2009 ENGINE PERFORMANCE

Engine Control System (2GR-FE) - Highlander

SFI SYSTEM

PRECAUTION

1. **INITIALIZATION**

NOTE:

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

SYSTEM PROCEDURE CHART

System Name	See procedure
Power Back Door System	(See INITIALIZATION)

- **Perform RESET MEMORY (AT initialization) when replacing the automatic transaxle assembly, engine assembly or ECM (U151E See INITIALIZATION , U151F See INITIALIZATION).**
- **Perform REGISTRATION (VIN registration) when replacing the ECM (See REGISTRATION).**

HINT:

Initialization cannot be completed by only removing the battery.

2. **FOR USING TECHSTREAM**

CAUTION: Observe the following items for safety reasons:

- **Before using the tester, read the instruction manual.**
- **Prevent the tester cable from being caught on the pedals, shift lever and steering wheel when driving with the tester connected to the vehicle.**
- **When driving the vehicle for testing purposes using the tester, two persons are required. One is for driving the vehicle, and the other operates the tester.**

3. **FOR USING BATTERY DURING INSPECTION**
   a. While using the battery during inspection, do not bring the positive and negative tester probes too close to each other as a short circuit may occur.
4. **EXPRESSION OF IGNITION SWITCH**

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HINT:

The type of ignition switch used on this model differs according to the specifications of the vehicle.

The expressions listed in the table below are used in this section.

SWITCH SPECIFICATION CHART

Expression	Switch Type	
	Ignition Switch (Position)	Engine Switch (Condition)
Ignition switch off	LOCK	Off
Ignition switch on (IG)	ON	On (IG)
Ignition switch on (ACC)	ACC	On (ACC)
Engine Start	START	Start

5. **COOLING FAN SYSTEM**

CAUTION:

- **When the ignition switch is turned off and the engine temperature is high, the cooling fans may operate for approximately 3 minutes.**
- **After turning the ignition switch off, keep hands and objects away from the fans when they are operating.**

HINT:

If all of the following are met for a certain period of time during a few minute period immediately before the engine is stopped, the electric fans will continue to operate for 3 minutes after the engine is stopped. This is performed to ensure restartability and stabilize idle speed.

- Techstream indicates a very high coolant temperature.
- Techstream indicates a high outside air temperature.
- The vehicle has been driven under high load (driving on an uphill or equivalent).

The following sensors are used for this control:

- Coolant temperature sensor
- Outside air temperature sensor
- Mass air flow meter
- Vehicle speed sensors

DEFINITION OF TERMS

TERMS DEFINITION CHART

Terms	Definitions
	Description of what ECM monitors and how to detect malfunctions (monitoring

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Monitor Description	purpose and details).
Related DTCs	A group of diagnostic trouble codes that are output by ECM based on the same malfunction detection logic.
Typical Enabling Conditions	Preconditions that allow ECM to detect malfunction. With all preconditions satisfied, ECM sets 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 monitored in turn and not monitored until previous detection operation is completed.
Required Sensors/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 performs checks for that malfunction only once in single driving cycle. "Continuous" means ECM performs checks for that malfunction whenever enabling conditions are met.
Duration	Minimum time for which ECM must detect continuous deviation in monitored value(s) in order to set DTC. Timing begins when typical enabling conditions are met.
Malfunction Thresholds	Values, beyond which, ECM determines malfunctions exist and sets DTCs.
MIL Operation	Timing of MIL illumination after defect is detected. "Immediate" means ECM illuminates MIL as soon as malfunction is detected. "2 driving cycles" means ECM illuminates MIL if the same malfunction is detected twice during the next sequential driving cycle.

PARTS LOCATION

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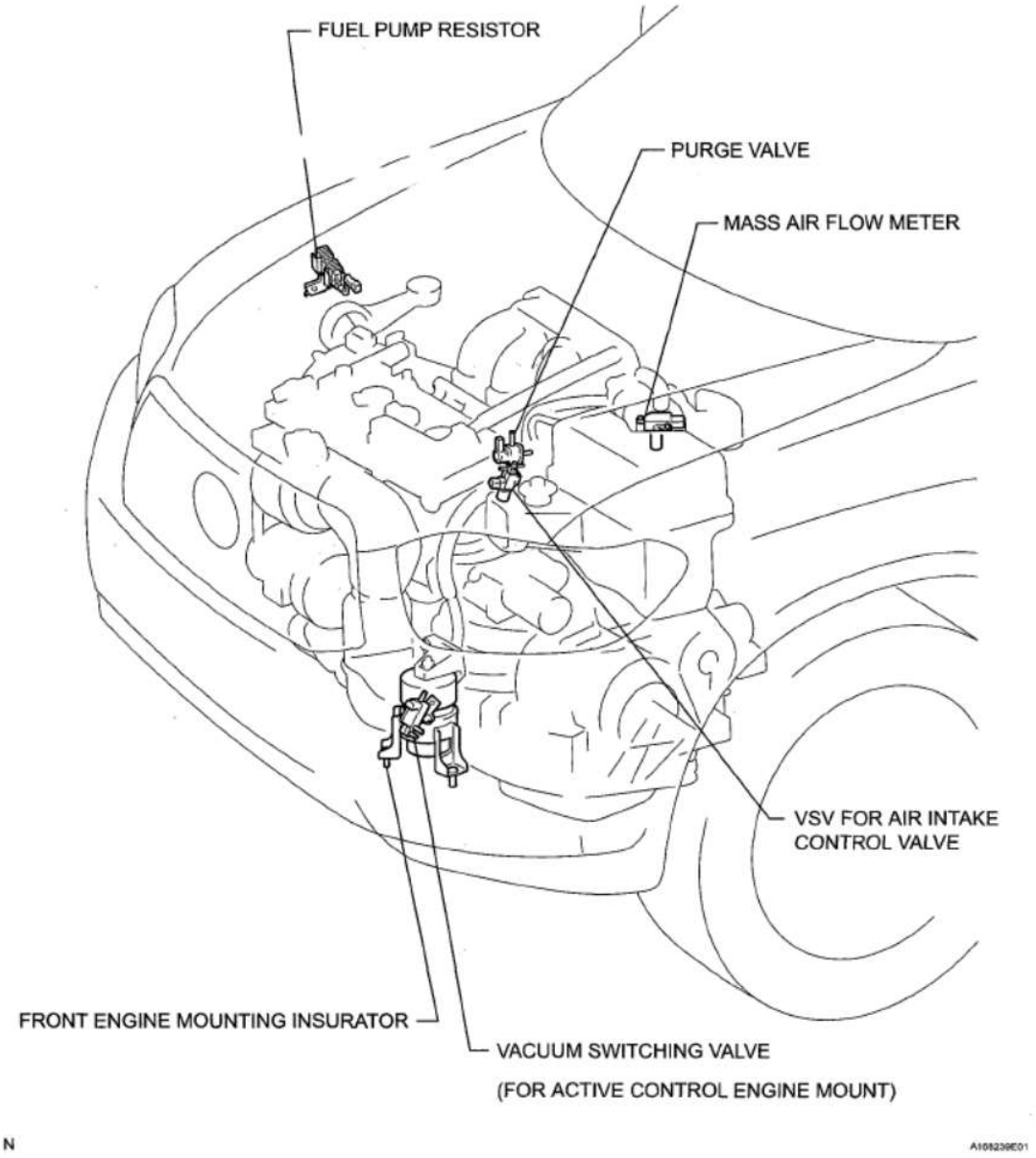


Fig. 1: Identifying SFI System Parts Location (1 Of 5)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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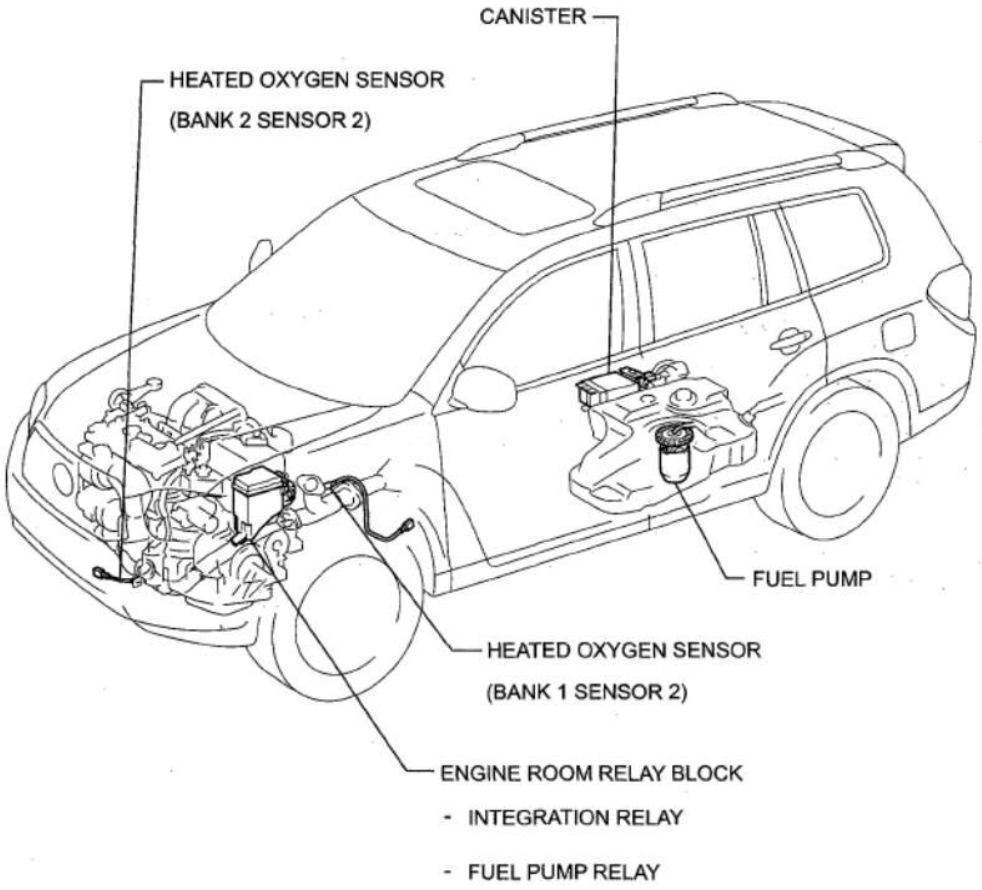


Fig. 2: Identifying SFI System Parts Location (2 Of 5)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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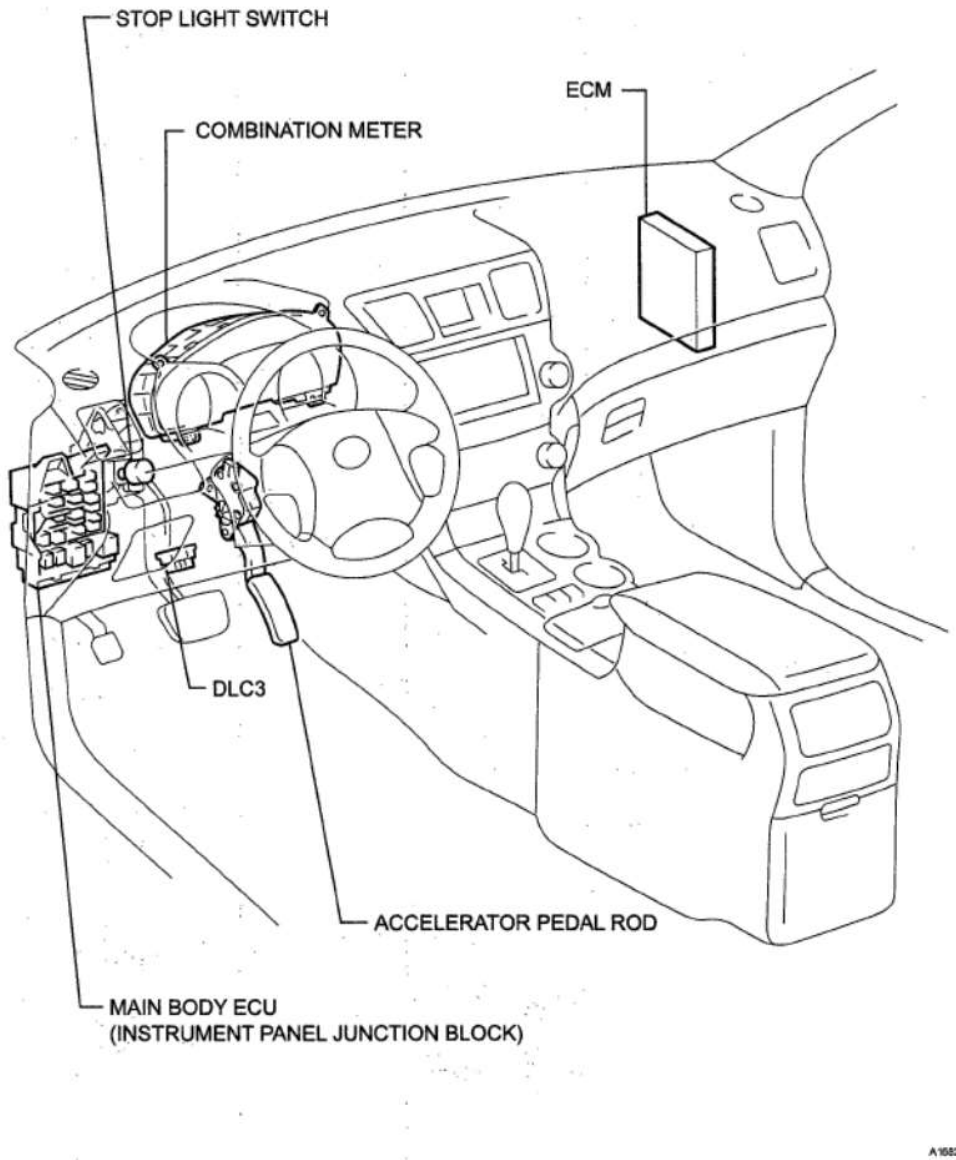


Fig. 3: Identifying SFI System Parts Location (3 Of 5)
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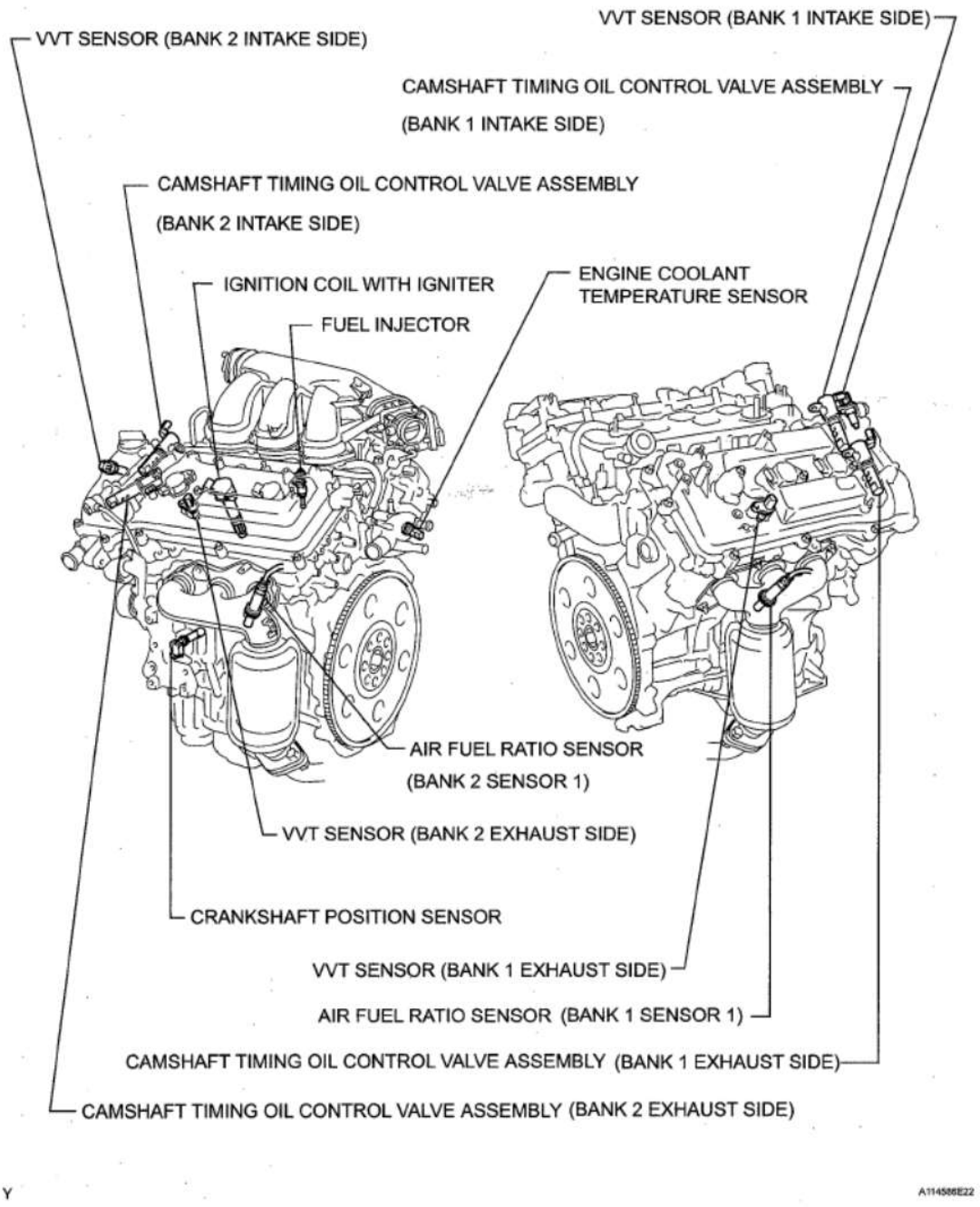


Fig. 4: Identifying SFI System Parts Location (4 Of 5)
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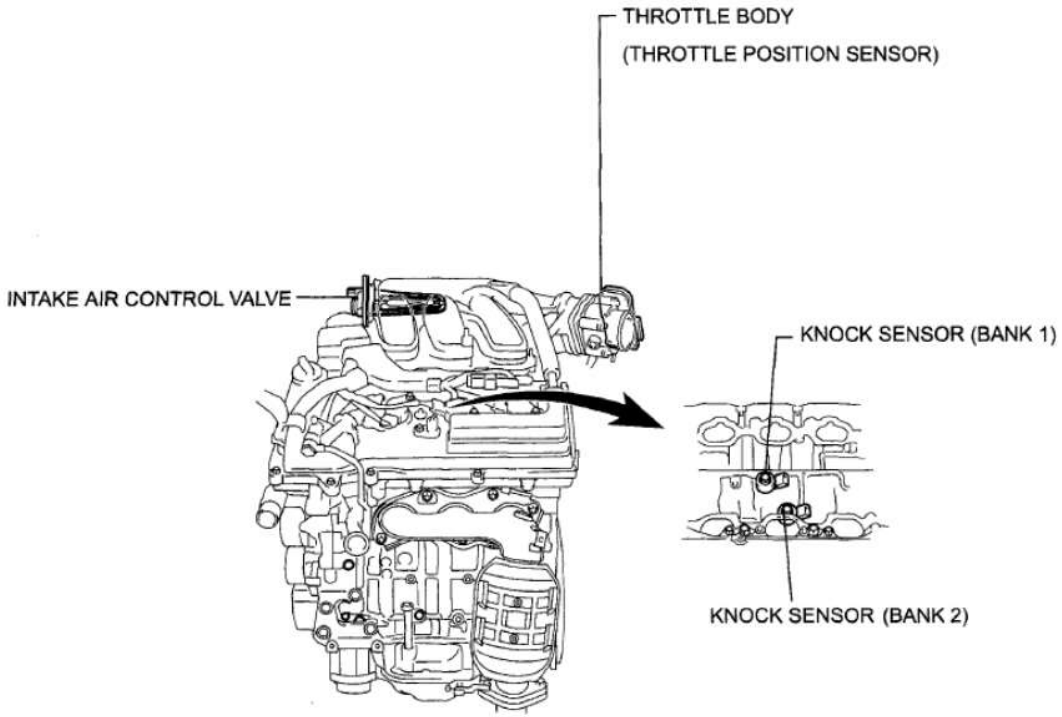


Fig. 5: Identifying SFI System Parts Location (5 Of 5)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

SYSTEM DIAGRAM

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w/o Smart Key System:

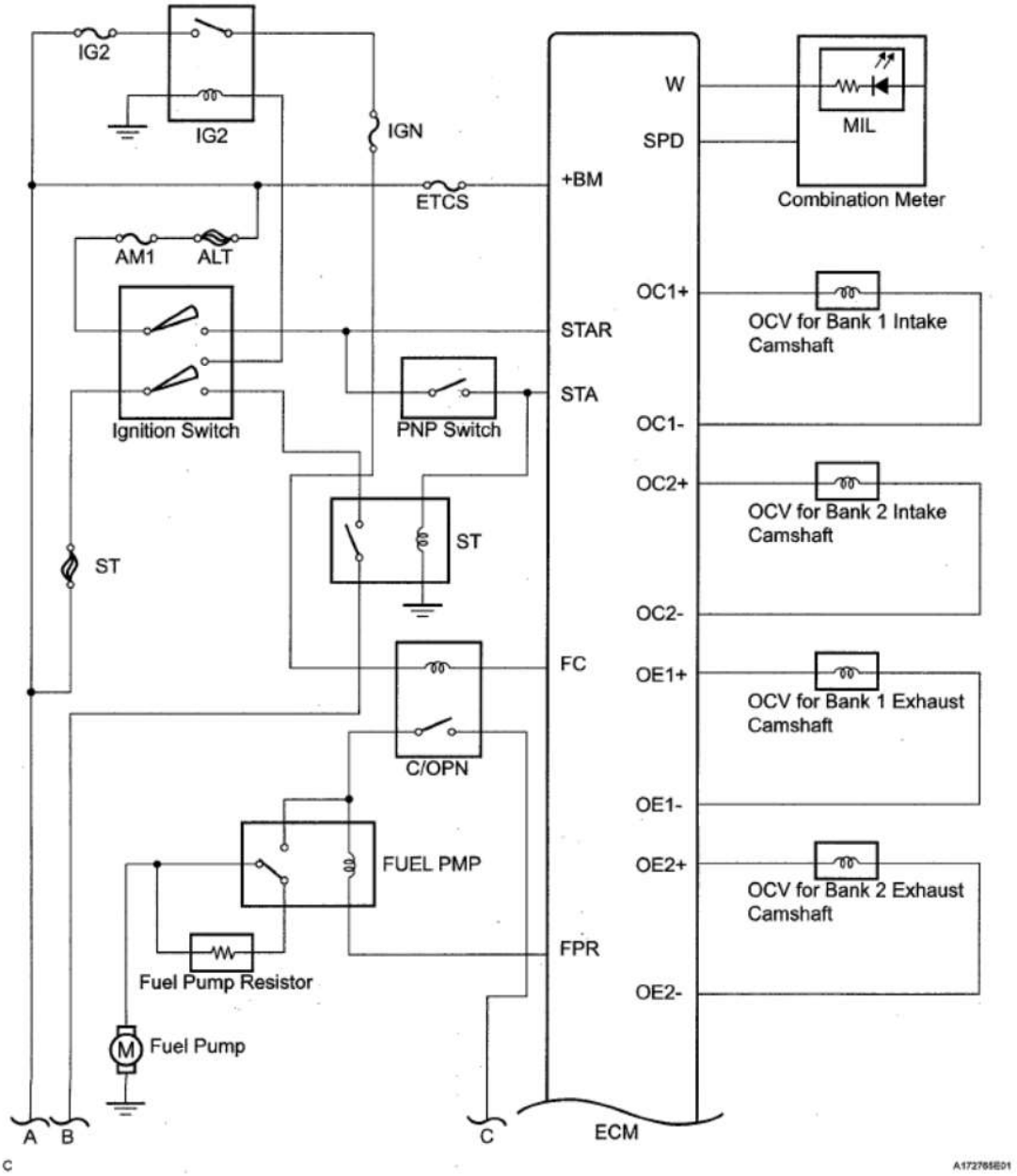


Fig. 6: SFI System Diagram (1 Of 5)
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w/ Smart Key System:

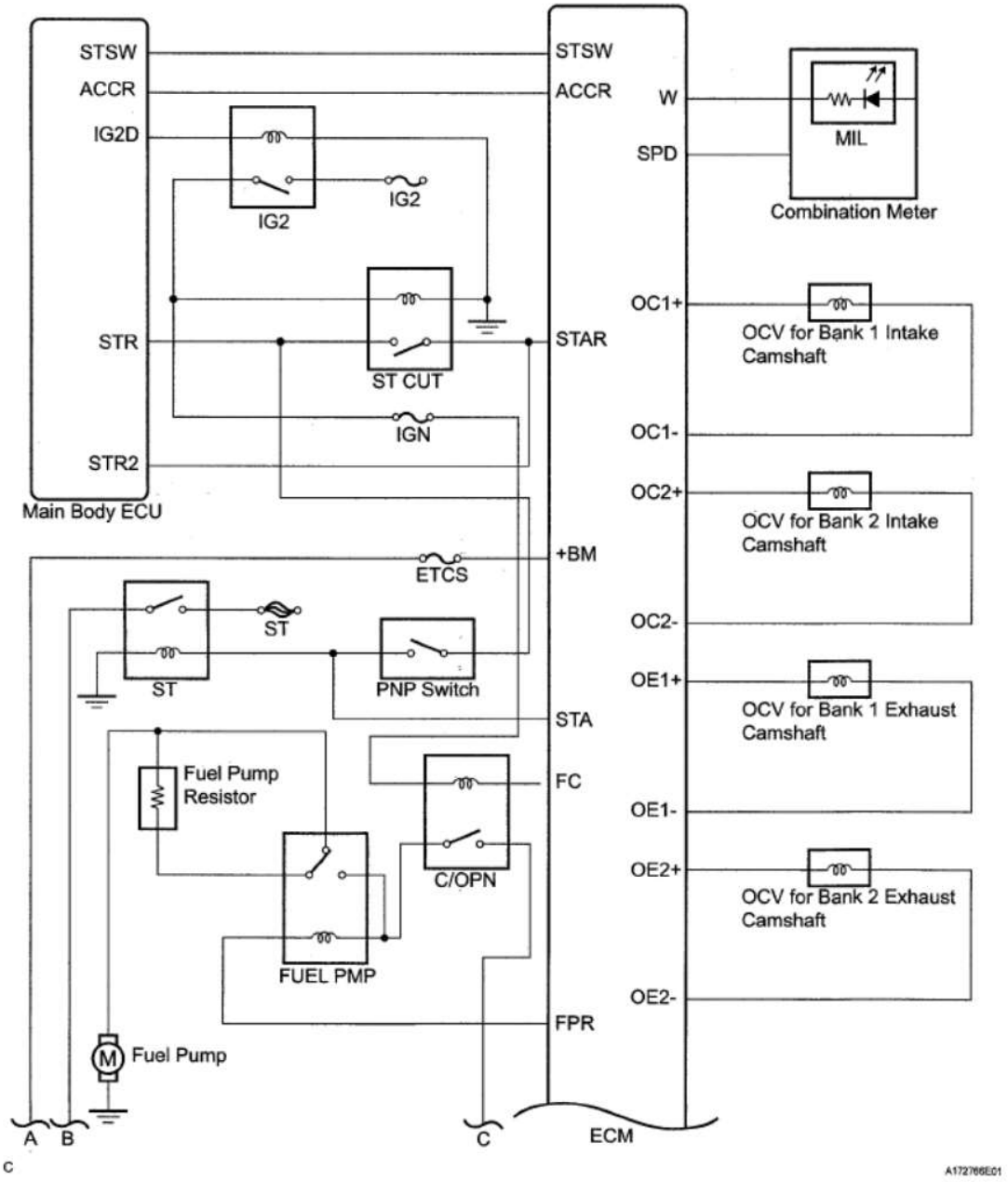


Fig. 7: SFI System Diagram (2 Of 5)
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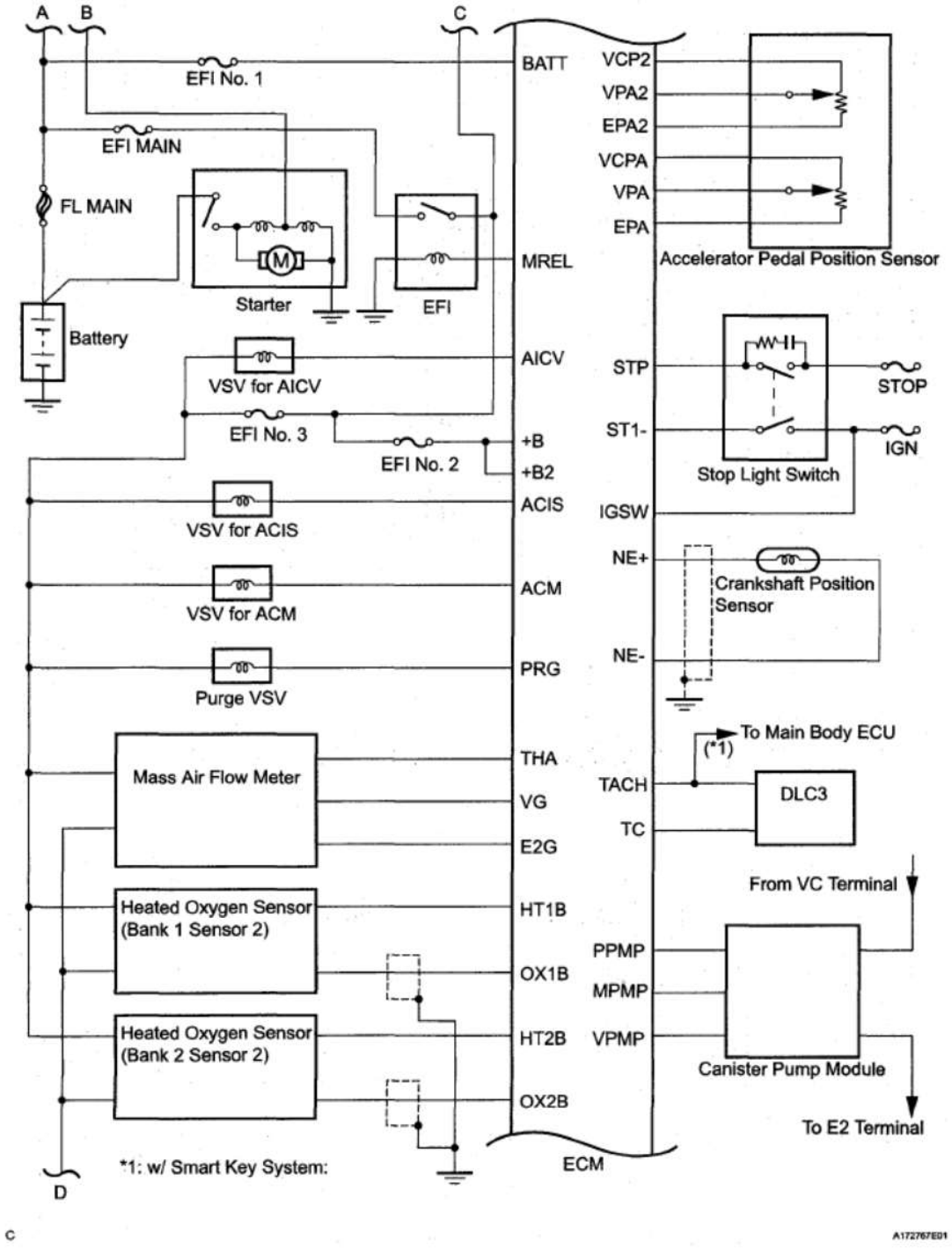


Fig. 8: SFI System Diagram (3 Of 5)
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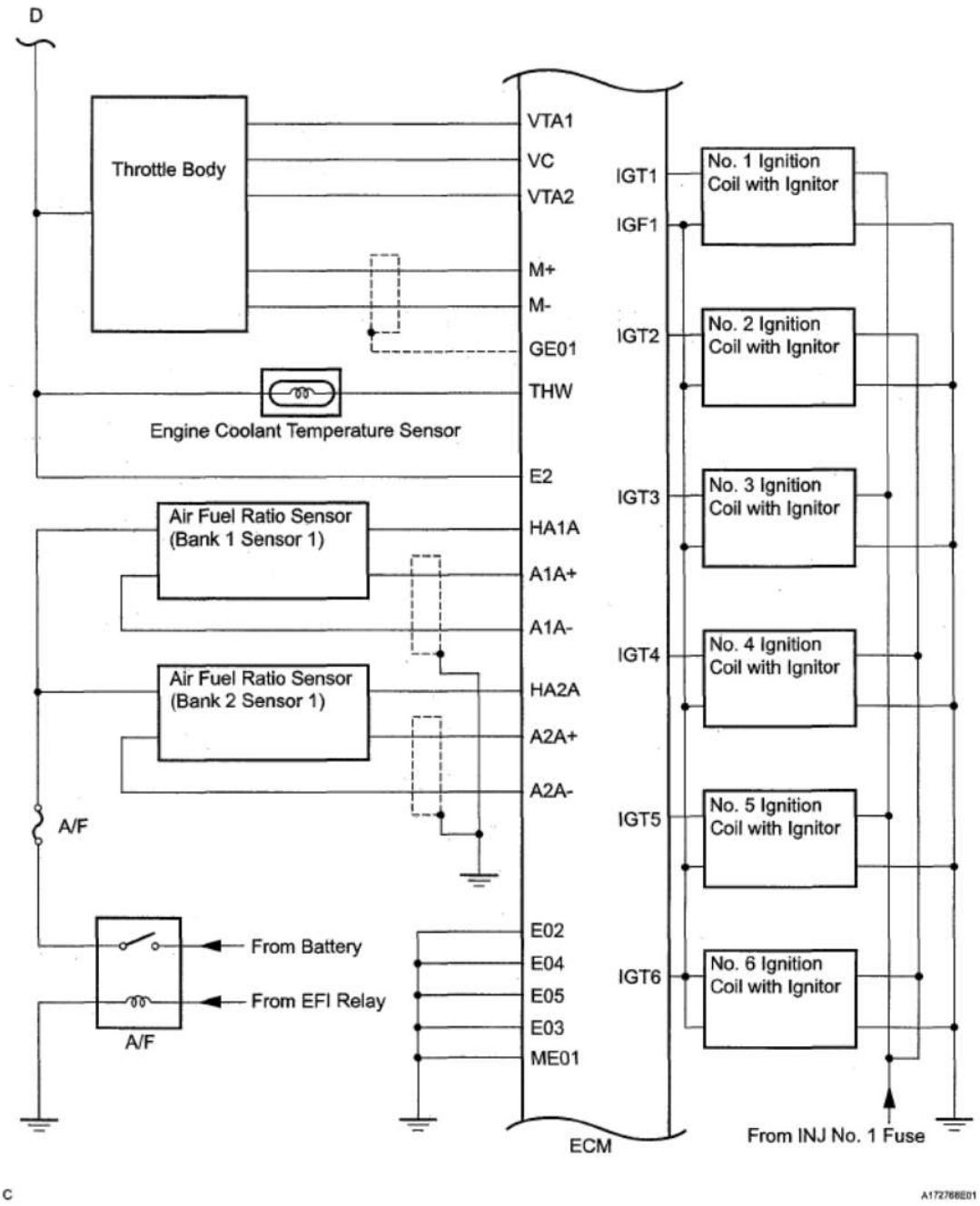


Fig. 9: SFI System Diagram (4 Of 5)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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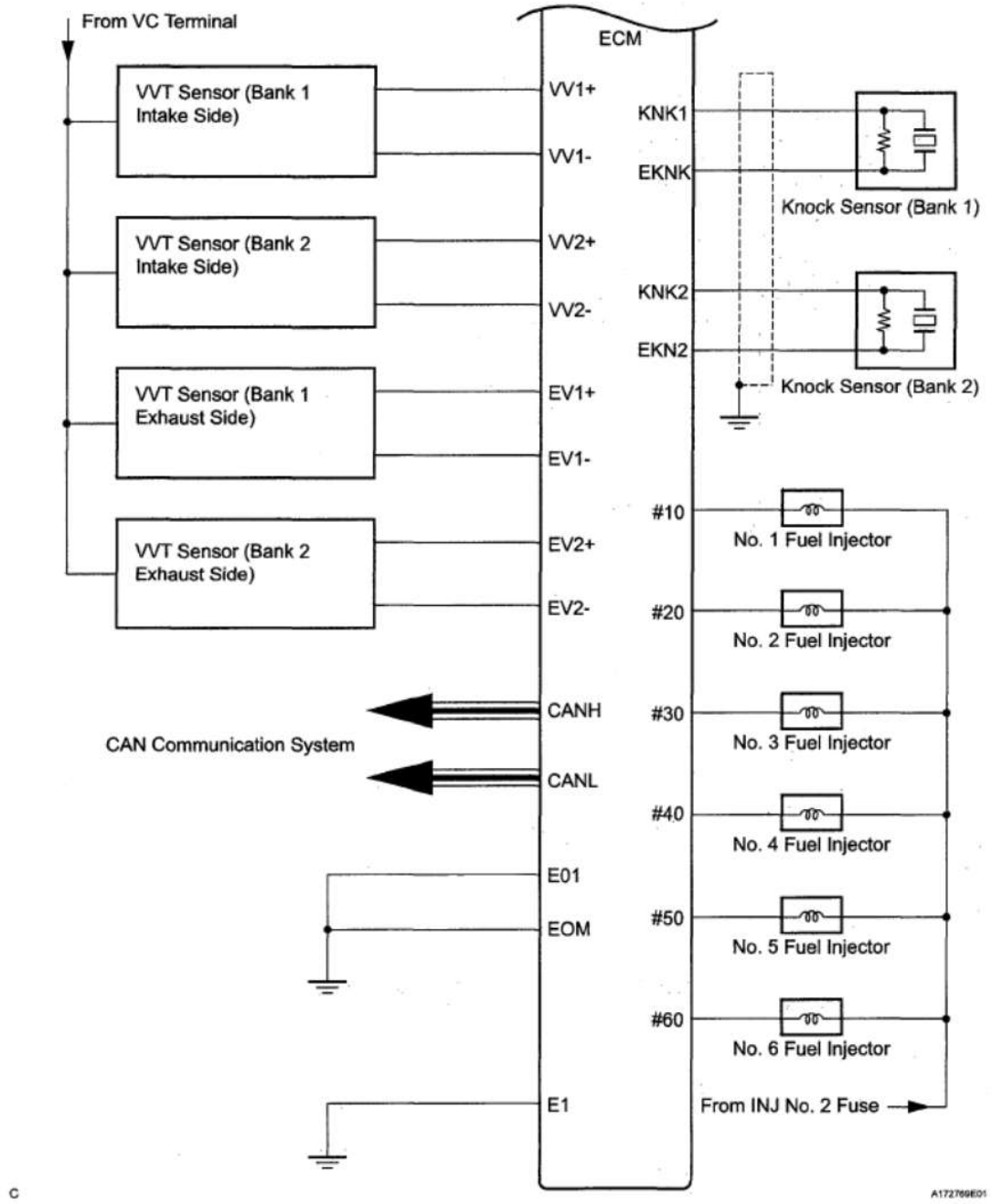


Fig. 10: SFI System Diagram (5 Of 5)
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HOW TO PROCEED WITH TROUBLESHOOTING

HINT:

Techstream can be used in steps 2, 3, 4, 6 and 9.

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1. **VEHICLE BROUGHT TO WORKSHOP**
2. **CONNECT TECHSTREAM TO DLC3**

   HINT:

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

3. **CHECK DTC AND FREEZE FRAME DATA**
   a. Check for DTC(s) and freeze frame data (See **DTC CHECK/CLEAR**).

      HINT:

      Record or print the DTCs and freeze frame data, if necessary.

4. **CLEAR DTC AND FREEZE FRAME DATA**
   a. Clear the DTC(s) and freeze frame data (See **DTC CHECK/CLEAR**).
5. **CONDUCT VISUAL INSPECTION**
6. **SET CHECK MODE DIAGNOSIS**
   a. Set the check mode (See **CHECK MODE PROCEDURE**).
7. **CONFIRM PROBLEM SYMPTOMS**

   HINT:

   If the engine does not start, perform steps 10 and 12 first.

   Result

   RESULT CHART

Result	Proceed to
Malfunction does not occur	A
Malfunction occurs	B

   B: GO TO STEP 9

   A: Go to next step

8. **SIMULATE SYMPTOMS**
9. **CHECK FOR DTCS**
   a. Check for DTCs (See **DTC CHECK/CLEAR**).

      Result

      RESULT CHART

Result	Proceed to

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Trouble code	A
No code	B

B: GO TO STEP 11

A: Go to next step

10. REFER TO **DTC CHART**

HINT:

Refer to the **DTC CHART** .

NEXT: GO TO STEP 13

11. **CONDUCT BASIC INSPECTION**

HINT:

Refer to "**BASIC INSPECTION**" .

Result

RESULT CHART

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

B: GO TO STEP 16

A: Go to next step

12. REFER TO **PROBLEM SYMPTOMS TABLE**

HINT:

Refer to "**PROBLEM SYMPTOMS TABLE**" .

Result

RESULT CHART

Result	Proceed to
Malfunctioning circuit confirmed	A
Malfunctioning parts confirmed	B

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B: GO TO STEP 16

A: Go to next step

13. **CHECK ECM POWER SOURCE CIRCUIT**

HINT:

Refer to "**ECM POWER SOURCE CIRCUIT**" .

14. **CONDUCT CIRCUIT INSPECTION**

Result

RESULT CHART

Result	Proceed to
Malfunction not confirmed	A
Malfunction confirmed	B

B: GO TO STEP 17

A: Go to next step

15. **CHECK FOR INTERMITTENT PROBLEMS**

HINT:

Refer to "**CHECK FOR INTERMITTENT PROBLEMS**" .

NEXT: GO TO STEP 17

16. **CONDUCT PARTS INSPECTION**
17. **IDENTIFY PROBLEM**
18. **ADJUST AND/OR REPAIR**
19. **CONDUCT CONFIRMATION TEST**

NEXT: END

CHECK FOR INTERMITTENT PROBLEMS

1. **CHECK FOR INTERMITTENT PROBLEMS**

HINT:

For use of the Techstream only:

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Inspect the vehicle's 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.

a. Clear the DTCs (See **DTC CHECK/CLEAR**).
b. Switch the ECM from normal mode to check mode using the Techstream (See **CHECK MODE PROCEDURE**).
c. Perform a simulation test (See **HOW TO PROCEED WITH TROUBLESHOOTING**).
d. Check the connector(s) and terminal(s) (See **ELECTRONIC CIRCUIT INSPECTION PROCEDURE**).
e. Check and wiggle the harness(es), connector(s) and terminal(s) (See **ELECTRONIC CIRCUIT INSPECTION PROCEDURE**).

BASIC INSPECTION

When a malfunction is not confirmed by the DTC check, troubleshooting should be carried out in 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 ignition switch off.

Result

RESULT CHART

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

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**

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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

      OK: Go to next step

5. **CHECK IDLING SPEED**
   a. Check the idling speed (See **ENGINE**).

      NG: TROUBLESHOOT IDLING SPEED AND PROCEED TO NEXT STEP

      OK: Go to next step

6. **CHECK FUEL PRESSURE**
   a. Check the fuel pressure (See **ON-VEHICLE INSPECTION**).

      NG: TROUBLESHOOT FUEL PRESSURE AND PROCEED TO NEXT STEP

      OK: Go to next step

7. **CHECK FOR SPARKS**
   a. Check for sparks (See **ON-VEHICLE INSPECTION**).

      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.

HINT:

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

1. **DESCRIPTION**

   HINT:

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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's 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 changed, 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 on (IG).
   d. Turn the tester on.
   e. Select the following menu items: Powertrain/Engine and ECT/Utility/VIN/VIN Read.
3. **WRITE VIN**
   a. Confirm the vehicle VIN.
   b. Connect the Techstream to the DLC3.
   c. Turn the ignition switch on (IG).
   d. Turn the tester on.
   e. Select the following menu items: Powertrain/Engine and ECT/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 catalyst, evaporative emission (EVAP) 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 instructions to view the monitor status. Although the Lexus diagnostic tester is used in the following instructions, it can be checked using a generic OBD II scan tool. Refer to your scan tool operator's manual for specific procedures.

1. **PERFORM MONITOR DRIVE PATTERN**

   The monitor results and test values can be checked with the OBD II scan tool or the Techstream. The engine control module (ECM) monitors the emissions-related components such as the thermostat, catalyst converter and evaporative emissions (EVAP), and determines whether they are functioning normally or not. When monitoring is finished, the ECM stores the monitor results and the test values. The monitor

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result indicates whether the component is functioning normally or not. The test value is the value that was used to determine the monitor result. If the test value is outside of the test limit (malfunction criterion), the ECM determines the component is malfunctioning. Some emissions-related components have multiple test values to determine monitor result. If one of these test values is outside of the test limit, the ECM determines the component is malfunctioning.

a. Connect the Techstream to the DLC3.
b. Start the engine and turn the tester on.
c. Clear the DTCs.
d. Run 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. Select the following menu items: Powertrain/Engine and ECT/Monitor/Result. The monitor status appears after the component name.
      - Pass: The component is functioning normally.
      - Fail: The component is malfunctioning.
   b. Confirm that the component is either Pass or Fail.
   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 MIN LIMIT and MAX 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 higher or lower 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 be Pass on rare occasions even if the Malfunction Indicator Lamp (MIL) is illuminated. This indicates that the system was malfunctioning in the previous driving cycle. This might be caused by an intermittent problem.

4. **MONITOR RESULT INFORMATION**

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

Air Fuel Ratio Sensor Bank 1

AIR FUEL RATIO SENSOR BANK CHART

Monitor ID	Test ID	Scaling	Unit	Description

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$01	$8E	Multiply by 0.0003	No dimension	A/F sensor deterioration level
$01	$91	Multiply by 0.004	mA	A/F sensor current

Heated Oxygen Sensor Bank 1 Sensor 2

HEATED OXYGEN SENSOR BANK CHART

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	$8F	Multiply by 0.003	g	Maximum oxygen storage capacity
$02	$8D	Multiply by 0.001	Seconds	Duration that sensor voltage drops to 0.2 V during fuel-cut

Air Fuel Ratio Sensor Bank 2

AIR FUEL RATIO SENSOR BANK CHART

Monitor ID	Test ID	Scaling	Unit	Description
$05	$8E	Multiply by 0.0003	No dimension	A/F sensor deterioration level
$05	$91	Multiply by 0.004	mA	A/F sensor current

HO2S Bank 2 Sensor 2

HO2S BANK CHART

Monitor ID	Test ID	Scaling	Unit	Description
$06	$07	Multiply by 0.001	V	Minimum sensor voltage
$06	$08	Multiply by 0.001	V	Maximum sensor voltage
$06	$8F	Multiply by 0.003	g	Maximum oxygen storage capacity
$06	$8D	Multiply by 0.001	Seconds	Duration that sensor voltage drops to 0.2 V during fuel-cut

Catalyst-Bank 1

CATALYST-BANK CHART

Monitor ID	Test ID	Scaling	Unit	Description
$21	$A9	Multiply by 0.0003	No dimension	Oxygen storage capacity of catalyst-bank 1

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Catalyst-Bank 2

CATALYST-BANK CHART

Monitor ID	Test ID	Scaling	Unit	Description
$22	$A9	Multiply by 0.0003	No dimension	Oxygen storage capacity of catalyst-bank 2

EVAP

EVAP CHART

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 OFF stuck (P2401)
$3D	$CD	Multiply by 0.001	kPa	Test value for leak detection pump ON stuck (P2402)
$3D	$CE	Multiply by 0.001	kPa	Test value for vent valve OFF stuck (P2420)
$3D	$CF	Multiply by 0.001	kPa	Test value for vent valve ON stuck (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 close stuck (P0441)
$3D	$D5	Multiply by 0.001	kPa	Test value for purge VSV open stuck (P0441)

Misfire

MISFIRE CHART

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.

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				• 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 current driving cycle is displayed.
$A6	$0B	Multiply by 1	Time	Total EWMA misfire count of cylinder 5 in last ten driving cycles
$A6	$0C	Multiply by 1	Time	• When ignition switch is ON, total misfire count of cylinder 5 in last driving cycle is displayed. • While engine is running, total misfire count of cylinder 5 in current driving cycle is displayed.
$A7	$0B	Multiply by 1	Time	Total EWMA misfire count of cylinder 6 in last ten driving cycles
$A7	$0C	Multiply by 1	Time	• When ignition switch is ON, total misfire count of cylinder 6 in last driving cycle is displayed. • While engine is running, total misfire count of cylinder 6 in 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 in different driving conditions, the OBD II system is designed to run separate monitoring programs called Readiness Monitors.
   - To view the status, select the following menu items: Powertrain/Engine and ECT/Monitor/Status 2.
   - When the Readiness Monitor status reads 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 Inspection and Maintenance (I/M) programs require a vehicle's Readiness Monitor status to show Complete before beginning emission tests.

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The Readiness Monitor will be reset to Incomplete if:

- The ECM has lost battery power or broken 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).

Contents:

STEPS SECTION REFERENCE CHART

Steps	Section Titles
1	Catalyst Monitor (Active Air Fuel Ratio Control Type)
2	EVAP System Monitor (Key-Off Type)
3	Air Fuel Ratio and Heated Oxygen Sensor Monitors (Active Air Fuel Ratio Control Type)
4	Air Fuel Ratio and Heated Oxygen Sensor Heater Monitors (Front Air Fuel Ratio and Rear Heated Oxygen Sensor Type)

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

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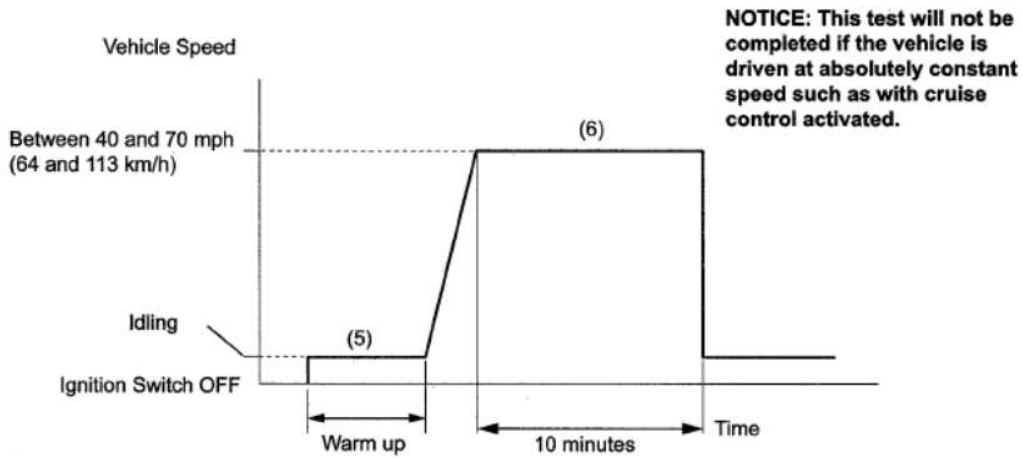


Fig. 11: Vehicle Drive Pattern
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a. Preconditions

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 on (IG).
   3. Turn the tester or scan tool ON.
   4. Clear the DTCs.
   5. Start the engine and warm it up.
   6. Drive the vehicle at between 40 mph and 70 mph (64 km/h and 113 km/h) for at least 10 minutes.

c. Monitor Status
   1. Check the Readiness Monitor status displayed on the tester.
   2. If the status does not switch to Complete, extend the driving time.

3. **EVAP 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. (2450 m).
- The vehicle is stationary.

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- The engine coolant temperature is between 4.4°C and 35°C (40°F and 95°F).
- The intake air temperature is between 4.4°C and 35°C (40°F and 95°F).
- Vehicle was driven in the city area (or on freeway) for 10 minutes or more.

b. Monitor Conditions

1. Turn the ignition switch off and wait for 6 hours.

   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 on (IG).
3. Turn the tester or scan tool ON.
4. Check the Readiness Monitor status displayed on the tester or scan tool.

   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 again.

4. **AIR FUEL RATIO SENSOR AND HEATED OXYGEN SENSOR MONITORS**

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 more.
- 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.
- Fuel-cut control is performed for 8 seconds or more (for the Rear Heated Oxygen Sensor Monitor).

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

1. Connect the Techstream to the DLC3.
2. Turn the ignition switch on (IG).
3. Turn the tester on.
4. Clear the DTCs.
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 38 mph and 75 mph (61 km/h and 120 km/h) for at least 10 minutes.
7. Change the transmission to the 2nd gear.
8. Accelerate the vehicle to 40 mph (64 km/h) or more by depressing the accelerator pedal for at

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least 10 seconds (Procedure "A").

9. Soon after performing procedure "A" above, release the accelerator pedal for at least 10 seconds without depressing the brake pedal, in order to execute fuel-cut control (Procedure "B").
10. Allow the vehicle to decelerate until the vehicle speed declines to less than 6 mph (10 km/h) (Procedure "C").
11. Repeat procedures from "A" through "C" above at least 3 times in one driving cycle.

c. Monitor Status

1. Check the Readiness Monitor status displayed on the tester.
2. If the status does not switch to Complete, make sure that the preconditions have been met and then perform the Drive Pattern again.

Monitor Drive Pattern

ECT: 75°C or more

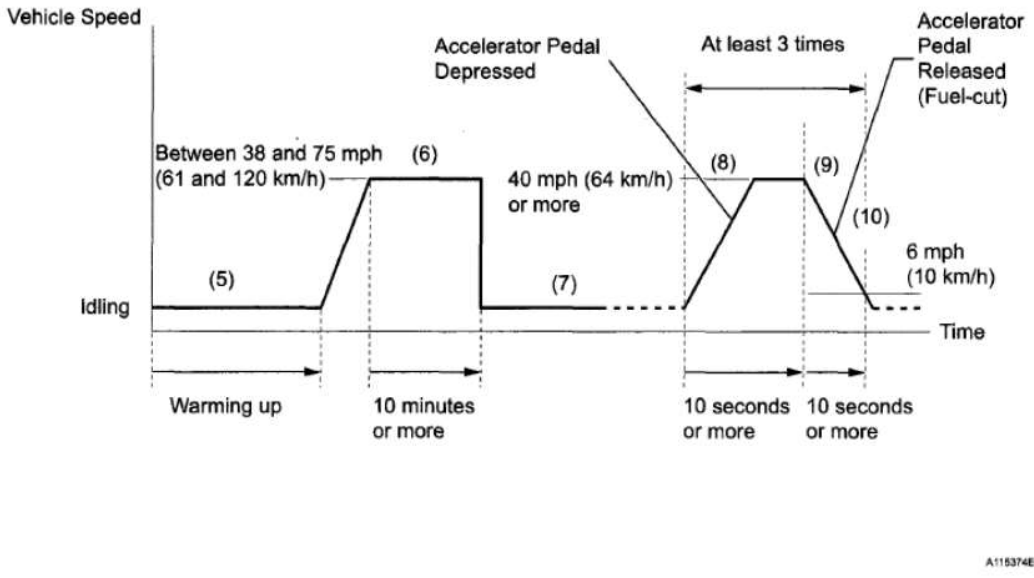


Fig. 12: Vehicle Drive Pattern
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

5. **AIR FUEL RATIO AND HEATED OXYGEN SENSOR HEATER MONITORS (FRONT AIR FUEL RATIO AND REAR HEATED OXYGEN SENSOR TYPE)**

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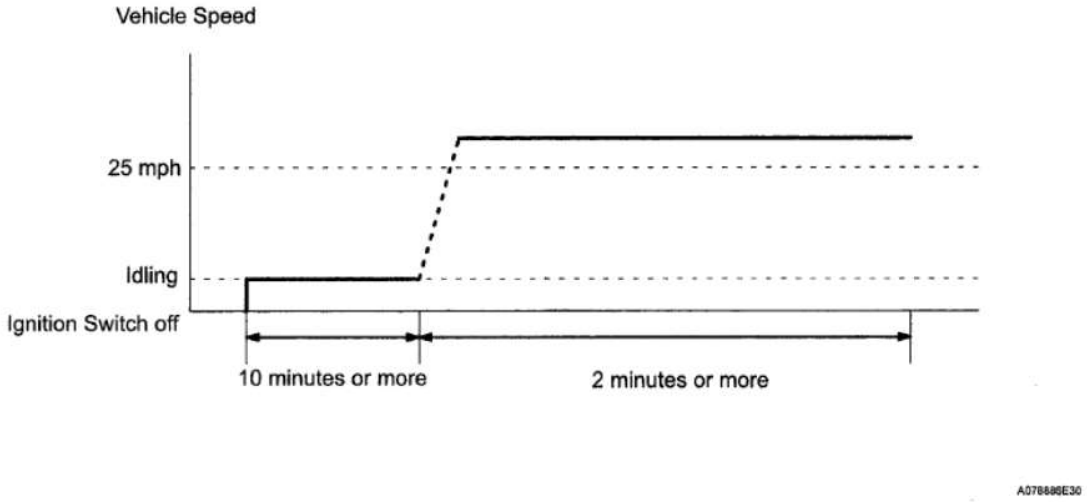


Fig. 13: Vehicle Drive Pattern
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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 on (IG).
   3. Clear the DTCs.
   4. Start the engine.
   5. Allow the engine to idle for 10 minutes or more.
   6. 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 tester or scan tool.

      If the status does not switch to Complete, make sure that the preconditions have been met, and repeat the Drive Pattern.

PROBLEM SYMPTOMS TABLE

HINT:

When a malfunction is not confirmed by a DTC (Diagnostic Trouble Code) check and the cause of problem cannot be identified through a basic inspection, troubleshoot according to the priority order indicated in the table below.

SFI SYSTEM:

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SFI SYSTEM SYMPTOM CHART

Symptom	Suspected Area	See page
Engine does not crank (does not start)	Immobilizer system (w/ Smart Key System)	HOW TO PROCEED WITH TROUBLESHOOTING
	Immobilizer system (w/o Smart Key System)	HOW TO PROCEED WITH TROUBLESHOOTING
	Starter	INSPECTION
	STARTER relay	STARTER RELAY
	Cranking holding function circuit (w/ Smart Key System)	CRANKING HOLDING FUNCTION CIRCUIT
	Starter signal circuit (w/o Smart Key System)	STARTER SIGNAL CIRCUIT
No initial combustion (does not start)	ECM power source circuit	ECM POWER SOURCE CIRCUIT
	Ignition system	ON-VEHICLE INSPECTION
	Fuel pump control circuit	FUEL PUMP CONTROL CIRCUIT
	Fuel injector	INSPECTION
	VC output circuit	VC OUTPUT CIRCUIT
	ECM	-
Difficult to start (engine cranks normally)	Electronic throttle control system	DTC P2102 THROTTLE ACTUATOR CONTROL MOTOR CIRCUIT LOW; DTC P2103 THROTTLE ACTUATOR CONTROL MOTOR CIRCUIT HIGH
	Fuel pump control circuit	FUEL PUMP CONTROL CIRCUIT
	Ignition system	ON-VEHICLE INSPECTION
	Spark plug	ON-VEHICLE INSPECTION
	Compression	ENGINE
	Fuel injector	INSPECTION
	VC output circuit	VC OUTPUT CIRCUIT
Difficult to start with cold engine	Electronic throttle control system	DTC P2102 THROTTLE ACTUATOR CONTROL MOTOR CIRCUIT LOW; DTC P2103 THROTTLE ACTUATOR CONTROL MOTOR CIRCUIT HIGH
	Fuel pump control circuit	FUEL PUMP CONTROL CIRCUIT
	Spark plug	ON-VEHICLE INSPECTION
	Ignition system	ON-VEHICLE INSPECTION
	Fuel injector	INSPECTION
	Engine coolant temperature sensor	ENGINE COOLANT TEMPERATURE SENSOR

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Difficult to start with hot engine	Electronic throttle control system	**DTC P2102 THROTTLE ACTUATOR CONTROL MOTOR CIRCUIT LOW; DTC P2103 THROTTLE ACTUATOR CONTROL MOTOR CIRCUIT HIGH**
	Fuel pump control circuit	**FUEL PUMP CONTROL CIRCUIT**
	Spark plug	**ON-VEHICLE INSPECTION**
	Ignition system	**ON-VEHICLE INSPECTION**
	Fuel injector	**INSPECTION**
	Engine coolant temperature sensor	**ENGINE COOLANT TEMPERATURE SENSOR**
High engine idle speed (poor idling)	Electronic throttle control system	**DTC P2102 THROTTLE ACTUATOR CONTROL MOTOR CIRCUIT LOW; DTC P2103 THROTTLE ACTUATOR CONTROL MOTOR CIRCUIT HIGH**
	ECM power source circuit	**ECM POWER SOURCE CIRCUIT**
	A/C signal circuit (Compressor circuit)	-
	Acoustic control induction system	**ACIS CONTROL CIRCUIT**
	PCV hose	**EMISSION CONTROL SYSTEM**
	ECM	-
Low engine idle speed (poor idling)	Electronic throttle control system	**DTC P2102 THROTTLE ACTUATOR CONTROL MOTOR CIRCUIT LOW; DTC P2103 THROTTLE ACTUATOR CONTROL MOTOR CIRCUIT HIGH**
	ECM power source circuit	**ECM POWER SOURCE CIRCUIT**
	A/C signal circuit (Compressor circuit)	-
	Acoustic control induction system	**ACIS CONTROL CIRCUIT**
	PCV hose	**EMISSION CONTROL SYSTEM**
	Fuel injector	**INSPECTION**
	ECM	-
Rough idling (poor idling)	Electronic throttle control system	**DTC P2102 THROTTLE ACTUATOR CONTROL MOTOR CIRCUIT LOW; DTC P2103 THROTTLE ACTUATOR CONTROL MOTOR CIRCUIT HIGH**
	Fuel injector	**INSPECTION**
	Ignition system	**ON-VEHICLE INSPECTION**
	Compression	**ENGINE**
	Fuel pump control circuit	**FUEL PUMP CONTROL CIRCUIT**
	Spark plug	**ON-VEHICLE INSPECTION**
	Acoustic control induction system	**ACIS CONTROL CIRCUIT**

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	PCV hose	**EMISSION CONTROL SYSTEM**
Hunting (poor idling)	Electronic throttle control system	**DTC P2102 THROTTLE ACTUATOR CONTROL MOTOR CIRCUIT LOW; DTC P2103 THROTTLE ACTUATOR CONTROL MOTOR CIRCUIT HIGH**
	ECM power source circuit	**ECM POWER SOURCE CIRCUIT**
	Fuel pump control circuit	**FUEL PUMP CONTROL CIRCUIT**
	Spark plug	**ON-VEHICLE INSPECTION**
	Ignition system	**ON-VEHICLE INSPECTION**
	Fuel injector	**INSPECTION**
	Acoustic control induction system	**ACIS CONTROL CIRCUIT**
	PCV hose	**EMISSION CONTROL SYSTEM**
Hesitation/Poor acceleration (poor driveability)	Fuel injector	**INSPECTION**
	Fuel pump control circuit	**FUEL PUMP CONTROL CIRCUIT**
	Ignition system	**ON-VEHICLE INSPECTION**
	Spark plug	**ON-VEHICLE INSPECTION**
	Air intake control system	**ACIS CONTROL CIRCUIT**
	A/T faulty (U151E)	**SYSTEM DESCRIPTION**
	A/T faulty (U151F)	**SYSTEM DESCRIPTION**
Surging (poor driveability)	Fuel pump control circuit	**FUEL PUMP CONTROL CIRCUIT**
	Spark plug	**ON-VEHICLE INSPECTION**
	Ignition system	**ON-VEHICLE INSPECTION**
	Fuel injector	**INSPECTION**
Engine stalls soon after starting	Fuel pump control circuit	**FUEL PUMP CONTROL CIRCUIT**
	Electronic throttle control system	**DTC P2102 THROTTLE ACTUATOR CONTROL MOTOR CIRCUIT LOW; DTC P2103 THROTTLE ACTUATOR CONTROL MOTOR CIRCUIT HIGH**
	Crankshaft position sensor	**CRANKSHAFT POSITION SENSOR**
	Spark plug	**ON-VEHICLE INSPECTION**
	Ignition system	**ON-VEHICLE INSPECTION**
	Fuel injector	**INSPECTION**
Engine stalls during A/C operation	A/C signal circuit (Compressor circuit)	-
	ECM	-
Unable/difficult to refuel	Refueling valve (canister)	-

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Engine vibrates frequently when idling (Active Control)	Active control engine mount circuit	**ACTIVE CONTROL ENGINE MOUNT SYSTEM**

TERMINALS OF ECM

1. **SFI SYSTEM**

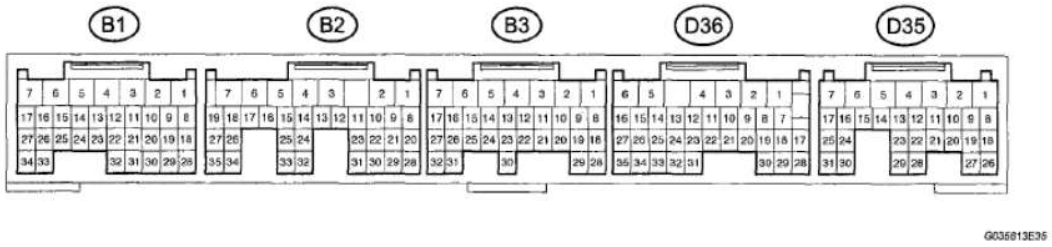


Fig. 14: Identifying ECM B1, B2, B3, D36 And D35 Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

HINT:

The standard normal voltage between each pair of the ECM terminals is shown in the table below. The appropriate conditions for checking each pair of the terminals are also indicated.

The check results should be compared with the standard normal voltage for that pair of terminals, listed in the "Specified Condition" column.

The illustration above can be used as a reference to identify the ECM terminal locations.

TERMINAL DESCRIPTION CHART

Terminal No. (Symbol)	Wiring Color	Terminal Description	Condition	Specified Condition
D35-1 (+B) - B3-1 (E1)	SB - W-B	Power source of ECM	Ignition switch on (IG)	9 to 14 V
D35-2 (+B2) - B3-1 (E1)	GR - W-B	Power source of ECM	Ignition switch on (IG)	9 to 14 V
D35-3 (BATT) - B3-1 (E1)	R - W-B	Battery (for measuring the battery voltage and for the ECM memory)	Always	9 to 14 V
D35-5 (VPMP) - B3-1 (E1)	W - W-B	Vent valve operation signal (built into pump module)	Ignition switch on (IG)	9 to 14 V
D35-6 (MPMP) - B3-1 (E1)	G - W-B	Vacuum pump operation signal (built into pump module)	Vacuum pump OFF	0 to 3 V
D35-6 (MPMP) - B3-1 (E1)	G - W-B	Vacuum pump operation signal (built into pump module)	Vacuum pump ON	9 to 14 V
D35-7 (+BM) -	L - W-B	Power source of ETCS throttle	Always	9 to 14 V

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B3-1 (E1)		motor		
D35-8 (MREL) - B3-1 (E1)	L - W-B	EFI relay operation signal	Ignition switch on (IG)	9 to 14 V
D35-9 (IGSW) - B3-1 (E1)	W - W-B	Ignition switch signal	Ignition switch on (IG)	9 to 14 V
D35-10 (FC) - B3-1 (E1)	P - W-B	C/OPEN relay operation signal (fuel pump control)	Ignition switch on (IG)	9 to 14 V
D35-15 (STP) - B3-1 (E1)	R - W-B	Stop light switch signal	Brake pedal depressed	7.5 to 14 V
D35-15 (STP) - B3-1 (E1)	R - W-B	Stop light switch signal	Brake pedal released	Below 1.5 V
D35-16 (ST1-) - B3-1 (E1)	LG - W-B	Stop light switch signal (opposite to STP terminal)	Ignition switch on (IG), Brake pedal depressed	Below 1.5 V
D35-16 (ST1-) - B3-1 (E1)	LG - W-B	Stop light switch signal (opposite to STP terminal)	Ignition switch on (IG), Brake pedal released	7.5 to 14 V
D35-17 (ACCR) (2) - B3-1 (E1)	O - W-B	ACC relay control signal	Cranking	Below 1.5 V
D35-18 (VPA) - D35-20 (EPA)	GR - SB	Accelerator pedal position sensor signal (for engine control)	Ignition switch on (IG), Accelerator pedal fully released	0.5 to 1.1 V
D35-18 (VPA) - D35-20 (EPA)	GR - SB	Accelerator pedal position sensor signal (for engine control)	Ignition switch on (IG), Accelerator pedal fully depressed	2.6 to 4.5 V
D35-19 (VPA2) - D35-21 (EPA2)	R - V	Accelerator pedal position sensor signal (for sensor malfunction detection)	Ignition switch on (IG), Accelerator pedal fully released	1.2 to 2.0 V
D35-19 (VPA2) - D35-21 (EPA2)	R - V	Accelerator pedal position sensor signal (for sensor malfunction detection)	Ignition switch on (IG), Accelerator pedal fully depressed	3.4 to 5.0 V
D35-22 (PPMP) - B1-28 (E2)	B - BR	Pressure sensor signal (built into pump module)	Ignition switch on (IG)	3 to 3.6 V
D35-23 (TC) - B3-1 (E1)	L - W-B	Terminal TC of DLC3	Ignition switch on (IG)	9 to 14 V
D35-26 (VCPA) - D35-20 (EPA)	SB - SB	Power source of accelerator pedal position sensor (for VPA)	Ignition switch on (IG)	4.5 to 5.0 V
D35-27 (VCP2) - D35-21 (EPA2)	LG - V	Power source of accelerator pedal position sensor (for VPA2)	Ignition switch on (IG)	4.5 to 5.0 V
D36-1 (TACH) - B3-1 (E1)	B - W-B	Engine speed signal (for combination meter)	Idling	Pulse generation (see waveform 12 k)
D36-8 (SPD) - B3-1 (E1)	LG - W-B	Vehicle speed signal from combination meter	Ignition switch on (IG), driving wheel rotated slowly	Pulse generation (see waveform 9 h)
D36-30 (W) -		Malfunction Indicator Lamp		

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B3-1 (E1)	Y - W-B	(MIL) operation signal	Ignition switch on (IG)	Below 3.0 V
D36-30 (W) - B3-1 (E1)	Y - W-B	Malfunction Indicator Lamp (MIL) operation signal	Idling	9 to 14 V
D36-33 (CANH) - B3-1 (E1)	B - W-B	CAN communication circuit	Ignition switch on (IG)	Pulse generation (see waveform 13 l)
D36-34 (CANL) - B3-1 (E1)	W - W-B	CAN communication circuit	Ignition switch on (IG)	Pulse generation (see waveform 14 m)
B3-1 (E1) - Body ground	W - B --	Earth (ground) circuit of ECM	Always	Below 1 V
B3-2 (#10) - B1-7 (E01)	L - W-B	Fuel injector operation signal	Ignition switch on (IG)	9 to 14 V
B3-3 (#20) - B1-7 (E01)	Y - W-B			
B3-4 (#30) - B1-7 (E01)	B - W-B			
B3-5 (#40) - B1-7 (E01)	W - W-B			
B3-6 (#50) - B1-7 (E01)	R - W-B			
B3-7 (#60) - B1-7 (E01)	G - W-B			
B3-2 (#10) - B1-7 (E01)	L - W-B	Fuel injector operation signal	Idling	Pulse generation (see waveform 3 b)
B3-3 (#20) - B1-7 (E01)	Y - W-B			
B3-4 (#30) - B1-7 (E01)	B - W-B			
B3-5 (#40) - B1-7 (E01)	W - W-B			
B3-6 (#50) - B1-7 (E01)	R - W-B			
B3-7 (#60) - B1-7 (E01)	G - W-B			
B2-8 (STAR) - B3-1 (E1)	GR - W-B	Park/neutral position switch signal	Ignition switch on (IG), Shift lever position P or N	9 to 14 V
B3-11 (STA) - B3-1 (E1)	B - W-B	Starter relay operation signal	Cranking	9 to 14 V
B3-12 (STSW) (2) - B3-1 (E1)	P - W-B	Starter relay operation signal	Cranking	9 to 14 V
B3-14 (OC2-) - B3-15 (OC2+)	P - LG	Camshaft timing oil control valve operation signal (Intake side)	Ignition switch on (IG)	Pulse generation (see waveform 1)
		Camshaft timing oil control		

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B3-16 (OC1-) - B3-17 (OC1+)	L - Y	valve operation signal (Intake side)	Ignition switch on (IG)	Pulse generation (see waveform 1)
B3-18 (VV2+) - B3-28 (VV2-)	P - L	Variable valve timing sensor signal (Intake side)	Idling	Pulse generation (see waveform 6 e)
B3-19 (VV1+) - B3-29 (VV1-)	G - R	Variable valve timing sensor signal (Intake side)	Idling	Pulse generation (see waveform 6 e)
B3-21 (NE+) - B3-20 (NE-)	W - B	Crankshaft position sensor signal	Idling	Pulse generation (see waveform 5 d)
B3-23 (EV2+) - B3-22 (EV2-)	L - R	Variable valve timing sensor signal (Exhaust side)	Idling	Pulse generation (see waveform 5 d)
B3-25 (EV1+) - B3-24 (EV1-)	B - W	Variable valve timing sensor signal (Exhaust side)	Idling	Pulse generation (see waveform 5 d)
B3-26 (OE1+) - B3-31 (OE1-)	G - R	Camshaft timing oil control valve operation signal (Intake side)	Ignition switch on (IG)	Pulse generation (see waveform 1)
B3-27 (OE2+) - B3-32 (OE2-)	P - W	Camshaft timing oil control valve operation signal (Intake side)	Ignition switch on (IG)	Pulse generation (see waveform 1)
B3-30 (FPR) - B3-1 (E1)	G - W-B	Fuel pump control	Cranking	9 to 14 V
			Idling	Below 3 V
B1-1 (HT1B) - B3-1 (E1)	R - W-B	Heated oxygen sensor heater operation signal	Idling	Below 3.0 V
B1-1 (HT1B) - B3-1 (E1)	R - W-B	Heated oxygen sensor heater operation signal	Ignition switch on (IG)	9 to 14 V
B1-3 (ACM) - B3-1 (E1)	G - W-B	VSV for active control mount system operation signal	Ignition switch on (IG)	9 to 14 V
B1-4 (M-) - B2-3 (ME01)	L - W-B	Throttle drive motor operation signal (negative terminal)	Idling with warm engine	Pulse generation (see waveform 11 j)
B1-5 (M+) - B2-3 (ME01)	R - W-B	Throttle drive motor operation signal (positive terminal)	Idling with warm engine	Pluse generation (see waveform 10 i)
B1-6 (E02) - Body ground	W - B --	Earth (ground) circuit of ECM	Always	Below 1 V
B1-7 (E01) - Body ground	W - B --	Earth (ground) circuit of ECM	Always	Below 1 V
B1-8 (IGT1) - B3-1 (E1)	Y - W-B			
B1-9 (IGT2) - B3-1 (E1)	P - W-B			

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B1-10 (IGT3) - B3-1 (E1) B1-11 (IGT4) - B3-1 (E1) B1-12 (IGT5) - B3-1 (E1) B1-13 (IGT6) - B3-1 (E1)	G - W-B L - W-B B - W-B BR - W-B	Ignition coil with igniter (ignition signal)	Idling	Pulse generation (see waveform 7 f)
B1-17 (GE01) - B3-1 (E1)	- - W - B	Shielded earth (ground) circuit of throttle drive motor	Always	Below 1 V
B1-18 (OX1B) - B1-28 (E2)	B - BR	Heated oxygen sensor signal	With engine speed at 2500 rpm for 2 minutes after warming up	Pulse generation (see waveform 2 a)
B1-19 (VTA2) - B1-28 (E2)	LG - BR	Throttle position sensor signal (for sensor malfunction detection)	Ignition switch on (IG), Accelerator pedal fully released	2.1 to 3.1 V
B1-19 (VTA2) - B1-28 (E2)	LG - BR	Throttle position sensor signal (for sensor malfunction detection)	Ignition switch on (IG), Accelerator pedal fully depressed	4.5 to 5.0 V
B1-20 (VTA1) - B1-28 (E2)	B - BR	Throttle position sensor signal (for engine control)	Ignition switch on (IG), Throttle valve fully closed	0.5 to 1.2 V
B1-20 (VTA1) - B1-28 (E2)	B - BR	Throttle position sensor signal (for engine control)	Ignition switch on (IG), Throttle valve fully open	3.2 to 4.8 V
B1-21 (THW) - B1-28 (E2)	W - BR	Engine coolant temperature sensor signal	Idling, Engine coolant temperature 80°C (176°F)	0.2 to 1.0 V
B1-22 (THA) - B1-29 (E2G)	P - Y	Intake air temperature sensor signal	Idling, Intake air temperature 20°C (68°F)	0.5 to 3.4 V
B1-23 (VC) - B1-28 (E2)	R - BR	Power source of sensors (specific voltage)	Ignition switch on (IG)	4.5 to 5.0 V
B1-24 (IGF1) - B3-1 (E1)	W - W-B	Ignition coil with igniter (ignition confirmation signal)	Ignition switch on (IG)	4.5 to 5.0 V
B1-24 (IGF1) - B3-1 (E1)	W - W-B	Ignition coil with igniter (ignition confirmation signal)	Idling	Pulse generation (see waveform 7 f)
B1-27 (AICV) - B3-1 (E1)	W - W-B	VSV for air intake control system operation signal	Ignition switch on (IG)	9 to 14 V
B1-28 (E2) - B3-1 (E1)	BR - W-B	Earth (ground) circuit of sensors for ETCS	Always	Below 1 V
B1-29 (E2G) - B3-1 (E1)	Y - W-B	Earth (ground) circuit of sensor for mass air flow meter	Always	Below 1 V
B1-30 (VG) - B1-29 (E2G)	R - Y	Mass air flow meter signal	Idling, Shift lever position P or N, A/C switch OFF	0.5 to 3.0 V
		VSV for acoustic control		

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B1-33 (ACIS) - B3-1 (E1)	L - W-B	induction system operation signal	Ignition switch on (IG)	9 to 14 V
B1-34 (PRG) - B3-1 (E1)	G - W-B	Purge VSV for EVAP system operation signal	Ignition switch on (IG)	9 to 14 V
B1-34 (PRG) - B3-1 (E1)	G - W-B	Purge VSV for EVAP system operation signal	Idling	Pulse generation (see waveform 8 g)
B2-1 (HA2A) - B2-6 (E05)	B - W-B	Air fuel ratio sensor heater operation signal	Idling	Below 3.0 V
B2-1 (HA2A) - B2-6 (E05)	B - W-B	Air fuel ratio sensor heater operation signal	Ignition switch on (IG)	9 to 14 V
B2-2 (HA1A) - B2-7 (E04)	L - W-B	Air fuel ratio sensor heater operation signal	Idling	Below 3.0 V
B2-2 (HA1A) - B2-7 (E04)	L - W-B	Air fuel ratio sensor heater operation signal	Ignition switch on (IG)	9 to 14 V
B2-3 (ME01) - B3-1 (E1)	W-B - W-B	Earth (ground) circuit of ECM	Always	Below 1 V
B2-4 (E03) - B3-1 (E1)	W-B - W-B	Earth (ground) circuit of ECM	Always	Below 1 V
B2-5 (HT2B) - B3-1 (E1)	R - W-B	Heated oxygen sensor heater operation signal	Idling	Below 3.0 V
B2-5 (HT2B) - B3-1 (E1)	R - W-B	Heated oxygen sensor heater operation signal	Ignition switch on (IG)	9 to 14 V
B2-6 (E05) - B3-1 (E1)	W-B - W-B	Earth (ground) circuit of ECM	Always	Below 1 V
B2-7 (E04) - B3-1 (E1)	W-B - W-B	Earth (ground) circuit of ECM	Always	Below 1 V
B2-21 (KNK2) - B2-20 (EKN2)	R - G	Knock sensor signal	With engine speed at 4000 rpm after warming up	Pulse generation (see waveform 4 c)
B2-22 (A1A+) - B3-1 (E1)	BR - W-B	Air fuel ratio sensor signal	Ignition switch on (IG)	3.3 V(1)
B2-23 (A2A+) - B3-1 (E1)	P - W-B	Air fuel ratio sensor signal	Ignition switch on (IG)	3.3 V(1)
B2-29 (KNK1) - B2-28 (EKNK)	B - W	Knock sensor signal	With engine speed at 4000 rpm after warming up	Pulse generation (see waveform 4 c)
B2-30 (A1A-) - B3-1 (E1)	Y - W-B	Air fuel ratio sensor	Ignition switch on (IG)	3.0 V(1)
B2-31 (A2A-) - B3-1 (E1)	L - W-B	Air fuel ratio sensor	Ignition switch on (IG)	3.0 V(1)
B2-33 (OX2B) - B1-28 (E2)	B - BR	Heated oxygen sensor signal	With engine speed at 2500 rpm for 2 minutes after warming up	Pulse generation (see waveform 2 a)

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(1) The ECM terminal voltage is constant regardless of the output voltage from the sensor.

(2) w/ Smart Key System

a. WAVEFORM 1

1. Camshaft timing oil control valve operation signal

WAVEFORM REFERENCE CHART

ECM Terminal Names	Between OC1+ and OC1-, OC2+ and OC2-, OE1+ and OE1-, or OE2+ and OE2-
Tester Ranges	5 V/DIV, 1 msec./DIV
Conditions	Idling

HINT:

The wavelength becomes shorter as the engine rpm increases.

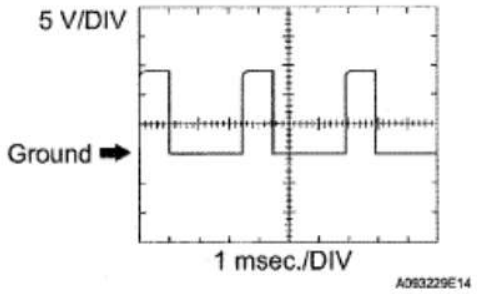


Fig. 15: Camshaft Timing Oil Control Valve Operation Signal Waveform
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. WAVEFORM 2

1. Heated oxygen sensor signal

WAVEFORM REFERENCE CHART

ECM Terminal Names	Between OX1B and E2, or OX2B and E2
Tester Ranges	0.2 V/DIV, 200 msec./DIV
Conditions	With engine speed at 2500 rpm for 2 minutes after warming up

HINT:

In the DATA LIST, item O2S B1S2 shows the ECM input values from the heated oxygen sensor.

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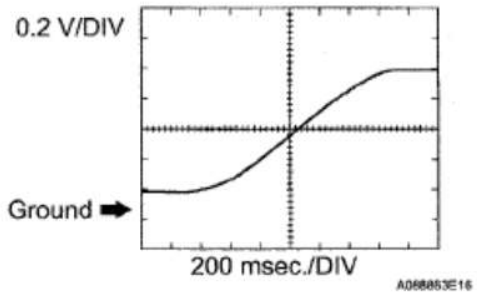


Fig. 16: Heated Oxygen Sensor Signal Waveform
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

c. WAVEFORM 3

1. Fuel injector operation signal

WAVEFORM REFERENCE CHART

ECM Terminal Names	Between #10 (to 60) and E01
Tester Ranges	30 V/DIV, 20 msec./DIV
Conditions	Idling

HINT:

The wavelength becomes shorter as the engine rpm increases.

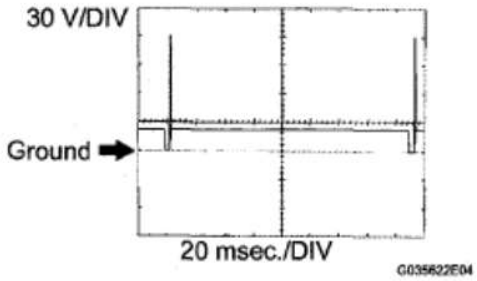


Fig. 17: Fuel Injector Operation Signal Waveform
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

d. WAVEFORM 4

1. Knock sensor signal

WAVEFORM REFERENCE CHART

ECM Terminal Names	Between KNK1 and EKNK, or KNK2 and EKN2
Tester Ranges	0.01 to 10 V/DIV, 0.01 to 10 msec./DIV
Conditions	With engine speed at 4000 rpm after warming up

HINT:

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

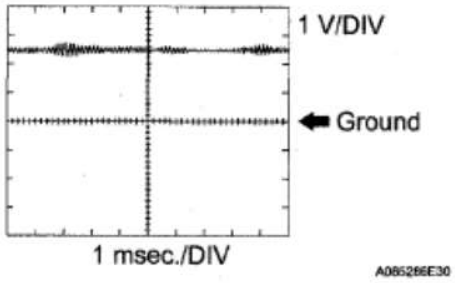


Fig. 18: Knock Sensor Signal Waveform
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

e. WAVEFORM 5
   1. Variable Valve Timing (VVT) sensor signal (1)
   2. Crankshaft position sensor signal (2)

WAVEFORM REFERENCE CHART

ECM Terminal Names	1. EV1+ and EV1-, or EV2+ and EV2- 2. Between NE+ and NE-
Tester Ranges	5 V/DIV, 20 ms./DIV
Conditions	Idling

HINT:

The wavelength becomes shorter as the engine rpm increases.

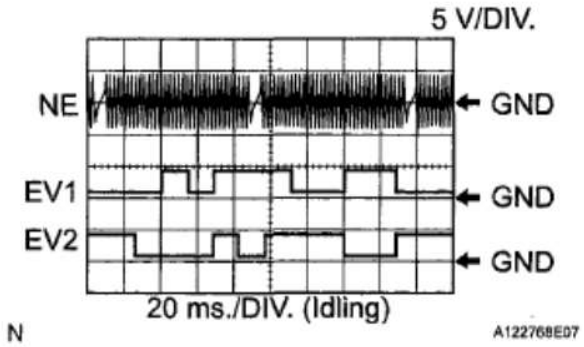


Fig. 19: Variable Valve Timing (VVT) And Crankshaft Position Sensor Signal Waveform
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

f. WAVEFORM 6

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1. Variable Valve Timing (VVT) sensor signal (1)
2. Crankshaft position sensor signal (2)

WAVEFORM REFERENCE CHART

ECM Terminal Names	1. Between VV1+ and VV1-, VV2+ and VV2- 2. Between NE+ and NE-
Tester Ranges	5 V/DIV, 20 ms./DIV
Conditions	Idling

HINT:

The wavelength becomes shorter as the engine rpm increases.

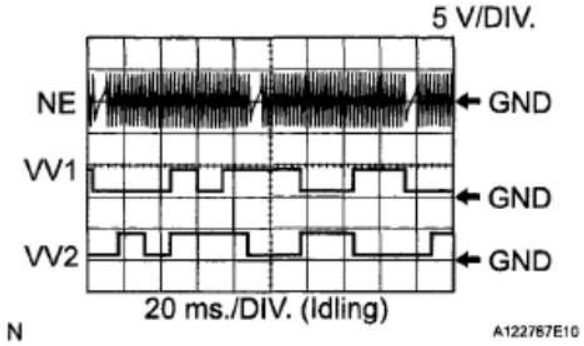


Fig. 20: Variable Valve Timing (VVT) And Crankshaft Position Sensor Signal Waveform
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

g. WAVEFORM 7
   1. Igniter IGT signal (from ECM to igniter) (1)
   2. Igniter IGF signal (from igniter to ECM) (2)

WAVEFORM REFERENCE CHART

ECM Terminal Names	1. Between IGT (1 to 6) and E1 2. Between IGF1 and E1
Tester Ranges	2 V/DIV, 20 msec./DIV
Conditions	Idling

HINT:

The wavelength becomes shorter as the engine rpm increases.

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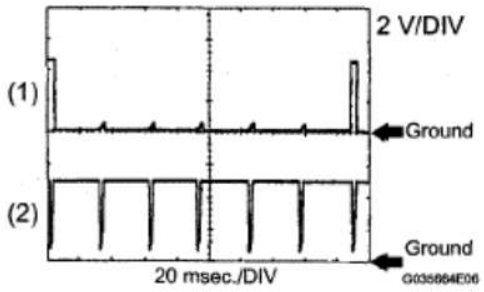


Fig. 21: Igniter IGT (From ECM To Igniter) And IGF Signal (From Igniter To ECM) Waveform
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

h. WAVEFORM 8
   1. Purge VSV for EVAP system operation signal

WAVEFORM REFERENCE CHART

ECM Terminal Names	Between PRG and E1
Tester Ranges	10 V/DIV, 50 msec./DIV
Conditions	Idling

HINT:

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

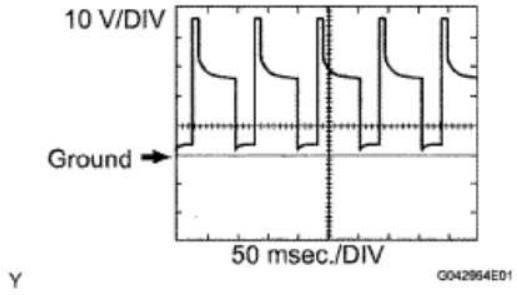


Fig. 22: Purge VSV For EVAP System Operation Signal Waveform
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

i. WAVEFORM 9
   1. Vehicle speed signal

WAVEFORM REFERENCE CHART

ECM Terminal Names	Between SPD and E1
Tester Ranges	2 V/DIV, 20 msec./DIV
Conditions	Driving at 12 mph (20 km/h)

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HINT:

- The wavelength becomes shorter as the vehicle speed increases.
- Depending on the vehicle, the output waveform voltage may rise to 12 V if influenced by optionally installed systems.

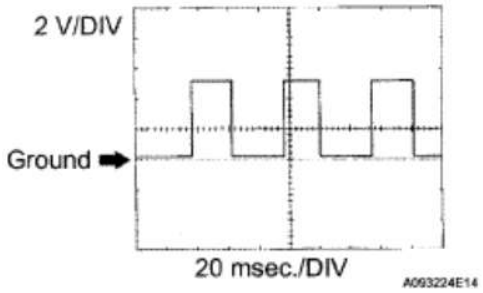


Fig. 23: Vehicle Speed Signal Waveform
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

j. WAVEFORM 10

1. Throttle drive motor operation signal (positive terminal)

WAVEFORM REFERENCE CHART

ECM Terminal Names	Between M+ and ME01
Tester Ranges	5 V/DIV, 1 msec./DIV
Conditions	Idling with warm engine

HINT:

The duty ratio varies depending on the throttle actuator operation.

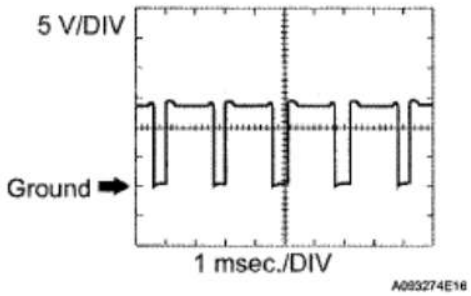


Fig. 24: Throttle Drive Motor Operation Signal (Positive Terminal) Waveform
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

k. WAVEFORM 11

1. Throttle drive motor operation signal (negative terminal)

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WAVEFORM REFERENCE CHART

ECM Terminal Names	Between M- and ME01
Tester Ranges	5 V/DIV, 1 msec./DIV
Conditions	Idling with warm engine

HINT:

The duty ratio varies depending on the throttle actuator operation.

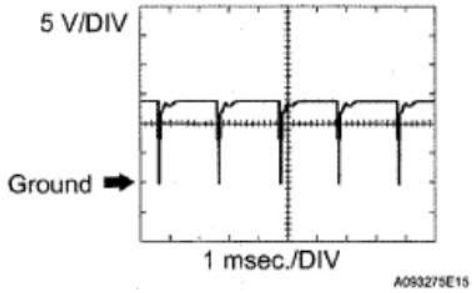


Fig. 25: Throttle Drive Motor Operation Signal (Negative Terminal) Waveform
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

l. WAVEFORM 12
   1. Engine speed signal

WAVEFORM REFERENCE CHART

ECM Terminal Names	Between TACH and E1
Tester Ranges	5 V/DIV, 10 msec./DIV
Conditions	Idling

HINT:

The wavelength becomes shorter as the engine rpm increases.

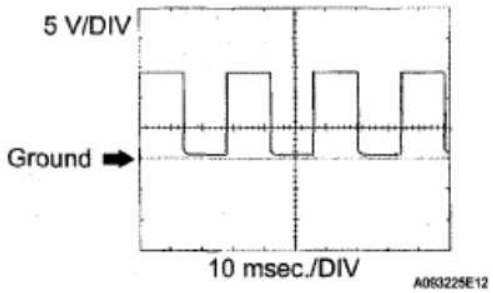


Fig. 26: Engine Speed Signal Waveform
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m. WAVEFORM 13

1. CAN communication signal

WAVEFORM REFERENCE CHART

ECM Terminal Name	Between CANH and E1
Tester Range	1 V/DIV, 10 µs./DIV.
Condition	Engine stopped engine and ignition switch on (IG)

HINT:

The wavelength varies depending on the CAN communication signal.

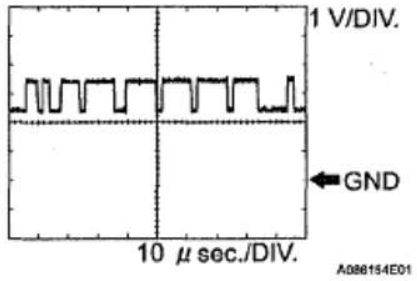


Fig. 27: CAN Communication Signal Waveform
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

n. WAVEFORM 14

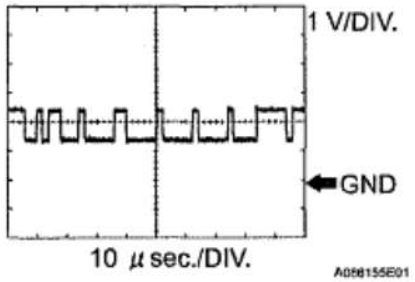
1. CAN communication signal

WAVEFORM REFERENCE CHART

ECM Terminal Name	Between CANL and E1
Tester Range	1 V/DIV., µs./DIV.
Condition	Engine stopped and ignition switch on (IG)

HINT:

The wavelength varies depending on the CAN communication signal.



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Fig. 28: CAN Communication Signal Waveform
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DIAGNOSIS SYSTEM

1. **DESCRIPTION**
   a. 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 ECM (Engine Control Module) can be then read.
   b. OBD II regulations require that the vehicle's onboard computer illuminates the MIL (Malfunction Indicator Lamp) on the instrument panel when the computer detects a malfunction in:
      1. The emission control systems and components
      2. The power train control components (which affect vehicle emissions)
      3. The computer itself

      In addition, the applicable DTCs (Diagnostic Trouble Codes) prescribed by SAE J2012 are recorded on 3 consecutive trips, the MIL turns off automatically but the DTCs remain recorded in the ECM memory.



Fig. 29: Identifying (MIL) Malfunction Indicator Lamp
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

   c. To check for DTCs, connect the Techstream to the DLC3. The tester displays DTCs, freeze frame data, and a variety of engine data. The DTCs and freeze frame data can be erased with the tester (See **DTC CHECK/CLEAR**).

      In order to enhance OBD function on vehicles and develop the Off-Board diagnosis system, CAN communication is introduced in this system (CAN: Controller Area Network). It minimizes a gap between technician skills and vehicle technology. CAN is a network, which uses a pair of data transmission lines, spanning multiple computers and sensors. It allows a high speed communication between the systems and to simplify the wire harness connection.

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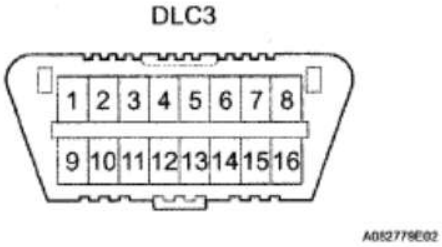


Fig. 30: Identifying DLC3
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

2. **NORMAL MODE AND CHECK MODE**
   a. 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 system's ability to detect malfunctions, including intermittent problems (The Techstream only) (See **CHECK MODE PROCEDURE**).
3. **TRIP DETECTION LOGIC**
   a. 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. **FREEZE FRAME DATA**
   a. 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.
5. **DLC3 (Data Link Connector 3)**
   a. Check DLC3 (See **HOW TO TROUBLESHOOT ECU CONTROLLED SYSTEMS**).
6. **BATTERY VOLTAGE**

   Battery Voltage: 11 to 14 V

   If the voltage is below 11 V, recharge the battery before proceeding to the next step.

7. **MIL (Malfunction Indicator Lamp)**
   a. The MIL illuminates when turned the ignition switch on (IG) (the engine is not running).
   b. The MIL should turn 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 does not illuminate when turned the ignition switch on (IG), check the MIL circuit (See **MIL CIRCUIT**).

8. **ALL READINESS**

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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 on (IG).
c. Turn the tester on.
d. Clear the DTCs (See **DTC CHECK/CLEAR**).
e. Perform the DTC judgment driving pattern to run the DTC judgment.
f. Select the following menu items: Powertrain/Engine/Utility/All Readiness.
g. Input the DTCs to be confirmed.
h. Check the DTC judgment result.

TESTER DISPLAY DESCRIPTION CHART

Tester Display	Description
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's memory limit

DTC CHECK/CLEAR

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

HINT:

- DTCs which are stored in the ECM can be displayed on the Techstream. The Techstream can display current and pending DTCs.
- Some DTCs are not set if the ECM does not detect the same malfunction again during the second

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consecutive driving cycle. However, such malfunctions, detected on only one occasion, are stored as pending DTCs.

1. **CHECK DTC**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch on (IG).
   c. Turn the tester on.
   d. Select the following menu items: Powertrain/Engine and ECT/Trouble Codes.
   e. Check for 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**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch on (IG).
   c. Turn the tester on.
   d. Select the following menu items: Powertrain/Engine and ECT/Trouble Codes.
   e. Erase the DTCs.
3. **CLEAR DTC (Without using the Techstream)**
   a. Perform either one of the following operations:
      1. Disconnect the negative battery cable for more than 1 minute.
      2. Remove the EFI No. 1 and ETCS fuses from the relay block located inside the engine compartment for more than 1 minute.

FREEZE FRAME DATA

1. **DESCRIPTION**
   a. 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.

      HINT:

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

   b. The ECM records engine conditions in the form of freeze frame data every 0.5 seconds. Using the Techstream, five separate sets of freeze frame data, including the data values at the time when the DTC was set, can be checked.
      - 3 data sets before the DTC was set
      - 1 data set when the DTC was set
      - 1 data set after the DTC was set

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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 of the cause of the malfunction, and in judging whether it was temporary or not.

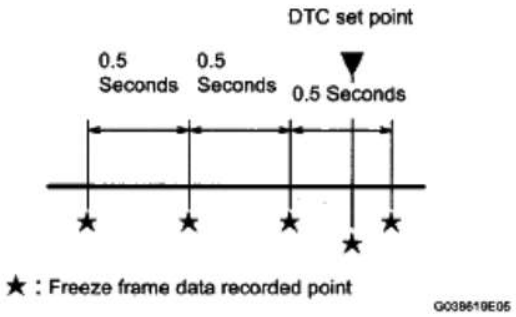


Fig. 31: Identifying DTC Set Point
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

2. **LIST OF FREEZE FRAME DATA**

LIST OF FREEZE FRAME DATA

Tester Display	Measurement Item	Diagnostic Note
Vehicle Speed	Vehicle speed	Speed indicated on speedometer
Engine Speed	Engine speed	-
Calculate Load	Calculated load	Calculated load by ECM
Vehicle Load	Vehicle load	-
MAF	Mass air flow volume	If approximately 0.0 g/sec.: • Mass air flow meter power source circuit open or shorted • VG circuit open or shorted If 160.0 g/sec. or more: • E2G circuit open
Atmosphere Pressure	Atmosphere pressure	-
Coolant Temp	Engine coolant temperature	If value -40°C (-40°F), sensor circuit open If value 140°C (284°F) or more, sensor circuit shorted
Intake Air	Intake air temperature	If value -40°C (-40°F), sensor circuit open If value 140°C (284°F) or more, sensor circuit shorted
Engine Run Time	Accumulated engine running time	-
Initial Engine	Initial engine coolant	

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Coolant Temp	temperature	-
Initial Intake Air Temp	Initial intake air temperature	-
Battery Voltage	Battery voltage	-
Accelerator Sens. No. 1 Volt%	Absolute accelerator pedal position No. 1	-
Accelerator Sens. No. 2 Volt%	Absolute accelerator pedal position No. 2	-
Throttle Sensor Volt%	Absolute throttle position	-
Throttle Sensor #2 Volt%	Absolute throttle sensor positioning #2	-
Throttle Sensor Position	Throttle sensor positioning	-
Throttle Motor DUTY	Throttle actuator	-
Injector (Port)	Injection period of No. 1 cylinder	-
Injection Volum (Cylinder1)	Injection volume	-
Fuel Pump Speed Control	Fuel pump speed control status	-
Fuel Pump/Speed Status	Fuel pump/speed status	-
Vacuum Pump	Key-off EVAP system leak detection pump status	Refer to **EVAP SYSTEM**
EVAP (Purge) VSV	EVAP purge VSV duty ratio	-
Evap Purge Flow	Ratio of evaporative purge flow to intake air volume	-
Purge Density Learn Value	Learning value of purge density	-
EVAP System Vent Value	Key-off EVAP system vent valve status	-
EVAP Purge VSV	EVAP Purge VSV	-
Target Air-Fuel Ratio	Ratio compared to stoichiometric level	-
AF Lambda B1 S1	Fuel trim at air fuel ratio sensor	-
AF Lambda B2	Fuel trim at air fuel ratio sensor	-

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S1		
AFS Voltage B1 S1	Air fuel ratio sensor output voltage	Performing Control the Injection Volume or Control the Injection Volume for A/F Sensor function of Active Test enables technician to check output voltage of sensor
AFS voltage B2 S1	Air fuel ratio sensor output voltage	Performing Control the Injection Volume or Control the Injection Volume for A/F Sensor function of Active Test enables technician to check output voltage of sensor
AFS Current B1 S1	Air fuel ratio sensor current	-
AFS Current B2 S1	Air fuel ratio sensor current	-
O2S B1 S2	Heated oxygen sensor output voltage	Performing Control the Injection Volume or Control the Injection Volume for A/F Sensor function of Active Test enables technician to check output voltage of sensor
O2S B2 S2	Heated oxygen sensor output voltage	Performing Control the Injection Volume or Control the Injection Volume for A/F Sensor function of Active Test enables technician to check output voltage of sensor
O2S Impedance B1S2	Sub heated oxygen sensor impedance (bank 1 sensor 2)	-
O2S Impedance B2S2	Sub heated oxygen sensor impedance (bank 2 sensor 2)	-
Short FT #1	Short-term fuel trim	Short-term fuel compensation used to maintain air-fuel ratio at stoichiometric air fuel ratio
Long FT #1	Long-term fuel trim	Overall fuel compensation carried out in long-term to compensate a continual deviation of short-term fuel trim from central valve
Total FT #1	Total fuel trim (bank 1)	-
Short FT #2	Short-term fuel trim	Short-term fuel compensation used to maintain air fuel ratio at stoichiometric air fuel ratio
Long FT #2	Long-term fuel trim	Overall fuel compensation carried out in long-term to compensate a continual deviation of short-term fuel trim from central valve
Total FT #2	Total fuel trim (bank 2)	-
Fuel System Status #1	Fuel system status (bank 1)	• OL (Open Loop): Has not yet satisfied conditions to go closed loop • CL (Closed Loop): Using heated oxygen sensor as feedback for fuel control • OL Drive: Open loop due to driving conditions (fuel enrichment) • OL Fault: Open loop due to detected system

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		fault • CL Fault: Closed loop but heated oxygen sensor, which used for fuel control, malfunctioning
Fuel System Status #2	Fuel system status (bank 2)	• OL (Open Loop): Has not yet satisfied conditions to go closed loop • CL (Closed Loop): Using heated oxygen sensor as feedback for fuel control • OL Drive: Open loop due to driving conditions (fuel enrichment) • OL Fault: Open loop due to detected system fault • CL Fault: Closed loop but heated oxygen sensor, which used for fuel control, malfunctioning
IGN Advance	Ignition advance	-
Knock Feedback Value	Feedback value of knocking	-
Knock Correct Learn Value	Correction learning value of knocking	-
ACIS VSV	VSV for Acoustic control induction system	-
AICV VSV	VSV for Air Intake Control Induction System (AICS)	-
VVT Control Status #1	VVT control status	-
VVT Control Status #2	VVT control status	-
VVT Aim Angle #1	VVT aim angle	-
VVT Change Angle #1	VVT change angle	-
VVT OCV Duty #1	VVT OCV operation duty	-
VVT Aim Angle #2	VVT aim angle	-
VVT Change Angle #2	VVT change angle	-
VVT OCV Duty #2	VVT OCV operation duty	-
VVT Ex Hold Lrn Val #1	VVT exhaust hold duty ratio learning value (bank 1 Exhaust side)	-
VVT Ex Chg	VVT change angle (bank 1	

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Angle #1	Exhaust side)	-
VVT Ex OCV Duty #1	VVT OCV (bank 1 Exhaust side) operation duty	-
VVT Ex Hold Lrn Val #2	VVT exhaust hold duty ratio learning value (bank 2 Exhaust side)	-
VVT Ex Chg Angle #2	VVT change angle (bank 2 Exhaust side)	-
VVT Ex OCV Duty #2	VVT OCV (bank 2 Exhaust side) operation duty	-
Catalyst Temp B1 S1	Estimated catalyst temperature (bank 1 sensor 1)	-
Catalyst Temp B2 S1	Estimated catalyst temperature (bank 2 sensor 1)	-
Catalyst Temp B1 S2	Estimated catalyst temperature (bank 1 sensor 2)	-
Catalyst Temp B2 S2	Estimated catalyst temperature (bank 2 sensor 2)	-
Starter Signal	Starter switch signal	-
Starter Control	Starter switch status	-
Power Steering Signal Record	Power steering switch	-
Starter Relay	Starter relay status	-
Power Steer. Sig. Record	Power steering signal (history)	-
ACC Relay	ACC relay status	-
Neutral Position SW Signal	Park/neutral position switch signal	-
Stop Light Switch	Stop light switch	-
A/C Signal	A/C signal	-
Closed Throttle Position SW	Closed throttle position switch	-
Electrical Load Signal	Electrical load signal	-
Time after DTC Cleared	Cumulative time after DTC cleared	-
Distance from DTC Cleared	Accumulated distance from DTC cleared	-
Warmup Cycle Cleared DTC	Warm-up cycle after DTC cleared	-
TC and TE1	TC and CG (TE1) terminals of DLC3	-
Ignition Trig.		

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Count	Ignition counter	-
Cylinder #1 Misfire Count	Cylinder #1 misfire	Only displayed during idling
Cylinder #2 Misfire Count	Cylinder #2 misfire	Only displayed during idling
Cylinder #3 Misfire Count	Cylinder #3 misfire	Only displayed during idling
Cylinder #4 Misfire Count	Cylinder #4 misfire	Only displayed during idling
Cylinder #5 Misfire Count	Cylinder #5 misfire	Only displayed during idling
Cylinder #6 Misfire Count	Cylinder #6 misfire	Only displayed during idling
All Cylinders Misfire Count	All cylinders misfire	Only displayed during idling
Misfire RPM	Engine speed when misfire occurred	-
Misfire Load	Engine load when misfire occurred	-
Misfire Margin	Margin to detect engine misfire	-
Catalyst OT MF F/C	Catalyst over temperature prevention misfire fuel cut	-
Cat OT MF F/C History	Catalyst over temperature prevention misfire fuel cut 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)	-
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)	-
Cat OT MF F/C Cylinder#5	Display of fuel cut operation in No. 5 cylinder (if certain level of misfire malfunction is detected)	-
Cat OT MF F/C Cylinder#6	Display of fuel cut operation in No. 6 cylinder (if certain level of misfire malfunction is detected)	-
ACM	ACM control status	-
Electric Fan		

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Motor	Electric fan motor	-
Idle Fuel Cut	Fuel cut idle	ON: when throttle valve fully closed and engine speed over 3500 rpm
FC TAU	Fuel cut during very light load	Fuel cut being performed under very light load to prevent engine combustion from becoming incomplete

CHECK MODE PROCEDURE

HINT:

Techstream:

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

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

1. **CHECK MODE PROCEDURE**
   a. Check and ensure the following conditions:
      1. Battery voltage 12 V or more
      2. Throttle valve fully closed
      3. The shift lever in the P or N position
      4. A/C switched OFF
   b. Turn the ignition switch off.
   c. Connect the Techstream to the DLC3.
   d. Turn the ignition switch on (IG).
   e. Turn the tester on.
   f. Select the following menu items: Powertrain/Engine and ECT/Utility/Check Mode.
   g. Switch the ECM from normal mode to check mode.
   h. Make sure that the MIL flashes as shown in the illustration.
   i. Start the engine.
   j. Make sure that the MIL goes off.
   k. Simulate the conditions of the malfunction described by the customer.
   l. Check for DTCs and freeze frame data using the tester.

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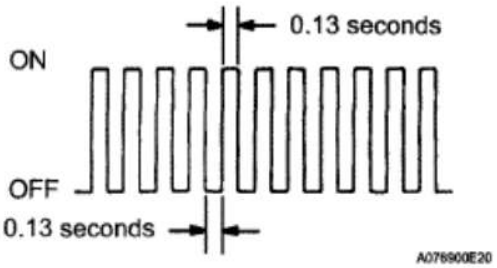


Fig. 32: MIL Flashes Pattern
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

FAIL-SAFE CHART

If any of the following DTCs are set, the ECM enters fail-safe mode to allow the vehicle to be driven temporarily.

FAIL-SAFE CHART

DTCs	Components	Fail-Safe Operations	Fail-Safe Deactivation Conditions
P0031, P0032, P0051 and P0052	Air fuel ratio sensor heater	ECM turns off air fuel ratio sensor heater	Ignition switch off
P0037, P0038, P0057 and P0058	Heated oxygen sensor heater	ECM turns off heated oxygen sensor heater	Ignition switch off
P0100, P0102 and P0103	Mass air flow meter	ECM calculates ignition timing according to engine speed and throttle valve position	Pass condition detected
P0110, P0112 and P0113	Intake air temperature sensor	ECM estimates Intake air temperature to be 20°C (68°F)	Pass condition detected
P0115, P0117 and P0118	Engine coolant temperature sensor	ECM estimates engine coolant temperature sensor to be 80°C (176°F)	Pass condition detected
P0120, P0121, P0122, P0123, P0220, P0222, P0223, P0604, P0606, P0607, P0657, P2102, P2103, P2111, P2112, P2118, P2119 and P2135	Electronic throttle control system	ECM cuts off throttle actuator current and throttle valve returned to 6° throttle position by return spring ECM then adjusts engine output by controlling fuel injection (intermittent fuel-cut) and ignition timing in accordance with accelerator pedal opening angle, to allow vehicle to continue at minimal speed*1	Pass condition detected and then ignition switch turned off
	• Fuel	When misfire occurs, fuel cut is performed for catalyst overheat malfunction prevention • During normal load and normal engine speed (MIL is blinking)	

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P0300, P0301, P0302, P0303, P0304, P0305 and P0306*2	injector • Electronic throttle control system	○ Fuel cut is performed on malfunctioning cylinder • During high load and high engine speed (MIL is blinking) ○ Throttle valve opening angle control is performed ○ All cylinder fuel cut or malfunction cylinder fuel cut	Pass condition detected and then ignition switch turned off
P0327, P0328, P0332 and P0333	Knock Sensor	ECM sets ignition timing to maximum retard	Ignition switch off
P0351 to P0356	Igniter	ECM cuts fuel	Pass condition detected
P2120, P2121, P2122, P2123, P2125, P2127, P2128 and P2138	Accelerator pedal position sensor	Accelerator pedal position sensor has 2 sensor circuits: Main and Sub If either of circuits malfunctions, ECM controls engine using the other circuit If both of circuits malfunction, ECM regards accelerator pedal as being released. As a result, throttle valve is closed and 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**

HINT:

Reading the Data List displayed on the Techstream enables values, including those of the switches, sensors, and actuators, to be checked without removing any parts. Reading the Data List as the first step in troubleshooting is one method to shorten diagnostic time.

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

a. Warm up the engine.
b. Turn the ignition switch off.
c. Connect the Techstream to the DLC3.
d. Start the engine.

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e. Turn the tester on.
f. Select the following menu items: Powertrain/Engine and ECT/Data List.
g. Check the values by referring to the table below.

TESTER DISPLAY DIAGNOSTIC CHART

Tester Display	Measurement Item/Range	Normal Condition	Diagnostic Note
Vehicle Speed	Vehicle speed: Min.,: 0 km/h (0 mph), Max.: 255 km/h (158 mph)	Actual vehicle speed	Speed indicated on speedometer
Engine Speed	Engine speed: Min.: 0 rpm, Max.: 16383.75 rpm	600 to 700 rpm: Idling	-
Calculate Load	Load calculated by ECM: Min.: 0%, Max.: 100%	• 10 to 20%: Idling • 10 to 20%: Running without load (2500 rpm)	-
Vehicle Load	Vehicle load: Min.: 0%, Max.: 25700%	Actual vehicle load	-
MAF	Air flow rate from MAF meter: Min.: 0 g/sec., Max.: 655.35 g/ sec.	2 to 5 g/sec.: Idling 8 to 19 g/sec.: 2500 rpm	If value is approximately 0.0 g/ sec.: • Mass air flow meter power source circuit open • VG circuit open or shorted If value is 160.0 g/sec. or more: • E2G circuit open
Atmosphere Pressure	Atmospheric pressure: Min.: 0 kPa, Max.: 255 kPa	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 value is -40°C (-40°F): sensor circuit open • If value is 140°C (284°F): sensor circuit shorted
Intake Air	Intake air temperature: Min.: -40°C (-40°F), Max.: 140°C (284°F)	Equivalent to ambient air temperature	• If value is -40°C (-40°F): sensor circuit open • If value is 140°C (284°F): sensor circuit

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Engine Run Time	Engine run time: Min.: 0 second, Max.: 65535 seconds	Time after engine start	Service data
Initial Engine Coolant Temp	Initial engine coolant temperature: Min.: -40°C (-40°F), Max.: 120°C (248°F)	Close to ambient air temperature	Service data
Initial Intake Air Temp	Initial intake air temperature: Min.: -40°C (-40°F), Max.: 120°C (248°F)	Close to ambient air temperature	Service data
Battery Voltage	Battery voltage: Min.: 0 V, Max.: 65.535 V	9 to 14 V: Idling	-
Accel Sens. No. 1 Volt%	Absolute accelerator pedal position No. 1: Min.: 0%, Max.: 100%	10 to 22%: Accelerator pedal released 54 to 86%: Accelerator pedal fully depressed	-
Accel Sens. No. 2 Volt%	Absolute accelerator pedal position No. 2: Min.: 0 %, Max.: 100%	12 to 42%: Accelerator pedal released 66 to 98%: Accelerator pedal fully depressed	-
Accel sensor Out No. 1	Accelerator pedal position sensor No. 1 voltage: Min.: 0 V, Max.: 4.98 V	-	Electronic throttle control system freeze frame data
Accel sensor Out No. 2	Accelerator pedal position sensor No. 2 voltage: Min.: 0 V, Max.: 4.98 V	-	Electronic throttle control system freeze frame data
Accel sensor Out No. 1	Accelerator pedal position sensor No. 1 voltage: Min.: 0 V, Max.: 5 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.: 5 V	1.2 to 2.0 V: Accelerator pedal released 3.4 to 5.0 V: Accelerator pedal fully depressed	-
Accelerator Idle Position	Whether or not accelerator pedal position sensor detecting idle: ON or OFF	ON: Idling	-
Accelerator Fully Close #1 (AD)	Accelerator fully closed value No. 1 (AD): Min.: 0, Max.: 4.9804 V	-	Electronic throttle control system service data
Accelerator Fully Close Learn #1	Accelerator fully closed learning value No. 1: Min.: 0, Max.: 124.512 deg.	-	Electronic throttle control system service data
Accelerator	Accelerator fully closed		

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Fully Close Learn #2	learning value No. 2: Min.: 0, Max.: 124.512 deg.	-	Electronic throttle control system service data
Throttle Sensor Volt%	Throttle sensor positioning: Min.: 0%, Max.: 100%	10 to 18%: Idling	Calculated value based on VTA1
Throttle Sensor #2 Volt%	Throttle sensor positioning #2: Min.: 0%, Max.: 100%	-	Calculated value based on VTA2
ST1	Starter signal: ON or OFF	ON: Cranking	-
System Gcuard	System guard: ON or OFF	-	Electronic throttle control system service data
Open Side Malfunction	Open side malfunction: ON or OFF	-	Electronic throttle control system service data
Throttle Idle Position	Whether or not throttle position sensor detecting idle: ON or OFF	ON: Idling	-
Throttle Require Position	Throttle requirement position: Min.: 0 V, Max.: 5 V	0.5 to 1.0 V: Idling	-
Throttle Sensor Position	Absolute throttle position sensor: Min.: 0%, Max.: 100%	• 10 to 24%: Throttle fully closed • 64 to 96%: Throttle fully open	Read value with operation (active test)
Throttle Position No. 1	Throttle position sensor No. 1 output voltage: Min.: 0 V, Max.: 4.98 V	-	Electronic throttle control system freeze frame data
Throttle Position No. 2	Throttle position sensor No. 2 output voltage: Min.: 0 V, Max.: 4.98 V	-	Electronic throttle control system freeze frame data
Throttle Position No. 1	Throttle position No. 1: Min.: 0 V, Max.: 5 V	• 0.5 to 1.2 V: Throttle fully closed • 3.2 to 4.8 V: Throttle fully opened	-
Throttle Position No. 2	Throttle position No. 2: Min.: 0 V, Max.: 5 V	• 2.0 to 2.9 V: Throttle fully closed • 4.6 to 5.0 V: Throttle fully open	Read value with operation (active test)
Throttle Position	Throttle position command value: Min.: 0 V, Max.:	0.5 to 4.8 V	Electronic throttle control system service data

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Command	4.9804 V		
Throttle Sens Open Pos #1	Throttle sensor opener position No. 1: Min.: 0 V, Max.: 4.9804 V	0.6 to 0.9 V	Electronic throttle control system service data
Throttle Sens Open Pos #2	Throttle sensor opener position No. 2: Min.: 0 V, Max.: 4.9804 V	2.2 to 2.6 V	Electronic throttle control system service data
Throttle Sens Open #1 (AD)	Throttle sensor opener position No. 1 (AD): Min.: 0 V, Max.: 4.9804 V	0.6 to 0.9 V	Electronic throttle control system service data
Throttle Motor	Whether or not throttle motor control permitted: ON or OFF	ON: Idling	Read value with ignition switch on (Do not start engine)
Throttle Motor Current	Throttle motor current: Min.: 0 A, Max.: 20 A	0 to 3.0 A: Idling	-
Throttle Motor DUTY	Throttle motor: Min.: 0%, Max.: 100%	0.5 to 40%: Idling	-
Throttle Motor Current	Throttle motor current: Min.: 0 A, Max.: 19.92 A	0 to 3.0 A: Idling	-
Throttle Motor Open Duty	Throttle actuator opening duty ratio: Min.: 0%, Max.: 100%	0 to 40%: Idling	• When accelerator pedal is depressed, duty ratio increaseds • Read value with ignition switch on (Do not start engine)
Throttle Motor Close Duty	Throttle actuator closed duty ratio: Min.: 0%, Max.: 100%	0 to 40%: Idling	• When accelerator pedal is increased quickly, duty ratio increaseds • Read value with ignition switch on (Do not start engine)
Throttle Motor Duty (Open)	Throttle motor duty ratio (open): Min.: 0%, Max.: 100%	-	Electronic throttle control system service data
Throttle Motor Duty (Close)	Throttle motor duty ratio (close): Min.: 0%, Max.: 100%	-	Electronic throttle control system service data
Throttle Fully Close Learn	Throttle valve fully closed (learned value): Min.: 0 V, Max.: 5 V	0.4 to 0.8 V	-
ETCS Actuator Power	Whether or not electric throttle control system power input: ON or OFF	ON: Idling	-

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+BM Voltage	+BM voltage: Min.: 0, Max.: 19.92182 [V]	10 to 15 V: Idling	Electronic throttle control system service data
Actuator Power Supply	Actuator power supply: ON or OFF	ON: Idling	Electronic throttle control system service data
Clutch Current	Clutch current: Min.: 0 A, Max.: 2.49 A	-	-
Fail Safe Drive	Whether or not fail safe function executed: ON or OFF	ON: Electronic throttle control system has failed	-
Fail Safe Drive (Main CPV)	Whether or not fail safe function executed (Main CPU): ON or OFF	ON: Electronic throttle control system has failed	-
Injector (Port)	Injection period of No. 1 cylinder: Min.: 0 ms, Max.: 32.64 ms	1.2 to 2.4 ms: Idling	-
Injection Volume (Cylinder 1)	Injection volume (cylinder 1): Min.: 0 ml, Max.: 2.048 ml	Max.: 0.5 ml	Quantity of fuel injected in 10 injections
Fuel Pump Speed Control	Fuel pump speed control status: ON or OFF	-	Active Test support status
Fuel Pump/Speed Status	Fuel pump/status: ON or OFF	-	Active Test support data
Vacuum Pump ((1))	Key-off EVAP system pump status: ON or OFF	-	Active Test support data
EVAP (Purge) VSV	EVAP (Purge) VSV control duty: Min.: 0%, Max.: 100%	0 to 100%: Idling	Commanded signal from ECM
EVAP Purge Flow	EVAP purge flow: Min.: 0%, Max.: 102.4%	-	-
Purge Density Lean Value	Learning value of purge density: Min.: -50, Max.: 350	-40 to 0%: Idling	Service data
Vapor Pressure Pump	Vapor pressure: Min.: 33.853 kPa, Max.: 125.596 kPa	0 kPa: Fuel tank cap removed	Pressure inside fuel tank monitored by vapor pressure sensor
Vapor Pressure (calculated) ((1))	Vapor pressure: (calculated) Min.: -5.632 kPa, Max.: 715.264 kPa	0 kPa: Fuel tank cap removed	Pressure inside fuel tank monitored by vapor pressure sensor
EVAP System Vent Valve ((1))	Key-off EVAP system vent valve status: ON or OFF	-	Active Test support data
EVAP Purge VSV	VSV status for EVAP control: ON or OFF	-	Active Test support data

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Target Air-Fuel Ratio	Air fuel ratio: Min.: 0, Max.: 1.999	0.8 to 1.2: Idling	-
AF Lambda B1 S1	Short-term fuel trim associated with bank 1 sensor 1: Min.: 0, Max.: 1.999	• Value less than 1 (0.000 to 0.999) = Rich • Stoichiometric air-fuel ratio = 1 • Value greater than 1 (1.001 to 1.999) = Lean	-
AF Lambda B2 S1	Short-term fuel trim associated with bank 2 sensor 1: Min.: 0, Max.: 1.999	• Value less than 1 (0.000 to 0.999) = Rich • Stoichiometric air fuel ratio = 1 • Value greater 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	2.8 to 3.8 V: Idling	Performing INJ VOL or A/F CONTROL function of ACTIVE TEST enables technician to check voltage output of sensor
AFS Voltage B2 S1	Air fuel ratio sensor output voltage for bank 2 sensor 1: Min.: 0 V, Max.: 7.999 V	2.8 to 3.8 V: Idling	Performing INJ VOL or A/F CONTROL function of ACTIVE TEST enables technician to check voltage output of sensor
AFS Current B1 S1	Air fuel ratio sensor current: Min.: -128 mA, Max.: 127.99 mA	-	-
AFS Current B2 S1	Air fuel ratio sensor current: Min.: -128 mA, Max.: 127.99 mA	-	-
O2S B1 S2	Heated oxygen sensor output voltage for bank 1 sensor 2: Min.: 0 V, Max.: 1.275 V	0.1 to 0.9 V: Driving 44 mph (70 km/h)	Performing INJ VOL or A/F CONTROL function of ACTIVE TEST enables technician to check voltage output of sensor
O2S B2 S2	Heated oxygen sensor output voltage for bank 2 sensor 2: Min.: 0 V, Max.: 1.275V	0.1 to 0.9 V: Driving 44 mph (70 km/h)	Performing INJ VOL or A/F CONTROL function of ACTIVE TEST enables technician to check voltage output of sensor
	Sub heated oxygen sensor		

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O2S Impedance (B1S2) ((1))	impedance (bank 1 sensor 2): Min.: 0 ohms, Max.: 21247.68 ohms	5 to 15000 ohm: After driving for 10 minutes or more in urban area	-
O2S Impedance (B2S2) ((1))	Sub heated oxygen sensor impedance (bank 2 sensor 2): Min.: O ohms, Max.: 21247.68 ohms	5 to 15000 ohm: After driving for 10 minutes or more in urban area	-
Short FT #1	Short-term fuel trim of bank 1: Min.:-100%, Max.: 99.2%	0 +/- 20%	Short-term fuel compensation used to maintain air fuel ratio at stoichiometric air fuel ratio
Long FT #1	Long-term fuel trim of bank 1: Min.: -100%, Max.: 99.2%	0 +/- 20%	Overall fuel compensation carried out in long-term to compensate for a continual deviation of short-term fuel trim from 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	-0.2 to 0.2: Idling	-
Short FT #2	Short-term fuel trim of bank 2: Min.: -100%, Max.: 99.2%	0 +/- 20%	Short-term fuel compensation used to maintain air fuel ratio at stoichiometric air fuel ratio
Long FT #2	Long-term fuel trim of bank 2: Min.: -100%, Max.: 99.2%	0 +/- 20%	Overall fuel compensation carried out in long-term to compensate for a continual deviation of short-term fuel trim from central value
Total FT #2	Total fuel trim of bank 2 Average value for fuel trim system of bank 2: Min.: -0.5, Max.: 0.496	-0.2 to 0.2: Idling	-
Fuel System Status #1	Fuel system status (Bank 1): OL or CL or OLDRIVE or OLFAULT or CLFAULT	CL: Idling after warming up	• OL (Open Loop): Has not yet satisfied conditions to become a closed loop • CL (Closed Loop): Using heated oxygen sensor as feedback for fuel control • OL DRIVE: Open loop due to driving conditions (fuel enrichment)

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			• OL FAULT: Open loop due to detected system fault • CL FAULT: Closed loop but heated oxygen sensor, used for fuel control, malfunctions
Fuel System Status #2	Fuel system status (Bank 2): OL or CL or OLDRIVE or OLFAULT or CLFAULT	CL: Idling after warming up	• OL (Open Loop): Has not yet satisfied conditions to go closed loop • CL (Closed Loop): Using heated oxygen sensor as feedback for fuel control • OL DRIVE: Open loop due to driving conditions (fuel enrichment) • OL FAULT: Open loop due to detected system fault • CL FAULT: Closed loop but heated oxygen sensor, used for fuel control, malfunctions
IGN Advance	Ignition timing advance for No. 1 cylinder: Min.: -64 deg., Max.: 63.5 deg.	BTDC 7 to 24°: Idling	-
Knock Feedback Value	Feedback value of knocking: Min.: -64 CA, Max.: 1984 CA	-22 to 0° CA Driving, 44 mph (70 km/h)	Service data
Knock Correct Learn Value	Correction learning value of knocking: Min.: -64 CA, Max.: 1984 CA	0 to 22° CA: Driving, 44 mph (70 km/h)	Service data
ACIS VSV	VSV for Acoustic Control Induction System Status: ON or OFF	-	ON: Open OFF: Closed
AICV VSV	AICV VSV: ON or OFF		
VVT Control Status #1	VVT control (bank 1) status: ON or OFF	-	Active Test support data
VVT Control Status #2	VVT control (bank 2) status: ON or OFF	-	Active Test support data

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VVT Aim Angle #1	VVT aim angle (bank 1 Intake side): Min.: 0%, Max.: 100%	-	VVT duty signal value during operation
VVT Change Angle #1	VVT change angle (bank 1 Intake side): Min.: 0° FR, Max.: 60° FR	0 to 5° FR: Idling	Displacement angle during operation
VVT OCV Duty #1 ((2))	VVT OCV (bank 1 Intake side) operation duty: Min.: 0%, Max.: 100%	0 to 100%	Requested duty value for operation
VVT Aim Angle #2 ((2))	VVT aim angle (bank 2 Intake side): Min.: 0%, Max.: 100%	-	VVT duty signal value during operation
VVT Change Angle #2 ((2))	VVT change angle (bank 2 Intake side): Min.: 0° FR, Max.: 60° FR	0 to 5° FR: Idling	Displacement angle during operation
VVT OCV Duty #2 ((2))	VVT OCV (bank 2 Intake side) operation duty: Min.: 0%, Max.: 100%	0 to 100%:	Requested duty value for operation
VVT Ex Hold Lrn Val #1 ((2))	VVT exhaust hold duty ratio learning value (bank 1 Exhaust side): Min.: 0%, Max.: 100%	0 to 50%: Idling	Requested duty value for operation
VVT Ex Chg Angle #1 ((2))	VVT change angle (bank 1 Exhaust side): Min.: 0° FR, Max.: 60° FR	0 to 5° FR: Idling	Displacement angle during operation
VVT Ex OCV Duty #1 ((2))	VVT OCV (bank 1 Exhaust side) operation duty: Min.: 0%, Max.: 100%	0 to 100%	Requested duty value for intrusive operation
VVT Ex Hold Lrn Val #2 ((2))	VVT exhaust hold duty ratio learning value (bank 2 Exhaust side): Min.: 0%, Max.: 100%	10 to 50%: Idling	Requested duty value for operation
VVT Ex Chg Angle #2 ((2))	VVT change angle (bank 2 Exhaust side): Min.: 0° FR, Max.: 60° FR	0 to 5° FR: Idling	Displacement angle during operation
VVT Ex OCV Duty #2 ((2))	VVT exhaust (bank 2 Exhaust side) operation duty: Min.: 0%, Max.: 100%	0 to 100%	Requested duty value for operation
Catalyst Temp B1S1	Catalyst temperature (Bank 1, Sensor 1): Min.: -40°C (-40°F), Max.: 6513.5°C (11756.3°F)	Close to catalyst inlet temperature (Bank 1)	-
Catalyst Temp	Catalyst temperature (Bank 2, Sensor 1): Min.: -40°C	Close to catalyst inlet	

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B2S1	(-40°F), Max.: 6513.5°C (11756.3°F)	temperature (Bank 2)	-
Catalyst Temp B1S2	Catalyst temperature (Bank 1, Sensor 2): Min.: -40°C (-40°F), Max.: 6513.5°C (11756.3°F)	Close to catalyst outlet temperature	-
Catalyst Temp B2S2	Catalyst temperature (Bank 2, Sensor 2): Min.: -40°C (-40°F), Max.: 6513.5°C (11756.3°F)	Close to catalyst outlet temperature	-
Starter Signal	Starter signal: ON or OFF	ON: Cranking	-
Starter Control	Starter switch signal: ON or OFF	-	-
Power Steering Signal Record	Power steering signal: ON or OFF	ON: Steering wheel is first turned after ignition switch is turned on	This signal status is usually ON until ignition switch is turned off
Starter Relay	Starter relay: ON or OFF	ON: Cranking	-
Power Steer. Sig. Record	Power steering signal: ON or OFF	ON: Power steering operation	-
ACC Relay	ACC Relay: ON or OFF	ON: Cranking	-
Neutral Position SW Signal	Park/neutral position switch status: ON or OFF	ON: P or N position	-
Stop Light Switch	Stop light switch: ON or OFF	ON: Brake pedal depressed	-
A/C Signal	A/C signal: ON or OFF	ON: A/C ON	-
Closed Throttle Position SW	Closed throttle position switch: ON or OFF	• ON: Throttle fully closed • OFF: Throttle open	-
Electrical Load Signal	Electrical load signal: ON or OFF	ON: Headlights or defogger turned ON	-
Check Mode	Check mode: 0: OFF, 1: ON	ON: Check mode ON	See **CHECK MODE PROCEDURE**
SPD Test Result	Check mode result for vehicle speed sensor: 0: COMPL, 1: INCMPL	-	-
Misfire Test Result	Check mode result for misfire monitor: 0: COMPL, 1: INCMPL	-	-
OXS1 Test Result	Check mode result for heated oxygen sensor (bank 1): 0: COMPL, 1: INCMPL	-	-

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OXS2 Test Result	Check mode result for heated oxygen sensor (bank 2): 0: COMPL, 1: INCMPL	-	-
A/F Test Results #2	Check mode result for air fuel ratio sensor (bank 2): 0: COMPL, 1: INCMPL	-	-
A/F Test Results #1	Check mode result for air fuel ratio sensor (bank 1): 0: COMPL, 1: INCMPL	-	-
Complete Parts Monitor	Comprehensive Component Monitor: NOT AVL/AVAIL	-	-
Fuel System Monitor	Fuel System Monitor: NOT AVL/AVAIL	-	-
Misfire Monitor	Misfire Monitor: NOT AVL/AVAIL	-	-
O2S (A/FS) Heater Monitor	O2S (A/FS) heater Monitor: NOT AVL/AVAIL	-	-
O2S (A/FS) Heater Monitor	O2S (A/FS) heater Monitor: COMPL/INCMPL	-	-
O2S (A/FS) Monitor	O2S (A/FS) Monitor: NOT AVL/AVAIL	-	-
O2S (A/FS) Monitor	O2S (A/FS) Monitor: COMPL/INCMPL	-	-
EVAP Monitor ((1))	EVAP Monitor: NOT AVL: AVAIL	-	-
EVAP Monitor	-EVAP Monitor: COMPL/INCMPL	-	-
Catalyst Monitor	Catalyst Monitor: NOT AVL/AVAIL	-	-
Catalyst Monitor	Catalyst Monitor: COMPL/IINCMPL	-	-
Component Monitor ENA ((1))	Component Monitor ENA: Unable or Enable	-	-
Component Monitor CMPL ((1))	Component Monitor CMPL: Complete or Incomplete	-	-
Fuel System Monitor ENA ((1))	Fuel System Monitor ENA: Unable or Enable	-	-

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Fuel System Monitor CMPL ((1))	Fuel System Monitor CMPL: Complete or Incomplete	-	-
Misfire Monitor ENA ((1))	Misfire Monitor ENA: Unable or Enable	-	-
Misfire Monitor CMPL ((1))	Misfire Monitor CMPL: Complete or Incomplete	-	-
EGR/VVT Monitor CMPL	EGR Monitor: COMPL/INCMPL	-	-
EGR/VVT Monitor CMPL ((1))	EGR Monitor CMPL: Complete or Incomplete	-	-
Heater Monitor ENA ((1))	Heater Monitor ENA: Unable or Enable	-	-
Heater Monitor CMPL ((1))	Heater Monitor CMPL: Complete or Incomplete	-	-
O2S (A/FS) Monitor ENA ((1))	O2S (A/FS) Monitor ENA: Unable or Enable	-	-
O2S (A/FS) Monitor CMPL ((1))	O2S (A/FS) Monitor CMPL: Complete or Incomplete	-	-
A/C Monitor ENA ((1))	A/C Monitor ENA: Unable or Enable	-	-
A/C Monitor CMPL ((1))	A/C Monitor CMPL: Complete or Incomplete	-	-
2nd Air Monitor ENA ((1))	2nd Air Monitor ENA: Unable or Enable	-	-
2nd Air Monitor CMPL ((1))	2nd Air Monitor CMPL: Complete or Incomplete	-	-
EVAP Monitor ENA ((1))	EVAP Monitor ENA: Unable or Enable	-	-
EVAP Monitor CMPL ((1))	EVAP Monitor CMPL: Complete or Incomplete	-	-
Heater Cat Monitor ENA ((1))	Heated Cat Monitor ENA: Unable or Enable	-	-

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Heated Cat Monitor CMPL ((1))	Heated Cat Monitor CMPL: Complete or Incomplete	-	-
Catalyst Monitor ENA ((1))	Catalyst Monitor ENA: Unable or Enable	-	-
Catalyst Monitor CMPL ((1))	Catalyst Monitor CMPL: Complete or Incomplete	-	-
#Codes (Include History)	#Codes: Min.: 0, Max.: 255	-	Number of detected DTCs
MIL	MIL Status: ON or OFF	ON: MIL ON	-
MIL ON Run Distance	MIL ON Run Distance: Min.: 0 km (0 mile), Max.: 65535 km (40723 mile)	Distance driven after DTC detected	-
Running Time from MIL ON	Running time from MIL ON: Min.: 0 minute, Max.: 65535 minutes	Running time after MIL ON	-
Time after DTC Cleared	Time after DTC cleared: Min.: 0 minute, Max.: 65535 minutes	Time after DTCs erased	-
Distance from DTC Cleared	Distance after DTC cleared: Min.: 0 km (0 mile), Max.: 65535 km/h (40723 mile)	Distance driven after DTCs erased	-
Warm up Cycle Cleared DTC	Warm-up cycle after DTC cleared: Min.: 0, Max.: 255	-	Number of warm-up cycles after DTC cleared
OBD Requirements	OBD Requirement:	OBD2 (CARB)	-
Number of Emission DTC	Number of Emission related DTC	-	-
TC and TE1	TC and TE1 terminals of DLC3: ON or OFF	-	-
Ignition Trig. Count	Ignition counter: Min.: 0, Max.: 800	0 to 600	-
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 is operating	-
Cat OT MF F/C Cylinder	Display of fuel cut operation in No. 2 cylinder (if certain level of misfire	ON: Fuel cut is	-

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#2	malfunction is detected): ON or OFF	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 is 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 or OFF	ON: Fuel cut is operating	-
Cat OT MF F/C Cylinder #5	Display of fuel cut operation in No. 5 cylinder (if certain level of misfire malfunction is detected): ON or OFF	ON: Fuel cut is operating	-
Cat OT MF F/C Cylinder #6	Display of fuel cut operation in No. 6 cylinder (if certain level of misfire malfunction is detected): ON or OFF	ON: Fuel cut is operating	-
All Cylinders Misfire Count	All cylinders misfire rate: Min.: 0, Max.: 255	0 to 35	-
Misfire RPM	Engine RPM 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.: -100%, Max.: 99.22%	-100 to 99.2%	Misfire detecting margin
Catalyst OT MF F/C	Catalyst overheat misfire prevention fuel cut availability: NOT AVL or AVAIL	AVAIL: CAT OT FC available NOT AVL: CAT OT FC not available	Service data
Cat OT MF F/C History	Catalyst overheat misfire prevention fuel cut history: ON or OFF	ON: Fuel cut operation history exists	Service data
Cylinder #1 Misfire Count	Misfire ratio of cylinder 1: Min.: 0, Max.: 255	0%	This item displayed only during idling
Cylinder #2 Misfire Count	Misfire ratio of cylinder 2: Min.: 0, Max.: 255	0%	This item displayed only during idling
Cylinder #3 Misfire Count	Misfire ratio of cylinder 3: Min.: 0, Max.: 255	0%	This item displayed only during idling
Cylinder #4	Misfire ratio of cylinder 4:		This item displayed only

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Misfire Count	Min.: 0, Max.: 255	0%	during idling
Cylinder #5 Misfire Count	Misfire ratio of cylinder 5: Min.: 0, Max.: 255	0%	This item displayed only during idling
Cylinder #6 Misfire Count	Misfire ratio of cylinder 6: Min.: 0, Max.: 255	0%	This item displayed only during idling
ACM	VSV for ACM duty control: Min.: 0%, Max.: 255%	-	Active Test support data
Electric Fan Motor	Electric fan motor: ON or OFF	ON: Electric cooling fan motor operating	Active Test support data
Idle Fuel Cut	Fuel cut idle: ON or OFF	ON: Fuel cut operation	FC IDL = ON when throttle valve is fully closed and engine speed is over 2800 rpm
FC TAU	Fuel cut TAU: Fuel cut with very light load: ON or OFF	ON: Fuel cut operation	Fuel cut being performed with very light load to prevent incomplete engine combustion
Model Code	Model code	-	Identifying model code: GSU4#
Engine Type	Engine type	-	Identifying engine type: 2GRFE
Cylinder Number	Cylinder number	-	Identifying cylinder number: 6
Transmission Type	Transmission Type	-	Identifying transmission type: 5AT
Destination	Destination	-	Identifying destination: A
Model Year	Model year	-	Identifying model year: 200#
System Identification	System Identification	-	Identifying engine system: gasoline engine
Normal condition: If no idling conditions are specified, the transmission gear selector lever should be in the N or P position, and the A/C switch and all accessory switches should be OFF.			
(1) USA, Canada (2) Values are only displayed when performing the Active Test: Control the VVT Linear (Bank 1 or Bank 2) or Control the VVT Exhaust Linear (Bank 1 or Bank 2). For other Active Tests, the value will be 0.			

2. **ACTIVE TEST**

HINT:

Performing an Active Test enables components including the relays, vacuum switching valve, and actuators, to be operated without removing any parts. The Active Test can be performed with the Techstream. Performing an Active Test in the first step in troubleshooting is one method to shorten

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diagnostic time.

Data List can be displayed during Active Tests.

a. Connect the Techstream to the DLC3.
b. Start the engine.
c. Turn the tester on.
d. Select the following menu items: Powertrain/Engine and ECT/Active Test.
e. Perform the Active Test by referring to the table below.

TESTER DISPLAY DIAGNOSTIC CHART

Tester Display	Test Part	Control Range	Diagnostic Note
Control the Injection Volume	Change the injection volume	Between -12.5% and 24.8%	• All injectors tested at the same time • Perform test at less than 3000 rpm • Injection volume can be changed by 1 % within control range
Control the Injection Volume A/F Sensor	Change the injection volume	Lower by 12.5% or increase by 24.8%	• Perform test at less than 3000 rpm • Control the Injection Volume for A/F sensor Operation enables to check and to graph A/F (Air Fuel Ratio) sensor and Heated Oxygen (HO2) sensor voltage outputs • To conduct test, select following menu items: Active Test/Control the Injection volume for A/F sensor/A/F Control system/AFS B1S1 or AFS B2 S1 and O2S B1 S2 or O2S B2S2 then press the graph button on the Data List view.
Activate the Fuel Pump Speed Control	Fuel pump speed control	ON (low speed)/OFF (high speed)	Test is possible when following conditions met: Ignition switch on (IG) Engine is stopped
Activate the VSV for Intake Control	Activate the VSV for Acoustic Control Induction System (ACIS)	ON/OFF	-
Activate the VSV for EVAP Control	Activate EVAP VSV control	ON/OFF	-
Control the Fuel Pump/Speed	Activate fuel pump (C/OPN Relay)	ON/OFF	-
Control the ACM Inhibit	Control the ACM inhibit	ON/OFF	Test is possible while engine is idling

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Connect the TC and TE1	Turn on and off TC and TE1 connection	ON/OFF	• ON: TC and TE1 connected • OFF: TC and TE1 disconnected
Control the Idle Fuel Cut Prohibit	Prohibit idling fuel cut control	ON/OFF	-
Prohibit the Catalyst OT Misfire Prevent F/C	Prohibit catalyst overheat malfunction prevention fuel cut operation during misfire	ON: Fuel cut is prohibited	Confirm that the vehicle is stopped and engine speed is 3000 rpm or less.
Control the Electric Cooling Fan	Control the electric cooling fan	ON/OFF	-
Activate the Starter Relay	Starter	ON/OFF	-
Activate the ACC Cut Relay	Active ACC cut relay	ON/OFF	Test is possible when following conditions are met: • Ignition switch on (IG) • Engine is stopped
Control the ETCS Open Slow Speed	Control the ETCS (throttle motor) opening slow speed	1: Throttle valve opens slowly	Test is possible when the following conditions are met: • Ignition switch on (IG) • Engine does not start • Accelerator pedal fully depressed (APP: 58 degrees or more)
Control the ETCS Close Slow Speed	Control the ETCS (throttle motor) closing slow speed	2: Throttle valve closes slowly	Same as above
Control the ETCS Open Fast Speed	Control the ETCS (throttle motor) opening fast speed	3: Throttle valve opens fast	Same as above
Control the ETCS Close Fast Speed	Control the ETCS (throttle motor) closing fast speed	4: Throttle valve closes fast	Same as above
Control the VVT Linear (Bank 1)	Control the VVT (bank 1 Intake Side)	Between -128 and 127% This valve added to present OCV control duty 100%: Maximum	Engine stalls or idles roughly when VVT actuator operated by 100%. Test is possible while idling.

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		advance -100% : Maximum retard	
Control the VVT System (Bank 1)	Turn on and off oil control valve	ON/OFF	• Engine stalls or idles roughly when oil control valve turned ON • Normal engine running or idling when oil control valve OFF
Control the VVT Linear (Bank 2)	Control the VVT (bank 2 Intake Side)	Between -128% and 127%	Same as above
Control the VVT System (Bank 2)	Turn on and off oil control valve	ON/OFF	• Engine stalls or idles roughly when oil control valve turned ON • Normal engine running or idling when oil control valve OFF
Control the VVT Exhaust Linear (Bank 1)	Control the VVT (bank 1 Exhaust Side)	Between -128 and 127% This valve added to present OCV control duty 100%: Maximum retard -100%: Maximum advance	Same as above
Control the VVT Exhaust Liner (Bank 2)	Control the VVT (bank 2 Exhaust Side)	Same as above	Same as above
Activate the Vacuum Pump	Activate the Vacuum Pump built into pump module	ON/OFF	-
Activate the VSV for Vent Valve	Activate the VSV for Vent Valve built into pump module	ON/OFF	-
Activate the VSV for AICS	Activate the VSV for Air Intake Control System (AICS)	ON/OFF	-
Control the Cylinder #1 Fuel Cut	Cylinder #1 injector fuel cut	ON/OFF	
Control the Cylinder #2	Cylinder #2 injector fuel cut	ON/OFF	

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Fuel Cut			Test is possible while vehicle stopped and engine idling(1)
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 Cylinder #5 Fuel Cut	Cylinder #5 injector fuel cut	ON/OFF	
Control the Cylinder #6 Fuel Cut	Cylinder #6 injector fuel cut	ON/OFF	
(1) If the display of the Data List's Catalyst OT MF F/C item is Not Avl, perform this Active Test with the vehicle stopped and the engine idling.			

NOTE:

- ***1: If the display of the Data List's Catalyst OT MF F/C item is Avail, perform this Active Test as described below.**
  a. **Stop the engine and turn the ignition switch on (IG) to turn #1 Fuel Cut (to #6 Fuel Cut) ON.**
  b. **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 one cylinder's speed is higher than the others, that cylinder's compression pressure can be concluded to be lower 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 on (IG).
5. Turn the tester on.
6. Select the following menu items: Powertrain/Engine and ECT/Active Test/Check the Cylinder Compression.
7. Select the following monitor items: Compression/Engine Speed of Cyl #1 to #6, Av Engine Speed of All Cyl.
8. Press the RIGHT or LEFT button to change the Check the Cylinder Compression to ON.

   HINT:

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

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9. Crank the engine until the monitor item values "Engine speed of Cyl #1 to #6" and "Av Engine Speed of All Cyl" change.
10. Monitor the engine speed (Engine Speed of Cyl #1 to #6, Av Engine Speed of All Cyl) displayed on the tester.

HINT:

The tester displays the values to be extremely high before cranking the engine. Each cylinder's engine speed is measured while cranking the engine and then the tester displays the actual engine speed values.

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 each cylinder's engine speed measurement 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**

HINT:

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

a. Connect the Techstream to the DLC3.
b. Start the engine.
c. Turn the tester on.
d. Select the following menu items: Powertrain/Engine and ECT/Utility.
e. Perform the System Check by referring to the table below.

TESTER DISPLAY DIAGNOSTIC CHART

Tester Display	Test Part	Control Range	Diagnostic Notes
Evaporative System Check (Automatic Mode)	Perform 5 steps in order to operate EVAP key-off monitor automatically	-	35°C (95°F) or less
Evaporative System Check (Manual Mode)	Perform 5 steps in order to operate EVAP key-off monitor manually	-	35°C (95°F) or less

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DIAGNOSTIC TROUBLE CODE CHART

HINT:

The parameters listed in the chart may not confirm exactly to those read during the DTC check due to the type of instrument or other factors.

If a trouble code is displayed during the DTC check in the check mode, check the circuit for the code listed in the table below. For details of each code, refer to the "Refer to" column in the DTC chart.

SFI SYSTEM:

DIAGNOSTIC TROUBLE CODE CHART - SFI SYSTEM

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

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P0012	Camshaft Position "A" - Timing Over-Retarded (Bank 1)	1. Valve timing 2. Camshaft timing oil control valve for intake camshaft 3. Camshaft timing oil control valve filter 4. Intake camshaft (bank 2) timing gear assembly 5. ECM	Comes on	Applies	DTC stored
P0013	Camshaft Position "B" Actuator Circuit/Open (Bank 1)	1. Open or short in camshaft timing oil control valve for exhaust camshaft (bank 1) circuit 2. Camshaft timing oil control valve for exhaust camshaft (bank 1) 3. ECM	Comes on	Applies	DTC stored
P0014	Camshaft Position "B" - Timing Over-Advanced or System Performance (Bank 1)	1. Valve timing 2. Camshaft timing oil control valve for exhaust camshaft 3. Camshaft timing oil control valve filter 4. Exhaust camshaft timing gear assembly 5. ECM	Comes on	Applies	DTC stored

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P0015	Camshaft Position "B" - Timing Over-Retarded (Bank 1)	1. Valve timing 2. Camshaft timing oil control valve for exhaust camshaft 3. Camshaft timing oil control valve filter 4. Exhaust camshaft timing gear assembly 5. ECM	Comes on	Applies	DTC stored
P0016	Crankshaft Position - Camshaft Position Correlation (Bank 1 Sensor A)	1. Valve timing 2. Camshaft timing oil control valve for intake camshaft 3. Camshaft timing oil control valve filter 4. Intake camshaft timing gear assembly 5. ECM	Comes on	Applies	DTC stored
P0017	Crankshaft Position - Camshaft Position Correlation (Bank 1 Sensor B)	1. Valve timing 2. Camshaft timing oil control valve for exhaust camshaft 3. Camshaft timing oil control valve filter 4. Exhaust camshaft timing gear assembly	Comes on	Applies	DTC stored

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		5. ECM			
P0018	Crankshaft Position - Camshaft Position Correlation (Bank 2 Sensor A)	1. Valve timing 2. Camshaft timing oil control valve for intake camshaft 3. Camshaft timing oil control valve filter 4. Intake camshaft timing gear assembly 5. ECM	Comes on	Applies	DTC stored
P0019	Crankshaft Position - Camshaft Position Correlation (Bank 2 Sensor B)	1. Valve timing 2. Camshaft timing oil control valve for exhaust camshaft 3. Camshaft timing oil control valve filter 4. Exhaust camshaft timing gear assembly 5. ECM	Comes on	Applies	DTC stored
P0020	Camshaft Position "A" Actuator Circuit (Bank 2)	1. Open or short in camshaft timing oil control valve for intake camshaft (bank 2) circuit 2. Camshaft timing oil control valve for intake camshaft (bank 2)	Comes on	Applies	DTC stored

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		3. ECM			
P0021	Camshaft Position "A" - Timing Over-Advanced or System Performance (Bank 2)	1. Valve timing 2. Camshaft timing oil control valve for intake camshaft 3. Camshaft timing oil control valve filter 4. Intake camshaft (bank 1) timing gear assembly 5. ECM	Comes on	Applies	DTC stored
P0022	Camshaft Position "A" - Timing Over-Retarded (Bank 2)	1. Valve timing 2. Camshaft timing oil control valve for intake camshaft 3. Camshaft timing oil control valve filter 4. Intake camshaft (bank 2) timing gear assembly 5. ECM	Comes on	Applies	DTC stored
P0023	Camshaft Position "B" Actuator Circuit/Open (Bank 2)	1. Open or short in camshaft timing oil control valve for exhaust camshaft (bank 2) circuit 2. Camshaft timing oil control valve for exhaust camshaft (bank 2)	Comes on	Applies	DTC stored

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		3. ECM			
P0024	Camshaft Position "B" - Timing Over-Advanced or System Performance (Bank 2)	1. Valve timing 2. Camshaft timing oil control valve for exhaust camshaft 3. Camshaft timing oil control valve filter 4. Exhaust camshaft timing gear assembly 5. ECM	Comes on	Applies	DTC stored
P0025	Camshaft Position "B" - Timing Over-Retarded (Bank 2)	1. Valve timing 2. Camshaft timing oil control valve for exhaust camshaft 3. Camshaft timing oil control valve filter 4. Exhaust camshaft timing gear assembly 5. ECM	Comes on	Applies	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) 3. A/F relay 4. ECM	Comes on	Applies	DTC stored
P0032	Oxygen (A/F) Sensor Heater	1. Short in air fuel ratio	Comes on	Applies	DTC stored

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	Control Circuit High (Bank 1 Sensor 1)	sensor heater circuit 2. Air fuel ratio sensor heater (Bank 1 Sensor 1) 3. A/F relay 4. ECM			
P0037	Oxygen Sensor Heater Control Circuit Low (Bank 1 Sensor 2)	1. Open in heated oxygen sensor heater circuit 2. Heated oxygen sensor heater 3. ECM	Comes on	Applies	DTC stored
P0038	Oxygen Sensor Heater Control Circuit High (Bank 1 Sensor 2)	1. Open in heated oxygen sensor heater circuit 2. Heated oxygen sensor heater 3. ECM	Comes on	Applies	DTC stored
P0051	Oxygen (A/F) Sensor Heater Control Circuit Low (Bank 2 Sensor 1)	1. Open in air fuel ratio sensor heater circuit 2. Air fuel ratio sensor heater (Bank 2 Sensor 1) 3. A/F relay 4. ECM	Comes on	Applies	DTC stored
P0052	Oxygen (A/F) Sensor Heater Control Circuit High (Bank 2 Sensor 1)	1. Short in air fuel ratio sensor heater circuit 2. Air fuel ratio sensor heater (Bank 2 Sensor 1) 3. A/F relay 4. ECM	Comes on	Applies	DTC stored
P0057	Oxygen Sensor Heater Control	1. Open in heated oxygen sensor	Comes on	Applies	DTC stored

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	Circuit Low (Bank 2 Sensor 2)	heater circuit 2. Heated oxygen sensor heater 3. ECM			
P0058	Oxygen Sensor Heater Control Circuit High (Bank 2 Sensor 2)	1. Open in heated oxygen sensor heater circuit 2. Heated oxygen sensor heater 3. ECM	Comes on	Applies	DTC stored
P0100	Mass or Volume Air Flow Circuit	1. Open or short in mass air flow meter circuit 2. Mass air flow meter 3. ECM	Comes on	Applies	DTC stored
P0101	Mass or Volume Air Flow Circuit Range/Performance Problem	Mass air flow meter	Comes on	-	DTC stored
P0102	Mass or Volume Air Flow Circuit Low Input	1. Open in mass air flow meter circuit 2. Short in ground circuit 3. Mass air flow meter 4. ECM	Comes on	Applies	DTC stored
P0103	Mass or Volume Air Flow Circuit High Input	1. Short in mass air flow meter circuit (+B circuit) 2. Mass air flow meter 3. ECM	Comes on	Applies	DTC stored
P0110	Intake Air Temperature Circuit	1. Open or short in intake air temperature sensor circuit 2. Intake air temperature	Comes on	Applies	DTC stored

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		sensor (built into mass air flow meter) 3. ECM			
P0111	Intake Air Temperature Sensor Gradient Too High	1. Mass airflow meter assembly 2. Air induction system 3. PCV hose connections	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 airflow meter) 3. ECM	Comes on	Applies	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	Applies	DTC stored
P0115	Engine Coolant Temperature Circuit	1. Open or short in engine coolant temperature sensor circuit 2. Engine coolant temperature sensor 3. ECM	Comes on	Applies	DTC stored
P0116	Engine Coolant Temperature Circuit Range/Performance Problem	1. Thermostat 2. Engine coolant temperature sensor	Comes on	Applies	DTC stored

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P0117	Engine Coolant Temperature Circuit Low Input	1. Short in engine coolant temperature sensor circuit 2. Engine coolant temperature sensor 3. ECM	Comes on	Applies	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	Applies	DTC stored
P011B	Engine Coolant Temperature/Intake Air Temperature Correlation	1. IAT sensor 2. ECT sensor 3. ECM	Comes on	-	DTC stored
P0120	Throttle/Pedal Position Sensor/Switch "A" Circuit	1. Throttle position sensor (built into throttle body) 2. ECM	Comes on	Applies	DTC stored
P0121	Throttle/Pedal Position Sensor/Switch "A" Circuit Range/Performance Problem	Throttle position sensor (built into throttle body)	Comes on	Applies	DTC stored
P0122	Throttle/Pedal Position Sensor/Switch "A" Circuit Low Input	1. Throttle position sensor (built into throttle body) 2. Short in VTA1 circuit 3. Open in VC circuit 4. ECM	Comes on	Applies	DTC stored
P0123	Throttle/Pedal Position Sensor/Switch "A" Circuit High Input	1. Throttle position sensor (built into	Comes on	Applies	DTC stored

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		throttle body) 2. Open in VTA1 circuit 3. Open in E2 circuit 4. Short between VC and VTA1 circuits 5. ECM			
P0125	Insufficient Coolant Temperature for Closed Loop Fuel Control	1. Cooling system 2. Engine coolant temperature sensor 3. Thermostat	Comes on	Applies	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	Applies	DTC stored
P0136	Oxygen Sensor Circuit Malfunction (Bank 1 Sensor 2)	1. Heated oxygen sensor (bank 1 sensor 2) 2. Air fuel ratio sensor (bank 1 sensor 1) 3. Gas leak from exhaust system 4. Fuel pressure 5. Fuel injector 6. PCV valve and hose 7. Air induction system	Comes on	-	DTC stored
P0137	Oxygen Sensor Circuit Low Voltage (Bank 1 Sensor 2)	1. Open or short in heated oxygen sensor (bank 1 sensor 2) circuit 2. Heated oxygen	Comes on	Applies	DTC stored

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		sensor (bank 1 sensor 2) 3. Heated oxygen sensor heater (bank 1 sensor 2) 4. Air fuel ratio sensor (bank 1 sensor 1) 5. Gas leak from exhaust system			
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 internal circuit malfunction 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 internal circuit malfunction	Comes on	-	DTC stored
P0141	Oxygen Sensor Heater Circuit Malfunction (Bank 1 Sensor 2)	1. Heated oxygen sensor 2. ECM	Comes on	Applies	DTC stored
P0156	Oxygen Sensor Circuit Malfunction (Bank 2 Sensor 2)	1. Heated oxygen sensor (bank 2 sensor 2) 2. Air fuel ratio sensor (bank 2 sensor 1)	Comes on	-	DTC stored

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		3. Gas leak from exhaust system 4. Fuel pressure 5. Fuel injector 6. PCV valve and hose 7. Air induction system			
P0157	Oxygen Sensor Circuit Low Voltage (Bank 2 Sensor 2)	1. Open or short in heated oxygen sensor (bank 2 sensor 2) circuit 2. Heated oxygen sensor (bank 2 sensor 2) 3. Heated oxygen sensor heater (bank 2 sensor 2) 4. Air fuel ratio sensor (bank 2 sensor 1) 5. Gas leak from exhaust system	Comes on	Applies	DTC stored
P0158	Oxygen Sensor Circuit High Voltage (Bank 2 Sensor 2)	1. Short in heated oxygen sensor (bank 2 sensor 2) circuit 2. Heated oxygen sensor (bank 2 sensor 2) 3. ECM internal circuit malfunction 4. Air fuel ratio sensor (bank 2 sensor 1)	Comes on	-	DTC stored
P0159	Oxygen Sensor Circuit Slow Response (Bank 2 Sensor 2)	1. Short in heated oxygen sensor (bank 2 sensor 2) circuit 2. Heated oxygen	Comes on	-	DTC stored

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		sensor (bank 2 sensor 2) 3. ECM internal circuit malfunction			
P0161	Oxygen Sensor Heater Circuit Malfunction (Bank 2 Sensor 2)	1. Heated oxygen sensor 2. ECM	Comes on	Applies	DTC stored
P0171	System Too Lean (Bank 1)	1. Air induction system 2. Injector blockage 3. Mass air flow meter 4. Engine coolant temperature sensor 5. Fuel pressure 6. Gas leakage 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. EFI No. 2 fuse 10. PCV valve and hose 11. PCV hose connections 12. ECM	Comes on	Applies	DTC stored
P0172	System Too Rich (Bank 1)	1. Injector leak or blockage 2. Mass air flow meter 3. Engine coolant temperature sensor	Comes on	Applies	DTC stored

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		4. Ignition system 5. Fuel pressure 6. Gas leakage 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. EFI No. 2 fuse 10. ECM			
P0174	System Too Lean (Bank 2)	1. Air induction system 2. Injector blockage 3. Mass air flow meter 4. Engine coolant temperature sensor 5. Fuel pressure 6. Gas leakage from exhaust system 7. Open or short in air fuel ratio sensor (bank 2 sensor 1) circuit 8. Air fuel ratio sensor (bank 2 sensor 1) 9. EFI No. 2 fuse 10. PCV valve and hose 11. PCV hose connections 12. ECM	Comes on	Applies	DTC stored

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P0175	System Too Rich (Bank 2)	1. Injector leak or blockage 2. Mass air flow meter 3. Engine coolant temperature sensor 4. Ignition system 5. Fuel pressure 6. Gas leakage from exhaust system 7. Open or short in air fuel ratio sensor (bank 2 sensor 1) circuit 8. Air fuel ratio sensor (bank 2 sensor 1) 9. EFI No. 2 fuse 10. ECM	Comes on	Applies	DTC stored
P0220	Throttle/Pedal Position Sensor/Switch "B" Circuit	1. Throttle position sensor (built into throttle body) 2. ECM	Comes on	Applies	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	Applies	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	Comes on	Applies	DTC stored

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		3. Open in E2 circuit 4. Short between VC and VTA2 circuits 5. ECM			
P0230	Fuel Pump Primary Circuit	1. Open or short in FUEL PUMP relay circuit 2. FUEL PUMP relay 3. ECM	Does not come on	Applies	DTC stored
P0300	Random/Multiple Cylinder Misfire Detected	1. Open or short in engine wire harness 2. Connector connection 3. Vacuum hose connections 4. Ignition system 5. Injector 6. Fuel pressure 7. Mass air flow meter 8. Engine coolant temperature sensor 9. Compression pressure 10. Valve clearance 11. Valve timing 12. PCV valve and hose 13. PCV hose connections 14. Air induction system 15. ECM	Comes on/Blinks CD	Applies	DTC stored
P0301	Cylinder 1 Misfire	Same as DTC P0300	Comes	Applies	DTC stored

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	Detected		on/Blinks (*1)		
P0302	Cylinder 2 Misfire Detected	Same as DTC P0300	Comes on/Blinks (*1)	Applies	DTC stored
P0303	Cylinder 3 Misfire Detected	Same as DTC P0300	Comes on/Blinks (*1)	Applies	DTC stored
P0304	Cylinder 4 Misfire Detected	Same as DTC P0300	Comes on/Blinks (*1)	Applies	DTC stored
P0305	Cylinder 5 Misfire Detected	Same as DTC P0300	Comes on/Blinks (*1)	Applies	DTC stored
P0306	Cylinder 6 Misfire Detected	Same as DTC P0300	Comes on/Blinks (*1)	Applies	DTC stored
P0327	Knock Sensor 1 Circuit Low Input (Bank 1 or Single Sensor)	1. Short in knock sensor 1 circuit 2. Knock sensor 1 3. ECM	Comes on	Applies	DTC stored
P0328	Knock Sensor 1 Circuit High Input (Bank 1 or Single Sensor)	1. Open in knock sensor 1 circuit 2. Knock sensor 1 3. ECM	Comes on	Applies	DTC stored
P0332	Knock Sensor 2 Circuit Low Input (Bank 2)	1. Short in knock sensor 2 circuit 2. Knock sensor 2 3. ECM	Comes on	Applies	DTC stored
P0333	Knock Sensor 2 Circuit High Input (Bank 2)	1. Open in knock sensor 2 circuit 2. Knock sensor 2 3. ECM	Comes on	Applies	DTC stored
P0335	Crankshaft Position Sensor "A" Circuit	1. Open or short in crankshaft position sensor circuit 2. Crankshaft position sensor 3. Sensor plate (crankshaft position sensor plate) 4. ECM	Comes on	Applies	DTC stored
P0339	Crankshaft Position Sensor "A" Circuit Intermittent	1. Open or short in crankshaft position sensor	Does not come on	Applies	DTC stored

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		circuit 2. Crankshaft position sensor 3. Sensor plate (crankshaft position sensor plate) 4. ECM			
P0340	Camshaft Position Sensor "A" Circuit (Bank 1 or Single Sensor)	1. Open or short in VVT sensor circuit for intake camshaft 2. VVT sensor for intake camshaft 3. Camshaft timing gear for intake camshaft 4. Jumped tooth or timing chain for intake camshaft 5. ECM	Comes on	Applies	DTC stored
P0342	Camshaft Position Sensor "A" Circuit Low Input (Bank 1 or Single Sensor)	1. Open or short in VVT sensor circuit for intake camshaft 2. VVT sensor for intake camshaft 3. Camshaft timing gear for intake camshaft 4. Jumped tooth of timing chain for intake camshaft 5. ECM	Comes on	Applies	DTC stored
P0343	Camshaft Position Sensor "A" Circuit	1. Open or short	Comes on	Applies	DTC stored

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	High Input (Bank 1 or Single Sensor)	in VVT sensor circuit for intake camshaft 2. VVT sensor for intake camshaft 3. Camshaft timing gear for intake camshaft 4. Jumped tooth of timing chain for intake camshaft 5. ECM			
P0345	Camshaft Position Sensor "A" Circuit (Bank 2)	1. Open or short in VVT sensor circuit for intake camshaft 2. VVT sensor for intake camshaft 3. Camshaft timing gear for intake camshaft 4. Jumped tooth or timing chain for intake camshaft 5. ECM	Comes on	Applies	DTC stored
P0347	Camshaft Position Sensor "A" Circuit Low Input (Bank 2)	1. Open or short in VVT sensor circuit for intake camshaft 2. VVT sensor for intake camshaft 3. Camshaft timing gear for intake	Comes on	Applies	DTC stored

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		camshaft 4. Jumped tooth of timing chain for intake camshaft 5. ECM			
P0348	Camshaft Position Sensor "A" Circuit High Input (Bank 2)	1. Open or short in VVT sensor circuit for intake camshaft 2. VVT sensor for intake camshaft 3. Camshaft timing gear for intake camshaft 4. Jumped tooth of timing chain for intake camshaft 5. ECM	Comes on	Applies	DTC stored
P0351	Ignition Coil "A" Primary/Secondary Circuit	1. Ignition system 2. Open or short in IGF1 or IGT circuit (1 to 6) between ignition coil with igniter and ECM 3. No. 1 to No. 6 ignition coils with igniters 4. ECM	Comes on	Applies	DTC stored
P0352	Ignition Coil "B" Primary/Secondary Circuit	Same as DTC P0351	Comes on	Applies	DTC stored
P0353	Ignition Coil "C" Primary/Secondary Circuit	Same as DTC P0351	Comes on	Applies	DTC stored
P0354	Ignition Coil "D" Primary/Secondary Circuit	Same as DTC P0351	Comes on	Applies	DTC stored

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P0355	Ignition Coil "E" Primary/Secondary Circuit	Same as DTC P0351	Comes on	Applies	DTC stored
P0356	Ignition Coil "F" Primary/Secondary Circuit	Same as DTC P0351	Comes on	Applies	DTC stored
P0365	Camshaft Position Sensor "B" Circuit (Bank 1)	1. Open or short in VVT sensor for exhaust camshaft circuit 2. VVT sensor for exhaust camshaft 3. Exhaust camshaft 4. Jumped tooth of timing chain 5. ECM	Comes on	Applies	DTC stored
P0367	Camshaft Position Sensor "B" Circuit Low Input (Bank 1)	1. Open or short in VVT sensor for exhaust camshaft circuit 2. VVT sensor for exhaust camshaft 3. Exhaust camshaft 4. Jumped teeth of timing chain 5. ECM	Comes on	Applies	DTC stored
P0368	Camshaft Position Sensor "B" Circuit High Input (Bank 1)	1. Open or short in VVT sensor for exhaust camshaft circuit 2. VVT sensor for exhaust camshaft 3. Exhaust camshaft 4. Jumped teeth	Comes on	Applies	DTC stored

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		of timing chain 5. ECM			
P0390	Camshaft Position Sensor "B" Circuit (Bank 2)	1. Open or short in VVT sensor for exhaust camshaft circuit 2. VVT sensor for exhaust camshaft 3. Exhaust camshaft 4. Jumped tooth of timing chain 5. ECM	Comes on	Applies	DTC stored
P0392	Camshaft Position Sensor "B" Circuit Low Input (Bank 2)	1. Open or short in VVT sensor for exhaust camshaft circuit 2. VVT sensor for exhaust camshaft 3. Exhaust camshaft 4. Jumped teeth of timing chain 5. ECM	Comes on	Applies	DTC stored
P0393	Camshaft Position Sensor "B" Circuit High Input (Bank 2)	1. Open or short in VVT sensor for exhaust camshaft circuit 2. VVT sensor for exhaust camshaft 3. Exhaust camshaft 4. Jumped teeth of timing chain 5. ECM	Comes on	Applies	DTC stored
P0420	Catalyst System Efficiency Below	1. Gas leakage	Comes on	Applies	DTC stored

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	Threshold (Bank D	from exhaust system 2. Air fuel ratio sensor (bank 1 sensor 1) 3. Heated oxygen sensor (bank 1 sensor 2) 4. Exhaust manifold sub-assembly (three-way catalytic converter) 5. Center exhaust pipe assembly (three-way catalyst converter)			
P0430	Catalyst System Efficiency Below Threshold (Bank 2)	1. Gas leakage from exhaust system 2. Air fuel ratio sensor (bank 2 sensor 1) 3. Heated oxygen sensor (bank 2 sensor 2) 4. Exhaust manifold sub-assembly (three-way catalytic converter) 5. Center exhaust pipe assembly (three-way catalyst converter)	Comes on	Applies	DTC stored
P043E	Evaporative Emission System Reference Orifice Clog Up	1. Pump module 2. Connector/wire harness (Pump module - ECM)	Comes on	-	DTC stored

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		3. ECM			
P043F	Evaporative Emission System Reference Orifice High Flow	1. Pump module 2. Connector/wire harness (Pump module - ECM) 3. ECM	Comes on	-	DTC stored
P0441	Evaporative Emission Control System Incorrect Purge Flow	1. Purge VSV 2. Purge VSV circuit (between purge VSV and ECM) 3. Leakage from EVAP line (between purge VSV and intake manifold) 4. EVAP line clogged (between purge VSV and canister) 5. ECM	Comes on	Applies	DTC stored
P0451	Evaporative Emission Control System Pressure Sensor Range/Performance	1. Canister pump module 2. Connector/wire harness (Canister pump module - ECM) 3. ECM	Comes on	-	DTC stored
P0452	Evaporative Emission Control System Pressure Sensor/Switch Low Input	1. Canister pump module 2. Connector/wire harness (Canister pump module - ECM) 3. ECM	Comes on	Applies	DTC stored
P0453	Evaporative Emission Control	1. Canister pump module	Comes on	Applies	DTC stored

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	System Pressure Sensor/Switch High Input	2. Connector/wire harness (Canister pump module - ECM) 3. ECM			
P0455	Evaporative Emission Control System Leak Detected (Gross Leak)	1. Fuel tank cap (loose) 2. Leakage from EVAP line (Canister - Fuel tank) 3. Leakage from EVAP line (Purge VSV - Canister) 4. Leakage from pump module 5. Leakage from fuel tank 6. Leakage from canister	Comes on	-	DTC stored
P0456	Evaporative Emission Control System Leak Detected (Very Small Leak)	Same as DTC P0455	Comes on	-	DTC stored
P0500	Vehicle Speed Sensor "A"	1. Open or short in speed sensor circuit 2. Speed sensor 3. Combination meter 4. ECM 5. Skid control ECU	Comes on	Applies	DTC stored
P0504	Brake Switch "A"/"B" Correlation	1. Short in stop light switch signal circuit 2. STOP fuse 3. Stop light switch	Does not come on	Applies	DTC stored

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		4. ECM			
P0505	Idle Control System Malfunction	1. Electronic throttle control system 2. Intake system 3. PCV hose connection 4. ECM	Comes on	Applies	DTC stored
P0560	System Voltage	1. Open in back up power source circuit 2. EFI No. 1 fuse 3. ECM	Comes on	Applies	DTC stored
P050A	Cold Start Idle Air Control System Performance	1. Thorottle body assembly 2. Mass air flow meter 3. Intake system 4. PCV hose connections 5. VVT system 6. Air cleaner filter element 7. ECM	Comes on	-	DTC stored
P050B	Cold Start Ignition Timing Performance	1. Thorottle body assembly 2. Mass air flow meter 3. Intake system 4. PCV hose connections 5. VVT system 6. Air cleaner filter element 7. ECM	Comes on	-	DTC stored
P0604	Internal Control Module Random Access Memory (RAM) Error	ECM	Comes on	Applies	DTC stored
P0606	ECM/PCM Processor	1. Exhaust gas	Comes on (Except when	Applies	DTC stored

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		leak 2. Heated oxygen sensor 3. ECM	there is a malfunction in the ECM internal circuit)		
P0607	Control Module Performance	ECM	Comes on (Except when there is a malfunction in the cruise control switch circuit)	Applies	DTC stored
P0617	Starter Relay Circuit High	1. Park/neutral position switch 2. Starter relay circuit 3. Ignition switch 4. ECM	Comes on	Applies	DTC stored
P0630	VIN not Programmed or Mismatch - ECM/PCM	ECM	Comes on	-	DTC stored
P0657	Actuator Supply Voltage Circuit/Open	ECM	Comes on	Applies	DTC stored
P0724	Brake Switch "B" Circuit High	1. Short in stop light switch signal circuit 2. Stop light switch 3. ECM	Comes on	Applies	DTC stored
P2102	Throttle Actuator Control Motor Circuit Low	1. Open in throttle actuator circuit 2. Throttle actuator 3. ECM	Comes on	Applies	DTC stored
P2103	Throttle Actuator Control Motor Circuit High	1. Short in throttle actuator circuit 2. Throttle actuator 3. Throttle valve	Comes on	Applies	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	Comes on	Applies	DTC stored
P2112	Throttle Actuator Control System - Stuck Closed	1. Throttle actuator 2. Throttle body 3. Throttle valve	Comes on	Applies	DTC stored
P2118	Throttle Actuator Control Motor Current Range/Performance	1. Open in electronic throttle control system power source circuit 2. Electronic throttle control system fuse 3. ECM	Comes on	Applies	DTC stored
P2119	Throttle Actuator Control Throttle Body Range/Performance	1. Electronic throttle control system 2. ECM	Comes on	Applies	DTC stored
P2120	Throttle/Pedal Position Sensor/Switch "D" Circuit	1. Accelerator pedal position sensor 2. ECM	Comes on	Applies	DTC stored
P2121	Throttle/Pedal Position Sensor/Switch "D" Circuit Range/Performance	1. Accelerator pedal position sensor 2. ECM	Comes on	Applies	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 ground short in VPA circuit 4. ECM	Comes on	Applies	DTC stored

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P2123	Throttle/Pedal Position Sensor/Switch "D" Circuit High Input	1. Accelerator pedal position sensor 2. Open in EPA circuit 3. ECM	Comes on	Applies	DTC stored
P2125	Throttle/Pedal Position Sensor/Switch "E" Circuit	1. Accelerator pedal position sensor 2. ECM	Comes on	Applies	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	Applies	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	Applies	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	Applies	DTC stored
P2138	Throttle/Pedal Position Sensor/Switch "D"/"E" Voltage Correlation	1. Short between VPA and VPA2 circuits 2. Accelerator pedal position sensor 3. ECM	Comes on	Applies	DTC stored
P2195	Oxygen (A/F) Sensor Signal	1. Open or short in air fuel ratio	Comes on	-	DTC stored

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	Stuck Lean (Bank 1 Sensor 1)	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. Intake system 5. Fuel pressure 6. Injector 7. ECM			
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. Intake system 5. Fuel pressure 6. Injector 7. ECM	Comes on	-	DTC stored
P2197	Oxygen (A/F) Sensor Signal Stuck Lean (Bank 2 Sensor 1)	1. Open or short in air fuel ratio sensor (bank 2 sensor 1) circuit 2. Air fuel ratio sensor (bank 2 sensor 1) 3. Air fuel ratio sensor (bank 2 sensor 1) heater 4. Intake system	Comes on	-	DTC stored

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		5. Fuel pressure 6. Injector 7. ECM			
P2198	Oxygen (A/F) Sensor Signal Stuck Rich (Bank 2 Sensor 1)	1. Open or short in air fuel ratio sensor (bank 2 sensor 1) circuit 2. Air fuel ratio sensor (bank 2 sensor 1) 3. Air fuel ratio sensor (bank 2 sensor 1) heater 4. Intake system 5. Fuel pressure 6. Injector 7. ECM	Comes on	-	DTC stored
P2237	Oxygen (A/F) Sensor Pumping Current Circuit/Open (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	Applies	DTC stored
P2238	Oxygen (A/F) Sensor Pumping Current Circuit Low (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	Applies	DTC stored
P2239	Oxygen (A/F) Sensor Pumping Current Circuit High (Bank 1 Sensor 1)	1. Open or short in air fuel ratio sensor (bank 1 sensor 1) circuit	Comes on	Applies	DTC stored

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		2. Air fuel ratio sensor (bank 1 sensor 1) 3. ECM			
P2240	Oxygen (A/F) Sensor Pumping Current Circuit/Open (Bank 2 Sensor 1)	1. Open or short in air fuel ratio sensor (bank 2 sensor 1) circuit 2. Air fuel ratio sensor (bank 2 sensor 1) 3. ECM	Comes on	Applies	DTC stored
P2241	Oxygen (A/F) Sensor Pumping Current Circuit Low (Bank 2 Sensor 1)	1. Open or short in air fuel ratio sensor (bank 2 sensor 1) circuit 2. Air fuel ratio sensor (bank 2 sensor 1) 3. ECM	Comes on	Applies	DTC stored
P2242	Oxygen (A/F) Sensor Pumping Current Circuit High (Bank 2 Sensor 1)	1. Open or short in air fuel ratio sensor (bank 2 sensor 1) circuit 2. Air fuel ratio sensor (bank 2 sensor 1) 3. ECM	Comes on	Applies	DTC stored
P2252	Oxygen (A/F) Sensor Reference Ground Circuit Low (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	Applies	DTC stored
P2253	Oxygen (A/F) Sensor Reference Ground Circuit	1. Open or short in air fuel ratio sensor (bank 1	Comes on	Applies	DTC stored

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	High (Bank 1 Sensor 1)	sensor 1) circuit 2. Air fuel ratio sensor (bank 1 sensor 1) 3. ECM			
P2255	Oxygen (A/F) Sensor Reference Ground Circuit Low (Bank 2 Sensor 1)	1. Open or short in air fuel ratio sensor (bank 2 sensor 1) circuit 2. Air fuel ratio sensor (bank 2 sensor 1) 3. ECM	Comes on	Applies	DTC stored
P2256	Oxygen (A/F) Sensor Reference Ground Circuit High (Bank 2 Sensor 1)	1. Open or short in air fuel ratio sensor (bank 2 sensor 1) circuit 2. Air fuel ratio sensor (bank 2 sensor 1) 3. ECM	Comes on	Applies	DTC stored
P2401	Evaporative Emission System Leak Detection Pump Control Circuit Low	1. Canister pump module 2. Connector/wire harness (Canister pump module - ECM) 3. ECM	Comes on	-	DTC stored
P2402	Evaporative Emission System Leak Detection Pump Control Circuit High	1. Canister pump module 2. Connector/wire harness (Canister pump module - ECM) 3. ECM	Comes on	-	DTC stored
P2419	Evaporative Emission System Switching Valve	1. Canister pump module 2. Connector/wire	Comes on	-	DTC stored

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	Control Circuit Low	harness (Canister pump module - ECM) 3. ECM			
P2420	Evaporative Emission System Switching Valve Control Circuit High	1. Canister pump module (0.02 inch orifice, vacuum 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. Open or short in air fuel ratio sensor circuit 2. Air fuel ratio sensor 3. ECM	Comes on	Applies	DTC stored
P2A03	A/F Sensor Circuit Slow Response (Bank 2 Sensor 1)	1. Open or short in air fuel ratio sensor circuit 2. Air fuel ratio sensor 3. ECM	Comes on	Applies	DTC stored
HINT: *1: MIL flushes when a catalyst damaged misfire is detected.					

