness connected:
(Camshaft Timing Oil Control Valve Assembly)



A148713E03

Fig. 60: Inspecting Camshaft Timing Oil Control Valve Assembly
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

c. Connect the positive (+) battery terminal to terminal 1 and connect the negative (-) battery terminal to terminal 2. Check the valve operation.

OK:

Valve moves quickly.

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d. Reinstall the camshaft timing oil control valve assembly (for intake or exhaust camshaft).

NG: REPLACE CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY (INTAKE OR EXHAUST CAMSHAFT) (See **REMOVAL**)

Component without harness connected:
(Camshaft Timing Oil Control Valve Assembly)

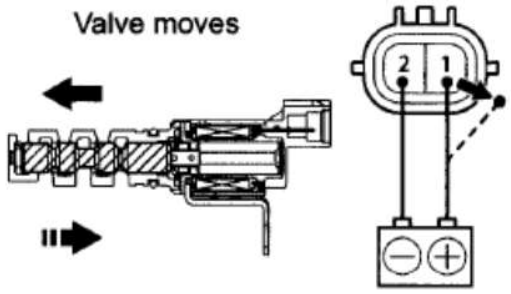


Fig. 61: Connecting Battery Terminals To Camshaft Timing Oil Control Valve Assembly
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

5. **CHECK VALVE TIMING (CHECK FOR LOOSE TIMING CHAIN AND JUMPED TEETH)** (See **INSPECTION PROCEDURE**)

NG: ADJUST VALVE TIMING (See **REMOVAL**)

OK: Go to next step

6. **INSPECT CAMSHAFT TIMING GEAR ASSEMBLY (INTAKE OR EXHAUST CAMSHAFT)**
   a. Inspect the camshaft timing gear assembly (camshaft timing gear assembly for intake or exhaust camshaft) (See **INSPECTION**).

NG: REPLACE CAMSHAFT TIMING GEAR ASSEMBLY (See **REMOVAL**)

OK: Go to next step

7. **INSPECT OIL CONTROL VALVE FILTER** (See **INSPECTION PROCEDURE**)

NG: REPLACE OIL CONTROL VALVE FILTER (See **DISASSEMBLY**)

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OK: Go to next step

8. **CHECK WHETHER DTC OUTPUT RECURS (DTC P0016 OR P0017)**
   a. Connect the Techstream to the DLC 3.
   b. Turn the ignition switch to ON.
   c. Turn the Techstream on.
   d. Clear the DTCs (See **DTC CHECK/CLEAR**).
   e. Turn the ignition switch off.
   f. Turn the ignition switch to ON and turn the Techstream on.
   g. Start the engine and warm it up.
   h. Drive the vehicle in accordance with the driving pattern described in the **CONFIRMATION DRIVING PATTERN**.
   i. Enter the following menus: Powertrain/Engine/Utility/All Readiness.
   j. Input the DTC: P0016 or P0017.
   k. Check the DTC judgment result.

Result

RESULT CHART

Result	Proceed to
NORMAL (DTC is not output)	A
ABNORMAL (DTC P0016 or P0017 is output)	B

HINT:

DTC P0016 or P0017 may be stored when foreign objects in the engine oil are caught in some parts of the system. The DTC will remain stored even if the system returns to normal after a short time. These foreign objects may then be captured by the oil filter.

B: REPLACE ECM (See **REMOVAL**)

A: CHECK FOR INTERMITTENT PROBLEMS (See **CHECK FOR INTERMITTENT PROBLEMS**)

DTC P0031 OXYGEN (A/F) SENSOR HEATER CONTROL CIRCUIT LOW (BANK 1 SENSOR 1); DTC P0032 OXYGEN (A/F) SENSOR HEATER CONTROL CIRCUIT HIGH (BANK 1 SENSOR 1); DTC P101D A/F SENSOR HEATER CIRCUIT PERFORMANCE BANK 1 SENSOR 1 STUCK ON

DESCRIPTION

Refer to **DTC P2195** .

HINT:

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- When any of these DTCs is stored, the ECM enters fail-safe mode. The ECM turns off the air fuel ratio sensor heater in fail-safe mode. Fail-safe mode continues until the ignition switch is turned off.
- Although the DTC titles say oxygen sensor, these DTCs relate to the air fuel ratio sensor.
- Sensor 1 refers to the sensor mounted in front of the three-way catalytic converter and located near the engine assembly.
- The ECM provides a pulse width modulated control circuit to adjust the current through the heater. The air fuel ratio sensor heater circuit uses a relay on the +B side of the circuit.

Reference (System Diagram of Bank 1 Sensor 1):

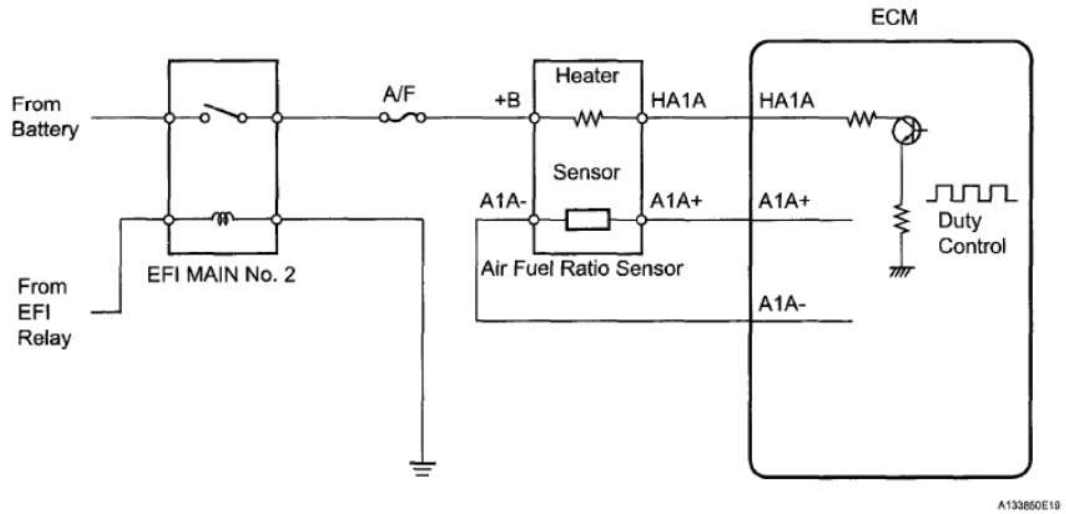


Fig. 62: Air Fuel Ratio Sensor - Circuit Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

DTC DETECTION CONDITION CHART

DTC No.	DTC Detection Condition	Trouble Area
P0031	The heater current is less than the specified value while the heater is operating (1 trip detection logic).	• Open in air fuel ratio sensor heater circuit • Air fuel ratio sensor heater (bank 1 sensor 1) • EFI MAIN No. 2 relay • ECM
P0032	An air fuel ratio sensor heater current failure (1 trip detection logic).	• Short in air fuel ratio sensor heater circuit • Air fuel ratio sensor heater (bank 1 sensor 1) • EFI MAIN No. 2 relay • ECM
	The heater current is higher than the specified value while the	

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P101D	heater is not operating (1 trip detection logic).	ECM

HINT:

- Sensor 1 refers to the sensor closest to the engine assembly.
- Sensor 2 refers to the sensor farthest away from the engine assembly.

MONITOR DESCRIPTION

The ECM uses information from the air fuel ratio sensor to regulate the air fuel ratio and keep it close to the stoichiometric level. This maximizes the ability of the three-way catalytic converter to purify the exhaust gases.

The air fuel ratio sensor detects oxygen levels in the exhaust gas and transmits the information to the ECM. The inner surface of the sensor element is exposed to the outside air. The outer surface of the sensor element is exposed to the exhaust gas. The sensor element is made of platinum-coated zirconia and includes an integrated heating element.

The zirconia element generates a small voltage when there is a large difference in the oxygen concentrations between the exhaust gas and outside air. The platinum coating amplifies this voltage generation.

The air fuel ratio sensor is more efficient when heated. When the exhaust gas temperature is low, the sensor cannot generate useful voltage signals without supplementary heating. The ECM regulates the supplementary heating using a duty-cycle approach to adjust the average current in the sensor heater element. If the heater current is outside the normal range, the signal transmitted by the air fuel ratio sensor becomes inaccurate. As a result, the ECM is unable to regulate the air fuel ratio properly.

When the current in the air fuel ratio sensor heater is outside the normal operating range, the ECM interprets this as a malfunction in the sensor heater and stores a DTC.

MONITOR STRATEGY

MONITOR STRATEGY CHART

Related DTCs	P0031: Air Fuel Ratio Sensor Heater Open/Short (Low Electrical Current) P0032: Air Fuel Ratio Sensor Heater Open/Short (High Electrical Current) P101D: Air Fuel Ratio Sensor Heater Performance
Required Sensors/Components (Main)	Air fuel ratio sensor heater
Required Sensors/Components (Related)	-
Frequency of Operation	Continuous
Duration	10 seconds: P0031 10.2 seconds: P0032 1 second: P101D
MIL Operation	Immediate

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Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

P0031:

TYPICAL ENABLING CONDITIONS CHART

Monitor runs whenever following DTCs not stored	None
Battery voltage	10.5 V or more
Time after engine start	10 seconds or more
Active heater OFF control	Not operating
Active heater ON control	Not operating
Air fuel ratio sensor heater duty-cycle ratio	50% or more

P0032:

TYPICAL ENABLING CONDITIONS CHART

Monitor runs whenever following DTCs not stored	None
Battery voltage	10.5 V or more
Time after engine start	10 seconds or more
Active heater OFF control	Not operating
Active heater ON control	Not operating
Air fuel ratio sensor heater performance fail (P101D)	Not detected

P101D:

TYPICAL ENABLING CONDITIONS CHART

Monitor runs whenever following DTCs not stored	None
Battery voltage	10.5 V or more
Time after engine start	10 seconds or more
Air fuel ratio sensor heater duty-cycle ratio	10 to 60%
Air fuel ratio sensor heater ON current	0.8 A or more
Air fuel ratio sensor heater range check low current fail (P0031)	Not detected

TYPICAL MALFUNCTION THRESHOLDS

P0031:

TYPICAL MALFUNCTION THRESHOLDS CHART

Air fuel ratio sensor heater ON current	Less than 0.8 A

P0032:

TYPICAL MALFUNCTION THRESHOLDS CHART

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Air fuel ratio sensor heater output	ON
Hybrid IC high current limiter port	Fail

P101D:

TYPICAL MALFUNCTION THRESHOLDS CHART

Air fuel ratio sensor heater OFF current	11 A or more
Active heater OFF control flag for ON stuck	ON
Hybrid IC high current limiter port	Fail

COMPONENT OPERATING RANGE

P0031:

COMPONENT OPERATING RANGE CHART

Air fuel ratio sensor heater ON current	0.8 A or more

P0032:

COMPONENT OPERATING RANGE CHART

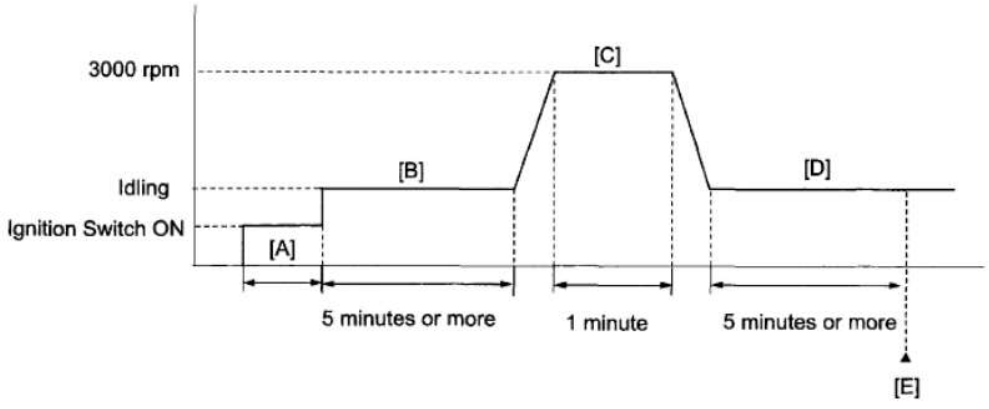
All of the following conditions are met	-
1. Air fuel ratio sensor heater output	ON
2. Hybrid IC high current limiter monitor input	Pass

P101D:

COMPONENT OPERATING RANGE CHART

Air fuel ratio sensor heater ON current	11 A or less

CONFIRMATION DRIVING PATTERN



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Fig. 63: Confirmation Driving Pattern
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

1. Connect the Techstream to the DLC3.
2. Turn the ignition switch to ON and turn the Techstream on.
3. Clear the DTCs (even if no DTCs are stored, perform the clear DTC procedure).
4. Turn the ignition switch off.
5. Turn the ignition switch to ON and turn the Techstream on [A].
6. Start the engine and idle it for 5 minutes or more [B].
7. With the vehicle stationary, depress the accelerator pedal and maintain an engine speed of 3000 rpm for 1 minute [C].
8. Idle the engine for 5 minutes or more [D].
9. Enter the following menus: Powertrain/Engine/Utility/All Readiness.
10. Input the DTC: P0031, P0032, or P101D.
11. Check the DTC judgment result [E].

TECHSTREAM DISPLAY DESCRIPTION

Techstream Display	Description
NORMAL	• DTC judgment completed • System normal
ABNORMAL	• DTC judgment completed • System abnormal
INCOMPLETE	• DTC judgment not completed • Perform driving pattern after confirming DTC enabling conditions
UNKNOWN	• Unable to perform DTC judgment • Number of DTCs which do not fulfill DTC preconditions has reached ECU memory limit

12. If the judgment result shows INCOMPLETE or UNKNOWN, perform steps [B] through [E] again.
13. If the test result is UNKNOWN, enter the following menus: Powertrain/Engine/Trouble Codes/Pending.
14. Read Pending DTCs.

    HINT:

    If a pending DTC is output, the system is malfunctioning.

15. If the test result is INCOMPLETE or UNKNOWN and no pending DTC is output, perform a universal trip and check for permanent DTCs (See **DTC CHECK/CLEAR**).

    HINT:

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- If a permanent DTC is output, the system is malfunctioning.
- If no permanent DTC is output, the system is normal.

WIRING DIAGRAM

Refer to **DTC P2195** .

INSPECTION PROCEDURE

NOTE: Inspect the fuses for circuits related to this system before performing the following inspection procedure.

HINT:

Read freeze frame data using the Techstream. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1. **INSPECT AIR FUEL RATIO SENSOR (HEATER RESISTANCE)**
   a. Disconnect the air fuel ratio sensor connector.
   b. Measure the resistance according to the value(s) in the table below.

   Standard Resistance

   TESTER CONNECTION SPECIFIED CONDITION CHART

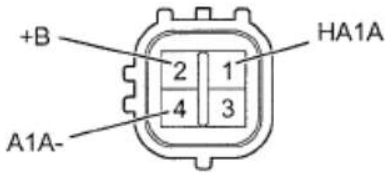
Tester Connection	Condition	Specified Condition
1 (HA1A) - 2 (+B)	20°C (68°F)	1.8 to 3.4 ohms
1 (HA1A) - 4 (A1A-)	Always	10 kohms or higher

   c. Reconnect the air fuel ratio sensor connector.

   NG: REPLACE AIR FUEL RATIO SENSOR (See **REMOVAL**)

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Component without harness connected:
(Air Fuel Ratio Sensor)



A195026E01

Fig. 64: Identifying Air Fuel Ratio Sensor Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

2. **CHECK TERMINAL VOLTAGE (POWER SOURCE OF AIR FUEL RATIO SENSOR)**
   a. Disconnect the air fuel ratio sensor connector.
   b. Turn the ignition switch to ON.
   c. Measure the voltage according to the value(s) in the table below.

Standard Voltage

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Switch Condition	Specified Condition
B20-2 (+B) - Body ground	Ignition switch ON	11 to 14 V

   d. Reconnect the air fuel ratio sensor connector.

NG: Go to step 5

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Front view of wire harness connector:
(to Air Fuel Ratio Sensor)



A165029E05

Fig. 65: Identifying Air Fuel Ratio Sensor Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

3. **CHECK HARNESS AND CONNECTOR (AIR FUEL RATIO SENSOR - ECM)**
   a. Disconnect the air fuel ratio sensor connector.
   b. Disconnect the ECM connector.
   c. Measure the resistance according to the value(s) in the table below.

Standard Resistance (Check for Open)

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
B20-1 (HA1A) - B49-29 (HA1A)	Always	Below 1 ohms

Standard Resistance (Check for Short)

TESTER CONNECTION SPECIFIED CONDITION CHART

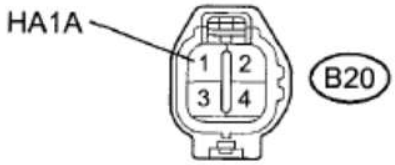
Tester Connection	Condition	Specified Condition
B20-1 (HA1A) or B49-29 (HA1A) - Body ground	Always	10 kohms or higher

   d. Reconnect the air fuel ratio sensor connector.
   e. Reconnect the ECM connector.

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR

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Front view of wire harness connector:
(to Air Fuel Ratio Sensor)



Rear view of wire harness connector:
(to ECM)

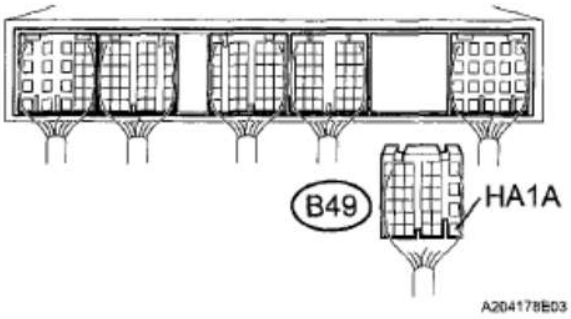


Fig. 66: Identifying Air Fuel Ratio Sensor And ECM Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

4. **CHECK WHETHER DTC OUTPUT RECURS (DTC P0031, P0032 OR P101D)**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the Techstream on.
   d. Clear the DTCs (See **DTC CHECK/CLEAR**).
   e. Turn the ignition switch off.
   f. Turn the ignition switch to ON and turn the Techstream on.
   g. Start the engine and allow the engine to idle for 1 minute or more.
   h. Enter the following menus: Powertrain/Engine/Trouble Codes.
   i. Read the DTCs.

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Result

RESULT CHART

Result	Proceed to
DTC is not output	A
DTC P0031, P0032 or P101D is output	B

B: REPLACE ECM (See **REMOVAL**)

A: CHECK FOR INTERMITTENT PROBLEMS (See **CHECK FOR INTERMITTENT PROBLEMS**)

5. **INSPECT ENGINE ROOM JUNCTION BLOCK ASSEMBLY (EFI MAIN NO. 2 RELAY)**
   a. Inspect the EFI MAIN No. 2 relay (See **INSPECTION**).

   NG: REPLACE ENGINE ROOM JUNCTION BLOCK ASSEMBLY (See **REMOVAL**)

   OK: Go to next step

6. **CHECK HARNESS AND CONNECTOR (AIR FUEL RATIO SENSOR - EFI MAIN NO. 2 RELAY)**
   a. Disconnect the air fuel ratio sensor connector.
   b. Remove the engine room junction block assembly from the engine room relay block.
   c. Measure the resistance according to the value(s) in the table below.

   Standard Resistance (Check for Open)

   TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
B20-2 (+B) - 2A-4	Always	Below 1 ohms

   Standard Resistance (Check for Short)

   TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
B20-2 (+B) or 2A-4 - Body ground	Always	10 kohms or higher

   d. Reconnect the air fuel ratio sensor connector.
   e. Reinstall the engine room junction block assembly.

   NG: REPAIR OR REPLACE HARNESS OR CONNECTOR

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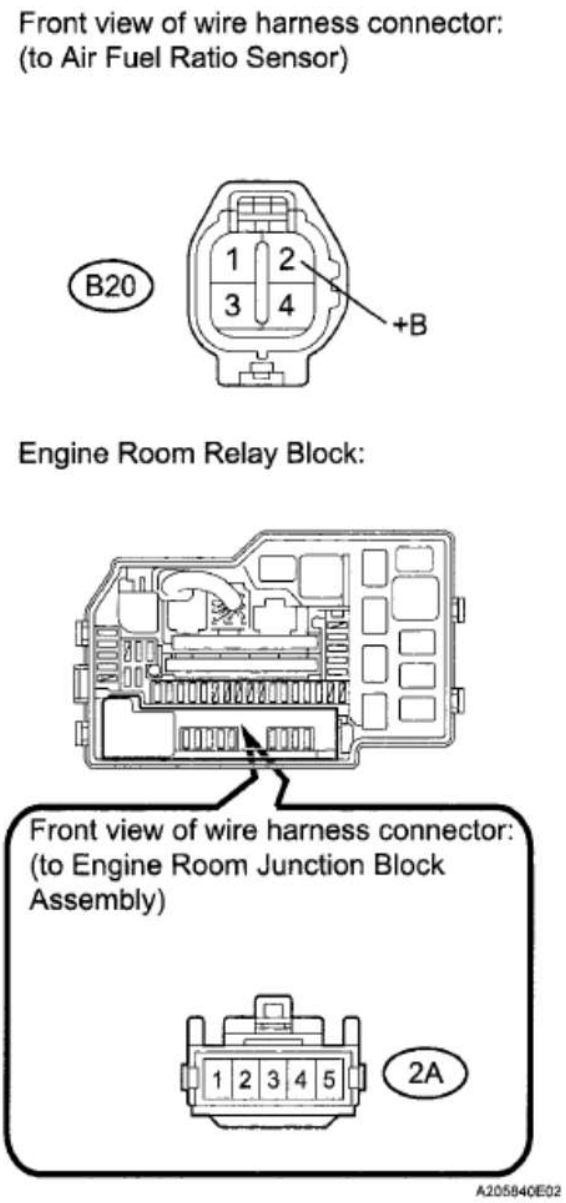


Fig. 67: Identifying Engine Room Junction Block Assembly And Air Fuel Ratio Sensor Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: REPAIR OR REPLACE HARNESS OR CONNECTOR (BATTERY - EFI MAIN NO. 2 RELAY)

DTC P0037 OXYGEN SENSOR HEATER CONTROL CIRCUIT LOW (BANK 1 SENSOR 2); DTC P0038 OXYGEN SENSOR HEATER CONTROL CIRCUIT HIGH (BANK 1 SENSOR 2); DTC P0141 OXYGEN SENSOR HEATER CIRCUIT MALFUNCTION (BANK 1 SENSOR 2); DTC P102D O2 SENSOR HEATER CIRCUIT PERFORMANCE BANK 1 SENSOR 2 STUCK ON

DESCRIPTION

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Refer to **DTC P0136** .

HINT:

- Sensor 2 refers to the sensor mounted behind the three-way catalytic converter and located far from the engine assembly.
- When any of these DTCs is stored, the ECM enters fail-safe mode. The ECM turns off the heated oxygen sensor heater in fail-safe mode. Fail-safe mode continues until the ignition switch is turned off.
- The ECM provides a pulse width modulated control circuit to adjust the current through the heater. The heated oxygen sensor heater circuit uses a relay on the +B side of the circuit.

Reference (System Diagram of Bank 1 Sensor 2):

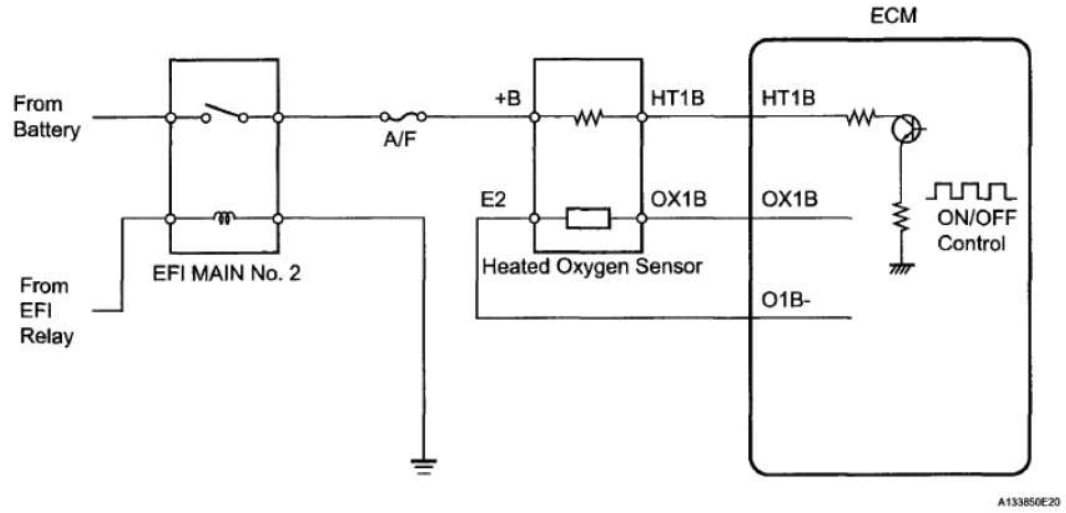


Fig. 68: Heated Oxygen Sensor - Circuit Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

DTC DETECTION CONDITION CHART

DTC No.	DTC Detection Condition	Trouble Area
P0037	The heater current less than the specified value while the heater is operating (1 trip detection logic).	• Open in heated oxygen sensor (bank 1 sensor 2) heater circuit • Heated oxygen sensor (bank 1 sensor 2) heater • EFI MAIN No. 2 relay • ECM
P0038	The heater current is higher than the specified value while the heater is operating (1 trip detection logic).	• Short in heated oxygen sensor (bank 1 sensor 2) heater circuit • Heated oxygen sensor (bank 1 sensor 2) heater • EFI MAIN No. 2 relay

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		• ECM
P0141	The cumulative heater resistance correction value exceeds the threshold (2 trip detection logic).	• Open or short in heated oxygen sensor (bank 1 sensor 2) heater circuit • Heated oxygen sensor (bank 1 sensor 2) heater • EFI MAIN No. 2 relay • ECM
P102D	The heater current is higher than the specified value while the heater is not operating (1 trip detection logic).	ECM

HINT:

- Sensor 1 refers to the sensor closest to the engine assembly.
- Sensor 2 refers to the sensor farthest away from the engine assembly.

MONITOR DESCRIPTION

The sensing portion of the heated oxygen sensor has a zirconia element which is used to detect the oxygen concentration in the exhaust gas. If the zirconia element is at the appropriate temperature, and the difference between the oxygen concentrations surrounding the inside and outside surfaces of the sensor is large, the zirconia element generates voltage signals. In order to increase the oxygen concentration detecting capacity of the zirconia element, the ECM supplements the heat from the exhaust with heat from a heating element inside the sensor.

Heated Oxygen Sensor Heater Range Check (P0037, P0038 and P102D):

The ECM monitors the current applied to the heated oxygen sensor heater to check the heater for malfunctions.

If the heater current is outside the normal range, the signal transmitted by the heated oxygen sensor becomes inaccurate. When the current in the heated oxygen sensor heater is outside the normal operating range, the ECM interprets this as a malfunction in the sensor heater and stores a DTC.

Heated Oxygen Sensor Heater Performance (P0141):

After the accumulated heater ON time exceeds 100 seconds, the ECM calculates the heater resistance using battery voltage and the current applied to the heater. If the resistance is above the threshold value, the ECM determines that there is a malfunction in the heated oxygen sensor heater and stores DTC P0141.

MONITOR STRATEGY

MONITOR STRATEGY CHART

	P0037: Heated Oxygen Sensor Heater (Bank 1 Sensor 2) Open/Short (Low Electrical Current)

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Related DTCs	P0038: Heated Oxygen Sensor Heater (Bank 1 Sensor 2) Open/Short (High Electrical Current) P0141: Heated Oxygen Sensor Heater Performance (Bank 1 Sensor 2) P102D: Heated Oxygen Sensor Heater ON Stuck (Bank 1 Sensor 2)
Required Sensors/Components (Main)	Heated oxygen sensor heater (bank 1 sensor 2)
Required Sensors/Components (Related)	-
Frequency of Operation	Continuous: P0037, P0038, P102D Once per driving cycle: P0141
Duration	0.5 seconds: P0037 Within 3 seconds: P0038 10 seconds: P0141 0.5 seconds: P102D
MIL Operation	Immediate: P0037, P0038, P102D 2 driving cycles: P0141
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

P0037 (Case1)

TYPICAL ENABLING CONDITIONS CHART

Monitor runs whenever following DTCs not stored	None
Battery voltage	10.5 V or higher
Engine	Running
Starter	OFF
Catalyst active air fuel ratio control	Not operating
Time after heater ON	10 seconds or more
Learned heater OFF current operation	Complete
Heater OFF current learned value	Acquired
Heated oxygen sensor heater high current fail (P0038)	Not detected

P0037 (Case 2)

TYPICAL ENABLING CONDITIONS CHART

Monitor runs whenever following DTCs not stored	None
Battery voltage	10.5 V or higher
Time after heater ON	10 seconds or more
Learned heater OFF current operation	Complete
Heated oxygen sensor heater OFF current	Higher than 3.5 A
Hybrid IC high current limiter port	Fail
Heated oxygen sensor heater high current fail (P0038)	Not detected

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P0038

TYPICAL ENABLING CONDITIONS CHART

Monitor runs whenever following DTCs not stored	None
Battery voltage	10.5 V or higher
Engine	Running
Starter	OFF
Catalyst active air fuel ratio control	Not operating
Time after heater ON	10 seconds or more
Learned heater OFF current operation	Complete

P0141 (Case 1)

TYPICAL ENABLING CONDITIONS CHART

Monitor runs whenever following DTCs not stored	None
Heated oxygen sensor heater circuit fail (P0037 and P0038)	Not detected
Battery voltage	10.5 V or higher
Fuel cut	OFF
Time after fuel cut ON to OFF	30 seconds or more
Accumulated heater ON time	100 seconds or more
Learned heater OFF current operation	Complete

P0141 (Case 2)

TYPICAL ENABLING CONDITIONS CHART

Monitor runs whenever following DTCs not stored	None
Duration that rear heated oxygen sensor impedance is less than 15 kohms	2 seconds or more

P102D

TYPICAL ENABLING CONDITIONS CHART

Monitor runs whenever following DTCs not stored	None
Battery voltage	10.5 V or higher
Engine	Running
Starter	OFF
Catalyst active air fuel ratio control	Not operating

TYPICAL MALFUNCTION THRESHOLDS

P0037 (Case1)

TYPICAL MALFUNCTION THRESHOLDS CHART

Heater ON current - Learned heater OFF current	0.3 A or less

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P0037 (Case 2)

TYPICAL MALFUNCTION THRESHOLDS CHART

Heated oxygen sensor heater ON current	1 A or less

P0038

TYPICAL MALFUNCTION THRESHOLDS CHART

Hybrid IC high current limiter port	Fail
Heated oxygen sensor heater output	ON

P0141

TYPICAL MALFUNCTION THRESHOLDS CHART

Accumulated heater resistance	Varies with sensor element temperature (Example: Higher than 23 ohms)

P102D

TYPICAL MALFUNCTION THRESHOLDS CHART

Heated oxygen sensor heater ON current	Higher than 1 A

COMPONENT OPERATING RANGE

COMPONENT OPERATING RANGE CHART

Heated oxygen sensor heater current	0.4 to 1 A (when engine idles, heated oxygen sensor warmed up and battery voltage 11 to 14 V)

MONITOR RESULT

Refer to **CHECKING MONITOR STATUS** .

CONFIRMATION DRIVING PATTERN

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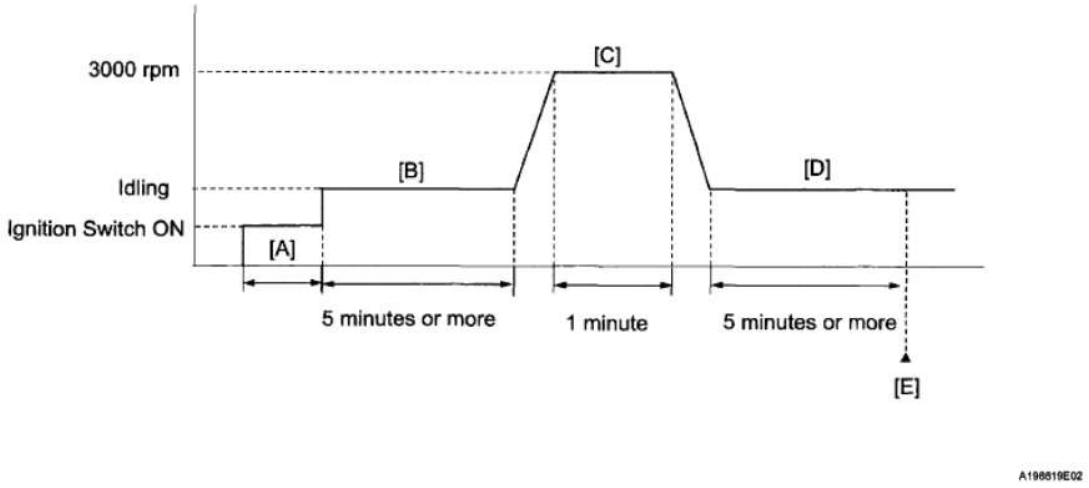


Fig. 69: Confirmation Driving Pattern
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

1. Connect the Techstream to the DLC3.
2. Turn the ignition switch to ON and turn the Techstream on.
3. Clear the DTCs (even if no DTCs are stored, perform the clear DTC procedure).
4. Turn the ignition switch off.
5. Turn the ignition switch to ON and turn the Techstream on [A].
6. Start the engine and idle it for 5 minutes or more [B].
7. With the vehicle stationary, depress the accelerator pedal and maintain an engine speed of 3000 rpm for 1 minute [C].
8. Idle the engine for 5 minutes or more [D].
9. Enter the following menus: Powertrain/Engine/Utility/All Readiness.
10. Input the DTC: P0037, P0038, P0141, or P102D.
11. Check the DTC judgment result [E].

TECHSTREAM DISPLAY DESCRIPTION

Techstream Display	Description
NORMAL	• DTC judgment completed • System normal
ABNORMAL	• DTC judgment completed • System abnormal
INCOMPLETE	• DTC judgment not completed • Perform driving pattern after confirming DTC enabling conditions
UNKNOWN	• Unable to perform DTC judgment • Number of DTCs which do not fulfill DTC preconditions has reached ECU

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	memory limit

12. If the judgment result shows INCOMPLETE or UNKNOWN, perform steps [B] through [E] again.
13. If the test result is UNKNOWN, enter the following menus: Powertrain/Engine/Trouble Codes/Pending.
14. Read Pending DTCs.

    HINT:

    If a pending DTC is output, the system is malfunctioning.

15. If the test result is INCOMPLETE or UNKNOWN and no pending DTC is output, perform a universal trip and check for permanent DTCs (See **DTC CHECK/CLEAR**).

    HINT:

    - If a permanent DTC is output, the system is malfunctioning.
    - If no permanent DTC is output, the system is normal.

WIRING DIAGRAM

Refer to **DTC P0136** .

INSPECTION PROCEDURE

NOTE: Inspect the fuses for circuits related to this system before performing the following inspection procedure.

HINT:

Read freeze frame data using the Techstream. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1. **INSPECT HEATED OXYGEN SENSOR (HEATER RESISTANCE)**
   a. Disconnect the heated oxygen sensor connector.
   b. Measure the resistance according to the value(s) in the table below.

      Standard Resistance

      TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
1 (HT1B) - 2 (+B)	20°C (68°F)	11 to 16 ohms
1 (HT1B) - 4 (E2)	Always	10 kohms or higher

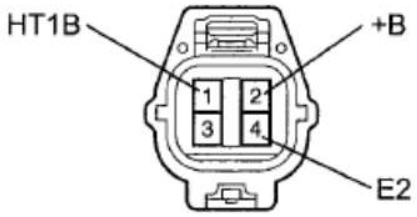
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c. Reconnect the heated oxygen sensor connector.

NG: REPLACE HEATED OXYGEN SENSOR (See **REMOVAL**)

Component without harness connected:
(Heated Oxygen Sensor)



A204433E03

Fig. 70: Identifying Heated Oxygen Sensor Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

2. **CHECK TERMINAL VOLTAGE (POWER SOURCE)**
   a. Disconnect the heated oxygen sensor connector.
   b. Turn the ignition switch to ON.
   c. Measure the voltage according to the value(s) in the table below.

Standard Voltage

TESTER CONNECTION SPECIFIED CONDITION CHART

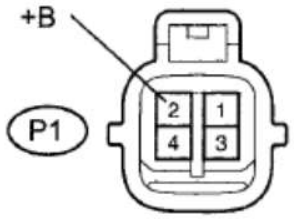
Tester Connection	Switch Condition	Specified Condition
P1-2 (+B) - Body ground	Ignition switch ON	11 to 14 V

   d. Reconnect the heated oxygen sensor connector.

NG: Go to step 5

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Front view of wire harness connector:
(to Heated Oxygen Sensor)



A204434E02

Fig. 71: Identifying Heated Oxygen Sensor Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

3. **CHECK HARNESS AND CONNECTOR (HEATED OXYGEN SENSOR - ECM)**
   a. Disconnect the heated oxygen sensor connector.
   b. Disconnect the ECM connector.
   c. Measure the resistance according to the value(s) in the table below.

Standard Resistance (Check for Open)

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
P1-1 (HT1B) - B49-23 (HT1B)	Always	Below 1 ohms

Standard Resistance (Check for Short)

TESTER CONNECTION SPECIFIED CONDITION CHART

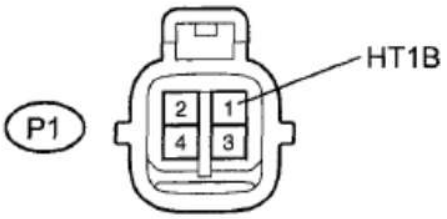
Tester Connection	Condition	Specified Condition
P1-1 (HT1B) or B49-23 (HT1B) - Body ground	Always	10 kohms or higher

   d. Reconnect the heated oxygen sensor connector.
   e. Reconnect the ECM connector.

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR

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Front view of wire harness connector:
(to Heated Oxygen Sensor)



Rear view of wire harness connector:
(to ECM)

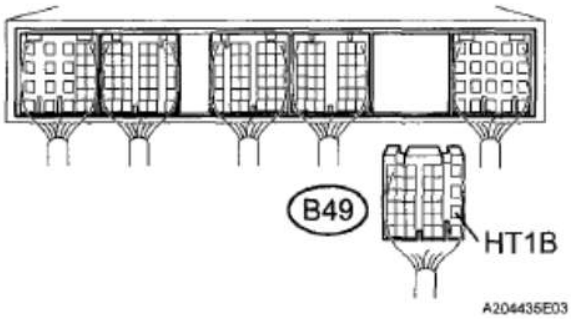


Fig. 72: Identifying Heated Oxygen Sensor And ECM Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

4. **CHECK WHETHER DTC OUTPUT RECURS (DTC P0037, P0038, P0141 OR P102D)**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the Techstream on.
   d. Clear the DTCs (See **DTC CHECK/CLEAR**).
   e. Turn the ignition switch off.
   f. Turn the ignition switch to ON and turn the Techstream on.
   g. Start the engine and allow the engine to idle for 1 minute or more.
   h. Enter the following menus: Powertrain/Engine/Trouble Codes/Pending.
   i. Read the Pending DTCs.

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Result

RESULT CHART

Result	Proceed to
DTC P0037, P0038, P0141 or P102D is output	A
DTC is not output	B

B: CHECK FOR INTERMITTENT PROBLEMS (See **CHECK FOR INTERMITTENT PROBLEMS**)

A: REPLACE ECM (See **REMOVAL**)

5. **INSPECT ENGINE ROOM JUNCTION BLOCK ASSEMBLY (EFI MAIN NO. 2 RELAY)**
   a. Inspect the EFI MAIN No. 2 relay (See **INSPECTION**).

NG: REPLACE ENGINE ROOM JUNCTION BLOCK ASSEMBLY (See **REMOVAL**)

OK: Go to next step

6. **CHECK HARNESS AND CONNECTOR (HEATED OXYGEN SENSOR - EFI MAIN NO. 2 RELAY)**
   a. Disconnect the heated oxygen sensor connector.
   b. Remove the engine room junction block assembly from the engine room relay block.
   c. Measure the resistance according to the value(s) in the table below.

Standard Resistance (Check for Open)

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
P1-2 (+B) - 2A-4	Always	Below 1 ohms

Standard Resistance (Check for Short)

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
P1-2 (+B) or 2A-4 - Body ground	Always	10 kohms or higher

   d. Reconnect the heated oxygen sensor connector.
   e. Reinstall the engine room junction block assembly.

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR

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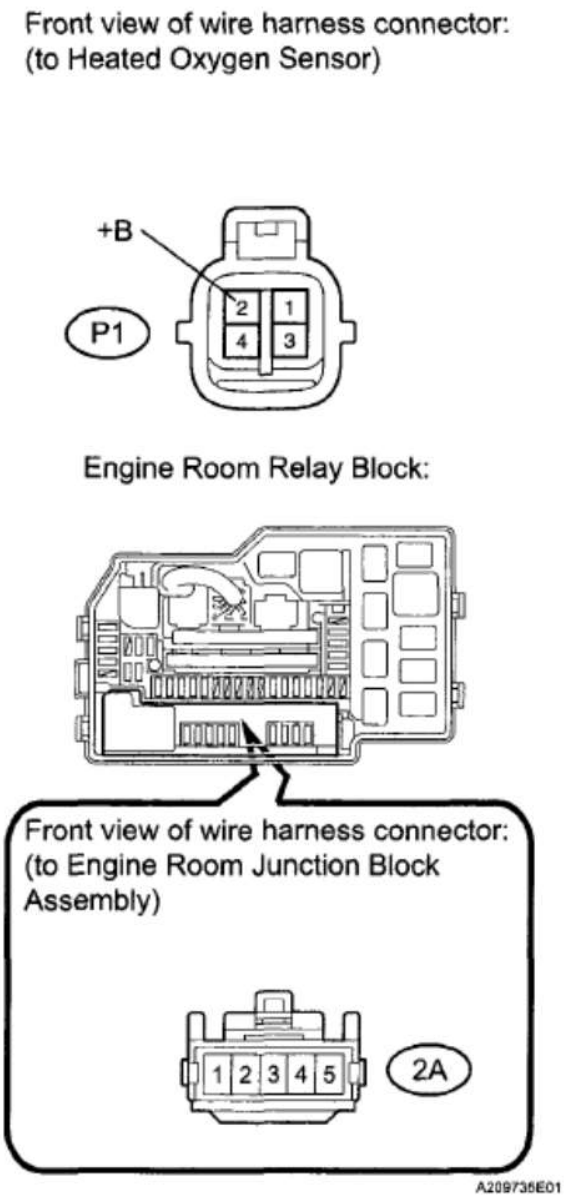


Fig. 73: Identifying Heated Oxygen Sensor Connector And Engine Room Junction Block Assembly
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: REPAIR OR REPLACE HARNESS OR CONNECTOR (BATTERY - EFI MAIN NO. 2 RELAY)

DTC P0101 MASS AIR FLOW CIRCUIT RANGE/PERFORMANCE PROBLEM

DESCRIPTION

Refer to **DTC P0102** .

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DTC DETECTION CONDITION CHART

DTC No.	DTC Detection Condition	Trouble Area
P0101	All of the following conditions continue for more than 10 seconds (2 trip detection logic): a. The engine is running. b. The engine coolant temperature is 70°C (158°F) or higher. c. The throttle position sensor voltage is 0.24 to 2 V. d. The average engine load value ratio is less than 0.81, or more than 1.21 (varies with estimated engine load). Average engine load value ratio = Average engine load based on mass air flow meter output/Average engine load estimated from driving conditions e. The average air fuel ratio is less than -20% or more than 20%.	• Mass air flow meter • Intake system • PCV hose connections

MONITOR DESCRIPTION

The mass air flow meter is a sensor that measures the amount of air flowing through the throttle valve. The ECM uses this information to determine the fuel injection time and to provide an appropriate air fuel ratio. Inside the mass air flow meter, there is a heated platinum wire which is exposed to the flow of intake air. By applying a specific electrical current to the wire, the ECM heats it to a specific temperature. The flow of incoming air cools both the wire and an internal thermistor, affecting their resistance. To maintain a constant current value, the ECM varies the voltage applied to the mass air flow meter. The voltage level is proportional to the airflow through the sensor, and the ECM uses it to calculate the intake air volume. The ECM monitors the average engine load value ratio to check the mass airflow meter for malfunctions. The average engine load value ratio is obtained by comparing the average engine load calculated from the MAF meter output to the average engine load estimated from the driving conditions, such as the engine speed and the throttle opening angle. If the average engine load value ratio is below the threshold value, the ECM determines that the intake air volume is low, and if the average engine load value ratio is above the threshold value, the ECM determines that the intake air volume is high.

If this is detected in 2 consecutive driving cycles, the MIL is illuminated and the DTC is stored.

MONITOR STRATEGY

MONITOR STRATEGY CHART

Related DTCs	P0101: Mass Air Flow Meter Rationality
Required Sensors/Components (Main)	Mass air flow meter
Required Sensors/Components (Related)	Crankshaft position sensor Camshaft position sensor Engine coolant temperature sensor Throttle position sensor
Frequency of Operation	Continuous

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Duration	10 times
MIL Operation	2 driving cycles
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

TYPICAL ENABLING CONDITIONS CHART

Monitor runs whenever following DTCs not stored	None
Throttle position (throttle position sensor voltage)	0.24 to 2 V
Time after engine starts	5 seconds or more
Battery voltage	10.5 V or higher
Estimated load	30 to 70%
Engine coolant temperature	70°C (158°F) or higher
Mass air flow meter circuit fail (P0102, P0103)	Not detected
Intake air temperature circuit fail (P0112, P0113)	Not detected
Engine coolant temperature circuit fail (P0115, P0117, P0118)	Not detected
Crankshaft position sensor circuit fail (P0335)	Not detected
Throttle position sensor circuit fail (P0120, P0121, P0122, P0123, P0220, P0222, P0223, P2135)	Not detected
EVAP system pressure sensor circuit fail (P0452, P0453)	Not detected
Leak detection pump fail (P2401, P2402)	Not detected
EVAP vent valve fail (P2419, P2420)	Not detected

TYPICAL MALFUNCTION THRESHOLDS

TYPICAL MALFUNCTION THRESHOLDS CHART

Both of following conditions 1 and 2 met	-
1. Average engine load value ratio	Less than 0.81 or more than 1.21 (varies with estimated engine load)
2. Average air fuel ratio	Less than -20% or more than 20%

WIRING DIAGRAM

Refer to **DTC P0102** .

CONFIRMATION DRIVING PATTERN

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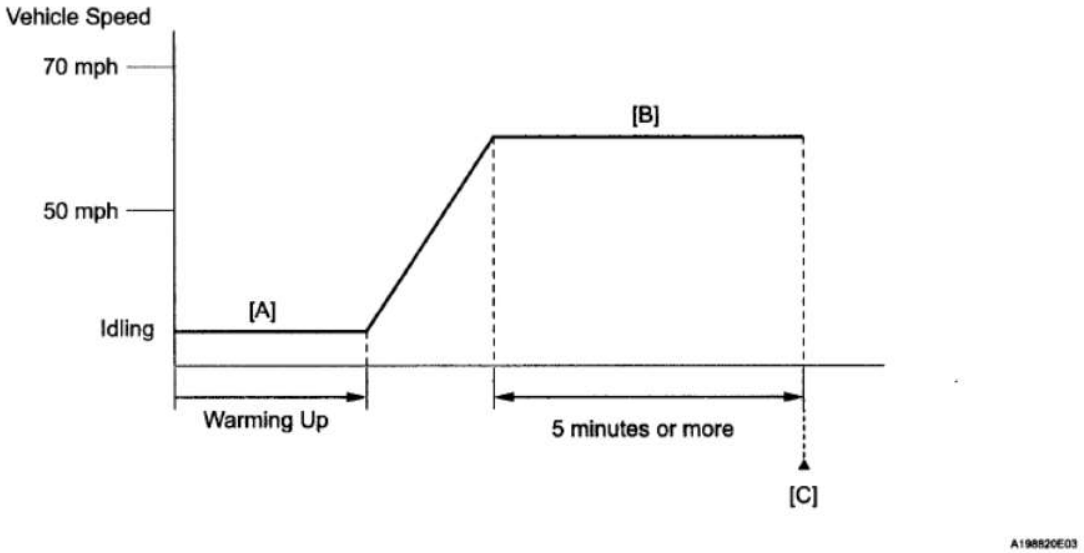


Fig. 74: Vehicle Speed Driving Pattern
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

1. Connect the Techstream to the DLC3.
2. Turn the ignition switch to ON.
3. Turn the Techstream on.
4. Clear the DTCs (even if no DTCs are stored, perform the clear DTC procedure).
5. Turn the ignition switch off.
6. Turn the ignition switch to ON and turn the Techstream on.
7. Start the engine and warm it up until the engine coolant temperature reaches 70°C (158°F) or higher [A].
8. Drive the vehicle at approximately 50 mph (80 km/h) to 70 mph (112 km/h) for 5 minutes or more [B].

   HINT:

   Drive while keeping the engine load as stable as possible.

9. Enter the following menus: Powertrain/Engine/Utility/All Readiness.
10. Input the DTC: P0101.
11. Check the DTC judgment result [C].

TECHSTREAM DISPLAY DESCRIPTION

Techstream Display	Description
NORMAL	• DTC judgment completed • System normal
ABNORMAL	• DTC judgment completed • System abnormal

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INCOMPLETE	• DTC judgment not completed • Perform driving pattern after confirming DTC enabling conditions
UNKNOWN	• Unable to perform DTC judgment • Number of DTCs which do not fulfill DTC preconditions has reached ECU memory limit

CAUTION: When performing the confirmation driving pattern, obey all speed limits and traffic laws.

HINT:

If the judgment result shows INCOMPLETE or UNKNOWN, perform steps [B] and [C] again.

12. If the test result is UNKNOWN, enter the following menus: Powertrain/Engine/Trouble Codes/Pending.
13. Read Pending DTCs.

HINT:

If a pending DTC is output, the system is malfunctioning.

14. If the test result is INCOMPLETE or UNKNOWN and no pending DTC is output, perform a universal trip and check for permanent DTCs (See **DTC CHECK/CLEAR**).

HINT:

- If a permanent DTC is output, the system is malfunctioning.
- If no permanent DTC is output, the system is normal.

INSPECTION PROCEDURE

HINT:

Read freeze frame data using the Techstream. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1. **CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P0101)**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the Techstream on.
   d. Enter the following menus: Powertrain/Engine/Trouble Codes.
   e. Read the DTCs.

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Result

RESULT CHART

Result	Proceed to
DTC P0101 is output	A
DTC P0101 and other DTCs are output	B

HINT:

If any DTCs other than P0101 are output, troubleshoot those DTCs first.

B: GO TO **DTC CHART**

A: Go to next step

2. **CHECK INTAKE SYSTEM**
   a. Check the intake system for vacuum leakage (See **ON-VEHICLE INSPECTION**).

OK:

No leakage from intake system.

NG: REPAIR OR REPLACE INTAKE SYSTEM

OK: Go to next step

3. **CHECK PCV HOSE CONNECTIONS**
   a. Check the PCV hose connections.

OK:

PCV hose is connected correctly and is not damaged.

NG: REPAIR OR REPLACE PCV HOSE

OK: REPLACE MASS AIR FLOW METER (See **REMOVAL**)

DTC P0102 MASS OR VOLUME AIR FLOW CIRCUIT LOW INPUT; DTC P0103 MASS OR VOLUME AIR FLOW CIRCUIT HIGH INPUT

DESCRIPTION

The mass air flow meter is a sensor that measures the amount of air flowing through the throttle valve. The ECM uses this information to determine the fuel injection time and to provide the appropriate air-fuel ratio.

Inside the mass air flow meter, there is a heated platinum wire which is exposed to the flow of intake air. By

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applying a specific electrical current to the wire, the ECM heats it to a given temperature. The flow of incoming air cools both the wire and an internal thermistor, affecting their resistance. To maintain a constant current value, the ECM varies the voltage applied to the wire and internal thermistor. The voltage level is proportional to the airflow through the sensor, and the ECM uses it to calculate the intake air volume.

The circuit is constructed so that the platinum hot wire and the temperature sensor create a bridge circuit, and the power transistor is controlled so that the potentials of A and B remain equal to maintain the predetermined temperature.

HINT:

When any of these DTCs is stored, the ECM enters fail-safe mode. During fail-safe mode, the ignition timing is calculated by the ECM, according to the engine speed and throttle valve position. Fail-safe mode continues until a pass condition is detected.

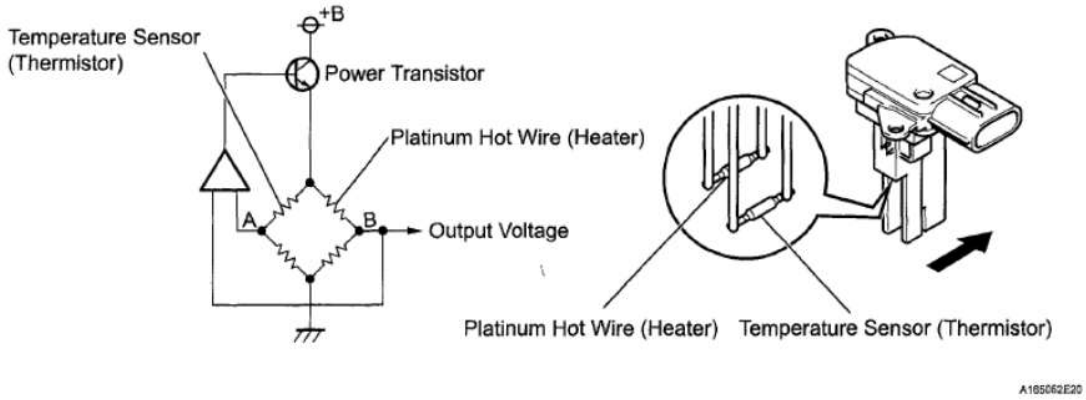


Fig. 75: Mass Air Flow Meter Sensor - Circuit Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

DTC DETECTION CONDITION CHART

DTC No.	DTC Detection Condition	Trouble Area
P0102	The mass air flow meter voltage is less than 0.2 V for 3 seconds. (1 trip detection logic: Engine speed is less than 4000 rpm) (2 trip detection logic: Engine speed is 4000 rpm or more)	• Open or short in mass air flow meter circuit • Mass air flow meter • ECM
P0103	The mass air flow meter voltage is more than 4.9 V for 3 seconds. (1 trip detection logic: Engine speed is less than 4000 rpm) (2 trip detection logic: Engine speed is 4000 rpm or more)	• Open or short in mass air flow meter circuit • Mass air flow meter • ECM

HINT:

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When any of these DTCs are output, check the air-flow rate using the Techstream. Enter the following menus: Powertrain/Engine/Data List/All Data/MAF.

MASS AIR FLOW RATE CHART

Mass Air Flow Rate (gm/sec)	Condition	Malfunction
Approximately 0.0	• Engine not running • 30 seconds after ignition switch turned to ON	• Open in mass air flow meter power source circuit • Open or short in VG circuit
0.71 or more	• Engine not running • 30 seconds after ignition switch turned to ON	• Open in E2G circuit

NOTE:

- **Perform the inspection with the vehicle indoors and on a level surface.**
- **Perform the inspection of the mass air flow meter while it is installed to the air cleaner case (installed to the vehicle).**
- **During the test, do not use an exhaust air duct on the exhaust tail pipe assembly.**

MONITOR DESCRIPTION

If there is a defect in the mass air flow meter or an open or short circuit, the voltage level deviates from the normal operating range. The ECM interprets this deviation as a malfunction in the mass air flow meter circuit and stores a DTC.

Example:

When the sensor output voltage remains below 0.2 V or higher than 4.9 V for more than 3 seconds, the ECM stores a DTC.

If the malfunction is not repaired successfully, a DTC is stored 3 seconds after the engine is next started.

MONITOR STRATEGY

MONITOR STRATEGY CHART

Related DTCs	P0102: Mass Air Flow Meter Range Check (Low Voltage) P0103: Mass Air Flow Meter Range Check (High Voltage)
Required Sensors/Components (Main)	Mass air flow meter
Required Sensors/Components (Related)	Crankshaft position sensor
Frequency of Operation	Continuous
Duration	3 seconds
MIL Operation	Immediate: Engine speed less than 4000 rpm 2 driving cycles: Engine speed 4000 rpm or more
Sequence of Operation	None

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TYPICAL ENABLING CONDITIONS

TYPICAL ENABLING CONDITIONS CHART

Monitor runs whenever following DTCs not stored	None

TYPICAL MALFUNCTION THRESHOLDS

P0102:

TYPICAL MALFUNCTION THRESHOLDS CHART

Mass air flow meter voltage	Less than 0.2 V

P0103:

TYPICAL MALFUNCTION THRESHOLDS CHART

Mass air flow meter voltage	More than 4.9 V

COMPONENT OPERATING RANGE

COMPONENT OPERATING RANGE CHART

Mass air flow meter voltage	0.2 V or more, and 4.9 V or less

CONFIRMATION DRIVING PATTERN

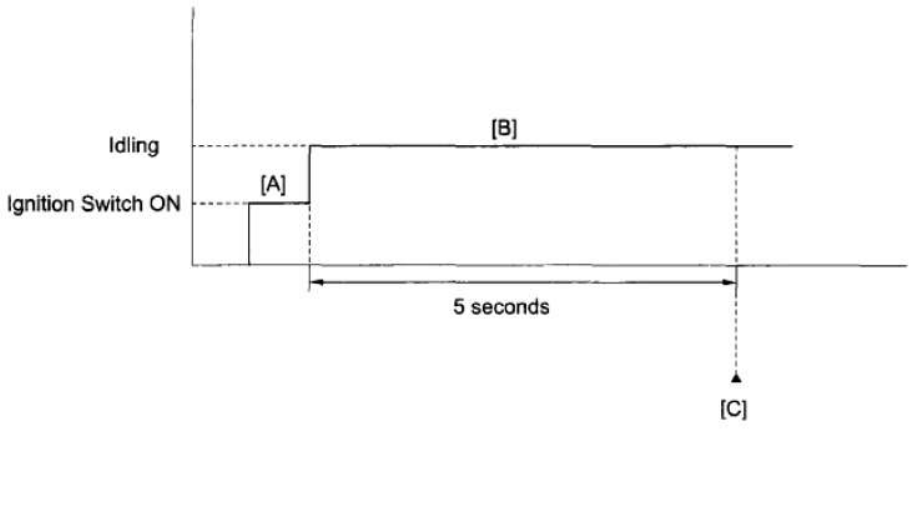


Fig. 76: Confirmation Driving Pattern
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

1. Connect the Techstream to the DLC3.
2. Turn the ignition switch to ON and turn the Techstream on.
3. Clear the DTCs (even if no DTCs are stored, perform the clear DTC procedure).

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4. Turn the ignition switch off.
5. Turn the ignition switch to ON and turn the Techstream on [A].
6. Start the engine.
7. Idle the engine for 5 seconds [B].
8. Enter the following menus: Powertrain/Engine/Utility/All Readiness.
9. Input the DTC: P0102 or P0103.
10. Check the DTC judgment result [C].

TECHSTREAM DISPLAY DESCRIPTION

Techstream Display	Description
NORMAL	• DTC judgment completed • System normal
ABNORMAL	• DTC judgment completed • System abnormal
INCOMPLETE	• DTC judgment not completed • Perform driving pattern after confirming DTC enabling conditions
UNKNOWN	• Unable to perform DTC judgment • Number of DTCs which do not fulfill DTC preconditions has reached ECU memory limit

HINT:

If the judgment result shows INCOMPLETE or UNKNOWN, perform steps [B] and [C] again.

11. If the test result is UNKNOWN, enter the following menus: Powertrain/Engine/Trouble Codes/Pending.
12. Read Pending DTCs.

HINT:

If a pending DTC is output, the system is malfunctioning.

13. If the test result is INCOMPLETE or UNKNOWN and no pending DTC is output, perform a universal trip and check for permanent DTCs (See **DTC CHECK/CLEAR**).

HINT:

- If a permanent DTC is output, the system is malfunctioning.
- If no permanent DTC is output, the system is normal.

WIRING DIAGRAM

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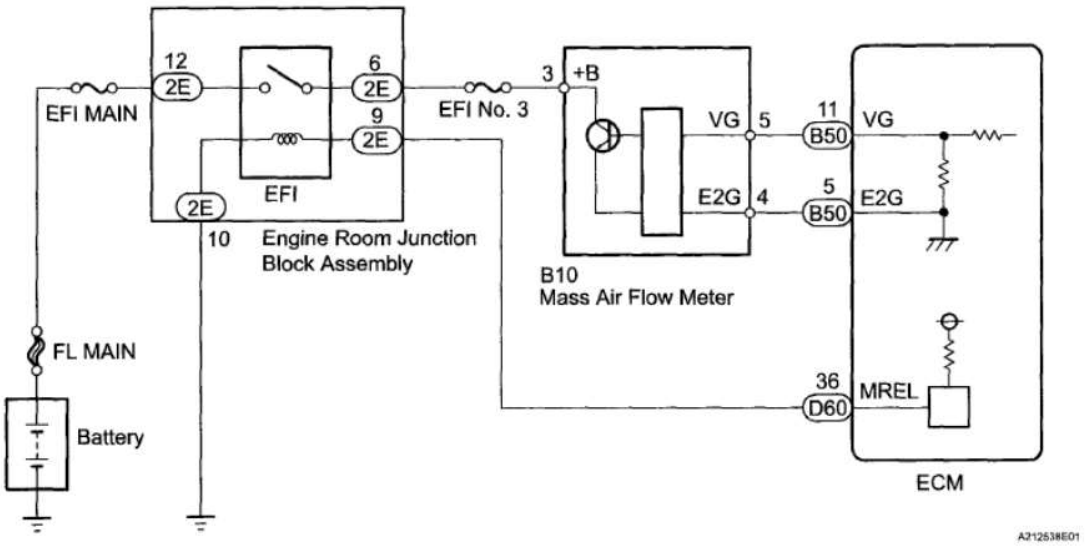


Fig. 77: Mass Or Volume Air Flow Circuit Low Input - Wiring Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSPECTION PROCEDURE

NOTE: Inspect the fuses for circuits related to this system before performing the following inspection procedure.

HINT:

Read freeze frame data using the Techstream. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1. **READ DTC OUTPUT**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the Techstream on.
   d. Enter the following menus: Powertrain/Engine/Trouble Codes.
   e. Wait 30 seconds, and read the DTCs.

   Result

   RESULT CHART

Result	Proceed to
DTC P0102 is output	A
DTC P0103 is output	B

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B: Go to step 5

A: Go to next step

2. **INSPECT MASS AIR FLOW METER (POWER SOURCE VOLTAGE)**
   a. Disconnect the mass air flow meter connector.
   b. Turn the ignition switch to ON.
   c. Measure the voltage according to the value(s) in the table below.

Standard Voltage

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Switch Condition	Specified Condition
B10-3 (+B) - Body ground	Ignition switch ON	11 to 14 V

   d. Reconnect the mass air flow meter connector.

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR (EFI RELAY - MASS AIR FLOW METER)

Front view of wire harness connector:
(to Mass Air Flow Meter)

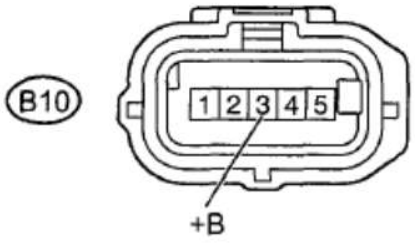


Fig. 78: Identifying Mass Air Flow Meter Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

3. **CHECK HARNESS AND CONNECTOR (MASS AIR FLOW METER - ECM)**
   a. Disconnect the mass air flow meter connector.
   b. Disconnect the ECM connector.

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c. Measure the resistance according to the value(s) in the table below.

Standard Resistance (Check for Open)

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
B10-5 (VG) - B50-11 (VG)	Always	Below 1 ohms
B10-4 (E2G) - B50-5 (E2G)		

Standard Resistance (Check for Short)

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
B10-5 (VG) or B50-11 (VG) - Body ground	Always	10 kohms or higher

d. Reconnect the mass air flow meter connector.
e. Reconnect the ECM connector.

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR

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Front view of wire harness connector:
(to Mass Air Flow Meter)



Rear view of wire harness connector:
(to ECM)

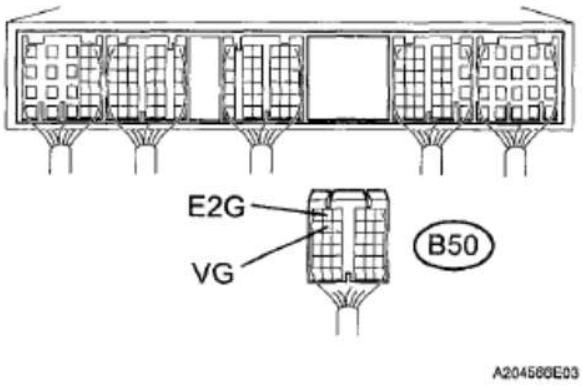


Fig. 79: Identifying Mass Air Flow Meter And ECM Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

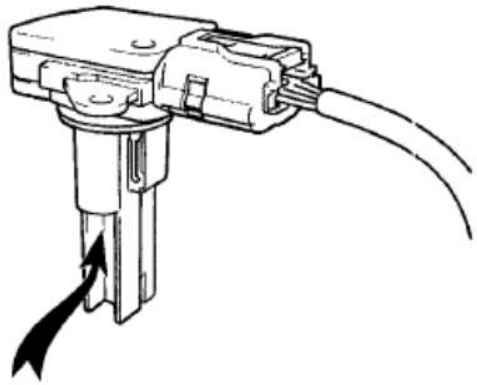
4. **INSPECT MASS AIR FLOW METER**
   a. Perform On-vehicle Inspection (See **ON-VEHICLE INSPECTION**).
   b. Perform Inspection (See **INSPECTION**).
   c. Inspect the function of the mass air flow meter.
      1. Remove the mass air flow meter with the connector connected.
      2. Connect the Techstream to the DLC3.
      3. Turn the ignition switch to ON.
      4. Turn the Techstream to the DLC3.
      5. Enter the following menus: Powertrain/Engine/Data List/All Data/MAF.
      6. Blow air to the mass air flow meter and check that the intake air amount reading changes.

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OK:

The reading changes.

NG: REPLACE MASS AIR FLOW METER (See **REMOVAL**)



A210576

Fig. 80: Identifying Mass Air Flow Meter
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: REPLACE ECM (See **REMOVAL**)

5. **CHECK HARNESS AND CONNECTOR (SENSOR GROUND)**
   a. Disconnect the mass air flow meter connector.
   b. Measure the resistance according to the value(s) in the table below.

Standard Resistance (Check for Open)

TESTER CONNECTION SPECIFIED CONDITION CHART

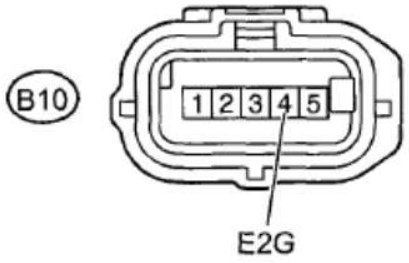
Tester Connection	Condition	Specified Condition
B10-4 (E2G) - Body ground	Always	Below 1 ohms

   c. Reconnect the mass air flow meter connector.

NG: Go to step 6

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Front view of wire harness connector:
(to Mass Air Flow Meter)



P A148755E62

Fig. 81: Identifying Mass Air Flow Meter Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: REPLACE MASS AIR FLOW METER (See **REMOVAL**)

6. **CHECK HARNESS AND CONNECTOR (MASS AIR FLOW METER - ECM)**
   a. Disconnect the mass air flow meter connector.
   b. Disconnect the ECM connector.
   c. Measure the resistance according to the value(s) in the table below.

Standard Resistance (Check for Open)

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
B10-5 (VG) - B50-11 (VG)	Always	Below 1 ohms
B10-4 (E2G) - B50-5 (E2G)		

Standard Resistance (Check for Short)

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
B10-5 (VG) or B50-11 (VG) - Body ground	Always	10 kohms or higher

   d. Reconnect the mass air flow meter connector.
   e. Reconnect the ECM connector.

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR

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Front view of wire harness connector:
(to Mass Air Flow Meter)



Rear view of wire harness connector:
(to ECM)

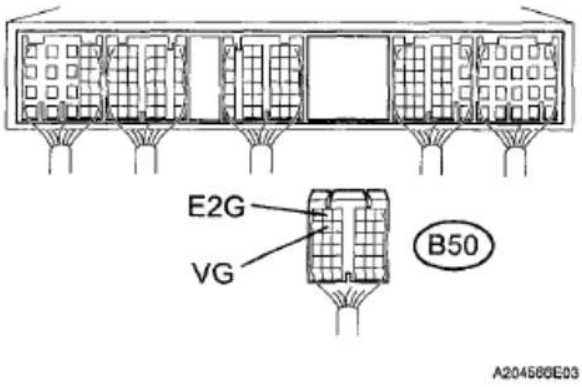


Fig. 82: Identifying Mass Air Flow Meter And ECM Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: REPLACE ECM (See **REMOVAL**)

DTC P0111 INTAKE AIR TEMPERATURE SENSOR GRADIENT TOO HIGH

DESCRIPTION

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Fig. 1:

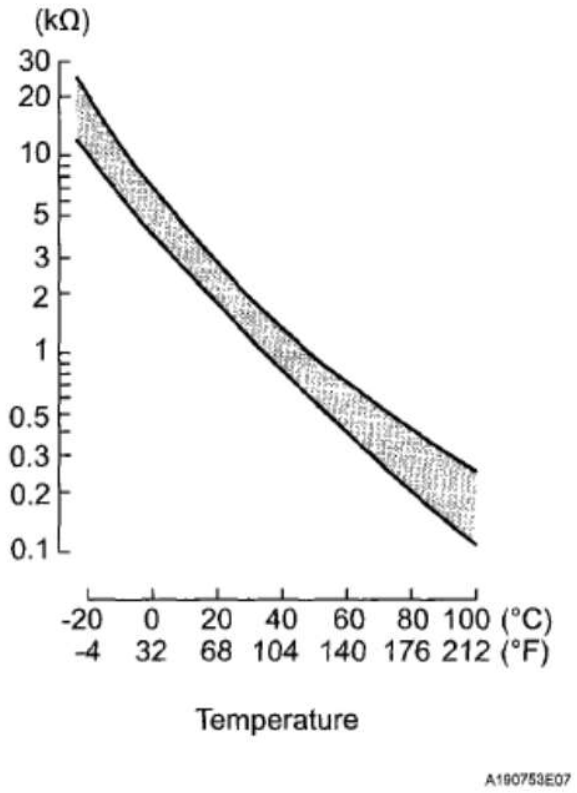


Fig. 83: Resistance And Temperature Graph
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

The intake air temperature sensor, mounted on the mass air flow meter, monitors the intake air temperature. The intake air temperature sensor has a built-in thermistor with a resistance that varies according to the temperature of the intake air. When the intake air temperature is low, the resistance of the thermistor increases. When the temperature is high, the resistance drops. These variations in resistance are transmitted to the ECM as voltage changes (see **Fig. 83**).

The intake air temperature sensor is powered by a 5 V supply from the THA terminal of the ECM, via resistor R.

Resistor R and the intake air temperature sensor are connected in series. When the resistance value of the intake air temperature sensor changes, according to changes in the intake air temperature, the voltage at terminal THA also varies. Based on this signal, the ECM increases the fuel injection volume when the engine is cold to improve driveability.

DTC DETECTION CONDITION CHART

DTC No.	DTC Detection Condition	Trouble Area

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P0111	When either of the following conditions is met (2 trip detection logic): • In the duration between when the engine is warmed up and the next engine start, the change in the intake air temperature sensor output is below the threshold. • While the engine is warming up after a cold engine start, the change in the intake air temperature sensor output is below the threshold.	Mass air flow meter

MONITOR DESCRIPTION

After Warmed Engine Stop

The ECM monitors the intake air temperature variation in the period from when the engine was warmed up on the previous trip until the next engine start. If the change in intake air temperature sensor output is less than the threshold, it is determined that a malfunction has occurred in the intake air temperature sensor. When this is detected, the MIL is illuminated and the DTC is stored.

After Cold Engine Start

The monitor runs when the engine is started cold after 5 hours or more have elapsed since the engine stopped. If the intake air temperature sensor output variation until the engine has warmed up completely is less than the threshold, it is determined that a malfunction has occurred in the intake air temperature sensor. When this is detected in 2 consecutive driving cycles, the MIL is illuminated and the DTC is stored.

MONITOR STRATEGY

MONITOR STRATEGY CHART

Related DTCs	P0111: Intake Air Temperature Sensor Rationality (After Engine Stop) P0111: Intake Air Temperature Sensor Rationality (After Cold Engine Start)
Required Sensors/Components (Main)	Intake air temperature sensor
Required Sensors/Components (Related)	-
Frequency of Operation	Once per driving cycle
Duration	10 seconds or more
MIL Operation	2 driving cycles
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

All

TYPICAL ENABLING CONDITIONS CHART

Monitor runs whenever following DTCs not stored	None

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After Engine Stop

TYPICAL ENABLING CONDITIONS CHART

Time after engine start	10 seconds or more
Battery voltage	10.5 V or higher
Engine coolant temperature at ECM started by soak timer	-40°C (-40°F) or higher
Engine coolant temperature before engine stop	70°C (158°F) or higher
Time that mass air flow is low before engine stop	2100 seconds
Accumulated mass air flow amount before engine stop	2580 g or more
Key-off duration	30 minutes
Mass air flow meter circuit fail (P0102, P0103)	Not detected
Engine coolant temperature sensor circuit (P0115, P0117, P0118)	Not detected

After Cold Engine Start

TYPICAL ENABLING CONDITIONS CHART

Key-off duration	5 hours
Time after engine start	10 seconds or more
Engine coolant temperature	70°C (158°F) or higher
Accumulated mass air flow amount	2580 g or more
Either of the following conditions 1 or 2 is met:	-
1. Duration while engine load is low	120 seconds or more
2. Duration while engine load is high	10 seconds or more
Mass air flow meter circuit fail (P0102, P0103)	Not detected
Engine coolant temperature sensor circuit (P0115, P0117, P0118)	Not detected

TYPICAL MALFUNCTION THRESHOLDS

After Engine Stop

TYPICAL MALFUNCTION THRESHOLDS CHART

Intake air temperature change	Below 1°C (2°F)

After Cold Engine Start

TYPICAL MALFUNCTION THRESHOLDS CHART

Intake air temperature change	Below 1°C (2°F)

CONFIRMATION DRIVING PATTERN

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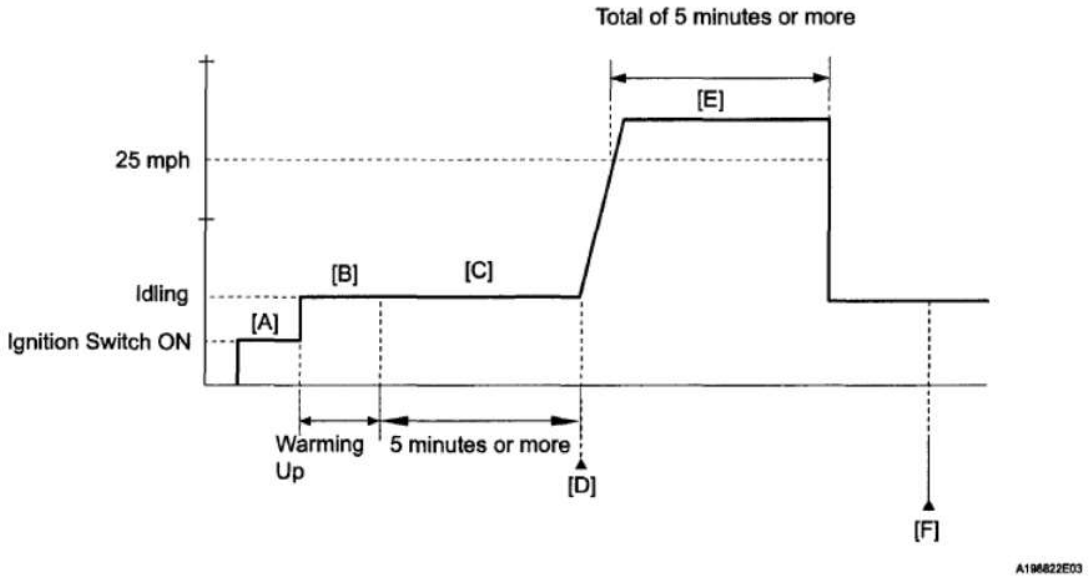


Fig. 84: Confirmation Driving Pattern
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

1. Connect the Techstream to the DLC3.
2. Turn the ignition switch to ON and turn the Techstream on.
3. Clear the DTCs (even if no DTCs are stored, perform the clear DTC procedure).
4. Turn the ignition switch off.
5. Turn the ignition switch to ON and turn the Techstream on [A].
6. Start the engine and warm it up until the engine coolant temperature reaches 75°C (167°F) or higher [B].
7. Idle the engine for 5 minutes or more [C].

   HINT:

   During steps [A] through [C], if the change in the intake air temperature is below 1°C (2°F), the intake air temperature sensor (mass air flow meter) is malfunctioning. It is not necessary to continue this procedure.

8. Enter the following menus: Powertrain/Engine/Utility/All Readiness.
9. Input the DTC: P0111.
10. Check the DTC judgment result [D].

TECHSTREAM DISPLAY DESCRIPTION

Techstream Display	Description
NORMAL	• DTC judgment completed • System normal
ABNORMAL	• DTC judgment completed • System abnormal

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INCOMPLETE	• DTC judgment not completed • Perform driving pattern after confirming DTC enabling conditions
UNKNOWN	• Unable to perform DTC judgment • Number of DTCs which do not fulfill DTC preconditions has reached ECU memory limit

CAUTION: When performing the confirmation driving pattern, obey all speed limits and traffic laws.

HINT:

- If the judgment result shows ABNORMAL, the system has a malfunction.
- If the judgment result shows INCOMPLETE or UNKNOWN, perform steps [E] and [F].

11. Drive the vehicle at 25 mph (40 km/h) or more for a total of 5 minutes or more [E].
12. Check the DTC judgment result again [F].

HINT:

If the judgment result shows INCOMPLETE or UNKNOWN, perform steps [E] and [F] again.

13. If the test result is UNKNOWN, enter the following menus: Powertrain/Engine/Trouble Codes/pending.
14. Read Pending DTCs.

HINT:

If a pending DTC is output, the system is malfunctioning.

15. If the test result is INCOMPLETE or UNKNOWN and no pending DTC is output, perform a universal trip and check for permanent DTCs (See **DTC CHECK/CLEAR**).

HINT:

- If a permanent DTC is output, the system is malfunctioning.
- If no permanent DTC is output, the system is normal.

WIRING DIAGRAM

Refer to **DTC P0112** .

INSPECTION PROCEDURE

HINT:

Read freeze frame data using the Techstream. The ECM records vehicle and driving condition information as

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freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1. **CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P0111)**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the Techstream on.
   d. Enter the following menus: Powertrain/Engine/Trouble Codes.
   e. Read the DTCs.

   Result

   RESULT CHART

Result	Proceed to
DTC P0111 and other DTCs are output	A
DTC P0111 is output	B

   HINT:

   If any DTCs other than P0111 are output, troubleshoot those DTCs first.

   B: REPLACE MASS AIR FLOW METER (See **REMOVAL**)

   A: GO TO **DTC CHART**

DTC P0112 INTAKE AIR TEMPERATURE CIRCUIT LOW INPUT; DTC P0113 INTAKE AIR TEMPERATURE CIRCUIT HIGH INPUT

DESCRIPTION

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Fig. 1:

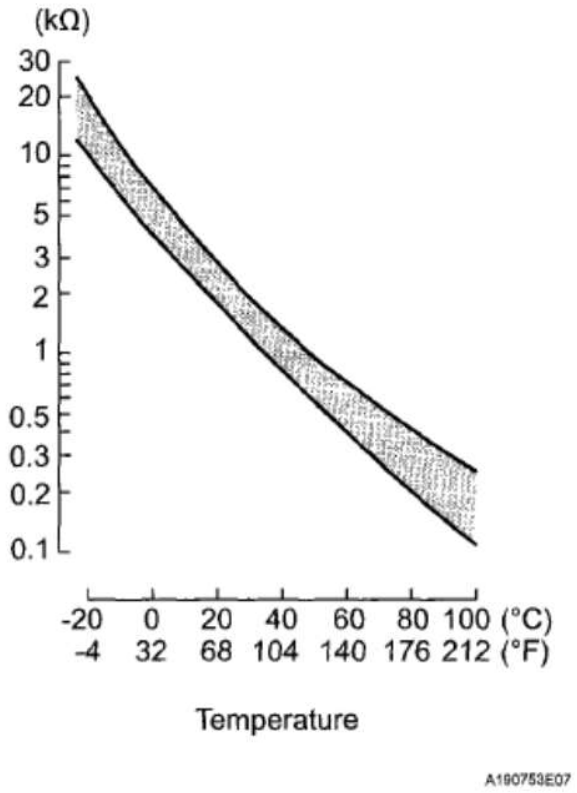


Fig. 85: Resistance And Temperature Graph
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

The intake air temperature sensor, mounted on the mass air flow meter, monitors the intake air temperature. The intake air temperature sensor has a built-in thermistor with a resistance that varies according to the temperature of the intake air. When the intake air temperature is low, the resistance of the thermistor increases. When the temperature is high, the resistance drops. These variations in resistance are transmitted to the ECM as voltage changes (see **Fig. 85**).

The intake air temperature sensor is powered by a 5 V supply from the THA terminal of the ECM, via resistor R.

Resistor R and the intake air temperature sensor are connected in series. When the resistance value of the intake air temperature sensor changes, according to changes in the intake air temperature, the voltage at terminal THA also varies. Based on this signal, the ECM increases the fuel injection volume when the engine is cold to improve driveability.

HINT:

When DTC P0112 or P0113 is stored, the ECM enters fail-safe mode. During fail-safe mode, the intake air

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temperature is estimated to be 20°C (68°F) by the ECM. Fail-safe mode continues until a pass condition is detected.

DTC DETECTION CONDITION CHART

DTC No.	DTC Detection Condition	Trouble Area
P0112	A short in the intake air temperature sensor circuit for 0.5 seconds (1 trip detection logic).	• Short in intake air temperature sensor circuit • Intake air temperature sensor (built into mass air flow meter) • ECM
P0113	An open in the intake air temperature sensor circuit for 0.5 seconds (1 trip detection logic).	• Open in intake air temperature sensor circuit • Intake air temperature sensor (built into mass air flow meter) • ECM

HINT:

When any of these DTCs are output, check the intake air temperature using the Techstream. Enter the following menus: Powertrain/Engine/Data List/All Data/Intake Air.

TEMPERATURE DISPLAYED CHART

Temperature Displayed	Malfunction
-40°C (-40°F)	Open circuit
140°C (284°F) or higher	Short circuit

MONITOR DESCRIPTION

The ECM monitors the sensor voltage and uses this value to calculate the intake air temperature. When the sensor output voltage deviates from the normal operating range, the ECM interprets this as a malfunction in the intake air temperature sensor and stores a DTC.

Example:

If the sensor output voltage is more than 4.91 V for 0.5 seconds or more, the ECM determines that there is an open in the intake air temperature sensor circuit, and stores DTC P0113. Conversely, if the output voltage is less than 0.18 V for 0.5 seconds or more, the ECM determines that there is a short in the sensor circuit, and stores DTC P0112.

If the malfunction is not repaired successfully, a DTC is stored 0.5 seconds after the engine is next started.

MONITOR STRATEGY

MONITOR STRATEGY CHART

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Related DTCs	P0112: Intake Air Temperature Sensor Range Check (Low Voltage) P0113: Intake Air Temperature Sensor Range Check (High Voltage)
Required Sensors/Components (Main)	Intake air temperature sensor
Required Sensors/Components (Related)	-
Frequency of Operation	Continuous
Duration	0.5 seconds
MIL Operation	Immediately
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

TYPICAL ENABLING CONDITIONS CHART

Monitor runs whenever following DTCs not stored	None
Battery voltage	8 V or more
Ignition switch	ON
Starter	OFF

TYPICAL MALFUNCTION THRESHOLDS

P0112

TYPICAL MALFUNCTION THRESHOLDS CHART

Intake air temperature sensor voltage [Intake air temperature]	Less than 0.18 V [140°C (284°F) or higher]

P0113

TYPICAL MALFUNCTION THRESHOLDS CHART

Intake air temperature sensor voltage [Intake air temperature]	More than 4.91 V [Below -40°C (-40°F)]

COMPONENT OPERATING RANGE

COMPONENT OPERATING RANGE CHART

Intake air temperature sensor voltage [Intake air temperature]	0.18 to 4.91 V [-40 to 140°C (-40 to 284°F)]

CONFIRMATION DRIVING PATTERN

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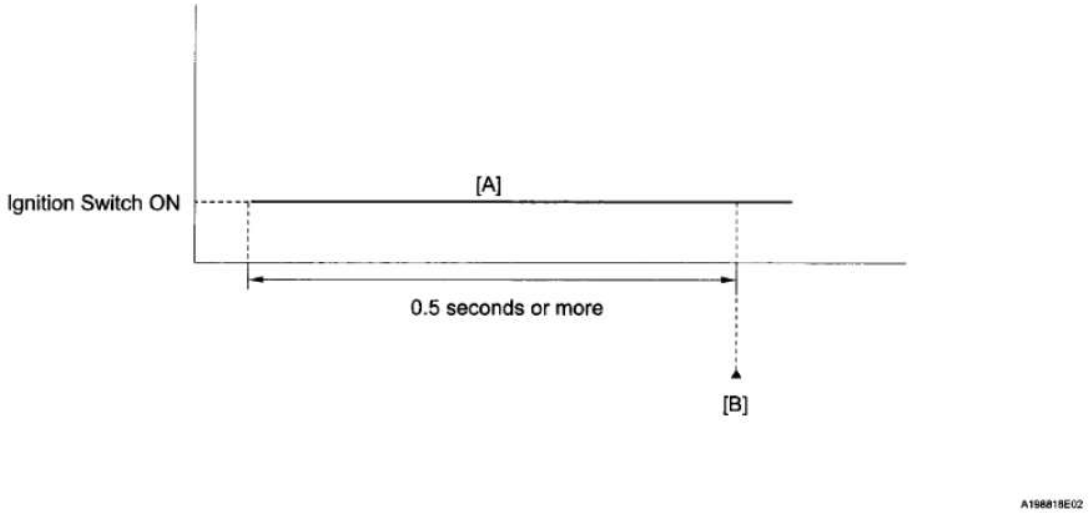


Fig. 86: Confirmation Driving Pattern
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

1. Connect the Techstream to the DLC3.
2. Turn the ignition switch to ON and turn the Techstream on.
3. Clear the DTCs (even if no DTCs are stored, perform the clear DTC procedure).
4. Turn the ignition switch off.
5. Turn the ignition switch to ON and turn the Techstream on.
6. Wait 0.5 seconds or more [A].
7. Enter the following menus: Powertrain/Engine/Utility/All Readiness.
8. Input the DTC: P0112 or P0113.
9. Check the DTC judgment result [B].

TECHSTREAM DISPLAY DESCRIPTION

Techstream Display	Description
NORMAL	• DTC judgment completed • System normal
ABNORMAL	• DTC judgment completed • System abnormal
INCOMPLETE	• DTC judgment not completed • Perform driving pattern after confirming DTC enabling conditions
UNKNOWN	• Unable to perform DTC judgment • Number of DTCs which do not fulfill DTC preconditions has reached ECU memory limit

10. If the test result is UNKNOWN, enter the following menus: Powertrain/Engine/Trouble Codes/Pending.

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11. Read Pending DTCs.

    HINT:

    If a pending DTC is output, the system is malfunctioning.

12. If the test result is INCOMPLETE or UNKNOWN and no pending DTC is output, perform a universal trip and check for permanent DTCs (See **DTC CHECK/CLEAR**).

    HINT:

    - If a permanent DTC is output, the system is malfunctioning.
    - If no permanent DTC is output, the system is normal.

WIRING DIAGRAM

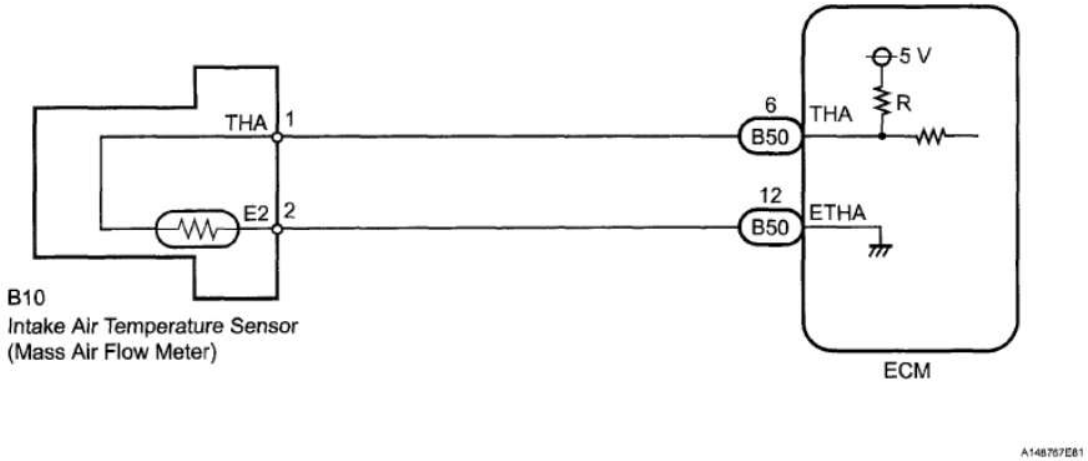


Fig. 87: Intake Air Temperature Circuit Low Input - Wiring Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSPECTION PROCEDURE

HINT:

Read freeze frame data using the Techstream. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1. **READ VALUE USING TECHSTREAM (INTAKE AIR TEMPERATURE)**
    a. Connect the Techstream to the DLC3.
    b. Turn the ignition switch to ON.
    c. Turn the Techstream on.

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d. Enter the following menus: Powertrain/Engine/Data List/All Data/Intake Air.
e. Read the value displayed on the Techstream.

OK:

Same as actual intake air temperature.

Result

RESULT CHART

Result	Proceed to
-40°C (-40°F)	A
140°C (284°F) or higher	B
Same as actual intake air temperature	C

HINT:

- If there is an open circuit, the Techstream indicates 40°C (-40°F).
- If there is a short circuit, the Techstream indicates 140°C (284°F) or higher.

B: Go to step 4

C: CHECK FOR INTERMITTENT PROBLEMS (See **CHECK FOR INTERMITTENT PROBLEMS**)

A: Go to next step

2. **READ VALUE USING TECHSTREAM (CHECK FOR OPEN IN WIRE HARNESS)**
   a. Disconnect the mass air flow meter connector.
   b. Connect terminals 1 (THA) and 2 (E2) of the mass air flow meter wire harness side connector.
   c. Connect the Techstream to the DLC3.
   d. Turn the ignition switch to ON.
   e. Turn the Techstream on.
   f. Enter the following menus: Powertrain/Engine/Data List/All Data/Intake Air.
   g. Read the value displayed on the Techstream.

Standard value:

140°C (284°F) or higher

h. Reconnect the mass air flow meter connector.

NG: Go to step 3

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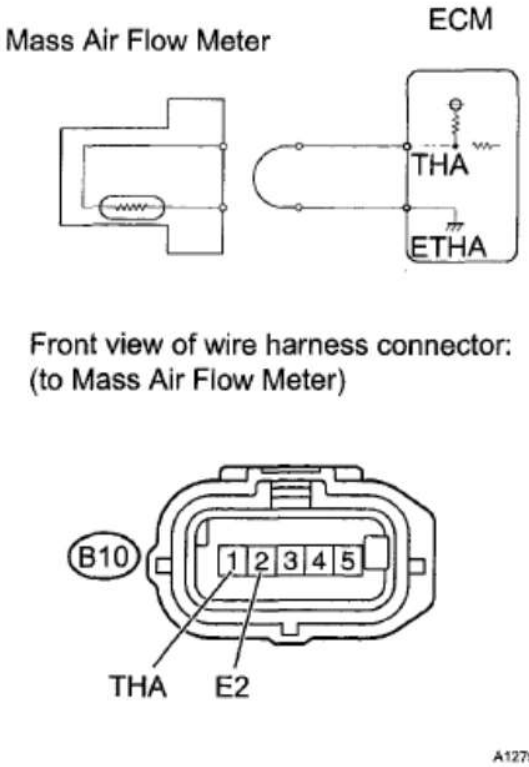


Fig. 88: Identifying Mass Air Flow Meter Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: REPLACE MASS AIR FLOW METER (See **REMOVAL**)

3. **CHECK HARNESS AND CONNECTOR (MASS AIR FLOW METER - ECM)**
   a. Disconnect the mass air flow meter connector.
   b. Disconnect the ECM connector.
   c. Measure the resistance according to the value(s) in the table below.

Standard Resistance (Check for Open)

TESTER CONNECTION SPECIFIED CONDITION CHART

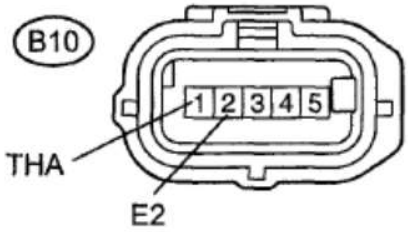
Tester Connection	Condition	Specified Condition
B10-1 (THA) - B50-6 (THA)	Always	Below 1 ohms
B10-2 (E2) - B50-12 (ETHA)	Always	Below 1 ohms

   d. Reconnect the mass air flow meter connector.
   e. Reconnect the ECM connector.

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR

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Front view of wire harness connector:
(to Mass Air Flow Meter)



Rear view of wire harness connector:
(to ECM)

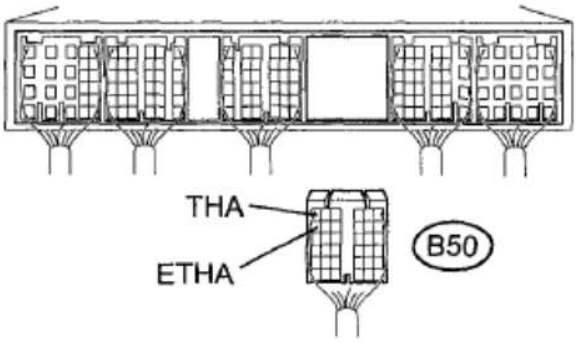


Fig. 89: Identifying Mass Air Flow Meter And ECM Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: REPLACE ECM (See **REMOVAL**)

4. **READ VALUE USING TECHSTREAM (CHECK FOR SHORT IN WIRE HARNESS)**
   a. Disconnect the mass air flow meter connector.
   b. Connect the Techstream to the DLC3.
   c. Turn the ignition switch to ON.
   d. Turn the Techstream on.
   e. Enter the following menus: Powertrain/Engine/Data List/All Data/Intake Air.
   f. Read the value displayed on the Techstream.

   Standard value:

   -40°C (-40°F)

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g. Reconnect the mass air flow meter connector.

NG: Go to step 5

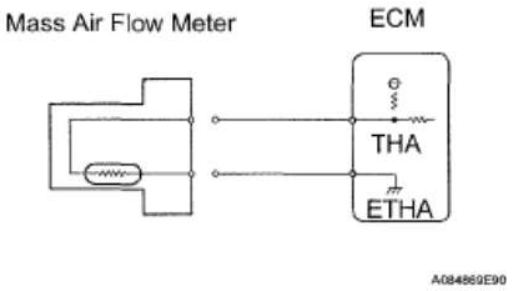


Fig. 90: Mass Air Flow Meter Circuit Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: REPLACE MASS AIR FLOW METER (See **REMOVAL**)

5. **CHECK HARNESS AND CONNECTOR (MASS AIR FLOW METER - ECM)**
   a. Disconnect the mass air flow meter connector.
   b. Disconnect the ECM connector.
   c. Measure the resistance according to the value(s) in the table below.

Standard Resistance (Check for Short)

TESTER CONNECTION SPECIFIED CONDITION CHART

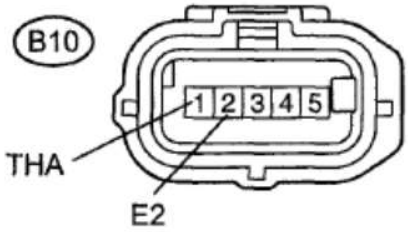
Tester Connection	Condition	Specified Condition
B10-1 (THA) or B50-6 (THA) - Body ground	Always	10 kohms or higher

   d. Reconnect the mass air flow meter connector.
   e. Reconnect the ECM connector.

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR

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Front view of wire harness connector:
(to Mass Air Flow Meter)



Rear view of wire harness connector:
(to ECM)

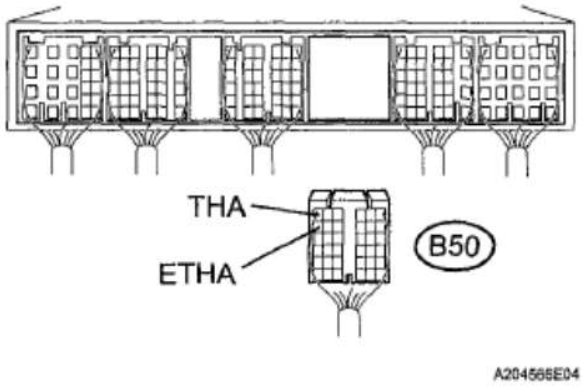


Fig. 91: Identifying Mass Air Flow Meter And ECM Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: REPLACE ECM (See **REMOVAL**)

DTC P0115 ENGINE COOLANT TEMPERATURE CIRCUIT MALFUNCTION; DTC P0117 ENGINE COOLANT TEMPERATURE CIRCUIT LOW INPUT; DTC P0118 ENGINE COOLANT TEMPERATURE CIRCUIT HIGH INPUT

DESCRIPTION

A thermistor, whose resistance value varies according to the engine coolant temperature, is built into the engine coolant temperature sensor. The structure of the sensor and its connection to the ECM are the same as those of the intake air temperature sensor.

HINT:

When any of DTCs P0115, P0117 and P0118 is stored, the ECM enters fail-safe mode. During fail-safe mode,

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the engine coolant temperature is estimated to be 80°C (176°F) by the ECM. Fail-safe mode continues until a pass condition is detected.

DTC DETECTION CONDITION CHART

DTC No.	DTC Detection Condition	Trouble Area
P0115	An open or short in the engine coolant temperature sensor circuit for 0.5 seconds (1 trip detection logic).	• Open or short in engine coolant temperature sensor circuit • Engine coolant temperature sensor • ECM
P0117	A short in the engine coolant temperature sensor circuit for 0.5 seconds (1 trip detection logic).	• Short in engine coolant temperature sensor circuit • Engine coolant temperature sensor • ECM
P0118	An open in the engine coolant temperature sensor circuit for 0.5 seconds (1 trip detection logic).	• Open in engine coolant temperature sensor circuit • Engine coolant temperature sensor • ECM

HINT:

When any of these DTCs are output, check the engine coolant temperature using the Techstream. Enter the following menus: Powertrain/Engine/Data List/All Data/Coolant Temp.

TEMPERATURE DISPLAYED CHART

Temperature Displayed	Malfunction
-40°C (-40°F)	Open circuit
140°C (284°F) or higher	Short circuit

MONITOR DESCRIPTION

The engine coolant temperature sensor is used to monitor the engine coolant temperature. The engine coolant temperature sensor has a thermistor with a resistance that varies according to the temperature of the engine coolant. When the coolant temperature is low, the resistance in the thermistor increases. When the temperature is high, the resistance drops. These variations in resistance are reflected in the output voltage from the sensor. The ECM monitors the sensor voltage and uses this value to calculate the engine coolant temperature. When the sensor output voltage deviates from the normal operating range, the ECM interprets this as a fault in the engine coolant temperature sensor circuit and stores a DTC.

Example:

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If the sensor output voltage is more than 4.91 V for 0.5 seconds or more, the ECM determines that there is an open in the engine coolant temperature sensor circuit, and stores DTC P0118. Conversely, if the voltage output is less than 0.14 V for 0.5 seconds or more, the ECM determines that there is a short in the sensor circuit, and stores DTC P0117.

If the malfunction is not repaired successfully, a DTC is stored 0.5 seconds after the engine is next started.

MONITOR STRATEGY

MONITOR STRATEGY CHART

Related DTCs	P0115: Engine Coolant Temperature Sensor Range Check (Fluctuating) P0117: Engine Coolant Temperature Sensor Range Check (Low Voltage) P0118: Engine Coolant Temperature Sensor Range Check (High Voltage)
Required Sensors/Components (Main)	Engine coolant temperature sensor
Required Sensors/Components (Related)	-
Frequency of Operation	Continuous
Duration	0.5 seconds
MIL Operation	Immediate
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

TYPICAL ENABLING CONDITIONS CHART

Monitor runs whenever following DTCs not stored	None

TYPICAL MALFUNCTION THRESHOLDS

P0115

TYPICAL MALFUNCTION THRESHOLDS CHART

Engine coolant temperature sensor voltage	Less than 0.14 V, or higher than 4.91 V

P0117

TYPICAL MALFUNCTION THRESHOLDS CHART

Engine coolant temperature sensor voltage [Engine coolant temperature]	Less than 0.14 V [Higher than 140°C (284°F)]

P0118

TYPICAL MALFUNCTION THRESHOLDS CHART

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Engine coolant temperature sensor voltage [Engine coolant temperature]	More than 4.91 V [Below -40°C (-40°F)]

COMPONENT OPERATING RANGE

COMPONENT OPERATING RANGE CHART

Engine coolant temperature sensor voltage [Engine coolant temperature]	0.14 to 4.91 V [-40 to 140°C (-40 to 284°F)]

CONFIRMATION DRIVING PATTERN

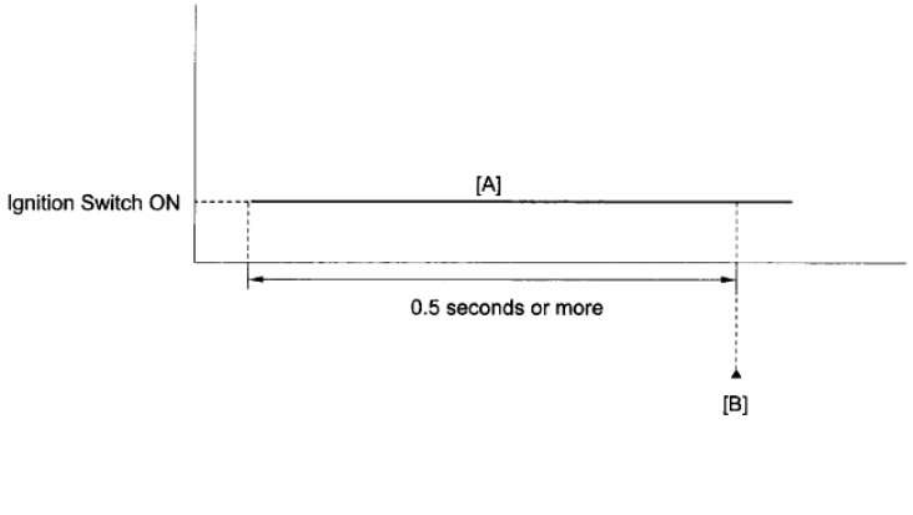


Fig. 92: Confirmation Driving Pattern
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

1. Connect the Techstream to the DLC3.
2. Turn the ignition switch to ON and turn the Techstream on.
3. Clear the DTCs (even if no DTCs are stored, perform the clear DTC procedure).
4. Turn the ignition switch off.
5. Turn the ignition switch to ON and turn the Techstream on.
6. Wait 0.5 seconds or more [A].
7. Enter the following menus: Powertrain/Engine/Utility/All Readiness.
8. Input the DTC: P0115, P0117 or P0118.
9. Check the DTC judgment result [B].

TECHSTREAM DISPLAY DESCRIPTION

Techstream Display	Description
NORMAL	• DTC judgment completed • System normal

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ABNORMAL	• DTC judgment completed • System abnormal
INCOMPLETE	• DTC judgment not completed • Perform driving pattern after confirming DTC enabling conditions
UNKNOWN	• Unable to perform DTC judgment • Number of DTCs which do not fulfill DTC preconditions has reached ECU memory limit

10. If the test result is UNKNOWN, enter the following menus: Powertrain/Engine/Trouble Codes/Pending.
11. Read Pending DTCs.

    HINT:

    If a pending DTC is output, the system is malfunctioning.

12. If the test result is INCOMPLETE or UNKNOWN and no pending DTC is output, perform a universal trip and check for permanent DTCs (See **DTC CHECK/CLEAR**).

    HINT:

    - If a permanent DTC is output, the system is malfunctioning.
    - If no permanent DTC is output, the system is normal.

WIRING DIAGRAM

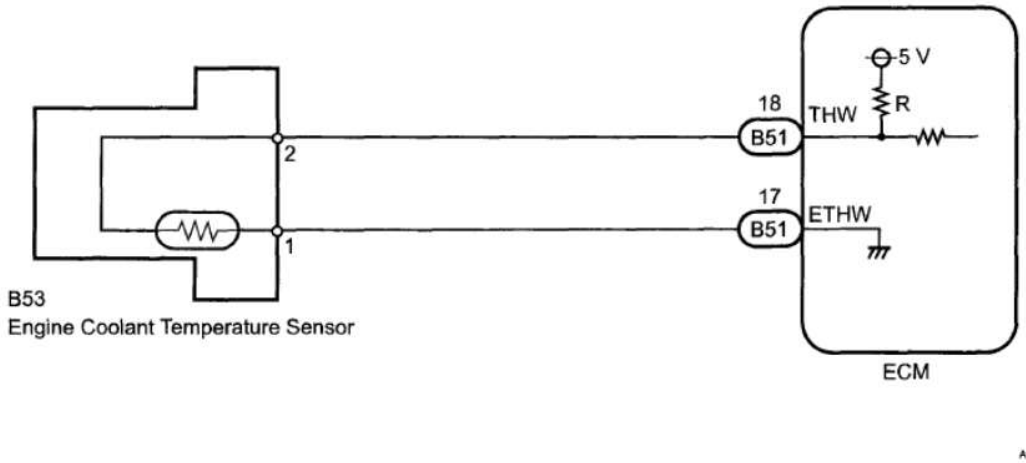


Fig. 93: Engine Coolant Temperature Circuit Malfunction - Wiring Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSPECTION PROCEDURE

HINT:

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Read freeze frame data using the Techstream. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1. **READ VALUE USING TECHSTREAM (ENGINE COOLANT TEMPERATURE)**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the Techstream on.
   d. Enter the following menus: Powertrain/Engine/Data List/All Data/Coolant Temp.
   e. Read the value displayed on the Techstream.

   OK:

   Between 80 and 100 C (167 and 212 F) with warm engine.

   Result

   RESULT CHART

Result	Proceed to
-40°C (-40°F)	A
140°C (284°F) or higher	B
Between 80 and 100°C (176 and 212°F)	C

   HINT:

   - If there is an open circuit, the Techstream indicates 40°C (-40°F).
   - If there is a short circuit, the Techstream indicates 140°C (284°F) or higher.

   B: Go to step 4

   C: CHECK FOR INTERMITTENT PROBLEMS (See **CHECK FOR INTERMITTENT PROBLEMS**)

   A: Go to next step

2. **READ VALUE USING TECHSTREAM (CHECK FOR OPEN IN WIRE HARNESS)**
   a. Disconnect the engine coolant temperature sensor connector.
   b. Connect terminals 1 and 2 of the engine coolant temperature sensor connector on the wire harness side.
   c. Connect the Techstream to the DLC3.
   d. Turn the ignition switch to ON.
   e. Turn the Techstream on.

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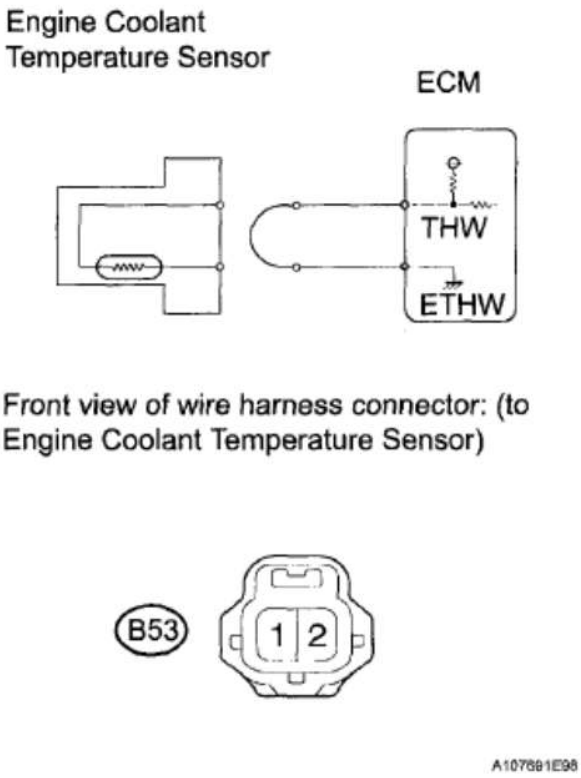
f. Enter the following menus: Powertrain/Engine/Data List/All Data/Coolant Temp.
g. Read the value displayed on the Techstream.

Standard value:

140°C (284°F) or higher

h. Reconnect the engine coolant temperature sensor connector.

NG: Go to step 3



Front view of wire harness connector: (to Engine Coolant Temperature Sensor)

Fig. 94: Identifying B53 Engine Coolant Temperature Sensor Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: REPLACE ENGINE COOLANT TEMPERATURE SENSOR (See **REMOVAL**)

3. **CHECK HARNESS AND CONNECTOR (ENGINE COOLANT TEMPERATURE SENSOR - ECM)**
   a. Disconnect the engine coolant temperature sensor connector.
   b. Disconnect the ECM connector.
   c. Measure the resistance according to the value(s) in the table below.

Standard Resistance (Check for Open)

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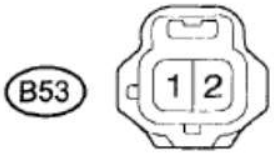
TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
B53-2 - B51-18 (THW)	Always	Below 1 ohms
B53-1 - B51-17 (ETHW)	Always	Below 1 ohms

d. Reconnect the engine coolant temperature sensor connector.
e. Reconnect the ECM connector.

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR

Front view of wire harness connector: (to Engine Coolant Temperature Sensor)



Rear view of wire harness connector: (to ECM)

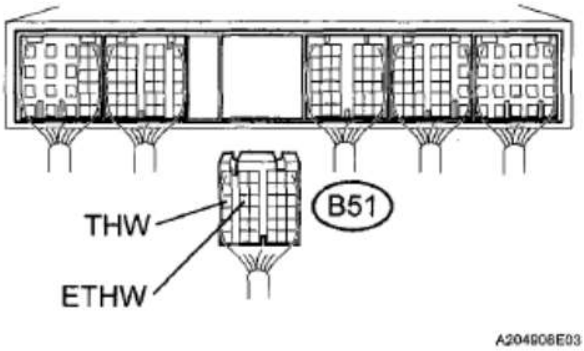


Fig. 95: Identifying Engine Coolant Temperature Sensor And ECM Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: REPLACE ECM (See **REMOVAL**)

4. **READ VALUE USING TECHSTREAM (CHECK FOR SHORT IN WIRE HARNESS)**
   a. Disconnect the engine coolant temperature sensor connector.

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b. Connect the Techstream to the DLC3.
c. Turn the ignition switch to ON.
d. Turn the Techstream on.
e. Enter the following menus: Powertrain/Engine/Data List/All Data/Coolant Temp.
f. Read the value displayed on the Techstream.

Standard value:

-40°C (-40°F)

g. Reconnect the engine coolant temperature sensor connector.

NG: Go to step 5

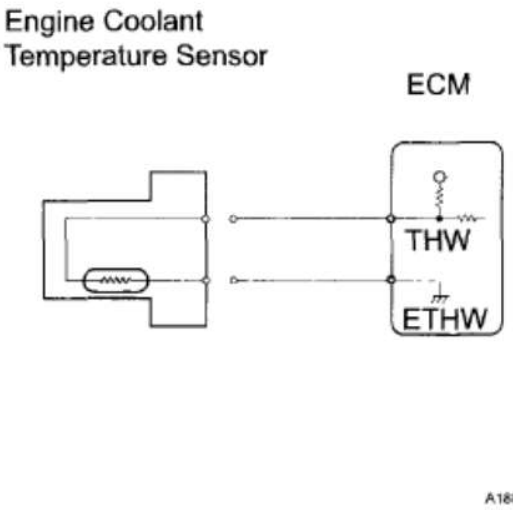


Fig. 96: Engine Coolant Temperature Sensor Communication Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: REPLACE ENGINE COOLANT TEMPERATURE SENSOR (See **REMOVAL**)

5. **CHECK HARNESS AND CONNECTOR (ENGINE COOLANT TEMPERATURE SENSOR - ECM)**
   a. Disconnect the engine coolant temperature sensor connector.
   b. Disconnect the ECM connector.
   c. Measure the resistance according to the value(s) in the table below.

Standard Resistance (Check for Short)

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition

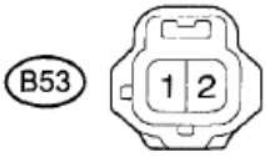
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B53-2 or B51-18 (THW) - Body ground	Always	10 kohms or higher

d. Reconnect the engine coolant temperature sensor connector.
e. Reconnect the ECM connector.

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR

Front view of wire harness connector: (to Engine Coolant Temperature Sensor)



Rear view of wire harness connector: (to ECM)

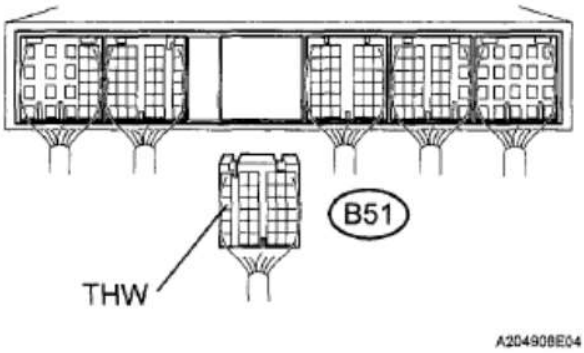


Fig. 97: Identifying Engine Coolant Temperature Sensor And ECM Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: REPLACE ECM (See **REMOVAL**)

DTC P0116 ENGINE COOLANT TEMPERATURE CIRCUIT RANGE/PERFORMANCE PROBLEM

DESCRIPTION

Refer to **DTC P0115** .

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DTC DETECTION CONDITION CHART

DTC No.	DTC Detection Condition	Trouble Area
P0116	When either of the following conditions is met (2 trip detection logic): • While the engine is warming up after a cold engine start, the change in the engine coolant temperature sensor output is below the threshold. • In the duration between when a warmed-up engine is stopped and the next cold engine start, the change in the engine coolant temperature sensor output is below the threshold.	• Thermostat • Engine coolant temperature sensor

MONITOR DESCRIPTION

Engine Coolant Temperature Sensor Cold Start Monitor

The monitor runs when the engine is started cold. If the change in engine coolant temperature sensor output until the engine is warmed up completely is less than the threshold, it is determined that a malfunction has occurred in the engine coolant temperature sensor. When this is detected in 2 consecutive driving cycles, the MIL is illuminated and the DTC is stored.

Engine Coolant Temperature Sensor Soak Monitor

When more than 5 hours have elapsed since the engine was stopped, the ECM compares the engine coolant temperature from the time the warmed-up engine is stopped with the engine coolant temperature when the engine is started on the next trip. If the change in engine coolant temperature sensor output is less than the threshold, it is determined that a malfunction has occurred in the engine coolant temperature sensor. When this is detected in 2 consecutive driving cycles, the MIL is illuminated and the DTC is stored.

MONITOR STRATEGY

MONITOR STRATEGY CHART

Related DTCs	P0116: Engine Coolant Temperature Sensor Cold Start Monitor P0116: Engine Coolant Temperature Sensor Soak Monitor
Required Sensors/Components (Main)	Engine coolant temperature sensor
Required Sensors/Components (Related)	None
Frequency of Operation	Once per driving cycle
Duration	10 seconds or more
MIL Operation	2 driving cycles
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

All

TYPICAL ENABLING CONDITIONS CHART

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Monitor runs whenever following DTCs not stored	None

Engine Coolant Temperature Sensor Cold Start Monitor

TYPICAL ENABLING CONDITIONS CHART

Battery voltage	10.5 V or higher
Time after engine start	1 second or more
Engine coolant temperature at engine start	Below 60°C (140° F)
Soak time	0 seconds or more
Accumulated mass air flow	931 g or more
Fuel cut	OFF
Intake air temperature sensor circuit fail (P0112, P0113)	Not detected
Difference between engine coolant temperature at engine start and intake air temperature	Below 40°C (72°F)

Engine Coolant Temperature Sensor Soak Monitor

TYPICAL ENABLING CONDITIONS CHART

Battery voltage	10.5 V or higher
Engine	Running
Soak time	5 hours or more
Either condition (a) or (b) met	-
(a) Engine coolant temperature	60°C (140°F) or higher
(b) Accumulated mass air flow	1993 g or more
Intake air temperature sensor circuit fail (P0112, P0113)	Not detected

TYPICAL MALFUNCTION THRESHOLDS

Engine Coolant Temperature Sensor Cold Start Monitor

TYPICAL MALFUNCTION THRESHOLDS CHART

Engine coolant temperature sensor value change	Below 5°C (9°F)

Engine Coolant Temperature Sensor Soak Monitor

TYPICAL MALFUNCTION THRESHOLDS CHART

Difference between current engine coolant temperature sensor value and previous engine coolant temperature sensor value when engine stopped	Below 5°C (9°F)

COMPONENT OPERATING RANGE

COMPONENT OPERATING RANGE CHART

Engine coolant	Engine coolant temperature sensor value changes in accordance with actual

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temperature	engine coolant temperature

CONFIRMATION DRIVING PATTERN

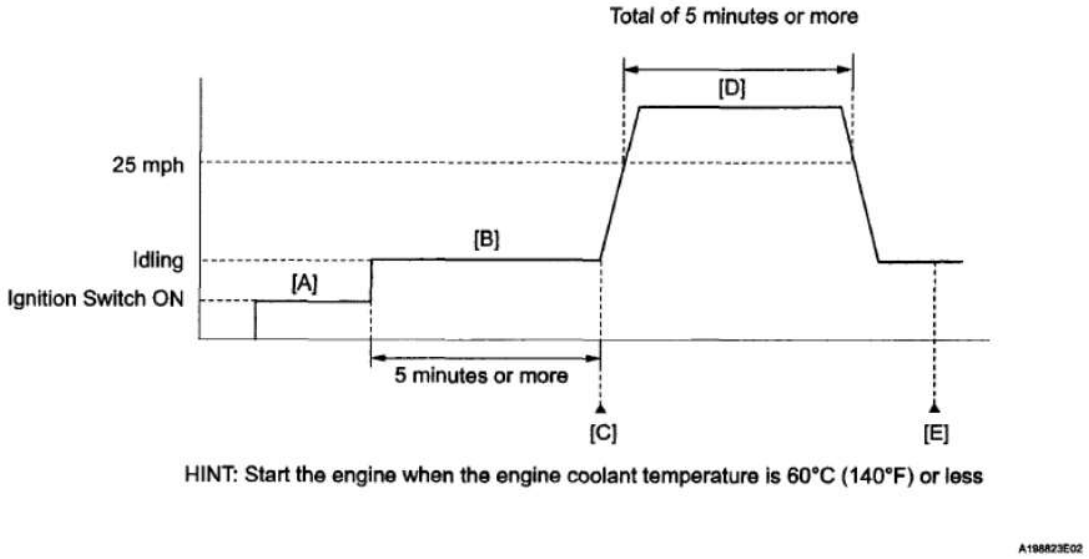


Fig. 98: Confirmation Driving Pattern
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

1. Connect the Techstream to the DLC3.
2. Turn the ignition switch to ON and turn the Techstream on.
3. Enter the following menus: Powertrain/Engine/Data List/All Data/Coolant Temp.
4. Check that the engine coolant temperature is 60°C (140°F)or less.
5. Clear the DTCs (even if no DTCs are stored, perform the clear DTC procedure).
6. Turn the ignition switch off.
7. Turn the ignition switch to ON and turn the Techstream on [A].
8. Start the engine and idle it for 5 minutes or more [B].

   HINT:

   If the engine coolant temperature does not change by 5°C (9°F) or higher, the engine coolant temperature sensor is malfunctioning. It is not necessary to continue this procedure.

9. Enter the following menus: Powertrain/Engine/Utility/All Readiness.
10. Input the DTC: P0116.
11. Check the DTC judgment result [C].

TECHSTREAM DISPLAY DESCRIPTION

Techstream Display	Description

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NORMAL	• DTC judgment completed • System normal
ABNORMAL	• DTC judgment completed • System abnormal
INCOMPLETE	• DTC judgment not completed • Perform driving pattern after confirming DTC enabling conditions
UNKNOWN	• Unable to perform DTC judgment • Number of DTCs which do not fulfill DTC preconditions has reached ECU memory limit

CAUTION: When performing the confirmation driving pattern, obey all speed limits and traffic laws.

HINT:

If the judgment result shows INCOMPLETE or UNKNOWN, perform steps [D] and [E].

12. Drive the vehicle at 25 mph (40 km/h) or more for a total of 5 minutes or more [D].

HINT:

In the event of the drive pattern being interrupted (possibly due to factors such as traffic conditions), the drive pattern can be resumed.

13. Check the DTC judgment result again [E].

HINT:

If the judgment result shows INCOMPLETE or UNKNOWN, perform steps [D] and [E] again.

14. If the test result is UNKNOWN, enter the following menus: Powertrain/Engine/Trouble Codes/Pending.
15. Read Pending DTCs.

HINT:

If a pending DTC is output, the system is malfunctioning.

16. If the test result is INCOMPLETE or UNKNOWN and no pending DTC is output, perform a universal trip and check for permanent DTCs (See **DTC CHECK/CLEAR**).

HINT:

- If a permanent DTC is output, the system is malfunctioning.

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- If no permanent DTC is output, the system is normal.

INSPECTION PROCEDURE

HINT:

- If any of DTCs P0115, P0117, P0118 or P0125 are output simultaneously with DTC P0116, the engine coolant temperature sensor may have an open or a short circuit. Troubleshoot those DTCs first.
- Read freeze frame data using the Techstream. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1. **CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P0116)**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the Techstream on.
   d. Enter the following menus: Powertrain/Engine/Trouble Codes.
   e. Read the DTCs.

   Result

   RESULT CHART

Result	Proceed to
DTC P0116 is output	A
DTC P0116 and other DTCs are output	B

   HINT:

   If any DTCs and other than P0116 are output, troubleshoot those DTCs first.

   B: GO TO **DTC CHART**

   A: Go to next step

2. **INSPECT THERMOSTAT**
   a. Remove the thermostat (See **REMOVAL**).
   b. Measure the valve opening temperature of the thermostat.

   Standard value:

   80 to 84°C (176 to 183°F)

   HINT:

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In addition to the above check, confirm that the valve is completely closed when the temperature is below the standard.

c. Reinstall the thermostat (See **INSTALLATION**).

NG: REPLACE THERMOSTAT (See **REMOVAL**)

OK: REPLACE ENGINE COOLANT TEMPERATURE SENSOR (See **REMOVAL**)

DTC P011B ENGINE COOLANT TEMPERATURE/INTAKE AIR TEMPERATURE CORRELATION

DESCRIPTION

The engine has two temperature sensors, an engine coolant temperature sensor and an intake air temperature sensor, to detect the temperature while the engine is in operation. A thermistor, whose resistance value varies according to the temperature, is built into each sensor. When the temperature is low, the resistance of the thermistor increases. When the temperature is high, the resistance drops. These variations in resistance are transmitted to the ECM as voltage changes. Based on these temperature signals output from the sensors, the ECM determines the fuel injection time and the ignition timing to control the engine.

DTC DETECTION CONDITION CHART

DTC No.	DTC Detection Condition	Trouble Area
P011B	All of the following conditions are met (2 trip detection logic): a. The battery voltage is 10.5 V or higher. b. 7 hours or more have elapsed since the engine stopped on the previous trip. c. 15 seconds after a cold engine start. d. The minimum intake air temperature after the engine starts is higher than -10°C (14°F). e. The average engine coolant temperature before the engine starts is higher than -10°C (14°F). f. The difference between the readings of the engine coolant temperature and intake air temperature is more than 20°C (36°F).	• Intake air temperature sensor • Engine coolant temperature sensor • ECM

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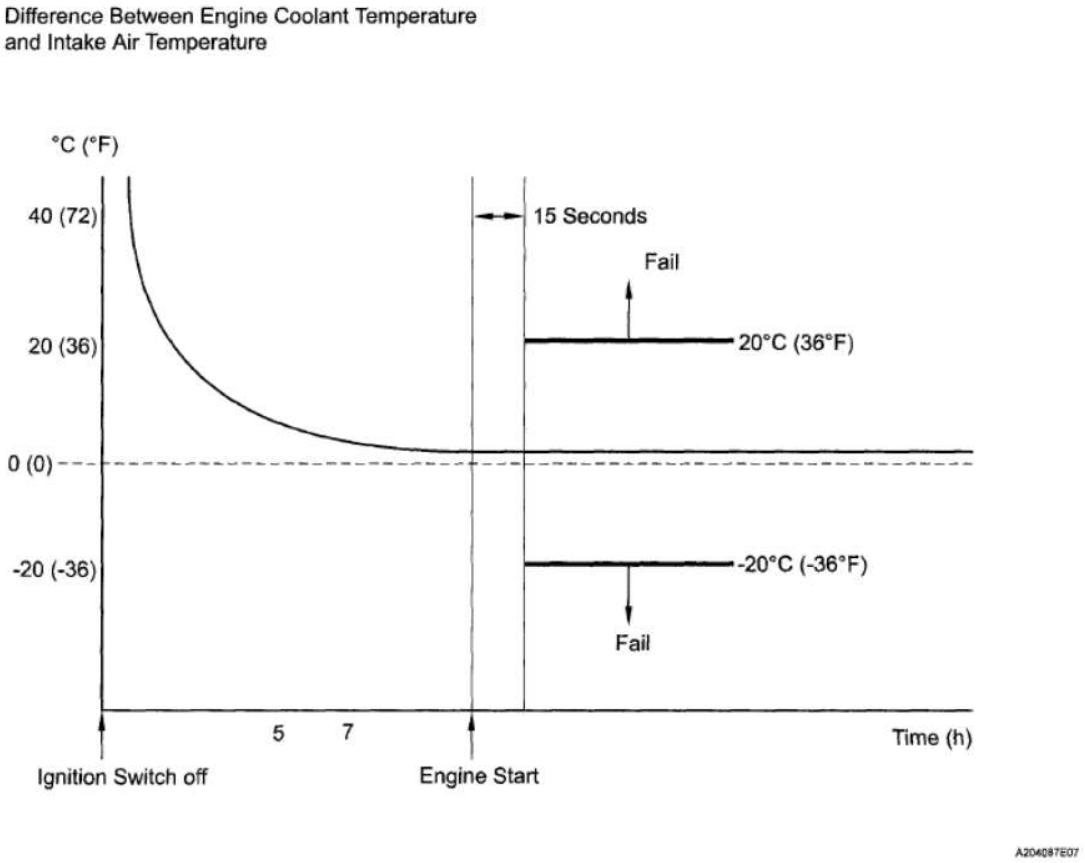


Fig. 99: Engine Coolant Temperature And Intake Air Temperature Graph
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

HINT:

- Waiting is required to prevent the temperature of the engine from affecting the readings. If the engine has been operated recently, it is not possible to accurately compare the readings.
- For diagnosis, in order to duplicate the detection conditions of the DTC, it is necessary to park the vehicle for 7 hours. Parking the vehicle for 7 hours ensures that the actual temperature of the engine coolant temperature and intake air temperature are very similar. When the vehicle has been parked for less than 7 hours, differences in the readings may exist, but this does not necessarily indicate a fault.

MONITOR DESCRIPTION

The ECM monitors the difference between the engine coolant temperature and the intake air temperature when the engine is started cold to accurately detect the engine temperature conditions. The monitor runs when the engine started cold after 7 hours or more have elapsed since the engine was stopped (ignition switch turned off) on the previous trip. If the difference between the engine coolant temperature and the intake air temperature on a cold start exceeds 20°C (36°F), the ECM interprets this as a malfunction in the engine coolant temperature sensor circuit and intake air temperature sensor circuit, and stores the DTC.

MONITOR STRATEGY

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MONITOR STRATEGY CHART

Related DTCs	P011B: Engine Coolant Temperature/Intake Air Temperature Sensor Correlation
Required Sensors/Components (Main)	Engine coolant temperature sensor Intake air temperature sensor
Required Sensors/Components (Related)	-
Frequency of Operation	Once per driving cycle
Duration	7 hours or more
MIL Operation	2 driving cycles
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

TYPICAL ENABLING CONDITIONS CHART

The monitor will run whenever these DTCs are not stored	None
Both of following conditions met	Conditions 1 and 2
1. All of following conditions met	Conditions (a), (b), (c) and (d)
(a) Time after ignition switch ON and engine not running	Less than 20 seconds
(b) Soak Time	7 hours or more
(c) Battery voltage	10.5 V or higher
(d) Time after engine start	15 seconds or more
2. Either of the following conditions is met	Conditions (a) and (b)
(a) Minimum intake air temperature after engine start	-10°C (14°F) or higher
(b) Average engine coolant temperature before engine start	-10°C (14°F) or higher
Soak timer circuit fail (P2610)	Not detected

TYPICAL MALFUNCTION THRESHOLDS

TYPICAL MALFUNCTION THRESHOLDS CHART

Deviated engine coolant temperature and intake air temperature	Below -20°C (-36°F) or higher than 20°C (36°F)

CONFIRMATION DRIVING PATTERN

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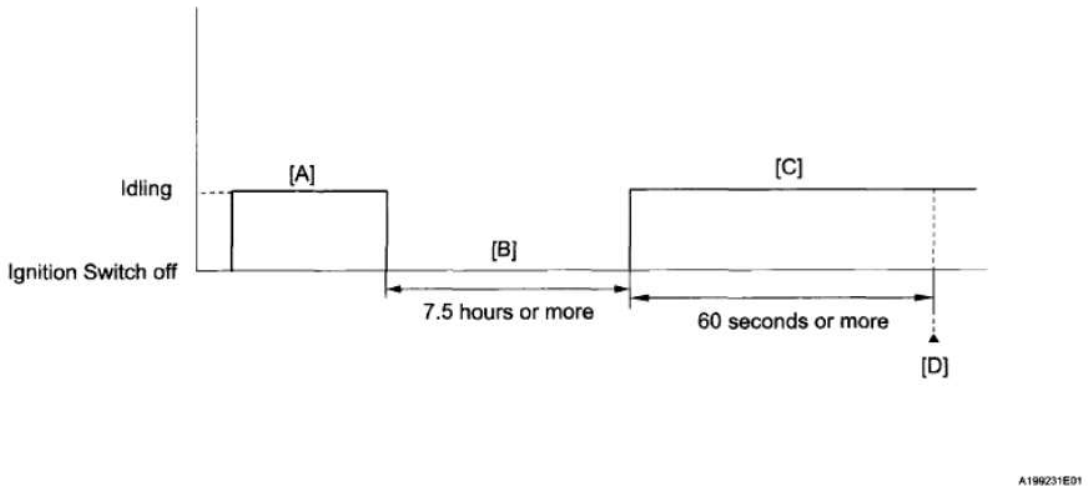


Fig. 100: Confirmation Driving Pattern
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

1. Connect the Techstream to the DLC3.
2. Turn the ignition switch to ON and turn the Techstream on.
3. Clear the DTCs (even if no DTCs are stored, perform the clear DTC procedure).
4. Turn the ignition switch off.
5. Turn the ignition switch to ON and turn the Techstream on [A].
6. With the engine stopped, leave the vehicle as is for 7.5 hours or more [B].
7. Start the engine and wait 60 seconds or more [C].
8. Enter the following menus: Powertrain/Engine/Utility/All Readiness.
9. Input the DTC: P011B.
10. Check the DTC judgment result [D].

TECHSTREAM DISPLAY DESCRIPTION

Techstream Display	Description
NORMAL	• DTC judgment completed • System normal
ABNORMAL	• DTC judgment completed • System abnormal
INCOMPLETE	• DTC judgment not completed • Perform driving pattern after confirming DTC enabling conditions
UNKNOWN	• Unable to perform DTC judgment • Number of DTCs which do not fulfill DTC preconditions has reached ECU memory limit

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HINT:

If the judgment result shows INCOMPLETE or UNKNOWN, perform steps [A] through [D] again.

11. If the test result is UNKNOWN, enter the following menus: Powertrain/Engine/Trouble Codes/Pending.
12. Read Pending DTCs.

    HINT:

    If a pending DTC is output, the system is malfunctioning.

13. If the test result is INCOMPLETE or UNKNOWN and no pending DTC is output, perform a universal trip and check for permanent DTCs (See **DTC CHECK/CLEAR**).

    HINT:

    - If a permanent DTC is output, the system is malfunctioning.
    - If no permanent DTC is output, the system is normal.

INSPECTION PROCEDURE

HINT:

Read freeze frame data using the Techstream. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1. **CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO P011B)**
    a. Connect the Techstream to the DLC3.
    b. Turn the ignition switch to ON.
    c. Turn the Techstream on.
    d. Enter the following menus: Powertrain/Engine/Trouble Codes.
    e. Read the DTCs.

    Result

    RESULT CHART

Result	Proceed to
DTC P011B is output	A
DTC P011B and other DTCs are output	B

    HINT:

    If any DTCs other than P011B are output, troubleshoot those DTCs first.

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B: GO TO **DTC CHART**

A: Go to next step

2. **READ VALUE USING TECHSTREAM (INTAKE AIR TEMPERATURE)**
   a. Leave the vehicle for 7 hours or more.

      HINT:

      It is necessary to leave the vehicle for 7 hours or more to create conditions similar to the DTC detection conditions.

   b. Connect the Techstream to the DLC3.
   c. Turn the ignition switch to ON.
   d. Turn the Techstream on.
   e. Enter the following menus: Powertrain/Engine/Data List/All Data/Intake Air.
   f. Read the value displayed on the Techstream.

      OK:

      Difference between the intake air temperature and the actual outside air temperature is within 10°C (18°F).

      HINT:

      Temperature readings on the outside temperature gauge of the vehicle (if equipped) are not suitable for comparing to the intake air temperature reading. The outside temperature gauge has a significant delay built in to prevent swings in the temperature display. Use an accurate thermometer to determine the outside air temperature.

      NG: REPLACE MASS AIR FLOW METER (See **REMOVAL**)

      OK: Go to next step

3. **READ VALUE USING TECHSTREAM (COOLANT TEMPERATURE)**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the Techstream on.
   d. Enter the following menus: Powertrain/Engine/Data List/All Data/Coolant Temp.
   e. Read the value displayed on the Techstream.

      OK:

      The difference between the coolant temperature and the actual outside air temperature is within 10°C (18°F).

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HINT:

If the result is not as specified, check that there are no heat sources such as a block heater in the engine compartment.

NG: REPLACE ENGINE COOLANT TEMPERATURE SENSOR (See **REMOVAL**)

OK: REPLACE ECM (See **REMOVAL**)

DTC P0120 THROTTLE/PEDAL POSITION SENSOR/SWITCH "A" CIRCUIT MALFUNCTION; DTC P0121 THROTTLE/PEDAL POSITION SENSOR/SWITCH "A" CIRCUIT RANGE/PERFORMANCE PROBLEM; DTC P0122 THROTTLE/PEDAL POSITION SENSOR/SWITCH "A" CIRCUIT LOW INPUT; DTC P0123 THROTTLE/PEDAL POSITION SENSOR/SWITCH "A" CIRCUIT HIGH INPUT; DTC P0220 THROTTLE/PEDAL POSITION SENSOR/SWITCH "B" CIRCUIT; DTC P0222 THROTTLE/PEDAL POSITION SENSOR/SWITCH "B" CIRCUIT LOW INPUT; DTC P0223 THROTTLE/PEDAL POSITION SENSOR/SWITCH "B" CIRCUIT HIGH INPUT; DTC P2135 THROTTLE/PEDAL POSITION SENSOR/SWITCH "A"/"B" VOLTAGE CORRELATION

DESCRIPTION

HINT:

These DTCs relate to the throttle position sensor.

The throttle position sensor is mounted on the throttle body, and detects the opening angle of the throttle valve. This sensor is a non-contact type sensor. It uses Hall-effect elements in order to yield accurate signals even in extreme driving conditions, such as at high speeds as well as very low speeds.

The throttle position sensor has 2 sensor circuits, each of which transmits a signal, VTA1 and VTA2. VTA1 is used to detect the throttle valve angle and VTA2 is used to detect malfunctions in VTA1. The sensor signal voltages vary between 0 V and 5 V in proportion to the throttle valve opening angle, and are transmitted to the VTA1 and VTA2 terminals of the ECM.

As the valve closes, the sensor output voltage decreases and as the valve opens, the sensor output voltage increases. The ECM calculates the throttle valve opening angle according to these signals and controls the throttle actuator in response to driver inputs. These signals are also used in calculations such as air fuel ratio correction, power increase correction and fuel-cut control.

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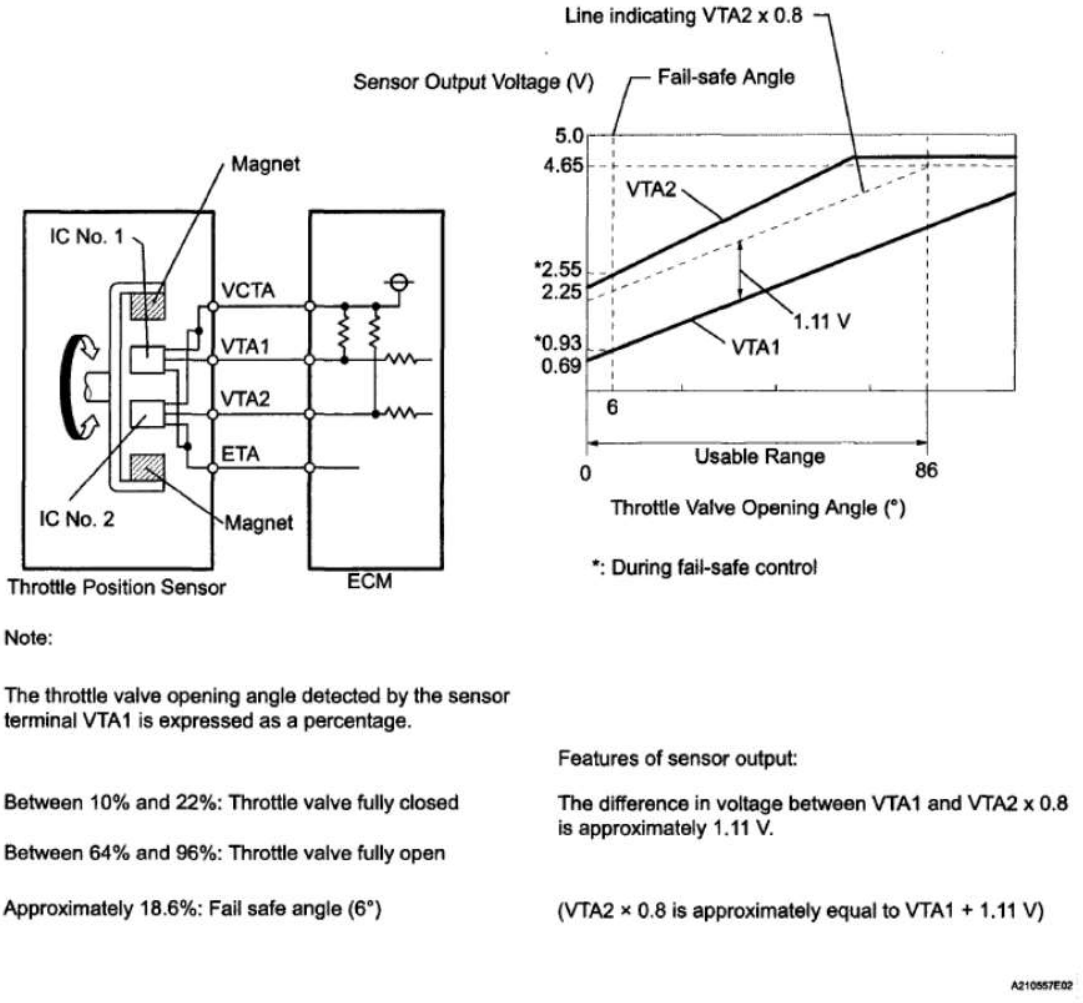


Fig. 101: Throttle Position Sensor Communication Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

DTC DETECTION CONDITION CHART

DTC No.	DTC Detection Condition	Trouble Area
P0120	The output voltage of VTA1 quickly fluctuates beyond the lower and upper malfunction thresholds for 2 seconds or more (1 trip detection logic).	• Throttle position sensor (built into throttle body) • ECM
P0121	The difference between the VTA1 and VTA2 voltages is below 0.8 V or higher than 1.6 V for 2 seconds (1 trip detection logic).	• Throttle position sensor (built into throttle body) • Throttle position sensor circuit • ECM

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P0122	The output voltage of VTA1 is 0.2 V or less for 2 seconds or more (1 trip detection logic).	• Throttle position sensor (built into throttle body) • Short in VTA1 circuit • Open in VC circuit • ECM
P0123	The output voltage of VTA1 is 4.54 V or higher for 2 seconds or more (1 trip detection logic).	• Throttle position sensor (built into throttle body) • Open in VTA1 circuit • Open in E2 circuit • Short between VC and VTA1 circuits • ECM
P0220	The output voltage of VTA2 quickly fluctuates beyond the lower and upper malfunction thresholds for 2 seconds or more (1 trip detection logic).	• Throttle position sensor (built into throttle body) • ECM
P0222	The output voltage of VTA2 is 1.75 V or less for 2 seconds or more (1 trip detection logic).	• Throttle position sensor (built into throttle body) • Short in VTA2 circuit • Open in VC circuit • ECM
P0223	The output voltage of VTA2 is 4.8 V or higher and VTA1 is between 0.2 V and 2.02 V for 2 seconds or more (1 trip detection logic).	• Throttle position sensor (built into throttle body) • Open in VTA2 circuit • Open in E2 circuit • Short between VC and VTA2 circuits • ECM
P2135	Either of the following conditions is met (1 trip detection logic): a. The difference between the output voltages of VTA1 and VTA2 is 0.02 V or less for 0.5 seconds or more. b. The output voltage of VTA1 is 0.2 V or less and VTA2 is 1.75 V or less for 0.4 seconds or more.	• Short between VTA1 and VTA2 circuits • Throttle position sensor (built into throttle body) • ECM

HINT:

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- When any of these DTCs are output, check the throttle valve opening angle using the Techstream. Enter the following menus: Powertrain/Engine/Data List/All Data/Throttle Position No. 1 and Throttle Position No. 2.
- Throttle Position No. 1 is the VTA1 signal, and Throttle Position No. 2 is the VTA2 signal.

Reference (Normal Condition)

TECHSTREAM DISPLAY DESCRIPTION

Techstream Display	Accelerator Pedal Fully Released	Accelerator Pedal Fully Depressed
Throttle Position No. 1	0.5 to 1.1 V	3.2 to 4.8 V
Throttle Position No. 2	2.1 to 3.1 V	4.6 to 5.0 V

MONITOR DESCRIPTION

P0120, P0122, P0123, P0220, P0222, P0223, P2135:

The ECM uses the throttle position sensor to monitor the throttle valve opening angle. There are several checks that the ECM performs to confirm the proper operation of the throttle position sensor.

- A specific voltage difference is expected between the sensor terminals, VTA1 and VTA2, for each throttle valve opening angle. If the difference between VTA1 and VTA2 is incorrect, the ECM interprets this as a malfunction in the sensor circuit, and stores a DTC.
- VTA1 and VTA2 each have a specific voltage range. If VTA1 or VTA2 is outside the normal operating range, the ECM interprets this as a malfunction in the sensor circuit, and stores a DTC.
- VTA1 and VTA2 should never be close to the same voltage level. If VTA1 is within 0.02 V of VTA2, the ECM determines that there is a short circuit in the sensor circuit, and stores a DTC.

If the malfunction is not repaired successfully, a DTC is stored 10 seconds after the engine is next started.

P0121:

This sensor transmits two signals: VTA1 and VTA2. VTA1 is used to detect the throttle opening angle and VTA2 is used to detect malfunctions in VTA1. The ECM performs several checks to confirm the proper operation of the throttle position sensor and VTA1.

For each throttle opening angle, a specific voltage difference is expected between the outputs of VTA1 and VTA2. If the output voltage difference between the two signals deviates from the normal operating range, the ECM interprets this as a malfunction in the throttle position sensor. The ECM illuminates the MIL and stores the DTC.

If the malfunction is not repaired successfully, the DTC is stored 2 seconds after the engine is next started.

MONITOR STRATEGY

MONITOR STRATEGY CHART

	P0120: Throttle Position Sensor 1 Range Check (Fluctuating)

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Related DTCs	P0121: Throttle Position Sensor Rationality P0122: Throttle Position Sensor 1 Range Check (Low Voltage) P0123: Throttle Position Sensor 1 Range Check (High Voltage) P0220: Throttle Position Sensor 2 Range Check (Fluctuating) P0222: Throttle Position Sensor 2 Range Check (Low Voltage) P0223: Throttle Position Sensor 2 Range Check (High Voltage) P2135: Throttle Position Sensor Range Check (Correlation)
Required Sensors/Components (Main)	Throttle position sensor
Required Sensors/Components (Related)	-
Frequency of Operation	Continuous
Duration	2 seconds: P0120, P0122, P0123, P0220, P0222 and P0223 Within 2 seconds: P0121 0.5 seconds: P2135 Case 1 0.4 seconds: P2135 Case 2
MIL Operation	Immediate
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

P0120, P0122, P0123, P0220, P0222, P0223, P2135

TYPICAL ENABLING CONDITIONS CHART

Monitor runs whenever following DTCs not stored	None
Either of following conditions met	-
A. Ignition switch ON	0.012 seconds or more
B. Electronic throttle actuator power	ON

P0121

TYPICAL ENABLING CONDITIONS CHART

Monitor runs whenever following DTCs not stored	None
Either of following conditions met	-
A. Ignition switch	ON
B. Electric throttle motor power	ON
C. Throttle position sensor circuit fail (P0120, P0122, P0123, P0220, P0222, P0223, P2135)	Not detected

TYPICAL MALFUNCTION THRESHOLDS

P0120

TYPICAL MALFUNCTION THRESHOLDS CHART

VTA1 voltage	0.2 V or less, or 4.54 V or higher

P0121

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TYPICAL MALFUNCTION THRESHOLDS CHART

Either of following conditions met	-
Difference of throttle position sensor voltage between VTA1 and (VTA2 x 0.8)	Higher than 1.6 V
Difference of throttle position sensor voltage between VTA1 and (VTA2 x 0.8)	Below 0.8 V

P0122

TYPICAL MALFUNCTION THRESHOLDS CHART

VTA1 voltage	0.2 V or less

P0123

TYPICAL MALFUNCTION THRESHOLDS CHART

VTA1 voltage	4.54 V or higher

P0220

TYPICAL MALFUNCTION THRESHOLDS CHART

Either of following conditions met	-
A. VTA2 voltage	1.75 V or less
B. VTA2 voltage when VTA1 0.2 V or higher, and 2.02 V or less	4.8 V or higher

P0222

TYPICAL MALFUNCTION THRESHOLDS CHART

VTA2 voltage	175 V or less

P0223

TYPICAL MALFUNCTION THRESHOLDS CHART

VTA2 voltage when VTA1 0.2 V or higher, and 2.02 V or less	4.8 V or higher

P2135 Case 1

TYPICAL MALFUNCTION THRESHOLDS CHART

Difference between VTA1 and VTA2 voltages	0.02 V or less

P2135 Case 2

TYPICAL MALFUNCTION THRESHOLDS CHART

VTA1 voltage	0.2 V or less
VTA2 voltage	1.75 V or less

COMPONENT OPERATING RANGE

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COMPONENT OPERATING RANGE CHART

VTA1 voltage	More than 0.2 V, and less than 4.54 V
VTA2 voltage	More than 1.75 V, and less than 4.8 V

CONFIRMATION DRIVING PATTERN

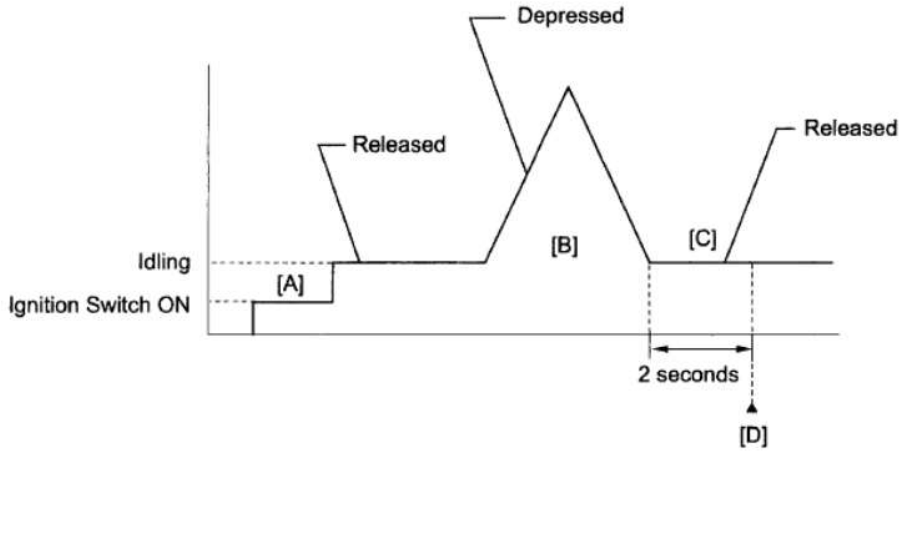


Fig. 102: Confirmation Driving Pattern
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

1. Connect the Techstream to the DLC3.
2. Turn the ignition switch to ON and turn the Techstream on.
3. Clear the DTCs (even if no DTCs are stored, perform the clear DTC procedure).
4. Turn the ignition switch off.
5. Turn the ignition switch to ON and turn the Techstream on [A].
6. Start the engine.
7. With the vehicle stationary, fully depress and release the accelerator pedal [B].
8. Idle the engine for 2 seconds or more [C].
9. Enter the following menus: Powertrain/Engine/Utility/All Readiness.
10. Input the DTC: P0120, P0121, P0122, P0123, P0220, P0222, P0223 or P2135.
11. Check the DTC judgment result [D].

TECHSTREAM DISPLAY DESCRIPTION

Techstream Display	Description
NORMAL	• DTC judgment completed • System normal
	• DTC judgment completed

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ABNORMAL	• System abnormal
INCOMPLETE	• DTC judgment not completed • Perform driving pattern after confirming DTC enabling conditions
UNKNOWN	• Unable to perform DTC judgment • Number of DTCs which do not fulfill DTC preconditions has reached ECU memory limit

HINT:

- If the judgment result shows ABNORMAL, the system has a malfunction.
- If the judgment result shows INCOMPLETE or UNKNOWN, perform steps [B] and [D] again.

12. If the test result is UNKNOWN, enter the following menus: Powertrain/Engine/Trouble Codes/Pending.
13. Read Pending DTCs.

    HINT:

    If a pending DTC is output, the system is malfunctioning.

14. If the test result is INCOMPLETE or UNKNOWN and no pending DTC is output, perform a universal trip and check for permanent DTCs (See **DTC CHECK/CLEAR**).

    HINT:

    - If a permanent DTC is output, the system is malfunctioning.
    - If no permanent DTC is output, the system is normal.

FAIL-SAFE

When any of these DTCs as well as other DTCs relating to Electronic Throttle Control System (ETCS) malfunctions are stored, the ECM enters fail-safe mode. During fail-safe mode, the ECM cuts the current to the throttle actuator, and the throttle valve is returned to a 6° throttle angle by the return spring. The ECM then adjusts the engine output by controlling the fuel injection (intermittent fuel-cut) and ignition timing, in accordance with the accelerator pedal angle, to allow the vehicle to continue at a minimal speed. If the accelerator pedal is depressed firmly and gently, the vehicle can be driven slowly. Fail-safe mode continues until a pass condition is detected, and the ignition switch is then turned off.

WIRING DIAGRAM

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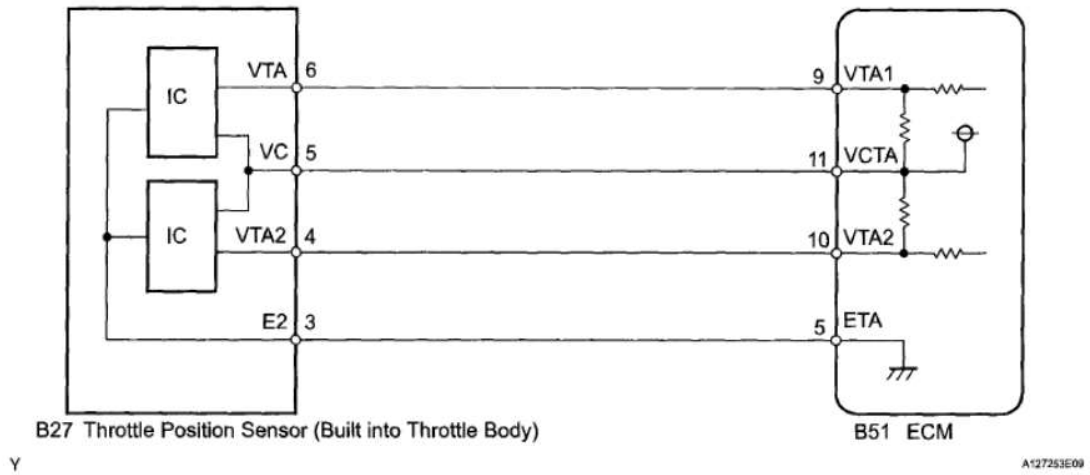


Fig. 103: Throttle/Pedal Position Sensor/Switch "A" Circuit Malfunction - Wiring Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSPECTION PROCEDURE

HINT:

Read freeze frame data using the Techstream. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1. **READ VALUE USING TECHSTREAM (THROTTLE POSITION SENSOR)**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the Techstream on.
   d. Enter the following menus: Powertrain/Engine/Data List/ETCS/Throttle Position No. 1 and Throttle Position No. 2.
   e. Read the values displayed on the Techstream.

