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2008 ENGINE PERFORMANCE 2ZR-FE Engine Control System - xD

2008 ENGINE PERFORMANCE

2ZR-FE Engine Control System - xD

SFI SYSTEM

PRECAUTION

1. **INITIALIZATION**

NOTE:

- **Perform the RESET MEMORY (AT initialization) when replacing the automatic transaxle assembly, engine assembly or ECM (See INITIALIZATION).**
- **Perform the 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:

- Read its instruction books before using the tester.
- 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 person drives the vehicle, and the other operates the tester.

3. **DISCONNECT AND RECONNECT CABLE OF NEGATIVE BATTERY TERMINAL**
   a. Before performing electronic work, disconnect the cable from the negative (-) battery terminal in order to prevent it from shorting and burning out.
   b. Before disconnecting and reconnecting the battery cable, turn the ignition switch to OFF and the headlight dimmer switch OFF. Then loosen the terminal nut completely. Do not damage the cable or terminal.
   c. When the battery cable is disconnected, the clock and radio settings and stored DTCs are erased. Therefore, before disconnecting the battery cable, make a note of the settings.

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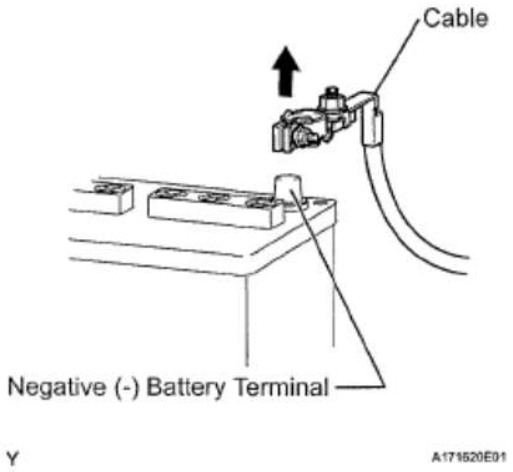


Fig. 1: Disconnecting Cable Of Negative Battery Terminal
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

DEFINITION OF TERMS

DEFINITION OF TERMS

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

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	"2 driving cycle" means ECM illuminates MIL if same malfunction detected second time during next sequential driving cycle.

PARTS LOCATION

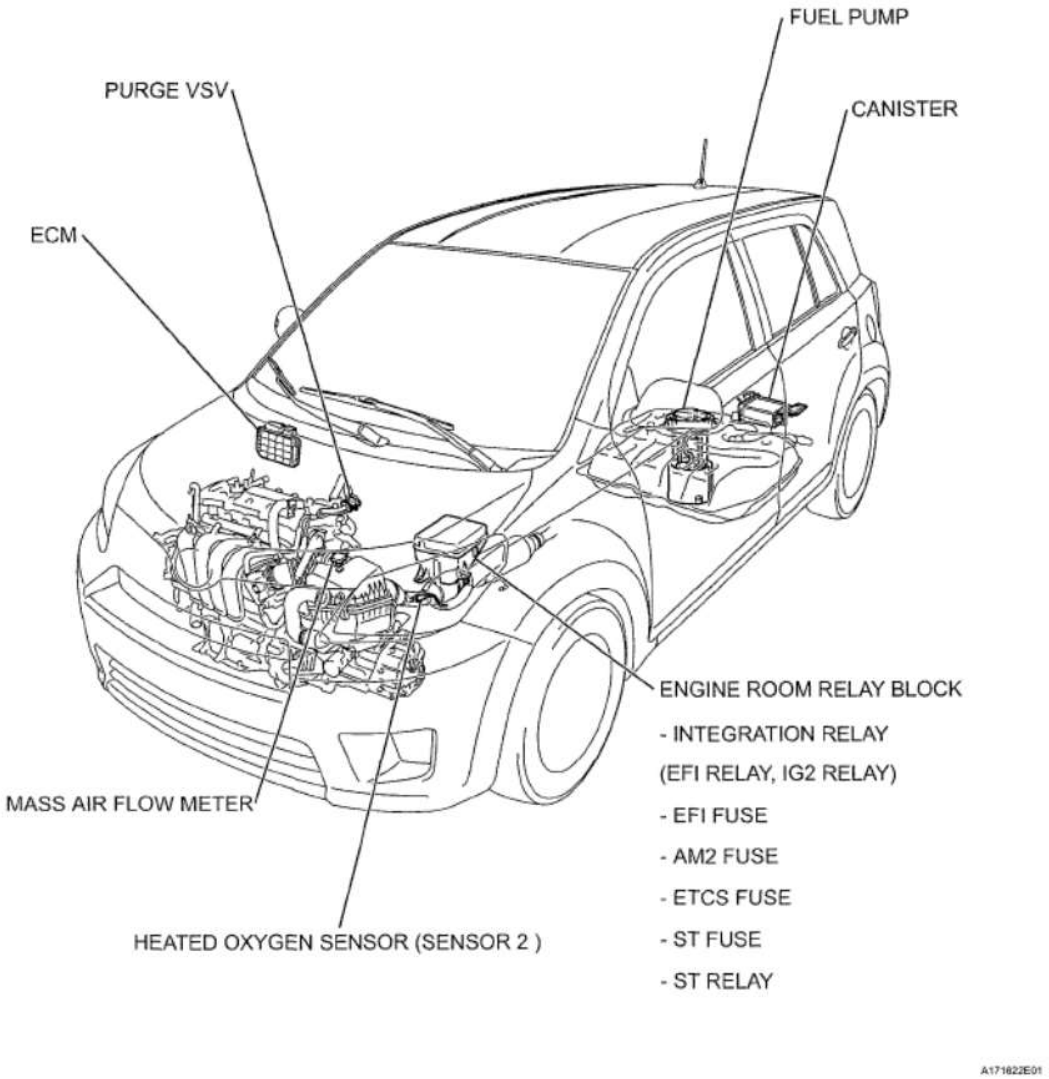


Fig. 2: Identifying Engine Control System Components Location (1 Of 3)
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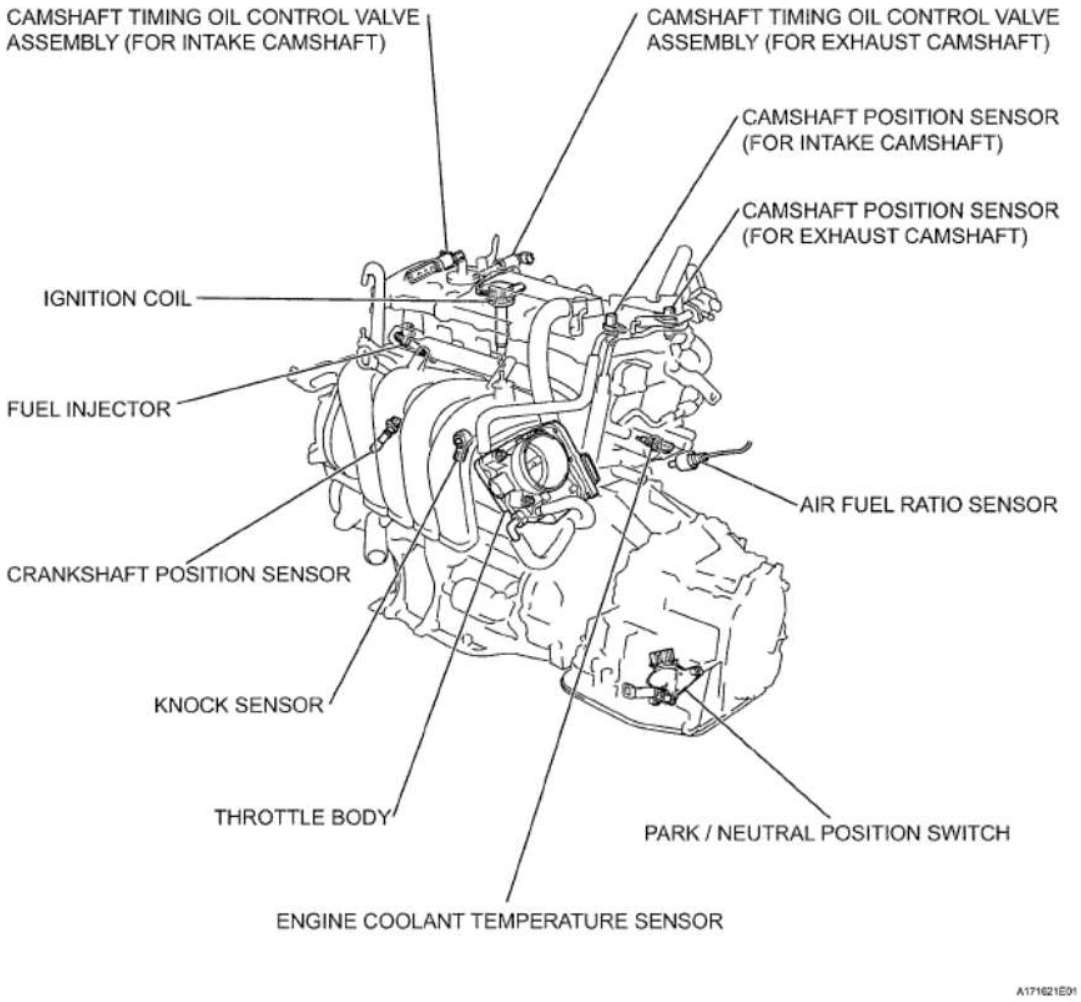


Fig. 3: Identifying Engine Control System Components Location (2 Of 3)
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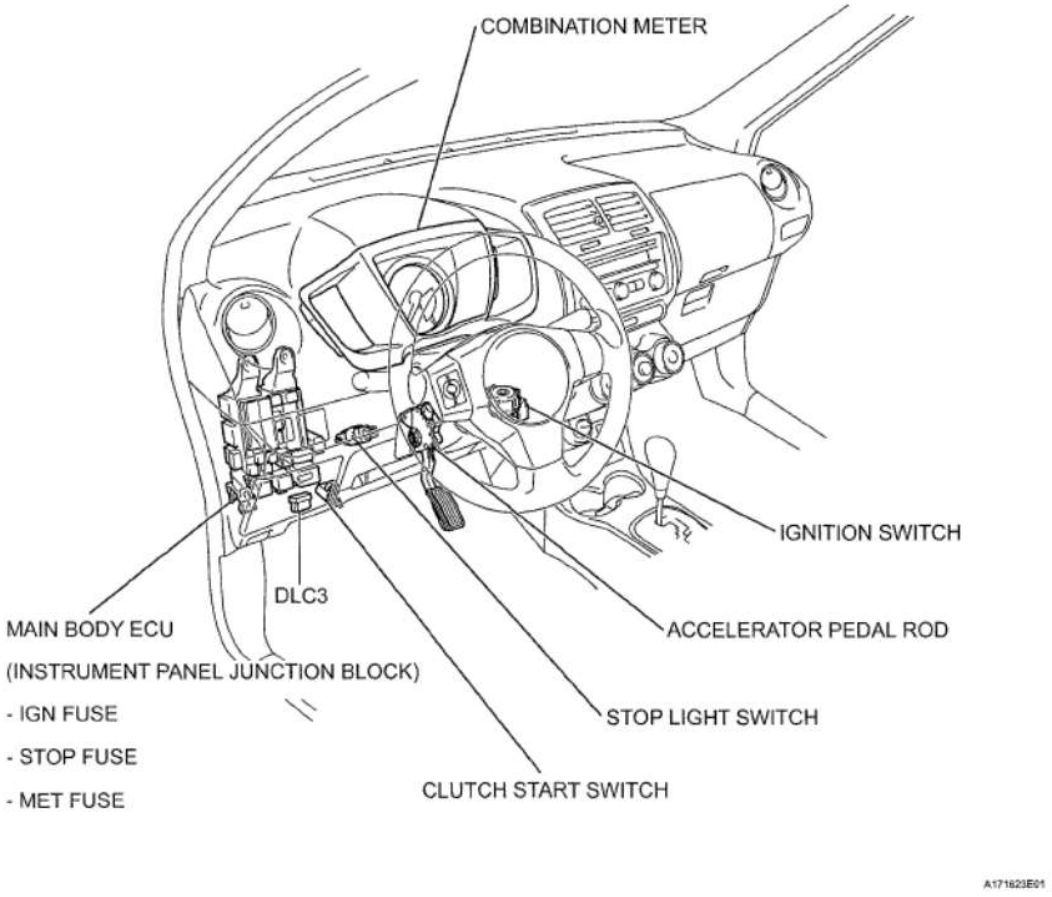


Fig. 4: Identifying Engine Control System Components Location (3 Of 3)
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SYSTEM DIAGRAM

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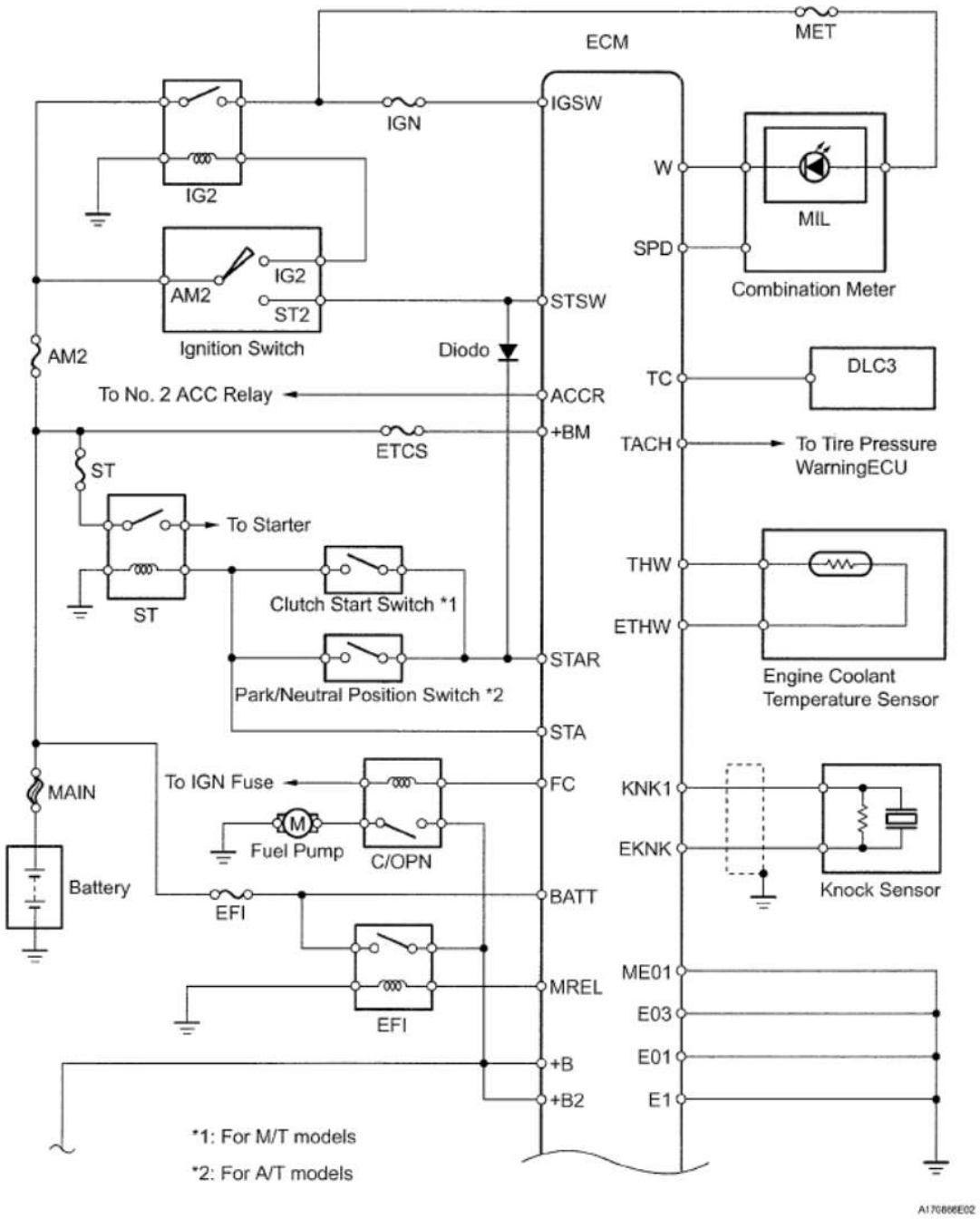


Fig. 5: Engine Control System Diagram (1 Of 4)
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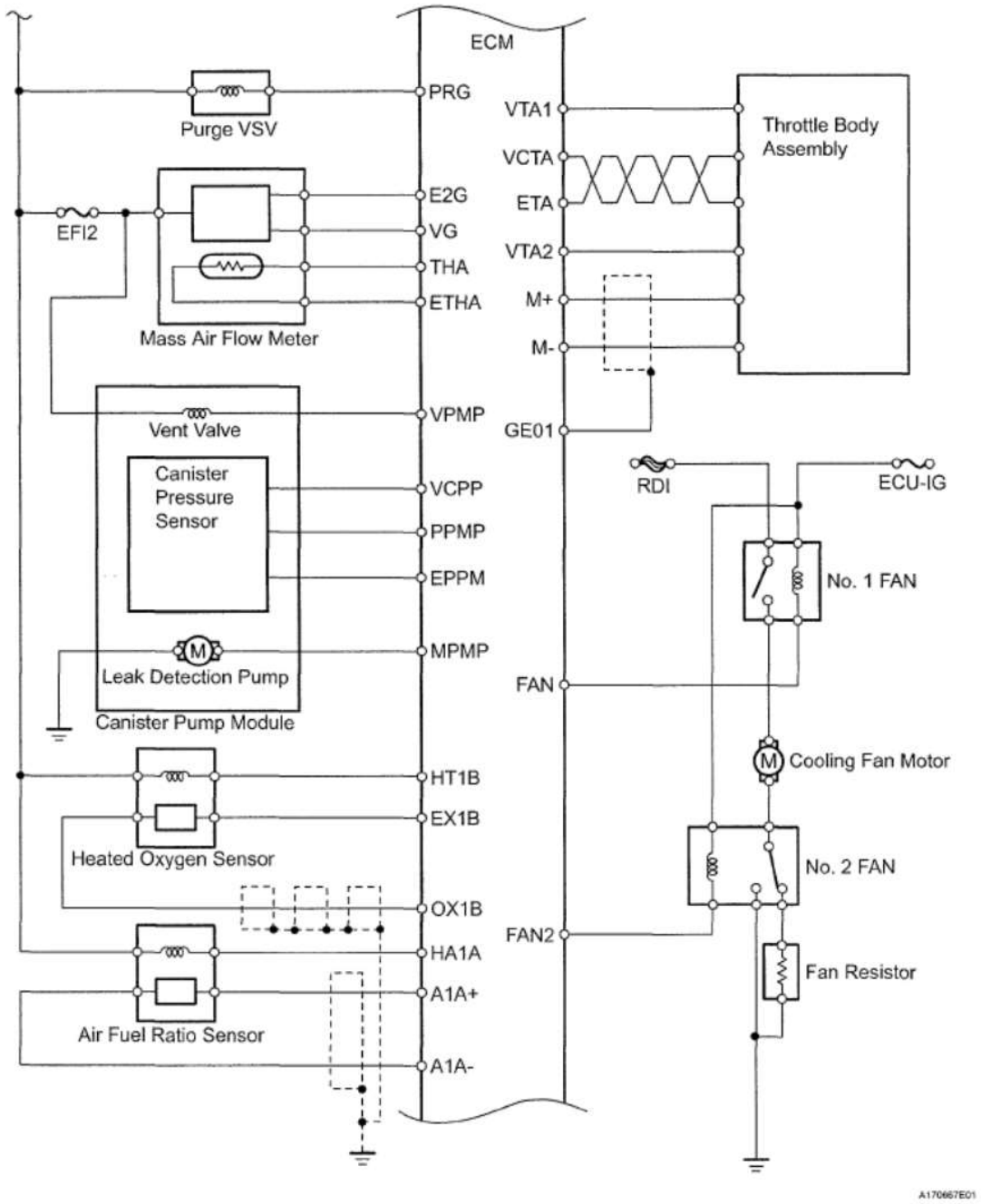


Fig. 6: Engine Control System Diagram (2 Of 4)
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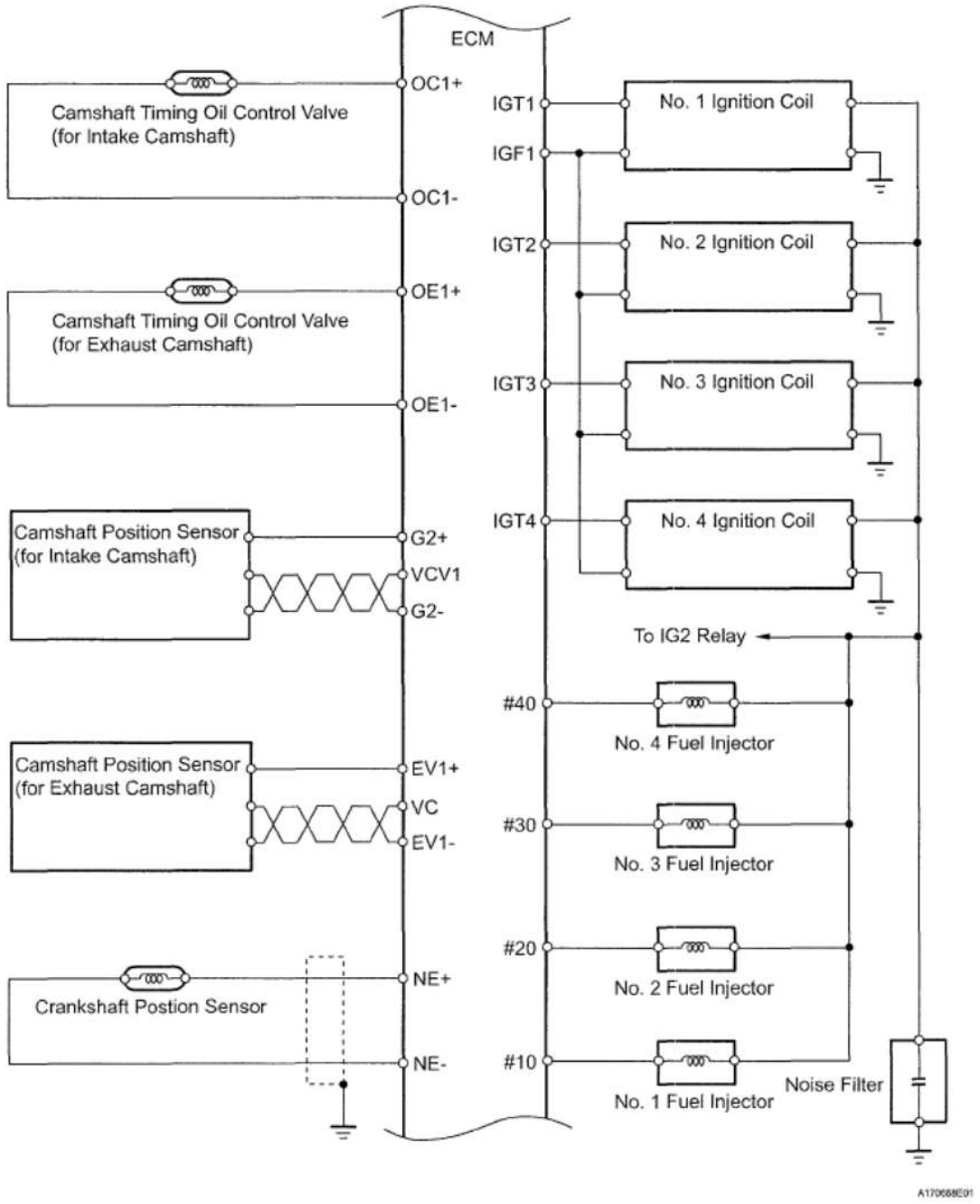


Fig. 7: Engine Control System Diagram (3 Of 4)
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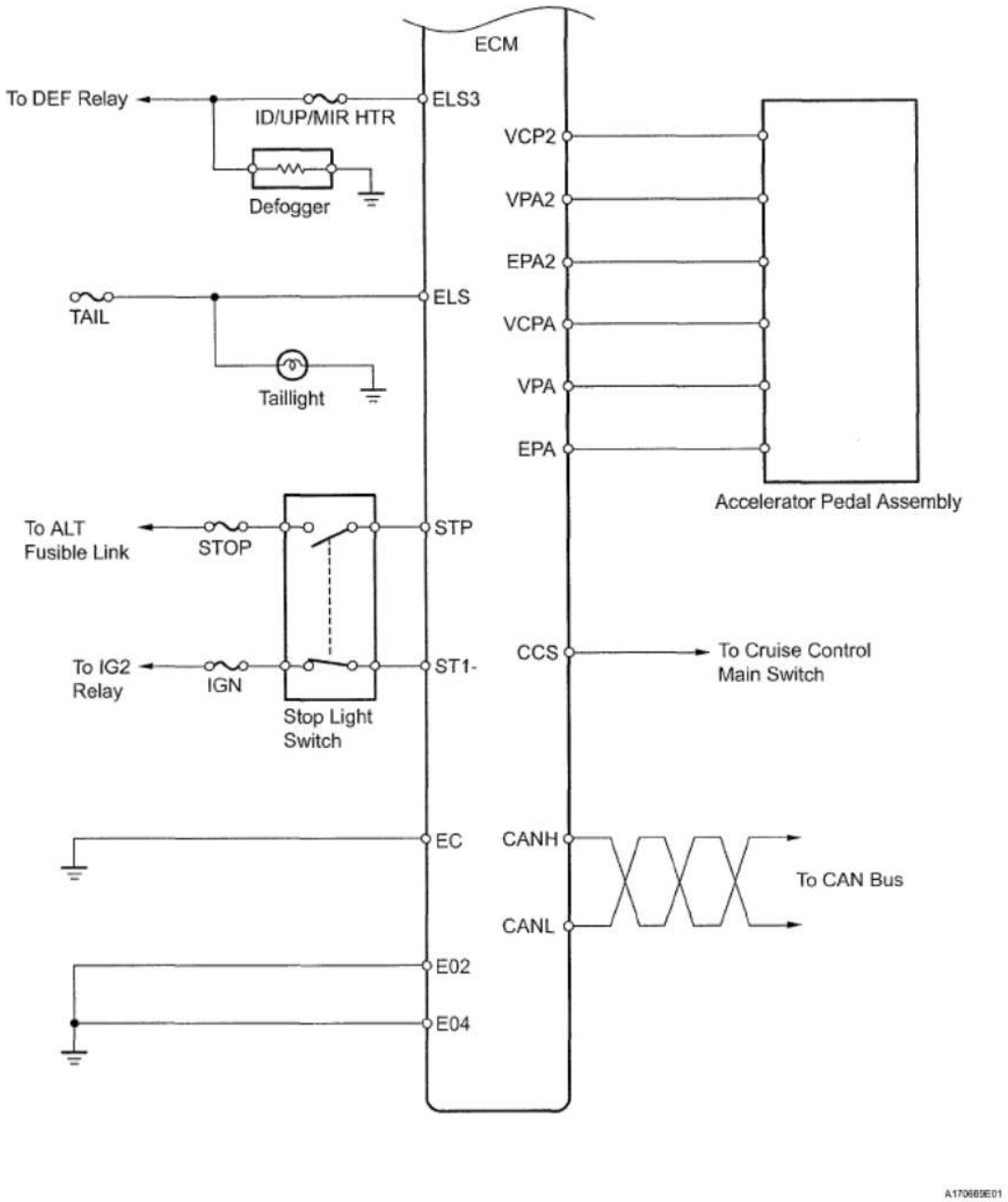


Fig. 8: Engine Control System Diagram (4 Of 4)
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HOW TO PROCEED WITH TROUBLESHOOTING

HINT:

*: Use a Techstream.

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

   HINT:

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

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

   HINT:

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

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

   HINT:

   If the engine does not start, first perform the "CHECK DTC" procedures and "CONDUCT BASIC INSPECTION" procedures below.

   RESULT REFERENCE

Result	Proceed to
Malfunction does not occur	A
Malfunction occurs	B

   B: Go to STEP 10

   A: Go to next step

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

    RESULT REFERENCE

Result	Proceed to
Malfunction code	A
No code	B

    B: Go to STEP 12

    A: Go to next step

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

RESULT REFERENCE

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

B: Go to STEP 17

A: Go to next step

13. REFER TO **PROBLEM SYMPTOMS TABLE**

RESULT REFERENCE

Result	Proceed to
Malfunctioning circuit confirmed	A
Malfunctioning parts confirmed	B

B: Go to STEP 17

A: Go to next step

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

RESULT REFERENCE

Result	Proceed to
Malfunction not confirmed	A
Malfunction confirmed	B

B: Go to STEP 18

A: Go to next step

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

NEXT : END

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CHECK FOR INTERMITTENT PROBLEMS

HINT:

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

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

BASIC INSPECTION

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

   Result

   RESULT REFERENCE

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 (See **REMOVAL**)

   OK: Go to next step

5. **CHECK IDLING SPEED**

   NG: TROUBLESHOOT IDLING SPEED AND PROCEED TO NEXT STEP

   OK: Go to next step

6. **CHECK FUEL PRESSURE**

   NG: TROUBLESHOOT FUEL PRESSURE AND PROCEED TO NEXT STEP

   OK: Go to next step

7. **CHECK FOR SPARK**

   NG: TROUBLESHOOT SPARK AND PROCEED TO NEXT STEP

   OK : PROCEED TO **PROBLEM SYMPTOMS TABLE**

REGISTRATION

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

HINT:

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

1. **DESCRIPTION**

   HINT:

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

   a. Read VIN: This process allows the VIN stored in the ECM to be read in order to confirm that the

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two VINs, provided with the vehicle and stored in the vehicle's ECM, are the same.

b. Write VIN: 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 a Techstream to the DLC3.
   c. Turn the ignition switch to ON.
   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 to ON.
   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 the 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 instruction to view the monitor status.

Although this instruction reference the Lexus/Toyota diagnostic tester, it can be checked using a generic OBD II scan tool. Refer to your scan tool operator's manual for specific procedures.

1. **PERFORM MONITOR DRIVE PATTERN**
   a. Connect a Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the tester ON.
   d. Clear DTCs (See **DTC CHECK / CLEAR**).
   e. Run the vehicle in accordance with the applicable drive pattern described in READINESS MONITOR DRIVE PATTERN (See **READINESS MONITOR DRIVE PATTERN**). Do not

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turn the ignition switch to OFF.

NOTE: The test results will be lost if the ignition switch is turned to 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 minimum test limit and maximum test limit.
   b. If the test value is between the minimum test limit and maximum test limit, the component is functioning normally. If not, the component is malfunctioning. The test value is usually significantly 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 on rare occasions be Pass even if the malfunction indicator lamp (MIL) is illuminated. This indicates the system malfunctioned on a previous driving cycle. This might be caused by an intermittent problem.

4. **MONITOR RESULT INFORMATION**

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

A/F Sensor(Sensor 1)

MONITOR RESULT INFORMATION - A/F SENSOR (SENSOR 1)

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

HO2 Sensor (Sensor 2)

MONITOR RESULT INFORMATION - HO2 SENSOR (SENSOR 2)

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

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$02	$8B	Multiply by 0.001	Seconds	0.35 - 0.2 V sensor switch time
$02	$8D	Multiply by 0.001	Seconds	Duration that sensor voltage drops to 0.2 V during fuel cut
$02	$8F	Multiply by 0.0003	g	Maximum oxygen storage capacity

Catalyst

MONITOR RESULT INFORMATION - CATALYST

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

Rear Oxygen Sensor Heater

MONITOR RESULT INFORMATION - REAR OXYGEN SENSOR HEATER

Monitor ID	Test ID	Scaling	Unit	Description
$42	$91	Multiply by 0.001	Ohm	Oxygen sensor heater resistance bank1 sensor 2

EVAP

MONITOR RESULT INFORMATION - EVAP

Monitor ID	Test ID	Scaling	Unit	Description
$3D	$C9	Multiply by 0.001	kPa	Test value for small leak (P0456)
$3D	$CA	Multiply by 0.001	kPa	Test value for gross leak (P0455)
$3D	$CB	Multiply by 0.001	kPa	Test value for leak detection pump stuck OFF (P2401)
$3D	$CD	Multiply by 0.001	kPa	Test value for leak detection pump stuck ON (P2402)
$3D	$CE	Multiply by 0.001	kPa	Test value for vent valve stuck OFF (P2420)
$3D	$CF	Multiply by 0.001	kPa	Test value for vent valve stuck ON (P2419)
$3D	$D0	Multiply by 0.001	kPa	Test value for reference orifice low flow (P043E)
$3D	$D1	Multiply by 0.001	kPa	Test value for reference orifice high flow (P043F)
$3D	$D4	Multiply by 0.001	kPa	Test value for purge VSV stuck closed (P0441)
$3D	$D5	Multiply by 0.001	kPa	Test value for purge VSV stuck open (P0441)
$3D	$D7	Multiply by 0.001	kPa	Test value for purge flow insufficient (P0441)

Misfire

MONITOR RESULT INFORMATION - MISFIRE

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
				• When ignition switch is ON, total misfire count of all

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

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READINESS MONITOR DRIVE PATTERN

1. **PURPOSE OF READINESS TESTS**
   - The On-Board Diagnostic (OBD II) system is designed to monitor the performance of emission related components, and indicate any detected abnormalities with DTCs (Diagnostic Trouble Codes). Since various components need to be monitored during different driving conditions, the OBD II system is designed to run separate monitoring programs called Readiness Monitors.
   - To view the status, select the following menu items: Powertrain / Engine and ECT / Monitor / Status2.
   - 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:

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

The Readiness Monitor will be reset to Incomplete if:

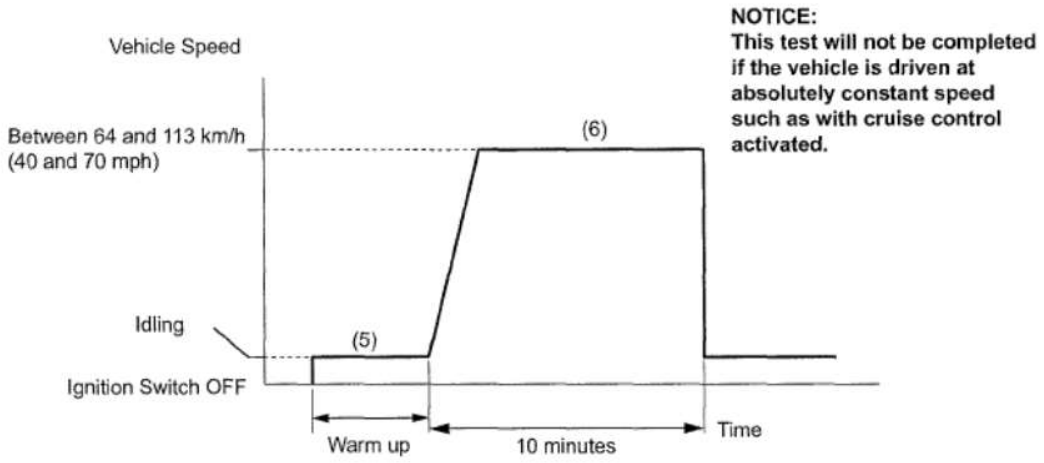
- The ECM has lost battery power or blown a fuse.
- DTCs have been cleared.
- The conditions for running the Readiness Monitor have not been met.

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

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

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

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



(Note: Even when vehicle stops during drive pattern, test can be resumed.)

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Fig. 9: Vehicle Speed Graph
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 a Techstream to the DLC3.
2. Turn the ignition switch to ON.
3. Turn the tester ON.
4. Clear DTCs (if set) (See **DTC CHECK / CLEAR**).
5. Start the engine and warm it up.
6. Drive the vehicle at between 64 km/h and 113 km/h (40 mph and 70 mph) for at least 10 minutes.

c. Monitor Status

Check the Readiness Monitor status displayed on the tester.

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

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

a. Preconditions

The monitor will not run unless:

- The fuel tank is less than 90% full.
- The altitude is less than 8000 ft. (2438 m).
- The vehicle is stationary.
- 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 to OFF and wait for 6 hours (8 or 10.5 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

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

   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 (A/F) AND HEATED OXYGEN (HO2) SENSOR MONITORS (ACTIVE AIR-FUEL RATIO CONTROL TYPE)**

Monitor Drive Pattern

ECT: 75°C (167°F) or more

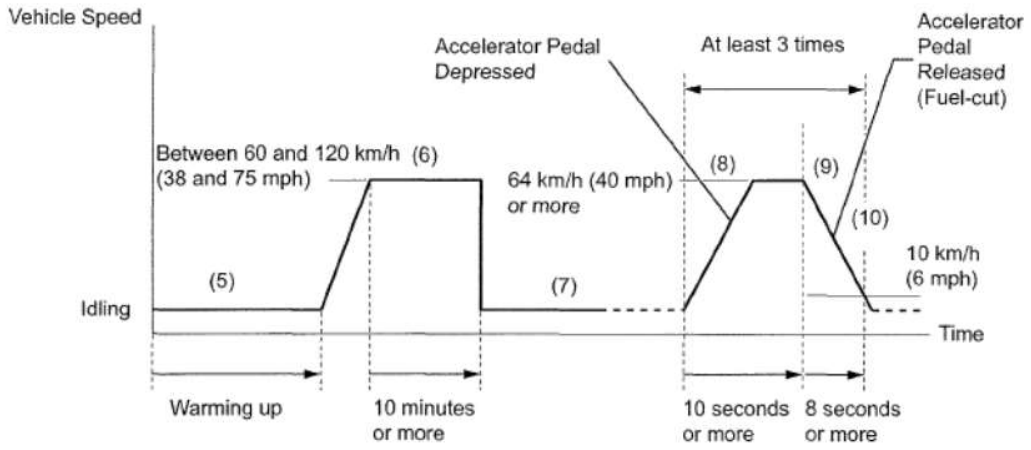


Fig. 10: Vehicle Speed Graph
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

a. Preconditions

   The monitor will not run unless:

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

b. Drive Pattern for front A/F sensor and HO2 sensor

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1. Connect the Techstream to the DLC3.
2. Turn the ignition switch to ON.
3. Turn the tester ON.
4. Clear DTCs (See **DTC CHECK / CLEAR**).
5. Start the engine, and warm it up until the ECT reaches 75°C (167°F) or higher.
6. Drive the vehicle at between 60 km/h (38 mph) and 120 km/h (75 mph) for at least 10 minutes.
7. Change the transmission to 2nd gear.
8. Accelerate the vehicle to 64 km/h (40 mph) or more by depressing the accelerator pedal for at least 10 seconds.
9. Soon after performing step (8) above, release the accelerator pedal for at least 8 seconds without depressing the brake pedal, in order to execute fuel-cut control.
10. Allow the vehicle to decelerate until the vehicle speed declines to less than 10 km/h (6 mph).
11. Repeat steps from (8) through (10) 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 steps from (5) through (11) in Drive Pattern above.

5. **AIR-FUEL RATIO (A/F) AND HEATED OXYGEN (HO2) SENSOR HEATER MONITORS (FRONT A/F AND REAR HO2 SENSOR TYPE)**

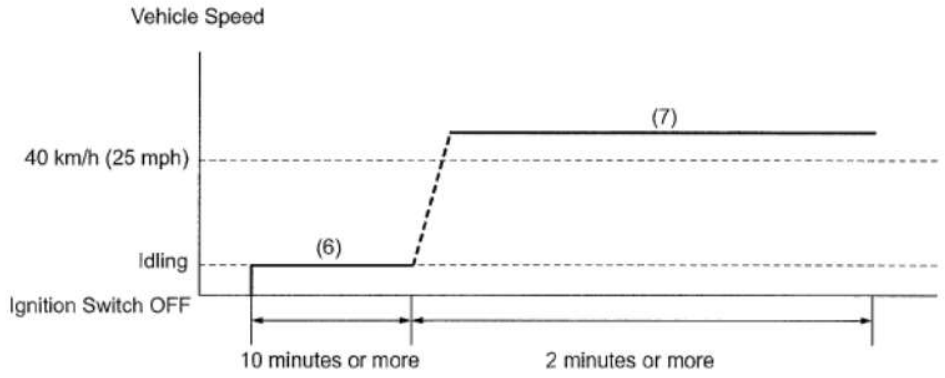


Fig. 11: Vehicle Speed Graph
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

a. Preconditions

The monitor will not run unless:

- The MIL is OFF.

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

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

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

PROBLEM SYMPTOMS TABLE

PROBLEM SYMPTOMS TABLE

Symptom	Suspected Area	See
Engine does not crank (Does not start)	Battery	-
	Starter	**INSPECTION**
	Cranking holding function circuit	**CRANKING HOLDING FUNCTION CIRCUIT**
	Starter relay	**STARTER RELAY**
	Park/neutral position switch	**INSPECTION**
	Clutch start switch	**ON-VEHICLE INSPECTION**
No initial combustion (Does	ECM power source circuit	**ECM POWER SOURCE CIRCUIT**
	Crankshaft position sensor	**DTC P0335 CRANKSHAFT POSITION SENSOR "A" CIRCUIT; DTC P0339 CRANKSHAFT POSITION SENSOR "A" CIRCUIT INTERMITTENT**
	Camshaft position sensor (for intake camshaft)	**DTC P0010 CAMSHAFT POSITION "A" ACTUATOR CIRCUIT (BANK 1)**
	Camshaft position sensor (for exhaust camshaft)	**DTC P0013 CAMSHAFT POSITION "B" ACTUATOR CIRCUIT / OPEN (BANK 1)**
	Ignition system	**ON-VEHICLE INSPECTION**

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not start)	Fuel pump control circuit	**FUEL PUMP CONTROL CIRCUIT**
	Fuel injector circuit	**FUEL INJECTOR CIRCUIT**
	Valve timing	**DTC P0011 CAMSHAFT POSITION "A" - TIMING OVER - ADVANCED OR SYSTEM PERFORMANCE (BANK 1); DTC P0012 CAMSHAFT POSITION "A" - TIMING OVER-RETARDED (BANK 1)**
	VC output circuit	**VC OUTPUT CIRCUIT**
	ECM	**ECM**
Engine cranks normally but difficult to start	Fuel pump control circuit	**FUEL PUMP CONTROL CIRCUIT**
	Fuel pump	**INSPECTION**
	Fuel injector circuit	**FUEL INJECTOR CIRCUIT**
	ECM power source circuit	**ECM POWER SOURCE CIRCUIT**
	Engine coolant temperature sensor	**DTC P0115 ENGINE COOLANT TEMPERATURE CIRCUIT MALFUNCTION; DTC P0117 ENGINE COOLANT TEMPERATURE CIRCUIT LOW INPUT; DTC P0118 ENGINE COOLANT TEMPERATURE CIRCUIT HIGH INPUT**
	Air induction system	**ON-VEHICLE INSPECTION**
	Ignition system	**ON-VEHICLE INSPECTION**
	Spark plug	**ON-VEHICLE INSPECTION**
	Throttle body	**DTC P0120 THROTTLE / PEDAL POSITION SENSOR / SWITCH "A" CIRCUIT MALFUNCTION; 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**
	Compression	**ON-VEHICLE INSPECTION**
	Fuel pump control circuit	**FUEL PUMP CONTROL CIRCUIT**
	Fuel pump	**INSPECTION**
	Ignition circuit	**DTC P0351 IGNITION COIL "A" PRIMARY / SECONDARY CIRCUIT; DTC P0352 IGNITION COIL "B" PRIMARY / SECONDARY CIRCUIT; DTC P0353 IGNITION COIL "C"**

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Incomplete intermittent combustion occurs (Does not start)		PRIMARY / SECONDARY CIRCUIT; DTC P0354 IGNITION COIL "D" PRIMARY / SECONDARY CIRCUIT
	Ignition system	ON-VEHICLE INSPECTION
	Fuel injector circuit	FUEL INJECTOR CIRCUIT
	ECM power source circuit	ECM POWER SOURCE CIRCUIT
	Crankshaft position sensor	DTC P0335 CRANKSHAFT POSITION SENSOR "A" CIRCUIT; DTC P0339 CRANKSHAFT POSITION SENSOR "A" CIRCUIT INTERMITTENT
	Camshaft position sensor (for intake camshaft)	DTC P0010 CAMSHAFT POSITION "A" ACTUATOR CIRCUIT (BANK 1)
	Camshaft position sensor (for exhaust camshaft)	DTC P0013 CAMSHAFT POSITION "B" ACTUATOR CIRCUIT / OPEN (BANK 1)
	Valve timing	DTC P0011 CAMSHAFT POSITION "A" - TIMING OVER - ADVANCED OR SYSTEM PERFORMANCE (BANK 1); DTC P0012 CAMSHAFT POSITION "A" - TIMING OVER-RETARDED (BANK 1)
High engine idle speed	Throttle body	DTC P0120 THROTTLE / PEDAL POSITION SENSOR / SWITCH "A" CIRCUIT MALFUNCTION; 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
	Air induction system	ON-VEHICLE INSPECTION
	A/C signal circuit	-
	ECM power source circuit	ECM POWER SOURCE CIRCUIT
	Engine coolant temperature sensor	DTC P0115 ENGINE COOLANT TEMPERATURE CIRCUIT MALFUNCTION; DTC P0117 ENGINE COOLANT TEMPERATURE CIRCUIT LOW INPUT; DTC P0118 ENGINE COOLANT TEMPERATURE CIRCUIT HIGH INPUT
	PCV valve and	INSPECTION

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	hose	
Low engine idle speed (Poor idling)	Throttle body	**DTC P0120 THROTTLE / PEDAL POSITION SENSOR / SWITCH "A" CIRCUIT MALFUNCTION; 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**
	A/C signal circuit	-
	Fuel pump control circuit	**FUEL PUMP CONTROL CIRCUIT**
	Fuel pump	**INSPECTION**
	Air induction system	**ON-VEHICLE INSPECTION**
	PCV valve and hose	**INSPECTION**
Rough idling	Compression	**ON-VEHICLE INSPECTION**
	Ignition system	**ON-VEHICLE INSPECTION**
	Spark plug	**ON-VEHICLE INSPECTION**
	Fuel injector circuit	**FUEL INJECTOR CIRCUIT**
	ECM power source circuit	**ECM POWER SOURCE CIRCUIT**
	Fuel pump control circuit	**FUEL PUMP CONTROL CIRCUIT**
	Fuel pump	**INSPECTION**
	Throttle body	**DTC P0120 THROTTLE / PEDAL POSITION SENSOR / SWITCH "A" CIRCUIT MALFUNCTION; 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**
	Air induction	

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	system	**ON-VEHICLE INSPECTION**
	PCV valve and hose	**INSPECTION**
	Air fuel ratio sensor	**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)**
	Heated oxygen sensor	**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)**
	Mass air flow meter	**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**
Idle hunting	Throttle body	**DTC P0120 THROTTLE / PEDAL POSITION SENSOR / SWITCH "A" CIRCUIT MALFUNCTION; 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**
	Air induction system	**ON-VEHICLE INSPECTION**
	PCV valve and hose	**INSPECTION**
	Air fuel ratio sensor	**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)**
	Mass air flow meter	**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**
	Fuel pump control circuit	**FUEL PUMP CONTROL CIRCUIT**
	Fuel pump	**INSPECTION**
	Spark plug	**ON-VEHICLE INSPECTION**

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Hesitation/Poor acceleration	Ignition system	ON-VEHICLE INSPECTION
	Fuel injector circuit	FUEL INJECTOR CIRCUIT
	ECM power source circuit	ECM POWER SOURCE CIRCUIT
	Mass air flow meter	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
	Throttle body	DTC P0120 THROTTLE / PEDAL POSITION SENSOR / SWITCH "A" CIRCUIT MALFUNCTION; 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
	Air induction system	ON-VEHICLE INSPECTION
	Valve timing	DTC P0011 CAMSHAFT POSITION "A" - TIMING OVER - ADVANCED OR SYSTEM PERFORMANCE (BANK 1); DTC P0012 CAMSHAFT POSITION "A" - TIMING OVER-RETARDED (BANK 1)
	Compression	ON-VEHICLE INSPECTION
Surging (Poor driveability)	Spark plug	ON-VEHICLE INSPECTION
	Fuel pump control circuit	FUEL PUMP CONTROL CIRCUIT
	Fuel pump	INSPECTION
	Ignition system	ON-VEHICLE INSPECTION
	Fuel injector circuit	FUEL INJECTOR CIRCUIT
	ECM power source circuit	ECM POWER SOURCE CIRCUIT
	Mass air flow meter	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
	Variable valve	DTC P0011 CAMSHAFT POSITION "A" - TIMING OVER - ADVANCED OR SYSTEM PERFORMANCE (BANK 1); DTC

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	timing (VVT) system	**P0012 CAMSHAFT POSITION "A" - TIMING OVER-RETARDED (BANK 1)**
	Compression	**ON-VEHICLE INSPECTION**
Engine stalls soon after starting	Fuel pump control circuit	**FUEL PUMP CONTROL CIRCUIT**
	Fuel pump	**INSPECTION**
	Spark plug	**ON-VEHICLE INSPECTION**
	Ignition system	**ON-VEHICLE INSPECTION**
	Fuel injector circuit	**FUEL INJECTOR CIRCUIT**
	ECM power source circuit	**ECM POWER SOURCE CIRCUIT**
	Mass air flow meter	**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**
	Variable valve timing (VVT) system	**DTC P0011 CAMSHAFT POSITION "A" - TIMING OVER - ADVANCED OR SYSTEM PERFORMANCE (BANK 1); DTC P0012 CAMSHAFT POSITION "A" - TIMING OVER-RETARDED (BANK 1)**
	Throttle body	**DTC P0120 THROTTLE / PEDAL POSITION SENSOR / SWITCH "A" CIRCUIT MALFUNCTION; 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**
	Air induction system	**ON-VEHICLE INSPECTION**
	PCV valve and hose	**INSPECTION**
	Compression	**ON-VEHICLE INSPECTION**
Engine stalls only during A/C operation	A/C signal circuit	-
	ECM	**ECM**
Unable/difficult to refuel	Refueling valve (canister)	**INSPECTION**

TERMINALS OF ECM

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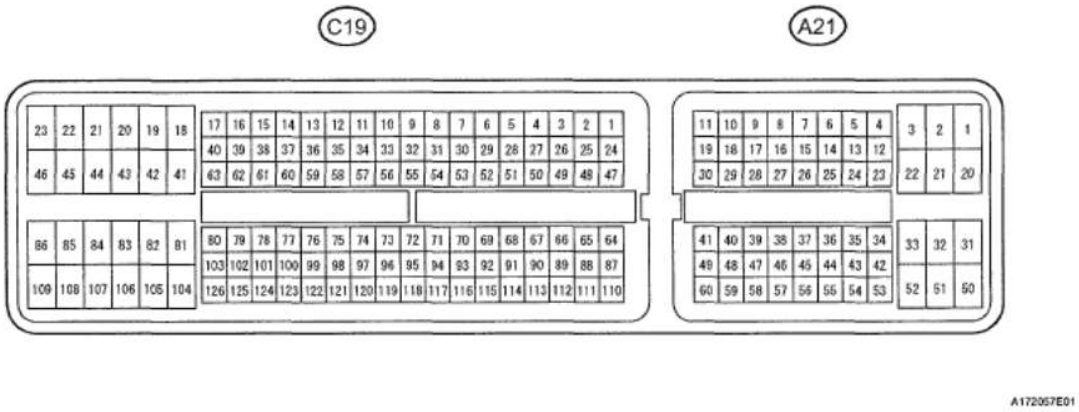


Fig. 12: Identifying ECM Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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 result of checks should be compared with the standard normal voltage for that pair of the terminals, and displayed in the "Specified Conditions" column. The illustration above can be used as a reference to identify the ECM terminal locations.

VOLTAGE SPECIFICATION

Terminal No. (Symbols)	Wiring Colors	Terminal Descriptions	Conditions	Specified Conditions
A21-20 (BATT) - C19-104 (E1)	Y - W	Battery (for measuring battery voltage and for ECM memory)	Always	11 to 14 V
A21-2 (+B) - C19-104 (E1)	B - W	Power source of ECM	Ignition switch ON	11 to 14 V
A21-1 (+B2) - C19-104 (E1)	B - W	Power source of ECM	Ignition switch ON	11 to 14 V
A21-3 (+BM) - C19-104 (E1)	GR - W	Power source of throttle actuator	Always	11 to 14 V
C19-85 (IGT1) - C19-104 (E1)	W - W	Ignition coil (ignition signal)	Idling	Pulse generation (see 1 waveform 1)
C19-84 (IGT2) - C19-104 (E1)	L - W			
C19-83 (IGT3) - C19-104 (E1)	G - W			
C19-82 (IGT4) - C19-104 (E1)	B - W			
C19-81 (IGF1) - C19-104 (E1)	Y - W	Ignition coil (ignition confirmation signal)	Ignition switch ON	4.5 to 5.5 V
			Idling	Pulse generation (see 1 waveform

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				1)
C19-122 (NE+) - C19-121 (NE-)	R - G	Crankshaft position sensor	Idling	Pulse generation (see 2 waveform 2)
C19-99 (G2+) - C19-98 (G2-)	P - W	Camshaft position sensor (for intake camshaft)	Idling	Pulse generation (see 2 waveform 2)
C19-76 (EV1+) - C19-75 (EV1-)	P - G	Camshaft position sensor (for exhaust camshaft)	Idling	Pulse generation (see 2 waveform 2)
C19-108 (#10) - C19-45 (E01)	R-BR	Fuel injector	Ignition switch ON	11 to 14 V
C19-107 (#20) - C19-45 (E01)	Y-BR			
C19-106 (#30) - C19-45 (E01)	P-BR		Idling	Pulse generation (see 3 waveform 3)
C19-105 (#40) - C19-45 (E01)	L-BR			
C19-109 (HA1A) - C19-46 (E04)	G - W-B	Air fuel ratio sensor (sensor 1) heater	Ignition switch ON	11 to 14 V
			Idling	Pulse generation (see 4 waveform 4)
C19-112 (A1A+) - C19-113 (A1A-)	Y - BR	Air fuel ratio sensor (sensor 1)	Idling	Below 3.3 V*1
C19-47 (HT1B) - C19-86 (E03)	R - W-B	Heated oxygen sensor (sensor 2) heater	Ignition switch ON	11 to 14 V
			Idling	Below 3.0 V
C19-64 (OX1B) - C19-87 (EX1B)	W - P	Heated oxygen sensor (sensor 2)	Engine speed maintained at 2,500 rpm for 2 minutes after warming up sensor	Pulse generation (see 5 waveform 5)
C19-110 (KNK1) - C19-111 (EKNK)	R - G	Knock sensor	Engine speed maintained at 4,000 after warming up engine	Pulse generation (see 6 waveform 6)
A21-8 (SPD) - C19-104 (E1)	V - W	Speed signal from combination meter	Driving at 20 km/h (12 mph)	Pulse generation (see 7 waveform 7)
C19-97 (THW) - C19-96 (ETHW)	L - P	Engine coolant temperature sensor	Idling, Engine coolant temperature 80°C (176°F)	0.2 to 1.0 V
C19-65 (THA) - C19-88 (ETHA)	Y - L	Intake air temperature sensor (built into mass air flow meter	Idling, Intake air temperature 20°C (68°F)	0.5 to 3.4 V
C19-118 (VG) - C19-116 (E2G)	P - G	Mass air flow meter	Idling, transmission gear neutral, A/C switch OFF	0.5 to 3.0 V
A21-24 (W) -			Ignition switch ON (MIL	Below 3.0 V

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C19-104 (E1)	B - W	MIL	goes ON)	
			Idling	11 to 14 V
A21-48 (STA) - C19-104 (E1)	BR - W	Starter signal	Ignition switch ON	Below 1.5 V
			Cranking	5.5 V or more
C19-52 (STAR) -C19-104 (E1)	B - W	Starter relay control	Ignition switch ON	Below 1.5 V
			Cranking	5.5 V or more
A21-13 (ACCR) - C19-104 (E1)	G - W	ACC (cut) relay control signal	Ignition switch ON	11 to 14 V
			Cranking	Below 1.5 V
A21-14 (STSW) - C19-104 (E1)	B - W	Starter relay operation signal	Ignition switch ON	Below 1.5 V
			Cranking	11 to 14 V
C19-115 (VTA1) - C19-91 (ETA)	Y - B	Throttle position sensor (for engine control)	Ignition switch ON, Throttle valve fully closed	0.5 to 1.1 V
			Ignition switch ON, Throttle valve fully open	3.2 to 4.8 V
C19-114 (VTA2) - C19-91 (ETA)	P - B	Throttle position sensor (for sensor malfunction detection)	Ignition switch ON, Accelerator pedal released	2.1 to 3.1 V
			Ignition switch ON, Accelerator pedal depressed	4.5 to 5.5 V
C19-67 (VCTA) - C19-91 (ETA)	W - B	Power source of sensor (specific voltage)	Ignition switch ON	4.5 to 5.5 V
A21-57 (VCPA) - A21-59 (EPA)	B - G	Power source of accelerator pedal position sensor (for VPA)	Ignition switch ON	4.5 to 5.5 V
A21-55 (VPA) - A21-59 (EPA)	R - G	Accelerator pedal position sensor (for engine control)	Ignition switch ON, Accelerator pedal released	0.5 to 1.1 V
			Ignition switch ON, Accelerator pedal fully depressed	2.5 to 4.5 V
A21-56 (VPA2) - A21-60 (EPA2)	L - BR	Accelerator pedal position sensor (for sensor malfunctioning detection)	Ignition switch ON, Accelerator pedal released	1.2 to 2.0 V
			Ignition switch ON, Accelerator pedal fully depressed	3.4 to 5.5 V
A21-58 (VCP2) - A21-60 (EPA2)	W - BR	Power source of accelerator pedal position sensor (for VPA2)	Ignition switch ON	4.5 to 5.5 V
C19-42 (M+) - C19-43 (ME01)	G - BR	Throttle actuator	Idling with warm engine	Pulse generation (see 8 waveform 8)
C19-41 (M-) - C19-43 (ME01)	R - BR	Throttle actuator	Idling with warm engine	Pulse generation (see 9 waveform 9)
A21-36 (STP) -	G - W	Stop light switch	Brake pedal depressed	11 to 14 V

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C19-104 (E1)			Brake pedal released	Below 1.5 V
A21-35 (ST1-) - C19-104 (E1)	Y - W	Stop light switch	Ignition switch ON, Brake pedal depressed	Below 1.5 V
			Ignition switch ON, Brake pedal released	11 to 14 V
C19-49 (PRG) - C19-104 (E1)	L - W	Purge VSV	Ignition switch ON	11 to 14 V
			Idling, under purge control	Pulse generation (see 10 waveform 10)
A21-7 (FC) - C19-104 (E1)	V - W	Fuel pump control	Ignition switch ON	11 to 14 V
			Idling	Below 1.5 V
A21-15 (TACH) - C19-104 (E1)	LG - W	Engine speed	Idling	Pulse generation (see 11 waveform 11)
A21-27 (TC) - C19-104 (E1)	P - W	Terminal TC of DLC3	Ignition switch ON	11 to 14V
C19-100 (OC1+) - C19-123 (OC1-)	Y - B	Camshaft timing oil control valve (OCV) (for intake camshaft)	Idling	Pulse generation (see 12 waveform 12)
A21-41 (CANH) - C19-104 (E1)	L - W	CAN communication line	Ignition switch ON	Pulse generation (see 13 waveform 13)
A21-49 (CANL) - C19-104 (E1)	W - W	CAN communication line	Ignition switch ON	Pulse generation (see 14 waveform 14)
A21-21 (FAN) - C19-104 (E1)	O - W	NO. 1 FAN relay	Ignition switch ON	11 to 14 V
			Idling with A/C ON or High engine coolant temperature	Below 1.5 V
A21-22 (FAN2) - C19-104 (E1)	LG - W	NO. 2 FAN relay	Idling with high engine coolant temperature	Below 1.5 V
A21-28 (IGSW) - C19-104 (E1)	R - W	Ignition switch	Ignition switch ON	11 to 14 V
A21-44 (MREL) - C19-104 (E1)	GR - W	EFI relay	Ignition switch ON	11 to 14 V
C19-60 (OE1+) - C19-61 (OE1-)	L - W	Camshaft timing oil control valve (OCV) (for exhaust camshaft)	Ignition switch ON	Pulse generation (see 15 waveform 15)
C19-70 (VCV1) - C19-104 (E1)	R - W	Power source of camshaft position sensor (for intake camshaft)	Ignition switch ON	4.5 to 5.5 V
C19-117 (VC) - C19-104 (E1)	L - W	Power source of camshaft position sensor (for exhaust camshaft)	Ignition switch ON	4.5 to 5.5 V
A21-31 (ELS) -			Tail light switch ON	7.5 to 14 V

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C19-104 (E1)	G - W	Electric load	Tail light switch ON	Below 1.5 V
A21-33 (ELS3) - C19-104 (E1)	V - W	Electric load	Defogger switch ON	7.5 to 14 V
			Defogger switch ON	Below 1.5 V
A21-42 (VPMP) - C19-104 (E1)	P - W	Vent valve (built into canister pump module)	Ignition switch ON	11 to 14 V
A21-34 (MPMP) - C19-104 (E1)	V - W	Leak detection pump (built into canister pump module)	Leak detection pump OFF	Below 3 V
			Leak detection pump ON	11 to 14 V
C19-69 (VCPP) - C19-92 (EPPM)	V - B	Power source for canister pressure sensor (specific voltage)	Ignition switch ON	4.5 to 5.5 V
C19-68 (PPMP) - C19-92 (EPPM)	L - B	Canister pressure sensor (built into canister pump module)	Ignition switch ON	3 to 3.6 V
HINT: *1: The ECM terminal voltage is constant regardless of the output voltage from the sensor.				

1. **WAVEFORM 1**

Igniter IGT signal (from ECM to igniter)

WAVEFORM REFERENCE (WAVEFORM 1)

ECM Terminal Name	Between IGT (1 to 4) and E1 Between IGF1 and E1
Tester Range	2 v/DIV, 20 ms/DIV
Condition	Idling

HINT:

The wavelength becomes shorter as the engine rpm increases.

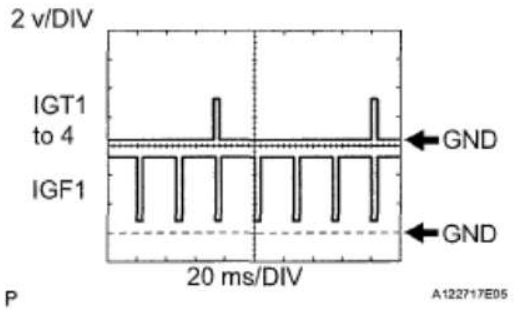


Fig. 13: Waveform Graph (Waveform 1)
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2. **WAVEFORM 2**

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Crankshaft position sensor and camshaft position sensors

WAVEFORM REFERENCE (WAVEFORM 2)

ECM Terminal Name	Between NE+ and NE- Between G2+ and G2- Between EV1+ and EV1-
Tester Range	5 v/DIV, 20 ms/DIV
Condition	Idle after engine warmed-up

HINT:

The wavelength becomes shorter as the engine rpm increases.

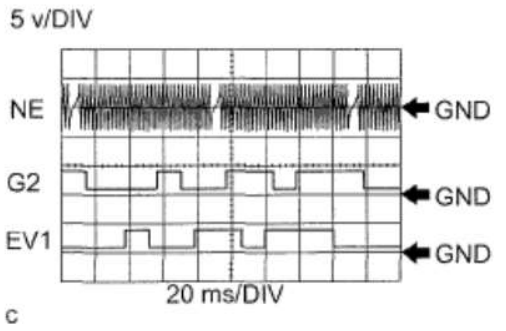


Fig. 14: Waveform Graph (Waveform 2)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

3. **WAVEFORM 3**

No. 1 (to No. 4) injector signal

WAVEFORM REFERENCE (WAVEFORM 3)

ECM Terminal Name	Between #10 (to #40) and E01
Tester Range	20 v/DIV, 20 ms/DIV
Condition	Idling

HINT:

The wavelength becomes shorter as the engine rpm increases.

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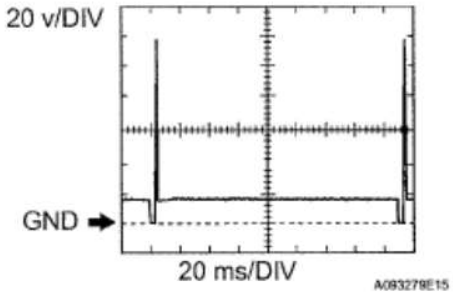


Fig. 15: Waveform Graph (Waveform 3)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

4. **WAVEFORM 4**

Air fuel ration sensor (sensor 1) heater

WAVEFORM REFERENCE (WAVEFORM 4)

ECM Terminal Name	Between HA1A and E04
Tester Range	5 v/DIV, 10 ms/DIV
Condition	Idling with warm engine

HINT:

The wavelength varies in accordance with the engine operating condition.

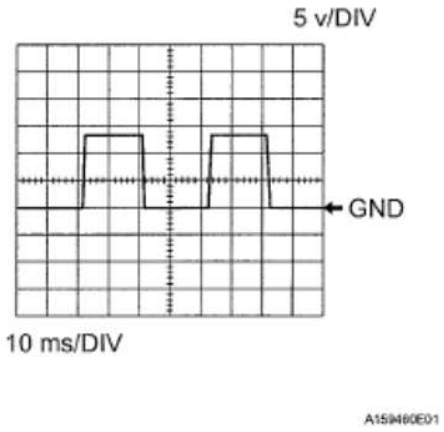


Fig. 16: Waveform Graph (Waveform 4)
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5. **WAVEFORM 5**

Heated oxygen sensor (sensor 2)

WAVEFORM REFERENCE (WAVEFORM 5)

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ECM Terminal Name	Between OX1B and EX1B
Tester Range	0.2 v/DI.V, 200 ms/DIV
Condition	Maintain engine speed at 2,500 rpm for 2 minutes after warming up sensor

HINT:

In the Data List, the items O2S B1 S2 show the values input to the ECM from the heated oxygen sensor.

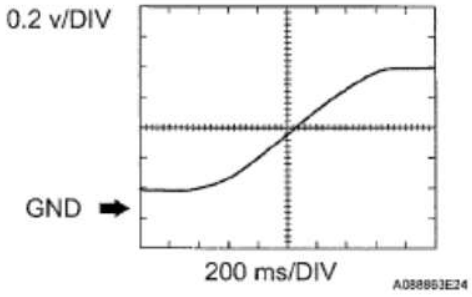


Fig. 17: Waveform Graph (Waveform 5)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

6. **WAVEFORM 6**

Knock sensor

WAVEFORM REFERENCE (WAVEFORM 6)

ECM Terminal Name	Between KNK1 and EKNK
Tester Range	500 mv/DIV, 1 ms/DIV
Condition	Maintain engine RPM at 4,000 rpm after engine warmed-up

HINT:

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

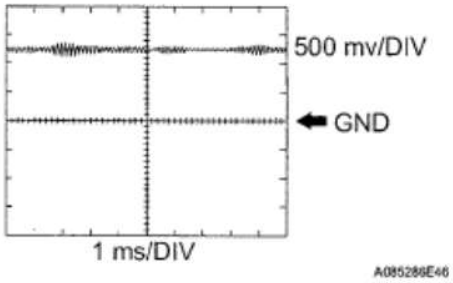


Fig. 18: Waveform Graph (Waveform 6)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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7. **WAVEFORM 7**

Vehicle speed signal

WAVEFORM REFERENCE (WAVEFORM 7)

ECM Terminal Name	Between SPD and E1
Tester Range	5 v/DIV, 20 ms/DIV
Condition	Rotate driving wheel slowly

HINT:

The wavelength becomes shorter as the vehicle speed increases.

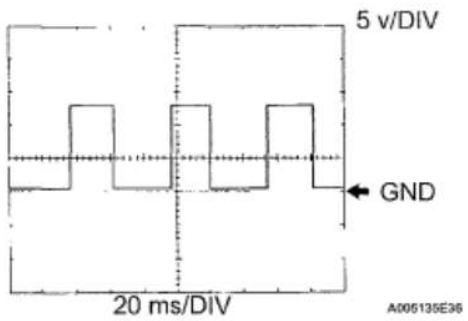


Fig. 19: Waveform Graph (Waveform 7)
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8. **WAVEFORM 8**

Throttle actuator positive terminal

WAVEFORM REFERENCE (WAVEFORM 8)

ECM Terminal Name	Between M+ and ME01
Tester Range	5 v/DIV, 1 ms/DIV
Condition	Idle after engine warmed-up

HINT:

The duty ratio varies depending on the throttle actuator operation.

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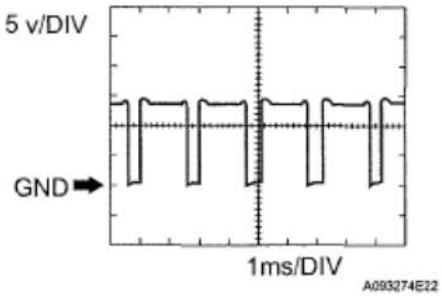


Fig. 20: Waveform Graph (Waveform 8)
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9. **WAVEFORM 9**

Throttle actuator negative terminal

WAVEFORM REFERENCE (WAVEFORM 9)

ECM Terminal Name	Between M- and ME01
Tester Range	5 v/DIV, 1 ms/DIV
Condition	Idle after engine warmed-up

HINT:

The duty ratio varies depending on the throttle actuator operation.

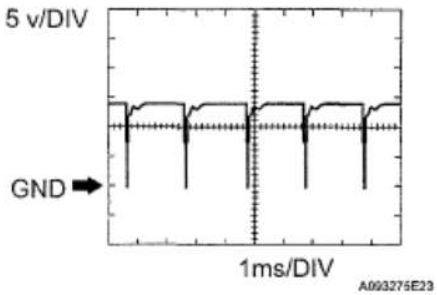


Fig. 21: Waveform Graph (Waveform 9)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

10. **WAVEFORM 10**

Purge VSV

WAVEFORM REFERENCE (WAVEFORM 10)

ECM Terminal Name	Between PRG and E1
Tester Range	10 v/DIV, 20 ms/DIV
Condition	Idling, under purge control

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HINT:

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

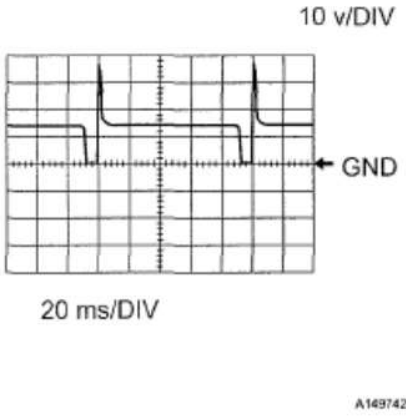


Fig. 22: Waveform Graph (Waveform 10)
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11. **WAVEFORM 11**

Engine speed signal

WAVEFORM REFERENCE (WAVEFORM 11)

ECM Terminal Name	Between TACH and E1
Tester Range	5 v/DIV, 10ms/DIV
Condition	Idling

HINT:

The wavelength becomes shorter as the engine rpm increases.

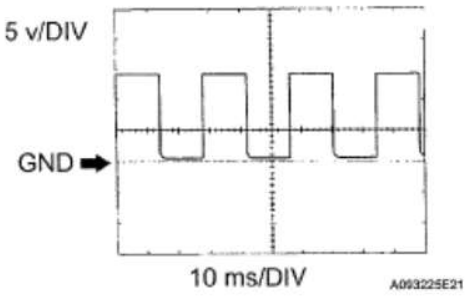


Fig. 23: Waveform Graph (Waveform 11)
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12. **WAVEFORM 12**

Camshaft timing oil control valve (OCV) (for intake camshaft)

WAVEFORM REFERENCE (WAVEFORM 12)

ECM Terminal Name	Between OC1+ and OC1-
Tester Range	5 v/DIV, 1ms/DIV
Condition	Idling

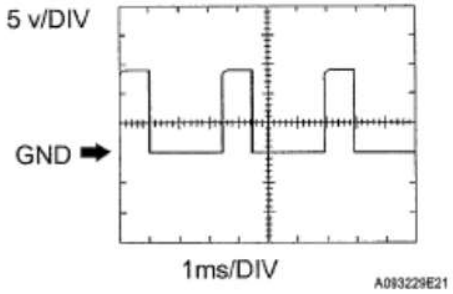


Fig. 24: Waveform Graph (Waveform 12)
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13. **WAVEFORM 13**

CAN communication signal (Reference)

WAVEFORM REFERENCE (WAVEFORM 13)

ECM Terminal Name	Between CANH and E1
Tester Range	1 v/DIV, 10 µs/DIV
Condition	Engine stop and ignition switch ON

HINT:

The waveform varies depending on the CAN communication signal.

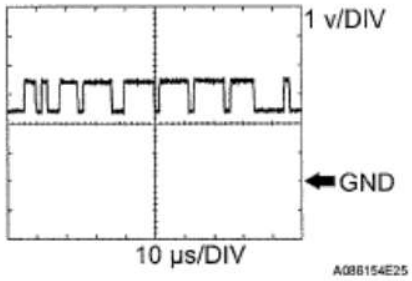


Fig. 25: Waveform Graph (Waveform 13)
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14. **WAVEFORM 14**

CAN communication signal (Reference)

WAVEFORM REFERENCE (WAVEFORM 14)

ECM Terminal Name	Between CANL and E1
Tester Range	1 v/DIV, 10 µs/DIV
Condition	Engine stop and ignition switch ON

HINT:

The waveform varies depending on the CAN communication signal.

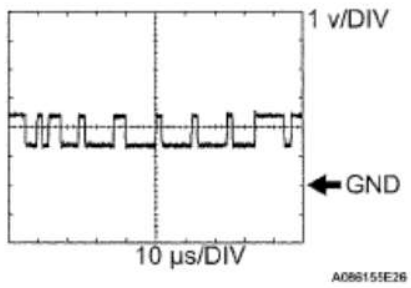


Fig. 26: Waveform Graph (Waveform 14)
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15. **WAVEFORM 15**

Camshaft timing oil control valve (OCV) (for exhaust camshaft)

WAVEFORM REFERENCE (WAVEFORM 15)

ECM Terminal Name	Between OE1+ and OE1-
Tester Range	5 v/DIV, 1ms/DIV
Condition	Idling

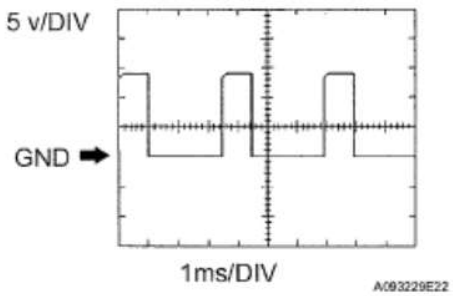


Fig. 27: Waveform Graph (Waveform 15)
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DIAGNOSIS SYSTEM

1. DESCRIPTION

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

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

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

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

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



Fig. 28: Identifying Malfunction Indicator Lamp
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

2. NORMAL MODE AND CHECK MODE

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

3. TRIP DETECTION LOGIC

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

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

   The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can be helpful in determining whether the vehicle was 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.

6. **BATTERY VOLTAGE**

   Standard voltage:

   11 to 14 V

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

7. **MIL (Malfunction Indicator Lamp)**
   a. The MIL is illuminated when the ignition switch is first turned to ON (the engine is not running).
   b. The MIL 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 is not illuminated when the ignition switch is first turned to ON, check the MIL circuit (See **MIL CIRCUIT**).

8. **ALL READINESS**

   HINT:

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

   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the tester ON.
   d. Clear the DTCs (See **DTC CHECK / CLEAR**).
   e. Perform the DTC judgment driving pattern to run the DTC judgment.

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f. Select the following menu items: Powertrain / Engine / Utility / All Readiness.
g. Input the DTCs to be confirmed.
h. Check the DTC judgment result.

Techstream

TESTER DISPLAY DESCRIPTION

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

HINT:

- DTCs which are stored in the ECM can be displayed on a Techstream. The Techstream can display the current and pending DTCs.
- Same DTCs are not set if the ECM does not detect the same malfunction again during a second consecutive driving cycle. However, such malfunctions, detected on only one occasion, are stored as pending DTCs.

1. **CHECK DTC**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the tester ON.
   d. Select the following menu items: Powertrain / Engine and ECT / Trouble Codes.
   e. Check the DTC(s) and freeze frame data, and then write them down.
   f. Check the details of the DTC(s) (See **DIAGNOSTIC TROUBLE CODE CHART**).

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2. **CLEAR DTC**
   a. Connect the Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   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 Techstream)**
   a. Perform either of the following operations:
      1. Disconnect the negative battery cable for more than 1 minute.
      2. Remove the EFI and ETCS fuses from the engine room relay block located inside the engine compartment for more than 1 minute.

FREEZE FRAME DATA

1. **DESCRIPTION**

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

HINT:

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

The ECM records engine conditions in the form of freeze frame data every 0.5 seconds. Using a 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.

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

2. **LIST OF FREEZE FRAME DATA**

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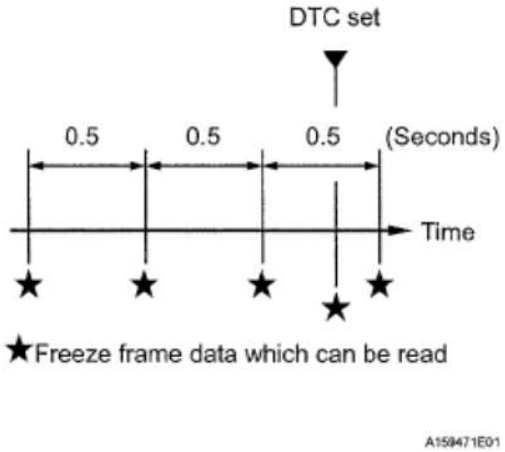


Fig. 29: [DTC Timing Chart]
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

LIST OF FREEZE FRAME DATA

Tester Display	Measurement Item	Diagnostic Note
Injector (Port)	Injection period of No. 1 cylinder	-
IGN Advance	Ignition timing advance for No. 1 cylinder	-
Calculate Load	Calculated load by ECM	-
Vehicle Load	Vehicle load	Load percentage in terms of maximum intake air flow amount
MAF	Air flow rate from Mass Air Flow (MAF) meter	If value approximately 0.0 g/sec: • MAF meter power source circuit open • VG circuit open or short If value 271.0 g/sec or more: • E2G circuit open
Engine Speed	Engine speed	-
Vehicle Speed	Vehicle speed	Speed indicated on speedometer
Coolant Temp	Engine coolant temperature	• If value -40°C (-40°F): sensor circuit open • If value 140°C (284°F): sensor circuit shorted
Intake Air	Intake air temperature	• If value -40°C (-40°F): sensor circuit open • If value 140°C (284°F): sensor circuit shorted
Air-Fuel Ratio	Ratio compared to stoichiometric level	-
Purge Density		

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Learn Value	Learning value of purge density	Service data
Evap Purge Flow	Ratio of evaporative purge flow to intake air volume	Service data
EVAP (Purge) VSV	EVAP (Purge) VSV control duty	Order signal from ECM
Knock Correct Learn Value	Correction learning value of knocking	Service data
Knock Feedback Value	Feedback value of knocking	Service data
Accelerator Position No.1	Accelerator pedal position No. 1	-
Accelerator Position No.2	Accelerator pedal position No. 2	-
Throttle Position	Absolute throttle position sensor	Calculated value based on VTA1 Read value with ignition switch ON
Throttle Sensor Position	Throttle sensor positioning	Recognition value for throttle opening angle on ECM Read value with ignition switch ON
Throttle Sensor Position #2	Absolute throttle sensor positioning #2	Recognition value for throttle opening angle on ECM Read value with ignition switch ON
Throttle Motor	Throttle actuator	-
O2S B1 S2	Heated oxygen sensor output voltage for bank 1 sensor 2	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 B1 S1	A/F sensor output voltage for bank 1 sensor 1	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
Short FT #1	Short-term fuel trim of bank 1	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	Overall fuel compensation carried out in long-term to compensate continual deviation of short-term fuel trim from central value
Fuel System Status (Bank 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 • OLDRIVE: Open loop due to driving conditions (fuel enrichment) • OLFAULT: Open loop due to detected system fault • CLFAULT: Closed loop but heated oxygen sensor, which is used for fuel control,
Fuel System Status (Bank 2)	Fuel system status (bank 2)	

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		malfunctioning
AF FT B1 S1	Short-term fuel trim associated with bank 1 sensor 1	-
AFS B1 S1	Air fuel ratio sensor output current for bank 1 sensor 1	Value becomes higher when fuel-cut executed under high engine speed
Catalyst Temp (B1 S1)	Catalyst temperature (associated sensor 1)	-
Catalyst Temp (B1 S2)	Catalyst temperature (associated sensor 2)	-
Sub O2S Impedance B1S2	Sub heated oxygen sensor impedance (bank 1 sensor 2)	-
Initial Engine Coolant Temp	Initial engine coolant temperature	Service data
Initial Intake Air Temp	Initial intake air temperature	Service data
Injection Volum (Cylinder 1)	Injection volume (Cylinder 1)	Quantity of fuel injection volume for 10 times
Starter Signal	Starter signal (STA terminal input status)	-
Power Steering Switch	Power steering switch	-
Closed Throttle Position SW	Closed throttle position switch	-
Stop Light Switch	Stop light switch status	-
Battery Voltage	Battery voltage	-
Atmosphere Pressure	Atmospheric pressure	-
EVAP Purge VSV	VSV status for EVAP control	Active Test support data
Fuel Pump/Speed Status	Fuel pump/status	Active Test support data
VVT Control Status (Bank 1)	VVT control (bank 1) status	Active Test support data
Vacuum Pump	Key-off EVAP system leak detection pump status	Active Test support data
EVAP System Vent Valve	key-off EVAP system vent valve status	Active Test support data
Electric Fan Motor	Electric cooling fan motor	Active Test support data
TC and TE1	TC and CG (TE1) terminals of DLC3	Active Test support data
		Output only when Check the Cylinder Compression

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Engine Speed of Cyl #1	Engine RPM for cylinder 1	performed using Active Test 51199 rpm: Not performed Active Test
Engine Speed of Cyl #2	Engine RPM for cylinder 2	Output only when Check the Cylinder Compression performed using Active Test 51199 rpm: Not performed Active Test
Engine Speed of Cyl #3	Engine RPM for cylinder 3	Output only when Check the Cylinder Compression performed using Active Test 51199 rpm: Not performed Active Test
Engine Speed of Cyl #4	Engine RPM for cylinder 4	Output only when Check the Cylinder Compression performed using Active Test 51199 rpm: Not performed Active Test
Av Engine Speed of All Cyl	Engine RPM for all cylinders	Output only when Check the Cylinder Compression performed using Active Test 51199 rpm: Not performed Active Test
VVT Aim Angle (Bank 1)	VVT aim angle (bank 1)	VVT duty signal value during intrusive operation
VVT Change Angle (Bank 1)	VVT change angle (bank 1)	Displacement angle during intrusive operation
VVT OCV Duty (Bank 1)	VVT OCV operation duty	Requested duty value for intrusive operation
Idle Fuel Cut	Fuel cut idle	Idle Fuel Cut = "ON" when throttle valve fully closed and engine speed over 2800 rpm
FC TAU	Fuel cut TAU (Fuel cut during very light load)	Fuel cut being performed under very light load to prevent engine combustion from becoming incomplete
Ignition	Ignition counter to calculated misfire rate	-
Cylinder #1 Misfire Count	Misfire ratio of cylinder 1	This item displayed only when idling
Cylinder #2 Misfire Count	Misfire ratio of cylinder 2	This item displayed only when idling
Cylinder #3 Misfire Count	Misfire ratio of cylinder 3	This item displayed only when idling
Cylinder #4 Misfire Count	Misfire ratio of cylinder 4	This item displayed only when idling
All Cylinders Misfire Count	All cylinders misfire rate	-
Multiple Cylinders Misfire Count	Multiple cylinders misfire rate	-
Misfire RPM	Average engine speed when misfire occurs	-
Misfire Load	Average engine load when misfire occurred	-

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Misfire Margin	Margin to detect engine misfire	Misfire detection margin
Catalyst OT MF F/C	Catalyst overheat misfire prevention fuel cut function availability	Service data
Cat OT MF F/C History	Catalyst overheat misfire prevention fuel cut function history	Service data
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)	-
Engine Run Time	Engine run time	-
Time after DTC Cleared	Time since DTCs cleared	-
Distance from DTC Cleared	Distance traveled since DTCs cleared	-
Warmup Cycle Cleard DTC	Warm-up cycles since DTCs cleared	Number of warm-up cycles since DTCs cleared

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CHECK MODE PROCEDURE

Compared to normal mode, check mode is more sensitive to malfunctions. Therefore, check mode can detect the malfunctions that cannot be detected in 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 from ON to ACC or OFF while in check mode. Before changing modes, always check and note any DTCs and freeze frame data.

1. **CHECK MODE PROCEDURE**
   a. Check and ensure the following conditions:
      1. Battery voltage 11 V or more.
      2. Throttle valve fully closed.
      3. Transmission in the P or N (neutral) position.
      4. A/C switch OFF.

b. Turn the ignition switch to OFF.
c. Connect a Techstream to the DLC3.
d. Turn the ignition switch to ON.
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 the MIL flashes as shown in the illustration.
i. Start the engine.
j. Make sure the MIL turns OFF.
k. Simulate the conditions of the malfunction described by the customer.
l. Check DTCs and freeze frame data using the tester.

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 or stops fuel injection.

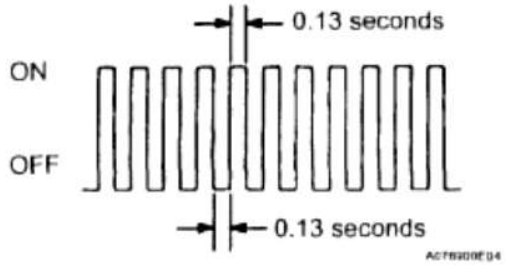


Fig. 30: Identifying MIL Flashes
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

FAIL-SAFE CHART

DTC	Component	Fail-Safe Operation	Fail-Safe Deactivation Condition
P0031 P0032	Air Fuel Ratio (A/F) Sensor Heater	ECM turns off A/F sensor heater	Ignition switch OFF
P0037 P0038	Heated Oxygen (HO2) Sensor Heater	ECM turns off HO2 sensor heater	Ignition switch OFF
P0102 P0103	Mass Air Flow (MAF) Meter	ECM calculates ignition timing according to engine speed and throttle valve position	Pass condition detected
P0112 P0113	Intake Air Temperature (IAT) Sensor	ECM estimates IAT to be 20°C (68°F)	Pass condition detected

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P0115 P0117 P0118	Engine Coolant Temperature (ECT) Sensor	ECM estimates ECT to be 80°C (176°F)	Pass condition detected
P0120 P0121 P0122 P0123 P0220 P0222 P0223 P0604 P0606 P060A P060D P060E P0657 P1607 P2102 P2103 P2111 P2112 P2118 P2119 P2135	Electronic Throttle Control System (ETCS)	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
P0300 P0301 P0302 P0303 P0304 *2	• Fuel injector • Electronic Throttle Control System (ETCS)	When catalyst damage misfire occurs (MIL blinking), following fail-safe operation performed for catalyst overheat malfunction prevention 1. Under low load and low engine speed o Fuel cut performed on malfunctioning cylinder 2. Under high load and high engine speed o Throttle valve opening angle control is performed o All cylinder fuel cut or malfunction cylinder fuel cut	Pass condition detected and then ignition switch turned OFF
P0327 P0328	Knock Sensor	ECM sets ignition timing to maximum retard	Ignition switch OFF
P0351 to P0354	Igniter	ECM cuts fuel	Pass condition detected
P2120 P2121 P2122 P2123	Accelerator Pedal Position (APP)	APP sensor has 2 sensor circuits: Main and Sub. If either of circuits malfunctions, ECM controls engine using other circuit.	Pass condition detected and then

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P2125 P2127 P2128 P2138	Sensor	If both of circuits malfunction, ECM regards accelerator pedal as being released. As a result, throttle valve is closed and engine idles.	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:

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

NOTE: In the table below, the values listed under Normal Condition are reference 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 to OFF.
c. Connect the Techstream to the DLC3.
d. Turn the ignition switch to ON.
e. Turn the tester ON.
f. Select the following menu items: Powertrain / Engine and ECT / Data List.
g. According to the display on tester, read the DATA LIST.

DATA LIST

Tester Display	Measurement Item/Range	Normal Condition *1	Diagnostic Note
Injector (Port)	Injection period of No. 1 cylinder: Min.: 0 ms, Max.: 32.64 ms	1.0 to 3.0 ms: Idling	-
IGN Advance	Ignition timing advance for No. 1 cylinder: Min.: -64 deg., Max.:	BTDC 0 to 15 deg: Idling	-

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	63.5 deg.		
Calculate Load	Calculated load by ECM: Min.: 0%, Max.: 100%	• 10 to 30%: Idling • 10 to 30%: Running without load (2500 rpm)	-
Vehicle Load	Vehicle load: Min.: 0%, Max.: 25700%	Actual vehicle load	Load percentage in terms of maximum intake air flow amount
MAF	Air flow rate from Mass Air Flow (MAF) meter: Min.: 0 g/sec, Max.: 655.35 g/sec	1 to 3 g/sec: Idling 2 to 7 g/sec: Running without load (2500 rpm)	If value approximately 0.0 g/sec: • MAF meter power source circuit open • VG circuit open or short If value 160.0 g/sec or more: • E2G circuit open
Engine Speed	Engine speed: Min.: 0 rpm, Max.: 16383.75 rpm	650 to 750 rpm: Idling	-
Vehicle Speed	Vehicle speed: Min.: 0 km/h (0 mph), Max.: 255 km/h (158.4 mph)	Actual vehicle speed	Speed indicated on speedometer
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 -40°C (-40°F): sensor circuit open • If value 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 -40°C (-40°F): sensor circuit open • If value 140°C (284°F): sensor circuit shorted
Air-Fuel Ratio	Ratio compared to stoichiometric level: Min.: 0, Max.: 1.999	0.8 to 1.2: Idling	-
Purge Density Learn Value	Learning value of purge density: Min.: -50, Max.: 350	-40 to 10: Idling	Service data
Evap Purge Flow	Ratio of evaporative purge flow to intake air volume:: Min.: 0%, Max.: 102.4%	0 to 10%: Idling	Service data

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EVAP (Purge) VSV	EVAP (Purge) VSV control duty: Min.: 0%, Max.: 100%	10 to 50%: Idling, under purge control	Order signal from ECM
Vapor Pressure Pump	Vapor pressure: Min.: 33.853 kPa, Max.: 125.596 kPa	Approximately 100 kPa (absolute): Ignition switch ON	EVAP system pressure monitored by canister pressure sensor
Vapor pressure (calculated)	Vapor pressure (calculated): Min.: -5.632 kPa, Max.: 715.264 kPa	Approximately 100 kPa (absolute): Ignition switch ON	EVAP system pressure monitored by canister pressure sensor
Knock Correct Learn Value	Correction learning value of knocking: Min.: -64°CA, Max.: 1984°CA	0 to 20°CA: Driving at 70 km/h (44 mph)	Service data
Knock Feedback Value	Feedback value of knocking: Min.: -64°CA, Max.: 1984°CA	-20 to 0°CA: Driving at 70 km/h (44 mph)	Service data
Clutch Current	Clutch current: Min.: 0A, Max.: 2.49 A	-	-
Accelerator Position No.1	Accelerator pedal position No. 1: Min.: 0%, Max.: 100%	10 to 22%: Accelerator pedal released 52 to 90%: Accelerator pedal fully depressed	-
Accelerator Position No.2	Accelerator pedal position No. 2: Min.: 0%, Max.: 100%	24 to 40%: Accelerator pedal released 68 to 100%: Accelerator pedal fully depressed	-
Accelerator Position No.1	Accelerator pedal position sensor No. 1 voltage: Min.: 0 V, Max.: 4.98 V	-	ETCS service data
Accelerator Position No.2	Accelerator pedal position sensor No. 2 voltage: Min.: 0 V, Max.: 4.98 V	-	ETCS service data
Accelerator Position 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	-
Accelerator	Accelerator pedal position sensor No. 2	1.2 to 2.0 V: Accelerator pedal released	

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Position No.2	voltage: Min.: 0 V, Max.: 5 V	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	-
Throttle Fully Close Learn	Throttle valve fully closed (learned value): Min.: 0 V, Max.: 5 V	0.4 to 0.8 V	-
Accel Fully Close #1 (AD)	Accelerator fully closed value No. 1 (AD): Min.: 0 V, Max.: 4.98 V	-	ETCS service data
Accel Fully Close Learn #1	Accelerator fully closed learning value No. 1: Min.: 0 deg, Max.: 124.512 deg	-	ETCS service data
Accel Fully Close Learn #2	Accelerator fully closed learning value No. 2: Min.: 0 deg., Max.: 124.512 deg.	-	ETCS service data
Fail Safe Drive	Whether or not fail safe function executed: ON or OFF	ON: ETCS has failed	ETCS service data
Fail Safe Drive (Main CPU)	Whether or not fail safe function executed: ON or OFF	ON: ETCS has failed	ETCS service data
ST1	Brake pedal signal: ON or OFF	ON: Brake pedal depressed	-
System Guard	System guard: ON or OFF	-	ETCS service data
Open Side Malfunction	Open side malfunction: ON or OFF	-	ETCS service data
Throttle Position	Absolute throttle position sensor: Min.: 0%, Max.: 100%	• 10 to 22%: Throttle fully closed • 66 to 98%:	Calculated value based on VTA1 Read value with ignition switch ON

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		Throttle fully open	
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	Throttle sensor positioning: Min.: 0%, Max.: 100%	0 to 10%: Throttle fully closed 50 to 80%: Throttle fully open	Recognition value for throttle opening angle on ECM Read value with ignition switch ON
Throttle Sensor Position #2	Absolute throttle sensor positioning #2: Min.: 0%, Max.: 100%	42 to 62%: Throttle fully closed 92 to 100%: Throttle fully open	Recognition value for throttle opening angle on ECM Read value with ignition switch ON
Throttle Position No.1	Throttle position sensor No. 1 output voltage: Min.: 0 V, Max.: 4.98 V	-	ETCS service data
Throttle Position No.2	Throttle position sensor No. 2 output voltage: Min.: 0 V, Max.: 4.98 V	-	ETCS service data
Throttle Position No.1	Throttle position No. 1: Min.: 0 V, Max.: 5 V	• 0.5 to 1.1 V: Throttle fully closed • 3.3 to 4.9 V: Throttle fully open	-
Throttle Position No.2	Throttle position No. 2: Min.: 0 V, Max.: 5 V	• 2.1 to 3.1 V: Throttle fully closed • 4.6 to 5.0 V: Throttle fully open	-
Throttle Position Command	Throttle position command value: Min.: 0 V, Max.: 4.9804 V	0.5 to 4.9 V	ETCS service data
Throttle Sens Open Pos #1	Throttle sensor opener position No. 1: Min.: 0 V, Max.: 4.9804 V	0.6 to 1.0 V	ETCS service data

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Throttle Sens Open Pos #2	Throttle sensor opener position No. 2: Min.: 0 V, Max.: 4.9804 V	2.0 to 2.6 V	ETCS 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: Idling	ETCS service data
Throttle Motor	Whether or not throttle actuator control permitted: ON or OFF	ON: Idling	Read value with ignition switch ON (do not start engine)
Throttle Motor Current	Throttle actuator current: Min.: 0 A, Max.: 20 A	0 to 3.0 A: Idling	-
Throttle Motor	Throttle actuator: Min.: 0%, Max.: 100%	0.5 to 40%: Idling	-
Throttle Motor Current	Throttle actuator 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 depressed, duty ratio increased
Throttle Motor Close Duty	Throttle actuator closed duty ratio: Min.: 0%, Max.: 100%	0 to 40%: Idling	When accelerator pedal released quickly, duty ratio increased
Throttle Motor Duty (Open)	Throttle actuator duty ratio (open): Min.: 0%, Max.: 100%	0 to 40%: Idling	-
Throttle Motor Duty (Close)	Throttle actuator duty ratio (close): Min.: 0%, Max.: 100%	0 to 40%: Idling	-
O2S B1 S2	Heated oxygen sensor output voltage for bank 1 sensor 2: Min.: 0 V, Max.: 1.275 V	0.0 to 0.9 V: Driving at 70 km/h (44 mph)	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 B1 S1	A/F sensor output voltage for bank 1 sensor 1:	2.6 to 3.8 V: Idling,	Performing Control the Injection Volume or Control the Injection Volume for A/F Sensor function

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	Min.: 0 V, Max.: 7.999 V	engine warmed up	of Active Test enables technician to check output voltage of sensor
Short FT #1	Short-term fuel trim of bank 1: Min.:-100%, Max.: 99.2%	-20 to 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%	-20 to 20%	Overall fuel compensation carried out in long-term to compensate continual deviation of short-term fuel trim from central value
Fuel System Status (Bank 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 go closed loop • CL (Closed Loop): Using heated oxygen sensor as feedback for fuel control • OLDRIVE: Open loop due to driving conditions (fuel enrichment) • OLFAULT: Open loop due to detected system fault • CLFAULT: Closed loop but heated oxygen sensor, which used for fuel control malfunctioning
Fuel System Status (Bank 2)	Fuel system status (bank 2):	Unused	
AF FT 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	-
AFS B1 S1	Air fuel ratio sensor output current for bank 1 sensor 1: Min.: -128 mA, Max.: 127.99 mA	-0.5 to 0.5 mA: Idling, engine warmed up	Value becomes higher when fuel-cut executed under high engine speed
Catalyst Temp (B1 S1)	Catalyst temperature (associated sensor 1): Min.: -40°C (-40°F), Max.: 6513.5°C (11756.3°F)	Close to catalyst inlet temperature	-

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Catalyst Temp (B1 S2)	Catalyst temperature (associated sensor 2): Min.: -40°C (-40°F), Max.: 6513.5°C (11756.3°F)	Close to catalyst outlet temperature	-
Sub O2S Impedance B1S2	Sub heated oxygen sensor impedance (bank 1 sensor 2): Min.: 0 ohm, Max.: 21247.68 ohm	5 to 15000 ohm: After driving for 10 minutes or more in urban area	-
Initial Engine Coolant Temp	Initial engine coolant temperature: Min.: -40°C (-40°F), Max.: 120°C (248°F)	Coolant temperature when engine started	Service data
Initial Intake Air Temp	Initial intake air temperature: Min.: -40°C (-40°F), Max.: 120°C(248°F)	Intake air temperature when engine started	Service data
Injection Volum (Cylinder 1)	Injection volume (Cylinder 1): Min.: 0 ml, Max.: 2.048 ml	0.05 to 0.15 ml: Idling	Quantity of fuel injection volume for 10 times
ACC Relay	ACC (cut) relay (ACCR terminal output status): ON or OFF	ON: Cranking	-
Starter Relay	Starter relay (STAR terminal output status): ON or OFF	ON: Cranking	-
Starter Signal	Starter signal (STA terminal input status): ON or OFF	ON: Cranking	-
Starter Control	Starter switch signal (STSW terminal input status): ON or OFF	ON: Cranking (during ignition switch or engine switch operation)	-
Power Steering Switch	Power steering switch: ON or OFF	-	-
Closed Throttle Position SW	Closed throttle position switch: ON or OFF	• ON: Throttle fully closed • OFF: Throttle open	-
	Stop light switch		

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Stop Light Switch	status: ON or OFF	ON: Brake pedal depressed	-
ETCS Actuator Power	Whether or not electric throttle control system power input: ON or OFF	ON: Idling	-
+BM Voltage	+BM voltage: Min.: 0, Max.: 19.922	10 to 15: Idling	-
Battery Voltage	Battery voltage: Min.: 0 V, Max.: 65.535 V	11 to 14 V: Idling	-
Actuator Power Supply	Actuator power supply ON or OFF	ON: Idling	-
Atmosphere Pressure	Atmospheric pressure: Min.: 0 kPa, Max.: 150 kPa	Equivalent to atmospheric pressure	-
EVAP Purge VSV	VSV status for EVAP control: ON or OFF	-	Active Test support data
Fuel Pump/Speed Status	Fuel pump/status: ON or OFF	-	Active Test support data
VVT Control Status (Bank 1)	VVT control (bank 1) status: ON or OFF	-	Active Test support data
Vacuum Pump	Key-off EVAP system leak detection pump status: ON or OFF	-	Active Test support data
EVAP System Vent Valve	key-off EVAP system vent valve status: ON or OFF	-	Active Test support data
Electric Fan Motor	Electric cooling fan motor: ON or OFF	ON: Electric cooling fan motor operating	Active Test support data
TC and TE1	TC and CG (TE1) terminals of DLC3: ON or OFF	-	Active Test support data
Engine Speed of Cyl #1	Engine RPM for cylinder 1: Min.: 0 rpm, Max.: 25600 rpm	-	Output only when Check the Cylinder Compression performed using Active Test 51199 rpm: Not performed Active Test
Engine Speed	Engine RPM for cylinder 2:	-	Output only when Check the Cylinder Compression performed

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of Cyl #2	Min.: 0 rpm, Max.: 25600 rpm		using Active Test 51199 rpm: Not performed Active Test
Engine Speed of Cyl #3	Engine RPM for cylinder 3: Min.: 0 rpm, Max.: 25600 rpm	-	Output only when Check the Cylinder Compression performed using Active Test 51199 rpm: Not performed Active Test
Engine Speed of Cyl #4	Engine RPM for cylinder 4: Min.: 0 rpm, Max.: 25600 rpm	-	Output only when Check the Cylinder Compression performed using Active Test 51199 rpm: Not performed Active Test
Av Engine Speed of All Cyl	Engine RPM for all cylinders: Min.: 0 rpm, Max.: 25600 rpm	-	Output only when Check the Cylinder Compression performed using Active Test 51199 rpm: Not performed Active Test
VVT Aim Angle (Bank 1) *2	VVT aim angle (bank 1): Min.: 0%, Max.: 100%	0 to 100%	VVT duty signal value during intrusive operation
VVT Change Angle (Bank 1) *2	VVT change angle (bank 1): Min.: 0°FR, Max.: 60°FR	0 to 56°FR: Idling	Displacement angle during intrusive operation
VVT OCV Duty (Bank 1) *2	VVT OCV operation duty: Min.: 0%, Max.: 100%	0 to 100%	Requested duty value for intrusive operation
VVT Ex Hold Lm Val (Bank 1) *2	VVT exhaust hold duty ratio learning value (bank 1): Min.: 0%, Max.: 100%	0 to 100%: Idling	-
VVT Ex Chg Angle (Bank 1) *2	VVT exhaust change angle (bank 1): Min.: 0°FR, Max.: 60°FR	0°FR: Idling	Displacement angle during intrusive operation (Active Test)
VVT Ex OCV Duty (Bank 1) *2	VVT exhaust OCV duty (bank 1): Min.: 0%, Max.: 100%	0 to 100%: Idling	Requested duty value for intrusive operation (Active Test)
Idle Fuel Cut	Fuel cut idle: ON or OFF	ON: Fuel cut operating	Idle Fuel Cut = "ON" when throttle valve fully closed and engine speed over 2800 rpm
FC TAU	Fuel cut TAU (Fuel cut during very light load): ON or OFF	ON: Fuel cut operating	Fuel cut being performed under very light load to prevent engine combustion from becoming incomplete

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Ignition	Ignition counter to calculated misfire rate: Min.: 0, Max.: 800	0 to 400	-
Cylinder #1 Misfire Count	Misfire ratio of cylinder 1 : Min.: 0, Max.: 255	0	This item displayed only when idling
Cylinder #2 Misfire Count	Misfire ratio of cylinder 2: Min.: 0, Max.: 255	0	This item displayed only when idling
Cylinder #3 Misfire Count	Misfire ratio of cylinder 3: Min.: 0, Max.: 255	0	This item displayed only when idling
Cylinder #4 Misfire Count	Misfire ratio of cylinder 4: Min.: 0, Max.: 255	0	This item displayed only when idling
All Cylinders Misfire Count	All cylinders misfire rate: Min.: 0, Max.: 255	0	-
Multiple Cylinders Misfire Count	Multiple cylinders misfire count: Min.: 0, Max.: 65535	0	-
Misfire RPM	Average of engine speed when misfire occurs: Min.: 0 rpm, Max.: 6375 rpm	0 rpm: Misfire 0	-
Misfire Load	Average of engine load when misfire occurred: Min.: 0 g/rev, Max.: 3.98 g/rev	0 g/rev: Misfire 0	-
Misfire Margin	Margin to detect engine misfire: Min.:-100%, Max.: 99.22%	-100 to 99.22%	Misfire detection margin
Catalyst OT MF F/C	Catalyst overheat misfire prevention fuel cut function availability: Not Avl or Avail	Avail: Catalyst overheat misfire prevention fuel cut function available Not Avl: Catalyst overheat misfire prevention fuel cut function not available	Service data
Cat OT MF	Catalyst overheat misfire prevention fuel cut function	ON: Fuel cut operation	Service data

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F/C History	history: ON or OFF	history exists	
Cat OT MF F/C Cylinder#1	Display of fuel cut operation in No. 1 cylinder (if certain level of misfire malfunction is detected): ON or OFF	ON: Fuel cut is operating	-
Cat OT MF F/C Cylinder#2	Display of fuel cut operation in No. 2 cylinder (if certain level of misfire malfunction is detected): ON or OFF	ON: Fuel cut is 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	-
# Codes	Number of emission related DTCs	0: No emission related DTC detected	-
Check Mode	Check mode: ON or OFF	ON: Check mode ON	(See **CHECK MODE PROCEDURE**)
SPD Test	Check mode result for vehicle speed sensor: Compl or Incmpl	-	-
Misfire Test	Check mode result for misfire monitor: Compl or Incmpl	-	-
OXS1 Test	Check mode result for heated oxygen sensor (bank 1): Compl or Incmpl	-	-
MIL	MIL status: ON or OFF	ON: MIL ON	-

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MIL ON Run Distance	Distance traveled since MIL turned ON: Min.: 0 km (0 mile), Max.: 65535 km (40721.56 mile)	Distance since DTC detected	-
Running Time from MIL ON	Running time since MIL turned ON: Min.: 0 min, Max.: 65535 min	Equivalent to running time since MIL turned ON	-
Engine Run Time	Engine run time: Min.: 0 s, Max.: 65535 s	Time since engine started	-
Time after DTC Cleared	Time since DTCs cleared: Min.: 0 min., Max.: 65535 min.	Equivalent to time since DTCs erased	-
Distance from DTC Cleared	Distance traveled since DTCs cleared: Min.: 0 km (0 mile), Max.: 65535 km (40721.56 mile)	Equivalent to distance driven since DTCs erased	-
Warmup Cycle Cleard DTC	Warm-up cycles since DTCs cleared: Min.: 0, Max.: 255	-	Number of warm-up cycles since DTCs cleared
OBD Requirements	OBD requirement	OBD2	-
Number of Emission DTC	Emission related DTCs	-	Number of emission related DTCs
Complete Parts Monitor	Comprehensive component monitor: Not Avl or Avail	-	-
Fuel System Monitor	Fuel system monitor: Not Avl or Avail	-	-
Misfire Monitor	Misfire monitor: Not Avl or Avail	-	-
O2S(A/FS) Heater Monitor	O2S (A/FS) heater monitor: Not Avl or Avail	-	-
O2S(A/FS) Heater Monitor	O2S (A/FS) heater monitor: Compl or Incmpl	-	-
O2S(A/FS) Monitor	O2S (A/FS) monitor: Not Avl or Avail	-	-
O2S(A/FS) Monitor	O2S (A/FS) monitor: Compl or Incmpl	-	-

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EVAP Monitor	EVAP monitor: Not Avl or Avail	-	-
EVAP Monitor	EVAP monitor: Compl or Incmpl	-	-
Catalyst Monitor	Catalyst monitor: Not Avl or Avail	-	-
Catalyst Monitor	Catalyst monitor: Compl or Incmpl	-	-
Component Monitor ENA	Comprehensive component monitor: Unable or Enable	-	-
Component Monitor CMPL	Comprehensive component monitor: Compl or Incmpl	-	-
Fuel System Monitor ENA	Fuel system monitor: Unable or Enable	-	-
Fuel System Monitor CMPL	Fuel system monitor: Compl or Incmpl	-	-
Misfire Monitor ENA	Misfire monitor: Unable or Enable	-	-
Misfire Monitor CMPL	Misfire monitor: Compl or Incmpl	-	-
EGR Monitor ENA	EGR monitor: Unable or Enable	-	-
EGR Monitor CMPL	EGR monitor: Compl or Incmpl	-	-
Heater Monitor ENA	O2S (A/FS) heater monitor: Unable or Enable	-	-
Heater Monitor CMPL	O2S (A/FS) heater monitor: Compl or Incmpl	-	-
O2S(A/FS) Monitor ENA	O2S (A/FS) monitor: UNABLE or ENABLE	-	-
O2S(A/FS) Monitor CMPL	O2S (A/FS) monitor: Compl or Incmpl	-	-
A/C Monitor ENA	A/C monitor: Unable or Enable	-	-
A/C Monitor CMPL	A/C monitor: Compl or Incmpl	-	-
2nd Aur Monitor ENA	2nd air monitor: Unable or Enable	-	-
2nd Air	2nd air monitor:		

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Monitior CMPL	Compl or Incmpl	-	-
EVAP Monitor ENA	EVAP monitor: Unable or Enable	-	-
EVAP Monitor CMPL	EVAP monitor: Compl or Incmpl	-	-
Heated Cat Monitor ENA	Heated catalyst monitor: Unable or Enable	-	-
Heated Cat Monitor CMPL	Heated catalyst monitor: Compl or Incmpl	-	-
Catalyst Monitor ENA	Catalyst monitor: Unable or Enable	-	-
Catalyst Monitor CMPL	Catalyst monitor: Compl or Incmpl	-	-
Model Code	Model code	-	Identifying model code: ZST11#
Engine Type	Engine type	-	Identifying engine type: 2ZRFE
Cylinder Number	Cylinder number: Min.: 0, Max.: 255	-	Identifying cylinder number: 4
Transmission Type	Transmission type	-	Identifying transmission type: ECT 4th
Destination	Destination	-	Identifying destination: A (America)
Model Year	Model year: Min.: 1900, Max.: 2155	-	Identifying model year: 200#
System Identification	System identification	-	Identifying engine system: GASOLINE (gasoline engine)
HINT: • *1: If no idling conditions are specified, the shift lever should be in the N or P position, and the A/C switch and all accessory switches should be OFF. • *2: Values are only displayed when performing the Active Tests: Control the VVT Linear (Bank 1). For other Active Tests, the value will be 0.			

2. **ACTIVE TEST**

HINT:

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

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a. Warm up the engine.
b. Turn the ignition switch to OFF.
c. Connect the Techstream to the DLC3.
d. Turn the ignition switch to ON.
e. Turn the tester ON.
f. Select the following menu items: Powertrain / Engine and ECT / Active Test.
g. According to the display on tester, perform the Active Test.

ACTIVE TEST DETAIL

Tester Display	Test Part	Control Range	Diagnostic Note
Control the Injection Volume	Change injection volume	-12.5 to 24.8%	• All injectors tested at the same time • Perform test at less than 3000 rpm • Injection volume can be changed in 1% graduations within control range
Control the Injection Volume for A/F Sensor	Change 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 enables checking and graphing of A/F (Air Fuel Ratio) sensor and Heated Oxygen (HO2) sensor voltage outputs • To conduct test, enter the following menus: Active Test/ Control the Injection Volume for A/F Sensor / Data List / A/F Control System / AFS B1 S1 and O2S B1 S2
Activate the VSV for EVAP Control	Activate purge VSV control	ON/OFF	-
Control the Fuel Pump / Speed	Activate fuel pump (C/OPN Relay)	ON/OFF	Test possible when following conditions met: • Ignition switch ON • Engine is stopped
Connect the TC and TE1	Turn on and off TC and CG (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	Idling fuel-cut turned ON when throttle valve fully closed and engine speed over 2800 rpm

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Prohibit the Catalyst OT Misfire prevent F/C	Prohibit catalyst overheat malfunction prevention fuel cut operation during misfire	ON/OFF ON: Fuel cut prohibited	Confirm that vehicle stopped and engine speed 3000 rpm or less
Control the Electric Cooling Fan	Control electric cooling fan motor	ON/OFF	-
Activate the Starter Relay	Starter	ON/OFF	-
Activate the ACC Cut Relay	Activate ACC cut relay	ON/OFF	Test is possible when following conditions are met: • Ignition switch ON • Engine is stopped
Control the ETCS Open/Close Slow Speed	Throttle actuator	Close/Open	Test possible when following conditions met: • Ignition switch ON • Engine is stopped • Fully depressing accelerator pedal (APP: 58 degrees or more)
Control the ETCS Open/Close Fast Speed	Throttle actuator	Close/Open	
Control the VVT Linear (Bank 1)	Control VVT (bank 1)	Between -128 and 127 %	• Engine stall or rough idle when VVT actuator operated by 100%. • Test possible during idle.
Control the VVT System (Bank 1)	Turn on and off OCV (Camshaft Timing Oil Control Valve)	ON/OFF	• Engine stalls or idles roughly when OCV turned ON • Normal engine running or idling when OCV OFF • Test possible during idle.
Control the VVT Exhaust Linear (Bank 1)	Control VVT (Bank 1)	Between -128 and 127 % This value added to present OCV control duty 100 %: Maximum advance -100 %: Maximum retard	-
Activate the	Leak detection pump	ON/OFF	-

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Vacuum Pump			
Activate the VSV for Vent Valve	Vent valve	ON/OFF	-
Control the Cylinder #1 Fuel Cut	Cylinder #1 injector fuel cut	ON/OFF	Test possible while vehicle stopped and engine idling (1)
Control the Cylinder #2 Fuel Cut	Cylinder #2 injector fuel cut	ON/OFF	
Control the Cylinder #3 Fuel Cut	Cylinder #3 injector fuel cut	ON/OFF	
Control the Cylinder #4 Fuel Cut	Cylinder #4 injector fuel cut	ON/OFF	
Control the All Cylinder Fuel Cut	All cylinder fuel cut	ON/OFF	
Check the Cylinder Compression *2	Check the cylinder compression pressure (measuring engine speed for each cylinder)	ON/OFF	Fuel injection and ignition stop in all cylinders

NOTE:

(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. If the display of the Data List's Catalyst OT MF F/C item is Avail, perform this Active Test as described below.

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

HINT:*2: When performing the Active Test item "Check the Cylinder Compression" and then cranking the engine, the ECM stops the fuel injection and ignition, and measures the engine speed for each cylinder.

If 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 to OFF.
3. Connect a Techstream to the DLC3.
4. Turn the ignition switch to ON.

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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 #4, 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.

9. Crank the engine until the monitor item values "Engine speed of Cyl #1 to #4" and "Av Engine Speed of All Cyl" change.
10. Monitor the engine speed (Engine Speed of Cyl #1 to #4, 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 in the Utility menu enables the system, which consists of multiple actuators, to be operated without removing any parts. In addition, it can show whether or not any DTCs are set, and can detect potential malfunctions in the system.

   a. Connect the Techstream to the DLC3.

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b. Turn the ignition switch to ON.
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.

ACTIVE TEST DETAIL

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

DIAGNOSTIC TROUBLE CODE CHART

HINT:

Parameters listed in the chart may be different than your readings depending on the type of instrument and other factors.

If any DTCs are displayed during a check mode DTC check, check the circuit for the DTCs listed in the table below. For details of each DTC, refer to the page indicated.