DTC P0010 CAMSHAFT POSITION "A" ACTUATOR CIRCUIT (BANK 1); DTC P0020 CAMSHAFT POSITION "A" ACTUATOR CIRCUIT (BANK 2)

DESCRIPTION

The Variable Valve Timing (VVT) system includes the ECM, camshaft oil control valve and VVT controller. The ECM sends a target duty-cycle control signal to the camshaft oil control valve. This control signal regulates the oil pressure supplied to the VVT controller. Camshaft timing control is performed according to engine operating conditions such as intake air volume, throttle valve position and engine coolant temperature. The ECM controls the camshaft oil control valve, based on the signals transmitted by several sensors. The VVT

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controller regulates the intake camshaft angle using oil pressure through the camshaft oil control valve. As a result, the relative positions of the camshaft and crankshaft are optimized, the engine torque and fuel economy improves, and the exhaust emissions decrease under overall driving conditions. The ECM detects the actual intake valve timing using signals from the camshaft and crankshaft position sensors, and performs feedback control. This is how the target intake valve timing is verified by the ECM.

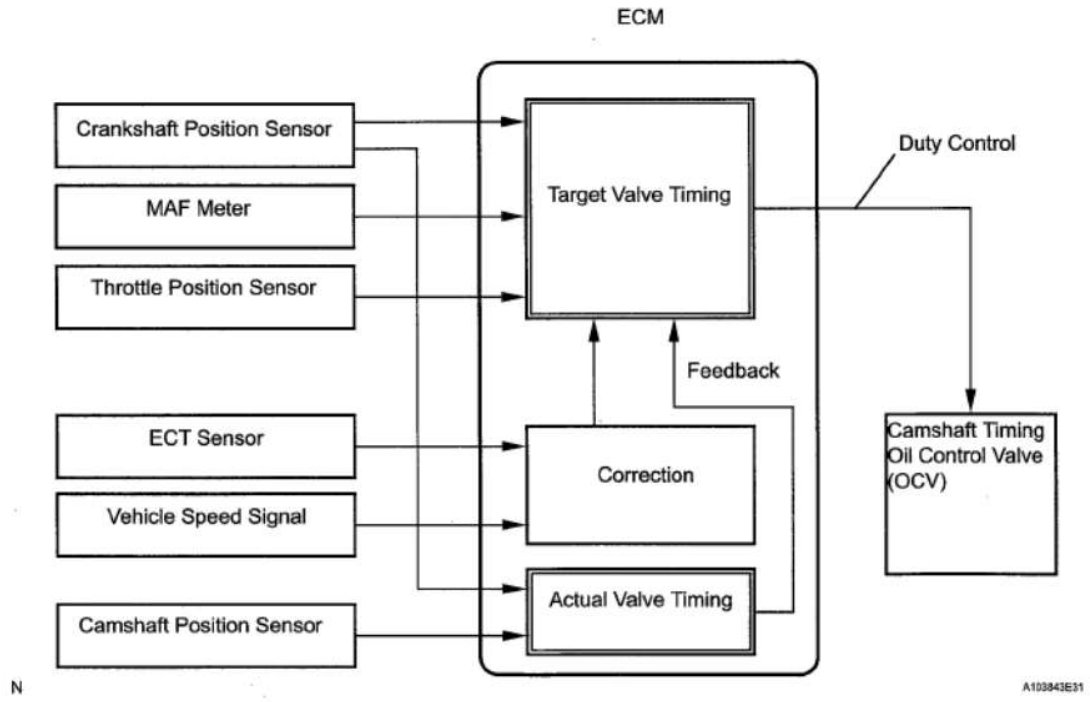


Fig. 33: Camshaft Position Sensor Communication Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

DTC DETECTION CONDITION CHART

DTC No.	DTC Detection Condition	Trouble Area
P0010	Open or short in camshaft oil control valve for intake camshaft (bank 1) circuit timing (1 trip detection logic)	• Open or short in camshaft timing oil control valve for intake camshaft (bank 1) circuit • Camshaft timing oil control valve for intake camshaft (bank 1) • ECM
P0020	Open or short in camshaft timing oil control valve for intake camshaft (bank 2) circuit (1 trip detection logic)	• Open or short in camshaft timing oil control valve for intake camshaft (bank 2) circuit • Camshaft timing oil control valve for intake camshaft (bank 2) • ECM

MONITOR DESCRIPTION

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After the ECM sends the "target" duty-cycle signal to the camshaft timing oil control valve, the ECM monitors the camshaft oil control valve current to establish an "actual" duty-cycle. The ECM detects a malfunction and sets a DTC when the actual duty-cycle ratio varies from the target duty-cycle ratio.

MONITOR STRATEGY

MONITOR STRATEGY REFERENCE CHART

Related DTCs	P0010: VVT OCV (bank 1) range check P0020: VVT OCV (bank 2) range check
Required sensors/components (Main)	VVT OCV (VVT camshaft oil control valve)
Required sensors/components (Sub)	-
Frequency of operation	Continuous
Duration	1 second
MIL operation	Immediately
Sequence of operation	None

TYPICAL ENABLING CONDITIONS

TYPICAL ENABLING CONDITIONS CHART

The monitor will run whenever these DTCs are not present	None
All of the following conditions are met:	-
Starter	OFF
Ignition switch	ON (IG)
Time after turning ignition switch off to on (IG)	0.5 seconds or more

TYPICAL MALFUNCTION THRESHOLDS

TYPICAL MALFUNCTION THRESHOLDS REFERENCE CHART

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

COMPONENT OPERATING RANGE

COMPONENT OPERATING RANGE REFERENCE CHART

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VVT OCV duty ratio	More than 3%, and Less than 100%

WIRING DIAGRAM

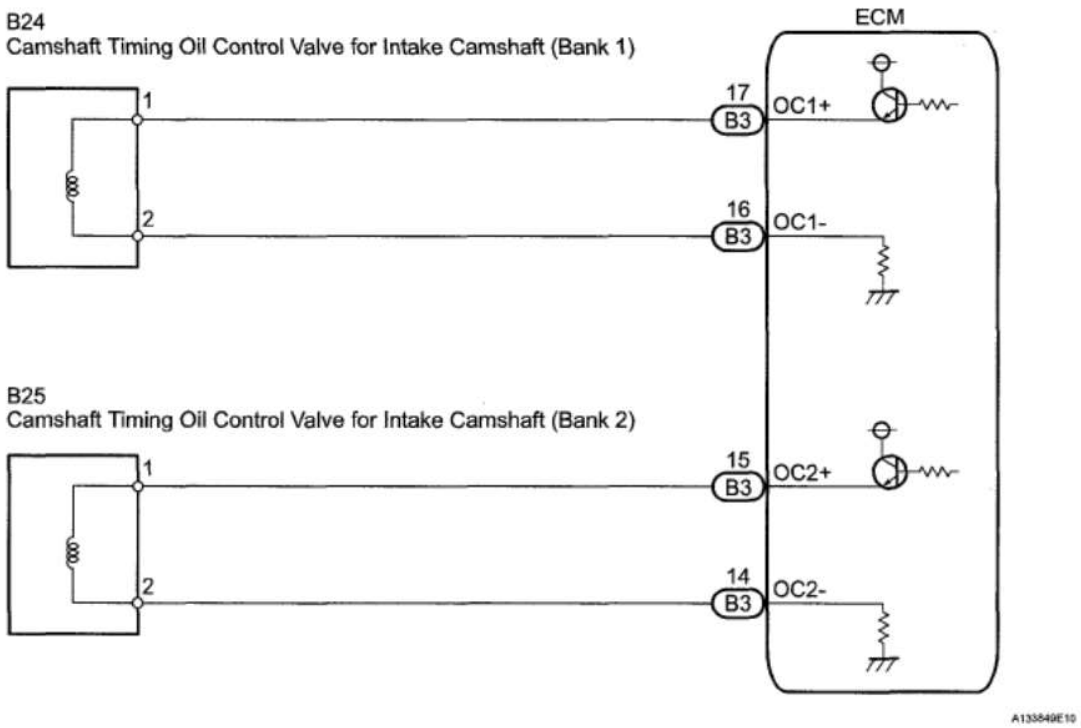


Fig. 34: Camshaft Position Sensor - Wiring Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSPECTION PROCEDURE

HINT:

- If DTC P0010 is displayed, check the intake camshaft circuit for the right bank VVT system.
- Bank 1 refers to the bank that includes cylinder No. 1.
- If DTC P0020 is displayed, check the intake camshaft circuit for the left bank VVT system.
- Bank 2 refers to the bank that does not include cylinder No. 1.
- 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 TECHSTREAM (OPERATE OIL CONTROL VALVE FOR INTAKE CAMSHAFT)**
   a. Connect the Techstream to the DLC3.

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b. Start the engine and turn the tester on.
c. Warm up the engine.
d. Select the following menu items: Powertrain/Engine and ECT/Active Test/Control the VVT System (Bank 1) or Control the VVT System (Bank 2).
e. Check the engine speed while operating the oil control valve using the tester.

OK

TESTER OPERATION SPECIFIED CONDITION CHART

Tester Operation	Specified Condition
OCV OFF	Normal engine speed
OCV ON	Engine idles roughly or stalls (soon after OCV 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 INTAKE CAMSHAFT)**
   a. Disconnect the intake camshaft timing oil control valve 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 - 2	20°C (68°F)	6.9 to 7.9 ohms

   c. Reconnect the camshaft timing oil control valve connector.

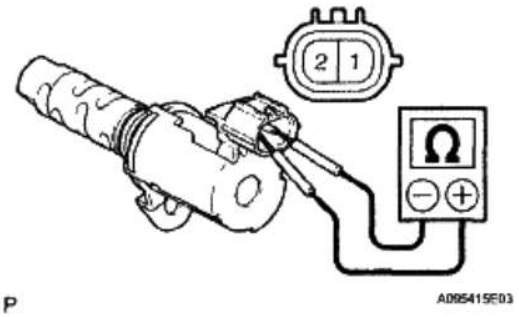


Fig. 35: Inspecting Camshaft Timing Oil Control Valve Assembly
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

NG: REPLACE CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY (See

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REMOVAL)

OK: Go to next step

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

Standard resistance (Check for open):

Bank 1

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
B3-17 (OC1+) - B24-1	Always	Below 1 ohms
B3-16 (OC1-) - B24-2	Always	Below 1 ohms

Bank 2

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
B3-15 (OC2+) - B25-1	Always	Below 1 ohms
B3-14 (OC2-) - B25-2	Always	Below 1 ohms

Standard resistance (Check for short):

Bank 1

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
B3-17 (OC1+) or B24-1 - Body ground	Always	10 kohms or higher
B3-16 (OC1-) or B24-2 - Body ground	Always	10 kohms or higher

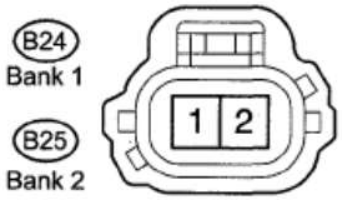
Bank 2

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
B3-15 (OC2+) or B25-1 - Body ground	Always	10 kohms or higher
B3-14 (OC2-) or B25-2 - Body ground	Always	10 kohms or higher

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



Rear view of wire harness connector:
(to ECM)

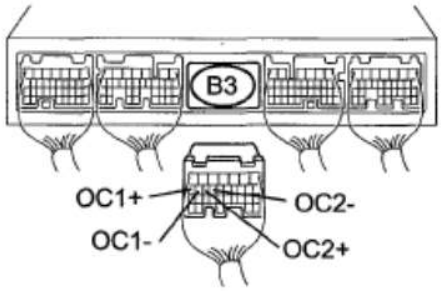


Fig. 36: Identifying Camshaft Timing Oil Control Valve And ECM Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

d. Reconnect the camshaft timing oil control valve connector.
e. Reconnect the ECM connector.

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

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); DTC P0021 CAMSHAFT POSITION "A" - TIMING OVER-ADVANCED OR SYSTEM PERFORMANCE (BANK 2); DTC P0022 CAMSHAFT POSITION "A" - TIMING OVER-RETARDED (BANK 2)

HINT:

If DTC P0011, P0012, P0021 or P0022 is present, check the VVT (Variable Valve Timing) system.

DESCRIPTION

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Refer to **DTC P0010** .

DTC DETECTION CONDITION CHART

DTC No.	DTC Detection Condition	Trouble Area
P0011 P0021	Valve timing is not adjusted in valve timing advance range (1 trip detection logic)	• Valve timing • Camshaft timing oil control valve for intake camshaft • Camshaft timing oil control valve filter • Intake camshaft (bank 1) timing gear assembly • ECM
P0012 P0022	Valve timing is not adjusted in valve timing retard range (2 trip detection logic)	• Valve timing • Camshaft timing oil control valve for intake camshaft • Camshaft timing oil control valve filter • Intake camshaft (bank 2) timing gear assembly • ECM

MONITOR DESCRIPTION

The ECM optimizes the intake valve timing using the VVT (Variable Valve Timing) system to control the intake camshaft. The VVT system includes the ECM, the oil control valve and the VVT controller. The ECM sends a target duty-cycle control signal to the camshaft timing oil control valve. This control signal regulates the oil pressure applied 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 actual intake valve timing are small, the ECM interprets this as the VVT controller stuck malfunction and sets a DTC.

Example:

A DTC will be set when the following conditions 1), 2) and 3) are met:

1. It takes 5 seconds or more to change the valve timing by 5° CA.
2. After above conditions 1) and 2) are met, the camshaft timing oil control valve is forcibly activated 63 times or more.

DTCs P0011 and P0021 (Advanced Cam Timing) are detected with 1 trip detection logic.

DTCs P0012 and P0022 (Retarded Cam Timing) are detected with 2 trip detection logic.

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

The monitor will not run unless 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 REFERENCE CHART

Related DTCs	P0011: Advanced intake camshaft timing (bank 1) P0012: Retarded intake camshaft timing (bank 1) P0021: Advanced intake camshaft timing (bank 2) P0022: Retarded intake camshaft timing (bank 2)
Required sensors/components (Main)	VVT OCV, VVT Actuator
Required sensors/components (Related)	Crankshaft position sensor, Camshaft position sensor, ECT sensor
Frequency of operation	Once per driving cycles
Duration	Less than 10 seconds
MIL operation	P0011 and P0021: Immediate P0012 and P0022: 2 driving cycles
Sequence operation	None

TYPICAL ENABLING CONDITIONS

TYPICAL ENABLING CONDITIONS CHART

The monitor will run whenever these DTCs are not present	P0010, P0020 (OCV bank 1, 2) P0016, P0018 (VVT system bank 1,2 - misalignment) P0100, P0102, P0103 (MAF meter) P0115, P0117, P0118 (ECT sensor) P0125 (Insufficient ECT for closed loop) P0335 (CKP sensor)
Battery voltage	11 V or more
Engine RPM	500 to 4000 rpm
ECT	75 to 100°C (167 to 212°F)

TYPICAL MALFUNCTION THRESHOLDS

P0011, P0021:

TYPICAL MALFUNCTION THRESHOLDS REFERENCE CHART

Duration of actual valve timing and target valve timing	More than 5°CA (Crankshaft angle)

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Valve timing	No change in advanced valve timing

P0012, P0022:

TYPICAL MALFUNCTION THRESHOLDS REFERENCE CHART

Duration of actual valve timing and target valve timing	More than 5°CA (Crankshaft angle)
Valve timing	No change in retarded valve timing

If the difference between the target and actual camshaft timings is greater than the specified value, the ECM operates the VVT actuator.

Then, the ECM monitors the camshaft timing change for 5 seconds.

WIRING DIAGRAM

Refer to **DTC P0010** .

INSPECTION PROCEDURE

ABNORMAL BANK REFERENCE CHART

Abnormal bank	Advanced timing over (Valve timing is out of specified range)	Retarded timing over (Valve timing is out of specified range)
Bank 1	P0011	P0012
Bank 2	P0021	P0022

HINT:

- If DTC P0011 or P0012 is displayed, check the bank 1 VVT system circuit.
- Bank 1 refers to the bank that includes cylinder No. 1.
- If DTC P0021 or P0022 is displayed, check the bank 2 VVT system circuit.
- Bank 2 refers to the bank that does not include cylinder No. 1.
- 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. **CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P0011, P0012, P0021 OR P0022)**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch on (IG) and turn the tester on.
   c. Select the following menu items: Powertrain/Engine and ECT/Trouble Code.
   d. Read the DTCs.

   Result

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RESULT CHART

Display (DTC Output)	Proceed to
P0011, P0012, P0021 or P0022	A
P0011, P0012, P0021 or P0022 and other DTCs	B

HINT:

If any DTCs other than P0011, P0012, P0021 or P0022 are output, troubleshoot those DTCs first.

B: GO TO **DTC CHART**

A: Go to next step

2. **PERFORM ACTIVE TEST USING TECHSTREAM (OPERATE OIL CONTROL VALVE FOR INTAKE CAMSHAFT)**
   a. Connect the Techstream to the DLC3.
   b. Start the engine and turn the tester on.
   c. Warm up the engine.
   d. Select the following menu items: Powertrain/Engine and ECT/Active Test/Control the VVT System (Bank 1) or Control the VVT System (Bank 2).
   e. Check the engine speed while operating the oil control valve using the tester.

OK

TESTER OPERATION SPECIFIED CONDITION CHART

Tester Operation	Specified Condition
OCV OFF	Normal engine idle speed
OCV ON	Engine idles roughly or stalls (soon after OCV switched from OFF to ON)

NG: Go to step 4

OK: Go to next step

3. **CHECK WHETHER DTC OUTPUT RECURS (DTC P0011, P0012, P0021 OR P0022)**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch on (IG) and turn the tester on.
   c. Clear the DTCs (See **DTC CHECK/CLEAR**).
   d. Start the engine and warm it up.
   e. Switch the check mode using the tester (See **CHECK MODE PROCEDURE**).
   f. Drive the vehicle for more than 10 minutes.
   g. Read the DTCs using the tester.

OK: No DTC output.

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NG: Go to step 4

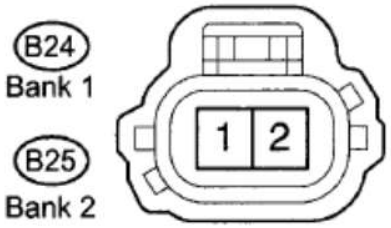
OK: SYSTEM IS OK

4. **CHECK VALVE TIMING (CHECK FOR LOOSE AND JUMPED TEETH ON TIMING CHAIN)**
   a. Remove the cylinder head covers RH and LH.
   b. Turn the crankshaft to align the timing marks of the crankshaft.
   c. Align the notch of the crankshaft pulley to the "0" position.
   d. Check if the timing marks of the camshaft pulley and camshaft bearing cap align.
   e. Turn the crankshaft clockwise by 360° if the timing marks do not align. Check if they align once again.

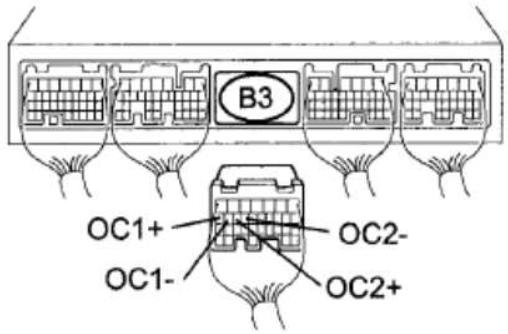
   OK: The timing marks of the camshaft pulley and the camshaft bearing cap align when the notch of the crankshaft pulley is in the "0" position.

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

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



Rear view of wire harness connector:
(to ECM)



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Fig. 37: Identifying Timing Mark
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

5. **INSPECT CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY (FOR INTAKE CAMSHAFT)**
   a. Remove the intake camshaft timing oil control valve.
   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

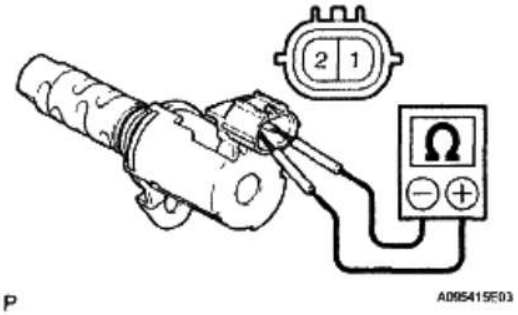


Fig. 38: Inspecting Camshaft Timing Oil Control Valve Assembly
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

   c. Apply the positive battery voltage to terminal 1 and the negative battery voltage to terminal 2. Check the valve operation.

OK: Valve moves quickly.

   d. Reinstall the camshaft timing oil control valve.

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

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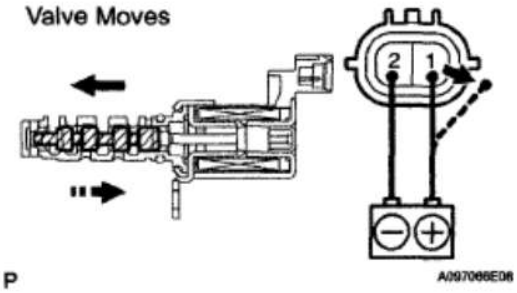


Fig. 39: Checking Valve Operation
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

6. **CHECK OIL PIPE AND OIL CONTROL VALVE FILTER**
   a. Remove the oil pipe No. 1 or oil pipe assembly.
   b. Remove the oil control valve filter.
   c. Check that the filter and pipe are not clogged.

OK: The filter and pipe are not clogged.

NG: REPLACE OIL CONTROL VALVE FILTER OR PIPE

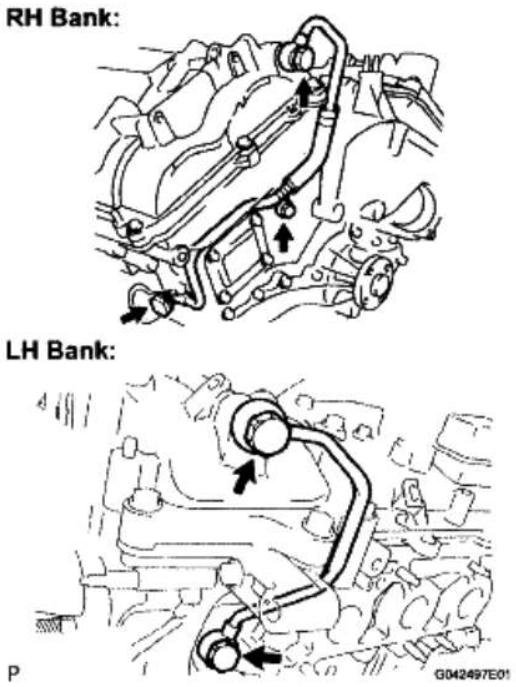


Fig. 40: Locating Oil Pipe Assembly Bolts
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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OK: Go to next step

7. **REPLACE CAMSHAFT TIMING GEAR ASSEMBLY**
8. **CHECK WHETHER DTC OUTPUT RECURS**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch on (IG) and turn the tester on.
   c. Clear the DTCs (See **DTC CHECK/CLEAR**).
   d. Start the engine and warm it up.
   e. Switch the check mode using the tester (See **CHECK MODE PROCEDURE**).
   f. Drive the vehicle for more than 10 minutes.
   g. Confirm that no DTC is set using the tester.

OK: No DTC output.

HINT:

DTC P0011, P0012, P0021 or P0022 is output when foreign objects in engine oil are caught in some parts of the system. These codes will stay output even if the system returns to normal after a short time. These foreign objects are then captured by the oil filter, thus eliminating the source of the problem.

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

OK: SYSTEM IS OK

DTC P0013 CAMSHAFT POSITION "B" ACTUATOR CIRCUIT/OPEN (BANK 1); DTC P0023 CAMSHAFT POSITION "B" ACTUATOR CIRCUIT/OPEN (BANK 2)

DESCRIPTION

The Variable Valve Timing (VVT) system includes the ECM, camshaft timing oil control valve and VVT controller. The ECM sends a target duty-cycle control signal to the camshaft timing oil control valve. This control signal regulates the oil pressure supplied to the VVT controller. Camshaft timing control is performed according to engine operating conditions such as the intake air volume, throttle valve position and engine coolant temperature. The ECM controls the camshaft timing oil control valve, based on the signals transmitted by several sensors. The VVT controller regulates the exhaust camshaft angle using oil pressure through the camshaft timing oil control valve. As a result, the relative positions of the camshaft and crankshaft are optimized, the engine torque and fuel economy improve, and the exhaust emissions decrease under overall driving conditions. The ECM detects the actual exhaust valve timing using signals from the camshaft and crankshaft position sensors, and performs feedback control. This is how the target intake valve timing is verified by the ECM.

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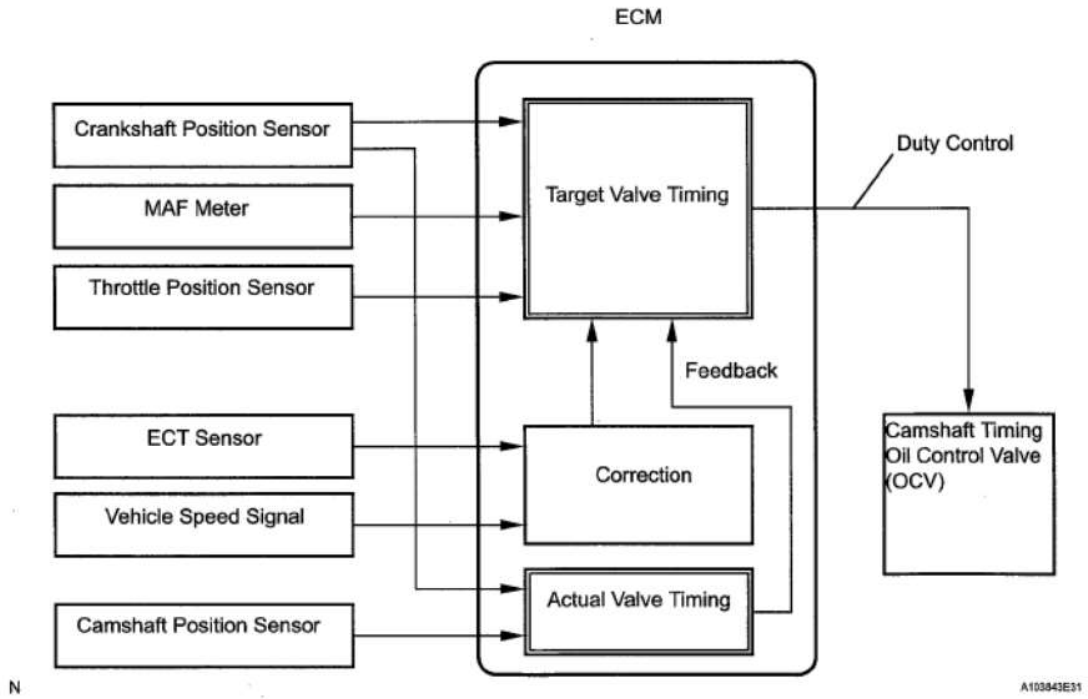


Fig. 41: Camshaft Position Sensor Communication Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

MONITOR STRATEGY REFERENCE CHART

DTC No.	DTC Detection Condition	Trouble Area
P0013	Open or short in camshaft timing oil control valve for exhaust camshaft (bank 1) circuit (1 trip detection logic)	• Open or short in camshaft timing oil control valve for exhaust camshaft (bank 1) circuit • Camshaft timing oil control valve for exhaust camshaft (bank 1) • ECM
P0023	Open or short in camshaft timing oil control valve for exhaust camshaft (bank 2) circuit (1 trip detection logic)	• Open or short in camshaft timing oil control valve for exhaust camshaft (bank 2) circuit • Camshaft timing oil control valve for exhaust camshaft (bank 2) • ECM

MONITOR DESCRIPTION

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

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sends the target duty-cycle signal to the camshaft timing oil control valve, the ECM monitors the camshaft timing oil control valve current to establish an actual duty-cycle. The ECM determines the existence of a malfunction and sets the DTC when the actual duty-cycle ratio varies from the target duty-cycle ratio.

MONITOR STRATEGY

MONITOR STRATEGY REFERENCE CHART

Related DTCs	P0013: VVT OCV (bank 1) open/short P0023: VVT OCV (bank 2) open/short
Required sensors/components (Main)	VVT OCV (Variable Valve Timing oil control valve)
Required sensors/components (Sub)	-
Frequency of operation	Continuous
Duration	1 second
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
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:	Condition A, B or C
A. All of the following conditions are met	-
Battery voltage	11 to 13 V
Target duty ratio	Less than 70%
Current cut status	Not cut
B. All of the following conditions are met:	-
Battery voltage	13 V or more
Target duty ratio	Less than 80%
Current cut status	Not cut

TYPICAL MALFUNCTION THRESHOLDS

TYPICAL MALFUNCTION THRESHOLDS REFERENCE CHART

Exhaust VVT oil control valve condition	No operation record

COMPONENT OPERATING RANGE

COMPONENT OPERATING RANGE REFERENCE CHART

Exhaust VVT oil control valve condition	No operation record

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WIRING DIAGRAM

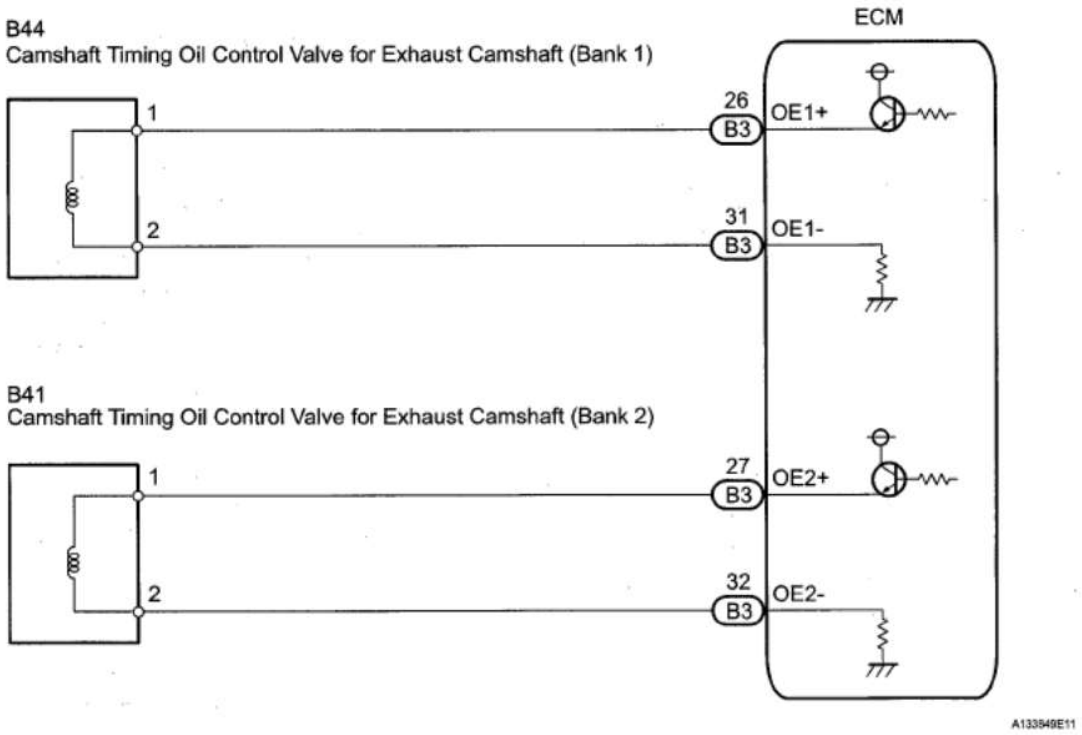


Fig. 42: Camshaft Position Sensor - Wiring Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSPECTION PROCEDURE

HINT:

- If DTC P0013 is displayed, check the exhaust camshaft circuit for the bank 1 VVT system.
- Bank 1 refers to the bank that includes cylinder No. 1.
- If DTC P0023 is displayed, check the exhaust camshaft circuit for the bank 2 VVT system.
- Bank 2 refers to the bank that does not include cylinder No. 1.
- 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 TECHSTREAM (OPERATE OIL CONTROL VALVE FOR INTAKE CAMSHAFT)**
   a. Connect the Techstream to the DLC3.
   b. Start the engine and turn the tester on.
   c. Warm up the engine.

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d. Select the following menus: Powertrain/Engine and ECT/Active Test/Control the VVT Exhaust Linear (Bank 1) or Control the VVT Exhaust Linear (Bank 2).

e. Check the engine speed while operating the oil control valve using the tester.

OK

TESTER OPERATION SPECIFIED CONDITION CHART

Tester Operation	Specified Condition
-128% (Oil control valve OFF)	Normal engine speed
127% (Oil control valve ON)	Engine idles roughly or stalls (soon after oil control valve 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**

a. Disconnect the exhaust camshaft timing oil control valve 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 - 2	20°C (68°F)	6.9 to 7.9 ohms

c. Reconnect the camshaft timing oil control valve connector.

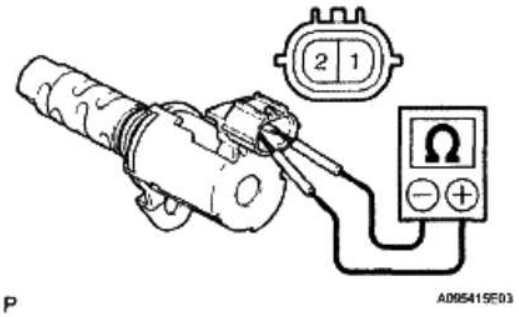


Fig. 43: Inspecting Camshaft Timing Oil Control Valve Assembly
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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

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OK: Go to next step

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

Standard resistance (Check for open):

Bank 1

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
B3-26 (OE1+) - B44-1	Always	Below 1 ohms
B3-31 (OE1-) - B44-2	Always	Below 1 ohms

Bank 2

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
B3-27 (OE2+) - B41-1	Always	Below 1 ohms
B3-32 (OE2-) - B41-2	Always	Below 1 ohms

Standard resistance (Check for short):

Bank 1

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
B3-26 (OE1+) or B44-1 - Body ground	Always	10 kohms or higher
B3-31 (OE1-) or B44-2 - Body ground	Always	10 kohms or higher

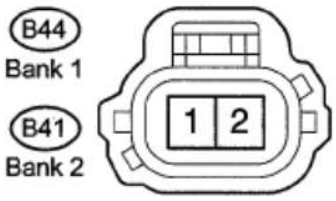
Bank 2

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
B3-27 (OE2+) or B41-1 - Body ground	Always	10 kohms or higher
B3-32 (OE2-) or B41-2 - Body ground	Always	10 kohms or higher

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



Rear view of wire harness connector:
(to ECM)

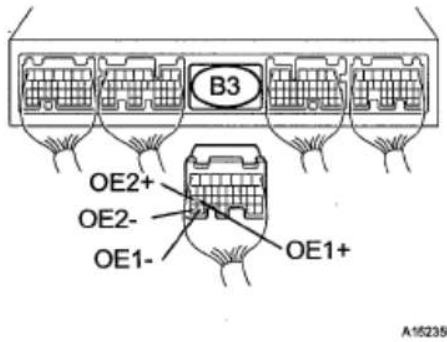


Fig. 44: Identifying Camshaft Timing Oil Control Valve And ECM Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

d. Reconnect the ECM connector.
e. Reconnect the camshaft timing oil control valve connector.

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

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); DTC P0024 CAMSHAFT POSITION "B" - TIMING OVER-ADVANCED OR SYSTEM PERFORMANCE (BANK 2); DTC P0025 CAMSHAFT POSITION "B" - TIMING OVER-RETARDED (BANK 2)

HINT:

If DTC P0014, P0015, P0024 or P0025 is present, check the VVT (Variable Valve Timing) system.

DESCRIPTION

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Refer to **DTC P0013** .

DTC DETECTION CONDITION CHART

DTC No.	DTC Detection Condition	Trouble Area
P0014 P0024	Valve timing is not adjusted in valve timing advance range (2 trip detection logic)	• Valve timing • Camshaft timing oil control valve for exhaust camshaft • Camshaft timing oil control valve filter • Exhaust camshaft timing gear assembly • ECM
P0015 P0025	Valve timing is not adjusted in valve timing retard range (1 trip detection logic)	• Valve timing • Camshaft timing oil control valve for exhaust camshaft • Camshaft timing oil control valve filter • Exhaust camshaft timing gear assembly • ECM

MONITOR DESCRIPTION

DTC P0014 and P0024

The ECM compares current valve timing with target valve timing, while the engine is running and after being warmed up, in order to monitor the VVT system on the exhaust side. Valve timing is calculated from the positions of the camshaft and crankshaft. The ECM controls the engine so that current valve timing meets target valve timing. If these timings are not met, the ECM determines this as a malfunction.

DTC P0015 and P0025

The ECM compares current valve timing with target valve timing, while the engine is running and after being warmed up, in order to monitor the VVT system on the exhaust side. Valve timing is calculated from the positions of the camshaft and crankshaft. The ECM controls the engine so that current valve timing meets target valve timing. If these timings are not met, the ECM determines this as a malfunction.

MONITOR STRATEGY

MONITOR STRATEGY REFERENCE CHART

Related DTCs	P0014: Advanced exhaust camshaft timing (bank 1) P0015: Retarded exhaust camshaft timing (bank 1) P0024: Advanced exhaust camshaft timing (bank 2)

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	P0025: Retarded exhaust camshaft timing (bank 2)
Required Sensors/Components (Main)	VVT camshaft timing oil control valve and VVT Actuator
Required Sensors/Components (Related)	P0014 and P0015: Exhaust camshaft control actuator bank 1 Exhaust camshaft timing oil control valve bank 1 P0024 and P0025: Exhaust camshaft control actuator bank 2 Exhaust camshaft timing oil control valve bank 2
Frequency of Operation	Continuously
Duration	Less than 10 seconds
MIL Operation	P0014 and P0024: 2 driving cycles P0015 and P0025: Immediate
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

TYPICAL ENABLING CONDITIONS CHART

The monitor will run whenever these DTCs are not present	P0013, P0023 (Exhaust OCV bank 1, 2) P0017, P0019 (Exhaust VVT system bank 1, 2 - misalignment) P0100, P0102, P0103 (MAF meter) P0115, P0117, P0118 (ECT sensor) P0125 (Insufficient ECT for closed loop) P0335 (CKP sensor)
Battery voltage	11 V or more
Engine RPM	500 to 4000 rpm
Engine coolant temperature	75 to 100°C (167 to 212°F)

TYPICAL MALFUNCTION THRESHOLDS

Advanced camshaft timing:

TYPICAL MALFUNCTION THRESHOLDS REFERENCE CHART

Valve timing	No change
Valve timing	Advanced position

Retarded camshaft timing:

TYPICAL MALFUNCTION THRESHOLDS REFERENCE CHART

Valve timing	No change
Valve timing	Retarded position

If the difference between the target and actual camshaft timings is greater than the specified value, the ECM operates the VVT actuator.

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Then, the ECM monitors the camshaft timing change for 5 seconds.

WIRING DIAGRAM

Refer to **DTC P0013** .

INSPECTION PROCEDURE

ABNORMAL BANK REFERENCE CHART

Abnormal bank	Advanced timing over (Valve timing is out of specified range)	Retarded timing over (Valve timing is out of specified range)
Bank 1	P0014	P0015
Bank 2	P0024	P0025

HINT:

- If DTC P0014 or P0015 is displayed, check the bank 1 VVT system circuit.
- Bank 1 refers to the bank that includes cylinder No. 1.
- If DTC P0024 or P0025 is displayed, check the bank 2 VVT system circuit.
- Bank 2 refers to the bank that does not include cylinder No. 1.
- 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. **CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P0014, P0015, P0024 OR P0025)**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch on (IG) and turn the tester on.
   c. Select the following menu items: Powertrain/Engine and ECT/Trouble Code.
   d. Read the DTCs.

   Result

   RESULT CHART

Display (DTC Output)	Proceed to
P0014, P0015, P0024 or P0025	A
P0014, P0015, P0024 or P0025 and other DTCs	B

   HINT:

   If any DTCs other than P0014, P0015, P0024 or P0025 are output, troubleshoot those DTCs first.

   B: GO TO **DTC CHART**

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A: Go to next step

2. **PERFORM ACTIVE TEST USING TECHSTREAM (OPERATE OIL CONTROL VALVE FOR EXHAUST CAMSHAFT)**
   a. Connect the Techstream to the DLC3.
   b. Start the engine and turn the tester on.
   c. Warm up the engine.
   d. Select the following menu items: Powertrain/Engine and ECT/Active Test/Control the VVT Exhaust Linear (Bank 1) or Control the VVT Exhaust Linear (Bank 2).
   e. Check the engine speed while operating the oil control valve using the tester.

   OK

   TESTER OPERATION SPECIFIED CONDITION CHART

Tester Operation	Specified Condition
-128% (Oil control valve OFF)	Normal engine idle speed
127% (Oil control valve ON)	Engine idles roughly or stalls (soon after OCV switched from OFF to ON)

   NG: Go to step 4

   OK: Go to next step

3. **CHECK WHETHER DTC OUTPUT RECURS (DTC P0014, P0015, P0024 OR P0025)**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch on (IG) and turn the tester on.
   c. Clear the DTCs (See **DTC CHECK/CLEAR**).
   d. Start the engine and warm it up.
   e. Switch the check mode using the tester (See **CHECK MODE PROCEDURE**).
   f. Drive the vehicle for more than 10 minutes.
   g. Read the DTCs using the tester.

   OK: No DTC output.

   NG: Go to step 4

   OK: SYSTEM IS OK

4. **CHECK VALVE TIMING (CHECK FOR LOOSE AND JUMP TEETH ON TIMING CHAIN)**
   a. Remove the cylinder head covers RH and LH.
   b. Turn the crankshaft to align the matchmarks of the crankshaft.
   c. Align the notch of the crankshaft pulley to the "0" position.

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d. Check if the matchmarks of the camshaft pulley and camshaft bearing cap align.
e. Turn the crankshaft clockwise by 360° if the matchmarks do not align. Check if they align once again.

OK: The matchmarks of the camshaft pulley and the camshaft bearing cap align when the notch of the crankshaft pulley is in the "0" position.

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

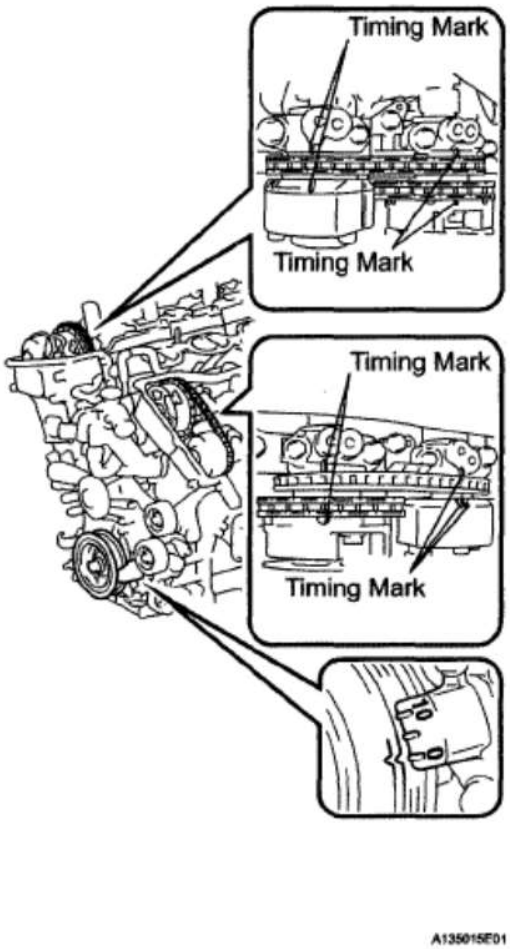


Fig. 45: Identifying Timing Mark
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

5. **INSPECT CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY (FOR EXHAUST CAMSHAFT)**
   a. Remove the exhaust camshaft timing oil control valve.
   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

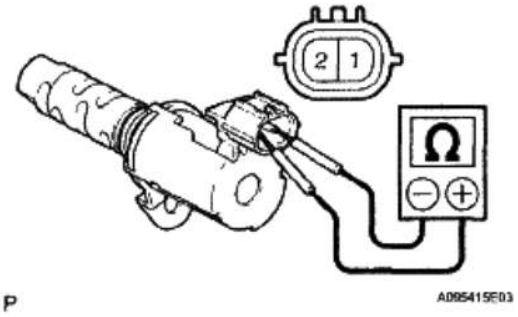


Fig. 46: Inspecting Camshaft Timing Oil Control Valve Assembly
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

c. Apply the positive battery voltage to terminal 1 and the negative battery voltage to terminal 2. Check the valve operation.

OK: Valve moves quickly.

d. Reinstall the camshaft timing oil control valve.

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

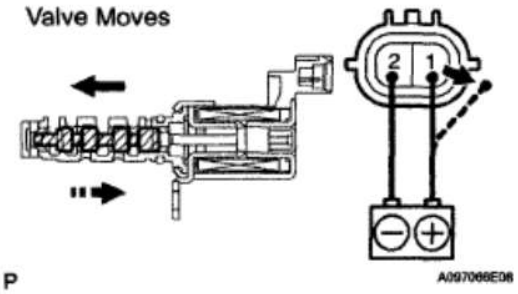


Fig. 47: Checking Valve Operation
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

6. **CHECK OIL PIPE AND OIL CONTROL VALVE FILTER**
   a. Remove the oil pipe No. 1 or oil pipe assembly.
   b. Remove the oil control valve filter.

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c. Check that the filter and pipe are not clogged.

OK: The filter and pipe are not clogged.

NG: REPLACE OIL CONTROL VALVE FILTER OR PIPE

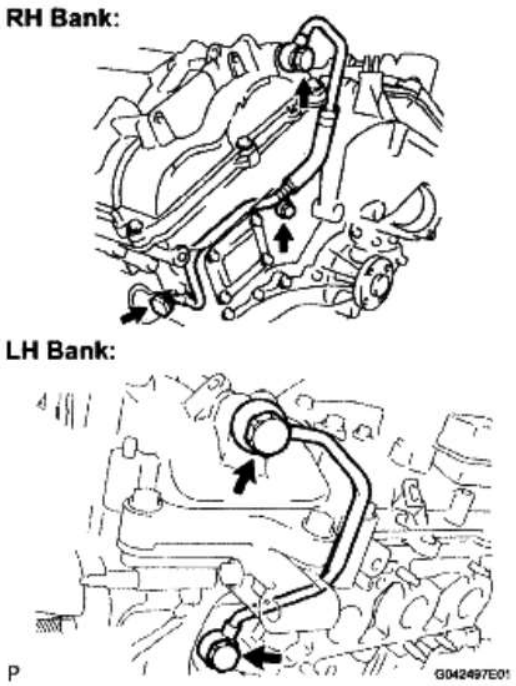


Fig. 48: Locating Oil Pipe Assembly Bolts
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

7. **REPLACE CAMSHAFT TIMING GEAR ASSEMBLY**
8. **CHECK WHETHER DTC OUTPUT RECURS**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch on (IG) and turn the tester on.
   c. Clear the DTCs (See **DTC CHECK/CLEAR**).
   d. Start the engine and warm it up.
   e. Switch the check mode using the tester (See **CHECK MODE PROCEDURE**).
   f. Drive the vehicle for more than 10 minutes.
   g. Confirm that no DTC is set using the tester.

OK: No DTC output.

HINT:

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DTC P0014, P0015, P0024 or P0025 is output when foreign objects in engine oil are caught in some parts of the system. These codes will stay registered even if the system returns to normal after a short time. These foreign objects are then captured by the oil filter, thus eliminating the source of the problem.

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

OK: SYSTEM IS OK

DTC P0016 CRANKSHAFT POSITION - CAMSHAFT POSITION CORRELATION (BANK 1 SENSOR A); DTC P0018 CRANKSHAFT POSITION - CAMSHAFT POSITION CORRELATION (BANK 2 SENSOR A)

DESCRIPTION

Refer to **DTC P0335** .

DTC DETECTION CONDITION CHART

DTC No.	DTC Detection Condition	Trouble Area
P0016	Deviations in crankshaft position sensor and VVT sensor 1 (for intake camshaft) 1 signals (2 trip detection logic)	• Valve timing • Camshaft timing oil control valve for intake camshaft • Camshaft timing oil control valve filter • Intake camshaft timing gear assembly • ECM
P0018	Deviations in crankshaft position sensor and VVT sensor 2 (for intake camshaft) 1 signals (2 trip detection logic)	

MONITOR DESCRIPTION

The ECM optimizes the valve timing by using the VVT (Variable Valve Timing) system to control the intake camshaft. The VVT system includes the ECM, the camshaft timing oil control valve and the VVT controller.

The ECM sends a target duty-cycle control signal to the camshaft timing oil control valve. This control signal regulates the oil pressure applied to the VVT controller. The VVT controller can advance or retard the intake camshaft. The ECM calibrates the intake valve timing by setting the intake camshaft to the most retarded angle while the engine is idling. The ECM closes the camshaft timing oil control valve to retard the cam. The ECM stores this value as the VVT learning value. When the difference between the target and actual intake valve timings is 5° CA (Crankshaft Angle) or less, the ECM stores it.

If the VVT learning value matches the following conditions, the ECM determines the existence of a malfunction in the VVT system, and sets the DTC.

- The VVT learning value: Less than 18.5°CA, or more than 43.5°CA.
- The above condition continues for 18 seconds or more.

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This DTC indicates that the intake camshaft has been installed toward the crankshaft at an incorrect angle, 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 REFERENCE CHART

Related DTCs	Deviation in crankshaft position sensor signal and camshaft position sensor signal (Bank 1)
Required Sensors/Components (Main)	VVT actuator
Required Sensors/Components (Related)	Camshaft position sensor, Crankshaft position sensor
Frequency of Operation	Once per driving cycle
Duration	Less than 60 seconds
MIL Operation	2 driving cycles
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

All:

TYPICAL ENABLING CONDITIONS CHART

The monitor will run whenever these DTCs are not present	P0010, P0020 (OCV bank 1, 2) P0100, P0102, P0103 (MAF meter) P0115, P0117, P0118 (ECT sensor) P0125 (Insufficient ECT for closed loop) P0335 (CKP sensor)
Engine RPM	500 to 1000 rpm

TYPICAL MALFUNCTION THRESHOLDS

TYPICAL MALFUNCTION THRESHOLDS REFERENCE CHART

One of the following conditions is met:	Condition 1 or 2
1. VVT learning value at maximum retarded valve timing	Less than 18.5°CA
2. VVT learning value at maximum retarded valve timing	More than 43.5°CA

WIRING DIAGRAM

Refer to **DTC P0335** .

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 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. **CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P0016 OR P0018)**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch on (IG) and turn the tester on.
   c. Select the following menu items: Powertrain/Engine and ECT/Trouble Codes.
   d. Read the DTCs.

   Result

   RESULT CHART

Display (DTC Output)	Proceed to
P0016 or P0018	A
P0016 or P0018 and other DTCs	B

   HINT:

   If any DTCs other than P0016 or P0018 are output, troubleshoot those DTCs first.

   B: GO TO **DTC CHART**

   A: Go to next step

2. **PERFORM ACTIVE TEST USING TECHSTREAM (OPERATE OIL CONTROL VALVE FOR INTAKE CAMSHAFT)**
   a. Connect the Techstream to the DLC3.
   b. Start the engine and turn the tester on.
   c. Warm up the engine.
   d. Select the following menu items: Powertrain/Engine and ECT/Active Test/Control the VVT System (Bank 1) or Control the VVT System (Bank 2).
   e. Check the engine speed while operating the oil control valve using the tester.

   OK

   TESTER OPERATION SPECIFIED CONDITION CHART

Tester Operation	Specified Condition
OCV OFF	Normal engine idle speed
OCV ON	Engine idles roughly or stalls (soon after OCV switched from OFF to ON)

   NG: Go to step 4

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OK: Go to next step

3. **CHECK WHETHER DTC OUTPUT RECURS (DTC P0016 OR P0018)**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch on (IG) and turn the tester on.
   c. Clear the DTCs (See **DTC CHECK/CLEAR**).
   d. Start the engine and warm it up.
   e. Switch the check mode using the tester (See **CHECK MODE PROCEDURE**).
   f. Drive the vehicle for more than 10 minutes.
   g. Read the DTCs using the tester.

   OK: No DTC output.

   NG: Go to step 4

   OK: END

4. **CHECK VALVE TIMING (CHECK FOR LOOSE AND JUMPED TEETH ON TIMING CHAIN)**
   a. Remove the cylinder head covers RH and LH.
   b. Turn the crankshaft to align the timing marks of the crankshaft.
   c. Align the notch of the crankshaft pulley to the "0" position.
   d. Check if the timing marks of the camshaft pulley and camshaft bearing cap align.
   e. Turn the crankshaft clockwise 360° if the timing marks do not align. Check if they align once again.

   OK: The timing marks of the camshaft pulley and the camshaft bearing cap align when the notch of the crankshaft pulley is in the "0" position.

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

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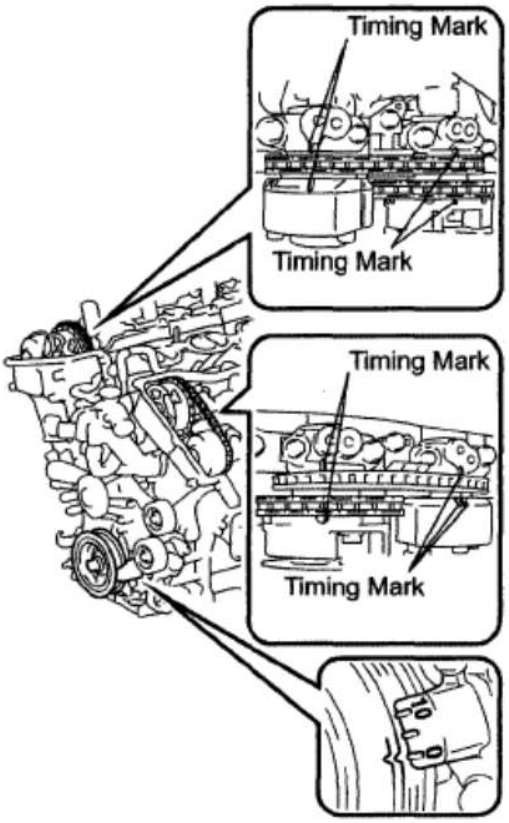


Fig. 49: Identifying Timing Mark
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

5. **INSPECT CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY (FOR INTAKE CAMSHAFT)**
   a. Remove the intake camshaft timing oil control valve.
   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

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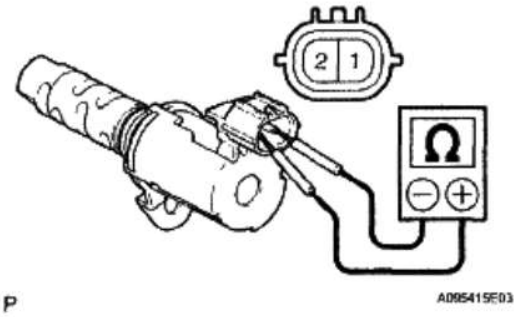


Fig. 50: Inspecting Camshaft Timing Oil Control Valve Assembly
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

c. Apply the positive battery voltage to terminal 1 and the negative battery voltage to terminal 2. Check the valve operation.

OK: Valve moves quickly.

d. Reinstall the camshaft timing oil control valve.

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

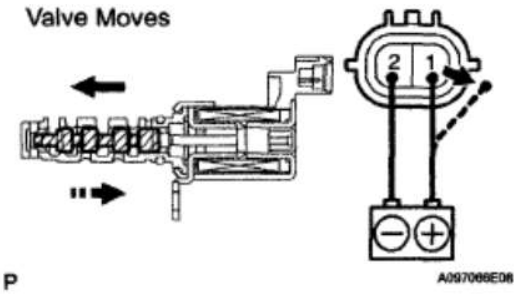


Fig. 51: Checking Valve Operation
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

6. **CHECK OIL PIPE AND OIL CONTROL VALVE FILTER**
   a. Remove the oil pipe No. 1 or oil pipe assembly.
   b. Remove the oil control valve filter.
   c. Check that the filter and pipe are not clogged.

OK: The filter and pipe are not clogged.

NG: REPLACE OIL CONTROL VALVE FILTER OR PIPE

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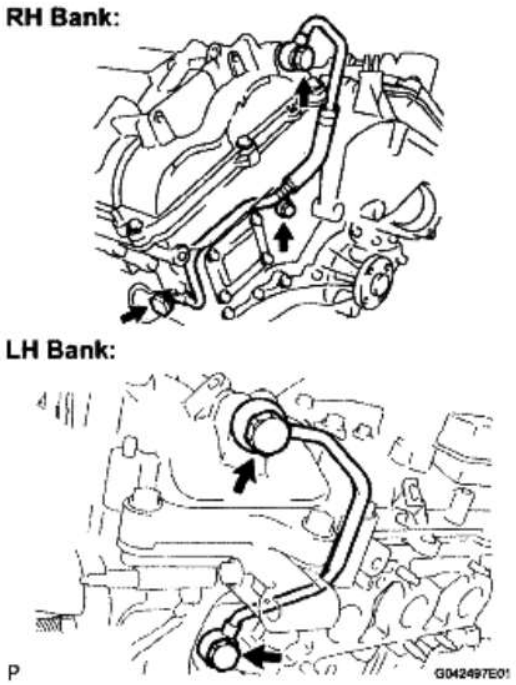


Fig. 52: Locating Oil Pipe Assembly Bolts
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

7. **REPLACE CAMSHAFT TIMING GEAR ASSEMBLY**
8. **CHECK WHETHER DTC OUTPUT RECURS**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch on (IG) and turn the tester on.
   c. Clear the DTCs (See **DTC CHECK/CLEAR**).
   d. Start the engine and warm it up.
   e. Switch the check mode using the tester (See **CHECK MODE PROCEDURE**).
   f. Drive the vehicle for more than 10 minutes.
   g. Confirm that no DTC is set using the tester.

OK: No DTC output.

HINT:

DTC P0016 or P0018 is output when foreign objects in engine oil are caught in some parts of the system. These codes will stay output even if the system returns to normal after a short time. These foreign objects are then captured by the oil filter, thus eliminating the source of the problem.

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

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OK: END

DTC P0017 CRANKSHAFT POSITION - CAMSHAFT POSITION CORRELATION (BANK 1 SENSOR B); DTC P0019 CRANKSHAFT POSITION - CAMSHAFT POSITION CORRELATION (BANK 2 SENSOR B)

DESCRIPTION

Refer to **DTC P0335** .

DTC DETECTION CONDITION CHART

DTC No.	DTC Detection Condition	Trouble Area
P0017	Deviations in crankshaft position sensor and VVT sensor 1 (for exhaust camshaft) 1 signals (2 trip detection logic)	• Valve timing • Camshaft timing oil control valve for exhaust camshaft • Camshaft timing oil control valve filter • Exhaust camshaft timing gear assembly • ECM
P0019	Deviations in crankshaft position sensor and VVT sensor 2 (for exhaust camshaft) 2 signals (2 trip detection logic)	

MONITOR DESCRIPTION

The ECM checks valve timing (VVT learning value) on the exhaust side while the engine is running at a low speed, in order to monitor the gap between current and target valve timings on the exhaust side. The VVT learning value is calculated from the positions of the camshaft and crankshaft. The camshaft will come to the most retarded position when the engine is running at a low speed. If the camshaft position is normal, the VVT learning value should be within the specified range. If the VVT learning value is not within the specified range, the ECM determines this as a malfunction.

MONITOR STRATEGY

MONITOR STRATEGY REFERENCE CHART

Related DTCs	Deviation in crankshaft position sensor signal and camshaft position sensor signal
Required Sensors/Components (Main)	Timing chain/belt
Required Sensors/Components (Related)	None
Frequency of Operation	Once per driving cycle
Duration	Less than 60 seconds
MIL Operation	2 driving cycles
Sequence of Operation	None

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TYPICAL ENABLING CONDITIONS

All:

TYPICAL ENABLING CONDITIONS CHART

The monitor will run whenever these DTCs are not present	P0013, P0023 (Exhaust OCV bank 1, 2) P0100, P0102, P0103 (MAF meter) P0115, P0117, P0118 (ECT sensor) P0125 (Insufficient ECT for closed loop) P0335 (CKP sensor)
VVT feedback mode	Executing
VVT	Maximum advanced position
Engine RPM	500 to 1000 rpm

TYPICAL MALFUNCTION THRESHOLDS

TYPICAL MALFUNCTION THRESHOLDS REFERENCE CHART

One of the following conditions is met:	Condition 1 or 2
1. VVT learning value	Less than 77°CA
2. VVT learning value	More than 102°CA

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 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. **CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P0017 AND P0019)**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch on (IG) and turn the tester on.
   c. Select the following menu items: Powertrain/Engine and ECT/Trouble Code.
   d. Read the DTCs.

   Result

   RESULT CHART

Display (DTC Output)	Proceed to
P0017 or P0019	A

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P0017 or P0019 and other DTCs	B

HINT:

If any DTCs other than P0017 or P0019 are output, troubleshoot those DTCs first.

B: GO TO **DTC CHART**

A: Go to next step

2. **PERFORM ACTIVE TEST USING TECHSTREAM (OPERATE OIL CONTROL VALVE FOR EXHAUST CAMSHAFT)**
   a. Connect the Techstream to the DLC3.
   b. Start the engine and turn the tester on.
   c. Warm up the engine.
   d. Select the following menu items: Powertrain/Engine and ECT/Active Test/Control the VVT Exhaust Linear (Bank 1) or Control the VVT Exhaust Linear (Bank 2).
   e. Check the engine speed while operating the oil control valve using the tester.

   OK

   TESTER OPERATION SPECIFIED CONDITION CHART

Tester Operation	Specified Condition
-128% (Oil control valve OFF)	Normal engine idle speed
127% (Oil control valve ON)	Engine idles roughly or stalls (soon after OCV switched from OFF to ON)

   NG: Go to step 4

   OK: Go to next step

3. **CHECK WHETHER DTC OUTPUT RECURS (DTC P0017 OR P0019)**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch on (IG) and turn the tester on.
   c. Clear the DTCs (See **DTC CHECK/CLEAR**).
   d. Start the engine and warm it up.
   e. Switch the check mode using the tester (See **CHECK MODE PROCEDURE**).
   f. Drive the vehicle for more than 10 minutes.
   g. Read the DTCs using the tester.

   OK: No DTC output.

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NG: Go to step 4

OK: END

4. **CHECK VALVE TIMING (CHECK FOR LOOSE AND JUMP TEETH ON TIMING CHAIN)**
   a. Remove the cylinder head covers RH and LH.
   b. Turn the crankshaft to align the matchmarks of the crankshaft.
   c. Align the notch of the crankshaft pulley to the "0" position.
   d. Check if the matchmarks of the camshaft pulley and camshaft bearing cap align.
   e. Turn the crankshaft clockwise by 360° if the matchmarks do not align. Check if they align once again.

   OK: The matchmarks of the camshaft pulley and the camshaft bearing cap align when the notch of the crankshaft pulley is in the "0" position.

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

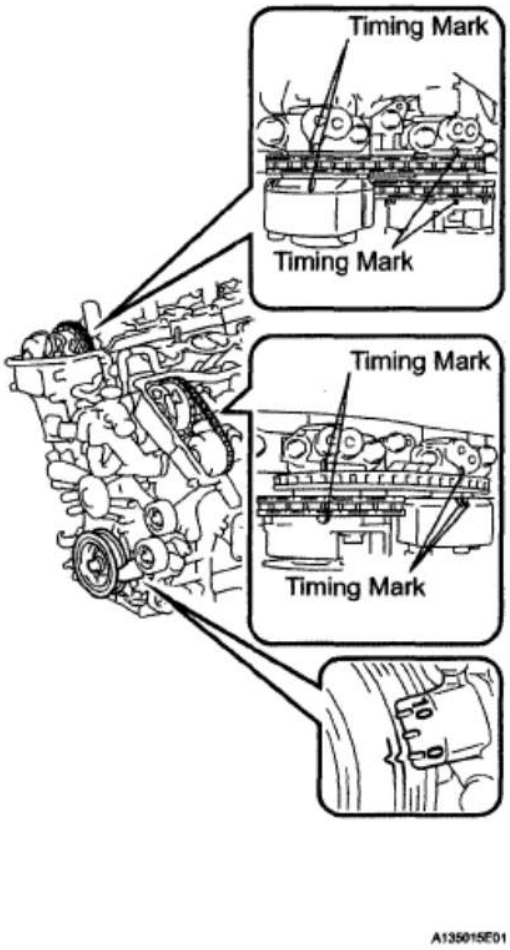


Fig. 53: Identifying Timing Mark

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OK: Go to next step

5. **INSPECT CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY (FOR EXHAUST CAMSHAFT)**
   a. Remove the exhaust camshaft timing oil control valve.
   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

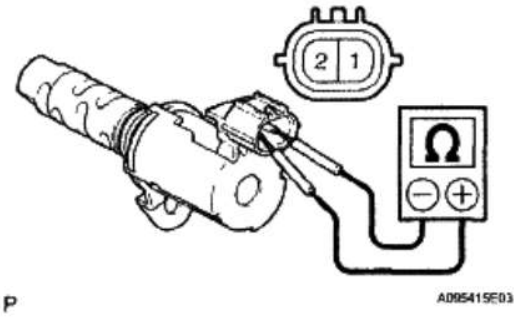


Fig. 54: Inspecting Camshaft Timing Oil Control Valve Assembly
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

   c. Apply the positive battery voltage to terminal 1 and the negative battery voltage to terminal 2. Check the valve operation.

OK: Valve moves quickly.

   d. Reinstall the camshaft timing oil control valve.

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

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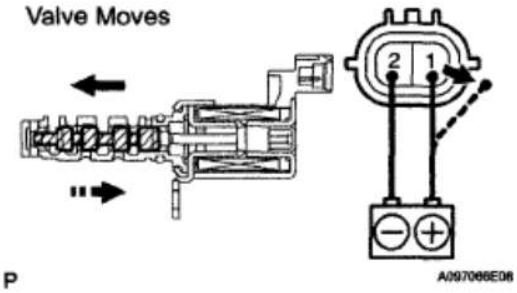


Fig. 55: Checking Valve Operation
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

6. **CHECK OIL CONTROL VALVE FILTER AND PIPE**
   a. Remove the oil pipe No. 1 or oil pipe assembly.
   b. Remove the oil control valve filter.
   c. Check that the filter and pipe are not clogged.

OK: The filter and pipe are not clogged.

NG: REPLACE OIL CONTROL VALVE FILTER OR PIPE

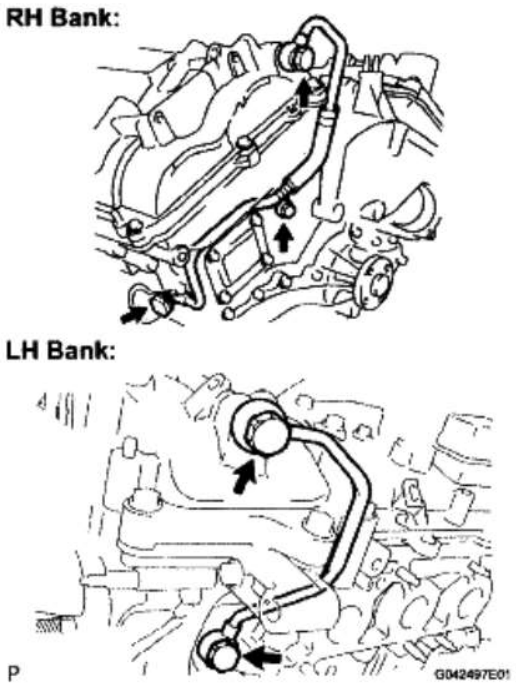


Fig. 56: Locating Oil Pipe Assembly Bolts
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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OK: Go to next step

7. **REPLACE CAMSHAFT TIMING GEAR ASSEMBLY**
8. **CHECK WHETHER DTC OUTPUT RECURS**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch on (IG) and turn the tester on.
   c. Clear the DTCs (See **DTC CHECK/CLEAR**).
   d. Start the engine and warm it up.
   e. Switch the check mode using the tester (See **CHECK MODE PROCEDURE**).
   f. Drive the vehicle for more than 10 minutes.
   g. Confirm that no DTC is set using the tester.

   OK: No DTC output.

   HINT:

   DTC P0017 or P0019 is output when foreign objects in engine oil are caught in some parts of the system. These codes will stay registered even if the system returns to normal after a short time. These foreign objects are then captured by the oil filter, thus eliminating the source of the problem.

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

   OK: END

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 P0051 OXYGEN (A/F) SENSOR HEATER CONTROL CIRCUIT LOW (BANK 2 SENSOR 1);
DTC P0052 OXYGEN (A/F) SENSOR HEATER CONTROL CIRCUIT HIGH (BANK 2 SENSOR 1)

HINT:

- Although the DTC titles say the 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.

DESCRIPTION

Refer to **DTC P2195** .

HINT:

- When any of these DTCs are set, 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.
- 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.

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Reference (System Diagram of Bank 1 Sensor 1):

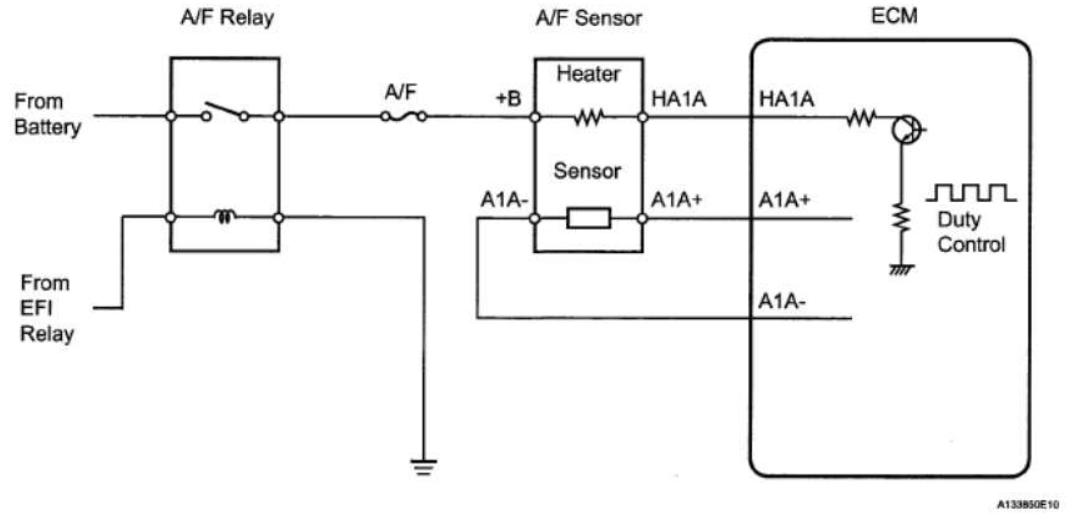


Fig. 57: System Diagram Of Bank 1 Sensor 1
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

DTC DETECTION CONDITION CHART

DTC No.	DTC Detection Condition	Trouble Area
P0031 P0051	Air fuel ratio sensor heater current less than 0.8 A (1 trip detection logic)	• Open in air fuel ratio sensor heater circuit • Air fuel ratio sensor heater (Bank 1, 2 Sensor 1) • A/F relay • ECM
P0032 P0052	Air-Fuel Ratio (A/F) sensor heater current fail (1 trip detection logic)	• Short in air fuel ratio sensor heater circuit • Air fuel ratio sensor heater (Bank 1, 2 Sensor 1) • A/F relay • ECM

HINT:

- Bank 1 refers to the bank that includes cylinder No. 1.
- Bank 2 refers to the bank that does not include cylinder No. 1.
- Sensor 1 refers to the closest sensor to the engine assembly.
- Sensor 2 refers to the furthest sensor away from the engine assembly.

MONITOR DESCRIPTION

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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 gas.

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 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 will be inaccurate, as a result, the ECM will be unable to regulate 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 sets a DTC.

Example:

The ECM sets DTC P0032 or P0052 when the current in the air fuel ratio sensor heater is fail. Conversely, when the heater current is less than 0.8 A, DTC P0031 or P0051 is set.

MONITOR STRATEGY

MONITOR STRATEGY REFERENCE CHART

Related DTCs	P0031: Air fuel ratio sensor heater (Bank 1) range check (Low current) P0032: Air fuel ratio sensor heater (Bank 1) range check (High current) P0051: Air fuel ratio sensor heater (Bank 2) range check (Low current) P0052: Air fuel ratio sensor heater (Bank 2) range check (High current)
Required sensors/components (Main)	Air fuel ratio sensor heater
Required sensors/components (Related)	-
Frequency of operation	Continuous
Duration	10 seconds
MIL operation	Immediate
Sequence operation	None

TYPICAL ENABLING CONDITIONS

All:

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TYPICAL ENABLING CONDITIONS CHART

The monitor will run whenever these DTCs are not present	None

P0031 and P0051:

TYPICAL ENABLING CONDITIONS CHART

Battery voltage	10.5 V or more
Heater ON duty ratio	50% or more
Time after engine starts	10 seconds or more

P0032 and P0052:

TYPICAL ENABLING CONDITIONS CHART

Time after engine starts	10 seconds or more

TYPICAL MALFUNCTION THRESHOLDS

P0031 and P0051:

TYPICAL MALFUNCTION THRESHOLDS REFERENCE CHART

Heater current	Less than 0.8 A

P0032 and P0052:

TYPICAL MALFUNCTION THRESHOLDS REFERENCE CHART

Hybrid IC high current limit port	Fail

COMPONENT OPERATING RANGE

COMPONENT OPERATING RANGE REFERENCE CHART

Air fuel ratio sensor heater current	0.8 A or more

MONITOR RESULT

Refer to **CHECKING MONITOR STATUS** .

WIRING DIAGRAM

Refer to **DTC P2195** .

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

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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. **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:

   Bank 1

   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

   Bank 2

   TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
1 (HA2A) - 2 (+B)	20°C (68°F)	1.8 to 3.4 ohms
1 (HA2A) - 4 (A2A-)	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)

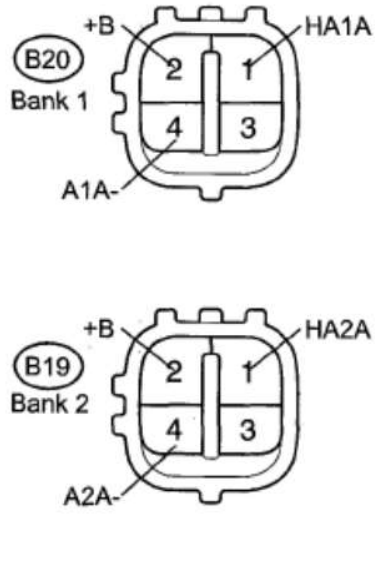


Fig. 58: Identifying Air Fuel Ratio Sensor Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

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

Standard voltage:

Bank 1

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Switch Condition	Specified Condition
B20-2 (+B) - Body ground	Ignition switch on (IG)	9 to 14 V

Bank 2

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Switch Condition	Specified Condition
B19-2 (+B) - Body ground	Ignition switch on (IG)	9 to 14 V

   d. Reconnect the air fuel ratio sensor connector.

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

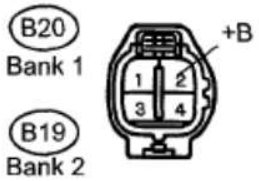


Fig. 59: Identifying Air Fuel Ratio Sensor +B Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

NG: Go to step 5

OK: Go to next step

3. **CHECK HARNESS AND CONNECTOR (AIR FUEL RATIO SENSOR RELAY - 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):

Bank 1

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
B20-1 (HA1A) - B2-2 (HA1A)	Always	Below 1 ohms

Bank 2

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
B19-1 (HA2A) - B2-1 (HA2A)	Always	Below 1 ohms

Standard resistance (Check for short):

Bank 1

TESTER CONNECTION SPECIFIED CONDITION CHART

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Tester Connection	Condition	Specified Condition
B20-1 (HA1A) or B2-2 (HA1A) - Body ground	Always	10 kohms or higher

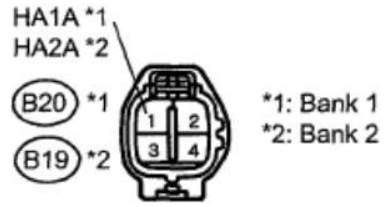
Bank 2

TESTER CONNECTION SPECIFIED CONDITION CHART

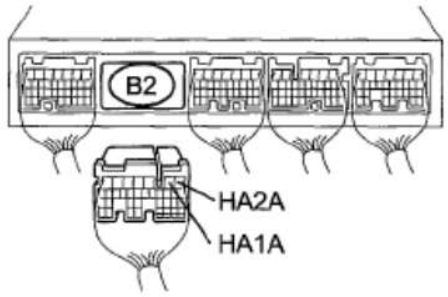
Tester Connection	Condition	Specified Condition
B19-1 (HA2A) or B2-1 (HA2A) - Body ground	Always	10 kohms or higher

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

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



Rear view of wire harness connector:
(to ECM)



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Fig. 60: Identifying Air Fuel Ratio Sensor And ECM Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR (AIR FUEL RATIO SENSOR - ECM)

OK: Go to next step

4. **CHECK WHETHER DTC OUTPUT RECURS**

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a. Connect the Techstream to the DLC3.
b. Turn the ignition switch on (IG).
c. Turn the tester on.
d. Clear the DTCs (See **DTC CHECK/CLEAR**).
e. Start the engine.
f. Allow the engine to idle for 1 minute or more.
g. Select the following menu items: Powertrain/Engine and ECT/Trouble Code.
h. Read the DTCs.

Result

RESULT CHART

Display (DTC Output)	Proceed to
No output	A
P0031, P0032, P0051 and/or P0052	B

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

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

5. **INSPECT FUSE (A/F FUSE)**
   a. Remove the A/F fuse 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
A/F fuse	Always	Below 1 ohms

   c. Reinstall the A/F fuse.

NG: REPLACE FUSE (A/F FUSE)

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Engine Room Relay Block:

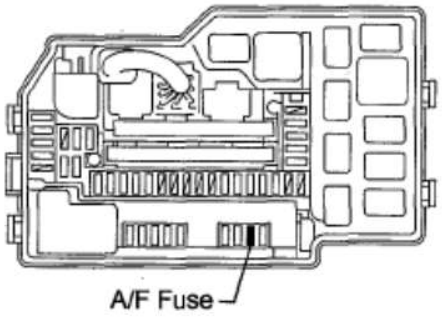


Fig. 61: Identifying A/F Fuse
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

6. **INSPECT ENGINE ROOM JUNCTION BLOCK ASSEMBLY (A/F RELAY)**
   a. Inspect the A/F relay (See **INSPECTION**).

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

   OK: REPAIR OR REPLACE HARNESS OR CONNECTOR (A/F FUSE - AIR FUEL RATIO SENSOR)

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 P0057 OXYGEN SENSOR HEATER CONTROL CIRCUIT LOW (BANK 2 SENSOR 2); DTC P0058 OXYGEN SENSOR HEATER CONTROL CIRCUIT HIGH (BANK 2 SENSOR 2); DTC P0141 OXYGEN SENSOR HEATER CIRCUIT MALFUNCTION (BANK 1 SENSOR 2); DTC P0161 OXYGEN SENSOR HEATER CIRCUIT MALFUNCTION (BANK 2 SENSOR 2)

HINT:

Sensor 2 refers to the sensor mounted behind the three-way catalytic converter and located furthest from the engine assembly.

DESCRIPTION

Refer to **DTC P0136** .

HINT:

When any of these DTCs are set, the ECM enters fail-safe mode. The ECM turns off the heated oxygen sensor

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heater in fail-safe mode. Fail-safe mode continues until the ignition switch is turned off.

Reference (System Diagram of Bank 1 Sensor 2):

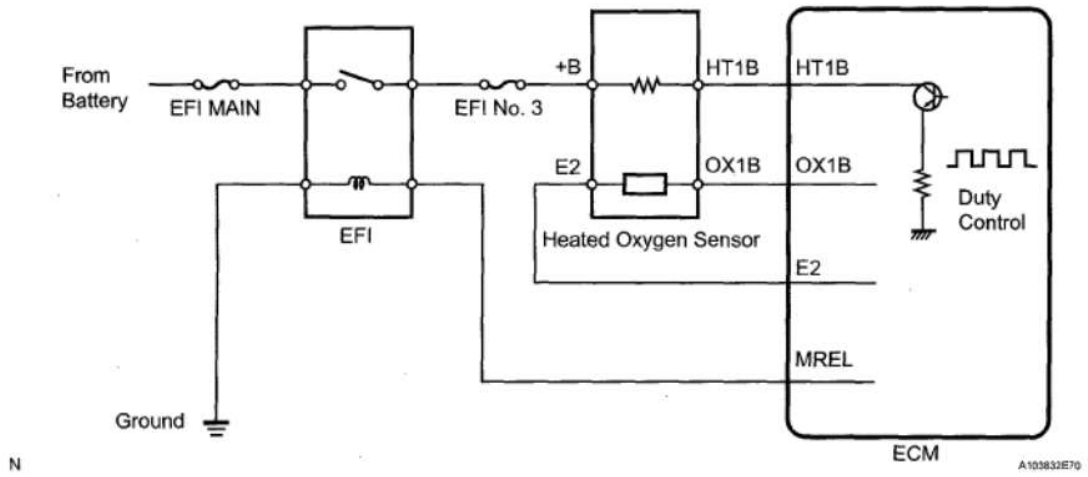


Fig. 62: System Diagram Of Bank 1 Sensor 2
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

DTC DETECTION CONDITION CHART

DTC No.	DTC Detection Condition	Trouble Area
P0037 P0057	Heated oxygen sensor heater current is less than 0.3 A (1 trip detection logic)	• Open in heated oxygen sensor heater circuit • Heated oxygen sensor heater • ECM
P0038 P0058	Heated oxygen sensor heater current is more than 2 A (1 trip detection logic)	• Open in heated oxygen sensor heater circuit • Heated oxygen sensor heater • ECM
P0141 P0161	Cumulative heater resistance correction value exceeds the acceptable threshold (2 trip detection logic)	• Heated oxygen sensor • ECM

HINT:

- Bank 1 refers to the bank that includes cylinder No. 1.
- Bank 2 refers to the bank that does not include cylinder No. 1.
- Sensor 1 refers to the sensor closest to the engine assembly.
- Sensor 2 refers to the sensor furthest away from the engine assembly.

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MONITOR DESCRIPTION

The sensing position 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, P0057 and P0058):

The ECM monitors the current applied to the heated oxygen sensor heater to check the heater for malfunctions. If the current is below the threshold value, the ECM will determine that there is an open circuit in the heater. If the current is above the threshold value, the ECM will determine that there is a short circuit in the heater.

Example:

The ECM sets DTC P0038 or P0058 when the current in the heated oxygen sensor heater is more than 2 A. Conversely, when the heater current is less than 0.3 A, DTC P0037 or P0057 is set.

Heated oxygen sensor heater performance (P0141 and P0161):

After the accumulated heater ON time exceeds 100 seconds, the ECM calculates the heater resistance using the battery voltage and the current applied to the heater. If the resistance is above the threshold value, the ECM will determine that there is a malfunction in the heated oxygen sensor heater and set DTC P0141 and P0161.

MONITOR STRATEGY

MONITOR STRATEGY REFERENCE CHART

Related DTCs	P0037: Heated oxygen sensor heater (bank 1) open/short (Low electrical current) P0038: Heated oxygen sensor heater (bank 1) open/short (High electrical current) P0057: Heated oxygen sensor heater (bank 2) open/short (Low electrical current) P0058: Heated oxygen sensor heater (bank 2) open/short (High electrical current) P0141: Heated oxygen sensor heater performance (bank 1 sensor 2) P0161: Heated oxygen sensor heater performance (bank 2 sensor 2)
Required Sensors/Components (Main)	Heated oxygen sensor heater (bank 1 and 2)
Required Sensors/Components (Related)	Vehicle speed sensor
Frequency of Operation	Continuous
Duration	0.5 seconds: P0037 and P0057 1 second: P0038 and P0058 10 seconds: P0141 and P0161

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MIL Operation	Immediate: P0037, P0038, P0057 and P0058 2 driving cycles: P0141 and P0161
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

All:

TYPICAL ENABLING CONDITIONS CHART

The monitor will run whenever these DTCs are not present	None

P0037 and P0057:

TYPICAL ENABLING CONDITIONS CHART

Battery voltage	10.5 to 20 V

P0038 and P0058:

TYPICAL ENABLING CONDITIONS CHART

Battery voltage	10.5 V or more
Engine	Running
Starter	OFF

P0141 and P0161:

TYPICAL ENABLING CONDITIONS CHART

One of the following conditions is met:	Condition A or B
A. All of the following conditions are met:	Conditions 1, 2, 3, 4 and 5
1. Battery voltage	10.5 V or more
2. Fuel cut	OFF
3. Time after fuel cut ON to OFF	30 seconds or more
4. Accumulated heater ON time	100 seconds or more
5. Learned heater OFF current operation	Completed
B. Duration that rear heated oxygen sensor impedance is less than 15 kohms	2 seconds or more

TYPICAL MALFUNCTION THRESHOLDS

P0037 and P0057:

TYPICAL MALFUNCTION THRESHOLDS REFERENCE CHART

Heater Current - Learned heater OFF current	Less than 0.3 A

P0038 and P0058:

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TYPICAL MALFUNCTION THRESHOLDS REFERENCE CHART

Learned heater OFF current	More than 2 A
Heater Current - Learned heater OFF current	2 A or more

P0141 and P0161 (Heater performance monitor check):

TYPICAL MALFUNCTION THRESHOLDS REFERENCE CHART

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

COMPONENT OPERATING RANGE

COMPONENT OPERATING RANGE REFERENCE CHART

Heated oxygen sensor heater current	0.3 to 2 A (when engine idles, heated oxygen sensor warmed up and battery voltage 11 to 14 V)

MONITOR RESULT

Refer to **CHECKING MONITOR STATUS** .

WIRING DIAGRAM

Refer to **DTC P0136** .

INSPECTION PROCEDURE

HINT:

- If other DTCs relating to different systems that have terminal E2 as the ground terminal are output simultaneously, terminal E2 may have an open 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. **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:

   Bank 1

   TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition

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

Bank 2

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
1 (HT2B) - 2 (+B)	20°C (68°F)	11 to 16 ohms
1 (HT2B) - 4 (E2)	Always	10 kohms or higher

c. Reconnect the heated oxygen sensor connector.

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

Component without harness connected:
(Heated Oxygen Sensor)

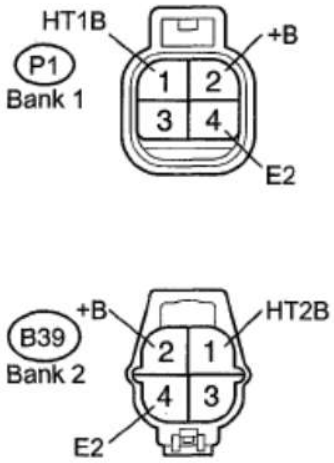


Fig. 63: Identifying Heated Oxygen Sensor Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

2. **CHECK TERMINAL VOLTAGE (+B TERMINAL OF HEATED OXYGEN SENSOR)**
   a. Disconnect the heated oxygen sensor connector.
   b. Turn the ignition switch on (IG).
   c. Measure the voltage according to the value(s) in the table below.

Standard voltage:

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Bank 1

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Switch Condition	Specified Condition
P1-2 (+B) - Body ground	Ignition switch on (IG)	9 to 14 V

Bank 2

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Switch Condition	Specified Condition
B39-2 (+B) - Body ground	Ignition switch on (IG)	9 to 14 V

d. Reconnect the heated oxygen sensor connector.

NG: Go to step 5

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

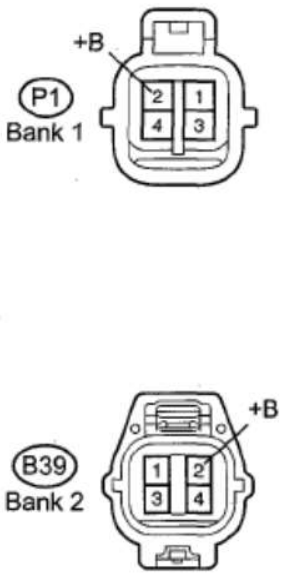


Fig. 64: Identifying Heated Oxygen Sensor +B Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

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

Standard resistance (Check for open):

Bank 1

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
P1-1 (HT1B) - B1-1 (HT1B)	Always	Below 1 ohms

Bank 2

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
B39-1 (HT2B) - B2-5 (HT2B)	Always	Below 1 ohms

Standard resistance (Check for short):

Bank 1

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
P1-1 (HT1B) or B1-1 (HT1B) - Body ground	Always	10 kohms or higher

Bank 2

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
B39-1 (HT2B) or B2-5 (HT2B) - Body ground	Always	10 kohms or higher

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

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR (HEATED OXYGEN SENSOR - ECM)

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

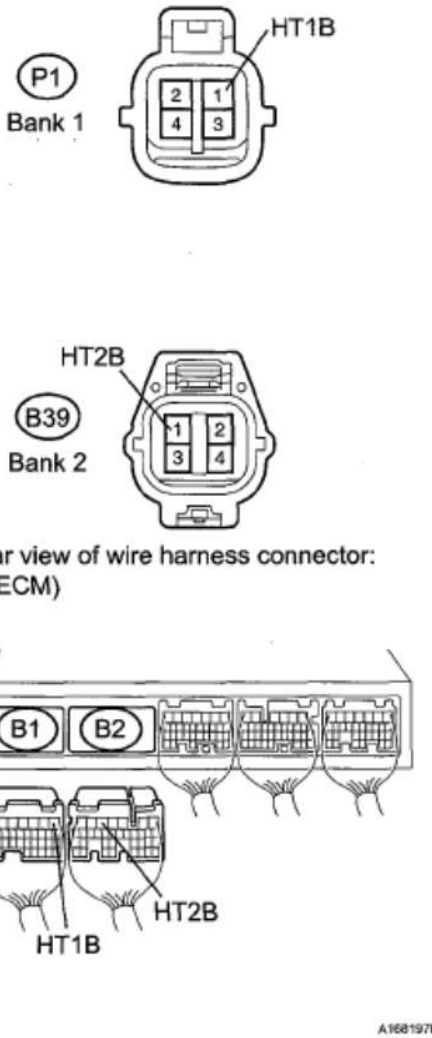


Fig. 65: Identifying Heated Oxygen Sensor And ECM Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

4. **CHECK WHETHER DTC OUTPUT RECURS**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch on (IG).
   c. Turn the tester on.
   d. Clear the DTCs (See **DTC CHECK/CLEAR**).

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e. Start the engine.
f. Allow the engine to idle for 1 minute or more.
g. Select the following menu items: Powertrain/Engine and ECT/Trouble Code.
h. Read the DTCs.

Result

RESULT CHART

Display (DTC Output)	Proceed to
No output	A
P0037, P0038, P0057, P0058, P0141 and/or P0161	B

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

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

5. **INSPECT FUSE (EFI NO. 3 FUSE)**
   a. Remove the EFI No. 3 fuse 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

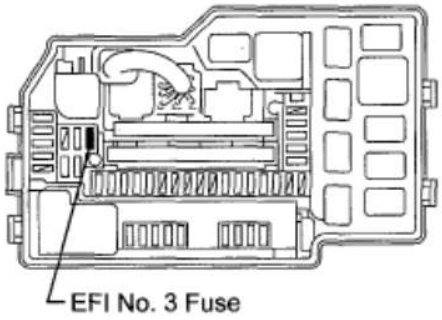
Tester Connection	Condition	Specified Condition
EFI No. 3 fuse	Always	Below 1 ohms

   c. Reinstall the EFI No. 3 fuse.

NG: REPLACE FUSE (EFI NO. 3)

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Engine Room Relay Block:



N A168235E02

Fig. 66: Identifying EFI No. 3 Fuse
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: REPAIR OR REPLACE HARNESS OR CONNECTOR (EFI NO. 3 FUSE - HEATED OXYGEN SENSOR)

DTC P0100 MASS OR VOLUME AIR FLOW CIRCUIT; 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 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, changing their resistance. To maintain a constant current value, the ECM varies the voltage applied to these components in the mass air flow meter. The voltage level is proportional to the air flow 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 provide 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 are set, the ECM enters fail-safe mode. During fail-safe mode, the ignition timing is calculated by the ECM, according to the engine RPM and throttle valve position. Fail-safe mode continues until a pass condition is detected.

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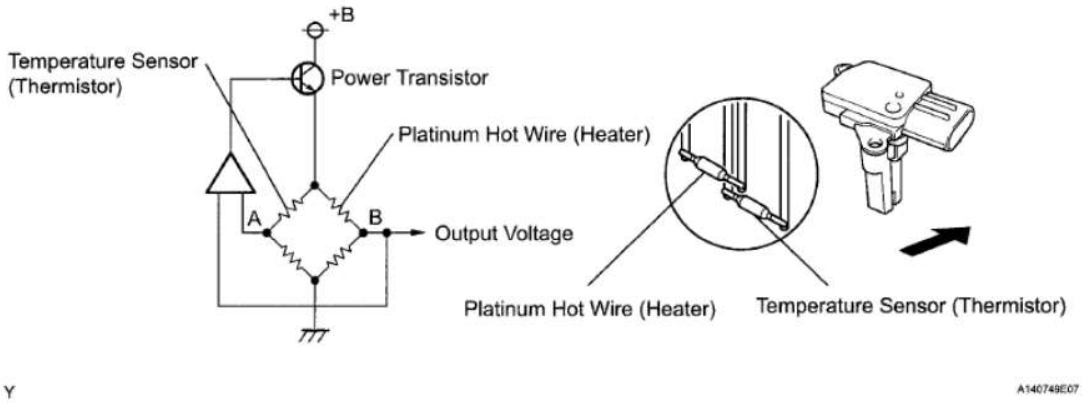


Fig. 67: Temperature Sensor Circuit
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

DTC DETECTION CONDITION CHART

DTC No.	DTC Detection Condition	Trouble Area
P0100	Open or short in mass air flow meter circuit for 3 seconds	• Open or short in mass air flow meter circuit • Mass air flow meter • ECM
P0102	Open in mass air flow circuit for 3 seconds	• Open in mass air flow meter circuit • Short in ground circuit • Mass air flow meter • ECM
P0103	Short in mass air flow circuit for 3 seconds	• Short in mass air flow meter circuit (+B circuit) • Mass air flow meter • ECM

HINT:

When any of these DTCs are set, check the air flow rate by selecting the following menu items:

Powertrain/Engine and ECT/Data List/All Data/MAF.

MASS AIR FLOW REFERENCE CHART

Mass Air Flow Rate (gm/s)	Malfunctions
Approximately 0.0	• Open in mass air flow meter power source circuit • Open or short in VG circuit
271.0 or more	Open in E2G circuit

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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 and sets a DTC.

Example:

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

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

MONITOR STRATEGY

MONITOR STRATEGY REFERENCE CHART

Related DTCs	P0100: Mass air flow meter range check (Fluctuating) 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 RPM less than 4000 rpm 2 driving cycles: Engine RPM 4000 rpm or more
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

TYPICAL ENABLING CONDITIONS CHART

The monitor will run whenever these DTCs are not present	None

TYPICAL MALFUNCTION THRESHOLDS

P0100:

TYPICAL MALFUNCTION THRESHOLDS REFERENCE CHART

Mass air flow meter voltage	Less than 0.2 V, or more than 4.9 V

P0102:

TYPICAL MALFUNCTION THRESHOLDS REFERENCE CHART

Mass air flow meter voltage	Less than 0.2 V

P0103:

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TYPICAL MALFUNCTION THRESHOLDS REFERENCE CHART

Mass air flow meter voltage	More than 4.9 V

COMPONENT OPERATING RANGE

COMPONENT OPERATING RANGE REFERENCE CHART

Mass air flow meter voltage	Between 0.2 V and 4.9 V

WIRING DIAGRAM

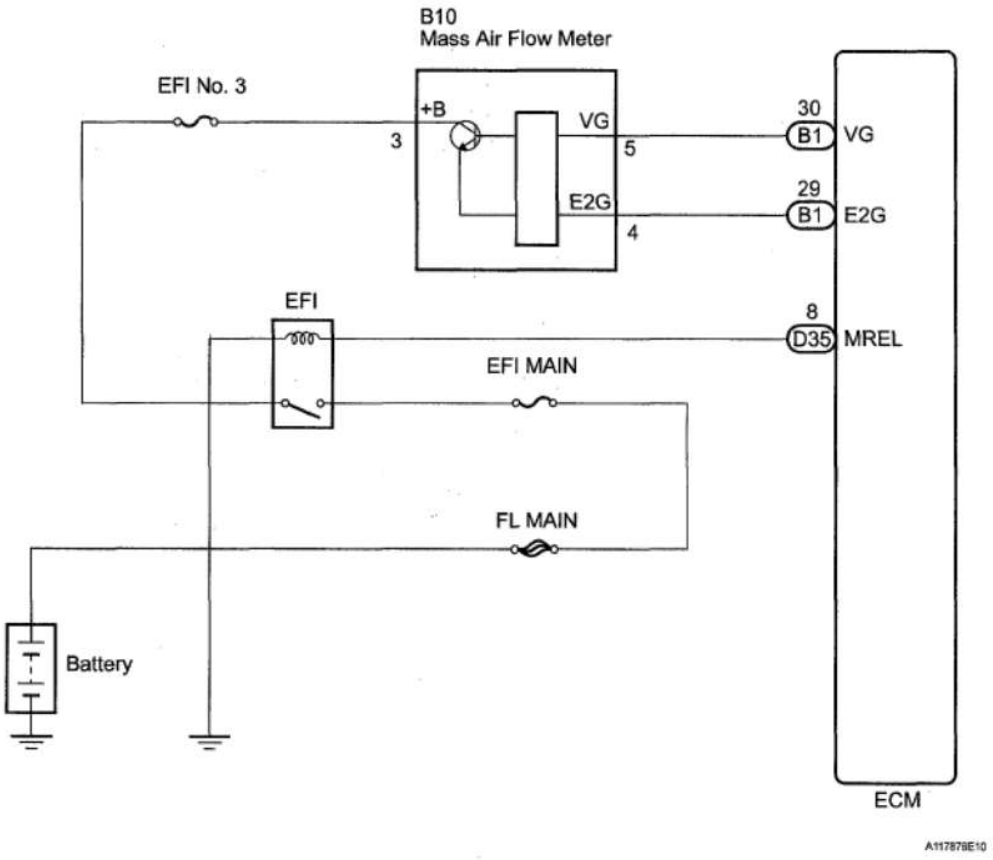


Fig. 68: Mass Air Flow - Wiring Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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 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.

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1. **READ VALUE USING TECHSTREAM (MASS AIR FLOW RATE)**
   a. Connect the Techstream to the DLC3.
   b. Start the engine.
   c. Turn the tester on.
   d. Select the following menu items: Powertrain/Engine and ECT/Data List/All Data/MAF.
   e. Read the values displayed on the tester.

   Result

   RESULT CHART

Mass Air Flow Rate (gm/s)	Proceed to
0.0	A
271.0 or more	B
Between 1.0 and 270.0 ((1))	C
(1) The value must be changed when the throttle valve is open or closed.	

   B: Go to step 6

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

   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 on (IG).
   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 (IG)	9 to 14 V

   d. Reconnect the mass air flow meter connector.

   NG: Go to step 5

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

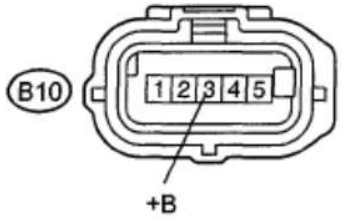


Fig. 69: Identifying Mass Air Flow Meter Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

3. **INSPECT ECM (VG VOLTAGE)**
   a. Start the engine.
   b. Measure the voltage between the terminals of the ECM connector.

   HINT:

   The transmission gear selector lever should be in the P or N position and the A/C switch should be turned off.

   Standard voltage

   TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
B1-30 (VG) - B1-29 (E2G)	Engine idling	0.5 to 3.0 V

   NG: Go to step 4

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Component with harness connected:
(ECM)

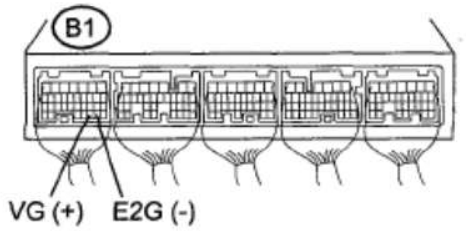


Fig. 70: Identifying ECM Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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

4. **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) - B1-30 (VG)	Always	Below 1 ohms
B10-4 (E2G) - B1-29 (E2G)	Always	Below 1 ohms

Check for short

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
B10-5 (VG) or B1-30 (VG) - Body ground	Always	10 kohms or higher
B10-4 (E2G) or B1-29 (E2G) - Body ground	Always	10 kohms or higher

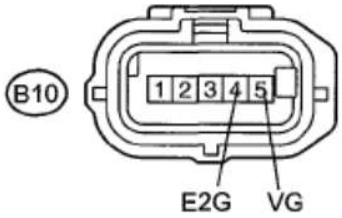
   d. Reconnect the mass air flow meter connector.
   e. Reconnect the ECM connector.

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

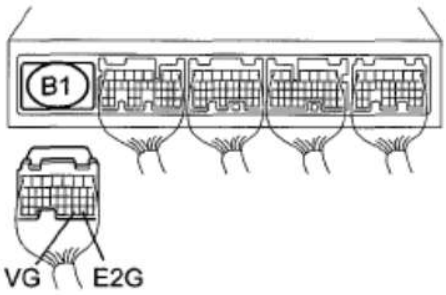
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ECM)

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



Rear view of wire harness connector:
(to ECM)



A168200E04

Fig. 71: Identifying Mass Air Flow Meter And ECM Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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

5. **INSPECT FUSE (EFI NO. 3 FUSE)**
   a. Remove the EFI No. 3 fuse 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

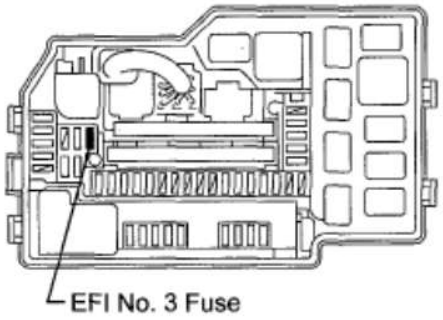
Tester Connection	Condition	Specified Condition
EFI No. 3 fuse	Always	Below 1 ohms

   c. Reinstall the EFI No. 3 fuse.

NG: REPLACE EFI NO. 3 FUSE

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Engine Room Relay Block:



N A168235E02

Fig. 72: Identifying EFI No. 3 Fuse
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: REPAIR OR REPLACE HARNESS OR CONNECTOR (MASS AIR FLOW METER - NO. 3 FUSE)

6. **INSPECT ECM (SENSOR GROUND)**
   a. Measure the resistance according to the value(s) in the table below.

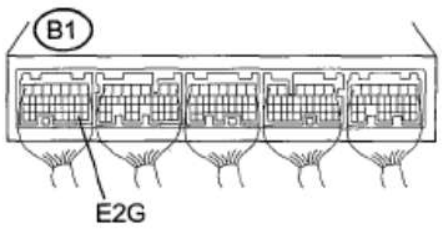
Standard resistance

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
B1-29 (E2G) - Body ground	Always	Below 1 ohms

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

Component with harness connected:
(ECM)



A168199E14

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Fig. 73: Identifying ECM Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

7. **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) - B1-30 (VG)	Always	Below 1 ohms
B10-4 (E2G) - B1-29 (E2G)	Always	Below 1 ohms

Check for short

TESTER CONNECTION SPECIFIED CONDITION CHART

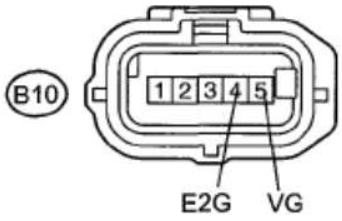
Tester Connection	Condition	Specified Condition
B10-5 (VG) or B1-30 (VG) - Body ground	Always	10 kohms or higher
B10-4 (E2G) or B1-29 (E2G) - Body ground	Always	10 kohms or higher

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

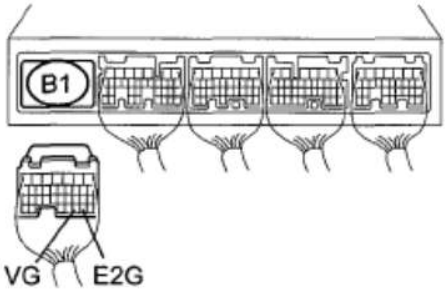
NG: REPAIR OR REPLACE HARNESS OR CONNECTOR (MASS AIR FLOW METER - ECM)

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



Rear view of wire harness connector:
(to ECM)



A168200E04

Fig. 74: Identifying Mass Air Flow Meter And ECM Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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

DTC P0101 MASS OR VOLUME AIR FLOW CIRCUIT RANGE/PERFORMANCE PROBLEM

DESCRIPTION

Refer to **DTC P0100** .

DTC DETECTION CONDITION CHART

DTC No.	DTC Detection Condition	Trouble Area
P0101	Conditions (a), (b), (c), (d) and (e) continue for more than 10 seconds (2 trip detection logic): a. Engine running b. Engine coolant temperature 70°C (158°F) or higher c. Throttle Position (TP) sensor voltage 0.24 V or more d. Average engine load value ratio less than 0.85, or more than 1.39	• Mass Air Flow (MAF) meter • Air induction system

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	(varies with estimated engine load) Average engine load value ratio = Average engine load based on MAF meter output/Average engine load estimated from driving conditions e. Average air-fuel ratio less than -20%, or more than 20%	• 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, changing their resistance. To maintain a constant current value, the ECM varies the voltage applied to these components of 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.

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

Example:

If the voltage is more than 2.2 V, or less than 0.73 V while idling, the ECM determines that there is a malfunction in the mass air flow meter and sets the DTC.

MONITOR STRATEGY

MONITOR STRATEGY REFERENCE CHART

Related DTCs	P0101: Mass air flow meter rationality
Required Sensors/Components (Main)	Mass air flow meter
Required Sensors/Components (Related)	Crankshaft position sensor, engine coolant temperature sensor and throttle position sensor
Frequency of Operation	Continuous
Duration	10 times
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 present	None
Throttle position (Throttle position sensor voltage)	0.24 V or more
Engine	Running
Battery voltage	10.5 V or more

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Engine coolant temperature	70°C (158°F) or more
Intake air temperature sensor current (P0110, P0112)	OK
Engine coolant temperature sensor current (P0115, P0117, P0118)	OK
Crankshaft position sensor current (P0335)	OK
Throttle position sensor current (P0120, P0121, P0122, P0123)	OK
Fuel tank pressure sensor (P0452, P0453)	OK
EVAP leak detection pump (P2401, P2402)	OK
EVAP vent valve (P2419, P2420)	OK

TYPICAL MALFUNCTION THRESHOLDS

TYPICAL MALFUNCTION THRESHOLDS REFERENCE CHART

Both of following conditions 1 and 2 met	-
1. Averaged engine load value ratio	Less than 0.85, or more than 1.39 (varies with estimated engine load)
2. Averaged air-fuel ratio	Less than -20%, or more than 20%

WIRING DIAGRAM

Refer to **DTC P0100** .

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.

1. **CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P0101)**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch on (IG).
   c. Turn the tester on.
   d. Select the following menu items: Powertrain/Engine and ECT/Trouble Code.
   e. Read the DTCs.

   Result

   RESULT CHART

Display (DTC Output)	Proceed to
P0101 and other DTCs	A
P0101	B

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HINT:

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

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

A: GO TO **DTC CHART**

DTC P0110 INTAKE AIR TEMPERATURE CIRCUIT; DTC P0112 INTAKE AIR TEMPERATURE CIRCUIT LOW INPUT; DTC P0113 INTAKE AIR TEMPERATURE CIRCUIT HIGH INPUT

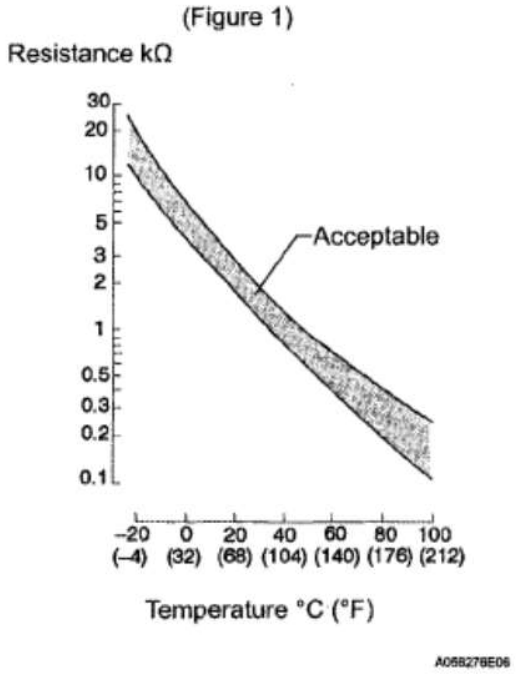
DESCRIPTION

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. 75**).

The intake air temperature sensor is powered by a 5 V applied 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.

(Figure 1)



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Fig. 75: Temperature/Resistance Graph
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

HINT:

When any of DTCs P0110, P0112 and P0113 are set, the ECM enters fail-safe mode. During fail-safe mode, the intake air 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.	Proceed to	DTC Detection Condition	Trouble Area
P0110	Step 1	Open or short in intake air temperature sensor circuit for 0.5 seconds (1 trip detection logic)	• Open or short in intake air temperature sensor circuit • Intake air temperature sensor (built into mass air flow meter) • ECM
P0112	Step 4	Short in 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	Step 2	Open in 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 set, check the IAT by selecting the following menu items: Powertrain/Engine and ECT/Data List/All Data/Intake Air.

TEMPERATURE RESISTANCE REFERENCE CHART

Temperature Displayed	Malfunctions
-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 sets a DTC.

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Example:

If the sensor voltage output is -40°C (-40°F) for 0.5 seconds or more, the ECM determines that there is an open in the intake air temperature sensor circuit, and sets DTC P0113. Conversely, if the voltage output is more than 140°C (284°F) for 0.5 seconds or more, the ECM determines that there is a short in the sensor circuit, and sets DTC P0112.

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

MONITOR STRATEGY

MONITOR STRATEGY REFERENCE CHART

Related DTCs	P0110: Intake air temperature sensor open/short (Fluctuating) P0112: Intake air temperature sensor short (Low electrical voltage) P0113: Intake air temperature sensor open (High electrical voltage)
Required Sensors/Components (Main)	Intake air 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

The monitor will run whenever these DTCs are not present	None

TYPICAL MALFUNCTION THRESHOLDS

P0110:

TYPICAL MALFUNCTION THRESHOLDS REFERENCE CHART

Intake air temperature sensor voltage	Less than 0.18 V or more than 4.91 V

P0112:

TYPICAL MALFUNCTION THRESHOLDS REFERENCE CHART

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

P0113:

TYPICAL MALFUNCTION THRESHOLDS REFERENCE CHART

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

COMPONENT OPERATING RANGE

COMPONENT OPERATING RANGE REFERENCE CHART

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

WIRING DIAGRAM

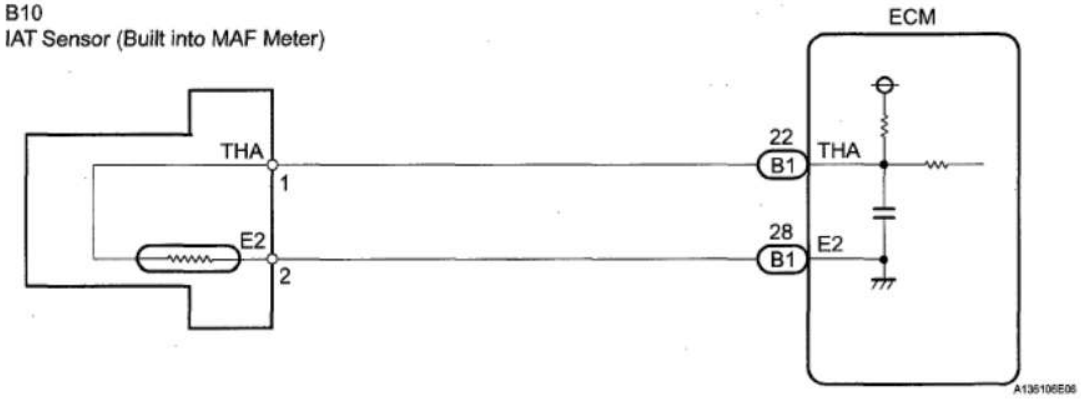


Fig. 76: Intake Air Temperature - Wiring Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSPECTION PROCEDURE

HINT:

- If other DTCs relating to different systems that have terminal E2 as the ground terminal are output simultaneously, terminal E2 may have an open 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. **READ VALUE USING TECHSTREAM (INTAKE AIR TEMPERATURE)**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch on (IG).
   c. Turn the tester on.
   d. Select the following menu items: Powertrain/Engine and ECT/Data List/Intake Air.
   e. Read the value displayed on the tester.

   Standard: Same as actual intake air temperature.

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Result

RESULT CHART

Temperature Displayed	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 THA and E2 of the mass air flow meter wire harness side connector.
   c. Connect the Techstream to the DLC3.
   d. Turn the ignition switch on (IG).
   e. Turn the tester on.
   f. Select the following menu items: Powertrain/Engine and ECT/Data List/Intake Air.
   g. Read the value displayed on the tester.

   Standard: 140°C (284°F) or higher

   h. Reconnect the mass air flow meter connector.

   NG: Go to step 3

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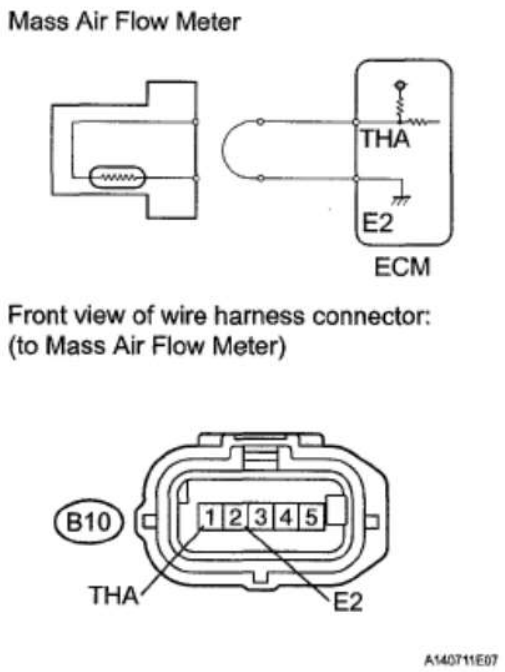


Fig. 77: Identifying Mass Air Flow Meter Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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
B1-22 (THA) - B10-1 (THA)	Always	Below 1 ohms
B1-28 (E2) - B10-2 (E2)	Always	Below 1 ohms

Check for short

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
B1-22 (THA) or B10-1 (THA) - Body ground	Always	10 kohms or higher
B1-28 (E2) or B10-2 (E2) - Body ground	Always	10 kohms or higher

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

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

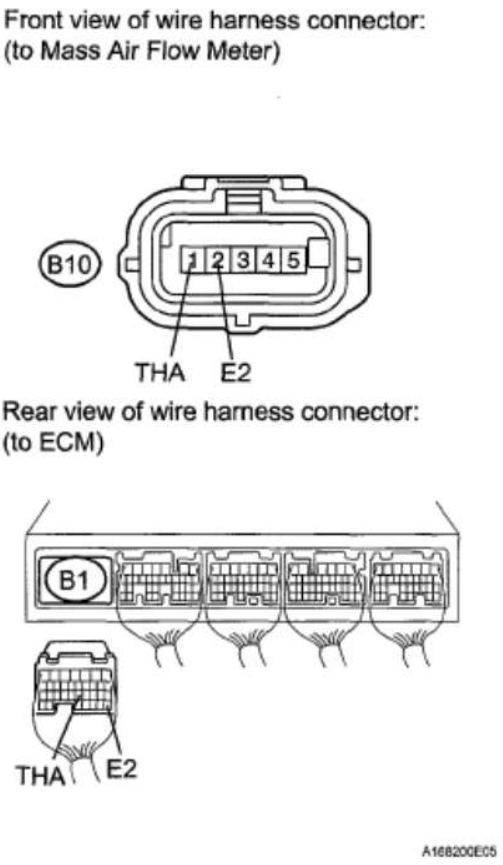


Fig. 78: Identifying Mass Air Flow Meter And ECM Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: REPAIR OR REPLACE HARNESS OR CONNECTOR (MASS AIR FLOW METER - ECM)

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 on (IG).
   d. Turn the tester on.
   e. Select the following menu items: Powertrain/Engine and ECT/Data List/Intake Air.
   f. Read the value displayed on the tester.

Standard: -40°C (-40°F)

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g. Reconnect the mass air flow meter connector.

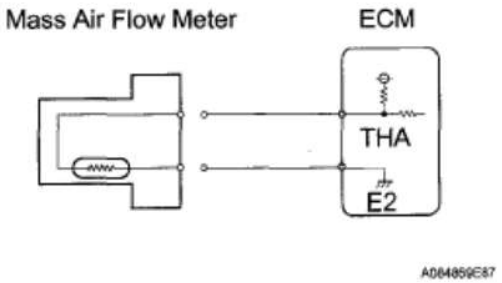


Fig. 79: Identifying Mass Air Flow Meter Connection With ECM
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

NG: Go to step 5

OK: REPLACE MASS AIR FLOW METER

5. **CHECK HARNESS AND CONNECTOR (MASS AIR FLOW METER - ECM)**
   a. Disconnect the mass air flow meter connector.
   b. Connect the Techstream to the DLC3.
   c. Turn the ignition switch on (IG).
   d. Turn the tester on.
   e. Select the following menu items: Powertrain/Engine and ECT/Data List/Intake Air.
   f. Read the value displayed on the tester.

   Standard: -40°C (-40°F)

   g. Reconnect the mass air flow meter connector.

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

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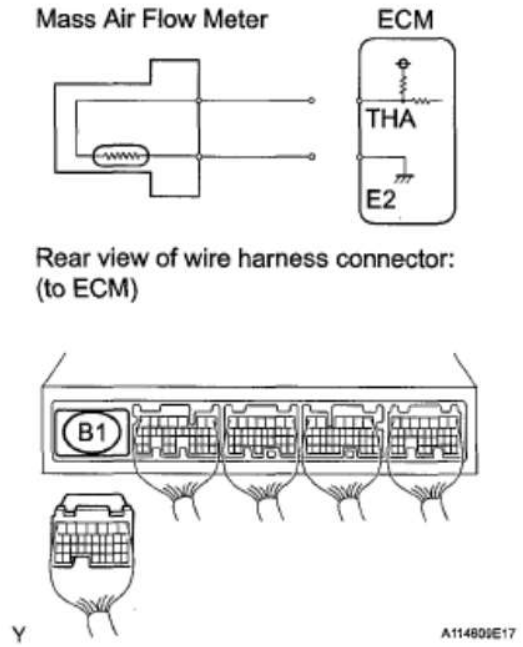


Fig. 80: Identifying ECM Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: REPAIR OR REPLACE HARNESS OR CONNECTOR (MASS AIR FLOW METER - ECM)

DTC P0111 INTAKE AIR TEMPERATURE SENSOR GRADIENT TOO HIGH

DESCRIPTION

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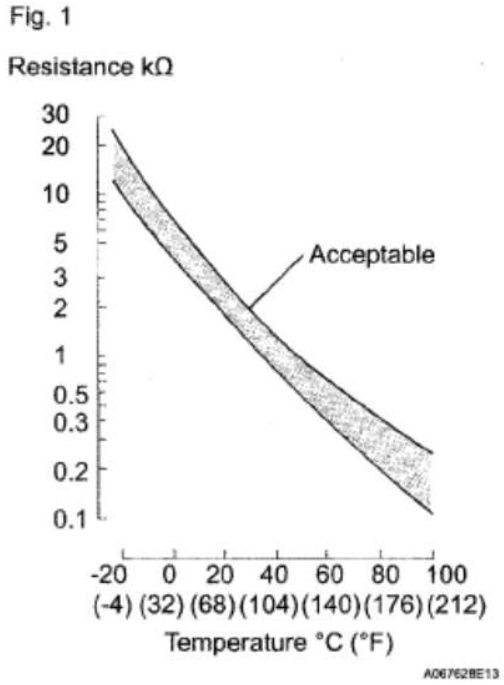


Fig. 81: Temperature Resistance Characteristic Graph
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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 becomes low, the resistance of the thermistor increases. When the temperature becomes high, the resistance drops. These variations in resistance are transmitted to the ECM as voltage changes (see **Fig. 81**).

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
P0111	1. The intake air temperature rise becomes larger, from the previous trip warm-up to the following trip. (2 trip detection logic) 2. When the change in the intake air temperature after engine start is less than the threshold value.	Mass air flow meter assembly

MONITOR DESCRIPTION

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The ECM performs OBD II monitoring based on the values from the intake air temperature sensor. If there is no change in the sensor value, the ECM will not be able to perform OBD II monitoring or will misdiagnose that there is a malfunction in the sensor. The ECM detects the stuck intake air temperature sensor value by performing monitoring after the ignition switch is turned off or the ignition is started (short soak or long soak).

MONITOR STRATEGY

MONITOR STRATEGY REFERENCE 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 (IAT) sensor
Required Sensors/Components (Sub)	-
Frequency of Operation	Once per driving cycle
Duration	5 hours
MIL Operation	2 driving cycles
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

All:

TYPICAL ENABLING CONDITIONS CHART

The monitor will run whenever these DTCs are not present	None

After engine stop:

TYPICAL ENABLING CONDITIONS CHART

Time after engine start	10 seconds or more
Battery voltage	10.5 V or more
Engine coolant temperature sensor	OK
Engine coolant temperature change since engine stopped	Less than 180°C (356°F)
Engine coolant temperature before engine stop	70°C (158°F) or more
Time that mass air flow is low before engine stop	70 minutes
Accumulated mass air flow amount before engine stop	1720 g or more
Key-off duration	30 minutes

After cold engine start:

TYPICAL ENABLING CONDITIONS CHART

Key-off duration	5 hours
Time after engine start	10 seconds or more
Engine coolant temperature sensor	OK

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Engine coolant temperature	70°C (158°F) or more
Accumulated mass air flow amount	1720 g or more
One 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

TYPICAL MALFUNCTION THRESHOLDS

After engine stop:

TYPICAL MALFUNCTION THRESHOLDS REFERENCE CHART

Intake air temperature change	Less than 1°C (33.8°F)

After cold engine start:

TYPICAL MALFUNCTION THRESHOLDS REFERENCE CHART

Intake air temperature change	Less than 1°C (33.8°F)

WIRING DIAGRAM

Refer to **DTC P0110** .

INSPECTION PROCEDURE

1. **CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P0111)**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch on (IG).
   c. Turn the tester on.
   d. Select the following menu items: Powertrain/Engine and ECT/Trouble Code.
   e. Read the DTCs.

   Result

   RESULT CHART

Display (DTC Output)	Proceed to
P0111 and other DTCs	A
P0111	B

   HINT:

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

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

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A: GO TO **DTC CHART**

DTC P0115 ENGINE COOLANT TEMPERATURE CIRCUIT; DTC P0117 ENGINE COOLANT TEMPERATURE CIRCUIT LOW INPUT; DTC P0118 ENGINE COOLANT TEMPERATURE CIRCUIT HIGH INPUT

DESCRIPTION

A thermistor is built into the engine coolant temperature sensor, of which the resistance value varies according to the engine coolant temperature.

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 are set, the ECM enters fail-safe mode. During fail-safe mode, 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.	Proceed to	DTC Detection Condition	Trouble Area
P0115	Step 1	Open or short in 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	Step 4	Short in 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	Step 2	Open in 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 set, check the engine coolant temperature by selecting the following menu items: Powertrain/Engine and ECT/Data List/All Data/Coolant Temp.

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TEMPERATURE RESISTANCE REFERENCE CHART

Temperature Displayed	Malfunctions
-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 becomes low, the resistance in the thermistor increases. When the temperature becomes high, the resistance drops.

These variations in resistance are reflected in the voltage output 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 and sets a DTC.

Example:

If the sensor voltage output is -40°C (-40°F) for 0.5 seconds or more, the ECM determines that there is an open in the engine coolant temperature sensor circuit, and sets DTC P0118. Conversely, if the voltage output is more than 140°C (284°F) for 0.5 seconds or more, the ECM determines that there is a short in the sensor circuit, and sets DTC P0117.

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

MONITOR STRATEGY

MONITOR STRATEGY REFERENCE CHART

Related DTCs	P0115: Engine coolant temperature sensor open/short (Fluctuating) P0117: Engine coolant temperature sensor short (Low electrical voltage) P0118: Engine coolant temperature sensor open (High electrical 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

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The monitor will run whenever these DTCs are not present	None

TYPICAL MALFUNCTION THRESHOLDS

P0115:

TYPICAL MALFUNCTION THRESHOLDS REFERENCE CHART

Engine coolant temperature sensor voltage	Less than 0.14 V or more than 4.91 V

P0117:

TYPICAL MALFUNCTION THRESHOLDS REFERENCE CHART

Engine coolant temperature sensor voltage	Less than 0.14 V [More than 140°C (284°F)]

P0118:

TYPICAL MALFUNCTION THRESHOLDS REFERENCE CHART

Engine coolant temperature sensor voltage	More than 4.91 V [Less than -40°C (-40°F)]

COMPONENT OPERATING RANGE

COMPONENT OPERATING RANGE REFERENCE CHART

Engine coolant temperature sensor voltage	0.14 V to 4.91 V [-40 to 140°C (-40 to 284°F)]

WIRING DIAGRAM

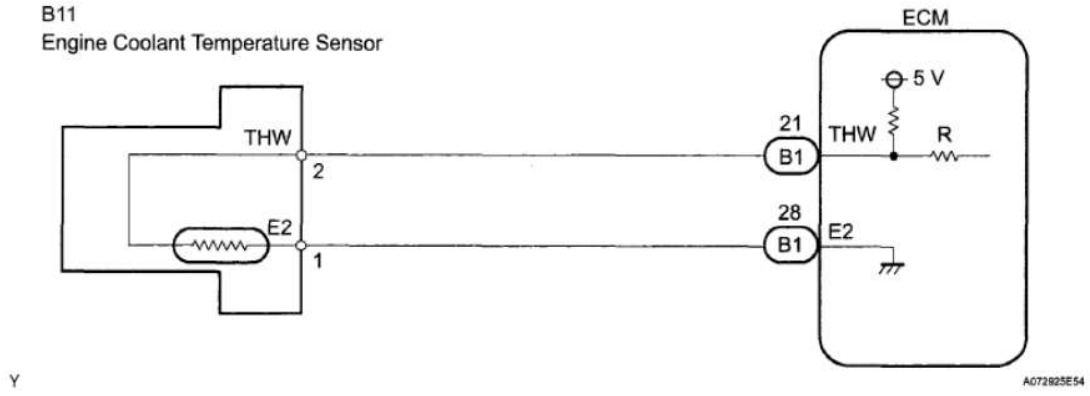


Fig. 82: Engine Coolant Temperature Sensor - Wiring Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSPECTION PROCEDURE

HINT:

- If other DTCs relating to different systems that have terminal E2 as the ground terminal are output

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simultaneously, terminal E2 may have an open 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. **READ VALUE USING TECHSTREAM (ENGINE COOLANT TEMPERATURE)**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch on (IG).
   c. Turn the tester on.
   d. Select the following menu items: Powertrain/Engine and ECT/Data List/Coolant Temp.
   e. Read the value displayed on the tester.

   Standard: Between 80°C and 97°C (176°F and 207°F) with warm engine.

   Result

   RESULT CHART

Temperature Displayed	Proceed to
-40°C (-40°F)	A
140°C (284°F) or higher	B
Between 80°C and 97°C (176°F and 207°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 on (IG).
   e. Turn the tester on.

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f. Select the following menu items: Powertrain/Engine and ECT/Data List/Coolant Temp.
g. Read the value displayed on the tester.

Standard: 140°C (284°F) or higher

h. Reconnect the engine coolant temperature sensor connector.

NG: Go to step 3

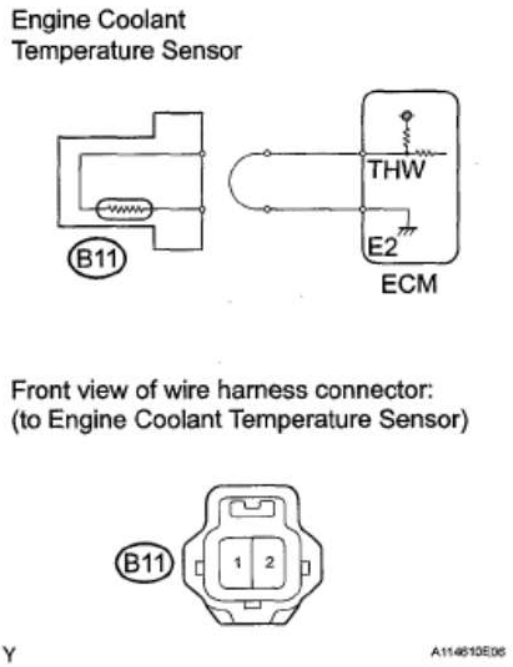


Fig. 83: Identifying Engine Coolant Temperature Sensor Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: REPLACE ENGINE COOLANT TEMPERATURE SENSOR (See **REMOVAL**)

3. **CHECK HARNESS AND CONNECTOR (ENGINE COOLANT TEMPERATURE SENSOR - ECM)**
   a. Confirm and connection at the engine coolant temperature sensor.
   b. Disconnect the engine coolant temperature sensor connector.
   c. Connect terminals THW and E2 of the ECM connector.

   HINT:

   Before checking, do visual and contact pressure checks on the ECM connector.

   d. Connect the Techstream to the DLC3.
   e. Turn the ignition switch on (IG).

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f. Turn the tester on.
g. Select the following menu items: Powertrain/Engine and ECT/Data List/Coolant Temp.
h. Read the value displayed on the tester.

Standard: 140°C (284°F) or higher

i. Reconnect the engine coolant temperature sensor connector.

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

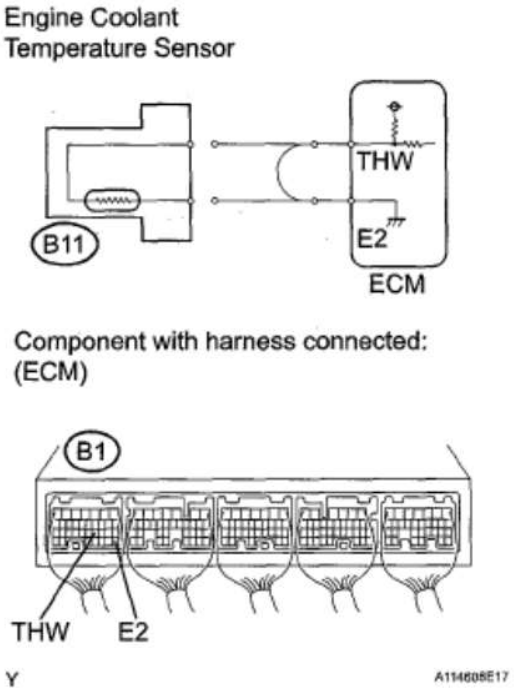


Fig. 84: Identifying B11 And B1 Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: REPAIR OR REPLACE HARNESS OR CONNECTOR (ENGINE COOLANT TEMPERATURE SENSOR - ECM)

4. **READ VALUE USING TECHSTREAM (CHECK FOR SHORT IN WIRE HARNESS)**
   a. Disconnect the engine coolant temperature sensor connector.
   b. Connect the Techstream to the DLC3.
   c. Turn the ignition switch on (IG).
   d. Turn the tester on.
   e. Select the following menu items: Powertrain/Engine and ECT/Data List/Coolant Temp.
   f. Read the value displayed on the tester.

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Standard: -40°C (-40°F)

g. Reconnect the engine coolant temperature sensor connector.

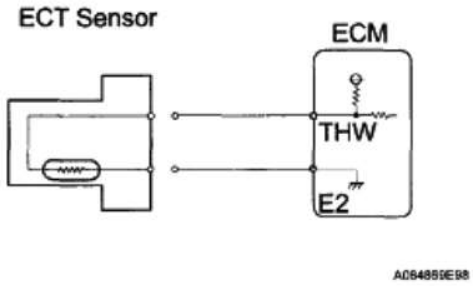


Fig. 85: Identifying ECT Senor Connection With ECM
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

NG: Go to step 5

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. Connect the Techstream to the DLC3.
   c. Turn the ignition switch on (IG).
   d. Turn the tester on.
   e. Select the following menu items: Powertrain/Engine and ECT/Data List/Coolant Temp.
   f. Read the value displayed on the tester.

   Standard: -40°C (-40°F)

   g. Reconnect the engine coolant temperature sensor connector.

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

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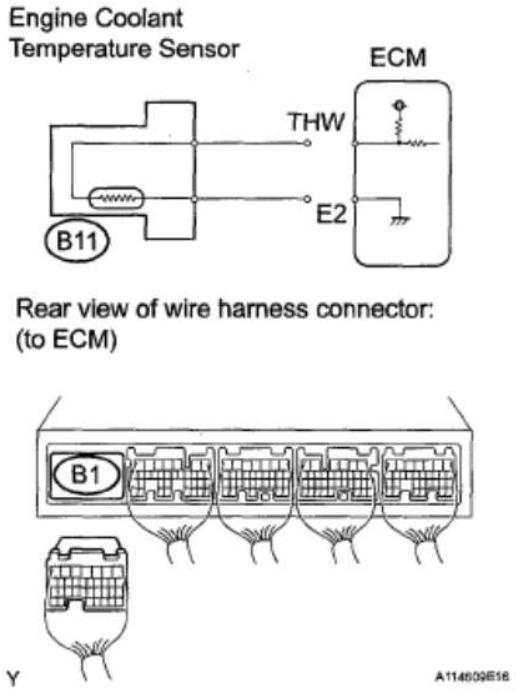


Fig. 86: Identifying B11 And B1 Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: REPAIR OR REPLACE HARNESS OR CONNECTOR (ENGINE COOLANT TEMPERATURE SENSOR - ECM)

DTC P0116 ENGINE COOLANT TEMPERATURE CIRCUIT RANGE/PERFORMANCE PROBLEM

DESCRIPTION

Refer to **DTC P0115** .

DTC DETECTION CONDITION CHART

DTC No.	DTC Detection Condition	Trouble Area
P0116	When either of following conditions met (2 trip detection logic): • When cold engine started and engine warmed up, Engine Coolant Temperature (ECT) sensor value does not change. • After warmed up engine started, ECT sensor value does not change when engine stopped and then next cold engine start performed.	• Thermostat • Engine coolant temperature sensor
	For Mexico Models: Case 1: Engine Coolant Temperature (ECT) between 35°C and 60°C (95°F and 140°F) when engine started, and conditions (a) and (b) met (2 trip	

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	detection logic) a. Vehicle driven at varying speeds (accelerated and decelerated) b. ECT remains within 3°C (37.4°F) of initial ECT	
P0116	Case 2: ECT more than 60°C (140°F) when engine started, and conditions (a) and (b) met (6 trip detection logic) a. Vehicle driven at varying speeds (accelerated and decelerated) b. ECT measurements remain within 1°C (33.8°F) of initial ECT on 6 successive occasions	• Thermostat • ECT sensor

MONITOR DESCRIPTION

The engine coolant temperature sensor is used to monitor the engine coolant temperature. The engine coolant temperature sensor has a built-in thermistor with a resistance that varies according to the temperature of the engine coolant. When the engine coolant temperature becomes low, the resistance of the thermistor increases. When the temperature becomes high, the resistance drops. These variations in the resistance are reflected in the voltage output from the engine coolant temperature sensor.

The ECM monitors the sensor voltage and uses this value to calculate the engine coolant temperature. If the sensor voltage output deviates from the normal operating range, the ECM interprets this deviation as a malfunction in the engine coolant temperature sensor and sets the DTC.

Examples:

- Upon starting the engine, the engine coolant temperature is between 35°C and 60°C (95°F and 140°F). If the engine coolant temperature remains within 3°C (37.4°F) of the stating temperature after driving for 250 seconds, the DTC is set (2 trip detection logic).
- Upon starting the engine, the engine coolant temperature is over 60°C (140°F). If the engine coolant temperature remains within 1°C (33.8°F) of the starting temperature after driving for 250 seconds, the DTC is set (6 trip detection logic).

ECT sensor high side stuck monitor (only for Mexico models)

The ECM monitors the sensor voltage and uses this value to calculate the ECT. If the sensor voltage output deviates from the normal operating range, the ECM interprets this deviation as a malfunction in the ECT sensor and sets the DTC.

Examples:

- Upon starting the engine, the ECT is between 35°C and 60°C (95°F and 140°F). If after driving for 250 seconds, the ECT remains within 3°C (37.4°F) of the starting temperature, the DTC is set (2 trip detection logic).

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- Upon starting the engine, the ECT is over 60°C (140°F). If after driving for 250 seconds, the ECM remains within 1°C (33.8°F) of the starting temperature, the DTC is set (6 trip detection logic).

MONITOR STRATEGY

MONITOR STRATEGY REFERENCE CHART

Related DTCs	P0116: Engine coolant temperature sensor output stuck at low engine coolant temperature P0116: Engine coolant temperature sensor output stuck at high engine coolant temperature
Required Sensors/Components (Main)	Engine coolant temperature sensor
Required Sensors/Components (Related)	Crankshaft position sensor, intake air temperature sensor and mass air flow meter
Frequency of Operation	Continuous
Duration	5 hours
MIL Operation	2 driving cycles
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

All:

TYPICAL ENABLING CONDITIONS CHART

The monitor will run whenever these DTCs are not present.	None

Engine coolant temperature sensor cold start monitor:

TYPICAL ENABLING CONDITIONS CHART

Battery voltage	10.5 V or more
Time after engine start	1 second or more
Engine coolant temperature at engine start	Less than 60°C (140°F)
Intake air temperature sensor circuit	OK
Soak time	0 second or more
Accumulated mass air flow	2206 g or more
Engine	Running
Fuel cut	OFF
Difference between engine coolant temperature at engine start and intake air temperature	Less than 40°C (104°F)

Engine coolant temperature sensor soak monitor:

TYPICAL ENABLING CONDITIONS CHART

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Battery voltage	10.5V or more
Engine	Running
Soak time	5 hours or more
Engine coolant temperature at engine start	60°C (140°F) or more
Accumulated mass air flow	4459 g or more

TYPICAL MALFUNCTION THRESHOLDS

Engine coolant temperature sensor cold start monitor:

TYPICAL MALFUNCTION THRESHOLDS REFERENCE CHART

Engine coolant temperature sensor value change	Less than 5°C (41°F)

Engine coolant temperature sensor soak monitor:

TYPICAL MALFUNCTION THRESHOLDS REFERENCE CHART

Engine coolant temperature sensor value change	Less than 5°C (41°F)

COMPONENT OPERATING RANGE

COMPONENT OPERATING RANGE REFERENCE CHART

Engine coolant temperature	Varies with actual engine coolant temperature

INSPECTION PROCEDURE

HINT:

- If any of DTC P0115, P0117, P0118 or P0125 are set 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 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. **CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P0166)**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch on (IG).
   c. Turn the tester on.
   d. Select the following menu items: Powertrain/Engine and ECT/Trouble Code.
   e. Read the DTC.

   Result

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RESULT CHART

Display (DTC output)	Proceed to
P0116	A
P0116 and other DTCs	B

HINT:

If any DTCs 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. Check the valve opening temperature of the thermostat.

      Standard: 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 **INSPECTION**).

      NG: REPLACE THERMOSTAT (See **THERMOSTAT**)

      OK: REPLACE ENGINE COOLANT TEMPERATURE SENSOR (See **REMOVAL**)

DTC P011B ENGINE COOLANT TEMPERATURE/INTAKE AIR TEMPERATURE CORRELATION

DESCRIPTION

The ECM calculates the difference between the readings of the coolant temperature sensor and intake air temperature sensor. If the difference is greater than 20°C (36°F), the ECM will judge this as a malfunction and will set this DTC.

DTC DETECTION CONDITION CHART

DTC No.	DTC Detection Condition	Trouble Area
	When conditions (a), (b), (c), (d) and (e) are met (2 trip detection) a. Battery voltage is 10.5 V or more b. 21 seconds after the engine has been started after the ignition switch has been off for more than 7 hours	• IAT

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P011B	c. The minimum intake air temperature after the engine has been started is more than -10°C (14°F) d. The average coolant temperature before the engine is started is more than -10°C (14°F) e. The difference between the readings of the ECT and IAT is greater than 20°C (36°F)	sensor • ECT sensor • ECM

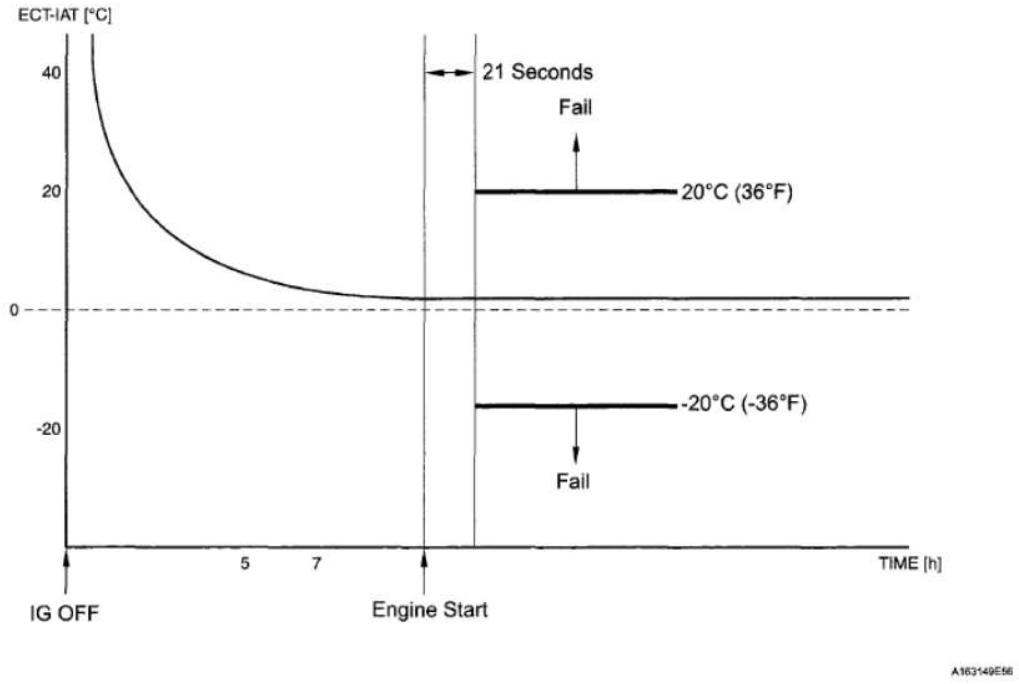


Fig. 87: Identifying Readings Of Coolant Temperature Sensor And Intake Air Temperature Sensor
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

HINT:

- Waiting is required to prevent the temperature of the engine from affecting the readings. If the engine has been operated recently, it will not be 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 ECT and IAT are very similar. When the vehicle has been parked for less than 7 hours, differences in the readings may exist, this does not necessarily indicate a fault.

MONITOR DESCRIPTION

The ECM monitors the difference between the Engine Coolant Temperature (ECT) and the Intake Air Temperature (IAT) when the engine is started cold to detect the engine temperature accurately. 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 ECT and the IAT on a cold start exceeds 20°C (36°F), the ECM interprets this as a malfunction in the ECT sensor circuit and IAT sensor circuit, and sets

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the DTC.

MONITOR STRATEGY

MONITOR STRATEGY REFERENCE CHART

Related DTCs	P011B: ECT/IAT sensor correlation
Required Sensors/Components (Main)	ECT/IAT sensor
Required Sensors/Components (Related)	-
Frequency of Operation	Once per driving cycle
Duration	21 seconds
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 present	None
All of following conditions are met	Conditions 1 and 2
1. All of following conditions are met	Conditions (a), (b), (c) and (d)
(a) After ignition switch ON and engine not running time	Less than 20 seconds
(b) Soak Time	7 hours or more
(c) Battery voltage	10.5 V or more
(d) Time after engine start	21 seconds or more
2. Either of the following conditions is met	Conditions (a) and (b)
(a) After engine start minimum IAT	-10°C (14°F) or more
(b) Before engine start ECT	-10°C (14°F) or more

TYPICAL MALFUNCTION THRESHOLDS

TYPICAL MALFUNCTION THRESHOLDS REFERENCE CHART

Deviated ECT minus Deviated IAT	Less than -20°C (-36°F) or more than 20°C (36°F)

INSPECTION PROCEDURE

1. **CHECK ANY OTHER DTCS OUTPUT (IN ADDITION P011B)**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch to the ON position.
   c. Turn the tester on.
   d. Enter the following menus: Powertrain/Engine and ECT/Trouble Code.
   e. Read the DTCs.

   Result

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RESULT CHART

Display (DTC Output)	Proceed to
P011B	A
P011B and other DTCs	B

HINT:

If any DTCs other than P011B are output, troubleshoot those DTCs first.

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 allow conditions similar to the DTC detection conditions.

   b. Connect the Techstream to the DLC3.
   c. Turn the ignition switch to the ON position.
   d. Turn the tester ON.
   e. Enter the following menus: Powertrain/Engine and ECT/Data List/All Data/Intake Air.
   f. Read the value displayed on the tester.

      OK: The intake air temperature and the outside air temperature are within 10°C (50°F) of each other.

      HINT:

      Temperature readings on the vehicle's outside temperature gauge (if equipped) are not suitable for comparing to the IAT reading. The outside temperature gauge has a significant delay built in to prevent temperature swings from being displayed on its 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 the ON position.
   c. Turn the tester ON.

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d. Enter the following menus: Powertrain/Engine and ECT/Data List/Coolant Temp.

OK: The coolant temperature and the outside air temperature are within 10°C (50°F) of each other.

HINT:

If the result is not as specified, check if there are 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; 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:

This electrical throttle control system does not use a throttle cable.

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, 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 throttle position sensor has two sensor circuits which each 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 VTA 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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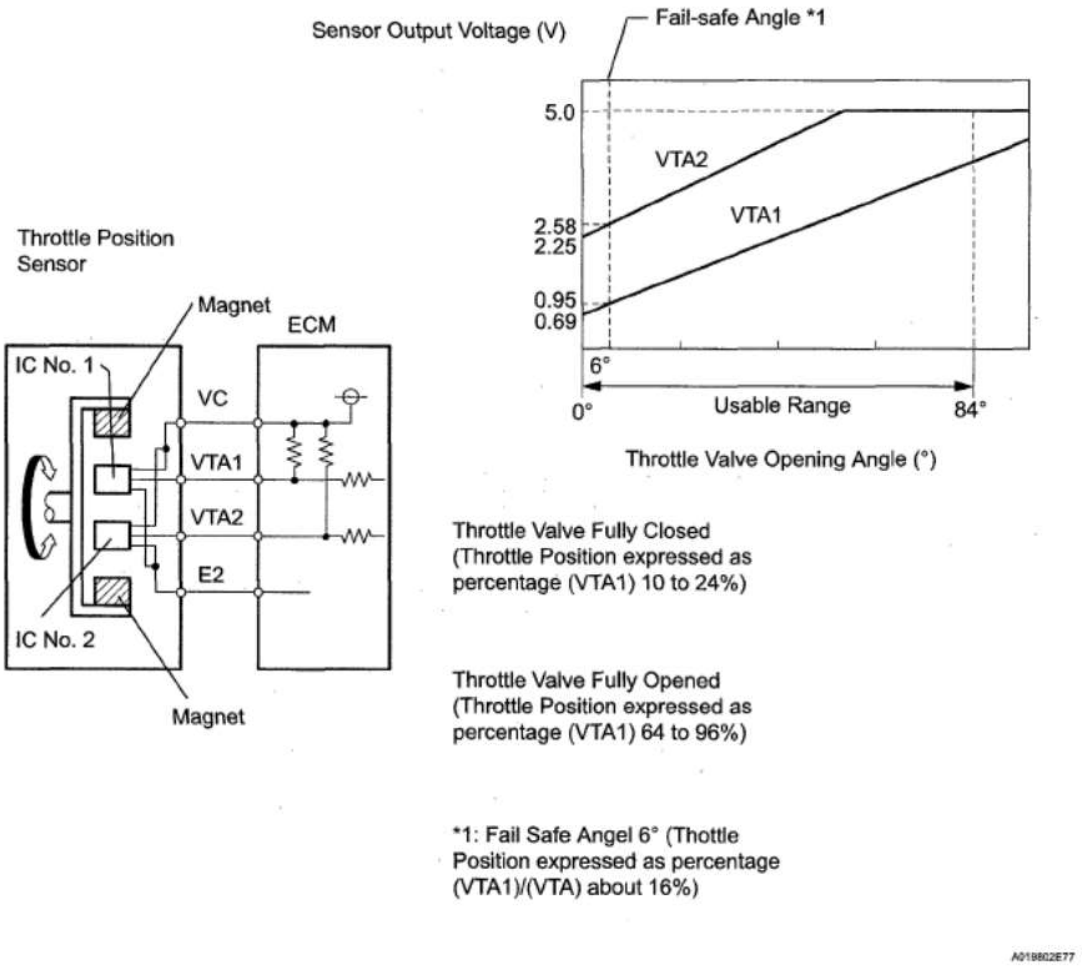


Fig. 88: Throttle Position Sensor Operation Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

DTC DETECTION CONDITION CHART

DTC No.	DTC Detection Condition	Trouble Area
P0120	Output voltage of VTA1 quickly fluctuates beyond lower and upper malfunction thresholds for 2 seconds (1 trip detection logic)	• Throttle position sensor (built into throttle body) • ECM
P0122	Output voltage of VTA1 is 0.2 V or less for 2 seconds (1 trip detection logic)	• Throttle position sensor (built into throttle body) • Short in VTA1 circuit • Open in VC circuit • ECM
		• Throttle position sensor (built into throttle body)

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P0123	Output voltage of VTA1 is 4.535 V or more for 2 seconds (1 trip detection logic)	• Open in VTA1 circuit • Open in E2 circuit • Short between VC and VTA1 circuits • ECM
P0220	Output voltage of VTA2 quickly fluctuates beyond lower and upper malfunction thresholds for 2 seconds (1 trip detection logic)	• Throttle position sensor (built into throttle body) • ECM
P0222	Output voltage of VTA2 is 1.75 V or less for 2 seconds (1 trip detection logic)	• Throttle position sensor (built into throttle body) • Short in VTA2 circuit • Open in VC circuit • ECM
P0223	Output voltage of VTA2 is 4.8 V or more, and VTA1 is between 0.2 V and 2.02 V, for 2 seconds (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 condition (a) or (b) is met (1 trip detection logic): a. Difference between output voltages of VTA1 and VTA2 is 0.02 V or less for 0.5 seconds or more b. 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:

- When any of these DTCs are set, check the throttle valve opening angle by selecting the following menu items on the Techstream: Powertrain/Engine and ECT/Data List/ETCS/Throttle Sensor Position No. 1 and Throttle Sensor Position No. 2.
- Throttle Sensor Position No. 1 denotes the VTA1 signal (expressed in percentages), and Throttle Sensor Position No. 2 denotes the VTA2 signal (expressed in voltages).

Reference (Normal Condition)

TESTER DISPLAY REFERENCE CHART

Tester Display	Accelerator Pedal Fully Released	Accelerator Pedal Fully Depressed
Throttle Sensor Position No. 1	0.5 to 1.1 V	3.3 to 4.9 V
Throttle Sensor Position No. 2	2.1 to 3.1 V	4.5 to 5.0 V

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MONITOR DESCRIPTION

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, and sets 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, and sets 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, and sets a DTC.

If the malfunction is not repaired successfully, a DTC is set 2 seconds after the engine is next started.