   Result

   RESULT CHART

When Accelerator Pedal Released		When Accelerator Pedal Depressed		Trouble Area	Proceed to
Throttle Position No. 1	Throttle Position No. 2 Throttle	Position No. 1	Throttle Position No. 2		
0 to 0.2 V	0 to 0.2 V	0 to 0.2 V	0 to 0.2 V	VC circuit open	A
4.5 to 5.0 V	4.5 to 5.0 V	4.5 to 5.0 V	4.5 to 5.0 V	E2 circuit open	
0 to 0.2 V, or 4.5 to 5.0 V	2.1 V to 3.1 V (Fail-safe)	0 to 0.2 V, or 4.5 to 5.0 V	2.1 V to 3.1 V (Fail-safe)	VTA1 circuit open or ground short	

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0.6 V to 1.4 V (Fail-safe)	0 to 0.2 V, or 4.5 to 5.0 V	0.6 V to 1.4 V (Fail-safe)	0 to 0.2 V, or 4.5 to 5.0 V	VTA2 circuit open or ground short	
0.5 to 1.1 V	2.1 to 3.1 V	3.2 to 4.8 V (Not fail-safe)	4.6 to 5.0 V (Not fail-safe)	Throttle position sensor circuit normal	B

HINT:

- DTC P0121 is stored when the voltages output from VTA1 and VTA2 are not consistent with the characteristics of the sensors. Therefore, check the Freeze Frame Data when this DTC is output. Use the following formula to confirm relative fluctuations in voltage.

  Features of sensor output:

  VTA2 x 0.8 is approximately equal to VTA1 + 1.11 V

  VTA1: Throttle Position No. 1

  VTA2: Throttle position No. 2

- If DTC P0121 is output, proceed ti the "CHECK HARNESS AND CONNECTOR (THROTTLE POSITION SENSOR - ECM)".

  B: Go to step 5

  A: Go to next step

2. **CHECK HARNESS AND CONNECTOR (THROTTLE POSITION SENSOR - ECM)**
   a. Disconnect the throttle body connector.
   b. Disconnect the ECM connector.
   c. Measure the resistance according to the value(s) in the table below.

Standard Resistance (Check for Open)

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
B27-5 (VC) - B51-11 (VCTA)	Always	Below 1 ohms
B27-6 (VTA) - B51-9 (VTA1)	Always	Below 1 ohms
B27-4 (VTA2) - B51-10 (VTA2)	Always	Below 1 ohms
B27-3 (E2) - B51-5 (ETA)	Always	Below 1 ohms

Standard Resistance (Check for Short)

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition

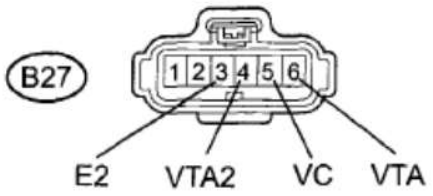
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B27-5 (VC) or B51-11 (VCTA) - Body ground	Always	10 kohms or higher
B27-6 (VTA) or B51-9 (VTA1) - Body ground	Always	10 kohms or higher
B27-4 (VTA2) or B51-10 (VTA2) - Body ground	Always	10 kohms or higher

d. Reconnect the throttle body connector.
e. Reconnect the ECM connector.

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR

Front view of wire harness connector:
(to Throttle Body)



Rear view of wire harness connector:
(to ECM)

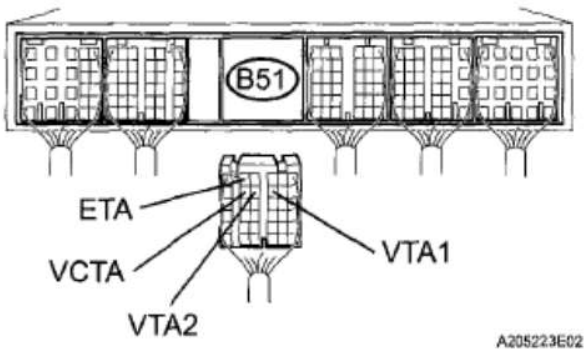


Fig. 104: Identifying Throttle Body Connector And ECM Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

3. **INSPECT ECM (VC VOLTAGE)**
   a. Disconnect the throttle body connector.
   b. Turn the ignition switch to ON.

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c. Measure the voltage according to the value(s) in the table below.

Standard Voltage

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
B27-5 (VC) - B27-3 (E2)	Ignition switch ON	4.5 to 5.5 V

d. Reconnect the throttle body connector.

NG: REPLACE ECM (See **REMOVAL**)

Front view of wire harness connector:
(to Throttle Body)

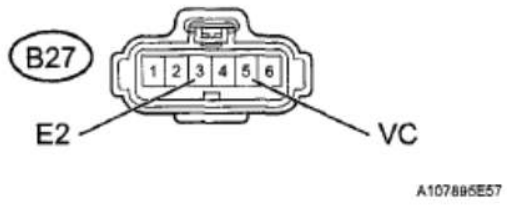


Fig. 105: Identifying B27 Throttle Body Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

4. **REPLACE THROTTLE BODY**
   a. Replace the throttle body (See **REMOVAL**).
5. **CHECK WHETHER DTC OUTPUT RECURS (THROTTLE POSITION SENSOR DTCS)**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the Techstream on.
   d. Clear the DTCs (See **DTC CHECK/CLEAR**).
   e. Turn the ignition switch off.
   f. Turn the ignition switch to ON and turn the Techstream on.
   g. Start the engine.
   h. Allow the engine to idle for 15 seconds or more.
   i. Enter the following menus: Powertrain/Engine/Trouble Codes.
   j. Read the DTCs.

Result

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RESULT CHART

Result	Proceed to
DTC P0120, P0121, P0122, P0123, P0220, P0222, P0223 and/or P2135 are output	A
DTC is not output	B

B: END

A: REPLACE ECM (See **REMOVAL**)

DTC P0125 INSUFFICIENT COOLANT TEMPERATURE FOR CLOSED LOOP FUEL CONTROL

DESCRIPTION

Refer to **DTC P0115** .

DTC DETECTION CONDITION CHART

DTC No.	DTC Detection Condition	Trouble Area
P0125	The engine coolant temperature does not reach the closed loop enabling temperature for 20 minutes (this period varies with the engine coolant temperature at engine start) (2 trip detection logic).	• Cooling system • Engine coolant temperature sensor • Thermostat

MONITOR DESCRIPTION

The resistance of the engine coolant temperature sensor varies in proportion to the actual engine coolant temperature. The ECM supplies a constant voltage to the sensor and monitors the signal output voltage of the sensor. The signal output voltage varies according to the changing resistance of the sensor. After the engine is started, the engine coolant temperature is monitored by this signal. If the engine coolant temperature sensor indicates that the engine is not yet warm enough for closed loop fuel control, despite a specified period of time having elapsed since the engine was started, the ECM interprets this as a malfunction in the sensor or cooling system and stores the DTC.

Example:

The engine coolant temperature is 5°C (41°F) at engine start. After approximately 1 minute of running time, the engine coolant temperature sensor still indicates that the engine is not warm enough to begin closed loop fuel (air fuel ratio feedback) control. The ECM interprets this as a malfunction in the sensor or cooling system and stores the DTC.

MONITOR STRATEGY

MONITOR STRATEGY CHART

Related DTCs	P0125: Insufficient Engine Coolant Temperature for Closed Loop Fuel Control

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Required Sensors/Components (Main)	Engine coolant temperature sensor Thermostat Cooling system
Required Sensors/Components (Related)	-
Frequency of Operation	Once per driving cycle
Duration	54 seconds: Engine coolant temperature at engine start 1.67°C (35° F) or higher 101 seconds: Engine coolant temperature at engine start -9.44 to 1.67°C (15 to 35°F) 1200 seconds: Engine coolant temperature at engine start below -9.44°C (15°F)
MIL Operation	2 driving cycles
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

TYPICAL ENABLING CONDITIONS CHART

Monitor runs whenever following DTCs not stored	None
Thermostat fail (P0128)	Not detected
Intake air temperature sensor circuit fail (P0112, P0113)	Not detected
Engine coolant temperature sensor circuit fail (P0115, P0117, P0118)	Not detected
Mass air flow meter sensor circuit fail (P0101, P0102, P103)	Not detected

TYPICAL MALFUNCTION THRESHOLDS

TYPICAL MALFUNCTION THRESHOLDS CHART

Time until actual engine coolant temperature reaches closed loop fuel control enabling temperature	54 seconds: Engine coolant temperature at engine start 1.67°C (35°F) or higher 101 seconds: Engine coolant temperature at engine start -9.44 to 1.67°C (15 to 35°F) 1200 seconds: Engine coolant temperature at engine start below -9.44°C (15°F)

CONFIRMATION DRIVING PATTERN

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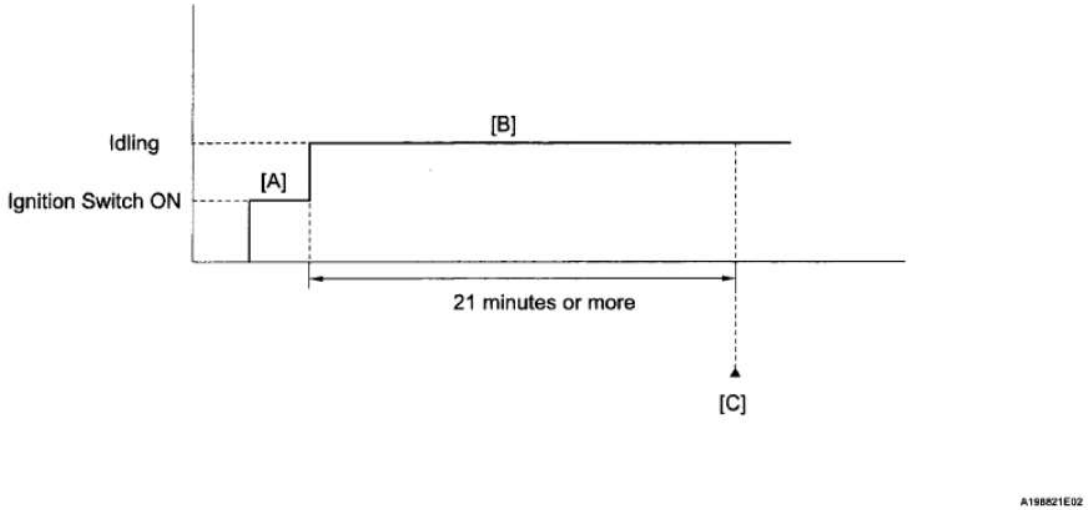


Fig. 106: Confirmation Driving Pattern
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

1. Leave the vehicle outside overnight.
2. Connect the Techstream to the DLC3.
3. Turn the ignition switch to ON and turn the Techstream on.
4. Enter the following menus: Powertrain/Engine/Data List/All Data/Coolant Temp.
5. Check that the engine coolant temperature is 10°C (50°F) or less.
6. Clear the DTCs (even if no DTCs are stored, perform the clear DTC procedure).
7. Turn the ignition switch off.
8. Turn the ignition switch to ON and turn the Techstream on [A].
9. Start the engine.
10. After starting the engine, wait 21 minutes or more [B].
11. Enter the following menus: Powertrain/Engine/Utility/All Readiness.
12. Input the DTC: P0125.
13. Check the DTC judgment result [C].

TECHSTREAM DISPLAY DESCRIPTION

Techstream Display	Description
NORMAL	• DTC judgment completed • System normal
ABNORMAL	• DTC judgment completed • System abnormal
INCOMPLETE	• DTC judgment not completed • Perform driving pattern after confirming DTC enabling conditions

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UNKNOWN	• Unable to perform DTC judgment • Number of DTCs which do not fulfill DTC preconditions has reached ECU memory limit

14. If the test result is UNKNOWN, enter the following menus: Powertrain/Engine/Trouble Codes/Pending.
15. Read Pending DTCs.

    HINT:

    If a pending DTC is output, the system is malfunctioning.

16. If the test result is INCOMPLETE or UNKNOWN and no pending DTC is output, perform a universal trip and check for permanent DTCs (See **DTC CHECK/CLEAR**).

    HINT:

    - If a permanent DTC is output, the system is malfunctioning.
    - If no permanent DTC is output, the system is normal.

WIRING DIAGRAM

Refer to **DTC P0115** .

INSPECTION PROCEDURE

HINT:

- If any of DTCs P0115, P0116, P0117 or P0118 are output simultaneously with DTC P0125, the engine coolant temperature sensor may have an open or a short circuit. Troubleshoot those DTCs first.
- Read freeze frame data using the Techstream. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1. **CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P0125)**
    a. Connect the Techstream to the DLC3.
    b. Turn the ignition switch to ON.
    c. Turn the Techstream on.
    d. Enter the following menus: Powertrain/Engine/Trouble Codes.
    e. Read the DTCs.

    Result

    RESULT CHART

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Result	Proceed to
DTC P0125 is output	A
DTC P0125 and other DTCs are output	B

HINT:

If any DTCs other than P0125 are output, troubleshoot those DTCs first.

B: GO TO **DTC CHART**

A: Go to next step

2. **INSPECT THERMOSTAT**
   a. Remove the thermostat (See **REMOVAL**).
   b. Check the valve opening temperature of the thermostat.

      Standard value:

      80 to 84°C (176 to 183°F)

      HINT:

      In addition to the above check, confirm that the valve is completely closed when the temperature is below the standard.

   c. Reinstall the thermostat (See **REMOVAL**).

      NG: REPLACE THERMOSTAT (See **REMOVAL**)

      OK: Go to next step

3. **CHECK COOLING SYSTEM**
   a. Check for defects in the cooling system that might cause the system to be too cold, such as abnormal cooling fan operation or any modifications.

      NG: REPAIR OR REPLACE COOLING SYSTEM

      OK: REPLACE ENGINE COOLANT TEMPERATURE SENSOR (See **REMOVAL**)

DTC P0128 COOLANT THERMOSTAT (COOLANT TEMPERATURE BELOW THERMOSTAT REGULATING TEMPERATURE)

DESCRIPTION

HINT:

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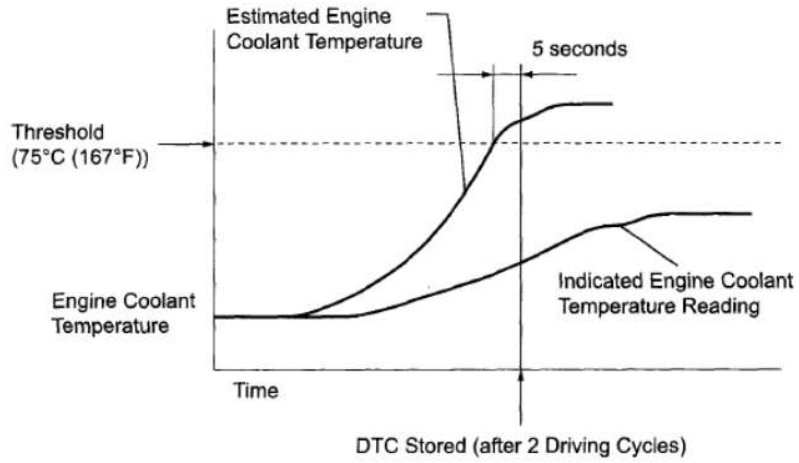
This DTC relates to the thermostat.

This DTC is stored when the engine coolant temperature does not reach 75°C (167°F) despite sufficient engine warm-up time having elapsed.

DTC DETECTION CONDITION CHART

DTC No.	DTC Detection Condition	Trouble Area
P0128	All of the following conditions are met for 5 seconds (2 trip detection logic): a. Cold start. b. The engine is warmed up. c. The engine coolant temperature is below 75°C (167° F).	• Thermostat • Cooling system • Engine coolant temperature sensor • ECM

MONITOR DESCRIPTION



Y A121605E16

Fig. 107: Engine Coolant Temperature Malfunction Graph
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

The ECM estimates the engine coolant temperature based on the starting temperature, engine loads, and engine speeds. The ECM then compares the estimated temperature with the actual engine coolant temperature. When the estimated engine coolant temperature reaches 75°C (167°F), the ECM checks the actual engine coolant temperature. If the actual engine coolant temperature is less than 75°C (167°F), the ECM interprets this as a malfunction in the thermostat or the engine cooling system and stores the DTC.

MONITOR STRATEGY

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MONITOR STRATEGY CHART

Related DTCs	P0128: Coolant Thermostat
Required Sensors/Components (Main)	Thermostat Engine coolant temperature sensor
Required Sensors/Components (Related)	Intake air temperature sensor Vehicle speed sensor
Frequency of Operation	Once per driving cycle
Duration	900 seconds
MIL Operation	2 driving cycles
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

TYPICAL ENABLING CONDITIONS CHART

Monitor runs whenever following DTCs not stored	P0010 (Camshaft Timing Oil Control Valve) P0011 (VVT System - Advance) P0012 (VVT System - Retard) P0016 (VVT System - Misalignment) P0013 (Exhaust Camshaft Timing Oil Control Valve) P0014 (Exhaust VVT System - Advance) P0015 (Exhaust VVT System - Retard) P0017 (Exhaust VVT System - Misalignment) P0031, P0032, P0101D (Air Fuel Ratio Sensor Heater) P2195, P2196, P2237, P2238, P2239, P2252, P2253, P2A00 (Air Fuel Ratio Sensor) P0102, P0103 (Mass Air Flow Sensor) P0112, P0113 (Intake Air Temperature Sensor) P0115, P0117, P0118 (Engine Coolant Temperature Sensor) P0120, P0121, P0122, P0123, P0220, P0222, P0223, P2135 (Throttle Position Sensor) P0171, P0172 (Fuel System) P0301 - P0304 (Misfire) P0335 (Crankshaft Position Sensor) P0340, P0342, P0343 (Camshaft Position Sensor) P0365, P0367, P0368 (Exhaust Camshaft Position Sensor) P0351 - P0354 (Igniter) P0500 (Vehicle Speed Sensor)
Battery voltage	11 V or higher
Either of following conditions met:	-
1. All of following conditions met:	-
• Engine coolant temperature at engine start - Intake air temperature at engine start	-15 to 7°C (-27 to 12.6°F)

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• Engine coolant temperature at engine start	-10 to 56°C (14 to 133°F)
• Intake air temperature at engine start	-10 to 56°C (14 to 133°F)
2. All of following conditions met:	-
• Engine coolant temperature at engine start - Intake air temperature at engine start	Higher than 7°C (12.6°F)
• Engine coolant temperature at engine start	56°C (133°F) or less
• Intake air temperature at engine start	-10°C (14°F) or higher
Accumulated time at vehicle speed of 80 mph (128 km/h) or more	Less than 20 seconds

TYPICAL MALFUNCTION THRESHOLDS

TYPICAL MALFUNCTION THRESHOLDS CHART

Duration that both of following conditions met	5 seconds or more
(a) Estimated engine coolant temperature	75°C (167°F) or higher
(b) Engine coolant temperature sensor output	Below 75°C (167°F)

CONFIRMATION DRIVING PATTERN

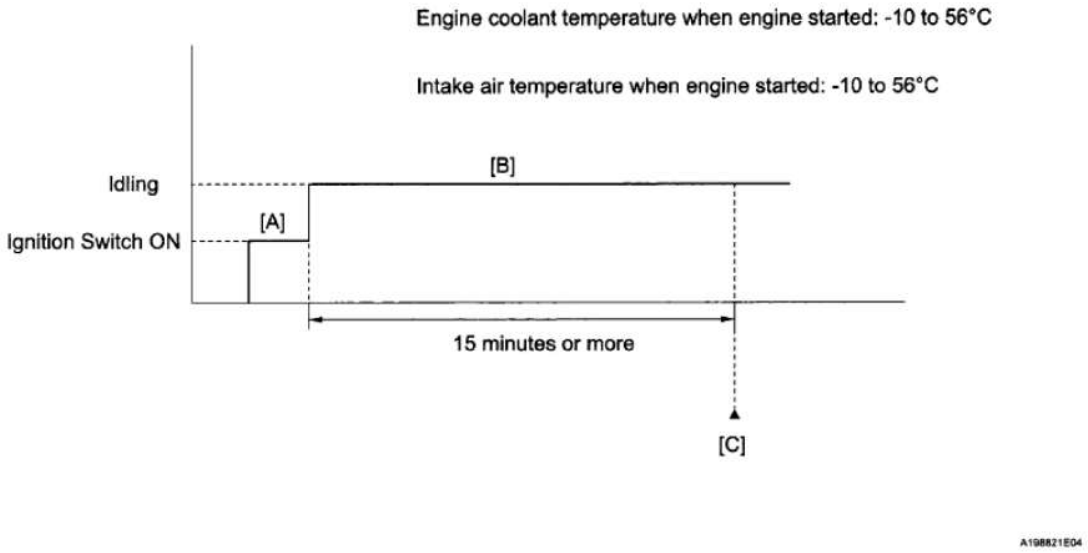


Fig. 108: Confirmation Driving Pattern
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

1. Connect the Techstream to the DLC3.
2. Turn the ignition switch to ON and turn the Techstream on.
3. Clear the DTCs (even if no DTCs are stored, perform the clear DTC procedure).
4. Turn the ignition switch off.
5. Turn the ignition switch to ON and turn the Techstream on [A].

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6. Enter the following menus: Powertrain/Engine/Data List/All Data/Coolant Temp and Intake Air.
7. Check that "Coolant Temp" and "Intake Air" in the Data List are within the range of -10 to 56°C (14 to 133°F).
8. Start the engine and wait 15 minutes or more [B].
9. Enter the following menus: Powertrain/Engine/Utility/All Readiness.
10. Input the DTC: P0128.
11. Check the DTC judgment result [C].

TECHSTREAM DISPLAY DESCRIPTION

Techstream Display	Description
NORMAL	• DTC judgment completed • System normal
ABNORMAL	• DTC judgment completed • System abnormal
INCOMPLETE	• DTC judgment not completed • Perform driving pattern after confirming DTC enabling conditions
UNKNOWN	• Unable to perform DTC judgment • Number of DTCs which do not fulfill DTC preconditions has reached ECU memory limit

HINT:

If the judgment result shows INCOMPLETE or UNKNOWN, perform steps [B] and [C].

12. If the test result is UNKNOWN, enter the following menus: Powertrain/Engine/Trouble Codes/Pending.
13. Read Pending DTCs.

HINT:

If a pending DTC is output, the system is malfunctioning.

14. If the test result is INCOMPLETE or UNKNOWN and no pending DTC is output, perform a universal trip and check for permanent DTCs (See **DTC CHECK/CLEAR**).

HINT:

- If a permanent DTC is output, the system is malfunctioning.
- If no permanent DTC is output, the system is normal.

INSPECTION PROCEDURE

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HINT:

Read freeze frame data using the Techstream. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1. **CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P0128)**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the Techstream on.
   d. Enter the following menus: Powertrain/Engine/Trouble Codes.
   e. Read the DTCs.

   Result

   RESULT CHART

Result	Proceed to
DTC P0128 is output	A
DTC P0128 and other DTCs are output	B

   HINT:

   If any DTCs other than P0128 are output, troubleshoot those DTCs first.

   B: GO TO **DTC CHART**

   A: Go to next step

2. **CHECK COOLING SYSTEM**
   a. Check for defects in the cooling system that might cause the system to be too cold, such as abnormal cooling fan operation or any modifications.

   NG: REPAIR OR REPLACE COOLING SYSTEM

   OK: Go to next step

3. **INSPECT THERMOSTAT**
   a. Remove the thermostat (See **REMOVAL**).
   b. Check the valve opening temperature of the thermostat.

   Standard value:

   80 to 84°C (176 to 183°F)

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HINT:

In addition to the above check, confirm that the valve is completely closed when the temperature is below the standard.

c. Reinstall the thermostat (See **INSTALLATION**).

NG: REPLACE THERMOSTAT (See **REMOVAL**)

OK: REPLACE ECM (See **REMOVAL**)

DTC P0136 OXYGEN SENSOR CIRCUIT MALFUNCTION (BANK 1 SENSOR 2); DTC P0137 OXYGEN SENSOR CIRCUIT LOW VOLTAGE (BANK 1 SENSOR 2); DTC P0138 OXYGEN SENSOR CIRCUIT HIGH VOLTAGE (BANK 1 SENSOR 2); DTC P0139 OXYGEN SENSOR CIRCUIT SLOW RESPONSE (BANK 1 SENSOR 2)

DESCRIPTION

HINT:

Sensor 2 refers to the sensor mounted behind the three way catalytic converter and located far from the engine assembly.

A three way catalytic converter is used in order to convert the carbon monoxide, hydrocarbons, and nitrogen oxide, into less harmful substances. To allow the three way catalytic converter to function effectively, it is necessary to keep the air fuel ratio of the engine near the stoichiometric air fuel ratio. For the purpose of helping the ECM to deliver accurate air fuel ratio control, a heated oxygen sensor is used. The heated oxygen sensor is located behind the three way catalytic converter, and detects the oxygen concentration in the exhaust gas. Since the sensor is integrated with the heater that heats the sensing portion, it is possible to detect the oxygen concentration even when the intake air volume is low (the exhaust gas temperature is low).

When the air fuel ratio becomes lean, the oxygen concentration in the exhaust gas is great. The heated oxygen sensor informs the ECM that the post-three way catalytic converter air fuel ratio is lean (low voltage, i.e. less than 0.45 V).

Conversely, when the air fuel ratio is richer than the stoichiometric air fuel level, the oxygen concentration in the exhaust gas becomes small. The heated oxygen sensor informs the ECM that the post-three way catalytic converter air fuel ratio is rich (high voltage, i.e. more than 0.45 V). The heated oxygen sensor has the property of changing its output voltage drastically when the air fuel ratio is close to the stoichiometric level.

The ECM uses the supplementary information from the heated oxygen sensor to determine whether the air fuel ratio after the three way catalytic converter is rich or lean, and adjusts the fuel injection time accordingly. Thus, if the heated oxygen sensor is working improperly due to internal malfunctions, the ECM is unable to compensate for deviations in the primary air fuel ratio control.

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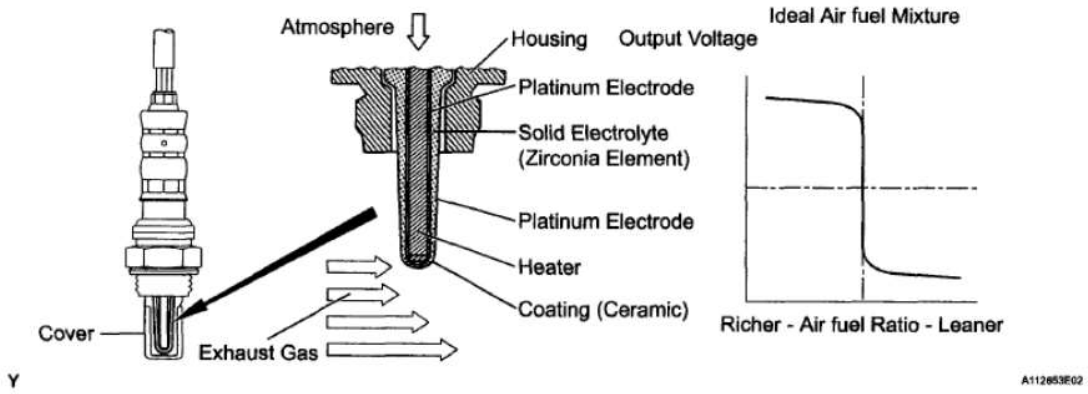


Fig. 109: Air Fuel Mixture Ratio Graph
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

DTC DETECTION CONDITION CHART

DTC No.	DTC Detection Condition	Trouble Area
P0136	• Abnormal voltage output: During active air fuel ratio control, both of the following conditions are met for a certain period of time (2 trip detection logic): a. The heated oxygen sensor voltage does not decrease to below 0.21 V. b. The heated oxygen sensor voltage does not increase to higher than 0.69 V. • Low impedance: The sensor impedance is below 5 (I for more than 30 seconds when the ECM presumes the sensor is warmed up and operating normally (2 trip detection logic).	• Open or short in heated oxygen sensor (bank 1 sensor 2) circuit • Heated oxygen sensor (bank 1 sensor 2) • Heated oxygen sensor heater (bank 1 sensor 2) • Air fuel ratio sensor (bank 1 sensor 1) • Gas leak from exhaust system
P0137	• Low voltage (open): During active air fuel ratio control, both of the following conditions are met for a certain period of time (2 trip detection logic): a. The heated oxygen sensor voltage output is below 0.21 V. b. The target air fuel ratio is rich. • High impedance: The sensor impedance is 15 kohms or higher for more than 90 seconds when the ECM presumes the sensor to be	• Open in heated oxygen sensor (bank 1 sensor 2) circuit • Heated oxygen sensor (bank 1 sensor 2) • Heated oxygen sensor heater (bank 1 sensor 2) • Gas leak from exhaust system

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	warmed up and operating normally (2 trip detection logic).	
P0138	• High voltage (short): During active air fuel ratio control, both of the following conditions are met for a certain period of time (2 trip detection logic): a. The heated oxygen sensor voltage output is 0.69 V or higher. b. The target air fuel ratio is lean. • Extremely high voltage (short): The heated oxygen sensor voltage output exceeds 1.2 V for more than 10 seconds (2 trip detection logic).	• Short in heated oxygen sensor (bank 1 sensor 2) circuit • Heated oxygen sensor (bank 1 sensor 2) • ECM • Air fuel ratio sensor (bank 1 sensor 1)
P0139	• The heated oxygen sensor (sensor 2) voltage does not drop to below 0.2 V immediately after fuel cut starts. • The heated oxygen sensor (sensor 2) voltage does not drop from 0.35 V to 0.2 V immediately after fuel cut starts.	• Short in heated oxygen sensor (bank 1 sensor 2) circuit • Heated oxygen sensor (bank 1 sensor 2) • ECM

MONITOR DESCRIPTION

1. **Active Air Fuel Ratio Control**

   The ECM usually performs air fuel ratio feedback control so that the air fuel ratio sensor output indicates a near stoichiometric air fuel level. This vehicle includes active air fuel ratio control in addition to regular air fuel ratio control. The ECM performs active air fuel ratio control to detect any deterioration in the three-way catalytic converter and heated oxygen sensor malfunctions (refer to the diagram below).

   Active air fuel ratio control is performed for approximately 15 to 20 seconds while driving with a warm engine. During active air fuel ratio control, the air fuel ratio is forcibly regulated to become lean or rich by the ECM. If the ECM detects a malfunction, a DTC is stored.

2. **Abnormal Voltage Output of Heated Oxygen Sensor (DTC P0136)**

   While the ECM is performing active air fuel ratio control, the air fuel ratio is forcibly regulated to become rich or lean. If the sensor is not functioning properly, the voltage output variation is small. For example, when the heated oxygen sensor voltage does not decrease to below 0.21 V or does not increase to higher than 0.69 V during active air fuel ratio control, the ECM determines that the sensor voltage output is abnormal and stores DTC P0136.

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Heated Oxygen Sensor Circuit Malfunction (P0136: Abnormal Voltage)

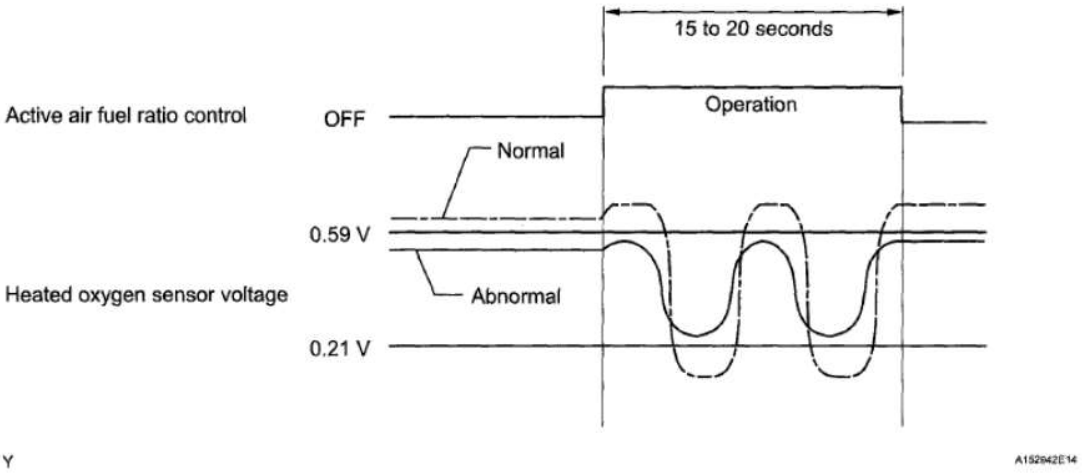


Fig. 110: Heated Oxygen Sensor Circuit Malfunction Waveform
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

3. **Open or Short in Heated Oxygen Sensor Circuit (DTCs P0137 or P0138)**

During active air fuel ratio control, the ECM calculates the oxygen storage capacity* of the three-way catalytic converter by forcibly regulating the air fuel ratio to become rich or lean.

If the heated oxygen sensor has an open or short, or the voltage output of the sensor noticeably decreases, the oxygen storage capacity indicates an extraordinarily high value. Even if the ECM attempts to continue regulating the air fuel ratio to become rich or lean, the heated oxygen sensor output does not change.

While performing active air fuel ratio control, when the target air fuel ratio is rich and the heated oxygen sensor voltage output is 0.21 V or less (lean), the ECM interprets this as an abnormally low sensor output voltage and stores DTC P0137. When the target air fuel ratio is lean and the voltage output is 0.69 V or higher (rich) during active air fuel ratio control, the ECM determines that the sensor voltage output is abnormally high, and stores DTC P0138.

HINT:

DTC P0138 is also set if the heated oxygen sensor voltage output is higher than 1.2 V for 10 seconds or more.

*: The three-way catalytic converter has the capability to store oxygen. The oxygen storage capacity and the emission purification capacity of the three-way catalytic converter are mutually related. The ECM determines whether the catalyst has deteriorated, based on the calculated oxygen storage capacity value (See **DTC P0420 CATALYST SYSTEM EFFICIENCY BELOW THRESHOLD (BANK 1)**).

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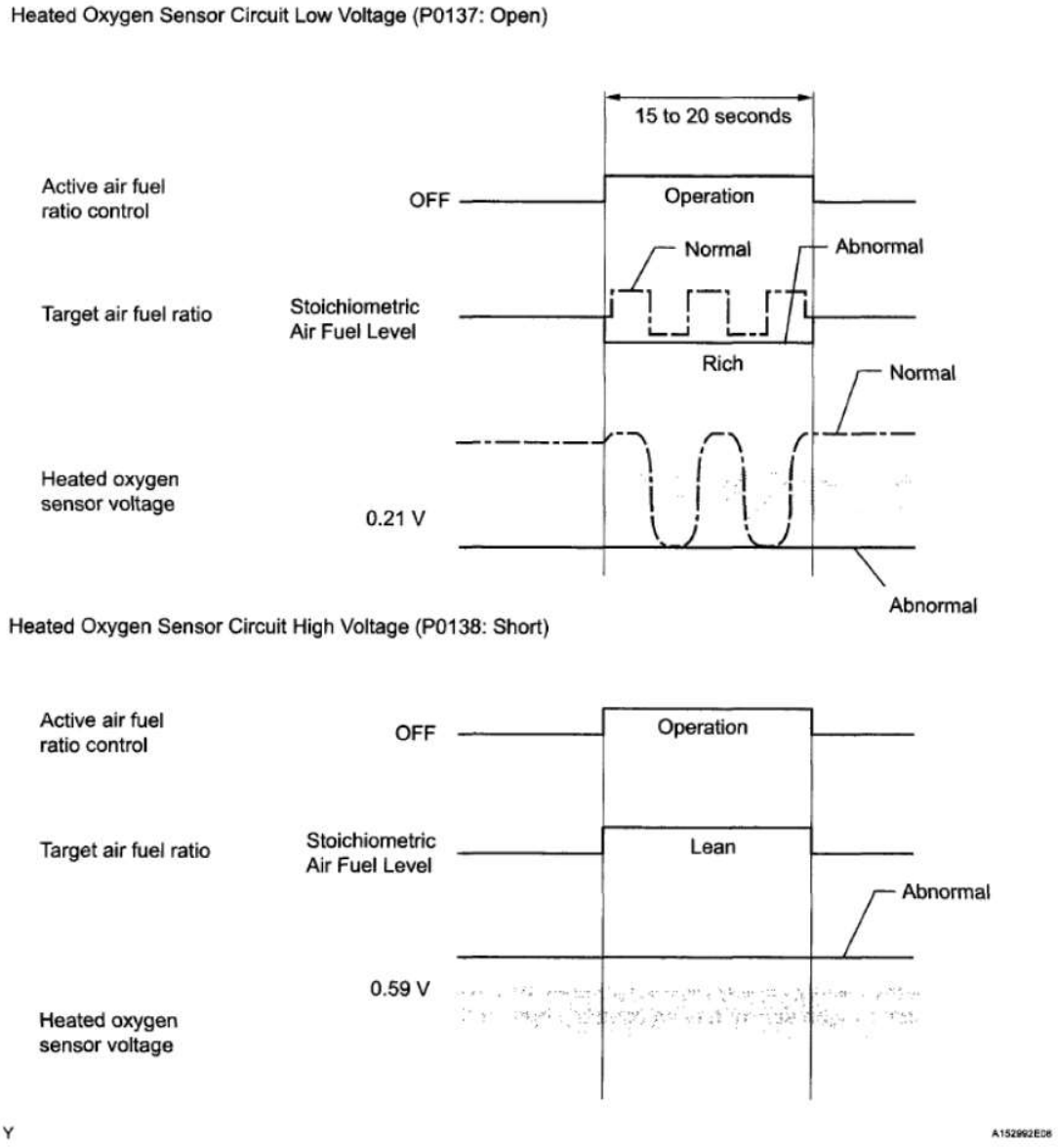


Fig. 111: Heated Oxygen Sensor Circuit Voltage Waveform
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

4. **High or Low Impedance of Heated Oxygen Sensor (DTCs P0136 or P0137)**

During normal air fuel ratio feedback control, there are small variations in the exhaust gas oxygen concentration. In order to continuously monitor the slight variation of the heated oxygen sensor signal while the engine is running, the impedance* of the sensor is measured by the ECM. The ECM determines that there is a malfunction in the sensor when the measured impedance deviates from the standard range.

*: The effective resistance in an alternating current electrical circuit.

HINT:

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- The impedance cannot be measured using an ohmmeter.
- DTC P0136 indicates the deterioration of the heated oxygen sensor. The ECM stores the DTC by calculating the impedance of the sensor when the typical enabling conditions are satisfied (2 driving cycles).
- DTC P0137 indicates an open or short circuit in the heated oxygen sensor (2 driving cycles). The ECM stores the DTC when the impedance of the sensor exceeds the threshold of 15 kohms.

Relationship between element temperature and impedance:

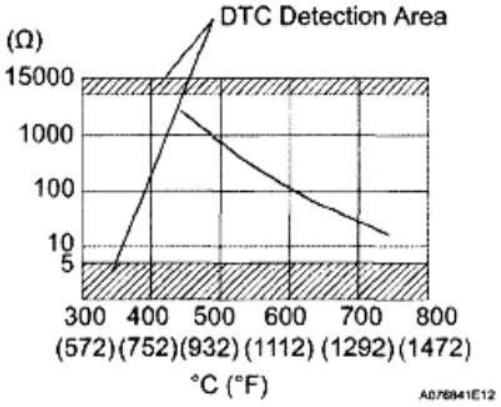


Fig. 112: DTC Detection Area Chart
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

5. **Abnormal Voltage Output of Heated Oxygen Sensor During Fuel-cut (DTC P0139)**

The sensor output voltage drops to below 0.2 V (extremely lean status) immediately when the vehicle decelerates and fuel cut is operating. If the voltage does not drop to below 0.2 V for 7 seconds or more, or voltage does not drop from 0.35 V to 0.2 V for 1 second, the ECM determines that the sensor response has deteriorated, illuminates the MIL and stores a DTC.

MONITOR STRATEGY

MONITOR STRATEGY CHART

Related DTCs	P0136: Heated Oxygen Sensor Output Voltage (Output Voltage) P0136: Heated Oxygen Sensor Impedance (Low) P0137: Heated Oxygen Sensor Output Voltage (Low Voltage) P0137: Heated Oxygen Sensor Impedance (High) P0138: Heated Oxygen Sensor Output Voltage (High Voltage) P0138: Heated Oxygen Sensor Output Voltage (Extremely High) P0139: Heated Oxygen Sensor Output Voltage During Fuel Cut
Required Sensors/Components (Main)	Heated oxygen sensor (bank 1 sensor 2)
Required Sensors/Components	Crankshaft position sensor Engine coolant temperature sensor

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(Related)	Mass air flow meter Throttle position sensor
Frequency of Operation	Once per driving cycle: Active air fuel ratio control detection, Heated oxygen sensor voltage during fuel-cut Continuous: Other
Duration	20 seconds: Heated oxygen sensor output (Output voltage, High voltage, Low voltage) 30 seconds: Heated oxygen sensor impedance (Low) 90 seconds: Heated oxygen sensor impedance (High) 10 seconds: Heated oxygen sensor voltage (Extremely high) 7 seconds: Heated oxygen sensor voltage during fuel cut
MIL Operation	2 driving cycles
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

All

TYPICAL ENABLING CONDITIONS CHART

Monitor runs whenever following DTCs not stored	P0016 (VVT System - Misalignment) P0017 (Exhaust VVT System - Misalignment) P0031, P0032, P101D (Air Fuel Ratio Sensor Heater) P0037, P0038, P102D (Heated Oxygen Sensor Heater) P2195, P2196, P2237, P2238, P2239, P2252, P2253, P2A00 (Air Fuel Ratio Sensor) P0102, P0103 (Mass Air Flow Meter) P0112, P0113 (Intake Air Temperature Sensor) P0115, P0117, P0118 (Engine Coolant Temperature Sensor) P0125 (Insufficient Coolant Temperature for Closed Loop Fuel Control) P0120, P0121, P0122, P0123, P0220, P0222, P0223, P2135 (Throttle Position Sensor) P0128 (Thermostat) P0171, P0172 (Fuel System) P0301 - P0304 (Misfire) P0335 (Crankshaft Position Sensor) P0340 (Camshaft Position Sensor) P0451, P0452, P0453 (EVAP System) P0500 (Vehicle Speed Sensor)

Heated Oxygen Sensor Output Voltage (Output Voltage, High Voltage and Low Voltage)

TYPICAL ENABLING CONDITIONS CHART

Active air fuel ratio control	Executing
Active air fuel ratio control begins when all of following conditions met:	-
Battery voltage	11 V or higher

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Engine coolant temperature	75°C (167°F) or higher
Idling	OFF
Engine speed	Less than 4000 rpm
Air fuel ratio sensor status	Activated
Fuel system status	Closed loop
Fuel cut	OFF
Engine load	10 to 80%
Shift position	5th or more

Heated Oxygen Sensor Impedance (Low)

TYPICAL ENABLING CONDITIONS CHART

Battery voltage	11 V or higher
Estimated sensor temperature	Below 700°C (1292°F)
ECM monitor	Completed
DTC P0607	Not detected

Heated Oxygen Sensor Impedance (High)

TYPICAL ENABLING CONDITIONS CHART

Battery voltage	11 V or higher
Estimated sensor temperature	450 to 750°C (842 to 1382°F)
DTC P0607	Not detected

Heated Oxygen Sensor Output Voltage (Extremely High)

TYPICAL ENABLING CONDITIONS CHART

Battery voltage	11 V or higher
Time after engine start	2 seconds or more

Heated Oxygen Sensor Voltage During Fuel Cut

TYPICAL ENABLING CONDITIONS CHART

Engine coolant temperature	75°C (167°F) or higher
Estimated catalyst temperature	400°C (752°F) or higher
Fuel cut	Executing

TYPICAL MALFUNCTION THRESHOLDS

Heated Oxygen Sensor Output Voltage (Output Voltage)

TYPICAL MALFUNCTION THRESHOLDS CHART

Either of following conditions met:	1 or 2

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1. All of following conditions met	-
(a) Commanded air fuel ratio	14.4 or less
(b) Heated oxygen sensor voltage	0.21 to 0.69 V
(c) OSC (Oxygen Storage Capacity of Catalyst)	2.0 g or more
2. All of following conditions met	-
(a) Commanded air fuel ratio	14.8 or more
(b) Heated oxygen sensor voltage	0.21 to 0.69 V
(c) OSC (Oxygen Storage Capacity of Catalyst)	2.0 g or more

Heated Oxygen Sensor Output Voltage (Low Output Voltage)

TYPICAL MALFUNCTION THRESHOLDS CHART

All of following conditions met	-
(a) Commanded air fuel ratio	14.4 or less
(b) Heated oxygen sensor voltage	Below 0.21 V
(c) OSC (Oxygen Storage Capacity of Catalyst)	2.0 g or more

Heated Oxygen Sensor Output Voltage (High Output Voltage)

TYPICAL MALFUNCTION THRESHOLDS CHART

All of following conditions met	-
(a) Commanded air fuel ratio	14.8 or more
(b) Heated oxygen sensor voltage	Higher than 0.69 V
(c) OSC (Oxygen Storage Capacity of Catalyst)	2.0 g or more

Heated Oxygen Sensor Impedance (Low)

TYPICAL MALFUNCTION THRESHOLDS CHART

Duration of following condition	30 seconds or more
Heated oxygen sensor impedance	Below 5 ohms

Heated Oxygen Sensor Impedance (High)

TYPICAL MALFUNCTION THRESHOLDS CHART

Duration of following condition	90 seconds or more
Heated oxygen sensor impedance	15 kohms or higher

Heated Oxygen Sensor Output Voltage (Extremely High)

TYPICAL MALFUNCTION THRESHOLDS CHART

Duration of following condition	10 seconds or more
Heated oxygen sensor voltage	1.2 V or higher

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Heated Oxygen Sensor Voltage During Fuel-cut

TYPICAL MALFUNCTION THRESHOLDS CHART

Duration until rear heated oxygen sensor voltage drops to 0.2 V after fuel cut	7 seconds or more
Duration that rear heated oxygen sensor voltage drops from 0.35 V to 0.2 V during fuel cut	1 second or more

COMPONENT OPERATING RANGE

COMPONENT OPERATING RANGE CHART

Duration of following condition	30 seconds or more
Heated oxygen sensor voltage	Varies between 0.1 V and 0.9 V

MONITOR RESULT

Refer to **CHECKING MONITOR STATUS** .

CONFIRMATION DRIVING PATTERN

P0136, P0137 and P0138

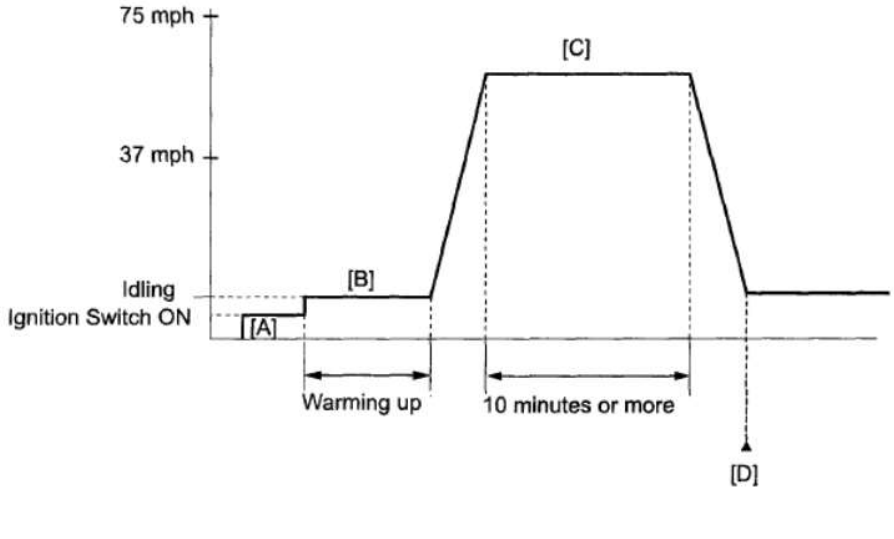


Fig. 113: Confirmation Driving Pattern
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

1. Connect the Techstream to the DLC3.
2. Turn the ignition switch to ON and turn the Techstream on.
3. Clear the DTCs (even if no DTCs are stored, perform the clear DTC procedure).
4. Turn the ignition switch off.
5. Turn the ignition switch to ON and turn the Techstream on [A].

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6. Start the engine and warm it up until the engine coolant temperature reaches 75°C (167°F) or higher [B].
7. With the transmission in 4th gear or higher, drive the vehicle at 37 to 75 mph (60 to 120 km/h) for 10 minutes or more [C].
8. Enter the following menus: Powertrain/Engine/Utility/All Readiness.
9. Input the DTC: P0136, P0137 or P0138.
10. Check the DTC judgment result [D].

TECHSTREAM DISPLAY DESCRIPTION

Techstream Display	Description
NORMAL	• DTC judgment completed • System normal
ABNORMAL	• DTC judgment completed • System abnormal
INCOMPLETE	• DTC judgment not completed • Perform driving pattern after confirming DTC enabling conditions
UNKNOWN	• Unable to perform DTC judgment • Number of DTCs which do not fulfill DTC preconditions has reached ECU memory limit

CAUTION: When performing the confirmation driving pattern, obey all speed limits and traffic laws.

HINT:

If the judgment result shows INCOMPLETE or UNKNOWN, perform steps [C] and [D].

11. If the test result is UNKNOWN, enter the following menus: Powertrain/Engine/Trouble Codes/Pending.
12. Read Pending DTCs.

HINT:

If a pending DTC is output, the system is malfunctioning.

13. If the test result is INCOMPLETE or UNKNOWN and no pending DTC is output, perform a universal trip and check for permanent DTCs (See **DTC CHECK/CLEAR**).

HINT:

- If a permanent DTC is output, the system is malfunctioning.
- If no permanent DTC is output, the system is normal.

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P0139

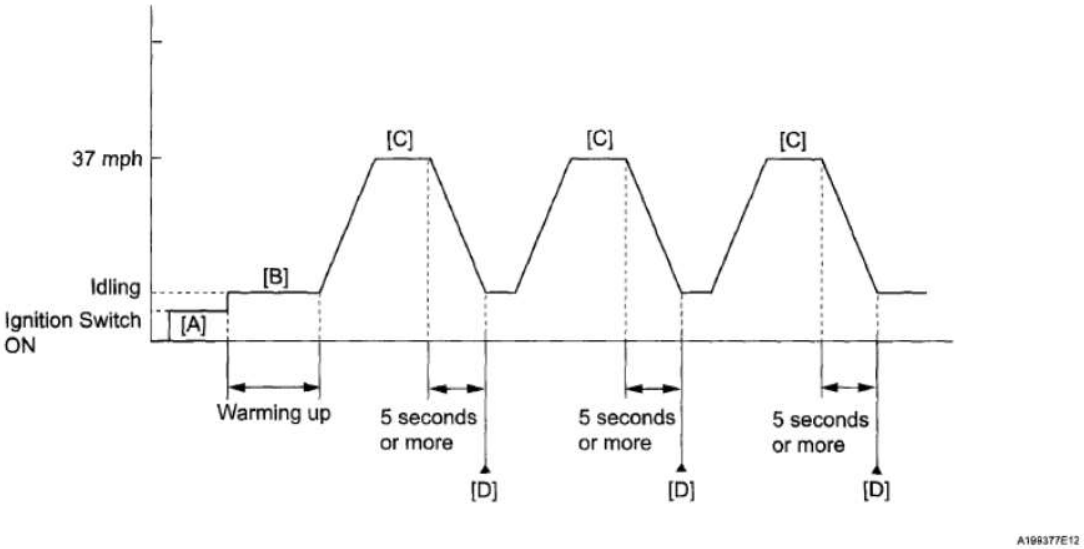


Fig. 114: Confirmation Driving Pattern
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

1. Connect the Techstream to the DLC3.
2. Turn the ignition switch to ON and turn the Techstream on.
3. Clear the DTCs (even if no DTCs are stored, perform the clear DTC procedure).
4. Turn the ignition switch off.
5. Turn the ignition switch to ON and turn the Techstream on [A].
6. Start the engine and warm it up until the engine coolant temperature reaches 75°C (167°F) or higher [B].
7. Drive the vehicle at 37 mph (60 km/h), and then decelerate the vehicle by releasing the accelerator pedal for 5 seconds or more to perform the fuel-cut [C].
8. Enter the following menus: Powertrain/Engine/Utility/All Readiness.
9. Input the DTC: P0139.
10. Check the DTC judgment result [D].

TECHSTREAM DISPLAY DESCRIPTION

Techstream Display	Description
NORMAL	• DTC judgment completed • System normal
ABNORMAL	• DTC judgment completed • System abnormal
INCOMPLETE	• DTC judgment not completed • Perform driving pattern after confirming DTC enabling conditions

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UNKNOWN	• Unable to perform DTC judgment • Number of DTCs which do not fulfill DTC preconditions has reached ECU memory limit

CAUTION: When performing the confirmation driving pattern, obey all speed limits and traffic laws.

HINT:

If the judgment result shows INCOMPLETE or UNKNOWN, move the shift lever to 2 and then perform steps [C] through [D] again.

11. If the test result is UNKNOWN, enter the following menus: Powertrain/Engine/Trouble Codes/Pending.
12. Read Pending DTCs.

    HINT:

    If a pending DTC is output, the system is malfunctioning.

13. If the test result is INCOMPLETE or UNKNOWN and no pending DTC is output, perform a universal trip and check for permanent DTCs (See **DTC CHECK/CLEAR**).

    HINT:

    - If a permanent DTC is output, the system is malfunctioning.
    - If no permanent DTC is output, the system is normal.

WIRING DIAGRAM

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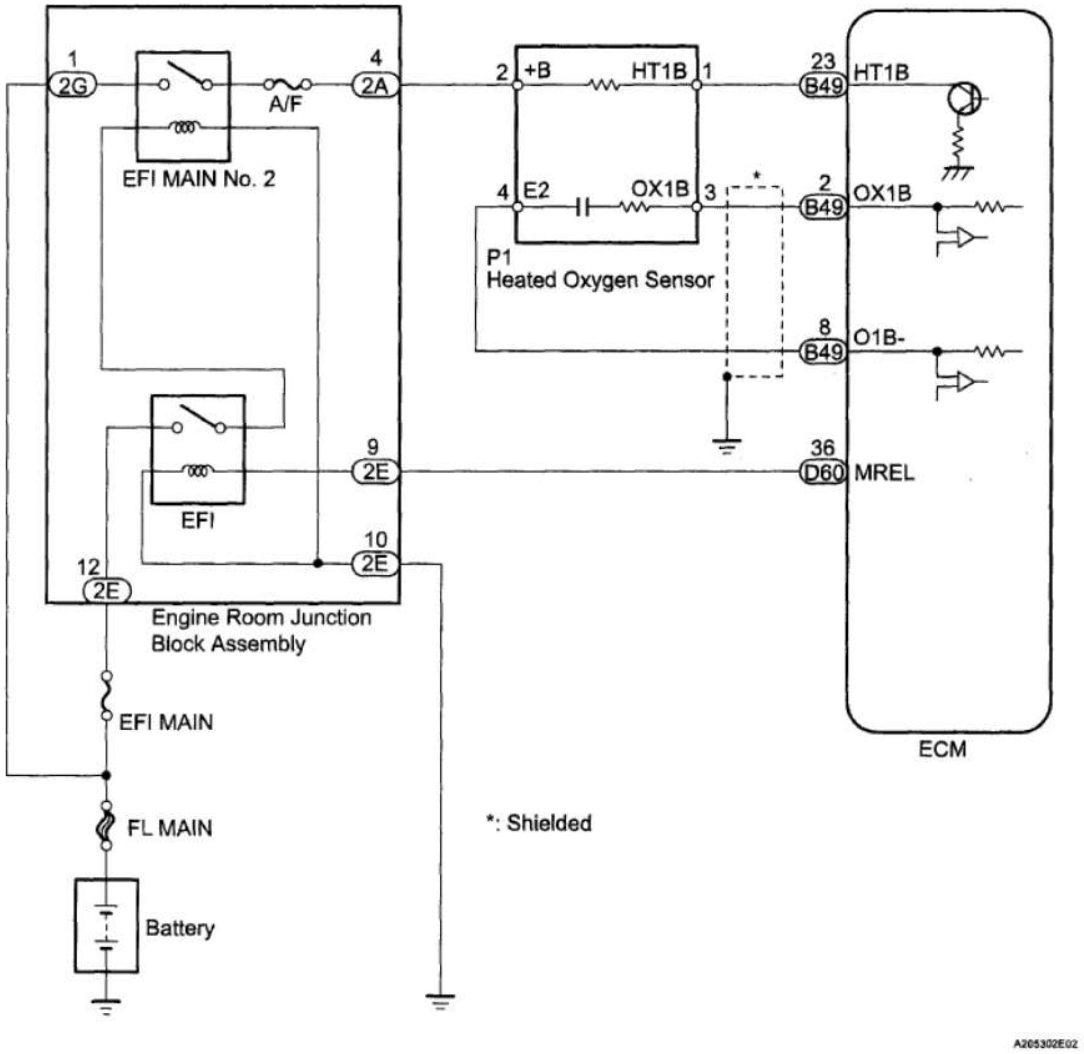


Fig. 115: Oxygen Sensor Circuit Malfunction (Bank 1 Sensor 2) - Wiring Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSPECTION PROCEDURE

HINT:

Malfunctioning areas can be identified by performing the Control the Injection Volume for A/F Sensor function provided in the Active Test. The Control the Injection Volume for A/F Sensor function can help to determine whether the air fuel ratio sensor, heated oxygen sensor and other potential trouble areas are malfunctioning.

The following instructions describe how to conduct the Control the Injection Volume for A/F Sensor operation using the Techstream.

1. Connect the Techstream to the DLC3.
2. Start the engine.

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3. Turn the Techstream on.
4. Warm up the engine at an engine speed of 2500 rpm for approximately 90 seconds.
5. Enter the following menus: Powertrain/Engine/Active Test/Control the Injection Volume for A/F Sensor.
6. Perform the Active Test operation with the engine idling (press the RIGHT or LEFT button to change the fuel injection volume).
7. Monitor the output voltages of the air fuel ratio and heated oxygen sensors (AFS Voltage B1 S1 and O2S B1 S2) displayed on the Techstream.

HINT:

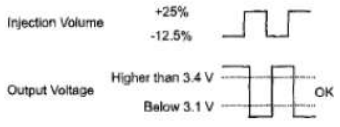
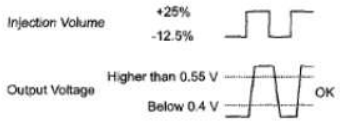
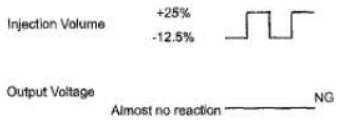
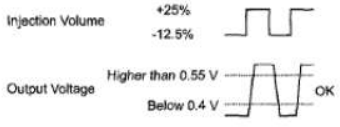
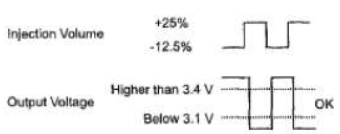
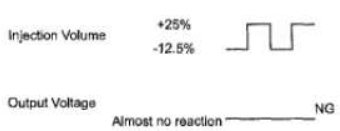
- The Control the Injection Volume for A/F Sensor operation lowers the fuel injection volume by -12.5% or increases the injection volume by 25%.
- Each sensor reacts in accordance with increases and decreases in the fuel injection volume.

VOLTAGE STATUS CHART

Techstream Display (Sensor)	Injection Volume	Status	Voltage
AFS Voltage B1 S1 (Air fuel ratio)	+25%	Rich	Below 3.1 V
	-12.5%	Lean	Higher than 3.4 V
O2S B1 S2 (Heated oxygen)	+25%	Rich	Higher than 0.55 V
	-12.5%	Lean	Below 0.4 V

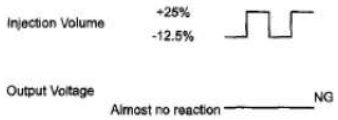
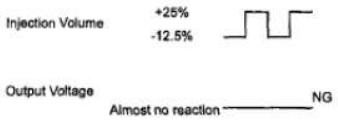
NOTE: The air fuel ratio sensor has an output delay of a few seconds and the heated oxygen sensor has a maximum output delay of approximately 20 seconds.

AIR FUEL RATIO SENSOR REFERENCE

Case	Air Fuel Ratio Sensor (Bank 1 Sensor 1) Output Voltage	Heated Oxygen Sensor (Bank 1 Sensor 2) Output Voltage	Main Suspected Trouble Area
1			-
2			• Air fuel ratio sensor • Air fuel ratio sensor heater • Air fuel ratio sensor circuit
3			• Heated oxygen sensor • Heated oxygen sensor heater

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			• Heated oxygen sensor circuit
4			• Injector • Fuel pressure • Gas leak from exhaust system (Air fuel ratio extremely rich or lean)

- Following the Control the Injection Volume for A/F Sensor procedure enables technicians to check and graph the voltage outputs of both the air fuel ratio and heated oxygen sensors.
- To display the graph, enter the following menus: Powertrain/Engine/Active Test/Control the Injection Volume for A/F Sensor/All Data/AFS Voltage B1 S1 and O2S B1 S2; and then press the graph button on the Data List view.

NOTE: Inspect the fuses for circuits related to this system before performing the following inspection procedure.

HINT:

Read freeze frame data using the Techstream. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1. **READ OUTPUT DTC (DTC P0136, P0137, P0138 OR P0139)**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the Techstream on.
   d. Enter the following menus: Powertrain/Engine/Trouble Codes.
   e. Read the DTCs.

   Result

   RESULT CHART

Result	Proceed to
DTC P0138 is output	A
DTC P0137 is output	B
DTC P0136 is output	C
DTC P0139 is output	D

   B: Go to step 9

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C: Go to step 7

D: Go to step 18

A: Go to next step

2. **READ VALUE USING TECHSTREAM (OUTPUT VOLTAGE OF HEATED OXYGEN SENSOR)**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the Techstream on.
   d. Enter the following menus: Powertrain/Engine/Data List/All Data/O2S B1 S2.
   e. Allow the engine to idle.
   f. Read the heated oxygen sensor output voltage while idling.

Result

RESULT CHART

Result	Proceed to
1.0 V or higher	A
Below 1.0 V	B

B: Go to step 5

A: Go to next step

3. **INSPECT HEATED OXYGEN SENSOR (CHECK FOR SHORT)**
   a. Turn the ignition switch off and wait for 5 minutes or more.
   b. Disconnect the heated oxygen sensor connector.
   c. Measure the resistance according to the value(s) in the table below.

Standard Resistance

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
2 (+B) - 4 (E2)	Always	10 kohms or higher
2 (+B) - 3 (OX1B)		

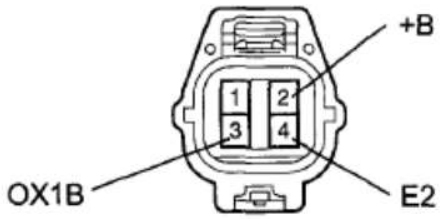
   d. Reconnect the heated oxygen sensor connector.

NG: REPLACE HEATED OXYGEN SENSOR (See **REMOVAL**)

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Component without harness connected:
(Heated Oxygen Sensor)



A204433E04

Fig. 116: Identifying Heated Oxygen Sensor Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

4. **CHECK HARNESS AND CONNECTOR (CHECK FOR SHORT)**
   a. Disconnect the ECM connector.
   b. Measure the resistance according to the value(s) in the table below.

Standard Resistance (Check for Short)

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
B49-23 (HT1B) - B49-2 (OX1B)	Always	10 kohms or higher

   c. Reconnect the ECM connector.

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR

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Rear view of wire harness connector:
(to ECM)

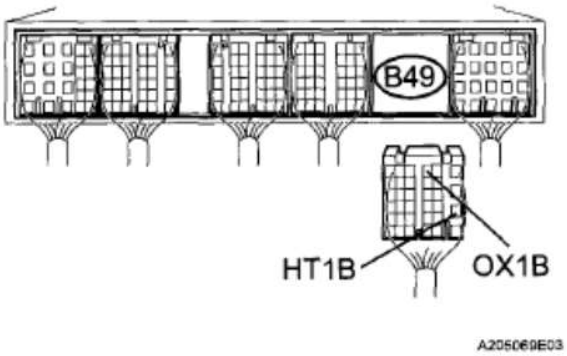


Fig. 117: Disconnecting B49 ECM Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: REPLACE ECM (See **REMOVAL**)

5. **PERFORM ACTIVE TEST USING TECHSTREAM (INJECTION VOLUME)**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the Techstream on.
   d. Start the engine and warm it up.
   e. Enter the following menus: Powertrain/Engine/Active Test/Control the Injection Volume.
   f. Change the fuel injection volume using the Techstream, and monitor the voltage output of the air fuel ratio and heated oxygen sensors displayed on the Techstream.

   HINT:

   - Change the fuel injection volume within the range of -12% to +12%. The injection volume can be changed in 0.1 or 0.2% graduations within the range.
   - The air fuel ratio sensor is displayed as AFS Voltage B1 S1, and the heated oxygen sensor is displayed as O2S B1 S2 on the Techstream.

   Result

   RESULT CHART

Techstream Display (Sensor)	Voltage Variation	Proceed to
AFS Voltage B1 S1 (Air fuel	Alternates between higher than and below 3.3 V	OK

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ratio)	Remains at higher than 3.3 V	NG
	Remains at below 3.3 V	NG

HINT:

A normal heated oxygen sensor voltage (O2S B1 S2) reacts in accordance with increases and decreases in fuel injection volumes. When the air fuel ratio sensor voltage remains at either below or higher than 3.3 V despite the heated oxygen sensor indicating a normal reaction, the air fuel ratio sensor is malfunctioning.

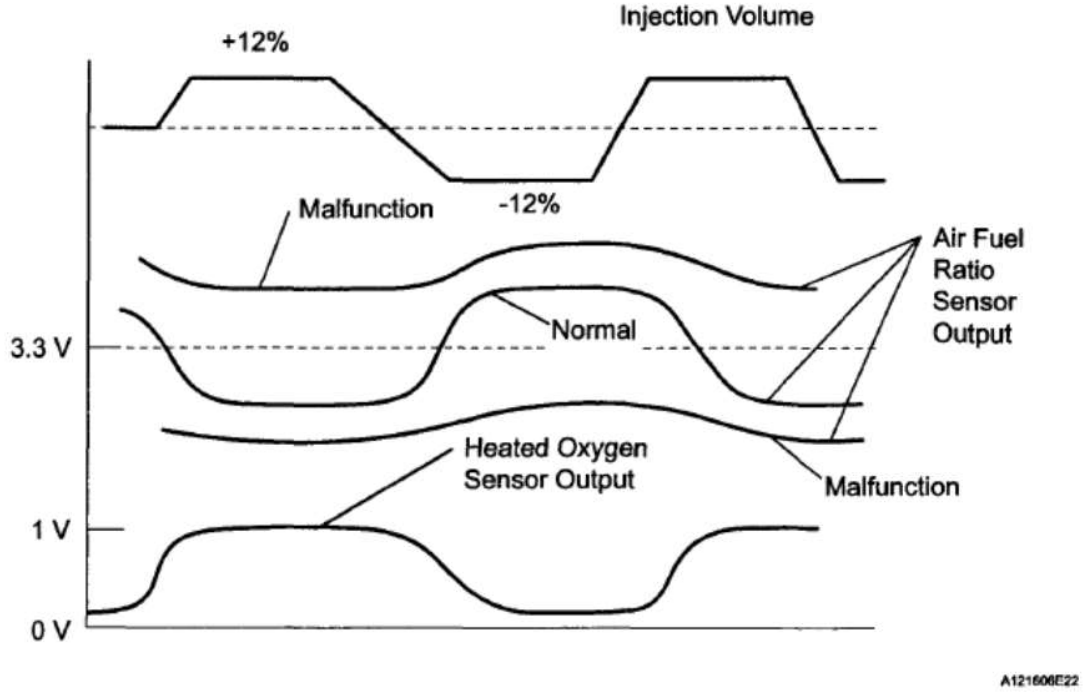


Fig. 118: Heated Oxygen Sensor Voltage Malfunction Chart
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

NG: Go to step 15

OK: Go to next step

6. **INSPECT AIR FUEL RATIO SENSOR**

HINT:

This air fuel ratio sensor test is to check the air fuel ratio sensor current during fuel-cut. When the sensor is normal, the sensor current indicates below 3.0 mA in this test.

a. Connect the Techstream to the DLC3.
b. Turn the ignition switch to ON.

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c. Turn the Techstream on.
d. Drive the vehicle according to the drive pattern listed below:
   1. Warm up the engine until the engine coolant temperature reaches 75°C (167°F) or higher.
   2. Drive the vehicle at 37 mph (60 km/h) or more and decelerate the vehicle for 5 seconds or more.
   3. Repeat the step above at least 3 times.

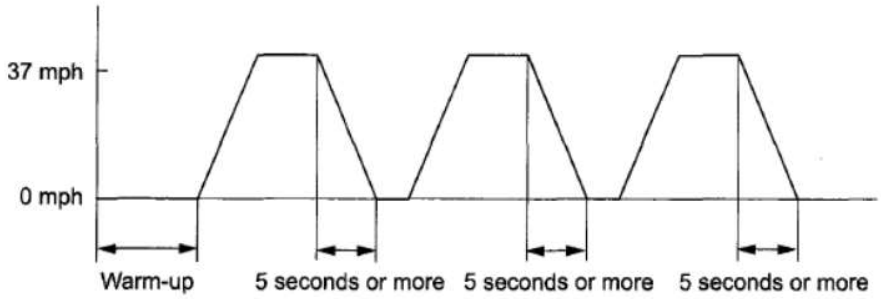


Fig. 119: Vehicle Speed Driving Pattern
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

e. Enter the following menus: Powertrain/Engine/Monitor/O2 Sensor/Details.
f. Confirm that RANGE B1S1/Result is either Pass or Fail. If the Techstream shows Fail, recheck RANGE B1S1/Result after performing the drive pattern.
g. Select the RANGE B1S1/Details.
h. Read the test value.

Standard current:

Below 3.0 mA

HINT:

If the Techstream shows Fail again, accelerate the vehicle and use second gear to decelerate the vehicle. Refer to the **CONFIRMATION DRIVING PATTERN**.

OK: Go to step 12

NG: Go to step 15

7. **READ VALUE USING TECHSTREAM (OUTPUT VOLTAGE OF HEATED OXYGEN SENSOR)**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the Techstream on.

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d. Start the engine.
e. Enter the following menus: Powertrain/Engine/Data List/All Data/O2S B1 S2.
f. After warming up the engine, run the engine at an engine speed of 2500 rpm for 3 minutes.
g. Read the output voltage of the heated oxygen sensor when the engine speed is suddenly increased.

HINT:

Quickly accelerate the engine to 4000 rpm 3 times using the accelerator pedal.

Standard:

Fluctuates between 0.4 V or less and 0.5 V or higher.

NG: Go to step 9

OK: Go to next step

8. **PERFORM ACTIVE TEST USING TECHSTREAM (INJECTION VOLUME)**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the Techstream on.
   d. Start the engine and warm it up.
   e. Enter the following menus: Powertrain/Engine/Active Test/Control the Injection Volume.
   f. Change the fuel injection volume using the Techstream, and monitor the voltage output of the air fuel ratio and heated oxygen sensors displayed on the Techstream.

HINT:

- Change the fuel injection volume within the range of -12% to +12%. The injection volume can be changed in 0.1 or 0.2% graduations within the range.
- The air fuel ratio sensor is displayed as AFS Voltage B1 S1, and the heated oxygen sensor is displayed as O2S B1 S2 on the Techstream.

Result

RESULT CHART

Techstream Display (Sensor)	Voltage Variation	Proceed to
AFS Voltage B1 S1 (Air fuel ratio)	Alternates between higher than and below 3.3 V	OK
	Remains at higher than 3.3 V	NG
	Remains at below 3.3 V	NG

HINT:

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A normal heated oxygen sensor voltage (O2S B1 S2) reacts in accordance with increases and decreases in fuel injection volumes. When the air fuel ratio sensor voltage remains at either below or higher than 3.3 V despite the heated oxygen sensor indicating a normal reaction, the air fuel ratio sensor is malfunctioning.

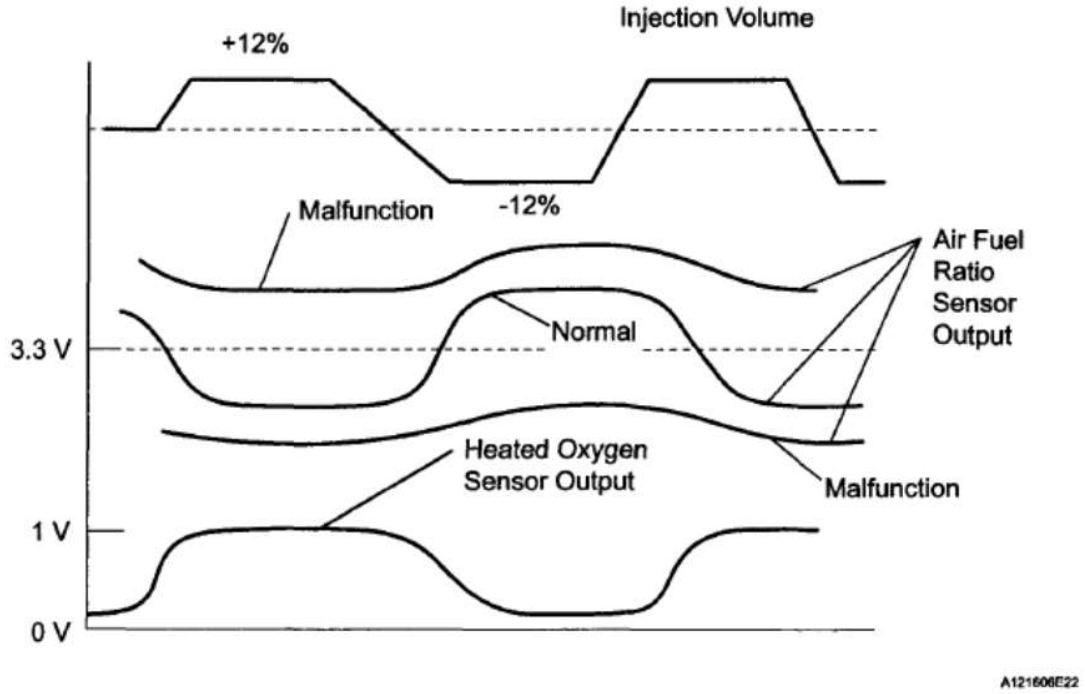


Fig. 120: Heated Oxygen Sensor Voltage Malfunction Chart
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

NG: Go to step 15

OK: CHECK ENGINE TO DETERMINE CAUSE OF EXTREMELY RICH OR LEAN ACTUAL AIR FUEL RATIO (See **INSPECTION PROCEDURE**)

9. **CHECK FOR EXHAUST GAS LEAK**
   a. Check for exhaust gas leaks.

   OK:

   No gas leaks.

   NG: REPAIR OR REPLACE EXHAUST GAS LEAK POINT

   OK: Go to next step

10. **INSPECT HEATED OXYGEN SENSOR (HEATER RESISTANCE)** (See **INSPECTION PROCEDURE**)

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NG: REPLACE HEATED OXYGEN SENSOR (See **REMOVAL**)

OK: Go to next step

11. **CHECK HARNESS AND CONNECTOR (HEATED OXYGEN SENSOR - ECM)**
    a. Disconnect the heated oxygen sensor connector.
    b. Disconnect the ECM connector.
    c. Measure the resistance according to the value(s) in the table below.

Standard Resistance (Check for Open)

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
P1-1 (HT1B) - B49-23 (HT1B)	Always	Below 1 ohms
P1-3 (OX1B) - B49-2 (OX1B)		
P1-4 (E2) - B49-8 (O1B-)		

Standard Resistance (Check for Short)

TESTER CONNECTION SPECIFIED CONDITION CHART

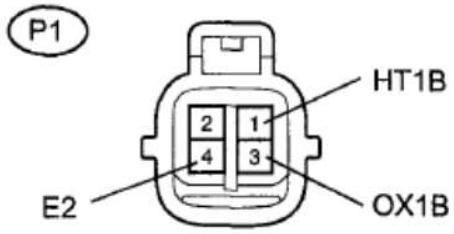
Tester Connection	Condition	Specified Condition
P1-1 (HT1B) or B49-23 (HT1B) - Body ground	Always	10 kohms or higher
P1-3 (OX1B) or B49-2 (OX1B) - Body ground		

    d. Reconnect the heated oxygen sensor connector.
    e. Reconnect the ECM connector.

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR

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Front view of wire harness connector:
(to Heated Oxygen Sensor)



Rear view of wire harness connector:
(to ECM)

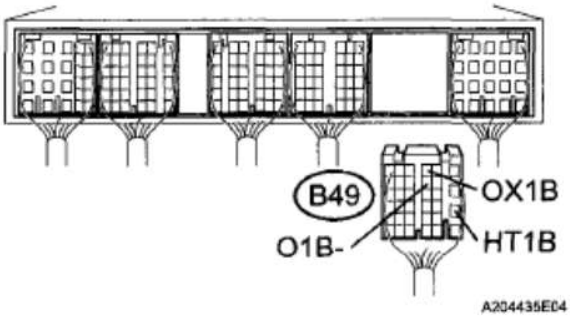


Fig. 121: Identifying Heated Oxygen Sensor And ECM Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

12. **REPLACE HEATED OXYGEN SENSOR**
    a. Replace the heated oxygen sensor (See **REMOVAL**).
13. **PERFORM CONFIRMATION DRIVING PATTERN**
    a. Connect the Techstream to the DLC3.
    b. Turn the ignition switch to ON and turn the Techstream on (Step A).
    c. Clear the DTCs (even if no DTCs are stored, perform the Clear DTC procedure) (See **DTC CHECK/CLEAR**).
    d. Turn the ignition switch off.
    e. Turn the ignition switch to ON and turn the Techstream on.
    f. Start the engine and warm it up until the engine coolant temperature reaches 75°C (167°F) or higher (Step B).

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g. With the transmission in 4th gear or more, drive the vehicle at 37 to 75 mph (60 to 120 km/h) for 10 minutes or more (Step C).

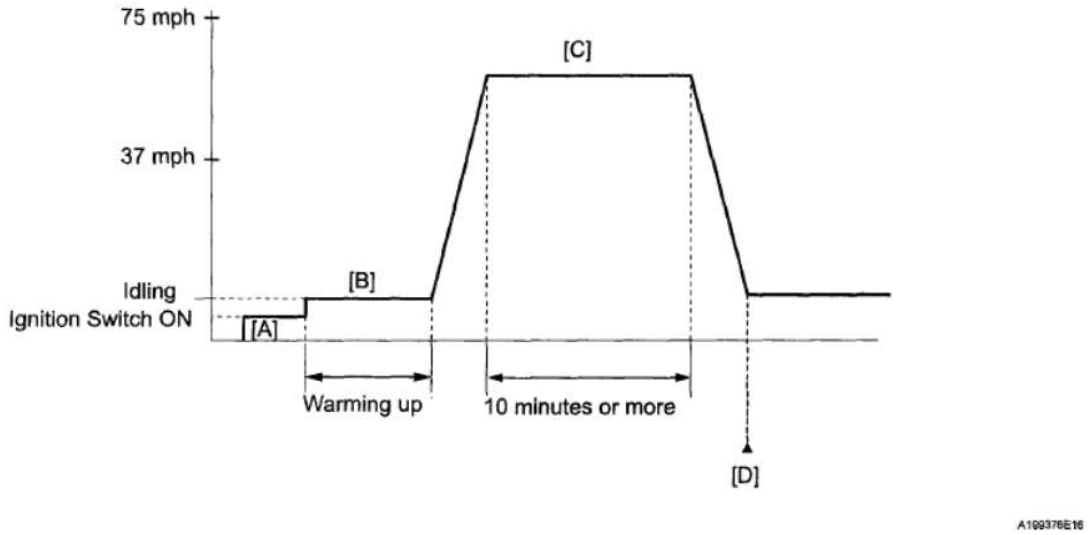


Fig. 122: Confirmation Driving Pattern
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

14. **CHECK WHETHER DTC OUTPUT RECURS (DTC P0136, P0137 OR P0138)**
    a. Connect the Techstream to the DLC3.
    b. Turn the ignition switch to ON.
    c. Turn the Techstream on.
    d. Enter the following menus: Powertrain/Engine/Utility/All Readiness.
    e. Input DTCs: P0136, P0137 and P0138.
    f. Check the DTC judgment.

Result

RESULT CHART

Result	Proceed to
NORMAL (No DTC output)	A
ABNORMAL (P0136, P0137 or P0138 is output)	B

B: REPLACE AIR FUEL RATIO SENSOR (See **REMOVAL**)

A: REPAIR COMPLETED

15. **REPLACE AIR FUEL RATIO SENSOR**
    a. Replace the air fuel ratio sensor (See **REMOVAL**).
16. **PERFORM CONFIRMATION DRIVING PATTERN**

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a. Connect the Techstream to the DLC3.
b. Turn the ignition switch to ON and turn the Techstream on (Step A).
c. Clear the DTCs (even if no DTCs are stored, perform the Clear DTC procedure) (See **DTC CHECK/CLEAR**).
d. Turn the ignition switch off.
e. Turn the ignition switch to ON and turn the Techstream on.
f. Start the engine and warm it up until the engine coolant temperature reaches 75°C (167°F) or higher (Step B).
g. With the transmission in 4th gear or more, drive the vehicle at 37 to 75 mph (60 to 120 km/h) for 10 minutes or more (Step C).

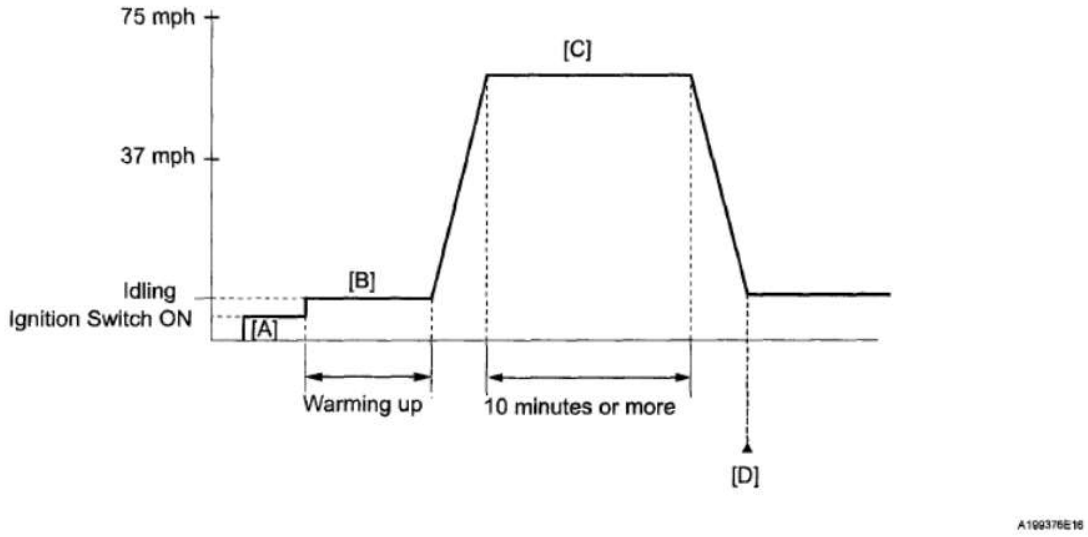


Fig. 123: Confirmation Driving Pattern
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

17. **CHECK WHETHER DTC OUTPUT RECURS (DTC P0136 OR P0138)**
a. Connect the Techstream to the DLC3.
b. Turn the ignition switch to ON.
c. Turn the Techstream on.
d. Enter the following menus: Powertrain/Engine/Utility/All Readiness.
e. Input DTCs: P0136 and P0138.
f. Check the DTC judgment.

Result

RESULT CHART

Result	Proceed to
NORMAL (No DTC output)	A
ABNORMAL (P0136 or P0138 is output)	B

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B: REPLACE HEATED OXYGEN SENSOR (See **REMOVAL**)

A: REPAIR COMPLETED

18. **READ VALUE USING TECHSTREAM (OUTPUT VOLTAGE OF HEATED OXYGEN SENSOR)**
    a. Connect the Techstream to the DLC3.
    b. Turn the ignition switch to ON.
    c. Turn the Techstream on.
    d. Enter the following menus: Powertrain/Engine/Data List/All Data/O2S B1 S2.
    e. After warming up the engine, run the engine at an engine speed of 2500 rpm for 3 minutes.
    f. Allow the engine to idle.
    g. Depress the accelerator pedal quickly until the engine speed reaches 2500 rpm 3 times.

    Result

    RESULT CHART

Result	Proceed to
Higher than 1.0 V	A
Below 1.0 V	B

    B: Go to step 21

    A: Go to next step

19. **INSPECT HEATED OXYGEN SENSOR (CHECK FOR SHORT)**
    a. Turn the ignition switch off and wait for 5 minutes or more.
    b. Disconnect the heated oxygen sensor connector.
    c. Measure the resistance according to the value(s) in the table below.

    Standard Resistance

    TESTER CONNECTION SPECIFIED CONDITION CHART

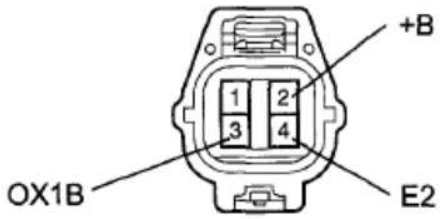
Tester Connection	Condition	Specified Condition
2 (+B) - 4 (E2)	Always	10 kohms or higher
2 (+B) - 3 (OX1B)		

    d. Reconnect the heated oxygen sensor connector.

    NG: REPLACE HEATED OXYGEN SENSOR (See **REMOVAL**)

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Component without harness connected:
(Heated Oxygen Sensor)



A204433E04

Fig. 124: Identifying Heated Oxygen Sensor Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

20. **CHECK HARNESS AND CONNECTOR (CHECK FOR SHORT)**
    a. Disconnect the ECM connector.
    b. Measure the resistance according to the value(s) in the table below.

Standard Resistance (Check for Short)

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
B49-23 (HT1B) - B49-2 (OX1B)	Always	10 kohms or higher

    c. Reconnect the ECM connector.

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR

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Rear view of wire harness connector:
(to ECM)

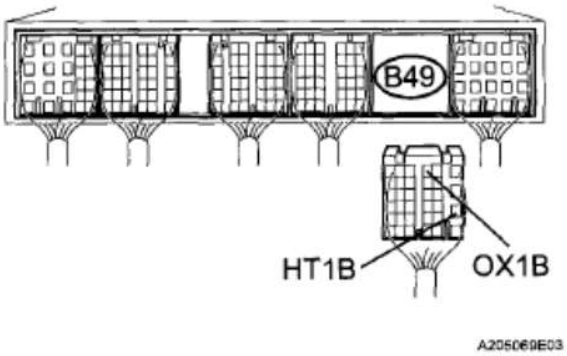


Fig. 125: Disconnecting B49 ECM Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: REPLACE ECM (See **REMOVAL**)

21. **READ DTC OUTPUT (DTC P0139 IS OUTPUT AGAIN)**
    a. Connect the Techstream to the DLC3.

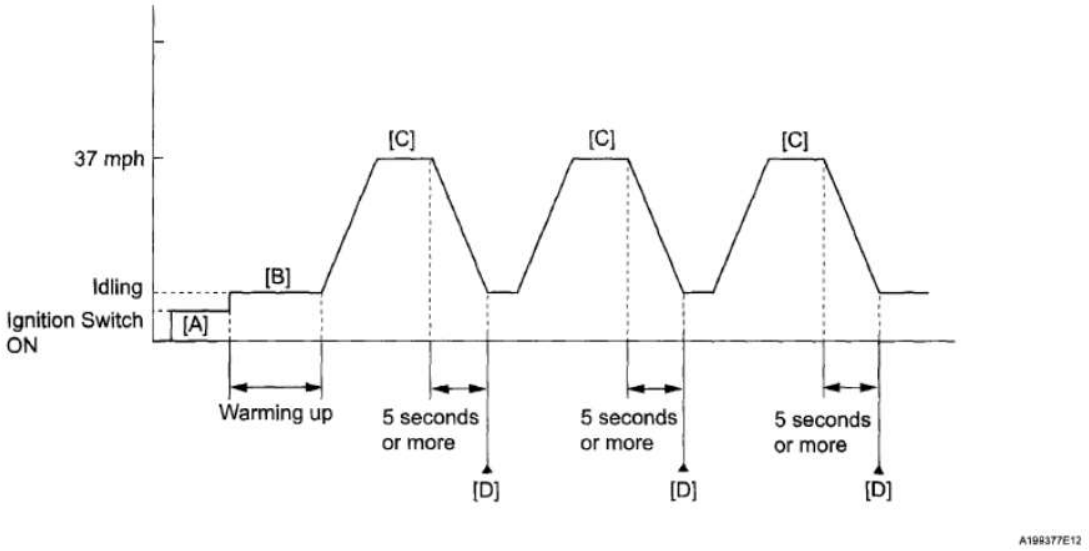


Fig. 126: Vehicle Speed Driving Pattern
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

    b. Turn the ignition switch to ON and turn the Techstream on (Step A).
    c. Clear the DTCs (even if no DTCs are stored, perform the Clear DTC procedure) (See **DTC CHECK/CLEAR**).

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d. Turn the ignition switch off.
e. Turn the ignition switch to ON and turn the Techstream on.
f. Start the engine and warm it up until the engine coolant temperature reaches 75°C (167°F) or higher (Step B).
g. Drive the vehicle at 37 mph (60 km/h), and then decelerate the vehicle by releasing the accelerator pedal for 5 seconds or more to perform the fuel-cut (Step C).
h. Turn the Techstream on.
i. Enter the following menus: Powertrain/Engine/Utility/All Readiness (Step D).
j. Input DTCs: P0139.
k. Check the STATUS is NORMAL. If STATUS is INCOMPLETE, perform the drive pattern adding the vehicle speed and using the second gear to decelerate the vehicle.

Result

RESULT CHART

Result	Proceed to
ABNORMAL (P0139 is output)	A
NORMAL (No DTC output)	B

B: CHECK FOR INTERMITTENT PROBLEMS (See **CHECK FOR INTERMITTENT PROBLEMS**)

A: REPLACE HEATED OXYGEN SENSOR (See **REMOVAL**)

DTC P0171 SYSTEM TOO LEAN (BANK 1); DTC P0172 SYSTEM TOO RICH (BANK 1)

DESCRIPTION

The fuel trim is related to the feedback compensation value, not to the basic injection duration. The fuel trim consists of both the short-term and long-term fuel trims.

The short-term fuel trim is fuel compensation that is used to constantly maintain the air fuel ratio at stoichiometric levels. The signal from the air fuel ratio sensor indicates whether the air fuel ratio is rich or lean compared to the stoichiometric ratio. This triggers a reduction in the fuel injection volume if the air fuel ratio is rich and an increase in the fuel injection volume if lean.

Factors such as individual engine differences, wear over time and changes in operating environment cause short-term fuel trim to vary from the central value. The long-term fuel trim, which controls overall fuel compensation, compensates for long-term deviations in the fuel trim from the central value caused by the short-term fuel trim compensation.

If both the short-term and long-term fuel trims are lean or rich beyond predetermined values, it is interpreted as a malfunction, and the ECM illuminates the MIL and stores a DTC.

DTC DETECTION CONDITION CHART

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DTC No.	DTC Detection Condition	Trouble Area
P0171	With a warm engine and stable air fuel ratio feedback, the fuel trim is considerably in error to the lean side (2 trip detection logic).	• Intake system • Injector blockage • Mass air flow meter • Engine coolant temperature sensor • Fuel pressure • Gas leak from exhaust system • Open or short in air fuel ratio sensor (bank 1 sensor 1) circuit • Air fuel ratio sensor (bank 1 sensor 1) • PCV valve and hose • PCV hose connections • ECM
P0172	With a warm engine and stable air fuel ratio feedback, the fuel trim is considerably in error to the rich side (2 trip detection logic).	• Injector leak or blockage • Mass air flow meter • Engine coolant temperature sensor • Ignition system • Fuel pressure • Gas leak from exhaust system • Open or short in air fuel ratio sensor (bank 1 sensor 1) circuit • Air fuel ratio sensor (bank 1 sensor 1) • ECM

HINT:

- When DTC P0171 is stored, the actual air fuel ratio is on the lean side. When DTC P0172 is stored, the actual air fuel ratio is on the rich side.
- If the vehicle runs out of fuel, the air fuel ratio is lean and DTC P0171 may be stored. The MIL is then illuminated.
- When the total of the short-term and long-term fuel trim values is within the malfunction threshold (and the engine coolant temperature is higher than 75°C [167°F]), the system is functioning normally.

MONITOR DESCRIPTION

Under closed loop fuel control, fuel injection volumes that deviate from those estimated by the ECM cause

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changes in the long-term fuel trim compensation value. The long-term fuel trim is adjusted when there are persistent deviations in the short-term fuel trim values. Deviations from the fuel injection volumes estimated by the ECM also affect the average fuel trim learned value, which is a combination of the average short-term fuel trim (fuel feedback compensation value) and the average long-term fuel trim (learned value of the air fuel ratio). If the average fuel trim learned value exceeds the malfunction thresholds, the ECM interprets this as a fault in the fuel system and stores a DTC.

Example:

The average fuel trim learned value is more than +35% or less than -35%, the ECM interprets this as a fuel system malfunction.

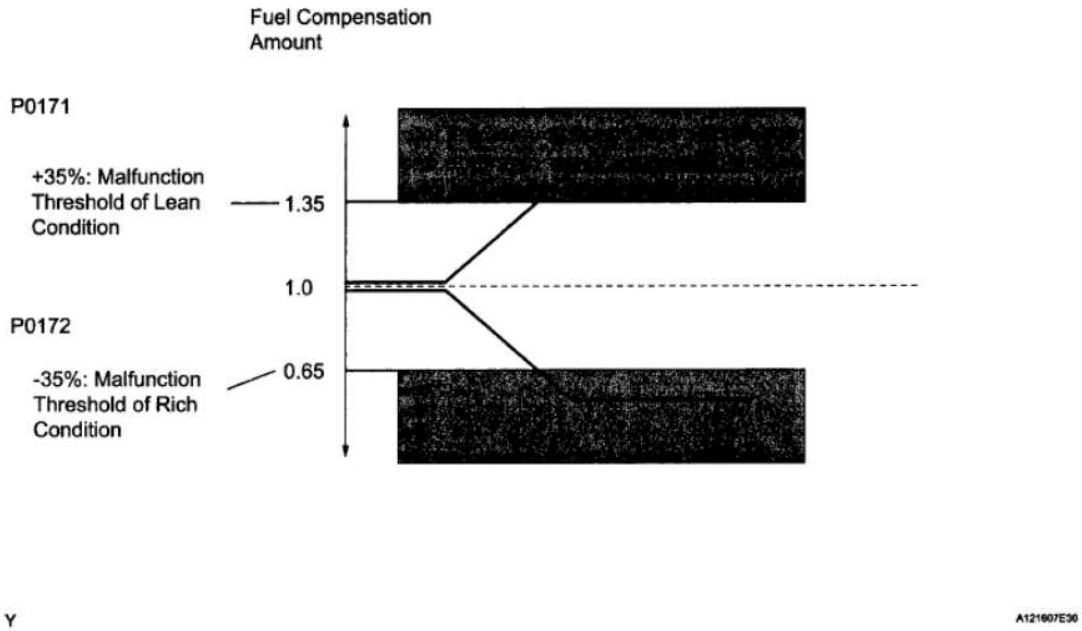


Fig. 127: Fuel Compensation Amount Chart
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

MONITOR STRATEGY

MONITOR STRATEGY CHART

Related DTCs	P0171: Fuel Trim Lean P0172: Fuel Trim Rich
Required Sensors/Components (Main)	Fuel system
Required Sensors/Components (Related)	Air fuel ratio sensor Mass air flow meter Crankshaft position sensor
Frequency of Operation	Continuous
Duration	Within 10 seconds
MIL Operation	2 driving cycles
Sequence of Operation	None

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TYPICAL ENABLING CONDITIONS

Fuel-trim:

TYPICAL ENABLING CONDITIONS CHART

Monitor runs whenever following DTCs not stored	P0010 (Camshaft Timing Oil Control Valve) P0011 (VVT System - Advance) P0012 (VVT System - Retard) P0016 (VVT System - Misalignment) P0013 (Exhaust Camshaft Timing Oil Control Valve) P0014 (Exhaust VVT System - Advance) P0015 (Exhaust VVT System - Retard) P0017 (Exhaust VVT System - Misalignment) P0031, P0032, P101D (Air Fuel Ratio Sensor Heater) P0102, P0103 (Mass Air Flow Meter) P0115, P0117, P0118 (Engine Coolant Temperature Sensor) P0125 (Insufficient Coolant Temperature for Closed Loop Fuel Control) P0120, P0121, P0122, P0123, P0220, P0222, P0223, P2135 (Throttle Position Sensor) P0335 (Crankshaft Position Sensor) P0340, P0342, P0343 (Camshaft Position Sensor) P0365, P0367, P0368 (Exhaust Camshaft Position Sensor) P0351 - P0354 (Igniter) P0500 (Vehicle Speed Sensor)
Fuel system status	Closed loop
Battery voltage	11 V or higher
Either of following conditions met	-
1. Engine speed	Less than 800 rpm
2. Engine load	11.52% or more
Catalyst monitor	Not executed

TYPICAL MALFUNCTION THRESHOLDS

Fuel-trim:

TYPICAL MALFUNCTION THRESHOLDS CHART

Purge-cut	Executing
Either of following conditions met	-
1. Average between short-term fuel trim and long-term fuel trim	35% or more (varies with engine coolant temperature)
2. Average between short-term fuel trim and long-term fuel trim	-35% or less (varies with engine coolant temperature)

CONFIRMATION DRIVING PATTERN

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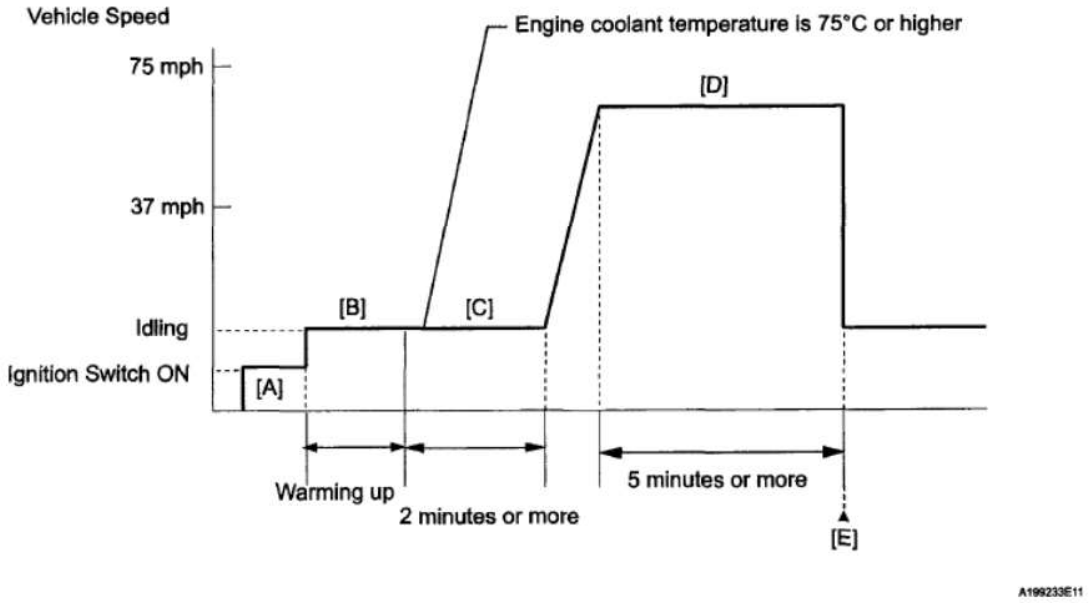


Fig. 128: Vehicle Speed Driving Pattern
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

1. Connect the Techstream to the DLC3.
2. Turn the ignition switch to ON and turn the Techstream on.
3. Clear the DTCs (even if no DTCs are stored, perform the clear DTC procedure).
4. Turn the ignition switch off.
5. Turn the ignition switch to ON and turn the Techstream on [A].
6. Start the engine and warm it up (until the engine coolant temperature is 75°C (167°F) or higher) with all the accessories switched off [B].
7. With the engine warmed up, idle the engine for 2 minutes or more [C].
8. Drive the vehicle at between 37 and 75 mph (60 and 120 km/h) and at an engine speed of between 1400 and 3200 rpm for 5 minutes or more [D].
9. Enter the following menus: Powertrain/Engine/Utility/All Readiness.
10. Input the DTC: P0171 or P0172.
11. Check the DTC judgment result [E].

TECHSTREAM DISPLAY DESCRIPTION

Techstream Display	Description
NORMAL	• DTC judgment completed • System normal
ABNORMAL	• DTC judgment completed • System abnormal
INCOMPLETE	• DTC judgment not completed

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	• Perform driving pattern after confirming DTC enabling conditions
UNKNOWN	• Unable to perform DTC judgment • Number of DTCs which do not fulfill DTC preconditions has reached ECU memory limit

CAUTION: When performing the confirmation driving pattern, obey all speed limits and traffic laws.

HINT:

If the judgment result shows INCOMPLETE or UNKNOWN, perform steps [C] through [E] again.

12. If the test result is UNKNOWN, enter the following menus: Powertrain/Engine/Trouble Codes/Pending.
13. Read Pending DTCs.

HINT:

If a pending DTC is output, the system is malfunctioning.

14. If the test result is INCOMPLETE or UNKNOWN and no pending DTC is output, perform a universal trip and check for permanent DTCs (See **DTC CHECK/CLEAR**).

HINT:

- If a permanent DTC is output, the system is malfunctioning.
- If no permanent DTC is output, the system is normal.

WIRING DIAGRAM

Refer to **DTC P2195** .

INSPECTION PROCEDURE

HINT:

Malfunctioning areas can be identified by performing the Control the Injection Volume for A/F Sensor function provided in the Active Test. The Control the Injection Volume for A/F Sensor function can help to determine whether the air fuel ratio sensor, heated oxygen sensor and other potential trouble areas are malfunctioning.

The following instructions describe how to conduct the Control the Injection Volume for A/F Sensor operation using the Techstream.

1. Connect the Techstream to the DLC3.
2. Start the engine.

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3. Turn the Techstream on.
4. Warm up the engine at an engine speed of 2500 rpm for approximately 90 seconds.
5. Enter the following menus: Powertrain/Engine/Active Test/Control the Injection Volume for A/F Sensor.
6. Perform the Active Test operation with the engine idling (press the RIGHT or LEFT button to change the fuel injection volume).
7. Monitor the output voltages of the air fuel ratio and heated oxygen sensors (AFS Voltage B1 S1 and O2S B1 S2) displayed on the Techstream.

HINT:

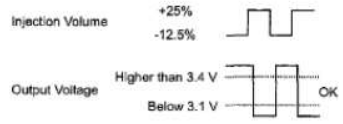
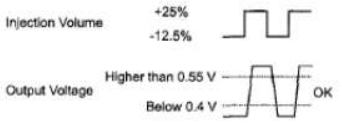
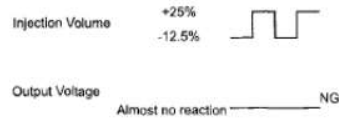
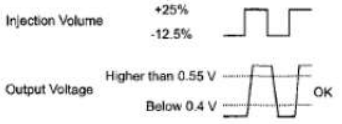
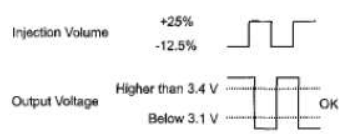
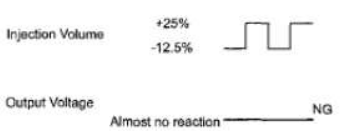
- The Control the Injection Volume for A/F Sensor operation lowers the fuel injection volume by -12.5% or increases the injection volume by 25%.
- Each sensor reacts in accordance with increases and decreases in the fuel injection volume.

VOLTAGE STATUS CHART

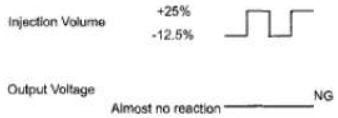
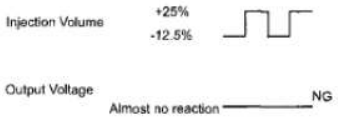
Techstream Display (Sensor)	Injection Volume	Status	Voltage
AFS Voltage B1 S1 (Air fuel ratio)	+25%	Rich	Below 3.1 V
	-12.5%	Lean	Higher than 3.4 V
O2S B1 S2 (Heated oxygen)	+25%	Rich	Higher than 0.55 V
	-12.5%	Lean	Below 0.4 V

NOTE: The air fuel ratio sensor has an output delay of a few seconds and the heated oxygen sensor has a maximum output delay of approximately 20 seconds.

AIR FUEL RATIO SENSOR REFERENCE

Case	Air Fuel Ratio Sensor (Bank 1 Sensor 1) Output Voltage	Heated Oxygen Sensor (Bank 1 Sensor 2) Output Voltage	Main Suspected Trouble Area
1			-
2			• Air fuel ratio sensor • Air fuel ratio sensor heater • Air fuel ratio sensor circuit
3			• Heated oxygen sensor • Heated oxygen sensor heater

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			• Heated oxygen sensor circuit
4			• Injector • Fuel pressure • Gas leak from exhaust system (Air fuel ratio extremely rich or lean)

- Following the Control the Injection Volume for A/F Sensor procedure enables technicians to check and graph the voltage outputs of both the air fuel ratio and heated oxygen sensors.
- To display the graph, enter the following menus: Powertrain/Engine/Active Test/Control the Injection Volume for A/F Sensor/All Data/AFS Voltage B1 S1 and O2S B1 S2; then press the graph button on the Data List view.

NOTE: Inspect the fuses for circuits related to this system before performing the following inspection procedure.

HINT:

- Read freeze frame data using the Techstream. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.
- A low air fuel ratio sensor voltage could be caused by a rich air fuel mixture. Check for conditions that would cause the engine to run rich.
- A high air fuel ratio sensor voltage could be caused by a lean air fuel mixture. Check for conditions that would cause the engine to run lean.

1. **CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P0171 OR P0172)**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the Techstream on.
   d. Enter the following menus: Powertrain/Engine/Trouble Codes.
   e. Read the DTCs.

   Result

   RESULT CHART

Result	Proceed to
DTC P0171 or P0172 is output	A
DTC P0171 or P0172 and other DTCs are output	B

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HINT:

If any DTCs other than P0171 or P0172 are output, troubleshoot those DTCs first.

B: GO TO **DTC CHART**

A: Go to next step

2. **CHECK PCV HOSE CONNECTIONS**
   a. Check the PCV hose connections.

   OK:

   PCV hose is connected correctly and is not damaged.

   NG: REPAIR OR REPLACE PCV HOSE

   OK: Go to next step

3. **CHECK INTAKE SYSTEM**
   a. Check the intake system for vacuum leakage (See **ON-VEHICLE INSPECTION**).

   OK:

   No leakage from intake system.

   NG: REPAIR OR REPLACE INTAKE SYSTEM

   OK: Go to next step

4. **PERFORM ACTIVE TEST USING TECHSTREAM (CONTROL THE INJECTION VOLUME)**
   a. Connect the Techstream to the DLC3.
   b. Start the engine.
   c. Turn the Techstream on.
   d. Warm up the engine at an engine speed of 2500 rpm for approximately 90 seconds.
   e. Enter the following menus: Powertrain/Engine/Active Test/Control the Injection Volume for A/F Sensor.
   f. Perform the Control the Injection Volume for A/F Sensor operation with the engine idling (press the RIGHT or LEFT button to change the fuel injection volume).
   g. Monitor the voltage outputs of the air fuel ratio sensor and the heated oxygen sensor (AFS Voltage B1 S1 and O2S B1 S2) displayed on the Techstream.

   HINT:

   - The Control the Injection Volume for A/F Sensor operation lowers the fuel injection volume

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by -12.5% or increases the injection volume by 25%.

- Each sensor reacts in accordance with increases and decreases in the fuel injection volume.

Standard

VOLTAGE STATUS CHART

Techstream Display (Sensor)	Injection Volume	Status	Voltage
AFS Voltage B1 S1 (Air fuel ratio)	+25%	Rich	Below 3.1 V
	-12.5%	Lean	Higher than 3.4 V
O2S B1 S2 (Heated oxygen)	+25%	Rich	Higher than 0.55 V
	-12.5%	Lean	Below 0.4 V

Result

RESULT CHART

Status AFS Voltage B1 S1	Status O2S B1 S2	Air Fuel Ratio Condition and Air Fuel Ratio Sensor Condition	Misfire	Suspected Trouble Area	Proceed to
Lean	Lean	Actual air fuel ratio lean	May occur	• PCV valve and hose • PCV hose connections • Injector blockage • Gas leak from exhaust system • Intake system • Fuel pressure • Mass air flow meter • Engine coolant temperature sensor	A
Rich	Rich	Actual air fuel ratio rich	-	• Injector leak or blockage • Gas leak from exhaust system • Ignition system • Fuel pressure • Mass air flow meter • Engine coolant temperature	

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				sensor	
Lean	Lean/Rich	Air fuel ratio sensor malfunction	-	• Air fuel ratio sensor	B
Rich	Lean/Rich	Air fuel ratio sensor malfunction	-	• Air fuel ratio sensor	
Lean: During Control the Injection Volume for A/F Sensor, the air fuel ratio sensor output voltage (AFS Voltage B1 S1) is consistently higher than 3.4 V, and the heated oxygen sensor output voltage (O2S B1 S2) is consistently below 0.4 V. Rich: During Control the Injection Volume for A/F Sensor, the AFS Voltage B1 S1 is consistently below 3.1 V, and the O2S B1 S2 is consistently higher than 0.55 V. Lean/Rich: During Control the Injection Volume for A/F Sensor of the Active Test, the output voltage of the heated oxygen sensor alternates correctly.					

B: Go to step 11

A: Go to next step

5. **READ VALUE USING TECHSTREAM (COOLANT TEMP)**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the Techstream on.
   d. Enter the following menus: Powertrain/Engine/Data List/All Data/Coolant Temp.
   e. Read the Data List twice, when the engine is both cold and warmed up.

   Standard value:

   With cold engine: Same as ambient air temperature.

   With warm engine: 80 to 100°C (176 to 212°F).

   NG: REPLACE ENGINE COOLANT TEMPERATURE SENSOR (See **REMOVAL**)

   OK: Go to next step

6. **INSPECT MASS AIR FLOW METER**
   a. Inspect the mass air flow meter (See **INSPECTION PROCEDURE**).

   NG: REPLACE MASS AIR FLOW METER (See **REMOVAL**)

   OK: Go to next step

7. **CHECK FUEL PRESSURE**
   a. Check the fuel pressure (See **ON-VEHICLE INSPECTION**).

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NG: REPAIR OR REPLACE FUEL SYSTEM

OK: Go to next step

8. **CHECK FOR EXHAUST GAS LEAK**
   a. Check for exhaust gas leaks.

   OK:

   No gas leaks.

   NG: REPAIR OR REPLACE EXHAUST SYSTEM

   OK: Go to next step

9. **CHECK SPARK AND IGNITION**

   HINT:

   - Refer to the ignition system inspection procedure (See **ON-VEHICLE INSPECTION**).
   - If the spark plugs or ignition system malfunctions, engine misfire may occur. The misfire count can be read using the Techstream. Enter the following menus: Powertrain/Engine/Data List/All Data/Cylinder #1 Misfire Count (to Cylinder #4 Misfire Count).

   NG: REPAIR OR REPLACE IGNITION SYSTEM

   OK: Go to next step

10. **INSPECT FUEL INJECTOR ASSEMBLY (INJECTION AND VOLUME)**

    HINT:

    - Refer to the fuel injector inspection procedure (See **INSPECTION**).
    - If the injectors malfunction, engine misfire may occur. The misfire count can be read using the Techstream. Enter the following menus: Powertrain/Engine/Data List/All Data/Cylinder #1 Misfire Count (to Cylinder #4 Misfire Count).

    NG: REPLACE FUEL INJECTOR ASSEMBLY (See **REMOVAL**)

    OK: Go to next step

11. **INSPECT AIR FUEL RATIO SENSOR (HEATER RESISTANCE)** (See **INSPECTION PROCEDURE**)

    NG: REPLACE AIR FUEL RATIO SENSOR (See **REMOVAL**)

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OK: Go to next step

12. **CHECK TERMINAL VOLTAGE (POWER SOURCE OF AIR FUEL RATIO SENSOR)** (See **INSPECTION PROCEDURE**)

NG: Go to step 17

OK: Go to next step

13. **CHECK HARNESS AND CONNECTOR (AIR FUEL RATIO SENSOR - ECM)** (See **INSPECTION PROCEDURE**)

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR

OK: Go to next step

14. **REPLACE AIR FUEL RATIO SENSOR**
    a. Replace the air fuel ratio sensor (See **REMOVAL**).
15. **PERFORM CONFIRMATION DRIVING PATTERN**
    a. Connect the Techstream to the DLC3.

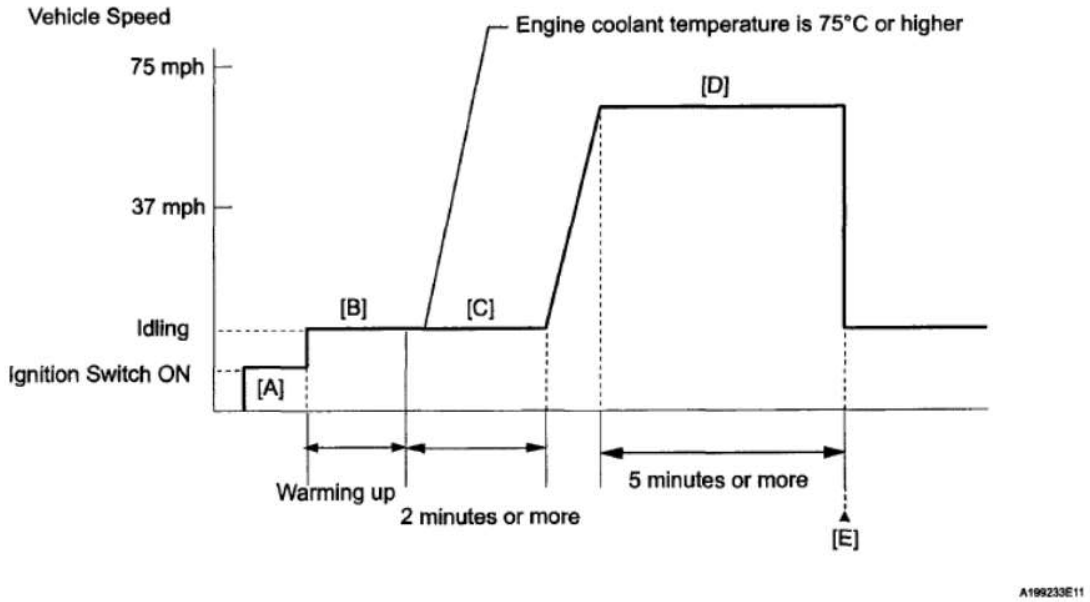


Fig. 129: Vehicle Speed Driving Pattern
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    b. Turn the ignition switch to ON and turn the Techstream on.
    c. Clear the DTCs (even if no DTCs are stored, perform the Clear DTC procedure).
    d. Turn the ignition switch off.
    e. Turn the ignition switch to ON and turn the Techstream on [A].

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f. Start the engine and warm it up (until the engine coolant temperature is 75°C (167°F) or higher) with all the accessories switched off [B].
g. With the engine warmed up, idle the engine for 2 minutes or more [C].
h. Drive the vehicle at between 37 and 75 mph (60 and 120 km/h) and at an engine speed of between 1400 and 3200 rpm for 5 minutes or more [D].

NOTE: If the conditions in this test are not strictly followed, no malfunction will be detected.

16. **CHECK WHETHER DTC OUTPUT RECURS (DTC P0171 OR P0172)**
    a. Enter the following menus: Powertrain/Engine/Utility/All Readiness.
    b. Input the DTC: P0171 or P0172.
    c. Check the DTC judgment.

    Result

    RESULT CHART

Result	Proceed to
NORMAL (DTC is not output)	A
ABNORMAL (DTC P0171 or P0172 is output)	B

    B: REPLACE ECM (See **REMOVAL**)

    A: REPAIR COMPLETED

17. **INSPECT ENGINE ROOM JUNCTION BLOCK ASSEMBLY (EFI MAIN O. 2 RELAY)**
    a. Inspect the engine room junction block assembly (See **INSPECTION**).

    NG: REPLACE ENGINE ROOM JUNCTION BLOCK ASSEMBLY (See **REMOVAL**)

    OK: Go to next step

18. **CHECK HARNESS AND CONNECTOR (AIR FUEL RATIO SENSOR - EFI MAIN NO. 2 RELAY)** (See **INSPECTION PROCEDURE**)

    NG: REPAIR OR REPLACE HARNESS OR CONNECTOR

    OK: REPAIR OR REPLACE HARNESS OR CONNECTOR (BATTERY - EFI MAIN NO. 2 RELAY)

DTC P0300 RANDOM/MULTIPLE CYLINDER MISFIRE DETECTED; DTC P0301 CYLINDER 1 MISFIRE DETECTED; DTC P0302 CYLINDER 2 MISFIRE DETECTED; DTC P0303 CYLINDER 3 MISFIRE DETECTED; DTC P0304 CYLINDER 4 MISFIRE DETECTED

DESCRIPTION

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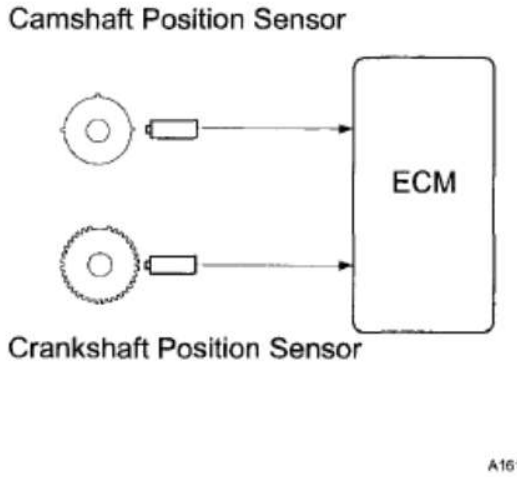


Fig. 130: ECM Communication Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

When the engine misfires, high concentrations of hydrocarbons (HC) enter the exhaust gas. Extremely high hydrocarbon concentration levels can cause an increase in exhaust emission levels. Extremely high concentrations of hydrocarbons can also cause increases in the three-way catalytic converter temperature, which may cause damage to the three-way catalytic converter. To prevent this increase in emissions and to limit the possibility of thermal damage, the ECM monitors the misfire count. When the temperature of the three-way catalytic converter reaches the point of thermal degradation, the ECM blinks the MIL. To monitor misfires, the ECM uses both the camshaft position sensor and the crankshaft position sensor. The camshaft position sensor is used to identify any misfiring cylinders and the crankshaft position sensor is used to measure variations in the crankshaft rotation speed. Misfires are counted when the crankshaft rotation speed variations exceed predetermined thresholds. If the misfire count exceeds the threshold levels, and could cause emission control system performance deterioration, the ECM illuminates the MIL and sets a DTC.

DTC DETECTION CONDITION CHART

DTC No.	DTC Detection Condition	Trouble Area
P0300	One of the following conditions is met (2 trip detection logic): • A misfire occurs that may damage the three-way catalytic converter (MIL blinks). • An emission deterioration misfire occurs (MIL illuminates). • Simultaneous misfiring of several cylinders occurs.	• Open or short in engine wire harness • Connector connection • Vacuum hose connections • Ignition system • Fuel injector • Fuel pressure • Mass air flow meter • Engine coolant temperature sensor • Compression pressure • Valve timing
	One of the following conditions is met (2 trip detection logic):	

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P0301 P0302 P0303 P0304	• A misfire occurs that may damage the three-way catalytic converter (MIL blinks). • An emission deterioration misfire occurs (MIL illuminates). • Misfiring of a specific cylinder occurs.	• PCV valve and hose • PCV hose connections • Intake system • Tumble Control Valve (TCV) • ECM

When DTCs for misfiring cylinders are randomly stored, but DTC P0300 is not stored, it indicates that misfires have been detected in different cylinders at different times. DTC P0300 is only stored when several misfiring cylinders are detected at the same time.

MONITOR DESCRIPTION

The ECM illuminates the MIL and stores a DTC when either one of the following conditions, which could cause emission deterioration, is detected (2 trip detection logic).

- Within the first 1000 crankshaft revolutions after the engine starts, an excessive number of misfires (approximately 20 to 50 misfires per 1000 crankshaft revolutions) occurs once.
- An excessive number of misfires (approximately 20 to 50 misfires per 1000 crankshaft revolutions) occurs a total of 4 times.

The ECM flashes the MIL and stores a DTC when either one of the following conditions, which could cause damage to the three-way catalytic converter, is detected (2 trip detection logic).

HINT:

If a catalyst-damaging misfire occurs, the monitor informs the driver by blinking the MIL (1 trip).

- In every 200 crankshaft revolutions at a high engine speed, the threshold misfiring percentage is recorded once.
- In every 200 crankshaft revolutions at a normal engine speed, the threshold misfiring percentage is recorded 3 times.

The ECM illuminates the MIL and stores a DTC when either one of the following conditions, which could cause emission deterioration, is detected (2 trip detection logic).

MONITOR STRATEGY

MONITOR STRATEGY CHART

Related DTCs	P0300: Multiple Cylinder Misfire P0301: Cylinder 1 Misfire P0302: Cylinder 2 Misfire P0303: Cylinder 3 Misfire P0304: Cylinder 4 Misfire
Required Sensors/Components (Main)	Crankshaft position sensor

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	Camshaft position sensor
Required Sensors/Components (Related)	Engine coolant temperature Intake air temperature sensor Mass air flow meter
Frequency of Operation	Continuous
Duration	1000 to 4000 crankshaft revolutions: Emission-related misfire 200 to 600 crankshaft revolutions: Catalyst-damaging misfire
MIL Operation	2 driving cycles: Emission-related misfire MIL flashes immediately. Catalyst-damaging misfire
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

Misfire

TYPICAL ENABLING CONDITIONS CHART

Monitor runs whenever following DTCs not stored	P0016 (VVT System - Misalignment) P0017 (Exhaust VVT System - Misalignment) P0102, P0103 (Mass Air Flow Meter) P0112, P0113 (Intake Air Temperature Sensor) P0115, P0117, P0118 (Engine Coolant Temperature Sensor) P0125 (Insufficient Coolant Temperature for Closed Loop Fuel Control) P0120, P0121, P0122, P0123, P0220, P0222, P0223, P2135 (Throttle Position Sensor) P0327, P0328 (Knock Sensor) P0335 (Crankshaft Position Sensor) P0340 (Camshaft Position Sensor) P0351 - P0354 (Igniter) P0500 (Vehicle Speed Sensor) P0705 (Shift Lever Position Switch)
Battery voltage	8 V or higher
VVT system	Not operated by scan tool
Engine speed	400 to 6100 rpm
Either of following conditions (a) or (b) met	-
(a) Engine coolant temperature at engine start	Higher than-7°C (19°F)
(b) Engine coolant temperature	Higher than 20°C (68°F)
Fuel cut	OFF

Monitor Period of Emission-related Misfire

TYPICAL ENABLING CONDITIONS CHART

First 1000 revolutions after engine start, or during check mode	Crankshaft 1000 revolutions

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Except above	Crankshaft 1000 revolutions x 4

Monitor Period of Catalyst-damaging Misfire (MIL Blinks)

TYPICAL ENABLING CONDITIONS CHART

All of following conditions 1, 2 and 3 met	Crankshaft 200 revolutions x 3
1. Driving cycles	1st
2. Check mode	OFF
3. Engine speed	Less than 2300 rpm
Except above	Crankshaft 200 revolutions

TYPICAL MALFUNCTION THRESHOLDS

Monitor Period of Emission-related Misfire

TYPICAL MALFUNCTION THRESHOLDS CHART

Misfire rate	0.99% or more

Monitor Period of Catalyst-damaging Misfire (MIL Blinks)

TYPICAL MALFUNCTION THRESHOLDS CHART

Number of misfires per 200 revolutions	124 or more (varies with intake air amount and RPM)

MONITOR RESULT

Refer to **CHECKING MONITOR STATUS** .

WIRING DIAGRAM

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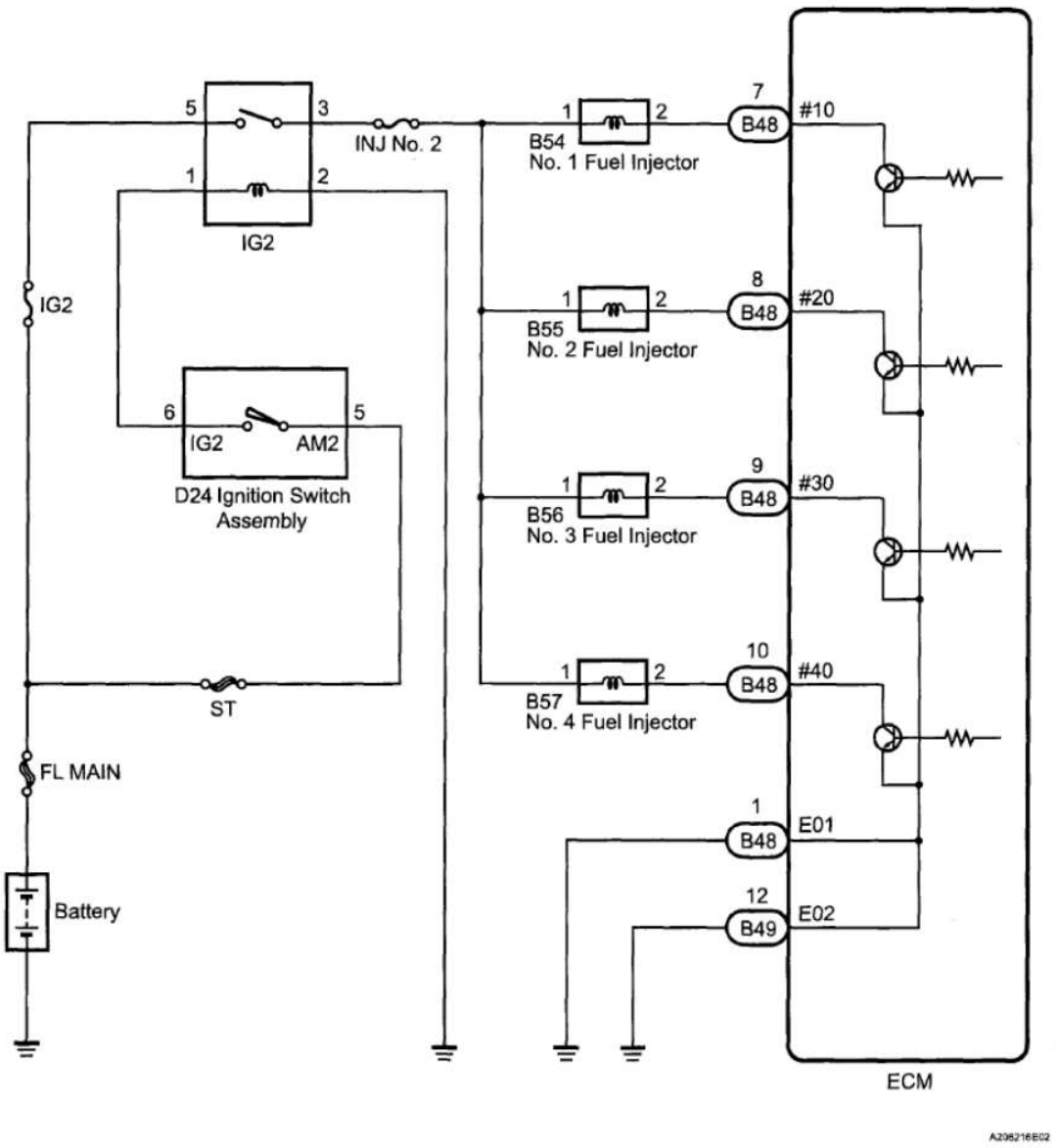


Fig. 131: Random/Multiple Cylinder Misfire Detected - Wiring Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

CONFIRMATION DRIVING PATTERN

1. Connect the Techstream to the DLC3.
2. Turn the ignition switch to ON.
3. Turn the Techstream on.
4. Record the DTC (s) and freeze frame data.
5. Clear the DTCs (even if no DTCs are stored, perform the Clear DTC procedure).
6. Using the Techstream, switch the ECM from normal mode to check mode (See **CHECK MODE PROCEDURE**).

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7. Read the misfire counts of each cylinder, Cylinder #1 Misfire Count to Cylinder #4 Misfire Count, with the engine idling. If any misfire count is displayed, skip the following confirmation driving pattern.
8. Drive the vehicle so that the vehicle conditions displayed in Misfire RPM and Misfire Load of the Data List are the same as the freeze frame data. Perform this step several times.

   HINT:

   In order to store misfire DTCs, it is necessary to operate the vehicle for the period of time shown in the table below, confirm the Misfire RPM and Misfire Load in the Data List.

ENGINE SPEED CHART

Engine speed	Duration
Idling	8 minutes or more
1000	4.5 minutes or more
2000	2.5 minutes or more
3000	1.5 minutes or more

9. Check whether misfires have occurred by checking DTCs and freeze frame data.

   HINT:

   Do not turn the ignition switch off until the output DTC (s) and freeze frame data have been recorded. When the ECM returns to normal mode (default), the stored DTC (s), freeze frame data and other data are cleared.

10. Record the DTC (s), freeze frame data and misfire counts.
11. Turn the ignition switch off and wait for at least 15 seconds.
12. Clear the DTCs (even if no DTCs are stored, perform the Clear DTC procedure).

INSPECTION PROCEDURE

HINT:

- If any DTCs other than misfire DTCs are output, troubleshoot those DTCs first.
- Read freeze frame data using the Techstream. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.
- If the misfire does not recur when the vehicle is brought to the workshop, reproduce the conditions stored in the ECM as freeze frame data.
- If the misfire still cannot be reproduced even though the conditions stored in the ECM as freeze frame data have been reproduced, one of the following factors is considered to be a possible cause of the problem:
  a. There was insufficient fuel in the tank.

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b. Improper fuel was used.
c. The spark plugs have been contaminated.
d. The problem requires further diagnosis.

- After finishing repairs, check the misfire counts of the cylinders (Cylinder #1 Misfire Count to Cylinder #4 Misfire Count).
- Be sure to confirm that no misfiring cylinder DTCs are stored again by conducting the confirmation driving pattern after finishing repairs.
- When one of Short FT #1 or Long FT #1 in the freeze frame data is outside the range of +/-20%, the air fuel ratio may be rich (-20% or less) or lean (+20% or more).
- When Coolant Temp in the freeze frame data is below 75°C (167°F), the misfires have occurred only while warming up the engine.
- An extremely imbalanced drive wheel which causes body vibration may cause misfire DTCs to be stored.

1. **CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO MISFIRE DTCS)**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the Techstream on.
   d. Enter the following menus: Powertrain/Engine/Trouble Codes.
   e. Read the DTCs.

   HINT:

   Write down the output DTCs.

   Result

   RESULT CHART

Result	Proceed to
P0300, P0301, P0302, P0303 and/or P0304	A
P0300, P0301, P0302, P0303 and/or P0304 and other DTCs	B

   HINT:

   If any DTCs other than P0300, P0301, P0302, P0303 and P0304 are output, troubleshoot those DTCs first.

   B: GO TO **DTC CHART**

   A: Go to next step

2. **READ VALUE USING TECHSTREAM (MISFIRE RPM AND MISFIRE LOAD)**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch to ON.

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c. Turn the Techstream on.
d. Enter the following menus: Powertrain/Engine/Data List/All Data/Misfire/Misfire RPM and Misfire Load.
e. Read and note the Misfire RPM and Misfire Load values.

HINT:

The Misfire RPM and Misfire Load values indicate the vehicle conditions under which the misfire occurred.

3. **CHECK PCV HOSE CONNECTIONS**
   a. Check the PCV hose connections.

OK:

PCV hose is correctly connected and is not damaged.

NG: REPAIR OR REPLACE PCV HOSE

OK: Go to next step

4. **READ VALUE USING TECHSTREAM (CATALYST OT MF F/C)**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the Techstream on.
   d. Enter the following menus: Powertrain/Engine/Data List/All Data/Catalyst OT MF F/C.
   e. Read the value displayed on the Techstream.

Result

RESULT CHART

Data List	Techstream Display	Proceed to
Catalyst OT MF F/C	Avail	A
	Not Avl	B

B: Go to step 6

A: Go to next step

5. **PERFORM ACTIVE TEST USING TECHSTREAM (PROHIBIT CAT OT F/C)**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the Techstream on.

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d. Enter the following menus: Powertrain/Engine/Active Test/Prohibit the Catalyst OT Misfire prevent F/C.
e. Perform the Active Test.

NOTE: When performing the Active Test, make sure the vehicle is stopped and the engine is either idling or being revved within 3000 rpm.

6. **READ VALUE USING TECHSTREAM (CYLINDER MISFIRE COUNT)**
   a. Enter the following menus: Powertrain/Engine/Data List/All Data/Misfire/Cylinder #1 Misfire Count, Cylinder #2 Misfire Count, Cylinder #3 Misfire Count and Cylinder #4 Misfire Count.
   b. Start the engine and allow the engine to idle.
   c. Read each value for Cylinder #1 Misfire Count to Cylinder #4 Misfire Count displayed on the Techstream. If no misfire counts occur in any cylinders, perform steps (d) and (e) and then check the misfire counts again.
   d. Drive the vehicle with the Misfire RPM and Misfire Load noted in the "Read Value Using Techstream (Misfire Rpm And Misfire Load)" procedures above.
   e. Read the Cylinder #1 Misfire Count to Cylinder #4 Misfire Count or DTCs displayed on the Techstream.

Result

RESULT CHART

Result (Misfire Count)	Proceed to
Most misfires occur in only 1 or 2 cylinders	A
3 cylinders or more have equal misfire counts	B

HINT:

- If it is difficult to reproduce misfires for each cylinder, check the Data List item called Misfire Margin. Try to find vehicle driving conditions that lower the Misfire Margin value. Values above 30% are considered normal.
- If the freeze frame data record of the engine coolant temperature is below 75°C (167°F), the misfire may be detected only when the engine is cold.
- If the freeze frame data record of the Engine Run Time is below 120 seconds, the misfire may be detected immediately after the engine is started.

B: Go to step 18

A: Go to next step

7. **INSPECT SPARK PLUG**
   a. Remove the ignition coil and the spark plug from the misfiring cylinder.
   b. Measure the spark plug electrode gap.

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Standard gap:

1.0 to 1.1 mm (0.0394 to 0.0433 in.)

NOTE: If the electrode gap is more than 1.1 mm (0.0433 in.), replace the spark plug. Do not adjust the electrode gap.

Recommended Spark Plug

MANUFACTURER CHART

Manufacturer	Product
DENSO made	SK16HR11

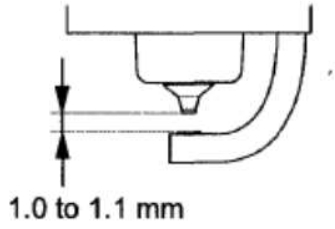


Fig. 132: Identifying Spark Plug Electrode Gap
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

c. Check the electrode for carbon deposits.

NOTE: If necessary, clean the spark plug.

d. Reinstall the ignition coil and spark plug.

NG: REPLACE SPARK PLUG (See **REMOVAL**)

OK: Go to next step

8. **CHECK FOR SPARK (SPARK TEST)**
   a. Disconnect the injector connectors to prevent the engine from starting.

CAUTION: Always disconnect all the injector connectors.

   b. Remove the ignition coil from the cylinder head.
   c. Install the spark plug onto the ignition coil.
   d. Attach the spark plug assembly to the cylinder head.

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e. Crank the engine for less than 2 seconds and check for spark.

NOTE: Do not crank the engine for more than 2 seconds.

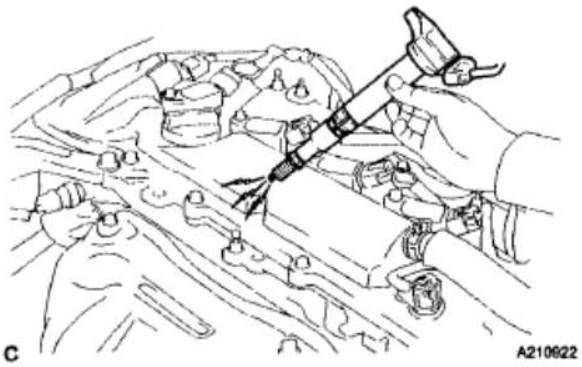


Fig. 133: Checking Spark Plug Spark
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK:

Spark jumps across electrode gap.

f. Install the ignition coil.
g. Reconnect the injector connectors.

NG: Go to step 29

OK: Go to next step

9. **CHECK CYLINDER COMPRESSION PRESSURE**
   a. Measure the cylinder compression pressure of the misfiring cylinder (See **ON-VEHICLE INSPECTION**).

   NG: CHECK ENGINE TO DETERMINE CAUSE OF LOW COMPRESSION

   OK: Go to next step

10. **INSPECT ECM TERMINAL OF MISFIRING CYLINDER (#10, #20, #30 AND/OR #40 VOLTAGE)**
    a. Disconnect the ECM connector.
    b. Turn the ignition switch to ON.
    c. Measure the voltage according to the value(s) in the table below.

    Standard Voltage

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TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Switch Condition	Specified Condition
B48-7 (#10) - Body ground	Ignition switch ON	11 to 14 V
B48-8 (#20) - Body ground	Ignition switch ON	11 to 14 V
B48-9 (#30) - Body ground	Ignition switch ON	11 to 14 V
B48-10 (#40) - Body ground	Ignition switch ON	11 to 14 V

d. Reconnect the ECM connector.

Rear view of wire harness connector:
(to ECM)

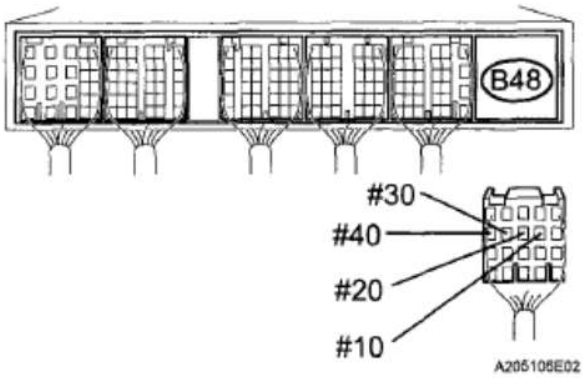


Fig. 134: Disconnecting B48 ECM Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

NG: GO TO **FUEL INJECTOR CIRCUIT**

OK: Go to next step

11. **CHECK FUEL INJECTOR OF MISFIRING CYLINDER**
    a. Check the injector injection (whether fuel volume is high or low, and whether injection pattern is poor) (See **INSPECTION**).

    NG: REPLACE FUEL INJECTOR (See **REMOVAL**)

    OK: Go to next step

12. **CHECK INTAKE SYSTEM**
    a. Check the intake system for vacuum leakage (See **ON-VEHICLE INSPECTION**).

    OK:

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No leakage from intake system.

NG: REPAIR OR REPLACE INTAKE SYSTEM

OK: Go to next step

13. **CHECK INTAKE AIR CONTROL VALVE (FOR TUMBLE CONTROL VALVE)**
    a. Check the intake air control valve for tumble control valve (See **ON-VEHICLE INSPECTION**).

    NG: REPLACE INTAKE AIR CONTROL VALVE (FOR TUMBLE CONTROL VALVE) (See **INTAKE AIR CONTROL VALVE ACTUATOR (FOR TCV)**)

    OK: Go to next step

14. **CHECK VALVE TIMING** (See **INSPECTION PROCEDURE**)

    NG: ADJUST VALVE TIMING (See **REMOVAL**)

    OK: Go to next step

15. **CHECK FUEL PRESSURE**
    a. Check the fuel pressure (See **ON-VEHICLE INSPECTION**).

    NG: REPAIR OR REPLACE FUEL PUMP, PRESSURE REGULATOR, FUEL PIPE LINE OR FILTER

    OK: Go to next step

16. **READ VALUE USING TECHSTREAM (COOLANT TEMP)** (See **INSPECTION PROCEDURE**)

    NG: REPLACE ENGINE COOLANT TEMPERATURE SENSOR (See **REMOVAL**)

    OK: Go to next step

17. **INSPECT MASS AIR FLOW METER** (See **INSPECTION PROCEDURE**)

    NG: REPLACE MASS AIR FLOW METER (See **REMOVAL**)

    OK: REPLACE ECM (See **REMOVAL**)

18. **CHECK INTAKE SYSTEM**
    a. Check the intake system for vacuum leakage (See **ON-VEHICLE INSPECTION**).

    OK:

    No leakage from intake system.

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NG: REPAIR OR REPLACE INTAKE SYSTEM

OK: Go to next step

19. **CHECK INTAKE AIR CONTROL VALVE (FOR TUMBLE CONTROL VALVE)**
    a. Check the intake air control valve for tumble control valve (See **ON-VEHICLE INSPECTION**).

    NG: REPLACE INTAKE AIR CONTROL VALVE (FOR TUMBLE CONTROL VALVE) (See **INTAKE AIR CONTROL VALVE ACTUATOR (FOR TCV)**)

    OK: Go to next step

20. **CHECK VALVE TIMING** (See **INSPECTION PROCEDURE**)

    NG: ADJUST VALVE TIMING (See **REMOVAL**)

    OK: Go to next step

21. **CHECK FUEL PRESSURE**
    a. Check the fuel pressure (See **ON-VEHICLE INSPECTION**).

    NG: REPAIR OR REPLACE FUEL PUMP, PRESSURE REGULATOR, FUEL PIPE LINE OR FILTER

    OK: Go to next step

22. **READ VALUE USING TECHSTREAM (COOLANT TEMP)** (See **INSPECTION PROCEDURE**)

    NG: REPLACE ENGINE COOLANT TEMPERATURE SENSOR (See **REMOVAL**)

    OK: Go to next step

23. **INSPECT MASS AIR FLOW METER** (See **INSPECTION PROCEDURE**)

    NG: REPLACE MASS AIR FLOW METER (See **REMOVAL**)

    OK: Go to next step

24. **INSPECT SPARK PLUG**
    a. Remove the ignition coil and the spark plug from the misfiring cylinder.
    b. Measure the spark plug electrode gap.

    Standard gap:

    1.0 to 1.1 mm (0.0394 to 0.0433 in.)

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NOTE: **If the electrode gap is more than 1.1 mm (0.0433 in.), replace the spark plug. Do not adjust the electrode gap.**

Recommended Spark Plug

MANUFACTURER CHART

Manufacturer	Product
DENSO made	SK16HR11

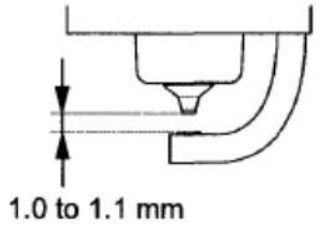


Fig. 135: Identifying Spark Plug Electrode Gap
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

c. Check the electrode for carbon deposits.

NOTE: **If necessary, clean the spark plug.**

d. Reinstall the ignition coil and spark plug.

NG: REPLACE SPARK PLUG (See **REMOVAL**)

OK: Go to next step

25. **CHECK FOR SPARK (SPARK TEST)**
   a. Disconnect the injector connectors to prevent the engine from starting.

CAUTION: Always disconnect all the injector connectors.

   b. Remove the ignition coil from the cylinder head.
   c. Install the spark plug onto the ignition coil.
   d. Attach the spark plug assembly to the cylinder head.
   e. Crank the engine for less than 2 seconds and check for spark.

NOTE: **Do not crank the engine for more than 2 seconds.**

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OK:

Spark jumps across electrode gap.

f. Install the ignition coil.
g. Reconnect the injector connectors.

NG: Go to step 29

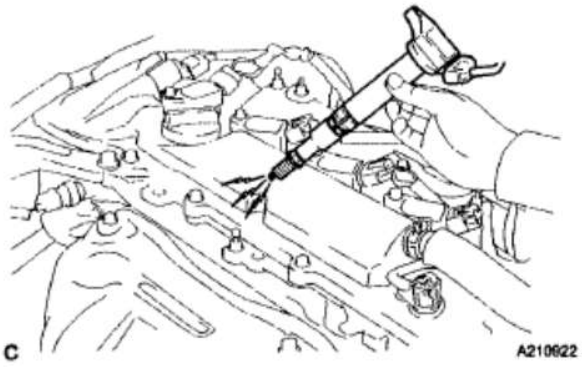


Fig. 136: Checking Spark Plug Spark
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

26. **CHECK CYLINDER COMPRESSION PRESSURE**
    a. Measure the cylinder compression pressure of the misfiring cylinder (See **ON-VEHICLE INSPECTION**).

    NG: CHECK ENGINE TO DETERMINE CAUSE OF LOW COMPRESSION

    OK: Go to next step

27. **INSPECT ECM TERMINAL OF MISFIRING CYLINDER (#10, #20, #30 AND/OR #40 VOLTAGE)**
    a. Disconnect the ECM connector.
    b. Turn the ignition switch to ON.
    c. Measure the voltage according to the value(s) in the table below.

    Standard Voltage

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Switch Condition	Specified Condition
B48-7 (#10) - Body ground	Ignition switch ON	11 to 14 V
B48-8 (#20) - Body ground	Ignition switch ON	11 to 14 V

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B48-9 (#30) - Body ground	Ignition switch ON	11 to 14 V
B48-10 (#40) - Body ground	Ignition switch ON	11 to 14 V

d. Reconnect the ECM connector.

NG: GO TO **FUEL INJECTOR CIRCUIT**

Rear view of wire harness connector:
(to ECM)

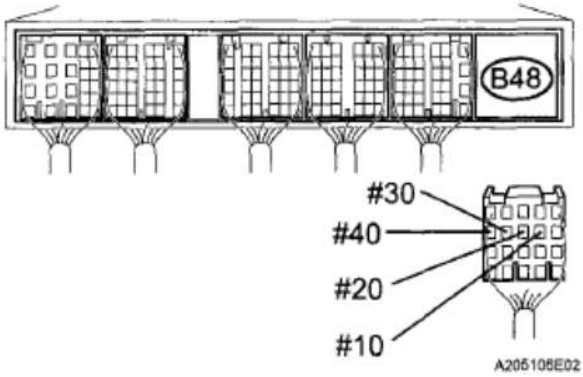


Fig. 137: Disconnecting B48 ECM Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

28. **CHECK FUEL INJECTOR OF MISFIRING CYLINDER**
    a. Check the injector injection (whether fuel volume is high or low, and whether injection pattern is poor) (See **INSPECTION**).

    NG: REPLACE FUEL INJECTOR (See **REMOVAL**)

    OK: REPLACE ECM (See **REMOVAL**)

29. **CHANGE TO KNOWN GOOD SPARK PLUG AND CHECK SPARK OF MISFIRING CYLINDER**
    a. Change the installed spark plug to a known good spark plug.
    b. Perform a spark test.

CAUTION: Always disconnect all the injector connectors.

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NOTE: Do not crank the engine for more than 2 seconds.

1. Install the spark plug into the ignition coil and connect the ignition coil connector.
2. Disconnect the injector connectors.
3. Touch the spark plug to the cylinder head bolts.
4. Check if spark occur while the engine is being cranked.

OK:

Spark jumps across electrode gap.

NG: Go to step 30

OK: REPLACE SPARK PLUG (See **REMOVAL**)

30. **CHANGE TO KNOWN GOOD IGNITION COIL AND CHECK SPARK OF MISFIRING CYLINDER**
    a. Change the known good ignition coil.
    b. Perform a spark test.

CAUTION: Always disconnect all the injector connectors.

NOTE: Do not crank the engine for more than 2 seconds.

1. Install the spark plug into the ignition coil and connect the ignition coil connector.
2. Disconnect the injector connectors.
3. Touch the spark plug to the cylinder head bolts.
4. Check if spark occurs while the engine is being cranked.

OK:

Spark jumps across electrode gap.

NG: REPLACE ECM (See **REMOVAL**)

OK: REPLACE IGNITION COIL (See **REMOVAL**)

DTC P0327 KNOCK SENSOR 1 CIRCUIT LOW INPUT (BANK 1 OR SINGLE SENSOR); DTC P0328 KNOCK SENSOR 1 CIRCUIT HIGH INPUT (BANK 1 OR SINGLE SENSOR)

DESCRIPTION

Flat-type knock sensors (non-resonant type) have structures that can detect vibrations between approximately 6

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kHz and 15 kHz.

Knock sensors are fitted onto the engine block to detect engine knocking.

The knock sensor contains a piezoelectric element which generates a voltage when it becomes deformed. The voltage is generated when the engine block vibrates due to knocking. Any occurrence of engine knocking can be suppressed by delaying the ignition timing.

DTC DETECTION CONDITION CHART

DTC No.	DTC Detection Condition	Trouble Area
P0327	The output voltage of the knock sensor is below 0.5 V for 1 second or more (1 trip detection logic).	• Short in knock sensor circuit • Knock sensor • ECM
P0328	The output voltage of the knock sensor is higher than 4.5 V for 1 second or more (1 trip detection logic).	• Open in knock sensor circuit • Knock sensor • ECM

HINT:

When DTC P0327 or P0328 is stored, the ECM enters fail-safe mode. During fail-safe mode, the ignition timing is delayed to its maximum retardation. Fail-safe mode continues until the ignition switch is turned off.

Reference: Inspection using an oscilloscope

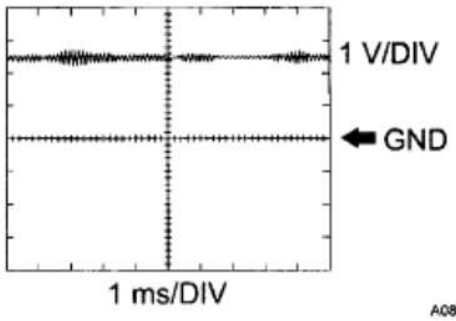


Fig. 138: Identifying Signal Waveform
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

The correct waveform is as shown.

WAVEFORM REFERENCE

Terminal No. (Symbol)	Tool Setting	Condition
B51-12 (KNK1) - B51-6	1 V/DIV, 1	Engine speed maintained at 4000 rpm after warming up

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(EKNK)	ms/DIV	engine

MONITOR DESCRIPTION

If the output voltage transmitted by the knock sensor remains low or high for more than 1 second, the ECM interprets this as a malfunction in the sensor circuit, and stores a DTC.

The monitor for DTCs P0327 and P0328 begins to run when 5 seconds have elapsed since the engine was started.

If the malfunction is not repaired successfully, DTC P0327 or P0328 is stored 5 seconds after the engine is next started.

MONITOR STRATEGY

MONITOR STRATEGY CHART

Related DTCs	P0327: Knock Sensor Range Check (Low Voltage) P0328: Knock Sensor Range Check (High Voltage)
Required Sensors/Components (Main)	Knock sensor
Required Sensors/Components (Related)	-
Frequency of Operation	Continuous
Duration	1 second
MIL Operation	Immediate
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

TYPICAL ENABLING CONDITIONS CHART

Monitor runs whenever following DTCs not stored	None
Battery voltage	10.5 V or higher
Time after engine start	5 seconds or more

TYPICAL MALFUNCTION THRESHOLDS

Knock Sensor Range Check (Low Voltage) P0327

TYPICAL MALFUNCTION THRESHOLDS CHART

Knock sensor voltage	Below 0.5 V

Knock Sensor Range Check (High Voltage) P0328

TYPICAL MALFUNCTION THRESHOLDS CHART

Knock sensor voltage	Higher than 4.5 V

CONFIRMATION DRIVING PATTERN

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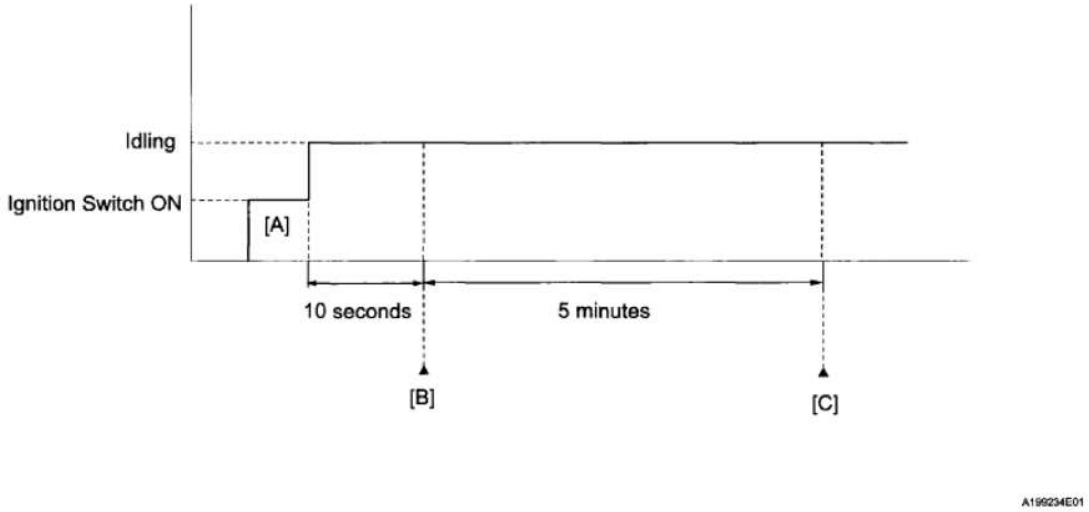


Fig. 139: Confirmation Driving Pattern
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

1. Connect the Techstream to the DLC3.
2. Turn the ignition switch to ON and turn the Techstream on.
3. Clear the DTCs (even if no DTCs are stored, perform the clear DTC procedure).
4. Turn the ignition switch off.
5. Turn the ignition switch to ON and turn the Techstream on [A].
6. Start the engine and wait 10 seconds.
7. Enter the following menus: Powertrain/Engine/Utility/All Readiness.
8. Input the DTC: P0327 or P0328.
9. Check the DTC judgment result [B].

TECHSTREAM DISPLAY DESCRIPTION

Techstream Display	Description
NORMAL	• DTC judgment completed • System normal
ABNORMAL	• DTC judgment completed • System abnormal
INCOMPLETE	• DTC judgment not completed • Perform driving pattern after confirming DTC enabling conditions
UNKNOWN	• Unable to perform DTC judgment • Number of DTCs which do not fulfill DTC preconditions has reached ECU memory limit

HINT:

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If the judgment result shows INCOMPLETE or UNKNOWN, idle the engine for 5 minutes and check the DTC judgment result again [C].