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DIAGNOSTIC TROUBLE CODE CHART

DTC Code	Detection Item	Trouble Area	MIL	Memory
P0010	Camshaft Position "A" Actuator Circuit (Bank 1)	○ Open or short in OCV (for intake camshaft) circuit ○ OCV (for exhaust camshaft) ○ ECM	Comes on	DTC stored
P0011	Camshaft Position "A" - Timing Over-Advanced or System Performance (Bank 1)	○ Valve timing ○ Camshaft Timing Oil Control Valve (OCV)	Comes on	DTC stored

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		○ OCV filter ○ Camshaft timing gear assembly ○ ECM		
P0012	Camshaft Position "A" - Timing Over-Retarded (Bank 1)	○ Valve timing ○ Camshaft Timing Oil Control Valve (OCV) ○ OCV filter ○ Camshaft timing gear assembly ○ ECM	Comes on	DTC stored
P0013	Camshaft Position "B" Actuator Circuit/Open (Bank 1)	○ Open or short in OCV (for exhaust camshaft) circuit ○ OCV (for exhaust camshaft) ○ ECM	Comes on	DTC stored
P0014	Camshaft Position "B" - Timing Over-Advanced or System Performance (Bank 1)	○ Valve timing ○ Camshaft Timing Oil Control Valve (OCV) (for exhaust camshaft) ○ OCV filter ○ Camshaft timing gear assembly (for exhaust camshaft) ○ ECM	Comes on	DTC stored
P0015	Camshaft Position "B" - Timing Over-Retarded (Bank 1)	○ Valve timing ○ Camshaft Timing Oil Control Valve (OCV) (for exhaust camshaft)	Comes on	DTC stored

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		○ OCV filter ○ Camshaft timing gear assembly (for exhaust camshaft) ○ ECM		
P0016	Crankshaft Position - Camshaft Position Correlation (Bank 1 Sensor A)	○ Mechanical system (Timing chain has jumped tooth or chain stretched) ○ Camshaft Timing Oil Control Valve (OCV) (for intake camshaft) ○ Camshaft timing gear assembly (for intake camshaft) ○ ECM	Comes on	DTC stored
P0017	Crankshaft Position - Camshaft Position Correlation (Bank 1 Sensor B)	○ Mechanical system (Timing chain has jumped tooth or chain stretched) ○ Camshaft Timing Oil Control Valve (OCV) (for exhaust camshaft) ○ Camshaft timing gear assembly (for exhaust camshaft) ○ ECM	Comes on	DTC stored
P0031	Oxygen (A/F) Sensor Heater Control Circuit Low (Bank 1 Sensor 1)	○ Open in A/F sensor heater circuit ○ A/F sensor heater (sensor 1) ○ ECM power	Comes on	DTC stored

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		source circuit o ECM		
P0032	Oxygen (A/F) Sensor Heater Control Circuit High (Bank 1 Sensor 1)	o Short in A/F sensor heater circuit o A/F sensor heater (sensor 1) o ECM power source circuit o ECM	Comes on	DTC stored
P0037	Oxygen Sensor Heater Control Circuit Low (Bank 1 Sensor 2)	o Open in HO2 sensor (sensor 2) heater circuit o HO2 sensor (sensor 2) heater o ECM power source circuit o ECM	Comes on	DTC stored
P0038	Oxygen Sensor Heater Control Circuit High (Bank 1 Sensor 2)	o Short in HO2 sensor (sensor 2) heater circuit o HO2 sensor (sensor 2) heater o ECM power source circuit o ECM	Comes on	DTC stored
P0101	Mass Air Flow Circuit Range / Performance Problem	o Mass Air Flow (MAF) meter o Air induction system - PCV hose connections	Comes on	DTC stored
P0102	Mass or Volume Air Flow Circuit Low Input	o Open or short in Mass Air Flow (MAF) meter circuit o MAF meter o ECM	Comes on	DTC stored
P0103	Mass or Volume Air Flow Circuit High Input	o Open or short in Mass Air Flow (MAF) meter	Comes on	DTC stored

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		circuit ○ MAF meter ○ ECM		
P0111	Intake Air Temperature Sensor Gradient Too High	○ Mass air flow meter	Comes on	DTC stored
P0112	Intake Air Temperature Circuit Low Input	○ Short in Intake Air Temperature (IAT) sensor circuit ○ IAT sensor (built into mass air flow meter) ○ ECM	Comes on	DTC stored
P0113	Intake Air Temperature Circuit High Input	○ Open in Intake Air Temperature (IAT) sensor circuit ○ IAT sensor (built into mass air flow meter) ○ ECM	Comes on	DTC stored
P0115	Engine Coolant Temperature Circuit Malfunction	○ Open or short in Engine Coolant Temperature (ECT) sensor circuit ○ ECT sensor ○ ECM	Comes on	DTC stored
P0116	Engine Coolant Temperature Circuit Range / Performance Problem	○ Thermostat ○ Engine Coolant Temperature (ECT) sensor	Comes on	DTC stored
P0117	Engine Coolant Temperature Circuit Low Input	○ Short in Engine Coolant Temperature (ECT) sensor circuit ○ ECT sensor ○ ECM	Comes on	DTC stored
P0118	Engine Coolant Temperature Circuit	○ Open in Engine	Comes on	DTC stored

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	High Input	Coolant Temperature (ECT) sensor circuit ○ ECT sensor ○ ECM		
P011B	Engine Coolant Temperature / Intake Air Temperature Correlation	○ Intake Air Temperature (IAT) sensor ○ Engine Coolant Temperature (ECT) sensor ○ ECM	Comes on	DTC stored
P0120	Throttle / Pedal Position Sensor / Switch "A" Circuit Malfunction	○ Throttle position sensor (built into throttle body) ○ ECM	Comes on	DTC stored
P0121	Throttle / Pedal Position Sensor / Switch "A" Circuit Range / Performance Problem	○ Throttle position sensor (built into throttle body)	Comes on	DTC stored
P0122	Throttle / Pedal Position Sensor / Switch "A" Circuit Low Input	○ Throttle position sensor (built into throttle body) ○ Short in VTA1 circuit ○ Open in VC circuit ○ ECM	Comes on	DTC stored
P0123	Throttle / Pedal Position Sensor / Switch "A" Circuit High Input	○ Throttle position sensor (built into throttle body) ○ Open in VTA1 circuit ○ Open in E2 circuit ○ Short between VC and VTA1	Comes on	DTC stored

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		circuits o ECM		
P0125	Insufficient Coolant Temperature for Closed Loop Fuel Control	o Cooling system o Engine coolant temperature sensor o Thermostat	Comes on	DTC stored
P0128	Coolant Thermostat (Coolant Temperature Below Thermostat Regulating Temperature)	o Thermostat o Cooling system o Engine coolant temperature sensor o ECM	Comes on	DTC stored
P0136	Oxygen Sensor Circuit Malfunction (Bank 1 Sensor 2)	o Heated Oxygen (HO2) sensor (sensor 2) o Air-Fuel Ratio (A/F) sensor (sensor 1) o Gas leak from exhaust system o Fuel pressure o Fuel injector o PCV valve and hose o Air induction system	Comes on	DTC stored
P0137	Oxygen Sensor Circuit Low Voltage (Bank 1 Sensor 2)	o Open or short in Heated Oxygen (HO2) sensor (sensor 2) circuit o HO2 sensor (sensor 2) o HO2 sensor heater (sensor 2) o Air-Fuel Ratio (A/F) sensor (sensor 1) o Gas leak from exhaust system	Comes on	DTC stored

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P0138	Oxygen Sensor Circuit High Voltage (Bank 1 Sensor 2)	○ Short in Heated Oxygen (HO2) sensor (sensor 2) circuit ○ HO2 sensor (sensor 2) ○ ECM internal circuit malfunction ○ Air-Fuel Ratio (A/F) sensor (sensor 1)	Comes on	DTC stored
P0139	Oxygen Sensor Circuit Slow Response (Bank 1 Sensor 2)	○ Short in Heated Oxygen (HO2) sensor (sensor 2) circuit ○ HO2 sensor (sensor 2) ○ ECM internal circuit malfunction ○ Air-Fuel Ratio (A/F) sensor (sensor 1)	Comes on	DTC stored
P0141	Oxygen Sensor Heater Circuit Malfunction (Bank 1 Sensor 2)	○ Open or short in Heated Oxygen (HO2) sensor (sensor 2) heater circuit ○ HO2 sensor (sensor 2) heater ○ ECM power source circuit ○ ECM	Comes on	DTC stored
P0171	System Too Lean (Bank 1)	○ Air induction system ○ Injector blockage ○ Mass air flow meter ○ Engine coolant temperature	Comes on	DTC stored

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		sensor ○ Fuel pressure ○ Gas leak from exhaust system ○ Open or short in air fuel ratio sensor (sensor 1) circuit ○ Air fuel ratio sensor (sensor 1) ○ EFI fuse ○ PCV valve and hose ○ PCV hose connections ○ ECM		
P0172	System Too Rich (Bank 1)	○ 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 (sensor 1) circuit ○ Air fuel ratio sensor (sensor 1) ○ EFI fuse ○ ECM	Comes on	DTC stored
P0220	Throttle / Pedal Position Sensor / Switch "B" Circuit	○ Throttle position sensor (built into throttle body)	Comes on	DTC stored

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		○ ECM		
P0222	Throttle / Pedal Position Sensor / Switch "B" Circuit Low Input	○ Throttle position sensor (built into throttle body) ○ Short in VTA2 circuit ○ Open in VC circuit ○ ECM	Comes on	DTC stored
P0223	Throttle / Pedal Position Sensor / Switch "B" Circuit High Input	○ Throttle position sensor (built into throttle body) ○ Open in VTA2 circuit ○ Open in E2 circuit ○ Short between VC and VTA2 circuits ○ ECM	Comes on	DTC stored
P0300	Random / Multiple Cylinder Misfire Detected	○ Open or short in engine wire harness ○ Connector connection ○ Vacuum hose connections ○ Ignition system ○ Fuel injector ○ Fuel pressure ○ Mass Air Flow (MAF) meter ○ Engine Coolant Temperature (ECT) sensor ○ Compression pressure ○ Valve clearance ○ Valve timing	Comes on / Blinks*	DTC stored

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		○ PCV valve and hose ○ PCV hose connections ○ Air induction system ○ ECM		
P0301	Cylinder 1 Misfire Detected	○ Same as DTC P0300	Comes on / Blinks*	DTC stored
P0302	Cylinder 2 Misfire Detected	○ Same as DTC P0300	Comes on / Blinks*	DTC stored
P0303	Cylinder 3 Misfire Detected	○ Same as DTC P0300	Comes on / Blinks*	DTC stored
P0304	Cylinder 4 Misfire Detected	○ Same as DTC P0300	Comes on / Blinks*	DTC stored
P0327	Knock Sensor 1 Circuit Low Input (Bank 1 or Single Sensor)	○ Short in knock sensor circuit ○ Knock sensor ○ ECM	Comes on	DTC stored
P0328	Knock Sensor 1 Circuit High Input (Bank 1 or Single Sensor)	○ Open in knock sensor circuit ○ Knock sensor ○ ECM	Comes on	DTC stored
P0335	Crankshaft Position Sensor "A" Circuit	○ Open or short in Crankshaft Position (CKP) sensor circuit ○ CKP sensor ○ Crankshaft position sensor plate ○ ECM	Comes on	DTC stored
P0339	Crankshaft Position Sensor "A" Circuit Intermittent	○ Open or short in Crankshaft Position (CKP) sensor circuit ○ CKP sensor ○ Crankshaft position sensor plate	-	DTC stored

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		○ ECM		
P0340	Camshaft Position Sensor Circuit Malfunction	○ Open or short in CMP sensor circuit for intake camshaft ○ CMP sensor for intake camshaft ○ Camshaft timing gear for intake camshaft ○ Jumped tooth of timing chain for intake camshaft ○ ECM	Comes on	DTC stored
P0342	Camshaft Position Sensor "A" Circuit Low Input (Bank 1 or Single Sensor)	Open or short in CMP sensor circuit for intake camshaft ○ CMP sensor for intake camshaft ○ Camshaft timing gear for intake camshaft ○ Jumped tooth of timing chain for intake camshaft ○ ECM	Comes on	DTC stored
P0343	Camshaft Position Sensor "A" Circuit High Input (Bank 1 or Single Sensor)	○ Open or short in CMP sensor circuit for intake camshaft ○ CMP sensor for intake camshaft ○ Camshaft timing gear for intake camshaft ○ Jumped tooth of timing chain for intake camshaft ○ ECM	Comes on	DTC stored
P0351	Ignition Coil "A" Primary / Secondary Circuit	○ Ignition system ○ Open or short in	Comes on	DTC stored

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		IGF1 or IGT1 circuit between ignition coil and ECM o No. 1 ignition coil o ECM		
P0352	Ignition Coil "B" Primary/ Secondary Circuit	o Ignition system o Open or short in IGF1 or IGT2 circuit between ignition coil and ECM o No. 2 ignition coil o ECM	Comes on	DTC stored
P0353	Ignition Coil "C" Primary / Secondary Circuit	o Ignition system o Open or short in IGF1 or IGT3 circuit between ignition coil and ECM o No. 3 ignition coil o ECM	Comes on	DTC stored
P0354	Ignition Coil "D" Primary / Secondary Circuit	o Ignition system o Open or short in IGF1 or IGT4 circuit between ignition coil and ECM o No. 4 ignition coil o ECM	Comes on	DTC stored
P0365	Camshaft Position Sensor "B" Circuit (Bank 1)	o Open or short in exhaust camshaft position sensor circuit o Exhaust camshaft position sensor	Comes on	DTC stored

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		○ Camshaft timing gear for exhaust camshaft ○ Jumped tooth of timing chain for exhaust camshaft ○ ECM		
P0367	Camshaft Position Sensor "B" Circuit Low Input (Bank 1)	○ Open or short in exhaust camshaft position sensor circuit ○ Exhaust camshaft position sensor ○ Camshaft timing gear for exhaust camshaft ○ Jumped tooth of timing chain for exhaust camshaft ○ ECM	Comes on	DTC stored
P0368	Camshaft Position Sensor "B" Circuit High Input (Bank 1)	○ Open or short in exhaust camshaft position sensor circuit ○ Exhaust camshaft position sensor ○ Camshaft timing gear for exhaust camshaft ○ Jumped tooth of timing chain for exhaust camshaft ○ ECM	Comes on	DTC stored
P0420	Catalyst System Efficiency Below Threshold (Bank 1)	○ Gas leak from exhaust system ○ Air fuel ratio	Comes on	DTC stored

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		sensor (sensor 1) o Heated oxygen sensor (sensor 2) o Exhaust manifold (three-way catalytic converter)		
P043E	Evaporative Emission System Reference Orifice Clog Up	o Canister pump module (Reference orifice, leak detection pump, vent valve) o Connector/wire harness (Canister pump module - ECM) o EVAP system hose (pipe from air inlet port to canister pump module, canister filter, fuel tank vent hose) o ECM	Comes on	DTC stored
P043F	Evaporative Emission System Reference Orifice High Flow	o Canister pump module (Reference orifice, leak detection pump, vent valve) o Connector/wire harness (Canister pump module - ECM) o EVAP system hose (pipe from air inlet port to canister pump module, canister filter, fuel tank vent hose)	Comes on	DTC stored

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		○ ECM		
P0441	Evaporative Emission Control System Incorrect Purge Flow	○ Purge VSV - Connector/wire harness (Purge VSV - ECM) ○ ECM ○ Canister pump module ○ Leak from EVAP system ○ Leak from EVAP line (Purge VSV - Intake manifold)	Comes on	DTC stored
P0451	Evaporative Emission Control System Pressure Sensor Range / Performance	○ Canister pump module - Connector/wire harness (Canister pump module - ECM) ○ EVAP system hose (pipe from air inlet port to canister pump module, canister filter, fuel tank vent hose) ○ ECM	Comes on	DTC stored
P0452	Evaporative Emission Control System Pressure Sensor / Switch Low Input	○ Canister pump module - Connector/wire harness (Canister pump module - ECM) ○ EVAP system hose (pipe from air inlet port to canister pump module, canister filter, fuel tank vent hose) ○ ECM	Comes on	DTC stored
P0453	Evaporative	○ Canister pump	Comes on	DTC stored

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	Emission Control System Pressure Sensor / Switch High Input	module - Connector/wire harness (Canister pump module - ECM) o EVAP system hose (pipe from air inlet port to canister pump module, canister filter, fuel tank vent hose) o ECM		
P0455	Evaporative Emission Control System Leak Detected (Gross Leak)	o Fuel tank cap (loose) o Leak from EVAP line (Canister - Fuel tank) o Leak from EVAP line (Purge VSV - Canister) o Canister pump module o Leak from fuel tank o Leak from canister	Comes on	DTC stored
P0456	Evaporative Emission Control System Leak Detected (Very Small Leak)	o Fuel tank cap (loose) o Leak from EVAP line (Canister - Fuel tank) o Leak from EVAP line (Purge VSV - Canister) o Canister pump module o Leak from fuel tank	Comes on	DTC stored

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		○ Leak from canister		
P0500	Vehicle Speed Sensor "A"	○ Open or short in speed signal circuit ○ Speed meter circuit (wheel speed sensor, skid control ECU) ○ Combination meter ○ ECM	Comes on	DTC stored
P0504	Brake Switch "A" / "B" Correlation	○ Short in stop light switch signal circuit ○ STOP fuse ○ IGN fuse ○ Stop light switch ○ ECM	-	DTC stored
P0505	Idle Control System Malfunction	○ ETCS (Electronic Throttle Control System) ○ Air induction system ○ PCV hose connections ○ ECM	Comes on	DTC stored
P050A	Cold Start Idle Air Control System Performance	○ Throttle body ○ Mass air flow meter ○ PCV system ○ Air cleaner filter element ○ Air induction system ○ VVT system ○ ECM	Comes on	DTC stored
P050B	Cold Start Ignition		Comes on	DTC stored

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	Timing Performance	○ Throttle body assembly ○ Mass air flow meter ○ PCV system ○ Air cleaner filter element ○ Air induction system ○ VVT system ○ ECM		
P0560	System Voltage	○ Open in back up power source circuit ○ Battery ○ Battery terminals ○ EFI fuse ○ ECM	Comes on	DTC stored
P0604	Random Access Memory (RAM)	○ ECM	Comes on	DTC stored
P0606	ECM / PCM Processor	○ ECM	Comes on	DTC stored
P0607	Control Module Performance	○ Exhaust gas leak ○ Heated Oxygen (HO2) sensor ○ ECM	Comes on	DTC stored
P060A	Internal Control Module Monitoring Processor Performance	○ ECM	Comes on	DTC stored
P060D	Internal Control Module Accelerator Pedal Position Performance	○ ECM	Comes on	DTC stored
P060E	Internal Control Module Throttle Position Performance	○ ECM	Comes on	DTC stored
P0617	Starter Relay Circuit High	○ Park/neutral position switch	Comes on	DTC stored

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		○ Clutch start switch ○ Starter relay circuit ○ Ignition switch ○ ECM		
P0630	VIN not Programmed or Mismatch - ECM / PCM	○ ECM	Comes on	DTC stored
P0657	Actuator Supply Voltage Circuit / Open	○ ECM	Comes on	DTC stored
P0724	Brake Switch "B" Circuit High	○ Short in stop light switch signal circuit ○ Stop light switch ○ ECM	Comes on	DTC stored
P1607	Cruise Control Input Processor	○ ECM	Comes on	DTC stored
P2102	Throttle Actuator Control Motor Circuit Low	○ Open in throttle actuator circuit ○ Throttle actuator ○ ECM	Comes on	DTC stored
P2103	Throttle Actuator Control Motor Circuit High	○ Short in throttle actuator circuit ○ Throttle actuator ○ Throttle valve ○ Throttle body ○ ECM	Comes on	DTC stored
P2111	Throttle Actuator Control System - Stuck Open	○ Throttle actuator ○ Throttle body ○ Throttle valve ○ ECM	Comes on	DTC stored
P2112	Throttle Actuator Control System - Stuck Closed	○ Throttle actuator ○ Throttle body ○ Throttle valve ○ ECM	Comes on	DTC stored

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P2118	Throttle Actuator Control Motor Current Range / Performance	○ Open in ETCS power source circuit ○ Battery ○ Battery terminals ○ ETCS fuse ○ ECM	Comes on	DTC stored
P2119	Throttle Actuator Control Throttle Body Range / Performance	○ Electronic Throttle Control System (ETCS) ○ ECM	Comes on	DTC stored
P2120	Throttle / Pedal Position Sensor / Switch "D" Circuit	○ Accelerator Pedal Position (APP) sensor ○ ECM	Comes on	DTC stored
P2121	Throttle / Pedal Position Sensor / Switch "D" Circuit Range / Performance	○ Accelerator Pedal Position (APP) sensor ○ ECM	Comes on	DTC stored
P2122	Throttle / Pedal Position Sensor / Switch "D" Circuit Low Input	○ Accelerator Pedal Position (APP) sensor ○ Open in VCP1 circuit ○ Open or ground short in VPA circuit ○ ECM	Comes on	DTC stored
P2123	Throttle / Pedal Position Sensor / Switch "D" Circuit High Input	○ Accelerator Pedal Position (APP) sensor ○ Open in EPA circuit ○ ECM	Comes on	DTC stored
P2125	Throttle / Pedal Position Sensor / Switch "E" Circuit	○ Accelerator Pedal Position (APP) sensor ○ ECM	Comes on	DTC stored
P2127	Throttle / Pedal Position Sensor /	○ Accelerator	Comes on	DTC stored

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	Switch "E" Circuit Low Input	Pedal Position (APP) sensor o Open in VCP2 circuit o Open or ground short in VPA2 circuit o ECM		
P2128	Throttle / Pedal Position Sensor / Switch "E" Circuit High Input	o Accelerator Pedal Position (APP) sensor o Open in EPA2 circuit o ECM	Comes on	DTC stored
P2135	Throttle / Pedal Position Sensor/ Switch "A" / "B" Voltage Correlation	o Short between VTA1 and VTA2 circuits o Throttle position sensor (built into throttle body) o ECM	Comes on	DTC stored
P2138	Throttle / Pedal Position Sensor / Switch "D" / "E" Voltage Correlation	o Short between VPA and VPA2 circuits o Accelerator Pedal Position (APP) sensor o ECM	Comes on	DTC stored
P2195	Oxygen (A/F) Sensor Signal Stuck Lean (Bank 1 Sensor 1)	o Open or short in Air Fuel Ratio (A/F) sensor (sensor 1) circuit o A/F sensor (sensor 1) o A/F sensor (sensor 1) heater o A/F sensor heater circuit o Air induction system	Comes on	DTC stored

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		○ Fuel pressure ○ Fuel injector ○ ECM		
P2196	Oxygen (A/F) Sensor Signal Stuck Rich (Bank 1 Sensor 1)	○ Open of short in Air Fuel Ratio (A/F) sensor (sensor 1) circuit ○ A/F sensor (sensor 1) ○ A/F sensor (sensor 1) heater ○ A/F sensor heater circuit ○ Air induction system ○ Fuel pressure ○ Fuel injector ○ ECM	Comes on	DTC stored
P2237	Oxygen (A/F) Sensor Pumping Current Circuit / Open (Bank 1 Sensor 1)	○ Open in Air Fuel Ratio (A/F) sensor (sensor 1) circuit ○ A/F sensor (sensor 1) ○ ECM	Comes on	DTC stored
P2238	Oxygen (A/F) Sensor Pumping Current Circuit Low (Bank 1 Sensor 1)	○ Open or short in Air Fuel Ratio (A/F) sensor (sensor 1) circuit ○ A/F sensor (sensor 1) ○ ECM	Comes on	DTC stored
P2239	Oxygen (A/F) Sensor Pumping Current Circuit High (Bank 1 Sensor 1)	○ Open or short in Air Fuel Ratio (A/F) sensor (sensor 1) circuit ○ A/F sensor (sensor 1)	Comes on	DTC stored

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		○ ECM		
P2252	Oxygen (A/F) Sensor Reference Ground Circuit Low (Bank 1 Sensor 1)	○ Open or short in Air Fuel Ratio (A/F) sensor (sensor 1) circuit ○ A/F sensor (sensor 1) ○ ECM	Comes on	DTC stored
P2253	Oxygen (A/F) Sensor Reference Ground Circuit High (Bank 1 Sensor 1)	○ Open or short in Air Fuel Ratio (A/F) sensor (sensor 1) circuit ○ A/F sensor (sensor 1) ○ ECM	Comes on	DTC stored
P2401	Evaporative Emission Leak Detection Pump Stuck OFF	○ Canister pump module (Reference orifice, leak detection pump, vent valve) ○ Connector/wire harness (Canister pump module - ECM) ○ EVAP system hose (pipe from air inlet port to canister pump module, canister filter, fuel tank vent hose) ○ ECM	Comes on	DTC stored
P2402	Evaporative Emission Leak Detection Pump Stuck ON	○ Canister pump module (Reference orifice, leak detection pump, vent valve) ○ Connector/wire harness	Comes on	DTC stored

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		(Canister pump module - ECM) ○ EVAP system hose (pipe from air inlet port to canister pump module, canister filter, fuel tank vent hose) ○ ECM		
P2419	Evaporative Emission System Switching Valve Control Circuit Low	○ Canister pump module (Reference orifice, leak detection pump, vent valve) ○ Connector/wire harness (Canister pump module - ECM) ○ EVAP system hose (pipe from air inlet port to canister pump module, canister filter, fuel tank vent hose) ○ ECM	Comes on	DTC stored
P2420	Evaporative Emission System Switching Valve Control Circuit High	○ Canister pump module (Reference orifice, leak detection pump, vent valve) ○ Connector/wire harness (Canister pump module - ECM) ○ 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	○ Open or short in Air Fuel Ratio	Comes on	DTC stored

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	(Bank 1 Sensor 1)	(A/F) sensor (sensor 1) circuit o A/F sensor o A/F sensor heater o ECM		
HINT: *: MIL flashes when a catalyst damaged misfire is detected.				

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

DESCRIPTION

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

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

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VVT System:

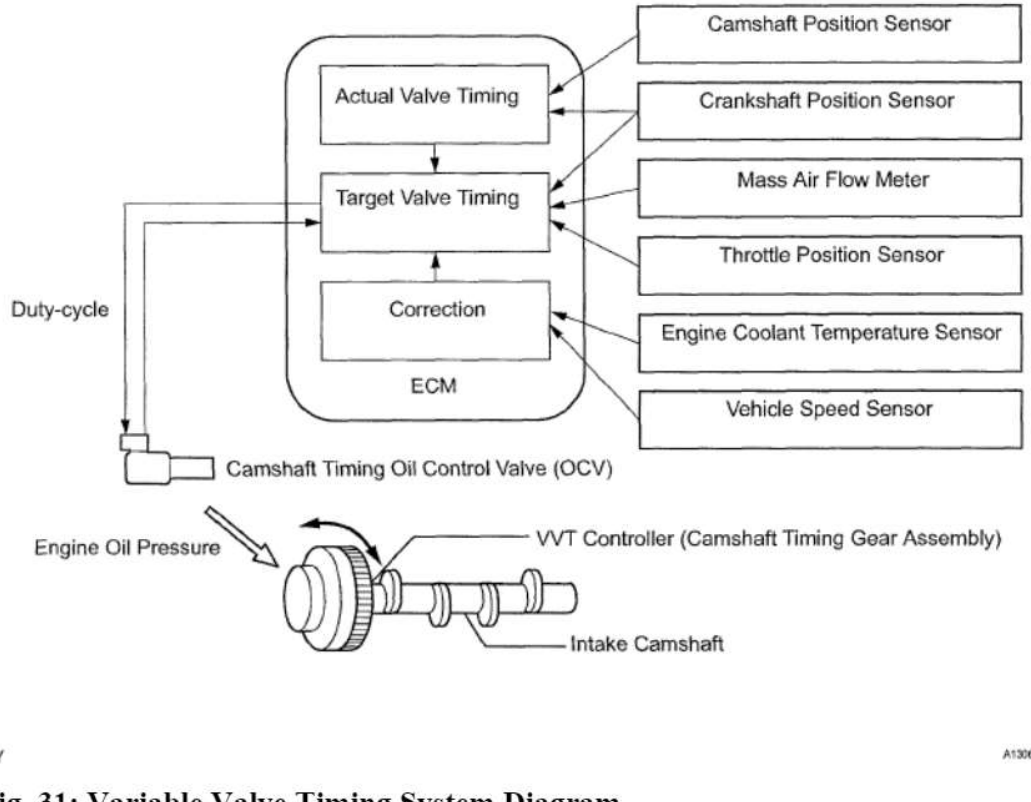


Fig. 31: Variable Valve Timing System Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

DTC DETECTION CONDITION AND TROUBLE AREA

DTC No.	DTC Detection Condition	Trouble Area
P0010	Open or short in Camshaft Timing Oil Control Valve (OCV) (for intake camshaft) circuit (1 trip detection logic)	• Open or short in OCV (for intake camshaft) circuit • OCV (for intake camshaft) • ECM

MONITOR DESCRIPTION

This DTC is designed to detect opens or shorts in the Camshaft Timing Oil Control Valve (OCV) (for intake camshaft) circuit. If the OCV's duty-cycle is excessively high or low while the engine is running, the ECM will illuminate the MIL and set the DTC.

MONITOR STRATEGY

MONITOR STRATEGY

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Related DTCs	P0010 VVT OCV range check (bank 1)
Required Sensors/Components (Main)	VVT OCV
Required Sensors/Components (Related)	-
Frequency of Operation	Continuous
Duration	1 second
MIL Operation	Immediate
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

TYPICAL ENABLING CONDITIONS

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

TYPICAL MALFUNCTION THRESHOLDS

TYPICAL MALFUNCTION THRESHOLDS

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

COMPONENT OPERATING RANGE

COMPONENT OPERATING RANGE

VVT OCV duty ratio	3 to 100%

WIRING DIAGRAM

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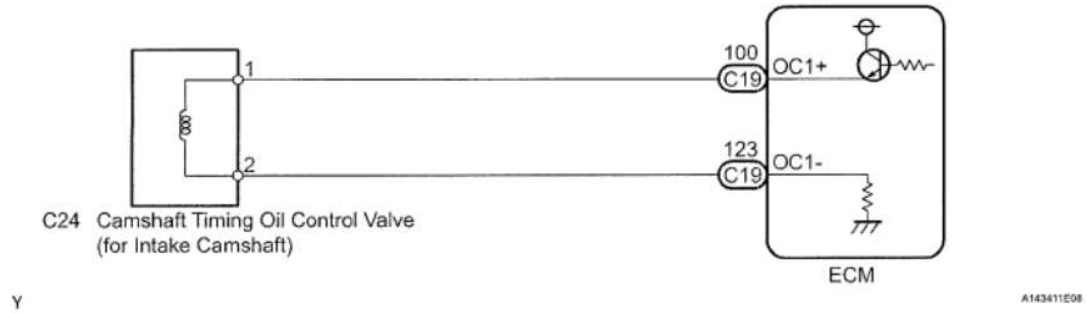


Fig. 32: Camshaft Timing Oil Control Valve - Wiring Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSPECTION PROCEDURE

HINT:

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

1. **CHECK WHETHER DTC OUTPUT RECURS (DTC P0010)**
   a. Connect a Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the tester ON.
   d. Clear DTCs.
   e. Start the engine and warm it up.
   f. Allow the engine to idle 1 minute or more.
   g. Select the following menu items: Powertrain / Engine and ECT / Trouble Codes.
   h. Read DTCs.

   Result

   RESULT REFERENCE

Result	Proceed to
P0010	A
No output	B

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

A: Go to next step

2. **INSPECT CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY (FOR INTAKE**

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CAMSHAFT)

a. Remove the OCV (for intake camshaft).

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

Standard resistance

RESISTANCE SPECIFICATION

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

Component without harness connected:
(OCV for Intake Camshaft)



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Fig. 33: Identifying Camshaft Timing Oil Control Valve Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

c. Apply battery voltage to terminals of the OCV (for intake camshaft). Check the valve operation.

OK:

Valve moves quickly.

d. Reinstall the OCV (for intake camshaft).

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

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Component without harness connected:
(OCV for Intake Camshaft)

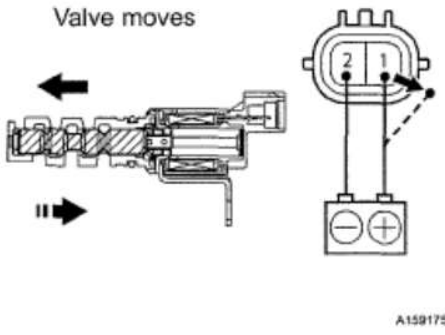


Fig. 34: Inspecting Camshaft Timing Oil Control Valve Assembly (For Intake Camshaft)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

3. **CHECK HARNESS AND CONNECTOR (OCV FOR INTAKE CAMSHAFT - ECM)**
   a. Disconnect the OCV (for intake camshaft) connector.
   b. Disconnect the ECM connector.
   c. Measure the resistance according to the value(s) in the table below.

Standard resistance (Check for open)

RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
C24-1 (OC1+) - C19-100 (OC1+)	Always	Below 1 ohms
C24-2 (OC1-) - C19-123 (OC1-)	Always	Below 1 ohms

Standard resistance (Check for short)

RESISTANCE SPECIFICATION

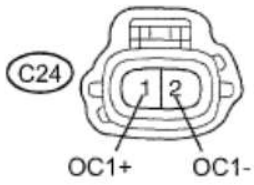
Tester Connection	Condition	Specified Condition
C24-1 (OC1+) or C19-100 (OC1+) - Body ground	Always	10 kohms or higher
C24-2 (OC1-) or C19-123 (OC1-) - Body ground	Always	10 kohms or higher

   d. Reconnect the OCV (for intake camshaft) connector.
   e. Reconnect the ECM connector.

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR

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Front view of wire harness connector:
(to OCV for Intake Camshaft)



Front view of wire harness connector:
(to ECM)

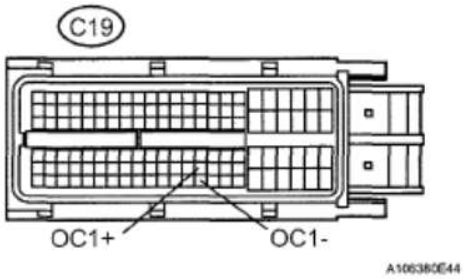


Fig. 35: Identifying Oil Control Valve (For Intake Camshaft) And ECM Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK : REPLACE ECM

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

DESCRIPTION

Refer to **DTC P0010**

DTC DETECTION CONDITION AND TROUBLE AREA

DTC No.	DTC Detection Condition	Trouble Area
P0011	Valve timing is not adjusted in valve timing advance range (1 trip detection logic)	• Valve timing • Camshaft Timing Oil Control Valve (OCV) • OCV filter • Camshaft timing gear assembly • ECM
P0012	Valve timing is not adjusted in valve timing retard range (2 trip detection logic)	

MONITOR DESCRIPTION

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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 Camshaft Timing Oil Control Valve (OCV) and the VVT controller (camshaft timing gear assembly). The ECM sends a target duty-cycle control signal to the OCV. This control signal regulates the oil pressure supplied to the VVT controller. The VVT controller can advance or retard the intake camshaft.

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

Example:

A DTC is set when the following conditions 1, 2 and 3 are met:

a. The difference between the target and actual intake valve timing is more than 5°CA (Crankshaft Angle) and the condition continues for more than 4.5 seconds.
b. It takes 5 seconds or more to change the valve timing by 5°CA.
c. After above conditions 1 and 2 are met, the OCV is forcibly activated during 10 seconds.

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

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

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

These DTCs indicate that the VVT controller cannot operate properly due to OCV malfunctions or the presence of foreign objects in the OCV.

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

MONITOR STRATEGY

MONITOR STRATEGY

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

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TYPICAL ENABLING CONDITIONS

TYPICAL ENABLING CONDITIONS

Monitor runs whenever following DTCs not present	P0102 - P0103 (Mass airflow meter) P0115 - P0118 (Engine coolant temperature sensor) P0125 (Insufficient engine coolant temperature for closed loop) P0335 (Crankshaft position sensor) P0340 (Camshaft position sensor) P0351 - P0356 (Igniter)
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

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

Retarded camshaft timing:

TYPICAL MALFUNCTION THRESHOLDS

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

NOTE: DTC P0011 or P0012 may be set when foreign objects in the engine oil are caught in some parts of the system. The DTC will remain set even if the system returns to normal after a short time. Foreign objects are filtered out by the oil filter.

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HINT:

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

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

   Result

   RESULT REFERENCE

Result	Proceed to
P0011 or P0012	A
P0011 or P0012 and other DTCs	B

   HINT:

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

B: Go to DTC CHART (See **DIAGNOSTIC TROUBLE CODE CHART**)

A: Go to next step

2. **PERFORM ACTIVE TEST USING TECHSTREAM (OPERATE OCV FOR INTAKE CAMSHAFT)**
   a. Connect a Techstream to the DLC3.
   b. Start the engine.
   c. Turn the tester ON.
   d. Turn the air conditioning switch to ON.
   e. Select the following menu items: Powertrain / Engine and ECT / Active Test / Control the VVT System (Bank 1).
   f. Check the engine speed while operating the OCV (for intake camshaft) using the tester.

   Result

   TESTER OPERATION AND SPECIFIED CONDITION

Tester Operation	Specified Condition

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OCV OFF	Normal engine speed
OCV ON	Engine idles roughly or stalls (soon after OCV switched from OFF to ON)

HINT:

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

g. Start the engine when the engine coolant temperature is 30°C or less.
h. Turn the tester ON.
i. Turn the air conditioning switch to ON.
j. Select the following menu items: Powertrain / Engine and ECT / Active Test / Control the VVT System (Bank 1).
k. Check the engine speed while operating the OCV (for intake camshaft) using the tester with the engine coolant temperature is 50°C or less.

Result

TESTER OPERATION AND SPECIFIED CONDITION

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 4

OK: Go to next step

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

Result

RESULT REFERENCE

Result	Proceed to
No output	A

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P0011 or P0012	B

B: Go to step 7

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

4. **INSPECT CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY (FOR INTAKE CAMSHAFT)**
   a. Remove the OCV (for intake camshaft) (See **REMOVAL**).
   b. Measure the resistance according to the value(s) in the table below.

Standard resistance

RESISTANCE SPECIFICATION

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

Component without harness connected:
(OCV for Intake Camshaft)



Y A159178E01

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

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

OK:

Valve moves quickly.

   d. Reinstall the OCV (for intake camshaft) (See **INSTALLATION**).

NG: REPLACE CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY (FOR INTAKE

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CAMSHAFT)

Component without harness connected:
(OCV for Intake Camshaft)

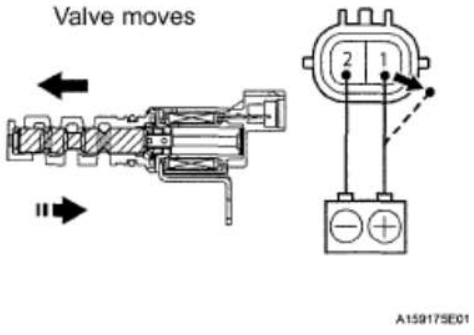


Fig. 37: Inspecting Camshaft Timing Oil Control Valve Assembly (For Intake Camshaft)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

5. **INSPECT CAMSHAFT TIMING GEAR ASSEMBLY (FOR INTAKE CAMSHAFT)**
   a. Inspect the camshaft timing gear assembly (for intake camshaft) (See **INSPECTION**).

NG: REPLACE CAMSHAFT TIMING GEAR ASSEMBLY (FOR INTAKE CAMSHAFT)

OK: Go to next step

6. **INSPECT OIL CONTROL VALVE FILTER**
   a. Remove the OCV filter (See **DISASSEMBLY**).
   b. Check that the filter is not clogged.

      OK:

      Filter is not clogged.

   c. Reinstall the OCV filter (See **REASSEMBLY**).

NG: CLEAN OIL CONTROL VALVE FILTER

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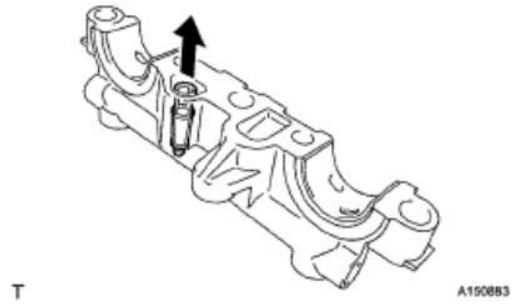


Fig. 38: Removing Oil Control Valve Filter
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

7. **ADJUST VALVE TIMING**

HINT:

There are no marks on the cylinder head to match-up for the purpose of checking valve timing. Valve timing can only be inspected by lining up the colored plates on the timing chain with the marks on the pulleys. It may be necessary to remove and re-install the chain to match up the alignment marks (See **REASSEMBLY**).

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Reference: Camshafts Layout

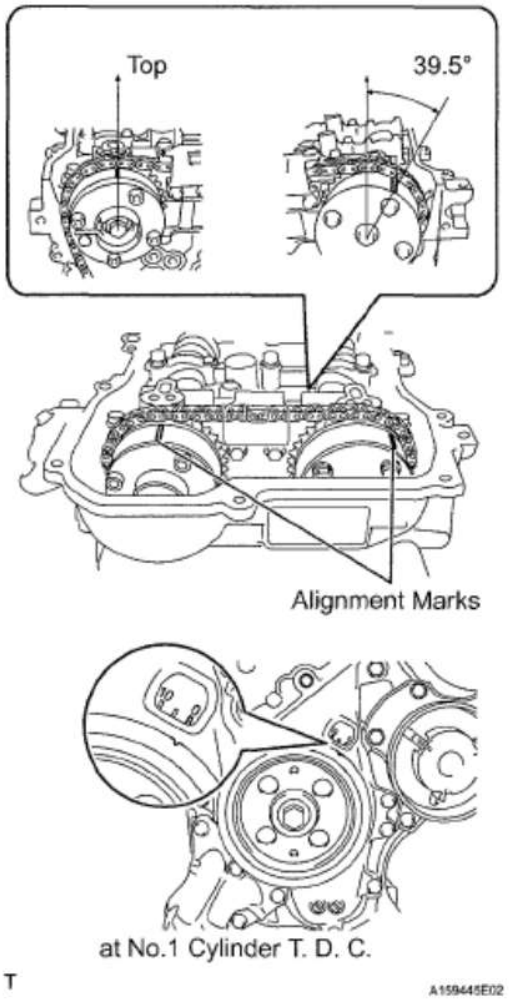


Fig. 39: Identifying Valve Timing
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

8. **CHECK WHETHER DTC OUTPUT RECURS (DTC P0011 OR P0012)**
   a. Connect a Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the tester ON.
   d. Clear DTCs (See **DTC CHECK / CLEAR**).
   e. Start the engine and warm it up.
   f. Switch the ECM from normal mode to check mode using the tester.
   g. Drive the vehicle for more than 10 minutes.
   h. Read DTCs.

   Result

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RESULT REFERENCE

Result	Proceed to
No output	A
P0011 or P0012	B

HINT:

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

B : REPLACE ECM

A : END

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

DESCRIPTION

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

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

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VVT System:

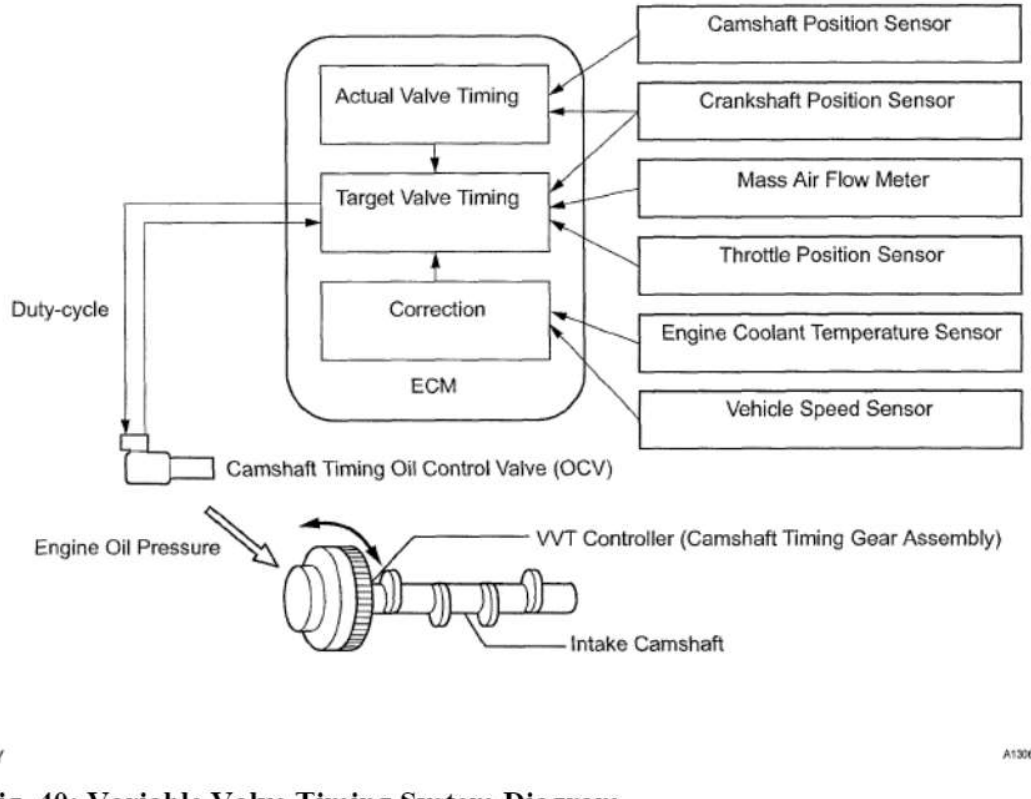


Fig. 40: Variable Valve Timing System Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

DTC DETECTION CONDITION AND TROUBLE AREA

DTC No.	DTC Detection Condition	Trouble Area
P0013	Open or short in Camshaft Timing Oil Control Valve (OCV) (for exhaust camshaft) circuit (1 trip detection logic)	• Open or short in OCV (for exhaust camshaft) circuit • OCV (for exhaust camshaft) • ECM

MONITOR DESCRIPTION

This DTC is designed to detect opens or shorts in the Camshaft Timing Oil Control Valve (OCV) (for exhaust camshaft) circuit. If the OCV's duty-cycle is excessively high or low while the engine is running, the ECM will illuminate the MIL and set the DTC.

MONITOR STRATEGY

MONITOR STRATEGY

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Related DTCs	P0013 Exhaust VVT OCV range check
Required Sensors/Components (Main)	Exhaust VVT OCV
Required Sensors/Components (Related)	-
Frequency of Operation	Continuous
Duration	1 second
MIL Operation	Immediate
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

TYPICAL ENABLING CONDITIONS

Monitor runs whenever following DTCs not present	None
All of following conditions met	-
Starter	OFF
Ignition switch	ON
Time after ignition switch OFF to ON	0.5 seconds or more
One of following conditions met	-
A. All of following conditions met	-
Battery voltage	11 to 13 V
CPU commanded duty	Less than 70 %
Current cut status	Not cut
B. All of following conditions met	-
Battery voltage	13 V or more
Target duty ratio	Less than 80 %
Current cut status	Not cut

TYPICAL MALFUNCTION THRESHOLDS

TYPICAL MALFUNCTION THRESHOLDS

Exhaust VVT OCV condition	No operation record

COMPONENT OPERATING RANGE

COMPONENT OPERATING RANGE

Exhaust VVT OCV condition	Operation record

WIRING DIAGRAM

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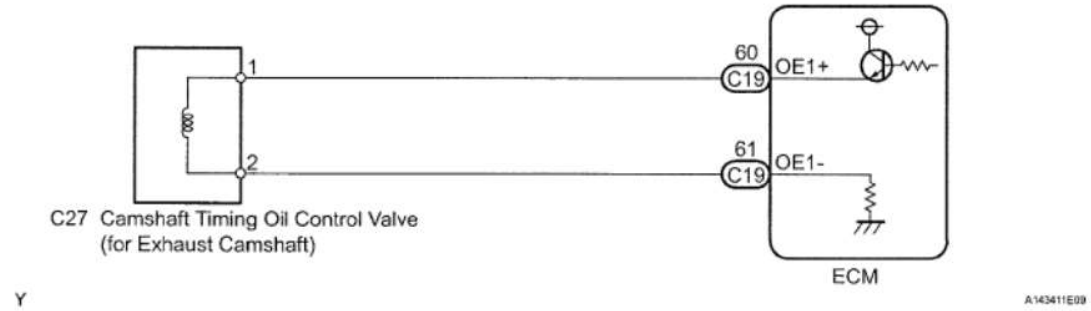


Fig. 41: Camshaft Timing Oil Control Valve - Wiring Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSPECTION PROCEDURE

HINT:

- If DTC P0013 is displayed, check the VVT system (for exhaust camshaft) circuit.
- Read freeze frame data using a Techstream. Freeze frame data records the engine conditions 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. **CHECK WHETHER DTC OUTPUT RECURS (DTC P0013)**
   a. Connect a Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the tester ON.
   d. Clear DTCs (See **DTC CHECK / CLEAR**).
   e. Start the engine and warm it up.
   f. Allow the engine to idle 1 minute or more.
   g. Select the following menu items: Powertrain / Engine and ECT / Trouble Codes.
   h. Read DTCs.

   Result

   RESULT REFERENCE

Result	Proceed to
P0013	A
No output	B

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

A: Go to next step

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

Standard resistance

RESISTANCE SPECIFICATION

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

Component without harness connected:
(OCV for Exhaust Camshaft)



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Fig. 42: Identifying Camshaft Timing Oil Control Valve Connector Terminals (For Exhaust Camshaft)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

   c. Apply battery voltage to terminals of the OCV (for exhaust camshaft). Check the valve operation.

OK:

Valve moves quickly.

   d. Reinstall the OCV (for exhaust camshaft).

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

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Component without harness connected:
(OCV for Exhaust Camshaft)

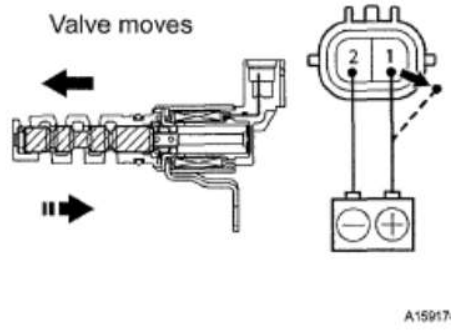


Fig. 43: Inspecting Camshaft Timing Oil Control Valve Assembly (For Exhaust Camshaft)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

3. **CHECK HARNESS AND CONNECTOR (OCV FOR EXHAUST CAMSHAFT - ECM)**
   a. Disconnect the OCV (for exhaust camshaft) connector.
   b. Disconnect the ECM connector.
   c. Measure the resistance according to the value(s) in the table below.

Standard resistance (Check for open)

RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
C27-1 (OE1+) - C19-60 (OE1+)	Always	Below 1 ohms
C27-2 (OE1-) - C19-61 (OE1-)	Always	Below 1 ohms

Standard resistance (Check for short)

RESISTANCE SPECIFICATION

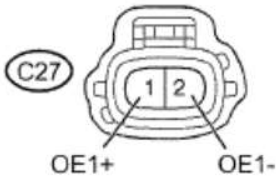
Tester Connection	Condition	Specified Condition
C27-1 (OE1+) or C19-60 (OE1+) - Body ground	Always	10 kohms or higher
C27-2 (OE1-) or C19-61 (OE1-) - Body ground	Always	10 kohms or higher

   d. Reconnect the OCV (for exhaust camshaft) connector.
   e. Reconnect the ECM connector.

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR

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Front view of wire harness connector:
(to OCV for Exhaust Camshaft)



Front view of wire harness connector:
(to ECM)

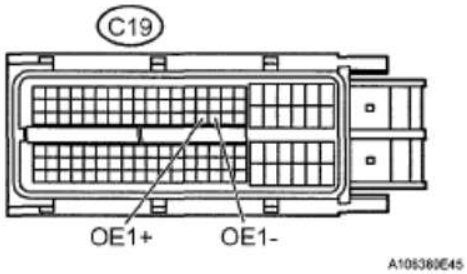


Fig. 44: Identifying Oil Control Valve (For Exhaust Camshaft) And ECM Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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

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

DESCRIPTION

Refer to **DTC P0013** .

DTC DETECTION CONDITION AND TROUBLE AREA

DTC No.	DTC Detection Condition	Trouble Area
P0014	Valve timing is not adjusted in exhaust valve timing advance range (2 trip detection logic)	• Valve timing • Camshaft Timing Oil Control Valve (OCV) (for exhaust camshaft) • OCV filter • Camshaft timing gear assembly (for exhaust camshaft) • ECM
P0015	Valve timing is not adjusted in exhaust valve timing retard range (1 trip detection logic)	

MONITOR DESCRIPTION

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

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

Example:

A DTC is set when the following conditions 1, 2 and 3 are met:

a. The difference between the target and actual exhaust valve timing is more than 5°CA (Crankshaft Angle) and the condition continues for more than 4.5 seconds.
b. It takes 5 seconds or more to change the valve timing by 5°CA.
c. After above conditions 1 and 2 are met, the OCV is forcibly activated during 10 seconds.

DTC P0014 (Advanced Cam Timing) is subject to 1 trip detection logic.

DTC P0015 (Retarded Cam Timing) is subject to 2 trip detection logic.

These DTCs indicate that the VVT controller cannot operate properly due to OCV malfunctions or the presence of foreign objects in the OCV.

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

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

MONITOR STRATEGY

MONITOR STRATEGY

Related DTCs	P0014: Advanced camshaft timing P0015: Retarded camshaft timing
Required Sensors/Components (Main)	VVT OCV and VVT controller
Required Sensors/Components (Related)	Crankshaft position sensor Camshaft position sensor Engine coolant temperature sensor
Frequency of Operation	Once per driving cycle
Duration	Within 10 seconds
MIL Operation	Advanced camshaft timing: Immediate Retarded camshaft timing: 2 driving cycles
Sequence of Operation	None

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TYPICAL ENABLING CONDITIONS

TYPICAL ENABLING CONDITIONS

Monitor runs whenever following DTCs not present	P0102 - P0103 (Mass airflow meter) P0115 - P0118 (Engine coolant temperature sensor) P0125 (Insufficient engine coolant temperature for closed loop) P0335 (Crankshaft position sensor) P0340 (Camshaft position sensor) P0351 - P0356 (Igniter)
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

All of following conditions are met	-
Valve timing	No change
Valve timing	Advance position

Retarded camshaft timing:

TYPICAL MALFUNCTION THRESHOLDS

All of following conditions are met	-
Valve timing	No change
Valve timing	Retarded position

WIRING DIAGRAM

Refer to **DTC P0013** .

INSPECTION PROCEDURE

HINT:

Read freeze frame data using a Techstream. Freeze frame data records the engine conditions 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. **CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P0014 OR P0015)**
   a. Connect a Techstream to the DLC3.

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b. Turn the ignition switch to ON.
c. Turn the tester ON.
d. Select the following menu items: Powertrain / Engine and ECT / Trouble Codes.
e. Read DTCs.

Result

RESULT REFERENCE

Result	Proceed to
P0014 or P0015	A
P0014 or P0015 and other DTCs	B

HINT:

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

B: Go to DTC CHART (See **DIAGNOSTIC TROUBLE CODE CHART**)

A: Go to next step

2. **PERFORM ACTIVE TEST USING TECHSTREAM (OPERATE OCV)**
   a. Connect a Techstream to the DLC3.
   b. Start the engine.
   c. Turn the tester ON.
   d. Turn the air conditioning switch to ON.
   e. Select the following menu items: Powertrain / Engine and ECT / Active Test / Control the VVT Exhaust Linear (Bank 1).
   f. Check the engine speed while operating the OCV (for exhaust camshaft) using the tester.

Result

TESTER OPERATION AND SPECIFIED CONDITION

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

HINT:

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

g. Start the engine when the engine coolant temperature is 30°C or less.
h. Turn the tester ON.

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i. Turn the air conditioning switch to ON.
j. Select the following menu items: Powertrain / Engine and ECT / Active Test / Control the VVT Exhaust Linear (Bank 1).
k. Check the engine speed while operating the OCV (for exhaust camshaft) using the tester with the engine coolant temperature is 50°C or less.

Result

TESTER OPERATION AND SPECIFIED CONDITION

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 4

OK: Go to next step

3. **CHECK WHETHER DTC OUTPUT RECURS (DTC P0014 OR P0015)**
   a. Connect a Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the tester ON.
   d. Clear DTCs (See **DTC CHECK / CLEAR**).
   e. Start the engine and warm it up.
   f. Switch the ECM from normal mode to check mode using the tester (See **CHECK MODE PROCEDURE**).
   g. Allow the engine to idle for 3 minutes or more.
   h. Drive the vehicle for more than 10 minutes.
   i. Read DTCs.

Result

RESULT REFERENCE

Result	Proceed to
No output	A
P0014 or P0015	B

B: Go to step 7

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

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

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CAMSHAFT)

a. Remove the OCV (for exhaust camshaft) (See **REMOVAL**).

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

Standard resistance

RESISTANCE SPECIFICATION

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

Component without harness connected:
(OCV for Exhaust Camshaft)



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Fig. 45: Identifying Oil Control Valve (For Exhaust Camshaft) Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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

OK:

Valve moves quickly.

d. Reinstall the OCV (for exhaust camshaft) (See **INSTALLATION**).

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

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Component without harness connected:
(OCV for Exhaust Camshaft)

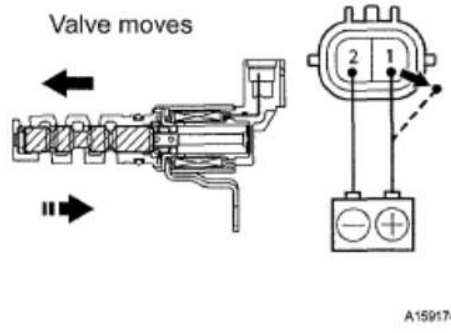


Fig. 46: Inspecting Camshaft Timing Oil Control Valve Assembly (For Exhaust Camshaft)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

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

NG: REPLACE CAMSHAFT TIMING GEAR ASSEMBLY (FOR EXHAUST CAMSHAFT)

OK: Go to next step

6. **INSPECT OIL CONTROL VALVE FILTER**
   a. Remove the OCV filter (See **DISASSEMBLY**).
   b. Check that the filter is not clogged.

      OK:

      Filter is not clogged.

   c. Reinstall the OCV filter (See **REASSEMBLY**).

NG: CLEAN OIL CONTROL VALVE FILTER

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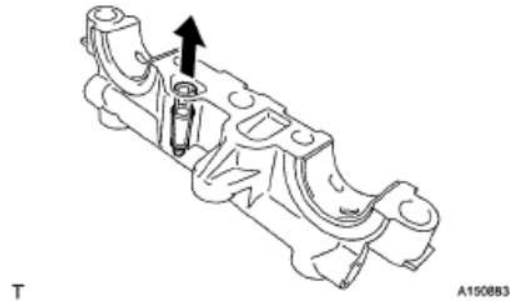


Fig. 47: Removing Oil Control Valve Filter
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

7. **ADJUST VALVE TIMING**

HINT:

There are no marks on the cylinder head to match-up for the purpose of checking valve timing. Valve timing can only be inspected by lining up the colored plates on the timing chain with the marks on the pulleys. It may be necessary to remove and re-install the chain to match up the alignment marks (See **REASSEMBLY**).

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Reference: Camshafts Layout

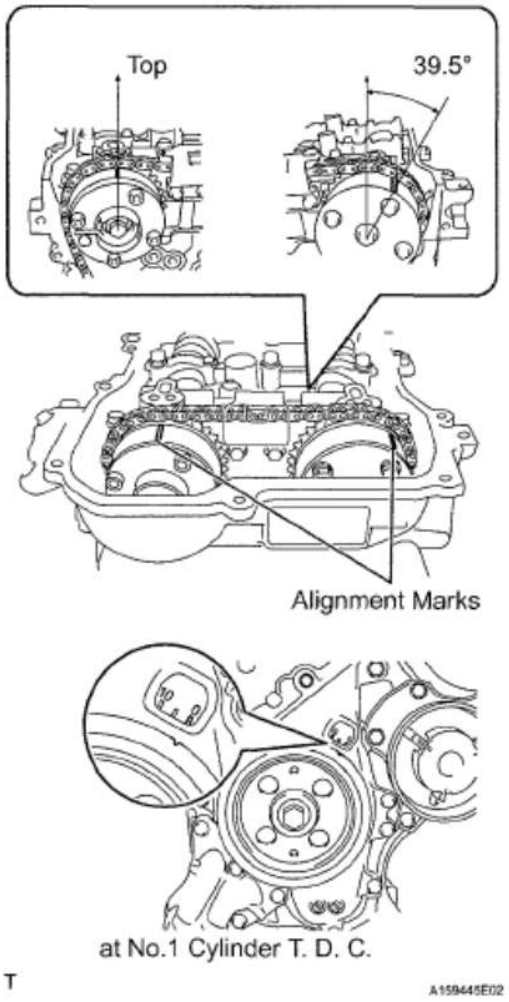


Fig. 48: Identifying Valve Timing
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

8. **CHECK WHETHER DTC OUTPUT RECURS (DTC P0014 OR P0015)**
   a. Connect a Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the tester ON.
   d. Clear DTCs (See **DTC CHECK / CLEAR**).
   e. Start the engine and warm it up.
   f. Switch the ECM from normal mode to check mode using the tester (See **CHECK MODE PROCEDURE**).
   g. Allow the engine to idle for 3 minutes or more.
   h. Drive the vehicle for more than 10 minutes.

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i. Read DTCs.

Result

RESULT REFERENCE

Result	Proceed to
No output	A
P0014 or P0015	B

HINT:

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

B : REPLACE ECM

A : END

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

DESCRIPTION

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

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

DTC DETECTION CONDITION AND TROUBLE AREA

DTC No.	Detection Condition	Trouble Area
P0016	Deviation in crankshaft position sensor signal and camshaft position sensor (for intake camshaft) signal (2 trip detection logic)	Mechanical system (Timing chain has jumped tooth or chain stretched) Camshaft Timing Oil Control Valve (OCV) (for intake camshaft) Camshaft timing gear assembly (for intake camshaft) ECM
P0017	Deviation in crankshaft position sensor signal and camshaft position sensor (for exhaust camshaft) signal (2 trip	Mechanical system (Timing chain has jumped tooth or chain stretched) Camshaft Timing Oil Control Valve (OCV) (for exhaust camshaft)

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	detection logic)	Camshaft timing gear assembly (for exhaust camshaft) ECM

MONITOR DESCRIPTION

To monitor the correlation of the intake camshaft position and crankshaft position, the ECM checks the VVT learning value while the engine is idling. The VVT learning value is calibrated based on the camshaft position and crankshaft position. The intake valve timing is set to the most retarded angle while the engine is idling. If the VVT learning value is out of specified range in consecutive driving cycles, the ECM illuminates the MIL and sets the DTC P0016.

To monitor the correlation of the exhaust camshaft position and crankshaft position, the ECM checks the VVT learning value while the engine is idling. The VVT learning value is calibrated based on the camshaft position and crankshaft position. The exhaust valve timing is set to the most advanced angle while the engine is idling. If the VVT learning value is out of specified range in consecutive driving cycles, the ECM illuminates the MIL and sets the DTC P0017.

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

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

TYPICAL ENABLING CONDITIONS

TYPICAL ENABLING CONDITIONS

Monitor runs whenever following DTCs not present	P0011 (VVT system 1 - advance) P0012 (VVT system 1 - retard) P0014 (Ex VVT system - advance) P0015 (Ex VVT system - retard) P0115 - P0118 (ECT sensor)

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Engine RPM	500 to 1000 rpm

TYPICAL MALFUNCTION THRESHOLDS

P0016 (Intake side)

TYPICAL MALFUNCTION THRESHOLDS

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

P0017 (Exhaust side)

TYPICAL MALFUNCTION THRESHOLDS

One of following conditions met	-
VVT learning value at maximum retarded valve timing	Less than 82.5°CA (crankshaft angle)
VVT learning value at maximum retarded valve timing	More than 104.4°CA (crankshaft angle)

INSPECTION PROCEDURE

HINT:

Read freeze frame data using a Techstream. Freeze frame data records the engine conditions 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. **CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P0016 AND P0017)**
   a. Connect a Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the tester ON.
   d. Select the following menu items: Powertrain / Engine and ECT / Trouble Codes.
   e. Read DTCs.

   Result

   RESULT REFERENCE

Result	Proceed to
P0016 or P0017	A
P0016 or P0017 and other DTCs	B

   HINT:

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

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B: Go to DTC CHART (See **DIAGNOSTIC TROUBLE CODE CHART**)

A: Go to next step

2. **PERFORM ACTIVE TEST USING TECHSTREAM (OPERATE OCV)**
   a. Connect a Techstream to the DLC3.
   b. Start the engine.
   c. Turn the tester ON.
   d. Warm up the engine.
   e. Select the following menu items: Powertrain / Engine and ECT / Active Test / Control the VVT System (Bank 1).
   f. Select the following monitor items: VVT Change Angle (Bank 1) and VVT OCV Duty (Bank 1).
   g. Check that the VVT Change Angle (Bank 1) varies when operating the OCV (for intake camshaft) using the tester.

      OK:

      The VVT Change Angle (Bank 1) value and engine speed vary.

   h. Select the following menu items: Powertrain / Engine and ECT / Active Test / Control the VVT Exhaust Linear (Bank 1).
   i. Select the following monitor items: VVT Ex Change Angle (Bank 1) and VVT Ex OCV Duty (Bank 1).
   j. Check that the VVT Ex Change Angle (Bank 1) value varies when operating the OCV (for exhaust camshaft) using the tester.

      OK:

      The VVT Ex Change Angle (Bank 1) value and engine speed vary.

      HINT:

      If the VVT system can be operated through the ACTIVE TEST, it can be assumed that the VVT system is operating normally.

NG: Go to step 4

OK: Go to next step

3. **ADJUST VALVE TIMING**

HINT:

There are no marks on the cylinder head to match-up for the purpose of checking valve timing. Valve

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timing can only be inspected by lining up the colored plates on the timing chain with the marks on the pulleys. It may be necessary to remove and re-install the chain to match up the alignment marks (See **REASSEMBLY**).

NEXT: Go to step 7

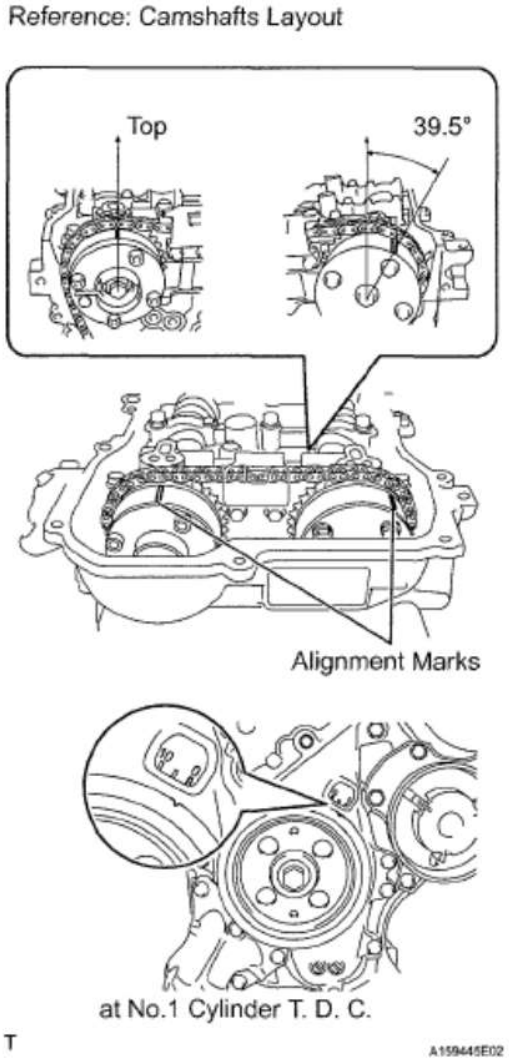


Fig. 49: Identifying Valve Timing
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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

HINT:

Inspect the specified OCV (OCV for intake camshaft or OCV for exhaust camshaft) in accordance with the inspection result of step 2.

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a. Remove the OCV (for intake camshaft) or OCV (for exhaust camshaft) (See **REMOVAL**).
b. Measure the resistance according to the value(s) in the table below.

Standard resistance

RESISTANCE SPECIFICATION

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

Component without harness connected:
(OCV for Intake or Exhaust Camshaft)



Y A159178E03

Fig. 50: Identifying Camshaft Timing Oil Control Valve Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

c. Apply battery voltage to terminals of the OCV (for intake camshaft) or OCV (for exhaust camshaft). Check the valve operation.

OK:

Valve moves quickly.

d. Reinstall the OCV (for intake camshaft) or OCV (for exhaust camshaft) (See **INSTALLATION**).

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

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Component without harness connected:
(OCV for Intake Camshaft or OCV for Exhaust Camshaft)

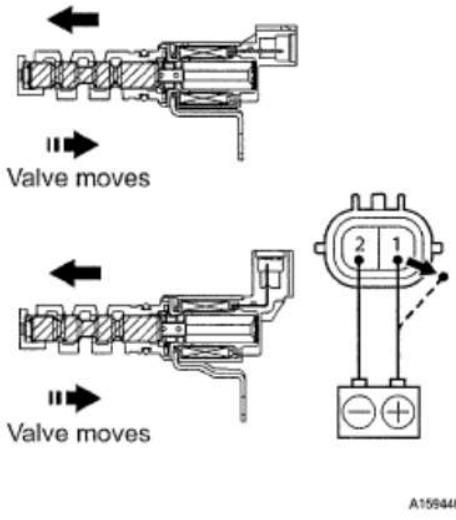


Fig. 51: Inspecting Camshaft Timing Oil Control Valve Assembly (For Intake Or Exhaust Camshaft)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

5. **INSPECT OIL CONTROL VALVE FILTER**
   a. Remove the OCV filter (See **DISASSEMBLY**).
   b. Check that the filter is not clogged.

      OK:

      Filter is not clogged.

   c. Reinstall the OCV filter (See **REASSEMBLY**).

NG: CLEAN OIL CONTROL VALVE FILTER

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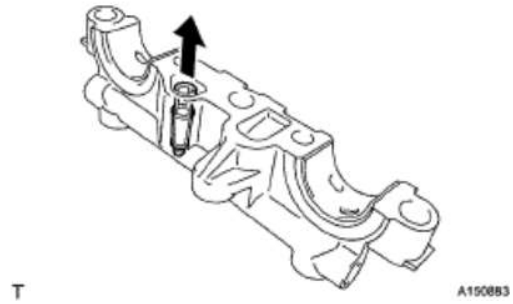


Fig. 52: Removing Oil Control Valve Filter
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

6. **REPLACE CAMSHAFT TIMING GEAR ASSEMBLY**

HINT:

Replace the specified camshaft timing gear (camshaft timing gear for intake camshaft or exhaust camshaft) in accordance with the inspection result of step 2.

a. Replace the camshaft timing gear assembly (camshaft timing gear for intake camshaft or exhaust camshaft) (See **REMOVAL**).

7. **CONFIRM WHETHER MALFUNCTION HAS BEEN SUCCESSFULLY REPAIRED**

a. In order to erase the ECM's learned values for valve timing, disconnect the cable from the negative (-) battery terminal for 1 minute.
b. Reconnect the cable to the negative (-) battery terminal.
c. Connect a Techstream to the DLC3.
d. Turn the ignition switch to ON.
e. Turn the tester ON.
f. Clear DTCs (See **DTC CHECK / CLEAR**).
g. Start the engine and warm it up.
h. Switch the ECM from normal mode to check mode using the tester (See **CHECK MODE PROCEDURE**).
i. Allow the engine to idle for 5 minutes or more.
j. Drive the vehicle with a city drive pattern for more than 10 minutes.
k. Select the following menu items: Powertrain / Engine and ECT / Trouble Codes.
l. Read DTCs.

Result

RESULT REFERENCE

Result	Proceed to

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No output	A
P0016 or P0017	B

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

A : 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)

DESCRIPTION

Refer to **DTC P2195** .

HINT:

- When either of these DTCs is set, the ECM enters fail-safe mode. The ECM turns off the Air Fuel Ratio (A/F) sensor heater in fail-safe mode. Fail-safe mode continues until the ignition switch is turned to OFF.
- Although the DTC titles say the oxygen sensor, these DTCs relate to the A/F sensor.
- Sensor 1 refers to the sensor mounted in front of the Three-Way Catalytic Converter (TWC) and located near the engine assembly.
- The ECM provides a pulse width modulated control circuit to adjust the current through the heater. The A/F sensor heater circuit uses a relay on the +B side of the circuit.

Reference (System Diagram of Sensor 1):

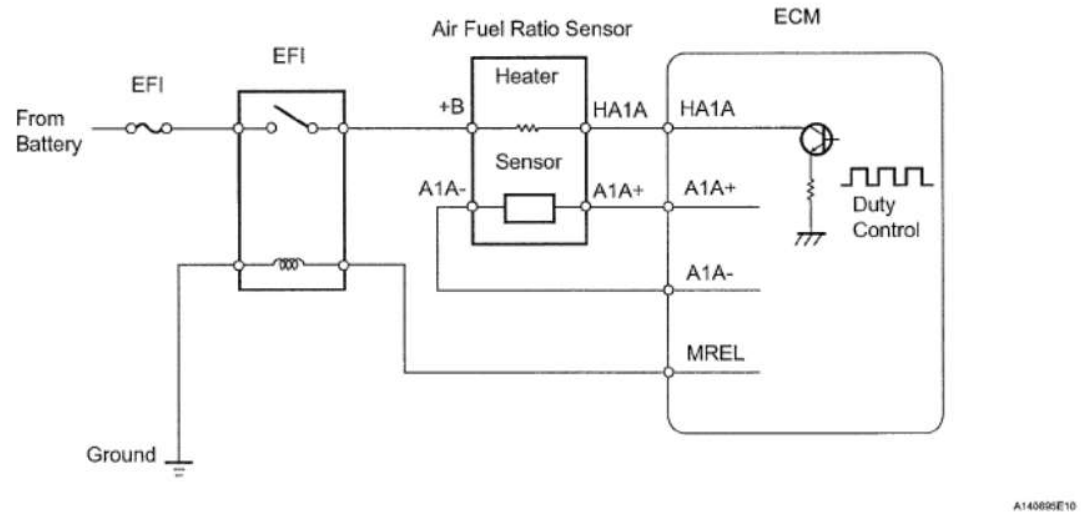


Fig. 53: Air Fuel Ratio Sensor System Diagram (Bank 1 Sensor 1)
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DTC DETECTION CONDITION AND TROUBLE AREA

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DTC No.	DTC Detection Condition	Trouble Area
P0031	Air Fuel Ratio (A/F) sensor heater current less than 0.8 A (1 trip detection logic)	• Open in A/F sensor heater circuit • A/F sensor heater (sensor 1) • ECM power source circuit • ECM
P0032	Air Fuel Ratio (A/F) sensor heater current fail (1 trip detection logic)	• Short in A/F sensor heater circuit • A/F sensor heater (sensor 1) • ECM power source circuit • ECM

HINT:

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

MONITOR DESCRIPTION

The ECM uses information from the Air Fuel Ratio (A/F) 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 (TWC) to purify the exhaust gases.

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

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

The A/F 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 A/F sensor becomes inaccurate, as a result, the ECM is unable to regulate air-fuel ratio properly.

When the current in the A/F sensor heater is outside the normal operating range, the ECM interprets this as a malfunction in the sensor heater and sets a DTC.

MONITOR STRATEGY

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MONITOR STRATEGY

Related DTCs	P0031: Air Fuel Ratio (A/F) sensor heater open/short (Low electrical current) P0032: A/F sensor heater open/short (High electrical current)
Required Sensors/Components (Main)	A/F sensor heater
Required Sensors/Components (Related)	-
Frequency of Operation	Continuous
Duration	10 seconds
MIL Operation	Immediate
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

All:

TYPICAL ENABLING CONDITIONS

Monitor runs whenever following DTCs not present	None

P0031:

TYPICAL ENABLING CONDITIONS

Battery voltage	10.5 V or more
A/F sensor heater duty-cycle ratio	50% or more
Time after engine start	10 seconds or more

P0032:

TYPICAL ENABLING CONDITIONS

Battery voltage	Less than 20 V
Engine	Running

TYPICAL MALFUNCTION THRESHOLDS

P0031:

TYPICAL MALFUNCTION THRESHOLDS

A/F sensor heater current	Less than 0.8 A

P0032:

TYPICAL MALFUNCTION THRESHOLDS

Hybrid IC high current limiter port	Fail

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COMPONENT OPERATING RANGE

COMPONENT OPERATING RANGE

A/F sensor heater resistance	1.8 to 3.4 ohms at 20°C (68°F)

WIRING DIAGRAM

Refer to **DTC P2195** .

INSPECTION PROCEDURE

HINT:

Read freeze frame data using a 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. **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

      RESISTANCE SPECIFICATION

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

   c. Reconnect the air fuel ratio sensor connector.

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

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Component without harness connected:
(Air Fuel Ratio Sensor)



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Fig. 54: Identifying Air Fuel Ratio Sensor Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

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

Standard voltage

VOLTAGE SPECIFICATION

Tester Connection	Switch Condition	Specified Condition
C21-2 (+B) - Body ground	Ignition switch ON	11 to 14 V

   d. Reconnect the air fuel ratio sensor connector.

NG: Go to step 5

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



Fig. 55: 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)

RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
C21-1 (HA1A) - C19-109 (HA1A)	Always	Below 1 ohms

Standard resistance (Check for short)

RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
C21-1 (HA1A) or C19-109 (HA1A) - Body ground	Always	10 kohms or higher

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

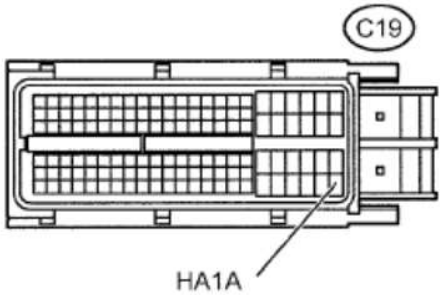
NG: REPAIR OR REPLACE HARNESS OR CONNECTOR

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



Front view of wire harness connector:
(to ECM)



A154642E01

Fig. 56: Identifying Air Fuel Ratio 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 (DTC P0031 OR P0032)**
   a. Connect a Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the tester ON.
   d. Clear 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 Codes.
   h. Read DTCs.

Result

RESULT REFERENCE

Result	Proceed to

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No output	A
P0031 or P0032	B

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

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

5. **CHECK HARNESS AND CONNECTOR (AIR FUEL RATIO SENSOR - INTEGRATION RELAY)**
   a. Disconnect the air fuel ratio sensor connector.
   b. Remove the integration relay (EFI relay) from the engine room relay block (See **REMOVAL**).
   c. Measure the resistance according to the value(s) in the table below.

Standard resistance (Check for open)

RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
C21-2 (+B) - 1A-4	Always	Below 1 ohms

Standard resistance (Check for short)

RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
C21-2 (+B) or 1A-4-Body ground	Always	10 kohms or higher

   d. Reconnect the air fuel ratio sensor connector.
   e. Reinstall the integration relay.

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR

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



Front view of wire harness connector:
(to Integration Relay)

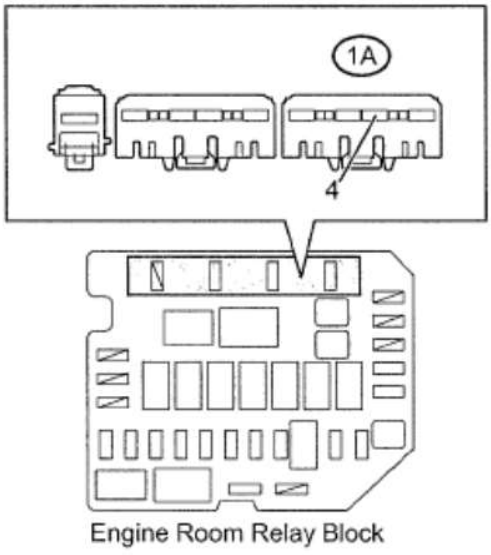


Fig. 57: Identifying Air Fuel Ratio Sensor And Integration Relay Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK : REPAIR OR REPLACE ECM POWER SOURCE CIRCUIT (See **ECM POWER SOURCE CIRCUIT**)

DTC P0037 OXYGEN SENSOR HEATER CONTROL CIRCUIT LOW (BANK 1 SENSOR 2); DTC P0038 OXYGEN SENSOR HEATER CONTROL CIRCUIT HIGH (BANK 1 SENSOR 2); DTC P0141 OXYGEN SENSOR HEATER CIRCUIT MALFUNCTION (BANK 1 SENSOR 2)

DESCRIPTION

Refer to **DTC P0136** .

HINT:

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- Sensor 2 refers to the sensor mounted behind the Three-Way Catalytic Converter (TWC) and located far from the engine assembly.
- When any of these DTCs are set, the ECM enters fail-safe mode. The ECM turns off the Heated Oxygen (HO2) sensor heater in fail-safe mode. Fail-safe mode continues until the ignition switch is turned to OFF.
- The ECM provides a pulse width modulated control circuit to adjust the current through the heater. The HO2 sensor heater circuit uses a relay on the +B side of the circuit.

Reference (System Diagram of Sensor 2):

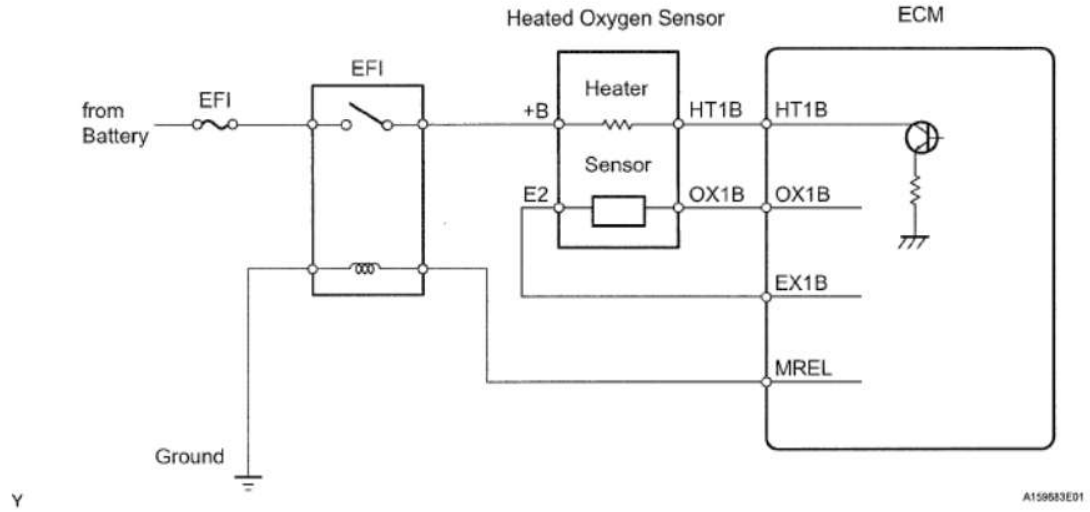


Fig. 58: Heated Oxygen Sensor System Diagram (Bank 1 Sensor 2)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

DTC DETECTION CONDITION AND TROUBLE AREA

DTC No.	DTC Detection Condition	Trouble Area
P0037	Heated Oxygen (HO2) sensor (sensor 2) heater current less than 0.3 A (1 trip detection logic)	• Open in HO2 sensor (sensor 2) heater circuit • HO2 sensor (sensor 2) heater • ECM power source circuit • ECM
P0038	Heated Oxygen (HO2) sensor (sensor 2) heater current more than 2 A (1 trip detection logic)	• Short in HO2 sensor (sensor 2) heater circuit • HO2 sensor (sensor 2) heater • ECM power source circuit • ECM
		• Open or short in HO2 sensor (sensor 2) heater circuit

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P0141	Cumulative heater resistance correction value exceeds the acceptable threshold (2 trip detection logic)	• HO2 sensor (sensor 2) heater • ECM power source circuit • ECM

HINT:

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

MONITOR DESCRIPTION

The sensing portion of the Heated Oxygen (HO2) 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 and P0038):

The ECM monitors the current applied to the HO2 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 when the current in the HO2 sensor heater is more than 2 A. Conversely, when the heater current is less than 0.3 A, DTC P0037 is set.

Heated oxygen sensor heater performance (P0141):

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 HO2 sensor heater and set DTC P0141.

MONITOR STRATEGY

MONITOR STRATEGY

Related DTCs	P0037: Heated oxygen sensor heater (sensor 2) open/short (Low electrical current) P0038: Heated oxygen sensor heater (sensor 2) open/short (High electrical current) P0141: Heated oxygen sensor heater performance (sensor 2)
Required sensors/Components (Main)	Heated oxygen sensor heater (sensor 2)

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Required sensors/Components (Related)	-
Frequency of operation	Continuous: P0037, P0038 Once per driving cycle: P0141
Duration	0.5 seconds: P0037 Within 2.048 seconds: P0038 10 seconds: P0141
MIL operation	Immediate: P0037, P0038 2 driving cycles: P0141
Sequence of operation	None

TYPICAL ENABLING CONDITIONS

All:

TYPICAL ENABLING CONDITIONS

Monitor runs whenever following DTCs are not present	None

P0037:

TYPICAL ENABLING CONDITIONS

Battery voltage	10.5 to 20 V

P0038 (Case 1):

TYPICAL ENABLING CONDITIONS

Battery voltage	10.5 V or more
Engine	Running
Starter	OFF

P0038 (Case 2):

TYPICAL ENABLING CONDITIONS

Battery voltage	10.5 to 20 V

P0141:

TYPICAL ENABLING CONDITIONS

One of the following conditions is met:	Condition A or B
A. All of the following conditions are met:	Condition 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

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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:

TYPICAL MALFUNCTION THRESHOLDS

Learned heater OFF current	Less than 0.3 A

P0038:

TYPICAL MALFUNCTION THRESHOLDS

One of the following conditions is met:	Condition A or B
A. Learned heater OFF current	More than 2 A
B. Hybrid IC high current limiter port	Fail

P0141 (Heater performance monitor check):

TYPICAL MALFUNCTION THRESHOLDS

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

COMPONENT OPERATING RANGE

COMPONENT OPERATING RANGE

Heated Oxygen (HO2) sensor heater current	0.4 to 1 A (when engine idles, HO2 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:

Read freeze frame data using a 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.

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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

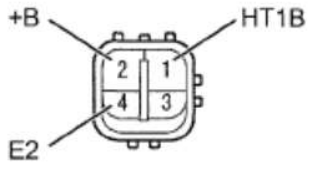
RESISTANCE SPECIFICATION

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

   c. Reconnect the heated oxygen sensor connector.

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

Component without harness connected:
(Heated Oxygen Sensor)



A170692E01

Fig. 59: Identifying Heated Oxygen Sensor Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

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

Standard voltage

VOLTAGE SPECIFICATION

Tester Connection	Switch Condition	Specified Condition

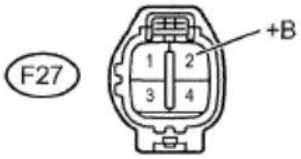
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F27-2 (+B) - Body ground	Ignition switch ON	11 to 14 V

d. Reconnect the heated oxygen sensor connector.

NG: Go to step 5

Component without harness connected:
(Heated Oxygen Sensor)



A170693E01

Fig. 60: Identifying Heated Oxygen Sensor Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

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

Standard resistance (Check for open)

RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
F27-1 (HT1B) - C19-47 (HT1B)	Always	Below 1 ohms

Standard resistance (Check for short)

RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
F27-1 (HT1B) or C19-47 (HT1B) - Body ground	Always	10 kohms or higher

d. Reconnect the heated oxygen sensor connector.

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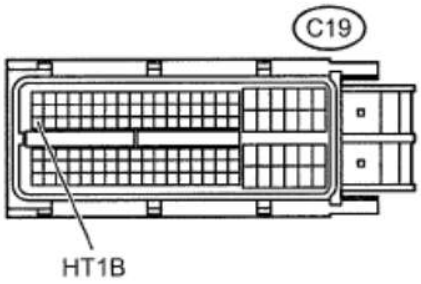
e. Reconnect the ECM connector.

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR

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



Front view of wire harness connector:
(to ECM)



A170676E01

Fig. 61: 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 (DTC P0037, P0038 OR P0141)**
   a. Connect a Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the tester ON.
   d. Clear 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 Codes.
   h. Read DTCs.

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Result

RESULT REFERENCE

Result	Proceed to
No output	A
P0037, P0038 or P0141	B

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

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

5. **CHECK HARNESS AND CONNECTOR (HEATED OXYGEN SENSOR - INTEGRATION RELAY)**
   a. Disconnect the heated oxygen sensor connector.
   b. Remove the integration relay (EFI relay) from the engine room relay block (See **REMOVAL**).
   c. Measure the resistance according to the value(s) in the table below.

Standard resistance (Check for open)

RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
F27-2 (+B) - 1A-4	Always	Below 1 ohms

Standard resistance (Check for short)

RESISTANCE SPECIFICATION

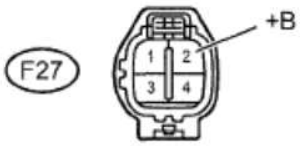
Tester Connection	Condition	Specified Condition
F27-2 (+B) or 1A-4 - Body ground	Always	10 kohms or higher

   d. Reconnect the heated oxygen sensor connector.
   e. Reinstall the integration relay.

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR

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



Front view of wire harness connector:
(to Integration Relay)

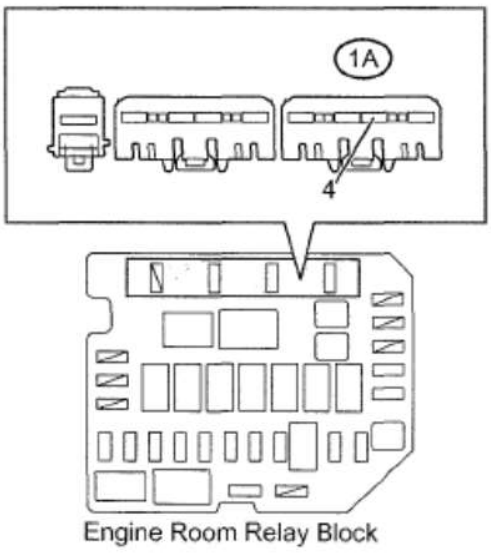


Fig. 62: Identifying Heated Oxygen Sensor And Integration Relay Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK : REPAIR OR REPLACE ECM POWER SOURCE CIRCUIT (See **ECM POWER SOURCE CIRCUIT**)

DTC P0101 MASS AIR FLOW CIRCUIT RANGE / PERFORMANCE PROBLEM

DESCRIPTION

Refer to **DTC P0102** .

DTC DETECTION CONDITION AND TROUBLE AREA

DTC No.	DTC Detection Condition	Trouble Area
	Conditions (a), (b), (c), (d) and (e) continue for more than 10 seconds (2	

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P0101	trip detection logic): a. Engine running b. Engine coolant temperature 70°C (158°F) or higher c. Throttle Position (TP) sensor voltage 0.24 to 2 V d. Average engine load value ratio less than 0.85, or more than 1.15 (varies with estimated engine load) Average engine load value ratio = Average engine load based on mass air flow meter output / Average engine load estimated from driving conditions e. Average air-fuel ratio less than -20%, or more than 20%	• Mass Air Flow (MAF) meter • Air induction system • PCV hose connections

MONITOR DESCRIPTION

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

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

MONITOR STRATEGY

MONITOR STRATEGY

Related DTCs	P0101: Mass airflow meter rationality
Required Sensors/Components (Main)	Mass air flow meter
Required Sensors/Components (Related)	Crankshaft Position (CKP) sensor Camshaft Position (CMP) sensor Engine Coolant Temperature (ECT) sensor Throttle Position (TP) sensor
Frequency of Operation	Continuous
Duration	10 times
MIL Operation	2 driving cycles
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

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TYPICAL ENABLING CONDITIONS

Monitor runs whenever following DTCs not present	P0115 - P0118 (ECT sensor) P0120 - P0223, P2135 (TP sensor) P0125 (Insufficient ECT for closed loop) P0335 (CKP sensor) P0340 (CMP sensor)
Throttle position (TP sensor voltage)	0.24 to 2 V
Time after engine starts	5 seconds
Battery voltage	10.5 V or more
Estimated Load	30 to 70 %
Engine coolant temperature	70°C (158°F) or more
IAT sensor circuit	OK
ECT sensor circuit	OK
CKP sensor circuit	OK
TP sensor circuit	OK
EVAP system pressure sensor circuit	OK
EVAP leak detection pump	OK
EVAP system vent valve	OK

TYPICAL MALFUNCTION THRESHOLDS

TYPICAL MALFUNCTION THRESHOLDS

Both of following conditions 1 and 2 met	-
1. Averaged engine load value ratio	Less than 0.85, or more than 1.15 (varies with estimated engine load)
2. Averaged air-fuel ratio	Less than -20%, or more than 20%

WIRING DIAGRAM

Refer to **DTC P0102** .

CONFIRMATION DRIVING PATTERN

HINT:

Performing this confirmation pattern will activate the mass air flow performance monitor.

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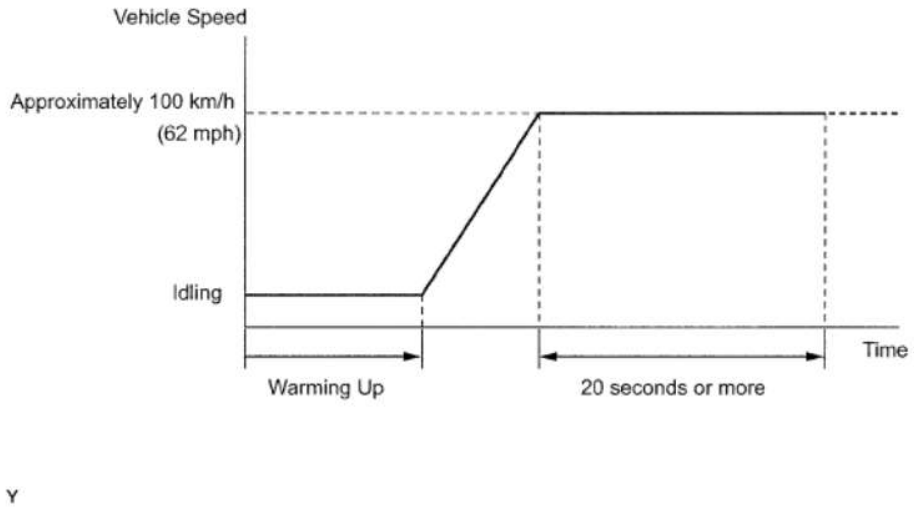


Fig. 63: Vehicle Speed Graph
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

1. Connect a Techstream to the DLC3.
2. Turn the ignition switch to ON.
3. Turn the tester ON.
4. Clear DTCs (See **DTC CHECK / CLEAR**).
5. Start the engine, and warm it up until the engine coolant temperature reaches 70°C (158°F) or higher.
6. Drive the vehicle at approximately 100 km/h (62 mph) for 20 seconds or more.
7. Select the following menu items: Powertrain / Engine and ECT / Trouble Codes / Pending; then check if any DTCs (any pending DTCs) are set.

INSPECTION PROCEDURE

HINT:

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

   Result

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RESULT REFERENCE

Result	Proceed to
P0101	A
P0101 and other DTCs	B

HINT:

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

B: Go to DTC CHART (See **DIAGNOSTIC TROUBLE CODE CHART**)

A: Go to next step

2. **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

3. **CHECK PCV HOSE CONNECTIONS**

OK:

PCV hose is connected correctly and is not damaged.

NG: REPAIR OR REPLACE PCV HOSE

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

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

DESCRIPTION

The Mass Air Flow (MAF) meter is a sensor that measures the amount of air flowing through the throttle valve.

The ECM uses this information to determine the fuel injection time and to provide the appropriate air fuel ratio.

Inside the MAF 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 given temperature. The flow of

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incoming air cools both the wire and an internal thermistor, affecting their resistance. To maintain a constant current value, the ECM varies the voltage applied to these components in the MAF meter. The voltage level is proportional to the airflow through the sensor, and the ECM uses it to calculate the intake air volume.

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

HINT:

When any of these DTCs 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.

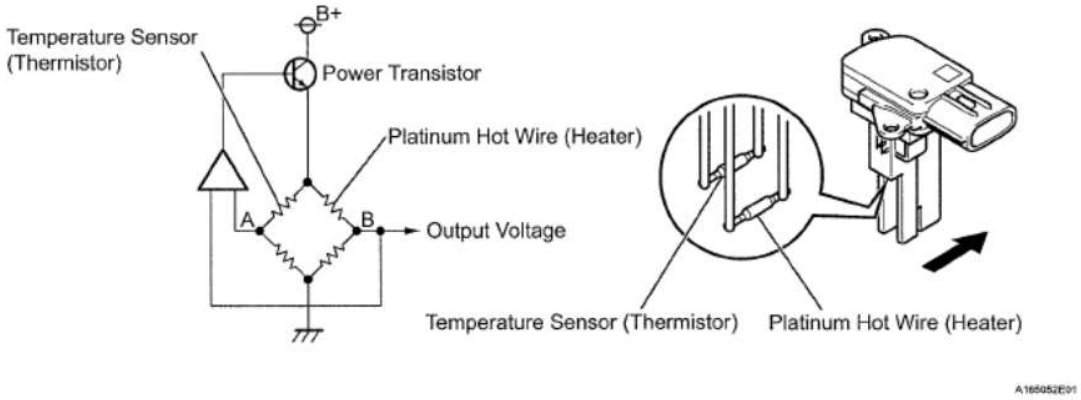


Fig. 64: Mass Air Flow Meter Circuit Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

DTC DETECTION CONDITION AND TROUBLE AREA

DTC No.	DTC Detection Condition	Trouble Area
P0102	Mass Air Flow (MAF) meter voltage less than 0.2 V for 3 seconds (1 trip detection logic)	• Open or short in MAF meter circuit • MAF meter • ECM
P0103	Mass Air Flow (MAF) meter voltage more than 4.9 V for 3 seconds (1 trip detection logic)	• Open or short in MAF meter circuit • MAF 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.

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MASS AIR FLOW RATE SPECIFICATION

Mass Air Flow Rate (g/sec)	Malfunction
Approximately 0.0	• Open in Mass Air Flow (MAF) meter power source circuit • Open or short in VG circuit
271.0 or more	• Open in EVG circuit

MONITOR DESCRIPTION

If there is a defect in the Mass Air Flow (MAF) 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 MAF meter circuit and sets a DTC.

Example:

When the sensor output voltage 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

Related DTCs	P0102: Mass Air Flow (MAF) meter range check (Low voltage) P0103: MAF meter range check (High voltage)
Required Sensors/Components (Main)	MAF meter
Required Sensors/Components (Related)	Crankshaft position sensor Throttle 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

Monitor runs whenever following DTCs not present	None

TYPICAL MALFUNCTION THRESHOLDS

P0102:

TYPICAL MALFUNCTION THRESHOLDS

MAF meter voltage	Less than 0.2 V

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P0103:

TYPICAL MALFUNCTION THRESHOLDS

MAF meter voltage	More than 4.9 V

COMPONENT OPERATING RANGE

COMPONENT OPERATING RANGE

MAF meter voltage	Between 0.4 V and 2.2 V

WIRING DIAGRAM

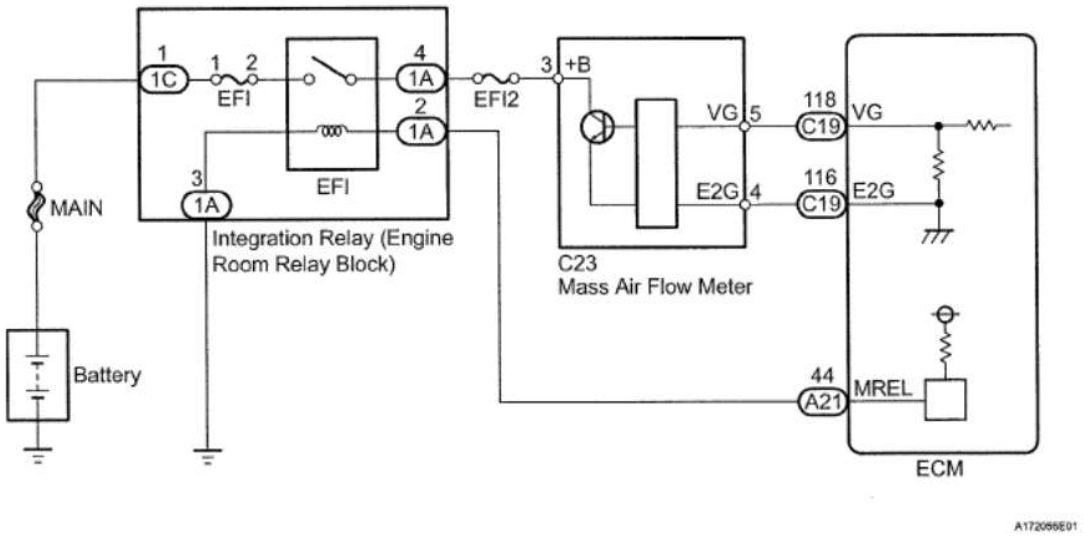


Fig. 65: Mass Air Flow Meter - Wiring Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSPECTION PROCEDURE

HINT:

Read freeze frame data using a 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 VALUE USING TECHSTREAM (MASS AIR FLOW RATE)**
   a. Connect a 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.

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e. Read the values displayed on the tester.

Result

RESULT REFERENCE

Result	Proceed to
0.0	A
271.0 or more	B
Between 1.0 and 270.0*	C
HINT: *: The value must change when the throttle valve is open or closed with the engine running.	

B: Go to step 7

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

Standard voltage

VOLTAGE SPECIFICATION

Tester Connection	Switch Condition	Specified Condition
C23-3 (+B) - Body ground	Ignition switch ON	11 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)

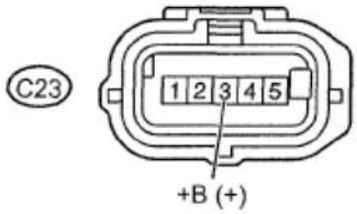


Fig. 66: Identifying Mass Air Flow Meter Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

3. **INSPECT MASS AIR FLOW METER**
   a. Inspect output voltage.
      1. Disconnect the mass air flow meter connector.
      2. Apply battery voltage across terminals +B and E2G.
      3. Connect the positive (+) tester probe to terminal VG, and the negative (-) tester probe to terminal E2G.
      4. Measure the voltage according to the value(s) in the table below.

         Standard voltage

         VOLTAGE SPECIFICATION

Tester Connection	Condition	Specified Condition
5 (VG) - 4 (E2G)	Apply battery voltage across terminal +B and E2G	0.2 to 4.9 V

      5. Reconnect the mass air flow meter connector.

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

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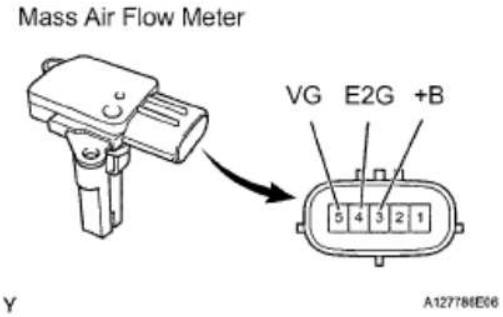


Fig. 67: Identifying Mass Air Flow Meter Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

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)

RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
C23-5 (VG) - C19-118 (VG)	Always	Below 1 ohms
C23-4 (E2G) - C19-116 (E2G)		

Standard resistance (Check for short)

RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
C23-5 (VG) or C19-118 (VG) - Body ground	Always	10 kohms or higher

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

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR

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



Front view of wire harness connector:
(to ECM)

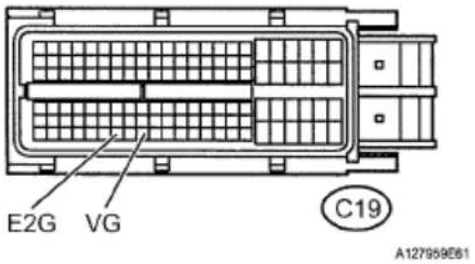


Fig. 68: Identifying Mass Air Flow Meter And ECM Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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

5. **INSPECT FUSE (EFI2 FUSE)**
   a. Remove the EFI2 fuse from the engine room relay block.
   b. Measure the resistance according to the value(s) in the table below.

Standard resistance

RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
EFI2 fuse	Always	Below 1 ohms

   c. Reinstall the EFI2 fuse.

NG: CHECK FOR SHORT IN ALL HARNESSES AND CONNECTORS CONNECTED TO FUSE AND REPLACE FUSE

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Engine Room Relay Block:

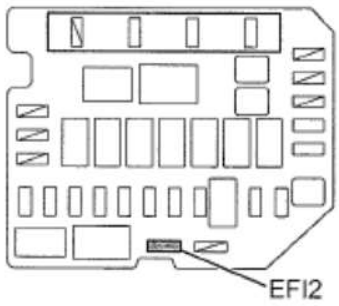


Fig. 69: Identifying EFI2 Fuse
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

6. **CHECK HARNESS AND CONNECTOR (MASS AIR FLOW METER - INTEGRATION RELAY)**
   a. Disconnect the mass air flow meter connector.
   b. Remove the integration relay (EFI 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)

RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
C23-3 (+B) - 1A-4	Always	Below 1 ohms

Standard resistance (Check for short)

RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
C23-3 (+B) or 1A-4 - Body ground	Always	10 kohms or higher

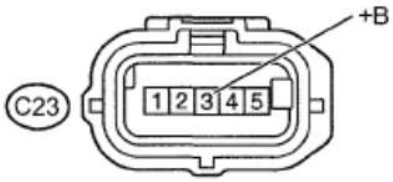
   d. Reconnect the mass air flow meter connector.
   e. Reinstall the integration relay.

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR

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



Front view of wire harness connector:
(to Integration Relay)

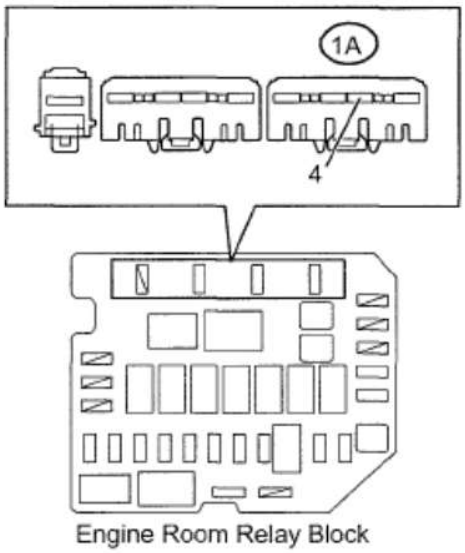


Fig. 70: Identifying Mass Air Flow Meter And Integration Relay Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK : REPAIR OR REPLACE ECM POWER SOURCE CIRCUIT (See **ECM POWER SOURCE CIRCUIT**)

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

Standard resistance

RESISTANCE SPECIFICATION

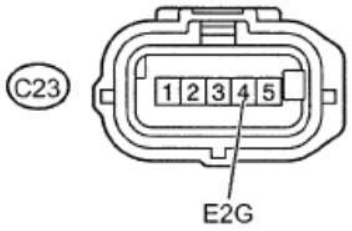
Tester Connection	Condition	Specified Condition
C23-4 (E2G) - Body ground	Always	Below 1 ohms

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c. Reconnect the mass air flow meter connector.

NG: Go to step 8

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



P A148765E21

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

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

8. **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)

RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
C23-5 (VG) - C19-118 (VG)	Always	Below 1 ohms
C23-4 (E2G) - C19-116 (E2G)		

Standard resistance (Check for short)

RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
C23-5 (VG) or C19-118 (VG) - Body ground	Always	10 kohms or higher

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

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NG: REPAIR OR REPLACE HARNESS OR CONNECTOR

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



Front view of wire harness connector:
(to ECM)

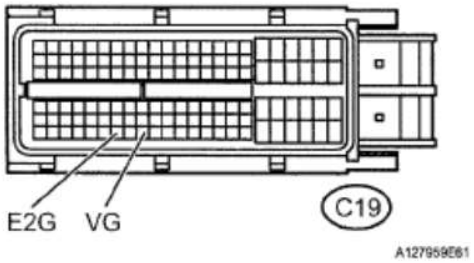


Fig. 72: Identifying Mass Air Flow Meter And ECM Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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

DTC P0111 INTAKE AIR TEMPERATURE SENSOR GRADIENT TOO HIGH

DESCRIPTION

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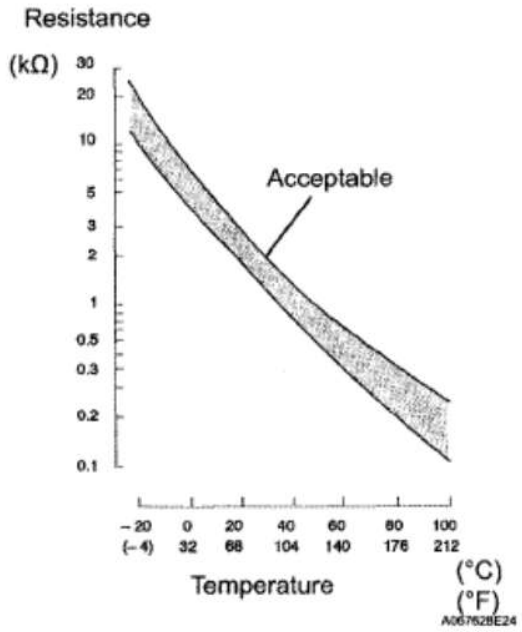


Fig. 73: Intake Air Temperature Sensor Resistance Graph
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

The Intake Air Temperature (IAT) sensor, mounted on the Mass Air Flow (MAF) meter, monitors the IAT. The IAT sensor has a built-in thermistor with a resistance that varies according to the temperature of the intake air. When the IAT 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. 73**).

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

Resistor R and the IAT sensor are connected in series. When the resistance value of the IAT sensor changes, according to changes in the IAT, 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 AND TROUBLE AREA

DTC No.	DTC Detection Condition	Trouble Area
P0111	When either of following conditions are met (2 trip detection logic): • In duration between engine warmed up and next engine starts, change in Intake Air Temperature (IAT) sensor output bellow threshold • During engine warming up after cold engine starts, change in IAT sensor output bellow threshold	Mass air flow meter

MONITOR DESCRIPTION

After warmed engine stop

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

After cold engine start

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

MONITOR STRATEGY

MONITOR STRATEGY

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 or more
MIL Operation	2 driving cycles
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

All:

TYPICAL ENABLING CONDITIONS

Monitor runs whenever following DTCs are not present	None

After engine stop:

TYPICAL ENABLING CONDITIONS

Time after engine start	10 seconds or more
Battery voltage	10.5 V or more
ECT sensor circuit	OK
ECT before engine stop	70°C(158°F) or more
Time that MAF is low before engine stop	2100 seconds
Accumulated MAF amount before engine stop	1328 g or more
Key-off duration	30 minutes

After cold engine start:

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TYPICAL ENABLING CONDITIONS

Key-off duration	5 hours
Time after engine start	10 seconds or more
ECT sensor circuit	OK
ECT	70°C(158°F) or more
Accumulated MAF amount	1328 g or more
Either of the following conditions 1 or 2 is met:	-
1. Duration while engine load is low	120 seconds or more
2. Duration while engine load is high	10 seconds or more

TYPICAL MALFUNCTION THRESHOLDS

After engine stop:

TYPICAL MALFUNCTION THRESHOLDS

IAT change	Less than 1°C(2°F)

After cold engine start:

TYPICAL MALFUNCTION THRESHOLDS

IAT change	Less than 1°C(2°F)

WIRING DIAGRAM

Refer to **DTC P0112** .

INSPECTION PROCEDURE

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

   Result

   RESULT REFERENCE

Result	Proceed to
P0111 and other DTCs	A
P0111	B

   HINT:

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

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

A: Go to DTC CHART (See **DIAGNOSTIC TROUBLE CODE CHART**)

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

DESCRIPTION

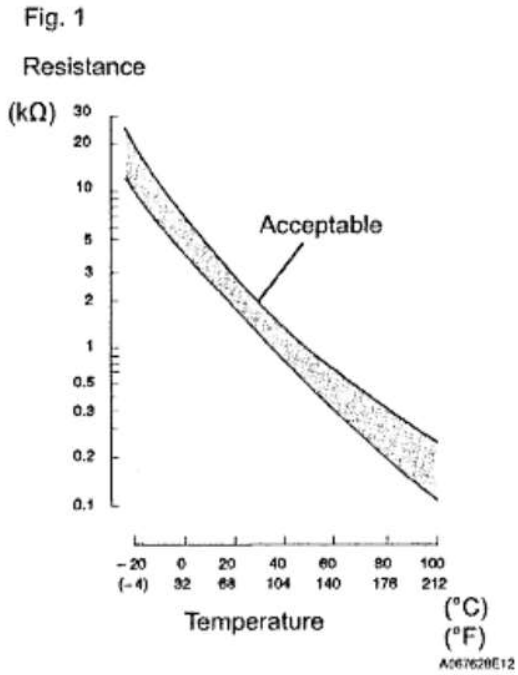


Fig. 74: Intake Air Temperature Sensor Resistance Graph
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

The Intake Air Temperature (IAT) sensor, mounted on the Mass Air Flow (MAF) meter, monitors the IAT. The IAT sensor has a built-in thermistor with a resistance that varies according to the temperature of the intake air. When the IAT 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. 74**).

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

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

HINT:

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When any of DTCs P0112 and P0113 are set, the ECM enters fail-safe mode. During fail-safe mode, the IAT is estimated to be 20°C (68°F) by the ECM. Fail-safe mode continues until a pass condition is detected.

DTC DETECTION CONDITION AND TROUBLE AREA

DTC No.	DTC Detection Condition	Trouble Area
P0112	Short in Intake Air Temperature (IAT) sensor circuit for 0.5 seconds (1 trip detection logic)	• Short in IAT sensor circuit • IAT sensor (built into mass air flow meter) • ECM
P0113	Open in Intake Air Temperature (IAT) sensor circuit for 0.5 seconds (1 trip detection logic)	• Open in IAT sensor circuit • IAT sensor (built into mass air flow meter) • ECM

HINT:

When any of these DTCs are set, check the intake air temperature by selecting the following menu items: Powertrain / Engine and ECT / All Data / Intake Air.

TEMPERATURE SPECIFICATION

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

MONITOR DESCRIPTION

The ECM monitors the sensor voltage and uses this value to calculate the Intake Air Temperature (IAT). When the sensor output voltage deviates from the normal operating range, the ECM interprets this as a malfunction in the IAT sensor and sets a DTC.

Example:

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

Related DTCs	P0112: Intake Air Temperature (IAT) sensor range check (Low voltage)

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	P0113: IAT sensor range check (High voltage)
Required Sensors/Components (Main)	IAT 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

Monitor runs whenever following DTCs not present	None

TYPICAL MALFUNCTION THRESHOLDS

P0112:

TYPICAL MALFUNCTION THRESHOLDS

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

P0113:

TYPICAL MALFUNCTION THRESHOLDS

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

COMPONENT OPERATING RANGE

COMPONENT OPERATING RANGE

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

WIRING DIAGRAM

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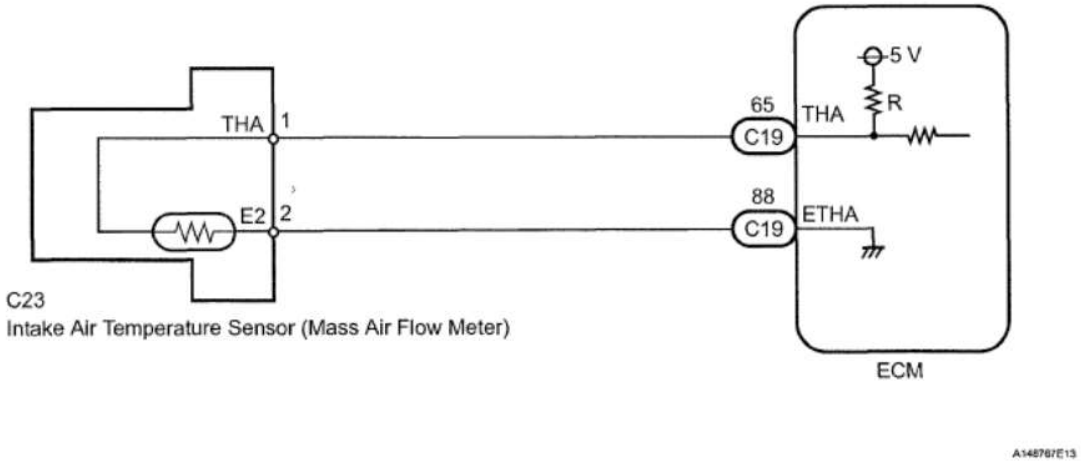


Fig. 75: Intake Air Temperature Sensor - Wiring Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSPECTION PROCEDURE

HINT:

Read freeze frame data using a 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 VALUE USING TECHSTREAM (INTAKE AIR TEMPERATURE)**
   a. Connect a Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the tester ON.
   d. Select the following menu items: Powertrain / Engine and ECT / All Data / Intake Air.
   e. Read the value displayed on the tester.

   OK:

   Same as actual Intake Air Temperature (IAT).

   Result

   RESULT REFERENCE

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

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HINT:

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

B: Go to step 4

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

A: Go to next step

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

      Standard value:

      140°C(284°F) or higher

   h. Reconnect the mass air flow meter connector.

NG: Go to step 3

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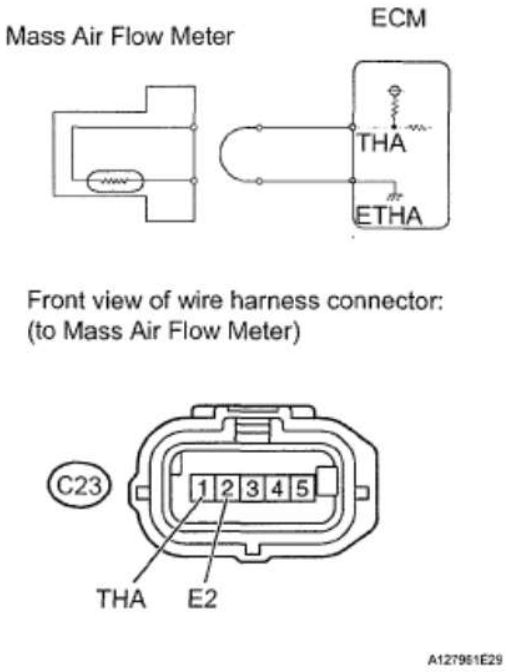


Fig. 76: Identifying Mass Air Flow Meter Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK : CONFIRM GOOD CONNECTION TO SENSOR. IF 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

RESISTANCE SPECIFICATION

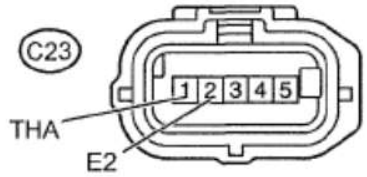
Tester Connection	Condition	Specified Condition
C23-1 (THA) -C19-65 (THA)	Always	Below 1 ohms
C23-2 (E2) - C19-88 (ETHA)	Always	Below 1 ohms

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

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR

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



Front view of wire harness connector:
(to ECM)

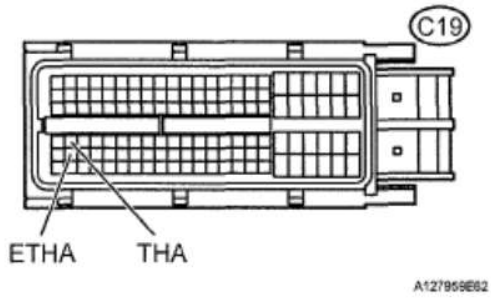


Fig. 77: Identifying Mass Air Flow Meter And ECM Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK : CONFIRM GOOD CONNECTION TO ECM. IF OK, REPLACE ECM (See **ELECTRONIC CIRCUIT INSPECTION PROCEDURE**)

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

      Standard value:

      -40°C (-40°F)

   g. Reconnect the mass air flow meter connector.

NG: Go to step 5

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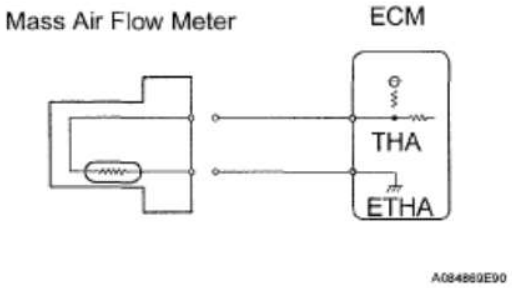


Fig. 78: Checking For Short In Wire Harness
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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

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

Standard resistance

RESISTANCE SPECIFICATION

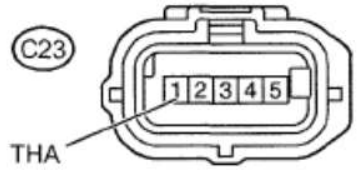
Tester Connection	Condition	Specified Condition
C23-1 (THA) or C19-65 (THA) - Body ground	Always	10 kohms or higher

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

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR

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



Front view of wire harness connector:
(to ECM)

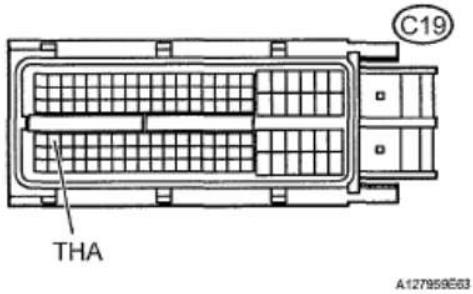


Fig. 79: Identifying Mass Air Flow Meter And ECM Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK : REPLACE ECM (See **ELECTRONIC CIRCUIT INSPECTION PROCEDURE**)

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

DESCRIPTION

A thermistor, whose resistance value varies according to the Engine Coolant Temperature (ECT), is built into the ECT sensor.

The structure of the sensor and its connection to the ECM are the same as those of the Intake Air Temperature (IAT) sensor.

HINT:

When any of DTCs P0115, P0117 and P0118 are set, the ECM enters fail-safe mode. During fail-safe mode, the ECT is estimated to be 80°C (176°F) by the ECM. Fail-safe mode continues until a pass condition is detected.

DTC DETECTION CONDITION AND TROUBLE AREA

DTC No.	DTC Detection Condition	Trouble Area
		• Open or short in ECT

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		sensor circuit • ECT sensor • ECM
P0115	Open or short in Engine Coolant Temperature (ECT) sensor circuit for 0.5 seconds (1 trip detection logic)	
P0117	Short in Engine Coolant Temperature (ECT) sensor circuit for 0.5 seconds (1 trip detection logic)	• Short in ECT sensor circuit • ECT sensor • ECM
P0118	Open in Engine Coolant Temperature (ECT) sensor circuit for 0.5 seconds (1 trip detection logic)	• Open in ECT sensor circuit • ECT sensor • ECM

HINT:

When any of these DTCs are set, check the ECT by selecting the following menu items: Powertrain / Engine and ECT / Data List / All Data / Coolant Temp.

TEMPERATURE SPECIFICATION

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

MONITOR DESCRIPTION

The Engine Coolant Temperature (ECT) sensor is used to monitor the ECT. The ECT sensor has a thermistor with a resistance that varies according to the temperature of the engine coolant. When the coolant temperature is low, the resistance in the thermistor increases. When the temperature is high, the resistance drops. These variations in resistance are reflected in the output voltage from the sensor. The ECM monitors the sensor voltage and uses this value to calculate the ECT. When the sensor output voltage deviates from the normal operating range, the ECM interprets this as a fault in the ECT sensor circuit and sets a DTC.

Example:

If the sensor output voltage is more than 4.91 V for 0.5 seconds or more, the ECM determines that there is an open in the ECT sensor circuit, and sets DTC P0118. Conversely, if the voltage output is less than 0.14 V for 0.5 seconds or more, the ECM determines that there is a short in the sensor circuit, and 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

	P0115: Engine Coolant Temperature (ECT) sensor range check

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Related DTCs	(Fluctuating) P0117: ECT sensor range check (Low voltage) P0118: ECT sensor range check (High voltage)
Required Sensors/Components (Main)	ECT 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

Monitor runs whenever following DTCs not present	None

TYPICAL MALFUNCTION THRESHOLDS

P0115:

TYPICAL MALFUNCTION THRESHOLDS

ECT sensor voltage	Less than 0.14 V, or more than 4.91 V

P0117:

TYPICAL MALFUNCTION THRESHOLDS

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

P0118:

TYPICAL MALFUNCTION THRESHOLDS

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

COMPONENT OPERATING RANGE

COMPONENT OPERATING RANGE

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

WIRING DIAGRAM

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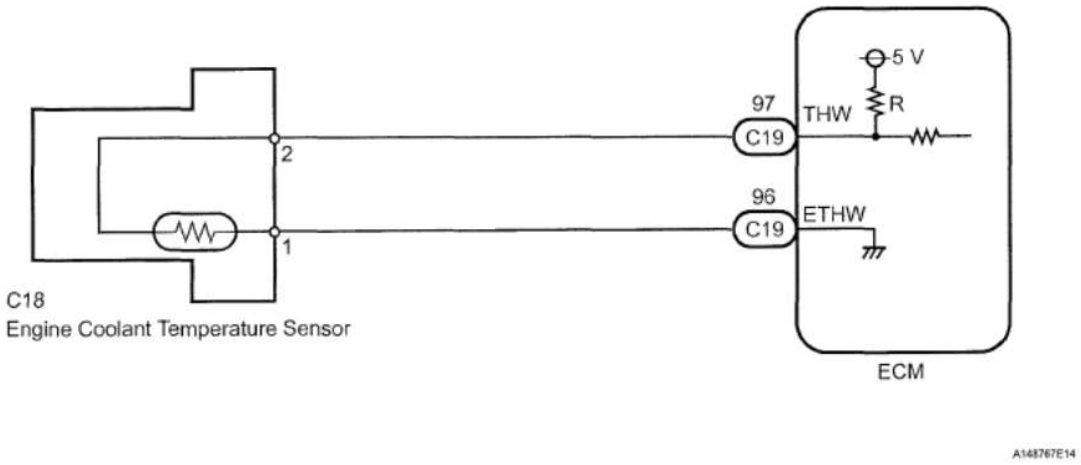


Fig. 80: Engine Coolant Temperature Sensor - Wiring Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSPECTION PROCEDURE

HINT:

Read freeze frame data using a 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 VALUE USING TECHSTREAM (ENGINE COOLANT TEMPERATURE)**
   a. Connect a Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the tester ON.
   d. Select the following menu items: Powertrain / Engine and ECT / Data List / All Data / Coolant Temp.
   e. Read the value displayed on the tester.

   Standard value:

   Between 80°C and 100°C (167°F and 212°F) with warm engine.

   Result

RESULT REFERENCE

Result	Proceed to
-40°C (-40°F)	A
140°C(284°F) or higher	B
Between 80°C and 100°C (176°F and 212°F)	C

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HINT:

- If there is an open circuit, the tester indicates -40°C (-40°F).
- If there is a short circuit, the tester 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 a Techstream to the DLC3.
   d. Turn the ignition switch to ON.
   e. Turn the tester ON.
   f. Select the following menu items: Powertrain / Engine and ECT / Data List / All Data / Coolant Temp.
   g. Read the value displayed on the tester.

      Standard value:

      140°C(284°F) or higher.

   h. Reconnect the engine coolant temperature sensor connector.

NG: Go to step 3

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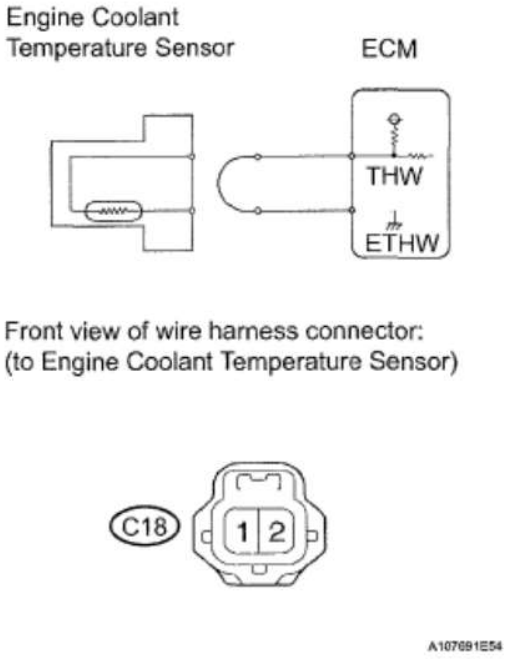


Fig. 81: Identifying Engine Coolant Temperature Sensor Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK : CONFIRM GOOD CONNECTION TO SENSOR. IF OK, REPLACE ENGINE COOLANT TEMPERATURE SENSOR (See **REMOVAL**)

3. **CHECK HARNESS AND CONNECTOR (ENGINE COOLANT TEMPERATURE SENSOR ECM)**
   a. Disconnect the engine coolant temperature sensor connector.
   b. Disconnect the ECM connector.
   c. Measure the resistance according to the value(s) in the table below.