MONITOR STRATEGY

MONITOR STRATEGY REFERENCE CHART

Related DTCs	P0120: Throttle position sensor 1 range check (Fluctuating) 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 (Accelerator pedal ON) 0.5 seconds: P2135
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
Either of following conditions A or B met	-
A. Ignition switch on (IG)	0.012 seconds or more
B. Electronic throttle actuator power	ON

TYPICAL MALFUNCTION THRESHOLDS

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P0120:

TYPICAL MALFUNCTION THRESHOLDS REFERENCE CHART

VTA1 voltage	0.2 V or less, or 4.535 V or more

P0122:

TYPICAL MALFUNCTION THRESHOLDS REFERENCE CHART

VTA1 voltage	0.2 V or less

P0123:

TYPICAL MALFUNCTION THRESHOLDS REFERENCE CHART

VTA1 voltage	4.535 V or more

P0220:

TYPICAL MALFUNCTION THRESHOLDS REFERENCE CHART

VTA2 voltage	1.75 V or less, or 4.8 V or more

P0222:

TYPICAL MALFUNCTION THRESHOLDS REFERENCE CHART

VTA2 voltage	1.75 V or less

P0223:

TYPICAL MALFUNCTION THRESHOLDS REFERENCE CHART

VTA2 voltage when VTA1 0.2 V to 2.02 V	4.8 V or more

P2135:

TYPICAL MALFUNCTION THRESHOLDS REFERENCE CHART

Either of following conditions A or B is met:	-
Condition A	-
Difference between VTA1 and VTA2 voltages	0.02 V or less
Condition B	-
Both of the following conditions are met	(a) or (b)
(a) VTA1 voltage	0.2 V or less
(b) VTA2 voltage	1.75 V or less

COMPONENT OPERATING RANGE

COMPONENT OPERATING RANGE REFERENCE CHART

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VTA1 voltage	0.2 to 4.535 V
VTA2 voltage	1.75 to 4.8 V

FAIL-SAFE

When any of these DTCs, as well as other DTCs relating to electronic throttle control system malfunctions, are set, the ECM enters fail-safe mode. During fail-safe mode, the ECM cuts the current to the throttle actuator off, 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 slowly, the vehicle can be driven slowly.

Fail-safe mode continues until a pass condition is detected, and the ignition switch is turned off.

WIRING DIAGRAM

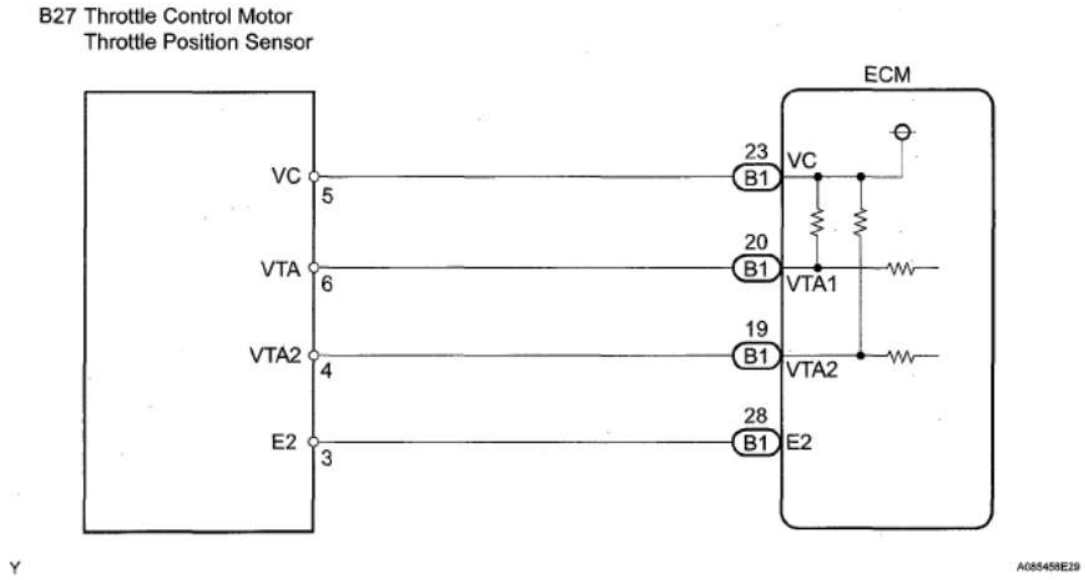


Fig. 89: Throttle Position Sensor - Wiring Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSPECTION PROCEDURE

HINT:

- If other DTCs relating to different systems that have terminal E2 as the ground terminal are output simultaneously, terminal E2 may have an open 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.

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1. **READ VALUE USING TECHSTREAM (THROTTLE POS AND THROTTLE POS #2)**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch on (IG) and turn the tester on.
   c. Select the following menu items: Powertrain/Engine and ECT/Data List/Throttle Position No. 1 and Throttle Sensor Position No. 2.
   d. Check the values displayed on the tester.

   Result

   RESULT CHART

When accelerator pedal released		When accelerator pedal depressed		Trouble Area	Proceed to
Throttle Sensor Position No. 1	Throttle Sensor Position No. 2	Throttle Sensor Position No. 1	Throttle Sensor Position No. 2		
0 to 0.2 V	Between 0 V and 0.2 V	0 to 0.2 V	Between 0 V and 0.2 V	VC circuit open	A
4.5 to 5.0 V	Between 4.5 V and 5.0 V	4.5 to 5.0 V	Between 4.5 V and 5.0 V	E2 circuit open	A
0 to 0.2 V or 4.5 to 5.0 V	Between 2.4 V and 3.4 V (Fail-safe)	0 to 0.2 V or 4.5 to 5.0 V	Between 2.4 V and 3.4 V (Fail-safe)	VTA1 circuit open or ground short	A
0.7 to 1.3 V (Fail-safe)	Between 0 V and 0.2 V, or 4.5 V and 5.0 V	0.7 to 1.3 V (Fail-safe)	Between 0 V and 0.2 V, or 4.5 V and 5.0 V	VTA2 circuit open or ground short	A
0.5 to 1.1 V	Between 2.1 V and 3.1 V	3.2 to 4.8 V (Not fail-safe)	Between 4.5 V and 5.0 V (Not fail-safe)	Throttle position sensor circuit normal	B

   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

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B27-5 (VC) - B1-23 (VC)	Always	Below 1 ohms
B27-6 (VTA) - B1-20 (VTA1)	Always	Below 1 ohms
B27-4 (VTA2) - B1-19 (VTA2)	Always	Below 1 ohms
B27-3 (E2) - B1-28 (E2)	Always	Below 1 ohms

Check for short

TESTER CONNECTION SPECIFIED CONDITION CHART

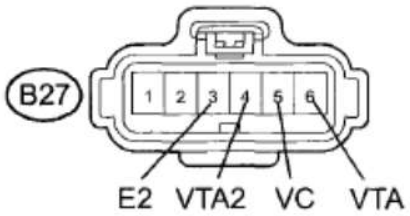
Tester Connection	Condition	Specified Condition
B27-5 (VC) or B1-23 (VC) - Body ground	Always	10 kohms or higher
B27-6 (VTA) or B1-20 (VTA1) - Body ground	Always	10 kohms or higher
B27-4 (VTA2) or B1-19 (VTA2) - Body ground	Always	10 kohms or higher

d. Reconnect the throttle body connector.
e. Reconnect the ECM connector.

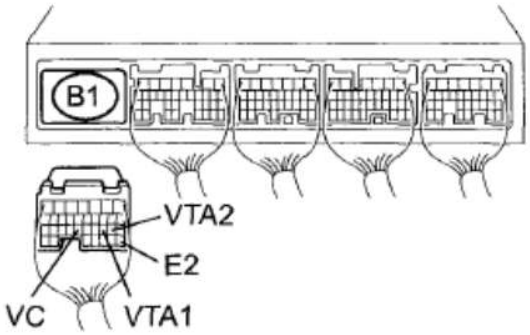
NG: REPAIR OR REPLACE HARNESS OR CONNECTOR (THROTTLE POSITION SENSOR - ECM)

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Front view of wire harness connector:
(to Throttle Position Sensor)



Rear view of wire harness connector:
(to ECM)



Y

A168201E02

Fig. 90: Identifying Throttle Body And ECM Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

3. **INSPECT ECM (VC VOLTAGE)**
   a. Turn the ignition switch on (IG).
   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
B1-23 (VC) - B1-28 (E2)	Ignition switch on (IG)	4.5 to 5.0 V

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

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Component with harness connected:
(ECM)

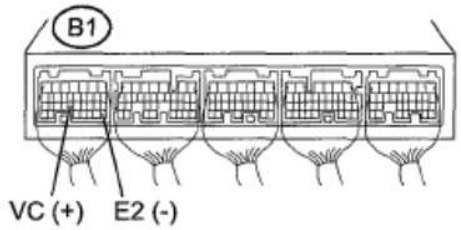


Fig. 91: Identifying ECM Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

4. **REPLACE THROTTLE BODY**
   a. Replace the throttle body (See **THROTTLE BODY**).
5. **CHECK WHETHER DTC OUTPUT RECURS (THROTTLE POSITION SENSOR DTCS)**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch on (IG) and turn the tester on.
   c. Clear the DTCs (See **DTC CHECK/CLEAR**).
   d. Start the engine.
   e. Allow the engine to idle for 15 seconds or more.
   f. Select the following menu items: Powertrain/Engine and ECT/Trouble Code.
   g. Read the DTCs.

Result

RESULT CHART

Display (DTC Output)	Proceed to
P0120, P0122, P0123, P0220, P0222, P0223 and/or P2135	A
No output	B

B: SYSTEM OK

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

DTC P0121 THROTTLE/PEDAL POSITION SENSOR/SWITCH "A" CIRCUIT RANGE/PERFORMANCE PROBLEM

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HINT:

This DTC relates to the throttle position sensor.

DESCRIPTION

Refer to **DTC P0120** .

DTC DETECTION CONDITION CHART

DTC No.	DTC Detection Condition	Trouble Area
P0121	Difference between VTA1 and VTA2 voltages less than 0.8 V, or more than 1.6 V for 2 seconds (1 trip detection logic)	Throttle position sensor (built into throttle body)

MONITOR DESCRIPTION

The ECM uses the throttle position sensor to monitor the throttle valve opening angle.

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 voltage output difference between the two signals deviates from the normal operating range, the ECM interprets this as a malfunction of the throttle position sensor. The ECM illuminates the MIL and sets the DTC.

If the malfunction is not repaired successfully, the DTC is set 2 seconds after the engine is next started.

MONITOR STRATEGY

MONITOR STRATEGY REFERENCE CHART

Related DTCs	P0121: Throttle position sensor rationality
Required Sensors/Components (Main)	Throttle position sensor
Required Sensors/Components (Related)	-
Frequency of Operation	Continuous
Duration	Within 2 seconds
MIL Operation	Immediate
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

TYPICAL ENABLING CONDITIONS CHART

This monitor will not run whenever these DTCs are not present	None
Either of the following conditions is met:	Condition 1 or 2

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1. Ignition switch	ON (IG)
2. Electric throttle motor power	ON
Throttle position sensor malfunction (P0120, P0122, P0123, P0220, P0222, P0223, P2135)	Not detected

TYPICAL MALFUNCTION THRESHOLDS

TYPICAL MALFUNCTION THRESHOLDS REFERENCE CHART

Difference of throttle position sensor voltage between VTA1 and VTA2 x 0.8	Less than 0.8 V, or more than 1.6 V

FAIL-SAFE

When this DTC, as well as other DTCs relating to electronic throttle control system malfunctions, is set, the ECM enters fail-safe mode. During fail-safe mode, the ECM cuts the current to the throttle actuator off, 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 slowly, the vehicle can be driven slowly.

Fail-safe mode continues until a pass condition is detected, and the ignition switch is then turned off.

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.

1. **CHECK ANY OTHER DTC OUTPUT (IN ADDITION TO DTC P0121)**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch on (IG).
   c. Turn the tester on.
   d. Select the following menu items: Powertrain/Engine and ECT/Trouble Code.
   e. Read the DTC.

   Result

   RESULT CHART

Display (DTC output)	Proceed to
P0121	A
P0121 and other DTCs	B

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HINT:

If any DTCs other than P0121 are output, troubleshoot those DTCs first.

B: GO TO **DTC CHART**

A: REPLACE THROTTLE BODY (See **THROTTLE BODY**)

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	Engine coolant temperature does not reach closed-loop enabling temperature for 20 minutes (this period varies with engine start engine coolant temperature)	• 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 voltage output varies according to the changing resistance of the sensor. After the engine is started, the engine coolant temperature is monitored through 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 sets the DTC.

Example:

The engine coolant temperature is 0°C (32°F) at engine start. After 5 minutes 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 sets the DTC.

MONITOR STRATEGY

MONITOR STRATEGY REFERENCE CHART

Related DTCs	P0125: Insufficient engine coolant temperature for closed-loop fuel control
Required Sensors/Components (Main)	Thermostat, cooling system
Required Sensors/Components	

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(Related)	Engine coolant temperature sensor and mass air flow meter
Frequency of Operation	Continuous
Duration	71 seconds: Engine coolant temperature at engine start -8.33°C (17° F) or more 126 seconds: Engine coolant temperature at engine start -19.44 to -8.33°C (-3 to 17°F) 20 minutes: Engine coolant temperature at engine start less than -19.44°C (-3°F)
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 present	None
Thermostat (P0128)	OK
Mass air flow meter (P0100, P0101, P0102, P0103)	OK
Intake air temperature sensor (P0110, P0112)	OK
Engine coolant temperature sensor (P0115, P0117, P0118)	OK

TYPICAL MALFUNCTION THRESHOLDS

TYPICAL MALFUNCTION THRESHOLDS REFERENCE CHART

Time until actual engine coolant temperature reaches closed-loop fuel control enabling temperature	71 seconds or more: Engine coolant temperature at engine start -8.33°C (17°F) or more 126 seconds or more: Engine coolant temperature at engine start -19.44 to -8.33°C (-3 to 17°F) 20 minutes or more: Engine coolant temperature at engine start less than -19.44°C (-3°F)

WIRING DIAGRAM

Refer to **DTC P0115** .

INSPECTION PROCEDURE

HINT:

- If any of DTCs P0115, P0116, P0117 or P0118 are set 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 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.

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1. **CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P0125)**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch on (IG).
   c. Turn the tester on.
   d. Select the following menu items: Powertrain/Engine and ECT/Trouble Code.
   e. Read the DTCs.

   Result

   RESULT CHART

Display (DTC Output)	Proceed to
P0125	A
P0125 and other DTCs	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: 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 **INSPECTION**).

   NG: REPLACE THERMOSTAT (See **THERMOSTAT**)

   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 radiator fan operation or any modifications.

   NG: REPAIR OR REPLACE COOLING SYSTEM

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OK: REPLACE ENGINE COOLANT TEMPERATURE SENSOR (See **REMOVAL**)

DTC P0128 COOLANT THERMOSTAT (COOLANT TEMPERATURE BELOW THERMOSTAT REGULATING TEMPERATURE)

HINT:

This DTC relates to the thermostat.

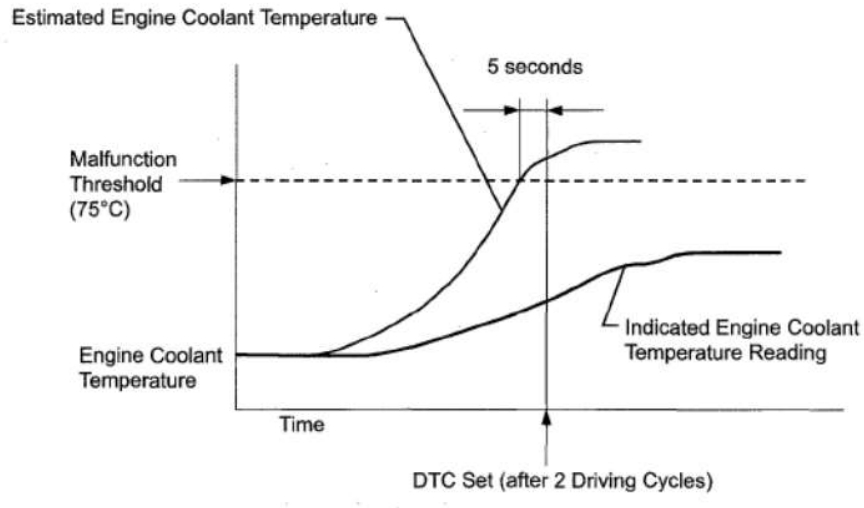
DESCRIPTION

This DTC is set when the engine coolant temperature does not reach 75°C (167°F) despite sufficient engine warm-up time.

DTC DETECTION CONDITION CHART

DTC No.	DTC Detection Condition	Trouble Area
P0128	Conditions (a), (b) and (c) are met for 5 seconds (2 trip detection logic): a. Cold start b. Engine warmed up c. Engine coolant temperature less than 75°C (167°F)	• Thermostat • Cooling system • Engine coolant temperature sensor • ECM

MONITOR DESCRIPTION



Y A082385E28

Fig. 92: Estimated Engine Coolant Temperature Graph
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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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 sets the DTC.

MONITOR STRATEGY

MONITOR STRATEGY REFERENCE CHART

Related DTCs	P0128: Coolant Thermostat
Required Sensors/Components (Main)	Thermostat
Required Sensors/Components (Related)	Engine coolant temperature sensor, 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

The monitor will run whenever these DTCs are not present	P0010, P0020 (OCV bank 1, 2) P0011, P0021 (VVT system bank 1, 2 - advance) P0012, P0022 (VVT system bank 1, 2 - retard) P0013, P0023 (Exhaust OCV bank 1, 2) P0014, P0024 (Exhaust VVT system bank 1, 2 - advance) P0015, P0025 (Exhaust VVT system bank 1, 2 - retard) P0016, P0018 (VVT system bank 1, 2 - misalignment) P0017, P0019 (Exhaust VVT system bank 1, 2 - misalignment) P0031, P0032, P0051, P0052 (A/F sensor heater) P0100, P0102, P0103 (MAF meter) P0110, P0112, P0113 (IAT sensor) P0115, P0117, P0118 (ECT sensor) P0120, P0121, P0122, P0123, P0220, P0222, P0223, P2135 (TP sensor) P0171, P0172, P0174, P0175 (Fuel system) P0301, P0302, P0303, P0304, P0305, P0306 (Misfire) P0335 (CKP sensor) P0340, P0342, P0343, P0345, P0347, P0348 (VVT sensor)

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	P0351, P0352, P0353, P0354, P0355, P0356 (Igniter) P0365, P0367, P0368, P0390, P0392, P0393 (Exhaust VVT sensor) P0500 (Vehicle speed sensor) P2195, P2196, P2197, P2198 (A/F sensor - rationality) P2237, P2240 (A/F sensor - open) P2238, P2241, P2252, P2255 (A/F sensor - low impedance) P2239, P2242, P2253, P2256 (A/F sensor - high impedance) P2A00, P2A03 (A/F sensor - slow response)
Battery voltage	11 V or more
Either of following conditions is met:	Condition 1 or 2
1. All of following conditions are met:	Conditions (a), (b) and (c)
(a) Engine coolant temperature at engine start - Intake air temperature at engine start	-15 to 7°C (5 to 45°F)
(b) Engine coolant temperature at engine start	-10 to 56°C (14 to 133°F)
(c) Intake air temperature at engine start	-10 to 56°C (14 to 133°F)
2. All of following conditions are met:	Conditions (d), (e) and (f)
(d) Engine coolant temperature at engine start - Intake air temperature at engine start	More than 7°C (45°F)
(e) Engine coolant temperature at engine start	56°C (133°F) or less
(f) Intake air temperature at engine start	-10°C (14°F) or more
Accumulated time that vehicle speed is 80 mph (128 km/h) or more	Less than 20 seconds

TYPICAL MALFUNCTION THRESHOLDS

TYPICAL MALFUNCTION THRESHOLDS REFERENCE CHART

Duration that all of the following conditions 1 and 2 are met	5 seconds or more
1. Estimated engine coolant temperature	75°C (167°F) or more
2. Engine coolant temperature sensor output	Less than 75°C (167°F)

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.

1. **CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P0128)**

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a. Connect the Techstream to the DLC3.
b. Turn the ignition switch on (IG).
c. Turn the tester on.
d. Select the following menu items: Powertrain/Engine and ECT/Trouble Code.
e. Read the DTCs.

Result

RESULT CHART

Display (DTC Output)	Proceed to
P0128	A
P0128 and other DTCs	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 radiator 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: 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 **INSPECTION**).

   NG: REPLACE THERMOSTAT (See **THERMOSTAT**)

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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); DTC P0156 OXYGEN SENSOR CIRCUIT MALFUNCTION (BANK 2 SENSOR 2); DTC P0157 OXYGEN SENSOR CIRCUIT LOW VOLTAGE (BANK 2 SENSOR 2); DTC P0158 OXYGEN SENSOR CIRCUIT HIGH VOLTAGE (BANK 2 SENSOR 2); DTC P0159 OXYGEN SENSOR CIRCUIT SLOW RESPONSE (BANK 2 SENSOR 2)

DESCRIPTION

HINT:

Sensor 2 refers to the sensor mounted behind the three-way catalytic converter and located far from the engine assembly.

In order to obtain a high purification rate of the carbon monoxide (CO), hydrocarbon 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 air fuel level. 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 rich. 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 lean. 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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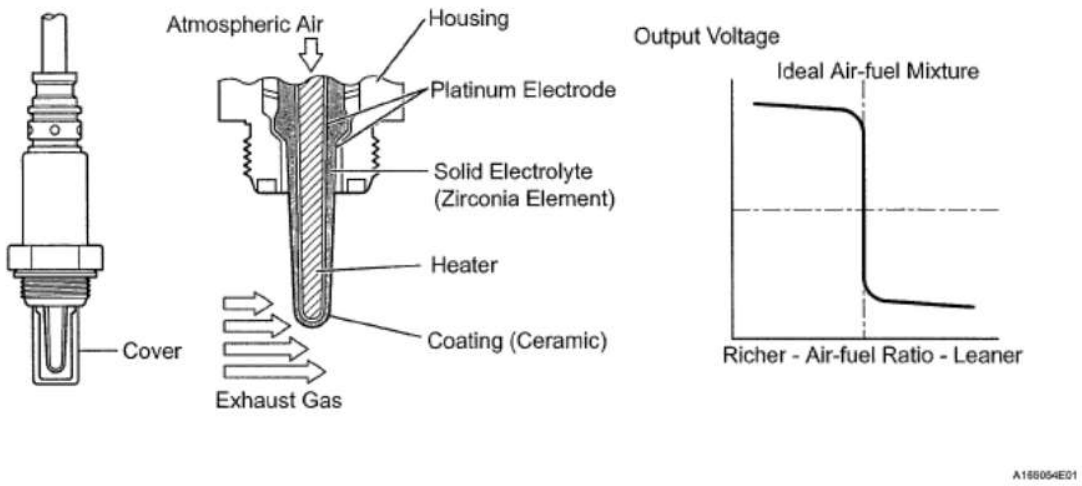


Fig. 93: Identifying Oxygen Sensor Components
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

DTC DETECTION CONDITION CHART

DTC No.	DTC Detection Condition	Trouble Area
P0136 P0156	• Abnormal voltage output: During active air fuel ratio control, following conditions (a) and (b) met for certain period of time (2 trip detection logic) a. Heated oxygen sensor voltage does not decrease to less than 0.21 V b. Heated oxygen sensor voltage does not increase to more than 0.59 V • Low impedance: Sensor impedance less than 5 ohms for more than 30 seconds when ECM presumes sensor to being warmed up and operating normally (2 trip detection logic)	• Heated oxygen sensor (bank 1, 2 sensor 2) • Air fuel ratio sensor (bank 1, 2 sensor 1) • Gas leak from exhaust system • Fuel pressure • Fuel injector • PCV valve and hose • Air induction system
P0137 P0157	• Low voltage (open): During active air fuel ratio control, following conditions (a) and (b) met for certain period of time (2 trip detection logic) a. Heated oxygen sensor voltage output less than 0.21 V b. Target air fuel ratio rich • High impedance:	• Open or short in heated oxygen sensor (bank 1, 2 sensor 2) circuit • Heated oxygen sensor (bank 1, 2 sensor 2) • Heated oxygen sensor heater (bank 1, 2 sensor 2) • Air fuel ratio sensor (bank

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	Sensor impedance 15 kohms or more for more than 90 seconds when ECM presumes sensor to be warmed up and operating normally (2 trip detection logic)	1, 2 sensor 1) • Gas leak from exhaust system
P0138 P0158	• High voltage (short): During active air fuel ratio control, following conditions (a) and (b) met for certain period of time (2 trip detection logic) a. Heated oxygen sensor voltage output 0.59 V or more b. Target air fuel ratio lean • Extremely high voltage (short): 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, 2 sensor 2) circuit • Heated oxygen sensor (bank 1, 2 sensor 2) • ECM internal circuit malfunction • Air fuel ratio sensor (bank 1, 2 sensor 1)
P0139 P0159	Heated oxygen sensor (sensor 2) voltage does not drop to below 0.2 V immediately after fuel cut starts	• Short in heated oxygen sensor (bank 1, 2 sensor 2) circuit • Heated oxygen sensor (bank 1, 2 sensor 2) • ECM internal circuit malfunction • Air fuel ratio sensor (bank 1, 2 sensor 1)

For Mexico Models

DTC DETECTION CONDITION CHART

DTC No.	DTC Detection Condition	Trouble Area
P0136 P0156	Not applicable	None
P0137 P0157	• Low voltage (open): During active air-fuel ratio control, following conditions (a) and (b) are met for a certain period of time (2 trip detection logic) a. Heated oxygen sensor voltage output less than 0.21 V b. Target air-fuel ratio rich	• Open or short in heated oxygen sensor (bank 1, 2 sensor 2) circuit • Heated oxygen sensor (bank 1, 2 sensor 2) • Heated oxygen sensor heater (bank 1, 2 sensor 2) • Air fuel ratio sensor (bank 1, 2 sensor 1) • Gas leak from exhaust

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		system
P0138 P0158	Not applicable	None
P0139 P0159	Not applicable	None

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 set.

2. **Abnormal Voltage Output of Heated Oxygen Sensor (DTC P0136 and P0156)**

   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 less than 0.21 V and does not increase to more than 0.59 V during active air fuel ratio control, the ECM determines that the sensor voltage output is abnormal and sets DTCs P0136.

Heated Oxygen Sensor Circuit Malfunction (P0136 and P0156: Abnormal Voltage)

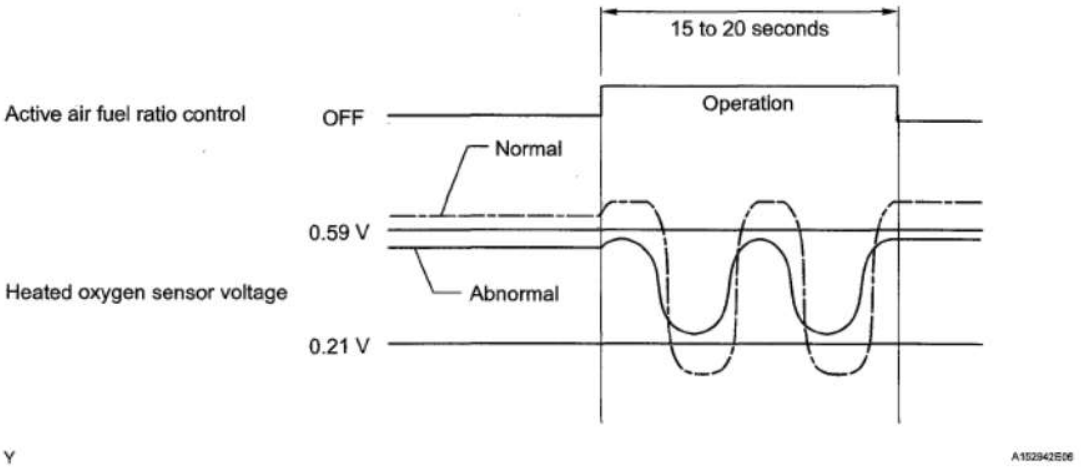


Fig. 94: Heated Oxygen Sensor Circuit Malfunction (P0136 And P0156: Abnormal Voltage)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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3. **Open or Short in Heated Oxygen Sensor Circuit (DTCs P0137 and P0157 or P0138 and P0158)**

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 sets DTC P0137. When the target air fuel ratio is lean and the voltage output is 0.59 V or more (rich) during active air fuel ratio control, the ECM determines that the sensor voltage output is abnormally high, and sets DTC P0138.

HINT:

DTC P0138 is also set if the heated oxygen sensor voltage output is more 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); DTC P0430 CATALYST SYSTEM EFFICIENCY BELOW THRESHOLD (BANK 2)**).

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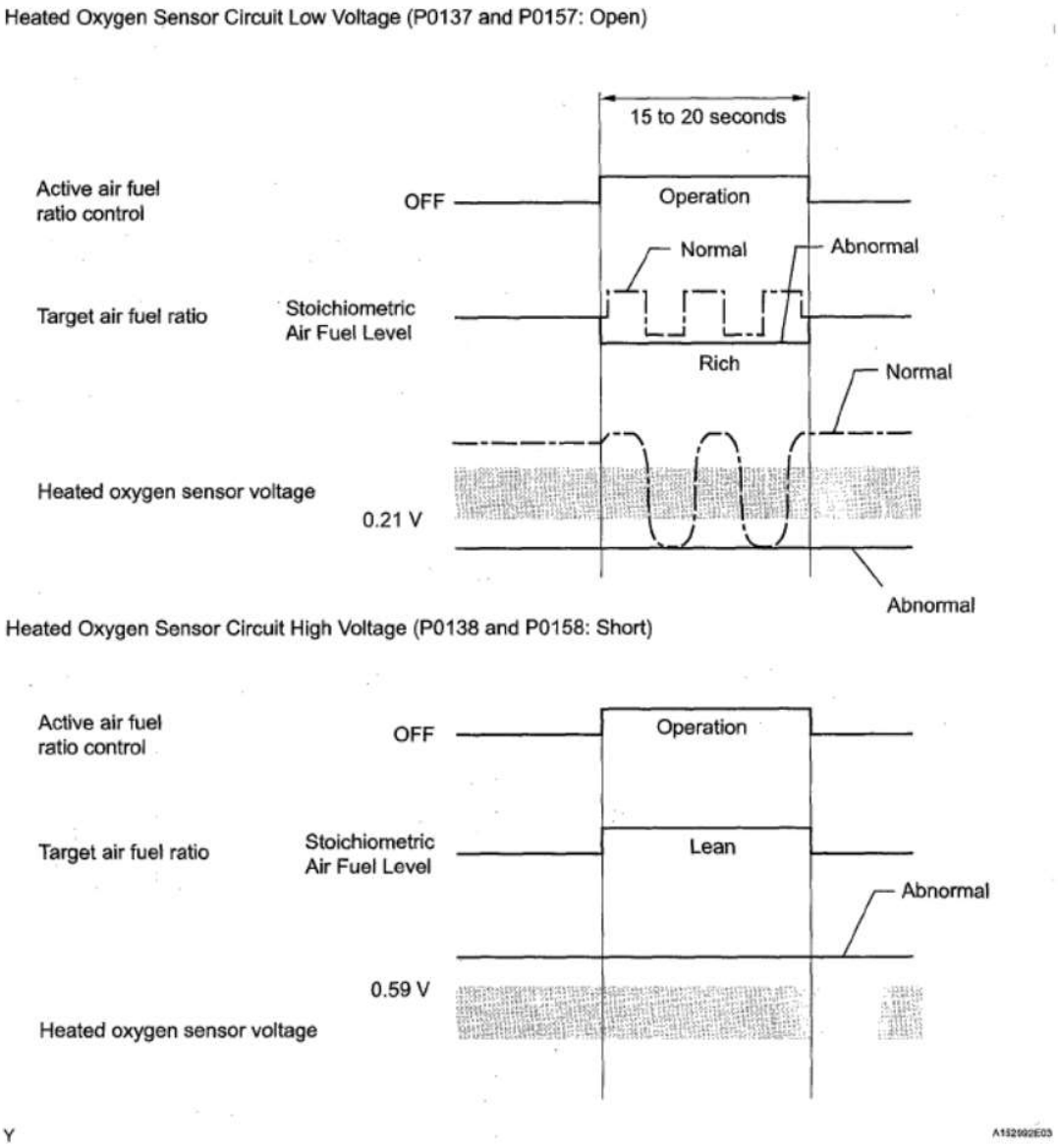


Fig. 95: Open Or Short In Heated Oxygen Sensor Circuit (DTCS P0137 And P0157 Or P0138 And P0158)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

4. **High or Low Impedance of Heated Oxygen Sensor (DTCs P0136 and P0156 or P0137 and P0157)**

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.

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Relationship between element temperature and impedance:

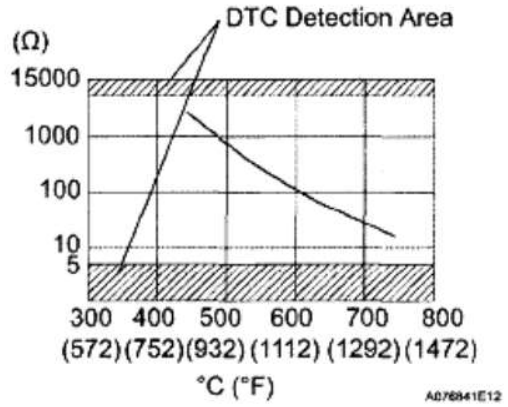


Fig. 96: Relationship Between Element Temperature And Impedance
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

HINT:

- The impedance cannot be measured using an ohmmeter.
- DTCs P0136 indicate the deterioration of the heated oxygen sensor. The ECM sets the DTCs by calculating the impedance of the sensor when the typical enabling conditions are satisfied (2 driving cycles).
- DTCs P0137 indicate an open or short circuit in the heated oxygen sensor (2 driving cycles). The ECM sets the DTCs when the impedance of the sensor exceeds the threshold 15 kohms.

5. **Abnormal Voltage Output of Heated Oxygen Sensor During Fuel-cut (DTC P0139 and P0159)**

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, the ECM determines that the sensor's response feature has deteriorated, illuminates the MIL and sets a DTC.

MONITOR STRATEGY

MONITOR STRATEGY REFERENCE CHART

Related DTCs	P0136: Heated oxygen sensor output voltage (Output voltage) (bank 1) P0136: Heated oxygen sensor impedance (Low) (bank 1) P0137: Heated oxygen sensor output voltage (Low voltage) (bank 1) P0137: Heated oxygen sensor impedance (High) (bank 1) P0138: Heated oxygen sensor output voltage (High voltage) (bank 1) P0138: Heated oxygen sensor output voltage (Extremely high) (bank 1) P0139: Heated oxygen sensor output voltage during fuel cut (bank 1) P0156: Heated oxygen sensor output voltage (Output voltage) (bank 2)

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	P0156: Heated oxygen sensor impedance (Low) (bank 2) P0157: Heated oxygen sensor output voltage (Low voltage) (bank 2) P0157: Heated oxygen sensor impedance (High) (bank 2) P0158: Heated oxygen sensor output voltage (High voltage) (bank 2) P0158: Heated oxygen sensor output voltage (Extremely high) (bank 2) P0159: Heated oxygen sensor output voltage during fuel cut (bank 2)
Required Sensors/Components (Main)	Heated oxygen sensor (sensor 2)
Required Sensors/Components (Related)	Crankshaft position sensor Engine coolant temperature sensor Mass air flow meter Throttle position sensor
Frequency of Operation	Once per driving cycle: Active air fuel ratio control detection, Abnormal 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

The monitor will run whenever these DTCs are not present	P0016, P0018 (VVT system bank 1,2- misalignment) P0017, P0019 (Exhaust VVT system bank 1,2- misalignment) P0031, P0032, P0051, P0052 (A/F sensor heater) P0037, P0038, P0057, P0058 (HO2 sensor heater) P0100, P0102, P0103 (MAF meter) P0110, P0112, P0113 (IAT sensor) P0115, P0117, P0118 (ECT sensor) P0120, P0121, P0122, P0123, P0220, P0222, P0223, P2135 (TP sensor) P0125 (Insufficient ECT for closed loop) P0128 (Thermostat) P0171, P0172, P0174, P0175 (Fuel system) P0301, P0302, P0303, P0304, P0305, P0306 (Misfire) P0335 (CKP sensor) P0450, P0451, P0452, P0453 (EVAP system) P0500 (Vehicle speed sensor)

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	P2195, P2196, P2197, P2198 (A/F sensor - rationality) P2238, P2241, P2252, P2255 (A/F sensor - low impedance) P2A00, P2A03 (A/F sensor - slow response)

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 more
Engine coolant temperature	75°C (167°F) or more
Idling	OFF
Engine RPM	Less than 3200 rpm
Air fuel ratio sensor status	Activated
Fuel system status	Closed loop
Fuel cut	OFF
Engine load	10 to 70%
Shift position	4th or more

Heated Oxygen Sensor Impedance (Low):

TYPICAL ENABLING CONDITIONS CHART

Battery voltage	11 V or more
Estimated sensor temperature	Less than 700°C (1292°F)
ECM monitor	Completed
DTC P0606	Not set

Heated Oxygen Sensor Impedance (High):

TYPICAL ENABLING CONDITIONS CHART

Battery voltage	11 V or more
Estimated sensor temperature	450°C (842°F) or higher
DTC P0606	Not set

Heated Oxygen Sensor Output Voltage (Extremely High):

TYPICAL ENABLING CONDITIONS CHART

Battery voltage	11 V or more
Time after engine start	2 seconds or more

Heated oxygen sensor voltage during fuel cut:

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ENGINE COOLANT TEMPERATURE CHART

Engine coolant temperature	75°C (167°F) or more
Catalyst temperature	400°C (752°F) or more
Fuel cut	Executing

TYPICAL MALFUNCTION THRESHOLDS

Heated Oxygen Sensor Output Voltage (Output voltage):

TYPICAL MALFUNCTION THRESHOLDS REFERENCE CHART

Either of following conditions met:	1 or 2
1. All of following conditions (a), (b) and (c) met	-
(a) Commanded air fuel ratio	14.3 or less
(b) Rear heated oxygen sensor voltage	0.21 to 0.59 V
(c) Oxygen storage capacity of catalyst	2.0 g or more
2. All of following conditions (d), (e) and (f) met	-
(d) Commanded air fuel ratio	14.9 or more
(e) Rear heated oxygen sensor voltage	0.21 to 0.59 V
(f) Oxygen storage capacity	2.0 g or more

Heated Oxygen Sensor Output Voltage (Low output voltage):

TYPICAL MALFUNCTION THRESHOLDS REFERENCE CHART

All of following conditions (a), (b) and (c) met	-
(a) Commanded air fuel ratio	14.3 or less
(b) Rear heated oxygen sensor voltage	Less than 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 REFERENCE CHART

All of following conditions (a), (b) and (c) met	-
(a) Commanded air fuel ratio	14.9 or more
(b) Rear heated oxygen sensor voltage	More than 0.59 V
(c) Oxygen storage capacity of catalyst	2.0 g or more

Heated Oxygen Sensor Impedance (Low):

TYPICAL MALFUNCTION THRESHOLDS REFERENCE CHART

Duration of following condition	30 seconds or more
Heated oxygen sensor impedance	Less than 5 ohms

Heated Oxygen Sensor Impedance (High):

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TYPICAL MALFUNCTION THRESHOLDS REFERENCE CHART

Duration of following condition	90 seconds or more
Heated oxygen sensor impedance	15 kohms or more

Heated Oxygen Sensor Output Voltage (Extremely High):

TYPICAL MALFUNCTION THRESHOLDS REFERENCE CHART

Duration of following condition	10 seconds or more
Heated oxygen sensor voltage	1.2 V or higher

Heated Oxygen Sensor Voltage During Fuel-cut:

TYPICAL MALFUNCTION THRESHOLDS REFERENCE CHART

Duration until rear heated oxygen sensor voltage drops to 0.2 V after fuel cut	10 seconds or more

COMPONENT OPERATING RANGE

COMPONENT OPERATING RANGE REFERENCE 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** .

WIRING DIAGRAM

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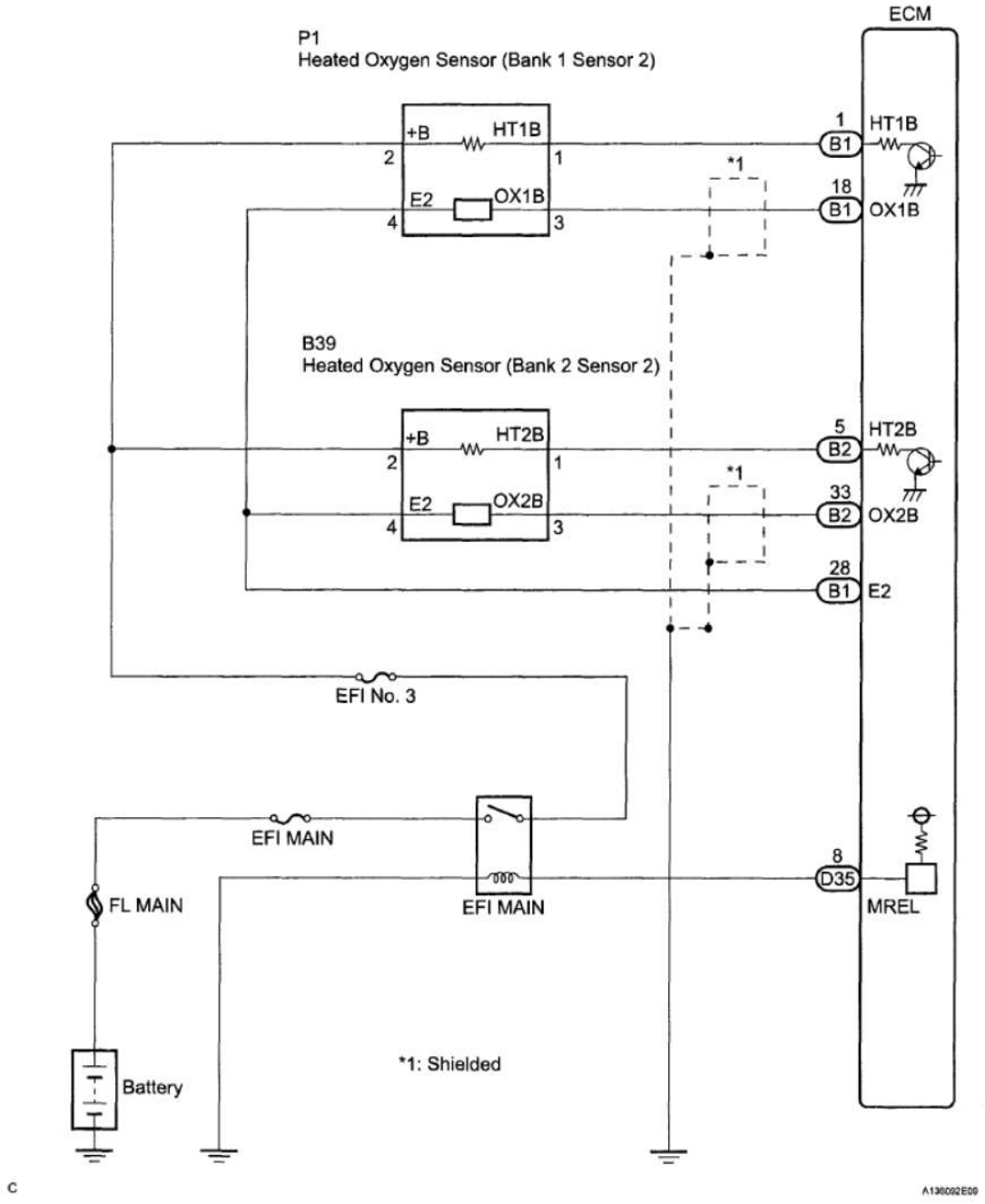


Fig. 97: Oxygen Sensor - Wiring Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

CONFIRMATION DRIVING PATTERN

HINT:

- This confirmation driving pattern is used in the "PERFORM CONFIRMATION DRIVING PATTERN" procedure of the following diagnostic troubleshooting procedure.

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- Performing this confirmation driving pattern will activate the heated oxygen sensor monitor (The catalyst monitor is performed simultaneously). This is very useful for verifying the completion of a repair.

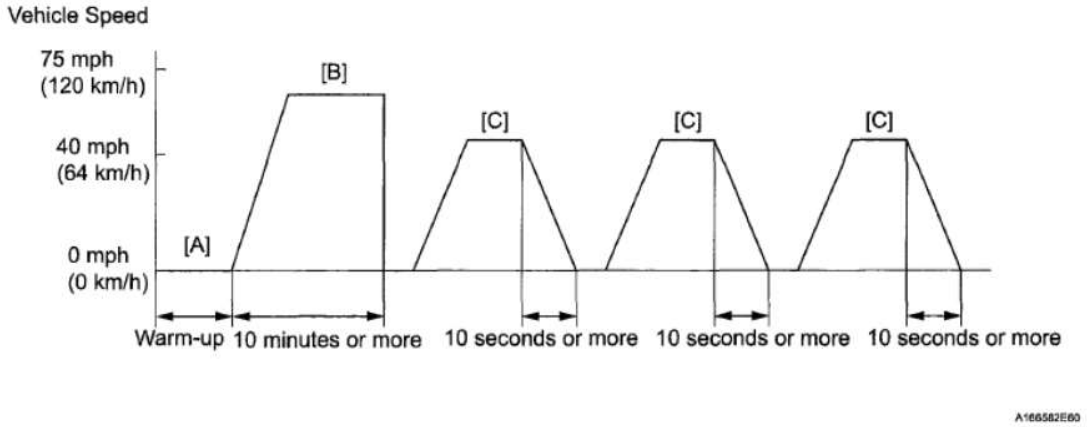


Fig. 98: Vehicle Drive Pattern
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

1. Connect the Techstream to the DLC3.
2. Turn the ignition switch on (IG).
3. Warm-up the engine until the engine coolant temperature reaches 75°C (167°F) or more [A].
4. Drive the vehicle at between 40 mph and 75 mph (64 km/h and 120 km/h) for at least 10 minutes [B].
5. Drive the vehicle 40 mph (64 km/h) or more and decelerate the vehicle for 10 seconds or more. Perform this 3 times [C].
6. Turn the tester on.
7. Select the following menu items: Powertrain/Engine/Utility/All Readiness.
8. Input DTCs: P0136, P0137, P0138, P0139, P0156, P0157, P0158 and P0159.

   Check the DTC MONITOR is NORMAL. If DTC MONITOR is INCOMPLETE, perform the drive pattern increasing the vehicle speed and using second gear to decelerate the vehicle.

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 tester on.
4. Warm up the engine at an engine speed of 2500 rpm for approximately 90 seconds.
5. Select the following menu items: Powertrain/Engine and ECT/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 or AFS Voltage B2 S1 and O2S B1 S2 or O2S B2 S2) displayed on the tester.

   HINT:

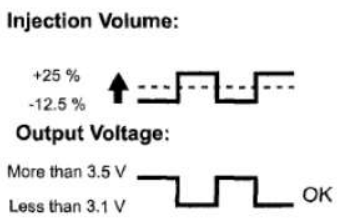
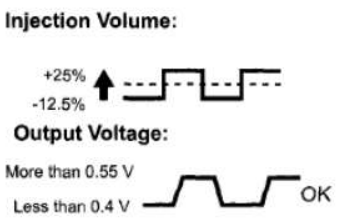
   - The Control the Injection Volume for air fuel ratio sensor operation lowers the fuel injection volume by 12.5% or increases the injection volume by 25%.
   - Each sensor reacts in accordance with increases and decreases in the fuel injection volume.

TESTER DISPLAY REFERENCE CHART

Tester Display	Injection Volume	Status	Voltage
AFS Voltage B1 S1 or AFS Voltage B2 S1 (Air fuel ratio sensor)	+25%	Rich	Less than 3.1 V
	-12.5%	Lean	More than 3.5 V
O2S B1 S2 or O2S B2 S2 (Heated oxygen sensor)	+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 CHART

Case	Air Fuel Ratio Sensor (Sensor 1) Output Voltage	Heated Oxygen Sensor (Sensor 2) Output Voltage	Main Suspected Trouble Area
1			-
2			• Air fuel ratio sensor • Air fuel ratio sensor heater • Air fuel ratio sensor

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	Injection Volume: +25% -12.5% Output Voltage: Almost no reaction — NG	Injection Volume: +25% -12.5% Output Voltage: More than 0.55 V / Less than 0.4 V — OK	circuit
3	Injection Volume: +25 % -12.5 % Output Voltage: More than 3.5 V / Less than 3.1 V — OK	Injection Volume: +25% -12.5% Output Voltage: Almost no reaction — NG	• Heated oxygen sensor • Heated oxygen sensor heater • Heated oxygen sensor circuit
4	Injection Volume: +25% -12.5% Output Voltage: Almost no reaction — NG	Injection Volume: +25% -12.5% Output Voltage: Almost no reaction — NG	• Fuel pressure • Gas leakage from exhaust system (Air fuel ratio extremely lean or rich)

- 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, select the following menu items: Powertrain/Engine and ECT/Active Test/Control the Injection Volume for A/F Sensor/A/F Control System/AFS Voltage B1 S1 or AFS Voltage B2 S1 and O2S B1 S2 or O2S B2 S2 then press the graph button on the Data List view.

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.
- If the OX1B or OX2B wire from the ECM connector is short-circuited to the +B wire, DTC P0136 or P0156 may be set.

1. **READ DTC OUTPUT (DTC P0136, P0137, P0138, P0156, P0157 OR P0158)**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch on (IG).
   c. Turn the tester on.
   d. Select the following menu items: Powertrain/Engine and ECT/Trouble Codes.
   e. Read DTCs.

Result

RESULT CHART

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Result	Proceed to
P0138 or P0158	A
P0137 or P0157	B
P0136 or P0156	C
P0139 or P0159	D

B: Go to step 8

C: Go to step 6

D: Go to step 17

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 on (IG).
   c. Turn the tester on.
   d. Select the following menu items: Select: Powertrain/Engine and ECT/Data List/A/F Control System/O2S B1 S2 or O2S B2 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 more	A
Less than 1.0 V	B

   B: Go to step 5

   A: Go to next step

3. **INSPECT HEATED OXYGEN SENSOR (CHECK FOR SHORT)**
   a. Disconnect the heated oxygen sensor connector.
   b. Measure the resistance according to the value(s) in the table below.

   Standard resistance:

   Bank 1

   TESTER CONNECTION SPECIFIED CONDITION CHART

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Tester Connection	Condition	Specified Condition
2 (+B) - 4 (E2)	Always	10 kohms or higher
2 (+B) - 3 (OX1B)		

Bank 2

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
2 (+B) - 4 (E2)	Always	10 kohms or higher
2 (+B) - 3 (OX2B)		

c. Reconnect the heated oxygen sensor connector.

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

Component without harness connected:
(Heated Oxygen Sensor)

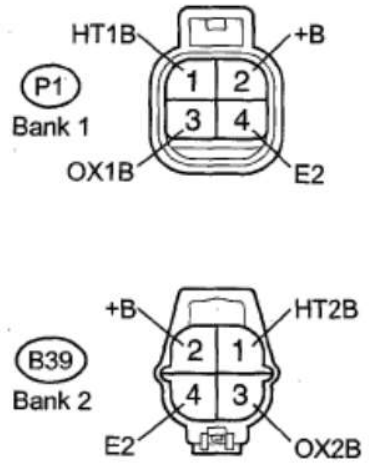


Fig. 99: Identifying Heated Oxygen Sensor Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

4. **CHECK HARNESS AND CONNECTOR (CHECK FOR SHORT)**
   a. Turn the ignition switch off and wait for 5 minutes or more.
   b. Disconnect the ECM connector.
   c. Measure the resistance according to the value(s) in the table below.

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Standard resistance:

Bank 1

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
B1-1 (HT1B) - B1-18 (OX1B)	Always	10 kohms or higher

Bank 2

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
B2-5 (HT2B) - B2-33 (OX2B)	Always	10 kohms or higher

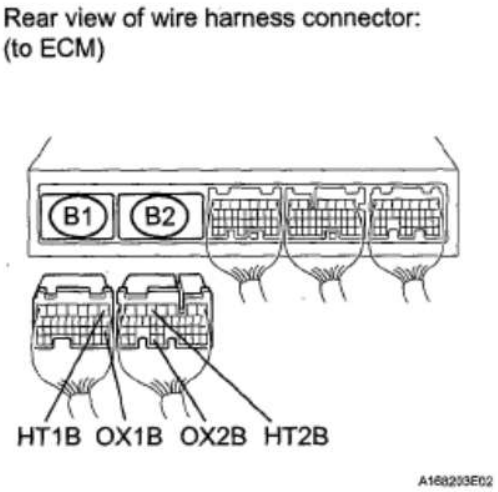


Fig. 100: Identifying ECM Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

d. Reconnect the ECM connector.

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR

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

5. **INSPECT AIR FUEL RATIO SENSOR**

HINT:

This air fuel ratio sensor test is to check the air fuel ratio sensor current during the fuel-cut. When the sensor is normal, the sensor current will indicate below 3.0 mA in this test.

a. Connect the Techstream to the DLC3.

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b. Turn the ignition switch on (IG).
c. Turn the tester 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 more.
   2. Drive the vehicle at 40 mph (64 km/h) or more and decelerate the vehicle for 5 seconds or more.
   3. Repeat the deceleration above at least 3 times.

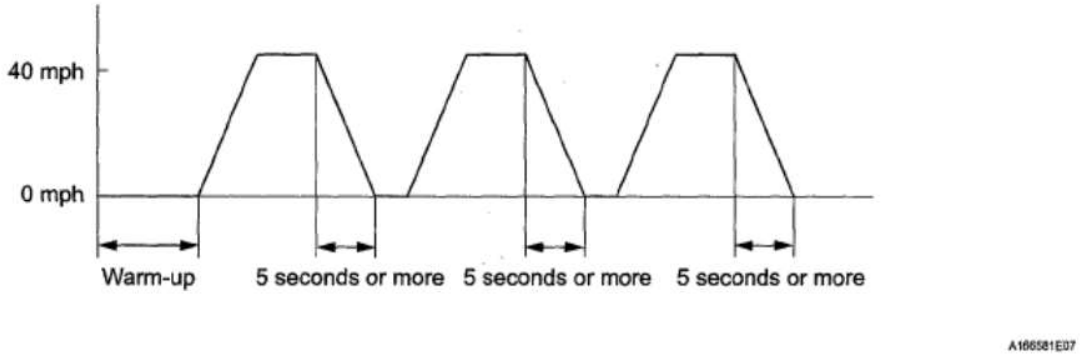


Fig. 101: Vehicle Drive Pattern
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

e. Select the following menu items: Select: Powertrain/Engine and ECT/Monitor/O2 Sensor/Details.
f. Confirm that RANGE B1S1 is either PASS or FAIL. If the tester shows incomplete, re-check RANGE B1S1 after performing the drive pattern.
g. Select the RANGE B1S1.
h. Read the Test Value.

Standard current:

Less than 3.0 mA

HINT:

If the tester shows incomplete again, increasing the vehicle speed and use second gear to decelerate vehicle. Refer to the **CONFIRMATION DRIVING PATTERN**.

OK: Go to step 11

NG: Go to step 14

6. **READ VALUE USING TECHSTREAM (OUTPUT VOLTAGE OF HEATED OXYGEN SENSOR)**
   a. Connect the Techstream to the DLC3.

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b. Turn the ignition switch on (IG).
c. Turn the tester on.
d. Start the engine.
e. Select the following menu items: Powertrain/Engine and ECT/Data List/A/F Control System/O2S B1 S2 or O2S B2 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 rpm 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 more.

NG: Go to step 8

OK: Go to next step

7. **PERFORM ACTIVE TEST USING TECHSTREAM (INJECTION VOLUME)**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch on (IG).
   c. Turn the tester on.
   d. Start the engine and warm it up.
   e. Select the following menu items: Powertrain/Engine and ECT/Active Test/Control the Injection Volume.
   f. Change the fuel injection volume using the tester, and monitor the voltage output of air fuel ratio and heated oxygen sensors displayed on the tester.

HINT:

- Change the fuel injection volume within the range of -12% and +12%. The injection volume can be changed in 1% graduations within the range.
- The air fuel ratio sensor is displayed as AFS Voltage B1 S1 or AFS Voltage B2 S1, and the heated oxygen sensor is displayed as O2S B1 S2 or O2S B2 S2 on the Techstream.

Result

RESULT CHART

Tester Display	Voltage Variation	Proceed to
AFS Voltage B1 S1 or AFS Voltage B2 S1 (Air fuel ratio sensor)	Alternates between more and less than 3.3 V	OK
	Remains at more than 3.3 V	NG

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	Remains at less than 3.3 V	NG

HINT:

A normal heated oxygen sensor voltage (O2S B1 S2 or O2S B2 S2) reacts in accordance with increases and decreases in fuel injection volumes. When the air fuel ratio sensor voltage remains at either less or more than 3.3 V despite the heated oxygen sensor indicating a normal reaction, the air fuel ratio sensor is malfunctioning.

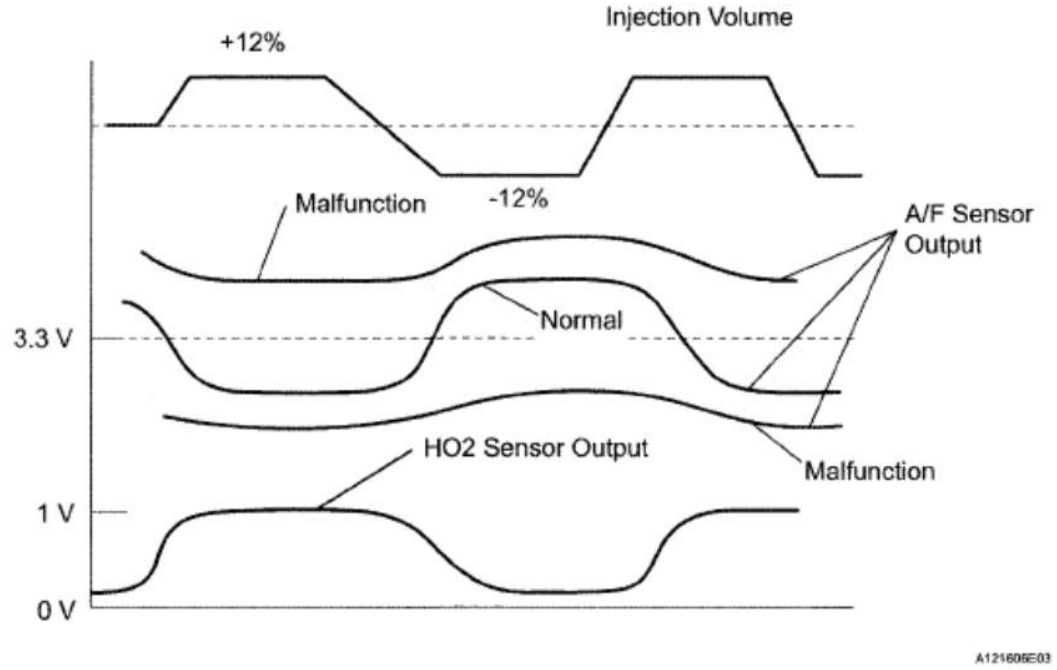


Fig. 102: Identifying Normal Heated Oxygen Sensor Voltage Output
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

NG: Go to step 14

OK: CHECK ENGINE TO DETERMINE CAUSE OF EXTREMELY RICH OR LEAN ACTUAL AIR FUEL RATIO (See **TYPICAL ENABLING CONDITIONS**)

8. **CHECK FOR EXHAUST GAS LEAK**

   OK: No gas leak.

   NG: REPAIR OR REPLACE EXHAUST GAS LEAK POINT

   OK: Go to next step

9. **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

10. **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):

Bank 1

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
P1-1 (HT1B) - B1-1 (HT1B)	Always	Below 1 ohms
P1-3 (OX1B) - B1-18 (OX1B)		
P1-4 (E2) - B1-28 (E2)		

Bank 2

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
B39-1 (HT2B) - B2-5 (HT2B)	Always	Below 1 ohms
B39-3 (OX2B) - B2-33 (OX2B)		
B39-4 (E2) - B1-28 (E2)		

Standard resistance (Check for short):

Bank 1

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
P1-1 (HT1B) or B1-1 (HT1B) - Body ground	Always	10 kohms or higher
P1-3 (OX1B) or B1-18 (OX1B) - Body ground		

Bank 2

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
B39-1 (HT2B) or B2-5 (HT2B) - Body ground	Always	10 kohms or higher
B39-3 (OX2B) or B2-33 (OX2B) - Body ground		

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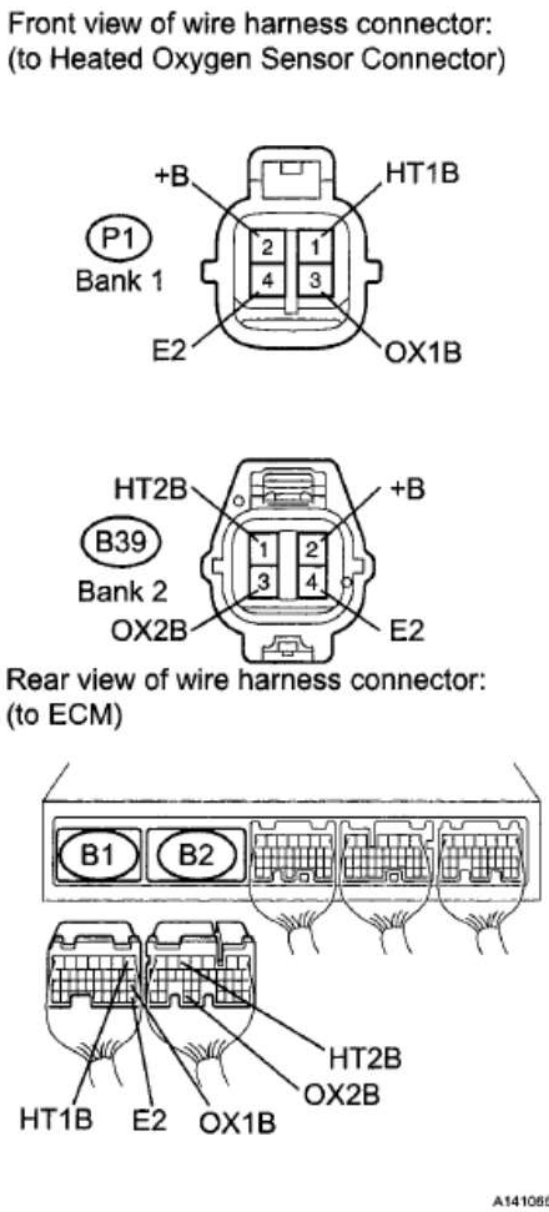


Fig. 103: Identifying Heated Oxygen Sensor And ECM Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR

OK: Go to next step

11. **REPLACE HEATED OXYGEN SENSOR**
    a. Replace the heated oxygen sensor (See **REMOVAL**).

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12. **PERFORM CONFIRMATION DRIVING PATTERN**

HINT:

Refer to the **CONFIRMATION DRIVING PATTERN**.

13. **CHECK WHETHER DTC OUTPUT RECURS (DTC P0136, P0137, P0138, P0156, P0157 OR P0158)**
    a. Connect the Techstream to the DLC3.
    b. Turn the ignition switch on (IG).
    c. Turn the tester on.
    d. Select the following menu items: Powertrain/Engine and ECT/Utility/All Readiness.
    e. Input DTCs: P0136, P0137, P0138, P0156, P0157 and P0158.

    Check the DTC MONITOR is NORMAL. If DTC MONITOR is INCOMPLETE, perform the drive pattern increasing the vehicle speed and using the second gear to decelerate the vehicle.

    Result

    RESULT CHART

Result	Proceed to
No output	A
P0136, P0137, P0138, P0156, P0157 or P0158 detected	B

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

    A: END

14. **REPLACE AIR FUEL RATIO SENSOR**
    a. Replace the air fuel ratio sensor (See **REMOVAL**).
15. **PERFORM CONFIRMATION DRIVING PATTERN**

HINT:

Refer to the **CONFIRMATION DRIVING PATTERN**.

16. **CHECK WHETHER DTC OUTPUT RECURS (DTC P0136, P0137, P0138, P0156, P0157 OR P0158)**
    a. Connect the Techstream to the DLC3.
    b. Turn the ignition switch on (IG).
    c. Turn the tester on.
    d. Select the following menu items: Powertrain/Engine and ECT/Utility/All Readiness.
    e. Input DTCs: P0136, P0137, P0138, P0156, P0157 and P0158.

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Check the DTC MONITOR is NORMAL. If DTC MONITOR is INCOMPLETE, perform the drive pattern increasing the vehicle speed and using the second gear to decelerate the vehicle.

Result

RESULT CHART

Result	Proceed to
No output	A
P0136, P0137, P0138, P0156, P0157 or P0158 detected	B

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

A: END

17. **READ VALUE USING TECHSTREAM (OUTPUT VOLTAGE OF HEATED OXYGEN SENSOR)**
    a. Connect the Techstream to the DLC3.
    b. Turn the ignition switch on (IG).
    c. Turn the tester on.
    d. Select the following menu items: Select: Powertrain/Engine and ECT/Data List/A/F Control System/O2S B1 S2 or O2S B2 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 more	A
Less than 1.0 V	B

B: Go to step 20

A: Go to next step

18. **INSPECT HEATED OXYGEN SENSOR (CHECK FOR SHORT)**
    a. Disconnect the heated oxygen sensor connector.
    b. Measure the resistance according to the value(s) in the table below.

Standard resistance:

Bank 1

TESTER CONNECTION SPECIFIED CONDITION CHART

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Tester Connection	Condition	Specified Condition
2 (+B) - 4 (E2)	Always	10 kohms or higher
2 (+B) - 3 (OX1B)		

Bank 2

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
2 (+B) - 4 (E2)	Always	10 kohms or higher
2 (+B) - 3 (OX2B)		

c. Reconnect the heated oxygen sensor connector.

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

Component without harness connected:
(Heated Oxygen Sensor)

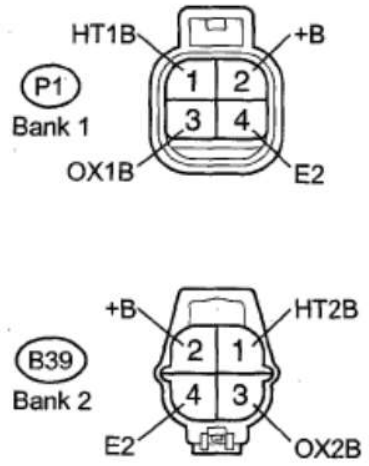


Fig. 104: Identifying Heated Oxygen Sensor Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

19. **CHECK HARNESS AND CONNECTOR (CHECK FOR SHORT)**
    a. Turn the ignition switch off and wait for 5 minutes or more.
    b. Disconnect the ECM connector.
    c. Measure the resistance according to the value(s) in the table below.

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Standard resistance:

Bank 1

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
B1-1 (HT1B) - B1-18 (OX1B)	Always	10 kohms or higher

Bank 2

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
B2-5 (HT2B) - B2-33 (OX2B)	Always	10 kohms or higher

d. Reconnect the ECM connector.

Rear view of wire harness connector:
(to ECM)

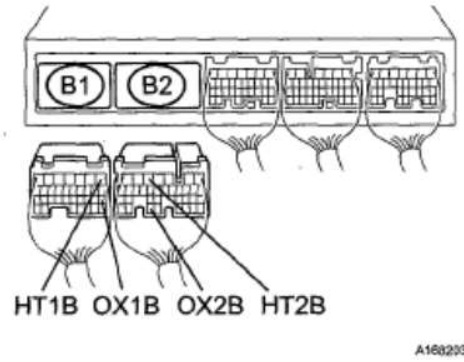


Fig. 105: Identifying ECM Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR

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

20. **READ VALUE USING DTC OUTPUT (DTC P0139 OR P0159)**
    a. Connect the Techstream to the DLC3.
    b. Clear the DTC (See **DTC CHECK/CLEAR**).
    c. Turn the ignition switch on (IG).
    d. Turn the tester on.
    e. 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 more.

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2. Drive the vehicle at 40 mph (64 km/h) or more and decelerate the vehicle for 5 seconds or more.
3. Repeat the deceleration above at least 3 times.

f. Select the following menu items: Powertrain/Engine and ECT/Utility/All Readiness.

g. Input DTCs: P0139 and P0159.

Check the DTC MONITOR is NORMAL. If DTC MONITOR is INCOMPLETE, perform the drive pattern increasing the vehicle speed and using second gear to decelerate the vehicle.

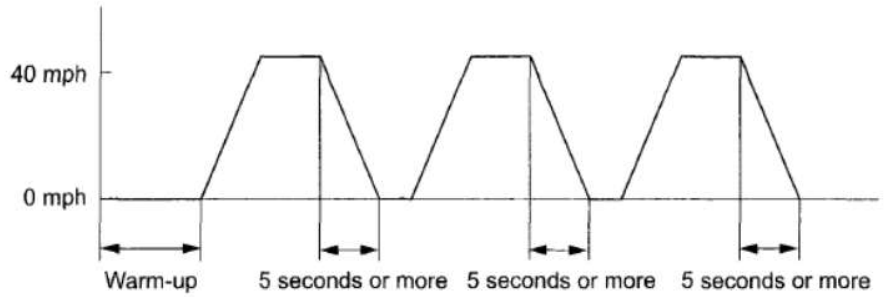


Fig. 106: Vehicle Drive Pattern
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Result

RESULT CHART

Result	Proceed to
No output	A
P0139 or P0159 detected	B

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

A: CHECK FOR INTERMITTENT PROBLEMS

DTC P0171 SYSTEM TOO LEAN (BANK 1); DTC P0172 SYSTEM TOO RICH (BANK 1); DTC P0174 SYSTEM TOO LEAN (BANK 2); DTC P0175 SYSTEM TOO RICH (BANK 2)

DESCRIPTION

The fuel trim is related to the feedback compensation value, not to the basic injection time. 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 it is lean.

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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 sets a DTC.

DTC DETECTION CONDITION CHART

DTC No.	DTC Detection Condition	Trouble Area
P0171 P0174	With warm engine and stable air fuel ratio feedback, fuel trim considerably in error to lean side (2 trip detection logic)	• Air induction 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, 2 sensor 1) circuit • Air fuel ratio sensor (bank 1, 2 sensor 1) • EFI NO. 2 fuse • PCV valve and hose • PCV hose connections • ECM
P0172 P0175	With warm engine and stable air fuel ratio feedback, fuel trim considerably in error to 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, 2 sensor 1) circuit • Air fuel ratio sensor (bank 1, 2 sensor 1) • EFI NO. 2 fuse • ECM

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HINT:

- When DTC P0171 or P0174 is set, the actual air fuel ratio is on the lean side. When DTC P0172 or P0175 is set, 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 or P0174 may be set. 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 more 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 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 ECM's estimated fuel injection volumes also affect the average fuel trim learning value, which is a combination of the average short-term fuel trim (fuel feedback compensation value) and the average long-term fuel trim (learning value of the air fuel ratio). If the average fuel trim learning value exceeds the malfunction thresholds, the ECM interprets this a fault in the fuel system and sets a DTC.

Example:

The average fuel trim learning value is more than +35% or less than -35%, the ECM interprets this as a fuel system malfunction.

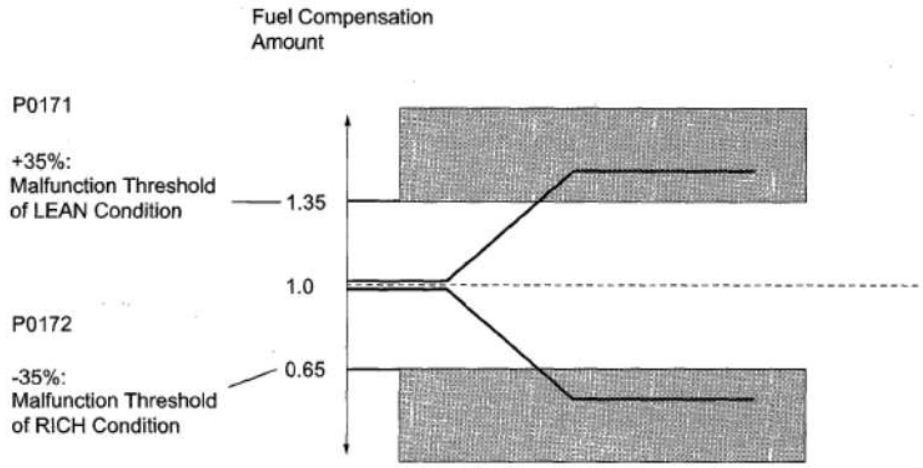


Fig. 107: Fuel System Malfunction Threshold Condition Graph
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

MONITOR STRATEGY

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MONITOR STRATEGY REFERENCE CHART

Related DTCs	P0171: Fuel trim Lean (bank 1) P0172: Fuel trim Rich (bank 1) P0174: Fuel trim Lean (bank 2) P0175: Fuel trim Rich (bank 2)
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	Less than 10 seconds
MIL Operation	2 driving cycles
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

Fuel-trim:

TYPICAL ENABLING CONDITIONS CHART

The monitor will run whenever these DTCs are not present	P0010, P0020 (OCV bank 1, 2) P0011, P0021 (VVT system bank 1, 2 - advance) P0012, P0022 (VVT system bank 1, 2 - retard) P0013, P0023 (Exhaust OCV bank 1, 2) P0014, P0024 (Exhaust VVT system bank 1, 2 - advance) P0015, P0025 (Exhaust VVT system bank 1, 2 - retard) P0016, P0018 (VVT system bank 1, 2 - misalignment) P0017, P0019 (Exhaust VVT system bank 1, 2 - misalignment) P0031, P0032, P0051, P0052 (A/F sensor heater) P0100, P0102, P0103 (MAF meter) P0115, P0117, P0118 (ECT sensor) P0120, P0121, P0122, P0123, P0220, P0222, P0223, P2135 (TP sensor) P0125 (Insufficient ECT for closed loop) P0335 (CKP sensor) P0340, P0342, P0343, P0345, P0347, P0348 (VVT sensor) P0351, P0352, P0353, P0354, P0355, P0356 (Igniter) P0365, P0367, P0368, P0390, P0392, P0393 (Exhaust VVT sensor) P0500 (Vehicle speed sensor)
Fuel system status	Closed-loop
Battery voltage	11 V or more
Either of following conditions 1 or 2 set	-
1. Engine RPM	Less than 1100 rpm
2. Intake air amount per revolution	0.22 g/rev or more

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Catalyst monitor	No executed

TYPICAL MALFUNCTION THRESHOLDS

Fuel-trim:

TYPICAL MALFUNCTION THRESHOLDS REFERENCE CHART

Purge-cut	Executing
Either of following conditions 1 or 2 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)

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.
3. Turn the tester on.
4. Warm up the engine at an engine speed of 2500 rpm for approximately 90 seconds.
5. Select the following menu items: Powertrain/Engine and ECT/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 or AFS Voltage B2 S1 and O2S B1 S2 or O2S B2 S2) displayed on the tester.

   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.

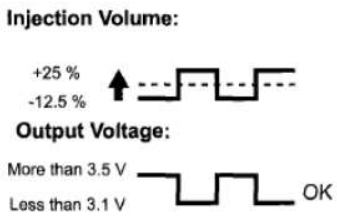
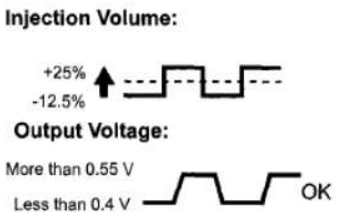
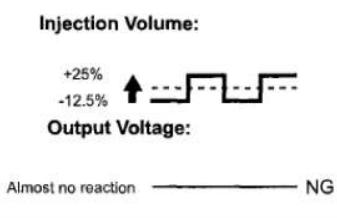
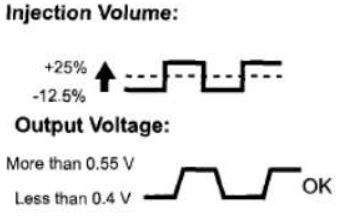
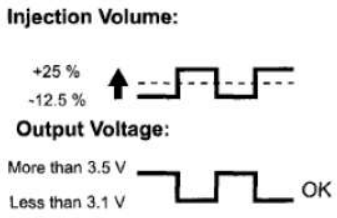
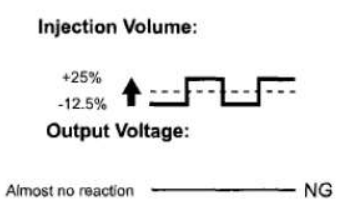
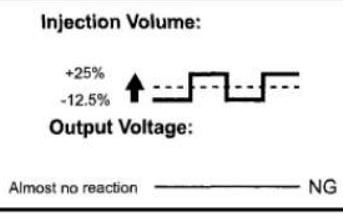
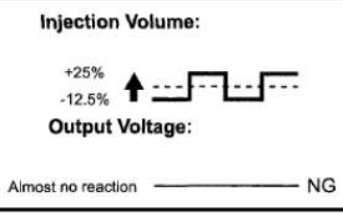
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TESTER DISPLAY REFERENCE CHART

Tester Display	Injection Volume	Status	Voltage
AFS Voltage B1 S1 AFS Voltage B2 S1 (Air fuel ratio sensor)	+25%	Rich	Less than 3.1 V
	-12.5%	Lean	More than 3.5 V
O2S B1 S2 O2S B2 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 CHART

Case	Air Fuel Ratio Sensor (Sensor 1) Output Voltage	Heated Oxygen Sensor (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			• Fuel pressure • Gas leakage from exhaust system (Air fuel ratio extremely lean or rich)

- 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, select the following menu items:

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Powertrain/Engine and ECT/Active Test/Control the Injection Volume for A/F Sensor/A/F Control System/AFS Voltage B1 S1 or AFS Voltage B2 S1 and O2S B1 S2 or O2S B2 S2; then press the graph button on the Data List view.

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.
- 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, P0172, P0174 OR P0175)**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch on (IG).
   c. Turn the tester on.
   d. Select the following menu items: Powertrain/Engine and ECT/Trouble Codes.
   e. Read DTCs.

   Result

   RESULT CHART

Result	Proceed to
P0171, P0172, P0174 or P0175	A
P0171, P0172, P0174 or P0175 and other DTCs	B

   HINT:

   If any DTCs other than P0171, P0172, P0174 or P0175 are output, troubleshoot those DTCs first.

   B: GO TO **DTC CHART**

   A: Go to next step

2. **CHECK PCV HOSE CONNECTIONS**

   OK: PCV hose is connected correctly and is not damaged.

   NG: REPAIR OR REPLACE PCV HOSE

   OK: Go to next step

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3. **CHECK AIR INDUCTION SYSTEM**
   a. Check the air induction system for vacuum leak (See **ON-VEHICLE INSPECTION**).

   OK: No leak from air induction system.

   NG: REPAIR OR REPLACE AIR INDUCTION SYSTEM

   OK: Go to next step

4. **PERFORM ACTIVE TEST USING TECHSTREAM (AIR FUEL RATIO CONTROL)**
   a. Connect the Techstream to the DLC3.
   b. Start the engine.
   c. Turn the tester on.
   d. Warm up the engine at an engine speed of 2500 rpm for approximately 90 seconds.
   e. Select the following menu items: Powertrain/Engine and ECT/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 in an idling condition (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 or AFS Voltage B2 S1 and O2S B1 S2 or O2S B2 S2) displayed on the tester.

   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.

   Standard

   TESTER DISPLAY REFERENCE CHART

Tester Display	Injection Volume	Status	Voltage
AFS Voltage B1 S1 AFS Voltage B2 S1 (Air fuel ratio sensor)	+25%	Rich	Less than 3.1 V
	-12.5%	Lean	More than 3.5 V
O2S B1 S2 O2S B2 S2 (Heated oxygen)	+25%	Rich	More than 0.55 V
	-12.5%	Lean	Less than 0.4 V

   Result

   RESULT CHART

Status AFS B1 S1 AFS B2 S1	Status O2S B1 S2 O2S B2 S2	Air Fuel Ratio Condition and Air Fuel Ratio Sensor Condition	Misfire	Suspected Trouble Area	Proceed to

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Lean/Rich	Lean/Rich	Normal	-	-	C
Lean	Lean	Actual air fuel ratio lean	May occur	• PCV valve and hose • PCV hose connections • Injector blockage • Gas leak from exhaust system • Air induction system • Fuel pressure • Mass air flow meter • Engine coolant temperature sensor	A
Rich	Rich	Actual air fuel ratio rich	-	• Injector blockage or blockage • Gas leak from exhaust system • Ignition system • Fuel pressure • Mass air flow meter • Engine coolant temperature 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) is consistently more than 3.5 V, and the heated oxygen sensor output voltage (O2S) is consistently less than 0.4 V. Rich: During Control the Injection Volume for A/F Sensor, the AFS is consistently less than 3.1 V, and the O2S is consistently more 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

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C: Go to step 15

A: Go to next step

5. **READ VALUE USING TECHSTREAM (COOLANT TEMP)**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch on (IG).
   c. Turn the tester on.
   d. Select the following menu items: Powertrain/Engine and ECT/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. Read the values using the Techstream (mass air flow).

NOTE:

- **Turn the ignition switch off.**
- **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 in the air cleaner case (installed on the vehicle).**
- **During the test, do not use the exhaust air duct to perform suction on the exhaust pipe.**

1. Turn the ignition switch on (IG) (do not start the engine).
2. Turn the tester on.
3. Select the following menu items: Select: Powertrain/Engine and ECT/Data List/MAF.
4. Wait for 30 seconds, and read the values on the tester.

Standard value: Less than 0.70 g/sec

   b. Inspect the mass air flow meter.
      1. Remove the mass air flow meter (See **REMOVAL**).
      2. Using a work light, check that the platinum filament (heater portion) in the mass air flow meter has no foreign matter attached.

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OK: No foreign matter attached.

3. Reinstall the mass air flow meter (See **REMOVAL**).

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

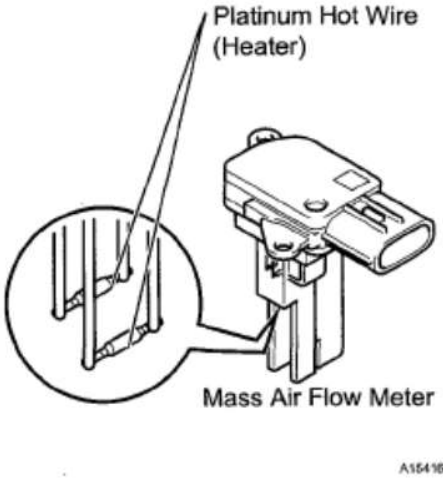


Fig. 108: Identifying Platinum Hot Wire (Heater) And Mass Air Flow Meter
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

7. **CHECK FUEL PRESSURE**
   a. Check the fuel pressure (See **ON-VEHICLE INSPECTION**).

   NG: REPAIR OR REPLACE FUEL SYSTEM

   OK: Go to next step

8. **CHECK FOR EXHAUST GAS LEAK**

   OK: No gas leak.

   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

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be read using the Techstream. Select the following menu items: Powertrain/Engine and ECT/Data List/All Data/Cylinder #1 Misfire Rate (to Cylinder #6 Misfire Rate)

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. Select the following menu items: Powertrain/Engine and ECT/Data List/All Data/Cylinder #1 Misfire Rate (to Cylinder #6 Misfire Rate).

NG: REPLACE FUEL INJECTOR ASSEMBLY (See **FUEL INJECTOR**)

OK: Go to next step

11. **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:

Bank 1

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

Bank 2

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
1 (HA2A) - 2 (+B)	20°C (68°F)	1.8 to 3.4 ohms
1 (HA2A) - 4 (A2A-)	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)

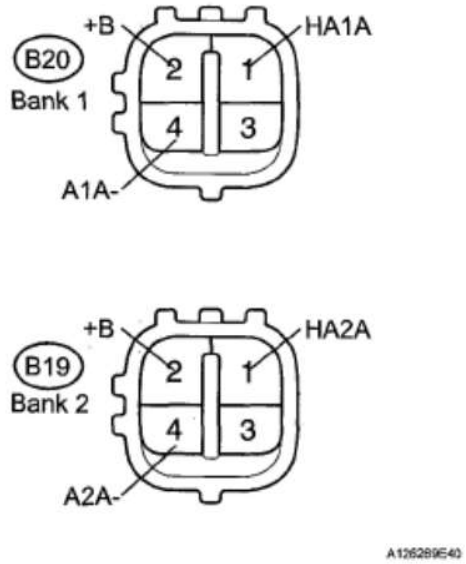


Fig. 109: Identifying Air Fuel Ratio Sensor Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

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

Standard voltage:

Bank 1

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Switch Condition	Specified Condition
B20-2 (+B) - Body ground	Ignition switch on (IG)	9 to 14 V

Bank 2

TESTER CONNECTION SPECIFIED CONDITION CHART

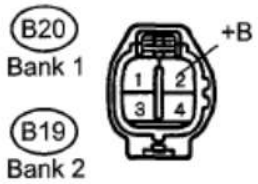
Tester Connection	Switch Condition	Specified Condition
B19-2 (+B) - Body ground	Ignition switch on (IG)	9 to 14 V

    d. Reconnect the air fuel ratio sensor connector.

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NG: Go to step 17

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



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Fig. 110: Identifying Air Fuel Ratio Sensor +B Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

13. **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):

Bank 1

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
B20-1 (HA1A) - B2-2 (HA1A)	Always	Below 1 ohms

Bank 2

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
B19-1 (HA2A) - B2-1 (HA2A)	Always	Below 1 ohms

Standard resistance (Check for short):

Bank 1

TESTER CONNECTION SPECIFIED CONDITION CHART

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Tester Connection	Condition	Specified Condition
B20-1 (HA1A) or B2-2 (HA1A) - Body ground	Always	10 kohms or higher

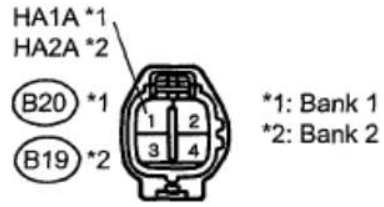
Bank 2

TESTER CONNECTION SPECIFIED CONDITION CHART

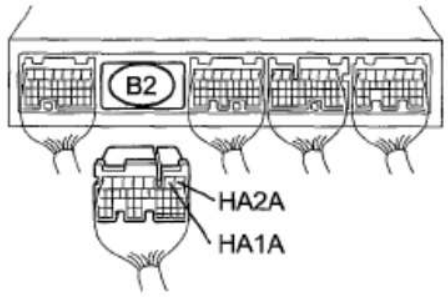
Tester Connection	Condition	Specified Condition
B19-1 (HA2A) or B2-1 (HA2A) - Body ground	Always	10 kohms or higher

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

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



Rear view of wire harness connector:
(to ECM)



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Fig. 111: Identifying Air Fuel Ratio Sensor And ECM Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR

OK: Go to next step

14. **REPLACE AIR FUEL RATIO SENSOR**

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a. Replace the air fuel ratio sensor (See **REMOVAL**).

15. **PERFORM CONFIRMATION DRIVING PATTERN**

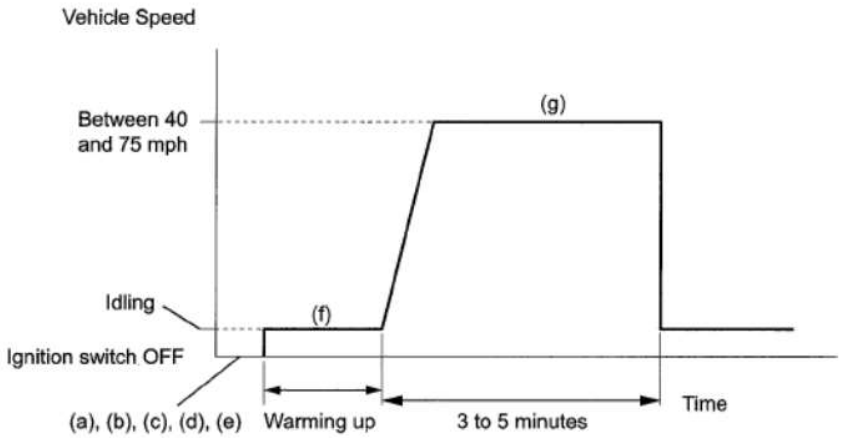


Fig. 112: Vehicle Drive Pattern
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

a. Connect the Techstream to the DLC3.
b. Turn the ignition switch on (IG).
c. Turn the tester on.
d. Clear DTCs (See **DTC CHECK/CLEAR**).
e. Switch the ECM from normal mode to check mode using the tester (See **CHECK MODE PROCEDURE**).
f. Start the engine and warm it up with all the accessories switched OFF.
g. Drive the vehicle at between 40 mph and 75 mph (64 km/h and 120 km/h) and at an engine speed of between 1400 rpm and 3200 rpm for 3 to 5 minutes.

HINT:

If the system is still malfunctioning, the MIL will be illuminated during step (g).

NOTE: If the conditions in this test are not strictly followed, no malfunction will be detected.

16. **CHECK WHETHER DTC OUTPUT RECURS (DTC P0171, P0172, P174 OR P0175)**

a. Connect the Techstream to the DLC3.
b. Turn the ignition switch on (IG).
c. Turn the tester on.
d. Select the following menu items: Powertrain/Engine and ECT/Trouble Codes/Pending.

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e. Read DTCs.

Result

RESULT CHART

Result	Proceed to
No output	A
P0171, P0172, P0174 or P0175	B

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

A: END

17. **INSPECT FUSE (A/F FUSE)**
    a. Remove the A/F fuse 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
A/F fuse	Always	Below 1 ohms

    c. Reinstall the A/F fuse.

NG: CHECK FOR SHORT IN ALL HARNESSES AND CONNECTORS CONNECTED TO FUSE AND REPLACE FUSE

Engine Room Relay Block:

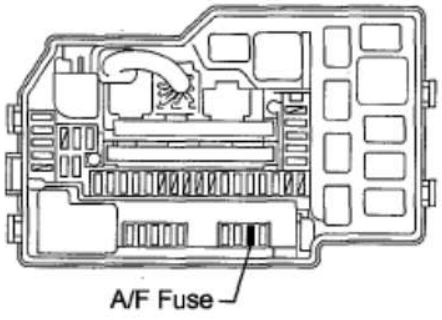


Fig. 113: Identifying A/F Fuse
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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OK: Go to next step

18. **INSPECT ENGINE ROOM JUNCTION BLOCK ASSEMBLY (A/F RELAY)**
    a. Inspect the A/F relay (See **INSPECTION**).

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

    OK: REPAIR OR REPLACE HARNESS OR CONNECTOR (AIR FUEL RATIO FUSE - AIR FUEL RATIO SENSOR)

DTC P0230 FUEL PUMP PRIMARY CIRCUIT

DESCRIPTION

- This DTC is designed to detect a malfunction in the fuel pump (FUEL PMP) relay circuit. When the system is normal, the battery voltage is applied to FPR terminal of the ECM while the FUEL PMP relay is turned OFF. If the battery voltage is not applied to the FPR terminal while the FUEL PMP relay is OFF, the ECM interprets this as a malfunction. The ECM then illuminates the MIL and sets a DTC.
- The FUEL PMP relay switches the fuel pump speed according to the engine conditions. The fuel pump operates when the ECM receives the starter-operating signal (STA) and crankshaft-rotating signal (NE). The FUEL relay is turned ON while the engine is idling or operating at low load. This causes current to flow through the fuel pump resistor to the fuel pump. The fuel pump then operates at low speed. The FUEL relay is turned OFF while the engine is cranking or operating at high load. The fuel pump then operates at normal speed.

DTC DETECTION CONDITION CHART

DTC No.	DTC Detection Condition	Trouble Area
P0230	Open or short in FUEL PUMP relay circuit (1 trip detection logic)	• Open or short in FUEL PUMP relay circuit • FUEL PMP relay • ECM

WIRING DIAGRAM

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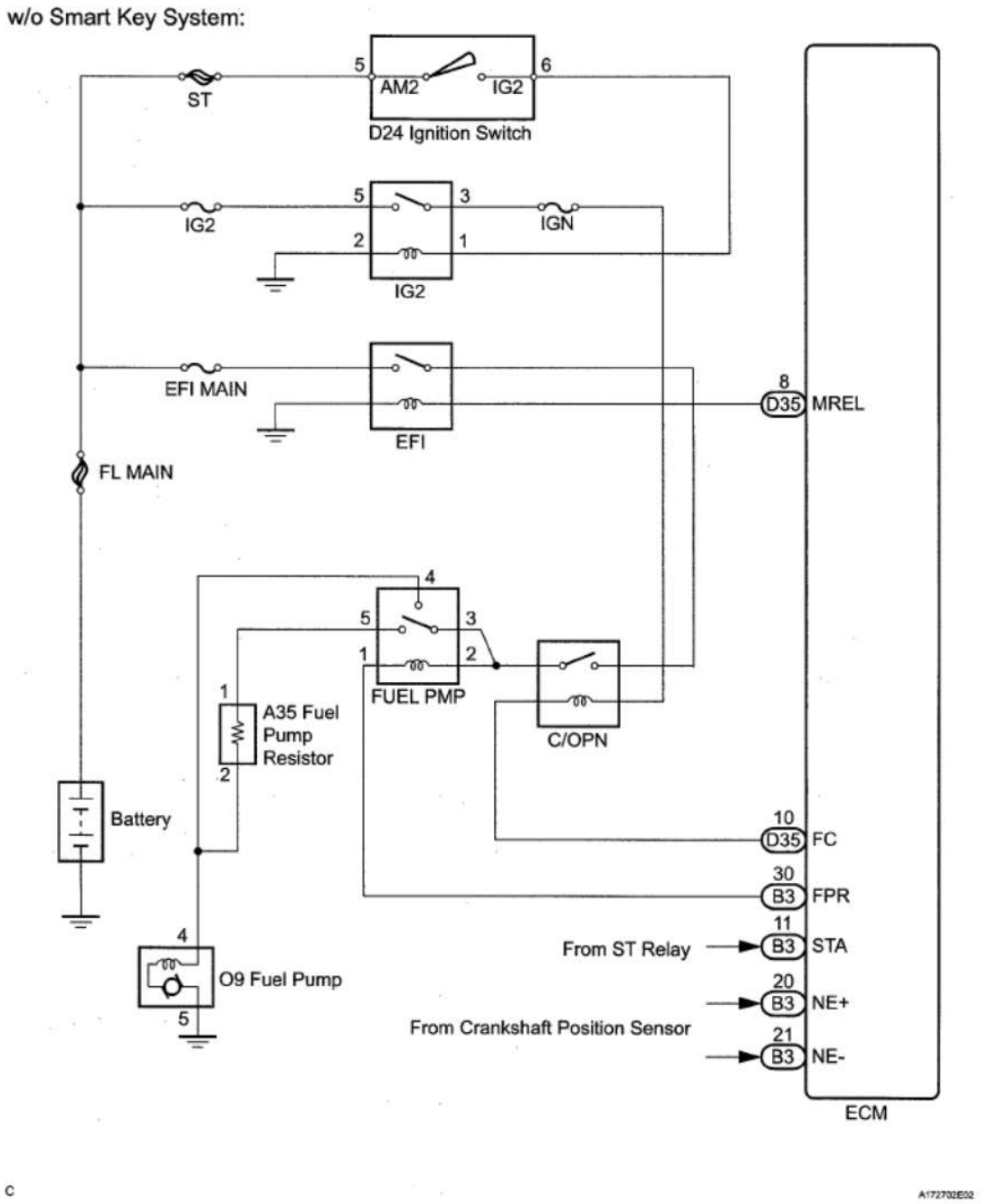


Fig. 114: Fuel Pump - Wiring Diagram (1 Of 2)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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w/ Smart Key System:

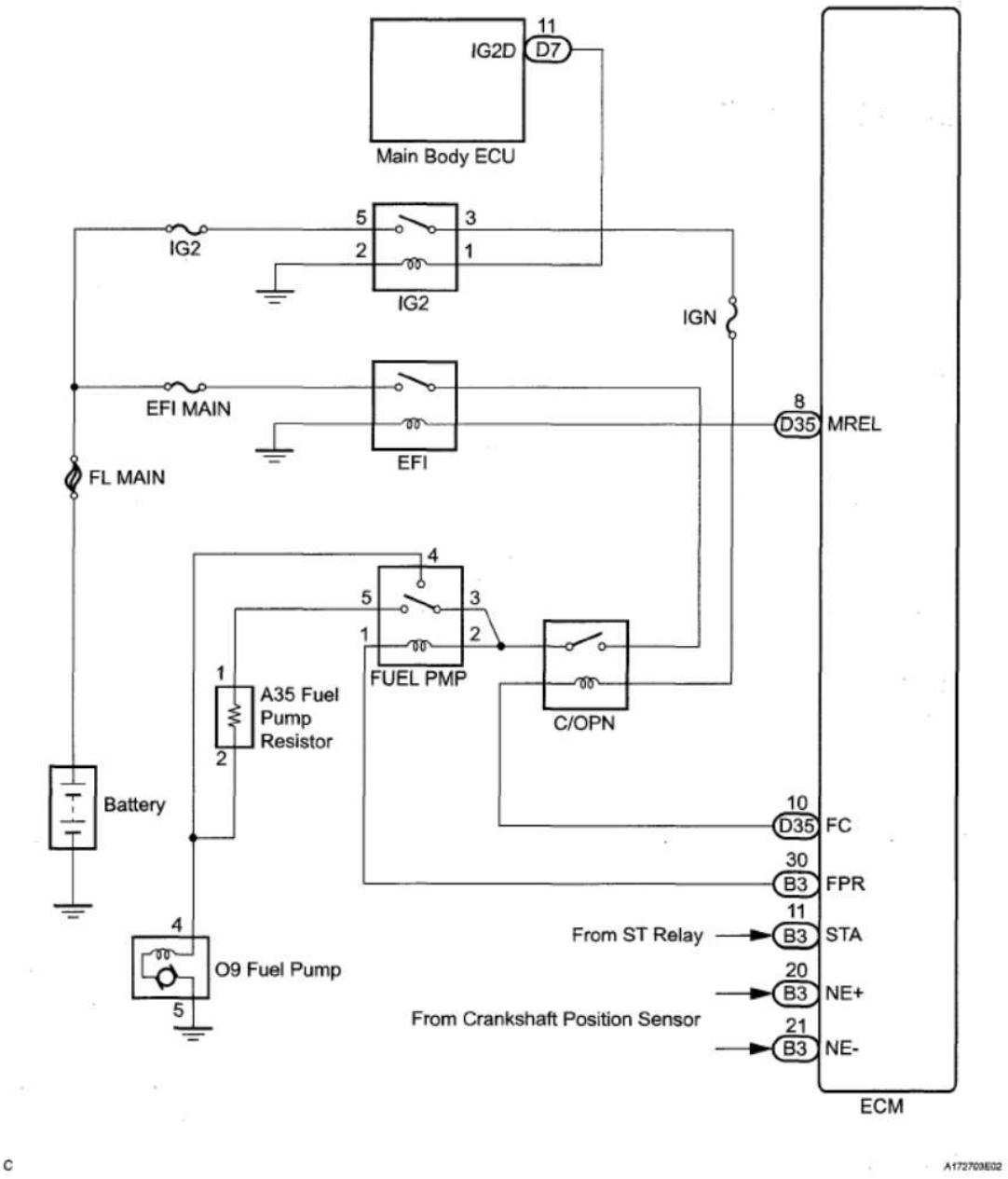


Fig. 115: Fuel Pump - Wiring Diagram (2 Of 2)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

This troubleshooting procedure is based on the premise that the engine is started. If the engine is not started, proceed to the **PROBLEM SYMPTOMS TABLE** .

INSPECTION PROCEDURE

1. **PERFORM ACTIVE TEST USING TECHSTREAM**

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a. Connect the Techstream to the DLC3.
b. Turn the ignition switch on (IG) and turn the tester on.
c. Select the following menu items: Powertrain/Engine and ECT/Active Test/Active the Fuel Pump Speed Control.
d. Check the operation of the relay while operating it using the tester.

OK: Operating noise can be heard from the relay.

NG: Go to step 2

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

2. **INSPECT RELAY (FUEL PMP RELAY)**
   a. Remove the FUEL PMP relay from the engine room junction 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
1 - 2	Always	Approximately 111 ohms

   c. Reinstall the FUEL PMP relay.

NG: REPLACE RELAY (FUEL PMP RELAY)

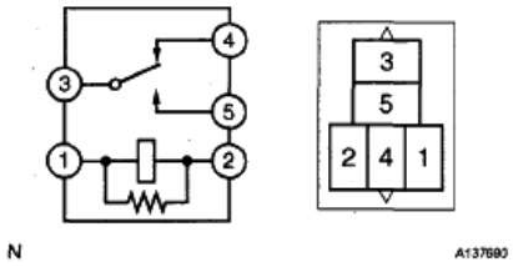


Fig. 116: Fuel PMP Relay Circuit
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

3. **CHECK HARNESS AND CONNECTOR (FUEL PMP RELAY - ECM)**
   a. Remove the FUEL PMP 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.

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Standard resistance

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
FUEL PMP relay terminal 1 - B3-30 (FPR)	Always	Below 1 ohms
FUEL PMP relay terminal 1 or B3-30 (FPR) - Body Ground	Always	10 kohms or higher

d. Reconnect the ECM connector.
e. Reinstall the FUEL PMP relay.

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR (FUEL PMP RELAY - ECM)

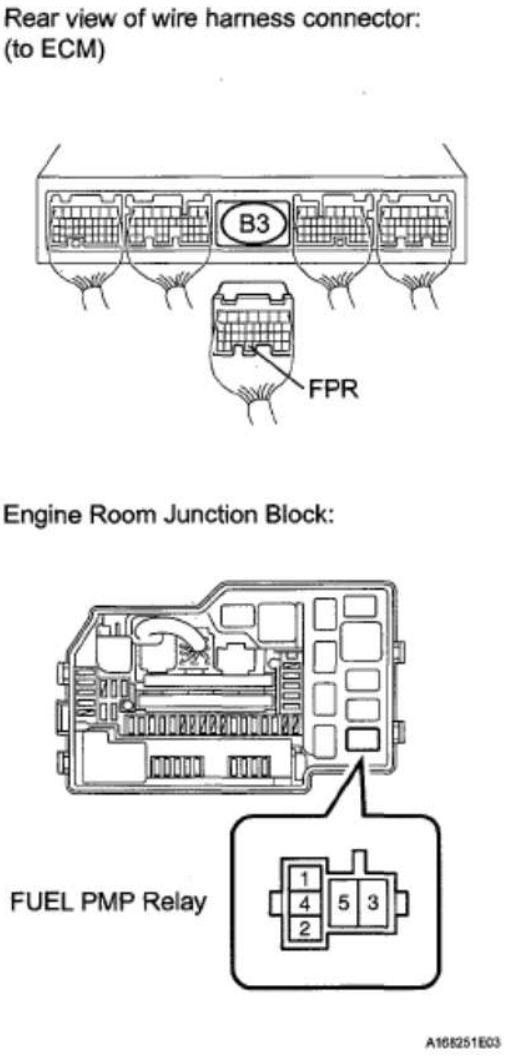


Fig. 117: Identifying Fuel PMP Circuit And ECM Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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

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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; DTC P0305 CYLINDER 5 MISFIRE DETECTED; DTC P0306 CYLINDER 6 MISFIRE DETECTED

DESCRIPTION

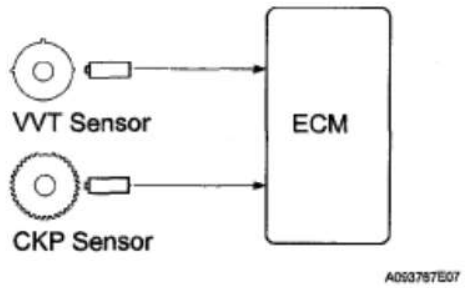


Fig. 118: VVT And CKP Sensor Communication Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

When the engine misfires, high concentrations of hydrocarbons enter the exhaust gas. High hydrocarbons concentration levels can cause 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 rate. 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 VVT sensor and the crankshaft position sensor. The VVT 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, the ECM illuminates the MIL and sets a DTC.

DTC DETECTION CONDITION CHART

DTC No.	DTC Detection Condition	Trouble Area
P0300	Simultaneous misfiring of several cylinders occurs and one of following conditions below is detected (2 trip detection logic): • High temperature misfire occurs in three-way catalytic converter (MIL blinks) • Emission deterioration misfire occurs (MIL illuminates)	• Open or short in engine wire harness • Connector connection • Vacuum hose connections • Ignition system • Injector • Fuel pressure • Mass air flow meter • Engine coolant temperature sensor • Compression pressure
P0301	Misfiring of specific cylinder occurs and one of following	

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P0302 P0303 P0304 P0305 P0306	conditions below is detected (2 trip detection logic): • High temperature misfire occurs in three-way catalytic converter (MIL blinks) • Emission deterioration misfire occurs (MIL illuminates)	• Valve clearance • Valve timing • PCV valve and hose • PCV hose connections • Air induction system • ECM

When multiple DTCs for misfiring cylinders are set, but DTC P0300 is not set, it indicates that misfires have been detected in different cylinders at different times. DTC P0300 is only set when several misfiring cylinders are detected at the same time.

MONITOR DESCRIPTION

The ECM illuminates the MIL and sets 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 of the engine starting, an excessive misfiring rate (approximately 20 to 50 misfires per 1000 crankshaft revolutions) occurs once.
- An excessive misfiring rate (approximately 20 to 50 misfires per 1000 crankshaft revolutions) occurs a total of 4 times.

The ECM flashes the MIL and sets a DTC when either one of the following conditions, which could cause the three-way catalytic converter damage, is detected (2 trip detection logic).

- At a high engine rpm, a catalyst damage misfire, which monitored every 200 crankshaft revolutions, occurs once.
- At a normal engine rpm, a catalyst damage misfire, which monitored every 200 crankshaft revolutions, occurs 3 times.

HINT:

If a catalyst damage misfire occurs, the ECM informs the driver by flashing the MIL.

Misfire Monitor for Mexico Models

The ECM illuminates the MIL and sets 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 of the engine starting, an excessive misfiring rate (approximately 1000 misfires per 1000 crankshaft revolutions) occurs once.
- An excessive misfiring rate (approximately 500 misfires per 1000 crankshaft revolutions) occurs a total of 4 times.

The ECM flashes the MIL and sets a DTC when the following condition, which could cause the Three-Way Catalytic Converter (TWC) damage, is detected (2 trip detection logic).

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- A catalyst damage misfire, which is monitored every 200 crankshaft revolutions, occurs 3 times.

MONITOR STRATEGY

MONITOR STRATEGY REFERENCE CHART

Related DTCs	P0300: Multiple cylinder misfire P0301: Cylinder 1 misfire P0302: Cylinder 2 misfire P0303: Cylinder 3 misfire P0304: Cylinder 4 misfire P0305: Cylinder 5 misfire P0306: Cylinder 6 misfire
Required Sensors/Components (Main)	Injector, Ignition coil and spark plug
Required Sensors/Components (Related)	Crankshaft position, Camshaft position Engine coolant temperature and intake air temperature sensors and Mass air flow meter
Frequency of Operation	Continuous
Duration	1000 to 4000 crankshaft revolutions: Emission related misfire 200 to 600 crankshaft revolutions: Catalyst damaged misfire
MIL Operation	2 driving cycles: (MIL illuminates when misfire detected) MIL flashes immediately: When catalyst damaged misfire occur
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

Misfire:

TYPICAL ENABLING CONDITIONS CHART

The monitor will run whenever these DTCs are not present	P0016, P0018 (VVT system bank 1, 2 - misalignment) P0017, P0019 (Exhaust VVT system bank 1,2-misalignment) P0100, P0102, P0103 (MAF meter) P0110, P0112, P0113 (IAT sensor) P0115, P0117, P0118 (ECT sensor) P0120, P0121, P0122, P0123, P0220, P0222, P0223, P2135 (TP sensor) P0125 (Insufficient ECT for closed loop) P0327, P0328, P0332, P0333 (Knock sensor) P0335 (CKP sensor) P0351, P0352, P0353, P0354, P0355, P0356 (Igniter) P0500 (Vehicle speed sensor)
Battery voltage	8 V or more
VVT system	Not operated by scan tool
Engine RPM	450 to 6500 rpm
Either of following conditions (a) or (b) met	-

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(a) Engine coolant temperature at engine start	More than -7°C (19°F)
(b) Engine coolant temperature	More 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 Check Mode	Crankshaft 1000 revolutions
Except above	Crankshaft 1000 revolutions x 4

Monitor period of catalyst-damaged-misfire (MIL blinks):

TYPICAL ENABLING CONDITIONS CHART

All of following conditions 1, 2 and 3 met	Crankshaft 200 revolutions
1. Driving cycles	1st
2. Check mode	OFF
3. Engine RPM	Less than 3000 rpm
Except above	Crankshaft 200 revolutions x 3

FOR MEXICO MODELS:

Misfire: for Mexico models

TYPICAL ENABLING CONDITIONS CHART

The monitor will run whenever these DTCs are not present	P0016, P0018 (VVT system bank 1,2- misalignment) P0017, P0019 (Exhaust VVT system bank 1,2- misalignment) P0100, P0102, P0103 (MAF meter) P0110, P0112, P0113 (IAT sensor) P0115, P0117, P0118 (ECT sensor) P0120, P0121, P0122, P0123, P0220, P0222, P0223, P2135 (TP sensor) P0125 (Insufficient ECT for closed loop) P0327, P0328, P0332, P0333 (Knock sensor) P0335 (CKP sensor) P0351, P0352, P0353, P0354, P0355, P0356 (Igniter) P0500 (Vehicle speed sensor)
Battery voltage	8 V or more
VVT system	Not operated by scan tool
Engine RPM	450 to 6500 rpm
Engine coolant temperature	More than 65°C (149°F)
Fuel cut	OFF

Monitor period of emission-related-misfire: for Mexico models

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TYPICAL ENABLING CONDITIONS CHART

First 1000 revolutions after engine start, or Check mode	Crankshaft 1000 revolutions
Except above	Crankshaft 1000 revolutions x 4

Monitor period of catalyst-damaged-misfire (MIL blinks): for Mexico models

TYPICAL ENABLING CONDITIONS CHART

All of following conditions 1, 2 and 3 met	Crankshaft 200 revolutions
1. Driving cycles	1st
2. Check mode	OFF
Except above	Crankshaft 200 revolutions x 3

TYPICAL MALFUNCTION THRESHOLDS

Monitor period of emission-related-misfire:

TYPICAL MALFUNCTION THRESHOLDS REFERENCE CHART

Misfire rate	1 % or more

Monitor period of catalyst-damaged-misfire (MIL blinks):

TYPICAL MALFUNCTION THRESHOLDS REFERENCE CHART

Number of misfire per 200 revolutions	94 or more (varies with intake air amount and RPM)
Paired cylinder misfire (MIL blinks immediately)	Detected

FOR MEXICO MODELS:

Monitor period of emission-related-misfire: for Mexico models

TYPICAL MALFUNCTION THRESHOLDS REFERENCE CHART

Misfire rate	26 % or more: for 1st 1000 revolutions 13 % or more: after 1st 1000 revolutions

Monitor period of catalyst-damaged-misfire (MIL blinks): for Mexico models

TYPICAL MALFUNCTION THRESHOLDS REFERENCE CHART

Number of misfire per 200 revolutions	94 or more (varies with intake air amount and RPM)
Paired cylinder misfire (MIL blinks immediately)	Detected

MONITOR RESULT

Refer to **CHECKING MONITOR STATUS** .

WIRING DIAGRAM

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Wiring diagram of the ignition system.

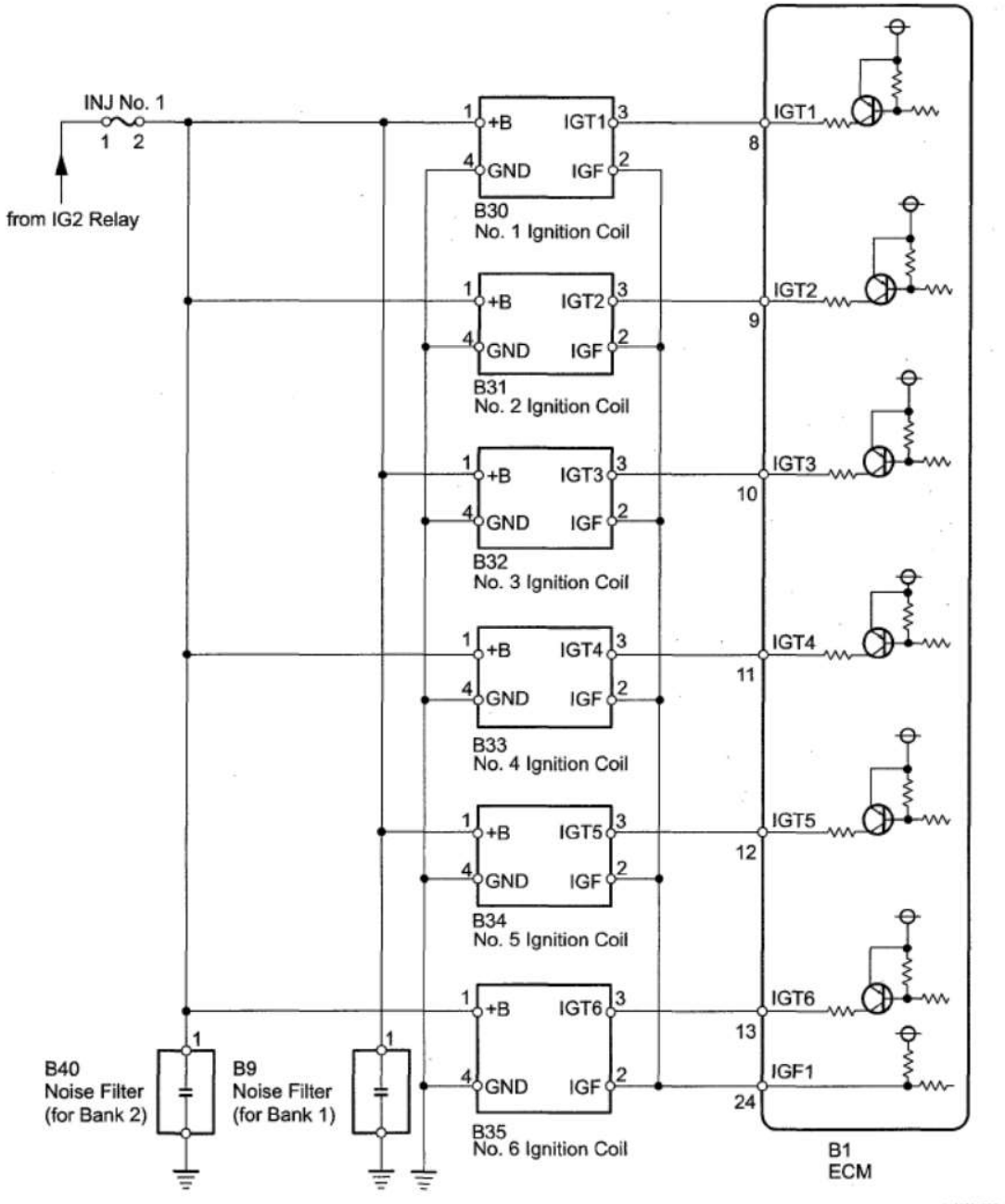


Fig. 119: Ignition System - Wiring Diagram (1 Of 2)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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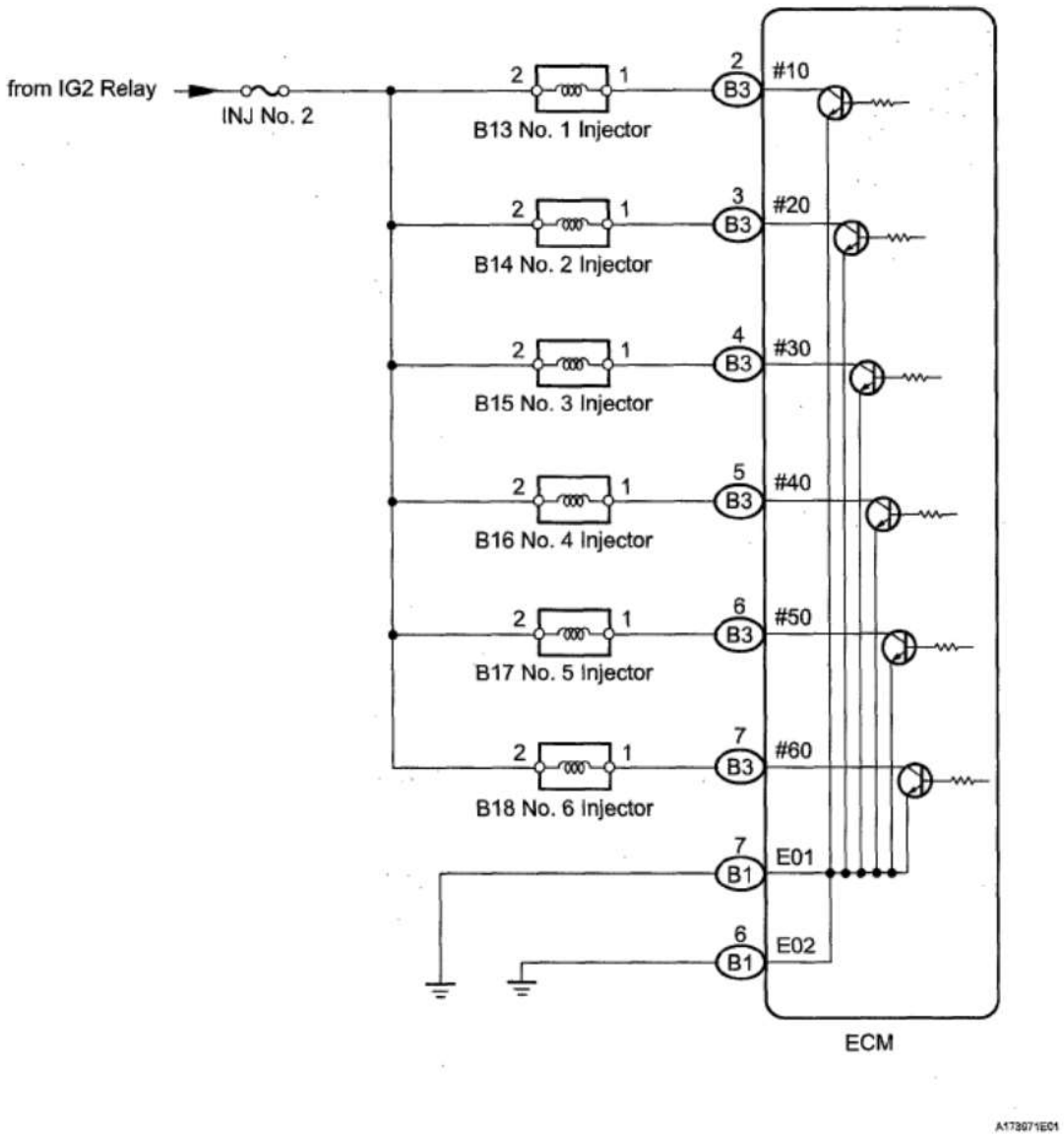


Fig. 120: Ignition System - Wiring Diagram (2 Of 2)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

CONFIRMATION DRIVING PATTERN

1. Connect the Techstream to the DLC3.
2. Turn the ignition switch on (IG).
3. Turn the tester on.
4. Record the DTC(s) and freeze frame data.
5. Using the tester, switch the ECM from normal mode to check mode (See **CHECK MODE PROCEDURE**).
6. Read the misfire counts of each cylinder (Cylinder #1 Misfire Count to Cylinder #6 Misfire Count) with the engine in an idling condition. If any misfire count is displayed, skip the following confirmation

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driving pattern.

7. Drive the vehicle several times with the conditions, such as engine rpm and engine load, shown in, Misfire RPM and Misfire Load in the Data List.

   HINT:

   In order to store misfire DTCs, it is necessary to operate the vehicle for the period of time shown in the table below, using the Misfire RPM and Misfire Load in the Data List.

   ENGINE RPM REFERENCE CHART

Engine RPM	Duration
Idling	3.5 minutes or more
1000	3 minutes or more
2000	1.5 minutes or more
3000	1 minute or more

8. Check whether misfires have occurred by checking DTCs and freeze frame data.

   HINT:

   Do not turn the ignition switch off until the stored 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 will be erased.

9. Record the DTC(s), freeze frame data and misfire counts.
10. Turn the ignition switch off and wait for at least 5 seconds.

INSPECTION PROCEDURE

HINT:

- If any DTCs other than misfire DTCs are output, troubleshoot those DTCs first.
- 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.
- 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 volume in the tank.
  b. Improper fuel is used.
  c. The spark plugs have been contaminated.

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- After finishing repairs, check the misfire counts of the cylinders (Cylinder #1 Misfire Count to Cylinder #6 Misfire Count).
- Be sure to confirm that no misfiring cylinder DTCs are set again by conducting the confirmation driving pattern after finishing repairs.
- For 6 and 8 cylinder engines, the ECM intentionally does not set the specific misfiring cylinder DTCs at high engine RPM. If misfires occur only in high engine RPM areas, only DTC P0300 is set.

  In the event of DTC P0300 being present, perform the following operations:

  a. Clear the DTC (See **DTC CHECK/CLEAR**).
  b. Start the engine and conduct the confirmation driving pattern.
  c. Read the misfiring rates of each cylinder or DTC(s) using the tester.
  d. Repair the cylinder(s) that has a high misfiring rate or is indicated by the DTC.
  e. After finishing repairs, conduct the confirmation driving pattern again, in order to verify that DTC P0300 is not set.
- When one of Short FT #1, Long FT #1, Short FT #2 or Long FT #2 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 the Coolant Temp in the freeze frame data is less than 75°C (167°F), the misfire have occurred only while warming up the engine.
- An extremely imbalanced drive wheel which causes body vibration may cause misfire DTCs detection.

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

   HINT:

   Write down the DTCs.

   Result

   RESULT CHART

Display (DTC Output)	Proceed to
P0300, P0301, P0302, P0303, P0304, P0305 and/or P0306	A
P0300, P0301, P0302, P0303, P0304, P0305 and/or P0306 and other DTCs	B

   HINT:

   If any DTCs other than P0300, P0301, P0302, P0303, P0304, P0305 and P0306 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 (MISFIRE RPM AND MISFIRE LOAD)**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch on (IG) and turn the tester on.
   c. Enter the following menus: Powertrain/Engine and ECT/Data List/Misfire/Misfire RPM and Misfire Load.
   d. 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**

   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**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch on (IG) and turn the tester on.
   c. Enter the following menus: Powertrain/Engine and ECT/Data List/Catalyst OT MF F/C.
   d. Read the value displayed on the tester.

   Result

   RESULT CHART

Data List	Tester 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**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch on (IG) and turn the tester on.

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c. Enter the following menus: Powertrain/Engine and ECT/Active Test/Prohibit the Catalyst OT Misfire prevent F/C.

d. Perform the Active Test.

NOTE: When performing the Active Test, make sure the vehicle is stopped and either idling or being revved within 3000 rpm.

6. **READ VALUE USING TECHSTREAM**

a. Enter the following menus: Powertrain/Engine and ECT/Data List/Misfire/Cylinder #1 Misfire Count, #2, #3, #4, #5 and #6

b. Read each value for Cylinder #1 Misfire Count to #6 displayed on the tester. If no misfire counts occur in any cylinders, perform the following procedures:

1. Start the engine and let it idle.
2. Move the shift lever to the D position.
3. Check the Cylinder #1 Misfire Count to #6.
4. If misfire counts are still not displayed, perform steps (c) and (d).

c. Drive the vehicle with the Misfire RPM and Misfire Load noted in the "READ VALUE OF THE TECHSTREAM Misfire RPM AND Misfire Load)" procedures above.

d. Read the Cylinder #1 Misfire Count to #6 or DTCs displayed on the tester.

Result

RESULT CHART

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's 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's 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. **CHECK SPARK PLUG**

a. Remove the ignition coil and the spark plug of the misfiring cylinder.

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b. Measure the spark plug electrode gap.

Maximum gap: 1.3 mm (0.0512 in.)

c. Check the electrode for carbon deposits.

Recommended spark plug:

SPARK PLUG REFERENCE CHART

Manufacturer	Product
DENSO	FK20HR11

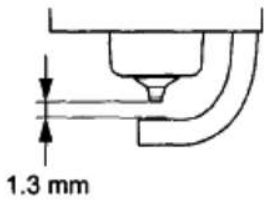


Fig. 121: Identifying Spark Plug Electrode Gap
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

NOTE: If the electrode gap is larger than standard, replace the spark plug. Do not adjust the electrode gap.

NG: REPLACE SPARK PLUG (See **IGNITION COIL AND SPARK PLUG**)

OK: Go to next step

8. **CHECK FOR SPARKS AND IGNITION**
   a. Disconnect the injector connectors to prevent the engine from starting.

CAUTION: Always disconnect all injector connectors.

NOTE: Do not crank the engine for more than 2 seconds.

   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 the spark.

OK: Sparks jump across electrode gap.

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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 **ENGINE**).

   NG: CHECK ENGINE TO DETERMINE CAUSE OF LOW COMPRESSION

   OK: Go to next step

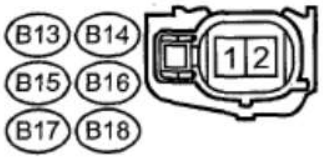
10. **CHECK HARNESS AND CONNECTOR (INJECTOR OF MISFIRING CYLINDER POWER SOURCE)**
   a. Disconnect the injector connector (of the misfiring cylinder).
   b. Measure the voltage according to the value(s) in the table below.

   Standard voltage

TESTER CONNECTION SPECIFIED CONDITION CHART

Cylinder	Tester Connection	Switch Condition	Specified Condition
No. 1	B13-2 - Body ground	Ignition switch on (IG)	9 to 14 V
No. 2	B14-2 - Body ground	Ignition switch on (IG)	9 to 14 V
No. 3	B15-2 - Body ground	Ignition switch on (IG)	9 to 14 V
No. 4	B16-2 - Body ground	Ignition switch on (IG)	9 to 14 V
No. 5	B17-2 - Body ground	Ignition switch on (IG)	9 to 14 V
No. 6	B18-2 - Body ground	Ignition switch on (IG)	9 to 14 V

Front view of wire harness connector:
(to Fuel Injector)



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Fig. 122: Identifying Fuel Injector Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR (INJ NO. 2 FUSE - INJECTOR)

OK: Go to next step

11. **CHECK HARNESS AND CONNECTOR (ECM - INJECTOR OF MISFIRING)**
    a. Turn the ignition switch off.
    b. Measure the resistance according to the value(s) in the table below.

Standard resistance:

Check for open

TESTER CONNECTION SPECIFIED CONDITION CHART

Cylinder	Tester Connection	Condition	Specified Condition
No. 1	B13 - 1-B3-2 (#10)	Always	Below 1 ohms
No. 2	B14-1 - B3-3 (#20)	Always	Below 1 ohms
No. 3	B15-1 - B3-4 (#30)	Always	Below 1 ohms
No. 4	B16-1 - B3-5 (#40)	Always	Below 1 ohms
No. 5	B17-1 - B3-6 (#50)	Always	Below 1 ohms
No. 6	B18-1 - B3-7 (#60)	Always	Below 1 ohms

Check for short

TESTER CONNECTION SPECIFIED CONDITION CHART

Cylinder	Tester Connection	Condition	Specified Condition
No. 1	B13-1 - Body ground	Always	10 kohms or higher
No. 2	B14-1 - Body ground	Always	10 kohms or higher
No. 3	B15-1 - Body ground	Always	10 kohms or higher
No. 4	B16-1 - Body ground	Always	10 kohms or higher
No. 5	B17-1 - Body ground	Always	10 kohms or higher
No. 6	B18-1 - Body ground	Always	10 kohms or higher

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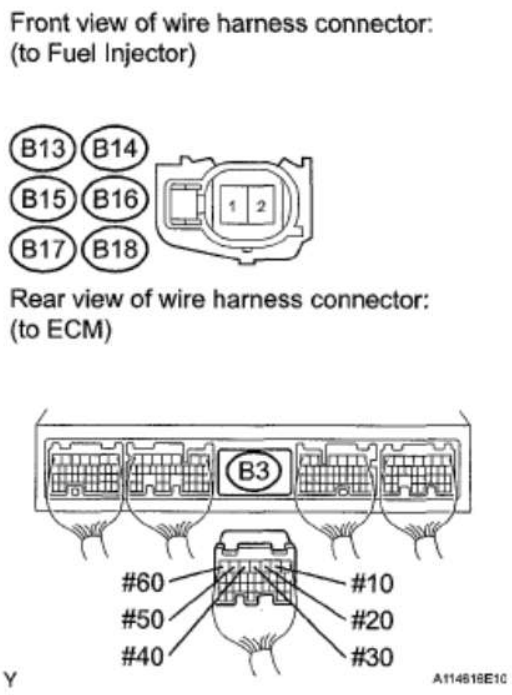


Fig. 123: Identifying Fuel Injector And ECM Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR (FUEL NJECTOR - ECM)

OK: Go to next step

12. **CHECK FUEL INJECTOR OF MISFIRING CYLINDER**
    a. Check the injector resistance (See **INSPECTION**).
    b. Check the injector injection (whether fuel volume is high or low, and whether injection pattern is poor) (See **INSPECTION**).

    NG: REPLACE FUEL INJECTOR ASSEMBLY (See **FUEL INJECTOR**)

    OK: Go to next step

13. **CHECK AIR INDUCTION SYSTEM**
    a. Check the air induction system for vacuum leakage (See **ON-VEHICLE INSPECTION**).

    OK: No leakage from air induction system.

    NG: REPAIR OR REPLACE AIR INDUCTION SYSTEM

    OK: Go to next step

14. **CHECK VALVE TIMING** (See **INSPECTION PROCEDURE**)

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NG: ADJUST VALVE TIMING

OK: Go to next step

15. **CHECK FUEL PRESSURE**
    a. Check the fuel pressure (See **ON-VEHICLE INSPECTION**).

    NG: CHECK AND REPLACE FUEL PUMP, PRESSURE REGULATOR, FUEL PIPE LINE AND 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**
    a. Inspect mass air flow meter (See **REMOVAL**).

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

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

18. **CHECK AIR INDUCTION SYSTEM**
    a. Check the air induction system for vacuum leakage (See **ON-VEHICLE INSPECTION**).

    OK: No leakage from air induction system.

    NG: REPAIR OR REPLACE AIR INDUCTION SYSTEM

    OK: Go to next step

19. **CHECK VALVE TIMING** (See **INSPECTION PROCEDURE**)

    NG: ADJUST VALVE TIMING

    OK: Go to next step

20. **CHECK FUEL PRESSURE**
    a. Check the fuel pressure (See **ON-VEHICLE INSPECTION**).

    NG: CHECK AND REPLACE FUEL PUMP, PRESSURE REGULATOR, FUEL PIPE LINE AND FILTER

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OK: Go to next step

21. **READ VALUE USING TECHSTREAM (COOLANT TEMP)** (See **INSPECTION PROCEDURE**)

    NG: REPLACE ENGINE COOLANT TEMPERATURE SENSOR (See **REMOVAL**)

    OK: Go to next step

22. **INSPECT MASS AIR FLOW METER**
    a. Inspect mass air flow meter (See **REMOVAL**).

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

    OK: Go to next step

23. **CHECK SPARK PLUG**
    a. Remove the ignition coil and the spark plug of the misfiring cylinder.
    b. Measure the spark plug electrode gap.

    Maximum gap: 1.3 mm (0.0512 in.)

    c. Check the electrode for carbon deposits.

    Recommended spark plug:

    SPARK PLUG REFERENCE CHART

Manufacturer	Product
DENSO	FK20HR11

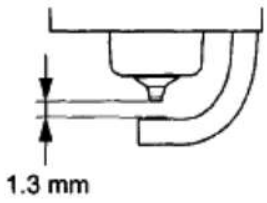


Fig. 124: Identifying Spark Plug Electrode Gap
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

NOTE: **If the electrode gap is larger than standard, replace the spark plug. Do not adjust the electrode gap.**

NG: REPLACE SPARK PLUG (See **IGNITION COIL AND SPARK PLUG**)

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OK: Go to next step

24. **CHECK FOR SPARKS AND IGNITION**
    a. Disconnect the injector connectors to prevent the engine from starting.

CAUTION: Always disconnect all injector connectors.

NOTE: Do not crank the engine for more than 2 seconds.

    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 the spark.

OK: Sparks jump across electrode gap.

    f. Install the ignition coil.
    g. Reconnect the injector connectors.

NG: Go to step 29

OK: Go to next step

25. **CHECK CYLINDER COMPRESSION PRESSURE**
    a. Measure the cylinder compression pressure of the misfiring cylinder (See **ENGINE**).

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR (FUEL NJECTOR - ECM)

OK: Go to next step

26. **CHECK HARNESS AND CONNECTOR (INJECTOR OF MISFIRING CYLINDER POWER SOURCE)**
    a. Disconnect the injector connector (of the misfiring cylinder).
    b. Measure the voltage according to the value(s) in the table below.

Standard voltage

TESTER CONNECTION SPECIFIED CONDITION CHART

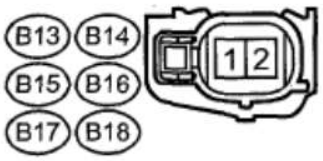
Cylinder	Tester Connection	Switch Condition	Specified Condition
No. 1	B13-2 - Body ground	Ignition switch on (IG)	11 to 14 V
No. 2	B14-2 - Body ground	Ignition switch on (IG)	11 to 14 V
No. 3	B15-2 - Body ground	Ignition switch on (IG)	11 to 14 V

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No. 4	B16-2 - Body ground	Ignition switch on (IG)	11 to 14 V
No. 5	B17-2 - Body ground	Ignition switch on (IG)	11 to 14 V
No. 6	B18-2 - Body ground	Ignition switch on (IG)	11 to 14 V

Front view of wire harness connector:
(to Fuel Injector)



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Fig. 125: Identifying Fuel Injector Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR (INJ NO. 2 FUSE - INJECTOR)

OK: Go to next step

27. **CHECK HARNESS AND CONNECTOR (ECM - INJECTOR OF MISFIRING)**
    a. Turn the ignition switch off.
    b. Measure the resistance according to the value(s) in the table below.

Standard resistance:

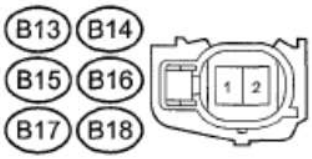
Check for open

TESTER CONNECTION SPECIFIED CONDITION CHART

Cylinder	Tester Connection	Condition	Specified Condition
No. 1	B13-1 - B3-2 (#10)	Always	Below 1 ohms
No. 2	B14-1 - B3-3 (#20)	Always	Below 1 ohms
No. 3	B15-1 - B3-4 (#30)	Always	Below 1 ohms
No. 4	B16-1 - B3-5 (#40)	Always	Below 1 ohms
No. 5	B17-1 - B3-6 (#50)	Always	Below 1 ohms
No. 6	B18-1 - B3-7 (#60)	Always	Below 1 ohms

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Front view of wire harness connector:
(to Fuel Injector)



Rear view of wire harness connector:
(to ECM)

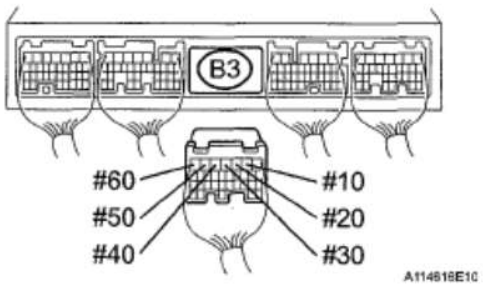


Fig. 126: Identifying Fuel Injector And ECM Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Check for short

TESTER CONNECTION SPECIFIED CONDITION CHART

Cylinder	Tester Connection	Condition	Specified Condition
No. 1	B13-1 - Body ground	Always	10 kohms or higher
No. 2	B14-1 - Body ground	Always	10 kohms or higher
No. 3	B15-1 - Body ground	Always	10 kohms or higher
No. 4	B16-1 - Body ground	Always	10 kohms or higher
No. 5	B17-1 - Body ground	Always	10 kohms or higher
No. 6	B18-1 - Body ground	Always	10 kohms or higher

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR (FUEL NJECTOR - ECM)

OK: Go to next step

28. **CHECK FUEL INJECTOR OF MISFIRING CYLINDER**
    a. Check the injector resistance (See **FUEL INJECTOR**).
    b. Check the injector injection (whether fuel volume is high or low, and whether injection pattern is poor) (See **FUEL INJECTOR**).

NG: REPLACE FUEL INJECTOR ASSEMBLY (See **FUEL INJECTOR**)

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

29. **CHANGE TO NORMAL SPARK PLUG AND CHECK SPARK OF MISFIRING CYLINDER**
    a. Change the installed spark plug to a spark plug that functions normally.
    b. Perform a spark test.

CAUTION: Always disconnect all injector connectors.

NOTE: Do not crank the engine for more than 2 seconds.

1. Install the spark plug to the ignition coil and connect the ignition coil connector.
2. Disconnect the injector connector.
3. Ground the spark plug.
4. Check if sparks occur while the engine is being cranked.

OK: Sparks jump across electrode gap.

NG: Go to step 30

OK: REPLACE SPARK PLUG (See **IGNITION COIL AND SPARK PLUG**)

30. **CHANGE TO NORMAL IGNITION COIL AND CHECK SPARK OF MISFIRING CYLINDER**

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

OK: REPLACE IGNITION COIL (See **IGNITION COIL AND SPARK PLUG**)

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); DTC P0332 KNOCK SENSOR 2 CIRCUIT LOW INPUT (BANK 2); DTC P0333 KNOCK SENSOR 2 CIRCUIT HIGH INPUT (BANK 2)

DESCRIPTION

A flat type knock sensor (non-resonant type) has a structure that can detect vibrations over a wide band of frequencies: between approximately 6 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 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		

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No.	DTC Detection Condition	Trouble Area
P0327 P0332	Output voltage of knock sensor 1 or 2 is less than 0.5 V (1 trip detection logic)	• Short in knock sensor 1 or 2 circuit • Knock sensor 1 or 2 • ECM
P0328 P0333	Output voltage of knock sensor 1 or 2 is more than 4.5 V (1 trip detection logic)	• Open in knock sensor 1 or 2 circuit • Knock sensor 1 or 2 • ECM

HINT:

When any of DTCs P0327, P0328, P0332 and P0333 are set, the ECM enters fail-safe mode. During failsafe 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

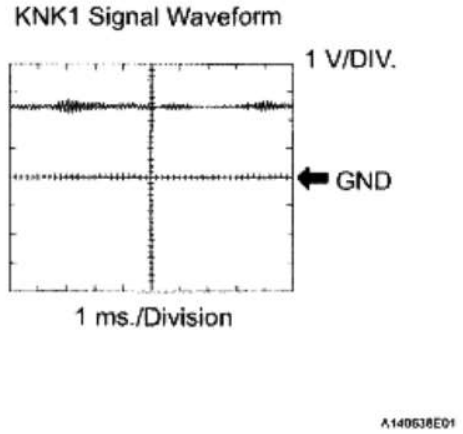


Fig. 127: KNK1 Signal Waveform
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

The correct waveform is as shown.

ITEM CONTENT REFERENCE CHART

Item	Content
Terminals	KNK1 - EKNK or KNK2 - EKN2
Equipment Settings	0.01 to 10 V/DIV., 0.01 to 10 ms./DIV.
Conditions	Keep engine speed at 4000 rpm with warm engine

MONITOR DESCRIPTION

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The knock sensor, located on the cylinder block, detects spark knock. When a spark knock occurs, the piezoelectric element of the sensor vibrates. When the ECM detects a voltage in this frequency range, it retards the ignition timing to suppress the spark knock.

The ECM also senses background engine noise with the knock sensor and uses this noise to check for faults in the sensor. If the knock sensor signal level is too low for more than 10 seconds, or if the knock sensor output voltage is outside the normal range, the ECM interprets this as a fault in the knock sensor and sets a DTC.

MONITOR STRATEGY

MONITOR STRATEGY REFERENCE CHART

Related DTCs	P0327: Knock sensor (Bank 1) open/short (Low voltage) P0328: Knock sensor (Bank 1) open/short (High voltage) P0332: Knock sensor (Bank 2) open/short (Low voltage) P0333: Knock sensor (Bank 2) open/short (High voltage)
Required Sensors/Components (Main)	Knock sensor (Bank 1 and 2)
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

The monitor will run whenever these DTCs are not present	None
Battery voltage	10.5 V or more
Time after engine start	5 seconds or more
Ignition switch	ON (IG)
Starter	OFF

TYPICAL MALFUNCTION THRESHOLDS

Knock Sensor Range Check (Low voltage) P0327 and P0332:

TYPICAL MALFUNCTION THRESHOLDS REFERENCE CHART

Knock sensor voltage	Less than 0.5 V

Knock Sensor Range Check (High voltage) P0328 and P0333:

TYPICAL MALFUNCTION THRESHOLDS REFERENCE CHART

Knock sensor voltage	More than 4.5 V

WIRING DIAGRAM

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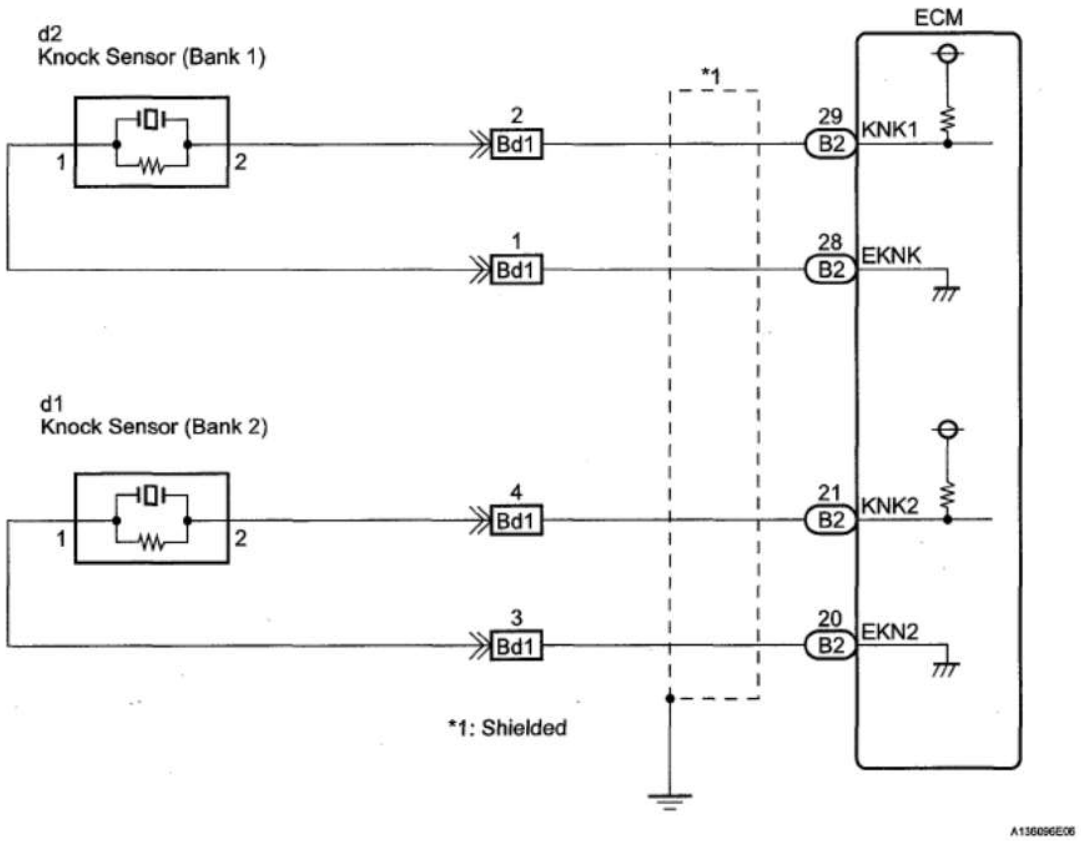


Fig. 128: Knock Sensor - Wiring Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSPECTION PROCEDURE

HINT:

- DTCs P0327 and P0328 are for the bank 1 knock sensor circuit.
- DTCs P0332 and P0333 are for the bank 2 knock sensor 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. **READ VALUE USING DTC OUTPUT (CHECK KNOCK SENSOR CIRCUIT)**
   a. Disconnect the Bd1 connector.
   b. Using lead wires, connect the connectors as follows.

TERMINAL CONNECTOR REFERENCE CHART

Male Connector - Female Connector

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Terminal 2 - Terminal 4
Terminal 1 - Terminal 3
Terminal 4 - Terminal 2
Terminal 3 - Terminal 1

c. Warm up the engine.
d. Run the engine at 3000 rpm for 10 seconds or more.
e. Connect the Techstream to the DLC3.
f. Turn the ignition switch on (IG) and turn the Techstream on.
g. Select the following menu items: Powertrain/Engine and ECT/Trouble Code.
h. Read the DTCs.

Result

RESULT CHART

Display	Proceed to
DTCs that are same as when vehicle brought in P0327, P0328 --> P0327, P0328 or P0332, P0333 --> P0332, P0333	A
DTCs that are different from when vehicle brought in P0327, P0328 --> P0332, P0333 or P0332, P0333 --> P0327, P0328	B

i. Reconnect the Bd1 connector.

B: Go to step 4

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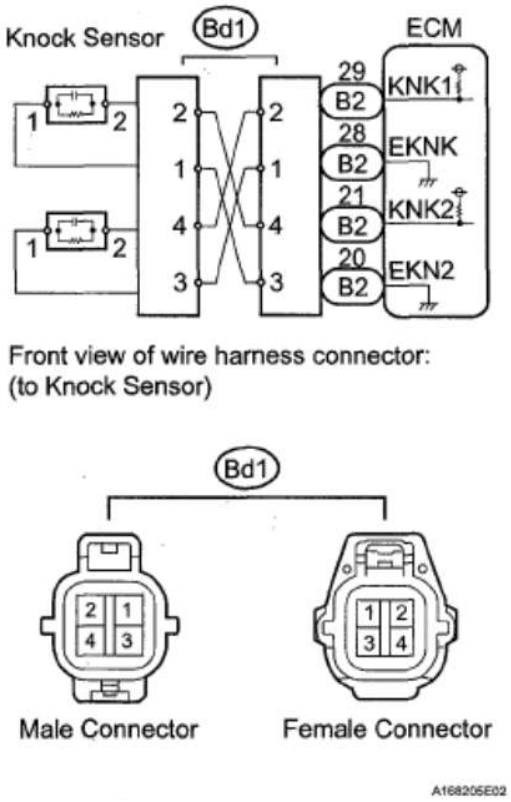


Fig. 129: Identifying Knock Sensor Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

A: Go to next step

2. **CHECK HARNESS OR CONNECTOR (Ba1 CONNECTOR - ECM)**
   a. Disconnect the Bd1 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
Bd1 female connector 2 - B2-29 (KNK1)	Always	Below 1 ohms
Bd1 female connector 1 - B2-28 (EKNK)	Always	Below 1 ohms
Bd1 female connector 4 - B2-21 (KNK2)	Always	Below 1 ohms
Bd1 female connector 3 - B2-20 (EKN2)	Always	Below 1 ohms

Check for short

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TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
Bd1 female connector 2 or B2-29 (KNK1) - Body ground	Always	10 kohms or higher
Bd1 female connector 1 or B2-28 (EKNK) - Body ground	Always	10 kohms or higher
Bd1 female connector 4 or B2-21 (KNK2) - Body ground	Always	10 kohms or higher
Bd1 female connector 3 or B2-20 (EKN2) - Body ground	Always	10 kohms or higher

Front view of wire harness connector:
(to Female Connector)



Rear view of wire harness connector:
(to ECM)

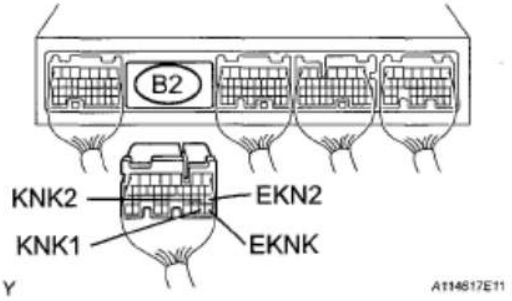


Fig. 130: Identifying BD1 And ECM Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

d. Reconnect the Bd1 connector.
e. Reconnect the ECM connector.

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR (Ba1 CONNECTOR - ECM)

OK: Go to next step

3. **INSPECT ECM**
   a. Disconnect the ECM connector.
   b. Turn the ignition switch on (IG).
   c. Measure the voltage according to the value(s) in the table below.

Standard voltage

TESTER CONNECTION SPECIFIED CONDITION CHART

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Tester Connection	Switch Condition	Specified Condition
B2-29 (KNK1) - B2-28 (EKNK)	Ignition switch on (IG)	4.5 to 5.5 V
B2-21 (KNK2) - B2-20 (EKN2)	Ignition switch on (IG)	4.5 to 5.5 V

d. Reconnect the ECM connector.

NOTE: Fault may be intermittent. Check the wire harness and connectors carefully and retest.

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

Rear view of wire harness connector:
(to ECM)

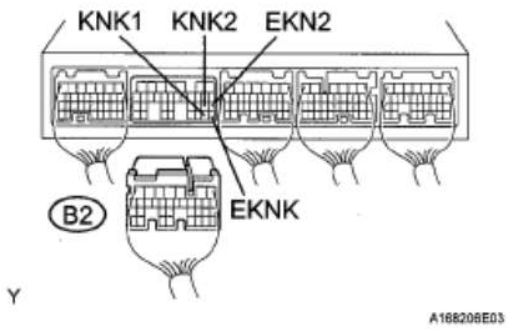


Fig. 131: Identifying ECM Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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

4. **INSPECT KNOCK SENSOR**
   a. Disconnect the Bd1 connector.
   b. Measure the resistance according to the value(s) in the table below.

Standard resistance

TESTER CONNECTION SPECIFIED CONDITION CHART

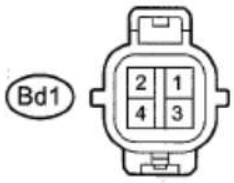
Tester Connection	Condition	Specified Condition
Bd1 male connector 1 - 2	Always	120 to 280 kohms
Bd1 male connector 3 - 4	Always	120 to 280 kohms

c. Reconnect the Bd1 connector.

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NG: Go to step 5

Front view of wire harness connector:
(to Male Connector)



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Fig. 132: Identifying BD1 Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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

5. **CHECK HARNESS AND CONNECTOR (Ba1 CONNECTOR - KNOCK SENSOR)**

HINT:

- If DTC P0327 or P0328 has changed to P0332 or P0333, check the knock sensor circuit on the right bank side.
- If DTC P0332 or P0333 has changed to P0327 or P0328, check the knock sensor circuit on the left bank side.

a. Disconnect the Bd1 connector.
b. Disconnect the knock sensor connectors.
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
Bd1 male connector 2 - d2-2	Always	Below 1 ohms
Bd1 male connector 1 - d2-1	Always	Below 1 ohms
Bd1 male connector 4 - d1-2	Always	Below 1 ohms
Bd1 male connector 3 - d1-1	Always	Below 1 ohms

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Check for short

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
Bd1 male connector 2 or d2-2 - Body ground	Always	10 kohms or higher
Bd1 male connector 1 or d2-1 - Body ground	Always	10 kohms or higher
Bd1 male connector 4 or d1-2 - Body ground	Always	10 kohms or higher
Bd1 male connector 3 or d1-1 - Body ground	Always	10 kohms or higher

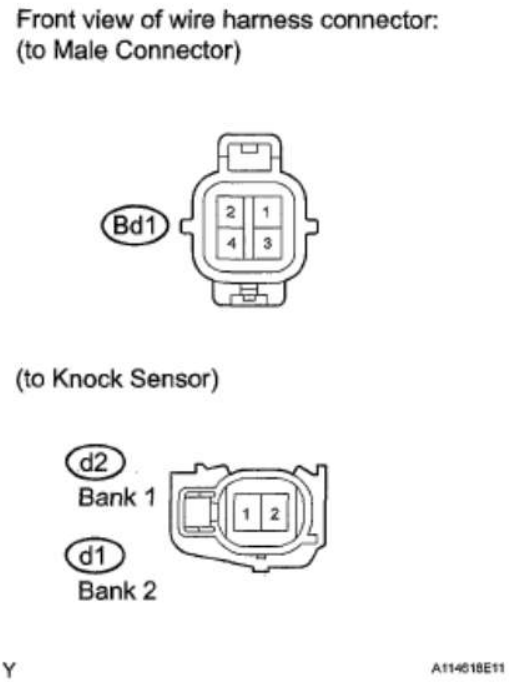


Fig. 133: Identifying BD1 And Knock Sensor Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

d. Reconnect the Bd1 connector.
e. Reconnect the knock sensor connectors.

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR (Ba1 CONNECTOR - KNOCK SENSOR)

OK: REPLACE KNOCK SENSOR (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

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sensor plate has 34 teeth and is installed on the crankshaft. The pickup coil is made of an iron core and a magnet.

The sensor plate rotates as each tooth passes through the pickup coil, and a pulse signal is created. The pickup coil generates 34 signals per engine revolution. Based on these signals, the ECM calculates the crankshaft position and engine RPM. Using these calculations, the fuel injection time and ignition timing are controlled.

DTC DETECTION CONDITION CHART

DTC No.	DTC Detection Condition	Trouble Area
P0335	• No crankshaft position sensor signal to ECM while cranking (1 trip detection logic) • No crankshaft position sensor signal to ECM at engine speed of 600 rpm or more (1 trip detection logic)	• Open or short in crankshaft position sensor circuit • Crankshaft position sensor • Sensor plate (crankshaft position sensor plate) • ECM
P0339	Under conditions (a), (b) and (c), no crankshaft position sensor signal to ECM for 0.05 seconds or more (1 trip detection logic): a. Engine speed 1000 rpm or more b. Starter signal OFF c. 3 seconds or more have lapsed since starter signal switched from ON to OFF	• Open or short in crankshaft position sensor circuit • Crankshaft position sensor • Sensor plate (crankshaft position sensor plate) • ECM

Reference: Inspection using an oscilloscope

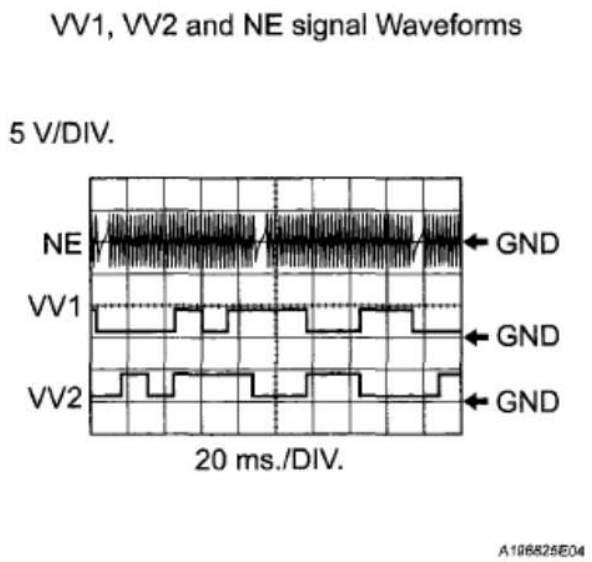


Fig. 134: VV1, VV2 And NE Signal Waveform
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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HINT:

- The correct waveform is shown in the illustration.
- VV1+ and VV2+ stand for the VVT sensor signal, and NE+ stands for the crankshaft position sensor signal.

ITEM CONTENT REFERENCE CHART

Item	Content
Terminals	VV1+ - VV1- VV2+ - VV2- NE+ - NE-
Equipment Settings	5 V/DIV., 20 ms./DIV.
Conditions	Cranking or idling

MONITOR DESCRIPTION

If there is no signal from the crankshaft position sensor despite the engine revolving, the ECM interprets this as a malfunction of the sensor.

If the malfunction is not repaired successfully, a DTC is set 10 seconds after the engine is next started.

MONITOR STRATEGY

MONITOR STRATEGY REFERENCE CHART

Related DTCs	P0335: Crankshaft position sensor range check during cranking P0335: Crankshaft position sensor range check during engine running
Required Sensors/Components (Main)	Crankshaft position sensor
Required Sensors/Components (Related)	-
Frequency of Operation	Continuous
Duration	3 times
MIL Operation	Immediate
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

All:

TYPICAL ENABLING CONDITIONS CHART

The monitor will run whenever these DTCs are not present	None

Crankshaft Position Sensor Range Check during Cranking P0335:

TYPICAL ENABLING CONDITIONS CHART

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Starter	OFF
Ignition switch	ON (IG)
Battery voltage	7 V or more
Minimum battery voltage while starter ON	Less than 11 V
Number of VVT sensor signal pulse	6 times
CMP sensor circuit fail (P0340, P0342, P0343)	Not detected

Crankshaft Position Sensor Range Check during Engine Running P0335:

TYPICAL ENABLING CONDITIONS CHART

Engine speed	600 rpm or more
Starter	OFF
Time after starter from ON to OFF	3 seconds or more

TYPICAL MALFUNCTION THRESHOLDS

Crankshaft Position Sensor Range Check during Cranking P0335:

TYPICAL MALFUNCTION THRESHOLDS REFERENCE CHART

Number of crankshaft position sensor signal pulse	132 or less, or 174 or more

Crankshaft Position Sensor Range Check during Engine Running P0335:

TYPICAL MALFUNCTION THRESHOLDS REFERENCE CHART

Crankshaft position sensor signal	No signal

COMPONENT OPERATING RANGE

COMPONENT OPERATING RANGE REFERENCE CHART

Crankshaft position sensor	• Crankshaft position sensor output voltage fluctuates while crankshaft is revolving • 34 crankshaft position sensor signals per crankshaft revolution

WIRING DIAGRAM

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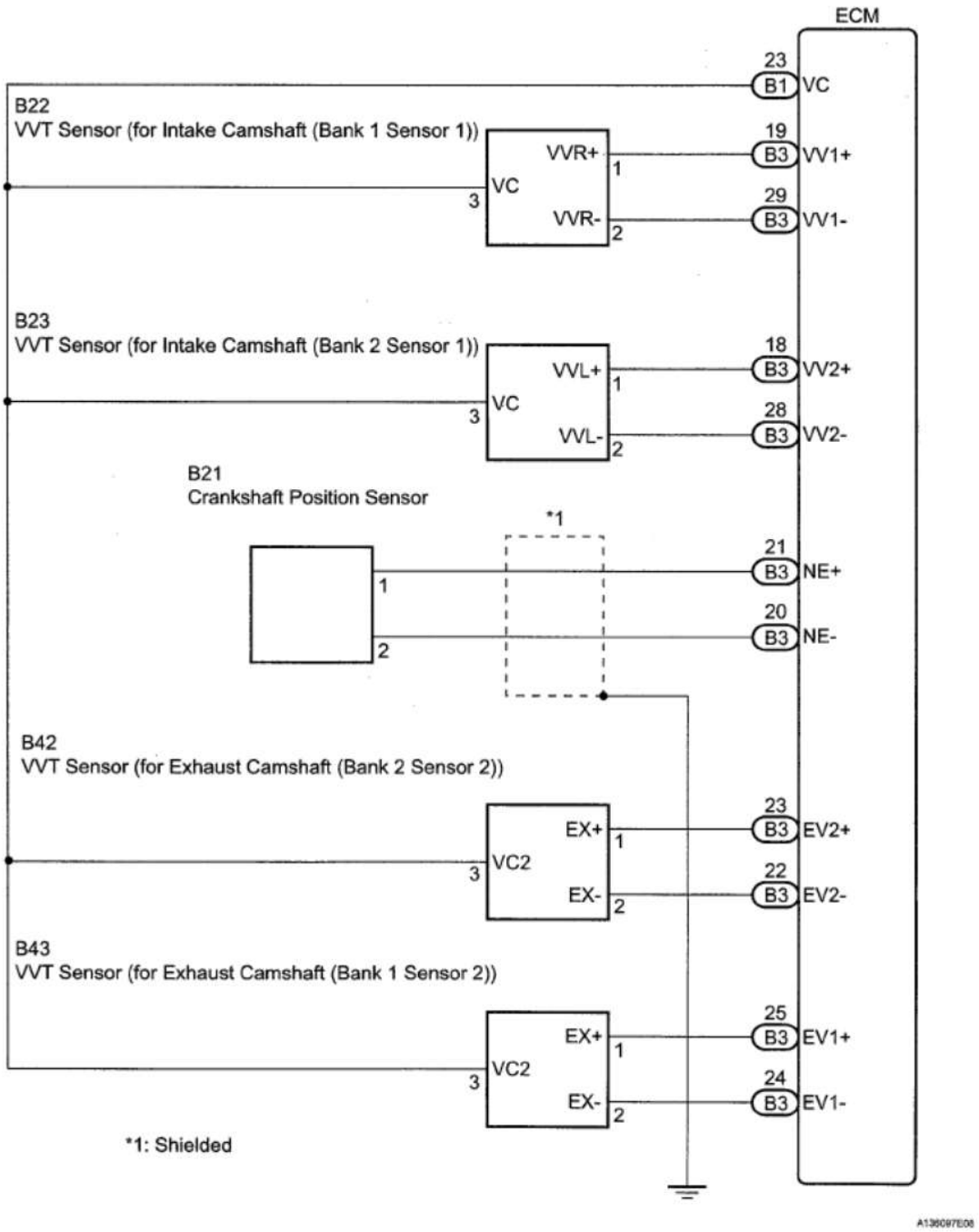


Fig. 135: VVT Sensor - Wiring Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSPECTION PROCEDURE

HINT:

- If no problem is found by this diagnostic troubleshooting procedure, troubleshoot the engine mechanical

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systems.

- 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. **INSPECT CRANKSHAFT POSITION SENSOR (RESISTANCE)**
   a. Disconnect the crankshaft position 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 - 2	Cold	1630 to 2740 ohms
1 - 2	Hot	2065 to 3225 ohms

HINT:

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).

   c. Reconnect the crankshaft position sensor connector.

NG: REPLACE CRANKSHAFT POSITION SENSOR (See **REMOVAL**)

Component without harness connected:
(Crankshaft Position Sensor)



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Fig. 136: Identifying Crankshaft Position Sensor Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

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2. **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 (NE+) - B3-21 (NE+)	Always	Below 1 ohms
B21-2 (NE-) - B3-20 (NE-)	Always	Below 1 ohms

Check for short

TESTER CONNECTION SPECIFIED CONDITION CHART

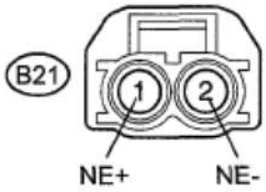
Tester Connection	Condition	Specified Condition
B21-1 (NE+) or B3-21 (NE+) - Body ground	Always	10 kohms or higher
B21-2 (NE-) or B3-20 (NE-) - Body ground	Always	10 kohms or higher

   d. Reconnect the ECM connector.
   e. Reconnect the crankshaft position sensor connector.

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR (CRANKSHAFT POSITION SENSOR - ECM)

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Front view of wire harness connector:
(to Crankshaft Position Sensor)



Rear view of wire harness connector:
(to ECM)

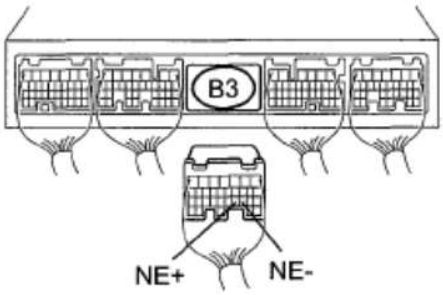


Fig. 137: Identifying Crankshaft Position Sensor And ECM Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

3. **CHECK SENSOR INSTALLATION (CRANKSHAFT POSITION SENSOR)**
   a. Check the crankshaft position sensor installation condition.

OK: Sensor is installed correctly.

NG: REPAIR OR REPLACE CRANKSHAFT POSITION SENSOR (See **REMOVAL**)

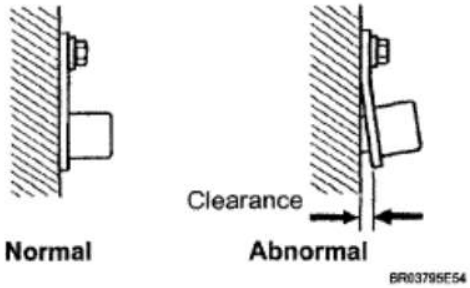


Fig. 138: Checking Sensor Installation

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

OK: Go to next step

4. **CHECK CRANKSHAFT POSITION SENSOR PLATE (TEETH OF SENSOR PLATE)**
   a. Remove the crankshaft position sensor plate (See **REMOVAL**).
   b. Check the teeth of the sensor plate.

      OK: Sensor plate does not have any cracks or deformation.

   c. Reinstall the crankshaft position sensor plate (See **INSPECTION**).

      NG: REPLACE CRANKSHAFT POSITION SENSOR PLATE (See **INSTALLATION**)

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

DTC P0340 CAMSHAFT POSITION SENSOR "A" CIRCUIT (BANK 1 OR SINGLE SENSOR); 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); DTC P0345 CAMSHAFT POSITION SENSOR "A" CIRCUIT (BANK 2); DTC P0347 CAMSHAFT POSITION SENSOR "A" CIRCUIT LOW INPUT (BANK 2); DTC P0348 CAMSHAFT POSITION SENSOR "A" CIRCUIT HIGH INPUT (BANK 2)

DESCRIPTION

The intake camshaft's VVT sensor (G signal) consists of a magnet and magneto resistance element. The VVT camshaft drive gear has a sensor plate with 3 teeth on its outer circumference. When the gear rotates, changes occur in the air gaps between the sensor plate and magneto resistance element, which affects the magnetic field. As a result, the resistance of the magneto resistance element material fluctuates. The VVT sensor converts the gear rotation data to pulse signals, uses the pulse signals to determine the camshaft angle, and sends it to the ECM.

The crankshaft angle sensor plate has 34 teeth. The pickup coil generates 34 signals for each engine revolution. Based on combination of the G signal and NE signal, the ECM detects the crankshaft angle. Then the ECM uses this data to control fuel injection time and injection timing. Also, based on the NE signal, the ECM detects the engine speed.