10. If the test result is UNKNOWN, enter the following menus: Powertrain/Engine/Trouble Codes/Pending.
11. Read Pending DTCs.

    HINT:

    If a pending DTC is output, the system is malfunctioning.

12. If the test result is INCOMPLETE or UNKNOWN and no pending DTC is output, perform a universal trip and check for permanent DTCs (See **DTC CHECK/CLEAR**).

    HINT:

    - If a permanent DTC is output, the system is malfunctioning.
    - If no permanent DTC is output, the system is normal.

WIRING DIAGRAM

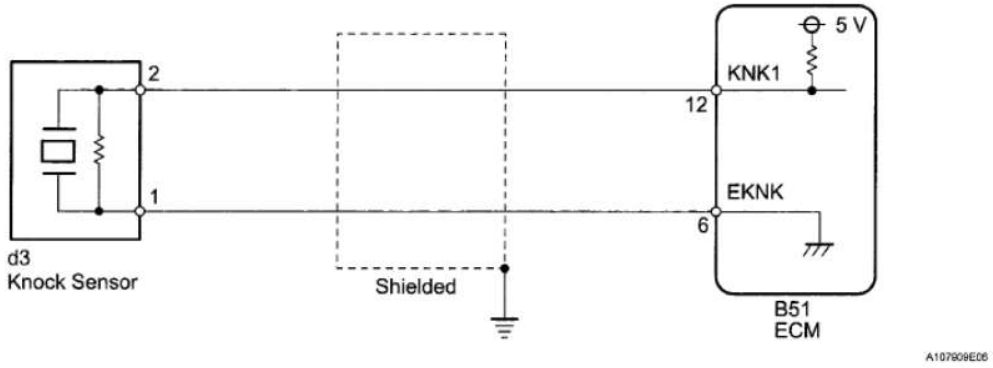


Fig. 140: Knock Sensor 1 Circuit Low Input (Bank 1 Or Single Sensor) - Wiring Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSPECTION PROCEDURE

HINT:

Read freeze frame data using the Techstream. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1. **READ VALUE USING TECHSTREAM (KNOCK FEEDBACK VALUE)**
    a. Connect the Techstream to the DLC3.
    b. Start the engine.

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c. Turn the Techstream on.
d. Warm up the engine.
e. Enter the following menus: Powertrain/Engine/Data List/All Data/Knock Feedback Value.
f. Read the value while driving the vehicle.

OK:

The value changes.

HINT:

MALFUNCTION CHART

Malfunction does not occur	Knock Feedback Value changes
Malfunctions occur	Knock Feedback Value does not change

The knock feedback value change can be confirmed by running the engine with a high load, for example, by activating the air conditioning system and racing the engine.

NG: Go to step 2

OK: CHECK FOR INTERMITTENT PROBLEMS (See **CHECK FOR INTERMITTENT PROBLEMS**)

2. **INSPECT ECM (KNK1 VOLTAGE)**
   a. Disconnect the knock sensor connector.
   b. Turn the ignition switch to ON.
   c. Measure the voltage according to the value(s) in the table below.

Standard Voltage

TESTER CONNECTION SPECIFIED CONDITION CHART

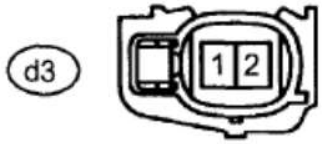
Tester Connection	Switch Condition	Specified Condition
d3-2 - d3-1	Ignition switch ON	4.5 to 5.5 V

   d. Reconnect the knock sensor connector.

NG: Go to step 4

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Front view of wire harness connector:
(to Knock Sensor)



A148715E45

Fig. 141: Identifying Knock Sensor Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

3. **INSPECT KNOCK SENSOR**
   a. Remove the knock sensor.
   b. Measure the resistance according to the value(s) in the table below.

Standard Resistance

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
1 - 2	20°C (68°F)	120 to 280 kohms

   c. Reinstall the knock sensor.

NG: REPLACE KNOCK SENSOR (See **REMOVAL**)

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Component without harness connected:
(Knock Sensor)

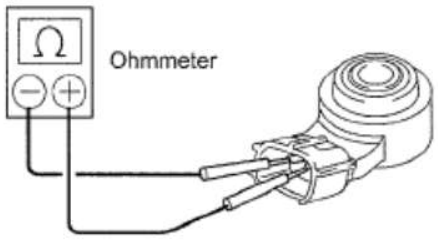


Fig. 142: Inspecting Knock Sensor
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: REPLACE ECM (See **REMOVAL**)

4. **CHECK HARNESS AND CONNECTOR (ECM - KNOCK SENSOR)**
   a. Disconnect the knock sensor connector.
   b. Disconnect the ECM connector.
   c. Measure the resistance according to the value(s) in the table below.

Standard Resistance (Check for Open)

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
d3-2 - B51-12 (KNK1)	Always	Below 1 ohms
d3-1 - B51-6 (EKNK)	Always	Below 1 ohms

Standard Resistance (Check for Short)

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
d3-2 or B51-12 (KNK1) - Body ground	Always	10 kohms or higher

   d. Reconnect the knock sensor connector.
   e. Reconnect the ECM connector.

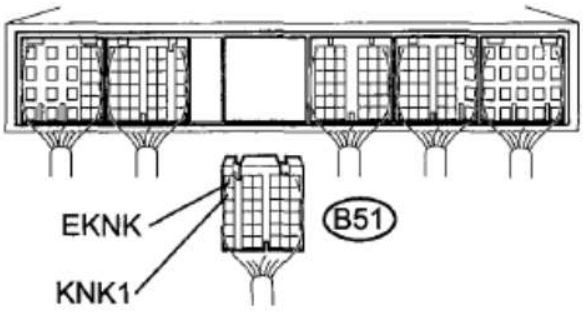
NG: REPAIR OR REPLACE HARNESS OR CONNECTOR

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Front view of wire harness connector:
(to Knock Sensor)



Rear view of wire harness connector:
(to ECM)



A205156E02

Fig. 143: Identifying Knock Sensor Connector And ECM Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: REPLACE ECM (See **REMOVAL**)

DTC P0335 CRANKSHAFT POSITION SENSOR "A" CIRCUIT; DTC P0339 CRANKSHAFT POSITION SENSOR "A" CIRCUIT INTERMITTENT

DESCRIPTION

The crankshaft position sensor system consists of a crankshaft position sensor plate and a pickup coil. The sensor plate has 34 teeth and is installed on the crankshaft. The pickup coil is made of wound copper wire, an iron core and magnet. The sensor plate rotates and, as each tooth passes by the pickup coil, a pulse signal is created. The pickup coil generates 34 signals per crankshaft revolution. Based on these signals, the ECM calculates the crankshaft position and engine speed. Using these calculations, the fuel injection time and ignition timing are controlled.

DTC DETECTION CONDITION CHART

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DTC No.	DTC Detection Condition	Trouble Area
P0335	When either of the following conditions is met (1 trip detection logic): • A missing crankshaft position sensor signal despite the camshaft position sensor signal inputs being normal after the engine is cranked. • No crankshaft position sensor signal to the ECM at an engine speed of 600 rpm or less.	• Open or short in crankshaft position sensor circuit • Crankshaft position sensor • Crankshaft (crank angle sensor plate) • ECM
P0339	All of the following conditions are met (1 trip detection logic): a. The engine speed is 1000 rpm or more. b. No crankshaft position sensor signal for 0.05 seconds or more. c. 3 seconds or more have elapsed since the starter signal switched from ON to OFF.	• Open or short in crankshaft position sensor circuit • Crankshaft position sensor • Crankshaft (crank angle sensor plate) • ECM

Reference: Inspection using an oscilloscope.

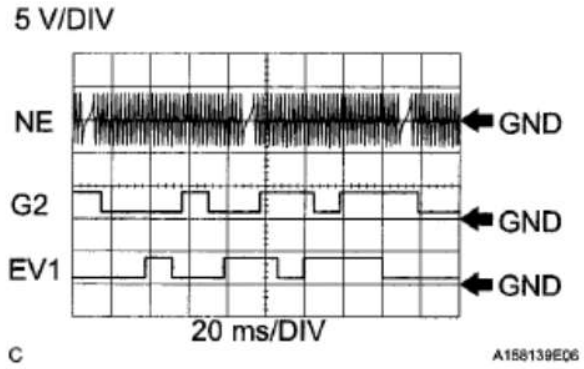


Fig. 144: Identifying Signal Waveform
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

HINT:

- The correct waveform is as shown.
- G2 stands for the camshaft position sensor signal, NE stands for the crankshaft position sensor signal (for intake side) and EV1 stands for the camshaft position sensor (for exhaust side) signal.
- Grounding failure of the shielded wire may cause noise in waveforms.

TOOL SETTING CHART

Terminal No. (Symbol)	Tool Setting	Condition

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B50-14 (NE+) - B50-2 (NE-)	5 V/DIV, 20 ms/DIV	Idling
B49-76 (G2+) - B49-5 (G2-)	5 V/DIV, 20 ms/DIV	Idling
B50-75 (EV1+) - B50-1 (EV1-)	5 V/DIV, 20 ms/DIV	Idling

MONITOR DESCRIPTION

If there is no signal from the crankshaft position sensor despite the crankshaft revolving, the ECM interprets this as a malfunction of the sensor.

If the malfunction is not repaired successfully, a DTC is stored 10 seconds after the engine is next started.

MONITOR STRATEGY

MONITOR STRATEGY CHART

Related DTCs	P0335: Crankshaft Position Sensor Range Check or Rationality
Required Sensors/Components (Main)	Crankshaft position sensor
Required Sensors/Components (Related)	Camshaft position sensor
Frequency of Operation	Continuous
Duration	4.7 seconds
MIL Operation	Immediate
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

P0335: Crankshaft Position Sensor Range Check/Rationality

TYPICAL ENABLING CONDITIONS CHART

Monitor runs whenever following DTCs not stored	None
Time after starter OFF to ON	3 seconds or more
Number of camshaft position sensor signal pulses	6 times
Battery voltage	7 V or higher
Minimum battery voltage while starter ON	Below 11 V
Camshaft position sensor circuit (P0340, P0342, P0343)	Not detected

P0355: Crankshaft Position Sensor Verify Pulse Input

TYPICAL ENABLING CONDITIONS CHART

Monitor runs whenever following DTCs not stored	None
Starter	OFF
Engine speed	600 rpm or less
Time after starter from ON to OFF	3 seconds or more

P0355: Crankshaft Position Sensor Verify Pulse Input

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TYPICAL ENABLING CONDITIONS CHART

Monitor runs whenever following DTCs not stored	None
Starter	ON
Minimum battery voltage while starter ON	Below 11 V

TYPICAL MALFUNCTION THRESHOLDS

P0335: Crankshaft Position Sensor Range Check/Rationality

TYPICAL MALFUNCTION THRESHOLDS CHART

Number of crankshaft position sensor signal pulses	132 or less, and 174 or more

P0355: Crankshaft Position Sensor Verify Pulse Input

TYPICAL MALFUNCTION THRESHOLDS CHART

Engine speed signal	No signal

COMPONENT OPERATING RANGE

COMPONENT OPERATING RANGE CHART

Crankshaft position sensor	• Crankshaft position sensor output voltage fluctuates while crankshaft revolving • 34 crankshaft position sensor signals per crankshaft revolution

CONFIRMATION DRIVING PATTERN

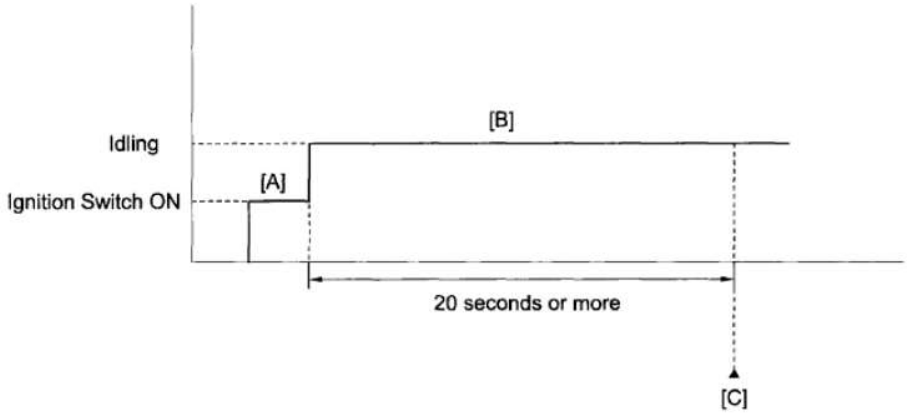


Fig. 145: Confirmation Driving Pattern
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

1. Connect the Techstream to the DLC3.

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2. Turn the ignition switch to ON and turn the Techstream on.
3. Clear the DTCs (even if no DTCs are stored, perform the clear DTC procedure).
4. Turn the ignition switch off.
5. Turn the ignition switch to ON and turn the Techstream on [A].
6. Start the engine.
7. Idle the engine for 20 seconds or more [B].
8. Enter the following menus: Powertrain/Engine/Utility/All Readiness.
9. Input the DTC: P0335 or P0339.
10. Check the DTC judgment result [C].

TECHSTREAM DISPLAY DESCRIPTION

Techstream Display	Description
NORMAL	• DTC judgment completed • System normal
ABNORMAL	• DTC judgment completed • System abnormal
INCOMPLETE	• DTC judgment not completed • Perform driving pattern after confirming DTC enabling conditions
UNKNOWN	• Unable to perform DTC judgment • Number of DTCs which do not fulfill DTC preconditions has reached ECU memory limit

HINT:

If the judgment result shows INCOMPLETE or UNKNOWN, perform steps [B] and [C] again.

11. If the test result is UNKNOWN, enter the following menus: Powertrain/Engine/Trouble Codes/Pending.
12. Read Pending DTCs.

HINT:

If a pending DTC is output, the system is malfunctioning.

13. If the test result is INCOMPLETE or UNKNOWN and no pending DTC is output, perform a universal trip and check for permanent DTCs (See **DTC CHECK/CLEAR**).

HINT:

- If a permanent DTC is output, the system is malfunctioning.
- If no permanent DTC is output, the system is normal.

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WIRING DIAGRAM

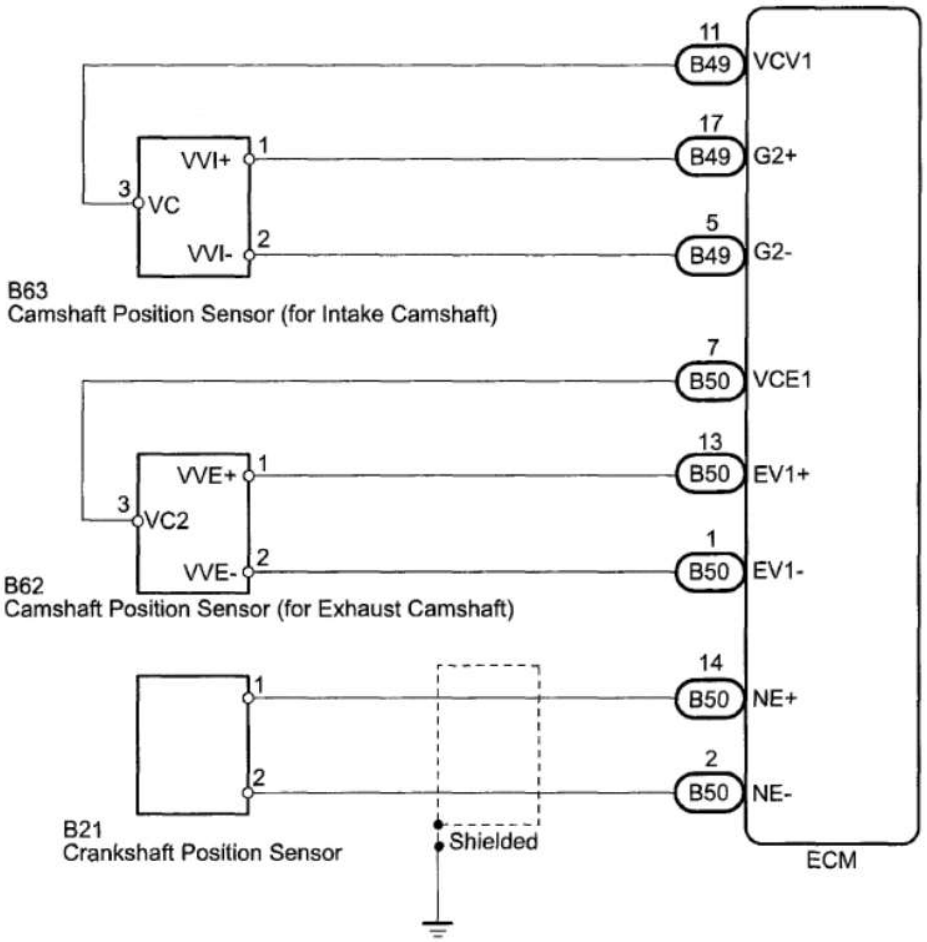


Fig. 146: Crankshaft Position Sensor "A" Circuit - Wiring Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSPECTION PROCEDURE

HINT:

- If no problem is found through this diagnostic troubleshooting procedure, there may be a mechanical problem with the engine.
- Check the engine speed. The engine speed can be checked by using the Techstream. To check, follow the procedure below:
  a. Connect the Techstream to the DLC3.
  b. Start the engine.

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c. Turn the Techstream on.
d. Enter the following menus: Powertrain/Engine/Data List/All Data/Engine Speed.

The engine speed may be indicated as zero despite the crankshaft revolving normally. This is caused by a lack of NE signals from the crankshaft position sensor. Alternatively, the engine speed may be indicated as less than the actual engine speed if the crankshaft position sensor output voltage is insufficient.

- Read freeze frame data using the Techstream. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1. **READ VALUE USING TECHSTREAM (ENGINE SPEED)**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the Techstream on.
   d. Enter the following menus: Powertrain/Engine/Data List/All Data/Engine Speed.
   e. Start the engine.
   f. Read the values displayed on the Techstream while the engine is running.

   OK:

   Correct values are displayed.

   HINT:

   - To check the engine speed change, display the graph on the Techstream.
   - If the engine does not start, check the engine speed while cranking.
   - If the engine speed indicated on the Techstream remains at zero (0), there may be an open or short in the crankshaft position sensor circuit.

   NG: Go to step 2

   OK: CHECK FOR INTERMITTENT PROBLEMS (See **CHECK FOR INTERMITTENT PROBLEMS**)

2. **INSPECT CRANKSHAFT POSITION SENSOR (RESISTANCE)**
   a. Inspect the crankshaft position sensor (See **INSPECTION**).

   NG: REPLACE CRANKSHAFT POSITION SENSOR (See **INSPECTION**)

   OK: Go to next step

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3. **CHECK HARNESS AND CONNECTOR (CRANKSHAFT POSITION SENSOR - ECM)**
   a. Disconnect the crankshaft position sensor connector.
   b. Disconnect the ECM connector.
   c. Measure the resistance according to the value(s) in the table below.

Standard Resistance (Check for Open)

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
B21-1 - B50-14 (NE+)	Always	Below 1 ohms
B21-2 - B50-2 (NE-)	Always	Below 1 ohms

Standard Resistance (Check for Short)

TESTER CONNECTION SPECIFIED CONDITION CHART

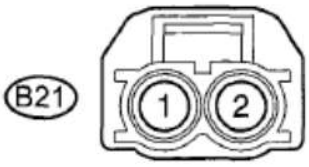
Tester Connection	Condition	Specified Condition
B21-1 or B50-14 (NE+) - Body ground	Always	10 kohms or higher
B21-2 or B50-2 (NE-) - Body ground	Always	10 kohms or higher

   d. Reconnect the crankshaft position sensor connector.
   e. Reconnect the ECM connector.

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR

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Front view of wire harness connector:
(to Crankshaft Position Sensor)



Rear view of wire harness connector:
(to ECM)

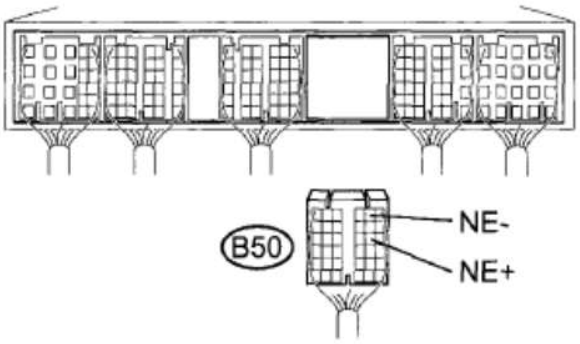


Fig. 147: Identifying Crankshaft Position Sensor And ECM Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

4. **CHECK SENSOR INSTALLATION (CRANKSHAFT POSITION SENSOR)**
   a. Check the crankshaft position sensor installation.

   OK:

   Sensor is installed correctly.

   NG: SECURELY REINSTALL SENSOR (See **INSPECTION**)

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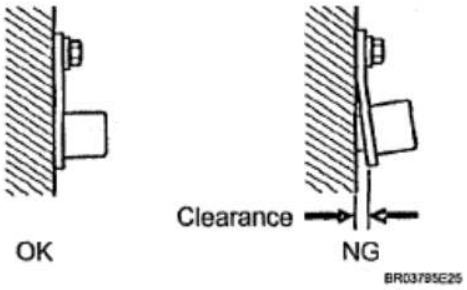


Fig. 148: Identifying Clearance Between Crankshaft Position Sensor
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

5. **INSPECT CRANK ANGLE SENSOR PLATE (TEETH OF SENSOR PLATE)**
   a. Check the teeth of the crank angle sensor plate.

   OK:

   Crank angle sensor plate does not have any cracks or deformation.

   NG: REPLACE CRANKSHAFT (See **REMOVAL**)

   OK: Go to next step

6. **REPLACE CRANKSHAFT POSITION SENSOR**
   a. Replace the crankshaft position sensor (See **INSPECTION**).
7. **CHECK WHETHER DTC OUTPUT RECURS**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the Techstream on.
   d. Clear the DTCs (See **DTC CHECK/CLEAR**).
   e. Turn the ignition switch off.
   f. Start the engine.
   g. Enter the following menus: Powertrain/Engine/Trouble Codes.
   h. Read the DTCs.

   Result

   RESULT CHART

Result	Proceed to
DTC is not output	A
DTC P0335 or P0339 is output	B

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HINT:

If the engine does not start, replace the ECM.

B: REPLACE ECM (See **REMOVAL**)

A: REPAIR COMPLETED

DTC P0340 CAMSHAFT POSITION SENSOR CIRCUIT MALFUNCTION; DTC P0342 CAMSHAFT POSITION SENSOR "A" CIRCUIT LOW INPUT (BANK 1 OR SINGLE SENSOR); DTC P0343 CAMSHAFT POSITION SENSOR "A" CIRCUIT HIGH INPUT (BANK 1 OR SINGLE SENSOR)

DESCRIPTION

The camshaft position sensor for the intake camshaft (G signal sensor) consists of a magnet and MRE element.

The camshaft has a timing rotor for the camshaft position sensor. When the camshaft rotates, changes occur in the air gaps between the timing rotor and MRE element, which affects the magnet. As a result, the resistance of the MRE material fluctuates. The camshaft position sensor converts the camshaft rotation data to pulse signals, uses the pulse signals to determine the camshaft angle, and sends it to the ECM. Then the ECM uses this data to control fuel injection time and injection timing.

DTC DETECTION CONDITION CHART

DTC No.	DTC Detection Condition	Trouble Area
P0340	When one of the following conditions is met: • No camshaft position sensor signal to the ECM while cranking (2 trip detection logic). • A missing camshaft position sensor signal despite the crankshaft position sensor inputs being normal at an engine speed of 600 rpm or more (1 trip detection logic).	• Open or short in camshaft position sensor circuit for intake camshaft • Camshaft position sensor for intake camshaft • Intake camshaft • Timing chain jumped tooth • ECM
P0342	The output voltage of the camshaft position sensor is below 0.3 V for 4 seconds (1 trip detection logic).	• Open or short in camshaft position sensor circuit for intake camshaft • Camshaft position sensor for intake camshaft • Intake camshaft • Timing chain jumped tooth • ECM
		• Open or short in camshaft position sensor circuit for intake camshaft

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P0343	The output voltage is 4.7 V for 4 seconds (1 trip detection logic).	• Camshaft position sensor for intake camshaft • Intake camshaft • Timing chain jumped tooth • ECM

HINT:

DTC P0340 indicates a malfunction relating to the camshaft position sensor circuit (the wire harness between the ECM and camshaft position sensor, and the camshaft position sensor itself). Reference: Inspection using an oscilloscope (See **DTC P0335 CRANKSHAFT POSITION SENSOR "A" CIRCUIT; DTC P0339 CRANKSHAFT POSITION SENSOR "A" CIRCUIT INTERMITTENT**).

MONITOR DESCRIPTION

If no signal is transmitted by the camshaft position sensor despite the camshaft revolving, or the rotation of the camshaft and the crankshaft is not synchronized, the ECM interprets this as a malfunction of the sensor.

If the malfunction is not repaired successfully, the DTC is stored 10 seconds after the engine is next started.

MONITOR STRATEGY

MONITOR STRATEGY CHART

Related DTCs	P0340: Camshaft Position Sensor Range Check/Rationality P0340: Camshaft Position Verify Pulse Input P0342: Camshaft Position Sensor Range Check (Low Voltage) P0343: Camshaft Position Sensor Range Check (High Voltage)
Required Sensors/Components (Main)	Camshaft position sensor
Required Sensors/Components (Related)	Crankshaft position sensor
Frequency of Operation	Continuous
Duration	4 seconds: Camshaft position sensor range check/rationality (P0340), Camshaft position sensor range check (P0342, P0343) 5 seconds: Camshaft position verify pulse input(P0340)
MIL Operation	2 driving cycles: Camshaft position sensor range check/rationality (P0340) Immediate: Camshaft position verify pulse input (P0340), Camshaft position sensor range check (P0342, P0343)
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

P0340: Camshaft Position Sensor Range Check/Rationality

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TYPICAL ENABLING CONDITIONS CHART

Monitor runs whenever following DTCs not stored	None
Starter	ON and not starter ON again
Minimum battery voltage while starter ON	Below 11 V

P0340: Camshaft Position Sensor Verify Pulse Input

TYPICAL ENABLING CONDITIONS CHART

Monitor runs whenever following DTCs not stored	None
Engine speed	600 rpm or more
Starter	OFF
Camshaft position sensor voltage	0.3 to 4.7 V
VVT system misalignment	Not detected
Camshaft position sensor range check fail (P0342, P0343)	Not detected

P0342, P0343: Camshaft Position Sensor Range Check

TYPICAL ENABLING CONDITIONS CHART

Monitor runs whenever following DTCs not stored	None
Starter	OFF
Ignition switch	ON
Time after ignition switch turned from off to ON	2 seconds
Battery voltage	8 V or higher
Camshaft position sensor verify pulse input fail (P0340)	Not detected

TYPICAL MALFUNCTION THRESHOLDS

P0340: Camshaft Position Sensor Range Check/Rationality

TYPICAL MALFUNCTION THRESHOLDS CHART

Camshaft position sensor signal	No signal

P0340: Camshaft Position Sensor Verify Pulse Input

TYPICAL MALFUNCTION THRESHOLDS CHART

Camshaft position and crankshaft position phase	Misaligned

P0342: Camshaft Position Sensor Range Check

TYPICAL MALFUNCTION THRESHOLDS CHART

Camshaft position sensor voltage	Below 0.3 V

P0343: Camshaft Position Sensor Range Check

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TYPICAL MALFUNCTION THRESHOLDS CHART

Camshaft position sensor voltage	Higher than 4.7 V

COMPONENT OPERATING RANGE

COMPONENT OPERATING RANGE CHART

Camshaft position sensor voltage	0.3 to 4.7 V

CONFIRMATION DRIVING PATTERN

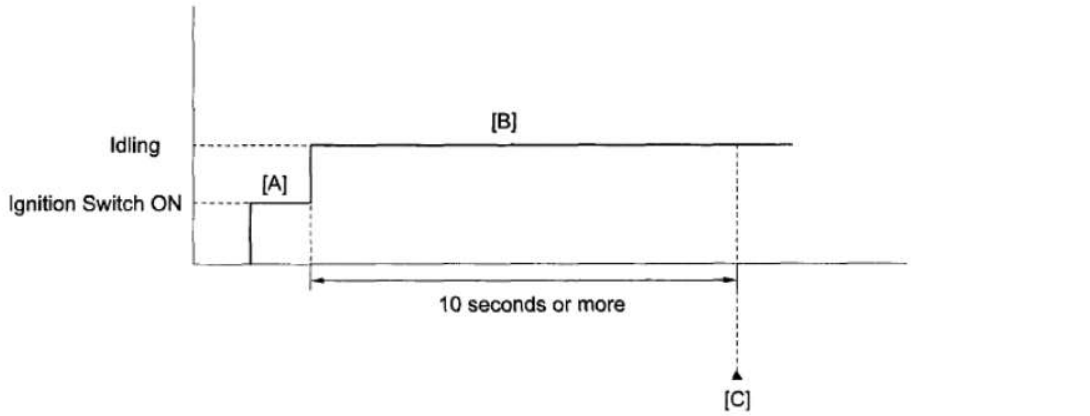


Fig. 149: Confirmation Driving Pattern
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

1. Connect the Techstream to the DLC3.
2. Turn the ignition switch to ON and turn the Techstream on.
3. Clear the DTCs (even if no DTCs are stored, perform the clear DTC procedure).
4. Turn the ignition switch off.
5. Turn the ignition switch to ON and turn the Techstream on [A].
6. Start the engine.
7. Idle the engine for 10 seconds or more [B].
8. Enter the following menus: Powertrain/Engine/Utility/All Readiness.
9. Input the DTC: P0340, P0342 or P0343.
10. Check the DTC judgment result [C].

TECHSTREAM DISPLAY DESCRIPTION

Techstream Display	Description
NORMAL	• DTC judgment completed

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	• System normal
ABNORMAL	• DTC judgment completed • System abnormal
INCOMPLETE	• DTC judgment not completed • Perform driving pattern after confirming DTC enabling conditions
UNKNOWN	• Unable to perform DTC judgment • Number of DTCs which do not fulfill DTC preconditions has reached ECU memory limit

HINT:

If the judgment result shows INCOMPLETE or UNKNOWN, perform steps [B] and [C] again.

11. If the test result is UNKNOWN, enter the following menus: Powertrain/Engine/Trouble Codes/Pending.
12. Read Pending DTCs.

HINT:

If a pending DTC is output, the system is malfunctioning.

13. If the test result is INCOMPLETE or UNKNOWN and no pending DTC is output, perform a universal trip and check for permanent DTCs (See **DTC CHECK/CLEAR**).

HINT:

- If a permanent DTC is output, the system is malfunctioning.
- If no permanent DTC is output, the system is normal.

WIRING DIAGRAM

Refer to **DTC P0335** .

INSPECTION PROCEDURE

HINT:

- Read freeze frame data using the Techstream. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.
- If no problem is found through this diagnostic troubleshooting procedure, there may be a mechanical problem with the engine.

1. **CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P0340, P0342 OR P0343)**

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a. Connect the Techstream to the DLC3.
b. Turn the ignition switch to ON.
c. Turn the Techstream on.
d. Enter the following menus: Powertrain/Engine/Trouble Codes.
e. Read the DTCs.

Result

RESULT CHART

Result	Proceed to
DTC P0340, P0342 or P0343 is output	A
DTC P0340, P0342 or P0343 and other DTCs are output	B

HINT:

If any DTCs other than P0340, P0342 or P0343 are output, troubleshoot those DTCs first.

B: GO TO **DTC CHART**

A: Go to next step

2. **INSPECT CAMSHAFT POSITION SENSOR (FOR INTAKE CAMSHAFT) (POWER SOURCE)**
   a. Disconnect the camshaft position sensor (for intake camshaft) connector.
   b. Turn the ignition switch to ON.
   c. Measure the voltage according to the value(s) in the table below.

Standard Voltage

TESTER CONNECTION SPECIFIED CONDITION CHART

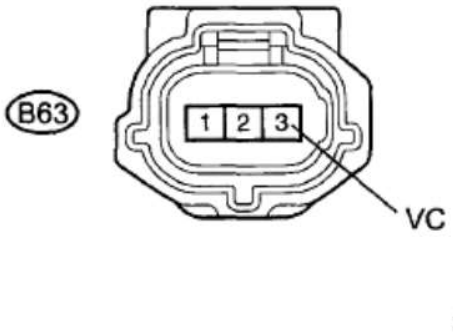
Tester Connection	Switch Condition	Specified Condition
B63-3 (VC) - Body ground	Ignition switch ON	4.5 to 5.5 V

   d. Reconnect the camshaft position sensor (for intake camshaft) connector.

NG: Go to step 9

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Front view of wire harness connector:
(to Camshaft Position Sensor for
Intake Camshaft)



A187252E05

Fig. 150: Identifying Camshaft Position Sensor Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

3. **CHECK HARNESS AND CONNECTOR (CAMSHAFT POSITION SENSOR - ECM)**
   a. Disconnect the camshaft position sensor (for intake camshaft) connector.
   b. Disconnect the ECM connector.
   c. Measure the resistance according to the value(s) in the table below.

Standard Resistance (Check for Open)

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
B63-1 (VVI+) - B49-17 (G2+)	Always	Below 1 ohms
B63-2 (VVI-) - B49-5 (G2-)	Always	Below 1 ohms

Standard Resistance (Check for Short)

TESTER CONNECTION SPECIFIED CONDITION CHART

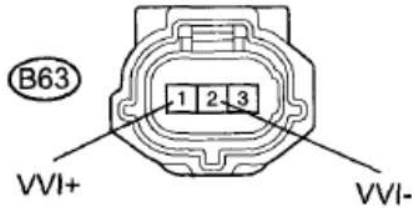
Tester Connection	Condition	Specified Condition
B63-1 (VVI+) or B49-17 (G2+) - Body ground	Always	10 kohms or higher
B63-2 (VVI-) or B49-5 (G2-) - Body ground	Always	10 kohms or higher

   d. Reconnect the camshaft position sensor (for intake camshaft) connector.
   e. Reconnect the ECM connector.

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR

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Front view of wire harness connector: (to Camshaft Position Sensor for Intake Camshaft)



Rear view of wire harness connector: (to ECM)

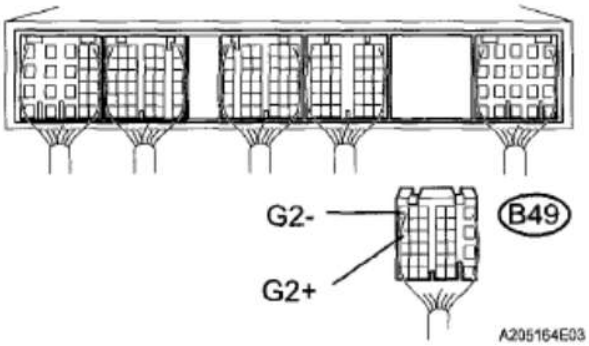


Fig. 151: Identifying Camshaft Position Sensor And ECM Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

4. **CHECK SENSOR INSTALLATION (CAMSHAFT POSITION SENSOR FOR INTAKE CAMSHAFT)**
   a. Check the camshaft position sensor (for intake camshaft) installation.

   OK:

   Sensor is installed correctly.

   NG: SECURELY REINSTALL SENSOR (See **INSTALLATION**)

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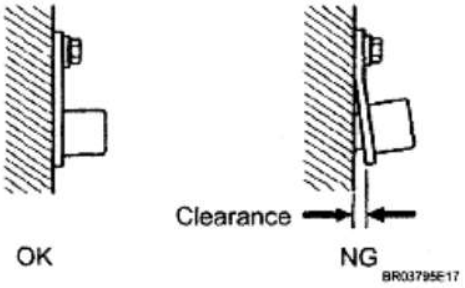


Fig. 152: Identifying Clearance Between Camshaft Position Sensor
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

5. **INSPECT INTAKE CAMSHAFT (TIMING ROTOR)**
   a. Check the timing rotor of the intake camshaft.

   OK:

   Camshaft timing rotor does not have any cracks or deformation.

   NG: REPLACE INTAKE CAMSHAFT (See **REMOVAL**)

   OK: Go to next step

6. **CHECK VALVE TIMING**
   a. Check the valve timing (See **INSPECTION PROCEDURE**).

   NG: ADJUST VALVE TIMING (See **REMOVAL**)

   OK: Go to next step

7. **REPLACE CAMSHAFT POSITION SENSOR (FOR INTAKE CAMSHAFT)**
   a. Replace the camshaft position sensor (See **INSTALLATION**).
8. **CHECK WHETHER DTC OUTPUT RECURS (P0340, P0342 OR P0343)**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the Techstream on.
   d. Clear the DTCs (See **DTC CHECK/CLEAR**).
   e. Turn the ignition switch off.
   f. Start the engine and allow the engine to idle for 10 seconds or more.
   g. Enter the following menus: Powertrain/Engine/Trouble Codes/Pending.
   h. Read the pending DTCs.

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Result

RESULT CHART

Result	Proceed to
DTC P0340, P0342 or P0343 is output	A
DTC is not output	B

HINT:

If the engine does not start, replace the ECM.

B: REPAIR COMPLETED

A: REPLACE ECM (See **REMOVAL**)

9. **CHECK HARNESS AND CONNECTOR (CAMSHAFT POSITION SENSOR - ECM)**
   a. Disconnect the camshaft position sensor (for intake camshaft) connector.
   b. Disconnect the ECM connector.
   c. Measure the resistance according to the value(s) in the table below.

Standard Resistance (Check for Open)

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
B63-3 (VC) - B49-11 (VCV1)	Always	Below 1 ohms

Standard Resistance (Check for Short)

TESTER CONNECTION SPECIFIED CONDITION CHART

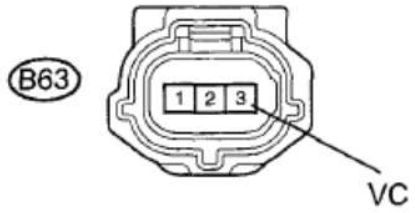
Tester Connection	Condition	Specified Condition
B63-3 (VC) or B49-11 (VCV1) - Body ground	Always	10 kohms or higher

   d. Reconnect the camshaft position sensor (for intake camshaft) connector.
   e. Reconnect the ECM connector.

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR

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Front view of wire harness connector: (to Camshaft Position Sensor for Intake Camshaft)



Rear view of wire harness connector: (to ECM)

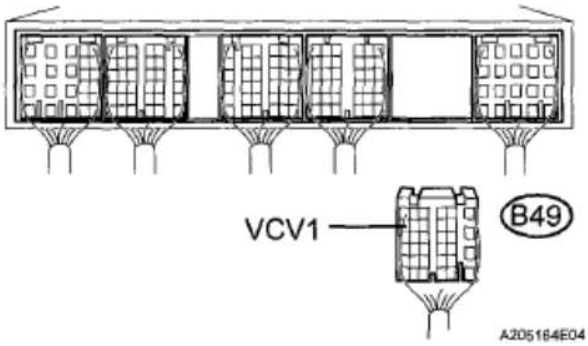


Fig. 153: Identifying Camshaft Position Sensor And ECM Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: REPLACE ECM (See **REMOVAL**)

DTC P0351 IGNITION COIL "A" PRIMARY/SECONDARY CIRCUIT; DTC P0352 IGNITION COIL "B" PRIMARY/SECONDARY CIRCUIT; DTC P0353 IGNITION COIL "C" PRIMARY/SECONDARY CIRCUIT; DTC P0354 IGNITION COIL "D" PRIMARY/SECONDARY CIRCUIT

DESCRIPTION

HINT:

- These DTCs indicate malfunctions relating to the primary circuit.
- If DTC P0351 is output, check the No. 1 ignition coil circuit.
- If DTC P0352 is output, check the No. 2 ignition coil circuit.
- If DTC P0353 is output, check the No. 3 ignition coil circuit.

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- If DTC P0354 is output, check the No. 4 ignition coil circuit.

A Direct Ignition System (DIS) is used on this vehicle.

The DIS is a 1-cylinder ignition system in which each cylinder is ignited by one ignition coil and one spark plug is connected to the end of each secondary wiring. A powerful voltage, generated in the secondary wiring, is applied directly to each spark plug. The spark of the spark plugs passes from the center electrode to the ground electrodes.

The ECM determines the ignition timing and transmits the ignition (IGT) signals to each cylinder. Using the IGT signal, the ECM turns the power transistor inside the igniter on and off. The power transistor, in turn, switches on and off the current to the primary coil. When the current to the primary coil is cut off, a powerful voltage is generated in the secondary coil. This voltage is applied to the spark plugs, causing them to spark inside the cylinders. As the ECM cuts the current to the primary coil, the igniter sends back an ignition confirmation (IGF) signal to the ECM for each cylinder ignition.

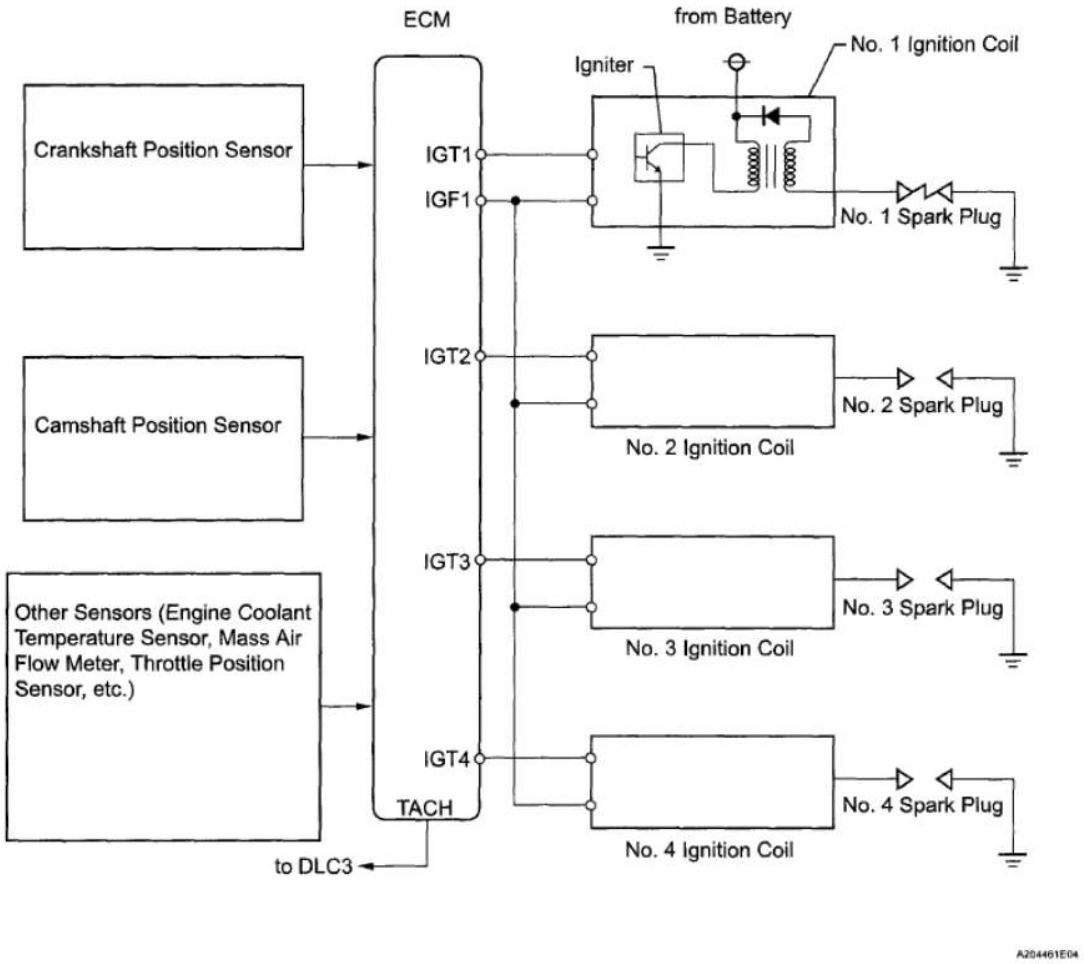


Fig. 154: Ignition Coil Communication Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

DTC DETECTION CONDITION CHART

DTC No.	DTC Detection Condition	Trouble Area
P0351 P0352 P0353 P0354	No IGF signal to the ECM while the engine is running (1 trip detection logic).	• Ignition system • Open or short in IGF1 or IGT circuit (1 to 4) between ignition coil and ECM • No. 1 to No. 4 ignition coils • ECM

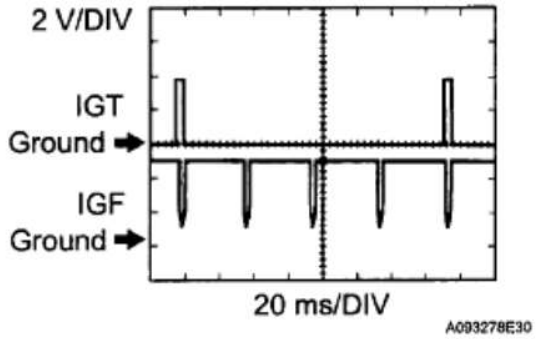


Fig. 155: Identifying Signal Waveform
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Reference: Inspection using an oscilloscope.

While cranking or idling the engine, check the waveform between terminals IGT (1 to 4) and E1, and IGF1 and E1 of the ECM connector.

TOOL SETTING CHART

Terminal No. (Symbol)	Tool Setting	Condition
B48-2 (IGT1) - B49-6 (E1)	2 V/DIV, 20 ms/DIV	Idling
B48-3 (IGT2) - B49-6 (E1)	2 V/DIV, 20 ms/DIV	Idling
B48-4 (IGT3) - B49-6 (E1)	2 V/DIV, 20 ms/DIV	Idling
B48-5 (IGT4) - B49-6 (E1)	2 V/DIV, 20 ms/DIV	Idling
B48-16 (IGF1) - B49-6 (E1)	2 V/DIV, 20 ms/DIV	Idling

MONITOR DESCRIPTION

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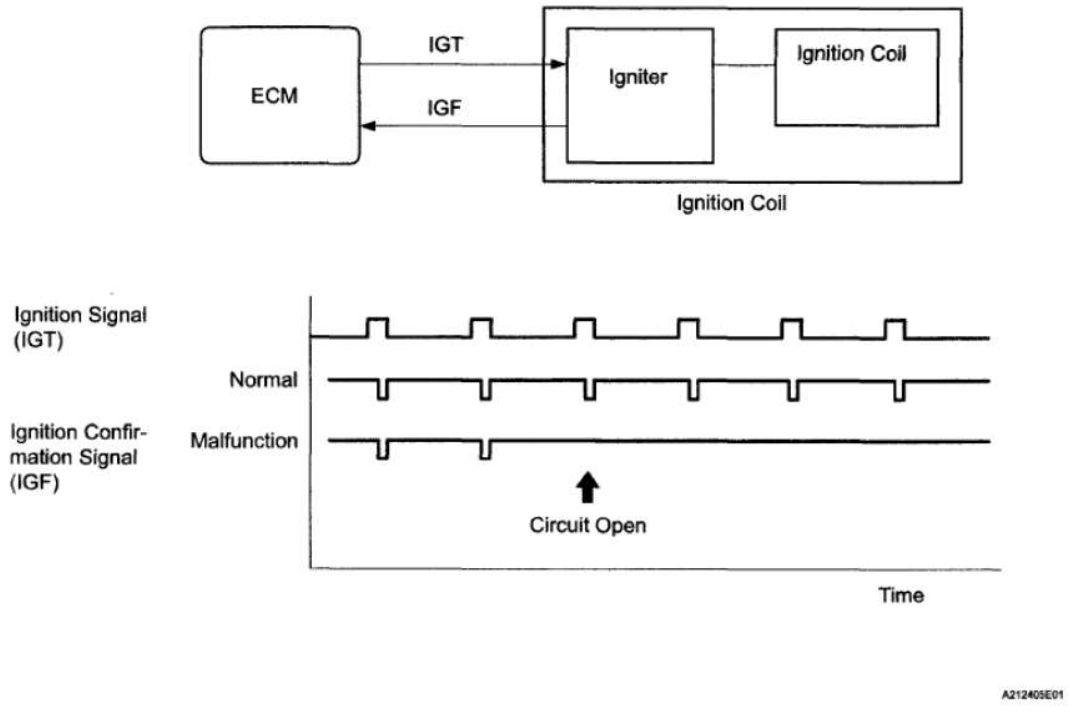


Fig. 156: Ignition Signal Waveform
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

If the ECM does not receive any IGF signals despite transmitting the IGT signal, it interprets this as a fault in the igniter and stores a DTC.

If the malfunction is not repaired successfully, a DTC is stored 1 second after the engine is next started.

MONITOR STRATEGY

MONITOR STRATEGY CHART

Related DTCs	P0351: Igniter (Cylinder 1) Malfunction P0352: Igniter (Cylinder 2) Malfunction P0353: Igniter (Cylinder 3) Malfunction P0354: Igniter (Cylinder 4) Malfunction
Required Sensors/Components (Main)	Igniter
Required Sensors/Components (Related)	Crankshaft position sensor
Frequency of Operation	Continuous
Duration	0.256 seconds for 2 times
MIL Operation	Immediate
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

TYPICAL ENABLING CONDITIONS CHART

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Monitor runs whenever following DTCs not stored	None
Spark cut	Not operating
Either of following conditions met	-
A. Engine speed	1500 rpm or less
B. Starter	OFF
Either of following conditions met	-
C. Both of following conditions met	-
(a) Engine speed	500 rpm or less
(b) Battery voltage	6 V or higher
D. All of following conditions met	-
(a) Engine speed	More than 500 rpm
(b) Battery voltage	10 V or higher
(c) Number of sparks after CPU reset	5 sparks or more

TYPICAL MALFUNCTION THRESHOLDS

TYPICAL MALFUNCTION THRESHOLDS CHART

A. Ignition signal fail counter	More than 2 times
B. Ignition signal fail counter after A conditions is met	More than 2 times

COMPONENT OPERATING RANGE

COMPONENT OPERATING RANGE CHART

Confirmed ignition signal input when ignition signal is on to off	2 times

CONFIRMATION DRIVING PATTERN

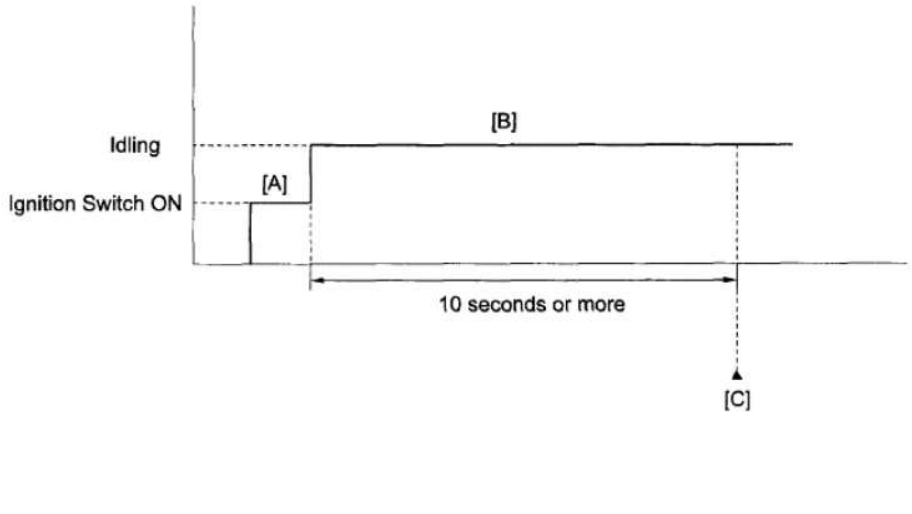


Fig. 157: Confirmation Driving Pattern
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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1. Connect the Techstream to the DLC3.
2. Turn the ignition switch to ON and turn the Techstream on.
3. Clear the DTCs (even if no DTCs are stored, perform the clear DTC procedure).
4. Turn the ignition switch off.
5. Turn the ignition switch to ON and turn the Techstream on [A].
6. Start the engine.
7. Idle the engine for 10 seconds or more [B].
8. Enter the following menus: Powertrain/Engine/Utility/All Readiness.
9. Input the DTC: P0351, P0352, P0353 or P0354.
10. Check the DTC judgment result [C].

TECHSTREAM DISPLAY DESCRIPTION

Techstream Display	Description
NORMAL	• DTC judgment completed • System normal
ABNORMAL	• DTC judgment completed • System abnormal
INCOMPLETE	• DTC judgment not completed • Perform driving pattern after confirming DTC enabling conditions
UNKNOWN	• Unable to perform DTC judgment • Number of DTCs which do not fulfill DTC preconditions has reached ECU memory limit

HINT:

- If the judgment result shows ABNORMAL, the system has a malfunction.
- If the judgment result shows INCOMPLETE or UNKNOWN, perform steps [B] and [C] again.

11. If the test result is UNKNOWN, enter the following menus: Powertrain/Engine/Trouble Codes/Pending.
12. Read Pending DTCs.

HINT:

If a pending DTC is output, the system is malfunctioning.

13. If the test result is INCOMPLETE or UNKNOWN and no pending DTC is output, perform a universal trip and check for permanent DTCs (See **DTC CHECK/CLEAR**).

HINT:

- If a permanent DTC is output, the system is malfunctioning.

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- If no permanent DTC is output, the system is normal.

WIRING DIAGRAM

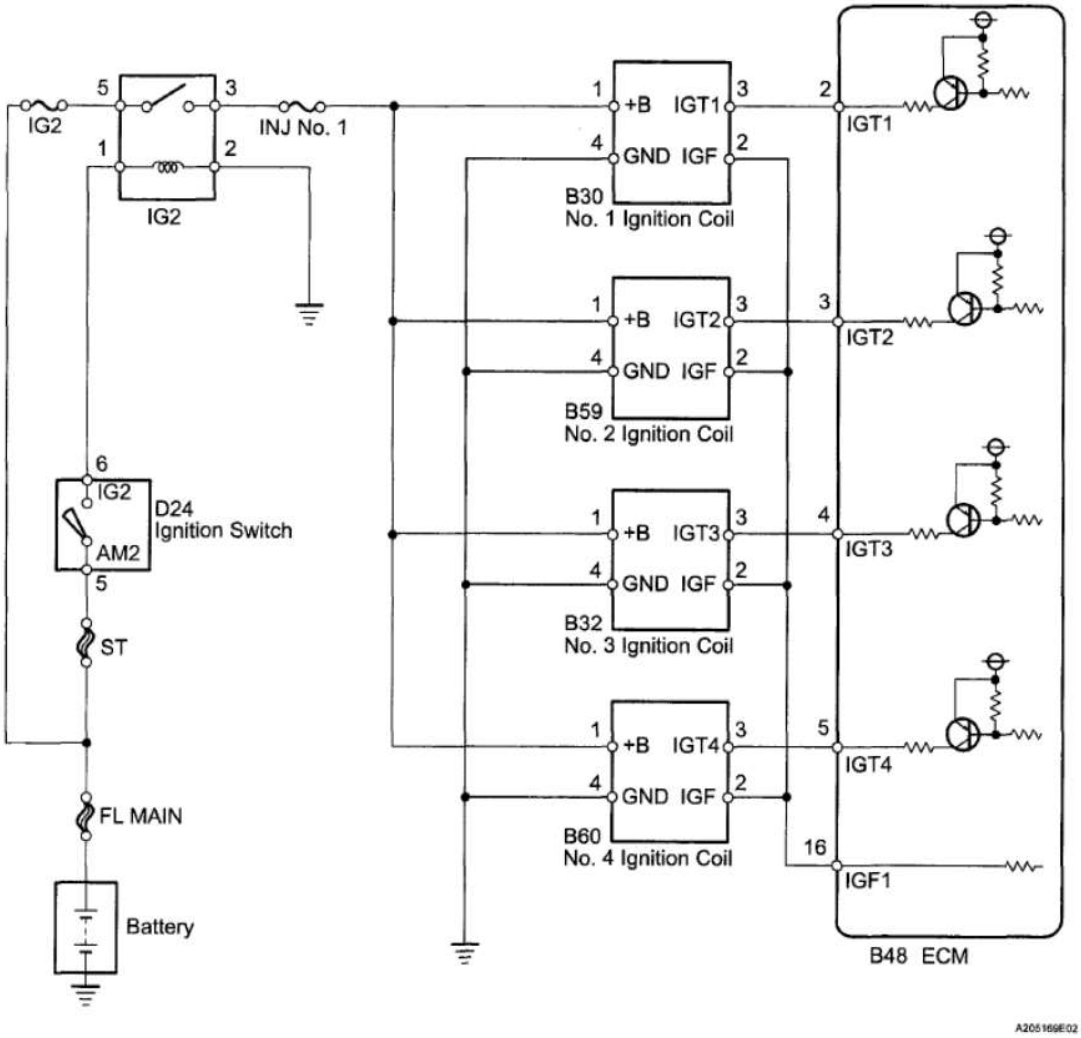


Fig. 158: Ignition Coil "A" Primary/Secondary Circuit - Wiring Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSPECTION PROCEDURE

NOTE: Inspect the fuses for circuits related to this system before performing the following inspection procedure.

HINT:

Read freeze frame data using the Techstream. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich,

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and other data from the time the malfunction occurred.

1. **CHECK HARNESS AND CONNECTOR (IG2 RELAY - IGNITION COIL, IGNITION COIL BODY GROUND)**
   a. Disconnect the ignition coil connectors.
   b. Measure the resistance according to the value(s) in the table below.

Standard Resistance (Check for Open)

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
B60-4 (GND) - Body ground	Always	Below 1 ohms
B32-4 (GND) - Body ground	Always	Below 1 ohms
B59-4 (GND) - Body ground	Always	Below 1 ohms
B30-4 (GND) - Body ground	Always	Below 1 ohms

   c. Turn the ignition switch to ON.
   d. Measure the voltage according to the value(s) in the table below.

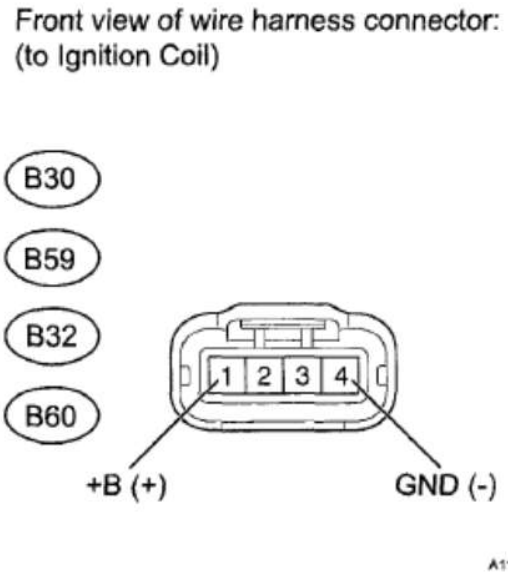


Fig. 159: Identifying Ignition Coil Connectors
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Standard Voltage

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
B60-1 (+B) - B60-4 (GND)	Ignition switch ON	11 to 14 V
B32-1 (+B) - B32-4 (GND)	Ignition switch ON	11 to 14 V

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B59-1 (+B) - B59-4 (GND)	Ignition switch ON	11 to 14 V
B30-1 (+B) - B30-4 (GND)	Ignition switch ON	11 to 14 V

e. Reconnect the ignition coil connectors.

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR (IG2 RELAY - IGNITION COIL, IGNITION COIL - BODY GROUND)

OK: Go to next step

2. **CHECK HARNESS AND CONNECTOR (IGNITION COIL - ECM)**
   a. Disconnect the ignition coil connectors.
   b. Disconnect the ECM connector.
   c. Measure the resistance according to the value(s) in the table below.

Standard Resistance (Check for Open)

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
B60-2 (IGF) - B48-16 (IGF1)	Always	Below 1 ohms
B32-2 (IGF) - B48-16 (IGF1)	Always	Below 1 ohms
B59-2 (IGF) - B48-16 (IGF1)	Always	Below 1 ohms
B30-2 (IGF) - B48-16 (IGF1)	Always	Below 1 ohms

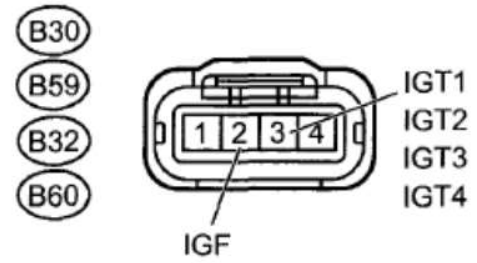
Standard Resistance (Check for Open)

TESTER CONNECTION SPECIFIED CONDITION CHART

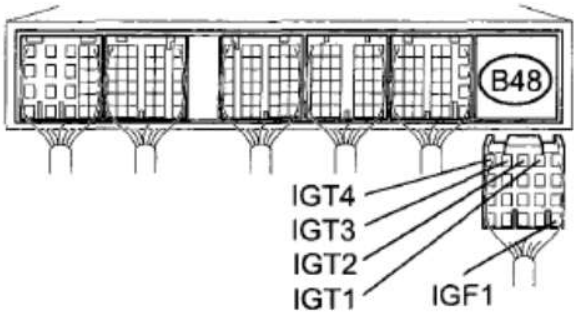
Tester Connection	Condition	Specified Condition
B30-3 (IGT1) - B48-2 (IGT1)	Always	Below 1 ohms
B59-3 (IGT2) - B48-3 (IGT2)	Always	Below 1 ohms
B32-3 (IGT3) - B48-4 (IGT3)	Always	Below 1 ohms
B60-3 (IGT4) - B48-5 (IGT4)	Always	Below 1 ohms

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Front view of wire harness connector:
(to Ignition Coil)



Rear view of wire harness connector:
(to ECM)



A205170E02

Fig. 160: Identifying Ignition Coil Connectors And ECM Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Standard Resistance (Check for Short)

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
B60-2 (IGF) or B48-16 (IGF1) - Body ground	Always	10 kohms or higher
B32-2 (IGF) or B48-16 (IGF1) - Body ground	Always	10 kohms or higher
B59-2 (IGF) or B48-16 (IGF1) - Body ground	Always	10 kohms or higher
B30-2 (IGF) or B48-16 (IGF1) - Body ground	Always	10 kohms or higher

Standard Resistance (Check for Short)

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
B30-3 (IGT1) or B48-2 (IGT1) - Body ground	Always	10 kohms or higher

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B59-3 (IGT2) or B48-3 (IGT2) - Body ground	Always	10 kohms or higher
B32-3 (IGT3) or B48-4 (IGT3) - Body ground	Always	10 kohms or higher
B60-3 (IGT4) or B48-5 (IGT4) - Body ground	Always	10 kohms or higher

d. Reconnect the ECM connector.
e. Reconnect the ignition coil connectors.

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR

OK: Go to next step

3. **CHECK WHETHER DTC OUTPUT RECURS (DTC P0351, P0352, P0353 OR P0354)**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the Techstream on.
   d. Clear the DTCs (See **DTC CHECK/CLEAR**).
   e. Shuffle the arrangement of the ignition coils with igniters (among No. 1 to No. 4 cylinders).

NOTE: Do not shuffle the connectors.

   f. Perform a simulation test.
   g. Enter the following menus: Powertrain/Engine/Trouble Codes.
   h. Read the DTCs.

Result

RESULT CHART

Result	Proceed to
Same DTC output	A
Different ignition coil DTC output	B

B: REPLACE IGNITION COIL (See **REMOVAL**)

A: REPLACE ECM (See **REMOVAL**)

DTC P0365 CAMSHAFT POSITION SENSOR "B" CIRCUIT (BANK 1); DTC P0367 CAMSHAFT POSITION SENSOR "B" CIRCUIT LOW INPUT (BANK 1); DTC P0368 CAMSHAFT POSITION SENSOR "B" CIRCUIT HIGH INPUT (BANK 1)

DESCRIPTION

The camshaft position sensor for the exhaust camshaft (EV signal sensor) consists of a magnet and MRE element.

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The exhaust camshaft has a timing rotor for the camshaft position sensor. When the camshaft rotates, changes occur in the air gaps between the timing rotor and MRE element, which affects the magnet. As a result, the resistance of the MRE material fluctuates. The camshaft position sensor converts the camshaft rotation data to pulse signals, uses the pulse signals to determine the camshaft angle, and sends it to the ECM. Then the ECM uses this data to control fuel injection duration, injection timing and the Variable Valve Timing (VVT) system.

DTC DETECTION CONDITION CHART

DTC No.	DTC Detection Condition	Trouble Area
P0365	No exhaust camshaft position sensor signal for 5 seconds at an engine speed of 600 rpm or more (1 trip detection logic).	• Open or short in exhaust camshaft position sensor circuit • Exhaust camshaft position sensor • Exhaust camshaft • Timing chain jumped tooth • ECM
P0367	The output voltage of the exhaust camshaft position sensor is below 0.3 V for 4 seconds (1 trip detection logic).	• Open or short in exhaust camshaft position sensor circuit • Exhaust camshaft position sensor • Exhaust camshaft • Timing chain jumped tooth • ECM
P0368	The output voltage of the exhaust camshaft position sensor is 4.7 V for 4 seconds (1 trip detection logic).	• Open or short in exhaust camshaft position sensor circuit • Exhaust camshaft position sensor • Exhaust camshaft • Timing chain jumped tooth • ECM

HINT:

DTC P0365, P0367 and P0368 indicate a malfunction relating to the exhaust camshaft position sensor circuit (the wire harness between the ECM and exhaust camshaft position sensor, and the exhaust camshaft position sensor itself).

Reference: Inspection using an oscilloscope (See **DTC P0335 CRANKSHAFT POSITION SENSOR "A" CIRCUIT; DTC P0339 CRANKSHAFT POSITION SENSOR "A" CIRCUIT INTERMITTENT**).

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MONITOR DESCRIPTION

If no signal is transmitted by the exhaust camshaft position sensor despite the camshaft revolving, or the rotation of the exhaust camshaft and the crankshaft is not synchronized, the ECM interprets this as a malfunction of the sensor.

If the malfunction is not repaired successfully, the DTC is stored 10 seconds after the engine is next started.

MONITOR STRATEGY

MONITOR STRATEGY CHART

Related DTCs	P0365: Exhaust Camshaft Position Sensor Verify Pulse Input P0367: Exhaust Camshaft Position Sensor Range Check (Low Voltage) P0368: Exhaust Camshaft Position Sensor Range Check (High Voltage)
Required Sensors/Components (Main)	Exhaust camshaft position sensor
Required Sensors/Components (Related)	Crankshaft position sensor
Frequency of Operation	Continuous
Duration	5 seconds: Exhaust camshaft position sensor verify pulse input (P0365) 4 seconds: Exhaust camshaft position sensor range check (P0367, P0368)
MIL Operation	Immediate
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

P0365: Exhaust Camshaft Position Sensor Verify Pulse Input

TYPICAL ENABLING CONDITIONS CHART

Monitor runs whenever following DTCs not stored	None
Engine speed	600 rpm or more
Exhaust camshaft position sensor range check fail (P0367, P0368)	Not detected
Ignition switch	ON
Starter	OFF
Battery voltage	8 V or higher
Exhaust camshaft position sensor voltage	0.3 to 4.7 V

P0367, P0368: Exhaust Camshaft Position Sensor Range Check

TYPICAL ENABLING CONDITIONS CHART

Monitor runs whenever following DTCs not stored	None
Starter	OFF

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Ignition switch	ON
Time after ignition switch turned from off to ON	2 seconds or more
Exhaust camshaft position sensor verify pulse input fail (P0365)	Not detected
Battery voltage	8 V or higher

TYPICAL MALFUNCTION THRESHOLDS

P0365: Exhaust Camshaft Position Sensor Range Check (Running)

TYPICAL MALFUNCTION THRESHOLDS CHART

Exhaust camshaft position signal	No signal

P0367: Exhaust Camshaft Position Sensor Range Check (Low Voltage)

TYPICAL MALFUNCTION THRESHOLDS CHART

Exhaust camshaft position sensor voltage	Below 0.3 V

P0368: Exhaust Camshaft Position Sensor Range Check (High Voltage)

TYPICAL MALFUNCTION THRESHOLDS CHART

Exhaust camshaft position sensor voltage	Higher than 4.7 V

COMPONENT OPERATING RANGE

COMPONENT OPERATING RANGE CHART

Exhaust camshaft position sensor voltage	0.3 to 4.7 V

CONFIRMATION DRIVING PATTERN

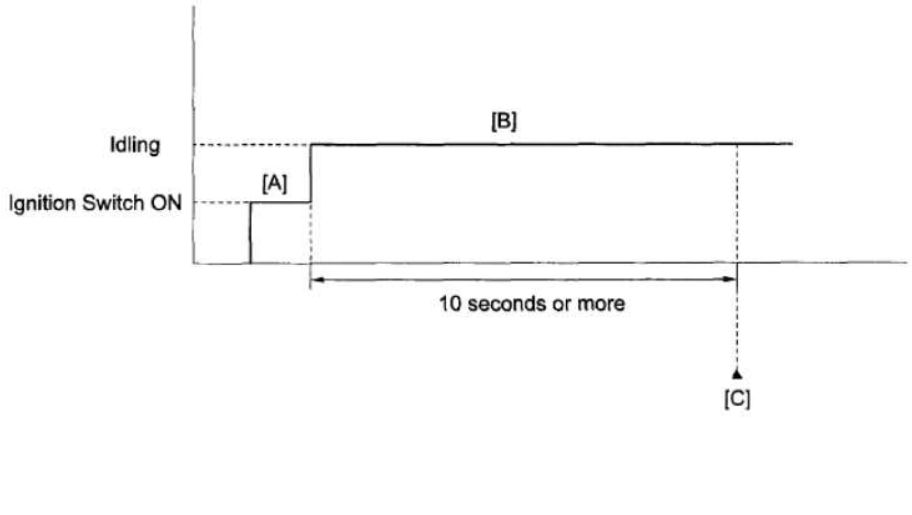


Fig. 161: Confirmation Driving Pattern

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

1. Connect the Techstream to the DLC3.
2. Turn the ignition switch to ON and turn the Techstream on.
3. Clear the DTCs (even if no DTCs are stored, perform the clear DTC procedure).
4. Turn the ignition switch off.
5. Turn the ignition switch to ON and turn the Techstream on [A].
6. Start the engine.
7. Idle the engine for 10 seconds or more [B].
8. Enter the following menus: Powertrain/Engine/Utility/All Readiness.
9. Input the DTC: P0365, P0367 or P0368.
10. Check the DTC judgment result [C].

TECHSTREAM DISPLAY DESCRIPTION

Techstream Display	Description
NORMAL	• DTC judgment completed • System normal
ABNORMAL	• DTC judgment completed • System abnormal
INCOMPLETE	• DTC judgment not completed • Perform driving pattern after confirming DTC enabling conditions
UNKNOWN	• Unable to perform DTC judgment • Number of DTCs which do not fulfill DTC preconditions has reached ECU memory limit

HINT:

- If the judgment result shows ABNORMAL, the system has a malfunction.
- If the judgment result shows INCOMPLETE or UNKNOWN, perform steps [B] and [C] again.

11. If the test result is UNKNOWN, enter the following menus: Powertrain/Engine/Trouble Codes/Pending.
12. Read Pending DTCs.

HINT:

If a pending DTC is output, the system is malfunctioning.

13. If the test result is INCOMPLETE or UNKNOWN and no pending DTC is output, perform a universal trip and check for permanent DTCs (See **DTC CHECK/CLEAR**).

HINT:

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- If a permanent DTC is output, the system is malfunctioning.
- If no permanent DTC is output, the system is normal.

WIRING DIAGRAM

Refer to **DTC P0335** .

INSPECTION PROCEDURE

HINT:

- Read freeze frame data using the Techstream. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.
- If no problem is found through this diagnostic troubleshooting procedure, there may be a mechanical problem with the engine.

1. **CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P0365, P0367 OR P0368)**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the Techstream on.
   d. Enter the following menus: Powertrain/Engine/Trouble Codes.
   e. Read the DTCs.

   Result

   RESULT CHART

Result	Proceed to
DTC P0365, P0367 or P0368 is output	A
DTC P0365, P0367 or P0368 and other DTCs are output	B

   HINT:

   If any DTCs other than P0365, P0367 or P0368 are output, troubleshoot those DTCs first.

   B: GO TO **DTC CHART**

   A: Go to next step

2. **INSPECT CAMSHAFT POSITION SENSOR (FOR EXHAUST CAMSHAFT) (POWER SOURCE)**
   a. Disconnect the camshaft position sensor (for exhaust camshaft) connector.
   b. Turn the ignition switch to ON.

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c. Measure the voltage according to the value(s) in the table below.

Standard Voltage

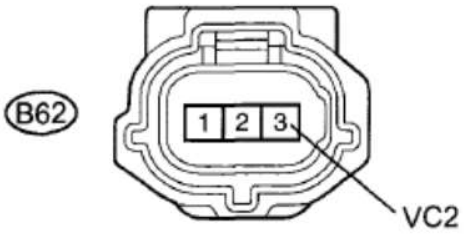
TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Switch Condition	Specified Condition
B62-3 (VC2) - Body ground	Ignition switch ON	4.5 to 5.5 V

d. Reconnect the camshaft position sensor (for exhaust camshaft) connector.

NG: Go to step 9

Front view of wire harness connector:
(to Camshaft Position Sensor for
Exhaust Camshaft)



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Fig. 162: Identifying Camshaft Position Sensor Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

3. **CHECK HARNESS AND CONNECTOR (CAMSHAFT POSITION SENSOR - ECM)**
   a. Disconnect the camshaft position sensor (for exhaust camshaft) connector.
   b. Disconnect the ECM connector.
   c. Measure the resistance according to the value(s) in the table below.

Standard Resistance (Check for Open)

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
B62-1 (VVE+) - B50-13 (EV1+)	Always	Below 1 ohms
B62-2 (VVE-) - B50-1 (EV1-)	Always	Below 1 ohms

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Standard Resistance (Check for Short)

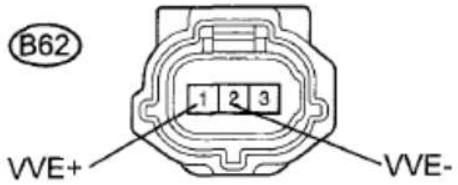
TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
B62-1 (VVE+) or B50-13 (EV1+) - Body ground	Always	10 kohms or higher
B62-2 (VVE-) or B50-1 (EV1-) - Body ground	Always	10 kohms or higher

d. Reconnect the camshaft position sensor (for exhaust camshaft) connector.
e. Reconnect the ECM connector.

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR

Front view of wire harness connector:
(to Camshaft Position Sensor for
Exhaust Camshaft)



Rear view of wire harness connector:
(to ECM)

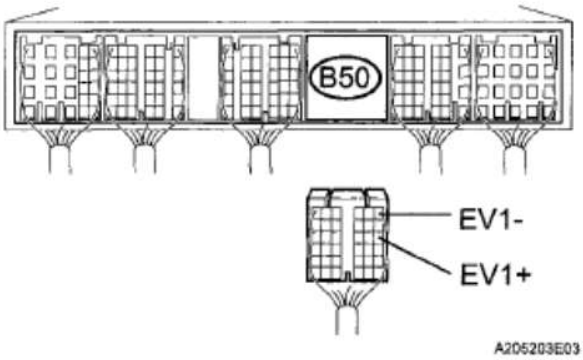


Fig. 163: Identifying Camshaft Position Sensor And ECM Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

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4. **CHECK SENSOR INSTALLATION (CAMSHAFT POSITION SENSOR FOR EXHAUST CAMSHAFT)**
   a. Check the camshaft position sensor (for exhaust camshaft) installation.

   OK:

   Sensor is installed correctly.

   NG: SECURELY REINSTALL SENSOR (See **INSTALLATION**)

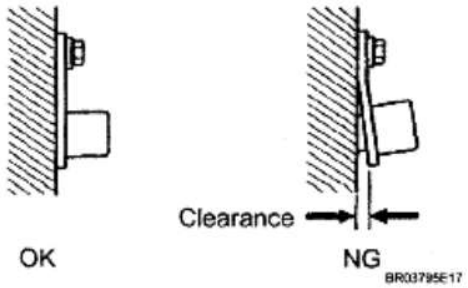


Fig. 164: Identifying Clearance Between Camshaft Position Sensor
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

   OK: Go to next step

5. **INSPECT EXHAUST CAMSHAFT (TIMING ROTOR)**
   a. Check the timing rotor of the exhaust camshaft.

   OK:

   Camshaft timing rotor does not have any cracks or deformation.

   NG: REPLACE EXHAUST CAMSHAFT (See **REMOVAL**)

   OK: Go to next step

6. **CHECK VALVE TIMING**
   a. Check the valve timing (See **INSPECTION PROCEDURE**).

   NG: ADJUST VALVE TIMING (See **REMOVAL**)

   OK: Go to next step

7. **REPLACE CAMSHAFT POSITION SENSOR (FOR EXHAUST CAMSHAFT)**
   a. Replace the camshaft position sensor (See **INSTALLATION**).
8. **CHECK WHETHER DTC OUTPUT RECURS (DTC P0365, P0367 OR P0368)**

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a. Connect the Techstream to the DLC3.
b. Turn the ignition switch to ON.
c. Turn the Techstream on.
d. Clear the DTCs (See **DTC CHECK/CLEAR**).
e. Turn the ignition switch off.
f. Start the engine and allow the engine to idle for 10 seconds or more.
g. Enter the following menus: Powertrain/Engine/Trouble Codes.
h. Read the DTCs.

Result

RESULT CHART

Result	Proceed to
DTC P0365, P0367 or P0368 is output	A
DTC is not output	B

HINT:

If the engine does not start, replace the ECM.

B: REPAIR COMPLETED

A: REPLACE ECM (See **REMOVAL**)

9. **CHECK HARNESS AND CONNECTOR (CAMSHAFT POSITION SENSOR - ECM)**
   a. Disconnect the camshaft position sensor (for exhaust camshaft) connector.
   b. Disconnect the ECM connector.
   c. Measure the resistance according to the value(s) in the table below.

Standard Resistance (Check for Open)

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
B62-3 (VC2) - B50-7 (VCE1)	Always	Below 1 ohms

Standard Resistance (Check for Short)

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
B62-3 (VC2) or B50-7 (VCE1) - Body ground	Always	10 kohms or higher

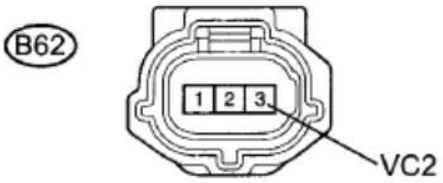
   d. Reconnect the camshaft position sensor (for exhaust camshaft) connector.
   e. Reconnect the ECM connector.

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NG: REPAIR OR REPLACE HARNESS OR CONNECTOR

Front view of wire harness connector:
(to Camshaft Position Sensor for
Exhaust Camshaft)



Rear view of wire harness connector:
(to ECM)

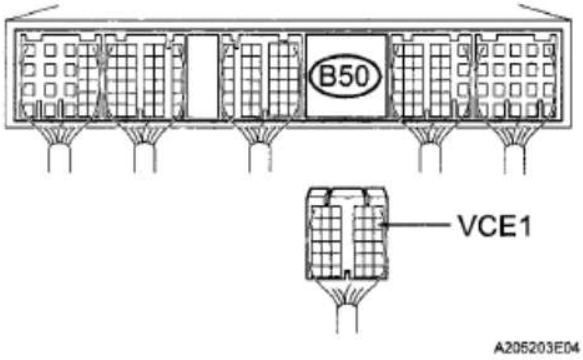


Fig. 165: Identifying Camshaft Position Sensor And ECM Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: REPLACE ECM (See **REMOVAL**)

DTC P0420 CATALYST SYSTEM EFFICIENCY BELOW THRESHOLD (BANK 1)

MONITOR DESCRIPTION

The ECM uses sensors mounted in front of and behind the Three-Way Catalytic Converter (TWC) to monitor its efficiency.

The first sensor, the air fuel ratio sensor, sends pre-catalyst information to the ECM. The second sensor, the heated oxygen sensor, sends post-catalyst information to the ECM.

In order to detect any deterioration in the three-way catalytic converter, the ECM calculates the oxygen storage

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capacity of the three-way catalytic converter. This calculation is based on the voltage output of the heated oxygen sensor while performing active air fuel ratio control.

The oxygen storage capacity value is an indication of the oxygen storage capacity of the three-way catalytic converter. When the vehicle is being driven with a warm engine, active air fuel ratio control is performed for approximately 15 to 20 seconds. When it is performed, the ECM deliberately sets the air fuel ratio to lean or rich levels. If the cycle of the waveform for the heated oxygen sensor is long, the oxygen storage capacity is great. There is a direct correlation between the heated oxygen sensor and the oxygen storage capacity of the three-way catalytic converter.

The ECM uses the oxygen storage capacity value to determine the state of the three-way catalytic converter. If any deterioration has occurred, the ECM illuminates the MIL and sets the DTC.

DTC DETECTION CONDITION CHART

DTC No.	DTC Detection Condition	Trouble Area
P0420	The oxygen storage capacity value is less than the standard value under active air fuel ratio control (2 trip detection logic).	• Gas leak from exhaust system • Air fuel ratio sensor (bank 1 sensor 1) • Heated oxygen sensor (bank 1 sensor 2) • Front exhaust pipe assembly (TWC: Front catalyst) • Exhaust center pipe assembly (TWC: Rear catalyst)

HINT:

- Sensor 1 refers to the sensor closest to the engine assembly.
- Sensor 2 refers to the sensor farthest away from the engine assembly.

CATALYST LOCATION

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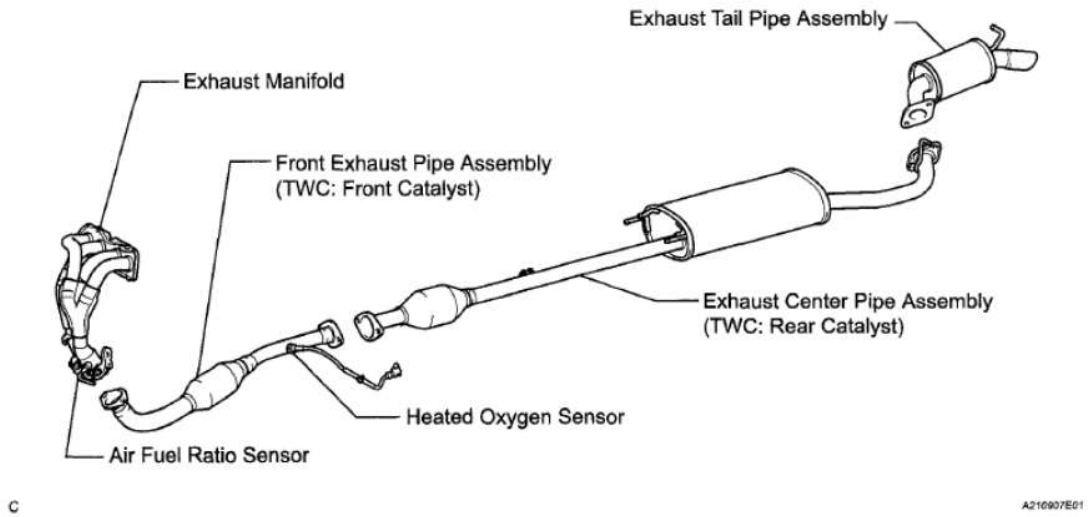


Fig. 166: Identifying Catalyst System Components
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

MONITOR STRATEGY

MONITOR STRATEGY CHART

Related DTCs	P0420: Catalyst Deterioration
Required Sensors/Components (Main)	Air fuel ratio sensor Heated oxygen sensor
Required Sensors/Components (Related)	Intake air temperature sensor Mass air flow meter Crankshaft position sensor Engine coolant temperature sensor
Frequency of Operation	Once per driving cycle
Duration	Approximately 30 seconds
MIL Operation	2 driving cycles
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

TYPICAL ENABLING CONDITIONS CHART

	P0010 (Camshaft Timing Oil Control Valve) P0011 (VVT System - Advance) P0012 (VVT System - Retard) P0016 (VVT System - Misalignment) P0013 (Exhaust Camshaft Timing Oil Control Valve) P0014 (Exhaust VVT System - Advance) P0015 (Exhaust VVT System - Retard) P0017 (Exhaust VVT System - Misalignment) P0031, P0032, P101D (Air Fuel Ratio Sensor Heater) P0037, P0038, P102D (Heated Oxygen Sensor Heater)

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Monitor runs whenever following DTCs not stored	P2195, P2196, P2237, P2238, P2239, P2252, P2253, P2A00 (Air Fuel Ratio Sensor) P0136, P0137, P0138, P0139, P0607 (Rear Oxygen Sensor) P0102, P0103 (Mass Air Flow Meter) P0115, P0117, P0118 (Engine Coolant Temperature Sensor) P0125 (Insufficient Coolant Temperature for Closed Loop Fuel Control) P0120, P0121, P0122, P0123, P0220, P0222, P0223, P2135 (Throttle Position Sensor) P0171, P0172 (Fuel System) P0301 - P0304 (Misfire) P0335 (Crankshaft Position Sensor) P0340, P0342, P0343 (Camshaft Position Sensor) P0365, P0367, P0368 (Exhaust Camshaft Position Sensor) P0351 - P0354 (Igniter) P0500 (Vehicle Speed Sensor)
Battery voltage	11 V or higher
Intake air temperature	-10°C (14°F) or higher
Engine coolant temperature	75°C (167°F) or higher
Atmospheric pressure	76 kPa (570 mmHg) or higher
Idling	OFF
Engine speed	Less than 4000 rpm
Air fuel ratio sensor status	Activated
Fuel system status	Closed loop
Engine load	10 to 80%
All of the following conditions are met	Condition 1, 2 and 3
1. Mass air flow rate	2.5 to 60 gm/sec
2. Front catalyst temperature (estimated)	510 to 840°C (950 to 1544°F)
3. Rear catalyst temperature (estimated)	370 to 770°C (698 to 1418°F)
Shift position	5th or higher

TYPICAL MALFUNCTION THRESHOLDS

TYPICAL MALFUNCTION THRESHOLDS CHART

Oxygen Storage Capacity (OSC) of Three-Way Catalytic Converter (TWC)	Less than 0.08 g

MONITOR RESULT

Refer to **CHECKING MONITOR STATUS** .

CONFIRMATION DRIVING PATTERN

HINT:

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Performing this confirmation pattern will activate the catalyst monitor. This is very useful for verifying the completion of a repair.

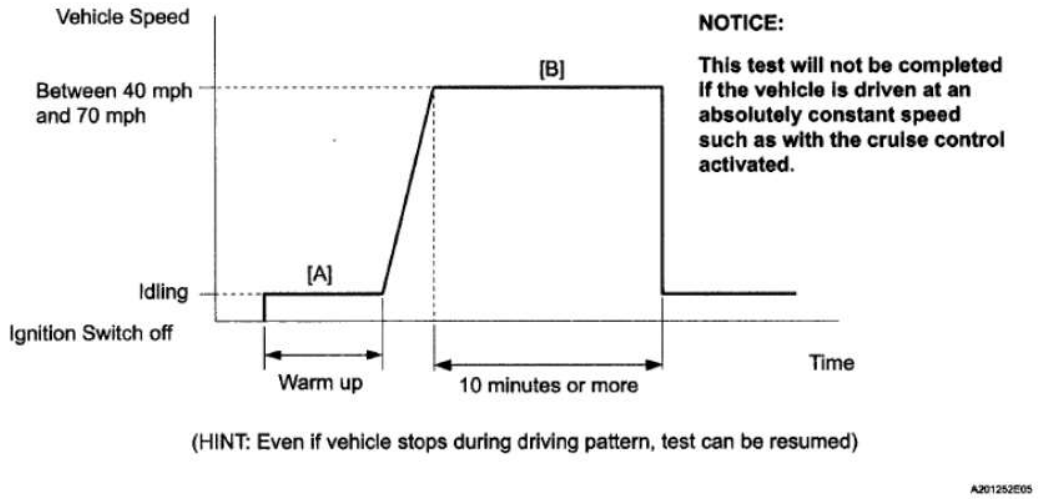


Fig. 167: Vehicle Speed Driving Pattern
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

1. Connect the Techstream to the DLC3.
2. Turn the ignition switch to ON.
3. Turn the Techstream on.
4. Clear the DTCs (even if no DTCs are stored, perform the clear DTC procedure).
5. Turn the ignition switch off.
6. Turn the ignition switch to ON and turn the Techstream on.
7. Enter the following menus: Powertrain/Engine/Monitor.
8. Check that Catalyst Efficiency/Status2 is Incomplete.
9. Start the engine and warm it up (until the engine coolant temperature is 75°C (167°F) or higher) [A].
10. Drive the vehicle at between 40 and 70 mph (64 and 113 km/h) for at least 10 minutes or more [B].
11. Those items will change to Complete after completing the driving pattern.
12. Enter the following menus: Powertrain/Engine/Trouble Codes/Pending.
13. Check if any DTCs (pending DTCs) are set.

    HINT:

    If Catalyst does not change to Complete, and no pending DTCs are stored, extend the driving time.

CONDITIONING FOR SENSOR TESTING

HINT:

Perform the operation with the engine speeds and time durations described below prior to checking the

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waveforms of the air fuel ratio sensor and heated oxygen sensor. This is to activate the sensors sufficiently to obtain the appropriate inspection results.

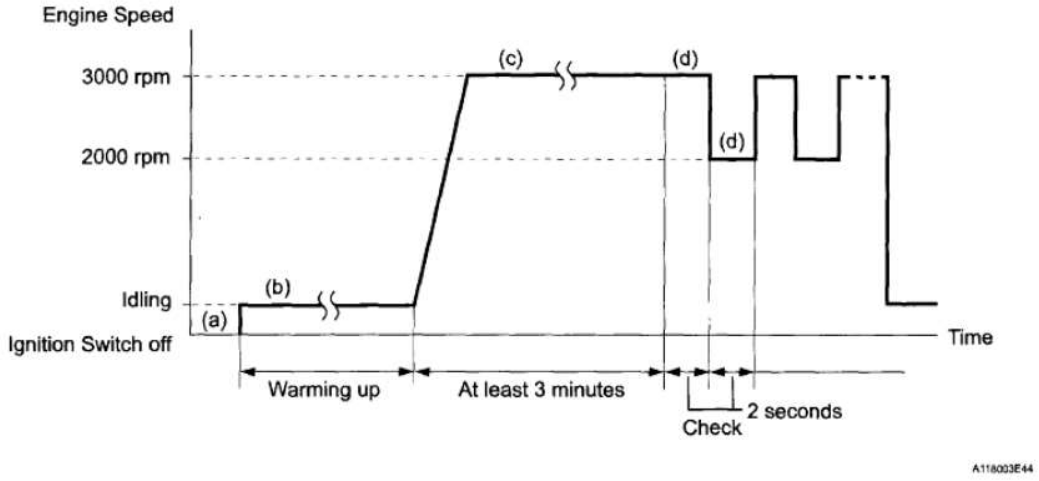


Fig. 168: Engine Speed Driving Pattern
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

a. Connect the Techstream to the DLC3.
b. Start the engine and warm it up with all the accessories switched off until the engine coolant temperature stabilizes.
c. Run the engine at an engine speed of between 2500 rpm and 3000 rpm for at least 3 minutes.
d. While running the engine at 3000 rpm for 2 seconds and 2000 rpm for 2 seconds, check the waveforms of the air fuel ratio and heated oxygen sensors using the Techstream.

HINT:

- If either voltage output of the air fuel ratio or heated oxygen sensor does not fluctuate, or there is noise in the waveform of either sensor, the sensor may be malfunctioning.
- If the voltage outputs of both the sensors remain lean or rich, the air fuel ratio may be extremely lean or rich. In such cases, enter the following menus: Powertrain/Engine/Active Test/Control the Injection Volume for A/F Sensor.
- If the three-way catalytic converter has deteriorated, the heated oxygen sensor (located behind the three-way catalytic converter) voltage output fluctuates up and down frequently, even under normal driving conditions (active air fuel ratio control is not performed).

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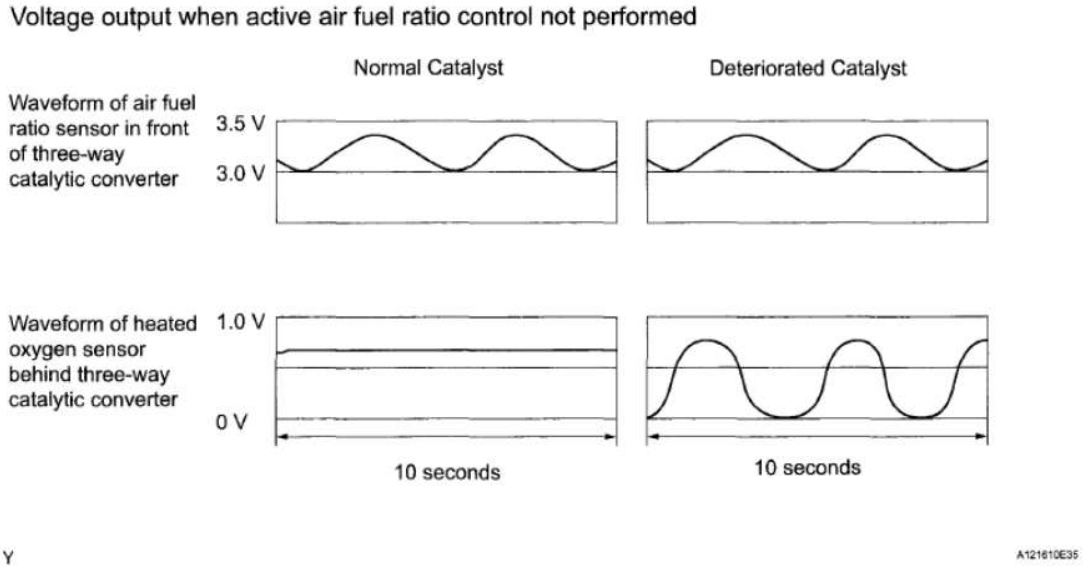


Fig. 169: Heated Oxygen Sensor And Air Fuel Ratio Sensor Voltage Waveform
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSPECTION PROCEDURE

HINT:

Malfunctioning areas can be identified by performing the Control the Injection Volume for A/F Sensor function provided in the Active Test. The Control the Injection Volume for A/F Sensor function can help to determine whether the air fuel ratio sensor, heated oxygen sensor and other potential trouble areas are malfunctioning.

The following instructions describe how to conduct the Control the Injection Volume for A/F Sensor operation using the Techstream.

1. Connect the Techstream to the DLC3.
2. Start the engine.
3. Turn the Techstream on.
4. Warm up the engine at an engine speed of 2500 rpm for approximately 90 seconds.
5. Enter the following menus: Powertrain/Engine/Active Test/Control the Injection Volume for A/F Sensor.
6. Perform the Active Test operation with the engine idling (press the RIGHT or LEFT button to change the fuel injection volume).
7. Monitor the output voltages of the air fuel ratio and heated oxygen sensors (AFS Voltage B1 S1 and O2S B1 S2) displayed on the Techstream.

   HINT:

   - The Control the Injection Volume for A/F Sensor operation lowers the fuel injection volume by -12.5% or increases the injection volume by 25%.
   - Each sensor reacts in accordance with increases and decreases in the fuel injection volume.

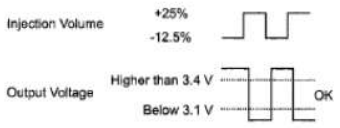
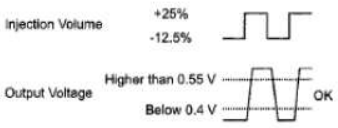
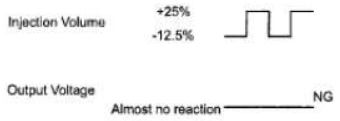
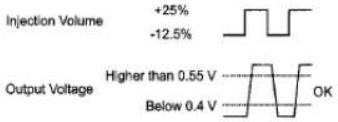
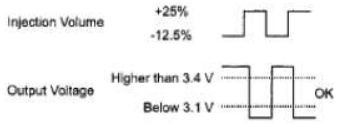
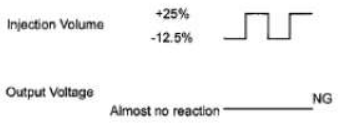
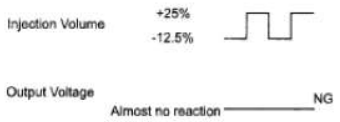
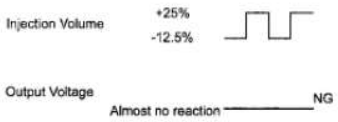
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VOLTAGE STATUS CHART

Techstream Display (Sensor)	Injection Volume	Status	Voltage
AFS Voltage B1 S1 (Air fuel ratio)	+25%	Rich	Below 3.1 V
	-12.5%	Lean	Higher than 3.4 V
O2S B1 S2 (Heated oxygen)	+25%	Rich	Higher than 0.55 V
	-12.5%	Lean	Below 0.4 V

NOTE: The air fuel ratio sensor has an output delay of a few seconds and the heated oxygen sensor has a maximum output delay of approximately 20 seconds.

AIR FUEL RATIO SENSOR REFERENCE

Case	Air Fuel Ratio Sensor (Bank 1 Sensor 1) Output Voltage	Heated Oxygen Sensor (Bank 1 Sensor 2) Output Voltage	Main Suspected Trouble Area
1			-
2			• Air fuel ratio sensor • Air fuel ratio sensor heater • Air fuel ratio sensor circuit
3			• Heated oxygen sensor • Heated oxygen sensor heater • Heated oxygen sensor circuit
4			• Injector • Fuel pressure • Gas leak from exhaust system (Air fuel ratio extremely rich or lean)

- Following the Control the Injection Volume for A/F Sensor procedure enables technicians to check and graph the voltage outputs of both the air fuel ratio and heated oxygen sensors.
- To display the graph, enter the following menus: Powertrain/Engine/Active Test/Control the Injection Volume for A/F Sensor/All Data/AFS Voltage B1 S1 and O2S B1 S2; and then press the graph button on the Data List view.

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HINT:

Read freeze frame data using the Techstream. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1. **CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P0420)**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the Techstream on.
   d. Enter the following menus: Powertrain/Engine/Trouble Codes.
   e. Read the DTCs.

   Result

   RESULT CHART

Result	Proceed to
DTC P0420 is output	A
DTC P0420 and other DTCs are output	B

   HINT:

   If any DTCs other than P0420 are output, troubleshoot those DTCs first.

   B: GO TO **DTC CHART**

   A: Go to next step

2. **PERFORM ACTIVE TEST USING TECHSTREAM (CONTROL THE INJECTION VOLUME FOR A/F SENSOR)**
   a. Connect the Techstream to the DLC3.
   b. Start the engine and warm it up.
   c. Turn the Techstream on.
   d. Run the engine at an engine speed of 2500 rpm for approximately 90 seconds.
   e. Enter the following menus: Powertrain/Engine/Active Test/Control the Injection Volume for A/F Sensor.
   f. Perform the Active Test operation with the engine idling (press the RIGHT or LEFT button to change the fuel injection volume).
   g. Monitor the voltage outputs of the air fuel ratio sensor and heated oxygen sensor (AFS Voltage B1 S1 and O2S B1 S2) displayed on the Techstream.

   HINT:

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- The Control the Injection Volume for A/F Sensor operation lowers the fuel injection volume by -12.5% or increases the injection volume by 25%.
- Each sensor reacts in accordance with increases and decreases in the fuel injection volume.

Standard

VOLTAGE STATUS CHART

Techstream Display (Sensor)	Injection Volume	Status	Voltage
AFS Voltage B1 S1 (Air fuel ratio)	+25%	Rich	Below 3.1 V
	-12.5%	Lean	Higher than 3.4 V
O2S B1 S2 (Heated oxygen)	+25%	Rich	Higher than 0.55 V
	-12.5%	Lean	Below 0.4 V

Result

RESULT CHART

Status AFS Voltage B1 S1	Status O2S B1 S2	Air Fuel Ratio Condition and Air Fuel Ratio and Heated Oxygen Sensors Condition	Misfire	Main Suspected Trouble Area	Proceed to
Lean/Rich	Lean/Rich	Normal	-	• Three-way catalytic converter • Gas leak from exhaust system	A
Lean	Lean/Rich	Air fuel ratio sensor malfunction	-	• Air fuel ratio sensor	B
Rich	Lean/Rich	Air fuel ratio sensor malfunction	-	• Air fuel ratio sensor	
Lean/Rich	Lean	Heated oxygen sensor malfunction	-	• Heated oxygen sensor • Gas leak from exhaust system	C
Lean/Rich	Rich	Heated oxygen sensor malfunction	-	• Heated oxygen sensor • Gas leak from exhaust system	
Lean	Lean	Actual air fuel ratio lean	May occur	• Extremely rich or lean actual air fuel ratio • Gas leak from	

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				exhaust system	
Rich	Rich	Actual air fuel ratio rich	-	• Extremely rich or lean actual air fuel ratio • Gas leak from exhaust system	D
Lean: During Control the Injection Volume for A/F Sensor, the air fuel ratio sensor output voltage (AFS Voltage B1 S1) is consistently higher than 3.4 V, and the heated oxygen sensor output voltage (O2S B1 S2) is consistently below 0.4 V. Rich: During Control the Injection Volume for A/F Sensor, the AFS Voltage B1 S1 is consistently below 3.1 V, and the O2S B1 S2 is consistently higher than 0.55 V. Lean/Rich: During Control the Injection Volume for A/F Sensor of the Active Test, the output voltage of the heated oxygen sensor alternates correctly.					

B: REPLACE AIR FUEL RATIO SENSOR (SENSOR 1) (See **REMOVAL**)

C: Go to step 5

D: GO TO NEXT STEP AFTER CHECKING ENGINE TO DETERMINE CAUSE OF EXTREMELY RICH OR LEAN ACTUAL AIR FUEL RATIO (See **INSPECTION PROCEDURE**)

A: Go to next step

3. **CHECK FOR EXHAUST GAS LEAK**
   a. Check for exhaust gas leaks.

   OK:

   No gas leaks.

   NG: REPAIR OR REPLACE EXHAUST GAS LEAK POINT

   OK: Go to next step

4. **REPLACE FRONT EXHAUST PIPE ASSEMBLY (TWC: FRONT CATALYST)**
   a. Replace the front exhaust pipe assembly (TWC: Front catalyst) (See **EXHAUST MANIFOLD**).

   NEXT: REPLACE EXHAUST CENTER PIPE ASSEMBLY (TWC: REAR CATALYST) (See **EXHAUST PIPE**)

5. **CHECK FOR EXHAUST GAS LEAK**
   a. Check for exhaust gas leaks.

   OK:

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No gas leaks.

NG: REPAIR OR REPLACE EXHAUST GAS LEAK POINT

OK: REPLACE HEATED OXYGEN SENSOR (See **REMOVAL**)

DTC P043E EVAPORATIVE EMISSION SYSTEM LEAK DETECTION REFERENCE ORIFICE LOW FLOW; DTC P043F EVAPORATIVE EMISSION SYSTEM REFERENCE ORIFICE HIGH FLOW; DTC P2401 EVAPORATIVE EMISSION LEAK DETECTION PUMP STUCK OFF; DTC P2402 EVAPORATIVE EMISSION LEAK DETECTION PUMP STUCK ON; DTC P2419 EVAPORATIVE EMISSION SYSTEM SWITCHING VALVE CONTROL CIRCUIT LOW

DTC SUMMARY

DTC SUMMARY

DTC No.	Monitoring Item	Malfunction Detection Condition	Trouble Area	Detection Timing	Detection Logic
P043E	Reference orifice clogged	P043E, P043F, P2401, P2402 and P2419 stored when one of following conditions met during key-off EVAP monitor: • Reference orifice clogged • Reference orifice high-flow • Leak detection pump OFF malfunction • Leak detection pump ON malfunction • Vent valve ON (closed) malfunction	• Canister pump module (Reference orifice, leak detection pump, vent valve) • Connector/wire harness (Canister pump module - ECM) • EVAP system hose (pipe from air inlet port to canister pump module, canister filter, fuel tank vent hose) • ECM	While ignition switch off	2 trip
P043F	Reference orifice high-flow				
P2401	Leak detection pump stuck OFF				
P2402	Leak detection pump stuck ON				
P2419	Vent valve stuck closed				

HINT:

The reference orifice is located inside the canister pump module.

DESCRIPTION

The description can be found in EVAP (Evaporative Emission) System (See **EVAP SYSTEM**).

HINT:

Unit expressions

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- [kPa-a (mmHg-a)] denotes the absolute pressure.
- [kPa-g (mmHg-g)] denotes the gauge pressure (relative pressure).
- On the Techstream, convert the unit of measurement according to the inspection procedure.

INSPECTION PROCEDURE

Refer to **EVAP SYSTEM** .

MONITOR DESCRIPTION

5 hours* after the ignition switch is turned off, the leak detection pump creates negative pressure (vacuum) in the EVAP system. The ECM monitors for leaks and actuator malfunctions based on the EVAP pressure.

HINT:

*: If the engine coolant temperature is not below 35°C (95°F) 5 hours after the ignition switch is turned off, the monitor check starts 2 hours later. If it is still not below 35°C (95°F) 7 hours after the ignition switch is turned off, the monitor check starts 2.5 hours later.

OPERATION DESCRIPTION

Sequence	Operation	Description	Duration
-	ECM activation	Activated by soak timer 5, 7 or 9.5 hours after ignition switch turned off.	-
A	Atmospheric pressure measurement	Vent valve turned OFF (vent) and EVAP system pressure measured by ECM in order to register atmospheric pressure. If pressure in EVAP system not between 70 kPa-a and 110 kPa-a (525 mmHg-a and 825 mmHg-a), ECM cancels EVAP system monitor.	10 seconds
B	First reference pressure measurement	In order to determine reference pressure, leak detection pump creates negative pressure (vacuum) through reference orifice and then ECM checks if leak detection pump and vent valve operate normally.	60 seconds
C	EVAP system pressure measurement	Vent valve turned ON (closed) to shut EVAP system. Negative pressure (vacuum) created in EVAP system, and EVAP system pressure then measured. Write down measured value as it will be used in leak check. If EVAP pressure does not stabilize within 15 minutes, ECM cancels EVAP system monitor.	15 minutes(1)
D	Purge VSV monitor	Purge VSV opened and then EVAP system pressure measured by ECM. Large increase indicates normality.	10 seconds
E	Second reference pressure measurement	After second reference pressure measurement, leak check performed by comparing first and second reference pressure. If stabilized system pressure higher than second reference pressure, ECM determines that EVAP system leaking.	60 seconds
		Atmospheric pressure measured and then monitoring result	

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-	Final check	recorded by ECM.	-

(1) If only a small amount of fuel is in the fuel tank, it takes longer for the EVAP pressure to stabilize.

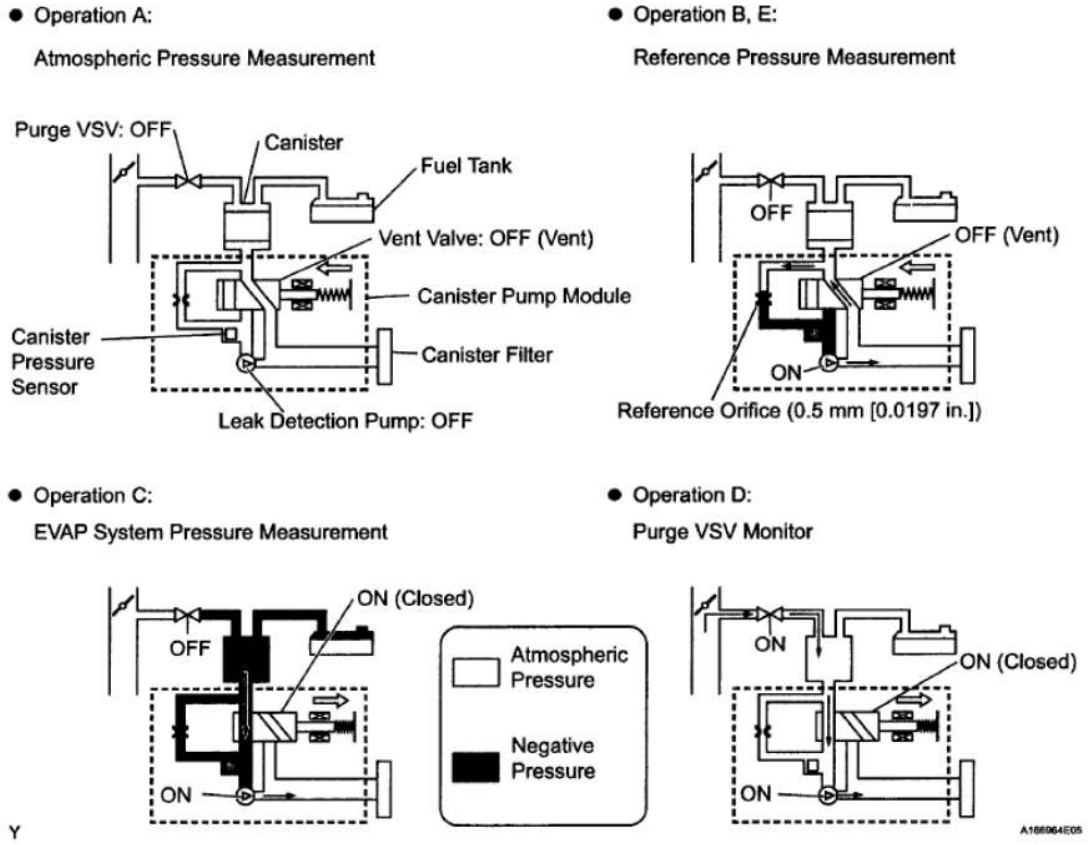


Fig. 170: EVAP Pressure Chart
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

The leak detection pump creates negative pressure through the reference orifice (in operation B and E). When the system is normal, the EVAP pressure is between 97 to 100 kPa (724 to 750 mmHg)* and saturated within a minute. If not, the ECM interprets this as a malfunction. The ECM illuminates the MIL and stores a DTC if this malfunction is detected in consecutive drive cycles.

*: Typical value.

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EVAP Pressure during EVAP Key-off Monitor:

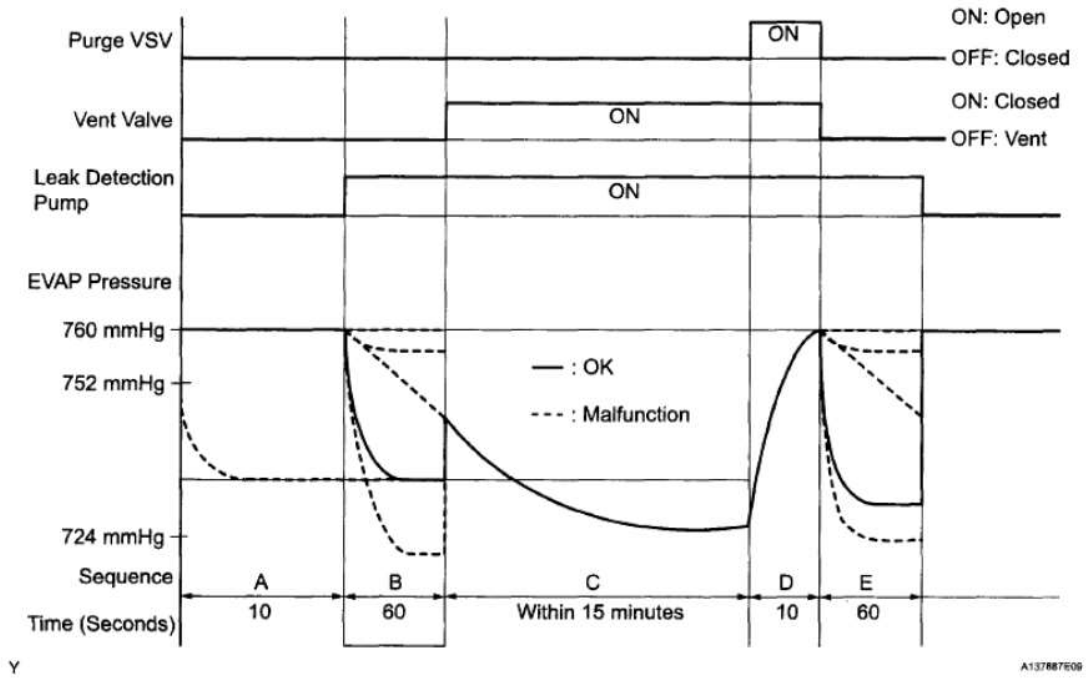


Fig. 171: EVAP Pressure Malfunction Chart
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

MONITOR STRATEGY

MONITOR STRATEGY CHART

Related DTCs	P043E: Reference Orifice Low-flow P043F: Reference Orifice High-flow P2401: Leak Detection Pump Stuck Off P2402: Leak Detection Pump Stuck On P2419: Vent Valve Stuck Open (Vent)
Required Sensors/Components	Canister pump module
Frequency of Operation	Once per driving cycle
Duration	Within 2 minutes
MIL Operation	2 driving cycles
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

TYPICAL ENABLING CONDITIONS CHART

Monitor runs whenever following DTCs not stored	None
EVAP key-off monitor runs when all of following conditions met	-
Atmospheric pressure	70 to 110 kPa-a (525 to 825 mmHg-a)
Battery voltage	10.5 V or higher

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Vehicle speed	Less than 2.5 mph (4 km/h)
Ignition switch	off
Time after key-off	5, 7 or 9.5 hours
Canister pressure sensor malfunction (P0452, P0453)	Not detected
Purge VSV	Not operated by scan tool
Vent valve	Not operated by scan tool
Leak detection pump	Not operated by scan tool
Both of following conditions met before key-off	Conditions 1 and 2
1. Duration that vehicle is driven	5 minutes or more
2. EVAP purge operation	Performed
Engine coolant temperature	4.4 to 35°C (40 to 95°F)
Intake air temperature	4.4 to 35°C (40 to 95°F)

TYPICAL MALFUNCTION THRESHOLDS

"Saturated" indicates that the EVAP pressure change is below 0.286 kPa-g (2.14 mmHg-g) in 60 seconds.

TYPICAL MALFUNCTION THRESHOLDS CHART

One of following conditions met	-
EVAP pressure just after reference pressure measurement started	Higher than -1 kPa-g (-7.5 mmHg-g)
Reference pressure	Below -4.85 kPa-g (-36.4 mmHg-g)
Reference pressure	-1.057 kPa-g (-7.93 mmHg-g) or higher
Reference pressure	Not saturated within 60 seconds
Reference pressure difference between first and second	0.7 kPa-g (5.25 mmHg-g) or higher

MONITOR RESULT

Refer to **CHECKING MONITOR STATUS** .

CONFIRMATION DRIVING PATTERN

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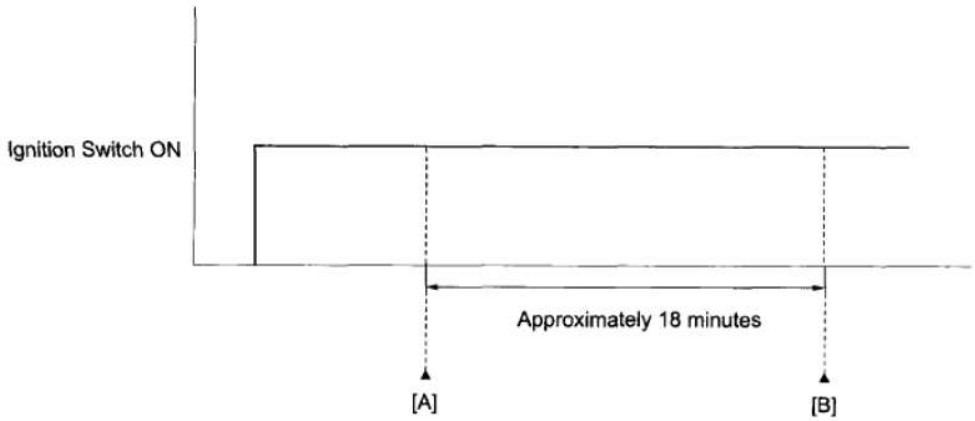


Fig. 172: Confirmation Driving Pattern
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

NOTE:

- **The Evaporative System Check (Automatic Mode) consists of 5 steps performed automatically by the Techstream. ft takes a maximum of approximately 18 minutes.**
- **Do not perform the Evaporative System Check when the fuel tank is more than 90% full because the cut-off valve may be closed, making the fuel tank leak check unavailable.**
- **Do not run the engine during this operation.**
- **When the temperature of the fuel is 35°C (95°F) or higher, a large amount of vapor forms and any check results become inaccurate. When performing the Evaporative System Check, keep the fuel temperature below 35°C (95°F).**

1. Connect the Techstream to the DLC3.
2. Turn the ignition switch to ON and turn the Techstream on.
3. Clear the DTCs (even if no DTCs are stored, perform the clear DTC procedure).
4. Turn the ignition switch off.
5. Turn the ignition switch to ON and turn the Techstream on [A].
6. Enter the following menus: Powertrain/Engine/Utility/Evaporative System Check/Automatic Mode.
7. After the "Evaporative System Check" is completed, check for All Readiness by entering the following menus: Powertrain/Engine/Utility/All readiness.
8. Input the DTC: P043E, P043F, P2401, P2402 or P2419.
9. Check the DTC judgment result [B].

TECHSTREAM DISPLAY DESCRIPTION

Techstream	Description

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Display	
NORMAL	• DTC judgment completed • System normal
ABNORMAL	• DTC judgment completed • System abnormal
INCOMPLETE	• DTC judgment not completed • Perform driving pattern after confirming DTC enabling conditions
UNKNOWN	• Unable to perform DTC judgment • Number of DTCs which do not fulfill DTC preconditions has reached ECU memory limit

HINT:

If the judgment result shows ABNORMAL, the system has a malfunction.

10. If the test result is UNKNOWN, enter the following menus: Powertrain/Engine/Trouble Codes/Pending.
11. Read Pending DTCs.

HINT:

If a pending DTC is output, the system is malfunctioning.

12. If the test result is INCOMPLETE or UNKNOWN and no pending DTC is output, perform a universal trip and check for permanent DTCs (See **DTC CHECK/CLEAR**).

HINT:

- If a permanent DTC is output, the system is malfunctioning.
- If no permanent DTC is output, the system is normal.

DTC P0441 EVAPORATIVE EMISSION CONTROL SYSTEM INCORRECT PURGE FLOW

DTC SUMMARY

DTC SUMMARY

DTC No.	Monitoring Item	Malfunction Detection Condition	Trouble Area	Detection Timing	Detection Logic
	Purge VSV (Vacuum Switching Valve) stuck	Leak detection pump creates negative pressure (vacuum) in EVAP system and EVAP system pressure measured. Reference pressure measured at start and at end of leak check.	• Purge VSV • Connector/wire harness (Purge VSV - ECM) • ECM	While ignition switch off	2 trip

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	open	If stabilized pressure higher than [second reference pressure x 0.2], ECM determines that purge VSV stuck open.	• Canister pump module Leak from EVAP system		
	Purge VSV stuck closed	After EVAP leak check performed, purge VSV turned ON (open), and atmospheric air introduced into EVAP system. Reference pressure measured at start and at end of check. If pressure does not return to near atmospheric pressure, ECM determines that purge VSV stuck closed.	• Purge VSV • Connector/wire harness (Purge VSV - ECM) • ECM • Canister pump module • Leak from EVAP system	While ignition switch off	2 trip
P0441	Purge flow	While engine running, following conditions successively met: • Negative pressure not created in EVAP system when purge VSV turned ON (open) • EVAP system pressure change less than 0.4 kPa-g (3.0 mmHg-g) when vent valve turned ON (closed) • Atmospheric pressure change before and after purge flow monitor less than 0.1 kPa-g (0.75 mmHg-g)	• Purge VSV • Connector/wire harness (Purge VSV - ECM) • Leak from EVAP line (Purge VSV - Intake manifold) • ECM	While engine running	2 trip

DESCRIPTION

The description can be found in EVAP (Evaporative Emission) System (See **DESCRIPTION**).

INSPECTION PROCEDURE

Refer to **EVAP SYSTEM** .

HINT:

Unit expressions

- [kPa-a (mmHg-a)] denotes the absolute pressure.
- [kPa-g (mmHg-g)] denotes the gauge pressure (relative pressure).
- On the Techstream, convert the unit of measurement according to the inspection procedure.

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MONITOR DESCRIPTION

The two monitors, Key-Off and Purge Flow, are used to detect malfunctions relating to DTC P0441. The Key-Off monitor is initiated by the ECM internal timer, known as the soak timer, 5 hours* after the ignition switch is turned off. The purge flow monitor runs while the engine is running.

1. KEY-OFF MONITOR

   5 hours* after the ignition switch is turned off, the leak detection pump creates negative pressure (vacuum) in the EVAP system. The ECM monitors for leaks and actuator malfunctions based on the EVAP pressure.

   HINT:

   *: If the engine coolant temperature is not below 35°C (95°F) 5 hours after the ignition switch is turned off, the monitor check starts 2 hours later. If it is still not below 35°C (95°F) 7 hours after the ignition switch is turned off, the monitor check starts 2.5 hours later.

OPERATION DESCRIPTION

Sequence	Operation	Description	Duration
-	ECM activation	Activated by soak timer 5, 7 or 9.5 hours after ignition switch turned off.	-
A	Atmospheric pressure measurement	Vent valve turned OFF (vent) and EVAP system pressure measured by ECM in order to register atmospheric pressure. If pressure in EVAP system not between 70 kPa-a and 110 kPa-a (525 mmHg-a and 825 mmHg-a), ECM cancels EVAP system monitor.	10 seconds
B	First reference pressure measurement	In order to determine reference pressure, leak detection pump creates negative pressure (vacuum) through reference orifice and then ECM checks if leak detection pump and vent valve operate normally.	60 seconds
C	EVAP system pressure measurement	Vent valve turned ON (closed) to shut EVAP system. Negative pressure (vacuum) created in EVAP system, and EVAP system pressure then measured. Write down measured value as it will be used in leak check. If EVAP pressure does not stabilize within 15 minutes, ECM cancels EVAP system monitor.	15 minutes(1)
D	Purge VSV monitor	Purge VSV opened and then EVAP system pressure measured by ECM. Large increase indicates normality.	10 seconds
E	Second reference pressure measurement	After second reference pressure measurement, leak check performed by comparing first and second reference pressure. If stabilized system pressure higher than second reference pressure, ECM determines that EVAP system leaking.	60 seconds
-	Final check	Atmospheric pressure measured and then monitoring result recorded by ECM.	-

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(1) If only a small amount of fuel is in the fuel tank, it takes longer for the EVAP pressure to stabilize.

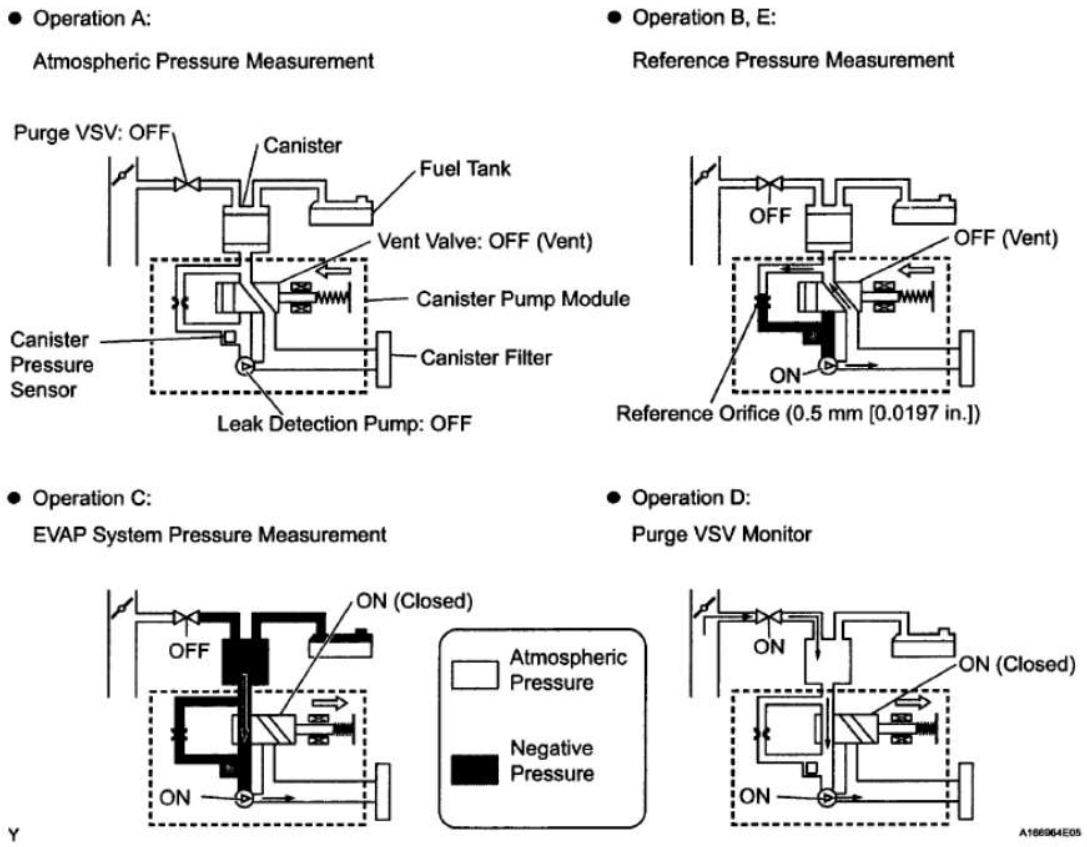


Fig. 173: EVAP Pressure Chart
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

a. Purge VSV stuck open

In operation C, the leak detection pump creates negative pressure (vacuum) in the EVAP system. The EVAP system pressure is then measured by the ECM using the canister pressure sensor. If the stabilized system pressure is higher than [second reference pressure x 0.2], the ECM interprets this as the purge VSV (Vacuum Switching Valve) being stuck open. The ECM illuminates the MIL and stores the DTC (2 trip detection logic).

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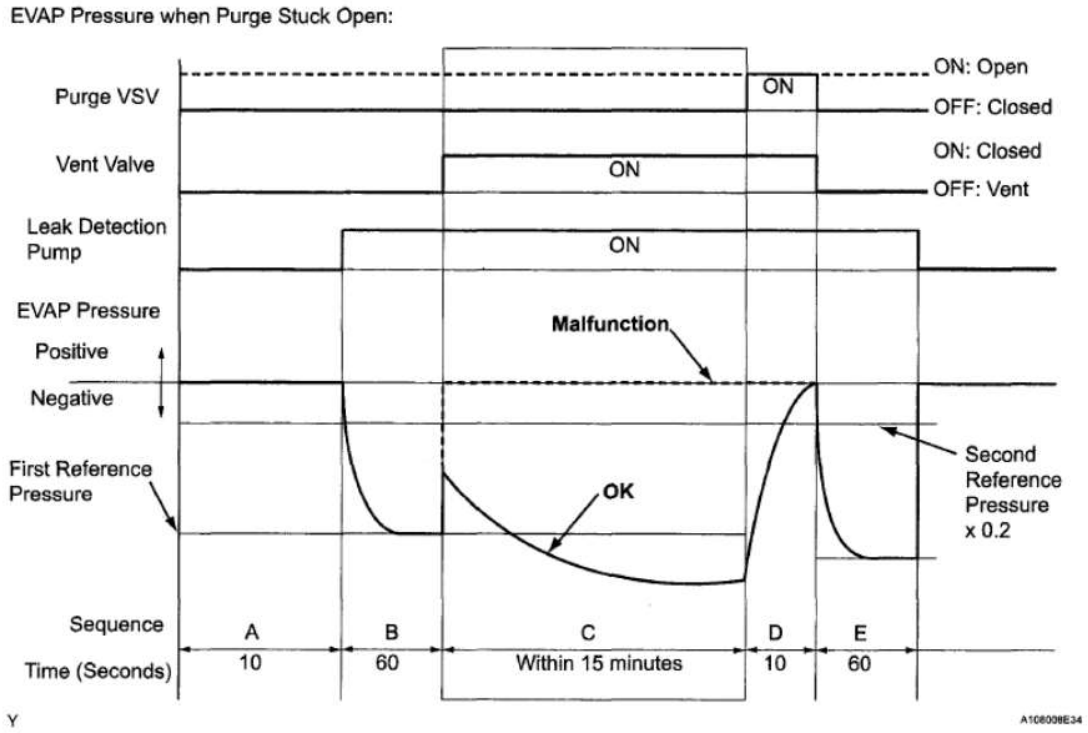


Fig. 174: EVAP Pressure Chart - Purge VSV Stuck Open
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. Purge VSV stuck closed

In operation D, the canister pressure sensor measures the EVAP system pressure. The pressure measurement for the purge VSV monitor is begun when the purge VSV is turned ON (open) after the EVAP leak check. When the measured pressure indicates an increase of 0.3 kPa-g (2.25 mmHg-g) or more, the purge VSV is functioning normally. If the pressure does not increase, the ECM interprets this as the purge VSV being stuck closed. The ECM illuminates the MIL and stores the DTC (2 trip detection logic).

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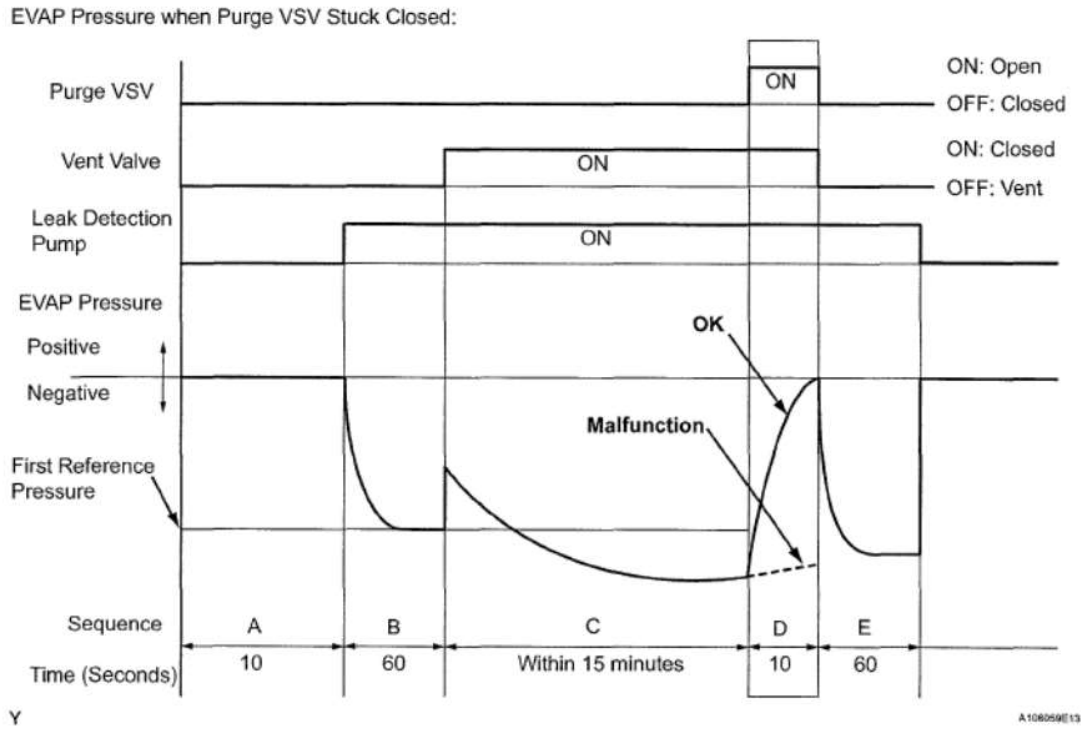


Fig. 175: EVAP Pressure Chart - Purge VSV Stuck Closed
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

2. PURGE FLOW MONITOR

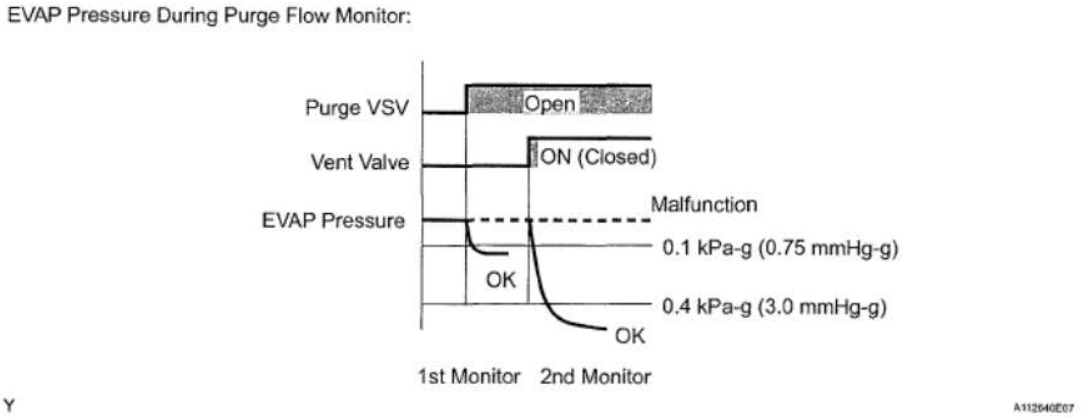


Fig. 176: Purge Flow Monitor Chart
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

The purge flow monitor consists of two monitors. The 1st monitor is conducted every time and the 2nd monitor is activated if necessary.

- The 1st monitor

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While the engine is running and the purge VSV is ON (open), the ECM monitors the purge flow by measuring the EVAP pressure change. If negative pressure is not created, the ECM begins the 2nd monitor.

- The 2nd monitor

  The vent valve is turned ON (closed) and the EVAP pressure is then measured. If the variation in the pressure is less than 0.4 kPa-g (3.0 mmHg-g), the ECM interprets this as the purge VSV being stuck closed, illuminates the MIL and stores DTC P0441 (2 trip detection logic).

Atmospheric pressure check:

In order to ensure reliable malfunction detection, the variation between the atmospheric pressures, before and after conduction of the purge flow monitor, is measured by the ECM.

OBD II MONITOR SPECIFICATIONS

1. **Key-off Monitor**

Monitor Strategy

MONITOR STRATEGY CHART

Required Sensors/Components	Purge VSV Canister pump module
Frequency of Operation	Once per driving cycle
Duration	Within 15 minutes (varies with amount of fuel in tank)
MIL Operation	2 driving cycles
Sequence of Operation	None

Typical Enabling Conditions

TYPICAL ENABLING CONDITIONS CHART

Monitor runs whenever following DTCs not stored	None
EVAP key-off monitor runs when all of following conditions met	-
Atmospheric pressure	70 to 110 kPa-a (525 to 825 mmHg-a)
Battery voltage	10.5V or higher
Vehicle speed	Less than 2.5 mph (4 km/h)
Ignition switch	off
Time after key-off	5, 7 or 9.5 hours
Canister pressure sensor malfunction (P0451, P0452)	Not detected
Purge VSV	Not operated by scan tool
Vent valve	Not operated by scan tool
Leak detection pump	Not operated by scan tool
Both of following conditions met before key-off	Conditions 1 and 2
1. Duration that vehicle is driven	5 minutes or more

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2. EVAP purge operation	Performed
Engine coolant temperature	4.4 to 35°C (40 to 95°F)
Intake air temperature	4.4 to 35°C (40 to 95°F)

Typical Malfunction Thresholds

TYPICAL MALFUNCTION THRESHOLDS CHART

Purge VSV stuck open:	-
EVAP pressure when vacuum introduction complete	Higher than reference pressure x 0.2

TYPICAL MALFUNCTION THRESHOLDS CHART

Purge VSV stuck closed:	-
EVAP pressure change after purge VSV open	Below 0.3 kPa-g (2.25 mmHg-g)

OBD II MONITOR SPECIFICATIONS

1. **Purge Flow Monitor**

Monitor Strategy

MONITOR STRATEGY CHART

Required Sensors/Components	Purge VSV Canister pump module
Frequency of Operation	Once per driving cycle
Duration	Within 10 minutes
MIL Operation	2 driving cycles
Sequence of Operation	None

Typical Enabling Conditions

TYPICAL ENABLING CONDITIONS CHART

Monitor runs whenever following DTCs not stored	None
Engine	Running
Engine coolant temperature	4.4°C (40°F) or higher
Intake air temperature	4.4°C (40°F) or higher
Canister pressure sensor malfunction (P0451, P0452)	Not detected
Purge VSV	Not operated by scan tool
EVAP system check	Not operated by scan tool
Battery voltage	10 V or higher
Purge duty-cycle	8% or more

Typical Malfunction Thresholds

TYPICAL MALFUNCTION THRESHOLDS CHART

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Both of following conditions met	Conditions 1 and 2
1. EVAP pressure change when purge operation started	Below 0.1 kPa-g (0.75 mmHg-g)
2. EVAP pressure change during purge operation when vent valve closed	Below 0.4 kPa-g (3.0 mmHg-g)

MONITOR RESULT

Refer to **CHECKING MONITOR STATUS** .

CONFIRMATION DRIVING PATTERN

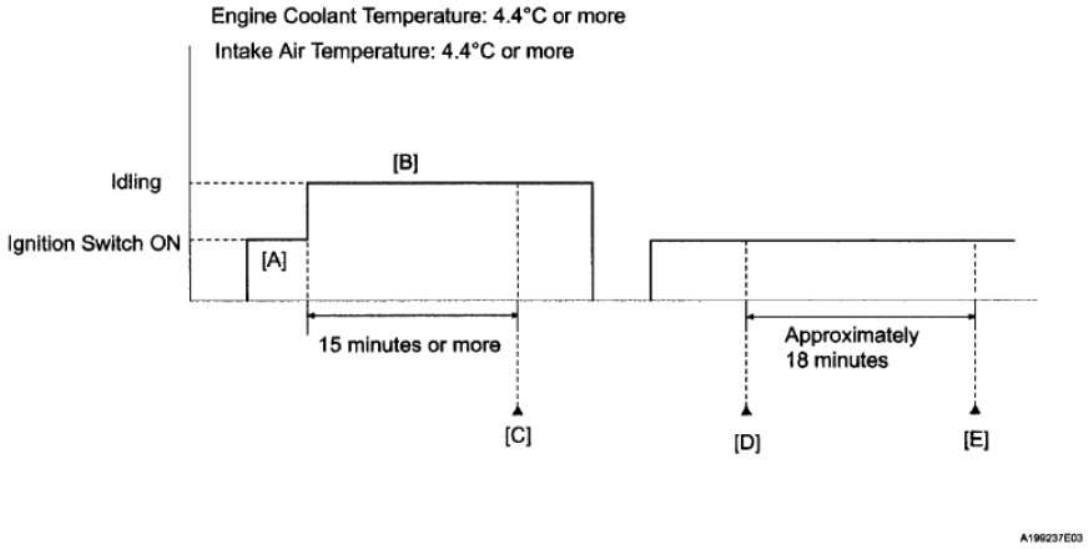


Fig. 177: Confirmation Driving Pattern
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

1. Connect the Techstream to the DLC3.
2. Turn the ignition switch to ON and turn the Techstream on.
3. Clear the DTCs (even if no DTCs are stored, perform the clear DTC procedure).
4. Turn the ignition switch off.
5. Turn the ignition switch to ON and turn the Techstream on [A].
6. Start the engine and wait 15 minutes or more [B].
7. Enter the following menus: Powertrain/Engine/Utility/All readiness.
8. Input the DTC: P0441.
9. Check the DTC judgment result [C].

TECHSTREAM DISPLAY DESCRIPTION

Techstream Display	Description

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NORMAL	• DTC judgment completed • System normal
ABNORMAL	• DTC judgment completed • System abnormal
INCOMPLETE	• DTC judgment not completed • You should perform driving pattern after confirming DTC enabling conditions
UNKNOWN	• Unable to perform DTC judgment • Number of DTCs which do not fulfill DTC preconditions has reached ECU memory limit

NOTE:

- **The Evaporative System Check (Automatic Mode) consists of 5 steps performed automatically by the Techstream. It takes a maximum of approximately 18 minutes.**
- **Do not perform the Evaporative System Check when the fuel tank is more than 90% full because the cut-off valve may be closed, making the fuel tank leak check unavailable.**
- **Do not run the engine during this operation.**
- **When the temperature of the fuel is 35°C (95°F) or higher, a large amount of vapor forms and any check results become inaccurate. When performing the Evaporative System Check, keep the fuel temperature below 35°C (95°F).**

10. Turn the ignition switch to ON and turn the Techstream on.
11. Clear the DTCs (even if no DTCs are stored, perform the clear DTC procedure) [D].
12. Enter the following menus: Powertrain/Engine/Utility/Evaporative System Check/Automatic Mode.
13. After the "Evaporative System Check" is completed, check for All Readiness by entering the following menus: Powertrain/Engine/Utility/All Readiness.
14. Input the DTC: P0441.
15. Check the DTC judgment result [E].

TECHSTREAM DISPLAY DESCRIPTION

Techstream Display	Description
NORMAL	• DTC judgment completed • System normal
ABNORMAL	• DTC judgment completed • System abnormal
INCOMPLETE	• DTC judgment not completed

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	• Perform driving pattern after confirming DTC enabling conditions
UNKNOWN	• Unable to perform DTC judgment • Number of DTCs which do not fulfill DTC preconditions has reached ECU memory limit

HINT:

If the judgment result shows ABNORMAL, the system has a malfunction.

16. If the test result is UNKNOWN, enter the following menus: Powertrain/Engine/Trouble Codes/Pending.
17. Read Pending DTCs.

HINT:

If a pending DTC is output, the system is malfunctioning.

18. If the test result is INCOMPLETE or UNKNOWN and no pending DTC is output, perform a universal trip and check for permanent DTCs (See **DTC CHECK/CLEAR**).

HINT:

- If a permanent DTC is output, the system is malfunctioning.
- If no permanent DTC is output, the system is normal.

DTC P0451 EVAPORATIVE EMISSION CONTROL SYSTEM PRESSURE SENSOR RANGE/PERFORMANCE; DTC P0452 EVAPORATIVE EMISSION CONTROL SYSTEM PRESSURE SENSOR/SWITCH LOW INPUT; DTC P0453 EVAPORATIVE EMISSION CONTROL SYSTEM PRESSURE SENSOR/SWITCH HIGH INPUT

DTC SUMMARY

DTC SUMMARY

DTC No.	Monitoring Item	Malfunction Detection Condition	Trouble Area	Detection Timing	Detection Logic
	Canister pressure sensor noise	Sensor output voltage fluctuates frequently within certain time period.	• Canister pump module • Connector/wire harness (Canister pump module - ECM) • EVAP system hose (pipe from air inlet port to canister pump module, canister filter, fuel tank vent hose)	• EVAP monitoring (ignition switch off) • Engine running	2 trip

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			• ECM		
P0451	Canister pressure sensor signal becomes fixed/flat	Sensor output voltage does not vary within certain time period.	• Canister pump module • Connector/wire harness (Canister pump module - ECM) • EVAP system hose (pipe from air inlet port to canister pump module, canister filter, fuel tank vent hose) • ECM	• EVAP monitoring (ignition switch off)	2 trip
P0452	Canister pressure sensor low input	EVAP pressure below 42.1 kPa (316 mmHg) for 0.5 seconds.	• Canister pump module • Connector/wire harness (Canister pump module - ECM) • EVAP system hose (pipe from air inlet port to canister pump module, canister filter, fuel tank vent hose) • ECM	• Ignition switch ON • EVAP monitoring (ignition switch off)	1 trip
P0453	Canister pressure sensor high input	EVAP pressure higher than 123.8 kPa (929 mmHg) for 0.5 seconds.	• Canister pump module • Connector/wire harness (Canister pump module - ECM) • EVAP system hose (pipe from air inlet port to canister pump module, canister filter, fuel tank vent hose) • ECM	• Ignition switch ON • EVAP monitoring (ignition switch off)	1 trip

HINT:

The canister pressure sensor is built into the canister pump module.

DESCRIPTION

The description can be found in EVAP (Evaporative Emission) System (See **DESCRIPTION**).

HINT:

Unit expressions

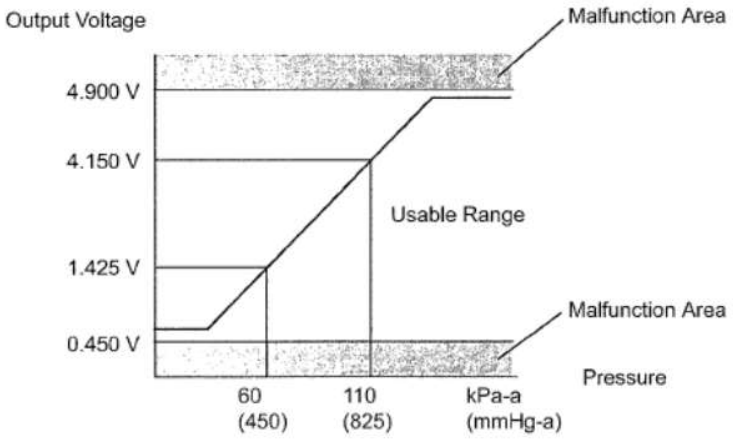
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- [kPa-a (mmHg-a)] denotes the absolute pressure.
- [kPa-g (mmHg-g)] denotes the gauge pressure (relative pressure).
- On the Techstream, convert the unit of measurement according to the inspection procedure.

MONITOR DESCRIPTION

Canister Pressure Sensor Specification:



HINT:

Standard atmospheric pressure is 101.3 kPa-a (760 mmHg-a)

A115543E16

Fig. 178: Canister Pressure Sensor Output Voltage Graph
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

1. DTC P0451: Canister pressure sensor noise or signal fixed/flat

   If the canister pressure sensor voltage output fluctuates rapidly for 10 seconds, the ECM stops the EVAP system monitor. The ECM interprets this as noise from the canister pressure sensor, and stops the EVAP system monitor. The ECM then illuminates the MIL and stores the DTC. Alternatively, if the sensor voltage output does not change for 10 seconds, the ECM interprets this as the sensor signal being fixed/flat, and stops the monitor. The ECM then illuminates the MIL and stores the DTC (both malfunctions are detected by 2 trip detection logic).

2. DTC P0452: Canister pressure sensor voltage low

   If the canister pressure sensor voltage output [pressure] is below 0.45 V [42.1 kPa-a (315.7 mmHg-a)], the ECM interprets this as an open or short circuit malfunction in the canister pressure sensor or its circuit, and stops the EVAP system monitor. The ECM then illuminates the MIL and stores the DTC (1 trip detection logic).

3. DTC P0453: Canister pressure sensor voltage high

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If the canister pressure sensor voltage output [pressure] is 4.9 V [123.8 kPa-a (928.5 mmHg-a)] or more, the ECM interprets this as an open or short circuit malfunction in the canister pressure sensor or its circuit, and stops the EVAP system monitor. The ECM then illuminates the MIL and stores the DTC (1 trip detection logic).

MONITOR STRATEGY

MONITOR STRATEGY CHART

Related DTCs	P0451: Evaporative Emission Control System Canister Pressure Sensor Noise P0451: Evaporative Emission Control System Canister Pressure Sensor Stuck P0452: Evaporative Emission Control System Canister Pressure Sensor/Switch low Input P0453: Evaporative Emission Control System Canister Pressure Sensor/Switch High Input
Required Sensors/Components	Canister pump module
Frequency of Operation	Once per driving cycle: P0451 sensor fixed/flat Continuous: P0451 sensor noise, P0452 and P0453
Duration	0.5 seconds: P0452 and P0453 Within 2 minutes: P0451 (sensor stuck) Less than 15 minutes: P0451 (sensor noise)
MIL Operation	Immediate: P0452 and P0453 2 driving cycles: P0451
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

P0451 (Noise Monitor)

TYPICAL ENABLING CONDITIONS CHART

Monitor runs whenever following DTCs not stored	None
Atmospheric pressure (absolute pressure)	70 to 110 kPa-a (525 to 825 mmHg-a)
Battery voltage	10.5 V or higher
Intake air temperature	4.4 to 50°C (40 to 122°F)
Canister pressure sensor malfunction (P0452, P0453)	Not detected
Either of following conditions met	A or B
A. Engine condition	Running
B. Time after key-off	5, 7 or 9.5 hours

P0451 (Stuck Monitor)

TYPICAL ENABLING CONDITIONS CHART

Monitor runs whenever following DTCs not stored	None

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Battery voltage	10.5 V or higher
Intake air temperature	4.4 to 50°C (40 to 122°F)
Atmospheric pressure (absolute pressure)	70 to 110 kPa-a (525 to 825 mmHg-a)
Time after key-off	5, 7 or 9.5 hours

P0452 and P0453

TYPICAL ENABLING CONDITIONS CHART

Monitor runs whenever following DTCs not stored	None
Either of following conditions met	(a) or (b)
(a) Ignition switch	ON
(b) Soak timer	ON

TYPICAL MALFUNCTION THRESHOLDS

P0451: Canister Pressure Sensor Noise

TYPICAL MALFUNCTION THRESHOLDS CHART

Frequency that EVAP pressure change 0.3 kPa-g (2.25 mmHg-g) or higher	10 times or more in 10 seconds

P0451: Canister Pressure Sensor Fixed/flat

TYPICAL MALFUNCTION THRESHOLDS CHART

EVAP pressure change during reference pressure measurement	Below 0.65 kPa-g (4.87 mmHg-g)

P0452: Canister Pressure Sensor Low Voltage

TYPICAL MALFUNCTION THRESHOLDS CHART

EVAP pressure	Below 42.1 kPa-a (315.7 mmHg-a)

P0453: Canister Pressure Sensor High Voltage

TYPICAL MALFUNCTION THRESHOLDS CHART

EVAP pressure	Higher than 123.8 kPa-a (928.5 mmHg-a)

CONFIRMATION DRIVING PATTERN

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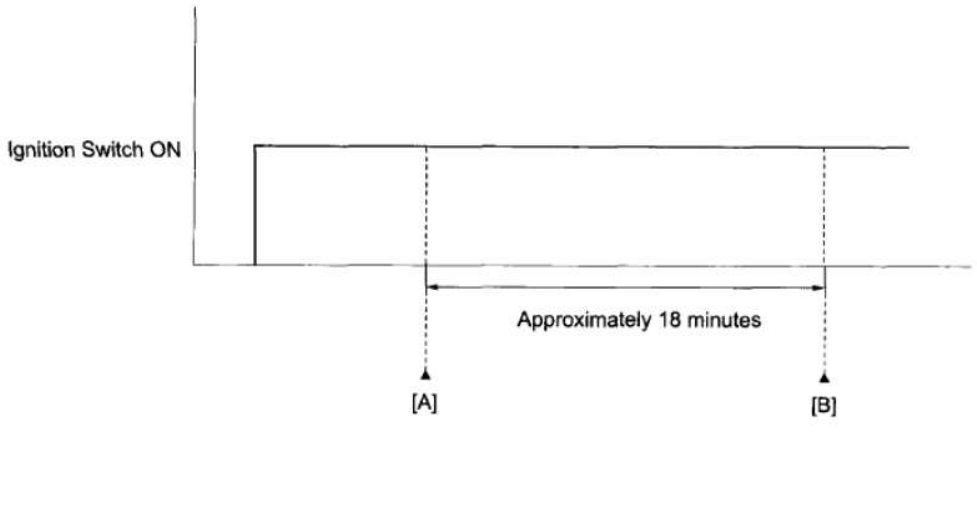


Fig. 179: Confirmation Driving Pattern
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

NOTE:

- **The Evaporative System Check (Automatic Mode) consists of 5 steps performed automatically by the Techstream. It takes a maximum of approximately 18 minutes.**
- **Do not perform the Evaporative System Check when the fuel tank is more than 90% full because the cut-off valve may be closed, making the fuel tank leak check unavailable.**
- **Do not run the engine during this operation.**
- **When the temperature of the fuel is 35°C (95°F) or higher, a large amount of vapor forms and any check results become inaccurate. When performing the Evaporative System Check, keep the fuel temperature below 35°C (95°F).**

1. Connect the Techstream to the DLC3.
2. Turn the ignition switch to ON and turn the Techstream on.
3. Clear the DTCs (even if no DTCs are stored, perform the clear DTC procedure).
4. Turn the ignition switch off.
5. Turn the ignition switch to ON and turn the Techstream on [A].
6. Enter the following menus: Powertrain/Engine/Utility/Evaporative System Check/Automatic Mode.
7. After the "Evaporative System Check" is completed, check for All Readiness by entering the following menus: Powertrain/Engine/Utility/All readiness.
8. Input the DTC: P0451, P0452 or P0453.
9. Check the DTC judgment result [B].

TECHSTREAM DISPLAY DESCRIPTION

Techstream	Description

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Display	
NORMAL	• DTC judgment completed • System normal
ABNORMAL	• DTC judgment completed • System abnormal
INCOMPLETE	• DTC judgment not completed • Perform driving pattern after confirming DTC enabling conditions
UNKNOWN	• Unable to perform DTC judgment • Number of DTCs which do not fulfill DTC preconditions has reached ECU memory limit

HINT:

If the judgment result shows ABNORMAL, the system has a malfunction.

10. If the test result is UNKNOWN, enter the following menus: Powertrain/Engine/Trouble Codes/Pending.
11. Read Pending DTCs.

HINT:

If a pending DTC is output, the system is malfunctioning.

12. If the test result is INCOMPLETE or UNKNOWN and no pending DTC is output, perform a universal trip and check for permanent DTCs (See **DTC CHECK/CLEAR**).

HINT:

- If a permanent DTC is output, the system is malfunctioning.
- If no permanent DTC is output, the system is normal.