Standard resistance

RESISTANCE SPECIFICATION

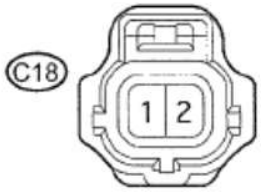
Tester Connection	Condition	Specified Condition
C18-2 - C19-97 (THW)	Always	Below 1 ohms
C18-1 - C19-96 (ETHW)	Always	Below 1 ohms

   d. Reconnect the engine coolant temperature sensor connector.
   e. Reconnect the ECM connector.

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR

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Front view of wire harness connector:
(to Engine Coolant Temperature Sensor)



Front view of wire harness connector:
(to ECM)

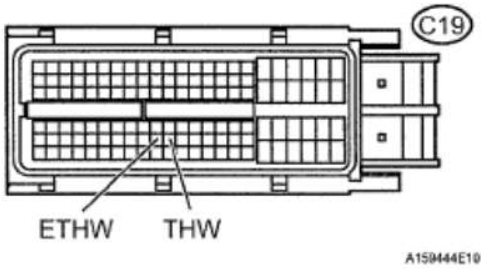


Fig. 82: Identifying Engine Coolant Temperature Sensor And ECM Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK : CONFIRM GOOD CONNECTION TO ECM. IF OK, REPLACE ECM (See **REMOVAL**)

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

      Standard value:

      -40°C (-40°F)

   g. Reconnect the engine coolant temperature sensor connector.

NG: Go to step 5

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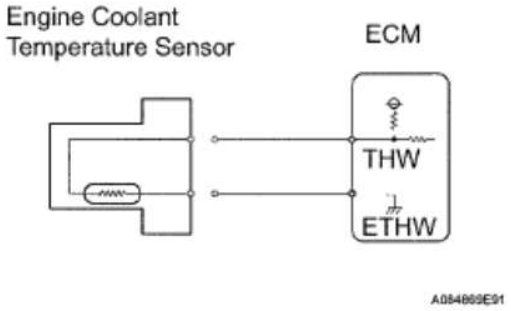


Fig. 83: Checking For Short In Wire Harness
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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

5. **CHECK HARNESS AND CONNECTOR (ENGINE COOLANT TEMPERATURE SENSOR ECM)**
   a. Disconnect the engine coolant temperature sensor connector.
   b. Disconnect the ECM connector.
   c. Measure the resistance according to the value(s) in the table below.

Standard resistance

RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
C18-2 or C19-97 (THW) - Body ground	Always	10 kohms or higher

   d. Reconnect the engine coolant temperature sensor connector.
   e. Reconnect the ECM connector.

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR

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Front view of wire harness connector:
(to Engine Coolant Temperature Sensor)



Front view of wire harness connector:
(to ECM)

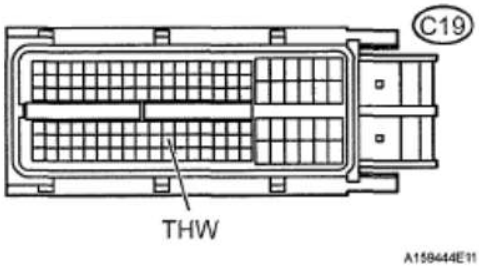


Fig. 84: Identifying Engine Coolant Temperature Sensor And ECM Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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

DTC P0116 ENGINE COOLANT TEMPERATURE CIRCUIT RANGE / PERFORMANCE PROBLEM

DESCRIPTION

Refer to **DTC P0115** .

DTC DETECTION CONDITION AND TROUBLE AREA

DTC No.	DTC Detection Condition	Trouble Area
P0116	When either of following conditions met (2 trip detection logic): • During engine warming up after cold engine starts, change in Engine Coolant Temperature (ECT) sensor output bellow threshold • In duration between warmed engine stopped and next cold engine starts, change in ECT sensor output bellow threshold	• Thermostat • ECT sensor

MONITOR DESCRIPTION

Engine coolant temperature (ECT) sensor cold start monitor

The monitor runs when the engine is started cold. If the change in engine coolant temperature sensor output

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until the engine warmed up completely is less than the threshold, it is determined that a malfunction has occurred in the engine coolant temperature sensor. When this is detected in 2 consecutive driving cycles, the MIL is illuminated and the DTC is set.

ECT sensor soak monitor

The ECM compares the engine coolant temperature when the warmed engine is stopped and when the engine is started on the next trip when more than 5 hours has elapsed since the engine was stopped. If the change in engine coolant temperature sensor output is less than the threshold, it is determined that a malfunction has occurred in the engine coolant temperature sensor. When this is detected in 2 consecutive driving cycles, the MIL is illuminated and the DTC is set.

MONITOR STRATEGY

MONITOR STRATEGY

Related DTCs	P0116: Engine coolant temperature (ECT) sensor cold start monitor P0116: ECT sensor soak monitor
Required Sensors/Components (Main)	ECT sensor
Required Sensors/Components (Related)	None
Frequency of Operation	Once per driving cycle
Duration	5 hours or more
MIL Operation	2 driving cycles
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

ECT sensor cold start monitor:

TYPICAL ENABLING CONDITIONS

Monitor runs whenever following DTCs not present	P0102 to P0103: Mass Air Flow (MAF) meter P0110 to P0113: Intake Air Temperature (IAT) sensor
Battery voltage	10.5 V or more
Time after engine start	1 second or more
ECT at engine start	Less than 60°C(140°F)
IAT sensor circuit	OK
Soak time	0 or more
Accumulated MAF	835 g or more
Engine	Running
Fuel cut	OFF
Difference between ECT at engine start and IAT	Less than 40°C (72°F)

ECT sensor soak monitor:

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TYPICAL ENABLING CONDITIONS

Monitor runs whenever following DTCs not present	P0102 to P0103: MAF meter
Battery voltage	10.5 V or more
Engine	Running
Soak time	5 hours or more
Either (a) or (b) condition met	-
(a) ECT	60°C(140°F) or more
(b) Accumulated MAF	1515 g or more

TYPICAL MALFUNCTION THRESHOLDS

ECT sensor cold start monitor:

TYPICAL MALFUNCTION THRESHOLDS

ECT sensor value change	Less than 5°C (9°F)

ECT sensor soak monitor:

TYPICAL MALFUNCTION THRESHOLDS

Difference between current ECT sensor value and previous ECT sensor value when engine stopped	Less than 5°C (9°F)

COMPONENT OPERATING RANGE

COMPONENT OPERATING RANGE

ECT	ECT sensor value changes in accordance with actual ECT

INSPECTION PROCEDURE

HINT:

- If any of DTCs P0115, P0117, P0118 or P0125 are set simultaneously with DTC P0116, the ECT sensor may have an open or a short circuit. Troubleshoot those DTCs first.
- Read freeze frame data using a 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. **CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P0116)**
   a. Connect a Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the tester ON.
   d. Select the following menu items: Powertrain / Engine and ECT / Trouble Codes.

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e. Read DTCs.

Result

RESULT REFERENCE

Result	Proceed to
P0116	A
P0116 and other DTCs	B

B: Go to DTC CHART (See **DIAGNOSTIC TROUBLE CODE CHART**)

A: Go to next step

2. **INSPECT THERMOSTAT**
   a. Remove the thermostat (See **REMOVAL**).
   b. Measure the valve opening temperature of the thermostat.

Standard value:

80 to 84°C (176 to 183°F)

HINT:

In addition to the above check, confirm that the valve is completely closed when the temperature is below the standard.

c. Reinstall the thermostat (See **INSTALLATION**).

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

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

DTC P011B ENGINE COOLANT TEMPERATURE / INTAKE AIR TEMPERATURE CORRELATION

DESCRIPTION

The engine has two temperature sensors, an Engine Coolant Temperature (ECT) sensor and an Intake Air Temperature (IAT) sensor, to detect the temperature while the engine is in operation. A thermistor, whose resistance value varies according to the temperature, is built into each sensor. When the temperature is low, the resistance of the thermistor increases. When the temperature is high, the resistance drops. These variations in resistance are transmitted to the ECM as voltage changes. Based on these temperature signals output from the sensors, the ECM determines the fuel injection time and the ignition timing to control the engine.

DTC DETECTION CONDITION AND TROUBLE AREA

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DTC No.	DTC Detection Condition	Trouble Area
P011B	All of following conditions met: (2 trip detection logic) a. Battery voltage 10.5 V or more b. 7 hours or more elapsed from engine stops on previous trip c. 15 seconds after cold engine starts d. Minimum Intake Air Temperature (IAT) after engine starts more than -10°C(14°F) e. Average Engine Coolant Temperature (ECT) before engine starts more than -10°C (14°F) f. Difference between readings of ECT and IAT greater than 20°C (36°F)	• IAT sensor • ECT sensor • ECM

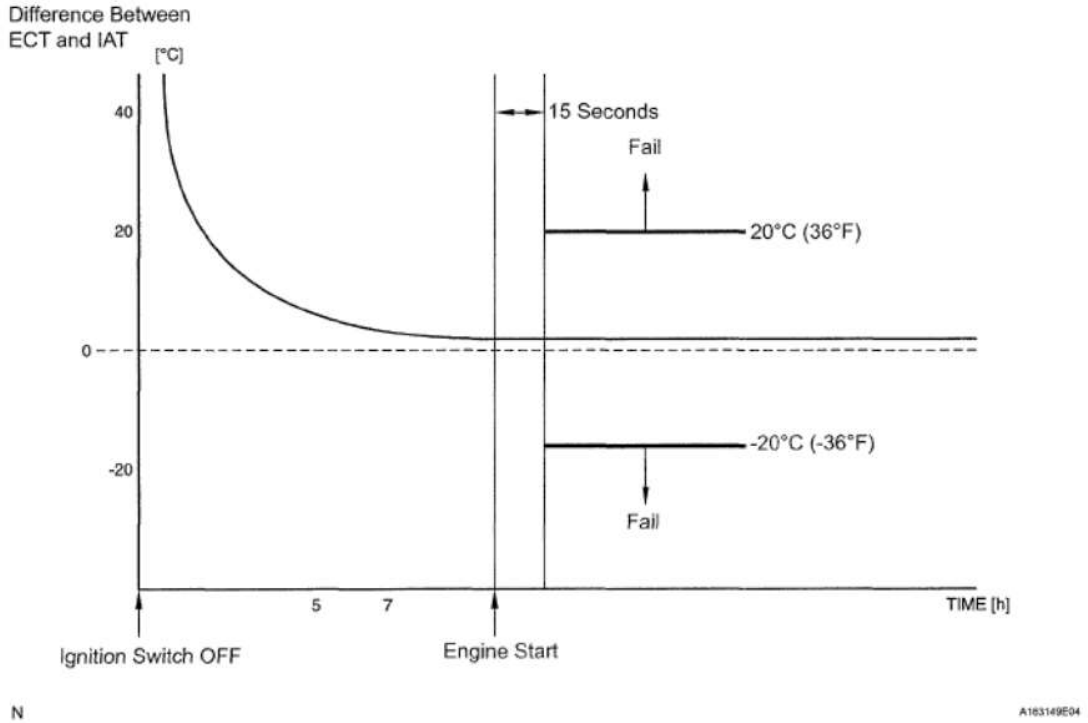


Fig. 85: Engine Coolant Temperature Graph
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

HINT:

- Waiting is required to prevent the temperature of the engine from affecting the readings. If the engine has been operated recently, it 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

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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 conditions accurately. The monitor runs when the engine started cold after 7 hours or more has elapsed since the engine was stopped (ignition switch turned to 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 the DTC.

MONITOR STRATEGY

MONITOR STRATEGY

Related DTCs	P011B: Engine Coolant Temperature (ECT) / Intake Air Temperature (IAT) sensor correlation
Required Sensors / Components (Main)	ECT / IAT sensor
Required Sensors / Components (Related)	-
Frequency of Operation	Once per driving cycle
Duration	7 hours or more
MIL Operation	2 driving cycles
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

TYPICAL ENABLING CONDITIONS

The monitor will run whenever these DTCs are not present	P2610 (ECM internal engine off timer)
All of following conditions met	Conditions 1 and 2
1. All of following conditions 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	15 seconds or more
2. Either of the following conditions is met	Condition (a) and (b)
(a) Minimum IAT after engine start	-10°C(14°F) or more
(b) ECT before engine start	-10°C(14°F) or more

TYPICAL MALFUNCTION THRESHOLDS

TYPICAL MALFUNCTION THRESHOLDS

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

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INSPECTION PROCEDURE

1. **CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO P011B)**
   a. Connect a Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the tester ON.
   d. Select the following menu items: Powertrain / Engine and ECT / Trouble Codes.
   e. Read DTCs.

   Result

   RESULT REFERENCE

Result	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 (See **DIAGNOSTIC TROUBLE CODE 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 leave the vehicle for 7 hours or more to allow conditions similar to the DTC detection conditions.

   b. Connect a Techstream to the DLC3.
   c. Turn the ignition switch to ON.
   d. Turn the tester ON.
   e. Select the following menu items: Powertrain / Engine and ECT / All Data / Intake Air.
   f. Read the value displayed on the tester.

   OK:

   The difference between the intake air temperature and the actual outside air temperature is within 10°C(18°F).

   HINT:

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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 a Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the tester ON.
   d. Select the following menu items: Powertrain / Engine and ECT / All Data / Coolant Temp.
   e. Read the value displayed on the tester.

   OK:

   The difference between the coolant temperature and the actual outside air temperature is within 10°C(18°F).

   HINT:

   If the result is not as specified, check that 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 MALFUNCTION; DTC P0122 THROTTLE / PEDAL POSITION SENSOR / SWITCH "A" CIRCUIT LOW INPUT; DTC P0123 THROTTLE / PEDAL POSITION SENSOR / SWITCH "A" CIRCUIT HIGH INPUT; DTC P0220 THROTTLE / PEDAL POSITION SENSOR / SWITCH "B" CIRCUIT; DTC P0222 THROTTLE / PEDAL POSITION SENSOR / SWITCH "B" CIRCUIT LOW INPUT; DTC P0223 THROTTLE / PEDAL POSITION SENSOR / SWITCH "B" CIRCUIT HIGH INPUT; DTC P2135 THROTTLE / PEDAL POSITION SENSOR / SWITCH "A" / "B" VOLTAGE CORRELATION

DESCRIPTION

HINT:

- These DTCs relate to the Throttle Position (TP) sensor.

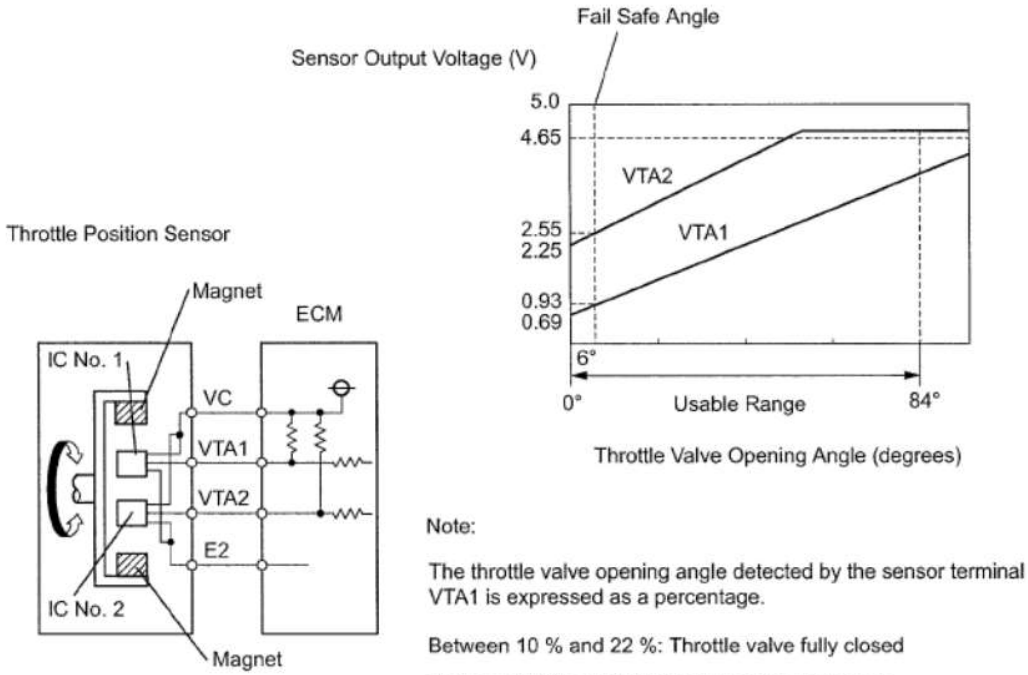
The Throttle Position (TP) sensor is mounted on the throttle body, and detects the opening angle of the throttle valve. This sensor is a non-contact type. It uses Hall-effect elements in order to yield accurate signals even in

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extreme driving conditions, such as at high speeds as well as very low speeds.

The TP sensor has 2 sensor circuits, each of which transmits a signal, VTA1 and VTA2. VTA1 is used to detect the throttle valve angle and VTA2 is used to detect malfunctions in VTA1. The sensor signal voltages vary between 0 V and 5 V in proportion to the throttle valve opening angle, and are transmitted to the 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.



Note:

The throttle valve opening angle detected by the sensor terminal VTA1 is expressed as a percentage.

Between 10 % and 22 %: Throttle valve fully closed

Between 40 % and 98 %: Throttle valve fully open

Approximately 19 %: Fail-safe angle (6°)

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Fig. 86: Throttle Position Sensor Output Voltage Graph
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

DTC DETECTION CONDITION AND TROUBLE AREA

DTC No.	DTC Detection Condition	Trouble Area
	Output voltage of VTA1 quickly fluctuates beyond lower and upper malfunction thresholds for 2 seconds or more when accelerator pedal	• Throttle position sensor (built into

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P0120	depressed (10 seconds or more when accelerator pedal released) (1 trip detection logic)	throttle body) • ECM
P0122	Output voltage of VTA1 0.2 V or less for 2 seconds or more when accelerator pedal depressed (10 seconds or more when accelerator pedal released) (1 trip detection logic)	• Throttle position sensor (built into throttle body) • Short in VTA1 circuit • Open in VC circuit • ECM
P0123	Output voltage of VTA1 4.535 V or more for 2 seconds or more when accelerator pedal depressed (10 seconds or more when accelerator pedal released) (1 trip detection logic)	• Throttle position sensor (built into throttle body) • Open in VTA1 circuit • Open in E2 circuit • Short between VC and VTA1 circuits • ECM
P0220	Output voltage of VTA2 quickly fluctuates beyond lower and upper malfunction thresholds for 2 seconds or more when accelerator pedal depressed (10 seconds or more when accelerator pedal released) (1 trip detection logic)	• Throttle position sensor (built into throttle body) • ECM
P0222	Output voltage of VTA2 1.75 V or less for 2 seconds or more when accelerator pedal depressed (10 seconds or more when accelerator pedal released) (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 4.8 V or more, and VTA1 between 0.2 V and 2.02 V, for 2 seconds or more when accelerator pedal depressed (10 seconds or more when accelerator pedal released) (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
	Either condition (a) or (b) met (1 trip detection logic):	• Short between VTA1 and VTA2

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P2135	a. Difference between output voltages of VTA1 and VTA2 0.02 V or less for 0.5 seconds or more b. Output voltage of VTA1 0.2 V or less, and VTA2 1.75 V or less, for 0.4 seconds or more	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: Powertrain / Engine and ECT / Data List / ETCS / Throttle Position No.1 and Throttle Position No.2.
- Throttle Position No.1 denotes the VTA1 signal, and Throttle Position No.2 denotes the VTA2 signal.

Reference (Normal Condition)

VOLTAGE SPECIFICATION

Tester Display	Accelerator Pedal Fully Released	Accelerator Pedal Fully Depressed
Throttle Position No.1	0.5 to 1.1 V	3.3 to 4.9 V
Throttle Position No.2	2.1 to 3.1 V	4.6 to 5.0 V

MONITOR DESCRIPTION

The ECM uses the Throttle Position (TP) sensor to monitor the throttle valve opening angle. There are several checks that the ECM performs to confirm the proper operation of the TP sensor.

- A specific voltage difference is expected between the sensor terminals, VTA1 and VTA2, for each throttle valve opening angle. If the difference between VTA1 and VTA2 is incorrect, the ECM interprets this as a malfunction in the sensor circuit, and 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 circuit, 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 circuit, and sets a DTC.

If the malfunction is not repaired successfully, a DTC is set 10 seconds after the engine is next started.

MONITOR STRATEGY

MONITOR STRATEGY

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)

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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) 10 seconds: P0120, P0122, P0123, P0220, P0222 and P0223 (Accelerator pedal OFF) 0.5 seconds: P2135 Case 1 0.4 seconds: P2135 Case 2
MIL Operation	Immediate
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

TYPICAL ENABLING CONDITIONS

Monitor runs whenever following DTCs not present	None
Either of following conditions A or B met	-
A. Ignition switch ON	0.012 seconds or more
B. Electronic throttle actuator power	ON

TYPICAL MALFUNCTION THRESHOLDS

P0120:

TYPICAL MALFUNCTION THRESHOLDS

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

P0122:

TYPICAL MALFUNCTION THRESHOLDS

VTA1 voltage	0.2 V or less

P0123:

TYPICAL MALFUNCTION THRESHOLDS

VTA1 voltage	4.535 V or more

P0220:

TYPICAL MALFUNCTION THRESHOLDS

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

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P0222:

TYPICAL MALFUNCTION THRESHOLDS

VTA2 voltage	1.75 V or less

P0223:

TYPICAL MALFUNCTION THRESHOLDS

VTA2 voltage when VTA1 0.2 V or more, and 2.02 V or less	4.8 V or more

P2135 Case 1:

TYPICAL MALFUNCTION THRESHOLDS

Difference between VTA1 and VTA2 voltages	0.02 V or less

P2135 Case 2:

TYPICAL MALFUNCTION THRESHOLDS

VTA1 voltage	0.2 V or less
VTA2 voltage	1.75 V or less

COMPONENT OPERATING RANGE

COMPONENT OPERATING RANGE

VTA1 voltage	0.69 to 4.05 V
VTA2 voltage	2.25 to 4.8 V

FAIL-SAFE

When any of these DTCs, as well as other DTCs relating to ETCS (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, and the throttle valve is returned to a 6° throttle angle by the return spring. The ECM then adjusts the engine output by controlling the fuel injection (intermittent fuel-cut) and ignition timing, in accordance with the accelerator pedal opening angle, to allow the vehicle to continue at a minimal speed. If the accelerator pedal is depressed firmly and gently, the vehicle can be driven slowly.

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

WIRING DIAGRAM

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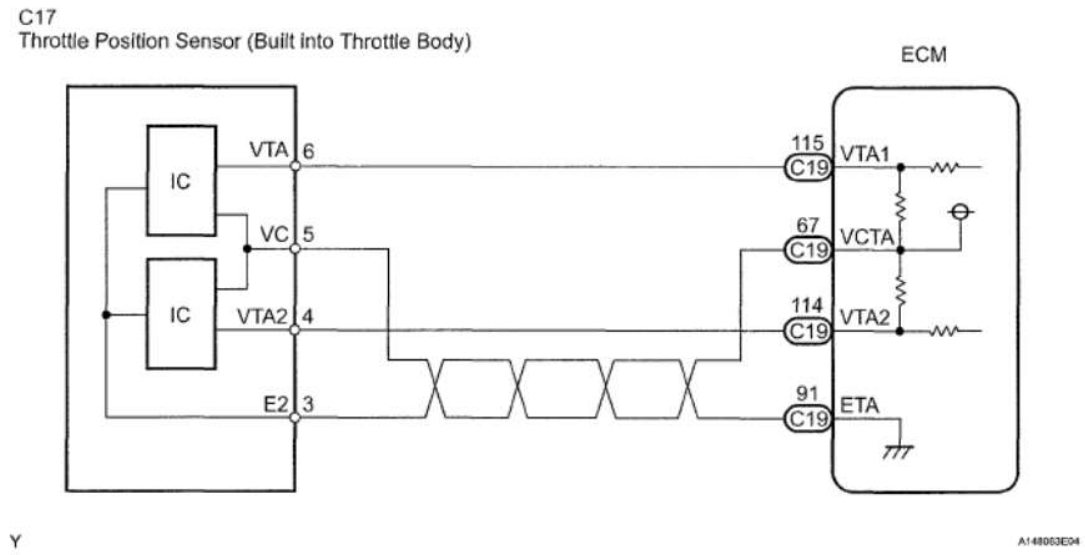


Fig. 87: Throttle Position Sensor - Wiring Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSPECTION PROCEDURE

HINT:

Read freeze frame data using a 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 VALUE USING TECHSTREAM (THROTTLE POSITION SENSOR)**
   a. Connect a Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the tester ON.
   d. Select the following menu items: Powertrain / Engine and ECT / Data List / ETCS / Throttle Position No.1 and Throttle Position No.2.
   e. Read the values displayed on the tester.

   Result

   VOLTAGE SPECIFICATION

When Accelerator Pedal Released		When Accelerator Pedal Depressed		Trouble Area	Proceed to
Throttle Position No.1	Throttle Position No.2	Throttle Position No.1	Throttle Position No.2		
0 to 0.2 V	0 to 0.2 V	0 to 0.2 V	0 to 0.2 V	VC circuit open	
4.5 to 5.0 V	4.5 to 5.0 V	4.5 to 5.0 V	4.5 to 5.0 V	E2 circuit open	

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0 to 0.2 V, or 4.5 to 5.0 V	2.4 V to 3.4 V (Fail-safe)	0 to 0.2 V, or 4.5 to 5.0 V	2.4 V to 3.4 V (Fail-safe)	VTA1 circuit open or ground short	A
0.7 V to 1.3 V (Fail-safe)	0 to 0.2 V, or 4.5 to 5.0 V	0.7 V to 1.3 V (Fail-safe)	0 to 0.2 V, or 4.5 to 5.0 V	VTA2 circuit open or ground short	
0.5 to 1.1 V	2.1 to 3.1 V	3.3 to 4.9 V (Not fail-safe)	4.6 to 5.0 V (Not fail-safe)	TP 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)

RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
C17-5 (VC) - C19-67 (VCTA)	Always	Below 1 ohms
C17-6 (VTA) - C19-115 (VTA1)	Always	Below 1 ohms
C17-4 (VTA2) - C19-114 (VTA2)	Always	Below 1 ohms
C17-3 (E2) - C19-91 (ETA)	Always	Below 1 ohms

Standard resistance (Check for short)

RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
C17-5 (VC) or C19-67 (VCTA) - Body ground	Always	10 kohms or higher
C17-6 (VTA) or C19-115 (VTA1) - Body ground	Always	10 kohms or higher
C17-4 (VTA2) or C19-114 (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

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Front view of wire harness connector:
(to Throttle Body)



Front view of wire harness connector:
(to ECM)

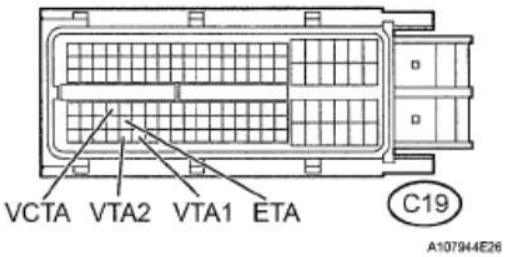


Fig. 88: Identifying Throttle Body And ECM Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

3. **INSPECT ECM (VC VOLTAGE)**
   a. Disconnect the throttle body connector.
   b. Turn the ignition switch to ON.
   c. Measure the voltage according to the value(s) in the table below.

Standard voltage

VOLTAGE SPECIFICATION

Tester Connection	Condition	Specified Condition
C17-5 (VC) - C17-3 (E2)	Ignition switch ON	4.5 to 5.5 V

   d. Reconnect the throttle body connector.

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

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Front view of wire harness connector:
(to Throttle Body)

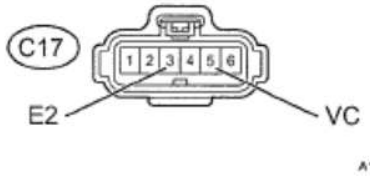


Fig. 89: Identifying Throttle Body Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

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

Result

RESULT REFERENCE

Result	Proceed to
P0120, P0122, P0123, P0220, P0222, P0223 and/or P2135	A
No output	B

B : END

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

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

DESCRIPTION

HINT:

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- This DTC relates to the Throttle Position (TP) sensor.

Refer to **DTC P0120** .

DTC DETECTION CONDITION AND TROUBLE AREA

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 (TP) 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 TP sensor and VTA1.

For each throttle opening angle, a specific voltage difference is expected between the outputs of VTA1 and VTA2. If the output voltage difference between the two signals deviates from the normal operating range, the ECM interprets this as a malfunction in the TP 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

Related DTCs	P0121: Throttle Position (TP) sensor rationality
Required Sensors/Components (Main)	TP 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

Either of following conditions A or B set	-
A. Ignition switch	ON
B. Electric throttle motor power	ON
TP sensor malfunction (P0120, P0122, P0123, P0220, P0222, P0223, P2135)	Not detected

TYPICAL MALFUNCTION THRESHOLDS

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TYPICAL MALFUNCTION THRESHOLDS

Either of following conditions set	-
Difference of TP sensor voltage between VTA1 and (VTA2 x 0.8)	Higher than 1.6 V
Difference of TP sensor voltage between VTA1 and (VTA2 x 0.8)	Lower than 0.8 V

FAIL-SAFE

When this DTC, as well as other DTCs relating to ETCS (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, and the throttle valve is returned to a 6° throttle angle by the return spring. The ECM then adjusts the engine output by controlling the fuel injection (intermittent fuel-cut) and ignition timing, in accordance with the accelerator pedal opening angle, to allow the vehicle to continue at a minimal speed. If the accelerator pedal is depressed firmly and gently, the vehicle can be driven slowly.

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

INSPECTION PROCEDURE

HINT:

Read freeze frame data using a 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. **CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P0121)**
   a. Connect a Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the tester ON.
   d. Select the following menu items: Powertrain / Engine and ECT / Trouble Codes.
   e. Read DTCs.

   Result

   RESULT REFERENCE

Result	Proceed to
P0121	A
P0121 and other DTCs	B

   HINT:

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

B: Go to DTC CHART (See **DIAGNOSTIC TROUBLE CODE CHART**)

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A : REPLACE THROTTLE BODY (See **DIAGNOSTIC TROUBLE CODE CHART**)

DTC P0125 INSUFFICIENT COOLANT TEMPERATURE FOR CLOSED LOOP FUEL CONTROL

DESCRIPTION

Refer to **DTC P0115** .

DTC DETECTION CONDITION AND TROUBLE AREA

DTC No.	DTC Detection Condition	Trouble Area
P0125	Engine Coolant Temperature (ECT) does not reach closed-loop enabling temperature for 20 minutes (this period varies with engine start ECT) (2 trip detection logic)	• Cooling system • Engine coolant temperature sensor • Thermostat

MONITOR DESCRIPTION

The resistance of the Engine Coolant Temperature (ECT) sensor varies in proportion to the actual ECT. The ECM supplies a constant voltage to the sensor and monitors the signal output voltage of the sensor. The signal output voltage varies according to the changing resistance of the sensor. After the engine is started, the ECT is monitored through this signal. If the ECT 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 ECT is 5°C (41°F) at engine start. After about 1 minute running time, the ECT 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

Related DTCs	P0125: Insufficient engine coolant temperature for closed-loop fuel control
Required Sensors/Components (Main)	Engine coolant temperature sensor Thermostat Cooling system
Required Sensors/Components (Related)	-
Frequency of Operation	Once per driving cycle
Duration	59 seconds: Engine coolant temperature at engine start 1.66°C (34.98°F) or more 103 seconds: Engine coolant temperature at engine start -9.45 to

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	1.66°C (14.99 to 34.98°F) 1200 seconds: Engine coolant temperature at engine start less than -9.45°C (14.99°F)
MIL Operation	2 driving cycles
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

TYPICAL ENABLING CONDITIONS

Monitor runs whenever following DTCs not present	P0102 - P0103 (Mass air flow meter) P0112 - P0113 (Intake air temperature sensor) P0115 - P0118 (Engine coolant temperature sensor)
Thermostat fail	Not detected

TYPICAL MALFUNCTION THRESHOLDS

TYPICAL MALFUNCTION THRESHOLDS

Time until actual engine coolant temperature reaches closed-loop fuel control enabling temperature	59 seconds: Engine coolant temperature at engine start 1.66°C (34.98°F) or more 103 seconds: Engine coolant temperature at engine start -9.45 to 1.66°C (14.99 to 34.98°F) 1200 seconds: Engine coolant temperature at engine start less than -9.45°C (14.99°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 (ECT) sensor may have an open or a short circuit. Troubleshoot those DTCs first.
- Read freeze frame data using a 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. **CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P0125)**
   a. Connect a Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the tester ON.
   d. Select the following menu items: Powertrain / Engine and ECT / Trouble Codes.

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e. Read DTCs.

Result

RESULT REFERENCE

Result	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 (See **DIAGNOSTIC TROUBLE CODE CHART**)

A: Go to next step

2. **INSPECT THERMOSTAT**
   a. Remove the thermostat (See **REMOVAL**).
   b. Check the valve opening temperature of the thermostat.

Standard value:

80 to 84°C (176 to 183°F)

HINT:

In addition to the above check, confirm that the valve is completely closed when the temperature is below the standard.

   c. Reinstall the thermostat (See **INSTALLATION**).

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

OK: Go to next step

3. **CHECK COOLING SYSTEM**
   a. Check for defects in the cooling system that might cause the system to be too cold, such as abnormal radiator fan operation or any modifications.

NG: REPAIR OR REPLACE COOLING SYSTEM

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

DTC P0128 COOLANT THERMOSTAT (COOLANT TEMPERATURE BELOW THERMOSTAT

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REGULATING TEMPERATURE)

DESCRIPTION

HINT:

- This DTC relates to the thermostat.

This DTC is set when the Engine Coolant Temperature (ECT) does not reach 75°C (167°F) despite sufficient engine warm-up time having elapsed.

DTC DETECTION CONDITION AND TROUBLE AREA

DTC No.	DTC Detection Condition	Trouble Area
P0128	Conditions (a), (b) and (c) 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

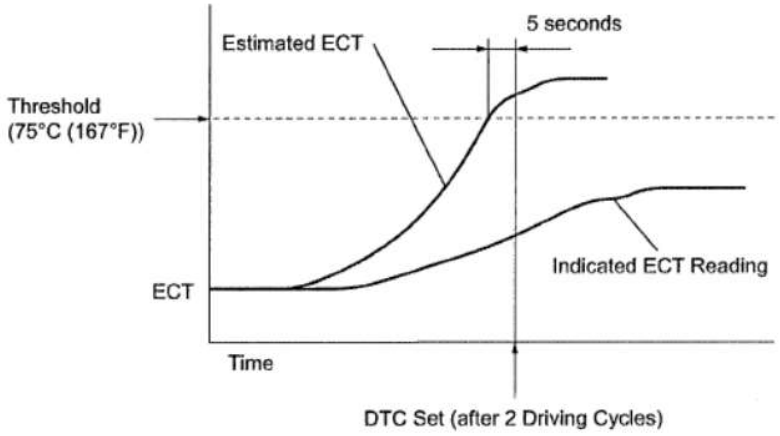


Fig. 90: Engine Coolant Temperature Graph
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

The ECM estimates the Engine Coolant Temperature (ECT) based on the starting temperature, engine loads, and engine speeds. The ECM then compares the estimated temperature with the actual ECT. When the estimated ECT reaches 75°C (167°F), the ECM checks the actual ECT. If the actual ECT is less than 75°C

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(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

Related DTCs	P0128: Coolant Thermostat
Required Sensors/Components (Main)	Thermostat Engine Coolant Temperature (ECT) sensor
Required Sensors/Components (Related)	Intake Air Temperature (IAT) 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

Monitor runs whenever following DTCs not present	P0010 (VVT OCV) P0011 (VVT System 1 - Advance) P0012 (VVT System 1 - Retard) P0031, P0032 (Air fuel ratio sensor heater - Sensor 1) P0102 - P0103 (Mass airflow meter) P0112 - P0113 (IAT sensor) P0115 - P0118 (ECT sensor) P0125 (Insufficient ECT for Closed Loop) P0171, P0172 (Fuel system) P0300 - P0304 (Misfire) P0335 (Crankshaft position sensor) P0340 (Camshaft position sensor) P0351 - P0354 (Igniter) P0500 (Vehicle speed sensor) P2196 (Air fuel ratio sensor - rationality) P2237, P2240 (A/F Sensor open) P2A00 (Air fuel ratio sensor - slow response)
Battery voltage	11 V or more
Either of following conditions 1 or 2 met:	-
1. All of following conditions met:	-
• ECT at engine start - IAT at engine start	-15 to 7°C (-27 to 12.6°F)
• ECT at engine start	-10 to 56°C (14 to 133°F)
• IAT at engine start	-10 to 56°C (14 to 133°F)
2. All of following conditions met:	-

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• ECT at engine start - IAT at engine start	More than 7°C(12.6°F)
• ECT at engine start	56°C(133°F) or less
• IAT at engine start	-10°C (14°F) or more
Accumulated time at 128 km/h (80 mph) or more of vehicle speed	Less than 20 seconds

TYPICAL MALFUNCTION THRESHOLDS

TYPICAL MALFUNCTION THRESHOLDS

Duration that both of following conditions (a) and (b) met	5 seconds or more
(a) Estimated ECT	75°C(167°F) or more
(b) ECT sensor output	Below 75°C(167°F)

INSPECTION PROCEDURE

HINT:

Read freeze frame data using a 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. **CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P0128)**
   a. Connect a Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the tester ON.
   d. Select the following menu items: Powertrain / Engine and ECT / Trouble Codes.
   e. Read DTCs.

   Result

   RESULT REFERENCE

Result	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 (See **DIAGNOSTIC TROUBLE CODE CHART**)

A: Go to next step

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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. Measure the valve opening temperature of the thermostat.

Standard value:

80 to 84°C (176 to 183°F)

HINT:

In addition to the above check, confirm that the valve is completely closed when the temperature is below the standard.

   c. Reinstall the thermostat (See **INSTALLATION**).

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

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

DTC P0136 OXYGEN SENSOR CIRCUIT MALFUNCTION (BANK 1 SENSOR 2); DTC P0137 OXYGEN SENSOR CIRCUIT LOW VOLTAGE (BANK 1 SENSOR 2); DTC P0138 OXYGEN SENSOR CIRCUIT HIGH VOLTAGE (BANK 1 SENSOR 2); DTC P0139 OXYGEN SENSOR CIRCUIT SLOW RESPONSE (BANK 1 SENSOR 2)

DESCRIPTION

HINT:

Sensor 2 refers to the sensor mounted behind the Three-Way Catalytic Converter (TWC) and located far from the engine assembly.

In order to obtain a high purification rate of the carbon monoxide (CO), hydrocarbon (HC) and nitrogen oxide (NOx) components in the exhaust gas, a TWC (Three-Way Catalytic Converter) is used. For the most efficient use of the TWC, 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 (HO2) sensor is used.

The HO2 sensor is located behind the TWC, and detects the oxygen concentration in the exhaust gas. Since the

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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 HO2 sensor informs the ECM that the post-TWC 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 HO2 sensor informs the ECM that the post-TWC air-fuel ratio is rich (high voltage, i.e. more than 0.45 V). The HO2 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 HO2 sensor to determine whether the air-fuel ratio after the TWC is rich or lean, and adjusts the fuel injection time accordingly. Thus, if the HO2 sensor is working improperly due to internal malfunctions, the ECM is unable to compensate for deviations in the primary air-fuel ratio control.

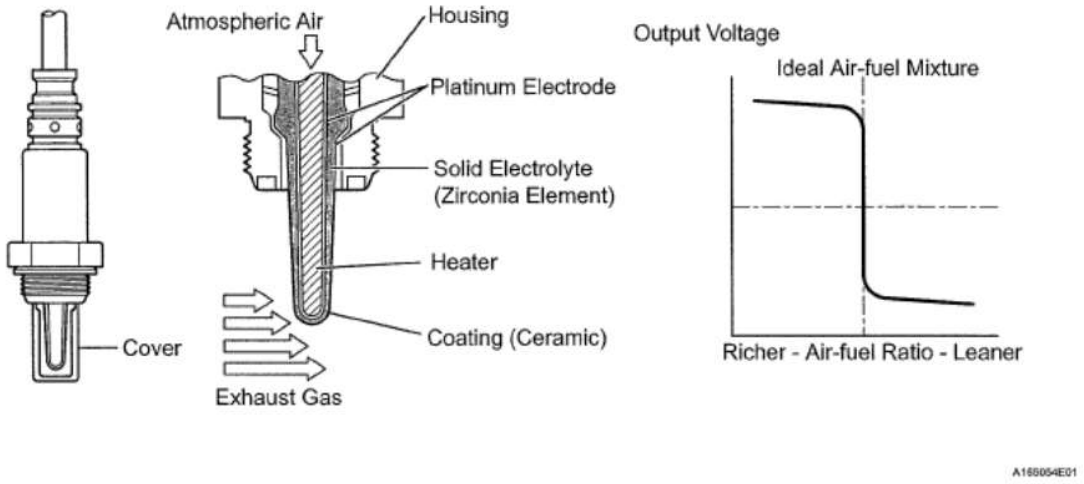


Fig. 91: Heated Oxygen Sensor Output Voltage Graph
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

DTC DETECTION CONDITION AND TROUBLE AREA

DTC No.	DTC Detection Condition	Trouble Area
P0136	• 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 (HO2) sensor voltage does not decrease to less than 0.21 V b. HO2 sensor voltage does not increase to more than 0.59 V • Low impedance:	• HO2 sensor (sensor 2) • Air-Fuel Ratio (A/F) sensor (sensor 1) • Gas leak from exhaust system • Fuel pressure • Fuel injector • PCV valve and hose

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	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)	• Air induction system
P0137	• 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 (HO2) sensor voltage output less than 0.21 V b. Target air-fuel ratio rich • High impedance: 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)	• Open or short in HO2 sensor (sensor 2) circuit • HO2 sensor (sensor 2) • HO2 sensor heater (sensor 2) • Air-Fuel Ratio (A/F) sensor (sensor 1) • Gas leak from exhaust system
P0138	• 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 (HO2) sensor voltage output 0.59 V or more b. Target air-fuel ratio lean • Extremely high voltage (short): HO2 sensor voltage output exceeds 1.2 V for more than 10 seconds (2 trip detection logic)	• Short in HO2 sensor (sensor 2) circuit • HO2 sensor (sensor 2) • ECM internal circuit malfunction • Air-Fuel Ratio (A/F) sensor (sensor 1)
P0139	Heated oxygen sensor (sensor 2) voltage does not drop to below 0.2 V immediately after fuel cut starts	• Short in HO2 sensor (sensor 2) circuit • HO2 sensor (sensor 2) • ECM internal circuit malfunction • Air-Fuel Ratio (A/F) sensor (sensor 1)

MONITOR DESCRIPTION

1. **Active Air-Fuel Ratio Control**

The ECM usually performs air-fuel ratio feedback control so that the Air-Fuel Ratio (A/F) 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 (TWC) and Heated Oxygen (HO2) sensor malfunctions (refer to

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the diagram below See **Fig. 92**).

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 (HO2) Sensor (DTC P0136)**

While the ECM is performing active air-fuel ratio control, the air-fuel ratio is forcibly regulated to become rich or lean. If the sensor is not functioning properly, the voltage output variation is small. For example, when the HO2 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.

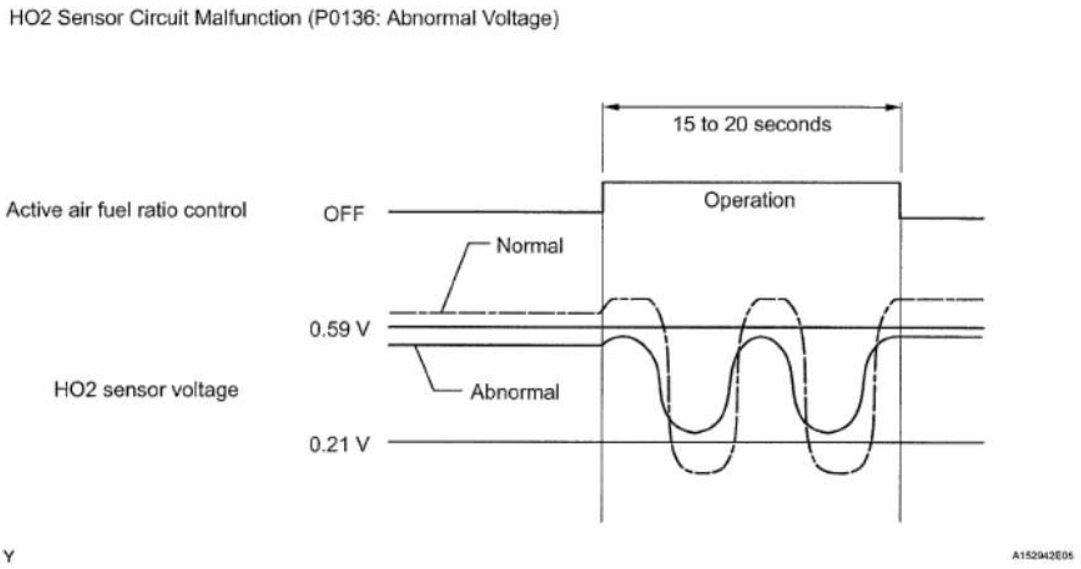


Fig. 92: Heated Oxygen Sensor Voltage Graph
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

3. **Open or Short in Heated Oxygen (HO2) Sensor Circuit (DTCs P0137 or P0138)**

During active air-fuel ratio control, the ECM calculates the Oxygen Storage Capacity (OSC)* of the Three-Way Catalytic Converter (TWC) by forcibly regulating the air-fuel ratio to become rich or lean. If the HO2 sensor has an open or short, or the voltage output of the sensor noticeably decreases, the OSC indicates an extraordinarily high value. Even if the ECM attempts to continue regulating the air-fuel ratio to become rich or lean, the HO2 sensor output does not change.

While performing active air-fuel ratio control, when the target air-fuel ratio is rich and the HO2 sensor voltage output is less than 0.21 V (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.

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HINT:

DTC P0138 is also set if the HO2 sensor voltage output is more than 1.2 V for 10 seconds or more.

*: The TWC has the capability to store oxygen. The OSC and the emission purification capacity of the TWC are mutually related. The ECM determines whether the catalyst has deteriorated, based on the calculated OSC value (See **DTC P0420 CATALYST SYSTEM EFFICIENCY BELOW THRESHOLD (BANK 1)**).

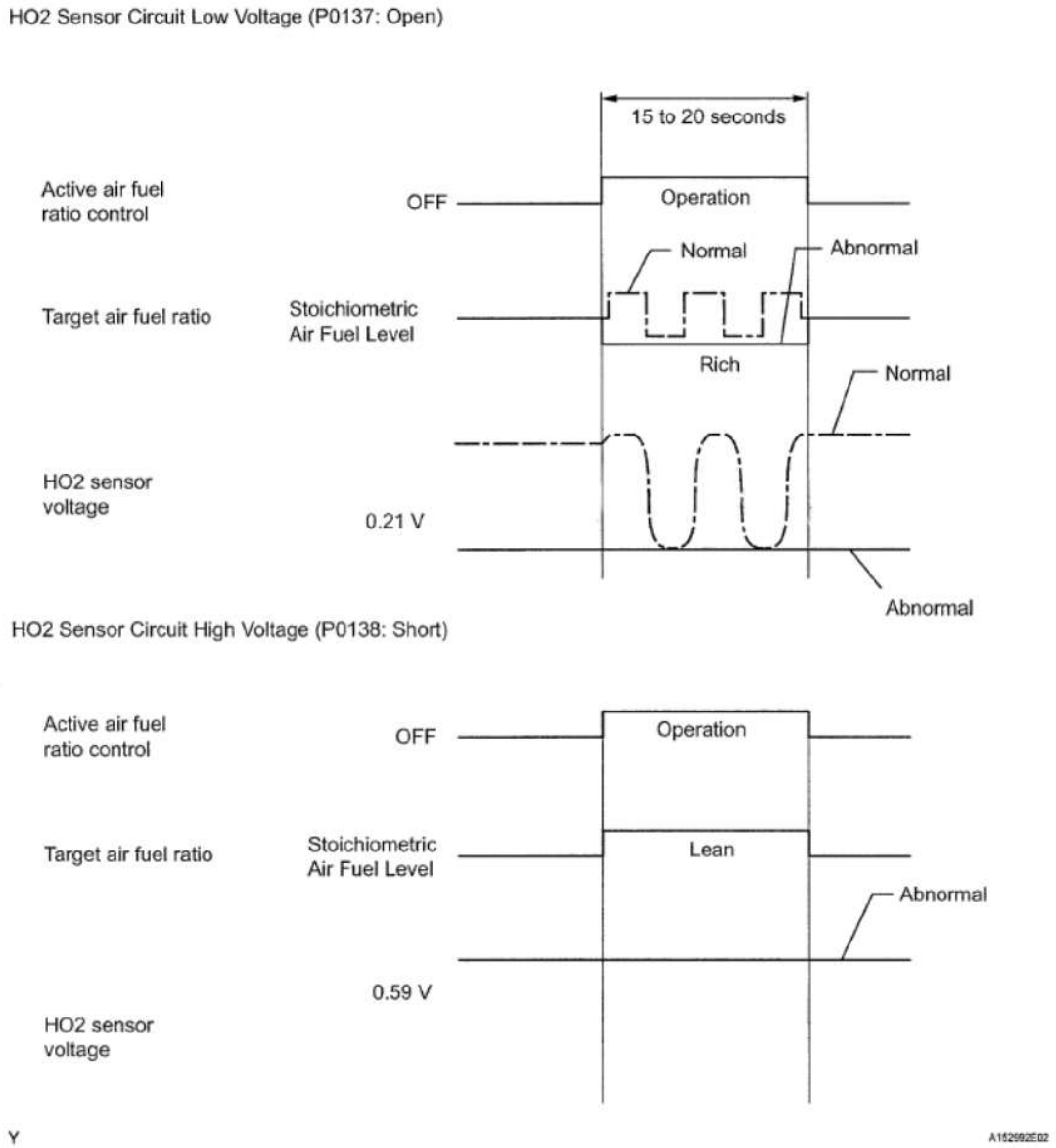


Fig. 93: Heated Oxygen Sensor Voltage Graph
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

4. **High or Low Impedance of Heated Oxygen (HO2) Sensor (DTCs P0136 or P0137)**

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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 HO2 sensor signal while the engine is running, the impedance* of the sensor is measured by the ECM. The ECM determines that there is a malfunction in the sensor when the measured impedance deviates from the standard range.

*: The effective resistance in an alternating current electrical circuit.

HINT:

- The impedance cannot be measured using an ohmmeter.
- DTCs P0136 indicate the deterioration of the HO2 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 HO2 sensor (2 driving cycles). The ECM sets the DTCs when the impedance of the sensor exceeds the threshold 15 kohms.

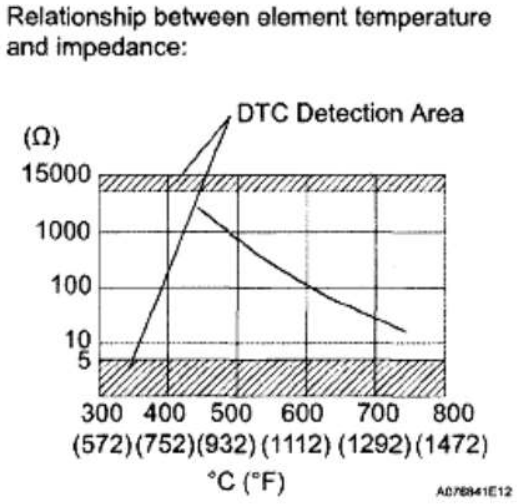


Fig. 94: [Identifying DTC Detection Area]
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

5. **Abnormal Voltage Output of Heated Oxygen (HO2) Sensor During Fuel-cut (DTC P0139)**

The sensor output voltage drops to below 0.2 V (extremely Lean status) immediately when the vehicle decelerates and fuel cut is operating. If the voltage does not drop to below 0.2 V, the ECM determines that the sensor's response feature has deteriorated, illuminates the MIL and sets a DTC.

MONITOR STRATEGY

MONITOR STRATEGY

Related DTCs	P0136: Heated oxygen sensor output voltage (Output voltage) P0136: Heated oxygen sensor impedance (Low) P0137: Heated oxygen sensor output voltage (Low voltage) P0137: Heated oxygen sensor impedance (High)

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	P0138: Heated oxygen sensor output voltage (High voltage) P0138: Heated oxygen sensor output voltage (Extremely high) P0139: Heated oxygen sensor output voltage during fuel cut
Required Sensors/Components (Main)	Heated oxygen sensor (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 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

Monitor runs whenever following DTCs not present	P0031, P0032 (Air fuel ratio sensor heater - Sensor 1) P0037, P0038 (Heated oxygen sensor heater - Sensor 2) P0102, P0103 (Mass airflow meter) P0112, P0113 (Intake air temperature sensor) P0115 - P0118 (Engine coolant temperature sensor) P0120 - P0223, P2135 (Throttle position sensor) P0125 (Insufficient ECT for closed loop) P0171, P0172 (Fuel system) P0300 - P0304 (Misfire) P0335 (Crankshaft position sensor) P0340 (Camshaft position sensor) P0455, P0456 (EVAP System) P0500 (Vehicle speed sensor) P2196 (Air fuel ratio sensor - rationality) P2237, P2240 (Air fuel ratio sensor open) P2A00 (Air fuel ratio sensor - slow response)

Heated Oxygen Sensor Output Voltage (Output Voltage, High Voltage and Low Voltage)

TYPICAL ENABLING CONDITIONS

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Active air-fuel ratio control	Performing
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 4000 rpm
A/F sensor status	Activated
Fuel system status	Closed loop
Fuel cut	OFF
Engine load	10 to 80%
Shift position	3rd or more (AT), 4th (MT)

Heated Oxygen Sensor Impedance (Low):

TYPICAL ENABLING CONDITIONS

Battery voltage	11 V or more
Estimated sensor temperature	Less than 700°C (1292°F)
ECM monitor	Completed
DTC P0607	Not set

Heated Oxygen Sensor Impedance (High):

TYPICAL ENABLING CONDITIONS

Battery voltage	11 V or more
Estimated sensor temperature	450 to 750°C (842 to 1472°F) or higher
DTC P0607	Not set

Heated Oxygen Sensor Output Voltage (Extremely High):

TYPICAL ENABLING CONDITIONS

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

Heated oxygen sensor voltage during fuel cut:

TYPICAL ENABLING CONDITIONS

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

TYPICAL MALFUNCTION THRESHOLDS

Heated Oxygen Sensor Output Voltage (Output voltage):

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TYPICAL MALFUNCTION THRESHOLDS

Either of following conditions met:	1 or 2
1. All of following conditions (a), (b) and (c) met	-
(a) Commanded air-fuel ratio	14.2 or less
(b) Rear HO2 sensor voltage	0.21 to 0.59 V
(c) OSC (Oxygen Storage Capacity of Catalyst)	2 g or more
2. All of following conditions (d), (e) and (f) met	-
(d) Commanded air-fuel ratio	15 or more
(e) Rear HO2 sensor voltage	0.21 to 0.59 V
(f) OSC	2 g or more

Heated Oxygen Sensor Output Voltage (Low output voltage):

TYPICAL MALFUNCTION THRESHOLDS

All of following conditions (a), (b) and (c) met	-
(a) Commanded air-fuel ratio	14.2 or less
(b) Rear HO2 sensor voltage	Less than 0.21 V
(c) OSC (Oxygen Storage Capacity of Catalyst)	2 g or more

Heated Oxygen Sensor Output Voltage (High output voltage):

TYPICAL MALFUNCTION THRESHOLDS

All of following conditions (a), (b) and (c) met	-
(a) Commanded air-fuel ratio	15 or more
(b) Rear HO2 sensor voltage	More than 0.59 V
(c) OSC (Oxygen Storage Capacity of Catalyst)	2 g or more

Heated Oxygen Sensor Impedance (Low):

TYPICAL MALFUNCTION THRESHOLDS

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

Heated Oxygen Sensor Impedance (High):

TYPICAL MALFUNCTION THRESHOLDS

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

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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

Duration until rear heated oxygen sensor voltage drops to 0.2 V after fuel cut	7 seconds or more

COMPONENT OPERATING RANGE

COMPONENT OPERATING RANGE

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

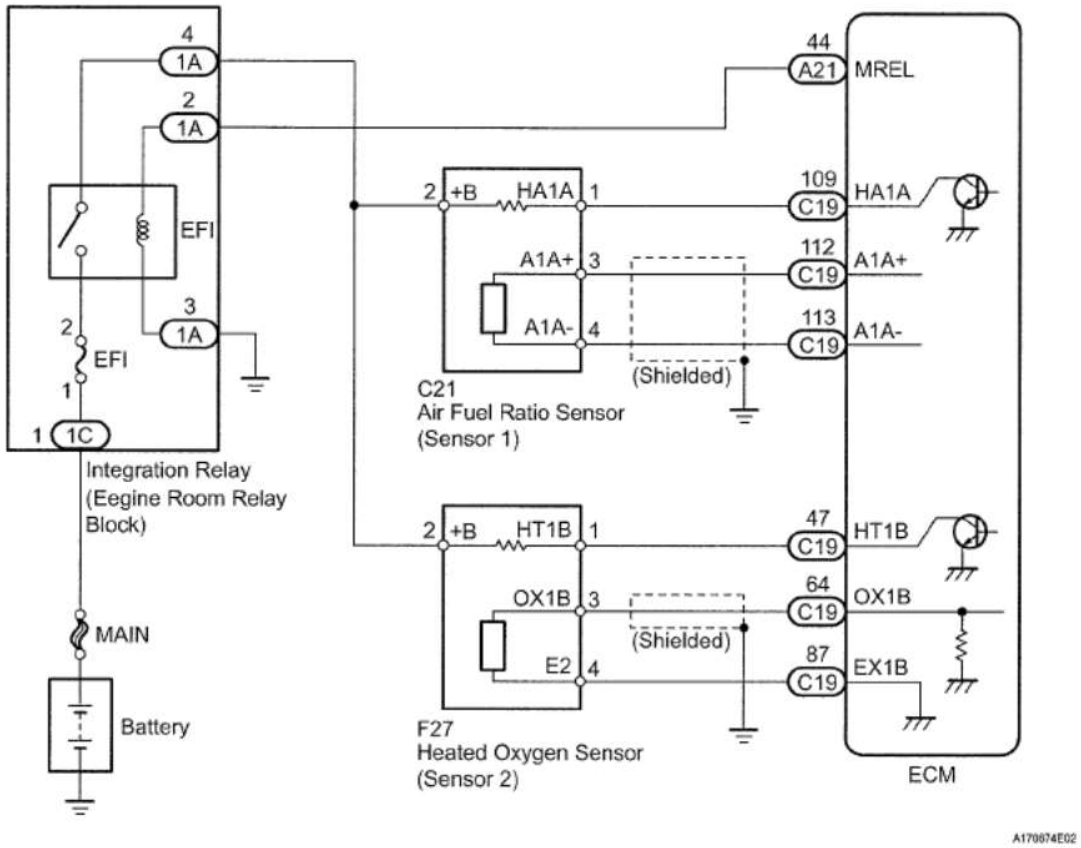


Fig. 95: Heated Oxygen Sensor - Wiring Diagram (Bank 1 Sensor 2)

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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.
- Performing this confirmation driving pattern will activate the Heated Oxygen (HO2) sensor monitor (The catalyst monitor is performed simultaneously). This is very useful for verifying the completion of a repair.

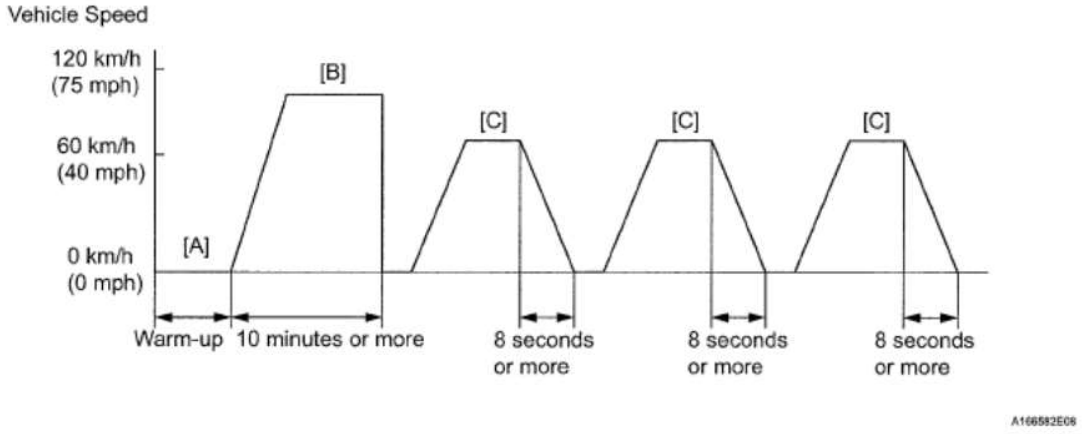


Fig. 96: Vehicle Speed Graph
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

1. Connect a Techstream to the DLC3.
2. Turn the ignition switch to ON.
3. Warm-up the engine until the engine coolant temperature reaches 75°C (167°F) or more [A].
4. Drive the vehicle at between 60 km/h and 120 km/h (40 mph and 75 mph) for at least 10 minutes [B].
5. Drive the vehicle 60 km/h (40 mph) or more and decelerate the vehicle for 8 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 and P0139.
    - Check the DTC MONITOR is NORMAL. If DTC MONITOR is INCOMPLETE, perform the drive pattern adding the vehicle speed and using the 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

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provided in the Active Test. The Control the Injection Volume for A/F sensor function can help to determine whether the Air Fuel Ratio (A/F) sensor, Heated Oxygen (HO2) 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 a 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 A/F and HO2 sensors (AFS B1 S1 and O2S B1 S2) displayed on the tester.

   HINT:

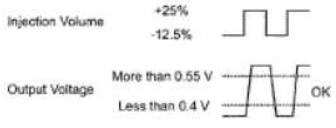
   - The Control the Injection Volume for A/F sensor operation lowers the fuel injection volume by 12.5% or increases the injection volume by 25%.
   - Each sensor reacts in accordance with increases and decreases in the fuel injection volume.

INJECTION VOLUME AND VOLTAGE SPECIFICATION

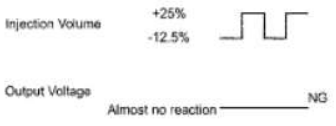
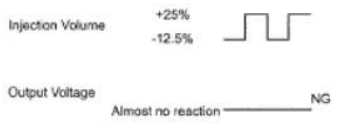
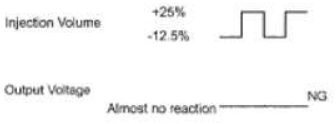
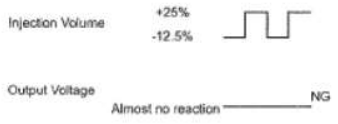
Tester Display (Sensor)	Injection Volume	Status	Voltage
AFS B1 S1 (A/F)	+25%	Rich	Less than 3.0 V
	-12.5%	Lean	More than 3.35 V
O2S B1 S2 (HO2)	+25%	Rich	More than 0.55 V
	-12.5%	Lean	Less than 0.4 V

NOTE: The Air Fuel Ratio (A/F) sensor has an output delay of a few seconds and the Heated Oxygen (HO2) sensor has a maximum output delay of approximately 20 seconds.

A/F SENSOR AND HO2 SENSOR OUTPUT VOLTAGE SPECIFICATION

Case	A/F Sensor (Sensor 1) Output Voltage	HO2 Sensor (Sensor 2) Output Voltage	Main Suspected Trouble Area
1			-
			• A/F sensor

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2			• A/F sensor heater • A/F sensor circuit
3			• HO2 sensor • HO2 sensor heater • HO2 sensor circuit
4			• Injector • Fuel pressure • Gas leak from exhaust system (Air fuel ratio extremely rich or lean)

- Following the Control the Injection Volume for A/F sensor procedure enables technicians to check and graph the voltage outputs of both the A/F and HO2 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 B1 S1 and O2S B1 S2; then press the graph button on the Data List view.

HINT:

Read freeze frame data using a 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 P0136, P0137, P0138 OR P0139)**
   a. Connect a Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the tester ON.
   d. Select the following menu items: Powertrain / Engine and ECT / Trouble Codes.
   e. Read DTCs.

   Result

   RESULT REFERENCE

Result	Proceed to
P0138 or P0139	A
P0137	B
P0136	C

B: Go to step 8

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C: Go to step 6

A: Go to next step

2. **READ VALUE USING TECHSTREAM (OUTPUT VOLTAGE OF HEATED OXYGEN SENSOR)**
   a. Connect a Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the tester ON.
   d. Select the following menu items: Powertrain / Engine and ECT / Data List / A/F Control System / O2S B1 S2.
   e. Allow the engine to idle.
   f. Read the Heated Oxygen (HO2) sensor output voltage while idling.

   Result

   RESULT REFERENCE

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

   RESISTANCE SPECIFICATION

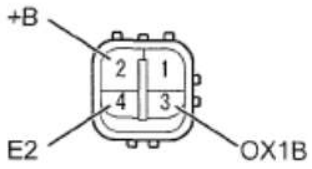
Tester Connection	Condition	Specified Condition
2 (+B) - 4 (E2)	Always	10 kohms or higher
2 (+B) - 3 (OX1B)		

   c. Reconnect the heated oxygen sensor connector.

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

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Component without harness connected:
(Heated Oxygen Sensor)



A170692E02

Fig. 97: 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 to 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.

Standard resistance

RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
C19-47 (HT1B) - C19-64 (OX1B)	Always	10 kohms or higher

   d. Reconnect the ECM connector.

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR

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Front view of wire harness connector:
(to ECM)

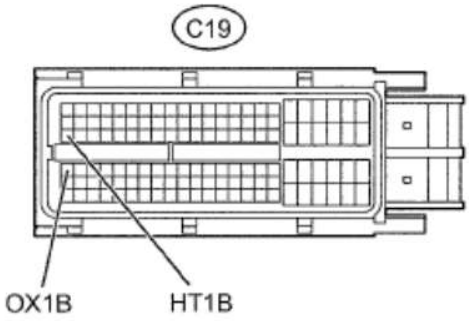


Fig. 98: Identifying ECM Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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

5. **INSPECT AIR FUEL RATIO SENSOR**

HINT:

This A/F sensor test is to check the A/F 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 a Techstream to the DLC3.
b. Turn the ignition switch to ON.
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 60 km/h (40 mph) or more and decelerate the vehicle for 5 seconds or more.
    3. Repeat the deceleration above at least 3 times.

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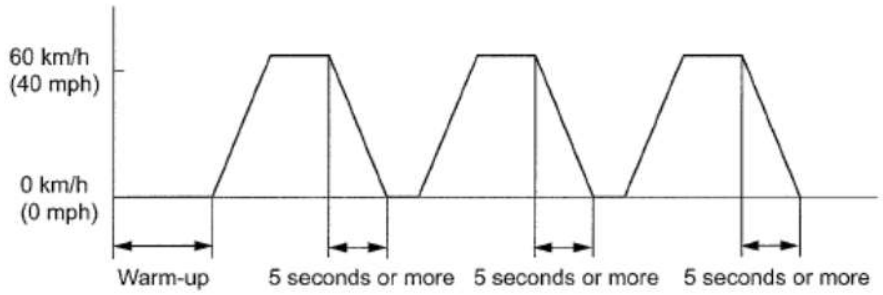


Fig. 99: Vehicle Speed Graph
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

e. Select the following menu items: 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, add the vehicle speed and use the second gear to decelerate the 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 a Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   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.
   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.

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HINT:

Quickly accelerate the engine to 4000 rpm 3 times using the accelerator pedal.

Standard voltage:

Fluctuates between below 0.4 V and 0.5 V or higher.

NG: Go to step 8

OK: Go to next step

7. **PERFORM ACTIVE TEST USING TECHSTREAM (INJECTION VOLUME)**
   a. Connect a Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   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 (A/F) and Heated Oxygen (HO2) 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 A/F sensor is displayed as AFS B1 S1 or AFS B2 S1, and the HO2 sensor is displayed as O2S B1 S2 or O2S B2 S2 on Techstream.

   Result

   VOLTAGE SPECIFICATION

Tester Display (Sensor)	Voltage Variation	Proceed to
AFS B1 S1 (A/F)	Alternates between more and less than 3.3 V	OK
	Remains at more than 3.3 V	NG
	Remains at less than 3.3 V	NG

   HINT:

   A normal HO2 sensor voltage (O2S B1 S2) reacts in accordance with increases and decreases in fuel injection volumes. When the A/F sensor voltage remains at either less or more than 3.3 V despite the HO2 sensor indicating a normal reaction, the A/F sensor is malfunctioning.

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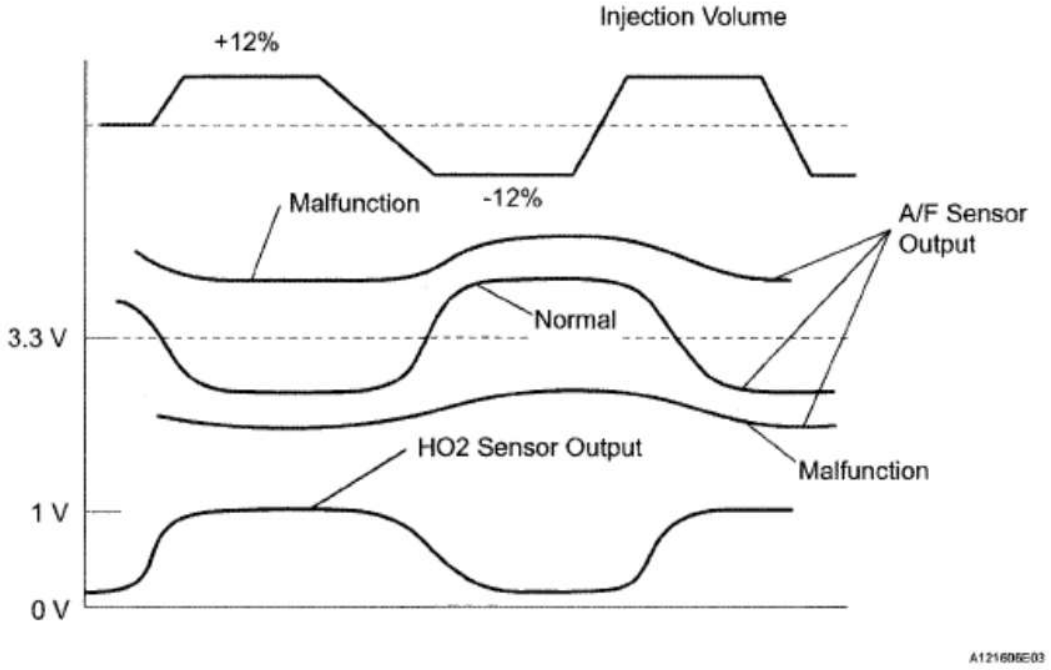


Fig. 100: Injection Volume And Heated Oxygen Sensor Voltage Graph
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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 (See **COMPONENTS**)

OK: Go to next step

9. **INSPECT HEATED OXYGEN SENSOR (HEATER RESISTANCE)** (See **INSPECTION PROCEDURE**)

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.

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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)

RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
F27-1 (HT1B) - C19-47 (HT1B)	Always	Below 1 ohms
F27-3 (OX1B) - C19-64 (OX1B)		
F27-4 (E2) - C19-87 (EX1B)		

Standard resistance (Check for short)

RESISTANCE SPECIFICATION

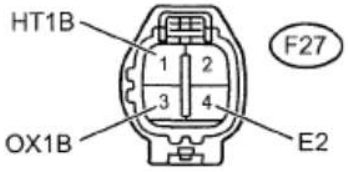
Tester Connection	Condition	Specified Condition
F27-1 (HT1B) or C19-47 (HT1B) - Body ground	Always	10 kohms or higher
F27-3 (OX1B) or C19-64 (OX1B) - Body ground		

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

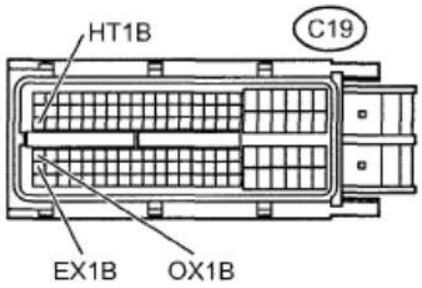
NG: REPAIR OR REPLACE HARNESS OR CONNECTOR

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



Front view of wire harness connector:
(to ECM)



A170676E02

Fig. 101: Identifying Heated Oxygen Sensor And ECM Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

11. **REPLACE HEATED OXYGEN SENSOR**
    a. Replace the heated oxygen sensor (See **REMOVAL**).
12. **PERFORM CONFIRMATION DRIVING PATTERN**

    HINT:

    Refer to the **CONFIRMATION DRIVING PATTERN**.

13. **CHECK WHETHER DTC OUTPUT RECURS (DTC P0136, P0137, P0138 OR P0139)**
    a. Connect a Techstream to the DLC3.
    b. Turn the ignition switch to ON.
    c. Turn the tester ON.
    d. Select the following menu items: Powertrain / Engine and ECT / Utility / All Readiness.
    e. Input DTCs: P0136, P0137, P0138 and P0139.

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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 REFERENCE

Result	Proceed to
No output	A
P0136, P0137, P0138 or P0139 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 OR P0139)**
    a. Connect a Techstream to the DLC3.
    b. Turn the ignition switch to ON.
    c. Turn the tester ON.
    d. Select the following menu items: Powertrain / Engine and ECT / Utility / All Readiness.
    e. Input DTCs: P0136, P0137, P0138 and P0139.
    - 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 REFERENCE

Result	Proceed to
No output	A
P0136, P0137, P0138 or P0139 detected	B

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

A : END

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DTC P0171 SYSTEM TOO LEAN (BANK 1); DTC P0172 SYSTEM TOO RICH (BANK 1)

DESCRIPTION

The fuel trim is related to the feedback compensation value, not to the basic injection 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 (A/F) 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.

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 AND TROUBLE AREA

DTC No.	DTC Detection Condition	Trouble Area
P0171	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 (sensor 1) circuit • Air fuel ratio sensor (sensor 1) • EFI Fuse • PCV valve and hose • PCV hose connections • ECM
	With warm engine and stable air fuel ratio feedback,	• Injector leak or blockage • Mass air flow meter • Engine coolant temperature sensor • Ignition system

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P0172	fuel trim considerably in error to rich side (2 trip detection logic)	• Fuel pressure • Gas leak from exhaust system • Open or short in air fuel ratio sensor (sensor 1) circuit • Air fuel ratio sensor (sensor 1) • EFI fuse • ECM

HINT:

- When DTC P0171 is set, the actual air fuel ratio is on the lean side. When DTC P0172 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 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.

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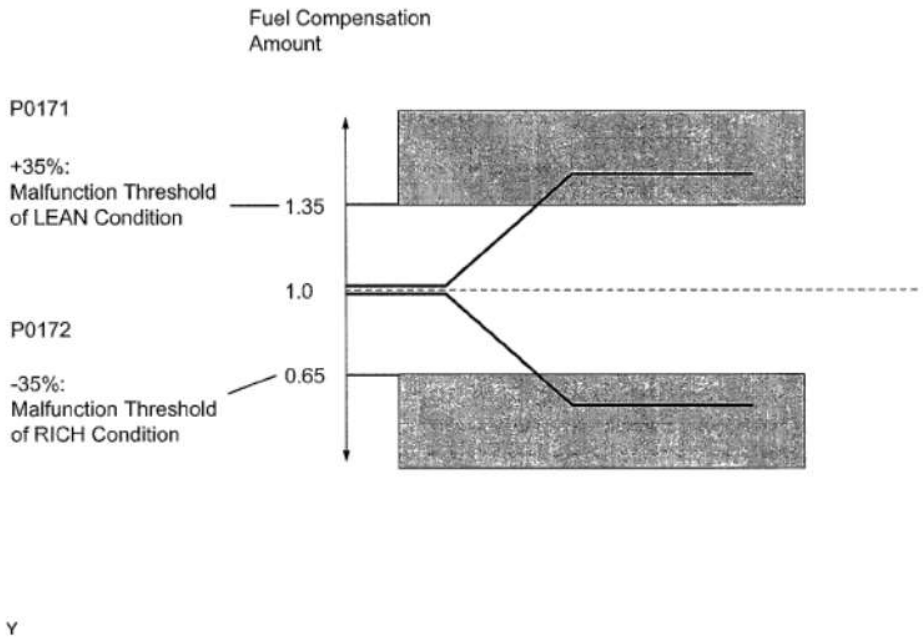


Fig. 102: [Fuel Compensation Amount Graph]
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

MONITOR STRATEGY

MONITOR STRATEGY

Related DTCs	P0171: Fuel trim Lean (bank 1) P0172: Fuel trim Rich (bank 1)
Required Sensors/Components (Main)	Fuel system
Required Sensors/Components (Related)	Air Fuel Ratio (A/F) sensor Mass air flow meter Crankshaft position sensor
Frequency of Operation	Continuous
Duration	Within 10 seconds
MIL Operation	2 driving cycles
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

Fuel-trim:

TYPICAL ENABLING CONDITIONS

	P0010 (VVT OCV) P0011 (VVT System 1 - Advance) P0012 (VVT System 1 - Retard) P0031, P0032 (A/F sensor heater - Sensor 1) P0102 - P0103 (Mass air flow meter)

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Monitor runs whenever following DTCs not present	P0115 - P0118 (Engine coolant temperature sensor) P0120 - P0223, P2135 (Throttle position sensor) P0125 (Insufficient engine coolant temperature for closed loop) P0335 (Crankshaft position sensor) P0340 (Camshaft position sensor) P0351 - P0354 (Igniter) 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	Below 1100 rpm
2. Intake air amount per revolution	0.22 g/rev or more
Catalyst monitor	No executed

TYPICAL MALFUNCTION THRESHOLDS

Fuel-trim:

TYPICAL MALFUNCTION THRESHOLDS

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 ECT)
2. Average between short-term fuel trim and long-term fuel trim	-35% or less (varies with ECT)

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 (A/F) sensor, Heated Oxygen (HO2) 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 a 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.

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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 A/F and HO2 sensors (AFS B1 S1 and O2S B1 S2) displayed on the tester.

HINT:

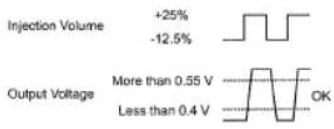
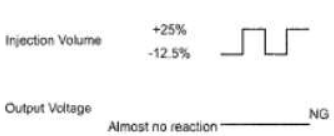
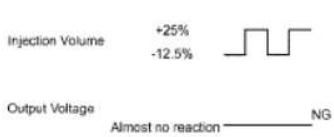
- The Control the Injection Volume for A/F sensor operation lowers the fuel injection volume by 12.5% or increases the injection volume by 25%.
- Each sensor reacts in accordance with increases and decreases in the fuel injection volume.

INJECTION VOLUME AND VOLTAGE SPECIFICATION

Tester Display (Sensor)	Injection Volume	Status	Voltage
AFS B1 S1 (A/F)	+25%	Rich	Less than 3.0 V
	-12.5%	Lean	More than 3.35 V
O2S B1 S2 (HO2)	+25%	Rich	More than 0.55 V
	-12.5%	Lean	Less than 0.4 V

NOTE: The Air Fuel Ratio (A/F) sensor has an output delay of a few seconds and the Heated Oxygen (HO2) sensor has a maximum output delay of approximately 20 seconds.

A/F SENSOR AND HO2 SENSOR OUTPUT VOLTAGE SPECIFICATION

Case	A/F Sensor (Sensor 1) Output Voltage	HO2 Sensor (Sensor 2) Output Voltage	Main Suspected Trouble Area
1			-
2			• A/F sensor • A/F sensor heater • A/F sensor circuit
3			• HO2 sensor • HO2 sensor heater • HO2 sensor circuit
4			• Injector • Fuel pressure • Gas leak from exhaust system (Air fuel ratio

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			extremely rich or lean)

- Following the Control the Injection Volume for A/F sensor procedure enables technicians to check and graph the voltage outputs of both the A/F and HO2 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 B1 S1 and O2S B1 S2; then press the graph button on the Data List view.

HINT:

- Read freeze frame data using a 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 A/F sensor voltage could be caused by a rich air fuel mixture. Check for conditions that would cause the engine to run rich.
- A high A/F sensor voltage could be caused by a lean air fuel mixture. Check for conditions that would cause the engine to run lean.

1. **CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P0171 OR P0172)**
   a. Connect a Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the tester ON.
   d. Select the following menu items: Powertrain / Engine and ECT / Trouble Codes.
   e. Read DTCs.

   Result

   RESULT REFERENCE

Result	Proceed to
P0171 or P0172	A
P0171 or P0172 and other DTCs	B

   HINT:

   If any DTCs other than P0171 or P0172 are output, troubleshoot those DTCs first.

   B: Go to DTC CHART (See **DIAGNOSTIC TROUBLE CODE CHART**)

   A: Go to next step

2. **CHECK PCV HOSE CONNECTIONS**

   OK:

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PCV hose is connected correctly and is not damaged.

NG: REPAIR OR REPLACE PCV HOSE

OK: Go to next step

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 (A/F CONTROL)**
   a. Connect a 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 (A/F) sensor and the Heated Oxygen (HO2) sensor (AFS B1S1 and O2S B1S2) 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

      INJECTION VOLUME AND VOLTAGE SPECIFICATION

Tester Display (Sensor)	Injection Volume	Status	Voltage
AFS B1S1 (A/F)	+25%	Rich	Less than 3.0
	-12.5%	Lean	More than 3.35
O2S B1S2 (HO2)	+25%	Rich	More than 0.55
	-12.5%	Lean	Less than 0.4

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Result:

RESULT REFERENCE

Status AFS B1S1	Status O2S B1S2	A/F Condition and A/F Sensor Condition	Misfire	Suspected Trouble Area	Proceed to
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 (MAF) meter • Engine Coolant Temperature (ECT) sensor	A
Rich	Rich	Actual air fuel ratio rich	-	• Injector blockage or blockage • Gas leak from exhaust system • Ignition system • Fuel pressure • MAF meter • ECT sensor	
Lean	Lean/Rich	A/F sensor malfunction	-	• A/F sensor	B
Rich	Lean/Rich	A/F sensor malfunction	-	• A/F sensor	

Lean: During Control the Injection Volume for A/F Sensor, the A/F sensor output voltage (AFS) is consistently more than 3.35 V, and the HO2 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 3.0 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

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output voltage of the heated oxygen sensor alternates correctly.

B: Go to step 11

C: Go to step 15

A: Go to next step

5. **READ VALUE USING TECHSTREAM (COOLANT TEMP)**
   a. Connect a Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   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 a Techstream (MAF).

   NOTE:

   - **Turn the ignition switch to 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. Connect a Techstream to the DLC3.
   2. Turn the ignition switch to ON (do not start the engine).
   3. Turn the tester ON.
   4. Select the following menu items: Powertrain / Engine and ECT / Data List / MAF.
   5. Wait for 30 seconds, and read the values on the tester.

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Standard value:

Less than 022g/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.

      OK:

      No foreign matter attached.

   3. Reinstall the mass air flow meter (See **INSTALLATION**).

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

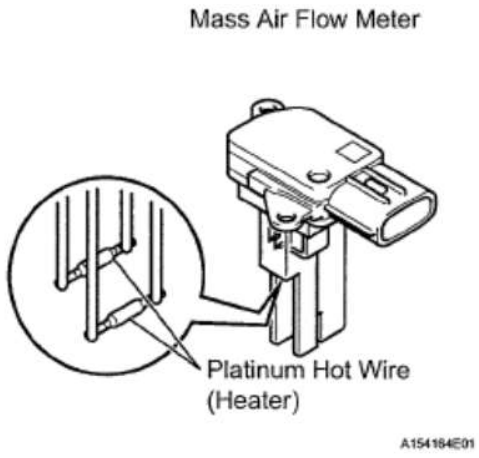


Fig. 103: Identifying Platinum Filament (Heater Portion) In Mass Air Flow Meter
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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:

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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 be read using a Techstream. Select the following menu items: Powertrain / Engine and ECT / Data List / All Data / Cylinder #1 Misfire Rate (to Cylinder #4 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 a Techstream. Select the following menu items: Powertrain / Engine and ECT/ Data List / All Data / Cylinder #1 Misfire Rate (to Cylinder #4 Misfire Rate).

NG: REPLACE FUEL INJECTOR ASSEMBLY (See **REMOVAL**)

OK: Go to next step

11. **INSPECT AIR FUEL RATIO SENSOR (HEATER RESISTANCE)** (See **INSPECTION PROCEDURE**)

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

OK: Go to next step

12. **CHECK TERMINAL VOLTAGE (POWER SOURCE OF AIR FUEL RATIO SENSOR)** (See **INSPECTION PROCEDURE**)

NG: Go to step 17

OK: Go to next step

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13. **CHECK HARNESS AND CONNECTOR (AIR FUEL RATIO SENSOR - ECM)** (See **INSPECTION PROCEDURE**)

    NG: REPAIR OR REPLACE HARNESS OR CONNECTOR

    OK: Go to next step

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

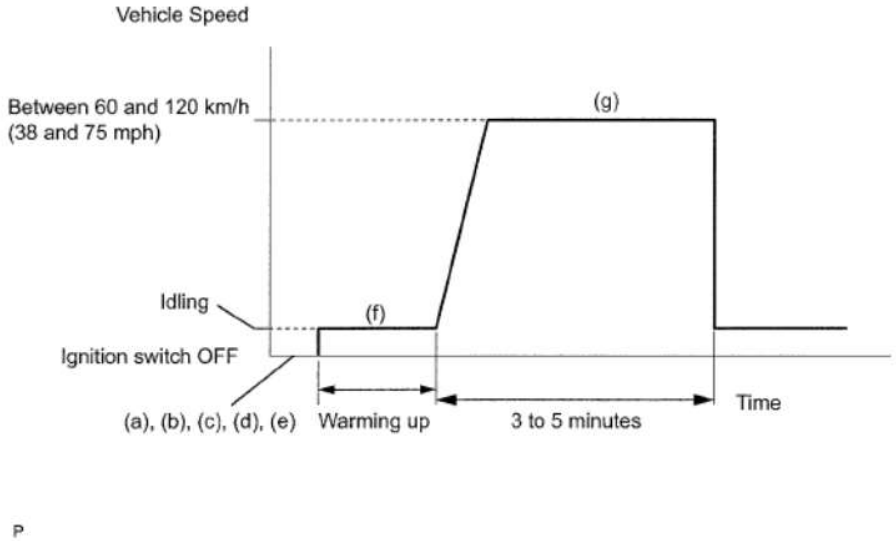


Fig. 104: Vehicle Speed Graph
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

a. Connect a Techstream to the DLC3.
b. Turn the ignition switch to ON.
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 60 km/h and 120 km/h (38 mph and 75 mph) 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).

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NOTE: **If the conditions in this test are not strictly followed, no malfunction will be detected.**

16. **CHECK WHETHER DTC OUTPUT RECURS (DTC P0171 OR P0172)**
    a. Connect a Techstream to the DLC3.
    b. Turn the ignition switch to ON.
    c. Turn the tester ON.
    d. Select the following menu items: Powertrain / Engine and ECT / Trouble Codes.
    e. Read DTCs.

    Result

    RESULT REFERENCE

Result	Proceed to
No output	A
P0171 or P0172	B

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

A : END

17. **CHECK HARNESS AND CONNECTOR (AIR FUEL RATIO SENSOR - INTEGRATION RELAY)** (See **INSPECTION PROCEDURE**)

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR

OK : REPAIR OR REPLACE ECM POWER SOURCE CIRCUIT (See **ECM POWER SOURCE CIRCUIT**)

DTC P0300 RANDOM / MULTIPLE CYLINDER MISFIRE DETECTED; DTC P0301 CYLINDER 1 MISFIRE DETECTED; DTC P0302 CYLINDER 2 MISFIRE DETECTED; DTC P0303 CYLINDER 3 MISFIRE DETECTED; DTC P0304 CYLINDER 4 MISFIRE DETECTED

DESCRIPTION

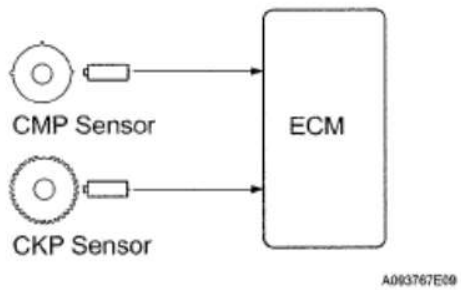


Fig. 105: Communication Diagram Between CMP/CKP Sensor And ECM

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When the engine misfires, high concentrations of hydrocarbons (HC) enter the exhaust gas. High HC concentration levels can cause increase in exhaust emission levels. Extremely high concentrations of HC can also cause increases in the Three-Way Catalytic Converter (TWC) temperature, which may cause damage to the TWC. 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 TWC reaches the point of thermal degradation, the ECM blinks the MIL. To monitor misfires, the ECM uses both the Camshaft Position (CMP) sensor and the Crankshaft Position (CKP) sensor. The CMP sensor is used to identify any misfiring cylinders and the CKP sensor is used to measure variations in the crankshaft rotation speed. Misfires are counted when the crankshaft rotation speed variations exceed predetermined thresholds. If the misfire count exceeds the threshold levels, and could cause emission deterioration, the ECM illuminates the MIL and sets a DTC.

DTC DETECTION CONDITION AND TROUBLE AREA

DTC No.	DTC Detection Condition	Trouble Area
P0300	When one of following conditions below is detected (2 trip detection logic): • High temperature misfire occurs in Three-Way Catalytic Converter (TWC) (MIL blinks) • Emission deterioration misfire occurs (MIL illuminates) Simultaneous misfiring of several cylinders occurs	• Open or short in engine wire harness • Connector connection • Vacuum hose connections • Ignition system • Fuel injector • Fuel pressure • Mass Air Flow (MAF) meter • Engine Coolant Temperature (ECT) sensor • Compression pressure • Valve clearance • Valve timing • PCV valve and hose • PCV hose connections • Air induction system • ECM
P0301 P0302 P0303 P0304	When one of following conditions below is detected (2 trip detection logic): • High temperature misfire occurs in Three-Way Catalytic Converter (TWC) (MIL blinks) • Emission deterioration misfire occurs (MIL illuminates) • Misfiring of specific cylinder occurs	

When DTCs for misfiring cylinders are randomly 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).

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- 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 1,000 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 (TWC) damage, is detected (2 trip detection logic).

HINT:

If a catalyst damage misfire occurs, the monitor informs the driver by blinking the MIL (1 trip).

- In every 200 crankshaft revolutions at a high engine rpm, the threshold misfiring percentage is recorded once.
- In every 200 crankshaft revolutions at a normal engine rpm, the threshold misfiring percentage is recorded 3 times.

MONITOR STRATEGY

MONITOR STRATEGY

Related DTCs	P0300: Multiple cylinder misfire P0301: Cylinder 1 misfire P0302: Cylinder 2 misfire P0303: Cylinder 3 misfire P0304: Cylinder 4 misfire
Required Sensors/Components (Main)	Crankshaft position sensor Camshaft position sensor
Required Sensors/Components (Related)	Engine coolant temperature Intake air temperature sensor Mass air flow meter
Frequency of Operation	Continuous
Duration	1000 to 4000 crankshaft revolutions: Emission related misfire 200 to 600 crankshaft revolutions: Catalyst damaged misfire
MIL Operation	2 driving cycles: Emission related misfire MIL flashes immediately: Catalyst damaged misfire
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

Misfire:

TYPICAL ENABLING CONDITIONS

	P0102 - P0103 (Mass air flow meter) P0111 - P0113 (Intake air temperature sensor) P0115 - P0118 (Engine coolant temperature sensor)

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Monitor runs whenever following DTCs not present	P0120 - P0223, P2135 (Throttle position sensor) P0125 (Insufficient ECT for Closed Loop) P0327, P0328 (Knock sensor) P0335 (Crankshaft position sensor) P0340 (Camshaft position sensor) P0500 (Vehicle speed sensor)
Battery voltage	8 V or more
VVT system	Not operated by scan tool
Engine RPM	450 to 6400 rpm
Either of following conditions (a) or (b) met	-
(a) ECT at engine start	More than-7°C(19°F)
(b) ECT	More than 20°C (68°F)
Fuel cut	OFF

Monitor period of emission-related-misfire:

TYPICAL ENABLING CONDITIONS

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

All of following conditions 1, 2 and 3 met	Crankshaft 200 revolutions x 3
1. Driving cycles	1st
2. Check mode	OFF
3. Engine RPM	Less than 2520 rpm
Except above	Crankshaft 200 revolutions

TYPICAL MALFUNCTION THRESHOLDS

Monitor period of emission-related-misfire:

TYPICAL MALFUNCTION THRESHOLDS

Misfire rate	2.04% or more

Monitor period of catalyst-damaged-misfire (MIL blinks):

TYPICAL MALFUNCTION THRESHOLDS

Number of misfire per 200 revolutions	124 or more (varies with intake air amount per RPM)

MONITOR RESULT

Refer to **CHECKING MONITOR STATUS** .

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WIRING DIAGRAM

Wiring diagram of the ignition system.

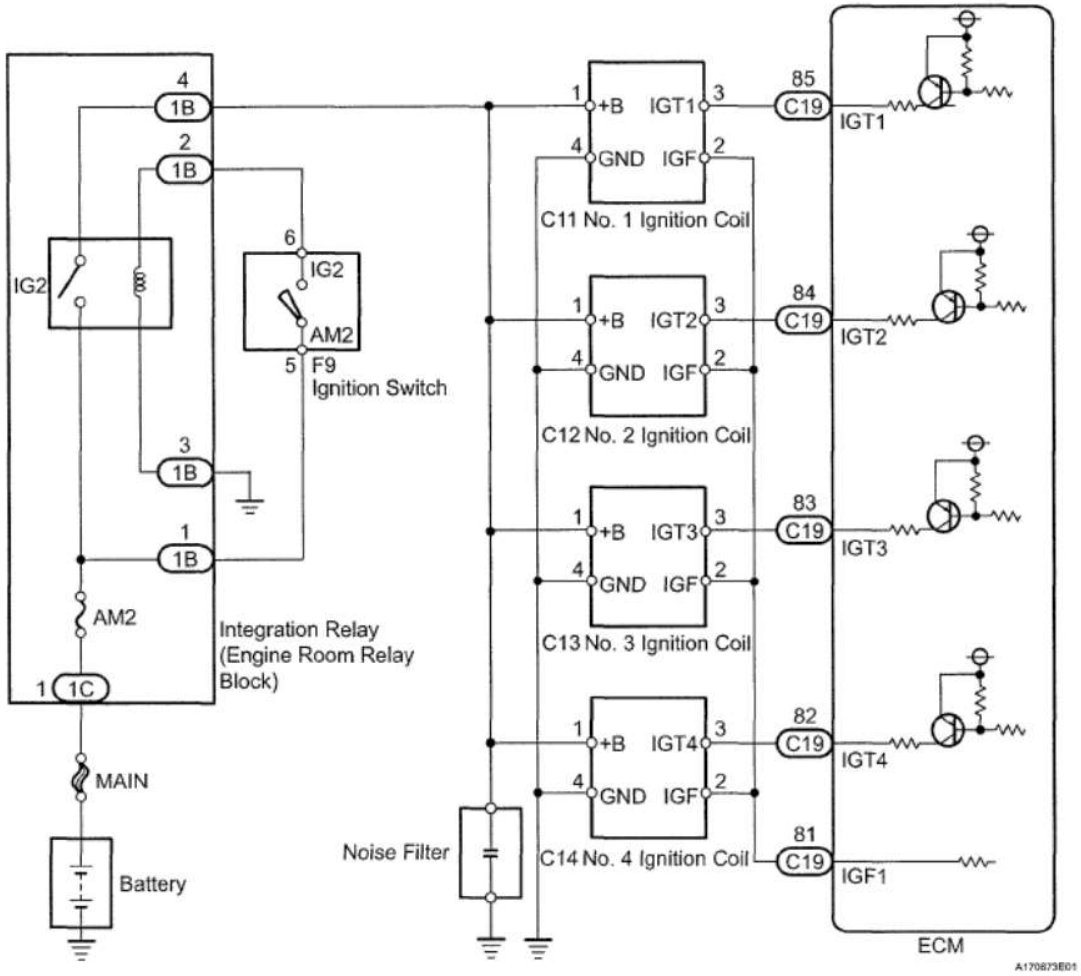


Fig. 106: Ignition System - Wiring Diagram (1 Of 2)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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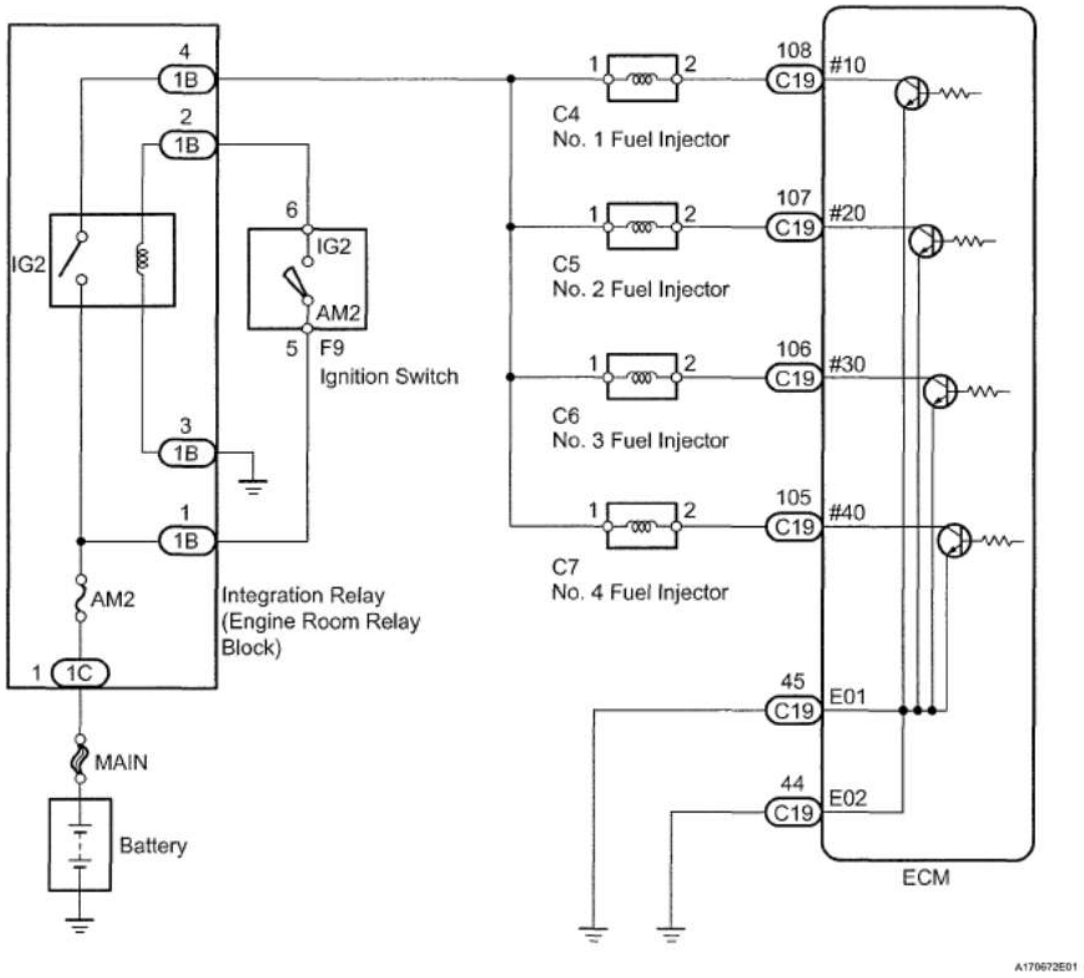


Fig. 107: Ignition System - Wiring Diagram (2 Of 2)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

CONFIRMATION DRIVING PATTERN

1. Connect a Techstream to the DLC3.
2. Turn the ignition switch to ON.
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 Rate to Cylinder #4 Misfire Rate, with the engine in an idling condition. If any misfire count is displayed, skip the following confirmation 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.

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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 AND TIME PERIOD REFERENCE

Engine RPM	Duration
Idling	8 minutes or more
1000	4.5 minutes or more
2000	2.5 minutes or more
3000	1.5 minute or more

8. Check whether misfires have occurred by checking DTCs and freeze frame data.

   HINT:

   Do not turn the ignition switch to 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 to 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 a 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 in the tank.
  b. Improper fuel is used.
  c. The spark plugs have been contaminated.
  d. The problem requires further diagnosis.
- After finishing repairs, check the misfire counts of the cylinders Cylinder #1 Misfire Rate to Cylinder #4 Misfire Rate.
- Be sure to confirm that no misfiring cylinder DTCs are set again by conducting the confirmation driving

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pattern after finishing repairs.

- 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.

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

   HINT:

   Write down indicated DTCs.

   Result

   RESULT REFERENCE

Result	Proceed to
P0300, P0301, P0302, P0303 and/or P0304	A
P0300, P0301, P0302, P0303 and/or P0304 and other DTCs	B

   HINT:

   If any DTCs other than P0300, P0301, P0302, P0303 and P0304 are output, troubleshoot those DTCs first.

B: Go to DTC CHART (See **DIAGNOSTIC TROUBLE CODE CHART**)

A: Go to next step

2. **READ VALUE USING TECHSTREAM (MISFIRE RPM AND MISFIRE LOAD)**
   a. Connect a Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the tester ON.
   d. Select the following menu items: Powertrain / Engine and ECT / Data List / Misfire / Misfire RPM and Misfire Load.
   e. Read and note the Misfire RPM and Misfire Load values.

   HINT:

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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 (CAT OT MF F/C)**
   a. Connect a Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the tester ON.
   d. Select the following menu items: Powertrain / Engine and ECT / Data List / Catalyst OT MF F/C.
   e. Read the value displayed on the tester.

Result

RESULT REFERENCE

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 (PROHIBIT CAT OT FC)**
   a. Connect a Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the tester ON.
   d. Select the following menu items: Powertrain / Engine and ECT / Active Test / Prohibit the Catalyst OT Misfire prevent F/C.
   e. Perform the Active Test.

NOTE: **When performing the Active Test, make sure the vehicle is stopped and either idling or being revved within 3000 rpm.**

6. **READ VALUE USING TECHSTREAM (CYLINDER #1 MISFIRE RATE, #2, #3 AND #4)**

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a. Select the following menu items: Powertrain / Engine and ECT / Data List / Misfire / Cylinder #1 Misfire Rate, #2, #3 and #4.
b. Start the engine and allow the engine to idle.
c. Read each value for Cylinder #1 Misfire Rate to #4 displayed on the tester. If no misfire counts occur in any cylinders, perform steps (d) and (e) and then check the misfire counts again.
d. Drive the vehicle with the Misfire RPM and Misfire Load noted in the "READ VALUE USING TECHSTREAM (MISFIRE RPM AND MISFIRE LOAD)" procedures above.
e. Read the Cylinder #1 Misfire Rate to #4 or DTCs displayed on the tester.

Result

RESULT REFERENCE

Result (Misfire Count)	Proceed to
Most misfires occur in only 1 or 2 cylinders	A
3 cylinders or more have equal misfire counts	B

HINT:

- If it is difficult to reproduce misfires for each cylinder, check the Data List item called Misfire Margin. Try to find vehicle driving conditions that lower the Misfire Margin value. Values above 30% are considered normal.
- If the freeze frame data's record of the ECT 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. **INSPECT SPARK PLUG**
   a. Remove the ignition coil and the spark plug from the misfiring cylinder.
   b. Measure the spark plug electrode gap.

   Standard gap:

   1.0 to 1.1 mm (0.039 to 0.043 in.)

   c. Check the electrode for carbon deposits.

   Recommended spark plug:

   RECOMMENDED SPARK PLUG REFERENCE

Manufacturer	Product

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DENSO	SC20HR11

NOTE: **If the electrode gap is larger than standard, replace the spark plug. Do not adjust the electrode gap.**

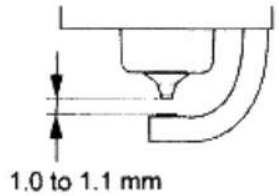


Fig. 108: Identifying Spark Plug Electrode Gap
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

d. Reinstall the ignition coil.

NG: REPLACE SPARK PLUG (See **REMOVAL**)

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.

   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.

NOTE: **Do not crank the engine for more than 2 seconds.**

OK:

Sparks jump across electrode gap.

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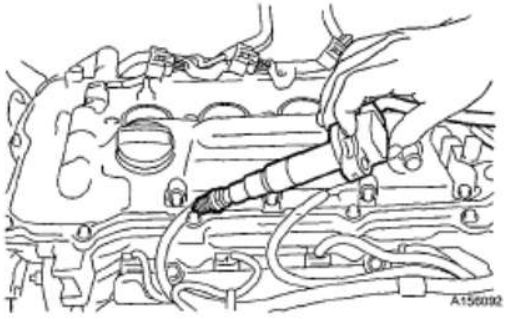


Fig. 109: Checking Spark Plug
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

f. Install the ignition coil.
g. Reconnect the injector connectors.

NG: Go to step 29

OK: Go to next step

9. **CHECK CYLINDER COMPRESSION PRESSURE**
   a. Measure the cylinder compression pressure of the misfiring cylinder (See **ON-VEHICLE INSPECTION**).

NG: CHECK ENGINE TO DETERMINE CAUSE OF LOW COMPRESSION

OK: Go to next step

10. **INSPECT ECM TERMINAL OF MISFIRING CYLINDER (#10, #20, #30 AND/OR #40 VOLTAGE)**
    a. Disconnect the ECM connector.
    b. Turn the ignition switch to ON.
    c. Measure the voltage according to the value(s) in the table below.

Standard voltage

VOLTAGE SPECIFICATION

Tester Connection	Switch Condition	Specified Condition
C19-108 (#10) - C19-45 (E01)	Ignition switch ON	11 to 14 V
C19-107 (#20) - C19-45 (E01)	Ignition switch ON	11 to 14 V
C19-106 (#30) - C19-45 (E01)	Ignition switch ON	11 to 14 V
C19-105 (#40) - C19-45 (E01)	Ignition switch ON	11 to 14 V

    d. Reconnect the ECM connector.

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Front view of wire harness connector:
(to ECM)

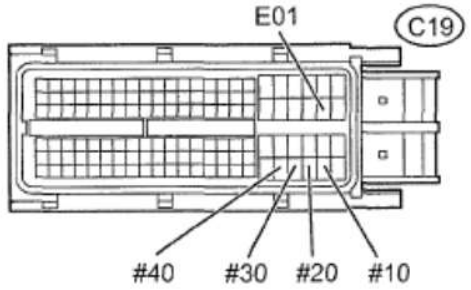


Fig. 110: Identifying ECM Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

NG: GO TO **FUEL INJECTOR CIRCUIT**

OK: Go to next step

11. **CHECK FUEL INJECTOR OF MISFIRING CYLINDER**
    a. Check the injector injection (whether fuel volume is high or low, and whether injection pattern is poor) (See **INSPECTION**).

NG: REPLACE FUEL INJECTOR (See **REMOVAL**)

OK: Go to next step

12. **CHECK VALVE CLEARANCE OF MISFIRING CYLINDER**
    a. Check the valve lash adjuster and valve rocker arm of misfiring cylinder (See **INSPECTION**).

NG: REPAIR OR REPLACE VALVE LASH ADJUSTER ASSEMBLY (See **DISASSEMBLY**)

OK: Go to next step

13. **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

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OK: Go to next step

14. **CHECK VALVE TIMING** (See **INSPECTION PROCEDURE**)

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

OK: Go to next step

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

NG: REPAIR OR REPLACE FUEL PUMP, PRESSURE REGULATOR, FUEL PIPE LINE OR FILTER

OK: Go to next step

16. **READ VALUE USING TECHSTREAM (COOLANT TEMP)** (See **INSPECTION PROCEDURE**)

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

OK: Go to next step

17. **INSPECT MASS AIR FLOW METER** (See **INSPECTION PROCEDURE**)

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

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

18. **CHECK 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

19. **CHECK VALVE TIMING** (See **INSPECTION PROCEDURE**)

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

OK: Go to next step

20. **CHECK FUEL PRESSURE**

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a. Check the fuel pressure (See **ON-VEHICLE INSPECTION**).

NG: REPAIR OR REPLACE FUEL PUMP, PRESSURE REGULATOR, FUEL PIPE LINE OR FILTER

OK: Go to next step

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** (See **INSPECTION PROCEDURE**)

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

OK: Go to next step

23. **INSPECT SPARK PLUG**
    a. Remove the ignition coil and the spark plug of the misfiring cylinder.
    b. Measure the spark plug electrode gap.

Standard gap:

1.0 to 1.1 mm (0.039 to 0.043 in.)

c. Check the electrode for carbon deposits.

Recommended spark plug:

RECOMMENDED SPARK PLUG REFERENCE

Manufacturer	Product
DENSO	SC20HR11

NOTE: **If the electrode gap is larger than standard, replace the spark plug. Do not adjust the electrode gap.**

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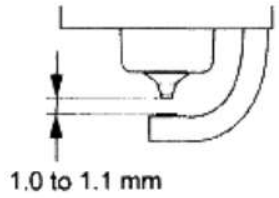


Fig. 111: Identifying Spark Plug Electrode Gap
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

d. Reinstall the ignition coil.

NG: REPLACE SPARK PLUG (See **REMOVAL**)

OK: Go to next step

24. **CHECK FOR SPARKS AND IGNITION**
    a. Disconnect the injector connectors to prevent the engine from starting.

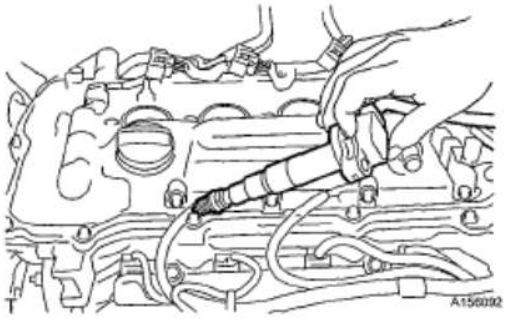
CAUTION: Always disconnect all injector connectors.

    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.

NOTE: Do not crank the engine for more than 2 seconds.

OK:

Sparks jump across electrode gap.



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Fig. 112: Checking Spark Plug
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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 **ON-VEHICLE INSPECTION**).

NG: CHECK ENGINE TO DETERMINE CAUSE OF LOW COMPRESSION

OK: Go to next step

26. **INSPECT ECM TERMINAL OF MISFIRING CYLINDER (#10, #20, #30 AND/OR #40 VOLTAGE)**
    a. Disconnect the ECM connector.
    b. Turn the ignition switch to ON.
    c. Measure the voltage according to the value(s) in the table below.

Standard voltage

VOLTAGE SPECIFICATION

Tester Connection	Switch Condition	Specified Condition
C19-108 (#10) - C19-45 (E01)	Ignition switch ON	11 to 14 V
C19-107 (#20) - C19-45 (E01)	Ignition switch ON	11 to 14 V
C19-106 (#30) - C19-45 (E01)	Ignition switch ON	11 to 14 V
C19-105 (#40) - C19-45 (E01)	Ignition switch ON	11 to 14 V

    d. Reconnect the ECM connector.

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Front view of wire harness connector:
(to ECM)

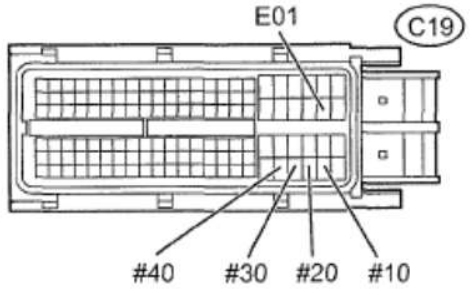


Fig. 113: Identifying ECM Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

NG: GO TO **FUEL INJECTOR CIRCUIT**

OK: Go to next step

27. **CHECK FUEL INJECTOR OF MISFIRING CYLINDER**
    a. Check the injector injection (whether fuel volume is high or low, and whether injection pattern is poor) (See **INSPECTION**).

NG: REPLACE FUEL INJECTOR (See **REMOVAL**)

OK: Go to next step

28. **CHECK VALVE CLEARANCE OF MISFIRING CYLINDER**
    a. Check the valve lash adjuster and valve rocker arm of misfiring cylinder (See **INSPECTION**).

NG: REPAIR OR REPLACE VALVE LASH ADJUSTER ASSEMBLY (See **DISASSEMBLY**)

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.

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NOTE: Do not crank the engine for more than 2 seconds.

1. Install the spark plug into the ignition coil and connect the ignition coil connector.
2. Disconnect the injector 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 **REMOVAL**)

30. **CHANGE TO NORMAL IGNITION COIL AND CHECK SPARK OF MISFIRING CYLINDER**
    a. Change the ignition coil to a ignition coil 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 into 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: REPLACE ECM (See **REMOVAL**)

OK : REPLACE IGNITION COIL (See **REMOVAL**)

DTC P0327 KNOCK SENSOR 1 CIRCUIT LOW INPUT (BANK 1 OR SINGLE SENSOR); DTC P0328 KNOCK SENSOR 1 CIRCUIT HIGH INPUT (BANK 1 OR SINGLE SENSOR)

DESCRIPTION

Flat type knock sensors (non-resonant type) have structures that can detect vibrations over a wide band of

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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 it becomes deformed.

The voltage is generated when the engine block vibrates due to knocking. Any occurrence of engine knocking can be suppressed by delaying the ignition timing.

DTC DETECTION CONDITION AND TROUBLE AREA

DTC No.	DTC Detection Condition	Trouble Area
P0327	Output voltage of knock sensor less than 0.5 V for 1 second or more (1 trip detection logic)	• Short in knock sensor circuit • Knock sensor • ECM
P0328	Output voltage of knock sensor more than 4.5 V for 1 second or more (1 trip detection logic)	• Open in knock sensor circuit • Knock sensor • ECM

HINT:

When any of DTCs P0327 and P0328 are set, the ECM enters fail-safe mode. During fail-safe mode, the ignition timing is delayed to its maximum retardation. Fail-safe mode continues until the ignition switch is turned to OFF.

Reference: Inspection using an oscilloscope

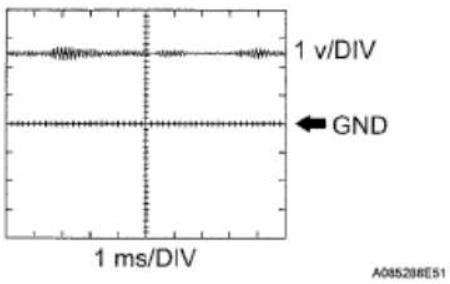


Fig. 114: Waveform Graph
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

The correct waveform is as shown.

WAVEFORM REFERENCE

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2008 ENGINE PERFORMANCE 2ZR-FE Engine Control System - xD

ECM Terminal Name	Between KNK1 and EKNK
Tester Range	1 v/DIV, 1 ms/DIV
Condition	Engine speed maintained at 4,000 rpm after warming up engine

MONITOR DESCRIPTION

If the output voltage transmitted by the knock sensor remains low or high for more than 1 second, the ECM interprets this as a malfunction in the sensor circuit, and sets a DTC.

The monitor for DTCs P0327 and P0328 begins to run when 5 seconds have elapsed since the engine was started.

If the malfunction is not repaired successfully, DTC P0327 or P0328 is set 5 seconds after the engine is next started.

MONITOR STRATEGY

MONITOR STRATEGY

Related DTCs	P0327: Knock sensor (bank 1) range check (Low voltage) P0328: Knock sensor (bank 1) range check (High voltage)
Required Sensors/Components (Main)	Knock sensor
Required Sensors/Components (Related)	-
Frequency of Operation	Continuous
Duration	1 second
MIL Operation	Immediate
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

TYPICAL ENABLING CONDITIONS

Monitor runs whenever following DTCs not present	None
Battery voltage	10.5 V or more
Time after engine start	5 seconds or more

TYPICAL MALFUNCTION THRESHOLDS

Knock Sensor Range Check (Low voltage) P0327:

TYPICAL MALFUNCTION THRESHOLDS

Knock sensor voltage	Less than 0.5 V

Knock Sensor Range Check (High voltage) P0328:

TYPICAL MALFUNCTION THRESHOLDS

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Knock sensor voltage	More than 4.5 V

WIRING DIAGRAM

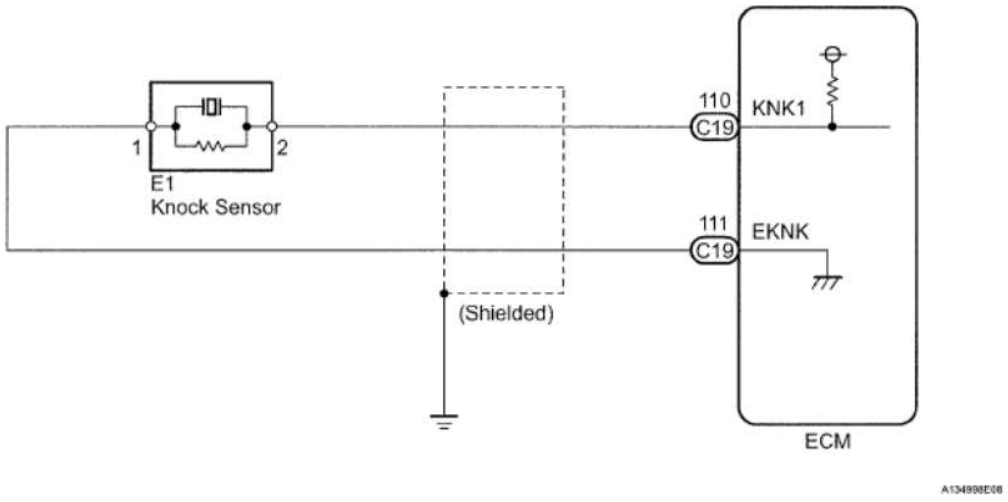


Fig. 115: Knock Sensor - Wiring Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSPECTION PROCEDURE

HINT:

Read freeze frame data using a 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 VALUE USING TECHSTREAM (KNOCK FEEDBACK VALUE)**
   a. Connect a Techstream to the DLC3.
   b. Start the engine.
   c. Turn the tester ON.
   d. Warm up the engine.
   e. Select the following menu items: Powertrain / Engine and ECT / All Data / Knock Feedback Value.
   f. Read the value while driving the vehicle.

   OK:

   The value changes.

   HINT:

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KNOCK FEEDBACK VALUE REFERENCE

Malfunction does not occur	Knock Feedback Value changes
Malfunctions occur	Knock Feedback Value does not change

The knock feedback value change can be confirmed by running the engine with a high load, for example, by activating the air conditioning system and racing the engine.

NG: Go to step 2

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

2. **INSPECT ECM (KNK1 VOLTAGE)**
   a. Disconnect the knock sensor connector.
   b. Turn the ignition switch to ON.
   c. Measure the voltage according to the value(s) in the table below.

Standard voltage

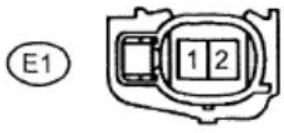
VOLTAGE SPECIFICATION

Tester Connection	Switch Condition	Specified Condition
E1-2-E1-1	Ignition switch ON	4.5 to 5.5 V

   d. Reconnect the knock sensor connector.

NG: Go to step 4

Front view of wire harness connector:
(to Knock Sensor)



A148715E10

Fig. 116: Identifying Knock Sensor Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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OK: Go to next step

3. **INSPECT KNOCK SENSOR**
   a. Remove the knock sensor.
   b. Measure the resistance according to the value(s) in the table below.

Standard resistance

RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
1 - 2	20°C (68°F)	120 to 280 kohms

   c. Reinstall the knock sensor.

NG: REPLACE KNOCK SENSOR (See **REMOVAL**)

Component without harness connected:
(Knock Sensor)

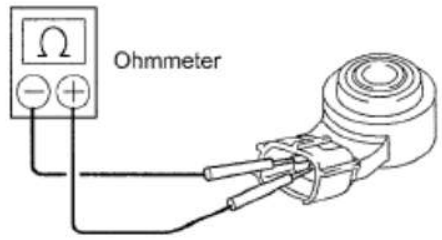


Fig. 117: Measuring Resistance Between Knock Sensor Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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

4. **CHECK HARNESS AND CONNECTOR (ECM - KNOCK SENSOR)**
   a. Disconnect the knock sensor connector.
   b. Disconnect the ECM connector.
   c. Measure the resistance according to the value(s) in the table below.

Standard resistance (Check for open)

RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition

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E1-2 - C19-110 (KNK1)	Always	Below 1 ohms
E1-1 - C19-111 (EKNK)	Always	Below 1 ohms

Standard resistance (Check for short)

RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
E1-2 or C19-110 (KNK1) - Body ground	Always	10 kohms or higher
E1-1 or C19-111 (EKNK) - Body ground	Always	10 kohms or higher

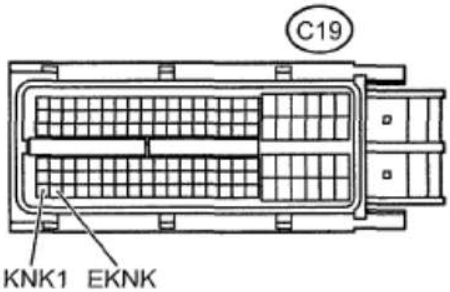
d. Reconnect the knock sensor connector.
e. Reconnect the ECM connector.

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR

Front view of wire harness connector:
(to Knock Sensor)



Front view of wire harness connector:
(to ECM)



A148717E09

Fig. 118: Identifying Knock Sensor And ECM Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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

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DTC P0335 CRANKSHAFT POSITION SENSOR "A" CIRCUIT; DTC P0339 CRANKSHAFT POSITION SENSOR "A" CIRCUIT INTERMITTENT

DESCRIPTION

The Crankshaft Position (CKP) sensor system consists of a CKP sensor plate and a pickup coil.