DTC DETECTION CONDITION CHART

DTC No.	DTC Detection Condition	Trouble Area
P0340	• Input voltage to ECM remains 0.3 V or less, or 4.7 V or higher for more than 4 seconds, when 2 or more seconds have elapsed after turning ignition switch on (IG) (1 trip detection logic) • Missing VVT sensor signal despite crankshaft position sensor	• Open or short in VVT sensor circuit for intake camshaft • VVT sensor for intake camshaft • Camshaft timing gear

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	inputs normal at engine speed of 600 rpm or more (1 trip detection logic) • No VVT sensor signal to ECM during cranking (2 trip detection logic)	for intake camshaft • Jumped tooth of timing chain for intake camshaft • ECM
P0342 P0347	Output voltage of VVT sensor is 0.3 V or less for 4 seconds (1 trip detection logic)	• Open or short in VVT sensor circuit for intake camshaft • VVT sensor for intake camshaft • Camshaft timing gear for intake camshaft • Jumped tooth of timing chain for intake camshaft • ECM
P0343 P0348	Output voltage of VVT sensor is 4.7 V or more for 4 seconds (1 trip detection logic)	• Open or short in VVT sensor circuit for intake camshaft • VVT sensor for intake camshaft • Camshaft timing gear for intake camshaft • Jumped tooth of timing chain for intake camshaft • ECM
P0345	• Input voltage to ECM remains 0.3 V or less, or 4.7 V or higher for more than 5 seconds, when 2 or more seconds have elapsed after turning ignition switch on (IG) (1 trip detection logic) • Missing VVT sensor signal despite crankshaft position sensor inputs normal at engine speed of 600 rpm or more (1 trip detection logic)	• Open or short in VVT sensor circuit for intake camshaft • VVT sensor for intake camshaft • Camshaft timing gear for intake camshaft • Jumped tooth of timing chain for intake camshaft • ECM

Reference: Inspection using an oscilloscope

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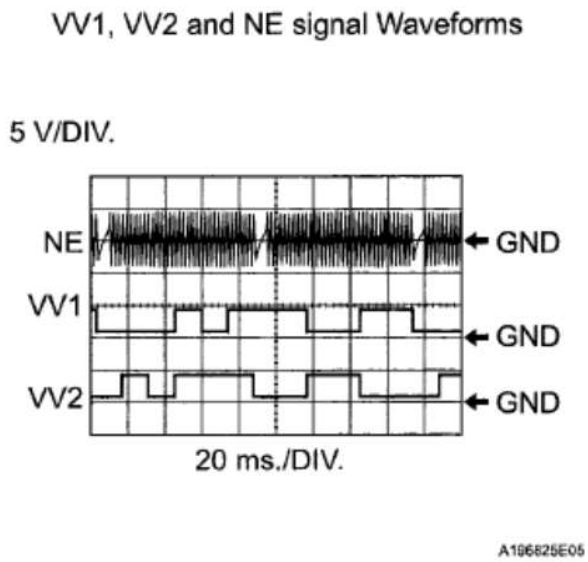


Fig. 139: VV1, VV2 And NE Signal Waveforms
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

HINT:

- The correct waveform is shown in the illustration.
- VV1 + and VV2+ stand for the VVT sensor signal, and NE+ stands for the crankshaft position sensor signal.

ITEM CONTENT REFERENCE CHART

Item	Content
Terminals	NE+ - NE- VV1+ - VV1- VV2+ - VV2-
Equipment Settings	5 V/DIV., 20 ms./DIV.
Conditions	Cranking or idling

MONITOR DESCRIPTION

If no signal is transmitted by the VVT sensor despite the engine revolving, or the rotations of the camshaft and the crankshaft are not synchronized, the ECM interprets this as a malfunction of the sensor.

MONITOR STRATEGY

MONITOR STRATEGY REFERENCE CHART

Related DTCs	P0340: Camshaft position sensor (Bank 1) open/short P0340: Camshaft position sensor (Bank 1) range check (Chattering) P0342: Camshaft position sensor (Bank 1) range check (low voltage) P0343: Camshaft position sensor (Bank 1) range check (high voltage) P0345: VVT sensor (Bank 2) open/short

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	P0345: VVT position sensor (Bank 2) range check (Chattering) P0347: VVT position sensor (Bank 2) range check (low voltage) P0348: VVT position sensor (Bank 2) range check (high voltage)
Required Sensors/Components (Main)	VVT position sensor (Bank 1 and 2)
Required Sensors/Components (Related)	Crankshaft position sensor
Frequency of Operation	Continuous
Duration	4 seconds: P0340 (Camshaft position sensor range check), P0340, P0342, P0343 (Camshaft position sensor range check (Chattering, Low voltage, High voltage)) P0345, P0347, P0348 (VVT sensor range check (Chattering, Low voltage, High voltage)) 5 seconds: Others
MIL Operation	2 driving cycles: P0340 (Camshaft position sensor range check) Immediate: Others
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

All:

TYPICAL ENABLING CONDITIONS CHART

The monitor will run whenever these DTCs are not present	None

VVT Sensor Range Check:

TYPICAL ENABLING CONDITIONS CHART

Starter	ON and not starter ON again
Minimal battery voltage while starter ON	Less than 11 V

Camshaft Position/Crankshaft Position Misalignment:

TYPICAL ENABLING CONDITIONS CHART

Engine RPM	600 rpm or more
Starter	OFF

VVT Sensor Range Check (Chattering, Low voltage, High voltage):

TYPICAL ENABLING CONDITIONS CHART

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Starter	OFF
Ignition switch on (IG) and time after ignition switch is off to on	2 seconds or more

VVT sensor range check:

TYPICAL ENABLING CONDITIONS CHART

Engine RPM	600 rpm or more
Starter	OFF
Battery voltage	8 V or more
Ignition switch	ON (IG)

VVT sensor range check (Chattering, Low voltage, High voltage):

TYPICAL ENABLING CONDITIONS CHART

Starter	OFF
Ignition switch on (IG) and time after ignition switch is off to on	2 seconds or more
Battery voltage	8 V or more

TYPICAL MALFUNCTION THRESHOLDS

VVT Sensor Range Check:

TYPICAL MALFUNCTION THRESHOLDS REFERENCE CHART

Camshaft position signal	No signal

Camshaft Position/Crankshaft Position Misalignment:

TYPICAL MALFUNCTION THRESHOLDS REFERENCE CHART

Camshaft position and crankshaft position phase	Mis-aligned

VVT Sensor Range Check (Chattering):

TYPICAL MALFUNCTION THRESHOLDS REFERENCE CHART

Camshaft position voltage	Less than 0.3 V, or more than 4.7 V

VVT Sensor Range Check (Low voltage):

TYPICAL MALFUNCTION THRESHOLDS REFERENCE CHART

Camshaft position voltage	Less than 0.3 V

VVT Sensor Range Check (High voltage):

TYPICAL MALFUNCTION THRESHOLDS REFERENCE CHART

Camshaft position voltage	More than 4.7 V

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VVT sensor range check (While starting engine):

TYPICAL MALFUNCTION THRESHOLDS REFERENCE CHART

VVT sensor signal	No signal

VVT sensor range check (After starting engine):

TYPICAL MALFUNCTION THRESHOLDS REFERENCE CHART

VVT sensor signal	No signal

VVT sensor range check (Chattering):

TYPICAL MALFUNCTION THRESHOLDS REFERENCE CHART

VVT sensor voltage	Less than 0.3 V, or more than 4.7 V

VVT sensor range check (Low voltage):

TYPICAL MALFUNCTION THRESHOLDS REFERENCE CHART

VVT sensor voltage	Less than 0.3 V

VVT sensor range check (High voltage):

TYPICAL MALFUNCTION THRESHOLDS REFERENCE CHART

VVT sensor voltage	More than 4.7 V

COMPONENT OPERATING RANGE

COMPONENT OPERATING RANGE REFERENCE CHART

VVT sensor voltage	0.3 to 4.7 V

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 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. **CHECK HARNESS AND CONNECTOR (SENSOR POWER SOURCE)**
   a. Disconnect the VVT sensor connector.

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b. Turn the ignition switch on (IG).
c. Measure the voltage according to the value(s) in the table below.

Standard voltage:

Bank 1

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Switch Condition	Specified Condition
B43-3 (VC2) - Body ground	Ignition switch on (IG)	4.5 to 5.0 V

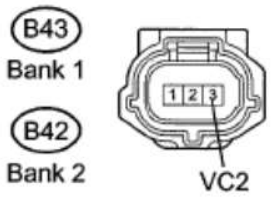
Bank 2

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Switch Condition	Specified Condition
B42-3 (VC2) - Body ground	Ignition switch on (IG)	4.5 to 5.0 V

d. Reconnect the VVT sensor connector.

Front view of wire harness connector:
(to VVT Sensor for Exhaust Camshaft)



A198210E07

Fig. 140: Identifying VVT Sensor For Exhaust Camshaft Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

NG: Go to step 7

OK: Go to next step

2. **CHECK HARNESS AND CONNECTOR (VVT SENSOR - ECM)**
   a. Disconnect the VVT sensor connector.
   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):

Bank 1

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
B22-1 (VVR+) - B3-19 (VV1+)	Always	Below 1 ohms
B22-2 (VVR-) - B3-29 (VV1-)	Always	Below 1 ohms

Bank 2

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
B23-1 (VVL+) - B3-18 (VV2+)	Always	Below 1 ohms
B23-2 (VVL-) - B3-28 (VV2-)	Always	Below 1 ohms

Standard resistance (Check for short):

Bank 1

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
B22-1 (VVR+) or B3-19 (VV1+) - Body ground	Always	10 kohms or higher
B22-2 (VVR-) or B3-29 (VV1-) - Body ground	Always	10 kohms or higher

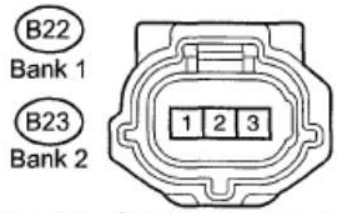
Bank 2

TESTER CONNECTION SPECIFIED CONDITION CHART

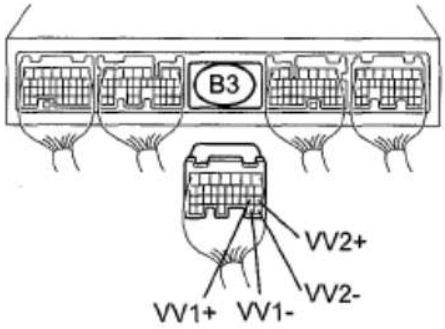
Tester Connection	Condition	Specified Condition
B23-1 (VVL+) or B3-18 (VV2+) - Body ground	Always	10 kohms or higher
B23-2 (VVL-) or B3-28 (VV2-) - Body ground	Always	10 kohms or higher

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Front view of wire harness connector:
(to VVT Sensor)



Rear view of wire harness connector:
(to ECM)



A140716E09

Fig. 141: Identifying VVT Sensor And ECM Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

d. Reconnect the VVT sensor connector.
e. Reconnect the ECM connector.

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR (VVT SENSOR - ECM)

OK: Go to next step

3. **CHECK SENSOR INSTALLATION (VVT SENSOR)**
   a. Check the VVT sensor installation condition.

OK: Sensor is installed correctly.

NG: REPAIR OR REPLACE VVT SENSOR

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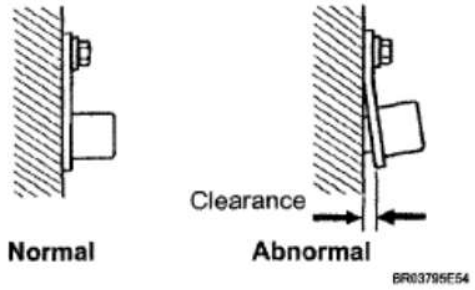


Fig. 142: Checking Sensor Installation
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

4. **CHECK CAMSHAFT TIMING GEAR ASSEMBLY (TEETH OF PLATE)**
   a. Check the teeth of the sensor plate.

   OK: Sensor plate teeth do not have any cracks or deformation.

   NG: REPLACE CAMSHAFT TIMING GEAR ASSEMBLY

   OK: Go to next step

5. **REPLACE VVT SENSOR**
   a. Replace the VVT sensor (See **VVT SENSOR**).
6. **CHECK WHETHER DTC OUTPUT RECURS**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch on (IG).
   c. Turn the tester on.
   d. Clear the DTCs.
   e. Select the following menu items: Powertrain/Engine and ECT/Trouble Codes.
   f. Read the DTCs.

   Result

   RESULT CHART

Display (DTC Output)	Proceed to
No output	A
P0340, P0342, P0343, P0345, P0347 or P0348	B

HINT:

If the engine does not start, replace the ECM.

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

A: END

7. **CHECK HARNESS AND CONNECTOR (VVT SENSOR - ECM)**
   a. Disconnect the VVT 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):

Bank 1

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
B22-3 (VC) - B1-23 (VC)	Always	Below 1 ohms

Bank 2

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
B23-3 (VC) - B1-23 (VC)	Always	Below 1 ohms

Standard resistance (Check for short):

Bank 1

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
B22-3 (VC) or B1-23 (VC) - Body ground	Always	10 kohms or higher

Bank 2

TESTER CONNECTION SPECIFIED CONDITION CHART

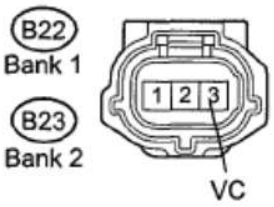
Tester Connection	Condition	Specified Condition
B23-3 (VC) or B1-23 (VC) - Body ground	Always	10 kohms or higher

   d. Reconnect the VVT sensor connector.
   e. Reconnect the ECM connector.

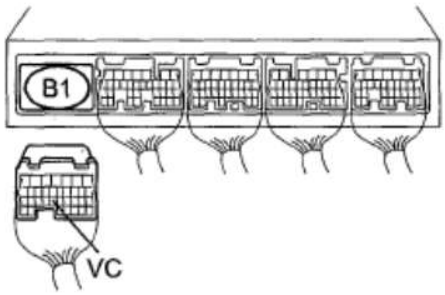
NG: REPAIR OR REPLACE HARNESS OR CONNECTOR (VVT SENSOR - ECM)

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Front view of wire harness connector:
(to VVT Sensor)



Rear view of wire harness connector:
(to ECM)



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Fig. 143: Identifying VVT Sensor And ECM Connector Terminals
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; DTC P0355 IGNITION COIL "E" PRIMARY/SECONDARY CIRCUIT; DTC P0356 IGNITION COIL "F" PRIMARY/SECONDARY CIRCUIT

HINT:

- These DTCs indicate malfunctions relating to the primary circuit.
- If DTC P0351 is set, check the No. 1 ignition coil with igniter circuit.
- If DTC P0352 is set, check the No. 2 ignition coil with igniter circuit.
- If DTC P0353 is set, check the No. 3 ignition coil with igniter circuit.
- If DTC P0354 is set, check the No. 4 ignition coil with igniter circuit.
- If DTC P0355 is set, check the No. 5 ignition coil with igniter circuit.
- If DTC P0356 is set, check the No. 6 ignition coil with igniter circuit.

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DESCRIPTION

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. High-voltage is generated in the secondary wiring and then applied directly to each spark plug. The sparks of the spark plugs pass from the center electrodes 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, high-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 off, the igniter sends back an ignition confirmation (IGF) signal to the ECM, for each cylinder ignition.

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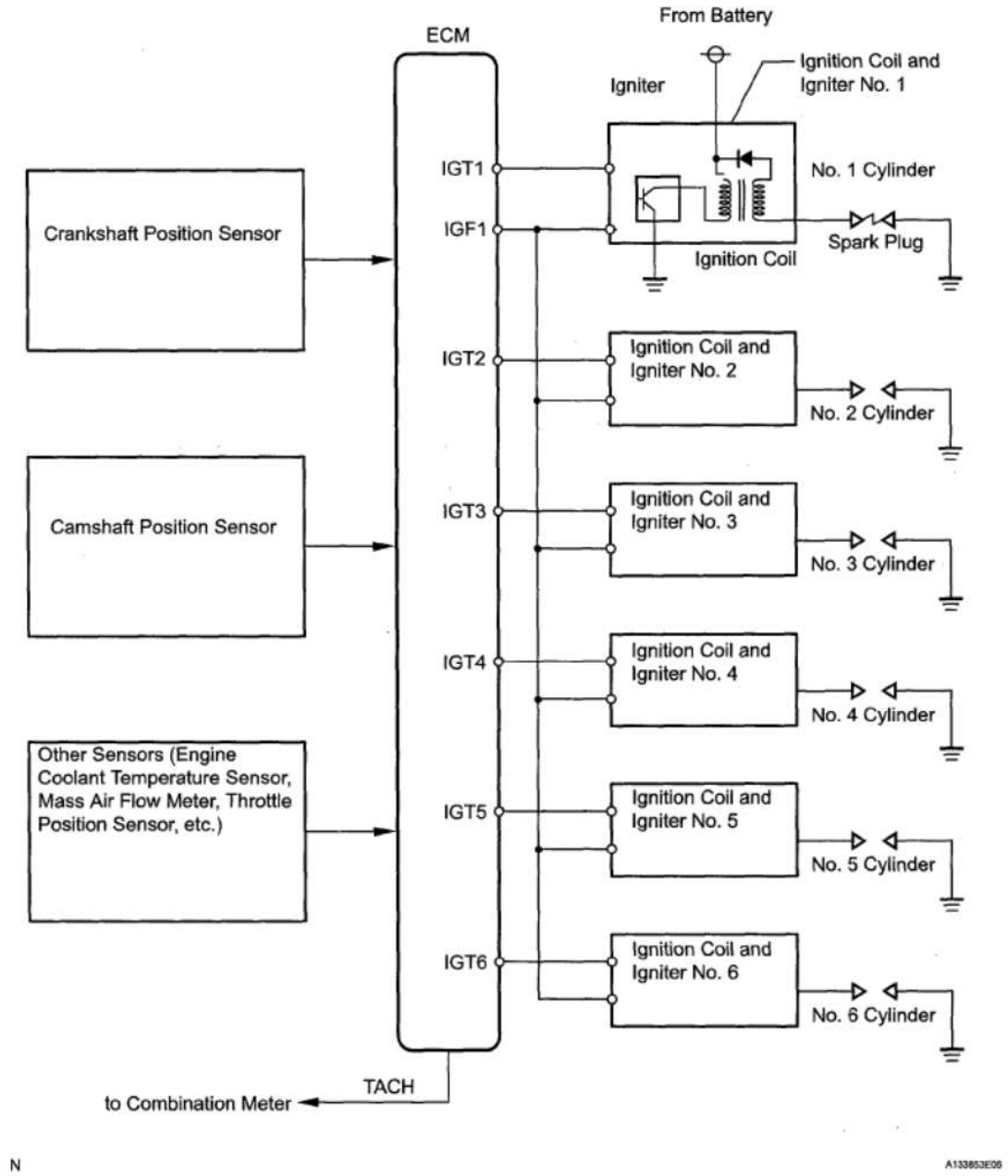


Fig. 144: Ignition Coil - Wiring Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

DTC DETECTION CONDITION CHART

DTC No.	DTC Detection Condition	Trouble Area
P0351 P0352 P0353 P0354	No IGF signal to ECM while engine is running (1 trip detection logic)	• Ignition system • Open or short in IGF1 or IGT circuit (1 to 6) between ignition coil with igniter and ECM

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P0355 P0356		• No. 1 to No. 6 ignition coils with igniters • ECM

Reference: Inspection using an oscilloscope

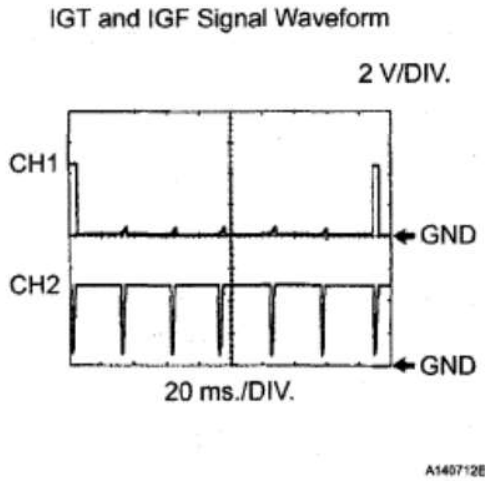


Fig. 145: IGT And IGF Signal Waveform
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

While cranking or idling, check the waveform between terminals IGT (1 to 6) and E1, and IGF1 and E1 of the ECM connector.

ITEM CONTENT REFERENCE CHART

Item	Content
Terminals	CH1: IGT1, IGT2, IGT3, IGT4, IGT5, IGT6 - E1 CH2: IGF1 - E1
Equipment Settings	2V/DIV., 20 ms./DIV.
Conditions	Cranking or idling

MONITOR DESCRIPTION

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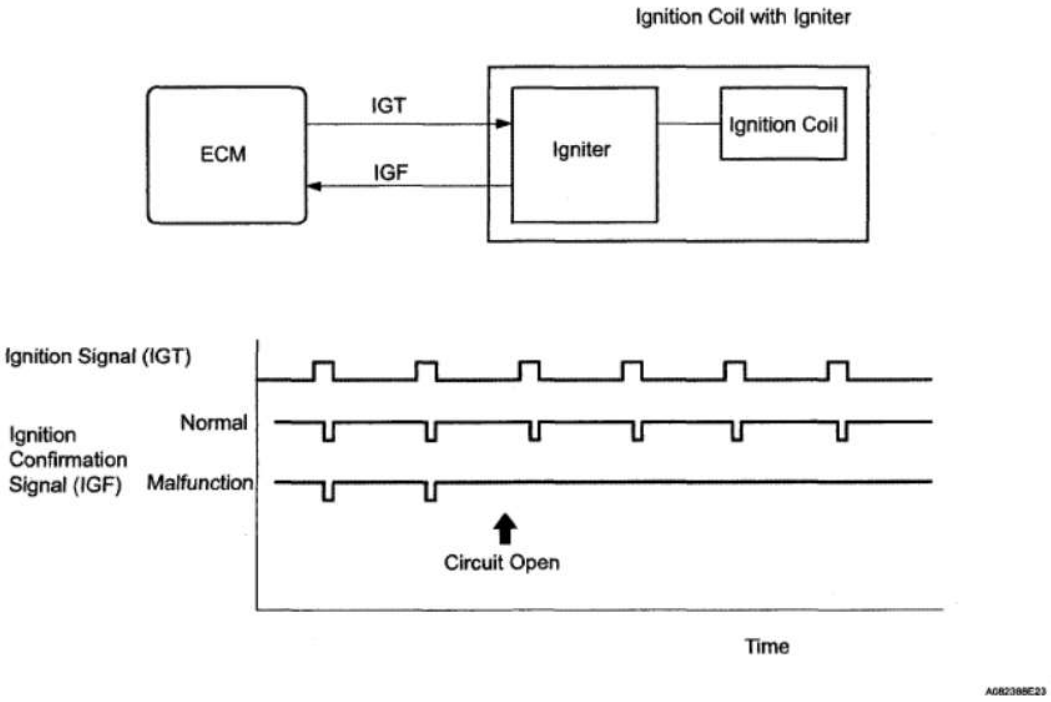


Fig. 146: Ignition Coil With Igniter Communication Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

If the ECM does not receive any IGF signals despite transmitting the IGT signal, it interprets this as a fault in the igniter and sets a DTC.

If the malfunction is not repaired successfully, a DTC is set 1 second after the engine is next started.

MONITOR STRATEGY

MONITOR STRATEGY REFERENCE CHART

Related DTCs	P0351: Igniter (Cylinder 1) malfunction P0352: Igniter (Cylinder 2) malfunction P0353: Igniter (Cylinder 3) malfunction P0354: Igniter (Cylinder 4) malfunction P0355: Igniter (Cylinder 5) malfunction P0356: Igniter (Cylinder 6) malfunction
Required Sensors/Components (Main)	Igniter (Cylinder 1 to 6)
Required Sensors/Components (Related)	Crankshaft position sensor
Frequency of Operation	Continuous
Duration	0.256 seconds and 5 sparks
MIL Operation	Immediate
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

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TYPICAL ENABLING CONDITIONS CHART

The monitor will run whenever these DTCs are not present	None
Either of the following conditions met	Condition 1 or 2
1. All of the following conditions are met:	Condition (a) and (b)
(a) Engine RPM	500 rpm or less
(b) Battery voltage	6 V or more
2. All of the following conditions are met:	Condition (c) and (d)
(c) Engine RPM	More than 500 rpm
(d) Battery voltage	10 V or more

TYPICAL MALFUNCTION THRESHOLDS

TYPICAL MALFUNCTION THRESHOLDS REFERENCE CHART

Ignition signal fail count	More than 2 times
Ignition signal fail count is on the right	No ignition confirmation signal from igniter.

COMPONENT OPERATING RANGE

COMPONENT OPERATING RANGE REFERENCE CHART

IGF signal	Igniter transmits IGF signal when it receives IGT signal from ECM

WIRING DIAGRAM

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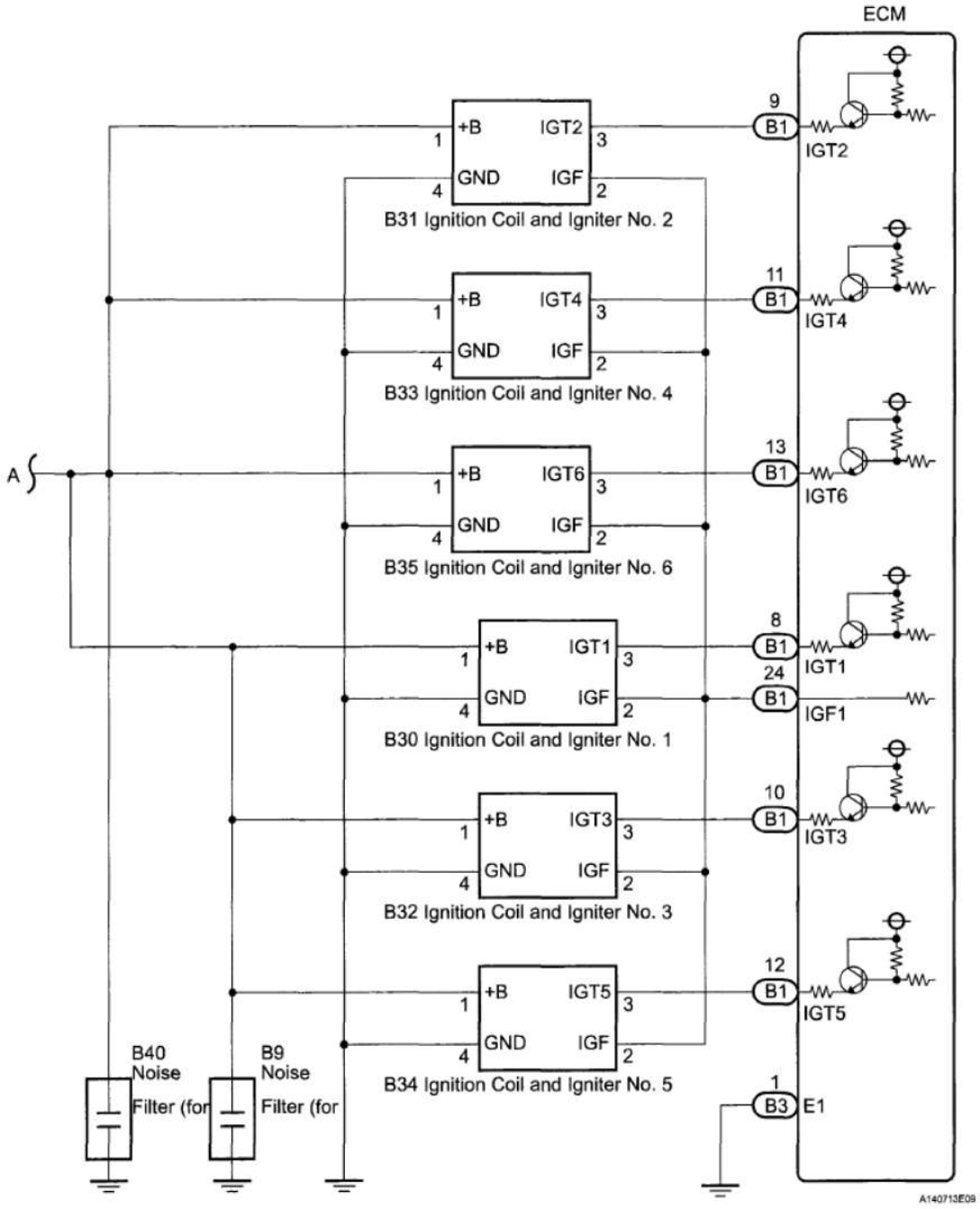


Fig. 147: Ignition Coil - Wiring Diagram (1 Of 3)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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w/o Smart Key System:

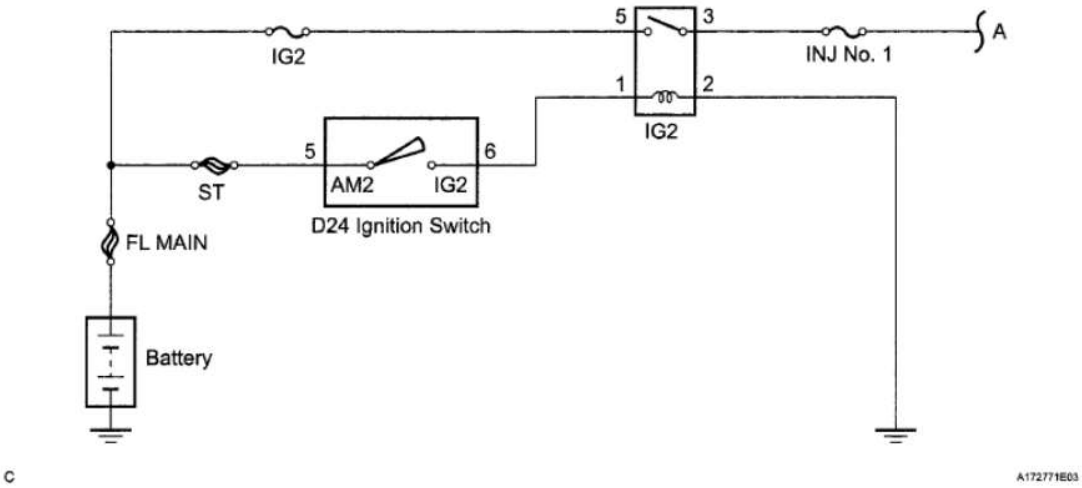


Fig. 148: Ignition Coil - Wiring Diagram (2 Of 3)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

w/ Smart Key System:

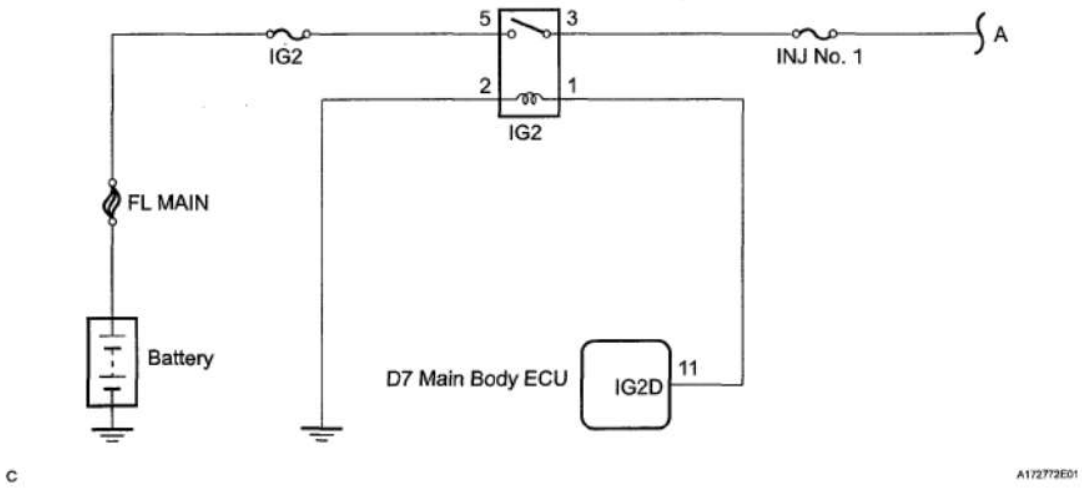


Fig. 149: Ignition Coil - Wiring Diagram (3 Of 3)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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 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.

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1. **CHECK DTC OUTPUT**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch on (IG).
   c. Turn the tester on.
   d. Enter the following menu items: Powertrain/Engine and ECT/DTC.
   e. Read the DTC.

   Result

   RESULT CHART

Result	Proceed to
DTC P0351, P0352, P0353. P0354 or P0356 is output	A
P0351, P0352, P0353, P0354 and P0356 are output	B

   B: Go to step 6

   A: Go to next step

2. **CHECK WHETHER DTC OUTPUT RECURS (DTC P0351, P0352, P0353, P0354, P0355 OR P0356)**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch on (IG).
   c. Turn the tester on.
   d. Clear the DTCs (See **DTC CHECK/CLEAR**).
   e. Shuffle 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. Check the DTCs displayed on the tester.

   Result

   RESULT CHART

Result	Proceed to
Same DTC output	A
Different ignition coil DTC output	B

   B: REPLACE IGNITION COIL ASSEMBLY (MALFUNCTIONING CYLINDER) (See **IGNITION COIL AND SPARK PLUG**)

   A: Go to next step

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3. **CHECK IGNITION COIL ASSEMBLY (POWER SOURCE)**
   a. Disconnect the ignition coil connector of malfunctioning cylinder.
   b. Turn the ignition switch on (IG).
   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
1 (+B) - Body ground	Ignition switch on (IG)	9 to 14 V

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

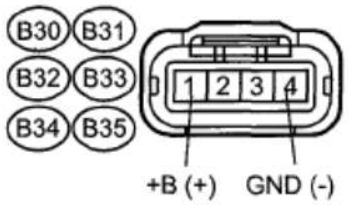
Standard resistance

TESTER CONNECTION SPECIFIED CONDITION CHART

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

   e. Reconnect the ignition coil connector.

Front view of wire harness connector:
(to Ignition Coil Assembly)



A157850E16

Fig. 150: Identifying Ignition Coil Assembly Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

NG: Go to step 6

OK: Go to next step

4. **CHECK HARNESS AND CONNECTOR (IGNITION COIL ASSEMBLY - ECM)**
   a. Disconnect the ignition coil connector.

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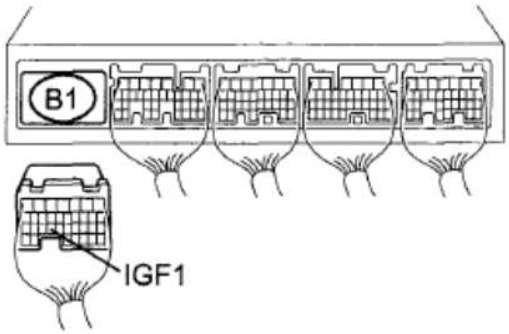
b. Disconnect the ECM connector.
c. Measure the resistance according to the value(s) in the table below.

Standard resistance (Check for open)

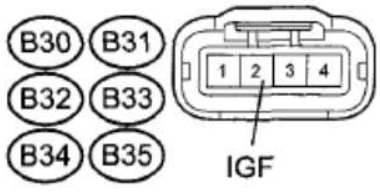
TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
B30-2 (IGF) - B1-24 (IGF1)	Always	Below 1 ohms
B31-2 (IGF) - B1-24 (IGF1)	Always	Below 1 ohms
B32-2 (IGF) - B1-24 (IGF1)	Always	Below 1 ohms
B33-2 (IGF) - B1-24 (IGF1)	Always	Below 1 ohms
B34-2 (IGF) - B1-24 (IGF1)	Always	Below 1 ohms
B35-2 (IGF) - B1-24 (IGF1)	Always	Below 1 ohms

Rear view of wire harness connector:
(to ECM)



Front view of wire harness connector:
(to Ignition Assembly)



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Fig. 151: Identifying Ignition Assembly And ECM Connector Terminals (IGF 1 And IGF)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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Standard resistance (Check for short)

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
B30-2 (IGF) or B1-24 (IGF1) - Body ground	Always	10 kohms or higher
B31-2 (IGF) or B1-24 (IGF1) - Body ground	Always	10 kohms or higher
B32-2 (IGF) or B1-24 (IGF1) - Body ground	Always	10 kohms or higher
B33-2 (IGF) or B1-24 (IGF1) - Body ground	Always	10 kohms or higher
B34-2 (IGF) or B1-24 (IGF1) - Body ground	Always	10 kohms or higher
B35-2 (IGF) or B1-24 (IGF1) - Body ground	Always	10 kohms or higher

d. Reconnect the ECM connector.
e. Reconnect the ignition coil connector.

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR (IGNITION COIL ASSEMBLY - ECM)

OK: Go to next step

5. **CHECK HARNESS AND CONNECTOR (IGNITION COIL ASSEMBLY - ECM)**
   a. Disconnect the ignition coil 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
B30-3 (IGT1) - B1-8 (IGT1)	Always	Below 1 ohms
B31-3 (IGT2) - B1-9 (IGT2)	Always	Below 1 ohms
B32-3 (IGT3) - B1-10 (IGT3)	Always	Below 1 ohms
B33-3 (IGT4) - B1-11 (IGT4)	Always	Below 1 ohms
B34-3 (IGT5) - B1-12 (IGT5)	Always	Below 1 ohms
B35-3 (IGT6) - B1-13 (IGT6)	Always	Below 1 ohms

Standard resistance (Check for short)

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
B30-3 (IGT1) or B1-8 (IGT1) - Body ground	Always	10 kohms or higher
B31-3 (IGT2) or B1-9 (IGT2) - Body ground	Always	10 kohms or higher
B32-3 (IGT3) or B1-10 (IGT3) - Body ground	Always	10 kohms or higher
B33-3 (IGT4) or B1-11 (IGT4) - Body ground	Always	10 kohms or higher

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B34-3 (IGT5) or B1-12 (IGT5) - Body ground	Always	10 kohms or higher
B35-3 (IGT6) or B1-13 (IGT6) - Body ground	Always	10 kohms or higher

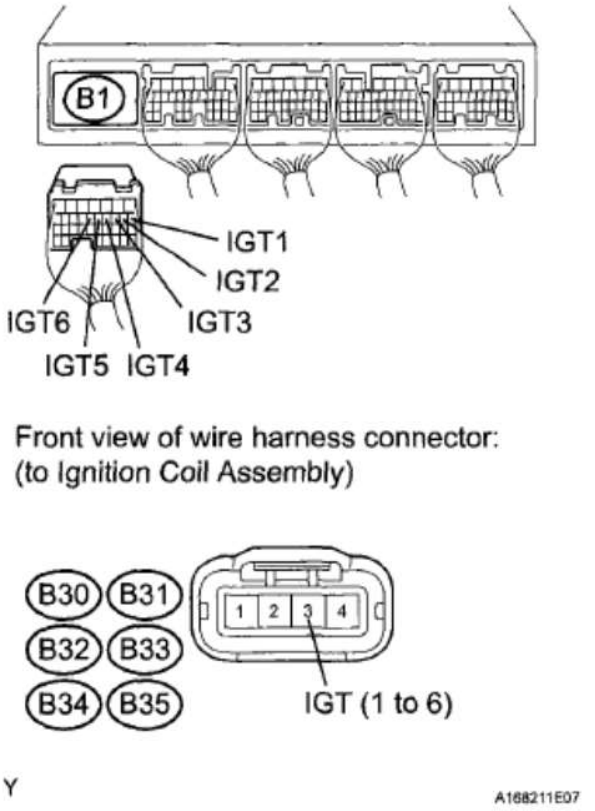


Fig. 152: Identifying Ignition Coil Assembly And ECM Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

d. Reconnect the ignition coil connector.
e. Reconnect the ECM connector.

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR (IGNITION COIL ASSEMBLY - ECM)

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

6. **INSPECT FUSE (INJ NO. 1 FUSE)**
   a. Remove the INJ No. 1 fuse from the engine room relay block.
   b. 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
INJ No. 1 fuse	Always	Below 1 ohms

c. Reinstall the INJ No. 1 fuse.

NG: REPLACE FUSE (INJ NO. 1 FUSE)

Engine Room Relay Block:

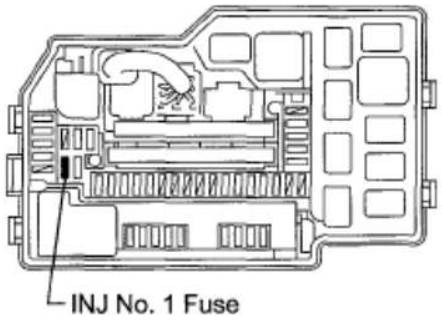


Fig. 153: Identifying INJ No. 1 Fuse
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

7. **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

Tester Connection	Condition	Specified Condition
3 - 5	When no battery voltage applied to terminals 1 and 2	10 kohms or higher
3 - 5	When battery voltage applied to terminals 1 and 2	Below 1 ohms

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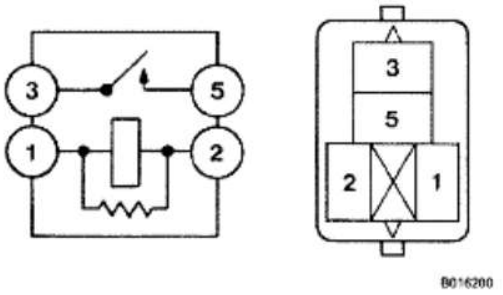


Fig. 154: IG2 Relay Circuit
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

c. Reinstall the IG2 relay.

NG: REPLACE RELAY

OK: REPAIR OR REPLACE HARNESS OR CONNECTOR (IG2 RELAY - INJ NO. 1 FUSE)

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); DTC P0390 CAMSHAFT POSITION SENSOR "B" CIRCUIT (BANK 2); DTC P0392 CAMSHAFT POSITION SENSOR "B" CIRCUIT LOW INPUT (BANK 2); DTC P0393 CAMSHAFT POSITION SENSOR "B" CIRCUIT HIGH INPUT (BANK 2)

DESCRIPTION

The exhaust camshaft's VVT sensor consists of a magnet and magneto resistance element.

The exhaust camshaft has a sensor plate with 3 teeth on its outer circumference.

When the exhaust camshaft rotates, changes occur in the air gaps between the 3 teeth and magneto resistance element, which affects the magnet. As a result, the resistance of the magneto resistance element material fluctuates. The VVT sensor converts the exhaust camshaft rotation data to pulse signals, uses the pulse signals to determine the camshaft angle, and sends it to the ECM.

DTC DETECTION CONDITION CHART

DTC No.	DTC Detection Condition	Trouble Area
P0365 P0390	• Input voltage to ECM remains 0.3 V or less, or 4.7 V or higher for more than 4 seconds, when 2 or more seconds have elapsed after turning ignition switch ON position (1 trip detection logic) • Missing VVT sensor signal despite crankshaft position sensor inputs normal at engine speed of 600 rpm or more (1 trip	• Open or short in VVT sensor for exhaust camshaft circuit • VVT sensor for exhaust camshaft • Exhaust camshaft • Jumped tooth of

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	detection logic)	timing chain • ECM
P0367 P0392	Output voltage of VVT sensor is 0.3 V or less for 4 seconds (1 trip detection logic)	• Open or short in VVT sensor for exhaust camshaft circuit • VVT sensor for exhaust camshaft • Exhaust camshaft • Jumped tooth of timing chain • ECM
P0368 P0393	Output voltage of VVT sensor is 4.7 V or more for 4 seconds (1 trip detection logic)	• Open or short in VVT sensor for exhaust camshaft circuit • VVT sensor for exhaust camshaft • Exhaust camshaft • Jumped tooth of timing chain • ECM

MONITOR DESCRIPTION

If no signal is transmitted by the VVT (for exhaust camshaft) sensor despite the engine revolving, or the rotations of the exhaust camshaft and the crankshaft are not synchronized, the ECM interprets this as a malfunction of the sensor.

MONITOR STRATEGY

MONITOR STRATEGY REFERENCE CHART

Related DTCs	P0365: Exhaust VVT Position (Bank 1) range check/rationality P0365: Exhaust VVT Position (Bank 1) range check (chattering) P0367: Exhaust VVT Position (Bank 1) range check (low voltage) P0368: Exhaust VVT Position (Bank 1) range check (high voltage) P0390: Exhaust VVT Position (Bank 2) range check/rationality P0390: Exhaust VVT Position (Bank 2) range check (chattering) P0392: Exhaust VVT Position (Bank 2) range check (low voltage) P0393: Exhaust VVT Position (Bank 2) range check (high voltage)
Required Sensors/Components (Main)	Exhaust VVT Position (Bank 1 and 2)
Required Sensors/Components	

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(Related)	Exhaust camshaft sensor
Frequency of Operation	Continuous
Duration	5 seconds: Exhaust VVT Position range check/rationality 4 seconds: Others
MIL Operation	Immediate: Others
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

All:

TYPICAL ENABLING CONDITIONS CHART

The monitor will run whenever these DTCs are not present	None

Exhaust VVT Position Sensor Range Check/Rationality:

TYPICAL ENABLING CONDITIONS CHART

Engine RPM	600 rpm or more
Starter	OFF
Battery voltage	8 V or more
Ignition Switch	on (IG)

Exhaust VVT Position Sensor Range Check (Chattering, Low voltage, High voltage):

TYPICAL ENABLING CONDITIONS CHART

Starter	OFF
Ignition switch on (IG) and time after ignition switch is off to on	2 seconds or more
Battery voltage	8 V or more

TYPICAL MALFUNCTION THRESHOLDS

Exhaust VVT Position Range Check/Rationality:

TYPICAL MALFUNCTION THRESHOLDS REFERENCE CHART

Exhaust camshaft sensor signal	No signal

Exhaust VVT Position Sensor Range Check (Chattering):

TYPICAL MALFUNCTION THRESHOLDS REFERENCE CHART

Exhaust camshaft sensor signal	Less than 0.3 V, or more than 4.7 V

Exhaust VVT Position Sensor Range Check (Low voltage):

TYPICAL MALFUNCTION THRESHOLDS REFERENCE CHART

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Exhaust camshaft sensor signal	Less than 0.3 V

Exhaust VVT Position Range Check (High voltage):

TYPICAL MALFUNCTION THRESHOLDS REFERENCE CHART

Exhaust camshaft sensor signal	More than 4.7 V

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 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. **CHECK VVT SENSOR FOR EXHAUST CAMSHAFT (SENSOR POWER SOURCE)**
   a. Disconnect the exhaust camshaft VVT sensor connector.
   b. Turn the ignition switch on (IG).
   c. Measure the voltage according to the value(s) in the table below.

   Standard voltage:

   Bank 1

   TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Switch Condition	Specified Condition
B43-3 (VC2) - Body ground	Ignition switch on (IG)	4.5 to 5.0 V

   Bank 2

   TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Switch Condition	Specified Condition
B42-3 (VC2) - Body ground	Ignition switch on (IG)	4.5 to 5.0 V

   d. Reconnect the VVT sensor connector.

   NG: Go to step 7

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Front view of wire harness connector:
(to VVT Sensor for Exhaust Camshaft)

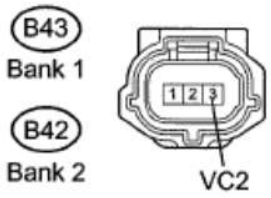


Fig. 155: Identifying VVT Sensor For Exhaust Camshaft Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

2. **CHECK HARNESS AND CONNECTOR (VVT SENSOR - ECM)**
   a. Disconnect the exhaust camshaft VVT sensor connector.
   b. Disconnect the ECM connector.
   c. Measure the resistance between the wire harness side connectors.

Standard resistance (Check for open):

Bank 1

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
B43-1 (EX+) - B3-25 (EV1+)	Always	Below 1 ohms
B43-2 (EX-) - B3-24 (EV1-)	Always	Below 1 ohms

Bank 2

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
B42-1 (EX+) - B3-23 (EV2+)	Always	Below 1 ohms
B42-2 (EX-) - B3-22 (EV2-)	Always	Below 1 ohms

Standard resistance (Check for short):

Bank 1

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TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
B43-1 (EX+) - B3-2S (EV1+) - Body ground	Always	10 kohms or higher
B43-2 (EX-) - B3-24 (EV1-) - Body ground	Always	10 kohms or higher

Bank 2

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
B42-1 (EX+) - B3-23 (EV2+) - Body ground	Always	10 kohms or higher
B42-2 (EX-) - B3-22 (EV2-) - Body ground	Always	10 kohms or higher

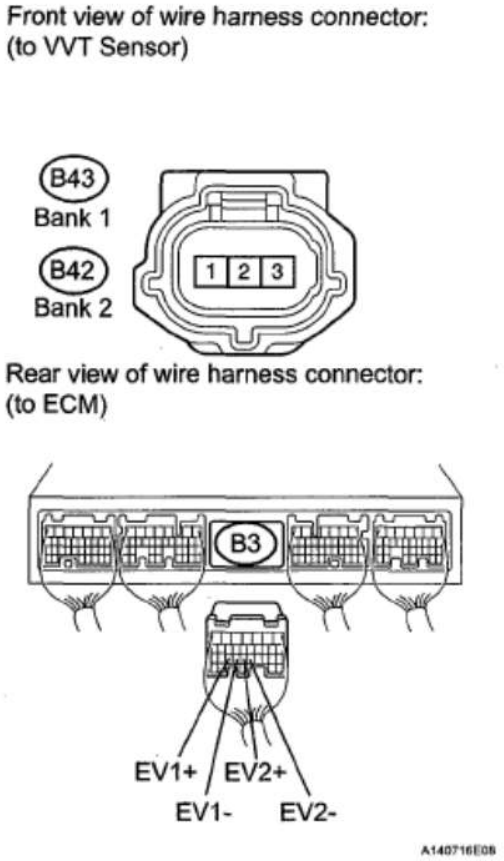


Fig. 156: Identifying VVT Sensor And ECM Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

d. Reconnect the VVT sensor connector.
e. Reconnect the ECM connector.

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR (VVT SENSOR - ECM)

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OK: Go to next step

3. **CHECK VVT SENSOR FOR EXHAUST CAMSHAFT (SENSOR INSTALLATION)**
   a. Check the VVT sensor installation.

   OK: Sensor is installed correctly.

   NG: REPAIR OR REPLACE VVT SENSOR

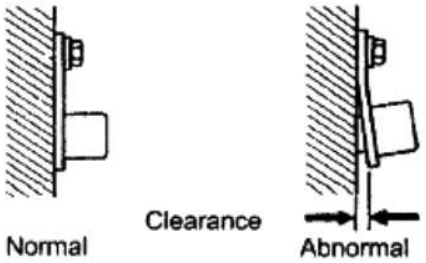


Fig. 157: Checking VVT Sensor Installation
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

4. **CHECK EXHAUST CAMSHAFT**
   a. Check the teeth of the camshaft.

   NG: REPLACE EXHAUST CAMSHAFT

   OK: Go to next step

5. **REPLACE VVT SENSOR (FOR EXHAUST CAMSHAFT)**
   a. Replace the VVT sensor (See **VVT SENSOR**).
6. **CHECK WHETHER DTC OUTPUT RECURS**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch on (IG).
   c. Turn the tester on.
   d. Clear the DTCs.
   e. Select the following menu items: Powertrain/Engine and ECT/Trouble Code/Pending.
   f. Read the DTCs.

   Result

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RESULT CHART

Display (DTC Output)	Proceed to
No output	A
P0365, P0352, P0353, P0354, P0355 or P0356	B

HINT:

If the engine does not start, replace the ECM.

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

A: END

7. **CHECK HARNESS AND CONNECTOR (VVT SENSOR - ECM)**
   a. Disconnect the exhaust camshaft VVT 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):

Bank 1

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
B43-3 (VC2) - B1-23 (VC)	Always	Below 1 ohms

Bank 2

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
B42-3 (VC2) - B1-23 (VC)	Always	Below 1 ohms

Standard resistance (Check for short):

Bank 1

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
B43-3 (VC2) or B1-23 (VC) - Body ground	Always	10 kohms or higher

Bank 2

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition

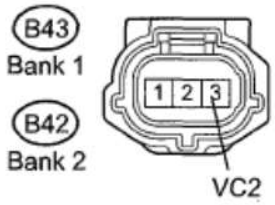
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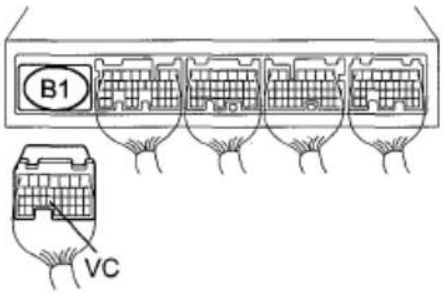
B42-3 (VC2) or B1-23 (VC) - Body ground	Always	10 kohms or higher

d. Reconnect the VVT sensor connector.
e. Reconnect the ECM connector.

Front view of wire harness connector:
(to VVT Sensor for Exhaust Camshaft)



Rear view of wire harness connector:
(to ECM)



A168231E04

Fig. 158: Identifying VVT Sensor For Exhaust Camshaft And ECM Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR (VVT SENSOR - ECM)

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

DTC P0420 CATALYST SYSTEM EFFICIENCY BELOW THRESHOLD (BANK 1); DTC P0430 CATALYST SYSTEM EFFICIENCY BELOW THRESHOLD (BANK 2)

MONITOR DESCRIPTION

The ECM uses the sensors mounted in front of and behind the three-way catalyst converter to monitor its efficiency. The first sensor, an air fuel ratio sensor, sends pre-catalyst air fuel ratio information to the ECM. The second sensor, a heated oxygen sensor (O2S), sends post-catalyst information to the ECM. The ECM compares these 2 signals to judge the efficiency of the catalyst and the catalyst's ability to store oxygen. During normal

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operation, the three-way catalyst converter stores and releases oxygen as needed. The capacity to store oxygen results in a low variation in the post-three-way catalyst converter exhaust stream.

If the catalyst is functioning normally, the waveform of the heated oxygen sensor slowly switches between RICH and LEAN. If the catalyst is deteriorated, the waveform will alternate frequently between RICH and LEAN. As the catalyst efficiency degrades, its ability to store oxygen is reduced and the catalyst output becomes more variable. When running the monitor, the ECM compares sensor 1 signals (air fuel ratio sensor) over a specific amount of time to determine catalyst efficiency. The ECM begins by calculating the signal length for both sensors (for the rear oxygen sensor, the ECM uses the output voltage signal length). If the oxygen sensor output voltage signal length is greater than the threshold (threshold is calculated based on the air fuel ratio sensor signal length), the ECM concludes that the catalyst is malfunctioning. The ECM will turn on the MIL and a DTC will be set.

DTC DETECTION CONDITION CHART

DTC No.	DTC Detection Condition	Trouble Area
P0420	Oxygen Storage Capacity (OSC) value is smaller than standard value under active air fuel ratio control (2 trip detection logic)	• Gas leakage from exhaust system • Air fuel ratio sensor (bank 1 sensor 1) • Heated oxygen sensor (bank 1 sensor 2) • Exhaust manifold sub- assembly (three-way catalyst converter) • Center exhaust pipe assembly (three-way catalyst converter)
P0430	OSC value is smaller than standard value under active air fuel ratio control (2 trip detection logic)	• Gas leakage from exhaust system • Air fuel ratio sensor (bank 2 sensor 1) • Heated oxygen sensor (bank 2 sensor 2) • Exhaust manifold manifold sub-assembly (three-way catalyst converter) • Center exhaust pipe assembly (three-way catalyst converter)

HINT:

- Bank 1 refers to the bank that includes cylinder No. 1.
- Bank 2 refers to the bank that does not include cylinder No. 1.
- Sensor 1 refers to the sensor closest to the engine assembly.
- Sensor 2 refers to the sensor farthest away from the engine assembly.

MONITOR STRATEGY

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MONITOR STRATEGY REFERENCE CHART

Related DTCs	P0420: Catalyst Deterioration P0430: Catalyst Deterioration
Required Sensors/Components (Main)	Three-way catalyst converter
Required Sensors/Components (Related)	Air fuel ratio sensor, heated oxygen sensor, intake air temperature sensor, mass air flow meter, crankshaft position sensor and 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

The monitor will run whenever these DTCs are not present	P0010, P0020 (OCV bank 1, 2) P0011, P0021 (VVT system bank 1,2- advance) P0012, P0022 (VVT system bank 1,2- retard) P0013, P0023 (Exhaust OCV bank 1, 2) P0014, P0024 (Exhaust VVT system bank 1,2- advance) P0015, P0025 (Exhaust VVT system bank 1,2- retard) P0016, P0018 (VVT system bank 1,2- misalignment) P0017, P0019 (Exhaust VVT system bank 1,2- misalignment) P0031, P0032, P0051, P0052 (A/F sensor heater) P0037, P0038, P0057, P0058 (HO2 sensor heater) P0100, P0102, P0103 (MAF meter) P0115, P0117, P0118 (ECT sensor) P0120, P0121, P0122, P0123, P0220, P0222, P0223, P2135 (TP sensor) P0125 (Insufficient ECT for closed loop) P0136, P0137, P0138, P0139 (HO2 sensor bank 1) P0156, P0157, P0158, P0159 (HO2 sensor bank 2) P0171, P0172, P0174, P0175 (Fuel system) P0301, P0302, P0303, P0304, P0305, P0306 (Misfire) P0335 (CKP sensor) P0340, P0342, P0343, P0345, P0347, P0348 (VVT sensor) P0351, P0352, P0353, P0354, P0355, P0356 (Igniter) P0365, P0367, P0368, P0390, P0392, P0393 (Exhaust VVT sensor) P0500 (Vehicle speed sensor) P0606, P0607 (HO2 sensor - sensor 2) P2195, P2196, P2197, P2198 (A/F sensor - rationality) P2237, P2240 (A/F sensor - open) P2238, P2241, P2252, P2255 (A/F sensor - low impedance)

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	P2239, P2242, P2253, P2256 (A/F sensor - high impedance) P2A00, P2A03 (A/F sensor - slow response)
Battery voltage	11 V or more
IAT	-10°C (14°F) or more
ECT	75°C (167°F) or more
Atmospheric pressure	0.75 or more
Idle	OFF
Engine RPM	Less than 3200 rpm
Air fuel ratio sensor	Activated
Fuel system status	Closed loop
Engine load	10 to 70%
All of the following conditions are met	Conditions 1, 2 and 3
1. Mass air flow rate	5 to 60 g/sec.
2. Front catalyst temperature (estimated)	600 to 750°C (1112 to 1382°F)
3. Rear catalyst temperature (estimated)	100 to 900°C (212 to 1652°F)
EVAP system monitor	The monitor has not run yet or the vacuum introduction has been completed
A/F sensor monitor	Completed
Rear HO2S monitor	Completed
Shift position	4th or more

TYPICAL MALFUNCTION THRESHOLDS

TYPICAL MALFUNCTION THRESHOLDS REFERENCE CHART

Oxygen Storage Capacity (OSC) of catalyst	Less than 0.046 g (0.000101 lb)

MONITOR RESULT

Refer to **CHECKING MONITOR STATUS** .

CONDITIONING FOR SENSOR TESTING

HINT:

Perform the operation with the engine speeds and durations described below prior to checking the waveforms of the air fuel ratio and heated oxygen sensors. This is in order to activate the sensors sufficiently to obtain the appropriate inspection results.

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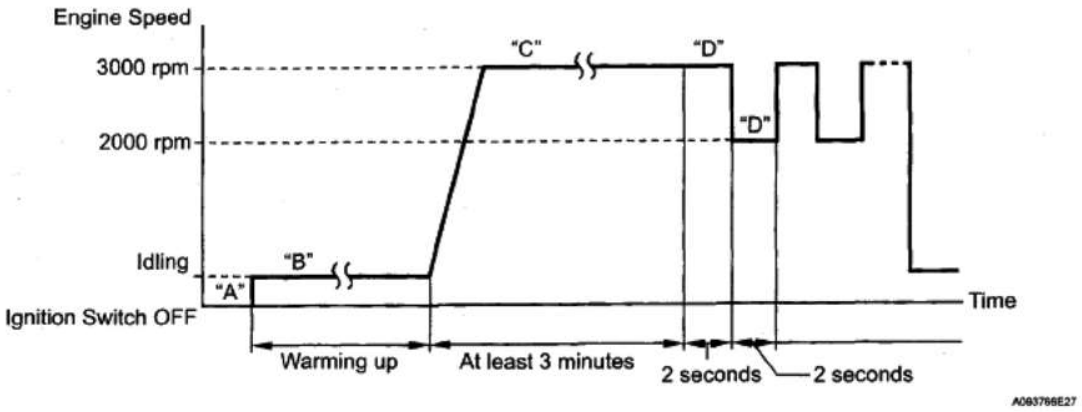


Fig. 159: Engine Speed Operation Graph
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

1. Connect the Techstream to the DLC3.
2. Start the engine and warm it up with all the accessories switched off, until the engine coolant temperature stabilizes (Procedure "B").
3. Run the engine at an engine speed of between 2500 rpm and 3000 rpm for at least 3 minutes (Procedure "C").
4. While running the engine at 3000 rpm for 2 seconds and at 2000 rpm for 2 seconds, check the waveforms of the air fuel ratio and heated oxygen sensors using the tester (Procedure "D").

   HINT:

   - If either of the voltage outputs of the Control the Injection Volume for A/F Sensor does not fluctuate, or either of the sensors makes a noise, 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, perform the following using the Techstream.
   - If the three-way catalyst converter has deteriorated, the heated oxygen sensor (located behind the three-way catalyst 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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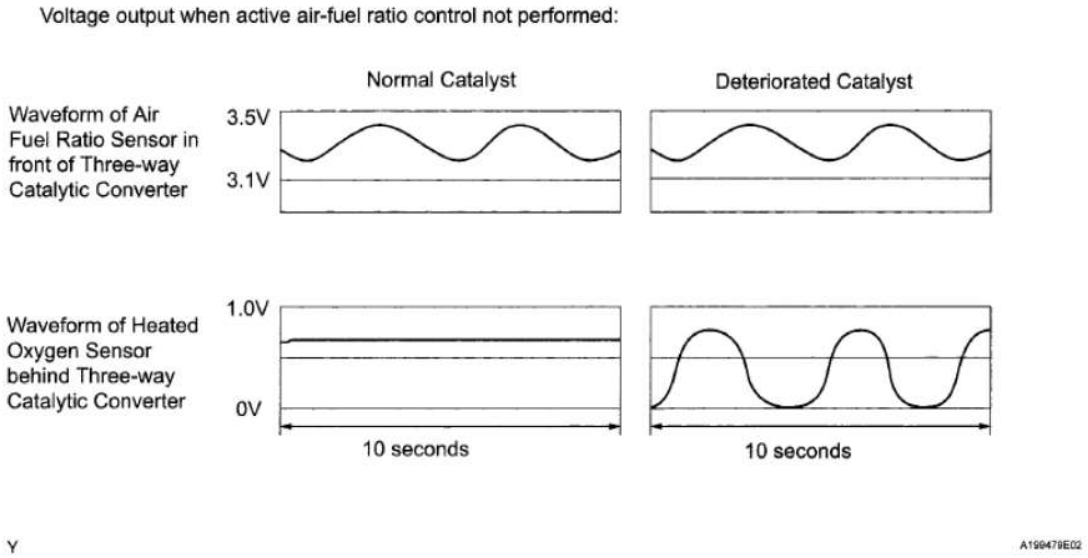


Fig. 160: Voltage Output When Active Air-Fuel Control Not Performed
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

1. **AIR FUEL RATIO CONTROL**

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.

a. Connect the Techstream to the DLC3.
b. Start the engine and turn the tester on.
c. Warm up the engine at an engine speed of 2500 rpm for approximately 90 seconds.
d. Select the following menu items: Powertrain/Engine and ECT/Active Test/Control the Injection Volume for A/F Sensor.
e. Perform the Control the Injection Volume for A/F Sensor operation with the engine in an idling condition (press the RIGHT or LEFT button to change the fuel injection volume).
f. Monitor the voltage outputs of the air fuel ratio and heated oxygen sensors (AFS Voltage B1S1 and O2S B1S2 or AFS Voltage B2S1 and O2S B2S2) displayed on the tester.

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.

Standard voltage

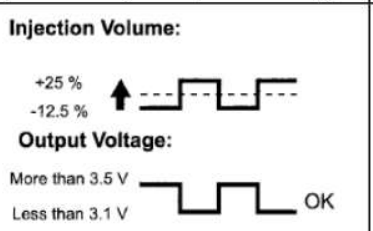
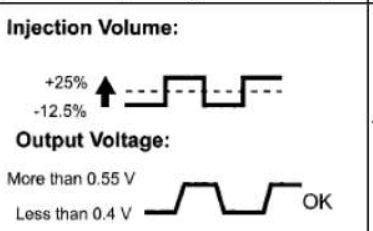
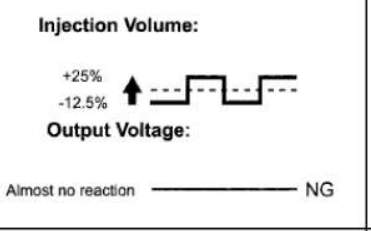
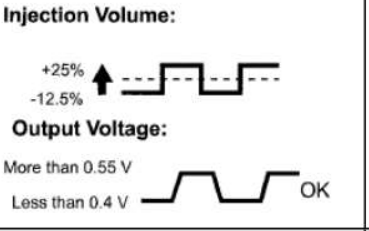
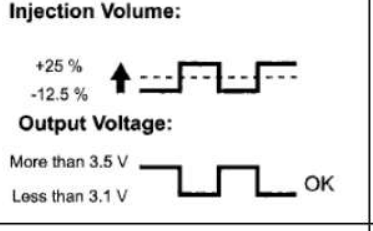
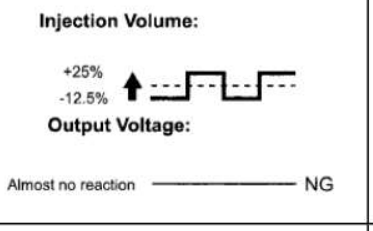
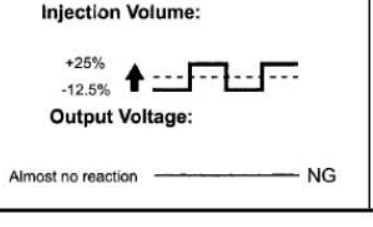
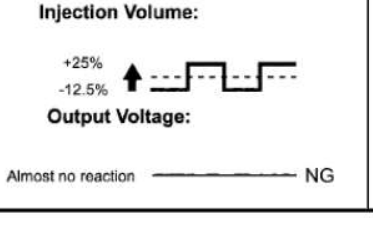
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TESTER DISPLAY REFERENCE CHART

Tester Display	Injection Volumes	Status	Voltages
AFS Voltage B1S1 or AFS B2S1 (Air fuel ratio)	+25%	Rich	Less than 3.1 V
AFS Voltage B1S1 or AFS B2S1 (Air fuel ratio)	-12.5%	Lean	More than 3.5 V
O2S B1S2 or O2S B2S2 (Heated oxygen)	+25%	Rich	More than 0.55 V
O2S B1S2 or O2S B2S2 (Heated oxygen)	-12.5%	Lean	Less than 0.4 V

CAUTION: 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 CHART

Case	Air Fuel Ratio Sensor (Sensor 1) Output Voltage	Heated Oxygen Sensor (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			• Fuel pressure • Gas leakage from exhaust system (Air fuel ratio extremely lean or rich)

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- 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, select the following menu items on the tester: Powertrain/Engine and ECT/Active Test/Control the Injection Volume for A/F Sensor/A/F Control System/AFS Voltage B1 S1 or AFS Voltage B2 S1 and O2S B1 S2 or O2S B2 S2. Then press the graph button on the Data List view.

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.

1. **CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P0420 AND/OR P0430)**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch on (IG) and turn the tester on.
   c. Select the following menu items: Powertrain/Engine and ECT/Trouble Code.
   d. Read the DTCs.

   Result

   RESULT CHART

Display (DTC Output)	Proceed to
P0420 and/or P0430	A
P0420 and/or P0430 and other DTCs	B

   HINT:

   If any DTCs other than P0420 or P0430 are output, troubleshoot those DTCs first.

   B: GO TO **DTC CHART**

   A: Go to next step

2. **PERFORM ACTIVE TEST USING TECHSTREAM (AIR FUEL RATIO CONTROL)**
   a. Connect the Techstream to the DLC3.
   b. Start the engine and turn the tester on.
   c. Warm up the engine at an engine speed of 2500 rpm for approximately 90 seconds.
   d. Select the following menu items: Powertrain/Engine and ECT/Active Test/Control the Injection Volume for A/F Sensor.
   e. Perform the Control the Injection Volume for A/F Sensor operation with the engine in an idling

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condition (press the RIGHT or LEFT button to change the fuel injection volume).

f. Monitor the voltage outputs of the air fuel ratio and heated oxygen sensors (AFS Voltage B1S1 and O2S B1S2 or AFS Voltage B2S1 and O2S B2S2) displayed on the tester.

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.

Standard voltage

TESTER DISPLAY REFERENCE CHART

Tester Display	Injection Volumes	Status	Voltages
AFS Voltage B1S1 or AFS B2S1 (Air fuel ratio)	+25%	Rich	Less than 3.1 V
AFS Voltage B1S1 or AFS B2S1 (Air fuel ratio)	-12.5%	Lean	More than 3.5 V
O2S B1S2 or O2S B2S2 (Heated oxygen)	+25%	Rich	More than 0.55 V
O2S B1S2 or O2S B2S2 (Heated oxygen)	-12.5%	Lean	Less than 0.4 V

Result

RESULT CHART

Status AFS B1S1 or AFS B2S1	Status O2S B1S2 or O2S B2S2	Air Fuel Ratio Condition and Air Fuel Ratio and Heated Oxygen Sensor Conditions	Misfires	Suspected Trouble Areas	Proceed to
Lean/Rich	Lean/Rich	Normal	-	• Three-way catalyst converter • Gas leakage 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	B
Lean/Rich	Lean	Heated oxygen sensor malfunction	-	• Heated oxygen sensor • Gas leakage	C

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				from exhaust system	
Lean/Rich	Rich	Heated oxygen sensor malfunction	-	• Heated oxygen sensor • Gas leakage from exhaust system	C
Lean	Lean	Actual air fuel ratio lean	May occur	• Extremely rich or lean actual air fuel ratio • Gas leakage from exhaust system	A
Rich	Rich	Actual air fuel ratio rich	-	• Extremely rich or lean actual air fuel ratio • Gas leakage from exhaust system	A
Lean: During Control the Injection Volume for A/F Sensor, the air fuel ratio sensor output voltage (AFS) is consistently more than 3.5 V, and the heated oxygen sensor output voltage (O2S) is consistently less than 0.4 V. Rich: During Control the Injection Volume for A/F Sensor, the AFS is consistently less than 3.1 V, and the O2S is consistently more 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

C: CHECK AND REPLACE HEATED OXYGEN SENSOR, AND CHECK AND REPAIR EXHAUST GAS LEAKAGE

A: Go to next step

3. **INSPECT FOR EXHAUST GAS LEAK**
   a. Check for exhaust gas leakage.

   OK: No gas leakage.

   NG: REPAIR OR REPLACE EXHAUST GAS LEAKAGE POINT

   OK: Go to next step

4. **CHECK DTC OUTPUT (DTC P0420 AND/OR P0430)**
   a. Connect the Techstream to the DLC3.

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b. Turn the ignition switch to the ON position and turn the tester on.
c. Enter the following menus: Powertrain/Engine and ECT/Trouble Code.
d. Read the DTCs.

Result

RESULT CHART

Display (DTC Output)	Proceed to
P0420	A
P0430	B
P0420 and P0430	A and B

B: Go to step 6

A: Go to next step

5. **REPLACE EXHAUST MANIFOLD SUB-ASSEMBLY RH**
   a. Replace exhaust manifold sub-assembly RH (See **REMOVAL**)

   NEXT: REPLACE CENTER EXHAUST PIPE ASSEMBLY

6. **REPLACE EXHAUST MANIFOLD SUB-ASSEMBLY LH**
   a. Replace exhaust manifold sub-assembly LH (See **REMOVAL**)

   NEXT: REPLACE CENTER EXHAUST PIPE ASSEMBLY

DTC P043E EVAPORATIVE EMISSION SYSTEM REFERENCE ORIFICE CLOG UP; DTC P043F EVAPORATIVE EMISSION SYSTEM REFERENCE ORIFICE HIGH FLOW; DTC P2401 EVAPORATIVE EMISSION SYSTEM LEAK DETECTION PUMP CONTROL CIRCUIT LOW; DTC P2402 EVAPORATIVE EMISSION SYSTEM LEAK DETECTION PUMP CONTROL CIRCUIT HIGH; DTC P2419 EVAPORATIVE EMISSION SYSTEM SWITCHING VALVE CONTROL CIRCUIT LOW

DTC SUMMARY

DTC SUMMARY

DTCs	Monitoring Item	Malfunction Detection Condition	Trouble Area	Detection Timing	Detection Logic
P043E	0.02 inch orifice clogged	P043E, P043F, P2401, P2402, P2419 are present when one of the following conditions is met during key-off EVAP monitor • Reference orifice clogged	• Canister pump module		
P043F	0.02 inch orifice high-flow				

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P2401	Leak detection pump stuck OFF	• Reference orifice high-flow • Leak detection pump OFF malfunction • Leak detection pump ON malfunction • Vent valve ON (close) malfunction	• Connector/wire harness (Canister pump module - ECM) • ECM	While ignition switch off	2 trip
P2402	Leak detection stuck ON				
P2419	Vent valve stuck open (vent)				

HINT:

The 0.02 inch orifice is located inside the canister pump module.

DESCRIPTION

The circuit description can be found in the EVAP (Evaporative Emission) System (See **DESCRIPTION**).

INSPECTION PROCEDURE

Refer to the **EVAP SYSTEM** .

MONITOR DESCRIPTION

5 hours*1 after the ignition switch is turned off, the leak detection pump creates negative pressure (vacuum) in the EVAP (Evaporative Emission) system. The ECM monitors for leaks and actuator malfunctions based on the EVAP pressure.

HINT:

*1 : 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.

MONITOR DESCRIPTION CHART

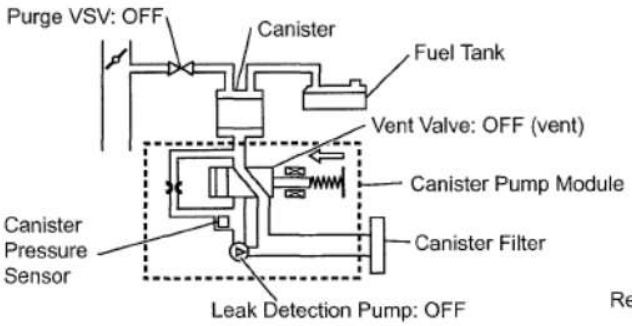
Sequence	Operation	Description	Duration
-	ECM activation	Activated by soak timer, 5 hours (7 or 9.5 hours) after ignition switch turned off.	-
A	Atmospheric pressure measurement	Vent valve is turned OFF (vent) and EVAP system pressure is measured by ECM in order to register atmospheric pressure. If pressure in EVAP system is not between 70 kPa and 110 kPa (525 mmHg and 825 mmHg), ECM cancels EVAP system monitor.	10 seconds
B	First 0.02 inch leak pressure measurement	In order to determine 0.02 inch leak pressure standard, leak detection pump creates negative pressure (vacuum) through 0.02 inch orifice and then ECM checks if leak detection pump	60 seconds

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		and vent valve operate normally.	
C	EVAP system pressure measurement	Vent valve is turned ON (closed) to shut EVAP system. Negative pressure (vacuum) is created in EVAP system, and EVAP system pressure is 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 is opened and then EVAP system pressure is measured by ECM. Large increase indicates normal.	10 seconds
E	Second 0.02 inch leak pressure measurement	After second 0.02 inch leak pressure measurement, leak check is performed by comparing first and second 0.02 inch leak pressure standards. If stabilized system pressure is higher than second 0.02 inch leak pressure standard, ECM determines that EVAP system is leaking.	60 seconds
F	Final check	Atmospheric pressure is measured and then monitoring result is recorded by ECM.	-
(1) If there is only a small amount of fuel in the fuel tank, stabilizing the EVAP pressure takes longer than usual.			

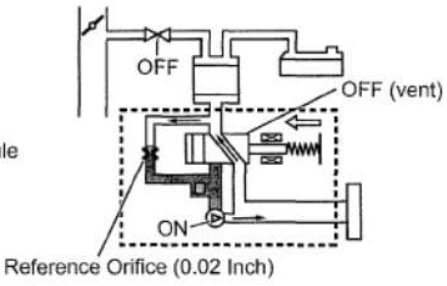
- Operation A:

Atmospheric Pressure Measurement



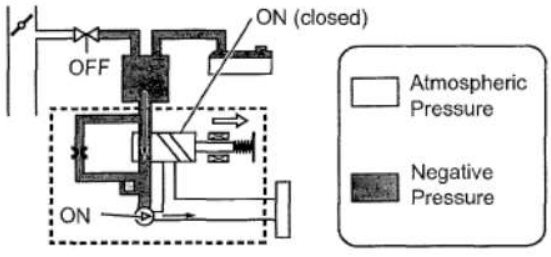
- Operation B, E:

Reference Pressure Measurement



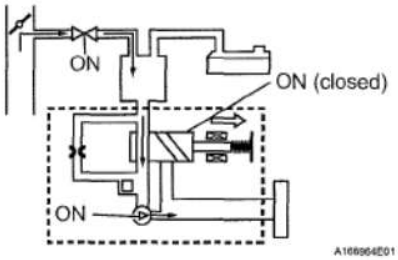
- Operation C:

EVAP System Pressure Measurement



- Operation D:

Purge VSV Monitor



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Fig. 161: Evaporative Emission System Operation Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

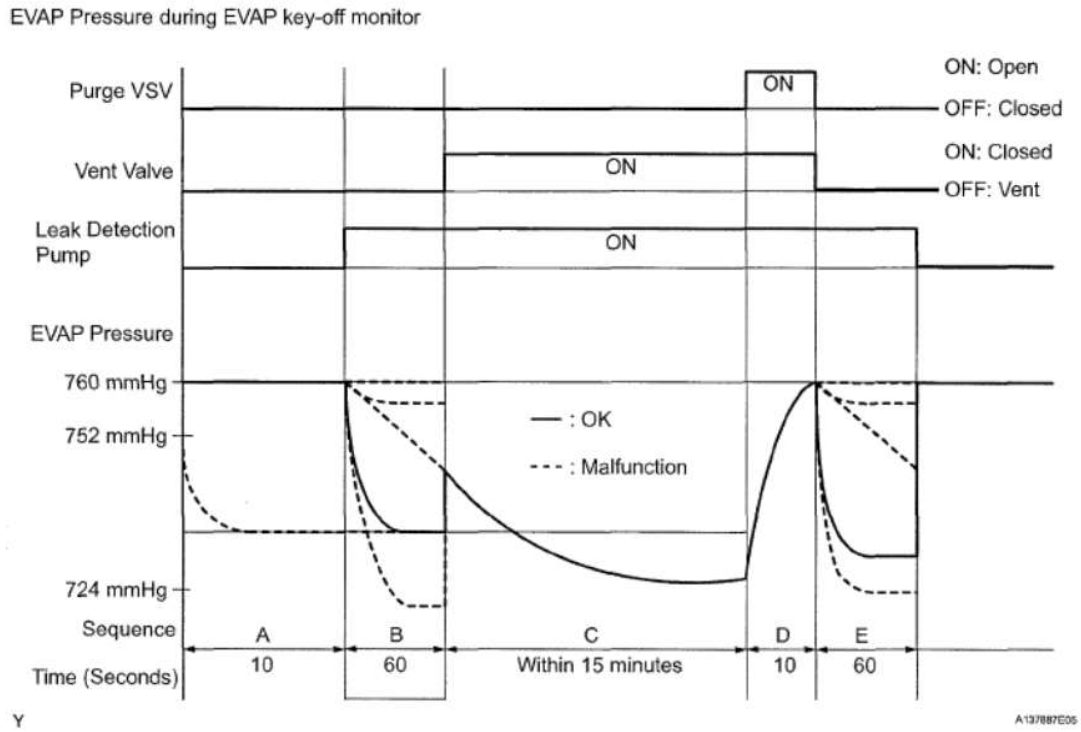


Fig. 162: EVAP Pressure Graph (EVAP Key-Off Monitor)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

The leak detection pump creates negative pressure through the reference orifice. When the system is normal, the EVAP pressure is in 724 to 752 mmHg* and saturated within a minute.

If not, the ECM interprets this as a malfunction. The ECM will illuminate the MIL and set DTC if this malfunction is detected in consecutive drive cycle.

*: Typical valve

MONITOR STRATEGY

MONITOR STRATEGY REFERENCE CHART

Related DTCs	P043E: 0.02 inch orifice clog (built-in pump module) P043F: 0.02 inch orifice high-flow (built-in pump module) P2401: Vacuum pump stuck OFF P2402: Vacuum 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

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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 present	None
Atmospheric pressure	70 to 110 kPa (525 to 825 mmHg)
Battery voltage	10.5 V or more
Vehicle speed	Less than 2.5 mph (4 km/h)
Ignition switch	off
Time after key-off	5 or 7 or 9.5 hours
EVAP pressure sensor malfunction (P0451, P0452, P0453)	Not detected
EVAP canister purge valve	Not operated by scan tool
EVAP canister vent valve	Not operated by scan tool
EVAP leak detection pump	Not operated by scan tool
Both of the following conditions 1 and 2 are met before key-off	-
1. Duration that vehicle 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 REFERENCE CHART

1. One of following conditions is met	-
2. EVAP pressure just after reference pressure measurement start	More than -1 kPa (-7.5 mmHg)
3. Reference pressure	Less than -4.85 kPa (-36.384 mmHg)
4. Reference pressure	-1.057 kPa (-7.929 mmHg) or more
5. Reference pressure	Not saturated
6. Difference between first reference pressure and second reference pressure	0.7 kPa (5.25 mmHg) or more

MONITOR RESULT

Refer to **CHECKING MONITOR STATUS** .

DTC P0441 EVAPORATIVE EMISSION CONTROL SYSTEM INCORRECT PURGE FLOW

DTC SUMMARY

DTC SUMMARY

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DTCs	Monitoring Item	Malfunction Detection Condition	Trouble Area	Detection Timing	Detection Logic
P0441	Purge VSV (Vacuum Switching Valve) stuck open	Leak detection pump creates negative pressure (vacuum) in EVAP system and EVAP system pressure is measured. 0.02 inch leak pressure standard is measured at start and end of leak check. If stabilized pressure is higher than [second 0.02 inch leak pressure standard x 0.2], ECM determines that purge VSV is stuck open	• Purge VSV • Purge VSV circuit (between purge VSV and ECM) • Leakage from EVAP line (between purge VSV and intake manifold) • EVAP line clogged (between purge VSV and canister) • ECM	While ignition switch off	2 trip
P0441	Purge VSV stuck closed	After EVAP leak check is performed, purge VSV is turned ON (open), and atmospheric air is introduced into EVAP system. 0.02 inch leak pressure standard is measured at the start and end of leak check. If pressure does not return to near atmospheric pressure, ECM determines that purge valve is stuck closed		While ignition switch off	2 trip
P0441	Purge flow	While engine running, the following conditions are successively met: • Negative pressure is not created in EVAP system when purge VSV is turned ON (open) • EVAP system pressure change is less than 0.4 kPa (3.0 mmHg) when vent valve is turned ON (closed) • Atmospheric pressure change before and after purge flow monitor is less than 0.1 kPa (0.75 mmHg)		While ignition switch off	2 trip

DESCRIPTION

The circuit description can be found in the EVAP (Evaporative Emission) System (See **DESCRIPTION**).

INSPECTION PROCEDURE

Refer to the **EVAP SYSTEM** .

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*1 after the ignition switch

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is turned off. The purge flow monitor runs while the engine is running.

1. **KEY-OFF MONITOR**

5 hours*1 after the ignition switch is turned off, the leak detection pump creates negative pressure (vacuum) in the EVAP (Evaporative Emission) system. The ECM monitors for leaks and actuator malfunctions based on the EVAP pressure.

HINT:

*1 : 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.

KEY-OFF MONITOR REFERENCE CHART

Sequence	Operation	Description	Duration
-	ECM activation	Activated by soak timer, 5 hours (7 or 9.5 hours) after ignition switch turned off.	-
A	Atmospheric pressure measurement	Vent valve is turned OFF (vent) and EVAP system pressure is measured by ECM in order to register atmospheric pressure. If pressure in EVAP system is not between 70 kPa and 110 kPa (525 mmHg and 825 mmHg), ECM cancels EVAP system monitor.	10 seconds
B	First 0.02 inch leak pressure measurement	In order to determine 0.02 inch leak pressure standard, leak detection pump creates negative pressure (vacuum) through 0.02 inch orifice and then ECM checks if leak detection pump and vent valve operate normally.	60 seconds
C	EVAP system pressure measurement	Vent valve is turned ON (closed) to shut EVAP system. Negative pressure (vacuum) is created in EVAP system, and EVAP system pressure is 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 is opened and then EVAP system pressure is measured by ECM. Large increase indicates normal.	10 seconds
E	Second 0.02 inch leak pressure measurement	After second 0.02 inch leak pressure measurement, leak check is performed by comparing first and second 0.02 inch leak pressure standards. If stabilized system pressure is higher than second 0.02 inch leak pressure standard, ECM determines that EVAP system leaking.	60 seconds
F	Final check	Atmospheric pressure is measured and then monitoring result is 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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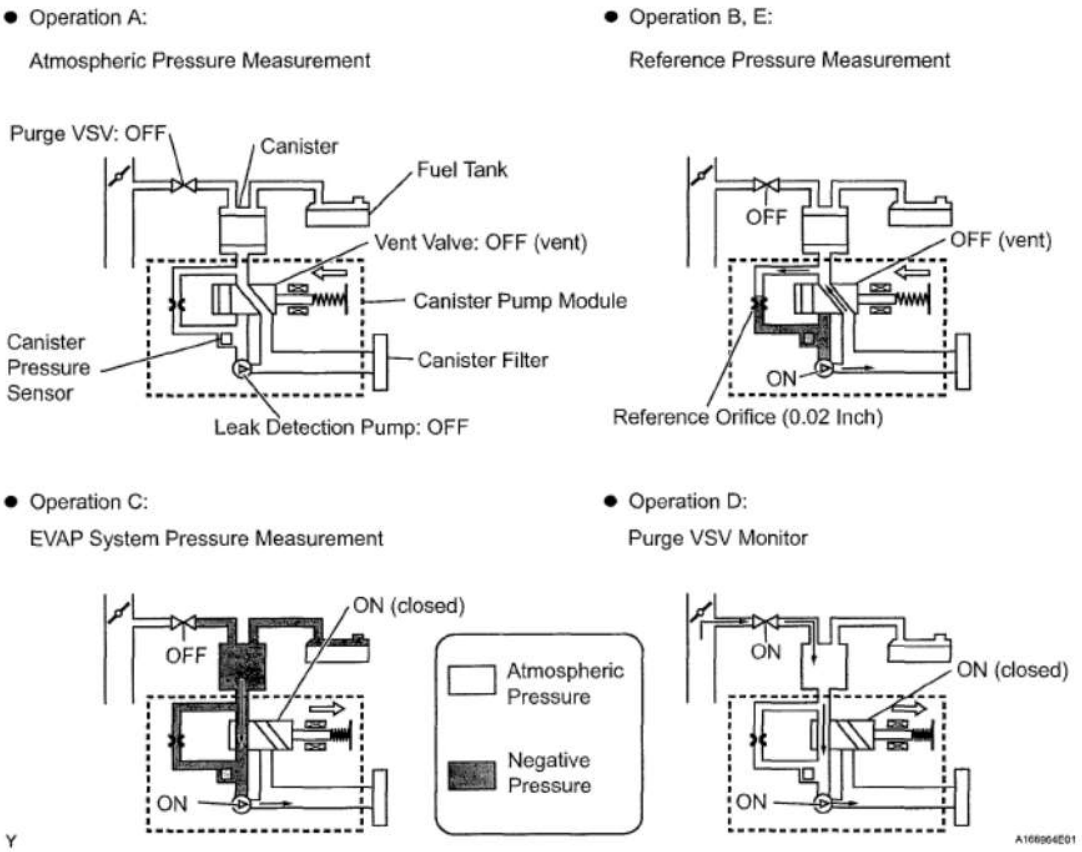


Fig. 163: Evaporative Emission Control System Operation Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

a. Purge VSV stuck open

In operation C, the leak detection pump creates negative pressure (vacuum) in the EVAP (Evaporative Emission) 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 0.02 inch leak pressure standard x 0.2], the ECM interprets this as the purge VSV (Vacuum Switching Valve) being stuck open. The ECM illuminates the MIL and sets the DTC (2 trip detection logic).

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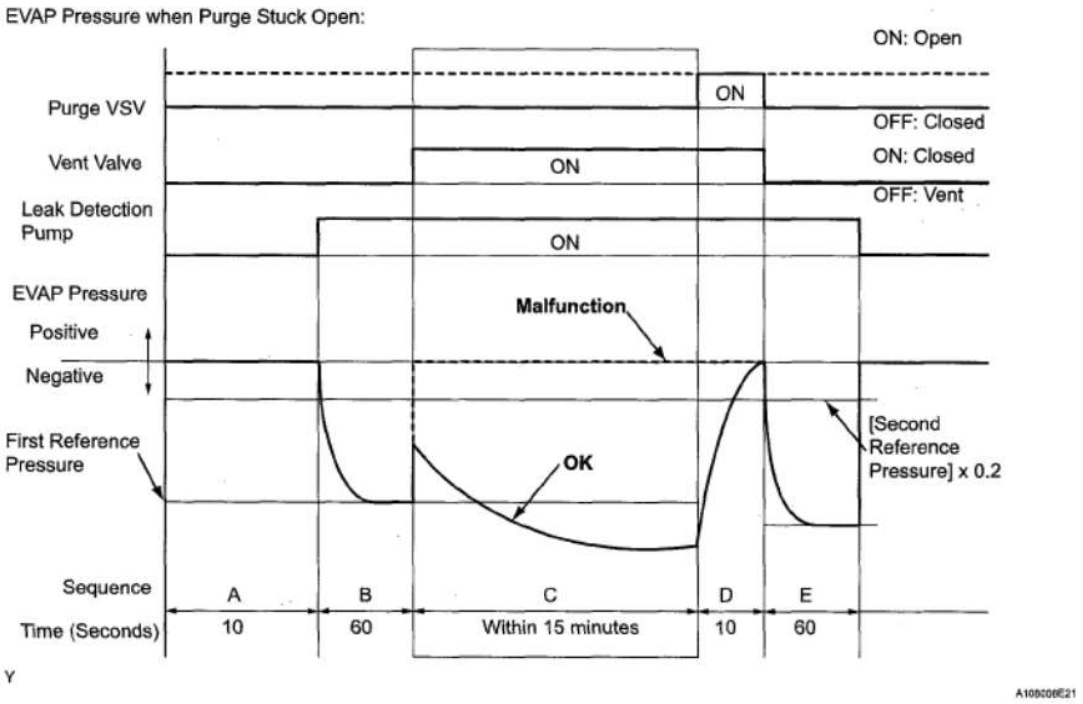


Fig. 164: EVAP Pressure Graph (Purge VSV Stuck Open)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. Purge VSV stuck closed

In operation D, the canister pressure sensor measures the EVAP (Evaporative Emission) system pressure. The pressure measurement for 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 (2.25 mmHg) 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 sets the DTC (2 trip detection logic).

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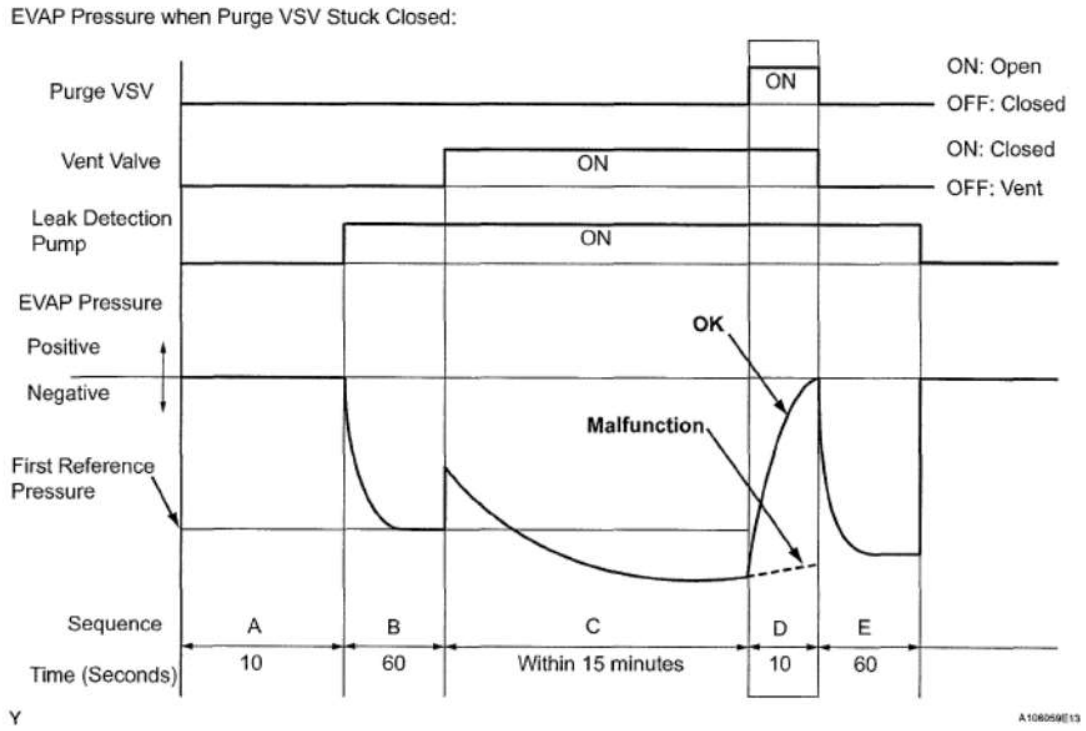


Fig. 165: EVAP Pressure Graph (Purge VCV Stuck Closed)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

2. PURGE FLOW MONITOR

The purge flow monitor consists of the two step monitors. The 1st monitor is 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 on (closed) and the EVAP pressure is then measured. If the variation in the pressure is less than 0.5 kPa (3.75 mmHg), the ECM interprets this as the purge VSV being stuck closed, and illuminates the MIL and sets DTC P0441 (2 trip detection logic).

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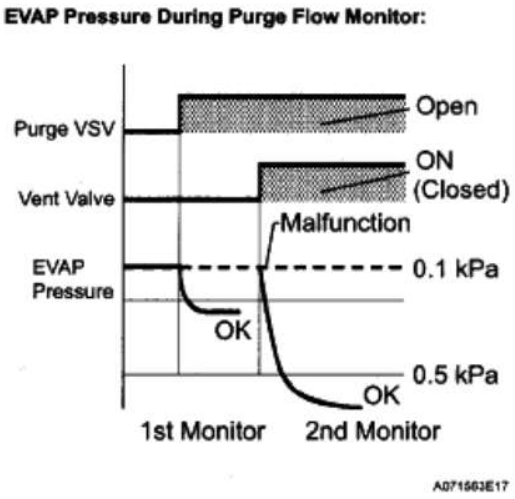


Fig. 166: EVAP Pressure Graph (Purge Flow Monitor)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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 SPECIFICATION CHART

Required Sensors/Components	Purge VSV Canister pump module
Frequency of Operation	Once per driving cycle
Duration	Within 15 minutes (varies with fuel in tank)
MIL Operation	2 driving cycles
Sequence of Operation	None

   Typical Enabling Conditions

   TYPICAL ENABLING CONDITIONS CHART

EVAP key-off monitor runs when all of following conditions are met	-
Atmospheric pressure	70 to 110 kPa-a (525 to 825 mmHg-a)
Battery voltage	10.5 V or more
Vehicle speed	Below 2.5 mph (4 km/h)

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Ignition switch	OFF
Time after key off	5 or 7 or 9.5 hours
Canister pressure sensor malfunction (P0450, 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 are 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 35°C (40 to 95°F)
Intake air temperature	4.4 to 35°C (40 to 95°F)

Typical Malfunction Thresholds

TYPICAL MALFUNCTION THRESHOLDS REFERENCE CHART

Purge VSV stuck open:	-
EVAP pressure when vacuum introduction complete	Higher than reference pressure x 0.2

TYPICAL MALFUNCTION THRESHOLDS REFERENCE CHART

Purge VSV stuck closed:	-
EVAP pressure change after purge VSV ON (open)	Less than 0.3 kPa (2.25 mmHg)

TYPICAL MALFUNCTION THRESHOLDS REFERENCE CHART

Purge flow:	-
Both of the following conditions are met	Conditions (a) and (b)
(a) EVAP pressure change when purge flow is started	Less then 0.1 kPa (0.75 mmHg)
(b) EVAP pressure change during purge flow when EVAP pressure switching valve ON (closed)	Less then 0.4 kPa (3.0 mmHg)

OBD II MONITOR SPECIFICATIONS

1. **Purge Flow Monitor**

Monitor Strategy

MONITOR STRATEGY SPECIFICATION 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

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Typical Enabling Conditions

TYPICAL ENABLING CONDITIONS CHART

The monitor will run whenever these DTCs are not present	None
Engine	Running
Engine coolant temperature	4.4°C (40°F) or more
Intake air temperature	4.4°C (40°F) or more
Canister pressure sensor malfunction	Not detected
Purge VSV	Not operated by scan tool
EVAP system check	Not operated by scan tool
Battery voltage	10 V or more
Purge duty cycle	8% or more

Typical Malfunction Thresholds

TYPICAL MALFUNCTION THRESHOLDS REFERENCE CHART

Both of following conditions are met	Conditions 1 and 2
1. EVAP pressure change when purge operation started	Less than 0.1 kPa-g (0.75 mmHg-g)
2. EVAP pressure change during purge operation when vent valve closed	Less than 0.4 kPa-g (3.0 mmHg-g)

MONITOR RESULT

Refer to **CHECKING MONITOR STATUS** .

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

DTCs	Monitoring Item	Malfunction Detection Condition	Trouble Area	Detection Timing	Detection Logic
P0451	Canister pressure sensor abnormal voltage fluctuation	Sensor output voltage fluctuates frequently in a certain time period.		• EVAP monitoring (ignition switch off) • Engine running	2 trip
	Canister pressure	Sensor output			

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P0451	sensor constant voltage	voltage does not vary in a certain time period.	• Canister pump module • Connector/wire harness (Canister pump module - ECM) • ECM	EVAP monitoring (ignition switch off)	2 trip
P0452	Canister pressure sensor voltage low	Sensor output voltage is less than 0.45 V for 0.5 seconds.		• Ignition switch on (IG) • EVAP monitoring (ignition switch off)	1 trip
P0453	Canister pressure sensor voltage high	Sensor output voltage is more than 4.9 V for 0.5 seconds.		• Ignition switch on (IG) • 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 the EVAP (Evaporative Emission) System (See **DESCRIPTION**).

MONITOR DESCRIPTION

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Canister Pressure Sensor Specification:

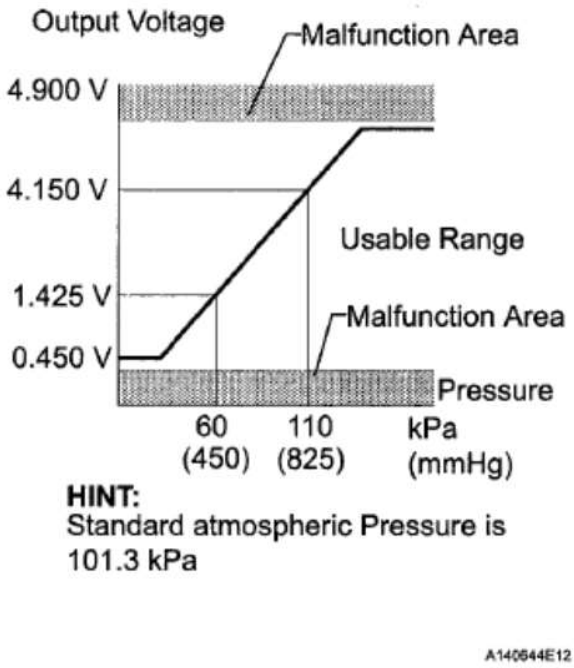


Fig. 167: Canister Pressure Sensor Specification
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

1. DTC P0451: Canister pressure sensor abnormal voltage fluctuation or being constant

   If the canister pressure sensor voltage output fluctuates rapidly for 10 seconds, the ECM stops the EVAP system monitor. The ECM interprets this as the canister pressure sensor voltage fluctuating, and stops the EVAP system monitor. The ECM then illuminates the MIL and sets the DTC.

   Alternatively, if the sensor voltage output does not change for 10 seconds, the ECM interprets this as the sensor being stuck, and stops the monitor. The ECM then illuminates the MIL and sets the DTC. (Both the malfunctions are detected by 2 trip detection logic.)

2. DTC P0452: Canister pressure sensor voltage low

   If the canister pressure sensor voltage output is below 0.45 V, 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 sets the DTC (1 trip detection logic).

3. DTC P0453: Canister pressure sensor voltage high

   If the canister pressure sensor voltage output is 4.9 V 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 sets the DTC (1 trip detection logic).

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MONITOR STRATEGY

MONITOR STRATEGY REFERENCE 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 stuck Continuous: P0451 sensor noising, P0452 and P0453
Duration	Less than 15 seconds: P0451 (Pressure sensor noise) Within 2 minutes: P0451 (Pressure sensor stuck) 0.5 seconds: P0452, P0453
MIL Operation	Immediate: P0452, P0453 2 driving cycles: P0451
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

All:

TYPICAL ENABLING CONDITIONS CHART

The monitor will run whenever these DTCs are not present	None

P0451 (Noise monitor):

TYPICAL ENABLING CONDITIONS CHART

Atmospheric pressure	70 to 110 kPa (525 to 825 mmHg)
Battery voltage	10.5 V or more
Intake air temperature	4.4 to 35°C (40 to 95°F)
EVAP pressure sensor malfunction (P0452, P0453)	Not detected
Either of the following conditions 1 or 2 is met	-
1. Engine condition	Running
2. Time after key-off	5 or 7 or 9.5 hours

P0451 (Stuck monitor):

TYPICAL ENABLING CONDITIONS CHART

Battery voltage	10.5 V or more
Intake air temperature	4.4 to 35°C (40 to 95°F)
EVAP pressure sensor malfunction (P0452, P0453)	Not detected

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Atmospheric pressure	70 to 110 kPa (525 to 825 mmHg)
Time after key-off	5 or 7 or 9.5 hours

P0452 and P0453:

TYPICAL ENABLING CONDITIONS CHART

Ignition switch	on (IG)
Battery voltage	8 V or more
Starter	OFF

TYPICAL MALFUNCTION THRESHOLDS

a. **P0451: Canister pressure sensor noise**

TYPICAL MALFUNCTION THRESHOLDS REFERENCE CHART

Frequency that EVAP pressure change is 0.3 kPa (2.25 mmHg) or more	10 times or more in 10 seconds

b. **P0451: Canister pressure sensor stuck**

TYPICAL MALFUNCTION THRESHOLDS REFERENCE CHART

EVAP pressure change during reference pressure measurement	Less than 0.65 kPa (4.876 mmHg)

c. **P0452: Canister pressure sensor low voltage**

TYPICAL MALFUNCTION THRESHOLDS REFERENCE CHART

EVAP pressure	Less than 42.11 kPa (316 mmHg)

d. **P0453: Canister pressure sensor high voltage**

TYPICAL MALFUNCTION THRESHOLDS REFERENCE CHART

EVAP pressure	More than 123.761 kPa (928 mmHg)

WIRING DIAGRAM

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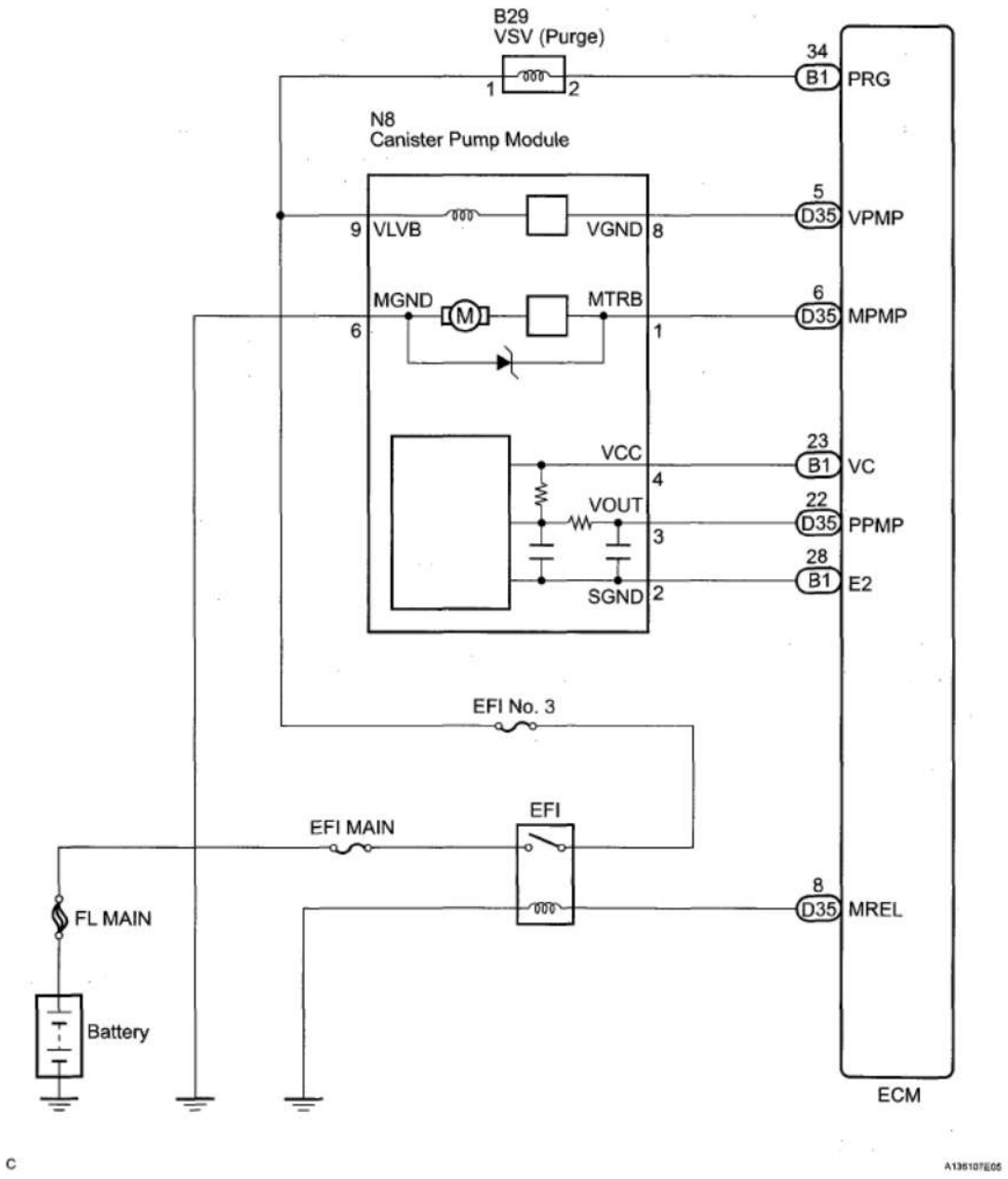


Fig. 168: Evaporative Emission Control System - Wiring Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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 on (IG) (do not start the engine).
   c. Turn the tester on.
   d. Select the following menu items: Powertrain/Engine and ECT/Trouble Code.
   e. Read DTCs.
   f. Select the following menu items: Powertrain/Engine and ECT/Data List/EVAP/Vapor Pressure Pump.
   g. Read the EVAP (Evaporative Emission) pressure displayed on the tester.

   Result

   RESULT CHART

Display (DTC Output)	Test Result	Suspected Trouble Area	Proceed to
P0451	-	Canister pressure sensor	C
P0452	Less than 45 kPa-a (336 mmHg-a)	• Wire harness/connector (ECM - Canister pressure sensor) • Canister pressure sensor • Short in ECM circuit	A
P0453	More than 120 kPa-a (900 mmHg-a)	• Wire harness/connector (ECM - Canister pressure sensor) • Canister pressure sensor • Open in ECM circuit	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)

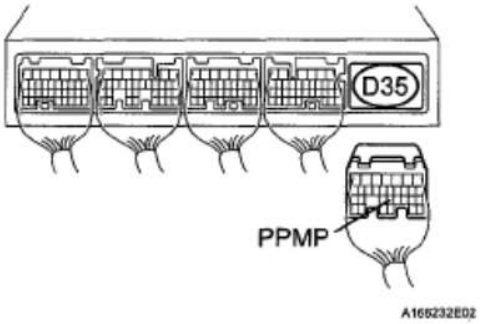


Fig. 169: Identifying ECM D35 Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Result

RESULT CHART

Tester Connection	Condition	Test Result	Suspected Trouble Area	Proceed to
D35-22 (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 more	• 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 PUMP MODULE - 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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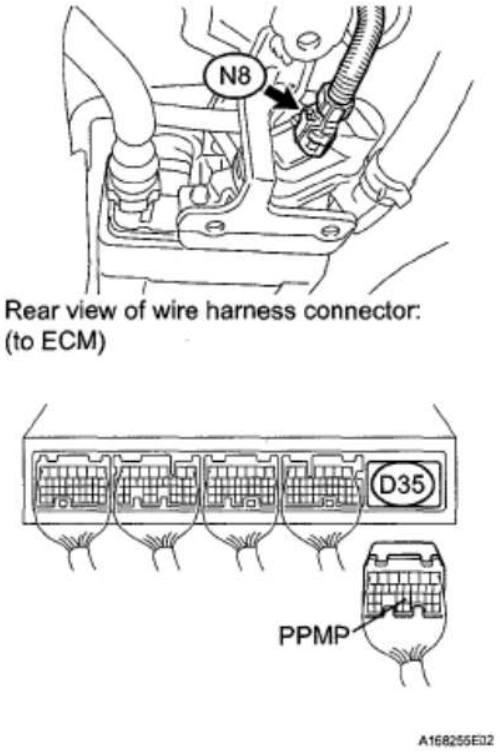


Fig. 170: Identifying Canister Pump Module And ECM Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Result

RESULT CHART

Tester Connection	Condition	Test Result	Suspected Trouble Area	Proceed to
D35-22 (PPMP) - Body ground	Always	10 kohms or more	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

4. **CHECK HARNESS AND CONNECTOR (CANISTER PUMP MODULE - ECM)**
   a. Disconnect the canister pump module connector.
   b. Turn the ignition switch on (IG).

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

Standard voltage

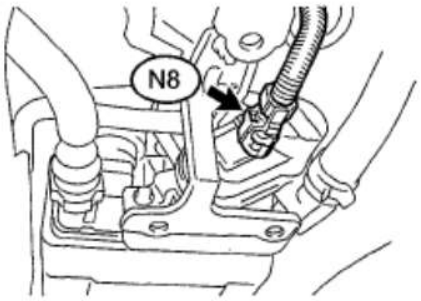
TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Switch Condition	Specified Condition
N8-4 - Body ground	Ignition switch on (IG)	4.5 to 5.5 V
N8-3 - Body ground	Ignition switch on (IG)	4.5 to 5.5 V

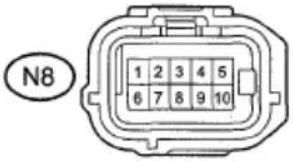
Standard resistance

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
N8-2 - Body ground	Always	100 ohms or less



Front view of wire harness connector:
(to Canister Pump Module)



A168256E02

Fig. 171: Identifying Canister Pump Module Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Result

RESULT CHART

Test Result	Suspected Trouble Area	Proceed to

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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

d. Reconnect the canister pump module connector.

A: Go to step 5

B: Go to step 6

5. **REPLACE CHARCOAL CANISTER ASSEMBLY**

a. Replace the canister assembly (See **CANISTER**).

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.

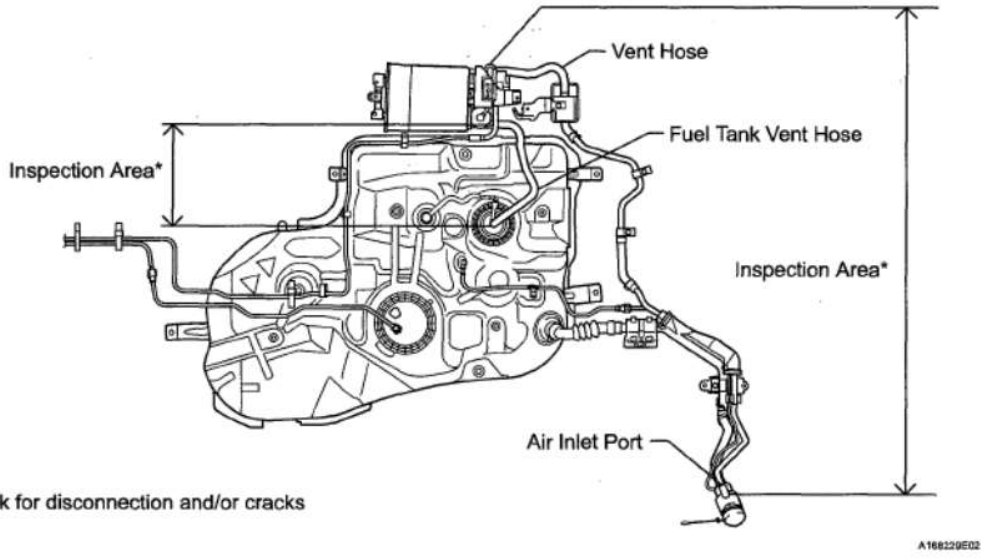


Fig. 172: Identifying Charcoal Canister Assembly Inspection Area
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

NEXT: Go to step 8

6. **REPAIR OR REPLACE HARNESS OR CONNECTOR (CANISTER PUMP MODULE - ECM)**

HINT:

If the exhaust tailpipe has been removed, go to the next step before reinstalling it.

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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 on (IG) and turn the tester on.
   c. Wait for at least 60 seconds.
   d. Select the following menu items: Powertrain/Engine and ECT/Trouble Code/Pending.

   HINT:

   If no pending DTCs are displayed on the tester, the repair has been successfully completed.

   NEXT: 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

DTCs	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 is measured. 0.02 inch leak pressure standard is measured at start and end of leak check. If stabilized pressure is higher than [second 0.02 inch leak pressure standard x 0.2], ECM determines that EVAP system has a large leak.	• Fuel tank cap (loose) • Leakage from EVAP line (Canister - Fuel tank) • Leakage from EVAP line (Purge VSV - Canister) • Leakage from canister pump module	While ignition switch off	2 trip
		Leak detection pump creates negative pressure (vacuum) in EVAP system and EVAP system pressure is measured. 0.02		While	

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P0456	EVAP small leak	inch leak pressure standard measured at start and end of leak check. If stabilized pressure is higher than second 0.02 inch leak pressure standard, ECM determines that EVAP system has a small leak.	• Leakage from fuel tank • Leakage from canister	ignition switch off	2 trip

DESCRIPTION

The circuit description can be found in the EVAP (Evaporative Emission) System (See **DESCRIPTION**).

INSPECTION PROCEDURE

Refer to the **EVAP SYSTEM** .

MONITOR DESCRIPTION

5 hours*1 after the ignition switch is turned off, the leak detection pump creates negative pressure (vacuum) in the EVAP (Evaporative Emission) system. The ECM monitors for leaks and actuator malfunctions based on the EVAP pressure.

HINT:

*1: 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.

MONITOR DESCRIPTION CHART

Sequence	Operation	Description	Duration
-	ECM activation	Activated by soak timer, 5 hours (7 or 9.5 hours) after ignition switch is turned off.	-
A	Atmospheric pressure measurement	Vent valve is turned OFF (vent) and EVAP system pressure is measured by ECM in order to register atmospheric pressure. If pressure in EVAP system is not between 70 kPa and 110 kPa (525 mmHg and 825 mmHg), ECM cancels EVAP system monitor.	10 seconds
B	First 0.02 inch leak pressure measurement	In order to determine 0.02 inch leak pressure standard, leak detection pump creates negative pressure (vacuum) through 0.02 inch orifice and then ECM checks if leak detection pump and vent valve operate normally.	60 seconds
C	EVAP system pressure measurement	Vent valve is turned ON (closed) to shut EVAP system. Negative pressure (vacuum) is created in EVAP system, and EVAP system pressure is 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 is opened and then EVAP system pressure is measured by ECM. Large increase indicates normal.	10 seconds
E	Second 0.02 inch leak pressure measurement	After second 0.02 inch leak pressure measurement, leak check is performed by comparing first and second 0.02 inch leak pressure standards. If stabilized system pressure is higher than second 0.02 inch leak pressure standard, ECM determines that EVAP system is leaking.	60 seconds
F	Final check	Atmospheric pressure is measured and then monitoring result is 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.			

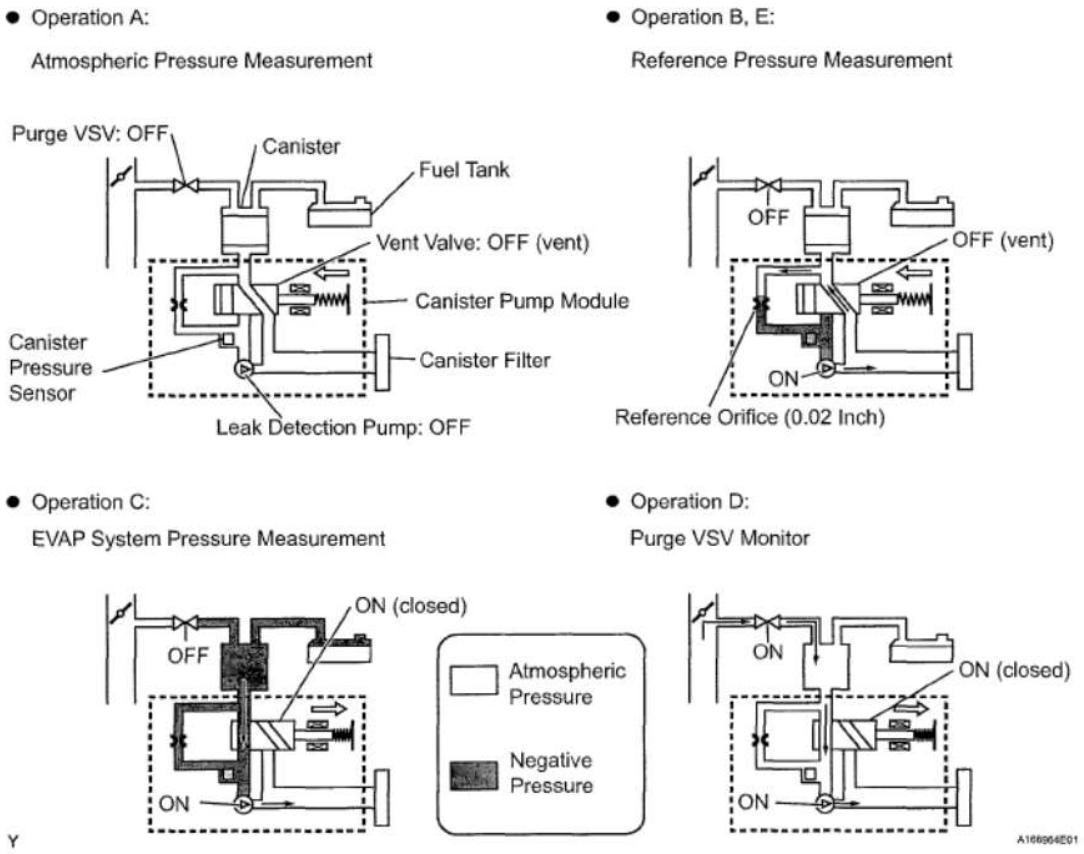


Fig. 173: Evaporative Emission Control System Operation Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

1. P0455: EVAP (Evaporative Emission) 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 0.02 inch leak pressure standard x 0.2] (near atmospheric pressure), the ECM determines that the EVAP system has a

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large leak, illuminates the MIL and sets the DTC (2 trip detection logic).

2. 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 higher than second 0.02 inch leak pressure standard, the ECM determines that the EVAP system has a small leak, illuminates the MIL and sets the DTC (2 trip detection logic).

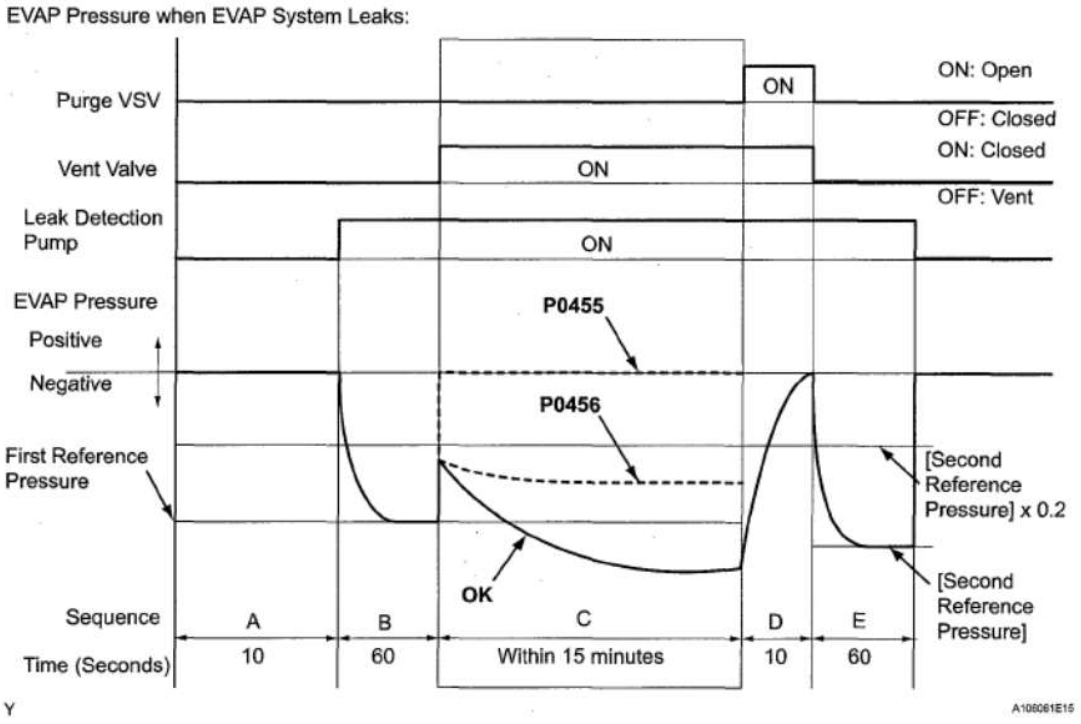


Fig. 174: EVAP Pressure Graph (EVAP System Leak)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

MONITOR STRATEGY

MONITOR STRATEGY REFERENCE CHART

Related DTCs	P0455: Gross leak detected P0456: Very small leak (0.020 inch hole) detected
Required Sensors/Components	Purge VSV and canister pump module
Frequency of Operation	Once per driving cycle
Duration	Within 15 minutes
MIL Operation	2 driving cycles
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

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TYPICAL ENABLING CONDITIONS CHART

The monitor will run whenever these DTCs are not present	None
Atmospheric pressure	70 to 110 kPa (525 to 825 mmHg)
Battery voltage	10.5 V or more
Vehicle speed	Less than 2.5 mph (4 km/h)
Ignition switch	off
Time after key-off	5 or 7 or 9.5 hours
Canister pressure sensor malfunction (P0452, P0453)	Not detected
EVAP canister purge valve	Not operated by scan tool
EVAP canister vent valve	Not operated by scan tool
EVAP leak detection pump	Not operated by scan tool
Both of the following conditions 1 and 2 are met before key-off	-
1. Duration that vehicle 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

P0455: EVAP gross leak

TYPICAL MALFUNCTION THRESHOLDS REFERENCE CHART

EVAP pressure when vacuum introduction is complete	Between reference pressure and reference pressure x 0.2

P0456: EVAP 0.02 inch leak

TYPICAL MALFUNCTION THRESHOLDS REFERENCE CHART

EVAP pressure when vacuum introduction is complete	Higher than reference pressure x 0.2

MONITOR RESULT

Refer to **CHECKING MONITOR STATUS** .

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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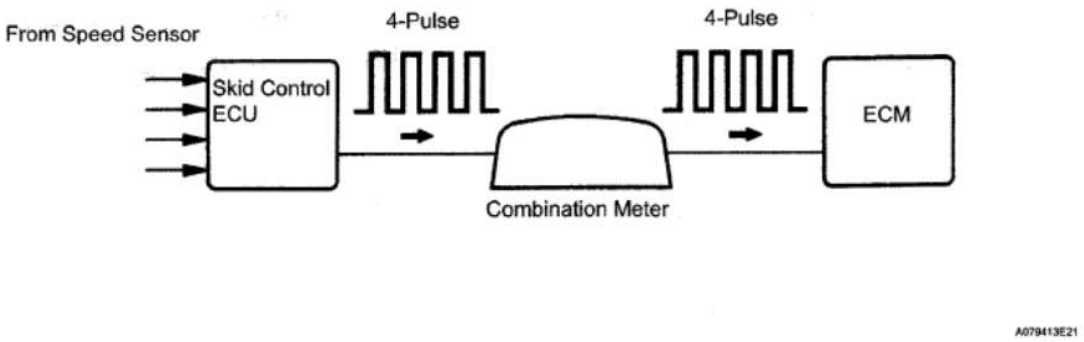


Fig. 175: Vehicle Speed Sensor Signalling Flow Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

DTC DETECTION CONDITION CHART

DTC No.	DTC Detection Condition	Trouble Area
P0500	The ECM detects the following conditions simultaneously for 2 seconds (1 trip detection logic): • No SPD (speed sensor) signal while ECM detects NC (transmission counter gear) signal is more than 300 rpm • Park/neutral position switch is OFF (When shift lever is in other than P and N positions)	• Open or short in speed sensor circuit • Speed sensor • Combination meter • ECM • Skid control ECU

MONITOR DESCRIPTION

The ECM assumes that the vehicle is being driven when the transmission counter gear indicates more than 300 rpm and over 30 seconds have passed since the park/neutral position switch was turned OFF. If thre is no signal from the vehicle speed sensor with these conditions satisfied, the ECM concludes that the vehicle speed sensor is malfunctioning. The ECM will turn on the MIL and a DTC will be set.

MONITOR STRATEGY

MONITOR STRATEGY REFERENCE CHART

Related DTCs	P0500: Vehicle speed sensor "A" pulse input error
Required Sensors/Components (Main)	Vehicle Speed Sensor (VSS), Combination meter and Skid control ECU
Required Sensors/Components (Related)	Park/neutral position switch, engine coolant temperature sensor, crankshaft position sensor and mass air flow meter
Frequency of Operation	Continuous
Duration	2 seconds
MIL Operation	Immediate
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

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TYPICAL ENABLING CONDITIONS CHART

The monitor will run whenever these DTCs are not present	None
Time after ignition switch off to on (IG)	3 seconds or more
Engine	Running
Transmission counter gear speed	300 rpm or more
Battery voltage	8 V or more
Ignition switch	on (IG)
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 (P0115, P0117, P0118, P0125)	20°C (68°F) or more
(b) Engine coolant temperature sensor fail	Not detected
(c) Time after park/neutral position switch ON to OFF	2 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

TYPICAL MALFUNCTION THRESHOLDS

TYPICAL MALFUNCTION THRESHOLDS REFERENCE CHART

Vehicle speed sensor signal	No signal

WIRING DIAGRAM

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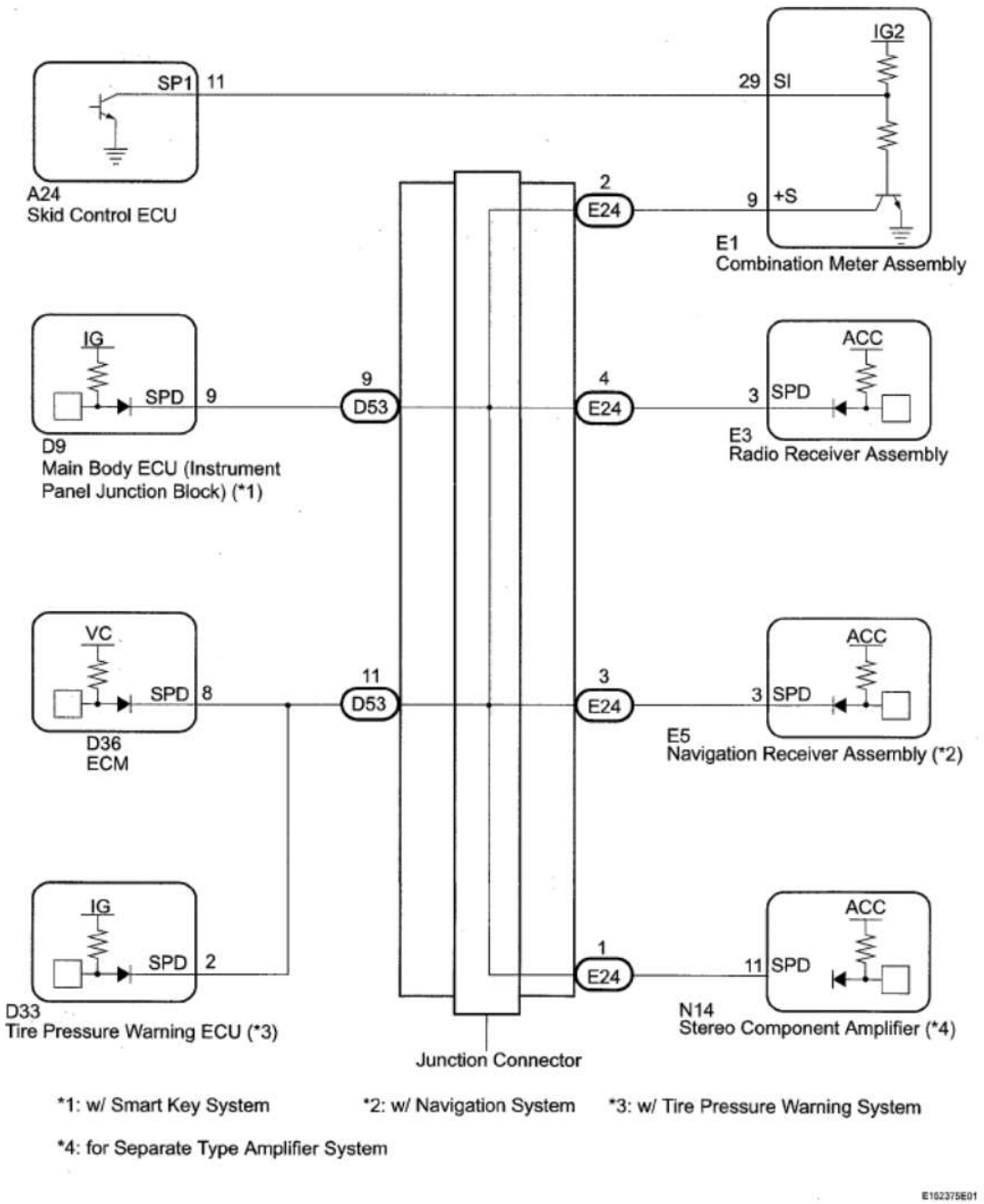


Fig. 176: Vehicle Speed Sensor - Wiring Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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 be helpful in

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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. **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	Specified Condition
E1-9 - D36-8 (SPD)	Below 1 ohms

   Standard resistance (Check for short)

   TESTER CONNECTION SPECIFIED CONDITION CHART

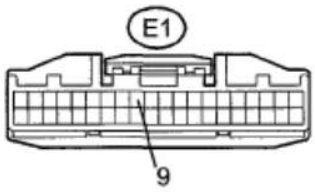
Tester Connection	Specified Condition
E1-9 or D36-8 (SPD) - Body ground	10 kohms or higher

   d. Reconnect the combination meter connector.
   e. Reconnect the ECM connector.

   NG: Go to step 3

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Front view of wire harness connector:
(to Combination Meter)



Rear view of wire harness connector:
(to ECM)

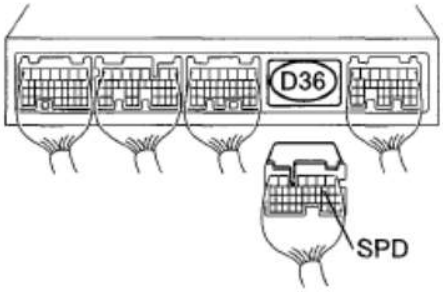


Fig. 177: Identifying Combination Meter And ECM Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

2. **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 on (IG).
   d. Turn the wheel slowly.
   e. Check the signal waveform according to the condition(s) in the table below.

ITEM CONDITION CHART

Item	Condition
Tool setting	5 V/DIV., 20 ms/DIV.
Vehicle condition	Driving at approx. 20 km/h (12 mph)

OK:

The waveform is displayed as shown in the illustration.

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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**)

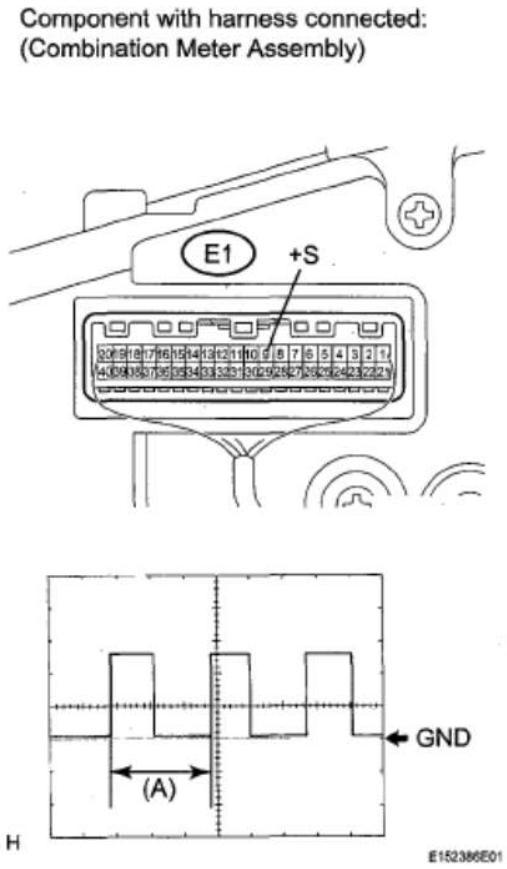


Fig. 178: Identifying Combination Meter Assembly Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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

3. **CHECK HARNESS AND CONNECTOR (ECM - JUNCTION CONNECTOR)**
   a. Disconnect the ECM connector.
   b. Disconnect the junction 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

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D53-11 - D36-8 (SPD)	Always	Below 1 ohms

d. Reconnect the ECM connector.
e. Reconnect the junction connector.

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR (ECM - JUNCTION CONNECTOR)

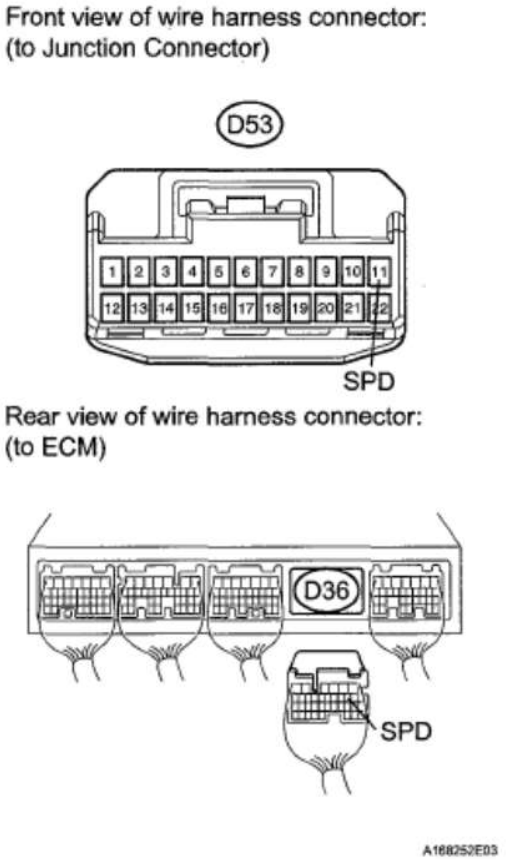


Fig. 179: Identifying Junction Connector And ECM Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: REPLACE JUNCTION CONNECTOR (JUNCTION CONNECTOR)

DTC P0504 BRAKE SWITCH "A"/"B" CORRELATION; DTC P0724 BRAKE SWITCH "B" CIRCUIT HIGH

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 the signals, which indicate the brake pedal is being depressed or released, are detected simultaneously, the ECM interprets this as a malfunction in the stop light switch and sets the DTC.

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HINT:

The normal conditions are as shown in the table below. The signals can be read using the Techstream.

BRAKE REFERENCE CHART

Signals	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	Conditions (a), (b) and (c) continue for 0.5 seconds or more (1 trip detection logic): a. Ignition switch on (IG) b. Brake pedal released c. STP signal OFF when ST1- signal OFF	• Short in stop light switch signal circuit • STOP fuse Stop light switch • ECM
P0724	The stop light switch remains ON even when the vehicle is driven in a STOP (less than 2 mph (3 km/h)) and GO (19 mph (30 km/h) or more) fashion 5 times. (2 trip detection logic)	• Short in stop light switch signal circuit • Stop light switch • 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 and the MIL comes on and the ECM stores the DTC. The vehicle must stop (less than 2 mph (3 km/h)) and go (19 mph (30 km/h) or more) 5 times for two driving cycles in order to detect a malfunction.

MONITOR STRATEGY

MONITOR STRATEGY REFERENCE CHART

Related DTCs	P0724: Stop light switch/Rationality
Required sensors/Components	Stop light switch, Vehicle speed sensor
Frequency of operation	Continuous
Duration	GO and STOP 5 times
MIL operation	2 driving cycles
Sequence of operation	None

TYPICAL ENABLING CONDITIONS

TYPICAL ENABLING CONDITIONS CHART

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The monitor will run whenever this DTC is not present	None
Ignition switch	on (IG)
Starter	OFF
Battery voltage	8 V or more
GO (Vehicle speed is 18.65 mph (30 km/h) or more)	Once
STOP (Vehicle speed is less than 1.86 mph (3 km/h))	Once

TYPICAL MALFUNCTION THRESHOLDS

TYPICAL MALFUNCTION THRESHOLDS REFERENCE CHART

Switch status ON stuck	Remain ON during GO and STOP 5 times

WIRING DIAGRAM

w/o Smart Key System:

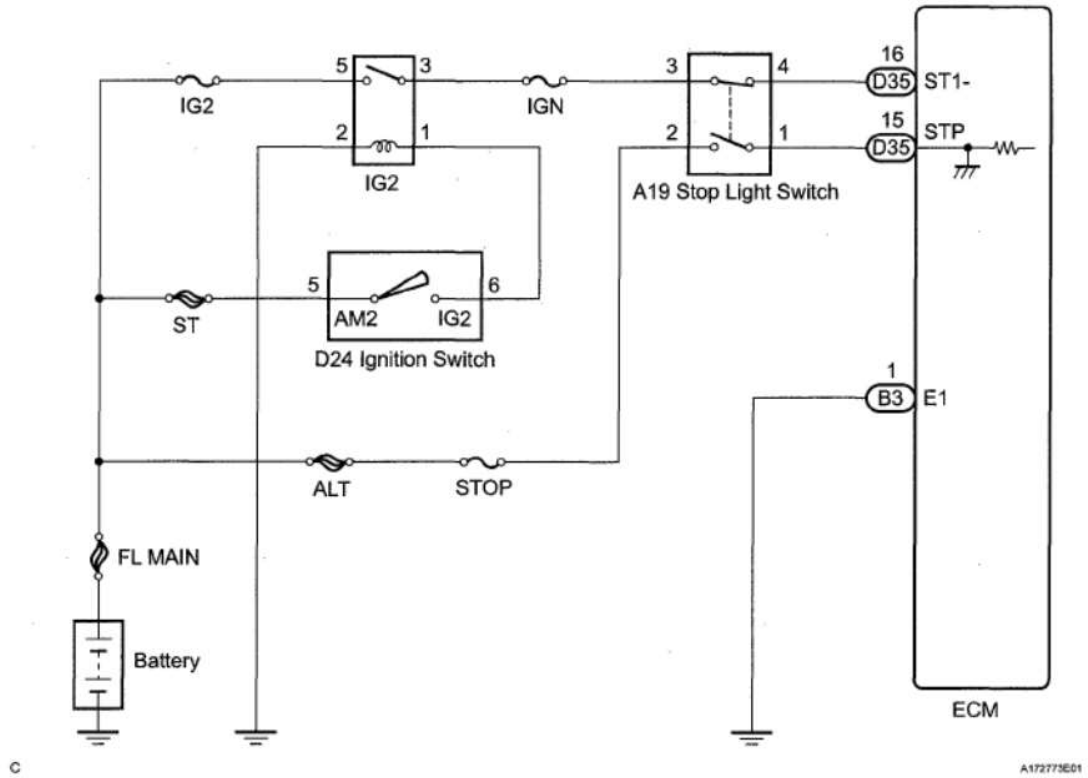


Fig. 180: Brake Switch - Wiring Diagram (1 Of 2)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

w/ Smart Key System:

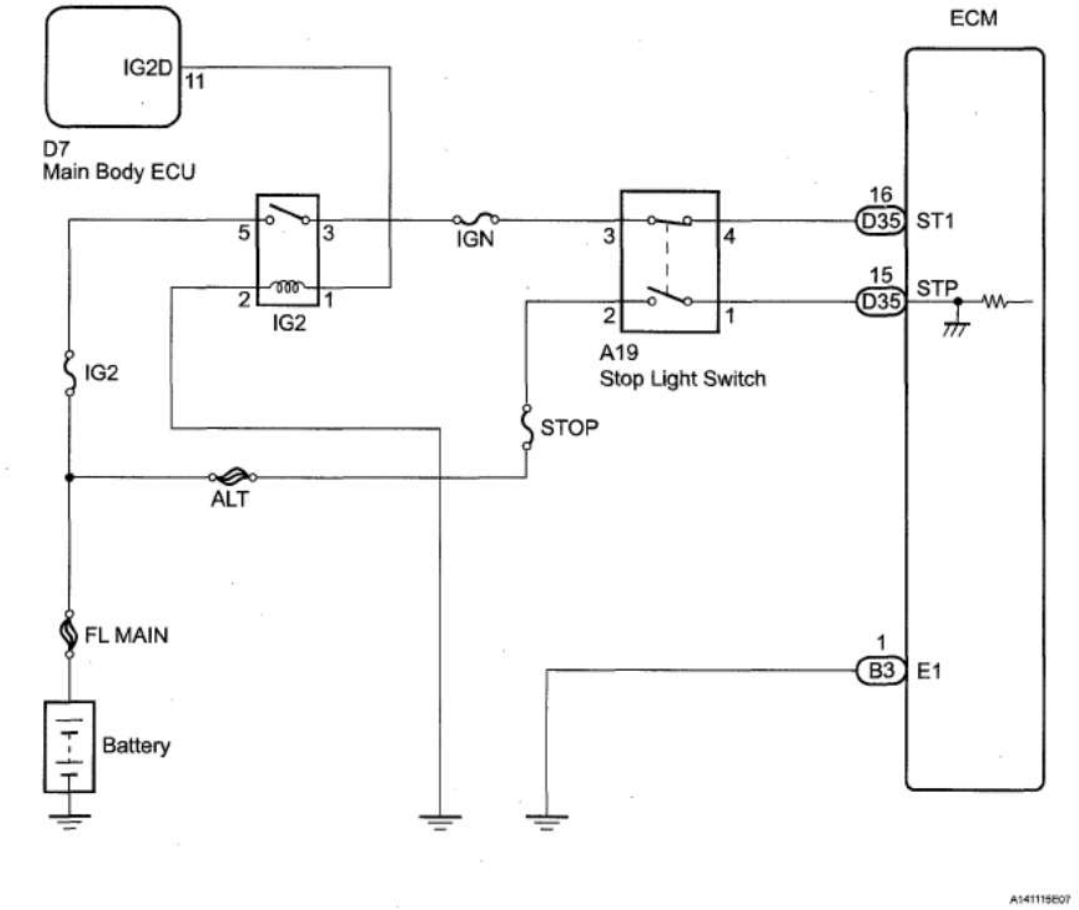


Fig. 181: Brake Switch - Wiring Diagram (2 Of 2)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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 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. **CHECK OPERATION OF STOP LIGHT**
   a. Check whether the stop lights turn on and off normally when the brake pedal is depressed and released.

      OK:

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Stop lights turn on when brake pedal is depressed.

NG: GO TO LIGHTING SYSTEM (STOP LIGHT SYSTEM) (See **PROBLEM SYMPTOMS TABLE**)

OK: Go to next step

2. **INSPECT STOP LIGHT SWITCH ASSEMBLY**
   a. Remove the stop light switch assembly.
   b. Measure the resistance according to the value(s) in the table below.

Standard resistance

TESTER CONNECTION SPECIFIED CONDITION CHART

Switch Position	Tester Connection	Specified Condition
Switch pin free	1 - 2	Below 1 ohms
Switch pin free	3 - 4	10 kohms or higher
Switch pin pushed in	1 - 2	10 kohms or higher
Switch pin pushed in	3 - 4	Below 1 ohms

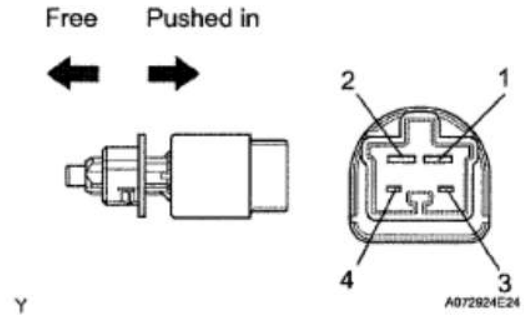


Fig. 182: Inspecting Stop Light Switch Assembly
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

   c. Reinstall the stop light switch assembly.

NG: REPLACE STOP LIGHT SWITCH ASSEMBLY

OK: Go to next step

3. **READ VALUE USING TECHSTREAM (STP SIGNAL AND ST1 - VOLTAGE)**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch on (IG) and turn the tester on.
   c. Select the following menu items: Powertrain/Engine and ECT/Data List/Stop Light Switch.
   d. Check the STP signal when the brake pedal is depressed and released.

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Standard

BRAKE PEDAL OPERATION SPECIFIED CONDITION CHART

Brake Pedal Operation	Specified Condition
Depressed	STP signal ON
Released	STP signal OFF

e. Measure the voltage according to the value(s) in the table below.

Standard voltage

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Brake Pedal Operation	Specified Condition
D35-16 (ST1-) - B3-1 (E1)	Depressed	Below 1.5 V
D35-16 (ST1-) - B3-1 (E1)	Released	7.5 to 14 V

NG: Go to step 4

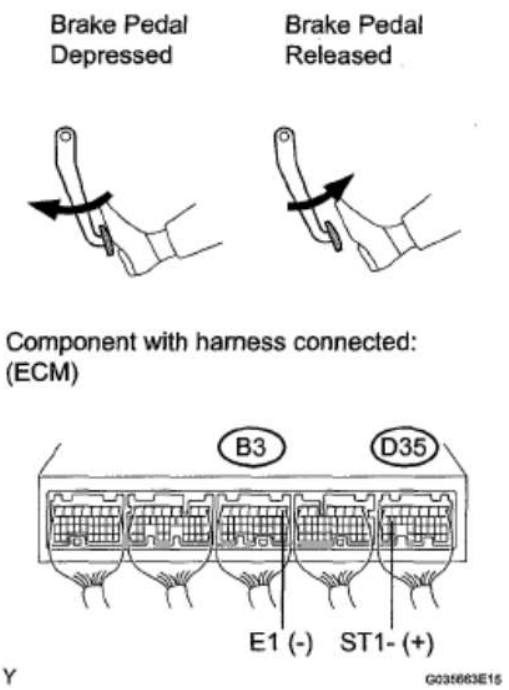


Fig. 183: Identifying ECM B3 And D35 Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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

4. **CHECK HARNESS AND CONNECTOR (STOP LIGHT SWITCH - ECM)**
   a. Disconnect the stop light switch connector.

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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
A19-1 (Stop light switch) - D35-15 (STP)	Always	Below 1 ohms
A19-4 (Stop light switch) - D35-16 (ST1-)	Always	Below 1 ohms

Check for short

TESTER CONNECTION SPECIFIED CONDITION CHART

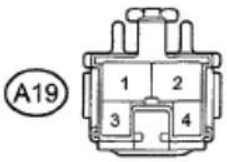
Tester Connection	Condition	Specified Condition
A19-1 (Stop light switch) or D35-15 (STP) - Body ground	Always	10 kohms or higher
A19-4 (Stop light switch) or D35-16 (ST1-) - Body ground	Always	10 kohms or higher

d. Reconnect the stop light switch connector.
e. Reconnect the ECM connector.

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR (STOP LIGHT SWITCH - ECM)

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Front view of wire harness connector:
(to Stop Light Switch)



Rear view of wire harness connector:
(to ECM)

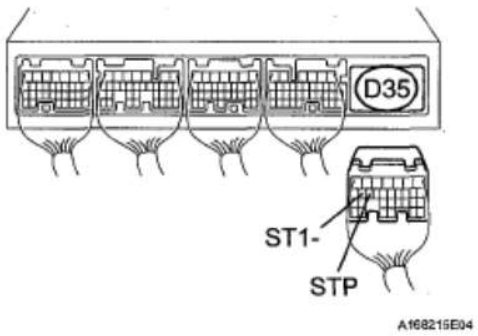


Fig. 184: Identifying Stop Light Switch Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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

DTC P0505 IDLE CONTROL SYSTEM MALFUNCTION

DESCRIPTION

The idling 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 idling 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

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P0505	Idling speed continues to vary greatly from target idling speed (2 trip detection logic)	• Electronic throttle control system • Intake system • PCV hose connection • ECM

MONITOR DESCRIPTION

The ECM monitors the idling speed and idling air flow volume to conduct Idle Speed Control (ISC). The ECM determines that the ISC system is malfunctioning if the following conditions are met:

- The learned idling air flow volume remains at the maximum or minimum volume 5 times or more in a drive cycle.
- After driving at 10 km/h (6 mph) or more, the actual engine idling speed varies from the target idling speed by between 100 rpm and 200 rpm, 5 times or more in a drive cycle.

Example:

If the actual idling speed varies from the target idling speed by more than 200 rpm* 5 times in a drive cycle, the ECM illuminates the MIL and sets the DTC.

*: Threshold idling speed varies according to the engine load.

Example:

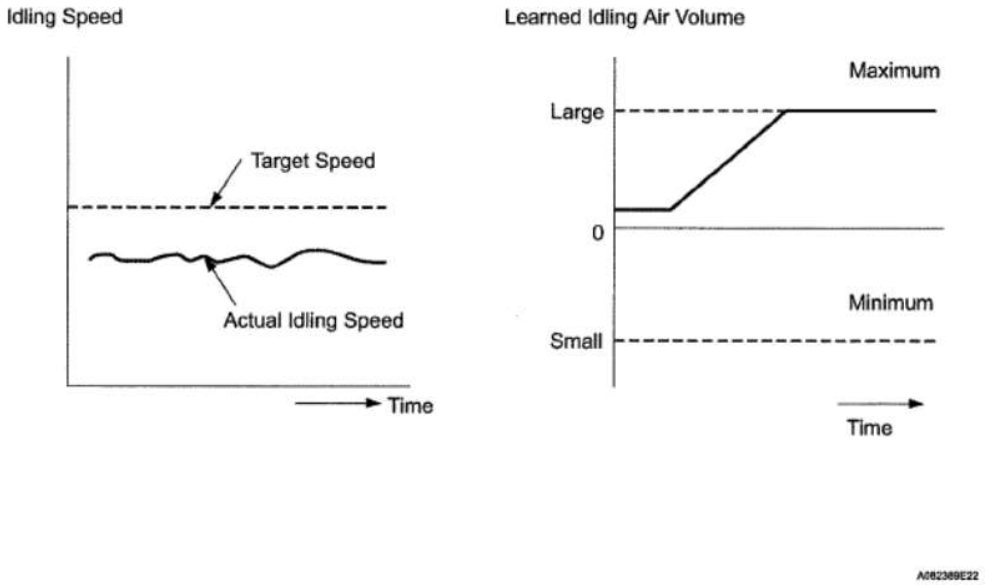


Fig. 185: Idling Speed Graph
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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MONITOR STRATEGY

MONITOR STRATEGY REFERENCE CHART

Related DTCs	P0505: ISC Function
Required Sensors/Components (Main)	Electronic throttle control system
Required Sensors/Components (Related)	Crankshaft position sensor, Engine coolant temperature sensor, and Vehicle speed sensor
Frequency of Operation	Continuous
Duration	10 minutes
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 present	P0010, P0020 (OCV bank 1, 2) P0011, P0021 (VVT system bank 1, 2 - advance) P0012, P0022 (VVT system bank 1, 2 - retard) P0013, P0023 (Exhaust OCV bank 1, 2) P0014, P0024 (Exhaust VVT system bank 1, 2 - advance) P0015, P0025 (Exhaust VVT system bank 1,2 - retard) P0016, P0018 (VVT system bank 1, 2 - misalignment) P0017, P0019 (Exhaust VVT system bank 1, 2 - misalignment) P0031, P0032, P0051, P0052 (A/F sensor heater) P0100, P0102, P0103 (MAF meter) P0115, P0117, P0118 (ECT sensor) P0120, P0121, P0122, P0123, P0220, P0222, P0223, P2135 (TP sensor) P0125 (Insufficient ECT for closed loop) P0171, P0172, P0174, P0175 (Fuel system) P0301, P0302, P0303, P0304, P0305, P0306 (Misfire) P0335 (CKP sensor) P0340, P0342, P0343, P0345, P0347, P0348 (VVT sensor) P0351, P0352, P0353, P0354, P0355, P0356 (Igniter) P0365, P0367, P0368, P0390, P0392, P0393 (Exhaust VVT sensor) P0450, P0451, P0452, P0453 (EVAP system) P0500 (Vehicle speed sensor) P2195, P2196, P2197, P2198 (A/F sensor - rationality) P2237, P2240 (A/F sensor - open) P2238, P2241, P2252, P2255 (A/F sensor - low impedance) P2239, P2242, P2253, P2256 (A/F sensor - high impedance)

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	P2A00, P2A03 (A/F sensor - slow response)
Engine	Running

TYPICAL MALFUNCTION THRESHOLDS

TYPICAL MALFUNCTION THRESHOLDS REFERENCE CHART

Either of following conditions is met	Condition 1 or 2
1. Frequency that both of the following conditions (a) and (b) met	5 times or more
(a) Engine RPM - target engine RPM	Below -100 rpm, or 150 rpm or more
(b) Vehicle condition	Stop after vehicle was driven by 6.25 mph (10.06 km/h) or more
2. Frequency that both of the following conditions (a) and (b) are met	Once
(a) Engine RPM - target engine RPM	Below -100 rpm, or 150 rpm or more
(b) IAC flow rate learning valve	1.3 L/sec. or less, or 8.5 L/sec. or more

INSPECTION PROCEDURE

HINT:

- The following conditions may also cause DTC P0505 to be set:
  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 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. **CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P0505)**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch on (IG).
   c. Turn the tester on.
   d. Select the following menu items: Powertrain/Engine and ECT/Trouble Code.
   e. Read the DTCs.

   Result

   RESULT CHART

Display (DTC Output)	Proceed to
P0505	A

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P0505 and other DTCs	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**

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.

OK:

No leakage from intake system.

NG: REPAIR OR REPLACE INTAKE SYSTEM

OK: Go to next step

4. **CHECK THROTTLE VALVE**
   a. Check the throttle valve condition.

OK:

No foreign objects between the throttle valve and housing.

NG: REPLACE THROTTLE BODY (See **THROTTLE BODY**)

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

DTC P050A COLD START IDLE AIR CONTROL SYSTEM PERFORMANCE

DESCRIPTION

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This monitor will run when the engine is started at -10 to 50°C (14 to 122°F) of the engine coolant temperature. The DTC will set after the engine idling 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 lower than 50°C (122°F) of the engine coolant temperature, the ECM measures the accumulated mass air flow at the engine idling. If it does not reach the criteria within 10 seconds, the ECM interprets this as a malfunction. The MIL is illuminated and a DTC is set when the malfunction is detected in consecutive driving cycles (2 trip detection logic).

The ETCS (Electrical Throttle Control System) controls the idle speed. The ETCS 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 negative battery terminal is disconnected during inspection or repairs, the ISC (Idle Speed Control) learned values are cleared. ISC learning is performed when the engine has been warmed up and idled for 5 minutes because this DTC cannot be set after the ISC learned values cleared.

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 assembly • Mass air flow meter • Intake system • PCV hose connections • VVT system • Air cleaner filter element • ECM

MONITOR DESCRIPTION

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P050A Detection Logic:

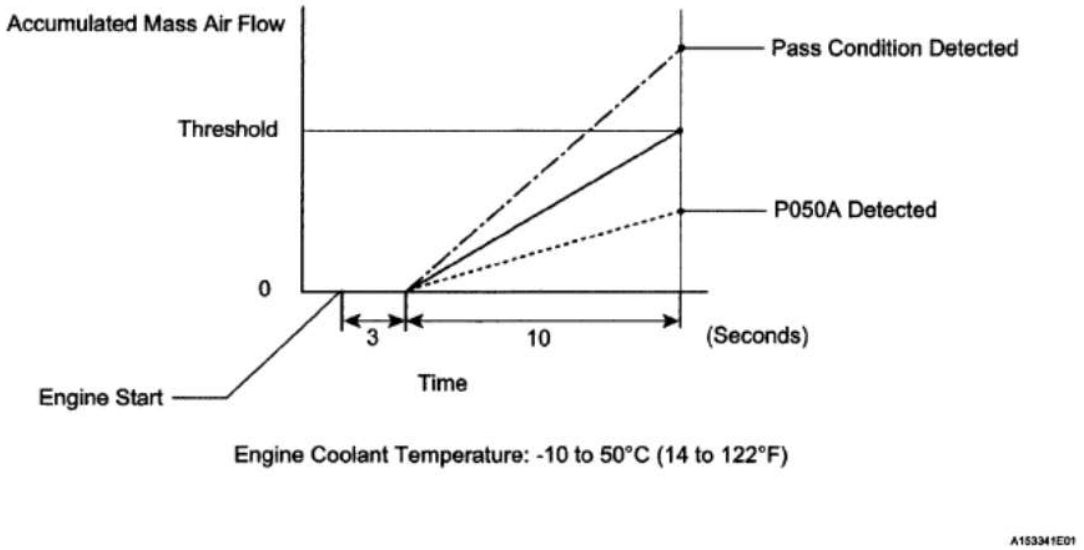


Fig. 186: Engine Coolant Temperature Graph (P050A Detection Logic)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

MONITOR STRATEGY

MONITOR STRATEGY REFERENCE CHART

Related DTCs	P050A: Idle speed control problem at cold
Required Sensors/Components (Main)	Mass air flow meter
Required Sensors/Components (Related)	Engine Coolant Temperature (ECT) sensor, Throttle position sensor, Vehicle speed 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

	P0010, P0020 (OCV bank 1, 2) P0011, P0021 (VVT system bank 1, 2 - advance) P0012, P0022 (VVT system bank 1,2 - retard) P0013, P0023 (Exhaust OCV bank 1, 2) P0014, P0024 (Exhaust VVT system bank 1,2 - advance) P0015, P0025 (Exhaust VVT system bank 1, 2 - retard)

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The monitor will run whenever these DTCs are not present	P0016, P0018 (VVT system bank 1,2 - misalignment) P0017, P0019 (Exhaust VVT system bank 1,2 - misalignment) P0100, P0102, P0103 (MAF meter) P0115, P0117, P0118 (ECT sensor) P0120, P0121, P0122, P0123, P0220, P0222, P0223, P2135 (TP sensor) P0125 (Insufficient ECT for closed loop) P0171, P0172, P0174, P0175 (Fuel system) P0301, P0302, P0303, P0304, P0305, P0306 (Misfire) P0335 (CKP sensor) P0340, P0342, P0343, P0345, P0347, P0348 (VVT sensor) P0351, P0352, P0353, P0354, P0355, P0356 (Igniter) P0365, P0367, P0368, P0390, P0392, P0393 (Exhaust VVT sensor) P0500 (Vehicle speed sensor) P2195, P2196, P2197, P2198 (A/F sensor - rationality) P2237, P2240 (A/F sensor - open) P2238, P2241, P2252, P2255 (A/F sensor - low impedance) P2239, P2242, P2253, P2256 (A/F sensor - high impedance) P2A00, P2A03 (A/F sensor - slow response)
Battery voltage	8 V or more
Time after engine start	3 seconds or more
Starter	OFF
ECT at engine start	-10°C (14°F) or more
ECT	-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 more

TYPICAL MALFUNCTION THRESHOLDS

TYPICAL MALFUNCTION THRESHOLDS REFERENCE CHART

Accumulated mass air flow	Varies with ECT (Example: Less than 18 g)

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

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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. **CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P050A)**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch on (IG).
   c. Turn the tester on.
   d. Select the following the menu items: Powertrain/Engine and ECT/Trouble Codes.
   e. Read the DTCs.

   Result

   RESULT CHART

Display (DTC Output)	Proceed to
P050A	A
P050A and other DTCs	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.

   a. Connect the Techstream to the DLC3.
   b. Start the engine.
   c. Turn the tester on.
   d. Select the following menu items: Powertrain/Engine and ECT/Data List/A/F Control System/Short FT #1 and Long FT #1, or Short FT #2 and Long FT #2.
   e. Read the values displayed on the tester at engine idles.
   f. Add together the Short FT #1 and Long FT #1, or Short FT #2 and Long FT #2 values to obtain the total Fuel Trim.

   OK:

   Total of Short FT #1 and Long FT #1, or Short FT #2 and Long FT #2 values is between -20% and 20%.

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Result

RESULT CHART

Result	Proceed to
NG	A
OK	B

B: Go to step 12

A: Go to next step

3. **PERFORM ACTIVE TEST USING TECHSTREAM (OPERATE OCV)**
   a. Connect Techstream to the DLC3.
   b. Start the engine and turn the tester on.
   c. Warm up the engine.
   d. Select the following menu items: Powertrain/Engine and ECT/Active Test/Control the VVT System (Bank 1) or Control the VVT System (Bank 2).
   e. Check the engine speed while operating the Oil Control Valve (OCV) using the tester.

   OK

   TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Operation	Specified Condition
OCV OFF	Normal engine speed
OCV ON	Engine idles roughly or stalls (soon after OCV switched from OFF to ON)

   NG: Go to step 8

   OK: Go to next step

4. **CHECK PCV HOSE CONNECTIONS**

   OK:

   PCV hose is connected correctly and is not damaged.

   NG: Go to step 9

   OK: Go to next step

5. **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: Go to step 10

OK: Go to next step

6. **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:

   Air cleaner filter element is not excessively contaminated with dirt or oil.

   NG: Go to step 11

   OK: Go to next step

7. **REPLACE MASS AIR FLOW METER**
   a. Replace the mass air flow meter (See **REMOVAL**).

   NEXT: Go to step 15

8. **CHECK AND REPAIR VVT SYSTEM**

   NEXT: Go to step 15

9. **REPAIR OR REPLACE PCV HOSE**

   NEXT: Go to step 15

10. **REPAIR OR REPLACE INTAKE SYSTEM**

    NEXT: Go to step 15

11. **REPLACE AIR CLEANER FILTER ELEMENT SUB-ASSEMBLY**

    NEXT: Go to step 15

12. **CHECK THROTTLE VALVE**
    a. Check for deposits around the throttle valve and throttle valve condition.

    OK:

    No deposits around throttle valve and throttle valve moves smoothly.

    NG: Go to step 14

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OK: Go to next step

13. **REPLACE ECM**
    a. Replace the ECM (See **REMOVAL**).

    NEXT: Go to step 15

14. **REPAIR OR REPLACE THROTTLE BODY ASSEMBLY**

    NEXT: Go to step 15

15. **CHECK WHETHER DTC OUTPUT RECURS (DTC P050A)**

    NOTE: In this operation, the engine must be cold (the same level as the engine coolant temperature recorded in the freeze frame data).

    a. Connect the Techstream to the DLC3.
    b. Turn the ignition switch on (IG).
    c. Turn the tester on.
    d. Clear the DTCs (See **DTC CHECK/CLEAR**).
    e. Switch the ECM from normal mode to check mode using the tester (See **CHECK MODE PROCEDURE**).
    f. Start the engine to idle for a minute.

    OK:

    Stable fast idling.

    g. Read the DTCs.

    OK:

    No DTC output.

    NEXT: END

DTC P050B COLD START IGNITION TIMING PERFORMANCE

DESCRIPTION

This monitor will run when the engine is started at -10 to 50°C (14 to 122°F) of the engine coolant temperature. The DTC will set after the engine idling 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 lower than 50°C (122°F) of the engine coolant temperature, the ECM measures the accumulated mass air flow at the engine

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idling. If it does not reach the criteria within 10 seconds, the ECM interprets this as a malfunction. The MIL is illuminated and a DTC is set when the malfunction is detected in consecutive driving cycles (2 trip detection logic).

The ETCS (Electrical Throttle Control System) controls the idle speed. The ETCS 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 negative battery terminal is disconnected during inspection or repairs, the ISC (Idle Speed Control) learned values are cleared. ISC learning is performed when the engine has been warmed up and idled for 5 minutes because this DTC cannot be set after the ISC learned values cleared.