WIRING DIAGRAM

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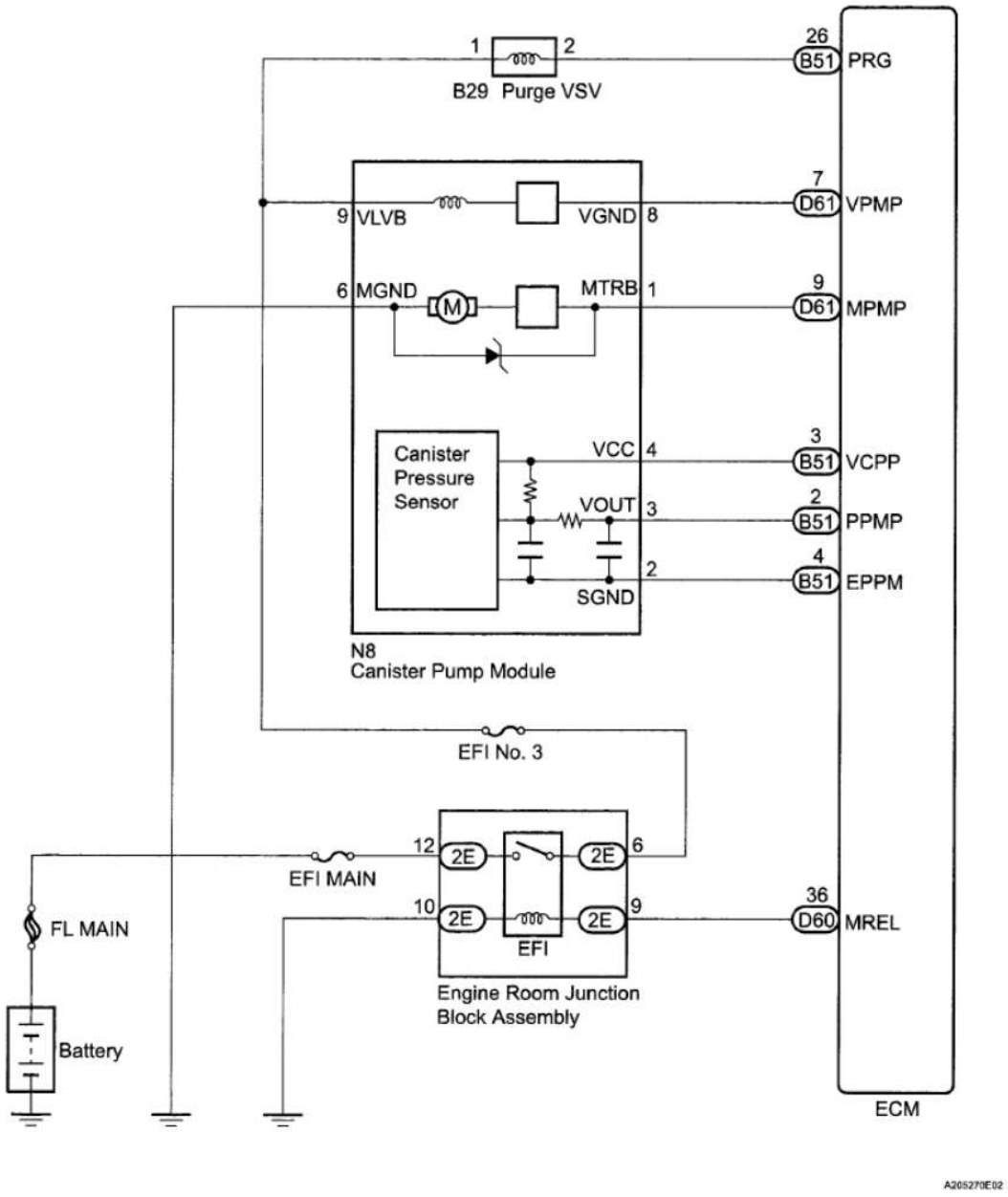


Fig. 180: Evaporative Emission Control System Pressure Sensor Range/Performance - Wiring Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSPECTION PROCEDURE

NOTE:

- **When a vehicle is brought into the workshop, leave it as it is. Do not change the vehicle condition. For example, do not tighten the fuel cap.**
- **Do not disassemble the canister pump module.**
- **The Techstream is required to conduct the following diagnostic troubleshooting procedure.**

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1. **CONFIRM DTC AND EVAP PRESSURE**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch to ON (do not start the engine).
   c. Turn the Techstream on.
   d. Enter the following menus: Powertrain/Engine/Trouble Codes.
   e. Read the DTCs.
   f. Enter the following menus: Powertrain/Engine/Data List/All Data/Vapor Pressure Pump.
   g. Read the EVAP (Evaporative Emission) pressure displayed on the Techstream.

   Result

   RESULT CHART

Display (DTC Output)	Test Result	Suspected Trouble Area	Proceed to
P0451	-	Canister pressure sensor	C
P0452	Below 45 kPa-a (337.5 mmHg-a)	• Wire harness/connector (ECM - Canister pressure sensor) • Canister pressure sensor • ECM	A
P0453	Higher than 120 kPa-a (900 mmHg-a)	• Wire harness/connector (ECM - Canister pressure sensor) • Canister pressure sensor • ECM	B

   B: Go to step 4

   C: GO TO **EVAP SYSTEM**

   A: Go to next step

2. **CHECK HARNESS AND CONNECTOR (CANISTER PUMP MODULE - ECM)**
   a. Turn the ignition switch off.
   b. Disconnect the ECM connector.
   c. Measure the resistance according to the value(s) in the table below.

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Rear view of wire harness connector:
(to ECM)

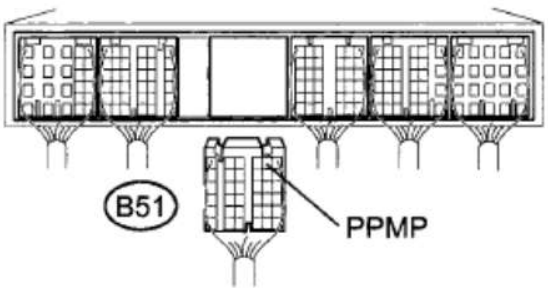


Fig. 181: Disconnecting B51 ECM Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Result

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition	Suspected Trouble Area	Proceed to
B51-2 (PPMP) - Body ground	Always	10 ohms or less	• Wire harness/connector (ECM - Canister pressure sensor) • Short in canister pressure sensor circuit	A
		10 kohms or higher	• Wire harness/connector (ECM - Canister pressure sensor) • Short in ECM circuit	B

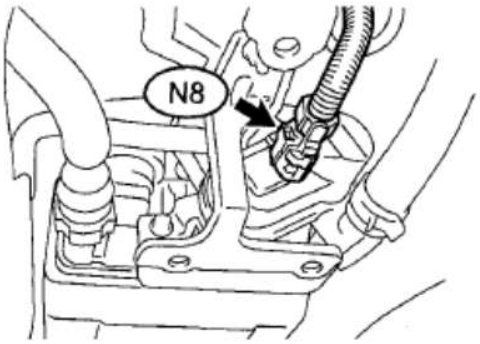
d. Reconnect the ECM connector.

B: Go to step 7

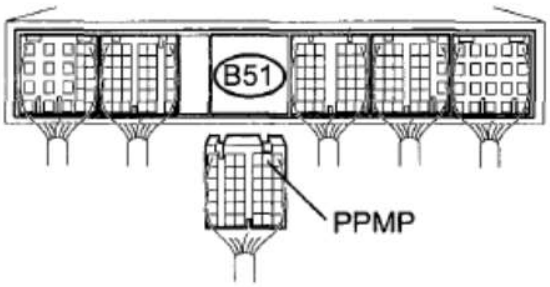
A: Go to next step

3. **CHECK HARNESS AND CONNECTOR (CANISTER - ECM)**
   a. Disconnect the canister pump module connector.
   b. Disconnect the ECM connector.
   c. Measure the resistance according to the value(s) in the table below.

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Rear view of wire harness connector:
(to ECM)



A205273E02

Fig. 182: Identifying Canister Pump Module Connector And ECM Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Result

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition	Suspected Trouble Area	Proceed to
B51-2 (PPMP) - Body ground	Always	10 kohms or higher	Short in canister pressure sensor circuit	A
		10 ohms or less	Short in wire harness/connector (ECM - Canister pressure sensor)	B

d. Reconnect the canister pump module connector.
e. Reconnect the ECM connector.

A: Go to step 5

B: Go to step 6

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4. **CHECK HARNESS AND CONNECTOR (CANISTER PUMP MODULE - ECM)**
   a. Disconnect the canister pump module connector.
   b. Measure the voltage and resistance according to the value(s) in the table below.

Standard Voltage

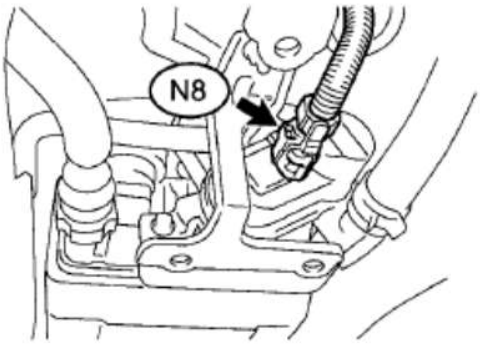
TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Switch Condition	Specified Condition
N8-4 (VCC) - Body ground	Ignition switch ON	4.5 to 5.5 V
N8-3 (VOUT) - Body ground	Ignition switch ON	4.5 to 5.5 V

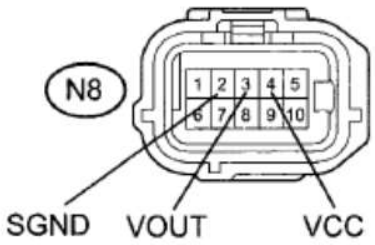
Standard Resistance

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
N8-2 (SGND) - Body ground	Always	100 ohms or less



Front view of wire harness connector:
(to Canister Pump Module)



A168256E06

Fig. 183: Locating Canister Pump Module Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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Result

RESULT CHART

Test Result	Suspected Trouble Area	Proceed to
Voltage and resistance within standard ranges	Open in canister pressure sensor circuit	A
Voltage and resistance outside standard ranges	Open in wire harness/connector (ECM - Canister pressure sensor)	B

c. Reconnect the canister pump module connector.

B: Go to step 6

A: Go to next step

5. **REPLACE CANISTER**

a. Replace the canister (See **REMOVE**).

NOTE: When replacing the canister, check the canister pump module interior and related pipes for water, fuel and other liquids. If liquids are present, check for disconnections and/or cracks in the following: 1) the pipe from the air inlet port to the canister pump module; 2) the canister filter; and 3) the fuel tank vent hose.

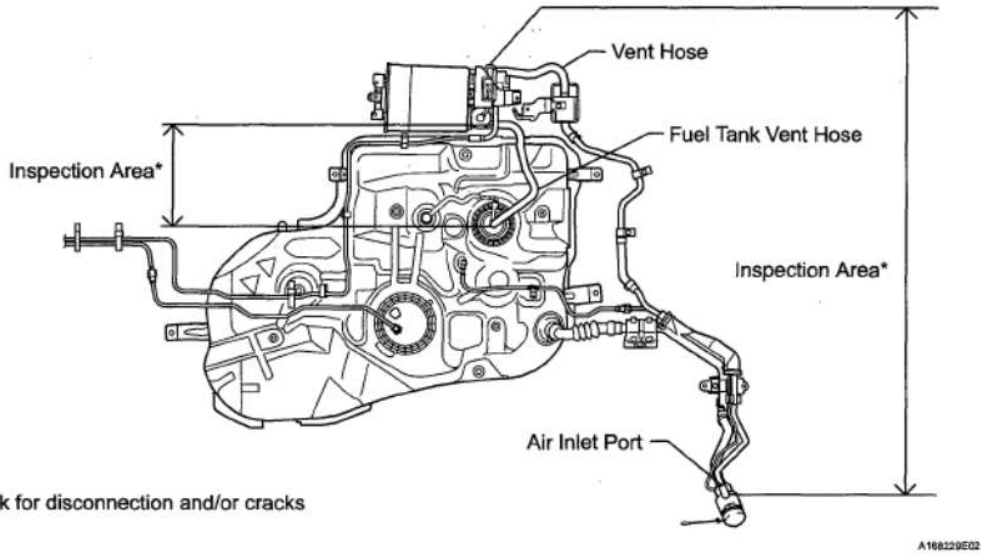


Fig. 184: Identifying Canister Inspection Area
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

NEXT: Go to step 8

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6. **REPAIR OR REPLACE HARNESS OR CONNECTOR (CANISTER - ECM)**

   HINT:

   If the exhaust tailpipe has been removed, go to the next step before reinstalling it.

   NEXT: Go to step 8

7. **REPLACE ECM**
   a. Replace the ECM (See **REMOVAL**).

      NEXT: Go to step 8

8. **CHECK WHETHER DTC OUTPUT RECURS (AFTER REPAIR)**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the Techstream on.
   d. Wait for at least 60 seconds.
   e. Enter the following menus: Powertrain/Engine/Trouble Codes/Pending.

      HINT:

      If no pending DTCs are output to the Techstream, the repair has been successfully completed.

      NEXT: REPAIR COMPLETED

DTC P0455 EVAPORATIVE EMISSION CONTROL SYSTEM LEAK DETECTED (GROSS LEAK); DTC P0456 EVAPORATIVE EMISSION CONTROL SYSTEM LEAK DETECTED (VERY SMALL LEAK)

DTC SUMMARY

DTC SUMMARY

DTC No.	Monitoring Item	Malfunction Detection Condition	Trouble Area	Detection Timing	Detection Logic
P0455	EVAP gross leak	Leak detection pump creates negative pressure (vacuum) in EVAP system and EVAP system pressure measured. Reference pressure measured at start and at end of leak check. If stabilized pressure higher than	• Fuel cap (loose) • Leak from EVAP line (Canister - Fuel tank) • Leak from EVAP line (Purge VSV -	While ignition switch off	2 trip

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		[second reference pressure x 0.2], ECM determines that EVAP system has large leak.	Canister) • Canister pump module • Leak from fuel tank • Leak from canister		
P0456	EVAP small leak	Leak detection pump creates negative pressure (vacuum) in EVAP system and EVAP system pressure measured. Reference pressure measured at start and at end of leak check. If stabilized pressure between second reference pressure and [second reference pressure x 0.2], ECM determines that EVAP system has small leak.	• Fuel cap (loose) • Leak from EVAP line (Canister - Fuel tank) • Leak from EVAP line (Purge VSV - Canister) • Canister pump module • Leak from fuel tank • Leak from canister	While ignition switch off	2 trip

DESCRIPTION

The description can be found in EVAP (Evaporative Emission) System (See **DESCRIPTION**).

INSPECTION PROCEDURE

Refer to **EVAP SYSTEM** .

HINT:

Unit expressions

- [kPa-a (mmHg-a)] denotes the absolute pressure.
- [kPa-g (mmHg-g)j denotes the gauge pressure (relative pressure).
- On the Techstream, convert the unit of measurement according to the inspection procedure.

MONITOR DESCRIPTION

5 hours* after the ignition switch is turned off, the leak detection pump creates negative pressure (vacuum) in the EVAP system. The ECM monitors for leaks and actuator malfunctions based on the EVAP pressure.

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HINT:

*: If the engine coolant temperature is not below 35°C (95°F) 5 hours after the ignition switch is turned off, the monitor check starts 2 hours later. If it is still not below 35°C (95°F) 7 hours after the ignition switch is turned off, the monitor check starts 2.5 hours later.

OPERATION DESCRIPTION

Sequence	Operation	Description	Duration
-	ECM activation	Activated by soak timer 5, 7 or 9.5 hours after ignition switch turned off.	-
A	Atmospheric pressure measurement	Vent valve turned OFF (vent) and EVAP system pressure measured by ECM in order to register atmospheric pressure. If pressure in EVAP system not between 70 kPa-a and 110 kPa-a (525 mmHg-a and 825 mmHg-a), ECM cancels EVAP system monitor.	10 seconds
B	First reference pressure measurement	In order to determine reference pressure, leak detection pump creates negative pressure (vacuum) through reference orifice and then ECM checks if leak detection pump and vent valve operate normally.	60 seconds
C	EVAP system pressure measurement	Vent valve turned ON (closed) to shut EVAP system. Negative pressure (vacuum) created in EVAP system, and EVAP system pressure then measured. Write down measured value as it will be used in leak check. If EVAP pressure does not stabilize within 15 minutes, ECM cancels EVAP system monitor.	15 minutes(1)
D	Purge VSV monitor	Purge VSV opened and then EVAP system pressure measured by ECM. Large increase indicates normality.	10 seconds
E	Second reference pressure measurement	After second reference pressure measurement, leak check performed by comparing first and second reference pressure. If stabilized system pressure higher than second reference pressure, ECM determines that EVAP system leaking.	60 seconds
-	Final check	Atmospheric pressure measured and then monitoring result recorded by ECM.	-

(1) If only a small amount of fuel is in the fuel tank, it takes longer for the EVAP pressure to stabilize.

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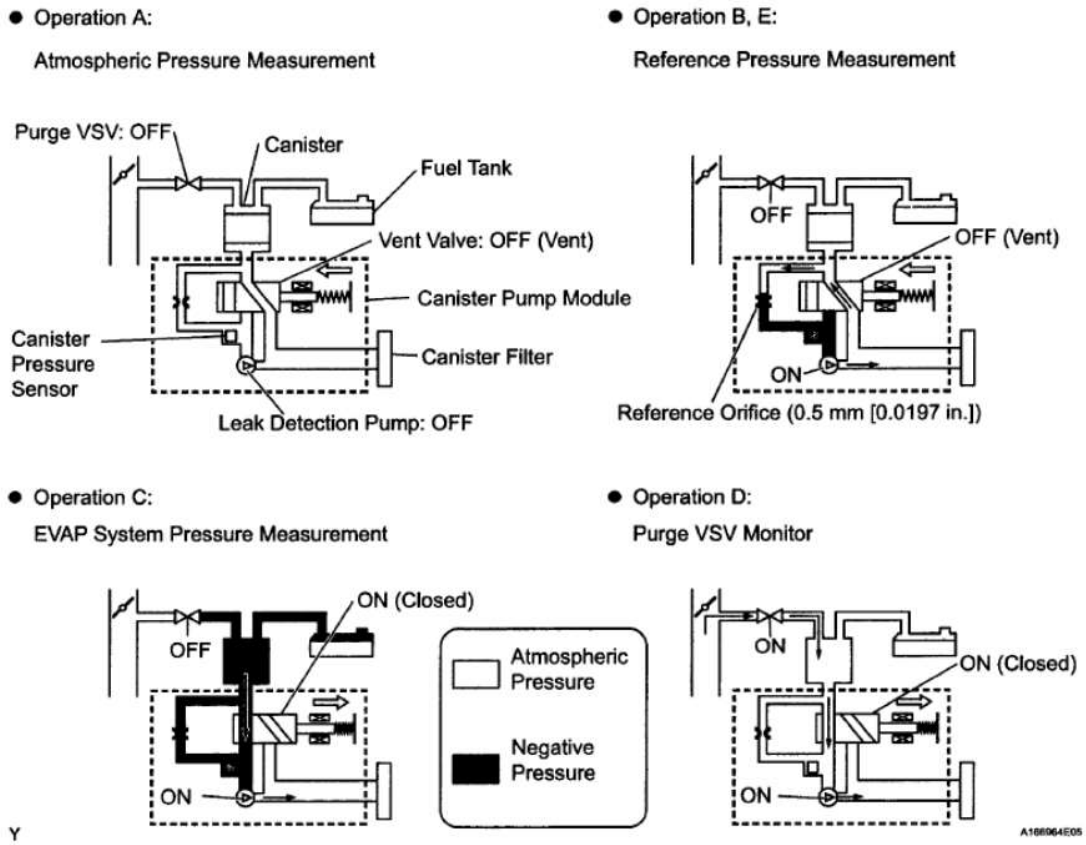


Fig. 185: EVAP Pressure Chart
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

a. P0455: EVAP gross leak

In operation C, the leak detection pump creates negative pressure (vacuum) in the EVAP system and the EVAP system pressure is measured. If the stabilized system pressure is higher than [second reference pressure x 0.2] (near atmospheric pressure), the ECM determines that the EVAP system has a large leak, illuminates the MIL and stores the DTC (2 trip detection logic).

b. P0456: EVAP very small leak

In operation C, the leak detection pump creates negative pressure (vacuum) in the EVAP system and the EVAP system pressure is measured. If the stabilized system pressure is between the second reference pressure and [second reference pressure x 0.2], the ECM determines that the EVAP system has a small leak, illuminates the MIL and stores the DTC (2 trip detection logic).

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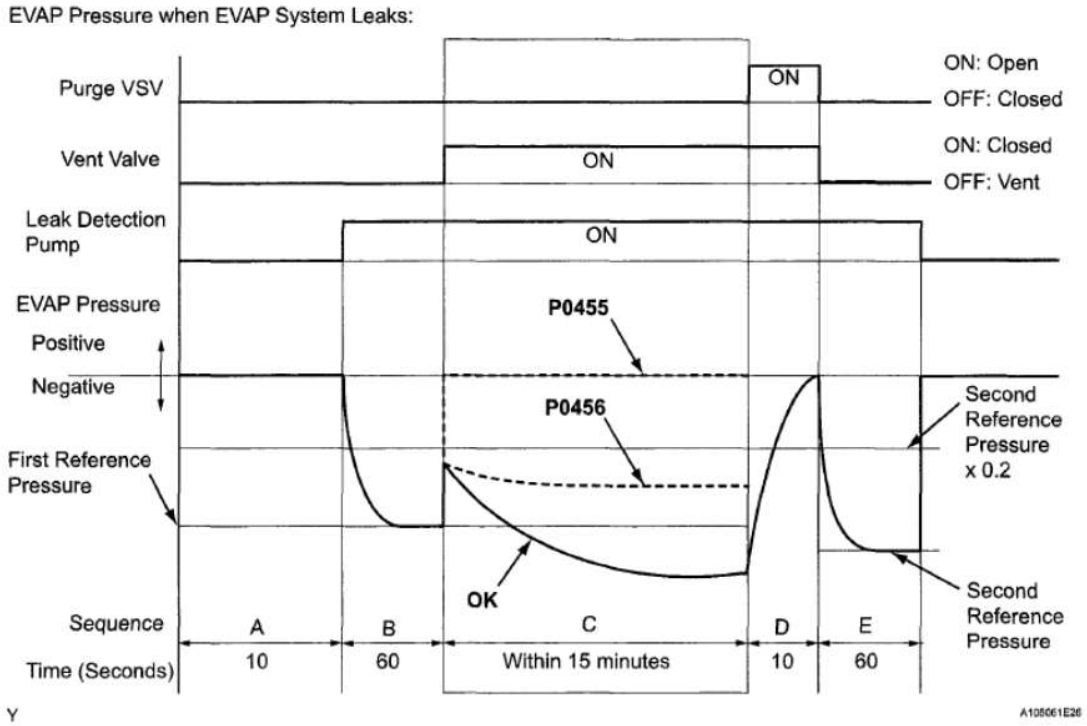


Fig. 186: EVAP Pressure Malfunction Chart - EVAP Very Small Leak
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

MONITOR STRATEGY

MONITOR STRATEGY CHART

Related DTCs	P0455: Gross Leak Detected P0456: Very Small Leak Detected
Required Sensors/Components	Purge VSV and canister pump module
Frequency of Operation	Once per driving cycle
Duration	Within 15 minutes (varies with amount of fuel in tank)
MIL Operation	2 driving cycles
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

P0455 (pattern A), P0456

TYPICAL ENABLING CONDITIONS CHART

Monitor runs whenever following DTCs not stored	None
EVAP key-off monitor runs when all of following conditions met	-
Atmospheric pressure	70 to 110 kPa-a (525 to 825 mmHg-a)
Battery voltage	10.5 V or higher
Vehicle speed	Less than 2.5 mph (4 km/h)

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Ignition switch	off
Time after key-off	5, 7 or 9.5 hours
Canister pressure sensor malfunction (P0452, P0453)	Not detected
Purge VSV	Not operated by scan tool
Vent valve	Not operated by scan tool
Leak detection pump	Not operated by scan tool
Both of following conditions met before-key off	Conditions 1 and 2
1. Duration that vehicle is driven	5 minutes or more
2. EVAP purge operation	Performed
Engine coolant temperature	4.4 to 35°C (40 to 95°F)
Intake air temperature	4.4 to 35°C (40 to 95°F)

P0455 (pattern B)

TYPICAL ENABLING CONDITIONS CHART

Monitor runs whenever following DTCs not stored	None
Atmospheric pressure	70 to 110 kPa-a (525 to 825 mmHg-a)
Battery voltage	10.5 V or higher
Vehicle speed	Less than 2.5 mph (4 km/h)
Ignition switch	off
Canister pressure sensor malfunction (P0451, P0452 and P0453)	Not detected
Purge VSV	Not operated by scan tool
Vent valve	Not operated by scan tool
Leak detection pump	Not operated by scan tool
Both of following conditions met before key-off	Conditions 1 and 2
1. Duration that vehicle driven	5 minutes or more
2. EVAP purge operation	Performed
Engine coolant temperature	4.4 to 45°C (40 to 113°F)
Intake air temperature	4.4 to 45°C (40 to 113°F)

TYPICAL MALFUNCTION THRESHOLDS

P0455: EVAP Gross Leak

TYPICAL MALFUNCTION THRESHOLDS CHART

EVAP pressure when vacuum introduction complete	Higher than [reference pressure x 0.2]

P0456: EVAP Small Leak

TYPICAL MALFUNCTION THRESHOLDS CHART

EVAP pressure when vacuum introduction complete	Between reference pressure and [reference pressure x 0.2]

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MONITOR RESULT

Refer to **CHECKING MONITOR STATUS** .

CONFIRMATION DRIVING PATTERN

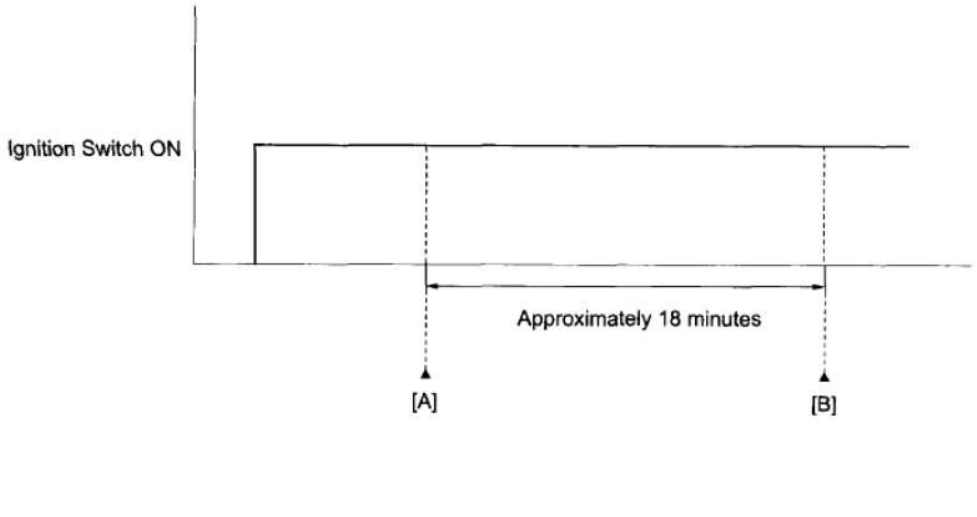


Fig. 187: Confirmation Driving Pattern
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

NOTE:

- **The Evaporative System Check (Automatic Mode) consists of 5 steps performed automatically by the Techstream. It takes a maximum of approximately 18 minutes.**
- **Do not perform the Evaporative System Check when the fuel tank is more than 90% full because the cut-off valve may be closed, making the fuel tank leak check unavailable.**
- **Do not run the engine during this operation.**
- **When the temperature of the fuel is 35°C (95°F) or higher, a large amount of vapor forms and any check results become inaccurate. When performing the Evaporative System Check, keep the fuel temperature below 35°C (95°F).**

1. Connect the Techstream to the DLC3.
2. Turn the ignition switch to ON and turn the Techstream on.
3. Clear the DTCs (even if no DTCs are stored, perform the clear DTC procedure).
4. Turn the ignition switch off.
5. Turn the ignition switch to ON and turn the Techstream on [A].
6. Enter the following menus: Powertrain/Engine/Utility/Evaporative System Check/Automatic Mode.
7. After the "Evaporative System Check" is completed, check for All Readiness by entering the following menus: Powertrain/Engine/Utility/All Readiness.

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8. Input the DTC: P0455 or P0456.
9. Check the DTC judgment result [B].

TECHSTREAM DISPLAY DESCRIPTION

Techstream Display	Description
NORMAL	• DTC judgment completed • System normal
ABNORMAL	• DTC judgment completed • System abnormal
INCOMPLETE	• DTC judgment not completed • Perform driving pattern after confirming DTC enabling conditions
UNKNOWN	• Unable to perform DTC judgment • Number of DTCs which do not fulfill DTC preconditions has reached ECU memory limit

HINT:

If the judgment result shows ABNORMAL, the system has a malfunction.

10. If the test result is UNKNOWN, enter the following menus: Powertrain/Engine/Trouble Codes/Pending.
11. Read Pending DTCs.

HINT:

If a pending DTC is output, the system is malfunctioning.

12. If the test result is INCOMPLETE or UNKNOWN and no pending DTC is output, perform a universal trip and check for permanent DTCs (See **DTC CHECK/CLEAR**).

HINT:

- If a permanent DTC is output, the system is malfunctioning.
- If no permanent DTC is output, the system is normal.

DTC P0500 VEHICLE SPEED SENSOR "A"

DESCRIPTION

The speed sensor detects the wheel speed and sends the appropriate signals to the skid control ECU. The skid control ECU converts these wheel speed signals into a 4-pulse signal and outputs it to the ECM via the combination meter. The ECM determines the vehicle speed based on the frequency of these pulse signals.

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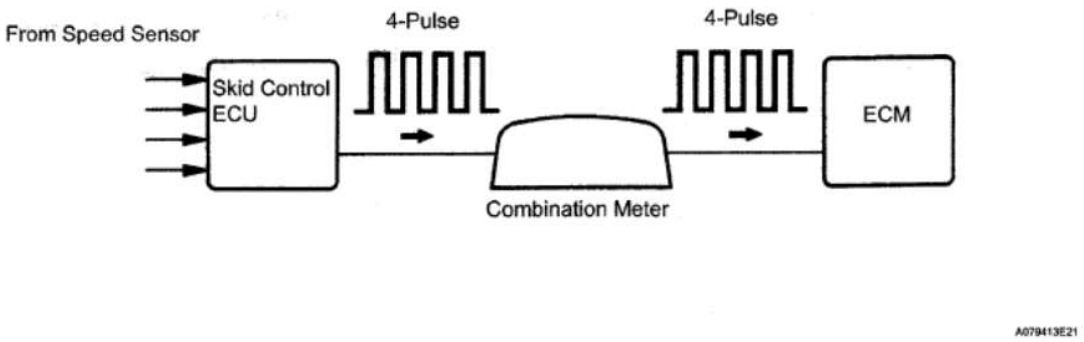


Fig. 188: Speed Sensor Pulse Chart
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

DTC DETECTION CONDITION CHART

DTC No.	DTC Detection Condition	Trouble Area
P0500	Both of the following conditions (A) and (B) are met (1 trip detection logic) A. Either of the following conditions 1 or 2 is met 1. All of the following conditions (a), (b) and (c) are met a. Engine coolant temperature is less than 20° C (68°F) b. Engine coolant temperature sensor malfunction is not detected c. Time after NSW input signal on to off is 10 seconds or more 2. All of the following conditions (a), (b) and (c) are met a. Engine coolant temperature is less than 20° C (68°F) b. Engine coolant temperature sensor malfunction is detected c. Time after NSW input signal on to off is 30 seconds or more B. While vehicle is being driven, no vehicle speed sensor signal is sent to ECM	• Open or short in speed sensor circuit • Speed sensor • Combination meter • Skid control ECU • Main body ECU(1) • TCM • ECM • Radio receiver assembly • Navigation receiver assembly(2) • Tire pressure warning ECU(3) • Stereo component amplifier(4)

(1) w/smart key system
(2) w/navigation system
(3) w/tire pressure warning system
(4) for separate type amplifier system

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MONITOR DESCRIPTION

The ECM assumes that the vehicle is being driven, when the indicated engine speed is more than 2300 rpm and 30 seconds have elapsed since the park/neutral position switch was turned off. If there is no speed signal from the combination meter despite these conditions being met, the ECM interprets this as a malfunction in the speed signal circuit. The ECM then illuminates the MIL and sets the DTC.

MONITOR STRATEGY

MONITOR STRATEGY CHART

Related DTCs	P0500: Vehicle Speed Sensor "A" Pulse Input Error
Required Sensors/Components (Main)	Vehicle speed sensor, combination meter and skid control ECU
Required Sensors/Components (Related)	Park/neutral position switch, engine coolant temperature sensor, crankshaft position sensor, throttle position sensor
Frequency of Operation	Continuous
Duration	2 seconds: Intake air temperature is more than -10°C (14°F) 8 seconds: Intake air temperature is less than -10°C (14°F)
MIL Operation	Immediate
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

TYPICAL ENABLING CONDITIONS CHART

The monitor will run whenever these DTCs are not present	None
Time after ignition switch off to ON	3 seconds or more
Battery voltage	8 V or more
Ignition switch	ON
Starter	OFF
Either of the following conditions is met	Condition 1 or 2
1. Both of the following conditions are met	Condition (a) or (b)
(a) Engine coolant temperature	20°C (68°F) or more
(b) Engine coolant temperature sensor fail (P0115, P0117, P0118, P0125)	Not detected
(c) Time after park/neutral position switch ON to OFF	10 seconds or more
2. Both of the following conditions are met	Conditions (a) and (b)
(a) Engine coolant temperature	Less than 20°C (68°F)
(b) Engine coolant temperature sensor fail (P0115, P0117, P0118, P0125)	Detected
(c) Time after park/neutral position switch ON to OFF	30 seconds or more
Engine speed with throttle position sensor opening angle is below 13°	2300 rpm or more
Engine speed with throttle position sensor opening angle is below 21°	2700 rpm or more
Engine speed with throttle position sensor opening angle is below 30°	2850 rpm or more
Engine speed with throttle position sensor opening angle is 30° or more	3250 rpm or more

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Throttle position sensor fail (P0120, P0121, P0122, P0123, P0220, P0222, P0223, P2135)	Not detected

TYPICAL MALFUNCTION THRESHOLDS

TYPICAL MALFUNCTION THRESHOLDS CHART

Vehicle speed sensor signal	No signal

CONFIRMATION DRIVING PATTERN

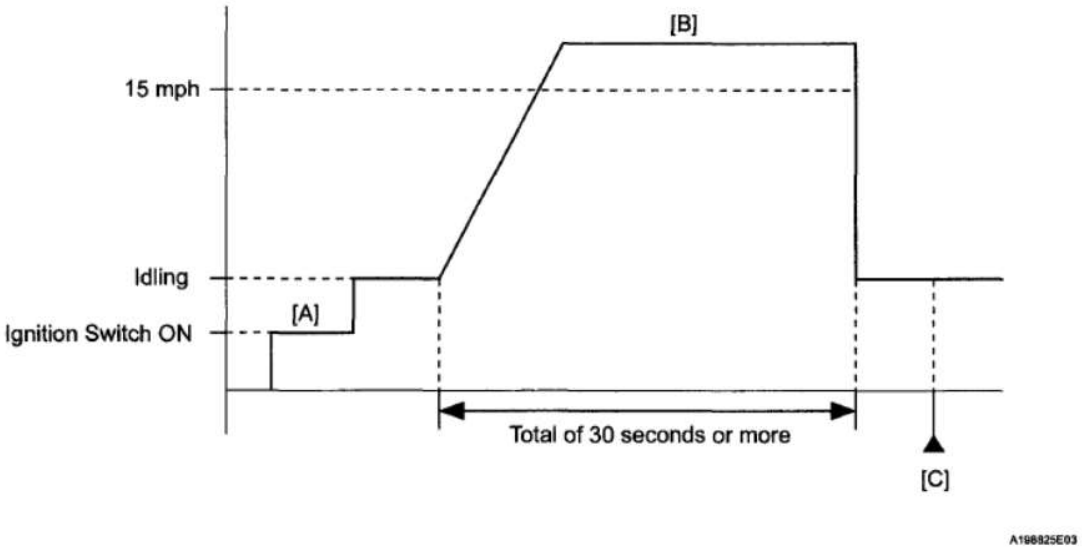


Fig. 189: Confirmation Driving Pattern
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

1. Connect the Techstream to the DLC3.
2. Turn the ignition switch to ON and turn the Techstream on.
3. Clear the DTCs (even if no DTCs are stored, perform the clear DTC procedure).
4. Turn the ignition switch off.
5. Turn the ignition switch to ON and turn the Techstream on [A].
6. Start the engine.
7. Drive the vehicle at 15 mph (24 km/h) or more for a total of 30 seconds or more [B].
8. Stop the vehicle.
9. Enter the following menus: Powertrain/Engine/Utility/All Readiness.
10. Input the DTC: P0500.
11. Check the DTC judgment result [C].

TECHSTREAM DISPLAY DESCRIPTION

Techstream Display	Description

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NORMAL	• DTC judgment completed • System normal
ABNORMAL	• DTC judgment completed • System abnormal
INCOMPLETE	• DTC judgment not completed • Perform driving pattern after confirming DTC enabling conditions
UNKNOWN	• Unable to perform DTC judgment • Number of DTCs which do not fulfill DTC preconditions has reached ECU memory limit

HINT:

If the judgment result shows ABNORMAL, the system has a malfunction.

12. If the test result is UNKNOWN, enter the following menus: Powertrain/Engine/Trouble Codes/Pending.
13. Read Pending DTCs.

    HINT:

    If a pending DTC is output, the system is malfunctioning.

14. If the test result is INCOMPLETE or UNKNOWN and no pending DTC is output, perform a universal trip and check for permanent DTCs (See **DTC CHECK/CLEAR**).

    HINT:

    - If a permanent DTC is output, the system is malfunctioning.
    - If no permanent DTC is output, the system is normal.

WIRING DIAGRAM

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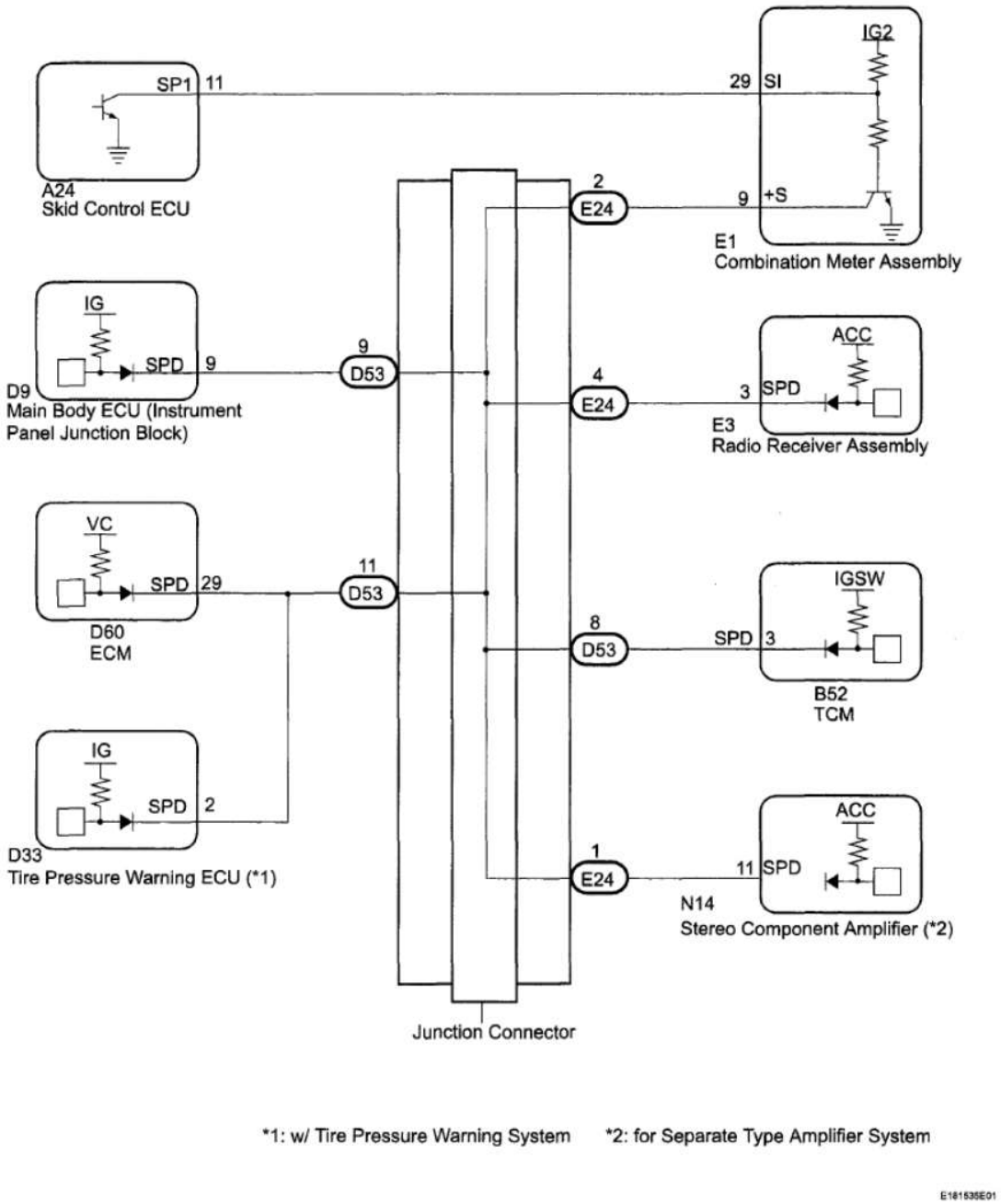


Fig. 190: Vehicle Speed Sensor "A" - Wiring Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSPECTION PROCEDURE

HINT:

Read freeze frame data using the Techstream. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich,

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and other data from the time the malfunction occurred.

1. **INSPECT COMBINATION METER ASSEMBLY (OUTPUT WAVEFORM)**
   a. Remove the combination meter.
   b. Connect the oscilloscope to terminal E1 -9 (+S) and body ground.
   c. Turn the ignition switch to ON.
   d. Turn the wheel slowly.
   e. Check the signal waveform according to the condition(s) in the table below.

WAVEFORM REFERENCE

Item	Condition
Tool setting	5V/DIV., 20ms/DIV.
Vehicle condition	Driving at approx. 12 mph (20 km/h)

OK:

The waveform is displayed as shown in the illustration.

HINT:

When the system is functioning normally, one wheel revolution generates 4 pulses. As the vehicle speed increases, the width indicated by (A) in the illustration narrows.

NG: GO TO METER/GAUGE SYSTEM (See **SPEED SIGNAL CIRCUIT**)

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Component with harness connected:
(Combination Meter Assembly)

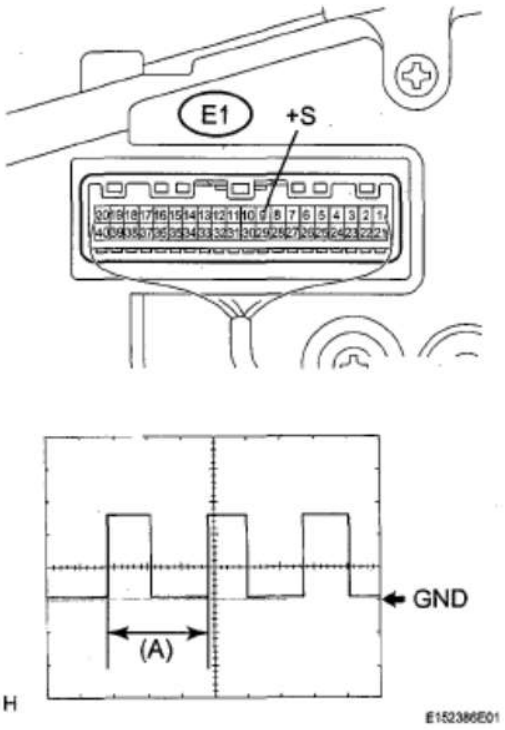


Fig. 191: Identifying Combination Meter Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

2. **CHECK HARNESS AND CONNECTOR (COMBINATION METER ASSEMBLY - ECM)**
   a. Disconnect the combination meter connector.
   b. Disconnect the ECM connector.
   c. Measure the resistance according to the value(s) in the table below.

Standard Resistance (Check for Open)

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
E1-9 (+S) - D60-29 (SPD)	Always	Below 1 ohms

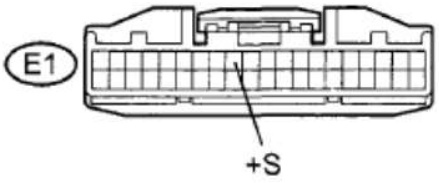
   d. Reconnect the combination meter connector.
   e. Reconnect the ECM connector.

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR (COMBINATION METER

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ASSEMBLY - ECM)

Front view of wire harness connector:
(to Combination Meter)



Rear view of wire harness connector:
(to ECM)

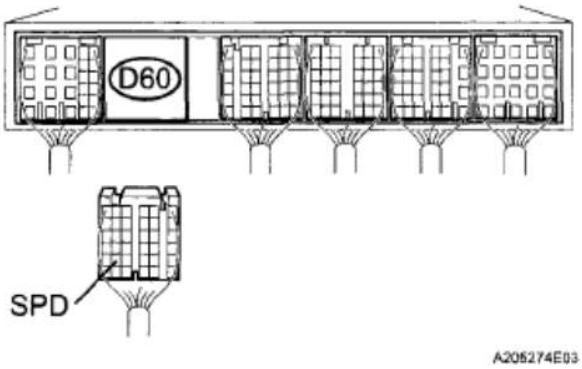


Fig. 192: Identifying Combination Meter Connector And ECM Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: REPLACE ECM (See **INSPECTION PROCEDURE**)

DTC P0504 BRAKE SWITCH "A"/"B" CORRELATION

DESCRIPTION

The stop light switch is a duplex system that transmits two signals: STP and ST1-. These two signals are used by the ECM to monitor whether or not the brake system is working properly. If signals which indicate the brake pedal is being depressed and released are detected simultaneously, the ECM interprets this as a malfunction in the stop light switch and stores the DTC.

HINT:

The normal conditions are as shown in the table below. The signals can be read using the Techstream.

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BRAKE PEDAL REFERENCE

Signal	Brake Pedal Released	In Transition	Brake Pedal Depressed
STP	OFF	ON	ON
ST1-	ON	ON	OFF

DTC DETECTION CONDITION CHART

DTC No.	DTC Detection Condition	Trouble Area
P0504	All of the following conditions continue for 0.5 seconds or more (1 trip detection logic): a. The ignition switch is ON. b. The brake pedal is released. c. The STP signal is OFF when the ST1- signal is OFF.	• Short in stop light switch signal circuit • STOP fuse • Stop light switch assembly • ECM

CONFIRMATION DRIVING PATTERN

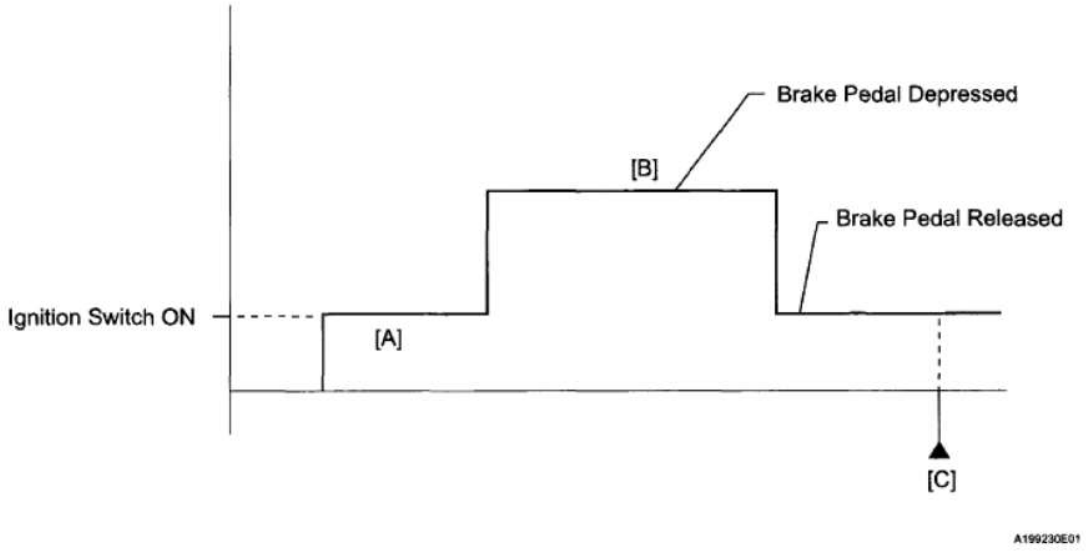


Fig. 193: Confirmation Driving Pattern
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

1. Connect the Techstream to the DLC3.
2. Turn the ignition switch to ON and turn the Techstream on.
3. Clear the DTCs (even if no DTCs are stored, perform the clear DTC procedure).
4. Turn the ignition switch off.
5. Turn the ignition switch to ON and turn the Techstream on [A].
6. Depress and release the brake pedal [B].
7. Enter the following menus: Powertrain/Engine/Utility/All Readiness.
8. Input the DTC: P0504.

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9. Check the DTC judgment result [C].

TECHSTREAM DISPLAY DESCRIPTION

Techstream Display	Description
NORMAL	• DTC judgment completed • System normal
ABNORMAL	• DTC judgment completed • System abnormal
INCOMPLETE	• DTC judgment not completed • Perform driving pattern after confirming DTC enabling conditions
UNKNOWN	• Unable to perform DTC judgment • Number of DTCs which do not fulfill DTC preconditions has reached ECU memory limit

HINT:

If the judgment result shows ABNORMAL, the system has a malfunction.

10. If the test result is UNKNOWN, enter the following menus: Powertrain/Engine/Trouble Codes/Pending.
11. Read Pending DTCs.

HINT:

If a pending DTC is output, the system is malfunctioning.

12. If the test result is INCOMPLETE or UNKNOWN and no pending DTC is output, perform a universal trip and check for permanent DTCs (See **DTC CHECK/CLEAR**).

HINT:

- If a permanent DTC is output, the system is malfunctioning.
- If no permanent DTC is output, the system is normal.

WIRING DIAGRAM

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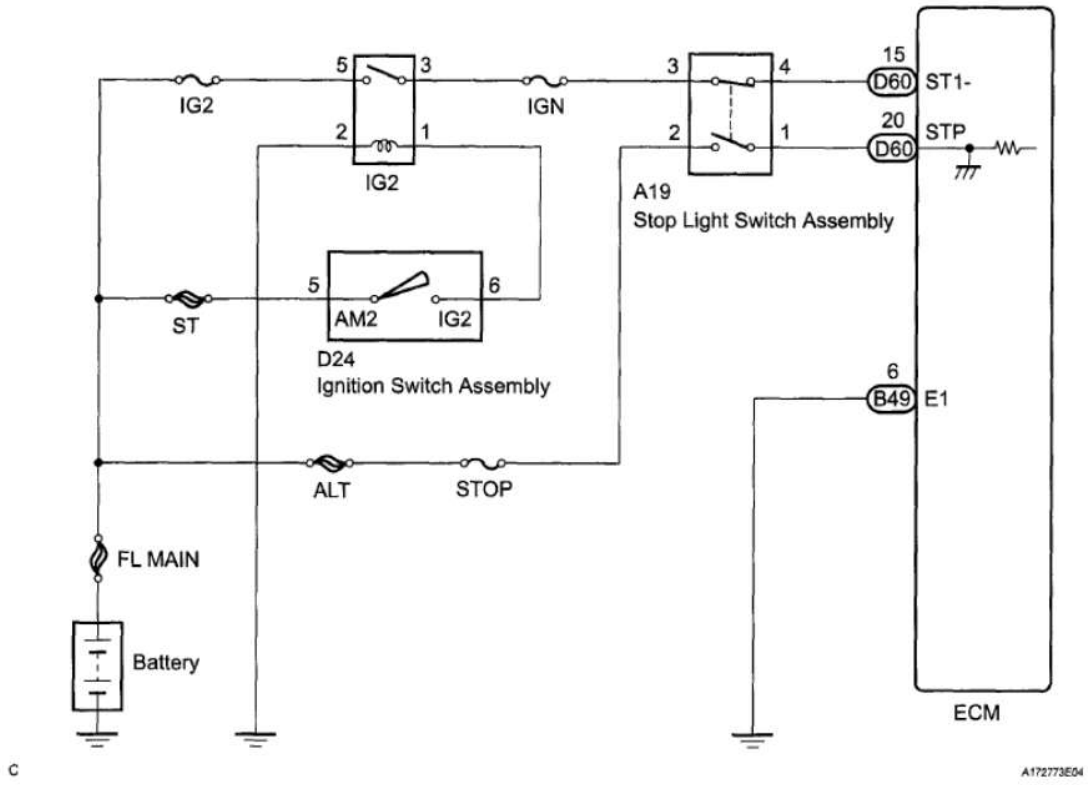


Fig. 194: Brake Switch "A"/"B" Correlation - Wiring Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSPECTION PROCEDURE

HINT:

- Read freeze frame data using the Techstream. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.
- STP signal conditions can be checked using the Techstream.
  a. Connect the Techstream to the DLC3.
  b. Turn the ignition switch to ON.
  c. Turn the Techstream on.
  d. Enter the following menus: Powertrain/Engine/Data List/All Data/Stop Light Switch.
  e. Check the Stop Light Switch (STP) signal when the brake pedal is depressed and released.

BRAKE PEDAL OPERATION CHART

Brake Pedal Operation	Display (Stop Light Switch)
Depressed	ON
Released	OFF

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NOTE: **Inspect the fuses for circuits related to this system before performing the following inspection procedure.**

1. **INSPECT STOP LIGHT SWITCH ASSEMBLY (TERMINAL VOLTAGE)**
   a. Disconnect the stop light switch assembly connector.
   b. Measure the voltage according to the value(s) in the table below.

Standard Voltage

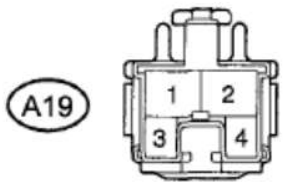
TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Switch Condition	Specified Condition
A19-2 - Body ground	Always	11 to 14 V
A19-3 - Body ground	Ignition switch ON	11 to 14 V

   c. Reconnect the stop light switch assembly connector.

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR (BATTERY - STOP LIGHT SWITCH, IG2 RELAY - STOP LIGHT SWITCH)

Front view of wire harness connector:
(to Stop Light Switch Assembly)



A148738E19

Fig. 195: Identifying A19 Stop Light Switch Assembly Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

2. **INSPECT STOP LIGHT SWITCH ASSEMBLY**
   a. Inspect the stop light switch assembly (See **INSPECTION**).

NG: REPLACE STOP LIGHT SWITCH ASSEMBLY (See **STOP LIGHT SWITCH**)

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OK: Go to next step

3. **INSPECT ECM (STP AND ST1- VOLTAGE)**
   a. Turn the ignition switch to ON.
   b. Measure the voltage according to the value(s) in the table below.

Standard Voltage

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
D60-15(ST1-)-Body ground	Brake pedal released	7.5 to 14 V
	Brake pedal depressed	Below 1.5 V
D60-20 (STP) - Body ground	Brake pedal released	Below 1.5 V
	Brake pedal depressed	7.5 to 14 V

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR (STOP LIGHT SWITCH ASSEMBLY - ECM)

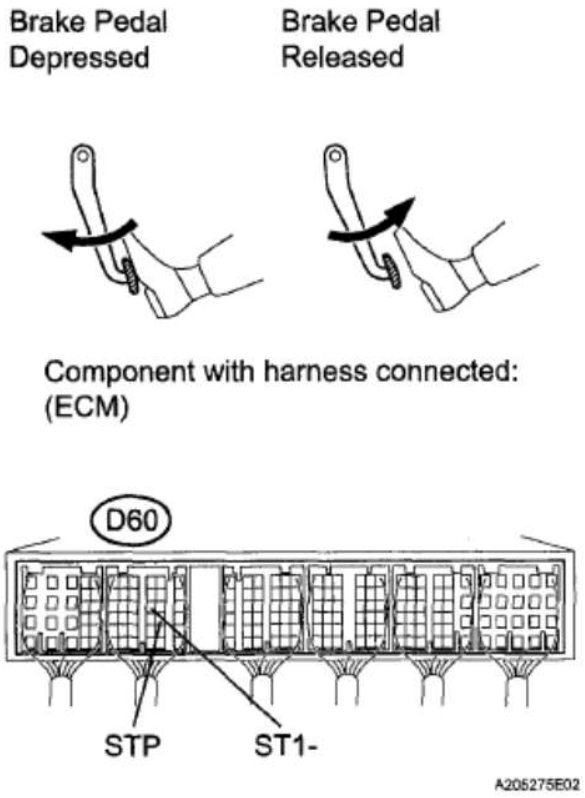


Fig. 196: Identifying Brake Pedal Depressed And Released Position
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: REPLACE ECM (See **REMOVAL**)

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DTC P0505 IDLE CONTROL SYSTEM MALFUNCTION

DESCRIPTION

The idle speed is controlled by the electronic throttle control system. The electronic throttle control system is comprised of: 1) the one-valve-type throttle body; 2) the throttle actuator, which operates the throttle valve; 3) the throttle position sensor, which detects the opening angle of the throttle valve; 4) the accelerator pedal position sensor, which detects the accelerator pedal position; and 5) the ECM, which controls the electronic throttle control system. Based on the target idle speed, the ECM controls the throttle actuator to provide the proper throttle valve opening angle.

DTC DETECTION CONDITION CHART

DTC No.	DTC Detection Condition	Trouble Area
P0505	The idle speed continues to vary greatly from the target idle speed (2 trip detection logic).	• Electronic throttle control system • Intake system PCV hose connections • ECM

MONITOR DESCRIPTION

The ECM monitors the idle speed and idle air flow volume to conduct idle speed control. The ECM determines that the idle speed control system is malfunctioning if the following conditions are met:

- The learned idle air flow volume remains at the maximum or minimum volume for 5 seconds or more during a driving cycle.
- After driving at a vehicle speed of 6.25 mph (10 km/h) or more, the actual engine idle speed varies from the target idle speed by less than -100 rpm or 150 rpm or more when the A/C and NSW are off, or less than -100 rpm or 200 rpm or more when the A/C or NSW are on, 5 times or more during a driving cycle, the ECM illuminates the MIL and sets the DTC.

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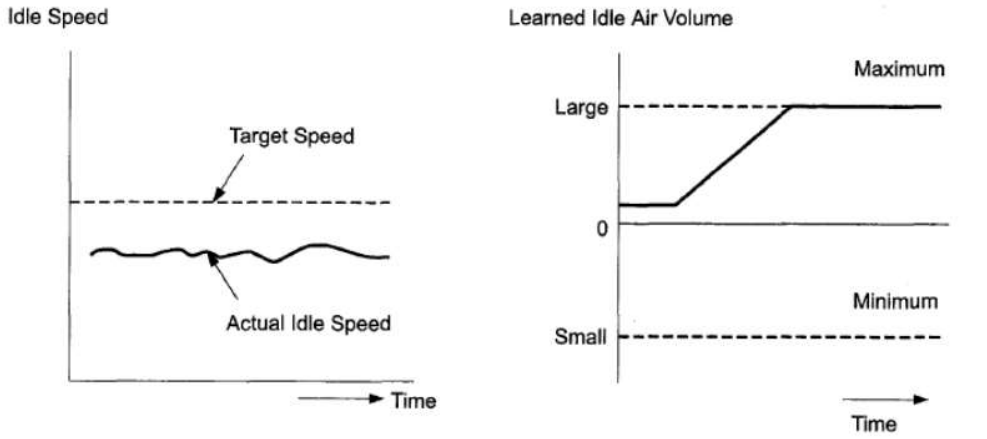


Fig. 197: Idle Speed Graph
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

MONITOR STRATEGY

MONITOR STRATEGY CHART

Related DTCs	P0505: Idle Speed Control Function
Required Sensors/Components (Main)	Electronic throttle control system
Required Sensors/Components (Related)	Crankshaft position sensor Engine coolant temperature sensor Vehicle speed sensor
Frequency of Operation	Once per driving cycle
Duration	10 minutes (Idling after warm up)
MIL Operation	2 driving cycles
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

TYPICAL ENABLING CONDITIONS CHART

	P0010 (Camshaft Timing Oil Control Valve) P0011 (VVT System - Advance) P0012 (VVT System - Retard) P0016 (VVT System - Misalignment) P0013 (Exhaust Camshaft Timing Oil Control Valve) P0014 (Exhaust VVT System - Advance) P0015 (Exhaust VVT System - Retard) P0017 (Exhaust VVT System - Misalignment) P0031, P0032, P101D (Air Fuel Ratio Sensor Heater) P2195, P2196, P2237, P2238, P2239, P2252, P2253, P2A00 (Air

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Monitor runs whenever following DTCs not stored	Fuel Ratio Sensor) P0136, P0137, P0138, P0139, P0607 (Heated Oxygen Sensor) P0102, P0103 (Mass Air Flow Meter) P0115, P0117, P0118 (Engine Coolant Temperature Sensor) P0125 (Insufficient Coolant Temperature for Closed Loop Fuel Control) P0120, P0121, P0122, P0123, P0220, P0222, P0223, P2135 (Throttle Position Sensor) P0171, P0172 (Fuel System) P0301 - P0304 (Misfire) P0335 (Crankshaft Position Sensor) P0340, P0342, P0343 (Camshaft Position Sensor) P0365, P0367, P0368 (Exhaust Camshaft Position Sensor) P0351 - P0354 (Igniter) P0451, P0452, P0453 (EVAP System) P0500 (Vehicle Speed Sensor) P0705 (Shift Lever Position Switch) P0748, P0778, P0798 (Pressure Control Solenoid)
Engine	Running

TYPICAL MALFUNCTION THRESHOLDS

TYPICAL MALFUNCTION THRESHOLDS CHART

Either of the following conditions is met:	Condition 1 or 2
1. Frequency that both of the following conditions (a) and (b) are met	5 times or more
(a) Either of the following conditions is met:	Condition A or B
A. Engine speed - target engine speed	Less than -100 rpm, or 150 rpm or more (A/C off and NSW off)
B. Engine speed - target engine speed	Less than -100 rpm, or 200 rpm or more (A/C on or NSW on)
(b) Vehicle condition	Stop after vehicle was driven by 6.25 mph (10 km/h) or more
2. Frequency that both of the following conditions (a) and (b) are met	Once
Either of the following conditions is met:	Condition A or B
A, Engine speed - target engine speed	Less than -100 rpm, or 150 rpm or more (A/C off and NSW off)
B, Engine speed - target engine speed	Less than -100 rpm, or 200 rpm or more (A/C on or NSW on)
(b) Idle air control flow rate learning valve	0.9 L/sec. or less, or 6 L/sec. or more

CONFIRMATION DRIVING PATTERN

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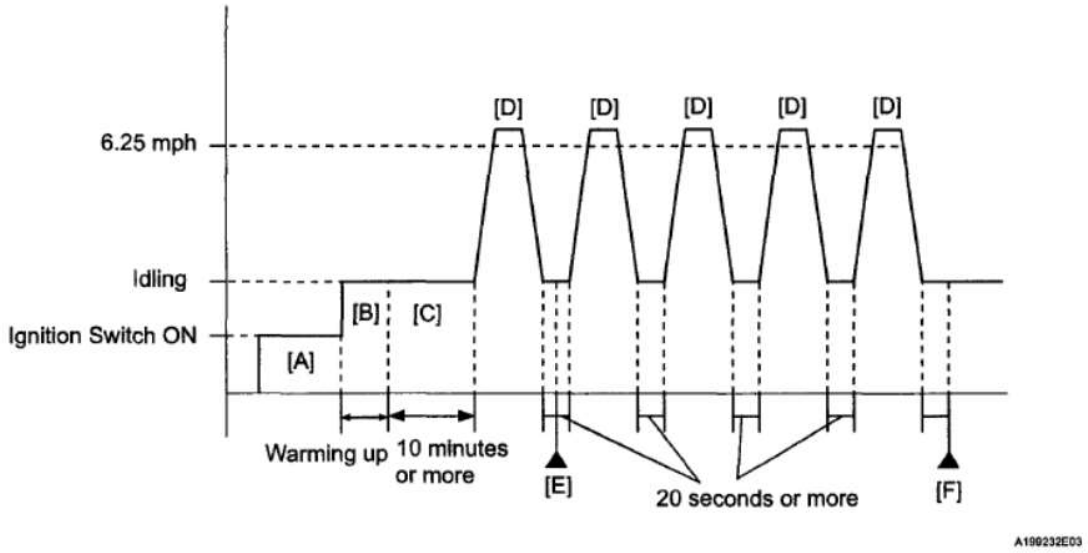


Fig. 198: Confirmation Driving Pattern
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

1. Connect the Techstream to the DLC3.
2. Turn the ignition switch to ON and turn the Techstream on.
3. Clear the DTCs (even if no DTCs are stored, perform the clear DTC procedure).
4. Turn the ignition switch off.
5. Turn the ignition switch to ON and turn the Techstream on [A].
6. Start the engine and warm it up (until the engine coolant temperature is 75°C (167°F) or more) with all the accessories switched off [B].
7. Idle the engine for 10 minute or more [C].
8. Accelerate the vehicle to 6.25 mph (10 km/h) or more, and then idle the engine [D].
9. Enter the following menus: Powertrain/Engine/Utility/All Readiness.
10. Input the DTC: P0505.
11. Check the DTC judgment result [E].

TECHSTREAM DISPLAY DESCRIPTION

Techstream Display	Description
NORMAL	• DTC judgment completed • System normal
ABNORMAL	• DTC judgment completed • System abnormal
INCOMPLETE	• DTC judgment not completed • Perform driving pattern after confirming DTC enabling conditions
	• Unable to perform DTC judgment

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UNKNOWN	• Number of DTCs which do not fulfill DTC preconditions has reached ECU memory limit

HINT:

- If the judgment result shows ABNORMAL, the system has a malfunction.
- If the judgment result shows INCOMPLETE or UNKNOWN, repeat step [D] 4 times, allowing 20 seconds or more between each repetition, and then check the DTC judgment result [F].

12. If the test result is UNKNOWN, enter the following menus: Powertrain/Engine/Trouble Codes/Pending.
13. Read Pending DTCs.

HINT:

If a pending DTC is output, the system is malfunctioning.

14. If the test result is INCOMPLETE or UNKNOWN and no pending DTC is output, perform a universal trip and check for permanent DTCs (See **DTC CHECK/CLEAR**).

HINT:

- If a permanent DTC is output, the system is malfunctioning.
- If no permanent DTC is output, the system is normal.

INSPECTION PROCEDURE

HINT:

- The following conditions may also cause DTC P0505 to be stored:
  a. The floor carpet overlapping slightly onto the accelerator pedal, causing the accelerator pedal to be slightly depressed and therefore the throttle valve position to be slightly open.
  b. The accelerator pedal being not fully released.
- Read freeze frame data using the Techstream. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1. **CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P0505)**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the Techstream on.
   d. Enter the following menus: Powertrain/Engine/Trouble Codes.
   e. Read the DTCs.

Result

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RESULT CHART

Result	Proceed to
DTC P0505 is output	A
DTC P0505 and other DTCs are output	B

HINT:

If any DTCs other than P0505 are output, troubleshoot those DTCs first.

B: GO TO **DTC CHART**

A: Go to next step

2. **CHECK PCV HOSE CONNECTIONS**
   a. Check the PCV hose connections.

OK:

PCV hose is connected correctly and is not damaged.

NG: REPAIR OR REPLACE PCV HOSE

OK: Go to next step

3. **CHECK INTAKE SYSTEM**
   a. Check the intake system for vacuum leakage (See **ON-VEHICLE INSPECTION**).

OK:

No leakage from the intake system.

NG: REPAIR OR REPLACE INTAKE SYSTEM

OK: Go to next step

4. **INSPECT THROTTLE BODY (THROTTLE VALVE)**
   a. Check the throttle valve condition.

OK:

Throttle valve is not contaminated with foreign objects and moves smoothly.

NG: REPLACE THROTTLE BODY (See **REMOVAL**)

OK: REPLACE ECM (See **REMOVAL**)

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DTC P050A COLD START IDLE AIR CONTROL SYSTEM PERFORMANCE

MONITOR DESCRIPTION

This monitor will run when the engine is started at an engine coolant temperature of -10 to 50°C (14 to 122°F). The DTC is stored after the engine idles for 13 seconds (2 trip detection logic).

The DTC is designed to monitor the idle air control at cold start. When the engine is started at an engine coolant temperature of below 50°C (122°F), the ECM measures the accumulated mass air flow during engine idling. If the accumulated mass air flow does not reach the specified level within 10 seconds, the ECM interprets this as a malfunction. The MIL is illuminated and a DTC is stored when the malfunction is detected in consecutive driving cycles (2 trip detection logic).

The electronic throttle control system controls the idle speed. The electronic throttle control system operates the throttle actuator to open and close the throttle valve, and adjusts the intake air amount to achieve the target idle speed.

NOTE: When the cable is disconnected from the negative (-) battery terminal during inspections or repairs, the idle speed control learned values are cleared. This DTC cannot be stored with the idle speed control learned values cleared.

HINT:

The idle speed control learning is performed when the engine is warmed up and has been idling for 5 minutes.

P050A Detection Logic:

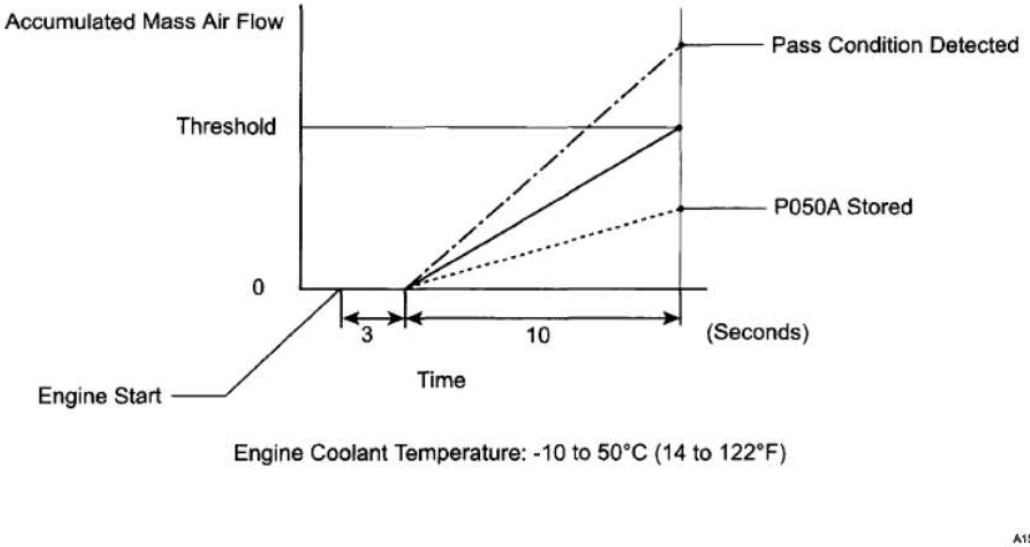


Fig. 199: Engine Coolant Temperature Graph

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

DTC DETECTION CONDITION CHART

DTC No.	DTC Detection Condition	Trouble Area
P050A	Accumulated intake air amount for 10 seconds of idling after cold start is less than threshold (2 trip detection logic).	• Throttle body • Mass air flow meter • PCV system • Air cleaner filter element • Intake system • VVT system • ECM

MONITOR STRATEGY

MONITOR STRATEGY CHART

Related DTCs	P050A: Cold Start Idle Air Speed Control System
Required Sensors/Components (Main)	Throttle body
Required Sensors/Components (Related)	Mass air flow meter Engine coolant temperature sensor
Frequency of Operation	Once per driving cycle
Duration	10 seconds
MIL Operation	2 driving cycles
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

TYPICAL ENABLING CONDITIONS CHART

Monitor runs whenever following DTCs not stored	P0010 (Camshaft Timing Oil Control Valve) P0011 (VVT System - Advance) P0012 (VVT System - Retard) P0016 (VVT System - Misalignment) P0013 (Exhaust Camshaft Timing Oil Control Valve) P0014 (Exhaust VVT System - Advance) P0015 (Exhaust VVT System - Retard) P0017 (Exhaust VVT System - Misalignment) P2195, P2196, P2237, P2238, P2239, P2252, P2253, P2A00 (Air Fuel Ratio Sensor) P0136, P0137, P0138, P0139, P0607 (Heated Oxygen Sensor) P0102, P0103 (Mass Air Flow Meter) P0115, P0117, P0118 (Engine Coolant Temperature Sensor) P0125 (Insufficient Coolant Temperature for Closed Loop Fuel

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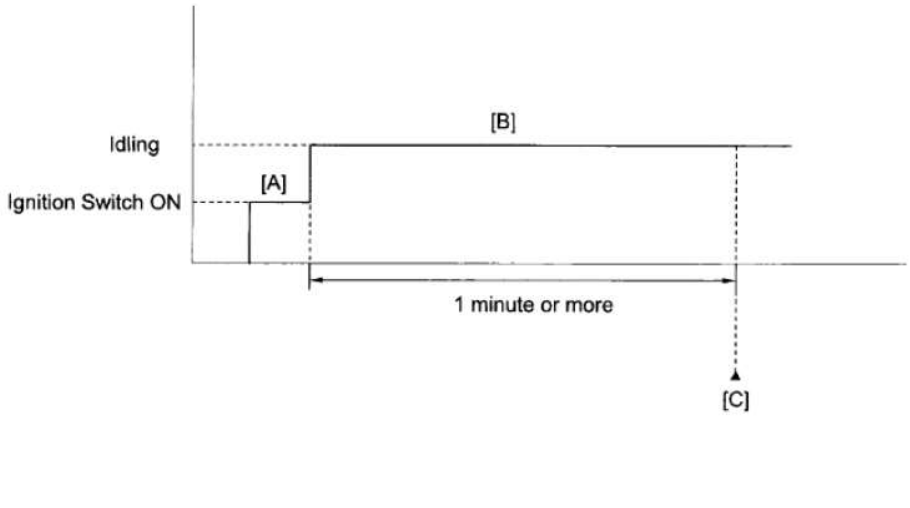
	Control) P0120, P0121, P0122, P0123, P0220, P0222, P0223, P2135 (Throttle Position Sensor) P0171, P0172 (Fuel System) P0301 - P0304 (Misfire) P0335 (Crankshaft Position Sensor) P0340, P0342, P0343 (Camshaft Position Sensor) P0365, P0367, P0368 (Exhaust Camshaft Position Sensor) P0351 - P0354 (Igniter) P0500 (Vehicle Speed Sensor) P0705 (Shift Lever Position Switch)
Battery voltage	8 V or higher
Time after engine start	3 seconds or more
Starter	OFF
Engine coolant temperature at engine start	-10°C(14°F) or higher
Engine coolant temperature	-10 to 50°C(14 to 122°F)
Engine idling time	3 seconds or more
Fuel-cut	OFF
Vehicle speed	Less than 1.875 mph (3 km/h)
Time after shift position changed	1 second or more
Atmospheric pressure	76 kPa (570 mmHg) or higher

TYPICAL MALFUNCTION THRESHOLDS

TYPICAL MALFUNCTION THRESHOLDS CHART

Accumulated mass air flow	Varies with ECT (Example: Less than 21.9 g)

CONFIRMATION DRIVING PATTERN



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Fig. 200: Confirmation Driving Pattern
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

1. Connect the Techstream to the DLC3.
2. Turn the ignition switch to ON and turn the Techstream on.
3. Clear the DTCs (even if no DTCs are stored, perform the clear DTC procedure)].
4. Turn the ignition switch off.
5. Turn the ignition switch to ON and turn the Techstream on [A].
6. Enter the following menus: Powertrain/Engine/Data List/All Data/Coolant Temp.
7. Check that "Coolant Temp" in the Data List are within the range of -10 to 50°C (14 to 122°F).
8. Start the engine and warm it up until the coolant temperature is the same as the coolant temperature in the freeze frame data.
9. Idle the engine for 1 minute or more [B].
10. Enter the following menus: Powertrain/Engine/Utility/All Readiness.
11. Input the DTC: P050A.
12. Check the DTC judgment result [C],

TECHSTREAM DISPLAY DESCRIPTION

Techstream Display	Description
NORMAL	• DTC judgment completed • System normal
ABNORMAL	• DTC judgment completed • System abnormal
INCOMPLETE	• DTC judgment not completed • Perform driving pattern after confirming DTC enabling conditions
UNKNOWN	• Unable to perform DTC judgment • Number of DTCs which do not fulfill DTC preconditions has reached ECU memory limit

HINT:

- If the judgment result shows ABNORMAL, the system has a malfunction.
- If the judgment result shows INCOMPLETE or UNKNOWN, idle the engine for 3 minutes, let the engine cool down, and then perform steps [A] through [C].

13. If the test result is UNKNOWN, enter the following menus: Powertrain/Engine/Trouble Codes/Pending.
14. Read Pending DTCs.

HINT:

If a pending DTC is output, the system is malfunctioning.

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15. If the test result is INCOMPLETE or UNKNOWN and no pending DTC is output, perform a universal trip and check for permanent DTCs (See **DTC CHECK/CLEAR**).

    HINT:

    - If a permanent DTC is output, the system is malfunctioning.
    - If no permanent DTC is output, the system is normal.

INSPECTION PROCEDURE

HINT:

Read freeze frame data using the Techstream. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1. **CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P050A)**
    a. Connect the Techstream to the DLC3.
    b. Turn the ignition switch to ON.
    c. Turn the Techstream on.
    d. Enter the following menus: Powertrain/Engine/Trouble Codes.
    e. Read the DTCs.

    Result

    RESULT CHART

Result	Proceed to
DTC P050A is output	A
DTC P050A and other DTCs are output	B

    HINT:

    If any DTCs other than P050A are output, troubleshoot those DTCs first.

    B: GO TO **DTC CHART**

    A: Go to next step

2. **READ VALUE USING TECHSTREAM (FUEL TRIM)**

    HINT:

    Calculate the total fuel trim values to check the characteristic deviation of the mass air flow meter.

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a. Connect the Techstream to the DLC3.
b. Turn the ignition switch to ON.
c. Turn the Techstream on.
d. Enter the following menus: Powertrain/Engine/Data List/All Data/Short FT #1 and Long FT #1.
e. Read the values displayed on the Techstream.
f. Add together the Short FT #1 and Long FT #1 values to obtain the total Fuel Trim.

OK:

Total of Short FT #1 and Long FT #1 values is between -20% and 20%.

NG: Go to step 5

OK: Go to next step

3. **INSPECT THROTTLE BODY**
   a. Check that there are no deposits around the throttle valve.

OK:

No deposits around the throttle valve.

NG: Go to step 10

OK: Go to next step

4. **REPLACE ECM**
   a. Replace the ECM (See **REMOVAL**).

NEXT: Go to step 15

5. **PERFORM ACTIVE TEST USING TECHSTREAM (OPERATE OIL CONTROL VALVE)**
   a. Connect the Techstream to the DLC3.
   b. Start the engine.
   c. Turn the Techstream on.
   d. Enter the following menus: Powertrain/Engine/Active Test/Control the VVT System (Bank 1).
   e. Check the engine speed while operating the camshaft timing oil control valve assembly using the Techstream.

OK

TECHSTREAM OPERATION CHART

Techstream Operation	Specified Condition

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OFF	Normal engine speed
ON	Engine idles roughly or stalls (soon after camshaft timing oil control valve assembly switched from OFF to ON)

NG: Go to step 11

OK: Go to next step

6. **CHECK PCV SYSTEM**
   a. Start the engine.
   b. Pinch the PCV hose.
   c. Check the engine speed.

   OK:

   The engine speed rises when the PCV hose is pinched.

   NG: Go to step 12

   OK: Go to next step

7. **CHECK AIR CLEANER FILTER ELEMENT SUB-ASSEMBLY**
   a. Visually check that the air cleaner filter element is not excessively contaminated with dirt or oil.

   OK:

   The air cleaner filter element is not excessively contaminated with dirt or oil.

   NG: Go to step 13

   OK: Go to next step

8. **CHECK INTAKE SYSTEM**
   a. Check the intake system for vacuum leakage (See **ON-VEHICLE INSPECTION**).

   OK:

   No leakage from the intake system.

   NG: Go to step 14

   OK: Go to next step

9. **REPLACE MASS AIR FLOW METER**
   a. Replace the mass air flow meter (See **REMOVAL**).

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NEXT: Go to step 15

10. **REPAIR OR REPLACE THROTTLE BODY**
    a. Repair or replace the throttle body (See **REMOVAL**).

    NEXT: Go to step 15

11. **CHECK AND REPAIR VVT SYSTEM**

    HINT:

    Refer to **DTC P0011 INSPECTION PROCEDURE** .

    NEXT: Go to step 15

12. **REPAIR OR REPLACE PCV SYSTEM**

    NEXT: Go to step 15

13. **REPLACE AIR CLEANER FILTER ELEMENT SUB-ASSEMBLY**

    NEXT: Go to Step 15

14. **REPAIR OR REPLACE INTAKE SYSTEM**

    NEXT: Go to step 15

15. **CHECK WHETHER DTC OUTPUT RECURS (DTC P050A)**

    NOTE: For this operation, the engine must be cold (the same temperature as the engine coolant temperature recorded in the freeze frame data).

    a. Connect the Techstream to the DLC3.
    b. Turn the ignition switch to ON.
    c. Turn the Techstream on.
    d. Clear the DTCs (See **DTC CHECK/CLEAR**).
    e. Start the engine and idle it for 1 minute.

    OK:

    Stable fast idle.

    f. Enter the following menus: Powertrain/Engine/Trouble Codes/Pending.
    g. Check for pending DTCs.

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OK:

No pending DTC is output.

NEXT: REPAIR COMPLETED

DTC P050B COLD START IGNITION TIMING PERFORMANCE

DESCRIPTION

This monitor will run when the engine is started at an engine coolant temperature of -10 to 50°C (14 to 122°F). The DTC is stored after the engine idles for 13 seconds (2 trip detection logic).

The DTC is designed to monitor the ignition timing at cold start. When the engine is started at an engine coolant temperature of below 50°C (122°F), the ECM checks the ignition timing during engine idling. If the ignition timing advances beyond the specified level within 10 seconds, the ECM interprets this as a malfunction. The MIL is illuminated and a DTC is stored when the malfunction is detected in consecutive driving cycles (2 trip detection logic).

NOTE: When the cable is disconnected from the negative (-) battery terminal during inspections or repairs, the idle speed control learned values are cleared. This DTC cannot be stored with the idle speed control learned values cleared.

HINT:

The idle speed control learning is performed when the engine is warmed up and has been idling for 5 minutes.

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P050B Detection Logic:

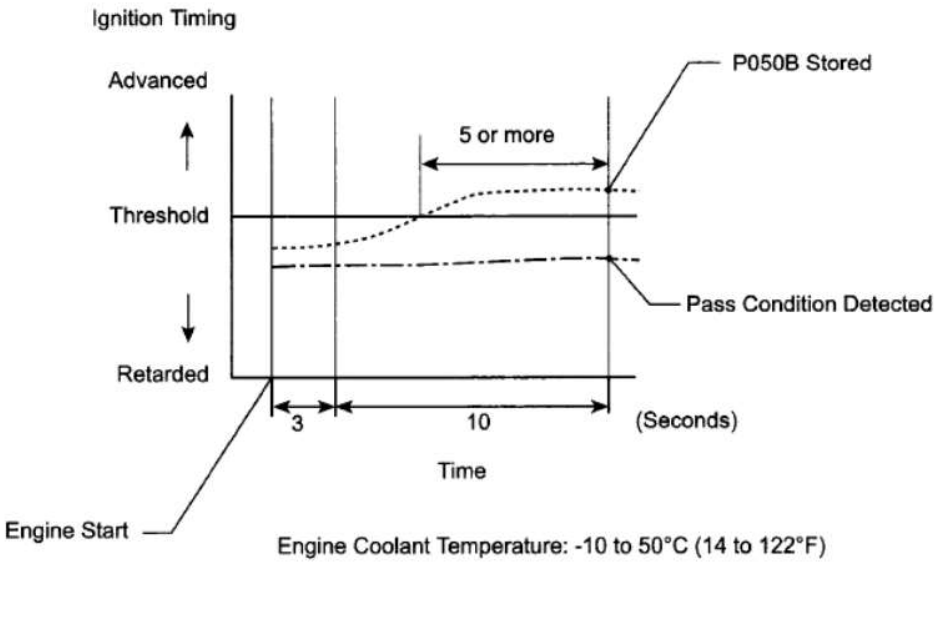


Fig. 201: Engine Coolant Temperature Graph
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

DTC DETECTION CONDITION CHART

DTC No.	DTC Detection Condition	Trouble Area
P050B	Ignition timing retard value insufficient for 5 seconds or more for 10 seconds of P050A monitoring duration at cold start (2 trip detection logic).	• Throttle body • Mass air flow meter • PCV system • Air cleaner filter element • Intake system • VVT system • ECM

MONITOR STRATEGY

MONITOR STRATEGY CHART

Related DTCs	P050B: Cold Start Ignition Timing Performance
Required Sensors/Components (Main)	Throttle body
Required Sensors/Components (Related)	Mass air flow meter Engine coolant temperature sensor
Frequency of Operation	Once per driving cycle

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Duration	10 seconds
MIL Operation	2 driving cycles
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

TYPICAL ENABLING CONDITIONS CHART

Monitor runs whenever following DTCs not stored	P0010 (Camshaft Timing Oil Control Valve) P0011 (VVT System - Advance) P0012 (VVT System - Retard) P0016 (VVT System - Misalignment) P0013 (Exhaust Camshaft Timing Oil Control Valve) P0014 (Exhaust VVT System - Advance) P0015 (Exhaust VVT System - Retard) P0017 (Exhaust VVT System - Misalignment) P2195, P2196, P2237, P2238, P2239, P2252, P2253, P2A00 (Air Fuel Ratio Sensor) P0136, P0137, P0138, P0139, P0607 (Heated Oxygen Sensor) P0102, P0103 (Mass Air Flow Meter) P0115, P0117, P0118 (Engine Coolant Temperature Sensor) P0125 (Insufficient Coolant Temperature for Closed Loop Fuel Control) P0120, P0121, P0122, P0123, P0220, P0222, P0223, P2135 (Throttle Position Sensor) P0171, P0172 (Fuel System) P0301 - P0304 (Misfire) P0335 (Crankshaft Position Sensor) P0340, P0342, P0343 (Camshaft Position Sensor) P0365, P0367, P0368 (Exhaust Camshaft Position Sensor) P0351 - P0354 (Igniter) P0500 (Vehicle Speed Sensor) P0705 (Shift Lever Position Switch)
Battery voltage	8 V or higher
Time after engine start	3 seconds or more
Starter	OFF
Engine coolant temperature at engine start	-10°C(14°F) or higher
Engine coolant temperature	-10 to 50°C (14 to 122°F)
Engine idling time	3 seconds or more
Fuel-cut	OFF
Vehicle speed	Less than 1.875 mph (3 km/h)
Atmospheric pressure	76 kPa (570 mmHg) or higher

TYPICAL MALFUNCTION THRESHOLDS

TYPICAL MALFUNCTION THRESHOLDS CHART

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Accumulated time when ignition timing retard value is cut off	5 seconds or more

CONFIRMATION DRIVING PATTERN

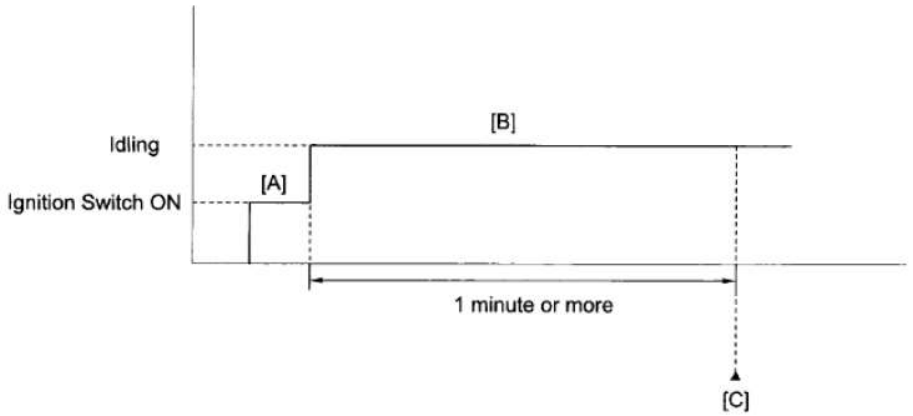


Fig. 202: Confirmation Driving Pattern
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

1. Connect the Techstream to the DLC3.
2. Turn the ignition switch to ON and turn the Techstream on.
3. Clear the DTCs (even if no DTCs are stored, perform the clear DTC procedure).
4. Turn the ignition switch off.
5. Turn the ignition switch to ON and turn the Techstream on [A].
6. Enter the following menus: Powertrain/Engine/Data List/All Data/Coolant Temp.
7. Check that "Coolant Temp" in the Data List are within the range of -10 to 50°C (14 to 122°F).
8. Start the engine and warm it up until the coolant temperature is the same as the coolant temperature in the freeze frame data.
9. Idle the engine for 1 minute or more [B].
10. Enter the following menus: Powertrain/Engine/Utility/All Readiness.
11. Input the DTC: P050B.
12. Check the DTC judgment result [C].

TECHSTREAM DISPLAY DESCRIPTION

Techstream Display	Description
NORMAL	• DTC judgment completed • System normal
ABNORMAL	• DTC judgment completed

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	• System abnormal
INCOMPLETE	• DTC judgment not completed • Perform driving pattern after confirming DTC enabling conditions
UNKNOWN	• Unable to perform DTC judgment • Number of DTCs which do not fulfill DTC preconditions has reached ECU memory limit

HINT:

- If the judgment result shows ABNORMAL, the system has a malfunction.
- If the judgment result shows INCOMPLETE or UNKNOWN, idle the engine for 3 minutes, let the engine cool down, and then perform steps [A] through [C].

13. If the test result is UNKNOWN, enter the following menus: Powertrain/Engine/Trouble Codes/Pending.
14. Read Pending DTCs.

    HINT:

    If a pending DTC is output, the system is malfunctioning.

15. If the test result is INCOMPLETE or UNKNOWN and no pending DTC is output, perform a universal trip and check for permanent DTCs (See **DTC CHECK/CLEAR**).

    HINT:

    - If a permanent DTC is output, the system is malfunctioning.
    - If no permanent DTC is output, the system is normal.

INSPECTION PROCEDURE

HINT:

- DTC P050B may be output when the engine has the symptoms listed below. If necessary, check the trouble areas listed below.

SYMPTOM CHART

Symptom	Factor	Trouble Area
Low idle speed when engine is cold (immediately after engine start)	Excessive engine friction	• Engine oil deterioration • Drive belt tension • A/C compressor • Generator • P/S pump
Rough idle when engine is cold (immediately after	Abnormal	

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engine start)	combustion	Fuel quality

- Read freeze frame data using the Techstream. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1. **CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P050B)**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the Techstream on.
   d. Enter the following menus: Powertrain/Engine/Trouble Codes.
   e. Read the DTCs.

   Result

   RESULT CHART

Result	Proceed to
DTC P050B is output	A
DTC P050B and other DTCs are output	B

   HINT:

   If any DTCs other than P050B are output, troubleshoot those DTCs first.

   B: GO TO **DTC CHART**

   A: Go to next step

2. **READ VALUE USING TECHSTREAM (FUEL TRIM)**

   HINT:

   Calculate the total fuel trim values to check the characteristic deviation of the mass air flow meter.

   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the Techstream on.
   d. Enter the following menus: Powertrain/Engine/Data List/All Data/Short FT #1 and Long FT #1.
   e. Read the values displayed on the Techstream.
   f. Add together the Short FT #1 and Long FT #1 values to obtain the total Fuel Trim.

   OK:

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Total of Short FT #1 and Long FT #1 values is between -20% and 20%.

NG: Go to step 5

OK: Go to next step

3. **INSPECT THROTTLE BODY**
   a. Check that there are no deposits around the throttle valve.

   OK:

   No deposits around the throttle valve.

   NG: Go to step 10

   OK: Go to next step

4. **REPLACE ECM**
   a. Replace the ECM (See **REMOVAL**).

   NEXT: Go to step 15

5. **PERFORM ACTIVE TEST USING TECHSTREAM (OPERATE OIL CONTROL VALVE)**
   a. Connect the Techstream to the DLC3.
   b. Start the engine and turn the Techstream on.
   c. Enter the following menus: Powertrain/Engine/Active Test/Control the VVT System (Bank 1).
   d. Check the engine speed while operating the camshaft timing oil control valve using the Techstream.

   OK

   TECHSTREAM OPERATION CHART

Techstream Operation	Specified Condition
OFF	Normal engine speed
ON	Engine idles roughly or stalls (soon after camshaft timing oil control valve assembly switched from OFF to ON)

   NG: Go to step 11

   OK: Go to next step

6. **CHECK PCV SYSTEM**
   a. Start the engine.
   b. Pinch the PCV hose.

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c. Check the engine speed.

OK:

The engine speed rises when the PCV hose is pinched.

NG: Go to step 12

OK: Go to next step

7. **INSPECT AIR CLEANER FILTER ELEMENT SUB-ASSEMBLY**
   a. Visually check that the air cleaner filter element is not excessively contaminated with dirt or oil.

   OK:

   The air cleaner filter element is not excessively contaminated with dirt or oil.

   NG: Go to step 13

   OK: Go to next step

8. **CHECK INTAKE SYSTEM**
   a. Check the intake system for vacuum leakage (See **ON-VEHICLE INSPECTION**).

   OK:

   No leakage from the intake system.

   NG: Go to step 14

   OK: Go to next step

9. **REPLACE MASS AIR FLOW METER**
   a. Replace the mass air flow meter (See **REMOVAL**).

   NEXT: Go to step 15

10. **REPAIR OR REPLACE THROTTLE BODY**
    a. Repair or replace the throttle body (See **REMOVAL**).

    NEXT: Go to step 15

11. **CHECK AND REPAIR VVT SYSTEM**

    HINT:

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Refer to **DTC P0011 INSPECTION PROCEDURE** .

NEXT: Go to step 15

12. **REPAIR OR REPLACE PCV SYSTEM**

NEXT: Go to step 15

13. **REPLACE AIR CLEANER FILTER ELEMENT SUB-ASSEMBLY**

NEXT: Go to step 15

14. **REPAIR OR REPLACE INTAKE SYSTEM**

NEXT: Go to step 15

15. **CHECK WHETHER DTC OUTPUT RECURS (DTC P050B)**

NOTE: For this operation, the engine must be cold (the same temperature as the engine coolant temperature recorded in the freeze frame data).

a. Connect the Techstream to the DLC3.
b. Turn the ignition switch to ON.
c. Turn the Techstream on.
d. Clear the DTCs (See **DTC CHECK/CLEAR**).
e. Start the engine and idle it for 1 minute.

OK:

Stable fast idle.

f. Enter the following menus: Powertrain/Engine/Trouble Codes/Pending.
g. Check for the pending DTCs.

OK:

No pending DTC is output.

NEXT: REPAIR COMPLETED

DTC P0560 SYSTEM VOLTAGE

MONITOR DESCRIPTION

The battery supplies electricity to the ECM even when the ignition switch is off. This power allows the ECM to store data such as DTC history, freeze frame data and fuel trim values. If the battery voltage falls below a

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minimum level, the memory is cleared and the ECM determines that there is a malfunction in the power supply circuit. When the engine is next started, the ECM illuminates the MIL and stores the DTC.

DTC DETECTION CONDITION CHART

DTC No.	DTC Detection Condition	Trouble Area
P0560	An open in the ECM back up power source circuit (1 trip detection logic).	• Open in back up power source circuit • Battery • Battery terminals • ECM

HINT:

If DTC P0560 is stored, the ECM does not store other DTCs or the data stored in the ECM is partly cleared.

MONITOR STRATEGY

MONITOR STRATEGY CHART

Related DTCs	P0560: ECM System Voltage
Required Sensors/Components (Main)	ECM
Required Sensors/Components (Related)	-
Frequency of Operation	Continuous
Duration	3 seconds
MIL Operation	Immediate (MIL illuminated after next engine start)
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

TYPICAL ENABLING CONDITIONS CHART

Monitor runs whenever following DTCs not stored	None

TYPICAL MALFUNCTION THRESHOLDS

TYPICAL MALFUNCTION THRESHOLDS CHART

ECM power source	Below 3.5 V

CONFIRMATION DRIVING PATTERN

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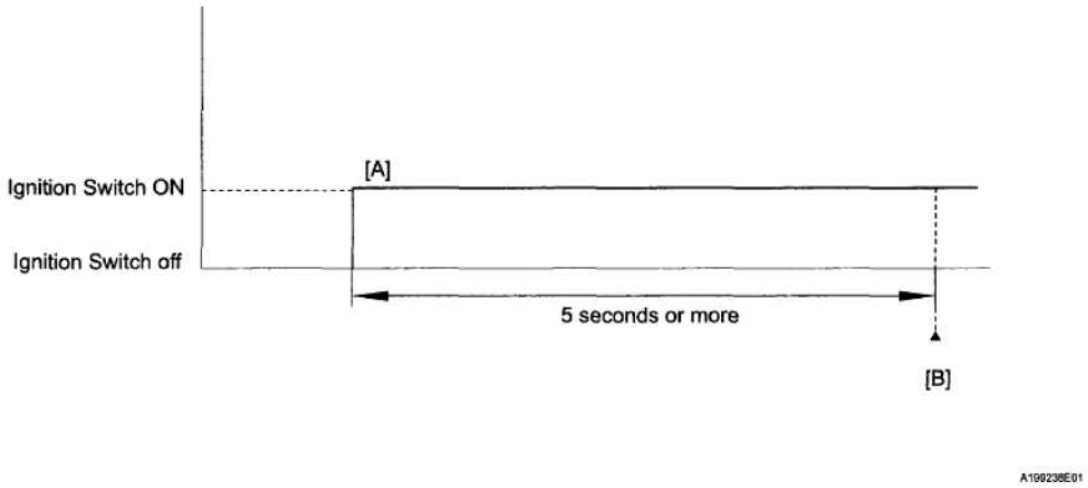


Fig. 203: Confirmation Driving Pattern
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

1. Connect the Techstream to the DLC3.
2. Turn the ignition switch to ON and turn the Techstream on.
3. Clear the DTCs (even if no DTCs are stored, perform the clear DTC procedure).
4. Turn the ignition switch off.
5. Turn the ignition switch to ON and turn the Techstream on [A].
6. Wait 5 seconds or more.
7. Enter the following menus: Powertrain/Engine/Utility/All Readiness.
8. Input the DTC: P0560.
9. Check the DTC judgment result [B].

TECHSTREAM DISPLAY DESCRIPTION

Techstream Display	Description
NORMAL	• DTC judgment completed • System normal
ABNORMAL	• DTC judgment completed • System abnormal
INCOMPLETE	• DTC judgment not completed • Perform driving pattern after confirming DTC enabling conditions
UNKNOWN	• Unable to perform DTC judgment • Number of DTCs which do not fulfill DTC preconditions has reached ECU memory limit

HINT:

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If the judgment result shows ABNORMAL, the system has a malfunction.

10. If the test result is UNKNOWN, enter the following menus: Powertrain/Engine/Trouble Codes/Pending.
11. Read Pending DTCs.

    HINT:

    If a pending DTC is output, the system is malfunctioning.

12. If the test result is INCOMPLETE or UNKNOWN and no pending DTC is output, perform a universal trip and check for permanent DTCs (See **DTC CHECK/CLEAR**).

    HINT:

    - If a permanent DTC is output, the system is malfunctioning.
    - If no permanent DTC is output, the system is normal.

WIRING DIAGRAM

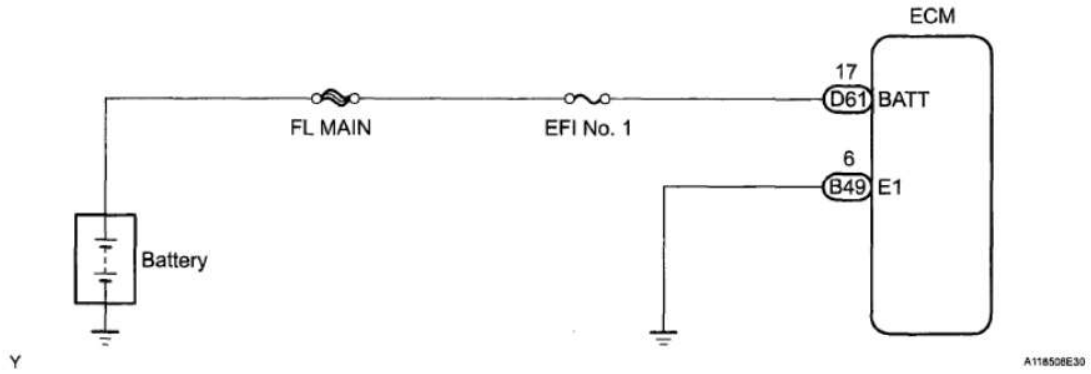


Fig. 204: System Voltage - Wiring Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSPECTION PROCEDURE

HINT:

Read freeze frame data using the Techstream. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.

NOTE: Inspect the fuses for circuits related to this system before performing the following inspection procedure.

1. **INSPECT ECM (BATT VOLTAGE)**

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a. Measure the voltage according to the value(s) in the table below.

Standard Voltage

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
D61-17 (BATT) - Body ground	Always	11 to 14 V

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR (EFI NO. 1 FUSE - ECM)

Component with harness connected:
(ECM)

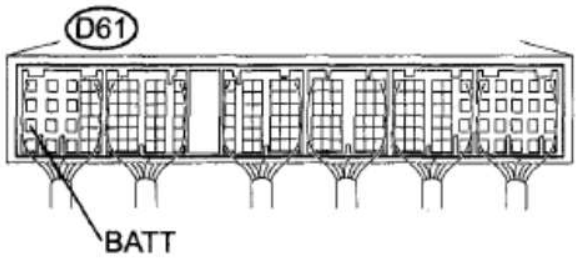


Fig. 205: Identifying ECM Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

2. **INSPECT BATTERY**
   a. Check that the battery is not depleted.

   OK:

   Battery is not depleted

   NG: REPLACE BATTERY

   OK: Go to next step

3. **CHECK BATTERY TERMINAL**
   a. Check that the battery terminals are not loose or corroded.

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OK:

Battery terminals are not loose or corroded

NG: REPAIR OR REPLACE BATTERY TERMINAL

OK: Go to next step

4. **CHECK WHETHER DTC OUTPUT RECURS**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the Techstream on.
   d. Clear the DTCs (See **DTC CHECK/CLEAR**).
   e. Turn the ignition switch off and turn the Techstream off.
   f. Start the engine and turn the Techstream on.
   g. Enter the following menus: Powertrain/Engine/Trouble Codes.
   h. Read the DTCs.

Result

RESULT CHART

Result	Proceed to
DTC P0560 is output	A
DTC is not output	B

B: CHECK FOR INTERMITTENT PROBLEMS (See **CHECK FOR INTERMITTENT PROBLEMS**)

A: REPLACE ECM (See **REMOVAL**)

DTC P0604 RANDOM ACCESS MEMORY (RAM)

MONITOR DESCRIPTION

The ECM continuously monitors its internal memory status. This self-check ensures that the ECM is functioning properly. It is diagnosed by internal "mirroring" of the main CPU and sub CPU to detect Random Access Memory (RAM) errors. If outputs from these CPUs are different and deviate from the standard, the ECM illuminates the MIL and stores the DTC immediately.

DTC DETECTION CONDITION CHART

DTC No.	DTC Detection Condition	Trouble Area
P0604	ECM RAM error (1 trip detection logic)	ECM

MONITOR STRATEGY

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MONITOR STRATEGY CHART

Related DTCs	P0604: ECM RAM Error
Required Sensors/Components (Main)	ECM
Required Sensors/Components (Related)	None
Frequency of Operation	Continuous
Duration	6 times
MIL Operation	Immediate
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

TYPICAL ENABLING CONDITIONS CHART

Monitor runs whenever following DTCs not stored	None

TYPICAL MALFUNCTION THRESHOLDS

TYPICAL MALFUNCTION THRESHOLDS CHART

Main CPU and sub CPU mirroring	Fail

CONFIRMATION DRIVING PATTERN

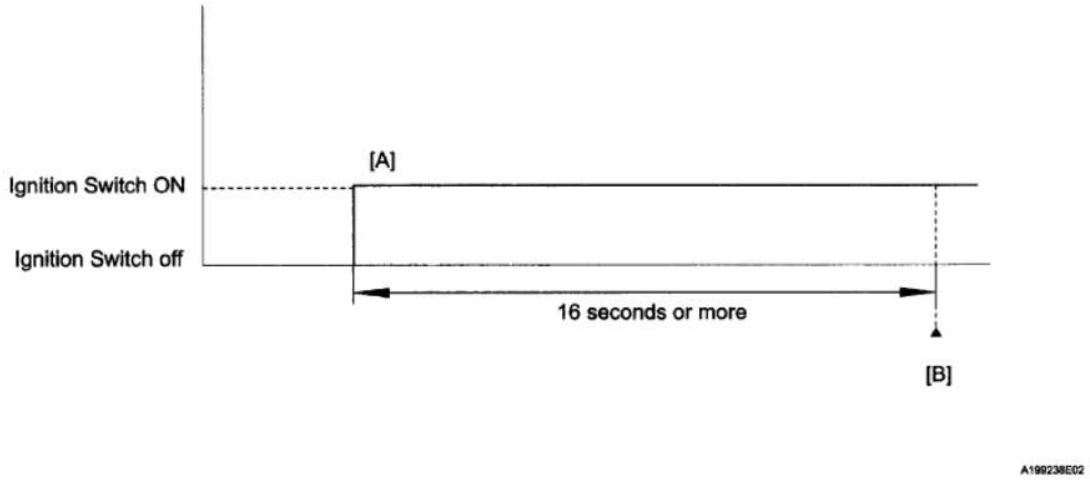


Fig. 206: Confirmation Driving Pattern
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

1. Connect the Techstream to the DLC3.
2. Turn the ignition switch to ON and turn the Techstream on.
3. Clear the DTCs (even if no DTCs are stored, perform the clear DTC procedure).
4. Turn the ignition switch off.
5. Turn the ignition switch to ON and turn the Techstream on [A].
6. Wait 16 seconds or more.

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7. Enter the following menus: Powertrain/Engine/Utility/All Readiness.
8. Input the DTC: P0604.
9. Check the DTC judgment result [B].

TECHSTREAM DISPLAY DESCRIPTION

Techstream Display	Description
NORMAL	• DTC judgment completed • System normal
ABNORMAL	• DTC judgment completed • System abnormal
INCOMPLETE	• DTC judgment not completed • Perform driving pattern after confirming DTC enabling conditions
UNKNOWN	• Unable to perform DTC judgment • Number of DTCs which do not fulfill DTC preconditions has reached ECU memory limit

HINT:

If the judgment result shows ABNORMAL, the system has a malfunction.

10. If the test result is UNKNOWN, enter the following menus: Powertrain/Engine/Trouble Codes/Pending.
11. Read Pending DTCs.

HINT:

If a pending DTC is output, the system is malfunctioning.

12. If the test result is INCOMPLETE or UNKNOWN and no pending DTC is output, perform a universal trip and check for permanent DTCs (See **DTC CHECK/CLEAR**).

HINT:

- If a permanent DTC is output, the system is malfunctioning.
- If no permanent DTC is output, the system is normal.

INSPECTION PROCEDURE

HINT:

Read freeze frame data using the Techstream. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich,

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and other data from the time the malfunction occurred.

1. **READ OUTPUT DTC (DTC P0604)**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the Techstream on.
   d. Clear the DTC (See **DTC CHECK/CLEAR**).
   e. Turn the ignition switch off and turn the Techstream off.
   f. Disconnect the Techstream.
   g. Disconnect the cable from the negative (-) battery terminal and wait for 1 minute.
   h. Connect the cable to the negative (-) battery terminal,
   i. Connect the Techstream to the DLC3.
   j. Turn the ignition switch to ON.
   k. Turn the Techstream on.
   l. Enter the following menus: Powertrain/Engine/Trouble Codes.
   m. Read the DTCs.

   Result

   RESULT CHART

Result	Proceed to
DTC is not output	A
DTC P0604 is output	B

   B: REPLACE ECM (See **REMOVAL**)

   A: CHECK FOR INTERMITTENT PROBLEMS (See **CHECK FOR INTERMITTENT PROBLEMS**)

DTC P0606 ECM/PCM PROCESSOR

MONITOR DESCRIPTION

The ECM continuously monitors its main and sub CPUs. This self-check ensures that the ECM is functioning properly. If outputs from the CPUs are different and deviate from the standard, the ECM illuminates the MIL and stores the DTC immediately.

DTC DETECTION CONDITION CHART

DTC No.	DTC Detection Condition	Trouble Area
P0606	An ECM main CPU error (1 trip detection logic)	ECM

MONITOR STRATEGY

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MONITOR STRATEGY CHART

Related DTC	P0606: ECM Range Check
Required Sensors/Components (Main)	ECM
Required Sensors/Components (Related)	-
Frequency of Operation	Continuous
Duration	Within 1 second
MIL Operation	Immediate
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

TYPICAL ENABLING CONDITIONS CHART

Monitor runs whenever following DTCs not stored	None

TYPICAL MALFUNCTION THRESHOLDS

TYPICAL MALFUNCTION THRESHOLDS CHART

DMA communication	No response

CONFIRMATION DRIVING PATTERN

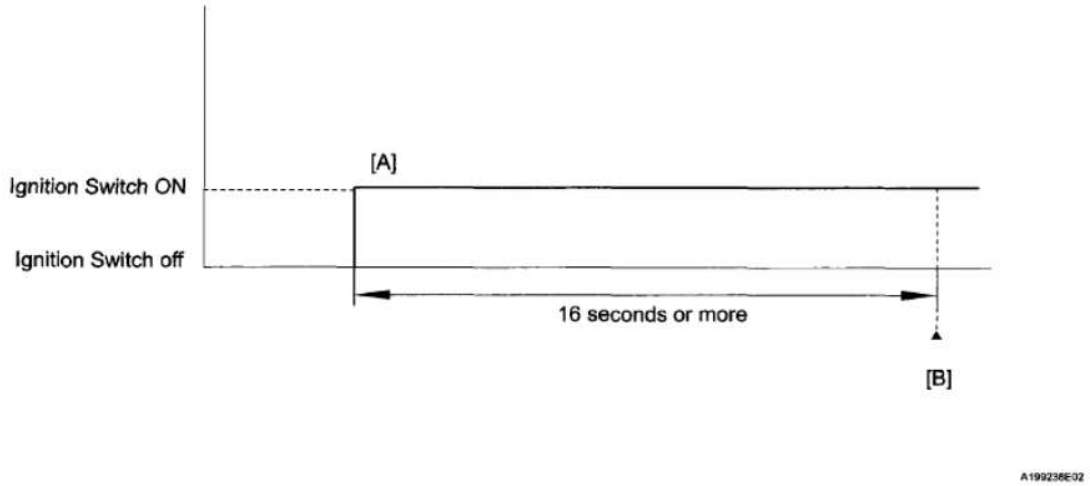


Fig. 207: Confirmation Driving Pattern
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

1. Connect the Techstream to the DLC3.
2. Turn the ignition switch to ON and turn the Techstream on.
3. Clear the DTCs (even if no DTCs are stored, perform the clear DTC procedure).
4. Turn the ignition switch off.
5. Turn the ignition switch to ON and turn the Techstream on [A].
6. Wait 16 seconds or more.

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7. Enter the following menus: Powertrain/Engine/Utility/All Readiness.
8. Input the DTC: P0606.
9. Check the DTC judgment result [B].

TECHSTREAM DISPLAY DESCRIPTION

Techstream Display	Description
NORMAL	• DTC judgment completed • System normal
ABNORMAL	• DTC judgment completed • System abnormal
INCOMPLETE	• DTC judgment not completed • Perform driving pattern after confirming DTC enabling conditions
UNKNOWN	• Unable to perform DTC judgment • Number of DTCs which do not fulfill DTC preconditions has reached ECU memory limit

HINT:

If the judgment result shows ABNORMAL, the system has a malfunction.

10. If the test result is UNKNOWN, enter the following menus: Powertrain/Engine/Trouble Codes/Pending.
11. Read Pending DTCs.

HINT:

If a pending DTC is output, the system is malfunctioning.

12. If the test result is INCOMPLETE or UNKNOWN and no pending DTC is output, perform a universal trip and check for permanent DTCs (See **DTC CHECK/CLEAR**).

HINT:

- If a permanent DTC is output, the system is malfunctioning.
- If no permanent DTC is output, the system is normal.

INSPECTION PROCEDURE

1. **READ OUTPUT DTC (DTC P0606)**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the Techstream on.

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d. Clear the DTCs (See **DTC CHECK/CLEAR**).
e. Turn the ignition switch off and turn the Techstream off.
f. Disconnect the Techstream.
g. Disconnect the cable from the negative (-) battery terminal and wait for 1 minute.
h. Connect the cable to the negative (-) battery terminal.
i. Connect the Techstream to the DLC3.
j. Turn the ignition switch to ON.
k. Turn the Techstream on.
l. Enter the following menus: Powertrain/Engine/Trouble Codes.
m. Read the DTCs.

Result

RESULT CHART

Result	Proceed to
DTC is not output	A
DTC P0606 is output	B

B: REPLACE ECM (See **REMOVAL**)

A: CHECK FOR INTERMITTENT PROBLEMS (See **CHECK FOR INTERMITTENT PROBLEMS**)

DTC P0607 CONTROL MODULE PERFORMANCE

MONITOR DESCRIPTION

The ECM continuously monitors its internal processors (CPUs) and heated oxygen sensor transistors. This self-check ensures that the ECM is functioning properly.

DTC DETECTION CONDITION CHART

DTC No.	DTC Detection Condition	Trouble Area
P0607	• The ECM CPUs malfunction. • The heated oxygen sensor transistor (built into the ECM) malfunctions.	• ECM • Heated oxygen sensor (bank 1 sensor 2) • Exhaust gas leak

MONITOR STRATEGY

MONITOR STRATEGY CHART

Related DTCs	P0607: Control Module Performance
Required Sensors/Components (Main)	ECM

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Required Sensors/Components (Related)	Heated oxygen sensor
Frequency of Operation	Continuous
Duration	60 seconds
MIL Operation	Immediate
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

TYPICAL ENABLING CONDITIONS CHART

Monitor runs whenever the following DTCs are not stored	None
Engine	Running
Estimated heated oxygen sensor temperature	450 to 800°C (842 to 1472°F)

TYPICAL MALFUNCTION THRESHOLDS

TYPICAL MALFUNCTION THRESHOLDS CHART

Heated oxygen sensor transistors	Fail

CONFIRMATION DRIVING PATTERN

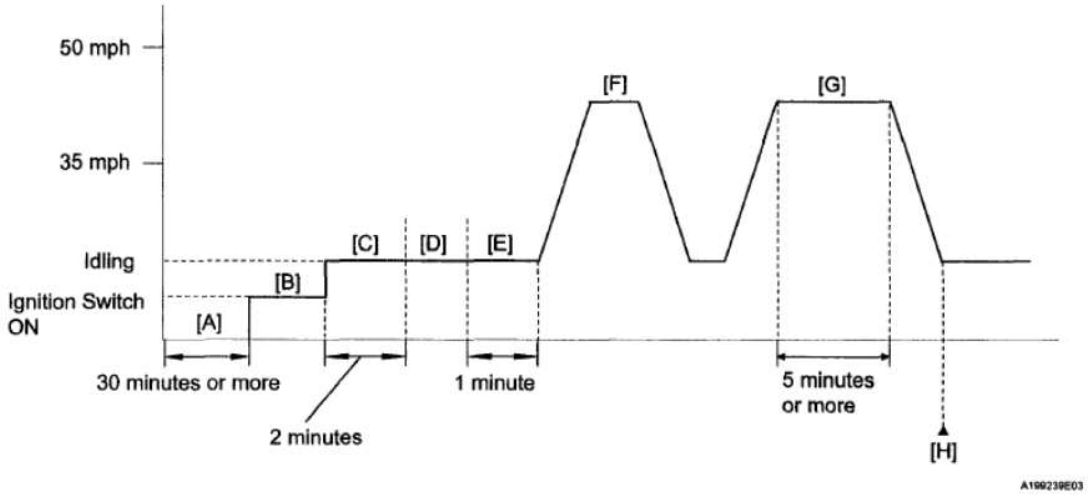


Fig. 208: Confirmation Driving Pattern
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

1. Stop the engine for 30 minutes or more [A].
2. Connect the Techstream to the DLC3.
3. Turn the ignition switch to ON and turn the Techstream on.
4. Clear the DTCs (even if no DTCs are stored, perform the clear DTC procedure).
5. Turn the ignition switch off.
6. Turn the ignition switch to ON and turn the Techstream on [B].
7. Start the engine, and wait 2 minutes [C].

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8. Warm up the engine until the engine coolant temperature is 75°C (167°F) or higher [D].
9. Idle the engine for 1 minute [E].
10. Accelerate the vehicle to 50 mph (80 km/h) and stop the vehicle [F].
11. Drive the vehicle at 35 to 50 mph (56 to 80 km/h) for 5 minutes or more [G].
12. Enter the following menus: Powertrain/Engine/Utility/All Readiness.
13. Input the DTC: P0607, P0136, P0137 or P0138.
14. Check the DTC judgment result [H].

TECHSTREAM DISPLAY DESCRIPTION

Techstream Display	Description
NORMAL	• DTC judgment completed • System normal
ABNORMAL	• DTC judgment completed • System abnormal
INCOMPLETE	• DTC judgment not completed • Perform driving pattern after confirming DTC enabling conditions
UNKNOWN	• Unable to perform DTC judgment • Number of DTCs which do not fulfill DTC preconditions has reached ECU memory limit

CAUTION: When performing the confirmation driving pattern, obey all speed limits and traffic laws.

HINT:

- If the judgment result shows ABNORMAL, the system has a malfunction.
- If the judgment result shows INCOMPLETE or UNKNOWN, perform steps [D] through [H].

15. If the test result is UNKNOWN, enter the following menus: Powertrain/Engine/Trouble Codes/Pending.
16. Read Pending DTCs.

HINT:

If a pending DTC is output, the system is malfunctioning.

17. If the test result is INCOMPLETE or UNKNOWN and no pending DTC is output, perform a universal trip and check for permanent DTCs (See **DTC CHECK/CLEAR**).

HINT:

- If a permanent DTC is output, the system is malfunctioning.

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- If no permanent DTC is output, the system is normal.

INSPECTION PROCEDURE

1. **CHECK ANY OTHER DTCS OUTPUT**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the Techstream on.
   d. Enter the following menus: Powertrain/Engine/Trouble Codes.
   e. Read the DTCs (See **DTC CHECK/CLEAR**).

   Result

   RESULT CHART

Result	Proceed to
P0607 and P0136, P0137 or P0138 are output	A
P0607 is output	B

   B: Go to step 3

   A: Go to next step

2. **INSPECT DTC (P0136, P0137 OR P0138)**
   a. Refer to the P0136, P0137 or P0138 flowchart.

   HINT:

   - If P0136 is output, troubleshoot for that DTC first (See **DTC P0136 OXYGEN SENSOR CIRCUIT MALFUNCTION (BANK 1 SENSOR 2); DTC P0137 OXYGEN SENSOR CIRCUIT LOW VOLTAGE (BANK 1 SENSOR 2); DTC P0138 OXYGEN SENSOR CIRCUIT HIGH VOLTAGE (BANK 1 SENSOR 2); DTC P0139 OXYGEN SENSOR CIRCUIT SLOW RESPONSE (BANK 1 SENSOR 2)**). Then proceed to "INSPECT ECM".
   - If P0137 is output, troubleshoot for that DTC first (See **DTC P0136 OXYGEN SENSOR CIRCUIT MALFUNCTION (BANK 1 SENSOR 2); DTC P0137 OXYGEN SENSOR CIRCUIT LOW VOLTAGE (BANK 1 SENSOR 2); DTC P0138 OXYGEN SENSOR CIRCUIT HIGH VOLTAGE (BANK 1 SENSOR 2); DTC P0139 OXYGEN SENSOR CIRCUIT SLOW RESPONSE (BANK 1 SENSOR 2)**). Then proceed to "INSPECT ECM".
   - If P0138 is output, troubleshoot for that DTC first (See **DTC P0136 OXYGEN SENSOR CIRCUIT MALFUNCTION (BANK 1 SENSOR 2); DTC P0137 OXYGEN SENSOR CIRCUIT LOW VOLTAGE (BANK 1 SENSOR 2); DTC P0138 OXYGEN SENSOR CIRCUIT HIGH VOLTAGE (BANK 1 SENSOR 2); DTC P0139 OXYGEN SENSOR CIRCUIT SLOW RESPONSE (BANK 1 SENSOR 2)**). Then proceed to "INSPECT ECM".

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- If DTC P0607 and P0136, P0137 or P0138 are output, the output voltage of the heated oxygen sensor may remain close to 0 V or become high (around 1 V or higher).

NEXT: Go to step 6

3. **CHECK FOR EXHAUST GAS LEAK**
   a. Allow the engine to idle and rev the engine.
   b. Check for exhaust gas leaks around the heated oxygen sensor.

   If any exhaust gas leaks are present, repair them and proceed to "4 PERFORM CONFIRMATION DRIVING PATTERN". If no exhaust gas leaks are present, proceed to "4 PERFORM CONFIRMATION DRIVING PATTERN".

   HINT:

   - If no exhaust gas leaks are present, a malfunction in the heated oxygen sensor circuit is suspected.
   - If any exhaust gas leaks are present around the heated oxygen sensor, noise appears in the output voltage of the heated oxygen sensor.

4. **PERFORM CONFIRMATION DRIVING PATTERN**

Engine Coolant Temperature: 75°C or more

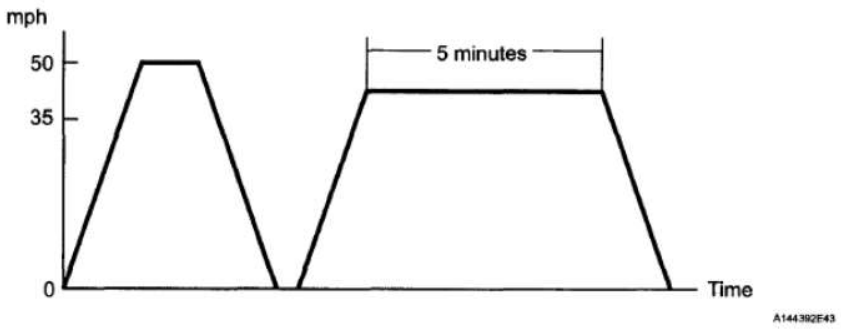


Fig. 209: Engine Coolant Temperature Pattern
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

   a. Clear the DTC (See **DTC CHECK/CLEAR**).
   b. Connect the Techstream to the DLC3.
   c. Start the engine.
   d. Switch the ECM from normal mode to check mode.
   e. Warm up the engine until the engine coolant temperature is 75°C(167°F) or higher.
   f. Perform the driving pattern.
      1. Accelerate the vehicle to 50 mph (80 km/h) and stop the vehicle.
      2. Drive the vehicle between 37 and 50 mph (60 and 80 km/h) for 5 minutes.
   g. Enter the following menus: Powertrain/Engine/Trouble Codes.

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h. Read the DTCs.

Result

RESULT CHART

Result	Proceed to
P0136, P0137, P0138 and/or P0607	A
Only P0607	B
No DTC output	C

B: REPLACE ECM (See **REMOVAL**)

C: Go to step 6

A: Go to next step

5. **INSPECT DTC (P0136, P0137 OR P0138)**
   a. Refer to the P0136, P0137 or P0138 flowchart.

   HINT:

   - If P0136 is output, troubleshoot for that DTC first (See **DTC P0136 OXYGEN SENSOR CIRCUIT MALFUNCTION (BANK 1 SENSOR 2); DTC P0137 OXYGEN SENSOR CIRCUIT LOW VOLTAGE (BANK 1 SENSOR 2); DTC P0138 OXYGEN SENSOR CIRCUIT HIGH VOLTAGE (BANK 1 SENSOR 2); DTC P0139 OXYGEN SENSOR CIRCUIT SLOW RESPONSE (BANK 1 SENSOR 2)**). Then proceed to "INSPECT ECM".
   - If P0137 is output, troubleshoot for that DTC first (See **DTC P0136 OXYGEN SENSOR CIRCUIT MALFUNCTION (BANK 1 SENSOR 2); DTC P0137 OXYGEN SENSOR CIRCUIT LOW VOLTAGE (BANK 1 SENSOR 2); DTC P0138 OXYGEN SENSOR CIRCUIT HIGH VOLTAGE (BANK 1 SENSOR 2); DTC P0139 OXYGEN SENSOR CIRCUIT SLOW RESPONSE (BANK 1 SENSOR 2)**). Then proceed to "INSPECT ECM".
   - If P0138 is output, troubleshoot for that DTC first (See **DTC P0136 OXYGEN SENSOR CIRCUIT MALFUNCTION (BANK 1 SENSOR 2); DTC P0137 OXYGEN SENSOR CIRCUIT LOW VOLTAGE (BANK 1 SENSOR 2); DTC P0138 OXYGEN SENSOR CIRCUIT HIGH VOLTAGE (BANK 1 SENSOR 2); DTC P0139 OXYGEN SENSOR CIRCUIT SLOW RESPONSE (BANK 1 SENSOR 2)**). Then proceed to "INSPECT ECM".
   - If DTC P0607 and P0136, P0137 or P0138 are output, the output voltage of the heated oxygen sensor may remain close to 0 V or become high (around 1 V or higher).

6. **INSPECT ECM**
   a. Clear the DTC (See **DTC CHECK/CLEAR**).
   b. Turn the ignition switch off.

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c. Turn the ignition switch to ON and turn the Techstream on.
d. Stop the engine and wait for 30 minutes.
e. Connect the Techstream to the DLC3.
f. Start the engine and allow it to idle for 2 minutes.
g. Turn the Techstream on.
h. Enter the following menus: Powertrain/Engine/Trouble Codes.
i. Check the DTCs.

Result

RESULT CHART

Result	Proceed to
DTC is not output	A
P0607 is output	B

B: REPLACE ECM (See **REMOVAL**)

A: END

DTC P060A INTERNAL CONTROL MODULE MONITORING PROCESSOR PERFORMANCE

MONITOR DESCRIPTION

The main CPU and sub CPU of the ECM perform data communication between each other. The main CPU monitors the communications and WDC pulses from the sub CPU. When the signal malfunctions below are detected, the DTC is output.

DTC DETECTION CONDITION CHART

DTC No.	DTC Detection Condition	Trouble Area
P060A	An ECM sub CPU error (1 trip detection logic)	ECM

MONITOR STRATEGY

MONITOR STRATEGY CHART

Related DTCs	P060A: ECM CPU Error
Required Sensors/Components (Main)	ECM
Required Sensors/Components (Related)	-
Frequency of Operation	Continuous
Duration	Within 1 second
MIL Operation	Immediate
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

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TYPICAL ENABLING CONDITIONS CHART

CPU reset	Occurred

TYPICAL MALFUNCTION THRESHOLDS

TYPICAL MALFUNCTION THRESHOLDS CHART

When either condition below is met:	Condition 1 or 2
1. When all conditions below are met:	-
○ CPU reset	1 time or more
○ Learned throttle position - Learned accelerator pedal position	0.4 V or higher
○ Electronic throttle actuator	OFF
2. CPU reset	2 times or more

CONFIRMATION DRIVING PATTERN

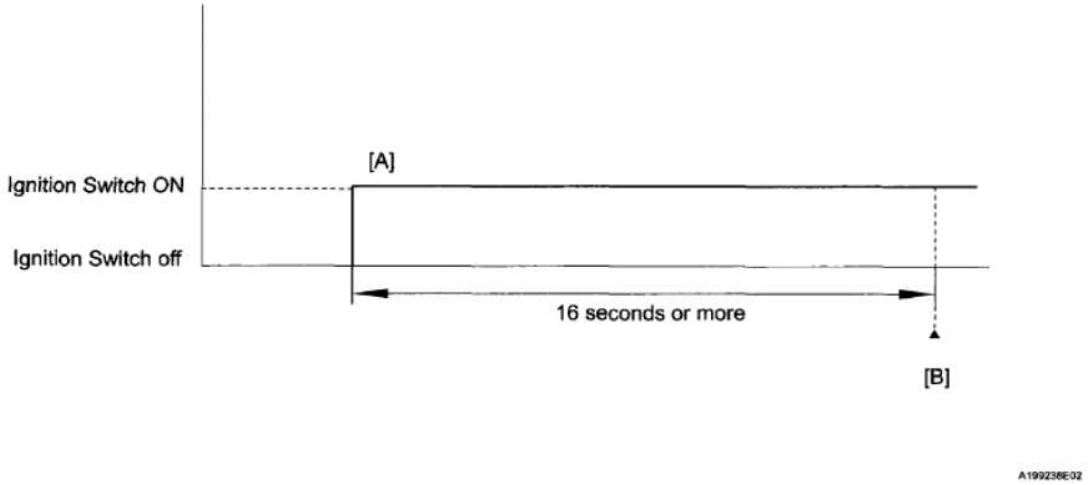


Fig. 210: Confirmation Driving Pattern
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

1. Connect the Techstream to the DLC3.
2. Turn the ignition switch to ON and turn the Techstream on.
3. Clear the DTCs (even if no DTCs are stored, perform the clear DTC procedure).
4. Turn the ignition switch off.
5. Turn the ignition switch to ON and turn the Techstream on [A].
6. Wait 16 seconds or more.
7. Enter the following menus: Powertrain/Engine/Utility/All Readiness.
8. Input the DTC: P060A.
9. Check the DTC judgment result [B].

TECHSTREAM DISPLAY DESCRIPTION

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Techstream Display	Description
NORMAL	• DTC judgment completed • System normal
ABNORMAL	• DTC judgment completed • System abnormal
INCOMPLETE	• DTC judgment not completed • Perform driving pattern after confirming DTC enabling conditions
UNKNOWN	• Unable to perform DTC judgment • Number of DTCs which do not fulfill DTC preconditions has reached ECU memory limit

HINT:

If the judgment result shows ABNORMAL, the system has a malfunction.

10. If the test result is UNKNOWN, enter the following menus: Powertrain/Engine/Trouble Codes/Pending.
11. Read Pending DTCs.

HINT:

If a pending DTC is output, the system is malfunctioning.

12. If the test result is INCOMPLETE or UNKNOWN and no pending DTC is output, perform a universal trip and check for permanent DTCs (See **DTC CHECK/CLEAR**).

HINT:

- If a permanent DTC is output, the system is malfunctioning.
- If no permanent DTC is output, the system is normal.

INSPECTION PROCEDURE

1. **READ OUTPUT DTC (DTC P060A)**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the Techstream on.
   d. Clear the DTC (See **DTC CHECK/CLEAR**).
   e. Turn the ignition switch off and turn the Techstream off.
   f. Disconnect the Techstream.
   g. Disconnect the cable from the negative (-) battery terminal and wait for 1 minute.
   h. Connect the cable to the battery negative (-) battery terminal.

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i. Connect the Techstream to the DLC3.
j. Turn the ignition switch to ON.
k. Turn the Techstream on.
l. Enter the following menus: Powertrain/Engine/Trouble Codes.
m. Read the DTCs.

Result

RESULT CHART

Result	Proceed to
DTC is not output	A
DTC P060A is output	B

B: REPLACE ECM (See **REMOVAL**)

A: CHECK FOR INTERMITTENT PROBLEMS (See **CHECK FOR INTERMITTENT PROBLEMS**)

DTC P060B INTERNAL CONTROL MODULE A/D PROCESSING PERFORMANCE

MONITOR DESCRIPTION

This DTC is stored when a communication error occurs in the ECM.

DTC DETECTION CONDITION CHART

DTC Code	DTC Detection Condition	Trouble Area
P060B	An ECM main CPU communication error (1 trip detection logic)	ECM

MONITOR STRATEGY

MONITOR STRATEGY CHART

Related DTCs	P060B: ECM main CPU communication error
Required Sensors/Components (Main)	ECM
Required Sensors/Components (Related)	-
Frequency of Operation	Continuous
Duration	2 Times: AD converter is fail 1 Time: Knock sensor circuit is fail
MIL Operation	Immediate
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

TYPICAL ENABLING CONDITIONS CHART

Monitor runs whenever following DTCs not stored	None

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TYPICAL MALFUNCTION THRESHOLDS

TYPICAL MALFUNCTION THRESHOLDS CHART

When one of the following conditions is met	-
AD converter	Fail
Knock sensor circuit	Fail

CONFIRMATION DRIVING PATTERN

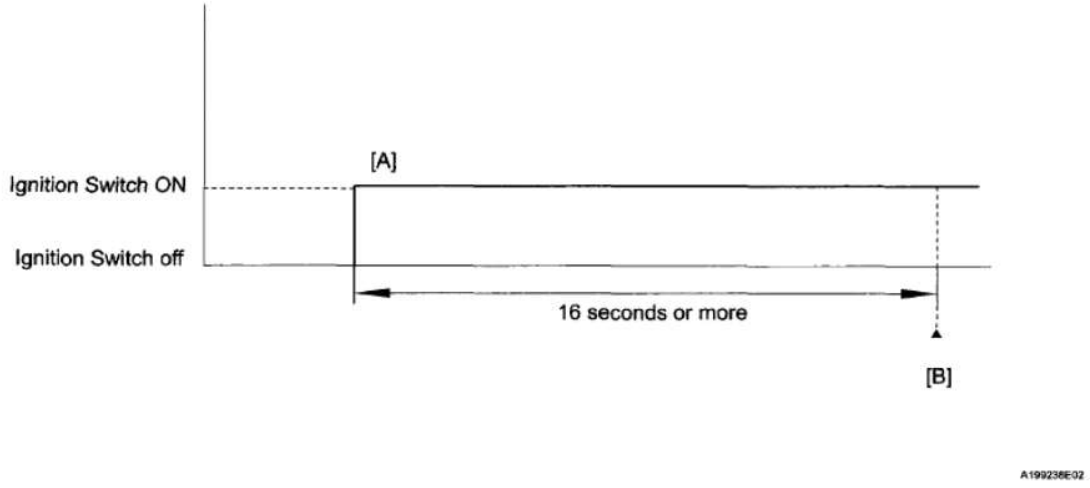


Fig. 211: Confirmation Driving Pattern
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

1. Connect the Techstream to the DLC3.
2. Turn the ignition switch to ON and turn the Techstream on.
3. Clear the DTCs (even if no DTCs are stored, perform the clear DTC procedure).
4. Turn the ignition switch off.
5. Turn the ignition switch to ON and turn the Techstream on [A].
6. Wait 16 seconds or more.
7. Enter the following menus: Powertrain/Engine/Utility/All Readiness.
8. Input the DTC: P060B.
9. Check the DTC judgment result [B].

TECHSTREAM DISPLAY DESCRIPTION

Techstream Display	Description
NORMAL	• DTC judgment completed • System normal
ABNORMAL	• DTC judgment completed • System abnormal

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INCOMPLETE	• DTC judgment not completed • Perform driving pattern after confirming DTC enabling conditions
UNKNOWN	• Unable to perform DTC judgment • Number of DTCs which do not fulfill DTC preconditions has reached ECU memory limit

HINT:

If the judgment result shows ABNORMAL, the system has a malfunction.

10. If the test result is UNKNOWN, enter the following menus: Powertrain/Engine/Trouble Codes/Pending.
11. Read Pending DTCs.

HINT:

If a pending DTC is output, the system is malfunctioning.

12. If the test result is INCOMPLETE or UNKNOWN and no pending DTC is output, perform a universal trip and check for permanent DTCs (See **DTC CHECK/CLEAR**).

HINT:

- If a permanent DTC is output, the system is malfunctioning.
- If no permanent DTC is output, the system is normal.

INSPECTION PROCEDURE

1. **READ OUTPUT DTC (DTC P060B)**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the Techstream on.
   d. Clear the DTC (See **DTC CHECK/CLEAR**).
   e. Turn the ignition switch off and turn the Techstream off.
   f. Disconnect the Techstream.
   g. Disconnect the cable from the negative (-) battery terminal and wait for 1 minute.
   h. Connect the cable to the negative (-) battery terminal.
   i. Connect the Techstream to the DLC3.
   j. Turn the ignition switch to ON.
   k. Turn the Techstream on.
   l. Enter the following menus: Powertrain/Engine/Trouble Codes.
   m. Read the DTCs.

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Result

RESULT CHART

Result	Proceed to
DTC is not output	A
DTC P060B is output	B
DTC P060B and P0327, P0328 are output	C

B: REPLACE ECM (See **REMOVAL**)

C: GO TO DTC (P0327, P0328) (See **DTC P0327 KNOCK SENSOR 1 CIRCUIT LOW INPUT (BANK 1 OR SINGLE SENSOR); DTC P0328 KNOCK SENSOR 1 CIRCUIT HIGH INPUT (BANK 1 OR SINGLE SENSOR)**)

A: CHECK FOR INTERMITTENT PROBLEMS (See **CHECK FOR INTERMITTENT PROBLEMS**)

DTC P060D INTERNAL CONTROL MODULE ACCELERATOR PEDAL POSITION PERFORMANCE

MONITOR DESCRIPTION

The ECM monitors the input signals of the accelerator pedal position sensor No. 1. When the input signals and control signals are deviated, the DTC is stored.

DTC DETECTION CONDITION CHART

DTC No.	DTC Detection Condition	Trouble Area
P060D	An ECM main CPU error (1 trip detection logic)	ECM

MONITOR STRATEGY

MONITOR STRATEGY CHART

Related DTCs	P060D: Internal control module, Accelerator pedal position
Required Sensors/Components (Main)	ECM
Required Sensors/Components (Related)	-
Frequency of Operation	Continuous
Duration	1 second
MIL Operation	Immediate
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

TYPICAL ENABLING CONDITIONS CHART

Monitor runs whenever following DTCs not stored	None

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TYPICAL MALFUNCTION THRESHOLDS

TYPICAL MALFUNCTION THRESHOLDS CHART

Difference of main accelerator pedal position and sub accelerator pedal position	0.3 V or higher

CONFIRMATION DRIVING PATTERN

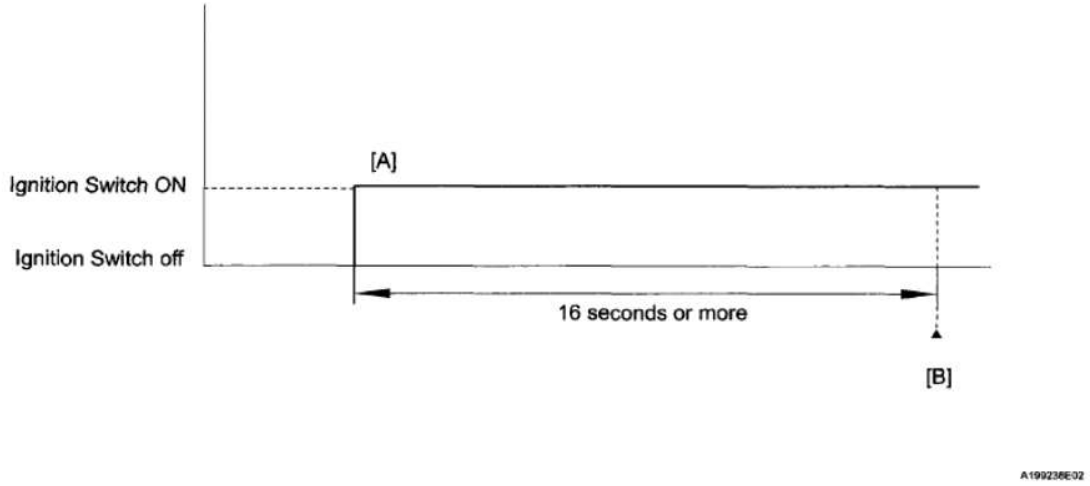


Fig. 212: Confirmation Driving Pattern
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

1. Connect the Techstream to the DLC3.
2. Turn the ignition switch to ON and turn the Techstream on.
3. Clear the DTCs (even if no DTCs are stored, perform the clear DTC procedure).
4. Turn the ignition switch off.
5. Turn the ignition switch to ON and turn the Techstream on [A].
6. Wait 16 seconds or more.
7. Enter the following menus: Powertrain/Engine/Utility/All Readiness.
8. Input the DTC: P060D.
9. Check the DTC judgment result [B].

TECHSTREAM DISPLAY DESCRIPTION

Techstream Display	Description
NORMAL	• DTC judgment completed • System normal
ABNORMAL	• DTC judgment completed • System abnormal
INCOMPLETE	• DTC judgment not completed

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	• Perform driving pattern after confirming DTC enabling conditions
UNKNOWN	• Unable to perform DTC judgment • Number of DTCs which do not fulfill DTC preconditions has reached ECU memory limit

HINT:

If the judgment result shows ABNORMAL, the system has a malfunction.

10. If the test result is UNKNOWN, enter the following menus: Powertrain/Engine/Trouble Codes/Pending.
11. Read Pending DTCs.

HINT:

If a pending DTC is output, the system is malfunctioning.

12. If the test result is INCOMPLETE or UNKNOWN and no pending DTC is output, perform a universal trip and check for permanent DTCs (See **DTC CHECK/CLEAR**).

HINT:

- If a permanent DTC is output, the system is malfunctioning.
- If no permanent DTC is output, the system is normal.

INSPECTION PROCEDURE

1. **READ OUTPUT DTC (DTC P060D)**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the Techstream on.
   d. Clear the DTC (See **DTC CHECK/CLEAR**).
   e. Turn the ignition switch off and turn the Techstream off.
   f. Disconnect the Techstream.
   g. Disconnect the cable from the negative (-) battery terminal and wait for 1 minute.
   h. Connect the cable to the negative (-) battery terminal.
   i. Connect the Techstream to the DLC3.
   j. Turn the ignition switch to ON.
   k. Turn the Techstream on.
   l. Enter the following menus: Powertrain/Engine/Trouble Codes.
   m. Read the DTCs.

Result

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RESULT CHART

Result	Proceed to
DTC is not output	A
DTC P060D is output	B

B: REPLACE ECM (See **DTC CHECK/CLEAR**)

A: CHECK FOR INTERMITTENT PROBLEMS (See **CHECK FOR INTERMITTENT PROBLEMS**)

DTC P060E INTERNAL CONTROL MODULE THROTTLE POSITION PERFORMANCE

MONITOR DESCRIPTION

The ECM monitors the input signals of the throttle position sensor No. 1 and stop light switch. As the ECM monitors the input signals of the throttle position sensor No. 1 and the STP signals of the stop light switch, if the input signals and control signals are deviated, the DTC is stored.

DTC DETECTION CONDITION CHART

DTC No.	DTC Detection Condition	Trouble Area
P060E	An ECM main CPU error (1 trip detection logic)	ECM

MONITOR STRATEGY

MONITOR STRATEGY CHART

Related DTCs	P060E: Internal Control Module, Throttle Position
Required Sensors/Components (Main)	ECM
Required Sensors/Components (Related)	-
Frequency of Operation	Continuous
Duration	1 second
MIL Operation	Immediate
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

TYPICAL ENABLING CONDITIONS CHART

Monitor runs whenever following DTCs not stored	None
DMA communication error	Not detected

TYPICAL MALFUNCTION THRESHOLDS

TYPICAL MALFUNCTION THRESHOLDS CHART

When one of following conditions is met:	Condition 1 or 2
1. Difference of main throttle position and sub throttle position	0.3 V or higher

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2. Value of main brake switch signal and sub brake switch signal	Different

CONFIRMATION DRIVING PATTERN

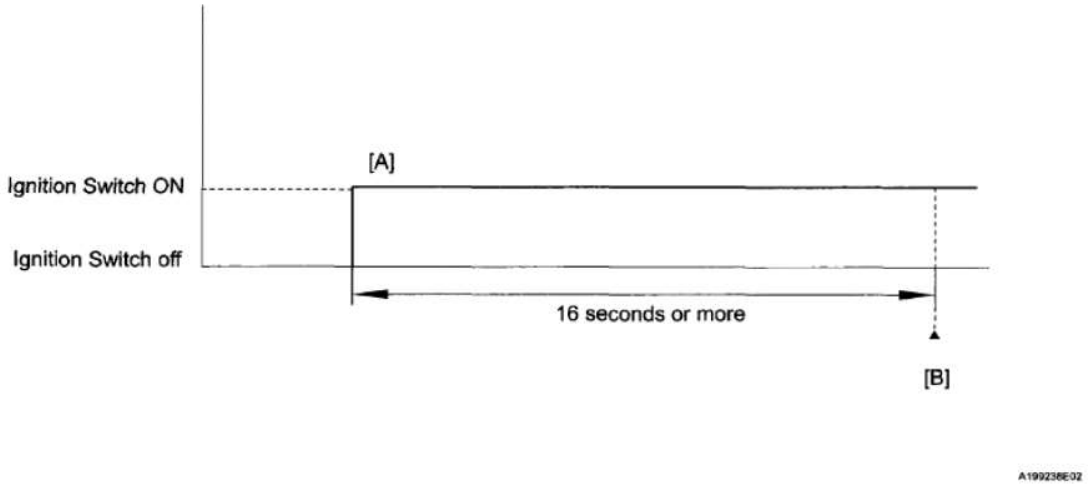


Fig. 213: Confirmation Driving Pattern
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

1. Connect the Techstream to the DLC3.
2. Turn the ignition switch to ON and turn the Techstream on.
3. Clear the DTCs (even if no DTCs are stored, perform the clear DTC procedure).
4. Turn the ignition switch off.
5. Turn the ignition switch to ON and turn the Techstream on [A].
6. Wait 16 seconds or more.
7. Enter the following menus: Powertrain/Engine/Utility/All Readiness.
8. Input the DTC: P060E.
9. Check the DTC judgment result [B].

TECHSTREAM DISPLAY DESCRIPTION

Techstream Display	Description
NORMAL	• DTC judgment completed • System normal
ABNORMAL	• DTC judgment completed • System abnormal
INCOMPLETE	• DTC judgment not completed • Perform driving pattern after confirming DTC enabling conditions
UNKNOWN	• Unable to perform DTC judgment

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	• Number of DTCs which do not fulfill DTC preconditions has reached ECU memory limit

HINT:

If the judgment result shows ABNORMAL, the system has a malfunction.

10. If the test result is UNKNOWN, enter the following menus: Powertrain/Engine/Trouble Codes/Pending.
11. Read Pending DTCs.

HINT:

If a pending DTC is output, the system is malfunctioning.

12. If the test result is INCOMPLETE or UNKNOWN and no pending DTC is output, perform a universal trip and check for permanent DTCs (See **DTC CHECK/CLEAR**).

HINT:

- If a permanent DTC is output, the system is malfunctioning.
- If no permanent DTC is output, the system is normal.

INSPECTION PROCEDURE

1. **READ OUTPUT DTC (DTC P060E)**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the Techstream on.
   d. Clear the DTC (See **DTC CHECK/CLEAR**).
   e. Turn the ignition switch off and turn the Techstream off.
   f. Disconnect the Techstream.
   g. Disconnect the cable from the negative (-) battery terminal and wait for 1 minute.
   h. Connect the cable to the negative (-) battery terminal.
   i. Connect the Techstream to the DLC3.
   j. Turn the ignition switch to ON.
   k. Turn the Techstream on.
   l. Enter the following menus: Powertrain/Engine/Trouble Codes.
   m. Read the DTCs.

Result

RESULT CHART

Result	Proceed to

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DTC is not output	A
DTC P060E is output	B

B: REPLACE ECM (See **REMOVAL**)

A: CHECK FOR INTERMITTENT PROBLEMS (See **CHECK FOR INTERMITTENT PROBLEMS**)

DTC P0617 STARTER RELAY CIRCUIT HIGH

MONITOR DESCRIPTION

While the engine is being cranked, battery voltage is applied to terminal STA of the ECM. If the ECM detects the Starter Control (STA) signal while the vehicle is being driven, it determines that there is a malfunction in the STA circuit. The ECM then illuminates the MIL and stores the DTC. This monitor runs when the vehicle is driven at 12.4 mph (20 km/h) or more for over 20 seconds.

DTC DETECTION CONDITION CHART

DTC No.	DTC Detection Condition	Trouble Area
P0617	When all of the following conditions are met, and a positive (+B) battery voltage of 10.5 V or higher is applied to the ECM for 20 seconds (1 trip detection logic): a. The vehicle speed is 12.4 mph (20 km/h) or more. b. The engine speed is 1000 rpm or more. c. The STA signal is ON.	• Park/neutral position switch assembly • ST relay circuit • Ignition switch assembly • ECM

MONITOR STRATEGY

MONITOR STRATEGY CHART

Related DTCs	P0617: Starter Signal
Required Sensors/Components (Main)	ST relay Park/neutral position switch Ignition switch
Required Sensors/Components (Related)	Vehicle speed sensor Crankshaft position sensor
Frequency of Operation	Continuous
Duration	20 seconds
MIL Operation	Immediate
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

TYPICAL ENABLING CONDITIONS CHART

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Monitor runs whenever following DTCs not stored	None
Battery voltage	10.5 V or higher
Vehicle speed	12.4 mph (20 km/h) or more
Engine speed	1000 rpm or more

TYPICAL MALFUNCTION THRESHOLDS

TYPICAL MALFUNCTION THRESHOLDS CHART

Starter signal	ON

CONFIRMATION DRIVING PATTERN

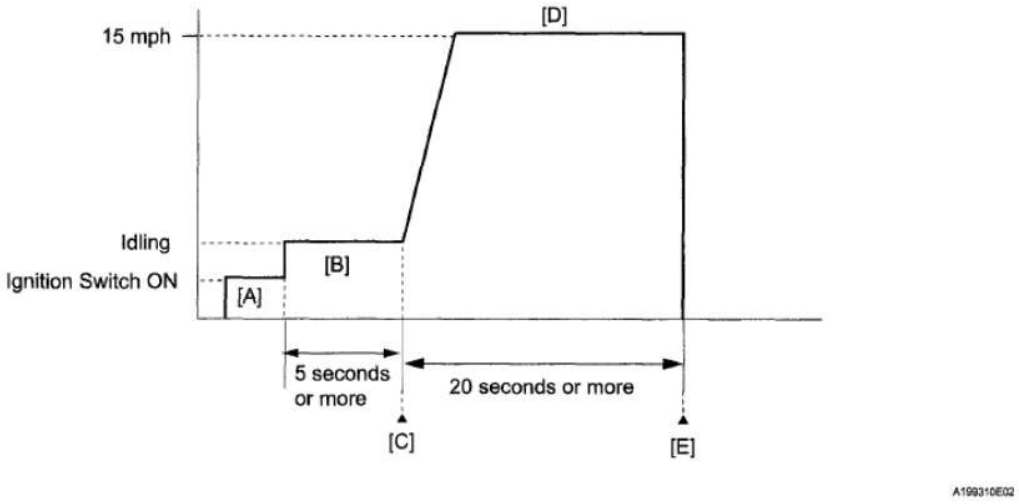


Fig. 214: Confirmation Driving Pattern
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

1. Connect the Techstream to the DLC3.
2. Turn the ignition switch to ON and turn the Techstream on.
3. Clear the DTCs (even if no DTCs are stored, perform the clear DTC procedure).
4. Turn the ignition switch off.
5. Turn the ignition switch to ON and turn the Techstream on [A].
6. Idle the engine for 5 minutes or more [B].
7. Enter the following menus: Powertrain/Engine/Utility/All Readiness.
8. Input the DTC: P0617.
9. Check the DTC judgment result [C].

TECHSTREAM DISPLAY DESCRIPTION

Techstream Display	Description
	• DTC judgment completed

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NORMAL	• System normal
ABNORMAL	• DTC judgment completed • System abnormal
INCOMPLETE	• DTC judgment not completed • Perform driving pattern after confirming DTC enabling conditions
UNKNOWN	• Unable to perform DTC judgment • Number of DTCs which do not fulfill DTC preconditions has reached ECU memory limit

CAUTION: When performing the confirmation driving pattern, obey all speed limits and traffic laws.

HINT:

- If the judgment result shows ABNORMAL, the system has a malfunction.
- If the judgment result shows INCOMPLETE or UNKNOWN, perform steps [D] and [E].

10. Drive the vehicle at 15 mph (24 km/h) or more for 20 seconds or more [D].
11. Check the DTC judgment result [E].
12. If the test result is UNKNOWN, enter the following menus: Powertrain/Engine/Trouble Codes/Pending.
13. Read Pending DTCs.

    HINT:

    If a pending DTC is output, the system is malfunctioning.

14. If the test result is INCOMPLETE or UNKNOWN and no pending DTC is output, perform a universal trip and check for permanent DTCs (See **DTC CHECK/CLEAR**).

    HINT:

    - If a permanent DTC is output, the system is malfunctioning.
    - If no permanent DTC is output, the system is normal.

WIRING DIAGRAM

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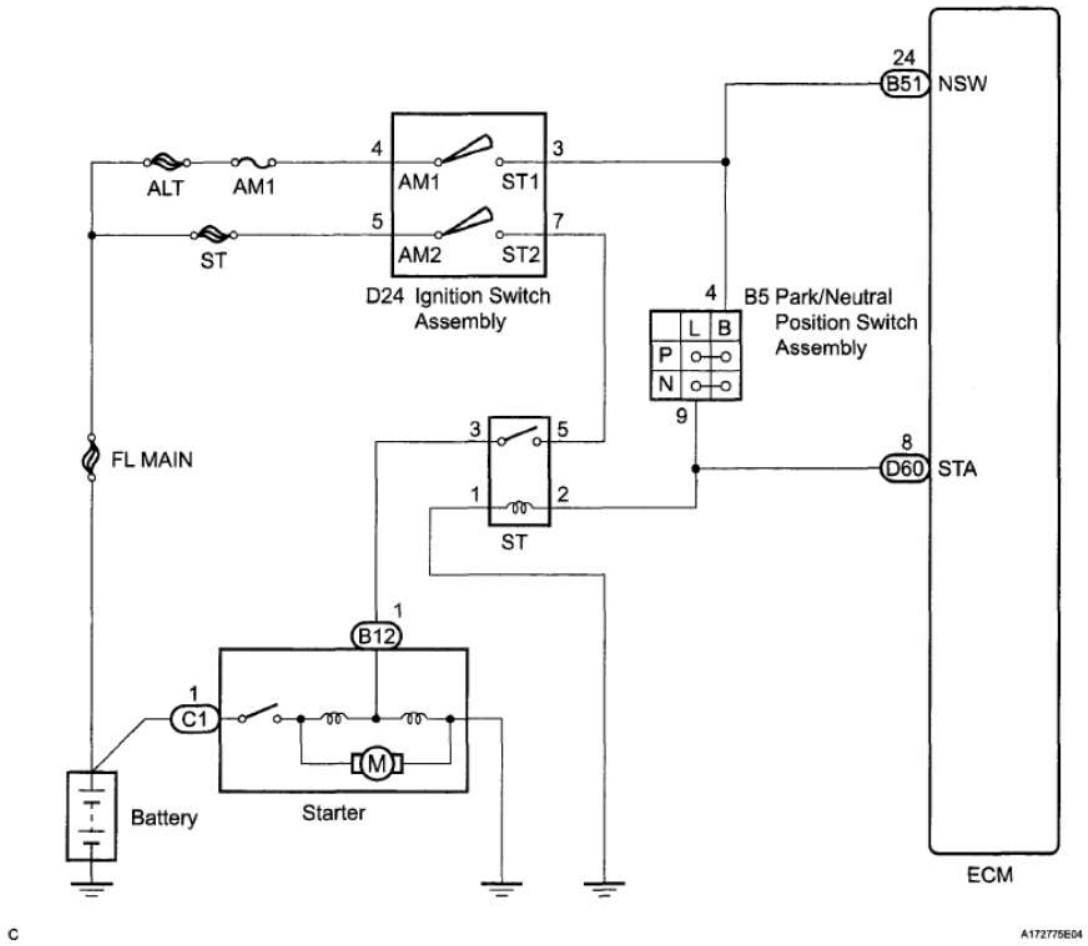


Fig. 215: Starter Relay Circuit High - Wiring Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSPECTION PROCEDURE

HINT:

Read freeze frame data using the Techstream. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.