The sensor plate has 34 teeth and is installed on the crankshaft. The pickup coil is made of wound copper wire, an iron core and magnet. The sensor plate rotates and, as each tooth passes by the pickup coil, a pulse signal is created. The pickup coil generates 34 signals per 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 AND TROUBLE AREA

DTC No.	DTC Detection Condition	Trouble Area
P0335	When either of following conditions are met: (1 trip detection logic) • Missing Crankshaft Position (CKP) sensor signal despite camshaft position sensor signal inputs normal after engine cranked • No CKP sensor signal to ECM at engine speed of 600 rpm or more	• Open or short in CKP sensor circuit • CKP sensor • Crankshaft position sensor plate • ECM
P0339	Following conditions (a), (b) and (c) are met: (1 trip detection logic) a. Engine speed 1,000 rpm or more b. No Crankshaft Position (CKP) sensor signal for 0.05 seconds or more c. 3 seconds or more have elapsed since starter signal switched from ON to OFF	• Open or short in CKP sensor circuit • CKP sensor • Crankshaft position sensor plate • ECM

Reference: Inspection using an oscilloscope.

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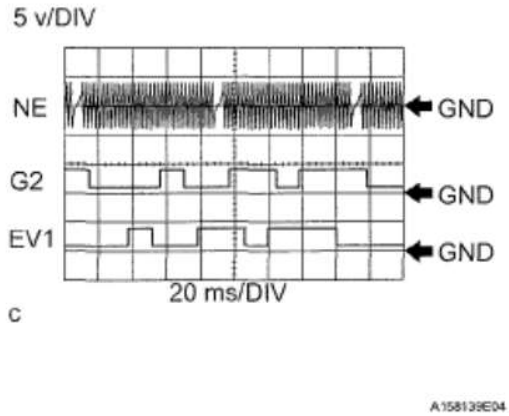


Fig. 119: Waveform Graph
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

HINT:

- The correct waveform is as shown.
- G2+ and EV1+ stand for the Camshaft Position (CMP) sensor signal, and NE+ stands for the CKP sensor signal.
- Grounding failure of the shielded wire may cause noise in waveforms.

WAVEFORM REFERENCE

ECM Terminal Name	Between G2+ and G2- Between NE+ and NE- Between EV1+ and EV1-
Tester Range	5 v/DIV, 20 ms/DIV
Condition	Idling after engine warmed-up

MONITOR DESCRIPTION

If there is no signal from the Crankshaft Position (CKP) 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

Related DTCs	P0335: Crankshaft Position (CKP) sensor range check or rationality
Required Sensors/Components (Main)	CKP sensor
Required Sensors/Components (Related)	Camshaft Position (CMP) sensor
Frequency of Operation	Continuous

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Duration	3 times
MIL Operation	Immediate
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

All:

TYPICAL ENABLING CONDITIONS

Monitor runs whenever following DTCs not present	None

Case 1:

TYPICAL ENABLING CONDITIONS

Time after starter OFF to ON	3 seconds or more
Number of CMP sensor signal pulse	6 times
Battery voltage	7 V or more
Ignition switch	ON

Case 2:

TYPICAL ENABLING CONDITIONS

Starter	OFF
Engine speed	600 rpm or more
Time after starter from ON to OFF	3 seconds or more

TYPICAL MALFUNCTION THRESHOLDS

Case 1:

TYPICAL MALFUNCTION THRESHOLDS

Number of CKP sensor signal pulse	132 or less, and 174 or more

Case 2:

TYPICAL MALFUNCTION THRESHOLDS

Engine speed signal	No signal

COMPONENT OPERATING RANGE

COMPONENT OPERATING RANGE

CKP sensor	• CKP sensor output voltage fluctuates while crankshaft revolving • 34 CKP sensor signals per crankshaft revolution

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WIRING DIAGRAM

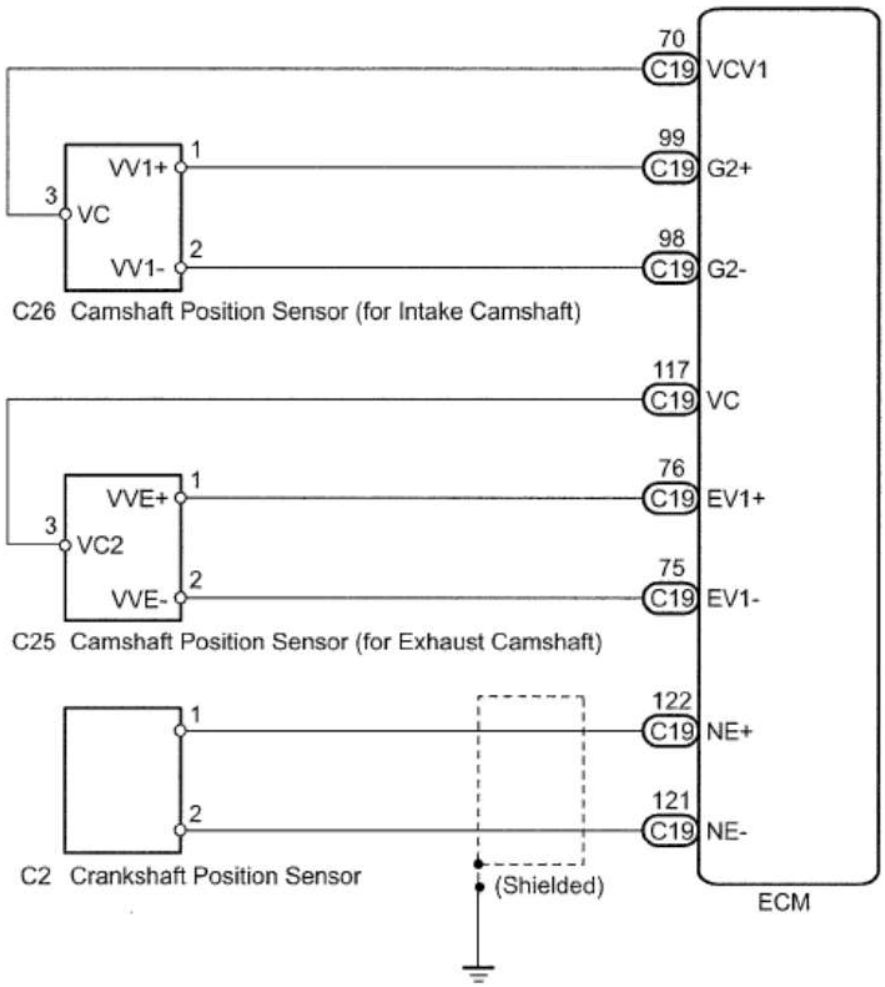


Fig. 120: Crankshaft Position Sensor - Wiring Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSPECTION PROCEDURE

HINT:

- If no problem is found through this diagnostic troubleshooting procedure, troubleshoot the engine mechanical systems.
- Check the engine speed. The engine speed can be checked by using a Techstream. To check, follow the operation below:
  a. Connect the Techstream to the DLC3.

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b. Start the engine.
c. Turn the tester ON.
d. Select the following menu items: Powertrain / Engine and ECT / Data List / All Data / Engine Speed.

The engine speed may be indicated as zero despite the engine revolving normally. This is caused by a lack of NE signals from the Crankshaft Position (CKP) sensor. Alternatively, the engine speed may be indicated as lower than the actual engine speed if the CKP sensor output voltage is insufficient.

- 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 VALUE USING TECHSTREAM (ENGINE SPEED)**
   a. Connect a Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the tester ON.
   d. Select the following menu items: Powertrain / Engine and ECT / Data List / All Data / Engine Speed.
   e. Start the engine.
   f. Read the values displayed on the tester while the engine is running.

   OK:

   Correct values are displayed.

   HINT:

   - To check the engine speed change, display the graph on the tester.
   - If the engine does not start, check the engine speed while cranking.
   - If the engine speed indicated on the tester remains at zero (0), there may be an open or short in the crankshaft position sensor circuit.

   NG: Go to step 2

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

2. **INSPECT CRANKSHAFT POSITION SENSOR (RESISTANCE)**
   a. Disconnect the crankshaft position sensor connector.
   b. Measure the resistance according to the value(s) in the table below.

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Standard resistance

RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
1 - 2	20°C (68°F)	1850 to 2450 ohms

c. Reconnect the crankshaft position sensor connector.

NG: REPLACE CRANKSHAFT POSITION SENSOR (See **REMOVAL**)

Component without harness connected:
(Crankshaft Position Sensor)



A148718E03

Fig. 121: Identifying Crankshaft Position Sensor Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

3. **CHECK HARNESS AND CONNECTOR (CRANKSHAFT POSITION SENSOR - ECM)**
   a. Disconnect the crankshaft position sensor connector.
   b. Disconnect the ECM connector.
   c. Measure the resistance according to the value(s) in the table below.

Standard resistance (Check for open)

RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
C2-1 - C19-122 (NE+)	Always	Below 1 ohms
C2-2 - C19-121 (NE-)	Always	Below 1 ohms

Standard resistance (Check for short)

RESISTANCE SPECIFICATION

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Tester Connection	Condition	Specified Condition
C2-1 or C19-122 (NE+) - Body ground	Always	10 kohms or higher
C2-2 or C19-121 (NE-) - Body ground	Always	10 kohms or higher

d. Reconnect the crankshaft position sensor connector.
e. Reconnect the ECM connector.

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR

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



Front view of wire harness connector:
(to ECM)

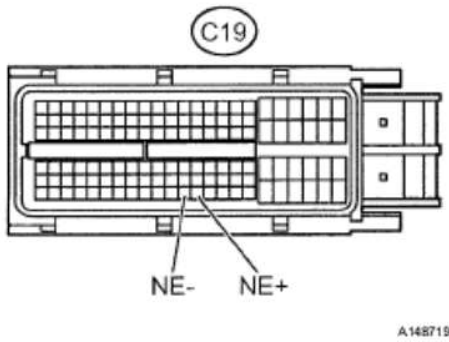


Fig. 122: Identifying Crankshaft Position Sensor And ECM Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

4. **CHECK SENSOR INSTALLATION (CRANKSHAFT POSITION SENSOR)**
   a. Check the crankshaft position sensor installation.

   OK:

   Sensor is installed correctly.

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NG: SECURELY REINSTALL SENSOR (See **INSTALLATION**)

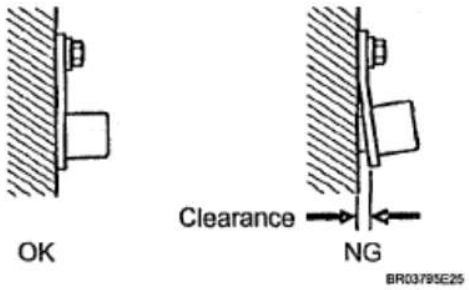


Fig. 123: Identifying Proper Installation Position Of Crankshaft Position Sensor
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

5. **INSPECT CRANKSHAFT POSITION SENSOR PLATE (TEETH OF SENSOR PLATE)**
   a. Check the teeth of the sensor plate.

      OK:

      Sensor plate does not have any cracks or deformation.

   NG: REPLACE CRANKSHAFT POSITION SENSOR PLATE (See **DISASSEMBLY**)

   OK: Go to next step

6. **REPLACE CRANKSHAFT POSITION SENSOR**
   a. Replace crankshaft position sensor (See **REMOVAL**).
7. **CHECK WHETHER DTC OUTPUT RECURS**
   a. Connect a Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the tester ON.
   d. Clear DTCs (See **DTC CHECK / CLEAR**).
   e. Start the engine.
   f. Select the following menu items: Powertrain / Engine and ECT / Trouble Codes.
   g. Read DTCs.

      Result

      RESULT REFERENCE

Result	Proceed to
No output	A

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P0335 or P0339	B

HINT:

If the engine does not start, replace the ECM.

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

A : END

DTC P0340 CAMSHAFT POSITION SENSOR CIRCUIT MALFUNCTION; DTC P0342 CAMSHAFT POSITION SENSOR "A" CIRCUIT LOW INPUT (BANK 1 OR SINGLE SENSOR); DTC P0343 CAMSHAFT POSITION SENSOR "A" CIRCUIT HIGH INPUT (BANK 1 OR SINGLE SENSOR)

DESCRIPTION

The camshaft position sensor for intake camshaft (G signal sensor) consists of a magnet and MRE element.

The camshaft has a timing rotor for the camshaft position sensor. When the camshaft rotates, changes occur in the air gaps between the timing rotor and MRE element, which affects the magnet. As a result, the resistance of the MRE material fluctuates. The camshaft position sensor converts the camshaft rotation data to pulse signals, and uses the pulse signals to determine the camshaft angle, which it sends to the ECM. Then the ECM uses this data to control fuel injection time and injection timing.

DTC DETECTION CONDITION AND TROUBLE AREA

DTC No.	DTC Detection Condition	Trouble Area
P0340	When one of following conditions is met: No Camshaft Position (CMP) sensor signal to ECM while cranking (2 trip detection logic) Missing CMP sensor signal despite crankshaft position sensor inputs normal at engine speed of 600 rpm or more (1 trip detection logic) Input voltage to ECM remains less than 0.3 V, or more than 4.7 V for 4 seconds when 2 or more seconds have elapsed after turning ignition switch ON (1 trip detection logic)	• Open or short in CMP sensor circuit for intake camshaft • CMP sensor for intake camshaft • Camshaft timing gear for intake camshaft • Jumped tooth of timing chain for intake camshaft • ECM
P0342	Output voltage of CMP sensor less than 0.3 V for 4 seconds (1 trip detection logic)	• Open or short in CMP sensor circuit for intake camshaft • CMP sensor for intake camshaft • Camshaft timing gear for

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		intake camshaft • Jumped tooth of timing chain for intake camshaft • ECM
P0343	Output voltage of 4.7 V for 4 seconds (1 trip detection logic)	• Open or short in CMP sensor circuit for intake camshaft • CMP sensor for intake camshaft • Camshaft timing gear for intake camshaft • Jumped tooth of timing chain for intake camshaft • ECM

HINT:

DTC P0340 indicates a malfunction relating to the CMP sensor circuit (the wire harness between the ECM and CMP sensor, and the CMP sensor itself).

Reference: Inspection using an oscilloscope

MONITOR DESCRIPTION

If no signal is transmitted by the CMP sensor despite the engine revolving, or the rotation of the camshaft and the crankshaft is not synchronized, the ECM interprets this as a malfunction of the sensor.

If the malfunction is not repaired successfully, the DTC is set 10 seconds after the engine is nest started.

MONITOR STRATEGY

MONITOR STRATEGY

Related DTCs	P0340: Camshaft position sensor range check (cranking) P0340: Camshaft position/crankshaft position misalignment P0340: Camshaft position sensor range check (fluctuating) P0342: Camshaft position sensor range check (Low voltage) P0343: Camshaft position sensor range check (High voltage)
Required Sensors/Components (Main)	Camshaft Position (CMP) sensor
Required Sensors/Components (Related)	Crankshaft Position (CKP) sensor
Frequency of Operation	Continuous
	4 seconds: CMP sensor range check (cranking) (P0340)

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Duration	5 seconds: Camshaft position /crankshaft position misalignment (P0340) 4 seconds: CMP sensor range check (P0340, P0342, P0340)
MIL Operation	2 driving cycles: CMP sensor range check (cranking) (P0340) Immediate: Camshaft position/crankshaft position misalignment (P0340) CMP sensor range check (P0340, P0342, P0340)
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

All:

TYPICAL ENABLING CONDITIONS

Monitor runs whenever following DTCs not present	None

P0340 Camshaft position Sensor Range Check (Cranking):

TYPICAL ENABLING CONDITIONS

Starter	ON
Minimal battery voltage while starter ON	Less than 11 V

P0340 Camshaft position/Crankshaft Position Misalignment:

TYPICAL ENABLING CONDITIONS

Engine speed	600 rpm or more
Starter	ON

P0340, P0342, P0343 CMP Sensor Range Check:

TYPICAL ENABLING CONDITIONS

Starter	OFF
Ignition switch	ON
Time after ignition switch OFF to ON	2 seconds

TYPICAL MALFUNCTION THRESHOLDS

P0340 Camshaft Position Sensor Range Check (Cranking):

TYPICAL MALFUNCTION THRESHOLDS

CMP sensor signal	No signal

P0340 Camshaft Position/Crankshaft Position Misalignment:

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TYPICAL MALFUNCTION THRESHOLDS

Camshaft position and crankshaft position phase	Misaligned

P0340 CMP Sensor Range Check:

TYPICAL MALFUNCTION THRESHOLDS

Camshaft position sensor voltage	Less than 0.3 V, or more than 4.7 V

P0342 CMP Sensor Range Check:

TYPICAL MALFUNCTION THRESHOLDS

Camshaft position sensor voltage	Less than 0.3 V

P0343 CMP Sensor Range Check:

TYPICAL MALFUNCTION THRESHOLDS

Camshaft position sensor voltage	More than 4.7 V

COMPONENT OPERATING RANGE

COMPONENT OPERATING RANGE

CMP sensor	CMP sensor output voltage fluctuates while camshaft revolving 3 CMP sensor signals per 2 crankshaft revolutions
CMP sensor voltage	0.3 to 4.7 V

WIRING DIAGRAM

Refer to **DTC P0335** .

INSPECTION PROCEDURE

HINT:

- Read freeze frame data using a Techstream. Freeze frame data records the engine conditions when a malfunction is detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, if the engine was warmed up or not, if the air-fuel ratio was LEAN or RICH, and other data from the time the malfunction occurred.
- If no problem is found through this diagnostic troubleshooting procedure, troubleshoot the engine mechanical system.

1. **CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P0340, P0342 AND P0343)**
   a. Connect a Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the tester ON.

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d. Select the following menu items: Powertrain / Engine and ECT / Trouble Codes.
e. Read DTCs.

Result

RESULT REFERENCE

Result	Proceed to
P0340, P0342 or P0343	A
P0340, P0342 or P0343 and other DTCs	B

HINT:

If any DTCs other than P0340, P0342 and P0343 are output, troubleshoot those DTCs first.

B: Go to DTC CHART (See **DIAGNOSTIC TROUBLE CODE CHART**)

A: Go to next step

2. **INSPECT CAMSHAFT POSITION SENSOR (FOR INTAKE CAMSHAFT) (POWER SOURCE)**
   a. Disconnect the camshaft position sensor (for intake camshaft) connector.
   b. Turn the ignition switch to ON.
   c. Measure the voltage according to the value(s) in the table below.

Standard voltage

VOLTAGE SPECIFICATION

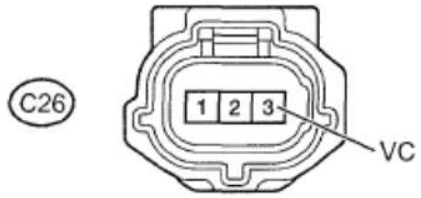
Tester Connection	Switch Condition	Specified Condition
C26-3 (VC) - Body ground	Ignition switch on (IG)	4.5 to 5.0 V

   d. Reconnect the camshaft position sensor (for intake camshaft) connector.

NG: Go to step 10

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Front view of wire harness connector:
(to Camshaft Position Sensor for
Intake Camshaft)



N A107149E75

Fig. 124: Identifying Camshaft Position Sensor Connector Terminals (For Intake Camshaft)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

3. **CHECK HARNESS AND CONNECTOR (CAMSHAFT POSITION SENSOR - ECM)**
   a. Disconnect the camshaft position sensor (for intake camshaft) connector.
   b. Disconnect the ECM connector.
   c. Measure the resistance according to the value(s) in the table below.

Standard resistance (Check for open)

RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
C26-1 (VV1+) - C19-99 (G2+)	Always	Below 1 ohms
C26-2 (VV1-) - C19-98 (G2-)	Always	Below 1 ohms

Standard resistance (Check for short)

RESISTANCE SPECIFICATION

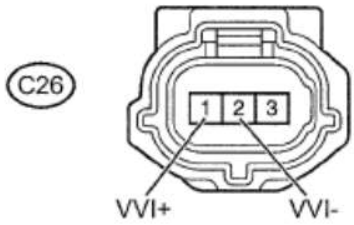
Tester Connection	Condition	Specified Condition
C26-1 (VV1+) or C19-99 (G2+) - Body ground	Always	10 kohms or higher
C26-2 (VV1-) or C19-98 (G2-) - Body ground	Always	10 kohms or higher

   d. Reconnect the camshaft position sensor (for intake camshaft) connector.
   e. Reconnect the ECM connector.

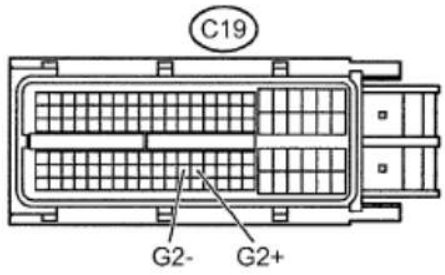
NG: REPAIR OR REPLACE HARNESS OR CONNECTOR

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Front view of wire harness connector:
(to Camshaft Position Sensor for
Intake Camshaft)



Front view of wire harness connector:
(to ECM)



A148721E23

Fig. 125: Identifying Camshaft Position Sensor And ECM Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

4. **CHECK SENSOR INSTALLATION (CAMSHAFT POSITION SENSOR FOR INTAKE CAMSHAFT)**
   a. Check the camshaft position sensor (for intake camshaft) installation.

      OK:

      Sensor is installed correctly.

NG: SECURELY REINSTALL SENSOR

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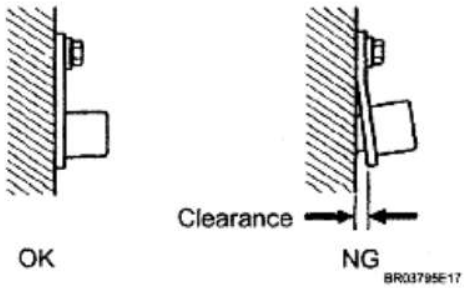


Fig. 126: Identifying Proper Installation Position Of Camshaft Position Sensor
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

5. **INSPECT INTAKE CAMSHAFT (TIMING ROTOR)**
   a. Check the timing rotor of the intake camshaft.

      OK:

      Camshaft timing rotor does not have any cracks or deformation.

   NG: REPLACE INTAKE CAMSHAFT

   OK: Go to next step

6. **REPLACE CAMSHAFT POSITION SENSOR (FOR INTAKE CAMSHAFT)**
7. **CHECK WHETHER DTC OUTPUT RECURS (P0340, P0342 OR P0343)**
   a. Connect a Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the tester ON.
   d. Clear DTCs (See **DTC CHECK / CLEAR**).
   e. Start the engine and allow the engine to idle for 10 seconds or more.
   f. Turn the ignition to off.
   g. Start the engine again and allow the engine to idle for 10 seconds or more.
   h. Select the following menu items: Powertrain / Engine and ECT / Trouble Codes.
   i. Read DTCs.

      Result

      RESULT REFERENCE

Result	Proceed to
No output	A
P0340, P0342 or P0343	B

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HINT:

If the engine does not start, replace the ECM.

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

A: Go to next step

8. **ADJUST VALVE TIMING**

HINT:

There are no marks on the cylinder head to match-up for the purpose of checking valve timing. Valve timing can only be inspected by lining up the colored plates on the timing chain with the marks on the pulleys. It may be necessary to remove and re-install the chain to match up the alignment marks (See **REASSEMBLY**).

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Reference: Camshafts Layout

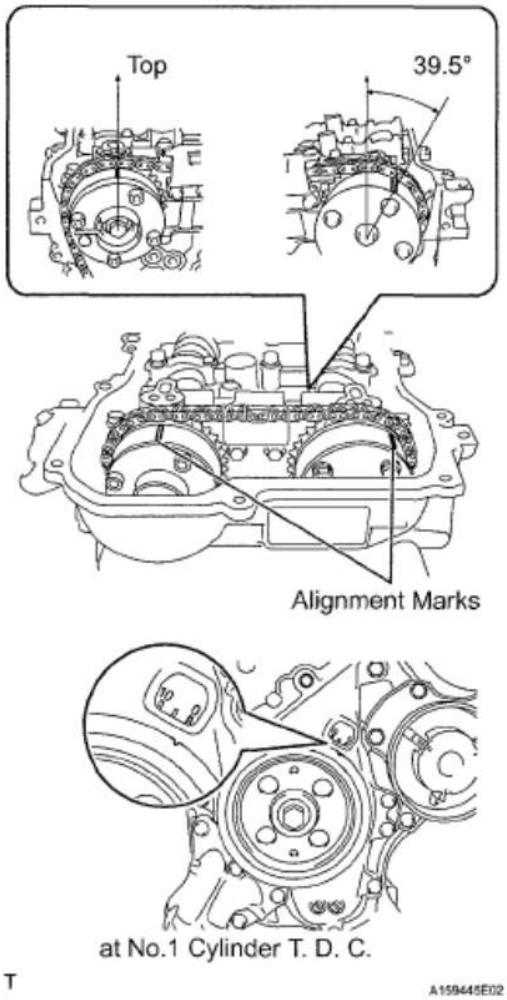


Fig. 127: Identifying Valve Timing
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

9. **CHECK WHETHER DTC OUTPUT RECURS (P0340, P0342 OR P0343)**
   a. Connect a Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the tester ON.
   d. Clear DTCs (See **DTC CHECK / CLEAR**).
   e. Start the engine and allow the engine to idle for 10 seconds or more.
   f. Turn the ignition switch to OFF.
   g. Start the engine again and allow the engine to idle for 10 seconds or more.
   h. Select the following menu items: Powertrain / Engine and ECT / Trouble codes.
   i. Read DTCs.

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Result

RESULT REFERENCE

Result	Proceed to
No output	A
P0340, P0342 or P0343	B

HINT:

If the engine does not start, replace the ECM.

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

A : END

10. **CHECK HARNESS AND CONNECTOR (CAMSHAFT POSITION SENSOR - ECM)**
    a. Disconnect the camshaft position sensor (for intake camshaft) connector.
    b. Disconnect the ECM connector.
    c. Measure the resistance according to the value(s) in the table below.

Standard resistance (Check for open)

RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
C26-3 (VC) - C19-70 (VCV1)	Always	Below 1 ohms

Standard resistance (Check for short)

RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
C26-3 (VC) or C19-70 (VCV1) - Body ground	Always	10 kohms or higher

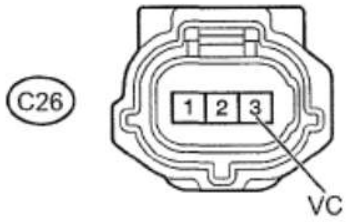
    d. Reconnect the camshaft position sensor (for intake camshaft) connector.
    e. Reconnect the ECM connector.

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR

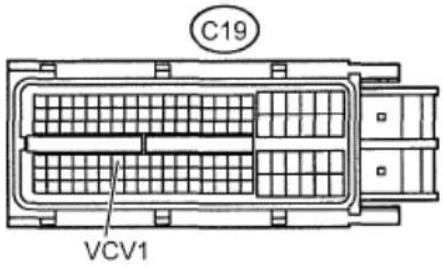
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Front view of wire harness connector:
(to Camshaft Position Sensor for
Intake Camshaft)



Front view of wire harness connector:
(to ECM)



A148721E24

Fig. 128: Identifying Camshaft Position 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

DESCRIPTION

HINT:

- These DTCs indicate malfunctions relating to the primary circuit.
- If DTC P0351 is set, check the No. 1 ignition coil circuit.
- If DTC P0352 is set, check the No. 2 ignition coil circuit.
- If DTC P0353 is set, check the No. 3 ignition coil circuit.
- If DTC P0354 is set, check the No. 4 ignition coil circuit.

A Direct Ignition System (DIS) is used on this vehicle.

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The DIS is a 1-cylinder ignition system in which each cylinder is ignited by one ignition coil and one spark plug is connected to the end of each secondary wiring. A powerful voltage, generated in the secondary wiring, is applied directly to each spark plug. The sparks of the spark plugs pass from the center electrode to the ground electrodes.

The ECM determines the ignition timing and transmits the ignition (IGT) signals to each cylinder. Using the IGT signal, the ECM turns the power transistor inside the igniter on and off. The power transistor, in turn, switches on and off the current to the primary coil. When the current to the primary coil is cut off, a powerful voltage is generated in the secondary coil. This voltage is applied to the spark plugs, causing them to spark inside the cylinders. As the ECM cuts the current to the primary coil, the igniter sends back an ignition confirmation (IGF) signal to the ECM, for each cylinder ignition.

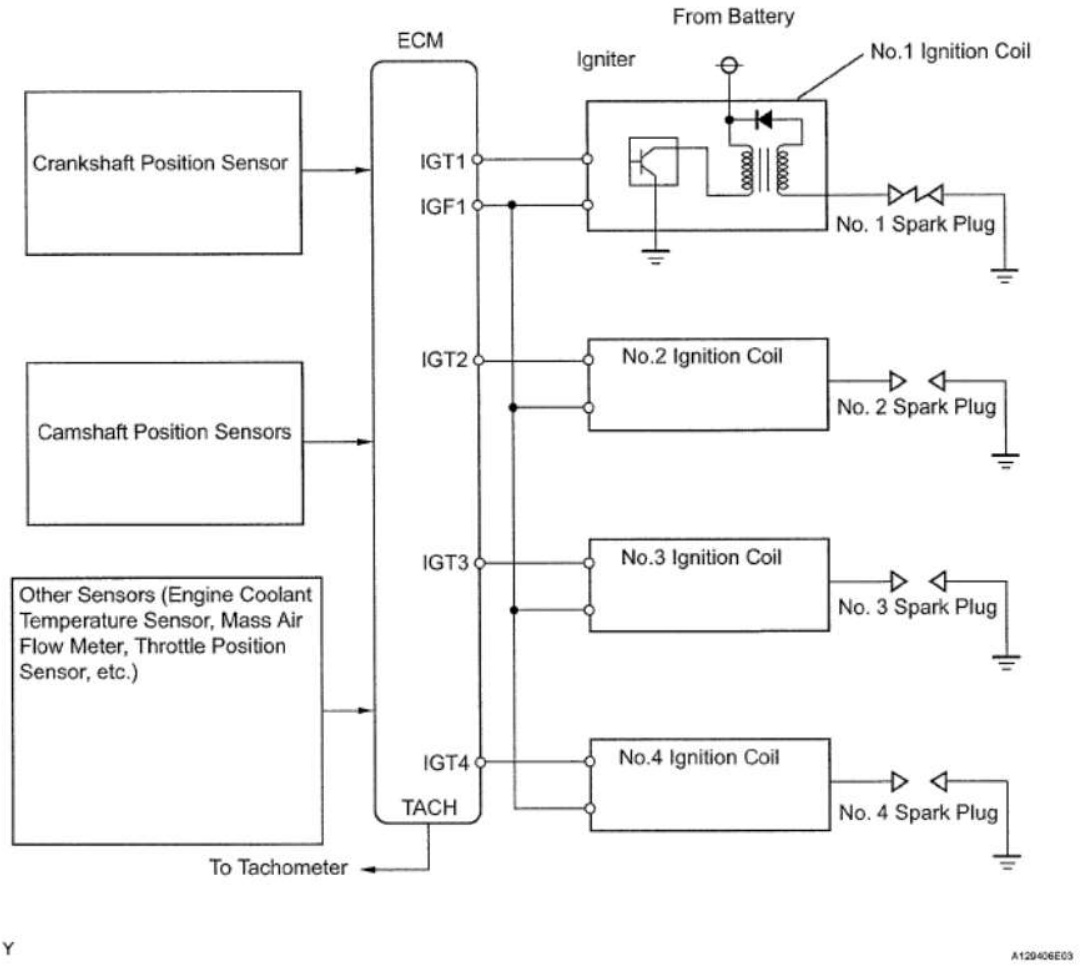


Fig. 129: Ignition Coil - Circuit Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

DTC DETECTION CONDITION AND TROUBLE AREA

DTC No.	DTC Detection Condition	Trouble Areas

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P0351 P0352 P0353 P0354	No IGF signal to ECM while engine running (1 trip detection logic)	• Ignition system • Open or short in IGF1 or IGT circuit (1 to 4) between ignition coil and ECM • No. 1 to No. 4 ignition coils • ECM

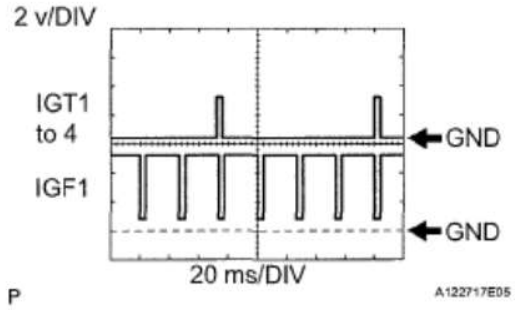


Fig. 130: Waveform Graph
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Reference: Inspection using an oscilloscope.

While cranking or idling the engine, check the waveform between terminals IGT (1 to 4) and E1, and IGF1 and E1 of the ECM connector.

WAVEFORM REFERENCE

ECM Terminal Name	Between IGT (1 to 4) and E1 Between IGF1 and E1
Tester Range	2 v/DIV, 20 ms/DIV
Condition	Idling

MONITOR DESCRIPTION

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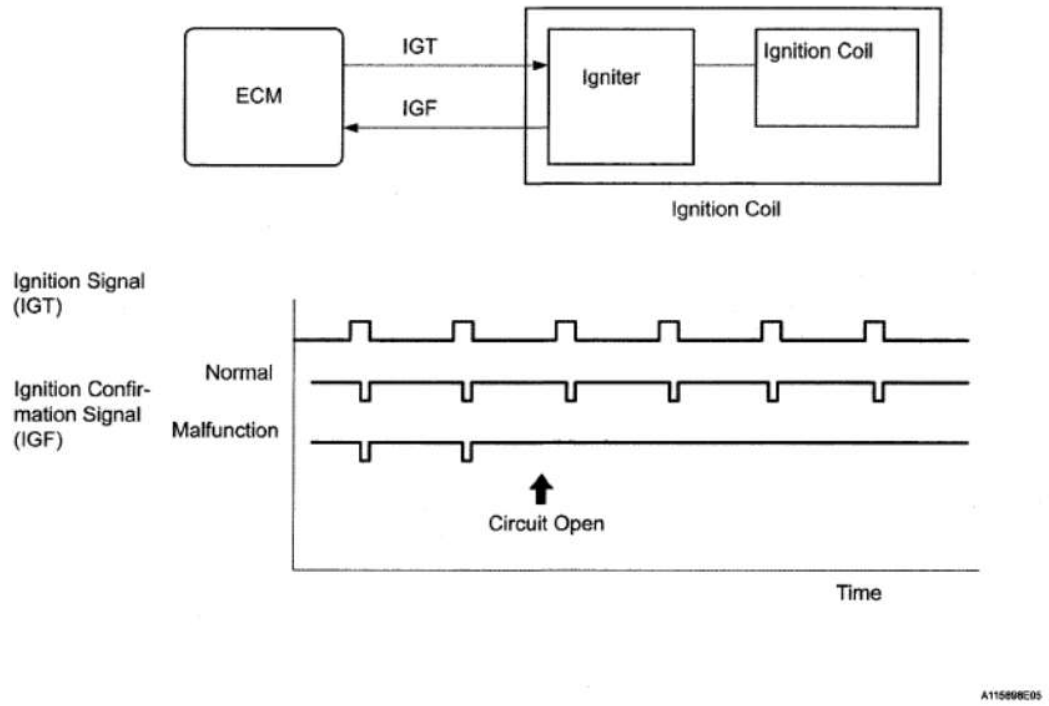


Fig. 131: Communication Diagram Between Ignition Coil And ECM
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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

Related DTCs	P0351: Igniter (cylinder 1) malfunction P0352: Igniter (cylinder 2) malfunction P0353: Igniter (cylinder 3) malfunction P0354: Igniter (cylinder 4) malfunction
Required Sensors/Components (Main)	Igniter
Required Sensors/Components (Related)	Crankshaft position sensor
Frequency of Operation	Continuous
Duration	0.512 seconds
MIL Operation	Immediate
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

TYPICAL ENABLING CONDITIONS

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Monitor runs whenever following DTCs not present	None
Either of following conditions A or B met	-
A. Engine RPM	1,500 rpm or less
B. Starter	OFF
Either of following conditions C or D met	-
C. Both of following conditions (a) and (b) met	-
(a) Engine speed	500 rpm or less
(b) Battery voltage	6 V or more
D. All of following conditions (a), (b) and (c) met	-
(a) Engine speed	More than 500 rpm
(b) Battery voltage	10 V or more
(c) Number of sparks after CPU reset	5 sparks or more

TYPICAL MALFUNCTION THRESHOLDS

TYPICAL MALFUNCTION THRESHOLDS

IGF signal	ECM does not receive any IGF signal despite ECM sending IGT signal to igniter

COMPONENT OPERATING RANGE

COMPONENT OPERATING RANGE

IGF signal	Igniter transmits IGF signal when it receives IGT signal from ECM

WIRING DIAGRAM

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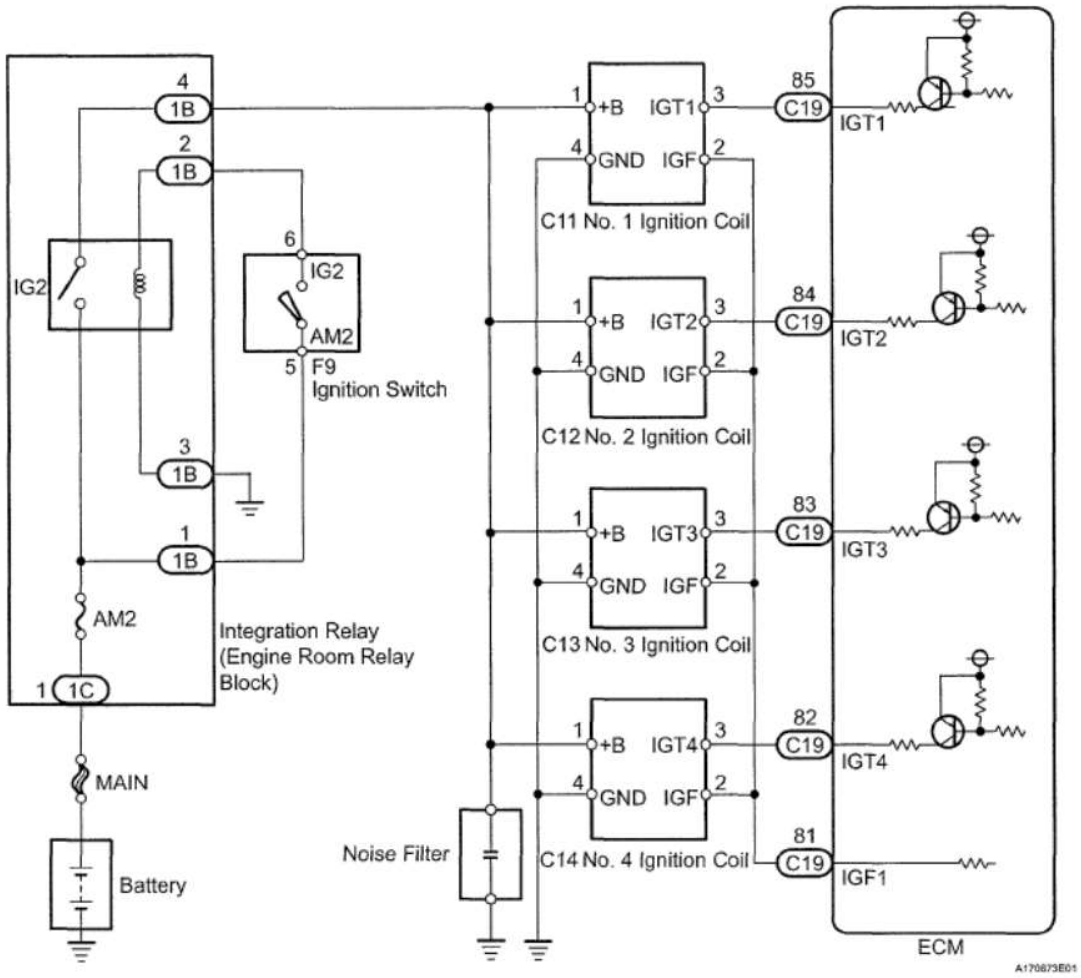


Fig. 132: Ignition Coil - Wiring Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSPECTION PROCEDURE

HINT:

Read freeze frame data using a 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. **INSPECT IGNITION COIL ASSEMBLY (POWER SOURCE)**
   a. Disconnect the ignition coil connectors.
   b. Measure the resistance according to the value(s) in the table below.

   Standard resistance (Check for open)

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RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
C11-4 (GND) - Body ground	Always	Below 1 ohms
C12-4 (GND) - Body ground	Always	Below 1 ohms
C13-4 (GND) - Body ground	Always	Below 1 ohms
C14-4 (GND) - Body ground	Always	Below 1 ohms

c. Turn the ignition switch to ON.

d. Measure the voltage according to the value(s) in the table below.

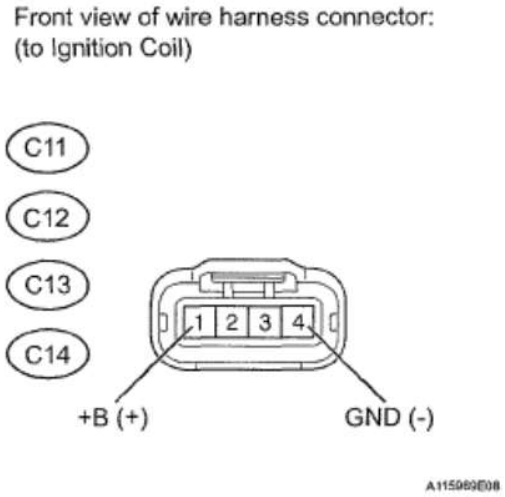


Fig. 133: Identifying Ignition Coil Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Standard voltage

VOLTAGE SPECIFICATION

Tester Connection	Condition	Specified Condition
C11-1 (+B) - C11-4 (GND)	Ignition switch ON	11 to 14 V
C12-1 (+B) - C12-4 (GND)	Ignition switch ON	11 to 14 V
C13-1 (+B) - C13-4 (GND)	Ignition switch ON	11 to 14 V
C14-1 (+B) - C14-4 (GND)	Ignition switch ON	11 to 14 V

e. Reconnect the ignition coil connectors.

NG: Go to step 4

OK: Go to next step

2. **CHECK HARNESS AND CONNECTOR (IGNITION COIL - ECM)**

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a. Disconnect the ignition coil connectors.
b. Disconnect the ECM connector.
c. Measure the resistance according to the value(s) in the table below.

Standard resistance (Check for open)

RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
C11-2 (IGF) - C19-81 (IGF1)	Always	Below 1 ohms
C12-2 (IGF) - C19-81 (IGF1)	Always	Below 1 ohms
C13-2 (IGF) -C19-81 (IGF1)	Always	Below 1 ohms
C14-2 (IGF) - C19-81 (IGF1)	Always	Below 1 ohms

Standard resistance (Check for open)

RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
C11-3 (IGT1) - C19-85 (IGT1)	Always	Below 1 ohms
C12-3 (IGT2) - C19-84 (IGT2)	Always	Below 1 ohms
C13-3 (IGT3) - C19-83 (IGT3)	Always	Below 1 ohms
C14-3 (IGT4) - C19-82 (IGT4)	Always	Below 1 ohms

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Front view of wire harness connector:
(to Ignition Coil)



Front view of wire harness connector:
(to ECM)

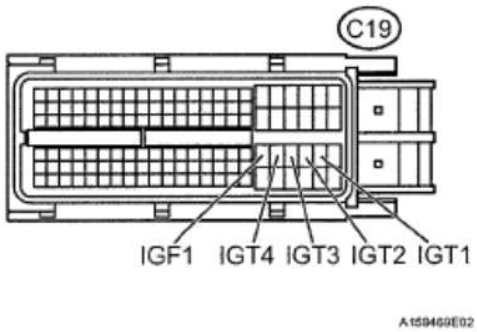


Fig. 134: Identifying Ignition Coil And ECM Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Standard resistance (Check for short)

RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
C11-2 (IGF) or C19-81 (IGF1) - Body ground	Always	10 kohms or higher
C12-2 (IGF) or C19-81 (IGF1) - Body ground	Always	10 kohms or higher
C13-2 (IGF) or C19-81 (IGF1) - Body ground	Always	10 kohms or higher
C14-2 (IGF) or C19-81 (IGF1) - Body ground	Always	10 kohms or higher

Standard resistance (Check for short)

RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
C11-3 (IGT1) or C19-85 (IGT1) - Body ground	Always	10 kohms or higher
C12-3 (IGT2) or C19-84 (IGT2) - Body ground	Always	10 kohms or higher
C13-3 (IGT3) or C19-83 (IGT3) - Body ground	Always	10 kohms or higher
C14-3 (IGT4) or C19-82 (IGT4) - Body ground	Always	10 kohms or higher

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d. Reconnect the ECM connector.
e. Reconnect the ignition coil connectors.

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR

OK: Go to next step

3. **CHECK WHETHER DTC OUTPUT RECURS (DTC P0351, P0352, P0353 OR P0354)**
   a. Connect a Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the tester ON.
   d. Clear 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. Select the following menu items: Powertrain / Engine and ECT / Trouble Codes.
   h. Read DTCs.

Result

RESULT REFERENCE

Result	Proceed To
Same DTC output	A
Different ignition coil DTC output	B

B : REPLACE IGNITION COIL (See **REMOVAL**)

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

4. **CHECK HARNESS AND CONNECTOR (IGNITION COIL - INTEGRATION RELAY)**
   a. Disconnect the ignition coil connectors.
   b. Remove the integration relay (IG2 relay) from the engine room relay block (See **REMOVAL**).
   c. Measure the resistance according to the value(s) in the table below.

Standard resistance (Check for open)

RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
C11-1 (+B) - 1B-4	Always	Below 1 ohms
C12-1 (+B) - 1B-4	Always	Below 1 ohms

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C13-1 (+B) - 1B-4	Always	Below 1 ohms
C14-1 (+B) - 1B-4	Always	Below 1 ohms

Standard resistance (Check for short)

RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
C11-1 (+B) or 1B-4-Body ground	Always	10 kohms or higher
C12-1 (+B) or 1B-4-Body ground	Always	10 ohms or higher
C13-1 (+B) or 1B-4-Body ground	Always	10 kohms or higher
C14-1 (+B) or 1B-4-Body ground	Always	10 kohms or higher

d. Reinstall the integration relay.
e. Reconnect the ignition coil connectors.

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR

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Front view of wire harness connector:
(to Ignition Coil)



Front view of wire harness connector:
(to Integration Relay)

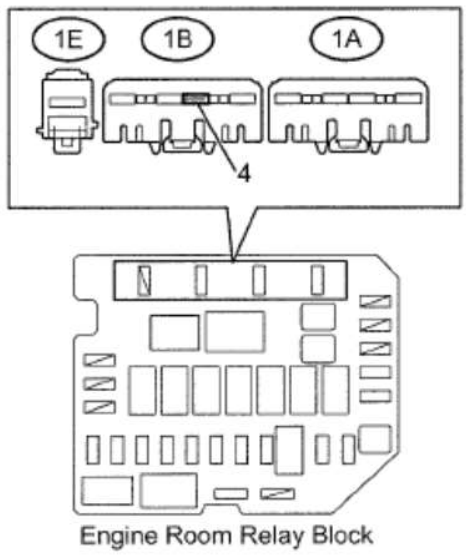


Fig. 135: Identifying Ignition Coil And Integration Relay Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK : REPAIR OR REPLACE ECM POWER SOURCE CIRCUIT (See **ECM POWER SOURCE CIRCUIT**)

DTC P0365 CAMSHAFT POSITION SENSOR "B" CIRCUIT (BANK 1); DTC P0367 CAMSHAFT POSITION SENSOR "B" CIRCUIT LOW INPUT (BANK 1); DTC P0368 CAMSHAFT POSITION SENSOR "B" CIRCUIT HIGH INPUT (BANK 1)

DESCRIPTION

The camshaft position sensor for exhaust camshaft (EV signal sensor) consists of a magnet and MRE element.

The exhaust camshaft has a timing rotor for camshaft position sensor. When the camshaft rotates, changes occur in the air gaps between the timing rotor and MRE element, which affects the magnet. As a result, the resistance

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of the MRE material fluctuates. The camshaft position sensor converts the camshaft rotation data to pulse signals, and uses the pulse signals to determine the camshaft angle, which it sends to the ECM. Then the ECM uses this data to control fuel injection time, injection timing and the Variable Valve Timing (VVT) system.

DTC DETECTION CONDITION AND TROUBLE AREA

DTC No.	DTC Detection Condition	Trouble Area
P0365	When one of following conditions is met: • No exhaust camshaft position sensor signal to ECM while cranking (2 trip detection logic) • Missing exhaust camshaft position sensor signal signal for 5 seconds at engine speed of 600 rpm or more (1 trip detection logic) • Input voltage to ECM remains less than 0.3 V, or more than 4.7 V for 4 seconds when 2 or more seconds have elapsed after turning ignition switch ON (1 trip detection logic)	• Open or short in exhaust camshaft position sensor circuit • Exhaust camshaft position sensor • Camshaft timing gear for exhaust camshaft • Jumped tooth of timing chain for exhaust camshaft • ECM
P0367	Output voltage of exhaust camshaft position sensor less than 0.3 V for 4 seconds (1 trip detection logic)	• Open or short in exhaust camshaft position sensor circuit • Exhaust camshaft position sensor • Camshaft timing gear for exhaust camshaft • Jumped tooth of timing chain for exhaust camshaft • ECM
P0368	Output voltage of exhaust camshaft position sensor 4.7 V for 4 seconds (1 trip detection logic)	• Open or short in exhaust camshaft position sensor circuit • Exhaust camshaft position sensor • Camshaft timing gear for exhaust camshaft • Jumped tooth of timing chain for exhaust camshaft • ECM

HINT:

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DTC P0365, P0367 and P0368 indicate a malfunction relating to the exhaust camshaft position sensor circuit (the wire harness between the ECM and exhaust camshaft position sensor, and the exhaust camshaft position sensor itself).

Reference: Inspection using an oscilloscope (See **DTC P0335 CRANKSHAFT POSITION SENSOR "A" CIRCUIT; DTC P0339 CRANKSHAFT POSITION SENSOR "A" CIRCUIT INTERMITTENT**)

MONITOR DESCRIPTION

If no signal is transmitted by the exhaust camshaft position sensor despite the engine revolving, or the rotation of the exhaust camshaft and the crankshaft is not synchronized, the ECM interprets this as a malfunction of the sensor.

If the malfunction is not repaired successfully, the DTC is set 10 seconds after the engine is next started.

MONITOR STRATEGY

MONITOR STRATEGY

Related DTCs	P0365: Exhaust camshaft position sensor range check (cranking) P0365: Exhaust camshaft position sensor range check (running) P0365: Exhaust camshaft position sensor range check (fluctuating) P0367: Exhaust camshaft position sensor range check (Low voltage) P0368: Exhaust camshaft position sensor range check (High voltage)
Required Sensors/Components (Main)	Exhaust camshaft position sensor
Required Sensors/Components (Related)	Crankshaft Position (CKP) sensor
Frequency of Operation	Continuous
Duration	4 seconds: Exhaust camshaft position sensor range check (cranking) (P0365) 5 seconds: Exhaust camshaft position sensor range check (running) (P0340) 4 seconds: Exhaust camshaft position sensor range check (P0365, P0367, P0368)
MIL Operation	2 driving cycles: Exhaust camshaft position sensor range check (cranking) (P0340) Immediate: Exhaust camshaft position sensor range check (running) (P0340) Exhaust camshaft position sensor range check (P0340, P0342, P0340)
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

All:

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TYPICAL ENABLING CONDITIONS

Monitor runs whenever following DTCs not present	None

P0365 Exhaust Camshaft position Sensor Range Check (Cranking):

TYPICAL ENABLING CONDITIONS

Starter	ON
Minimal battery voltage while starter ON	Less than 11 V

P0365 Exhaust Camshaft position/Crankshaft Position Misalignment:

TYPICAL ENABLING CONDITIONS

Engine speed	600 rpm or more
Ignition switch	ON
Starter	OFF

P0365, P0367, P0368 Exhaust Camshaft position Sensor Range Check:

TYPICAL ENABLING CONDITIONS

Starter	OFF
Ignition switch	ON
Time after ignition switch OFF to ON	2 seconds

TYPICAL MALFUNCTION THRESHOLDS

P0365 Exhaust Camshaft Position Sensor Range Check (Cranking):

TYPICAL MALFUNCTION THRESHOLDS

Exhaust camshaft position sensor signal	No signal

P0365 Exhaust Camshaft Position Sensor Range Check (Running):

TYPICAL MALFUNCTION THRESHOLDS

Exhaust camshaft position signal	No signal

P0365 Exhaust Camshaft Position Sensor Range Check (Fluctuating):

TYPICAL MALFUNCTION THRESHOLDS

Exhaust camshaft position sensor voltage	Less than 0.3 V, or more than 4.7 V

P0367 Exhaust Camshaft Position Sensor Range Check (Low voltage):

TYPICAL MALFUNCTION THRESHOLDS

Exhaust camshaft position sensor voltage	Less than 0.3 V

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P0368 Exhaust Camshaft Position Sensor Range Check (High voltage):

TYPICAL MALFUNCTION THRESHOLDS

Exhaust camshaft position sensor voltage	More than 4.7 V

COMPONENT OPERATING RANGE

COMPONENT OPERATING RANGE

Exhaust camshaft position sensor	• Exhaust camshaft position sensor output voltage fluctuates while camshaft revolving • 3 exhaust camshaft position sensor signals per 2 crankshaft revolutions
Exhaust camshaft position sensor voltage	0.3 to 4.7 V

WIRING DIAGRAM

Refer to **DTC P0335** .

INSPECTION PROCEDURE

HINT:

- Read freeze frame data using a Techstream. Freeze frame data records the engine conditions when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.
- If no problem is found through this diagnostic troubleshooting procedure, troubleshoot the engine mechanical system.

1. **CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P0365, P0367 OR P0368)**
   a. Connect a Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the tester ON.
   d. Select the following menu items: Powertrain / Engine and ECT / Trouble Codes.
   e. Read DTCs.

   Result

   RESULT REFERENCE

Result	Proceed to
P0365, P0367 or P0368	A
P0365, P0367 or P0368 and other DTCs	B

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HINT:

If any DTCs other than P0365, P0367 or P0368 are output, troubleshoot those DTCs first.

B: Go to DTC CHART (See **DIAGNOSTIC TROUBLE CODE CHART**)

A: Go to next step

2. **INSPECT CAMSHAFT POSITION SENSOR (FOR EXHAUST CAMSHAFT) (POWER SOURCE)**
   a. Disconnect the camshaft position sensor (for exhaust camshaft) connector.
   b. Turn the ignition switch to ON.
   c. Measure the voltage according to the value(s) in the table below.

Standard voltage

VOLTAGE SPECIFICATION

Tester Connection	Switch Condition	Specified Condition
C25-3 (VC2) - Body ground	Ignition switch ON	4.5 to 5.5 V

   d. Reconnect the camshaft position sensor (for exhaust camshaft) connector.

NG: Go to step 10

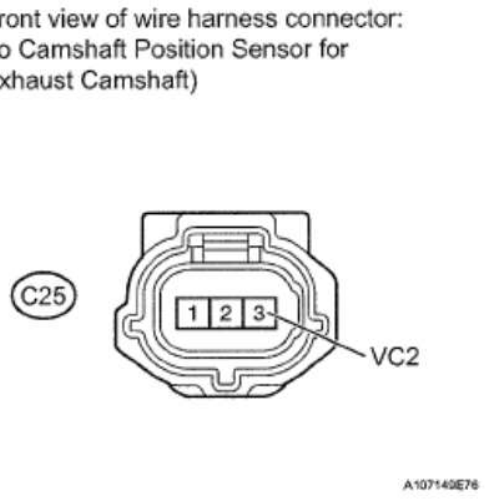


Fig. 136: Identifying Camshaft Position Sensor Connector Terminals (For Exhaust Camshaft)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

3. **CHECK HARNESS AND CONNECTOR (CAMSHAFT POSITION SENSOR - ECM)**

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a. Disconnect the camshaft position sensor (for exhaust camshaft) connector.
b. Disconnect the ECM connector.
c. Measure the resistance according to the value(s) in the table below.

Standard resistance (Check for open)

RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
C25-1 (VVE+) - C19-76 (EV1+)	Always	Below 1 ohms
C25-2 (VVE-) - C19-75 (EV1-)	Always	Below 1 ohms

Standard resistance (Check for short)

RESISTANCE SPECIFICATION

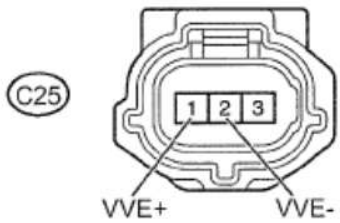
Tester Connection	Condition	Specified Condition
C25-1 (VVE+) or C19-76 (EV1+) - Body ground	Always	10 kohms or higher
C25-2 (VVE-) or C19-75 (EV1-) - Body ground	Always	10 kohms or higher

d. Reconnect the camshaft position sensor (for exhaust camshaft) connector.
e. Reconnect the ECM connector.

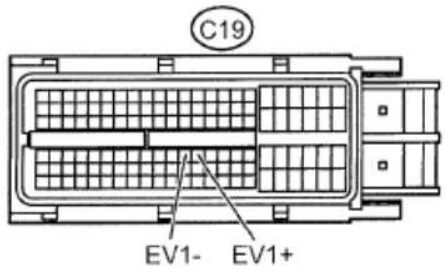
NG: REPAIR OR REPLACE HARNESS OR CONNECTOR

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Front view of wire harness connector:
(to Camshaft Position Sensor for
Exhaust Camshaft)



Front view of wire harness connector:
(to ECM)



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Fig. 137: Identifying Camshaft Position Sensor And ECM Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

4. **CHECK SENSOR INSTALLATION (CAMSHAFT POSITION SENSOR FOR EXHAUST CAMSHAFT)**
   a. Check the camshaft position sensor (for exhaust camshaft) installation.

      OK:

      Sensor is installed correctly.

NG: SECURELY REINSTALL SENSOR

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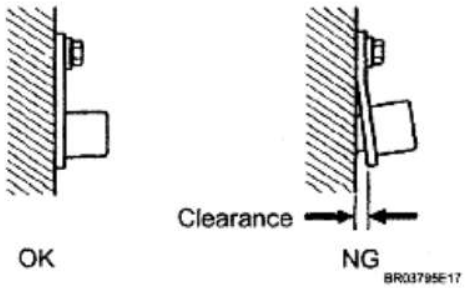


Fig. 138: Identifying Proper Installation Position Of Camshaft Position Sensor
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

5. **INSPECT EXHAUST CAMSHAFT (TIMING ROTOR)**
   a. Check the timing rotor of the exhaust camshaft.

      OK:

      Camshaft timing rotor does not have any cracks or deformation.

   NG: REPLACE EXHAUST CAMSHAFT

   OK: Go to next step

6. **REPLACE CAMSHAFT POSITION SENSOR (FOR EXHAUST CAMSHAFT)**
7. **CHECK WHETHER DTC OUTPUT RECURS (DTC P0365, P0367 OR P0368)**
   a. Connect a Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the tester ON.
   d. Clear DTCs (See **DTC CHECK / CLEAR**).
   e. Start the engine and allow the engine to idle for 10 seconds or more.
   f. Turn the ignition switch to OFF.
   g. Start the engine again and allow the engine to idle for 10 seconds or more.
   h. Select the following menu items: Powertrain / Engine and ECT / Trouble Codes.
   i. Read DTCs.

      Result

      RESULT REFERENCE

Result	Proceed to
No output	A
P0365, P0367 or P0368	B

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HINT:

If the engine does not start, replace the ECM.

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

A: Go to next step

8. **ADJUST VALVE TIMING**

HINT:

There are no marks on the cylinder head to match-up for the purpose of checking valve timing. Valve timing can only be inspected by lining up the colored plates on the timing chain with the marks on the pulleys. It may be necessary to remove and re-install the chain to match up the alignment marks (See **REASSEMBLY**).

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Reference: Camshafts Layout

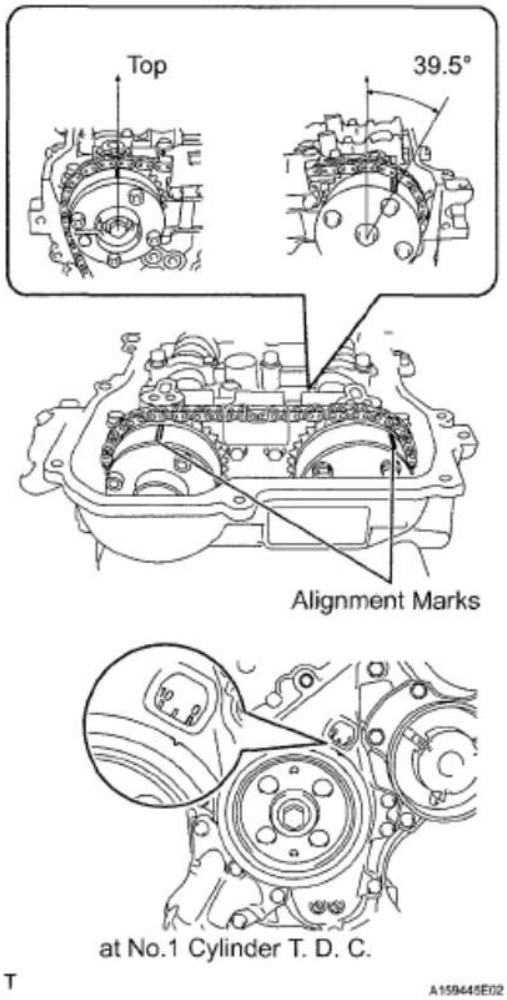


Fig. 139: Identifying Valve Timing
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

9. **CHECK WHETHER DTC OUTPUT RECURS (DTC P0365, P0367 OR P0368)**
   a. Connect a Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the tester ON.
   d. Clear DTCs (See **DTC CHECK / CLEAR**).
   e. Start the engine and allow the engine to idle for 10 seconds or more.
   f. Turn the ignition switch to OFF.
   g. Start the engine again and allow the engine to idle for 10 seconds or more.
   h. Select the following menu items: Powertrain / Engine and ECT / Trouble Codes.
   i. Read DTCs.

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Result

RESULT REFERENCE

Result	Proceed to
No output	A
P0365, P0367 or P0368	B

HINT:

If the engine does not start, replace the ECM.

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

A : END

10. **CHECK HARNESS AND CONNECTOR (CAMSHAFT POSITION SENSOR - ECM)**
    a. Disconnect the camshaft position sensor (for exhaust camshaft) connector.
    b. Disconnect the ECM connector.
    c. Measure the resistance according to the value(s) in the table below.

Standard resistance (Check for open)

RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
C25-3 (VC2) - C19-117 (VC)	Always	Below 1 ohms

Standard resistance (Check for short)

RESISTANCE SPECIFICATION

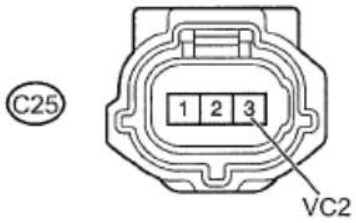
Tester Connection	Condition	Specified Condition
C25-3 (VC2) or C19-117 (VC) - Body ground	Always	10 kohms or higher

    d. Reconnect the camshaft position sensor (for exhaust camshaft) connector.
    e. Reconnect the ECM connector.

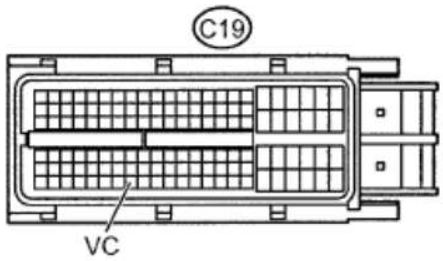
NG: REPAIR OR REPLACE HARNESS OR CONNECTOR

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Front view of wire harness connector:
(to Camshaft Position Sensor for
Exhaust Camshaft)



Front view of wire harness connector:
(to ECM)



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Fig. 140: Identifying Camshaft Position Sensor And ECM Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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

DTC P0420 CATALYST SYSTEM EFFICIENCY BELOW THRESHOLD (BANK 1)

MONITOR DESCRIPTION

The ECM uses sensors mounted in front of and behind the Three-Way Catalytic Converter (TWC) to monitor its efficiency.

The first sensor, the Air Fuel Ratio (A/F) sensor, sends pre-catalyst information to the ECM. The second sensor, the Heated Oxygen (HO2) sensor, sends post-catalyst information to the ECM.

In order to detect any deterioration in the TWC, the ECM calculates the Oxygen Storage Capacity (OSC) of the TWC. This calculation is based on the voltage output of the HO2 sensor while performing active air-fuel ratio control.

The OSC value is an indication of the oxygen storage capacity of the TWC. When the vehicle is being driven with a warm engine, active air-fuel ratio control is performed for approximately 15 to 20 seconds. When it is

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performed, the ECM deliberately sets the air-fuel ratio to lean or rich levels. If a rich-lean cycle of the HO2 sensor is long, the OSC becomes greater. There is a direct correlation between the OSCs of the HO2 sensor and the TWC.

The ECM uses the OSC value to determine the state of the TWC. If any deterioration has occurred, it illuminates the MIL and sets the DTC.

DTC DETECTION CONDITION AND TROUBLE AREA

DTC No.	DTC Detection Condition	Trouble Area
P0420	Oxygen Storage Capacity (OSC) value smaller than standard value under active air fuel ratio control (2 trip detection logic)	• Gas leak from exhaust system • Air fuel ratio sensor (sensor 1) • Heated oxygen sensor (sensor 2) • Exhaust manifold (three-way catalytic converter)

HINT:

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

MONITOR STRATEGY

MONITOR STRATEGY

Related DTCs	P0420: Catalyst Deterioration
Required Sensors/Components (Main)	Air fuel ratio sensor Heated oxygen sensor
Required Sensors/Components (Related)	Intake air temperature sensor Mass air flow meter Crankshaft position sensor Engine coolant temperature sensor
Frequency of Operation	Once per driving cycle
Duration	About 30 seconds
MIL Operation	2 driving cycles
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

TYPICAL ENABLING CONDITIONS

	P0011 (VVT System 1 - Advance) P0012 (VVT System 1 - Retard) P0031, P0032 (Air fuel ratio sensor heater - Sensor 1) P0037, P0038 (Heated oxygen sensor Heater - Sensor

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Monitor runs whenever following DTCs not present	2) P0102 - P0103 (Mass air flow meter) P0115 - P0118 (Engine coolant temperature sensor) P0120 - P0223, P2135 (Throttle position sensor) P0125 (Insufficient ECT for closed loop) P0136 (HO2 Sensor - Sensor 2) P0171, P0172 (Fuel system) P0300 - P0304 (Misfire) P0335 (Crankshaft position sensor) P0340 (Camshaft position sensor) P0351 - P0354 (Igniter) P0500 (Vehicle speed sensor) P2196 (Air fuel ratio sensor - rationality) P2237 (Air fuel ratio open) P2A00 (Air fuel ratio sensor - slow response)
Battery voltage	11 V or more
Intake air temperature	-10°C(14°F) or more
Engine coolant temperature	75°C(167°F) or more
Atmospheric pressure coefficient	0.75 or more
Idling	OFF
Engine RPM	Less than 4000 rpm
Air fuel ratio sensor status	Activated
Fuel system status	Closed loop
Engine load	10 to 80%
All of the following conditions are met	Condition 1, 2 and 3
1. Mass air flow rate	2.5 to 40 g/sec
2. Front catalyst temperature (estimated)	A/T models: 660 to 840°C (1220 to 1544°F) M/T models: 630 to 840°C (1166 to 1544°F)
3. Rear catalyst temperature (estimated)	400 to 760°C (752 to 1400°F)
Rear Heated oxygen sensor monitor	Completed
Shift position	A/T models: 3th or higher M/T models: 4th

TYPICAL MALFUNCTION THRESHOLDS

TYPICAL MALFUNCTION THRESHOLDS

Oxygen Storage Capacity (OSC) of Three-Way Catalytic Converter (TWC)	Less than 0.08 g

MONITOR RESULT

Refer to **CHECKING MONITOR STATUS** .

CONFIRMATION DRIVING PATTERN

HINT:

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Performing this confirmation pattern will activate the catalyst monitor. This is very useful for verifying the completion of a repair.

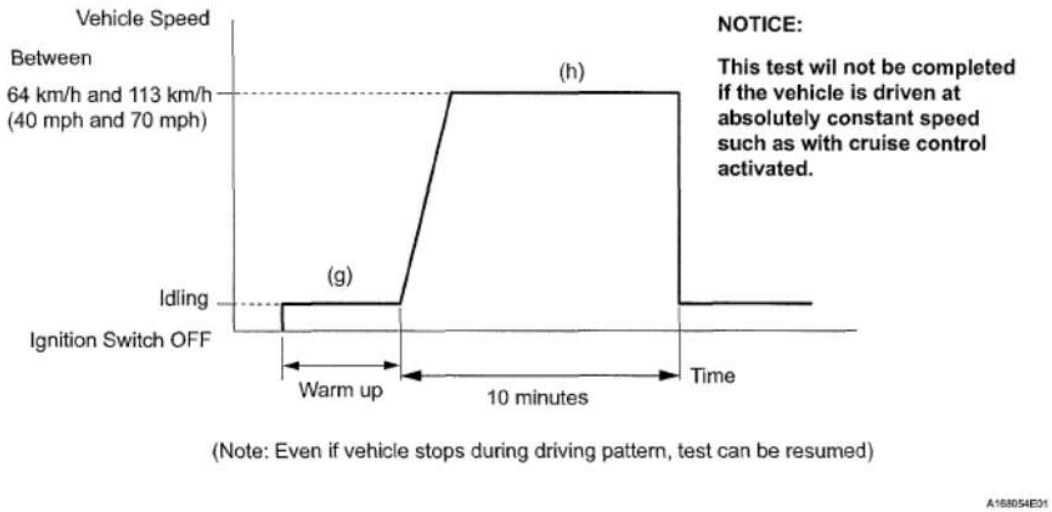


Fig. 141: Vehicle Speed Graph
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

HINT:

a. Connect a Techstream to the DLC3.
b. Turn the ignition switch to ON.
c. Turn the tester ON.
d. Clear DTCs (if set) (See **DTC CHECK / CLEAR**).
e. Select the following menu items: Powertrain / Engine and ECT / Monitor.
f. Check that Catalyst / Status2 is Incomplete.
g. Start the engine and warm it up.
h. Drive the vehicle at between 64 km/h and 113 km/h (40 mph and 70 mph) for at least 10 minutes.
i. Those items will change to Complete as Catalyst monitor operates.
j. Select the following menu items: Powertrain / Engine and ECT / Trouble Codes / Pending.
k. Check if any DTCs (any pending DTCs) are set.

HINT:

If Catalyst does not change to Complete, and any pending DTCs fail to set, extend the driving time.

CONDITIONING FOR SENSOR TESTING

HINT:

Perform the operation with the engine speeds and time durations described below prior to checking the

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waveforms of the Air Fuel Ratio (A/F) sensor and Heated Oxygen (HO2) sensor. This is in order to activate the sensors sufficiently to obtain the appropriate inspection results.

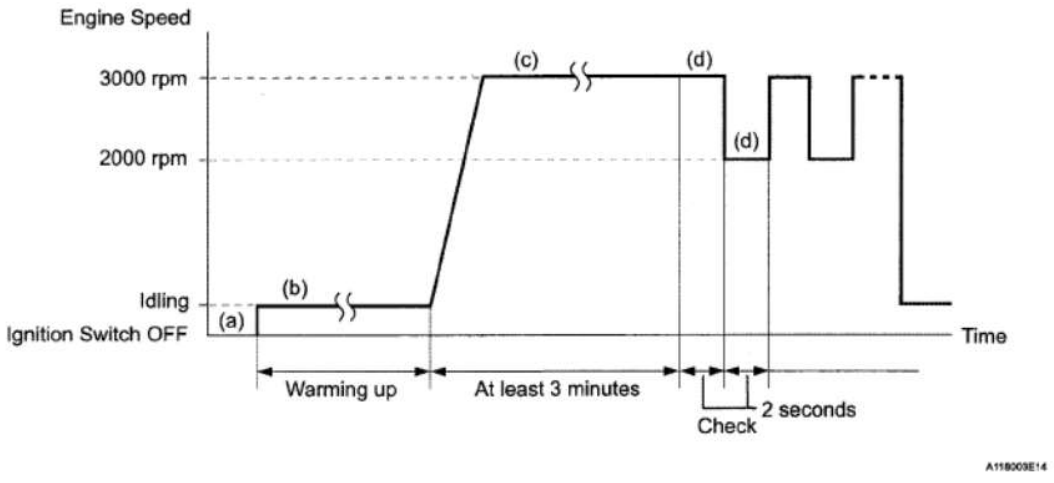


Fig. 142: Engine Speed Graph
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

a. Connect the Techstream to the DLC3.
b. Start the engine and warm it up with all the accessories switched OFF until the engine coolant temperature stabilizes.
c. Run the engine at an engine speed of between 2500 rpm and 3000 rpm for at least 3 minutes.
d. While running the engine at 3000 rpm for 2 seconds and 2000 rpm for 2 seconds, check the waveforms of the A/F and HO2 sensors using the tester.

   HINT:

   - If either of the voltage outputs of the A/F or HO2 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 menu items: Powertrain / Engine and ECT / Active Test / Control the Injection Volume for A/F sensor.
   - If the Three-Way Catalytic Converter (TWC) has deteriorated, the HO2 sensor (located behind the TWC) voltage output fluctuates up and down frequently, even under normal driving conditions (active air-fuel ratio control is not performed).

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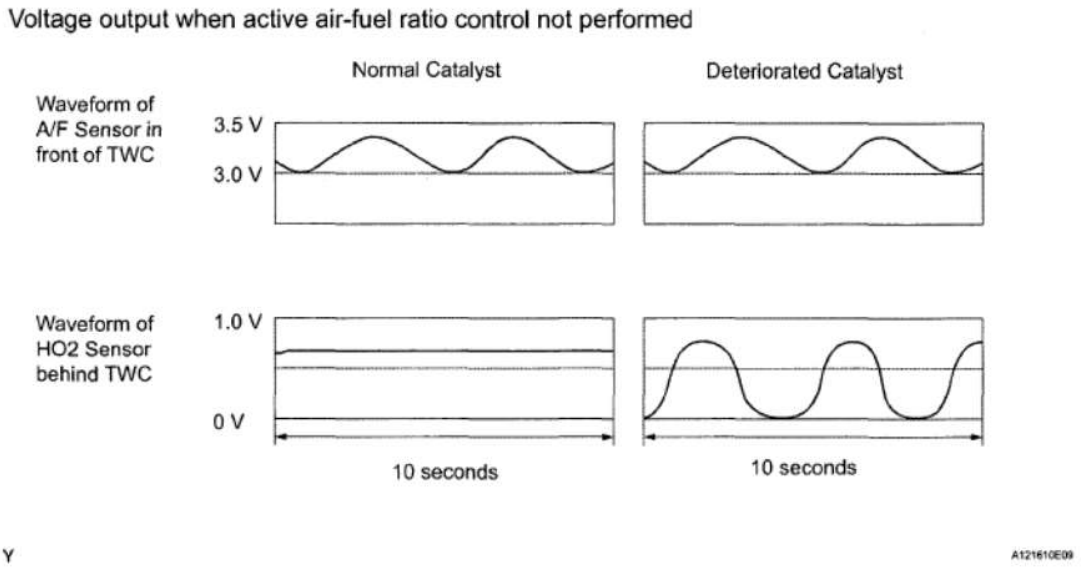


Fig. 143: A/F Sensor And HO2 Sensor Waveform Graph
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSPECTION PROCEDURE

HINT:

Malfunctioning areas can be identified by performing the Control the Injection Volume for A/F sensor function provided in the Active Test. The Control the Injection Volume for A/F sensor function can help to determine whether the Air Fuel Ratio (A/F) sensor, Heated Oxygen (HO2) 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 a 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 A/F and HO2 sensors (AFS B1 S1 and O2S B1 S2) displayed on the tester.

   HINT:

   - The Control the Injection Volume for A/F sensor operation lowers the fuel injection volume by

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12.5% or increases the injection volume by 25%.

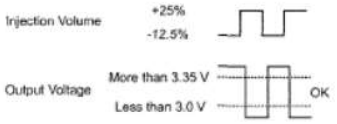
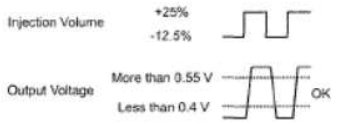
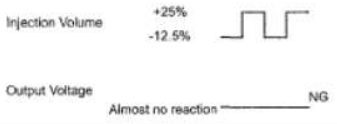
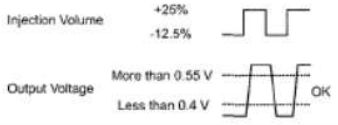
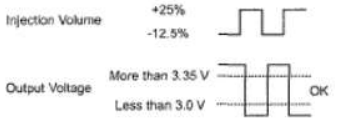
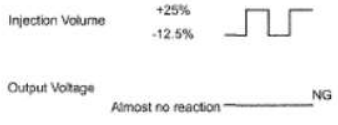
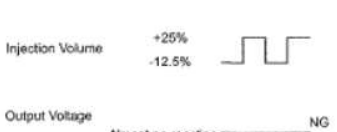
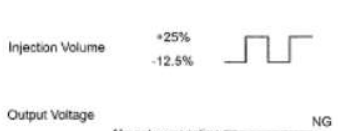
- Each sensor reacts in accordance with increases and decreases in the fuel injection volume.

INJECTION VOLUME AND VOLTAGE SPECIFICATION

Tester Display (Sensor)	Injection Volume	Status	Voltage
AFS B1 S1 (A/F)	+25%	Rich	Less than 3.0 V
	-12.5%	Lean	More than 3.35 V
O2S B1 S2 (HO2)	+25%	Rich	More than 0.55 V
	-12.5%	Lean	Less than 0.4 V

NOTE: The Air Fuel Ratio (A/F) sensor has an output delay of a few seconds and the Heated Oxygen (HO2) sensor has a maximum output delay of approximately 20 seconds.

A/F SENSOR AND HO2 SENSOR OUTPUT VOLTAGE SPECIFICATION

Case	A/F Sensor (Sensor 1) Output Voltage	HO2 Sensor (Sensor 2) Output Voltage	Main Suspected Trouble Area
1			-
2			• A/F sensor • A/F sensor heater • A/F sensor circuit
3			• HO2 sensor • HO2 sensor heater • HO2 sensor circuit
4			• Injector • Fuel pressure • Gas leak from exhaust system (Air fuel ratio extremely rich or lean)

- Following the Control the Injection Volume for A/F sensor procedure enables technicians to check and graph the voltage outputs of both the A/F and HO2 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 B1 S1 and O2S B1 S2; then press the graph button on the Data List view.

HINT:

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Read freeze frame data using a 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. **CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P0420)**
   a. Connect a Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the tester ON.
   d. Select the following menu items: Powertrain / Engine and ECT / Trouble Codes.
   e. Read DTCs.

   Result

   RESULT REFERENCE

Result	Proceed to
P0420	A
P0420 and other DTCs	B

   HINT:

   If any DTCs other than P0420 are output, troubleshoot those DTCs first.

   B: Go to DTC CHART (See **DIAGNOSTIC TROUBLE CODE CHART**)

   A: Go to next step

2. **PERFORM ACTIVE TEST USING TECHSTREAM (CONTROL THE INJECTION VOLUME FOR A/F SENSOR)**
   a. Connect a Techstream to the DLC3.
   b. Start the engine and warm it up.
   c. Turn the tester ON.
   d. Run 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 Active Test 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 heated oxygen sensor (AFS B1S1 and O2S B1S2) displayed on the tester.

   HINT:

   - The Control the Injection Volume for A/F sensor operation lowers the fuel injection volume

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by 12.5% or increases the injection volume by 25%.

- Each sensor reacts in accordance with increases and decreases in the fuel injection volume.

Standard

INJECTION VOLUME AND VOLTAGE SPECIFICATION

Tester Display (Sensor)	Injection Volume	Status	Voltage
AFS B1S1 (A/F)	+25%	Rich	Less than 3.0
	-12.5%	Lean	More than 3.35
O2S B1S2 (HO2)	+25%	Rich	More than 0.55
	-12.5%	Lean	Less than 0.4

Result

RESULT REFERENCE

Status AFS B1S1	Status O2S B1S2	A/F Condition and A/F and HO2 Sensors Condition	Misfire	Main Suspected Trouble Area	Proceed to
Lean/Rich	Lean/Rich	Normal	-	• Three-Way Catalytic Converter (TWC) • Gas leakage from exhaust system	A
Lean	Lean/Rich	A/F sensor malfunction	-	• A/F sensor	B
Rich	Lean/Rich	A/F sensor malfunction	-	• A/F sensor	
Lean/Rich	Lean	HO2 sensor malfunction	-	• HO2 sensor • Gas leakage from exhaust system	C
Lean/Rich	Rich	HO2 sensor malfunction	-	• HO2 sensor • Gas leakage from exhaust system	
Lean	Lean	Actual air fuel ratio lean	May occur	• Extremely rich or lean actual air-fuel ratio • Gas leakage from exhaust system	D
Rich	Rich	Actual air fuel ratio rich	-	• Extremely rich or lean actual air-fuel ratio • Gas leakage from	

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				exhaust system	

Lean: During Control the Injection Volume for A/F sensor, the A/F sensor output voltage (AFS) is consistently more than 3.35 V, and the HO2 sensor output voltage (O2S) is consistently less than 0.4 V.

Rich: During the AFS is consistently less than 3.0 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 HO2 sensor alternates correctly.

B : REPLACE AIR FUEL RATIO SENSOR (SENSOR 1) (See **REMOVAL**)

C: Go to step 4

D : CHECK ENGINE TO DETERMINE CAUSE OF EXTREMELY RICH OR LEAN ACTUAL AIR FUEL RATIO, AND GO TO STEP 3 (See **TYPICAL ENABLING CONDITIONS**)

A: Go to next step

3. **CHECK FOR EXHAUST GAS LEAK**

OK:

No gas leak.

NG: REPAIR OR REPLACE EXHAUST GAS LEAK POINT

OK : REPLACE EXHAUST MANIFOLD (THREE-WAY CATALYTIC CONVERTER) (See **REMOVAL**)

4. **CHECK FOR EXHAUST GAS LEAK**

OK:

No gas leak.

NG: REPAIR OR REPLACE EXHAUST GAS LEAK POINT

OK : REPLACE HEATED OXYGEN SENSOR (SENSOR 2) (See **REMOVAL**)

DTC P043E EVAPORATIVE EMISSION SYSTEM REFERENCE ORIFICE CLOG UP; DTC P043F EVAPORATIVE EMISSION SYSTEM REFERENCE ORIFICE HIGH FLOW; DTC P2401 EVAPORATIVE EMISSION LEAK DETECTION PUMP STUCK OFF; DTC P2402 EVAPORATIVE EMISSION LEAK DETECTION PUMP STUCK ON; DTC P2419 EVAPORATIVE EMISSION

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SYSTEM SWITCHING VALVE CONTROL CIRCUIT LOW

DTC SUMMARY

DTC SUMMARY

DTC No.	Monitoring Item	Malfunction Detection Condition	Trouble Area	Detection Timing	Detection Logic
P043E	Reference orifice clogged	P043E, P043F, P2401, P2402 and P2419 present when one of following conditions met during key-off EVAP monitor: • Reference orifice clogged • Reference orifice high-flow • Leak detection pump OFF malfunction • Leak detection pump ON malfunction • Vent valve ON (close) malfunction	• Canister pump module (Reference orifice, leak detection pump, vent valve) • Connector/wire harness (Canister pump module - ECM) • EVAP system hose (pipe from air inlet port to canister pump module, canister filter, fuel tank vent hose) • ECM	While ignition switch OFF	2 trip
P043F	Reference orifice high-flow				
P2401	Leak detection pump stuck OFF				
P2402	Leak detection pump stuck ON				
P2419	Vent valve stuck closed				

HINT:

The reference orifice is located inside the canister pump module.

DESCRIPTION

The description can be found in the EVAP (Evaporative Emission) System (See **DESCRIPTION**).

HINT:

Unit expressions

- [kPa-a (mmHg-a)] denotes the absolute pressure.
- [kPa-g (mmHg-g)] denotes the gauge pressure (relative pressure).
- On a Techstream, convert the unit of measurement according to the inspection procedure.

INSPECTION PROCEDURE

Refer to the **EVAP SYSTEM** .

MONITOR DESCRIPTION

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5 hours* after the ignition switch is turned to OFF, the leak detection pump creates negative pressure (vacuum) in the EVAP system. The ECM monitors for leaks and actuator malfunctions based on the EVAP pressure.

HINT:

*: If the engine coolant temperature is not below 35°C (95°F) 5 hours after the ignition switch is turned to 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 to OFF, the monitor check starts 2.5 hours later.

OPERATION DESCRIPTION CHART

Sequence	Operation	Description	Duration
-	ECM activation	Activated by soak timer 5, 7 or 9.5 hours after ignition switch turned to OFF.	-
A	Atmospheric pressure measurement	Vent valve turned OFF (vent) and EVAP system pressure measured by ECM in order to register atmospheric pressure. If pressure in EVAP system not between 70 kPa-a and 110 kPa-a (525 mmHg-a and 825 mmHg-a), ECM cancels EVAP system monitor.	10 seconds
B	First reference pressure measurement	In order to determine reference pressure, leak detection pump creates negative pressure (vacuum) through reference orifice and then ECM checks if leak detection pump and vent valve operate normally.	60 seconds
C	EVAP system pressure measurement	Vent valve turned ON (closed) to shut EVAP system. Negative pressure (vacuum) created in EVAP system, and EVAP system pressure then measured. Write down measured value as it will be used in leak check. If EVAP pressure does not stabilize within 15 minutes, ECM cancels EVAP system monitor.	15 minutes(1)
D	Purge VSV monitor	Purge VSV opened and then EVAP system pressure measured by ECM. Large increase indicates normality.	10 seconds
E	Second reference pressure measurement	After second reference pressure measurement, leak check performed by comparing first and second reference pressure. If stabilized system pressure higher than second reference pressure, ECM determines that EVAP system leaking.	60 seconds
-	Final check	Atmospheric pressure measured and then monitoring result recorded by ECM.	-

(1) If only a small amount of fuel is in the fuel tank, it takes longer for the EVAP pressure to stabilize.

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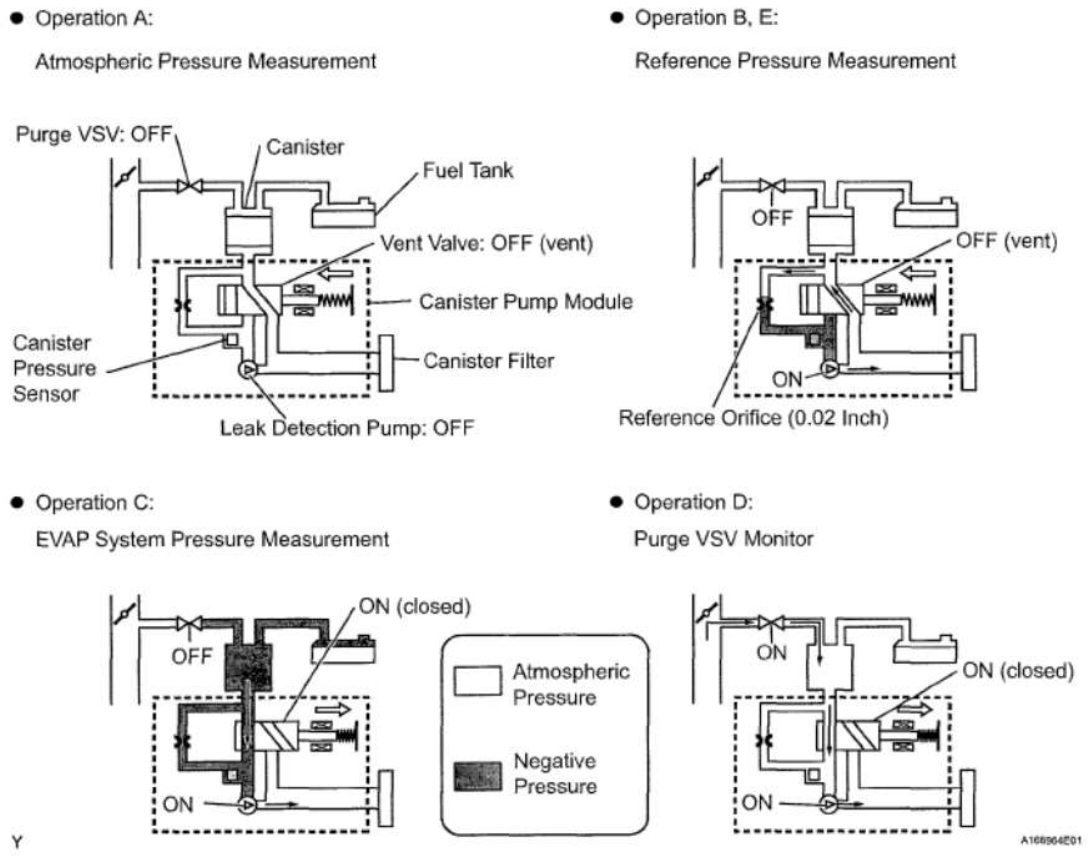


Fig. 144: Evaporative Emission System Operation Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

The leak detection pump creates negative pressure through the reference orifice (in operation B and E). When the system is normal, the EVAP pressure is between 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 cycles.

*: Typical value.

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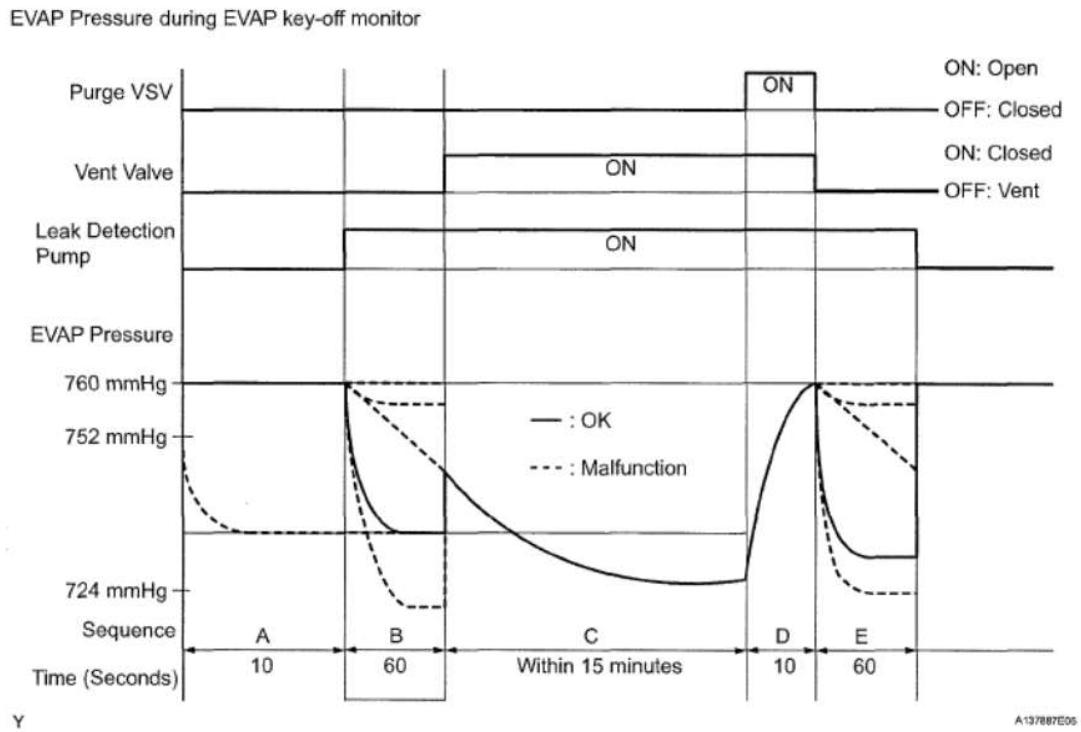


Fig. 145: EVAP Pressure Graph
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

MONITOR STRATEGY

MONITOR STRATEGY

Required Sensors/Components	Canister pump module
Frequency of Operation	Once per driving cycle
Duration	Within 2 minutes
MIL Operation	2 driving cycles
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

TYPICAL ENABLING CONDITIONS

Monitor runs whenever following DTCs not present	None
EVAP key-off monitor runs when all of following conditions met	-
Atmospheric pressure	70 to 110 kPa-a (525 to 825 mmHg-a)
Battery voltage	10.5 V or more
Vehicle speed	Below 4 km/h (2.5 mph)
Ignition switch	OFF
Time after key off	5 or 7 or 9.5 hours
Canister pressure sensor malfunction (P0451, P0452 and P0453)	Not detected

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Purge VSV	Not operated by scan tool
Vent valve	Not operated by scan tool
Leak detection pump	Not operated by scan tool
Both of following conditions met before key off	Conditions 1 and 2
1. Duration that vehicle driven	5 minutes or more
2. EVAP purge operation	Performed
ECT	4.4 to 35°C (40 to 95°F)
IAT	4.4 to 35°C (40 to 95°F)

TYPICAL MALFUNCTION THRESHOLDS

"Saturated" indicates that the EVAP pressure change is less than 0.286 kPa-g (2.14 mmHg-g) in 60 seconds.

TYPICAL MALFUNCTION THRESHOLDS

One of following conditions met	-
EVAP pressure just after reference pressure measurement started	More than -1 kPa-g (-7.5 mmHg-g)
Reference pressure	Less than -4.85 kPa-g (-36.4 mmHg-g)
Reference pressure	-1.057 kPa-g (-7.93 mmHg-g) or more
Reference pressure	Not saturated within 60 seconds
Reference pressure difference between first and second	0.5 kPa-g (3.75 mmHg-g) or more

MONITOR RESULT

Refer to **CHECKING MONITOR STATUS** .

DTC P0441 EVAPORATIVE EMISSION CONTROL SYSTEM INCORRECT PURGE FLOW

DTC SUMMARY

DTC SUMMARY

DTC No.	Monitoring Item	Malfunction Detection Condition	Trouble Area	Detection Timing	Detection Logic
	Purge VSV (Vacuum Switching Valve) stuck open	Leak detection pump creates negative pressure (vacuum) in EVAP system and EVAP system pressure measured. Reference pressure measured at start and at end of leak check. If stabilized pressure higher than [second reference pressure x 0.4], ECM determines that purge VSV stuck open.	• Purge VSV • Connector/wire harness (Purge VSV - ECM) • ECM • Canister pump module • Leak from EVAP system	White ignition switch OFF	2 trip
		After EVAP leak check performed, purge VSV turned	• Purge VSV		

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P0441	Purge VSV stuck closed	ON (open), and atmospheric air introduced into EVAP system. Reference pressure measured at start and at end of check. If pressure does not return to near atmospheric pressure, ECM determines that purge VSV stuck closed.	• Connector/wire harness (Purge VSV - ECM) • ECM • Canister pump module • leak from EVAP system	While ignition switch OFF	2 trip
	Purge flow	While engine running, following conditions successively met: • Negative pressure not created in EVAP system when purge VSV turned ON (open) • EVAP system pressure change less than 0.4 kPa-g (3.0 mmHg-g) when vent valve turned ON (closed) • Atmospheric pressure change before and after purge flow monitor less than 0.1 kPa-g (0.75 mmHg-g)	• Purge VSV • Connector/wire harness (Purge VSV - ECM) • leak from EVAP line (Purge VSV - Intake manifold) • ECM	While engine running	2 trip

DESCRIPTION

The description can be found in the EVAP (Evaporative Emission) System (See **DESCRIPTION**).

INSPECTION PROCEDURE

Refer to the **EVAP SYSTEM** .

HINT:

Unit expressions

- [kPa-a (mmHg-a)] denotes the absolute pressure.
- [kPa-g (mmHg-g)] denotes the gauge pressure (relative pressure).
- On a Techstream, convert the unit of measurement according to the inspection procedure.

MONITOR DESCRIPTION

The two monitors, Key-Off and Purge Flow, are used to detect malfunctions relating to DTC P0441. The Key-Off monitor is initiated by the ECM internal timer, known as the soak timer, 5 hours* after the ignition switch is

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turned to OFF. The purge flow monitor runs while the engine is running.

1. KEY-OFF MONITOR

5 hours* after the ignition switch is turned to OFF, the leak detection pump creates negative pressure (vacuum) in the EVAP system. The ECM monitors for leaks and actuator malfunctions based on the EVAP pressure.

HINT:

*: If the engine coolant temperature is not below 35°C (95°F) 5 hours after the ignition switch is turned to 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 to OFF, the monitor check starts 2.5 hours later.

OPERATION DESCRIPTION CHART

Sequence	Operation	Description	Duration
-	ECM activation	Activated by soak timer 5, 7 or 9.5 hours after ignition switch turned to OFF.	-
A	Atmospheric pressure measurement	Vent valve turned OFF (vent) and EVAP system pressure measured by ECM in order to register atmospheric pressure. If pressure in EVAP system not between 70 kPa-a and 110 kPa-a (525 mmHg-a and 825 mmHg-a), ECM cancels EVAP system monitor.	10 seconds
B	First reference pressure measurement	In order to determine reference pressure, leak detection pump creates negative pressure (vacuum) through reference orifice and then ECM checks if leak detection pump and vent valve operate normally.	60 seconds
C	EVAP system pressure measurement	Vent valve turned ON (closed) to shut EVAP system. Negative pressure (vacuum) created in EVAP system, and EVAP system pressure then measured. Write down measured value as it will be used in leak check. If EVAP pressure does not stabilize within 15 minutes, ECM cancels EVAP system monitor.	15 minutes(1)
D	Purge VSV monitor	Purge VSV opened and then EVAP system pressure measured by ECM. Large increase indicates normality.	10 seconds
E	Second reference pressure measurement	After second reference pressure measurement, leak check performed by comparing first and second reference pressure. If stabilized system pressure higher than second reference pressure, ECM determines that EVAP system leaking.	60 seconds
-	Final check	Atmospheric pressure measured and then monitoring result recorded by ECM.	-
(1) If only a small amount of fuel is in the fuel tank, it takes longer for the EVAP pressure to stabilize.			

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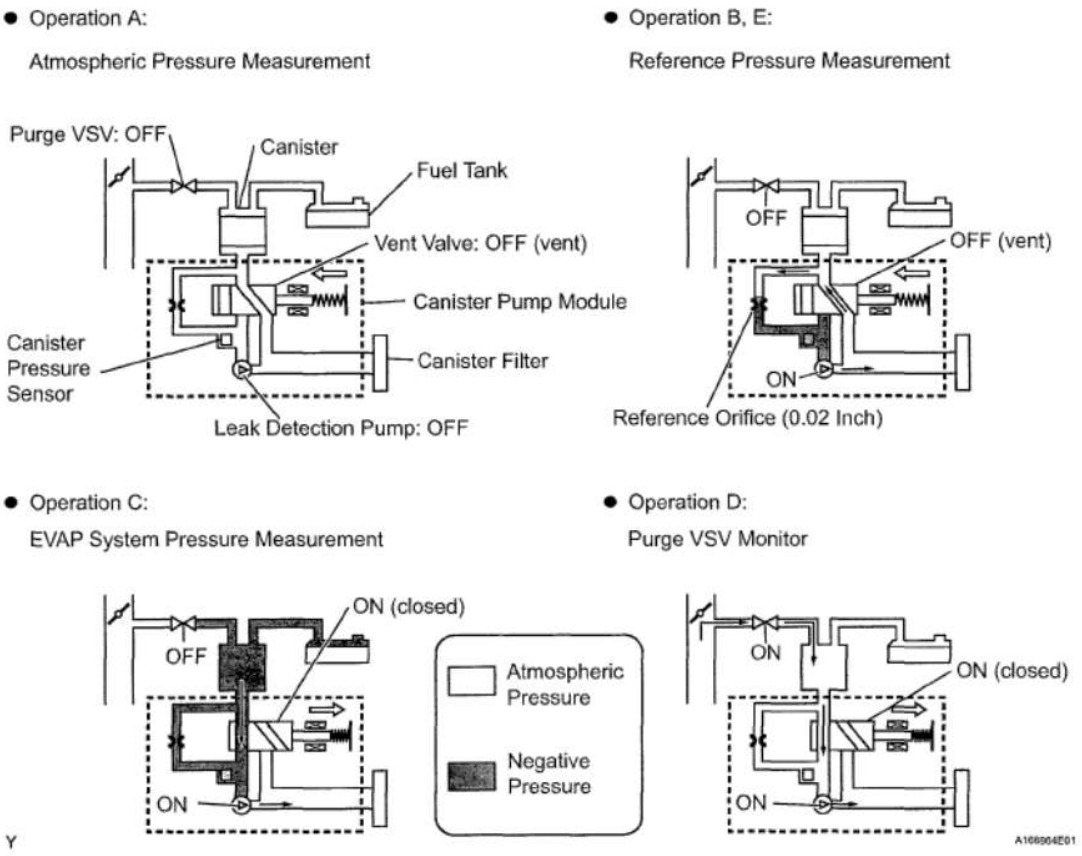


Fig. 146: Evaporative Emission System Operation Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

a. Purge VSV stuck open

In operation C, the leak detection pump creates negative pressure (vacuum) in the EVAP system. The EVAP system pressure is then measured by the ECM using the canister pressure sensor. If the stabilized system pressure is higher than [second reference pressure x 0.4], 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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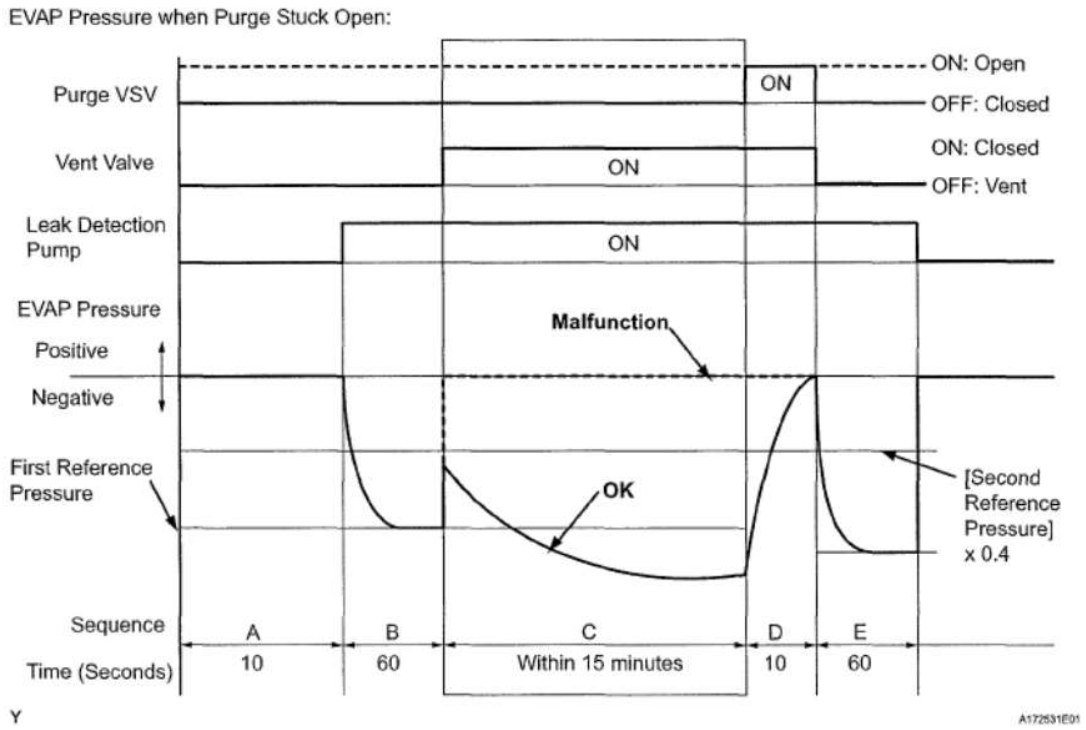


Fig. 147: EVAP Pressure Graph (Purge VSV Stuck Open)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. Purge VSV stuck closed

In operation D, the canister pressure sensor measures the EVAP system pressure. The pressure measurement for the purge VSV monitor is begun when the purge VSV is turned ON (open) after the EVAP leak check. When the measured pressure indicates an increase of 0.3 kPa-g (2.25 mmHg-g) or more, the purge VSV is functioning normally. If the pressure does not increase, the ECM interprets this as the purge VSV being stuck closed. The ECM illuminates the MIL and sets the DTC (2 trip detection logic).

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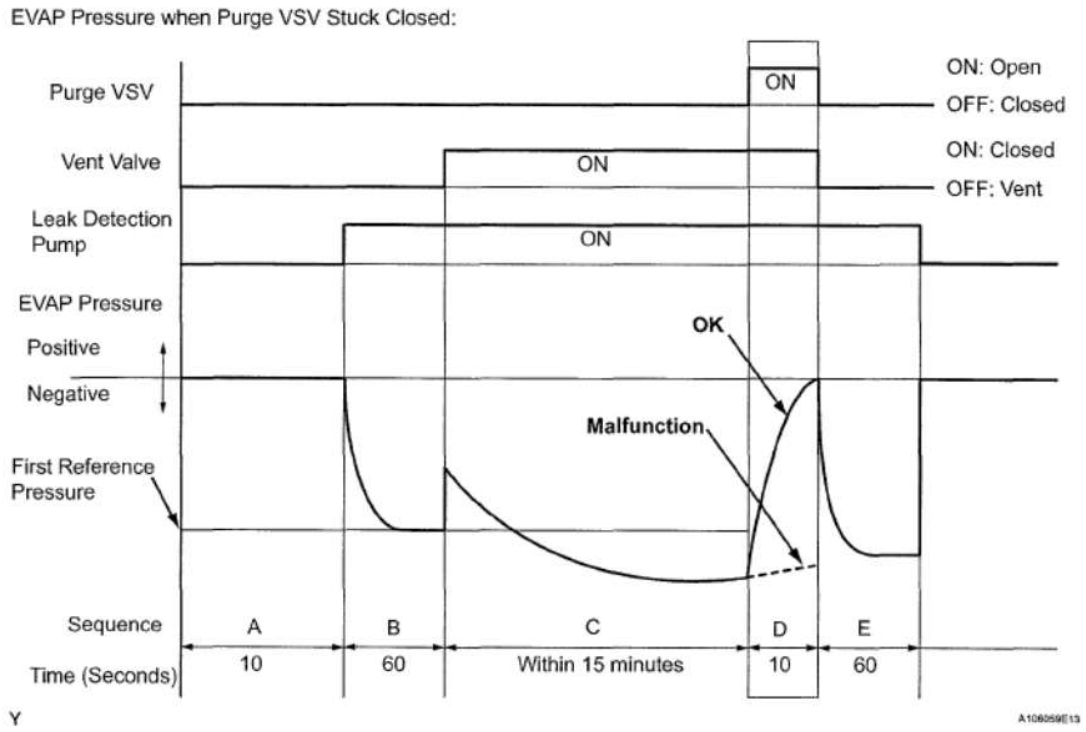


Fig. 148: EVAP Pressure Graph (Purge VSV Stuck Closed)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

2. PURGE FLOW MONITOR

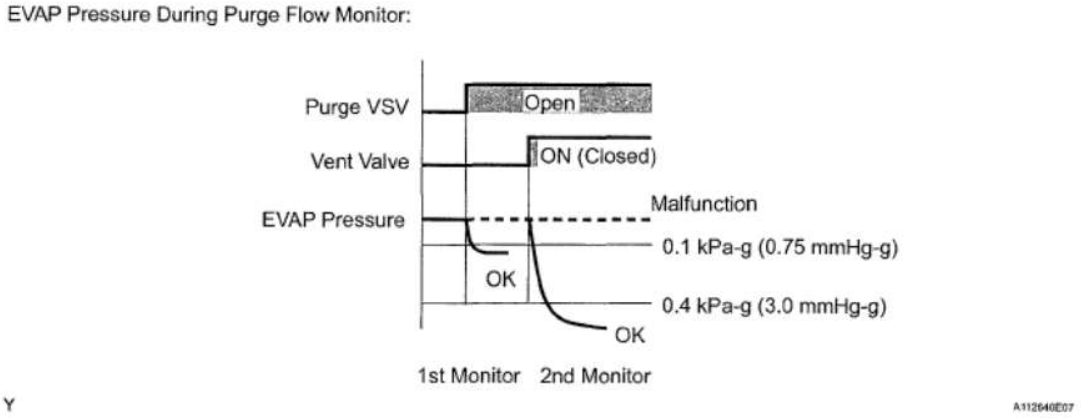


Fig. 149: EVAP Pressure Graph (Purge Flow Monitor)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

The purge flow monitor consists of two monitors. The 1st monitor is conducted every time and the 2nd monitor is activated if necessary.

- The 1st monitor

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While the engine is running and the purge VSV is ON (open), the ECM monitors the purge flow by measuring the EVAP pressure change. If negative pressure is not created, the ECM begins the 2nd monitor.

- The 2nd monitor

  The vent valve is turned ON (closed) and the EVAP pressure is then measured. If the variation in the pressure is less than 0.4 kPa-g (3.0 mmHg-g), the ECM interprets this as the purge VSV being stuck closed, 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.

OBD II MONITOR SPECIFICATIONS

1. **Key-off Monitor**

   Monitor Strategy

   MONITOR STRATEGY

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

EVAP key-off monitor runs when all of following conditions met	-
Atmospheric pressure	70 to 110 kPa-a (525 to 825 mmHg-a)
Battery voltage	10.5 V or more
Vehicle speed	Below 4 km/h (2.5 mph)
Ignition switch	OFF
Time after key off	5 or 7 or 9.5 hours
Canister pressure sensor malfunction (P0451, P0452 and P0453)	Not detected
Purge VSV	Not operated by scan tool
Vent valve	Not operated by scan tool
Leak detection pump	Not operated by scan tool
Both of following conditions met before key off	Conditions 1 and 2
1. Duration that vehicle driven	5 minutes or more

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2. EVAP purge operation	Performed
ECT	4.4 to 35°C (40 to 95°F)
IAT	4.4 to 35°C (40 to 95°F)

Typical Malfunction Thresholds

TYPICAL MALFUNCTION THRESHOLDS

Purge VSV stuck open:	-
EVAP pressure when vacuum introduction complete	Higher than reference pressure x 0.4

TYPICAL MALFUNCTION THRESHOLDS

Purge VSV stuck closed:	-
EVAP pressure change after purge VSV ON (open)	Less than 0.3 kPa-g (2.25 mmHg-g)

OBD II MONITOR SPECIFICATIONS

1. **Purge Flow Monitor**

Monitor Strategy

MONITOR STRATEGY

Required Sensors/Components	Purge VSV Canister pump module
Frequency of Operation	Once per driving cycle
Duration	Within 10 minutes
MIL Operation	2 driving cycles
Sequence of Operation	None

Typical Enabling Conditions

TYPICAL ENABLING CONDITIONS

Monitor runs whenever following DTCs not present	P0011 (VVT System 1 - Advance) P0012 (VVT System 1 - Retard) P0102 - P0103 (Mass airflow meter) P0113 (Intake air temperature sensor) P0115 - P0118 (Engine coolant temperature sensor) P0120 - P0223, P2135 (Throttle position sensor) P0125 (Insufficient ECT for Closed Loop) P0171, P0172 (Fuel system) P0300 - P0304 (Misfire) P0335 (Crankshaft position sensor) P0340 (Camshaft position sensor) P0351 - P0354 (Igniter) P0451 - P0453 (EVAP press sensor)

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	P0500 (Vehicle speed sensor)
Engine	Running
ECT	4.4°C (40°F) or more
IAT	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

Both of following conditions 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

DTC No.	Monitoring Item	Malfunction Detection Condition	Trouble Area	Detection Timing	Detection Logic
	Canister pressure sensor noise	Sensor output voltage fluctuates frequently within certain time period.	• Canister pump module • Connector/wire harness (Canister pump module - ECM) • EVAP system hose (pipe from air inlet port to canister pump module, canister filter, fuel tank vent hose) • ECM	• EVAP monitoring (ignition switch OFF) • Engine running	2 trip

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P0451	Canister pressure sensor signal becomes fixed/flat	Sensor output voltage does not vary within certain time period.	• Canister pump module • Connector/wire harness (Canister pump module - ECM) • EVAP system hose (pipe from air inlet port to canister pump module, canister filter, fuel tank vent hose) • ECM	• EVAP monitoring (ignition switch OFF)	2 trip
P0452	Canister pressure sensor low input	EVAP pressure less than 42.1 kPa for 0.5 seconds.	• Canister pump module • Connector/wire harness (Canister pump module - ECM) • EVAP system hose (pipe from air inlet port to canister pump module, canister filter, fuel tank vent hose) • ECM	• Ignition switch ON • EVAP monitoring (ignition switch OFF)	1 trip
P0453	Canister pressure sensor high input	EVAP pressure more than 123.8 kPa for 0.5 seconds.	• Canister pump module • Connector/wire harness (Canister pump module - ECM) • EVAP system hose (pipe from air inlet port to canister pump module, canister filter, fuel tank vent hose) • ECM	• Ignition switch ON • EVAP monitoring (ignition switch OFF)	1 trip

HINT:

The canister pressure sensor is built into the canister pump module.

DESCRIPTION

The description can be found in the EVAP (Evaporative Emission) System (See **DESCRIPTION**).

HINT:

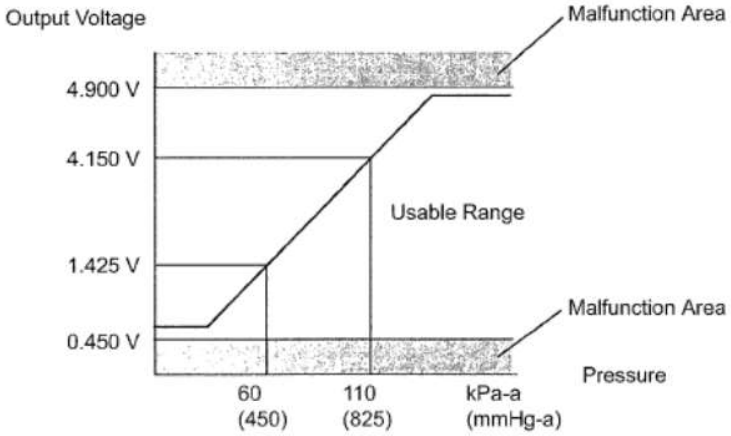
Unit expressions

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- [kPa-a (mmHg-a)] denotes the absolute pressure.
- [kPa-g (mmHg-g)] denotes the gauge pressure (relative pressure).
- On a Techstream, convert the unit of measurement according to the inspection procedure.

MONITOR DESCRIPTION

Canister Pressure Sensor Specification:



HINT:

Standard atmospheric pressure is 101.3 kPa-a (760 mmHg-a)

A115543E16

Fig. 150: Canister Pressure Sensor Output Voltage Graph
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

1. DTC P0451: Canister pressure sensor noise or fixed/flat

   If the canister pressure sensor voltage output fluctuates rapidly for 10 seconds, the ECM stops the EVAP system monitor. The ECM interprets this as noise from the canister pressure sensor, and stops the EVAP system monitor. The ECM then illuminates the MIL and sets the DTC.

   Alternatively, if the sensor voltage output does not change for 10 seconds, the ECM interprets this as the sensor being fixed/flat, and stops the monitor. The ECM then illuminates the MIL and sets the DTC. (Both malfunctions are detected by 2 trip detection logic.)

2. DTC P0452: Canister pressure sensor voltage low

   If the canister pressure sensor voltage output [pressure] is below 0.45 V [42.1 kPa-a (315.7 mmHg-a)], the ECM interprets this as an open or short circuit malfunction in the canister pressure sensor or its circuit, and stops the EVAP system monitor. The ECM then illuminates the MIL and sets the DTC (1 trip detection logic).

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3. DTC P0453: Canister pressure sensor voltage high

   If the canister pressure sensor voltage output [pressure] is 4.9 V [123.8 kPa-a (928.5 mmHg-a)] or more, the ECM interprets this as an open or short circuit malfunction in the canister pressure sensor or its circuit, and stops the EVAP system monitor. The ECM then illuminates the MIL and sets the DTC (1 trip detection logic).

MONITOR STRATEGY

MONITOR STRATEGY

Required Sensors/Components	Canister pump module
Frequency of Operation	Once per driving cycle: P0451 sensor fixed/flat Continuous: P0451 sensor noise, P0452 and P0453
Duration	0.5 seconds: P0452 and P0453 2 minutes: P0451
MIL Operation	Immediate: P0452 and P0453 2 driving cycles: P0451
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

P0451 (Noise monitor):

TYPICAL ENABLING CONDITIONS

Monitor runs whenever following DTCs not present	None
Atmospheric pressure (absolute pressure)	70 to 110 kPa-a (525 to 825 mmHg-a)
Battery voltage	10.5 V or more
Intake air temperature	4.4 to 35°C (40 to 95°F)
Canister pressure sensor malfunction (P0452, 0453)	Not detected
Either of following conditions met	A or B
A. Engine condition	Running
B. Time after key off	5 or 7 or 9.5 hours

P0451 (Fixed/flat monitor):

TYPICAL ENABLING CONDITIONS

Monitor runs whenever following DTCs not present	None
Battery voltage	10.5 V or more
Intake air temperature	4.4 to 35°C (40 to 95°F)
Canister pressure sensor malfunction (P0452, 0453)	Not detected
Atmospheric pressure (absolute pressure)	70 to 110 kPa-a (525 to 825 mmHg-a)
Time after key off	5 or 7 or 9.5 hours

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P0452 and P0453:

TYPICAL ENABLING CONDITIONS

Monitor runs whenever following DTCs not present	None
Either of following conditions met	(a) or (b)
(a) Ignition switch	ON
(b) Soak timer	ON

TYPICAL MALFUNCTION THRESHOLDS

P0451: Canister pressure sensor noise

TYPICAL MALFUNCTION THRESHOLDS

Frequency that EVAP pressure change 0.3 kPa-g (2.25 mmHg-g) or more	10 times or more in 10 seconds

P0451: Canister pressure sensor fixed/flat

TYPICAL MALFUNCTION THRESHOLDS

EVAP pressure change during reference pressure	Less than 0.65 kPa-g (4.87 mmHg-g)

P0452: Canister pressure sensor low voltage

TYPICAL MALFUNCTION THRESHOLDS

EVAP pressure	Less than 42.1 kPa-a (315.8 mmHg-a)

P0453: Canister pressure sensor high voltage

TYPICAL MALFUNCTION THRESHOLDS

EVAP pressure	More than 123.8 kPa-a (928.3 mmHg-a)

WIRING DIAGRAM

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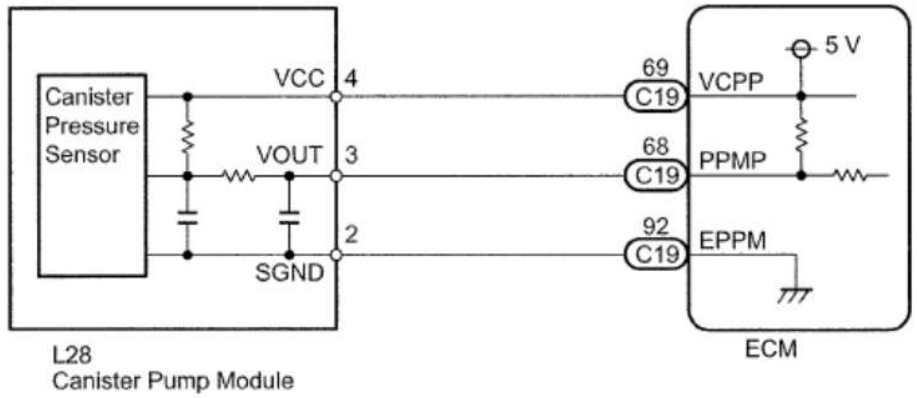


Fig. 151: Canister Pressure Sensor - Wiring Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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.**
- **A Techstream is required to conduct the following diagnostic troubleshooting procedure.**

1. **CONFIRM DTC AND EVAP PRESSURE**
   a. Connect a Techstream to the DLC3.
   b. Turn the ignition switch to ON (do not start the engine).
   c. Turn the tester ON.
   d. Select the following menu items: Powertrain / Engine and ECT / Trouble Codes.
   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 REFERENCE

Display (DTC Output)	Test Result	Suspected Trouble Area	Proceed to
P0451	-	Canister pressure sensor	C

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P0452	Less than 45 kPa-a (430 mmHg-a)	• Wire harness/connector (ECM - Canister pressure sensor) • Canister pressure sensor • ECM	A
P0453	More than 120 kPa-a (900 mmHg-a)	• Wire harness/connector (ECM - Canister pressure sensor) • Canister pressure sensor • ECM	B

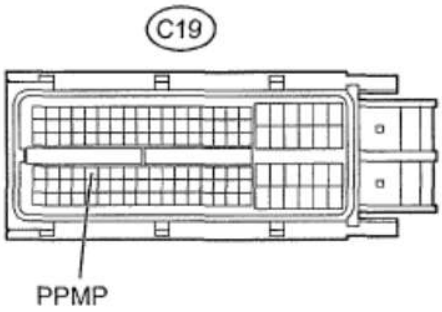
B: Go to step 4

C: Go to **EVAP SYSTEM**

A: Go to next step

2. **CHECK HARNESS AND CONNECTOR (CANISTER PUMP MODULE - ECM)**
   a. Turn the ignition switch to OFF.
   b. Disconnect the ECM connector.
   c. Measure the resistance according to the value(s) in the table below.