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 assembly • Mass air flow meter • Intake system • PCV hose connections • VVT system • Air cleaner filter element • ECM

MONITOR DESCRIPTION

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P050B Detection Logic:

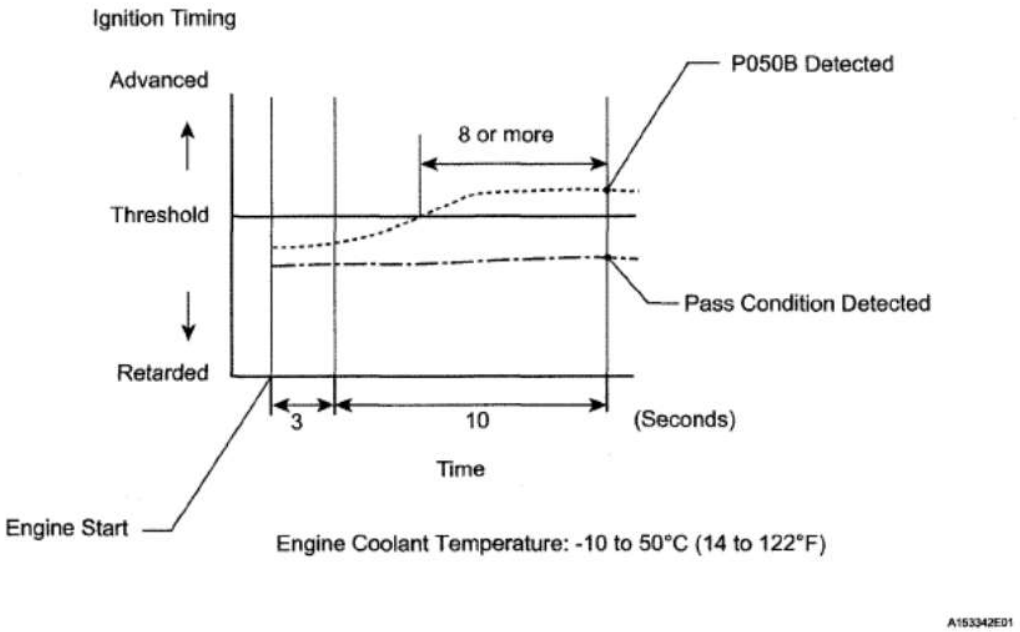


Fig. 187: Engine Coolant Temperature Graph (P050B Detection Logic)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

MONITOR STRATEGY

MONITOR STRATEGY REFERENCE CHART

Related DTCs	P050B: Idle ignition timing problem at cold
Required Sensors/Components (Main)	Mass air flow meter
Required Sensors/Components (Related)	Engine Coolant Temperature (ECT) sensor, Throttle position sensor, Vehicle speed 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

	P0010, P0020 (OCV bank 1, 2) P0011, P0021 (VVT system bank 1,2 - advance) P0012, P0022 (VVT system bank 1,2 - retard) P0013, P0023 (Exhaust OCV bank 1, 2) P0014, P0024 (Exhaust VVT system bank 1,2 - advance) P0016, P0018 (VVT system bank 1,2 - misalignment)

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The monitor will run whenever these DTCs are not present	P0017, P0019 (Exhaust VVT system bank 1, 2 - misalignment) P0100, P0102, P0103 (MAF meter) P0115, P0117, P0118 (ECT sensor) P0120, P0121, P0122, P0123, P0220, P0222, P0223, P2135 (TP sensor) P0125 (Insufficient ECT for closed loop) P0171, P0172, P0174, P0175 (Fuel system) P0301, P0302, P0303, P0304, P0305, P0306 (Misfire) P0335 (CKP sensor) P0340, P0342, P0343, P0345, P0347, P0348 (VVT sensor) P0351, P0352, P0353, P0354, P0355, P0356 (Igniter) P0500 (Vehicle speed sensor) P2195, P2196, P2197, P2198 (A/F sensor - rationality) P2238, P2241, P2252, P2255 (A/F sensor - low impedance) P2239, P2242, P2253, P2256 (A/F sensor - high impedance) P2A00, P2A03 (A/F sensor - slow response)
Battery voltage	8 V or more
Time after engine start	3 seconds or more
Starter	OFF
ECT at engine start	-10°C (14°F) or more
ECT	-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 more

TYPICAL MALFUNCTION THRESHOLDS

TYPICAL MALFUNCTION THRESHOLDS REFERENCE CHART

Accumulated time when ignition timing retard is cut off	5 seconds or more

INSPECTION PROCEDURE

HINT:

- DTC P050B may be set when the engine shows the symptom as listed below. If necessary, check the trouble area as listed below.

FACTOR SYMPTOMS CHART

Symptoms	Factor	Trouble Area
		• Engine oil deterioration

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Low idle speed at engine cold.	Excessive engine friction	• Drive belt tension • A/C compressor • Generator • P/S pump
Rough idle at engine cold.	Abnormal 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 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. **CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P050B)**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch on (IG).
   c. Turn the tester on.
   d. Select the following the menu items: Powertrain/Engine and ECT/Trouble Codes.
   e. Read the DTCs.

   Result

   RESULT CHART

Display (DTC Output)	Proceed to
P050B	A
P050B and other DTCs	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. Start the engine.
   c. Turn the tester on.

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d. Select the following menu items: Powertrain/Engine and ECT/Data List/A/F Control System/Short FT #1 and Long FT #1, or Short FT #2 and Long FT #2.
e. Read the values displayed on the tester at engine idles.
f. Add together the Short FT #1 and Long FT #1, or Short FT #2 and Long FT #2 values to obtain the total Fuel Trim.

OK:

Total of Short FT #1 and Long FT #1, or Short FT #2 and Long FT #2 values is between -20% and 20%.

Result

RESULT CHART

Result	Proceed to
NG	A
OK	B

B: Go to step 12

A: Go to next step

3. **PERFORM ACTIVE TEST USING TECHSTREAM (OPERATE OCV)**
   a. Connect the Techstream to the DLC3.
   b. Start the engine and turn the tester on.
   c. Warm up the engine.
   d. Select the following menu items: Powertrain/Engine and ECT/Active Test/Control the VVT System (Bank 1) or Control the VVT System (Bank 2).
   e. Check the engine speed while operating the Oil Control Valve (OCV) using the tester.

OK

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Operation	Specified Condition
OCV OFF	Normal engine speed
OCV ON	Engine idles roughly or stalls (soon after OCV switched from OFF to ON)

NG: Go to step 8

OK: Go to next step

4. **CHECK PCV HOSE CONNECTIONS**

OK:

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PCV hose is connected correctly and is not damaged.

NG: Go to step 9

OK: Go to next step

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

      OK:

      No leakage from intake system.

      NG: Go to step 10

      OK: Go to next step

6. **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:

      Air cleaner filter element is not excessively contaminated with dirt or oil.

      NG: Go to step 11

      OK: Go to next step

7. **REPLACE MASS AIR FLOW METER**
   a. Replace the mass air flow meter (See **REMOVAL**).

      NEXT: Go to step 15

8. **CHECK AND REPAIR VVT SENSOR**

   NEXT: Go to step 15

9. **REPAIR OR REPLACE PCV HOSE**

   NEXT: Go to step 15

10. **REPAIR OR REPLACE INTAKE SYSTEM**

    NEXT: Go to step 15

11. **REPLACE AIR CLEANER FILTER ELEMENT SUB-ASSEMBLY**

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NEXT: Go to step 15

12. **CHECK THROTTLE VALVE**
    a. Check for deposits around the throttle valve and throttle valve condition.

    OK:

    No deposits around throttle valve and throttle valve moves smoothly.

    NG: Go to step 14

    OK: Go to next step

13. **REPLACE ECM**
    a. Replace the ECM (See **REMOVAL**).

    NEXT: Go to step 15

14. **REPAIR OR REPLACE THROTTLE BODY ASSEMBLY**
15. **CHECK WHETHER DTC OUTPUT RECURS (DTC P050B)**

    NOTE: In this operation, the engine must be cold (the same level as the engine coolant temperature recorded in the freeze frame data).

    a. Connect the Techstream to the DLC3.
    b. Turn the ignition switch on (IG).
    c. Turn the tester on.
    d. Clear the DTCs (See **DTC CHECK/CLEAR**).
    e. Switch the ECM from normal mode to check mode using the tester (See **CHECK MODE PROCEDURE**).
    f. Start the engine to idle for a minute.

    OK:

    Stable fast idling.

    g. Read the DTCs.

    OK:

    No DTC outputs.

    NEXT: END

DTC P0560 SYSTEM VOLTAGE

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2009 Toyota Highlander Limited
2009 ENGINE PERFORMANCE Engine Control System (2GR-FE) - Highlander

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 minimum level, these memories are 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 sets the DTC.

DTC DETECTION CONDITION CHART

DTC No.	DTC Detection Condition	Trouble Area
P0560	Open in ECM back up power source circuit (1 trip detection logic)	• Open in back up power source circuit • EFI No. 1 fuse • ECM

HINT:

If DTC P0560 is set, the ECM does not store other DTCs.

MONITOR STRATEGY

MONITOR STRATEGY REFERENCE 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

The monitor will run whenever these DTCs are not present	None
Stand-by RAM	Initialized

TYPICAL MALFUNCTION THRESHOLDS

TYPICAL MALFUNCTION THRESHOLDS REFERENCE CHART

ECM power source	Less than 3.5 V

WIRING DIAGRAM

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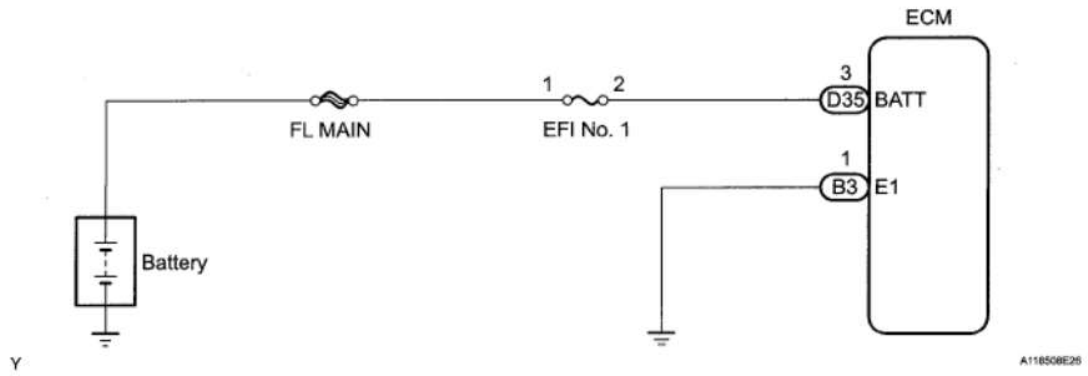


Fig. 188: System Voltage - Wiring Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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 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. **CHECK FUSE (EFI NO. 1 FUSE)**
   a. Remove the EFI No. 1 fuse 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
EFI No. 1 fuse	Always	Below 1 ohms

   c. Reinstall the EFI No. 1 fuse.

   NG: REPLACE FUSE (EFI NO. 1 FUSE)

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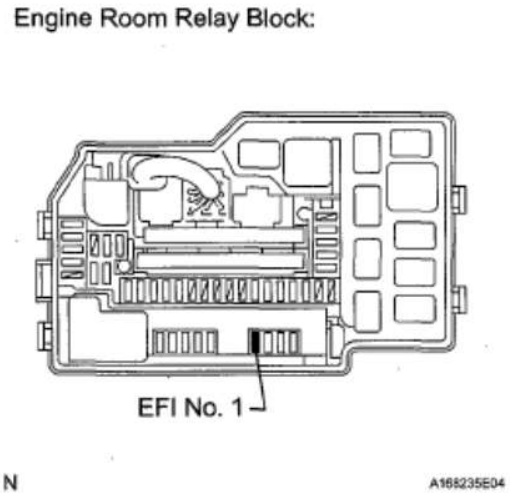


Fig. 189: Identifying EFI No. 1 Fuse
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

2. **INSPECT ECM (BATT VOLTAGE)**
   a. Measure the voltage according to the value(s) in the table below.

Standard voltage

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Specified Condition
D35-3 (BATT) - B3-1 (E1)	11 to 14 V

NG: Go to step 3

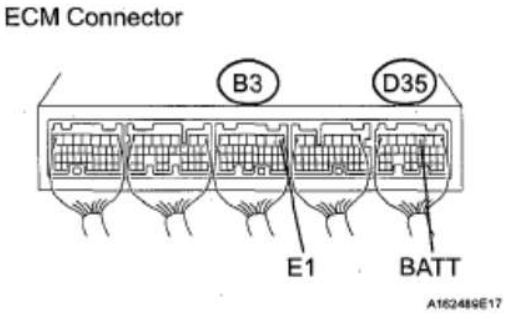


Fig. 190: Identifying ECM B3 And D35 Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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

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3. **CHECK HARNESS AND CONNECTOR (ECM - EFI NO. 1 FUSE)**
   a. Check the harness and the connector between the EFI No. 1 fuse and ECM.
      1. Remove the EFI No. 1 fuse from the engine room relay block.
      2. Disconnect the ECM connector.
      3. 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
EFI No. 1 fuse (2) - D35-3 (BATT)	Always	Below 1 ohms

      Check for short

      TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
EFI No. 1 fuse (2) or D35-3 (BATT) - Body ground	Always	10 kohms or higher

      4. Reconnect the ECM connector.
      5. Reinstall the EFI No. 1 fuse.

      NG: REPAIR OR REPLACE HARNESS OR CONNECTOR (ECM - EFI NO. 1 FUSE)

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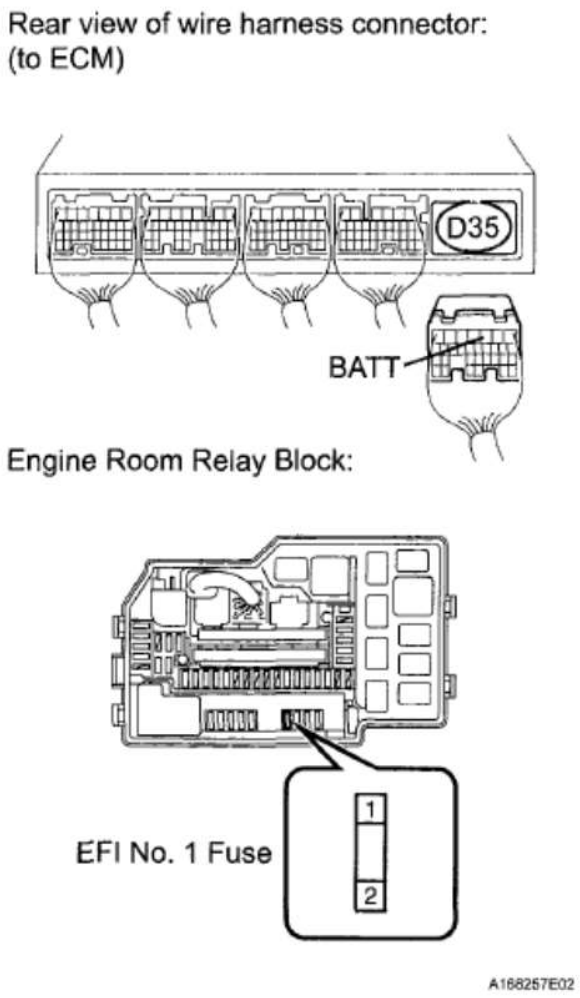


Fig. 191: Identifying ECM Connector Terminals And EFI No. 1 Fuse
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: CHECK AND REPLACE ENGINE ROOM RELAY BLOCK

DTC P0604 INTERNAL CONTROL MODULE RANDOM ACCESS MEMORY (RAM) ERROR

DESCRIPTION

The ECM continuously monitors its own internal memory status, internal circuits, and output signals transmitted to the throttle actuator. This self-check ensures that the ECM is functioning properly. If any malfunction is detected, the ECM sets the appropriate DTC and illuminates the MIL. The ECM memory status is diagnosed by internal mirroring of the main CPU and the sub CPU to detect Random Access Memory (RAM) errors. The two CPUs also perform continuous mutual monitoring. The ECM illuminates the MIL and sets a DTC if: 1) outputs from the two CPUs are different or deviate from the standards, 2) the signals sent to the throttle actuator deviate from the standards, 3) a malfunction is found in the throttle actuator supply voltage, and 4) any other ECM malfunction is found.

DTC DETECTION CONDITION CHART

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DTC No.	DTC Detection Condition	Trouble Area
P0604	ECM internal error (1 trip detection logic)	ECM

MONITOR STRATEGY

MONITOR STRATEGY REFERENCE CHART

Related DTCs	P0604: ECM RAM error
Required Sensors/Components (Main)	ECM
Required Sensors/Components (Related)	-
Frequency of Operation	Continuous
Duration	6 times
MIL Operation	Immediate
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

TYPICAL ENABLING CONDITIONS CHART

The monitor runs whenever following DTCs not present	None

TYPICAL MALFUNCTION THRESHOLDS

ECM RAM errors:

TYPICAL MALFUNCTION THRESHOLDS REFERENCE CHART

RAM mirror check	Fail

INSPECTION PROCEDURE

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 DTC OUTPUT (DTC P0604)**
   a. Clear the DTC.
   b. Turn the ignition switch OFF.
   c. Disconnect the battery negative terminal and wait for 1 minute.
   d. Connect the battery negative terminal.
   e. Turn the ignition switch on (IG).
   f. Select the following menu items: Powertrain/Engine and ECT/Trouble Codes.
   g. Read the DTCs.

   OK:

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P0604 is not present.

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

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

DTC P0606 ECM/PCM PROCESSOR

DESCRIPTION

The ECM continuously monitors its internal processors (CPUs), heated oxygen sensor transistors. This self-check ensures that the ECM is functioning properly.

DTC DETECTION CONDITION CHART

DTC	DTC Setting Condition	Trouble Area
P0606	• ECM CPUs malfunction • Heated oxygen sensor transistors malfunction	• Exhaust gas leak • Heated oxygen Sensor • ECM

MONITOR STRATEGY

MONITOR STRATEGY REFERENCE CHART

Related DTC	P0606: ECM range check
Required sensors/Components (main)	ECM
Required sensors/Components (sub)	Accelerator pedal position sensor, throttle position sensor, Brake switch, Cruise control, heated oxygen sensor
Frequency of Operation	Continuous
Duration	60 seconds
MIL Operation	Immediate
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

TYPICAL ENABLING CONDITIONS CHART

The monitor runs whenever the following DTCs are not present	None
Engine	Running
Estimated heated oxygen sensor temperature	450 to 800°C (842 to 1472°F)

TYPICAL MALFUNCTION THRESHOLDS

TYPICAL MALFUNCTION THRESHOLDS REFERENCE CHART

Difference of main accelerator pedal position and sub accelerator pedal position	0.3 V or more

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Difference of main throttle position and sub throttle position	0.3 V or more
Difference of main brake switch signal and sub brake switch signal	Different
Cruise control	Fail
Heated oxygen sensor transistors	Fail

INSPECTION PROCEDURE

1. **CHECK ANY OTHER DTCS OUTPUT**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch to the ON position.
   c. Turn the tester on.
   d. Enter the following menus: Powertrain/Engine and ECT/Trouble Codes.
   e. Read the DTCs.

   Result

   RESULT CHART

Result	Proceed to
DTC P0606 is output	A
DTC P0606 and P0136, P0137, P0138, P0156, P0157 or P0158 are output	B

   A: Go to step 3

   B: Go to next step

2. **INSPECT DTC (P0136, P0137, P0138, P0156, P0157 OR P0158)**
   a. Inspect the P0136, P0137, P0138, P0156, P0157 or P0158 flow chart.

   HINT:

   - If P0136 or P0156 is output, troubleshoot for that DTC first (See **CONFIRMATION DRIVING PATTERN**). Then proceed to step 6.
   - If P0137 or P0157 is output, troubleshoot for that DTC first (See **CONFIRMATION DRIVING PATTERN**). Then proceed to step 6.
   - If P0138 or P0158 is output, troubleshoot for that DTC first (See **CONFIRMATION DRIVING PATTERN**). Then proceed to step 6.
   - If DTC P0606 and P0136, P0137, P0138, P0156, P0157 or P0158 are output, the output voltage of the heated oxygen sensor may remain close to 0 V or become high (around 1 V or more).

   NEXT: Go to step 6

3. **CHECK FOR EXHAUST GAS LEAK**

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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 step 4. If no exhaust gas leaks are present, proceed to step 4.

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**

a. Clear the DTC (See **DTC CHECK/CLEAR**).
b. Connect the Techstream to the DLC3.
c. Warm up the engine until the engine coolant temperature becomes 75° (167°F) or more.
d. Perform the driving pattern.

Monitor Drive Pattern for P0606:

Engine Coolant Temperature: 75°C (167°F) or more

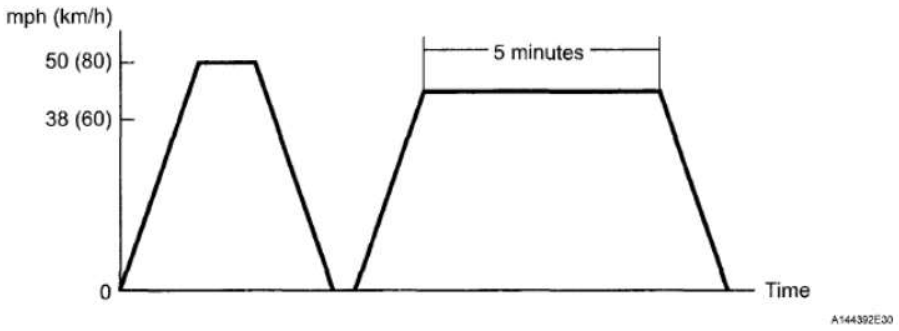


Fig. 192: Monitor Drive Pattern For P0606
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

1. Accelerate the vehicle to 50 mph (80 km/h) and stop the vehicle.
2. Drive the vehicle at 38 to 50 mph (60 to 80 km/h) for 5 minutes or more.

e. Enter the following menus: Powertrain/Engine and ECT/Trouble Codes.
f. Read the DTCs.

Result

RESULT CHART

Result	Proceed to
DTC P0606 and P0136, P0137, P0138, P0156, P0157 or P0158 are output	A

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DTC P0606 is output	B
DTC is not output	C

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

C: Go to step 6

A: Go to next step

5. **INSPECT DTC (P0136, P0137, P0138, P0156, P0157 OR P0158)**
   a. Inspect the P0136, P0137, P0138, P0156, P0157 or P0158 flow chart.

   HINT:

   - If P0136 or P0156 is output, troubleshoot for that DTC first (See **CONFIRMATION DRIVING PATTERN**). Then proceed to step 6.
   - If P0137 or P0157 is output, troubleshoot for that DTC first (See **CONFIRMATION DRIVING PATTERN**). Then proceed to step 6.
   - If P0138 or P0158 is output, troubleshoot for that DTC first (See **CONFIRMATION DRIVING PATTERN**) Then proceed to step 6.
   - If DTC P0606 and P0136, P0137, P0138, P0156, P0157 or P0158 are output, the output voltage of the heated oxygen sensor may remain close to 0 V or become high (around 1 V or more).

6. **INSPECT ECM**
   a. Clear the DTC (See **DTC CHECK/CLEAR**).
   b. Stop the engine and wait for 30 minutes.
   c. Connect the Techstream to the DLC3.
   d. Start the engine and allow it to idle for 2 minutes.
   e. Turn the tester on.
   f. Enter the following menus: Powertrain/Engine and ECT/Trouble Codes.
   g. Read the DTCs.

   Result

   RESULT CHART

Result	Proceed to
DTC P0606 is output	A
DTC is not output	B

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

B: END

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DTC P0607 CONTROL MODULE PERFORMANCE

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 standards, the ECM will illuminate the MIL and set a DTC immediately.

DTC DETECTION CONDITION CHART

DTC No.	DTC Detection Condition	Trouble Area
P0607	• ECM main CPU error • ECM sub CPU error	ECM

NOTE: First check for an exhaust gas leak around the heated oxygen sensor if P0606 is present. An exhaust gas leak generates noise in the heated oxygen sensor output. The ECM may interpret this as an heated oxygen sensor transistor malfunction.

MONITOR STRATEGY

MONITOR STRATEGY REFERENCE CHART

Related DTC	P0607: ECM CPU malfunction
Required sensors/Components	ECM
Frequency of Operation	Continuous
Duration	Within 1 second
MIL Operation	Immediate
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

TYPICAL ENABLING CONDITIONS CHART

The monitor runs whenever the following DTCs are not present	None

TYPICAL MALFUNCTION THRESHOLDS

TYPICAL MALFUNCTION THRESHOLDS REFERENCE CHART

Either of the following conditions is met:	Condition A or B
A. All of the following conditions are met:	Conditions (a), (b) and (c)
(a) CPU reset	1 time or more
(b) Learned throttle position - learned accelerator pedal position	0.4 V or more
(c) Throttle actuator	OFF
B. CPU reset	2 times or more

INSPECTION PROCEDURE

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1. **CHECK WHETHER DTC OUTPUT RECURS (IN ADDITION TO DTC P0607)**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch on (IG).
   c. Turn the tester on.
   d. Clear the DTC.
   e. Turn the ignition switch off.
   f. Disconnect the battery negative terminal and wait for 1 minute.
   g. Connect the battery negative terminal.
   h. Turn the ignition switch on (IG).
   i. Select the following menu items: Powertrain/Engine and ECT/Trouble Code.
   j. Read the DTCs.

   Result

   RESULT CHART

Display (DTC output)	Proceed to
P0607	A
No output DTC	B

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

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

DTC P0617 STARTER RELAY CIRCUIT HIGH

DESCRIPTION

While the engine is being cranked, the positive 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 sets the DTC. This monitor runs when the vehicle is driven at 12.4 mph (20 km/h) for over 20 seconds.

DTC DETECTION CONDITION CHART

DTC No.	DTC Detection Condition	Trouble Area
P0617	When conditions (a), (b) and (c) are met, positive (+B) battery voltage 10.5 V or more is applied to ECM for 20 seconds (1 trip detection logic): a. Vehicle speed more than 12.4 mph (20 km/h) b. Engine speed more than 1000 rpm c. STA signal ON	• Park/neutral position switch • Starter relay circuit • Ignition switch • ECM

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MONITOR STRATEGY

MONITOR STRATEGY REFERENCE CHART

Related DTCs	P0617: Starter signal
Required Sensors/Components (Main)	STARTER relay, Park/neutral position switch, Clutch start switch and Ignition switch
Required Sensors/Components (Related)	Vehicle Speed Sensor (VSS), Crankshaft position sensor
Frequency of Operation	Continuous
Duration	20 seconds
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
Battery voltage	10.5 V or more
Vehicle speed	12.43 mph (20 km/h) or more
Engine speed	1000 rpm or more

TYPICAL MALFUNCTION THRESHOLDS

TYPICAL MALFUNCTION THRESHOLDS REFERENCE CHART

Starter signal	ON

WIRING DIAGRAM

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w/o Smart Key System:

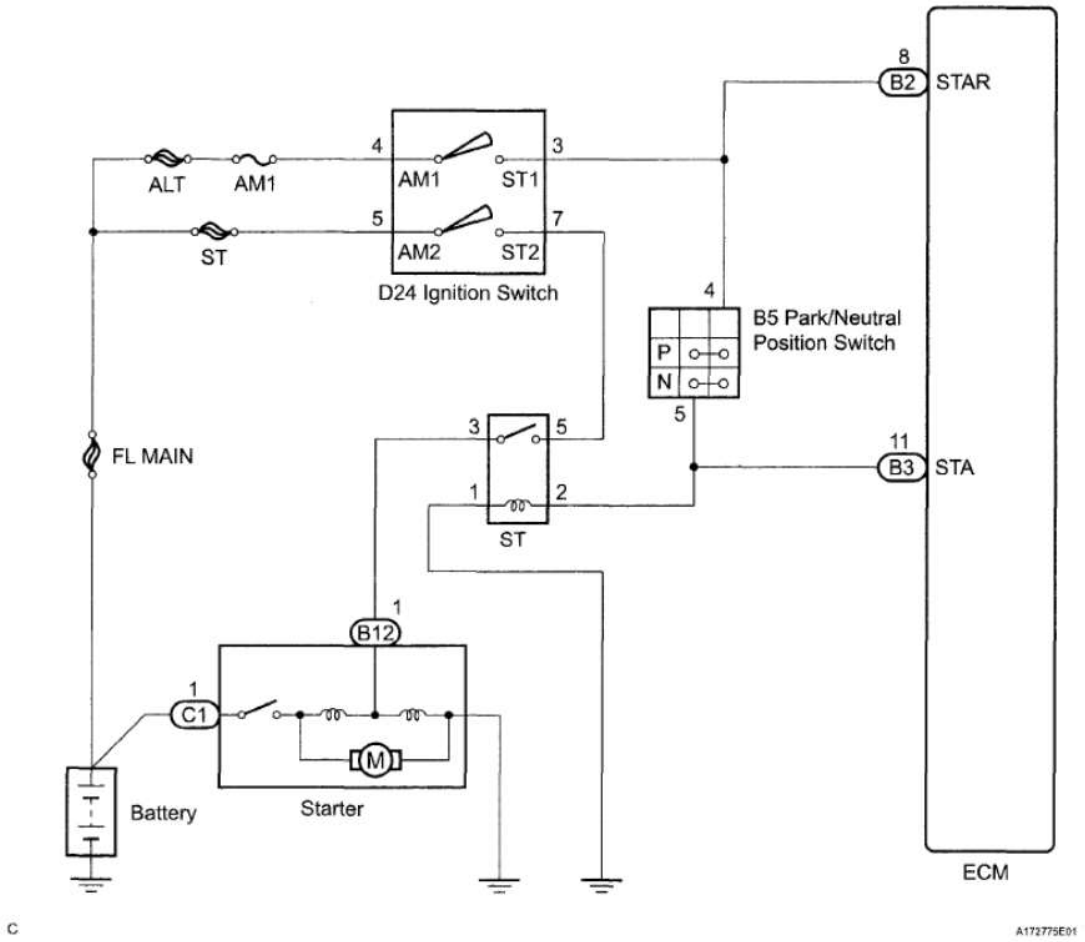


Fig. 193: Starter Relay - Wiring Diagram (1 Of 2)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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w/ Smart Key System:

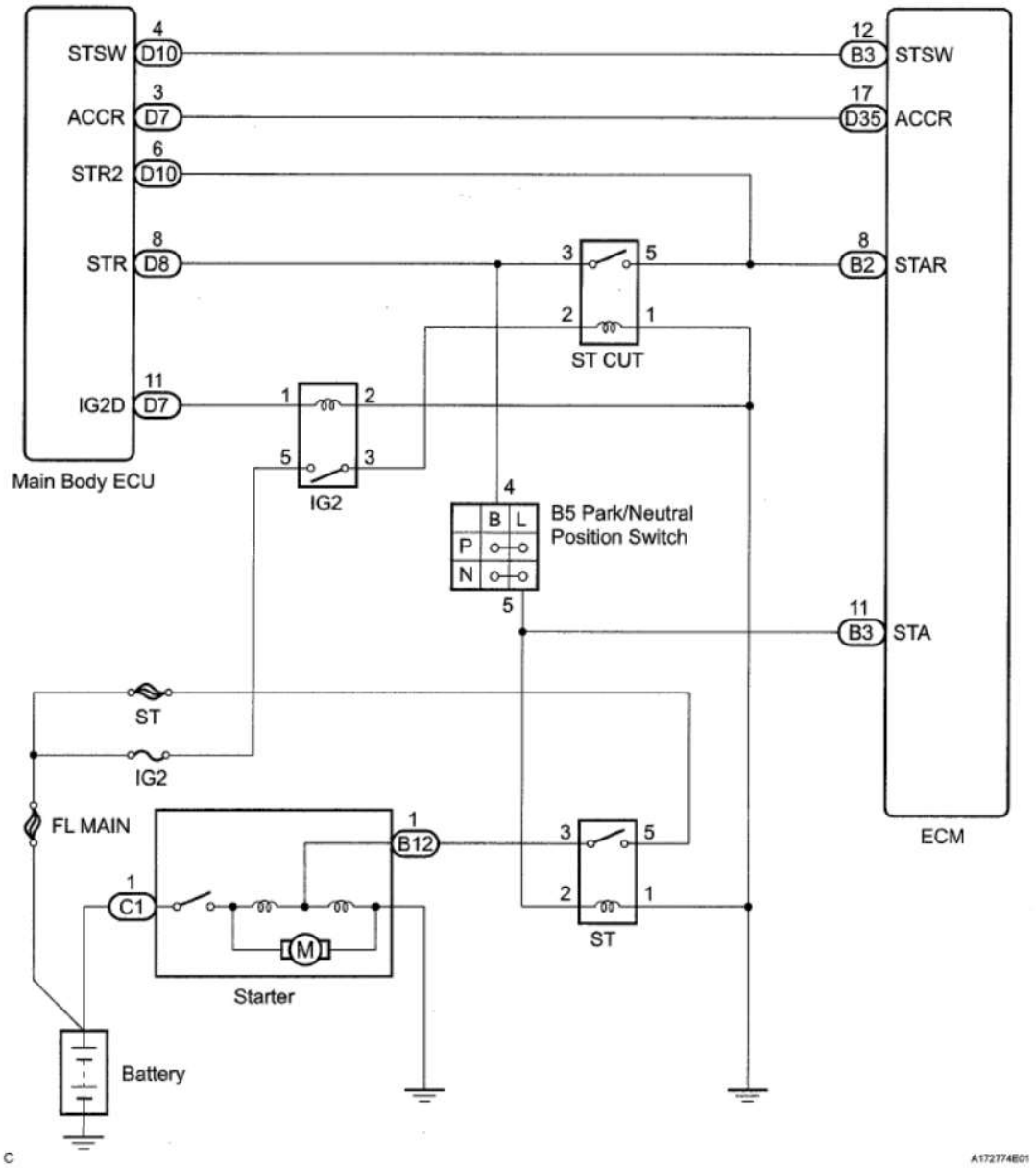


Fig. 194: Starter Relay - Wiring Diagram (2 Of 2)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSPECTION PROCEDURE

HINT:

- The following troubleshooting flowchart is based on the premise that the engine is cranked normally. If the engine will not crank, proceed to the **PROBLEM SYMPTOMS TABLE** .

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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 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. **CHECK IF VEHICLE IS EQUIPPED WITH SMART KEY SYSTEM**

Result

RESULT CHART

Result	Proceed to
w/o Smart Key System	A
w/ Smart Key System	B

B: Go to step 11

A: Go to next step

2. **READ VALUE USING TECHSTREAM (STARTER SIGNAL)**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch on (IG) and turn the tester on.
   c. Select the following menu items: Powertrain/Engine/Data List/Starter Signal.
   d. Check the result when the ignition switch is turned on (IG).
   e. Check the result when the engine starts.

Standard

IGNITION SWITCH CONDITION CHART

Ignition Switch Condition	Tester Display (Starter Signal)
On (IG)	OFF
Engine Starts	ON

Result

RESULT CHART

Result	Proceed to
NG	A
OK	B

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

A: Go to next step

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3. **INSPECT PARK/NEUTRAL POSITION SWITCH ASSEMBLY**
   a. Disconnect the park/neutral position switch connector.
   b. Measure the resistance according to the value(s) in the table below.

Standard resistance

TESTER CONNECTION SPECIFIED CONDITION CHART

Gear Selector Lever Position	Tester Connection	Specified Condition
P	4 - 5	Below 1 ohms
N	4 - 5	

Result

RESULT CHART

Result	Proceed to
NG	A
OK	B

   c. Reconnect the park/neutral position switch connector.

Component without harness connected:
(Park/Neutral Position Switch)



A107938E26

Fig. 195: Identifying Park/Neutral Position Switch Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

B: Go to step 6

A: Go to next step

4. **REPLACE PARK/NEUTRAL POSITION SWITCH ASSEMBLY**
   a. Replace the park/neutral position switch (U151E: See **PARK/NEUTRAL POSITION SWITCH** , U151F: See **PARK/NEUTRAL POSITION SWITCH**).

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5. **READ VALUE USING TECHSTREAM (STARTER SIGNAL)**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch on (IG) and turn the tester on.
   c. Select the following menu items: Powertrain/Engine/Data List/Starter Signal.
   d. Check the result when the ignition switch is turned on (IG).
   e. Check the result when the engine starts.

Standard

IGNITION SWITCH CONDITION CHART

Ignition Switch Condition	Tester Display (Starter Signal)
On (IG)	OFF
Engine Starts	ON

NG: Go to step 6

OK: SYSTEM OK

6. **INSPECT IGNITION SWITCH ASSEMBLY**
   a. Disconnect the ignition switch connector.
   b. Measure the resistance according to the value(s) in the table below.

Standard resistance

TESTER CONNECTION SPECIFIED CONDITION CHART

Ignition Switch Position	Tester Connection	Specified Condition
LOCK	All Terminals	10 kohms or higher
ACC	2 - 3	Below 1 ohms
ON	2 - 3, 2 - 4, 6 - 7	
START	1 - 2, 2 - 4, 6 - 7, 7 - 8	

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Component without harness connected:
(Ignition Switch)

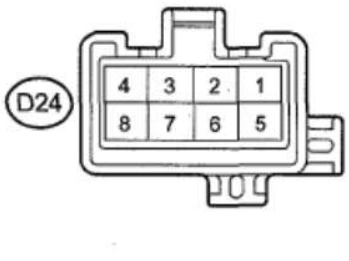


Fig. 196: Identifying Ignition Switch Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Result

RESULT CHART

Result	Proceed to
NG	A
OK	B

c. Reconnect the ignition switch connector.

B: Go to step 8

A: Go to next step

7. **REPLACE IGNITION OR STARTER SWITCH**
   a. Replace the ignition switch assembly (See **IGNITION SWITCH**).
8. **READ VALUE USING TECHSTREAM (STARTER SIGNAL)**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch on (IG) and turn the tester on.
   c. Select the following menu items: Powertrain/Engine/Data List/Starter Signal.
   d. Check the result when the ignition switch is turned on (IG).
   e. Check the result when the engine starts.

Standard

IGNITION SWITCH CONDITION CHART

Ignition Switch Condition	Tester Display (Starter Signal)
On (IG)	OFF

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Engine Starts	ON

Result

RESULT CHART

Result	Proceed to
NG	A
OK	B

B: SYSTEM OK

A: Go to next step

9. **REPAIR OR REPLACE HARNESS OR CONNECTOR (PARK/NEUTRAL POSITION SWITCH - ECM)**
10. **CHECK WHETHER DTC OUTPUT RECURS**
    a. Connect the Techstream to the DLC3.
    b. Turn the ignition switch on (IG) and turn the tester on.
    c. Clear DTCs (See **DTC CHECK/CLEAR**).
    d. Drive the vehicle at more than 20 km/h (12.4 mph) for over 20 seconds.
    e. Select the following menu items: Powertrain/Engine/Trouble Codes.
    f. Read DTCs.

Result

RESULT CHART

Display (DTC Output)	Proceed to
P0617	A
No DTC	B

B: SYSTEM OK

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

11. **READ VALUE USING TECHSTREAM (STARTER SIGNAL)**
    a. Connect the Techstream to the DLC3.
    b. Turn the ignition switch on (IG) and turn the tester on.
    c. Select the following menu items: Powertrain/Engine/Data List/Starter Signal.
    d. Check the result when the ignition switch is turned on (IG).
    e. Check the result when the engine starts.

Standard

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IGNITION SWITCH CONDITION CHART

Ignition Switch Condition	Tester Display (Starter Signal)
On (IG)	OFF
Engine Starts	ON

NG: Go to step 12

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

12. **INSPECT PARK/NEUTRAL POSITION SWITCH**
    a. Disconnect the park/neutral position switch connector.
    b. Measure the resistance according to the value(s) in the table below.

Standard resistance

TESTER CONNECTION SPECIFIED CONDITION CHART

Gear Selector Lever Position	Tester Connection	Specified Condition
P	4 - 5	Below 1 ohms
N	4 - 5	

Result:

RESULT CHART

Result	Proceed To
OK	A
NG (with U151E))	B
NG (with UI51F)	C

Component without harness connected:
(Park/Neutral Position Switch)



A107908E26

Fig. 197: Identifying Park/Neutral Position Switch Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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c. Reconnect the park/neutral position switch connector.

B: REPLACE PARK/NEUTRAL POSITION SWITCH (See **PARK/NEUTRAL POSITION SWITCH**)

C: REPLACE PARK/NEUTRAL POSITION SWITCH (See **PARK/NEUTRAL POSITION SWITCH**)

A: CHECK CRANKING HOLDING FUNCTION CIRCUIT (See **CRANKING HOLDING FUNCTION CIRCUIT**)

DTC P0630 VIN NOT PROGRAMMED OR MISMATCH - ECM/PCM

DESCRIPTION

DTC P0630 is set 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	• VIN is not stored in ECM • Input VIN in ECM is not accurate	ECM

MONITOR STRATEGY

MONITOR STRATEGY REFERENCE 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

The monitor will run whenever these DTCs are not present	None
Battery voltage	8 V or more
Ignition switch	ON (IG)
Starter	OFF

TYPICAL MALFUNCTION THRESHOLDS

TYPICAL MALFUNCTION THRESHOLDS REFERENCE CHART

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VIN code	Not programmed

COMPONENT OPERATING RANGE

COMPONENT OPERATING RANGE REFERENCE CHART

VIN code	Programmed

INSPECTION PROCEDURE

1. **READ CURRENT DTC**
   a. Connect Techstream to the DLC3.
   b. Turn the ignition switch on (IG) and turn the tester on.
   c. Select the following menu items: Powertrain/Engine and ECT/Trouble Code.
   d. Read the DTCs.

   Result

   RESULT CHART

Display (DTC Output)	Proceed to
P0630	A
P0630 and other DTCs	B

   If any DTCs other than P0630 are output, troubleshoot those DTCs first.

   NOTE: If P0630 is set, the VIN must be input to the ECM using the Techstream. However, all DTCs are cleared automatically by the tester when inputting the VIN.

   B: GO TO **DTC CHART**

   A: Go to next step

2. **INPUT VIN WITH TECHSTREAM**

   HINT:

   Refer to "**REGISTRATION**" .

3. **READ CURRENT DTC**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch on (IG) and turn the tester on.
   c. Select the following menu items: Powertrain/Engine and ECT/Trouble Codes.
   d. Read the DTCs again.

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Result:

DTC is not output (P0630).

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

OK: END

DTC P0657 ACTUATOR SUPPLY VOLTAGE CIRCUIT/OPEN

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 volts when the ignition switch is turned off, the ECM will illuminate the MIL and set a DTC when the ignition switch on (IG).

DTC DETECTION CONDITION CHART

DTC	DTC Detection Condition	Trouble Area
P0657	Throttle actuator power supply error	ECM

MONITOR STRATEGY

MONITOR STRATEGY REFERENCE CHART

Related DTC	P0657: ETCS power supply
Required sensors/Components (main)	ECM
Required sensors/Components (sub)	Throttle actuator
Frequency of Operation	Once per driving cycle
Duration	Within 1 second
MIL Operation	Immediate
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

TYPICAL ENABLING CONDITIONS CHART

The monitor will run whenever this DTC is not present	None
Ignition switch	From on (IG) to off

TYPICAL MALFUNCTION THRESHOLDS

TYPICAL MALFUNCTION THRESHOLDS REFERENCE CHART

Throttle actuator power supply	7 V or more

INSPECTION PROCEDURE

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1. **CHECK WHETHER DTC OUTPUT RECURS (IN ADDITION TO DTC P0657)**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch on (IG).
   c. Turn the tester on.
   d. Clear the DTC.
   e. Turn the ignition switch off.
   f. Disconnect the battery negative terminal and wait for 1 minute.
   g. Connect the battery negative terminal.
   h. Turn the ignition switch on (IG) for 10 seconds.
   i. Turn the ignition switch off.
   j. Turn the ignition switch on (IG).
   k. Select the following menu items: Powertrain/Engine and ECT/Trouble Codes.
   l. Read the DTCs.

   Result

   RESULT CHART

Display (DTC output)	Proceed to
P0657	A
No output DTC	B

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

   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 does not use a throttle cable.

DTC DETECTION CONDITION CHART

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DTC No.	DTC Detection Condition	Trouble Area
P2102	Conditions (a) and (b) continue for 2.0 seconds (1 trip detection logic): a. Throttle actuator duty ratio exceeds 80% or more b. Throttle actuator current is 0.5 A or less	• Open in throttle actuator circuit • Throttle actuator • ECM
P2103	Either of the following conditions is met: • Hybrid IC diagnosis signal fails • Hybrid IC current limiter port fails	• 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 sets a DTC.

Example:

When the electrical current is more than 10 A, or less than 0.5 A and the throttle actuator duty ratio exceeds 80%, the ECM interprets this as the current being outside the standard range, and illuminates the MIL and sets a DTC.

If the malfunction is not repaired successfully, a DTC is set when the engine is quickly revved up to a high rpm several times after the engine has idled for 5 seconds after engine start.

MONITOR STRATEGY

MONITOR STRATEGY REFERENCE 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: 25 times or 0.6 seconds
MIL Operation	Immediate
Sequence of Operation	None

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TYPICAL ENABLING CONDITIONS

All:

TYPICAL ENABLING CONDITIONS CHART

The monitor will run whenever these DTCs are not present	None

P2102:

TYPICAL ENABLING CONDITIONS CHART

Throttle motor	ON
Duty-cycle ratio to open throttle actuator	80% or more
Throttle actuator power supply	8 V or more
Motor current change during latest 0.016 sec	Less than 0.2 A

P2103:

TYPICAL ENABLING CONDITIONS CHART

Throttle motor	ON
Either of the following conditions is met:	Condition 1 or 2
1. Throttle actuator power supply	8 V or more
2. Throttle actuator power	ON
Battery voltage	8 V or more
Starter	OFF

TYPICAL MALFUNCTION THRESHOLDS

P2102:

TYPICAL MALFUNCTION THRESHOLDS REFERENCE CHART

Throttle actuator current	Less than 0.5 A

P2103:

TYPICAL MALFUNCTION THRESHOLDS REFERENCE CHART

Either of the following conditions is met	Condition 1 or 2
1. Hybrid IC diagnosis signal	Fail
2. Hybrid IC current limiter port	Fail

FAIL-SAFE

When either of these DTCs, as well as other DTCs relating to electronic throttle control system malfunctions, is set, the ECM enters fail-safe mode. During fail-safe mode, the ECM cuts the current to the throttle actuator off, 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

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accelerator pedal opening angle, to allow the vehicle to continue at a minimal speed.

If the accelerator pedal is depressed 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

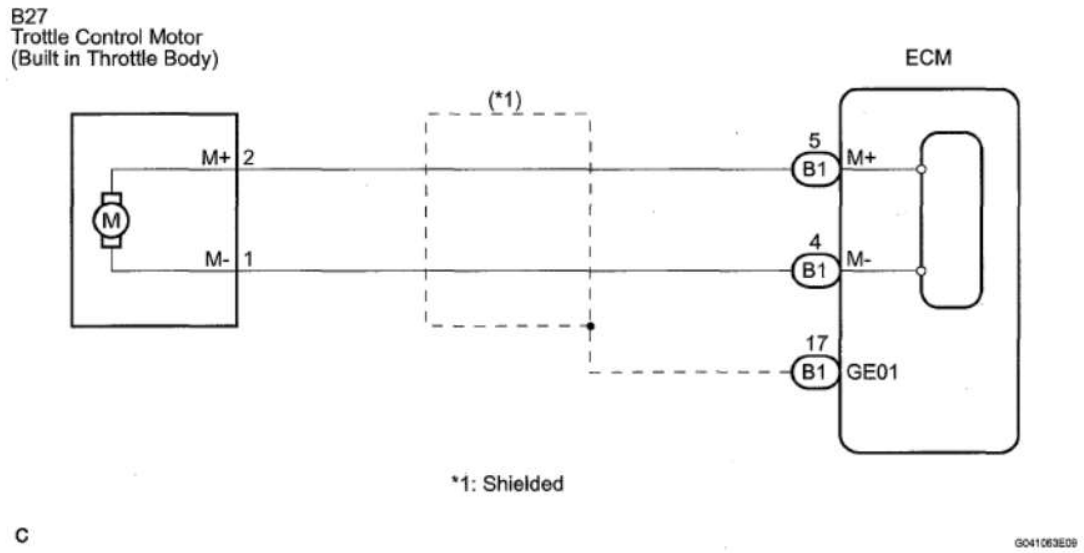


Fig. 198: Throttle Actuation Control Motor - Wiring Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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 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.
- The throttle actuator current (Throttle motor current) and the throttle actuator duty ratio (Throttle Motor Open Duty/Throttle Motor Close Duty) can be read using the Techstream. However, the ECM shuts off the throttle actuator current when the electronic throttle control system malfunctions.

1. **INSPECT THROTTLE BODY (RESISTANCE OF THROTTLE CONTROL MOTOR)**
   a. Disconnect the throttle body connector.
   b. Measure the resistance according to the value(s) in the table below.

   Standard resistance

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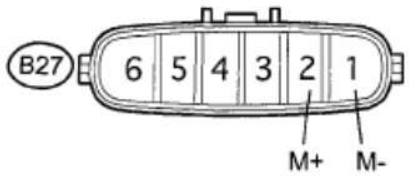
TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
B27-2 (M+) - B27-1 (M-)	20°C (68°F)	0.3 to 100 ohms

c. Reconnect the throttle body connector.

NG: REPLACE THROTTLE BODY (See **THROTTLE BODY**)

Component without harness connected:
(Throttle Position Sensor)



A159755E08

Fig. 199: Identifying Throttle Position Sensor Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

2. **CHECK HARNESS AND CONNECTOR (THROTTLE CONTROL MOTOR - 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+) - B1-5 (M+)	Always	Below 1 ohms
B27-1 (M-) - B1-4 (M-)	Always	Below 1 ohms

Check for short

TESTER CONNECTION SPECIFIED CONDITION CHART

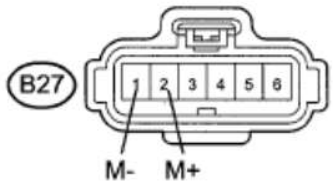
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Tester Connection	Condition	Specified Condition
B27-2 (M+) or B1-5 (M+) - Body ground	Always	10 kohms or higher
B27-1 (M-) or B1-4 (M-) - Body ground	Always	10 kohms or higher

d. Reconnect the throttle body connector.
e. Reconnect the ECM connector.

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR (THROTTLE CONTROL MOTOR - ECM)

Front view of wire harness connector:
(to Thorottle Body)



Rear view of wire harness connector:
(to ECM)

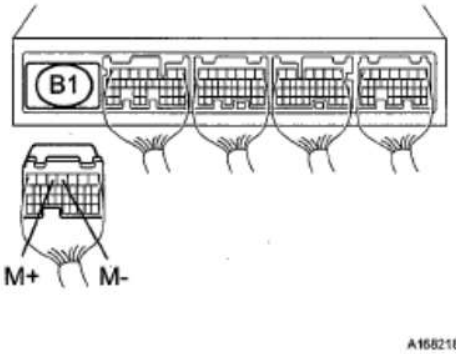


Fig. 200: Identifying Throttle Body And ECM Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

3. **INSPECT THROTTLE BODY**
   a. Check for foreign objects between the throttle valve and the housing.

OK:

Normal

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NG: REMOVE FOREIGN OBJECT AND CLEAN THROTTLE BODY

OK: Go to next step

4. **INSPECT THROTTLE VALVE**
   a. Check if the throttle valve opens and closes smoothly.

OK:

The throttle valve opens and closes smoothly.

NG: REPLACE THROTTLE BODY (See **THROTTLE BODY**)

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 the 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 so that it can control the throttle actuator and the throttle valve appropriately in response to driver inputs.

HINT:

This electronic throttle control system does not use a throttle cable.

DTC DETECTION CONDITION CHART

DTC No.	DTC Detection Condition	Trouble Area
P2111	ECM signals throttle actuator to close, but stuck (1 trip detection logic)	• Throttle actuator • Throttle body • Throttle valve
P2112	ECM signals throttle actuator to open, but stuck (1 trip detection logic)	• Throttle actuator • Throttle body • Throttle valve

MONITOR DESCRIPTION

The ECM determines that there is a malfunction in the electronic throttle control system when the throttle valve remains at the fixed angle despite a high drive current from the ECM. The ECM illuminates the MIL and sets a DTC.

If the malfunction is not repaired successfully, a DTC is set when the accelerator pedal is fully depressed and

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released quickly (to fully open and close the throttle valve) after the engine is next started.

MONITOR STRATEGY

MONITOR STRATEGY REFERENCE CHART

Related DTCs	P2111: Throttle actuator stuck open P2112: Throttle actuator stuck closed
Required Sensors/Components (Main)	Throttle actuator
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

The monitor will run whenever these DTCs are not present	None

P2111 (Throttle actuator stuck open):

TYPICAL ENABLING CONDITIONS CHART

All of the following conditions are met	-
System guard*	ON
Throttle actuator current	2 A or more
Throttle actuator close duty ratio	80% or more

P2112 (Throttle actuator stuck closed):

TYPICAL ENABLING CONDITIONS CHART

All of the following conditions are met	-
System guard(1)	ON
Throttle actuator current	2 A or more
Throttle actuator open duty-cycle	80% or more
(1) System guard set when following conditions met	

TYPICAL ENABLING CONDITIONS CHART

Throttle actuator	ON
Throttle actuator duty calculation	Executing
Throttle position sensor	Fail determined
Throttle actuator current-cut operation	Not executing

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Throttle actuator power supply	4 V or more
Throttle actuator	Fail determined

TYPICAL MALFUNCTION THRESHOLDS

P2111 (Throttle actuator stuck open):

TYPICAL MALFUNCTION THRESHOLDS REFERENCE CHART

Throttle position sensor voltage change	No change

P2112 (Throttle actuator stuck closed):

TYPICAL MALFUNCTION THRESHOLDS REFERENCE CHART

Throttle position sensor voltage change	No change

FAIL-SAFE

When either of these DTCs, as well as other DTCs relating to electronic throttle control system malfunctions, is set, the ECM enters fail-safe mode. During fail-safe mode, the ECM cuts the current to the throttle actuator off, 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 slowly, 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 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. **CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P2111 OR P2112)**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch on (IG).
   c. Turn the tester on.
   d. Select the following menu items: Powertrain/Engine and ECT/Trouble Codes.

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e. Read the DTCs.

Result

RESULT CHART

Display (DTC Output)	Proceed to
P2111 or P2112	A
P2111 or P2112 and other DTCs	B

HINT:

If any DTCs other than P2111 or P2112 are output, troubleshoot those DTCs first.

B: GO TO **DTC CHART**

A: Go to next step

2. **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 **THROTTLE BODY**)

OK: Go to next step

3. **CHECK WHETHER DTC OUTPUT RECURS (DTC P2111 OR P2112)**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch on (IG).
   c. Turn the tester on.
   d. Clear the DTCs (See **DTC CHECK/CLEAR**).
   e. Start the engine, and fully depress and release the accelerator pedal quickly (to fully open and close the throttle valve).
   f. Select the following menu items: Powertrain/Engine and ECT/Trouble Codes.
   g. Read the DTCs.

Result

RESULT CHART

Display (DTC Output)	Proceed to
No DTC	A

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P2111 or P2112	B

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

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

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 (less than 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.

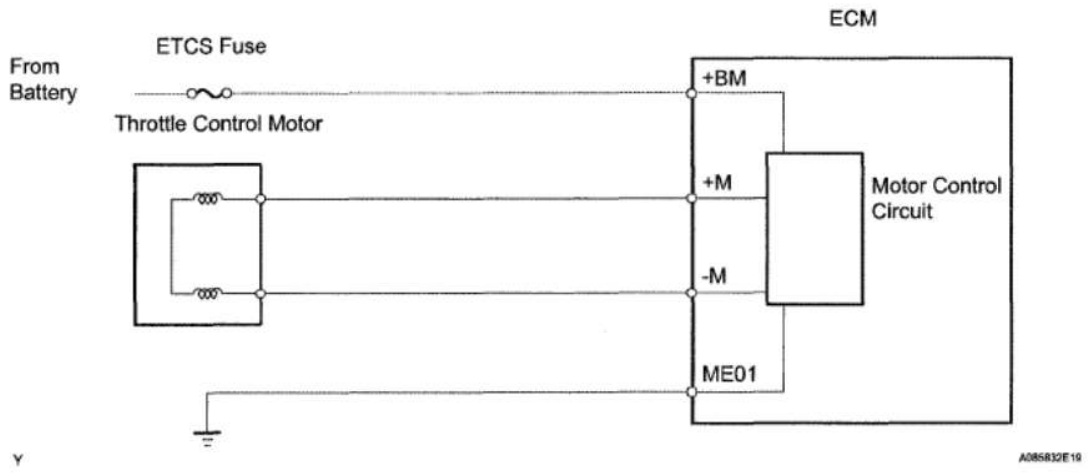


Fig. 201: Electronic Throttle Control System Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

DTC DETECTION CONDITION CHART

DTC No.	DTC Detection Condition	Trouble Area
	Open in electronic throttle control system power	• Open in electronic throttle control system power source circuit

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P2118	source (+BM) circuit (1 trip detection logic)	• Electronic throttle control system 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 sets the DTC.

If the malfunction is not repaired successfully, the DTC is set 5 seconds after the engine is next started.

MONITOR STRATEGY

MONITOR STRATEGY REFERENCE CHART

Related DTCs	P2118: Throttle actuator power supply
Required Sensors/Components (Main)	Throttle actuator, throttle valve, electronic throttle control system 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

The monitor will run whenever these DTCs are not present	None
Battery voltage	8 V or more
Throttle actuator power	ON

TYPICAL MALFUNCTION THRESHOLDS

TYPICAL MALFUNCTION THRESHOLDS REFERENCE CHART

Throttle actuator power supply voltage (+BM)	Less than 4 V

COMPONENT OPERATING RANGE

COMPONENT OPERATING RANGE REFERENCE CHART

Throttle actuator power supply voltage	9 to 14 V

FAIL-SAFE

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When this DTC, as well as other DTCs relating to electronic throttle control system malfunctions, is set, the ECM enters fail-safe mode. During fail-safe mode, the ECM cuts the current to the throttle actuator off, 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 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

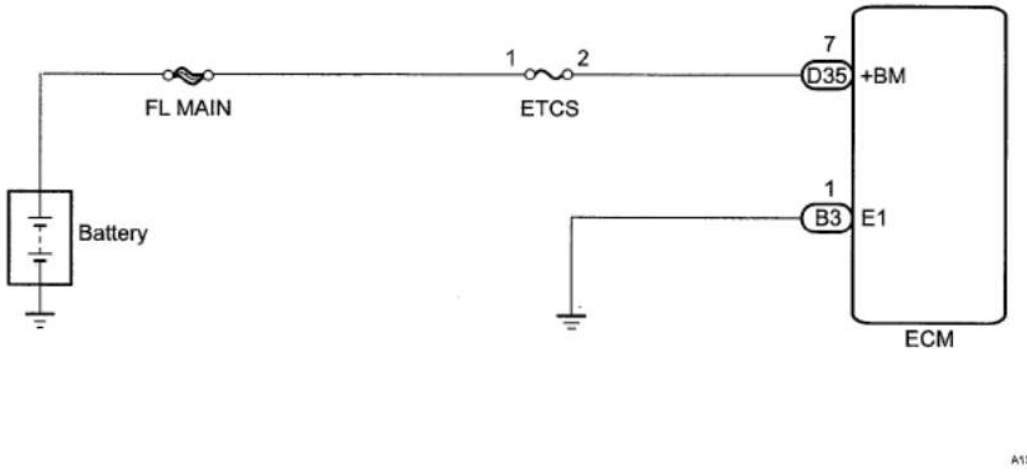


Fig. 202: Throttle Actuator Control Motor Current - Wiring Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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 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. **CHECK FUSE (ETCS FUSE)**
   a. Remove the ETCS fuse 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

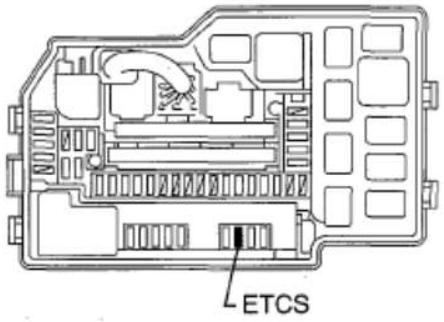
Tester Connection	Condition	Specified Condition
ETCS fuse	Always	Below 1 ohms

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c. Reinstall the ETCS fuse.

NG: REPLACE FUSE (ETCS FUSE)

Engine Room Relay Block:



N A168235E05

Fig. 203: Identifying ETCS Fuse
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

2. **INSPECT ECM (+BM VOLTAGE)**
   a. 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
D35-7 (+BM) - B3-1 (E1)	Ignition switch on (IG)	9 to 14 V

NG: Go to step 3

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Component with harness connected:
(ECM)

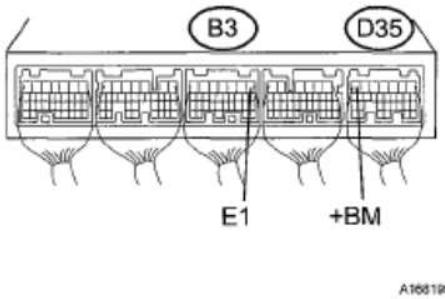


Fig. 204: Identifying ECM B3 And D35 Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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

3. **CHECK HARNESS AND CONNECTOR (ECM - ETCS FUSE)**
   a. Check the harness and connector between the ETCS fuse and ECM.
      1. Remove the ETCS fuse from the engine room relay block.
      2. Disconnect the ECM connector.
      3. Measure the resistance according to the value(s) in the table below.

Standard resistance:

Check for open

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Specified Condition
ETCS fuse (2) - D35-7 (+BM)	Below 1 ohms

Check for short

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Specified Condition
ETCS fuse (2) or D35-7 (+BM) - Body ground	10 kohms or higher

      4. Reconnect the ECM connector.
      5. Reinstall the ETCS fuse.

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR (ECM - ETCS FUSE)

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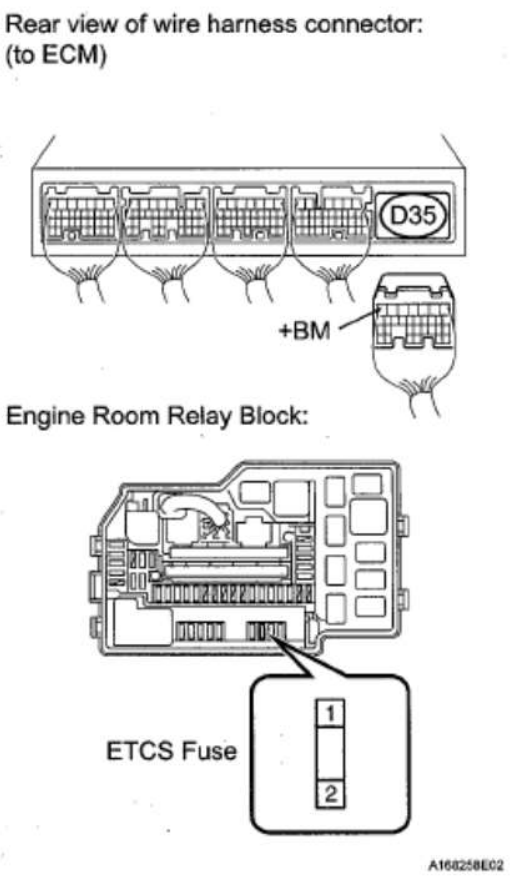


Fig. 205: Identifying ECM Connector Terminals And ETCS Fuse
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: REPAIR OR REPLACE HARNESS OR CONNECTOR (ETCS FUSE - FL MAIN FUSE)

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	Throttle valve opening angle continues to vary greatly from target opening angle (1 trip detection logic)	• Electronic throttle control system • ECM

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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 sets the DTC. If the malfunction is not repaired successfully, the DTC is set when the accelerator pedal is quickly released (to close the throttle valve) after the engine speed reaches 5000 rpm by the accelerator pedal being fully depressed (fully open the throttle valve).

MONITOR STRATEGY

MONITOR STRATEGY REFERENCE CHART

Related DTCs	P2119: Electronic throttle control system malfunction
Required Sensors/Components (Main)	Throttle actuator
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

The monitor will run whenever these DTCs are not present	None
System guard*	ON
*System guard set when the following conditions are met	-
Throttle actuator	ON
Throttle actuator duty calculation	Executing
Throttle position sensor	Fail determined
Throttle actuator current-cut	Not executing
Throttle actuator power supply	4 V or more
Throttle actuator	Fail determined

TYPICAL MALFUNCTION THRESHOLDS

TYPICAL MALFUNCTION THRESHOLDS REFERENCE CHART

Either of following conditions is met	Condition A or B
A. Commanded closed throttle position - current closed throttle position	0.3 V or more
B. Commanded open throttle position - current open throttle position	0.3 V or more

FAIL-SAFE

When this DTC, as well as other DTCs relating to electronic throttle control system malfunctions, is set, the ECM enters fail-safe mode. During fail-safe mode, the ECM cuts the current to the throttle actuator off, and the

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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 slowly, 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 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. **CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P2119)**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch on (IG).
   c. Turn the tester on.
   d. Select the following menu items: Powertrain/Engine and ECT/Trouble Codes.
   e. Read the DTCs.

   Result

   RESULT CHART

Display (DTC Output)	Proceed to
P2119	A
P2119 and other DTCs	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. **CHECK WHETHER DTC OUTPUT RECURS (DTC P2119)**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch on (IG).

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c. Turn the tester on.
d. Clear the DTCs (See **DTC CHECK/CLEAR**).
e. Allow the engine to idle for 15 seconds.

CAUTION: Perform the procedures "A" and "B" below with great care. Failure to do so may result in the vehicle unexpectedly rolling away.

f. Securely apply the parking brake and move the gear selector lever to the D position (Procedure "A").
g. While depressing the brake pedal securely, fully depress the accelerator pedal for 5 seconds (Procedure "B").
h. Select the following menu items: Powertrain/Engine and ECT/Trouble Codes.
i. Read the DTCs.

HINT:

The voltage output of the throttle position sensor can be checked during procedure "B" using the Techstream. Variations in the voltage output indicate that the throttle actuator is in operation. To check the voltage output using the Techstream, select the following menu items: Powertrain/Engine and ECT/Data List/Throttle Sensor Position No. 1.

OK:

No DTC outputs.

NG: REPLACE THROTTLE BODY (See **THROTTLE BODY**)

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

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 does not use a throttle cable.

The accelerator pedal position sensor is integrated with the accelerator pedal bracket and has 2 sensor circuits:

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VPA (main) and VPA2 (sub). This sensor is a non-contact type, 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 V and 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.

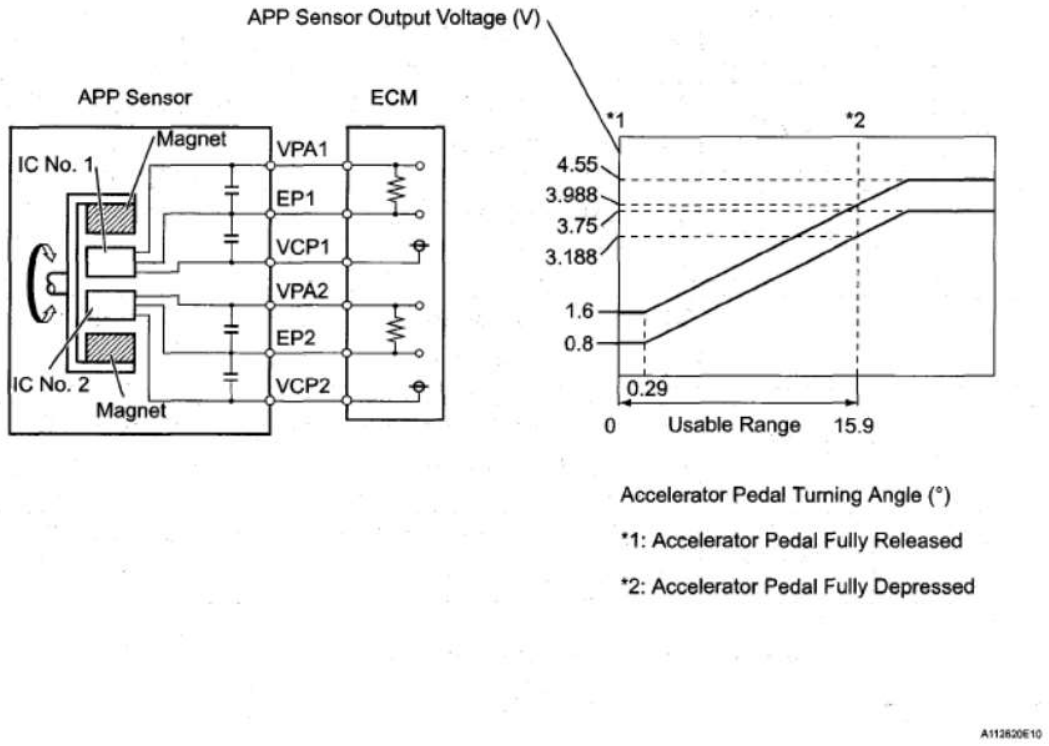


Fig. 206: Throttle / Pedal Position Sensor / Switch Circuit Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

DTC DETECTION CONDITION CHART

DTC No.	DTC Detection Condition	Trouble Area
P2120	VPA fluctuates rapidly beyond 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 accelerator pedal is fully released (1 trip detection logic)	• Accelerator pedal position sensor • Open in VCP1 circuit • Open or ground short in VPA circuit

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		• ECM
P2123	VPA is 4.8 V or more for 2.0 seconds or more (1 trip detection logic)	• Accelerator pedal position sensor • Open in EPA circuit • ECM
P2125	VPA2 fluctuates rapidly beyond upper and lower malfunction thresholds for 0.5 seconds or more (1 trip detection logic)	• Accelerator pedal position sensor • ECM
P2127	VPA2 is 1.2 V or less for 0.5 seconds or more when accelerator pedal is fully released (1 trip detection logic)	• Accelerator pedal position sensor • Open in VCP2 circuit • Open or ground short in VPA2 circuit • ECM
P2128	Conditions (a) and (b) continue for 2.0 seconds or more (1 trip detection logic): a. VPA2 is 4.8 V or more b. VPA is between 0.4 V and 3.45 V	• Accelerator pedal position sensor • Open in EPA2 circuit • ECM
P2138	Condition (a) or (b) continues for 2.0 seconds or more (1 trip detection logic): a. 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 set, check the accelerator pedal position sensor voltage by selecting the following menu items on the Techstream: Select the following menu items: Powertrain/Engine and ECT/Data List/Accel Sensor Out No. 1 and Accel Sensor Out No. 2.

ACCEL SENSOR REFERENCE CHART

Trouble Areas	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
VCP circuit open	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 5.0 V
Open or				

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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
EPA circuit open	4.5 to 5.0 V	4.5 to 5.0 V	4.5 to 5.0 V	4.5 to 5.0 V
Normal condition	0.5 to 1.1 V	1.2 to 2.0 V	2.6 to 4.5 V	3.4 to 5.0 V

HINT:

Accelerator pedal positions are expressed as voltages.

MONITOR DESCRIPTION

When either of the voltage outputs of VPA or VPA2 deviates from the standard range, or the difference between the voltage outputs 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 sets a DTC.

Example:

When the voltage output of VPA drops below 0.4 V for more than 0.5 seconds when the accelerator pedal is fully depressed, DTC P2122 is set.

If the malfunction is not repaired successfully, a DTC is set 2 seconds after the engine is next started.

MONITOR STRATEGY

MONITOR STRATEGY REFERENCE 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

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	2.0 seconds: P2123, P2128 and P2138
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
Throttle actuator power	ON
Ignition switch	ON (IG)

TYPICAL MALFUNCTION THRESHOLDS

P2120:

TYPICAL MALFUNCTION THRESHOLDS REFERENCE CHART

Either of the following conditions is met	Condition A or B
A. VPA voltage when VPA2 is 0.04 V or more	0.4 V or less
B. VPA voltage	4.8 V or more

P2122:

TYPICAL MALFUNCTION THRESHOLDS REFERENCE CHART

VPA voltage when VPA2 is 0.04 V or more	0.4 V or less

P2123:

TYPICAL MALFUNCTION THRESHOLDS REFERENCE CHART

VPA voltage	4.8 V or more

P2125:

TYPICAL MALFUNCTION THRESHOLDS REFERENCE CHART

Either of the following conditions is met	Condition A or B
A. VPA2 voltage when VPA is 0.04 V or more	1.2 V or less
B. VPA2 voltage when VPA is 0.4 to 3.45 V	4.8 V or more

P2127:

TYPICAL MALFUNCTION THRESHOLDS REFERENCE CHART

VPA2 voltage when VPA is 0.04 V or more	1.2 V or less

P2128:

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TYPICAL MALFUNCTION THRESHOLDS REFERENCE CHART

VPA2 voltage when VPA is 0.4 to 3.45 V	4.8 V or more

P2138:

TYPICAL MALFUNCTION THRESHOLDS REFERENCE CHART

Either of following conditions is met:	Condition A or B
Condition A	-
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 REFERENCE CHART

Parameter	Standard Value
VPA voltage	0.4 V to 4.8 V
VPA2 voltage	1.2 V to 4.8 V
Difference between VPA and VPA2 voltages	More than 0.02 V

FAIL-SAFE

When any of DTCs P2120, P2121, P2122, P2123, P2125, P2127, P2128 and P2138 are set, 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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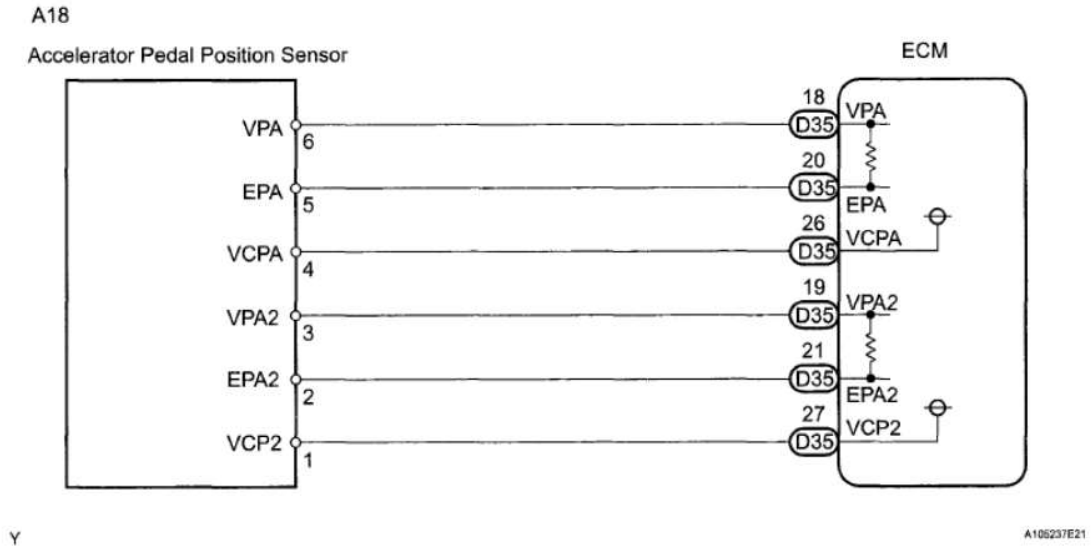


Fig. 207: Throttle / Pedal Position Sensor / Switch - Wiring Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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 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. **READ VALUE USING TECHSTREAM (ACCELERATOR PEDAL POSITION SENSOR)**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch on (IG) and turn the tester on.
   c. Select the following menu items: Powertrain/Engine and ECT/Data List/Accel Sensor Out No. 1 and Accel Sensor Out No. 2.
   d. Read the values displayed on the tester.



Fig. 208: Identifying Accelerator Pedal Operations
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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Standard voltage

STANDARD VOLTAGE REFERENCE 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

Result

RESULT CHART

Result	Proceed to
NG	A
OK	B

B: Go to step 5

A: Go to next step

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:

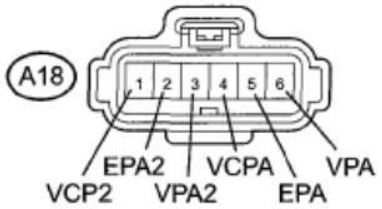
Check for open

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
A18-6 (VPA) - D35-18 (VPA)	Always	Below 1 ohms
A18-5 (EPA) - D35-20 (EPA)	Always	Below 1 ohms
A18-4 (VCPA) - D35-26 (VCPA)	Always	Below 1 ohms
A18-3 (VPA2) - D35-19 (VPA2)	Always	Below 1 ohms
A18-2 (EPA2) - D35-21 (EPA2)	Always	Below 1 ohms
A18-1 (VCP2) - D35-27 (VCP2)	Always	Below 1 ohms

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Front view of wire harness connector:
(to Accelerator Pedal Position Sensor)



Rear view of wire harness connector:
(to ECM)

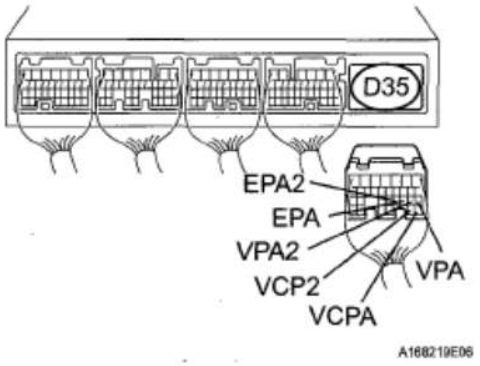


Fig. 209: Identifying Accelerator Pedal Position Sensor And ECM Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Check for short

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
A18-6 (VPA) or D35-18 (VPA) - Body ground	Always	10 kohms or higher
A18-5 (EPA) or D35-20 (EPA) - Body ground	Always	10 kohms or higher
A18-4 (VCPA) or D35-26 (VCPA) - Body ground	Always	10 kohms or higher
A18-3 (VPA2) or D35-19 (VPA2) - Body ground	Always	10 kohms or higher
A18-2 (EPA2) or D35-21 (EPA2) - Body ground	Always	10 kohms or higher
A18-1 (VCP2) or D35-27 (VCP2) - Body ground	Always	10 kohms or higher

d. Reconnect the accelerator pedal position sensor connector.
e. Reconnect the ECM connector.

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR (ACCELERATOR PEDAL POSITION SENSOR - ECM)

OK: Go to next step

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3. **INSPECT ECM (VCPA AND VCP2 VOLTAGE)**
   a. Disconnect the accelerator pedal position sensor connector.
   b. Turn the ignition switch on (IG).
   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
D35-26 (VCPA) - D35-20 (EPA)	Ignition switch on (IG)	4.5 to 5.0 V
D35-27 (VCP2) - D35-21 (EPA2)	Ignition switch on (IG)	4.5 to 5.0 V

   d. Reconnect the accelerator pedal position sensor connector.

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

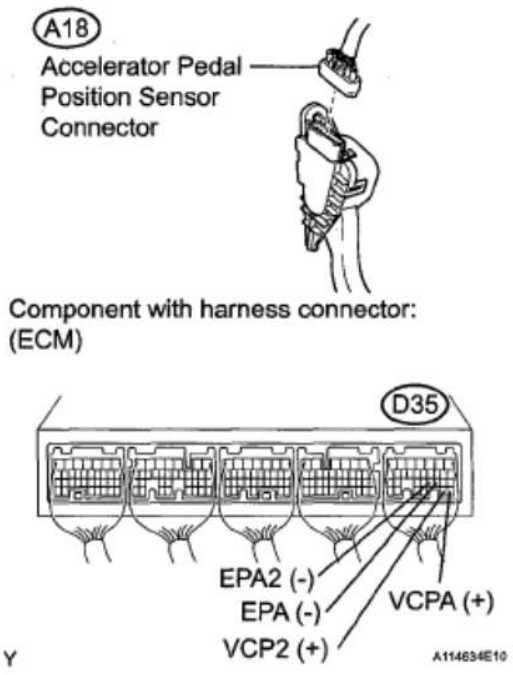


Fig. 210: Identifying Accelerator Pedal Position Sensor Connector And ECM Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

4. **REPLACE ACCELERATOR PEDAL ROD**
   a. Replace the accelerator pedal rod assembly (See **REMOVAL**).
5. **CHECK WHETHER DTC OUTPUT RECURS (ACCELERATOR PEDAL POSITION SENSOR**

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DTCS)

a. Connect the Techstream to the DLC3.
b. Turn the ignition switch on (IG) and turn the tester on.
c. Clear the DTCs (See **DTC CHECK/CLEAR**).
d. Start the engine.
e. Allow the engine to idle for 15 seconds.
f. Select the following menu items: Powertrain/Engine and ECT/Trouble Codes.
g. Read the DTCs.

Result

RESULT CHART

Display (DTC Output)	Proceed to
P2120, P2122, P2123, P2125, P2127, P2128 and/or P2138	A
No output	B

B: SYSTEM OK

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

DTC P2121 THROTTLE/PEDAL POSITION SENSOR/SWITCH "D" CIRCUIT RANGE/PERFORMANCE

DESCRIPTION

Refer to **DTC P2120** .

DTC DETECTION CONDITION CHART

DTC No.	DTC Detection Condition	Trouble Area
P2121	Difference between VPA and VPA2 is less than 0.4 V, or more than 1.2 V for 0.5 seconds (1 trip detection logic)	• Accelerator 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 voltage outputs 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 the DTC is set.

MONITOR STRATEGY

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MONITOR STRATEGY REFERENCE CHART

Related DTCs	P2121; Accelerator pedal position sensor rationality
Required Sensors/Components (Main)	Accelerator position sensor 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

The monitor will run whenever these DTCs are not present	None
Either of the following conditions is met.	Condition 1 or 2
1. Ignition switch	ON (IG)
2. Electronic throttle actuator power	ON

TYPICAL MALFUNCTION THRESHOLDS

TYPICAL MALFUNCTION THRESHOLDS REFERENCE CHART

Difference between VPA1 voltage (learned value) and VPA2 voltage (learned value)	Less than 0.4 V, or more than 1.2 V

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.

If a pass condition is detected and then the ignition switch is turned off, the fail-safe operation stops and the system returns to a normal condition.

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 be helpful in determining whether the vehicle was running or stopped, whether the engine was warmed up or not, whether the

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air fuel ratio was lean or rich, as well as other data recorded at the time of a malfunction.

1. **READ VALUE USING TECHSTREAM (ACCELERATOR PEAL POSITION SENSOR)**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch on (IG) and turn the tester on.
   c. Select the following menu items: Powertrain/Engine and ECT/Data List/Accelerator Position No. 1 and Accelerator Position No. 2.
   d. Read the values displayed on the tester.

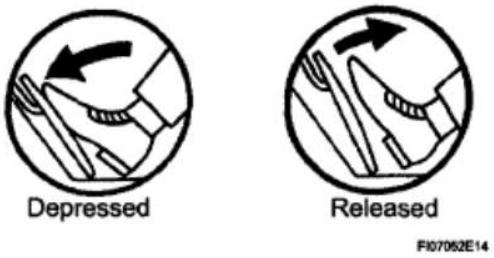


Fig. 211: Identifying Accelerator Pedal Operations
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Standard voltage

STANDARD VOLTAGE REFERENCE 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 3

OK: Go to next step

2. **CHECK WHETHER DTC OUTPUT RECURS (ACCELERATOR PEDAL POSITION SENSOR DTCS)**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch on (IG) and turn the tester on.
   c. Clear the DTCs (See **DTC CHECK/CLEAR**).
   d. Start the engine.
   e. Allow the engine to idle for 15 seconds.
   f. Select the following menu items: Powertrain/Engine and ECT/Trouble Codes.
   g. Read the DTCs.

Result

RESULT CHART

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Display (DTC Output)	Proceed to
P2121	A
No output	B

B: SYSTEM OK

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

3. **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) - D35-18 (VPA)	Always	Below 1 ohms
A18-5 (EPA) - D35-20 (EPA)	Always	Below 1 ohms
A18-4 (VCPA) - D35-26 (VCPA)	Always	Below 1 ohms
A18-3 (VPA2) - D35-19 (VPA2)	Always	Below 1 ohms
A18-2 (EPA2) - D35-21 (EPA2)	Always	Below 1 ohms
A18-1 (VCP2) - D35-27 (VCP2)	Always	Below 1 ohms

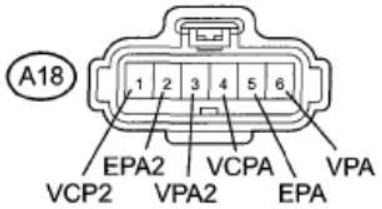
Check for short

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
A18-6 (VPA) or D35-18 (VPA) - Body ground	Always	10 kohms or higher
A18-5 (EPA) or D35-20 (EPA) - Body ground	Always	10 kohms or higher
A18-4 (VCPA) or D35-26 (VCPA) - Body ground	Always	10 kohms or higher
A18-3 (VPA2) or D35-19 (VPA2) - Body ground	Always	10 kohms or higher
A18-2 (EPA2) or D35-21 (EPA2) - Body ground	Always	10 kohms or higher
A18-1 (VCP2) or D35-27 (VCP2) - Body ground	Always	10 kohms or higher

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Front view of wire harness connector:
(to Accelerator Pedal Position Sensor)



Rear view of wire harness connector:
(to ECM)

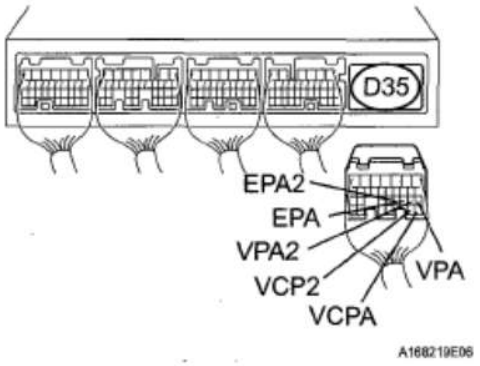


Fig. 212: Identifying Accelerator Pedal Position Sensor And ECM Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

d. Reconnect the accelerator pedal position sensor connector.
e. Reconnect the ECM connector.

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR (ACCELERATOR PEDAL POSITION SENSOR - ECM)

OK: Go to next step

4. **REPLACE ACCELERATOR PEDAL ROD**
   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 on (IG) and turn the tester on.
   c. Clear the DTCs (See **DTC CHECK/CLEAR**).
   d. Start the engine.
   e. Allow the engine to idle for 15 seconds.

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f. Select the following menu items: Powertrain/Engine and ECT/Trouble Codes.
g. Read the DTCs.

Result

RESULT CHART

Display (DTC Output)	Proceed to
P2121	A
No output	B

B: SYSTEM OK

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); DTC P2197 OXYGEN (A/F) SENSOR SIGNAL STUCK LEAN (BANK 2 SENSOR 1); DTC P2198 OXYGEN (A/F) SENSOR SIGNAL STUCK RICH (BANK 2 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 sensor and heater portions are narrower than the conventional type. The heat generated by the heater is conducted to the solid electrolyte through the alumina, therefore the sensor activation is accelerated.

A three-way catalytic converter is used in order to convert the carbon monoxide (CO), hydrocarbon, and nitrogen oxides (HOx) 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.

*: Value changes inside the ECM. Since the air fuel ratio sensor is the current output element, a current is converted to a voltage inside the ECM. Any measurements taken at the air fuel ratio sensor or ECM connectors will show a constant voltage.

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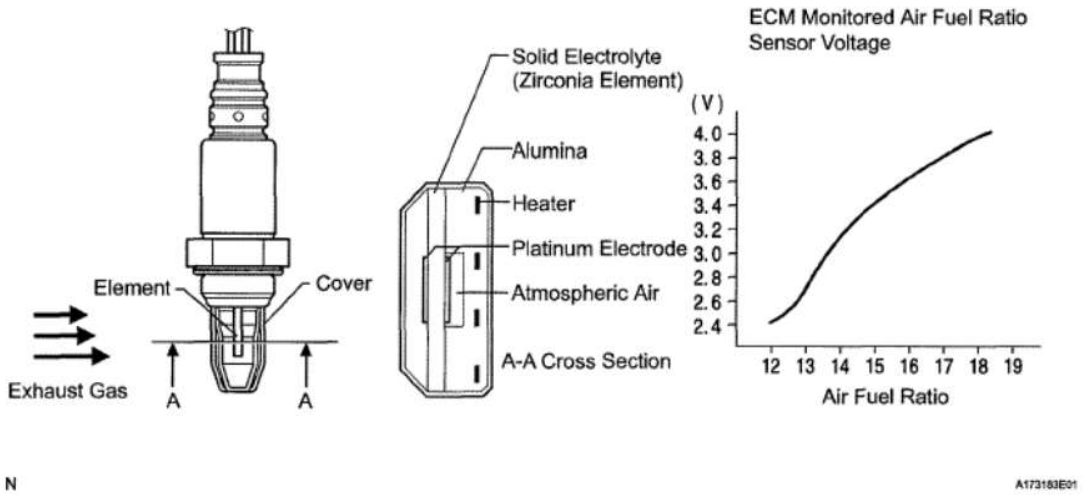


Fig. 213: Identifying Oxygen (A/F) Sensor Components
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

DTC DETECTION CONDITION CHART

DTC No.	DTC Detection Condition	Trouble Area
P2195 P2197	Conditions (a) and (b) continue for 2 seconds or more (2 trip detection logic): a. Air fuel ratio sensor voltage is more than 3.8 V b. Heated oxygen sensor voltage is 0.21 V or more	• Open or short in air fuel ratio sensor (bank 1, 2 sensor 1) circuit • Air fuel ratio sensor (bank 1, 2 sensor 1) • Air fuel ratio sensor (bank 1, 2 sensor 1) heater • Intake system • Fuel pressure • Injector • ECM
P2195 P2197	While fuel-cut operation is 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 • ECM
P2196 P2198	Conditions (a) and (b) continue for 2 seconds or more (2 trip detection logic): a. Air fuel ratio sensor voltage is less than 2.8 V b. Heated oxygen sensor voltage is less than 0.6 V	• Open or short in air fuel ratio sensor (bank 1, 2 sensor 1) circuit • Air fuel ratio sensor (bank 1, 2 sensor 1) • Air fuel ratio sensor (bank 1, 2 sensor 1) heater • Intake system • Fuel pressure

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		• Injector • ECM
P2196 P2198	While fuel-cut operation is performed (during vehicle deceleration), air fuel ratio sensor current is less than 1.4 mA for 3 seconds (2 trip detection logic)	• Air fuel ratio sensor • ECM

HINT:

- DTCs P2195 and P2196 indicate malfunctions related to the bank 1 air fuel ratio sensor circuit.
- DTCs P2197 and P2198 indicate malfunctions related to the bank 2 air fuel ratio sensor circuit.
- Bank 1 refers to the bank that includes cylinder No. 1.
- Bank 2 refers to the bank that includes cylinder No. 2.
- When any of these DTCs are set, check the air fuel ratio sensor voltage output by selecting the following menu items on the Techstream: Powertrain/Engine and ECT/Data List/A/F Control System/AFS Voltage B1 S1 or AFS Voltage B2 S1.
- Short-term fuel trim values can also be read using the Techstream.
- The ECM regulates the voltages at the A1A+, A2A+, A1 A- and A2A- 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 sets a DTC.

Example:

If the air fuel ratio sensor voltage output is less than 2.8 V (very rich condition) for 10 seconds, despite the heated oxygen sensor voltage output being less than 0.6 V, the ECM sets DTC P2196. Alternatively, if the air fuel ratio sensor voltage output is more than 3.8 V (very lean condition) for 10 seconds, despite the heated oxygen sensor voltage output being 0.15 V or more, DTC P2195 is set.

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 more for more than 3 seconds of cumulative time, the ECM interprets this as a malfunction in the air fuel ratio sensor and sets DTC P2195 (high-side stuck). If the air fuel

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ratio sensor output is 1.0 mA or less for more than 3 seconds of cumulative time, the ECM sets DTC P2196 (low-side stuck).

Air-fuel Ratio Sensor Current Monitor: Cumulative Time "t" = t1 + t2 = 3 seconds or more

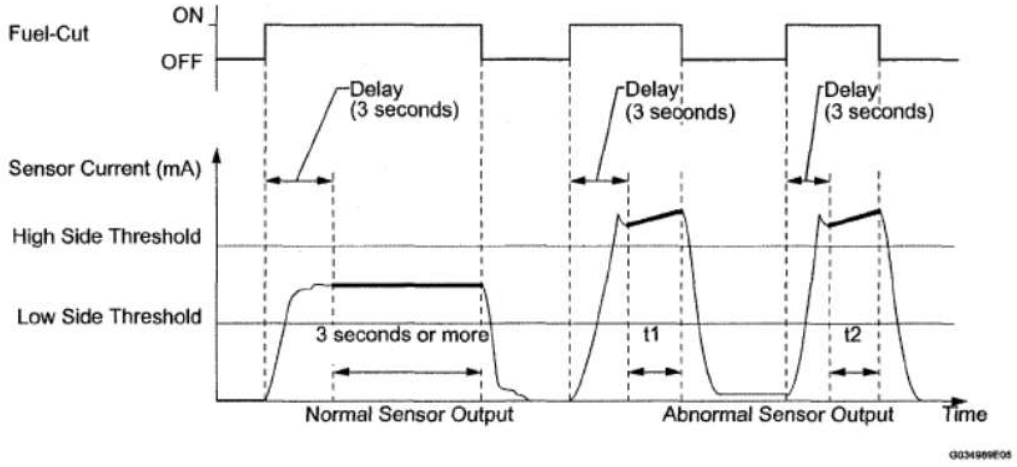


Fig. 214: Air-Fuel Ratio Sensor Current Monitor Graph
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

MONITOR STRATEGY

MONITOR STRATEGY REFERENCE CHART

Related DTCs	P2195: Air fuel ratio sensor (Bank 1) signal stuck lean P2196: Air fuel ratio sensor (Bank 1) signal stuck rich P2197: Air fuel ratio sensor (Bank 2) signal stuck lean P2198: Air fuel ratio sensor (Bank 2) signal stuck rich
Required Sensors/Components (Main)	Air fuel ratio sensor
Required Sensors/Components (Related)	Heated oxygen sensor
Frequency of Operation	Continuous
Duration	Sensor voltage detection monitor: 10 seconds Sensor current detection monitor: 3 seconds
MIL Operation	2 driving cycles
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

All:

TYPICAL ENABLING CONDITIONS CHART

	P0016, P0018 (VVT system bank 1, 2 - misalignment)

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The monitor will run whenever these DTCs are not present	P0017, P0019 (Exhaust VVT system bank 1,2 - misalignment) P0031, P0032, P0051, P0052 (A/F sensor heater) P0100, P0102, P0103 (MAF meter) P0110, P0112, P0113 (IAT sensor) P0115, P0117, P0118 (ECT sensor) P0120, P0121, P0122, P0123, P0220, P0222, P0223, P2135 (TP sensor) P0125 (Insufficient ECT for closed loop) P0128 (Thermostat) P0171, P0172, P0174, P0175 (Fuel system) P0301, P0302, P0303, P0304, P0305, P0306 (Misfire) P0335 (CKP sensor) P0450, P0451, P0452, P0453 (EVAP system) P0500 (Vehicle speed sensor) P0505 (Idle speed control) (IAC valve)

Sensor voltage detection monitor (Lean side malfunction P2195, P2197):

TYPICAL ENABLING CONDITIONS CHART

Time after engine start	30 seconds or more
Fuel system status	Closed-loop

Sensor voltage detection monitor (Rich side malfunction P2196, P2198):

TYPICAL ENABLING CONDITIONS CHART

Time after engine start	30 seconds or more
Fuel system status	Closed-loop

Sensor Current detection monitor P2195, P2196, P2197, P2198

TYPICAL ENABLING CONDITIONS CHART

Battery voltage	11 V or more
Atmospheric pressure	0.75 or more
Air fuel ratio sensor status	Activated
Engine coolant temperature	75°C (167°F) or more
Continuous time of fuel-cut	3 to 10 seconds

TYPICAL MALFUNCTION THRESHOLDS

Sensor voltage detection monitor (Lean side malfunction P2195, P2197):

TYPICAL MALFUNCTION THRESHOLDS REFERENCE CHART

Air fuel ratio sensor voltage	More than 3.8 V
Rear HO2S voltage	Rises from less than 0.21 V to 0.59 V or more

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Sensor voltage detection monitor (Rich side malfunction P2196, P2198)

TYPICAL MALFUNCTION THRESHOLDS REFERENCE CHART

Air fuel ratio sensor voltage	Less than 2.8 V
Rear HO2S voltage	Falls from 0.59 V or more to less than 0.21 V

Sensor current detection monitor (High side malfunction P2195, P2197):

TYPICAL MALFUNCTION THRESHOLDS REFERENCE CHART

Air fuel ratio sensor current during fuel cut	3.6 mA or more

Sensor current detection monitor (Rich side malfunction P2196, P2198):

TYPICAL MALFUNCTION THRESHOLDS REFERENCE CHART

Air fuel ratio sensor current during fuel cut	Less than 1.4 mA

MONITOR RESULT

Refer to **CHECKING MONITOR STATUS** .

WIRING DIAGRAM

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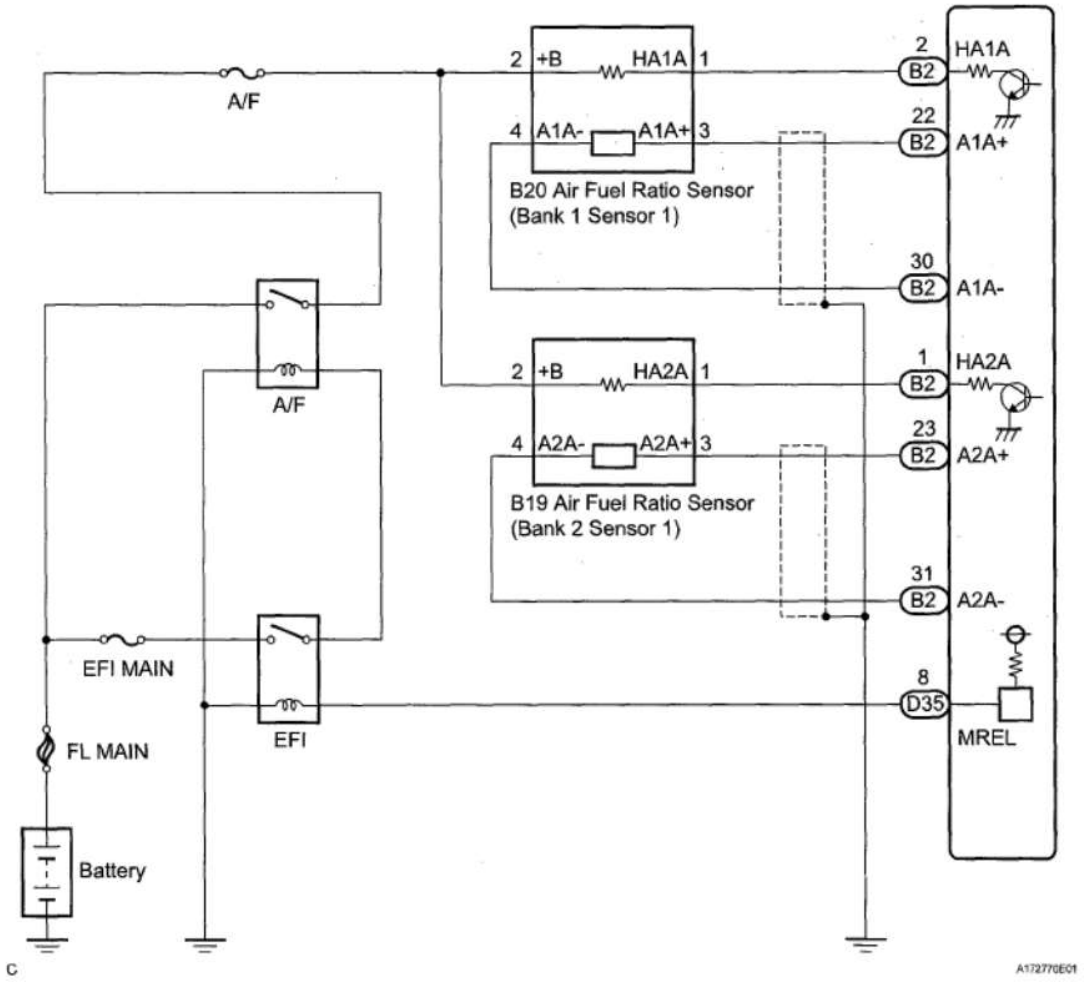


Fig. 215: Oxygen (A/F) Sensor - Wiring Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

CONFIRMATION DRIVING PATTERN

This confirmation driving pattern is used in steps 4, 7, 17, and 21 of the following diagnostic troubleshooting procedure when using the Techstream.

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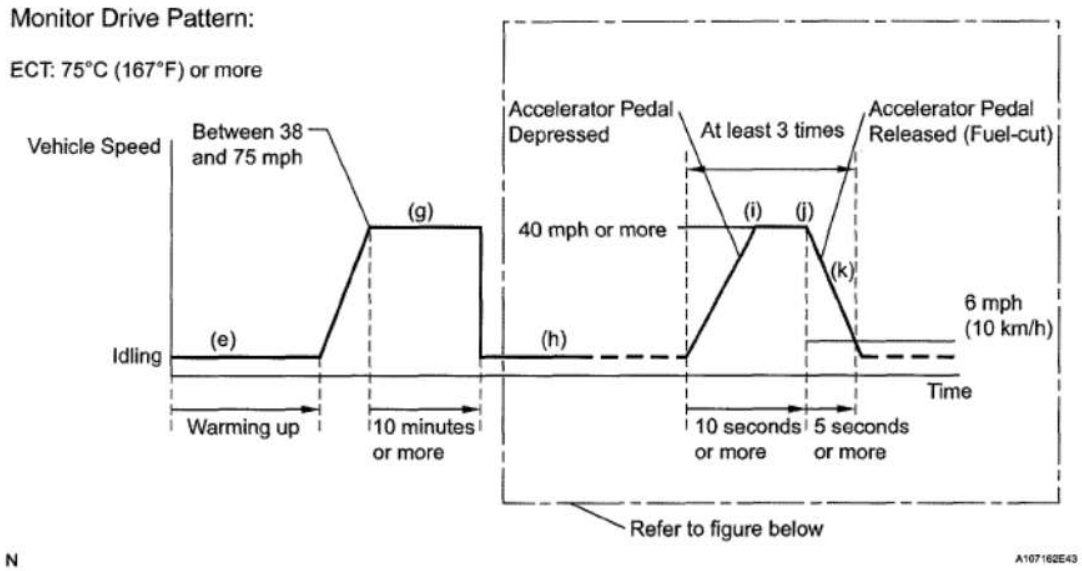


Fig. 216: Monitoring Drive Pattern (1 Of 2)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

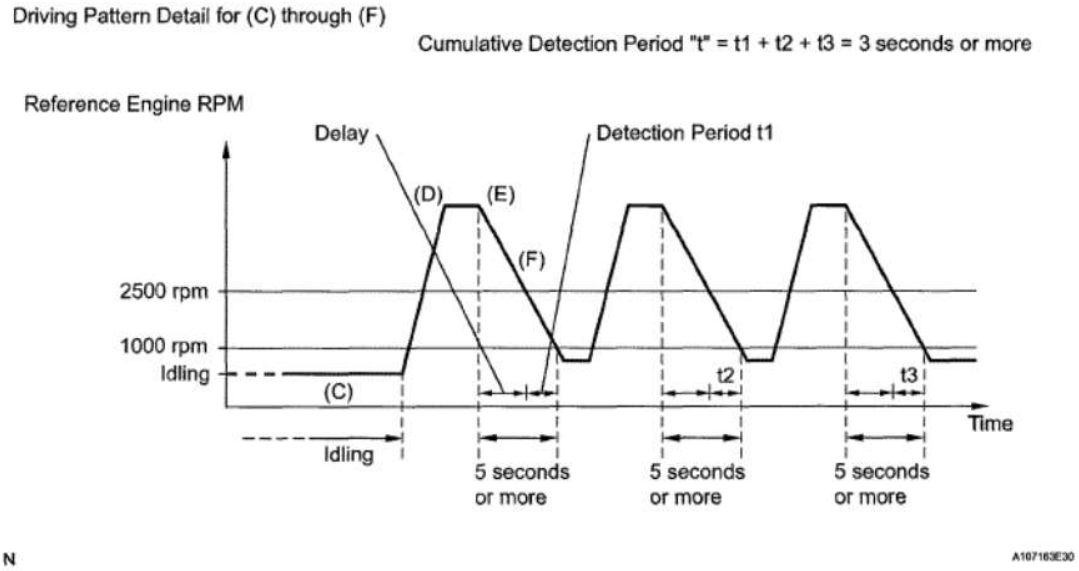


Fig. 217: Monitoring Drive Pattern (2 Of 2)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

1. Connect the Techstream to the DLC3.
2. Turn the ignition switch on (IG).
3. Turn the tester on.
4. Clear the DTCs (See **DTC CHECK/CLEAR**).
5. Start the engine, and warm it up until the ECT reaches 70°C (158°F) or higher (Procedure "A").
6. Select the following menu items: Powertrain/Engine and ECT/Data List/Idle Fuel Cut.

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7. Drive the vehicle at between 38 mph (61 km/h) and 75 mph (120 km/h) for at least 10 minutes (Procedure "B").
8. Change the transmission to the 2nd gear (Procedure "C").
9. Drive the vehicle at a proper vehicle speed to perform fuel-cut operation (refer to the following HINT) (Procedure "D").

   HINT:

   Fuel-cut is performed when the following conditions are met:

   - Accelerator pedal is fully released.
   - Engine speed is 2500 rpm or more (fuel injection resumes at 1000 rpm).
10. Accelerate the vehicle to 40 mph (64 km/h) or more by depressing the accelerator pedal for at least 10 seconds (Procedure "E").
11. Soon after performing procedure "J" on the previous page, release the accelerator pedal for at least 4 seconds without depressing the brake pedal, in order to execute fuel-cut control (Procedure "F").
12. Allow the vehicle to decelerate until the vehicle speed declines to less than 6 mph (10 km/h).
13. Repeat procedures from "H" through "K" in this section at least 3 times per driving cycle.

    HINT:

    Completion of all air fuel ratio sensor monitors is required to change the value in TEST RESULT.

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

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.

a. Connect the Techstream to the DLC3.
b. Start the engine and turn the tester on.
c. Warm up the engine at an engine speed of 2500 rpm for approximately 90 seconds.
d. Select the following menu items: Powertrain/Engine and ECT/Active Test/Control the Injection Volume for A/F Sensor.
e. Perform the Control the Injection Volume for A/F Sensor operation with the engine in an idling condition (press the RIGHT or LEFT button to change the fuel injection volume).

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f. Monitor the voltage outputs of the air fuel ratio and heated oxygen sensors (AFS B1S1 and O2S B1S2 or AFS Voltage B2S1 and O2S B2S2) displayed on the tester.

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.

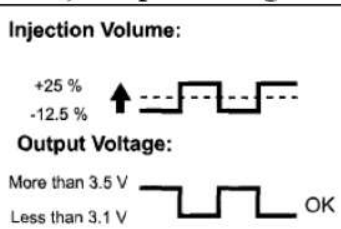
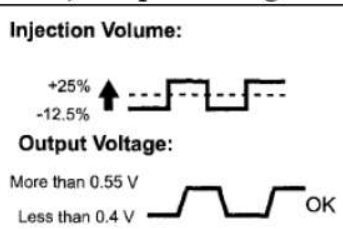
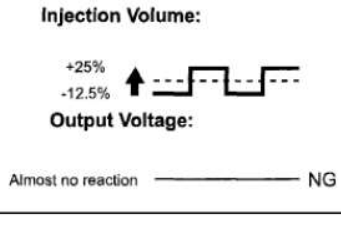
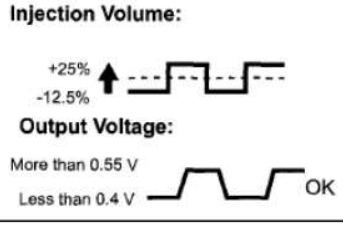
Standard voltage

STANDARD VOLTAGE REFERENCE CHART

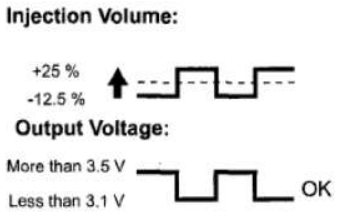
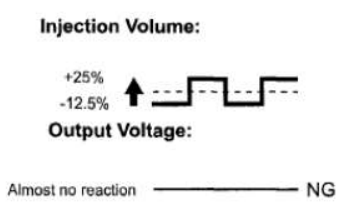
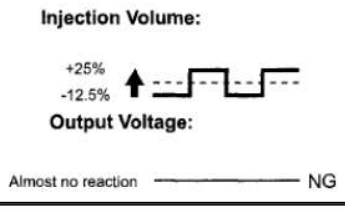
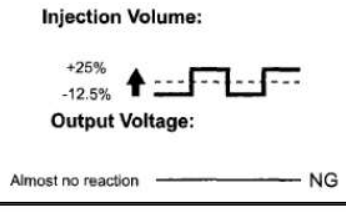
Tester Display	Injection Volumes	Status	Voltages
AFS Voltage B1S1 or AFS Voltage B2S1 (Air fuel ratio)	+25%	Rich	Less than 3.1 V
AFS Voltage B1S1 Voltage or AFS B2S1 (Air fuel ratio)	-12.5%	Lean	More than 3.5 V
O2S B1S2 or O2S B2S2 (Heated oxygen)	+25%	Rich	More than 0.55 V
O2S B1S2 or O2S B2S2 (Heated oxygen)	-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 CHART

Case	Air Fuel Ratio Sensor (Sensor 1) Output Voltage	Heated Oxygen Sensor (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 • Heated oxygen sensor

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3			heater • Heated oxygen sensor circuit
4			• Fuel pressure • Gas leakage from exhaust system (Air fuel ratio extremely lean or rich)

- 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, select the following menu items on the tester: Control the Injection Volume for A/F Sensor/A/F Control System/AFS Voltage B1 S1 or AFS Voltage B2 S1 and O2S B1 S2 or O2S B2 S2. 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 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, P2196, P2197 OR P2198)**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch on (IG).
   c. Turn the tester on.
   d. Select the following menu items: Powertrain/Engine and ECT/Trouble Codes.
   e. Read the DTCs.

Result

RESULT CHART

Display (DTC Output)	Proceed to
P2195, P2196, P2197 or P2198	A
P2195, P2196, P2197 or P2198 and other DTCs	B

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HINT:

If any DTCs other than P2195, P2196, P2197 or P2198 are output, troubleshoot those DTCs first.

B: GO TO **DTC CHART**

A: Go to next step

2. **READ VALUE USING TECHSTREAM (TEST VALUE OF AIR FUEL RATIO SENSOR)**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch on (IG) and turn the tester on.
   c. Clear the DTCs (See **DTC CHECK/CLEAR**).
   d. Allow the vehicle to drive in accordance with the driving pattern described in the **CONFIRMATION DRIVING PATTERN**.
   e. Select the following menu items: Powertrain/Engine and ECT/Monitor/O2 Sensor.
   f. Check that the status of O2 Sensor is Complete. If the status is still Incomplete, drive the vehicle according to the driving pattern again.
   g. Select the following menu items: Powertrain/Engine and ECT/Monitor/O2 Sensor/Details/RANGE B1S1.
   h. Check the test value of the air fuel ratio sensor output current during fuel-cut.

Result

RESULT CHART

Test Value	Proceed to
Within normal range (1.4 mA or more, and less than 3.6 mA)	A
Outside normal range (Less than 1.4 mA, or 3.6 mA or more)	B

B: Go to step 19

A: Go to next step

3. **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 tester on.
   d. Warm up the air fuel ratio sensor at an engine speed of 2500 rpm for 90 seconds.
   e. Select the following menu items on the tester: Powertrain/Engine and ECT/Data List/A/F Control System/AFS Voltage B1 S1 or AFS Voltage B2 S1 and Engine Speed.
   f. Check the air fuel ratio sensor voltage 3 times, when the engine is in each of the following conditions:
      1. While idling (check for at least 30 seconds) (Step (1))
      2. At an engine speed of approximately 2500 rpm (without any sudden changes in engine

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speed) (Step (2))

3. Raise the engine speed to 4000 rpm and then quickly release the accelerator pedal so that the throttle valve is fully closed (Step (3)).

Standard voltage

STANDARD VOLTAGE REFERENCE CHART

Conditions	Air Fuel Ratio Sensor Voltage Variations	Reference
Steps (1) and (2)	Changes at approximately 3.3 V	Between 3.1 V and 3.5 V
Step (3)	Increases to 3.8 V or more	This occurs during engine deceleration (when fuel-cut performed)

HINT:

For more information, see the diagrams below.

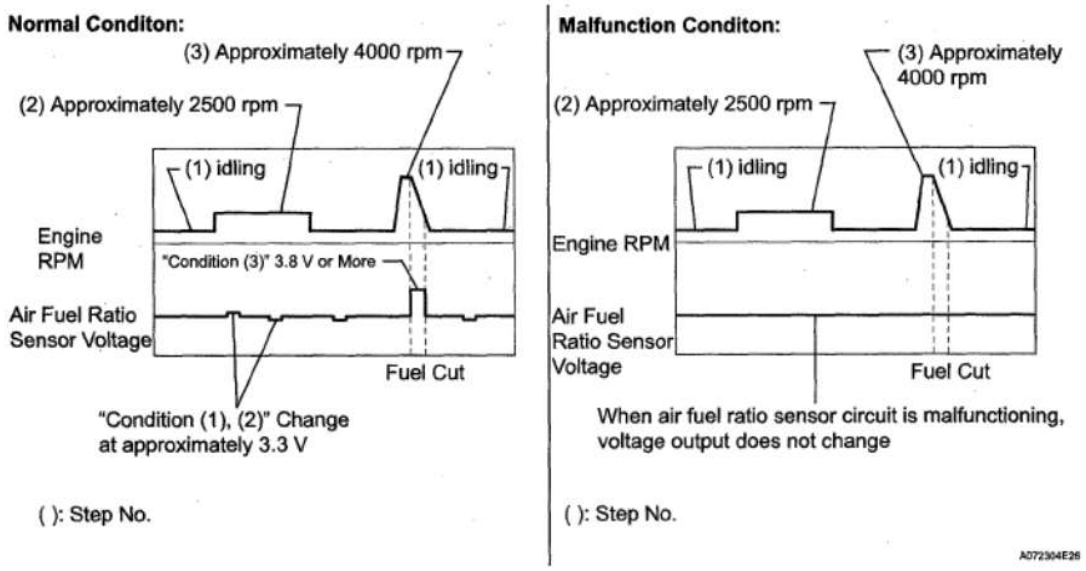


Fig. 218: Air Fuel Ratio Sensor Voltage Output (Normal And Malfunction Condition)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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 described on the previous page, 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 more, or 2.8 V or less (see Malfunction Condition diagram) under any conditions,

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including those described on the previous page, the air fuel ratio sensor may have a short circuit.

- The ECM stops fuel injection (fuel cut) during engine deceleration. This causes a lean 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

4. **PERFORM CONFIRMATION DRIVING PATTERN**
5. **CHECK WHETHER DTC OUTPUT RECURS (DTC P2195, P2196, P2197 OR P2198)**
   a. Read DTCs using the Techstream.
   b. Select the following menu items: Powertrain/Engine and ECT/Trouble Code/Pending.

Result

RESULT CHART

Display (DTC Output)	Proceed to
P2195, P2196, P2197 or P2198	A
No output	B

B: Go to step 9

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**
8. **CHECK WHETHER DTC OUTPUT RECURS (DTC P2195, P2196, P2197 OR P2198)**
   a. Read the DTCs using the Techstream.

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b. Select the following menu items: Powertrain/Engine and ECT/Trouble Code/Pending.

Result

RESULT CHART

Display (DTC Output)	Proceed to
No output	A
P2195, P2196, P2197 or P2198	B

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

A: END

9. **CONFIRM WHETHER VEHICLE HAS RUN OUT OF FUEL IN PAST**
   a. Has the vehicle run out of fuel in the past?

NO: CHECK FOR INTERMITTENT PROBLEMS

YES: DTC CAUSED BY RUNNING OUT OF FUEL

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:

Bank 1

TESTER CONNECTION SPECIFIED CONDITION CHART

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

Bank 2

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
HA2A (1) - +B (2)	20°C (68°F)	1.8 to 3.4 ohms
HA2A (1) - A2A- (4)	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)

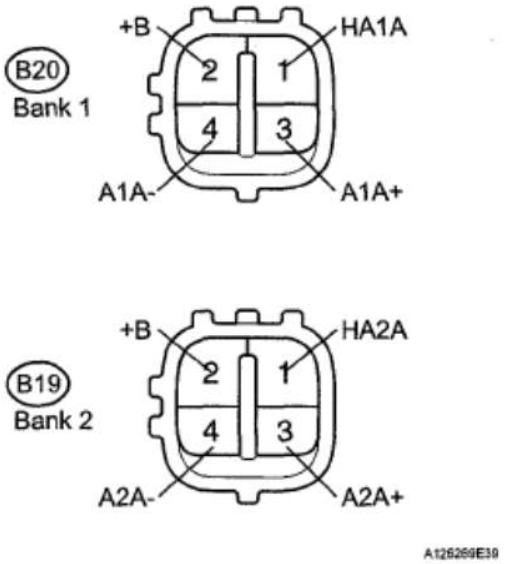


Fig. 219: Identifying Air Fuel Ratio Sensor Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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):

Bank 1

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
B20-1 (HA1A) - B2-2 (HA1A)	Always	Below 1 ohms
B20-3 (A1A+) - B2-22 (A1A+)	Always	Below 1 ohms
B20-4 (A1A-) - B2-30 (A1A-)	Always	Below 1 ohms

Bank 2

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
B19-1 (HA2A) - B2-1 (HA2A)	Always	Below 1 ohms

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B19-3 (A2A+) - B2-23 (A2A+)	Always	Below 1 ohms
B19-4 (A2A-) - B2-31 (A2A-)	Always	Below 1 ohms

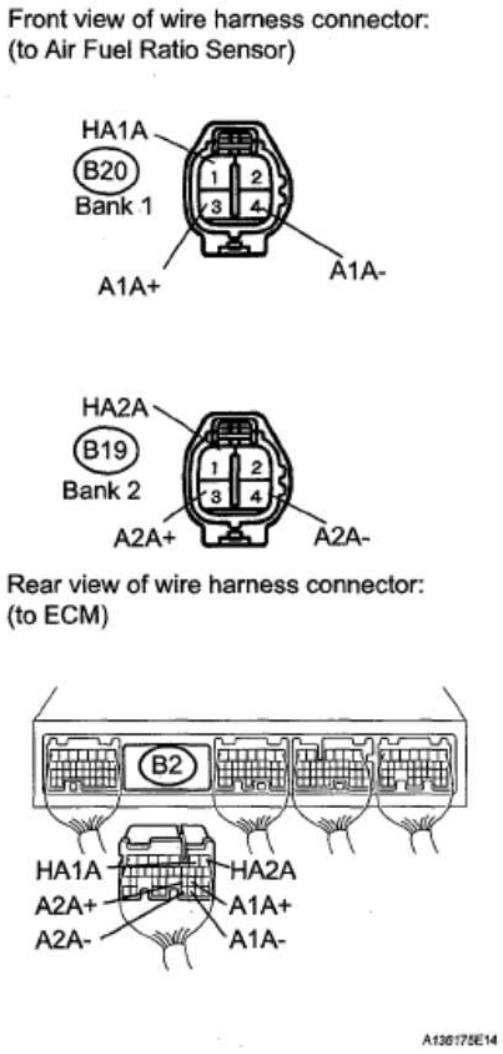


Fig. 220: Identifying Air Fuel Ratio Sensor And ECM Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Standard resistance (Check for short):

Bank 1

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
B20-1 (HA1A) or B2-2 (HA1A) - Body ground	Always	10 kohms or higher
B20-3 (A1A+) or B2-22 (A1A+) - Body ground	Always	10 kohms or higher
B20-4 (A1A-) or B2-30 (A1A-) - Body ground	Always	10 kohms or higher

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Bank 2

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
B19-1 (HA2A) or B2-1 (HA2A) - Body ground	Always	10 kohms or higher
B19-3 (A2A+) or B2-23 (A2A+) - Body ground	Always	10 kohms or higher
B19-4 (A2A-) or B2-31 (A2A-) - Body ground	Always	10 kohms or higher

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

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR (AIR FUEL RATIO SENSOR - ECM)

OK: Go to next step

12. **CHECK INTAKE SYSTEM**
    a. Check the intake system for vacuum leakage.

    OK:

    No leakage from intake system.

    NG: REPAIR OR REPLACE INTAKE SYSTEM

    OK: Go to next step

13. **CHECK FUEL PRESSURE (HIGH PRESSURE SIDE AND LOW PRESSURE SIDE)**
    a. Check the fuel pressure (See **ON-VEHICLE INSPECTION**).

    NG: REPAIR OR REPLACE FUEL SYSTEM

    OK: Go to next step

14. **INSPECT FUEL INJECTOR ASSEMBLY**
    a. Check the injector injection (whether fuel volume is high or low, and whether injection pattern is poor) (See **INSPECTION**).

    NG: REPLACE FUEL INJECTOR ASSEMBLY (See **FUEL INJECTOR**)

    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**

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17. **CHECK WHETHER DTC OUTPUT RECURS (DTC P2195, P2196, P2197 OR P2198)**
    a. Connect the Techstream to the DLC3.
    b. Select the following menu items: Powertrain/Engine and ECT/Trouble Codes/Pending.

    Result

    RESULT CHART

Display (DTC Output)	Proceed to
No output	A
P2195, P2196, P2197 or P2198	B

    B: REPLACE ECM AND PERFORM CONFIRMATION DRIVING PATTERN

    A: END

18. **REPLACE AIR FUEL RATIO SENSOR**
    a. Replace the air fuel ratio sensor (See **REMOVAL**).
19. **PERFORM CONFIRMATION DRIVING PATTERN**
20. **CHECK WHETHER DTC OUTPUT RECURS (DTC P2195, P2196, P2197 OR P2198)**
    a. Connect the Techstream to the DLC3.
    b. Turn the ignition switch on (IG) and turn the tester on.
    c. Read the DTCs using the Techstream.
    d. Select the following menu items: Powertrain/Engine and ECT/Trouble Codes/Pending.

    Result

    RESULT CHART

Display (DTC Output)	Proceed to
No output	A
P2195, P2196, P2197 or P2198 (Air fuel ratio sensor pending DTCs)	B

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

    A: END

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 P2240 OXYGEN (A/F) SENSOR PUMPING CURRENT CIRCUIT/OPEN (BANK 2 SENSOR 1);
DTC P2241 OXYGEN (A/F) SENSOR PUMPING CURRENT CIRCUIT LOW (BANK 2 SENSOR 1);
DTC P2242 OXYGEN (A/F) SENSOR PUMPING CURRENT CIRCUIT HIGH (BANK 2 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);
DTC P2255 OXYGEN (A/F) SENSOR REFERENCE GROUND CIRCUIT LOW (BANK 2 SENSOR 1);

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DTC P2256 OXYGEN (A/F) SENSOR REFERENCE GROUND CIRCUIT HIGH (BANK 2 SENSOR 1)

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.

DESCRIPTION

Refer to **DTC P2195** .

DTC DETECTION CONDITION CHART

DTC No.	DTC Detection Condition	Trouble Area
P2237 P2240	Open in the circuit between terminals A1A+ and A1A-/A2A+ and A2A- the air fuel ratio sensor while engine running. (2 trip detection logic)	• Open or short in air fuel ratio sensor (bank 1, 2 sensor 1) circuit • Air fuel ratio sensor (bank 1, 2 sensor 1) • ECM
P2238 P2241	• Condition (a) or (b) continues for 5.0 seconds or more (2 trip detection logic): a. Voltage at terminal A1A+/A2A+ is 0.5 V or less. b. Voltage difference between terminals A1A+ and A1A-/A2A+ and A2A- is 0.1 V or less.	• Open or short in air fuel ratio sensor (bank 1, 2 sensor 1) circuit • Air fuel ratio sensor (bank 1, 2 sensor 1) • ECM
P2239 P2242	A1A+/A2A+ voltage is more than 4.5 V for 5.0 seconds or more (2 trip detection logic)	• Open or short in air fuel ratio sensor (bank 1, 2 sensor 1) circuit • Air fuel ratio sensor (bank 1, 2 sensor 1) • ECM
P2252 P2255	A1A-/A2A- voltage is 0.5 V or less for 5.0 seconds or more (2 trip detection logic)	• Open or short in air fuel ratio sensor (bank 1, 2 sensor 1) circuit • Air fuel ratio sensor (bank 1, 2 sensor 1) • ECM
P2253 P2256	A1A-/A2A- voltage is more than 4.5 V for 5.0 seconds or more (2 trip detection logic)	• Open or short in air fuel ratio sensor (bank 1, 2 sensor 1) circuit • Air fuel ratio sensor (bank

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		1, 2 sensor 1) • ECM

HINT:

- DTC P2237, P2238, P2239, P2252 and P2253 indicate malfunctions related to the bank 1 air fuel ratio sensor circuit.
- DTC P2240, P2241, P2242, P2255 and P2256 indicate malfunctions related to the bank 2 air fuel ratio sensor circuit.
- Bank 1 refers to the bank that includes cylinder No. 1.
- Bank 2 refers to the bank that includes cylinder No. 2.

MONITOR DESCRIPTION

The air fuel ratio sensor varies its output voltage in proportion to the air fuel ratio. If the air fuel ratio sensor impedance (alternating current resistance) or voltage output deviates greatly from the standard range, the ECM determines that there is an open or short malfunction in the air fuel ratio sensor circuit.

MONITOR STRATEGY

MONITOR STRATEGY REFERENCE CHART

Related DTCs	P2237: Air fuel ratio sensor (Bank 1) open circuit between A1A+ and A1A- P2238: Air fuel ratio sensor (Bank 1) short circuit between A1A+ and A1A- P2238: Air fuel ratio sensor (Bank 1) short circuit between A1A+ and GND P2239: Air fuel ratio sensor (Bank 1) short circuit between A1A+ and +B P2240: Air fuel ratio sensor (Bank 2) open circuit between A2A+ and A2A- P2241: Air fuel ratio sensor (Bank 2) short circuit between A2A+ and A2A- P2241: Air fuel ratio sensor (Bank 2) short circuit between A2A+ and GND P2242: Air fuel ratio sensor (Bank 2) short circuit between A2A+ and +B P2252: Air fuel ratio sensor (Bank 1) short circuit between A1A- and GND P2253: Air fuel ratio sensor (Bank 1) short circuit between A1A- and +B P2255: Air fuel ratio sensor (Bank 2) short circuit between A2A- and GND P2256: Air fuel ratio sensor (Bank 2) short circuit between A2A- and +B
Required Sensors/Components (Main)	Air fuel ratio sensor
Required Sensors/Components (Related)	Engine coolant temperature sensor, Crankshaft position sensor

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Frequency of Operation	Continuous
Duration	P2238 and P2241: 10 seconds Others: 5 seconds
MIL Operation	2 driving cycles
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

TYPICAL ENABLING CONDITIONS CHART

The monitor runs whenever following DTCs are not present	P0016, P0018 (VVT system bank 1, 2 - misalignment) P0017, P0019 (Exhaust VVT system bank 1, 2 - misalignment) P0031, P0032, P0051, P0052 (A/F sensor heater) P0100, P0102, P0103 (MAF meter) P0110, P0112, P0113 (IAT sensor) P0115, P0117, P0118 (ECT sensor) P0120, P0121, P0122, P0123, P0220, P0222, P0223, P2135 (TP sensor) P0125 (Insufficient ECT for closed loop) P0128 (Thermostat) P0171, P0172, P0174, P0175 (Fuel system) P0301, P0302, P0303, P0304, P0305, P0306 (Misfire) P0335 (CKP sensor) P0450, P0451, P0452, P0453 (EVAP system) P0500 (Vehicle speed sensor) P0505 (Idle speed control) (IAC valve)

P2237 and P2240 (Air fuel ratio sensor open circuit between A1A+ and A1A-/A2A+ and A2A-):

TYPICAL ENABLING CONDITIONS CHART

Estimated sensor temperature	450 to 550°C (842 to 1022°F)
Engine	Running
Battery voltage	11 V or more

P2238 and P2241 (open circuit between A1A+ and A1A-/A2A+ and A2A-):

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

Others:

TYPICAL ENABLING CONDITIONS CHART

Battery voltage	11 V or more

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Ignition switch	on (IG)
Time after ignition switch is OFF to ON (IG)	5 seconds or more

TYPICAL MALFUNCTION THRESHOLDS

P2237 and P2240 (Open circuit between A1A+ and A1A-/A2A+ and A2A-):

TYPICAL MALFUNCTION THRESHOLDS REFERENCE CHART

Air fuel ratio sensor admittance	Below 0.002 1/ohms

P2238 and P2241 (Open circuit between A1A+ and A2A-):

TYPICAL MALFUNCTION THRESHOLDS REFERENCE CHART

A/F sensor admittance	Below 0.022 1/ohms

P2238 and P2241 (Short circuit between A1A+ and GND/A2A+ and GND):

TYPICAL MALFUNCTION THRESHOLDS REFERENCE CHART

A1A+/A2A+ terminal voltage	0.5 V or less

P2238 and P2241 (Short circuit between A1A+ and A1A-/A2A+ and A2A-):

TYPICAL MALFUNCTION THRESHOLDS REFERENCE CHART

Difference between A1A+ and A1A-/A2A+ and A2A-terminal voltage	0.1 V or less

P2239 and P2242 (Short circuit between A1A+ and +B/A2A+ and +B):

TYPICAL MALFUNCTION THRESHOLDS REFERENCE CHART

A1A+/A2A+ terminal voltage	More than 4.5 V

P2252 and P2255 (Short circuit between A1A- and GND/A2A- and GND):

TYPICAL MALFUNCTION THRESHOLDS REFERENCE CHART

A1A-/A2A- terminal voltage	0.5 V or less

P2253 and P2256 (Short circuit between A1A- and +B/A2A- and +B):

TYPICAL MALFUNCTION THRESHOLDS REFERENCE CHART

A1A-/A2A- terminal voltage	More than 4.5 V

WIRING DIAGRAM

Refer to **DTC P2195** .

INSPECTION PROCEDURE

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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.

a. Connect the Techstream to the DLC3.
b. Start the engine and turn the tester on.
c. Warm up the engine at an engine speed of 2500 rpm for approximately 90 seconds.
d. Select the following menu items: Powertrain/Engine and ECT/Active Test/Control the Injection Volume for A/F Sensor.
e. Perform the Control the Injection Volume for A/F Sensor operation with the engine in an idling condition (press the RIGHT or LEFT button to change the fuel injection volume).
f. Monitor the voltage outputs of the air fuel ratio and heated oxygen sensors (AFS B1S1 and O2S B1S2 or AFS B2S1 and O2S B2S2) displayed on the tester.

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.

Standard voltage

STANDARD VOLTAGE REFERENCE CHART

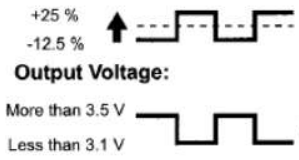
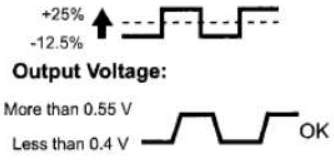
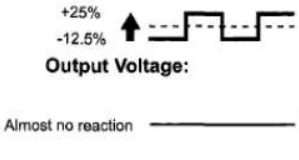
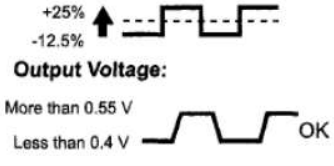
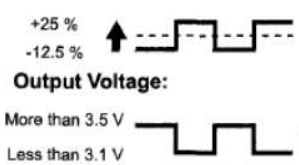
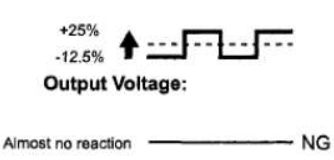
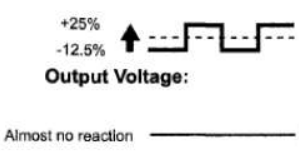
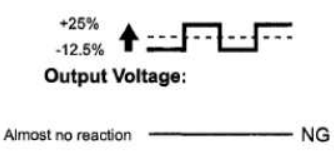
Tester Display	Injection Volumes	Status	Voltages
AFS B1S1 or AFS B2S1 (Air fuel ratio)	+25%	Rich	Less than 3.1 V
AFS B1S1 or AFS B2S1 (Air fuel ratio)	-12.5%	Lean	More than 3.5 V
O2S B1S2 or O2S B2S2 (Heated oxygen)	+25%	Rich	More than 0.55 V
O2S B1S2 or O2S B2S2 (Heated oxygen)	-12.5%	Lean	Less than 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 CHART

Case	Air Fuel Ratio Sensor (Sensor 1) Output Voltage Heated Oxygen Sensor (Sensor 2) Output Voltage	Main Suspected	Trouble Area

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1	Injection Volume: 	Injection Volume: 	-
2	Injection Volume: 	Injection Volume: 	• Air fuel ratio sensor • Air fuel ratio sensor heater • Air fuel ratio sensor circuit
3	Injection Volume: 	Injection Volume: 	• Heated oxygen sensor • Heated oxygen sensor heater • Heated oxygen sensor circuit
4	Injection Volume: 	Injection Volume: 	• Fuel pressure • Gas leakage from exhaust system (Air fuel ratio extremely lean or rich)

- 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, select the following menu items on the tester: Control the Injection Volume for A/F Sensor/A/F Control System/AFS B1 S1 or AFS B2 S1 and O2S B1 S2 or O2S B2 S2. 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 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 HARNESS AND CONNECTOR (AIR FUEL RATIO SENSOR - ECM)**

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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):

Bank 1

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Specified Condition
B20-3 (A1A+) - B2-22 (A1A+)	Below 1 ohms
B20-4 (A1A-) - B2-30 (A1A-)	Below 1 ohms

Bank 2

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Specified Condition
B19-3 (A2A+) - B2-23 (A2A+)	Below 1 ohms
B19-4 (A2A-) - B2-31 (A2A-)	Below 1 ohms

Standard resistance (Check for short):

Bank 1

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Specified Condition
B20-3 (A1A+) or B2-22 (A1A+) - Body ground	10 kohms or higher
B20-4 (A1A-) or B2-30 (A1A-) - Body ground	10 kohms or higher

Bank 2

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Specified Condition
B19-3 (A2A+) or B2-23 (A2A+) - Body ground	10 kohms or higher
B19-4 (A2A-) or B2-31 (A2A-) - Body ground	10 kohms or higher

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

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR (AIR FUEL RATIO SENSOR - ECM)

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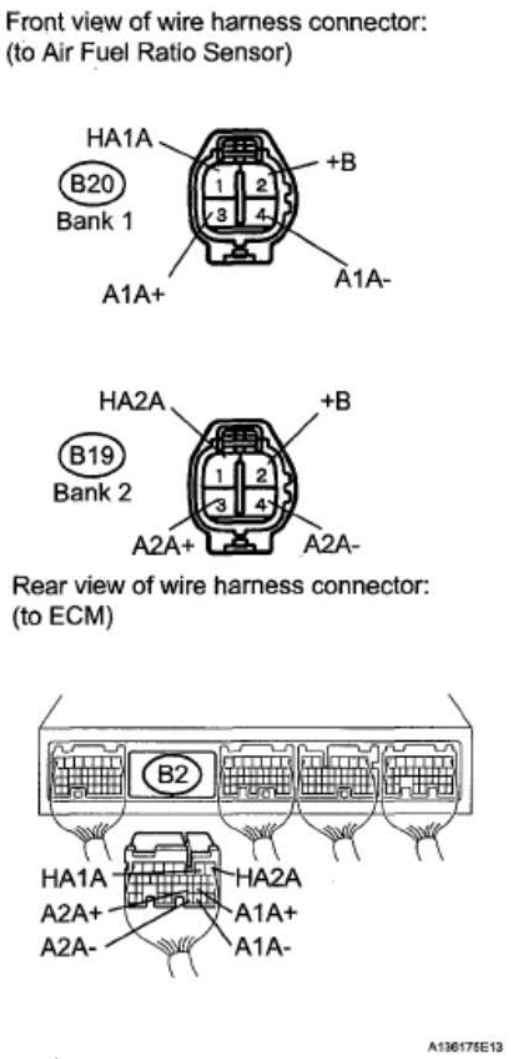


Fig. 221: Identifying Air Fuel Ratio Sensor And ECM Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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. Drive the vehicle referring the Confirmation Driving Pattern on DTC P2195 (See **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); DTC P2197 OXYGEN (A/F) SENSOR SIGNAL STUCK LEAN (BANK 2 SENSOR 1); DTC P2198 OXYGEN (A/F) SENSOR SIGNAL STUCK RICH (BANK 2 SENSOR 1)**).
4. **CHECK WHETHER DTC OUTPUT RECURS**
   a. Connect the Techstream to the DLC3.

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b. Turn the ignition switch on (IG).
c. Turn the tester on.
d. Select the following menu items: Powertrain/Engine and ECT/Trouble Codes/Pending.
e. Read pending DTCs.

Result

RESULT CHART

Result	Proceed to
No output	A
P2237, P2238, P2239, P2240, P2241, P2242, P2252, P2253, P2255 or P2256	B

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

A: END

DTC P2420 EVAPORATIVE EMISSION SYSTEM SWITCHING VALVE CONTROL CIRCUIT HIGH

DTC SUMMARY

DTC SUMMARY

DTC No.	Monitoring Item	DTC Detection Condition	Trouble Area	Detection Timing	Detection Logic
P2420	Vent valve stuck open (vent)	The following condition is met during key-off EVAP monitor • EVAP pressure change when vent valve is closed (ON) less than 2.3 mmHg	• Canister pump module (0.02 inch orifice, vacuum pump, vent valve) • Connector/wire harness (Canister pump module - ECM) • ECM	Ignition switch off	2 trip

DESCRIPTION

The circuit description can be found in the EVAP (Evaporative Emission) System (See **EVAP SYSTEM**).

INSPECTION PROCEDURE

Refer to the **EVAP SYSTEM** .

MONITOR DESCRIPTION

5 hours*1 after the ignition switch is turned off, the electric vacuum pump creates negative pressure (vacuum) in the EVAP (Evaporative Emission) system. The ECM monitors for leaks and actuator malfunctions based on the

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EVAP pressure.

HINT:

*1: 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.

MONITOR DESCRIPTION CHART

Sequence	Operation	Description	Duration
-	ECM activation	Activated by soak timer, 5 hours (7 or 9.5 hours) after ignition switch is turned off.	-
A	Atmospheric pressure measurement	Vent valve turned is OFF (vent) and EVAP system pressure is measured by ECM in order to register atmospheric pressure. If pressure in EVAP system is not between 70 kPa and 110 kPa (525 mmHg and 825 mmHg), ECM cancels EVAP system monitor.	10 seconds
B	First 0.02 inch leak pressure measurement	In order to determine 0.02 inch leak pressure standard, vacuum pump creates negative pressure (vacuum) through 0.02 inch orifice and then ECM checks if vacuum pump and vent valve operate normally.	60 seconds
C	EVAP system pressure measurement	Vent valve is turned ON (closed) to shut EVAP system. Negative pressure (vacuum) is created in EVAP system, and then EVAP system pressure is measured. Write down measured value as they 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 is opened and then EVAP system pressure is measured by ECM. Large increase indicates normal.	10 seconds
E	Second 0.02 inch leak pressure measurement	After second 0.02 inch leak pressure measurement, leak check is performed by comparing first and second 0.02 inch leak pressure standards. If stabilized system pressure is higher than second 0.02 inch leak pressure standard, ECM determines that there is a leak in EVAP system.	60 seconds
F	Final check	Atmospheric pressure is measured and then monitoring result is 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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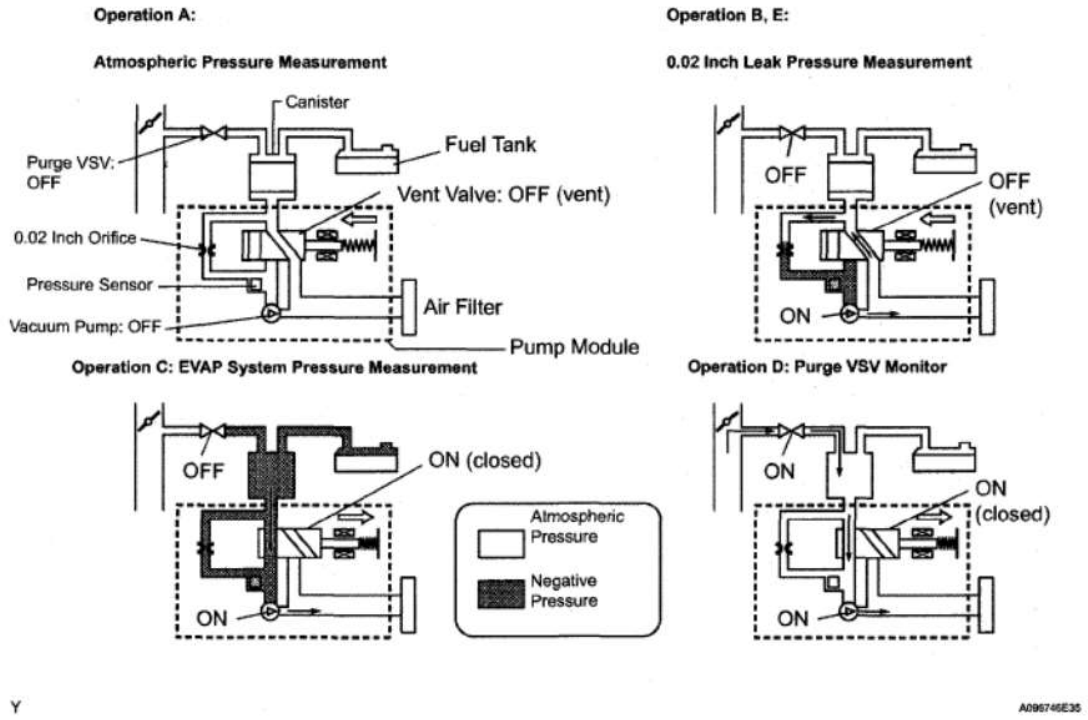


Fig. 222: Atmospheric Pressure Measurement Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

The vent valve turns ON (closes) and the EVAP (Evaporative Emission) system pressure is then measured by the ECM, using the 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 sets the DTC.

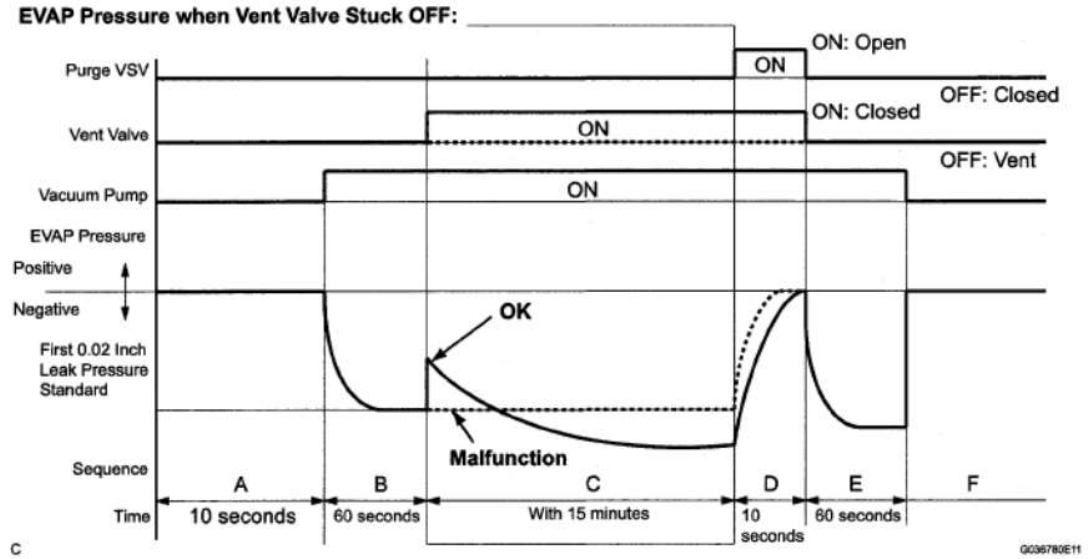


Fig. 223: EVAP Pressure Pattern (Vent Valve Stuck OFF)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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MONITOR STRATEGY

MONITOR STRATEGY REFERENCE CHART

Related DTC	P2420: Vent valve stuck open (vent)
Required Sensors/Components	Purge VSV and 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

The monitor will run whenever these DTCs are not present	None
Atmospheric pressure	70 to 110 kPa (525 to 825 mmHg)
Battery voltage	10.5 V or more
Vehicle speed	Less than 2.5 mph (4 km/h)
Ignition switch	off
Time after key-off	5 or 7 or 9.5 hours
EVAP pressure sensor malfunction (P0450, P0452, P0453)	Not detected
EVAP canister purge valve	Not operated by scan tool
EVAP canister vent valve	Not operated by scan tool
EVAP leak detection pump	Not operated by scan tool
Both of the following conditions 1 and 2 are set before key-off	-
1. Duration that vehicle 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)

Key-off monitor sequence 1 to 8

1. **Atmospheric pressure measurement**

TYPICAL ENABLING CONDITIONS CHART

Next sequence is run if the following condition is met	-
Atmospheric pressure change	Less than 0.3 kPa (2.25 mmHg) in 1 second

2. **First reference pressure measurement**

TYPICAL ENABLING CONDITIONS CHART

Next sequence is run if the following conditions are met	Condition 1, 2 and 3
1. EVAP pressure just after reference pressure measurement start	-1 kPa (-7.5 mmHg) or less

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2. Reference pressure	-4.85 to -1.057 kPa (-36.384 to -7.929 mmHg)
3. Reference pressure	Saturated within 1 minutes

3. **EVAP canister vent valve close stuck check**

TYPICAL ENABLING CONDITIONS CHART

Next sequence is run if the following condition is met	-
EVAP pressure change after vent valve is ON	0.3 kPa (2.25 mmHg) or more

4. **Vacuum introduction**

TYPICAL ENABLING CONDITIONS CHART

Next sequence is run if the following condition is met	-
EVAP pressure	Saturated within 15 minutes

5. **EVAP canister purge valve close stuck check**

TYPICAL ENABLING CONDITIONS CHART

Next sequence is run if the following condition is met	-
EVAP pressure change after purge valve is open	0.3 kPa (2.25 mmHg) or more

6. **Second reference pressure measurement**

TYPICAL ENABLING CONDITIONS CHART

Next sequence is run if the following conditions are met	Condition 1, 2, 3 and 4
1. EVAP pressure just after reference pressure measurement	-1 kPa (-7.5 mmHg) or less
2. Reference pressure	-4.85 to -1.057 kPa (-36.384 to -7.929 mmHg)
3. Reference pressure	Saturated
4. Difference between first reference pressure and second reference pressure	Less than 0.7 kPa (5.25 mmHg)

7. **Leak check**

TYPICAL ENABLING CONDITIONS CHART

Next sequence is run if the following condition is met	-
EVAP pressure when vacuum introduction was complete	Lower than second reference pressure

8. **Atmospheric pressure measurement**

TYPICAL ENABLING CONDITIONS CHART

EVAP monitor is complete if the following condition is met	-
Atmospheric pressure difference between sequence 1 and 8	Within 0.3 kPa (2.25 mmHg)

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TYPICAL MALFUNCTION THRESHOLDS

TYPICAL ENABLING CONDITIONS CHART

EVAP pressure change after EVAP canister vent valve is ON	Less than 0.3 kPa (2.25 mmHg)

MONITOR RESULT

Refer to **CHECKING MONITOR STATUS** .

DTC P2610 ECM/PCM INTERNAL ENGINE OFF TIMER PERFORMANCE

DTC SUMMARY

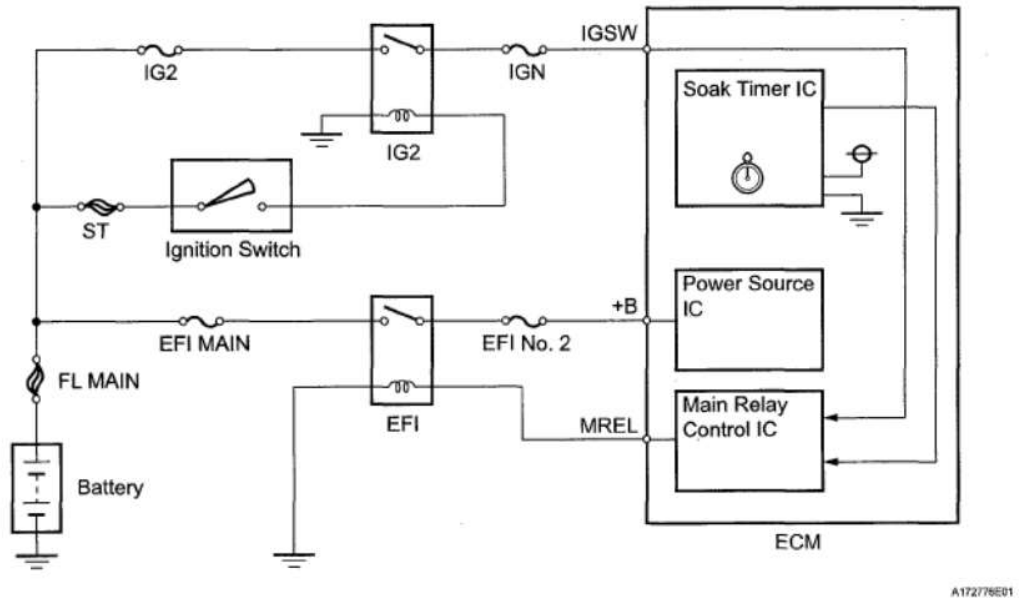
DTC SUMMARY

DTCs	Monitoring Item	Malfunction Detection Condition	Trouble Area	Detection Timing	Detection Logic
P2610	Soak timer (built into ECM)	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 Fuel Tank Pressure (FTP). When 5 hours have elapsed, the ECM turns on.

without Smart Key System:



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Fig. 224: ECM/PCM Internal Engine Circuit Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

MONITOR DESCRIPTION

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 sets the DTC (2 trip detection logic).

MONITOR STRATEGY

MONITOR STRATEGY REFERENCE 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

Case 1:

TYPICAL ENABLING CONDITIONS CHART

The monitor will run whenever these DTCs are not present	None
Ignition switch	ON (IG)
Engine	Running
Battery voltage	8 V or more
Starter	OFF

Case 2:

TYPICAL ENABLING CONDITIONS CHART

Internal engine OFF timer (elapsed time from engine stop)	10 to 30 minutes
Battery voltage	8 V or more
Ignition switch	ON (IG)
Starter	OFF

Case 3:

TYPICAL ENABLING CONDITIONS CHART

Internal engine OFF timer (elapsed time from engine stop)	40 minutes
Battery voltage	8 V or more
Ignition switch	ON (IG)

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Starter	OFF

TYPICAL MALFUNCTION THRESHOLDS

Case 1:

TYPICAL MALFUNCTION THRESHOLDS REFERENCE CHART

Soak timer measurement when ECM CPU clock counts 10 minutes	Less than 7 minutes or more than 13 minutes

Case 2:

TYPICAL MALFUNCTION THRESHOLDS REFERENCE CHART

ECM had the started record by internal engine	Yes

Case 3:

TYPICAL MALFUNCTION THRESHOLDS REFERENCE CHART

ECM had the started record by internal engine	No

INSPECTION PROCEDURE

HINT:

- DTC P2610 is set if an internal ECM problem is detected. Diagnostic procedures are not required. ECM replacement is required.
- 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. **REPLACE ECM**
   a. Replace the ECM (See **REMOVAL**).
2. **CHECK WHETHER DTC OUTPUT RECURS**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch on (IG).
   c. Clear the DTCs (See **DTC CHECK/CLEAR**).
   d. Start the engine and wait for 10 minutes or more.
   e. Select the following menu items: Powertrain/Engine and ECT/Trouble Codes/Pending.
   f. If no pending DTC is displayed, the repair has been successfully completed.

   OK:

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No DTC output.

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

OK: END

DTC P2A00 A/F SENSOR CIRCUIT SLOW RESPONSE (BANK 1 SENSOR 1); DTC P2A03 A/F SENSOR CIRCUIT SLOW RESPONSE (BANK 2 SENSOR 1)

HINT:

- DTC P2A00 indicates malfunctions related to the bank 1 air fuel ratio sensor.
- DTC P2A03 indicates malfunctions related to the bank 2 air fuel ratio sensor.
- Bank 1 refers to the bank that includes cylinder No. 1.
- Bank 2 refers to the bank that includes cylinder No. 2.
- Sensor 1 refers to the sensor mounted in front of the three-way catalytic converter and located near the engine assembly.

DESCRIPTION

Refer to **DTC P2195** .

DTC DETECTION CONDITION CHART

DTC No.	DTC Detection Condition	Trouble Area
P2A00 P2A03	Calculated value for air fuel ratio sensor response rate deterioration level is less than threshold	• Open or short in air fuel ratio sensor circuit • Air fuel ratio sensor • 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 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 ratio control, the ECM forcibly increases and decreases the injection volume to 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 ratio control and uses it to calculate the air fuel ratio sensor response rate deterioration level.

If the value for air fuel ratio sensor response rate deterioration level is less than the threshold, the ECM interprets this as a malfunction and sets the DTC.

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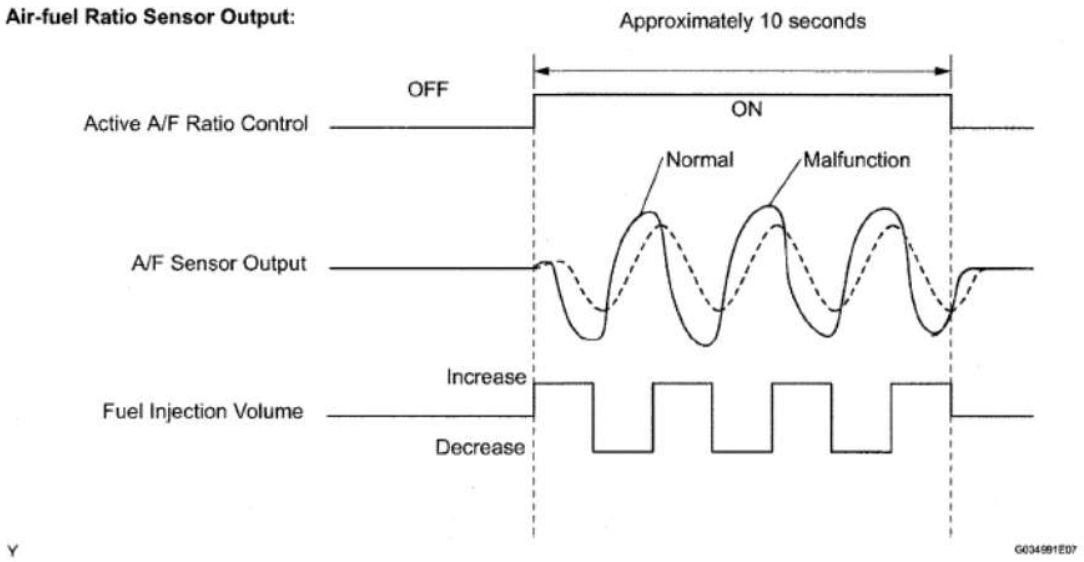


Fig. 225: Air-Fuel Ratio Sensor Output Voltage Graph
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

CONFIRMATION DRIVING PATTERN

HINT:

Performing this confirmation driving pattern will activate the air fuel ratio sensor response monitor.

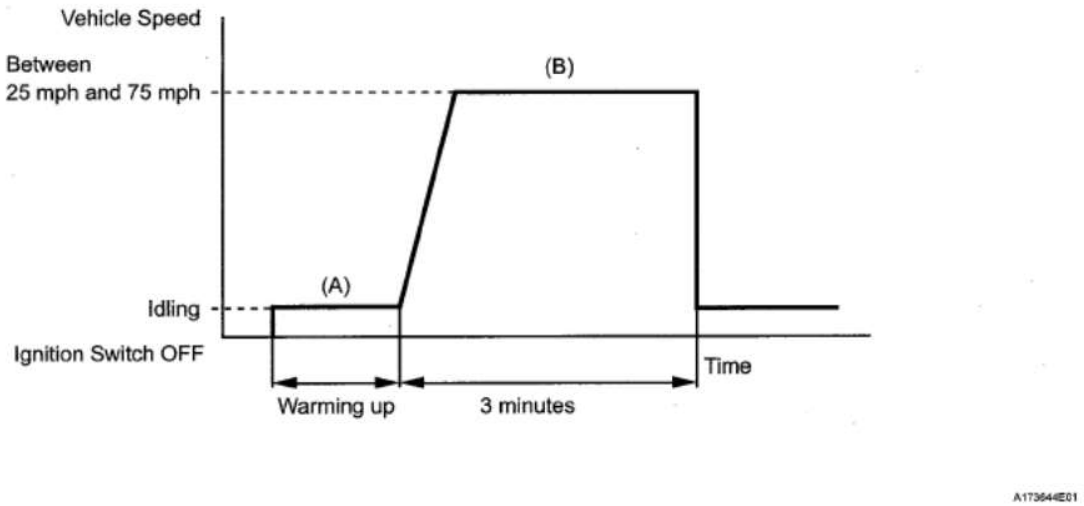


Fig. 226: Vehicle Drive Pattern
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

1. Connect the Techstream to the DLC3.
2. Turn the ignition switch on (IG).
3. Turn the tester on.

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4. Clear the DTCs (where set).
5. Select the following menu items: Powertrain/Engine and ECT/Monitor/O2 Sensor/Details.
6. Check that RES RATE B1S1 and RES RATE B2S1 are Incomplete.
7. Start the engine and warm it up (Procedure "A").
8. Drive the vehicle at between 25 mph and 75 mph (40 km/h and 120 km/h) for 3 minutes. However, the vehicle should be driven at a constant speed (Procedure "B").
9. Check the monitor result values on the Techstream by selecting the following menu items: Powertrain/Engine and ECT/Monitor/O2 Sensor/Details/RES RATE B1S1 and RES RATE B2S1.
10. If the values indicated on the tester do not change, perform READINESS MONITOR DRIVE PATTERN for the air fuel ratio sensor and the heated oxygen sensor (See **READINESS MONITOR DRIVE PATTERN**).

    HINT:

    Completion of all air fuel ratio sensor monitors is required to change the value in test result.

11. Note the value of the Monitor Result.
12. Select the following menu items: Powertrain/Engine and ECT/Trouble Code/Pending.
13. Check if any DTCs (any pending DTCs) are set.

MONITOR STRATEGY

MONITOR STRATEGY REFERENCE CHART

Related DTCs	P2A00: Air fuel ratio sensor (Bank 1) slow response P2A03: Air fuel ratio sensor (Bank 2) slow response
Required Sensors/Components (Main)	Air fuel ratio sensor
Required Sensors/Components (Related)	Vehicle speed sensor, Crankshaft position sensor
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

	P0016, P0018 (VVT system bank 1, 2 - misalignment) P0017, P0019 (Exhaust VVT system bank 1,2 - misalignment) P0031, P0032, P0051, P0052 (A/F sensor heater) P0100, P0102, P0103 (MAF meter) P0110, P0112, P0113 (IAT sensor) P0115, P0117, P0118 (ECT sensor) P0120, P0121, P0122, P0123, P0220, P0222,

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The monitor will run whenever these DTCs are not present	P0223, P2135 (TP sensor) P0125 (Insufficient ECT for closed loop) P0128 (Thermostat) P0171, P0172, P0174, P0175 (Fuel system) P0301, P0302, P0303, P0304, P0305, P0306 (Misfire) P0335 (CKP sensor) P0450, P0451, P0452, P0453 (EVAP system) P0500 (Vehicle speed sensor) P0505 (Idle speed control) (IAC valve)
Active air fuel ratio control	Performing
Active air fuel ratio control is performed when the following conditions are met	-
Battery voltage	11 V or more
Engine coolant temperature	75°C (167°F) or more
Idle	OFF
Engine RPM	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
Mass Air Flow	2.5 to 10g/s

TYPICAL MALFUNCTION THRESHOLDS

TYPICAL MALFUNCTION THRESHOLDS REFERENCE CHART

Response rate deterioration level	Less than 0.18 V

MONITOR RESULT

Refer to **CHECKING MONITOR STATUS** .

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

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using the Techstream.

a. Connect the Techstream to the DLC3.
b. Start the engine and turn the tester on.
c. Warm up the engine at an engine speed of 2500 rpm for approximately 90 seconds.
d. Select the following menu items: Powertrain/Engine and ECT/Active Test/Control the Injection Volume for A/F Sensor.
e. Perform the Control the Injection Volume for A/F Sensor operation with the engine in an idling condition (press the RIGHT or LEFT button to change the fuel injection volume).
f. Monitor the voltage outputs of the air fuel ratio and heated oxygen sensors (AFS B1S1 and O2S B1S2 or AFS B2S1 and O2S B2S2) displayed on the tester.

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.

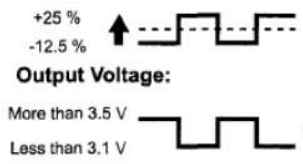
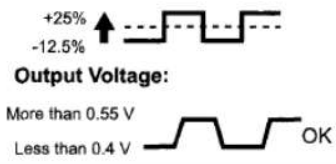
Standard voltage

STANDARD VOLTAGE REFERENCE CHART

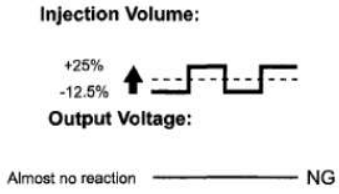
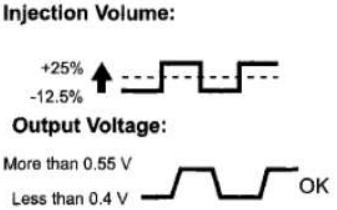
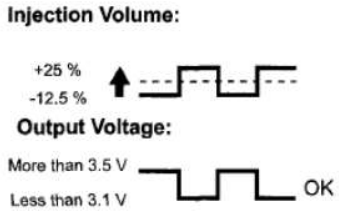
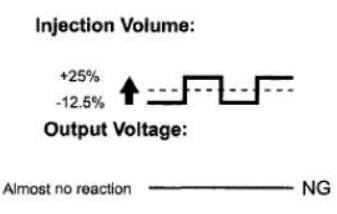
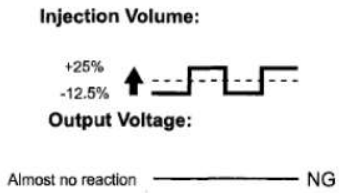
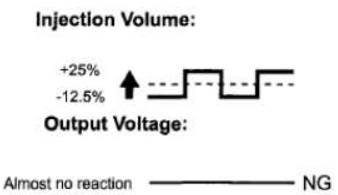
Tester Display	Injection Volumes	Status	Voltages
AFS B1S1 or AFS B2S1 (Air fuel ratio)	+25%	Rich	Less than 3.1 V
AFS B1S1 or AFS B2S1 (Air fuel ratio)	-12.5%	Lean	More than 3.5 V
O2S B1S2 or O2S B2S2 (Heated oxygen)	+25%	Rich	More than 0.55 V
O2S B1S2 or O2S B2S2 (Heated oxygen)	-12.5%	Lean	Less than 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 CHART

Case	Air Fuel Ratio Sensor (Sensor 1) Output Voltage Heated Oxygen Sensor (Sensor 2) Output Voltage	Main Suspected	Trouble Area
1			-
			• Air fuel ratio sensor • Air fuel ratio sensor

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2			heater • Air fuel ratio sensor circuit
3			• Heated oxygen sensor • Heated oxygen sensor heater • Heated oxygen sensor circuit
4			• Fuel pressure • Gas leakage from exhaust system (Air fuel ratio extremely lean or rich)

- 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, select the following menu items on the tester: Control the Injection Volume for A/F Sensor/A/F Control System/AFS B1 S1 or AFS B2 S1 and O2S B1 S2 or O2S B2 S2. 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 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 DTC P2A00 AND/OR P2A03)**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch on (IG).
   c. Turn the tester on.
   d. Select the following menu items: Powertrain/Engine and ECT/Trouble Codes.
   e. Read the DTCs.

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Result

RESULT CHART

Display (DTC Output)	Proceed to
P2A00 and/or P2A03	A
P2A00 and/or P2A03 and other DTCs	B

HINT:

If any DTCs other than P2A00 or P2A03 are output, troubleshoot those DTCs first.

B: GO TO **DTC CHART**

A: Go to next step

2. **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:

Bank 1

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

Bank 2

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
1 (HA2A) - 2 (+B)	20°C (68°F)	1.8 to 3.4 ohms
1 (HA2A) - 4 (A2A-)	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)

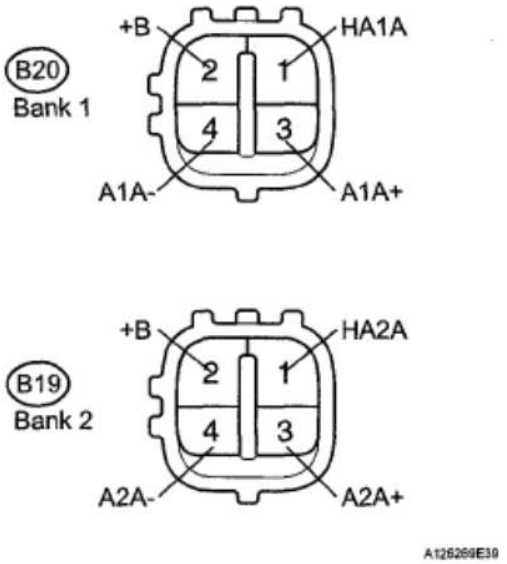


Fig. 227: Identifying Air Fuel Ratio Sensor Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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):

Bank 1

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
B20-3 (A1A+) - B2-22 (A1A+)	Always	Below 1 ohms
B20-4 (A1A-) - B2-30 (A1A-)	Always	Below 1 ohms

Bank 2

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
B19-3 (A2A+) - B2-23 (A2A+)	Always	Below 1 ohms
B19-4 (A2A-) - B2-31 (A2A-)	Always	Below 1 ohms

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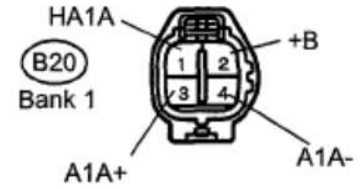
Standard resistance (Check for short):

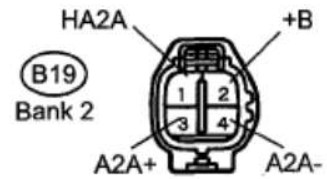
Bank 1

TESTER CONNECTION SPECIFIED CONDITION CHART

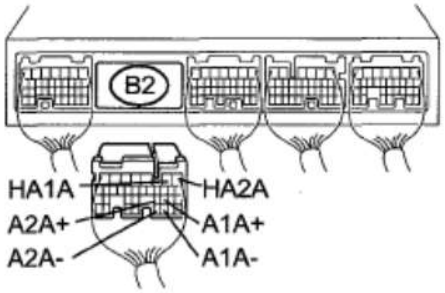
Tester Connection	Condition	Specified Condition
B20-3 (A1A+) or B2-22 (A1A+) - Body ground	Always	10 kohms or higher
B20-4 (A1A-) or B2-30 (A1A-) - Body ground	Always	10 kohms or higher

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





Rear view of wire harness connector:
(to ECM)



A136175E13

Fig. 228: Identifying Air Fuel Ratio Sensor And ECM Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Bank 2

TESTER CONNECTION SPECIFIED CONDITION CHART

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Tester Connection	Condition	Specified Condition
B19-3 (A2A+) or B2-23 (A2A+) - Body ground	Always	10 kohms or higher
B19-4 (A2A-) or B2-31 (A2A-) - Body ground	Always	10 kohms or higher

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

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR (AIR FUEL RATIO SENSOR - ECM)

OK: Go to next step

4. **PERFORM CONFIRMATION DRIVING PATTERN**
5. **CHECK WHETHER DTC OUTPUT RECURS (DTC P2A00 AND/OR P2A03)**
   a. Connect the Techstream to the DLC3.
   b. Select the following menu items: Powertrain/Engine and ECT/Trouble Codes/Pending.