NOTE: Inspect the fuses for circuits related to this system before performing the following inspection procedure.

1. **READ VALUE USING TECHSTREAM (STARTER SIGNAL)**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the Techstream on.

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d. Enter the following menus: Powertrain/Engine/Data List/All Data/Starter Signal.
e. Check the value displayed on the Techstream when the ignition switch is turned to ON and START.

OK

IGNITION SWITCH REFERENCE

Ignition Switch Position	Starter Signal
ON	Close (Starter signal OFF)
START	Open (Starter signal ON)

NG: Go to step 2

OK: CHECK FOR INTERMITTENT PROBLEMS (See **CHECK FOR INTERMITTENT PROBLEMS**)

2. **INSPECT PARK/NEUTRAL POSITION SWITCH ASSEMBLY**
   a. Inspect the park/neutral position switch assembly (See **ADJUSTMENT**).

Result

RESULT CHART

Result	Proceed to
NG	A
OK	B

B: Go to step 5

A: Go to next step

3. **REPLACE PARK/NEUTRAL POSITION SWITCH ASSEMBLY**
   a. Replace the park/neutral position switch assembly (See **REMOVAL**).
4. **CHECK WHETHER DTC OUTPUT RECURS**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the Techstream on.
   d. Clear the DTCs.
   e. Turn the ignition switch off.
   f. Turn the ignition switch to ON and turn the Techstream on.
   g. Drive the vehicle in accordance with the driving pattern described in the **CONFIRMATION DRIVING PATTERN**.
   h. Enter the following menus: Powertrain/Engine/Trouble Codes.

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i. Read the DTCs.

Result

RESULT CHART

Result	Proceed to
DTC P0617 is output	A
DTC is not output	B

B: REPAIR COMPLETED

A: Go to next step

5. **REPAIR OR REPLACE HARNESS OR CONNECTOR (STARTER SIGNAL CIRCUIT)**
6. **CHECK WHETHER DTC OUTPUT RECURS**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the Techstream on.
   d. Clear the DTCs.
   e. Turn the ignition switch off.
   f. Turn the ignition switch to ON and turn the Techstream on.
   g. Drive the vehicle in accordance with the driving pattern described in the **CONFIRMATION DRIVING PATTERN**.
   h. Enter the following menus: Powertrain/Engine/Trouble Codes.
   i. Read the DTCs.

Result

RESULT CHART

Result	Proceed to
DTC is not output	A
DTC P0617 is output	B

B: REPLACE ECM (See **FUEL INJECTOR CIRCUIT**)

A: REPAIR COMPLETED

DTC P062F INTERNAL CONTROL MODULE EEPROM ERROR

DESCRIPTION

The ECM monitors its internal operation and it stores this DTC when it detects an internal malfunction.

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DTC DETECTION CONDITION CHART

DTC No.	DTC Detection Condition	Trouble Area
P062F	An ECM internal error (EEPROM) (1 trip detection logic)	ECM

MONITOR DESCRIPTION

The ECM monitors its internal operation. If the internal operation is malfunctioning, the ECM illuminates the MIL and stores a DTC.

MONITOR STRATEGY

MONITOR STRATEGY CHART

Related DTCs	P062F: Internal Control Module EEPROM Error
Required Sensors/Components (Main)	ECM
Required Sensors/Components (Related)	-
Frequency of Operation	Once per driving cycle
Duration	11 seconds
MIL Operation	Immediate
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

TYPICAL ENABLING CONDITIONS CHART

Monitor runs whenever following DTCs not stored	None
Time after engine start	10 seconds or more
Battery voltage	8 V or higher
Ignition switch	ON
Starter	OFF

TYPICAL MALFUNCTION THRESHOLDS

TYPICAL MALFUNCTION THRESHOLDS CHART

Permanent fault code data	Mismatch (3 times or more)

CONFIRMATION DRIVING PATTERN

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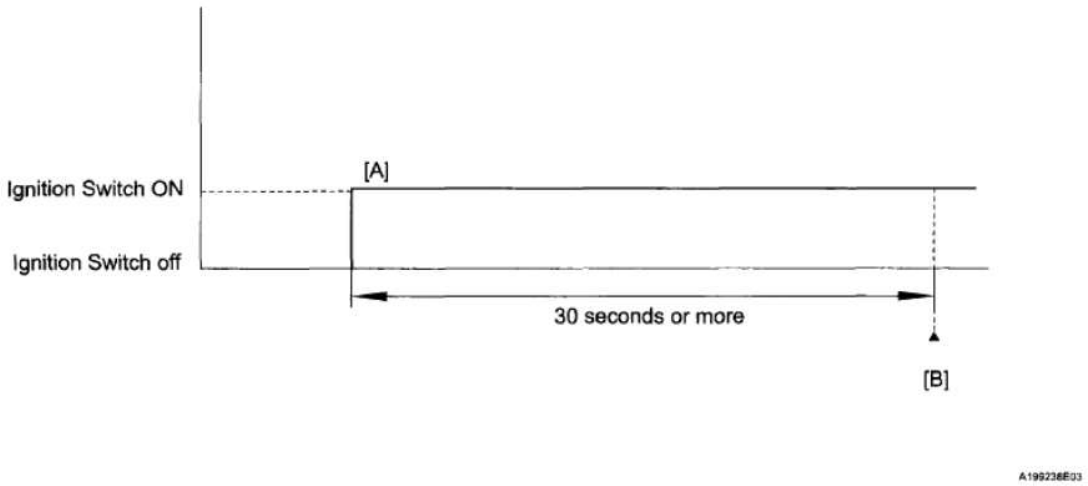


Fig. 216: Confirmation Driving Pattern
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

1. Connect the Techstream to the DLC3.
2. Turn the ignition switch to ON and turn the Techstream on.
3. Clear the DTCs (even if no DTCs are stored, perform the clear DTC procedure).
4. Turn the ignition switch off.
5. Turn the ignition switch to ON and turn the Techstream on [A].
6. Wait 30 seconds or more.
7. Enter the following menus: Powertrain/Engine/Utility/All Readiness.
8. Input the DTC: P062F.
9. Check the DTC judgment result [B].

TECHSTREAM DISPLAY DESCRIPTION

Techstream Display	Description
NORMAL	• DTC judgment completed • System normal
ABNORMAL	• DTC judgment completed • System abnormal
INCOMPLETE	• DTC judgment not completed • Perform driving pattern after confirming DTC enabling conditions
UNKNOWN	• Unable to perform DTC judgment • Number of DTCs which do not fulfill DTC preconditions has reached ECU memory limit

HINT:

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If the judgment result shows ABNORMAL, the system has a malfunction.

10. If the test result is UNKNOWN, enter the following menus: Powertrain/Engine/Trouble Codes/Pending.
11. Read Pending DTCs.

    HINT:

    If a pending DTC is output, the system is malfunctioning.

12. If the test result is INCOMPLETE or UNKNOWN and no pending DTC is output, perform a universal trip and check for permanent DTCs (See **DTC CHECK/CLEAR**).

    HINT:

    - If a permanent DTC is output, the system is malfunctioning.
    - If no permanent DTC is output, the system is normal.

INSPECTION PROCEDURE

1. **READ OUTPUT DTC (DTC P062F)**
    a. Connect the Techstream to the DLC3.
    b. Turn the ignition switch to ON.
    c. Turn the Techstream on.
    d. Clear the DTC (See **DTC CHECK/CLEAR**).
    e. Turn the ignition switch off and turn the Techstream off.
    f. Disconnect the Techstream.
    g. Disconnect the cable from the negative (-) battery terminal and wait for 1 minute.
    h. Connect the cable to the negative (-) battery terminal.
    i. Connect the Techstream to the DLC3.
    j. Turn the ignition switch to ON.
    k. Turn the Techstream on.
    l. Enter the following menus: Powertrain/Engine/Trouble Codes.
    m. Read the DTCs.

    Result

    RESULT CHART

Result	Proceed to
DTC is not output	A
DTC P062F is output	B

    B: REPLACE ECM (See **REMOVAL**)

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A: CHECK FOR INTERMITTENT PROBLEMS (See **CHECK FOR INTERMITTENT PROBLEMS**)

DTC P0630 VIN NOT PROGRAMMED OR MISMATCH - ECM/PCM

MONITOR DESCRIPTION

DTC P0630 is stored when the Vehicle Identification Number (VIN) is not stored in the Engine Control Module (ECM) or the input VIN is not accurate. Input the VIN with the Techstream.

DTC DETECTION CONDITION CHART

DTC No.	DTC Detection Condition	Trouble Area
P0630	When either of the following conditions is met: • The VIN is not stored in the ECM. • The VIN input into the ECM is not accurate.	ECM

MONITOR STRATEGY

MONITOR STRATEGY CHART

Related DTCs	P0630: VIN Not Programmed
Required Sensors/Components (Main)	ECM
Required Sensors/Components (Related)	-
Frequency of Operation	Continuous
Duration	0.325 seconds
MIL Operation	Immediate
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

TYPICAL ENABLING CONDITIONS CHART

Battery voltage	8 V or higher
Ignition switch	ON
Starter	OFF

TYPICAL MALFUNCTION THRESHOLDS

TYPICAL MALFUNCTION THRESHOLDS CHART

VIN code	Not programmed

COMPONENT OPERATING RANGE

COMPONENT OPERATING RANGE CHART

VIN code	Programmed

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CONFIRMATION DRIVING PATTERN

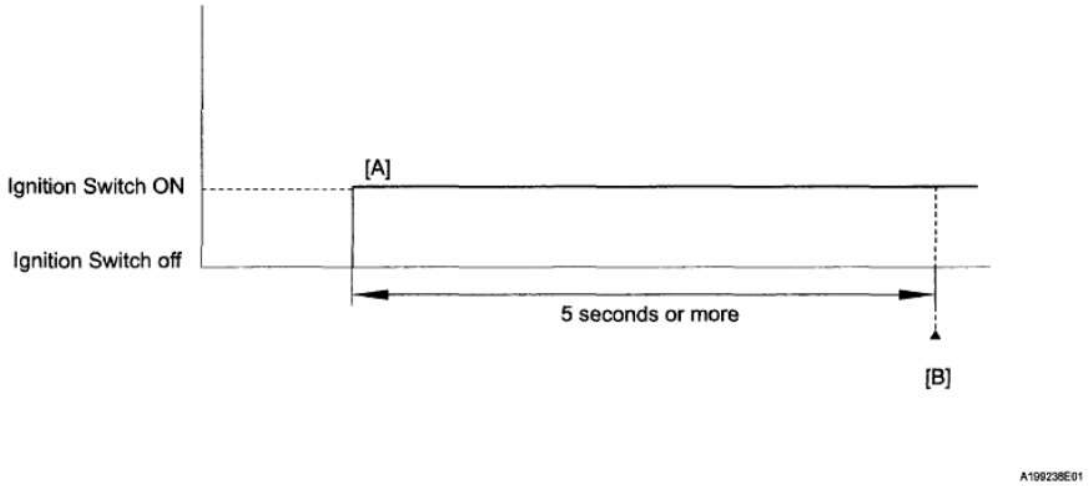


Fig. 217: Confirmation Driving Pattern
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

1. Connect the Techstream to the DLC3.
2. Turn the ignition switch to ON and turn the Techstream on.
3. Clear the DTCs (even if no DTCs are stored, perform the clear DTC procedure).
4. Turn the ignition switch off.
5. Turn the ignition switch to ON and turn the Techstream on.
6. Wait 5 seconds or more [A].
7. Enter the following menus: Powertrain/Engine/Utility/All Readiness.
8. Input the DTC: P0630.
9. Check the DTC judgment result [B].

TECHSTREAM DISPLAY DESCRIPTION

Techstream Display	Description
NORMAL	• DTC judgment completed • System normal
ABNORMAL	• DTC judgment completed • System abnormal
INCOMPLETE	• DTC judgment not completed • Perform driving pattern after confirming DTC enabling conditions
UNKNOWN	• Unable to perform DTC judgment • Number of DTCs which do not fulfill DTC preconditions has reached ECU memory limit

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HINT:

If the judgment result shows ABNORMAL, the system has a malfunction.

10. If the test result is UNKNOWN, enter the following menus: Powertrain/Engine/Trouble Codes/Pending.
11. Read Pending DTCs.

HINT:

If a pending DTC is output, the system is malfunctioning.

12. If the test result is INCOMPLETE or UNKNOWN and no pending DTC is output, perform a universal trip and check for permanent DTCs (See **DTC CHECK/CLEAR**).

HINT:

- If a permanent DTC is output, the system is malfunctioning.
- If no permanent DTC is output, the system is normal.

INSPECTION PROCEDURE

1. **CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P0630)**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the Techstream on.
   d. Enter the following menus: Powertrain/Engine/Trouble Codes.
   e. Read the DTCs.

Result

RESULT CHART

Result	Proceed to
DTC P0630 Is output	A
DTC P0630 and other DTCs are output	B

If any DTCs other than P0630 are output, troubleshoot those DTCs first.

NOTE: If P0630 is output, the VIN must be input into the ECM using the Techstream. However, all DTCs are cleared automatically by the Techstream when inputting the VIN. If DTCs other than P0630 are output, check them first.

B: GO TO **DTC CHART**

A: Go to next step

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2. **INPUT VIN**
   a. Input the VIN (See **REGISTRATION**).

NEXT: END

DTC P0657 ACTUATOR SUPPLY VOLTAGE CIRCUIT/OPEN

MONITOR DESCRIPTION

The ECM monitors the output voltage to the throttle actuator. This self-check ensures that the ECM is functioning properly. The output voltage is usually 0 V when the ignition switch is turned off. If the output voltage is higher than 7 V when the ignition switch is turned off, the ECM illuminates the MIL and stores the DTC when the ignition switch is turned to ON.

DTC DETECTION CONDITION CHART

DTC No.	DTC Detection Condition	Trouble Area
P0657	A throttle actuator power supply error (1 trip detection logic)	ECM

MONITOR STRATEGY

MONITOR STRATEGY CHART

Related DTCs	P0657: ETCS Power Supply
Required Sensors/Components (Main)	ECM
Required Sensors/Components (Related)	Throttle actuator
Frequency of Operation	Once per driving cycle
Duration	1 second or more
MIL Operation	Immediate
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

TYPICAL ENABLING CONDITIONS CHART

Throttle actuator power supply voltage	7 V or higher

TYPICAL MALFUNCTION THRESHOLDS

TYPICAL MALFUNCTION THRESHOLDS CHART

Electronic throttle actuator power supply	ON

CONFIRMATION DRIVING PATTERN

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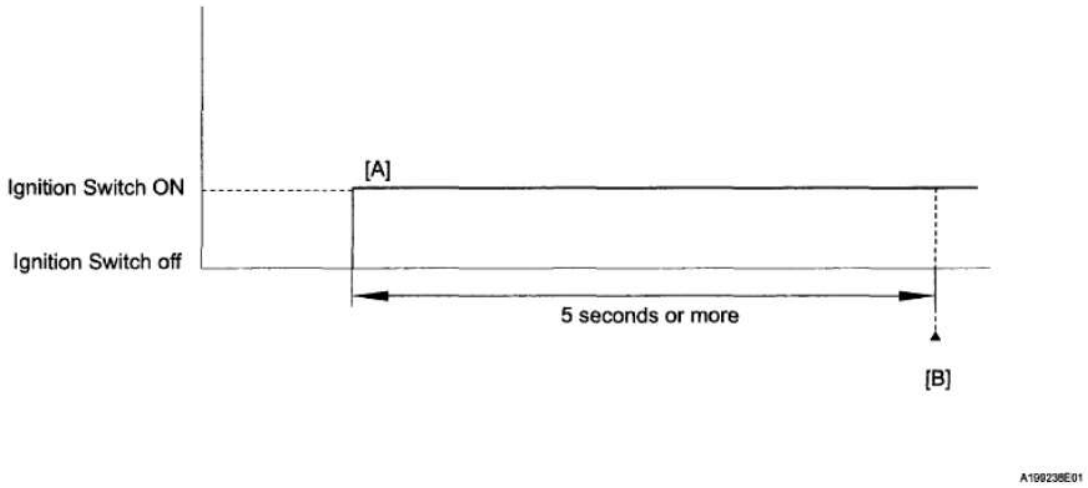


Fig. 218: Confirmation Driving Pattern
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

1. Connect the Techstream to the DLC3.
2. Turn the ignition switch to ON and turn the Techstream on.
3. Clear the DTCs (even if no DTCs are stored, perform the clear DTC procedure).
4. Turn the ignition switch off and turn the Techstream off.
5. Turn the ignition switch to ON and turn the Techstream on [A].
6. Wait 5 seconds or more.
7. Enter the following menus: Powertrain/Engine/Utility/All Readiness.
8. Input the DTC: P0657.
9. Check the DTC judgment result [B].

TECHSTREAM DISPLAY DESCRIPTION

Techstream Display	Description
NORMAL	• DTC judgment completed • System normal
ABNORMAL	• DTC judgment completed • System abnormal
INCOMPLETE	• DTC judgment not completed • Perform driving pattern after confirming DTC enabling conditions
UNKNOWN	• Unable to perform DTC judgment • Number of DTCs which do not fulfill DTC preconditions has reached ECU memory limit

HINT:

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If the judgment result shows ABNORMAL, the system has a malfunction.

10. If the test result is UNKNOWN, enter the following menus: Powertrain/Engine/Trouble Codes/Pending.
11. Read Pending DTCs.

    HINT:

    If a pending DTC is output, the system is malfunctioning.

12. If the test result is INCOMPLETE or UNKNOWN and no pending DTC is output, perform a universal trip and check for permanent DTCs (See **DTC CHECK/CLEAR**).

    HINT:

    - If a permanent DTC is output, the system is malfunctioning.
    - If no permanent DTC is output, the system is normal.

INSPECTION PROCEDURE

HINT:

Read freeze frame data using the Techstream. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1. **READ OUTPUT DTC (DTC P0657)**
    a. Connect the Techstream to the DLC3.
    b. Turn the ignition switch to ON.
    c. Turn the Techstream on.
    d. Clear the DTC (See **DTC CHECK/CLEAR**).
    e. Turn the ignition switch off and turn the Techstream off.
    f. Disconnect the Techstream.
    g. Disconnect the cable from the negative (-) battery terminal and wait for 1 minute.
    h. Connect the cable to the negative (-) battery terminal.
    i. Turn the ignition switch to ON for 10 seconds.
    j. Turn the ignition switch off.
    k. Turn the ignition switch to ON.
    l. Connect the Techstream to the DLC3.
    m. Turn the Techstream on.
    n. Enter the following menus: Powertrain/Engine/Trouble Codes.
    o. Read the DTCs.

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Result

RESULT CHART

Result	Proceed to
DTC is not output	A
DTC P0657 is output	B

B: REPLACE ECM (See **REMOVAL**)

A: CHECK FOR INTERMITTENT PROBLEMS (See **CHECK FOR INTERMITTENT PROBLEMS**)

DTC P0705 TRANSMISSION RANGE SENSOR CIRCUIT MALFUNCTION (PRNDL INPUT)

DESCRIPTION

The park/neutral position switch assembly detects the shift lever position and sends signals to the ECM.

DTC DETECTION CONDITION CHART

DTC No.	DTC Detection Condition	Trouble Area
P0705	A. Any 2 or more of the following signals are on simultaneously (2 trip detection logic): • P input signal is on. • N input signal is on. • R input signal is on. • D input signal is on. B. Any of the following conditions is met for 2.0 seconds or more in the S position (2 trip detection logic): • NSW input signal is on. • P input signal is on. • N input signal is on. • R input signal is on. C. All switches are off simultaneously for NSW, P, R, N and D. (2 trip detection logic)	• Open or short in park/neutral position switch circuit • Short in park/neutral position switch assembly • Open or short in transmission control switch circuit • Shift lock control unit assembly • ECM

MONITOR DESCRIPTION

This DTC indicates a problem with the park/neutral position switch assembly and the wire harness in the park/neutral position switch circuit.

The park/neutral position switch assembly detects the shift lever position and sends a signal to the ECM.

For security, the park/neutral position switch assembly detects the shift lever position so that the engine can be

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started only when the shift lever is in P or N.

The park/neutral position switch assembly sends a signal to the ECM according to the shift lever position (P, R, N, D, or S). The ECM determines that there is a problem with the switch or related parts if it receives more than 1 position signal simultaneously. The ECM will turn on the MIL and store the DTC.

MONITOR STRATEGY

MONITOR STRATEGY CHART

Related DTCs	P0705: Park/Neutral Position Switch/Verify Switch Input
Required Sensors/Components	Park/neutral position switch
Frequency of Operation	Continuous
Duration	Condition (A) and (B): 2 seconds Condition (C): 60 seconds
MIL Operation	2 driving cycles
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

All

TYPICAL ENABLING CONDITIONS CHART

Monitor runs whenever following DTCs not present	None
Ignition switch	ON
Battery voltage	10.5 V or more
Starter	OFF

Condition (B)

TYPICAL ENABLING CONDITIONS CHART

One of the following conditions is met:	Condition (a), (b), (c) or (d)
(a) Park/neutral position switch	ON
(b) Park position switch	ON
(c) Neutral position switch	ON
(d) R range position switch	ON

TYPICAL MALFUNCTION THRESHOLDS

1. **One of the Following Conditions is Met: Condition (A), (B) and (C)**

   Condition (A)

   TYPICAL MALFUNCTION THRESHOLDS CHART

Number of the following signal input at the same time	2 or more
Park position switch	ON

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Neutral position switch	ON
Park/neutral position switch	ON
R range position switch	ON
D range position switch	ON

Condition (B)

TYPICAL MALFUNCTION THRESHOLDS CHART

"S" switch	ON

Condition (C)

TYPICAL MALFUNCTION THRESHOLDS CHART

All of the following conditions are met	-
Park position switch	OFF
Neutral position switch	OFF
Park neutral position switch	OFF
R range position switch	OFF
D range position switch	OFF

COMPONENT OPERATING RANGE

COMPONENT OPERATING RANGE CHART

Park/neutral position switch	The park/neutral position switch sends only one signal to the ECM.

CONFIRMATION DRIVING PATTERN

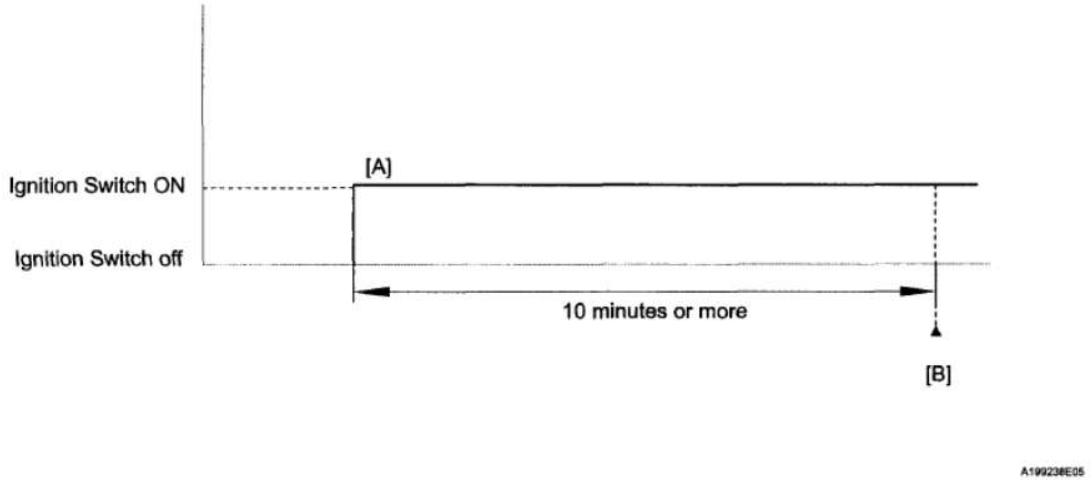


Fig. 219: Confirmation Driving Pattern
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

1. Connect Techstream to the DLC3.

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2. Turn the ignition switch to ON and turn the Techstream on.
3. Clear the DTCs (even if no DTCs are stored, perform the clear the DTC procedure) (See **DTC CHECK/CLEAR**).
4. Turn the ignition switch off.
5. Turn the ignition switch to ON and turn the Techstream on [A].
6. Wait 10 minutes or more.
7. Enter the following menus: Powertrain/Engine/Utility/All Readiness.
8. Input the DTC: P0705.
9. Check the DTC judgment result [B].

TECHSTREAM DISPLAY DESCRIPTION

Techstream Display	Description
NORMAL	• DTC judgment completed • System normal
ABNORMAL	• DTC judgment completed • System abnormal
INCOMPLETE	• DTC judgment not completed • Perform driving pattern after confirming DTC enabling conditions
UNKNOWN	• Unable to perform DTC judgment • Number of DTCs which do not fulfill DTC preconditions has reached ECU's memory limit

HINT:

If the judgment result shows ABNORMAL, the system has a malfunction.

10. If the test result is UNKNOWN, enter the following menus: Powertrain/Engine/Trouble Codes/Pending.
11. Read Pending DTCs.

HINT:

If a pending DTC is output, the system is malfunctioning.

12. If the test result is INCOMPLETE or UNKNOWN and no pending DTC is output, perform a universal trip and check for permanent DTCs (See **DTC CHECK/CLEAR**).

HINT:

- If a permanent DTC is output, the system is malfunctioning.
- If no permanent DTC is output, the system is normal.

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WIRING DIAGRAM

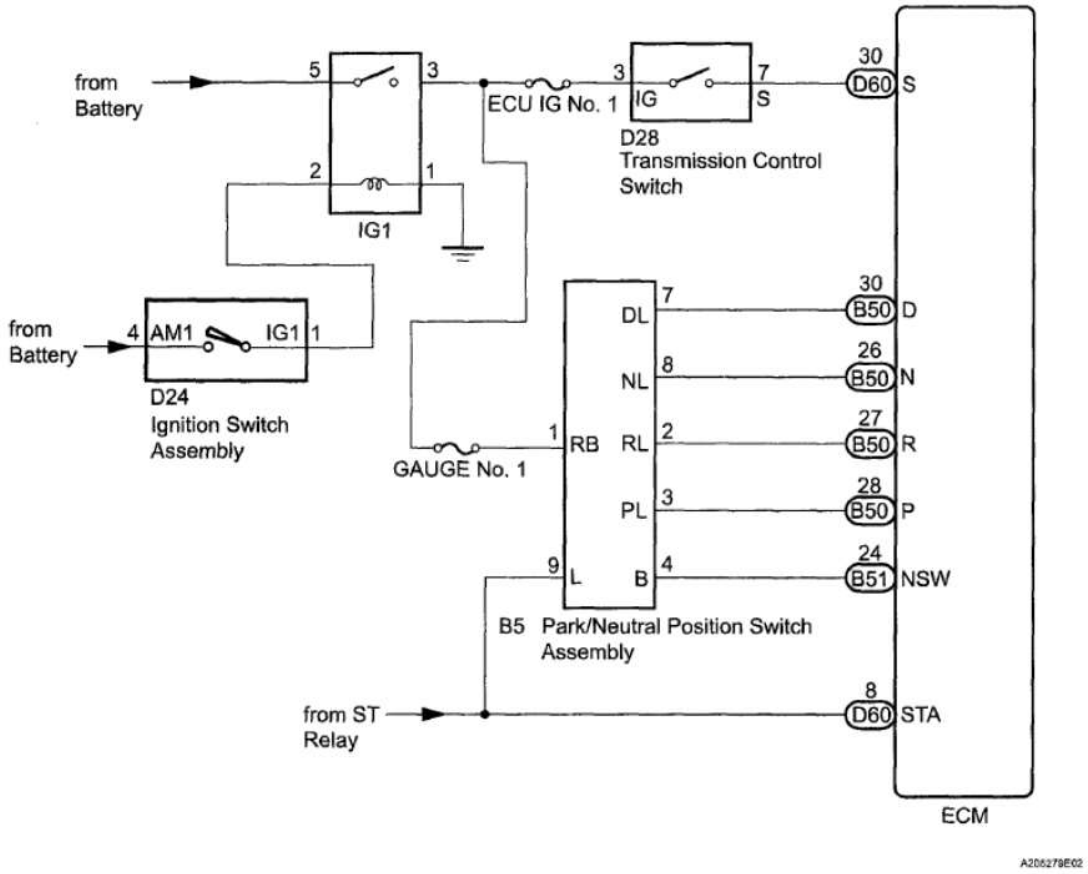


Fig. 220: Transmission Range Sensor Circuit Malfunction (PRNDL Input) - Wiring Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSPECTION PROCEDURE

NOTE: Inspect the fuses for circuits related to this system before performing the following inspection procedure.

HINT:

Using the Techstream to read the Data List allows the values or states of switches, sensor, actuators and other items to be read without removing any parts. This non-intrusive inspection can be very useful because intermittent conditions or signals may by discovered before parts or wiring is disturbed. Reading the Data List information early in troubleshooting is one way to save diagnostic time.

1. **DATA LIST**

NOTE: In the table below, the values listed under "Normal Condition" are reference values. Do not depend solely on these reference values when

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deciding whether a part is faulty or not.

a. Warm up the engine.
b. Turn the ignition switch off.
c. Connect the Techstream to the DLC3.
d. Turn the ignition switch to ON.
e. Turn the Techstream on.
f. Enter the following menus: Powertrain/Engine/Data List/All Data.
g. Read the values displayed on the Techstream.

DIAGNOSTIC NOTE

Techstream Display	Measurement Item/Range	Normal Condition	Diagnostic Note
Shift SW Status (R Range)	Park/neutral position switch status: ON or OFF	• ON: Shift lever in R • OFF: Shift lever not in R	When shift lever position displayed on Techstream differs from actual position, adjustment of park/neutral position switch assembly or shift cable may be incorrect
Shift SW Status (P Range)	Park/neutral position switch status: ON or OFF	• ON: Shift lever in P • OFF: Shift lever not in P	When shift lever position displayed on Techstream differs from actual position, adjustment of park/neutral position switch assembly or shift cable may be incorrect
Shift SW Status (N Range)	Park/neutral position switch status: ON or OFF	• ON: Shift lever in N • OFF: Shift lever not in N	When shift lever position displayed on Techstream differs from actual position, adjustment of park/neutral position switch assembly or shift cable may be incorrect
Shift SW Status (D Range)	Park/neutral position switch status: ON or OFF	• ON: Shift lever in D or S • OFF: Shift lever not in D or S	When shift lever position displayed on Techstream differs from actual position, adjustment of park/neutral position switch assembly or shift cable may be incorrect
Sports Mode Selection SW	Sport Mode Select Switch Status: ON or OFF	• ON: Shift lever in S, "+" or "-" • OFF: Shift lever not in S, "+" or "-"	-

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1. **READ VALUE USING TECHSTREAM**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the Techstream on.
   d. Enter the following menus: Powertrain/Engine/Data List/All Data/All Data.
   e. Read the values displayed on the Techstream.

   OK

   TECHSTREAM DISPLAY CHART

Techstream Display	Shift Lever	Specified Condition
Neutral Position SW Signal	P or N	ON
	Except P or N	OFF
Shift SW Status (R Range)	R	ON
	Except R	OFF
Shift SW Status (P Range)	P	ON
	Except P	OFF
Shift SW Status (N Range)	N	ON
	Except N	OFF
Shift SW Status (D Range)	D or S	ON
	Except D or S	OFF

   NG: Go to step 4

   OK: Go to next step

2. **READ VALUE USING TECHSTREAM (SPORTS MODE SELECTION SW)**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the Techstream on.
   d. Enter the following menus: Powertrain/Engine/Data List/All Data/Sports Mode Selection SW.
   e. Read the values displayed on the Techstream.

   OK

   TECHSTREAM DISPLAY CHART

Techstream Display	Shift Lever	Specified Condition
Sports Mode Selection SW	S	ON
	Except S	OFF

   NG: Go to step 3

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OK: CHECK FOR INTERMITTENT PROBLEMS (See **CHECK FOR INTERMITTENT PROBLEMS**)

3. **INSPECT TRANSMISSION CONTROL SWITCH**
   a. Disconnect the transmission control switch connector.
   b. Measure the resistance according to the value(s) in the table below.

Standard Resistance

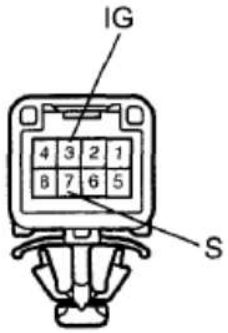
TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
3 (IG) - 7 (S)	Shift lever in S, "+" or "-"	Below 1 ohms
	Shift lever in any position other than S, "+" or "-"	10 kohms or higher

   c. Reconnect the transmission control switch connector.

NG: REPLACE SHIFT LOCK CONTROL UNIT ASSEMBLY (See **REMOVAL**)

Component without harness connected:
(Transmission Control Switch)



C168599E06

Fig. 221: Identifying Transmission Control Switch Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: REPAIR OR REPLACE HARNESS OR CONNECTOR (ECM - TRANSMISSION CONTROL SWITCH)

4. **CHECK HARNESS AND CONNECTOR (PARK/NEUTRAL POSITION SWITCH ASSEMBLY VOLTAGE)**
   a. Disconnect the park/neutral position switch assembly connector.
   b. Turn the ignition switch to ON.
   c. Measure the voltage according to the value(s) in the table below.

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Standard Voltage

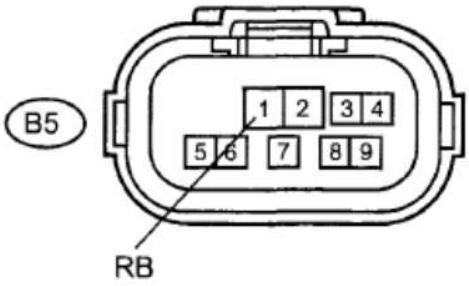
TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Switch Condition	Specified Condition
B5-1 (RB) - Body ground	Ignition switch ON	11 to 14 V

d. Reconnect the park/neutral position switch assembly connector.

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR (PARK/NEUTRAL POSITION SWITCH ASSEMBLY - BATTERY)

Front view of wire harness connector: (to park/Neutral Position Switch Assembly)



A205280E02

Fig. 222: Identifying Park/Neutral Position Switch Assembly Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

5. **INSPECT PARK/NEUTRAL POSITION SWITCH ASSEMBLY**
   a. Inspect the park/neutral position switch assembly (See **ADJUSTMENT**).

   NG: REPLACE PARK/NEUTRAL POSITION SWITCH ASSEMBLY (See **REMOVAL**)

   OK: Go to next step

6. **CHECK HARNESS AND CONNECTOR (ECM - PARK/NEUTRAL POSITION SWITCH ASSEMBLY)**
   a. Turn the ignition switch to ON.
   b. Measure the voltage according to the value(s) in the table below.

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Component with harness connected:
(ECM)

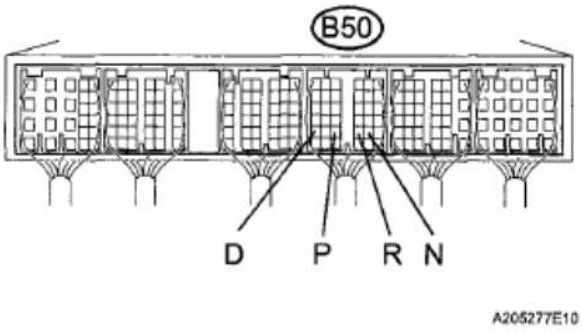


Fig. 223: Identifying ECM Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Standard Voltage

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
B50-28 (P) - Body ground	• Ignition switch ON • Shift lever in P	11 to 14 V
	• Ignition switch ON • Shift lever in any position other than P	0 to 1.5 V
B50-27 (R) - Body ground	• Ignition switch ON • Shift lever in R	11 to 14 V
	• Ignition switch ON • Shift lever in any position other than R	0 to 1.5 V
B50-26 (N) - Body ground	• Ignition switch ON • Shift lever in N	11 to 14 V
	• Ignition switch ON • Shift lever in any position other than N	0 to 1.5 V
B50-30 (D) - Body ground	• Ignition switch ON • Shift lever in D	11 to 14 V
	• Ignition switch ON • Shift lever in any position other than D	0 to 1.5 V

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR (ECM - PARK/NEUTRAL

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POSITION SWITCH ASSEMBLY)

OK: Go to next step

7. **CHECK HARNESS AND CONNECTOR (PARK/NEUTRAL POSITION SWITCH ASSEMBLY ECM)**
   a. Disconnect the park/neutral position switch assembly connector.
   b. Disconnect the ECM connector.
   c. Measure the resistance according to the value(s) in the table below.

Standard Resistance (Check for Open)

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
B5-4(B) - B51-24(NSW)	Always	Below 1 ohms

Standard Resistance (Check for Short)

TESTER CONNECTION SPECIFIED CONDITION CHART

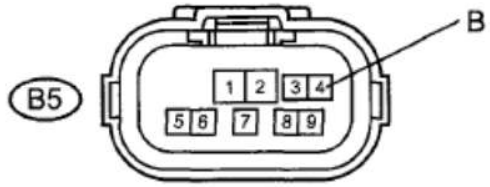
Tester Connection	Condition	Specified Condition
B5-4 (B) or B51-24 (NSW) - Body ground	Always	10 kohms or higher

   d. Reconnect the ECM connector.
   e. Reconnect the park/neutral position switch assembly connector.

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR (PARK/NEUTRAL POSITION SWITCH ASSEMBLY - ECM)

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Front view of wire harness connector: (to Park/Neutral Position Switch Assembly)



Rear view of wire harness connector: (to ECM)

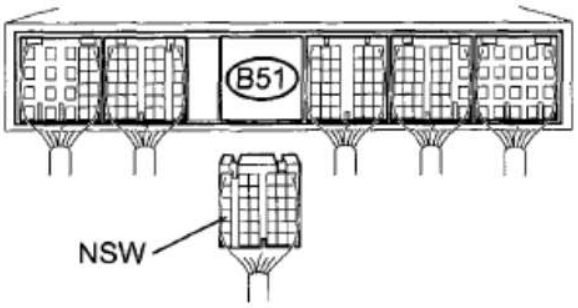


Fig. 224: Identifying ECM And Park/Neutral Position Switch Assembly Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: REPLACE ECM (See **REMOVAL**)

DTC P0724 BRAKE SWITCH "B" CIRCUIT HIGH

DESCRIPTION

The purpose of this circuit is to prevent the engine from stalling when brakes are suddenly applied while driving in lock-up condition.

When the brake pedal is depressed, the stop light switch sends a signal to the ECM. Then the ECM cancels the operation of the lock-up clutch while braking is in progress.

DTC DETECTION CONDITION CHART

DTC No.	DTC Detection Condition	Trouble Area

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P0724	The stop light switch remains on even when the vehicle repeats 5 cycles of STOP (less than 1.9 mph [3 km/h]) and GO (19 mph [30 km/h] or more) (2 trip detection logic).	• Short in stop light switch signal circuit • Stop light switch assembly • ECM

MONITOR DESCRIPTION

This DTC indicates that the stop light switch remains on. When the stop light switch remains on during "stop and go" driving, the ECM interprets this as a fault in the stop light switch. The ECM turns on MIL and stores the DTC. The vehicle must stop (less than 1.9 mph [3 km/h]) and go (19 mph [30 km/h] or more) 5 times during 2 driving cycles, in order to detect a malfunction.

MONITOR STRATEGY

MONITOR STRATEGY CHART

Related DTCs	P0724: Stop Light Switch/Range Check/Rationality
Required Sensors/Components (Main)	Stop light switch
Required Sensors/Components (Related)	Speed sensor
Frequency of Operation	Continuous
Duration	5 times
MIL Operation	2 driving cycles
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

The stop light switch remains ON during STOP and GO 5 times.

GO and STOP are Defined as Follows:

TYPICAL ENABLING CONDITIONS CHART

Monitor runs whenever following DTCs not stored	None
GO: Vehicle speed	19 mph (30 km/h) or more
STOP: Vehicle speed	Less than 1.86 mph (3 km/h)

TYPICAL MALFUNCTION THRESHOLDS

TYPICAL MALFUNCTION THRESHOLDS CHART

Stop light switch status	Stuck on

CONFIRMATION DRIVING PATTERN

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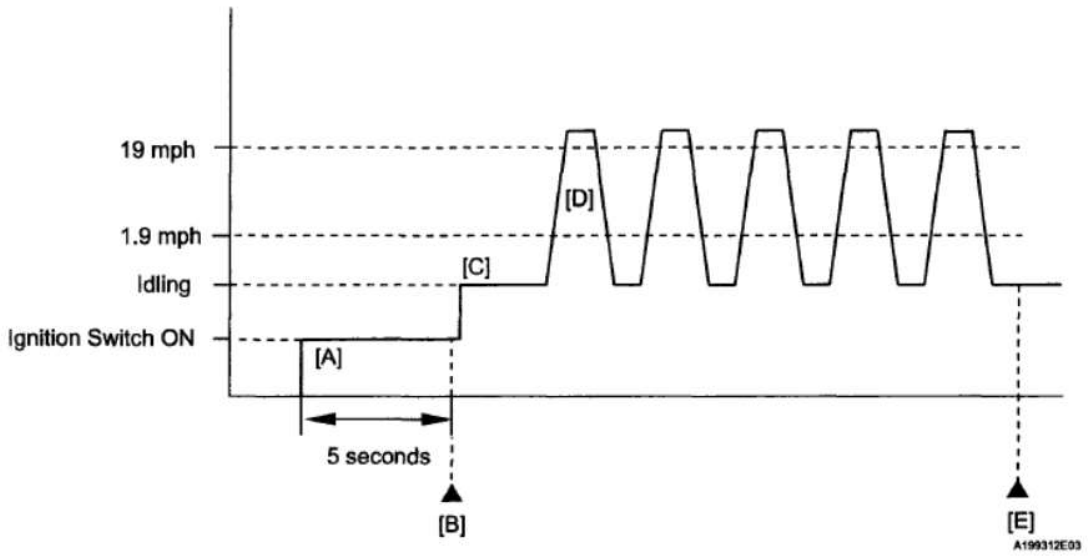


Fig. 225: Confirmation Driving Pattern
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

1. Connect the Techstream to the DLC3.
2. Turn the ignition switch to ON and turn the Techstream on.
3. Clear the DTCs (even if no DTCs are stored, perform the clear DTC procedure).
4. Turn the ignition switch off.
5. Turn the ignition switch to ON and turn the Techstream on [A].
6. Wait 5 seconds after clear DTCs.
7. Enter the following menus: Powertrain/Engine/Utility/All Readiness.
8. Input the DTC: P0724.
9. Check the DTC judgment result [B].

TECHSTREAM DISPLAY DESCRIPTION

Techstream Display	Description
NORMAL	• DTC judgment completed • System normal
ABNORMAL	• DTC judgment completed • System abnormal
INCOMPLETE	• DTC judgment not completed • Perform driving pattern after confirming DTC enabling conditions
UNKNOWN	• Unable to perform DTC judgment • Number of DTCs which do not fulfill DTC preconditions has reached ECU memory limit

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CAUTION: When performing the confirmation driving pattern, obey all speed limits and traffic laws.

HINT:

- If the judgment result shows ABNORMAL, the system has a malfunction.
- If the judgment result shows INCOMPLETE or UNKNOWN, perform steps [C] through [E].

10. Start the engine [C].
11. Accelerate the vehicle to 19 mph (30 km/h) or more, depress the brake pedal and decelerate the vehicle to 1.9 mph (3 km/h) or less [D]. Repeat step [D] 5 times.
12. Check the DTC judgment result [E].
13. If the test result is UNKNOWN, enter the following menus: Powertrain/Engine/Trouble Codes/Pending.
14. Read Pending DTCs.

    HINT:

    If a pending DTC is output, the system is malfunctioning.

15. If the test result is INCOMPLETE or UNKNOWN and no pending DTC is output, perform a universal trip and check for permanent DTCs (See **DTC CHECK/CLEAR**).

    HINT:

    - If a permanent DTC is output, the system is malfunctioning.
    - If no permanent DTC is output, the system is normal.

WIRING DIAGRAM

Refer to **DTC P0504** .

INSPECTION PROCEDURE

HINT:

Read freeze frame data using the Techstream. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.

NOTE: Inspect the fuses for circuits related to this system before performing the following inspection procedure.

1. **READ VALUE USING TECHSTREAM (STOP LIGHT SWITCH)**
   a. Connect the Techstream to the DLC3.

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b. Turn the ignition switch to ON.
c. Turn the Techstream on.
d. Enter the following menus: Powertrain/Engine/Data List/All Data/Stop Light Switch.
e. Read the values displayed on the Techstream.

OK

ITEM NORMAL CONDITION CHART

Item	Measurement Item/Range (display)	Normal Condition
Stop Light Switch	Stop light switch status: ON or OFF	• ON: Brake pedal depressed • OFF: Brake pedal released

NG: Go to step 2

OK: CHECK FOR INTERMITTENT PROBLEMS (See **CHECK FOR INTERMITTENT PROBLEMS**)

2. **INSPECT STOP LIGHT SWITCH ASSEMBLY**
   a. Inspect the stop light switch assembly (See **INSPECTION**).

   NG: REPLACE STOP LIGHT SWITCH ASSEMBLY (See **STOP LIGHT SWITCH**)

   OK: Go to next step

3. **CHECK HARNESS AND CONNECTOR (STOP LIGHT SWITCH - ECM)**
   a. Turn the ignition switch to ON.
   b. Measure the voltage according to the value(s) in the table below.

   Standard Voltage

   TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
D60-15 (ST1-) - Body ground	Brake pedal released	7.5 to 14 V
	Brake pedal depressed	Below 1.5 V
D60-20 (STP) - Body ground	Brake pedal released	Below 1.5 V
	Brake pedal depressed	7.5 to 14 V

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR

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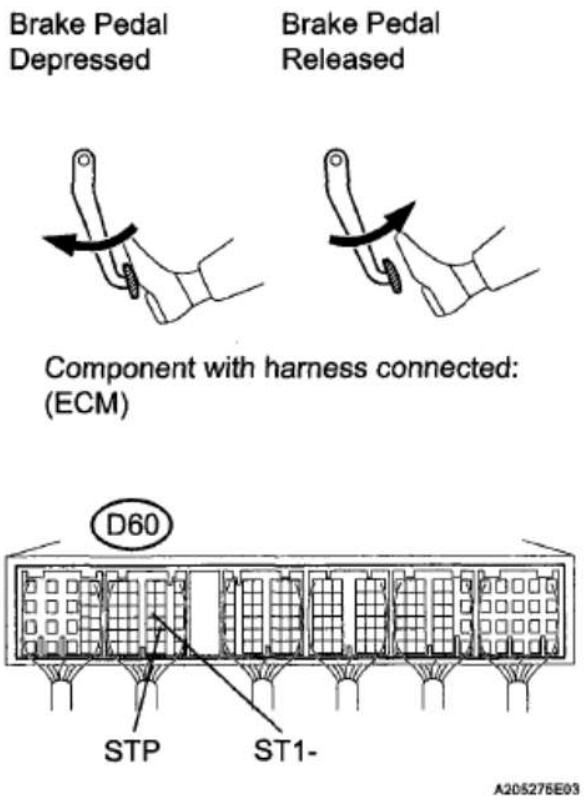


Fig. 226: Identifying Brake Pedal Depressed And Released Position
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: REPLACE ECM (See **REMOVAL**)

DTC P1607 CRUISE CONTROL INPUT PROCESSOR

MONITOR DESCRIPTION

The ECM continuously monitors its main and sub CPUs while cruise control is operating. This self-check ensures that the ECM is functioning properly. If outputs from the CPUs are different and deviate from the standard, the ECM illuminates the MIL and stores the DTC immediately.

DTC DETECTION CONDITION CHART

DTC No.	DTC Detection Condition	Trouble Area
P1607	An ECM internal error (1 trip detection logic)	ECM

MONITOR STRATEGY

MONITOR STRATEGY CHART

Related DTC	P1607: Internal Control Module Range Check
Required sensors/Components (Main)	ECM
Required sensors/Components (Related)	Cruise control

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Frequency of Operation	Continuous
Duration	0.3 seconds
MIL Operation	Immediate
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

TYPICAL ENABLING CONDITIONS CHART

Monitor runs whenever following DTCs not stored	None

TYPICAL MALFUNCTION THRESHOLDS

TYPICAL MALFUNCTION THRESHOLDS CHART

Cruise control	Prohibited
When either condition below is met:	-
Cruise control	Operating
Low speed control	Operating

CONFIRMATION DRIVING PATTERN

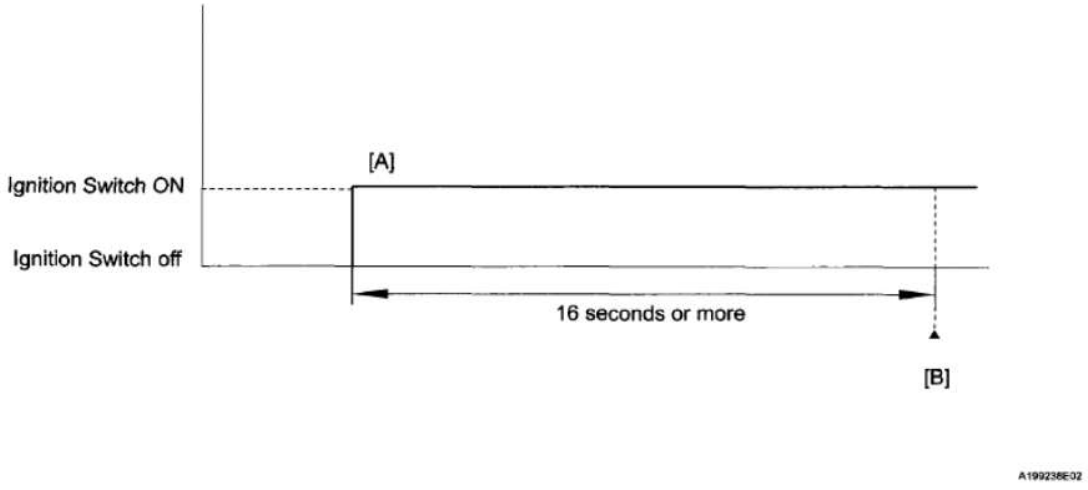


Fig. 227: Confirmation Driving Pattern
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

1. Connect the Techstream to the DLC3.
2. Turn the ignition switch to ON and turn the Techstream on.
3. Clear the DTCs (even if no DTCs are stored, perform the clear DTC procedure).
4. Turn the ignition switch off.
5. Turn the ignition switch to ON and turn the Techstream on [A].
6. Wait 16 seconds or more.
7. Enter the following menus: Powertrain/Engine/Utility/All Readiness.

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8. Input the DTC: P1607.
9. Check the DTC judgment result [B].

TECHSTREAM DISPLAY DESCRIPTION

Techstream Display	Description
NORMAL	• DTC judgment completed • System normal
ABNORMAL	• DTC judgment completed • System abnormal
INCOMPLETE	• DTC judgment not completed • Perform driving pattern after confirming DTC enabling conditions
UNKNOWN	• Unable to perform DTC judgment • Number of DTCs which do not fulfill DTC preconditions has reached ECU memory limit

HINT:

If the judgment result shows ABNORMAL, the system has a malfunction.

10. If the test result is UNKNOWN, enter the following menus: Powertrain/Engine/Trouble Codes/Pending.
11. Read Pending DTCs.

HINT:

If a pending DTC is output, the system is malfunctioning.

12. If the test result is INCOMPLETE or UNKNOWN and no pending DTC is output, perform a universal trip and check for permanent DTCs (See **DTC CHECK/CLEAR**).

HINT:

- If a permanent DTC is output, the system is malfunctioning.
- If no permanent DTC is output, the system is normal.

INSPECTION PROCEDURE

1. **READ OUTPUT DTC (DTC P1607)**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the Techstream on.
   d. Clear the DTC (See **DTC CHECK/CLEAR**).

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e. Turn the ignition switch off and turn the Techstream off.
f. Disconnect the Techstream.
g. Disconnect the cable from the negative (-) battery terminal and wait for 1 minute.
h. Connect the cable to the negative (-) battery terminal.
i. Connect the Techstream to the DLC3.
j. Turn the ignition switch to ON.
k. Turn the Techstream on.
l. Enter the following menus: Powertrain/Engine/Trouble Codes.
m. Read the DTCs.

Result

RESULT CHART

Result	Proceed to
DTC is not output	A
DTC P1607 is output	B

B: REPLACE ECM (See **REMOVAL**)

A: CHECK FOR INTERMITTENT PROBLEMS (See **CHECK FOR INTERMITTENT PROBLEMS**)

DTC P2004 INTAKE MANIFOLD RUNNER CONTROL STUCK OPEN (BANK 1); DTC P2006 INTAKE MANIFOLD RUNNER CONTROL STUCK CLOSED (BANK 1)

DESCRIPTION

The tumble control valve is built into the intake manifold. The tumble control valve is composed of a position sensor and a DC motor. The DC motor opens and closes the tumble control valve in response to signals from the ECM. The position sensor detects the opening angle of the tumble control valve. When the tumble control valve is closed, the intake air tumble flow intensifies and negative pressure is generated between the tumble control valve and intake valve which atomizes the fuel. Combustion is enhanced and exhaust gas emissions are reduced at low temperatures.

DTC DETECTION CONDITION CHART

DTC No.	DTC Detection Condition	Trouble Area
P2004 (Stuck open)	When the tumble control valve opening angle is 17° or more after requesting the tumble control valve to fully close (2 trip detection logic).	• DC Motor for tumble control valve circuit • DC Motor for tumble control valve • Tumble control valve position sensor • Tumble control valve
P2006 (Stuck closed)	When the tumble control valve opening angle is less than 35° after requesting the tumble control valve to fully open (2 trip detection logic).	

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		• ECM

HINT:

After confirming DTCs P2004 and/or P2006, use the Techstream to confirm the Intake Air Control Position while performing Control the IAC Duty Ratio of the Active Test.

Reference (Normal Condition):

IAC DUTY RATIO OPERATION CHART

Control the IAC Duty Ratio operation	Intake Air Control Position
100%	Approximately 70 deg
0%	Approximately 70 deg
-100%	Approximately 2 deg

Reference (Normal Condition):

ENGINE COOLANT TEMPERATURE REFERENCE

Engine Coolant Temperature and Intake Air Temperature at Engine Start	Intake Air Control Position
-10°C (14°F) or less	Approximately 70 deg
60°C (140°F) or higher	Approximately 70 deg
-10 to 60°C (14 to 140°F)	Approximately 2 deg

MONITOR DESCRIPTION

When the ECM has requested a tumble control valve close operation but the actual tumble control valve opening angle is 17° or more for 10 seconds, DTC P2004 is output. When the ECM has requested a tumble control valve open operation but the actual tumble control valve opening angle is less than 35° for 10 seconds, DTC P2006 is output.

MONITOR STRATEGY

MONITOR STRATEGY CHART

Related DTCs	P2004: Tumble Control Valve Stuck Open P2006: Tumble Control Valve Stuck Closed
Required Sensors/Components (Main)	Tumble control valve
Required Sensors/Components (Related)	Intake air temperature sensor, Engine coolant temperature sensor
Frequency of Operation	Once per driving cycle
Duration	Approximately 10 seconds
MIL Operation	2 driving cycles
Sequence Operation	None

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TYPICAL ENABLING CONDITIONS

All:

TYPICAL ENABLING CONDITIONS CHART

The monitor will run whenever these DTCs are not stored	None
Engine coolant temperature	-10°C (14°F) or higher
Intake air temperature	-10°C (14°F) or higher
Control valve half-open operation	Not operated
Ignition switch	ON
Control valve	Not operated by scan tool
Battery voltage during close operation	8 V or higher
When either condition below is met	Condition A or B
A. When both conditions below are met	-
Engine coolant temperature at engine start	5°C (41°F) or higher
Intake air temperature at engine start	5°C (41°F) or higher
B. When both conditions below are met	-
Engine coolant temperature	70°C (158°F) or higher
Vehicle speed	Less than 46 mph (75 km/h)

P2004:

TYPICAL ENABLING CONDITIONS CHART

Command to control valve	Closed

P2006:

TYPICAL ENABLING CONDITIONS CHART

Command to control valve	Open

TYPICAL MALFUNCTION THRESHOLDS

P2004:

TYPICAL MALFUNCTION THRESHOLDS CHART

Control valve angle	17° or more

P2006:

TYPICAL MALFUNCTION THRESHOLDS CHART

Control valve angle	Less than 35°

COMPONENT OPERATING RANGE

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COMPONENT OPERATING RANGE CHART

Control valve angle	0 to 70°

CONFIRMATION DRIVING PATTERN

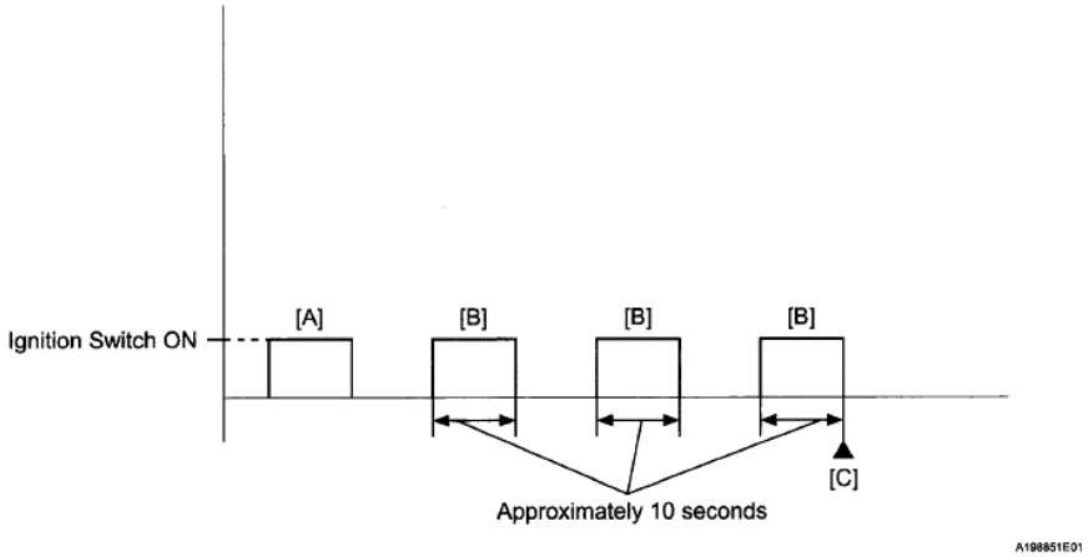


Fig. 228: Identifying Confirmation Driving Pattern
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

1. Connect the Techstream to the DLC3.
2. Turn the ignition switch to ON [A].
3. Turn the Techstream on.
4. Clear the DTCs.
5. Enter the following menus: Powertrain/Engine/Data List/All Data/Coolant Temp.

   HINT:

   - Check DTC P2004 at a coolant temperature of 30°C (86°F) or less.
   - Check DTC P2006 at a coolant temperature of 80°C (176°F) or higher.
6. Turn the ignition switch off.
7. Turn the ignition switch to ON, wait approximately 10 seconds, and then turn the ignition switch off. Repeat this procedure 3 times [B].
8. Enter the following menus: Powertrain/Engine/Utility/All readiness.
9. Input the DTC: P2004 or P2006.
10. Check the DTC judgment result [C].

TECHSTREAM DISPLAY DESCRIPTION

Techstream Display	Description

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NORMAL	• DTC judgment completed • System normal
ABNORMAL	• DTC judgment completed • System abnormal
INCOMPLETE	• DTC judgment not completed • Perform driving pattern after confirming DTC enabling conditions
UNKNOWN	• Unable to perform DTC judgment • Number of DTCs which do not fulfill DTC preconditions has reached ECU'S memory limit

HINT:

If the judgment result shows ABNORMAL, the system has a malfunction.

11. If the test result is UNKNOWN, enter the following menus: Powertrain/Engine/Trouble Codes/Pending.
12. Read Pending DTCs.

    HINT:

    If a pending DTC is output, the system is malfunctioning.

13. If the test result is INCOMPLETE or UNKNOWN and no pending DTC is output, perform a universal trip and check for permanent DTCs (See **DTC CHECK/CLEAR**).

    HINT:

    - If a permanent DTC is output, the system is malfunctioning.
    - If no permanent DTC is output, the system is normal.

WIRING DIAGRAM

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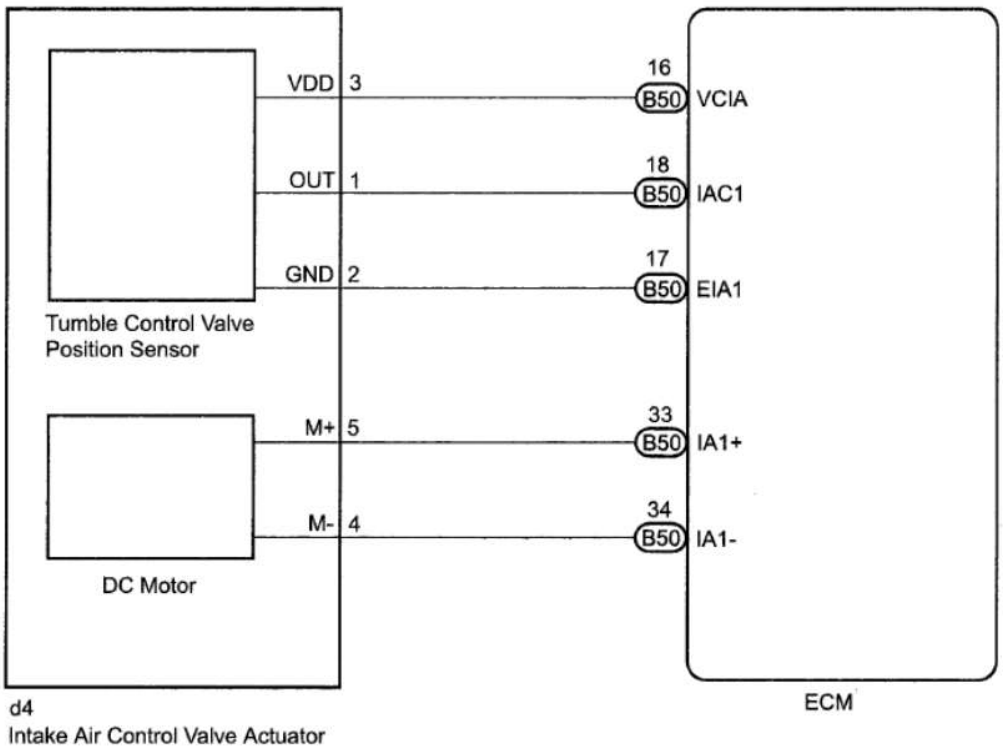


Fig. 229: Intake Manifold Runner Control Stuck Open (Bank 1) - Wiring Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSPECTION PROCEDURE

HINT:

Read freeze frame data using the Techstream. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1. **CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P2004 OR P2006)**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the Techstream on.
   d. Enter the following menus: Powertrain/Engine/Trouble Codes.
   e. Read the DTCs.

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Result

RESULT CHART

Result	Proceed to
DTC P2004 or P2006 is output	A
P2004 or P2006 and other DTCs are output	B

HINT:

If any DTCs other than P2004 or P2006 are output, troubleshoot those DTCs first.

B: GO TO **DTC CHART**

A: Go to next step

2. **INSPECT INTAKE AIR CONTROL VALVE ACTUATOR (FOR TUMBLE CONTROL VALVE)**
   a. Inspect the intake air control valve actuator (See **INSPECTION**).

   NG: REPLACE INTAKE AIR CONTROL VALVE ACTUATOR (FOR TUMBLE CONTROL VALVE) (See **INTAKE AIR CONTROL VALVE ACTUATOR (FOR TCV)**)

   OK: Go to next step

3. **INSPECT INTAKE MANIFOLD (TUMBLE CONTROL VALVE OPERATION)**
   a. Inspect the intake manifold (See **ON-VEHICLE INSPECTION**).

   NG: REPLACE INTAKE MANIFOLD (See **REMOVAL**)

   OK: Go to next step

4. **CHECK HARNESS AND CONNECTOR (ECM - INTAKE AIR CONTROL ACTUATOR)**
   a. Disconnect the ECM connector.
   b. Disconnect the intake air control valve actuator connector.
   c. Measure the resistance according to the value (s) in the table below.

   Standard Resistance (Check for Open)

   TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
B51-34 (IA1-) - d4-4 (M-)	Always	Below 1 ohms
B51-33 (IA1+) - d4-5 (M+)	Always	Below 1 ohms

   Standard Resistance (Check for Short)

   TESTER CONNECTION SPECIFIED CONDITION CHART

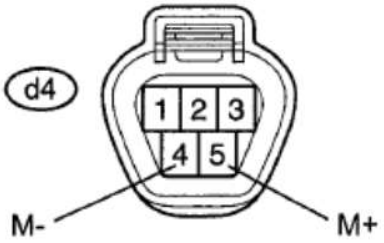
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Tester Connection	Condition	Specified Condition
B51-34 (IA1-) or d4-4 (M-) - Body ground	Always	10 kohms or higher
B51-33 (IA1+) or d4-5 (M+) - body ground	Always	10 kohms or higher

d. Reconnect the ECM connector.
e. Reconnect the intake air control valve actuator connector.

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR

Front view of wire harness connector:
(to Intake Air Control Valve Actuator)



Rear view of wire harness connector:
(to ECM)

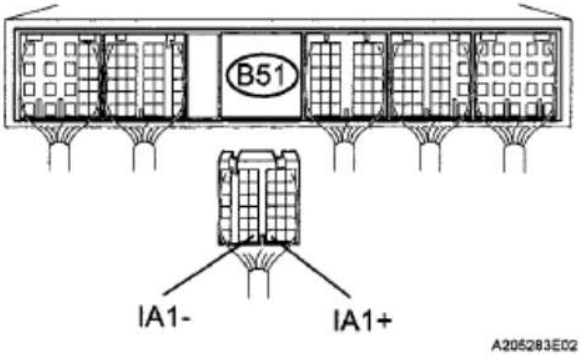


Fig. 230: Identifying ECM And Intake Air Control Valve Actuator Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

5. **CHECK WHETHER DTC OUTPUT RECURS (DTC P2004 OR P2006)**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch to ON.

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c. Turn the Techstream on.
d. Clear the DTCs.
e. Turn the ignition switch off.
f. Turn the ignition switch to ON and turn the Techstream on.
g. Drive the vehicle in accordance with the driving pattern described in the **CONFIRMATION DRIVING PATTERN**.
h. Enter the following menus: Powertrain/Engine/Trouble Codes/Pending.
i. Read the pending DTCs.

Result

RESULT CHART

Result	Proceed to
DTC P2004 or P2006 is output	A
DTC is not output	B

B: CHECK FOR INTERMITTENT PROBLEMS (See **CHECK FOR INTERMITTENT PROBLEMS**)

A: REPLACE ECM (See **REMOVAL**)

DTC P2009 INTAKE MANIFOLD RUNNER CONTROL CIRCUIT LOW (BANK 1); DTC P2010 INTAKE MANIFOLD RUNNER CONTROL CIRCUIT HIGH (BANK 1)

DESCRIPTION

The ECM activates the DC motor for the tumble control valve, which opens and closes the tumble control valve. The ECM activates the DC motor based on engine speed, coolant temperature, intake air temperature and other conditions.

DTC DETECTION CONDITION CHART

DTC No.	DTC Detection Condition	Trouble Area
P2009	Both of the following conditions continue for 1 second (1 trip detection logic): a. The output duty of the DC motor for the tumble control valve is 100%. b. The current of the DC motor for the tumble control valve is below 0.35 A.	• Open or short in DC motor for tumble control valve circuit • Intake manifold (DC motor for tumble control valve) • ECM
P2010	Either of the following conditions continues for 6 times or more (1 trip detection logic): a. The motor drive IC is overcurrent.	

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	b. The motor drive IC overheats.	

MONITOR DESCRIPTION

When the voltage of the DC motor deviates from the standard range, the ECM determines that a malfunction has occurred and outputs a DTC.

MONITOR STRATEGY

MONITOR STRATEGY CHART

Related DTCs	P2009: DC Motor for Tumble Control Valve Range Check (Low Current) P2010: DC Motor for Tumble Control Valve Range Check (High Current)
Required Sensors/Components (Main)	Tumble control valve (actuator)
Required Sensors/Components (Related)	None
Frequency of Operation	Continuous
Duration	DC motor for tumble control valve range check (low current): 1 second DC motor for tumble control valve range check (high current): 6 times
MIL Operation	Immediate
Sequence Operation	None

TYPICAL ENABLING CONDITIONS

P2009:

TYPICAL ENABLING CONDITIONS CHART

The monitor will run whenever these DTCs are not stored	None
Battery voltage	8 V or higher
Starter	OFF
Output signal duty	100%
Difference between motor current and previous motor current	Below 0.2 A

P2010:

TYPICAL ENABLING CONDITIONS CHART

The monitor will run whenever these DTCs are not stored	None
Battery voltage	8 V or higher
Starter	OFF

TYPICAL MALFUNCTION THRESHOLDS

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P2009:

TYPICAL MALFUNCTION THRESHOLDS CHART

DC motor for tumble control valve current	Below 0.35 A

P2010:

TYPICAL MALFUNCTION THRESHOLDS CHART

Motor drive IC high current limiter port	Fail

COMPONENT OPERATING RANGE

P2009:

COMPONENT OPERATING RANGE CHART

DC motor for tumble control valve current	0.35 A or more

P2010:

COMPONENT OPERATING RANGE CHART

Motor drive IC high current limiter port	Pass

CONFIRMATION DRIVING PATTERN

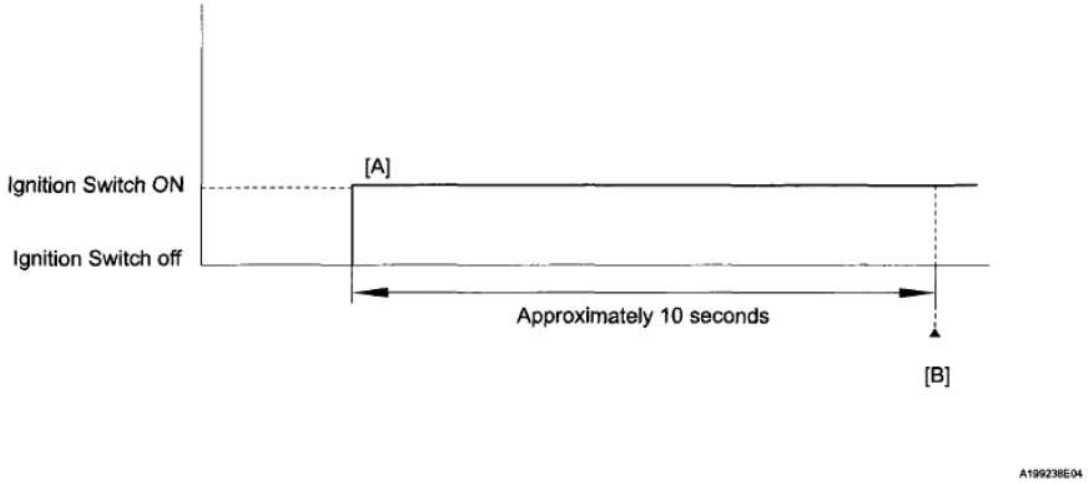


Fig. 231: Confirmation Driving Pattern
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

1. Connect the Techstream to the DLC3.
2. Turn the ignition switch to ON.
3. Turn the Techstream on.
4. Clear the DTCs.

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5. Turn the ignition switch off.
6. Turn the ignition switch to ON and turn the Techstream on.
7. Enter the following menus: Powertrain/Engine/Data List/All Data/Coolant Temp.
8. Check that the coolant temperature is 60°C (140°F) or higher.
9. Wait approximately 10 seconds [A].
10. Enter the following menus: Powertrain/Engine/Utility/All readiness.
11. Input the DTC: P2009 or P2010.
12. Check the DTC judgment result [B].

TECHSTREAM DISPLAY DESCRIPTION

Techstream Display	Description
NORMAL	• DTC judgment completed • System normal
ABNORMAL	• DTC judgment completed • System abnormal
INCOMPLETE	• DTC judgment not completed • Perform driving pattern after confirming DTC enabling conditions
UNKNOWN	• Unable to perform DTC judgment • Number of DTCs which do not fulfill DTC preconditions has reached ECU memory limit

HINT:

If the judgment result shows ABNORMAL, the system has a malfunction.

13. If the test result is UNKNOWN, enter the following menus: Powertrain/Engine/Trouble Codes/Pending.
14. Read Pending DTCs.

HINT:

If a pending DTC is output, the system is malfunctioning.

15. If the test result is INCOMPLETE or UNKNOWN and no pending DTC is output, perform a universal trip and check for permanent DTCs (See **DTC CHECK/CLEAR**).

HINT:

- If a permanent DTC is output, the system is malfunctioning.
- If no permanent DTC is output, the system is normal.

WIRING DIAGRAM

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Refer to **DTC P2004** .

INSPECTION PROCEDURE

HINT:

Read freeze frame data using the Techstream. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1. **INSPECT INTAKE AIR CONTROL VALVE ACTUATOR (FOR TUMBLE CONTROL VALVE)**
   a. Inspect the intake air control valve actuator (See **INSPECTION**).

   NG: REPLACE INTAKE AIR CONTROL VALVE ACTUATOR (FOR TUMBLE CONTROL VALVE) (See **INTAKE AIR CONTROL VALVE ACTUATOR (FOR TCV)**)

   OK: Go to next step

2. **INSPECT INTAKE MANIFOLD (TUMBLE CONTROL VALVE OPERATION)**
   a. Inspect the intake manifold (See **ON-VEHICLE INSPECTION**).

   NG: REPLACE INTAKE MANIFOLD (See **REMOVAL**)

   OK: Go to next step

3. **CHECK HARNESS AND CONNECTOR (ECM - INTAKE AIR CONTROL VALVE ACTUATOR)**
   a. Disconnect the ECM connector.
   b. Disconnect the intake air control valve actuator connector.
   c. Measure the resistance according to the value (s) in the table below.

   Standard Resistance (Check for Open):

   TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
B51-34 (IA1-) - d4-4 (M-)	Always	Below 1 ohms
B51-33 (IA1+) - d4-5 (M+)	Always	Below 1 ohms

   Standard Resistance (Check for Short):

   TESTER CONNECTION SPECIFIED CONDITION CHART

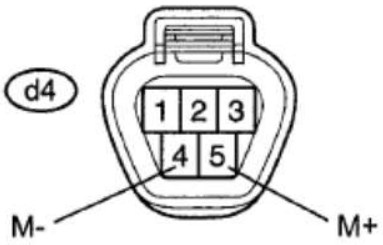
Tester Connection	Condition	Specified Condition
B51-34 (IA1-) or d4-4 (M-) - Body ground	Always	10 kohms or higher
B51-33 (IA1+) or d4-5 (M+) - body ground	Always	10 kohms or higher

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d. Reconnect the ECM connector.
e. Reconnect the intake air control valve actuator connector.

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR

Front view of wire harness connector:
(to Intake Air Control Valve Actuator)



Rear view of wire harness connector:
(to ECM)

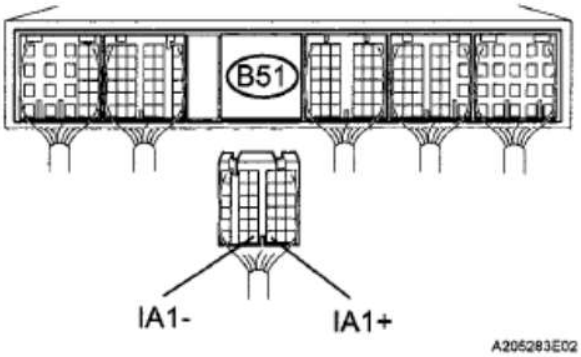


Fig. 232: Identifying ECM And Intake Air Control Valve Actuator Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

4. **CHECK WHETHER DTC OUTPUT RECURS (DTC P2009 OR P2010)**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the Techstream on.
   d. Clear the DTCs (See **DTC CHECK/CLEAR**).
   e. Turn the ignition switch off.

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f. Turn the ignition switch to ON and turn the Techstream on.
g. Drive the vehicle in accordance with the driving pattern described in the **CONFIRMATION DRIVING PATTERN**.
h. Enter the following menus: Powertrain/Engine/Trouble Codes.
i. Read the DTCs.

Result

RESULT CHART

Result	Proceed to
DTC P2009 or P2010 is output	A
DTC is not output	B

B: CHECK FOR INTERMITTENT PROBLEMS (See **CHECK FOR INTERMITTENT PROBLEMS**)

A: REPLACE ECM (See **REMOVAL**)

DTC P2014 INTAKE MANIFOLD RUNNER POSITION SENSOR/SWITCH CIRCUIT (BANK 1); DTC P2016 INTAKE MANIFOLD RUNNER POSITION SENSOR/SWITCH CIRCUIT LOW (BANK 1); DTC P2017 INTAKE MANIFOLD RUNNER POSITION SENSOR/SWITCH CIRCUIT HIGH (BANK 1)

DESCRIPTION

The tumble control valve position sensor is a non-contact type sensor.

The position sensor measures the opening angle of the tumble control valve. The sensor is reliable and accurate, as it is electrically controlled by Hall elements.

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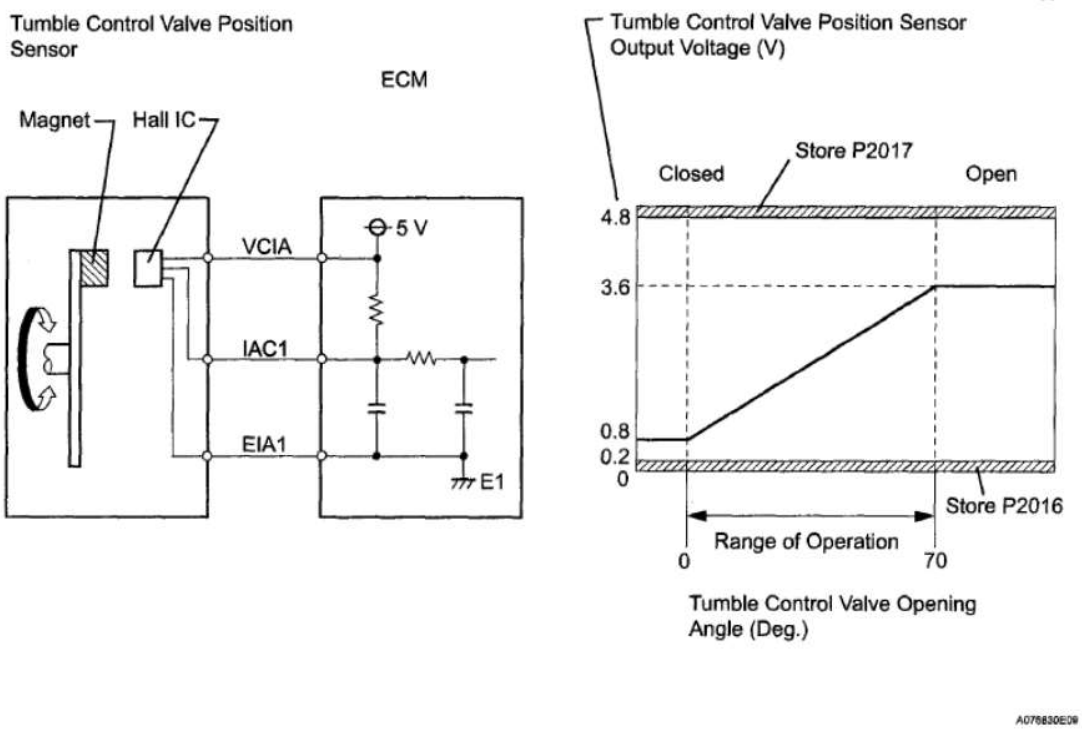


Fig. 233: Tumble Control Valve Position Sensor Circuit Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

DTC DETECTION CONDITION CHART

DTC No.	DTC Detection Connection	Trouble Area
P2014	The tumble control valve position sensor output voltage flutters up and down beyond the normal operating range (below 0.2 V or higher than 4.8 V) for more than 0.5 seconds (open or short) (1 trip detection logic).	• Open or short in tumble control valve position sensor circuit • Tumble control valve position sensor • ECM
P2016	The tumble control valve position sensor output voltage is below 0.2 V for more than 0.5 seconds (short) (1 trip detection logic).	
P2017	The tumble control valve position sensor output voltage is higher than 4.8 V for more than 0.5 seconds (open) (1 trip detection logic).	

HINT:

After confirming DTC P2014, P2016 or P2017, use the Techstream to confirm the IAC Sensor Voltage (tumble control valve position sensor output voltage). Enter the following menus: Powertrain/Engine/Data List/All Data/IAC Sensor Voltage.

IAC SENSOR VOLTAGE CHART

IAC Sensor Voltage	Malfunction
0.2 V or less	• IAC1 circuit shorted

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	• VCIA circuit open
4.8 V or higher	• VCIA and IAC1 circuit short-circuited • IAC1 circuit open • EIA1 circuit open

MONITOR DESCRIPTION

The ECM IAC1 terminal voltage increases in correlation with the opening angle of the tumble control valve. When the tumble control valve is fully closed, approximately 0.8 V is applied to the IAC1 terminal. When the tumble control valve is fully open, approximately 3.6 V is applied to the IAC1 terminal. When the output voltage of the IAC1 terminal deviates from the standard range, the ECM determines that a malfunction has occurred in the position sensor and stores a DTC. Refer to **ECM POWER SOURCE CIRCUIT** .

MONITOR STRATEGY

MONITOR STRATEGY CHART

Related DTCs	P2014: Tumble control valve position sensor range check (chattering) P2016: Tumble control valve position sensor range check (low voltage) P2017: Tumble control valve position sensor range check (high voltage)
Required Sensors/Components (Main)	Tumble control valve position sensor
Required Sensors/Components (Related)	None
Frequency of Operation	Continuous
Duration	0.5 seconds
MIL Operation	Immediate
Sequence Operation	None

TYPICAL ENABLING CONDITIONS

TYPICAL ENABLING CONDITIONS CHART

The monitor will run whenever these DTCs are not stored	None

TYPICAL MALFUNCTION THRESHOLDS

P2014:

TYPICAL MALFUNCTION THRESHOLDS CHART

Tumble control valve position sensor voltage	Below 0.2 V or higher than 4.8 V

P2016:

TYPICAL MALFUNCTION THRESHOLDS CHART

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Tumble control valve position sensor voltage	Below 0.2 V

P2017:

TYPICAL MALFUNCTION THRESHOLDS CHART

Tumble control valve position sensor voltage	Higher than 4.8 V

COMPONENT OPERATING RANGE

COMPONENT OPERATING RANGE CHART

Tumble control valve position sensor voltage	0.2 to 4.8 V

CONFIRMATION DRIVING PATTERN

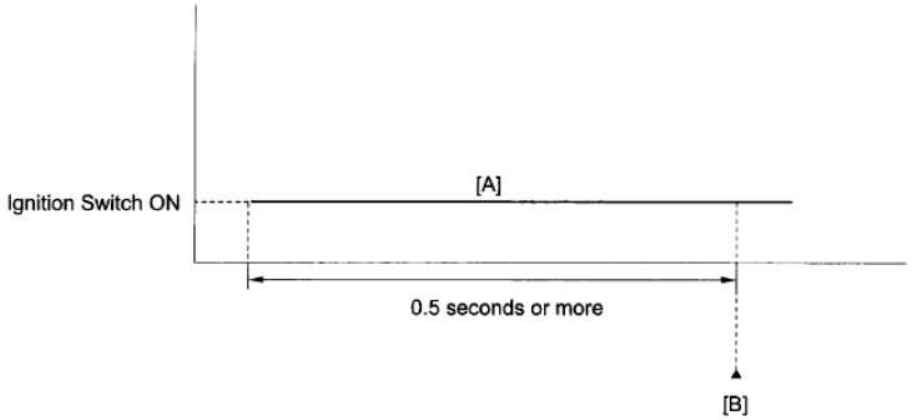


Fig. 234: Confirmation Driving Pattern
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

1. Connect the Techstream to the DLC3.
2. Turn the ignition switch to ON and turn the Techstream on.
3. Clear the DTCs.
4. Turn the ignition switch off.
5. Turn the ignition switch to ON and turn the Techstream on.
6. Allow 0.5 seconds or more to elapse [A].
7. Enter the following menus: Powertrain/Engine/Utility/All readiness.
8. Input the DTC: P2014, P2016 or P2017.
9. Check the DTC judgment result [B].

TECHSTREAM DISPLAY DESCRIPTION

Techstream	

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Display	Description
NORMAL	• DTC judgment completed • System normal
ABNORMAL	• DTC judgment completed • System abnormal
INCOMPLETE	• DTC judgment not completed • Perform driving pattern after confirming DTC enabling conditions
UNKNOWN	• Unable to perform • DTC judgment Number of DTCs which do not fulfill DTC preconditions has reached ECU memory limit

HINT:

If the judgment result shows ABNORMAL, the system has a malfunction.

10. If the test result is UNKNOWN, enter the following menus: Powertrain/Engine/Trouble Codes/Pending.
11. Read Pending DTCs.

HINT:

If a pending DTC is output, the system is malfunctioning.

12. If the test result is INCOMPLETE or UNKNOWN and no pending DTC is output, perform a universal trip and check for permanent DTCs (See **DTC CHECK/CLEAR**).

HINT:

- If a permanent DTC is output, the system is malfunctioning.
- If no permanent DTC is output, the system is normal.

WIRING DIAGRAM

Refer to **DTC P2004** .

INSPECTION PROCEDURE

HINT:

Read freeze frame data using the Techstream. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1. **PERFORM ACTIVE TEST USING TECHSTREAM (OPERATE TUMBLE CONTROL VALVE)**

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a. Connect the Techstream to the DLC3.
b. Turn the ignition switch to ON and turn the Techstream on.
c. Enter the following menus: Powertrain/Engine/Active Test/Control the IAC Duty Ratio/All Data/IAC Sensor Voltage.
d. Check the output voltage of IAC Sensor Voltage while changing Control the IAC Duty Ratio from -100 to 100% (or from 100 to -100%) using the Techstream.

OK:

The voltage output of IAC Sensor Voltage remains between 0.2 and 4.8 V while Control the IAC Duty Ratio is changed from -100 to 100% (or from 100 to -100%).

HINT:

IAC SENSOR VOLTAGE CHART

Control the IAC Duty Ratio operation	IAC Sensor Voltage (Normal)	Suspected Failure Area		
		• IAC1 circuit shorted • VCIA circuit open	• VCIA and IAC1 circuit short-circuited • IAC1 circuit open • EIA1 circuit open	• Sensor malfunction
-100%	0.2 to 1.0 V	Remain below 0.2 V	Remain higher than 4.8 V	Other than the voltage in the 2 columns on the left
100%	3.2 to 4.8 V	Remain below 0.2 V	Remain higher than 4.8 V	

NG: Go to step 3

OK: Go to next step

2. **CHECK WHETHER DTC OUTPUT RECURS (DTC P2014, P2016 AND/OR P2017 ARE OUTPUT AGAIN)**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch to ON and turn the Techstream on.
   c. Clear the DTCs (See **DTC CHECK/CLEAR**).
   d. Turn the ignition switch off.
   e. Turn the ignition switch to ON and turn the Techstream on.
   f. Enter the following menus: Powertrain/Engine/Trouble Codes.
   g. Read the DTCs.

   Result

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RESULT CHART

Result	Proceed to
P2014, P2016 and/or P2017 are output again	A
DTC is not output	B

B: CHECK FOR INTERMITTENT PROBLEMS (See **CHECK FOR INTERMITTENT PROBLEMS**)

A: REPLACE ECM (See **REMOVAL**)

3. **CHECK HARNESS AND CONNECTOR (INTAKE AIR CONTROL VALVE ACTUATOR - ECM)**
   a. Disconnect the ECM connector.
   b. Disconnect the intake air control valve actuator connector.
   c. Measure the resistance according to the value (s) in the table below.

Standard Resistance (Check for Open)

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
B50-16 (VCIA) - d4-3 (VDD)	Always	Below 1 ohms
B50-18 (IAC1) - d4-1 (OUT)	Always	Below 1 ohms
B50-17 (EIA1) - d4-2 (GND)	Always	Below 1 ohms

Standard Resistance (Check for Short)

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
B50-16 (VCIA) or d4-3 (VDD) - Body ground	Always	10 kohms or higher
B50-18 (IAC1) or d4-1 (OUT) - Body ground	Always	10 kohms or higher

   d. Reconnect the intake air control valve actuator connector.
   e. Reconnect the ECM connector.

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR

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Front view of wire harness connector:
(to Intake Air Control Valve Actuator)



Rear view of wire harness connector:
(to ECM)

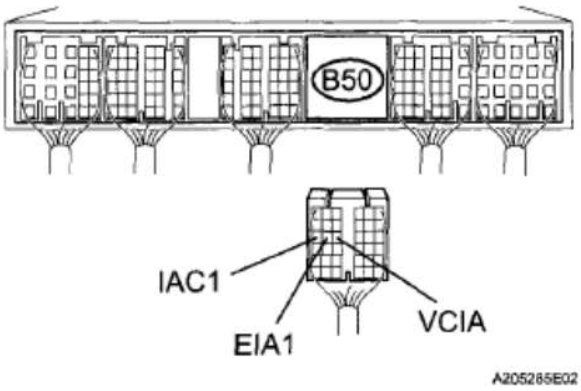


Fig. 235: Identifying Intake Air Control Valve Actuator And ECM Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

4. **INSPECT ECM (VCIA VOLTAGE)**
   a. Disconnect the intake air control valve actuator connector.
   b. Turn the ignition switch to ON.
   c. Measure the voltage according to the value (s) in the table below.

Standard Voltage

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Switch Condition	Specified Condition
d4-3 (VDD) - Body ground	Ignition switch ON	4.5 to 5.5 V

   d. Reconnect the intake air control valve actuator connector.

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NG: REPLACE ECM (See **REMOVAL**)

Front view of wire harness connector:
(to Intake Air Control Valve Actuator)



Fig. 236: Identifying Intake Air Control Valve Actuator Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

5. **REPLACE INTAKE AIR CONTROL VALVE ACTUATOR (FOR TUMBLE CONTROL VALVE)**
   a. Replace the intake air control valve actuator (See **INTAKE AIR CONTROL VALVE ACTUATOR (FOR TCV)**).
6. **CHECK WHETHER DTC OUTPUT RECURS (DTC P2014, P2016 AND/OR P2017 ARE OUTPUT AGAIN)**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch to ON and turn the Techstream on.
   c. Clear the DTCs (See **DTC CHECK/CLEAR**).
   d. Turn the ignition switch off.
   e. Turn the ignition switch to ON and turn the Techstream on.
   f. Enter the following menus: Powertrain/Engine/Trouble Codes.
   g. Read the DTCs.

Result

RESULT CHART

Result	Proceed to
P2014, P2016 and/or P2017 are output again	A
DTC is not output	B

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B: REPAIR COMPLETED

A: REPLACE ECM (See **REMOVAL**)

DTC P2102 THROTTLE ACTUATOR CONTROL MOTOR CIRCUIT LOW; DTC P2103 THROTTLE ACTUATOR CONTROL MOTOR CIRCUIT HIGH

DESCRIPTION

The throttle actuator is operated by the ECM and opens and closes the throttle valve using gears.

The opening angle of the throttle valve is detected by the throttle position sensor, which is mounted on the throttle body. The throttle position sensor provides feedback to the ECM. This feedback allows the ECM to appropriately control the throttle actuator and monitor the throttle opening angle as the ECM responds to driver inputs.

HINT:

This Electronic Throttle Control System (ETCS) does not use a throttle cable.

DTC DETECTION CONDITION CHART

DTC No.	DTC Detection Condition	Trouble Area
P2102	Both of the following conditions continue for 2.0 seconds (1 trip detection logic): a. The throttle actuator duty ratio is 80% or more. b. The throttle actuator current is below 0.5 A.	• Open in throttle actuator circuit • Throttle actuator • ECM
P2103	Either of the following conditions is met (1 trip detection logic): • A hybrid IC diagnosis signal failure. • A hybrid IC current limiter port failure.	• Short in throttle actuator circuit • Throttle actuator • Throttle valve • Throttle body • ECM

MONITOR DESCRIPTION

The ECM monitors the electrical current through the electronic actuator, and detects malfunctions and open circuits in the throttle actuator based on this value. If the current is outside the standard range, the ECM determines that there is a malfunction in the throttle actuator. In addition, if the throttle valve does not function properly (for example, stuck on), the ECM determines that there is a malfunction. The ECM then illuminates the MIL and stores a DTC.

Example:

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When the electrical current is below 0.5 A and the throttle actuator duty ratio exceeds 80%, the ECM interprets this as the current being outside the standard range, illuminates the MIL and stores a DTC. If the malfunction is not repaired successfully, a DTC is stored when the engine is quickly revved to a high rpm several times after the engine has idled for 5 seconds after engine start.

MONITOR STRATEGY

MONITOR STRATEGY CHART

Related DTCs	P2102: Throttle Actuator Current (Low Current) P2103: Throttle Actuator Current (High Current)
Required Sensors/Components (Main)	Throttle actuator (throttle body)
Required Sensors/Components (Related)	None
Frequency of Operation	Continuous
Duration	P2102: 2 seconds P2103: 0.6 seconds
MIL Operation	Immediate
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

TYPICAL ENABLING CONDITIONS CHART

Monitor runs whenever following DTCs not stored	None

P2102:

TYPICAL ENABLING CONDITIONS CHART

Throttle actuator	ON
Duty-cycle ratio to open throttle actuator	80% or more
Throttle actuator power supply	8 V or higher
Motor current change during last 0.016 seconds	Below 0.2 A

P2103:

TYPICAL ENABLING CONDITIONS CHART

Throttle actuator	ON
Either of the following conditions 1 or 2 is met:	-
1. Throttle actuator power supply	8 V or higher
2. Throttle actuator power	ON

TYPICAL MALFUNCTION THRESHOLDS

P2102:

TYPICAL MALFUNCTION THRESHOLDS CHART

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Throttle actuator current	Below 0.5 A

P2103:

TYPICAL MALFUNCTION THRESHOLDS CHART

Either of following conditions is met:	A or B
A. Hybrid IC diagnosis signal	Fail
B. Hybrid IC current limiter port	Fail

CONFIRMATION DRIVING PATTERN

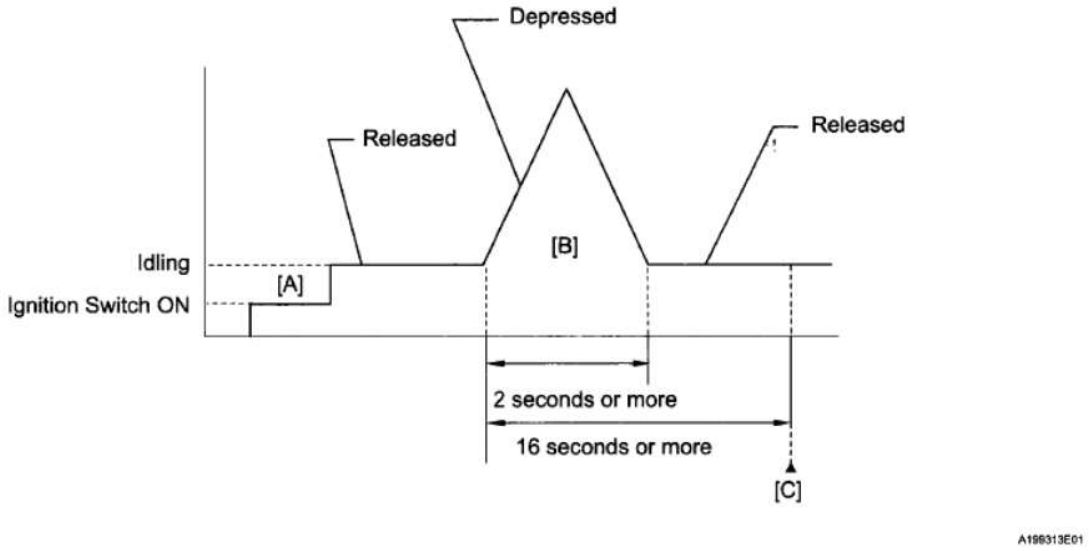


Fig. 237: Confirmation Driving Pattern
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

1. Connect the Techstream to the DLC3.
2. Turn the ignition switch to ON and turn the Techstream on.
3. Clear the DTCs (even if no DTCs are stored, perform the clear DTC procedure).
4. Turn the ignition switch off.
5. Turn the ignition switch to ON and turn the Techstream on [A].
6. Start the engine.
7. With the vehicle stationary, fully depress the accelerator pedal and quickly release it [B].
8. Check that 16 seconds or more have elapsed from the instant when the accelerator pedal is first depressed.
9. Enter the following menus: Powertrain/Engine/Utility/All Readiness.
10. Input the DTC: P2102 or P2103.
11. Check the DTC judgment result [C].

TECHSTREAM DISPLAY DESCRIPTION

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Techstream Display	Description
NORMAL	• DTC judgment completed • System normal
ABNORMAL	• DTC judgment completed • System abnormal
INCOMPLETE	• DTC judgment not completed • Perform driving pattern after confirming DTC enabling conditions
UNKNOWN	• Unable to perform DTC judgment • Number of DTCs which do not fulfill DTC preconditions has reached ECU memory limit

HINT:

- If the judgment result shows ABNORMAL, the system has a malfunction.
- If the judgment result shows INCOMPLETE or UNKNOWN, perform steps [B] through [C] again.

12. If the test result is UNKNOWN, enter the following menus: Powertrain/Engine/Trouble Codes/Pending.
13. Read Pending DTCs.

HINT:

If a pending DTC is output, the system is malfunctioning.

14. If the test result is INCOMPLETE or UNKNOWN and no pending DTC is output, perform a universal trip and check for permanent DTCs (See **DTC CHECK/CLEAR**).

HINT:

- If a permanent DTC is output, the system is malfunctioning.
- If no permanent DTC is output, the system is normal.

FAIL-SAFE

When either of these DTCs, as well as other DTCs relating to ETCS (Electronic Throttle Control System) malfunctions, is stored, the ECM enters fail-safe mode. During fail-safe mode, the ECM cuts the current to the throttle actuator, and the throttle valve is returned to a 6° throttle angle by the return spring. The ECM then adjusts the engine output by controlling the fuel injection (intermittent fuel-cut) and ignition timing, in accordance with the accelerator pedal opening angle, to allow the vehicle to continue running at a minimal speed. If the accelerator pedal is depressed firmly and gently, the vehicle can be driven slowly. Fail-safe mode continues until a pass condition is detected, and the ignition switch is then turned off.

WIRING DIAGRAM

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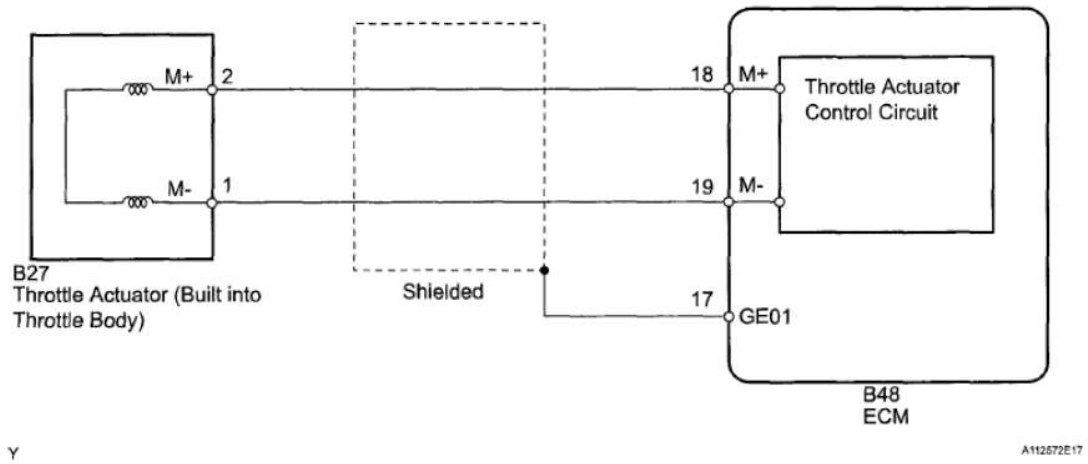


Fig. 238: Throttle Actuator Control Motor Circuit Low - Wiring Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSPECTION PROCEDURE

HINT:

Read freeze frame data using the Techstream. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1. **INSPECT THROTTLE BODY (RESISTANCE OF THROTTLE ACTUATOR)**
   a. Disconnect the throttle body connector.
   b. Measure the resistance according to the value (s) in the table below.

   Standard Resistance

   TESTER CONNECTION SPECIFIED CONDITION CHART

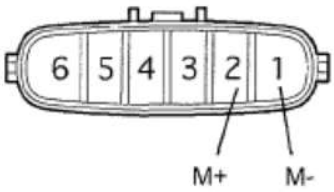
Tester Connection	Condition	Specified Condition
2 (M+) -1 (M-)	20°C (68°F)	0.3 to 100 ohms

   c. Reconnect the throttle body connector.

   NG: REPLACE THROTTLE BODY (See **REMOVAL**)

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Component without harness connected:
(Throttle Body)



A150305E04

Fig. 239: Identifying Throttle Body Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

2. **CHECK HARNESS AND CONNECTOR (THROTTLE BODY - ECM)**
   a. Disconnect the throttle body connector.
   b. Disconnect the ECM connector.
   c. Measure the resistance according to the value (s) in the table below.

Standard Resistance (Check for Open)

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
B27-2 (M+) - B48-18 (M+)	Always	Below 1 ohms
B27-1 (M-) - B48-19 (M-)	Always	Below 1 ohms

Standard Resistance (Check for Short)

TESTER CONNECTION SPECIFIED CONDITION CHART

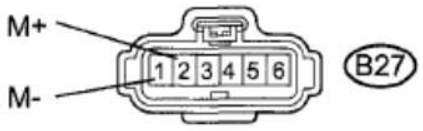
Tester Connection	Condition	Specified Condition
B27-2 (M+) or B48-18 (M+) - Body ground	Always	10 kohms or higher
B27-1 (M-) or B48-19 (M-) - Body ground	Always	10 kohms or higher

   d. Reconnect the ECM connector.
   e. Reconnect the throttle body connector.

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR

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Front view of wire harness connector:
(to Throttle Body)



Rear view of wire harness connector:
(to ECM)

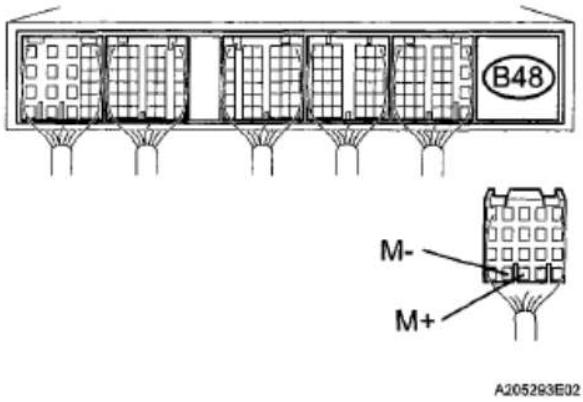


Fig. 240: Identifying ECM And Throttle Body Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

3. **INSPECT THROTTLE BODY (VISUALLY CHECK THROTTLE VALVE)**
   a. Check for foreign objects between the throttle valve and the housing.

   OK:

   No foreign objects between the throttle valve and housing.

   NG: REMOVE FOREIGN OBJECT AND CLEAN THROTTLE BODY

   OK: Go to next step

4. **INSPECT THROTTLE BODY (THROTTLE VALVE)**
   a. Check if the throttle valve opens and closes smoothly.

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OK:

Throttle valve opens and closes smoothly.

NG: REPLACE THROTTLE BODY (See **REMOVAL**)

OK: REPLACE ECM (See **REMOVAL**)

DTC P2111 THROTTLE ACTUATOR CONTROL SYSTEM - STUCK OPEN; DTC P2112 THROTTLE ACTUATOR CONTROL SYSTEM - STUCK CLOSED

DESCRIPTION

The throttle actuator is operated by the ECM, and opens and closes the throttle valve using gears. The opening angle of the throttle valve is detected by the throttle position sensor, which is mounted on the throttle body. The throttle position sensor provides feedback to the ECM. This feedback allows the ECM to appropriately control the throttle actuator and monitor the throttle opening angle as the ECM responds to driver inputs.

HINT:

This Electronic Throttle Control System (ETCS) does not use a throttle cable.

DTC DETECTION CONDITION CHART

DTC No.	DTC Detection Condition	Trouble Area
P2111	The ECM signals the throttle actuator to close, but the actuator is stuck (1 trip detection logic).	• Throttle actuator • Throttle body • Throttle valve • ECM
P2112	The ECM signals the throttle actuator to open, but the actuator is stuck (1 trip detection logic).	• Throttle actuator • Throttle body • Throttle valve • ECM

MONITOR DESCRIPTION

The ECM determines that there is a malfunction in the ETCS when the throttle valve remains at a fixed angle despite a high drive current from the ECM. The ECM illuminates the MIL and stores a DTC. If the malfunction is not repaired successfully, a DTC is stored when the accelerator pedal is fully depressed and released quickly (to fully open and close the throttle valve) after the engine is next started.

MONITOR STRATEGY

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MONITOR STRATEGY CHART

Related DTCs	P2111: Throttle Actuator Stuck Open P2112: Throttle Actuator Stuck Closed
Required Sensors/Components (Main)	Throttle actuator (throttle body)
Required Sensors/Components (Related)	-
Frequency of Operation	Continuous
Duration	0.5 seconds
MIL Operation	Immediate
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

All:

TYPICAL ENABLING CONDITIONS CHART

Monitor runs whenever following DTCs not stored	None

P2111 (Throttle Actuator Stuck Open):

TYPICAL ENABLING CONDITIONS CHART

All of following conditions are met:	-
System guard* judge condition	ON
Throttle actuator current	2 A or higher
Duty-cycle to close throttle	80% or more

P2112 (Throttle Actuator Stuck Closed):

TYPICAL ENABLING CONDITIONS CHART

All of following conditions are met:	-
System guard* judge condition	ON
Throttle actuator current	2 A or higher
Duty-cycle to open throttle	80% or more

TYPICAL ENABLING CONDITIONS CHART

*: System guard set when following conditions are met:	-
Throttle actuator	ON
Throttle actuator duty calculation	Executing
Throttle position sensor fail	Not detected
Throttle actuator current-cut operation	Not executing
Throttle actuator power supply	4 V or higher
Throttle actuator fail	Not detected

TYPICAL MALFUNCTION THRESHOLDS

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P2111 (Throttle Actuator Stuck Open):

TYPICAL MALFUNCTION THRESHOLDS CHART

Throttle position sensor voltage change	No change

P2112 (Throttle Actuator Stuck Closed):

TYPICAL MALFUNCTION THRESHOLDS CHART

Throttle position sensor voltage change	No change

CONFIRMATION DRIVING PATTERN

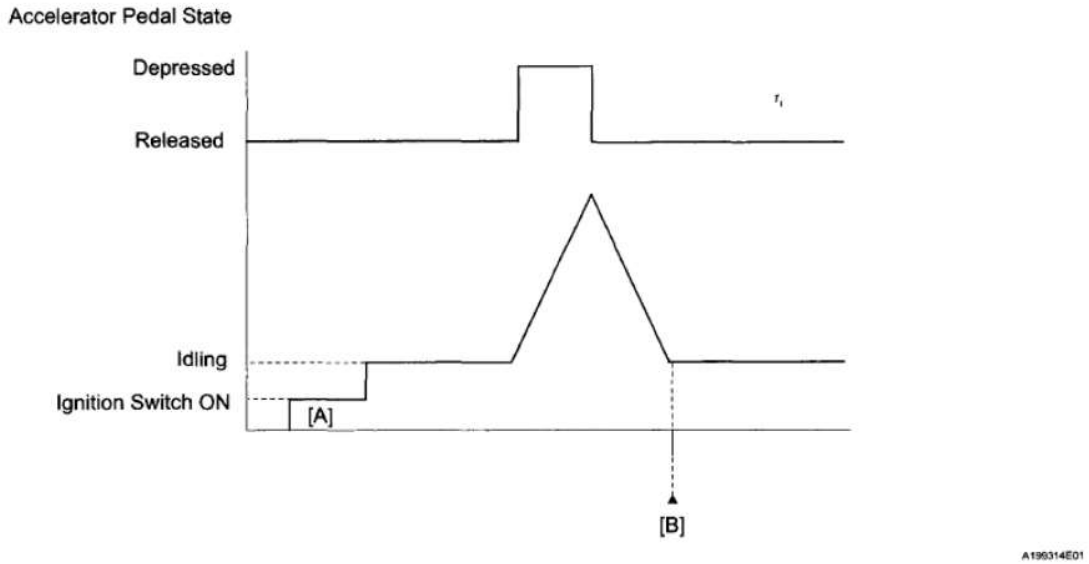


Fig. 241: Confirmation Driving Pattern
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

1. Connect the Techstream to the DLC3.
2. Turn the ignition switch to ON and turn the Techstream on.
3. Clear the DTCs (even if no DTCs are stored, perform the clear DTC procedure).
4. Turn the ignition switch off.
5. Turn the ignition switch to ON and turn the Techstream on [A].
6. Start the engine and fully depress and release the accelerator pedal quickly (to fully open and close the throttle valve).
7. Enter the following menus: Powertrain/Engine/Utility/All Readiness.
8. Input the DTC: P2111 or P2112.
9. Check the DTC judgment result [B].

TECHSTREAM DISPLAY DESCRIPTION

Techstream	

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Display	Description
NORMAL	• DTC judgment completed • System normal
ABNORMAL	• DTC judgment completed • System abnormal
INCOMPLETE	• DTC judgment not completed • Perform driving pattern after confirming DTC enabling conditions
UNKNOWN	• Unable to perform DTC judgment • Number of DTCs which do not fulfill DTC preconditions has reached ECU'S memory limit

HINT:

If the judgment result shows ABNORMAL, the system has a malfunction.

10. If the test result is UNKNOWN, enter the following menus: Powertrain/Engine/Trouble Codes/Pending.
11. Read Pending DTCs.

HINT:

If a pending DTC is output, the system is malfunctioning.

12. If the test result is INCOMPLETE or UNKNOWN and no pending DTC is output, perform a universal trip and check for permanent DTCs (See **DTC CHECK/CLEAR**).

HINT:

- If a permanent DTC is output, the system is malfunctioning.
- If no permanent DTC is output, the system is normal.

FAIL-SAFE

When either of these DTCs, as well as other DTCs relating to Electronic Throttle Control System (ETCS) malfunctions, is stored, the ECM enters fail-safe mode. During fail-safe mode, the ECM cuts the current to the throttle actuator, and the throttle valve is returned to a 6° throttle angle by the return spring. The ECM then adjusts the engine output by controlling the fuel injection (intermittent fuel-cut) and ignition timing, in accordance with the accelerator pedal opening angle, to allow the vehicle to continue running at a minimal speed. If the accelerator pedal is depressed firmly and gently, the vehicle can be driven slowly. Fail-safe mode continues until a pass condition is detected, and the ignition switch is then turned off.

WIRING DIAGRAM

Refer to **DTC P2102** .

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INSPECTION PROCEDURE

HINT:

Read freeze frame data using the Techstream. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1. **INSPECT THROTTLE BODY (VISUALLY CHECK THROTTLE VALVE)**
   a. Check for contamination between the throttle valve and the housing. If necessary, clean the throttle body. And check that the throttle valve moves smoothly.

   OK:

   Throttle valve is not contaminated with foreign objects and moves smoothly.

   NG: REPLACE THROTTLE BODY (See **REMOVAL**)

   OK: Go to next step

2. **CHECK WHETHER DTC OUTPUT RECURS (DTC P2111 OR P2112)**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the Techstream on.
   d. Clear the DTCs (See **DTC CHECK/CLEAR**).
   e. Turn the ignition switch off.
   f. Turn the ignition switch to ON and turn the Techstream on.
   g. Start the engine.
   h. Fully Depress and release the accelerator pedal quickly (to fully open and close the throttle valve).
   i. Enter the following menus: Powertrain/Engine/Trouble Codes.
   j. Read the DTCs.

   Result

   RESULT CHART

Result	Proceed to
DTC is not output	A
DTC P2111 or P2112 is output	B

   B: REPLACE ECM (See **REMOVAL**)

   A: CHECK FOR INTERMITTENT PROBLEMS (See **CHECK FOR INTERMITTENT PROBLEMS**)

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DTC P2118 THROTTLE ACTUATOR CONTROL MOTOR CURRENT RANGE/PERFORMANCE

DESCRIPTION

The electronic throttle control system has a dedicated power supply circuit. The voltage (+BM) is monitored and when it is low (below 4 V), the ECM determines that there is a malfunction in the electronic throttle control system and cuts off the current to the throttle actuator.

When the voltage becomes unstable, the electronic throttle control system itself becomes unstable. For this reason, when the voltage is low, the current to the throttle actuator is cut. If repairs are made and the system returns to normal, turn the ignition switch off. The ECM then allows the current to flow to the throttle actuator so that it can be restarted.

HINT:

The electronic throttle control system does not use a throttle cable.

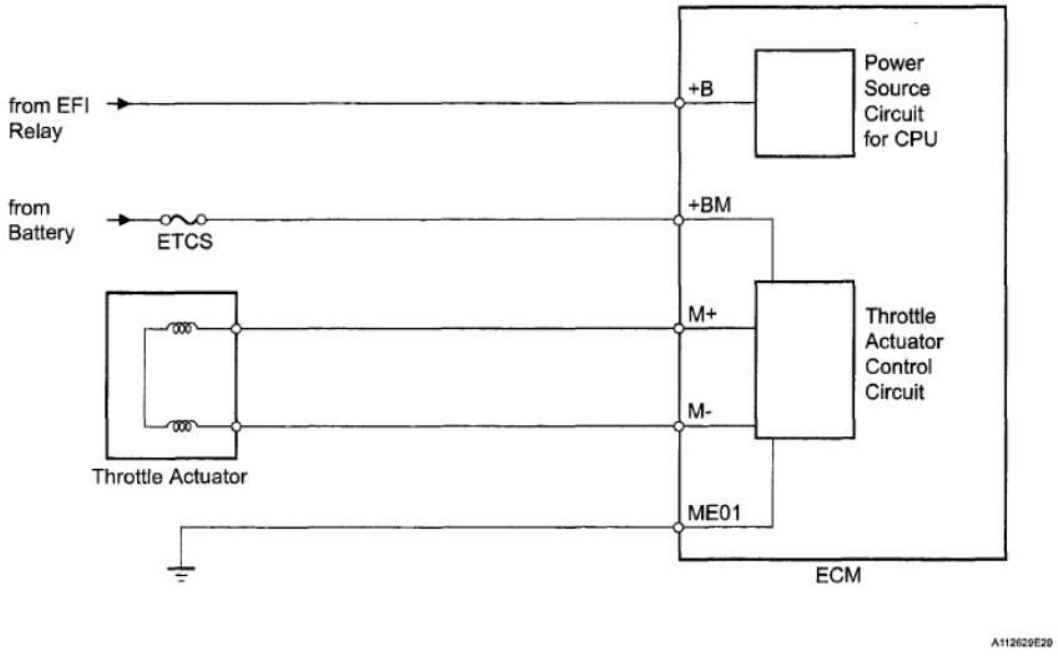


Fig. 242: Electronic Throttle Control System Communication Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

DTC DETECTION CONDITION CHART

DTC No.	DTC Detection Condition	Trouble Area
P2118	An open in the electronic throttle control system power source (+BM) circuit (1 trip detection logic).	• Open in electronic throttle control system power source circuit • Battery • Battery terminals

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		• ETCS fuse • ECM

MONITOR DESCRIPTION

The ECM monitors the battery supply voltage applied to the throttle actuator.

When the power supply voltage (+BM) drops below 4 V for 0.8 seconds or more, the ECM interprets this as an open in the power supply circuit (+BM). The ECM illuminates the MIL and stores the DTC.

If the malfunction is not repaired successfully, the DTC is stored 5 seconds after the engine is next started.

MONITOR STRATEGY

MONITOR STRATEGY CHART

Related DTCs	P2118: Throttle Actuator Power Supply
Required Sensors/Components (Main)	Throttle actuator, throttle valve (throttle body) ETCS fuse
Required Sensors/Components (Related)	None
Frequency of Operation	Continuous
Duration	0.8 seconds
MIL Operation	Immediate
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

TYPICAL ENABLING CONDITIONS CHART

Monitor runs whenever following DTCs not stored	None
Battery voltage	8 V or higher
Electronic throttle actuator power	ON

TYPICAL MALFUNCTION THRESHOLDS

TYPICAL MALFUNCTION THRESHOLDS CHART

Throttle actuator power supply voltage (+BM)	Below 4 V

COMPONENT OPERATING RANGE

COMPONENT OPERATING RANGE CHART

Throttle actuator power supply voltage (+BM)	11 to 14 V

CONFIRMATION DRIVING PATTERN

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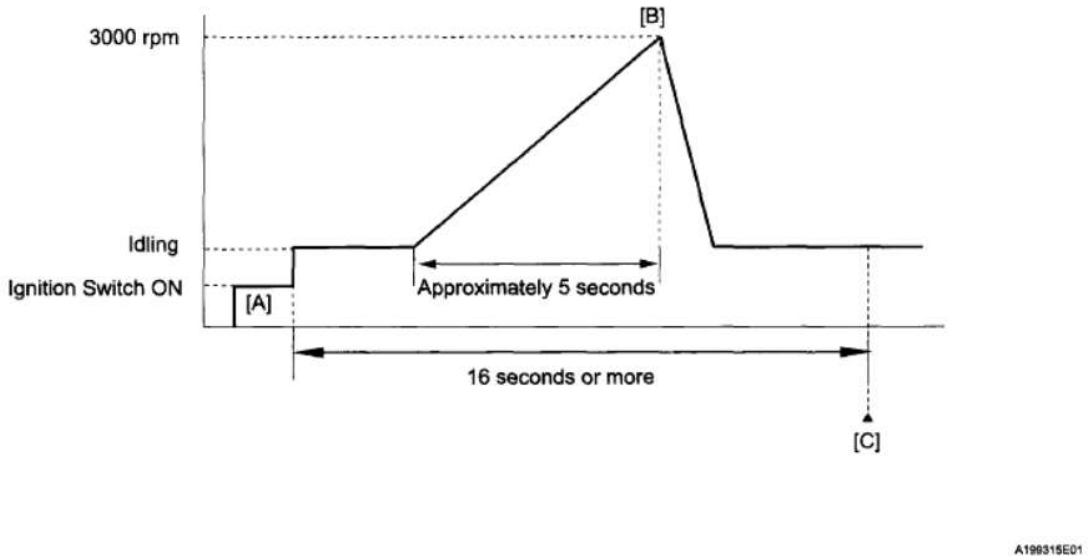


Fig. 243: Confirmation Driving Pattern
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

1. Connect the Techstream to the DLC3.
2. Turn the ignition switch to ON and turn the Techstream on.
3. Clear the DTCs (even if no DTCs are stored, perform the clear DTC procedure).
4. Turn the ignition switch off.
5. Turn the ignition switch to ON and turn the Techstream on [A].
6. Start the engine.
7. Slowly depress the accelerator pedal, raise the engine speed to approximately 3000 rpm for approximately 5 seconds, and then idle the engine [B].
8. Enter the following menus: Powertrain/Engine/Utility/All Readiness.
9. Input the DTC: P2118.
10. Check the DTC judgment result [C].

TECHSTREAM DISPLAY DESCRIPTION

Techstream Display	Description
NORMAL	• DTC judgment completed • System normal
ABNORMAL	• DTC judgment completed • System abnormal
INCOMPLETE	• DTC judgment not completed • Perform driving pattern after confirming DTC enabling conditions
UNKNOWN	• Unable to perform DTC judgment

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	• Number of DTCs which do not fulfill DTC preconditions has reached ECU memory limit

HINT:

- If the judgment result shows ABNORMAL, the system has a malfunction.
- If the judgment result shows INCOMPLETE or UNKNOWN, perform steps [B] and [C] again.

11. If the test result is UNKNOWN, enter the following menus: Powertrain/Engine/Trouble Codes/Pending.
12. Read Pending DTCs.

HINT:

If a pending DTC is output, the system is malfunctioning.

13. If the test result is INCOMPLETE or UNKNOWN and no pending DTC is output, perform a universal trip and check for permanent DTCs (See **DTC CHECK/CLEAR**).

HINT:

- If a permanent DTC is output, the system is malfunctioning.
- If no permanent DTC is output, the system is normal.

FAIL-SAFE

When this DTC or other DTCs relating to Electronic Throttle Control System (ETCS) malfunctions, are stored, the ECM enters fail-safe mode. During fail-safe mode, the ECM cuts the current to the throttle actuator, and the throttle valve is returned to a 6° throttle angle by the return spring. The ECM then adjusts the engine output by controlling the fuel injection (intermittent fuel-cut) and ignition timing, in accordance with the accelerator pedal opening angle, to allow the vehicle to continue at a minimal speed. If the accelerator pedal is depressed firmly and gently, the vehicle can be driven slowly. Fail-safe mode continues until a pass condition is detected, and the ignition switch is then turned off.

WIRING DIAGRAM

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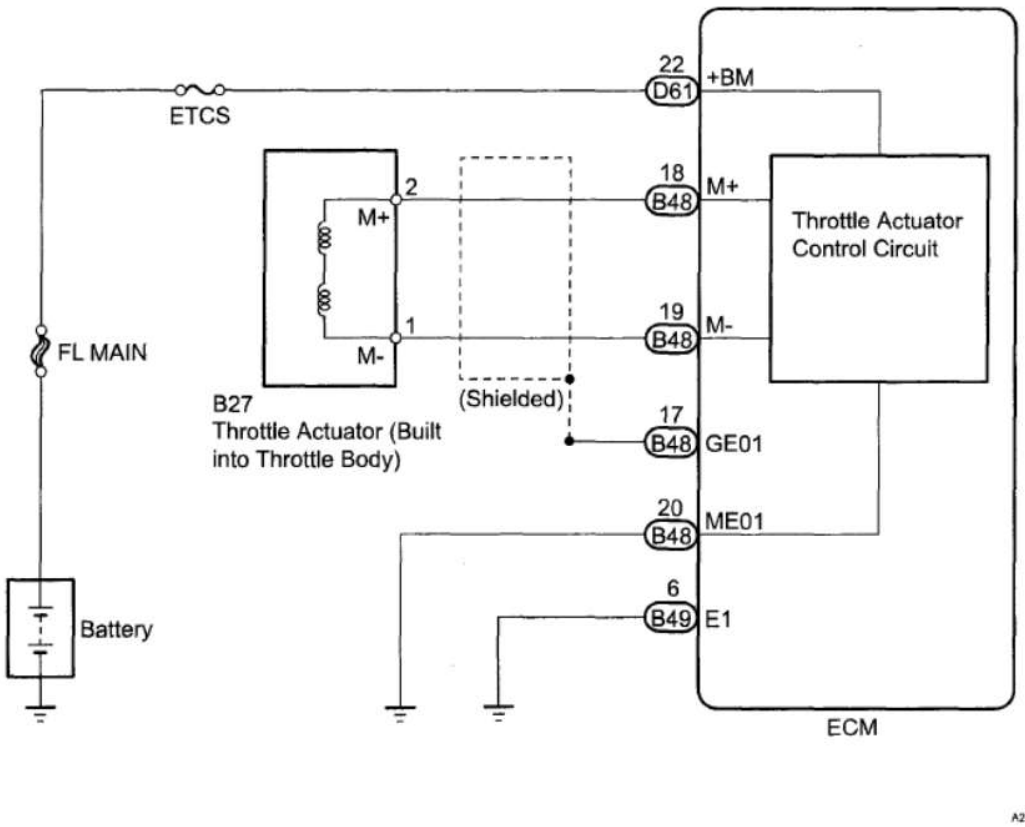


Fig. 244: Throttle Actuator Control Motor Current Range/Performance - Wiring Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSPECTION PROCEDURE

NOTE: Inspect the fuses for circuits related to this system before performing the following inspection procedure.

HINT:

Read freeze frame data using the Techstream. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1. **READ VALUE USING TECHSTREAM (+BM VOLTAGE)**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the Techstream on.
   d. Enter the following menus: Powertrain/Engine/Data List/All Data/+BM Voltage.
   e. Read the value displayed on the Techstream.

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Standard voltage:

11 to 14 V

NG: Go to step 2

OK: CHECK FOR INTERMITTENT PROBLEMS (See **CHECK FOR INTERMITTENT PROBLEMS**)

2. **CHECK HARNESS AND CONNECTOR (BATTERY - ECM, ECM - BODY GROUND)**
   a. Disconnect the ECM connectors.
   b. Measure the voltage according to the value (s) in the table below.

Standard Voltage

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
D61-22 (+BM) - Body ground	Always	11 to 14 V

   c. Measure the resistance according to the value (s) in the table below.

Standard Resistance (Check for Open)

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
B48-20 (ME01) - Body ground	Always	Below 1 ohms
B49-6 (E1) - Body ground	Always	Below 1 ohms

   d. Reconnect the ECM connectors.

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR

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Rear view of wire harness connector:
(to ECM)

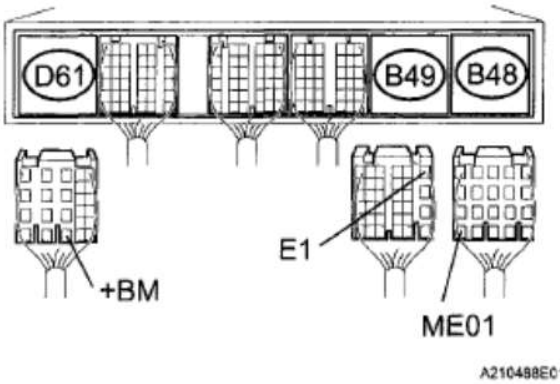


Fig. 245: Disconnecting ECM Connectors
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: REPLACE ECM (See **REMOVAL**)

DTC P2119 THROTTLE ACTUATOR CONTROL THROTTLE BODY RANGE/PERFORMANCE

DESCRIPTION

The electronic throttle control system is composed of the throttle actuator, throttle position sensor, accelerator pedal position sensor, and ECM. The ECM operates the throttle actuator to regulate the throttle valve in response to driver inputs. The throttle position sensor detects the opening angle of the throttle valve, and provides the ECM with feedback so that the throttle valve can be appropriately controlled by the ECM.

DTC DETECTION CONDITION CHART

DTC No.	DTC Detection Condition	Trouble Area
P2119	The throttle valve opening angle continues to vary greatly from the target opening angle (1 trip detection logic).	• Electronic throttle control system • ECM

MONITOR DESCRIPTION

The ECM determines the actual opening angle of the throttle valve from the throttle position sensor signal. The actual opening angle is compared to the target opening angle commanded by the ECM. If the difference between these two values is outside the standard range, the ECM interprets this as a malfunction in the electronic throttle control system. The ECM then illuminates the MIL and stores the DTC.

If the malfunction is not repaired successfully, the DTC is stored when the accelerator pedal is quickly released (to close the throttle valve) after the engine speed reaches 5000 rpm by fully depressing the accelerator pedal

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(fully open the throttle valve).

MONITOR STRATEGY

MONITOR STRATEGY CHART

Related DTCs	P2119: Electronic Throttle Control System Malfunction
Required Sensors/Components (Main)	Throttle actuator (throttle body)
Required Sensors/Components (Related)	-
Frequency of Operation	Continuous
Duration	Closed: 1 second Open: 0.6 seconds
MIL Operation	Immediate
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

TYPICAL ENABLING CONDITIONS CHART

Monitor runs whenever following DTCs not stored	None
System guard* judge condition	ON
*: System guard is on when the following conditions are met:	-
Throttle actuator	ON
Throttle actuator duty calculation	Executing
Throttle position sensor fail	Not detected
Throttle actuator current-cut operation	Not executing
Throttle actuator power supply	4 V or higher
Throttle actuator fail	Not detected

TYPICAL MALFUNCTION THRESHOLDS

TYPICAL MALFUNCTION THRESHOLDS CHART

Either of following conditions A or B is met	-
A. Commanded closed throttle position - current closed throttle position	0.3 V or higher
B. Commanded open throttle position - current open throttle position	0.3 V or higher

CONFIRMATION DRIVING PATTERN

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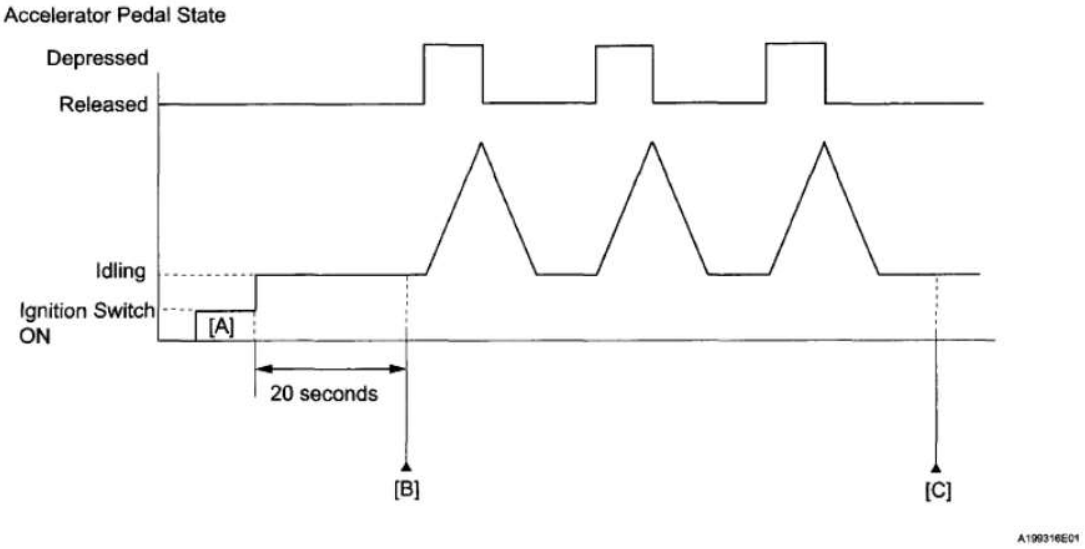


Fig. 246: Confirmation Driving Pattern
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

1. Connect the Techstream to the DLC3.
2. Turn the ignition switch to ON and turn the Techstream on.
3. Clear the DTCs (even if no DTCs are stored, perform the clear DTC operation).
4. Turn the ignition switch off.
5. Turn the ignition switch to ON and turn the Techstream on [A].
6. Start the engine.
7. Idle the engine for 20 seconds.
8. Enter the following menus: Powertrain/Engine/Utility/All Readiness.
9. Input the DTC: P2119.
10. Check the DTC judgment result [B].

TECHSTREAM DISPLAY DESCRIPTION

Techstream Display	Description
NORMAL	• DTC judgment completed • System normal
ABNORMAL	• DTC judgment completed • System abnormal
INCOMPLETE	• DTC judgment not completed • Perform driving pattern after confirming DTC enabling conditions
UNKNOWN	• Unable to perform DTC judgment • Number of DTCs which do not fulfill DTC preconditions has reached ECU memory limit

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HINT:

- If the judgment result shows ABNORMAL, the system has a malfunction.
- If the judgment result shows INCOMPLETE or UNKNOWN, fully depress and release the accelerator pedal 3 times, and then check the DTC judgment result at step [C].

11. If the test result is UNKNOWN, enter the following menus: Powertrain/Engine/Trouble Codes/Pending.
12. Read Pending DTCs.

    HINT:

    If a pending DTC is output, the system is malfunctioning.

13. If the test result is INCOMPLETE or UNKNOWN and no pending DTC is output, perform a universal trip and check for permanent DTCs (See **DTC CHECK/CLEAR**).

    HINT:

    - If a permanent DTC is output, the system is malfunctioning.
    - If no permanent DTC is output, the system is normal.

FAIL-SAFE

When this DTC, as well as other DTCs relating to Electronic Throttle Control System (ETCS) malfunctions, is stored, the ECM enters fail-safe mode. During fail-safe mode, the ECM cuts the current to the throttle actuator, and the throttle valve is returned to a 6° throttle angle by the return spring. The ECM then adjusts the engine output by controlling the fuel injection (intermittent fuel-cut) and ignition timing, in accordance with the accelerator pedal opening angle, to allow the vehicle to continue running at a minimal speed. If the accelerator pedal is depressed firmly and gently, the vehicle can be driven slowly. Fail-safe mode continues until a pass condition is detected, and the ignition switch is then turned off.

WIRING DIAGRAM

Refer to **DTC P2102** .

INSPECTION PROCEDURE

HINT:

Read freeze frame data using the Techstream. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1. **CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P2119)**
    a. Connect the Techstream to the DLC3.
    b. Turn the ignition switch to ON.

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c. Turn the Techstream on.
d. Enter the following menus: Powertrain/Engine/Trouble Codes.
e. Read the DTCs.

Result

RESULT CHART

Result	Proceed to
DTC P2119 is output	A
DTC P2119 and other DTCs are output	B

HINT:

If any DTCs other than P2119 are output, troubleshoot those DTCs first.

B: GO TO **DTC CHART**

A: Go to next step

2. **INSPECT THROTTLE BODY (RESISTANCE OF THROTTLE ACTUATOR)**
   a. Disconnect the throttle body connector.
   b. Measure the resistance according to the value (s) in the table below.

Standard Resistance

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
2 (M+) -1 (M-)	20°C (68°F)	0.3 to 100 ohms

   c. Reconnect the throttle body connector.

NG: REPLACE THROTTLE BODY (See **REMOVAL**)

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Component without harness connected:
(Throttle Body)

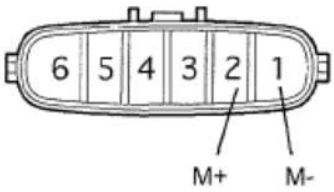


Fig. 247: Identifying Throttle Body Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

3. **REPLACE ECM**
   a. Replace the ECM (See **REMOVAL**).
4. **CHECK WHETHER DTC OUTPUT RECURS (DTC P2119)**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the Techstream on.
   d. Clear the DTCs (See **DTC CHECK/CLEAR**).
   e. Turn the ignition switch off.
   f. Turn the ignition switch to ON and turn the Techstream on.
   g. Start the engine.
   h. Allow the engine to idle for 15 seconds or more.
   i. Fully depress and release the accelerator pedal several times quickly.
   j. Enter the following menus: Powertrain/Engine/Trouble Codes.
   k. Read the DTCs.

Result

RESULT CHART

Result	Proceed to
DTC is not output	A
DTC P2119 is output	B

HINT:

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The output voltage of the throttle position sensor can be checked using the Techstream. Variations in the output voltage indicate that the throttle actuator is in operation. To check the output voltage using the Techstream, enter the following menus: Powertrain/Engine/ETCS/Throttle Position No. 1 and Throttle Position No. 2.

B: REPLACE THROTTLE BODY (See **REMOVAL**)

A: REPAIR COMPLETED

DTC P2120 THROTTLE/PEDAL POSITION SENSOR/SWITCH "D" CIRCUIT; DTC P2122 THROTTLE/PEDAL POSITION SENSOR/SWITCH "D" CIRCUIT LOW INPUT; DTC P2123 THROTTLE/PEDAL POSITION SENSOR/SWITCH "D" CIRCUIT HIGH INPUT; DTC P2125 THROTTLE/PEDAL POSITION SENSOR/SWITCH "E" CIRCUIT; DTC P2127 THROTTLE/PEDAL POSITION SENSOR/SWITCH "E" CIRCUIT LOW INPUT; DTC P2128 THROTTLE/PEDAL POSITION SENSOR/SWITCH "E" CIRCUIT HIGH INPUT; DTC P2138 THROTTLE/PEDAL POSITION SENSOR/SWITCH "D"/"E" VOLTAGE CORRELATION

DESCRIPTION

HINT:

- This Electronic Throttle Control System (ETCS) does not use a throttle cable.
- These DTCs relate to the accelerator pedal position sensor.

The accelerator pedal position sensor is mounted on the accelerator pedal bracket and has 2 sensor circuits: VPA (main) and VPA2 (sub). This sensor is a non-contact type sensor and uses Hall-effect elements in order to yield accurate signals even in extreme driving conditions, such as at high speeds as well as very low speeds. The voltage, which is applied to terminals VPA and VPA2 of the ECM, varies between 0.5 V and 4.5 V in proportion to the operating angle of the accelerator pedal (throttle valve). A signal from VPA indicates the actual accelerator pedal opening angle (throttle valve opening angle) and is used for engine control. A signal from VPA2 conveys the status of the VPA circuit and is used to check the accelerator pedal position sensor itself.

The ECM monitors the actual accelerator pedal opening angle (throttle valve opening angle) through the signals from VPA and VPA2, and controls the throttle actuator according to these signals.

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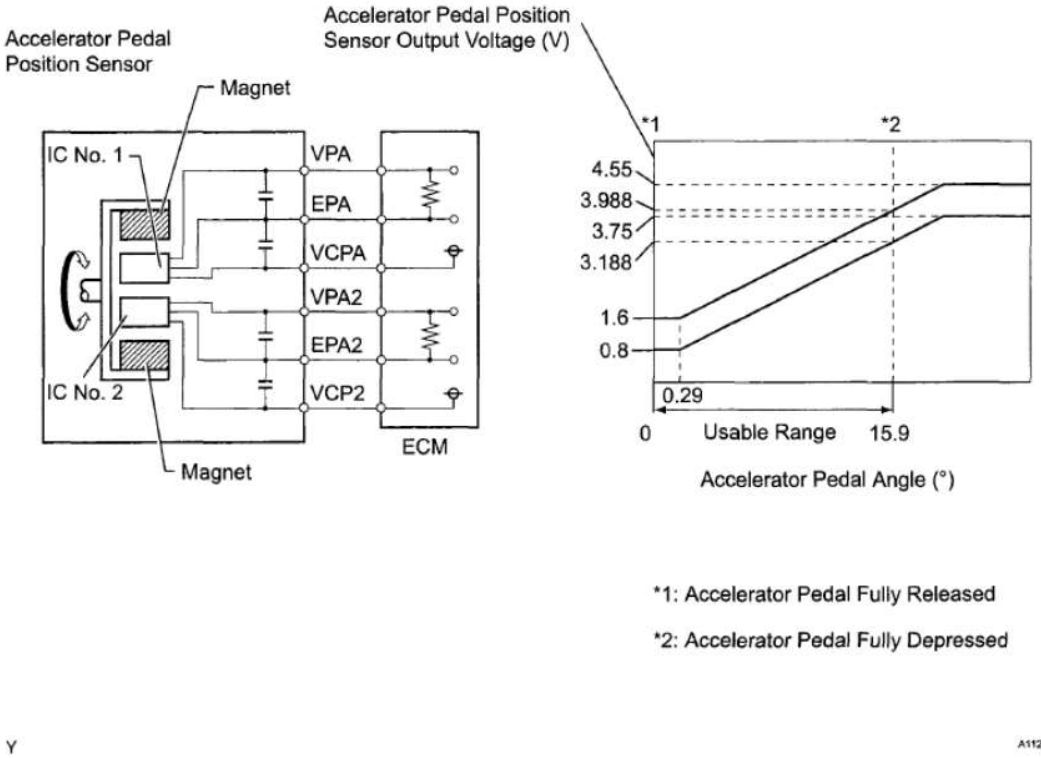


Fig. 248: Accelerator Pedal Position Sensor Circuit Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

DTC DETECTION CONDITION CHART

DTC No.	DTC Detection Condition	Trouble Area
P2120	VPA fluctuates rapidly beyond the upper and lower malfunction thresholds for 0.5 seconds or more (1 trip detection logic).	• Accelerator pedal position sensor • ECM
P2122	VPA is 0.4 V or less for 0.5 seconds or more when the accelerator pedal is depressed (1 trip detection logic).	• Accelerator pedal position sensor • Open in VCP1 circuit • Open or ground short in VPA circuit • ECM
P2123	VPA is 4.8 V or higher for 2.0 seconds or more (1 trip detection logic).	• Accelerator pedal position sensor • Open in EPA circuit • ECM
P2125	VPA2 fluctuates rapidly beyond the upper and lower malfunction thresholds for 0.5 seconds or more (1 trip detection logic).	• Accelerator pedal position sensor

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		• ECM
P2127	VPA2 is 1.2 V or less for 0.5 seconds or more when the accelerator pedal is depressed (1 trip detection logic).	• Accelerator pedal position sensor • Open in VCP2 circuit • Open or ground short in VPA2 circuit • ECM
P2128	Both of the following conditions continue for 2.0 seconds or more (1 trip detection logic): (a) VPA2 is 4.8 V or higher, (b) VPA is between 0.4 V and 3.45 V.	• Accelerator pedal position sensor • Open in EPA2 circuit • ECM
P2138	Either of the following conditions continues for 2.0 seconds or more (1 trip detection logic): a. The difference between VPA and VPA2 is 0.02 V or less. b. VPA is 0.4 V or less and VPA2 is 1.2 V or less.	• Short between VPA and VPA2 circuits • Accelerator pedal position sensor • ECM

HINT:

When any of these DTCs are output, check the accelerator pedal position sensor voltage using the Techstream. Enter the following menus: Powertrain/Engine/Data List/All Data/Accel Sensor Out No. 1 and Accel Sensor Out No. 2.

ACCELERATOR PEDAL REFERENCE

Trouble Area	Accel Sensor Out No. 1 When Accelerator Pedal Released	Accel Sensor Out No. 2 When Accelerator Pedal Released	Accel Sensor Out No. 1 When Accelerator Pedal Depressed	Accel Sensor Out No. 2 When Accelerator Pedal Depressed
Open in VCP circuit	0 to 0.2 V	0 to 0.2 V	0 to 0.2 V	0 to 0.2 V
Open or ground short in VPA circuit	0 to 0.2 V	1.2 to 2.0 V	0 to 0.2 V	3.4 to 4.98 V
Open or ground short in VPA2 circuit	0.5 to 1.1 V	0 to 0.2 V	2.6 to 4.5 V	0 to 0.2 V
Open in EPA circuit	4.5 to 4.98 V	4.5 to 4.98 V	4.5 to 4.98 V	4.5 to 4.98 V
Normal condition	0.5 to 1.1 V	1.2 to 2.0 V	2.6 to 4.5 V	3.4 to 4.98 V

HINT:

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Accelerator pedal positions are expressed as voltages.

MONITOR DESCRIPTION

When either output voltage of VPA or VPA2 deviates from the standard range, or the difference between the output voltages of the 2 sensor circuits is less than the threshold, the ECM determines that there is a malfunction in the accelerator pedal position sensor. The ECM then illuminates the MIL and stores a DTC.

Example:

When the output voltage of VPA drops below 0.4 V for more than 0.5 seconds when the accelerator pedal is fully depressed, DTC P2122 is stored.

If the malfunction is not repaired successfully, a DTC is stored 2 seconds after the engine is next started.

MONITOR STRATEGY

MONITOR STRATEGY CHART

Related DTCs	P2120: Accelerator Pedal Position Sensor 1 Range Check (Fluctuating) P2122: Accelerator Pedal Position Sensor 1 Range Check (Low Voltage) P2123: Accelerator Pedal Position Sensor 1 Range Check (High Voltage) P2125: Accelerator Pedal Position Sensor 2 Range Check (Fluctuating) P2127: Accelerator Pedal Position Sensor 2 Range Check (Low Voltage) P2128: Accelerator Pedal Position Sensor 2 Range Check (High Voltage) P2138: Accelerator Pedal Position Sensor Range Check (Correlation)
Required Sensors/Components (Main)	Accelerator pedal position sensor
Required Sensors/Components (Related)	-
Frequency of Operation	Continuous
Duration	0.5 seconds: P2120, P2122, P2125 and P2127 2.0 seconds: P2123, P2128 and P2138
MIL Operation	Immediate
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

TYPICAL ENABLING CONDITIONS CHART

Monitor runs whenever following DTCs not stored	None
Either of following conditions met:	-

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1. Ignition switch	ON (0.012 seconds or more)
2. Throttle actuator power	ON

TYPICAL MALFUNCTION THRESHOLDS

P2120:

TYPICAL MALFUNCTION THRESHOLDS CHART

Either of following conditions met:	-
1. VPA voltage when VPA2 voltage 0.04 V or higher	0.4 V or less
2. VPA voltage	4.8 V or higher

P2122:

TYPICAL MALFUNCTION THRESHOLDS CHART

VPA voltage when VPA2 voltage 0.04 V or higher	0.4 V or less

P2123:

TYPICAL MALFUNCTION THRESHOLDS CHART

VPA voltage	4.8 V or higher

P2125:

TYPICAL MALFUNCTION THRESHOLDS CHART

Either of following conditions met:	-
1. VPA2 voltage when VPA voltage 0.04 V or higher	1.2 V or less
2. VPA2 voltage when VPA voltage 0.4 to 3.45 V	4.8 V or higher

P2127:

TYPICAL MALFUNCTION THRESHOLDS CHART

VPA2 voltage when VPA voltage 0.04 V or higher	1.2 V or less

P2128:

TYPICAL MALFUNCTION THRESHOLDS CHART

VPA2 voltage when VPA voltage 0.4 to 3.45 V	4.8 V or higher

P2138:

TYPICAL MALFUNCTION THRESHOLDS CHART

Either of following conditions met:	-
Condition A	-

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Difference between VPA and VPA 2 voltages	0.02 V or less
Condition B	-
VPA voltage	0.4 V or less
VPA2 voltage	1.2 V or less

COMPONENT OPERATING RANGE

COMPONENT OPERATING RANGE CHART

VPA voltage	0.4 to 4.8 V
VPA2 voltage	1.2 to 4.8 V
Difference between VPA and VPA2 voltages	Higher than 0.02 V

CONFIRMATION DRIVING PATTERN

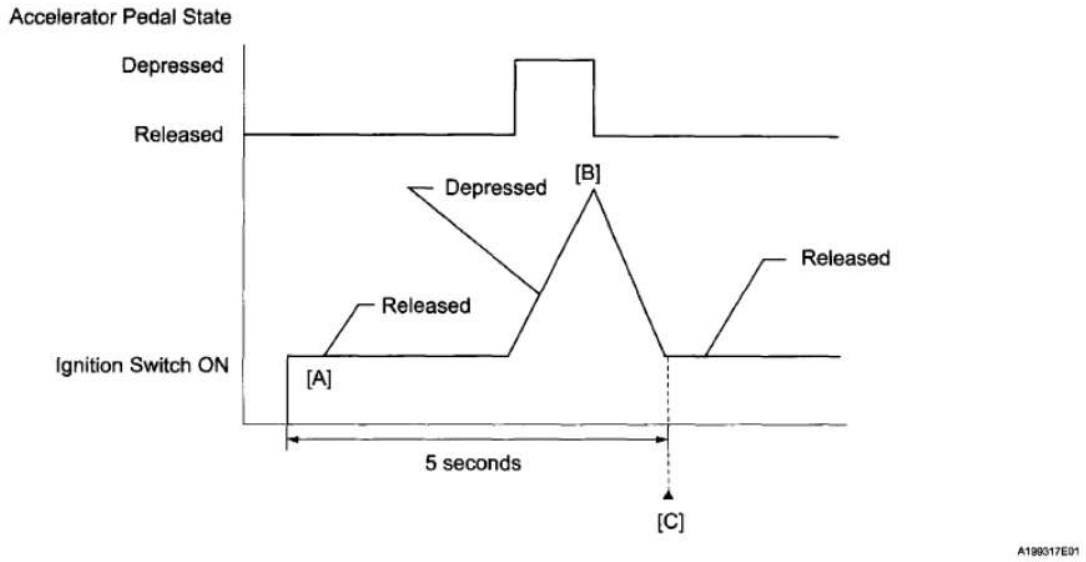


Fig. 249: Confirmation Driving Pattern
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

1. Connect the Techstream to the DLC3.
2. Turn the ignition switch to ON and turn the Techstream on.
3. Clear the DTCs (even if no DTCs are stored, perform the clear DTC procedure).
4. Turn the ignition switch off.
5. Turn the ignition switch to ON and turn the Techstream on [A].
6. Fully depress and release the accelerator pedal [B].
7. Check that 5 seconds or more have elapsed since the DTCs were cleared.
8. Enter the following menus: Powertrain/Engine/Utility/All Readiness.
9. Input the DTC: P2120, P2122, P2123, P2125, P2127, P2128 or P2138.
10. Check the DTC judgment result [C].

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TECHSTREAM DISPLAY DESCRIPTION

Techstream Display	Description
NORMAL	• DTC judgment completed • System normal
ABNORMAL	• DTC judgment completed • System abnormal
INCOMPLETE	• DTC judgment not completed • Perform driving pattern after confirming DTC enabling conditions
UNKNOWN	• Unable to perform DTC judgment • Number of DTCs which do not fulfill DTC preconditions has reached ECU memory limit

HINT:

- If the judgment result shows ABNORMAL, the system has a malfunction.
- If the judgment result shows INCOMPLETE or UNKNOWN, perform steps [B] and [C] again.

11. If the test result is UNKNOWN, enter the following menus: Powertrain/Engine/Trouble Codes/Pending.
12. Read Pending DTCs.

    HINT:

    If a pending DTC is output, the system is malfunctioning.

13. If the test result is INCOMPLETE or UNKNOWN and no pending DTC is output, perform a universal trip and check for permanent DTCs (See **DTC CHECK/CLEAR**).

    HINT:

    - If a permanent DTC is output, the system is malfunctioning.
    - If no permanent DTC is output, the system is normal.

FAIL-SAFE

When any of DTCs P2120, P2121, P2122, P2123, P2125, P2127, P2128 and P2138 is stored, the ECM enters fail-safe mode. If either of the 2 sensor circuits malfunctions, the ECM uses the remaining circuit to calculate the accelerator pedal position to allow the vehicle to continue driving. If both of the circuits malfunction, the ECM regards the accelerator pedal as being released. As a result, the throttle valve is closed and the engine idles.

Fail-safe mode continues until a pass condition is detected, and the ignition switch is turned off.

WIRING DIAGRAM

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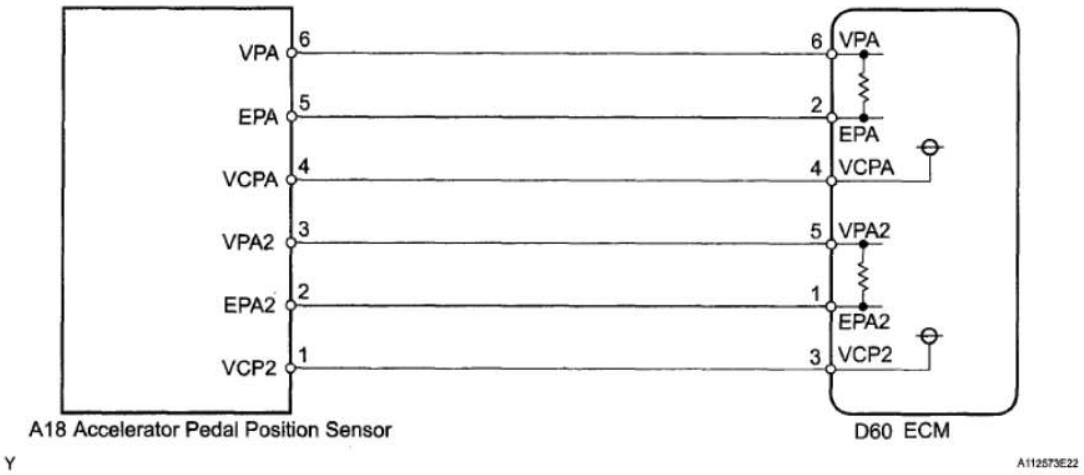


Fig. 250: Throttle/Pedal Position Sensor/Switch "D" Circuit - Wiring Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSPECTION PROCEDURE

HINT:

Read freeze frame data using the Techstream. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1. **READ VALUE USING TECHSTREAM (ACCELERATOR PEDAL POSITION SENSOR)**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the Techstream on.
   d. Enter the following menus: Powertrain/Engine/Data List/All Data/Accel Sensor Out No. 1 and Accel Sensor Out No. 2.
   e. Read the value displayed on the Techstream.

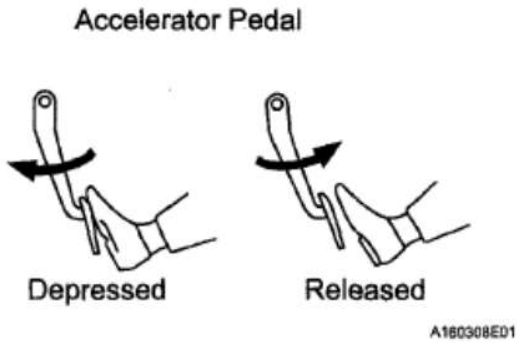


Fig. 251: Identifying Accelerator Pedal Depressed And Released Position

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

Standard Voltage

ACCELERATOR PEDAL OPERATION CHART

Accelerator Pedal Operation	Accel Sensor Out No. 1	Accel Sensor Out No. 2
Released	0.5 to 1.1 V	1.2 to 2.0 V
Depressed	2.6 to 4.5 V	3.4 to 5.0 V

NG: Go to step 2

OK: CHECK FOR INTERMITTENT PROBLEMS (See **CHECK FOR INTERMITTENT PROBLEMS**)

2. **CHECK HARNESS AND CONNECTOR (ACCELERATOR PEDAL POSITION SENSOR ECM)**
   a. Disconnect the accelerator pedal position sensor connector.
   b. Disconnect the ECM connector.
   c. Measure the resistance according to the value (s) in the table below.

Standard Resistance (Check for Open)

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
A18-6 (VPA) - D60-6 (VPA)	Always	Below 1 ohms
A18-5 (EPA) - D60-2 (EPA)	Always	Below 1 ohms
A18-4 (VCPA) - D60-4 (VCPA)	Always	Below 1 ohms
A18-3 (VPA2) - D60-5 (VPA2)	Always	Below 1 ohms
A18-2 (EPA2) - D60-1 (EPA2)	Always	Below 1 ohms
A18-1 (VCP2) - D60-3 (VCP2)	Always	Below 1 ohms

Standard Resistance (Check for Short)

TESTER CONNECTION SPECIFIED CONDITION CHART

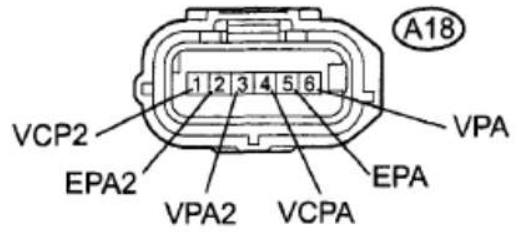
Tester Connection	Condition	Specified Condition
A18-6 (VPA) or D60-6 (VPA) - Body ground	Always	10 kohms or higher
A18-5 (EPA) or D60-2 (EPA) - Body ground	Always	10 kohms or higher
A18-4 (VCPA) or D60-4 (VCPA) - Body ground	Always	10 kohms or higher
A18-3 (VPA2) or D60-5 (VPA2) - Body ground	Always	10 kohms or higher
A18-2 (EPA2) or D60-1 (EPA2) - Body ground	Always	10 kohms or higher
A18-1 (VCP2) or D60-3 (VCP2) - Body ground	Always	10 kohms or higher

   d. Reconnect the accelerator pedal position sensor connector.
   e. Reconnect the ECM connector.