Front view of wire harness connector:
(to ECM)



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Fig. 152: Identifying ECM Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Result

RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition	Suspected Trouble Area	Proceed to

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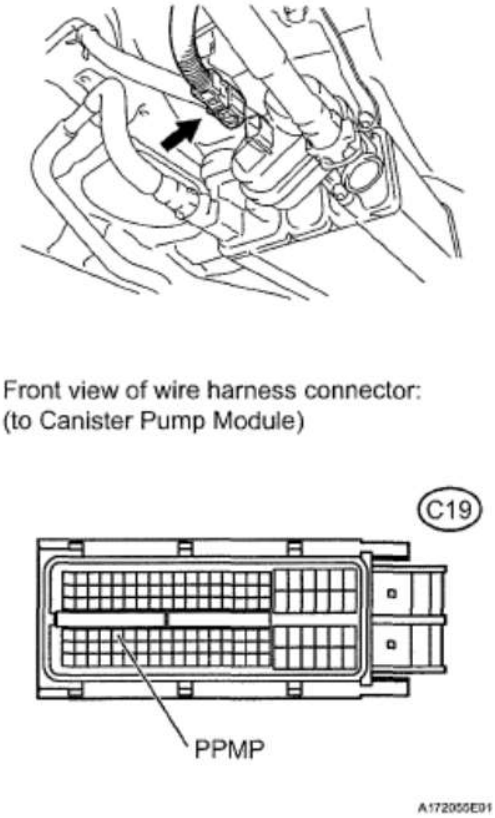
C19-68 (PPMP) - Body ground	Always	Below 10 ohms	• Wire harness/connector (ECM - Canister pressure sensor) • Short in canister pressure sensor circuit	A
		10 kohms or higher	• Wire harness/connector (ECM - Canister pressure sensor) • Short in ECM circuit	B

d. Reconnect the ECM connector.

B: Go to step 7

A: Go to next step

3. **CHECK HARNESS AND CONNECTOR (CANISTER 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.



Front view of wire harness connector:
(to Canister Pump Module)

Fig. 153: Locating Canister Pump Module Connector

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

Result

RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition	Suspected Trouble Area	Proceed to
C19-68 (PPMP) - Body ground	Always	10 kohms or higher	Short in canister pressure sensor circuit	A
		Below 10 ohms	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. Measure the voltage and resistance according to the value(s) in the table below.

Standard voltage

VOLTAGE SPECIFICATION

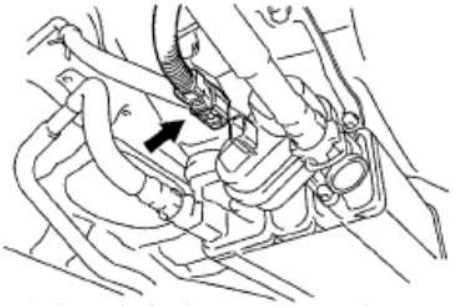
Tester Connection	Switch Condition	Specified Condition
L28-4 (VCC) - Body ground	Ignition switch ON	4.5 to 5.5 V
L28-3 (VOUT) - Body ground	Ignition switch ON	4.5 to 5.5 V

Standard resistance

RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
L28-2 (SGND) - Body ground	Always	Below 100 ohms

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Front view of wire harness connector:
(to Canister Pump Module Connector)

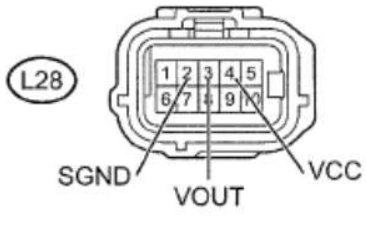


Fig. 154: Locating Canister Pump Module Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Result

RESULT REFERENCE

Test Result	Suspected Trouble Area	Proceed to
Voltage and resistance within standard ranges	Open in canister pressure sensor circuit	A
Voltage and resistance outside standard ranges	Open in wire harness/connector (ECM - Canister pressure sensor)	B

c. Reconnect the canister pump module connector.

B: Go to step 6

A: Go to next step

5. **REPLACE CHARCOAL CANISTER ASSEMBLY**
   a. Replace the charcoal canister assembly (See **REMOVAL**).

NOTE: **When replacing the charcoal canister assembly, 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**

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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.

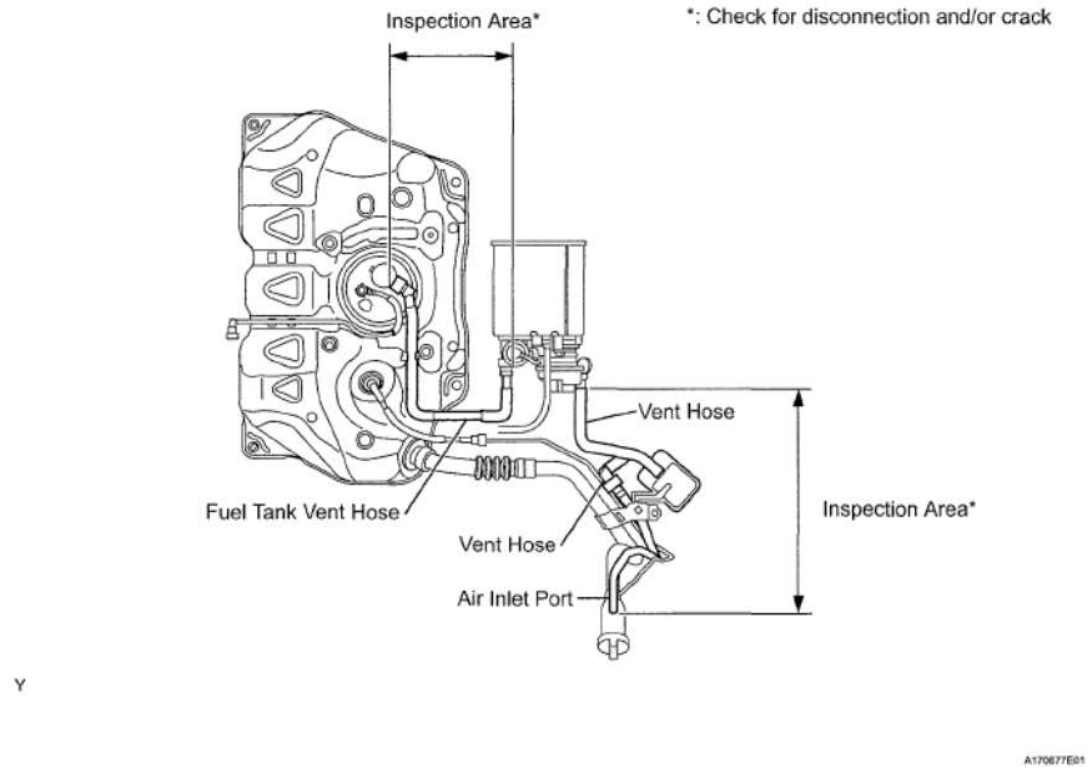


Fig. 155: Identifying Charcoal Canister Assembly Inspection Area
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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.

   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 a Techstream to the DLC3.

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b. Turn the ignition switch to ON.
c. Turn the tester ON.
d. Wait for at least 60 seconds.
e. Select the following menu items: Powertrain / Engine and ECT / Trouble Codes / Pending.

HINT:

If no pending DTCs are displayed on the tester, the repair has been successfully completed.

NEXT : END

DTC P0455 EVAPORATIVE EMISSION CONTROL SYSTEM LEAK DETECTED (GROSS LEAK); DTC P0456 EVAPORATIVE EMISSION CONTROL SYSTEM LEAK DETECTED (VERY SMALL LEAK)

DTC SUMMARY

DTC SUMMARY

DTC No.	Monitoring Item	Malfunction Detection Condition	Trouble Area	Detection Timing	Detection Logic
P0455	EVAP gross leak	Leak detection pump creates negative pressure (vacuum) in EVAP system and EVAP system pressure measured. Reference pressure measured at start and at end of leak check. If stabilized pressure higher than [second reference pressure x 0.2], ECM determines that EVAP system has large leak.	• Fuel tank cap (loose) • Leak from EVAP line (Canister - Fuel tank) • Leak from EVAP line (Purge VSV - Canister) • Canister pump module • Leak from fuel tank • Leak from canister	While ignition switch OFF	2 trip
		Leak detection pump creates negative pressure (vacuum) in EVAP system and EVAP system pressure measured. Reference pressure measured at start	• Fuel tank cap (loose) • Leak from EVAP line (Canister - Fuel tank) • Leak from	While	

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P0456	EVAP small leak	and at end of leak check. If stabilized pressure higher than second reference pressure, ECM determines that EVAP system has small leak.	EVAP line (Purge VSV - Canister) • Canister pump module • Leak from fuel tank • Leak from canister	ignition switch OFF	2 trip

DESCRIPTION

The description can be found in the EVAP (Evaporative Emission) System (See **DESCRIPTION**).

INSPECTION PROCEDURE

Refer to the **EVAP SYSTEM** .

HINT:

Unit expressions

- [kPa-a (mmHg-a)] denotes the absolute pressure.
- [kPa-g (mmHg-g)] denotes the gauge pressure (relative pressure).
- On a Techstream, convert the unit of measurement according to the inspection procedure.

MONITOR DESCRIPTION

5 hours* after the ignition switch is turned to OFF, the leak detection pump creates negative pressure (vacuum) in the EVAP system. The ECM monitors for leaks and actuator malfunctions based on the EVAP pressure.

HINT:

*: If the engine coolant temperature is not below 35°C (95°F) 5 hours after the ignition switch is turned to 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 to OFF, the monitor check starts 2.5 hours later.

OPERATION DESCRIPTION CHART

Sequence	Operation	Description	Duration
-	ECM activation	Activated by soak timer 5, 7 or 9.5 hours after ignition switch turned to OFF.	-
A	Atmospheric pressure measurement	Vent valve turned OFF (vent) and EVAP system pressure measured by ECM in order to register atmospheric pressure. If pressure in EVAP system not between 70 kPa-a and 110 kPa-a (525 mmHg-a and 825 mmHg-a), ECM cancels EVAP	10 seconds

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		system monitor.	
B	First reference pressure measurement	In order to determine reference pressure, leak detection pump creates negative pressure (vacuum) through reference orifice and then ECM checks if leak detection pump and vent valve operate normally.	60 seconds
C	EVAP system pressure measurement	Vent valve turned ON (closed) to shut EVAP system. Negative pressure (vacuum) created in EVAP system, and EVAP system pressure then measured. Write down measured value as it will be used in leak check. If EVAP pressure does not stabilize within 15 minutes, ECM cancels EVAP system monitor.	15 minutes(1)
D	Purge VSV monitor	Purge VSV opened and then EVAP system pressure measured by ECM. Large increase indicates normality.	10 seconds
E	Second reference pressure measurement	After second reference pressure measurement, leak check performed by comparing first and second reference pressure. If stabilized system pressure higher than second reference pressure, ECM determines that EVAP system leaking.	60 seconds
-	Final check	Atmospheric pressure measured and then monitoring result recorded by ECM.	-

(1) If only a small amount of fuel is in the fuel tank, it takes longer for the EVAP pressure to stabilize.

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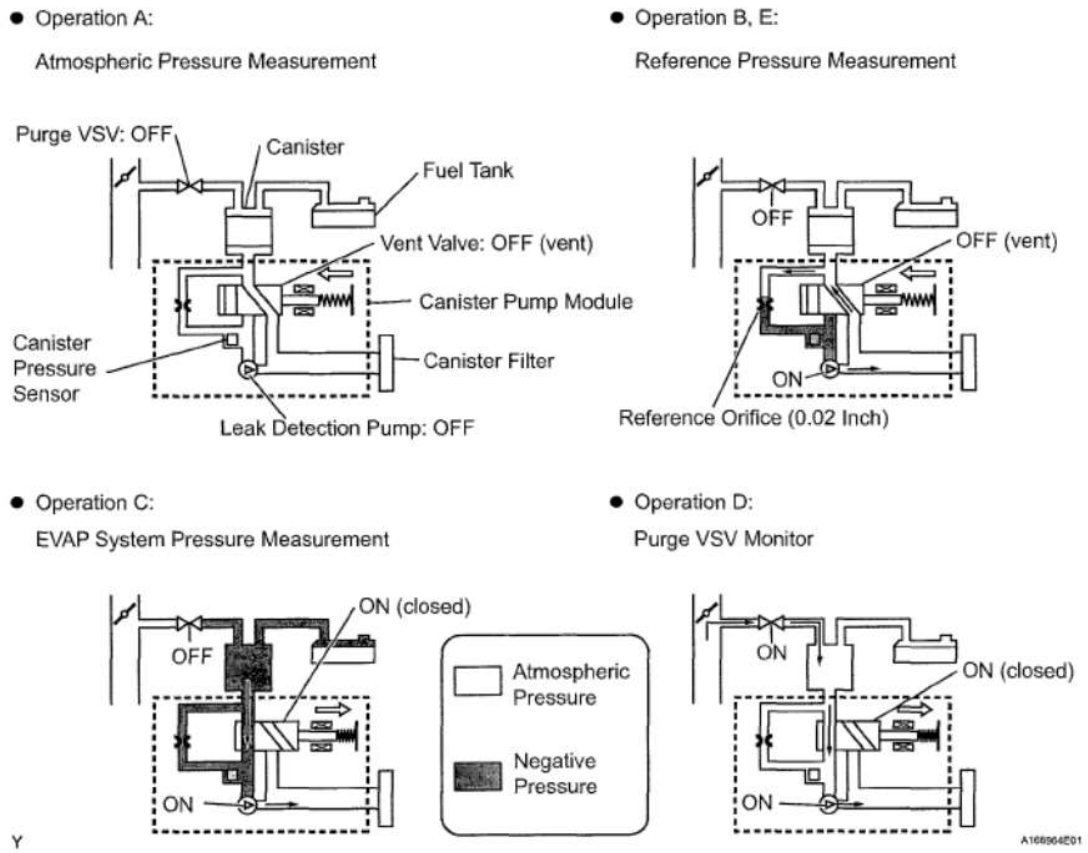


Fig. 156: Evaporative Emission System Operation Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

a. P0455: EVAP gross leak

In operation C, the leak detection pump creates negative pressure (vacuum) in the EVAP system and the EVAP system pressure is measured. If the stabilized system pressure is higher than [second reference pressure x 0.2] (near atmospheric pressure), the ECM determines that the EVAP system has a large leak, illuminates the MIL and sets the DTC (2 trip detection logic).

b. P0456: EVAP very small leak

In operation C, the leak detection pump creates negative pressure (vacuum) in the EVAP system and the EVAP system pressure is measured. If the stabilized system pressure is higher than the second reference pressure, the ECM determines that the EVAP system has a small leak, illuminates the MIL and sets the DTC (2 trip detection logic).

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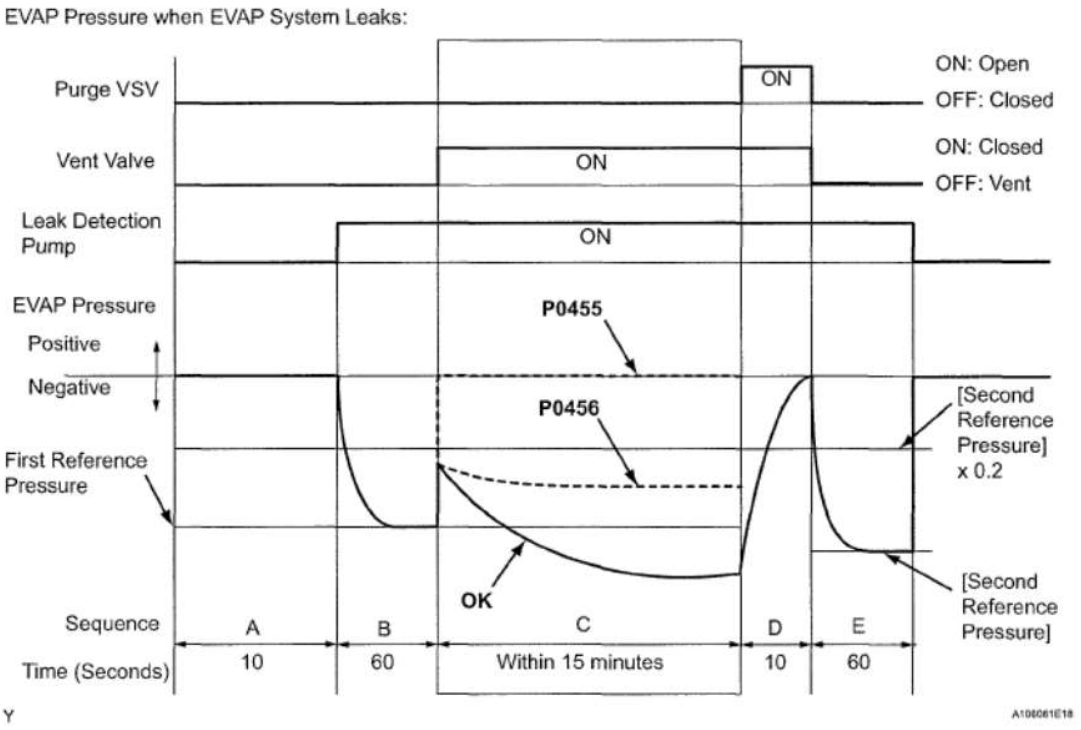


Fig. 157: EVAP Pressure Graph
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

MONITOR STRATEGY

MONITOR STRATEGY

Required Sensors/Components	Purge VSV and canister pump module
Frequency of Operation	Once per driving cycle
Duration	Within 15 minutes (varies with amount of fuel in tank)
MIL Operation	2 driving cycles
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

P0455, P0456:

TYPICAL ENABLING CONDITIONS

Monitor runs whenever following DTCs not present	None
EVAP key-off monitor runs when all of following conditions met	-
Atmospheric pressure	70 to 110 kPa-a (525 to 825 mmHg-a)
Battery voltage	10.5 V or more
Vehicle speed	Below 4 km/h (2.5 mph)
Ignition switch	OFF
Time after key off	5 or 7 or 9.5 hours

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Canister pressure sensor malfunction (P0451, P0452 and P0453)	Not detected
Purge VSV	Not operated by scan tool
Vent valve	Not operated by scan tool
Leak detection pump	Not operated by scan tool
Both of following conditions met before key off	Conditions 1 and 2
1. Duration that vehicle is driven	5 minutes or more
2. EVAP purge operation	Performed
ECT	4.4 to 35°C (40 to 95°F)
IAT	4.4 to 35°C (40 to 95°F)

TYPICAL MALFUNCTION THRESHOLDS

P0455: EVAP gross leak

TYPICAL MALFUNCTION THRESHOLDS

EVAP pressure when vacuum introduction complete	Higher than reference pressure x 0.2

P0456: EVAP small leak

TYPICAL MALFUNCTION THRESHOLDS

EVAP pressure when vacuum introduction complete	Between reference pressure and reference pressure x 0.2

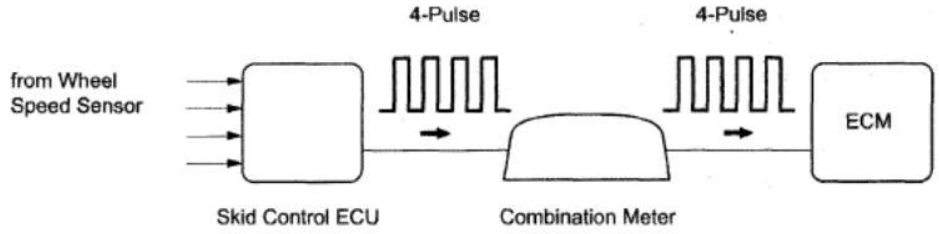
MONITOR RESULT

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. 158: Communication Diagram Between Wheel Speed Sensor And ECM
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DTC DETECTION CONDITION AND TROUBLE AREA

DTC No.	DTC Detection Condition	Trouble Area
P0500	While vehicle being driven, no vehicle speed sensor signal transmitted to ECM (2 trip detection logic: M/T models) (1 trip detection logic: A/T models)	• Open or short in speed signal circuit • Speed meter circuit (wheel speed sensor, skid control ECU) • Combination meter • ECM

MONITOR DESCRIPTION

Automatic Transaxle Models:

The ECM assumes that the vehicle is being driven when the vehicle speed sensor signal is being transmitted by the combination meter. If there is no signal from the combination meter, despite the ECM detecting the speed signal from the speed sensor NC, the ECM interprets this as a malfunction in the speed signal circuit. The ECM then illuminates the MIL and sets the DTC.

Manual Transaxle Models:

The ECM assumes that the vehicle is being driven when the indicated engine speed is more than 2,000 rpm and the engine load calculated by the ECM is more than a certain level or the idle fuel-cut operation* is being executed. If there is no signal from the vehicle speed sensor, despite these conditions being met, the ECM interprets this as a malfunction in the speed signal circuit. The ECM then illuminates the MIL and sets the DTC.

*: Idle fuel-cut is executed when the throttle valve is fully closed and engine speed is over 2800 rpm.

MONITOR STRATEGY

MONITOR STRATEGY

Related DTCs	P0500: Vehicle speed sensor "A" pulse input error
Required Sensors/Components (Main)	Vehicle Speed Sensor (VSS) Combination meter Skid control ECU
Required Sensors/Components (Related)	Park/Neutral Position (PNP) switch Engine Coolant Temperature (ECT) sensor Crankshaft Position (CKP) sensor Throttle Position (TP) sensor Mass Air Flow (MAF) meter
Frequency of Operation	Continuous
Duration	2 seconds: A/T models 8 seconds: M/T models, Case 1

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	4.9 seconds: M/T models, Case 2
MIL Operation	Immediate: A/T models 2 driving cycles: M/T models
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

M/T Models, Case 1

TYPICAL ENABLING CONDITIONS

Monitor runs whenever following DTCs not present	P0102 - P0103 (Mass air flow meter) P0115 - P0118 (Engine coolant temperature sensor) P0125 (Insufficient ECT for Closed Loop)
Engine coolant temperature	70°C(158°F) or more
Engine speed	2000 to 5000 rpm
Engine load	30.2 % or more
Fuel-cut at high engine speed	Not operating

M/T Models, Case 2

TYPICAL ENABLING CONDITIONS

Monitor runs whenever following DTCs not present	P0102 - P0103 (Mass air flow meter) P0115 - P0118 (Engine coolant temperature sensor) P0125 (Insufficient ECT for Closed Loop)
Idle	ON
Fuel-cut	ON

A/T Models

TYPICAL ENABLING CONDITIONS

Monitor runs whenever following DTCs not present	None
Time after ignition switch OFF to ON	3 seconds or more
Vehicle speed at output speed sensor	13 km/h (8 mph) or more
TP sensor angle < 21°	2640 rpm or more
TP sensor angle < 30°	2760 rpm or more
TP sensor angle > = 30°	3060 rpm or more
Battery voltage	8 V or more
Ignition switch	ON
Starter	OFF

TYPICAL MALFUNCTION THRESHOLDS

TYPICAL MALFUNCTION THRESHOLDS

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Vehicle speed sensor signal	No pulse input

WIRING DIAGRAM

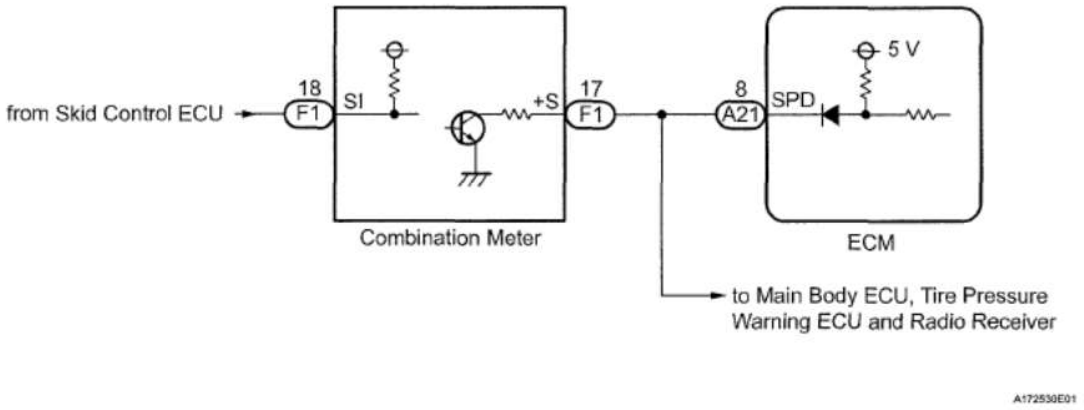


Fig. 159: Vehicle Speed Sensor - Wiring Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSPECTION PROCEDURE

HINT:

Read freeze frame data using a 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. **CHECK OPERATION OF SPEEDOMETER**
   a. Drive the vehicle and check whether the operation of the speedometer in the combination meter is normal.

      OK:

      The operation of the speedometer is normal.

      HINT:

      - The vehicle speed sensor is operating normally if the speedometer reading is normal.
      - If the speedometer does not operate, check it by following the procedure described in Speedometer Malfunction (See **SPEEDOMETER MALFUNCTION**).

   NG: GO TO MALFUNCTION IN SPEEDOMETER (See **SPEEDOMETER MALFUNCTION**)

   OK: Go to next step

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2. **READ VALUE USING TECHSTREAM (VEHICLE SPEED)**
   a. Connect a Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the tester ON.
   d. Select the following menu items: Powertrain / Engine and ECT / Data List / All Data / Vehicle Speed.
   e. Drive the vehicle.
   f. Read the value displayed on the tester.

   OK:

   Vehicle speeds displayed on tester and speedometer display are equal.

   NG: Go to step 3

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

3. **CHECK COMBINATION METER (+S VOLTAGE)**
   a. Disconnect the combination meter connector.
   b. Turn the ignition switch to ON.
   c. Measure the voltage according to the value(s) in the table below.

   Standard voltage

   VOLTAGE SPECIFICATION

Tester Connection	Switch Condition	Specified Condition
F1-17 (+S) - Body ground	Ignition switch ON	4.5 to 5.5 V

   d. Reconnect the combination meter connector.

   NG: Go to step 5

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Front view of wire harness connector:
(to Combination Meter)

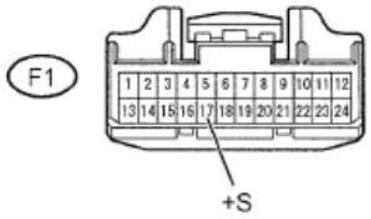


Fig. 160: Identifying Combination Meter Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

4. **CHECK COMBINATION METER (SPD SIGNAL WAVEFORM)**
   a. Remove the combination meter.
   b. Connect the combination meter connector.
   c. Move the shift lever to the neutral position.
   d. Jack up the vehicle.
   e. Turn the ignition switch to ON.
   f. Check the voltage between the terminal of the combination meter and the body ground while the wheel is turned slowly.

      Standard voltage

      VOLTAGE SPECIFICATION

Tester Connection	Switch Condition	Specified Condition
F1-17 (+S) - Body ground	Ignition switch ON (Turn wheel slowly)	Voltage generated intermittently

      HINT:

      The output voltage should fluctuate up and down, similarly to the diagram, when the wheel is turned slowly.

   g. Reinstall the combination meter.

NG: REPLACE COMBINATION METER (See **REMOVAL**)

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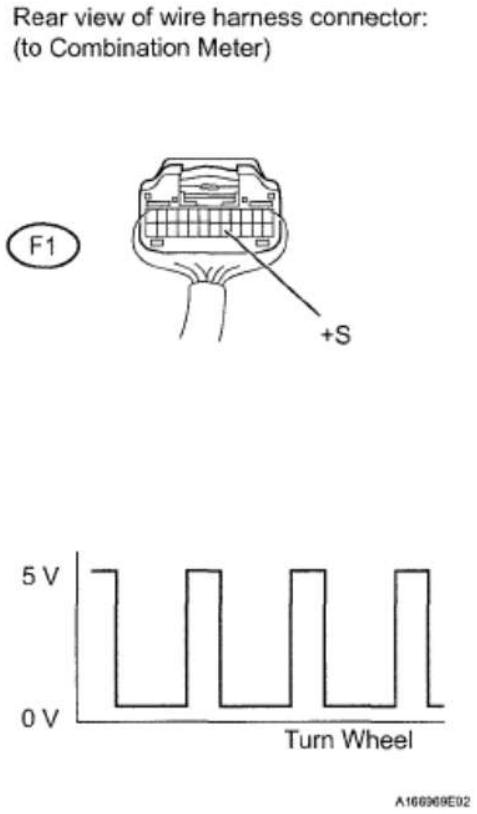


Fig. 161: Identifying Combination Meter Connector Terminal With Voltage Graph
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

5. **CHECK HARNESS AND CONNECTOR (COMBINATION METER - ECM)**
   a. Disconnect the combination meter connector.
   b. Disconnect the ECM connector.
   c. Measure the resistance according the value(s) in the table below.

Standard resistance (Check for open)

RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
F1-17 (+S) - A21-8 (SPD)	Always	Below 1 ohms

Standard resistance (Check for open)

RESISTANCE SPECIFICATION

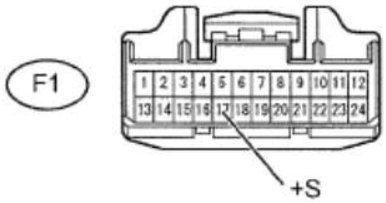
Tester Connection	Condition	Specified Condition
F1-17 (+S) or A21-8 (SPD) - Body ground	Always	10 kohms or higher

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d. Reconnect the combination meter connector.
e. Reconnect the ECM connector.

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR

Front view of wire harness connector:
(to Combination Meter)



Front view of wire harness connector:
(to ECM)

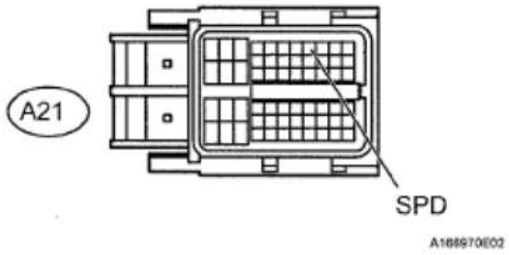


Fig. 162: Identifying Combination Meter And ECM Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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

DTC P0504 BRAKE SWITCH "A" / "B" CORRELATION

DESCRIPTION

The stop light switch is a duplex system that transmits two signals: STP and ST1-. These two signals are used by the ECM to monitor whether or not the brake system is working properly. If the signals, which indicate the brake pedal is being depressed and released, are detected simultaneously, the ECM interprets this as a malfunction in the stop light switch and sets the DTC.

HINT:

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The normal conditions are as shown in the table below. The signals can be read using a Techstream.

SIGNALS AND BRAKE PEDAL POSITION REFERENCE

Signal	Brake Pedal Released	In Transition	Brake Pedal Depressed
STP	OFF	ON	ON
ST1-	ON	ON	OFF

DTC DETECTION CONDITION AND TROUBLE AREA

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 b. Brake pedal released c. STP signal OFF when ST1- signal OFF	• Short in stop light switch signal circuit • STOP fuse • IGN fuse • Stop light switch • ECM

WIRING DIAGRAM

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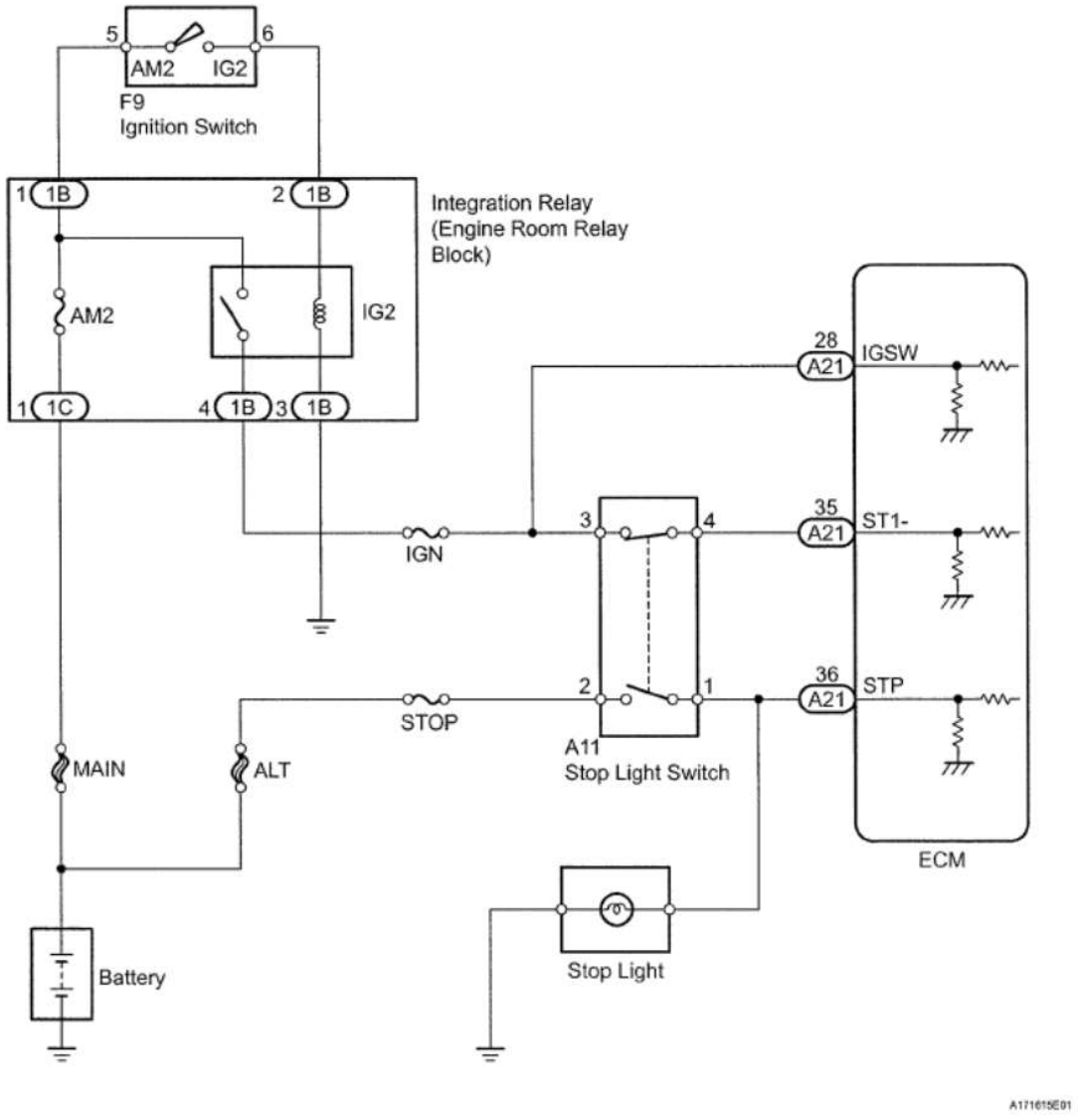


Fig. 163: Brake Switch - Wiring Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSPECTION PROCEDURE

HINT:

- Read freeze frame data using a 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.
- STP signal conditions can be checked using the Techstream.
  a. Connect the Techstream to the DLC3.
  b. Turn the ignition switch to ON.

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c. Turn the tester ON.
d. Select the following menu items: Powertrain / Engine and ECT / All Data / Stop Light Switch.
e. Check the STP signal when the brake pedal is depressed and released.

BRAKE PEDAL OPERATION AND SPECIFIED CONDITION

Brake Pedal Operation	Specified Condition
Depressed	STP signal ON
Released	STP signal OFF

1. **INSPECT STOP LIGHT SWITCH (TERMINAL VOLTAGE)**
   a. Disconnect the stop light switch connector.
   b. Measure the voltage according to the value(s) in the table below.

Standard voltage

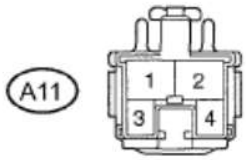
VOLTAGE SPECIFICATION

Tester Connection	Switch Condition	Specified Condition
A11-2 - Body ground	Always	11 to 14 V
A11-3 - Body ground	Ignition switch ON	11 to 14 V

   c. Reconnect the stop light switch connector.

NG: Go to step 4

Front view of wire harness connector:
(to Stop Light Switch)



A148738E11

Fig. 164: Identifying Stop Light Switch Connector Terminals
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OK: Go to next step

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2. **INSPECT STOP LIGHT SWITCH**
   a. Remove the stop light switch.
   b. Measure the resistance according to the value(s) in the table below.

Standard resistance

RESISTANCE SPECIFICATION

Tester Connection	Switch Condition	Specified Condition
1 - 2	Switch pin not pushed	Below 1 ohms
	Switch pin pushed	10 kohms or higher
3 - 4	Switch pin not pushed	10 kohms or higher
	Switch pin pushed	Below 1 ohms

   c. Reinstall the stop light switch.

NG: REPLACE STOP LIGHT SWITCH (See **REMOVAL**)

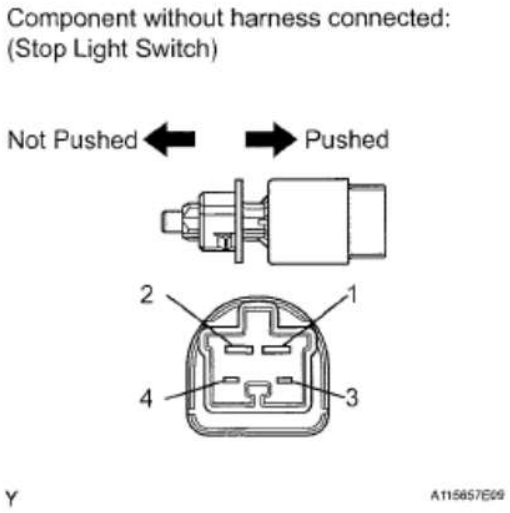


Fig. 165: Inspecting Stop Light Switch
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

3. **INSPECT ECM (STP AND ST1-VOLTAGE)**
   a. Disconnect the ECM connector.
   b. Turn the ignition switch to ON.
   c. Measure the voltage according to the value(s) in the table below.

Standard voltage

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VOLTAGE SPECIFICATION

Tester Connection	Condition	Specified Condition
A21-35 (ST1-) - Body ground	Brake pedal released	11 to 14 V
	Brake pedal depressed	0 to 3 V
A21-36 (STP) - Body ground	Brake pedal released	0 to 3 V
	Brake pedal depressed	11 to 14 V

d. Reconnect the ECM connector.

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR

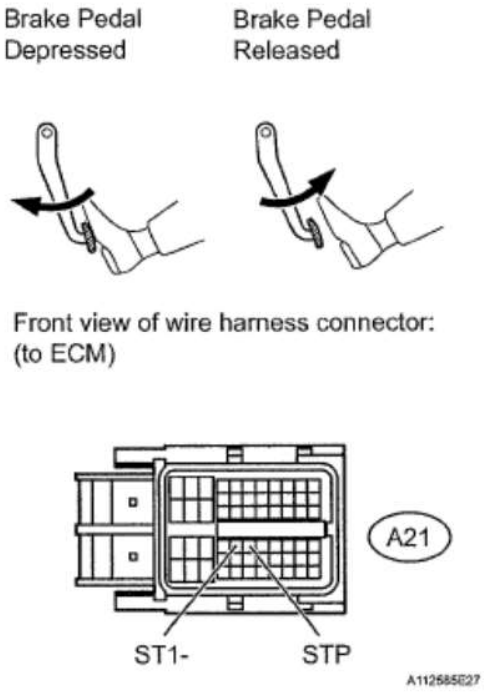


Fig. 166: Depressing And Releasing Brake Pedal
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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

4. **INSPECT FUSES (STOP AND IGN FUSES)**
   a. Remove the STOP and IGN fuses from the main body ECU.
   b. Measure the resistance according to the value(s) in the table below.

Standard resistance

RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition

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STOP fuse IGN fuse	Always	Below 1 ohms

c. Reinstall the STOP and IGN fuses.

NG: CHECK FOR SHORTS IN ALL HARNESSES AND CONNECTORS CONNECTED TO FUSE AND REPLACE FUSE

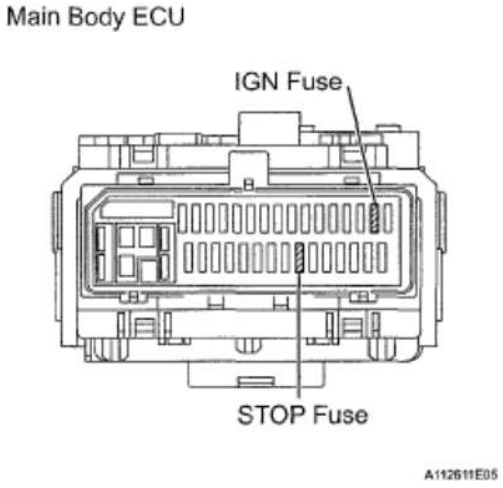


Fig. 167: Identifying STOP And IGN Fuse
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK : REPAIR OR REPLACE HARNESS OR CONNECTOR (BATTERY - STOP LIGHT SWITCH)

DTC P0505 IDLE CONTROL SYSTEM MALFUNCTION

DESCRIPTION

The idling speed is controlled by the ETCS (Electronic Throttle Control System). The ETCS is comprised of: 1) the one valve type throttle body; 2) the throttle actuator, which operates the throttle valve; 3) the Throttle Position (TP) sensor, which detects the opening angle of the throttle valve; 4) the Accelerator Pedal Position (APP) sensor, which detects the accelerator pedal position; and 5) the ECM, which controls the ETCS. Based on the target idling speed, the ECM controls the throttle actuator to provide the proper throttle valve opening angle.

DTC DETECTION CONDITION AND TROUBLE AREA

DTC No.	DTC Detection Condition	Trouble Area
P0505	Idling speed continues to vary greatly from target idling speed (2 trip detection logic)	• ETCS (Electronic Throttle Control System) • Air induction system • PCV hose connections

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		• 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 apply:

- The learned idling air flow volume remains at the maximum or minimum volume 5 times or more during a drive cycle.
- After driving at 10 km/h (6.25 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 during a drive cycle.

Example:

If the actual idling speed varies from the target idling speed by more than 200 rpm* 5 times during a drive cycle, the ECM illuminates the MIL and sets the DTC.

HINT:

*: Threshold idling speed varies with engine load.

Example:

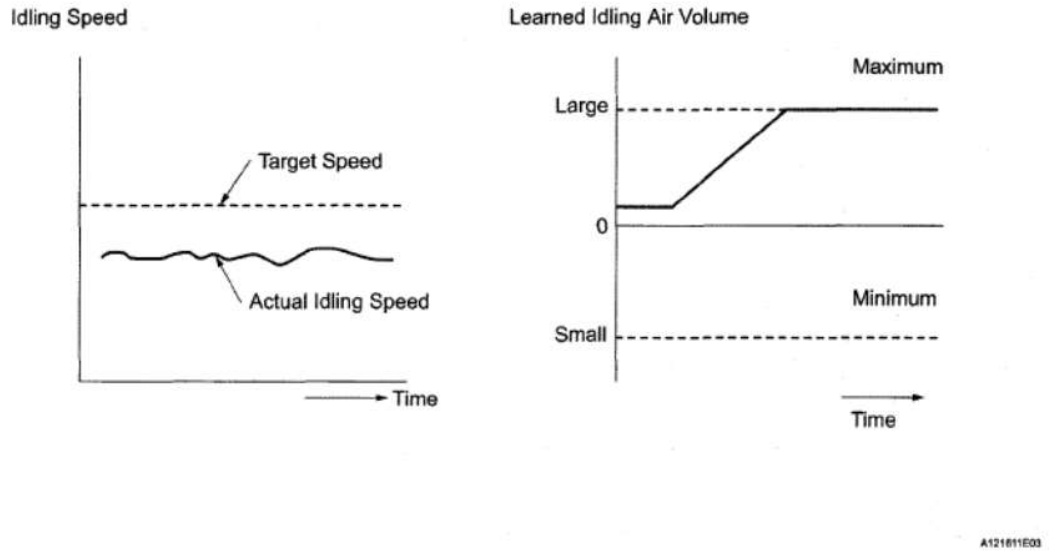


Fig. 168: Idling Speed Graph
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

MONITOR STRATEGY

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MONITOR STRATEGY

Related DTCs	P0505: ISC function
Required Sensors/Components (Main)	ETCS (Electronic Throttle Control System)
Required Sensors/Components (Related)	Crankshaft position sensor Engine coolant temperature sensor Vehicle speed sensor
Frequency of Operation	Once per driving cycle
Duration	10 minutes
MIL Operation	2 driving cycles
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

TYPICAL ENABLING CONDITIONS

Engine	Running

TYPICAL MALFUNCTION THRESHOLDS

TYPICAL MALFUNCTION THRESHOLDS

Either of following conditions 1 or 2 met	-
1. Frequency that both of following conditions (a) and (b) set	5 times or more
(a) Engine rpm - Target engine rpm	Less than -100 rpm, or more than 150 rpm
(b) Vehicle condition	Stop after vehicle was driven at 10 km/h (6.25 mph) or more
2. Frequency that both of following conditions (c) and (d) set	Once
(c) Engine rpm - Target engine rpm	Less than -100 rpm, or more than 150 rpm
(d) IAC flow rate learning value	0.5 L/sec. or less, or 6.1 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 a 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. **CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P0505)**

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

Result

RESULT REFERENCE

Result	Proceed to
P0505	A
P0505 and other DTCs	B

HINT:

If any DTCs other than P0505 are output, troubleshoot those DTCs first.

B: Go to DTC CHART (See **DIAGNOSTIC TROUBLE CODE 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 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. **INSPECT THROTTLE BODY (THROTTLE VALVE)**
   a. Check the throttle valve condition.

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OK:

Throttle valve is not contaminated with foreign objects and moves smoothly.

NG: REPAIR OR REPLACE THROTTLE BODY (See **REMOVAL**)

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

DTC P050A COLD START IDLE AIR CONTROL SYSTEM PERFORMANCE

MONITOR DESCRIPTION

This monitor will run when the engine is started at an engine coolant temperature of -10 to 50°C (14 to 122°F). The DTC will set after the engine idles for 13 seconds (2 trip detection logic).

The DTC is designed to monitor the idle air control at cold start. When the engine is started at an engine coolant temperature of lower than 50°C (122°F), the ECM measures the accumulated mass air flow at engine idling. If it does not reach the specified level 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 (Electronic 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 inspections or repairs, the ISC (Idle Speed Control) learning values are cleared. This DTC cannot be set with the ISC learning values cleared.

HINT:

The ISC learning is performed when the engine is warmed up and has been idling for 5 minutes.

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P050A Detection Logic:

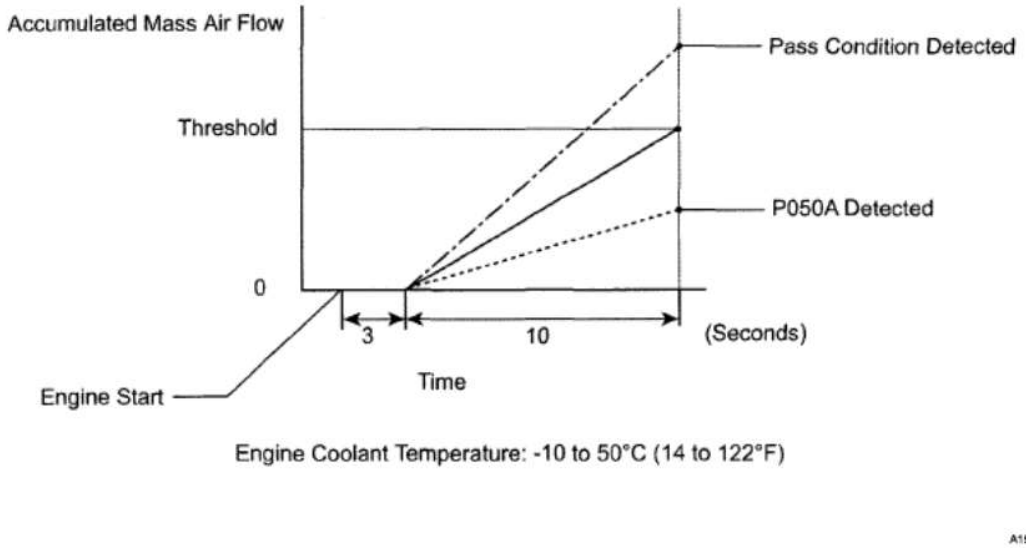


Fig. 169: Engine Coolant Temperature Graph
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

DTC DETECTION CONDITION AND TROUBLE AREA

DTC No.	DTC Detection Condition	Trouble Area
P050A	Insufficient mass air flow at cold start (2 trip detection logic)	• Throttle body • Mass air flow meter • PCV system • Air cleaner filter element • Air induction system • VVT system • ECM

MONITOR STRATEGY

MONITOR STRATEGY

Related DTCs	P050A: Cold start idle air speed control system
Required Sensors / Components (Main)	Throttle body
Required Sensors / Components (Related)	Mass air flow meter Engine Coolant Temperature (ECT) sensor
Frequency of Operation	Once per driving cycle
Duration	10 seconds
MIL Operation	2 driving cycles

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2008 ENGINE PERFORMANCE 2ZR-FE Engine Control System - xD

Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

TYPICAL ENABLING CONDITIONS

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 3 km/h (1.875 mph)
Atmospheric pressure	76 kPa (570 mmHg) or more

TYPICAL MALFUNCTION THRESHOLDS

TYPICAL MALFUNCTION THRESHOLDS

Accumulated mass air flow	Varies with ECT (Example: Less than 12.5 g)

INSPECTION PROCEDURE

HINT:

Read freeze frame data using a 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 P050A)**
   a. Connect a Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the tester ON.
   d. Select the following menu items:
      1. Techstream - Select: Powertrain / Engine and ECT / Trouble Codes.
   e. Read DTCs.

Result

RESULT REFERENCE

Result	Proceed to
P050A	A
P050A and other DTCs	B

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HINT:

If any DTCs other than P050A are output, troubleshoot those DTCs first.

NG: GO TO DTC CHART (See **DIAGNOSTIC TROUBLE CODE CHART**)

OK: 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 a Techstream to the DLC3.
b. Turn the ignition switch to ON.
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.
e. Read the values displayed on the tester.
f. Add together the Short FT #1 and Long FT #1 values to obtain the total Fuel Trim.

OK:

Total of Short FT #1 and Long FT #1 values is between -20% and 20%.

NG: Go to step 5

OK: Go to next step

3. **INSPECT THROTTLE BODY**
   a. Check that there are no deposits around the throttle valve.

OK:

No deposits around the throttle valve.

NG: Go to step 10

OK: Go to next step

4. **REPLACE ECM**
   a. Replace ECM (See **REMOVAL**).

NEXT: Go to step 15

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5. **PERFORM ACTIVE TEST USING TECHSTREAM (OPERATE OCV)**
   a. Connect a Techstream to the DLC3.
   b. Start the engine.
   c. Turn the tester ON.
   d. Turn the air conditioning switch to ON.
   e. Select the following menu items: Powertrain / Engine and ECT / Active Test / Control the VVT System (Bank 1).
   f. Check the engine speed while operating the OCV using the tester.

   Result

   TESTER OPERATION AND SPECIFIED CONDITION

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

   HINT:

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

   g. Start the engine when the engine coolant temperature is 30°C or less.
   h. Turn the tester ON.
   i. Turn the air conditioning switch to ON.
   j. Select the following menu items: Powertrain / Engine and ECT / Active Test / Control the VVT System (Bank 1).
   k. Check the engine speed while operating the OCV using the tester with the engine coolant temperature is 50°C or less.

   Result

   TESTER OPERATION AND SPECIFIED CONDITION

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 11

   OK: Go to next step

6. **CHECK PCV SYSTEM**
   a. Start the engine.
   b. Pinch the positive crankcase ventilation (PCV) hose.

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c. Check the engine rpm.

OK:

The engine rpm rises when the PCV hose is pinched.

NG: Go to step 12

OK: Go to next step

7. **CHECK AIR CLEANER FILTER ELEMENT SUB - ASSEMBLY**
   a. Visually check that the air cleaner filter element is not excessively contaminated with dirt or oil.

   OK:

   The air cleaner filter element is not excessively contaminated with dirt or oil.

   NG: Go to step 13

   OK: Go to next step

8. **CHECK AIR INDUCTION SYSTEM**
   a. Check the air induction system for vacuum leaks (See **ON-VEHICLE INSPECTION**).

   OK:

   No leakage from the air induction system.

   NG: Go to step 14

   OK: Go to next step

9. **REPLACE MASS AIR FLOW METER**
   a. Replace mass air flow meter (See **REMOVAL**).

   NEXT: Go to step 15

10. **REPAIR OR REPLACE THROTTLE BODY**
    a. Repair or replace throttle body (See **REMOVAL**).

    NEXT: Go to step 15

11. **CHECK AND REPAIR VVT SYSTEM**

    HINT:

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Refer to DTC P0011 Inspection Procedure (See **INSPECTION PROCEDURE**)

NEXT: Go to step 15

12. **REPAIR OR REPLACE PCV SYSTEM**

NEXT: Go to step 15

13. **REPLACE AIR CLEANER FILTER ELEMENT SUB - ASSEMBLY**

NEXT: Go to step 15

14. **REPAIR OR REPLACE AIR INDUCTION SYSTEM**

NEXT: Go to step 15

15. **CHECK WHETHER DTC OUTPUT RECURS (DTC P050A)**

NOTE: For this operation, the engine must be cold (the same level as the engine coolant temperature recorded in the freeze frame data).

a. Connect a Techstream to the DLC3.
b. Turn the ignition switch to ON.
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 idle it for one minute.

OK:

Stable fast idle

g. Read DTCs.

OK:

No DTC is output.

NEXT : END

DTC P050B COLD START IGNITION TIMING PERFORMANCE

DESCRIPTION

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This monitor will run when the engine is started at an engine coolant temperature of -10 to 50°C (14 to 122°F). The DTC will set after the engine idles for 13 seconds (2 trip detection logic).

The DTC is designed to monitor the ignition timing at cold start. When the engine is started at an engine coolant temperature of lower than 50°C (122°F), the ECM checks the ignition timing at engine idling. If the ignition timing advances beyond the specified level within 10 seconds, the ECM interprets this as a malfunction. The MIL is illuminated and a DTC is set when the malfunction is detected in consecutive driving cycles (2 tip detection logic).

NOTE: When the negative battery terminal is disconnected during inspections or repairs, the ISC (Idle Speed Control) learning values are cleared. This DTC cannot be set with the ISC learning values cleared.

HINT:

The ISC learning is performed when the engine is warmed up and has been idling for 5 minutes.

P050B Detection Logic:

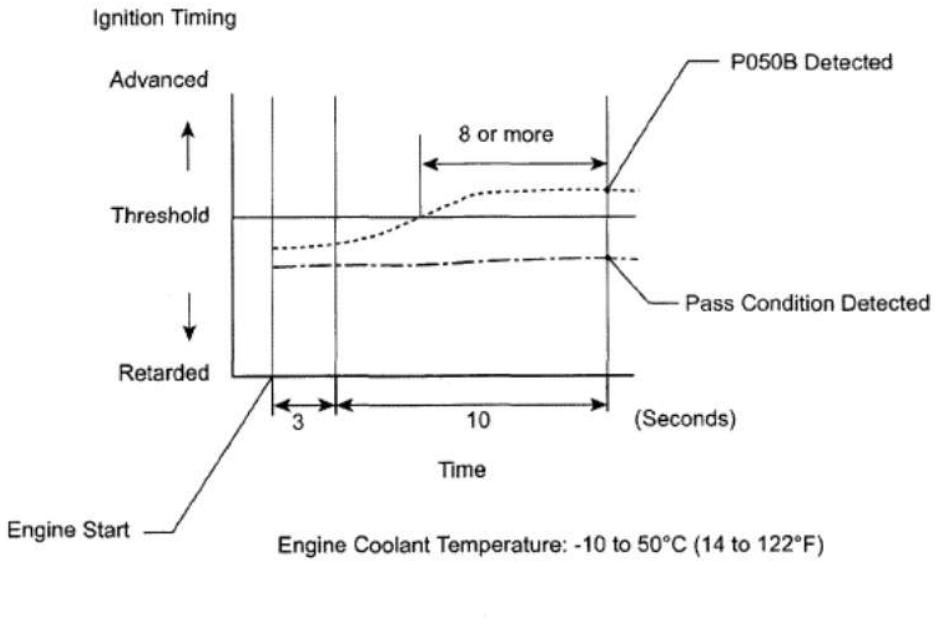


Fig. 170: Engine Coolant Temperature Graph
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

DTC DETECTION CONDITION AND TROUBLE AREA

DTC No.	DTC Detection Condition	Trouble Area
		• Throttle body assembly

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P050B	Insufficient ignition timing retard at cold start (2 trip detection logic)	• Mass air flow meter • PCV system • Air cleaner filter element • Air induction system • VVT system • ECM

MONITOR STRATEGY

MONITOR STRATEGY

Related DTCs	P050B: Cold start ignition timing performance
Required Sensors / Components (Main)	Throttle body
Required Sensors / Components (Related)	Mass air flow meter Engine Coolant Temperature (ECT) 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

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 3 km/h (1.875 mph)

TYPICAL MALFUNCTION THRESHOLDS

TYPICAL MALFUNCTION THRESHOLDS

Accumulated time when ignition timing retard value is cut off	5 seconds or more

INSPECTION PROCEDURE

HINT:

- DTC P050B may be set when the engine has the symptoms listed below. If necessary, check the trouble areas listed below

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TROUBLE AREAS REFERENCE

Symptoms	Factor	Trouble Area
Low idle speed when engine is cold (immediately after engine start)	Excessive engine friction	• Engine oil deterioration • Drive belt tension • A/C compressor • Generator • P/S pump
Rough idle when engine is cold (immediately after engine start)	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 to ON.
   c. Turn the tester ON.
   d. Select the following menu items: Powertrain / Engine and ECT / Trouble Codes.
   e. Read the DTCs.

   Result

   RESULT REFERENCE

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.

NG: GO TO DTC CHART (See **DIAGNOSTIC TROUBLE CODE CHART**)

OK: Go to next step

2. **READ VALUE USING TECHSTREAM (FUEL TRIM)**

HINT:

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Calculate the total fuel trim values to check the characteristic deviation of the mass air flow meter.

a. Connect the Techstream to the DLC3.
b. Turn the ignition switch to ON.
c. Turn the 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.
e. Read the values displayed on the tester.
f. Add together the Short FT #1 and Long FT #1 values to obtain the total Fuel Trim

OK:

Total of Short FT #1 and Long FT #1 values is between -20% and 20%.

NG: Go to step 5

OK: Go to next step

3. **CHECK THROTTLE BODY**
   a. Check that there are no deposits around the throttle valve.

OK:

No deposits around the throttle valve

NG: Go to step 10

OK: Go to next step

4. **REPLACE ECM**
   a. Replace ECM (See **REMOVAL**).

NEXT: Go to step 15

5. **PERFORM ACTIVE TEST USING TECHSTREAM (OCV OPERATION)**
   a. Connect the Techstream to the DLC3.
   b. Start the engine.
   c. Turn the tester ON.
   d. Turn the air conditioning switch to ON.
   e. Select the following menu items: Powertrain / Engine and ECT / Active Test / Control the VVT System (Bank 1).
   f. Check the engine speed while operating the OCV using the tester.

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Result

TESTER OPERATION AND SPECIFIED CONDITION

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

HINT:

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

g. Start the engine when the engine coolant temperature is 30°C or less.
h. Turn the tester ON.
i. Turn the air conditioning switch to ON.
j. Select the following menu items: Powertrain / Engine and ECT / Active Test / Control the VVT System (Bank 1).
k. Check the engine speed while operating the OCV using the tester with the engine coolant temperature is 50°C or less.

Result

TESTER OPERATION AND SPECIFIED CONDITION

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 11

OK: Go to next step

6. **CHECK PCV SYSTEM**
   a. Start the engine.
   b. Pinch the positive crankcase ventilation (PCV) hose.
   c. Check the engine rpm.

   OK:

   The engine rpm rises when the PCV hose is pinched.

NG: Go to step 12

OK: Go to next step

7. **CHECK AIR CLEANER FILTER ELEMENT SUB - ASSEMBLY**

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a. Visually check that the air cleaner filter element is not excessively contaminated with dirt or oil.

OK:

The air cleaner filter element is not excessively contaminated with dirt or oil.

NG: Go to step 13

OK: Go to next step

8. **CHECK AIR INDUCTION SYSTEM**
   a. Check the air induction system for vacuum leaks (See **ON-VEHICLE INSPECTION**).

   OK:

   No leakage from the air induction system.

   NG: Go to step 14

   OK: Go to next step

9. **REPLACE MASS AIR FLOW METER**
   a. Replace the mass air flow meter (See **REMOVAL**).

   NEXT: Go to step 15

10. **REPAIR OR REPLACE THROTTLE BODY**
    a. Repair or replace throttle body (See **REMOVAL**).

    NEXT: Go to step 15

11. **CHECK AND REPAIR VVT SYSTEM**

    NEXT: Go to step 15

12. **REPAIR OR REPLACE PCV SYSTEM**

    NEXT: Go to step 15

13. **REPLACE AIR CLEANER FILTER ELEMENT SUB - ASSEMBLY**

    NEXT: Go to step 15

14. **REPAIR OR REPLACE AIR INDUCTION SYSTEM**

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NEXT: Go to step 15

15. **CHECK WHETHER DTC OUTPUT RECURS (DTC P050B)**

NOTE: For 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 to ON.
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 and idle it for one minute.

OK:

Stable fast idle

g. Read the DTCs.

OK:

No DTC is output.

NEXT : END

DTC P0560 SYSTEM VOLTAGE

MONITOR DESCRIPTION

The battery supplies electricity to the ECM even when the ignition switch is in the OFF position. 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, the memory is cleared and the ECM determines that there is a malfunction in the power supply circuit. When the engine is next started, the ECM illuminates the MIL and sets the DTC.

DTC DETECTION CONDITION AND TROUBLE AREA

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 • Battery • Battery terminals • EFI fuse

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		• ECM

HINT:

If DTC P0560 is set, the ECM does not store other DTCs or the data stored in the ECM is partly erased.

MONITOR STRATEGY

MONITOR STRATEGY

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

Monitor runs whenever following DTCs not present	None

TYPICAL MALFUNCTION THRESHOLDS

TYPICAL MALFUNCTION THRESHOLDS

ECM power source	Less than 3.5 V

WIRING DIAGRAM

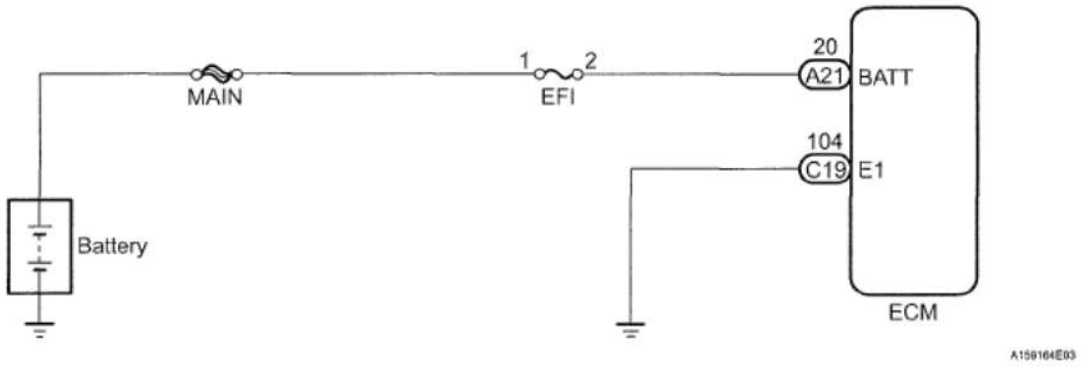


Fig. 171: System Voltage - Wiring Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSPECTION PROCEDURE

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HINT:

Read freeze frame data using a 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. **INSPECT FUSE (EFI FUSE)**
   a. Remove the EFI fuse from the engine room relay block.
   b. Measure the resistance according to the value(s) in the table below.

      Standard resistance

      RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
EFI Fuse	Always	Below 1 ohms

   c. Reinstall the EFI fuse.

NG: CHECK FOR SHORTS IN ALL HARNESSES AND CONNECTORS CONNECTED TO FUSE AND REPLACE FUSE

Engine Room Relay Block:

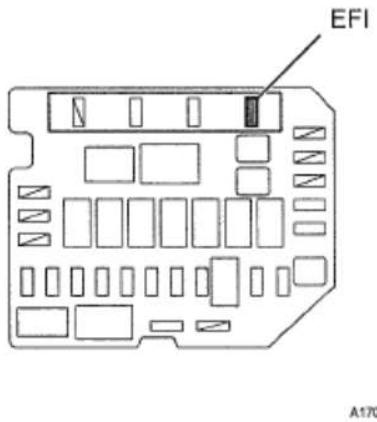


Fig. 172: Identifying EFI Fuse
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

2. **CHECK HARNESS AND CONNECTOR (ECM - EFI FUSE - BATTERY)**
   a. Disconnect the negative battery terminal.
   b. Disconnect the positive battery terminal.

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c. Remove the EFI fuse from the engine room relay block.
d. Disconnect the ECM connector.
e. Measure the resistance according to the value(s) in the table below.

Standard resistance (Check for open)

RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
EFI fuse(2) - A21-20 (BATT)	Always	Below 1 ohms
Battery positive terminal-EFI fuse (1)	Always	Below 1 ohms

Standard resistance (Check for short)

RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
EFI fuse (2) or A21-20 (BATT) - Body ground	Always	10 kohms or higher
Battery positive terminal or EFI fuse (1) - Body ground	Always	10 kohms or higher

f. Reinstall the EFI fuse.
g. Reconnect the ECM connector.
h. Reconnect the positive battery terminal,
i. Reconnect the negative battery terminal.

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR

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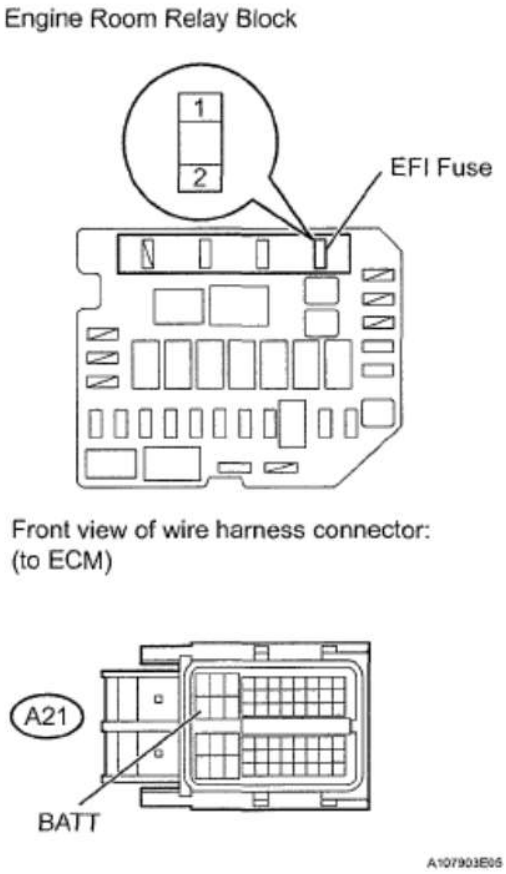


Fig. 173: Identifying ECM Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

3. **INSPECT BATTERY**
   a. Check that the battery is not depleted.

      OK:

      Battery is not depleted

   NG: REPLACE BATTERY

   OK: Go to next step

4. **CHECK BATTERY TERMINAL**
   a. Check that the battery terminals are not loose or corroded.

      OK:

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Battery terminals are not loose or corroded

NG: REPAIR OR REPLACE BATTERY TERMINAL

OK: Go to next step

5. **CHECK WHETHER DTC OUTPUT RECURS**
   a. Connect a Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the tester ON.
   d. Clear DTCs (See **DTC CHECK / CLEAR**).
   e. Turn the ignition switch to OFF and turn the tester OFF.
   f. Start the engine and turn the tester ON.
   g. Select the following menu items: Powertrain / Engine and ECT / Trouble Codes.
   h. Read DTCs.

Result

RESULT REFERENCE

Result	Proceed to
P0560	A
No output	B

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

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

DTC P0604 RANDOM ACCESS MEMORY (RAM)

MONITOR DESCRIPTION

The ECM continuously monitors its internal memory status. This self-check ensures that the ECM is functioning properly. It is diagnosed by internal "mirroring" of the main CPU and sub CPU to detect the Random Access Memory (RAM) errors. If outputs from these CPUs are different and deviate from the standards, the ECM will illuminate the MIL and set the DTC immediately.

DTC DETECTION CONDITION AND TROUBLE AREA

DTC No.	DTC Detection Condition	Trouble Area
P0604	ECM RAM errors	ECM

MONITOR STRATEGY

MONITOR STRATEGY

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Related DTCs	P0604: ECM RAM error
Required sensors/Components (Main)	ECM
Required sensors/Components (Related)	None
Frequency of operation	Continuous
Duration	6 times
MIL operation	Immediate
Sequence of operation	None

TYPICAL ENABLING CONDITIONS

TYPICAL ENABLING CONDITIONS

Monitor runs whenever following DTCs not present	None

TYPICAL MALFUNCTION THRESHOLDS

TYPICAL MALFUNCTION THRESHOLDS

Main CPU and sub CPU mirroring	Fail

INSPECTION PROCEDURE

HINT:

Read freeze frame data using a Techstream. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1. **READ OUTPUT DTC (DTC P0604)**
   a. Connect a Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the tester ON.
   d. Clear DTC (See **DTC CHECK / CLEAR**).
   e. Turn the ignition switch to OFF and turn the tester OFF.
   f. Disconnect the tester.
   g. Disconnect the cable from the battery negative (-) terminal and wait for 1 minute.
   h. Connect the cable to the battery negative (-) terminal,
   i. Connect the tester to the DLC3.
   j. Turn the ignition switch to ON.
   k. Turn the tester ON.
   l. Select the following menu items: Powertrain / Engine and ECT / Trouble Codes.
   m. Read DTCs.

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Result

RESULT REFERENCE

Result	Proceed to
No output	A
P0604	B

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

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

DTC P0606 ECM / PCM PROCESSOR

MONITOR DESCRIPTION

The ECM continuously monitors its main and sub CPUs. This self-check ensures that the ECM is functioning properly. If outputs from the CPUs are different and deviate from the standards, the ECM will illuminate the MIL and set the DTC immediately.

DTC DETECTION CONDITION AND TROUBLE AREA

DTC No.	DTC Detection Condition	Trouble Area
P0606	ECM main CPU error	ECM

MONITOR STRATEGY

MONITOR STRATEGY

Related DTC	P0606: ECM range check
Required sensors/Components (Main)	ECM
Required sensors/Components (Related)	-
Frequency of Operation	Continuous
Duration	16 seconds
MIL Operation	Immediate
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

TYPICAL ENABLING CONDITIONS

Monitor runs whenever the following DTCs are not present	None

TYPICAL MALFUNCTION THRESHOLDS

TYPICAL MALFUNCTION THRESHOLDS

CPU reset	Occurred

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INSPECTION PROCEDURE

1. **READ OUTPUT DTC (DTC P0606)**
   a. Connect a Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the tester ON.
   d. Clear DTCs (See **DTC CHECK / CLEAR**).
   e. Turn the ignition switch to OFF and turn the tester OFF.
   f. Disconnect the tester.
   g. Disconnect the cable from the battery negative (-) terminal and wait for 1 minute.
   h. Connect the cable to the battery negative (-) terminal.
   i. Connect the tester to the DLC3.
   j. Turn the ignition switch to ON.
   k. Turn the tester ON.
   l. Select the following menu items: Powertrain / Engine and ECT / Trouble Codes,
   m. Read DTCs.

   Result

   RESULT REFERENCE

Result	Proceed to
No output	A
P0606	B

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

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

DTC P0607 CONTROL MODULE PERFORMANCE

MONITOR DESCRIPTION

The ECM continuously monitors its internal processors (CPUs), Air Fuel Ratio (A/F) sensor transistors and Heated Oxygen (HO2) sensor transistors built into the ECM. This self-check ensures that the ECM is functioning properly. If outputs from the processors deviate from the standards, the ECM will illuminate the MIL and set the DTC immediately.

DTC DETECTION CONDITION AND TROUBLE AREA

DTC No.	DTC Detection Condition	Trouble Area
	When one of following conditions is met:	• Exhaust gas

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P0607	• Air Fuel Ratio (A/F) sensor transistors built into ECM malfunctions • Heated Oxygen (HO2) sensor transistors built into ECM malfunctions	leak • HO2 sensor • ECM

NOTE: **An exhaust gas leak generates noise in the HO2 sensor output. The ECM may interpret this as an HO2 sensor transistor malfunction and set P0607.**

MONITOR STRATEGY

MONITOR STRATEGY

Related DTCs	P0607: Control module performance
Required sensors/Components (Main)	ECM
Required sensors/Components (Related)	Air fuel ratio sensor Heated oxygen sensor
Frequency of operation	Continuous
Duration	60 seconds
MIL operation	immediate
Sequence of operation	None

TYPICAL ENABLING CONDITIONS

TYPICAL ENABLING CONDITIONS

Engine	Running

TYPICAL MALFUNCTION THRESHOLDS

TYPICAL MALFUNCTION THRESHOLDS

A/F sensor transistors	Fail
HO2 sensor transistors	Fail

INSPECTION PROCEDURE

1. **CHECK FOR EXHAUST GAS LEAK**
   a. Allow the engine to idle.
   b. Check for exhaust gas leak around the HO2 sensor.

   OK:

   No leak from the HO2 sensor.

NG: REPAIR OR REPLACE EXHAUST GAS LEAK POINT (See **COMPONENTS**)

OK: Go to next step

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2. **INSPECT HEATED OXYGEN SENSOR**

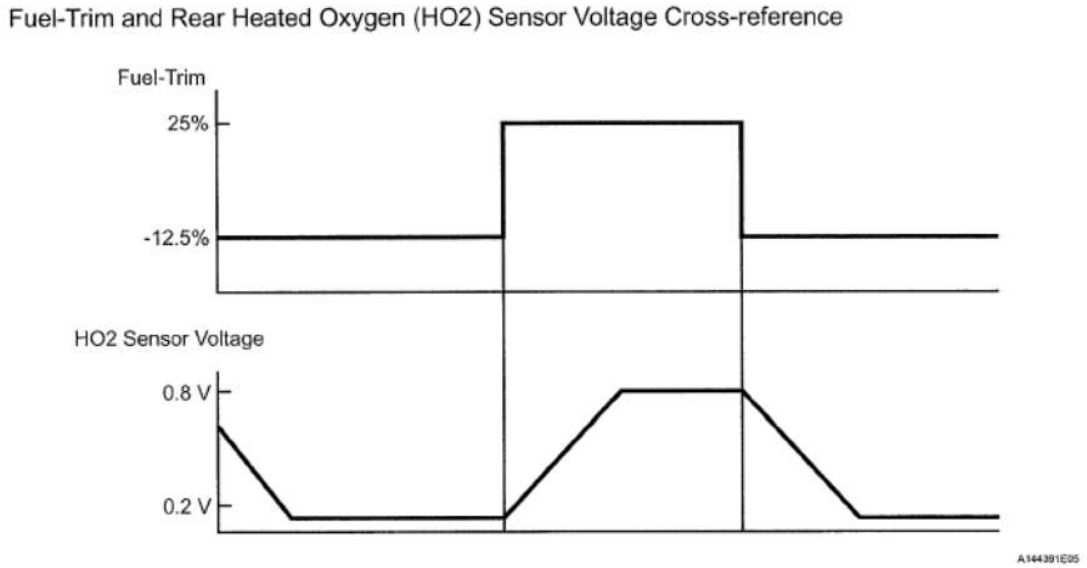


Fig. 174: Heated Oxygen Sensor Voltage Graph
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

a. Connect a Techstream to the DLC3.
b. Turn the ignition switch to ON.
c. Turn the tester ON.
d. Start the engine and warm it up.
e. Allow the engine to idle.
f. Select the following menu items: Powertrain / Engine and ECT Active Test / Control the Injection Volume for A/F Sensor.
g. Check the O2S B1S2 values when the Control the Injection Volume for A/F Sensor is -12.5% Lean fuel-trim.
h. Check the O2S B1S2 values when the Control the Injection Volume for A/F Sensor is 25% Rich fuel-trim.

Standard voltage

VOLTAGE SPECIFICATION

Control the Injection Volume for A/F Sensor	O2S B1S2
-12.5%	Below 0.2 V
25%	0.8 V or higher

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

OK: Go to next step

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3. **CHECK WHETHER DTC OUTPUT RECURS (DTC P0607)**
   a. Connect a Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the tester ON.
   d. Clear DTC (See **DTC CHECK / CLEAR**).
   e. Turn the ignition switch to OFF and turn the tester OFF.
   f. Disconnect the tester.
   g. Disconnect the cable from the battery negative (-) terminal and wait for 1 minute.
   h. Connect the cable to the battery negative (-) terminal,
   i. Connect the tester to the DLC3.
   j. Turn the ignition switch to ON.
   k. Turn the tester ON.
   l. Start the engine.

Monitor Drive Pattern for P0607:

Engine Coolant Temperature: 75°C (167°F) or more

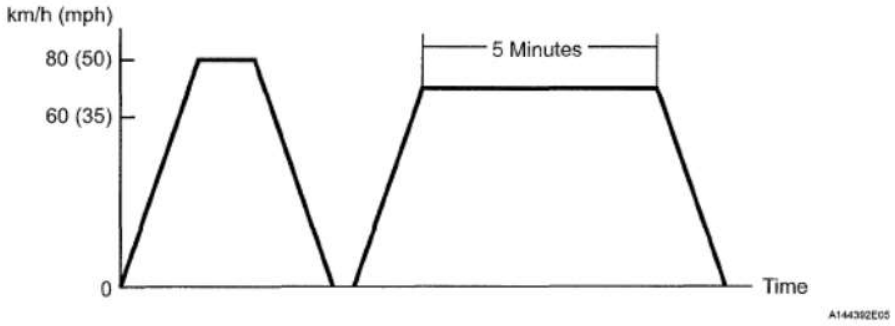


Fig. 175: Driving Pattern Graph
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

   m. Perform the drive pattern.
      1. Warm up the engine.
      2. Accelerate the vehicle until 80 km/h (50 mph) and stop the vehicle.
      3. Drive the vehicle at 60 to 80 km/h (35 to 50 mph) for 5 minutes or more.
   n. Select the following menu items: Powertrain / Engine and ECT / Trouble Codes.
   o. Read DTCs.

Result

RESULT REFERENCE

Result	Proceed to
No output	A

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P0607	B

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

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

DTC P060A INTERNAL CONTROL MODULE MONITORING PROCESSOR PERFORMANCE

MONITOR DESCRIPTION

The main CPU and sub CPU of the ECM perform data communication between each other. The main CPU monitors the communications and WDC pulses from the sub CPU. When the signal malfunctions below are detected, the DTC is output.

DTC DETECTION CONDITION AND TROUBLE AREA

DTC No.	DTC Detection Condition	Trouble Area
P060A	ECM sub CPU error	ECM

MONITOR STRATEGY

MONITOR STRATEGY

Related DTCs	P060A: ECM CPU error
Required sensors/Components (Main)	ECM
Required sensors/Components (Related)	-
Frequency of operation	Continuous
Duration	16 seconds
MIL operation	Immediate
Sequence of operation	None

TYPICAL ENABLING CONDITIONS

TYPICAL ENABLING CONDITIONS

CPU reset	Occurred

TYPICAL MALFUNCTION THRESHOLDS

TYPICAL MALFUNCTION THRESHOLDS

When either condition below is met:	Condition 1 or 2
1. When all conditions below are met:	-
- CPU reset	1 time or more
- Learned TP - Learned APP	0.4 V or more
- Electronic throttle actuator	OFF
2. CPU reset	2 times or more

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INSPECTION PROCEDURE

1. **READ OUTPUT DTC (DTC P060A)**
   a. Connect a Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the tester ON.
   d. Clear DTC (See **DTC CHECK / CLEAR**).
   e. Turn the ignition switch to OFF and turn the tester OFF.
   f. Disconnect the tester.
   g. Disconnect the cable from the battery negative (-) terminal and wait for 1 minute.
   h. Connect the cable to the battery negative (-) terminal,
   i. Connect the tester to the DLC3.
   j. Turn the ignition switch to ON.
   k. Turn the tester ON.
   l. Select the following menu items: Powertrain / Engine and ECT / Trouble Codes.
   m. Read DTCs.

   Result

   RESULT REFERENCE

Result	Proceed to
No output	A
P060A	B

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

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

DTC P060D INTERNAL CONTROL MODULE ACCELERATOR PEDAL POSITION PERFORMANCE

MONITOR DESCRIPTION

The ECM monitors the input signals of the Accelerator Pedal Position (APP) sensor No. 1. When the input signals and control signals are deviated, the DTC is output.

DTC DETECTION CONDITION AND TROUBLE AREA

DTC No.	DTC Detection Condition	Trouble Area
P060D	ECM main CPU error	ECM

MONITOR STRATEGY

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MONITOR STRATEGY

Related DTCs	P060D: Internal control module, Accelerator pedal position
Required sensors/Components (Main)	ECM
Required sensors/Components (Related)	-
Frequency of operation	Continuous
Duration	1 second
MIL operation	Immediate
Sequence of operation	None

TYPICAL ENABLING CONDITIONS

TYPICAL ENABLING CONDITIONS

None	-

TYPICAL MALFUNCTION THRESHOLDS

TYPICAL MALFUNCTION THRESHOLDS

Difference of main APP and sub APP	0.3 V or more

INSPECTION PROCEDURE

1. **READ OUTPUT DTC (DTC P060D)**
   a. Connect a Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the tester ON.
   d. Clear DTC (See **DTC CHECK / CLEAR**).
   e. Turn the ignition switch to OFF and turn the tester OFF.
   f. Disconnect the tester.
   g. Disconnect the cable from the battery negative (-) terminal and wait for 1 minute.
   h. Connect the cable to the battery negative (-) terminal.
   i. Connect the tester to the DLC3.
   j. Turn the ignition switch to ON.
   k. Turn the tester ON.
   l. Select the following menu items: Powertrain / Engine and ECT / Trouble Codes.
   m. Read DTCs.

Result

RESULT REFERENCE

Result	Proceed to
No output	A

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P060D	B

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

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

DTC P060E INTERNAL CONTROL MODULE THROTTLE POSITION PERFORMANCE

MONITOR DESCRIPTION

The ECM monitors the input signals of the Throttle Position (TP) sensor No. 1 and stop light switch. As the ECM monitors the input signals of the TP sensor No. 1 and the STP signals of the stop light switch, if the input signals and control signals are deviated, the DTC is output.

DTC DETECTION CONDITION AND TROUBLE AREA

DTC No.	DTC Detection Condition	Trouble Area
P060E	ECM main CPU error	ECM

MONITOR STRATEGY

MONITOR STRATEGY

Related DTCs	P060E: Internal control module, Throttle position
Required sensors/Components (Main)	ECM
Required sensors/Components (Related)	-
Frequency of operation	Continuous
Duration	1 second
MIL operation	Immediate
Sequence of operation	None

TYPICAL ENABLING CONDITIONS

TYPICAL ENABLING CONDITIONS

DMA communication error	Not detected

TYPICAL MALFUNCTION THRESHOLDS

TYPICAL MALFUNCTION THRESHOLDS

When one of following conditions is met:	Condition 1 or 2
1. Difference of main TP and sub TP	0.3 V or more
2. Difference of main brake switch signal and sub brake switch signal	Different

INSPECTION PROCEDURE

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1. **READ OUTPUT DTC (DTC P060E)**
   a. Connect a Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the tester ON.
   d. Clear DTC (See **DTC CHECK / CLEAR**).
   e. Turn the ignition switch to OFF and turn the tester OFF.
   f. Disconnect the tester.
   g. Disconnect the cable from the battery negative (-) terminal and wait for 1 minute.
   h. Connect the cable to the battery negative (-) terminal.
   i. Connect the tester to the DLC3.
   j. Turn the ignition switch to ON.
   k. Turn the tester ON.
   l. Select the following menu items: Powertrain / Engine and ECT / Trouble Codes.
   m. Read DTCs.

   Result

   RESULT REFERENCE

Result	Proceed to
No output	A
P060E	B

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

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

DTC P0617 STARTER RELAY CIRCUIT HIGH

DESCRIPTION

The cranking holding control system keeps energizing the starter relay from when the ECM detects the starter signal (STSW signal) from the ignition switch or the main body ECU until the ECM performs a judgement of "Engine started". Furthermore, the ECM outputs an accessory cut signal (ACCR signal) to the ACC cut relay during cranking to prevent flickering of the combination meter, clock, audio system, and soon.

When the ECM detects the STSW signal, the ECM outputs the starter relay drive signal (STAR signal) to the starter relay through the clutch start switch or the park/neutral position switch, and then, the engine is cranked. When the ECM receives a stable engine speed signal (NE signal), more specifically, when the NE signal reaches a predetermined value, the ECM stops outputting the STAR signal.

Also, the ECM monitors the starter relay operating conditions based on the STA terminal voltage status.

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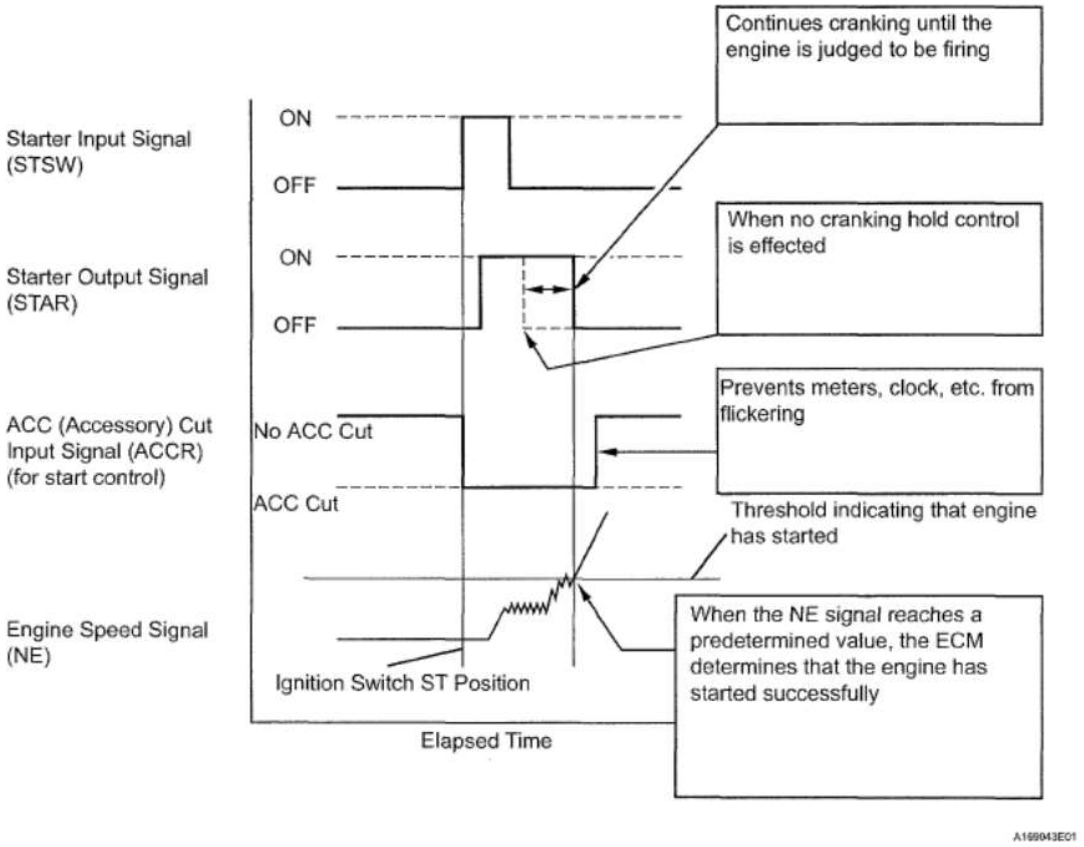


Fig. 176: Starter Relay Circuit Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

While the engine is being cranked, the battery voltage is applied to terminal STA of the ECM.

If the ECM detects the starter signal (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 20 km/h (12.4 mph) for over 20 seconds.

DTC DETECTION CONDITION AND TROUBLE AREA

DTC No.	DTC Detection Condition	Trouble Area
P0617	When conditions (a), (b) and (c) met, positive (+B) battery voltage 10.5 V or more applied to ECM for 20 seconds (1 trip detection logic): a. Vehicle speed more than 20 km/h (12.4 mph) b. Engine speed more than 1000 rpm c. STA signal ON	• Park/neutral position switch • Clutch start switch • Starter relay circuit • Ignition switch • ECM

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WIRING DIAGRAM

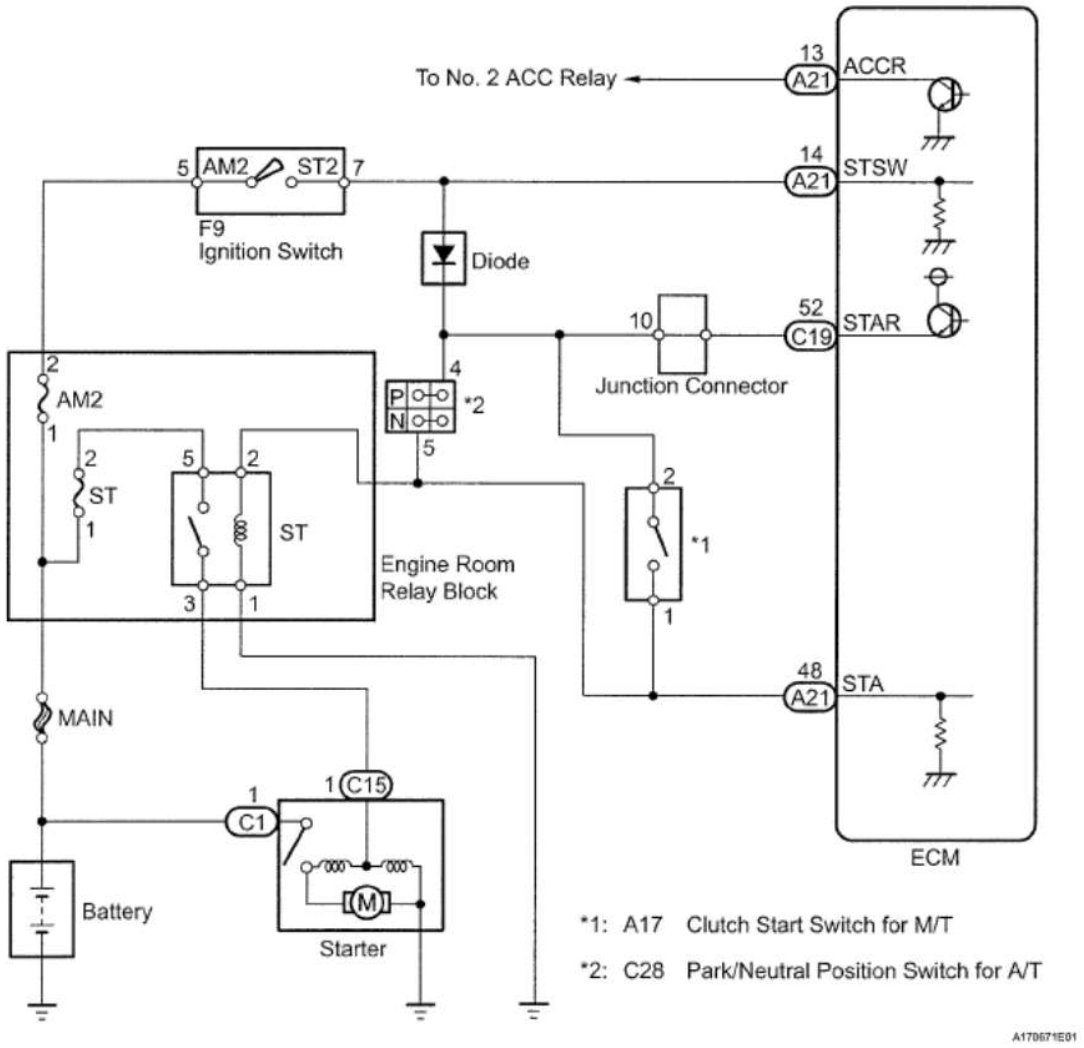


Fig. 177: Starter Relay - Wiring Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

MONITOR STRATEGY

MONITOR STRATEGY

Related DTCs	P0617: Starter signal
Required Sensors/Components (Main)	ST relay Park/Neutral Position (PNP) switch Ignition switch
Required Sensors/Components (Related)	Vehicle Speed Sensor (VSS) Crankshaft Position (CKP) sensor
Frequency of Operation	Continuous
Duration	20 seconds

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MIL Operation	immediate
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

TYPICAL ENABLING CONDITIONS

Monitor runs whenever following DTCs not present	None
Battery voltage	10.5 V or more
Vehicle speed	20 km/h (12.4 mph)
Engine speed	1000 rpm or more

TYPICAL MALFUNCTION THRESHOLDS

TYPICAL MALFUNCTION THRESHOLDS

Starter signal	ON

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 (See **PROBLEM SYMPTOMS TABLE**).
- Read freeze frame data using a Techstream. Freeze frame data record 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. **PERFORM ACTIVE TEST USING TECHSTREAM (STARTER RELAY)**
   a. Connect to a Techstream the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the tester ON.
   d. Select the following menu items: Powertrain / Engine and ECT / Active test / Activate the Starter Relay.
   e. Select the following monitor item: Starter Signal.
   f. Read the value displayed on the tester when the ignition switch is turned to the ON and START positions.

   OK

   IGNITION SWITCH POSITION AND STARTER SIGNAL REFERENCE

Ignition Switch Position	Starter Signal
ON	OFF

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START	ON

Result

RESULT REFERENCE

Result	Proceed to
Within standard range	A
Outside standard range	B

B: Go to step 2

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

2. **READ VALUE USING TECHSTREAM (STARTER SIGNAL)**
   a. Inspect the Park/Neutral Position (PNP) switch (for automatic transaxle models).
      1. Disconnect the park/neutral position switch connector.
      2. Connect a Techstream to the DLC3.
      3. Turn the ignition switch to ON.
      4. Turn the tester ON.
      5. Select the following menu items: Powertrain / Engine and ECT / Data List / Starter Signal.
      6. Read the value displayed on the tester when the ignition switch is turned to ON.

Result

RESULT REFERENCE

Starter Signal	Proceed to
ON	A
OFF	B

Front view of wire harness connector:
(to PNP Switch)



Fig. 178: Identifying Park/Neutral Position Switch Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

7. Reconnect the park/neutral position switch connector.

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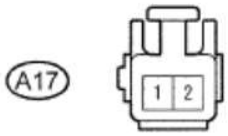
b. Inspect the clutch start switch circuit (for manual transaxle models).
   1. Disconnect the clutch start switch connector.
   2. Connect a Techstream to the DLC3.
   3. Turn the ignition switch to ON.
   4. Turn the tester ON.
   5. Select the following menu items: Powertrain / Engine and ECT / Data List / Starter Signal.
   6. Read the value displayed on the tester when the ignition switch is turned to ON.

Result

RESULT REFERENCE

Starter Signal	Proceed to
ON	A
OFF	B

Front view of wire harness connector:
(to Clutch Start Switch)



A172527E01

Fig. 179: Identifying Clutch Start Switch Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

   7. Reconnect the clutch start switch connector.

B: Go to step 4

A: Go to next step

3. **INSPECT ECM (STA TERMINAL VOLTAGE)**
   a. Disconnect the ECM connector.
   b. Disconnect the clutch start switch or Park/Neutral Position (PNP) switch connector.
   c. Turn the ignition switch to ON.
   d. Measure the voltage according to the value(s) in the table below.

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Front view of wire harness connector:
(to ECM)

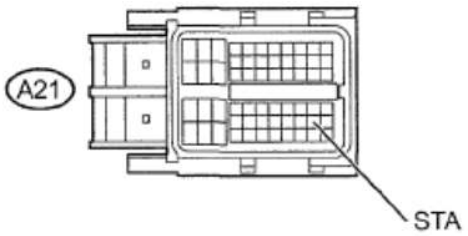


Fig. 180: Identifying ECM Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Result

VOLTAGE SPECIFICATION

Tester Connection	Switch Condition	Specified Condition	Proceed to
A20-48 (STA) - Body ground	Ignition switch ON	11 to 14 V	A
		Below 1.5 V	B

e. Reconnect the clutch start switch or park/neutral position switch connector.
f. Reconnect the ECM connector.

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

A : REPAIR OR REPLACE HARNESS OR CONNECTOR (ECM - CLUTCH START SWITCH OR PNP SWITCH - ST RELAY)

4. **INSPECT CLUTCH START SWITCH OR PARK/NEUTRAL POSITION SWITCH**
   a. Inspect the clutch start switch circuit (for manual transaxle models).
      1. Disconnect the clutch start switch connector.
      2. Measure the resistance according to the value(s) in the table below.

Standard resistance

RESISTANCE SPECIFICATION

Tester Connection	Switch Position	Specified Condition
1 - 2	OFF (free)	10 kohms or higher

3. Reconnect the clutch start switch connector.

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Result

RESULT REFERENCE

Result	Proceed to
Within standard range	A
Outside standard range	B

Component without harness connected:
(Clutch Start Switch)

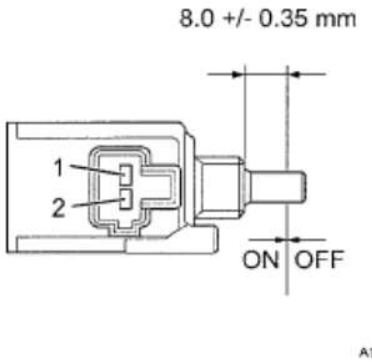


Fig. 181: Identifying Clutch Start Switch Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. Inspect the Park/Neutral Position (PNP) switch (for automatic transaxle models).
   1. Disconnect the park/neutral position switch connector.
   2. Measure the resistance according to the value(s) in the table below.

Standard resistance

RESISTANCE SPECIFICATION

Tester Connection	Shift Selector Lever Position	Specified Condition
4 - 5	Except P, N	10 kohms or higher
2 - 5	P	10 kohms or higher
	R	
	N	
	D	
	2	
	L	

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Component without harness connected:
(PNP Switch)

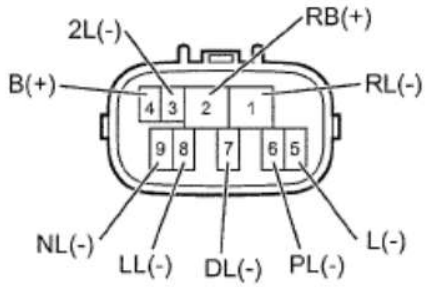


Fig. 182: Identifying Park/Neutral Position Switch Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

3. Reconnect the park/neutral position switch connector.

Result

RESULT REFERENCE

Result	Proceed to
Within standard range	A
Outside standard range 4 - 5	B
Outside standard range 2 - 5	C

B : REPLACE CLUTCH START SWITCH OR PARK/NEUTRAL POSITION SWITCH AND GO TO STEP 5 (See **REMOVAL**)

C : REPLACE PARK/NEUTRAL POSITION SWITCH (See **REMOVAL**)

A: Go to next step

5. **INSPECT IGNITION SWITCH**
   a. Disconnect the ignition switch connector.
   b. Measure the resistance according to the value(s) in the table below.

Standard resistance

RESISTANCE SPECIFICATION

Tester Connection	Switch Condition	Specified Condition
4 (AM1) - 7 (ST2)	ON position	10 kohms or higher
5 (AM2) - 7 (ST2)		

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c. Reconnect the ignition switch connector.

NG: REPLACE IGNITION SWITCH (See **REMOVAL**)

Component without harness connected:
(Ignition Switch)

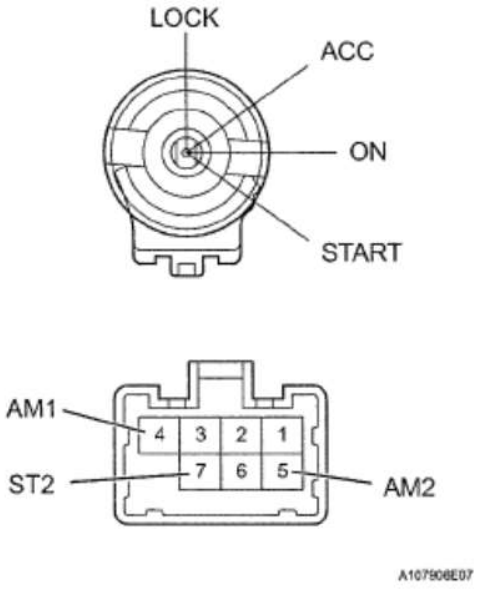


Fig. 183: Identifying Ignition Switch Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK : REPAIR OR REPLACE HARNESS OR CONNECTOR (CLUTCH START SWITCH - IGNITION SWITCH AND ECM)

DTC P0630 VIN NOT PROGRAMMED OR MISMATCH - ECM / PCM

MONITOR 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 a Techstream.

DTC DETECTION CONDITION AND TROUBLE AREA

DTC No.	DTC Detection Condition	Trouble Area
P0630	When either condition below is met: • VIN not stored in ECM • Input VIN in ECM not accurate	ECM

MONITOR STRATEGY

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MONITOR STRATEGY

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

Battery voltage	8 V or more
Ignition switch	ON
Starter	OFF

TYPICAL MALFUNCTION THRESHOLDS

TYPICAL MALFUNCTION THRESHOLDS

VIN code	Not programmed

COMPONENT OPERATING RANGE

COMPONENT OPERATING RANGE

VIN code	Programmed

INSPECTION PROCEDURE

1. **CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P0630)**
   a. Connect a Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the tester ON.
   d. Select the following menu items: Powertrain / Engine and ECT / Trouble Codes.
   e. Read DTCs.

   Result

   RESULT REFERENCE

Result	Proceed to
P0630	A
P0630 and other DTCs	B

   If any DTCs other than P0630 are output, troubleshoot those DTCs first.

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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. If DTCs other than P0630 are set, check them first.**

B: Go to DTC CHART (See **DIAGNOSTIC TROUBLE CODE CHART**)

A: Go to next step

2. **INPUT VIN**
   a. Input VIN (See **REGISTRATION**).

NEXT : END

DTC P0657 ACTUATOR SUPPLY VOLTAGE CIRCUIT / OPEN

MONITOR DESCRIPTION

The ECM monitors the output voltage to the throttle actuator. This self-check ensures that the ECM is functioning properly. The output voltage is usually 0 V when the ignition switch is turned to OFF. If the output voltage is higher than 7 volts when the ignition switch is turned to OFF, the ECM will illuminate the MIL and set the DTC when the ignition switch is turned to ON.

DTC DETECTION CONDITION AND TROUBLE AREA

DTC No.	DTC Detection Condition	Trouble Area
P0657	Throttle actuator power supply error	ECM

MONITOR STRATEGY

MONITOR STRATEGY

Related DTCs	P0657: ETCS power supply
Required sensors/Components (Main)	ECM
Required sensors/Components (Related)	Throttle actuator
Frequency of operation	Once per driving cycle
Duration	Within 1 second
MIL operation	Immediate
Sequence of operation	None

TYPICAL ENABLING CONDITIONS

TYPICAL ENABLING CONDITIONS

Ignition switch	ON to OFF

TYPICAL MALFUNCTION THRESHOLDS

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TYPICAL MALFUNCTION THRESHOLDS

Throttle actuator power supply	7 V or more

INSPECTION PROCEDURE

HINT:

Read freeze frame data using a Techstream. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1. **READ OUTPUT DTC (DTC P0657)**
   a. Connect a Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the tester ON.
   d. Clear DTC (See **DTC CHECK / CLEAR**).
   e. Turn the ignition switch to OFF and turn the tester OFF.
   f. Disconnect the tester.
   g. Disconnect the cable from the battery negative (-) terminal and wait for 1 minute.
   h. Connect the cable to the battery negative (-) terminal.
   i. Turn the ignition switch to ON for 10 seconds.
   j. Turn the ignition switch to OFF.
   k. Connect the tester to the DLC3.
   l. Turn the ignition switch to ON.
   m. Turn the tester ON.
   n. Select the following menu items: Powertrain / Engine and ECT / Trouble Codes.
   o. Read DTCs.

   Result

   RESULT REFERENCE

Result	Proceed to
No output	A
P0657	B

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

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

DTC P0724 BRAKE SWITCH "B" CIRCUIT HIGH

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DESCRIPTION

The purpose of this circuit is to prevent the engine from stalling when brakes are suddenly applied while driving in lock-up condition.

When the brake pedal is depressed, this switch sends a signal to the ECM. Then the ECM cancels the operation of the lock-up clutch while braking is in progress.

DTC DETECTION CONDITION AND TROUBLE AREA

DTC No.	DTC Detection Condition	Trouble Area
P0724	Stop light switch remains ON even when vehicle repeats 5 cycles of STOP (less than 3 km/h [1.86 mph]) and GO (30 km/h [18.65 mph] or more) (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 3 km/h [1.86 mph]) and go (30 km/h [1.865 mph] or more) 5 times during 2 driving cycles, in order to detect a malfunction.

MONITOR STRATEGY

MONITOR STRATEGY

Related DTCs	P0724: Stop light switch/Range check/Rationality
Required sensors/Components (Main)	Stop light switch
Required sensors/Components (Related)	Speed sensor
Frequency of Operation	Continuous
Duration	5 times
MIL Operation	2 driving cycles
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

The stop light switch remains ON during GO and STOP 5 times.

GO and STOP are defined as follows;

TYPICAL ENABLING CONDITIONS

Monitor runs whenever following DTCs not present	None
GO: Vehicle speed	30 km/h (18.65 mph) or more

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STOP: Vehicle speed	Less than 3 km/h (1.86 mph)

TYPICAL MALFUNCTION THRESHOLDS

TYPICAL MALFUNCTION THRESHOLDS

Stop light switch status	Stuck ON

WIRING DIAGRAM

Refer to **DTC P0504** .

INSPECTION PROCEDURE

HINT:

Read freeze frame data using a 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 VALUE USING TECHSTREAM (STOP LIGHT SWITCH)**
   a. Connect a Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the tester ON.
   d. Select the following menu items: Powertrain / Engine and ECT / Data List / All Data / Stop Light Switch.
   e. Read the values displayed on the tester.

   Result

   DATA LIST

Item	Measurement Item: Range (display)	Normal Condition
Stop Light Switch	Stop light switch status: ON or OFF	• ON: Brake pedal is depressed • OFF: Brake pedal is released

   NG: Go to step 2

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

2. **INSPECT STOP LIGHT SWITCH** (See **INSPECTION PROCEDURE**)

   NG: REPLACE STOP LIGHT SWITCH (See **REMOVAL**)

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OK: Go to next step

3. **CHECK HARNESS AND CONNECTOR (STOP LIGHT SWITCH - ECM)**
   a. Disconnect the ECM connector.
   b. Turn the ignition switch to ON.
   c. Measure the voltage according to the value(s) in the table below.

Standard voltage

VOLTAGE SPECIFICATION

Tester Connection	Condition	Specified Condition
A21-35 (ST1-) - Body ground	Brake pedal released	11 to 14 V
	Brake pedal depressed	0 to 3 V
A21-36 (STP) - Body ground	Brake pedal released	0 to 3 V
	Brake pedal depressed	11 to 14 V

   d. Reconnect the ECM connector.

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR

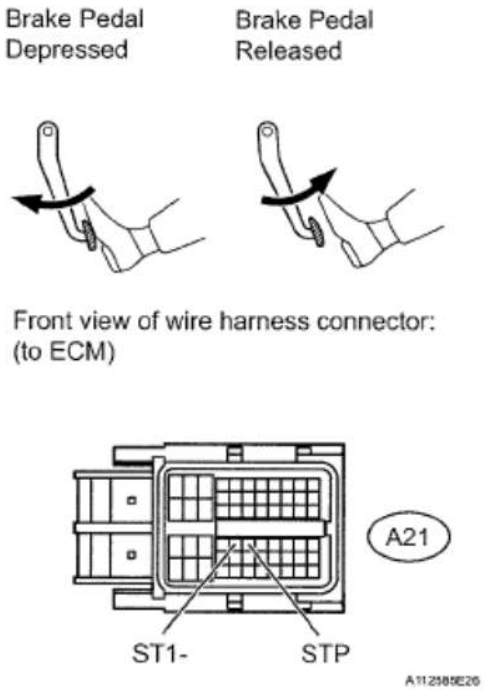


Fig. 184: Depressing And Releasing Brake Pedal
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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

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DTC P1607 CRUISE CONTROL INPUT PROCESSOR

MONITOR DESCRIPTION

The ECM continuously monitors its main and sub CPUs for the cruise control. 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 the DTC immediately.

DTC DETECTION CONDITION AND TROUBLE AREA

DTC No.	DTC Detection Condition	Trouble Area
P1607	ECM internal error	ECM

MONITOR STRATEGY

MONITOR STRATEGY

Related DTC	P1607: Internal control module range check
Required sensors/Components (Main)	ECM
Required sensors /Components (Related)	Cruise control
Frequency of Operation	Continuous
Duration	0.3 seconds
MIL Operation	Immediate
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

TYPICAL ENABLING CONDITIONS

Monitor runs whenever the following DTCs are not present	None

TYPICAL MALFUNCTION THRESHOLDS

TYPICAL MALFUNCTION THRESHOLDS

Cruise control	Forbiddance
When either condition below is met:	-
• Cruise control	Operating
• Low speed control	Operating

INSPECTION PROCEDURE

1. **READ OUTPUT DTC (DTC P1607)**
   a. Connect a Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the tester ON.
   d. Clear DTC (See **DTC CHECK / CLEAR**).

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e. Turn the ignition switch to OFF and turn the tester OFF.
f. Disconnect the tester.
g. Disconnect the cable from the battery negative (-) terminal and wait for 1 minute.
h. Connect the cable to the battery negative (-) terminal.
i. Connect the tester to the DLC3.
j. Turn the ignition switch to ON.
k. Turn the tester ON.
l. Select the following menu items: Powertrain / Engine and ECT / Trouble Codes.
m. Read DTCs.

Result

RESULT REFERENCE

Result	Proceed to
No output	A
P1607	B

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

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

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 (TP) sensor, which is mounted on the throttle body. The TP 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 ETCS (Electronic Throttle Control System) does not use a throttle cable.

DTC DETECTION CONDITION AND TROUBLE AREA

DTC No.	DTC Detection Condition	Trouble Area
P2102	Conditions (a) and (b) continue for 2.0 seconds (1 trip detection logic):	• Open in throttle actuator circuit • Throttle actuator

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	a. Throttle actuator duty ratio 80% or more b. Throttle actuator current less than 0.5 A	• ECM
P2103	Either of following conditions is met (1 trip detection logic): • Hybrid IC diagnosis signal fail • Hybrid IC current limiter port fail	• 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 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 to a high rpm several times after the engine has idled for 5 seconds after engine start.

MONITOR STRATEGY

MONITOR STRATEGY

Related DTCs	P2102: Throttle actuator current (low current) P2103: Throttle actuator current (high current)
Required Sensors/Components (Main)	Throttle actuator (throttle body)
Required Sensors/Components (Related)	None
Frequency of Operation	Continuous
Duration	P2102:2 seconds P2103: 0.6 seconds
MIL Operation	Immediate
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

TYPICAL ENABLING CONDITIONS

Monitor runs whenever following DTCs are not present	None

P2102:

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TYPICAL ENABLING CONDITIONS

Throttle actuator	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 seconds	Less than 0.2 A

P2103:

TYPICAL ENABLING CONDITIONS

Throttle actuator	ON
Either of the following conditions 1 or 2 is met:	-
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

Throttle actuator current	Less than 0.5 A

P2103:

TYPICAL MALFUNCTION THRESHOLDS

Either of following conditions is met:	A or B
A. Hybrid IC diagnosis signal	Fail
B. Hybrid IC current limiter port	Fail

FAIL-SAFE

When either of these DTCs, as well as other DTCs relating to ETCS (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, and the throttle valve is returned to a 6° throttle angle by the return spring. The ECM then adjusts the engine output by controlling the fuel injection (intermittent fuel-cut) and ignition timing, in accordance with the accelerator pedal opening angle, to allow the vehicle to continue running at a minimal speed. If the accelerator pedal is depressed firmly and gently, the vehicle can be driven slowly.

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

WIRING DIAGRAM

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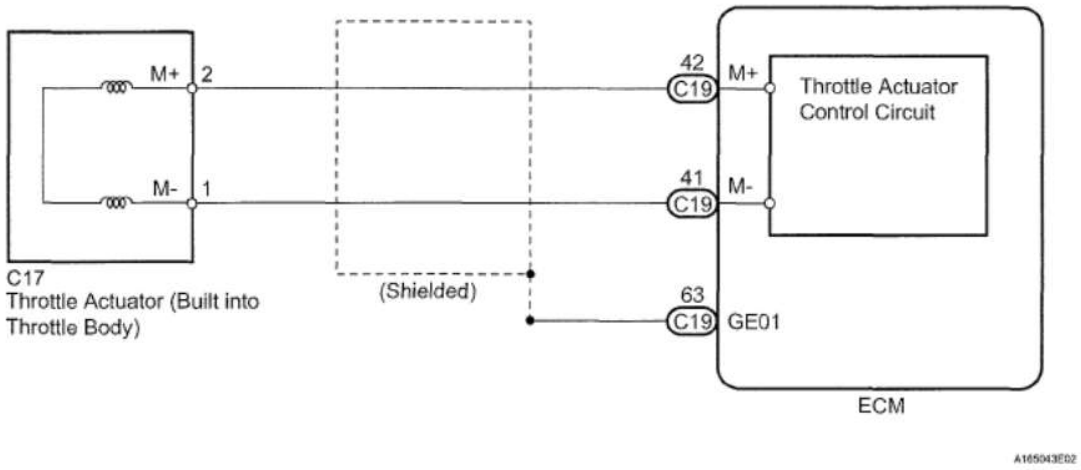


Fig. 185: Throttle Actuator Control Motor - Wiring Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSPECTION PROCEDURE

HINT:

- Read freeze frame data using a 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.
- 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 ETCS malfunctions.

1. **INSPECT THROTTLE BODY (RESISTANCE OF THROTTLE ACTUATOR)**
   a. Disconnect the throttle body connector.
   b. Measure the resistance according to the value(s) in the table below.

      Standard resistance

      RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
2 (M+) -1 (M-)	20°C (68°F)	0.3 to 100 ohms

   c. Reconnect the throttle body connector.

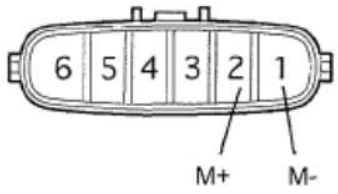
NG: REPLACE THROTTLE BODY (See **REMOVAL**)

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Component without harness connected:
(Throttle Body)



A150305E04

Fig. 186: Identifying Throttle Body Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

2. **CHECK HARNESS AND CONNECTOR (THROTTLE BODY - ECM)**
   a. Disconnect the throttle body connector.
   b. Disconnect the ECM connector.
   c. Measure the resistance according to the value(s) in the table below.

Standard resistance (Check for open)

RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
C17-2 (M+) - C19-42 (M+)	Always	Below 1 ohms
C17-1 (M-) - C19-41 (M-)	Always	Below 1 ohms

Standard resistance (Check for short)

RESISTANCE SPECIFICATION

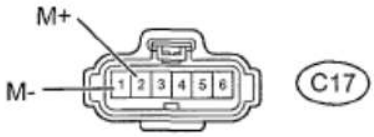
Tester Connection	Condition	Specified Condition
C17-2 (M+) or C19-42 (M+) - Body ground	Always	10 kohms or higher
C17-1 (M-) or C19-41 (M-) - Body ground	Always	10 kohms or higher

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

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR

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Front view of wire harness connector:
(to Throttle Body)



Front view of wire harness connector:
(to ECM)

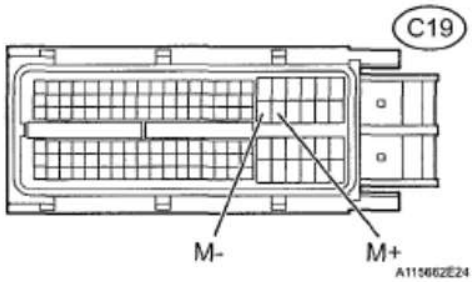


Fig. 187: Identifying Throttle Body And ECM Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

3. **INSPECT THROTTLE BODY (VISUALLY CHECK THROTTLE VALVE)**
   a. Check for foreign objects between the throttle valve and the housing.

NG: REMOVE FOREIGN OBJECT AND CLEAN THROTTLE BODY

OK: Go to next step

4. **INSPECT THROTTLE BODY (THROTTLE VALVE)**
   a. Check if the throttle valve opens and closes smoothly.

NG: REPLACE THROTTLE BODY (See **REMOVAL**)

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

DTC P2111 THROTTLE ACTUATOR CONTROL SYSTEM - STUCK OPEN; DTC P2112 THROTTLE ACTUATOR CONTROL SYSTEM - STUCK CLOSED

DESCRIPTION

The throttle actuator is operated by the ECM, and opens and closes the throttle valve using gears. The opening angle of the throttle valve is detected by the Throttle Position (TP) sensor, which is mounted on the throttle

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body. The TP 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 ETCS (Electronic Throttle Control System) does not use a throttle cable.

DTC DETECTION CONDITION AND TROUBLE AREA

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 • ECM
P2112	ECM signals throttle actuator to open, but stuck (1 trip detection logic)	• Throttle actuator • Throttle body • Throttle valve • ECM

MONITOR DESCRIPTION

The ECM determines that there is a malfunction in the ETCS when the throttle valve remains at a fixed angle despite a high drive current from the ECM. The ECM illuminates the MIL and sets a DTC. If the malfunction is not repaired successfully, a DTC is set when the accelerator pedal is fully depressed and released quickly (to fully open and close the throttle valve) after the engine is next started.

MONITOR STRATEGY

MONITOR STRATEGY

Related DTCs	P2111: Throttle actuator stuck open P2112: Throttle actuator stuck closed
Required Sensors/Components (Main)	Throttle actuator (throttle body)
Required Sensors/Components (Related)	-
Frequency of Operation	Continuous
Duration	0.5 seconds
MIL Operation	Immediate
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

All:

TYPICAL ENABLING CONDITIONS

Monitor runs whenever following DTCs are not present	None

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P2111 (Throttle actuator stuck open):

TYPICAL ENABLING CONDITIONS

All of following conditions are met:	-
System guard*	ON
Throttle actuator current	2 A or more
Duty cycle to close throttle	80% or more

P2112 (Throttle actuator stuck closed):

TYPICAL ENABLING CONDITIONS

All of following conditions are met:	-
System guard*	ON
Throttle actuator current	2 A or more
Duty cycle to open throttle	80% or more

TYPICAL ENABLING CONDITIONS

*System guard set when following conditions are met:	-
Throttle actuator	ON
Throttle actuator duty calculation	Executing
Throttle position sensor	Fail determined
Throttle actuator current-cut operation	Not executing
Throttle actuator power supply	4 V or more
Throttle actuator	Fail determined

TYPICAL MALFUNCTION THRESHOLDS

P2111 (Throttle actuator stuck open):

TYPICAL MALFUNCTION THRESHOLDS

TP sensor voltage change for 0.016 seconds	Less than 0.1 V for 0.5 seconds or more

P2112 (Throttle actuator stuck closed):

TYPICAL MALFUNCTION THRESHOLDS

TP sensor voltage change for 0.016 seconds	Less than 0.1 V for 0.5 seconds or more

FAIL-SAFE

When either of these DTCs, as well as other DTCs relating to ETCS (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, and the throttle valve is returned to a 6° throttle angle by the return spring. The ECM then adjusts the engine output by controlling the fuel injection (intermittent fuel-cut) and ignition timing, in accordance with the accelerator pedal opening angle, to allow the vehicle to continue running at a minimal

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speed. If the accelerator pedal is depressed firmly and gently, the vehicle can be driven slowly.

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

WIRING DIAGRAM

Refer to **DTC P2102** .

INSPECTION PROCEDURE

HINT:

Read freeze frame data using a 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. **CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P2111 or P2112)**
   a. Connect a Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the tester ON.
   d. Select the following menu items: Powertrain / Engine and ECT / Trouble Codes.
   e. Read DTCs.

   Result

   RESULT REFERENCE

Result	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 (See **DIAGNOSTIC TROUBLE CODE 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:

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Throttle valve is not contaminated with foreign objects and moves smoothly.

NG: REPAIR OR REPLACE THROTTLE BODY (See **REMOVAL**)

OK: Go to next step

3. **CHECK WHETHER DTC OUTPUT RECURS (DTC P2111 OR P2112)**
   a. Connect a Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the tester ON.
   d. Clear 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 DTCs.

   Result

   RESULT REFERENCE

Result	Proceed to
No output	A
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 ETCS (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 ETCS and cuts off the current to the throttle actuator.

When the voltage becomes unstable, the ETCS 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 to OFF. The ECM then allows the current to flow to the throttle actuator so that it can be restarted.

HINT:

The ETCS does not use a throttle cable.

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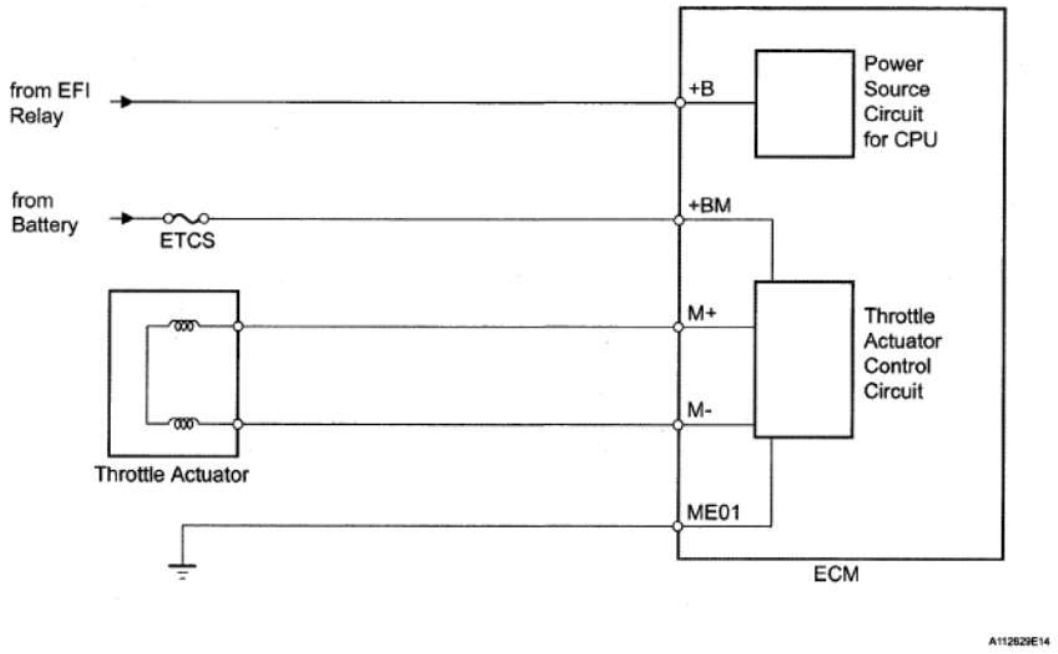


Fig. 188: Electronic Throttle Control System Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

DTC DETECTION CONDITION AND TROUBLE AREA

DTC No.	DTC Detection Condition	Trouble Area
P2118	Open in ETCS power source (+BM) circuit (1 trip detection logic)	• Open in ETCS power source circuit • Battery • Battery terminals • ETCS fuse • ECM

MONITOR DESCRIPTION

The ECM monitors the battery supply voltage applied to the throttle actuator.