Result

RESULT CHART

Display (DTC Output)	Proceed to
P2A00 and/or P2A03	A
No 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**
8. **CHECK WHETHER DTC OUTPUT RECURS (DTC P2A00 AND/OR P2A03)**
   a. Read the DTCs using the Techstream.
   b. Select the following menu items: Powertrain/Engine and ECT/Trouble Codes/Pending.

Result

RESULT CHART

Display (DTC Output)	Proceed to
No output	A
P2A00 and/or P2A03	B

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B: REPLACE ECM

A: END

ACTIVE CONTROL ENGINE MOUNT SYSTEM

DESCRIPTION

LOCATION

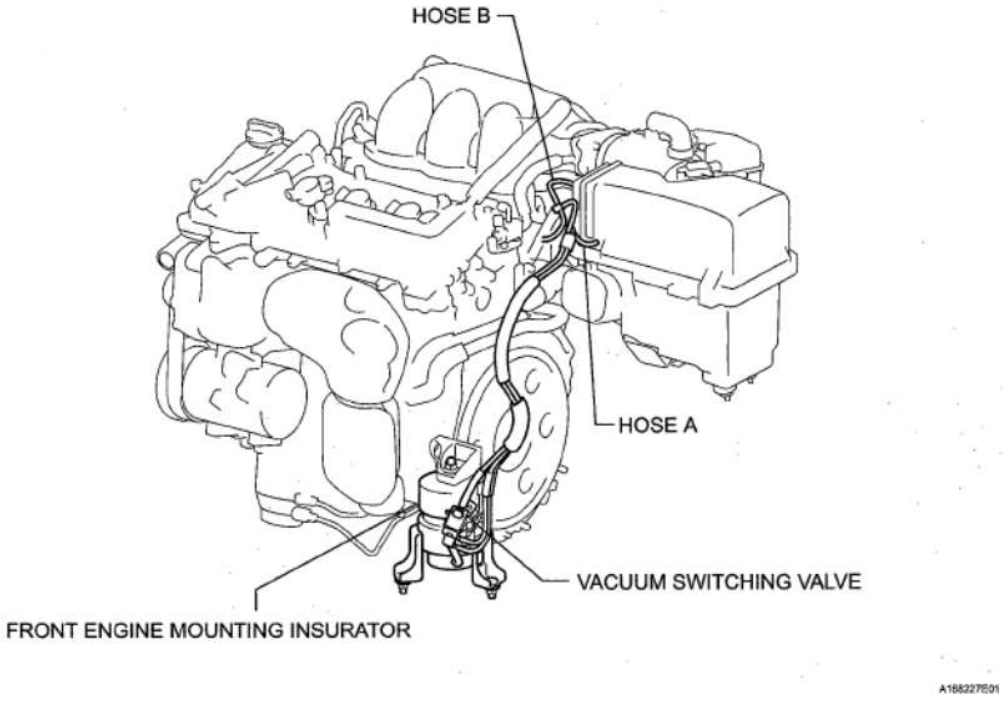


Fig. 229: Identifying Front Engine Mounting Insurator, Vacuum Switching Valve, Hose B And A
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

The Active Control Engine Mount (ACM) system decreases engine vibration at engine idling using the ACM VSV. The VSV is controlled by a pulse signal transmitted to the VSV from the ECM. The frequency of this pulse signal is matched to the engine speed to decrease engine vibration.

WIRING DIAGRAM

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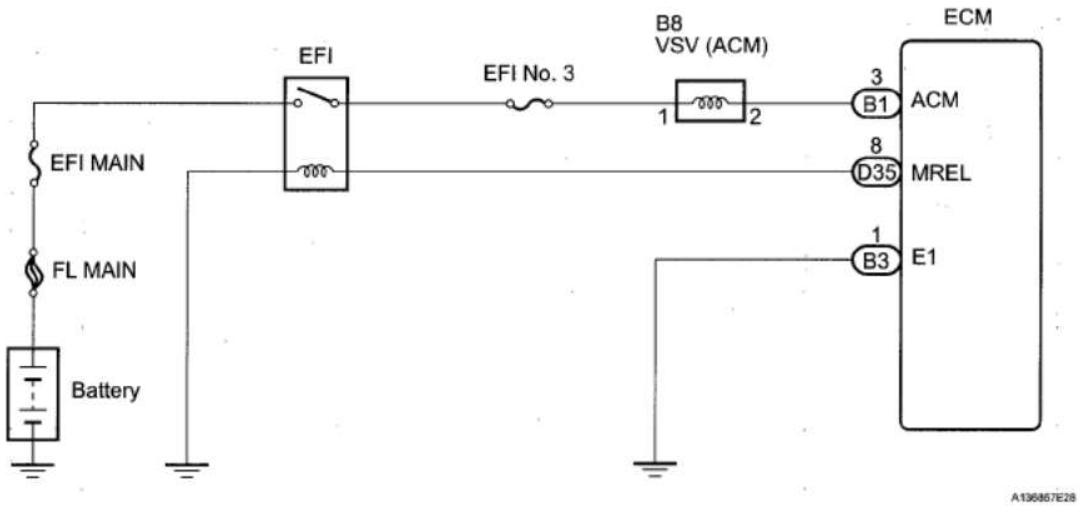


Fig. 230: Active Control Engine Mount - Wiring Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSPECTION PROCEDURE

1. **CHECK VACUUM HOSES**
   a. If the hose is damaged, replace the vacuum hose assembly.
   b. Check the air and vacuum hoses for looseness, disconnection and blockage.

   NG: REPAIR OR REPLACE VACUUM HOSES

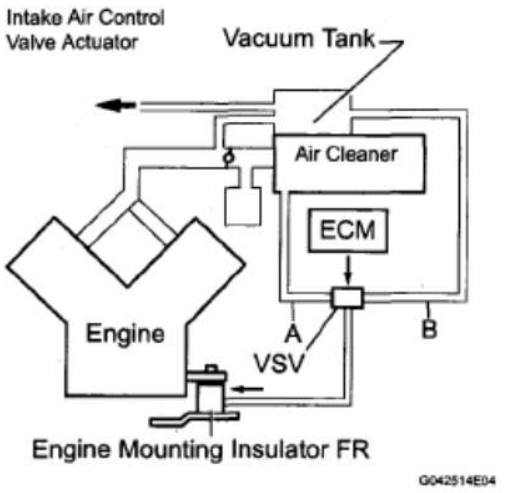


Fig. 231: Checking Air And Vacuum Hoses
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

2. **CHECK VACUUM TANK**

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a. Check the vacuum tank (See **VACUUM TANK**).

NG: REPLACE AIR CLEANER CAP

OK: Go to next step

3. **INSPECT ECM**
   a. Connect the oscilloscope between terminals ACM and E1 of the ECM connectors.
   b. Warm up the engine to normal operating temperature.
   c. Turn the A/C switch on.
   d. Measure the voltage according to the value(s) in the table below.

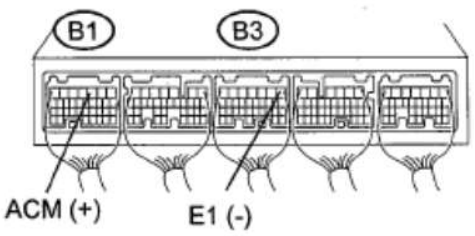
Standard voltage

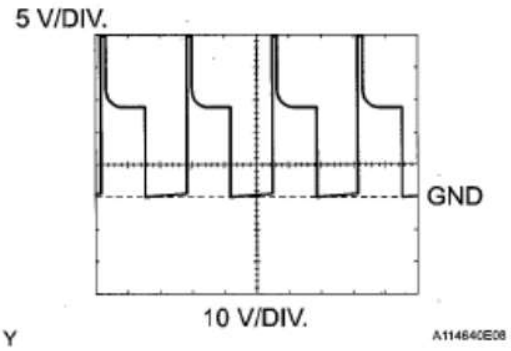
TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
B1-3 (ACM) - B3-1 (E1)	Shift position is D, and engine speed is 850 rpm or less	Pulse generation
	Shift position is D, and engine speed is 950 rpm or more	9 to 14 V
	Shift position is P	9 to 14 V

NG: Go to step 6

Component with harness connected:
(ECM)





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Fig. 232: Identifying ECM B1 And B3 Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

4. **INSPECT DUTY VACUUM SWITCHING VALVE (OPERATION)**
   a. Remove the VSV for ACM.
   b. Check operation of the VSV for ACM when positive battery voltage is applied to the terminals of the VSV for ACM connector.

      Positive battery voltage is not applied:

      The air from pipe G is flowing out through pipes E and H.

      Positive battery voltage is applied:

      The air from pipe F is flowing out through pipes E and H.

   c. Reinstall the VSV for ACM.

      NG: REPLACE DUTY VACUUM SWITCHING VALVE (See **REMOVAL**)

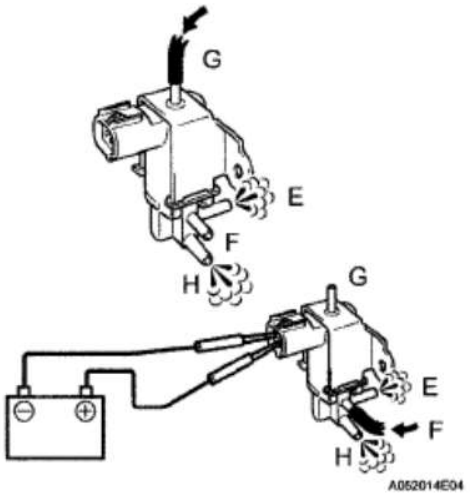


Fig. 233: Inspecting Duty Vacuum Switching Valve Operation
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

5. **INSPECT ENGINE MOUNTING INSULATOR ASSEMBLY FRONT**
   a. Disconnect the vacuum hose from the front engine mount insulator.
   b. Using a vacuum pump, apply vacuum of 80 kPa (600 mmHg, 25 in.Hg) and wait for 1 minute.
   c. Check that there is no change in the needle movement of the vacuum pump gauge.

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d. Check that there is no fluid leakage caused by a break in the diaphragm.

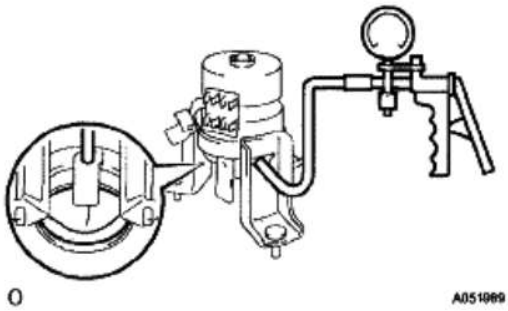


Fig. 234: Inspecting Engine Mounting Insulator Assembly Front
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK:

Vacuum pressure exists.

e. Reconnect the vacuum hose.

NG: REPLACE ENGINE MOUNTING INSULATOR ASSEMBLY FRONT (See **ACTIVE CONTROL ENGINE MOUNT**)

OK: SYSTEM OK

6. **INSPECT DUTY VACUUM SWITCHING VALVE (RESISTANCE)**
   a. Disconnect the VSV for ACM 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 - 2	20°C (68°F)	19 to 21 ohms

   c. Reconnect the VSV for ACM connector.

NG: REPLACE DUTY VACUUM SWITCHING VALVE (See **REMOVAL**)

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Component without harness connected:
(VSV for ACM Connector)

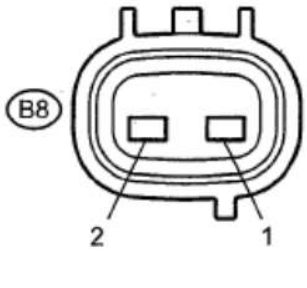


Fig. 235: Identifying VSV For ACM Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

7. **CHECK HARNESS AND CONNECTOR (VSV FOR ACM - ECM)**
   a. Disconnect the VSV for ACM 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
B8-2 - B1-3 (ACM)	Always	Below 1 ohms

Check for open

TESTER CONNECTION SPECIFIED CONDITION CHART

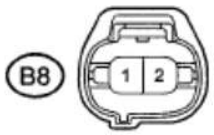
Tester Connection	Condition	Specified Condition
B8-2 or B1-3 (ACM) -Body ground	Always	10 kohms or higher

   d. Reconnect the ECM connector.
   e. Reconnect the VSV connector.

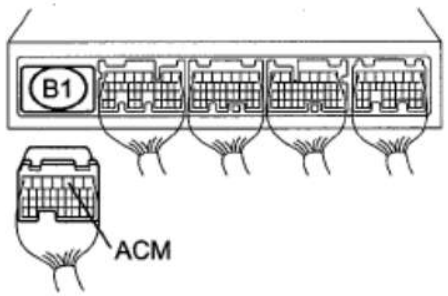
NG: REPAIR OR REPLACE HARNESS OR CONNECTOR (VSV FOR ACM - ECM)

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Front view of wire harness connector:
(to VSV for ACM Connector)



Rear view of wire harness connector:
(to ECM)



A168244E02

Fig. 236: Identifying VSV For ACM And ECM Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

8. **INSPECT FUSE (EFI NO. 3 FUSE)**
   a. Remove the EFI No. 3 fuse 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
EFI No. 3 fuse	Always	Below 1 ohms

   c. Reinstall the EFI No. 3 fuse.

NG: REPLACE FUSE (EFI NO. 3 FUSE)

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Engine Room Relay Block:

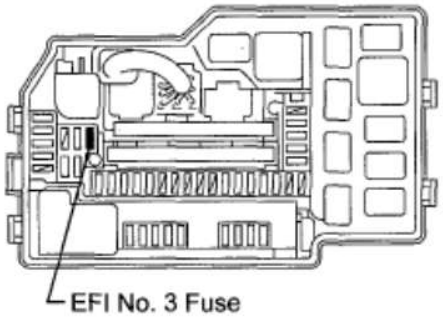


Fig. 237: Identifying EFI No. 3 Fuse
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: REPAIR OR REPLACE HARNESS OR CONNECTOR (EFI NO. 3 FUSE - VSV FOR ACM)

EVAP SYSTEM

RELATED DTCS

RELATED DTCS CHART

DTC	Monitoring Item	See procedure
P043E	0.02 inch orifice clogged (built into pump module)	
P043F	0.02 inch orifice high-flow (built into pump module)	
P0441	• Purge VSV (Vacuum Switching Valve) stuck closed • Purge VSV stuck open • Purge flow	
P0450	Pressure sensor (built into pump module) voltage abnormal fluctuation	
P0451	• Pressure sensor (built into pump module) noise • Pressure sensor (built into pump module) signal becomes fixed/flat	
P0452	Pressure sensor (built into pump module) voltage low	
P0453	Pressure sensor (built into pump module) voltage high	
P0455	EVAP gross leak	
P0456	EVAP small leak	
P2401	Vacuum pump stuck OFF (built into pump module)	
P2402	Vacuum pump stuck ON (built into pump module)	
P2419	Vent valve stuck ON (closed) (built into pump module)	
P2420	Vent valve stuck OFF (vent) (built into pump module)	
P2610	Soak timer (built into ECM)	

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If any EVAP system DTCs are set, the malfunctioning area can be determined using the table below.

DTCs / Malfunctioning Areas	P043E P043F	P0441	P0450	P0451	P0452	P0453	P0455	P0456	P2401 P2402	P2419	P2420
0.02 inch orifice clogged	●								●	●	
0.02 inch orifice high-flow	●								●	●	
Purge VSV stuck open		●					●				
Purge VSV stuck closed		●									
Pressure sensor stuck				●							
Pressure sensor noise				●							
Pressure sensor low output			●		●						
Pressure sensor high output			●			●					
Gross leak		●					●				
Small leak								●			
Vacuum pump stuck OFF	●								●	●	
Vacuum pump stuck ON	●								●	●	
Vent valve stuck ON (closed)	●								●	●	
Vent valve stuck OFF (vent)											●

Y A106731E15

Fig. 238: EVAP System DTC Chart
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

NOTE: If the 0.02 inch reference pressure difference between the first and second checks is greater than the specification, the DTCs corresponding to the reference pressure (P043E, P043F, P0441, P0455, P0456, P2401, P2420) will be all stored.

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:

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1. The vehicle has been driven for 10 minutes or more (in a city area or on a freeway)
2. The fuel tank is less than 90% full
3. The altitude is less than 8000 ft. (2400 m)
4. The Engine Coolant Temperature (ECT) is between 4.4°C and 35°C (40°F and 95°F)
5. The Intake Air Temperature (IAT) is between 4.4°C and 35°C (40°F and 95°F)
6. 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 6 hours (8 or 10.5 hours).

HINT:

Do not start the engine until 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 on (IG) and turn the tester on.
3. Select the following menu items: Powertrain/Engine and ECT/Monitor/Evaporative System.
4. Check the "Monitor Status" displayed on the tester.

HINT:

If Incomplete is displayed, the monitor is not completed. Make sure that the preconditions have been met, and perform "Monitor Conditions" again.

2. **PURGE FLOW MONITOR CONFIRMATION (P0441)**

HINT:

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 ECT is between 4.4°C and 35°C (40°F and 95°F)
- The IAT is between 4.4°C and 35°C (40°F and 95°F)

b. Monitor Conditions

1. Release the pressure from the fuel tank by removing and reinstalling the fuel tank cap.
2. Warm the engine up until the ECT reaches more than 75°C (167°F).

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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.
2. Connect the Techstream to the DLC3.
3. Turn the ignition switch on (IG) and turn the tester on.
4. Select the following menu items: Powertrain/Engine and ECT/Monitor.
5. Check the "Monitor Status" displayed on the tester.

HINT:

If Incomplete is displayed, the monitor is not completed. Make sure that the preconditions have been met, and perform "Monitor Conditions" again.

MONITOR RESULT

Refer to **CHECKING MONITOR STATUS** for detailed information .

The test value and test limit information are described as shown in the following table. This information is included in Monitor Result of the emissions-related DTC sections:

- MID (Monitor Identification Data) is assigned to each emissions-related component.
- TID (Test Identification Data) is assigned to each test value.
- Scaling is used to calculate the test value indicated on generic OBD II scan tools.

Thermostat

THERMOSTAT REFERENCE CHART

MID	TID	Scaling	Description of Test Value	Minimum Test Limit	Maximum Test Limit
$3D	$C9	Multiply by 0.01 [kPa]	Test value for small leak (P0456) Refer to pressure D(1)	Minimum test limit for small leak	Maximum test limit for small leak
$3D	$CA	Multiply by 0.01 [kPa]	Test value for gross leak (P0455) Refer to pressure E(1)	Minimum test limit for gross leak	Maximum test limit for gross leak
$3D	$CB	Multiply by 0.01 [kPa]	Test value for vacuum pump stuck OFF (P2401) Refer to pressure A(1)	Minimum test limit for vacuum pump stuck OFF	Maximum test limit for vacuum pump stuck OFF
$3D	$CD	Multiply by 0.01 [kPa]	Test value for vacuum pump stuck ON (P2402) Refer to pressure A(1)	Minimum test limit for vacuum pump stuck ON	Maximum test limit for vacuum pump stuck ON
$3D	$CE	Multiply by 0.01 [kPa]	Test value for vent valve stuck OFF (vent) (P2420) Refer to pressure C(1)	Minimum test limit for vent valve stuck ON	Maximum test limit for vent valve stuck ON
			Test value for vent valve stuck		

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$3D	$CF	Multiply by 0.01 [kPa]	ON (P2419) Refer to pressure A (1)	Minimum test limit for vent valve stuck OFF	Maximum test limit for vent valve stuck OFF
$3D	$D0	Multiply by 0.01 [kPa]	Test value for 0.02 inch orifice low flow (P043E) Refer to pressure B(1)	Minimum test limit for 0.02 inch orifice low flow	Maximum test limit for 0.02 inch orifice low flow
$3D	$D1	Multiply by 0.01 [kPa]	Test value for 0.02 inch orifice high flow (P043F) Refer to pressure A(1)	Minimum test limit for 0.02 inch orifice high flow	Maximum test limit for 0.02 inch orifice high flow
$3D	$D4	Multiply by 0.01 [kPa]	Test value for purge VSV stuck closed (P0441) Refer to pressure F(1)	Minimum test limit for purge VSV stuck closed	Maximum test limit for purge VSV stuck closed
$3D	$D5	Multiply by 0.01 [kPa]	Test value for purge VSV stuck open (P0441) Refer to pressure E(1)	Minimum test limit for purge VSV stuck open	Maximum test limit for purge VSV stuck open
$3D	$D7	Multiply by 0.01 [kPa]	Test value for purge flow (P0441) Refer to pressure G(1)	Minimum test limit for purge flow	Maximum test limit for purge flow
(1) Pressures A to G are indicated as shown in the diagram below.					

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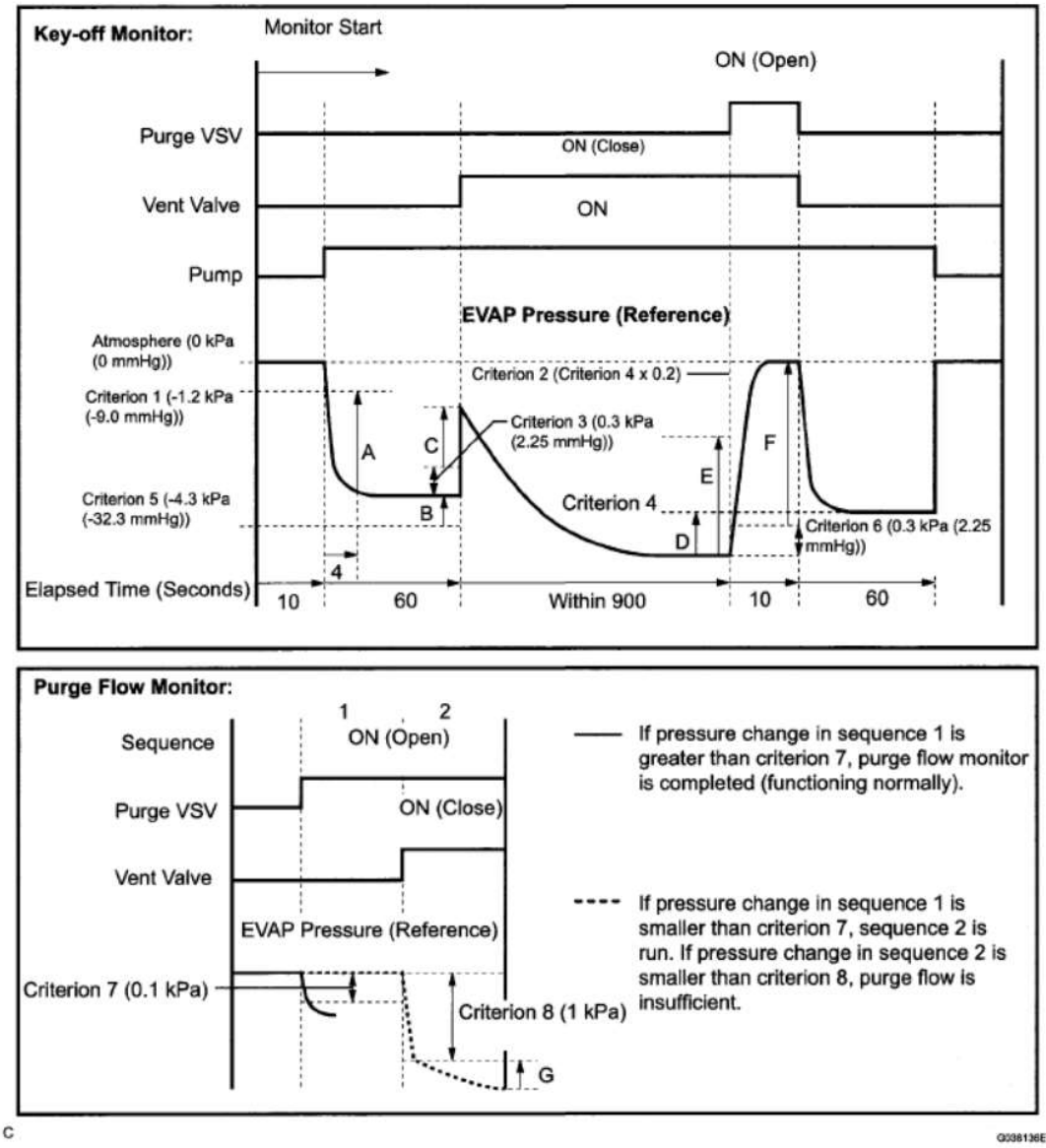


Fig. 239: Key-Off Monitor Driving Pattern
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

DESCRIPTION

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Location of EVAP (Evaporative Emission) System:

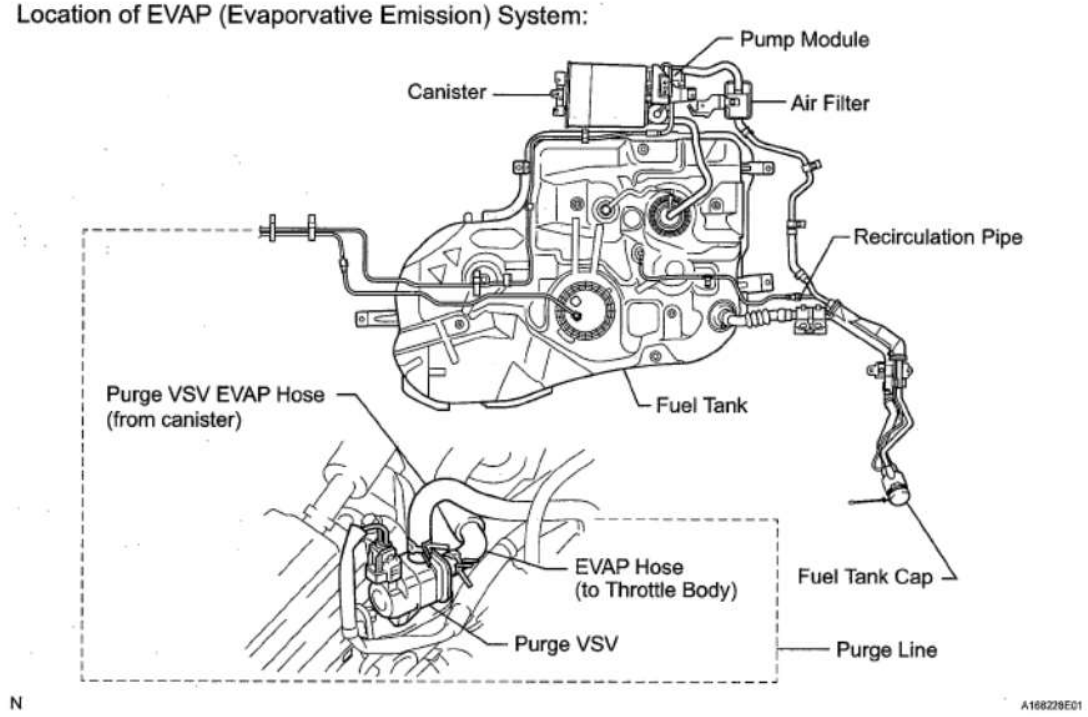


Fig. 240: Identifying EVAP System Component Location
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

EVAP System Circuit:

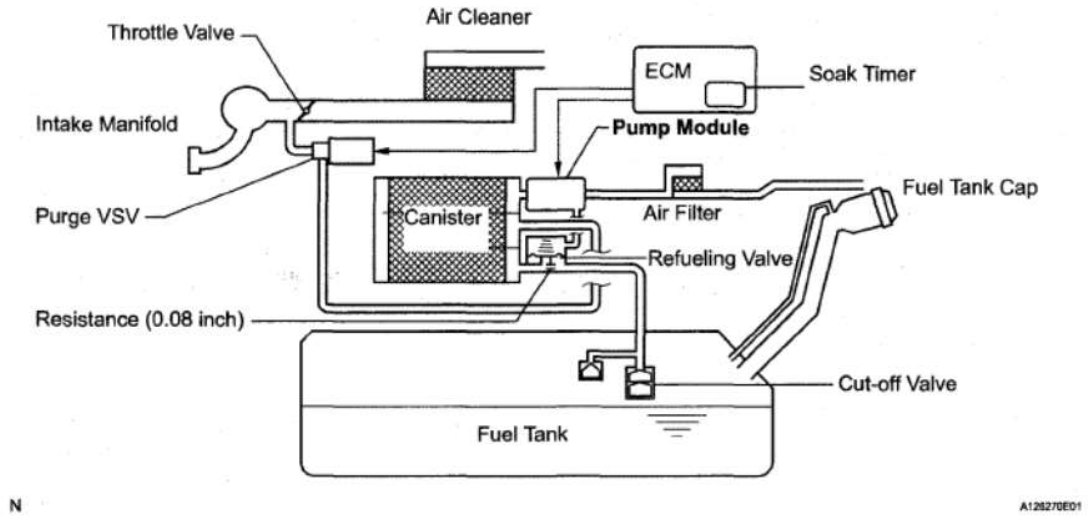


Fig. 241: EVAP System Circuit Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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.

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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 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 electric vacuum 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 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 (3.75 mmHg), the ECM interprets this as the purge VSV being stuck closed, and illuminates the MIL and sets DTC P0441 (2 trip detection logic).

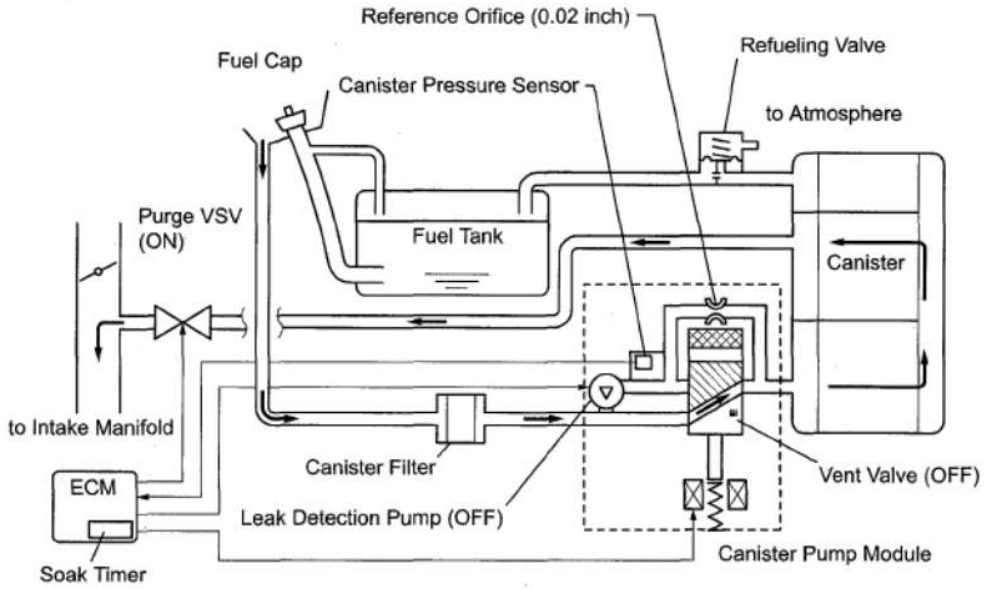
Atmospheric pressure check:

In order to ensure reliable malfunction detection, the variation between the atmospheric pressures, before and after conduction of the purge flow monitor, is measured by the ECM.

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EVAP Purge Flow:



Y

Fig. 242: EVAP Purge Flow Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

PURGE COMPONENT 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.
Service port	Used for connecting vacuum gauge for inspecting EVAP system.
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 approx. 5 hours elapsed, ECM activates.
Canister pump	Consists of (a) to (d) below. Pump module cannot be disassembled.

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module	
(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 vacuum pump are turned on (refer to **Fig. 243**).
(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. 244**).
(c) Vacuum pump	Creates negative pressure (vacuum) in EVAP system for leak check.
(d) 0.02 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 vacuum pump, to monitor 0.02 inch leak pressure. 0.02 inch leak pressure indicates a small leak of EVAP.

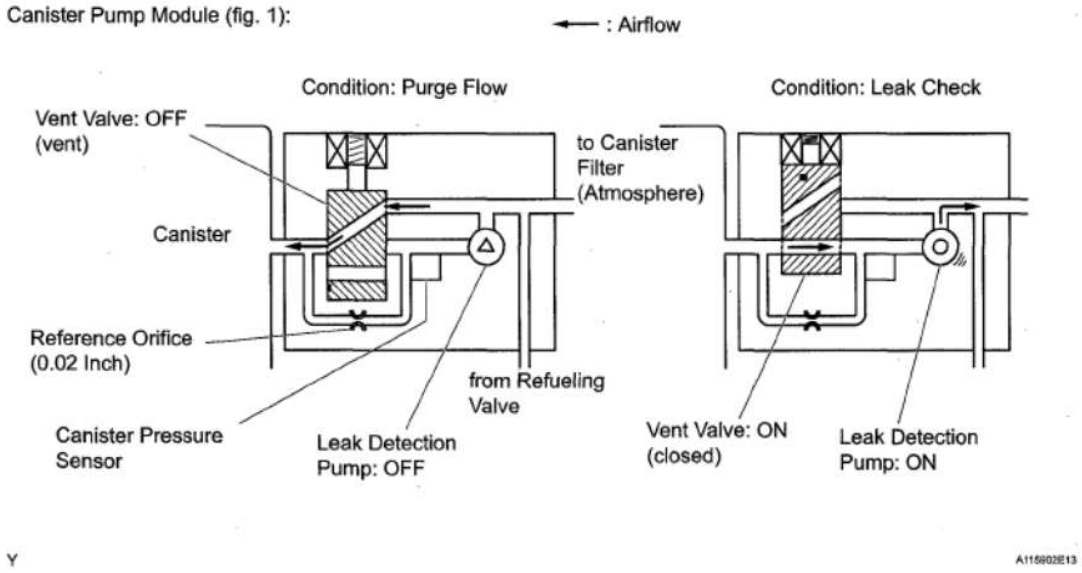
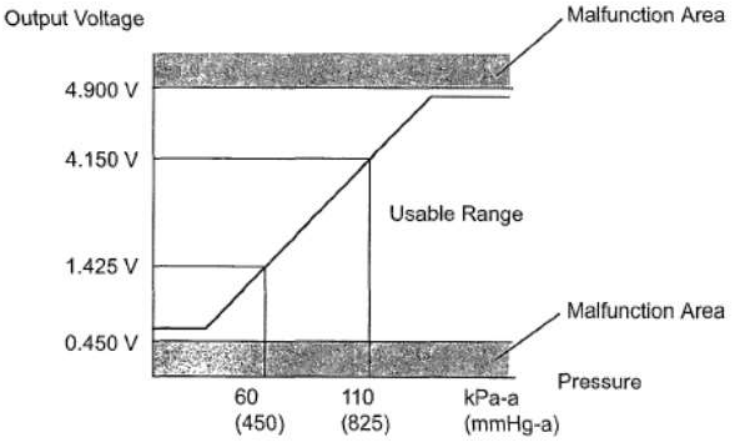


Fig. 243: Airflow Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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Canister Pressure Sensor Specification (fig. 2):



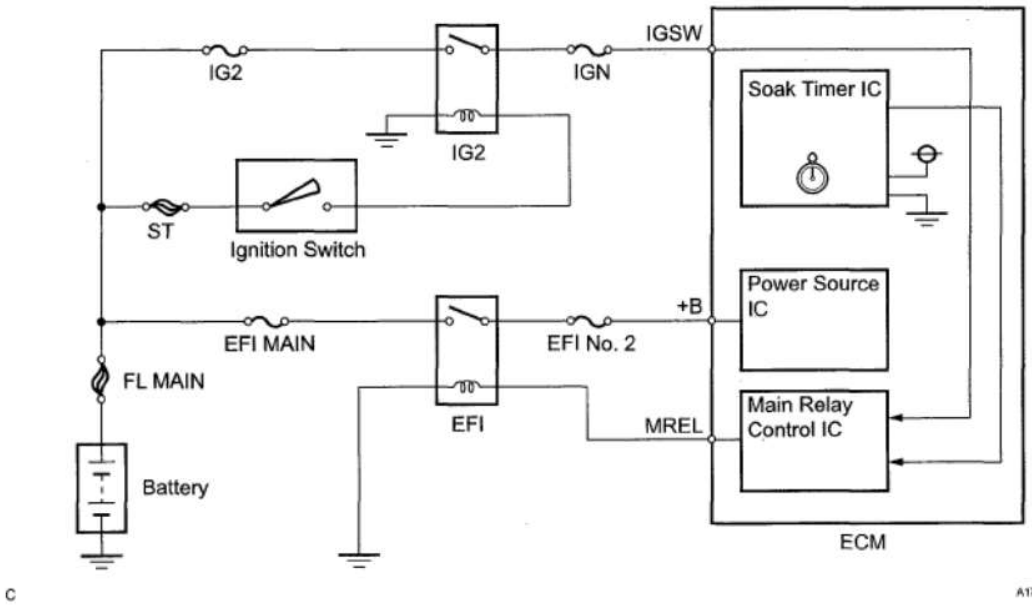
HINT:

Standard atmospheric pressure is 101.3 kPa-a (760 mmHg-a)

A115543E17

Fig. 244: Output Voltage Graph
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

without Smart Key System:



C

A172776E01

Fig. 245: EVAP - Wiring Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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WIRING DIAGRAM

Refer to DTC P0450 (See **WIRING DIAGRAM**).

INSPECTION PROCEDURE

NOTE: 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 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 on (IG).
   c. Turn the ignition switch off and wait for 10 seconds.
   d. Connect the Techstream to the DLC3.
   e. Turn the ignition switch on (IG) and turn the tester on.
   f. Select the following menus: Powertrain/Engine and ECT/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.

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DTCs / Malfunctioning Areas	P043E P043F	P0441	P0450	P0451	P0452	P0453	P0455	P0456	P2401 P2402	P2419	P2420
0.02 inch orifice clogged	●								●	●	
0.02 inch orifice high-flow	●								●	●	
Purge VSV stuck open		●					●				
Purge VSV stuck closed		●									
Pressure sensor signal becomes fixed/flax				●							
Pressure sensor noise				●							
Pressure sensor voltage low			●		●						
Pressure sensor voltage high			●			●					
Gross leak		●					●				
Small leak								●			
Vacuum pump stuck OFF	●								●	●	
Vacuum pump stuck ON	●								●	●	
Vent valve stuck ON (closed)	●								●	●	
Vent valve stuck OFF (vent)											●

A106731E16

Fig. 246: DTC Malfunction Reference Chart
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

NOTE: **If the 0.02 inch reference pressure difference between the first and second checks is greater than the specification, the DTCs corresponding to the reference pressure (P043E, P043F, P0441, P0455, P0456, P2401 and P2420) will all be stored.**

2. **PERFORM EVAP SYSTEM CHECK (AUTO OPERATION)**

NOTE:

- **In the Evaporative System Check (Automatic Mode) 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 in this step.**
- **When the temperature of the fuel is 35C (95°F) or more, a large amount of vapor forms and any check results become inaccurate. When performing the Evaporative System Check, keep the**

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temperature below 35°C (95°F).

a. Connect the Techstream to the DLC3.
b. Clear the DTCs (See **DTC CHECK/CLEAR**).
c. Select the following menu items on the tester: Powertrain/Engine and ECT/Utility/Evaporative System Check/Automatic Mode.
d. After the Evaporative System Check is completed, check for pending DTCs by selecting the following menu items: Powertrain/Engine and ECT/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 OPERATION)**

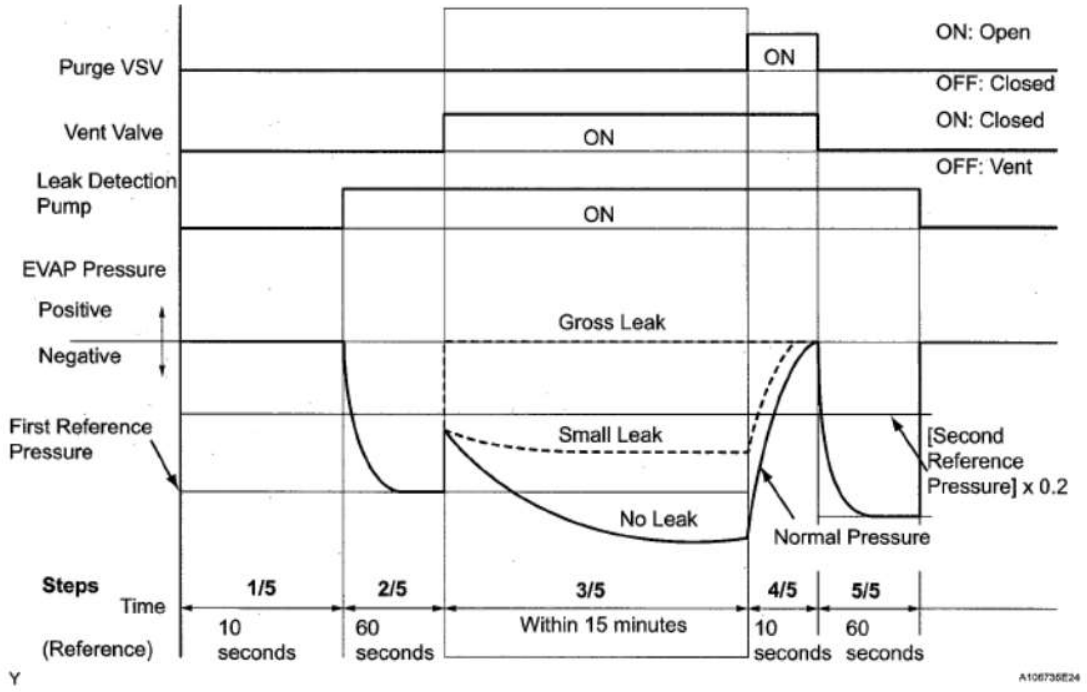


Fig. 247: EVAP System Perform Graph (Manual Operation)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

NOTE:

- **In the Evaporative System Check (Manual Mode), the series of 5 Evaporative System Check steps is performed manually by 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**

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the leak check of the fuel tank unavailable.

- **Do not run the engine in this step.**
- **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. Select the following menu items: Powertrain/Engine and ECT/Utility/Evaporative System Check/Manual Mode.

4. **PERFORM EVAP SYSTEM CHECK (STEP 1/5)**

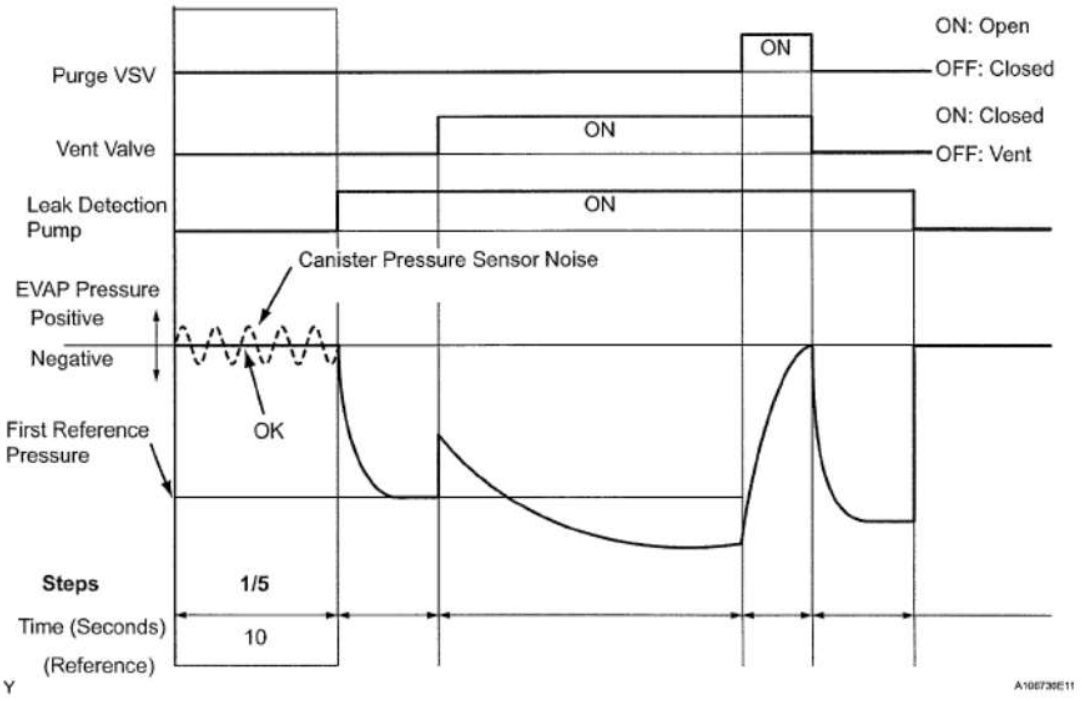


Fig. 248: EVAP System Perform Graph (Step 1/5)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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 (2.25 mmHg) 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)**

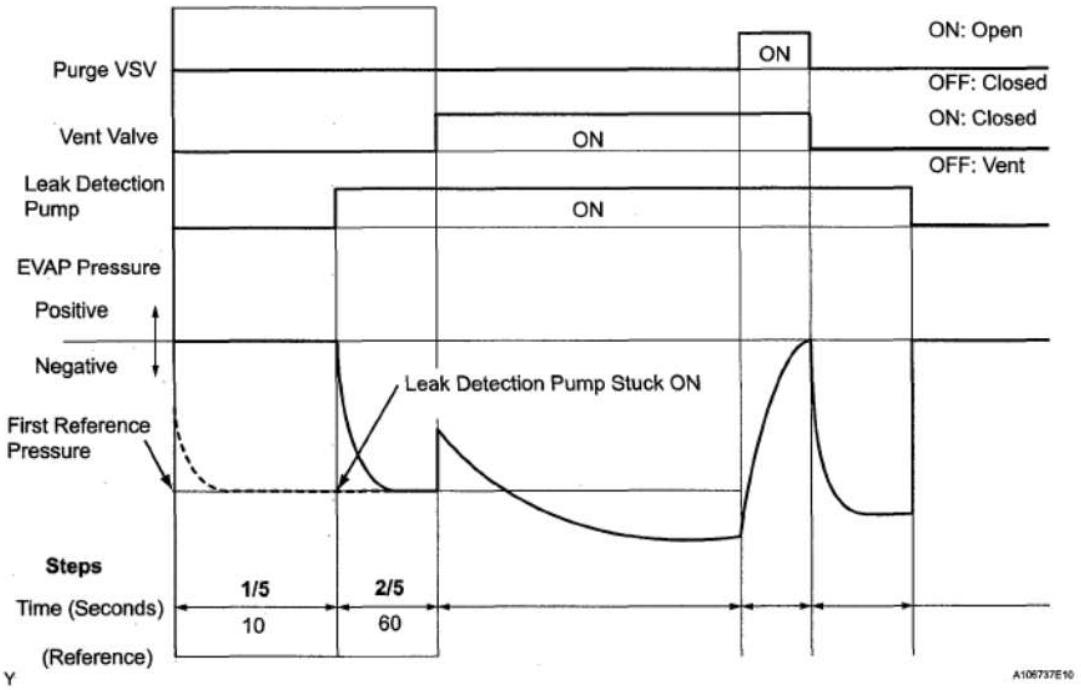


Fig. 249: EVAP System Perform Graph (Step 1/5 To 2/5)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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 0.02 inch leak 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

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(1) The DTCs related to the EVAP system are displayed on the Techstream when checking.

HINT:

The first 0.02 inch leak 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)**

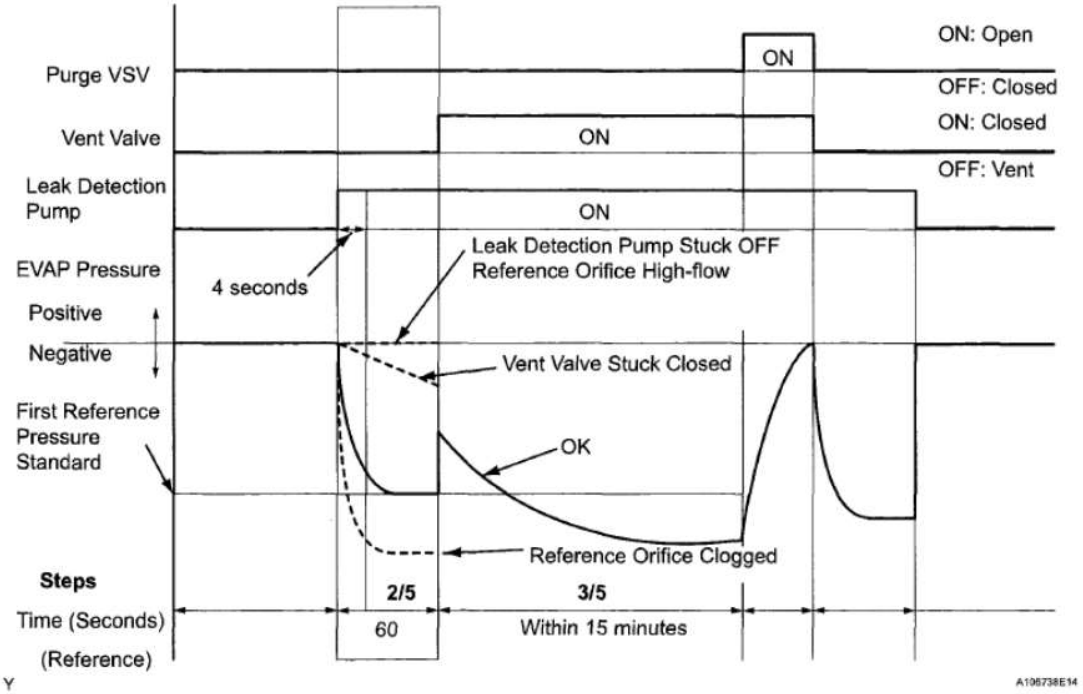


Fig. 250: EVAP System Perform Graph (Step 2/5)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

HINT:

Make a note of the pressures checked in steps (a) and (b) below.

a. Check the EVAP pressure 4 seconds after the vacuum pump is activated*1 (Step (a)).
b. Check the EVAP pressure again when it has stabilized. This pressure is the 0.02 inch leak pressure standard (Step (b)).

*1: The vacuum pump begins to operate at the time step 2/5 starts.

Result

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RESULT CHART

DTC(1)	Result	Suspected Trouble Area	Proceed to
-	EVAP pressure in step (b) is between -4.85 kPa and -1.06 kPa (-36.38 mmHg and -7.95 mmHg)	Not yet determined	A
P043F and P2401	EVAP pressure in step (b) is -1.06 kPa (-7.95 mmHg) or more	• 0.02 inch orifice high-flow • Vacuum pump stuck OFF	B
P043E	EVAP pressure in step (b) is less than -4.85 kPa (-36.38 mmHg)	0.02 inch orifice clogged	C
P2419	EVAP pressure in step (a) is more than -1.06 kPa (-7.95 mmHg)	Vent valve stuck closed	D
(1) The DTCs related to the EVAP system are displayed on the Techstream when checking.			

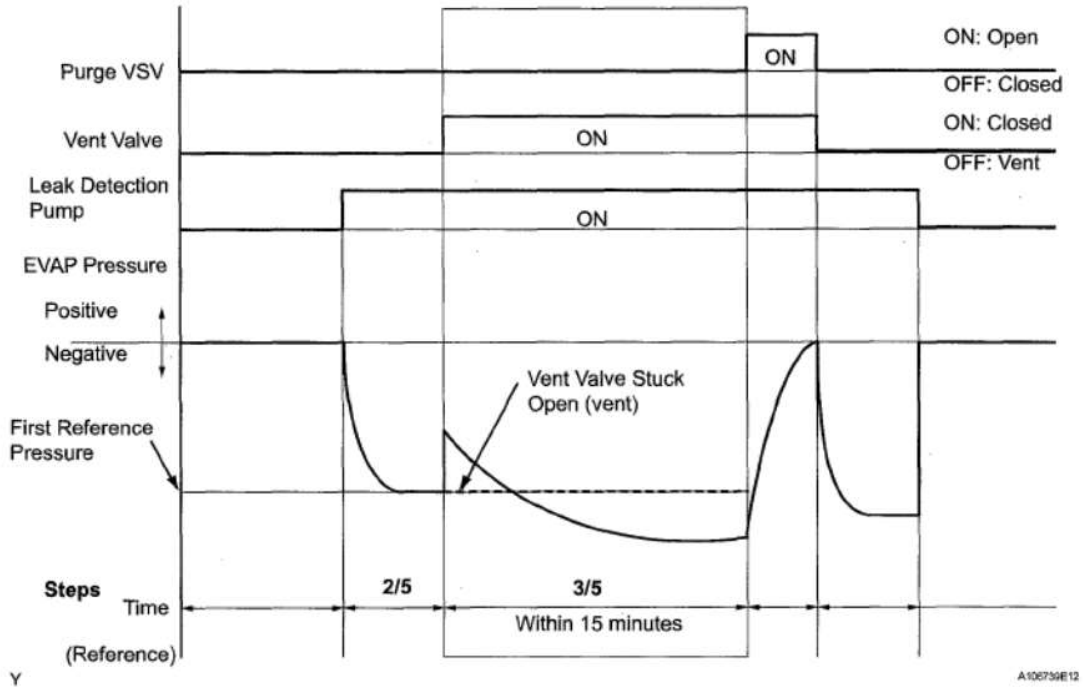
B: Go to step 11

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)**



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Fig. 251: EVAP System Perform Graph (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

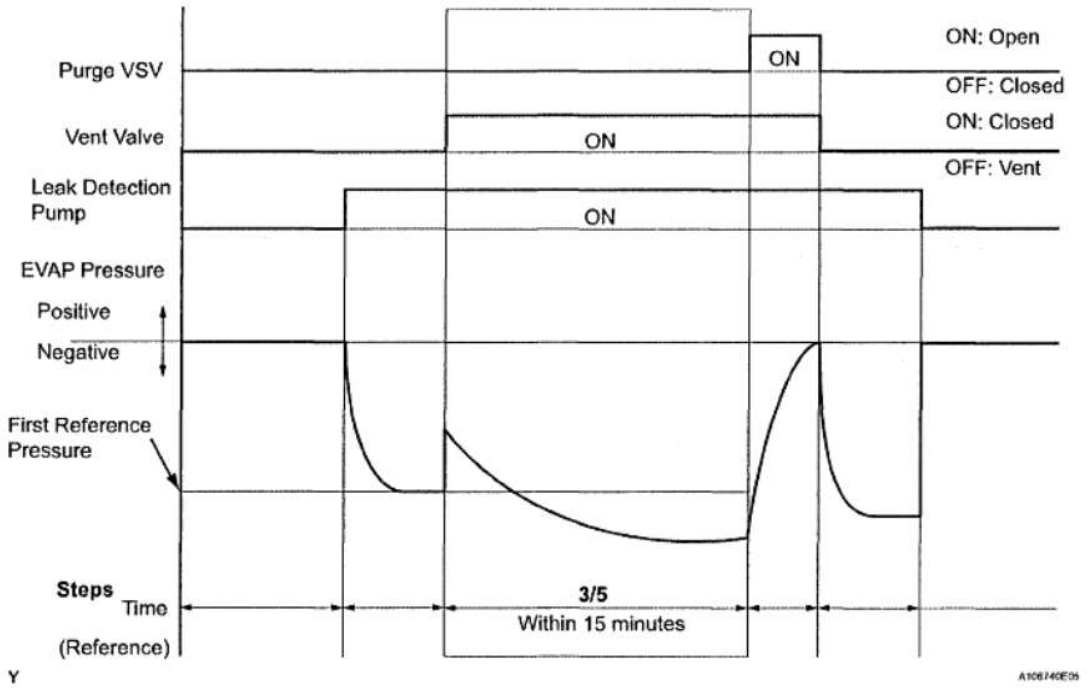
DTC (1)	Result	Suspected Trouble Area	Proceed to
-	EVAP pressure increases by 0.3 kPa (2.25 mmHg) or more within 10 seconds of proceeding from step 2/5 to step 3/5	Not yet determined	A
P2420	No variation in EVAP pressure even after proceeding from step 2/5 to step 3/5	Vent valve stuck open (vent)	B
P0451	No variation in EVAP pressure during steps 1/5 through 3/5	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)**



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Fig. 252: EVAP System Perform Graph (Step 3/5)Evap Pressure Graph (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 (0.75 mmHg) for 30 seconds.
b. Measure the EVAP pressure and record it.

HINT:

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)**

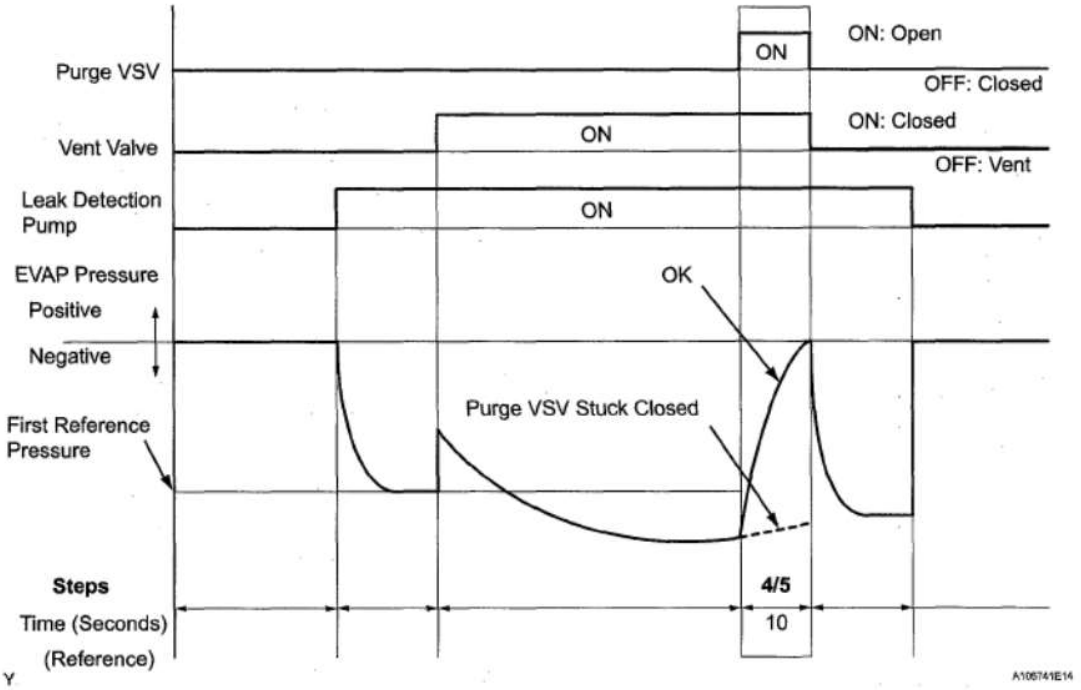


Fig. 253: EVAP System Perform Graph (Step 4/5)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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 (2.25 mmHg) or more within 10 seconds of proceeding from step 3/5 to step 4/5	Not yet determined	A

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P0441	EVAP pressure increases by 0.3 kPa (2.25 mmHg) 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 (2.25 mmHg) 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.			

B: Go to step 15

C: Go to step 12

A: Go to next step

10. **PERFORM EVAP SYSTEM CHECK (STEP 5/5)**

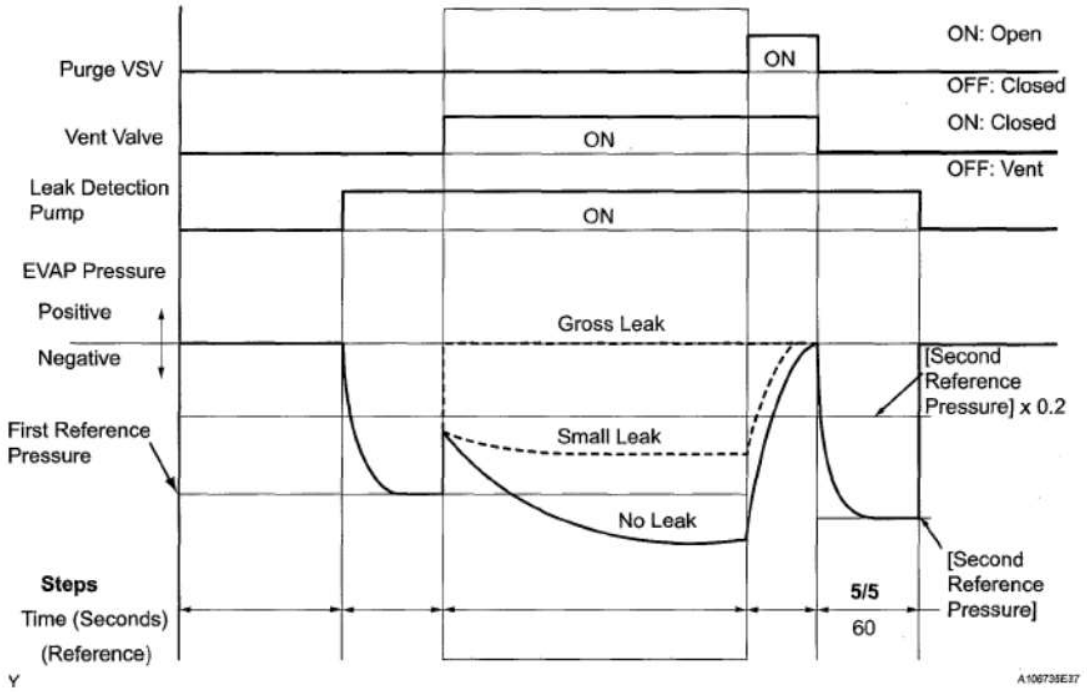


Fig. 254: EVAP System Perform Graph (Step 5/5)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

a. Check the EVAP pressure in step 5/5.
b. Compare the EVAP pressure in step 3/5 and the second 0.02 inch leak pressure standard (step 5/5).

Result

RESULT CHART

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DTC(1)	Result	Suspected Trouble Area	Proceed to
-	EVAP pressure (step 3/5) lower than second 0.02 inch leak 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 0.02 inch leak 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 0.02 inch leak pressure standard (step 5/5)	EVAP small leak	B
(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)**

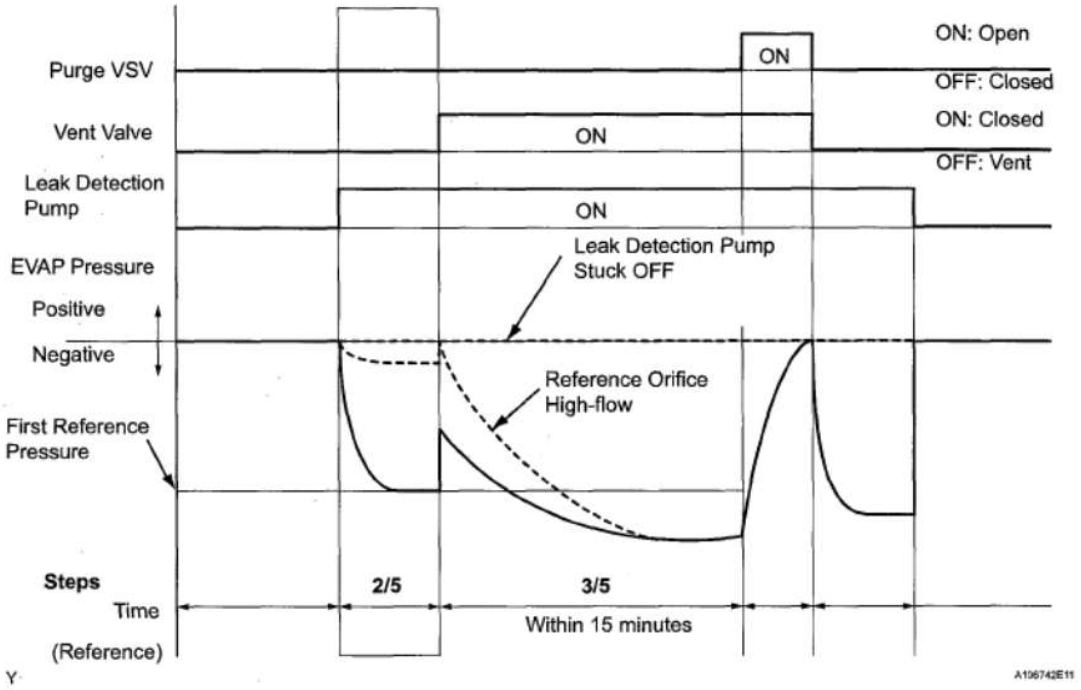


Fig. 255: EVAP System Perform Graph (Step 3/5)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

a. Check the EVAP pressure in step 3/5.

Result

RESULT CHART

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DTC (1)	Result	Suspected Trouble Area	Proceed to
P043F	EVAP pressure is less than [0.02 inch leak pressure standard] measured in step 2/5	0.02 inch orifice high-flow	A
P2401	EVAP pressure is almost the same as [0.02 inch leak pressure standard] measured in step 2/5	Vacuum pump stuck OFF	B
(1) The DTCs related to the EVAP system are displayed on the Techstream when checking.			

HINT:

The first 0.02 inch leak 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. Select the following menu items on the tester: Powertrain/Engine and ECT/Active Test/Activate the VSV for EVAP Control.
    b. Disconnect the hose (connected to the canister) from the purge VSV.
    c. Start the engine.

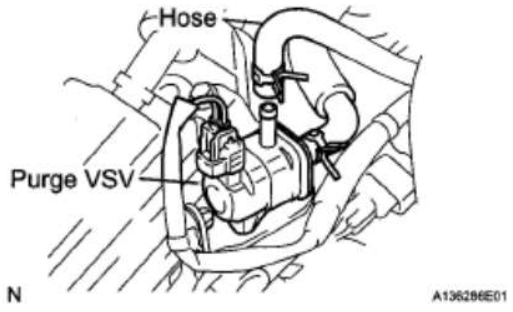


Fig. 256: Identifying Hose And Purge VSV
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

    d. Using the tester, turn off the purge VSV (EVAP VSV: OFF).
    e. Confirm that the purge VSV has no suction with your fingers.
    f. Using the tester, turn on the purge VSV (EVAP VSV: ON).
    g. Confirm that the purge VSV has suction with your fingers.

Result

RESULT CHART

Result	Suspected Trouble Area	Proceed

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		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
No suction when purge VSV turned ON	• Purge VSV stuck closed • Problems with EVAP hose between purge VSV and throttle body	C

h. Reconnect the hose.

B: Go to step 14

C: Go to step 15

A: Go to next step

13. **CHECK FUEL TANK CAP ASSEMBLY**

a. Check that the fuel tank cap is correctly installed and confirm the fuel tank cap meets OEM specification.

HINT:

If an EVAP tester is available, check the fuel tank cap using the tester.

1. Tighten the fuel tank cap.
2. Remove the fuel tank cap and install it onto the fuel tank cap adaptor.
3. Connect the EVAP tester pump hose to the adaptor, and pressurize the cap to 3.2 to 3.7 kPa (24 to 28 mmHg) using an EVAP tester pump.
4. Seal the adaptor and wait for 2 minutes.
5. Check the pressure. If the pressure is 2 kPa (15 mmHg) or more, the fuel tank cap is normal.

Result

RESULT CHART

Test Result	Suspected Trouble Area	Proceed to
Fuel tank cap correctly installed	-	A
Fuel tank cap loose	• Fuel tank cap improperly installed • Defective fuel tank cap • Fuel tank cap does not meet OEM specifications	B

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No fuel tank 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.
    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.

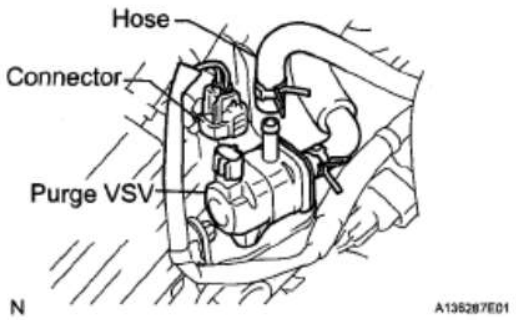


Fig. 257: Identifying Hose And V3 Purge VSV Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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

15. **CHECK EVAP HOSE (PURGE VSV - THROTTLE BODY)**
    a. Disconnect the hose (connected to the throttle body) from the purge VSV.

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b. Start the engine.
c. Confirm that the hose has suction with your fingers.

Result

RESULT CHART

Result	Suspected Trouble Area	Proceed to
Suction applied	-	A
No suction	• Throttle body • EVAP hose between purge VSV and throttle body	B

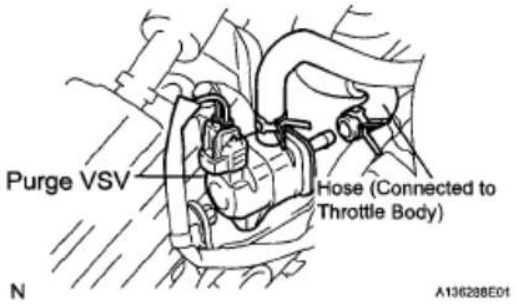


Fig. 258: Disconnecting Hose (Connected To Throttle Body) From Purge VSV
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

d. Reconnect the hose.

B: Go to step 26

A: Go to next step

16. **INSPECT VACUUM SWITCHING VALVE NO. 1 (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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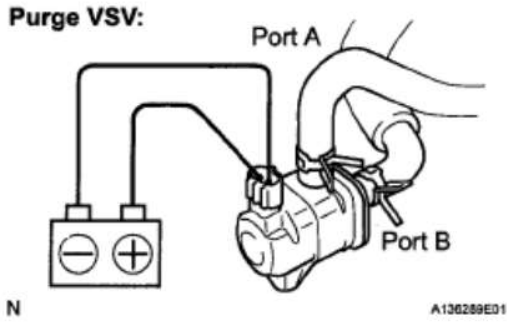


Fig. 259: Inspecting Vacuum Switching Valve No. 1 (Purge VSV)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

B: Go to step 31

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 on (IG).
    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
1 - 2	Ignition switch on (IG)	9 to 14 V

Result

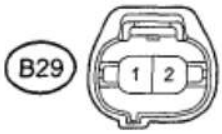
RESULT CHART

Result	Suspected Trouble Area	Proceed to
Between 9 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.

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Front view of wire harness connector:
(to Purge VSV)



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Fig. 260: Identifying Purge VSV Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

B: Go to step 32

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	Specified Condition
B1-34 (PRG) - B29-2	Below 1 ohms
B1-34 (PRG) - Body ground	10 kohms or higher
B29-1 - Body ground	10 kohms or higher

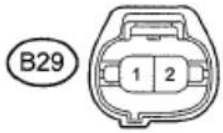
    c. Reconnect the purge VSV connector.
    d. Reconnect the ECM connector.

OK: Go to step 35

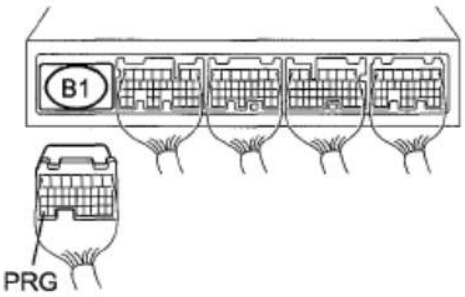
NG: Go to step 32

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Front view of wire harness connector:
(to Purge VSV)



Rear view of wire harness connector:
(to ECM)



A168213E03

Fig. 261: Identifying Purge VSV Connector And ECM Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

19. **PERFORM ACTIVE TEST USING TECHSTREAM (FOR VENT VALVE)**
    a. Turn the ignition switch on (IG).
    b. Select the following menu items on the tester: Powertrain/Engine and ECT/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
D35-5 (VPMP) - Body ground	Vent valve ON	9 to 14 V
	Vent valve OFF	Below 3 V

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Component with harness connected:
(ECM)

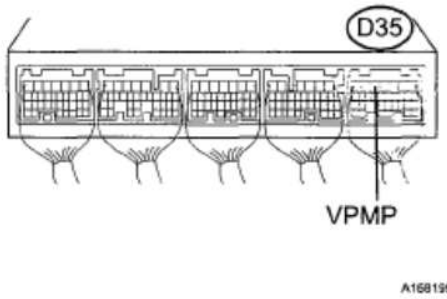


Fig. 262: Identifying ECM D35 Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Result

RESULT CHART

Result	Suspected Trouble Area	Proceed to
Between 9 V and 14 V when OFF Below 3 V when ON	Vent valve	A
Below 3 V when OFF and ON	ECM	B

A: Go to step 22

B: Go to step 35

20. **PERFORM ACTIVE TEST USING TECHSTREAM (FOR VENT VALVE)**
    a. Turn the ignition switch on (IG).
    b. Select the following menu items on the tester: Powertrain/Engine and ECT/Active Test/Activate the VSV for Vent Valve.
    c. Measure the voltage according to the value(s) in the table below.

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Component with harness connected:
(ECM)

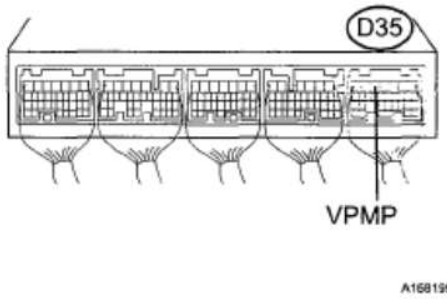


Fig. 263: Identifying ECM D35 Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Standard voltage

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
D35-5 (VPMP) - Body ground	Vent valve ON	9 to 14 V
	Vent valve OFF	Below 3 V

Result

RESULT CHART

Result	Suspected Trouble Area	Proceed to
Below 3 V when OFF and ON	Power source of vent valve	A
Between 9 V and 14 V when OFF Below 3 V when ON	Vent valve	B
Between 9 V and 14 V when OFF and ON	ECM	C

B: Go to step 22

C: Go to step 35

A: Go to next step

21. **INSPECT PUMP MODULE (POWER SOURCE FOR VENT VALVE)**
    a. Turn the ignition switch off.
    b. Disconnect the canister pomp module connector.
    c. Turn the ignition switch on (IG).
    d. 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
N8-9 - Body ground	Ignition switch on (IG)	9 to 14 V

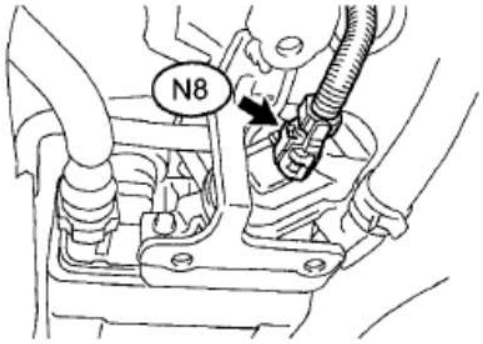
Result

RESULT CHART

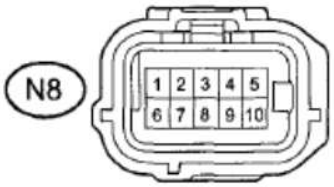
Test Result	Suspected Trouble Area	Proceed to
Between 9 V and 14 V	• Vent valve • ECM	A
Between 0 V and 3 V	Power source wire harness of vent valve	B

e. Reconnect the canister pomp module connector.

B: Go to step 32



Front view of wire harness connector:
(to Canister Pump Module)



A168256E03

Fig. 264: Identifying Canister Pump Module Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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A: Go to next step

22. **INSPECT PUMP MODULE (VENT VALVE OPERATION)**
    a. Turn the ignition switch off.
    b. Disconnect the canister pomp module connector.
    c. Apply the battery voltage to terminals 9 and 8 of the pump module.
    d. Touch the pump module to confirm the vent valve operation.

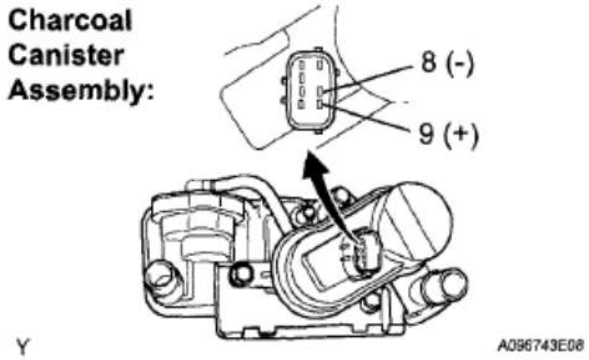


Fig. 265: Inspecting Pump Module (Vent Valve Operation)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Result

RESULT CHART

Result	Suspected Trouble Area	Proceed to
Operating	Wire harness between vent valve and ECM	A
Not operating	Vent valve	B

    e. Reconnect the canister pomp module connector.

A: Go to step 32

B: Go to step 30

23. **PERFORM ACTIVE TEST USING TECHSTREAM (FOR CANISTER PUMP MODULE (VACUUM PUMP))**
    a. Select the following menu items on the tester: Powertrain/Engine and ECT/Active Test/Activate the Vacuum Pump.
    b. Measure the voltage according to the value(s) in the table below.

Standard voltage

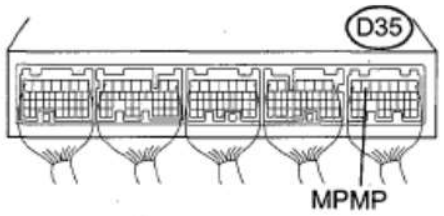
TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition

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D35-6 (MPMP) - Body ground	Vacuum Pump ON	9 to 14 V

Component with harness connected:
(ECM)



A168199E25

Fig. 266: Identifying ECM D35 Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Result

RESULT CHART

Test Result	Suspected Trouble Area	Proceed to
Between 0 V and 3 V when OFF Between 9 V and 14 V when ON	-	A
Between 9 V and 14 V when OFF Between 0 V and 3 V when ON	ECM	B

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 pomp module connector.
    c. Turn the ignition switch on (IG).
    d. Select the following menu items on the tester: Powertrain/Engine and ECT/Active Test/Activate the Vacuum Pump.
    e. Turn the vacuum pump ON.
    f. Measure the voltage according to the value(s) in the table below.

Standard voltage

TESTER CONNECTION SPECIFIED CONDITION CHART

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Tester Connection	Condition	Specified Condition
N8-1 - Body ground	Vacuum pump ON	9 to 14 V

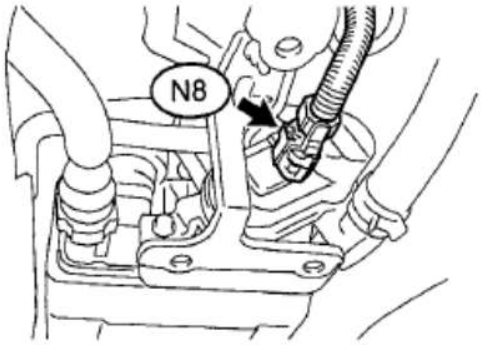
Result

RESULT CHART

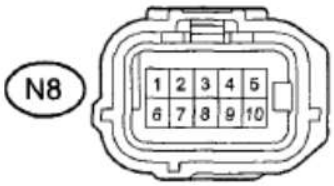
Test Result	Suspected Trouble Area	Proceed to
Between 9 V and 14 V	-	A
Between 0 V and 3 V	Wire harness between ECM and vacuum pump	B

g. Reconnect the canister pomp module connector.

B: Go to step 32



Front view of wire harness connector:
(to Canister Pump Module)



A168255E04

Fig. 267: Locating 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 pomp module connector.

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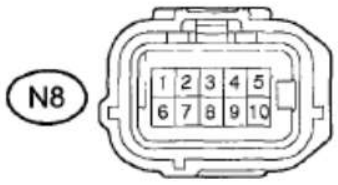
b. Turn the ignition switch off.
c. Check the resistance according to the value(s) in the table below.

Standard resistance

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
N8-6 - Body ground	Always	Below 1 ohms

Front view of wire harness connector:
(to Canister Pump Module)



A168260E03

Fig. 268: Identifying Canister Pump Module N8 Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Result

RESULT CHART

Test Result	Suspected Trouble Area	Proceed to
Below 1 ohms	Vacuum Pump	A
10 kohms or higher	Wire harness between vacuum pump and body ground	B

d. Reconnect the canister pomp 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.

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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.

A: Go to step 33

B: Go to step 34

27. **CORRECTLY REINSTALL OR REPLACE FUEL TANK CAP**

HINT:

- When reinstalling the fuel tank cap, tighten it until a few click sounds are heard.
- When replacing the fuel tank cap, use a fuel tank cap that meets OEM specifications, and tighten it until a few click sounds are heard.

NEXT: Go to step 37

28. **REPLACE FUEL TANK CAP ASSEMBLY**

HINT:

When installing the fuel tank cap, tighten it until a few click sounds are heard.

NEXT: Go to step 37

29. **LOCATE EVAP LEAK**

a. Disconnect the vent hose.

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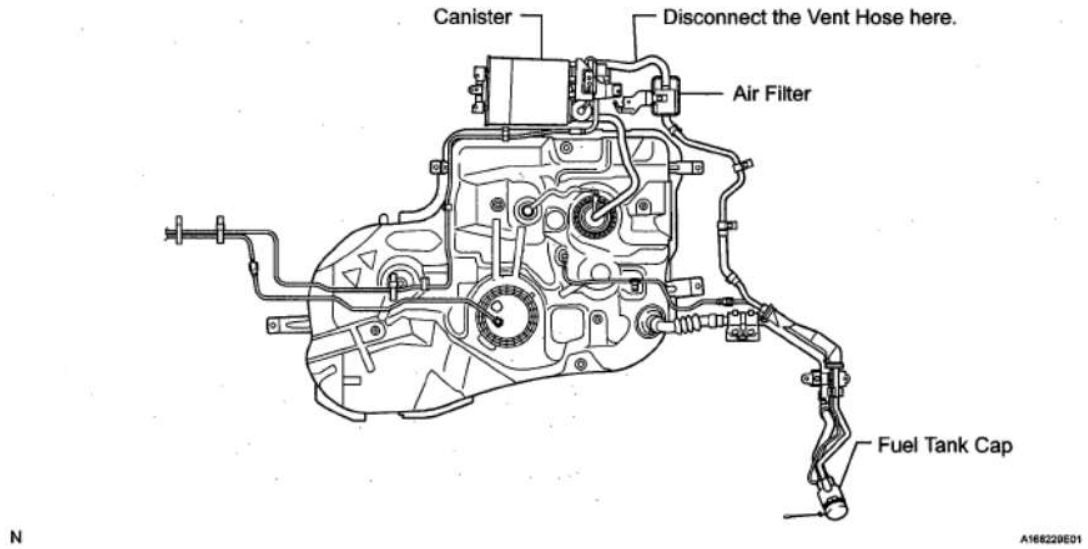


Fig. 269: Identifying Canister, Air Filter And Fuel Tank Cap
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. Connect the EVAP pressure tester tool to the canister with the adapter.

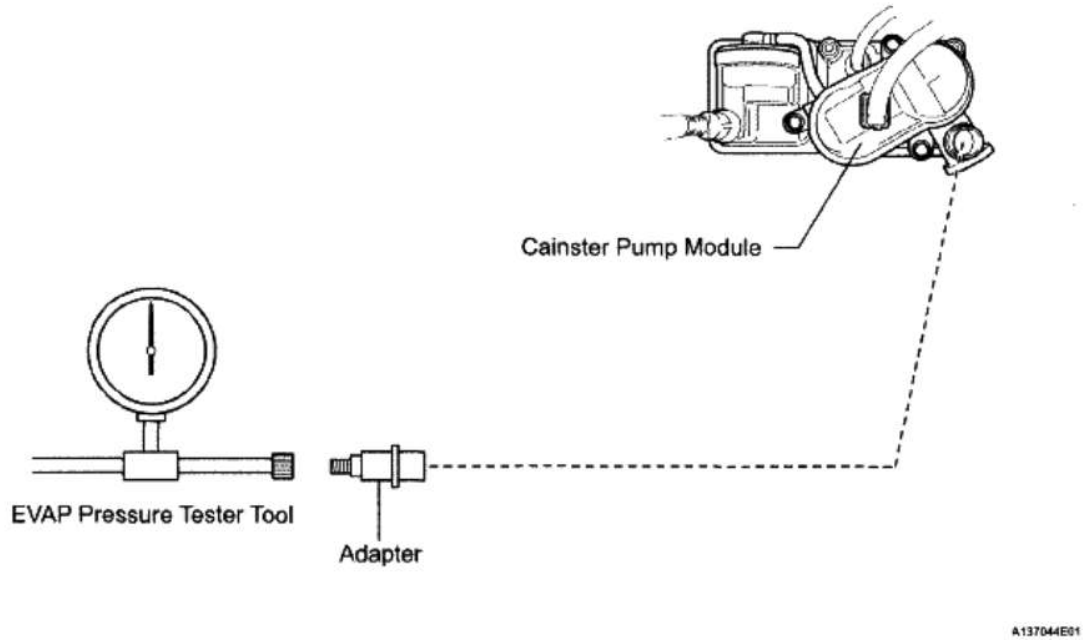


Fig. 270: Connecting EVAP Pressure Tester Tool To Canister With Adapter
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

c. Pressurize the EVAP system by 3.2 to 3.7 kPa (24 to 28 mmHg).
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.

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f. Repair or replace the leak point.

NEXT: Go to step 37

30. **REPLACE CHARCOAL CANISTER ASSEMBLY**

a. Replace the charcoal canister assembly (See **CANISTER**).

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; 3) the fuel tank vent hose.

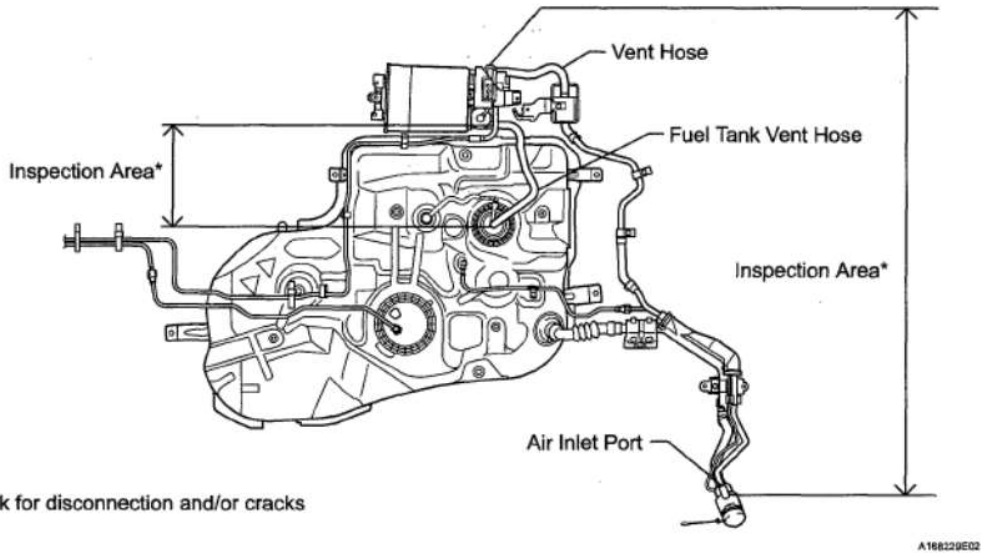


Fig. 271: Identifying Charcoal Canister Assembly Inspection Area
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

NEXT: Go to step 37

31. **REPLACE VACUUM SWITCHING VALVE NO. 1 (PURGE VSV)**

a. Disconnect the connector and 2 hoses from the purge VSV.
b. Remove the purge VSV.
c. Install a new purge VSV.
d. Reconnect the connector and 2 hoses.

NEXT: Go to step 37

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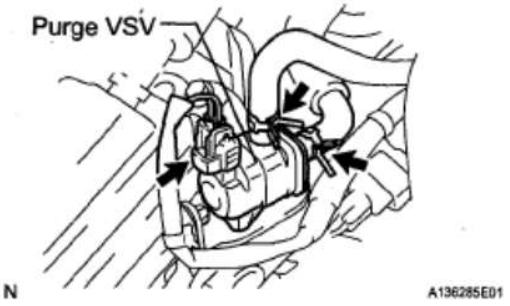


Fig. 272: Locating Connector And Hoses On Purge VSV
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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 **REMOVAL**).
    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

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 (AUTO OPERATION)**

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 in this step.**

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- **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, select the following menu items: Powertrain/Engine and ECT/Utility/Evaporative System Check/Automatic Mode.
c. After the Evaporative System Check is completed, check for pending DTCs by selecting the following menu items: Powertrain/Engine and ECT/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 on (IG), the battery voltage is applied to terminal IGSW 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 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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w/o Smart Key System:

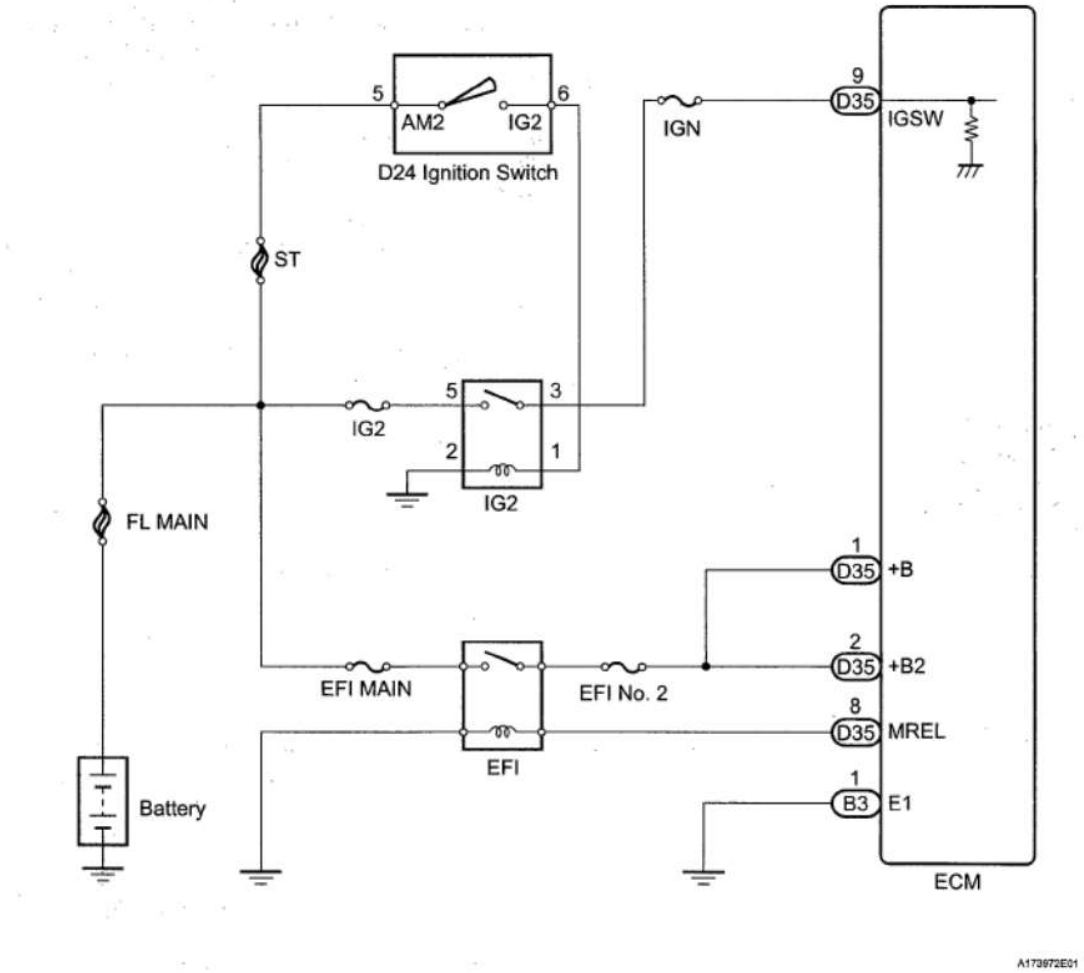


Fig. 273: ECM Power Source - Wiring Diagram (1 Of 2)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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w/ Smart Key System:

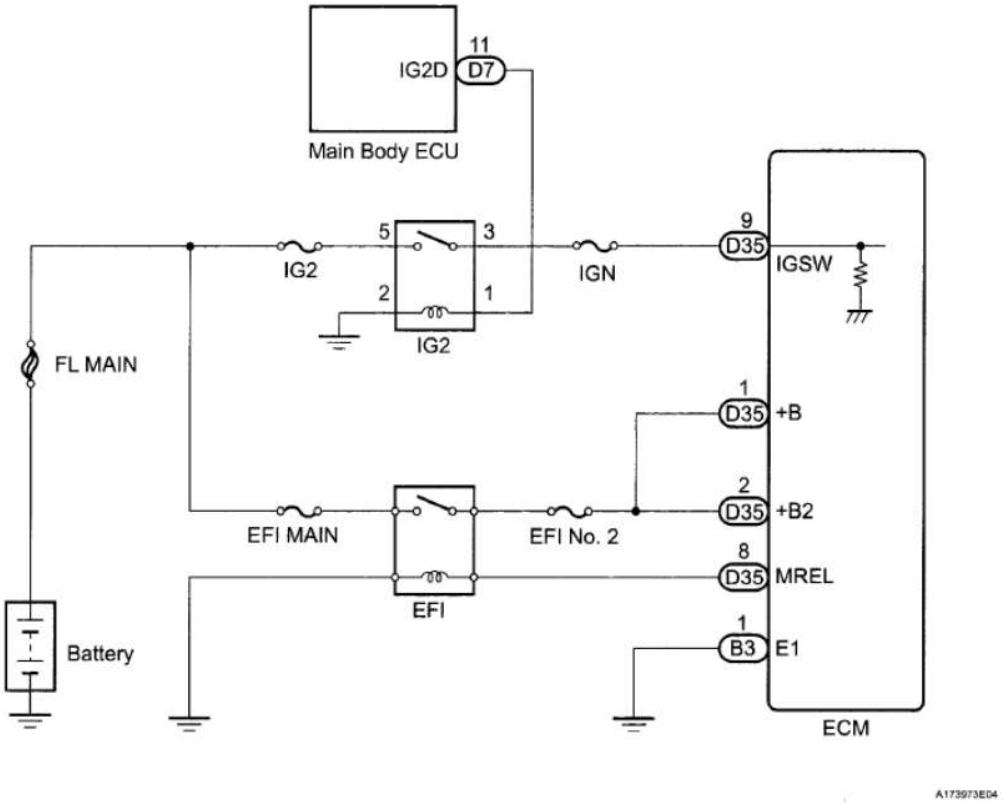


Fig. 274: ECM Power Source - Wiring Diagram (2 Of 2)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSPECTION PROCEDURE

1. **INSPECT ECM (+B VOLTAGE)**
   a. Turn the ignition switch on (IG).
   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
D35-1 (+B) - B3-1 (E1)	Ignition switch on (IG)	9 to 14 V
D35-2 (+B2) - B3-1 (E1)	Ignition switch on (IG)	9 to 14 V

NG: Go to step 2

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Component with harness connected:
(ECM)

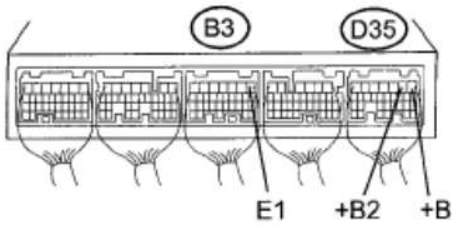


Fig. 275: Identifying ECM B3 And D35 Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: PROCEED TO NEXT CIRCUIT INSPECTION SHOWN IN PROBLEM SYMPTOMS TABLE (See **PROBLEM SYMPTOMS TABLE**)

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
B3-1 (E1) - Body ground	Always	Below 1 ohms

   c. Reconnect the ECM connector.

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR (ECM - BODY GROUND)

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Rear view of wire harness connector:
(to ECM)

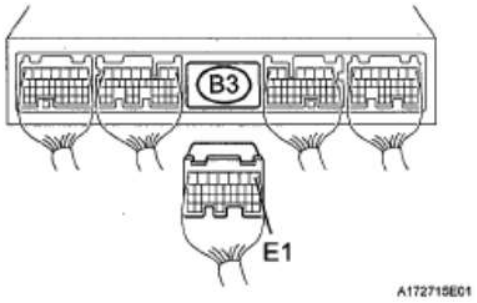


Fig. 276: Identifying ECM B3 Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

3. **INSPECT ECM (MREL VOLTAGE)**
   a. Turn the ignition switch on (IG).
   b. Measure the voltage according to the value(s) in the table below.

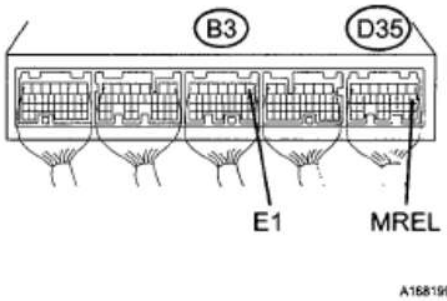
Standard voltage

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Switch Condition	Specified Condition
D35-8 (MREL) - B3-1 (E1)	Ignition switch on (IG)	9 to 14 V

NG: Go to step 8

Component with harness connected:
(ECM)



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Fig. 277: Identifying ECM B3 And D35 Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

4. **CHECK FUSE (EFI MAIN AND EFI NO. 2 FUSE)**
   a. Remove the EFI MAIN and EFI No. 2 fuse 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
EFI MAIN fuse	Always	Below 1 ohms
EFI No. 2 fuse	Always	Below 1 ohms

   c. Reinstall the fuses.

NG: REPLACE FUSE (EFI MAIN OR EFI NO. 2 FUSE)

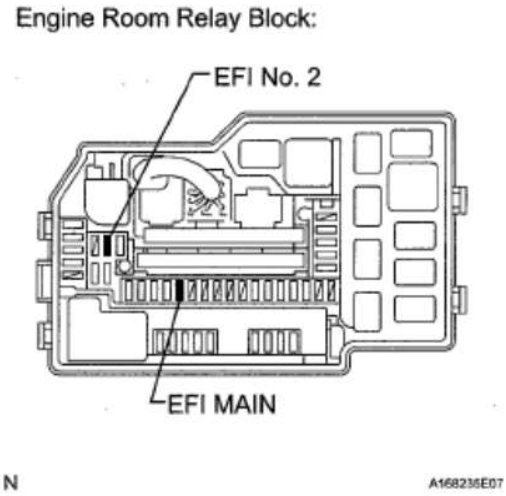


Fig. 278: Identifying EFI Main And EFI No. 2 Fuse
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

5. **INSPECT ENGINE ROOM JUNCTION BLOCK ASSEMBLY (EFI RELAY)**
   a. Inspect the EFI relay (See **INSPECTION**).

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

OK: Go to next step

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6. **CHECK HARNESS AND CONNECTOR (EFI RELAY - ECM, EFI RELAY - BODY GROUND)**
   a. Remove the engine room junction block 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 (EFI relay terminal) - D35-8 (MREL)	Always	Below 1 ohms
2E-10 (EFI relay terminal) - Body ground	Always	Below 1 ohms

Check for short

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
2E-9 (EFI relay terminal) or D35-8 (MREL) - Body ground	Always	10 kohms or higher

   d. Reinstall the engine room junction block.
   e. Reconnect the ECM connector.

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR (EFI RELAY - ECM)

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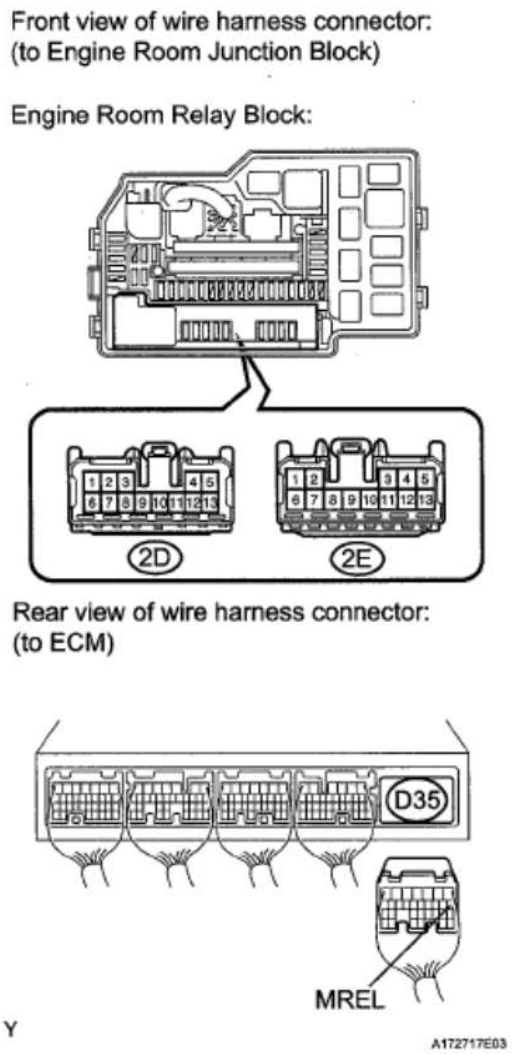


Fig. 279: Identifying Engine Room Junction Block And ECM MREL Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

7. **CHECK HARNESS AND CONNECTOR (EFI RELAY - ECM)**
   a. Remove the engine room junction block 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

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2E-6 (EFI relay terminal) - D35-1 (+B)	Always	Below 1 ohms
2E-6 (EFI relay terminal) - D35-2 (+B2)	Always	Below 1 ohms

Check for short

TESTER CONNECTION SPECIFIED CONDITION CHART

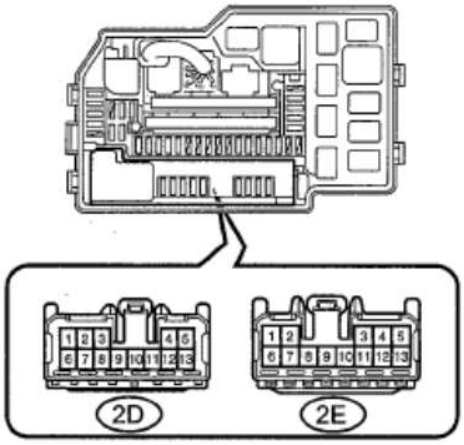
Tester Connection	Condition	Specified Condition
2E-6 (EFI relay terminal) or D35-1 (+B) - Body ground	Always	10 kohms or higher
2E-6 (EFI relay terminal) or D35-2 (+B2) - Body ground	Always	10 kohms or higher

d. Reinstall the engine room junction block assembly.
e. Reconnect the ECM connector.

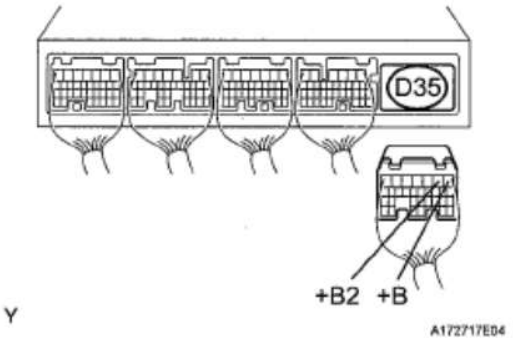
NG: REPAIR OR REPLACE HARNESS OR CONNECTOR (EFI RELAY - ECM)

Front view of wire harness connector:
(to Engine Room Junction Block)

Engine Room Relay Block:



Rear view of wire harness connector:
(to ECM)



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Fig. 280: Identifying Engine Room Junction Block And ECM +B2, +B Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: REPAIR OR REPLACE HARNESS OR CONNECTOR (EFI RELAY - EFI MAIN FUSE)

8. **INSPECT ECM (IGSW VOLTAGE)**
   a. Turn the ignition switch on (IG).
   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
D35-9 (IGSW) - B3-1 (E1)	Ignition switch on (IG)	9 to 14 V

NG: Go to step 9

Component with harness connected:
(ECM)

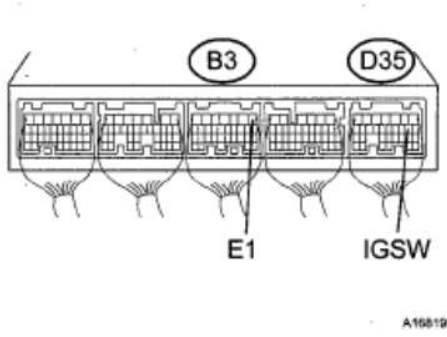


Fig. 281: Identifying ECM B3 And D35 Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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

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Tester Connection	Condition	Specified Condition
IG2 relay terminal 3 - D35-9 (IGSW)	Always	Below 1 ohms

d. Reconnect the ECM connector.
e. Reinstall the IG2 relay.

NG: Go to step 13

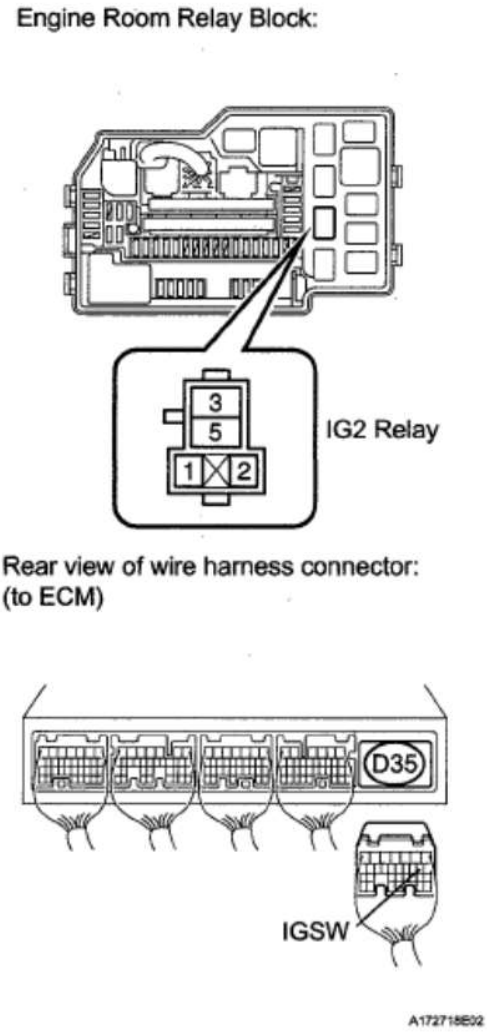


Fig. 282: Identifying Engine Room Relay Block And ECM Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

10. **INSPECT 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.

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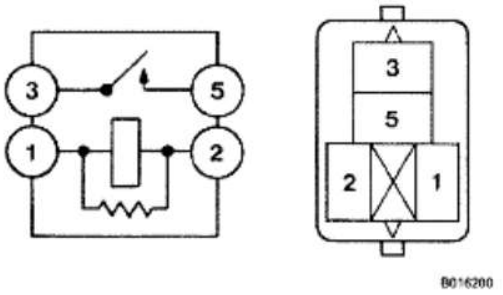


Fig. 283: IG2 Relay Circuit
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Standard resistance

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
3 - 5	When no battery voltage applied to terminals 1 and 2	10 kohms or higher
	When battery voltage applied to terminals 1 and 2	Below 1 ohms

c. Reinstall the IG2 relay.

NG: REPLACE 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. Turn the ignition switch on (IG)
    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
5 - Body ground	Ignition switch on (IG)	9 to 14 V

d. Reinstall the IG2 relay.

NG: Go to step 14

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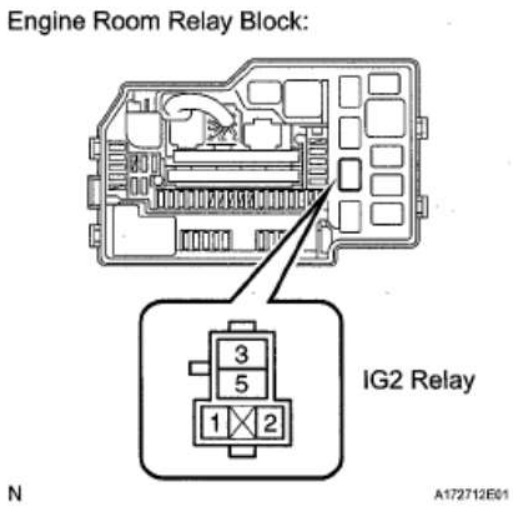


Fig. 284: Identifying IG2 Relay
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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
2 - Body ground	Always	Below 1 ohms

    c. Reinstall the IG2 relay.

Result

RESULT CHART

Result	Proceed to
NG	A
OK (w/o Smart Key System)	B
OK (w/ Smart Key System)	C

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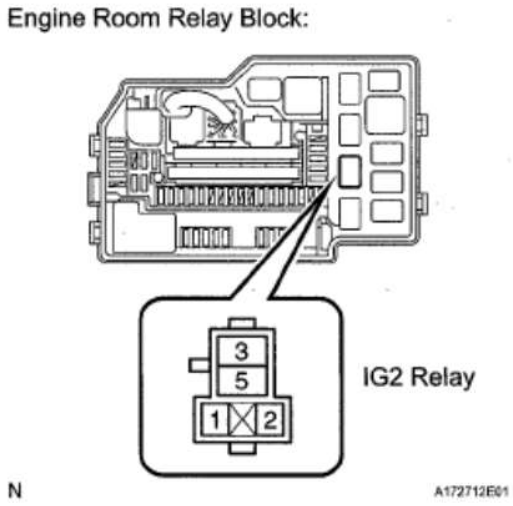


Fig. 285: Identifying IG2 Relay
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

B: Go to step 15

C: Go to step 17

A: REPAIR OR REPLACE HARNESS OR CONNECTOR (IG2 RELAY - BODY GROUND)

13. **CHECK FUSE (IG2 FUSE)**
    a. Remove the IG2 fuse 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 fuse	Always	Below 1 ohms

    c. Reinstall the IG2 fuse

NG: REPLACE FUSE (IG2 FUSE)

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Engine Room Relay Block:

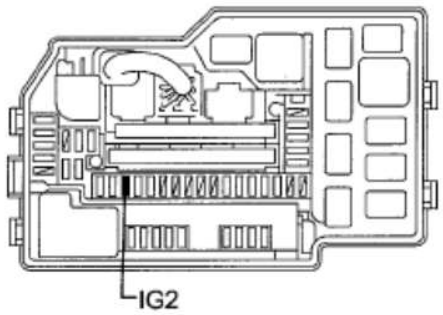


Fig. 286: Identifying IG2 Fuse
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: REPAIR OR REPLACE HARNESS OR CONNECTOR (IG2 RELAY - BATTERY)

14. **CHECK FUSE (IGN FUSE)**
    a. Remove the IGN fuse from the instrument panel junction 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
IGN fuse	Always	Below 1 ohms

    c. Reinstall the IGN fuse.

NG: REPLACE FUSE (IGN FUSE)

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Instrument Panel Junction Block:

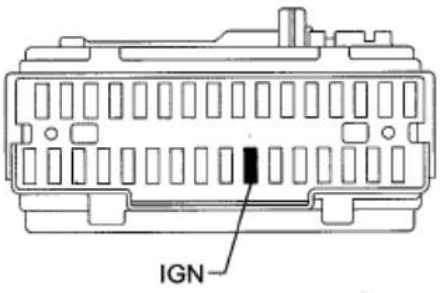


Fig. 287: Identifying IGN Fuse
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: REPAIR OR REPLACE HARNESS OR CONNECTOR (IG2 RELAY - ECM)

15. **CHECK HARNESS AND CONNECTOR (IGNITION SWITCH - IG2 RELAY)**
    a. Remove the IG2 relay from the engine room relay block.
    b. Disconnect the ignition switch 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

Check for short

TESTER CONNECTION SPECIFIED CONDITION CHART

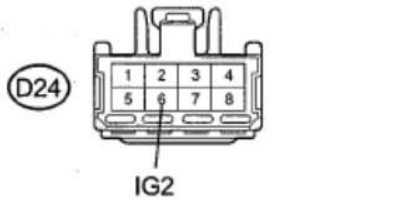
Tester Connection	Condition	Specified Condition
D24-6 (IG2) or IG2 relay terminal 1 - Body ground	Always	10 kohms or higher

    d. Reinstall the IG2 relay.
    e. Reconnect the ignition switch connector.

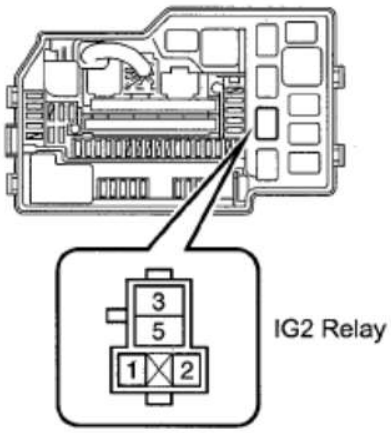
NG: REPAIR OR REPLACE HARNESS OR CONNECTOR (IGNITION SWITCH - IG2 RELAY)

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Front view of wire harness connector:
(to Ignition Switch)



Engine Room Relay Block:



A172716E02

Fig. 288: Identifying IG2 Relay And Ignition Switch Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

16. **INSPECT IGNITION SWITCH**
    a. Inspect the ignition switch assembly (See **INSPECTION**).

    NG: REPLACE IGNITION SWITCH (See **IGNITION SWITCH**)

    OK: REPAIR OR REPLACE HARNESS OR CONNECTOR (IGNITION SWITCH - BATTERY)

17. **CHECK HARNESS AND CONNECTOR (ENGINE ROOM RELAY BLOCK - MAIN BODY ECU)**
    a. Remove the IG2 relay from the engine room relay block.

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b. Remove the instrument panel junction block (main body ECU).
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
IG2 relay holder terminal (1) - D7-11 (IG2D)	Always	Below 1 ohms
IG2 relay holder terminal (2) - Body ground	Always	Below 1 ohms

Standard resistance (Check for short)

TESTER CONNECTION SPECIFIED CONDITION CHART

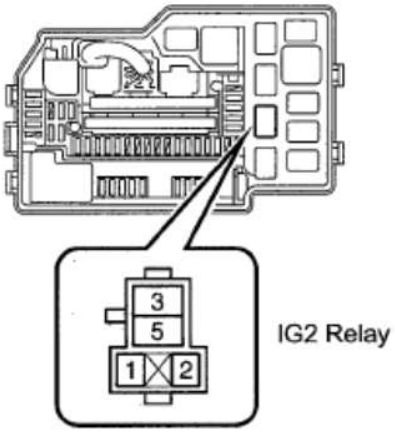
Tester Connection	Condition	Specified Condition
D7-11 (IG2D) - Body ground	Always	10 kohms or higher

d. Reinstall the IG2 relay.
e. Reconnect the main body ECU connector.

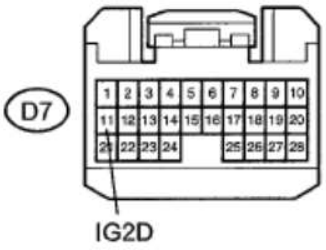
NG: CHECK SMART KEY SYSTEM (See **HOW TO PROCEED WITH TROUBLESHOOTING**)

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Engine Room Relay Block:



Front view of wire harness connector:
(to Main Body ECU)



A172719E02

Fig. 289: Identifying IG2 Relay Main Body ECU Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: REPAIR OR REPLACE HARNESS OR CONNECTOR

VC OUTPUT CIRCUIT

DESCRIPTION

The ECM constantly uses 5 V from the battery voltages supplied to the +B (BATT) terminal to operate the microprocessor. The ECM also provides this power to the sensors through the VC output circuit.

When the VC circuit is short-circuited, the microprocessor in the ECM and sensors that are supplied 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:

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Under normal conditions, the MIL is illuminated for several seconds when the ignition switch is first turned to the on (IG). The MIL goes off when the engine is started.

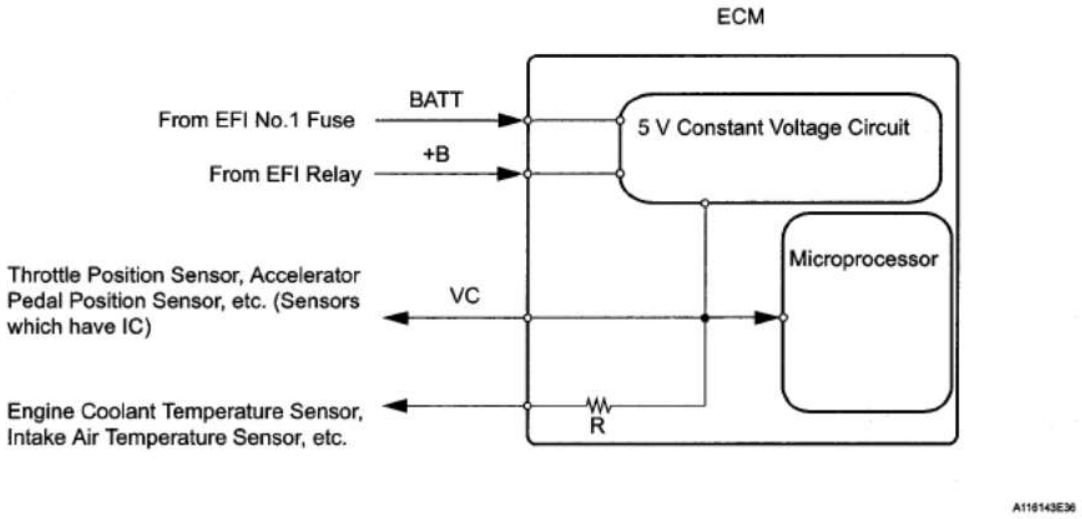


Fig. 290: VC Output Circuit Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

WIRING DIAGRAM

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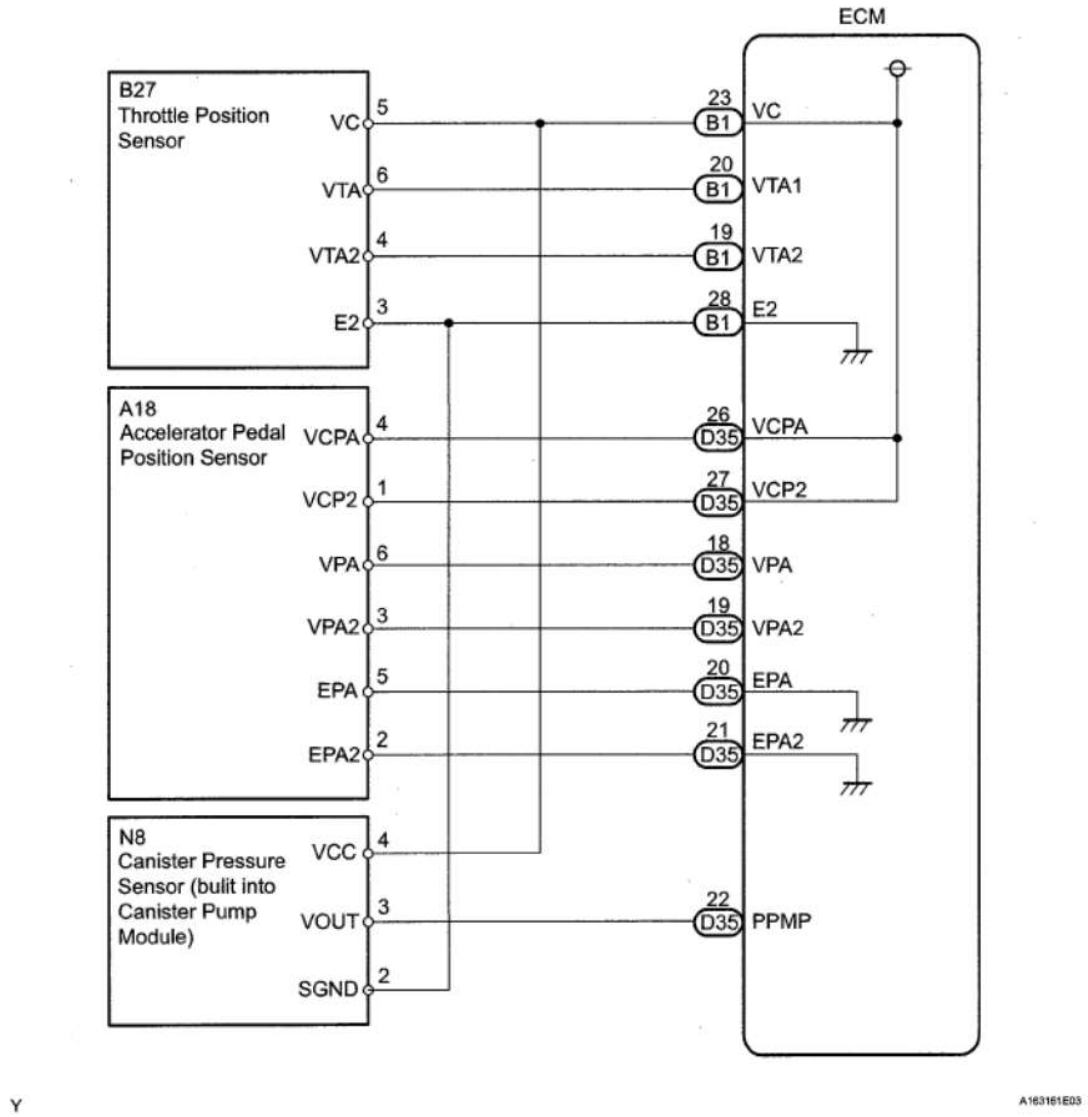


Fig. 291: VC Output - Wiring Diagram (1 Of 2)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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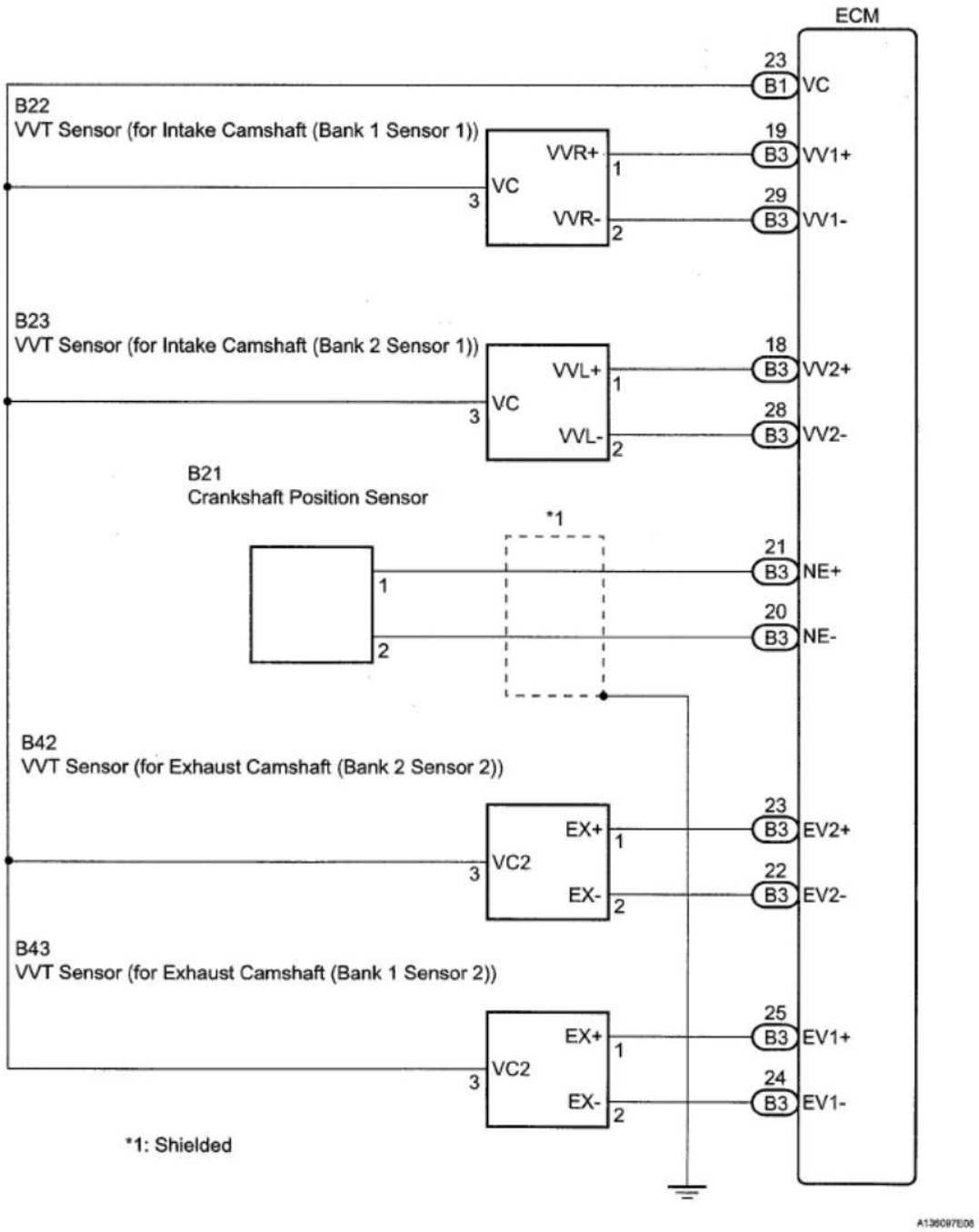


Fig. 292: VC Output - Wiring Diagram (2 Of 2)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSPECTION PROCEDURE

1. **CHECK MIL**
   a. Check that the Malfunction Indicator Lamp (MIL) lights up when turning the ignition switch on (IG).

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OK:

MIL lights up.

NG: Go to step 2

OK: GO TO **MIL CIRCUIT**

2. **CHECK CONNECTION BETWEEN TECHSTREAM AND ECM**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch on (IG) and turn the tester on.
   c. Check the communication between the tester and ECM.

Result

RESULT CHART

Result	Proceed to
Communication is possible	A
Communication is not possible	B

A: GO TO **MIL CIRCUIT**

B: Go to next step

3. **CHECK THROTTLE BODY (CHECK MIL ILLUMINATED)**
   a. Disconnect the throttle body connector.
   b. Turn the ignition switch on (IG).
   c. Check the MIL.

Result

RESULT CHART

Result	Proceed to
MIL illuminates	A
MIL does not illuminate	B

   d. Reconnect the throttle body connector.

A: REPLACE THROTTLE BODY (See **THROTTLE BODY**)

B: Go to next step

4. **CHECK ACCELERATOR PEDAL ROD (CHECK MIL ILLUMINATED)**
   a. Disconnect the accelerator pedal position sensor connector.

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b. Turn the ignition switch on (IG).
c. Check the MIL.

Result

RESULT CHART

Result	Proceed to
MIL illuminates	A
MIL does not illuminate	B

d. Reconnect the accelerator pedal position sensor connector.

A: REPLACE ACCELERATOR PEDAL ROD (See **REMOVAL**)

B: Go to next step

5. **CHECK VVT SENSOR FOR INTAKE CAMSHAFT BANK 1 (CHECK MIL ILLUMINATED)**
   a. Disconnect the VVT sensor for intake camshaft bank 1 connector.
   b. Turn the ignition switch on (IG).
   c. Check the MIL.

Result

RESULT CHART

Result	Proceed to
MIL illuminates	A
MIL does not illuminate	B

d. Reconnect the VVT sensor for intake camshaft bank 1 connector.

A: REPLACE VVT SENSOR FOR INTAKE CAMSHAFT BANK 1 (See **VVT SENSOR**)

B: Go to next step

6. **CHECK VVT SENSOR FOR EXHAUST CAMSHAFT BANK 1 (CHECK MIL ILLUMINATED)**
   a. Disconnect the VVT sensor for exhaust camshaft bank 1 connector.
   b. Turn the ignition switch on (IG).
   c. Check the MIL

Result

RESULT CHART

Result	Proceed to

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MIL illuminates	A
MIL does not illuminate	B

d. Reconnect the VVT sensor for exhaust camshaft bank 1 connector.

A: REPLACE VVT SENSOR FOR EXHAUST CAMSHAFT BANK 1 (See **VVT SENSOR**)

B: Go to next step

7. **CHECK VVT SENSOR FOR INTAKE CAMSHAFT BANK 2 (CHECK MIL ILLUMINATED)**
   a. Disconnect the VVT sensor for intake camshaft bank 2 connector.
   b. Turn the ignition switch on (IG).
   c. Check the MIL.

Result

RESULT CHART

Result	Proceed to
MIL illuminates	A
MIL does not illuminate	B

d. Reconnect the VVT sensor for intake camshaft bank 2 connector.

A: REPLACE VVT SENSOR FOR INTAKE CAMSHAFT BANK 2 (See **VVT SENSOR**)

B: Go to next step

8. **CHECK VVT SENSOR FOR EXHAUST CAMSHAFT BANK 2 (CHECK MIL ILLUMINATED)**
   a. Disconnect the VVT sensor for exhaust camshaft bank 2 connector.
   b. Turn the ignition switch on (IG).
   c. Check the MIL.

Result

RESULT CHART

Result	Proceed to
MIL illuminates	A
MIL does not illuminate	B

d. Reconnect the VVT sensor for exhaust camshaft bank 2 connector.

A: REPLACE VVT SENSOR FOR EXHAUST CAMSHAFT BANK 2 (See **VVT SENSOR**)

B: Go to next step

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9. **CHECK CHARCOAL CANISTER ASSEMBLY (CHECK MIL ILLUMINATED)**
   a. Disconnect the canister pump module connector.
   b. Turn the ignition switch on (IG).
   c. Check the MIL.

   Result

   RESULT CHART

Result	Proceed to
MIL illuminates	A
MIL does not illuminate	B

   d. Reconnect the canister pump module connector.

   A: REPLACE CHARCOAL CANISTER ASSEMBLY (See **CANISTER**)

   B: Go to next step

10. **CHECK HARNESS AND CONNECTOR**
   a. Disconnect the throttle body connector.
   b. Disconnect the accelerator pedal position sensor connector.
   c. Disconnect the VVT sensor for intake camshaft bank 1 connector.
   d. Disconnect the VVT sensor for exhaust camshaft bank 1 connector.
   e. Disconnect the VVT sensor for intake camshaft bank 2 connector.
   f. Disconnect the VVT sensor for exhaust camshaft bank 2 connector.
   g. Disconnect the canister pump module connector.
   h. Disconnect the ECM connectors.
   i. Measure the resistance according to the value(s) in the table below.

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Rear view of wire harness connector:
(to ECM)

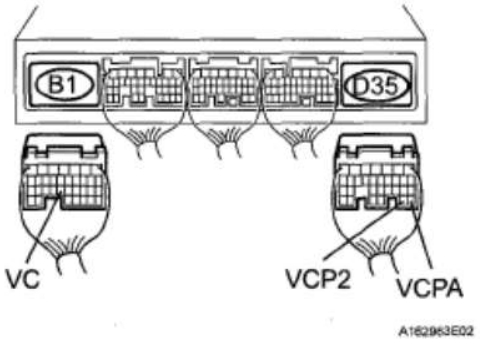


Fig. 293: Identifying ECM Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Standard resistance (Check for short)

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connections	Condition	Specified Conditions
VC (B1-23) - Body ground	Always	10 kohms or higher
VCPA (D35-26) - Body ground	Always	10 kohms or higher
VCP2 (D35-27) - Body ground	Always	10 kohms or higher

j. Reconnect the ECM connectors.
k. Reconnect the canister pump module connector.
l. Reconnect the VVT sensor for exhaust camshaft bank 2 connector.
m. Reconnect the VVT sensor for intake camshaft bank 2 connector.
n. Reconnect the VVT sensor for exhaust camshaft bank 1 connector.
o. Reconnect the VVT sensor for intake camshaft bank 1 connector.
p. Reconnect the accelerator pedal position sensor connector.
q. Reconnect the throttle body connector.

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR

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

FUEL PUMP CONTROL CIRCUIT

DESCRIPTION

The FUEL PUMP relay switches the fuel pump speed according to the engine conditions. The fuel pump operates when the ECM receives the starter-operating signal (STA) and crankshaft-rotating signal (NE). The

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FUEL PUMP relay is turned ON while the engine is idling or operating at low load. This causes current to flow through the fuel pump resistor to the fuel pump. The fuel pump then operates at low speed. The FUEL PUMP relay is turned OFF while the engine is cranking or operating at high load. The fuel pump then operates at normal speed.

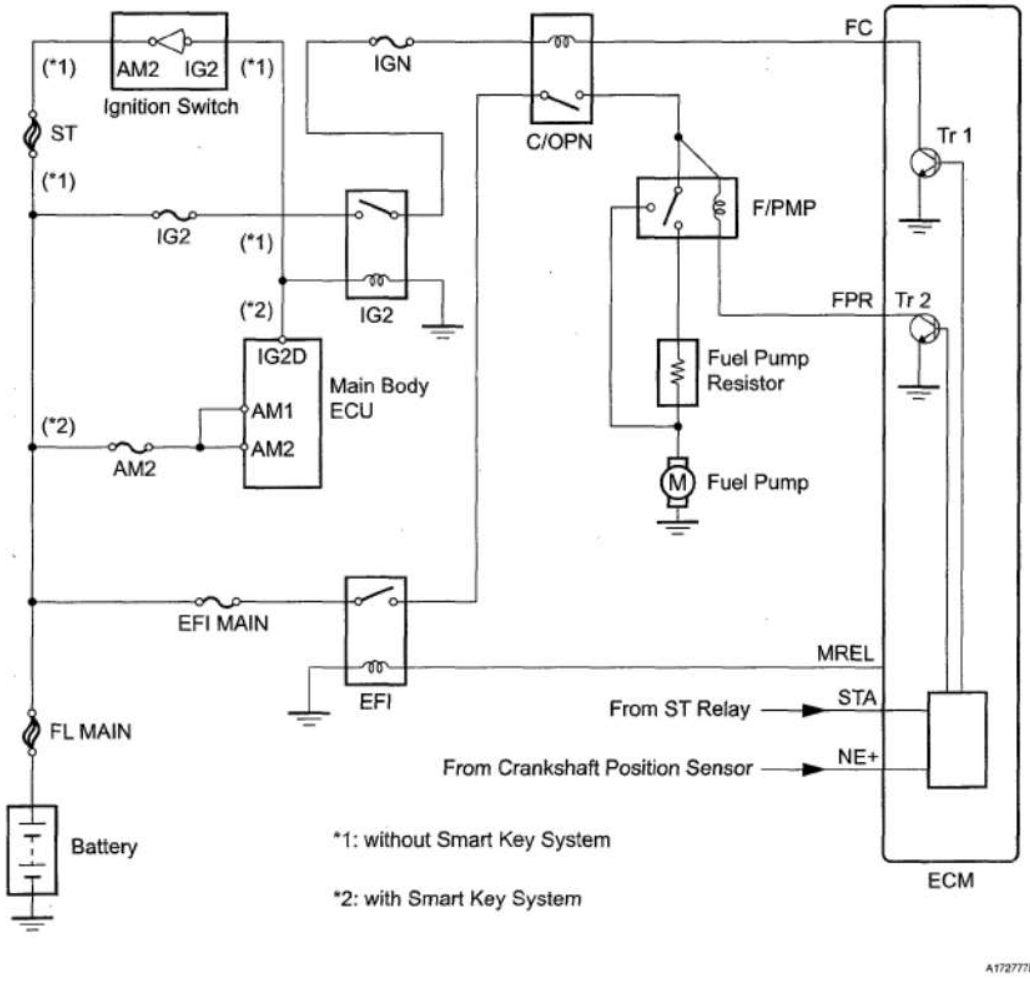


Fig. 294: Fuel Pump Control Circuit Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

WIRING DIAGRAM

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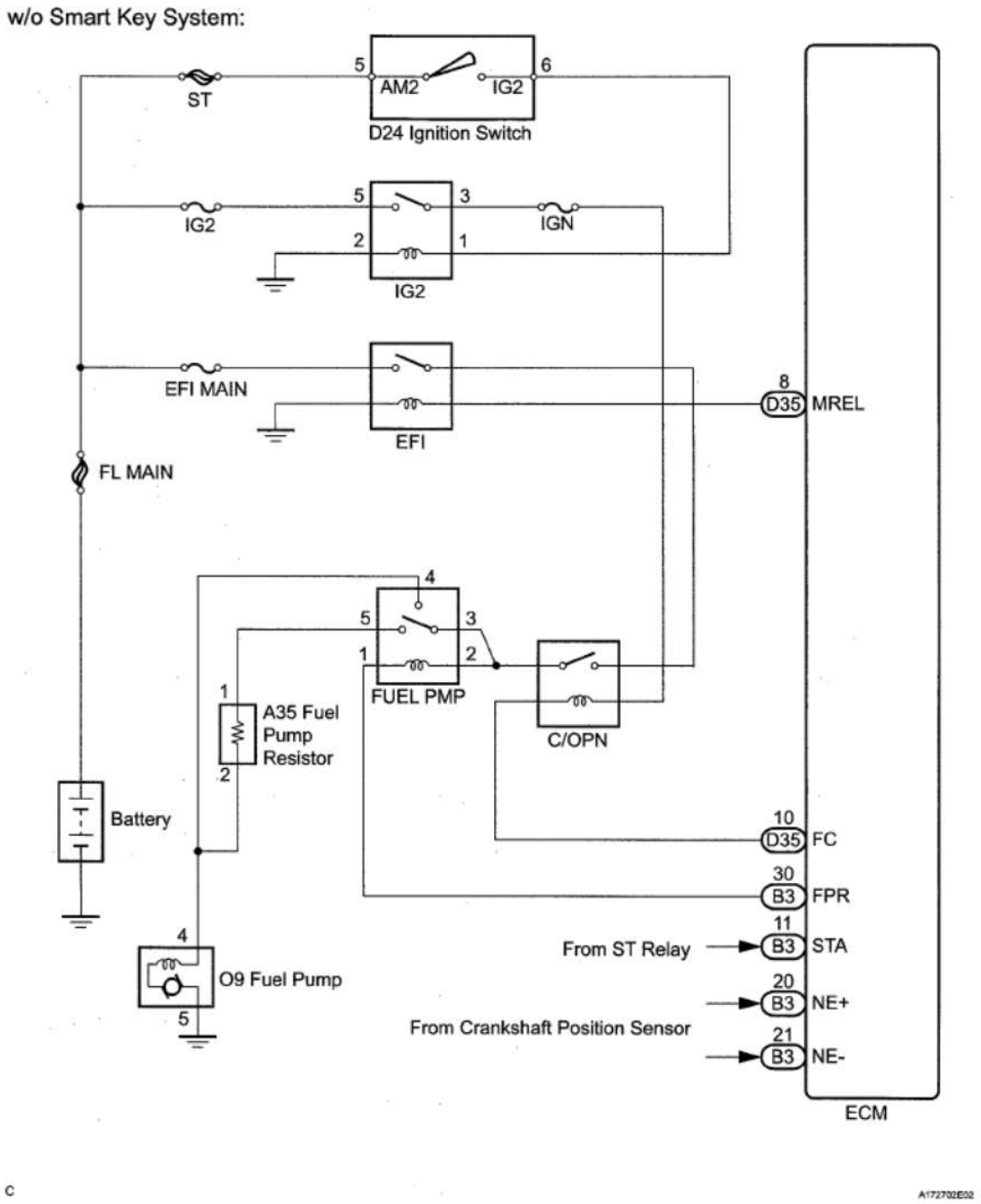


Fig. 295: Fuel Pump Control - Wiring Diagram (1 Of 2)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

w/ Smart Key System:

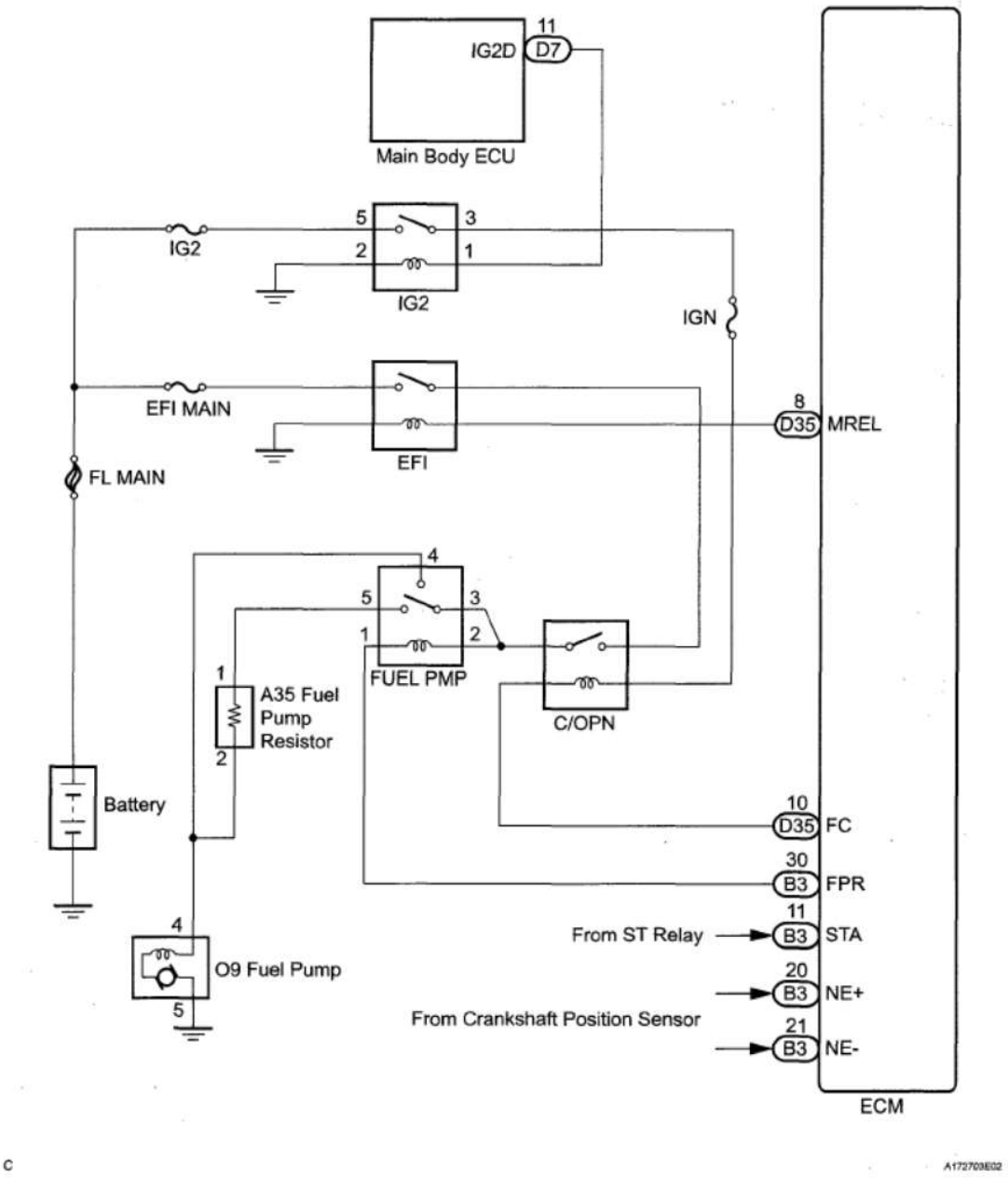


Fig. 296: Fuel Pump Control - Wiring Diagram (2 Of 2)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSPECTION PROCEDURE

1. **PERFORM ACTIVE TEST USING TECHSTREAM (OPERATE C/OPN RELAY)**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch on (IG), and turn the tester on.

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c. Enter the following menus: Powertrain/Engine and ECT/Active Test/Control the Fuel Pump/Speed.
d. Check the relay operation while operating it using the tester.

Standard:

Operating noise can be heard from the relay.

NG: PROCEED TO NEXT CIRCUIT INSPECTION SHOWN IN PROBLEM SYMPTOMS TABLE (See **PROBLEM SYMPTOMS TABLE**)

OK: Go to next step

2. **INSPECT TERMINAL VOLTAGE (FUEL PMP RELAY TERMINAL)**
   a. Remove the FUEL PMP relay from the engine room relay block.
   b. Turn the ignition switch on (IG).
   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
FUEL PMP relay terminal 2 - Body ground	Ignition switch on (IG)	9 to 14 V
FUEL PMP relay terminal 3 - Body ground	Ignition switch on (IG)	9 to 14 V

d. Reinstall the FUEL PMP relay.

Engine Room Relay Block:

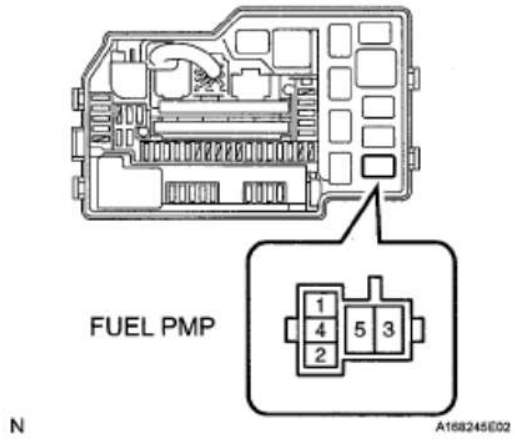


Fig. 297: Identifying FUEL PMP Relay
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR (FUEL PMP RELAY - C/OPN RELAY)

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OK: Go to next step

3. **INSPECT RELAY (FUEL PMP RELAY)**
   a. Remove the FUEL PMP relay from the engine room relay block.
   b. Measure the resistance according to the value(s) in the table below.

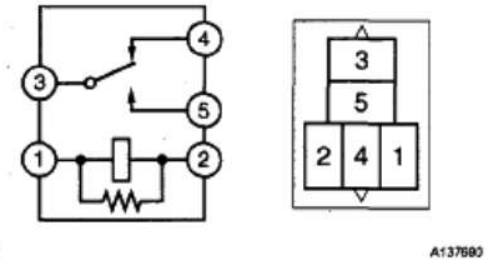


Fig. 298: Fuel PMP Relay Circuit
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Standard resistance

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
3 - 4	When no battery voltage is applied terminals 1 and 2	Below 1 ohms
3 - 5	When no battery voltage is applied terminals 1 and 2	10 kohms or higher
3 - 4	When battery voltage is applied terminals 1 and 2	10 kohms or higher
3 - 5	When battery voltage is applied terminals 1 and 2	Below 1 ohms

   c. Reinstall the FUEL PMP relay.

NG: REPLACE RELAY (FUEL PMP RELAY)

OK: Go to next step

4. **INSPECT FUEL PUMP RESISTOR**
   a. Disconnect the fuel pump resistor 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 - 2	20°C (68°F)	0.30 to 0.34 ohms

   c. Reconnect the fuel pump resistor connector.

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NG: REPLACE FUEL PUMP RESISTOR (See **FUEL PUMP RESISTOR**)

Component without harness connected:
(Fuel Pump Resistor)



A174006E01

Fig. 299: Identifying Fuel Pump Resistor Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

5. **CHECK HARNESS AND CONNECTOR (FUEL PUMP - FUEL PMP RELAY)**
   a. Check the wire harness between the FUEL PMP relay and fuel pump.
      1. Remove the fuel pump relay from the engine room relay block.
      2. Disconnect the fuel pump connector.
      3. Measure the resistance according to the value(s) in the table below.

Standard resistance

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
FUEL PMP relay terminal 4 - O9-4	Always	Below 1 ohms
FUEL PMP relay terminal 4 or O9-4 -Body ground	Always	10 kohms or higher

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR

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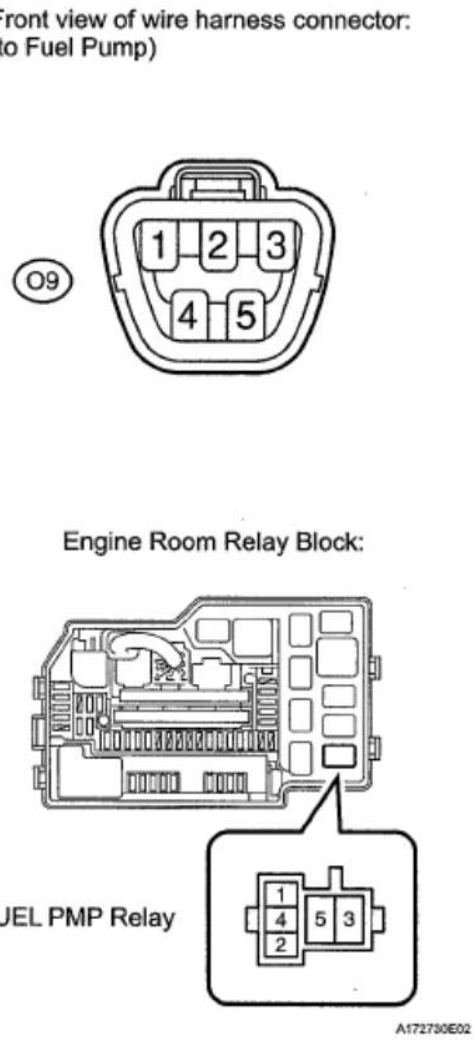


Fig. 300: Identifying Fuel PMP Relay And Fuel Pump Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

6. **CHECK HARNESS AND CONNECTOR (FUEL PUMP RELAY - FUEL PUMP RESISTOR)**
   a. Disconnect the fuel pump resistor connector.
   b. Remove the fuel pump 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
FUEL PMP relay terminal (5) - A35-1	Always	Below 1 ohms

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Standard resistance (Check for short)

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
FUEL PMP relay terminal (5) or A35-1 - Body ground	Always	10 kohms or higher

d. Reconnect the fuel pump resistor connector.
e. Reinstall the fuel pump relay.

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR

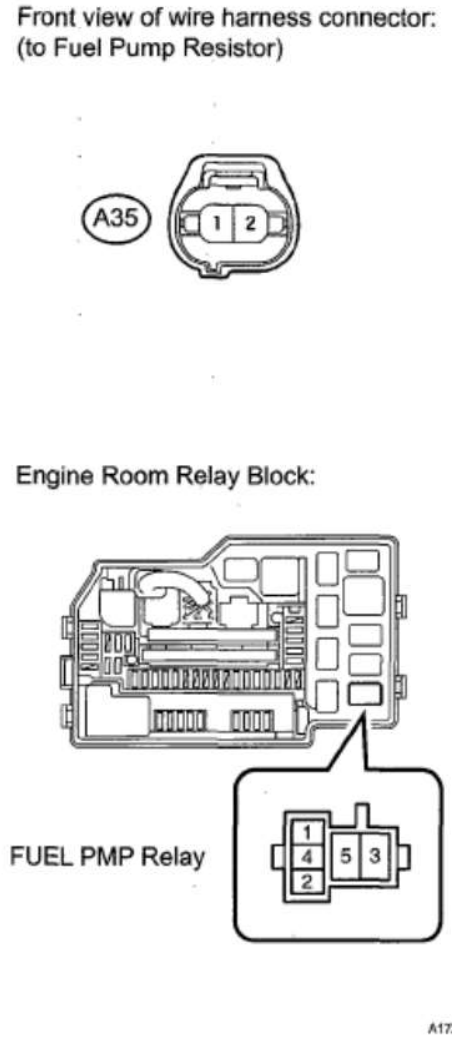


Fig. 301: Identifying Fuel PMP Relay And Fuel Pump Resistor Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

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7. **CHECK HARNESS AND CONNECTOR (FUEL PUMP RESISTOR - FUEL PUMP)**
   a. Disconnect the fuel pump resistor connector.
   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
A35-2 - O9-4	Always	Below 1 ohms

Standard resistance (Check for short)

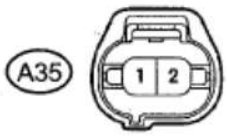
TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
A35-2 or O9-4 - Body ground	Always	10 kohms or higher

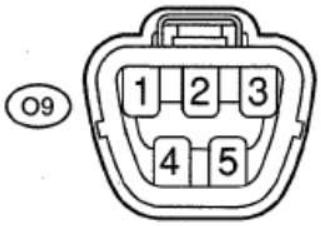
   d. Reconnect the fuel pump resistor connector.
   e. Reconnect the fuel pump connector.

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR

Front view of wire harness connector:
(to Fuel Pump Resistor)



(to Fuel Pump)



A137393E05

Fig. 302: Identifying Fuel Pump Resistor And Fuel Pump Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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OK: Go to next step

8. **INSPECT FUEL PUMP**
   a. Inspect the fuel pump.
      1. Measure the resistance according to the value(s) in the table below.

Standard resistance

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connections	Condition	Specified Condition
4 - 5	20°C (68°F)	0.2 to 0.3 ohms

      2. Apply battery voltage to both terminals 4 (+) and 5 (-). Check that the pump operates.

Component without harness connected:
(Fuel Pump)



A172728E02

Fig. 303: Identifying Fuel Pump Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

NOTE:
- **These tests must be done quickly (within 10 seconds) to prevent the coil from burning out.**
- **Keep the fuel pump as far away from the battery as possible.**
- **Always turn ON and OFF the voltage on the battery side, not on the fuel pump side.**

NG: REPLACE FUEL PUMP ASSEMBLY (See **FUEL PUMP**)

OK: CHECK AND REPLACE FUEL FILTER

9. **CHECK ECM POWER SOURCE CIRCUIT**

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HINT:

(See **ECM POWER SOURCE CIRCUIT**).

NG: REPAIR OR REPLACE ECM POWER SOURCE CIRCUIT

OK: Go to next step

10. **INSPECT ENGINE ROOM JUNCTION BLOCK ASSEMBLY (C/OPN RELAY)**
    a. Inspect the C/OPN relay (See **INSPECTION**).

    NG: REPLACE CIRCUIT OPENING RELAY (See **REMOVAL**)

    OK: Go to next step

11. **INSPECT ECM (FC VOLTAGE)**
    a. Turn the ignition switch on (IG).
    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
D35-10 (FC) - B3-1 (E1)	Ignition switch on (IG)	9 to 14 V

    NG: Go to step 12

Component with harness connected:
(ECM)

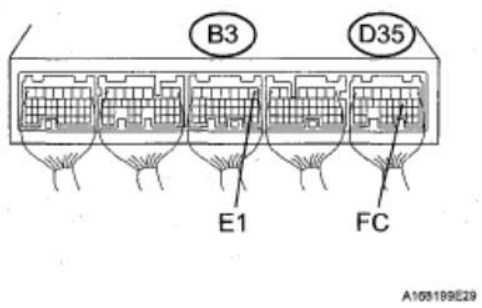


Fig. 304: Identifying ECM B3 And D35 Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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

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12. **CHECK HARNESS AND CONNECTOR (ECM - C/OPN RELAY)**
    a. Disconnect the ECM connector.
    b. Remove the engine room junction 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
D35-10 (FC) - 2D-12 (C/OPN relay terminal)	Always	Below 1 ohms

Standard resistance (Check for short)

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
D35-10 (FC) or 2D-12 (C/OPN relay terminal) - Body ground	Always	10 kohms or higher

    d. Reconnect the ECM connector.
    e. Reinstall the engine room junction block.

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR (ECM - C/OPN RELAY)

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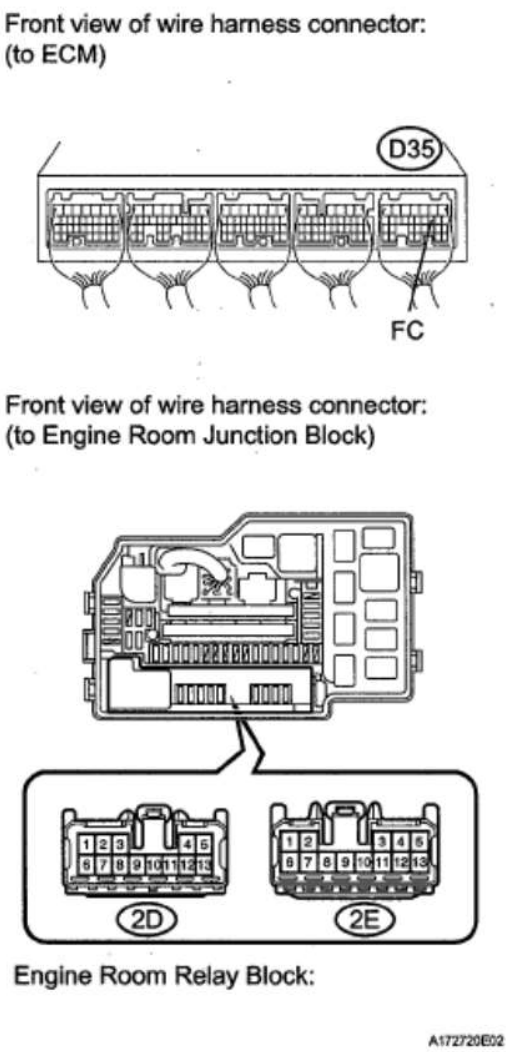


Fig. 305: Identifying Engine Room Relay Block And ECM Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: REPLACE ENGINE ROOM JUNCTION BLOCK ASSEMBLY (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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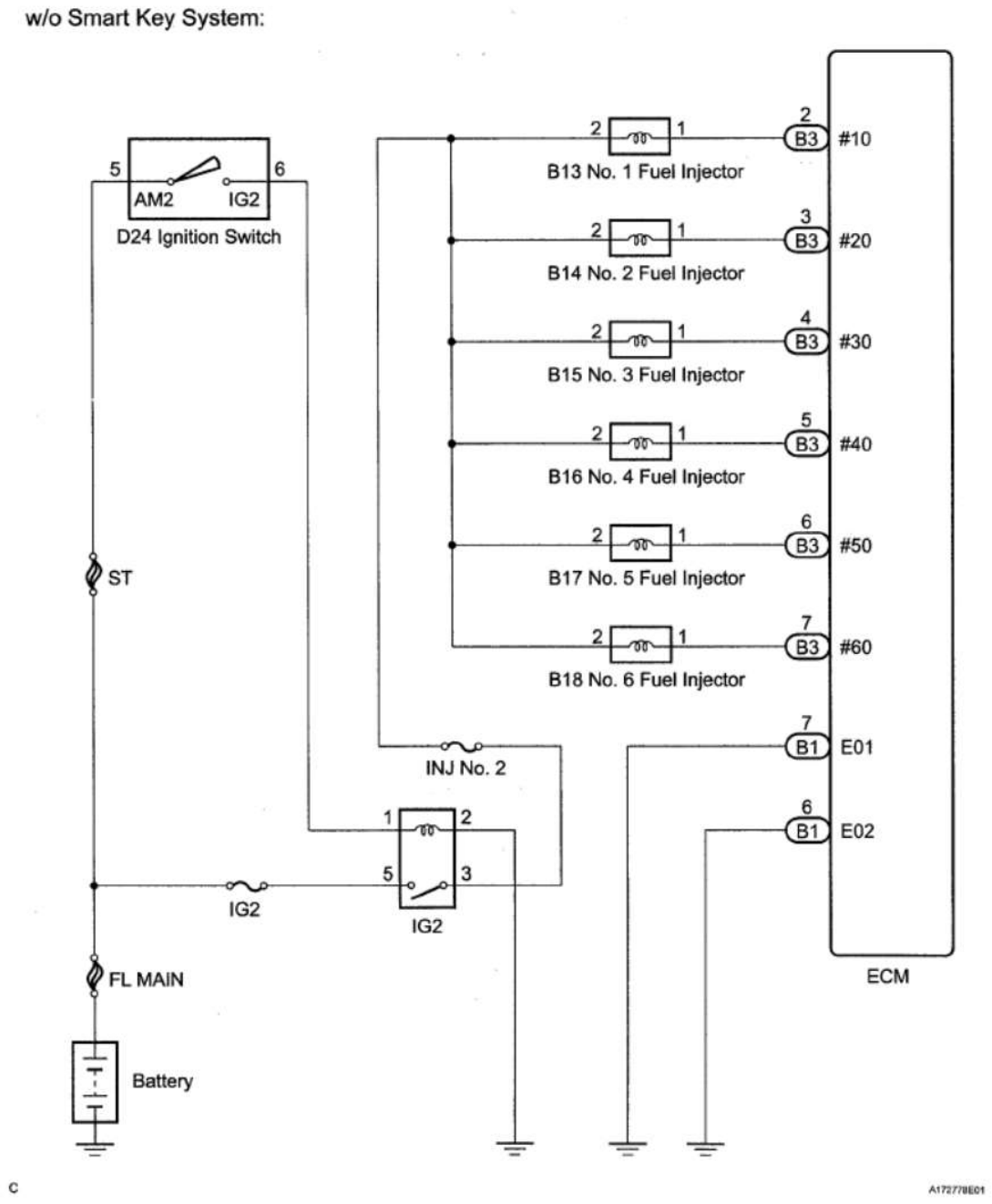


Fig. 306: Fuel Injector - Wiring Diagram (1 Of 2)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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w/ Smart Key System:

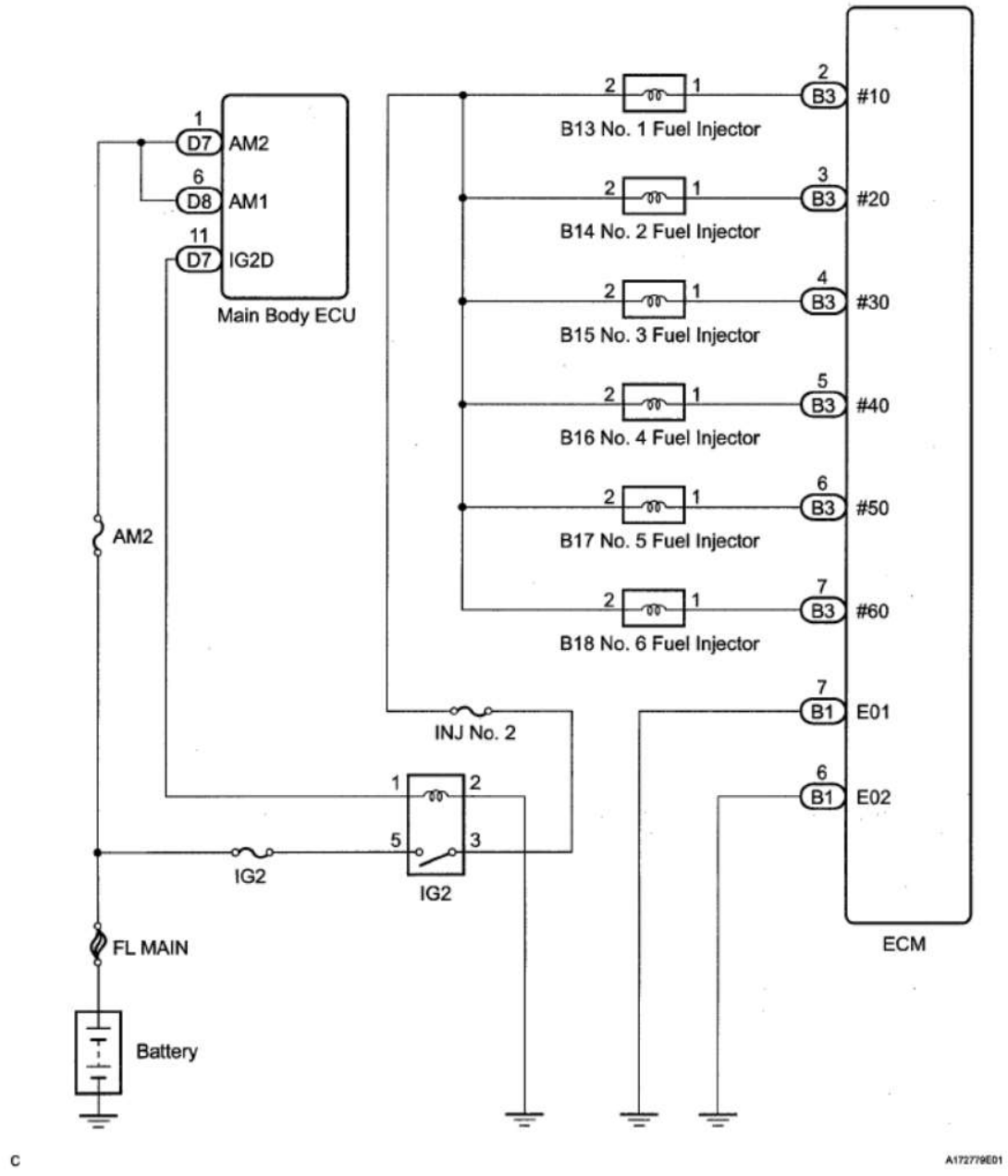


Fig. 307: Fuel Injector - Wiring Diagram (2 Of 2)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSPECTION PROCEDURE

1. **CHECK FUEL INJECTOR ASSEMBLY (POWER SOURCE)**
   a. Disconnect the fuel injector assembly connector.
   b. Turn the ignition switch on (IG).
   c. Measure the voltage according to the value(s) in the table below.

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Standard voltage

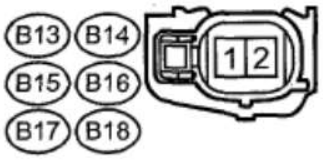
TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Switch Condition	Specified Condition
B13-2 - Body ground	Ignition switch on (IG)	9 to 14 V
B14-2 - Body ground	Ignition switch on (IG)	9 to 14 V
B15-2 - Body ground	Ignition switch on (IG)	9 to 14 V
B16-2 - Body ground	Ignition switch on (IG)	9 to 14 V
B17-2 - Body ground	Ignition switch on (IG)	9 to 14 V
B18-2 - Body ground	Ignition switch on (IG)	9 to 14 V

d. Turn the ignition switch off.
e. Reconnect the fuel injector assembly connector.

NG: Go to step 4

Front view of wire harness connector:
(to Fuel Injector)



A157859E14

Fig. 308: Identifying Fuel Injector Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

2. **INSPECT FUEL INJECTOR ASSEMBLY**
   a. Inspect the injector assembly (See **INSPECTION**).

   NG: REPLACE FUEL INJECTOR ASSEMBLY (See **FUEL INJECTOR**)

   OK: Go to next step

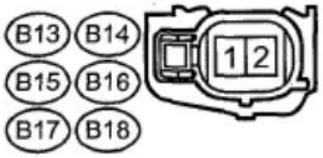
3. **CHECK HARNESS AND CONNECTOR (FIEL INJECTOR ASSEMBLY - ECM)**
   a. Disconnect the fuel injector connector (of the misfiring cylinder).

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b. Measure the voltage according to the value(s) in the table below.

Front view of wire harness connector:
(to Fuel Injector)



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Fig. 309: Identifying Fuel Injector Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Standard voltage

TESTER CONNECTION SPECIFIED CONDITION CHART

Cylinder	Tester Connection	Switch Condition	Specified Condition
No. 1	B13-2 - Body ground	Ignition switch on (IG)	11 to 14 V
No. 2	B14-2 - Body ground	Ignition switch on (IG)	11 to 14 V
No. 3	B15-2 - Body ground	Ignition switch on (IG)	11 to 14 V
No. 4	B16-2 - Body ground	Ignition switch on (IG)	11 to 14 V
No. 5	B17-2 - Body ground	Ignition switch on (IG)	11 to 14 V
No. 6	B18-2 - Body ground	Ignition switch on (IG)	11 to 14 V

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR (FUEL INJECTOR ASSEMBLY - ECM)

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

4. **INSPECT FUSE (INJ NO. 2 FUSE)**
   a. Remove the INJ No. 2 fuse from 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
INJ No. 2 fuse	Always	Below 1 ohms

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c. Reinstall the INJ No. 2 fuse.

NG: REPLACE FUSE

Engine Room Relay Block:

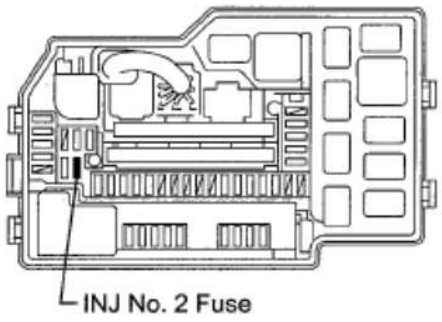


Fig. 310: Identifying INJ No. 2 Fuse
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: REPAIR OR REPLACE HARNESS OR CONNECTOR (INTEGRATION RELAY (IG2 RELAY) - FUEL INJECTOR ASSEMBLY)

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 (for automatic transaxle) or clutch pedal switch (for manual transaxle) and also flows to terminal STA of the ECM (STA Signal).