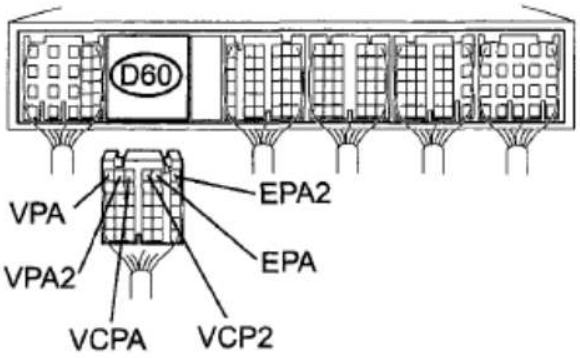
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Front view of wire harness connector:
(to Accelerator Pedal Position Sensor)



Rear view of wire harness connector:
(to ECM)



A205301E02

Fig. 252: Identifying Accelerator Pedal Position Sensor And ECM Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR

OK: Go to next step

3. **CHECK ECM (VCPA AND VCP2 VOLTAGE)**
   a. Disconnect the accelerator pedal position sensor connector.
   b. Turn the ignition switch to ON.
   c. Measure the voltage according to the value (s) in the table below.

Standard Voltage

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Switch Condition	Specified Condition
A18-4 (VCPA) - A18-5 (EPA)	Ignition switch ON	4.5 to 5.5 V

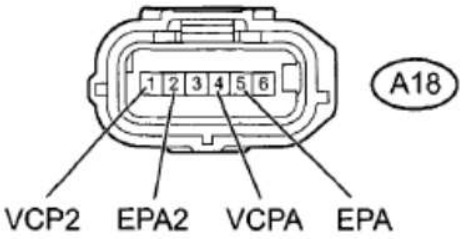
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A18-1 (VCP2) - A18-2 (EPA2)	Ignition switch ON	4.5 to 5.5 V

d. Reconnect the accelerator pedal position sensor connector.

NG: REPLACE ECM (See **REMOVAL**)

Front view of wire harness connector:
(to Accelerator Pedal Position Sensor)



A115666E80

Fig. 253: Identifying Accelerator Pedal Position Sensor Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

4. **REPLACE ACCELERATOR PEDAL ROD ASSEMBLY**
   a. Replace the accelerator pedal rod assembly (See **REMOVAL**).
5. **CHECK WHETHER DTC OUTPUT RECURS (ACCELERATOR PEDAL POSITION SENSOR DTCS)**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the Techstream on.
   d. Clear the DTCs (See **DTC CHECK/CLEAR**).
   e. Turn the ignition switch off.
   f. Turn the ignition switch to ON and turn the Techstream on.
   g. Drive the vehicle in accordance with the driving pattern described in the **CONFIRMATION DRIVING PATTERN**.
   h. Enter the following menus: Powertrain/Engine/Trouble Codes.
   i. Read the DTCs.

Result

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RESULT CHART

Result	Proceed to
DTC P2120, P2122, P2123, P2125, P2127, P2128, and/or P2138 are output	A
DTC is not output	B

B: REPAIR COMPLETED

A: REPLACE ECM (See **REMOVAL**)

DTC P2121 THROTTLE/PEDAL POSITION SENSOR/SWITCH "D" CIRCUIT RANGE/PERFORMANCE

DESCRIPTION

HINT:

- This DTC relates to the accelerator pedal position sensor.

Refer to **DTC P2120** .

DTC DETECTION CONDITION CHART

DTC No.	DTC Detection Condition	Trouble Area
P2121	The difference between VPA and VPA2 is below 0.4 V, or higher than 1.2 V for 0.5 seconds (1 trip detection logic).	• Accelerator pedal position sensor • ECM

MONITOR DESCRIPTION

The accelerator pedal position sensor is mounted on the accelerator pedal bracket. The accelerator pedal position sensor has 2 sensor elements and 2 signal outputs: VPA and VPA2. VPA is used to detect the actual accelerator pedal angle (used for engine control) and VPA2 is used to detect malfunctions in VPA. When the difference between the output voltages of VPA and VPA2 deviates from the standard, the ECM determines that the accelerator pedal position sensor is malfunctioning. The ECM turns on the MIL and stores the DTC.

MONITOR STRATEGY

MONITOR STRATEGY CHART

Related DTCs	P2121: Accelerator Pedal Position Sensor Rationality
Required Sensors/Components (Main)	Accelerator pedal position sensor
Required Sensors/Components (Related)	-
Frequency of Operation	Continuous
Duration	0.5 seconds
MIL Operation	Immediate
Sequence of Operation	None

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TYPICAL ENABLING CONDITIONS

TYPICAL ENABLING CONDITIONS CHART

Monitor runs whenever following DTCs not stored	None
Either of following conditions met:	-
1. Ignition switch	ON (0.012 seconds or more)
2. Electronic throttle actuator power	ON

TYPICAL MALFUNCTION THRESHOLDS

TYPICAL MALFUNCTION THRESHOLDS CHART

Difference between VPA voltage (learned value) and VPA2 voltage (learned value)	Below 0.4 V, or higher than 1.2 V

CONFIRMATION DRIVING PATTERN

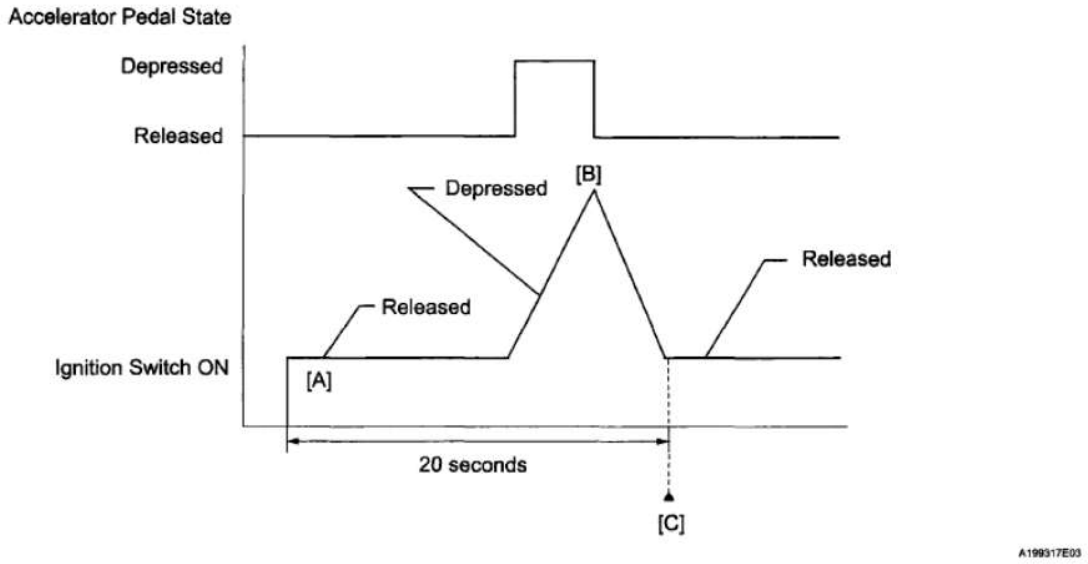


Fig. 254: Confirmation Driving Pattern
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

1. Connect the Techstream to the DLC3.
2. Turn the ignition switch to ON and turn the Techstream ON.
3. Clear the DTCs (even if no DTCs are stored, perform the clear DTC procedure).
4. Turn the ignition switch off.
5. Turn the ignition switch to ON and turn the Techstream on [A].
6. Fully depress and release the accelerator pedal [B].
7. Check that 20 seconds or more have elapsed since the DTCs were cleared.
8. Enter the following menus: Powertrain/Engine/Utility/All Readiness.
9. Input the DTC: P2121.

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10. Check the DTC judgment result [C].

TECHSTREAM DISPLAY DESCRIPTION

Techstream Display	Description
NORMAL	• DTC judgment completed • System normal
ABNORMAL	• DTC judgment completed • System abnormal
INCOMPLETE	• DTC judgment not completed • Perform driving pattern after confirming DTC enabling conditions
UNKNOWN	• Unable to perform DTC judgment • Number of DTCs which do not fulfill DTC preconditions has reached ECU memory limit

HINT:

- If the judgment result shows ABNORMAL, the system has a malfunction.
- If the judgment result shows INCOMPLETE or UNKNOWN, perform steps [B] and [C] again.

11. If the test result is UNKNOWN, enter the following menus: Powertrain/Engine/Trouble Codes/Pending.
12. Read Pending DTCs.

HINT:

If a pending DTC is output, the system is malfunctioning.

13. If the test result is INCOMPLETE or UNKNOWN and no pending DTC is output, perform a universal trip and check for permanent DTCs (See **DTC CHECK/CLEAR**).

HINT:

- If a permanent DTC is output, the system is malfunctioning.
- If no permanent DTC is output, the system is normal.

FAIL-SAFE

The accelerator pedal position sensor has 2 (main and sub) sensor circuits. If a malfunction occurs in either of the sensor circuits, the ECM detects the abnormal signal voltage difference between the 2 sensor circuits and switches to limp mode. In limp mode, the functioning circuit is used to calculate the accelerator pedal opening angle to allow the vehicle to continue driving. If both circuits malfunction, the ECM regards the opening angle of the accelerator pedal as being fully closed. In this case, the throttle valve remains closed as if the engine is idling.

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If a pass condition is detected and then the ignition switch is turned off, the fail-safe operation stops and the system returns to normal.

WIRING DIAGRAM

Refer to **DTC P2120** .

INSPECTION PROCEDURE

HINT:

Read freeze frame data using the Techstream. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1. **CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P2121)**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the Techstream on.
   d. Enter the following menus: Powertrain/Engine/Trouble Codes.
   e. Read the DTCs.

   Result

   RESULT CHART

Result	Proceed to
DTC P2121 is output	A
DTC P2121 and other DTCs are output	B

   HINT:

   If any DTCs other than P2121 are output, troubleshoot those DTCs first.

   B: GO TO **DTC CHART**

   A: Go to next step

2. **READ VALUE USING TECHSTREAM (ACCELERATOR PEDAL POSITION SENSOR)** (See **INSPECTION PROCEDURE**)

   NG: Go to step 3

   OK: CHECK FOR INTERMITTENT PROBLEMS (See **CHECK FOR INTERMITTENT PROBLEMS**)

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3. **REPLACE ACCELERATOR PEDAL ROD ASSEMBLY**
   a. Replace the accelerator pedal rod assembly (See **REMOVAL**).
4. **CHECK WHETHER DTC OUTPUT RECURS (ACCELERATOR PEDAL POSITION SENSOR DTCS)**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the Techstream on.
   d. Clear the DTCs (See **DTC CHECK/CLEAR**).
   e. Turn the ignition switch off.
   f. Turn the ignition switch to ON and turn the Techstream on.
   g. Drive the vehicle in accordance with the driving pattern described in the **CONFIRMATION DRIVING PATTERN**.
   h. Enter the following menus: Powertrain/Engine/Trouble Codes.
   i. Read the DTCs.

Result

RESULT CHART

Result	Proceed to
DTC P2121 is output	A
DTC is not output	B

B: REPAIR COMPLETED

A: REPLACE ECM (See **REMOVAL**)

DTC P2195 OXYGEN (A/F) SENSOR SIGNAL STUCK LEAN (BANK 1 SENSOR 1); DTC P2196 OXYGEN (A/F) SENSOR SIGNAL STUCK RICH (BANK 1 SENSOR 1)

DESCRIPTION

HINT:

- Although the DTC titles say oxygen sensor, these DTCs relate to the air fuel ratio sensor.
- Sensor 1 refers to the sensor mounted in front of the three-way catalytic converter and located near the engine assembly.

The air fuel ratio sensor generates a voltage* that corresponds to the actual air fuel ratio. This sensor voltage is used to provide the ECM with feedback so that it can control the air fuel ratio. The ECM determines the deviation from the stoichiometric air fuel ratio level, and regulates the fuel injection time. If the air fuel ratio sensor malfunctions, the ECM is unable to control the air fuel ratio accurately. The air fuel ratio sensor is the planar type and is integrated with the heater, which heats the solid electrolyte (zirconia element). This heater is controlled by the ECM. When the intake air volume is low (the exhaust gas temperature is low), a current flows into the heater to heat the sensor, in order to facilitate accurate oxygen concentration detection. In addition, the

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sensor and heater portions are the narrow type. The heat generated by the heater is conducted to the solid electrolyte through the alumina, therefore the sensor activation is accelerated.

In order to obtain a high purification rate of the carbon monoxide (CO), hydrocarbon (HC) and nitrogen oxide (NOx) components in the exhaust gas, a three-way catalytic converter is used. For the most efficient use of the three-way catalytic converter, the air fuel ratio must be precisely controlled so that it is always close to the stoichiometric level.

*: Value changes inside the ECM. Since the air fuel ratio sensor is a current output element, the current is converted into a voltage inside the ECM. Any measurements taken at the air fuel ratio sensor or ECM connectors will show a constant voltage.

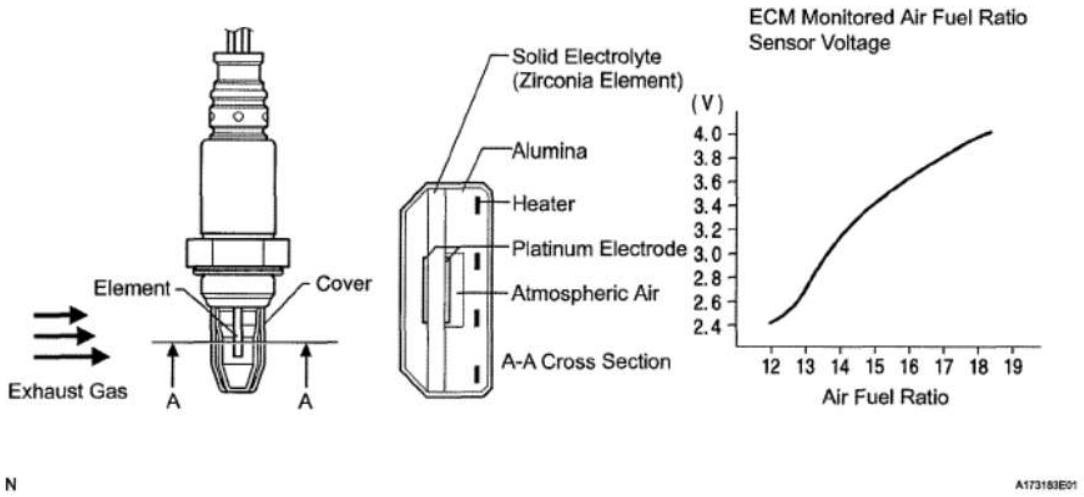


Fig. 255: Air Fuel Ratio Sensor Voltage Graph
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

DTC DETECTION CONDITION CHART

DTC No.	DTC Detection Condition	Trouble Area
P2195	Conditions (a) and (b) continue for 5 seconds or more (2 trip detection logic) a. Air fuel ratio sensor voltage more than 3.8 V b. Heated oxygen sensor voltage is rises from below 0.21 V to 0.59 V or more	• Open or short in air fuel ratio sensor (bank 1 sensor 1) circuit • Air fuel ratio sensor (bank 1 sensor 1) • Air fuel ratio sensor (bank 1 sensor 1) heater • Air fuel ratio sensor heater circuit • Intake system • Fuel pressure • Fuel injector assembly

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		• ECM
	While fuel-cut operation performed (during vehicle deceleration), air fuel ratio sensor current is 3.6 mA or more for 3 seconds (2 trip detection logic)	• Air fuel ratio sensor (bank 1 sensor 1) • ECM
P2196	Conditions (a) and (b) continue for 5 seconds or more (2 trip detection logic) a. Air fuel ratio sensor voltage less than 2.8 V b. Heated oxygen sensor voltage falls from 0.59 V or higher to below 0.21 V	• Open or short in air fuel ratio sensor (bank 1 sensor 1) circuit • Air fuel ratio sensor (bank 1 sensor 1) • Air fuel ratio sensor (bank 1 sensor 1) heater • Air fuel ratio sensor heater circuit • Intake system Fuel pressure • Fuel injector assembly • ECM
	While fuel-cut operation performed (during vehicle deceleration), air fuel ratio sensor current is less than 1.0 mA for 3 seconds (2 trip detection logic)	• Air fuel ratio sensor (bank 1 sensor 1) • ECM

HINT:

- When any of these DTCs are set, check the air fuel ratio sensor voltage output by entering the following menus on the Techstream: Powertrain/Engine/Data List/All Data/AFS Voltage B1 S1.
- Short-term fuel trim values can also be read using the Techstream.
- The ECM regulates the voltages at the A1A+ and A1 A- terminals of the ECM to a constant level. Therefore, the air fuel ratio sensor voltage output cannot be confirmed without using the Techstream.
- If an air fuel ratio sensor malfunction is detected, the ECM sets a DTC.

MONITOR DESCRIPTION

Sensor Voltage Detection Monitor

Under the air fuel ratio feedback control, if the air fuel ratio sensor voltage output indicates rich or lean for a certain period of time, the ECM determines that there is a malfunction in the air fuel ratio sensor. The ECM illuminates the MIL and stores a DTC.

Example:

If the air fuel ratio sensor voltage output is below 2.8 V (very rich condition) and heated oxygen sensor output voltage falls from 0.59 V or higher to below 0.21 V for 5 seconds, the ECM stores DTC P2196.

Alternatively, if the air fuel ratio sensor voltage output is higher than 3.8 V (very lean condition) and heated

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oxygen sensor output voltage rises from below 0.21 V to 0.59 V or more for 5 seconds, DTC P2195 is stored.

Sensor Current Detection Monitor

A rich air fuel mixture causes a low air fuel ratio sensor current, and a lean air fuel mixture causes a high air fuel ratio sensor current. Therefore, the sensor output becomes low during acceleration, and it becomes high during deceleration with the throttle valve fully closed. The ECM monitors the air fuel ratio sensor current during fuel-cut and detects any abnormal current values.

If the air fuel ratio sensor output is 3.6 mA or higher for more than 3 seconds of cumulative time, the ECM interprets this as a malfunction in the air fuel ratio sensor and stores DTC P2195 (stuck on high side). If the air fuel ratio sensor output is below 1.0 mA for more than 3 seconds of cumulative time, the ECM stores DTC P2196 (stuck on low side).

Air Fuel Ratio Sensor Current Monitor

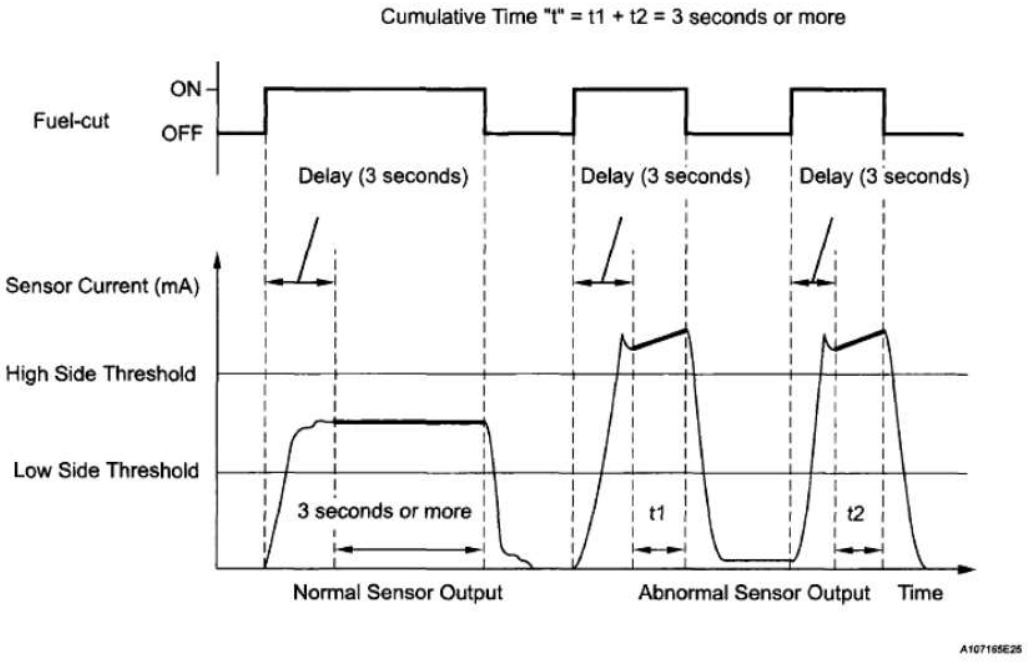


Fig. 256: Air Fuel Ratio Sensor Current Monitor Chart
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

MONITOR STRATEGY

MONITOR STRATEGY CHART

Related DTCs	P2195: Air Fuel Ratio Sensor (Bank 1 Sensor 1) Signal Stuck Lean P2196: Air Fuel Ratio Sensor (Bank 1 Sensor 1) Signal Stuck Rich
Required Sensors/Components (Main)	Air fuel ratio sensor
Required Sensors/Components	Heated oxygen sensor

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(Related)	
Frequency of Operation	Continuous: Sensor voltage detection monitor Once per driving cycle: Sensor current detection monitor
Duration	5 seconds: Sensor voltage detection monitor 3 seconds: Sensor current detection monitor
MIL Operation	2 driving cycles
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

ALL

TYPICAL ENABLING CONDITIONS CHART

Monitor runs whenever following DTCs not stored	P0016 (VVT System - Misalignment) P0017 (Exhaust VVT System - Misalignment) P0031, P0032, P101D (Air Fuel Ratio Sensor Heater) P0102, P0103 (Mass Air Flow Sensor) P0112, P0113 (Intake Air Temperature Sensor) P0115, P0117, P0118 (Engine Coolant Temperature Sensor) P0125 (Insufficient Coolant Temperature for Closed Loop Fuel Control) P0120, P0121, P0122, P0123, P0220, P0222, P0223, P2135 (Throttle Position Sensor) P0128 (Thermostat) P0171, P0172 (Fuel System) P0301 - P0304 (Misfire) P0335 (Crankshaft Position Sensor) P0340 (Camshaft Position Sensor) P0451, P0452, P0453 (EVAP System) P0500 (Vehicle Speed Sensor) P0505 (IAC Valve)

Sensor Voltage Detection Monitor (P2195, P2196):

TYPICAL ENABLING CONDITIONS CHART

Time after engine start	30 seconds or more
Fuel system status	Closed loop

Sensor Current Detection Monitor (P2195, P2196):

TYPICAL ENABLING CONDITIONS CHART

Battery voltage	11 V or higher
Atmospheric pressure	76 kPa (570 mmHg) or higher
Air fuel ratio sensor status	Activated
Engine coolant temperature	75°C (167°F) or higher

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Continuous time of fuel cut	3 to 10 seconds

TYPICAL MALFUNCTION THRESHOLDS

Sensor Voltage Detection Monitor (Lean Side Malfunction P2195):

TYPICAL MALFUNCTION THRESHOLDS CHART

Rear heated oxygen sensor voltage	Rises from below 0.21 V to 0.59 V or higher
Air fuel ratio sensor voltage	Higher than 3.8 V

Sensor Voltage Detection Monitor (Rich Side Malfunction P2196):

TYPICAL MALFUNCTION THRESHOLDS CHART

Rear heated oxygen sensor voltage	Falls from 0.59 V or higher to below 0.21 V
Air fuel ratio sensor voltage	Below 2.8 V

Sensor Current Detection Monitor (High Side Malfunction P2195):

TYPICAL MALFUNCTION THRESHOLDS CHART

Air fuel ratio sensor current	3.6 mA or higher

Sensor Current Detection Monitor (Low Side Malfunction P2196):

TYPICAL MALFUNCTION THRESHOLDS CHART

Air fuel ratio sensor current	Below 1.0 mA

MONITOR RESULT

Refer to **CHECKING MONITOR STATUS** .

WIRING DIAGRAM

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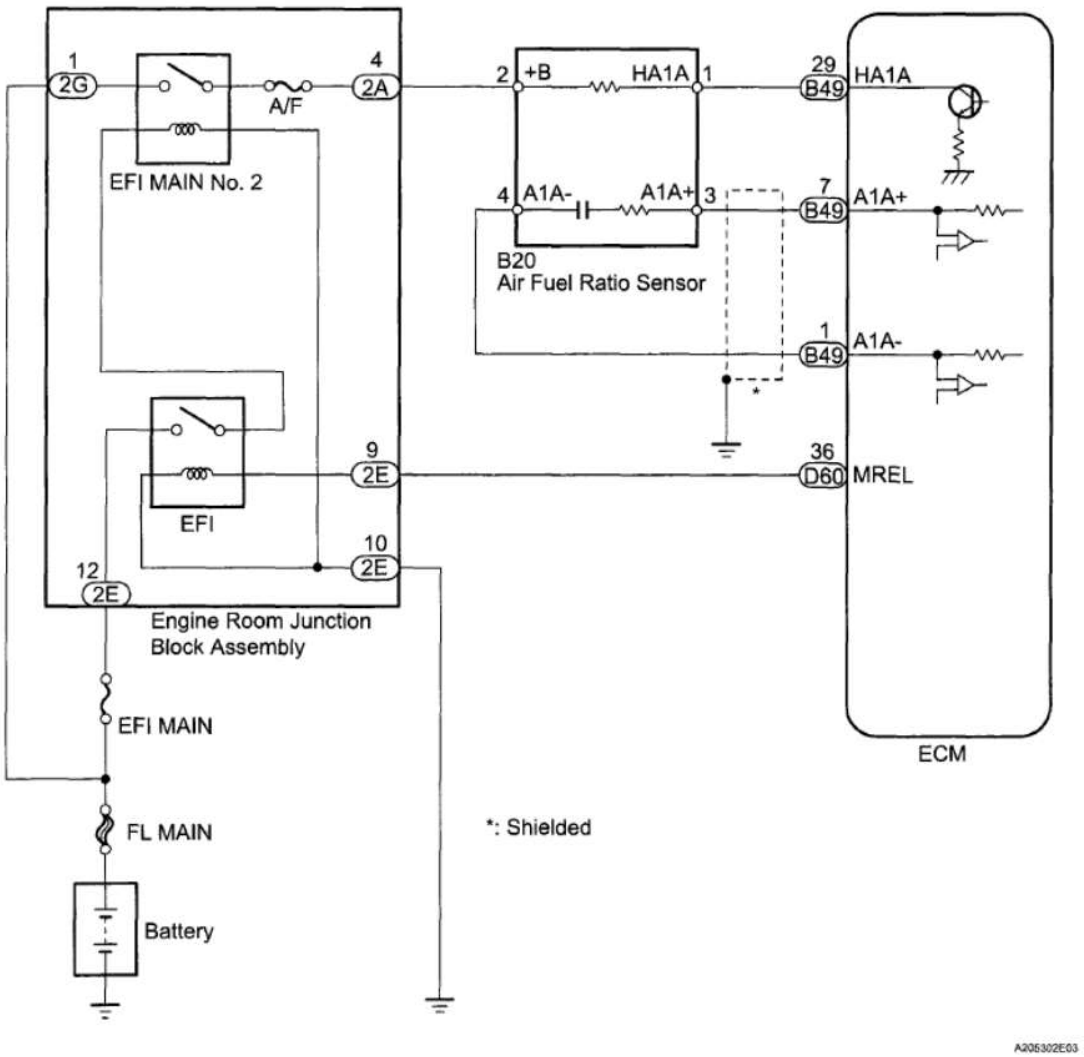


Fig. 257: Oxygen (A/F) Sensor Signal Stuck Lean (Bank 1 Sensor 1) - Wiring Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

CONFIRMATION DRIVING PATTERN

This confirmation driving pattern is used in the "Perform Confirmation Driving Pattern" procedure of the following diagnostic troubleshooting procedure.

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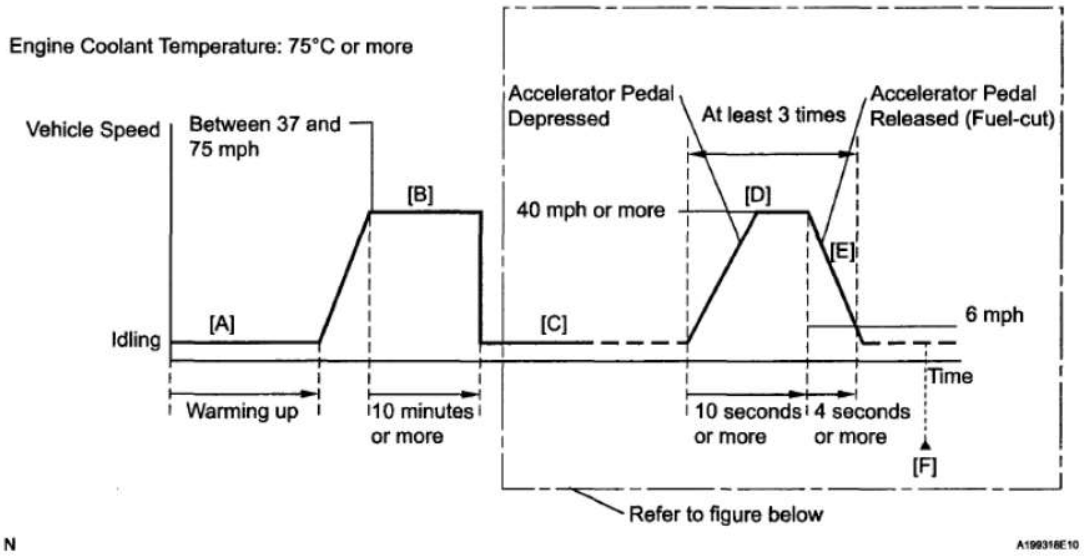


Fig. 258: Confirmation Driving Pattern (1 Of 2)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

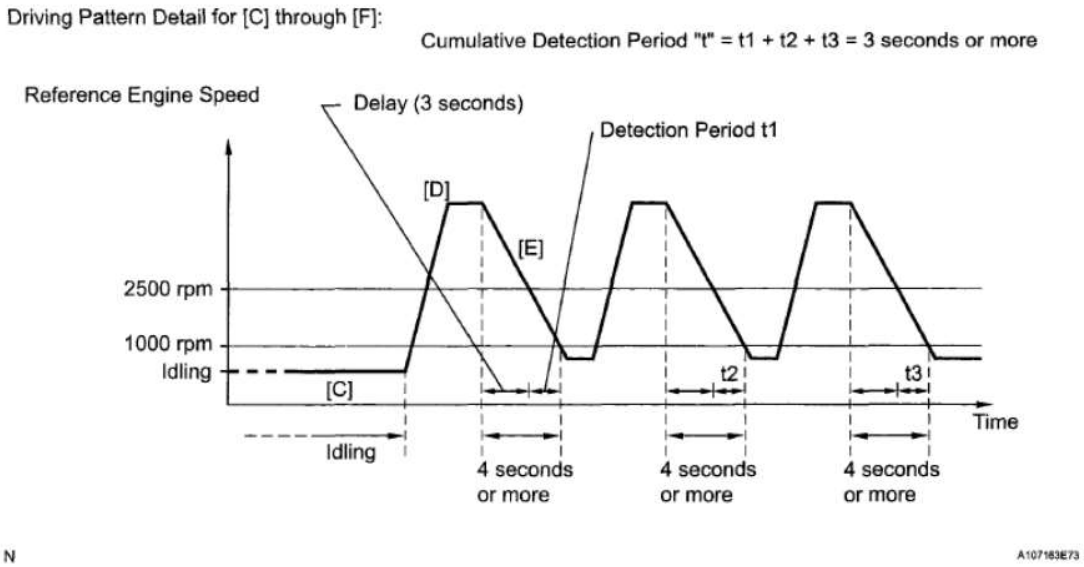


Fig. 259: Confirmation Driving Pattern (2 Of 2)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

1. Connect the Techstream to the DLC3.
2. Turn the ignition switch to ON.
3. Turn the Techstream on.
4. Clear the DTCs (even if no DTCs are stored, perform the clear DTC procedure).
5. Turn the ignition switch off.
6. Turn the ignition switch to ON and turn the Techstream on.
7. Start the engine, and warm it up until the engine coolant temperature reaches 75°C (167°F) or higher [A].

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8. On the Techstream, enter the following menus to check the fuel-cut status: Powertrain/Engine/Data List/All Data/Idle Fuel Cut.
9. Drive the vehicle at between 37 and 75 mph (60 and 120 km/h) for at least 10 minutes [B].

CAUTION: When performing the confirmation driving pattern, obey all speed limits and traffic laws.

10. Shift the transmission to 2nd gear [C].
11. Accelerate the vehicle to 40 mph (64 km/h) or more by depressing the accelerator pedal for at least 10 seconds [D].
12. Soon after performing step [D] above, release the accelerator pedal for at least 4 seconds without depressing the brake pedal in order to execute fuel-cut control [E].

HINT:

Fuel-cut is performed when the following conditions are met:

- Accelerator pedal is fully released.
- Engine speed is 2800 rpm or more (fuel injection returns at 1400 rpm).

13. Allow the vehicle to decelerate until the vehicle speed decreases to less than 6 mph (10 km/h).
14. Repeat steps [C] through [E] above at least 3 times in one driving cycle.
15. Enter the following menus: Powertrain/Engine/Utility/All Readiness.
16. Input the DTC: P2195 or P2196.
17. Check the DTC judgment result [F].

TECHSTREAM DISPLAY DESCRIPTION

Techstream Display	Description
NORMAL	• DTC judgment completed • System normal
ABNORMAL	• DTC judgment completed • System abnormal
INCOMPLETE	• DTC judgment not completed • Perform driving pattern after confirming DTC enabling conditions
UNKNOWN	• Unable to perform DTC judgment • Number of DTCs which do not fulfill DTC preconditions has reached ECU memory limit

HINT:

- If the judgment result shows ABNORMAL, the system has a malfunction.

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- If the judgment result shows INCOMPLETE or UNKNOWN, perform steps [B] through [F].

18. If the test result is UNKNOWN, enter the following menus: Powertrain/Engine/Trouble Codes/Pending.
19. Read Pending DTCs.

    HINT:

    If a pending DTC is output, the system is malfunctioning.

20. If the test result is INCOMPLETE or UNKNOWN and no pending DTC is output, perform a universal trip and check for permanent DTCs (See **DTC CHECK/CLEAR**).

    HINT:

    - If a permanent DTC is output, the system is malfunctioning.
    - If no permanent DTC is output, the system is normal.

INSPECTION PROCEDURE

HINT:

Malfunctioning areas can be identified by performing the Control the Injection Volume for A/F Sensor function provided in the Active Test. The Control the Injection Volume for A/F Sensor function can help to determine whether the air fuel ratio sensor, heated oxygen sensor and other potential trouble areas are malfunctioning.

The following instructions describe how to conduct the Control the Injection Volume for A/F Sensor operation using the Techstream.

1. Connect the Techstream to the DLC3.
2. Start the engine.
3. Turn the Techstream on.
4. Warm up the engine at an engine speed of 2500 rpm for approximately 90 seconds.
5. Enter the following menus: Powertrain/Engine/Active Test/Control the Injection Volume for A/F Sensor.
6. Perform the Active Test operation with the engine in an idling condition (press the RIGHT or LEFT button to change the fuel injection volume).
7. Monitor the output voltages of the air fuel ratio and heated oxygen sensors (AFS Voltage B1 S1 and O2S B1 S2) displayed on the Techstream.

    HINT:

    - The Control the Injection Volume for A/F Sensor operation lowers the fuel injection volume by -12.5% or increases the injection volume by 25%.
    - Each sensor reacts in accordance with increases and decreases in the fuel injection volume.

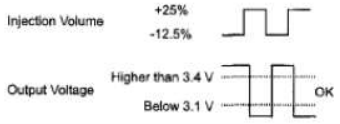
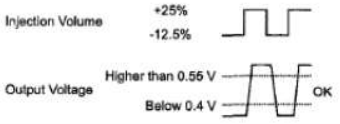
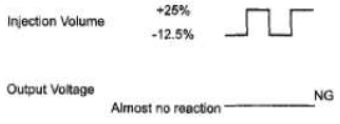
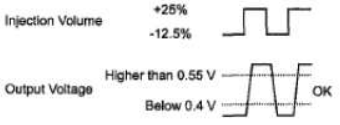
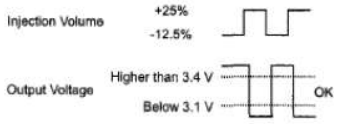
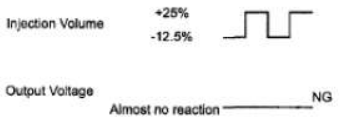
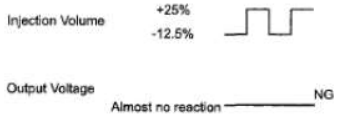
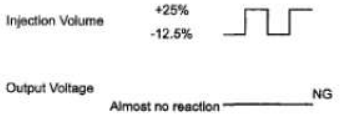
VOLTAGE STATUS CHART

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Techstream Display (Sensor)	Injection Volume	Status	Voltage
AFS Voltage B1 S1 (Air fuel ratio)	+25%	Rich	Less than 3.1 V
	-12.5%	Lean	More than 3.4 V
O2S B1 S2 (Heated oxygen)	+25%	Rich	More than 0.55 V
	-12.5%	Lean	Less than 0.4 V

NOTE: **The air fuel ratio sensor has an output delay of a few seconds and the heated oxygen sensor has a maximum output delay of approximately 20 seconds.**

AIR FUEL RATIO SENSOR REFERENCE

Case	Air Fuel Ratio Sensor (Bank 1 Sensor 1) Output Voltage	Heated Oxygen Sensor (Bank 1 Sensor 2) Output Voltage	Main Suspected Trouble Area
1			-
2			• Air fuel ratio sensor • Air fuel ratio sensor heater • Air fuel ratio sensor circuit
3			• Heated oxygen sensor • Heated oxygen sensor heater • Heated oxygen sensor circuit
4			• Injector • Fuel pressure • Gas leak from exhaust system (Air fuel ratio extremely rich or lean)

- Following the Control the Injection Volume for A/F Sensor procedure enables technicians to check and graph the voltage outputs of both the air fuel ratio and heated oxygen sensors.
- To display the graph, enter the following menus: Powertrain/Engine/Active Test/Control the Injection Volume for A/F Sensor/AFS Voltage B1 S1 and O2S B1 S2; then press the graph button on the Data List screen.

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NOTE: Inspect the fuses for circuits related to this system before performing the following inspection procedure.

HINT:

- Read freeze frame data using the Techstream. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can be helpful in determining whether the vehicle was running or stopped, whether the engine was warmed up or not, whether the air fuel ratio was lean or rich, as well as other data recorded at the time of a malfunction.
- A low air fuel ratio sensor voltage could be caused by a rich air fuel mixture. Check for conditions that would cause the engine to run rich.
- A high air fuel ratio sensor voltage could be caused by a lean air fuel mixture. Check for conditions that would cause the engine to run lean.

1. **CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO P2195 OR P2196)**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the Techstream on.
   d. Enter the following menus: Powertrain/Engine/Trouble Codes.
   e. Read the DTCs.

   Result

   RESULT CHART

Result	Proceed to
DTC P2195 or P2196 is output	A
DTC P2195 or P2196 and other DTCs are output	B

   HINT:

   If any DTCs other than P2195 and P2196 are output, troubleshoot those DTCs first.

   B: GO TO **DTC CHART**

   A: Go to next step

2. **CONFIRM IF VEHICLE HAS RUN OUT OF FUEL IN PAST**
   a. Has the vehicle run out of fuel in the past?

   NO: Go to step 3

   YES: DTC CAUSED BY RUNNING OUT OF FUEL

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3. **READ VALUE USING TECHSTREAM (TEST VALUE OF AIR FUEL RATIO SENSOR)**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the Techstream on.
   d. Clear the DTCs (See **DTC CHECK/CLEAR**).
   e. Turn the ignition switch off.
   f. Turn the ignition switch to ON and turn the Techstream on.
   g. Allow the vehicle to drive in accordance with the drive pattern described in the **CONFIRMATION DRIVING PATTERN**.
   h. Enter the following menus: Powertrain/Engine/Monitor/O2 Sensor.
   i. Check that the Status 2 of O2 Sensor is Complete.

      If the status is still Incomplete, perform the driving pattern increasing the vehicle speed and using second gear to decelerate the vehicle.

   j. Enter the following menus: Powertrain/Engine/Monitor/O2 Sensor/Details/RANGE B1S1.
   k. Check the test value of the air fuel ratio sensor output current during fuel-cut.

      Result

      RESULT CHART

Result	Proceed to
Within normal range (1.0 mA or more, and less than 3.6 mA)	A
Outside normal range (less than 1.0 mA, or 3.6 mA or more)	B

      B: Go to step 18

      A: Go to next step

4. **READ VALUE USING TECHSTREAM (OUTPUT VOLTAGE OF AIR FUEL RATIO SENSOR)**
   a. Connect the Techstream to the DLC3.
   b. Start the engine.
   c. Turn the Techstream on.
   d. Warm up the air fuel ratio sensor at an engine speed of 2500 rpm for 90 seconds.
   e. Enter the following menus: Powertrain/Engine/Data List/All Data/AFS Voltage B1 S1 and Engine Speed, then press the Record button.
   f. Check the air fuel ratio sensor voltage three times, when the engine is in each of the following conditions:
      1. While idling (check for at least 30 seconds) (step "A").
      2. At an engine speed of approximately 2500 rpm (without any sudden changes in engine speed) (step "B").
      3. Raise the engine speed to 4000 rpm and then quickly release the accelerator pedal so that the

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throttle valve is fully closed (step "C").

Standard Voltage

AIR FUEL RATIO SENSOR REFERENCE

Condition	Air Fuel Ratio Sensor Voltage Variation	Reference
Step "A" and "B"	Changes at approximately 3.3 V	Between 3.1 V and 3.4 V
Step "C"	Increases to 3.8 V or higher	This occurs during engine deceleration (when fuel-cut performed)

HINT:

For more information, see the diagrams below.

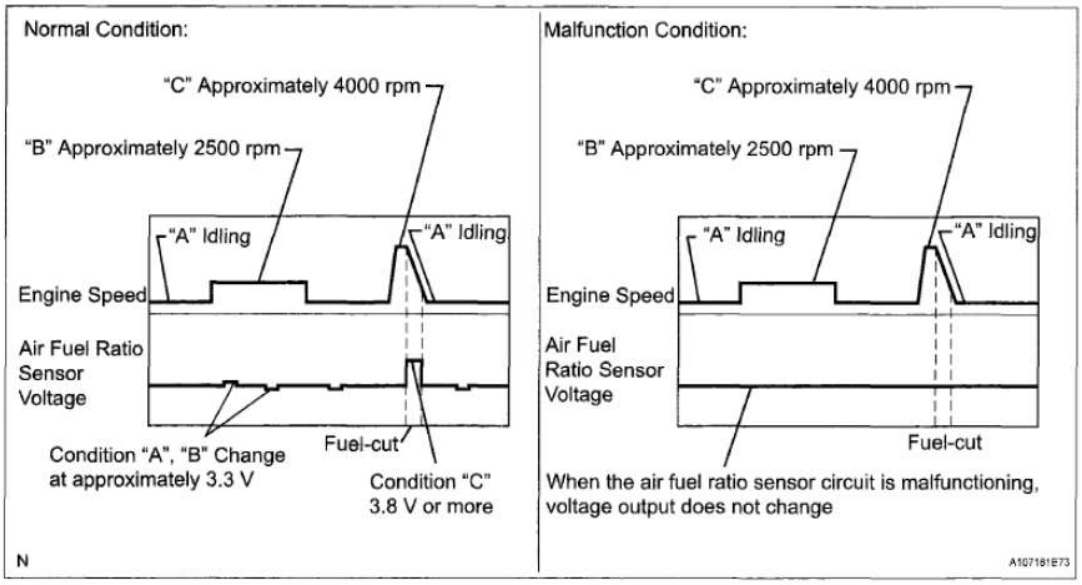


Fig. 260: Engine Speed And Air Fuel Ratio Sensor Voltage Malfunction Chart
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

HINT:

- If the output voltage of the air fuel ratio sensor remains at approximately 3.3 V (see Malfunction Condition diagram) under any conditions, including those above, the air fuel ratio sensor may have an open circuit. (This will also happen if the air fuel ratio sensor heater has an open circuit.)
- If the output voltage of the air fuel ratio sensor remains at either approximately 3.8 V or higher, or below 2.8 V (see Malfunction Condition diagram) under any conditions, including those above, the air fuel ratio sensor may have a short circuit.
- The ECM stops fuel injection (fuel cut) during engine deceleration. This causes a lean

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condition and results in a momentary increase in the air fuel ratio sensor output voltage.

- The ECM must establish a closed throttle valve position learning value to perform fuel cut. If the battery terminal has been reconnected, the vehicle must be driven over 10 mph (16 km/h) to allow the ECM to learn the closed throttle valve position.
- When the vehicle is driven:

  The output voltage of the air fuel ratio sensor may be below 2.8 V during fuel enrichment. For the vehicle, this translates to a sudden increase in speed with the accelerator pedal fully depressed when trying to overtake another vehicle. The air fuel ratio sensor is functioning normally.

- The air fuel ratio sensor is a current output element; therefore, the current is converted into a voltage inside the ECM. Measuring the voltage at the connectors of the air fuel ratio sensor or ECM will show a constant voltage result.

NG: Go to step 10

OK: Go to next step

5. **PERFORM CONFIRMATION DRIVING PATTERN**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the Techstream on.
   d. Clear the DTCs (See **DTC CHECK/CLEAR**).
   e. Turn the ignition switch off.
   f. Turn the ignition switch to ON and turn the Techstream on.
   g. Start the engine and warm it up.
   h. Drive the vehicle referring to the **CONFIRMATION DRIVING PATTERN**.
6. **CHECK WHETHER DTC OUTPUT RECURS (DTC P2195 OR P2196)**
   a. Enter the following menus: Powertrain/Engine/Utility/All Readiness.
   b. Input the DTC: P2195 or P2196.
   c. Check the DTC judgment.

Result

RESULT CHART

Result	Proceed to
ABNORMAL (DTC P2195 or P2196 is output)	A
NORMAL (DTC is not output)	B

B: CHECK FOR INTERMITTENT PROBLEMS (See **CHECK FOR INTERMITTENT PROBLEMS**)

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A: Go to next step

7. **REPLACE AIR FUEL RATIO SENSOR**
   a. Replace the air fuel ratio sensor (See **REMOVAL**).
8. **PERFORM CONFIRMATION DRIVING PATTERN**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the Techstream on.
   d. Clear the DTCs (See **DTC CHECK/CLEAR**).
   e. Turn the ignition switch off.
   f. Turn the ignition switch to ON and turn the Techstream on.
   g. Start the engine and warm it up.
   h. Drive the vehicle referring to the **CONFIRMATION DRIVING PATTERN**.
9. **CHECK WHETHER DTC OUTPUT RECURS (DTC P2195 OR P2196)**
   a. Enter the following menus: Powertrain/Engine/Utility/All Readiness.
   b. Input the DTC: P2195 or P2196.
   c. Check the DTC judgment.

Result

RESULT CHART

Result	Proceed to
NORMAL (DTC is not output)	A
ABNORMAL (DTC P2195 or P2196 is output)	B

B: REPLACE ECM (See **REMOVAL**)

A: REPAIR COMPLETED

10. **INSPECT AIR FUEL RATIO SENSOR (HEATER RESISTANCE)**
    a. Disconnect the air fuel ratio sensor connector.
    b. Measure the resistance according to the value (s) in the table below.

Standard Resistance

TESTER CONNECTION SPECIFIED CONDITION CHART

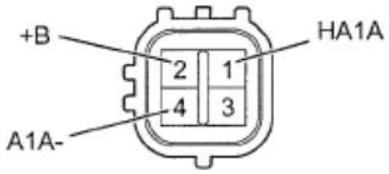
Tester Connection	Condition	Specified Condition
1 (HA1A) -2 (+B)	20°C (68°F)	1.8 to 3.4 ohms
1 (HA1A) - 4 (A1A-)	Always	10 kohms or higher

    c. Reconnect the air fuel ratio sensor connector.

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NG: REPLACE AIR FUEL RATIO SENSOR (See **REMOVAL**)

Component without harness connected:
(Air Fuel Ratio Sensor)



A185028E01

Fig. 261: Identifying Air Fuel Ratio Sensor Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

11. **CHECK HARNESS AND CONNECTOR (AIR FUEL RATIO SENSOR - ECM)**
    a. Disconnect the air fuel ratio sensor connector.
    b. Disconnect the ECM connector.
    c. Measure the resistance according to the value (s) in the table below.

Standard Resistance (Check for Open)

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
B20-1 (HA1A) - B49-29 (HA1A)	Always	Below 1 ohms
B20-3 (A1A+) - B49-7 (A1A+)	Always	Below 1 ohms
B20-4 (A1A-) - B49-1 (A1A-)	Always	Below 1 ohms

Standard Resistance (Check for Short)

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
B20-1 (HA1A) or B49-29 (HA1A) - Body ground	Always	10 kohms or higher
B20-3 (A1A+) or B49-7 (A1A+) - Body ground	Always	10 kohms or higher
B20-4 (A1A-) or B49-1 (A1A-) - Body ground	Always	10 kohms or higher

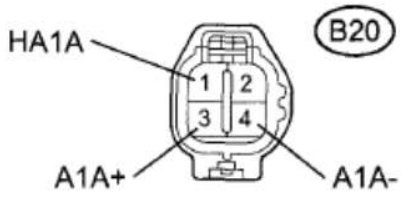
    d. Reconnect the air fuel ratio sensor connector.
    e. Reconnect the ECM connector.

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NG: REPAIR OR REPLACE HARNESS OR CONNECTOR (AIR FUEL RATIO SENSOR ECM)

Front view of wire harness connector:
(to Air Fuel Ratio Sensor)



Rear view of wire harness connector:
(to ECM)

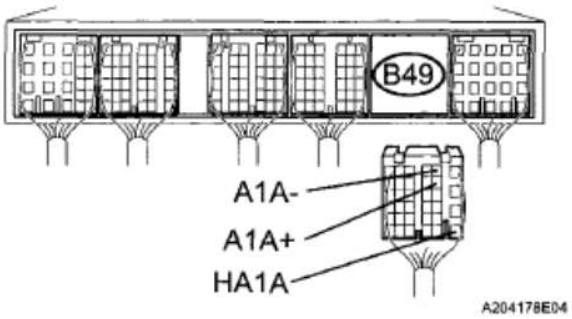


Fig. 262: Identifying Air Fuel Ratio Sensor And ECM Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

12. **CHECK INTAKE SYSTEM**
    a. Check the intake system for vacuum leaks (See **ON-VEHICLE INSPECTION**).

OK:

No leaks in the intake system.

NG: REPAIR OR REPLACE INTAKE SYSTEM

OK

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13. **CHECK FUEL PRESSURE**
    a. Check the fuel pressure (See **ON-VEHICLE INSPECTION**).

    NG: Go to step 21

    OK: Go to next step

14. **INSPECT FUEL INJECTOR ASSEMBLY**
    a. Check the fuel injector assembly injection (whether fuel volume is high or low, and whether injection pattern is poor) (See **INSPECTION**).

    NG: REPLACE FUEL INJECTOR ASSEMBLY (See **REMOVAL**)

    OK: Go to next step

15. **REPLACE AIR FUEL RATIO SENSOR**
    a. Replace the air fuel ratio sensor (See **REMOVAL**).
16. **PERFORM CONFIRMATION DRIVING PATTERN**
    a. Connect the Techstream to the DLC3.
    b. Turn the ignition switch to ON.
    c. Turn the Techstream on.
    d. Clear the DTCs (See **DTC CHECK/CLEAR**).
    e. Turn the ignition switch off.
    f. Turn the ignition switch to ON and turn the Techstream on.
    g. Start the engine and warm it up.
    h. Drive the vehicle referring to the **CONFIRMATION DRIVING PATTERN**.
17. **CHECK WHETHER DTC OUTPUT RECURS (DTC P2195 OR P2196)**
    a. Enter the following menus: Powertrain/Engine/Utility/All Readiness.
    b. Input the DTC: P2195 or P2196.
    c. Check the DTC judgment.

    Result

    RESULT CHART

Result	Proceed to
NORMAL (DTC is not output)	A
ABNORMAL (DTC P2195 or P2196 is output)	B

    B: REPLACE ECM (See **REMOVAL**)

    A: REPAIR COMPLETED

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18. **REPLACE AIR FUEL RATIO SENSOR**
    a. Replace the air fuel ratio sensor (See **REMOVAL**).
19. **PERFORM CONFIRMATION DRIVING PATTERN**
    a. Connect the Techstream to the DLC3.
    b. Turn the ignition switch to ON.
    c. Turn the Techstream on.
    d. Clear the DTCs (See **DTC CHECK/CLEAR**).
    e. Turn the ignition switch off.
    f. Turn the ignition switch to ON and turn the Techstream on.
    g. Start the engine and warm it up.
    h. Drive the vehicle referring to the **CONFIRMATION DRIVING PATTERN**.
20. **CHECK WHETHER DTC OUTPUT RECURS (DTC P2195 OR P2196)**
    a. Enter the following menus: Powertrain/Engine/Utility/All Readiness.
    b. Input the DTC: P2195 or P2196.
    c. Check the DTC judgment.

    Result

    RESULT CHART

Result	Proceed to
NORMAL (DTC is not output)	A
ABNORMAL (DTC P2195 or P2196 is output)	B

    B: REPLACE ECM (See **REMOVAL**)

    A: REPAIR COMPLETED

21. **CHECK FUEL LINE**
    a. Check the fuel lines for leaks or blockage.

    NG: REPAIR OR REPLACE FUEL LINE

    OK: REPLACE FUEL PUMP (See **REMOVAL**)

DTC P2237 OXYGEN (A/F) SENSOR PUMPING CURRENT CIRCUIT/OPEN (BANK 1 SENSOR 1);
DTC P2238 OXYGEN (A/F) SENSOR PUMPING CURRENT CIRCUIT LOW (BANK 1 SENSOR 1);
DTC P2239 OXYGEN (A/F) SENSOR PUMPING CURRENT CIRCUIT HIGH (BANK 1 SENSOR 1);
DTC P2252 OXYGEN (A/F) SENSOR REFERENCE GROUND CIRCUIT LOW (BANK 1 SENSOR 1);
DTC P2253 OXYGEN (A/F) SENSOR REFERENCE GROUND CIRCUIT HIGH (BANK 1 SENSOR 1)

DESCRIPTION

HINT:

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- Although the DTC titles say oxygen sensor, these DTCs relate to the air fuel ratio sensor.
- Sensor 1 refers to the sensor mounted in front of the three-way catalytic converter and located near the engine assembly.

The air fuel ratio sensor, which is located between the exhaust manifold and catalyst, consists of alloyed metal elements and a heater.

Depending on the engine operating conditions, the heater heats the sensor elements to activate them. Battery voltage is applied to the heater, and the sensor ground is controlled by the ECM using a duty ratio. The sensor elements convert the oxygen concentration in the exhaust gas into voltage values to output. Based on the voltage, the ECM determines the air fuel ratio and regulates the fuel injection volume depending on the air fuel ratio and engine operating conditions. The voltage changes between 0.6 V and 4.5 V while the engine is running. If the air fuel ratio is lean, which means that the oxygen concentration in the exhaust gas is high, the voltage is high. If the air fuel ratio is rich, which means that the oxygen concentration in the exhaust gas is low, the voltage is low.

Reference (System Diagram of Bank 1 Sensor 1):

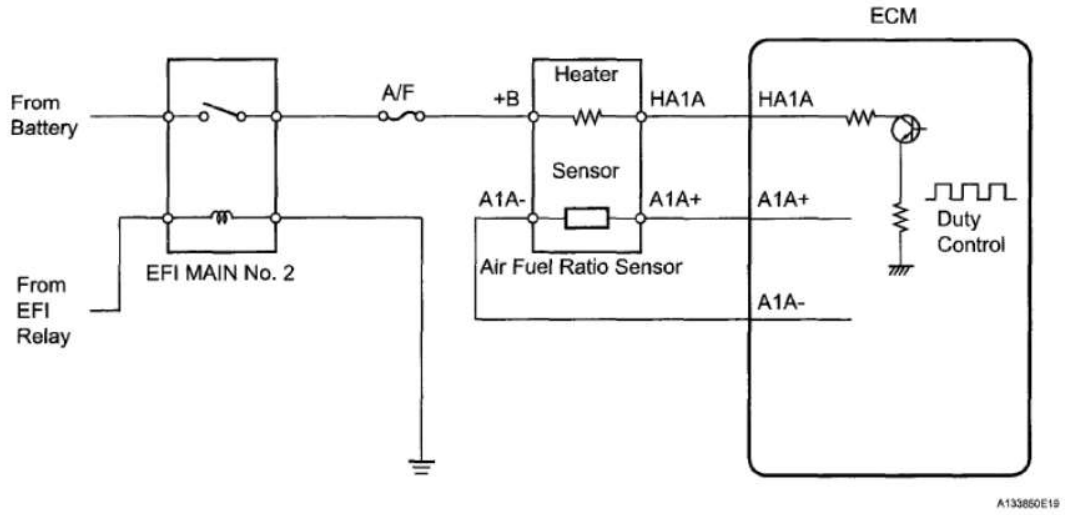


Fig. 263: Air Fuel Ratio Sensor - Circuit Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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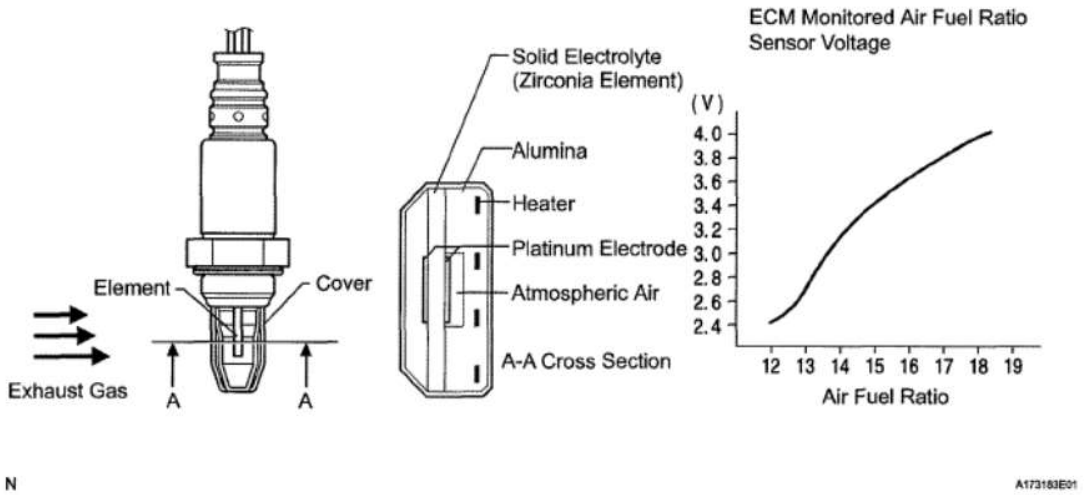


Fig. 264: Air Fuel Ratio Sensor Voltage Graph
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

DTC DETECTION CONDITION CHART

DTC No.	DTC Detection Condition	Trouble Area
P2237	An open in the circuit between terminals A1A+ and A1A- of the air fuel ratio sensor while the engine is running (2 trip detection logic).	• Open in air fuel ratio sensor (bank 1 sensor 1) circuit • Air fuel ratio sensor (bank 1 sensor 1) • ECM
P2238	• Case 1 Condition (a) or (b) continues for 5.0 seconds or more (2 trip detection logic) a. Voltage at terminal A1A+ is 0.5 V or less. b. Voltage difference between terminals A1A+ and A1A-is 0.5 V or less. • Case 2 Air fuel ratio sensor admittance: Less than 0.015 1/ohms (2 trip detection logic)	• Open or short in air fuel ratio sensor (bank 1 sensor 1) circuit • Air fuel ratio sensor (bank 1 sensor 1) • ECM
P2239	The A1A+ voltage is higher than 4.5 V (2 trip detection logic).	• Open or short in air fuel ratio sensor (bank 1 sensor 1) circuit • Air fuel ratio sensor (bank 1 sensor 1) • ECM

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P2252	The A1A- voltage is 0.5 V or less (2 trip detection logic).	• Open or short in air fuel ratio sensor (bank 1 sensor 1) circuit • Air fuel ratio sensor (bank 1 sensor 1) • ECM
P2253	The A1A- voltage is higher than 4.5 V (2 trip detection logic).	• Open or short in air fuel ratio sensor (bank 1 sensor 1) circuit • Air fuel ratio sensor (bank 1 sensor 1) • ECM

MONITOR DESCRIPTION

These DTCs are output when there is an open or short in the air fuel ratio sensor circuit, or if the air fuel ratio sensor output drops. To detect these problems, the voltage of the air fuel ratio sensor is monitored when turning the ignition switch to ON, and the admittance (admittance is an electrical term that indicates the ease of flow of current) is checked while driving. If the voltage of the air fuel ratio sensor is between 0.6 V and 4.5 V, it is considered normal. If the voltage is out of the specified range, or the admittance is less than the standard value, the ECM determines that there is a malfunction in the air fuel ratio sensor. If the same malfunction is detected in next driving cycle, the MIL is illuminated and a DTC is stored.

MONITOR STRATEGY

MONITOR STRATEGY CHART

Related DTCs	P2237: Air Fuel Ratio Sensor Open Circuit Between A1A+ and A1A- P2238: Air Fuel Ratio Sensor Short Circuit Between A1A+ and A1A- P2238: Air Fuel Ratio Sensor Short Circuit Between A1A+ and GND P2238: Air Fuel Ratio Sensor Low Impedance P2239: Air Fuel Ratio Sensor Short Circuit Between A1A+ and +B P2252: Air Fuel Ratio Sensor Short Circuit Between A1A- and GND P2253: Air Fuel Ratio Sensor Short Circuit Between A1A- and +B
Required Sensors/Components (Main)	Air fuel ratio sensor
Required Sensors/Components (Related)	Engine coolant temperature sensor Crankshaft position sensor
Frequency of Operation	Continuous
Duration	P2237:10 seconds P2238 (air fuel ratio sensor low admittance): 10 seconds

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	Others: 5 seconds
MIL Operation	2 driving cycles
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

All:

TYPICAL ENABLING CONDITIONS CHART

Monitor runs whenever following DTCs not stored	P0016 (VVT System - Misalignment) P0017 (Exhaust VVT System - Misalignment) P0031, P0032, P101D (Air Fuel Ratio Sensor Heater) P0102, P0103 (Mass Air Flow Sensor) P0112, P0113 (Intake Air Temperature Sensor) P0115, P0117, P0118 (Engine Coolant Temperature Sensor) P0125 (Insufficient Coolant Temperature for Closed Loop Fuel Control) P0120, P0121, P0122, P0123, P0220, P0222, P0223, P2135 (Throttle Position Sensor) P0128 (Thermostat) P0171, P0172 (Fuel System) P0301 - P0304 (Misfire) P0335 (Crankshaft Position Sensor) P0340 (Camshaft Position Sensor) P0451, P0452, P0453 (EVAP System) P0500 (Vehicle Speed Sensor) P0505 (IAC Valve)

P2237 (Air Fuel Ratio Sensor Open Circuit Between A1A+ and A1A-):

TYPICAL ENABLING CONDITIONS CHART

Estimated sensor temperature	450 to 550°C (842 to 1022°F)
Engine	Running
Battery voltage	11 V or higher

P2238 (Air Fuel Ratio Sensor Low Impedance):

TYPICAL ENABLING CONDITIONS CHART

Estimated sensor temperature	700 to 800°C (1292 to 1472°F)
Engine coolant temperature	10°C (50°F) or higher
Fuel cut	Not executed

P2238 (Air Fuel Ratio Sensor Short Circuit Between AF+ and AF-, GND):

TYPICAL ENABLING CONDITIONS CHART

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Battery voltage	11 V or higher
Ignition switch	ON
Time after ignition switch is turned from off to ON	5 seconds or more

Other:

TYPICAL ENABLING CONDITIONS CHART

Battery voltage	11 V or higher
Ignition switch	ON
Time after ignition switch is turned from off to ON	5 seconds or more

TYPICAL MALFUNCTION THRESHOLDS

P2237 (Air Fuel Ratio Sensor Open Circuit Between A1A+ and A1A-):

TYPICAL MALFUNCTION THRESHOLDS CHART

Air fuel ratio sensor admittance	Below 0.002 Mohms

P2238 (Air Fuel Ratio Sensor Low Impedance):

TYPICAL MALFUNCTION THRESHOLDS CHART

Air fuel ratio sensor admittance	Below 0.015 1/ohms

P2238 (Air Fuel Ratio Sensor Short Circuit Between A1A+ and GND):

TYPICAL MALFUNCTION THRESHOLDS CHART

A/F+ terminal voltage	0.5 V or less

P2239 (Air Fuel Ratio Sensor Short Circuit Between A1A+ and +B):

TYPICAL MALFUNCTION THRESHOLDS CHART

A/F+ terminal voltage	Higher than 4.5 V

P2252 (Air Fuel Ratio Sensor Short Circuit Between A1A- and GND):

TYPICAL MALFUNCTION THRESHOLDS CHART

A/F- terminal voltage	0.5 V or less

P2253 (Air Fuel Ratio Sensor Short Circuit Between A1A- and +B):

TYPICAL MALFUNCTION THRESHOLDS CHART

A/F- terminal voltage	Higher than 4.5 V

P2238 (Air Fuel Ratio Sensor Short Circuit Between A1A+ and A1A-):

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TYPICAL MALFUNCTION THRESHOLDS CHART

Difference between A/F+ terminal and A/F- terminal voltage	0.1 V or less

COMPONENT OPERATING RANGE

COMPONENT OPERATING RANGE CHART

Air fuel ratio sensor admittance	0.015 Mohms or higher
A1A+ terminal voltage	0.5 to 4.5 V
A1A- terminal voltage	0.5 to 4.5 V
Difference between A1A+ and A1A- terminal voltages	0.1 to 0.8 V

CONFIRMATION DRIVING PATTERN

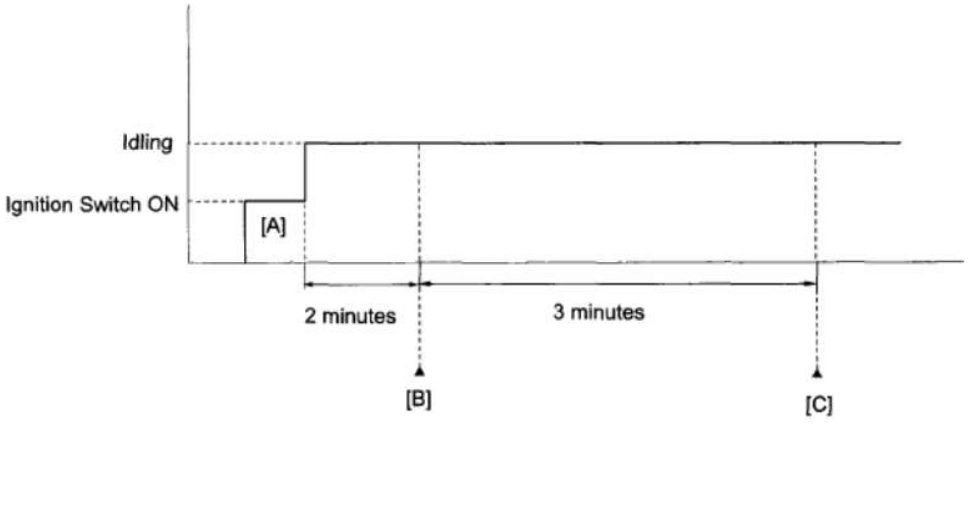


Fig. 265: Confirmation Driving Pattern
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

1. Connect the Techstream to the DLC3.
2. Turn the ignition switch to ON and turn the Techstream on.
3. Clear the DTCs (even if no DTCs are stored, perform the clear DTC procedure).
4. Turn the ignition switch off.
5. Turn the ignition switch to ON and turn the Techstream on [A].
6. Start the engine and wait 2 minutes.
7. Enter the following menus: Powertrain/Engine/Utility/All Readiness.
8. Input the DTC: P2237, P2238, P2239, P2252 or P2253.
9. Check the DTC judgment result [B].

TECHSTREAM DISPLAY DESCRIPTION

Techstream Display	Description

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NORMAL	• DTC judgment completed • System normal
ABNORMAL	• DTC judgment completed • System abnormal
INCOMPLETE	• DTC judgment not completed • Perform driving pattern after confirming DTC enabling conditions
UNKNOWN	• Unable to perform DTC judgment • Number of DTCs which do not fulfill DTC preconditions has reached ECU memory limit

HINT:

- If the judgment result shows ABNORMAL, the system has a malfunction.
- If the judgment result shows INCOMPLETE or UNKNOWN, idle the engine for 3 minutes and check the DTC judgment result again [C].

10. If the test result is UNKNOWN, enter the following menus: Powertrain/Engine/Trouble Codes/Pending.
11. Read Pending DTCs.

    HINT:

    If a pending DTC is output, the system is malfunctioning.

12. If the test result is INCOMPLETE or UNKNOWN and no pending DTC is output, perform a universal trip and check for permanent DTCs (See **DTC CHECK/CLEAR**).

    HINT:

    - If a permanent DTC is output, the system is malfunctioning.
    - If no permanent DTC is output, the system is normal.

WIRING DIAGRAM

Refer to **DTC P2195** .

INSPECTION PROCEDURE

HINT:

Malfunctioning areas can be identified by performing the Control the Injection Volume for A/F Sensor function provided in the Active Test. The Control the Injection Volume for A/F Sensor function can help to determine whether the air fuel ratio sensor, heated oxygen sensor and other potential trouble areas are malfunctioning.

The following instructions describe how to conduct the Control the Injection Volume for A/F Sensor operation using the Techstream.

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1. Connect the Techstream to the DLC3.
2. Start the engine.
3. Turn the Techstream on.
4. Warm up the engine at an engine speed of 2500 rpm for approximately 90 seconds.
5. Enter the following menus: Powertrain/Engine/Active Test/Control the Injection Volume for A/F Sensor.
6. Perform the Active Test operation with the engine idling (press the RIGHT or LEFT button to change the fuel injection volume).
7. Monitor the output voltages of the air fuel ratio and heated oxygen sensors (AFS Voltage B1 S1 and O2S B1 S2) displayed on the Techstream.

   HINT:

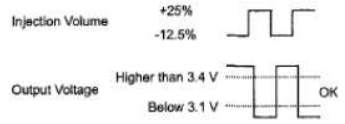
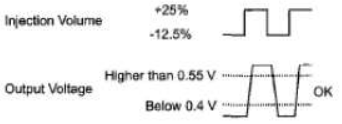
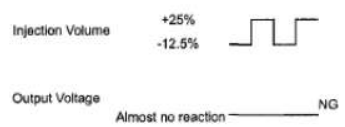
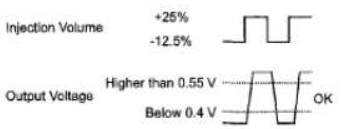
   - The Control the Injection Volume for A/F Sensor operation lowers the fuel injection volume by -12.5% or increases the injection volume by 25%.
   - Each sensor reacts in accordance with increases and decreases in the fuel injection volume.

VOLTAGE STATUS CHART

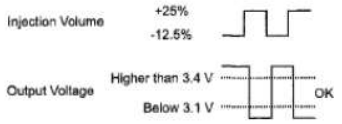
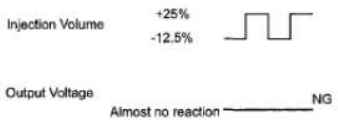
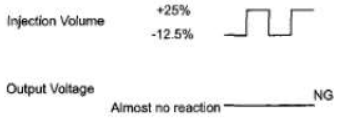
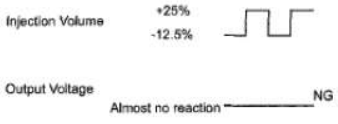
Techstream Display (Sensor)	Injection Volume	Status	Voltage
AFS Voltage B1 S1 (Air fuel ratio)	+25%	Rich	Below 3.1 V
	-12.5%	Lean	Higher than 3.4 V
O2S B1 S2 (Heated oxygen)	+25%	Rich	Higher than 0.55 V
	-12.5%	Lean	Below 0.4 V

NOTE: The air fuel ratio sensor has an output delay of a few seconds and the heated oxygen sensor has a maximum output delay of approximately 20 seconds.

AIR FUEL RATIO SENSOR REFERENCE

Case	Air Fuel Ratio Sensor (Bank 1 Sensor 1) Output Voltage	Heated Oxygen Sensor (Bank 1 Sensor 2) Output Voltage	Main Suspected Trouble Area
1			-
2			• Air fuel ratio sensor • Air fuel ratio sensor heater • Air fuel ratio sensor circuit
			• Heated oxygen sensor

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3			• Heated oxygen sensor heater • Heated oxygen sensor circuit
4			• Injector • Fuel pressure • Gas leak from exhaust system (Air fuel ratio extremely rich or lean)

- Following the Control the Injection Volume for A/F Sensor procedure enables technicians to check and graph the voltage outputs of both the air fuel ratio and heated oxygen sensors.
- To display the graph, enter the following menus: Powertrain/Engine/Active Test/Control the Injection Volume for A/F Sensor/All Data/AFS Voltage B1 S1 and O2S B1 S2; and then press the graph button on the Data List view.

HINT:

Read freeze frame data using the Techstream. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1. **CHECK HARNESS AND CONNECTOR (AIR FUEL RATIO SENSOR - ECM)**
   a. Disconnect the air fuel ratio sensor connector.
   b. Disconnect the ECM connector.
   c. Measure the resistance according to the value (s) in the table below.

Standard Resistance (Check for Open)

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
B20-1 (HA1A) - B49-29 (HA1A)	Always	Below 1 ohms
B20-3 (A1A+) - B49-7 (A1A+)	Always	Below 1 ohms
B20-4 (A1A-) - B49-1 (A1A-)	Always	Below 1 ohms

Standard Resistance (Check for Short)

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
B20-1 (HA1A) or B49-29 (HA1A) - Body ground	Always	10 kohms or higher

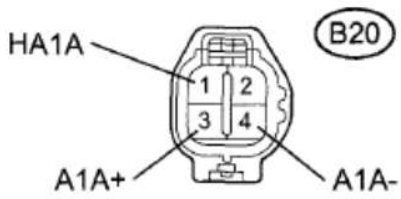
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B20-3 (A1A+) or B49-7 (A1A+) - Body ground	Always	10 kohms or higher
B20-4 (A1A-) or B49-1 (A1A-) - Body ground	Always	10 kohms or higher

d. Reconnect the air fuel ratio sensor connector.
e. Reconnect the ECM connector.

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR

Front view of wire harness connector:
(to Air Fuel Ratio Sensor)



Rear view of wire harness connector:
(to ECM)

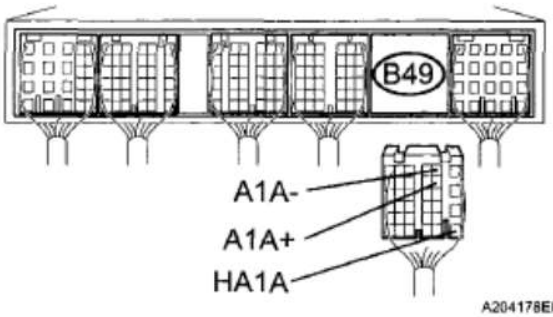


Fig. 266: Identifying Air Fuel Ratio Sensor And ECM Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

2. **REPLACE AIR FUEL RATIO SENSOR**
   a. Replace the air fuel ratio sensor (See **REMOVAL**).
3. **PERFORM CONFIRMATION DRIVING PATTERN**
   a. Connect the Techstream to the DLC3.

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b. Turn the ignition switch to ON.
c. Turn the Techstream on.
d. Clear the DTCs.
e. Turn the ignition switch off.
f. Turn the ignition switch to ON and turn the Techstream on.
g. Drive the vehicle in accordance with the driving pattern described in the **CONFIRMATION DRIVING PATTERN**.

4. **CHECK WHETHER DTC OUTPUT RECURS**
   a. Enter the following menus: Powertrain/Engine/Utility/All Readiness.
   b. Input the DTC: P2237, P2238, P2239, P2252 or P2253.
   c. Check the DTC judgment.

Result

RESULT CHART

Result	Proceed to
NORMAL (DTC is not output)	A
ABNORMAL (DTC P2237, P2238, P2239, P2252 or P2253 is output)	B

B: REPLACE ECM (See **REMOVAL**)

A: REPAIR COMPLETED

DTC P2420 EVAPORATIVE EMISSION SYSTEM SWITCHING VALVE CONTROL CIRCUIT HIGH

DTC SUMMARY

DTC SUMMARY

DTC No.	Monitoring Item	Malfunction Detection Condition	Trouble Area	Detection Timing	Detection Logic
P2420	Vent valve stuck open (vent)	Following condition met during key-off EVAP monitor: • EVAP pressure change when vent valve closed (ON) below 0.3 kPa-g (2.25 mmHg-g)	• Canister pump module (Reference orifice, leak detection pump, vent valve) • Connector/wire harness (Canister pump module - ECM) • ECM	While ignition switch off	2 trip

HINT:

The vent valve is built into the canister pump module.

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DESCRIPTION

The description can be found in EVAP (Evaporative Emission) System (See **DESCRIPTION**).

INSPECTION PROCEDURE

Refer to **EVAP SYSTEM** .

HINT:

Unit expressions

- [kPa-a (mmHg-a)] denotes the absolute pressure.
- [kPa-g (mmHg-g)j denotes the gauge pressure (relative pressure).
- On the Techstream, convert the unit of measurement according to the inspection procedure.

MONITOR DESCRIPTION

5 hours* after the ignition switch is turned off, the leak detection pump creates negative pressure (vacuum) in the EVAP system. The ECM monitors for leaks and actuator malfunctions based on the EVAP pressure.

HINT:

*: If the engine coolant temperature is not below 35°C (95°F) 5 hours after the ignition switch is turned off, the monitor check starts 2 hours later. If it is still not below 35°C (95°F) 7 hours after the ignition switch is turned off, the monitor check starts 2.5 hours later.

OPERATION DESCRIPTION

Sequence	Operation	Description	Duration
-	ECM activation	Activated by soak timer 5, 7 or 9.5 hours after ignition switch turned off.	-
A	Atmospheric pressure measurement	Vent valve turned OFF (vent) and EVAP system pressure measured by ECM in order to register atmospheric pressure. If pressure in EVAP system not between 70 kPa-a and 110 kPa-a (525 mmHg-a and 825 mmHg-a), ECM cancels EVAP system monitor.	10 seconds
B	First reference pressure measurement	In order to determine reference pressure, leak detection pump creates negative pressure (vacuum) through reference orifice and then ECM checks if leak detection pump and vent valve operate normally.	60 seconds
C	EVAP system pressure measurement	Vent valve turned ON (closed) to shut EVAP system. Negative pressure (vacuum) created in EVAP system, and EVAP system pressure then measured. Write down measured value as it will be used in leak check. If EVAP pressure does not stabilize within 15 minutes, ECM cancels EVAP system monitor.	15 minutes(1)

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D	Purge VSV monitor	Purge VSV opened and then EVAP system pressure measured by ECM. Large increase indicates normality.	10 seconds
E	Second reference pressure measurement	After second reference pressure measurement, leak check performed by comparing first and second reference pressure. If stabilized system pressure higher than second reference pressure, ECM determines that EVAP system leaking.	60 seconds
-	Final check	Atmospheric pressure measured and then monitoring result recorded by ECM.	-
(1) If only a small amount of fuel is in the fuel tank, it takes longer for the EVAP pressure to stabilize.			

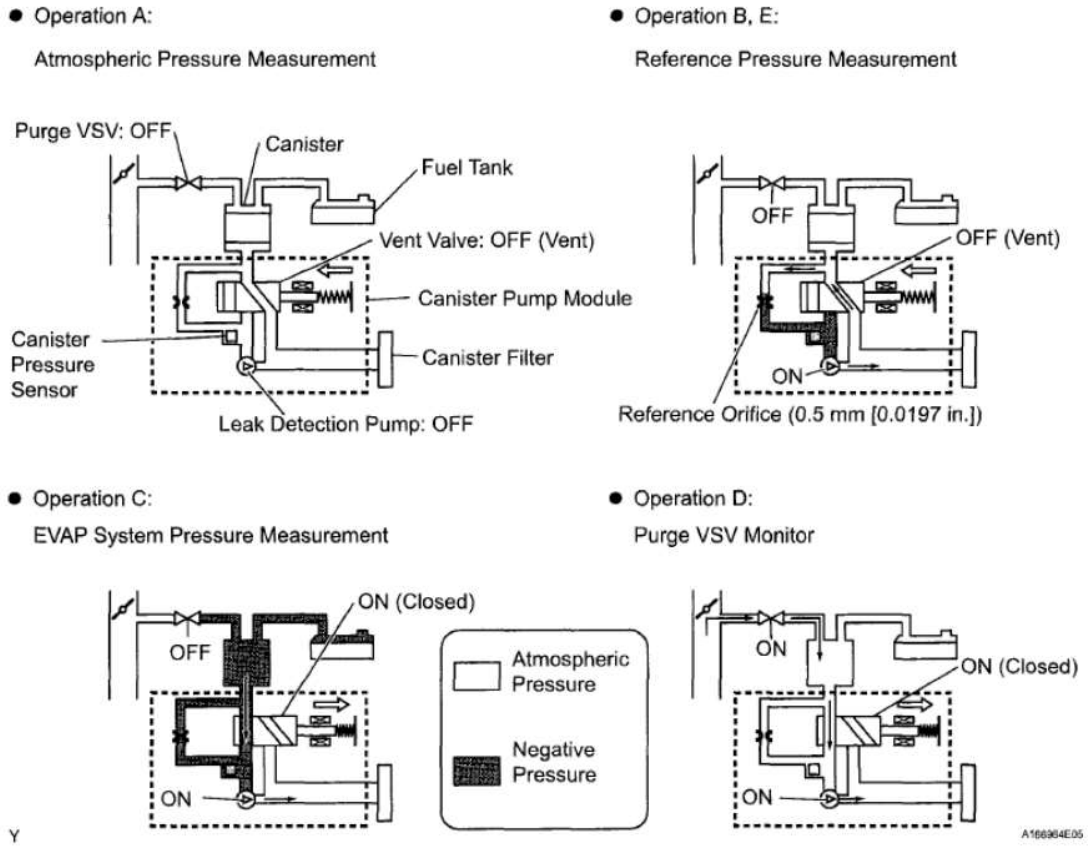


Fig. 267: EVAP Pressure Chart
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

P2420: Vent valve stuck open (vent)

In operation C, the vent valve turns ON (closes) and the EVAP system pressure is then measured by the ECM using the canister pressure sensor to conduct an EVAP leak check. If the pressure does not increase when the vent valve is open, the ECM interprets this as the vent valve being stuck open. The ECM illuminates the MIL and stores the DTC.

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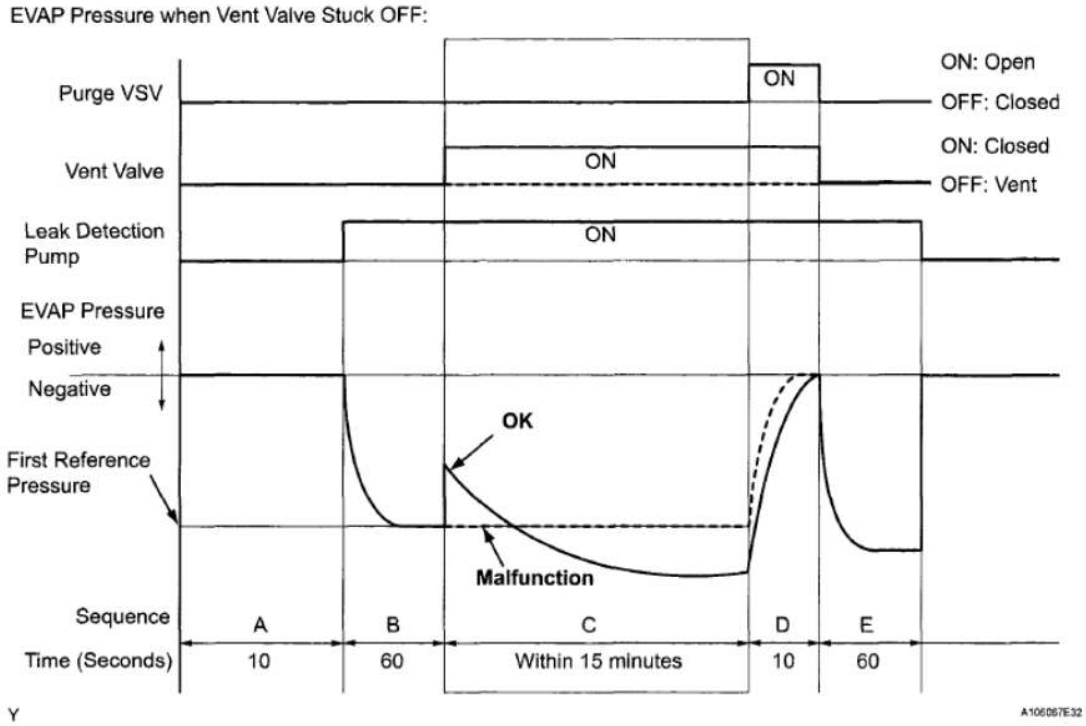


Fig. 268: EVAP Pressure Malfunction Chart - Vent Valve Stuck Open (Vent)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

MONITOR STRATEGY

MONITOR STRATEGY CHART

Required Sensors/Components	Purge VSV and canister pump module
Frequency of Operation	Once per driving cycle
Duration	Within 2 minutes (varies with amount of fuel in tank)
MIL Operation	2 driving cycles
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

TYPICAL ENABLING CONDITIONS CHART

Monitor runs whenever following DTCs not stored	None
EVAP key-off monitor runs when all of following conditions met	-
Atmospheric pressure	70 to 110 kPa-a (525 to 825 mmHg-a)
Battery voltage	10.5 V or higher
Vehicle speed	Less than 2.5 mph (4 km/h)
Ignition switch	off
Time after key-off	5, 7 or 9.5 hours
Canister pressure sensor malfunction (P0452, P0453)	Not detection
Purge VSV	Not operated by scan tool

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Vent valve	Not operated by scan tool
Leak detection pump	Not operated by scan tool
Both of following conditions met before key-off	Conditions 1 and 2
1. Duration that vehicle is driven	5 minutes or more
2. EVAP purge operation	Performed
Engine coolant temperature	4.4 to 35°C (40 to 95°F)
Intake air temperature	4.4 to 35°C (40 to 95°F)

TYPICAL MALFUNCTION THRESHOLDS

TYPICAL MALFUNCTION THRESHOLDS CHART

EVAP pressure change after EVAP canister vent valve ON	Less than 0.3 kPa-g (2.25 mmHg-g)

MONITOR RESULT

Refer to **CHECKING MONITOR STATUS** .

CONFIRMATION DRIVING PATTERN

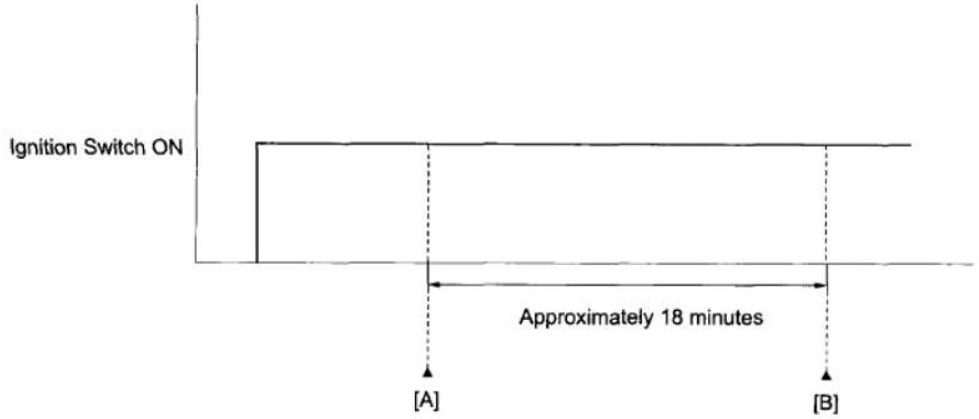


Fig. 269: Confirmation Driving Pattern
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

NOTE:

- **The Evaporative System Check (Automatic Mode) consists of 5 steps performed automatically by the Techstream. It takes a maximum of approximately 18 minutes.**
- **Do not perform the Evaporative System Check when the fuel tank is more than 90% full because the cut-off valve may be closed, making the fuel tank leak check unavailable.**
- **Do not run the engine during this operation.**

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- **When the temperature of the fuel is 35°C (95°F) or higher, a large amount of vapor forms and any check results become inaccurate. When performing the Evaporative System Check, keep the fuel temperature below 35°C (95°F).**

1. Connect the Techstream to the DLC3.
2. Turn the ignition switch to ON and turn the Techstream on.
3. Clear the DTCs (even if no DTCs are stored, perform the clear DTC procedure).
4. Turn the ignition switch off.
5. Turn the ignition switch to ON and turn the Techstream on [A].
6. Enter the following menus: Powertrain/Engine/Utility/Evaporative System Check/Automatic Mode.
7. After the "Evaporative System Check" is completed, check for All Readiness by entering the following menus: Powertrain/Engine/Utility/All Readiness.
8. Input the DTC: P2420.
9. Check the DTC judgment result [B].

TECHSTREAM DISPLAY DESCRIPTION

Techstream Display	Description
NORMAL	• DTC judgment completed • System normal
ABNORMAL	• DTC judgment completed • System abnormal
INCOMPLETE	• DTC judgment not completed • Perform driving pattern after confirming DTC enabling conditions
UNKNOWN	• Unable to perform DTC judgment • Number of DTCs which do not fulfill DTC preconditions has reached ECU memory limit

HINT:

If the judgment result shows ABNORMAL, the system has a malfunction.

10. If the test result is UNKNOWN, enter the following menus: Powertrain/Engine/Trouble Codes/Pending.
11. Read Pending DTCs.

HINT:

If a pending DTC is output, the system is malfunctioning.

12. If the test result is INCOMPLETE or UNKNOWN and no pending DTC is output, perform a universal

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trip and check for permanent DTCs (See **DTC CHECK/CLEAR**).

HINT:

- If a permanent DTC is output, the system is malfunctioning.
- If no permanent DTC is output, the system is normal.

DTC P2610 ECM/PCM INTERNAL ENGINE OFF TIMER PERFORMANCE

DTC SUMMARY

DTC SUMMARY

DTC No.	Monitoring Item	Malfunction Detection Condition	Trouble Area	Detection Timing	Detection Logic
P2610	Soak timer (built into ECM)	An ECM internal malfunction.	ECM	Engine running	2 trip

DESCRIPTION

To ensure the accuracy of the EVAP (Evaporative Emission) monitor values, the soak timer, which is built into the ECM, measures 5 hours (+/-15 minutes) from when the ignition switch is turned off before the monitor is run. This allows the fuel to cool down, which stabilizes the EVAP pressure. When 5 hours have elapsed, the ECM turns on.

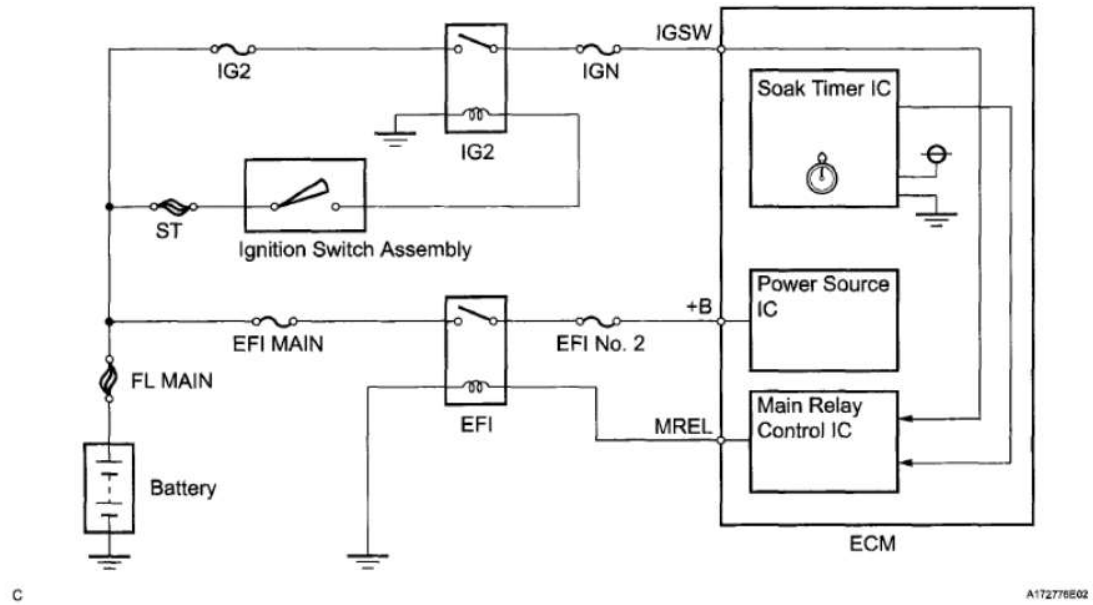


Fig. 270: ECM Circuit Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

MONITOR DESCRIPTION

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5 hours after the ignition switch is turned off, the soak timer activates the ECM to begin the EVAP system monitor. While the engine is running, the ECM monitors the synchronization of the soak timer and the CPU clock. If these two are not synchronized, the ECM interprets this as a malfunction, illuminates the MIL and stores the DTC (2 trip detection logic).

MONITOR STRATEGY

MONITOR STRATEGY CHART

Required Sensors/Components	ECM
Frequency of Operation	Once per driving cycle
Duration	10 minutes
MIL Operation	2 driving cycles
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

TYPICAL ENABLING CONDITIONS CHART

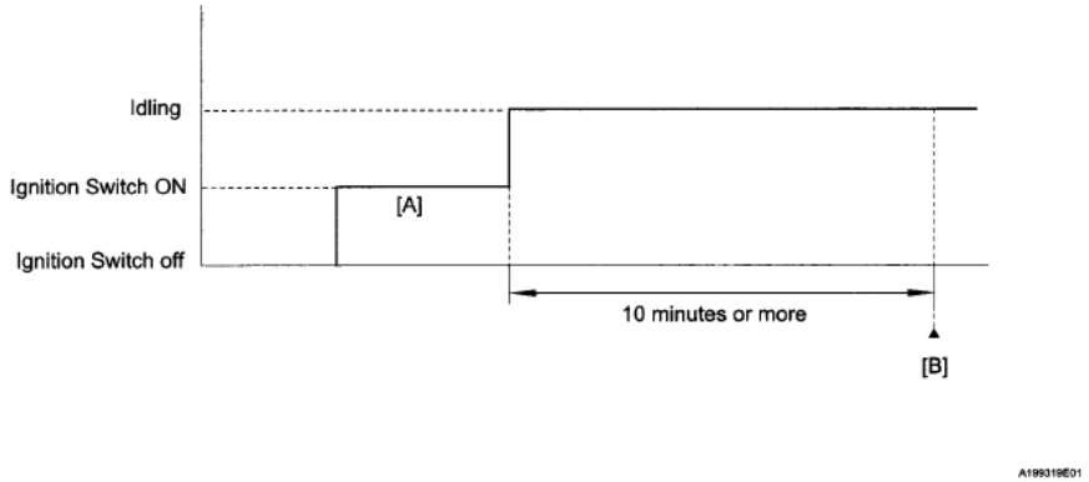
Monitor runs whenever following DTC not stored	None
Ignition switch	ON
Engine	Running
Battery voltage	8 V or higher
Starter	OFF

TYPICAL MALFUNCTION THRESHOLDS

TYPICAL MALFUNCTION THRESHOLDS CHART

Soak timer measurement when ECM CPU clock counts 10 minutes	Less than 7 minutes, or more than 13 minutes

CONFIRMATION DRIVING PATTERN



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Fig. 271: Confirmation Driving Pattern
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1. Connect the Techstream to the DLC3.
2. Turn the ignition switch to ON and turn the Techstream on.
3. Clear the DTCs (even if no DTCs are stored, perform the clear DTC procedure).
4. Turn the ignition switch off.
5. Turn the ignition switch to ON and turn the Techstream on [A].
6. Start the engine.
7. Idle the engine for 10 minutes or more.
8. Enter the following menus: Powertrain/Engine/Utility/All Readiness.
9. Input the DTC: P2610.
10. Check the DTC judgment result [B].

TECHSTREAM DISPLAY DESCRIPTION

Techstream Display	Description
NORMAL	• DTC judgment completed • System normal
ABNORMAL	• DTC judgment completed • System abnormal
INCOMPLETE	• DTC judgment not completed • Perform driving pattern after confirming DTC enabling conditions
UNKNOWN	• Unable to perform DTC judgment • Number of DTCs which do not fulfill DTC preconditions has reached ECU memory limit

HINT:

If the judgment result shows ABNORMAL, the system has a malfunction.

11. If the test result is UNKNOWN, enter the following menus: Powertrain/Engine/Trouble Codes/Pending.
12. Read Pending DTCs.

HINT:

If a pending DTC is output, the system is malfunctioning.

13. If the test result is INCOMPLETE or UNKNOWN and no pending DTC is output, perform a universal trip and check for permanent DTCs (See **DTC CHECK/CLEAR**).

HINT:

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- If a permanent DTC is output, the system is malfunctioning.
- If no permanent DTC is output, the system is normal.

INSPECTION PROCEDURE

HINT:

- DTC P2610 is stored if an internal ECM problem is detected. Diagnostic procedures are not required. ECM replacement is necessary.
- Read freeze frame data using the Techstream. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1. **REPLACE ECM**
   a. Replace the ECM (See **REMOVAL**).
2. **CHECK WHETHER DTC OUTPUT RECURS (DTC P2610)**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the Techstream on.
   d. Clear the DTCs (See **DTC CHECK/CLEAR**).
   e. Turn the ignition switch off.
   f. Turn the ignition switch to ON and turn the Techstream on.
   g. Start the engine and wait for 10 minutes or more.
   h. Enter the following menus: Powertrain/Engine/Trouble Codes/Pending.
   i. If no pending DTC is output, the repair has been successfully completed.

   NEXT: END

DTC P2A00 A/F SENSOR CIRCUIT SLOW RESPONSE (BANK 1 SENSOR 1)

DESCRIPTION

HINT:

- Refer to **DTC P2195** .
- Sensor 1 refers to the sensor mounted in front of the three-way catalytic converter and located near the engine assembly.

DTC DETECTION CONDITION CHART

DTC No.	DTC Detection Condition	Trouble Area
		• Air fuel ratio sensor

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P2A00	The calculated value for the air fuel ratio sensor response rate deterioration level is less than the threshold. (2 trip detection logic):	(bank 1 sensor 1) • Air fuel ratio sensor heater (bank 1 sensor 1) • ECM

MONITOR DESCRIPTION

After the engine is warmed up, the ECM performs air fuel ratio feedback control to maintain the air fuel ratio at the stoichiometric level. In addition, active air fuel ratio control is performed for approximately 10 seconds after preconditions are met in order to measure the air fuel ratio sensor response rate. During active air fuel ratio control, the ECM forcibly increases and decreases the injection volume by a certain amount, based on the stoichiometric air fuel ratio learned during normal air fuel ratio control, and measures the air fuel ratio sensor response rate. The ECM receives a signal from the air fuel ratio sensor while performing active air fuel ratio control and uses it to calculate the air fuel ratio sensor response rate deterioration level.

If the value for the air fuel ratio sensor response rate deterioration level is less than the threshold, the ECM interprets this as a malfunction and stores the DTC.

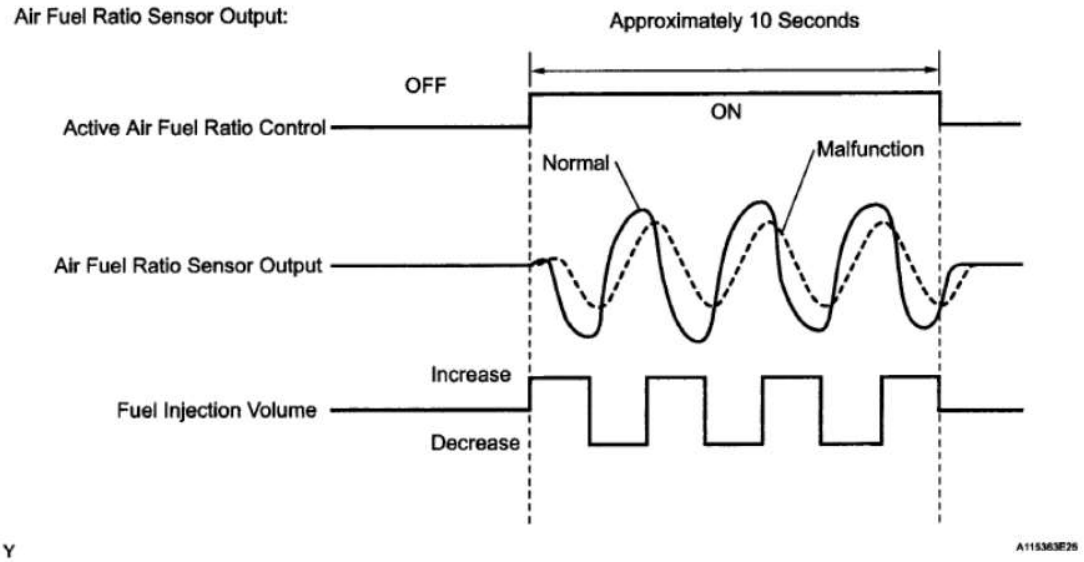


Fig. 272: Air Fuel Ratio Sensor Output Voltage Waveform
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

MONITOR STRATEGY

MONITOR STRATEGY CHART

Related DTCs	P2A00: Air Fuel Ratio Sensor (Bank 1 Sensor 1) Slow Response
Required Sensors/Components (Main)	Air fuel ratio sensor
Required Sensors/Components (Related)	Vehicle speed sensor, Crankshaft position sensor

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Frequency of Operation	Once per driving cycle
Duration	10 to 15 seconds
MIL Operation	2 driving cycles
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

TYPICAL ENABLING CONDITIONS CHART

Monitor runs whenever following DTCs not stored	P0016 (VVT System - Misalignment) P0017 (Exhaust VVT System - Misalignment) P0031, P0032, P101D (Air Fuel Ratio Sensor Heater) P0102, P0103 (Mass Air Flow Sensor) P0112, P0113 (Intake Air Temperature Sensor) P0115, P0117, P0118 (Engine Coolant Temperature Sensor) P0125 (Insufficient Coolant Temperature for Closed Loop Fuel Control) P0120, P0121, P0122, P0123, P0220, P0222, P0223, P2135 (Throttle Position Sensor) P0128 (Thermostat) P0171, P0172 (Fuel System) P0301 - P0304 (Misfire) P0335 (Crankshaft Position Sensor) P0340 (Camshaft Position Sensor) P0451, P0452, P0453 (EVAP System) P0500 (Vehicle Speed Sensor) P0505 (IAC Valve)
Active air fuel ratio control	Performing
Active air fuel ratio control performed when following conditions met	-
Battery voltage	11 V or higher
Engine coolant temperature	75°C (167°F) or higher
Idling	OFF
Engine speed	Less than 4000 rpm
Air fuel ratio sensor status	Activated
Fuel-cut	OFF
Engine load	10 to 70%
Shift position	2 or more
Catalyst monitor	Not yet
Intake air amount	4 to 16g/sec.

TYPICAL MALFUNCTION THRESHOLDS

TYPICAL MALFUNCTION THRESHOLDS CHART

Response rate deterioration level	Below 0.15 V

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MONITOR RESULT

Refer to **CHECKING MONITOR STATUS** .

CONFIRMATION DRIVING PATTERN

HINT:

Performing this confirmation pattern will activate the air fuel ratio sensor response monitor.

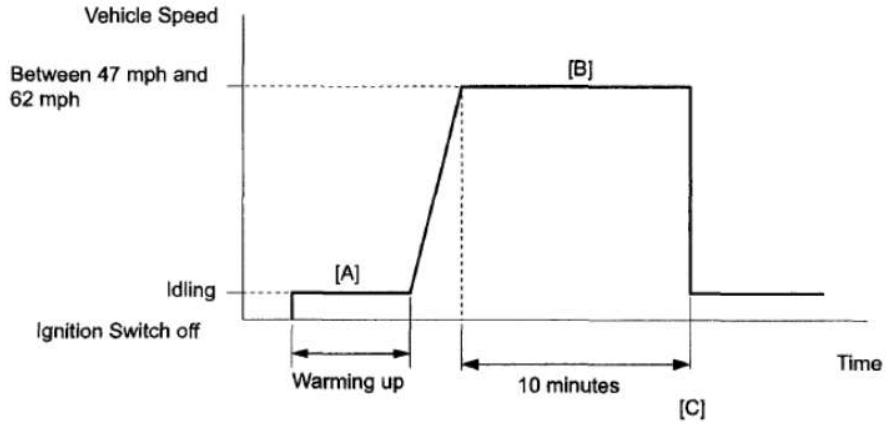


Fig. 273: Vehicle Speed Driving Pattern
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

1. Connect the Techstream to the DLC3.
2. Turn the ignition switch to ON.
3. Turn the Techstream on.
4. Clear the DTCs (even if no DTCs are stored, perform the clear DTC procedure).
5. Turn the ignition switch off.
6. Turn the ignition switch to ON and turn the Techstream on.
7. Enter the following menus: Powertrain/Engine/Monitor/O2 Sensor.
8. Check that the Status 2 of O2 Sensor is Incomplete.
9. Start the engine and warm it up (until the engine coolant temperature is 75°C (167°F) or higher) [A].
10. Drive the vehicle at a constant speed of between 47 and 62 mph (75 and 100 km/h) for 10 minutes [B].
11. Those items will change to Complete after completing the drive pattern.
12. If the values indicated on the Techstream do not change, perform Readiness Monitor Drive Pattern for the air fuel ratio sensor and heated oxygen sensor (See **READINESS MONITOR DRIVE PATTERN**).
13. Check the monitor result values on the Techstream by entering the following menus: Powertrain/Engine/Monitor/O2 Sensor/Details/RANGE B1S1.
14. Note the value of the Monitor Result.

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15. Enter the following menus: Powertrain/Engine/Utility/All Readiness.
16. Input the DTC: P2A00.
17. Check the DTC judgment result [C].

TECHSTREAM DISPLAY DESCRIPTION

Techstream Display	Description
NORMAL	• DTC judgment completed • System normal
ABNORMAL	• DTC judgment completed • System abnormal
INCOMPLETE	• DTC judgment not completed • Perform driving pattern after confirming DTC enabling conditions
UNKNOWN	• Unable to perform DTC judgment • Number of DTCs which do not fulfill DTC preconditions has reached ECU memory limit

HINT:

If the judgment result shows ABNORMAL, the system has a malfunction.

18. If the test result is UNKNOWN, enter the following menus: Powertrain/Engine/Trouble Codes/Pending.
19. Read Pending DTCs.

HINT:

If a pending DTC is output, the system is malfunctioning.

20. If the test result is INCOMPLETE or UNKNOWN and no pending DTC is output, perform a universal trip and check for permanent DTCs (See **DTC CHECK/CLEAR**).

HINT:

- If a permanent DTC is output, the system is malfunctioning.
- If no permanent DTC is output, the system is normal.

WIRING DIAGRAM

Refer to **DTC P2195** .

INSPECTION PROCEDURE

HINT:

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Malfunctioning areas can be identified by performing the Control the Injection Volume for A/F Sensor function provided in the Active Test. The Control the Injection Volume for A/F Sensor function can help to determine whether the air fuel ratio sensor, heated oxygen sensor and other potential trouble areas are malfunctioning.

The following instructions describe how to conduct the Control the Injection Volume for A/F Sensor operation using the Techstream.

1. Connect the Techstream to the DLC3.
2. Start the engine.
3. Turn the Techstream on.
4. Warm up the engine at an engine speed of 2500 rpm for approximately 90 seconds.
5. Enter the following menus: Powertrain/Engine/Active Test/Control the Injection Volume for A/F Sensor.
6. Perform the Active Test operation with the engine idling (press the RIGHT or LEFT button to change the fuel injection volume).
7. Monitor the output voltages of the air fuel ratio and heated oxygen sensors (AFS Voltage B1 S1 and O2S B1 S2) displayed on the Techstream.

   HINT:

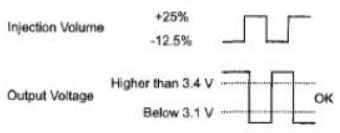
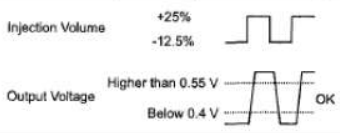
   - The Control the Injection Volume for A/F Sensor operation lowers the fuel injection volume by -12.5% or increases the injection volume by 25%.
   - Each sensor reacts in accordance with increases and decreases in the fuel injection volume.

VOLTAGE STATUS CHART

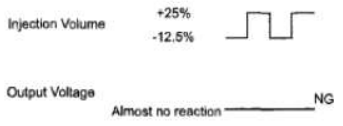
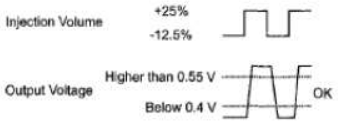
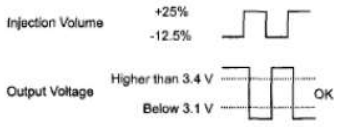
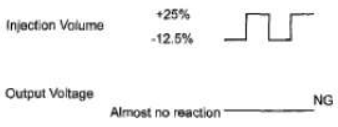
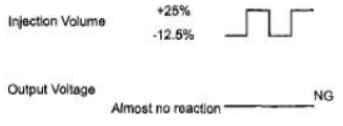
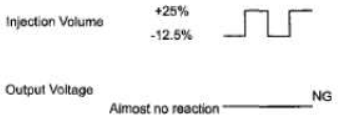
Techstream Display (Sensor)	Injection Volume	Status	Voltage
AFS Voltage B1 S1 (Air fuel ratio)	+25%	Rich	Below 3.1 V
	-12.5%	Lean	Higher than 3.4 V
O2S B1 S2 (Heated oxygen)	+25%	Rich	Higher than 0.55 V
	-12.5%	Lean	Below 0.4 V

NOTE: The air fuel ratio sensor has an output delay of a few seconds and the heated oxygen sensor has a maximum output delay of approximately 20 seconds.

AIR FUEL RATIO SENSOR REFERENCE

Case	Air Fuel Ratio Sensor (Bank 1 Sensor 1) Output Voltage	Heated Oxygen Sensor (Bank 1 Sensor 2) Output Voltage	Main Suspected Trouble Area
1			-
			• Air fuel ratio sensor

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2			• Air fuel ratio sensor heater • Air fuel ratio sensor circuit
3			• Heated oxygen sensor • Heated oxygen sensor heater • Heated oxygen sensor circuit
4			• Injector • Fuel pressure • Gas leak from exhaust system (Air fuel ratio extremely rich or lean)

- Following the Control the Injection Volume for A/F Sensor procedure enables technicians to check and graph the voltage outputs of both the air fuel ratio and heated oxygen sensors.
- To display the graph, enter the following menus: Powertrain/Engine/Active Test/Control the Injection Volume for A/F Sensor/All Data/AFS Voltage B1 S1 and O2S B1 S2; and then press the graph button on the Data List view.

HINT:

- DTC P2A00 may be also stored when the air fuel ratio is stuck at rich or lean.
- A low air fuel ratio sensor voltage could be caused by a rich air fuel mixture. Check for conditions that would cause the engine to run rich.
- A high air fuel ratio sensor voltage could be caused by a lean air fuel mixture. Check for conditions that would cause the engine to run lean.
- Read freeze frame data using the Techstream. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1. **CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P2A00)**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the Techstream on.
   d. Enter the following menus: Powertrain/Engine/Trouble Codes.
   e. Read the DTCs.

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Result

RESULT CHART

Result	Proceed to
DTC P2A00 is output	A
DTC P2A00 and other DTCs are output	B

HINT:

If any DTCs other than P2A00 are output, troubleshoot those DTCs first.

B: GO TO **DTC CHART**

A: Go to next step

2. **INSPECT AIR FUEL RATIO SENSOR (HEATER RESISTANCE)** (See **INSPECTION PROCEDURE**)

   NG: REPLACE AIR FUEL RATIO SENSOR (See **REMOVAL**)

   OK: Go to next step

3. **CHECK HARNESS AND CONNECTOR (AIR FUEL RATIO SENSOR - ECM)** (See **INSPECTION PROCEDURE**)

   NG: REPAIR OR REPLACE HARNESS OR CONNECTOR

   OK: Go to next step

4. **PERFORM CONFIRMATION DRIVING PATTERN**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the Techstream on.
   d. Clear the DTCs.
   e. Turn the ignition switch off.
   f. Turn the ignition switch to ON and turn the Techstream on.
   g. Drive the vehicle in accordance with the driving pattern described in the **CONFIRMATION DRIVING PATTERN**.
5. **CHECK WHETHER DTC OUTPUT RECURS (DTC P2A00)**
   a. Enter the following menus: Powertrain/Engine/Utility/All Readiness.
   b. Input the DTC: P2A00.
   c. Check the DTC judgment.

   Result

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RESULT CHART

Result	Proceed to
ABNORMAL (DTC P2A00 is output)	A
NORMAL (DTC is not output)	B

B: CHECK FOR INTERMITTENT PROBLEMS (See **CHECK FOR INTERMITTENT PROBLEMS**)

A: Go to next step

6. **REPLACE AIR FUEL RATIO SENSOR**
   a. Replace the air fuel ratio sensor (See **REMOVAL**).
7. **PERFORM CONFIRMATION DRIVING PATTERN**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the Techstream on.
   d. Clear the DTCs.
   e. Turn the ignition switch off.
   f. Turn the ignition switch to ON and turn the Techstream on.
   g. Drive the vehicle in accordance with the driving pattern described in the **CONFIRMATION DRIVING PATTERN**.
8. **CHECK WHETHER DTC OUTPUT RECURS (DTC P2A00)**
   a. Enter the following menus: Powertrain/Engine/Utility/All Readiness.
   b. Input the DTC: P2A00.
   c. Check the DTC judgment.

Result

RESULT CHART

Result	Proceed to
ABNORMAL (DTC P2A00 is output)	A
NORMAL (DTC is not output)	B

B: REPAIR COMPLETED

A: CHECK ENGINE TO DETERMINE CAUSE OF EXTREMELY RICH OR LEAN ACTUAL AIR FUEL RATIO (See **INSPECTION PROCEDURE**)

DTC U0101 LOST COMMUNICATION WITH TCM

DESCRIPTION

The Engine Control Module (ECM) intercommunicates with the Transmission Control Module (TCM) through

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the Controller Area Network (CAN).

If there is a problem in this intercommunication, the ECM sets a DTC.

DTC DETECTION CONDITION CHART

DTC No.	DTC Detection Condition	Trouble Area
U0101	Following conditions are met for 1.25 seconds (1 trip detection logic): a. Ignition switch ON b. Battery voltage is 10.5 V or more c. No intercommunication between ECM and TCM	• ECM to TCM circuit • TCM • ECM

MONITOR STRATEGY

MONITOR STRATEGY CHART

Related DTCs	U0101: Verify Communication
Required Sensors/Components (Main)	ECM
Required Sensors/Components (Sub)	-
Frequency of Operation	Continuous
Duration	1.25 seconds
MIL Operation	Immediately
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

TYPICAL ENABLING CONDITIONS CHART

Monitor runs whenever following DTCs not present	None
Battery voltage	10.5 V or more (1 second or more)
Ignition switch	ON
Starter	OFF

TYPICAL MALFUNCTION THRESHOLDS

TYPICAL MALFUNCTION THRESHOLDS CHART

Communication signal	Lost communication with TCM

CONFIRMATION DRIVING PATTERN

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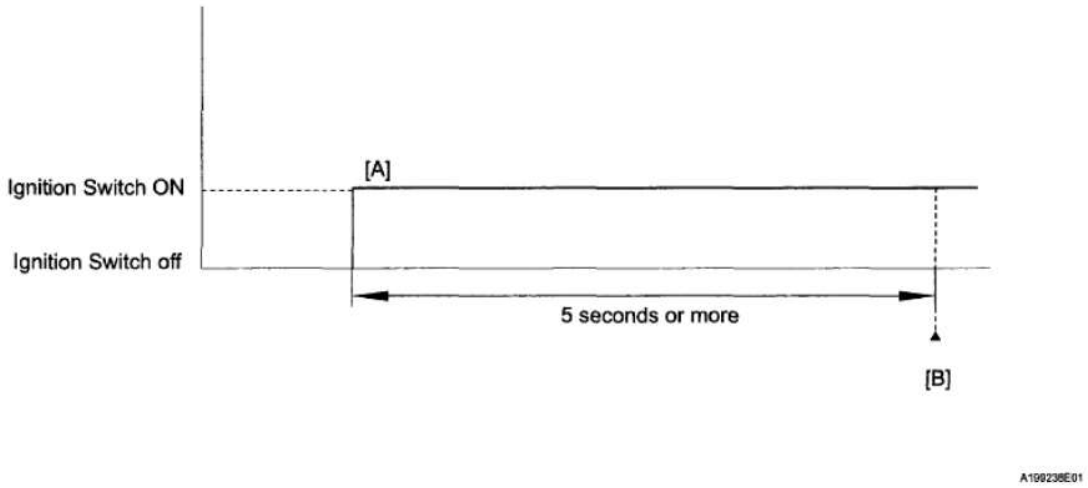


Fig. 274: Confirmation Driving Pattern
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

1. Connect the Techstream to the DLC3.
2. Turn the ignition switch to ON and turn the Techstream on.
3. Clear the DTCs (even if no DTCs are stored, perform the clear DTC procedure) (See **DTC CHECK/CLEAR**).
4. Turn the ignition switch off.
5. Turn the ignition switch to ON and turn the Techstream on [A].
6. Wait 5 seconds or more.
7. Enter the following menus: Powertrain/Engine/Utility/All Readiness.
8. Input the DTC: U0101.
9. Check the DTC judgment result [B].

TECHSTREAM DISPLAY DESCRIPTION

Techstream Display	Description
NORMAL	• DTC judgment completed • System normal
ABNORMAL	• DTC judgment completed • System abnormal
INCOMPLETE	• DTC judgment not completed • Perform driving pattern after confirming DTC enabling conditions
UNKNOWN	• Unable to perform DTC judgment • Number of DTCs which do not fulfill DTC preconditions has reached ECU'S memory limit

HINT:

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If the judgment result shows ABNORMAL, the system has a malfunction.

10. If the test result is UNKNOWN, enter the following menus: Powertrain/Engine/Trouble Codes/Pending.
11. Read Pending DTCs.

    HINT:

    If a pending DTC is output, the system is malfunctioning.

12. If the test result is INCOMPLETE or UNKNOWN and no pending DTC is output, perform a universal trip and check for permanent DTCs (See **DTC CHECK/CLEAR**).

    HINT:

    - If a permanent DTC is output, the system is malfunctioning.
    - If no permanent DTC is output, the system is normal.

WIRING DIAGRAM

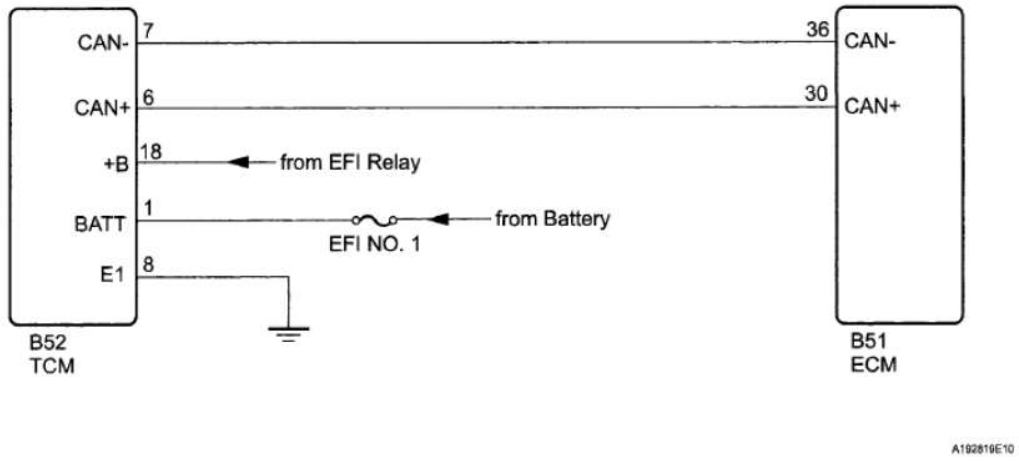


Fig. 275: Lost Communication With TCM - Wiring Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSPECTION PROCEDURE

1. **CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC U0101)**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the Techstream on.
   d. Enter the following menus: Powertrain/Engine/Trouble Codes.
   e. Read the DTCs.

   Result

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RESULT CHART

Result	Proceed to
DTC U0101 is output	A
DTC U0101 and other DTCs are output	B

HINT:

If any DTCs other than U0101 are output, troubleshoot those DTCs first.

B: GO TO **DTC CHART**

A: Go to next step

2. **INSPECT ECU POWER SOURCE CIRCUIT (TCM POWER SOURCE)**
   a. Disconnect the TCM connector.
   b. Turn the ignition switch to ON.
   c. Measure the voltage according to the value (s) in the table below.

Standard Voltage

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Switch Condition	Specified Condition
B52-18 (+B) - Body ground	Ignition switch ON	11 to 14 V
B52-1 (BATT) - Body ground	Always	11 to 14 V

   d. Reconnect the TCM connector.

NG: GO TO TCM POWER SOURCE CIRCUIT (See **COMPONENTS**)

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Front view of wire harness connector:
(to TCM)

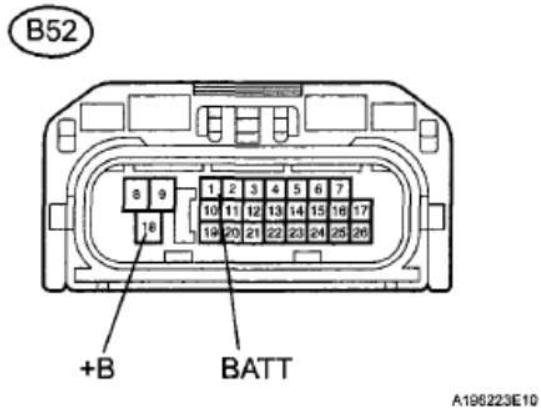


Fig. 276: Identifying TCM Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

3. **CHECK HARNESS AND CONNECTOR (TCM - BODY GROUND)**
   a. Disconnect the TCM connector.
   b. Measure the resistance according to the value (s) in the table below.

Standard Resistance (Check for Open)

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Condition	Condition	Specified Condition
B52-8 (E1) - Body ground	Always	Below 1 ohms

   c. Reconnect the TCM connector.

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR

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Front view of wire harness connector:
(to TCM)

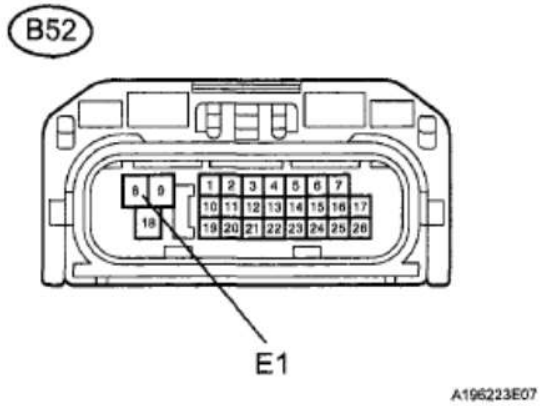


Fig. 277: Identifying TCM Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

4. **CHECK HARNESS AND CONNECTOR (ECM - TCM)**
   a. Disconnect the ECM connector.
   b. Disconnect the TCM connector.
   c. Measure the resistance according to the value (s) in the table below.

Standard Resistance (Check for Open)

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
B52-6 (CAN+) - B51-30 (CAN+)	Always	Below 1 ohms
B52-7 (CAN-) - B51-36 (CAN-)	Always	Below 1 ohms

Standard Resistance (Check for Short)

TESTER CONNECTION SPECIFIED CONDITION CHART

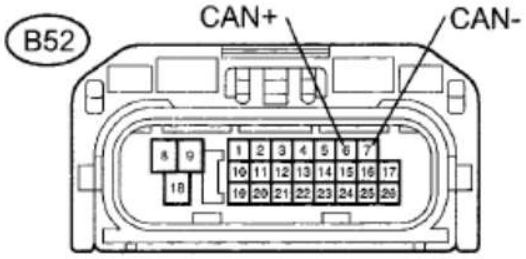
Tester Connection	Condition	Specified Condition
B52-6 (CAN+) or B51-30 (CAN+) - Body ground	Always	10 kohms or higher
B52-7 (CAN-) or B51-36 (CAN-) - Body ground	Always	10 kohms or higher

   d. Reconnect the ECM connector and TCM connector.

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR

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Front view of wire harness connector:
(to TCM)



Rear view of wire harness connector:
(to ECM)

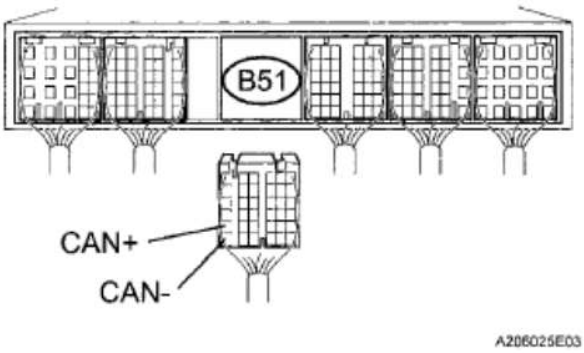


Fig. 278: Identifying ECM Connector And TCM Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

5. **REPLACE ECM**
   a. Replace the ECM (See **REMOVAL**).
6. **CHECK WHETHER DTC OUTPUT RECURS (DTC U0101)**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the Techstream on.
   d. Enter the following menus: Powertrain/Engine/Trouble Codes.
   e. Read the DTCs.

Result

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RESULT CHART

Result	Proceed to
DTC is not output	A
DTC U0101 is output	B

B: REPLACE TCM (See **REMOVAL**)

A: REPAIR COMPLETED

EVAP SYSTEM

RELATED DTCS

DTC CHART

DTC	Monitoring Item
P043E	Reference orifice clogged (built into canister pump module)
P043F	Reference orifice high-flow (built into canister pump module)
P0441	• Purge VSV (Vacuum Switching Valve) stuck closed • Purge VSV stuck open • Purge flow
P0451	• Canister pressure sensor (built into canister pump module) noise • Canister pressure sensor (built into canister pump module) signal becomes fixed/flat
P0452	Canister pressure sensor (built into canister pump module) voltage low
P0453	Canister pressure sensor (built into canister pump module) voltage high
P0455	EVAP gross leak
P0456	EVAP small leak
P2401	Leak detection pump stuck OFF (built into canister pump module)
P2402	Leak detection pump stuck ON (built into canister pump module)
P2419	Vent valve stuck closed (built into canister pump module)
P2420	Vent valve stuck open (vent) (built into canister pump module)
P2610	Soak timer (built into ECM)

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If any EVAP system DTCs are output, the malfunctioning area can be determined using the table below.

DTCs / Malfunctioning Areas	P043E P043F	P0441	P0451	P0452	P0453	P0455	P0456	P2401 P2402	P2419	P2420
Reference orifice clogged	●							●	●	
Reference orifice high-flow	●							●	●	
Purge VSV stuck open		●				●				
Purge VSV stuck closed		●								
Canister pressure sensor signal fixed			●							
Canister pressure sensor signal noise			●							
Canister pressure sensor low output				●						
Canister pressure sensor high output					●					
Gross leak		●				●				
Small leak							●			
Leak detection pump stuck OFF	●							●	●	
Leak detection pump stuck ON	●							●	●	
Vent valve stuck closed	●							●	●	
Vent valve stuck open (vent)										●

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Fig. 279: DTC Malfunctioning Area Chart
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

NOTE: If the reference pressure difference between the first and second checks is more than the specification, all the DTCs relating to the reference pressure (P043E, P043F, P0441, P0455, P0456, P2401, P2420) will be all stored.

DESCRIPTION

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Location of EVAP (Evaporative Emission) System:

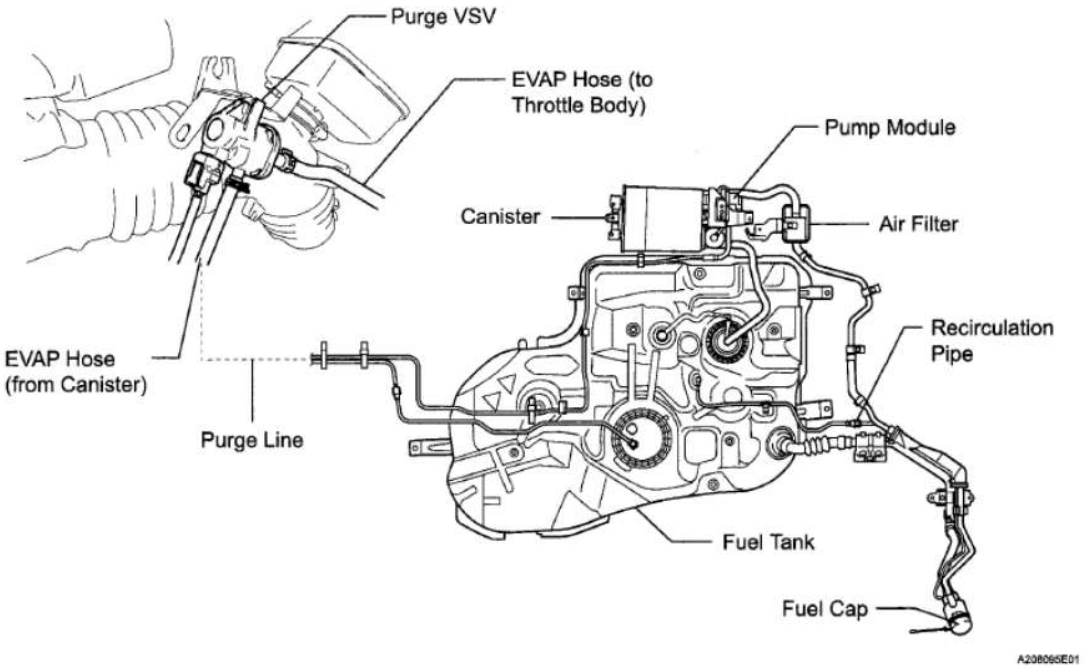


Fig. 280: Identifying EVAP System Components
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

EVAP System Circuit:

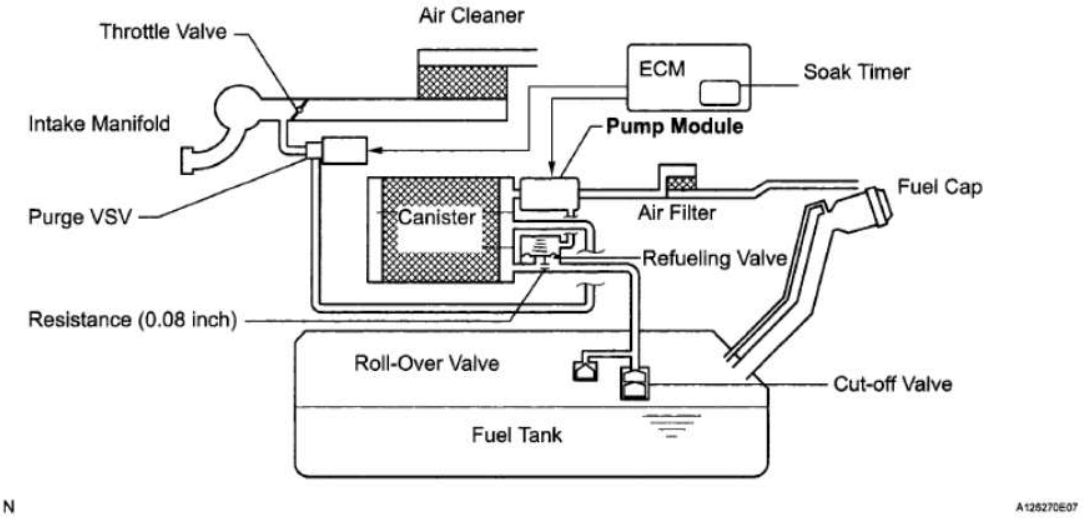


Fig. 281: EVAP System - System Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

NOTE: In the EVAP system of this vehicle, turning ON the vent valve does not seal off the EVAP system. To check for leaks in the EVAP system, disconnect the air inlet vent hose and apply pressure from atmospheric side of the canister.

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While the engine is running, if a predetermined condition (closed-loop, etc.) is met, the purge VSV is opened by the ECM and fuel vapors stored in the canister are purged to the intake manifold. The ECM changes the duty cycle ratio of the purge VSV to control purge flow volume.

The purge flow volume is also determined by the intake manifold pressure. Atmospheric pressure is allowed into the canister through the vent valve to ensure that the purge flow is maintained when negative pressure (vacuum) is applied to the canister.

The following two monitors run to confirm appropriate EVAP system operation.

1. **Key-off monitor**

   This monitor checks for EVAP (Evaporative Emission) system leaks and canister pump module malfunctions. The monitor starts 5 hours* after the ignition switch is turned off. More than 5 hours are required to allow the fuel to cool down to stabilize the Fuel Tank Pressure (FTP), thus making the EVAP system monitor more accurate.

   The leak detection pump creates negative pressure (vacuum) in the EVAP system, and the pressure is measured. Finally, the ECM monitors for leaks from the EVAP system and malfunctions in both the canister pump module and purge VSV, based on the EVAP pressure.

   HINT:

   *: If the engine coolant temperature is not below 35°C (95°F) 5 hours after the ignition switch is turned off, the monitor check starts 2 hours later. If it is still not below 35°C (95°F) 7 hours after the ignition switch is turned off, the monitor check starts 2.5 hours later.

2. **Purge flow monitor**

   The purge flow monitor consists of the two monitors. The 1st monitor is always conducted every time and the 2nd monitor is activated if necessary.

   - The 1st monitor

     While the engine is running and the purge VSV (Vacuum Switching Valve) is ON (open), the ECM monitors the purge flow by measuring the EVAP pressure change. If negative pressure is not created, the ECM begins the 2nd monitor.

   - The 2nd monitor

     The vent valve is turned OFF (open) and the EVAP pressure is then measured. If the variation in the pressure is less than 0.5 kPa-g (3.75 mmHg-g), the ECM interprets this as the purge VSV being stuck closed, and illuminates the MIL and sets DTC P0441 (2 trip detection logic).

Atmospheric pressure check:

In order to ensure reliable malfunction detection, the variation between the atmospheric pressures, before and

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after conduction of the purge flow monitor, is measured by the ECM.

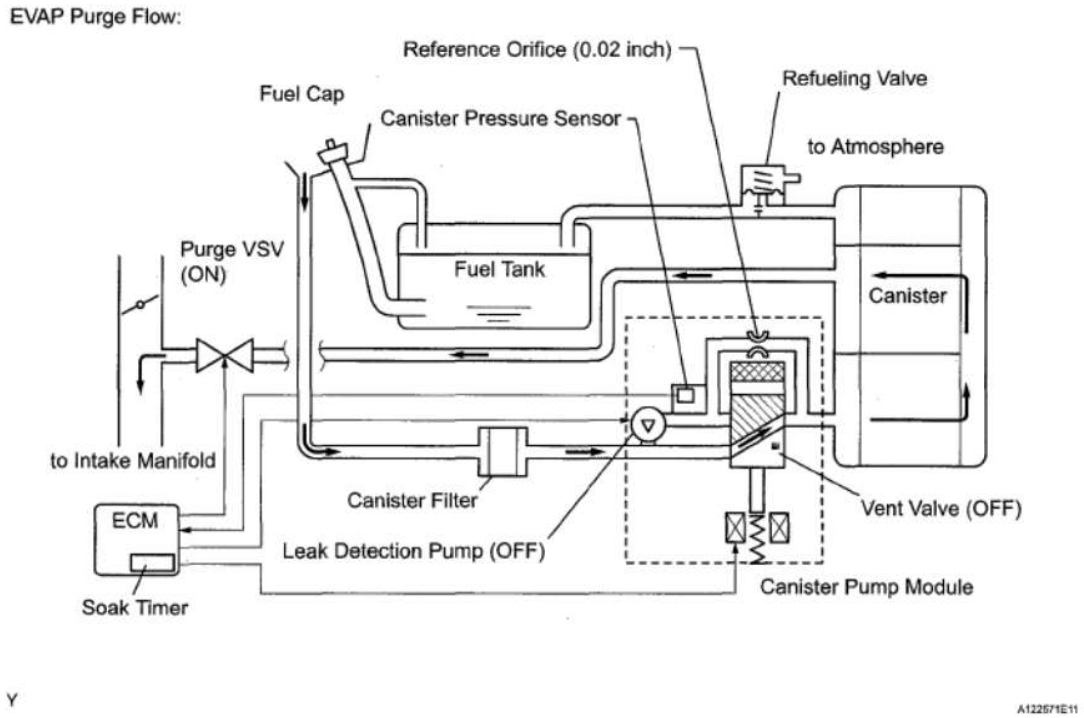


Fig. 282: EVAP Purge Flow Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

COMPONENT OPERATION CHART

Component	Operation
Canister	Contains activated charcoal to absorb EVAP (Evaporative Emissions) generated in fuel tank.
Cut-off valve	Located in fuel tank. Valve floats and closes when fuel tank is 100% full.
Purge VSV (Vacuum Switching Valve)	Opens or closes line between canister and intake manifold. ECM uses purge VSV to control EVAP purge flow. In order to discharge EVAP absorbed by canister to intake manifold, ECM opens purge VSV. EVAP discharge volume to intake manifold is controlled by purge VSV duty cycle ratio (current-carrying time). (Open: ON, Close: OFF)
Refueling valve	Controls EVAP pressure from fuel tank to canister. Valve consists of diaphragm, spring and restrictor (diameter: 0.08 inch). When fuel vapor and pressure inside fuel tank increase, valve opens. While EVAP is purged, valve closes and restrictor prevents a large amount of vacuum from affecting pressure in fuel tank. Valve is opened while refueling. When valve is open, adding fuel into fuel tank is possible.
Roll-over valve	Located in fuel tank. Valve closes by its own weight when vehicle overturns to prevent fuel from spilling out. %
Soak timer	Built into ECM. To ensure accurate EVAP monitor, measures 5 hours (+/-15 min.) after ignition switch is turned off. This allows fuel to cool down, stabilizing Fuel Tank Pressure (FTP). When approximately. 5 hours elapsed, ECM activates.

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Canister pump module	Consists of (a) to (d) below. Canister pump module cannot be disassembled.
(a) Vent valve	Vents and closes EVAP system. When ECM turns valve ON, EVAP system is closed. When ECM turns valve OFF, EVAP system is vented. Negative pressure (vacuum) is created in EVAP system to check for EVAP leaks by closing purge VSV and vent valve (closed), and operating leak detection pump are turned on (refer to **Fig. 283**).
(b) Canister pressure sensor	Indicates pressure as voltages. ECM supplies regulated 5 V to pressure sensor, and uses feedback from sensor to monitor EVAP system pressure (refer to **Fig. 284**).
(c) Vacuum pump	Creates negative pressure (vacuum) in EVAP system for leak check.
(d) Reference inch orifice	Has an opening with 0.02 inch diameter. Vacuum is produced through orifice by closing purge VSV, turning off vent valve and operating leak detection pump, to monitor reference pressure. Reference pressure indicates a small leak of EVAP.

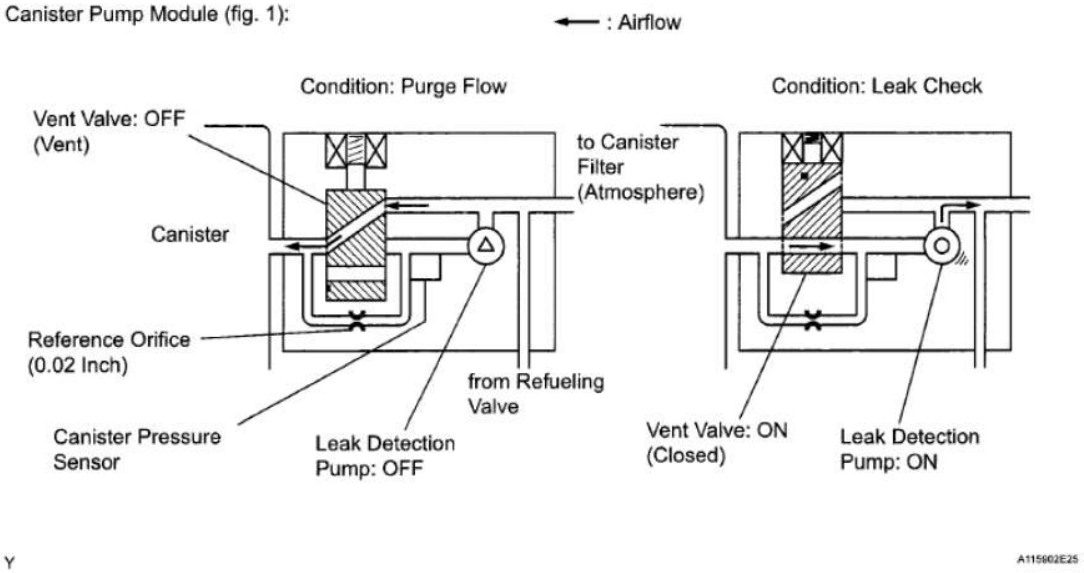
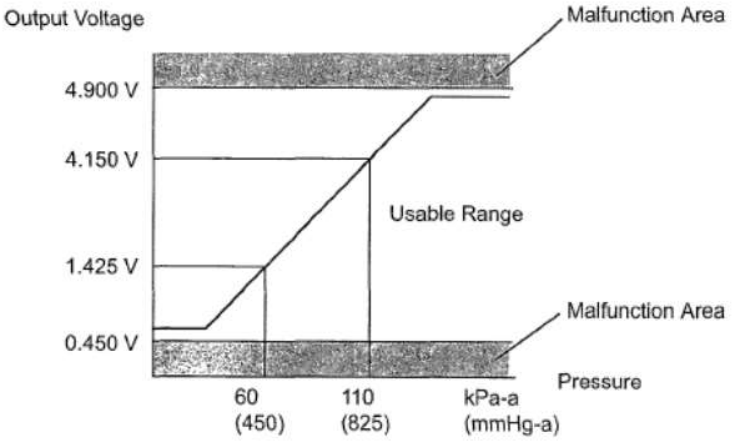


Fig. 283: Canister Pump Module System Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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Canister Pressure Sensor Specification (fig. 2):

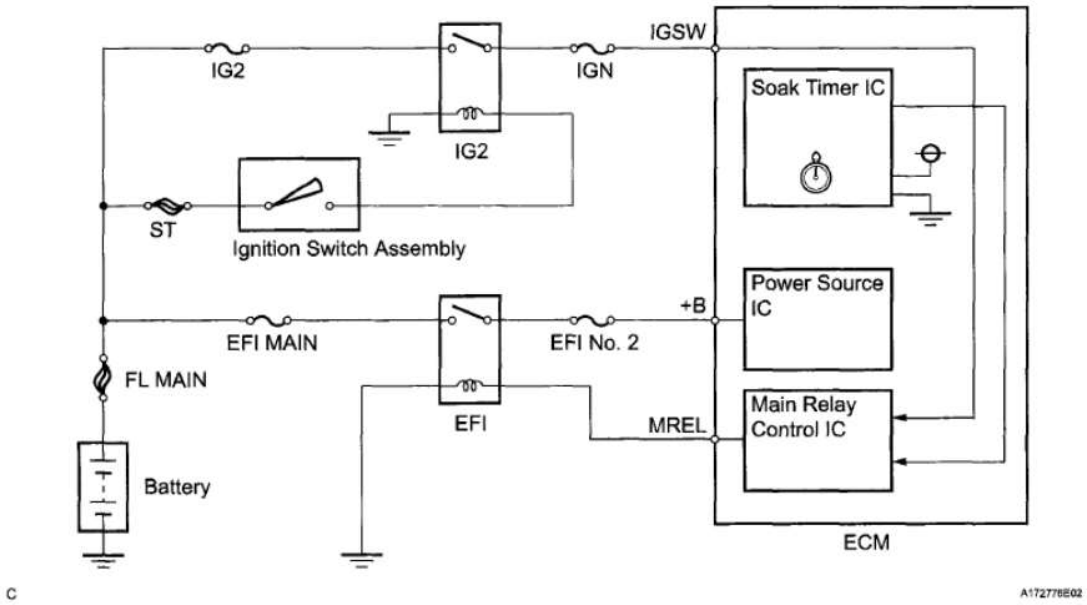


HINT:

Standard atmospheric pressure is 101.3 kPa-a (760 mmHg-a)

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Fig. 284: Canister Pressure Sensor Output Voltage Graph
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.



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Fig. 285: Canister Pressure Sensor Circuit Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

MONITOR RESULT

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Refer to **CHECKING MONITOR STATUS** .

CONFIRMATION DRIVING PATTERN

HINT:

After a repair, check Monitor Status by performing the Key-Off Monitor Confirmation and Purge Flow Monitor Confirmation described below.

1. **KEY-OFF MONITOR CONFIRMATION**
   a. Preconditions

      The monitor will not run unless:

      - The vehicle has been driven for 10 minutes or more (in a city area or on a freeway)
      - The fuel tank is less than 90% full
      - The altitude is less than 8000 ft. (2400 m)
      - The engine coolant temperature is between 4.4 and 35°C (40 and 95°F)
      - The intake air temperature is between 4.4 and 35°C (40 and 95°F)
      - The vehicle remains stationary (the vehicle speed is 0 mph [0 km/h])

   b. Monitor Conditions
      1. Allow the engine to idle for at least 5 minutes.
      2. Turn the ignition switch off and wait for 8 or 10.5 hours depending on certain vehicle conditions.

         HINT:

         Do not start the engine until after checking Monitor Status. If the engine is started, the steps described above must be repeated.

   c. Monitor Status
      1. Connect the Techstream to the DLC3.
      2. Turn the ignition switch to ON and turn the Techstream on.
      3. Enter the following menus: Powertrain/Engine/Monitor/Evaporative System.
      4. Check the "Status2" displayed on the Techstream.

         HINT:

         If Incomplete is displayed, the monitor is not complete. Make sure that the preconditions have been met, and perform the Monitor Conditions procedure again.

2. **PURGE FLOW MONITOR CONFIRMATION (P0441)**

   HINT:

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Perform this monitor confirmation after the Key-Off Monitor Confirmation shows Complete.

a. Preconditions

The monitor will not run unless:

- The vehicle has been driven for 10 minutes or more (in a city area or on a freeway)
- The engine coolant temperature is between 4.4 and 35°C (40 and 95°F)
- The intake air temperature is between 4.4 and 35°C (40 and 95°F)

b. Monitor Conditions

1. Release the pressure from the fuel tank by removing and reinstalling the fuel cap.
2. Warm the engine up until the engine coolant temperature reaches higher than 75°C (167°F).
3. Increase the engine speed to 3000 rpm once.
4. Allow the engine to idle and turn the A/C on for 1 minute.

c. Monitor Status

1. Turn the ignition switch off (if it is ON or the engine is running).
2. Connect the Techstream to the DLC3.
3. Turn the ignition switch to ON and turn the Techstream on.
4. Enter the following menus: Powertrain/Engine/Monitor/Evaporative System.
5. Check the "Status2" displayed on the Techstream.

HINT:

If Incomplete is displayed, the monitor is not complete. Make sure that the preconditions have been met, and perform the Monitor Conditions procedure again.

WIRING DIAGRAM

Refer to **DTC P0451** .

INSPECTION PROCEDURE

NOTE:

- **Inspect the fuses for circuits related to this system before performing the following inspection procedure.**
- **The Techstream is required to conduct the following diagnostic troubleshooting procedure.**

HINT:

- Using the Techstream monitor results enables the EVAP (Evaporative Emission) system to be confirmed.
- Read freeze frame data using the Techstream. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can be helpful in determining whether the vehicle was running or stopped, whether the engine was

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warmed up or not, whether the air fuel ratio was lean or rich, as well as other data recorded at the time of a malfunction.

1. **CONFIRM DTC**
   a. Turn the ignition switch off and wait for 10 seconds.
   b. Turn the ignition switch to ON.
   c. Turn the ignition switch off and wait for 10 seconds.
   d. Connect the Techstream to the DLC3.
   e. Turn the ignition switch to ON and turn the Techstream on.
   f. Enter the following menus: Powertrain/Engine/Trouble Codes.
   g. Confirm DTCs and freeze frame data.

   If any EVAP system DTCs are set, the malfunctioning area can be determined using the table below.

DTCs / Malfunctioning Areas	P043E P043F	P0441	P0451	P0452	P0453	P0455	P0456	P2401 P2402	P2419	P2420
Reference orifice clogged	●							●	●	
Reference orifice high-flow	●							●	●	
Purge VSV stuck open		●				●				
Purge VSV stuck closed		●								
Canister pressure sensor signal fixed			●							
Canister pressure sensor signal noise			●							
Canister pressure sensor low output				●						
Canister pressure sensor high output					●					
Gross leak		●				●				
Small leak							●			
Leak detection pump stuck OFF	●							●	●	
Leak detection pump stuck ON	●							●	●	
Vent valve stuck closed	●							●	●	
Vent valve stuck open (vent)										●

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Fig. 286: EVAP Malfunctioning Area Chart

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

NOTE: If the reference pressure difference between the first and second checks is more than the specification, the DTCs relating to the reference pressure (P043E, P043F, P0441, P0455, P0456, P2401 and P2420) will all be stored.

2. **PERFORM EVAP SYSTEM CHECK (AUTOMATIC MODE)**

NOTE:

- **In the Evaporative System Check (Automatic Mode) a series of 5 steps is performed automatically by the Techstream. It takes a maximum of approximately 18 minutes.**
- **Do not perform the Evaporative System Check when the fuel tank is more than 90% full because the cut-off valve may be closed, making the leak check of the fuel tank unavailable.**
- **Do not run the engine during this operation.**
- **When the temperature of the fuel is 35°C (95°F) or more, a large amount of vapor forms and any check results become inaccurate. When performing the Evaporative System Check, keep the temperature below 35°C (95°F).**

a. Connect the Techstream to the DLC3.
b. Clear the DTCs (See **DTC CHECK/CLEAR**).
c. Enter the following menus: Powertrain/Engine/Utility/Evaporative System Check/Automatic Mode.
d. After the Evaporative System Check is completed, check for pending DTCs. Enter the following menus: Powertrain/Engine/Trouble Codes/Pending.

HINT:

If no pending DTC is displayed, perform the Monitor Confirmation after this repair is completed. After this confirmation, check for pending DTCs. If no DTC is displayed, the EVAP system is normal.

3. **PERFORM EVAP SYSTEM CHECK (MANUAL MODE)**

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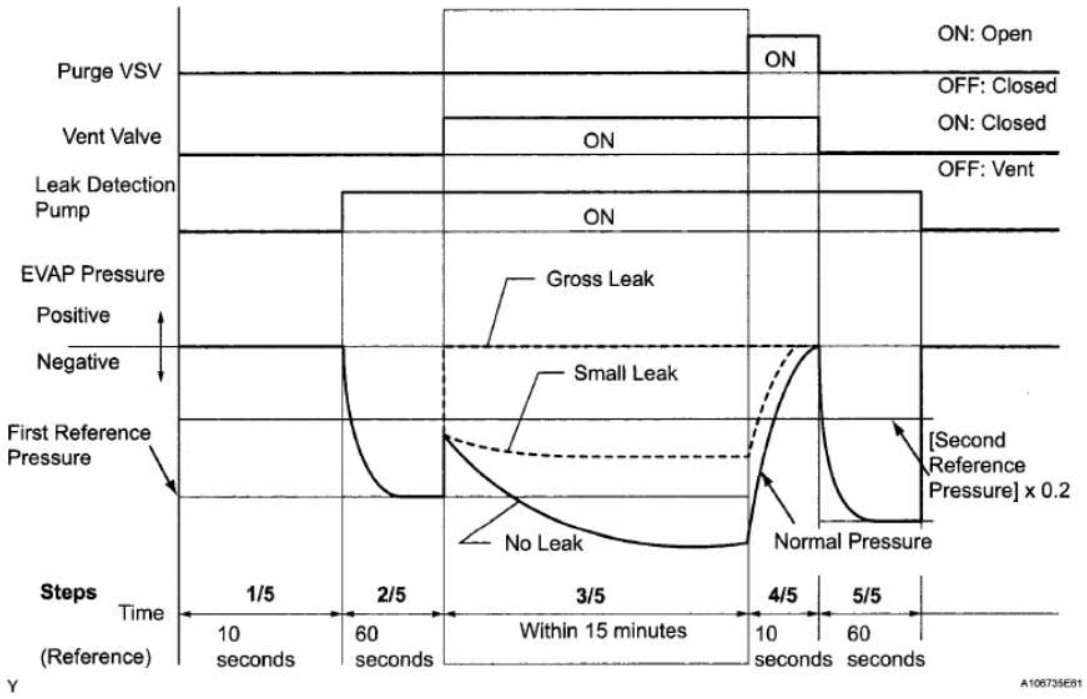


Fig. 287: EVAP Pressure Malfunction Chart - Manual Mode
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

NOTE:

- **In the Evaporative System Check (Manual Mode), the series of 5 Evaporative System Check steps are performed manually using the Techstream.**
- **Do not perform the Evaporative System Check when the fuel tank is more than 90% full because the cut-off valve may be closed, making the leak check of the fuel tank unavailable.**
- **Do not run the engine during this operation.**
- **When the temperature of the fuel is 35°C (95°F) or more, a large amount of vapor forms and any check results become inaccurate. When performing the Evaporative System Check, keep the temperature below 35°C (95°F).**

a. Connect the Techstream to the DLC3.
b. Clear the DTCs (See **DTC CHECK/CLEAR**).
c. Enter the following menus: Powertrain/Engine/Utility/Evaporative System Check/Manual Mode.