When the power supply voltage (+BM) drops below 4 V for 0.8 seconds or more, the ECM interprets this as an open in the power supply circuit (+BM). The ECM illuminates the MIL and 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

Related DTCs	P2118: Throttle actuator power supply

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Required Sensors/Components (Main)	Throttle actuator, throttle valve (throttle body) ETCS fuse
Required Sensors/Components (Related)	None
Frequency of Operation	Continuous
Duration	0.8 seconds
MIL Operation	Immediate
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

TYPICAL ENABLING CONDITIONS

Monitor runs whenever following DTCs not present	None
Battery voltage	8 V or more
Electronic throttle actuator power	ON

TYPICAL MALFUNCTION THRESHOLDS

TYPICAL MALFUNCTION THRESHOLDS

Throttle actuator power supply voltage (+BM)	Less than 4 V

COMPONENT OPERATING RANGE

COMPONENT OPERATING RANGE

Throttle actuator power supply voltage (+BM)	11 to 14 V

FAIL-SAFE

When this DTC, or other DTCs relating to ETCS (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, and the throttle valve is returned to a 6° throttle angle by the return spring. The ECM then adjusts the engine output by controlling the fuel injection (intermittent fuel-cut) and ignition timing, in accordance with the accelerator pedal opening angle, to allow the vehicle to continue at a minimal speed. If the accelerator pedal is depressed firmly and gently, the vehicle can be driven slowly.

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

WIRING DIAGRAM

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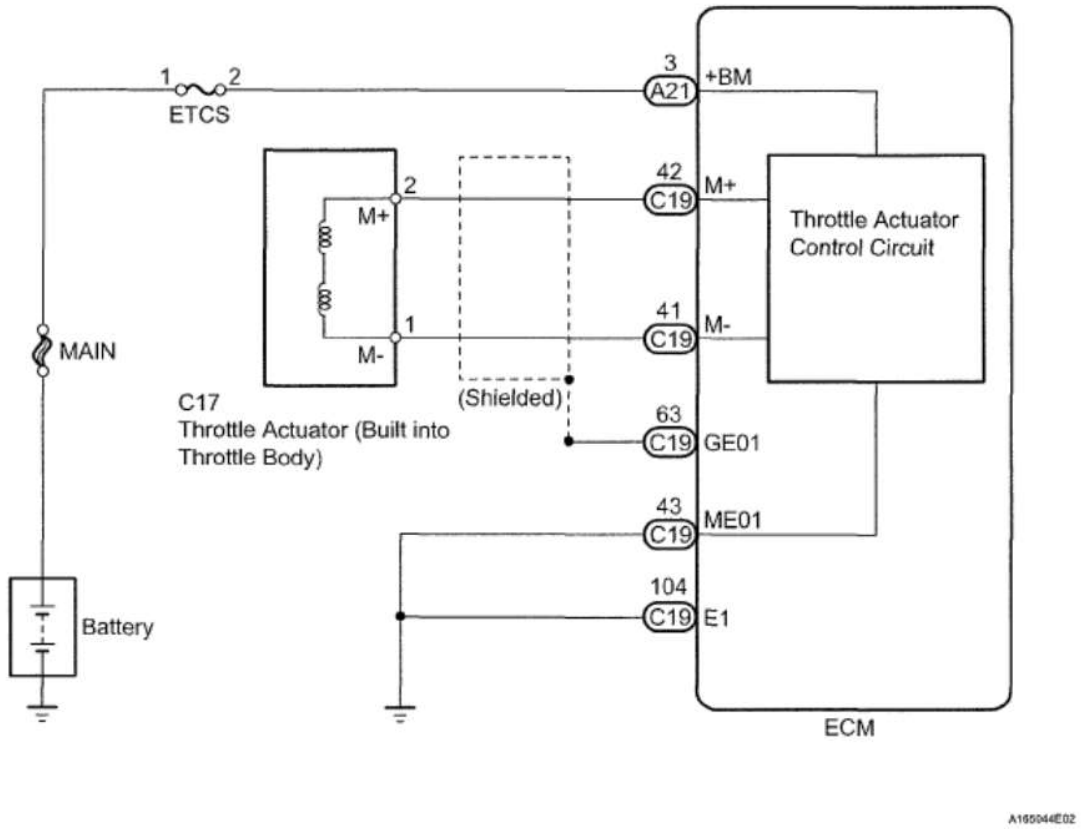


Fig. 189: Throttle Actuator Control Motor - Wiring Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSPECTION PROCEDURE

HINT:

Read freeze frame data using a 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 VALUE USING TECHSTREAM (+BM VOLTAGE)**
   a. Connect a Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the tester ON.
   d. Select the following menu items: Powertrain / Engine and ECT / Data List / All Data / +BM Voltage.
   e. Read the value displayed on the tester.

   Standard voltage:

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11 to 14 V

NG: Go to step 4

OK: Go to next step

2. **INSPECT BATTERY**
   a. Check that the battery is not depleted.

      OK:

      Battery is not depleted

   NG: REPLACE BATTERY

   OK: Go to next step

3. **CHECK BATTERY TERMINAL**
   a. Check that the battery terminals and ECM ground are not loose or corroded.

      OK:

      Battery terminals and ECM ground are not loose or corroded

   NG: REPAIR OR REPLACE BATTERY TERMINAL

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

4. **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

      RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
ETCS fuse	Always	Below 1 ohms

   c. Reinstall the ETCS fuse from the engine room relay block.

   NG: CHECK FOR SHORTS IN ALL HARNESSES AND CONNECTORS CONNECTED TO FUSE AND REPLACE FUSE

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Engine Room Relay Block:

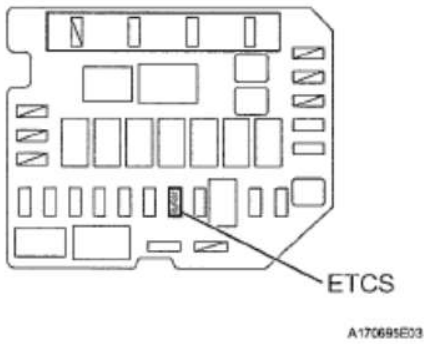


Fig. 190: Identifying ETCS Fuse
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OK: Go to next step

5. **CHECK HARNESS AND CONNECTOR (ECM - ETCS FUSE - BATTERY)**
   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)

         RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
ETCS fuse (2) - A21-3 (+BM)	Always	Below 1 ohms

         Standard resistance (Check for short)

         RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
ETCS fuse (2) or A21-3 (+BM) - Body ground	Always	10 kohms or higher

      4. Reinstall the ETCS fuse.
      5. Reconnect the ECM connector.
   b. Check the harness and connector between the ETCS fuse and positive (+) battery terminal.
      1. Remove the ETCS fuse from the engine room relay block.
      2. Disconnect the cable from the positive (+) battery terminal.
      3. Measure the resistance according to the value(s) in the table below

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Standard resistance (Check for open)

RESISTANCE SPECIFICATION

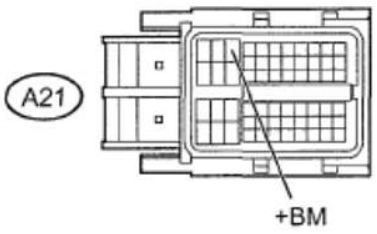
Tester Connection	Condition	Specified Condition
Positive battery cable - ETCS fuse (1)	Always	Below 1 ohms

Standard resistance (Check for short)

RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
Positive battery cable or ETCS fuse (1) - Body ground	Always	10 kohms or higher

Front view of wire harness connector:
(to ECM)



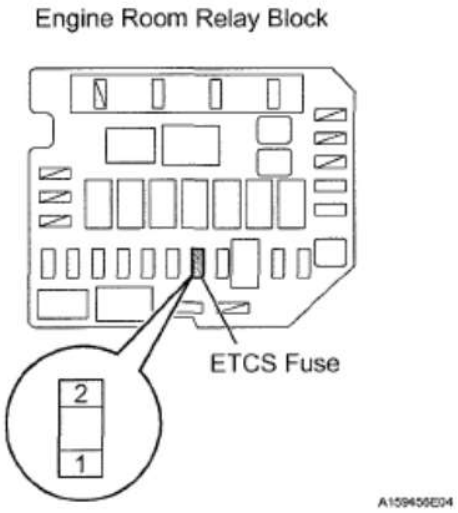


Fig. 191: Identifying ETCS Fuse And ECM Connector
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4. Reinstall the ETCS fuse.

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5. Reconnect the cable.

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR

OK: Go to next step

6. **INSPECT ECM (+BM VOLTAGE)**
   a. Disconnect the ECM connectors.
   b. Measure the voltage according to the value(s) in the table below.

Standard voltage

VOLTAGE SPECIFICATION

Tester Connection	Condition	Specified Condition
A21-3 (+BM) - C19-43 (ME01)	Always	11 to 14 V
A21-3 (+BM) - C19-104 (E1)		

   c. Reconnect the ECM connectors.

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR (TERMINALS E1 AND ME01 BODY GROUND)

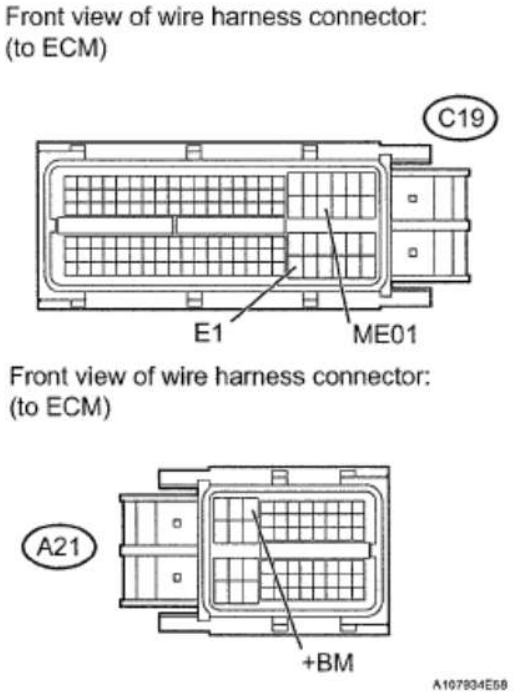


Fig. 192: Identifying ECM Connector Terminals
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OK : REPLACE ECM (See **REMOVAL**)

DTC P2119 THROTTLE ACTUATOR CONTROL THROTTLE BODY RANGE / PERFORMANCE

DESCRIPTION

The Electronic Throttle Control System (ETCS) is composed of the throttle actuator, Throttle Position (TP) sensor, Accelerator Pedal Position (APP) sensor, and ECM. The ECM operates the throttle actuator to regulate the throttle valve in response to driver inputs. The TP 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 AND TROUBLE AREA

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 (ETCS) • ECM

MONITOR DESCRIPTION

The ECM determines the actual opening angle of the throttle valve from the TP 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 ETCS. 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 fully depressing the accelerator pedal (fully open the throttle valve).

MONITOR STRATEGY

MONITOR STRATEGY

Related DTCs	P2119: ETCS malfunction
Required Sensors/Components (Main)	Throttle actuator (throttle body)
Required Sensors/Components (Related)	-
Frequency of Operation	Continuous
Duration	1 second
MIL Operation	Immediate
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

TYPICAL ENABLING CONDITIONS

Monitor runs whenever following DTCs are not present	None
System guard*	ON

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*System guard set when following conditions are met:	-
Throttle actuator	ON
Throttle actuator duty calculation	Executing
TP sensor	Fail determined
Throttle actuator current-cut operation	Not executing
Throttle actuator power supply	4 V or more
Throttle actuator	Fail determined

TYPICAL MALFUNCTION THRESHOLDS

TYPICAL MALFUNCTION THRESHOLDS

Either of following conditions A or B is met	-
A. Commanded closed TP - current closed TP	0.3 V or more for 1 second
B. Commanded open TP - current open TP	0.3 V or more for 0.6 seconds

FAIL-SAFE

When this DTC, as well as other DTCs relating to ETCS (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, and the throttle valve is returned to a 6° throttle angle by the return spring. The ECM then adjusts the engine output by controlling the fuel injection (intermittent fuel-cut) and ignition timing, in accordance with the accelerator pedal opening angle, to allow the vehicle to continue running at a minimal speed. If the accelerator pedal is depressed firmly and gently, the vehicle can be driven slowly.

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

WIRING DIAGRAM

Refer to **DTC P2102** .

INSPECTION PROCEDURE

HINT:

Read freeze frame data using a 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. **CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P2119)**
   a. Connect a Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the tester ON.
   d. Select the following menu items: Powertrain / Engine and ECT / Trouble Codes.

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e. Read DTCs.

Result

RESULT REFERENCE

Result	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 (See **DIAGNOSTIC TROUBLE CODE CHART**)

A: Go to next step

2. **CHECK WHETHER DTC OUTPUT RECURS (DTC P2119)**
   a. Connect a Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the tester ON.
   d. Clear DTCs (See **DTC CHECK / CLEAR**).
   e. Allow the engine to idle for 15 seconds or more.
   f. Fully depress and release the accelerator pedal several times quickly.
   g. Select the following menu items: Powertrain / Engine and ECT / Trouble Codes.
   h. Read DTCs.

OK:

No DTC output.

HINT:

The output voltage of the throttle position sensor can be checked using the Techstream. Variations in the output voltage indicate that the throttle actuator is in operation. To check the output voltage using the Techstream, select the following menu items: Powertrain / Engine and ECT/ ETCS / Throttle Position No.1.

NG: REPLACE THROTTLE BODY (See **REMOVAL**)

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

DTC P2120 THROTTLE / PEDAL POSITION SENSOR / SWITCH "D" CIRCUIT; DTC P2122

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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

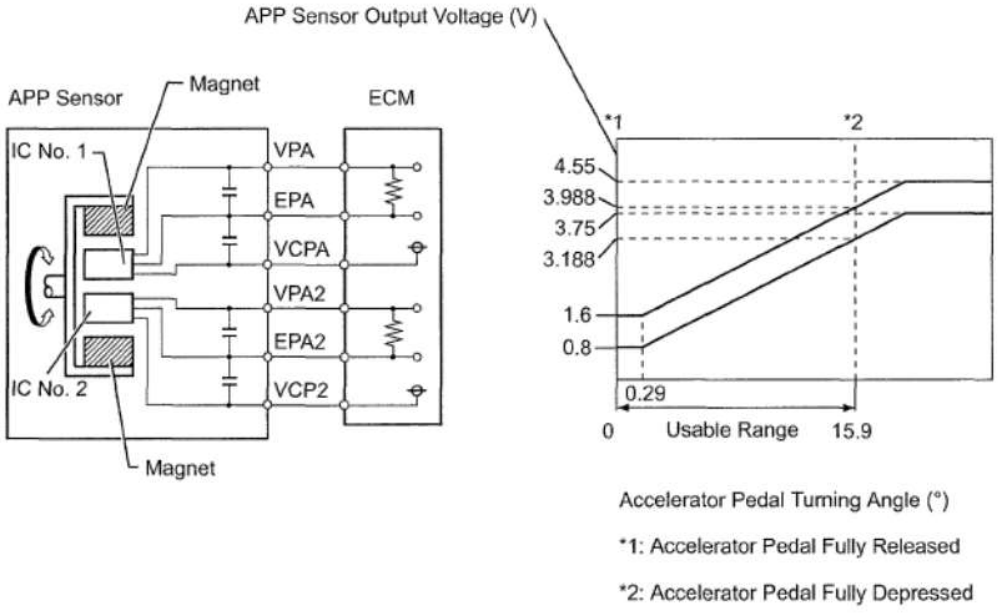
DESCRIPTION

HINT:

- This ETCS (Electronic Throttle Control System) does not use a throttle cable.
- These DTCs relate to the Accelerator Pedal Position (APP) sensor.

The Accelerator Pedal Position (APP) sensor is mounted on the accelerator pedal bracket and has 2 sensor circuits: VPA (main) and VPA2 (sub). This sensor is a non-contact type and uses Hall-effect elements in order to yield accurate signals even in extreme driving conditions, such as at high speeds as well as very low speeds. The voltage, which is applied to terminals VPA and VPA2 of the ECM, varies between 0.5 V and 4.5 V in proportion to the operating angle of the accelerator pedal (throttle valve). A signal from VPA indicates the actual accelerator pedal opening angle (throttle valve opening angle) and is used for engine control. A signal from VPA2 conveys the status of the VPA circuit and is used to check the APP sensor itself.

The ECM monitors the actual accelerator pedal opening angle (throttle valve opening angle) through the signals from VPA and VPA2, and controls the throttle actuator according to these signals.



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Fig. 193: Accelerator Pedal Position Sensor Output Voltage Graph
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

DTC DETECTION CONDITION AND TROUBLE AREA

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 (APP) sensor • ECM
P2122	VPA 0.4 V or less for 0.5 seconds or more when accelerator pedal depressed (1 trip detection logic)	• Accelerator Pedal Position (APP) sensor • Open in VCP1 circuit • Open or ground short in VPA circuit • ECM
P2123	VPA 4.8 V or more for 2.0 seconds or more (1 trip detection logic)	• Accelerator Pedal Position (APP) 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 (APP) sensor • ECM
P2127	VPA2 1.2 V or less for 0.5 seconds or more when accelerator pedal depressed (1 trip detection logic)	• Accelerator Pedal Position (APP) 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 4.8 V or more b. VPA between 0.4 V and 3.45 V	• Accelerator Pedal Position (APP) 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 0.02 V or less b. VPA 0.4 V or less and VPA2 1.2 V or less	• Short between VPA and VPA2 circuits • Accelerator Pedal Position (APP) sensor • ECM

HINT:

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When any of these DTCs are set, check the APP sensor voltage by selecting the following menu items using a Techstream: Powertrain / Engine and ECT / Data List / ETCS / Accelerator Position No.1 and Accelerator Position No.2.

VOLTAGE SPECIFICATION

Trouble Area	Accelerator Position No.1 When Accelerator Pedal Released	Accelerator Position No.2 When Accelerator Pedal Released	Accelerator Position No.1 When Accelerator Pedal Depressed	Accelerator Position 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 ground short in VPA2 circuit	0.5 to 1.1 V	0 to 0.2 V	2.5 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	2.5 to 4.5 V	3.4 to 5.0 V

HINT:

Accelerator pedal positions are expressed as voltages.

MONITOR DESCRIPTION

When either output voltage of VPA or VPA2 deviates from the standard range, or the difference between the output voltages of the 2 sensor circuits is less than the threshold, the ECM determines that there is a malfunction in the APP sensor. The ECM then illuminates the MIL and sets a DTC.

Example:

When the output voltage of VPA drops below 0.4 V for more than 0.5 seconds when the accelerator pedal is fully depressed, DTC P2122 is set.

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

MONITOR STRATEGY

MONITOR STRATEGY

	P2120: Accelerator Pedal Position (APP) sensor 1 range check (fluctuating) P2122: APP sensor 1 range check (low voltage)

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Related DTCs	P2123: APP sensor 1 range check (high voltage) P2125: APP sensor 2 range check (fluctuating) P2127: APP sensor 2 range check (low voltage) P2128: APP sensor 2 range check (high voltage) P2138: APP sensor range check (correlation)
Required Sensors/Components (Main)	APP sensor
Required Sensors/Components (Related)	-
Frequency of Operation	Continuous
Duration	0.5 seconds: P2120, P2122, P2125 and P2127 2.0 seconds: P2123, P2128 and P2138
MIL Operation	Immediate
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

TYPICAL ENABLING CONDITIONS

Monitor runs whenever following DTCs not present	None
Either of following conditions 1 or 2 met:	-
1. Ignition switch	ON
2. Throttle actuator power	ON

TYPICAL MALFUNCTION THRESHOLDS

P2120:

TYPICAL MALFUNCTION THRESHOLDS

Either of following conditions 1 or 2 met:	-
1. VPA voltage when VPA2 voltage 0.04 V or more	0.4 V or less
2. VPA voltage	4.8 V or more

P2122:

TYPICAL MALFUNCTION THRESHOLDS

VPA voltage when VPA2 voltage 0.04 V or more	0.4 V or less

P2123:

TYPICAL MALFUNCTION THRESHOLDS

VPA voltage	4.8 V or more

P2125:

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TYPICAL MALFUNCTION THRESHOLDS

Either of following conditions 1 or 2 met:	-
1. VPA2 voltage when VPA voltage 0.04 V or more	1.2 V or less
2. VPA2 voltage when VPA voltage 0.4 to 3.45 V	4.8 V or more

P2127:

TYPICAL MALFUNCTION THRESHOLDS

VPA2 voltage when VPA voltage 0.04 V or more	1.2 V or less

P2128:

TYPICAL MALFUNCTION THRESHOLDS

VPA2 voltage when VPA voltage 0.4 to 3.45 V	4.8 V or more

P2138:

TYPICAL MALFUNCTION THRESHOLDS

Either of following conditions A or B met:	-
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

VPA voltage	0.4 to 4.8 V
VPA2 voltage	1.2 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 to OFF.

WIRING DIAGRAM

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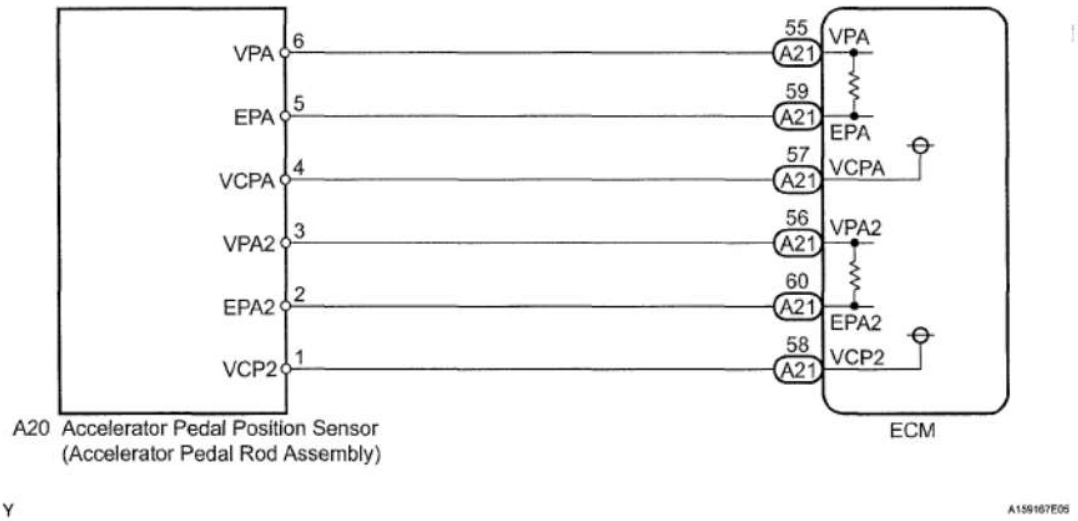


Fig. 194: Accelerator Pedal Position Sensor - Wiring Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSPECTION PROCEDURE

HINT:

Read freeze frame data using a 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 VALUE USING TECHSTREAM (ACCELERATOR POSITION SENSOR)**
   a. Connect a Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the tester ON.
   d. Select the following menu items: Powertrain / Engine and ECT / Data List / ETCS / Accelerator Position No.1 and Accelerator Position No.2.
   e. Read the value displayed on the tester.

Standard voltage

VOLTAGE SPECIFICATION

Accelerator Pedal Operation	Accelerator Position No.1	Accelerator Position No.2
Released	0.5 to 1.1 V	1.2 to 2.0 V
Depressed	2.5 to 4.5 V	3.4 to 5.0 V

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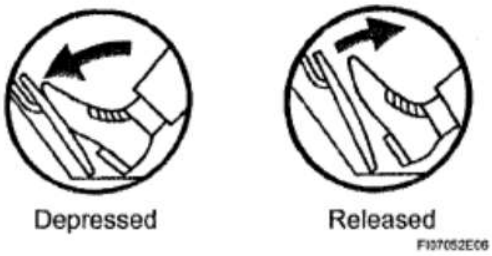


Fig. 195: Depressing And Releasing Accelerator Pedal
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

NG: Go to step 2

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

2. **CHECK HARNESS AND CONNECTOR (ACCELERATOR PEDAL POSITION SENSOR ECM)**
   a. Disconnect the accelerator pedal position sensor connector.
   b. Disconnect the ECM connector.
   c. Measure the resistance according to the value(s) in the table below.

Standard resistance (Check for open)

RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
A20-6 (VPA) - A21-55 (VPA)	Always	Below 1 ohms
A20-5 (EPA) - A21-59 (EPA)	Always	Below 1 ohms
A20-4 (VCPA) - A21-57 (VCPA)	Always	Below 1 ohms
A20-3 (VPA2) - A21-56 (VPA2)	Always	Below 1 ohms
A20-2 (EPA2) - A21-60 (EPA2)	Always	Below 1 ohms
A20-1 (VCP2) - A21-58 (VCP2)	Always	Below 1 ohms

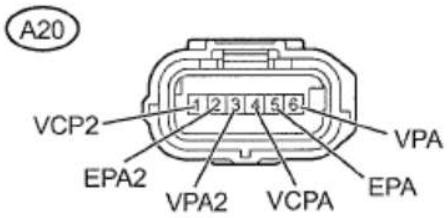
Standard resistance (Check for short)

RESISTANCE SPECIFICATION

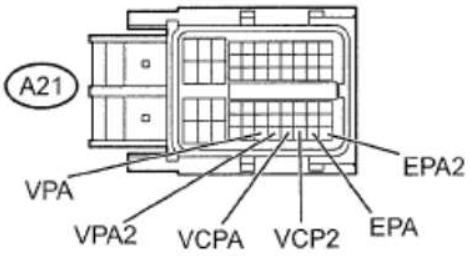
Tester Connection	Condition	Specified Condition
A20-6 (VPA) or A21-55 (VPA) - Body ground	Always	10 kohms or higher
A20-5 (EPA) or A21-59 (EPA) - Body ground	Always	10 kohms or higher
A20-4 (VCPA) or A21-57 (VCPA) - Body ground	Always	10 kohms or higher
A20-3 (VPA2) or A21-56 (VPA2) - Body ground	Always	10 kohms or higher
A20-2 (EPA2) or A21-60 (EPA2) - Body ground	Always	10 kohms or higher
A20-1 (VCP2) or A21-58 (VCP2) - Body ground	Always	10 kohms or higher

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



Front view of wire harness connector:
(to ECM)



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Fig. 196: 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

OK: Go to next step

3. **INSPECT ECM (VCPA AND VCP2 VOLTAGE)**
   a. Disconnect the accelerator pedal position sensor connector.
   b. Turn the ignition switch to ON.
   c. Measure the voltage according to the value(s) in the table below.

Standard voltage

VOLTAGE SPECIFICATION

Tester Connection	Switch Condition	Specified Condition
A20-4 (VCPA) - A20-5 (EPA)	Ignition switch ON	4.5 to 5.5 V

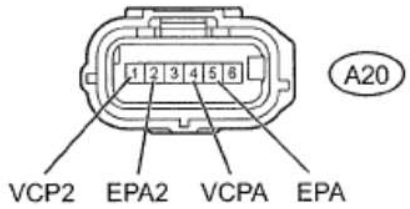
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A20-1 (VCP2) - A20-2 (EPA2)	Ignition switch ON	4.5 to 5.5 V

d. Reconnect the accelerator pedal position sensor connector.

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

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



A115666E39

Fig. 197: Identifying Accelerator Pedal Position Sensor Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

4. **REPLACE ACCELERATOR PEDAL ROD ASSEMBLY**
   a. Replace the accelerator pedal rod assembly (See **REMOVAL**).
5. **CHECK WHETHER DTC OUTPUT RECURS (ACCELERATOR PEDAL POSITION SENSOR DTCS)**
   a. Connect a Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the tester ON.
   d. Clear DTCs (See **DTC CHECK / CLEAR**).
   e. Start the engine.
   f. Allow the engine to idle for 15 seconds or more.
   g. Fully depress and release the accelerator pedal several times quickly.
   h. Select the following menu items: Powertrain / Engine and ECT / Trouble Codes.
   i. Read DTCs.

Result

RESULT REFERENCE

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Result	Proceed to
P2120, P2122, P2123, P2125, P2127, P2128, and/or P2138	A
No output	B

B : END

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

DTC P2121 THROTTLE / PEDAL POSITION SENSOR / SWITCH "D" CIRCUIT RANGE / PERFORMANCE

DESCRIPTION

HINT:

- This DTC relates to the Accelerator Pedal Position (APP) sensor.

Refer to **DTC P2120** .

DTC DETECTION CONDITION AND TROUBLE AREA

DTC No.	DTC Detection Condition	Trouble Area
P2121	Difference between VPA and VPA2 less than 0.4 V, or more than 1.2 V for 0.5 seconds (1 trip detection logic)	• Accelerator Pedal Position (APP) sensor • ECM

MONITOR DESCRIPTION

The accelerator pedal position sensor is mounted on the accelerator pedal bracket. The accelerator pedal position sensor has 2 sensor elements and 2 signal outputs: VPA and VPA2. VPA is used to detect the actual accelerator pedal angle (used for engine control) and VPA2 is used to detect malfunctions in VPA. When the difference between the output voltages of VPA and VPA2 deviates from the standard, the ECM determines that the accelerator pedal position sensor is malfunctioning. The ECM turns on the MIL and the DTC is set.

MONITOR STRATEGY

MONITOR STRATEGY

Related DTCs	P2121: Accelerator pedal position (APP) sensor rationality
Required Sensors/Components (Main)	APP sensor
Required Sensors/Components (Related)	-
Frequency of Operation	Continuous
Duration	0.5 seconds
MIL Operation	Immediate
Sequence of Operation	None

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TYPICAL ENABLING CONDITIONS

TYPICAL ENABLING CONDITIONS

Monitor runs whenever following DTCs are not present	None
Either of following conditions 1 or 2 met:	-
1. Ignition switch	ON
2. Electronic throttle actuator power	ON

TYPICAL MALFUNCTION THRESHOLDS

TYPICAL MALFUNCTION THRESHOLDS

Difference between VPA 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 two (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 two 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 to 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 a 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. **CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P2121)**
   a. Connect a Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the tester ON.
   d. Select the following menu items: Powertrain / Engine and ECT / Trouble Codes.
   e. Read DTCs.

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Result

RESULT REFERENCE

Result	Proceed to
P2121	A
P2121 and other DTCs	B

HINT:

If any DTCs other than P2121 are output, troubleshoot those DTCs first.

B: Go to DTC CHART (See **DIAGNOSTIC TROUBLE CODE CHART**)

A: Go to next step

2. **READ VALUE USING TECHSTREAM (ACCELERATOR POSITION SENSOR)** (See **INSPECTION PROCEDURE**)

NG: Go to step 3

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

3. **REPLACE ACCELERATOR PEDAL ROD ASSEMBLY**
   a. Replace the accelerator pedal rod assembly (See **REMOVAL**).
4. **CHECK WHETHER DTC OUTPUT RECURS (ACCELERATOR PEDAL POSITION SENSOR DTCS)**
   a. Connect a Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the tester ON.
   d. Clear DTCs (See **DTC CHECK / CLEAR**).
   e. Start the engine.
   f. Allow the engine to idle for 15 seconds.
   g. Fully depress and release the accelerator pedal several times quickly.
   h. Select the following menu items: Powertrain / Engine and ECT / Trouble Codes.
   i. Read DTCs.

Result

RESULT REFERENCE

Result	Proceed to
P2121	A
No output	B

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B : END

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

DTC P2195 OXYGEN (A/F) SENSOR SIGNAL STUCK LEAN (BANK 1 SENSOR 1); DTC P2196 OXYGEN (A/F) SENSOR SIGNAL STUCK RICH (BANK 1 SENSOR 1)

DESCRIPTION

HINT:

- Although the DTC titles say oxygen sensor, these DTCs relate to the Air-Fuel Ratio (A/F) sensor.
- Sensor 1 refers to the sensor mounted in front of the Three-Way Catalytic Converter (TWC) and located near the engine assembly.

The A/F 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 A/F sensor malfunctions, the ECM is unable to control the air-fuel ratio accurately.

The A/F 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 the narrow type. The heat generated by the heater is conducted to the solid electrolyte through the alumina, therefore the sensor activation is accelerated.

In order to obtain a high purification rate of the carbon monoxide (CO), hydrocarbon (HC) and nitrogen oxide (NOx) components in the exhaust gas, a TWC is used. For the most efficient use of the TWC, the air-fuel ratio must be precisely controlled so that it is always close to the stoichiometric level.

*: Value changes inside the ECM. Since the A/F sensor is the current output element, a current is converted into a voltage inside the ECM. Any measurements taken at the A/F sensor or ECM connectors will show a constant voltage.

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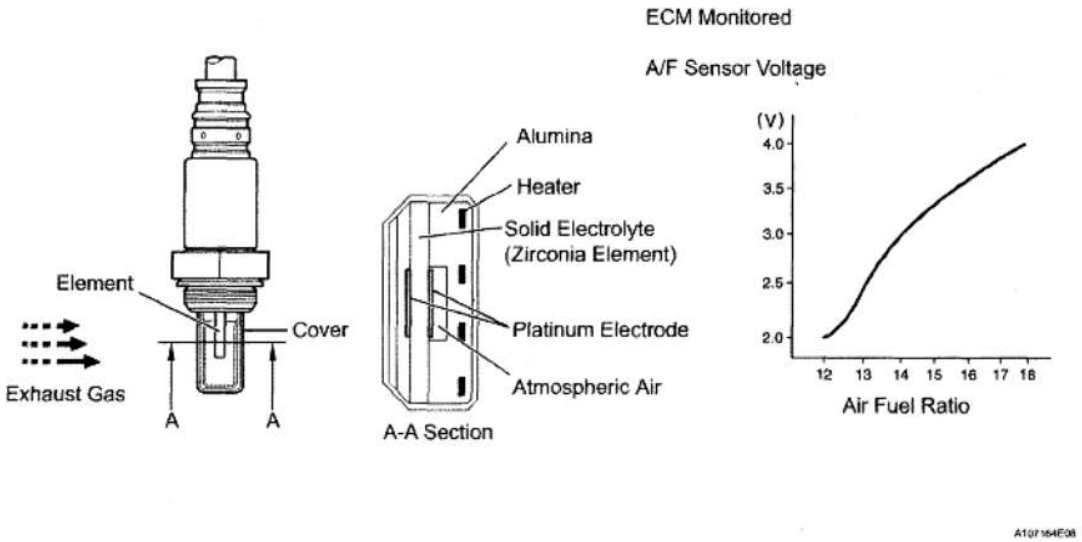


Fig. 198: A/F Sensor Voltage Graph
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

DTC DETECTION CONDITION AND TROUBLE AREA

DTC No.	DTC Detection Condition	Trouble Area
P2195	Conditions (a) and (b) continue for 10 seconds or more (2 trip detection logic) a. Air Fuel Ratio (A/F) sensor voltage more than 3.8 V b. Heated Oxygen (HO2) sensor voltage 0.15 V or more	• Open or short in A/F sensor (sensor 1) circuit • A/F sensor (sensor 1) • A/F sensor (sensor 1) heater • A/F sensor heater circuit • Air induction system • Fuel pressure • Fuel injector • ECM
	While fuel-cut operation performed (during vehicle deceleration), Air Fuel Ratio (A/F) sensor current 3.6 mA or more for 3 seconds (2 trip detection logic)	• A/F sensor • ECM
	Conditions (a) and (b) continue for 10 seconds or more (2 trip detection logic)	• Open or short in A/F sensor (sensor 1) circuit • A/F sensor(sensor 1) • A/F sensor (sensor 1) heater

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P2196	a. Air Fuel Ratio (A/F) sensor voltage less than 2.8 V b. Heated Oxygen (HO2) sensor voltage less than 0.6 V	• A/F sensor heater circuit • Air induction system • Fuel pressure • Fuel injector • ECM
	While fuel-cut operation performed (during vehicle deceleration), Air Fuel Ratio (A/F) sensor current less than 1.0 mA for 3 seconds (2 trip detection logic)	• A/F sensor • ECM

HINT:

- When any of these DTCs are set, check the A/F sensor voltage output by selecting the following menu items on a Techstream: Powertrain / Engine and ECT / Data List / A/F Control System / AFS B1 S1.
- Short-term fuel trim values can also be read using the Techstream.
- The ECM regulates the voltages at the A1A+ and A1 A- terminals of the ECM to a constant level. Therefore, the A/F sensor voltage output cannot be confirmed without using the Techstream.
- If a A/F 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 (A/F) sensor voltage output indicates rich or lean for a certain period of time, the ECM determines that there is a malfunction in the A/F sensor. The ECM illuminates the MIL and sets a DTC.

Example:

If the A/F sensor voltage output is less than 2.8 V (very rich condition) for 10 seconds, despite the HO2 sensor voltage output being less than 0.6 V, the ECM sets DTC P2196. Alternatively, if the A/F sensor voltage output is more than 3.8 V (very lean condition) for 10 seconds, despite the HO2 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 A/F sensor current, and a lean air-fuel mixture causes a high A/F 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 A/F sensor current during fuel-cut and detects any abnormal current values.

If the A/F 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 A/F sensor and sets DTC P2195 (high-side stuck). If the A/F sensor output is less than 1.0 mA for more than 3 seconds of cumulative time, the ECM sets DTC P2196 (low-side stuck).

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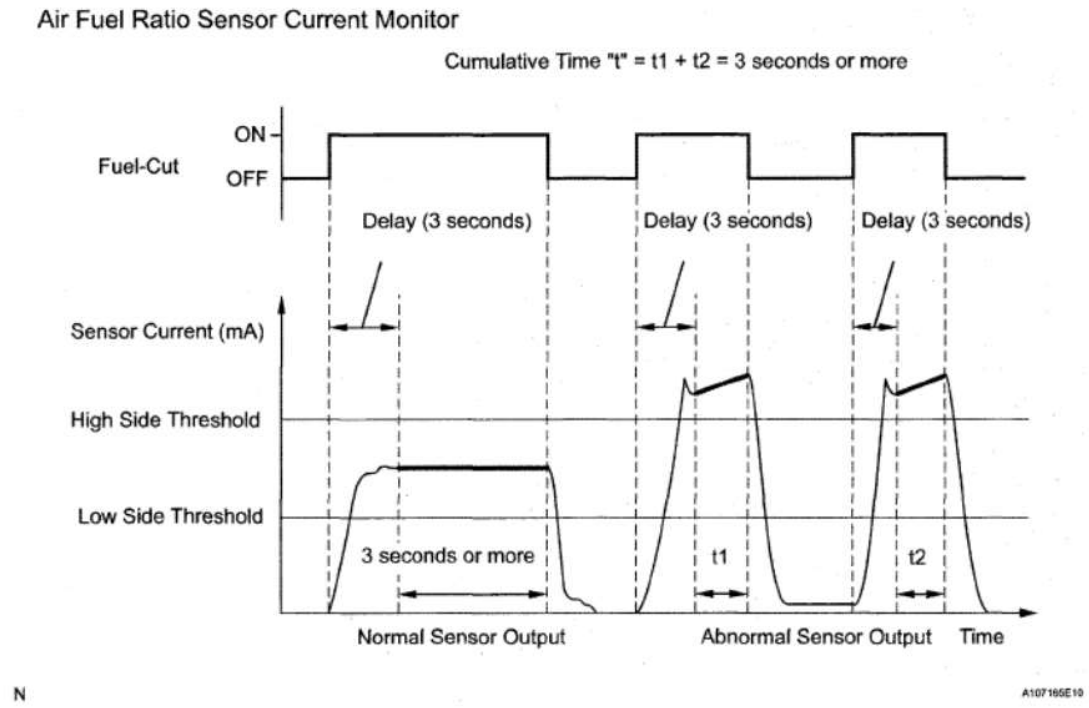


Fig. 199: Air Fuel Ratio Sensor Current Graph
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

MONITOR STRATEGY

MONITOR STRATEGY

Related DTCs	P2195: Air Fuel Ratio (A/F) sensor (Bank 1) signal stuck lean P2196: A/F sensor (Bank 1) signal stuck rich
Required Sensors/Components (Main)	A/F sensor
Required Sensors/Components (Related)	Heated Oxygen (HO2) sensor
Frequency of Operation	Continuous
Duration	5 seconds: Sensor voltage detection monitor 3 seconds: Sensor current detection monitor
MIL Operation	2 driving cycles
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

ALL

TYPICAL ENABLING CONDITIONS

	P0031, P0032 (A/F sensor heater - Sensor 1) P0037, P0038 (HO2 Sensor heater - Sensor 2) P0102, P0103 (Mass air flow meter) P0112, P0113 (Intake air temperature sensor)

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Monitor runs whenever following DTCs not present	P0115 - P0118 (Engine coolant temperature sensor) P0120 - P0223, P2135 (Throttle position sensor) P0125 (Insufficient ECT for closed loop) P0136 (HO2 Sensor - Sensor 2) P0171, P0172 (Fuel system) P0300 - P0304 (Misfire) P0335 (Crankshaft position sensor) P0340 (Camshaft position sensor) P0455, P0456 (EVAP system) P0500 (Vehicle speed sensor)

Sensor voltage detection monitor (Lean side malfunction P2195):

TYPICAL ENABLING CONDITIONS

Time after engine start	30 seconds or more
A/F sensor status	Activated
Fuel system status	Closed-loop

Sensor voltage detection monitor (Rich side malfunction P2196):

TYPICAL ENABLING CONDITIONS

Time after engine start	30 seconds or more
A/F sensor status	Activated
Fuel system status	Closed-loop

Sensor current detection monitor (P2195, P2196):

TYPICAL ENABLING CONDITIONS

Battery voltage	11 V or more
Atmospheric pressure	76 kPa (570 mmHg) or higher
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):

TYPICAL MALFUNCTION THRESHOLDS

Rear HO2 sensor output voltage	Rises from less than 0.21 V to 0.59 V or more
A/F sensor voltage	More than 3.8 V for 10 seconds

Sensor voltage detection monitor (Rich side malfunction P2196):

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TYPICAL MALFUNCTION THRESHOLDS

Rear HO2 sensor output voltage	Falls from 0.59 V or more to less than 0.21 V
A/F sensor voltage	Less than 2.8 V for 10 seconds

Sensor current detection monitor (High side malfunction P2195):

TYPICAL MALFUNCTION THRESHOLDS

Air-fuel ratio sensor current during fuel cut	3.6 mA or more

Sensor current detection monitor (Low side malfunction P2196):

TYPICAL MALFUNCTION THRESHOLDS

Air-fuel ratio sensor current during fuel cut	Less than 1.0 mA

MONITOR RESULT

Refer to **CHECKING MONITOR STATUS** .

WIRING DIAGRAM

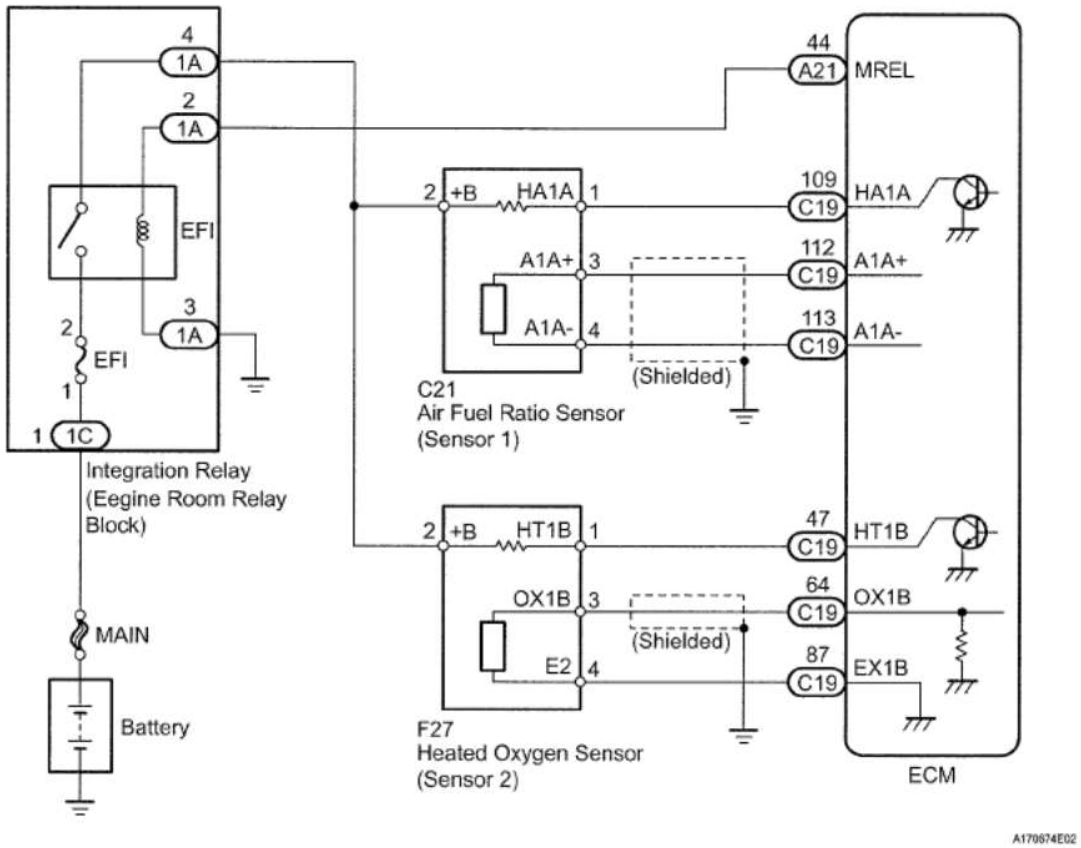


Fig. 200: Heated Oxygen Sensor - Wiring Diagram (Bank 1 Sensor 2)

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CONFIRMATION DRIVING PATTERN

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

HINT:

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

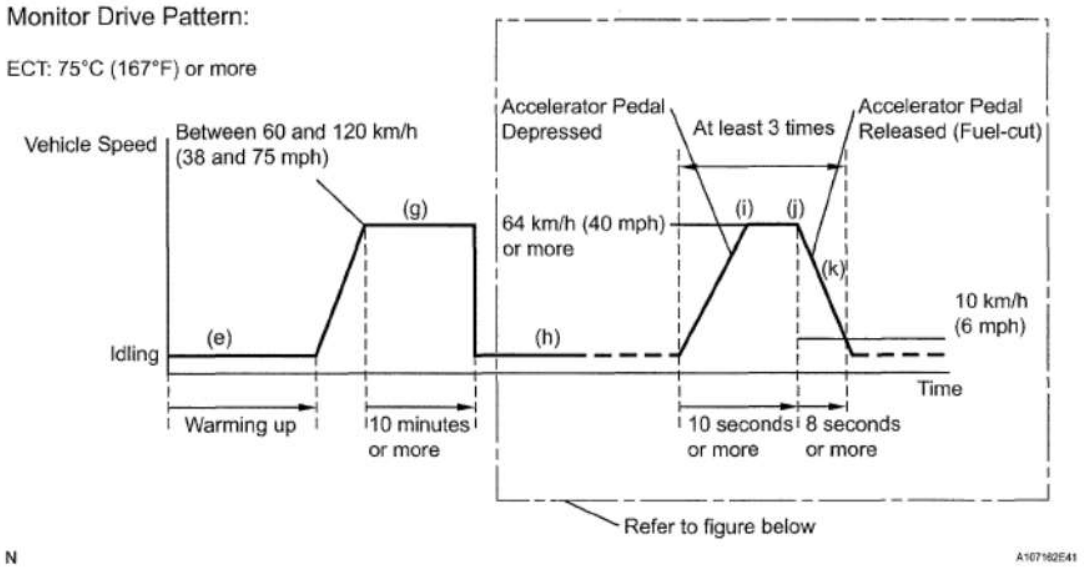


Fig. 201: Driving Pattern Graph (1 Of 2)
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Driving Pattern Detail for (h) through (k):

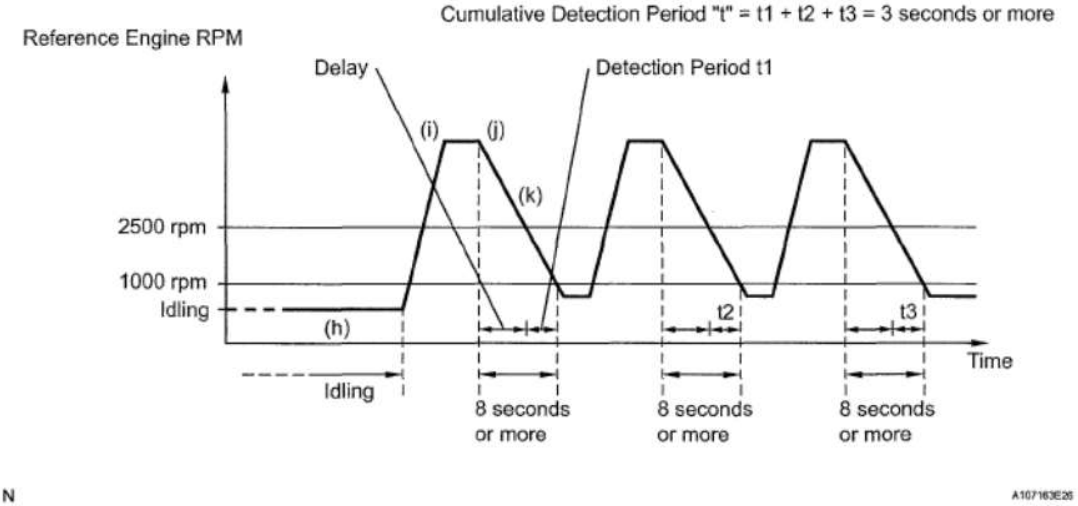


Fig. 202: Driving Pattern Graph (2 Of 2)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

a. Connect a Techstream to the DLC3.
b. Turn the ignition switch to ON.
c. Turn the tester ON.
d. Clear DTCs (See **DTC CHECK / CLEAR**).
e. Start the engine, and warm it up until the ECT reaches 75°C (167°F) or higher.
f. Select the following menu items to check the fuel-cut status: Powertrain / Engine and ECT / Data List / All Data / Idle Fuel Cut.
g. Drive the vehicle at between 60 km/h (38 mph) and 120 km/h (75 mph) for at least 10 minutes.
h. Change the transmission to 2nd gear.
i. Drive the vehicle at the proper vehicle speed to perform fuel-cut operation (refer to the following HINT).

   HINT:

   Fuel-cut is performed when the following conditions are met:

   - Accelerator pedal fully released.
   - Engine speed is 2500 rpm or more (fuel injection returns at 1000 rpm).

j. Accelerate the vehicle to 64 km/h (40 mph) or more by depressing the accelerator pedal for at least 10 seconds.
k. Soon after performing step (j) above, release the accelerator pedal for at least 8 seconds without depressing the brake pedal, in order to execute fuel-cut control.
l. Allow the vehicle to decelerate until the vehicle decelerates to less than 10 km/h (6 mph).
m. Repeat steps from (g) through (j) above at least 3 times in one driving cycle.

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HINT:

Completion of all O2S (A/F) Monitor is required to change the value in Monitor.

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 (A/F) sensor, Heated Oxygen (HO2) 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 a 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 A/F and HO2 sensors (AFS B1 S1 and O2S B1 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.

INJECTION VOLUME AND VOLTAGE SPECIFICATION

Tester Display (Sensor)	Injection Volume	Status	Voltage
AFS B1 S1 (A/F)	+25%	Rich	Less than 3.0 V
	-12.5%	Lean	More than 3.35 V
O2S B1 S2 (HO2)	+25%	Rich	More than 0.55 V
	-12.5%	Lean	Less than 0.4 V

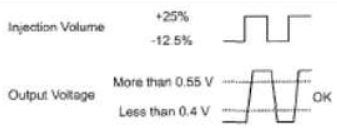
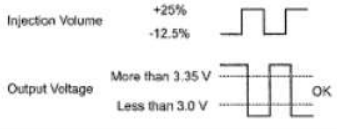
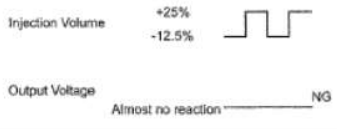
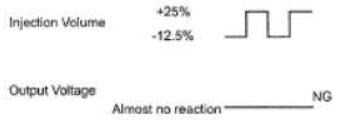
NOTE: The Air Fuel Ratio (A/F) sensor has an output delay of a few seconds and the Heated Oxygen (HO2) sensor has a maximum output delay of approximately 20 seconds.

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A/F SENSOR AND HO2 SENSOR OUTPUT VOLTAGE SPECIFICATION

Case	A/F Sensor (Sensor 1) Output Voltage	HO2 Sensor (Sensor 2) Output Voltage	Main Suspected Trouble Area
1			-
2			• A/F sensor • A/F sensor heater • A/F sensor circuit
3			• HO2 sensor • HO2 sensor heater • HO2 sensor circuit
4			• Injector • Fuel pressure • Gas leak from exhaust system (Air fuel ratio extremely rich or lean)

- Following the Control the Injection Volume for A/F sensor procedure enables technicians to check and graph the voltage outputs of both the A/F and HO2 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 B1 S1 and O2S B1 S2; then press the graph button on the Data List view.

HINT:

- Read freeze frame data using a 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 A/F sensor voltage could be caused by a rich air fuel mixture. Check for conditions that would cause the engine to run rich.
- A high A/F sensor voltage could be caused by a lean air fuel mixture. Check for conditions that would cause the engine to run lean.

1. **CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO P2195 OR P2196)**
   a. Connect a Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the tester ON.
   d. Select the following menu items: Powertrain / Engine and ECT / Trouble Codes.

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e. Read DTCs.

Result

RESULT REFERENCE

Result	Proceed to
P2195 or P2196	A
P2195 or P2196 and other DTCs	B

HINT:

If any DTCs other than P2195 and P2196 are output, troubleshoot those DTCs first.

B: Go to DTC CHART (See **DIAGNOSTIC TROUBLE CODE CHART**)

A: Go to next step

2. **READ VALUE USING TECHSTREAM (TEST VALUE OF AIR FUEL RATIO SENSOR)**
   a. Connect a Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the tester ON.
   d. Clear DTCs (See **DTC CHECK / CLEAR**).
   e. Allow the vehicle to drive in accordance with the drive pattern described in the **CONFIRMATION DRIVING PATTERN**.
   f. Select the following menu items: Powertrain / Engine and ECT / Monitor / O2 Sensor.
   g. Check that the status of O2 Sensor is Complete.

      If the status is still Incomplete, perform the drive pattern increasing the vehicle speed and using the second gear to decelerate the vehicle.

   h. Select the following menu items: Powertrain / Engine and ECT / Monitor / O2 Sensor / Details / RANGE B1 S1.
   i. Check the test value of the A/F sensor output current during fuel-cut.

      Result

      RESULT REFERENCE

Result	Proceed to
Within normal range (1.0 mA or higher, and below 3.6 mA)	A
Outside normal range (Below 1.0 mA, or 3.6 mA or higher)	B

B: Go to step 19

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A: Go to next step

3. **READ VALUE USING TECHSTREAM (OUTPUT VOLTAGE OF AIR FUEL RATIO SENSOR)**
   a. Connect a Techstream to the DLC3.
   b. Start the engine.
   c. Turn the tester ON.
   d. Warm up the Air-Fuel Ratio (A/F) sensor at an engine speed of 2500 rpm for 90 seconds.
   e. Select the following menu items: Powertrain / Engine and ECT / Data List / A/F Control System / AFS B1 S1 and Engine Speed, then press the Record button.
   f. Check the A/F sensor voltage three times, when the engine is in each of the following conditions:
      1. While idling (check for at least 30 seconds)
      2. At an engine speed of approximately 2500 rpm (without any sudden changes in engine speed)
      3. Raise the engine speed to 4000 rpm and then quickly release the accelerator pedal so that the throttle valve is fully closed.

      Standard voltage

      VOLTAGE SPECIFICATION

Condition	A/F Sensor Voltage Variation	Reference
(1) and (2)	Changes at approximately 3.3 V	Between 3.1 V and 3.5 V
(3)	Increases to 3.8 V or higher	This occurs during engine deceleration (when fuel-cut performed)

      HINT:

      For more information, see the diagrams below.

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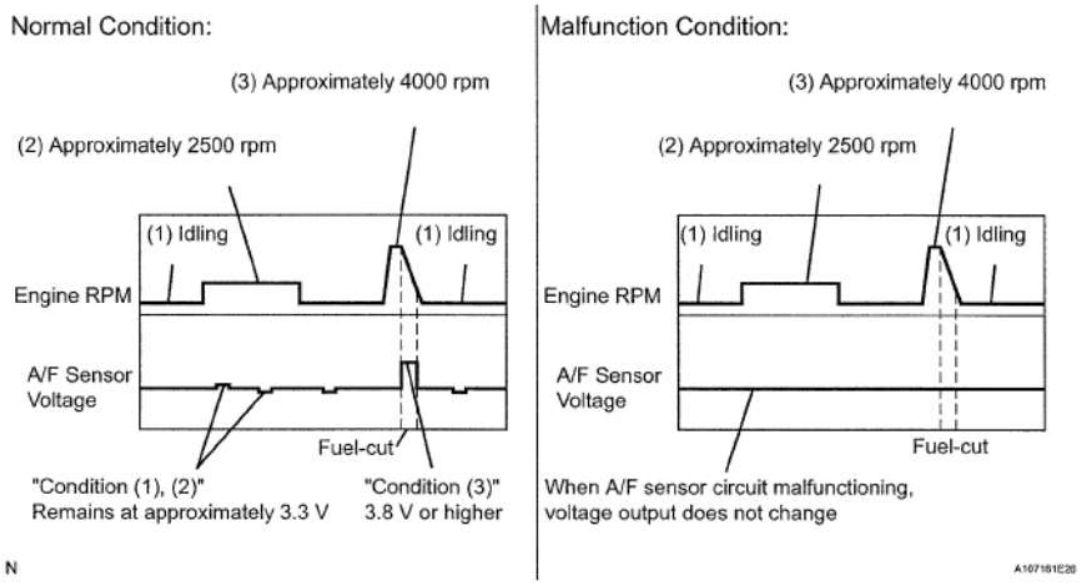


Fig. 203: A/F Sensor Voltage Graph
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

HINT:

- If the output voltage of the A/F sensor remains at approximately 3.3 V (see **Fig. 203**) under any conditions, including those above, the A/F sensor may have an open circuit. (This will also happen if the A/F sensor heater has an open circuit.)
- If the output voltage of the A/F sensor remains at either approximately 3.8 V or higher, or below 2.8 V (see **Fig. 203**) under any conditions, including those above, the A/F 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 A/F 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 16 km/h (10 mph) to allow the ECM to learn the closed throttle valve position.
- When the vehicle is driven:

  The output voltage of the A/F 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 A/F sensor is functioning normally.

- The A/F 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 A/F sensor or ECM will show a constant voltage result.

NG: Go to step 10

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OK: Go to next step

4. **PERFORM CONFIRMATION DRIVING PATTERN**
5. **CHECK WHETHER DTC OUTPUT RECURS (DTC P2195 OR P2196)**
   a. Connect a Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the tester ON.
   d. Select the following menu items: Powertrain / Engine and ECT / Trouble Codes / Pending.
   e. Read DTCs.

   Result

   RESULT REFERENCE

Result	Proceed to
P2195 or P2196	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 OR P2196)**
   a. Connect a Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the tester ON.
   d. Select the following menu items: Powertrain / Engine and ECT / Trouble Codes / Pending.
   e. Read DTCs.

   Result

   RESULT REFERENCE

Result	Proceed to
No output	A
P2195 or P2196	B

B : REPLACE ECM AND PERFORM CONFIRMATION DRIVING PATTERN (See **REMOVAL**)

A: Go to next step

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9. **CONFIRM IF VEHICLE HAS RUN OUT OF FUEL IN PAST**

   NO : CHECK FOR INTERMITTENT PROBLEMS (See **CHECK FOR INTERMITTENT PROBLEMS**)

   YES : DTC CAUSED BY RUNNING OUT OF FUEL

10. **INSPECT AIR FUEL RATIO SENSOR (HEATER RESISTANCE)** (See **INSPECTION PROCEDURE**)

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

    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)

    RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
C21-1 (HA1A) - C19-109 (HA1A)	Always	Below 1 ohms
C21-3 (A1A+) - C19-112 (A1A+)		
C21-4 (A1A-) - C19-113 (A1A-)		

    Standard resistance (Check for short)

    RESISTANCE SPECIFICATION

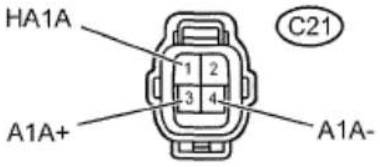
Tester Connection	Condition	Specified Condition
C21-1 (HA1A) or C19-109 (HA1A) - Body ground	Always	10 kohms or higher
C21-3 (A1A+) or C19-112 (A1A+) - Body ground		
C21-4 (A1A-) or C19-113 (A1A-) - Body ground		

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

    NG: REPAIR OR REPLACE HARNESS OR CONNECTOR

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



Front view of wire harness connector:
(to ECM)

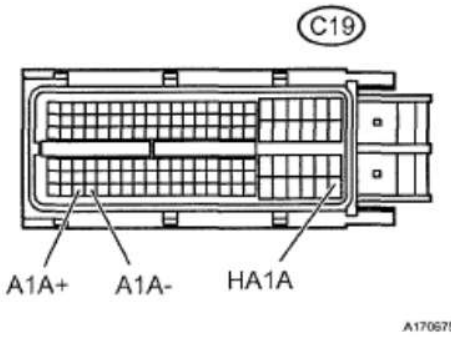


Fig. 204: Identifying Air Fuel Ratio Sensor And ECM Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

12. **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 (See **ON-VEHICLE INSPECTION**)

OK: Go to next step

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

NG: REPAIR OR REPLACE FUEL SYSTEM

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OK: Go to next step

14. **INSPECT FUEL INJECTOR**
    a. Check the injector injection (whether fuel volume is high or low, and whether injection pattern is poor) (See **INSPECTION**).

NG: REPLACE FUEL INJECTOR (See **REMOVAL**)

OK: Go to next step

15. **REPLACE AIR FUEL RATIO SENSOR**
    a. Replace the air fuel ratio sensor (See **REMOVAL**).
16. **PERFORM CONFIRMATION DRIVING PATTERN**
17. **CHECK WHETHER DTC OUTPUT RECURS (DTC P2195 OR P2196)**
    a. Connect a Techstream to the DLC3.
    b. Turn the ignition switch to ON.
    c. Turn the tester ON.
    d. Select the following menu items: Powertrain / Engine and ECT / Trouble Codes / Pending.
    e. Read DTCs.

Result

RESULT REFERENCE

Result	Proceed to
No output	A
P2195 or P2196	B

B : REPLACE ECM AND PERFORM CONFIRMATION DRIVING PATTERN (See **REMOVAL**)

A: Go to next step

18. **CONFIRM IF VEHICLE HAS RUN OUT OF FUEL IN PAST**

NO : CHECK FOR INTERMITTENT PROBLEMS (See **CHECK FOR INTERMITTENT PROBLEMS**)

YES : DTC CAUSED BY RUNNING OUT OF FUEL

19. **REPLACE AIR FUEL RATIO SENSOR**
    a. Replace the air fuel ratio sensor (See **REMOVAL**).
20. **PERFORM CONFIRMATION DRIVING PATTERN**
21. **CHECK WHETHER DTC OUTPUT RECURS (DTC P2195 OR P2196)**

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a. Connect a Techstream to the DLC3.
b. Turn the ignition switch to ON.
c. Turn the tester ON.
d. Select the following menu items: Powertrain / Engine and ECT / Trouble Codes / Pending.
e. Read DTCs.

Result

RESULT REFERENCE

Result	Proceed to
No output	A
P2195 or P2196 (A/F 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 P2252 OXYGEN (A/F) SENSOR REFERENCE GROUND CIRCUIT LOW (BANK 1 SENSOR 1);
DTC P2253 OXYGEN (A/F) SENSOR REFERENCE GROUND CIRCUIT HIGH (BANK 1 SENSOR 1)

DESCRIPTION

HINT:

- Although the DTC titles say oxygen sensor, these DTCs relate to the Air Fuel Ratio (A/F) sensor.
- Sensor 1 refers to the sensor mounted in front of the Three-Way Catalytic Converter (TWC) and located near the engine assembly.

The A/F sensor, which is located between the exhaust manifold and catalyst, consists of alloyed metal elements and a heater.

Depending on the engine operating conditions, the heater heats the sensor elements to activate them. Battery voltage is applied to the heater, the sensor ground is controlled by the ECM using a duty ratio. The sensor elements convert the oxygen concentration in the exhaust gas into voltage values to output. Based on the voltage, the ECM determines the air-fuel ratio and regulates the fuel injection volume depending on the air-fuel ratio and engine operating conditions. The voltage changes between 0.6 V and 4.5 V while the engine is running. If the air-fuel ratio is lean, which means the oxygen concentration in the exhaust gas is high, the voltage is high. If the air-fuel ratio is rich, which means the oxygen concentration in the exhaust gas is low, the voltage is low.

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Reference (System Diagram of Sensor 1):

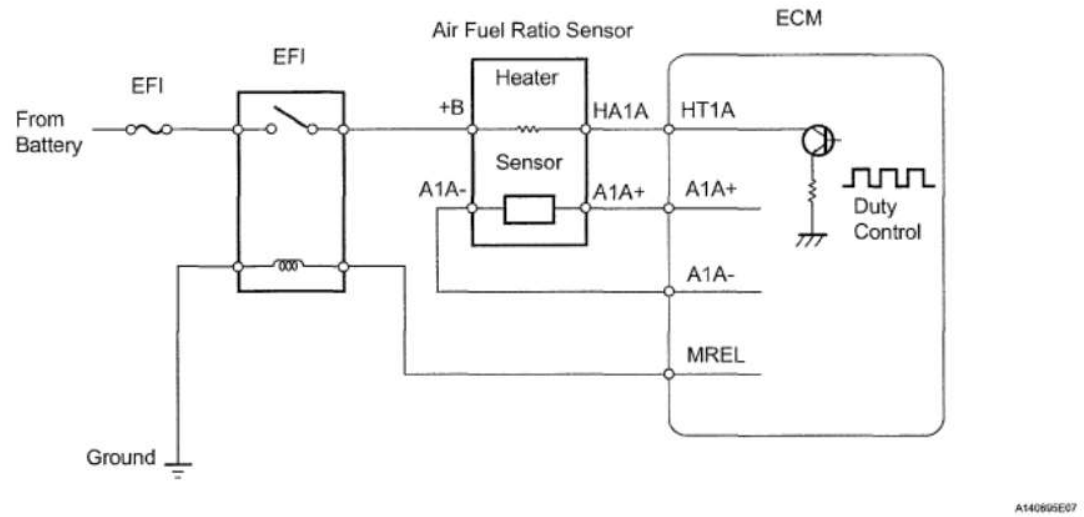


Fig. 205: Air Fuel Ratio Sensor System Diagram (Bank 1 Sensor 1)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

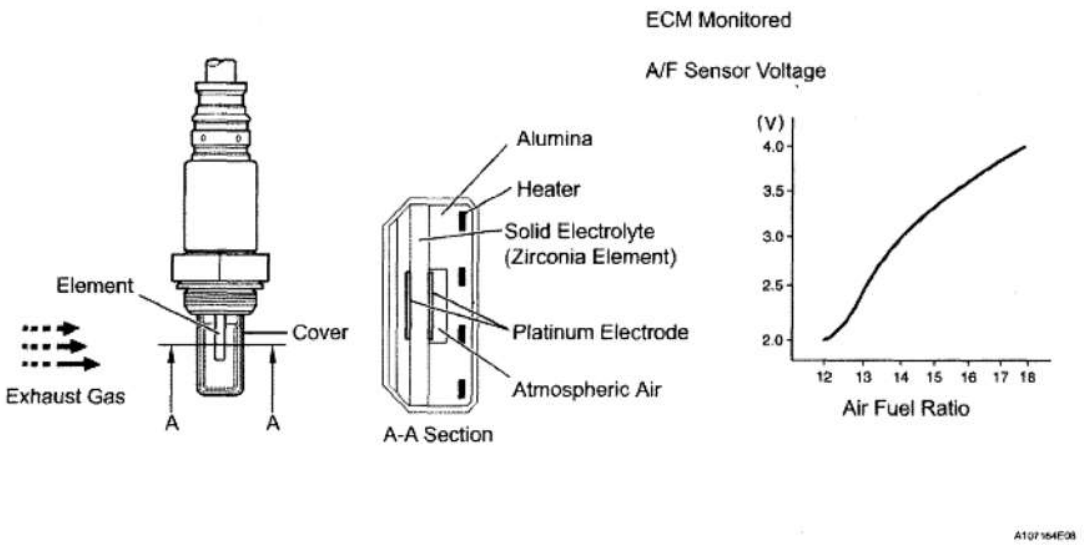


Fig. 206: Air Fuel Ratio Sensor Voltage Graph
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

DTC DETECTION CONDITION AND TROUBLE AREA

DTC No.	DTC Detection Condition	Trouble Area
P2237	Open in the circuit between terminals A1A+ and A1A-of the Air Fuel Ratio (A/F) sensor while engine is running (2 trip detection logic)	• Open in Air Fuel Ratio (A/F) sensor (sensor 1) circuit • A/F sensor (sensor 1) • ECM

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P2238	Any of the following conditions are met (2 trip detection logic) • Air Fuel Ratio (A/F) sensor output drops while engine is running. • Voltage at terminal A1A+ is 0.5 V or less. • Voltage difference between terminals A1A+ and A1A- is 0.1 V or less.	• Open or short in Air Fuel Ratio (A/F) sensor (sensor 1) circuit • A/F sensor (sensor 1) • ECM
P2239	A1A+ voltage more than 4.5 V (2 trip detection logic)	• Open or short in Air Fuel Ratio (A/F) sensor (sensor 1) circuit • A/F sensor(sensor 1) • ECM
P2252	A1A- voltage 0.5 V or less (2 trip detection logic)	• Open or short in Air Fuel Ratio (A/F) sensor (sensor 1) circuit • A/F sensor (sensor 1) • ECM
P2253	A1A- voltage more than 4.5 V (2 trip detection logic)	• Open or short in Air Fuel Ratio (A/F) sensor (sensor 1) circuit • A/F sensor (sensor 1) • ECM

MONITOR DESCRIPTION

These DTCs are output when there is an open or short in the Air Fuel Ratio (A/F) sensor circuit, or if A/F sensor output drops. To detect these problems, the voltage of the A/F sensor is monitored when turning the ignition switch to the ON position, and the admittance (admittance is an electrical term that indicates the ease of flow of current) is checked while driving. If the voltage of the A/F sensor is between 0.6 V and 4.5 V, it is considered normal. If the voltage is out of the specified range, or the admittance is less than the standard value, the ECM will determine that there is a malfunction in the A/F sensor. If the same malfunction is detected in next driving cycle, the MIL will be illuminated and a DTC will be stored.

MONITOR STRATEGY

MONITOR STRATEGY

Related DTCs	P2237: Air Fuel Ratio (A/F) sensor open circuit between A1A+ and A1A- P2238: A/F sensor short circuit between A1A+ and A1A- P2238: A/F sensor short circuit between A1A+ and GND P2238: A/F sensor low impedance P2239: A/F sensor short circuit between A1A+ and +B P2252: A/F sensor short circuit between A1A- and GND P2253: A/F sensor short circuit between A1A- and +B
Required Sensors/Components (Main)	A/F sensor

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Required Sensors/Components (Related)	Engine Coolant Temperature (ECT) sensor Crankshaft position sensor
Frequency of Operation	Continuous
Duration	10 seconds
MIL Operation	2 driving cycles
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

TYPICAL ENABLING CONDITIONS

Monitor runs whenever following DTCs are not present	P0031, P0032 (A/F sensor heater- Sensor 1) P0102, P0103 (Mass airflow meter) P0112, P0113 (Intake air temperature sensor) P0115 - P0118 (Engine coolant temperature sensor) P0120 - P0223, P2135 (Throttle position sensor) P0125 (Insufficient ECT for Closed Loop) P0171, P0172 (Fuel trim) P0300 - P0304 (Misfire) P0335 (Crankshaft position sensor) P0340 (Camshaft position sensor) P0441 - P0456, P2401 - P2420 (EVAP system) P0500 (Vehicle speed sensor)

P2237 (A/F sensor open circuit between A1A+ and A1A-):

TYPICAL ENABLING CONDITIONS

Engine	Running
Battery voltage	11 V or more

P2238 (A/F sensor low impedance):

TYPICAL ENABLING CONDITIONS

Engine coolant temperature	10°C(50°F) or higher
Fuel cut	No executed

Other:

TYPICAL ENABLING CONDITIONS

Battery voltage	11 V or more
Ignition switch	ON
Time after ignition switch is OFF to ON	5 seconds or more

TYPICAL MALFUNCTION THRESHOLDS

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P2237 (A/F sensor open circuit between A1A+ and A1A-):

TYPICAL MALFUNCTION THRESHOLDS

A/F sensor admittance	Below 0.002 1/ohms

P2238 (A/F sensor low impedance):

TYPICAL MALFUNCTION THRESHOLDS

A/F sensor admittance	Below 0.022 1/ohms

P2238 (A/F sensor short circuit between A1A+ and GND):

TYPICAL MALFUNCTION THRESHOLDS

A/F+ terminal voltage	0.5 V or less

P2239 (A/F sensor short circuit between A1A+ and +B):

TYPICAL MALFUNCTION THRESHOLDS

A/F+ terminal voltage	More than 4.5 V

P2252 (A/F sensor short circuit between A1A- and GND):

TYPICAL MALFUNCTION THRESHOLDS

A/F+ terminal voltage	0.5 V or less

P2253 (A/F sensor short circuit between A1A- and +B):

TYPICAL MALFUNCTION THRESHOLDS

A/F- terminal voltage	More than 4.5 V

P2238 (A/F sensor short circuit between A1A+ and A1A-):

TYPICAL MALFUNCTION THRESHOLDS

Difference between A/F+ terminal and A/F- terminal voltage	0.1 V or less

COMPONENT OPERATING RANGE

COMPONENT OPERATING RANGE

A/F sensor admittance	0.022 1/ohms or more
A1A+ terminal voltage	0.6 to 4.5 V
A1A- terminal voltage	0.6 to 4.5 V
Difference between A1A+ and A1A- terminal voltages	0.1 to 0.8 V

WIRING DIAGRAM

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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 (A/F) sensor, Heated Oxygen (HO2) 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 a 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 A/F and HO2 sensors (AFS B1 S1 and O2S B1 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.

INJECTION VOLUME AND VOLTAGE SPECIFICATION

Tester Display (Sensor)	Injection Volume	Status	Voltage
AFS B1 S1 (A/F)	+25%	Rich	Less than 3.0 V
	-12.5%	Lean	More than 3.35 V
O2S B1 S2 (HO2)	+25%	Rich	More than 0.55 V
	-12.5%	Lean	Less than 0.4 V

NOTE: The Air Fuel Ratio (A/F) sensor has an output delay of a few seconds and the Heated Oxygen (HO2) sensor has a maximum output delay of approximately 20 seconds.

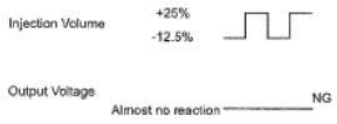
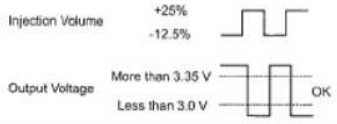
A/F SENSOR AND HO2 SENSOR OUTPUT VOLTAGE SPECIFICATION

	A/F Sensor (Sensor 1) Output	HO2 Sensor (Sensor 2)	

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Case	Voltage	Output Voltage	Main Suspected Trouble Area
1			-
2			• A/F sensor • A/F sensor heater • A/F sensor circuit
3			• HO2 sensor • HO2 sensor heater • HO2 sensor circuit
4			• Injector • Fuel pressure • Gas leak from exhaust system (Air fuel ratio extremely rich or lean)

- Following the Control the Injection Volume for A/F sensor procedure enables technicians to check and graph the voltage outputs of both the A/F and HO2 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 B1 S1 and O2S B1 S2; then press the graph button on the Data List view.

HINT:

Read freeze frame data using a 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. **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)

RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
C21-1 (HA1A) - C19-109 (HA1A)	Always	Below 1 ohms
C21-3 (A1A+) - C19-112 (A1A+)		

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C21-4 (A1A-) - C19-113 (A1A-)		

Standard resistance (Check for short)

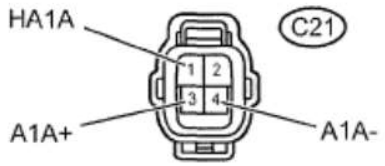
RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
C21-1 (HA1A) or C19-109 (HA1A) - Body ground	Always	10 kohms or higher
C21-3 (A1A+) or C19-112 (A1A+) - Body ground		
C21-4 (A1A-) or C19-113 (A1A-) - Body ground		

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

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR

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



Front view of wire harness connector:
(to ECM)

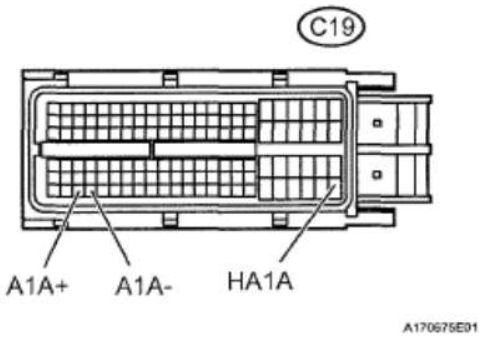


Fig. 207: Identifying Air Fuel Ratio Sensor And ECM Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

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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 **CONFIRMATION DRIVING PATTERN**).
4. **CHECK WHETHER DTC OUTPUT RECURS**
   a. Connect a Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the tester ON.
   d. Select the following menu items: Powertrain / Engine and ECT / Trouble Codes / Pending.
   e. Read pending DTCs.

Result

RESULT REFERENCE

Result	Proceed to
No output	A
P2237, P2238, P2239, P2252 or P2253	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	Malfunction Detection Condition	Trouble Area	Detection Timing	Detection Logic
P2420	Vent valve stuck open (vent)	Following condition met during key-off EVAP monitor: • EVAP pressure change when vent valve closed (ON) less than 0.3 kPa-g (2.25 mmHg-g)	• Canister pump module (Reference orifice, leak detection pump, vent valve) • Connector/wire harness (Canister pump module - ECM) • ECM	While ignition switch OFF	2 trip

HINT:

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The vent valve is built into the canister pump module.

DESCRIPTION

The description can be found in the EVAP (Evaporative Emission) System (See **DESCRIPTION**).

INSPECTION PROCEDURE

Refer to the **EVAP SYSTEM** .

HINT:

Unit expressions

- [kPa-a (mmHg-a)] denotes the absolute pressure.
- [kPa-g (mmHg-g)] denotes the gauge pressure (relative pressure).
- On a Techstream, convert the unit of measurement according to the inspection procedure.

MONITOR DESCRIPTION

5 hours* after the ignition switch is turned to OFF, the leak detection pump creates negative pressure (vacuum) in the EVAP system. The ECM monitors for leaks and actuator malfunctions based on the EVAP pressure.

HINT:

*: If the engine coolant temperature is not below 35°C (95°F) 5 hours after the ignition switch is turned to 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 to OFF, the monitor check starts 2.5 hours later.

OPERATION DESCRIPTION CHART

Sequence	Operation	Description	Duration
-	ECM activation	Activated by soak timer 5, 7 or 9.5 hours after ignition switch turned to OFF.	-
A	Atmospheric pressure measurement	Vent valve turned OFF (vent) and EVAP system pressure measured by ECM in order to register atmospheric pressure. If pressure in EVAP system not between 70 kPa-a and 110 kPa-a (525 mmHg-a and 825 mmHg-a), ECM cancels EVAP system monitor.	10 seconds
B	First reference pressure measurement	In order to determine reference pressure, leak detection pump creates negative pressure (vacuum) through reference orifice and then ECM checks if leak detection pump and vent valve operate normally.	60 seconds
C	EVAP system pressure	Vent valve turned ON (closed) to shut EVAP system. Negative pressure (vacuum) created in EVAP system, and EVAP system pressure then measured. Write down measured value as it will be used in leak check.	15 minutes(1)

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	measurement	If EVAP pressure does not stabilize within 15 minutes, ECM cancels EVAP system monitor.	
D	Purge VSV monitor	Purge VSV opened and then EVAP system pressure measured by ECM. Large increase indicates normality.	10 seconds
E	Second reference pressure measurement	After second reference pressure measurement, leak check performed by comparing first and second reference pressure. If stabilized system pressure higher than second reference pressure, ECM determines that EVAP system leaking.	60 seconds
-	Final check	Atmospheric pressure measured and then monitoring result recorded by ECM.	-
(1) If only a small amount of fuel is in the fuel tank, it takes longer for the EVAP pressure to stabilize.			

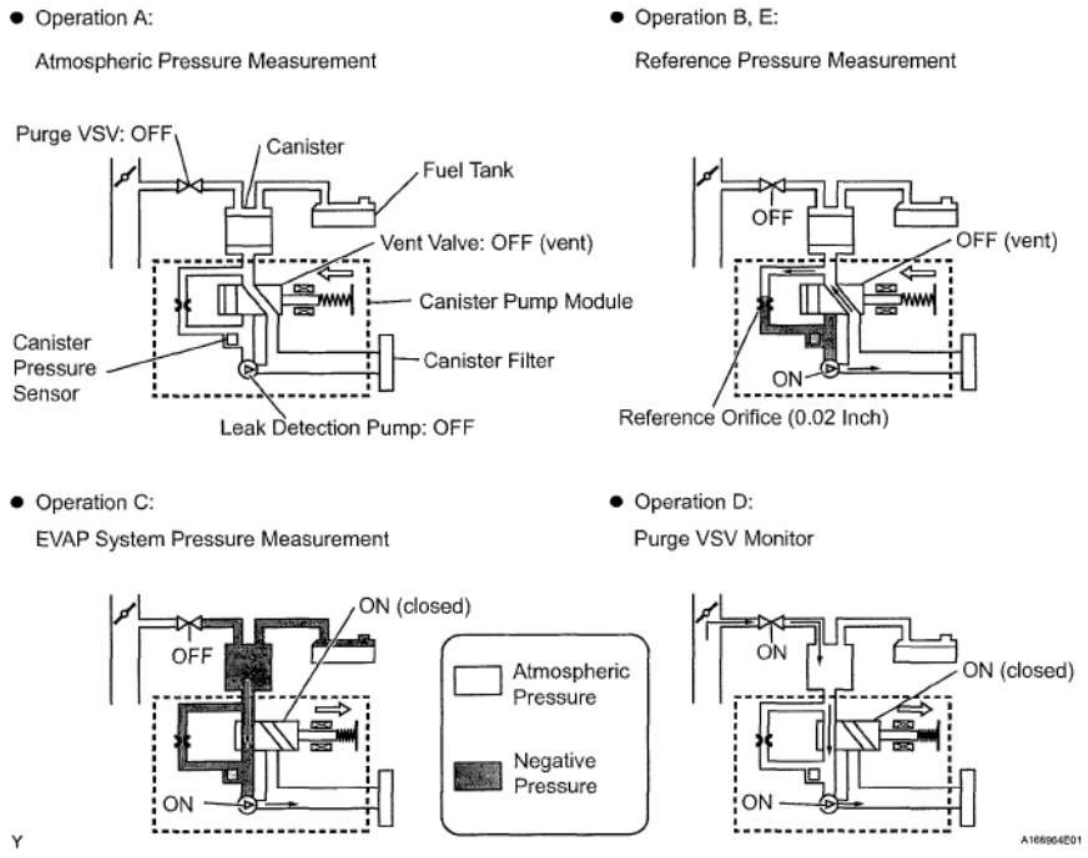


Fig. 208: Evaporative Emission System Operation Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

P2420: Vent valve stuck open (vent)

In operation C, the vent valve turns ON (closes) and the EVAP system pressure is then measured by the ECM using the canister pressure sensor to conduct an EVAP leak check. If the pressure does not increase when the vent valve is open, the ECM interprets this as the vent valve being stuck open. The ECM illuminates the MIL

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and sets the DTC.

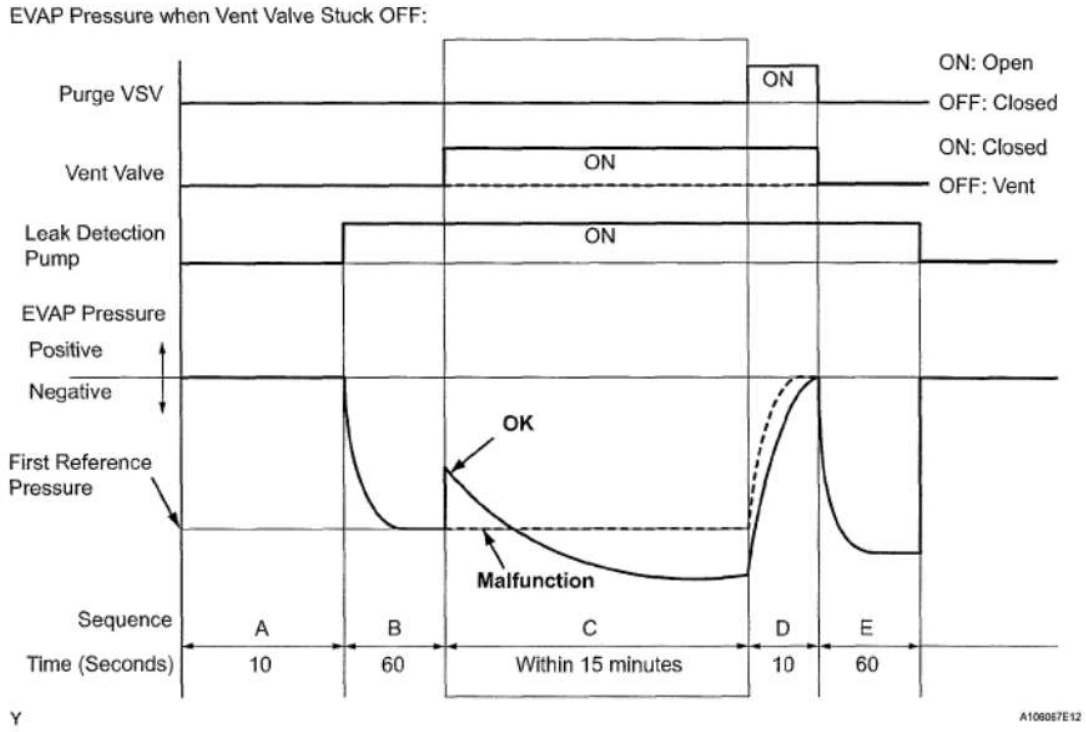


Fig. 209: EVAP Pressure Graph
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

MONITOR STRATEGY

MONITOR STRATEGY

Required Sensors/Components	Purge VSV and canister pump module
Frequency of Operation	Once per driving cycle
Duration	Within 2 minutes (varies with amount of fuel in tank)
MIL Operation	2 driving cycles
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

TYPICAL ENABLING CONDITIONS

Monitor runs whenever following DTCs not present	None
EVAP key-off monitor runs when all of following conditions met	-
Atmospheric pressure	70 to 110 kPa-a (525 to 825 mmHg-a)
Battery voltage	10.5 V or more
Vehicle speed	Below 4 km/h (2.5 mph)
Ignition switch	OFF

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Time after key off	5 or 7 or 9.5 hours
Canister pressure sensor malfunction (P0451, P0452 and P0453)	Not detected
Purge VSV	Not operated by scan tool
Vent valve	Not operated by scan tool
Leak detection pump	Not operated by scan tool
Both of following conditions met before key off	Conditions 1 and 2
1. Duration that vehicle driven	5 minutes or more
2. EVAP purge operation	Performed
ECT	4.4 to 35°C (40 to 95°F)
IAT	4.4 to 35°C (40 to 95°F)

TYPICAL MALFUNCTION THRESHOLDS

TYPICAL MALFUNCTION THRESHOLDS

EVAP pressure change after EVAP canister vent valve ON	Less than 0.3 kPa-g (2.25 mmHg-g)

MONITOR RESULT

Refer to **CHECKING MONITOR STATUS** .

DTC P2610 ECM / PCM INTERNAL ENGINE OFF TIMER PERFORMANCE

DTC SUMMARY

DTC SUMMARY

DTC No.	Monitoring Item	Malfunction Detection Condition	Trouble Area	Detection Timing	Detection Logic
P2610	Soak timer (built into ECM)	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 to OFF, before the monitor is run. This allows the fuel to cool down, which stabilizes the EVAP pressure. When 5 hours have elapsed, the ECM turns on.

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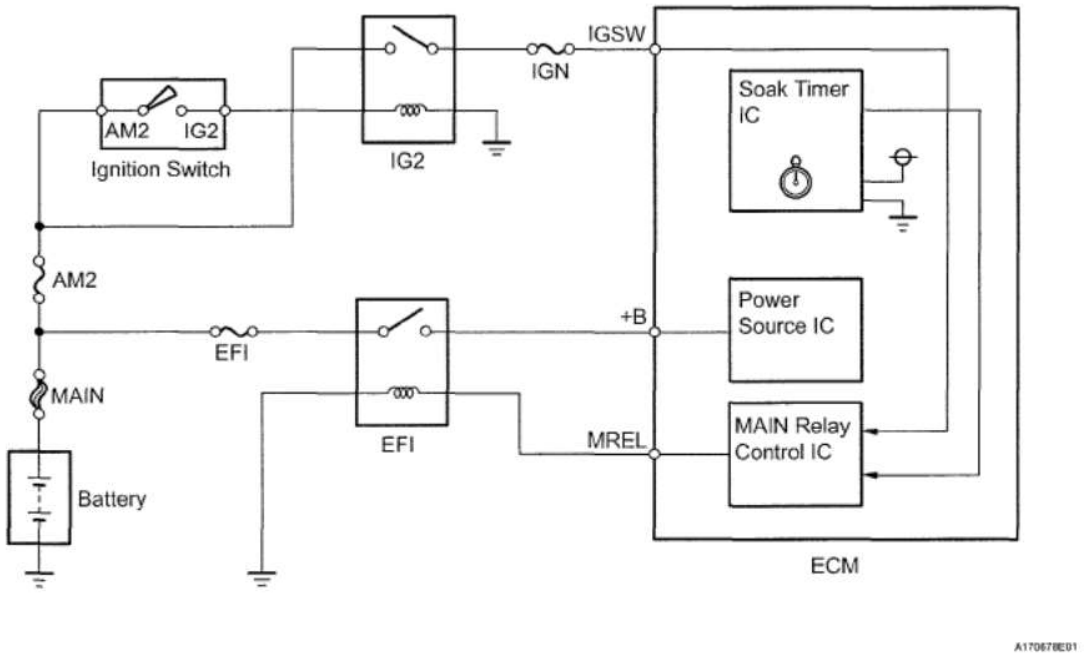


Fig. 210: Soak Timer Circuit Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

MONITOR DESCRIPTION

5 hours after the ignition switch is turned to 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

Required Sensors/Components	ECM
Frequency of Operation	Once per driving cycle
Duration	10 minutes
MIL Operation	2 driving cycles
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

TYPICAL ENABLING CONDITIONS

Monitor runs whenever following DTC not present	None
Ignition switch	ON
Engine	Running
Battery voltage	8 V or more

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Starter	OFF

TYPICAL MALFUNCTION THRESHOLDS

TYPICAL MALFUNCTION THRESHOLDS

Soak timer measurement when ECM CPU clock counts 10 minutes	Less than 7 minutes, or more than 13 minutes

INSPECTION PROCEDURE

HINT:

- DTC P2610 is set if an internal ECM problem is detected. Diagnostic procedures are not required. ECM replacement is necessary.
- Read freeze frame data using a 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. **REPLACE ECM**
   a. Replace the ECM (See **REMOVAL**).
2. **CHECK WHETHER DTC OUTPUT RECURS (DTC P2610)**
   a. Connect a Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the tester ON.
   d. Clear DTCs (See **DTC CHECK / CLEAR**).
   e. Start the engine and wait for 10 minutes or more.
   f. Select the following menu items: Powertrain / Engine and ECT / Trouble Codes / Pending.
   g. If no pending DTC is displayed, the repair has been successfully completed.

NEXT : END

DTC P2A00 A/F SENSOR CIRCUIT SLOW RESPONSE (BANK 1 SENSOR 1)

DESCRIPTION

HINT:

- Refer to **DTC P2195** .
- Sensor 1 refers to the sensor mounted in front of the Three-Way Catalytic Converter (TWC) and located near the engine assembly.

DTC DETECTION CONDITION AND TROUBLE AREA

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DTC No.	DTC Detection Condition	Trouble Area
P2A00	Calculated value for Air Fuel Ratio (A/F) sensor response rate deterioration level is less than threshold	• Open or short in Air Fuel Ratio (A/F) sensor (sensor 1) circuit • A/F sensor • A/F sensor heater • ECM

MONITOR DESCRIPTION

After 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 A/F control is performed for approximately 10 seconds after preconditions are met in order to measure the Air Fuel Ratio (A/F) sensor response rate. During active A/F control, the ECM forcibly increases and decreases the injection volume a certain amount, based on the stoichiometric air-fuel ratio learned during normal air-fuel ratio control, and measures the A/F sensor response rate. The ECM receives a signal from the A/F sensor while performing active A/F control and uses it to calculate the A/F sensor response rate deterioration level.

If the value for A/F sensor response rate deterioration level is less than the threshold, the ECM interprets this as a malfunction and sets the DTC.

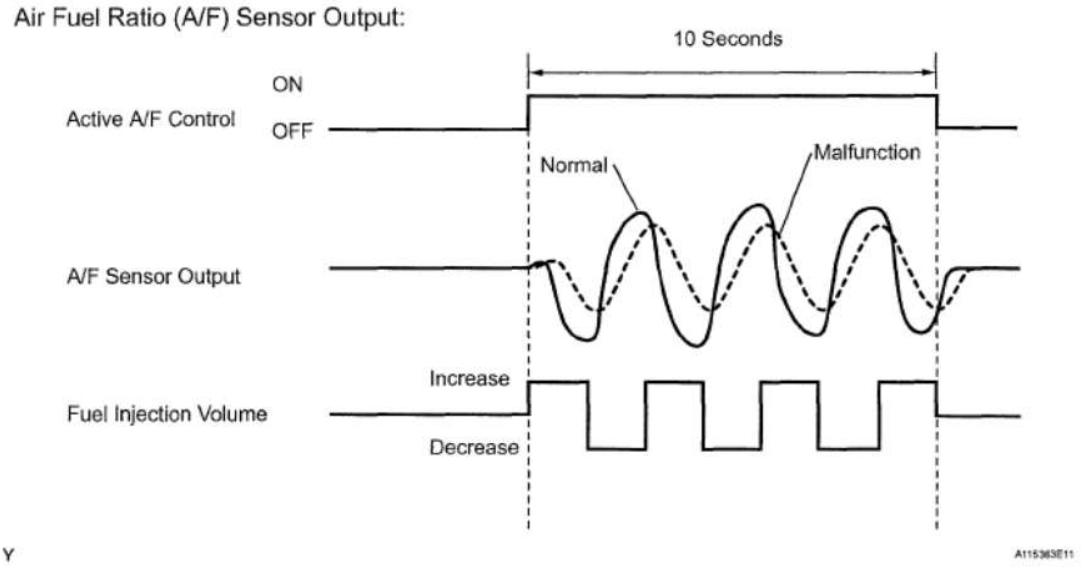


Fig. 211: Fuel Injection Volume And A/F Sensor Output Graph
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

CONFIRMATION DRIVING PATTERN

HINT:

This confirmation driving pattern is used in the "PERFORM CONFIRMATION DRIVING PATTERN"

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procedure of the following diagnostic troubleshooting procedure.

Performing this confirmation pattern will activate the Air Fuel Ratio (A/F) sensor response monitor.

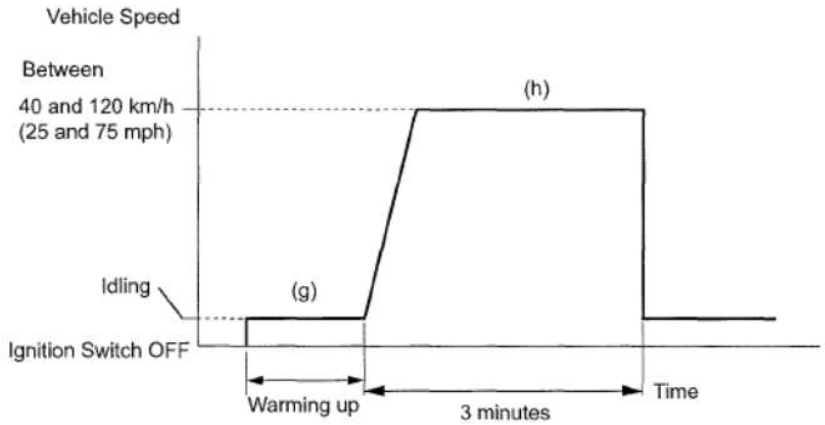


Fig. 212: Vehicle Speed Graph
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

a. Connect a Techstream to the DLC3.
b. Turn the ignition switch to ON.
c. Turn the tester ON.
d. Clear DTCs (See **DTC CHECK / CLEAR**).
e. Select the following menu items: Powertrain / Engine and ECT / Monitor / O2 Sensor / Details.
f. Check that RES RATE B1S1 is Incomplete.
g. Start the engine and warm it up.
h. Drive the vehicle at between 40 km/h and 120 km/h (25 mph and 75 mph) for 3 minutes. However, the vehicle should be driven at a constant speed.
i. Check the monitor result values on the tester by selecting the following menu items: Powertrain / Engine and ECT / Monitor / O2 Sensor / Details / RES RATE B1S1 / Details.
j. If the values indicated on the tester do not change, perform READINESS MONITOR DRIVE PATTERN for the A/F sensor and the heated oxygen sensor (See **READINESS MONITOR DRIVE PATTERN**).

   HINT:

   Completion of all A/F sensor monitors is required to change the value in RES RATE B1S1.

k. Note the value of the RES RATE B1S1.
l. Select the following menu items: Powertrain / Engine and ECT / Trouble Codes / Pending.
m. Check if any DTCs (any pending DTCs) are set.

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MONITOR STRATEGY

MONITOR STRATEGY

Related DTCs	P2A00: Air Fuel Ratio (A/F) sensor (bank 1) slow response
Required Sensors/Components (Main)	A/F 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

Monitor runs whenever following DTCs not present	P0031, P0032, (A/F sensor heater - Sensor 1) P0102, P0103 (Mass airflow meter) P0112, P0113 (Intake air temperature sensor) P0115 - P0118 (Engine coolant temperature sensor) P0120 - P0223, P2135 (Throttle position sensor) P0125 (Insufficient ECT for Closed Loop) P0171, P0172 (Fuel system) P2237 (A/F sensor open) P0300 - P0304 (Misfire) P0335 (Crankshaft position sensor) P0340 (Camshaft position sensor) P0455, P0456 (EVAP system) P0500 (Vehicle speed sensor) P2196, P2198 (A/F sensor - rationality) P2237 (A/F sensor open)
Active A/F control	Performing
Active A/F control performed when following conditions met	-
Battery voltage	11 V or more
Engine coolant temperature	75°C(167°F) or more
Idling	OFF
Engine RPM	Less than 4000 rpm
A/F sensor status	Activated
Fuel-cut	OFF
Engine load	10 to 70%
Shift position	2 or more
Catalyst monitor	Not yet
Intake air amount	4 to 16 g/sec.

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TYPICAL MALFUNCTION THRESHOLDS

TYPICAL MALFUNCTION THRESHOLDS

Response rate deterioration level	Less than 0.2 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 (A/F) sensor, Heated Oxygen (HO2) 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 a 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 A/F and HO2 sensors (AFS B1 S1 and O2S B1 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.

INJECTION VOLUME AND VOLTAGE SPECIFICATION

Tester Display (Sensor)	Injection Volume	Status	Voltage
	+25%	Rich	Less than 3.0 V

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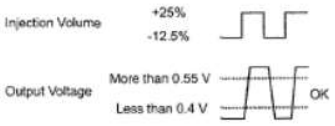
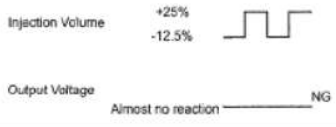
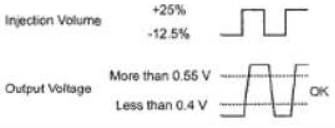
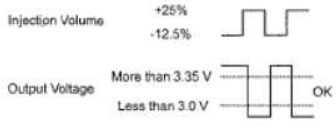
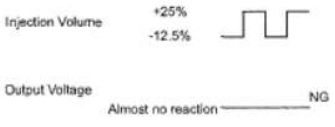
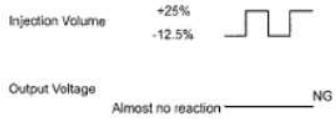
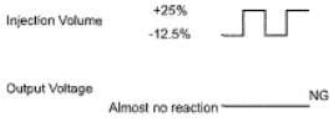
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AFS B1 S1 (A/F)	-12.5%	Lean	More than 3.35 V
O2S B1 S2 (HO2)	+25%	Rich	More than 0.55 V
	-12.5%	Lean	Less than 0.4 V

NOTE: The Air Fuel Ratio (A/F) sensor has an output delay of a few seconds and the Heated Oxygen (HO2) sensor has a maximum output delay of approximately 20 seconds.

A/F SENSOR AND HO2 SENSOR OUTPUT VOLTAGE SPECIFICATION

Case	A/F Sensor (Sensor 1) Output Voltage	HO2 Sensor (Sensor 2) Output Voltage	Main Suspected Trouble Area
1			-
2			• A/F sensor • A/F sensor heater • A/F sensor circuit
3			• HO2 sensor • HO2 sensor heater • HO2 sensor circuit
4			• Injector • Fuel pressure • Gas leak from exhaust system (Air fuel ratio extremely rich or lean)

- Following the Control the Injection Volume for A/F sensor procedure enables technicians to check and graph the voltage outputs of both the A/F and HO2 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 B1 S1 and O2S B1 S2; then press the graph button on the Data List view.

HINT:

- DTC P2A00 may be also set, when the air-fuel ratio is stuck rich or lean.
- A low A/F sensor voltage could be caused by a rich air-fuel mixture. Check for conditions that would cause the engine to run rich.
- A high A/F sensor voltage could be caused by a lean air-fuel mixture. Check for conditions that would cause the engine to run lean.
- Read freeze frame data using a Techstream. Freeze frame data records the engine condition when

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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. **CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P2A00)**
   a. Connect a Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the tester ON.
   d. Select the following menu items: Powertrain / Engine and ECT / Trouble Codes.
   e. Read DTCs.

   Result

   RESULT REFERENCE

Result	Proceed to
P2A00	A
P2A00 and other DTCs	B

   HINT:

   If any DTCs other than P2A00 are output, troubleshoot those DTCs first.

   B: Go to DTC CHART (See **DIAGNOSTIC TROUBLE CODE CHART**)

   A: Go to next step

2. **INSPECT AIR FUEL RATIO SENSOR (HEATER RESISTANCE)** (See **INSPECTION PROCEDURE**)

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

   OK: Go to next step

3. **CHECK HARNESS AND CONNECTOR (AIR FUEL RATIO SENSOR - ECM)** (See **INSPECTION PROCEDURE**)

   NG: REPAIR OR REPLACE HARNESS OR CONNECTOR

   OK: Go to next step

4. **PERFORM CONFIRMATION DRIVING PATTERN**
   a. Drive the vehicle referring the Confirmation Driving Pattern.
5. **CHECK WHETHER DTC OUTPUT RECURS (DTC P2A00)**
   a. Connect a Techstream to the DLC3.

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b. Turn the ignition switch to ON.
c. Turn the tester ON.
d. Select the following menu items: Powertrain / Engine and ECT / Trouble Codes / Pending.
e. Read DTCs.

Result

RESULT REFERENCE

Result	Proceed to
P2A00	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**
   a. Drive the vehicle referring the Confirmation Driving Pattern.
8. **CHECK WHETHER DTC OUTPUT RECURS (DTC P2A00)**
   a. Connect a Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the tester ON.
   d. Select the following menu items: Powertrain / Engine and ECT / Trouble Codes / Pending.
   e. Read DTCs.

Result

RESULT REFERENCE

Result	Proceed to
No output	A
P2A00	B

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

A : END

EVAP SYSTEM

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RELATED DTCS

DTCS REFERENCE

DTC	Monitoring Item
P043E	Reference orifice clogged (built into canister pump module)
P043F	Reference orifice high-flow (built into canister pump module)
P0441	• Purge VSV (Vacuum Switching Valve) stuck closed • Purge VSV stuck open • Purge flow
P0451	• Canister pressure sensor (built into canister pump module) noise • Canister pressure sensor (built into canister pump module) signal becomes fixed/flat
P0452	Canister pressure sensor (built into canister pump module) voltage low
P0453	Canister pressure sensor (built into canister pump module) voltage high
P0455	EVAP gross leak
P0456	EVAP small leak
P2401	Leak detection pump stuck OFF (built into canister pump module)
P2402	Leak detection pump stuck ON (built into canister pump module)
P2419	Vent valve stuck closed (built into canister pump module)
P2420	Vent valve stuck open (vent) (built into canister pump module)
P2610	Soak timer (built into ECM)

If any EVAP system DTCs are set, the malfunctioning area can be determined using the table below.

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DTC / Malfunctioning Area	P043E P043F	P0441	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 closed	●							●	●	
Vent valve stuck open (vent)										●

Y

A159818E04

Fig. 213: DTC Malfunctioning Area Reference Chart
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

NOTE: If the reference pressure difference between the first and second checks is greater than the specification, all the DTCs relating to the reference pressure (P043E, P043F, P2401, P2402 and P2419) are stored.

DESCRIPTION

HINT:

Unit expressions

- [kPa-a (mmHg-a)] denotes the absolute pressure.
- [kPa-g (mmHg-g)] denotes the gauge pressure (relative pressure).
- On a Techstream, convert the unit of measurement according to the inspection procedure.

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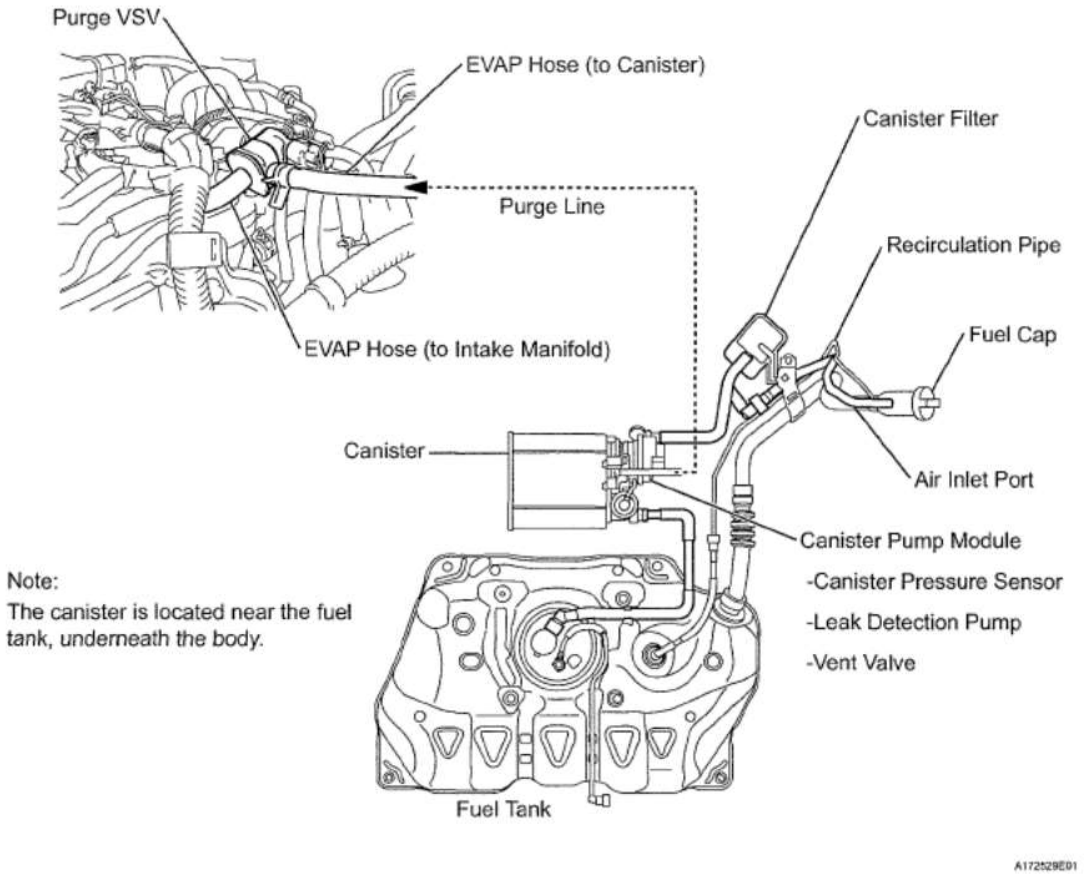


Fig. 214: Identifying EVAP System Components
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

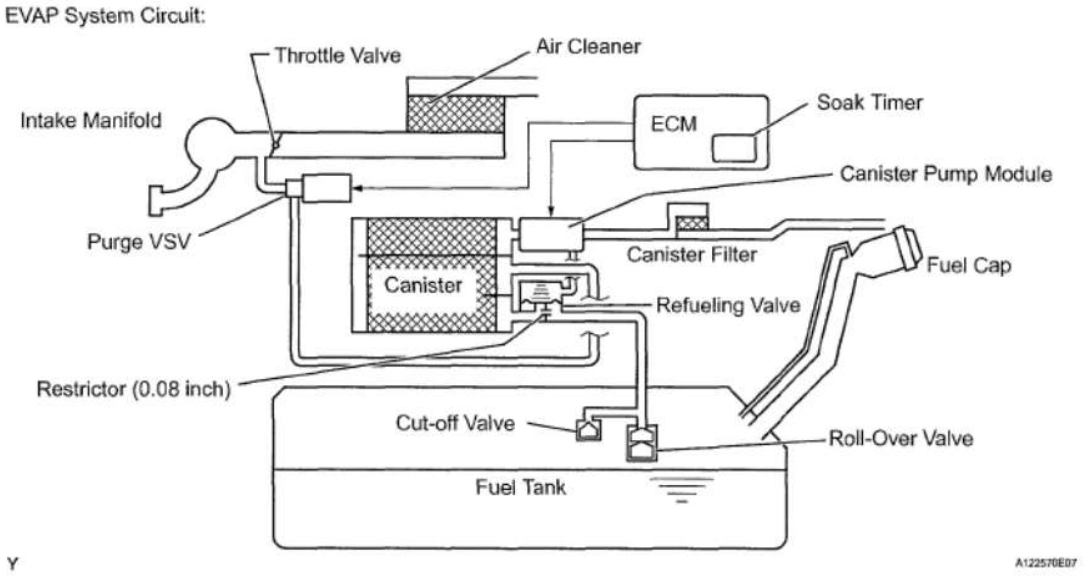


Fig. 215: EVAP System Diagram

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

NOTE: In this vehicle's EVAP system, turning ON the vent valve does not seal off the EVAP system. To check for leaks in the EVAP system, disconnect the air inlet vent hose and apply pressure from the atmospheric side of the canister.

While the engine is running, if a predetermined condition (closed-loop, etc.) is met, the purge VSV is opened by the ECM and stored fuel vapors in the canister are purged into the intake manifold. The ECM changes the duty cycle ratio of the purge VSV to control purge flow volume.

The purge flow volume is also determined by the intake manifold pressure. Atmospheric pressure is allowed into the canister through the vent valve to ensure that the purge flow is maintained when the negative pressure (vacuum) is applied to the canister.

The following two monitors run to confirm the appropriate EVAP system operation.

1. **Key-off monitor**

   This monitor checks for EVAP (Evaporative Emission) system leaks and canister pump module malfunctions. The monitor starts 5 hours* after the ignition switch is turned to OFF. At least 5 hours are required for the fuel to cool down to stabilize the EVAP pressure, thus making the EVAP system monitor more accurate.

   The leak detection pump creates negative pressure (vacuum) in the EVAP system and the pressure is measured. Finally, the ECM monitors for leaks from the EVAP system, and malfunctions in both the canister pump module and purge VSV, based on the EVAP pressure.

   HINT:

   *: If the engine coolant temperature is not below 35°C (95°F) 5 hours after the ignition switch is turned to 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 to OFF, the monitor check starts 2.5 hours later.

2. **Purge flow monitor**

   The purge flow monitor consists of 2 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 measured. If the variation in the

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pressure is less than 0.4 kPa-g (3.0 mmHg-g), the ECM interprets this as the purge VSV being stuck closed, and illuminates the MIL and sets DTC P0441 (2 trip detection logic).

Atmospheric pressure check:

In order to ensure reliable malfunction detection, the variation between the atmospheric pressures, before and after conduction of the purge flow monitor, is measured by the ECM.

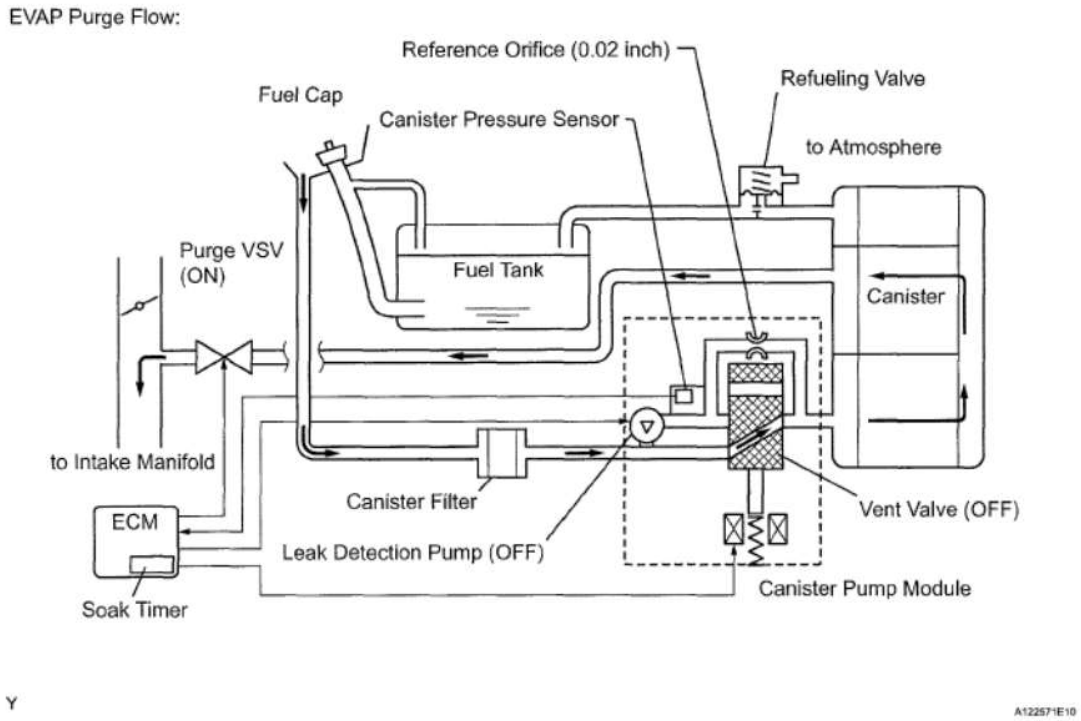


Fig. 216: EVAP Purge Flow Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

COMPONENTS OPERATION

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 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 controlled by purge VSV duty cycle ratio (current-carrying time) (Open: ON; Closed: 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 purged, valve closes and restrictor prevents large amount of vacuum from affecting pressure in fuel tank. Valve opened while

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	refueling.
Roll-over valve	Located in fuel tank. Valve closed by its own weight when vehicle overturns to prevent fuel from spilling out.
Soak timer	Built into ECM. To ensure accurate EVAP monitor, measures 5 hours (+/-15 min.) after ignition switch turned to OFF. This allows fuel to cool down, stabilizing EVAP pressure. When approximately 5 hours elapsed, ECM activates (refer to **Fig. 218**).
Canister pump module	Consists of (a) to (d) below. Canister pump module cannot be disassembled.
(a) Vent valve	Vents and closes EVAP system. When ECM turns valve ON, EVAP system closed. When ECM turns valve OFF, EVAP system vented. Negative pressure (vacuum) created in EVAP system to check for EVAP leaks by closing purge VSV, turning on vent valve (closed) and operating leak detection pump (refer to **Fig. 217**).
(b) Canister pressure sensor	Indicates pressure as voltages. ECM supplies regulated 5 V to canister pressure sensor, and uses feedback from sensor to monitor EVAP system pressure (refer to **Fig. 218**).
(c) Leak detection pump	Creates negative pressure (vacuum) in EVAP system for leak check.
(d) Reference orifice	Has opening with 0.02 inch diameter. Vacuum produced through orifice by closing purge VSV, turning off vent valve and operating leak detection pump, to monitor reference pressure. Reference pressure indicates small leak of EVAP.

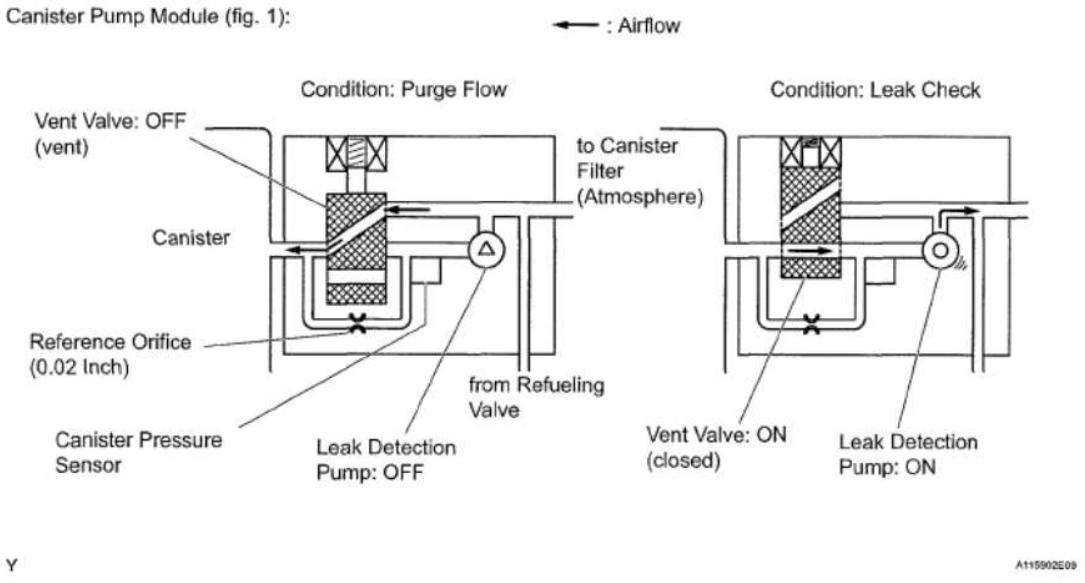


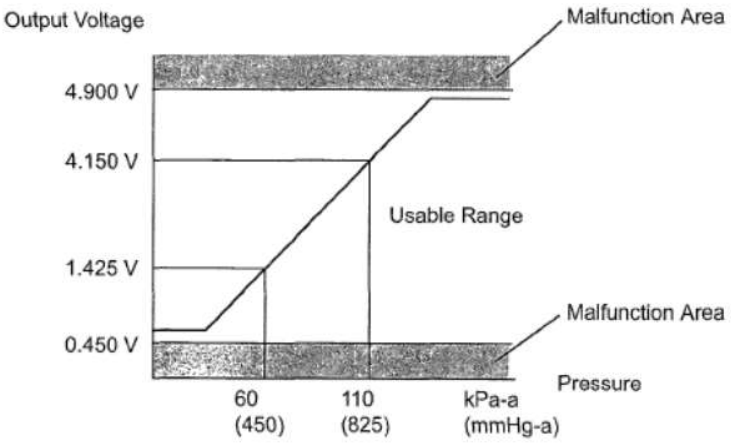
Fig. 217: Air Purge Flow Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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Canister Pressure Sensor Specification (fig. 2):

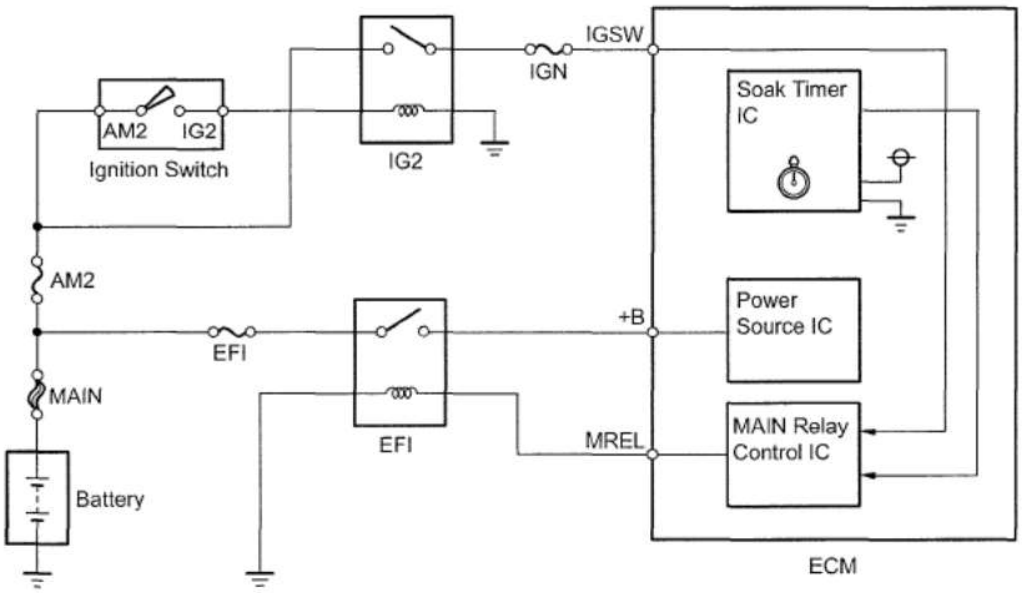


HINT:

Standard atmospheric pressure is 101.3 kPa-a (760 mmHg-a)

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Fig. 218: Canister Pressure Sensor Output Voltage Graph
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.