WIRING DIAGRAM

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w/o Smart Key System:

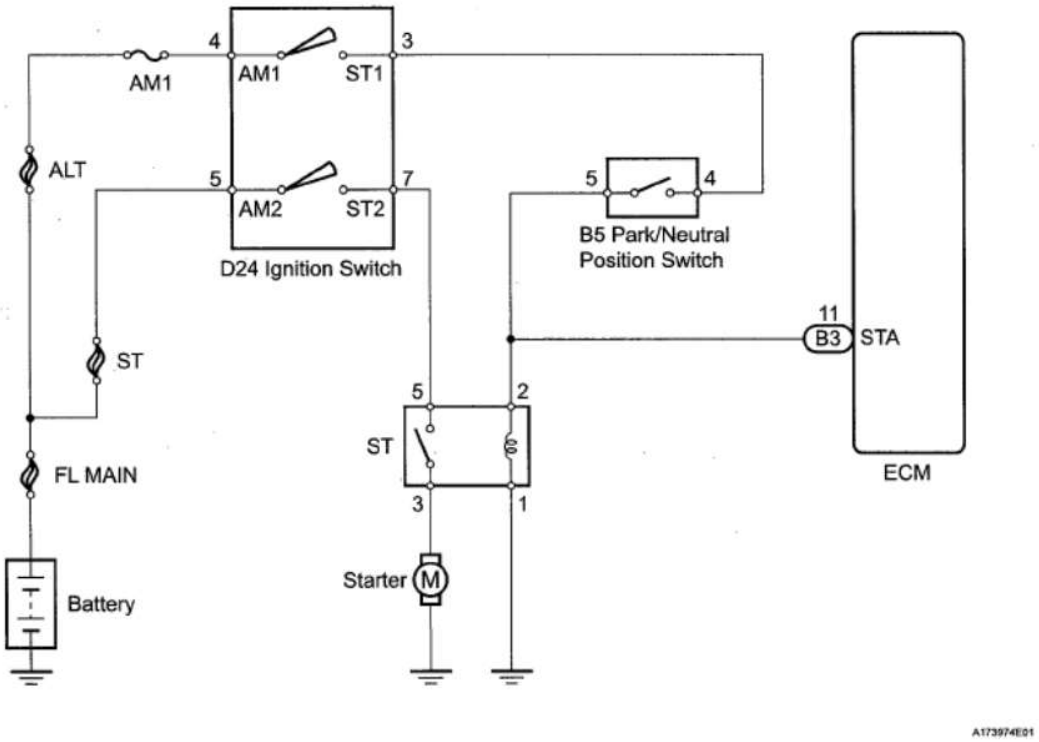


Fig. 311: Starter Signal - Wiring Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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. **INSPECT TERMINAL VOLTAGE (ST RELAY TERMINAL)**
   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	Condition	Specified Condition
ST relay terminal 1 - Body ground	Engine cranking	9 to 14 V

HINT:

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The engine does not crank because the relay is not installed.

c. Reinstall the ST relay.

NG: Go to step 11

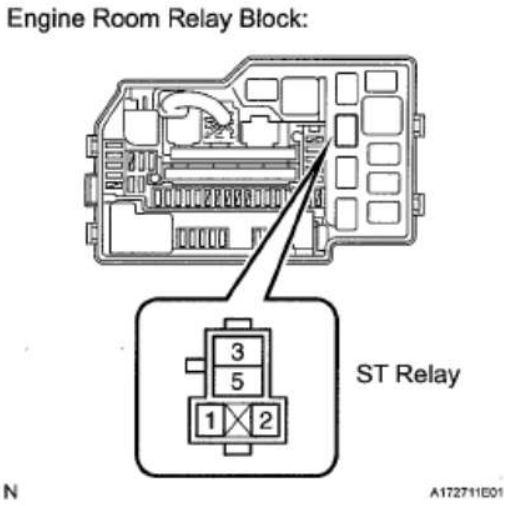


Fig. 312: Identifying ST Relay
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

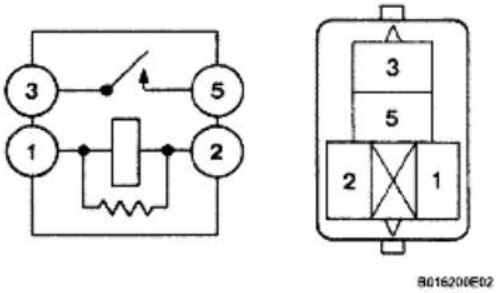
OK: Go to next step

2. **INSPECT ST RELAY**
   a. Remove the ST 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	When no battery voltage applied terminals 1 and 2	10 kohms or higher
3 - 5	When the battery voltage applied terminals 1 and 2	Below 1 ohms



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Fig. 313: ST Relay Circuit
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

c. Reinstall the ST relay.

NG: REPLACE ST RELAY

OK: Go to next step

3. **CHECK HARNESS AND CONNECTOR (ST RELAY - BODY GROUND)**
   a. Remove the ST 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
ST relay terminal 2 - Body ground	Always	Below 1 ohms

c. Reinstall the ST relay.

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR (ST RELAY - BODY GROUND)

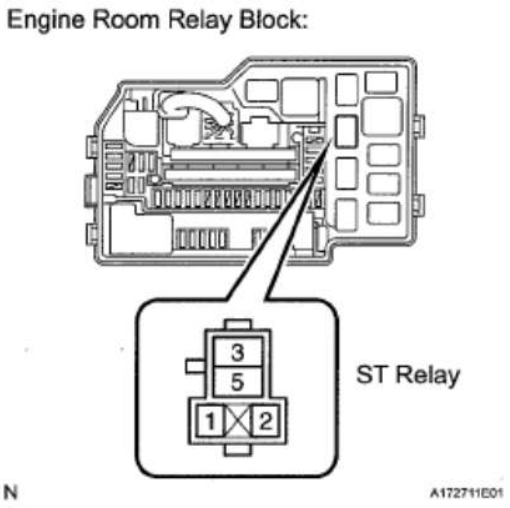


Fig. 314: Identifying ST Relay
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

4. **INSPECT TERMINAL VOLTAGE (ST RELAY TERMINAL)**
   a. Remove the ST relay from the engine room relay block.

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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
ST relay terminal 5 - Body ground	Cranking	9 to 14 V

c. Reinstall the ST relay.

NG: Go to step 6

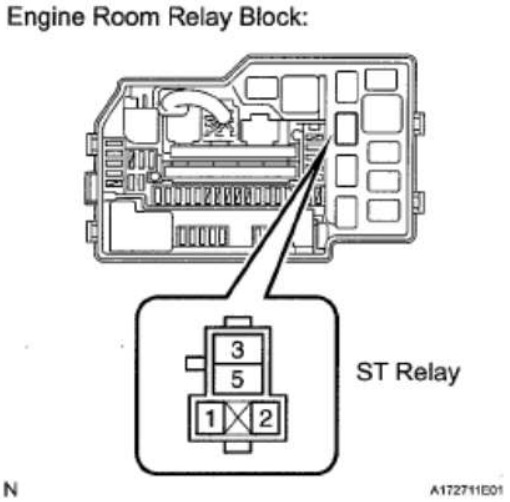


Fig. 315: Identifying ST Relay
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

5. **CHECK HARNESS AND CONNECTOR (ST RELAY - STARTER)**
   a. Remove the ST relay from the engine room relay block.
   b. Disconnect the starter 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
ST relay terminal 3 - B12-1	Always	Below 1 ohms

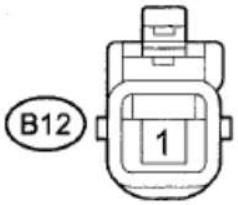
   d. Reconnect the starter connector.
   e. Reinstall the ST relay.

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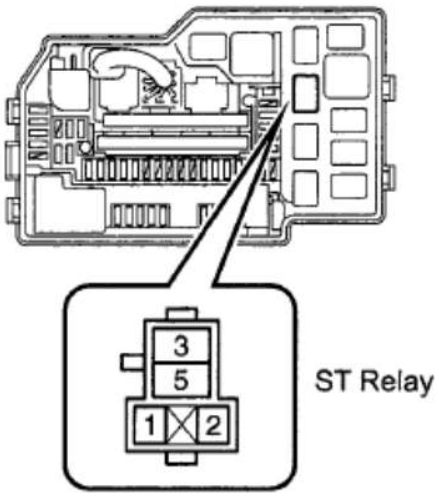
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NG: REPAIR OR REPLACE HARNESS OR CONNECTOR (ST RELAY - STARTER)

Front view of wire harness connector:
(to Starter)



Engine Room Relay Block:



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Fig. 316: Identifying ST Relay And Starter Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: REPAIR OR REPLACE STARTER ASSEMBLY

6. **CHECK HARNESS AND CONNECTOR (ST RELAY - IGNITION SWITCH ASSEMBLY)**
   a. Remove the ST relay from the engine room relay block.
   b. Disconnect the ignition switch 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
ST relay terminal 5 - D24-7 (ST2)	Always	Below 1 ohms

Standard resistance (Check for short)

TESTER CONNECTION SPECIFIED CONDITION CHART

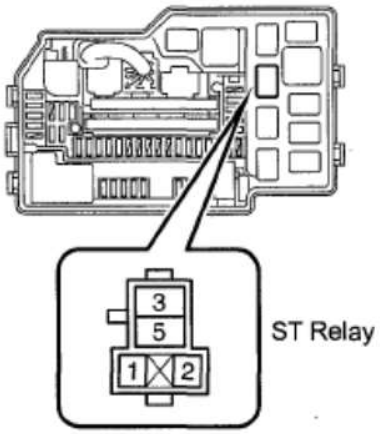
Tester Connection	Condition	Specified Condition
ST relay terminal 5 or D24-7 (ST2) - Body ground	Always	10 kohms or higher

d. Reinstall the ST relay.
e. Reconnect the ignition switch connector.

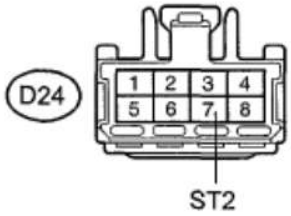
NG: REPAIR OR REPLACE HARNESS OR CONNECTOR (ST RELAY - IGNITION SWITCH ASSEMBLY)

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Engine Room Relay Block:



Front view of wire harness connector:
(to Ignition Switch Assembly)



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A172723E02

Fig. 317: Identifying ST Relay And Ignition Switch Assembly Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

7. **INSPECT IGNITION SWITCH ASSEMBLY**
   a. Disconnect the ignition switch assembly connector.
   b. Measure the resistance according to the value(s) in the table below.

Standard resistance

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Ignition Switch Position	Specified Condition
All terminals	LOCK	10 kohms or higher
D24-4 (AM1) - D24-3 (ST1)	START	Below 1 ohms

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c. Reconnect the ignition switch assembly connector.

NG: REPLACE IGNITION SWITCH ASSEMBLY (See **IGNITION SWITCH**)

Component without harness connected:
(Ignition Switch Assembly)

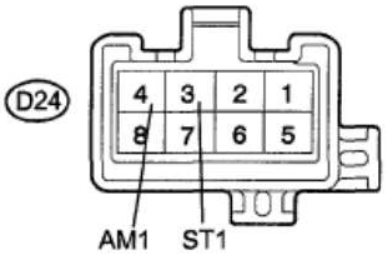


Fig. 318: Identifying Ignition Switch Assembly Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

8. **CHECK HARNESS AND CONNECTOR (ST RELAY - PARK/NEUTRAL POSITION SWITCH)**
   a. Remove the ST relay from the engine room relay block.
   b. Disconnect the park/neutral position switch 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
ST relay terminal 2 - B5-5	Always	Below 1 ohms

Standard resistance (Check for short)

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
ST relay terminal 2 or B5-5 - Body ground	Always	10 kohms or higher

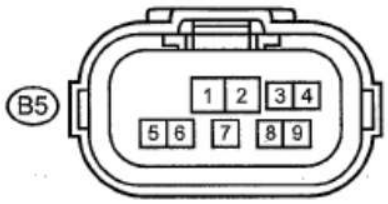
   d. Reinstall the ST relay.
   e. Reconnect the park/neutral position switch connector.

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR (ST RELAY -

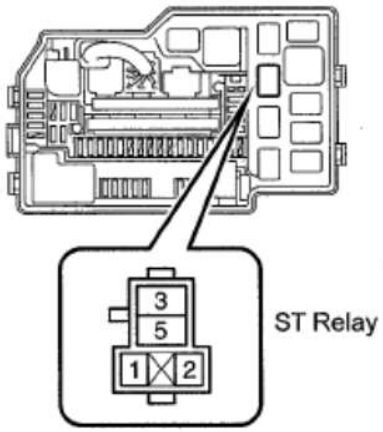
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PARK/NEUTRAL POSITION SWITCH)

Front view of wire harness connector:
(to Park/Neutral Position Switch)



Engine Room Relay Block:



A172724E01

Fig. 319: Identifying ST Relay And Park/Neutral Position Switch Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

9. **INSPECT PARK/NEUTRAL POSITION SWITCH ASSEMBLY**
   a. Inspect the park/neutral position switch assembly (U151E: See **INSPECTION** , U151F: See **INSPECTION**).

Result:

RESULT CHART

Result	Proceed To
OK	A

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NG (with U151E)	B
NG (with U151F)	C

B: REPLACE PARK/NEUTRAL POSITION SWITCH ASSEMBLY (See **PARK/NEUTRAL POSITION SWITCH**)

C: REPLACE PARK/NEUTRAL POSITION SWITCH (See **PARK/NEUTRAL POSITION SWITCH**)

A: Go to next step

10. **CHECK HARNESS AND CONNECTOR (PARK/NEUTRAL POSITION SWITCH - IGNITION SWITCH ASSEMBLY)**
    a. Disconnect the park/neutral position switch connector.
    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
B5-4 - D24-3 (ST1)	Always	Below 1 ohms

Standard resistance (Check for short)

TESTER CONNECTION SPECIFIED CONDITION CHART

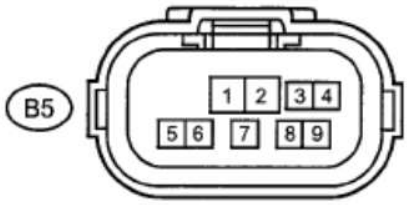
Tester Connection	Condition	Specified Condition
B5-4 or D24-3 (ST1) - Body ground	Always	10 kohms or higher

    d. Reconnect the park/neutral position switch connector.
    e. Reconnect the ignition switch assembly connector.

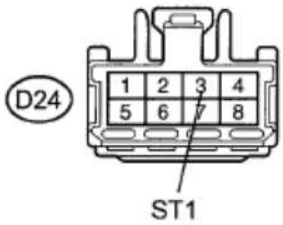
NG: REPAIR OR REPLACE HARNESS OR CONNECTOR (PARK/NEUTRAL POSITION SWITCH - IGNITION SWITCH ASSEMBLY)

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Front view of wire harness connector:
(to Park/Neutral Position Switch)



Front view of wire harness connector:
(to Ignition Switch Assembly)



A159656E04

Fig. 320: Identifying Ignition Switch Assembly And Park/Neutral Position Switch Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

11. **INSPECT IGNITION SWITCH ASSEMBLY**
    a. Disconnect the ignition switch assembly connector.
    b. Measure the resistance according to the value(s) in the table below.

Standard resistance

TESTER CONNECTION SPECIFIED CONDITION CHART

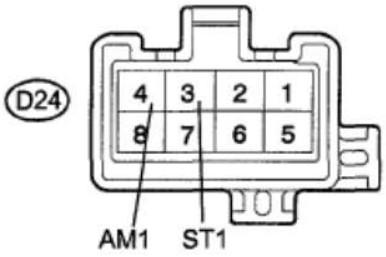
Tester Connection	Ignition Switch Position	Specified Condition
All terminals	LOCK	10 kohms or higher
D24-4 (AM1) - D24-3 (ST1)	START	Below 1 ohms

    c. Reconnect the ignition switch assembly connector.

NG: REPLACE IGNITION SWITCH ASSEMBLY (See **IGNITION SWITCH**)

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Component without harness connected:
(Ignition Switch Assembly)



A158012E13

Fig. 321: Identifying Ignition Switch Assembly Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

12. **INSPECT FUSE (AM1 FUSE)**
    a. Remove the AM1 fuse from the instrument panel junction 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
AM1 fuse	Always	Below 1 ohms

    c. Reinstall the AM1 fuse.

NG: REPLACE FUSE (AM1 FUSE)

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Instrument Panel Junction Block:

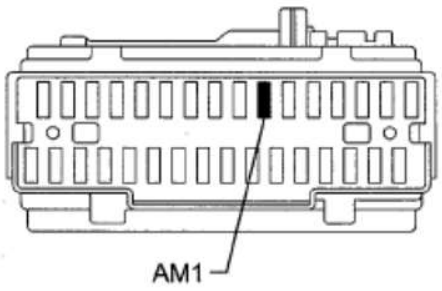


Fig. 322: Identifying AM1 Fuse
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: REPAIR OR REPLACE HARNESS OR CONNECTOR (IGNITION SWITCH ASSEMBLY - BATTERY)

CRANKING HOLDING FUNCTION CIRCUIT

DESCRIPTION

The system detects the ignition switch's starting signal (STSW) and then supplies current to the starter until the ECM judges that the engine has started successfully. The purpose is to reduce the holding time of the ignition key.

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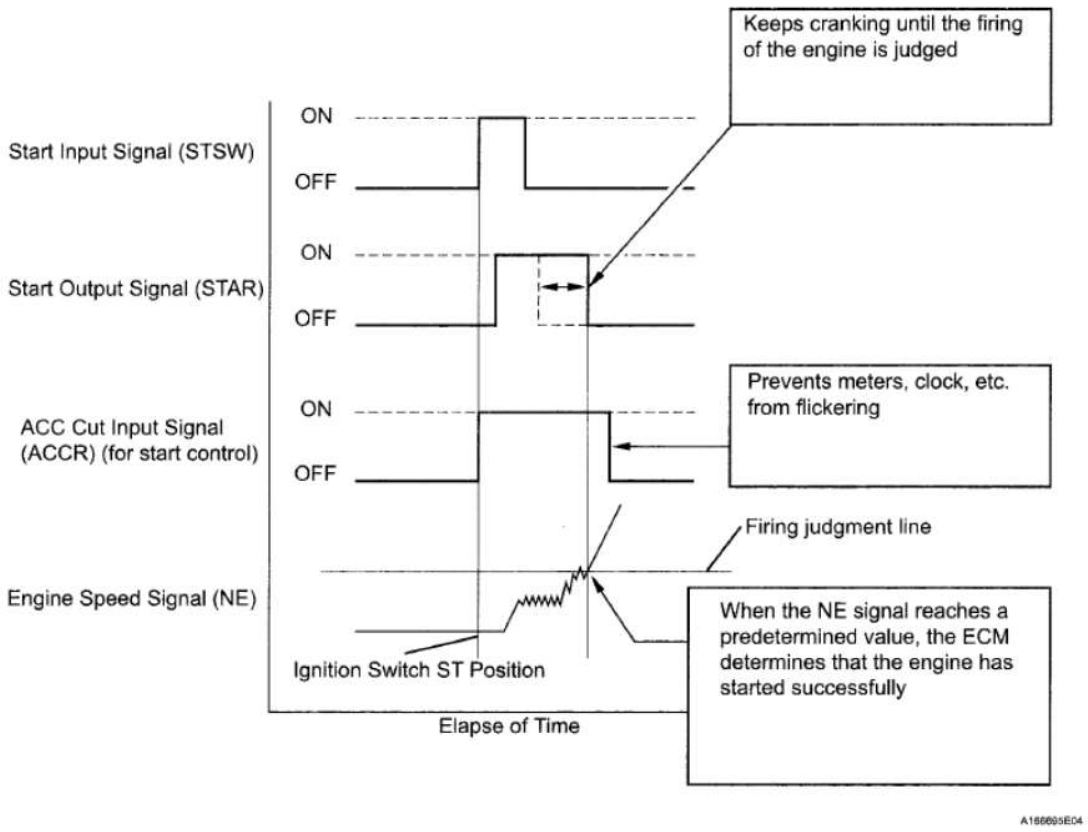


Fig. 323: Identifying Start Input And Engine Speed Signals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

WIRING DIAGRAM

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w/ Smart Key System:

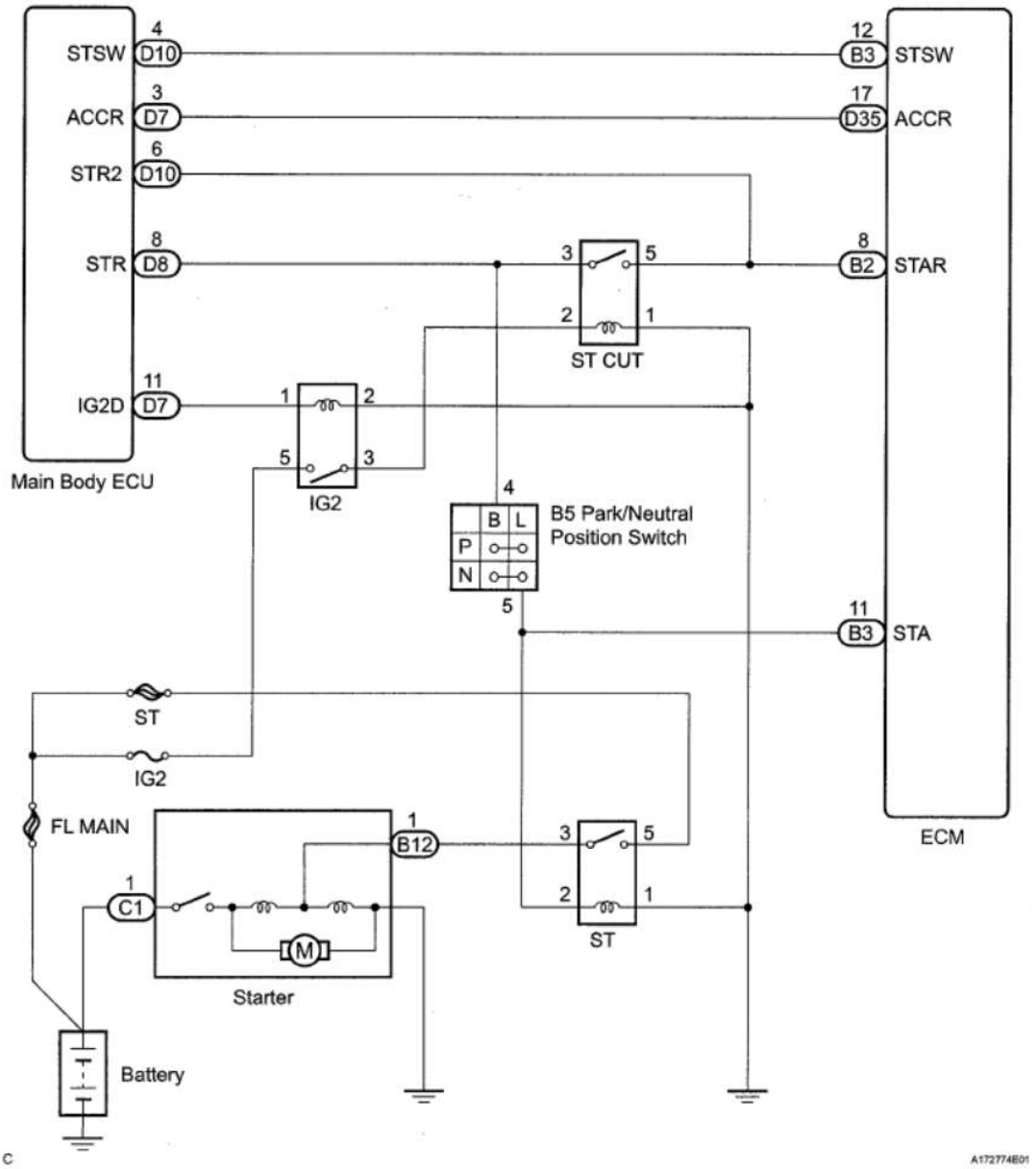


Fig. 324: Cranking Holding Function - Wiring Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSPECTION PROCEDURE

1. **CHECK CRANKING**
   a. When starting the engine, check whether the starter motor starts.

   OK:

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Engine is cranking.

NG: Go to step 2

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

2. **READ VALUE USING TECHSTREAM (STA SIGNAL)**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch on (IG).
   c. Turn the tester on.
   d. Select the following menu items: Powertrain/Engine and ECT/Data List/Starter Signal.
   e. Check the result when the ignition switch is turned on (IG) and when the engine is started.

OK

STARTER SIGNAL CONDITION CHART

Display (Starter Signal)	Condition
OFF	Ignition switch on (IG)
ON	Engine start

NG: Go to step 10

OK: Go to next step

3. **INSPECT ST RELAY**
   a. Remove the ST relay from the engine room relay block.
   b. Measure the resistance according to the value(s) in the table below.

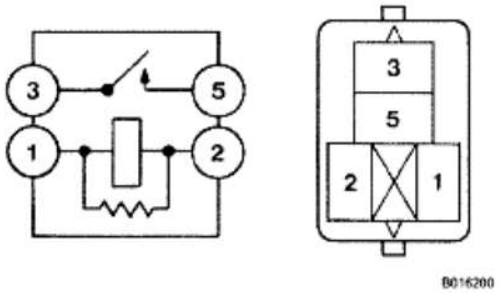


Fig. 325: ST Relay Circuit
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Standard resistance

TESTER CONNECTION SPECIFIED CONDITION CHART

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Tester Connection	Condition	Specified Condition
3 - 5	When no battery voltage applied terminals 1 and 2	10 kohms or higher
3 - 5	When battery voltage applied terminals 1 and 2	Below 1 ohms

c. Reinstall the ST relay.

NG: REPLACE ST RELAY

OK: Go to next step

4. **CHECK HARNESS AND CONNECTOR (PARK/NEUTRAL POSITION SWITCH - ST RELAY)**
   a. Disconnect the park/neutral position switch 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
B5-5 - ST relay terminal (2)	Always	Below 1 ohms

Standard resistance (check for short)

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
B5-5 or ST relay terminal (2) - Body ground	Always	10 kohms or higher

   d. Reconnect the park/neutral position switch connector.
   e. Reinstall the ST relay.

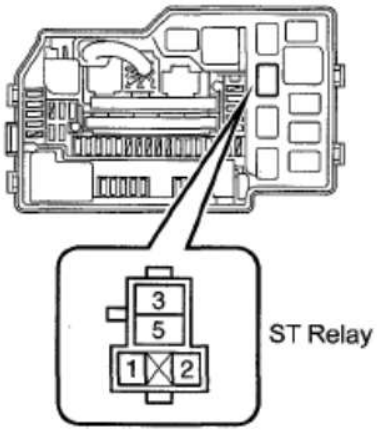
NG: REPAIR OR REPLACE HARNESS OR CONNECTOR (PARK/NEUTRAL POSITION SWITCH - ST RELAY)

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Front view of wire harness connector:
(to Park/Neutral Position Switch)



Engine Room Relay Block:



A172726E01

Fig. 326: Identifying ST Relay And Park/Neutral Position Switch Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

5. **CHECK HARNESS AND CONNECTOR (ST RELAY - BODY GROUND)**
   a. Remove the ST 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
ST relay terminal (2) - Body ground	Always	Below 1 ohms

   c. Reinstall the ST relay to the engine room relay block.

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NG: REPAIR OR REPLACE HARNESS OR CONNECTOR (ST RELAY - BODY GROUND)

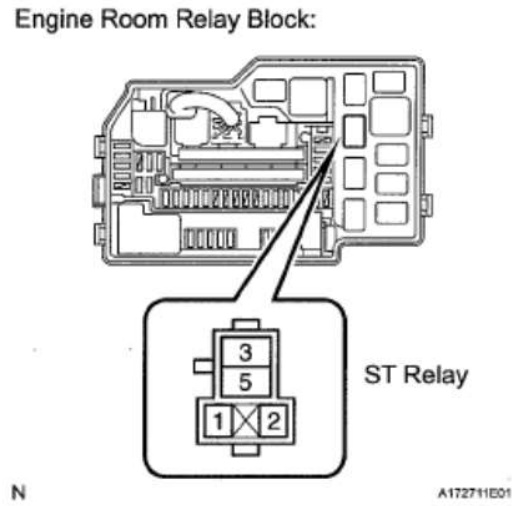


Fig. 327: Identifying ST Relay
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

6. **INSPECT TERMINAL VOLTAGE (ST RELAY TERMINAL)**
   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	Condition	Specified Condition
ST relay terminal (5) - Body ground	Always	9 to 14 V

   c. Reinstall the ST relay to the engine room relay block.

NG: Go to step 9

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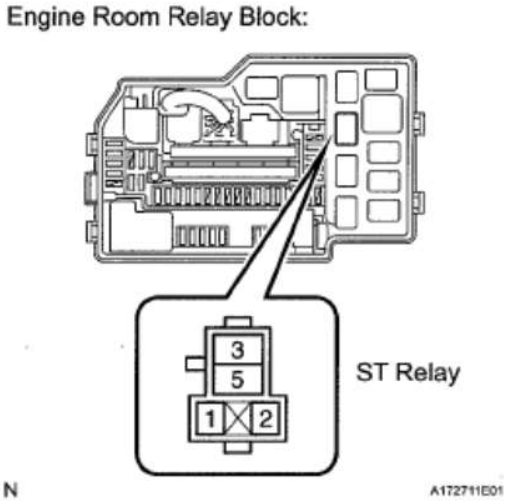


Fig. 328: Identifying ST Relay
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

7. **INSPECT STARTER ASSEMBLY**
   a. Inspect the starter assembly (See **INSPECTION**).

   NG: REPLACE STARTER ASSEMBLY (See **STARTER**)

   OK: Go to next step

8. **CHECK HARNESS AND CONNECTOR (ST RELAY - STARTER ASSEMBLY)**
   a. Remove the ST relay from the engine room relay block.
   b. Disconnect the starter 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
ST relay terminal (3) - B12-1	Always	Below 1 ohms

   Standard resistance (check for short)

   TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
ST relay terminal (3) or B12-1 - Body ground	Always	10 kohms or higher

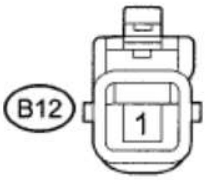
   d. Reconnect the starter connector.

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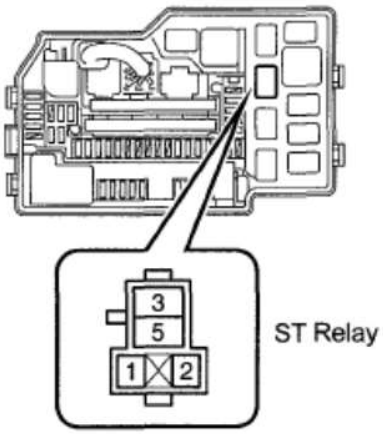
e. Reinstall the ST relay.

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR (ST RELAY - STARTER ASSEMBLY)

Front view of wire harness connector:
(to Starter)



Engine Room Relay Block:



A172722E01

Fig. 329: Identifying ST Relay And Starter Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: REPAIR OR REPLACE HARNESS OR CONNECTOR (BATTERY - STARTER ASSEMBLY)

9. **INSPECT FUSIBLE LINK (ST FUSE)**
   a. Remove the fusible link from the engine room relay block.
   b. Measure the resistance according to the value(s) in the table below.

Standard resistance

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TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
Fusible link	Always	Below 1 ohms

c. Reinstall the fusible link.

NG: REPLACE FUSIBLE LINK

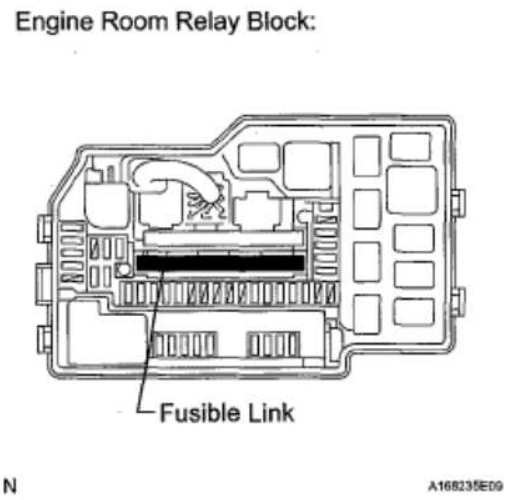


Fig. 330: Identifying Fusible Link
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: REPAIR OR REPLACE HARNESS OR CONNECTOR (BATTERY - STARTER RELAY)

10. **CHECK ECM (STAR AND STSW VOLTAGE)**

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
B2-8 (STAR) - Body ground	Always	9 to 14 V
B3-12 (STSW) - Body ground	Always	9 to 14 V

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Component with harness connected:
(ECM)

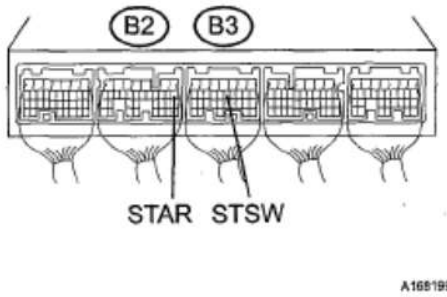


Fig. 331: Identifying ECM B2 And B3 Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Result

RESULT CHART

Terminal STAR	Terminal STSW	Proceed to
9 to 14 V	9 to 14 V	A
0 V	9 to 14 V	B
0 V	0 V	C

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

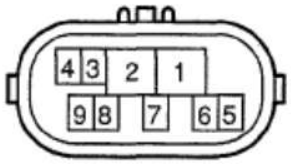
C: Go to step 15

A: Go to next step

11. **INSPECT PARK/NEUTRAL POSITION SWITCH ASSEMBLY**
    a. Inspect the park/neutral position switch.
    b. Disconnect the park/neutral position switch connector.
    c. Measure the resistance according to the value(s) in the table below.

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Component with harness connected:
(Park/Neutral Position Switch)



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Fig. 332: Identifying Park/Neutral Position Switch Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Standard resistance

TESTER CONNECTION SPECIFIED CONDITION CHART

Shift Position	Tester Connection	Specified Condition
P	2 - 6, 4 - 5	Below 1 ohms
R	1 - 2	Below 1 ohms
N	2 - 9, 4 - 5	Below 1 ohms
D	2 - 7	Below 1 ohms
2	2 - 3	Below 1 ohms
L	2 - 8	Below 1 ohms

Result:

RESULT CHART

Result	Proceed To
OK	A
NG (with U151E))	B
NG (with U151F)	C

d. Reconnect the park/neutral position switch connector.

B: REPLACE PARK/NEUTRAL POSITION SWITCH ASSEMBLY (See **PARK/NEUTRAL POSITION SWITCH**)

C: REPLACE PARK/NEUTRAL POSITION SWITCH (See **PARK/NEUTRAL POSITION SWITCH**)

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A: Go to next step

12. **CHECK HARNESS AND CONNECTOR (ECM - PARK/NEUTRAL POSITION SWITCH)**
    a. Disconnect the ECM connector.
    b. Disconnect the park/neutral position switch 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
B3-11 (STA) - B5-5	Always	Below 1 ohms

Standard resistance (check for short)

TESTER CONNECTION SPECIFIED CONDITION CHART

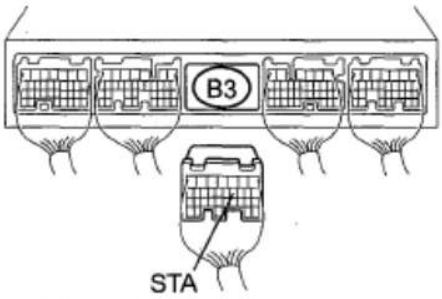
Tester Connection	Condition	Specified Condition
B3-11 (STA) or B5-5 - Body ground	Always	10 kohms or higher

    d. Reconnect the ECM connector.
    e. Reconnect the park/neutral position switch connector.

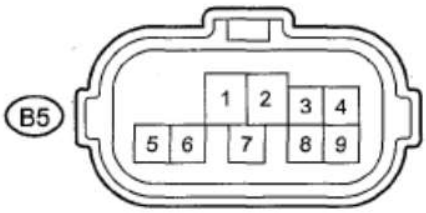
NG: REPAIR OR REPLACE HARNESS OR CONNECTOR (ECM - PARK/NEUTRAL POSITION SWITCH)

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Rear view of wire harness connector:
(to ECM)



Front view of wire harness connector:
(to Park/Neutral Position Switch)

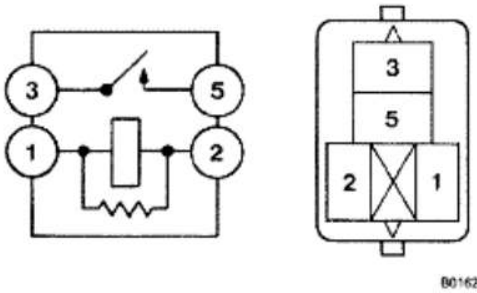


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Fig. 333: Identifying Park/Neutral Position Switch And ECM Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

13. **INSPECT RELAY (ST CUT RELAY)**
    a. Remove the ST CUT relay from the engine room relay block.
    b. Measure the resistance according to the value(s) in the table below.



B016200

Fig. 334: ST CUT Relay Circuit
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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Standard resistance

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
3 - 5	When no battery voltage applied terminals 1 and 2	10 kohms or higher
3 - 5	When battery voltage applied terminals 1 and 2	Below 1 ohms

c. Reinstall the ST CUT relay.

NG: REPLACE RELAY

OK: Go to next step

14. **INSPECT TERMINAL VOLTAGE (ST CUT RELAY TERMINAL)**
    a. Remove the ST CUT relay from the engine room relay block.
    b. Turn the ignition switch on (IG).
    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
2 - Body ground	Ignition switch on (IG)	9 to 14 V

d. Reinstall the ST CUT relay.

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR (ST CUT RELAY - IG2 RELAY)

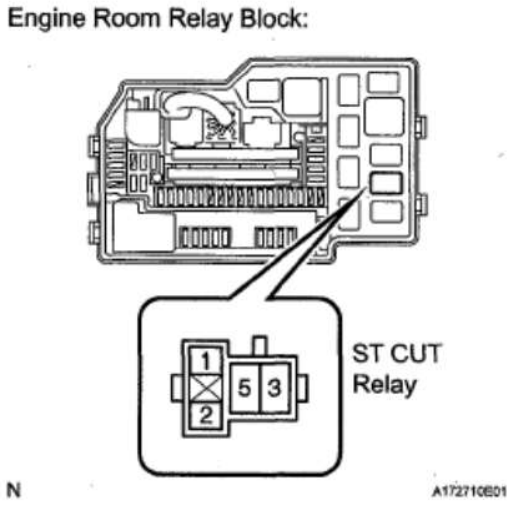


Fig. 335: Identifying ST CUT Relay

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

OK: REPAIR OR REPLACE HARNESS OR CONNECTOR (ST CUT RELAY - BODY GROUND)

15. **CHECK HARNESS AND CONNECTOR (ECM - MAIN BODY ECU)**
    a. Disconnect the ECM connector.
    b. Disconnect the main body ECU 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
B3-12 (STSW) - D10-4 (STSW)	Always	Below 1 ohms

Standard resistance (check for short)

TESTER CONNECTION SPECIFIED CONDITION CHART

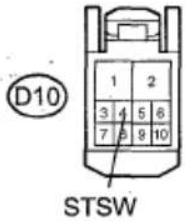
Tester Connection	Condition	Specified Condition
B3-12 (STSW) or D10-4 (STSW) - Body ground	Always	10 kohms or higher

    d. Reconnect the ECM connector.
    e. Reconnect the main body ECU connector.

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR (ECM - MAIN BODY ECU)

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Front view of wire harness connector:
(to Main Body ECU)



Rear view of wire harness connector:
(to ECM)

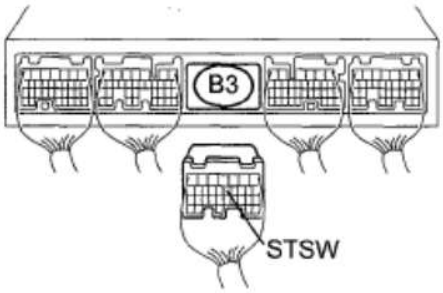


Fig. 336: Identifying Main Body ECU And ECM Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: CHECK SMART KEY SYSTEM (See **HOW TO PROCEED WITH TROUBLESHOOTING**)

ACIS CONTROL CIRCUIT

DESCRIPTION

This circuit opens and closes the Intake Air Control Valve (IACV) in response to changes in the engine load in order to increase the intake efficiency (ACIS: Acoustic Control Induction System).

When the engine speed is between 0 and 4450 rpm and the throttle valve opening angle is 60° or more, the ECM supplies current to the VSV (ON status), to close the IACV. Under other conditions, the VSV is usually OFF and the IACV is open.

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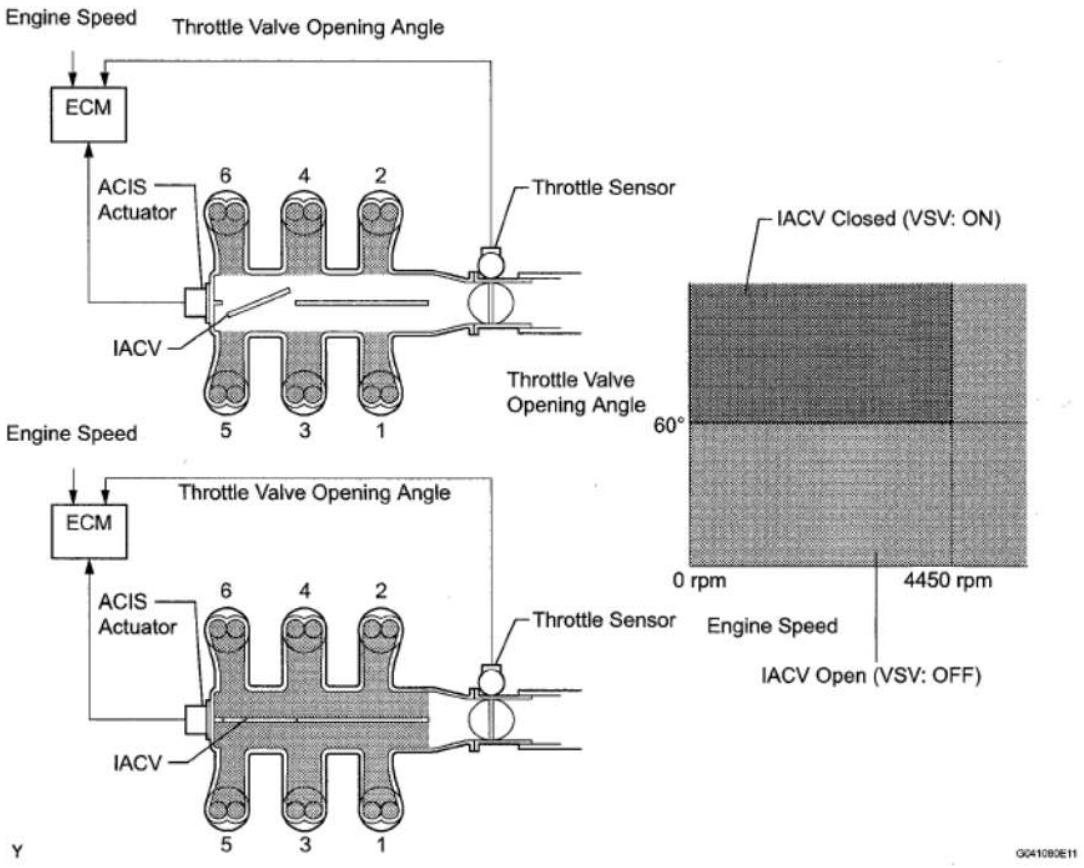


Fig. 337: Identifying Throttle Valve Opening Angle Position
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

WIRING DIAGRAM

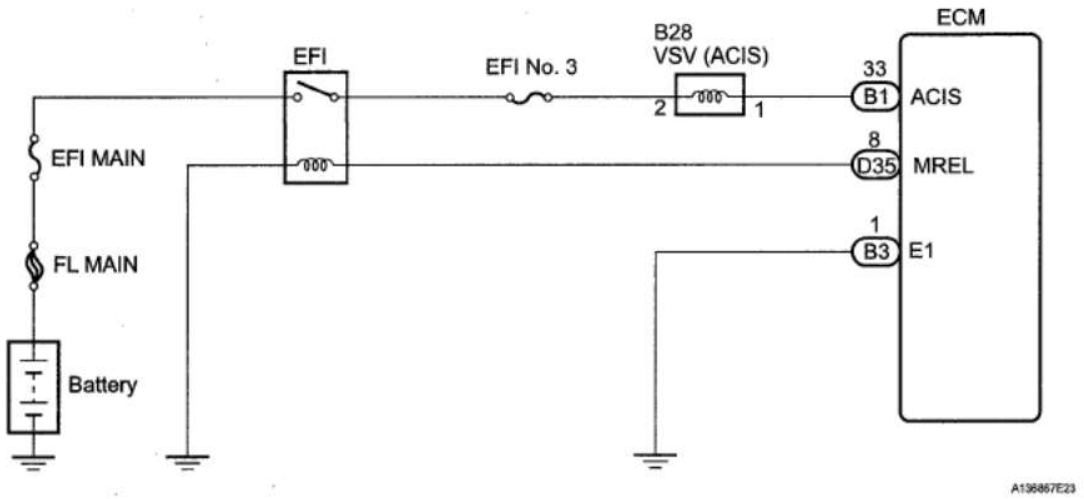


Fig. 338: ACIS Control - Wiring Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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INSPECTION PROCEDURE

1. **PERFORM ACTIVE TEST USING TECHSTREAM (ACTIVE THE VSV FOR INTAKE CONTROL)**
   a. Connect the Techstream to the DLC3.
   b. Start the engine and turn the tester on.
   c. Select the following menu items: Powertrain/Engine and ECT/Active Test/Active the VSV for Intake Control.
   d. Check the operation of the VSV when the intake air control is operated by the tester.

      OK:

      Operational noise can be heard.

      NG: Go to step 2

      OK: PROCEED TO NEXT CIRCUIT INSPECTION SHOWN IN PROBLEM SYMPTOMS TABLE (See **PROBLEM SYMPTOMS TABLE**)

2. **CHECK INTAKE AIR CONTROL VALVE (OPERATION)**
   a. Disconnect the intake air control valve connector.
   b. Apply battery voltage between the terminals of the air intake valve connector.
   c. Check the air intake valve operation.

      OK:

      Operational noise can be heard.

   d. Reconnect the intake air control valve connector.

      NG: REPLACE INTAKE AIR SURGE TANK (See **INTAKE MANIFOLD**)

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Component without harness connected:
(Intake Air Control Valve)

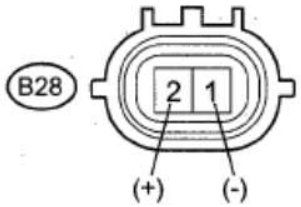


Fig. 339: Identifying Intake Air Control Valve Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

3. **INSPECT TERMINAL VOLTAGE (INTAKE AIR CONTROL VALVE CONNECTOR)**
   a. Disconnect the intake air control valve connection.
   b. Turn the ignition switch on (IG).
   c. Measure the voltage according to the value(s) in the table below.

Standard voltage

TESTER CONNECTION SPECIFIED CONDITION CHART

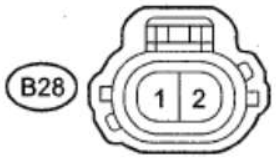
Tester Connection	Switch Condition	Specified Condition
2 - Body ground	Ignition switch on (IG)	9 to 14 V

   d. Reconnect the intake air control valve connector.

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR (EFI NO. 3 - INTAKE AIR CONTROL VALVE)

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Front view of wire harness connector:
(to Intake Air Control Valve)



A168221E02

Fig. 340: Identifying Intake Air Control Valve Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

4. **CHECK HARNESS AND CONNECTOR (INTAKE AIR CONTROL VALVE - ECM)**
   a. Disconnect the intake air control valve 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
B28-1 - B1-33 (ACIS)	Always	Below 1 ohms

Check for short

TESTER CONNECTION SPECIFIED CONDITION CHART

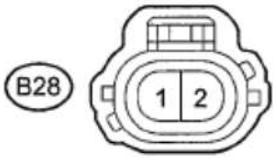
Tester Connection	Condition	Specified Condition
B28-1 or B1-33 (ACIS) - Body ground	Always	10 kohms or higher

   d. Reconnect the intake air control valve connector.
   e. Reconnect the ECM connector.

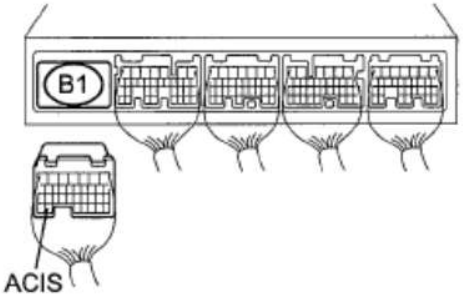
NG: REPAIR OR REPLACE HARNESS OR CONNECTOR (VSV FOR ACIS - ECM)

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Front view of wire harness connector:
(to Intake Air Control Valve)



Rear view of wire harness connector:
(to ECM)



A168216E02

Fig. 341: Identifying Intake Air Control Valve And ECM Connector Terminals
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.

When the engine is operating in the low-to-mid speed range, this control operates the AICV 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 AICV.

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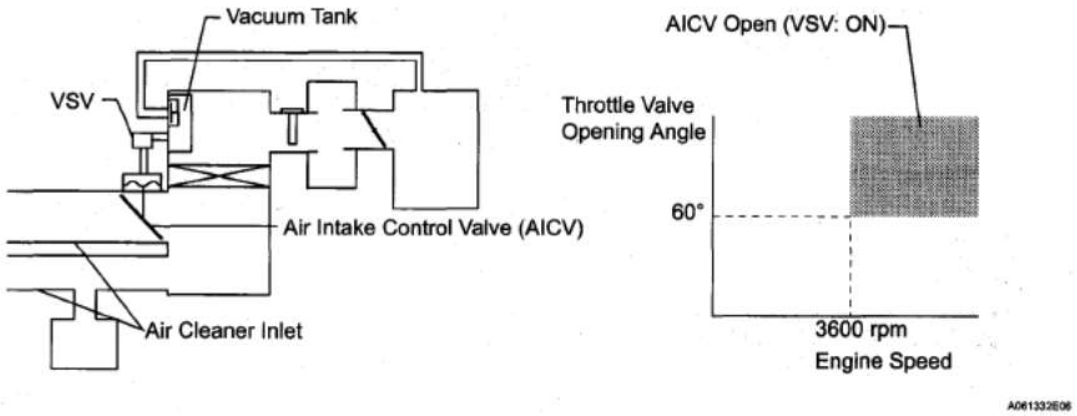


Fig. 342: Air Intake Control Operation Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

WIRING DIAGRAM

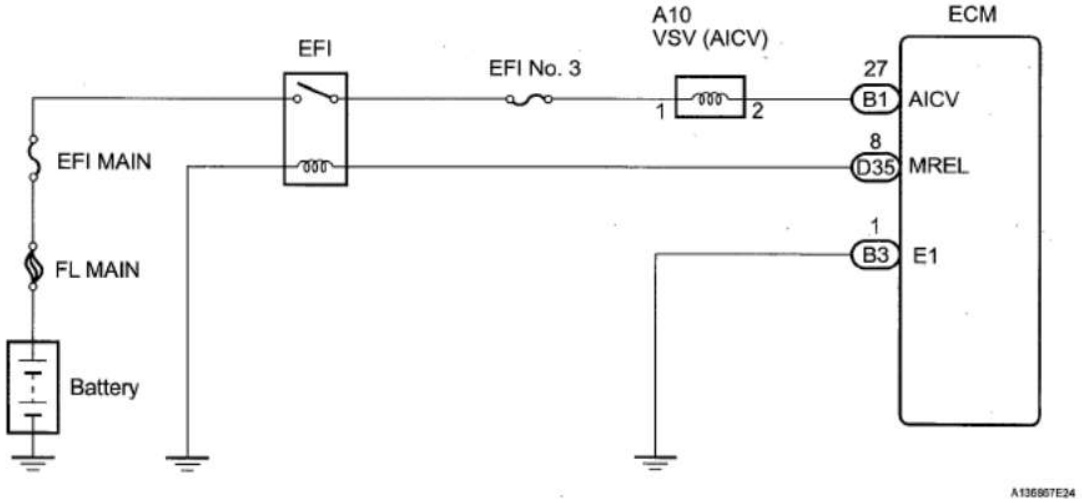


Fig. 343: Air Intake Control - Wiring Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSPECTION PROCEDURE

1. **PERFORM ACTIVE TEST USING TECHSTREAM (ACTIVATE THE VSV FOR AICS)**
   a. Disconnect the 2 hoses from the VSV for air intake control valve.
   b. Turn the ignition switch on (IG) and turn the tester on.
   c. Select the following menu items: Powertrain/Engine and ECT/Active Test/Activate the VSV for AICS.
   d. Check the operation of the VSV when the VSV is operated by the tester.

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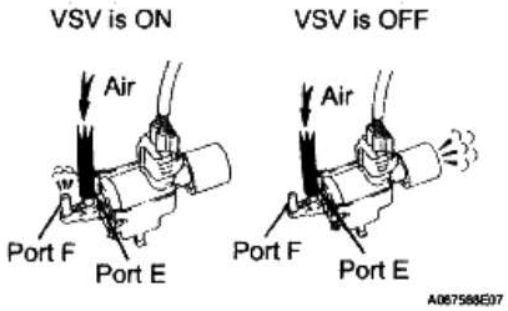


Fig. 344: Checking Operation Of VSV
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Standard

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester 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 3

OK: Go to next step

2. **INSPECT VACUUM TANK**
   a. Inspect the vacuum tank (See **VACUUM TANK**).

   NG: REPAIR OR REPLACE AIR CLEANER CAP

   OK: CHECK ECM POWER SOURCE CIRCUIT (See **ECM POWER SOURCE CIRCUIT**)

3. **CHECK VSV (FOR AICV)**
   a. Inspect the VSV for AICV (See **REMOVAL**).

   NG: REPLACE VSV (FOR AICV) (See **VACUUM SWITCHING VALVE**)

   OK: Go to next step

4. **INSPECT TERMINAL VOLTAGE (VSV FOR AIR INTAKE CONTROL VALVE CONNECTOR)**
   a. Disconnect the VSV for air intake control valve connector.
   b. Turn the ignition switch on (IG).
   c. Measure the voltage according to the value(s) in the table below.

   Standard voltage

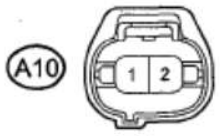
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TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Switch Condition	Specified Condition
1 - Body ground	Ignition switch on (IG)	9 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. 345: Identifying VSV For Air Intake Control Valve Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

5. **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.
   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 (VSV for AICV) - B1-27 (AICV)	Always	Below 1 ohms

Check for short

TESTER CONNECTION SPECIFIED CONDITION CHART

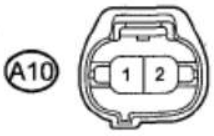
Tester Connection	Condition	Specified Condition
A10-2 (VSV for AICV) or B1-27 (AICV) - Body ground	Always	10 kohms or higher

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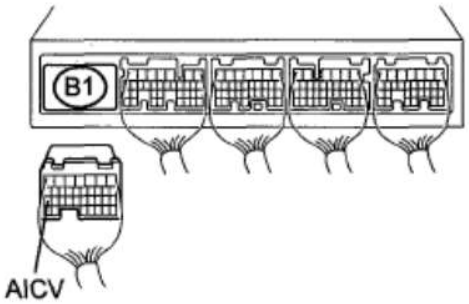
d. Reconnect the ECM connector.

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR (VSV FOR AICV - ECM)

Front view of wire harness connector:
(to VSV for Air Intake Control Valve)



Rear view of wire harness connector:
(to ECM)



A168217E02

Fig. 346: Identifying VSV For Air Intake Control Valve And ECM Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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

MIL CIRCUIT

DESCRIPTION

The MIL (Malfunction Indicator Lamp) is used to indicate vehicle malfunctions detected by the ECM.

When the ignition switch is turned on (IG), 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 on (IG), 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.

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WIRING DIAGRAM

w/o Smart Key System:

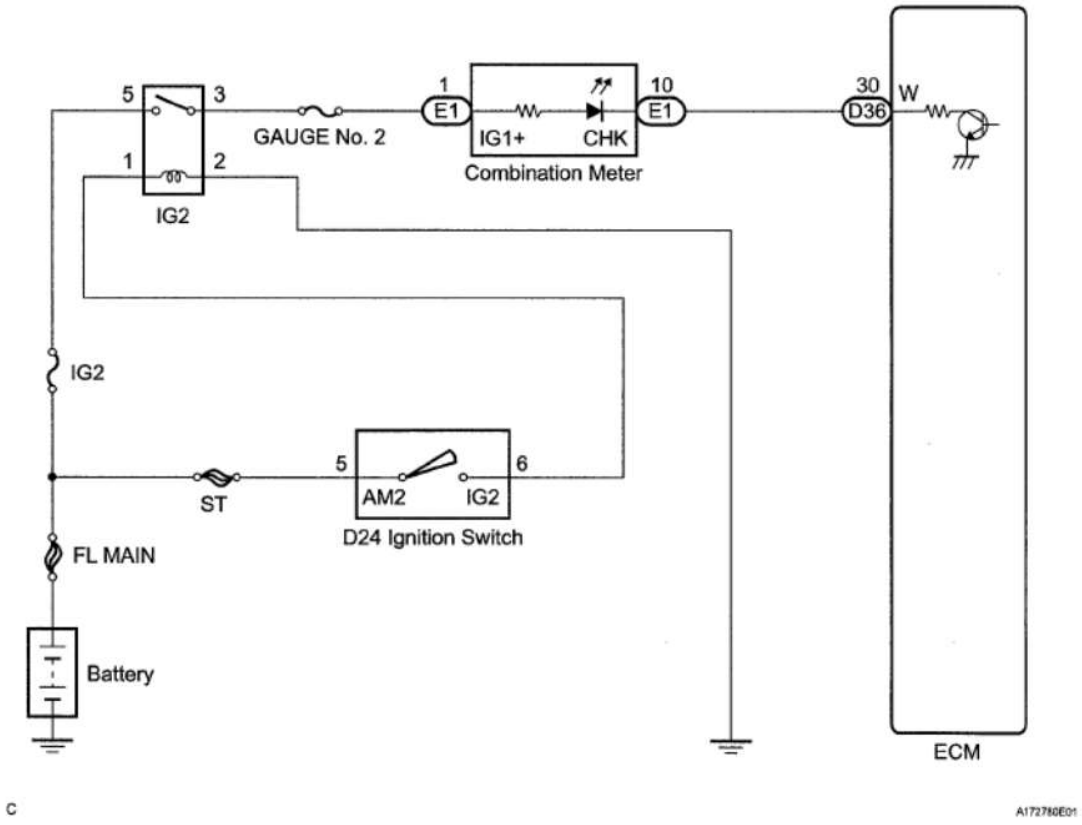


Fig. 347: MIL - Wiring Diagram (1 Of 2)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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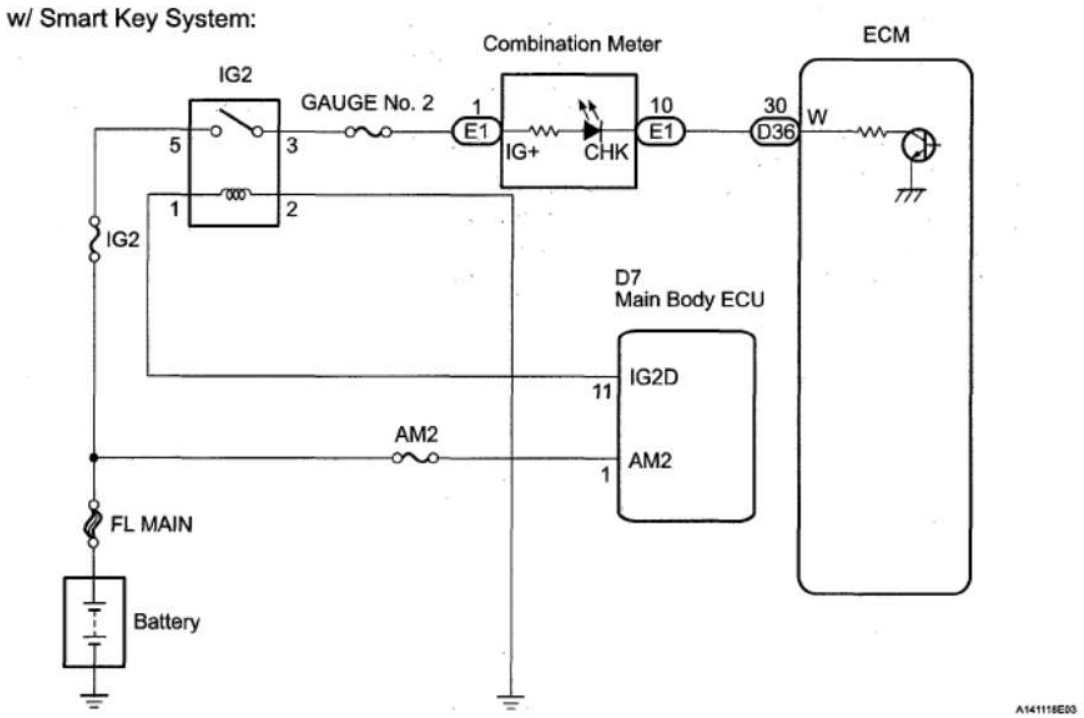


Fig. 348: MIL - Wiring Diagram (2 Of 2)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSPECTION PROCEDURE

1. **CHECK THAT MIL IS ILLUMINATED**
   a. Turn the ignition switch on (IG).
   b. Check the illumination of the MIL.

   Result

   RESULT CHART

Result	Proceed to
MIL remains illuminated (Even after ignition switch is turned on (IG) 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

2. **CHECK WHETHER MIL TURNS OFF**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch on (IG) and turn the tester on.

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c. Select the following menu items: Powertrain/Engine and ECT/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.

Standard:

MIL goes off.

NG: Go to step 3

OK: REPAIR CIRCUITS INDICATED BY OUTPUT DTCS

3. **CHECK HARNESS AND CONNECTOR (CHECK FOR SHORT IN WIRE HARNESS)**
   a. Disconnect the ECM connector.
   b. Turn the ignition switch on (IG).
   c. Check that the MIL is not illuminated.

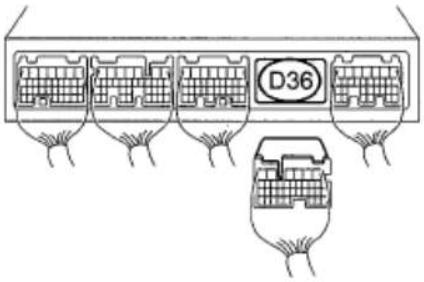
   OK:

   MIL is not illuminated.

   d. Reconnect the ECM connector.

   NG: Go to step 4

Rear view of wire harness connector:
(to ECM)



A163321E08

Fig. 349: Identifying ECM Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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

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4. **CHECK HARNESS AND CONNECTOR (COMBINATION METER - ECM)**
   a. Disconnect the ECM connector.
   b. Disconnect the combination meter 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
D36-30 (W) - E1-10	Always	Below 1 ohms

Standard resistance (Check for Short)

TESTER CONNECTION SPECIFIED CONDITION CHART

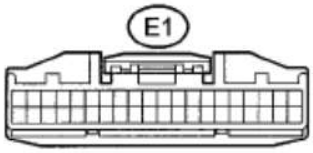
Tester Connection	Condition	Specified Condition
D36-30 (W) or E1-10 - Body ground	Always	10 kohms or higher

   d. Reconnect the ECM connector.
   e. Reconnect the combination meter connector.

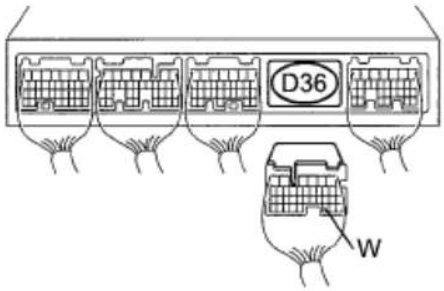
NG: REPAIR OR REPLACE HARNESS OR CONNECTOR (COMBINATION METER - ECM)

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Front view of wire harness connector:
(to Combination Meter)



Rear view of wire harness connector:
(to ECM)



A163122E09

Fig. 350: Identifying Combination Meter And ECM Connector Terminals
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 on (IG).
   b. Start the engine.

Result

RESULT CHART

Result	Proceed to
Engine starts	A
Engine does not start*	B
HINT: *: The tester cannot communicate with the ECM.	

B: GO TO **VC OUTPUT CIRCUIT**

A: Go to next step

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6. **CHECK HARNESS AND CONNECTOR (COMBINATION METER - BODY GROUND)**
   a. Disconnect the ECM connector.
   b. Turn the ignition switch on (IG).
   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
D36-30 (W) - Body ground	Ignition switch on (IG)	11 to 14 V

   d. Reconnect the ECM connector.

NG: Go to step 7

Rear view of wire harness connector:
(to ECM)

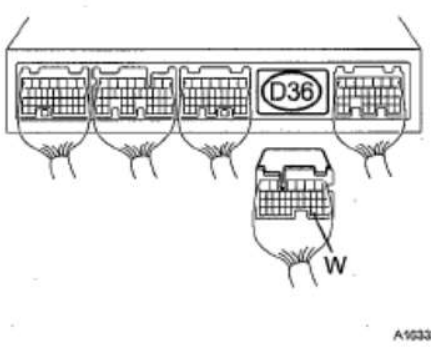


Fig. 351: Identifying ECM Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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

7. **CHECK HARNESS AND CONNECTOR (COMBINATION METER - ECM)**
   a. Disconnect the ECM connector.
   b. Disconnect the combination meter 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
D36-30 (W) - E1-10	Always	Below 1 ohms

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Standard resistance (Check for Short)

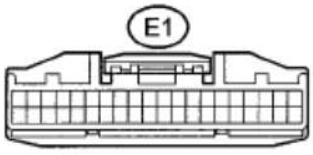
TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
D36-30 (W) or E1-10 - Body ground	Always	10 kohms or higher

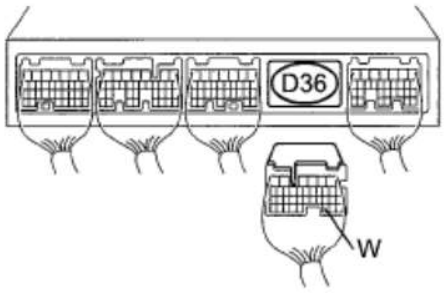
d. Reconnect the ECM connector.
e. Reconnect the combination meter connector.

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR (COMBINATION METER - ECM)

Front view of wire harness connector:
(to Combination Meter)



Rear view of wire harness connector:
(to ECM)



A163122E09

Fig. 352: Identifying Combination Meter And ECM Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: REPLACE COMBINATION METER ASSEMBLY (See **COMBINATION METER**)

THROTTLE BODY

COMPONENTS

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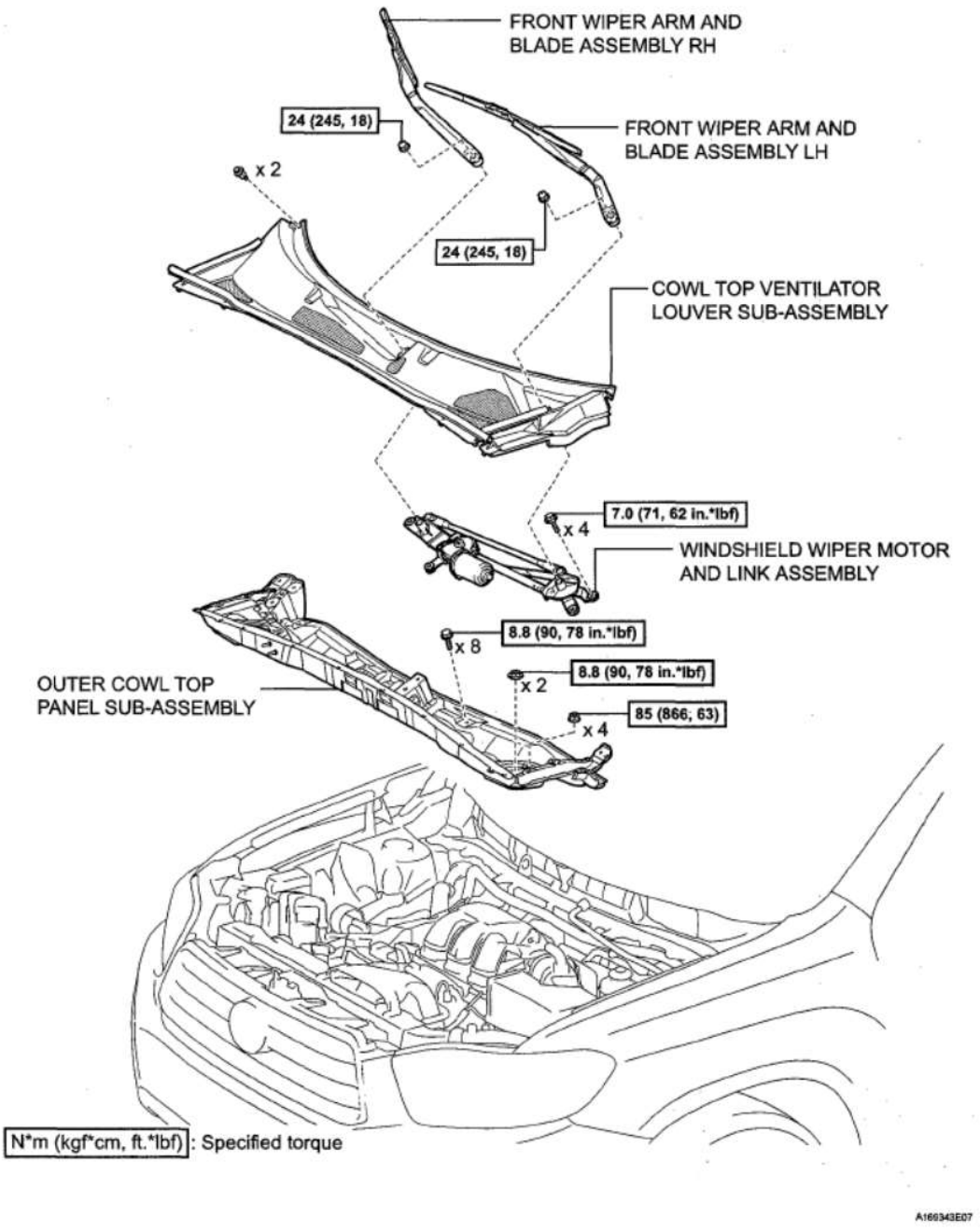


Fig. 353: Identifying Throttle Body Components (1 Of 2)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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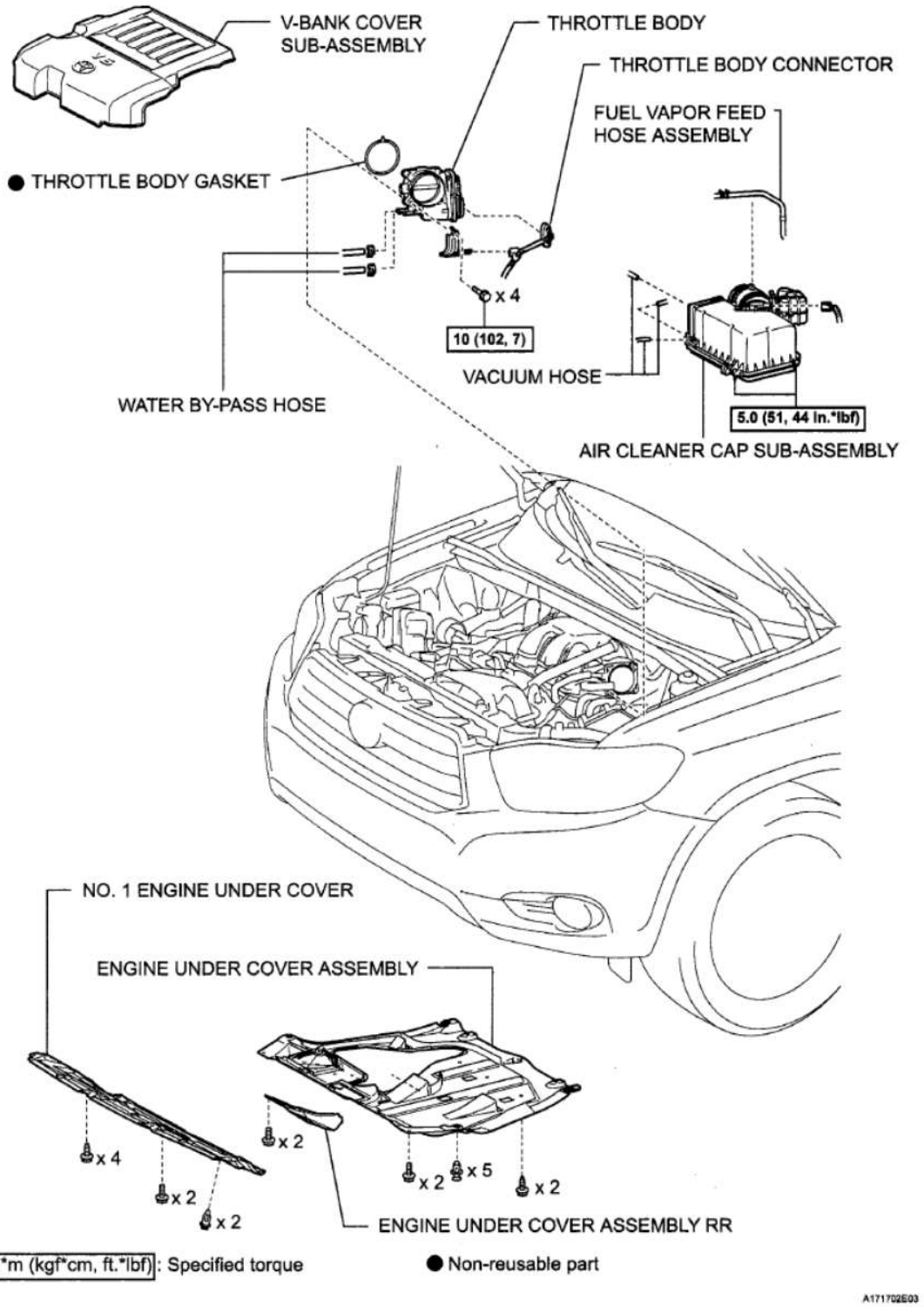


Fig. 354: Identifying Throttle Body Components (2 Of 2)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

ON-VEHICLE INSPECTION

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1. **INSPECT THROTTLE BODY**
   a. Listen to the throttle control motor operating sounds.
      1. Turn the ignition switch on (IG).
      2. When pressing the accelerator pedal position sensor lever, listen to the running motor. Make sure that no friction noise comes from the motor.

         If friction noise exists, replace the throttle body.

   b. Inspect the throttle position sensor.
      1. Connect Techstream to the DLC3.
      2. Turn the ignition switch on (IG).
      3. Check that the MIL turns off.
      4. Turn the Techstream main switch on.
      5. Select the menu items: Powertrain/Engine and ECT/Data List/Throttle Position.
      6. Check the value of throttle valve angle is within the standard range below.

         Standard throttle valve opening percentage: 60% or more

         If the percentage is less than 60%, replace the throttle body.

         NOTE: When checking the throttle valve opening percentage, the transmission should be in neutral.

REMOVAL

1. **REMOVE ENGINE UNDER COVER ASSEMBLY** (See **REMOVAL**)
2. **REMOVE NO. 1 ENGINE UNDER COVER** (See **REMOVAL**)
3. **DRAIN ENGINE COOLANT** (See **COOLANT**)
4. **REMOVE FRONT WIPER ARM AND BLADE ASSEMBLY LH** (See **REMOVAL**)
5. **REMOVE FRONT WIPER ARM AND BLADE ASSEMBLY RH** (See **REMOVAL**)
6. **REMOVE COWL TOP VENTILATOR LOUVER SUB-ASSEMBLY** (See **REMOVAL**)
7. **REMOVE WINDSHIELD WIPER MOTOR AND LINK ASSEMBLY** (See **REMOVAL**)
8. **REMOVE OUTER COWL TOP PANEL SUB-ASSEMBLY** (See **REMOVAL**)
9. **REMOVE V-BANK COVER SUB-ASSEMBLY** (See **REMOVAL**)
10. **REMOVE AIR CLEANER CAP SUB-ASSEMBLY** (See **REMOVAL**)
11. **REMOVE THROTTLE BODY**
    a. Disconnect the throttle body connector and clamp.

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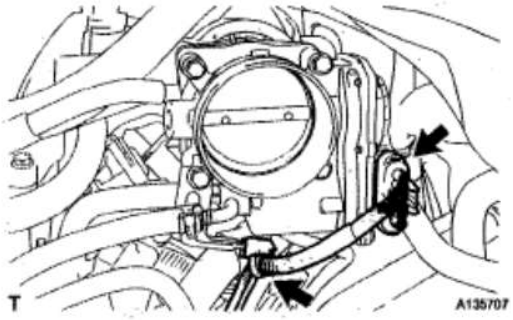


Fig. 355: Locating Throttle Body Connector And Clamp
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. Disconnect the 2 water by-pass hoses from the throttle body.

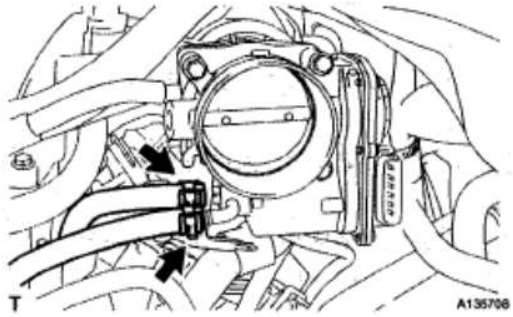


Fig. 356: Locating Water By-Pass Hoses On Throttle Body
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

c. Remove the 4 bolts and throttle body.

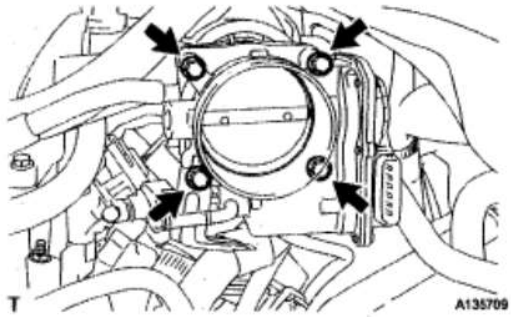


Fig. 357: Locating Bolts On Throttle Body
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

d. Remove the throttle body gasket from the intake air surge tank.

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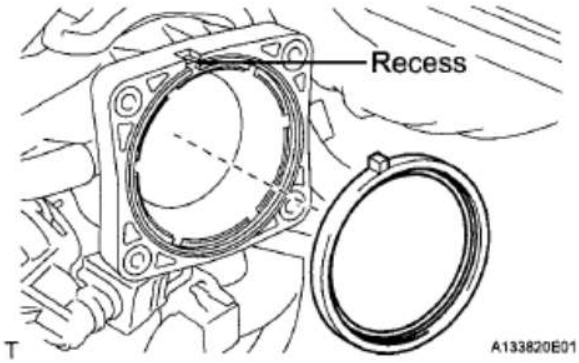


Fig. 358: Identifying Throttle Body Gasket On Intake Air Surge Tank
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSPECTION

1. **INSPECT THROTTLE BODY**
   a. Measure the resistance according to the value(s) in the table below.

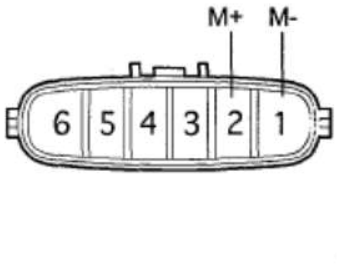


Fig. 359: Identifying Throttle Body Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Standard resistance

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
M+ (2) - M- (1)	20°C (68°F)	0.3 to 100 ohms

If the result is not as specified, replace the throttle body.

INSTALLATION

1. **INSTALL THROTTLE BODY**
   a. Install a new throttle body gasket to the intake air surge tank.

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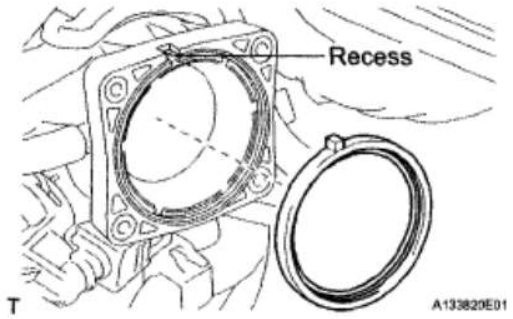


Fig. 360: Identifying Throttle Body Gasket On Intake Air Surge Tank
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. Install the throttle body with the 4 bolts.

Torque: 10 N*m (102 kgf*cm, 7 ft.*lbf)

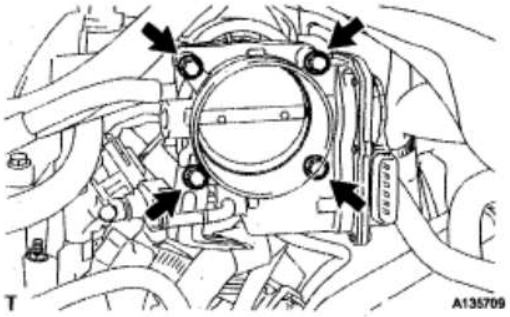


Fig. 361: Locating Bolts On Throttle Body
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

c. Connect the 2 water by-pass hoses.

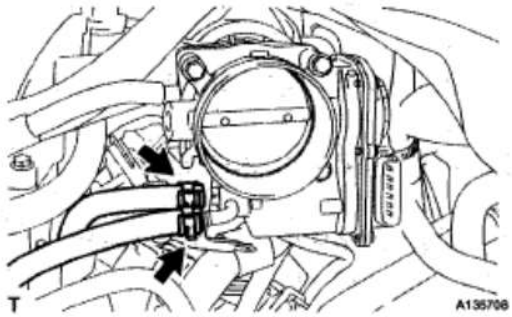


Fig. 362: Locating Water By-Pass Hoses On Throttle Body
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

d. Connect the throttle body connector and clamp.

2. **INSTALL AIR CLEANER CAP SUB-ASSEMBLY** (See **INSTALLATION**)

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3. **ADD ENGINE COOLANT** (See **REPLACEMENT**)
4. **INSPECT FOR COOLANT LEAK** (See **COOLING SYSTEM**)
5. **INSTALL OUTER COWL TOP PANEL SUB-ASSEMBLY** (See **INSTALLATION**)

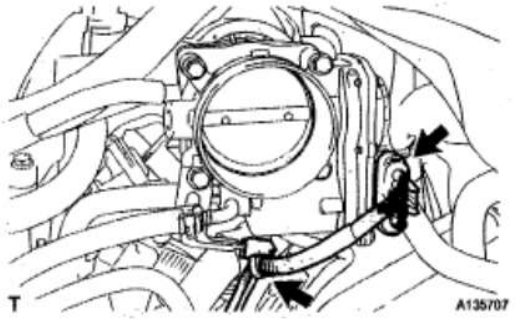


Fig. 363: Locating Throttle Body Connector And Clamp
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

6. **INSTALL WINDSHIELD WIPER MOTOR AND LINK ASSEMBLY** (See **INSTALLATION**)
7. **INSTALL COWL TOP VENTILATOR LOUVER SUB-ASSEMBLY** (See **INSTALLATION**)
8. **INSTALL FRONT WIPER ARM AND BLADE ASSEMBLY RH** (See **INSTALLATION**)
9. **INSTALL FRONT WIPER ARM AND BLADE ASSEMBLY LH** (See **INSTALLATION**)
10. **INSTALL V-BANK COVER SUB-ASSEMBLY** (See **INSTALLATION**)
11. **INSTALL NO. 1 ENGINE UNDER COVER** (See **INSTALLATION**)
12. **INSTALL ENGINE UNDER COVER ASSEMBLY** (See **INSTALLATION**)

VACUUM SWITCHING VALVE (FOR ENGINE MOUNTING)

COMPONENTS

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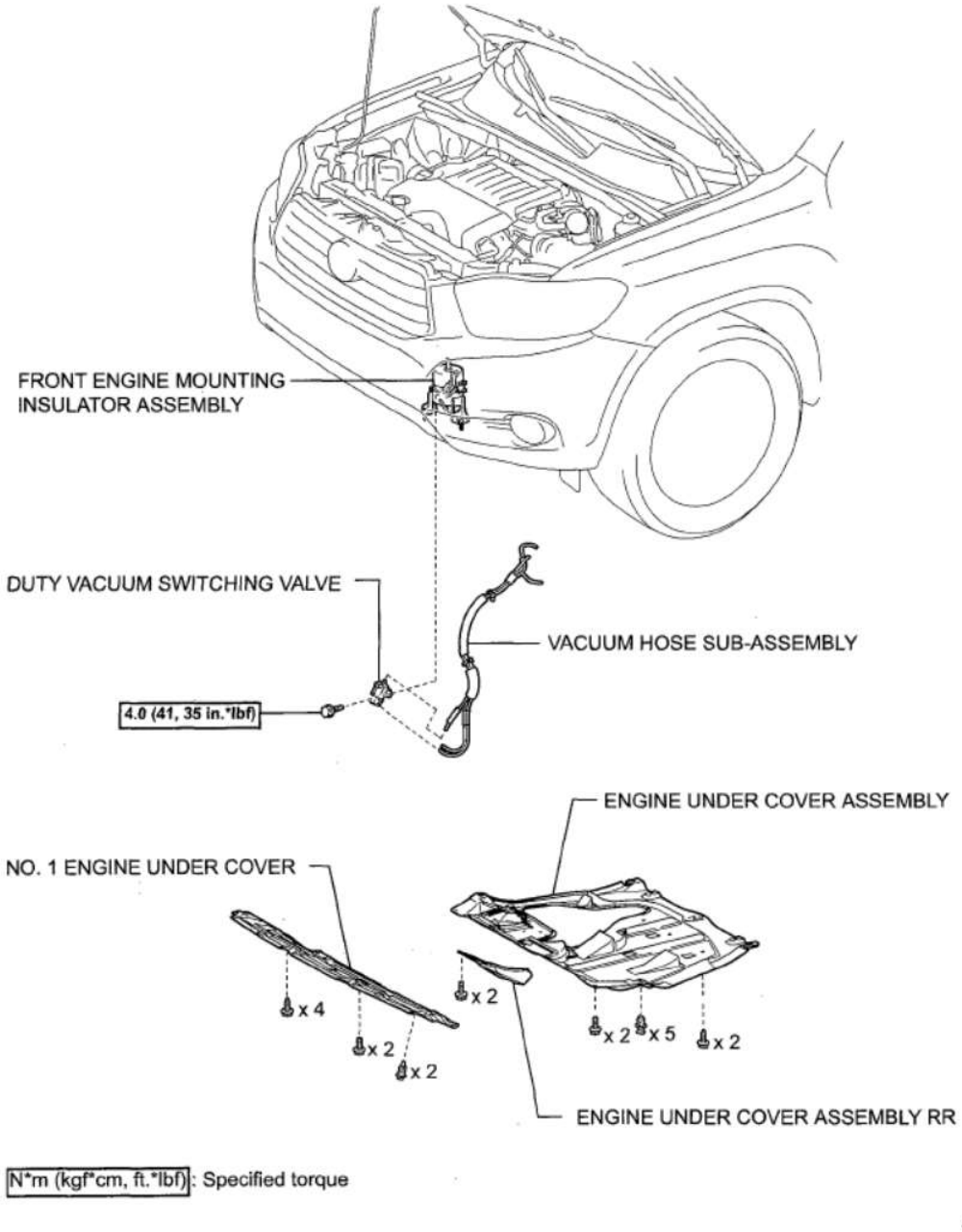


Fig. 364: Identifying Vacuum Switching Valve (For Engine Mounting) Components
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

REMOVAL

1. **REMOVE ENGINE UNDER COVER ASSEMBLY** (See **REMOVAL**)
2. **REMOVE NO. 1 ENGINE UNDER COVER** (See **REMOVAL**)
3. **REMOVE VACUUM HOSE SUB-ASSEMBLY**
   a. Disconnect the vacuum hose sub-assembly from the air cleaner cap sub-assembly and vacuum

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switching valve.

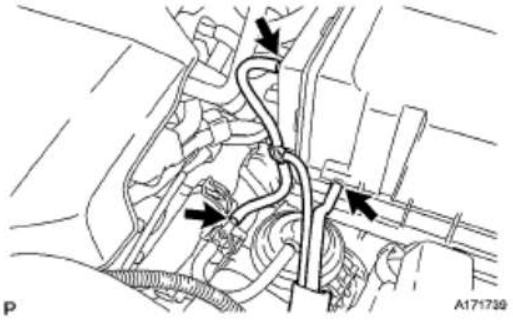


Fig. 365: Locating Vacuum Hose Sub-Assembly
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. Remove the 2 clamps.

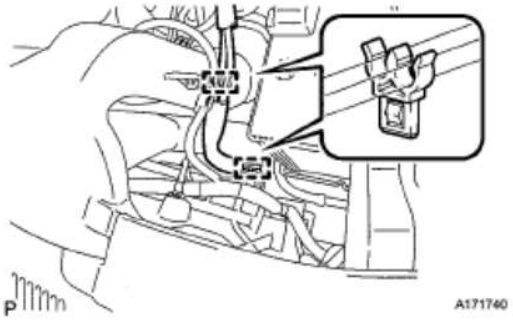


Fig. 366: Locating Vacuum Hose Sub-Assembly Clamps
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

c. Disconnect the vacuum hose sub-assembly from the duty vacuum switching valve and remove it.

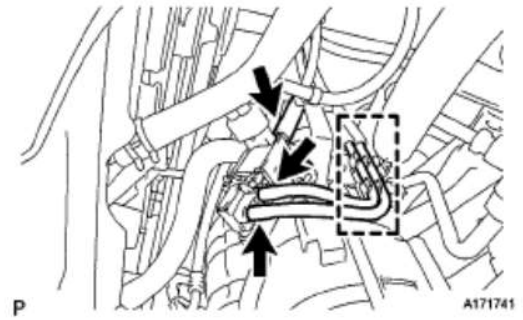


Fig. 367: Locating Vacuum Hose Sub-Assembly And Duty Vacuum Switching Valve
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

4. **REMOVE DUTY VACUUM SWITCHING VALVE**
   a. Disconnect the duty vacuum switching valve connector and the clamp.

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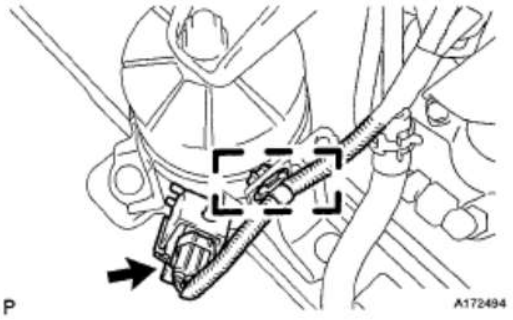


Fig. 368: Locating Duty Vacuum Switching Valve Connector And Clamp
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. Remove the bolt.

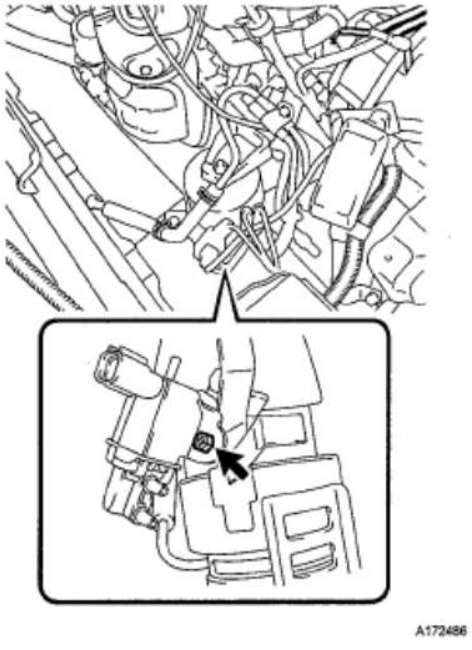


Fig. 369: Locating Duty Vacuum Switching Valve Bolt
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

c. Disconnect the hose from the duty vacuum switching valve and remove the duty vacuum switching valve.

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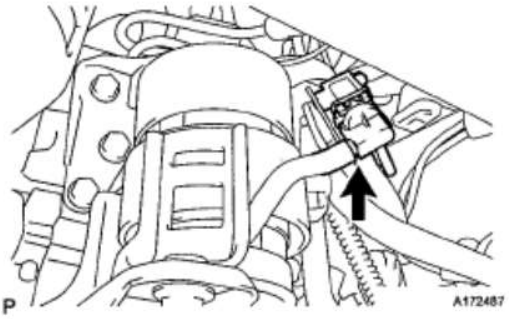


Fig. 370: Locating Duty Vacuum Switching Valve Hose
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSPECTION

1. **INSPECT DUTY VACUUM SWITCHING VALVE (OPERATION)**
   a. Check the operation of the duty vacuum switching valve when positive battery voltage is applied to its terminals.

   Positive battery voltage is not applied:

   The air from pipe G is flowing out through pipes E and H.

   Positive battery voltage is applied:

   The air from pipe F is flowing out through pipes E and H.

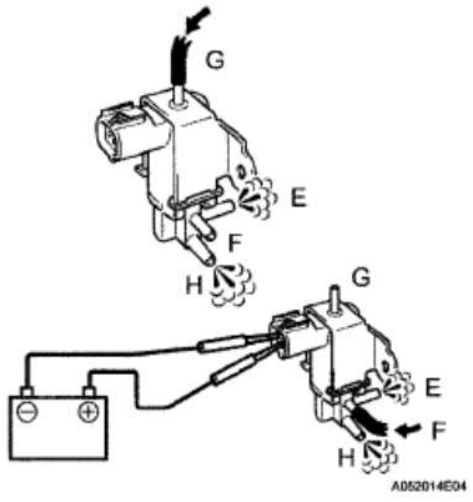


Fig. 371: Inspecting Duty Vacuum Switching Valve Operation
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

2. **INSPECT DUTY VACUUM SWITCHING VALVE (RESISTANCE)**
   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 - 2	20°C (68°F)	19 to 21 ohms

If the resistance is not as specified, replace the duty vacuum switching valve.

Component without wire harness connected:
(Duty Vacuum Switching Valve)

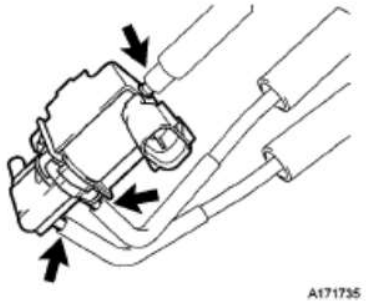


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Fig. 372: Identifying Duty Vacuum Switching Valve Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSTALLATION

1. **INSTALL DUTY VACUUM SWITCHING VALVE**
   a. Connect the vacuum hose sub-assembly to the duty vacuum switching valve.



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Fig. 373: Locating Vacuum Hose Sub-Assembly
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

   b. Connect the hose to the duty vacuum switching valve.

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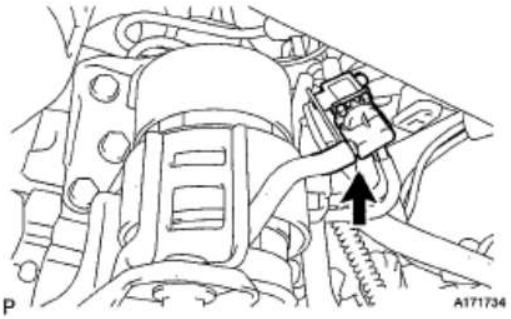


Fig. 374: Locating Duty Vacuum Switching Valve Hose
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

c. Install the duty vacuum switching valve with a bolt.

Torque: 4.0 N*m (41 kgf*cm, 35 in.*lbf)

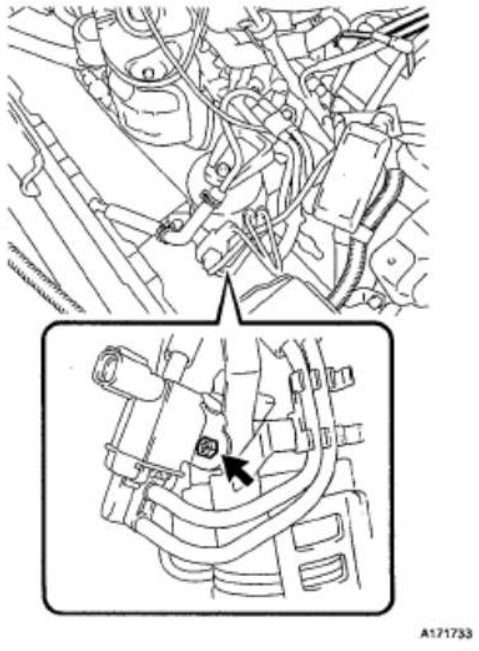


Fig. 375: Locating Duty Vacuum Switching Valve With Bolt
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

d. Connect the duty vacuum switching valve connector and clamp.

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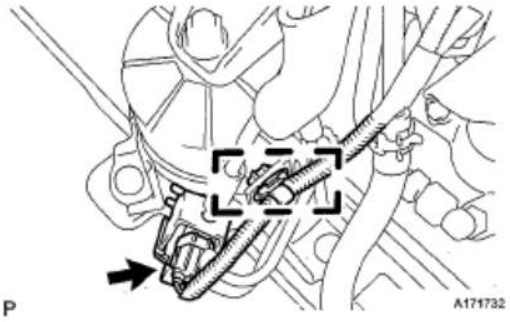


Fig. 376: Locating Duty Vacuum Switching Valve Connector And Clamp
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

2. **INSTALL VACUUM HOSE SUB-ASSEMBLY**
   a. Install the clamp of the vacuum hose sub-assembly to the front engine mounting insulator assembly.

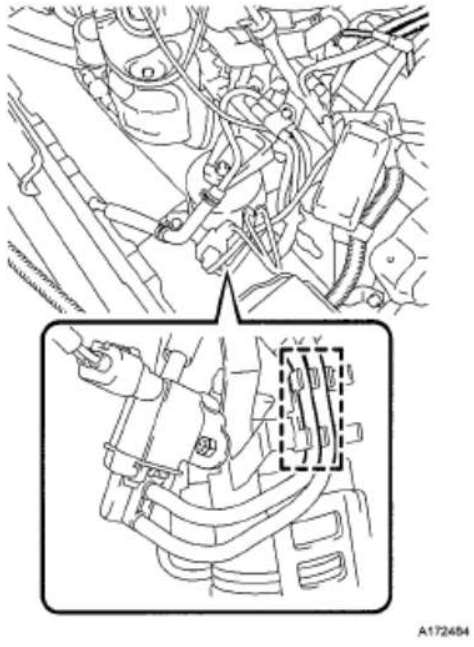


Fig. 377: Identifying Clamp Of Vacuum Hose Sub-Assembly
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

   b. Install the 2 clamps.

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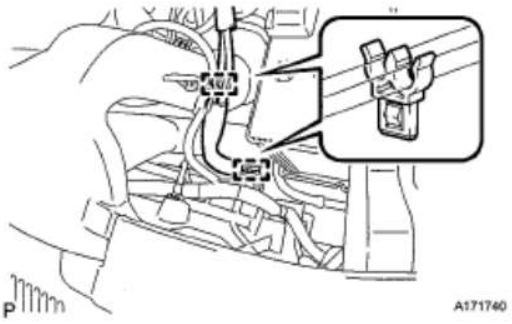


Fig. 378: Identifying Vacuum Hose Sub-Assembly Clamps
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

c. Connect the vacuum hose sub-assembly to the air cleaner cap sub-assembly and vacuum switching valve.

3. **INSTALL NO. 1 ENGINE UNDER COVER** (See **INSTALLATION**)
4. **INSTALL ENGINE UNDER COVER ASSEMBLY** (See **INSTALLATION**)

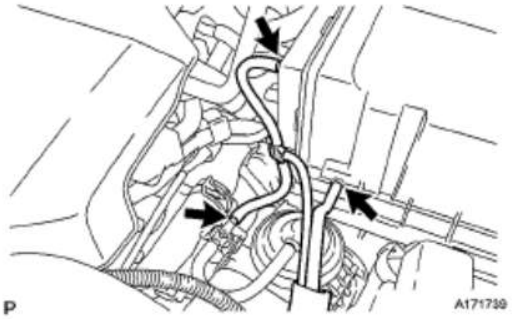


Fig. 379: Locating Vacuum Hose Sub-Assembly
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

ACTIVE CONTROL ENGINE MOUNT

COMPONENTS

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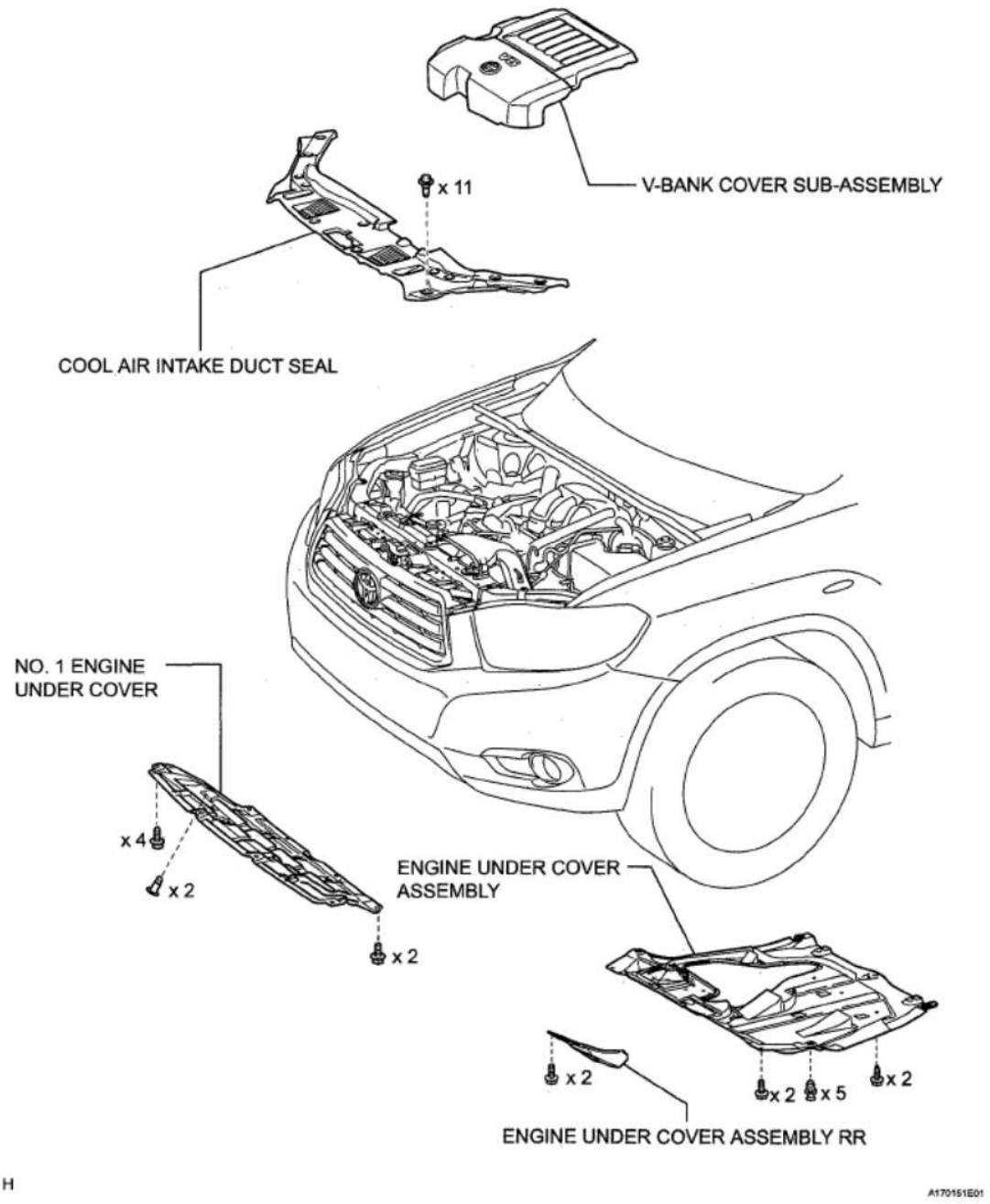


Fig. 380: Identifying Active Control Engine Mount Components (1 Of 5)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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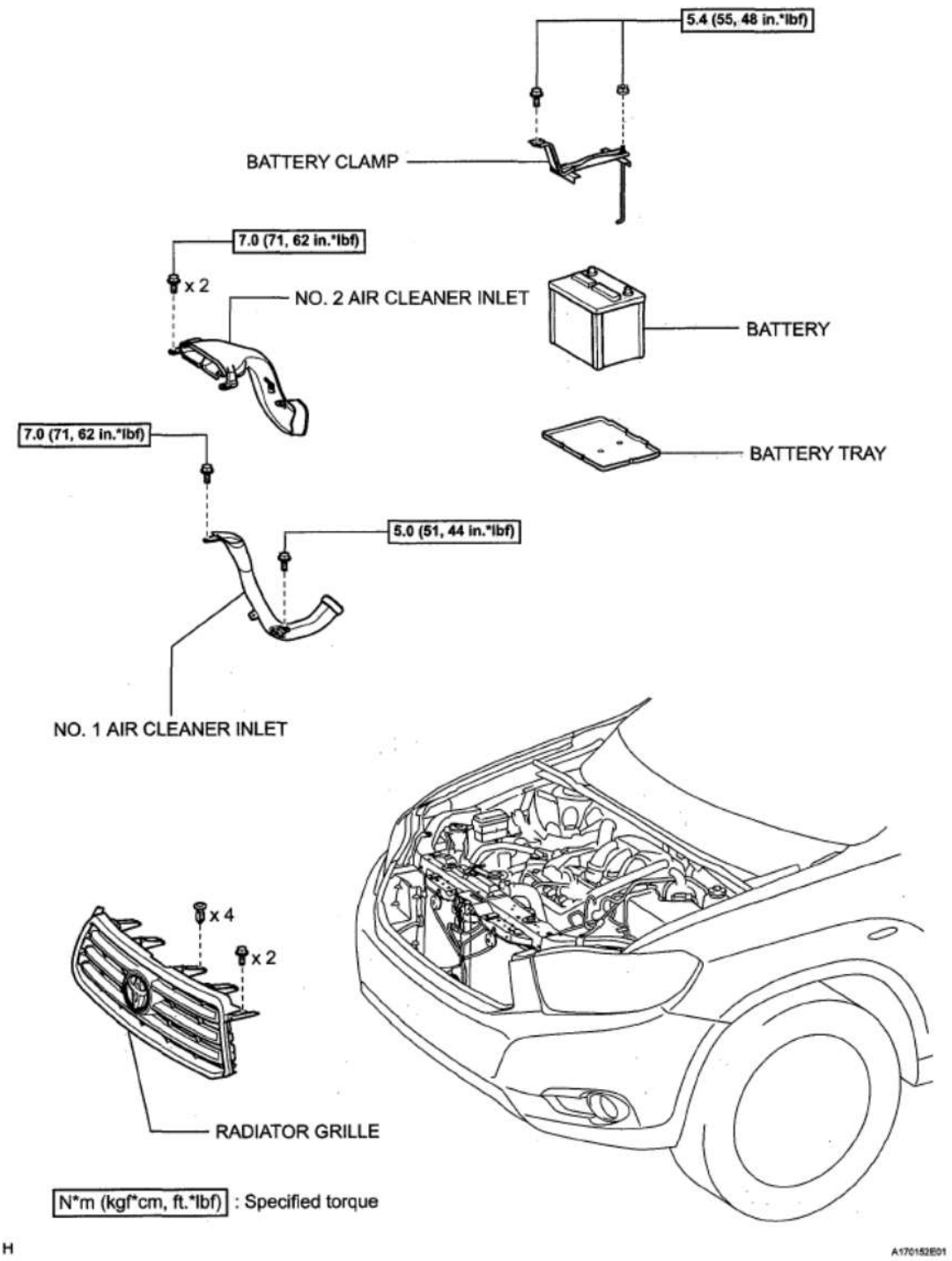


Fig. 381: Identifying Active Control Engine Mount Components (2 Of 5)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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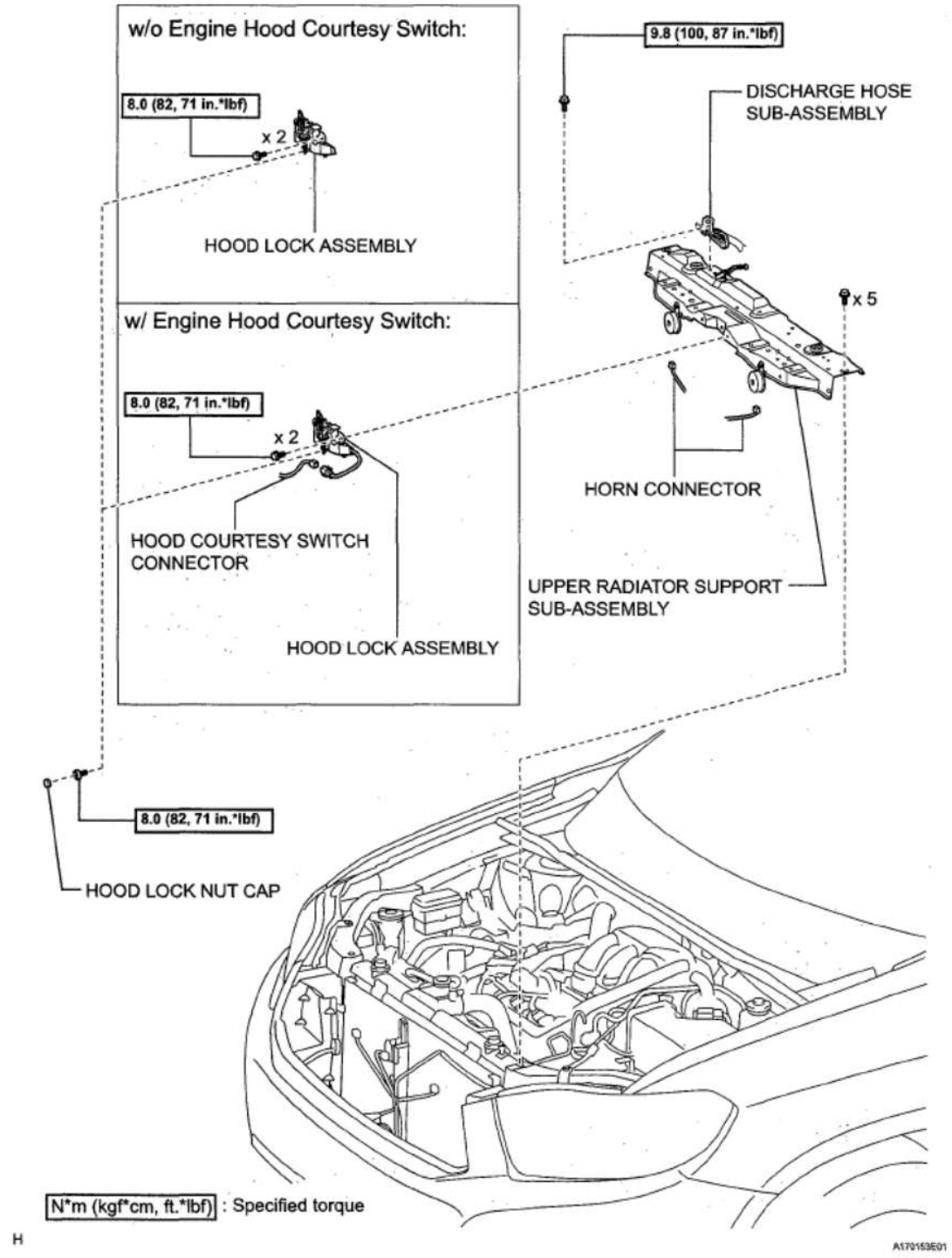


Fig. 382: Identifying Active Control Engine Mount Components (3 Of 5)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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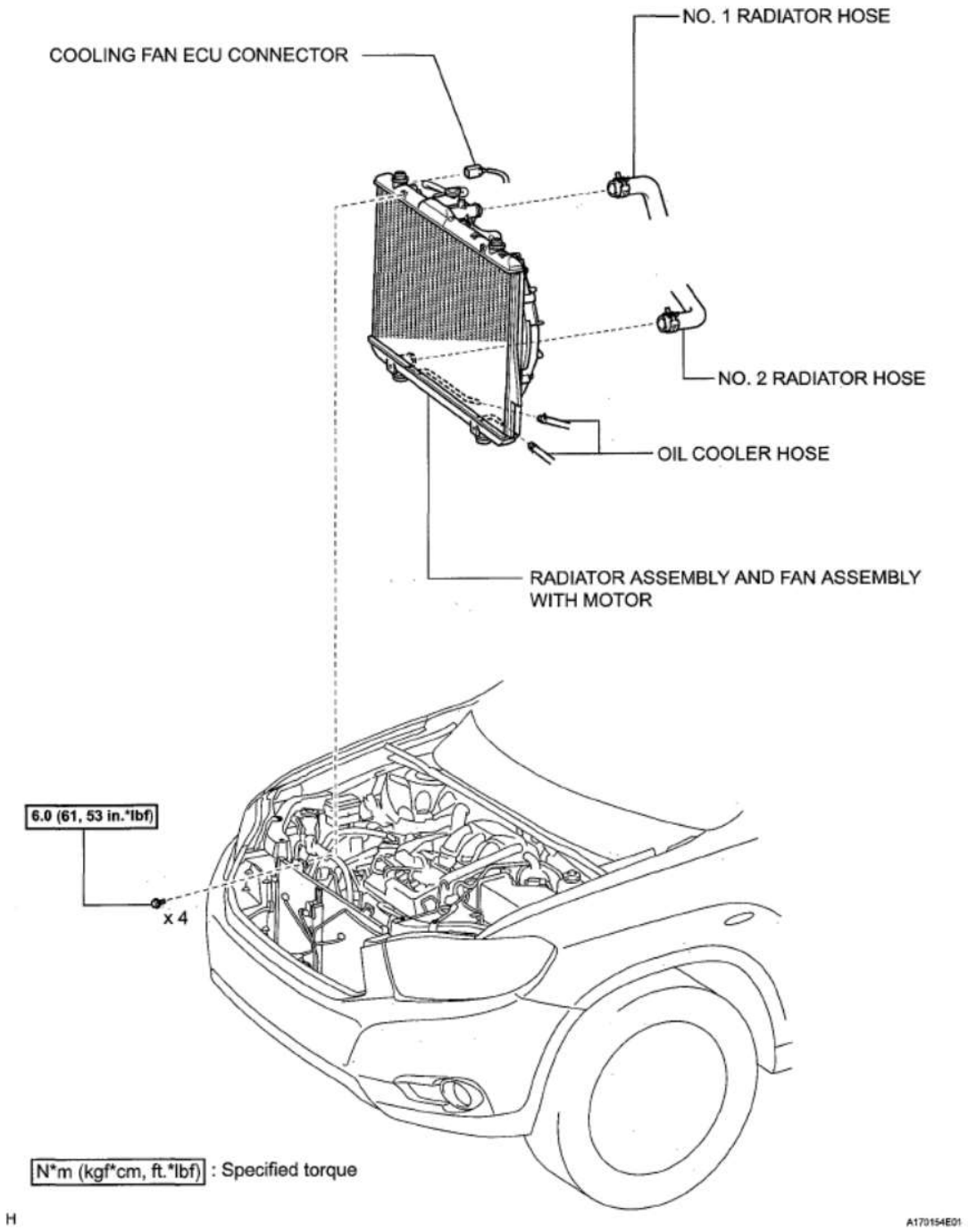


Fig. 383: Identifying Active Control Engine Mount Components (4 Of 5)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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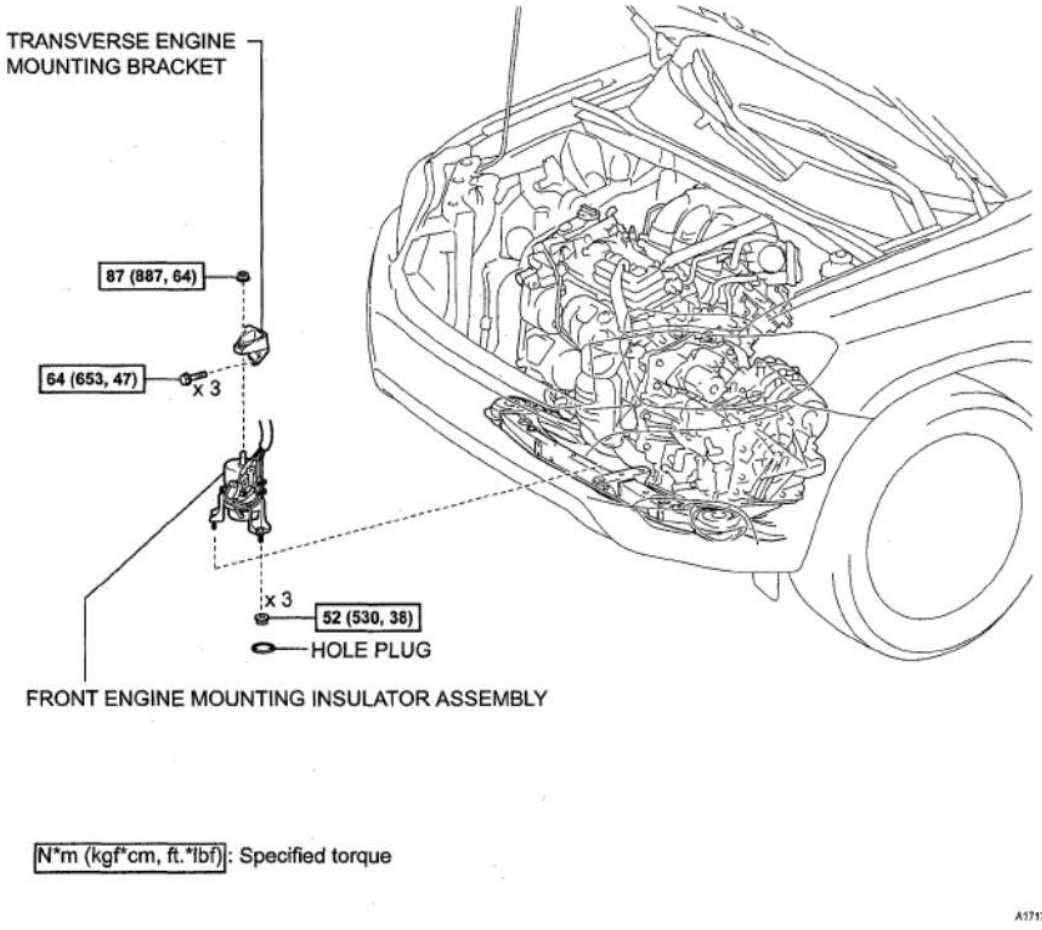


Fig. 384: Identifying Active Control Engine Mount Components (5 Of 5)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

ON-VEHICLE INSPECTION

1. **INSPECT FRONT ENGINE MOUNTING INSULATOR ASSEMBLY**
   a. Inspect the front engine mounting insulator assembly.
      1. Connect Techstream to DLC3.
      2. Start the engine and turn the Techstream main switch on.
      3. Enter the following menus: Powertrain/Engine and ECT/Active Test/Control the ACM Inhibit.

TESTER DISPLAY CHART

Tester Display	Test Part	Control Range	Diagnostic Note
Control the ACM Inhibit	ACM	ON/OFF	Test is possible while engine is idling

      4. Check if the front engine mounting insulator assembly operates in accordance with tester operation.

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Standard:

The front engine mounting insulator assembly operates normally in accordance with tester operation.

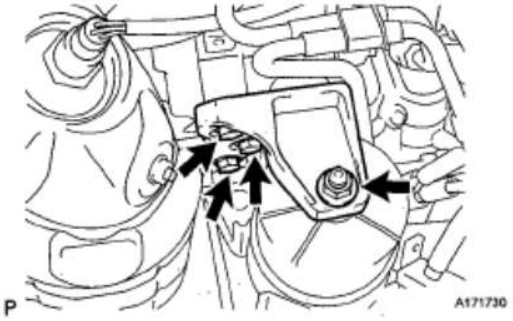
REMOVAL

1. **REMOVE V-BANK COVER SUB-ASSEMBLY** (See **REMOVAL**)
2. **REMOVE ENGINE UNDER COVER ASSEMBLY** (See **REMOVAL**)
3. **REMOVE NO. 1 ENGINE UNDER COVER** (See **REMOVAL**)
4. **DRAIN ENGINE COOLANT** (See **COOLANT**)
5. **REMOVE COOL AIR INTAKE DUCT SEAL** (See **REMOVAL**)
6. **REMOVE BATTERY** (See **REMOVAL**)
7. **REMOVE NO. 2 AIR CLEANER INLET** (See **REMOVAL**)
8. **REMOVE NO. 1 AIR CLEANER INLET** (See **REMOVAL**)
9. **DISCONNECT NO. 1 RADIATOR HOSE** (See **REMOVAL**)
10. **DISCONNECT NO. 2 RADIATOR HOSE** (See **REMOVAL**)
11. **DISCONNECT OIL COOLER HOSE** (See **REMOVAL**)
12. **DISCONNECT COOLING FAN ECU CONNECTOR** (See **REMOVAL**)
13. **REMOVE RADIATOR GRILLE** (See **REMOVAL**)
14. **REMOVE HOOD LOCK ASSEMBLY (w/o Engine Hood Courtesy Switch)** (See **REMOVAL**)
15. **REMOVE HOOD LOCK ASSEMBLY (w/ Engine Hood Courtesy Switch)** (See **REMOVAL**)
16. **REMOVE UPPER RADIATOR SUPPORT SUB-ASSEMBLY** (See **REMOVAL**)
17. **SEPARATE COOLER CONDENSER ASSEMBLY** (See **REMOVAL**)
18. **REMOVE RADIATOR ASSEMBLY AND FAN ASSEMBLY WITH MOTOR** (See **REMOVAL**)
19. **REMOVE TRANSVERSE ENGINE MOUNTING BRACKET**

HINT:

Securely support the automatic transaxle using a jack.

a. Remove the nut, 3 bolts and the transverse engine mounting bracket.



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Fig. 385: Locating Transverse Engine Mounting Bracket With Bolts And Nut
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

20. **REMOVE FRONT ENGINE MOUNTING INSULATOR ASSEMBLY**
    a. Disconnect the vacuum hose sub-assembly from the air cleaner cap sub-assembly and vacuum switching valve.

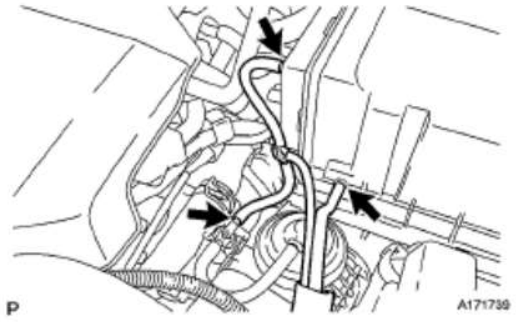


Fig. 386: Locating Vacuum Hose Sub-Assembly
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

    b. Remove the 2 clamps.

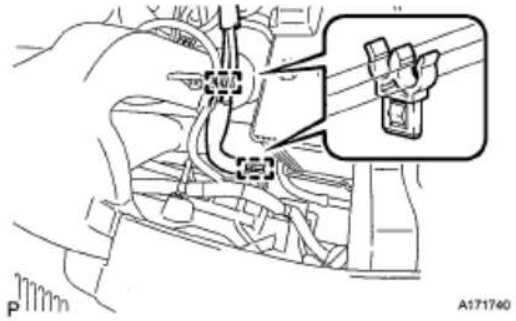
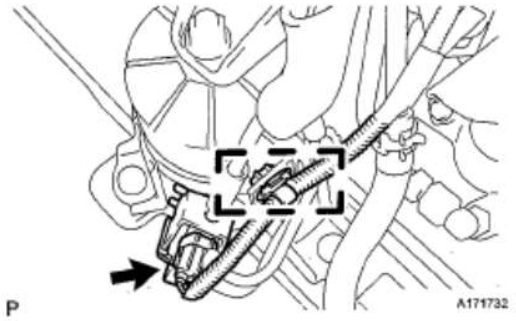


Fig. 387: Locating Vacuum Hose Sub-Assembly Clamps
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

    c. Disconnect the duty vacuum switching valve connector and clamp.



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Fig. 388: Locating Duty Vacuum Switching Valve Connector And Clamp
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

d. Remove the cap, 3 nuts and front engine mounting insulator assembly.

INSPECTION

1. **INSPECT FRONT ENGINE MOUNTING INSULATOR ASSEMBLY**
   a. Disconnect the vacuum hose from the front engine mounting insulator assembly.

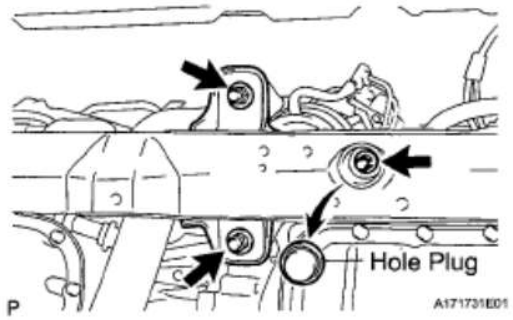


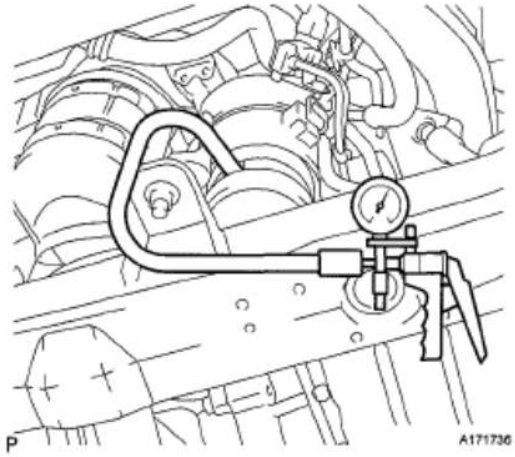
Fig. 389: Locating Front Engine Mounting Insulator Assembly With Nuts
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

   b. Using a vacuum pump, apply vacuum of 80 kPa (600 mmHg, 25 in.Hg) and wait for 1 minute.
   c. Check that there is no change in the needle movement of the vacuum pump gauge.

OK:

Vacuum pressure holds.

   d. Check that there is no fluid leakage caused by a break in the diaphragm.
   e. Reconnect the vacuum hose.



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Fig. 390: Checking Vacuum Hose
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSTALLATION

1. **INSTALL FRONT ENGINE MOUNTING INSULATOR ASSEMBLY**
   a. Install the front engine mounting insulator assembly with the 3 nuts and cap.

   Torque: 52 N*m (530 kgf*cm, 38 ft.*lbf)

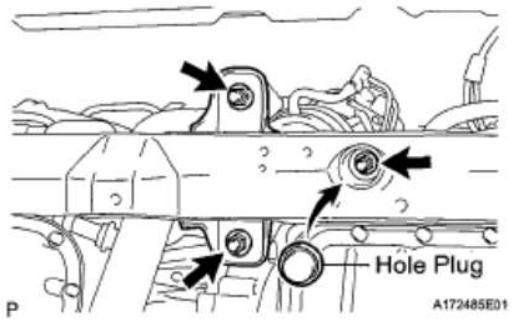


Fig. 391: Locating Front Engine Mounting Insulator Assembly With Nuts And Cap
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

   b. Connect the duty vacuum switching valve connector and clamp.

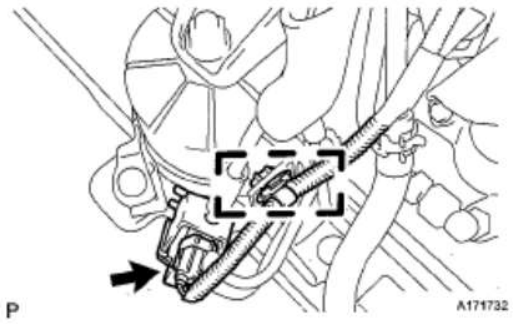


Fig. 392: Locating Duty Vacuum Switching Valve Connector And Clamp
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

   c. Install the 2 clamps.

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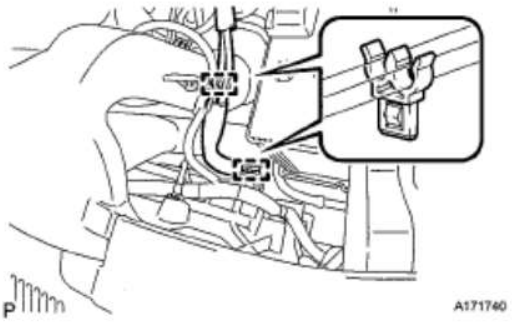


Fig. 393: Locating Vacuum Hose Sub-Assembly Clamps
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

d. Connect the vacuum hose sub-assembly to the air cleaner cap sub-assembly and vacuum switching valve.

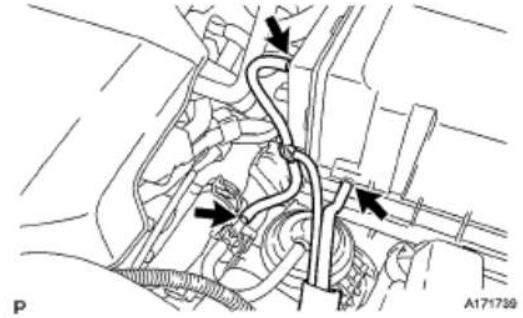


Fig. 394: Locating Vacuum Hose Sub-Assembly
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

2. **INSTALL TRANSVERSE ENGINE MOUNTING BRACKET**

a. Install the transverse engine mounting bracket with the 3 bolts and nut.

Torque: 64 N*m (653 kgf*cm, 47 ft.*lbf) for 3 Bolts

87 N*m (887 kgf*cm, 64 ft.*lbf) for Nut

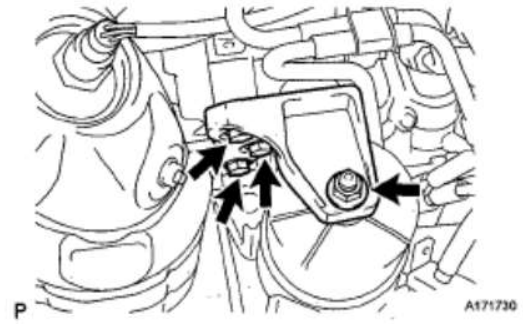


Fig. 395: Locating Transverse Engine Mounting Bracket With Bolts And Nut

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

3. **INSTALL RADIATOR ASSEMBLY AND FAN ASSEMBLY WITH MOTOR** (See **INSTALLATION**)
4. **INSTALL COOLER CONDENSER ASSEMBLY** (See **INSTALLATION**)
5. **INSTALL UPPER RADIATOR SUPPORT SUB-ASSEMBLY** (See **INSTALLATION**)
6. **INSTALL HOOD LOCK ASSEMBLY (w/o Engine Hood Courtesy Switch)** (See **INSTALLATION**)
7. **INSTALL HOOD LOCK ASSEMBLY (w/ Engine Hood Courtesy Switch)** (See **INSTALLATION**)
8. **INSTALL RADIATOR GRILLE** (See **INSTALLATION**)
9. **CONNECT COOLING FAN ECU CONNECTOR** (See **INSTALLATION**)
10. **CONNECT OIL COOLER HOSE** (See **INSTALLATION**)
11. **CONNECT NO. 2 RADIATOR HOSE** (See **INSTALLATION**)
12. **CONNECT NO. 1 RADIATOR HOSE** (See **INSTALLATION**)
13. **INSTALL NO. 1 AIR CLEANER INLET** (See **INSTALLATION**)
14. **INSTALL NO. 2 AIR CLEANER INLET** (See **INSTALLATION**)
15. **INSTALL BATTERY** (See **INSTALLATION**)
16. **INSTALL COOL AIR INTAKE DUCT SEAL** (See **INSTALLATION**)
17. **ADD ENGINE COOLANT** (See **REPLACEMENT**)
18. **INSPECT FOR COOLANT LEAK** (See **COOLING SYSTEM**)
19. **INSPECT AUTOMATIC TRANSAXLE FLUID**

    HINT:

    See **AUTOMATIC TRANSAXLE FLUID**

20. **INSPECT FOR OIL LEAK**
21. **INSTALL NO. 1 ENGINE UNDER COVER** (See **INSTALLATION**)
22. **INSTALL ENGINE UNDER COVER ASSEMBLY** (See **INSTALLATION**)
23. **INSTALL V-BANK COVER SUB-ASSEMBLY** (See **INSTALLATION**)

ECM

COMPONENTS

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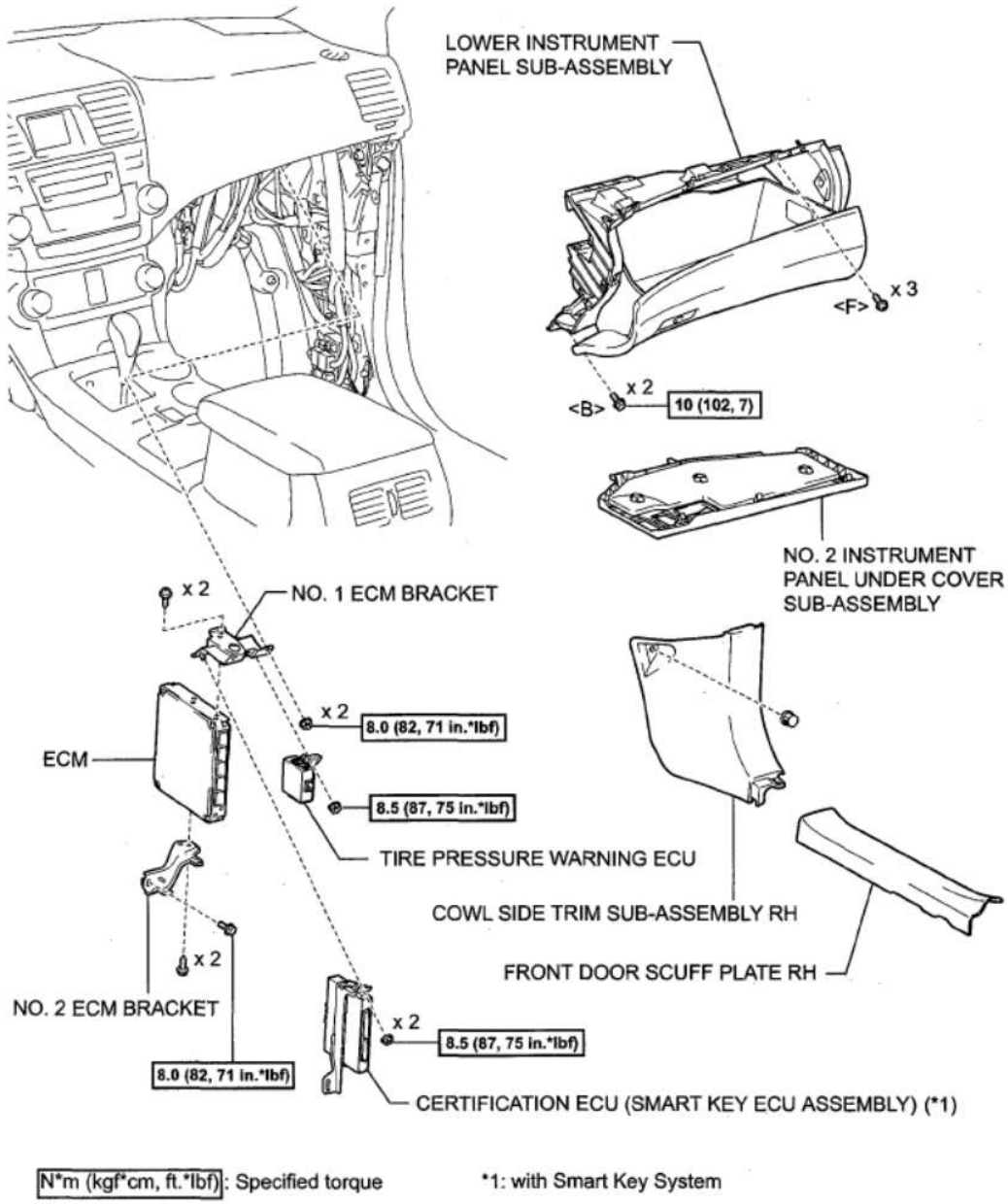


Fig. 396: Identifying ECM Components
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

REMOVAL

NOTE: Before removing the tire pressure warning ECU, read the registered transmitter IDs of all wheels and write them down to use for re-registration of transmitter IDs (See REGISTRATION).

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1. **DISCONNECT CABLE FROM NEGATIVE BATTERY TERMINAL**

CAUTION: Wait at least 90 seconds after disconnecting the cable from the negative (-) battery terminal to prevent airbag and seat belt pretensioner activation.

NOTE: When disconnecting the cable, some systems need to be initialized after the cable is reconnected (See INITIALIZATION).

2. **REMOVE FRONT DOOR SCUFF PLATE RH**

HINT:

Use the same procedure for the RH side and the LH side (See **REMOVAL**).

3. **REMOVE COWL SIDE TRIM SUB-ASSEMBLY RH**

HINT:

Use the same procedure for the RH side and the LH side (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 CERTIFICATION ECU (SMART KEY ECU ASSEMBLY) (w/ Smart Key System)** (See **REMOVAL**)
7. **REMOVE TIRE PRESSURE WARNING ECU** (See **INSTALLATION**)
8. **REMOVE ECM**
   a. Separate the harness connector.
   b. Disconnect the 5 ECM connectors.
   c. Remove the wire harness clamp.
   d. Remove the 2 nuts, bolt and ECM.

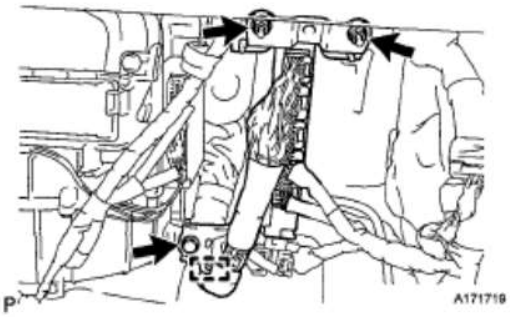


Fig. 397: Locating ECM With Nuts And Bolt
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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9. **REMOVE NO. 1 ECM BRACKET**
   a. Remove the 2 screws and No. 1 ECM bracket.

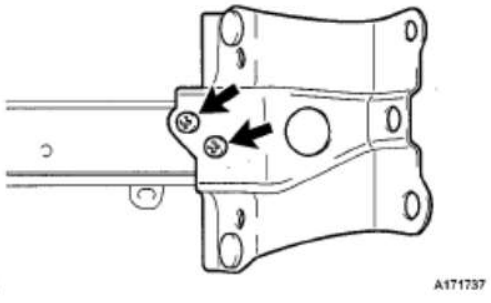


Fig. 398: Locating No. 1 ECM Bracket Screws
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

10. **REMOVE NO. 2 ECM BRACKET**
    a. Remove the 2 screws and No. 2 ECM bracket.

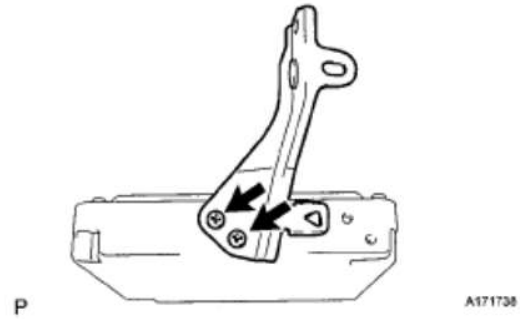
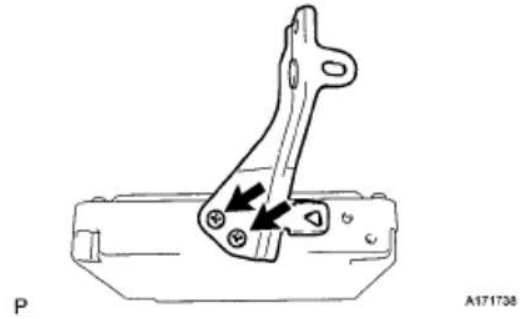


Fig. 399: Locating No. 2 ECM Bracket Screws
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSTALLATION

1. **INSTALL NO. 2 ECM BRACKET**
   a. Install the 2 screws and No. 2 ECM bracket.



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Fig. 400: Locating No. 2 ECM Bracket Screws
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

2. **INSTALL NO. 1 ECM BRACKET**
   a. Install the 2 screws and No. 1 ECM bracket.

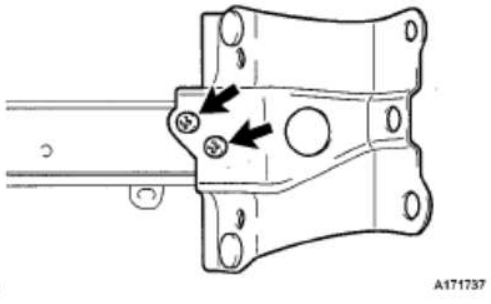


Fig. 401: Locating No. 1 ECM Bracket Screws
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

3. **INSTALL ECM**
   a. Install the 2 nuts, bolt and ECM.

   Torque: 8.0 N*m (82 kgf*cm, 71 in.*lbf)

   b. Install the wire harness clamp.
   c. Connect the 5 ECM connectors.
   d. Install the harness connector.
4. **INSTALL TIRE PRESSURE WARNING ECU** (See **INSTALLATION**)

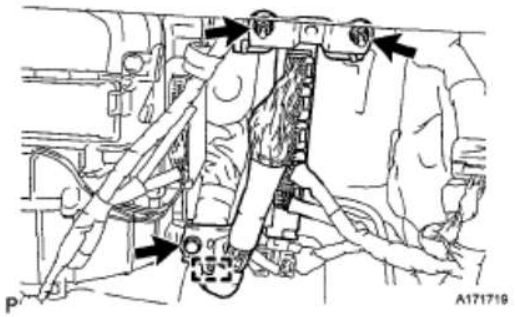


Fig. 402: Locating ECM With Nuts And Bolt
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

5. **INSTALL CERTIFICATION ECU (SMART KEY ECU ASSEMBLY) (w/ Smart Key System)** (See **REMOVAL**)
6. **INSTALL LOWER INSTRUMENT PANEL SUB-ASSEMBLY** (See **INSTALLATION**)
7. **INSTALL NO. 2 INSTRUMENT PANEL UNDER COVER SUB-ASSEMBLY** (See

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INSTALLATION)

8. **INSTALL COWL SIDE TRIM SUB-ASSEMBLY RH**

HINT:

Use the same procedures for the RH side and the LH side (See **INSTALLATION**).

9. **INSTALL FRONT DOOR SCUFF PLATE RH**

HINT:

Use the same procedures for the RH side and the LH side (See **INSTALLATION**).

10. **CONNECT CABLE TO NEGATIVE BATTERY TERMINAL**

NOTE: **When disconnecting the cable, some systems need to be initialized after the cable is reconnected (See INITIALIZATION).**

11. **RESISTER TRANSMITTER ID**

NOTE: **If the tire pressure warning ECU is replaced, resister the transmitter ID (See REGISTRATION).**

12. **INSPECT TIRE PRESSURE WARNING SYSTEM**

NOTE: **If the tire pressure warning ECU is replaced, inspect the tire pressure warning system (See TEST MODE PROCEDURE).**

13. **INITIALIZE TIRE PRESSURE WARNING SYSTEM**

NOTE:

- **Be sure to register the transmitter IDs of all tires in the ECU before initialization.**
- **Be sure to inflate all tires to the proper inflation pressure before initialization.**

HINT:

See **INITIALIZATION**

14. **REGISTER IMMOBILISER COMMUNICATION ID**

NOTE: **If the ECM is replaced, register the ECU communication ID for the immobiliser system (See REGISTRATION w/ Smart Key System, See REGISTRATION w/o Smart Key System).**

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15. **PERFORM INITIALIZATION**

NOTE: **If the ECM is replaced, perform RESET MEMORY (AT initialization) (See INITIALIZATION).**

ACCELERATOR PEDAL ROD

COMPONENTS

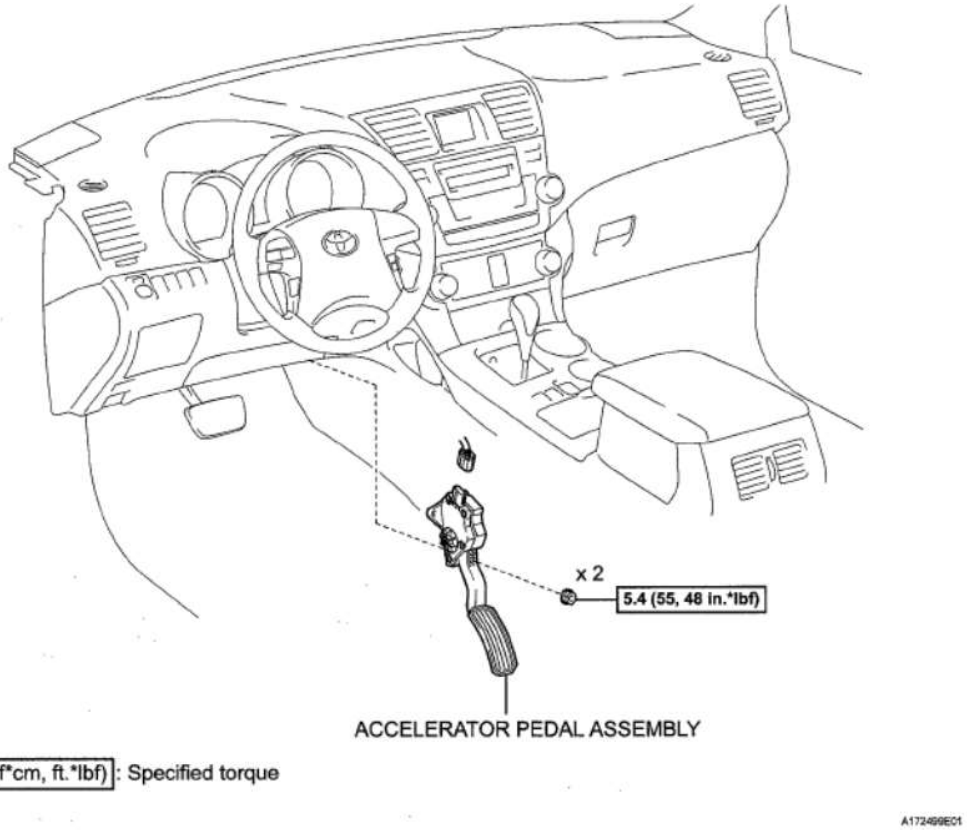


Fig. 403: Identifying Accelerator Pedal Rod Components
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

ON-VEHICLE INSPECTION

1. **CHECK ACCELERATOR PEDAL ASSEMBLY**
   a. Check the voltage.
      1. Connect Techstream to the DLC3.
      2. Turn the ignition switch on (IG).
      3. Turn the Techstream main switch on.
      4. Select the menu items: Powertrain/Engine and ECT/Data List/Accelerator Position No. 1, Acceleration Position No. 2.

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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 (Accelerator Position No. 1)

ACCELERATOR PEDAL ASSEMBLY CONDITION CHART

Accelerator Pedal Assembly Condition	Specified Condition
Released	0.5 to 1.1 V
Depressed	2.5 to 4.5 V

Standard voltage (Accelerator Position No. 2)

ACCELERATOR PEDAL ASSEMBLY CONDITION CHART

Accelerator Pedal Assembly Condition	Specified Condition
Released	1.2 to 2.0 V
Depressed	3.4 to 5.0 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.

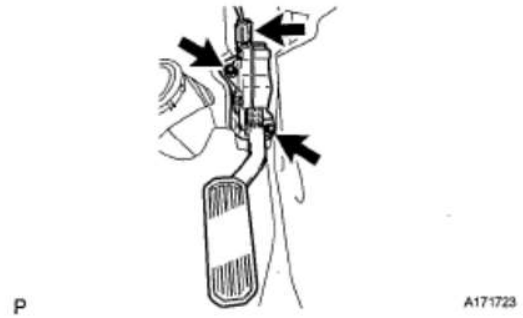


Fig. 404: Locating Accelerator Pedal Assembly Nuts And Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSTALLATION

1. **INSTALL ACCELERATOR PEDAL ASSEMBLY**

NOTE:
- **Avoid physical shock to the accelerator pedal assembly.**
- **Do not disassemble the accelerator pedal assembly.**

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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.

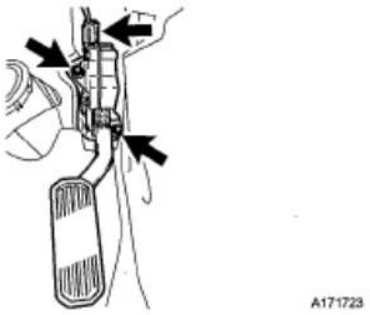


Fig. 405: Locating Accelerator Pedal Assembly Nuts And Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

MASS AIR FLOW METER

COMPONENTS

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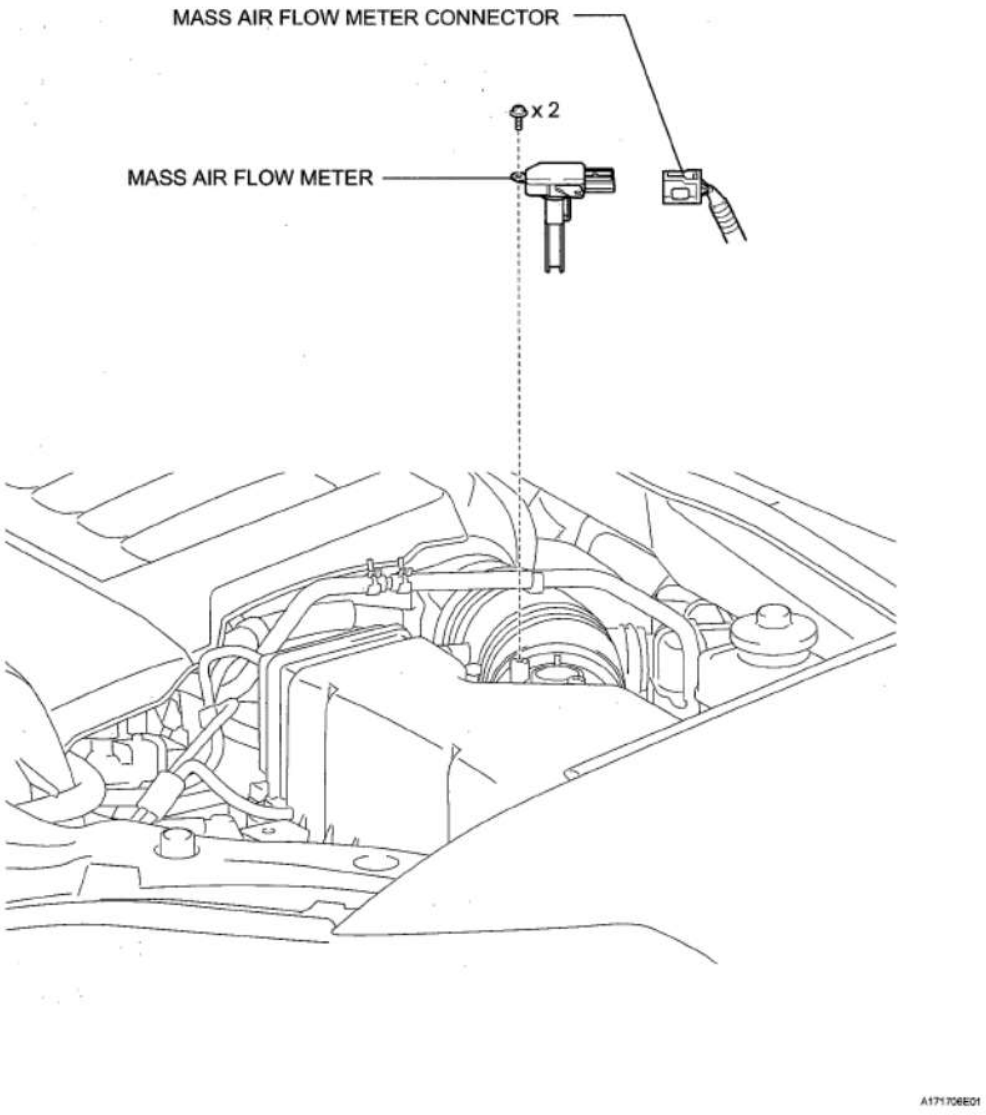


Fig. 406: Identifying Mass Air Flow Meter Components
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

ON-VEHICLE INSPECTION

1. **INSPECT MASS AIR FLOW METER**

NOTE:

- **Perform the mass air flow (MAF) meter inspection by following the procedures below.**
- **Only replace the MAF meter when the MAF value in the Data List (with the engine stopped) are not within the normal operating range or there is foreign matter on the MAF meter platinum hot wire (heater).**

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a. Read the values using Techstream (MAF).

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.**

1. Turn the ignition switch on (IG) (do not start the engine).
2. Turn the Techstream main switch on.
3. Select the following menu items: Powertrain/Engine and ECT/Data List/MAF.
4. Wait 30 seconds, and read the values on Techstream.

Standard condition:

Less than 0.70 g/s

- If the result is not as specified, replace the MAF meter.
- If the result is within the specified range, inspect the cause of the extremely rich or lean air fuel ratio.

REMOVAL

1. **REMOVE MASS AIR FLOW METER**
   a. Disconnect the mass air flow meter connector.
   b. Remove the 2 screws and mass air flow meter.

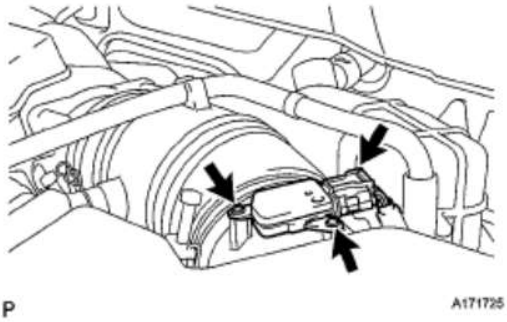


Fig. 407: Locating Mass Air Flow Meter Screws And Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSTALLATION

1. **INSTALL MASS AIR FLOW METER**

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a. Install the mass air flow meter with the 2 screws.
b. Connect the mass air flow meter connector.

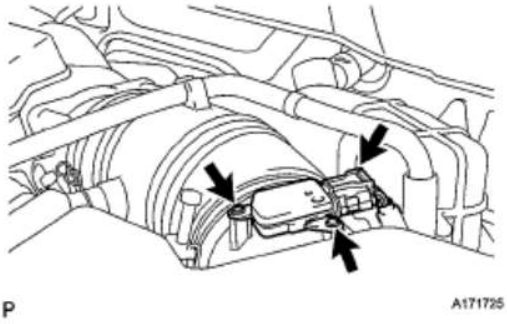


Fig. 408: Locating Mass Air Flow Meter Screws And Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

VVT SENSOR

COMPONENTS

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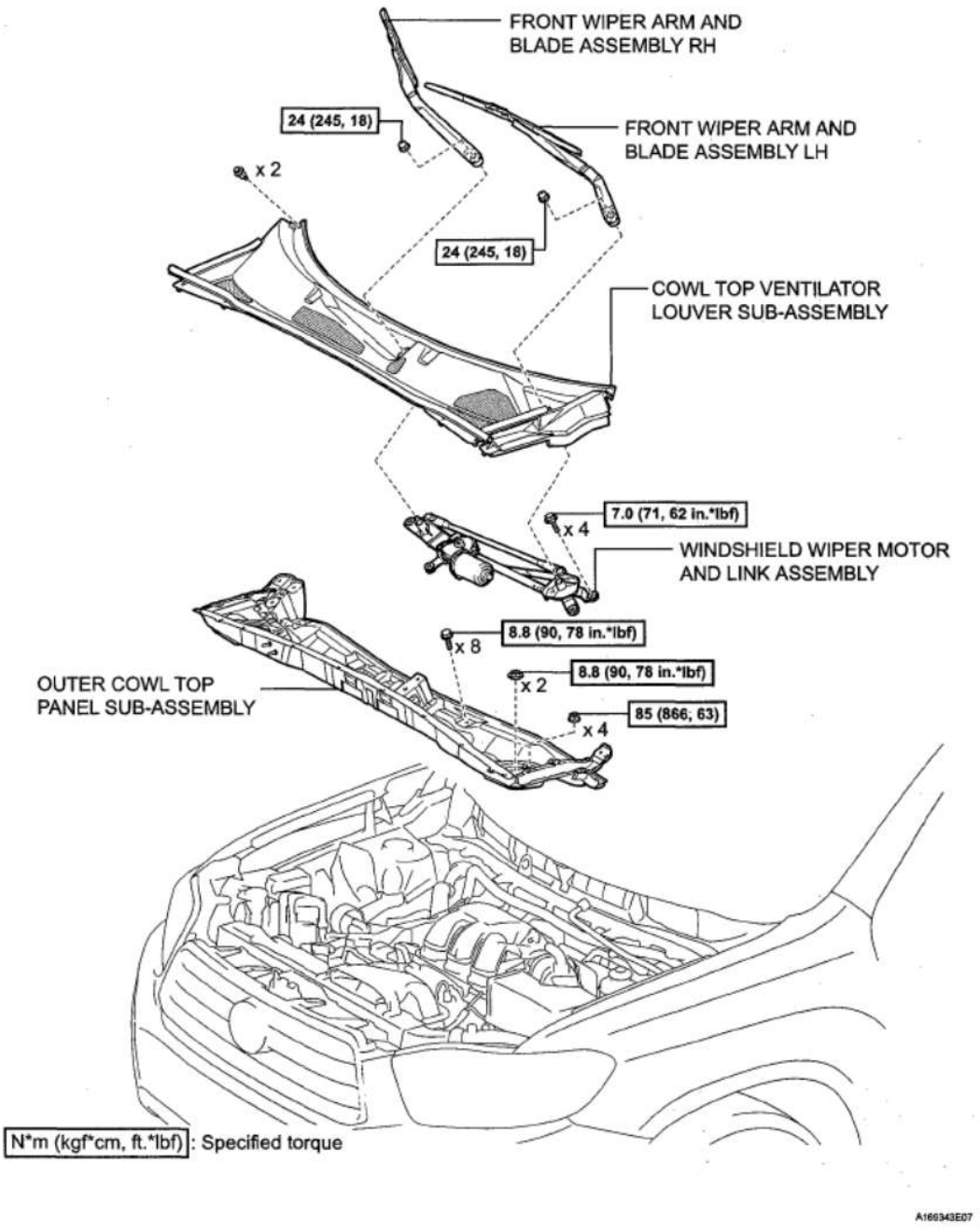


Fig. 409: Identifying VVT Sensor Components (1 Of 4)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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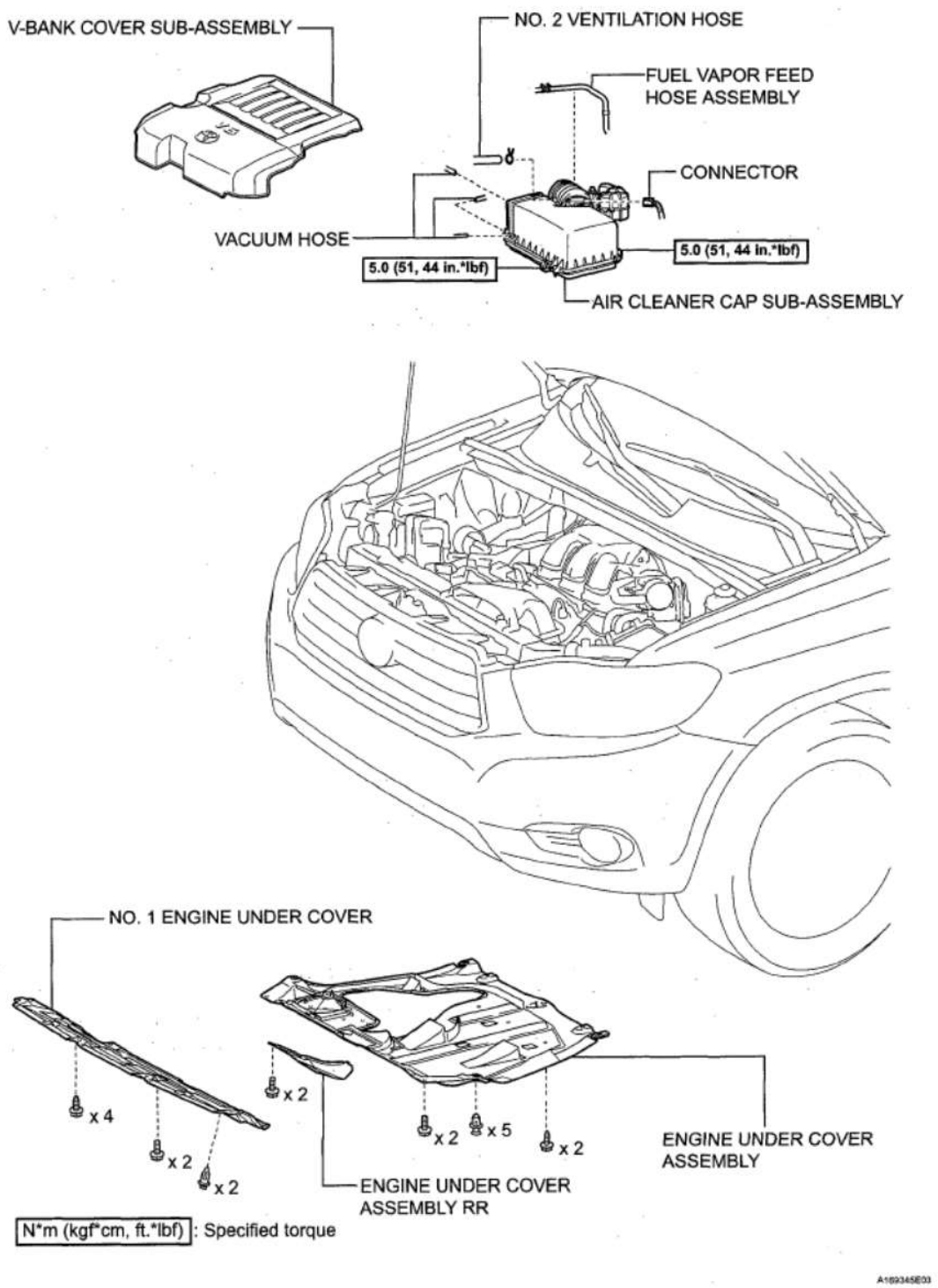


Fig. 410: Identifying VVT Sensor Components (2 Of 4)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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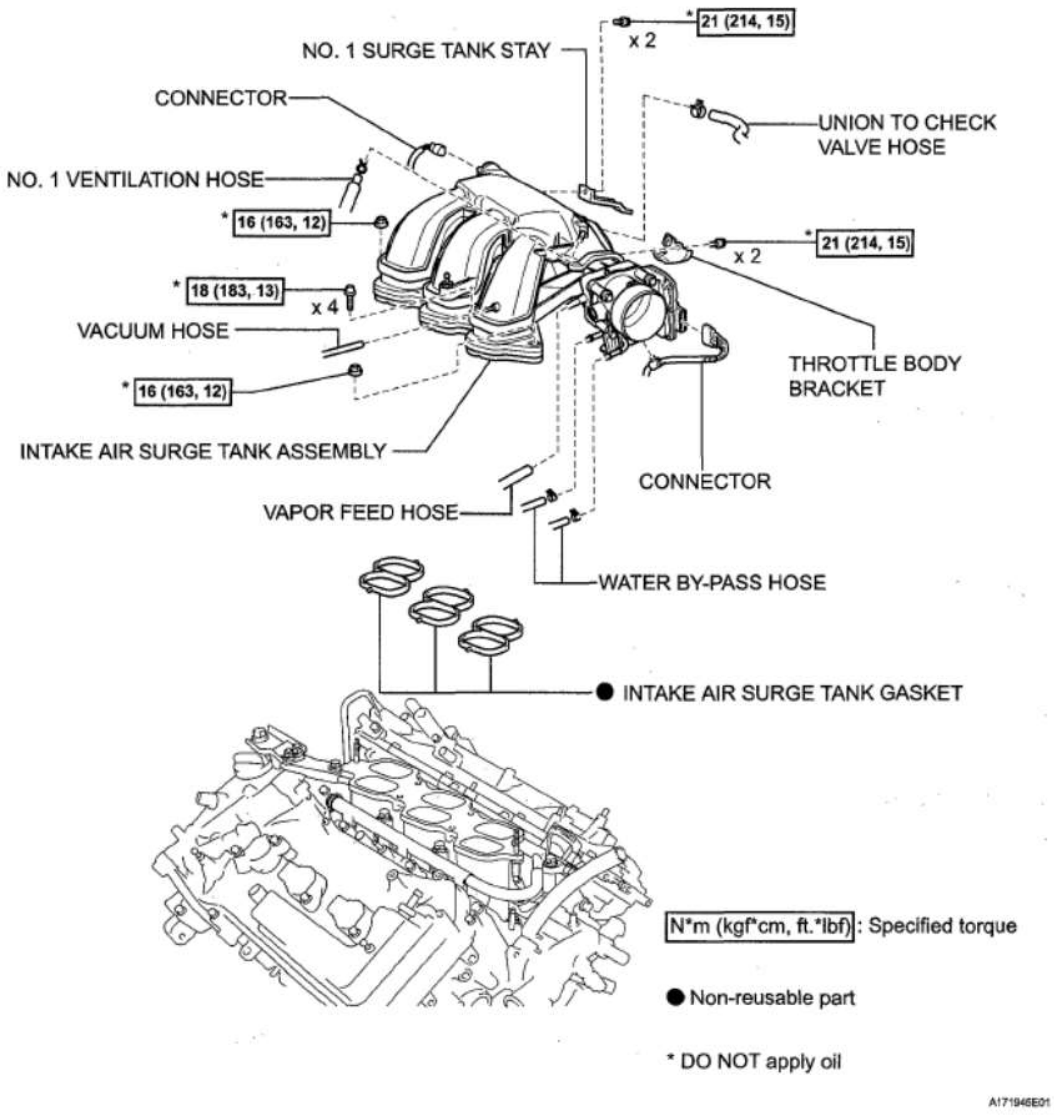


Fig. 411: Identifying VVT Sensor Components (3 Of 4)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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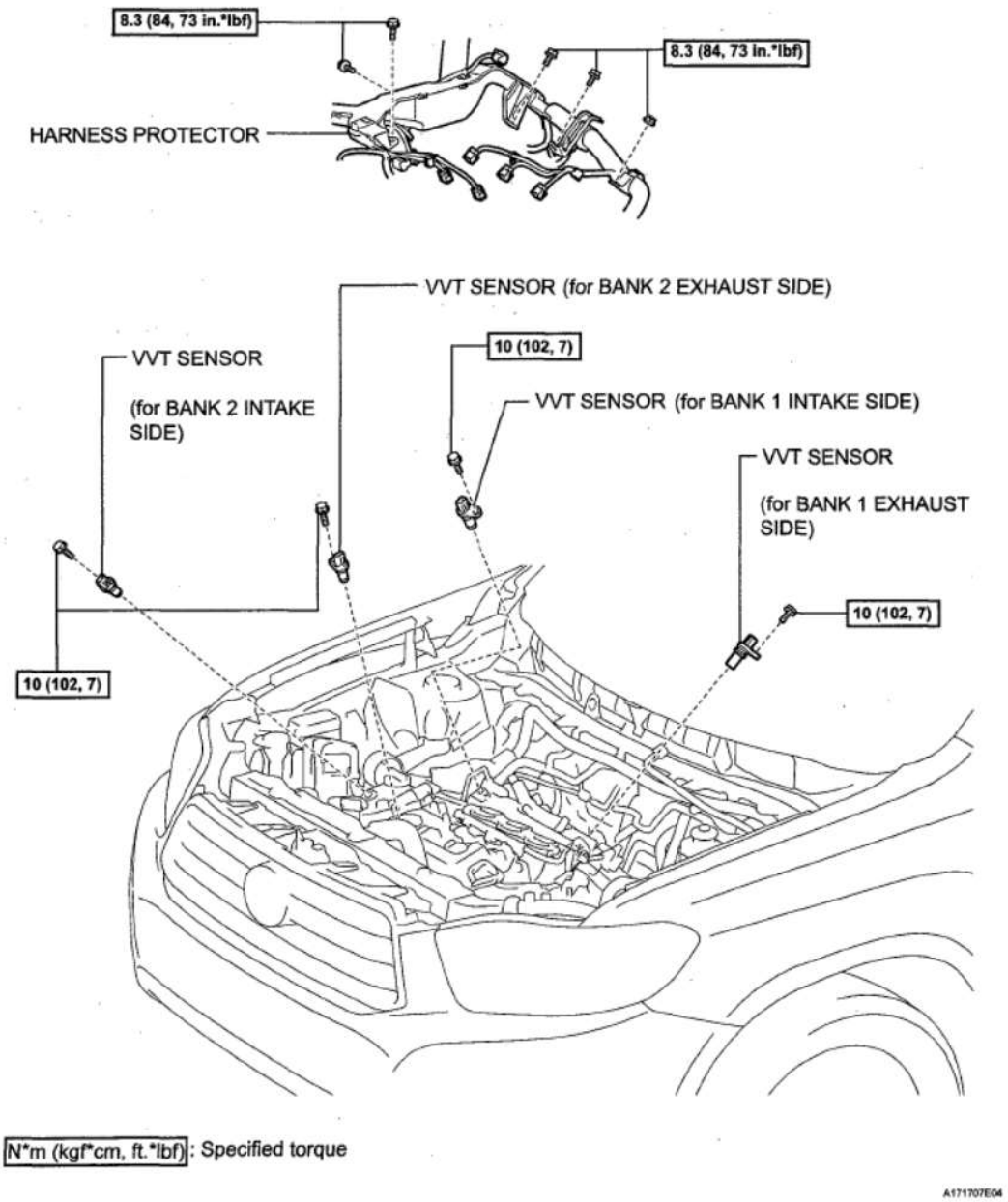


Fig. 412: Identifying VVT Sensor Components (4 Of 4)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

REMOVAL

1. **REMOVE ENGINE UNDER COVER ASSEMBLY** (See **REMOVAL**)
2. **REMOVE NO. 1 ENGINE UNDER COVER** (See **REMOVAL**)
3. **DRAIN ENGINE COOLANT** (See **COOLANT**)
4. **REMOVE FRONT WIPER ARM AND BLADE ASSEMBLY LH** (See **REMOVAL**)
5. **REMOVE FRONT WIPER ARM AND BLADE ASSEMBLY RH** (See **REMOVAL**)

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6. **REMOVE COWL TOP VENTILATOR LOUVER SUB-ASSEMBLY** (See **REMOVAL**)
7. **REMOVE WINDSHIELD WIPER MOTOR AND LINK ASSEMBLY** (See **REMOVAL**)
8. **REMOVE OUTER COWL TOP PANEL SUB-ASSEMBLY** (See **REMOVAL**)
9. **REMOVE V-BANK COVER SUB-ASSEMBLY** (See **REMOVAL**)
10. **REMOVE AIR CLEANER CAP SUB-ASSEMBLY** (See **REMOVAL**)
11. **DISCONNECT ENGINE ROOM MAIN WIRE** (See **REMOVAL**)
12. **REMOVE NO. 1 SURGE TANK STAY** (See **REMOVAL**)
13. **REMOVE THROTTLE BODY BRACKET** (See **REMOVAL**)
14. **REMOVE INTAKE AIR SURGE TANK ASSEMBLY** (See **REMOVAL**)
15. **SEPARATE HARNESS PROTECTOR** (See **REMOVAL**)
16. **REMOVE VVT SENSOR (for Bank 1)**
    a. Intake side:
        1. Remove the bolt and VVT sensor.