4. **PERFORM EVAP SYSTEM CHECK (STEP 1/5)**

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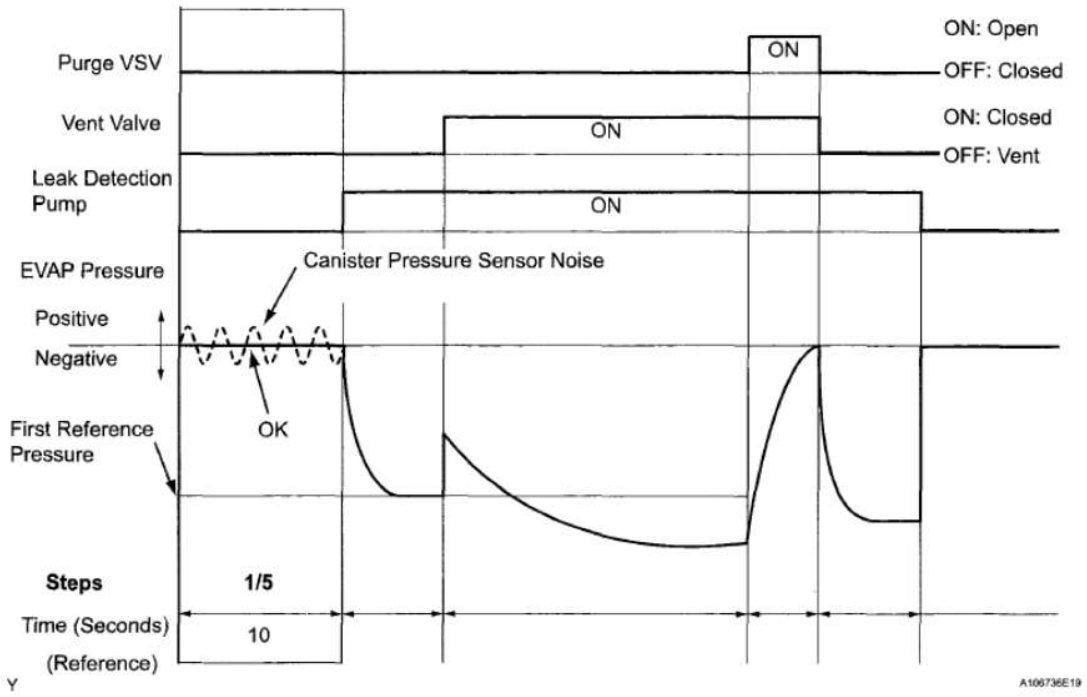


Fig. 288: EVAP Pressure Malfunction Chart - Step 1/5
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

a. Check the EVAP pressure in step 1/5.

Result

RESULT CHART

DTC (1)	Result	Suspected Trouble Area	Proceed to
-	Virtually no variation in EVAP pressure	Not yet determined	A
P0451	EVAP pressure fluctuates by +/-0.3 kPa-g (2.25 mmHg-g) or more	Pressure sensor noising	B
(1) The DTCs relating to the EVAP system displayed on the Techstream when checking.			

B: Go to step 30

A: Go to next step

5. **PERFORM EVAP SYSTEM CHECK (STEP 1/5 TO 2/5)**

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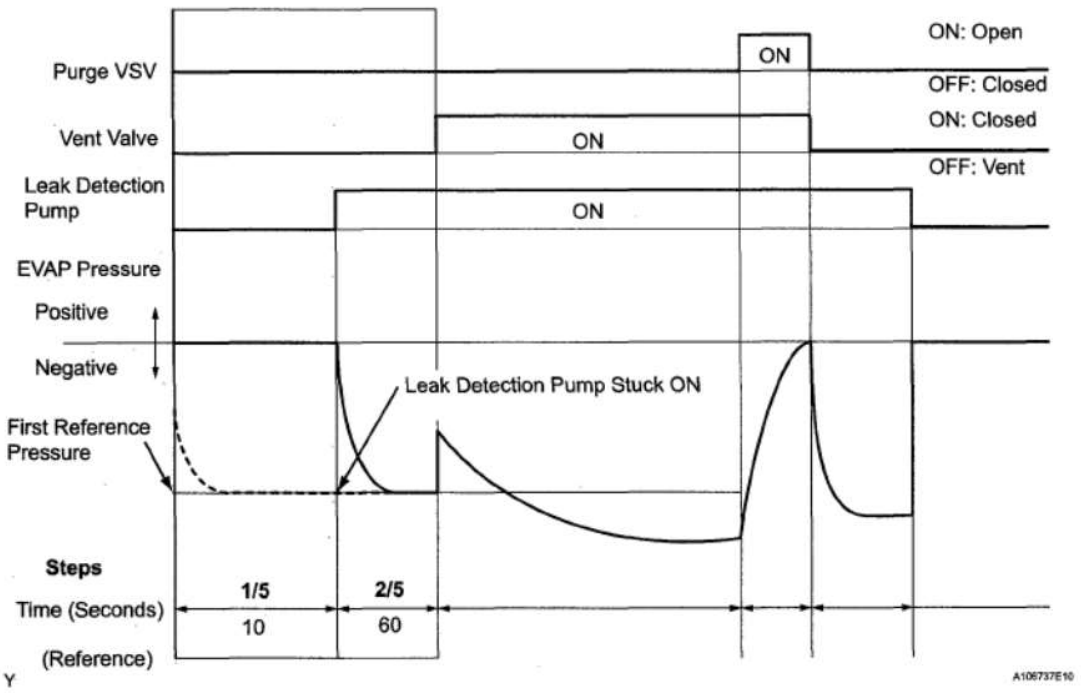


Fig. 289: EVAP Pressure Malfunction Chart - Step 1/5 To 2/5
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

a. Check the EVAP pressure in steps 1/5 and 2/5.

Result

RESULT CHART

DTC (1)	Result	Suspected Trouble Area	Proceed to
-	Virtually no variation in EVAP pressure during step 1/5. Then decreases to reference pressure standard(1)	Not yet determined	A
P2402	Small difference between EVAP pressures during steps 1/5 and 2/5	Vacuum pump stuck ON	B
(1) The DTCs related to the EVAP system are displayed on the Techstream when checking.			

HINT:

The first reference pressure standard is the value determined in step 2/5.

B: Go to step 23

A: Go to next step

6. **PERFORM EVAP SYSTEM CHECK (STEP 2/5)**

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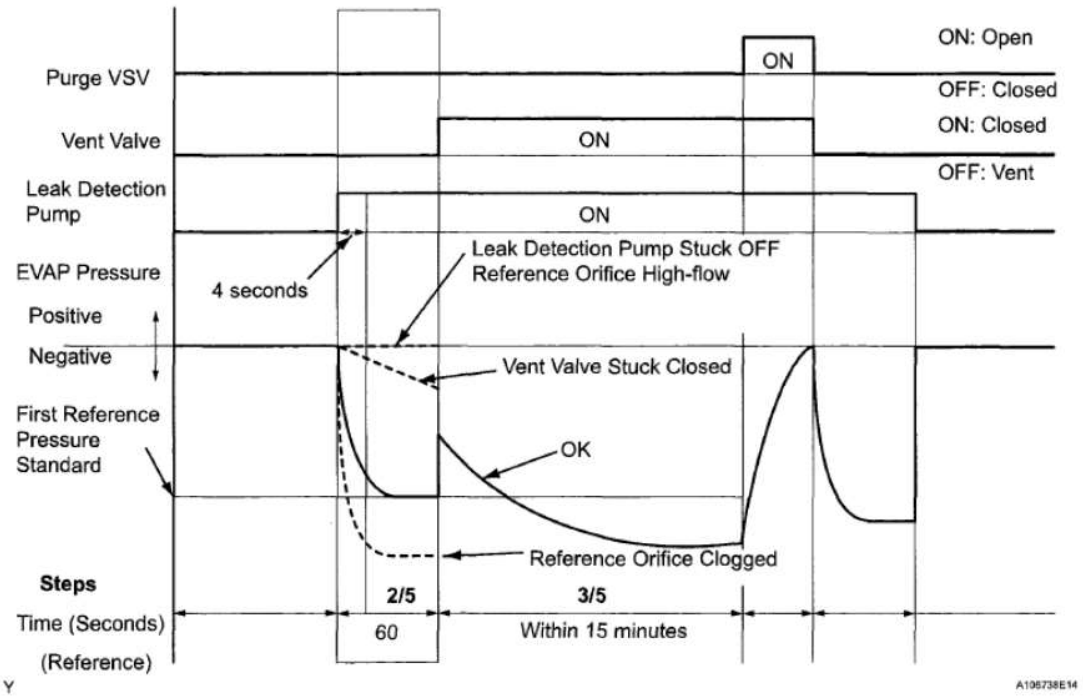


Fig. 290: EVAP Pressure Malfunction Chart - Step 2/5
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

HINT:

Make a note of the pressures checked in steps "A" and "B" below.

a. Check the EVAP pressure 4 seconds after the leak detection pump is activated*1 (Step "A").
b. Check the EVAP pressure again when it has stabilized. This pressure is the reference pressure standard (Step "B").

*1: The leak detection pump begins to operate at the time step 2/5 starts.

Result

RESULT CHART

DTC(1)	Result	Suspected Trouble Area	Proceed to
-	EVAP pressure in step (B) is between -4.85 kPa-g and -1.06 kPa-g (-36.38 mmHg-g and -7.95 mmHg-g)	Not yet determined	A
P043F and P2401	EVAP pressure in step (B) is -1.06 kPa-g (-7.95 mmHg-g) or more	• Reference orifice high-flow • Leak detection pump stuck OFF	B

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P043E	EVAP pressure in step (B) is less than -4.85 kPa-g (-36.38 mmHg-g)	Reference orifice clogged	C
P2419	EVAP pressure in step (A) is more than -1.06 kPa-g (-7.95 mmHg-g)	Vent valve stuck closed	D
(1) The DTCs related to the EVAP system are displayed on the Techstream when checking.			

B: Go to step 11

C: Go to step 30

D: Go to step 19

A: Go to next step

7. **PERFORM EVAP SYSTEM CHECK (STEP 2/5 TO 3/5)**

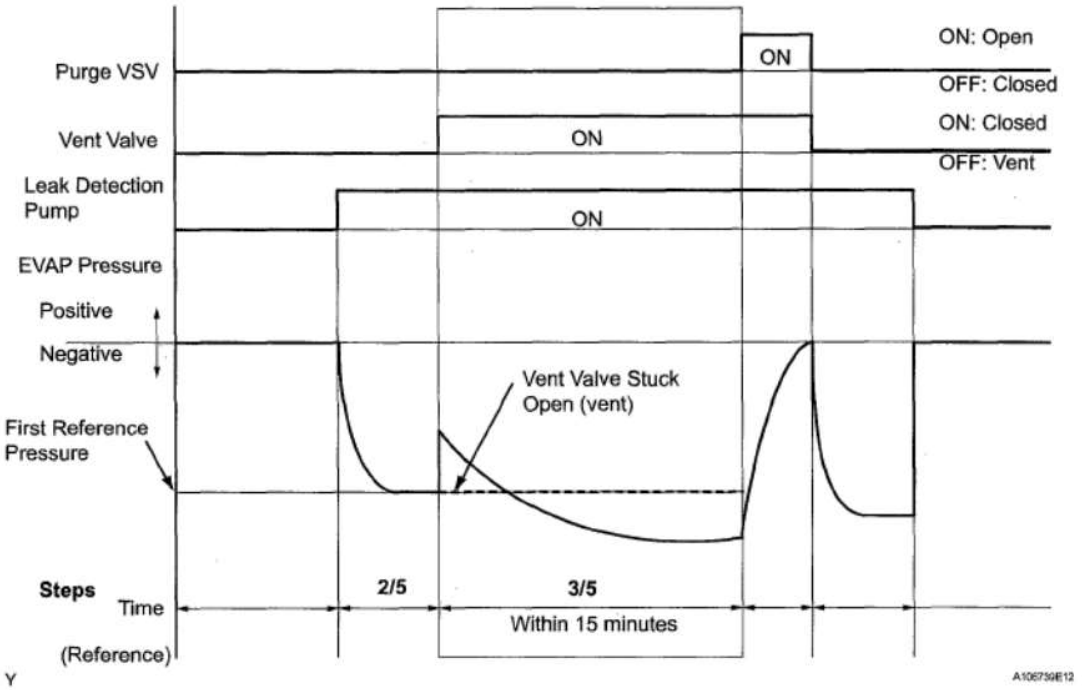


Fig. 291: EVAP Pressure Malfunction Chart - Step 2/5 To 3/5
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

a. Check the EVAP pressure increase in step 3/5.

Result

RESULT CHART

DTC	Result	Suspected Trouble	Proceed

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(1)		Area	to
-	EVAP pressure increases by 0.3 kPa-g (2.25 mmHg-g) or more within 10 seconds of proceeding from step 2/5 to step 3/5	Not yet determined	A
P2420	No variation in EVAP pressure even after proceeding from step 2/5 to step 3/5	Vent valve stuck open (vent)	B
P0451	No variation in EVAP pressure during steps 1/5 through 3/5	Canister pressure sensor malfunction	C
(1) The DTCs related to the EVAP system are displayed on the Techstream when checking.			

B: Go to step 20

C: Go to step 30

A: Go to next step

8. **PERFORM EVAP SYSTEM CHECK (STEP 3/5)**

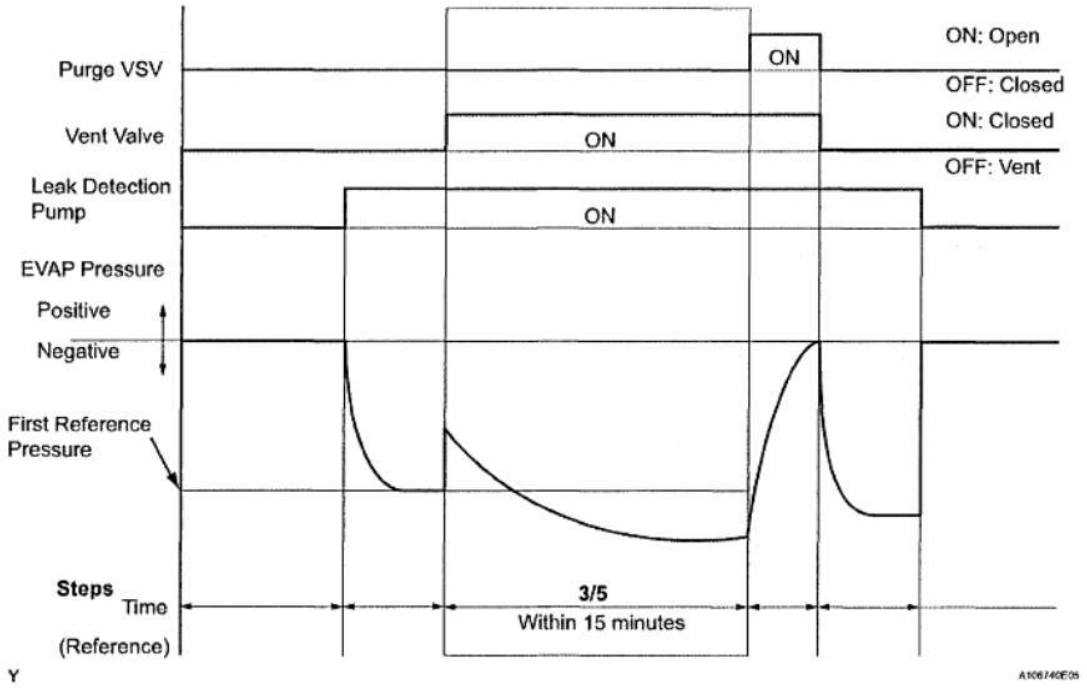


Fig. 292: EVAP Pressure Malfunction Chart - Step 3/5
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

a. Wait until the EVAP pressure change is less than 0.1 kPa-g (0.75 mmHg-g) for 30 seconds.
b. Measure the EVAP pressure and record it.

HINT:

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A few minutes are required for the EVAP pressure to become saturated. When there is little fuel in the fuel tank, it takes up to 15 minutes.

9. **PERFORM EVAP SYSTEM CHECK (STEP 4/5)**

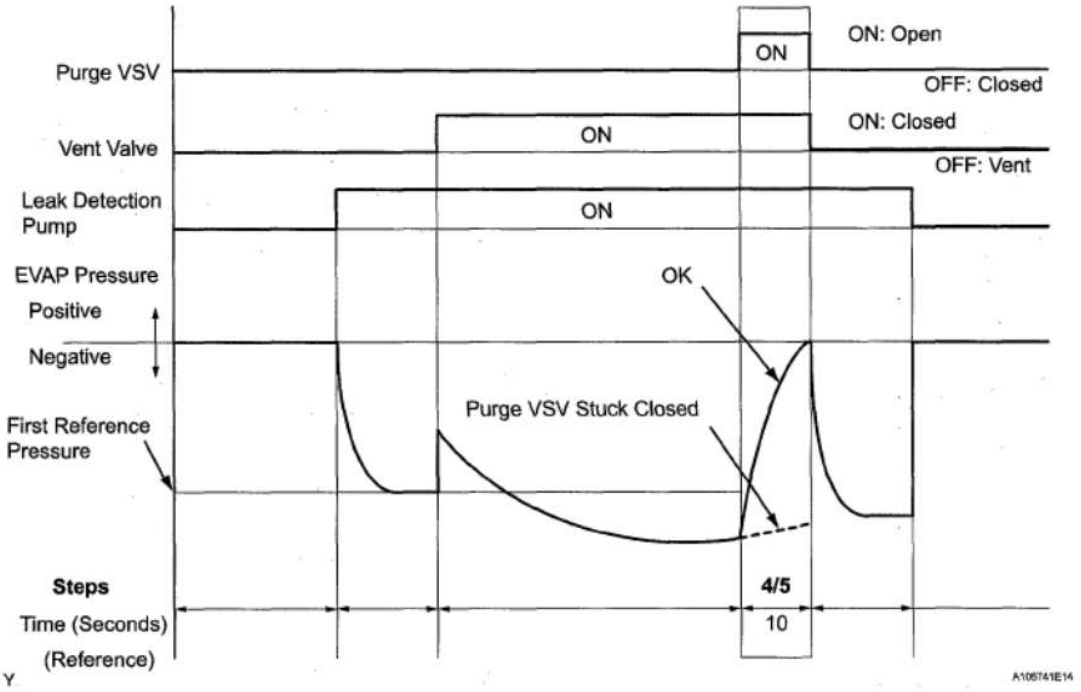


Fig. 293: EVAP Pressure Malfunction Chart - Step 4/5
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

a. Check the EVAP pressure in step 4/5.

Result

RESULT CHART

DTC (1)	Result	Suspected Trouble Area	Proceed to
-	EVAP pressure increases by 0.3 kPa-g (2.25 mmHg-g) or more within 10 seconds of proceeding from step 3/5 to step 4/5	Not yet determined	A
P0441	EVAP pressure increases by 0.3 kPa-g (2.25 mmHg-g) or more within 10 seconds of proceeding from step 3/5 to step 4/5	Problems in EVAP hose between purge VSV and intake manifold	B
P0441	Variation in EVAP pressure is less than 0.3 kPa-g (2.25 mmHg-g) for 10 seconds, after proceeding from step 3/5 to step 4/5	Purge VSV stuck closed	C
(1) The DTCs related to the EVAP system are displayed on the Techstream when checking.			

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B: Go to step 15

C: Go to step 12

A: Go to next step

10. **PERFORM EVAP SYSTEM CHECK (STEP 5/5)**

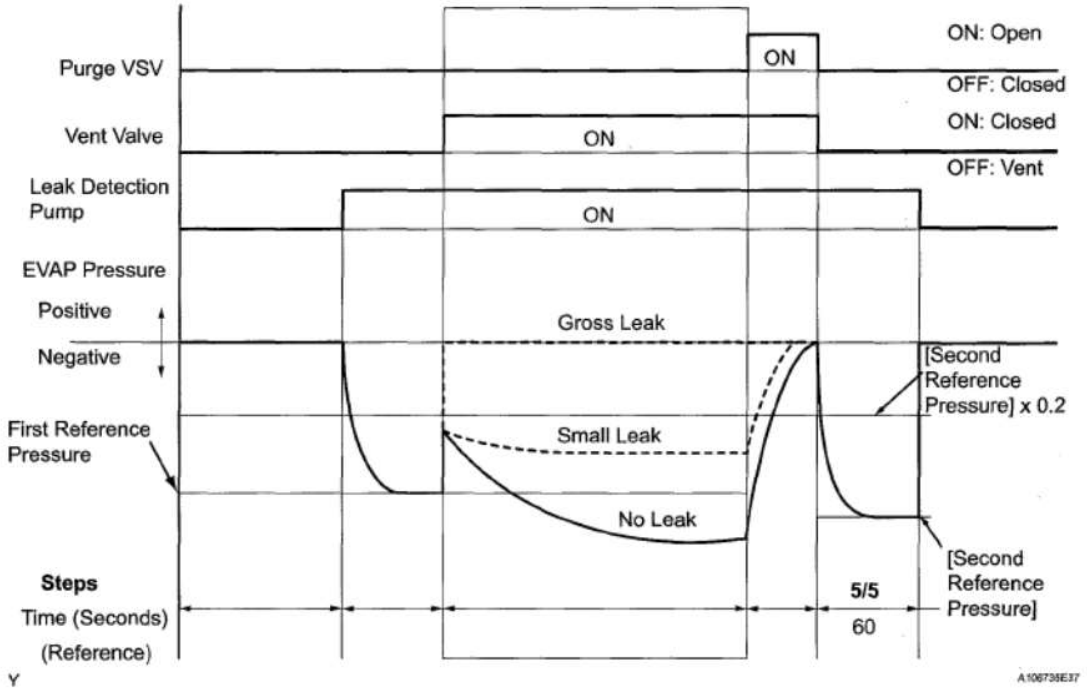


Fig. 294: EVAP Pressure Malfunction Chart - Step 5/5
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

a. Check the EVAP pressure in step 5/5.
b. Compare the EVAP pressure in step 3/5 and the second reference pressure standard (step 5/5).

Result

RESULT CHART

DTC(1)	Result	Suspected Trouble Area	Proceed to
-	EVAP pressure (step 3/5) lower than second reference pressure standard (step 5/5)	Not yet determined (no leakage from EVAP system)	A
P0441 and P0455	EVAP pressure (step 3/5) higher than [second reference pressure standard (step 5/5) x 0.2]	• Purge VSV stuck open • EVAP gross leak	B
P0456	EVAP pressure (step 3/5) higher than second reference pressure standard (step 5/5)	EVAP small leak	B

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(1) The DTCs related to the EVAP system are displayed on the Techstream when checking.

A: Go to step 36

B: Go to step 12

11. **PERFORM EVAP SYSTEM CHECK (STEP 3/5)**

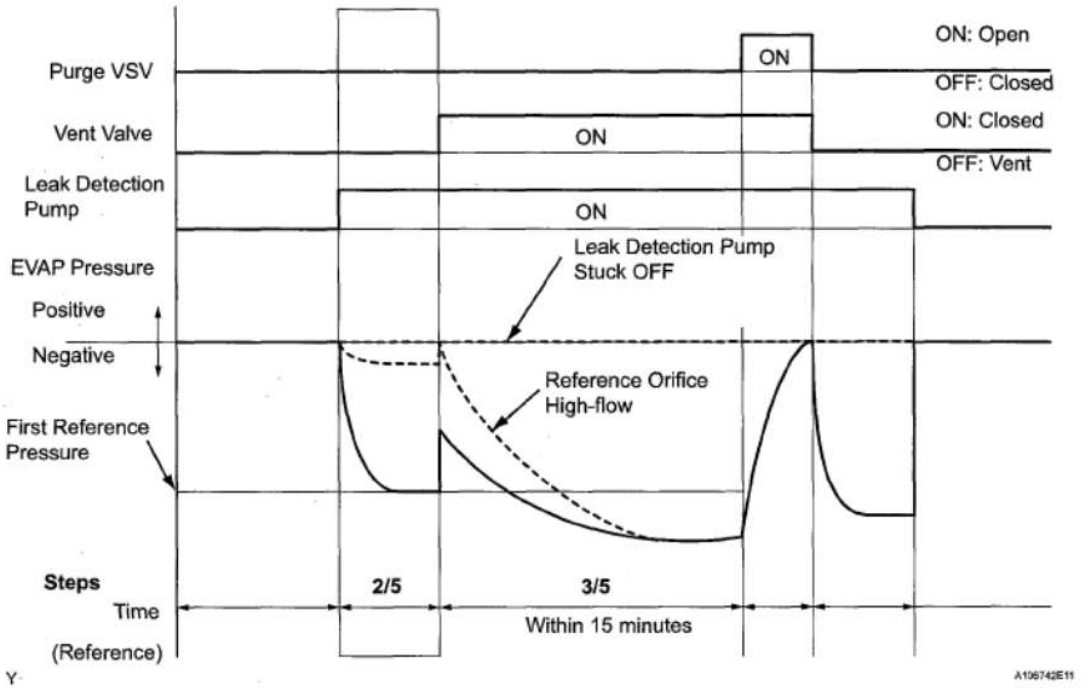


Fig. 295: EVAP Pressure Malfunction Chart - Step 3/5
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

a. Check the EVAP pressure in step 3/5.

Result

RESULT CHART

DTC (1)	Result	Suspected Trouble Area	Proceed to
P043F	EVAP pressure is less than [reference pressure standard] measured in step 2/5	Reference orifice high-flow	A
P2401	EVAP pressure is almost the same as [reference pressure standard] measured in step 2/5	Leak detection pump stuck OFF	B
(1) The DTCs related to the EVAP system are displayed on the Techstream when checking.			

HINT:

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The first reference pressure standard is the value determined in step 2/5.

A: Go to step 30

B: Go to step 23

12. **PERFORM ACTIVE TEST USING TECHSTREAM (PURGE VSV)**
    a. Enter the following menus: Powertrain/Engine/Active Test/Activate the VSV for EVAP Control.
    b. Disconnect the hose (connected to the canister) from the purge VSV.
    c. Start the engine.
    d. Using the Techstream, turn off the purge VSV (EVAP VSV: OFF).
    e. Confirm that the purge VSV has no suction with your fingers.
    f. Using the Techstream, turn on the purge VSV (EVAP VSV: ON).
    g. Confirm that the purge VSV has suction with your fingers.

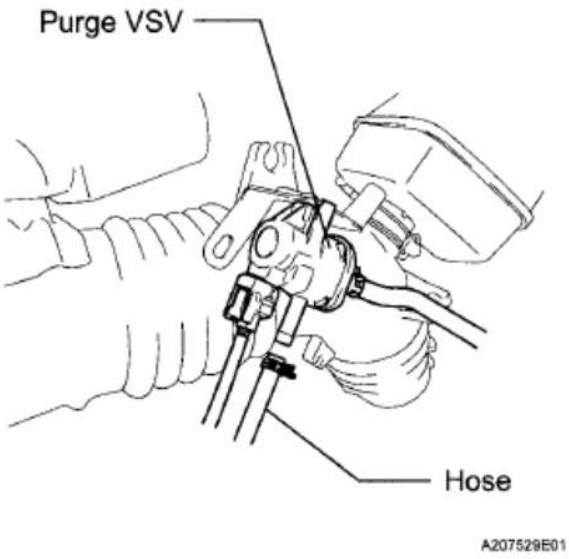


Fig. 296: Identifying Purge VSV
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Result

RESULT CHART

Result	Suspected Trouble Area	Proceed to
No suction when purge VSV turned OFF, and suction applied when turned ON	-	A
Suction applied when purge VSV turned OFF	Purge VSV stuck open	B
	• Purge VSV stuck closed	

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No suction when purge VSV turned ON	• Problems with EVAP hose between purge VSV and intake manifold	C

h. Reconnect the hose.

B: Go to step 14

C: Go to step 15

A: Go to next step

13. **CHECK FUEL CAP ASSEMBLY**

a. Check that the fuel cap is correctly installed and confirm the fuel cap meets OEM specification.

HINT:

If an EVAP tester is available, check the fuel cap using the tester.

1. Tighten the fuel cap.
2. Remove the fuel cap and install it onto the fuel cap adaptor.
3. Connect the EVAP tester pump hose to the adaptor, and pressurize the cap to 3.2 to 3.7 kPa-g (24 to 28 mmHg-g) using an EVAP tester pump.
4. Seal the adaptor and wait for 2 minutes.
5. Check the pressure. If the pressure is 2 kPa-g (15 mmHg-g) or more, the fuel cap is normal.

Result

RESULT CHART

Test Result	Suspected Trouble Area	Proceed to
Fuel cap correctly installed	-	A
Fuel cap loose	• Fuel cap improperly installed • Defective fuel cap • Fuel cap does not meet OEM specifications	B
No fuel cap	-	C

A: Go to step 29

B: Go to step 27

C: Go to step 28

14. **INSPECT PURGE VSV**

a. Turn the ignition switch off.

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b. Disconnect the purge VSV connector.
c. Disconnect the hose (connected to the canister) from the purge VSV.
d. Start the engine.
e. Confirm that the purge VSV has no suction with your fingers.

Result

RESULT CHART

Result	Suspected Trouble Area	Proceed to
No suction	ECM	A
Suction applied	Purge VSV	B

f. Reconnect the purge VSV connector.
g. Reconnect the hose.

A: Go to step 35

B: Go to step 31

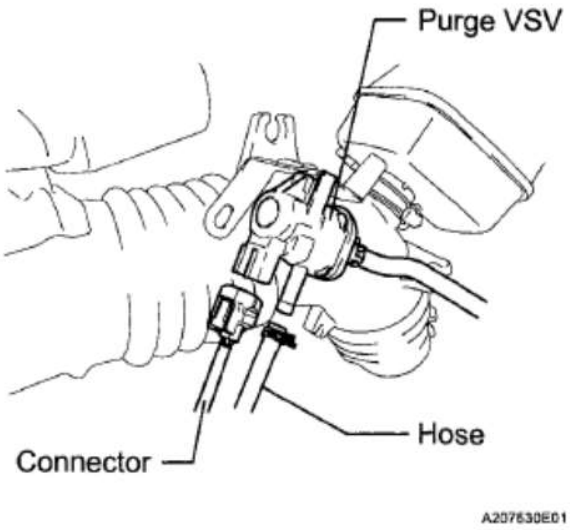


Fig. 297: Identifying Purge VSV And Purge VSV Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

15. **CHECK EVAP HOSE (PURGE VSV - THROTTLE BODY)**
    a. Disconnect the hose (connected to the throttle body) from the purge VSV.
    b. Start the engine.
    c. Confirm that the hose has suction with your fingers.

Result

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RESULT CHART

Result	Suspected Trouble Area	Proceed to
Suction applied	-	A
No suction	• Throttle body • EVAP hose between purge VSV and throttle body	B

d. Reconnect the hose.

B: Go to step 26

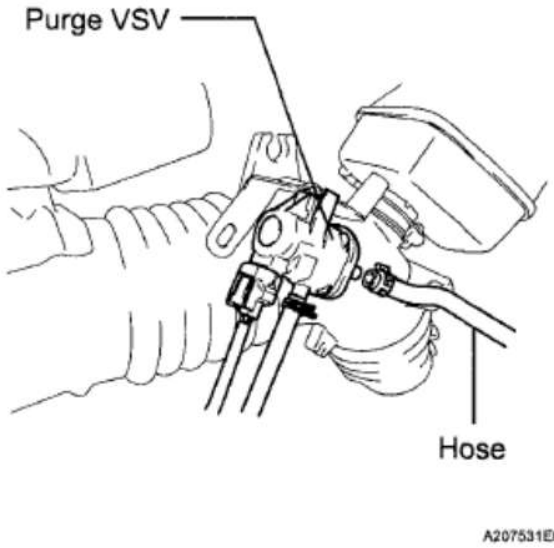


Fig. 298: Identifying Purge VSV And Hose
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

A: Go to next step

16. **INSPECT PURGE VSV**
    a. Remove the purge VSV.
    b. Apply battery voltage to the terminals of the purge VSV.
    c. Using compressed air, confirm that air flows from port A to port B.

Result

RESULT CHART

Result	Suspected Trouble Area	Proceed to
Air flows	-	A
No air flow	Purge VSV	B

d. Install the purge VSV.

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B: Go to step 31

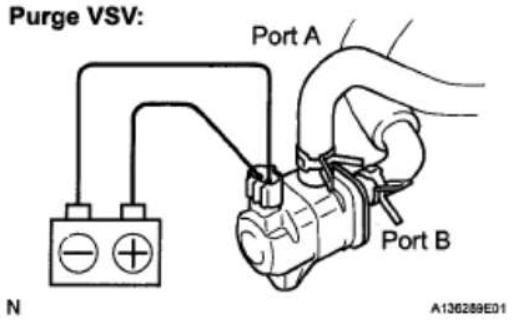


Fig. 299: Inspecting Purge VSV
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

A: Go to next step

17. **CHECK HARNESS AND CONNECTOR (POWER SOURCE OF PURGE VSV)**
    a. Disconnect the purge VSV connector.
    b. Turn the ignition switch to ON.
    c. Measure the voltage according to the value (s) in the table below.

Standard Voltage

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Switch Condition	Specified Condition
B29-1 - B29-2	Ignition switch ON	11 to 14 V

Result

RESULT CHART

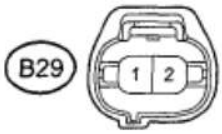
Result	Suspected Trouble Area	Proceed to
Between 11 V and 14 V	-	A
Other than result above	Wire harness or connectors between purge VSV and ECM	B

    d. Reconnect the purge VSV connector.

B: Go to step 32

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Front view of wire harness connector:
(to Purge VSV)



A168222E02

Fig. 300: Identifying B29 Purge VSV Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

A: Go to next step

18. **CHECK HARNESS AND CONNECTOR (PURGE VSV - ECM)**
    a. Disconnect the ECM connector and the purge VSV connector.
    b. Measure the resistance according to the value (s) in the table below.

Standard Resistance

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
B51-26 (PRG) - B29-2	Always	Below 1 ohms
B51-26 (PRG) - Body ground	Always	10 kohms or higher
B29-1 - Body ground	Always	10 kohms or higher

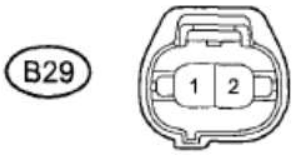
    c. Reconnect the purge VSV connector.
    d. Reconnect the ECM connector.

OK: Go to step 35

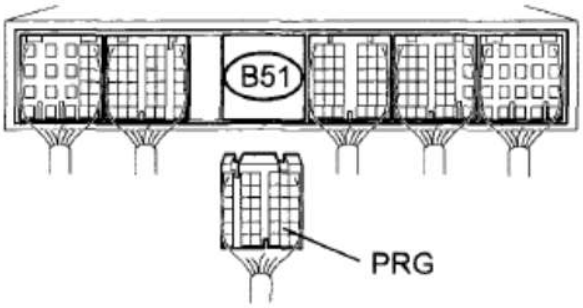
NG: Go to step 32

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Front view of wire harness connector:
(to Purge VSV)



Rear view of wire harness connector:
(to ECM)



A205897E02

Fig. 301: Identifying Purge VSV Connector And ECM Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

19. **PERFORM ACTIVE TEST USING TECHSTREAM (FOR VENT VALVE)**
    a. Turn the ignition switch to ON.
    b. Enter the following menus: Powertrain/Engine/Active Test/Activate the VSV for Vent Valve.
    c. Measure the voltage according to the value (s) in the table below.

Standard Voltage

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
D61-7 (VPMP) - Body ground	Vent valve ON	11 to 14 V
	Vent valve OFF	Below 3 V

Result

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RESULT CHART

Result	Suspected Trouble Area	Proceed to
Between 11V and 14 V when OFF Below 3 V when ON	Vent valve	A
Below 3 V when OFF and ON	ECM	B

Component with harness connected:
(ECM)

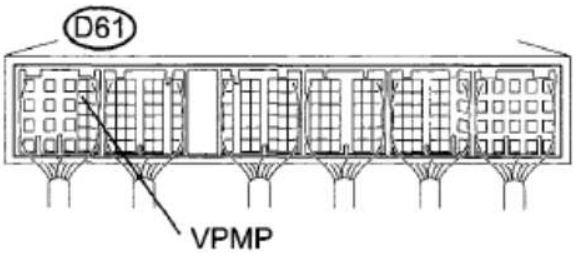


Fig. 302: Identifying ECM Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

A: Go to step 22

B: Go to step 35

20. **PERFORM ACTIVE TEST USING TECHSTREAM (FOR VENT VALVE)**
    a. Turn the ignition switch to ON.
    b. Enter the following menus: Powertrain/Engine/Active Test/Activate the VSV for Vent Valve.
    c. Measure the voltage according to the value (s) in the table below.

Standard Voltage

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
D61-7 (VPMP) - Body ground	Vent valve ON	11 to 14 V
	Vent valve OFF	Below 3 V

Result

RESULT CHART

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Result	Suspected Trouble Area	Proceed to
Below 3 V when OFF and ON	Power source of vent valve	A
Between 11V and 14 V when OFF Below 3 V when ON	Vent valve	B
Between 11V and 14 V when OFF and ON	ECM	C

Component with harness connected:
(ECM)

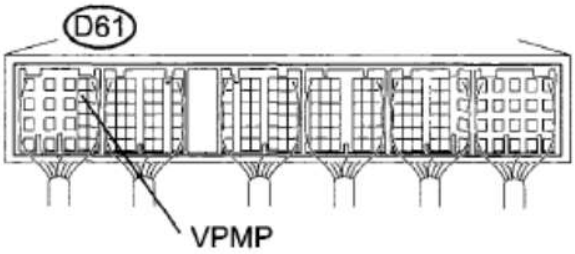


Fig. 303: Identifying ECM Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

B: Go to step 22

C: Go to step 35

A: Go to next step

21. **INSPECT CANISTER PUMP MODULE (POWER SOURCE FOR VENT VALVE)**
    a. Turn the ignition switch off.
    b. Disconnect the canister pump module connector.
    c. Turn the ignition switch to ON.
    d. Measure the voltage according to the value (s) in the table below.

Standard Voltage

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Switch Condition	Specified Condition
N8-9 (VLVB) - Body ground	Ignition switch ON	11 to 14 V

Result

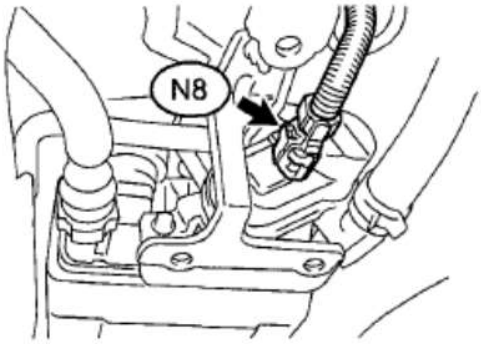
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RESULT CHART

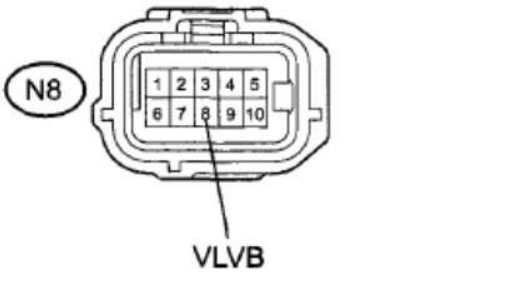
Test Result	Suspected Trouble Area	Proceed to
Between 11 V and 14 V	• Vent valve • ECM	A
Between 0 V and 3 V	Power source wire harness of vent valve	B

e. Reconnect the canister pump module connector.

B: Go to step 32



Front view of wire harness connector:
(to Canister Pump Module)



A166256E07

Fig. 304: Identifying Canister Pump Module Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

A: Go to next step

22. **INSPECT CANISTER PUMP MODULE (VENT VALVE OPERATION)**
    a. Turn the ignition switch off.
    b. Disconnect the canister pump module connector.
    c. Apply the battery voltage to terminals VLVB and VGND of the pump module.
    d. Touch the canister pump module to confirm the vent valve operation.

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Result

RESULT CHART

Result	Suspected Trouble Area	Proceed to
Operating	Wire harness between vent valve and ECM	A
Not operating	Vent valve	B

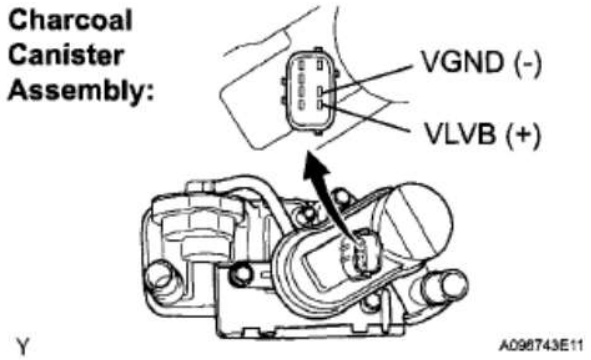


Fig. 305: Inspecting Canister Pump Module
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

e. Reconnect the canister pump module connector.

A: Go to step 32

B: Go to step 30

23. **PERFORM ACTIVE TEST USING TECHSTREAM (FOR CANISTER PUMP MODULE)**
    a. Enter the following menus: Powertrain/Engine/Active Test/Activate the Vacuum Pump.
    b. Measure the voltage according to the value (s) in the table below.

Standard Voltage

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
D61-9 (MPMP) - Body ground	Leak detection pump ON (Active Test ON)	11 to 14 V

Result

RESULT CHART

Test Result	Suspected Trouble Area	Proceed to
Between 0 V and 3 V when OFF Between 11V and 14 V when ON	-	A
Between 11 V and 14 V when OFF Between 0 V and 3 V when ON	ECM	B

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Component with harness connected:
(ECM)

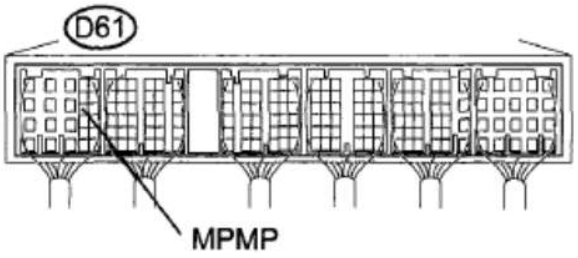


Fig. 306: Identifying ECM Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

B: Go to step 35

A: Go to next step

24. **CHECK HARNESS AND CONNECTOR (CANISTER PUMP MODULE - ECM)**
    a. Turn the ignition switch off.
    b. Disconnect the canister pump module connector.
    c. Turn the ignition switch to ON.
    d. Enter the following menus: Powertrain/Engine/Active Test/Activate the Vacuum Pump.
    e. Turn the vacuum pump on (Active Test ON).
    f. Measure the voltage according to the value (s) in the table below.

Standard Voltage

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
N8-1 (MTRB) - Body ground	Leak detection pump ON (Active Test ON)	11 to 14 V

Result

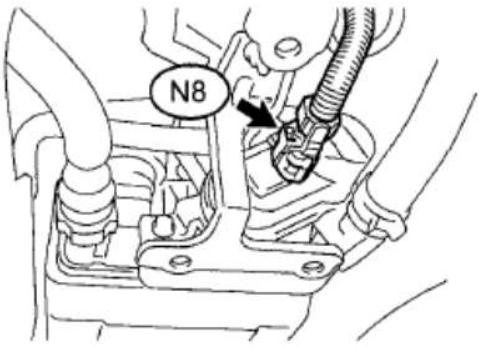
RESULT CHART

Test Result	Suspected Trouble Area	Proceed to
Between 11 V and 14 V	-	A
Between 0 V and 3 V	Wire harness between ECM and leak detection pump	B

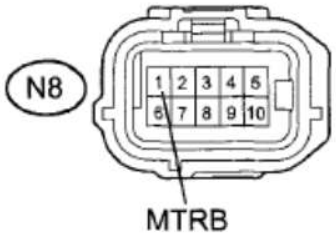
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g. Reconnect the canister pump module connector.

B: Go to step 32



Front view of wire harness connector:
(to Canister Pump Module)



A168256E08

Fig. 307: Identifying Canister Pump Module Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

A: Go to next step

25. **CHECK HARNESS AND CONNECTOR (CANISTER PUMP MODULE - BODY GROUND)**
    a. Disconnect the canister pump module connector.
    b. Turn the ignition switch off.
    c. Check the resistance according to the value (s) in the table below.

Standard Resistance

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
N8-6 (MGND) - Body ground	Always	Below 1 ohms

Result

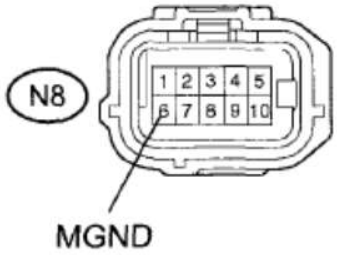
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RESULT CHART

Test Result	Suspected Trouble Area	Proceed to
Below 1 ohms.	Leak detection pump	A
10 kohms or higher	Wire harness between leak detection pump and body ground	B

Front view of wire harness connector:
(to Canister Pump Module)



A168260E12

Fig. 308: Identifying Canister Pump Module Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

d. Reconnect the canister pump module connector.

A: Go to step 30

B: Go to step 32

26. **INSPECT THROTTLE BODY**
    a. Stop the engine.
    b. Disconnect the EVAP hose from the throttle body.
    c. Start the engine.
    d. Confirm that the port of the throttle body has suction with your fingers.

Result

RESULT CHART

Test Result	Suspected Trouble Area	Proceed to
Suction applied	EVAP hose between throttle body and purge VSV	A
No suction	Throttle body	B

e. Reconnect the EVAP hose.

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A: Go to step 33

B: Go to step 34

27. **CORRECTLY REINSTALL OR REPLACE FUEL CAP**

HINT:

- When reinstalling the fuel cap, tighten it until a few click sounds are heard.
- When replacing the fuel cap, use a fuel cap that meets OEM specifications, and tighten it until a few click sounds are heard.

NEXT: Go to step 37

28. **REPLACE FUEL CAP ASSEMBLY**

HINT:

When installing the fuel cap, tighten it until a few click sounds are heard.

NEXT: Go to step 37

29. **LOCATE EVAP LEAK**
    a. Disconnect the vent hose.

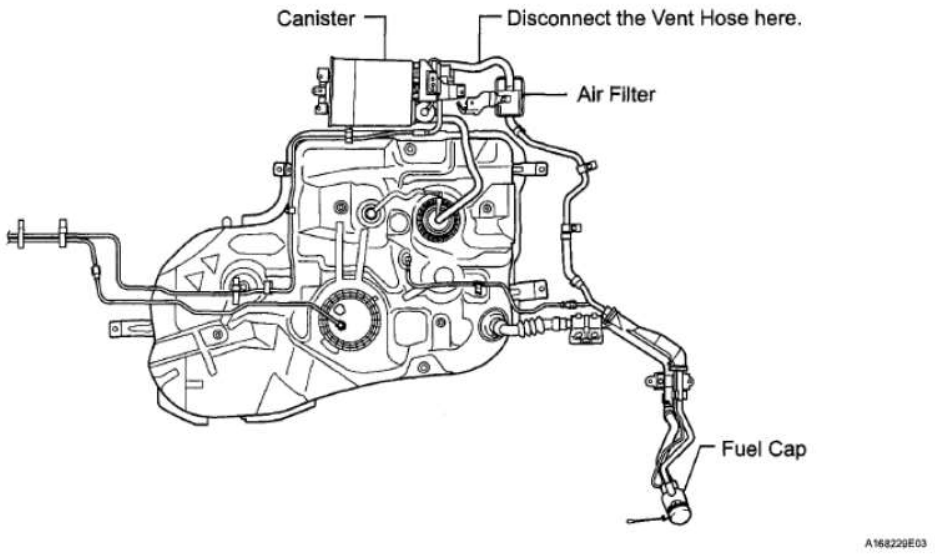


Fig. 309: Identifying EVAP Components Location
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

    b. Connect the EVAP pressure tester tool to the canister with the adapter.

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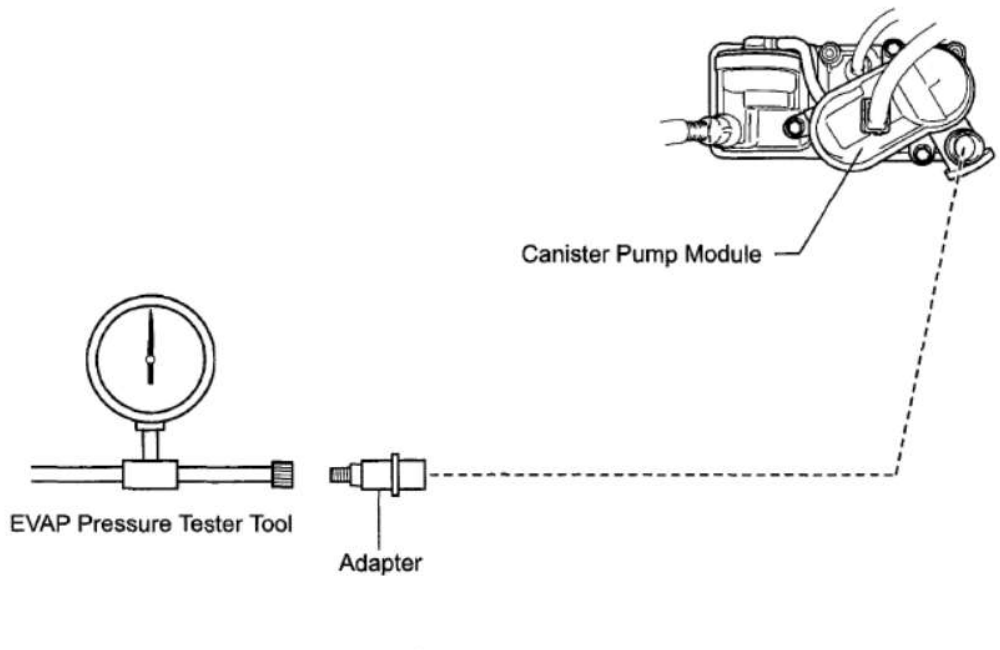


Fig. 310: Connecting EVAP Pressure Tester Tool To Canister
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

c. Pressurize the EVAP system by 3.2 to 3.7 kPa-g (24 to 28 mmHg-g).
d. Apply soapy water to the piping and the connecting parts of the EVAP system.
e. Look for areas where bubbles appear. This indicates a leak point.
f. Repair or replace the leak point.

NEXT: Go to step 37

30. **REPLACE CHARCOAL CANISTER ASSEMBLY**
a. Replace the charcoal canister assembly (See **REMOVE**).

NOTE: When replacing the canister, check the canister pump module interior and related pipes for water, fuel and other liquids. If liquids are present, check for disconnections and/or cracks in the following parts: 1) the pipe from the air inlet port to the canister pump module; 2) the canister filter; 3) the fuel tank vent hose.

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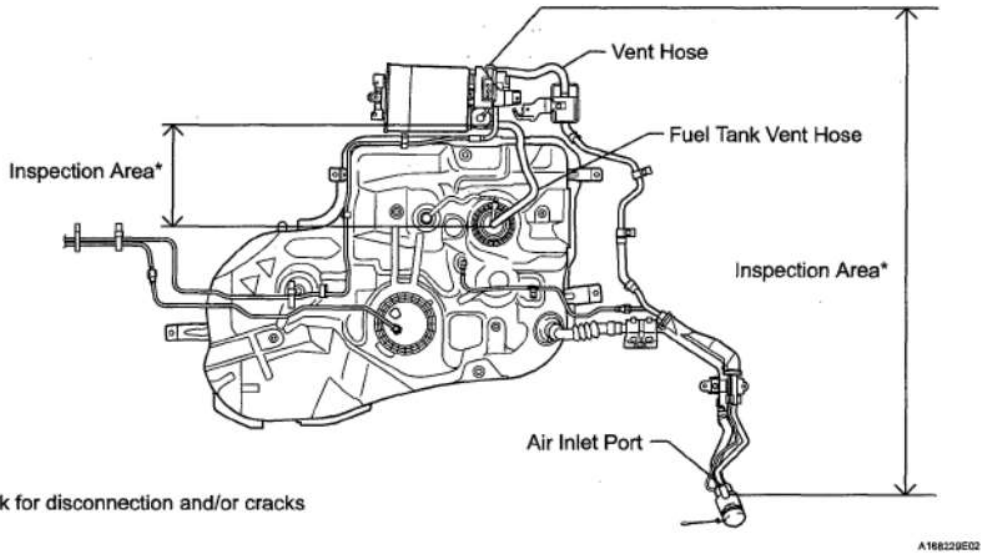


Fig. 311: Identifying Inspection Area Of Charcoal Canister Assembly
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

NEXT: Go to step 37

31. **REPLACE PURGE VSV**
    a. Replace the purge VSV (See **REMOVAL**).

    NEXT: Go to step 37

32. **REPAIR OR REPLACE HARNESS OR CONNECTOR**

    NEXT: Go to step 37

33. **REPLACE EVAP HOSE (THROTTLE BODY - PURGE VSV)**

    NEXT: Go to step 37

34. **INSPECT THROTTLE BODY**
    a. Remove the throttle body (See **INSPECTION PROCEDURE**).
    b. Check that the EVAP purge port of the throttle body is not clogged. If necessary, replace the throttle body.

    NEXT: Go to step 37

35. **REPLACE ECM**
    a. Replace the ECM (See **REMOVAL**).

    NEXT: Go to step 37

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36. **REPAIR OR REPLACE PARTS AND COMPONENTS INDICATED BY OUTPUT DTCS**
    a. Repair the malfunctioning areas indicated by the DTCs that had been confirmed when the vehicle was brought in.
37. **PERFORM EVAP SYSTEM CHECK (AUTOMATIC MODE)**

NOTE:

- **In the Evaporative System Check (Automatic Mode), the series of 5 Evaporative System Check steps are performed automatically. It takes a maximum of approximately 18 minutes.**
- **Do not perform the Evaporative System Check when the fuel tank is more than 90% full because the cut-off valve may be closed, making the leak check of the fuel tank unavailable.**
- **Do not run the engine during this operation.**
- **When the temperature of the fuel is 35°C (95°F) or more, a large amount of vapor forms and any check results become inaccurate. When performing an Evaporative System Check, keep the temperature below 35°C (95°F).**

a. Clear the DTCs (See **DTC CHECK/CLEAR**).
b. On the Techstream, enter the following menus: Powertrain/Engine/Utility/Evaporative System Check/Automatic Mode.
c. After the Evaporative System Check is completed, check for pending DTCs by entering the following menus: Powertrain/Engine/Trouble Codes/Pending.

HINT:

If no pending DTC is found, the repair has been successfully completed.

NEXT: COMPLETED

ECM POWER SOURCE CIRCUIT

DESCRIPTION

When the ignition switch is turned to ON, the battery voltage is applied to terminal IG SW of the ECM. The ECM MREL output signal causes a current to flow to the coil, closing the contacts of the EFI relay and supplying power to terminal +B, +B2 of the ECM.

If the ignition switch is turned off, the ECM holds the EFI relay ON for a maximum of 2 seconds to allow for the initial setting of the throttle valve.

WIRING DIAGRAM

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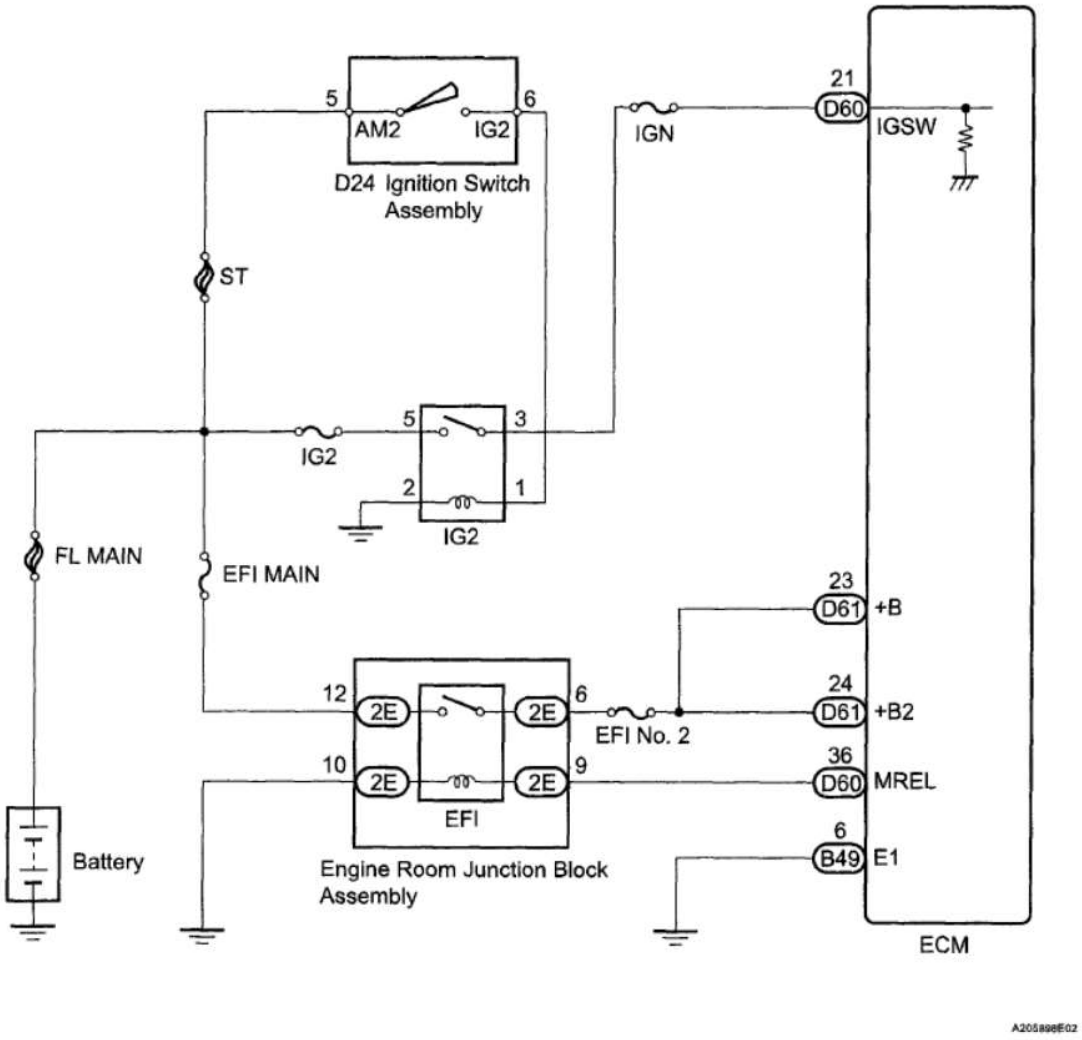


Fig. 312: ECM Power Source Circuit - Wiring Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSPECTION PROCEDURE

NOTE: Inspect the fuses for circuits related to this system before performing the following inspection procedure.

1. **INSPECT ECM (+B VOLTAGE)**
   a. Turn the ignition switch to ON.
   b. Measure the voltage according to the value (s) in the table below.

Standard Voltage

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Switch Condition	Specified Condition

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D61-23 (+B) - B49-6 (E1)	Ignition switch ON	11 to 14 V
D61-24 (+B2) - B49-6 (E1)	Ignition switch ON	11 to 14 V

NG: Go to step 2

Component with harness connected:
(ECM)

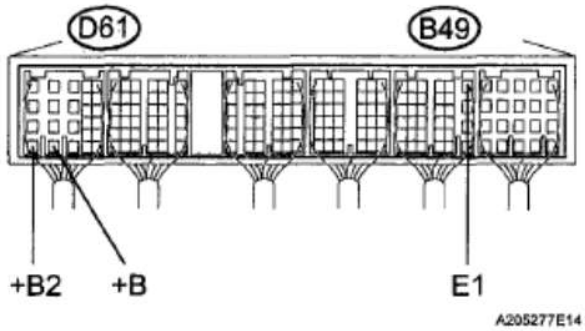


Fig. 313: Identifying ECM Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: PROCEED TO NEXT SUSPECTED AREA SHOWN IN PROBLEM SYMPTOMS TABLE (See **TERMINALS OF ECM**)

2. **CHECK HARNESS AND CONNECTOR (ECM - BODY GROUND)**
   a. Disconnect the ECM connector.
   b. Measure the resistance according to the value (s) in the table below.

Standard Resistance (Check for Open)

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
B49-6 (E1) - Body ground	Always	Below 1 ohms

   c. Reconnect the ECM connector.

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR

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Rear view of wire harness connector:
(to ECM)

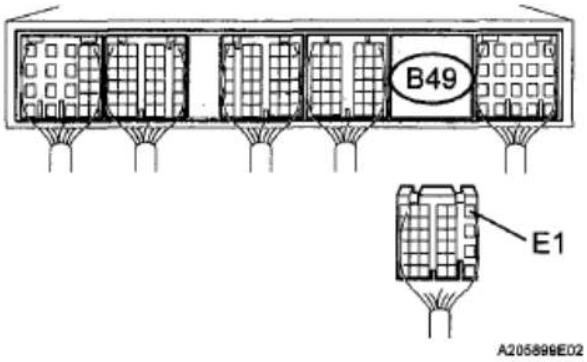


Fig. 314: Disconnecting ECM B49 Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

3. **INSPECT ECM (MREL VOLTAGE)**
   a. Turn the ignition switch to ON.
   b. Measure the voltage according to the value (s) in the table below.

Standard Voltage

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Switch Condition	Specified Condition
D60-36 (MREL) - B49-6 (E1)	Ignition switch ON	11 to 14 V

NG: Go to step 8

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Component with harness connected:
(ECM)

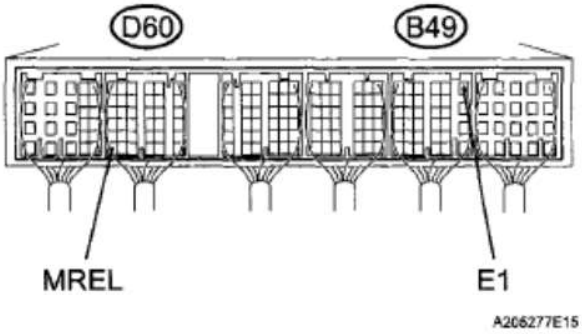


Fig. 315: Identifying ECM Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

4. **INSPECT ENGINE ROOM JUNCTION BLOCK ASSEMBLY (EFI RELAY)**
   a. Inspect the EFI relay (See **INSTALLATION**).

   NG: REPLACE ENGINE ROOM JUNCTION BLOCK ASSEMBLY

   OK: Go to next step

5. **CHECK HARNESS AND CONNECTOR (EFI RELAY - ECM)**
   a. Remove the engine room junction block assembly from the engine room relay block.
   b. Disconnect the ECM connector.
   c. Measure the resistance according to the value (s) in the table below.

   Standard Resistance (Check for Open)

   TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
2E-9 - D60-36 (MREL)	Always	Below 1 ohms

   Standard Resistance (Check for Short)

   TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
2E-9 or D60-36 (MREL) - Body ground	Always	10 kohms or higher

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d. Reinstall the engine room junction block assembly.
e. Reconnect the ECM connector.

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR

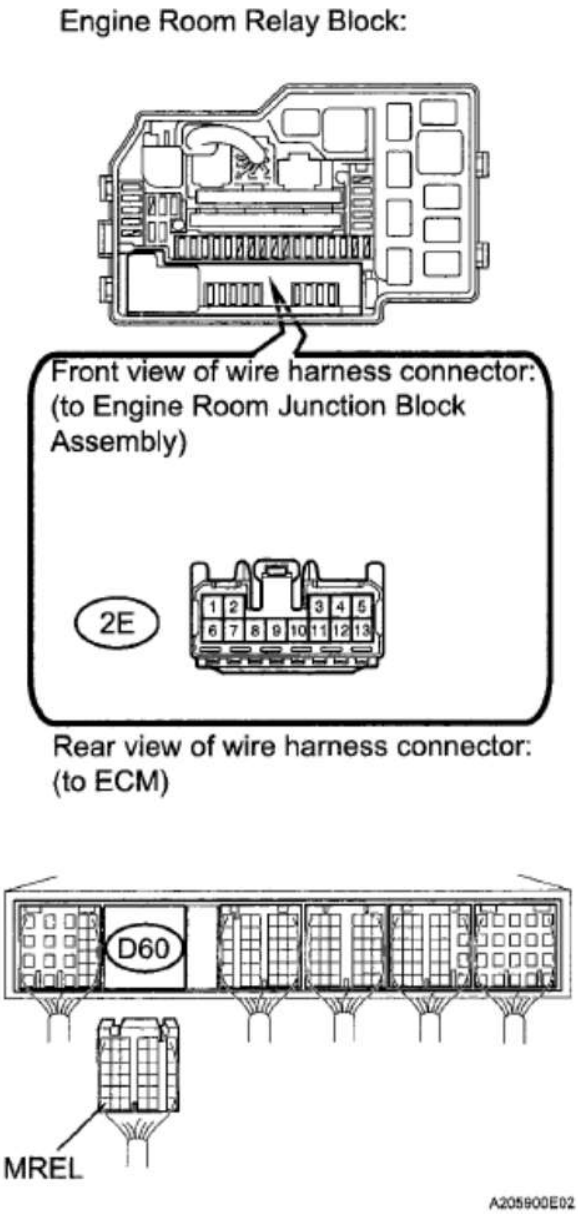


Fig. 316: Identifying Engine Room Junction Block Assembly And ECM Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

6. **CHECK HARNESS AND CONNECTOR (EFI RELAY - BODY GROUND)**

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a. Remove the engine room junction block assembly from the engine room relay block.
b. Measure the resistance according to the value (s) in the table below.

Standard Resistance (Check for Open)

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
2E-10 - Body ground	Always	Below 1 ohms

c. Reinstall the engine room junction block assembly.

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR

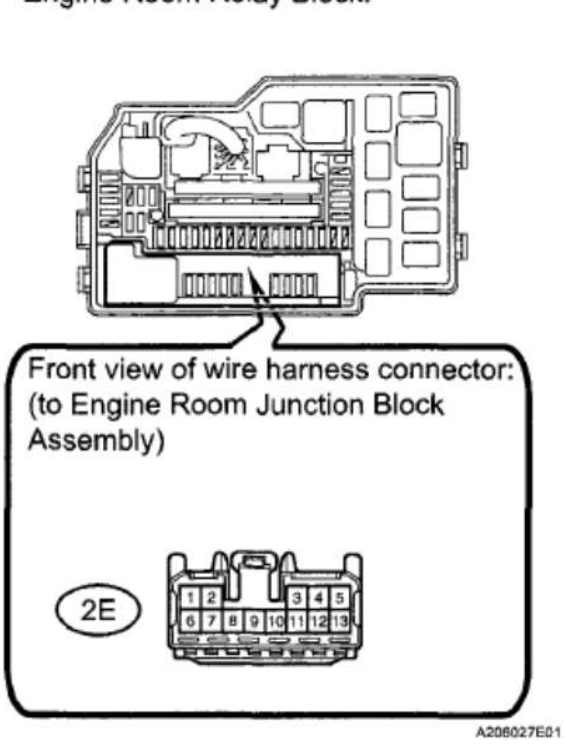


Fig. 317: Identifying Engine Room Junction Block Assembly
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

7. **CHECK HARNESS AND CONNECTOR (EFI RELAY - ECM)**
   a. Remove the engine room junction block assembly from the engine room relay block.
   b. Disconnect the ECM connector.
   c. Measure the resistance according to the value (s) in the table below.

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Standard Resistance (Check for Open)

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
2E-6 - D61-23 (+B)	Always	Below 1 ohms
2E-6 - D61-24 (+B2)	Always	Below 1 ohms

Standard Resistance (Check for Short)

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
2E-6 or D61-23 (+B) - Body ground	Always	10 kohms or higher
2E-6 or D61-24 (+B2) - Body ground	Always	10 kohms or higher

d. Reinstall the engine room junction block assembly.
e. Reconnect the ECM connector.

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR

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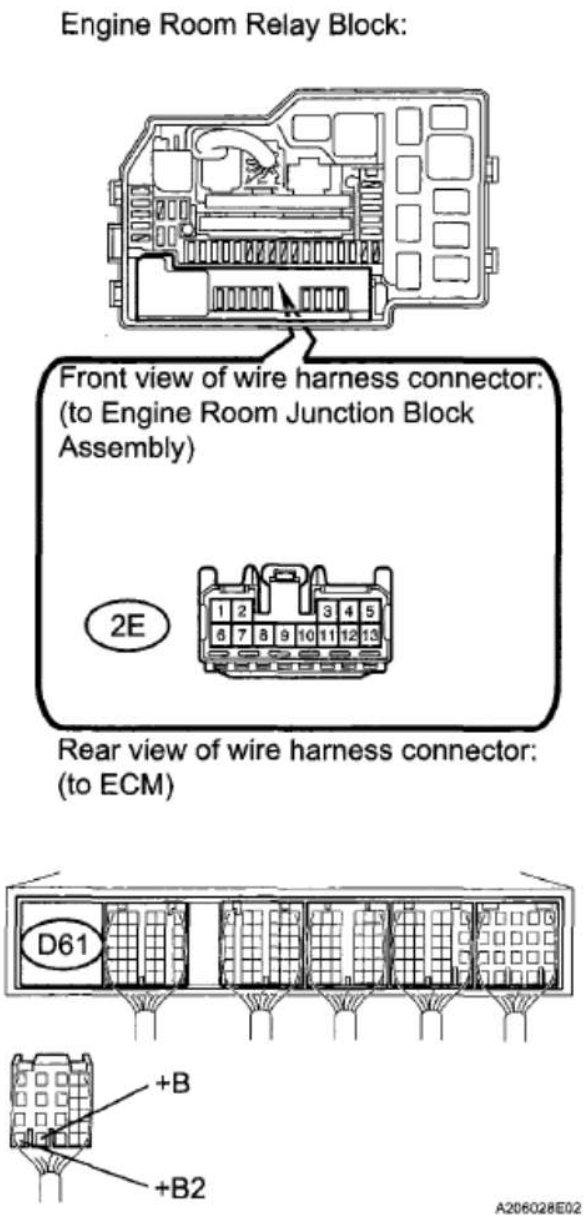


Fig. 318: Identifying Engine Room Junction Block Assembly And ECM Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: REPAIR OR REPLACE HARNESS OR CONNECTOR (BATTERY - EFI RELAY)

8. **INSPECT ECM (IG SW VOLTAGE)**
   a. Turn the ignition switch to ON.
   b. Measure the voltage according to the value (s) in the table below.

Standard Voltage

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TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Switch Condition	Specified Condition
D60-21 (IG SW) - B49-6 (E1)	Ignition switch ON	11 to 14 V

NG: Go to step 9

Component with harness connected:
(ECM)

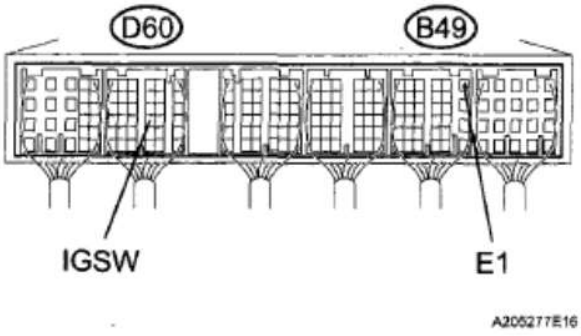


Fig. 319: Identifying ECM Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: REPLACE ECM (See **REMOVAL**)

9. **CHECK HARNESS AND CONNECTOR (ECM - IG2 RELAY)**
   a. Remove the IG2 relay from the engine room relay block.
   b. Disconnect the ECM connector.
   c. Measure the resistance according to the value (s) in the table below.

Standard Resistance

TESTER CONNECTION SPECIFIED CONDITION CHART

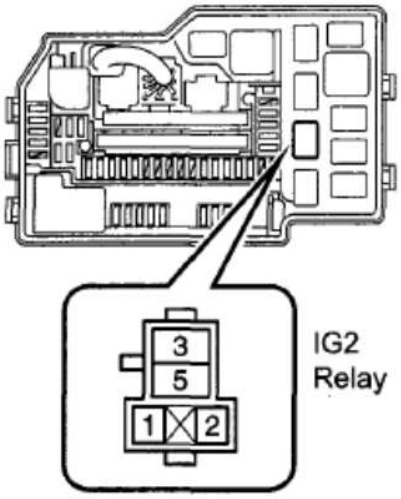
Tester Connection	Condition	Specified Condition
IG2 relay terminal 3 -D60-21 (IG SW)	Always	Below 1 ohms

   d. Reconnect the ECM connector.
   e. Reinstall the IG2 relay.

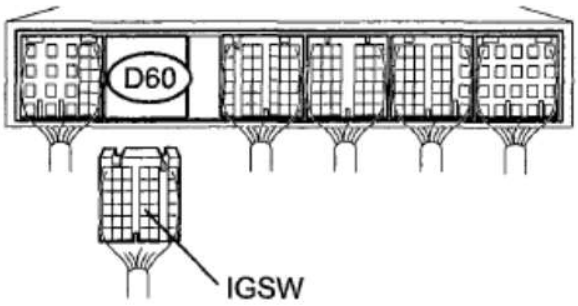
NG: Go to step 13

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Engine Room Relay Block:



Rear view of wire harness connector:
(to ECM)



A206029E02

Fig. 320: Identifying IG2 Relay And ECM Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

10. **INSPECT RELAY (IG2 RELAY)**
    a. Remove the IG2 relay from the engine room relay block.
    b. Measure the resistance according to the value (s) in the table below.

Standard Resistance

TESTER CONNECTION SPECIFIED CONDITION CHART

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Tester Connection	Condition	Specified Condition
3 - 5	Battery voltage is not applied between terminals 1 and 2	10 kohms or higher
	Battery voltage applied between terminals 1 and 2	Below 1 ohms

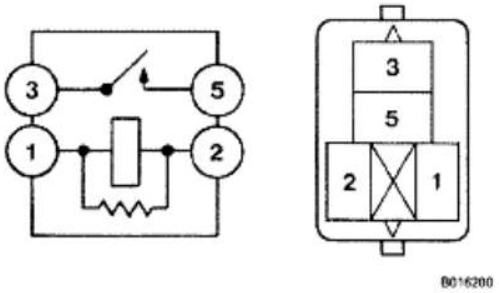


Fig. 321: IG2 Relay Circuit Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

c. Reinstall the IG2 relay.

NG: REPLACE RELAY (IG2 RELAY)

OK: Go to next step

11. **CHECK HARNESS AND CONNECTOR (IG2 RELAY POWER SOURCE)**
    a. Remove the IG2 relay from the engine room relay block.
    b. Measure the voltage according to the value (s) in the table below.

Standard Voltage

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
IG2 relay terminal 5 - Body ground	Always	11 to 14 V

c. Reinstall the IG2 relay.

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR (BATTERY - IG2 RELAY)

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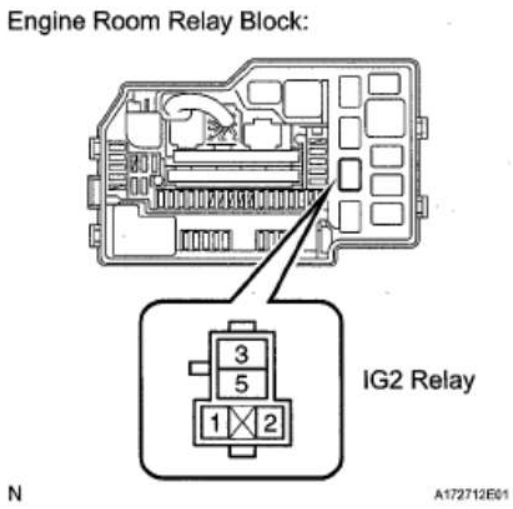


Fig. 322: Identifying IG2 Relay Location
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

12. **CHECK HARNESS AND CONNECTOR (IG2 RELAY - BODY GROUND)**
    a. Remove the IG2 relay from the engine room relay block.
    b. Measure the resistance according to the value (s) in the table below.

Standard Resistance

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
IG2 relay terminal 2 - Body ground	Always	Below 1 ohms

    c. Reinstall the IG2 relay.

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR

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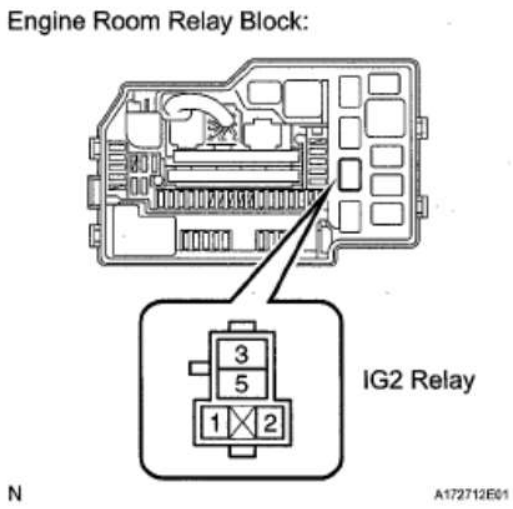


Fig. 323: Identifying IG2 Relay Location
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

13. **CHECK HARNESS AND CONNECTOR (IGNITION SWITCH ASSEMBLY - IG2 RELAY)**
    a. Remove the IG2 relay from the engine room relay block.
    b. Disconnect the ignition switch assembly connector.
    c. Measure the resistance according to the value (s) in the table below.

Standard Resistance (Check for Open)

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
D24-6 (IG2) - IG2 relay terminal 1	Always	Below 1 ohms

Standard Resistance (Check for Short)

TESTER CONNECTION SPECIFIED CONDITION CHART

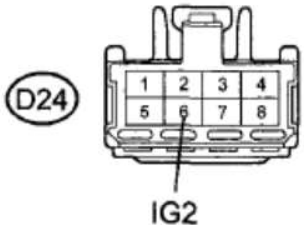
Tester Connection	Condition	Specified Condition
D24-6 (IG2) or IG2 relay terminal 1 - Body ground	Always	10 kohms or higher

    d. Reinstall the IG2 relay.
    e. Reconnect the ignition switch assembly connector.

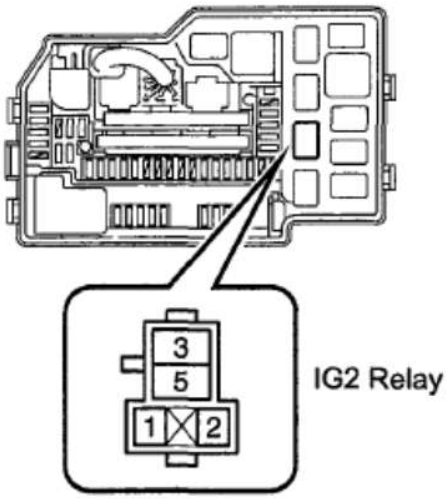
NG: REPAIR OR REPLACE HARNESS OR CONNECTOR

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Front view of wire harness connector:
(to Ignition Switch Assembly)



Engine Room Relay Block:



A172716E03

Fig. 324: Identifying IG2 Relay And Ignition Switch Assembly Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

14. **INSPECT IGNITION SWITCH ASSEMBLY**
    a. Inspect the ignition switch assembly (See **INSPECTION**).

NG: REPLACE IGNITION SWITCH ASSEMBLY (See **REMOVAL**)

OK: REPAIR OR REPLACE HARNESS OR CONNECTOR (IGNITION SWITCH ASSEMBLY - BATTERY)

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VC OUTPUT CIRCUIT

DESCRIPTION

The ECM constantly generates 5 V of power from battery voltage supplied to the +B (BATT) terminal to operate the microprocessor. The ECM also provides this power to the sensors through the VC output circuit.

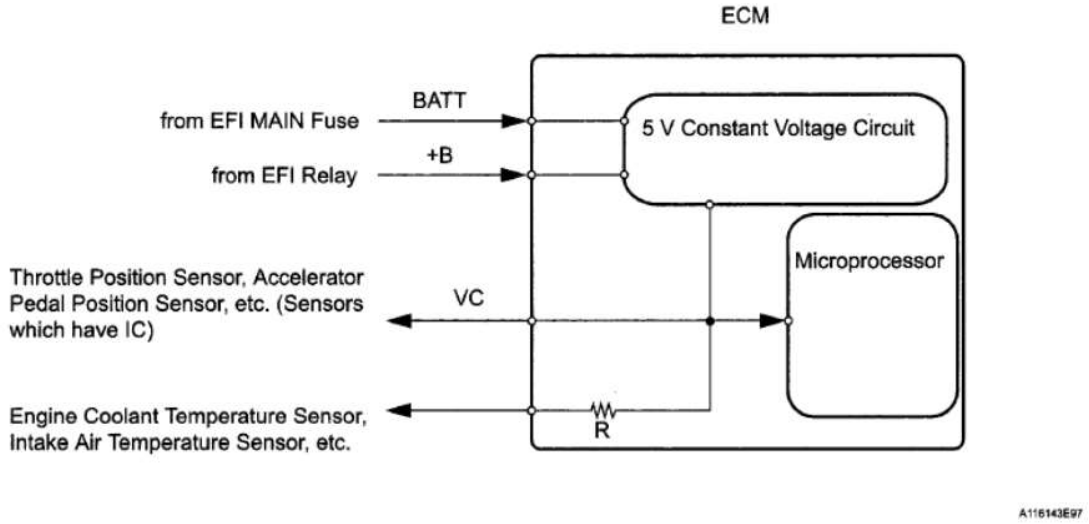


Fig. 325: ECM Communication Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

When the VC circuit is shorted, the microprocessor in the ECM and sensors that are supplied with power through the VC circuit are inactivated because the power is not supplied from the VC circuit. Under this condition, the system does not start up and the MIL does not illuminate even if the system malfunctions.

HINT:

Under normal conditions, the MIL is illuminated for several seconds when the ignition switch is first turned to ON. The MIL turns off when the engine is started.

WIRING DIAGRAM

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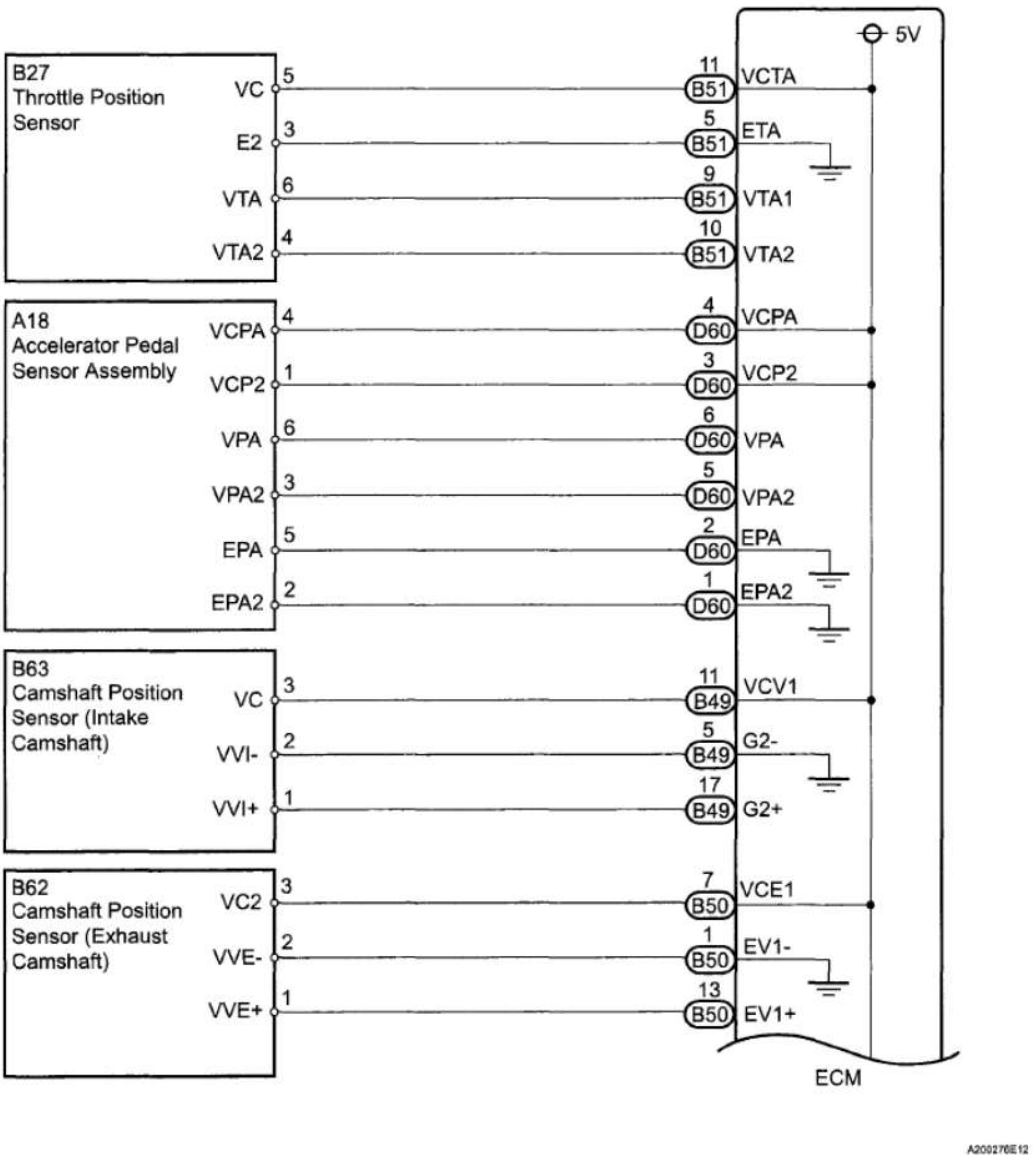


Fig. 326: VC Output Circuit - Wiring Diagram (1 Of 2)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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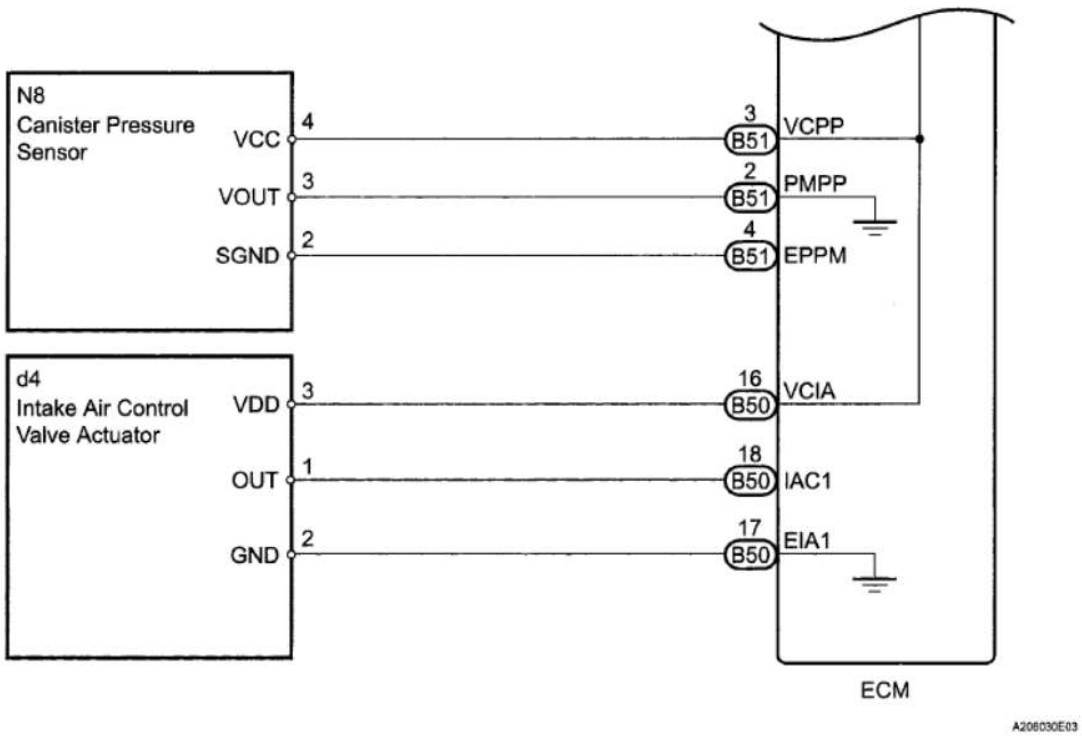


Fig. 327: VC Output Circuit - Wiring Diagram (2 Of 2)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSPECTION PROCEDURE

1. **CHECK MIL**
   a. Check that the Malfunction Indicator Lamp (MIL) turns on when turning the ignition switch to ON.

      OK:

      MIL turns on.

      NG: Go to step 2

      OK: PROCEED TO NEXT SUSPECTED AREA SHOWN IN PROBLEM SYMPTOMS TABLE (See **PROBLEM SYMPTOMS TABLE**)

2. **CHECK COMMUNICATION BETWEEN TECHSTREAM AND ECM**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the Techstream on.
   d. Check the communication between the Techstream and ECM.

      Result

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RESULT CHART

Result	Proceed to
Communication is not possible	A
Communication is possible	B

B: GO TO **MIL CIRCUIT**

A: Go to next step

3. **CHECK MIL (THROTTLE POSITION SENSOR)**
   a. Disconnect the throttle body connector.
   b. Turn the ignition switch to ON.
   c. Check the MIL

Result

RESULT CHART

Result	Proceed to
MIL does not illuminate	A
MIL illuminates	B

   d. Reconnect the throttle body connector.

B: REPLACE THROTTLE BODY (See **REMOVAL**)

A: Go to next step

4. **CHECK MIL (ACCELERATOR PEDAL POSITION SENSOR)**
   a. Disconnect the accelerator pedal position sensor connector.
   b. Turn the ignition switch to ON.
   c. Check the MIL.

Result

RESULT CHART

Result	Proceed to
MIL does not illuminate	A
MIL illuminates	B

   d. Reconnect the accelerator pedal position sensor connector.

B: REPLACE ACCELERATOR PEDAL ROD ASSEMBLY (See **REMOVAL**)

A: Go to next step

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5. **CHECK MIL (CANISTER PUMP MODULE)**
   a. Disconnect the canister pump module connector.
   b. Turn the ignition switch to ON.
   c. Check the MIL

   Result

   RESULT CHART

Result	Proceed to
MIL does not illuminate	A
MIL illuminates	B

   d. Reconnect the canister pump module connector.

   B: REPLACE CANISTER (See **REMOVE**)

   A: Go to next step

6. **CHECK MIL (CAMSHAFT POSITION SENSOR FOR INTAKE CAMSHAFT)**
   a. Disconnect the camshaft position sensor for intake side connector.
   b. Turn the ignition switch to ON.
   c. Check the MIL

   Result

   RESULT CHART

Result	Proceed to
MIL does not illuminate	A
MIL illuminates	B

   d. Reconnect the camshaft position sensor for intake side connector.

   B: REPLACE CAMSHAFT POSITION SENSOR (See **INSTALLATION**)

   A: Go to next step

7. **CHECK MIL (CAMSHAFT POSITION SENSOR FOR EXHAUST CAMSHAFT)**
   a. Disconnect the camshaft position sensor for exhaust side connector.
   b. Turn the ignition switch to ON.
   c. Check the MIL.

   Result

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RESULT CHART

Result	Proceed to
MIL does not illuminate	A
MIL illuminates	B

d. Reconnect the camshaft position sensor for exhaust side connector.

B: REPLACE CAMSHAFT POSITION SENSOR (See **INSTALLATION**)

A: Go to next step

8. **CHECK MIL (INTAKE AIR CONTROL VALVE ACTUATOR)**
   a. Disconnect the intake air control valve actuator connector.
   b. Turn the ignition switch to ON.
   c. Check the MIL.

Result

RESULT CHART

Result	Proceed to
MIL does not illuminate	A
MIL illuminates	B

d. Reconnect the intake air control valve actuator connector.

B: REPLACE INTAKE AIR CONTROL VALVE ACTUATOR (See **INTAKE AIR CONTROL VALVE ACTUATOR (FOR TCV)**)

A: Go to next step

9. **CHECK HARNESS AND CONNECTOR (VC CIRCUIT)**
   a. Disconnect the throttle body connector.
   b. Disconnect the accelerator pedal position sensor connector.
   c. Disconnect the canister pump module connector.
   d. Disconnect the camshaft position sensor for intake side connector.
   e. Disconnect the camshaft position sensor for exhaust side connector.
   f. Disconnect the intake air control valve actuator connector.
   g. Disconnect the ECM connectors.
   h. Measure the resistance according to the value (s) in the table below.

Standard Resistance (Check for Short)

TESTER CONNECTION SPECIFIED CONDITION CHART

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Tester Connection	Condition	Specified Condition
D60-4 (VCPA) - Body ground	Always	10 kohms or higher
D60-3 (VCP2) - Body ground	Always	10 kohms or higher
B50-16 (VCIA) - Body ground	Always	10 kohms or higher
B51-11 (VCTA) - Body ground	Always	10 kohms or higher
B50-7 (VCE1) - Body ground	Always	10 kohms or higher
B49-11 (VCV1) - Body ground	Always	10 kohms or higher
B51-3 (VCPP) - Body ground	Always	10 kohms or higher

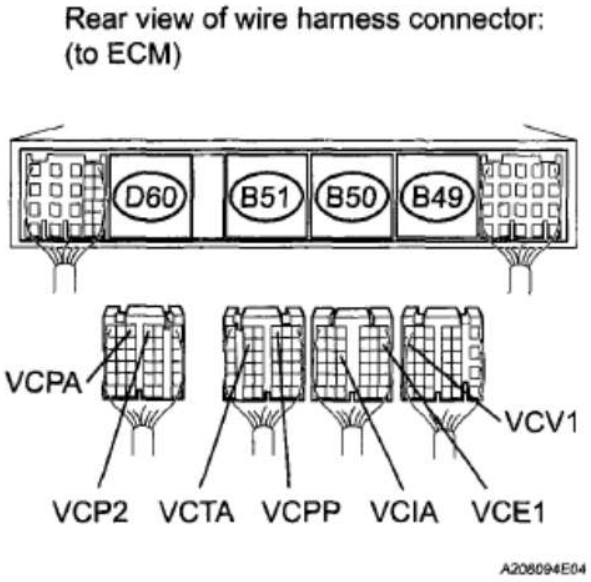


Fig. 328: Disconnecting ECM Connectors
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

i. Reconnect the throttle body connector.
j. Reconnect the accelerator pedal position sensor connector.
k. Reconnect the canister pump module connector.
l. Reconnect the camshaft position sensor for intake side connector.
m. Reconnect the camshaft position sensor for exhaust side connector.
n. Reconnect the intake air control valve actuator connector.
o. Reconnect the ECM connectors.

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR

OK: REPLACE ECM (See **REMOVAL**)

FUEL PUMP CONTROL CIRCUIT

DESCRIPTION

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When the engine is cranked, the starter relay drive signal output from the ignition switch is input into the STA terminal of the ECM, and the NE signal generated by the crankshaft position sensor is also input into the NE+ terminal. When the ECM interprets that the engine is cranked, it turns transistor Tr1 in the ECM internal circuit on. The current flows to the C/OPN (Circuit Opening) relay when Tr1 is turned on. Then, the fuel pump operates.

While the NE signal is input into the ECM when the engine is running, the ECM turns Tr1 on continuously.

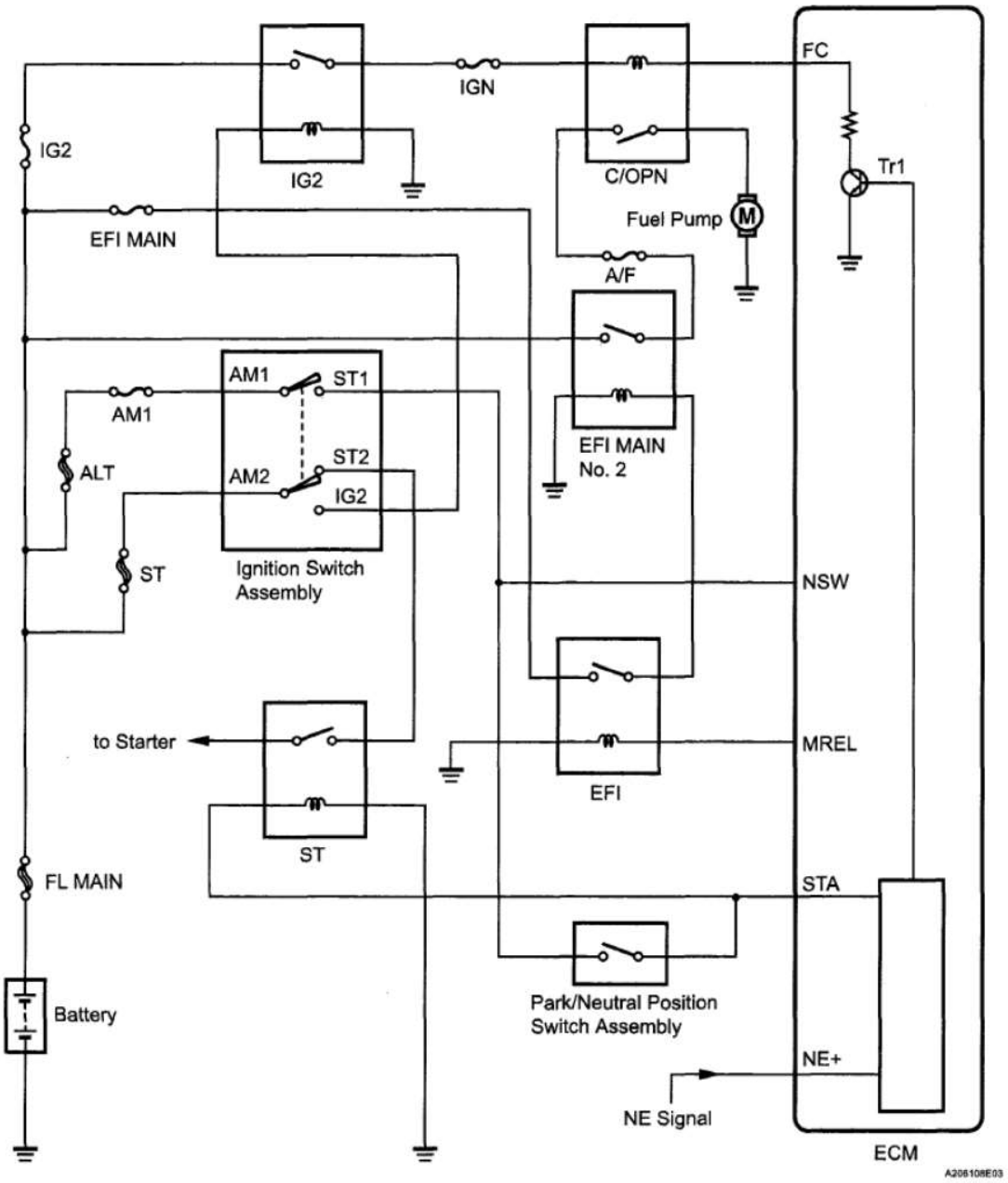


Fig. 329: Fuel Pump Control Circuit Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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WIRING DIAGRAM

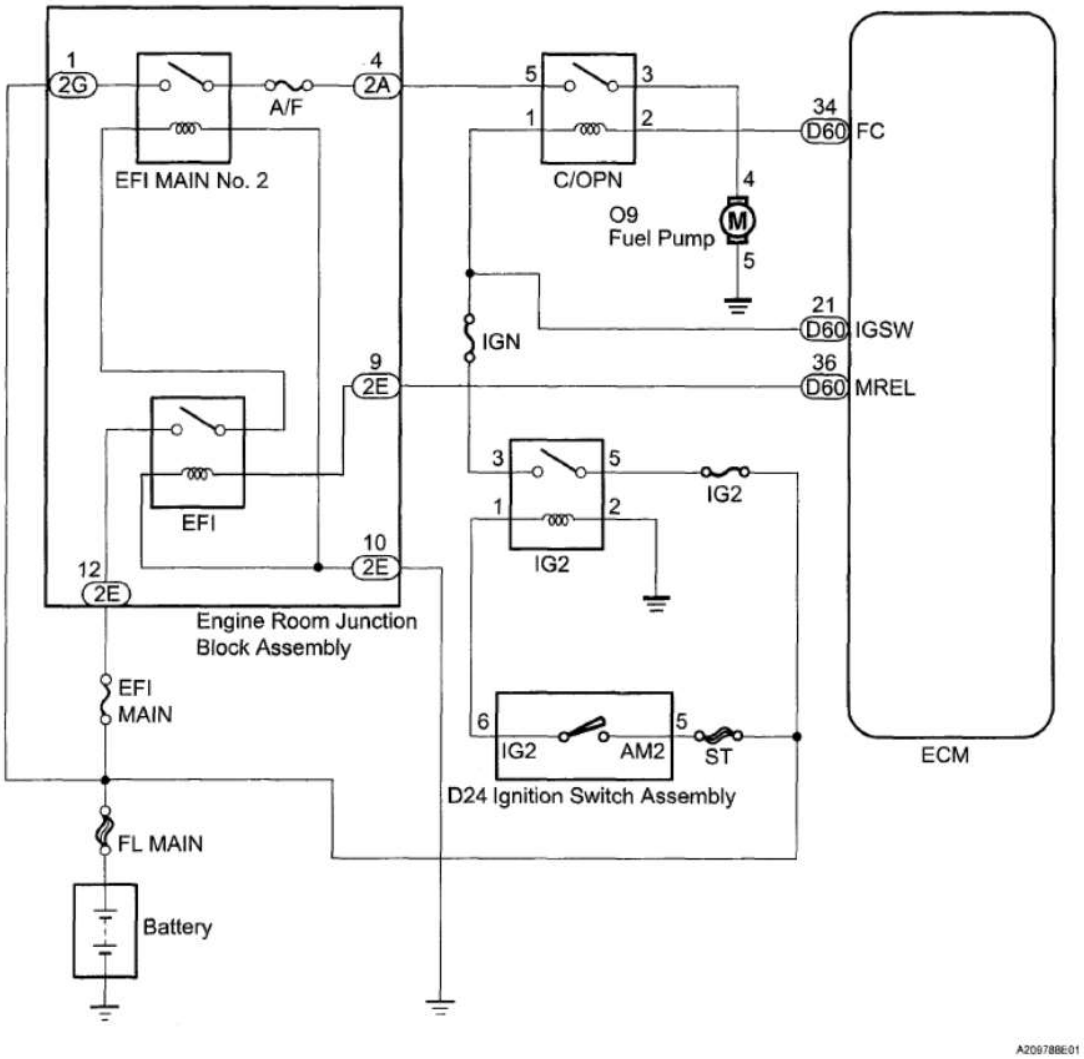


Fig. 330: Fuel Pump Control Circuit - Wiring Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSPECTION PROCEDURE

NOTE: Inspect the fuses for circuits related to this system before performing the following inspection procedure.

1. **PERFORM ACTIVE TEST USING TECHSTREAM (ACTIVE THE FUEL PUMP SPEED CONTROL)**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch to ON and turn the Techstream on.
   c. Enter the following menus: Powertrain/Engine/Active Test/Control the Fuel Pump/Speed.

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d. Check whether the fuel pump operating sound occurs when performing the Active Test on the Techstream.

OK:

Fuel pump operating sound occurs.

NG: Go to step 2

OK: PROCEED TO NEXT SUSPECTED AREA SHOWN IN PROBLEM SYMPTOMS TABLE (See **PROBLEM SYMPTOMS TABLE**)

2. **INSPECT RELAY (C/OPN RELAY)**
   a. Remove the C/OPN relay from the engine room relay block.
   b. Measure the resistance according to the value (s) in the table below.

Standard Resistance

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
3 - 5	Battery voltage is not applied between terminals 1 and 2	10 kohms or higher
	Battery voltage applied between terminals 1 and 2	Below 1 ohms

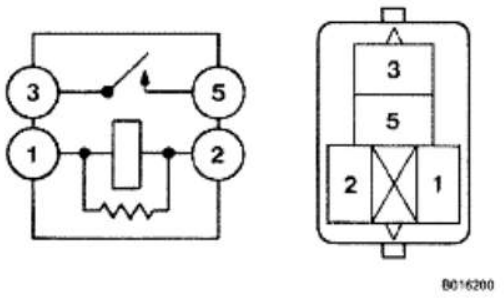


Fig. 331: C/OPN Relay Circuit Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

c. Reinstall the C/OPN relay.

NG: REPLACE RELAY (C/OPN RELAY)

OK: Go to next step

3. **CHECK HARNESS AND CONNECTOR (C/OPN RELAY - ECM)**
   a. Disconnect the ECM connector.
   b. Remove the C/OPN relay from the engine room relay block.
   c. Measure the resistance according to the value (s) in the table below.

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Standard Resistance (Check for Open)

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
D60-34 (FC) - C/OPN relay terminal 2	Always	Below 1 ohms

Standard Resistance (Check for Short)

TESTER CONNECTION SPECIFIED CONDITION CHART

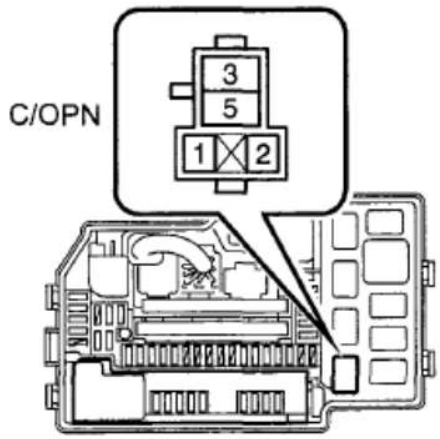
Tester Connection	Condition	Specified Condition
D60-34 (FC) or C/OPN relay terminal 2 - Body ground	Always	10 kohms or higher

d. Reconnect the ECM connector.
e. Reinstall the C/OPN relay.

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR

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Engine Room Relay Block:



Rear view of wire harness connector:
(to ECM)

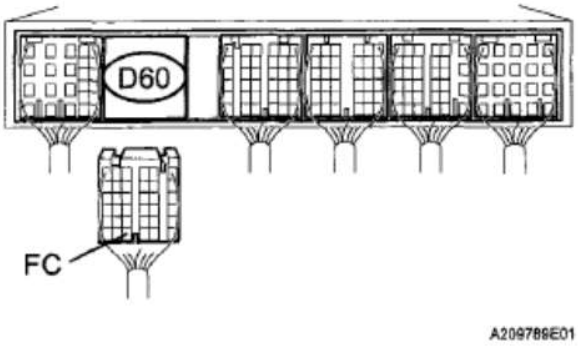


Fig. 332: Identifying C/OPN Relay And ECM Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

4. **INSPECT ENGINE ROOM RELAY BLOCK (IG2 RELAY - C/OPN RELAY)**
   a. Remove the IG2 relay from the engine room relay block.
   b. Remove the C/OPN relay from the engine room relay block.
   c. Measure the resistance according to the value (s) in the table below.

Standard Resistance (Check for Open)

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TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
IG2 relay terminal 3 - C/OPN relay terminal 1	Always	Below 1 ohms

Standard Resistance (Check for Short)

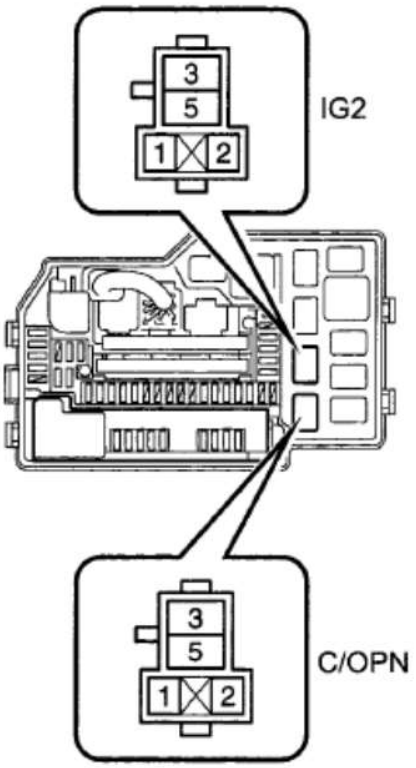
TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
IG2 relay terminal 3 or C/OPN relay terminal 1 - Body ground	Always	10 kohms or higher

d. Reinstall the IG2 relay.
e. Reinstall the C/OPN relay.

NG: REPLACE ENGINE ROOM RELAY BLOCK ASSEMBLY

Engine Room Relay Block:



A209790E01

Fig. 333: Identifying IG2 Relay And C/OPN Relay Location
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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OK: Go to next step

5. **CHECK HARNESS AND CONNECTOR (C/OPN RELAY - FUEL PUMP)**
   a. Remove the C/OPN relay from the engine room relay block.
   b. Disconnect the fuel pump connector.
   c. Measure the resistance according to the value (s) in the table below.

Standard Resistance (Check for Open)

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
C/OPN relay terminal 3-O9-4	Always	Below 1 ohms

Standard Resistance (Check for Short)

TESTER CONNECTION SPECIFIED CONDITION CHART

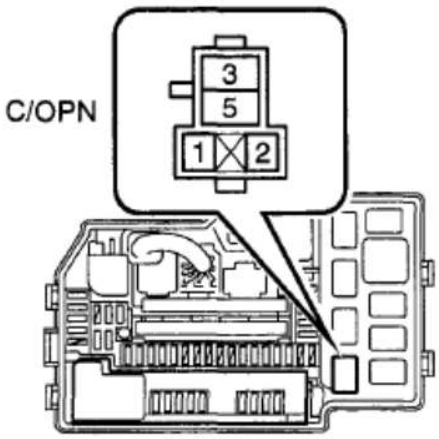
Tester Connection	Condition	Specified Condition
C/OPN relay terminal 3 or O9-4 - Body ground	Always	10 kohms or higher

   d. Reinstall the C/OPN relay.
   e. Reconnect the fuel pump connector.

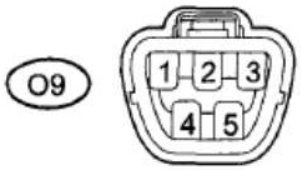
NG: REPAIR OR REPLACE HARNESS OR CONNECTOR

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Engine Room Relay Block:



Front view of wire harness connector:
(to Fuel Pump)



A209791E01

Fig. 334: Identifying C/OPN Relay And Fuel Pump Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

6. **CHECK HARNESS AND CONNECTOR (FUEL PUMP - BODY GROUND)**
   a. Disconnect the fuel pump connector.
   b. Measure the resistance according to the value (s) in the table below.

Standard Resistance

TESTER CONNECTION SPECIFIED CONDITION CHART

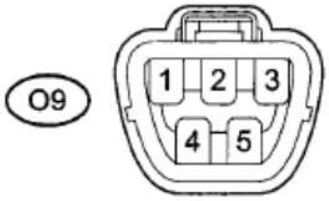
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Tester Connection	Condition	Specified Condition
O9-5 - Body ground	Always	Below 1 ohms

c. Reconnect the fuel pump connector.

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR

Front view of wire harness connector:
(to Fuel Pump)



P A148746E14

Fig. 335: Identifying Fuel Pump Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

7. **INSPECT FUEL PUMP**
   a. Inspect the fuel pump (See **INSPECTION**).

   NG: REPLACE FUEL PUMP (See **REMOVAL**)

   OK: REPLACE ECM (See **REMOVAL**)

FUEL INJECTOR CIRCUIT

DESCRIPTION

The fuel injectors are located on the intake manifold. They inject fuel into the cylinders based on the signals from the ECM.

WIRING DIAGRAM

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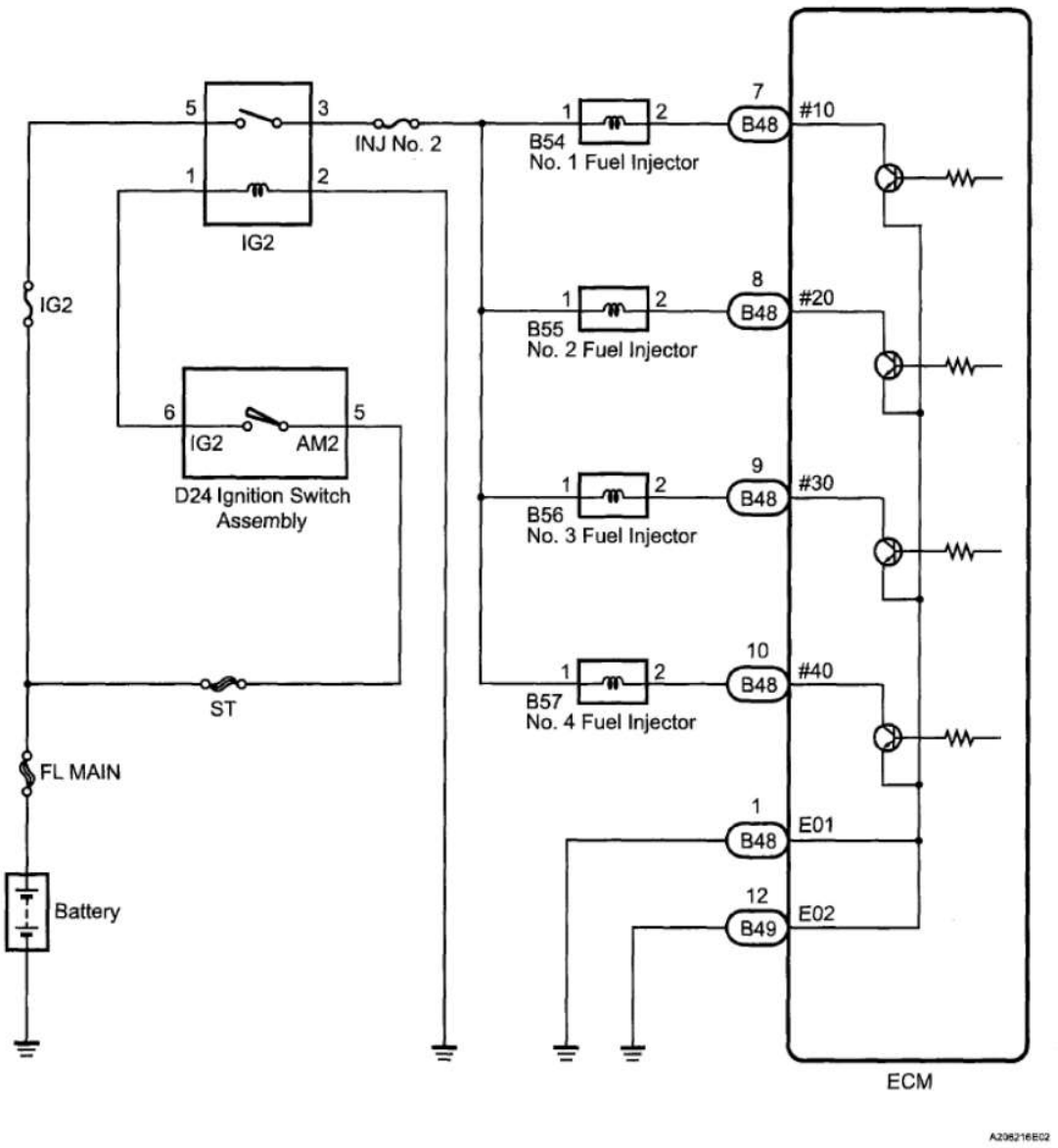


Fig. 336: Fuel Injector Circuit - Wiring Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSPECTION PROCEDURE

NOTE: Inspect the fuses for circuits related to this system before performing the following inspection procedure.

1. **INSPECT FUEL INJECTOR (POWER SOURCE)**
   a. Disconnect the fuel injector connectors.
   b. Turn the ignition switch to ON.
   c. Measure the voltage according to the value (s) in the table below.

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Standard Voltage

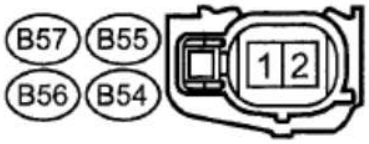
TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Switch Condition	Specified Condition
B57-1 - Body ground	Ignition switch ON	11 to 14 V
B56-1 - Body ground	Ignition switch ON	11 to 14 V
B55-1 - Body ground	Ignition switch ON	11 to 14 V
B54-1 - Body ground	Ignition switch ON	11 to 14 V

d. Reconnect the fuel injector connectors.

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR (IG2 RELAY - FUEL INJECTOR)

Front view of wire harness connector:
(to Fuel Injector)



A157859E42

Fig. 337: Identifying Fuel Injector Connectors
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

2. **INSPECT FUEL INJECTOR (INJECTOR RESISTANCE)**
   a. Inspect the fuel injector (See **INSPECTION**).

   NG: REPLACE FUEL INJECTOR (See **REMOVAL**)

   OK: Go to next step

3. **CHECK HARNESS AND CONNECTOR (FUEL INJECTOR - ECM)**
   a. Disconnect the ECM connector.
   b. Disconnect the fuel injector connectors.

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c. Measure the resistance according to the value (s) in the table below.

Standard Resistance (Check for Open)

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
B54-2-B48-7 (#10)	Always	Below 1 ohms
B55-2 - B48-8 (#20)	Always	Below 1 ohms
B56-2 - B48-9 (#30)	Always	Below 1 ohms
B57-2 - B48-10 (#40)	Always	Below 1 ohms

Standard Resistance (Check for Short)

TESTER CONNECTION SPECIFIED CONDITION CHART

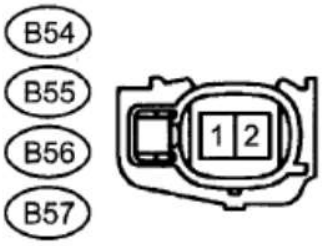
Tester Connection	Condition	Specified Condition
B54-2 or B48-7 (#10) - Body ground	Always	10 kohms or higher
B55-2 or B48-8 (#20) - Body ground	Always	10 kohms or higher
B56-2 or B48-9 (#30) - Body ground	Always	10 kohms or higher
B57-2 or B48-10 (#40) - Body ground	Always	10 kohms or higher

d. Reconnect the fuel injector connectors.
e. Reconnect the ECM connector.

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR

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Front view of wire harness connector:
(to Fuel Injector)



Rear view of wire harness connector:
(to ECM)

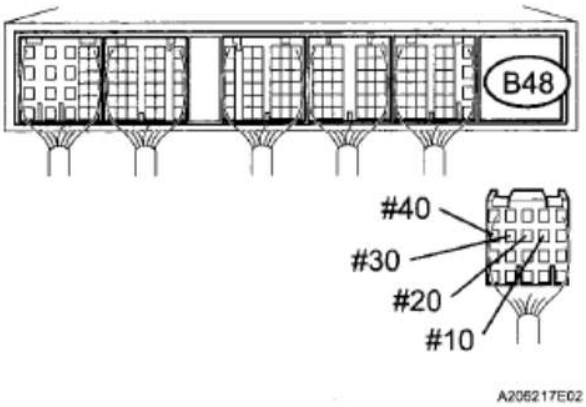


Fig. 338: Identifying Fuel Injector Connectors And ECM Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

4. **CHECK HARNESS AND CONNECTOR (ECM - BODY GROUND)**
   a. Disconnect the ECM connectors.
   b. Measure the resistance according to the value (s) in the table below.

Standard Resistance (Check for Open)

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
B48-1 (E01) - Body ground	Always	Below 1 ohms
B49-12 (E02) - Body ground	Always	Below 1 ohms

   c. Reconnect the ECM connectors.

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NG: REPAIR OR REPLACE HARNESS OR CONNECTOR

Rear view of wire harness connector:
(to ECM)

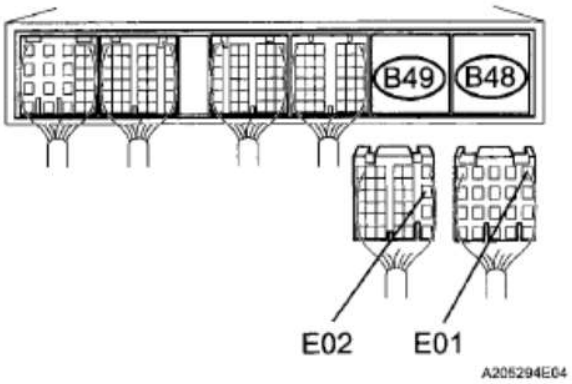


Fig. 339: Disconnecting ECM Connectors
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

5. **INSPECT FUEL INJECTOR (INJECTION AND VOLUME)**
   a. Check the fuel injector injection and volume (See **INSPECTION**).

   NG: REPLACE FUEL INJECTOR (See **REMOVAL**)

   OK: PROCEED TO NEXT SUSPECTED AREA SHOWN IN PROBLEM SYMPTOMS TABLE (See **PROBLEM SYMPTOMS TABLE**)

STARTER SIGNAL CIRCUIT

DESCRIPTION

While the engine is being cranked, current flows from terminal ST1 of the ignition switch to the park/neutral position switch and also flows to terminal STA of the ECM (STA Signal).

WIRING DIAGRAM

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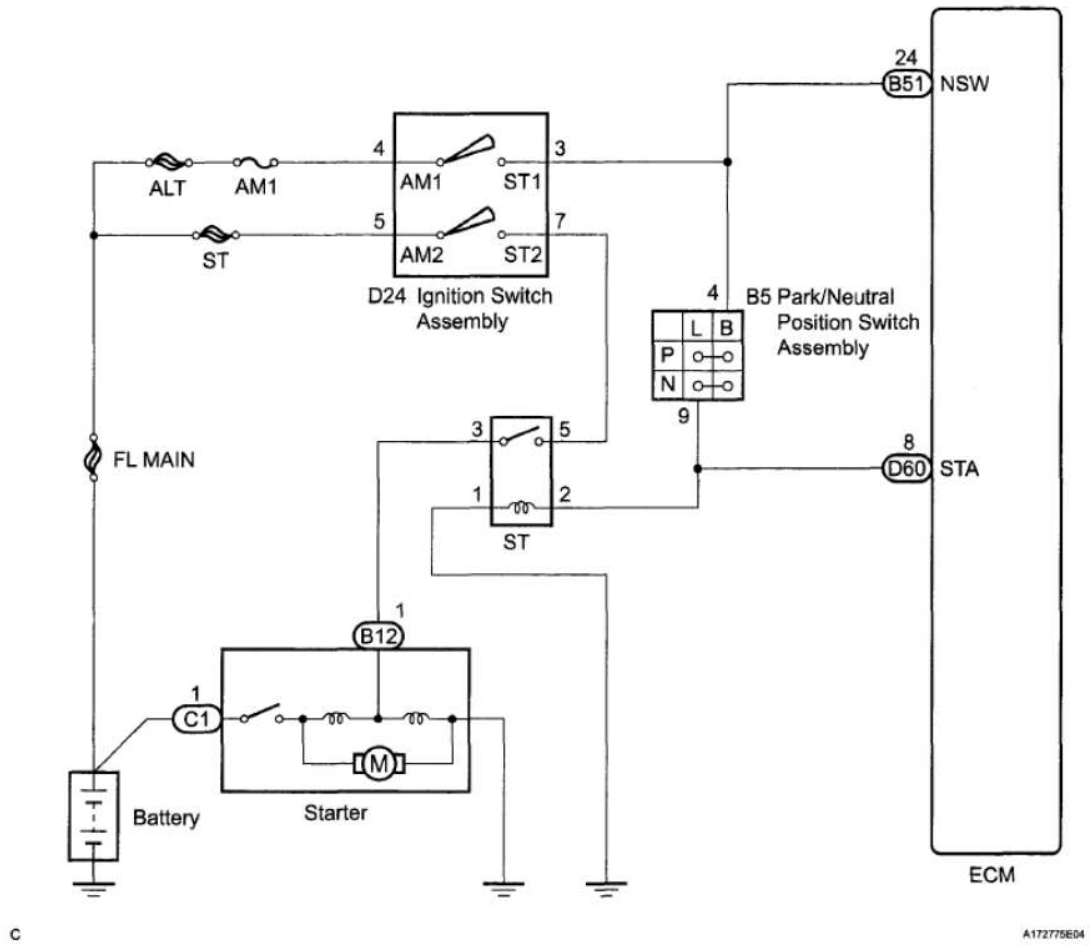


Fig. 340: Starter Signal Circuit - Wiring Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSPECTION PROCEDURE

NOTE: Inspect the fuses for circuits related to this system before performing the following inspection procedure.

HINT:

This chart is based on the premise that the engine can crank normally. If the engine cannot crank normally, proceed to the **PROBLEM SYMPTOMS TABLE** .

1. **READ VALUE USING TECHSTREAM (STARTER SIGNAL)**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the Techstream on.
   d. Enter the following menus: Powertrain/Engine/Data List/All Data/Starter Signal.

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e. Read the value.

OK

IGNITION SWITCH POSITION CHART

Ignition Switch Position	Starter Signal
ON	Close (Starter signal OFF)
START	Open (Starter signal ON)

NG: Go to step 2

OK: PROCEED TO NEXT SUSPECTED AREA SHOWN IN PROBLEM SYMPTOMS TABLE (See **PROBLEM SYMPTOMS TABLE**)

2. **INSPECT RELAY (ST RELAY VOLTAGE)**
   a. Remove the ST relay from the engine room relay block.
   b. Measure the voltage according to the value (s) in the table below.

Standard Voltage

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Switch Condition	Specified Condition
ST relay terminal 2 - Body ground	Engine cranking position	11 to 14 V

   c. Reinstall the ST relay.

NG: Go to step 3

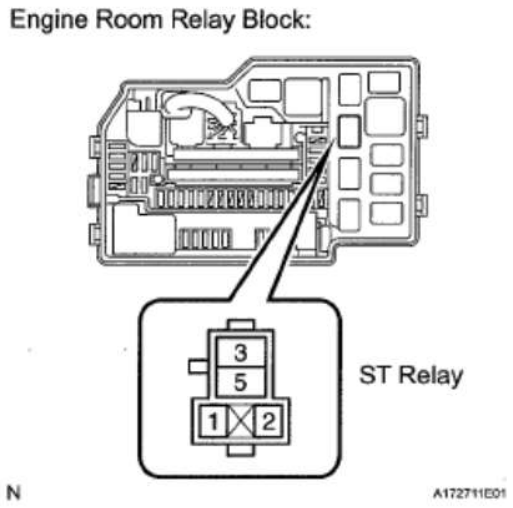


Fig. 341: Identifying ST Relay Location
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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OK: REPAIR OR REPLACE HARNESS OR CONNECTOR (ST RELAY - ECM)

3. **CHECK HARNESS AND CONNECTOR (PARK/NEUTRAL POSITION SWITCH ASSEMBLY ST RELAY)**
   a. Disconnect the park/neutral position switch assembly connector.
   b. Remove the ST relay from the engine room relay block.
   c. Measure the resistance according to the value (s) in the table below.

Standard Resistance (Check for Open)

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
B5-9 - ST relay terminal 2	Always	Below 1 ohms

Standard Resistance (Check for Short)

TESTER CONNECTION SPECIFIED CONDITION CHART

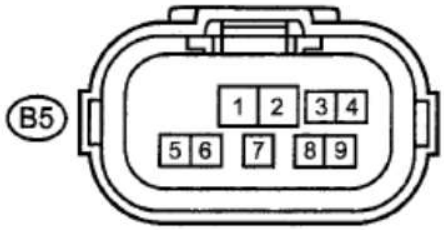
Tester Connection	Condition	Specified Condition
B5-9 or ST relay terminal 2 - Body ground	Always	10 kohms or higher

   d. Reconnect the park/neutral position switch assembly connector.
   e. Reinstall the ST relay.

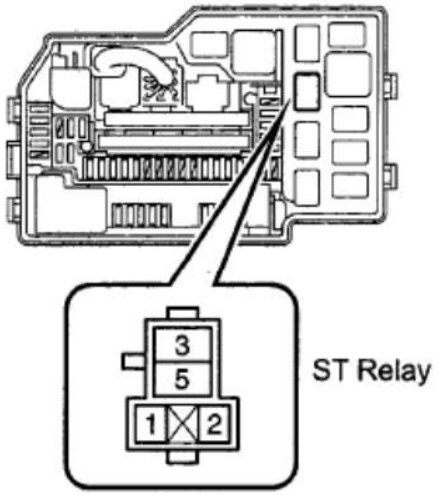
NG: REPAIR OR REPLACE HARNESS OR CONNECTOR

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Front view of wire harness connector: (to Park/Neutral Position Switch Assembly)



Engine Room Relay Block:



A172724E02

Fig. 342: Identifying ST Relay And Park/Neutral Position Switch Assembly Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

4. **INSPECT PARK/NEUTRAL POSITION SWITCH ASSEMBLY**
   a. Inspect the park/neutral position switch assembly (See **ADJUSTMENT**).

   NG: REPLACE PARK/NEUTRAL POSITION SWITCH ASSEMBLY (See **REMOVAL**)

   OK: Go to next step

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5. **CHECK HARNESS AND CONNECTOR (IGNITION SWITCH ASSEMBLY - PARK/NEUTRAL POSITION SWITCH)**
   a. Disconnect the ignition switch assembly connector.
   b. Disconnect the park/neutral position switch assembly connector.
   c. Measure the resistance according to the value (s) in the table below.

Standard Resistance (Check for Open)

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
D24-3 (ST1) - B5-4	Always	Below 1 ohms

Standard Resistance (Check for Short)

TESTER CONNECTION SPECIFIED CONDITION CHART

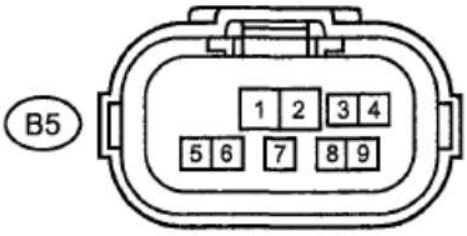
Tester Connection	Condition	Specified Condition
D24-3 (ST1) or B5-4-Body ground	Always	10 kohms or higher

   d. Reconnect the ignition switch assembly connector.
   e. Reconnect the park/neutral position switch assembly connector.

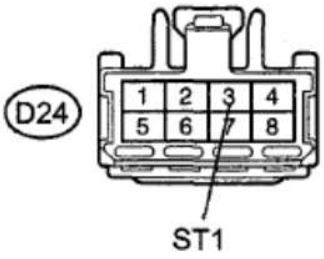
NG: REPAIR OR REPLACE HARNESS OR CONNECTOR

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Front view of wire harness connector: (to Park/Neutral Position Switch Assembly)



Front view of wire harness connector: (to Ignition Switch Assembly)



A159666E17

Fig. 343: Identifying Ignition Switch Assembly Connector And Park/Neutral Position Switch Assembly Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

6. **CHECK HARNESS AND CONNECTOR (IGNITION SWITCH ASSEMBLY - ECM)**
   a. Disconnect the ignition switch assembly connector.
   b. Disconnect the ECM connector.
   c. Measure the resistance according to the value (s) in the table below.

Standard Resistance (Check for Open)

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
D24-3 (ST1) - B51-24 (NSW)	Always	Below 1 ohms

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Standard Resistance (Check for Short)

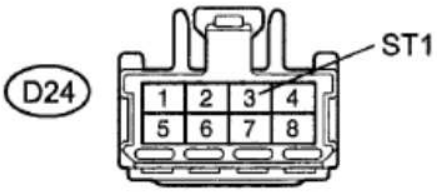
TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
D24-3 (ST1) or B51-24 (NSW) - Body ground	Always	10 kohms or higher

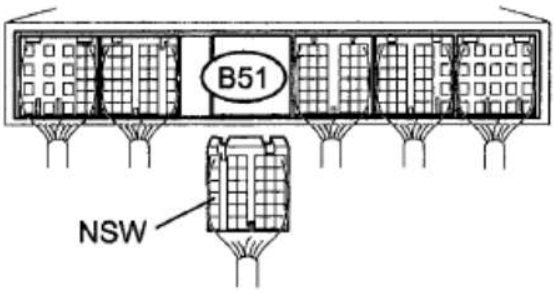
d. Reconnect the ignition switch assembly connector.
e. Reconnect the ECM connector.

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR

Front view of wire harness connector:
(to Ignition Switch Assembly)



Rear view of wire harness connector:
(to ECM)



A206261E03

Fig. 344: Identifying Ignition Switch Assembly Connector And ECM Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

7. **INSPECT IGNITION SWITCH ASSEMBLY**

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a. Inspect the ignition switch assembly (See **INSPECTION**).

NG: REPLACE IGNITION SWITCH ASSEMBLY (See **REMOVAL**)

OK: REPAIR OR REPLACE HARNESS OR CONNECTOR (BATTERY - IGNITION SWITCH ASSEMBLY)

ACIS CONTROL CIRCUIT

DESCRIPTION

This circuit opens and closes the Intake Air Control Valve (IACV) in response to the engine load in order to increase the intake efficiency (ACIS: Acoustic Control Induction System).

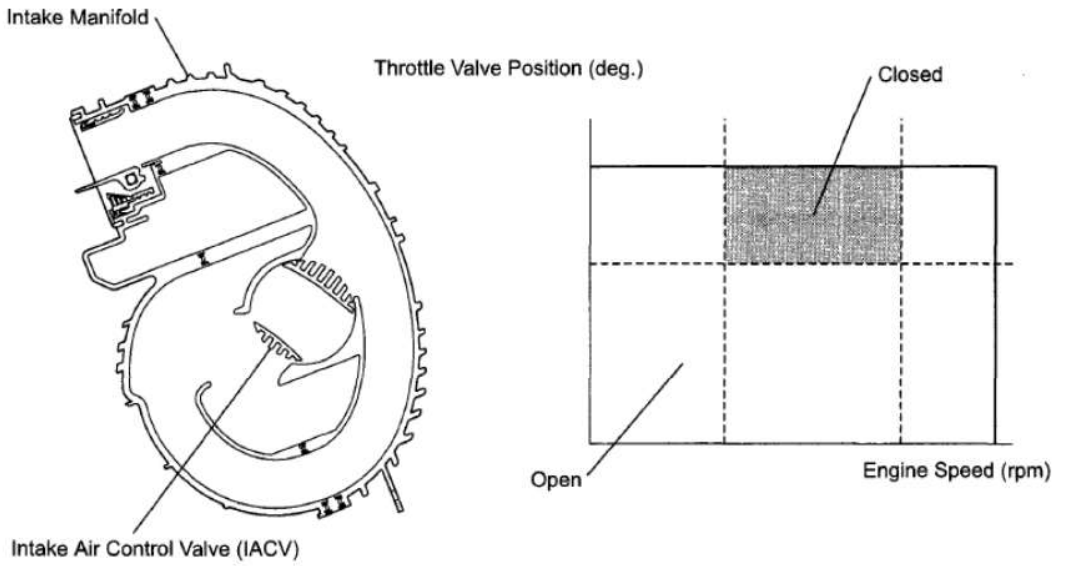


Fig. 345: Identifying Intake Manifold And Intake Air Control Valve (IACV)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

WIRING DIAGRAM

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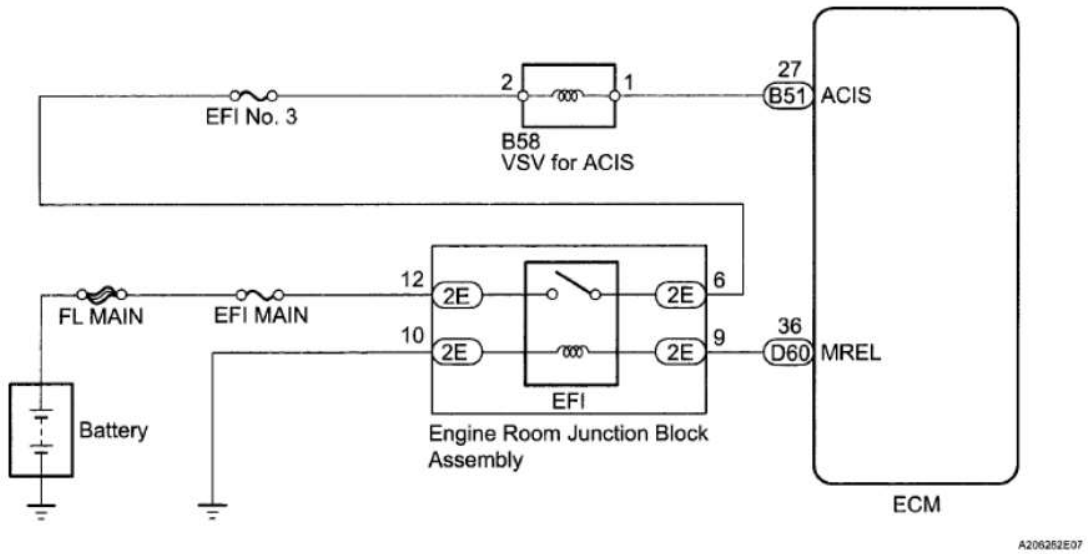


Fig. 346: Acis Control Circuit - Wiring Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSPECTION PROCEDURE

NOTE: Inspect the fuses for circuits related to this system before performing the following inspection procedure.

1. **PERFORM ACTIVE TEST USING TECHSTREAM (OPERATE VSV FOR ACIS)**
   a. Disconnect the vacuum hose from port F on the vacuum switching valve (for ACIS).
   b. Connect the Techstream to the DLC3.
   c. Start the engine.
   d. Enter the following menus: Powertrain/Engine/Active Test/Active the VSV for Intake Control.
   e. Operate the VSV for ACIS.
   f. Check the VSV air flow when switching the VSV on and off.

   OK

   SPECIFIED CONDITION CHART

Test Condition	Specified Condition
VSV is ON	Air from port E flows out through port F
VSV is OFF	Air from port E flows out through air filter

   NG: Go to step 4

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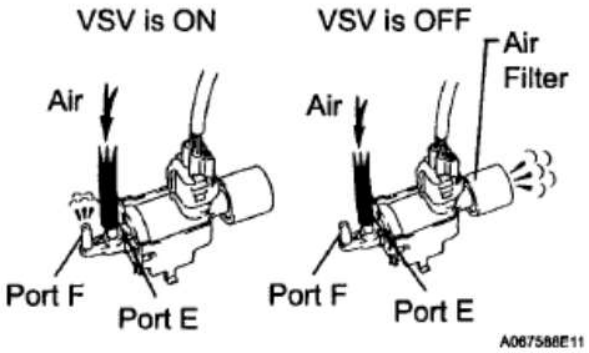


Fig. 347: Identifying VSV On And Off Position
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

2. **CHECK VACUUM HOSES (VACUUM SWITCHING VALVE - INTAKE AIR CONTROL VALVE, INTAKE MANIFOLD)**
   a. Check the vacuum hoses (See **ON-VEHICLE INSPECTION**).

   NG: REPAIR OR REPLACE VACUUM HOSES

   OK: Go to next step

3. **INSPECT INTAKE MANIFOLD (INTAKE AIR CONTROL VALVE)**
   a. Inspect the intake air control valve (See **INSPECTION**).

   NG: REPLACE INTAKE MANIFOLD (See **REMOVAL**)

   OK: PROCEED TO NEXT SUSPECTED AREA SHOWN IN PROBLEM SYMPTOMS TABLE (See **PROBLEM SYMPTOMS TABLE**)

4. **INSPECT VACUUM SWITCHING VALVE (VSV FOR ACIS)**
   a. Inspect the VSV for ACIS (See **INSPECTION**).

   NG: REPLACE VACUUM SWITCHING VALVE (See **REMOVAL**)

   OK: Go to next step

5. **CHECK HARNESS AND CONNECTOR (VSV FOR ACIS VOLTAGE)**
   a. Disconnect the VSV for ACIS connector.
   b. Turn the ignition switch to ON.
   c. Measure the voltage according to the value (s) in the table below.

   Standard Voltage

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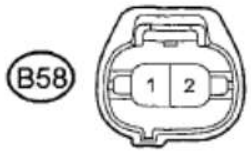
TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Switch Condition	Specified Condition
B58-2 - Body ground	Ignition switch ON	11 to 14 V

d. Reconnect the VSV for ACIS connector.

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR (EFI NO. 3 FUSE - VSV FOR ACIS)

Front view of wire harness connector:
(to VSV for ACIS)



A168222E12

Fig. 348: Identifying B58 VSV For ACIS Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

6. **CHECK HARNESS AND CONNECTOR (VSV FOR ACIS - ECM)**
   a. Disconnect the VSV for ACIS connector.
   b. Disconnect the ECM connector.
   c. Measure the resistance according to the value (s) in the table below.

Standard Resistance (Check for Open)

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
B58-1 - B51-27 (ACIS)	Always	Below 1 ohms

Standard Resistance (Check for Short)

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition

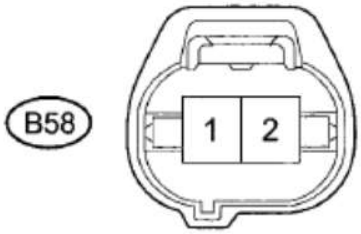
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B58-1 or B51-27 (ACIS) - Body ground	Always	10 kohms or higher

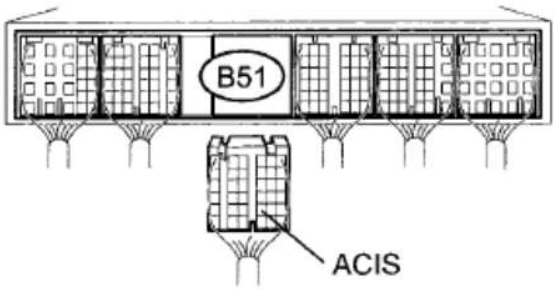
d. Reconnect the VSV for ACIS connector.
e. Reconnect the ECM connector.

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR

Front view of wire harness connector:
(to VSV for ACIS)



Rear view of wire harness connector:
(to ECM)



A206263E04

Fig. 349: Identifying ACIS Connector And ECM Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: REPLACE ECM (See **REMOVAL**)

AIR INTAKE CONTROL CIRCUIT

DESCRIPTION

The air cleaner is equipped with two inlets, one of which is opened or closed by the Air Intake Control Valve (AICV). This system reduces intake noise and increases engine power at low-to-high engine speed range.

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When the engine is operating in the low-to-mid speed range, this control operates the air intake control valve to close one of the air cleaner inlets. When the engine speed is more than 3600 rpm and the opening angle of the throttle valve is more than 60°, the ECM activates the VSV and opens the air intake control valve.

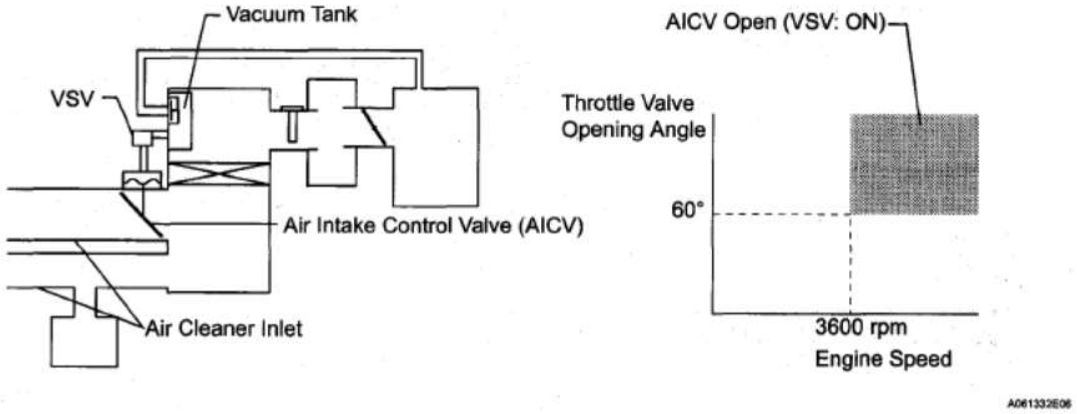


Fig. 350: Throttle Valve Opening Angle Graph
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

WIRING DIAGRAM

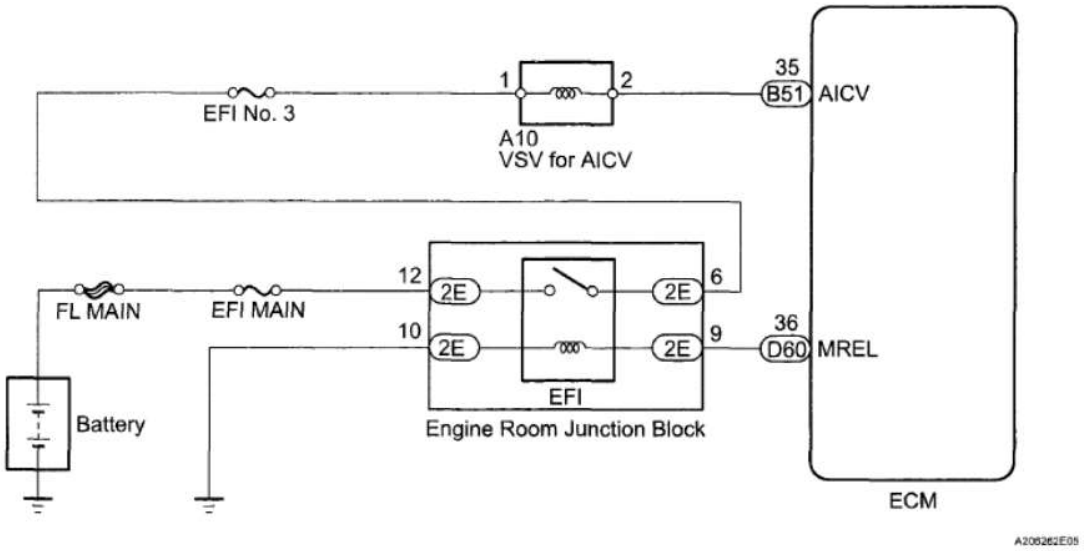


Fig. 351: Air Intake Control Circuit - Wiring Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSPECTION PROCEDURE

NOTE: Inspect the fuses for circuits related to this system before performing the following inspection procedure.

1. **PERFORM ACTIVE TEST USING TECHSTREAM (ACTIVATE THE VSV FOR AICS)**

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a. Disconnect the 2 hoses from the VSV for air intake control valve.
b. Turn the ignition switch to ON and turn the Techstream on.
c. Enter the following menus: Powertrain/Engine/Active Test/Activate the VSV for AICS.
d. Check the operation of the VSV when the VSV is operated by the Techstream.

Standard

TECHSTREAM OPERATION CHART

Techstream Operation	Specified Condition
VSV is ON	Air from port E flows out through port F
VSV is OFF	Air from port E flows out through the air filter

NG: Go to step 4

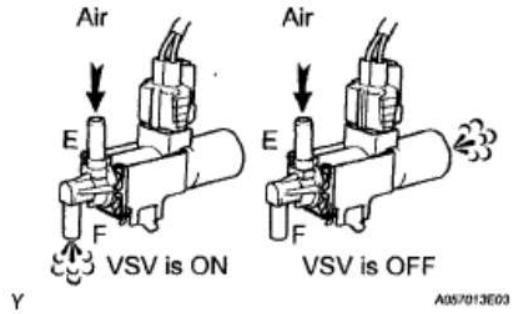


Fig. 352: Identifying VSV On And Off Position
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

2. **INSPECT VACUUM TANK**
   a. Inspect the vacuum tank (See **VACUUM TANK**).

   NG: REPLACE AIR CLEANER CAP SUB-ASSEMBLY

   OK: Go to next step

3. **INSPECT INTAKE AIR CONTROL VALVE ASSEMBLY**
   a. Inspect the intake air control valve assembly (See **INTAKE AIR CONTROL VALVE (FOR INTAKE AIR CONTROL SYSTEM)**).

   NG: REPLACE NO. 3 INTAKE AIR CONTROL VALVE ASSEMBLY

   OK: PROCEED TO NEXT SUSPECTED AREA SHOWN IN PROBLEM SYMPTOMS TABLE (See **PROBLEM SYMPTOMS TABLE**)

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4. **INSPECT VACUUM SWITCHING VALVE (VSV FOR AICV)**
   a. Inspect the VSV for air intake control valve (See **VACUUM SWITCHING VALVE (FOR INTAKE AIR CONTROL SYSTEM)**).

   NG: REPLACE VACUUM SWITCHING VALVE (See **ON-VEHICLE INSPECTION**)

   OK: Go to next step

5. **CHECK HARNESS AND CONNECTOR (VSV FOR AICV VOLTAGE)**
   a. Disconnect the VSV for air intake control valve connector.
   b. Turn the ignition switch to ON.
   c. Measure the voltage according to the value (s) in the table below.

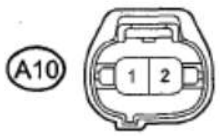
   Standard Voltage

   TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Switch Condition	Specified Condition
A10-1 - Body ground	Ignition switch ON	11 to 14 V

   NG: REPAIR OR REPLACE HARNESS OR CONNECTOR (EFI NO. 3 FUSE - VSV FOR AIR INTAKE CONTROL VALVE)

Front view of wire harness connector:
(to VSV for Air Intake Control Valve)



A168222E01

Fig. 353: Identifying VSV For Air Intake Control Valve Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

   OK: Go to next step

6. **CHECK HARNESS AND CONNECTOR (VSV FOR AIR INTAKE CONTROL VALVE - ECM)**
   a. Disconnect the VSV for air intake control valve connector.
   b. Disconnect the ECM connector.

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c. Measure the resistance according to the value (s) in the table below.

Standard Resistance (Check for Open)

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
A10-2-B51-35 (AICV)	Always	Below 1 ohms

Standard Resistance (Check for Short)

TESTER CONNECTION SPECIFIED CONDITION CHART

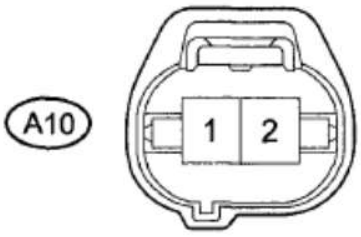
Tester Connection	Condition	Specified Condition
A10-2 or B51-35 (AICV) - Body ground	Always	10 kohms or higher

d. Reconnect the ECM connector.

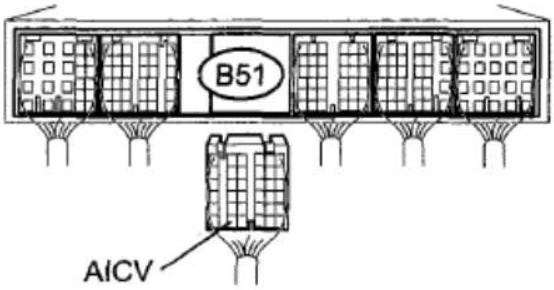
NG: REPAIR OR REPLACE HARNESS OR CONNECTOR

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Front view of wire harness connector:
(to VSV for Air Intake Control Valve)



Rear view of wire harness connector:
(to ECM)



A205263E05

Fig. 354: Identifying VSV For Air Intake Control Valve And ECM Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: REPLACE ECM (See **INSPECTION PROCEDURE**)

MIL CIRCUIT

DESCRIPTION

The Malfunction Indicator Lamp (MIL) is used to indicate vehicle malfunctions detected by the ECM. When the ignition switch is turned to ON, power is supplied to the MIL circuit, and the ECM provides the circuit ground which illuminates the MIL.

The MIL operation can be checked visually. When the ignition switch is first turned to ON, the MIL should be illuminated and should then turn off. If the MIL remains illuminated or is not illuminated, conduct the following troubleshooting procedure using the Techstream.

WIRING DIAGRAM

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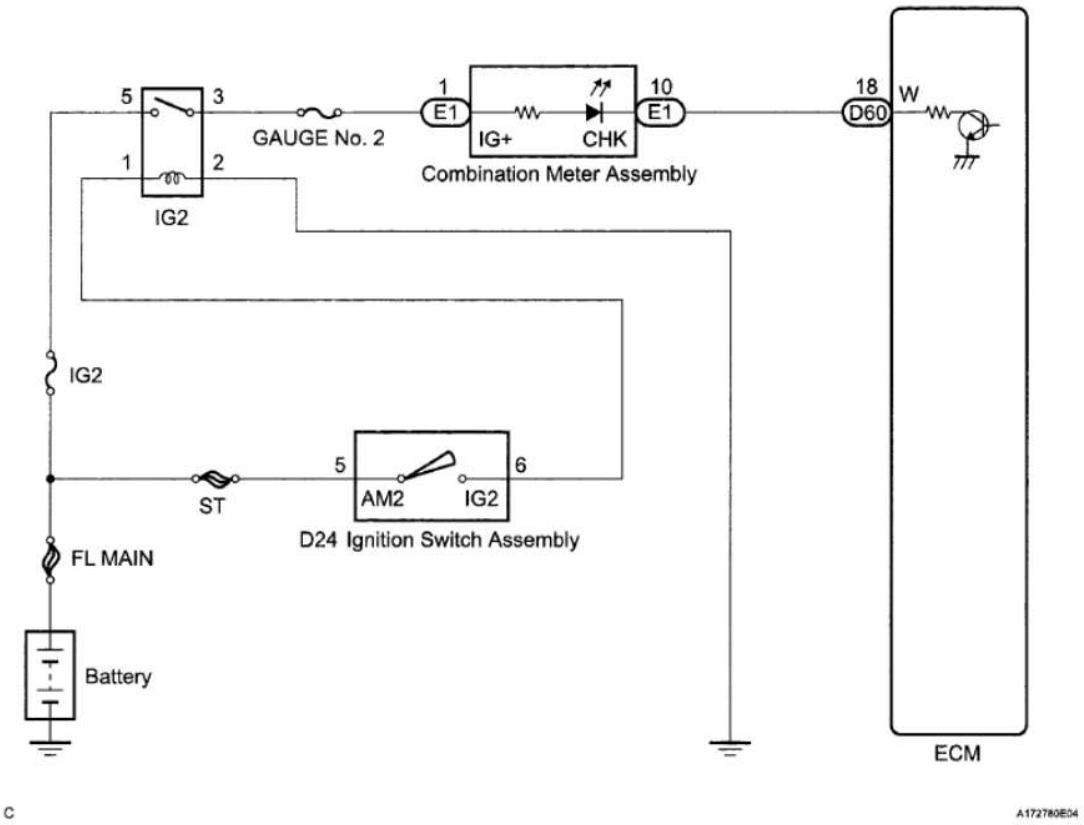


Fig. 355: MIL Circuit - Wiring Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSPECTION PROCEDURE

1. **CHECK THAT MIL IS ILLUMINATED**
   a. Turn the ignition switch to ON.
   b. Check the illumination of the MIL.

Result

RESULT CHART

Result	Proceed to
MIL remains illuminated (Even after ignition switch is turned to ON and several seconds have passed, MIL still remains illuminated)	A
MIL remains off (Does not illuminate at all)	B

B: Go to step 5

A: Go to next step

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2. **CHECK WHETHER MIL TURNS OFF**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch to ON and turn the Techstream on.
   c. Enter the following menus: Powertrain/Engine/Trouble Code.
   d. Check if any DTCs have been stored. Note down any DTCs.
   e. Clear the DTCs (See **DTC CHECK/CLEAR**).
   f. Check if the MIL goes off.

   OK:

   MIL goes off.

   NG: Go to step 3

   OK: REPAIR CIRCUITS INDICATED BY OUTPUT DTCS (See **DIAGNOSTIC TROUBLE CODE CHART**)

3. **CHECK HARNESS AND CONNECTOR (CHECK FOR SHORT IN WIRE HARNESS)**
   a. Disconnect the ECM connector.
   b. Turn the ignition switch to ON.
   c. Check that the MIL is not illuminated.