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Fig. 219: Soak Timer Circuit Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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WIRING DIAGRAM

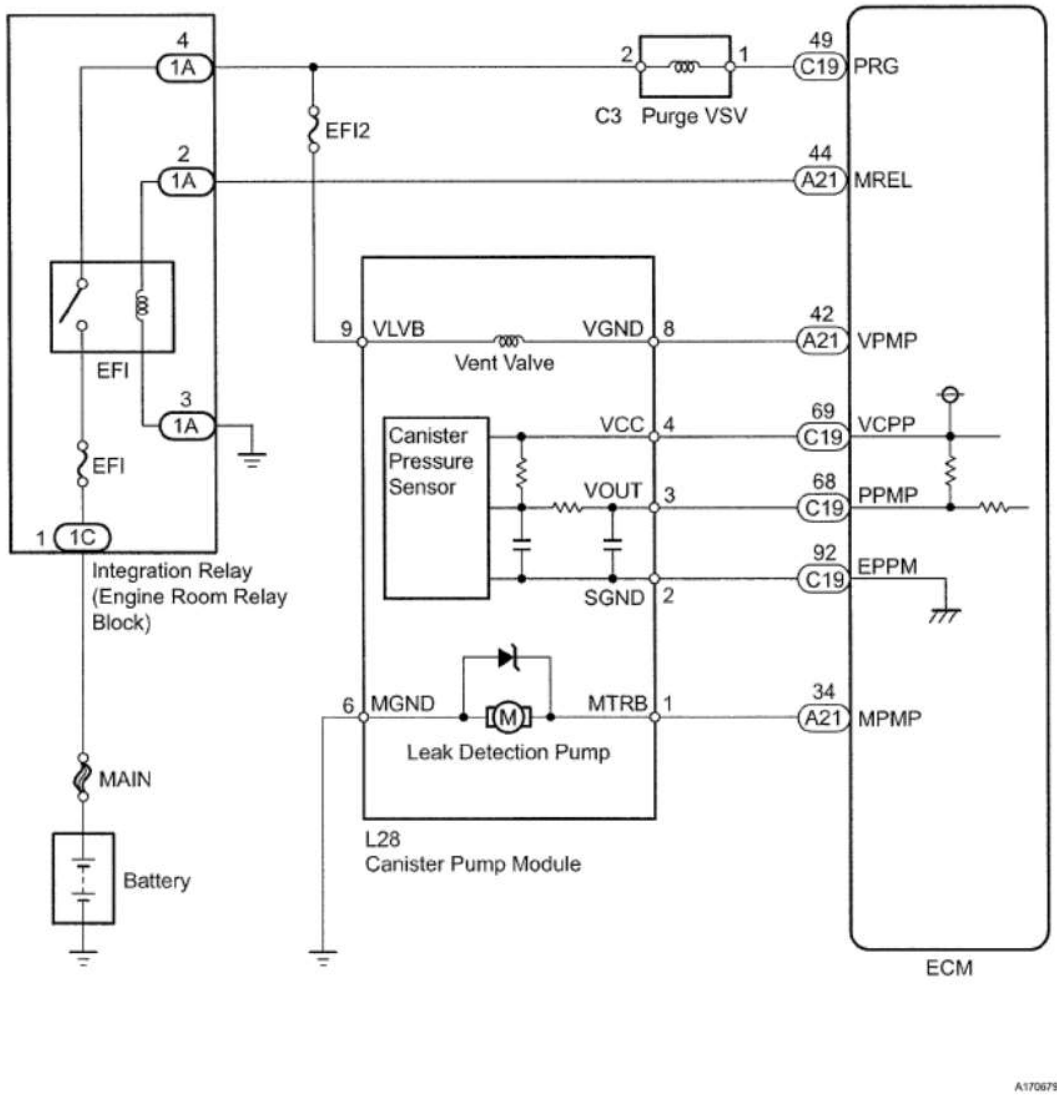


Fig. 220: Canister Pump Module - Wiring Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSPECTION PROCEDURE

NOTE: A Techstream is required to conduct the following diagnostic troubleshooting procedure.

HINT:

- Using a Techstream to monitor results enables the EVAP (Evaporative Emission) system to be confirmed.
- Read freeze frame data using a Techstream. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was

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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. **CONFIRM DTC**
   a. Turn the ignition switch to OFF and wait for 10 seconds.
   b. Turn the ignition switch to ON.
   c. Turn the ignition switch to OFF and wait for 10 seconds.
   d. Connect a Techstream to the DLC3.
   e. Turn the ignition switch to ON.
   f. Turn the tester ON.
   g. Select the following menu items: Powertrain / Engine and ECT / Trouble Codes.
   h. Confirm DTCs and freeze frame data.

   If any EVAP system DTCs are set, the malfunctioning area can be determined using the table below.

DTC / Malfunctioning Area	P043E P043F	P0441	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 closed	●							●	●	
Vent valve stuck open (vent)										●

Y

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Fig. 221: DTC Malfunctioning Area Reference Chart
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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2. **PERFORM EVAPORATIVE SYSTEM CHECK (AUTOMATIC MODE)**

NOTE:

- **The Evaporative System Check (Automatic Mode) consists of five steps performed automatically by a 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. If the cut-off valve is closed, the fuel tank leak check is not possible.**
- **Do not run the engine during this operation.**
- **When the temperature of the fuel is 35°C (95°F) or more, a large amount of vapor forms and any check results become inaccurate. When performing the Evaporative System Check, keep the temperature below 35°C (95°F).**

a. Clear DTCs (See **DTC CHECK / CLEAR**).

b. 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 DTCs are displayed, perform the **CONFIRMATION DRIVING PATTERN**. After this confirmation, check for pending DTCs. If no DTCs are displayed, the EVAP system is normal.

3. **PERFORM EVAPORATIVE SYSTEM CHECK (MANUAL MODE)**

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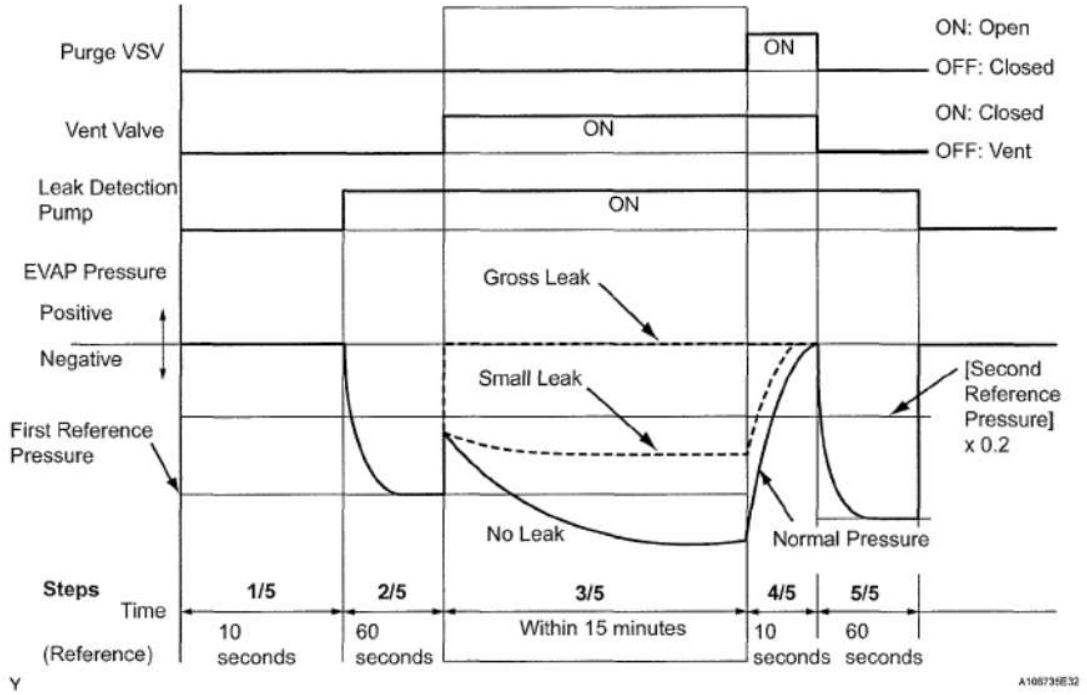


Fig. 222: EVAP Pressure Graph (Manual Mode)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

NOTE:

- **In the Evaporative System Check (Manual Mode), perform the series of 5 Evaporative System Check steps manually using a 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. If the cut-off valve is closed, the fuel tank leak check is not possible.**
- **Do not run the engine during this operation.**
- **When the temperature of the fuel is 35°C (95°F) or more, a large amount of vapor forms and any check results become inaccurate. When performing the Evaporative System Check, keep the temperature below 35°C (95°F).**

a. Clear DTCs (See **DTC CHECK / CLEAR**).
b. Select the following menu items: Powertrain / Engine and ECT / Utility / Evaporative System Check / Manual Mode.

4. **PERFORM EVAPORATIVE SYSTEM CHECK (STEP 1/5)**

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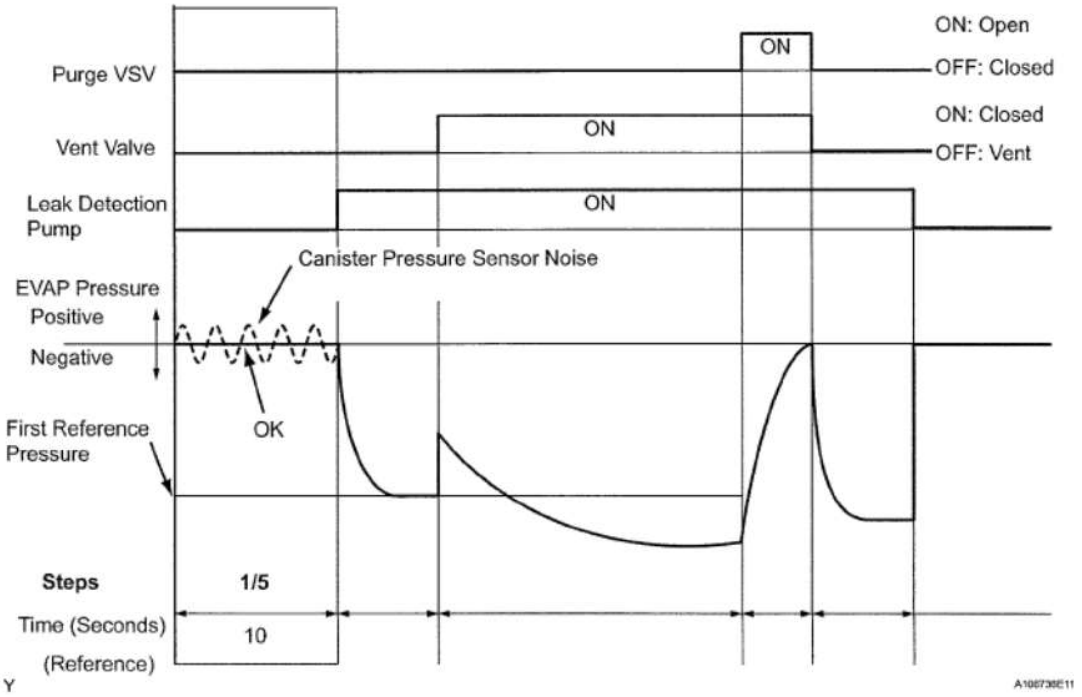


Fig. 223: EVAP Pressure Graph (Step 1/5)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

a. Check the EVAP pressure in step 1/5.

Result

PROBLEM SYMPTOMS CHART

DTCs (1)	Result	Suspected Trouble Area	Proceed to
-	Virtually no variation in EVAP pressure	Not yet determined	A
P0451	EVAP pressure fluctuates by +/-0.3 kPa-g (+/-2.25 mmHg-g) or more	Canister pressure sensor noise	B
(1) These DTCs are already present in the ECM when the vehicle arrives and are confirmed in the "CONFIRM DTC" procedures above.			

B: Go to step 29

A: Go to next step

5. **PERFORM EVAPORATIVE SYSTEM CHECK (STEP 1/5 TO 2/5)**

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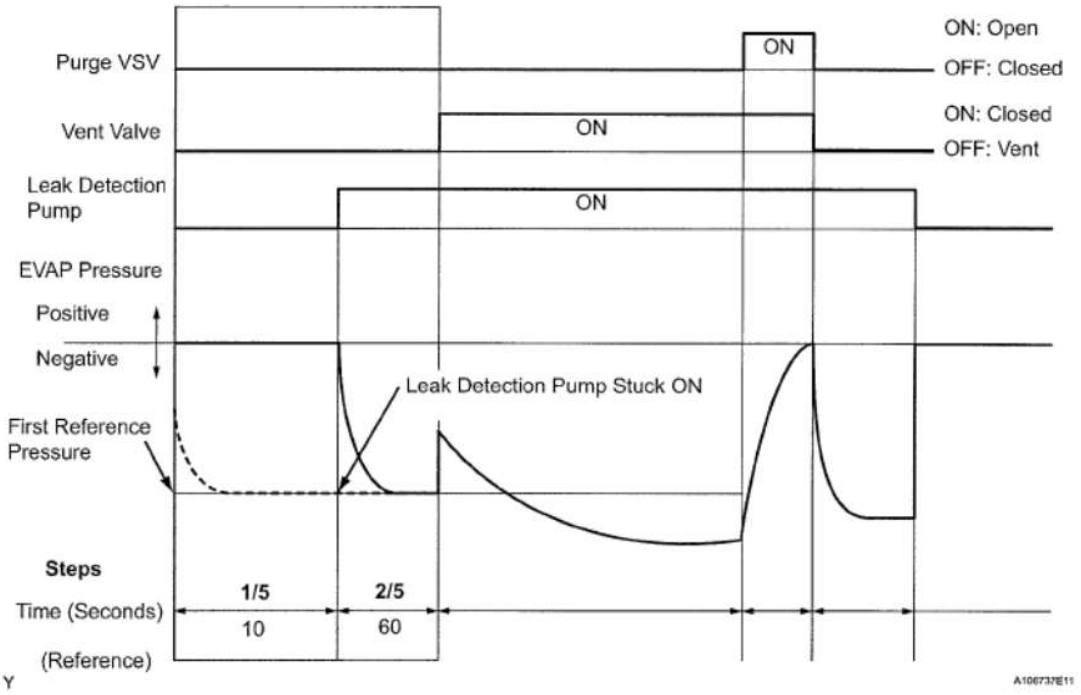


Fig. 224: EVAP Pressure Graph (Step 1/5 To 2/5)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

a. Check the EVAP pressure in steps 1/5 and 2/5.

Result

PROBLEM SYMPTOMS CHART

DTCs (1)	Result	Suspected Trouble Area	Proceed to
-	Virtually no variation in EVAP pressure during step 1/5. Then decreases to reference pressure	Not yet determined	A
P2402	Small difference between EVAP pressures during steps 1/5 and 2/5	Leak detection pump stuck ON	B
(1) These DTCs are already present in the ECM when the vehicle arrives and are confirmed in the "CONFIRM DTC" procedures above.			

HINT:

The first reference pressure is the value determined in step 2/5.

B: Go to step 22

A: Go to next step

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6. **PERFORM EVAPORATIVE SYSTEM CHECK (STEP 2/5)**

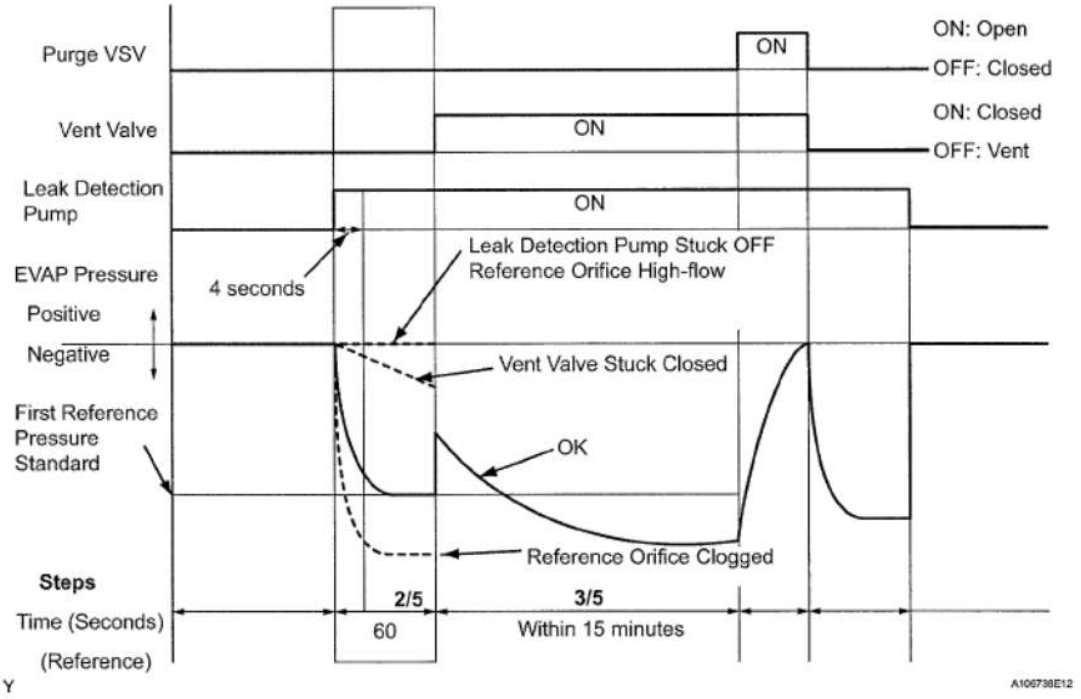


Fig. 225: EVAP Pressure Graph (Step 2/5)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

HINT:

Make a note of the pressures checked in steps (a) and (b) below.

a. Check the EVAP pressure 4 seconds after the leak detection pump is activated*.

   *: The leak detection pump begins to operate as step 1/5 finishes and step 2/5 starts.

b. Check the EVAP pressure again when it has stabilized.

   This pressure is the reference pressure.

Result

PROBLEM SYMPTOMS CHART

DTCs(1)	Result	Suspected Trouble Area	Proceed to
-	EVAP pressure in step (b) between -4.85 kPa-g and -1.057 kPa-g (-36.4 mmHg-g and -7.93 mmHg-g)	Not yet determined	A

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P043F and P2401	EVAP pressure in step (b) -1.057 kPa-g (-7.93 mmHg-g) or more	• Reference orifice high-flow • Leak detection pump stuck OFF	B
P043E	EVAP pressure in step (b) below -4.85 kPa-g (-36.4 mmHg-g)	Reference orifice clogged	C
P2419	EVAP pressure in step (a) more than -1.057 kPa-g (-7.93 mmHg-g)	Vent valve stuck closed	D
(1) These DTCs are already present in the ECM when the vehicle arrives and are confirmed in the "CONFIRM DTC" procedures above.			

B: Go to step 11

C: Go to step 29

D: Go to step 20

A: Go to next step

7. **PERFORM EVAPORATIVE SYSTEM CHECK (STEP 2/5 TO 3/5)**

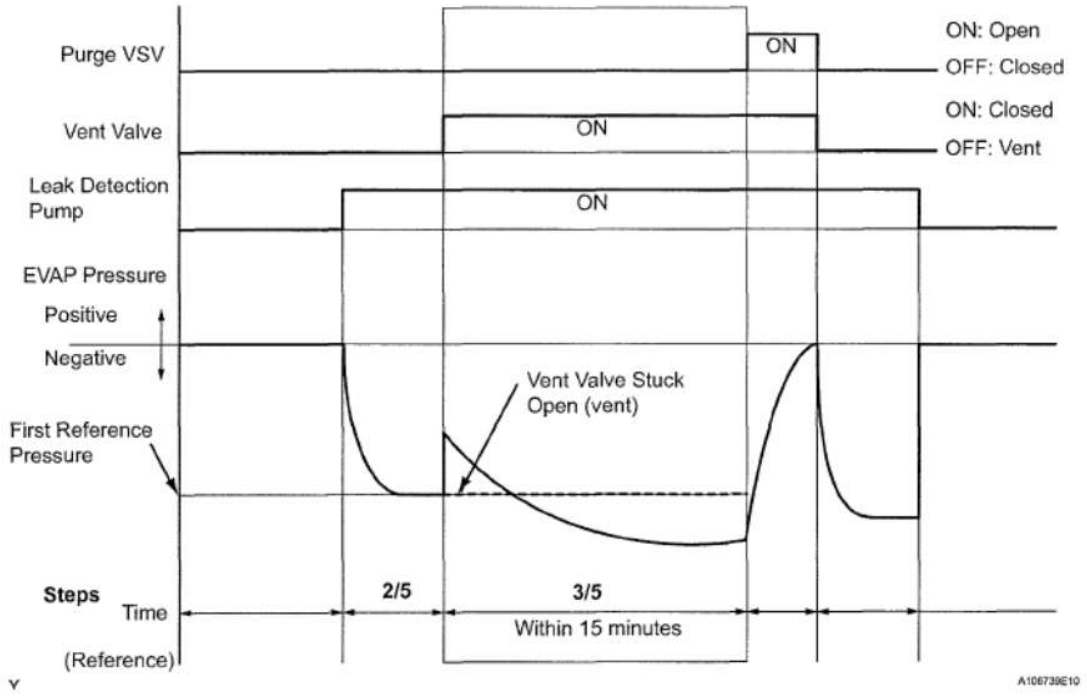


Fig. 226: EVAP Pressure Graph (Step 2/5 To 3/5)
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a. Check the EVAP pressure increase in step 3/5.

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Result

PROBLEM SYMPTOMS CHART

DTCs (1)	Result	Suspected Trouble Area	Proceed to
-	EVAP pressure increases by 0.3 kPa-g (2.25 mmHg-g) or more within 10 seconds of proceeding from step 2/5 to step 3/5	Not yet determined	A
P2420	No variation in EVAP pressure despite proceeding from step 2/5 to step 3/5	Vent valve stuck open (vent)	B
P0451	No variation in EVAP pressure during steps 1/5 through 3/5	Canister pressure sensor output value stuck	C
(1) These DTCs are already present in the ECM when the vehicle arrives and are confirmed in the "CONFIRM DTC" procedures above.			

B: Go to step 19

C: Go to step 29

A: Go to next step

8. **PERFORM EVAPORATIVE SYSTEM CHECK (STEP 3/5)**

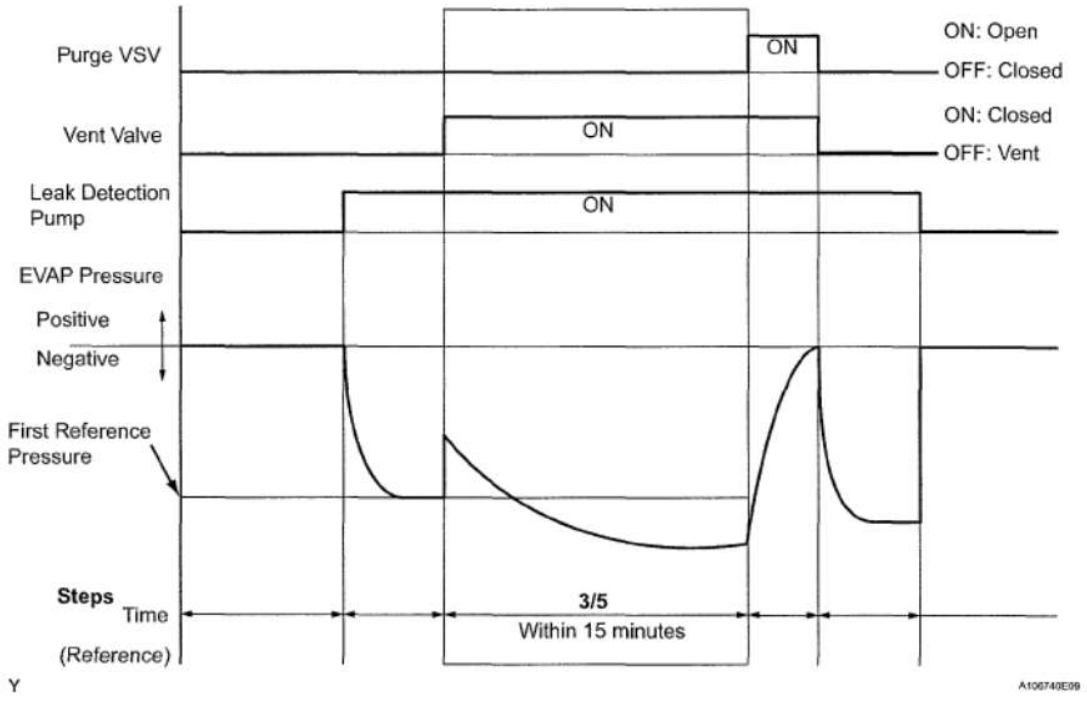


Fig. 227: EVAP Pressure Graph (Step 3/5)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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a. Wait until the EVAP pressure change is less than 0.1 kPa-g (0.75 mmHg-g) for 30 seconds.
b. Measure the EVAP pressure and record it.

HINT:

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 EVAPORATIVE SYSTEM CHECK (STEP 4/5)**

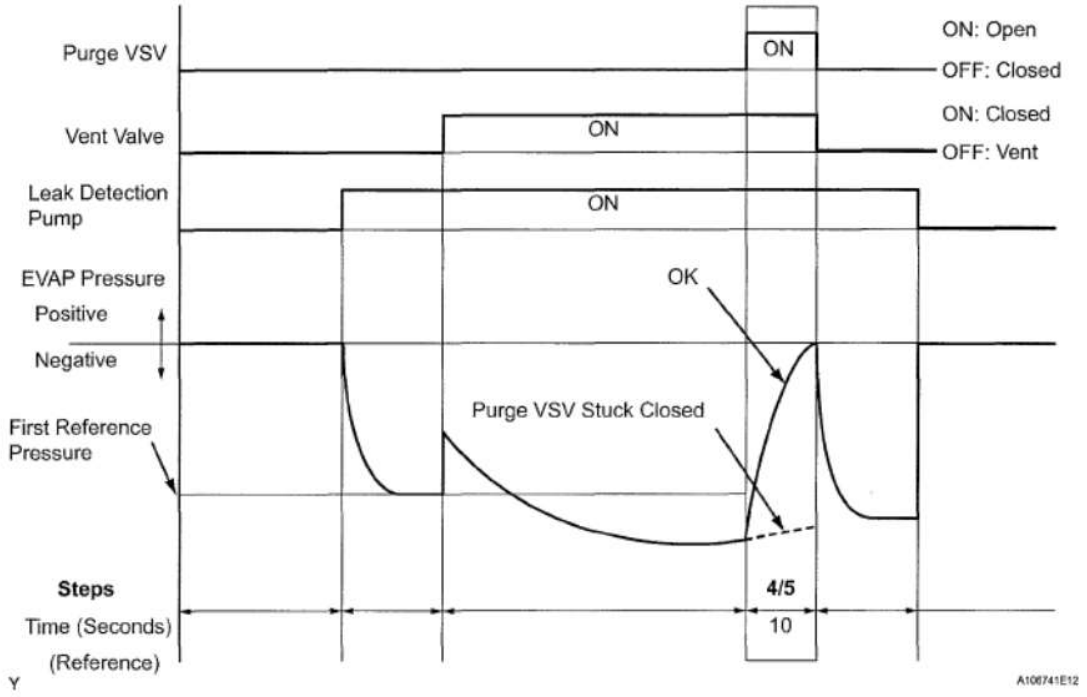


Fig. 228: EVAP Pressure Graph (Step 4/5)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

a. Check the EVAP pressure in step 4/5.

Result

PROBLEM SYMPTOMS CHART

DTCs (1)	Result	Suspected Trouble Area	Proceed to
-	EVAP pressure increases by 0.3 kPa-g (2.25 mmHg-g) or more within 10 seconds of proceeding from step 3/5 to step 4/5	Not yet determined	A
P0441	EVAP pressure increases by 0.3 kPa-g (2.25 mmHg-g) or more within 10 seconds of	Problems in EVAP hose between purge VSV and	B

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	proceeding from step 3/5 to step 4/5	intake manifold	
P0441	Variation in EVAP pressure less than 0.3 kPa-g (2.25 mmHg-g) for 10 seconds, after proceeding from step 3/5 to step 4/5	Purge VSV stuck closed	C
(1) These DTCs are already present in the ECM when the vehicle arrives and are confirmed in the "CONFIRM DTC" procedures above.			

B: Go to step 15

C: Go to step 12

A: Go to next step

10. **PERFORM EVAPORATIVE SYSTEM CHECK (STEP 5/5)**

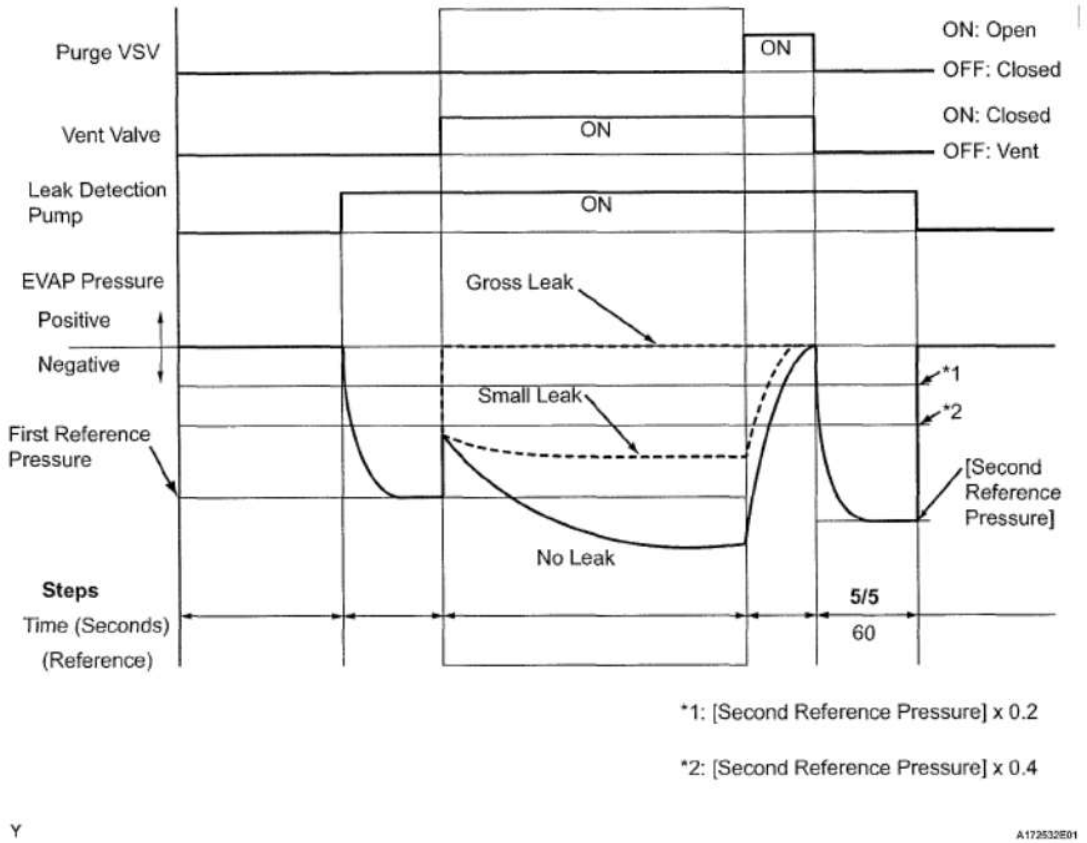


Fig. 229: EVAP Pressure Graph (Step 5/5)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

a. Check the EVAP pressure in step 5/5.
b. Compare the EVAP pressure in step 3/5 and the second reference pressure (step 5/5).

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Result

PROBLEM SYMPTOMS CHART

DTCs (1)	Result	Suspected Trouble Area	Proceed to
-	EVAP pressure (step 3/5) lower than second reference pressure (step 5/5)	Not yet determined (no leak from EVAP system)	A
P0455	EVAP pressure (step 3/5) higher than [second reference pressure (step 5/5) x 0.2]	EVAP gross leak	B
P0441	EVAP pressure (step 3/5) higher than [second reference pressure (step 5/5) x 0.4]	Purge VSV stuck open	B
P0456	EVAP pressure (step 3/5) higher than second reference pressure (step 5/5)	EVAP small leak	B
(1) These DTCs are already present in the ECM when the vehicle arrives and are confirmed in the "CONFIRM DTC" procedures above.			

A: Go to step 35

B: Go to step 12

11. **PERFORM EVAPORATIVE SYSTEM CHECK (STEP 3/5)**

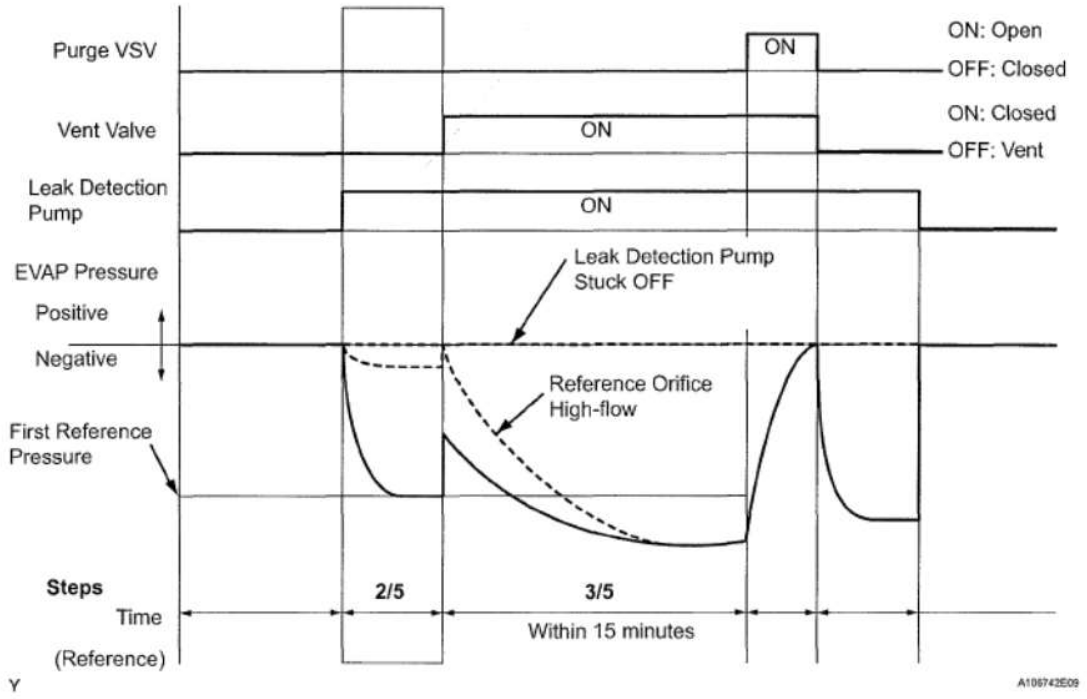


Fig. 230: EVAP Pressure Graph (Step 3/5)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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a. Check the EVAP pressure in step 3/5.

Result

PROBLEM SYMPTOMS CHART

DTCs (1)	Result	Suspected Trouble Area	Proceed to
P043F	EVAP pressure less than [reference pressure] measured at 2/5	Reference orifice high-flow	A
P2401	EVAP pressure almost same as [reference pressure] measured at 2/5	Leak detection pump stuck OFF	B
(1) These DTCs are already present in the ECM when the vehicle arrives and are confirmed in the "CONFIRM DTC" procedures above.			

HINT:

The first reference pressure is the value determined in step 2/5.

A: Go to step 29

B: Go to step 22

12. **PERFORM ACTIVE TEST USING TECHSTREAM (PURGE VSV)**
    a. Select the following menu items: 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.
    d. Using the tester, turn off the purge VSV (Activate the VSV for EVAP Control: OFF).
    e. Use your finger to confirm that the purge VSV has no suction.
    f. Using the tester, turn on the purge VSV (Activate the VSV for EVAP Control: ON).
    g. Use your finger to confirm that the purge VSV has suction.

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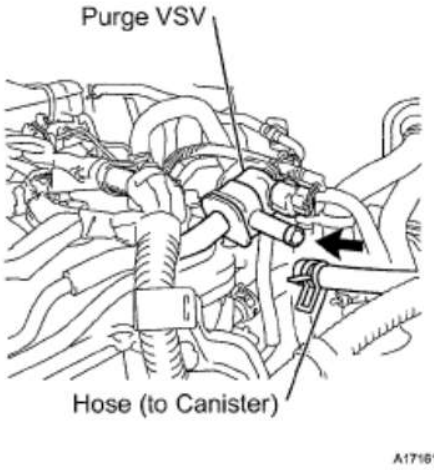


Fig. 231: Identifying Purge VSV
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Result

PROBLEM SYMPTOMS CHART

Result	Suspected Trouble Area	Proceed to
No suction when purge VSV turned OFF, and suction applied when turned ON	Purge VSV normal	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 intake manifold	C

h. Reconnect the hose.

B: Go to step 14

C: Go to step 15

A: Go to next step

13. **CHECK FUEL CAP ASSEMBLY**
    a. Check that the fuel cap is correctly installed and confirm that the fuel cap meets OEM specifications.
    b. Tighten the fuel cap until a few click sounds are heard.

    HINT:

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If an EVAP tester is available, check the fuel cap using the tester.

1. Remove the fuel cap and install it onto a fuel cap adapter.
2. Connect an EVAP tester pump hose to the adapter, and pressurize the cap to 3.2 to 3.7 kPa (24 to 28 mmHg) using an EVAP tester pump.
3. Seal the adapter and wait for 2 minutes.
4. Check the pressure. If the pressure is 2 kPa (15 mmHg) or more, the fuel cap is normal.

Result

PROBLEM SYMPTOMS CHART

Result	Suspected Trouble Area	Proceed to
Fuel cap correctly installed	-	A
Fuel cap loose	• Fuel cap improperly installed • Defective fuel cap • Fuel cap does not meet OEM specifications	B
Defective fuel cap	-	B
No fuel cap	-	C

A: Go to step 28

B: Go to step 26

C: Go to step 27

14. **INSPECT PURGE VSV**
    a. Turn the ignition switch to OFF.
    b. Disconnect the purge VSV connector.
    c. Disconnect the hose (connected to the canister) from the purge VSV.
    d. Start the engine.
    e. Use your finger to confirm that the purge VSV has no suction.

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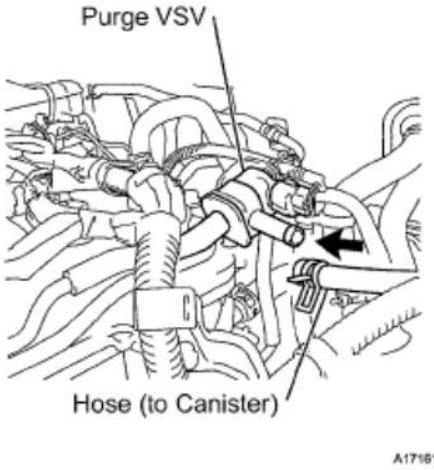


Fig. 232: Identifying Purge VSV
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Result

PROBLEM SYMPTOMS 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 34

B: Go to step 30

15. **CHECK EVAP HOSE (PURGE VSV - INTAKE MANIFOLD)**
    a. Disconnect the hose (connected to the intake manifold) from the purge VSV.
    b. Start the engine.
    c. Use your finger to confirm that the hose has suction.

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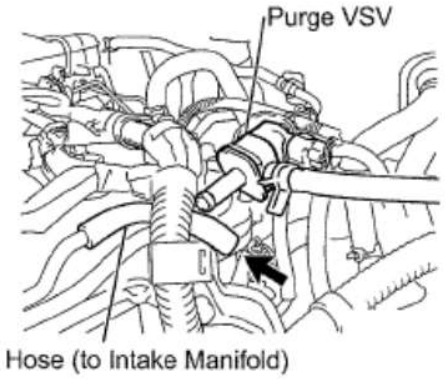


Fig. 233: Identifying Purge VSV And Hose
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Result

PROBLEM SYMPTOMS CHART

Result	Suspected Trouble Area	Proceed to
Suction applied	EVAP hose between purge VSV and intake manifold normal	A
No suction	• Intake manifold port • EVAP hose between purge VSV and intake manifold	B

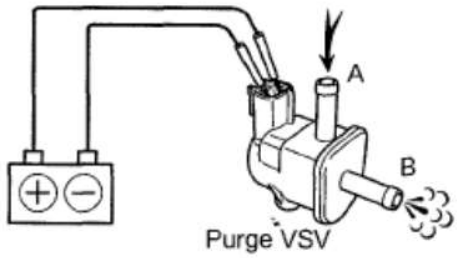
d. Reconnect the hose.

B: Go to step 25

A: Go to next step

16. **INSPECT PURGE VSV**
    a. Remove the purge VSV.
    b. Apply the battery voltage to the terminals of the purge VSV.
    c. Confirm that air flows from port A to port B.

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Fig. 234: Inspecting Purge VSV
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Result

PROBLEM SYMPTOMS CHART

Result	Condition	Suspected Trouble Area	Proceed to
Air flows	Apply battery voltage to purge VSV terminals	-	A
No airflow	Apply battery voltage to purge VSV terminals	Purge VSV	B

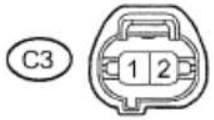
d. Reinstall the purge VSV.

B: Go to step 30

A: Go to next step

17. **CHECK HARNESS AND CONNECTOR (POWER SOURCE OF PURGE VSV)**
    a. Disconnect the purge VSV connector.
    b. Turn the ignition switch to ON.
    c. Measure the voltage according to the value(s) in the table below.

Front view of wire harness connector:
(to Purge VSV)



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Fig. 235: Identifying Purge VSV Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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Result

VOLTAGE SPECIFICATION

Tester Connection	Switch Condition	Specified Condition	Suspected Trouble Area	Proceed to
C3-2 - Body ground	Ignition Switch ON	11 to 14 V	Normal	A
		Other than result above	Wire harness or connectors between purge VSV and battery	B

d. Reconnect the purge VSV connector.

B: Go to step 31

A: Go to next step

18. **CHECK HARNESS AND CONNECTOR (PURGE VSV - ECM)**
    a. Disconnect the ECM connector.
    b. Disconnect the purge VSV connector.
    c. Measure the resistance according to the value(s) in the table below.

Standard resistance (Check for open)

RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
C19-49 (PRG) - C3-1	Always	Below 1 ohms

Standard resistance (Check for short)

RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
C19-49 (PRG) or C3-1 - Body ground	Always	10 kohms or higher

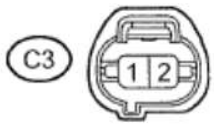
d. Reconnect the ECM connector.
e. Reconnect the purge VSV connector.

OK: Go to step 34

NG: Go to step 31

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Front view of wire harness connector:
(to Purge VSV)



Front view of wire harness connector:
(to ECM)

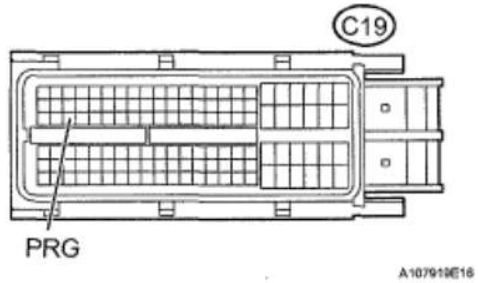
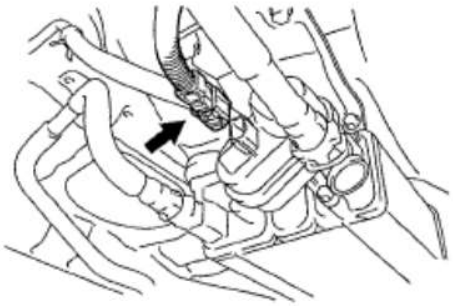


Fig. 236: Identifying Purge VSV And ECM Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

19. **INSPECT CANISTER PUMP MODULE (POWER SOURCE FOR VENT VALVE)**
    a. Turn the ignition switch to OFF.
    b. Disconnect the canister pump module connector.
    c. Turn the ignition switch to ON.
    d. Measure the voltage according to the value(s) in the table below.

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Front view of wire harness connector:
(to Canister Pump Module Connector)



A112614E07

Fig. 237: Identifying Canister Pump Module Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Result

TESTER CONNECTION AND SPECIFIED CONDITION

Tester Connection	Switch Condition	Specified Condition	Suspected Trouble Area	Proceed to
L28-9 (VLVB) - Body ground	Ignition switch ON	11 to 14 V	1. Wire harness between vent valve and ECM 2. Vent valve 3. ECM	A
		Below 3 V	Power source wire harness of vent valve	B

e. Reconnect the canister pump module connector.

B: Go to step 31

A: Go to next step

20. **INSPECT CANISTER PUMP MODULE (VENT VALVE OPERATION)**
    a. Turn the ignition switch to OFF.
    b. Disconnect the canister pump module connector.

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c. Apply the battery voltage to VLVB and VGND terminals of the canister pump module.
d. Touch the canister pump module to confirm the vent valve operation.

Component without harness connected:
(Canister Pump Module)

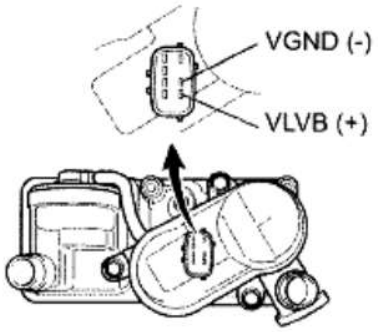


Fig. 238: Identifying Canister Pump Module Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Result

RESULT REFERENCE

Result	Suspected Trouble Area	Proceed to
Operating	1. Wire harness between vent valve and ECM 2. ECM	A
Not operating	Vent valve	B

e. Reconnect the canister pump module connector.

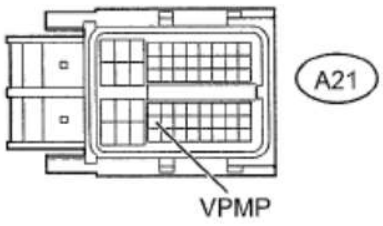
B: Go to step 29

A: Go to next step

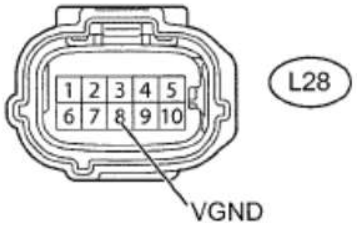
21. **CHECK HARNESS AND CONNECTOR (ECM - CANISTER PUMP MODULE)**
a. Disconnect the ECM connector.
b. Disconnect the canister pump module connector.
c. Measure the resistance according to the value(s) in the table below.

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Front view of wire harness connector:
(to ECM)



Front view of wire harness connector:
(to Canister Pump Module)



A196987E05

Fig. 239: Identifying Canister Pump Module And ECM Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Result

RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition	Suspected Trouble Area	Proceed to
A21-42 (VPMP) - L28-8 (VGND)	Always	Below 1 ohms	ECM	A
		10 kohms or higher	Wire harness between ECM and canister pump module	B

d. Reconnect the ECM connector.
e. Reconnect the canister pump module connector.

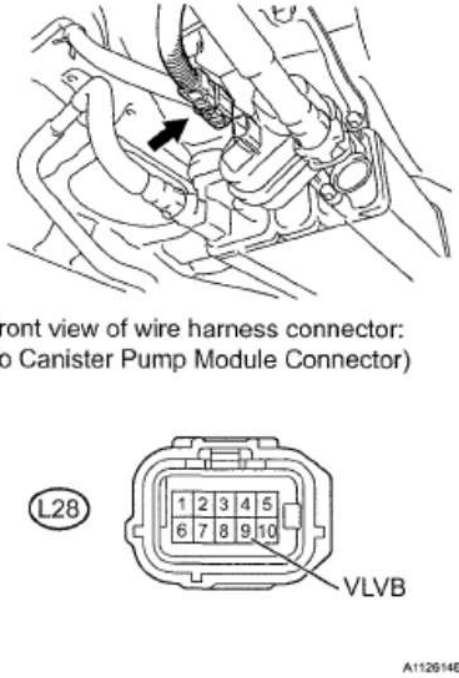
A: Go to step 34

B: Go to step 31

22. **PERFORM ACTIVE TEST USING TECHSTREAM (FOR LEAK DETECTION PUMP)**
    a. Turn the ignition switch to OFF.

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b. Disconnect the canister pump module connector.
c. Turn the ignition switch to ON.
d. Select the following menu items: Powertrain / Engine and ECT / Active Test / Activate the Vacuum Pump.
e. Measure the voltage according to the value(s) in the table below.



Front view of wire harness connector:
(to Canister Pump Module Connector)

Fig. 240: Identifying Canister Pump Module Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Result

VOLTAGE SPECIFICATION

Tester Connection	Condition	Specified Condition	Suspected Trouble Area	Proceed to
L28-1 (MTRB) - Body ground	Leak detection pump ON and OFF (Active Test ON and OFF)	Below 3 V when OFF 11 to 14 V when ON	1. Wire harness between leak detection pump and body ground 2. Leak detection pump	A
		Below 3 V when OFF and ON or 11 to 14 V when OFF and ON	1. Wire harness between leak detection pump and ECM	B

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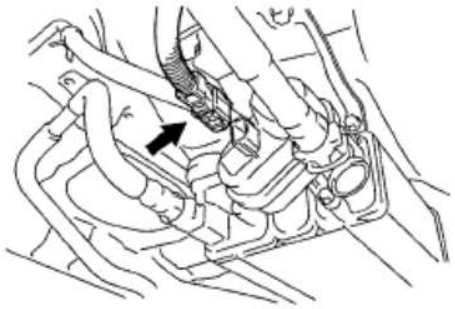
			2. ECM	

f. Reconnect the canister pump module connector.

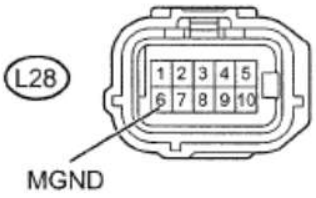
B: Go to step 24

A: Go to next step

23. **CHECK HARNESS AND CONNECTOR (CANISTER PUMP MODULE - BODY GROUND)**
    a. Turn the ignition switch to OFF.
    b. Disconnect the canister pump module connector.
    c. Measure the resistance according to the value(s) in the table below.



Front view of wire harness connector:
(to Canister Pump Module Connector)



A112614E08

Fig. 241: Identifying Canister Pump Module Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Result

RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition	Suspected Trouble Area	Proceed to
L28-6 (MGND) - Body ground	Always	Below 1 ohms	Leak detection pump	A
		10 kohms or higher	Wire harness between canister pump module and body ground	B

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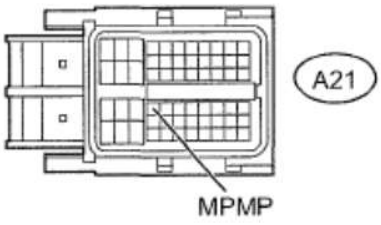
d. Reconnect the canister pump module connector.

A: Go to step 29

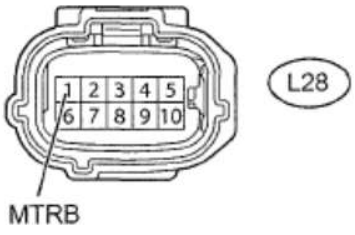
B: Go to step 31

24. **CHECK HARNESS AND CONNECTOR (ECM - CANISTER PUMP MODULE)**
    a. Turn the ignition switch to OFF.
    b. Disconnect the ECM connector.
    c. Disconnect the canister pump module connector.
    d. Measure the resistance according to the value(s) in the table below.

Front view of wire harness connector:
(to ECM)



Front view of wire harness connector:
(to Canister Pump Module)



A166967E06

Fig. 242: Identifying Canister Pump Module And ECM Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Result

RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition	Suspected Trouble Area	Proceed to

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A21-34 (MPMP) - L28-1 (MTRB)	Always	Below 1 ohms	ECM	A
		10 kohms or higher	Wire harness between ECM and canister pump module	B

e. Reconnect the ECM connector.
f. Reconnect the canister pump module connector.

A: Go to step 34

B: Go to step 31

25. **INSPECT INTAKE MANIFOLD (EVAP PURGE PORT)**
    a. Stop the engine.
    b. Disconnect the EVAP hose from the intake manifold.
    c. Start the engine.
    d. Use your finger to confirm that the port of the intake manifold has suction.

    Result

    RESULT REFERENCE

Result	Suspected Trouble Area	Proceed to
Suction applied	EVAP hose between intake manifold and purge VSV	A
No suction	Intake manifold	B

    e. Reconnect the EVAP hose.

A: Go to step 32

B: Go to step 33

26. **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 install it until a few click sounds are heard.

NEXT: Go to step 36

27. **REPLACE FUEL TANK CAP**

HINT:

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When replacing the fuel cap, use a fuel cap that meets OEM specifications, and install it until a few click sounds are heard.

NEXT: Go to step 36

28. **LOCATE EVAP LEAK PART**

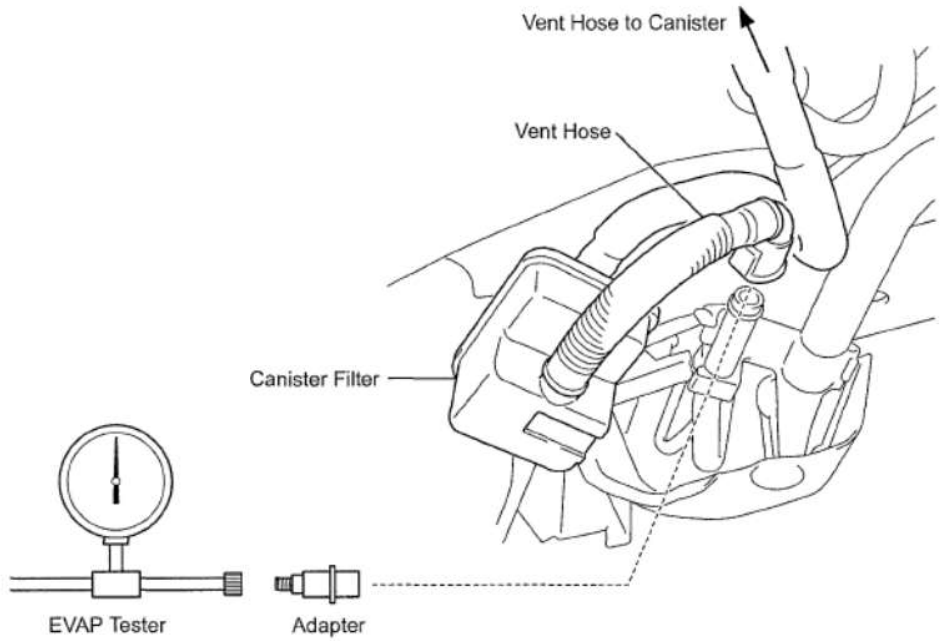


Fig. 243: Identifying Vent Hose, Canister Filter And EVAP Tester
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

a. Disconnect the vent hose.
b. Connect an EVAP tester to the canister pump module with the adapter.
c. Pressurize the EVAP system to 3.2 to 3.7 kPa (24 to 28 mmHg).
d. Apply soapy water to the piping and connecting parts of the EVAP system.
e. Look for areas where bubbles appear. This indicates a leak point.
f. Repair or replace the leak point.

HINT:

Disconnect the hose between the canister and the fuel tank from the canister. Block the canister side and conduct an inspection. In this way, the fuel tank can be excluded as an area suspected of causing fuel leaks.

NEXT: Go to step 36

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29. **REPLACE CANISTER ASSEMBLY**
    a. Replace the canister assembly (See **REMOVAL**).

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.**

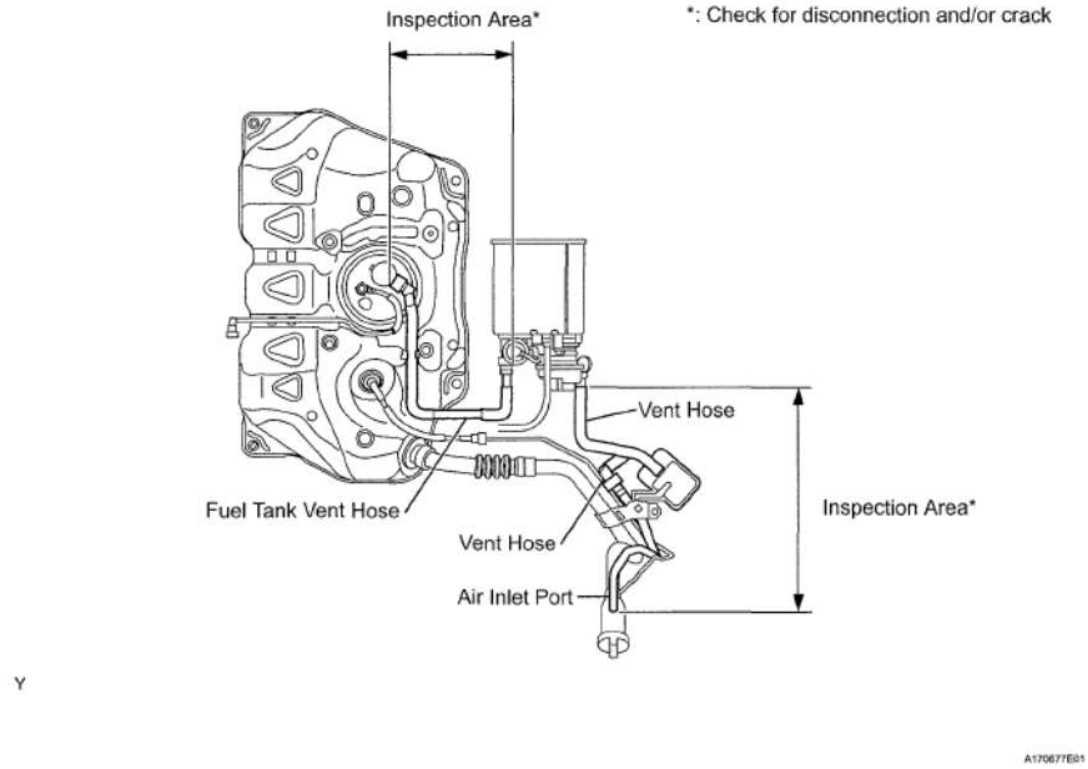


Fig. 244: Identifying Canister Assembly Inspection Area
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

NEXT: Go to step 36

30. **REPLACE PURGE VSV**
    a. Disconnect the connector and the hoses from the purge VSV.
    b. Remove the purge VSV.
    c. Install a new purge VSV.
    d. Reconnect the connector and hoses.

NEXT: Go to step 36

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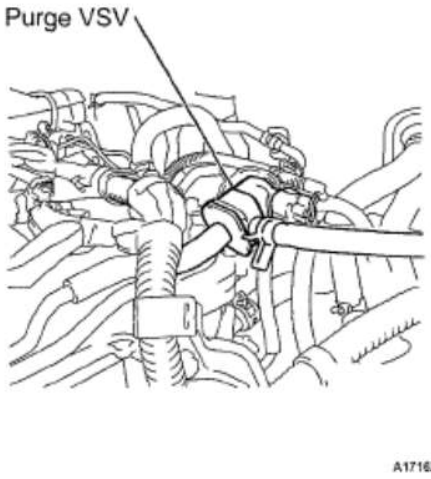


Fig. 245: Identifying Purge VSV
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

31. **REPAIR OR REPLACE HARNESS OR CONNECTOR**

NEXT: Go to step 36

32. **REPLACE PURGE LINE HOSE (INTAKE MANIFOLD - PURGE VSV)**

NEXT: Go to step 36

33. **INSPECT INTAKE MANIFOLD (EVAP PURGE PORT)**
    a. Check that the EVAP purge port of the intake manifold is not clogged. If necessary, replace the intake manifold.

NEXT: Go to step 36

34. **REPLACE ECM**
    a. Replace the ECM (See **REMOVAL**).

NEXT: Go to step 36

35. **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.

NEXT: Go to step 36

36. **PERFORM EVAPORATIVE SYSTEM CHECK (AUTOMATIC MODE)**

NOTE:
- **The Evaporative System Check (Automatic Mode) consists of five**

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steps performed automatically by a 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. If the cut-off valve is closed, the fuel tank leak check is not possible.**
- **Do not run the engine during this operation.**
- **When the temperature of the fuel is 35°C (95°F) or more, a large amount of vapor forms and any check results become inaccurate. When performing an Evaporative System Check, keep the temperature below 35°C (95°F).**

a. Clear DTCs (See **DTC CHECK / CLEAR**).
b. 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 DTCs are found, the repair has been successfully completed.

NEXT : END

CONFIRMATION DRIVING PATTERN

HINT:

After a repair, check Monitor Status by performing the Key-Off Monitor Confirmation and Purge Flow Monitor Confirmation described below.

1. **Key-off monitor confirmation**
   a. Preconditions

   The monitor will not run unless:

   - The vehicle has been driven for 10 minutes or more (in a city area or on a freeway)
   - The fuel tank is less than 90% full
   - The altitude is less than 8000 ft (2432 m)
   - The Engine Coolant Temperature (ECT) is between 4.4°C and 35°C (40°F and 95°F)
   - The Intake Air Temperature (IAT) is between 4.4°C and 35°C (40°F and 95°F)
   - The vehicle remains stationary (the vehicle speed is 0 km/h [0 mph])

   b. Monitor Conditions
      1. Allow the engine to idle for at least 5 minutes.

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2. Turn the ignition switch to OFF and wait for 5 hours (7 or 9.5 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 a Techstream to the DLC3.
   2. Turn the ignition switch to ON.
   3. Turn the tester ON.
   4. Select the following menu items: Powertrain / Engine and ECT / Monitor / Evaporative System.
   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 the 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 cap.
      2. Warm the engine up until the ECT reaches more than 75°C (167°F).
      3. Increase the engine speed to 3000 rpm once.
      4. Allow the engine to idle and turn A/C ON for 1 minute.

   c. Monitor Status
      1. Turn the ignition switch to OFF (if ON or the engine is running).
      2. Connect a Techstream to the DLC3.
      3. Turn the ignition switch to ON.

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4. Turn the tester ON.
5. Select the following menu items: Powertrain / Engine and ECT / Monitor.
6. 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 the Monitor Conditions again.

MONITOR RESULT

Refer to **CHECKING MONITOR STATUS** .

ECM POWER SOURCE CIRCUIT

DESCRIPTION

When the ignition switch is turned to ON, the battery voltage is applied to the IGSW terminal of the ECM. The output signal from the MREL terminal of the ECM causes a current to flow to the EFI relay coil, closing the EFI relay contacts and supplying power to terminal +B of the ECM.

WIRING DIAGRAM

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2008 ENGINE PERFORMANCE 2ZR-FE Engine Control System - xD

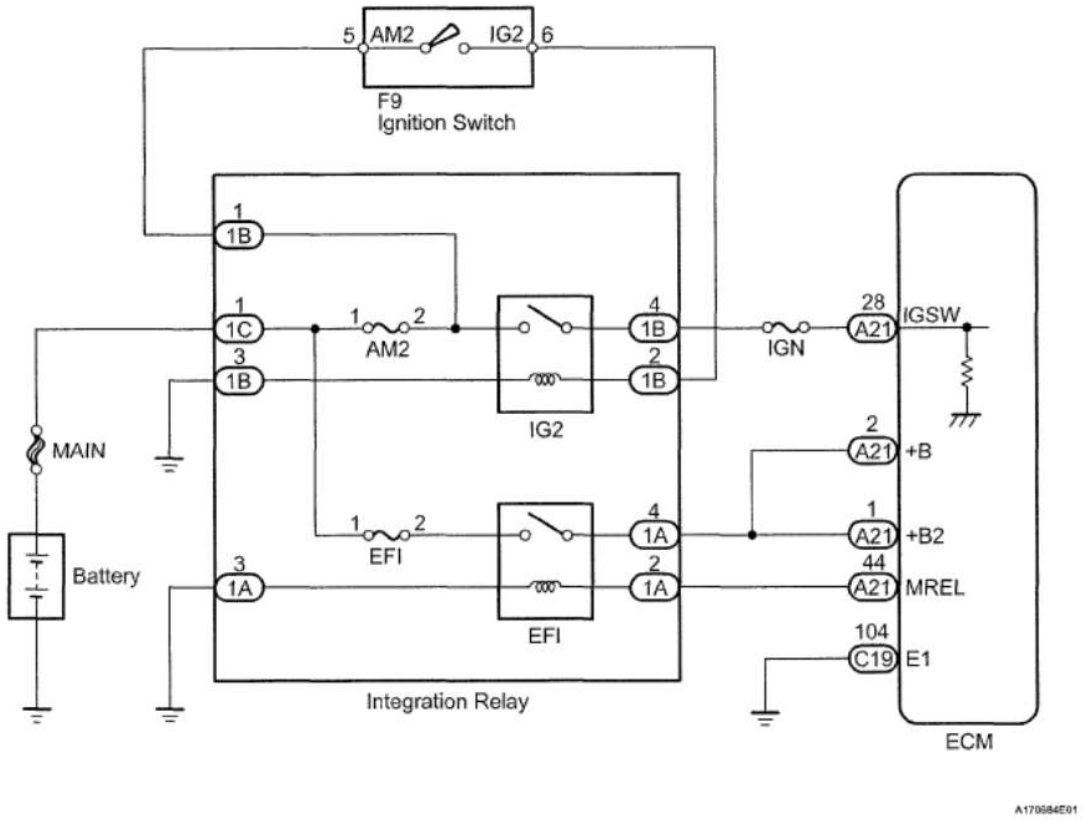


Fig. 246: ECM Power Source Circuit - Wiring Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSPECTION PROCEDURE

1. **INSPECT INTEGRATION RELAY (POWER SOURCE)**
   a. Remove the integration relay from the engine room relay block.
   b. Measure the voltage according to the value(s) in the table below.

   Standard voltage

   VOLTAGE SPECIFICATION

Tester Connection	Condition	Specified Condition
1C-1 - Body ground	Always	11 to 14 V

   c. Reinstall the integration relay.

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR (INTEGRATION RELAY - BATTERY)

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2008 ENGINE PERFORMANCE 2ZR-FE Engine Control System - xD

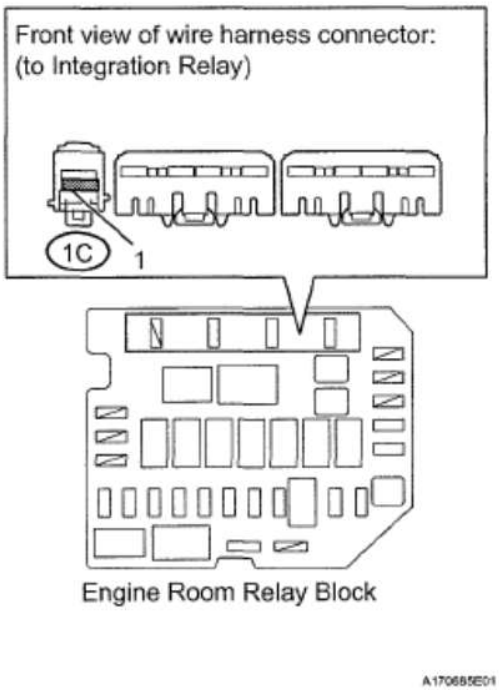


Fig. 247: Identifying Integration Relay Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

2. **INSPECT INTEGRATION RELAY (AM2 FUSE AND EFI FUSE)**
   a. Remove the AM2 fuse and EFI fuse from the integration relay.
   b. Measure the resistance according to the value(s) in the table below.

Standard resistance

RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
AM2 fuse	Always	Below 1 ohms
EFI fuse	Always	Below 1 ohms

   c. Reinstall the fuses.

NG: CHECK FOR SHORT IN ALL HARNESSES AND CONNECTORS CONNECTED TO FUSE AND REPLACE FUSE

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Component without harness connected:
(Fuse side of Integration Relay)

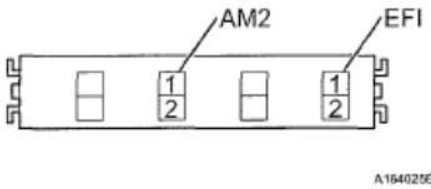


Fig. 248: Identifying Integration Relay Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

3. **INSPECT INTEGRATION RELAY (EFI RELAY AND IG2 RELAY)**
   a. Remove the integration relay from the engine room relay block.
   b. Measure the resistance according to the value(s) in the table below.

Standard resistance

RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
1C-1 - 1B-4	When battery voltage absent	10 kohms or higher
	When battery voltage applied to terminal 1B-2 - 1B-3	Below 1 ohms
1C-1 - 1A-4	When battery voltage absent	10 kohms or higher
	When battery voltage applied to terminal 1A-2 - 1A-3	Below 1 ohms
1C-1 - 1B-1	Always	Below 1 ohms

Component without harness connected:
(Connector side of Integration Relay)

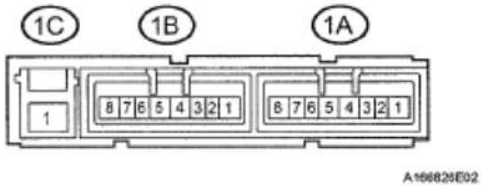


Fig. 249: Identifying Integration Relay Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

   c. Reinstall the integration relay.

NG: REPLACE INTEGRATION RELAY (See **REMOVAL**)

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OK: Go to next step

4. **CHECK HARNESS AND CONNECTOR (INTEGRATION RELAY - ECM)**
   a. Remove the integration 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 (Check for open)

RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
A2-M4 (MREL) - 1A-2	Always	Below 1 ohms
A21-2 (+B) - 1A-4	Always	Below 1 ohms

Standard resistance (Check for short)

RESISTANCE SPECIFICATION

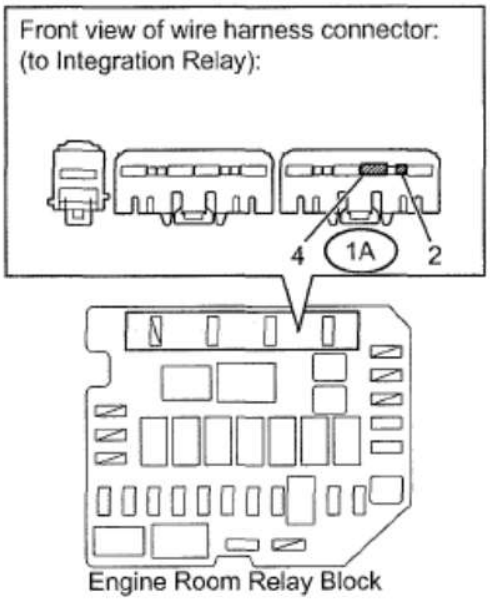
Tester Connection	Condition	Specified Condition
A21-44 (MREL) - Body ground	Always	10 kohms or higher
A21-2 (+B) - Body ground	Always	10 kohms or higher

   d. Reinstall the integration relay.
   e. Reconnect the ECM connector.

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR

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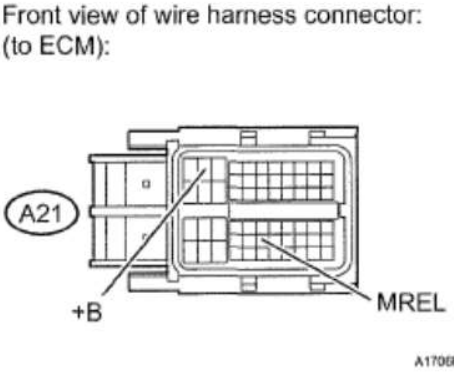


Fig. 250: Identifying Integration Relay And ECM Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

5. **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)

RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
C19-104 (E1) - Body ground	Always	Below 1 ohms

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c. Reconnect the ECM connector.

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR

Front view of wire harness connector:
(to ECM)

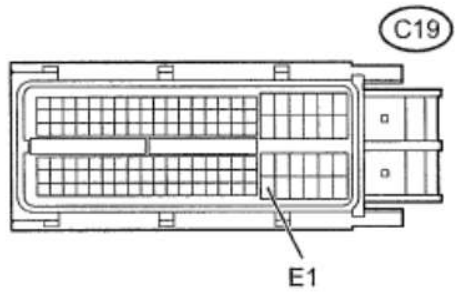


Fig. 251: Identifying ECM Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

6. **INSPECT ECM (IGSW TERMINAL VOLTAGE)**
   a. Disconnect the ECM connectors.
   b. Turn the ignition switch to ON.
   c. Measure the voltage according to the value(s) in the table below.

Standard voltage

VOLTAGE SPECIFICATION

Tester Connection	Condition	Specified Condition
A21-28 (IGSW) - C19-104 (E1)	Ignition switch ON	11 to 14V

   d. Reconnect the ECM connectors.

Result

RESULT REFERENCE

Result	Proceed to
Outside standard range	A
Within standard range	B

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

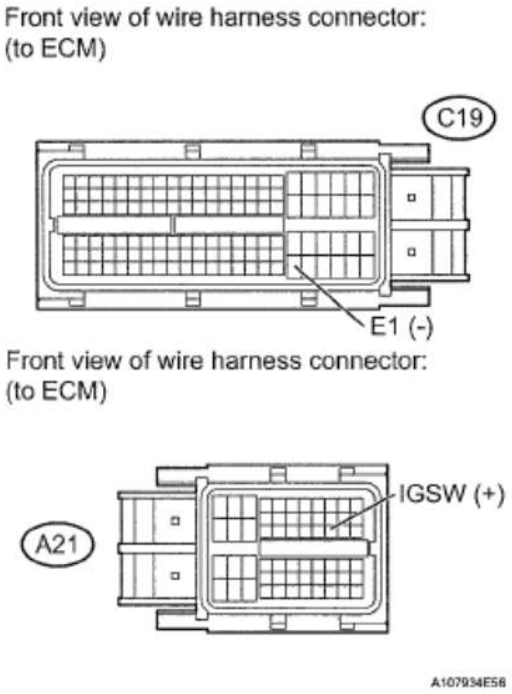


Fig. 252: Identifying ECM Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

A: Go to next step

7. **INSPECT FUSE (IGN FUSE)**
   a. Remove the IGN fuse from the main body ECU.
   b. Measure the resistance according to the value(s) in the table below.

Standard resistance

RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
IGN fuse	Always	Below 1 ohms

   c. Reinstall the IGN fuse.

NG: CHECK FOR SHORT IN ALL HARNESSES AND CONNECTORS CONNECTED TO FUSE AND REPLACE FUSE

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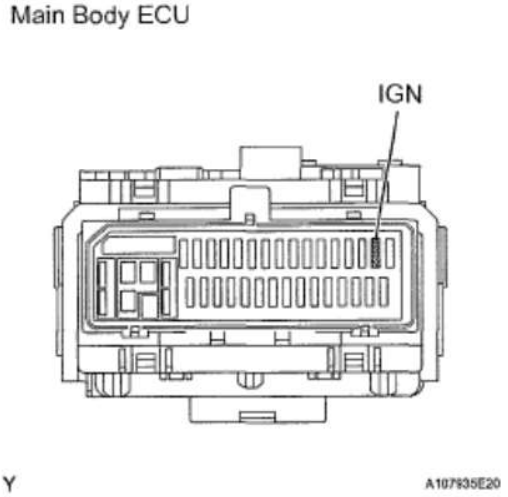


Fig. 253: Identifying IGN Fuse
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

8. **CHECK HARNESS AND CONNECTOR (ECM - INTEGRATION RELAY)**
   a. Remove the integration 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 (Check for open)

RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
A21-28 (IGSW) - 1B-4	Always	Below 1 ohms

Standard resistance (Check for short)

RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
A21-28 (IGSW) - Body ground	Always	10 kohms or higher

   d. Reinstall the integration relay.
   e. Reconnect the ECM connector.

Result

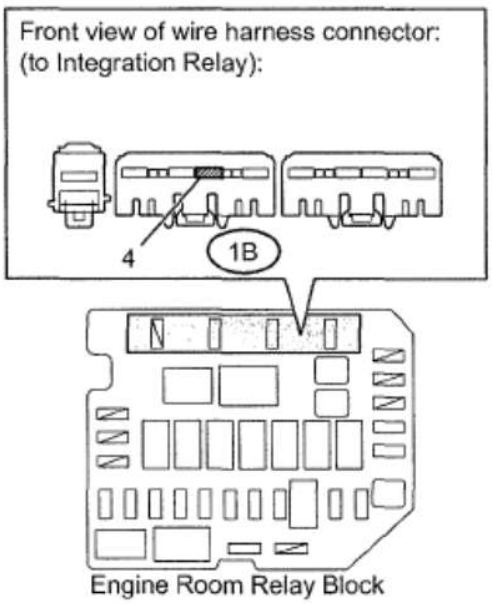
RESULT REFERENCE

Result	Proceed to

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Outside standard range	A
Within standard range	B

B: Go to step 9



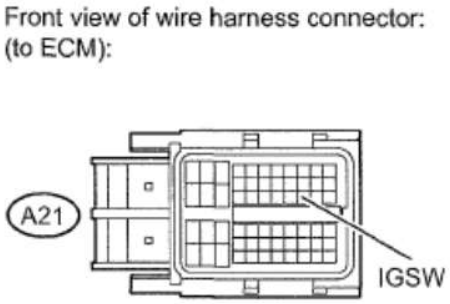


Fig. 254: Identifying Integration Relay And ECM Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

A : REPAIR OR REPLACE HARNESS OR CONNECTOR

9. **CHECK HARNESS AND CONNECTOR (INTEGRATION RELAY - IGNITION SWITCH)**
   a. Remove the integration 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)

RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
1B-2 - F9-6 (IG2)	Always	Below 1 ohms
1B-3 - Body ground	Always	Below 1 ohms

Standard resistance (Check for short)

RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
F9-6 (IG2) - Body ground	Always	10 kohms or higher

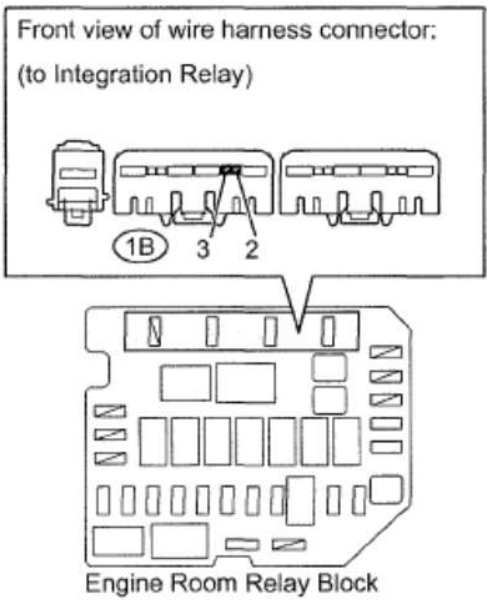
d. Reinstall the integration relay.
e. Reconnect the ignition switch connector.

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR

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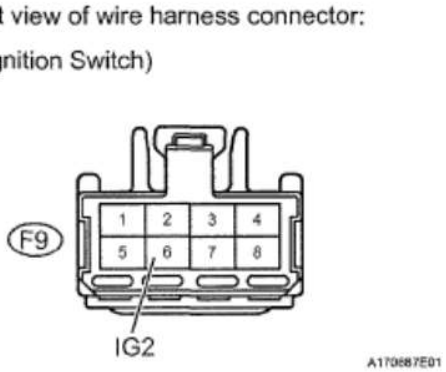


Fig. 255: Identifying Integration Relay And Ignition Switch Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

10. **INSPECT IGNITION SWITCH**
    a. Remove the ignition switch.
    b. Measure the resistance according to the value(s) in the table below.

Standard resistance

RESISTANCE SPECIFICATION

Tester Connection	Switch Condition	Specified Condition
All terminals	LOCK	10 kohms or higher
2 (ACC) - 4 (AM1)	ACC	

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1 (IG1) - 2 (ACC) - 4 (AM1)	ON	Below 1 ohms
5 (AM2) - 6 (IG2)		
1 (IG1) - 3 (ST1) - 4 (AM1)	START	
5 (AM2) - 6 (IG2) - 7 (ST2)		

c. Reinstall the ignition switch.

NG: REPLACE IGNITION SWITCH (See **REMOVAL**)

Component without harness connected:
(Ignition Switch)

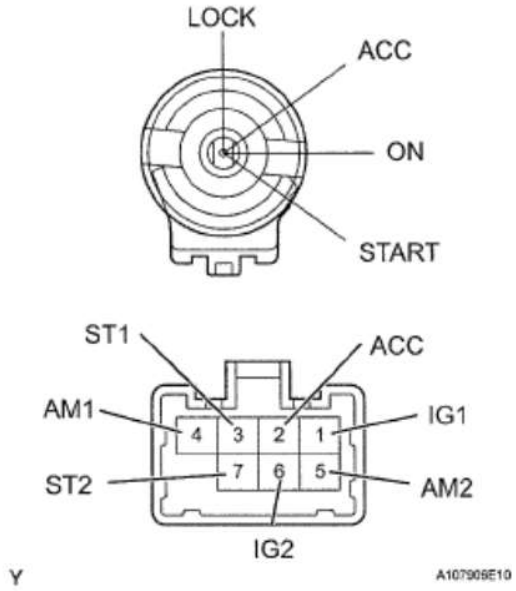


Fig. 256: Identifying Ignition Switch Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK : REPAIR OR REPLACE HARNESS OR CONNECTOR (IGNITION SWITCH - BATTERY)

VC OUTPUT CIRCUIT

DESCRIPTION

The ECM constantly generates 5 V power from the battery voltage supplied to the +B (BATT) terminal to operate the microprocessor. The ECM also provides this power to the sensors through the VC output circuit.

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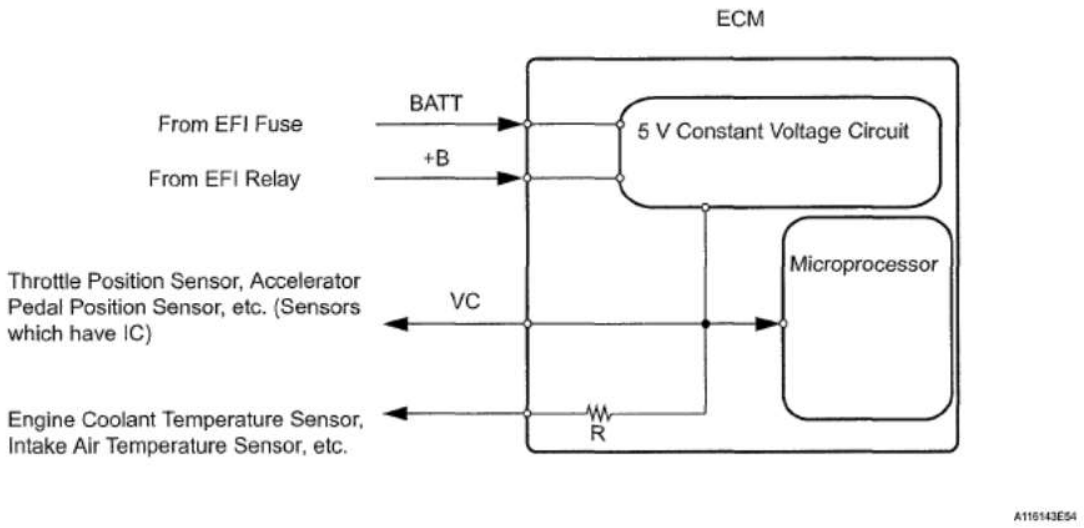


Fig. 257: VC Output Circuit Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

When the VC circuit is short-circuited, the microprocessor in the ECM and sensors that are supplied with power through the VC circuit are inactivated because the power is not supplied from the VC circuit. Under this condition, the system does not start up and the MIL does not illuminate even if the system malfunctions.

HINT:

Under normal conditions, the MIL is illuminated for several seconds when the ignition switch is first turned ON. The MIL goes off when the engine is started.

WIRING DIAGRAM

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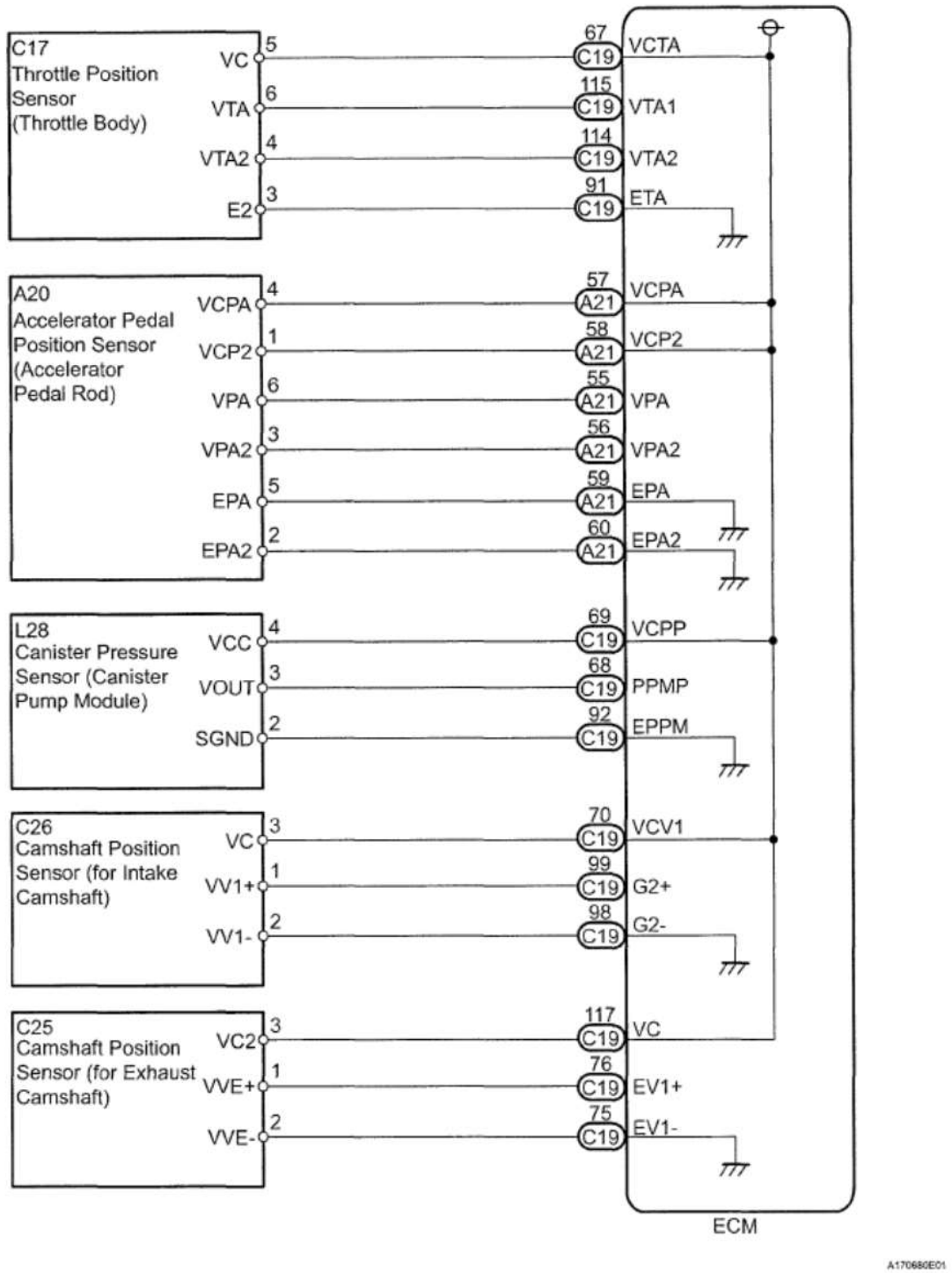


Fig. 258: VC Output Circuit - Wiring Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSPECTION PROCEDURE

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1. **CHECK MIL**
   a. Check that the Malfunction Indicator Lamp (MIL) lights up when turning the ignition switch to ON.

      OK:

      MIL lights up

   NG: Go to step 2

   OK : SYSTEM OK

2. **CHECK COMMUNICATION BETWEEN TECHSTREAM AND ECM**
   a. Connect a Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the tester ON.
   d. Check the communication between the tester and ECM.

      Result

      RESULT REFERENCE

Result	Proceed to
Communication is possible	A
Communication is not possible	B

   A: Go to **MIL CIRCUIT**

   B: Go to next step

3. **CHECK MIL (THROTTLE POSITION SENSOR)**
   a. Disconnect the throttle body connector.
   b. Turn the ignition switch to ON.
   c. Check the MIL.

      Result

      RESULT REFERENCE

Result	Proceed to
MIL illuminates	A
MIL does not illuminate	B

   d. Reconnect the throttle body connector.

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

B: Go to next step

4. **CHECK MIL (ACCELERATOR PEDAL POSITION SENSOR)**
   a. Disconnect the accelerator pedal position sensor connector.
   b. Turn the ignition switch to ON.
   c. Check the MIL.

   Result

   RESULT REFERENCE

Result	Proceed to
MIL illuminates	A
MIL does not illuminate	B

   d. Reconnect the accelerator pedal position sensor connector.

A : REPLACE ACCELERATOR PEDAL ROD ASSEMBLY (See **REMOVAL**)

B: Go to next step

5. **CHECK MIL (CANISTER PUMP MODULE)**
   a. Disconnect the canister pump module connector.
   b. Turn the ignition switch to ON.
   c. Check the MIL

   Result

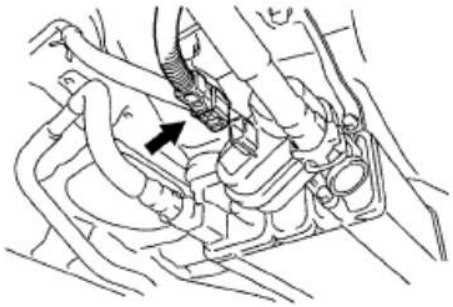
   RESULT REFERENCE

Result	Proceed to
MIL illuminates	A
MIL does not illuminate	B

   d. Reconnect the canister pump module connector.

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

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Fig. 259: Locating Canister Pump Module Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

B: Go to next step

6. **CHECK MIL (CAMSHAFT POSITION SENSOR FOR INTAKE CAMSHAFT)**
   a. Disconnect the camshaft position sensor (for intake camshaft) connector.
   b. Turn the ignition switch to ON.
   c. Check the MIL.

   Result

   RESULT REFERENCE

Result	Proceed to
MIL illuminates	A
MIL does not illuminate	B

   d. Reconnect the camshaft position sensor (for intake camshaft).

A : REPLACE CAMSHAFT POSITION SENSOR (FOR INTAKE CAMSHAFT)

B: Go to next step

7. **CHECK MIL (CAMSHAFT POSITION SENSOR FOR EXHAUST CAMSHAFT)**
   a. Disconnect the camshaft position sensor (for exhaust camshaft) connector.
   b. Turn the ignition switch to ON.
   c. Check the MIL

   Result

   RESULT REFERENCE

Result	Proceed to

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MIL illuminates	A
MIL does not illuminate	B

d. Reconnect the camshaft position sensor (for exhaust camshaft).

A : REPLACE CAMSHAFT POSITION SENSOR (FOR EXHAUST CAMSHAFT)

B: Go to next step

8. **CHECK HARNESS AND CONNECTOR (VC CIRCUIT))**
   a. Disconnect the throttle body connector.
   b. Disconnect the accelerator pedal position sensor connector.
   c. Disconnect the canister pump module connector.
   d. Disconnect the camshaft position sensor (for intake camshaft) connector.
   e. Disconnect the camshaft position sensor (for exhaust camshaft) connector.
   f. Disconnect the ECM connectors.
   g. Measure the resistance.

Standard resistance (check for short)

RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
C19-67 (VCTA) - Body ground	Always	10 kohms or higher
A21-57 (VCPA) - Body ground	Always	10 kohms or higher
A21-58 (VCP2) - Body ground	Always	10 kohms or higher
C19-69 (VCPP) - Body ground	Always	10 kohms or higher
C19-70 (VCVI) - Body ground	Always	10 kohms or higher
C19-117 (VC) - Body ground	Always	10 kohms or higher

   h. Reconnect the throttle body connector.
   i. Reconnect the accelerator pedal position sensor connector.
   j. Reconnect the canister pump module connector.
   k. Reconnect the camshaft position sensor (for intake camshaft) connector.

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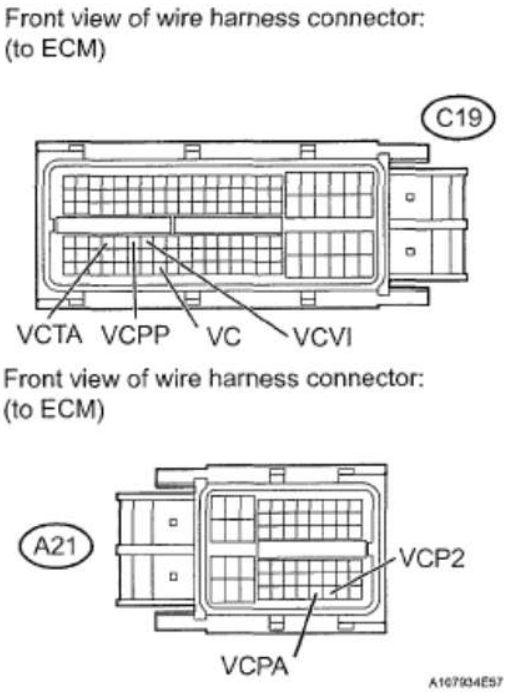


Fig. 260: Identifying ECM Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

l. Reconnect the camshaft position sensor (for exhaust camshaft) connector.
m. Reconnect the ECM connectors.

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR

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

FUEL PUMP CONTROL CIRCUIT

DESCRIPTION

When the engine is cranked, the starter relay drive signal from the ignition switch is input into the STA terminal of the ECM, and the NE signal generated by the crankshaft position sensor is also input into the NE+ terminal. Thus, the ECM interprets that the engine is being cranked, and turns transistor Tr1 in the ECM internal circuit ON. The current flows to the C/OPN (Circuit Opening) relay by turning Tr1 ON. Then, the fuel pump operates.

While the NE signal is input into the ECM, and the engine is running, the ECM turns Tr1 on continuously.

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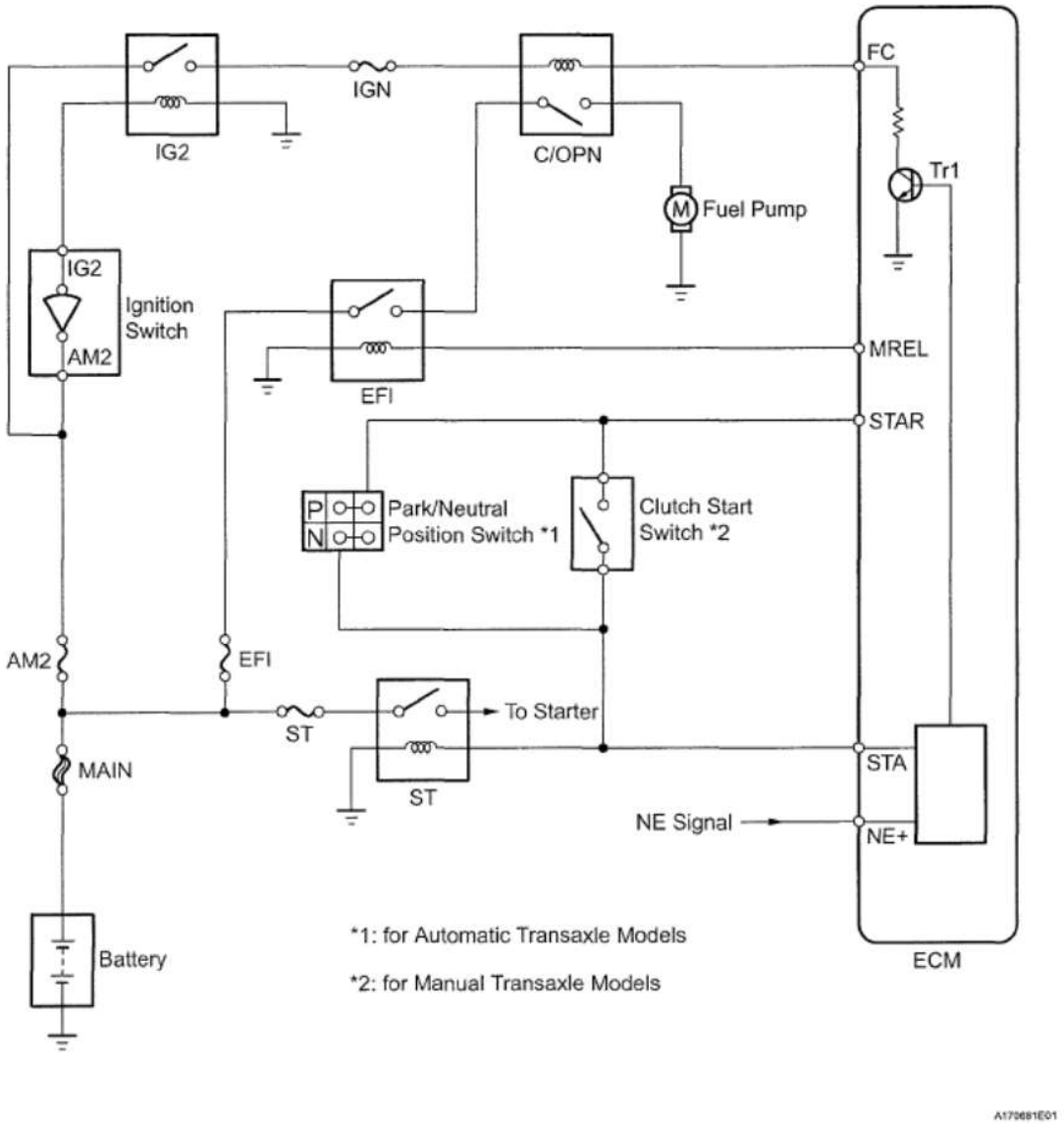


Fig. 261: Fuel Pump Control Circuit Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

WIRING DIAGRAM

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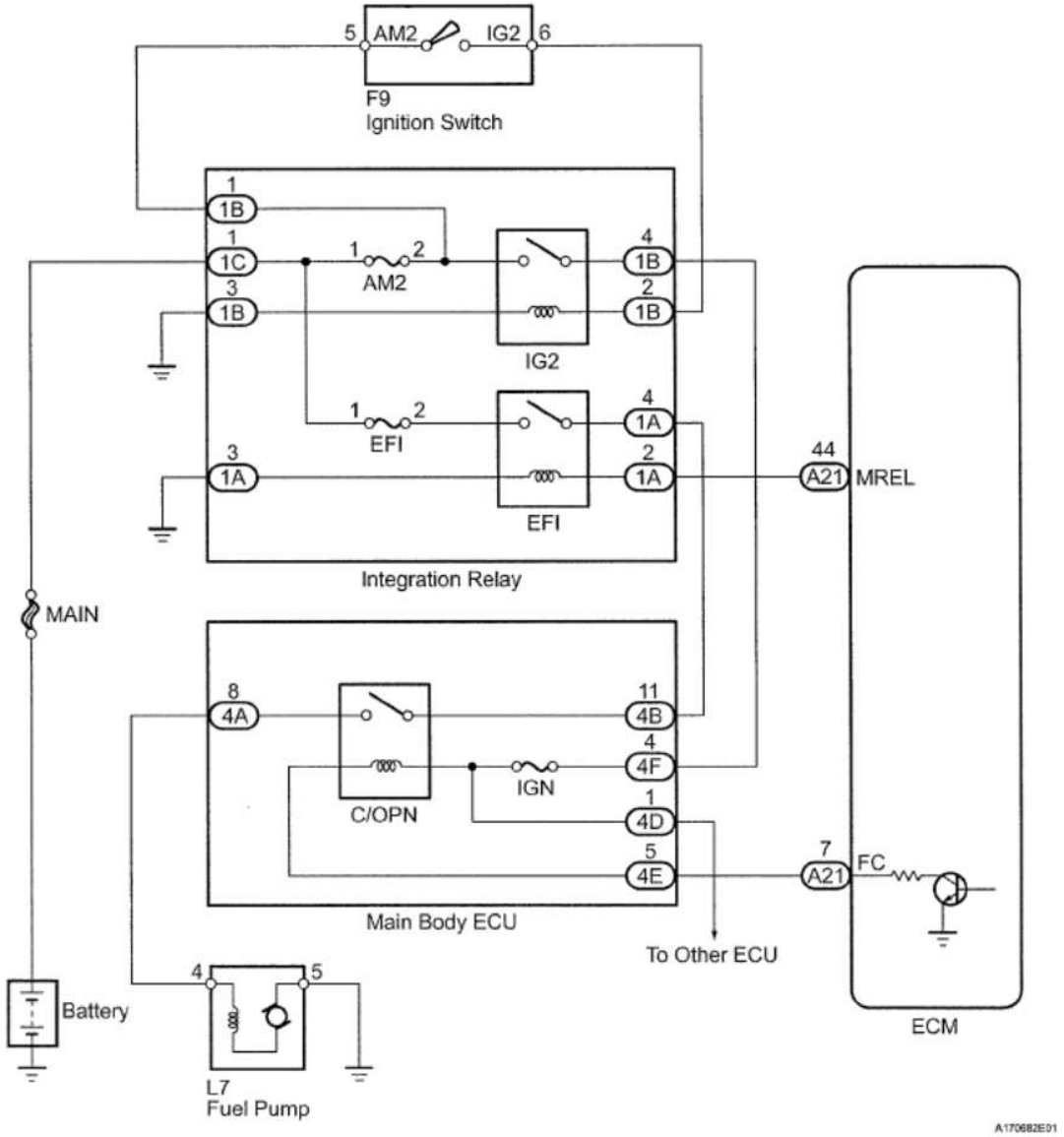


Fig. 262: Fuel Pump Control Circuit - Wiring Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSPECTION PROCEDURE

1. **PERFORM ACTIVE TEST USING TECHSTREAM (FUEL PUMP/SPD)**
   a. Connect a Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the tester ON.
   d. Select the following menu items: Powertrain / Engine and ECT / Active Test / Control the Fuel Pump/Speed.
   e. Check whether the fuel pump operating sound occurs when performing the Active Test on the

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tester.

Result

RESULT REFERENCE

Result	Proceed to
Fuel pump operating sound does not occur	A
Fuel pump operating sound occurs	B

B: Go to step 8

A: Go to next step

2. **INSPECT MAIN BODY ECU (C/OPN RELAY INPUT VOLTAGE)**
   a. Measure the voltage between the terminal of the main body ECU and the body ground when the ignition switch is turned to ON and OFF.

Standard voltage

VOLTAGE SPECIFICATION

Tester Connection	Switch Condition	Specified Condition
4B-11 (Main body ECU) - Body ground	Ignition switch OFF	Below 1 V
4F-4 (Main body ECU) - Body ground		
4B-11 (Main body ECU) - Body ground	Ignition switch ON	11 to 14 V
4F-4 (Main body ECU) - Body ground		

Result

RESULT REFERENCE

Result	Proceed to
Outside standard range	A
Within standard range	B

B: Go to step 4

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Rear view of wire harness connector:
(to Main Body ECU)

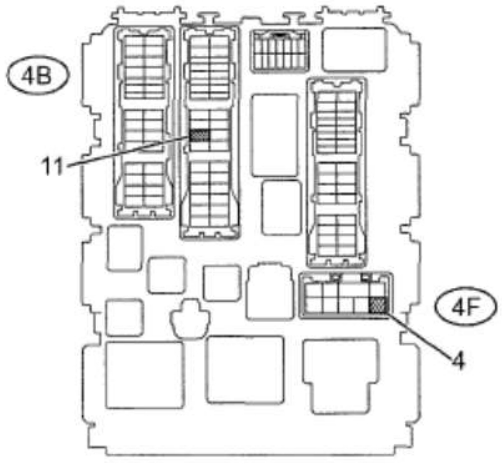


Fig. 263: Identifying Main Body ECU Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

A: Go to next step

3. **CHECK HARNESS AND CONNECTOR (MAIN BODY ECU - INTEGRATION RELAY)**
   a. Remove the integration relay from the engine room relay block.
   b. Disconnect the main body ECU connectors.
   c. Measure the resistance according to the value(s) in the table below.

Standard resistance (Check for open)

RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
1B-4 (Integration relay) - 4F-4 (Main body ECU)	Always	Below 1 ohms
1A-4 (Integration relay) - 4B-11 (Main body ECU)	Always	Below 1 ohms

Standard resistance (Check for short)

RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
4F-4 (Main body ECU) - Body ground	Always	10 kohms or higher
4B-11 (Main body ECU) - Body ground	Always	10 kohms or higher

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d. Reinstall the integration relay.
e. Reconnect the main body ECU connectors.

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR

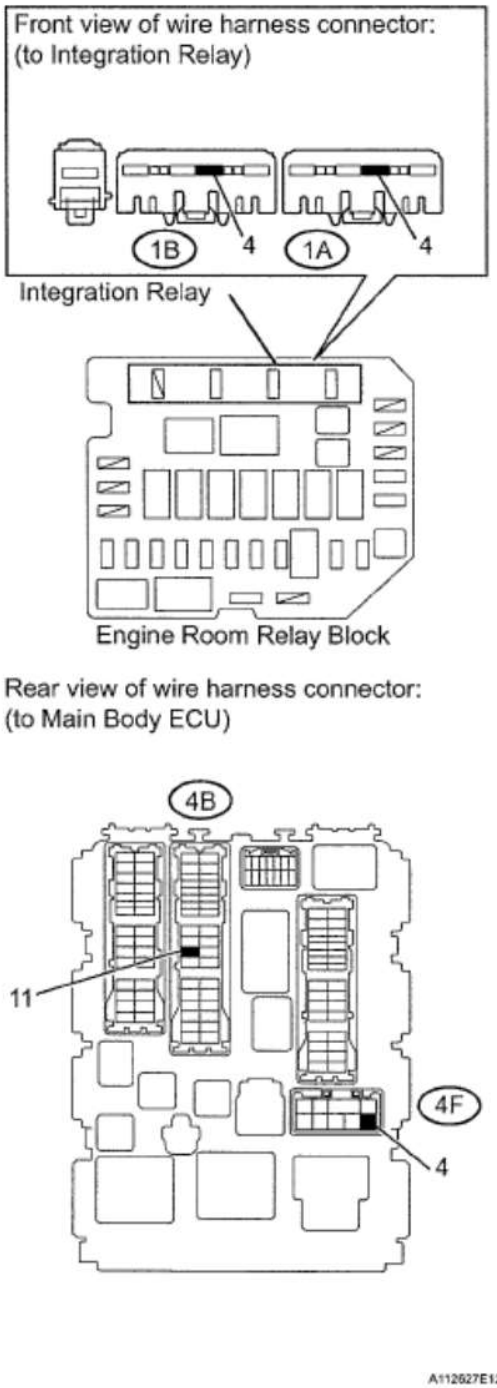


Fig. 264: Identifying Main Body ECU And Integration Relay Connector Terminals

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

OK: Go to **ECM POWER SOURCE CIRCUIT**

4. **INSPECT MAIN BODY ECU (C/OPN RELAY)**
   a. Remove the main body ECU.
   b. Measure the resistance according to the value(s) in the table below.

Standard resistance

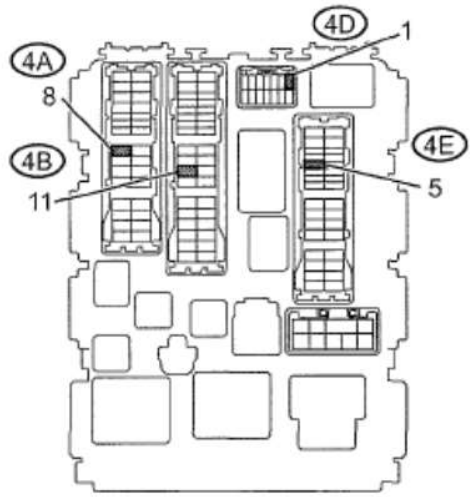
RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
4A-8 - 4B-11	When battery voltage absent	10 kohms or higher
	When battery voltage applied to terminals 4D-1 and 4E-5	Below 1 ohms

   c. Reinstall the main body ECU.

NG: REPLACE MAIN BODY ECU (See **REMOVAL**)

Component without harness connected:
(Main Body ECU)



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Fig. 265: Identifying Main Body ECU Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

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5. **CHECK HARNESS AND CONNECTOR (MAIN BODY ECU - ECM)**
   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)

RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
4E-5 (Main body ECU) - A21-7 (FC)	Always	Below 1 ohms

Standard resistance (Check for short)

RESISTANCE SPECIFICATION

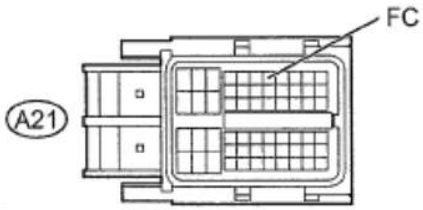
Tester Connection	Condition	Specified Condition
4E-5 (Main body ECU) or A21-7 (FC) - Body ground	Always	10 kohms or higher

   d. Reconnect the main body ECU connector.
   e. Reconnect the ECM connector.

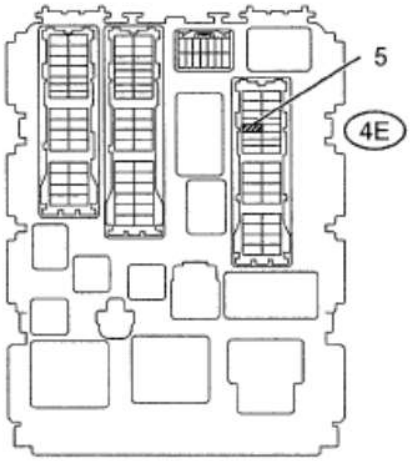
NG: REPAIR OR REPLACE HARNESS OR CONNECTOR

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Front view of wire harness connector:
(to ECM)



Rear view of wire harness connector:
(to Main Body ECU)



A115687E11

Fig. 266: Identifying Main Body ECU And ECM Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

6. **CHECK HARNESS AND CONNECTOR (MAIN BODY ECU - FUEL PUMP - BODY GROUND)**
   a. Check the harness and the connectors between the main body ECU (C/OPN relay) and the fuel pump.
      1. Disconnect the main body ECU connector.
      2. Disconnect the fuel pump connector.
      3. Measure the resistance according to the value(s) in the table below.

         Standard resistance (Check for open)

         RESISTANCE SPECIFICATION

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Tester Connections	Condition	Specified Conditions
4A-8 (Main body ECU) - L7-4 (Fuel pump)	Always	Below 1 ohms

Standard resistance (Check for short)

RESISTANCE SPECIFICATION

Tester Connections	Condition	Specified Conditions
4A-8 (Main body ECU) or L7-4 (Fuel pump) - Body ground	Always	10 kohms or higher

4. Reconnect the main body ECU connector.
5. Reconnect the fuel pump connector.

b. Check the harness and the connectors between the fuel pump and the body ground.
   1. Disconnect the fuel pump connector.
   2. Measure the resistance according to the value(s) in the table below.

Standard resistance (Check for open)

RESISTANCE SPECIFICATION

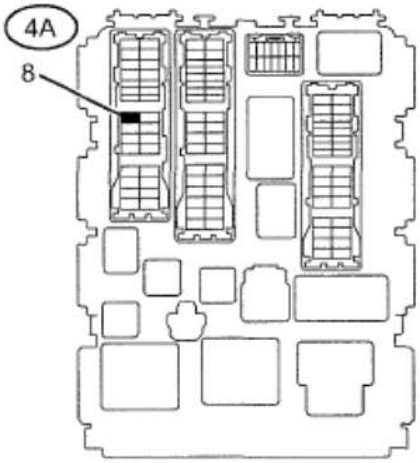
Tester Connections	Condition	Specified Conditions
L7-5 (Fuel pump) - Body ground	Always	Below 1 ohms

c. Reconnect the fuel pump connector.

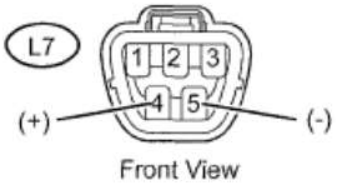
NG: REPAIR OR REPLACE HARNESS OR CONNECTOR

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Rear view of wire harness connector:
(to Main Body ECU)



Front view of wire harness connector:
(to Fuel Pump)



A116150E07

Fig. 267: Identifying Fuel Pump Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

7. **INSPECT FUEL PUMP**
   a. Remove the fuel pump.
   b. Inspect fuel pump resistance.
      1. Measure the resistance according to the value(s) in the table below.

RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
4 (+) - 5 (-)	20°C (68°F)	0.2 to 3.0 ohms

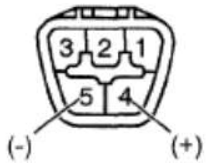
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c. Inspect fuel pump operation.
   1. Apply the battery voltage to both the terminals. Check that the pump operates.

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 the voltage on and off on the battery side, not the fuel pump side.**

Component without harness connected:
(Fuel Pump)



A159458E01

Fig. 268: Identifying Fuel Pump Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK:

The fuel pump operates normally.

d. Reinstall the fuel pump.

NG: REPLACE FUEL PUMP (See **REMOVAL**)

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

8. **READ VALUE USING TECHSTREAM (STARTER SIG)**
   a. Connect a Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the tester ON.
   d. Select the following menu items: Powertrain / Engine and ECT / Data List / All Data / Starter Signal.

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e. Check the result when the ignition switch is turned to ON and START.

Result

IGNITION SWITCH POSITION AND STARTER SIGNAL REFERENCE

Ignition Switch Position	Starter Signal
ON	OFF
START	ON

NG: REPAIR OR REPLACE STARTING SYSTEM (See **MONITOR STRATEGY**)

OK: Go to next step

9. **READ VALUE USING TECHSTREAM (ENGINE SPD)**
   a. Connect a Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the tester ON.
   d. Select the following menu items: Powertrain / Engine and ECT / Data List / All Data / Engine Speed.
   e. Read the values displayed on the tester while cranking.

OK:

Values are displayed continuously.

NG: REPAIR OR REPLACE CRANKSHAFT POSITION SENSOR CIRCUIT (See **INSPECTION PROCEDURE**)

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

FUEL INJECTOR CIRCUIT

DESCRIPTION

The fuel injectors are located on the intake manifold. They inject fuel into the cylinders based on the signals from the ECM.

WIRING DIAGRAM

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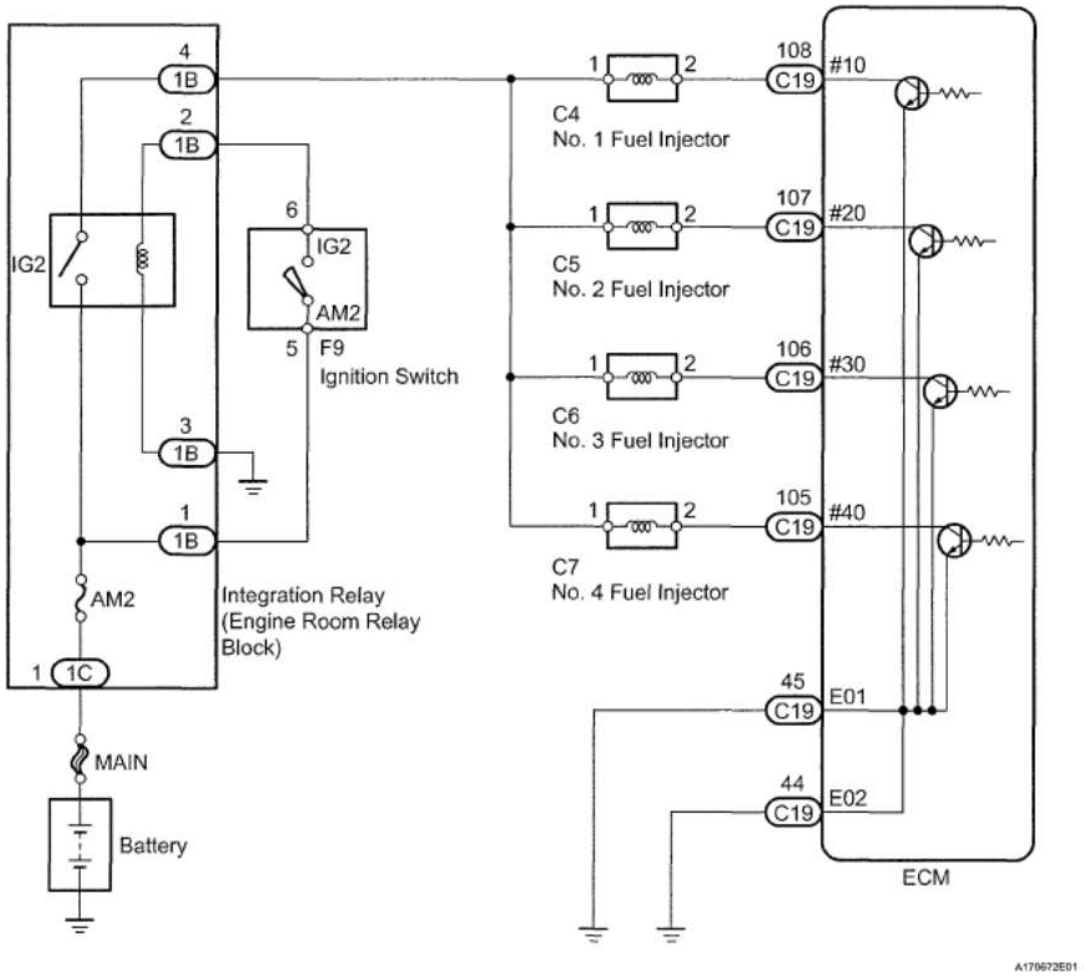


Fig. 269: Fuel Injector Circuit - Wiring Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSPECTION PROCEDURE

1. **INSPECT FUEL INJECTOR (POWER SOURCE)**
   a. Disconnect the fuel injector connectors.
   b. Turn the ignition switch to ON.
   c. Measure the voltage according to the value(s) in the table below.

Standard voltage

VOLTAGE SPECIFICATION

Tester Connection	Switch Condition	Specified Condition
C4-1 - Body ground	Ignition switch ON	11 to 14 V
C5-1 - Body ground	Ignition switch ON	11 to 14 V
C6-1 - Body ground	Ignition switch ON	11 to 14 V

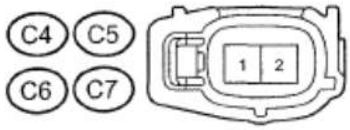
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C7-1 - Body ground	Ignition switch ON	11 to 14 V

d. Reconnect the fuel injector connectors.

NG: Go to step 6

Front view of wire harness connector:
(to Fuel Injector)



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Fig. 270: Identifying Fuel Injector Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

2. **INSPECT FUEL INJECTOR (INJECTOR RESISTANCE)**
   a. Disconnect the fuel injector connectors.
   b. Measure the resistance according to the value(s) in the table below.

Standard resistance

RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
1 - 2	20°C (68°F)	11.6 to 12.4 ohms

   c. Reconnect the fuel injector connectors.

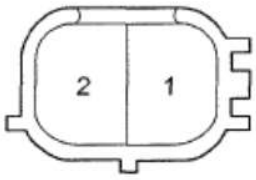
NG: REPLACE FUEL INJECTOR (See **REMOVAL**)

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Component without harness connected:
(Fuel Injector)



No. 1, No. 2, No. 3 and No. 4

Y A141550E06

Fig. 271: Identifying Fuel Injector Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

3. **CHECK HARNESS AND CONNECTOR (FUEL INJECTOR - ECM)**
   a. Disconnect the ECM connector.
   b. Disconnect the fuel injector connectors.
   c. Measure the resistance according to the value(s) in the table below.

Standard resistance (Check for open)

RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
C4-2 - C19-108 (#10)	Always	Below 1 ohms
C5-2 - C19-107 (#20)	Always	Below 1 ohms
C6-2 - C19-106 (#30)	Always	Below 1 ohms
C7-2 - C19-105 (#40)	Always	Below 1 ohms

Standard resistance (Check for short)

RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
C4-2 or C19-108 (#10) - Body ground	Always	10 kohms or higher
C5-2 or C19-107 (#20) - Body ground	Always	10 kohms or higher
C6-2 or C19-106 (#30) - Body ground	Always	10 kohms or higher
C7-2 or C19-105 (#40) - Body ground	Always	10 kohms or higher

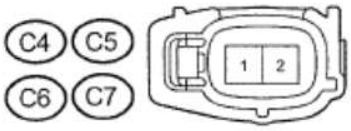
   d. Reconnect the fuel injector connectors.

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e. Reconnect the ECM connector.

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR

Front view of wire harness connector:
(to Fuel Injector)



Front view of wire harness connector:
(to ECM)

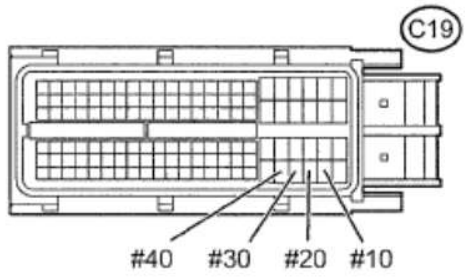


Fig. 272: Identifying Fuel Injector And ECM Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

4. **CHECK HARNESS AND CONNECTOR (ECM - BODY GROUND)**
   a. Disconnect the ECM connector.
   b. Measure the resistance according to the value(s) in the table below.

Standard resistance (Check for open)

RESISTANCE SPECIFICATION

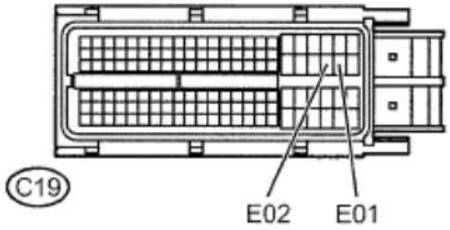
Tester Connection	Condition	Specified Condition
C19-45 (E01) - Body ground	Always	Below 1 ohms
C19-44 (E02) - Body ground	Always	Below 1 ohms

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c. Reconnect the ECM connector.