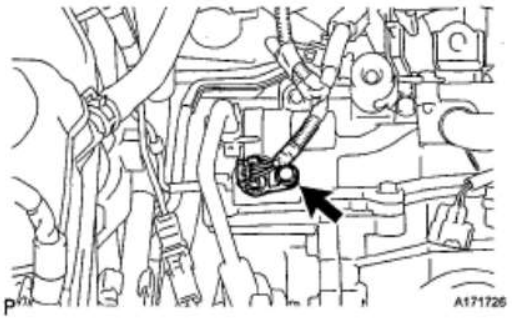


Fig. 413: Locating VVT Sensor Bolt (Intake Side)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

    b. Exhaust side:
        1. Remove the bolt and VVT sensor.

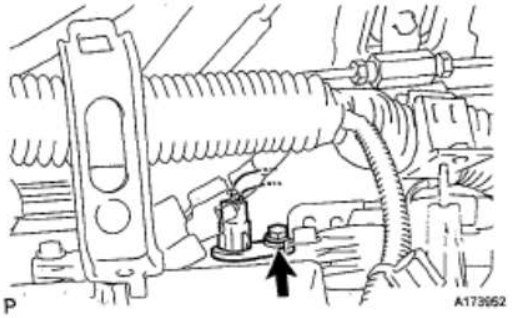


Fig. 414: Locating VVT Sensor Bolt (Exhaust Side)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

17. **REMOVE VVT SENSOR (for Bank 2)**

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a. Intake side:
   1. Remove the bolt and VVT sensor.

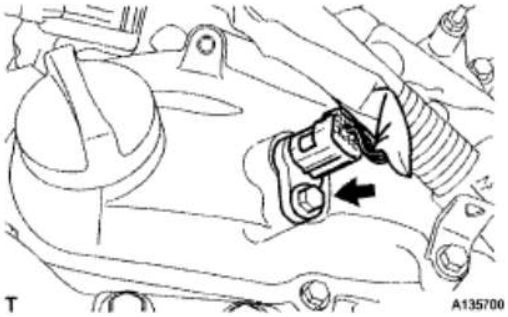


Fig. 415: Locating Bolt On VVT Sensor (For Bank 2 Intake Side)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. Exhaust side:
   1. Remove the bolt and VVT sensor.

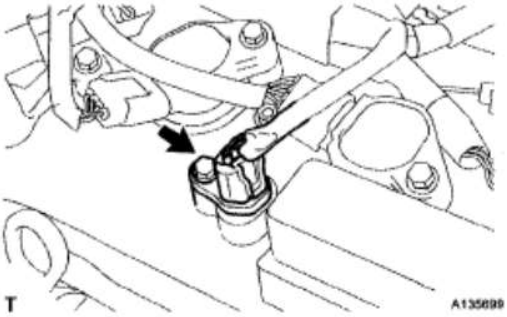


Fig. 416: Locating Bolt On VVT Sensor (For Bank 2 Exhaust Side)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSTALLATION

1. **INSTALL VVT SENSOR (for Bank 2)**
   a. Exhaust side:
      1. Install the VVT sensor with the bolt.

Torque: 10 N*m (102 kgf*cm, 7 ft.*lbf)

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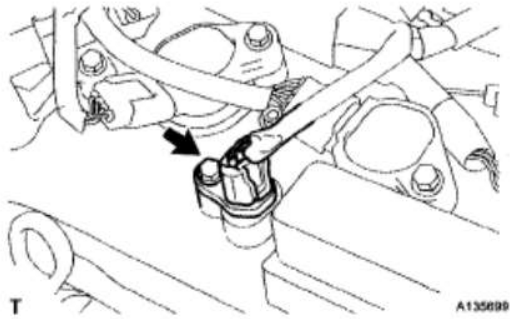


Fig. 417: Locating Bolt On VVT Sensor (For Bank 2 Exhaust Side)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. Intake side:
   1. Install the VVT sensor with the bolt.

Torque: 10 N*m (102 kgf*cm, 7 ft.*lbf)

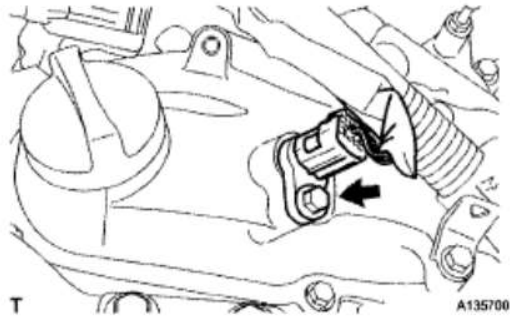
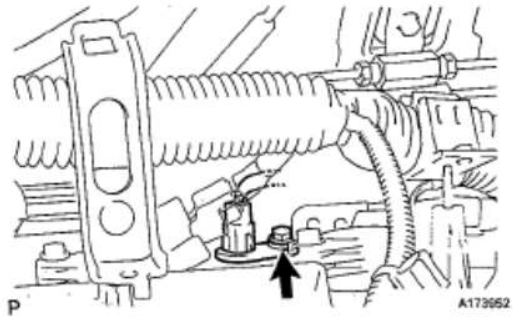


Fig. 418: Locating Bolt On VVT Sensor (For Bank 2 Intake Side)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

2. **INSTALL VVT SENSOR (for Bank 1)**
   a. Exhaust side:
      1. Install the VVT sensor with the bolt.

Torque: 10 N*m (102 kgf*cm, 7 ft.*lbf)



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Fig. 419: Locating VVT Sensor Bolt (Exhaust Side)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. Intake side:
   1. Install the VVT sensor with the bolt.

Torque: 10 N*m (102 kgf*cm, 7 ft.*lbf)

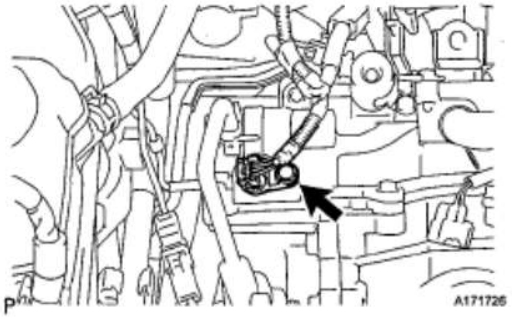


Fig. 420: Locating VVT Sensor Bolt (Intake Side)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

3. **INSTALL HARNESS PROTECTOR** (See **INSTALLATION**)
4. **TEMPORARILY INSTALL NO. 1 SURGE TANK STAY** (See **INSTALLATION**)
5. **TEMPORARILY INSTALL THROTTLE BODY BRACKET** (See **INSTALLATION**)
6. **INSTALL INTAKE AIR SURGE TANK ASSEMBLY** (See **INSTALLATION**)
7. **FULLY TIGHTEN NO. 1 SURGE TANK STAY** (See **INSTALLATION**)
8. **FULLY TIGHTEN THROTTLE BODY BRACKET** (See **INSTALLATION**)
9. **CONNECT ENGINE ROOM MAIN WIRE** (See **INSTALLATION**)
10. **INSTALL AIR CLEANER CAP SUB-ASSEMBLY** (See **INSTALLATION**)
11. **ADD ENGINE COOLANT** (See **REPLACEMENT**)
12. **INSPECT FOR COOLANT LEAK** (See **COOLING SYSTEM**)
13. **INSTALL OUTER COWL TOP PANEL SUB-ASSEMBLY** (See **INSTALLATION**)
14. **INSTALL WINDSHIELD WIPER MOTOR AND LINK ASSEMBLY** (See **INSTALLATION**)
15. **INSTALL COWL TOP VENTILATOR LOUVER SUB-ASSEMBLY** (See **INSTALLATION**)
16. **INSTALL FRONT WIPER ARM AND BLADE ASSEMBLY RH** (See **INSTALLATION**)
17. **INSTALL FRONT WIPER ARM AND BLADE ASSEMBLY LH** (See **INSTALLATION**)
18. **INSTALL V-BANK COVER SUB-ASSEMBLY** (See **INSTALLATION**)
19. **INSTALL NO. 1 ENGINE UNDER COVER** (See **INSTALLATION**)
20. **INSTALL ENGINE UNDER COVER ASSEMBLY** (See **INSTALLATION**)

CRANKSHAFT POSITION SENSOR

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COMPONENTS

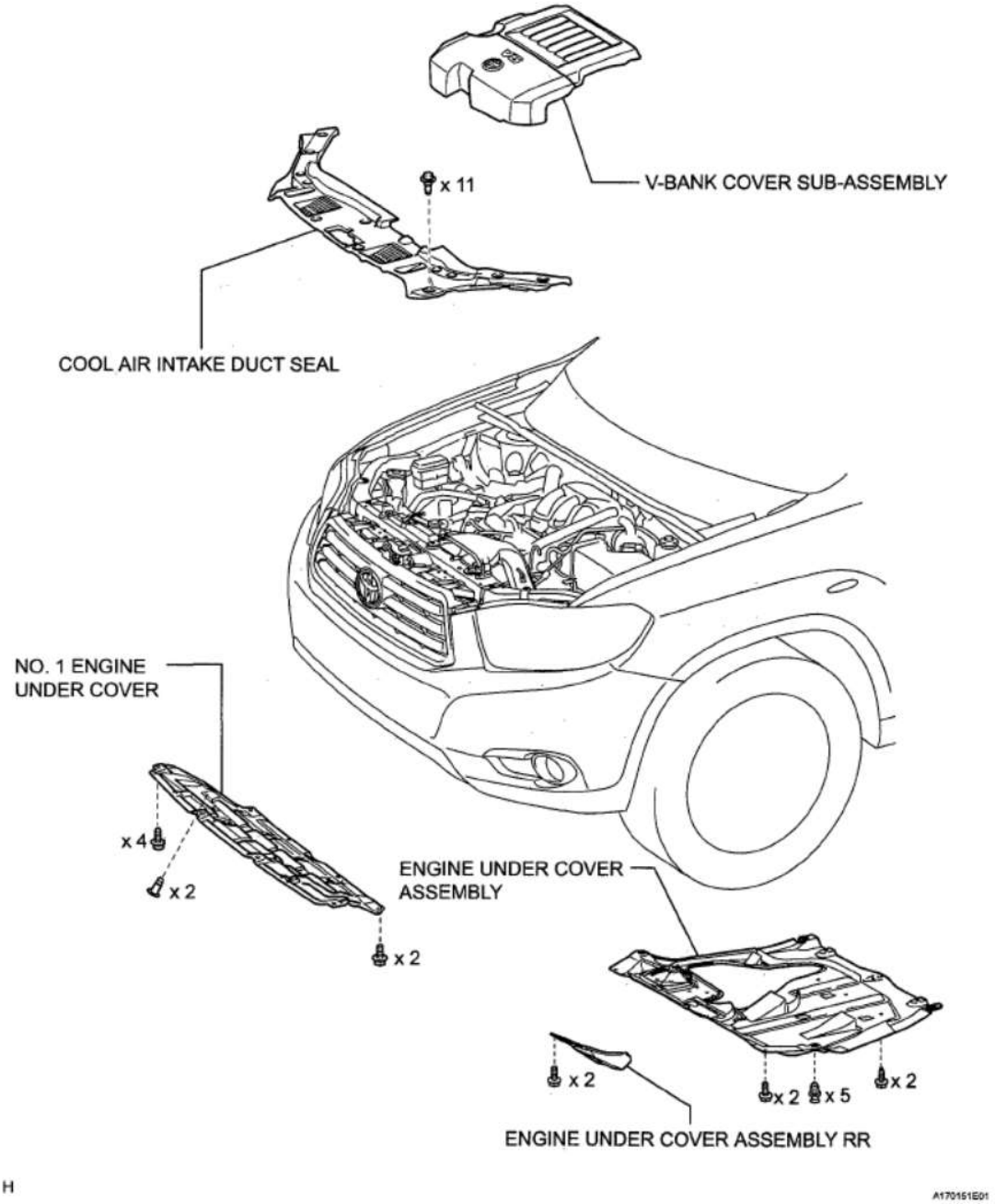


Fig. 421: Identifying Crankshaft Position Sensor Components (1 Of 5)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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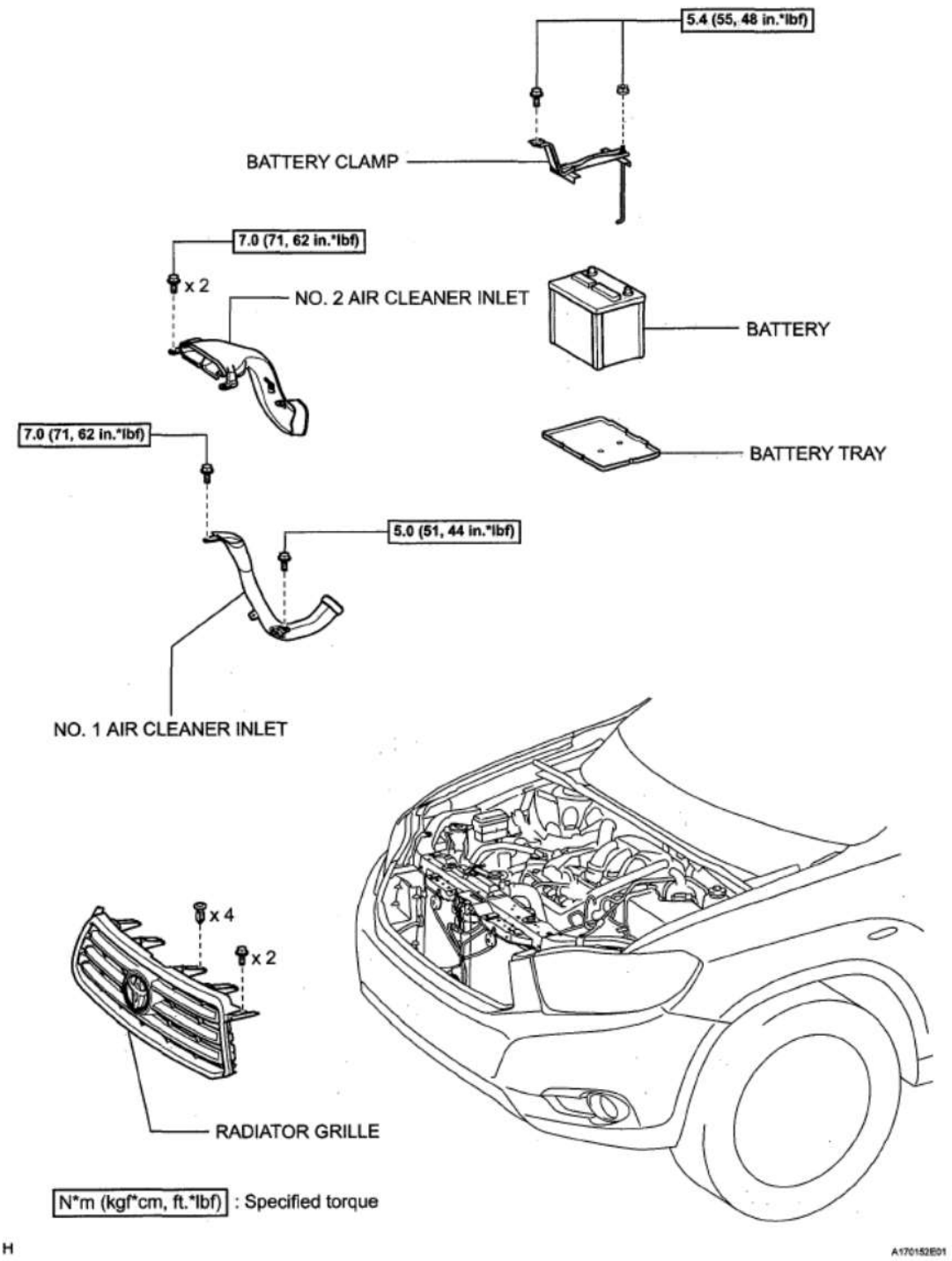


Fig. 422: Identifying Crankshaft Position Sensor Components (2 Of 5)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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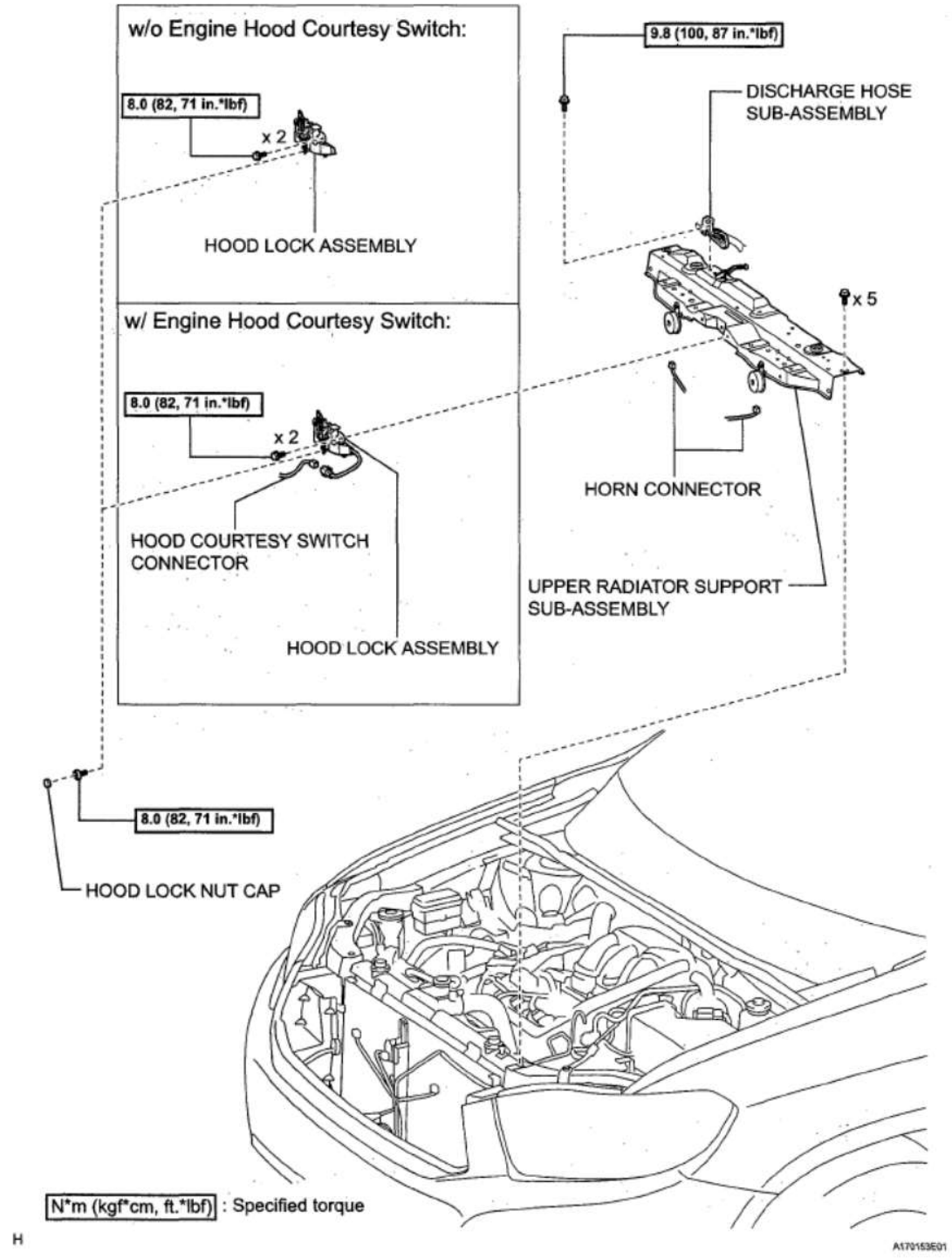


Fig. 423: Identifying Crankshaft Position Sensor Components (3 Of 5)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

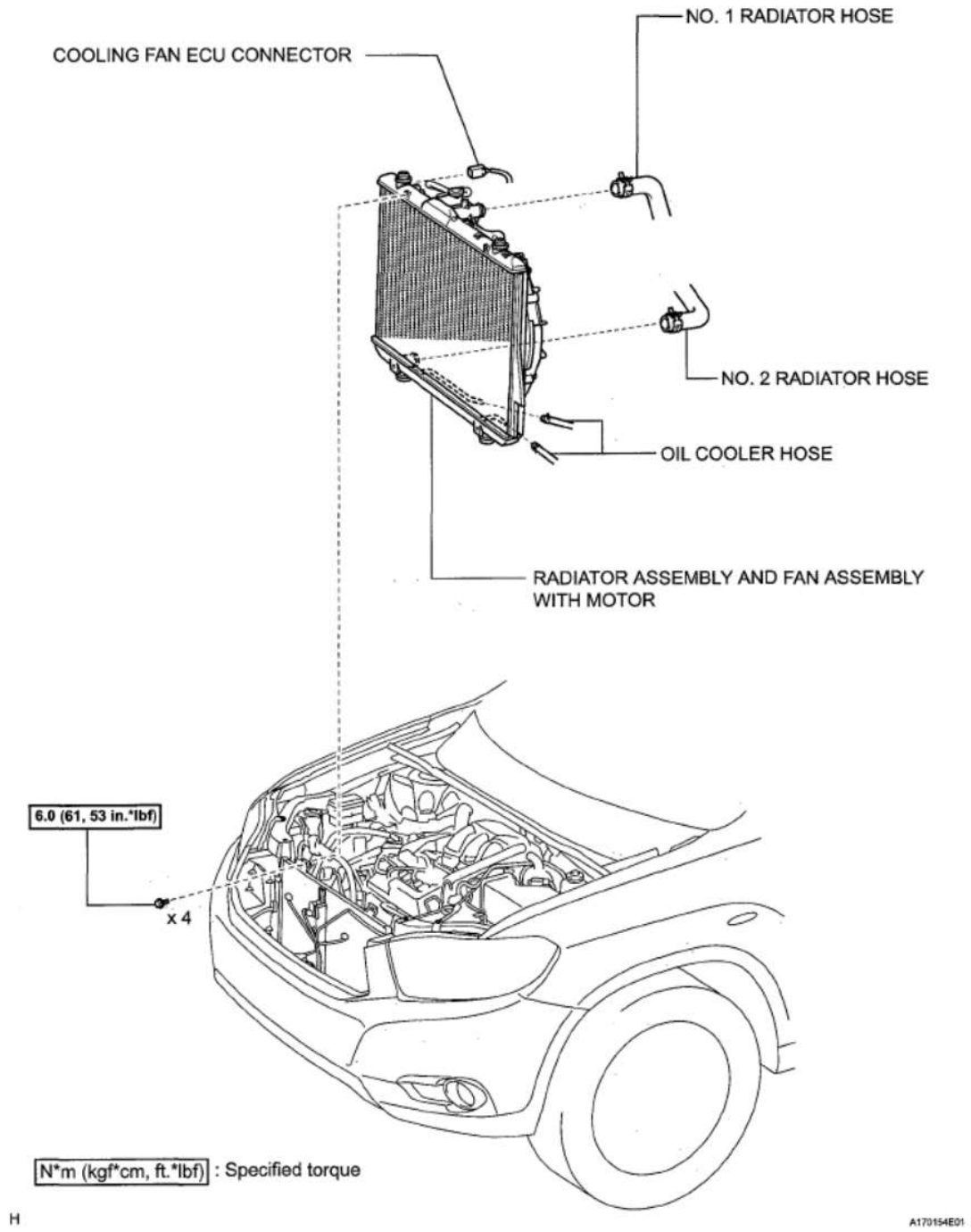


Fig. 424: Identifying Crankshaft Position Sensor Components (4 Of 5)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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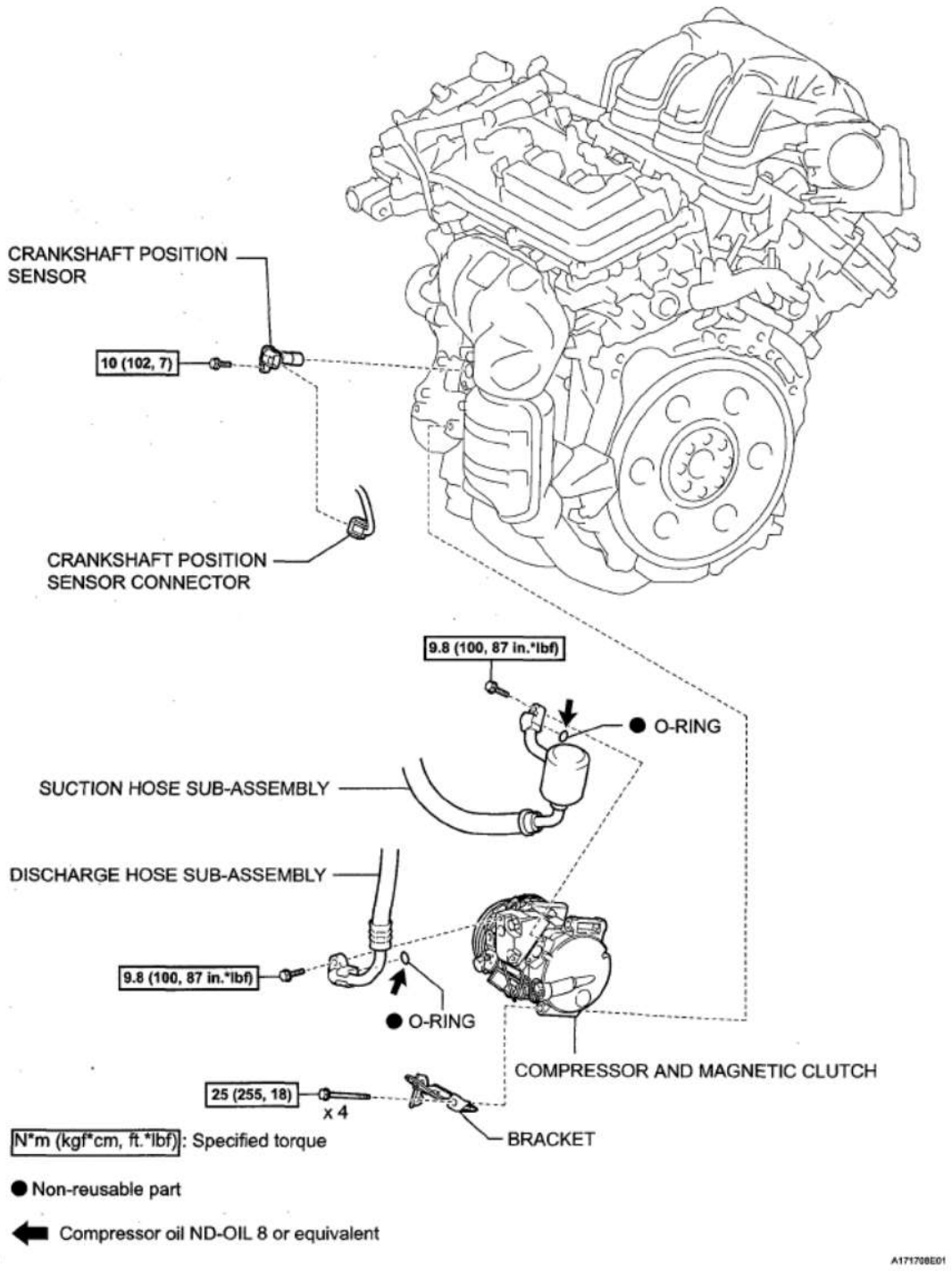


Fig. 425: Identifying Crankshaft Position Sensor Components (5 Of 5)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

REMOVAL

1. **RECOVER REFRIGERANT FROM REFRIGERATION SYSTEM** (See **REPLACEMENT**)

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2. **REMOVE V-BANK COVER SUB-ASSEMBLY** (See **REMOVAL**)
3. **REMOVE ENGINE UNDER COVER ASSEMBLY** (See **REMOVAL**)
4. **REMOVE NO. 1 ENGINE UNDER COVER** (See **REMOVAL**)
5. **DRAIN ENGINE COOLANT** (See **COOLANT**)
6. **REMOVE COOL AIR INTAKE DUCT SEAL** (See **REMOVAL**)
7. **REMOVE BATTERY** (See **REMOVAL**)
8. **REMOVE NO. 2 AIR CLEANER INLET** (See **REMOVAL**)
9. **REMOVE NO. 1 AIR CLEANER INLET** (See **REMOVAL**)
10. **DISCONNECT NO. 1 RADIATOR HOSE** (See **REMOVAL**)
11. **DISCONNECT NO. 2 RADIATOR HOSE** (See **REMOVAL**)
12. **DISCONNECT OIL COOLER HOSE** (See **REMOVAL**)
13. **DISCONNECT COOLING FAN ECU CONNECTOR** (See **REMOVAL**)
14. **REMOVE RADIATOR GRILLE** (See **REMOVAL**)
15. **REMOVE HOOD LOCK ASSEMBLY (w/o Engine Hood Courtesy Switch)** (See **REMOVAL**)
16. **REMOVE HOOD LOCK ASSEMBLY (w/ Engine Hood Courtesy Switch)** (See **REMOVAL**)
17. **REMOVE UPPER RADIATOR SUPPORT SUB-ASSEMBLY** (See **REMOVAL**)
18. **SEPARATE COOLER CONDENSER ASSEMBLY** (See **REMOVAL**)
19. **REMOVE RADIATOR ASSEMBLY AND FAN ASSEMBLY WITH MOTOR** (See **REMOVAL**)
20. **DISCONNECT DISCHARGE HOSE SUB-ASSEMBLY** (See **REMOVAL**)
21. **DISCONNECT SUCTION HOSE SUB-ASSEMBLY** (See **REMOVAL**)
22. **REMOVE COMPRESSOR AND MAGNETIC CLUTCH** (See **REMOVAL**)
23. **REMOVE CRANKSHAFT POSITION SENSOR**
    a. Disconnect the crankshaft position sensor connector.
    b. Remove the bolt and crankshaft position sensor.

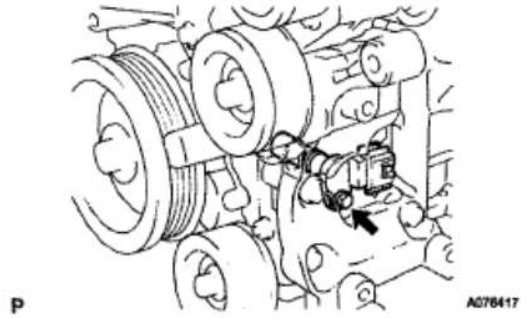


Fig. 426: Locating Crankshaft Position Sensor Bolt
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSPECTION

1. **INSPECT CRANKSHAFT POSITION SENSOR**

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

Standard resistance

TEMPERATURE SPECIFIED CONDITION CHART

Temperature	Specified Condition
Cold	1630 to 2740 ohms
Hot	2065 to 3225 ohms



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Fig. 427: Identifying Crankshaft Position Sensor Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

NOTE:
- **"Cold" and "Hot" mean the temperature of the coils themselves.**
- **"Cold" is from -10°C (14°F) to 50°C (122°F) and "Hot" is from 50° C (122°F) to 100°C (212°F).**

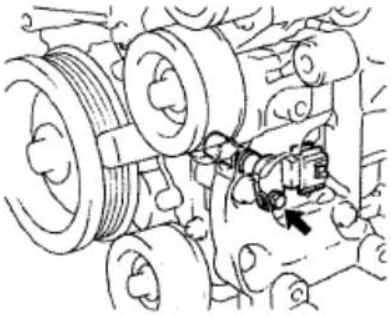
If the resistance is not as specified, replace the crankshaft position sensor.

INSTALLATION

1. **INSTALL CRANKSHAFT POSITION SENSOR**
   a. Apply a light coat of engine oil to the O-ring on the crankshaft position sensor.
   b. Install the crankshaft position sensor with the bolt.

   Torque: 10 N*m (102 kgf*cm, 7 ft.*lbf)

   c. Connect the crankshaft position sensor connector.



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Fig. 428: Locating Crankshaft Position Sensor Bolt
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

2. **TEMPORARILY TIGHTEN COMPRESSOR AND MAGNETIC CLUTCH** (See **INSTALLATION**)
3. **INSTALL COMPRESSOR AND MAGNETIC CLUTCH** (See **INSTALLATION**)
4. **CONNECT SUCTION HOSE SUB-ASSEMBLY** (See **INSTALLATION**)
5. **CONNECT DISCHARGE HOSE SUB-ASSEMBLY** (See **INSTALLATION**)
6. **INSTALL RADIATOR ASSEMBLY AND FAN ASSEMBLY WITH MOTOR** (See **INSTALLATION**)
7. **INSTALL COOLER CONDENSER ASSEMBLY** (See **INSTALLATION**)
8. **INSTALL UPPER RADIATOR SUPPORT SUB-ASSEMBLY** (See **INSTALLATION**)
9. **INSTALL HOOD LOCK ASSEMBLY (w/ Engine Hood Courtesy Switch)** (See **INSTALLATION**)
10. **INSTALL HOOD LOCK ASSEMBLY (w/o Engine Hood Courtesy Switch)** (See **INSTALLATION**)
11. **INSTALL RADIATOR GRILLE** (See **INSTALLATION**)
12. **CONNECT COOLING FAN ECU CONNECTOR** (See **INSTALLATION**)
13. **CONNECT OIL COOLER HOSE** (See **INSTALLATION**)
14. **CONNECT NO. 2 RADIATOR HOSE** (See **INSTALLATION**)
15. **CONNECT NO. 1 RADIATOR HOSE** (See **INSTALLATION**)
16. **INSTALL NO. 1 AIR CLEANER INLET** (See **INSTALLATION**)
17. **INSTALL NO. 2 AIR CLEANER INLET** (See **INSTALLATION**)
18. **INSTALL BATTERY** (See **INSTALLATION**)
19. **INSTALL COOL AIR INTAKE DUCT SEAL** (See **INSTALLATION**)
20. **CHARGE WITH REFRIGERANT** (See **REPLACEMENT**)
21. **ADD ENGINE COOLANT** (See **REPLACEMENT**)
22. **INSPECT FOR COOLANT LEAK** (See **COOLING SYSTEM**)
23. **INSPECT AUTOMATIC TRANSAXLE FLUID**

    HINT:

    See **AUTOMATIC TRANSAXLE FLUID**

24. **INSPECT FOR OIL LEAK**
25. **WARM UP ENGINE** (See **REPLACEMENT**)
26. **INSPECT FOR REFRIGERANT LEAK** (See **REPLACEMENT**)
27. **INSTALL NO. 1 ENGINE UNDER COVER** (See **INSTALLATION**)
28. **INSTALL ENGINE UNDER COVER ASSEMBLY** (See **INSTALLATION**)
29. **INSTALL V-BANK COVER SUB-ASSEMBLY** (See **INSTALLATION**)

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ENGINE COOLANT TEMPERATURE SENSOR

COMPONENTS

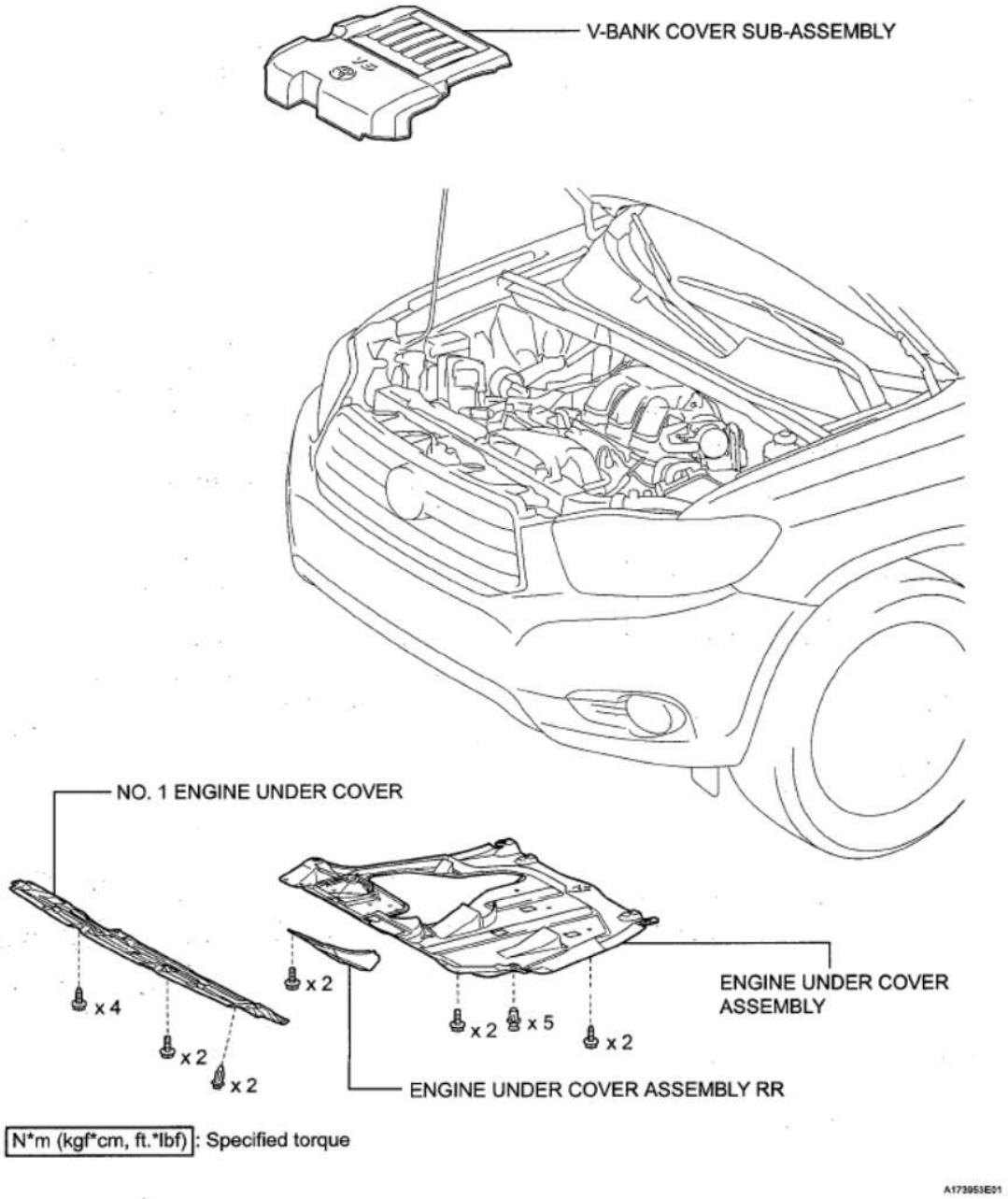


Fig. 429: Identifying Engine Coolant Temperature Sensor Components (1 Of 2)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

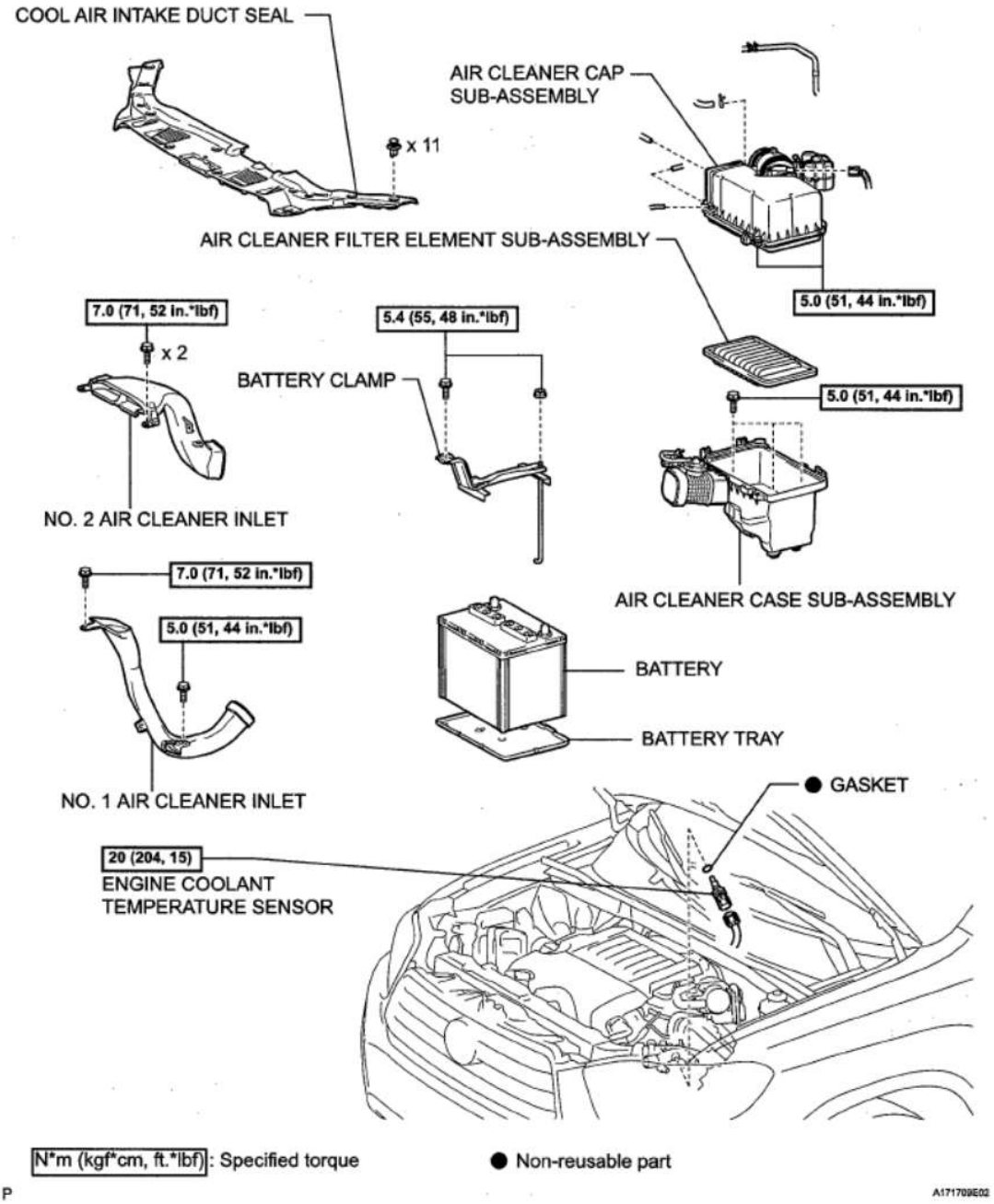


Fig. 430: Identifying Engine Coolant Temperature Sensor Components (2 Of 2)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

REMOVAL

1. **REMOVE V-BANK COVER SUB-ASSEMBLY** (See **REMOVAL**)
2. **REMOVE ENGINE UNDER COVER ASSEMBLY** (See **REMOVAL**)
3. **REMOVE NO. 1 ENGINE UNDER COVER** (See **REMOVAL**)
4. **DRAIN ENGINE COOLANT** (See **COOLANT**)

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5. **REMOVE COOL AIR INTAKE DUCT SEAL** (See **REMOVAL**)
6. **REMOVE BATTERY** (See **REMOVAL**)
7. **REMOVE NO. 2 AIR CLEANER INLET** (See **REMOVAL**)
8. **REMOVE NO. 1 AIR CLEANER INLET** (See **REMOVAL**)
9. **REMOVE AIR CLEANER CAP SUB-ASSEMBLY** (See **REMOVAL**)
10. **REMOVE AIR CLEANER CASE SUB-ASSEMBLY** (See **REMOVAL**)
11. **REMOVE ENGINE COOLANT TEMPERATURE SENSOR**
    a. Disconnect the engine coolant temperature sensor connector.
    b. Remove the engine coolant temperature sensor and gasket.

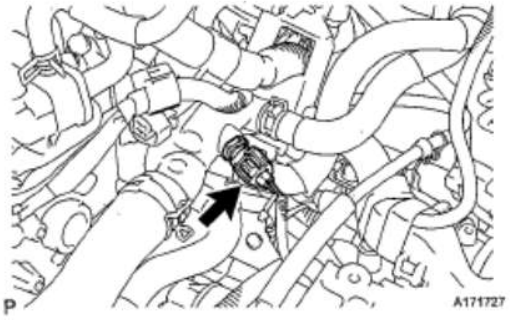


Fig. 431: Locating Engine Coolant Temperature Sensor Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSPECTION

1. **INSPECT ENGINE COOLANT TEMPERATURE 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)	2.32 to 2.59 kohms
	80°C (176°F)	0.310 to 0.326 kohms

If the result is not as specified, replace the engine coolant temperature sensor.

NOTE: When checking the engine coolant temperature sensor in water, do not allow water to go into the terminals. After checking, dry the engine coolant temperature sensor.

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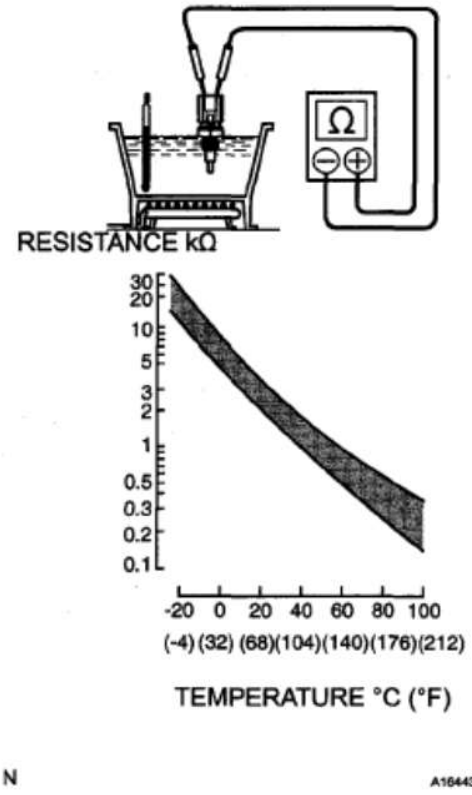


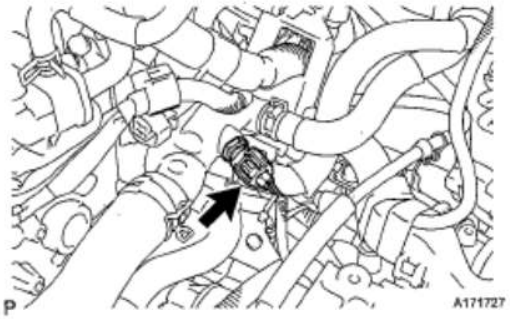
Fig. 432: Measuring Engine Coolant Temperature Sensor Resistance
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSTALLATION

1. **INSTALL ENGINE COOLANT TEMPERATURE SENSOR**
   a. Install a new gasket onto the engine coolant temperature sensor.
   b. Install the engine coolant temperature sensor.

      Torque: 20 N*m (204 kgf*cm, 15 ft.*lbf)

   c. Connect the engine coolant temperature sensor connector.



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Fig. 433: Locating Engine Coolant Temperature Sensor Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

2. **INSTALL AIR CLEANER CASE SUB-ASSEMBLY** (See **INSTALLATION**)
3. **INSTALL AIR CLEANER CAP SUB-ASSEMBLY** (See **INSTALLATION**)
4. **INSTALL NO. 1 AIR CLEANER INLET** (See **INSTALLATION**)
5. **INSTALL NO. 2 AIR CLEANER INLET** (See **INSTALLATION**)
6. **INSTALL BATTERY** (See **INSTALLATION**)
7. **INSTALL COOL AIR INTAKE DUCT SEAL** (See **INSTALLATION**)
8. **ADD ENGINE COOLANT** (See **REPLACEMENT**)
9. **INSPECT FOR COOLANT LEAK** (See **COOLING SYSTEM**)
10. **INSTALL NO. 1 ENGINE UNDER COVER** (See **INSTALLATION**)
11. **INSTALL ENGINE UNDER COVER ASSEMBLY** (See **INSTALLATION**)
12. **INSTALL V-BANK COVER SUB-ASSEMBLY** (See **INSTALLATION**)

KNOCK SENSOR

COMPONENTS

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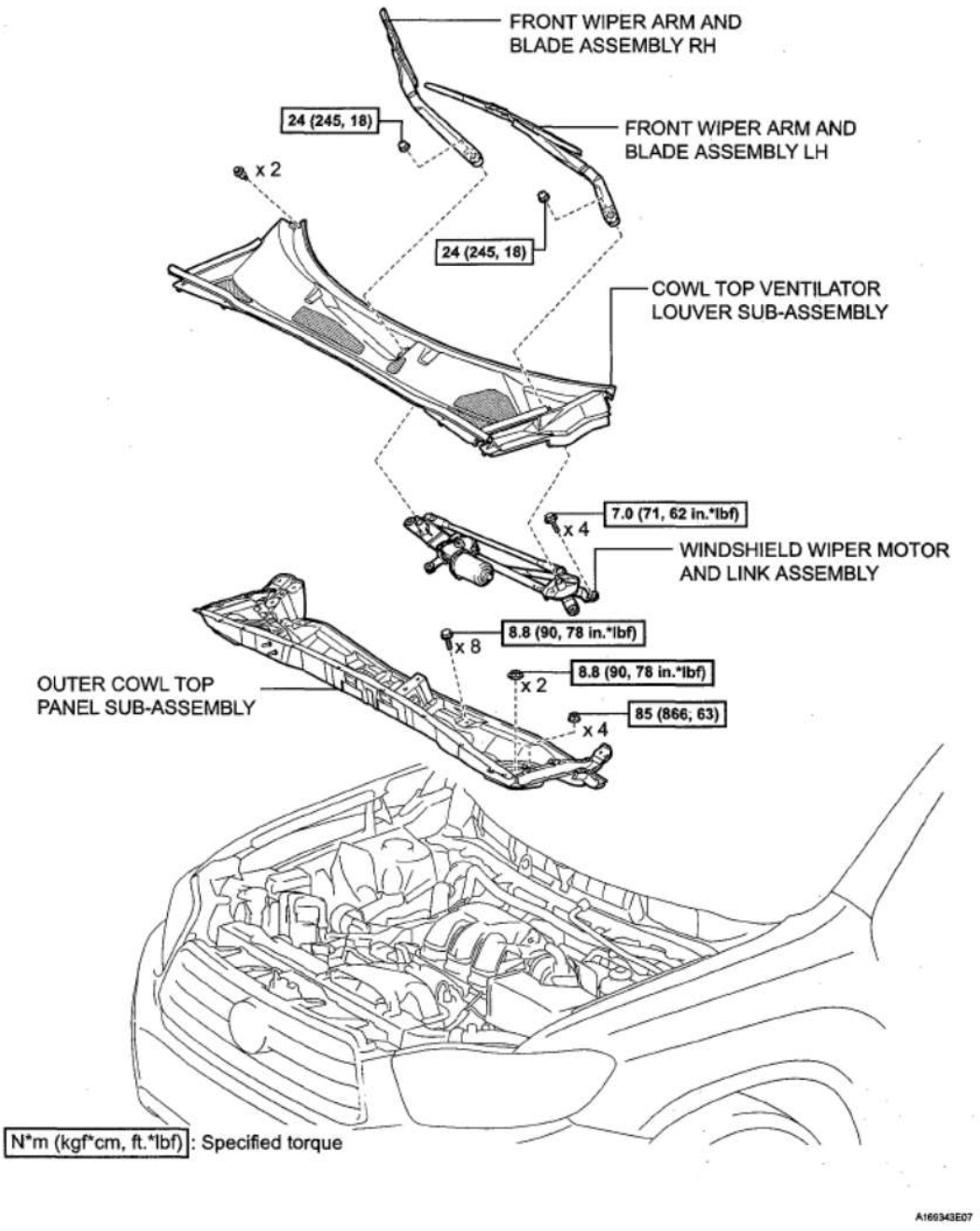


Fig. 434: Identifying Knock Sensor Components (1 Of 4)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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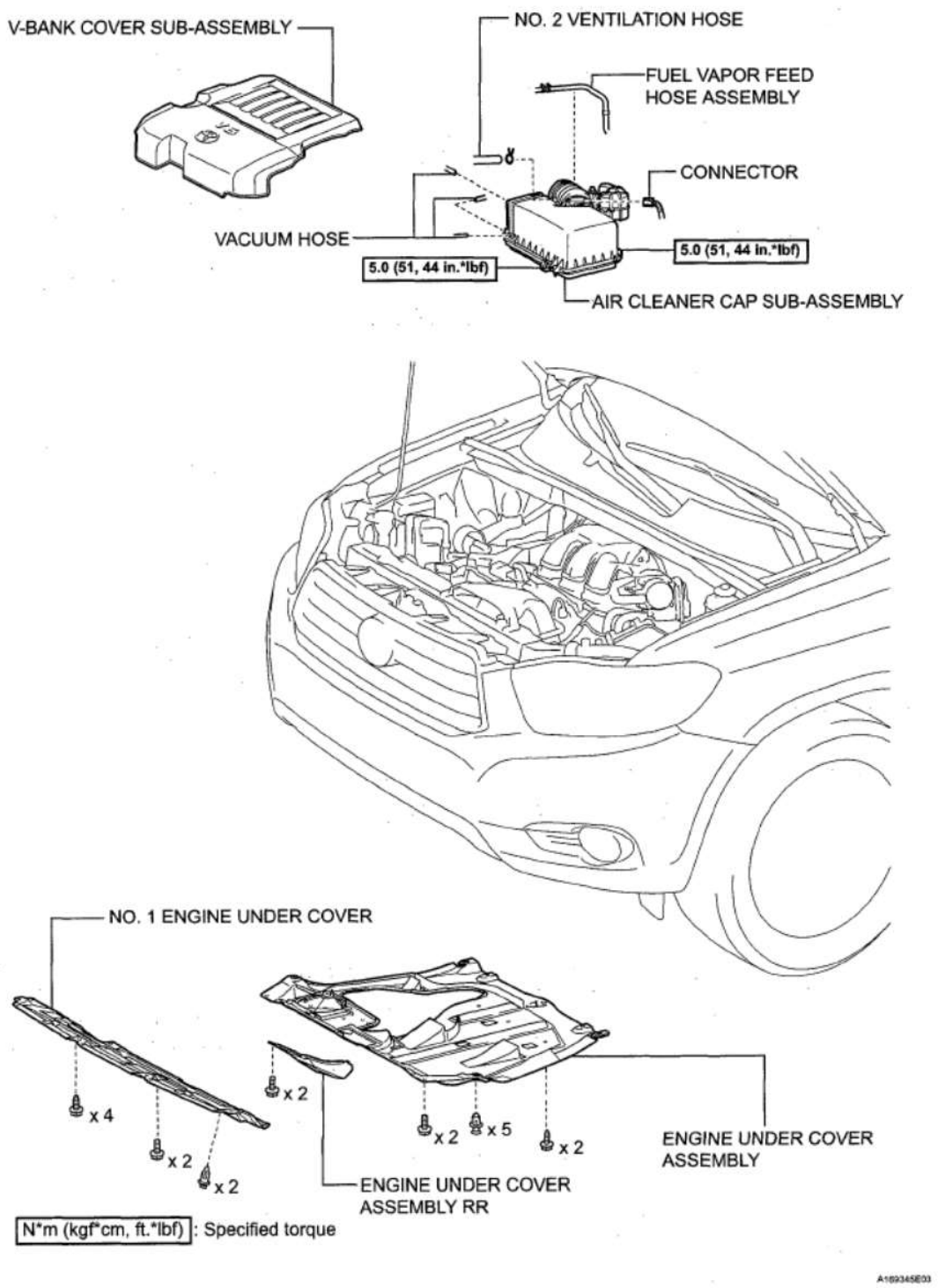


Fig. 435: Identifying Knock Sensor Components (2 Of 4)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

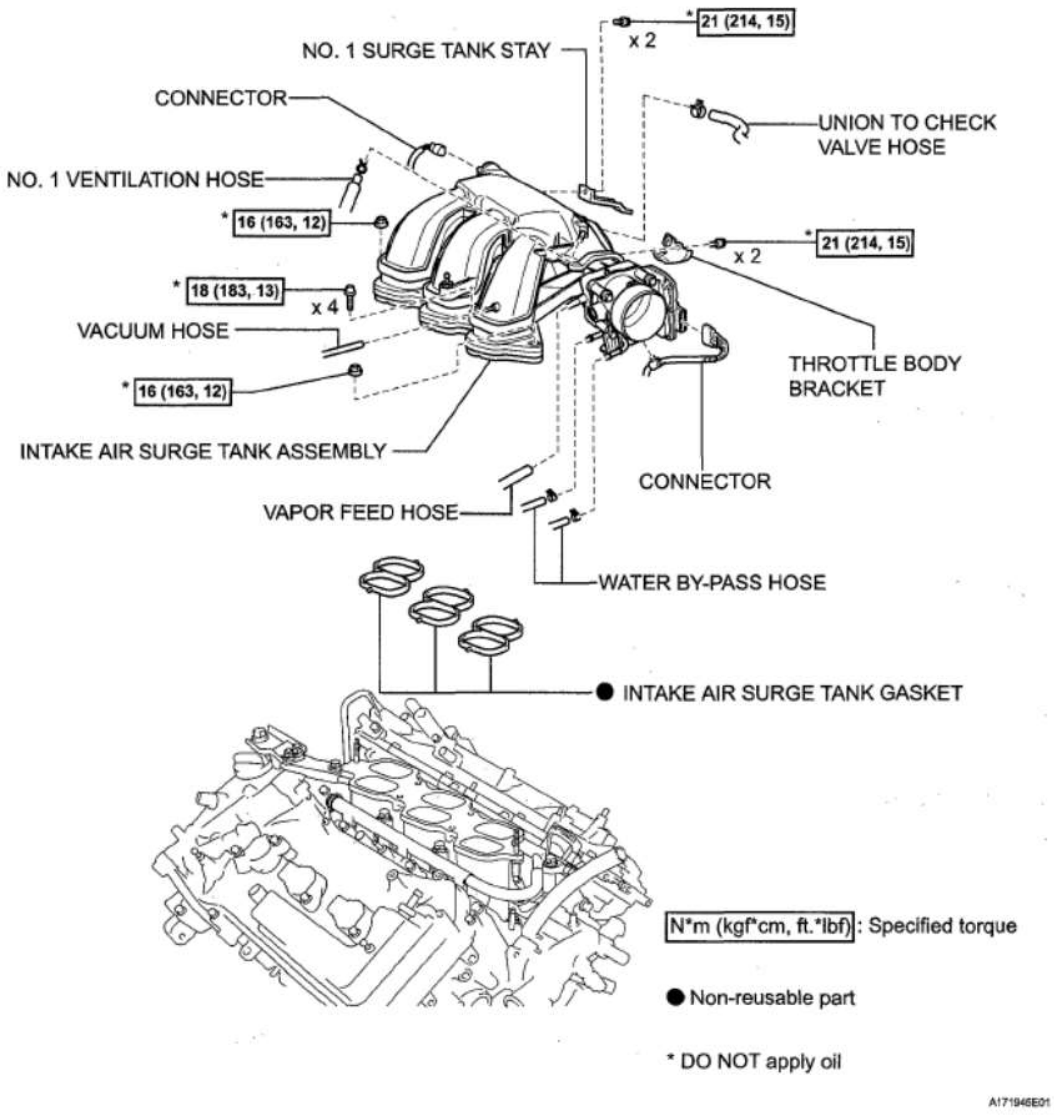


Fig. 436: Identifying Knock Sensor Components (3 Of 4)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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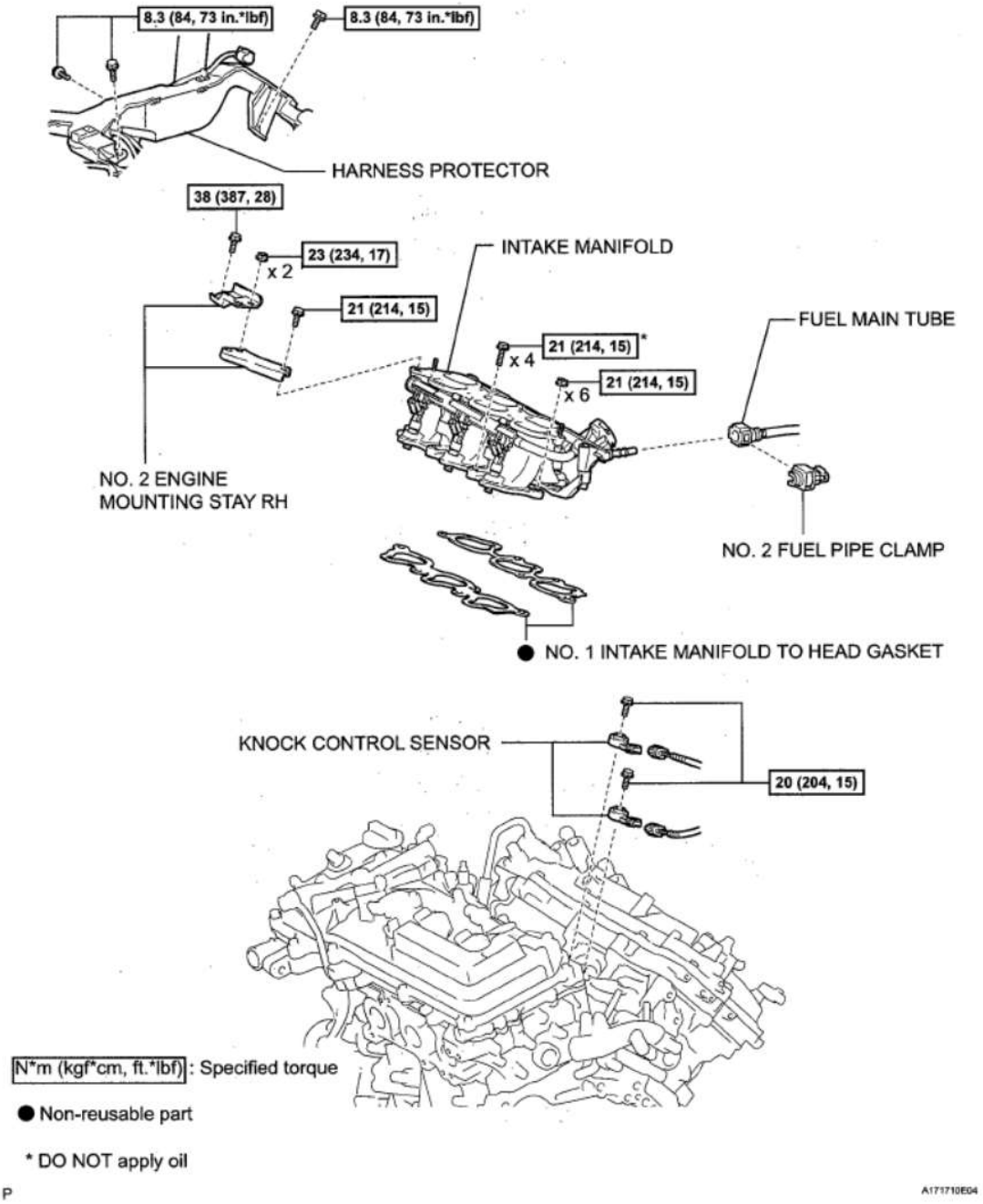


Fig. 437: Identifying Knock Sensor Components (4 Of 4)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

REMOVAL

1. **REMOVE ENGINE UNDER COVER ASSEMBLY** (See **REMOVAL**)
2. **REMOVE NO. 1 ENGINE UNDER COVER** (See **REMOVAL**)
3. **DRAIN ENGINE COOLANT** (See **COOLANT**)

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4. **DISCHARGE FUEL SYSTEM PRESSURE** (See **REMOVAL**)
5. **REMOVE FRONT WIPER ARM AND BLADE ASSEMBLY LH** (See **REMOVAL**)
6. **REMOVE FRONT WIPER ARM AND BLADE ASSEMBLY RH** (See **REMOVAL**)
7. **REMOVE COWL TOP VENTILATOR LOUVER SUB-ASSEMBLY** (See **REMOVAL**)
8. **REMOVE WINDSHIELD WIPER MOTOR AND LINK ASSEMBLY** (See **REMOVAL**)
9. **REMOVE OUTER COWL TOP PANEL SUB-ASSEMBLY** (See **REMOVAL**)
10. **REMOVE V-BANK COVER SUB-ASSEMBLY** (See **REMOVAL**)
11. **REMOVE AIR CLEANER CAP SUB-ASSEMBLY** (See **REMOVAL**)
12. **DISCONNECT ENGINE ROOM MAIN WIRE** (See **REMOVAL**)
13. **REMOVE THROTTLE BODY BRACKET** (See **REMOVAL**)
14. **REMOVE NO. 1 SURGE TANK STAY** (See **REMOVAL**)
15. **REMOVE INTAKE AIR SURGE TANK ASSEMBLY** (See **REMOVAL**)
16. **REMOVE NO. 2 ENGINE MOUNTING STAY RH** (See **REMOVAL**)
17. **DISCONNECT FUEL MAIN TUBE** (See **REMOVAL**)
18. **REMOVE INTAKE MANIFOLD** (See **INSPECTION**)
19. **REMOVE KNOCK CONTROL SENSOR**
    a. Disconnect the 2 knock control sensor connectors.
    b. Remove the 2 bolts and then remove the 2 knock control sensors.

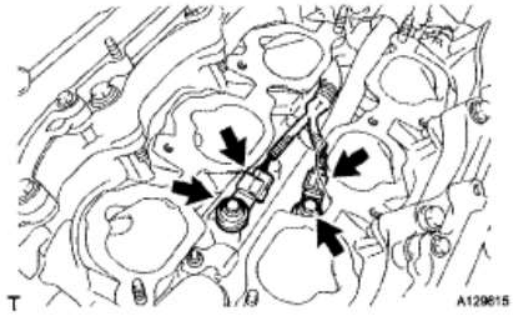


Fig. 438: Locating Knock Control Sensor Connectors And Bolts
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSPECTION

1. **INSPECT KNOCK CONTROL 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	25°C (77°F)	120 to 280 kohms

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If the result is not as specified, replace the knock control sensor.

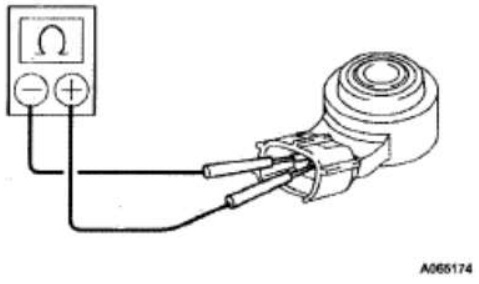


Fig. 439: Inspecting Knock Control Sensor
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSTALLATION

1. **INSTALL KNOCK CONTROL SENSOR**
   a. Install the 2 knock control sensors with the 2 bolts as shown in the illustration.

      Torque: 20 N*m (204 kgf*cm, 15 ft.*lbf)

   b. Connect the 2 knock control sensor connectors.
2. **INSTALL INTAKE MANIFOLD** (See **INSPECTION**)
3. **INSTALL NO. 2 ENGINE MOUNTING STAY RH** (See **INSTALLATION**)

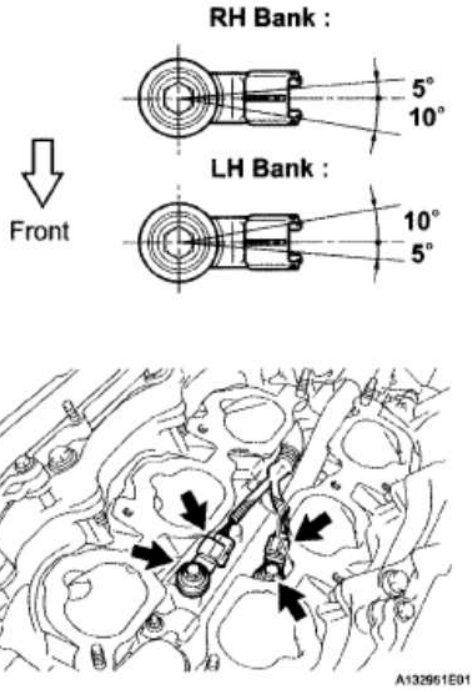


Fig. 440: Locating Knock Control Sensors With Bolts

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

4. **CONNECT FUEL MAIN TUBE** (See **INSTALLATION**)
5. **TEMPORARILY INSTALL NO. 1 SURGE TANK STAY** (See **INSTALLATION**)
6. **TEMPORARILY INSTALL THROTTLE BODY BRACKET** (See **INSTALLATION**)
7. **INSTALL INTAKE AIR SURGE TANK ASSEMBLY** (See **INSTALLATION**)
8. **FULLY TIGHTEN NO. 1 SURGE TANK STAY** (See **INSTALLATION**)
9. **FULLY TIGHTEN THROTTLE BODY BRACKET** (See **INSTALLATION**)
10. **CONNECT ENGINE ROOM WIRE** (See **INSTALLATION**)
11. **INSTALL AIR CLEANER CAP SUB-ASSEMBLY** (See **INSTALLATION**)
12. **ADD ENGINE COOLANT** (See **REPLACEMENT**)
13. **INSPECT FOR COOLANT LEAK** (See **COOLING SYSTEM**)
14. **INSPECT FOR FUEL LEAK** (See **ON-VEHICLE INSPECTION**)
15. **INSTALL OUTER COWL TOP PANEL SUB-ASSEMBLY** (See **INSTALLATION**)
16. **INSTALL WINDSHIELD WIPER MOTOR AND LINK ASSEMBLY** (See **INSTALLATION**)
17. **INSTALL COWL TOP VENTILATOR LOUVER SUB-ASSEMBLY** (See **INSTALLATION**)
18. **INSTALL FRONT WIPER ARM AND BLADE ASSEMBLY RH** (See **INSTALLATION**)
19. **INSTALL FRONT WIPER ARM AND BLADE ASSEMBLY LH** (See **INSTALLATION**)
20. **INSTALL NO. 1 ENGINE UNDER COVER** (See **INSTALLATION**)
21. **INSTALL ENGINE UNDER COVER ASSEMBLY** (See **INSTALLATION**)
22. **INSTALL V-BANK COVER SUB-ASSEMBLY** (See **INSTALLATION**)

AIR FUEL RATIO SENSOR

COMPONENTS

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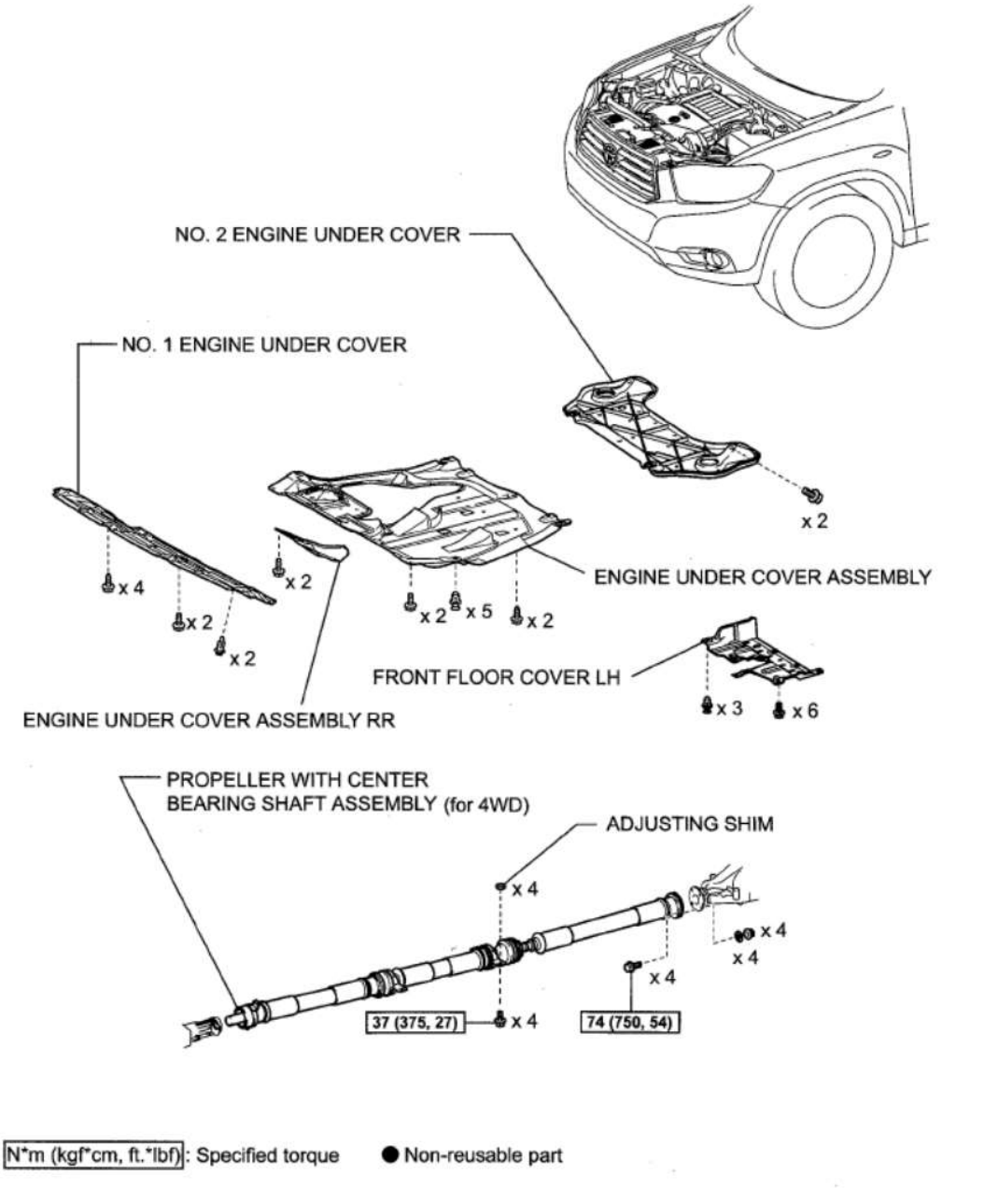


Fig. 441: Identifying Air Fuel Ratio Sensor Components (1 Of 3)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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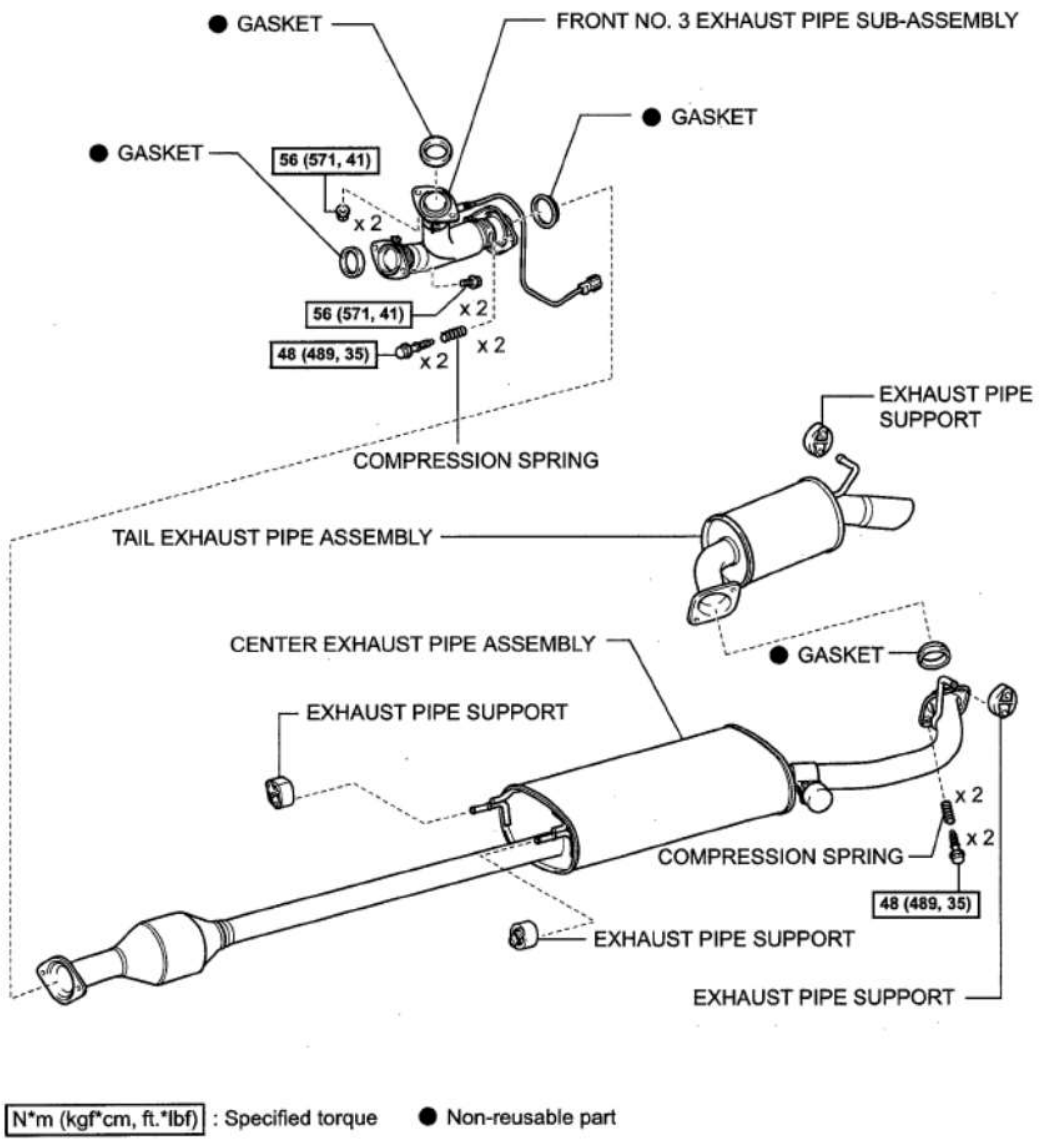


Fig. 442: Identifying Air Fuel Ratio Sensor Components (2 Of 3)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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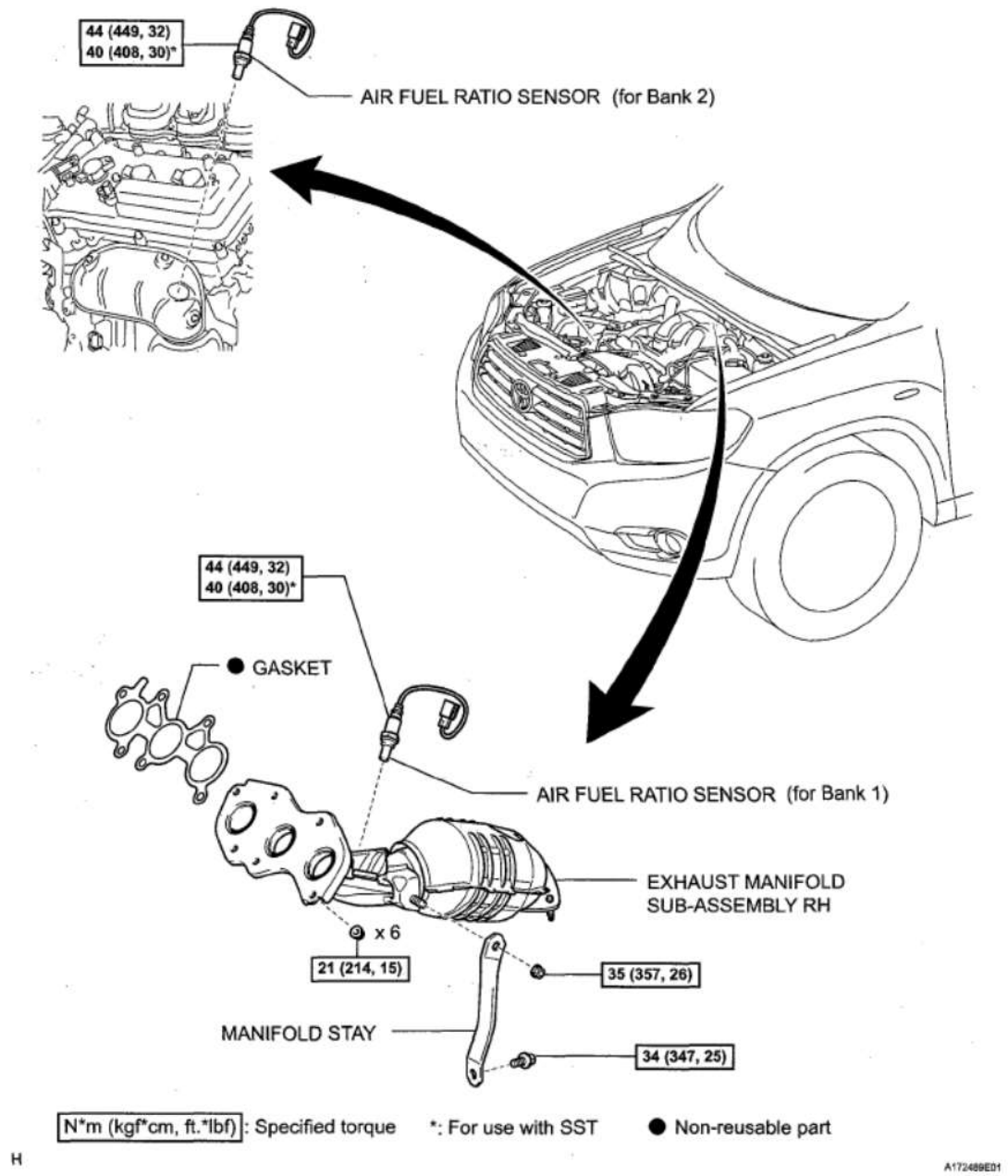


Fig. 443: Identifying Air Fuel Ratio Sensor Components (3 Of 3)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

REMOVAL

1. **REMOVE AIR FUEL RATIO SENSOR (for Bank 2 Sensor 1)**
   a. Disconnect the air fuel ratio sensor connector and remove the clamp.

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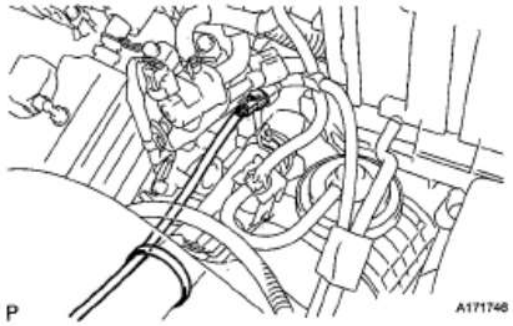


Fig. 444: Identifying Air Fuel Ratio Sensor Connector And Clamp
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. Using SST, remove the sensor from the exhaust manifold sub-assembly LH.

SST 09224-00010

2. **REMOVE ENGINE UNDER COVER ASSEMBLY** (See **REMOVAL**)
3. **REMOVE NO. 1 ENGINE UNDER COVER** (See **REMOVAL**)
4. **REMOVE NO. 2 ENGINE UNDER COVER** (See **REMOVAL**)

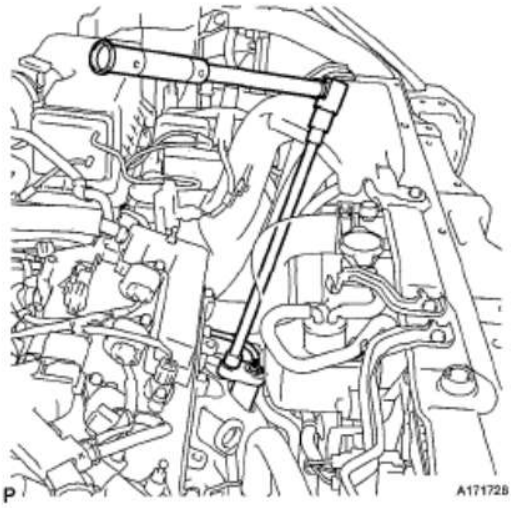


Fig. 445: Removing Sensor From Exhaust Manifold Sub-Assembly LH
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

5. **REMOVE FRONT FLOOR COVER LH** (See **REMOVAL**)
6. **REMOVE PROPELLER WITH CENTER BEARING SHAFT ASSEMBLY (for 4WD)** (See **REMOVAL**)
7. **REMOVE TAIL EXHAUST PIPE ASSEMBLY** (See **REMOVAL**)
8. **REMOVE CENTER EXHAUST PIPE ASSEMBLY** (See **REMOVAL**)
9. **REMOVE FRONT NO. 3 EXHAUST PIPE SUB-ASSEMBLY** (See **REMOVAL**)

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10. **REMOVE MANIFOLD STAY** (See **INSTALLATION**)
11. **REMOVE EXHAUST MANIFOLD SUB-ASSEMBLY RH** (See **INSTALLATION**)
12. **REMOVE AIR FUEL RATIO SENSOR (for Bank 1 Sensor 1)**
    a. Using SST, remove the air fuel ratio sensor from the exhaust manifold sub-assembly RH.

SST 09224-00010

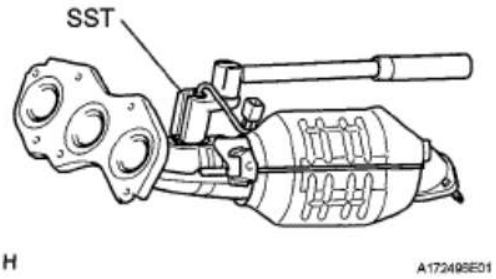


Fig. 446: Removing Air Fuel Ratio Sensor From Exhaust Manifold Sub-Assembly RH
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSPECTION

1. **INSPECT AIR FUEL RATIO SENSOR**
   a. Measure the resistance according to the value(s) in the table below.

Standard resistance

Bank 1

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

Bank 2

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
1 (HA2A) - 2 (+B)	20°C (68°F)	1.8 to 3.4 ohms
1 (HA2A) - 4 (A2A-)	Always	10 kohms or higher

If the result is not as specified, replace the air fuel ratio sensor.

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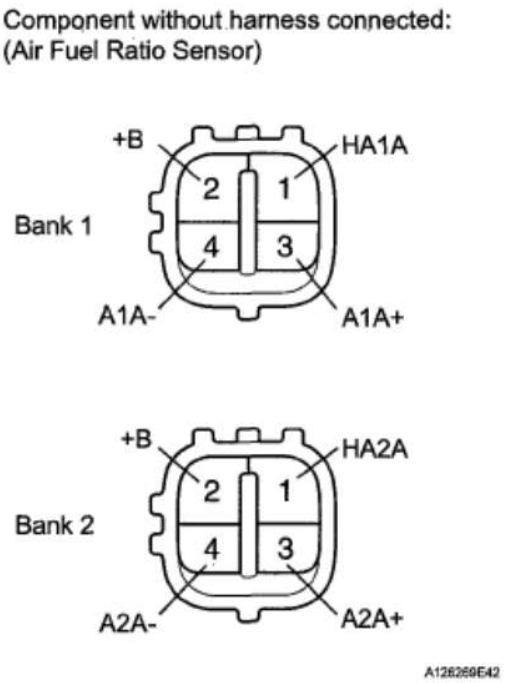


Fig. 447: Identifying Air Fuel Ratio Sensor Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSTALLATION

1. **INSTALL AIR FUEL RATIO SENSOR (for Bank 1 Sensor 1)**
   a. Using SST, install the air fuel ratio sensor to the exhaust manifold sub-assembly RH.

   SST 09224-00010

   Torque: 40 N*m (408 kgf*cm, 30 ft.*lbf) for use with SST

   44 N*m (449 kgf*cm, 32 ft.*lbf) for use without SST

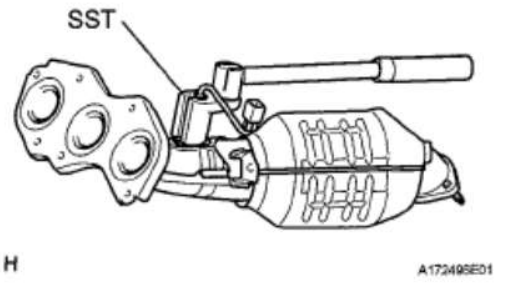


Fig. 448: Installing Air Fuel Ratio Sensor From Exhaust Manifold Sub-Assembly RH
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

HINT:

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- Use a torque wrench with a fulcrum length of 30 cm (11.81 in.).
- Make sure that SST and the wrench are connected in a straight line.

2. **INSTALL EXHAUST MANIFOLD SUB-ASSEMBLY RH** (See **INSTALLATION**)
3. **INSTALL MANIFOLD STAY** (See **INSTALLATION**)
4. **INSTALL FRONT NO. 3 EXHAUST PIPE SUB-ASSEMBLY** (See **INSTALLATION**)
5. **INSTALL CENTER EXHAUST PIPE ASSEMBLY** (See **INSTALLATION**)
6. **INSTALL TAIL EXHAUST PIPE ASSEMBLY** (See **INSTALLATION**)
7. **TEMPORARILY TIGHTEN PROPELLER WITH CENTER BEARING SHAFT ASSEMBLY (for 4WD)** (See **INSTALLATION**)
8. **FULLY TIGHTEN PROPELLER WITH CENTER BEARING SHAFT ASSEMBLY (for 4WD)** (See **INSTALLATION**)
9. **INSPECT FOR EXHAUST GAS LEAK** (See **INSTALLATION**)
10. **INSPECT AND ADJUST TRANSFER OIL (for 4WD)**

    HINT:

    See **TRANSFER OIL**

11. **INSTALL FRONT FLOOR COVER LH** (See **INSTALLATION**)
12. **INSTALL NO. 2 ENGINE UNDER COVER** (See **INSTALLATION**)
13. **INSTALL NO. 1 ENGINE UNDER COVER** (See **INSTALLATION**)
14. **INSTALL ENGINE UNDER COVER ASSEMBLY** (See **INSTALLATION**)
15. **INSTALL AIR FUEL RATIO SENSOR (for Bank 2 Sensor 1)**
    a. Using SST, install the air fuel ratio sensor to the exhaust manifold sub-assembly LH.

    SST 09224-00010

    Torque: 40 N*m (408 kgf*cm, 30 ft.*lbf) for use with SST

    44 N*m (449 kgf*cm, 32 ft.*lbf) for use without SST

    HINT:

    - Use a torque wrench with a fulcrum length of 30 cm (11.81 in.).
    - Make sure that SST and the wrench are connected in a straight line.

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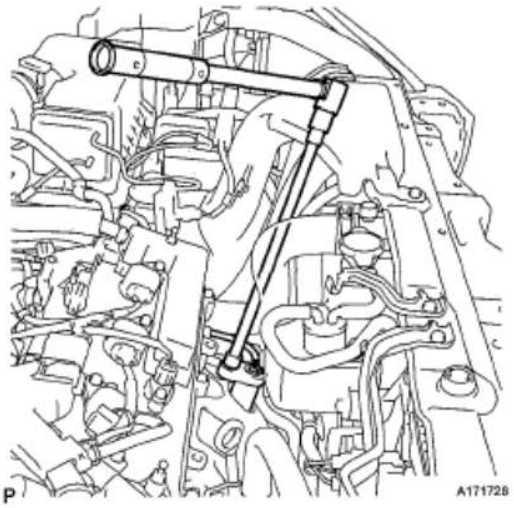


Fig. 449: Installing Sensor From Exhaust Manifold Sub-Assembly LH
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. Connect the air fuel ratio sensor connector and install the clamp.

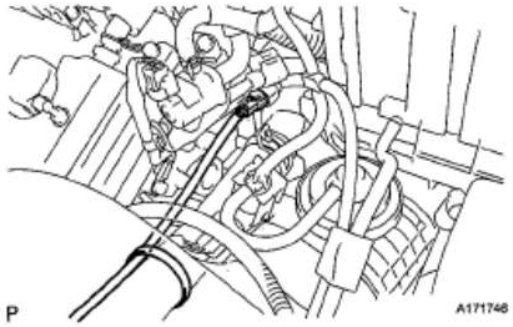


Fig. 450: Identifying Air Fuel Ratio Sensor Connector And Clamp
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

HEATED OXYGEN SENSOR

COMPONENTS

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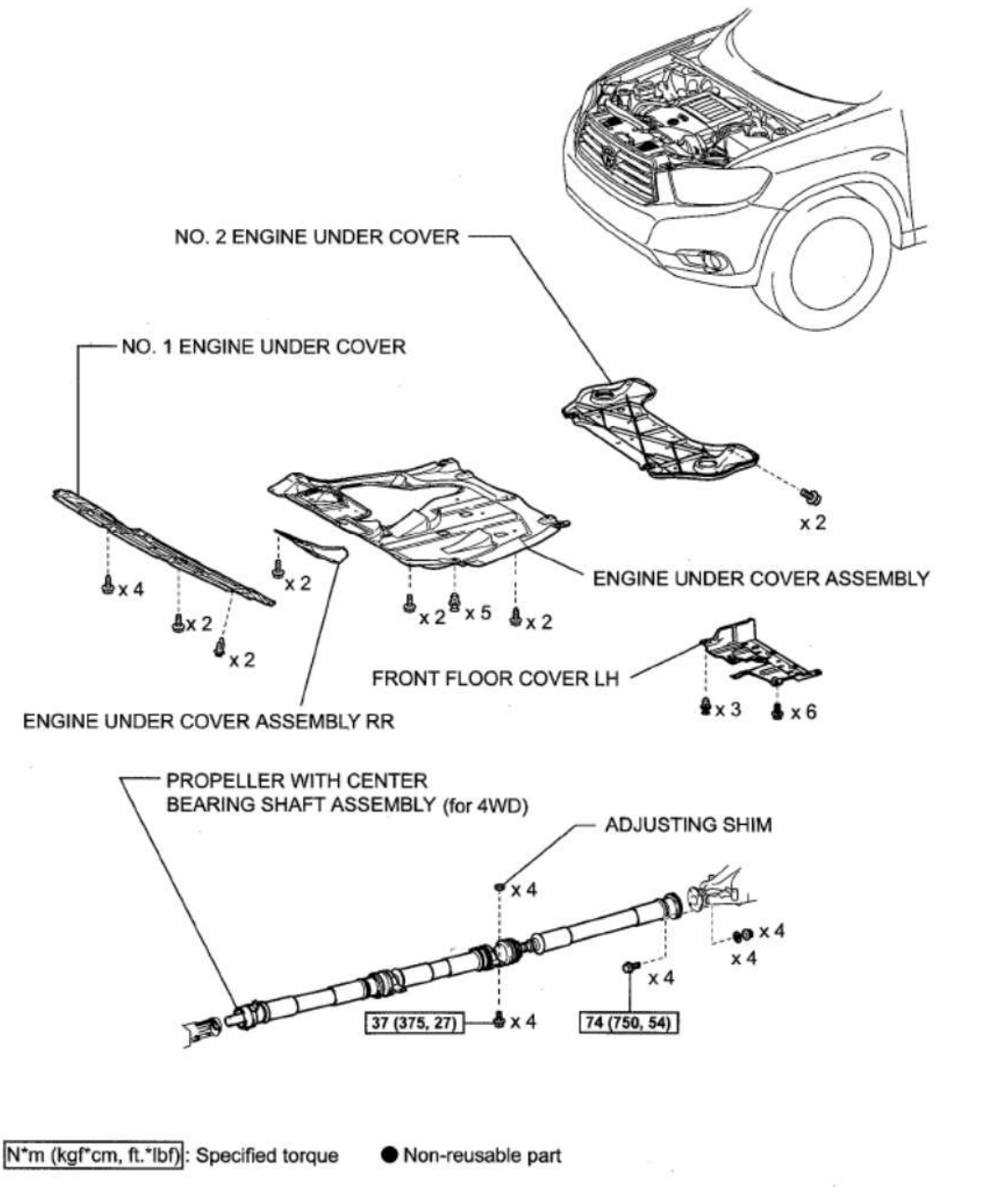


Fig. 451: Identifying Heated Oxygen Sensor Components (1 Of 2)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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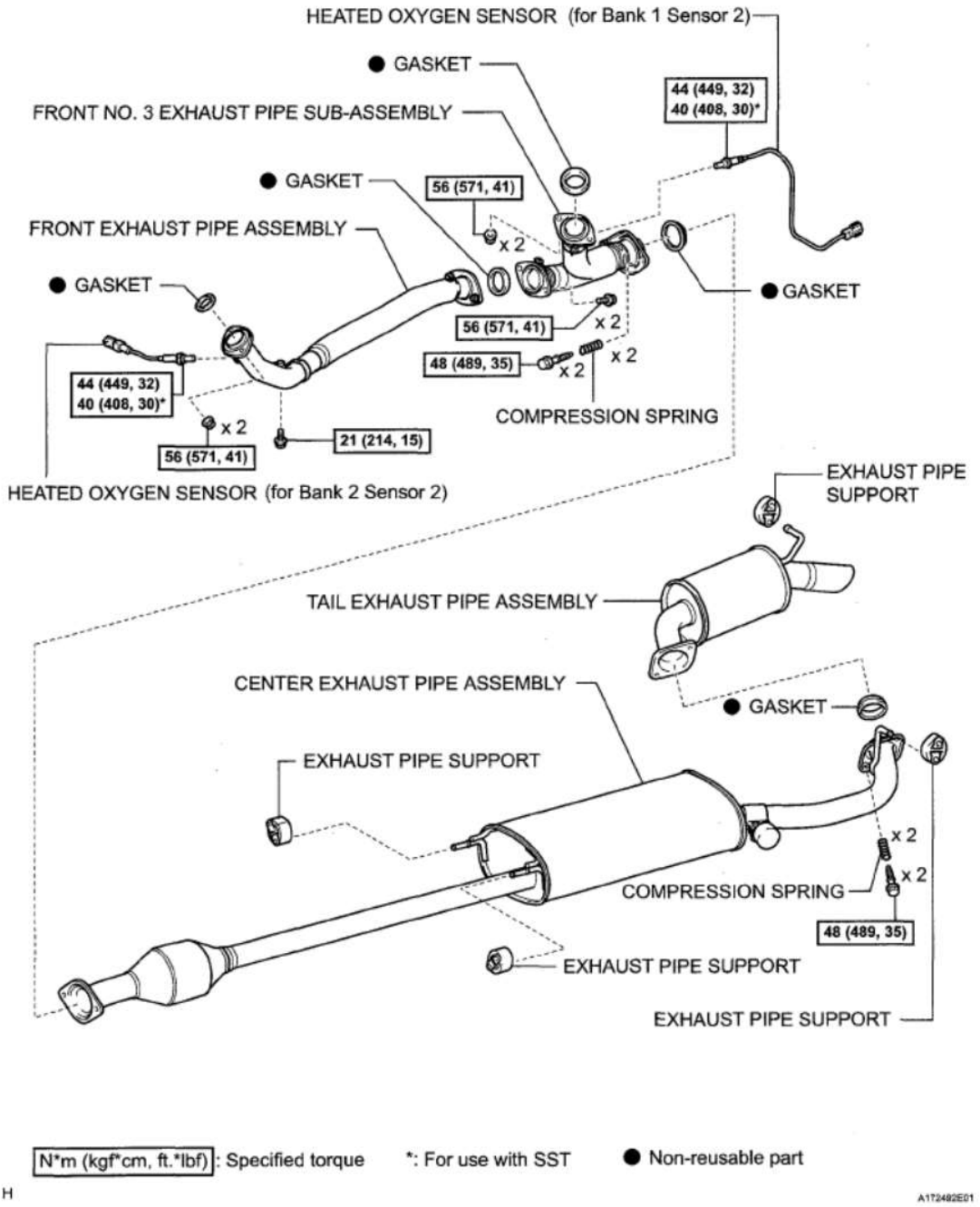


Fig. 452: Identifying Heated Oxygen Sensor Components (2 Of 2)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

REMOVAL

1. **REMOVE ENGINE UNDER COVER ASSEMBLY** (See **REMOVAL**)
2. **REMOVE NO. 1 ENGINE UNDER COVER** (See **REMOVAL**)
3. **REMOVE NO. 2 ENGINE UNDER COVER** (See **REMOVAL**)

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4. **REMOVE FRONT FLOOR COVER LH**
   a. Remove the 3 clamps, 6 bolts and front floor cover LH.
5. **REMOVE PROPELLER WITH CENTER BEARING SHAFT ASSEMBLY (for 4WD)** (See **REMOVAL**)
6. **REMOVE TAIL EXHAUST PIPE ASSEMBLY** (See **REMOVAL**)
7. **REMOVE CENTER EXHAUST PIPE ASSEMBLY** (See **REMOVAL**)
8. **REMOVE FRONT NO. 3 EXHAUST PIPE SUB-ASSEMBLY** (See **REMOVAL**)
9. **REMOVE FRONT EXHAUST PIPE ASSEMBLY** (See **INSTALLATION**)

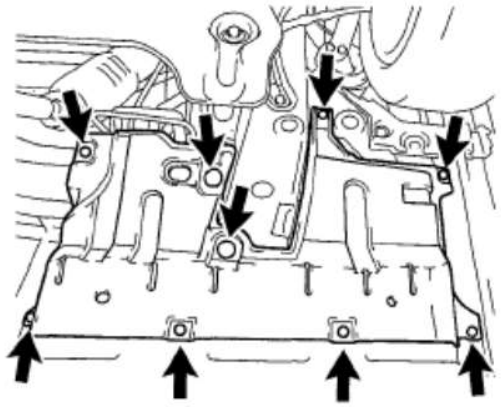


Fig. 453: Locating Front Floor Cover With Bolts And Clamps LH
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

10. **REMOVE HEATED OXYGEN SENSOR (for Bank 1 Sensor 2)**
    a. Using SST, remove the heated oxygen sensor from the front No. 3 exhaust pipe sub-assembly.

    SST 09224-00010

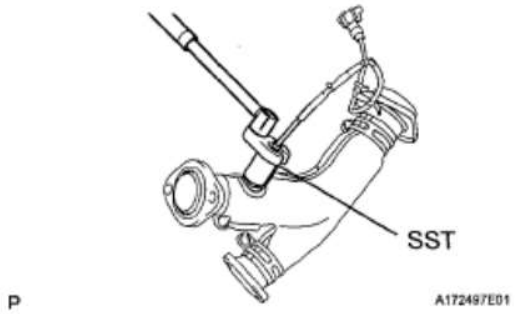


Fig. 454: Removing Heated Oxygen Sensor From Front No. 3 Exhaust Pipe Sub-Assembly
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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11. **REMOVE HEATED OXYGEN SENSOR (for Bank 2 Sensor 2)**
    a. Using SST, remove the heated oxygen sensor from the front exhaust pipe assembly.

SST 09224-00010

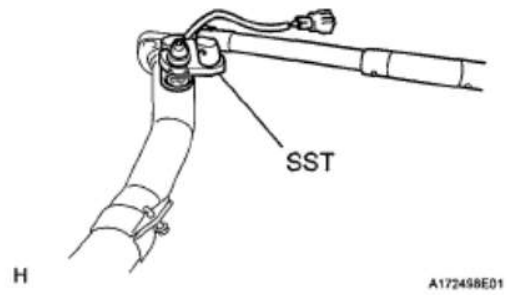


Fig. 455: Removing Heated Oxygen Sensor From Front Exhaust Pipe Assembly
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSPECTION

1. **INSPECT HEATED OXYGEN SENSOR**
    a. Measure the resistance according to the value(s) in the table below.

Standard resistance

Bank 1

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
2 (HT1B) - 1 (+B)	20°C (68°F)	11 to 16 ohms
2 (HT1B) - 3 (E2)	Always	10 kohms or higher

Bank 2

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
1 (HT2B) - 2 (+B)	20°C (68°F)	11 to 16 ohms
1 (HT2B) - 4 (E2)	Always	10 kohms or higher

If the resistance is not as specified, replace the heated oxygen sensor.

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Component without harness connected:
(Heated Oxygen Sensor)

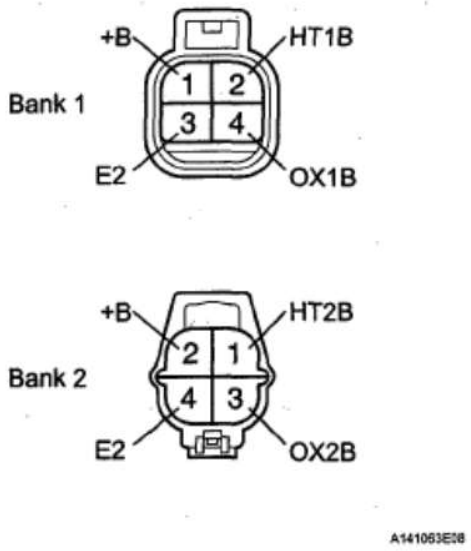


Fig. 456: Identifying Heated Oxygen Sensor Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSTALLATION

1. **INSTALL HEATED OXYGEN SENSOR (for Bank 1 Sensor 2)**

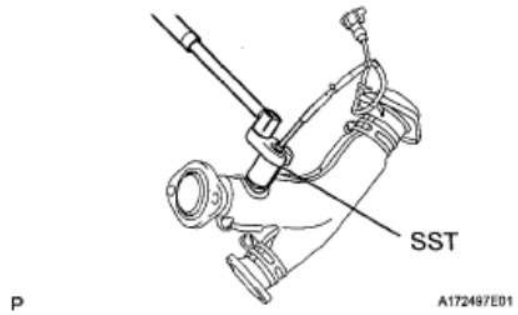


Fig. 457: Installing Heated Oxygen Sensor From Front No. 3 Exhaust Pipe Sub-Assembly
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

a. Using SST, install the heated oxygen sensor to the front No. 3 exhaust pipe sub-assembly.

SST 09224-00010

Torque: 40 N*m (408 kgf*cm, 30 ft.*lbf) for use with SST

44 N*m (449 kgf*cm, 32 ft.*lbf) for use without SST

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HINT:

- Use a torque wrench with a fulcrum length of 30 cm (11.81 in.).
- Make sure that SST and the wrench are connected in a straight line.

2. **INSTALL HEATED OXYGEN SENSOR (for Bank 2 Sensor 2)**
   a. Using SST, install the heated oxygen sensor to the front exhaust pipe assembly.

   SST 09224-00010

   Torque: 40 N*m (408 kgf*cm, 30 ft.*lbf) for use with SST

   44 N*m (449 kgf*cm, 32 ft.*lbf) for use without SST

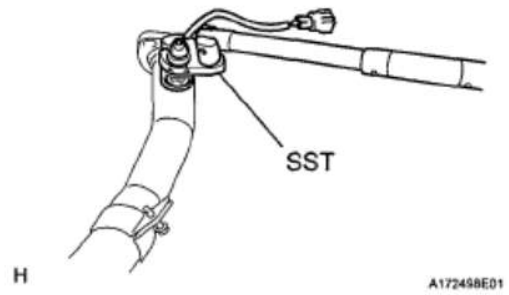


Fig. 458: Installing Heated Oxygen Sensor From Front Exhaust Pipe Assembly
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

HINT:

- Use a torque wrench with a fulcrum length of 30 cm (11.81 in.).
- Make sure that SST and the wrench are connected in a straight line.

3. **INSTALL FRONT EXHAUST PIPE ASSEMBLY** (See **INSTALLATION**)
4. **INSTALL FRONT NO. 3 EXHAUST PIPE SUB-ASSEMBLY** (See **INSTALLATION**)
5. **INSTALL CENTER EXHAUST PIPE ASSEMBLY** (See **INSTALLATION**)
6. **INSTALL TAIL EXHAUST PIPE ASSEMBLY** (See **INSTALLATION**)
7. **TEMPORARILY TIGHTEN PROPELLER WITH CENTER BEARING SHAFT ASSEMBLY (for 4WD)** (See **INSTALLATION**)
8. **FULLY TIGHTEN PROPELLER WITH CENTER BEARING SHAFT ASSEMBLY (for 4WD)** (See **INSTALLATION**)
9. **INSPECT FOR EXHAUST GAS LEAK** (See **INSTALLATION**)
10. **INSPECT AND ADJUST TRANSFER OIL (for 4WD)**

HINT:

See **TRANSFER OIL**

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11. **INSTALL FRONT FLOOR COVER LH**
    a. Install the 3 clamps, 6 bolts and the front floor cover LH.
12. **INSTALL NO. 2 ENGINE UNDER COVER** (See **INSTALLATION**)
13. **INSTALL NO. 1 ENGINE UNDER COVER** (See **INSTALLATION**)
14. **INSTALL ENGINE UNDER COVER ASSEMBLY** (See **INSTALLATION**)

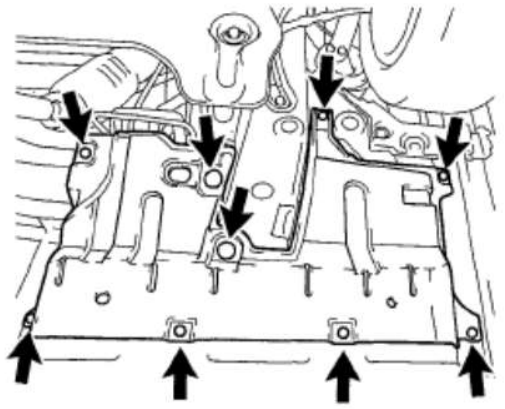


Fig. 459: Locating Front Floor Cover With Bolts And Clamps LH
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INTEGRATION RELAY

COMPONENTS

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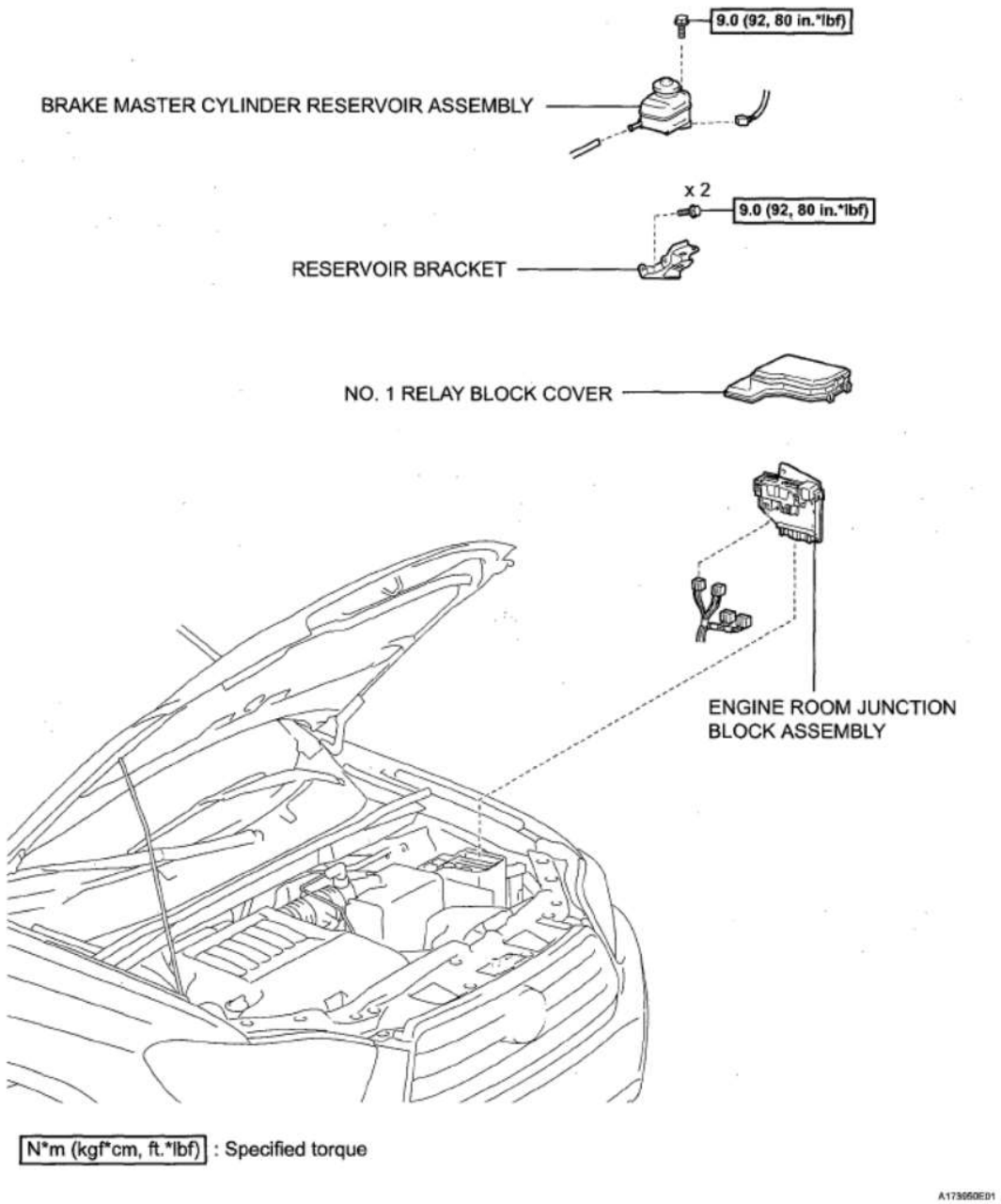


Fig. 460: Identifying Integration Relay Components
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

REMOVAL

1. **SEPARATE BRAKE MASTER CYLINDER RESERVOIR ASSEMBLY** (See **REMOVAL**)
2. **REMOVE RESERVOIR BRACKET** (See **REMOVAL**)
3. **REMOVE NO. 1 RELAY BLOCK COVER**
   a. Remove the No. 1 relay block cover.

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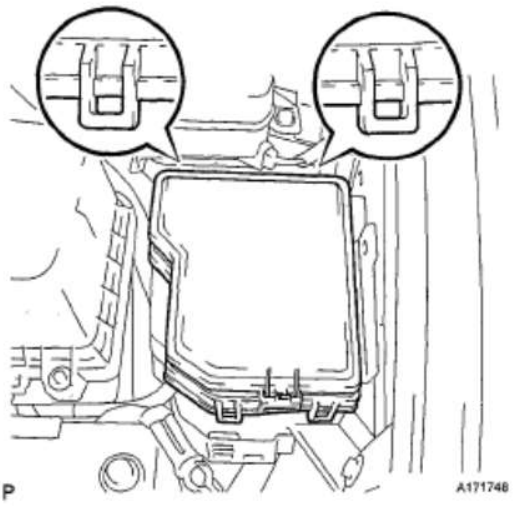


Fig. 461: Identifying No. 1 Relay Block Cover
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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.

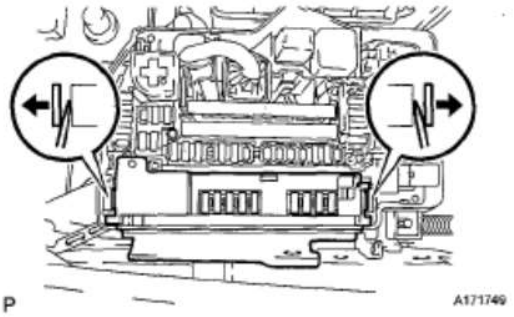
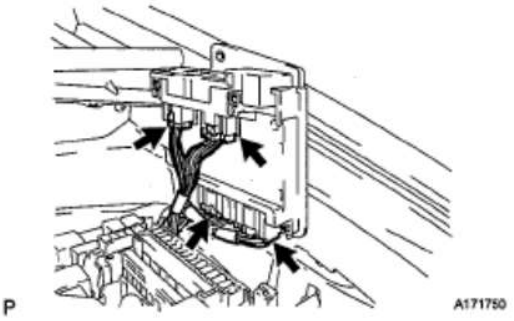


Fig. 462: Removing Engine Room Junction Block Assembly
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

   b. Disconnect the 4 connectors.



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Fig. 463: Locating Engine Room Junction Block Assembly Connectors
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSPECTION

1. **INSPECT ENGINE ROOM JUNCTION BLOCK ASSEMBLY**

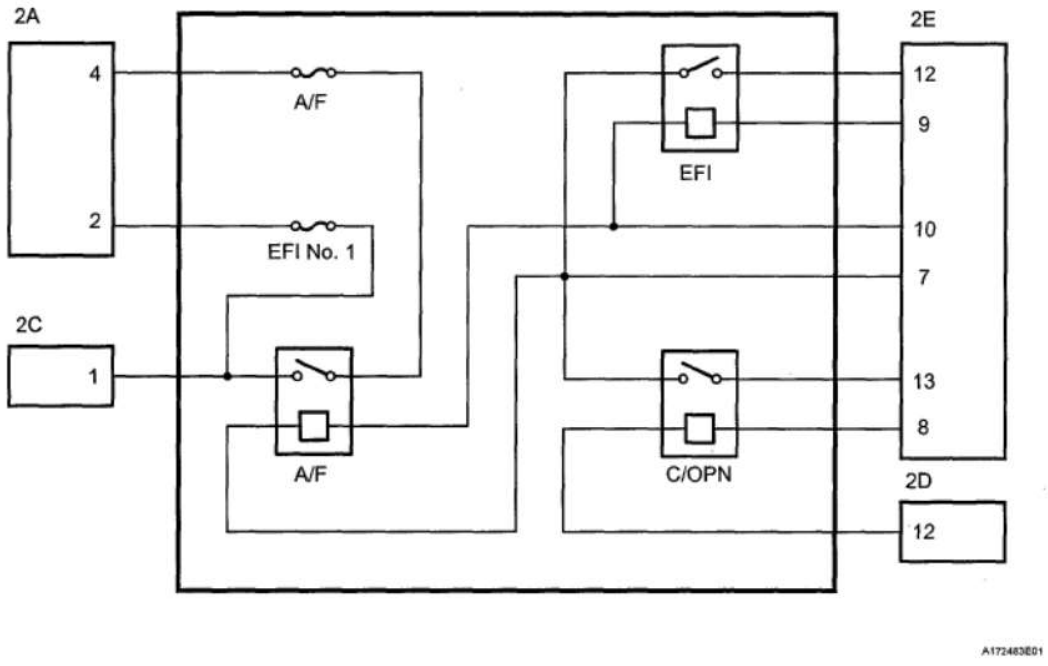


Fig. 464: Engine Room Junction Block Assembly Circuit Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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

b. Inspect the A/F fuse.
   1. Remove the A/F fuse.
   2. Using an ohmmeter, measure the resistance of the fuse.

   Standard resistance

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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 to 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)

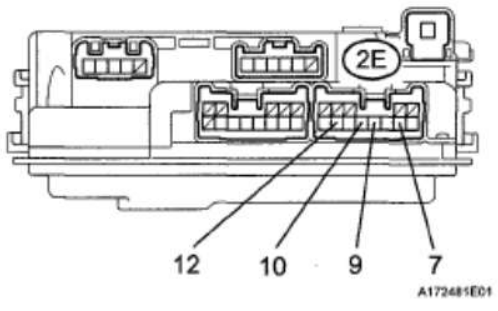


Fig. 465: Identifying Engine Room Junction Block Assembly Connector Terminals (EFI Relay)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

d. Inspect the C/OPN relay.

1. 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
2E-13 - 2E-7	No battery voltage applied	10 kohms or higher
2E-13 - 2E-7	Battery voltage applied to terminals 2E-8 and 2D-12	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)

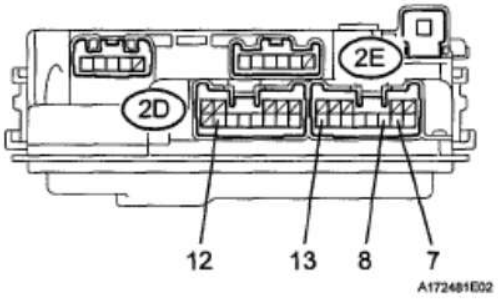


Fig. 466: Identifying Engine Room Junction Block Assembly Connector Terminals (C/OPN Relay)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

e. Inspect the A/F 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
2A-4 - 2C-1	No battery voltage applied	10 kohms or higher
2A-4 - 2C-1	Battery voltage applied to 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.

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Component without wire harness connected:
(Engine Room Junction Block Assembly)

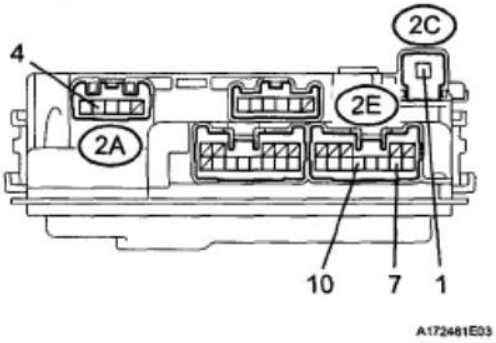


Fig. 467: Identifying Engine Room Junction Block Assembly Connector Terminals (A/F Relay)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSTALLATION

1. **INSTALL ENGINE ROOM JUNCTION BLOCK ASSEMBLY**
   a. Connect the 4 connectors.
   b. Attach the engine room junction block assembly.

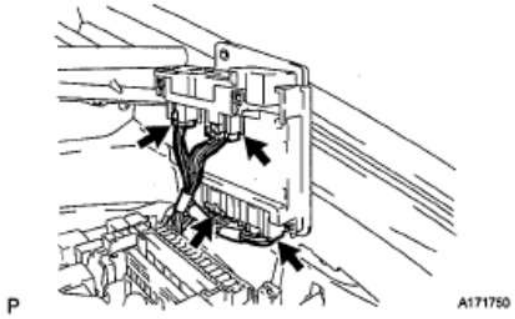


Fig. 468: Locating Engine Room Junction Block Assembly Connectors
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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**)

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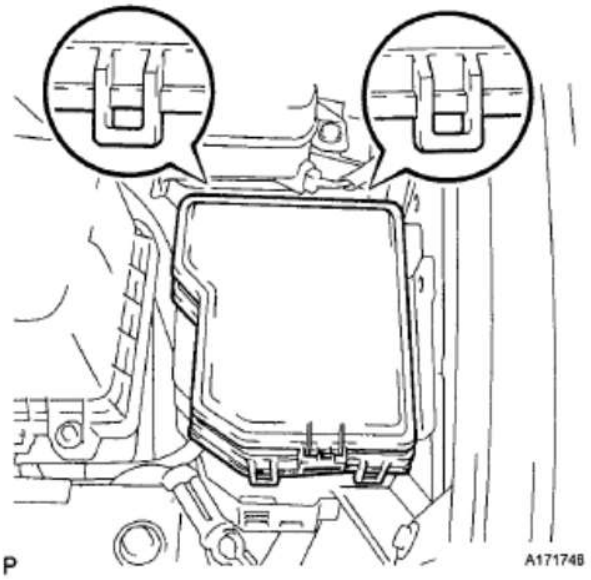


Fig. 469: Identifying No. 1 Relay Block Cover
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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.

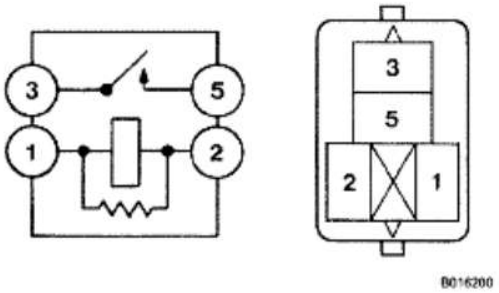


Fig. 470: No. 1 Ignition Relay Circuit
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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 to terminals 1 and 2	Below 1 ohms

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If the result is not as specified, replace the relay.

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.

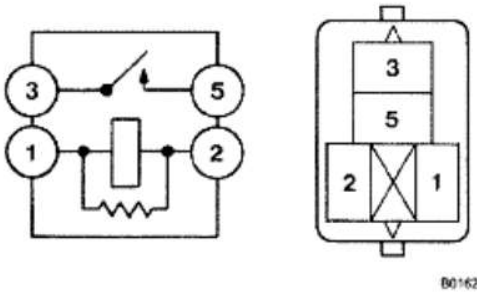


Fig. 471: No. 2 Ignition Relay Circuit
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Standard resistance

TESTER CONNECTION SPECIFIED CONDITION CHART

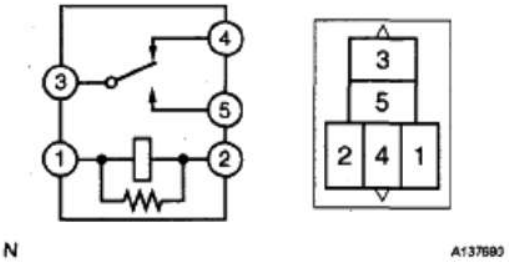
Tester Connection	Condition	Specified Condition
3 - 5	No battery voltage applied	10 kohms or higher
	Battery voltage applied to terminals 1 and 2	Below 1 ohms

If the result is not as specified, replace the relay.

FUEL PUMP RELAY

ON-VEHICLE INSPECTION

1. **INSPECT FUEL PUMP RELAY**
   a. Measure the resistance according to the value(s) in the table below.



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Fig. 472: Fuel PMP Relay Circuit
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Standard resistance

TESTER CONNECTION SPECIFIED CONDITION CHART

Tester Connection	Condition	Specified Condition
3 - 4	No battery voltage applied	Below 1 ohms
3 - 5	No battery voltage applied	10 kohms or higher
3 - 4	Battery voltage applied to terminals 1 and 2	10 kohms or higher
3 - 5	Battery voltage applied to terminals 1 and 2	Below 1 ohms

If the result is not as specified, replace the relay.

CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY

COMPONENTS

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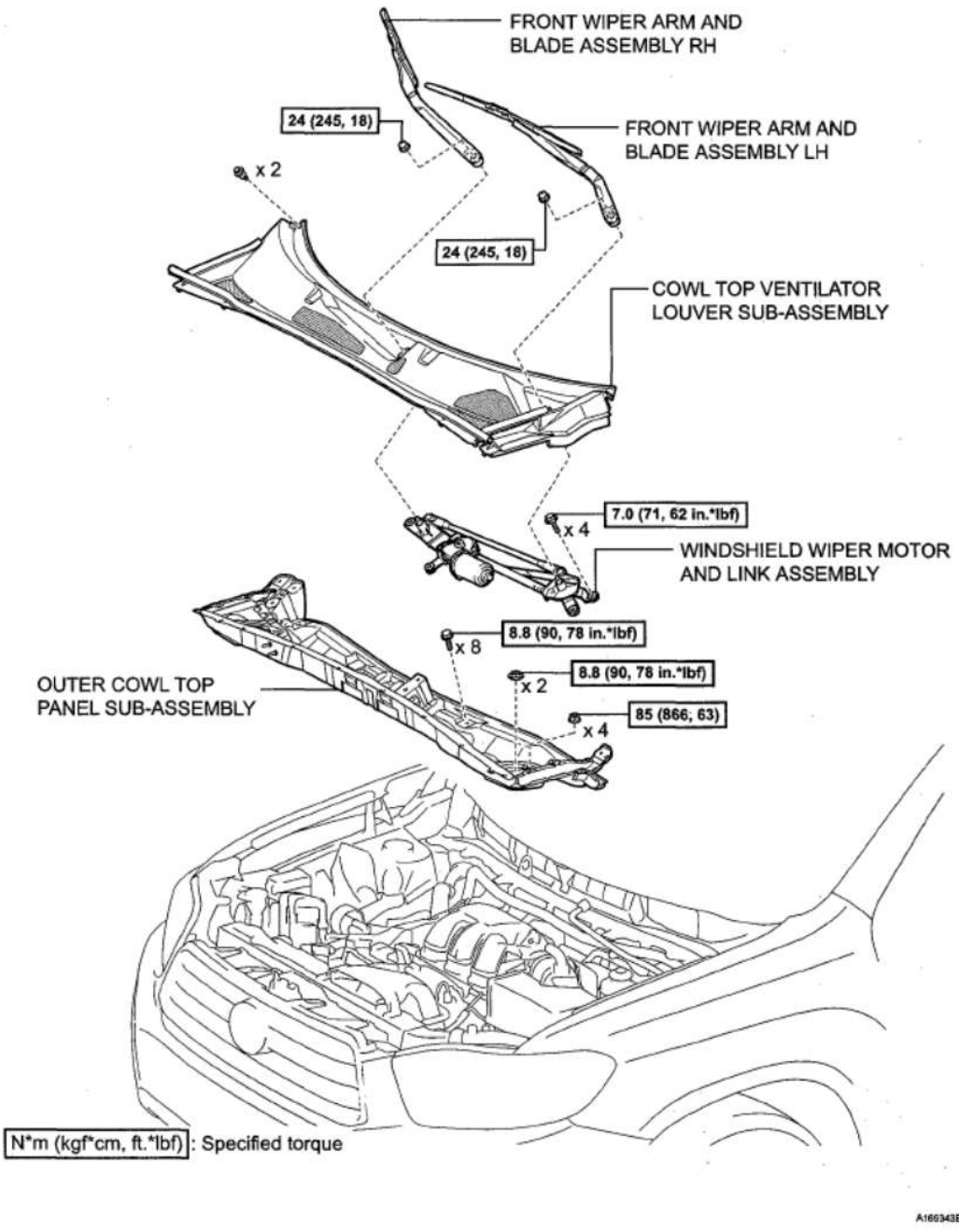


Fig. 473: Identifying Camshaft Timing Oil Control Valve Assembly Components (1 Of 4)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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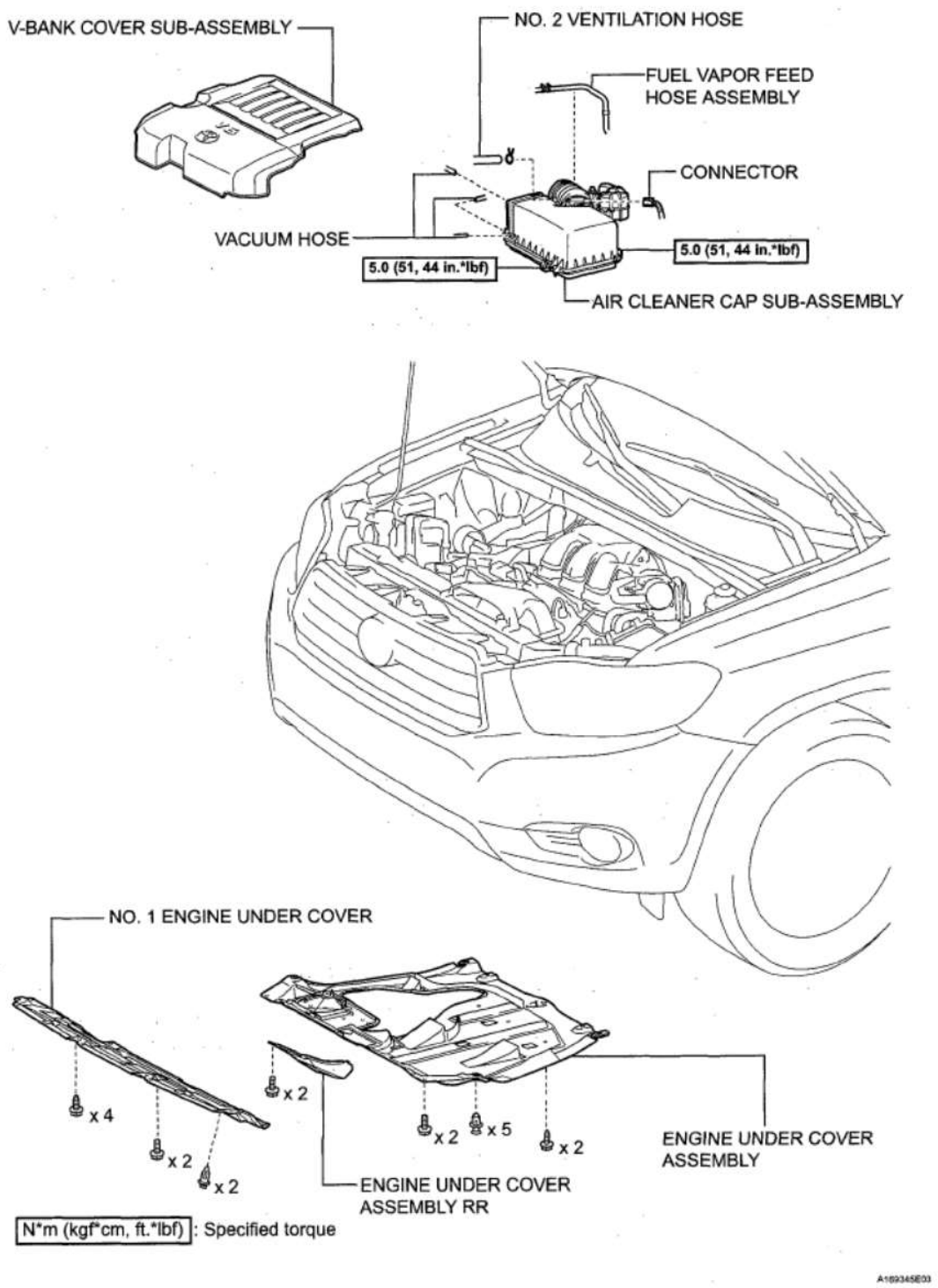


Fig. 474: Identifying Camshaft Timing Oil Control Valve Assembly Components (2 Of 4)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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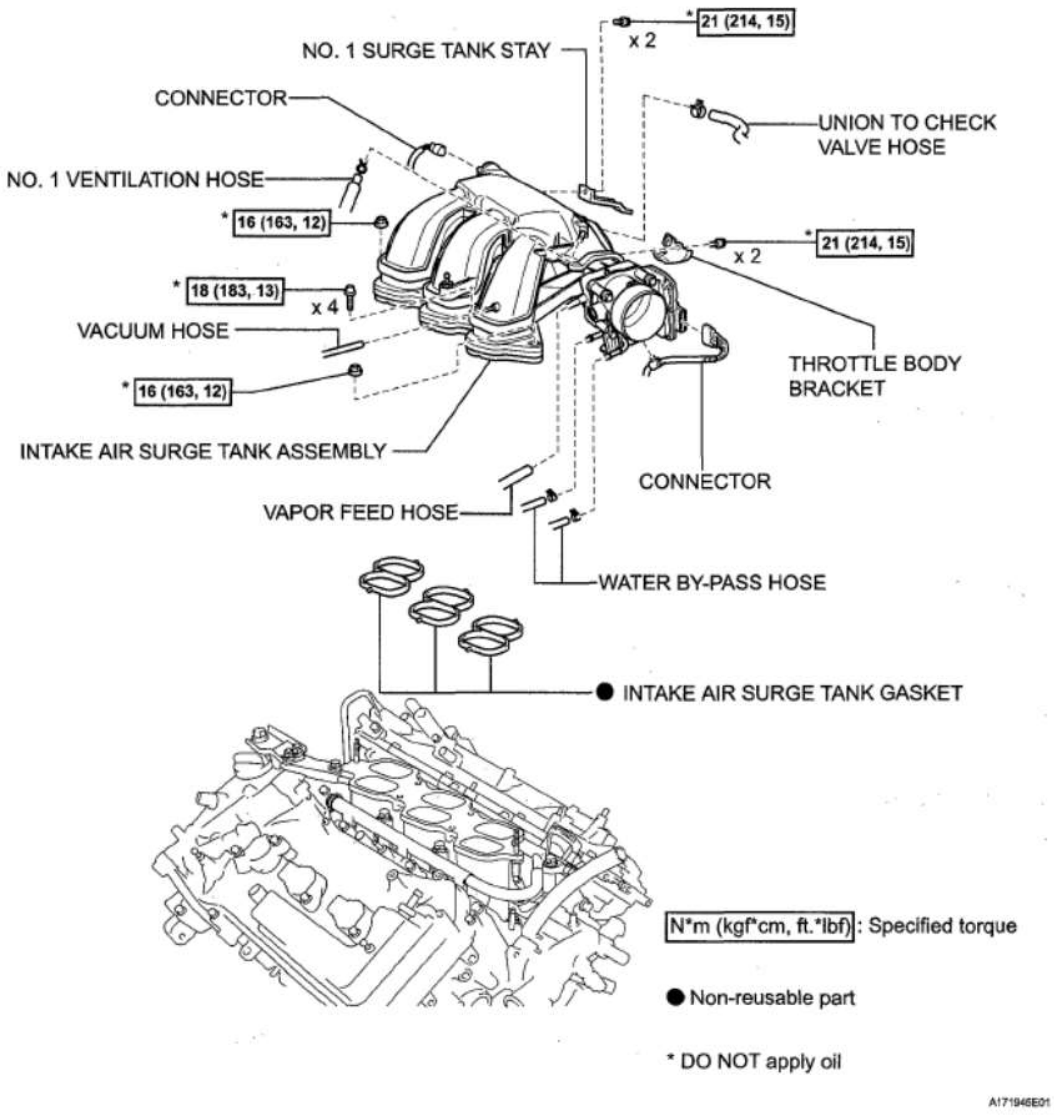


Fig. 475: Identifying Camshaft Timing Oil Control Valve Assembly Components (3 Of 4)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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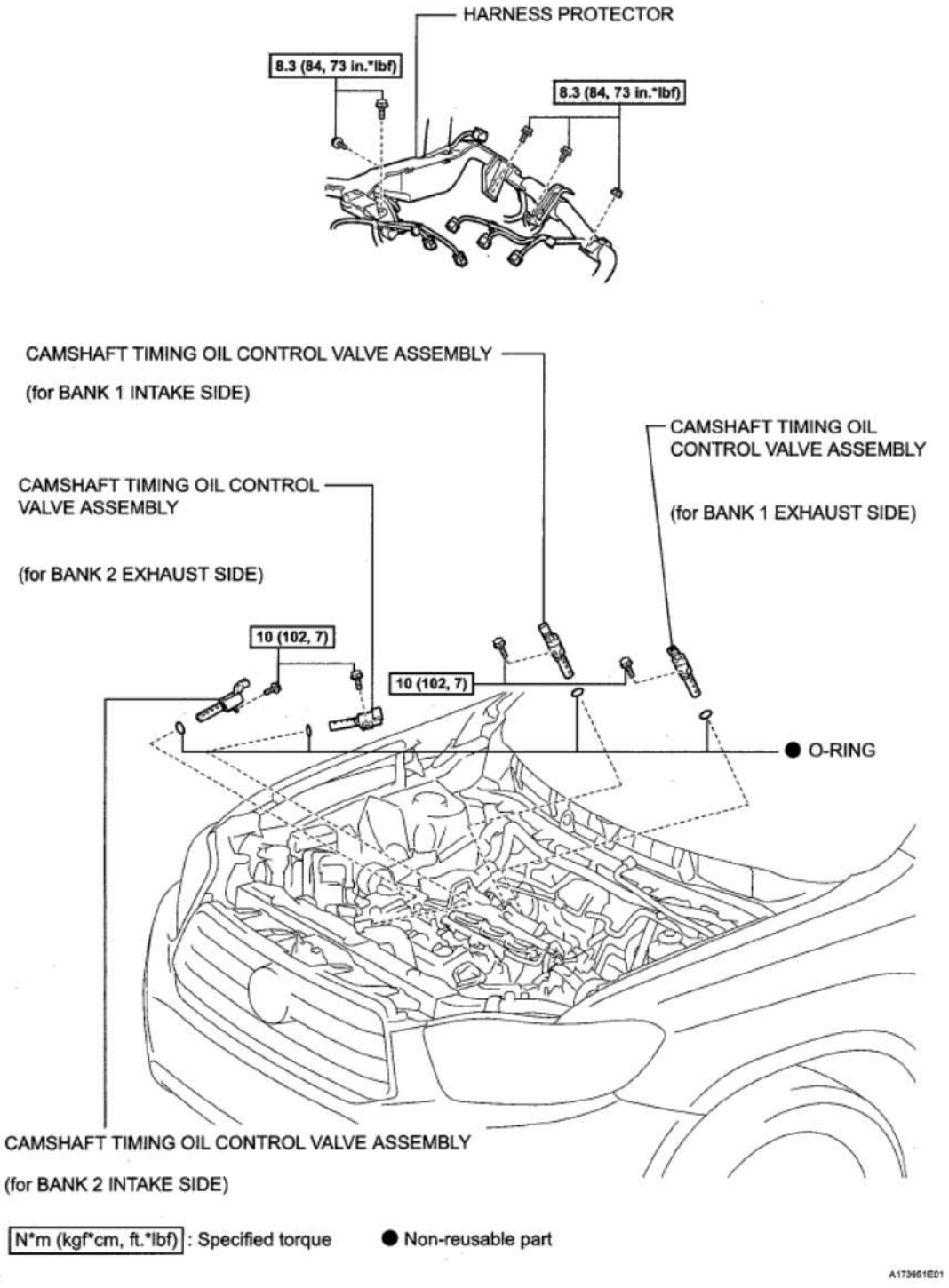


Fig. 476: Identifying Camshaft Timing Oil Control Valve Assembly Components (4 Of 4)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

ON-VEHICLE INSPECTION

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1. **INSPECT CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY**
   a. Connect Techstream to the DLC3.
   b. Turn the ignition switch on (IG).
   c. Start the engine and warm it up.
   d. Select Active Test menu on the Techstream.
   e. Check the engine speed when the OCV (camshaft timing oil control valve) is operated by Techstream.

TESTER DISPLAY CHART

Taster Display	Test Part	Control Range	Diagnostic Note
Control the VVT Linear (Bank 1)	VVT (bank 1 intake side)	Between -128 and 127% This valve added to present OCV control duty 100%: Maximum advance - 100%: Maximum retard	Engine stalls or idles roughly when VVT actuator operated by 100%. Test is possible while idling.
Control the VVT System (Bank 1)	Oil control valve	ON/OFF	• Engine stalls or idles roughly when oil control valve turned ON • Normal engine running or idling when oil control valve OFF
Control the VVT Linear (Bank 2)	VVT (bank 2 intake side)	Between -128 and 127%	Same as above
Control the VVT System (Bank 2)	Oil control valve	ON/OFF	• Engine stalls or idles roughly when oil control valve turned ON • Normal engine running or idling when oil control valve OFF
Control the VVT Exhaust Linear (Bank 1)	VVT (bank 1 exhaust side)	Between-128 and 127% This valve added to present OCV control duty 100%: Maximum retard - 100%: Maximum advance	Same as above
Control the VVT Exhaust Linear (Bank 2)	VVT (bank 2 exhaust side)	Same as above	Same as above

REMOVAL

1. **REMOVE ENGINE UNDER COVER ASSEMBLY** (See **REMOVAL**)
2. **REMOVE NO. 1 ENGINE UNDER COVER** (See **REMOVAL**)

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3. **DRAIN ENGINE COOLANT** (See **COOLANT**)
4. **REMOVE FRONT WIPER ARM AND BLADE ASSEMBLY LH** (See **REMOVAL**)
5. **REMOVE FRONT WIPER ARM AND BLADE ASSEMBLY RH** (See **REMOVAL**)
6. **REMOVE COWL TOP VENTILATOR LOUVER SUB-ASSEMBLY** (See **REMOVAL**)
7. **REMOVE WINDSHIELD WIPER MOTOR AND LINK ASSEMBLY** (See **REMOVAL**)
8. **REMOVE OUTER COWL TOP PANEL SUB-ASSEMBLY** (See **REMOVAL**)
9. **REMOVE V-BANK COVER SUB-ASSEMBLY** (See **REMOVAL**)
10. **REMOVE AIR CLEANER CAP SUB-ASSEMBLY** (See **REMOVAL**)
11. **DISCONNECT ENGINE ROOM MAIN WIRE** (See **REMOVAL**)
12. **REMOVE THROTTLE BODY BRACKET** (See **REMOVAL**)
13. **REMOVE NO. 1 SURGE TANK STAY** (See **REMOVAL**)
14. **REMOVE INTAKE AIR SURGE TANK ASSEMBLY** (See **REMOVAL**)
15. **SEPARATE HARNESS PROTECTOR**
    a. Remove the 5 bolts and nut [A].

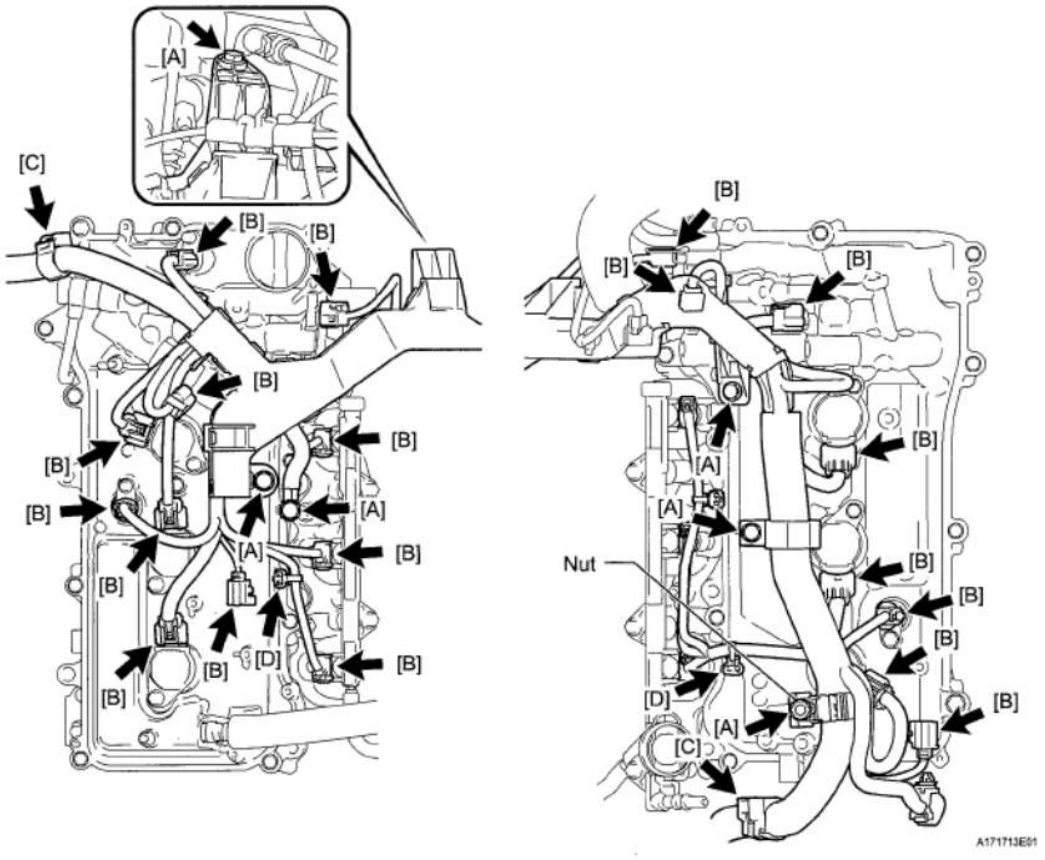


Fig. 477: Locating Harness Protector Bolts And Nut
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

    b. Disconnect the 19 connectors [B].

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c. Disconnect the 2 clamps [C].
d. Disconnect the 2 studs [D].

16. **REMOVE CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY (for Bank 1)**
    a. Exhaust side:
        1. Remove the bolt and camshaft timing oil control valve assembly.
        2. Remove the O-ring from the camshaft timing oil control valve assembly.

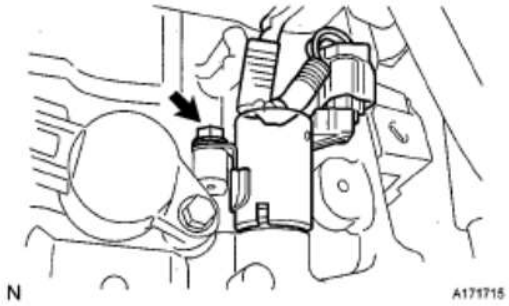


Fig. 478: Locating Camshaft Timing Oil Control Valve Assembly Bolt (Exhaust Side)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

    b. Intake side:
        1. Remove the bolt and camshaft timing oil control valve assembly.
        2. Remove the O-ring from the camshaft timing oil control valve assembly.

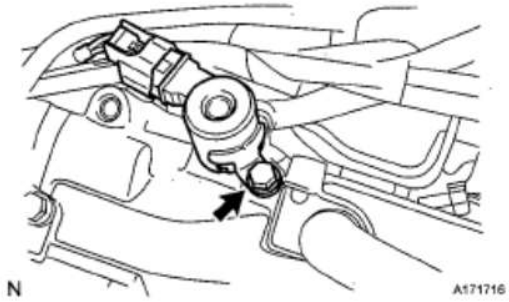


Fig. 479: Locating Camshaft Timing Oil Control Valve Assembly Bolt (Intake Side)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

17. **REMOVE CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY (for Bank 2)**
    a. Exhaust side:
        1. Remove the bolt and camshaft timing oil control valve assembly.
        2. Remove the O-ring from the camshaft timing oil control valve assembly.

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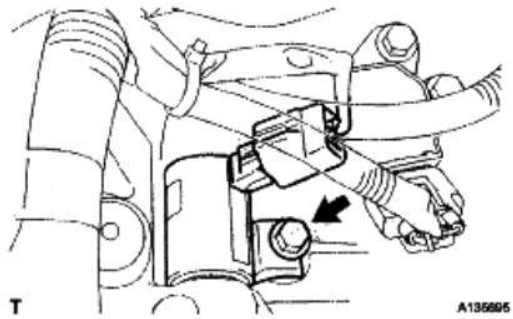


Fig. 480: Locating Camshaft Timing Oil Control Valve Assembly Bolt (For Bank 2 Exhaust Side)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. Intake side:
   1. Remove the bolt and camshaft timing oil control valve assembly.
   2. Remove the O-ring from the camshaft timing oil control valve assembly

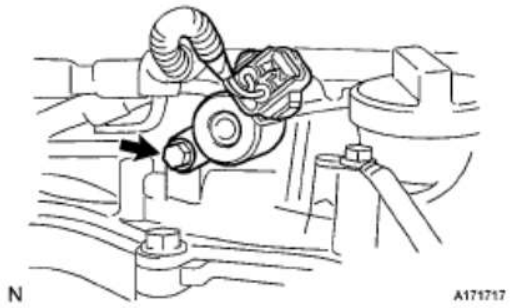


Fig. 481: Locating Camshaft Timing Oil Control Valve Assembly Bolt (For Bank 2 Intake Side)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSPECTION

1. **INSPECT CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY**
   a. Resistance inspection:
      1. Using an ohmmeter, measure the resistance between the terminals.

         Resistance:

         6.9 to 7.9 ohms at 20°C (68°F)

         If necessary, replace the camshaft timing oil control valve assembly.

   b. Movement inspection:
      1. Connect the positive (+) lead from the battery to terminal 1 and the negative (-) lead to

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terminal 2, and check the movement of the valve.

NOTE: Confirm that the valve moves freely and does not stick in any position. If necessary, replace the camshaft timing oil control valve assembly.

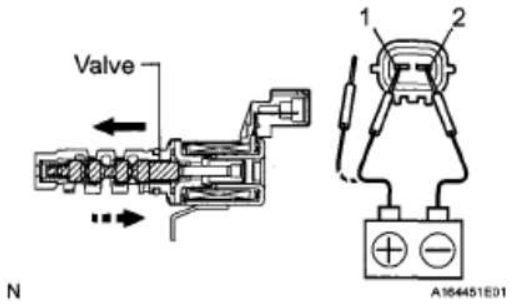


Fig. 482: Inspecting Camshaft Timing Oil Control Valve Assembly For Movement
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

HINT:

Accumulation of foreign objects causes subtle pressure leaks. The subtle pressure leaks will cause the cam to advance, and this will cause a DTC to be set.

INSTALLATION

1. **INSTALL CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY (for Bank 2)**
   a. Exhaust side:
      1. Apply a coat of engine oil to a new O-ring and install it onto the camshaft timing oil control valve assembly.

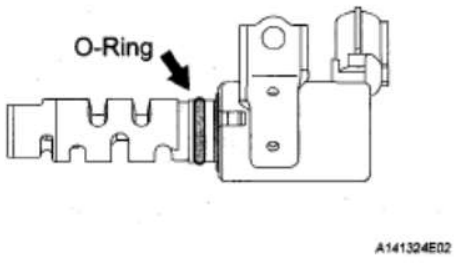


Fig. 483: Locating O-Ring
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

      2. Install the camshaft timing oil control valve assembly with the bolt.

Torque: 10 N*m (102 kgf*cm, 7 ft.*lbf)

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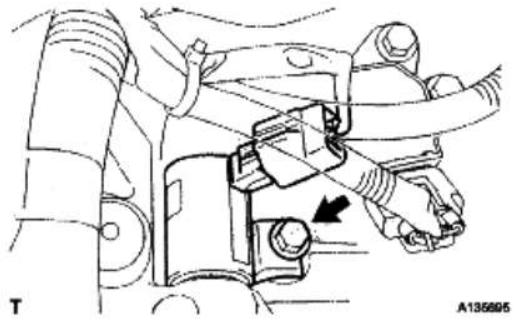


Fig. 484: Locating Camshaft Timing Oil Control Valve Assembly Bolt (For Bank 2 Exhaust Side)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. Intake side:
   1. Apply a coat of engine oil to a new O-ring and install it onto the camshaft timing oil control valve assembly.

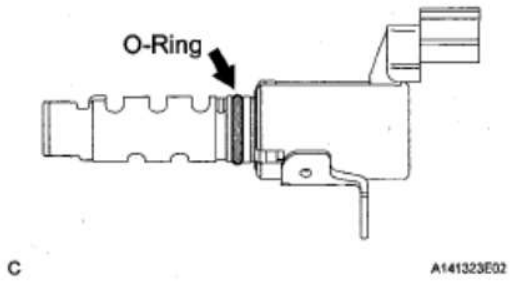


Fig. 485: Locating O-Ring
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

   2. Install the camshaft tinning oil control valve assembly with the bolt.

Torque: 10 N*m (102 kgf*cm, 7 ft.*lbf)

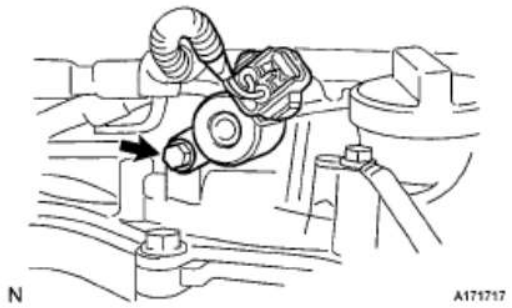


Fig. 486: Locating Camshaft Timing Oil Control Valve Assembly Bolt (For Bank 2 Intake Side)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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2. **INSTALL CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY (for Bank 1)**
   a. Exhaust side:
      1. Apply a coat of engine oil to a new O-ring and install it onto the camshaft timing oil control valve assembly.

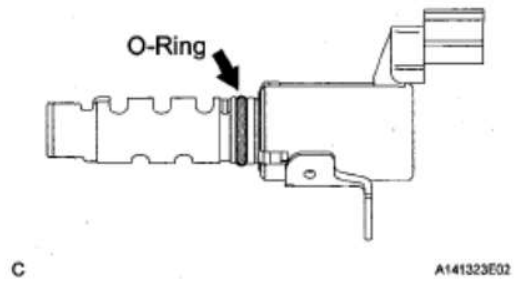


Fig. 487: Locating O-Ring
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

      2. Install the camshaft timing oil control valve assembly with the bolt.

Torque: 10 N*m (102 kgf*cm, 7 ft.*lbf)

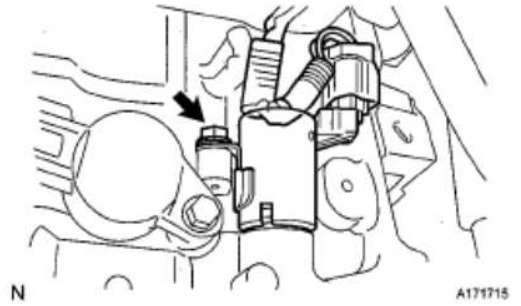
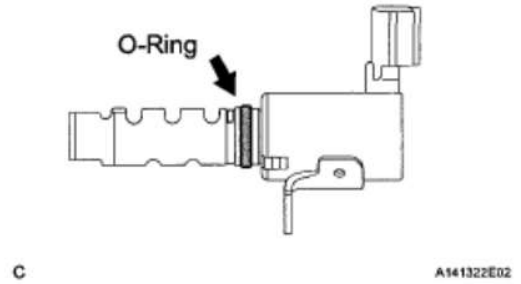


Fig. 488: Locating Camshaft Timing Oil Control Valve Assembly Bolt (Exhaust Side)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

   b. Intake side:
      1. Apply a coat of engine oil to a new O-ring and install it onto the camshaft timing oil control valve assembly.



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Fig. 489: Locating O-Ring
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

2. Install the camshaft timing oil control valve assembly with the bolt.

Torque: 10 N*m (102 kgf*cm, 7 ft.*lbf)

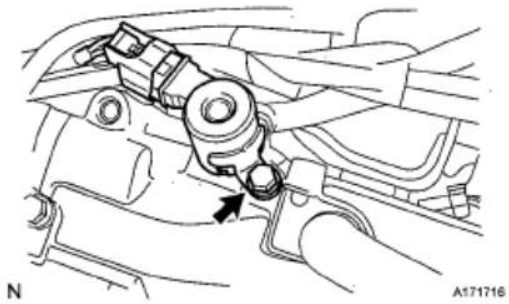
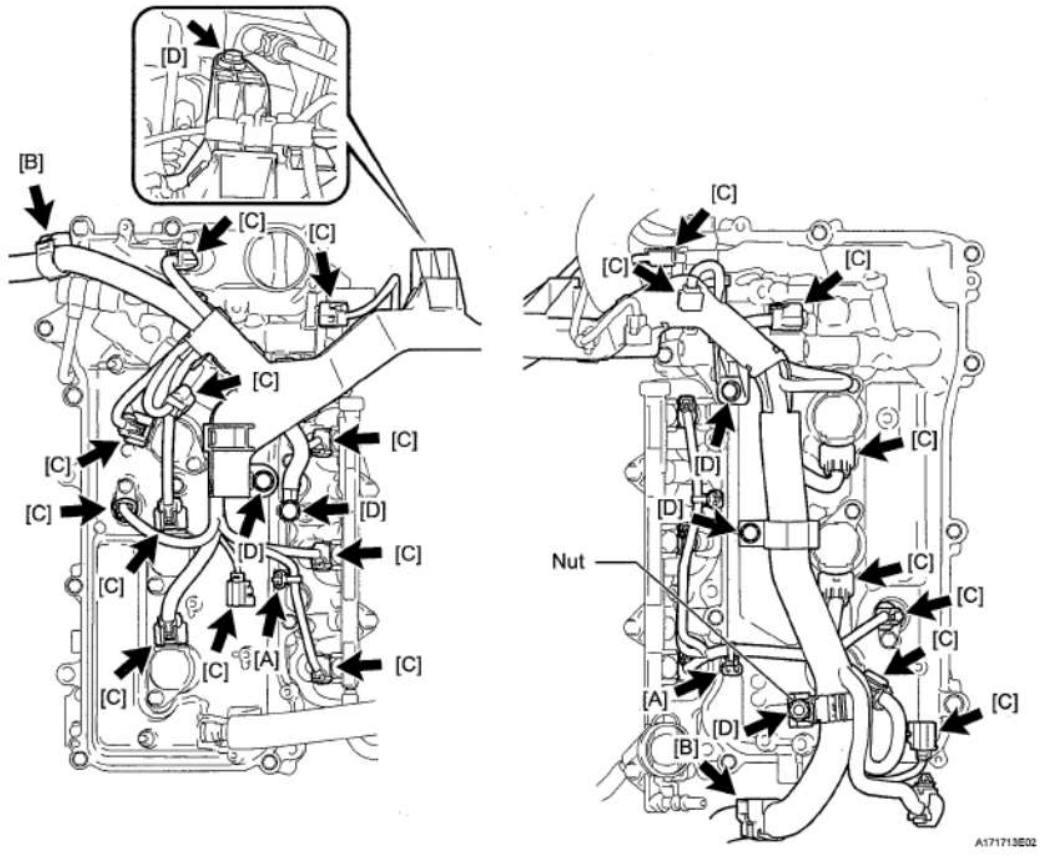


Fig. 490: Locating Camshaft Timing Oil Control Valve Assembly Bolt (Intake Side)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

3. **INSTALL HARNESS PROTECTOR**
   a. Connect the 2 studs [A].



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Fig. 491: Locating Harness Protector Studs
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. Connect the 2 clamps [B].
c. Connect the 19 connectors [C].
d. Install the 5 bolts and nut [D].

Torque: 8.3 N*m (84 kgf*cm, 73 in.*lbf)

4. **TEMPORARILY INSTALL NO. 1 SURGE TANK STAY** (See **INSTALLATION**)
5. **TEMPORARILY INSTALL THROTTLE BODY BRACKET** (See **INSTALLATION**)
6. **INSTALL INTAKE AIR SURGE TANK ASSEMBLY** (See **INSTALLATION**)
7. **FULLY TIGHTEN NO. 1 SURGE TANK STAY** (See **INSTALLATION**)
8. **FULLY TIGHTEN THROTTLE BODY BRACKET** (See **INSTALLATION**)
9. **CONNECT ENGINE ROOM MAIN WIRE** (See **INSTALLATION**)
10. **INSTALL AIR CLEANER CAP SUB-ASSEMBLY** (See **INSTALLATION**)
11. **ADD ENGINE COOLANT** (See **REPLACEMENT**)
12. **INSPECT FOR COOLANT LEAK** (See **COOLING SYSTEM**)
13. **INSTALL OUTER COWL TOP PANEL SUB-ASSEMBLY** (See **INSTALLATION**)
14. **INSTALL WINDSHIELD WIPER MOTOR AND LINK ASSEMBLY** (See **INSTALLATION**)
15. **INSTALL COWL TOP VENTILATOR LOUVER SUB-ASSEMBLY** (See **INSTALLATION**)
16. **INSTALL FRONT WIPER ARM AND BLADE ASSEMBLY RH** (See **INSTALLATION**)
17. **INSTALL FRONT WIPER ARM AND BLADE ASSEMBLY LH** (See **INSTALLATION**)
18. **INSTALL V-BANK COVER SUB-ASSEMBLY** (See **INSTALLATION**)
19. **INSTALL NO. 1 ENGINE UNDER COVER** (See **INSTALLATION**)
20. **INSTALL ENGINE UNDER COVER ASSEMBLY** (See **INSTALLATION**)

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