   OK:

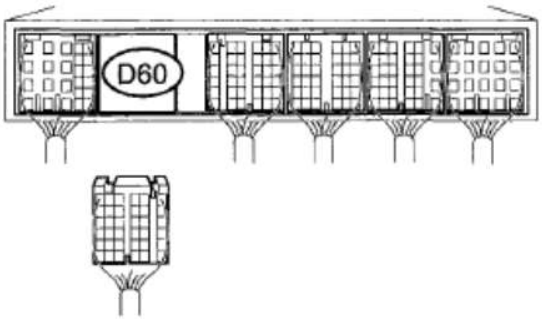
   MIL is not illuminated.

   d. Reconnect the ECM connector.

   NG: Go to step 4

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Rear view of wire harness connector:
(to ECM)



A206264E03

Fig. 356: Disconnecting ECM D60 Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: REPLACE ECM (See **INSPECTION PROCEDURE**)

4. **CHECK HARNESS AND CONNECTOR (COMBINATION METER ASSEMBLY - ECM)**
   a. Disconnect the ECM connector.
   b. Disconnect the combination meter assembly connector.
   c. Measure the resistance according to the value (s) in the table below.

Standard Resistance (Check for Short)

TESTER CONNECTION SPECIFIED CONDITION CHART

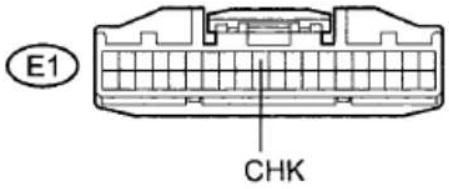
Tester Connection	Condition	Specified Condition
D60-18 (W) or E1-10 (CHK) - Body ground	Always	10 kohms or higher

   d. Reconnect the ECM connector.
   e. Reconnect the combination meter assembly connector.

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR

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Front view of wire harness connector:
(to Combination Meter Assembly)



Rear view of wire harness connector:
(to ECM)

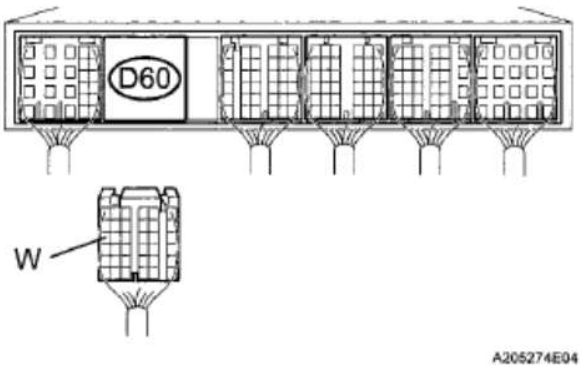


Fig. 357: Identifying ECM Connector And Combination Meter Assembly Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: REPLACE COMBINATION METER ASSEMBLY (See **COMBINATION METER**)

5. **CHECK THAT ENGINE STARTS**
   a. Turn the ignition switch to ON.
   b. Start the engine.

Result

RESULT CHART

Result	Proceed to
Engine starts	A
Engine does not start*	B
HINT: *: The Techstream cannot communicate with the ECM.	

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B: GO TO **VC OUTPUT CIRCUIT**

A: Go to next step

6. **CHECK HARNESS AND CONNECTOR (COMBINATION METER - BODY GROUND)**
   a. Disconnect the ECM connector.
   b. Turn the ignition switch to ON.
   c. Measure the voltage according to the value (s) in the table below.

Standard Voltage

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
D60-18 (W) - Body ground	Ignition switch ON	11 to 14 V

   d. Reconnect the ECM connector.

NG: Go to step 7

Rear view of wire harness connector:
(to ECM)

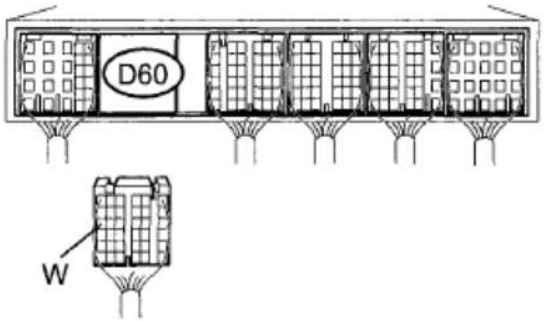


Fig. 358: Disconnecting ECM D60 Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: REPLACE ECM (See **INSPECTION PROCEDURE**)

7. **CHECK HARNESS AND CONNECTOR (COMBINATION METER ASSEMBLY - ECM)**
   a. Disconnect the ECM connector.
   b. Disconnect the combination meter assembly connector.
   c. Measure the resistance according to the value (s) in the table below.

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Standard Resistance (Check for Open)

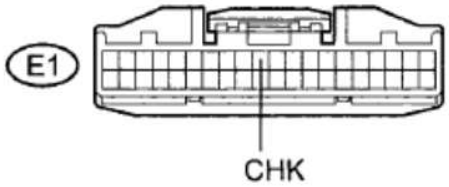
TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
D60-18 (W) - E1-10 (CHK)	Always	Below 1 ohms

d. Reconnect the ECM connector.
e. Reconnect the combination meter assembly connector.

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR

Front view of wire harness connector:
(to Combination Meter Assembly)



Rear view of wire harness connector:
(to ECM)

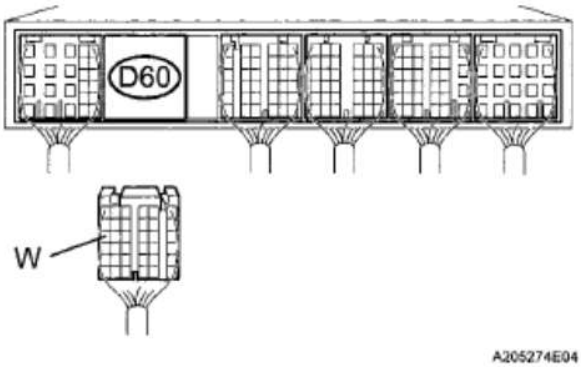


Fig. 359: Identifying ECM Connector And Combination Meter Assembly Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: REPLACE COMBINATION METER ASSEMBLY (See **COMBINATION METER**)

THROTTLE BODY

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COMPONENTS

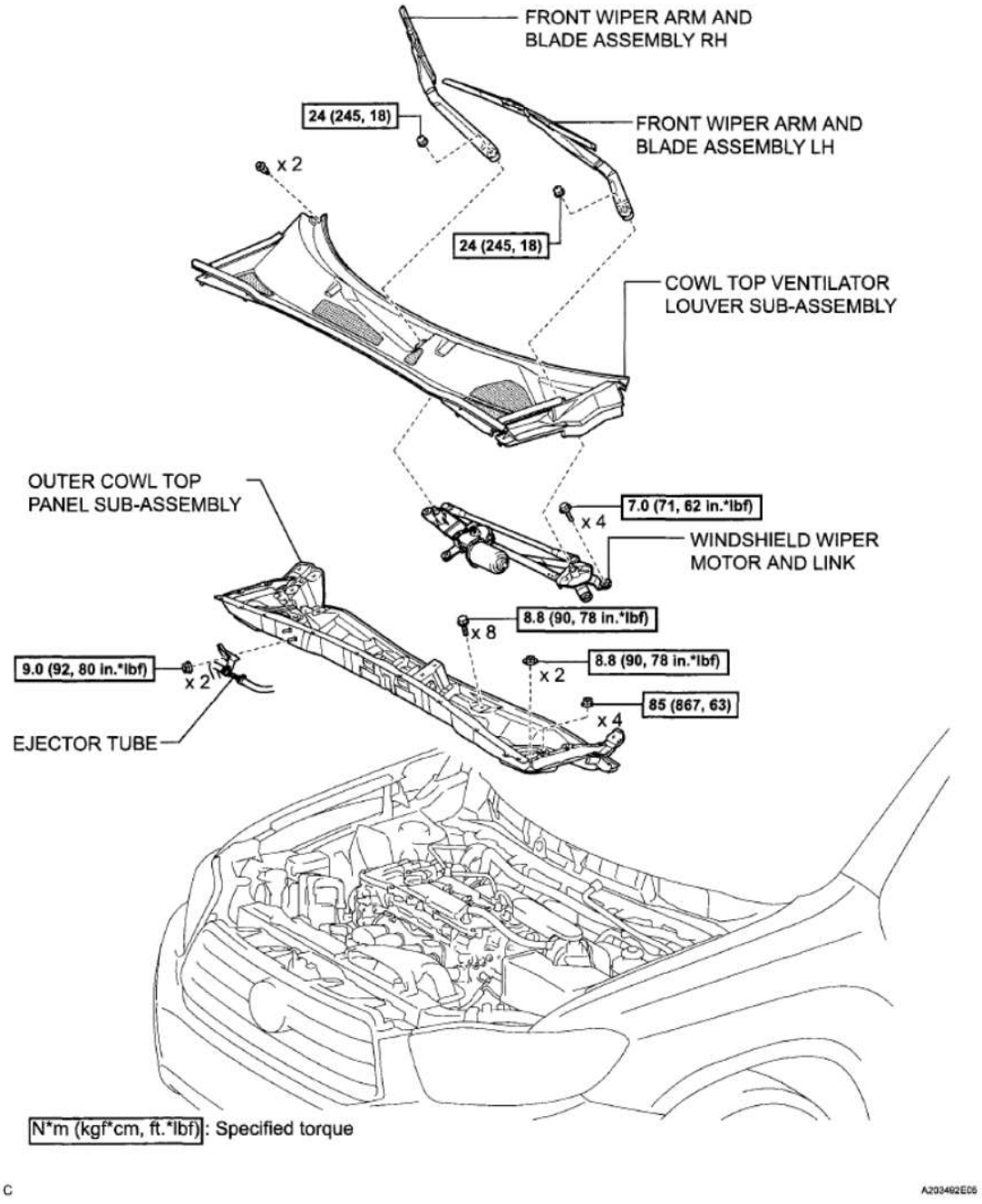


Fig. 360: Identifying Throttle Body Components And Torque Specifications (1 Of 3)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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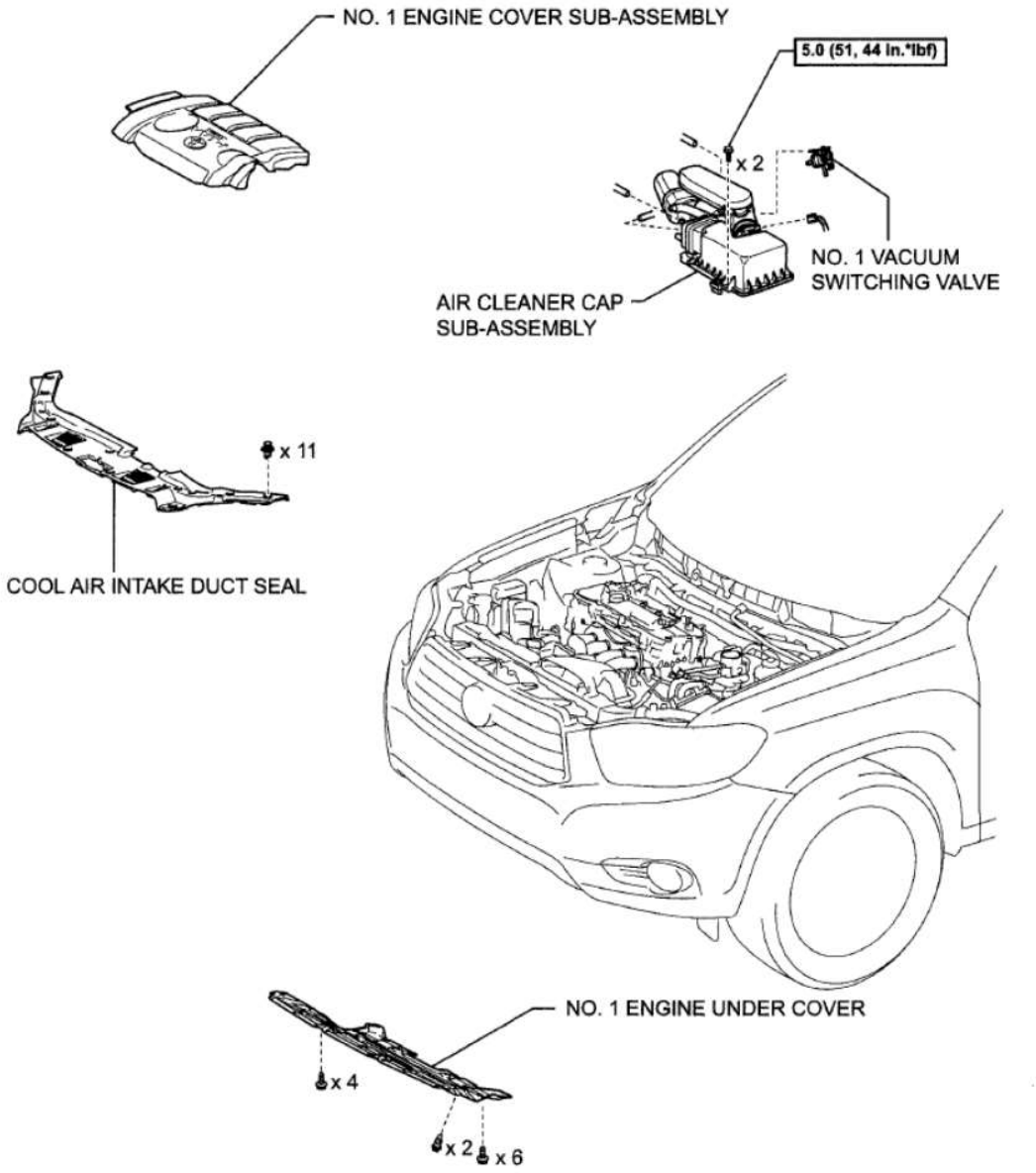


Fig. 361: Identifying Throttle Body Components And Torque Specifications (2 Of 3)
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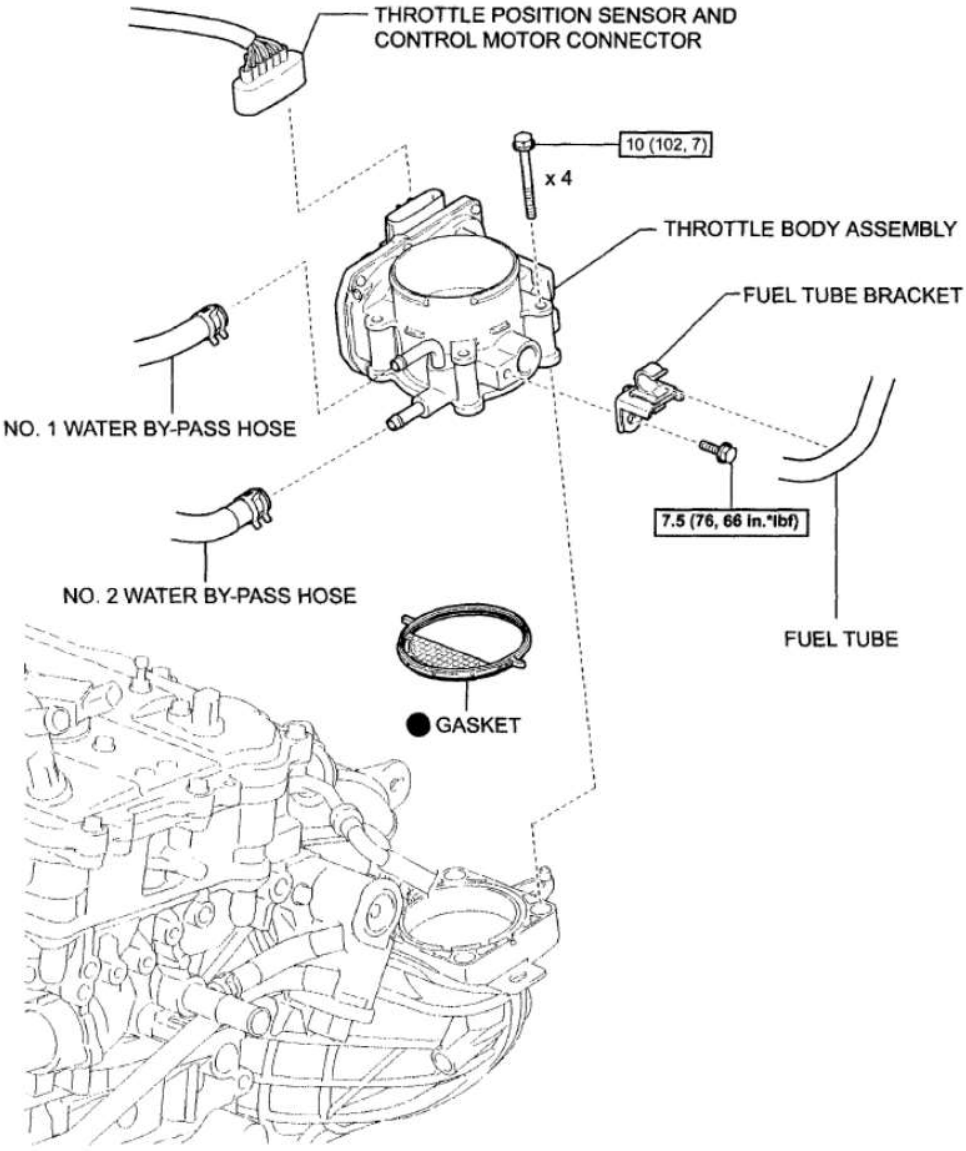


Fig. 362: Identifying Throttle Body Components And Torque Specifications (3 Of 3)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

ON-VEHICLE INSPECTION

1. **CHECK THROTTLE BODY ASSEMBLY**
   a. Check the throttle control motor operating sounds.
      1. Turn the ignition switch to ON.
      2. When pressing the accelerator pedal, check the operating sound of the running motor. Make

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sure that no friction noises are emitted from the motor.

If friction noise exists, replace the throttle body.

b. Check the throttle position sensor.
   1. Connect the Techstream to the DLC3.
   2. Turn the ignition switch to ON.
   3. Turn the Techstream on.
   4. Enter the following menus: Powertrain/Engine/Data List/Throttle Sensor Position.
   5. Depress the accelerator pedal. When the throttle valve is fully opened, check that the value of "Throttle Sensor Position" is within the specification.

      Standard throttle valve opening percentage:

      60% or more

      NOTE: When checking the standard throttle valve opening percentage, make sure the shift lever is in N.

      If the percentage is less than 60%, replace the throttle body assembly.

REMOVAL

1. **REMOVE WINDSHIELD WIPER MOTOR AND LINK**

   HINT:

   See the steps from "Remove front wiper arm and blade assembly LH" through "Remove windshield wiper motor and link" (See **REMOVAL**).

2. **SEPARATE EJECTOR TUBE** (See **REMOVAL**)
3. **REMOVE OUTER COWL TOP PANEL SUB-ASSEMBLY** (See **REMOVAL**)
4. **REMOVE COOL AIR INTAKE DUCT SEAL** (See **REMOVAL**)
5. **REMOVE NO. 1 ENGINE UNDER COVER**
6. **DRAIN ENGINE COOLANT** (See **COOLANT**)
7. **REMOVE NO. 1 ENGINE COVER SUB-ASSEMBLY** (See **REMOVAL**)
8. **REMOVE NO. 1 VACUUM SWITCHING VALVE** (See **REMOVAL**)
9. **REMOVE AIR CLEANER CAP SUB-ASSEMBLY**
   a. Disconnect the mass air flow meter connector and separate the hose from hose clamp.

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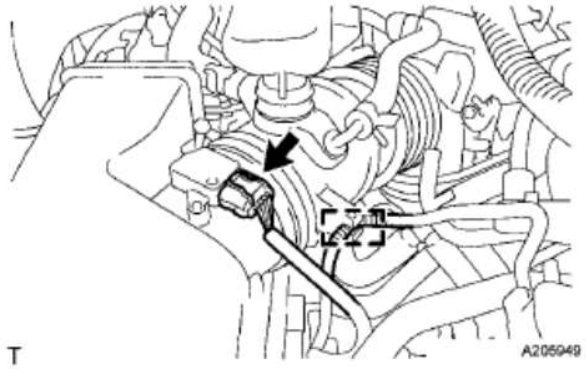


Fig. 363: Locating Mass Air Flow Meter Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. Disconnect the ventilation hose from the cylinder head cover.
c. Disconnect the hose from the air cleaner cap sub-assembly and the hose clamp.

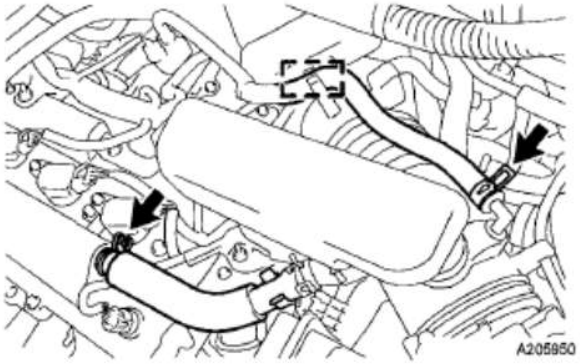


Fig. 364: Locating Air Cleaner Cap Sub-Assembly And Hose Clamp
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

d. Disconnect the 2 vacuum hoses from the air cleaner cap sub-assembly.
e. Separate the 2 vacuum hoses from the 2 hose clamps.

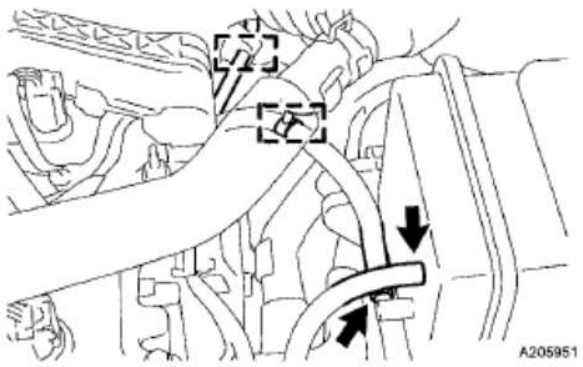


Fig. 365: Locating Vacuum Hoses

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

f. Unlock the hose band and separate the air cleaner cap sub-assembly from the throttle body assembly.

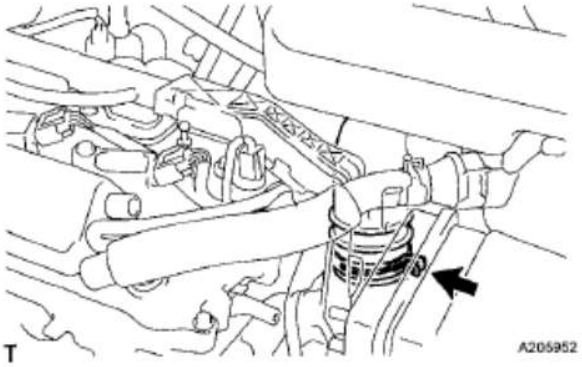


Fig. 366: Locating Hose Band
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

g. Remove the 2 bolts and air cleaner cap sub-assembly.

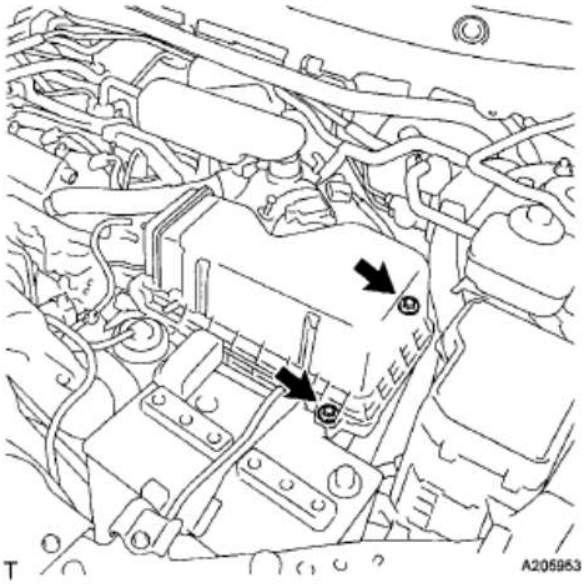


Fig. 367: Locating Bolts And Air Cleaner Cap Sub-Assembly
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

10. **REMOVE THROTTLE BODY ASSEMBLY**
    a. Disconnect the throttle body assembly connector.
    b. Disconnect the fuel tube from the clamp.

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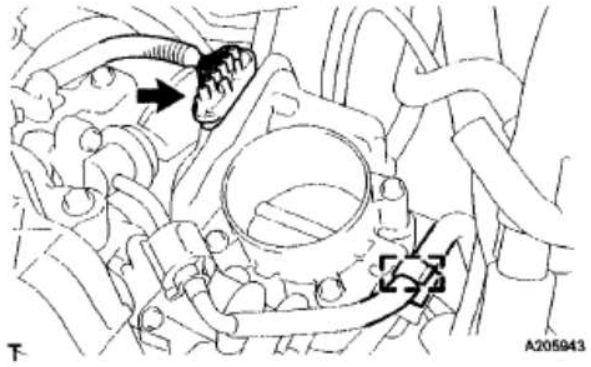


Fig. 368: Locating Throttle Body Assembly Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

c. Disconnect the 2 water by-pass hoses from the throttle body assembly.

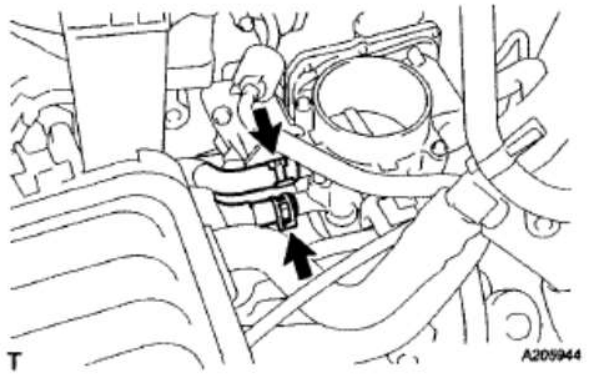


Fig. 369: Locating Water By-Pass Hoses
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

d. Remove the 4 bolts and the throttle body assembly with the fuel tube bracket.

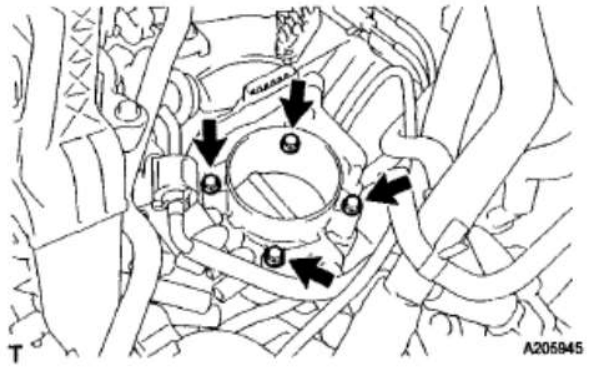


Fig. 370: Locating Bolts And Throttle Body Assembly
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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e. Remove the bolt and fuel tube bracket.

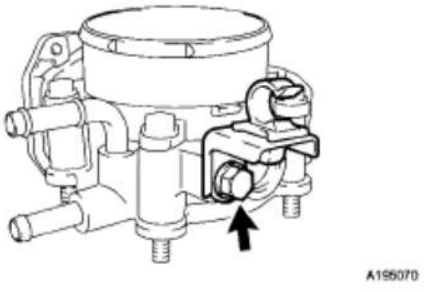


Fig. 371: Locating Bolt And Fuel Tube Bracket
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

f. Remove the gasket from the intake manifold.

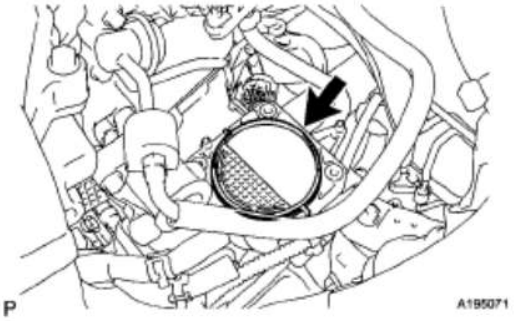


Fig. 372: Locating Gasket
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSPECTION

1. **INSPECT THROTTLE BODY ASSEMBLY**
   a. Check that the throttle valve opens and closes smoothly.
   b. Check that there is no sludge accumulating around the throttle body.
   c. Measure the resistance according to the value (s) in the table below.

Standard Resistance

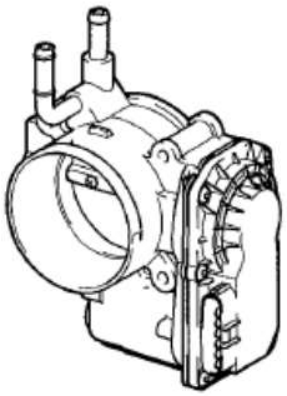
TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
1 (M-) - 2 (M+)	20°C (68°F)	0.3 to 100 ohms

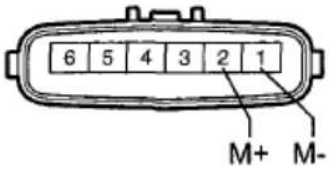
If the result is not as specified, replace the throttle body assembly.

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Component without harness connected:
(Throttle Body)

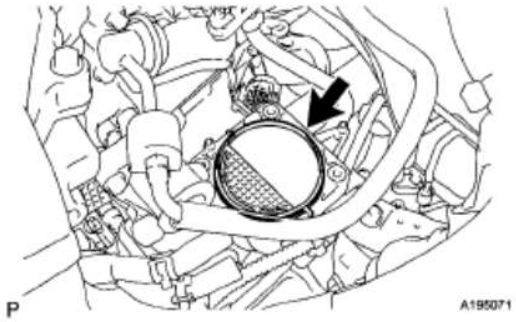


P A195072E03

Fig. 373: Identifying Throttle Body Assembly
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSTALLATION

1. **INSTALL THROTTLE BODY ASSEMBLY**
   a. Install a new gasket to the intake manifold.



P A195071

Fig. 374: Locating Gasket
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

   b. Install the fuel tube bracket with the bolt.

   Torque: 7.5 N*m (76 kgf*cm, 66 in.*lbf)

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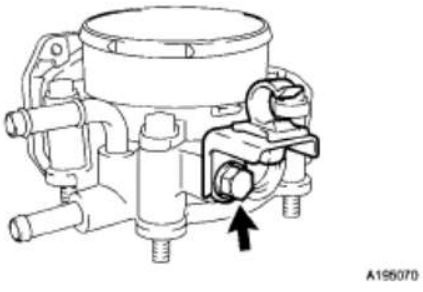


Fig. 375: Locating Bolt And Fuel Tube Bracket
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

c. Install the throttle body assembly with the 4 bolts.

Torque: 10 N*m (102 kgf*cm, 7 ft.*lbf)

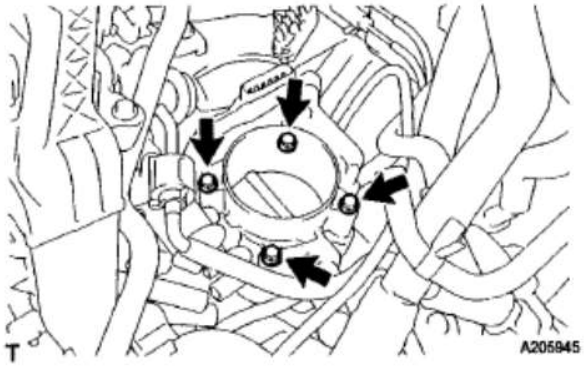


Fig. 376: Locating Bolts And Throttle Body Assembly
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

d. Connect the 2 water by-pass hoses to the throttle body.

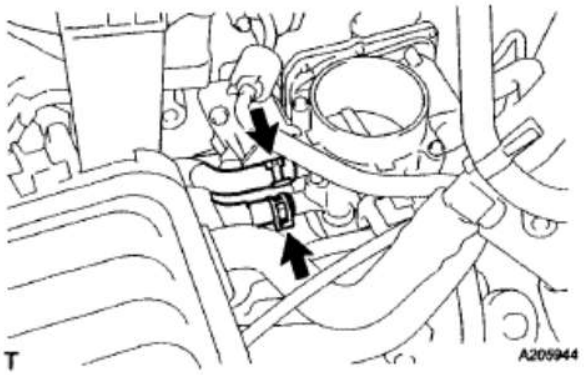


Fig. 377: Locating Water By-Pass Hoses
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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e. Connect the throttle body assembly connector.
f. Connect the fuel tube to the clamp.

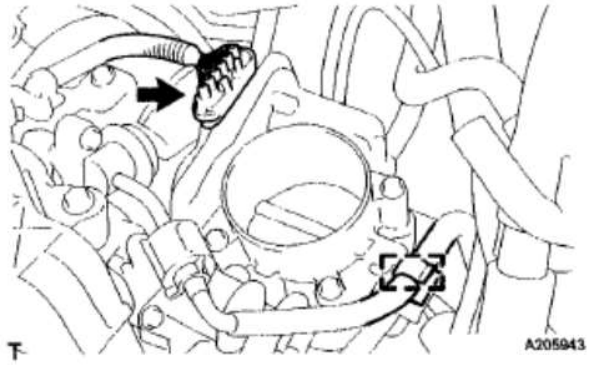


Fig. 378: Locating Throttle Body Assembly Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

2. **INSTALL AIR CLEANER CAP SUB-ASSEMBLY**
   a. Connect the air-cleaner cap sub-assembly to the throttle body assembly and lock the hose band.

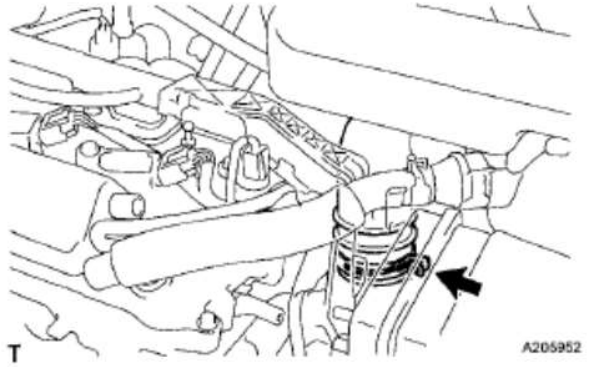


Fig. 379: Locating Hose Band
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

   b. Install the air cleaner cap sub-assembly with the 2 bolts.

Torque: 5.0 N*m (51 kgf*cm, 44 in.*lbf)

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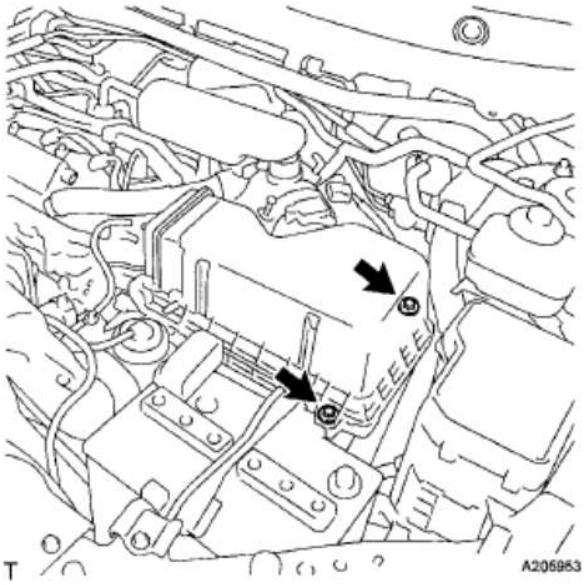


Fig. 380: Locating Bolts And Air Cleaner Cap Sub-Assembly
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

c. Connect the 2 vacuum hoses to the air cleaner cap sub-assembly.
d. Connect the 2 vacuum hoses to the 2 hose clamps.

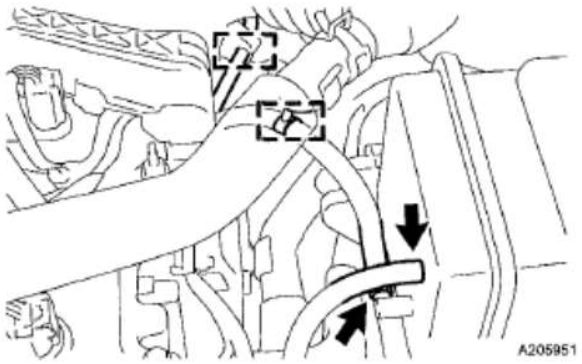


Fig. 381: Locating Vacuum Hoses
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

e. Connect the hose to the air cleaner cap sub-assembly and the hose clamp.
f. Connect the ventilation hose to the cylinder head cover.

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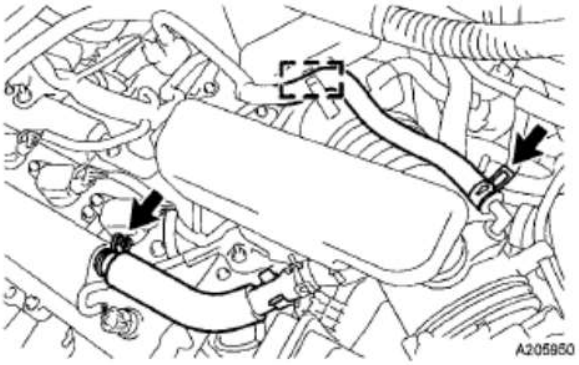


Fig. 382: Locating Air Cleaner Cap Sub-Assembly And Hose Clamp
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

g. Connect the hose to the hose clamp.
h. Connect the mass air flow meter connector.

3. **INSTALL NO. 1 VACUUM SWITCHING VALVE** (See **INSPECTION**)
4. **ADD ENGINE COOLANT** (See **COOLANT**)
5. **INSPECT FOR COOLANT LEAK** (See **COOLING SYSTEM**)

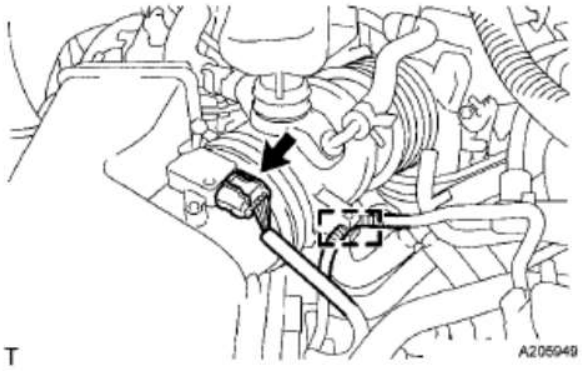


Fig. 383: Locating Mass Air Flow Meter Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

6. **INSTALL NO. 1 ENGINE COVER SUB-ASSEMBLY** (See **INSTALLATION**)
7. **INSTALL COOL AIR INTAKE DUCT SEAL** (See **INSTALLATION**)
8. **INSTALL OUTER COWL TOP PANEL SUB-ASSEMBLY** (See **INSTALLATION**)
9. **INSTALL EJECTOR TUBE** (See **INSTALLATION**)
10. **INSTALL WINDSHIELD WIPER MOTOR AND LINK**

HINT:

See the steps from "Install Windshield Wiper Motor and Link Assembly" through "Install front wiper arm and blade assembly LH" (See **INSTALLATION**).

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11. **INSTALL NO. 1 ENGINE UNDER COVER**
12. **PERFORM INITIALIZATION**

NOTE: Perform the following procedure after replacing the ECM, throttle body assembly or any throttle body components. The following procedure should also be performed if the throttle body is cleaned.

a. Disconnect the cable from the negative (-) battery terminal. Wait at least 60 seconds and reconnect the cable.
b. Turn the ignition switch to ON without operating the accelerator pedal.

NOTE: If the accelerator pedal is operated, perform the above steps again.

c. Connect the Techstream to the DLC3 and clear the DTCs (See **DTC CHECK/CLEAR**).
d. Start the engine and check that the MIL is not illuminated. After the engine is warmed up, check that the idle speed is within the specified range when the A/C is switched off.

Standard

ENGINE IDLE SPEED CHART

Condition	Engine Idle Speed
A/C switched off	600 to 700 rpm

NOTE:
- **Be sure to perform this step with all accessories off.**
- **Make sure that the shift lever is in neutral.**

e. Enter the following menus: Powertrain/Engine/Data List/Throttle Sensor Position. Fully depress the accelerator pedal and check that the value is 60% or more.
f. Perform a road test and confirm that there are no abnormalities.

ECM

COMPONENTS

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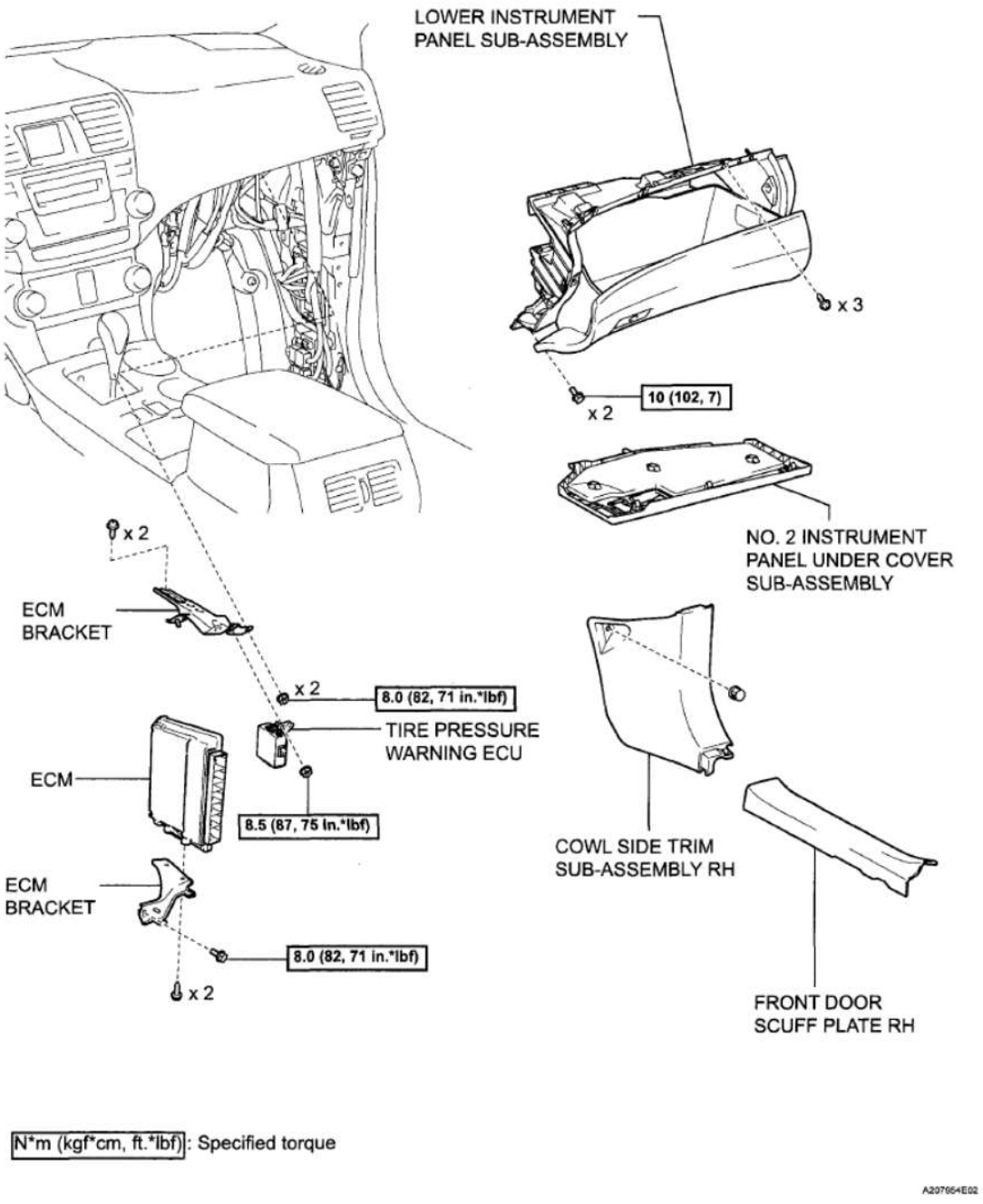


Fig. 384: Identifying ECM Components And Torque Specifications
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

REMOVAL

1. **DISCONNECT CABLE FROM NEGATIVE BATTERY TERMINAL**

NOTE: **When disconnecting the cable, some systems need to be initialized after the cable is reconnected (See INITIALIZATION).**

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2. **REMOVE FRONT DOOR SCUFF PLATE RH** (See **REMOVAL**)
3. **REMOVE COWL SIDE TRIM SUB-ASSEMBLY RH** (See **REMOVAL**)
4. **REMOVE NO. 2 INSTRUMENT PANEL UNDER COVER SUB-ASSEMBLY** (See **REMOVAL**)
5. **REMOVE LOWER INSTRUMENT PANEL SUB-ASSEMBLY** (See **REMOVAL**)
6. **REMOVE ECM**
   a. Disconnect the 6 ECM connectors.

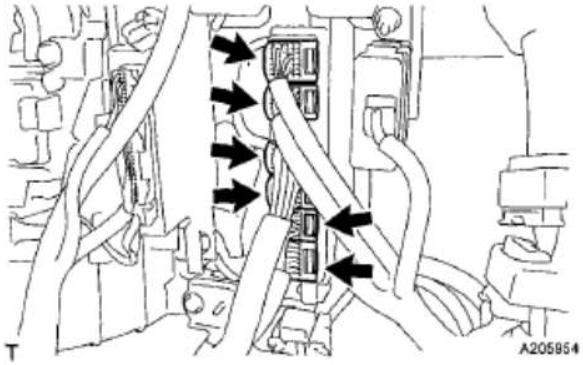


Fig. 385: Locating ECM Connectors
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

   b. Disconnect the tire pressure warning ECU connector and remove the nut and the tire pressure warning ECU.

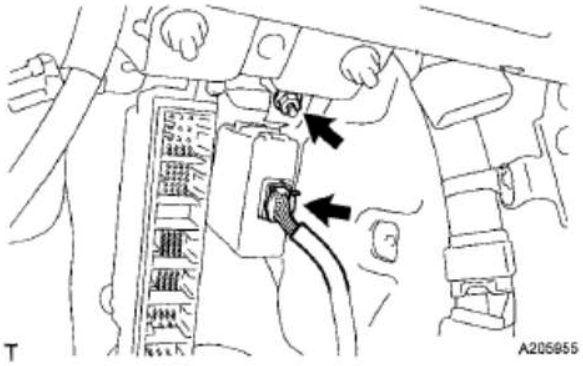


Fig. 386: Locating Tire Pressure Warning ECU Connector And Nut
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

   c. Separate the 2 wire harness clamps.
   d. Remove the 2 nuts, bolt and ECM with bracket.

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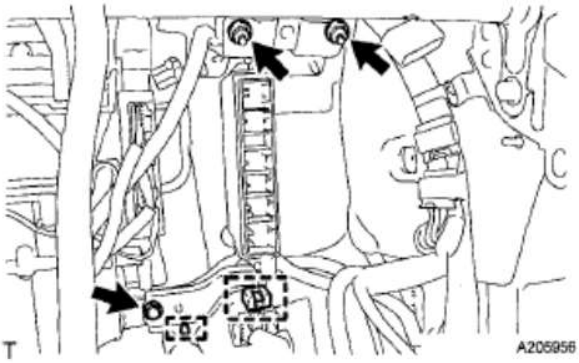


Fig. 387: Locating Nuts, Bolt And ECM With Bracket
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

e. Remove the 4 screws and 2 ECM brackets from the ECM.

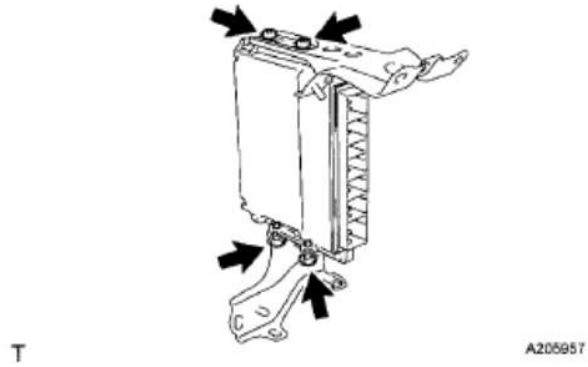
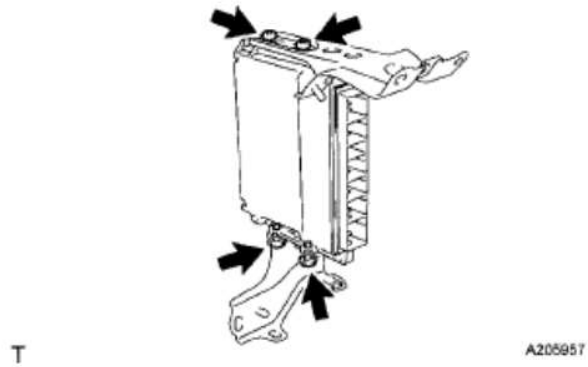


Fig. 388: Locating Screws And ECM Brackets
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSTALLATION

1. **INSTALL ECM**
   a. Install the 2 ECM brackets with the 4 screws.



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Fig. 389: Locating Screws And ECM Brackets
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. Install the ECM with bracket with the bolt and 2 nuts.

Torque: 8.0 N*m (82 kgf*cm, 71 in.*lbf)

c. Install the 2 wire harness clamps.

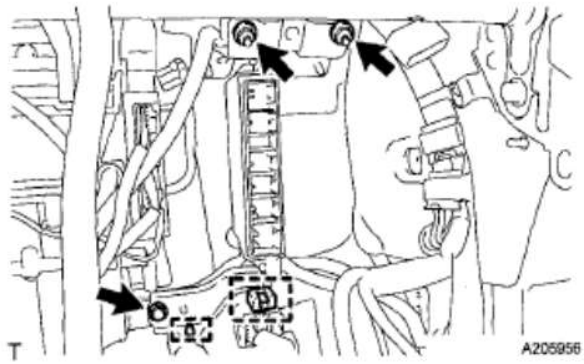


Fig. 390: Locating Nuts, Bolt And ECM With Bracket
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

d. Install the tire pressure warning ECU with the nut and connect the tire pressure warning ECU connector.

Torque: 8.5 N*m (87 kgf*cm, 75 in.*lbf)

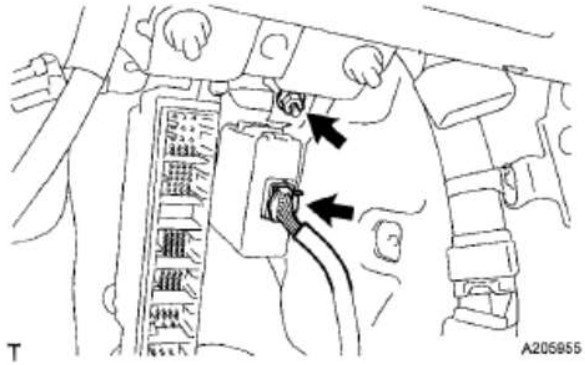


Fig. 391: Locating Tire Pressure Warning ECU Connector And Nut
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

e. Connect the 6 ECM connectors.

2. **INSTALL LOWER INSTRUMENT PANEL SUB-ASSEMBLY** (See **INSTALLATION**)
3. **INSTALL NO. 2 INSTRUMENT PANEL UNDER COVER SUB-ASSEMBLY** (See **INSTALLATION**)

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4. **INSTALL COWL SIDE TRIM SUB-ASSEMBLY RH** (See **INSTALLATION**)
5. **INSTALL FRONT DOOR SCUFF PLATE RH** (See **INSTALLATION**)

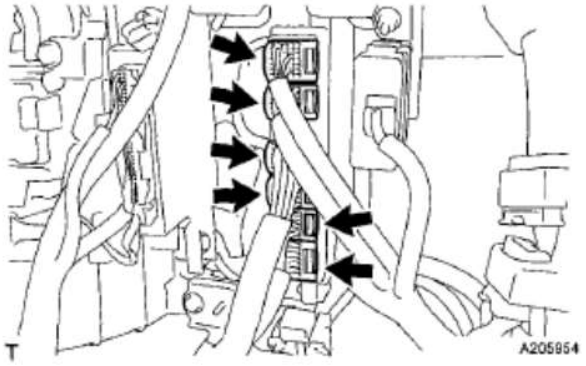


Fig. 392: Locating ECM Connectors
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

6. **CONNECT CABLE TO NEGATIVE BATTERY TERMINAL**

NOTE: **When disconnecting the cable, some systems need to be initialized after the cable is reconnected (See INITIALIZATION).**

7. **PERFORM INITIALIZATION**

NOTE:

- **If the ECM is replaced, register the ECU communication ID for the immobiliser system (See INITIALIZATION).**
- **The Vehicle Identification Number (VIN) must be input into the replacement ECM (See INITIALIZATION).**

HINT:

Initialization cannot be completed by only disconnecting and reconnecting the cable of the negative (-) battery terminal.

ACCELERATOR PEDAL ROD

COMPONENTS

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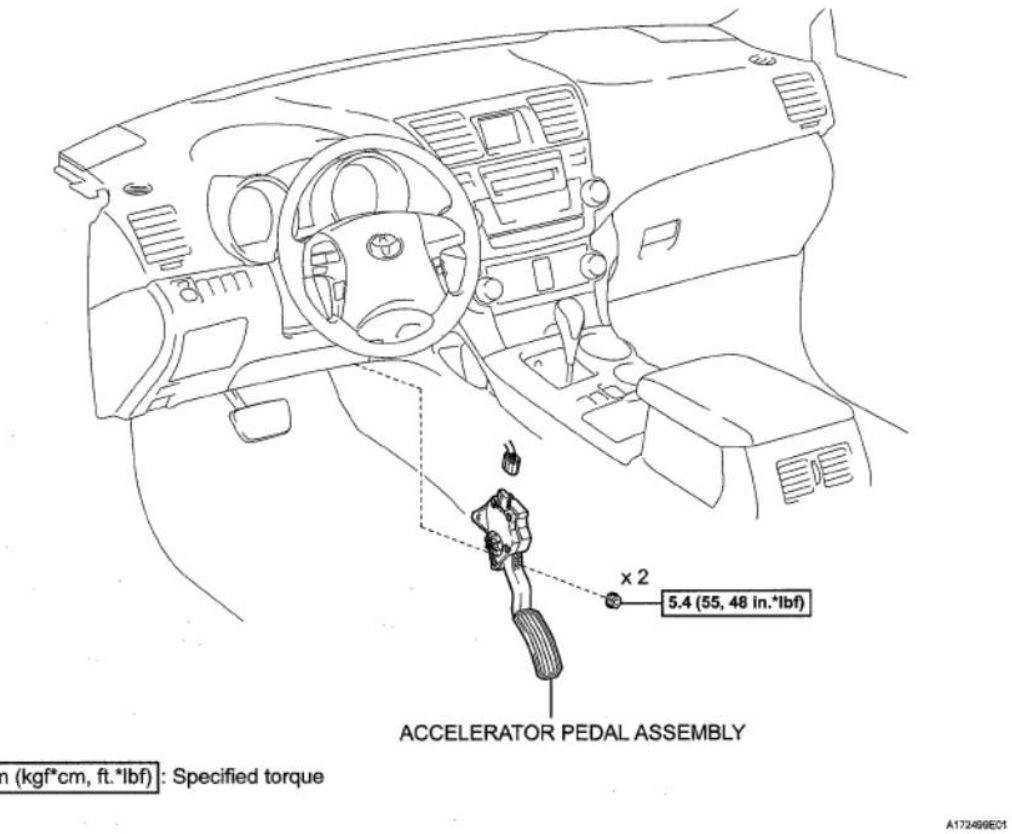


Fig. 393: Identifying Accelerator Pedal Rod Components And Torque Specifications
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

ON-VEHICLE INSPECTION

1. **CHECK ACCELERATOR PEDAL ASSEMBLY**
   a. Check the voltage.
      1. Connect Techstream to the DLC3.
      2. Turn the ignition switch to ON.
      3. Turn the Techstream main switch on.
      4. Select the menu items: Powertrain/Engine/Data List/Accel Sensor Out No. 1, Accel Sensor Out No. 2.
      5. Operate the accelerator pedal assembly, and then check that the Accelerator Position No. 1 and Accelerator Position No. 2 values are within the specifications.

      Standard Voltage (Accel Sensor Out No. 1)

ACCELERATOR PEDAL ASSEMBLY CONDITION CHART

Accelerator Pedal Assembly Condition	Specified Condition
Released	0.5 to 1.1 V
Depressed	2.6 to 4.5 V

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Standard Voltage (Accel Sensor Out No. 2)

ACCELERATOR PEDAL ASSEMBLY CONDITION CHART

Accelerator Pedal Assembly Condition	Specified Condition
Released	1.2 to 2.0 V
Depressed	3.4 to 4.98 V

If the result is not as specified, check the accelerator pedal assembly, wire harness or ECM.

REMOVAL

1. **REMOVE ACCELERATOR PEDAL ASSEMBLY**
   a. Disconnect the accelerator pedal assembly connector.
   b. Remove the 2 nuts and accelerator pedal assembly.

INSTALLATION

1. **INSTALL ACCELERATOR PEDAL ASSEMBLY**

NOTE:

- **Avoid physical shock to the accelerator pedal assembly.**
- **Do not disassemble the accelerator pedal assembly.**

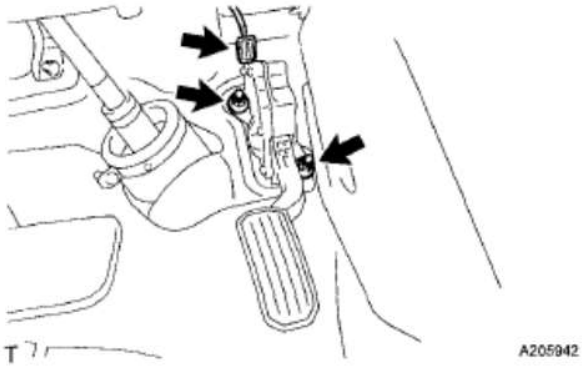


Fig. 394: Locating Nuts And Accelerator Pedal Assembly
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

a. Install the accelerator pedal assembly with the 2 nuts.

Torque: 5.4 N*m (55 kgf*cm, 48 in.*lbf)

b. Connect the accelerator pedal assembly connector.

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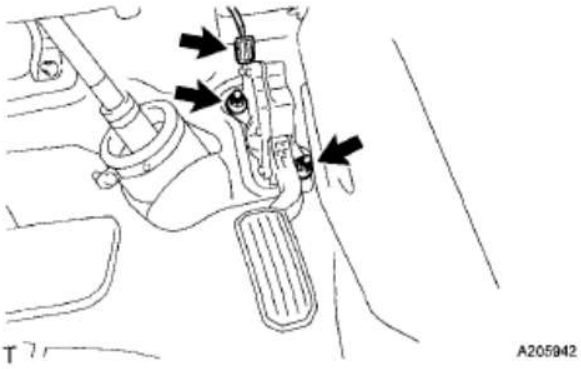


Fig. 395: Locating Nuts And Accelerator Pedal Assembly
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

MASS AIR FLOW METER

COMPONENTS

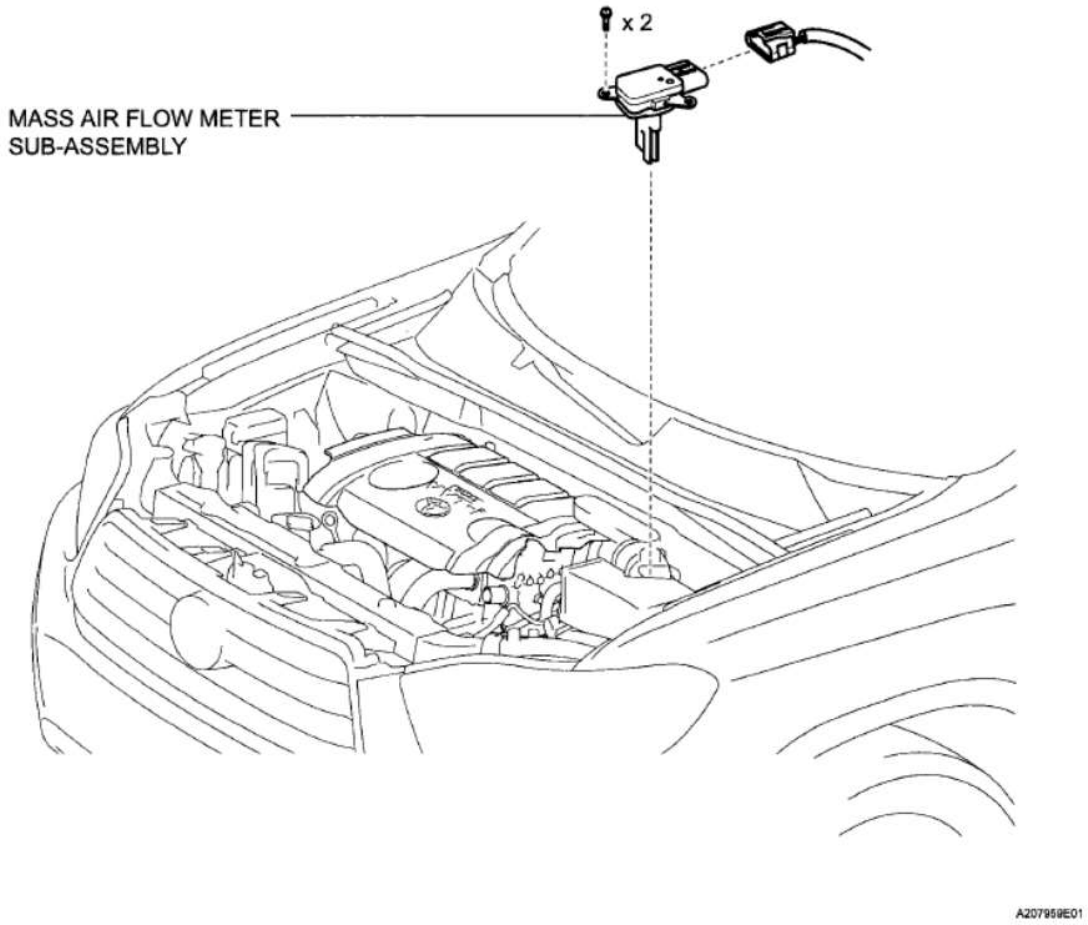


Fig. 396: Identifying Mass Air Flow Meter Components
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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ON-VEHICLE INSPECTION

NOTE:

- **Perform the MAF meter inspection according to the procedure below.**
- **Only replace the MAF meter when the MAF value in the Data List (with the engine stopped) is not within the normal operating range or there is foreign matter on the MAF meter platinum hot wire (heater).**

1. **INSPECT MASS AIR FLOW METER SUB-ASSEMBLY**

NOTE:

- **Perform the inspection with the vehicle indoors and on a level surface.**
- **Perform the inspection of the MAF meter while it is installed to the air cleaner case (installed to the vehicle).**
- **During the test, do not use the exhaust air duct to perform suction on the exhaust pipe.**

a. Connect the Techstream to the DLC3.
b. Turn the ignition switch to ON (do not run the engine).
c. Turn the Techstream on.
d. Enter the following menus: Powertrain/Engine/Data List/MAF.
e. Wait 30 seconds, and read the values on the Techstream.

Standard

ITEM SPECIFIED CONDITION CHART

Item	Condition	Specified Condition
MAF	• Engine not running • 30 seconds after turning ignition switch to ON	Less than 0.71 g/sec.

If the result is not as specified, replace the mass air flow meter sub-assembly.

If the result is as specified, inspect the mass air flow meter sub-assembly (See **INSPECTION**).

REMOVAL

1. **REMOVE MASS AIR FLOW METER SUB-ASSEMBLY**
   a. Disconnect the mass air flow meter connector.
   b. Remove the 2 screws and mass air flow meter.

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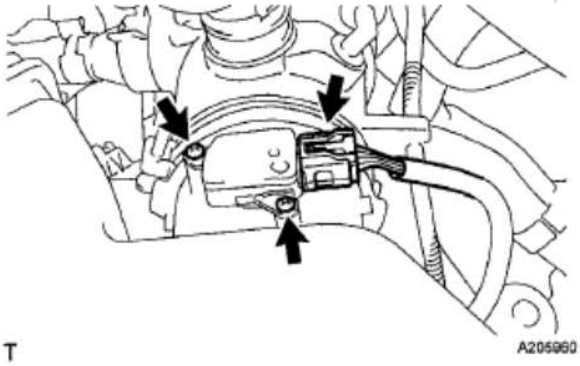


Fig. 397: Locating Screws And Mass Air Flow Meter
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSPECTION

1. **INSPECT MASS AIR FLOW METER SUB-ASSEMBLY**
   a. Perform a visual check for any foreign matter on the platinum hot wire (heater) of the mass air flow meter shown in the illustration.

   OK:

   There is no foreign material.

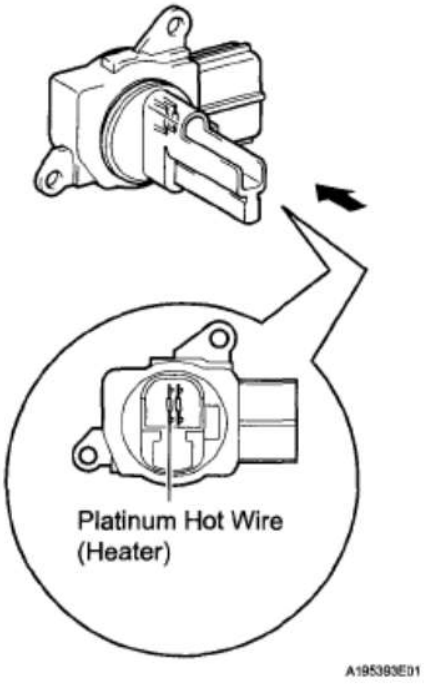


Fig. 398: Identifying Mass Air Flow Meter Sub-Assembly
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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b. Check the intake air temperature sensor (built into the mass air flow meter).
   1. Measure the resistance according to the value (s) in the table below.

Standard Resistance

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
1 (THA) - 2 (E2)	-20°C (-4°F)	13.6 to 18.4 kohms
1 (THA) - 2 (E2)	20°C (68°F)	2.21 to 2.69 kohms
1(THA) - 2 (E2)	60°C (140°F)	0.49 to 0.67 kohms

If the result is not as specified, replace the mass air flow meter sub-assembly.

Component without harness connected:
(Mass Air Flow Meter)

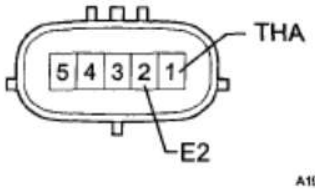


Fig. 399: Identifying Mass Air Flow Meter Sub-Assembly Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSTALLATION

1. **INSTALL MASS AIR FLOW METER SUB-ASSEMBLY**
   a. Install the mass air flow meter with the 2 screws.

NOTE: Make sure that the O-ring is not cracked or does not jump out of position during installation.

   b. Connect the mass air flow meter connector.

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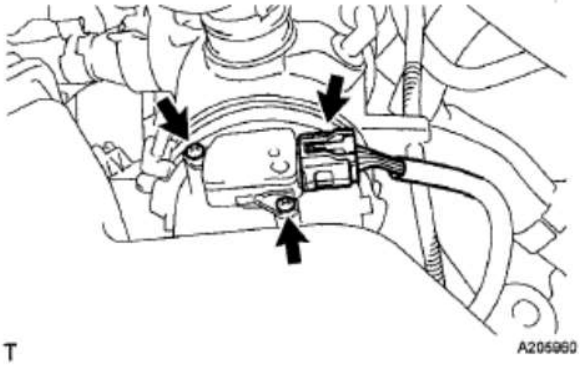


Fig. 400: Locating Screws And Mass Air Flow Meter
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

CAMSHAFT POSITION SENSOR

COMPONENTS

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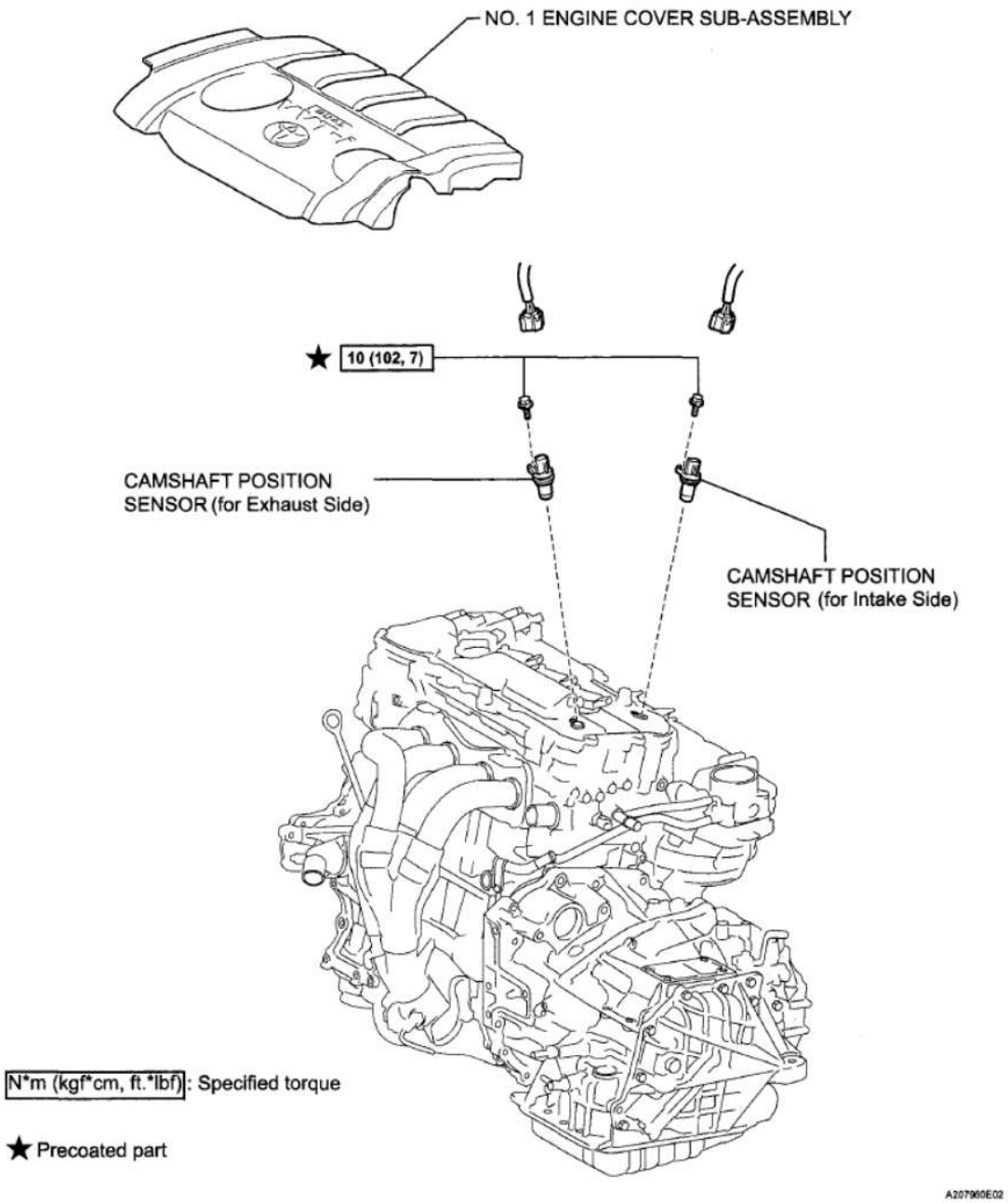


Fig. 401: Identifying Camshaft Position Sensor Components And Torque Specifications
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

REMOVAL

1. **REMOVE NO. 1 ENGINE COVER SUB-ASSEMBLY** (See **REMOVAL**)
2. **REMOVE CAMSHAFT POSITION SENSOR (for Exhaust Side)**
   a. Disconnect the sensor connector.
   b. Remove the bolt and sensor.

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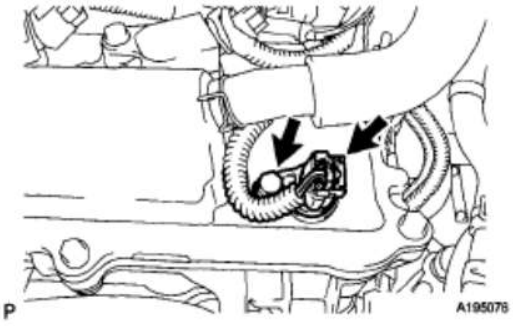


Fig. 402: Locating Bolt And Sensor
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

3. **REMOVE CAMSHAFT POSITION SENSOR (for Intake Side)**
   a. Disconnect the sensor connector.
   b. Remove the bolt and sensor.

INSTALLATION

1. **INSTALL CAMSHAFT POSITION SENSOR (for Exhaust Side)**
   a. Apply a light coat of engine oil to the O-ring of the sensor.

NOTE: Make sure that the O-ring is not cracked or does not jump out of position during installation.

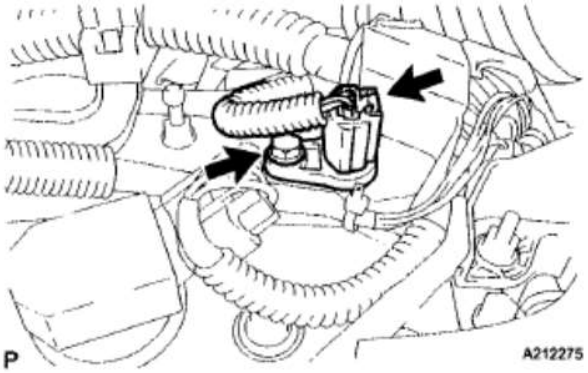


Fig. 403: Locating Bolt And Sensor
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

   b. Apply adhesive to 2 or 3 threads of the bolt.

Adhesive:

Toyota Genuine Adhesive 1344, Three Bond 1344 or equivalent.

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Fig. 404: Applying Adhesive To 2 Or 3 Threads Of Bolt
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

c. Install the sensor with the bolt.

Torque: 10 N*m (102 kgf*cm, 7 ft.*lbf)

d. Connect the sensor connector.

2. **INSTALL CAMSHAFT POSITION SENSOR (for Intake Side)**

a. Apply a light coat of engine oil to the O-ring of the sensor.

NOTE: Make sure that the O-ring is not cracked or does not jump out of position during installation.

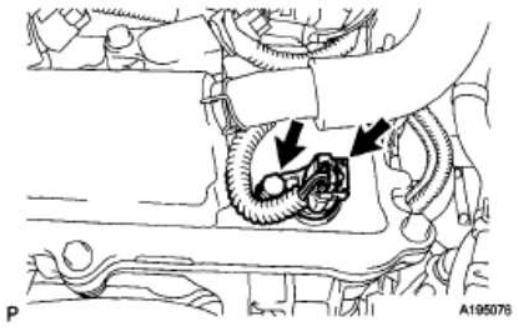


Fig. 405: Locating Bolt And Sensor
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. Apply adhesive to 2 or 3 threads of the bolt.

Adhesive:

Toyota Genuine Adhesive 1344, Three Bond 1344 or equivalent.

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Fig. 406: Applying Adhesive To 2 Or 3 Threads Of Bolt
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

c. Install the sensor with the bolt.

Torque: 10 N*m (102 kgf*cm, 7 ft.*lbf)

d. Connect the sensor connector.

3. **INSPECT FOR OIL LEAK**
4. **INSTALL NO. 1 ENGINE COVER SUB-ASSEMBLY** (See **INSTALLATION**)

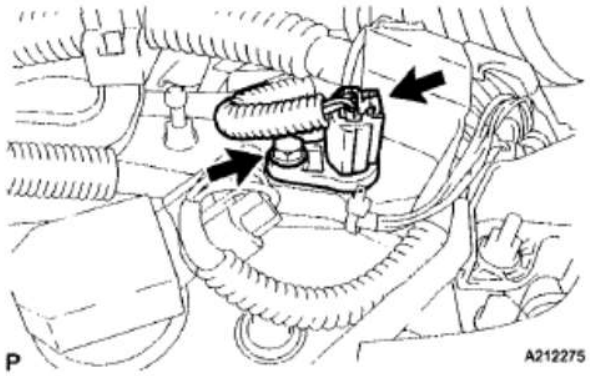


Fig. 407: Locating Bolt And Sensor
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

CRANKSHAFT POSITION SENSOR

COMPONENTS

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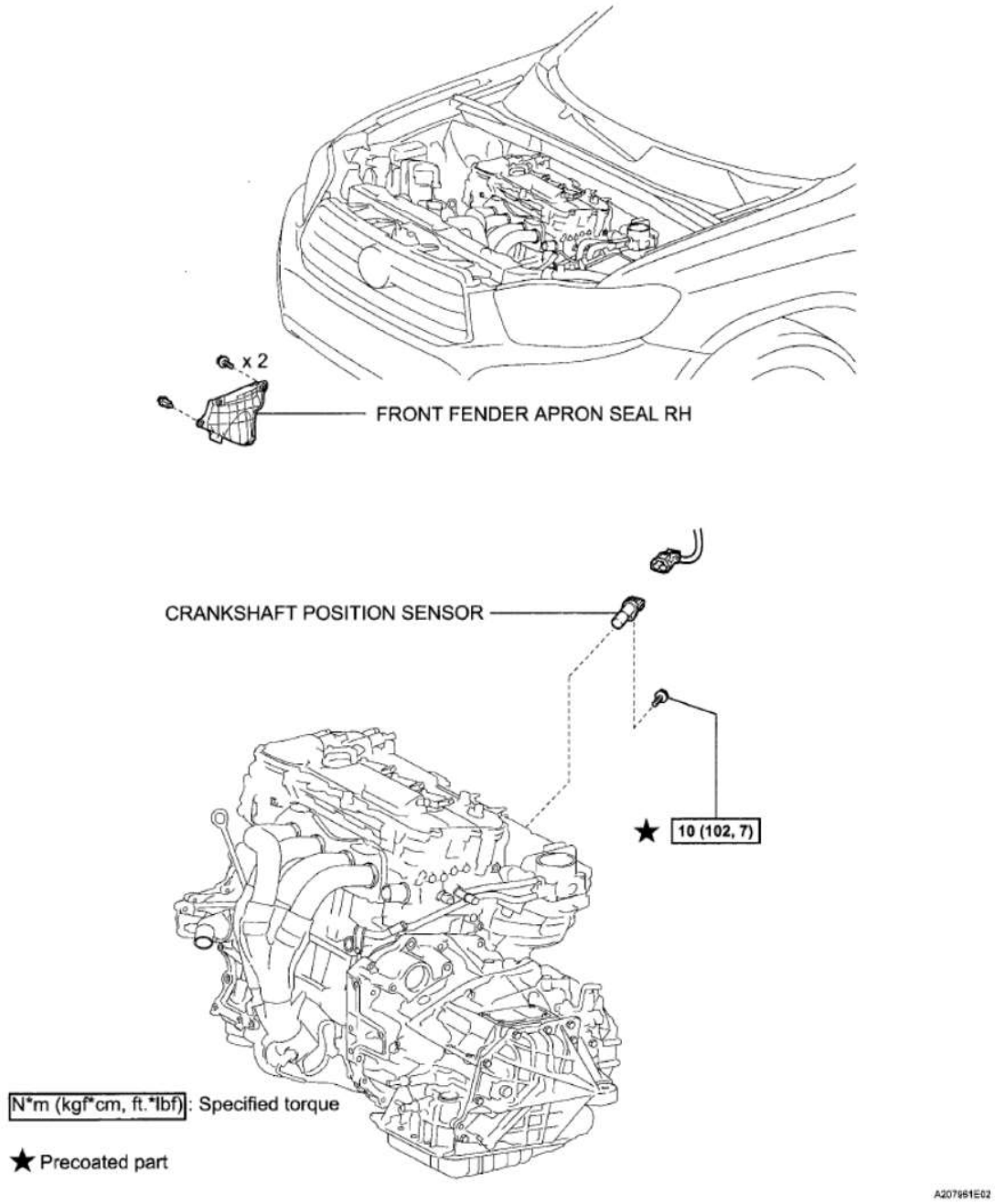


Fig. 408: Identifying Crankshaft Position Sensor Components And Torque Specifications
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

REMOVAL

1. **REMOVE FRONT FENDER APRON SEAL RH** (See **REMOVAL**)
2. **REMOVE CRANKSHAFT POSITION SENSOR**
   a. Disconnect the sensor connector.
   b. Remove the bolt and sensor.

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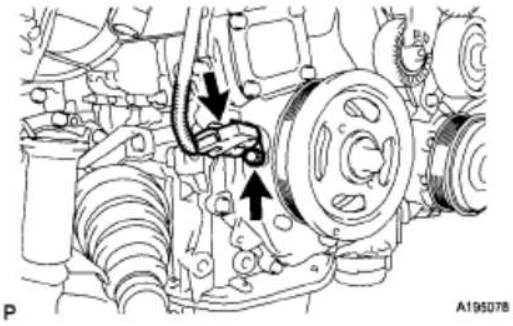


Fig. 409: Locating Bolt And Sensor
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSPECTION

1. **INSPECT CRANKSHAFT POSITION SENSOR**
   a. Measure the resistance according to the value (s) in the table below.

Standard Resistance

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
1-2	Cold	1630 to 2740 ohms
	Hot	2065 to 3225 ohms

HINT:

In the table above, the terms "Cold" and "Hot" refer to the temperature of the coils. "Cold" means approximately -10 to 50°C (14 to 122°F). "Hot" means approximately 50 to 100°C (122 to 212°F). If the result is not as specified, replace the crankshaft position sensor.

Component without harness connected:
(Crankshaft Position Sensor)



Fig. 410: Identifying Crankshaft Position Sensor Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSTALLATION

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1. **INSTALL CRANKSHAFT POSITION SENSOR**
   a. Apply a light coat of engine oil to the O-ring of the sensor.

   NOTE: Make sure that the O-ring is not cracked or does not jump out of position during installation.

   b. Apply adhesive to 2 or 3 threads of the bolt.

   Adhesive:

   Toyota Genuine Adhesive 1344, Three Bond 1344 or equivalent.

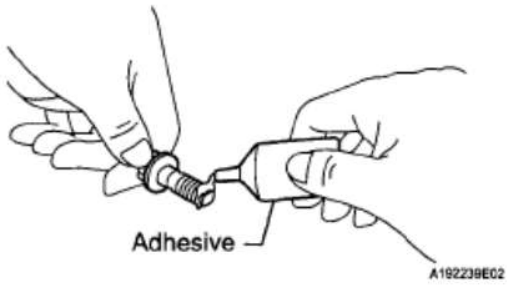


Fig. 411: Applying Adhesive To 2 Or 3 Threads Of Bolt
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

   c. Install the sensor with the bolt.

   Torque: 10 N*m (102 kgf*cm, 7 ft.*lbf)

   d. Connect the sensor connector.
2. **INSPECT FOR OIL LEAK**
3. **INSTALL FRONT FENDER APRON SEAL RH** (See **INSTALLATION**)

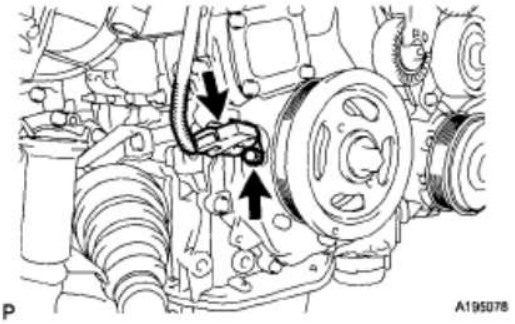


Fig. 412: Locating Bolt And Sensor
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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ENGINE COOLANT TEMPERATURE SENSOR

COMPONENTS

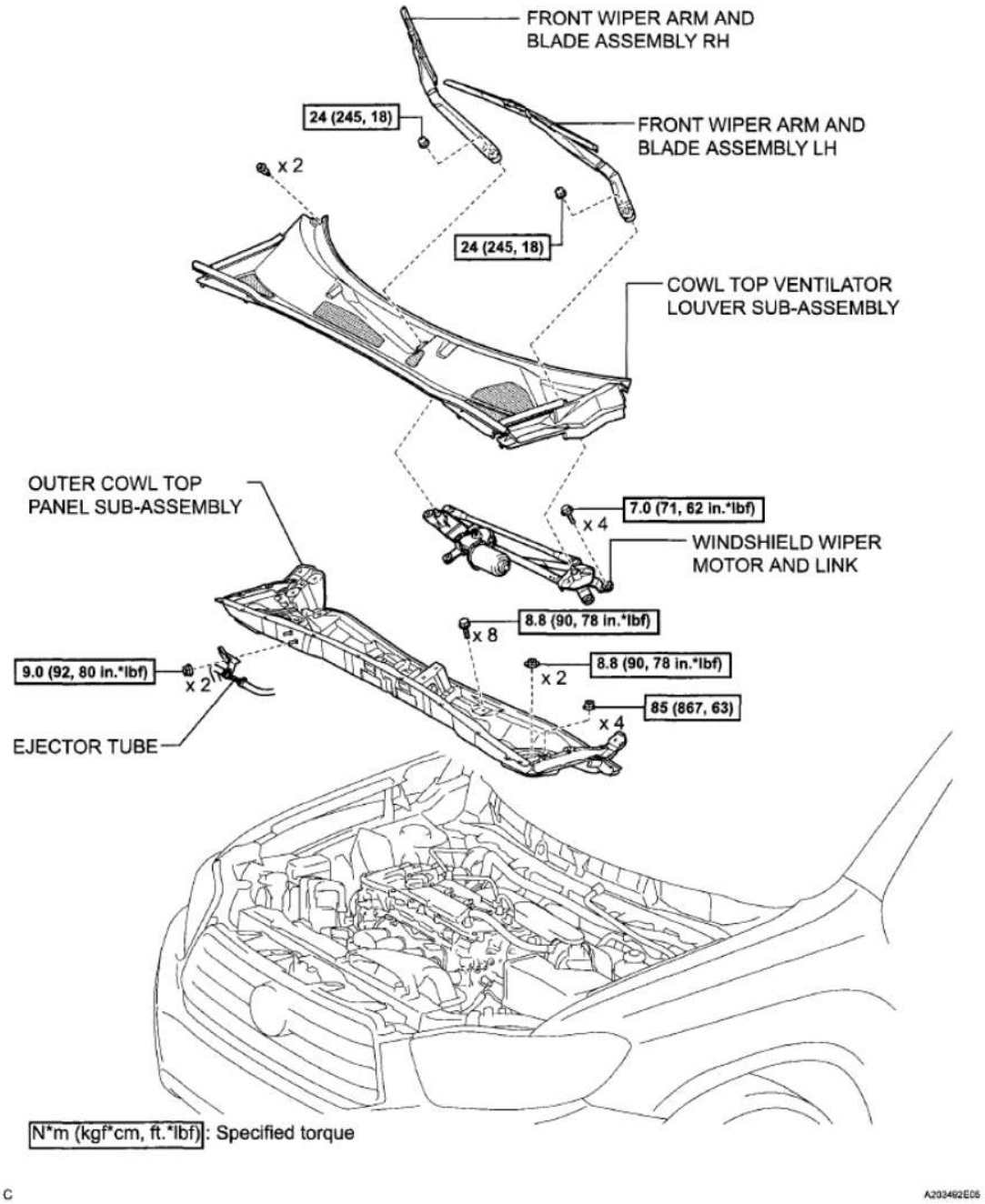


Fig. 413: Identifying Engine Coolant Temperature Sensor Components And Torque Specifications (1 Of 3)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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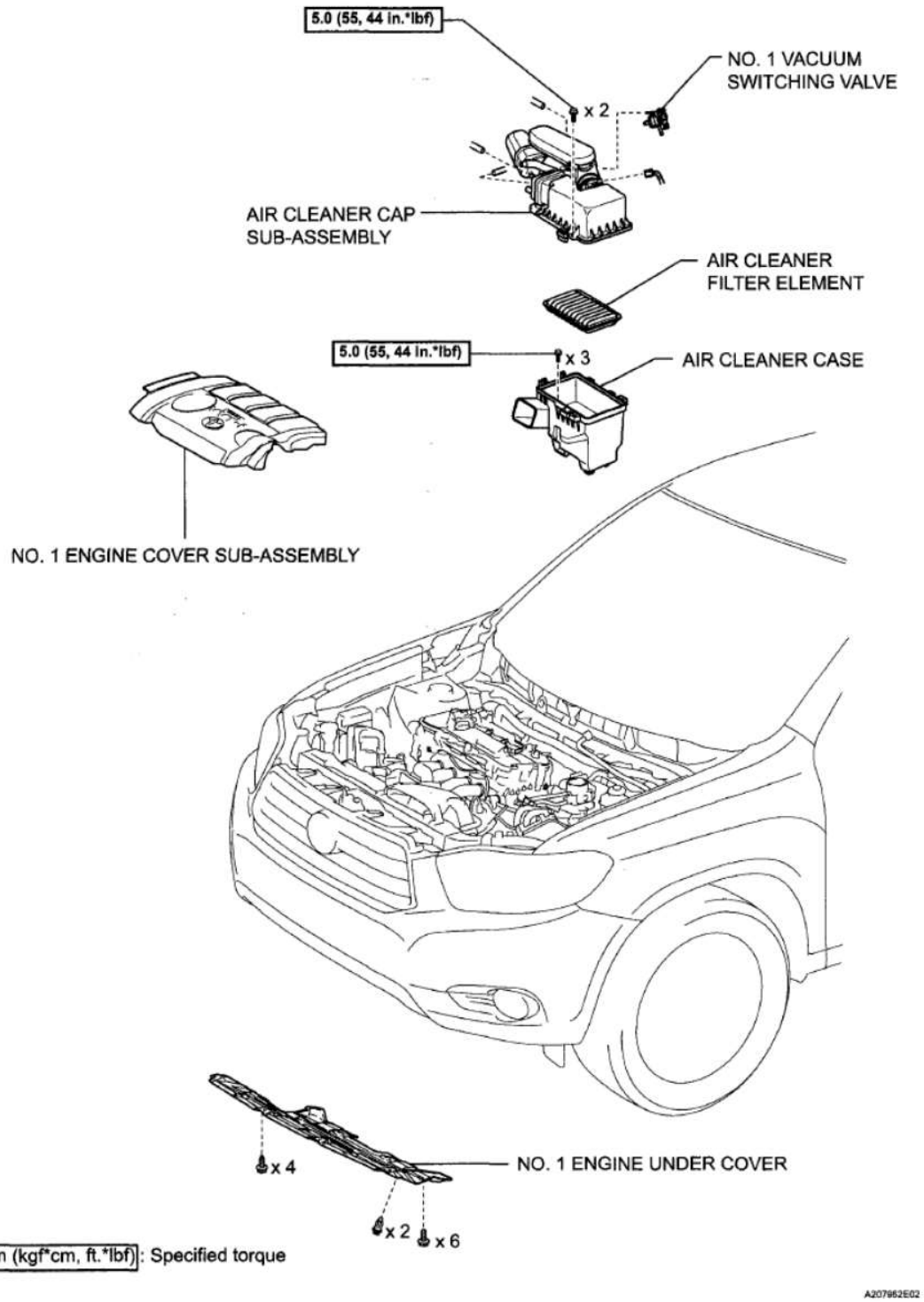


Fig. 414: Identifying Engine Coolant Temperature Sensor Components And Torque Specifications (2 Of 3)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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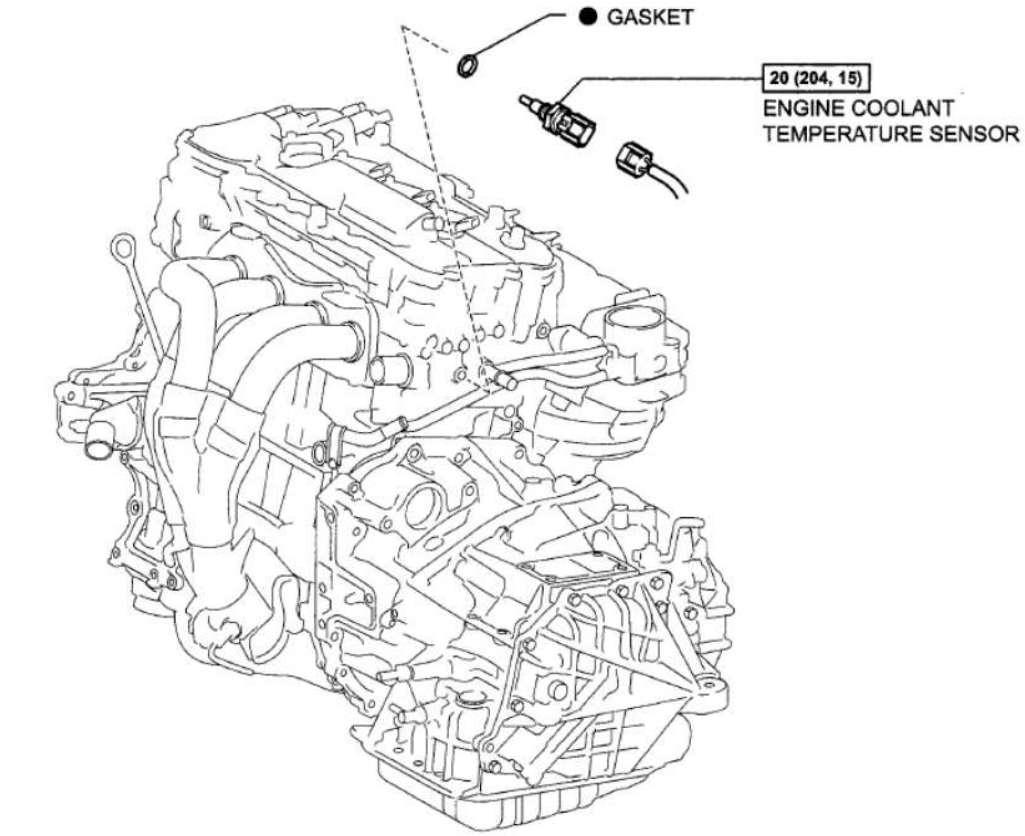


Fig. 415: Identifying Engine Coolant Temperature Sensor Components And Torque Specifications (3 Of 3)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

REMOVAL

1. **REMOVE WINDSHIELD WIPER MOTOR AND LINK**

   HINT:

   See the steps from "Remove front wiper arm and blade assembly LH" through "Remove windshield wiper motor and link" (See **REMOVAL**).

2. **SEPARATE EJECTOR TUBE** (See **REMOVAL**)
3. **REMOVE OUTER COWL TOP PANEL SUB-ASSEMBLY** (See **REMOVAL**)
4. **REMOVE NO. 1 ENGINE UNDER COVER**
5. **DRAIN ENGINE COOLANT** (See **COOLANT**)

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6. **REMOVE NO. 1 ENGINE COVER SUB-ASSEMBLY** (See **REMOVAL**)
7. **REMOVE NO. 1 VACUUM SWITCHING VALVE** (See **REMOVAL**)
8. **REMOVE AIR CLEANER CAP SUB-ASSEMBLY** (See **REMOVAL**)
9. **REMOVE AIR CLEANER CASE** (See **REMOVAL**)
10. **REMOVE ENGINE COOLANT TEMPERATURE SENSOR**
    a. Disconnect the engine coolant temperature sensor connector.

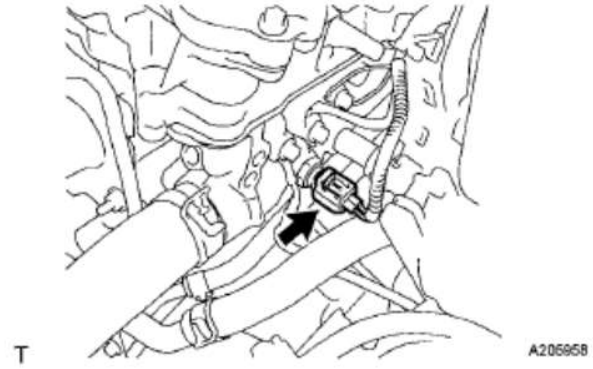


Fig. 416: Locating Engine Coolant Temperature Sensor Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

    b. Remove the engine coolant temperature sensor and gasket.

INSPECTION

1. **INSPECT ENGINE COOLANT TEMPERATURE SENSOR**

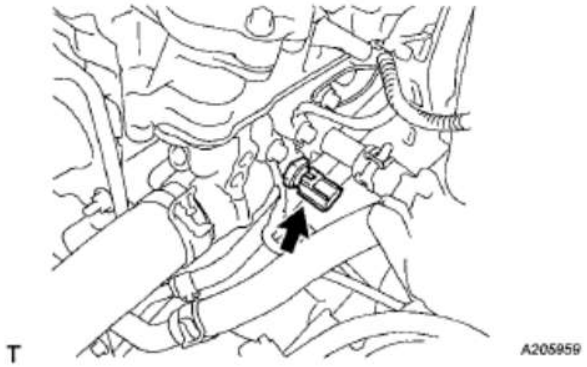


Fig. 417: Locating Engine Coolant Temperature Sensor And Gasket
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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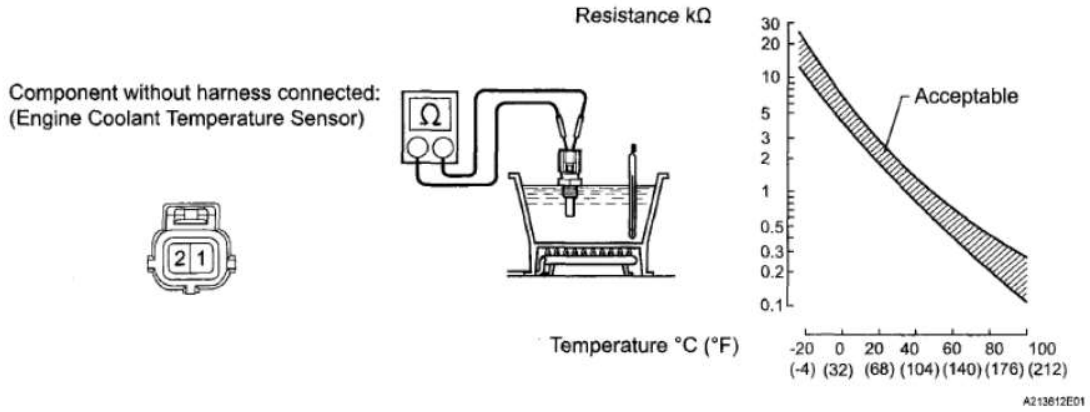


Fig. 418: Inspecting Engine Coolant Temperature Sensor
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

a. Partially immerse the sensor in water and warm up the water.
b. Measure the resistance according to the value (s) in the table below.

Standard Resistance

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
1-2	20°C (68°F)	2.32 to 2.59 kohms
1-2	80°C (176°F)	0.310 to 0.326 kohms

NOTE: When checking the sensor in water, keep the terminals dry. After the check, wipe the sensor dry.

If the result is not as specified, replace the engine coolant temperature sensor.

INSTALLATION

1. **INSTALL ENGINE COOLANT TEMPERATURE SENSOR**
   a. Install a new gasket to the sensor.
   b. Install the engine coolant temperature sensor.

   Torque: 20 N*m (204 kgf*cm, 15 ft.*lbf)

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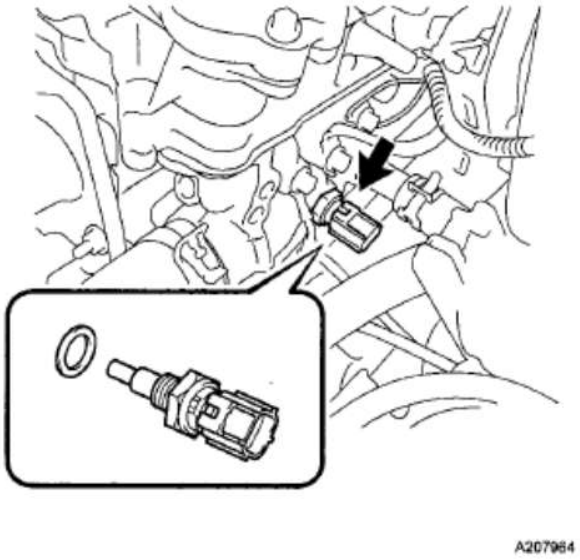


Fig. 419: Locating Gasket And Sensor
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

c. Connect the engine coolant temperature sensor connector.

2. **INSTALL AIR CLEANER CASE** (See **INSTALLATION**)
3. **INSTALL AIR CLEANER CAP SUB-ASSEMBLY** (See **INSTALLATION**)
4. **INSTALL NO. 1 VACUUM SWITCHING VALVE** (See **INSPECTION**)
5. **ADD ENGINE COOLANT** (See **COOLANT**)

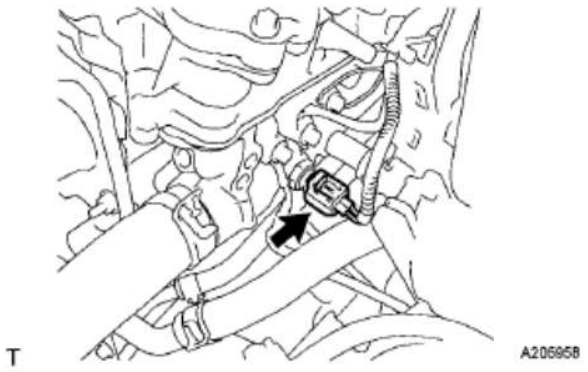


Fig. 420: Locating Engine Coolant Temperature Sensor Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

6. **INSPECT FOR COOLANT LEAK** (See **COOLING SYSTEM**)
7. **INSTALL NO. 1 ENGINE COVER SUB-ASSEMBLY** (See **INSTALLATION**)
8. **INSTALL OUTER COWL TOP PANEL SUB-ASSEMBLY** (See **INSTALLATION**)
9. **INSTALL WINDSHIELD WIPER MOTOR AND LINK**

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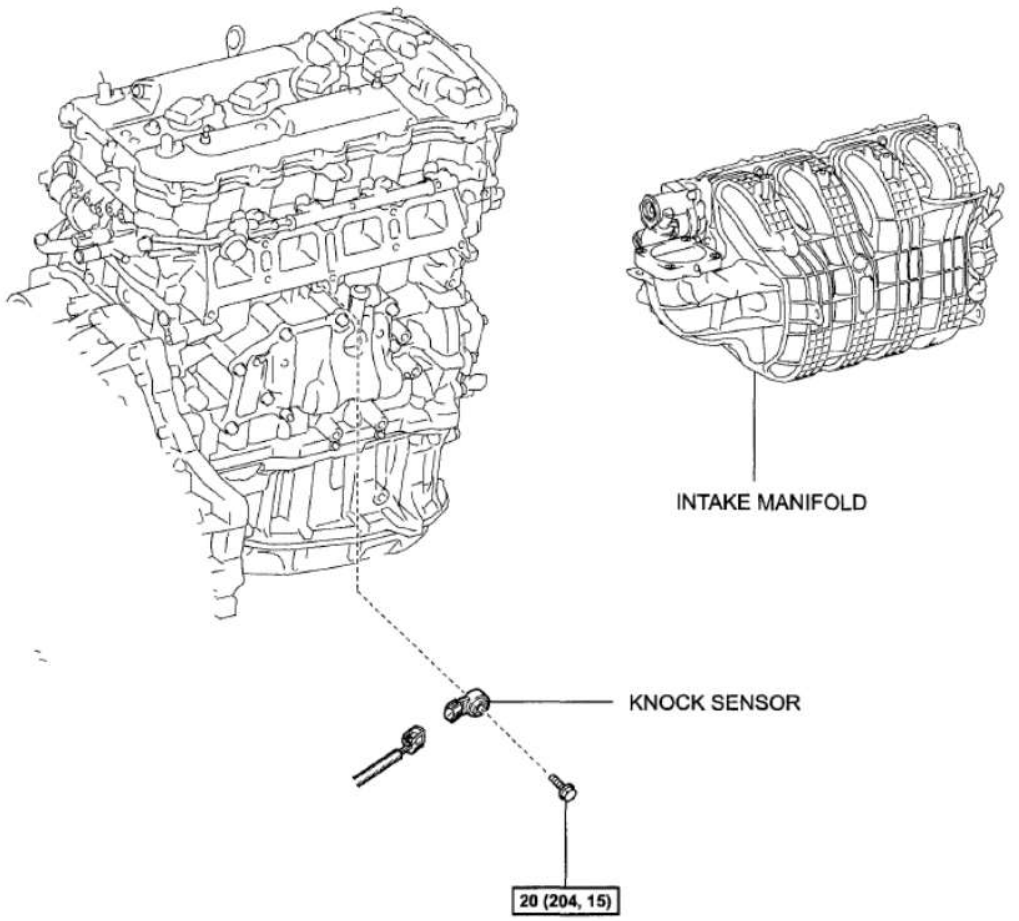
HINT:

See the steps from "Install Windshield Wiper Motor and Link Assembly" through "Install front wiper arm and blade assembly LH" (See **INSTALLATION**).

10. **INSTALL NO. 1 ENGINE UNDER COVER**

KNOCK SENSOR

COMPONENTS



N*m (kgf*cm, ft.*lbf): Specified torque

A207966E01

Fig. 421: Identifying Knock Sensor Components And Torque Specifications

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

REMOVAL

1. **REMOVE INTAKE MANIFOLD**
   a. Remove the intake manifold (See **REMOVAL**).
2. **REMOVE KNOCK SENSOR**
   a. Disconnect the sensor connector.
   b. Remove the bolt and sensor.

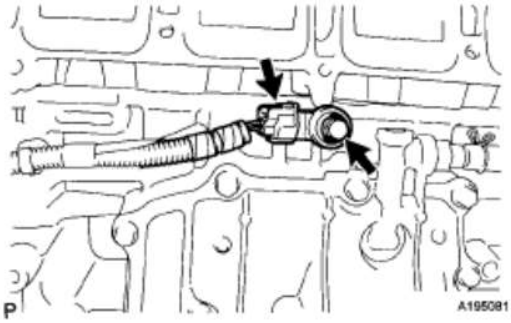


Fig. 422: Locating Bolt And Sensor
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSPECTION

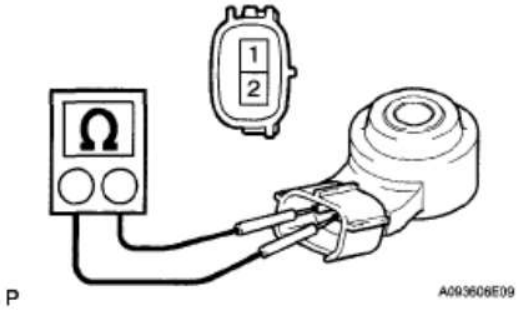
1. **INSPECT KNOCK SENSOR**
   a. Measure the resistance according to the value (s) in the table below.

Standard Resistance

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
1-2	20°C (68°F)	120 to 280 kohms

If the result is not as specified, replace the knock sensor.



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Fig. 423: Inspecting Knock Sensor
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSTALLATION

1. **INSTALL KNOCK SENSOR**
   a. Install the sensor with the bolt so that the sensor is angled as shown in the illustration.

   Torque: 20 N*m (204 kgf*cm, 15 ft.*lbf)

   NOTE: The acceptable installation angle of the sensor is between 7° upward and 10° downward from the horizontal position.

   b. Connect the sensor connector.
2. **INSTALL INTAKE MANIFOLD**
   a. Install the intake manifold (See **INSTALLATION**).

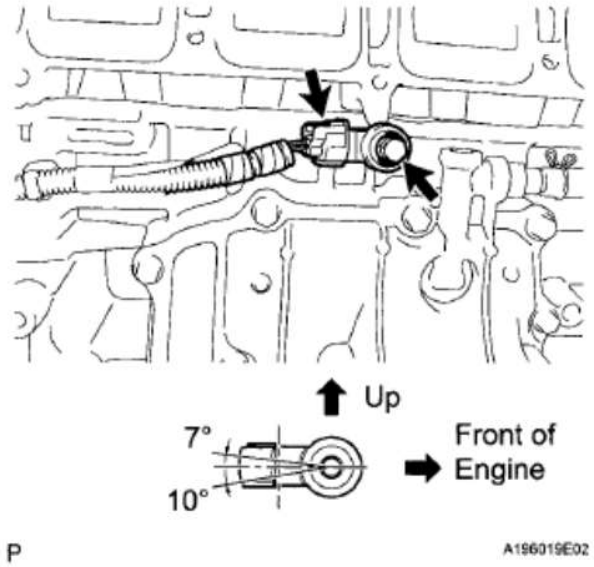


Fig. 424: Locating Bolt And Sensor
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

AIR FUEL RATIO SENSOR

COMPONENTS

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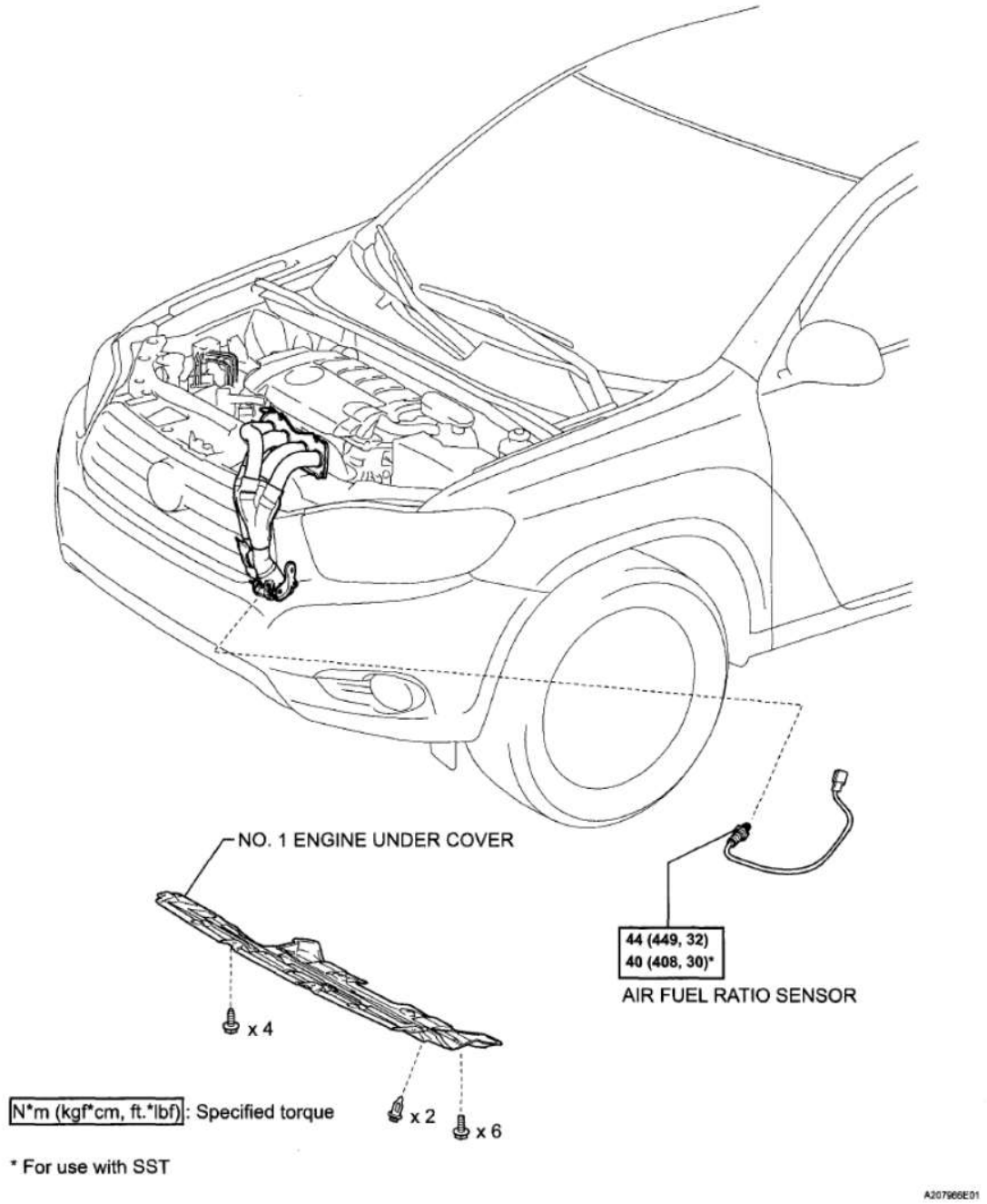


Fig. 425: Identifying Air Fuel Ratio Sensor Components And Torque Specifications
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

REMOVAL

1. **REMOVE NO. 1 ENGINE UNDER COVER**
2. **REMOVE AIR FUEL RATIO SENSOR**
   a. Disconnect the air fuel ratio sensor connector.

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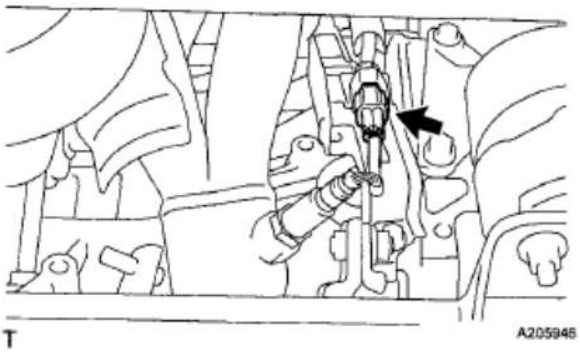


Fig. 426: Locating Air Fuel Ratio Sensor Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. Using SST, remove the air fuel ratio sensor from the exhaust manifold.

SST 09224-00010

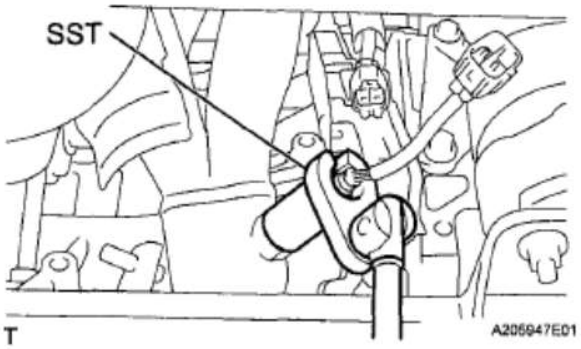


Fig. 427: Removing Air Fuel Ratio Sensor From Exhaust Manifold
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSPECTION

1. **INSPECT AIR FUEL RATIO SENSOR (for Bank 1 Sensor 1)**
   a. Measure the resistance according to the value (s) in the table below.

Standard Resistance

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
1 (HA1A) - 2 (+B)	20°C (68°F)	1.8 to 3.4 ohms

If the result is not as specified, replace the air fuel ratio sensor.

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Component without harness connected:
(Air Fuel Ratio Sensor)

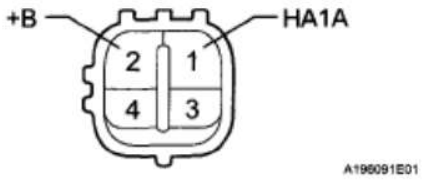


Fig. 428: Identifying Air Fuel Ratio Sensor Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSTALLATION

1. **INSTALL AIR FUEL RATIO SENSOR**
   a. Using SST, install the air fuel ratio sensor to the exhaust manifold.

   SST 09224-00010

   Torque: without SST

   44 N*m (449 kgf*cm, 32 ft.*lbf)

   with SST

   40 N*m (408 kgf*cm, 30 ft.*lbf)

   NOTE:
   - **The "with SST" torque value is effective when using SST with a fulcrum length of 30 mm (1.18 in.).**
   - **The "with SST" torque value is effective when using a torque wrench with a fulcrum length of 300 mm (11.81 in.) (See REPAIR INSTRUCTION).**
   - **This torque value is effective when SST is parallel to the torque wrench.**

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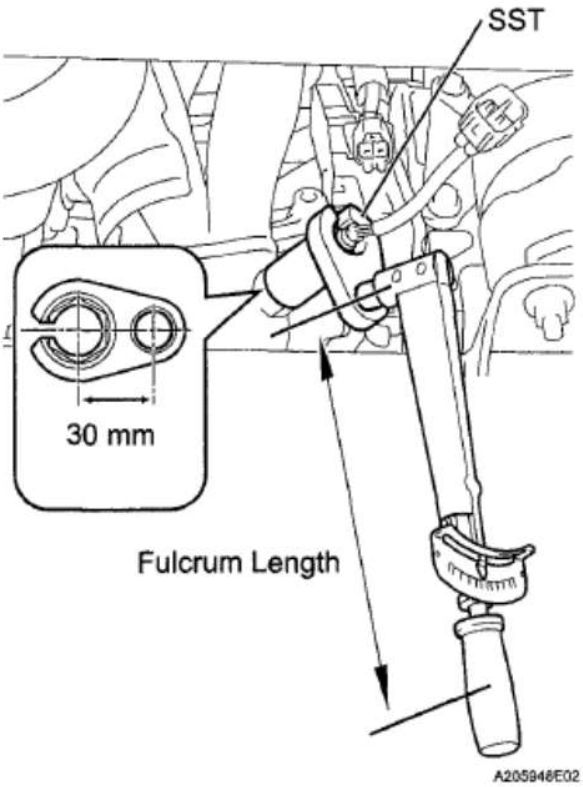


Fig. 429: Installing Air Fuel Ratio Sensor To Exhaust Manifold
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. Connect the air fuel ratio sensor connector.

2. **INSPECT FOR EXHAUST GAS LEAK**
3. **INSTALL NO. 1 ENGINE UNDER COVER**

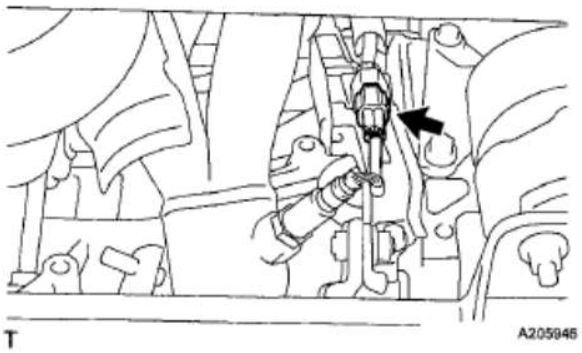


Fig. 430: Locating Air Fuel Ratio Sensor Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

HEATED OXYGEN SENSOR

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COMPONENTS

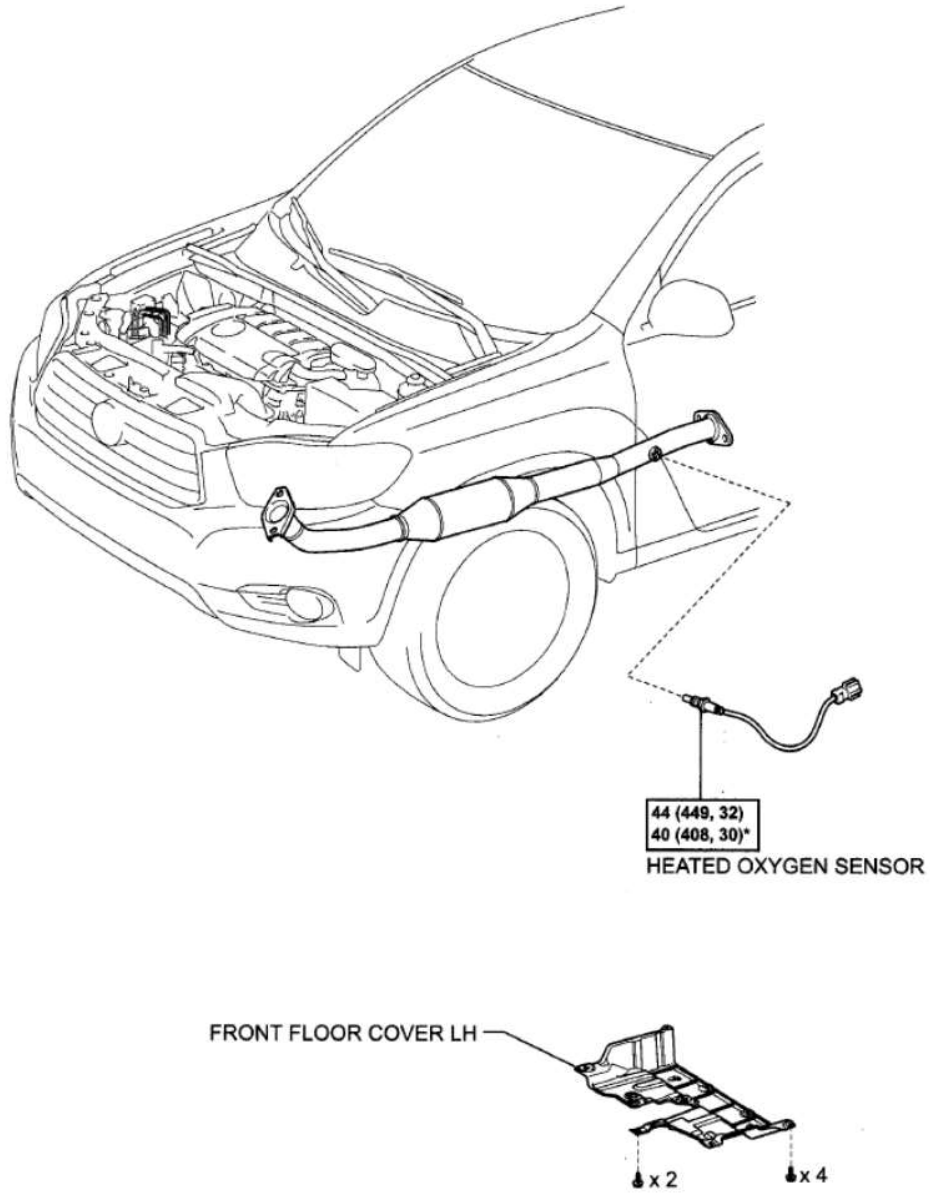


Fig. 431: Identifying Heated Oxygen Sensor Components And Torque Specifications
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

REMOVAL

1. **REMOVE FRONT FLOOR COVER LH** (See **REMOVAL**)
2. **REMOVE HEATED OXYGEN SENSOR**

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a. Disconnect the heated oxygen sensor connector.
b. Separate the 2 wire harness clamps.

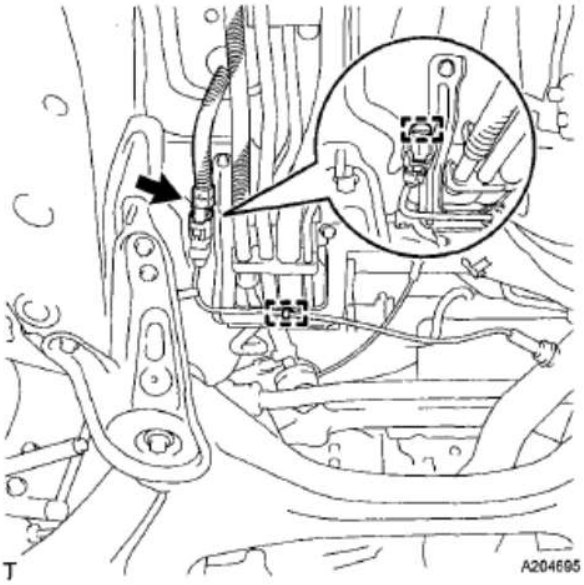


Fig. 432: Locating Heated Oxygen Sensor Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

c. Using SST, remove the heated oxygen sensor from the front exhaust pipe.

SST 09224-00010

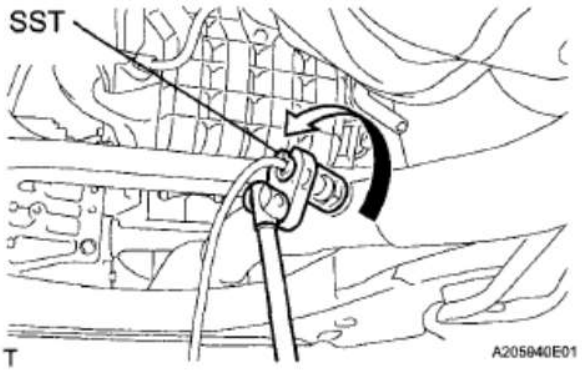


Fig. 433: Removing Heated Oxygen Sensor From Front Exhaust Pipe
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSPECTION

1. **INSPECT HEATED OXYGEN SENSOR (for Bank 1 Sensor 2)**
   a. Measure the resistance according to the value (s) in the table below.

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Standard Resistance

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
1 (HT1B) - 2 (+B)	20°C (68°F)	11 to 16 ohms

If the result is not as specified, replace the heated oxygen sensor.

Component without harness connected:
(Heated Oxygen Sensor)

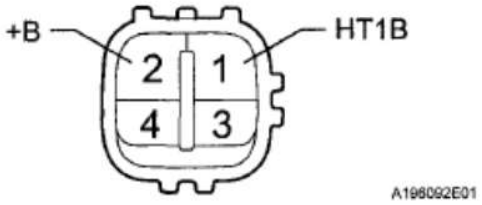


Fig. 434: Identifying Heated Oxygen Sensor Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSTALLATION

1. **INSTALL HEATED OXYGEN SENSOR**
   a. Using SST, install the heated oxygen sensor to the front exhaust pipe.

SST 09224-00010

Torque: without SST

44 N*m (449 kgf*cm, 32 ft.*lbf)

with SST

40 N*m (408 kgf*cm, 30 ft.*lbf)

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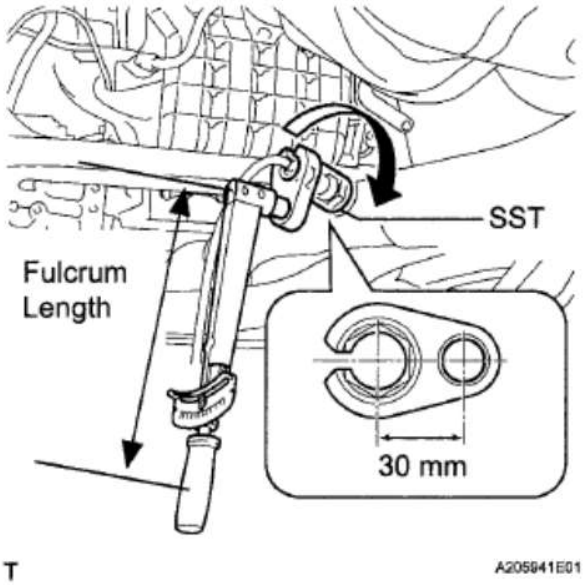


Fig. 435: Installing Heated Oxygen Sensor To Front Exhaust Pipe
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

NOTE:

- **The "with SST" torque value is effective when using SST with a fulcrum length of 30 mm (1.18 in.).**
- **The "with SST" torque value is effective when using a torque wrench with a fulcrum length of 300 mm (11.81 in.) (See REPAIR INSTRUCTION).**
- **This torque value is effective when SST is parallel to the torque wrench.**

b. Install the 2 wire harness clamps.
c. Connect the heated oxygen sensor connector.

2. **INSPECT FOR EXHAUST GAS LEAK**
3. **INSTALL FRONT FLOOR COVER LH** (See **INSTALLATION**)

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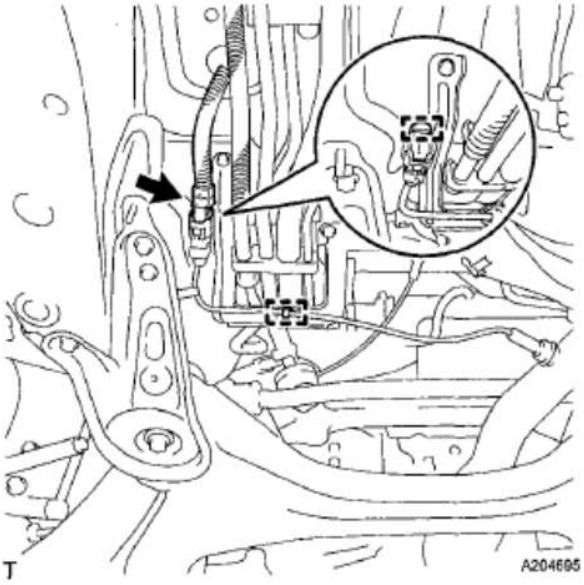


Fig. 436: Locating Heated Oxygen Sensor Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INTEGRATION RELAY

COMPONENTS

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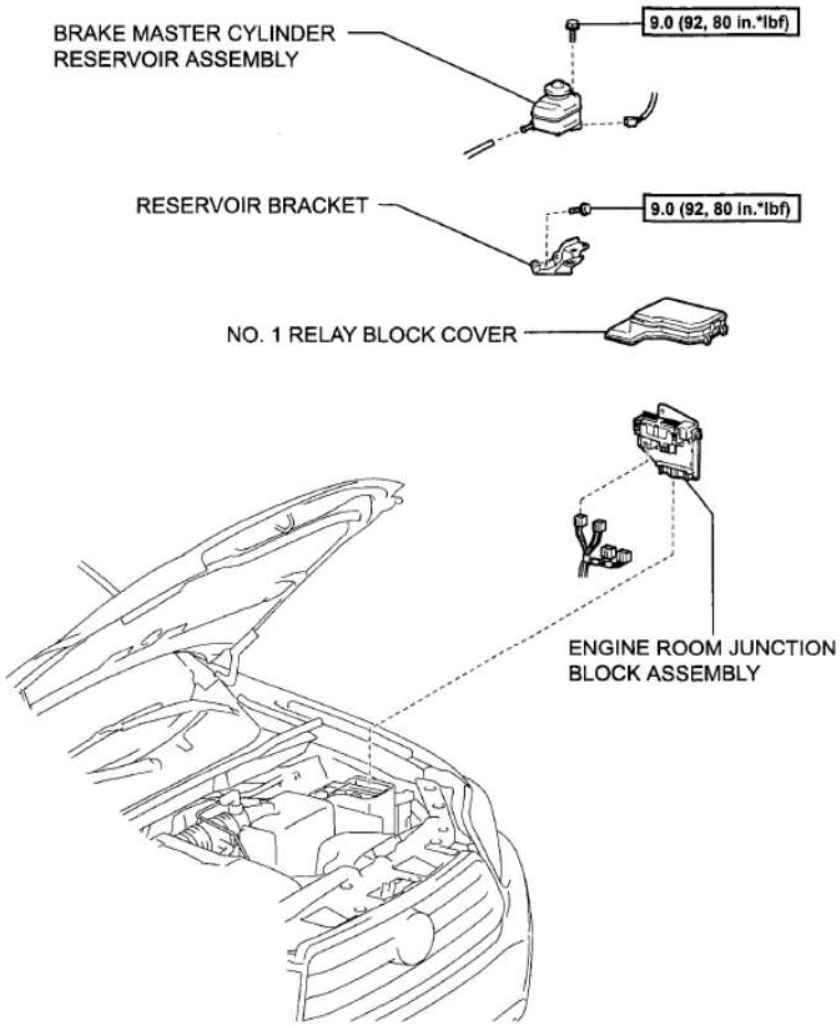


Fig. 437: Identifying Integration Relay Components And Torque Specifications
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

REMOVAL

1. **SEPARATE BRAKE MASTER CYLINDER RESERVOIR ASSEMBLY** (See **REASSEMBLY**)
2. **REMOVE RESERVOIR BRACKET** (See **REASSEMBLY**)
3. **REMOVE NO. 1 RELAY BLOCK COVER**
   a. Remove the No. 1 relay block cover.

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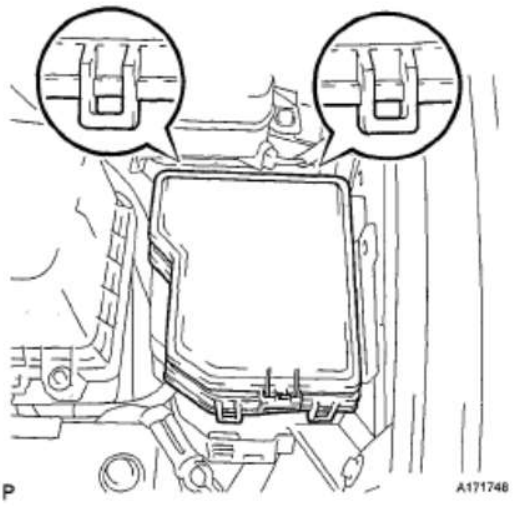


Fig. 438: Identifying No. 1 Relay Block Cover
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

4. **REMOVE ENGINE ROOM JUNCTION BLOCK ASSEMBLY**
   a. Using a screwdriver with its tip wrapped in protective tape, disengage the 2 claws and disconnect the engine room junction block assembly.

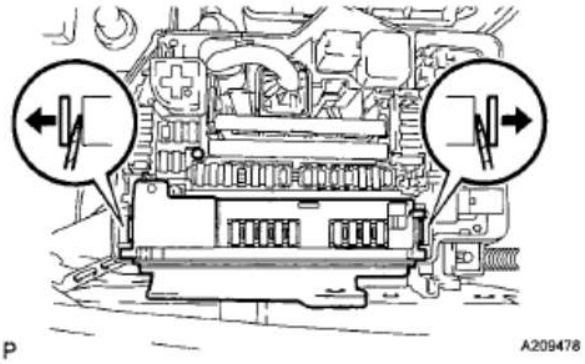


Fig. 439: Disengaging 2 Claws
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

   b. Disconnect the 4 connectors.

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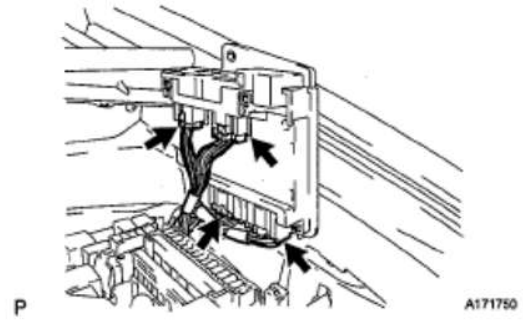


Fig. 440: Locating Connectors
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSPECTION

1. **INSPECT ENGINE ROOM JUNCTION BLOCK ASSEMBLY**

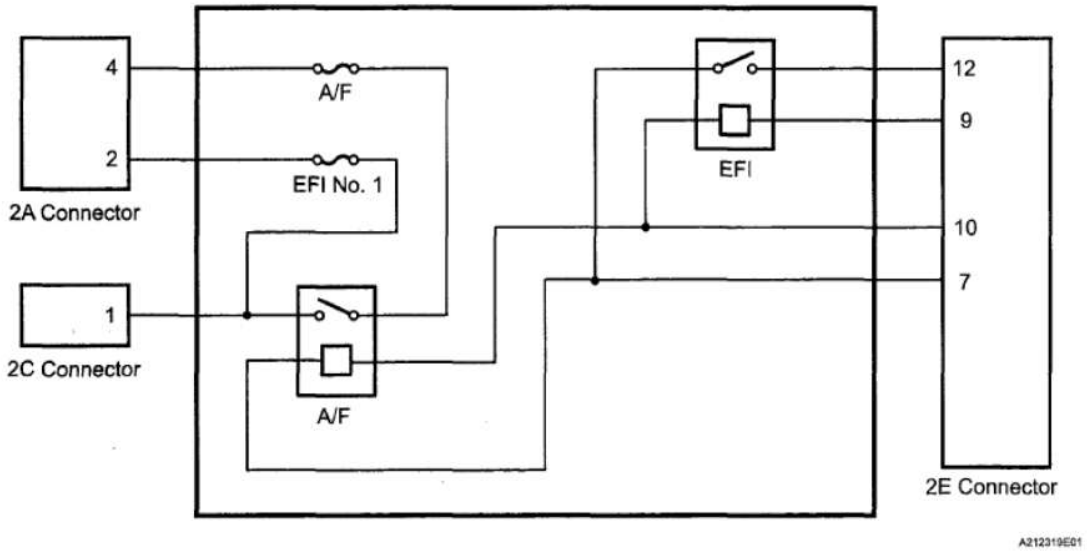


Fig. 441: Engine Room Junction Block Assembly Circuit Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

a. Inspect the EFI No. 1 fuse.
   1. Remove the EFI No. 1 fuse.
   2. Using an ohmmeter, measure the resistance of the fuse.

Standard Resistance

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
EFI No. 1 fuse	Always	Below 1 ohms

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b. Inspect the A/F fuse.
   1. Remove the A/F fuse.
   2. Using an ohmmeter, measure the resistance of the fuse.

Standard Resistance

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
A/F fuse	Always	Below 1 ohms

c. Inspect EFI relay.
   1. Measure the resistance according to the value (s) in the table below.

Standard Resistance

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
2E-12 - 2E-7	No battery voltage applied	10 kohms or higher
2E-12 - 2E-7	Battery voltage applied between terminals 2E-10 and 2E-9	Below 1 ohms

NOTE: While using the battery for the inspection, do not bring the positive (+) and negative (-) tester probes too close to each other as a short circuit may occur.

Component without wire harness connected:
(Engine Room Junction Block Assembly)

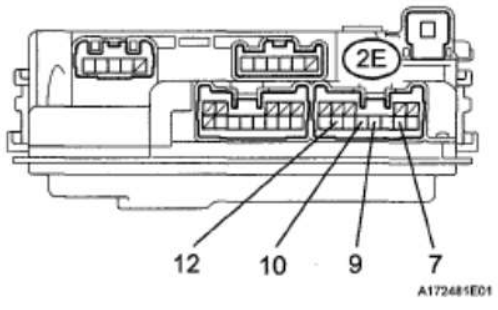


Fig. 442: Identifying Engine Room Junction Block Assembly
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

d. Inspect the A/F relay.

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1. Measure the resistance according to the value (s) in the table below.

Standard resistance

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
2A-4 - 2C-1	No battery voltage applied	10 kohms or higher
2A-4 - 2C-1	Battery voltage applied between terminals 2E-10 and 2E-7	Below 1 ohms

NOTE: While using the battery for the inspection, do not bring the positive (+) and negative (-) tester probes too close to each other as a short circuit may occur.

Component without wire harness connected:
(Engine Room Junction Block Assembly)

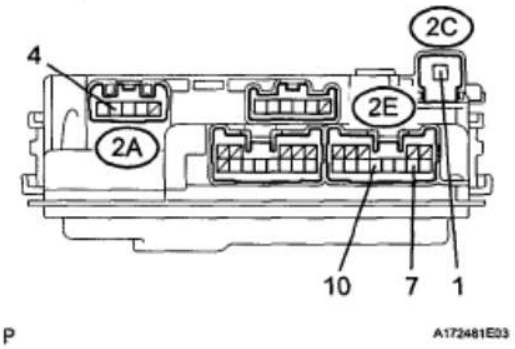


Fig. 443: Identifying Engine Room Junction Block Assembly
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSTALLATION

1. **INSTALL ENGINE ROOM JUNCTION BLOCK ASSEMBLY**
   a. Connect the 4 connectors.
   b. Attach the engine room junction block assembly.

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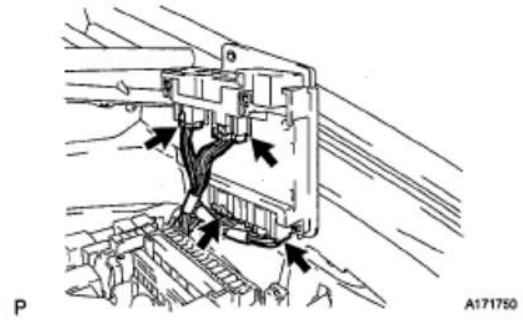


Fig. 444: Locating Connectors
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

2. **INSTALL NO. 1 RELAY BLOCK COVER**
   a. Install the No. 1 relay block cover.
3. **INSTALL RESERVOIR BRACKET** (See **INSTALLATION**)
4. **INSTALL BRAKE MASTER CYLINDER RESERVOIR ASSEMBLY** (See **INSTALLATION**)

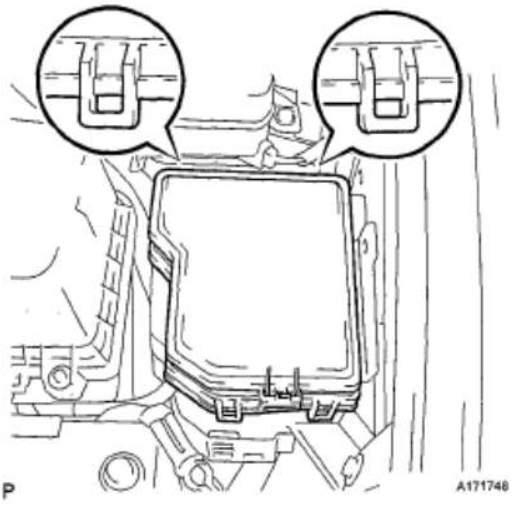


Fig. 445: Identifying No. 1 Relay Block Cover
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

IGNITION RELAY NO. 1

ON-VEHICLE INSPECTION

1. **INSPECT NO. 1 IGNITION RELAY**
   a. Measure the resistance according to the value (s) in the table below.

Standard Resistance

TESTER CONNECTION SPECIFIED CONDITION CHART

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Tester Connection	Condition	Specified Condition
3-5	No battery voltage applied	10 kohms or higher
	Battery voltage applied between terminals 1 and 2	Below 1 ohms

If the result is not as specified, replace the relay.

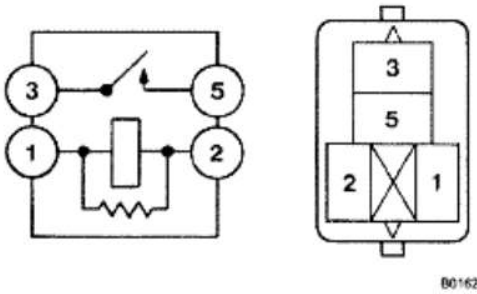


Fig. 446: No. 1 Ignition Relay Circuit Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

IGNITION RELAY NO. 2

ON-VEHICLE INSPECTION

1. **INSPECT NO. 2 IGNITION RELAY**
   a. Measure the resistance according to the value (s) in the table below.

Standard Resistance

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
3-5	No battery voltage applied	10 kohms or higher
	Battery voltage applied between terminals 1 and 2	Below 1 ohms

If the result is not as specified, replace the relay.

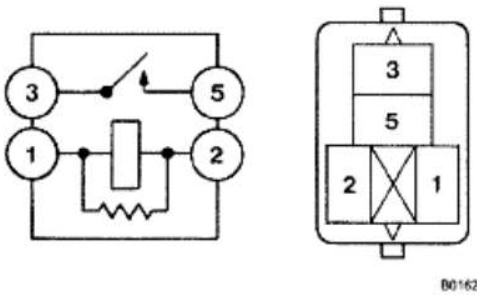


Fig. 447: No. 2 Ignition Relay Circuit Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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CIRCUIT OPENING RELAY

ON-VEHICLE INSPECTION

1. **INSPECT C/OPN RELAY**
   a. Measure the resistance according to the value (s) in the table below.

Standard Resistance

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
3-5	No battery voltage applied	10 kohms or higher
	Battery voltage applied between terminals 1 and 2	Below 1 ohms

If the result is not as specified, replace the relay.

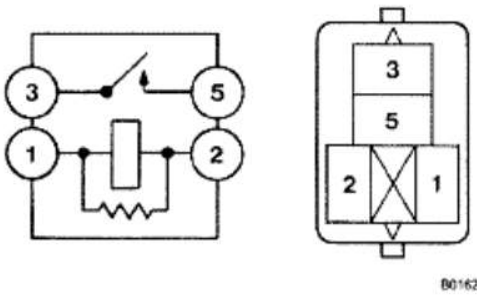


Fig. 448: C/OPN Relay Circuit Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY

COMPONENTS

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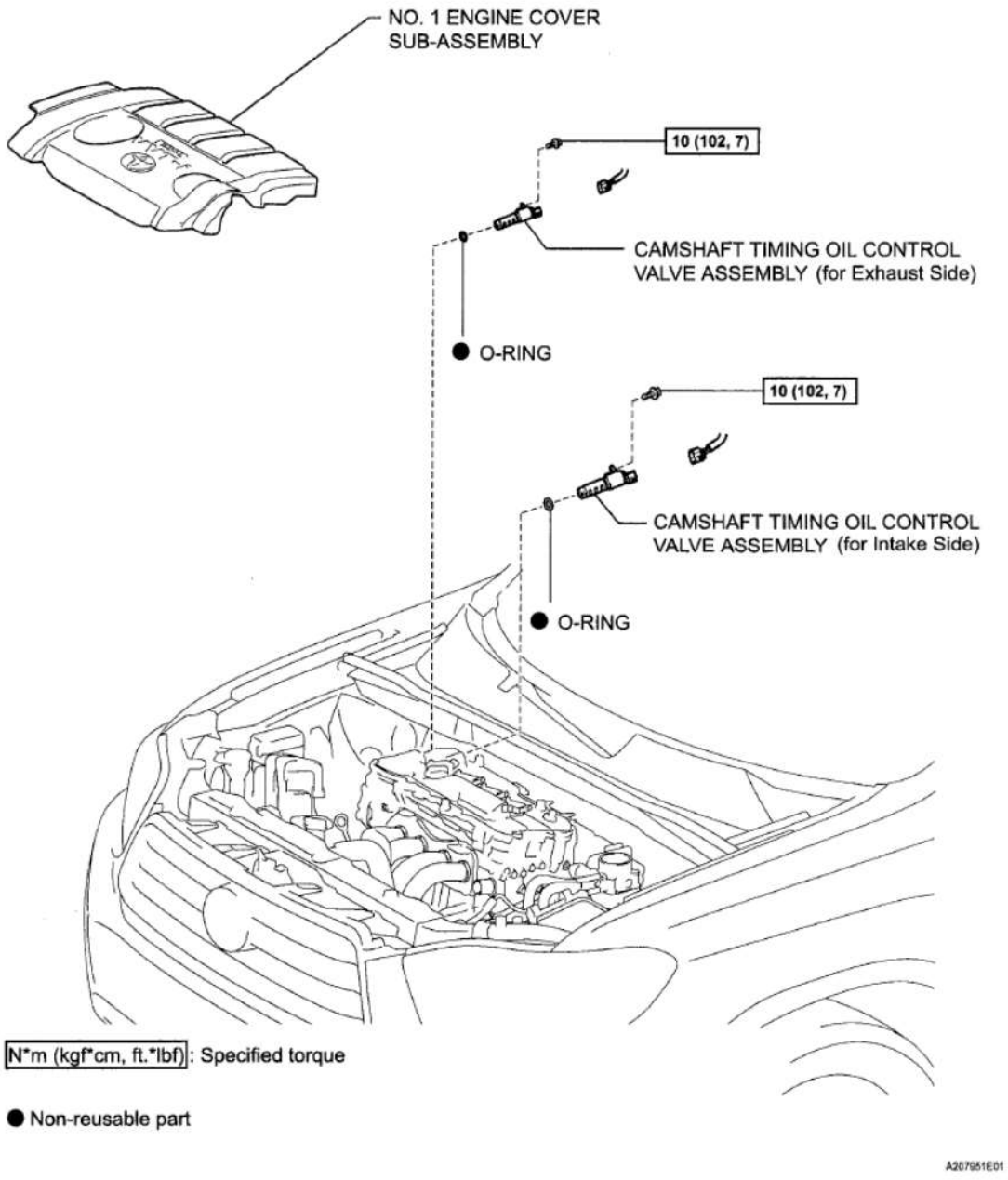


Fig. 449: Identifying Camshaft Timing Oil Control Valve Assembly Components And Torque Specifications
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

ON-VEHICLE INSPECTION

1. **INSPECT CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY**
   a. Connect the Techstream to the DLC3.
   b. Start the engine and turn the Techstream on.
   c. Inspect the oil control valve (for intake camshaft).

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1. Enter the following menus: Powertrain/Engine/Active Test/Control the VVT System (Bank 1).
2. Check the engine speed when the oil control valve is operated using the Techstream with the engine coolant temperature at 50°C (122°F) or less.

   HINT:

   - When performing the active test, the air conditioning should be on.
   - Engine coolant temperature when the engine is started should be 30°C (86°F) or less.

   Standard Condition

   TESTER OPERATION CHART

Tester Operation	Specified Condition
OCV is OFF	Normal engine speed
OCV is ON	Soon after OCV switched from OFF to ON, engine idles roughly or stalls

d. Inspect the oil control valve (for exhaust camshaft).
   1. Enter the following menus: Powertrain/Engine/Active Test/Control the VVT Exhaust Linear (Bank 1).
   2. Check the engine speed when the oil control valve is operated using the Techstream with the engine coolant temperature at 50°C (122°F) or less.

      HINT:

      - When performing the active test, the air conditioning should be on.
      - Engine coolant temperature when engine is started should be 30°C (86°F) or less.

      Standard Condition

      TESTER OPERATION CHART

Tester Operation	Specified Condition
100%	Soon after OCV switched from OFF (-100%) to ON (+100%), engine idles roughly or stalls.
-100%	Normal engine speed

REMOVAL

1. **REMOVE NO. 1 ENGINE COVER SUB-ASSEMBLY** (See **REMOVAL**)
2. **REMOVE CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY (for Exhaust Side)**
   a. Disconnect the oil control valve connector.

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b. Remove the bolt and oil control valve.
c. Remove the O-ring from the oil control valve.

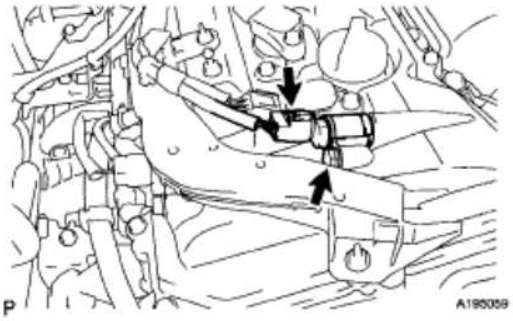


Fig. 450: Locating Bolt And Oil Control Valve
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

3. **REMOVE CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY (for Intake Side)**
   a. Disconnect the oil control valve connector.
   b. Remove the bolt and oil control valve.
   c. Remove the O-ring from the oil control valve.

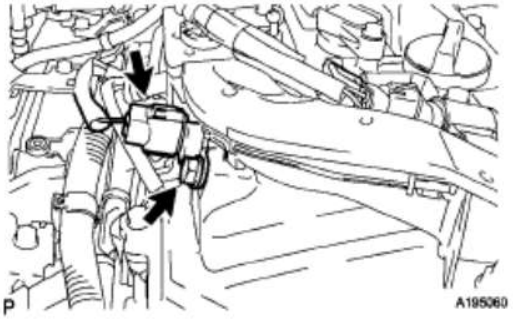


Fig. 451: Locating Bolt And Oil Control Valve
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSPECTION

1. **INSPECT CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY**
   a. Measure the resistance according to the value (s) in the table below.

Standard Resistance

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
1-2	20°C (68°F)	6.9 to 7.9 ohms

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If the result is not as specified, replace the oil control valve assembly.

Component without harness connected:
(Camshaft Timing Oil Control Valve)



Fig. 452: Identifying Camshaft Timing Oil Control Valve Assembly Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. Connect a battery positive (+) lead to terminal 1 and negative (-) lead to terminal 2, and check the movement of the valve.

OK

SPECIFIED CONDITION CHART

Condition	Specified Condition
Battery positive (+) voltage is applied	Valve moves in left arrow direction shown in illustration
Battery positive (+) voltage is cut off	Valve moves in right arrow direction shown in Illustration

Please confirm direction of movement in the event of a leak.

Component without harness connected:
(Camshaft Timing Oil Control Valve)

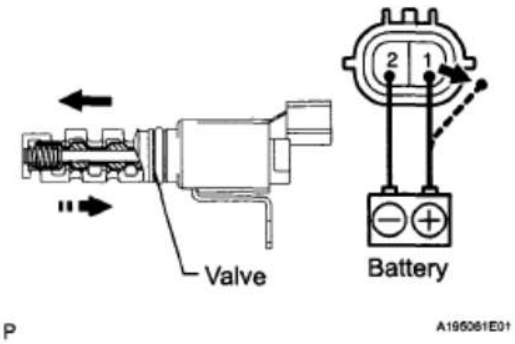


Fig. 453: Connecting Battery Terminals To Camshaft Timing Oil Control Valve Assembly
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSTALLATION

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1. **INSTALL CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY (for Exhaust Side)**
   a. Apply a light coat of engine oil to a new O-ring, and install it to the oil control valve.

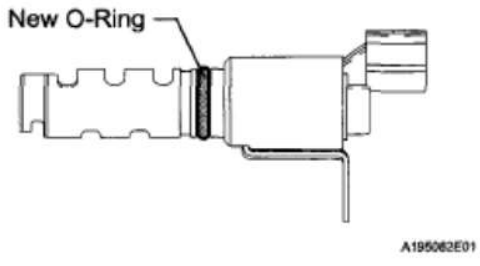


Fig. 454: Identifying O-Ring
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

   b. Install the oil control valve with the bolt.

Torque: 10 N*m (102 kgf*cm, 7 ft.*lbf)

NOTE:

- **Do not allow foreign matter to contact the oil seal face of the oil control valve (connecting surface with cylinder head cover).**
- **Be careful that the O-ring is not cracked or moved out of place when installing the oil control valve.**

   c. Connect the oil control valve connector.

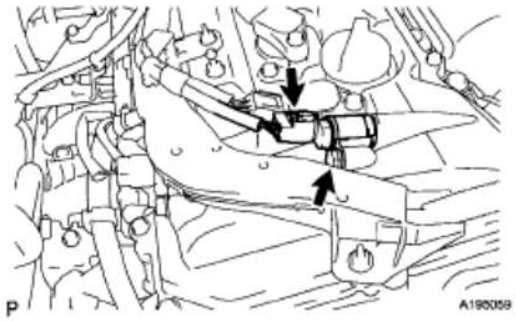


Fig. 455: Locating Bolt And Oil Control Valve
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

2. **INSTALL CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY (for Intake Side)**
   a. Apply a light coat of engine oil to a new O-ring, and install it to the oil control valve.

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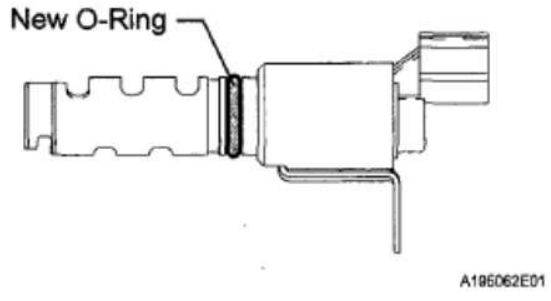


Fig. 456: Identifying O-Ring
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. Install the oil control valve with the bolt.

Torque: 10 N*m (102 kgf*cm, 7 ft.*lbf)

NOTE:

- **Do not allow foreign matter to contact the oil seal face of the oil control valve (connecting surface with cylinder head cover).**
- **Be careful that the O-ring is not cracked or moved out of place when installing the oil control valve.**

c. Connect the oil control valve connector.

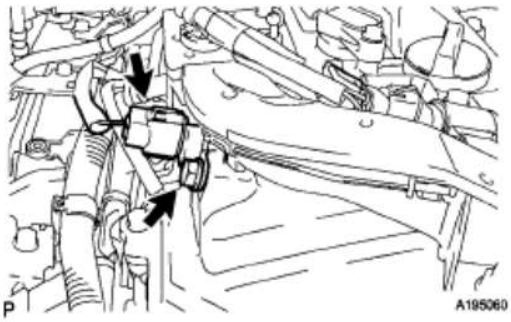


Fig. 457: Locating Bolt And Oil Control Valve
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

3. **INSPECT FOR OIL LEAK**
4. **INSTALL NO. 1 ENGINE COVER SUB-ASSEMBLY** (See **INSTALLATION**)

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