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR

Front view of wire harness connector:
(to ECM)



A164020E04

Fig. 273: Identifying ECM Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

5. **INSPECT FUEL INJECTOR (INJECTION AND VOLUME)**
   a. Check the fuel injector injection and volume (See **INSPECTION**).

NG: REPLACE FUEL INJECTOR (See **REMOVAL**)

OK : PROCEED TO NEXT CIRCUIT INSPECTION SHOWN IN PROBLEM SYMPTOMS TABLE (See **PROBLEM SYMPTOMS TABLE**)

6. **CHECK HARNESS AND CONNECTOR (FUEL INJECTOR - INTEGRATION RELAY)**
   a. Disconnect the fuel injector connectors.
   b. Remove the integration 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)

RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
C4-1 - 1B-4 (Integration relay)	Always	Below 1 ohms
C5-1 - 1B-4 (Integration relay)	Always	Below 1 ohms
C6-1 - 1B-4 (Integration relay)	Always	Below 1 ohms

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C7-1 - 1B-4 (Integration relay)	Always	Below 1 ohms

Standard resistance (Check for short)

RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
C4-1 or 1B-4 (Integration relay) - Body ground	Always	10 kohms or higher
C5-1 or 1B-4 (Integration relay) - Body ground	Always	10 kohms or higher
C6-1 o 1B-4 (Integration relay) - Body ground	Always	10 kohms or higher
C7-1 or 1B-4 (Integration relay) - Body ground	Always	10 kohms or higher

d. Reconnect the fuel injector connectors.
e. Reinstall the integration relay.

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR

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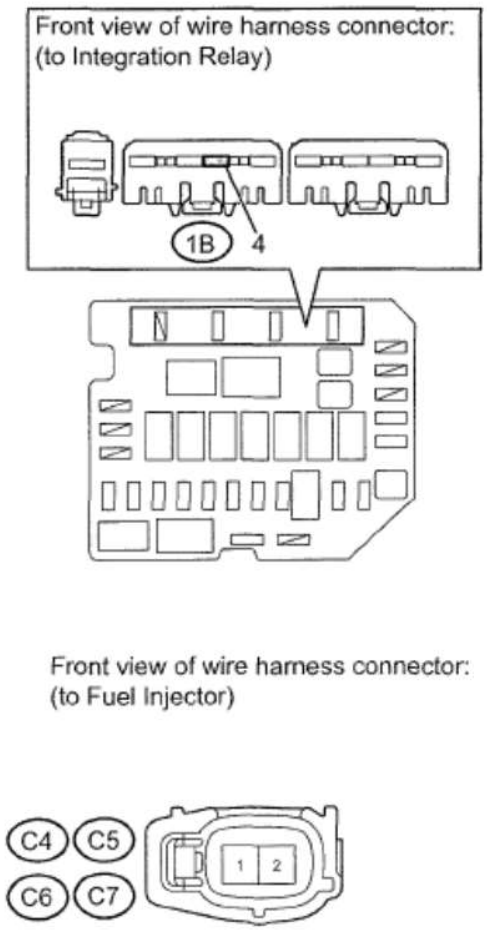


Fig. 274: Identifying Fuel Injector Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK : REPAIR OR REPLACE ECM POWER SOURCE CIRCUIT (See **ECM POWER SOURCE CIRCUIT**)

CRANKING HOLDING FUNCTION CIRCUIT

DESCRIPTION

The cranking holding control system keeps energizing the starter relay from when the ECM detects the starter signal (STSW signal) from the ignition switch until the ECM performs a judgement of "Engine started". Furthermore, the ECM outputs an accessory cut signal (ACCR signal) to the ACC cut relay during cranking to prevent flickering of the combination meter, clock, audio system, and so on. When the ECM detects the STSW signal, the ECM outputs the starter relay drive signal (STAR signal) to the starter relay through the clutch start switch or the park/neutral position switch, and then, the engine is cranked. When the ECM receives a stable

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engine speed signal (NE signal), more specifically, when the NE signal reaches a predetermined value, the ECM stops outputting the STAR signal.

Also, the ECM monitors the starter relay operating conditions based on the STA terminal voltage status.

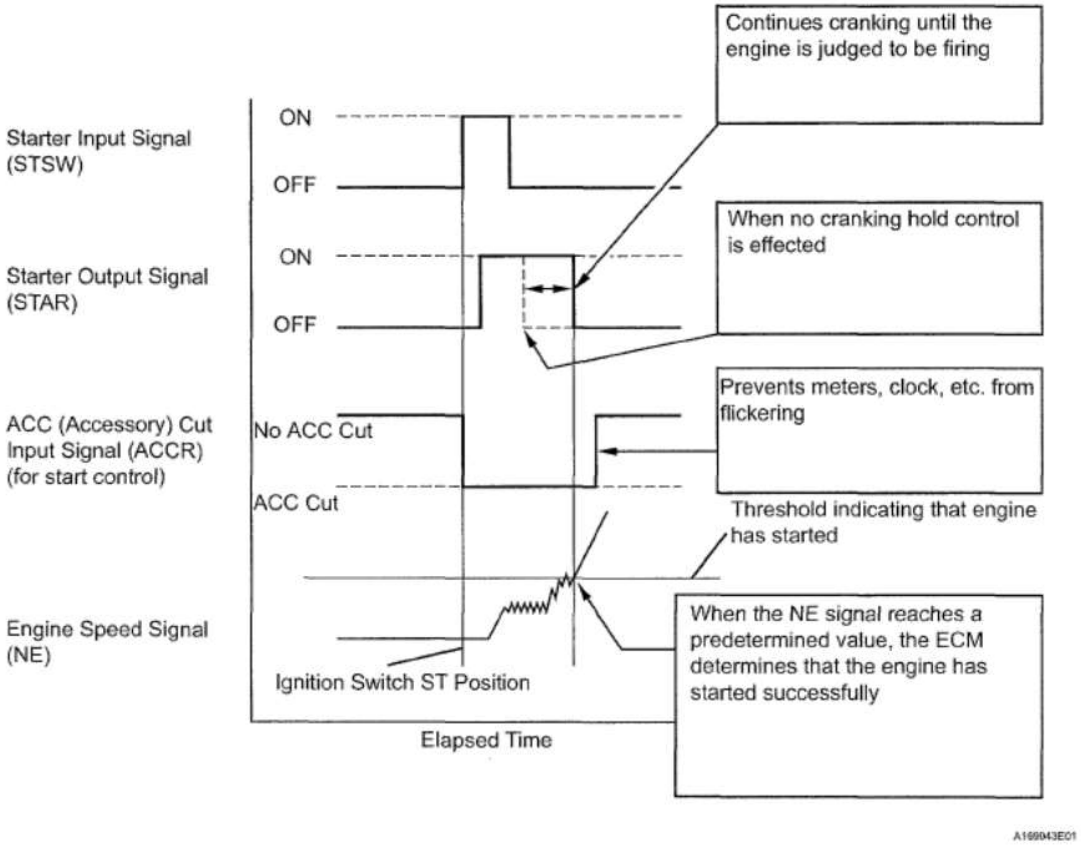


Fig. 275: Starter Relay Circuit Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

WIRING DIAGRAM

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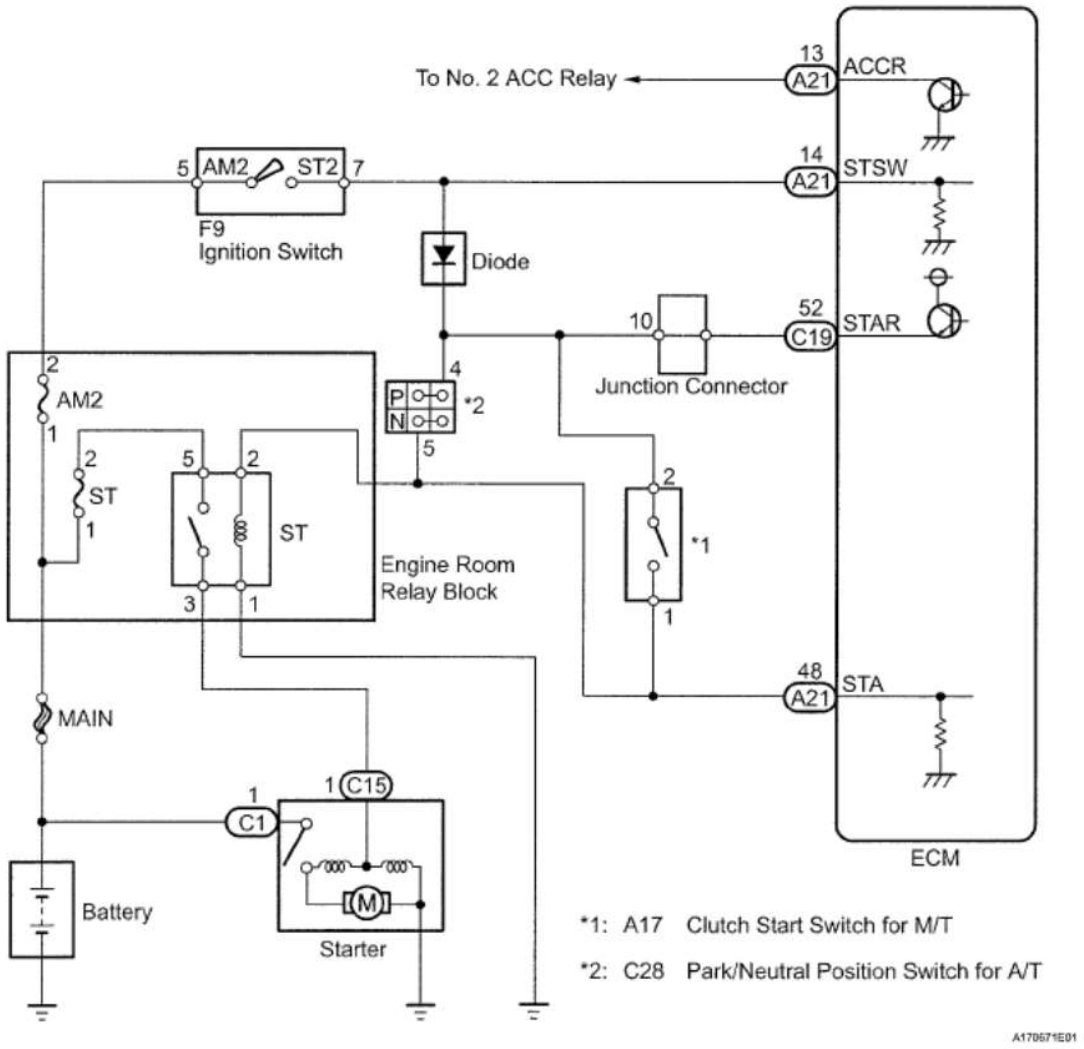


Fig. 276: Starter Relay - Wiring Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSPECTION PROCEDURE

1. **READ VALUE USING TECHSTREAM (STARTER SIGNAL)**
   a. Connect a Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the tester ON.
   d. Select the following menu items: Powertrain / Engine and ECT / Engine and ECT / Data List / All Data / Starter Signal.
   e. Check the result when the ignition switch is turned to ON and START positions.

   OK

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IGNITION SWITCH CONDITION AND STARTER SIGNAL REFERENCE

Ignition Switch Condition	Starter Signal
ON	OFF
START	ON

Result

RESULT REFERENCE

Result	Proceed to
Outside standard range	A
Within standard range	B

B: Go to step 2

A : PROCEED TO NEXT CIRCUIT INSPECTION SHOWN IN PROBLEM SYMPTOMS TABLE (See **PROBLEM SYMPTOMS TABLE**)

2. **INSPECT ECM (STSW TERMINAL VOLTAGE)**
   a. Disconnect the ECM connector.
   b. Perform the cranking operation.
   c. Measure the voltage according to the value(s) in the table below.

Standard voltage

VOLTAGE SPECIFICATION

Tester Connection	Switch Condition	Specified Condition
A21-14 (STSW) - Body ground	ON	Below 1 V
	START	9 to 13 V

   d. Reconnect the ECM connector.

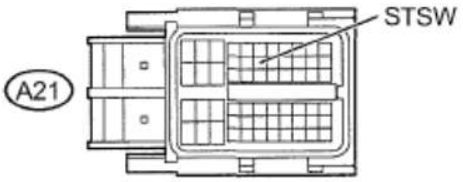
HINT:

DTCs related to the communication with other computers may be set due to this inspection. Clear those DTCs after the inspection.

NG: Go to step 7

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Front view of wire harness connector:
(to ECM)



A164014E03

Fig. 277: Identifying ECM Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

3. **INSPECT ECM (STAR TERMINAL OUTPUT VOLTAGE)**
   a. Connect a Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the tester ON.
   d. Select the following menu items: Powertrain / Engine and ECT / Active Test / Control the All Cylinders Fuel Cut.
   e. Move the shift lever to the P or N position (for automatic transaxle models).
   f. Fully depress the clutch pedal (for manual transaxle models).
   g. Measure the voltage according to the value(s) in the table below.

Standard voltage (for automatic transaxle models)

VOLTAGE SPECIFICATION

Tester Connection	Switch Condition	Specified Condition
10 (Junction Connector) - Body ground	Ignition switch ON (P or N position)	Below 1 V
	Cranking operation	9 to 13 V

Standard voltage (for manual transaxle models)

VOLTAGE SPECIFICATION

Tester Connection	Switch Condition	Specified Condition
A17-2 - Body	Ignition switch ON (Accelerator pedal Fully depressed)	Below 1 V

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ground	Cranking operation	9 to 13 V

Rear view of wire harness connector
(to Junction Connector)

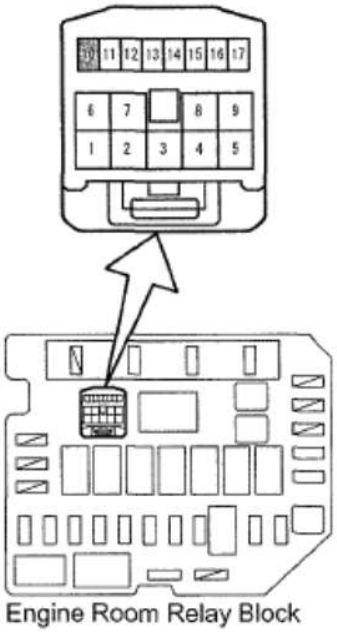


Fig. 278: Identifying Junction Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

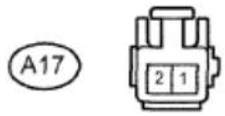
HINT:

- The junction connector is in the engine room relay block and junction block as the illustration above.
- During this inspection, all connectors and relays should be connected.

NG: Go to step 8

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Rear view of wire harness connector:
(to Clutch Start Switch)



A172524E01

Fig. 279: Identifying Clutch Start Switch Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

4. **INSPECT CLUTCH START SWITCH OR PARK/NEUTRAL POSITION SWITCH**
   a. Inspect the Park/Neutral Position (PNP) switch connector (for automatic transaxle models).
      1. Disconnect the park/neutral position switch connector.
      2. Measure the resistance according to the value(s) in the table below.

Standard resistance

RESISTANCE SPECIFICATION

Tester Connection	Shift Selector Lever Position	Specified Condition
2-6, 4-5	P	Below 1 ohms
1-2	R	
2-9,4-5	N	
2-7	D	
2-3	2	
2-8	L	
Except above terminals	All Positions	10 kohms or higher

      3. Reconnect the park/neutral position switch connector.

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Component without harness connected:
(PNP Switch)

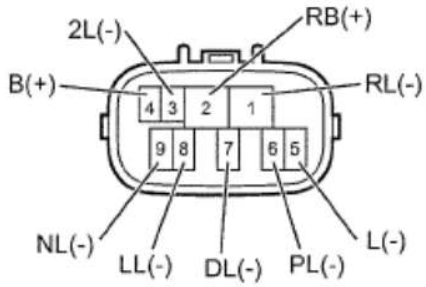


Fig. 280: Identifying Park/Neutral Position Switch Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. Inspect the clutch start switch (for manual transaxle models).
   1. Disconnect the clutch start switch connector.
   2. Measure the resistance according to the value(s) in the table below.

Standard resistance

RESISTANCE SPECIFICATION

Tester Connection	Switch Condition	Specified Condition
1 - 2	ON (Pushed)	Below 1 ohms
1 - 2	OFF (Not pushed)	10 kohms or higher

   3. Reconnect the clutch start switch connector.

Result

RESULT REFERENCE

Result	Proceed to
Outside standard range	A
Within standard range (for automatic transaxle models)	B
Within standard range (for manual transaxle models)	C

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Component Side:

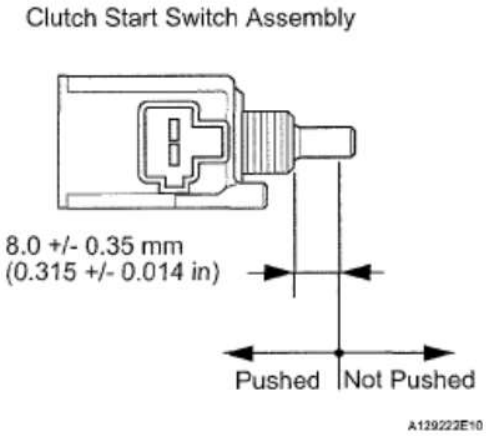


Fig. 281: Identifying Clutch Start Switch Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

B: Go to step 5

C: Go to step 6

A : REPLACE CLUTCH START SWITCH OR PARK/NEUTRAL POSITION SWITCH

5. **CHECK HARNESS AND CONNECTOR (PNP SWITCH - ECM)**
   a. Disconnect the Park/Neutral Position (PNP) switch connector.
   b. Disconnect the ECM connector.
   c. Measure the resistance according to the value(s) in the table below.

Standard resistance

RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
C28-4 - C19-52 (STAR)	Always	Below 1 ohms

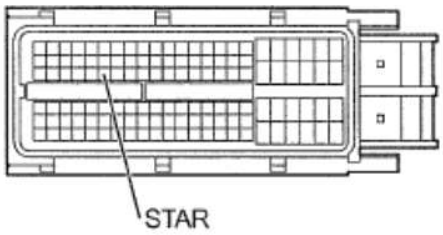
   d. Reconnect the PNP switch connector.
   e. Reconnect the ECM connector.

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR

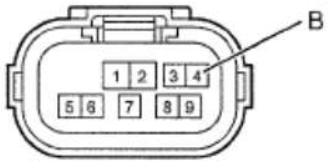
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Front view of wire harness connector:
(to ECM)



Front view of wire harness connector:
(to PNP Switch)



A172525E01

Fig. 282: Identifying Park/Neutral Position Switch Connector And ECM Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

6. **CHECK HARNESS AND CONNECTOR (CLUTCH START SWITCH OR PNP SWITCH - ECM ST RELAY)**
   a. Check the harness and connector (for automatic transaxle models).
      1. Remove the ST relay from the engine room relay block.
      2. Disconnect the Park/Neutral Position (PNP) switch connector.
      3. Disconnect the ECM connector.

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Front view of wire harness connector:
(to PNP Switch)



A172526E01

Fig. 283: Identifying Park/Neutral Position Switch Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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

Standard resistance (Check for open)

RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
C28-5 - A21-48 (STA)	Always	Below 1 ohms
C28-5 - 2 (ST relay)	Always	Below 1 ohms
1 (ST relay) - Body ground	Always	Below 1 ohms

5. Reinstall the ST relay.
6. Reconnect the park/neutral position switch connector.
7. Reconnect the ECM connector.

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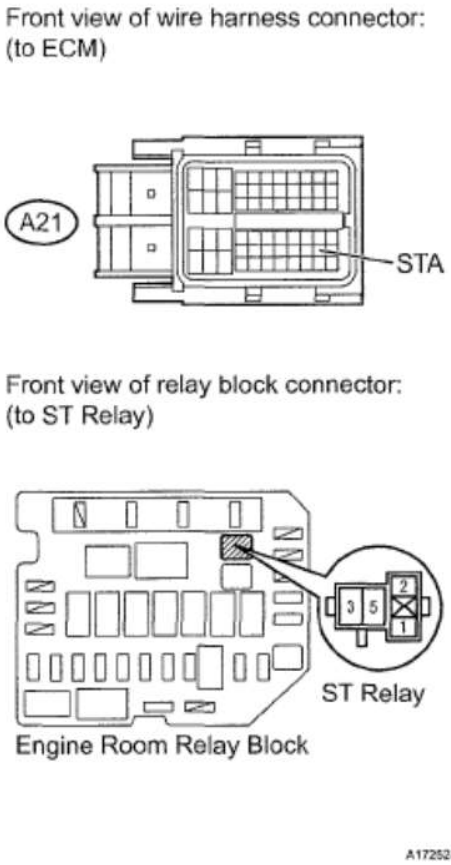


Fig. 284: Identifying ST Relay Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. Check the harness and connector (for manual transaxle models).
   1. Remove the ST relay from the engine room relay block.
   2. Disconnect the clutch start switch connector.
   3. Disconnect the ECM connector.
   4. Measure the resistance according to the value(s) in the table below.

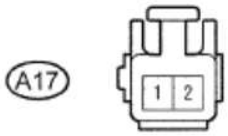
Standard resistance (Check for open)

RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
A17-1 - A21-48 (STA)	Always	Below 1 ohms
A17-1 - 2 (ST relay)	Always	Below 1 ohms
1 (ST relay) - Body ground	Always	Below 1 ohms

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Front view of wire harness connector:
(to Clutch Start Switch)



A172527E01

Fig. 285: Identifying Clutch Start Switch Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

5. Reinstall the ST relay.
6. Reconnect the clutch start switch connector.
7. Reconnect the ECM connector.

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR

OK : REPAIR OR REPLACE STARTER CIRCUIT (STARTER - ST RELAY)

7. **INSPECT IGNITION SWITCH**
   a. Remove the ignition switch.
   b. Measure the resistance according to the value(s) in the table below.

Standard resistance

RESISTANCE SPECIFICATION

Tester Connection	Switch Condition	Specified Condition
All terminals	LOCK	10 kohms or higher
2 (ACC) - 4 (AM1)	ACC	Below 1 ohms
1 (IG1) - 2 (ACC) - 4 (AM1)	ON	
5 (AM2) - 6 (1G2)		
1 (IG1) - 3 (ST1) - 4 (AM1)	START	
5 (AM2) - 6 (IG2) - 7 (ST2)		

   c. Reinstall the ignition switch.

NG: REPLACE IGNITION SWITCH (See **REMOVAL**)

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Component without harness connected:
(Ignition Switch)

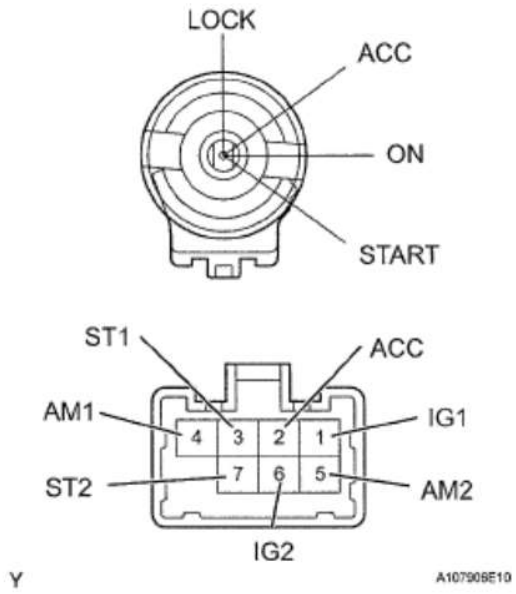


Fig. 286: Identifying Ignition Switch Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK : REPAIR OR REPLACE HARNESS OR CONNECTOR (IGNITION SWITCH - ECM)

8. **INSPECT CLUTCH START SWITCH OR PARK/NEUTRAL POSITION SWITCH**
   a. Inspect the Park/Neutral Position (PNP) switch connector (for automatic transaxle models).
      1. Disconnect the park/neutral position switch connector.
      2. Measure the resistance according to the value(s) in the table below.

Standard resistance

RESISTANCE SPECIFICATION

Tester Connection	Shift Selector Lever Position	Specified Condition
2-6,4-5	P	Below 1 ohms
1-2	R	
2-9, 4-5	N	
2-7	D	
2-3	2	
2-8	L	
Except above terminals	All Positions	10 kohms or higher

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Component without harness connected:
(PNP Switch)

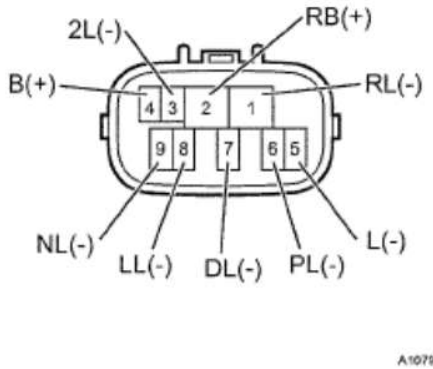


Fig. 287: Identifying Park/Neutral Position Switch Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

3. Reconnect the park/neutral position switch connector.

b. Inspect the clutch start switch (for manual transaxle models).
   1. Disconnect the clutch start switch connector.
   2. Measure the resistance according to the value(s) in the table below.

Standard resistance

RESISTANCE SPECIFICATION

Tester Connection	Switch Condition	Specified Condition
1 - 2	ON (Pushed)	Below 1 ohms
1 - 2	OFF (Not pushed)	10 kohms or higher

3. Reconnect the clutch start switch connector.

NG: REPLACE CLUTCH START SWITCH OR PARK/NEUTRAL POSITION SWITCH

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Component Side:

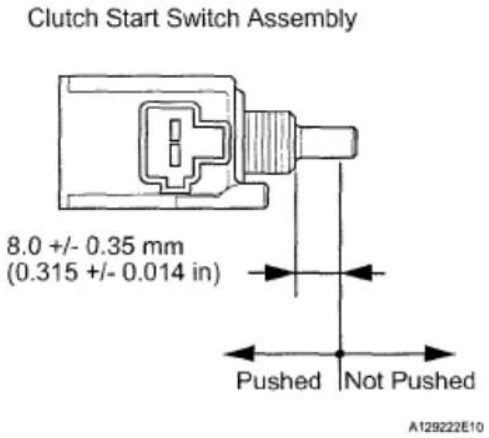


Fig. 288: Identifying Clutch Start Switch Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

9. **CHECK HARNESS AND CONNECTOR (CLUTCH START SWITCH OR PNP SWITCH IGNITION SWITCH AND ECM)**
   a. Check the harness and connector (for automatic transaxle models).
      1. Disconnect the ignition switch connector.
      2. Disconnect the Park/Neutral Position (PNP) switch connector
      3. Disconnect the ECM connector.
      4. Measure the resistance according to the value(s) in the table below.

Standard resistance (Check for open)

RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
F9-7 (ST2) - C28-4	Always	Below 1 ohms
C19-52 (STAR) - C28-4	Always	

Standard resistance (Check for short)

RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
F9-7 (ST2) or C28-4 - Body ground	Always	10 kohms or higher
C19-52 (STAR) or C28-4 - Body ground	Always	

HINT:

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The wire between the park/neutral position switch and the ignition switch has a diode (refer to the **WIRING DIAGRAM**). The current flowing to the park/ neutral position switch is rectified by the diode.

5. Reconnect the ignition switch connector.
6. Reconnect the clutch start switch connector.
7. Reconnect the ECM connector.

b. Check the harness and connector (for manual transaxle models).

1. Disconnect the ignition switch connector.
2. Disconnect the clutch start switch connector.
3. Disconnect the ECM connector.
4. Measure the resistance according to the value(s) in the table below.

Standard resistance (Check for open)

RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
F9-7 (ST2) - A17-2	Always	Below 1 ohms
C19-52 (STAR) - A17-2	Always	

Standard resistance (Check for short)

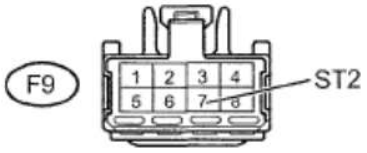
RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
F9-7 (ST2) or A17-2-Body ground	Always	10 kohms or higher
C19-52 (STAR) or A17-2 - Body ground	Always	

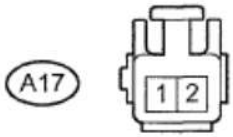
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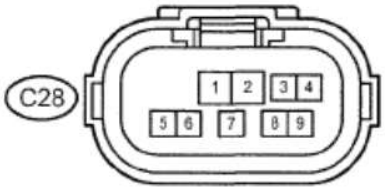
Front view of wire harness connector:
(to Ignition Switch)



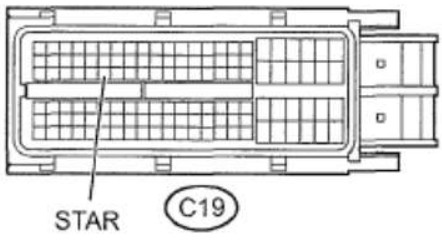
Front view of wire harness connector:
(to Clutch Start Switch)



Front view of wire harness connector:
(to PNP Switch)



Front view of wire harness connector:
(to ECM)



A164015E02

Fig. 289: Identifying Clutch Start Switch, PNP Switch And Ignition Switch Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

HINT:

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The wire between the clutch start switch and the ignition switch has a diode (refer to the **WIRING DIAGRAM**). The current flowing to the clutch start switch is rectified by the diode.

5. Reconnect the ignition switch connector.
6. Reconnect the clutch start switch connector.
7. Reconnect the ECM connector.

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR

OK: Go to next step

10. **CHECK HARNESS AND CONNECTOR (CLUTCH START SWITCH OR PNP SWITCH - ECM ST RELAY)**
    a. Check the harness and connector (for automatic transaxle models).
       1. Remove the ST relay from the engine room relay block.
       2. Disconnect the Park/Neutral Position (PNP) switch connector.
       3. Disconnect the ECM connector.

Front view of wire harness connector:
(to PNP Switch)



Fig. 290: Identifying Park/Neutral Position Switch Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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

Standard resistance (Check for short)

RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
C28-5 or A21-48 (STA) - Body ground	Always	10 kohms or higher
C28-5 or 2 (ST relay) - Body ground	Always	10 kohms or higher

5. Reinstall the ST relay.
6. Reconnect the park/neutral position switch connector.
7. Reconnect the ECM connector.

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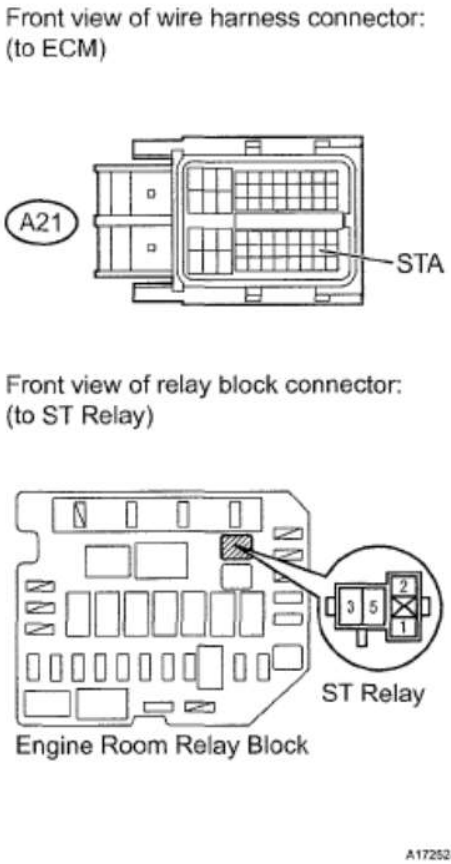


Fig. 291: Identifying ST Relay Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. Check the harness and connector (for manual transaxle models).
   1. Remove the ST relay from the engine room relay block.
   2. Disconnect the clutch start switch connector.
   3. Disconnect the ECM connector.
   4. Measure the resistance according to the value(s) in the table below.

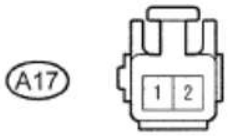
Standard resistance (Check for short)

RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
A17-1 or A21-48 (STA) - Body ground	Always	10 kohms or higher
A17-1 or 2 (ST relay) - Body ground	Always	10 kohms or higher

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Front view of wire harness connector:
(to Clutch Start Switch)



A172527E01

Fig. 292: Identifying Clutch Start Switch Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

5. Reinstall the ST relay.
6. Reconnect the clutch start switch connector.
7. Reconnect the ECM connector.

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR

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

MIL CIRCUIT

DESCRIPTION

The MIL (Malfunction Indicator Lamp) is used to indicate vehicle malfunction detections by the ECM. When the ignition switch is turned to ON, power is supplied to the MIL circuit, and the ECM provides the circuit ground which illuminates the MIL.

The MIL operation can be checked visually: When the ignition switch is first turned to ON, the MIL should be illuminated and should then turn off. If the MIL remains illuminated or is not illuminated, conduct the following troubleshooting procedure using a Techstream.

WIRING DIAGRAM

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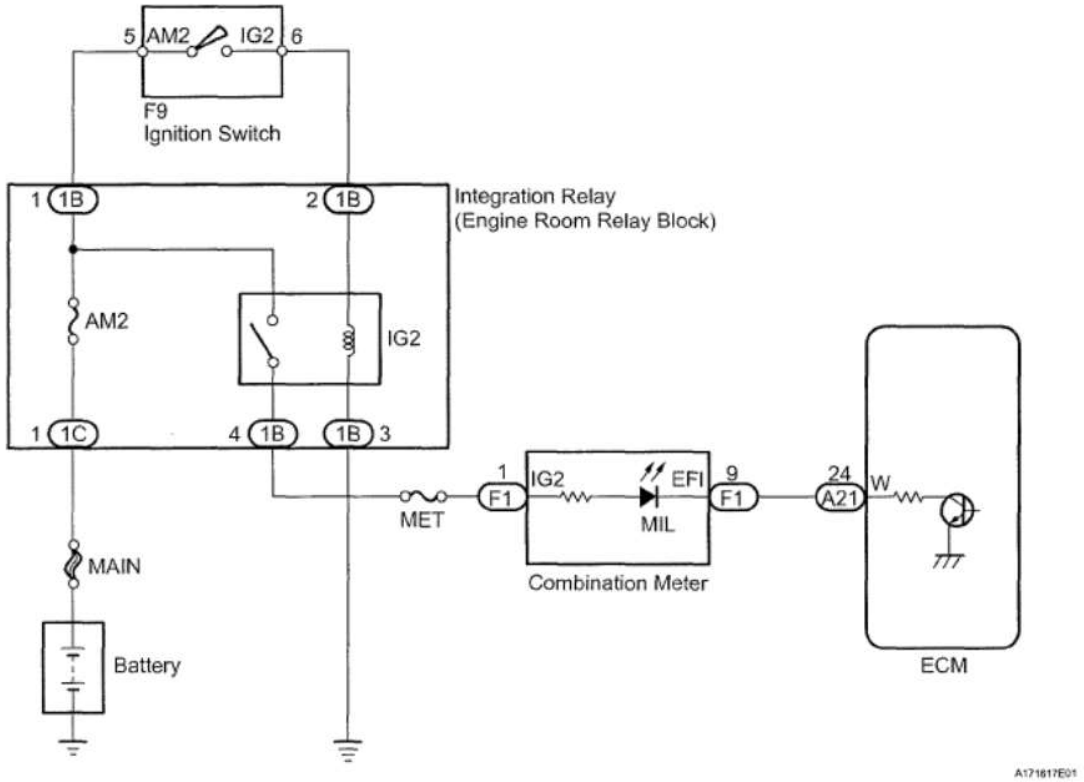


Fig. 293: MIL Circuit - Wiring Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSPECTION PROCEDURE

1. **CHECK THAT MIL IS ILLUMINATED**
   a. Perform troubleshooting in accordance with the table below.

   Result

   RESULT REFERENCE

MIL Condition	Proceed to
MIL remains ON	A
MIL does not illuminate	B

   B: Go to step 5

   A: Go to next step

2. **CHECK WHETHER MIL TURNS OFF**
   a. Connect a Techstream to the DLC3.
   b. Turn the ignition switch to ON.

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c. Turn the tester ON.
d. Select the following menu items: Powertrain / Engine and ECT / Trouble Codes.
e. Check if any DTCs have been detected. Note down any DTCs.

Result

RESULT REFERENCE

Result	Proceed to
No DTC detected	A
Any DTCs detected	B

HINT:

Check for detected DTCs output from other ECUs which relates to the MIL.

B : REPAIR CIRCUITS INDICATED BY OUTPUT DTCS (See **DIAGNOSTIC TROUBLE CODE CHART**)

A: Go to next step

3. **CHECK HARNESS AND CONNECTOR (CHECK FOR SHORT IN WIRE HARNESS)**
   a. Disconnect the ECM connector.
   b. Turn the ignition switch to ON.
   c. Check that the MIL is not illuminated.

OK:

MIL is not illuminated.

   d. Reconnect the ECM connector.

NG: Go to step 4

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Front view of wire harness connector:
(to ECM)



A122539E08

Fig. 294: Identifying ECM Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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

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 short)

RESISTANCE SPECIFICATION

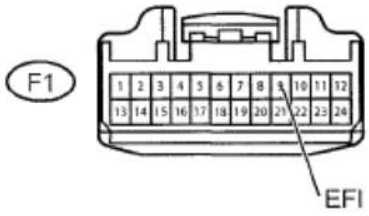
Tester Connection	Condition	Specified Condition
A21-24 (W) or F1-9 (EFI) - Body ground	Always	10 kohms or higher

   d. Reconnect the ECM connector.
   e. Reconnect the combination meter connector.

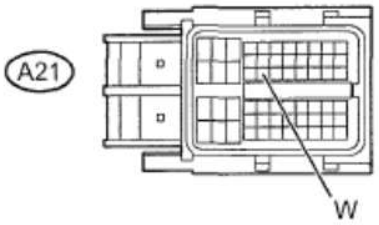
NG: REPAIR OR REPLACE HARNESS OR CONNECTOR

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Front view of wire harness connector:
(to Combination Meter)



Front view of wire harness connector:
(to ECM)



A176670E01

Fig. 295: Identifying Combination Meter And ECM Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK : REPLACE COMBINATION METER ASSEMBLY (See **REMOVAL**)

5. **CHECK THAT MIL IS ILLUMINATED**
   a. Check if the MIL is illuminated when the ignition switch is turned to ON.

      OK:

      MIL should be illuminated.

   NG: Go to step 6

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

6. **CHECK THAT ENGINE STARTS**
   a. Turn the ignition switch to ON.
   b. Start the engine.

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Result

RESULT REFERENCE

Result	Proceed to
Engine starts	A
Engine does not start*	B
HINT: *: A Techstream cannot communicate with the ECM.	

B: Go to **VC OUTPUT CIRCUIT**

A: Go to next step

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 open)

RESISTANCE SPECIFICATION

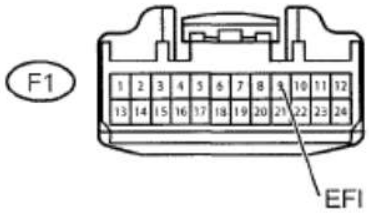
Tester Connection	Condition	Specified Condition
A21-24 (W) - F1-9 (EFI)	Always	Below 1 ohms

   d. Reconnect the ECM connector.
   e. Reconnect the combination meter connector.

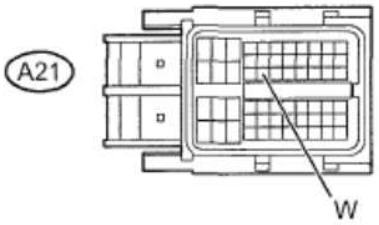
NG: REPAIR OR REPLACE HARNESS OR CONNECTOR

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Front view of wire harness connector:
(to Combination Meter)



Front view of wire harness connector:
(to ECM)



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Fig. 296: Identifying Combination Meter And ECM Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK : REPLACE COMBINATION METER (See **REMOVAL**)

CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY

COMPONENTS

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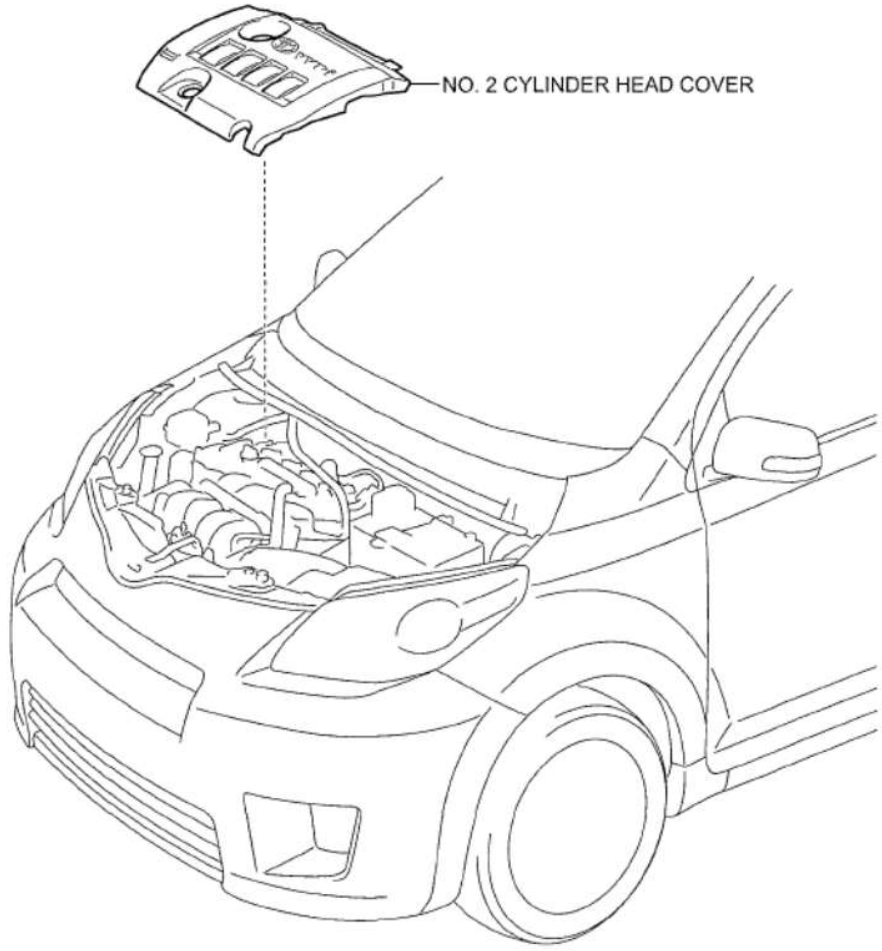


Fig. 297: Identifying Camshaft Timing Oil Control Valve Assembly Components (1 Of 2)
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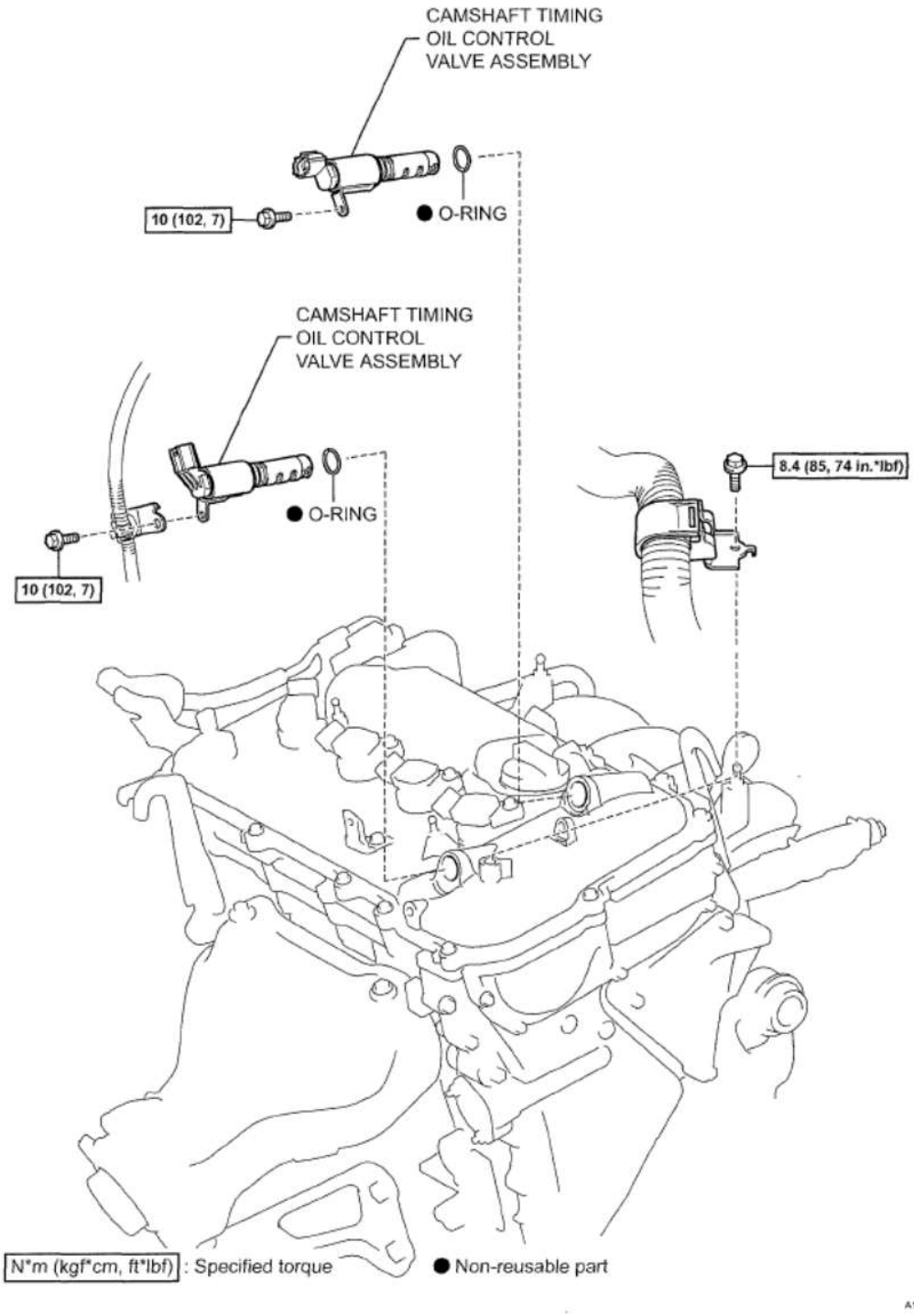


Fig. 298: Identifying Camshaft Timing Oil Control Valve Assembly Components With Torque Specifications (2 Of 2)
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ON-VEHICLE INSPECTION

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1. **INSPECT CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY**
   a. Connect a Techstream to the DLC3.
   b. Turn the ignition switch to ON.
   c. Turn the tester ON.
   d. Turn the air conditioning switch ON.
   e. Select the following menu items: Powertrain / Engine and ECT / Active Test / Control the VVT Linear (Bank 1) or Control the VVT Exhaust Linear (Bank 1).
   f. Check the engine speed when the OCV is operated by the Techstream.

      OK

      CAMSHAFT TIMING OIL CONTROL VALVE POSITION

Condition	Specified Condition
OCV is OFF (-128%)	Normal engine speed
OCV is ON (0%)	Rough idle or engine stalled

      If the result is not acceptable, cool the engine and perform the inspection again before working the final judgement.

   g. Check the engine speed when the OCV is operated using the Techstream with the engine coolant temperature is 50°C or lass.

      HINT:

      - When performing the active test, the air conditioning should be ON.
      - Engine coolant temperature when engine is started should be 30°C or less.

      OK

      CAMSHAFT TIMING OIL CONTROL VALVE POSITION

Condition	Specified Condition
OCV is OFF (-128%)	Normal engine speed
OCV is ON (0%)	Rough idle or engine stalled

REMOVAL

1. **REMOVE NO. 2 CYLINDER HEAD COVER** (See **REMOVAL**)
2. **REMOVE CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY**
   a. Remove the bolt and the wire harness bracket.

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Fig. 299: Locating Wire Harness Bracket Bolt
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. Disconnect the camshaft timing oil control valve assembly connector (for exhaust camshaft side).

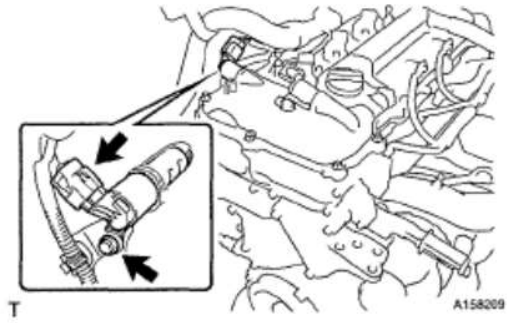


Fig. 300: Locating Camshaft Timing Oil Control Valve Connector Bolt (For Exhaust Camshaft Side)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

c. Remove the bolt and remove the camshaft timing oil control valve assembly (for exhaust camshaft side).
d. Remove the O-ring from the camshaft timing oil control valve assembly (for exhaust camshaft side).

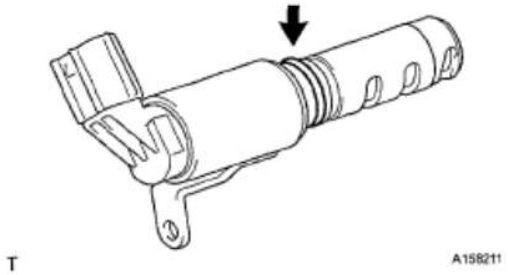


Fig. 301: Locating Camshaft Timing Oil Control Valve O-Ring (For Exhaust Camshaft Side)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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e. Disconnect the camshaft timing oil control valve assembly connector (for intake camshaft side).
f. Remove the bolt and remove the camshaft timing oil control valve assembly (for intake camshaft side).

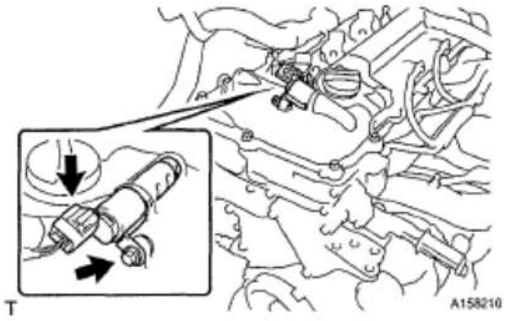


Fig. 302: Locating Camshaft Timing Oil Control Valve Bolt (For Intake Camshaft Side)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

g. Remove the O-ring from the camshaft timing oil control valve assembly (for intake camshaft side).

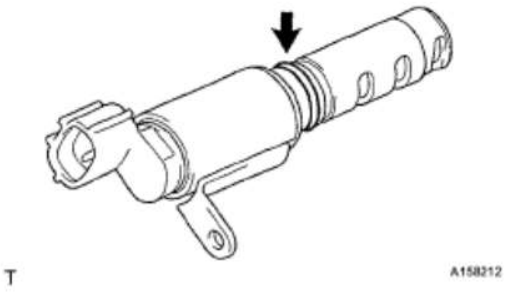


Fig. 303: Locating Camshaft Timing Oil Control Valve O-Ring (For Intake Camshaft Side)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSPECTION

1. **INSPECT CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY**
   a. Measure the resistance according to the value (s) in the below.

Standard resistance

RESISTANCE SPECIFICATION

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

If the result is not as specified, replace the oil control valve assembly.

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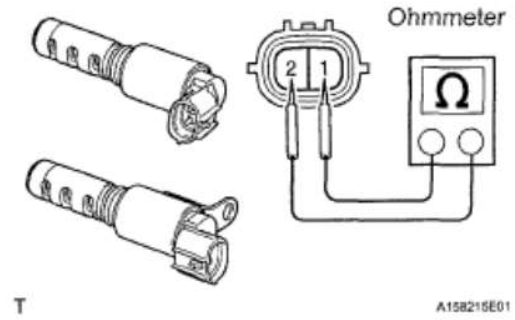


Fig. 304: Measuring Resistance Between Camshaft Timing Oil Control Valve Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. Check the operation.

1. Connect the positive (+) battery lead to terminal 1 and the negative (-) lead to terminal 2, and check the movement of the valve.

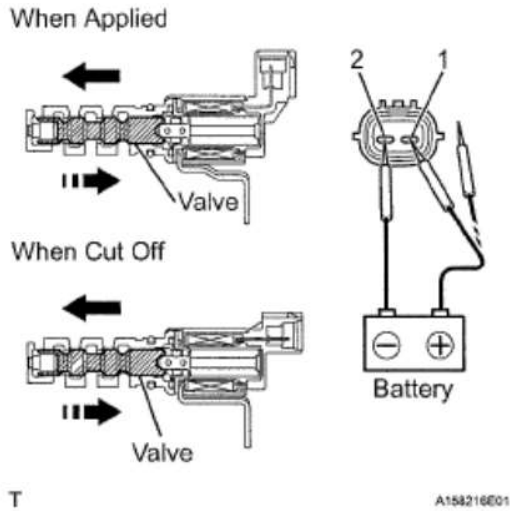
OK

CAMSHAFT TIMING OIL CONTROL VALVE CONDITION

Condition	Specified Condition
Battery positive (+) voltage applied	Valve moves to the left as shown in the illustration
Battery positive (+) voltage cut off	Valve moves to the right as shown in the illustration

If the result is not as specified, replace the camshaft timing oil control valve.

NOTE: If the valve cannot return properly because of foreign matter intrusion, a small amount of leakage in the advanced direction may occur and a DTC may be output.



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Fig. 305: Inspecting Camshaft Timing Oil Control Valve Assembly
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSTALLATION

1. **INSTALL CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY**
   a. Apply a light coat of engine oil to a new O-ring and install it onto the camshaft timing oil control valve assembly (for intake camshaft side).

NOTE: Do not twist the O-ring.

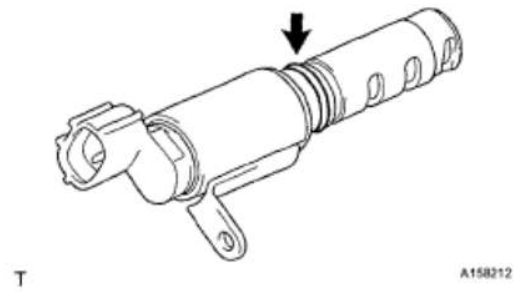


Fig. 306: Locating Camshaft Timing Oil Control Valve O-Ring (For Intake Camshaft Side)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

   b. Install the camshaft timing oil control valve assembly with the bolt (for intake camshaft side).

Torque: 10 N*m (102 kgf*cm, 7 ft.*lbf)

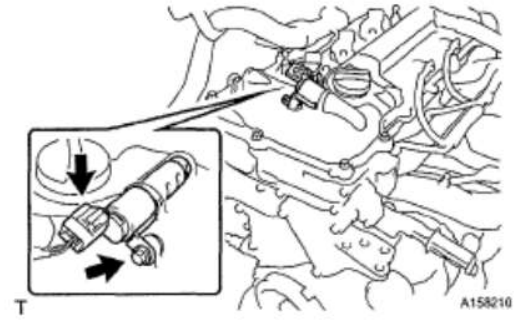


Fig. 307: Locating Camshaft Timing Oil Control Valve Bolt (For Intake Camshaft Side)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

   c. Connect the camshaft timing oil control valve assembly connector (for intake camshaft side).
   d. Apply a light coat of engine oil to a new O-ring and install it onto the camshaft timing oil control valve assembly (for exhaust camshaft side).

NOTE: Do not twist the O-ring.

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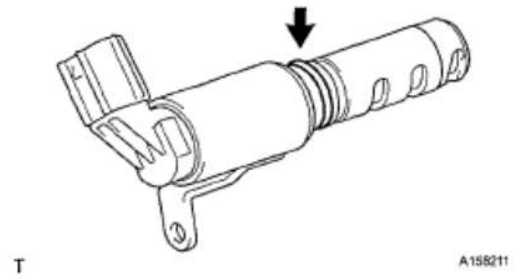


Fig. 308: Locating Camshaft Timing Oil Control Valve O-Ring (For Exhaust Camshaft Side)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

e. Install the camshaft timing oil control valve assembly with the bolt (for exhaust camshaft side).

Torque: 10 N*m (102 kgf*cm, 7 ft.*lbf)

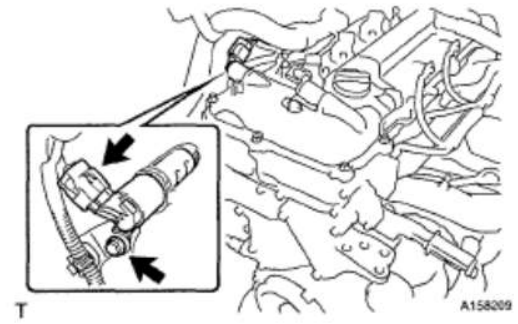


Fig. 309: Locating Camshaft Timing Oil Control Valve Connector Bolt (For Exhaust Camshaft Side)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

f. Connect the camshaft timing oil control valve assembly connector (for exhaust camshaft side).
g. Install the wire harness bracket with the bolt.

Torque: 8.4 N*m (85 kgf*cm, 74 in.*lbf)



Fig. 310: Locating Wire Harness Bracket Bolt

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

2. **INSPECT FOR OIL LEAK**
3. **INSTALL NO. 2 CYLINDER HEAD COVER** (See **INSTALLATION**)

THROTTLE BODY

COMPONENTS

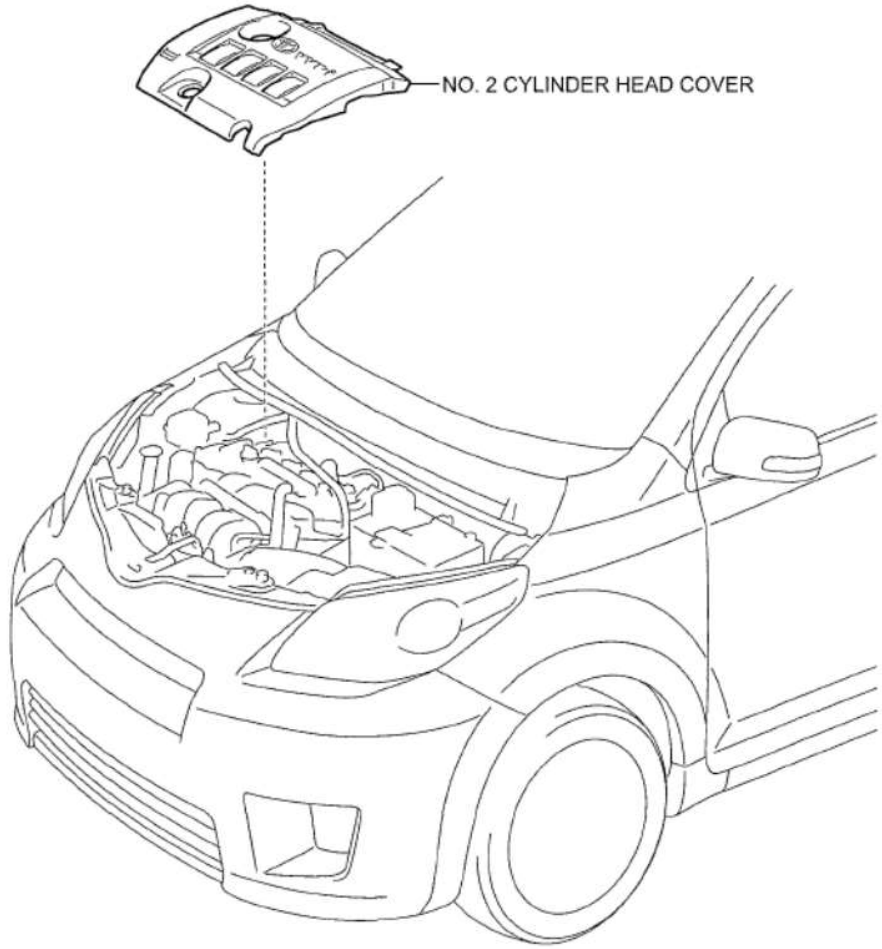


Fig. 311: Identifying Throttle Body Components (1 Of 2)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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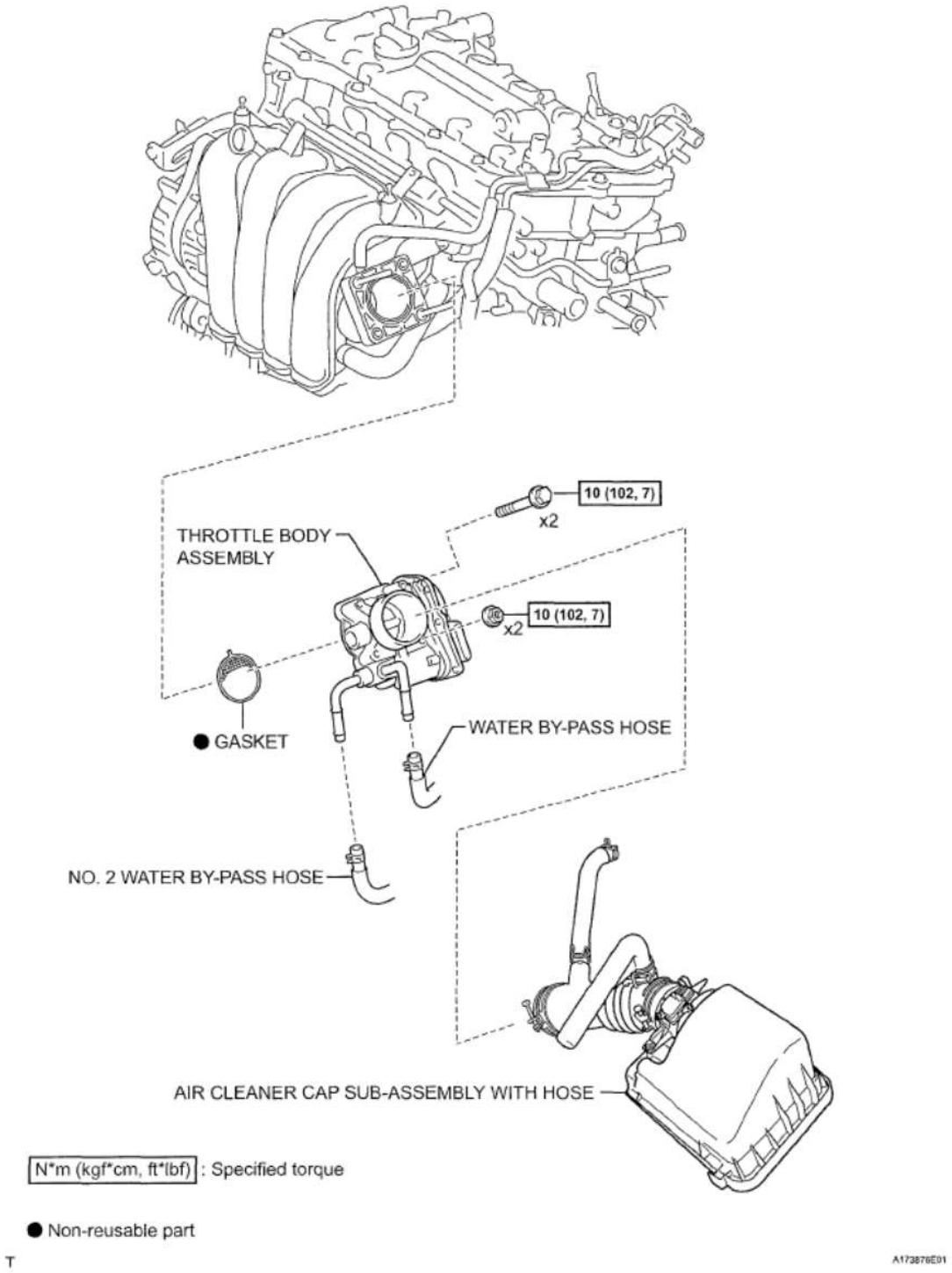


Fig. 312: Identifying Throttle Body Components With Torque Specifications (2 Of 2)
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ON-VEHICLE INSPECTION

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1. **INSPECT THROTTLE BODY ASSEMBLY**
   a. Check the throttle position sensor.
      1. Connect a Techstream to the DLC3.
      2. Turn the ignition switch to ON.
      3. Turn the tester ON.
      4. Start the engine.
      5. Select the following menu items: Powertrain / Engine and ECT / Data List / Throttle Position.
      6. Depress the accelerator pedal.

         OK:

         Make sure that the throttle valve is opened when the accelerator pedal is depressed.

REMOVAL

1. **DRAIN ENGINE COOLANT** (See **REPLACEMENT**)
2. **REMOVE NO. 2 CYLINDER HEAD COVER** (See **REMOVAL**)
3. **REMOVE AIR CLEANER CAP SUB - ASSEMBLY WITH HOSE**
   a. Disconnect the wire harness clamp and mass air flow meter connector.

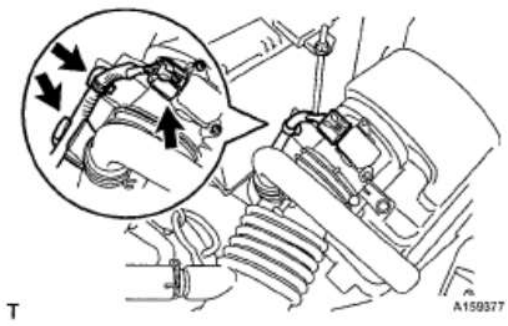


Fig. 313: Locating Wire Harness Clamp And Mass Air Flow Meter Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

   b. Disconnect the No. 2 ventilation hose.

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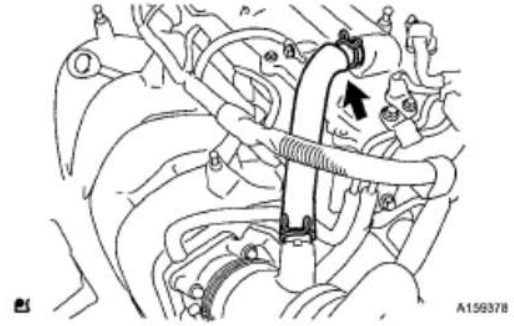


Fig. 314: Locating Ventilation Hose
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

c. Loosen the hose clamp, unlock the 2 clamps and remove air cleaner cap sub-assembly with hose.

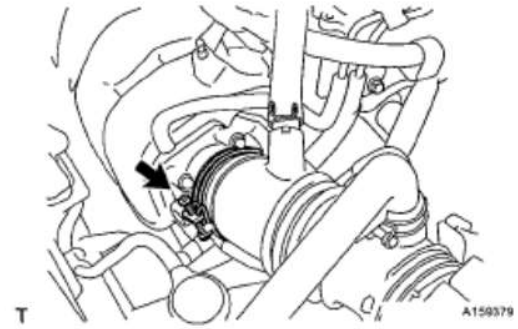


Fig. 315: Locating Hose Clamp
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

4. **REMOVE THROTTLE BODY ASSEMBLY**

a. Disconnect the throttle body connector.

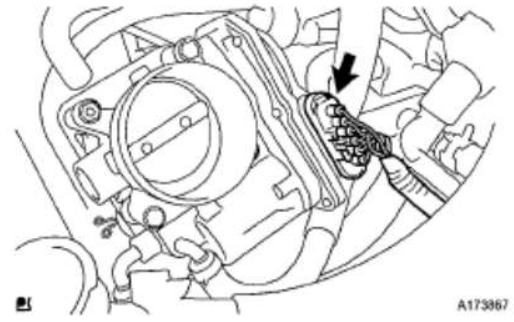


Fig. 316: Locating Throttle Body Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. Disconnect the water by-pass hose and the No. 2 water by-pass hose.

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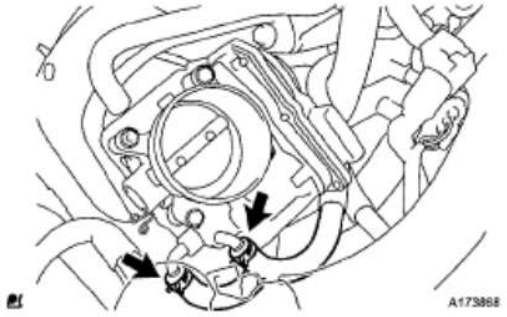


Fig. 317: Locating Water By-Pass Hoses
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

c. Remove the 2 bolts and 2 nuts and remove the throttle body assembly.

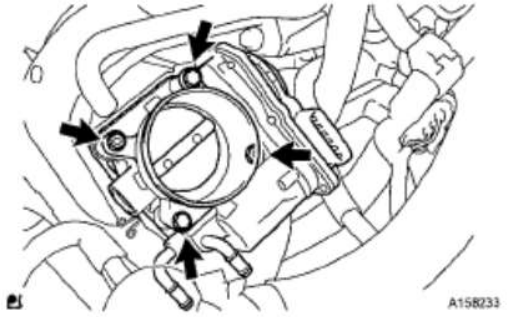


Fig. 318: Locating Throttle Body Assembly Bolts And Nuts
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

d. Remove the gasket from the intake manifold.

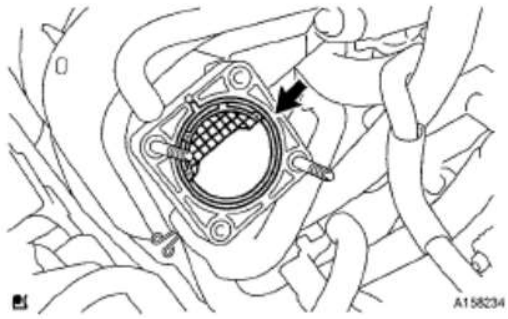


Fig. 319: Locating Intake Manifold Gasket
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSPECTION

1. **INSPECT THROTTLE BODY ASSEMBLY**
   a. Measure the resistance according to the value(s) in the table below.

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Standard resistance

RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
1 (M-) - 2 (M+)	20°C (68°F)	0.3 to 100 ohms

If the result is not as specified, replace the throttle body assembly.

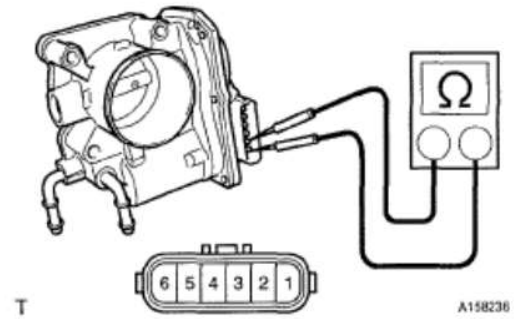


Fig. 320: Measuring Resistance Between Throttle Body Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSTALLATION

1. **INSTALL THROTTLE BODY ASSEMBLY**
   a. Install a new gasket onto the intake manifold.

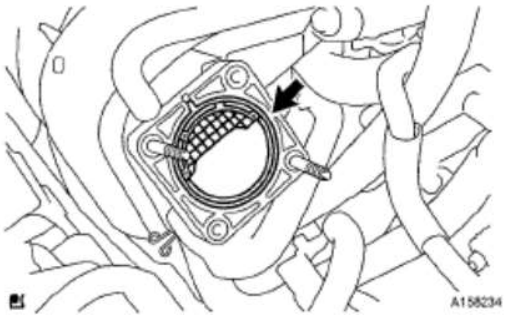


Fig. 321: Locating Intake Manifold Gasket
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

   b. install the throttle body assembly with the 2 bolts and 2 nuts.

Torque: 10 N*m (102 kgf*cm, 7 ft.*lbf)

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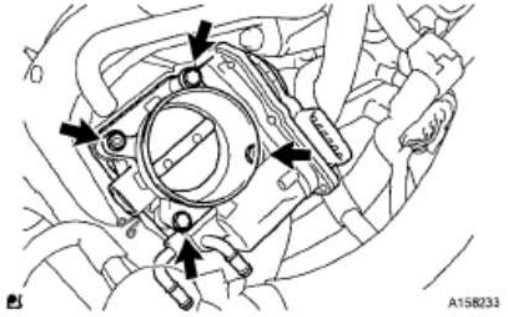


Fig. 322: Locating Throttle Body Assembly Bolts And Nuts
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

c. Connect the water by-pass hose and the No. 2 water by-pass hose.

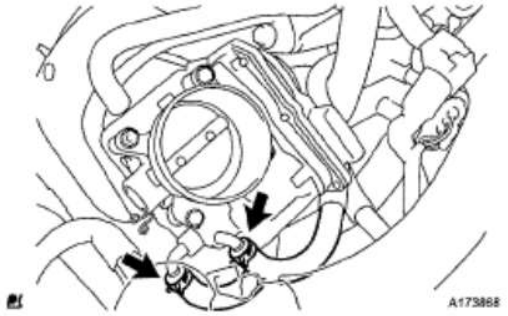


Fig. 323: Locating Water By-Pass Hoses
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

d. Connect the throttle body assembly connector.

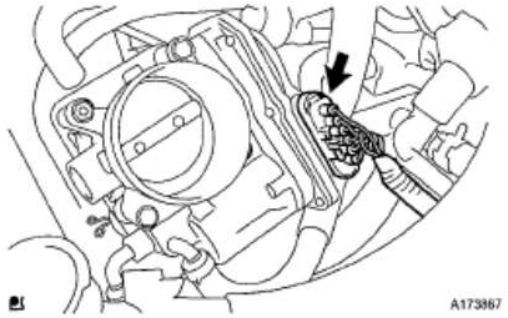


Fig. 324: Locating Throttle Body Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

2. **INSTALL AIR CLEANER CAP SUB - ASSEMBLY WITH HOSE**
   a. Install air cleaner cap sub-assembly with hose and lock the 2 clamps.
   b. Tighten the hose clamp to the specified torque.

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Torque: 3.0 N*m (31 kgf*cm, 27 in.*lbf)

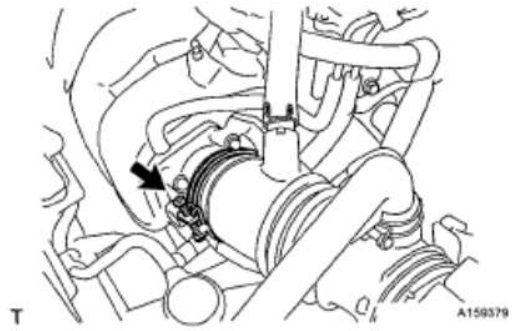


Fig. 325: Locating Hose Clamp
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

c. Connect the No. 2 ventilation hose.

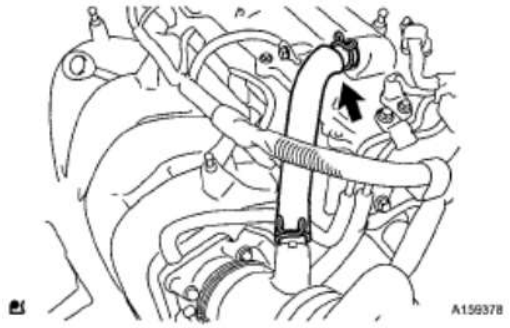


Fig. 326: Locating Ventilation Hose
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

d. Connect the wire harness clamp and mass air flow meter connector.

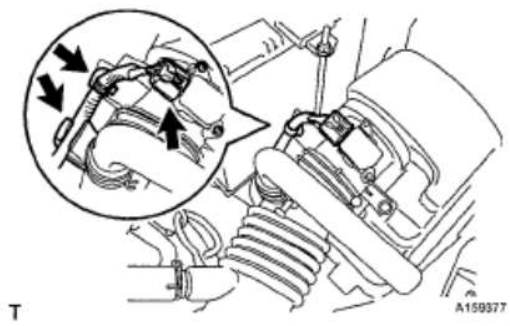


Fig. 327: Locating Wire Harness Clamp And Mass Air Flow Meter Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

3. **ADD ENGINE COOLANT** (See **REPLACEMENT**)

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4. **INSPECT FOR COOLANT LEAK** (See **ON-VEHICLE INSPECTION**)
5. **INSTALL NO. 2 CYLINDER HEAD COVER** (See **INSTALLATION**)

ECM

COMPONENTS

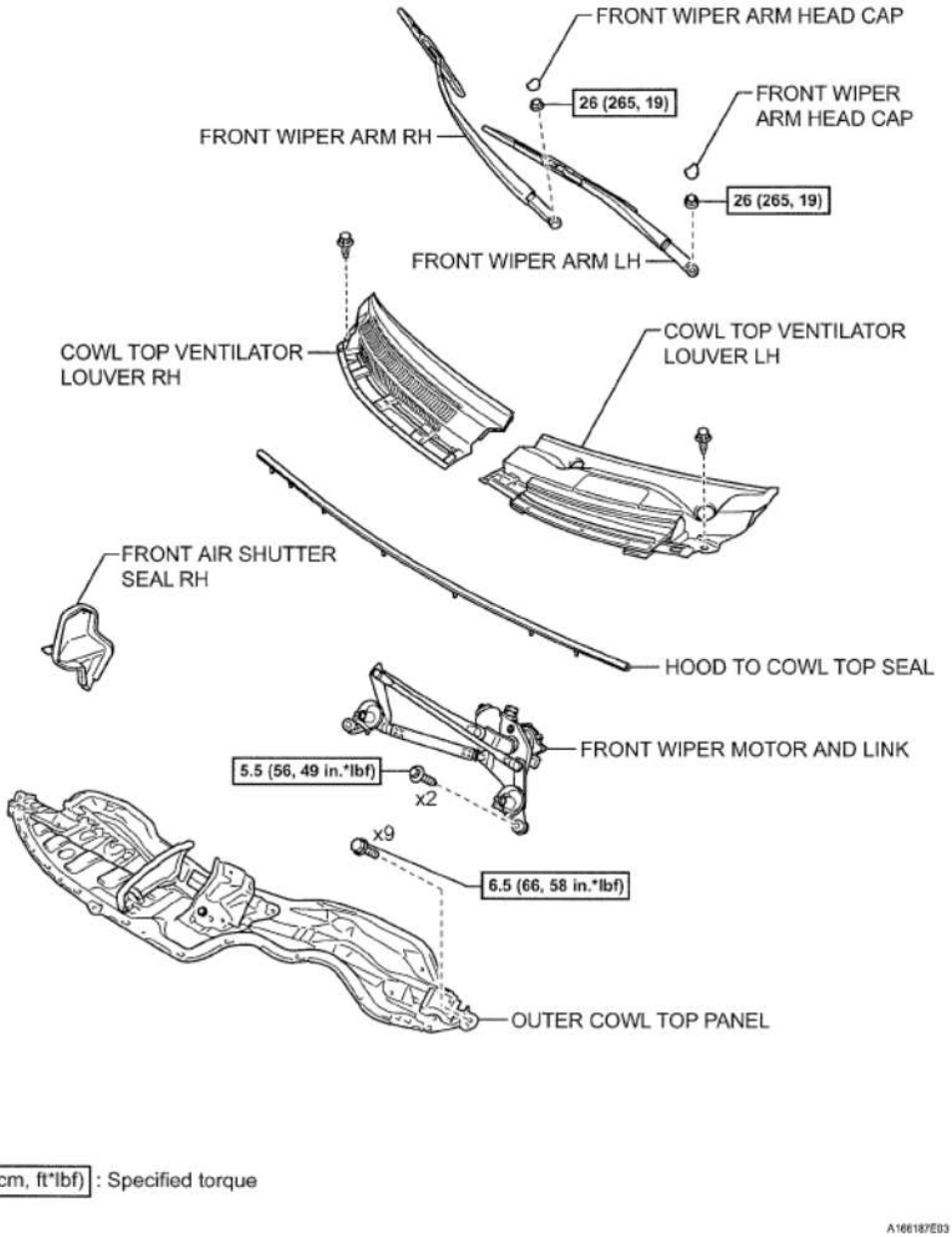


Fig. 328: Identifying ECM Components With Torque Specifications (1 Of 2)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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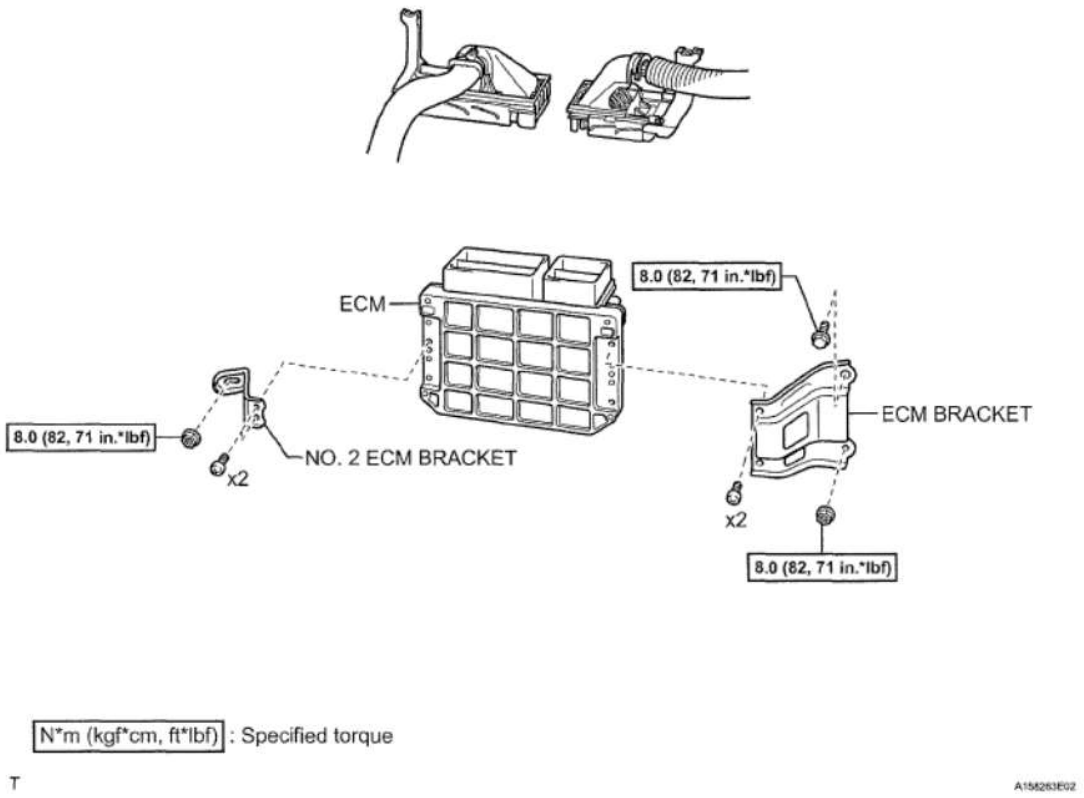


Fig. 329: Identifying ECM Components With Torque Specifications (2 Of 2)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

REMOVAL

NOTE: Replace the ECM with a new one if necessary.

1. **REMOVE FRONT WIPER ARM HEAD CAP** (See **REMOVAL**)
2. **REMOVE FRONT WIPER ARM AND BLADE ASSEMBLY LH** (See **REMOVAL**)
3. **REMOVE FRONT WIPER ARM AND BLADE ASSEMBLY RH** (See **REMOVAL**)
4. **REMOVE HOOD TO COWL TOP SEAL** (See **REMOVAL**)
5. **REMOVE COWL TOP VENTILATOR LOUVER RH** (See **REMOVAL**)
6. **REMOVE COWL TOP VENTILATOR LOUVER LH** (See **REMOVAL**)
7. **REMOVE FRONT WIPER MOTOR AND LINK** (See **REMOVAL**)
8. **REMOVE FRONT AIR SHUTTER SEAL RH** (See **REMOVAL**)
9. **REMOVE OUTER COWL TOP PANEL** (See **REMOVAL**)
10. **REMOVE ECM**
    a. Remove the 2 lock knobs and harness clamp.
    b. Disconnect the 2 ECM connectors.

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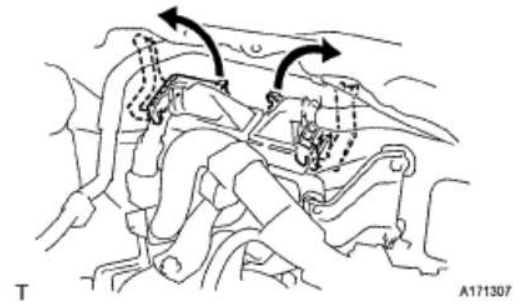


Fig. 330: Disconnecting ECM Connectors
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

c. Remove the bolt and 2 nuts and remove the ECM.

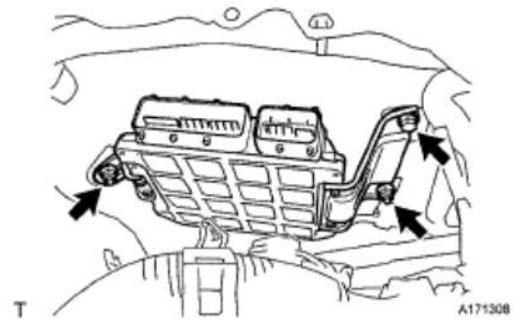


Fig. 331: Locating ECM Bolt And Nuts
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

11. **REMOVE ECM BRACKET**
    a. Remove the 2 screws and the ECM bracket.

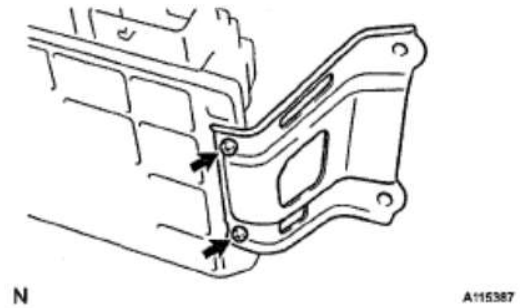


Fig. 332: Locating ECM Bracket Screws
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

12. **REMOVE NO. 2 ECM BRACKET**
    a. Remove the 2 screws and the No. 2 ECM bracket.

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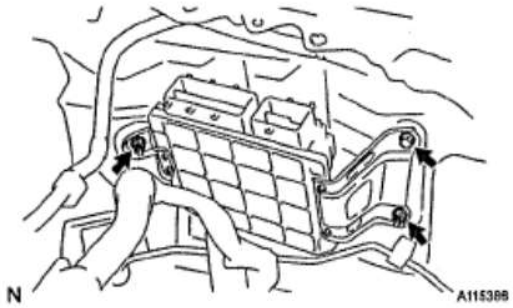


Fig. 333: Locating No 2 ECM Bracket Screws
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSTALLATION

1. **INSTALL NO. 2 ECM BRACKET**
   a. Install the No. 2 ECM bracket with the 2 screws.

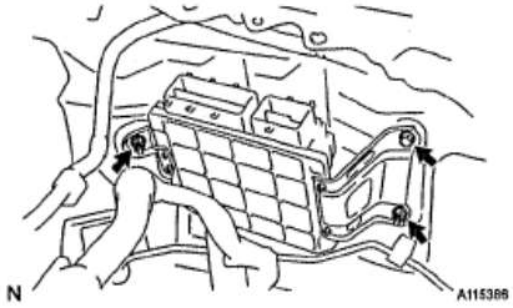


Fig. 334: Locating No 2 ECM Bracket Screws
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

2. **INSTALL ECM BRACKET**
   a. Install the ECM bracket with the 2 screws.

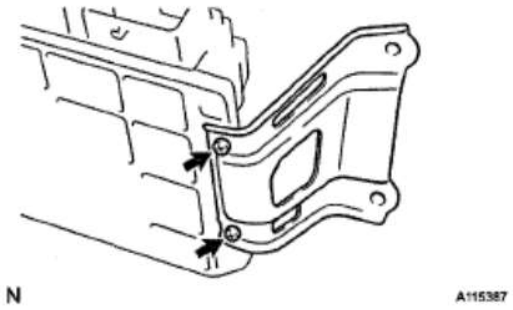


Fig. 335: Locating ECM Bracket Screws
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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3. **INSTALL ECM**
   a. Install the ECM with the bolt and 2 nuts.

   Torque: 8.0 N*m (82 kgf*cm, 71 in.*lbf)

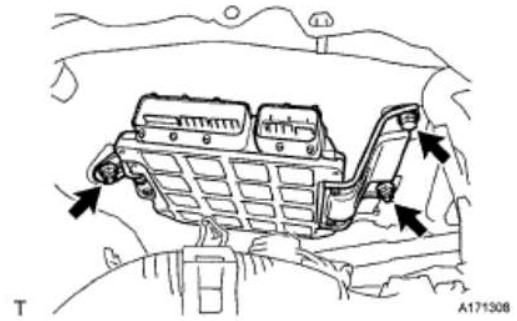


Fig. 336: Locating ECM Bolt And Nuts
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

   b. Connect the 2 ECM connectors.



Fig. 337: Connecting ECM Connectors
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

   c. Install the 2 lock knobs and harness clamp.
4. **INSTALL OUTER COWL TOP PANEL** (See **INSTALLATION**)
5. **INSTALL FRONT AIR SHUTTER SEAL RH** (See **INSTALLATION**)
6. **INSTALL FRONT WIPER MOTOR AND LINK** (See **INSTALLATION**)
7. **INSTALL COWL TOP VENTILATOR LOUVER LH** (See **INSTALLATION**)
8. **INSTALL COWL TOP VENTILATOR LOUVER RH** (See **INSTALLATION**)
9. **INSTALL HOOD TO COWL TOP SEAL** (See **INSTALLATION**)
10. **INSTALL FRONT WIPER ARM AND BLADE ASSEMBLY LH** (See **INSTALLATION**)
11. **INSTALL FRONT WIPER ARM AND BLADE ASSEMBLY RH** (See **INSTALLATION**)
12. **INSTALL FRONT WIPER ARM HEAD CAP** (See **INSTALLATION**)

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ACCELERATOR PEDAL ROD

COMPONENTS

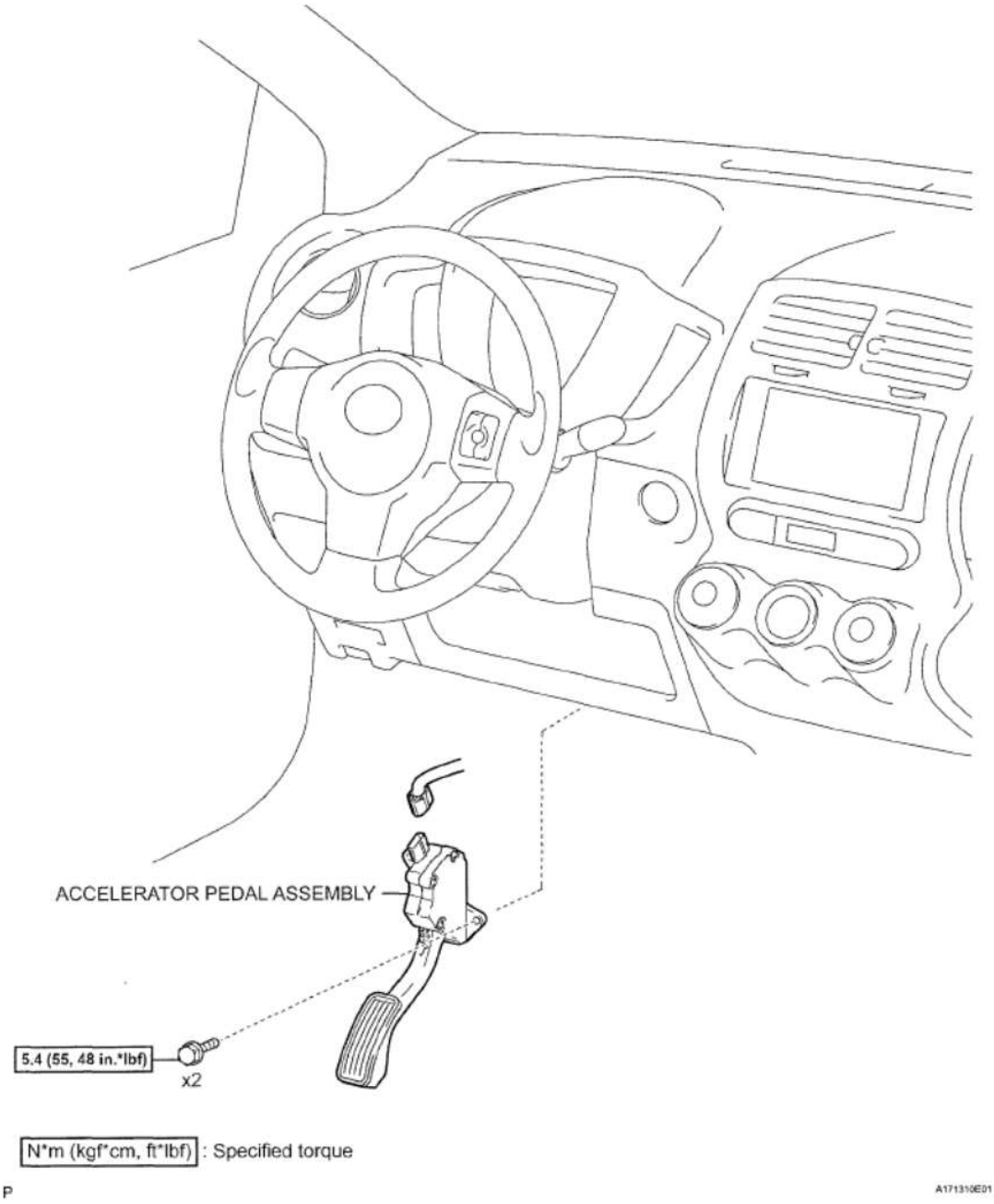


Fig. 338: Identifying Accelerator Pedal Assembly Components With Torque Specification
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

ON-VEHICLE INSPECTION

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1. **INSPECT ACCELERATOR PEDAL ASSEMBLY**
   a. Connect a Techstream to the DLC3.
   b. Turn the ignition switch ON 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. While the accelerator pedal is depressed and released, check that the values of accelerator position No. 1 and accelerator position No. 2 are within the specifications.

Accelerator Position No. 1 Standard voltage

VOLTAGE SPECIFICATION

Condition	Specified Condition
Accelerator pedal released	0.5 to 1.1 V
Accelerator pedal depressed	2.6 to 4.5 V

Accelerator Position No. 2 Standard voltage

VOLTAGE SPECIFICATION

Condition	Specified Condition
Accelerator pedal released	1.2 to 2.0 V
Accelerator pedal depressed	3.4 to 5.0 V

HINT:

If the results are not as specified, check the accelerator pedal, wire harness and ECM.

REMOVAL

1. **REMOVE ACCELERATOR PEDAL ASSEMBLY**
   a. Disconnect the accelerator pedal connector.

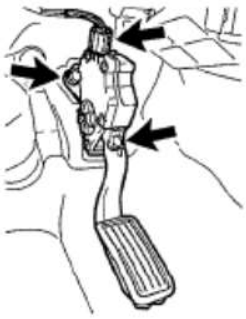


Fig. 339: Locating Accelerator Pedal Bolts And Accelerator Pedal Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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b. Remove the 2 bolts and accelerator pedal.

NOTE:

- **Do not drop or strike the accelerator pedal.**
- **Do not disassemble the accelerator pedal.**

INSTALLATION

NOTE:

- **Avoid any physical shock to the accelerator pedal.**

1. **INSTALL ACCELERATOR PEDAL ASSEMBLY**
   a. Install the accelerator pedal with the 2 bolts.

   Torque: 5.4 N*m (55 kgf*cm, 48 in.*lbf)

   b. Connect the accelerator pedal connector.

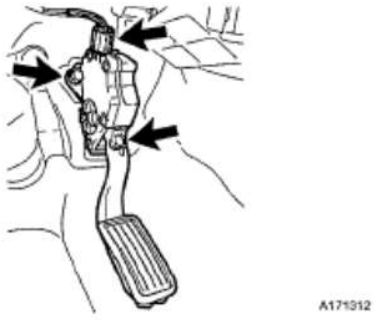


Fig. 340: Locating Accelerator Pedal Bolts And Accelerator Pedal Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

MASS AIR FLOW METER

COMPONENTS

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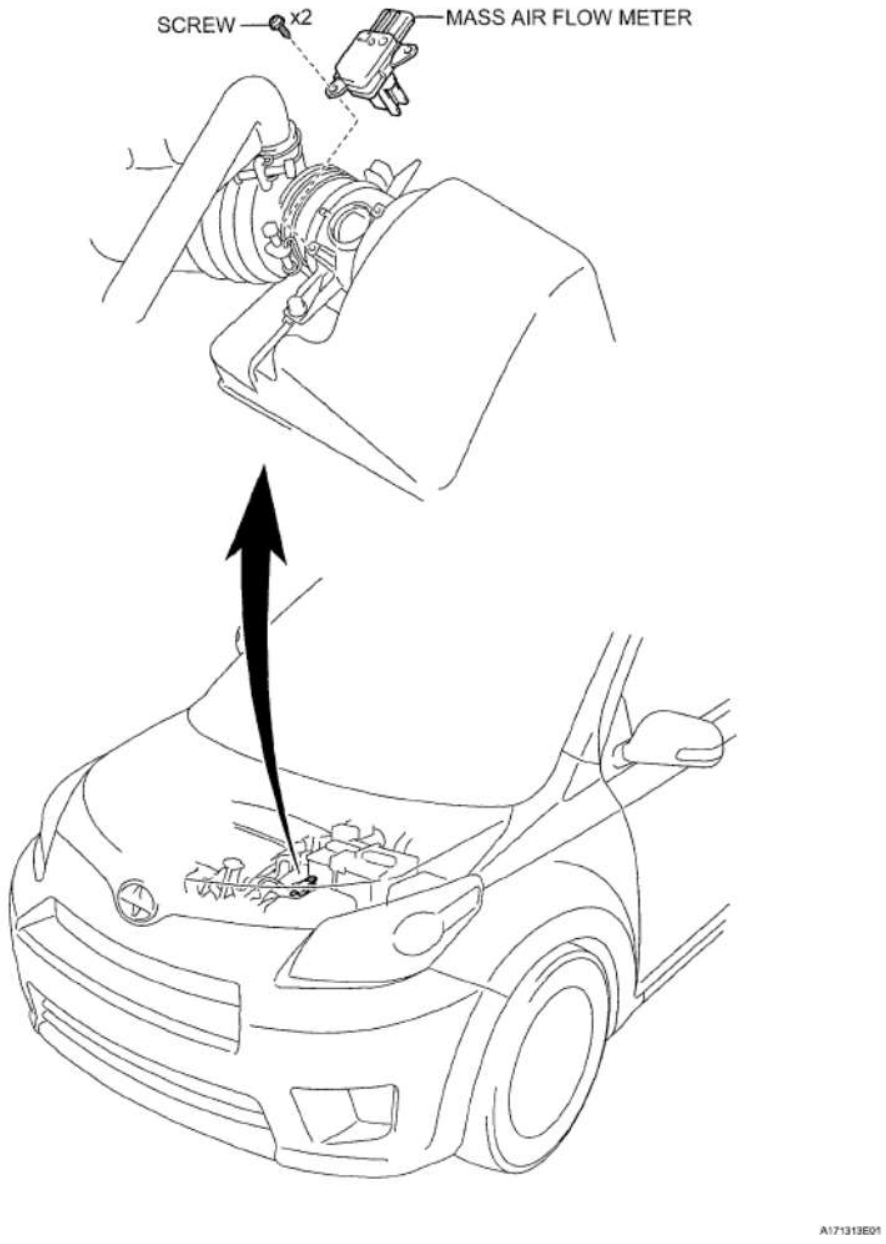


Fig. 341: Identifying Mass Air Flow Meter Components
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

ON-VEHICLE INSPECTION

NOTE:

- **Perform the mass air flow meter inspection in accordance with the procedures below.**
- **Only replace the mass air flow meter when foreign matter adheres to the sensor and the MAF value in the Data List (with the engine stopped) is not within the normal operating range.**

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1. **INSPECT MASS AIR FLOW METER**
   a. Read the values using a Techstream (MAF).

NOTE:

- **Perform the inspection with the vehicle indoors and on a level surface.**
- **Perform the inspection of the mass air flow meter while it is installed into 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. Connect a Techstream to the DLC3.
2. Turn the ignition switch ON (do not run the engine).
3. Turn the tester ON.
4. Select the following menu items: Powertrain / Engine and ECT / Data List / MAF.
5. Wait 30 seconds, and read the values on the intelligent tester.

Standard:

Less than 0.19 g/sec

- If the result is not as specified, replace the mass air flow meter.
- If the result is within the specified range, inspect the mass air flow meter (see **INSTALLATION**).

REMOVAL

1. **REMOVE MASS AIR FLOW METER**
   a. Disconnect the mass air flow meter connector.

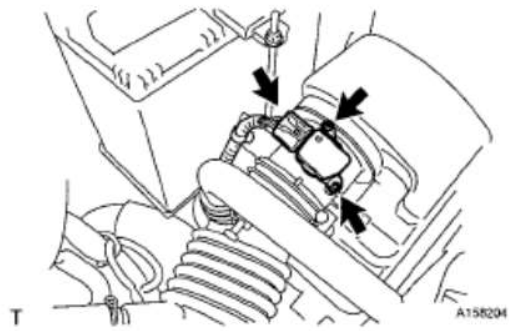


Fig. 342: Locating Mass Air Flow Meter Screws And Mass Air Flow Meter Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

   b. Remove the 2 screws and the mass air flow meter.

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INSPECTION

1. **INSPECT MASS AIR FLOW METER**
   a. Using a work light, check that the platinum filament (heater portion) in the mass air flow meter has no foreign matter attached.

      OK:

      No foreign matter attached.

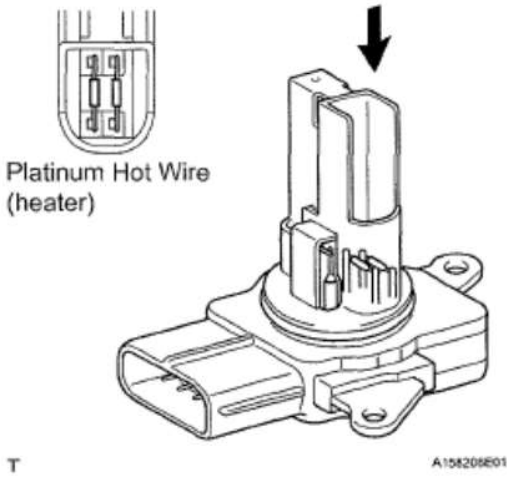


Fig. 343: Identifying Platinum Filament (Heater Portion) In Mass Air Flow Meter
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSTALLATION

1. **INSTALL MASS AIR FLOW METER**
   a. Install the mass air flow meter with the 2 screws.

      NOTE: Make sure that the O-ring is not cracked or jammed when installing.

   b. Connect the mass air flow meter connector.

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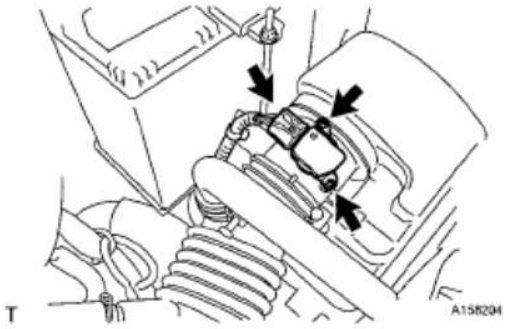


Fig. 344: Locating Mass Air Flow Meter Screws And Mass Air Flow Meter Connector
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CAMSHAFT POSITION SENSOR

COMPONENTS

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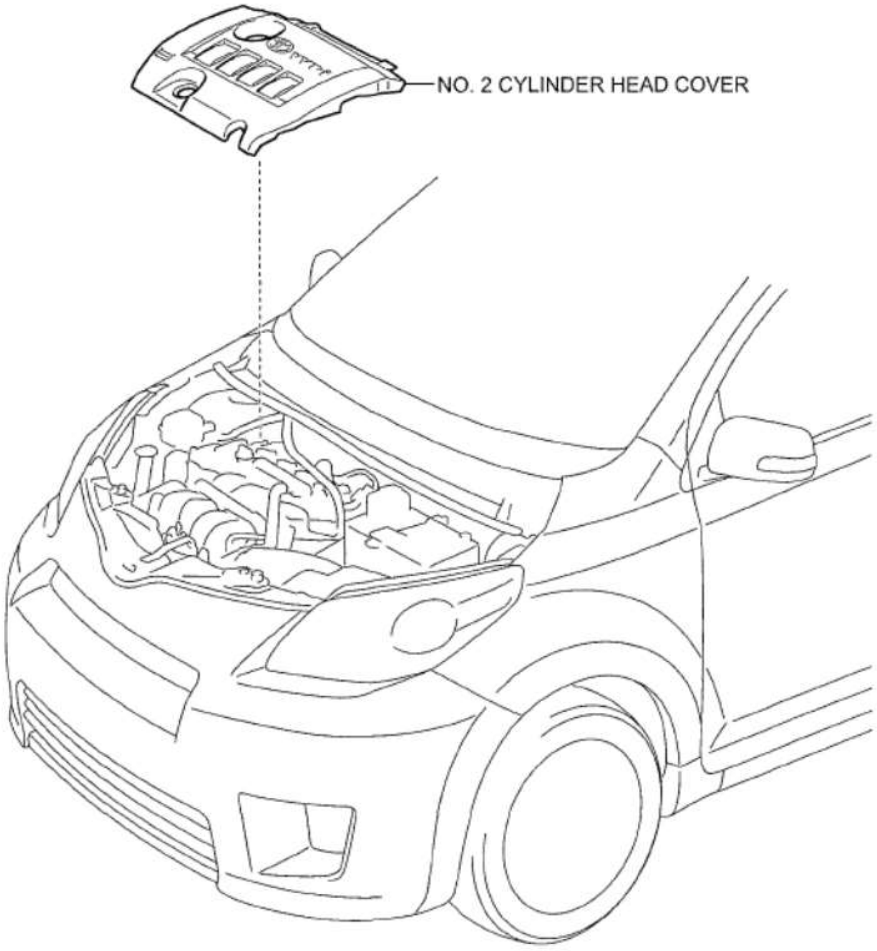


Fig. 345: Identifying Camshaft Position Sensor Components (1 Of 2)
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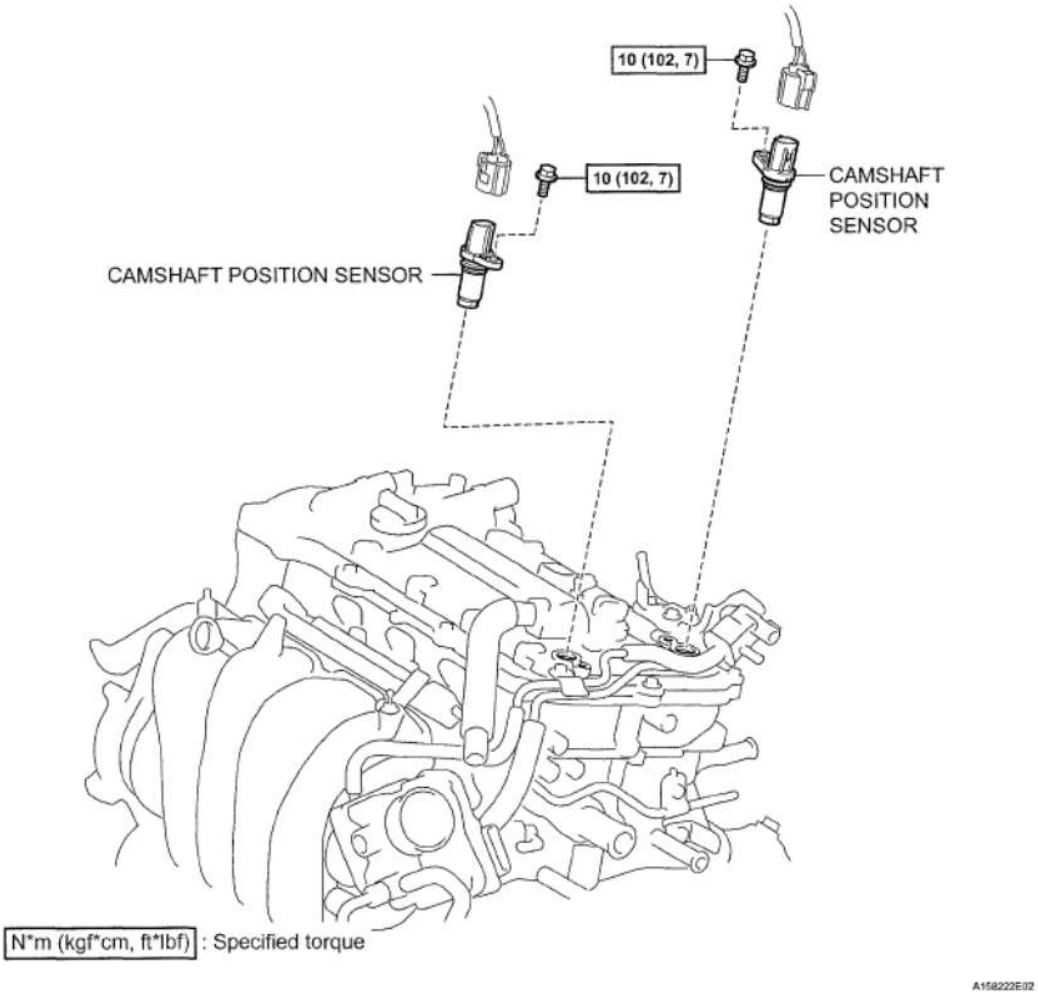


Fig. 346: Identifying Camshaft Position Sensor Components With Torque Specifications (2 Of 2)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

REMOVAL

1. **REMOVE NO. 2 CYLINDER HEAD COVER** (See **REMOVAL**)
2. **REMOVE CAMSHAFT POSITION SENSOR**
   a. Disconnect the duty vacuum switching valve connector and 3 engine wire harness clamps (for exhaust camshaft side).

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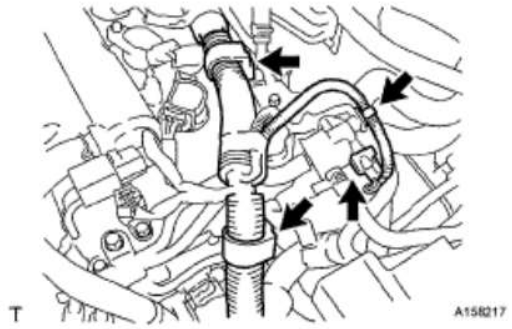


Fig. 347: Locating Engine Wire Harness Clamps (For Exhaust Camshaft Side)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. Remove the bolt and remove the camshaft position sensor (for exhaust camshaft side).

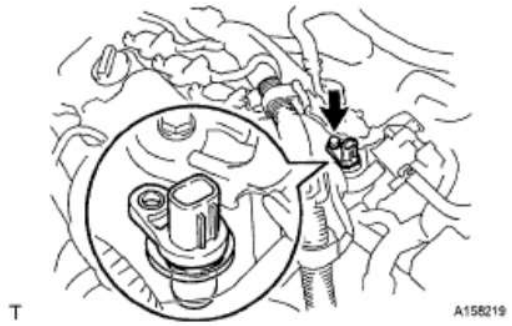


Fig. 348: Locating Camshaft Position Sensor Bolt (For Exhaust Camshaft Side)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

c. Remove the bolt and remove the camshaft position sensor (for intake camshaft side).

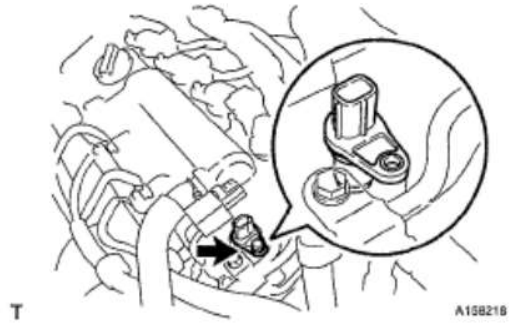


Fig. 349: Locating Camshaft Position Sensor Bolt (For Intake Camshaft Side)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSTALLATION

1. **INSTALL CAMSHAFT POSITION SENSOR**

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a. Apply a light coat of engine oil to the O-ring on the camshaft position sensor.

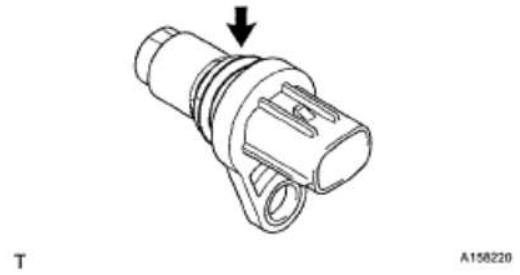


Fig. 350: Locating O-Ring On Camshaft Position Sensor
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. Install the camshaft position sensor with the bolt (for intake camshaft side).

Torque: 10 N*m (102 kgf*cm, 7 ft.*lbf)

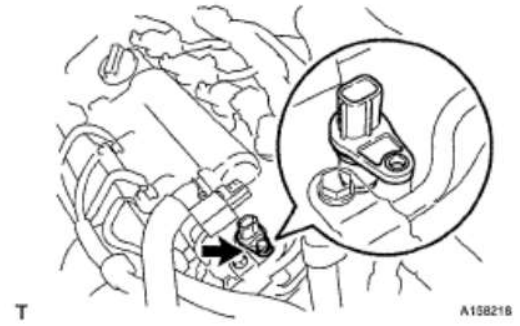


Fig. 351: Locating Camshaft Position Sensor Bolt (For Intake Camshaft Side)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

c. Install the camshaft position sensor with the bolt (for exhaust camshaft side).

Torque: 10 N*m (102 kgf*cm, 7 ft.*lbf)

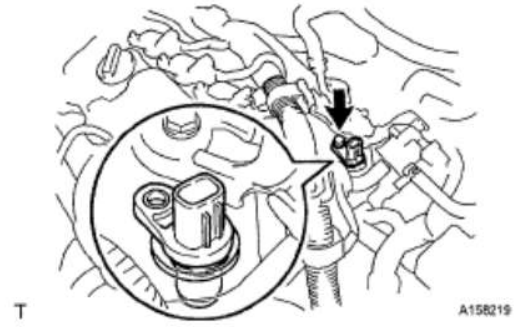


Fig. 352: Locating Camshaft Position Sensor Bolt (For Exhaust Camshaft Side)

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

d. Connect the 3 engine wire harness clamps and duty vacuum switching connector (for exhaust camshaft side).

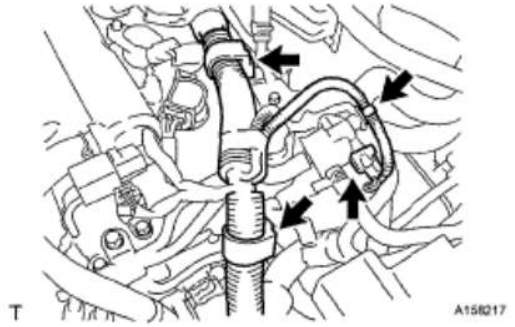


Fig. 353: Locating Engine Wire Harness Clamps (For Exhaust Camshaft Side)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

2. **INSPECT FOR OIL LEAK**
3. **INSTALL NO. 2 CYLINDER HEAD COVER** (See **INSTALLATION**)

CRANKSHAFT POSITION SENSOR

COMPONENTS

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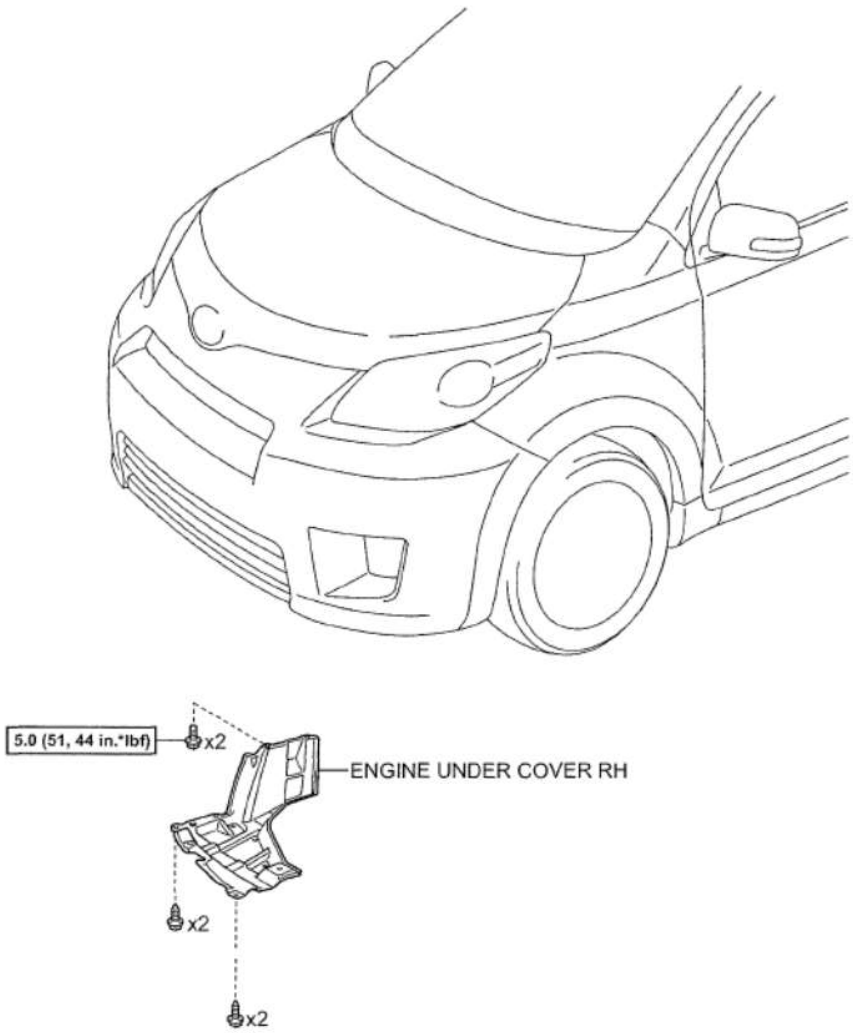
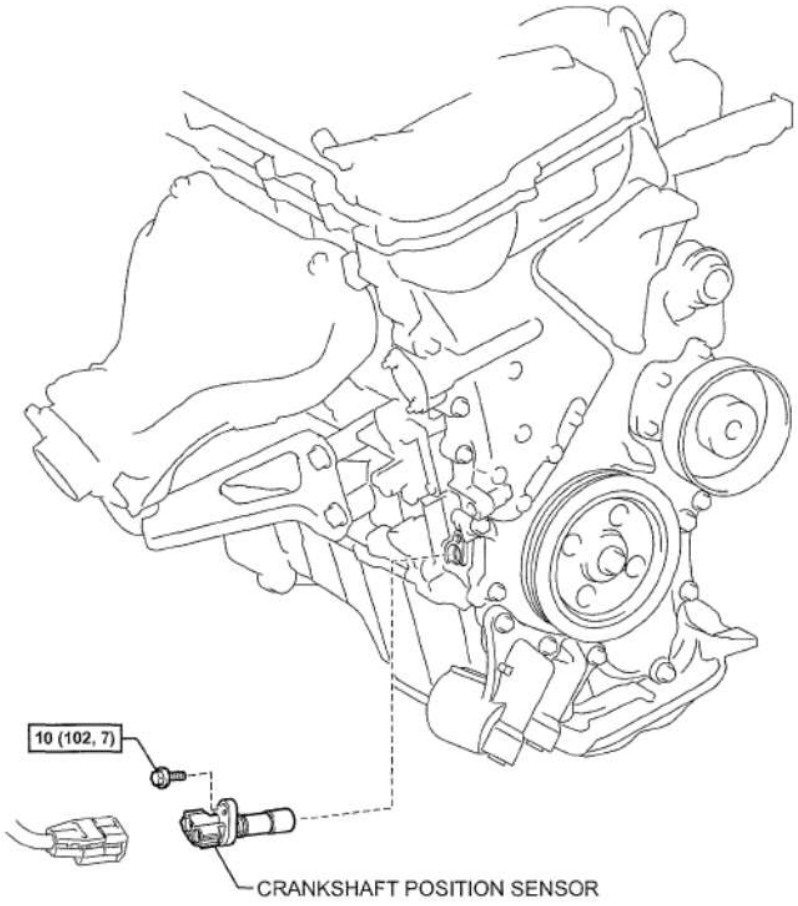


Fig. 354: Identifying Crankshaft Position Sensor Components With Torque Specification (1 Of 2)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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N*m (kgf*cm, ft*lbf) : Specified torque

T A158229E02

Fig. 355: Identifying Crankshaft Position Sensor Components With Torque Specification (2 Of 2)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

REMOVAL

1. **REMOVE ENGINE UNDER COVER RH**
2. **REMOVE CRANKSHAFT POSITION SENSOR**
   a. Disconnect the crankshaft position sensor connector.
   b. Remove the bolt and remove the crankshaft position sensor.

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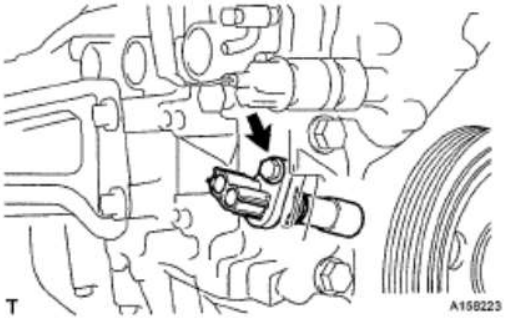


Fig. 356: Locating Crankshaft Position Sensor Bolt
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSPECTION

1. **INSPECT CRANKSHAFT POSITION SENSOR**
   a. Measure the resistance according to the value(s) in the table below.

Standard resistance

RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
1 - 2	20°C	1850 to 2450 ohms

HINT:

In the table above, the terms Cold and Hot refer to the temperature of the coils. Cold means approximately -10 to 50°C (14 to 122°F). Hot means approximately 50 to 100°C (122 to 212°F). If the resistance is not as specified, replace the crankshaft position sensor.

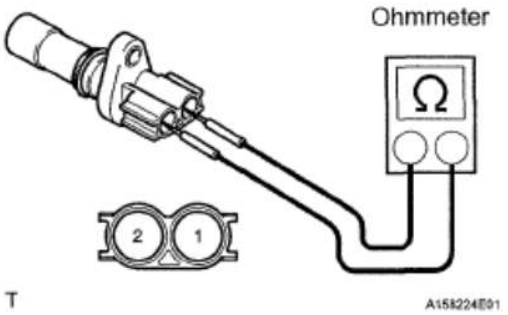


Fig. 357: Measuring Resistance Between Crankshaft Position Sensor Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSTALLATION

1. **INSTALL CRANKSHAFT POSITION SENSOR**

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a. Apply a light coat of engine oil to the O-ring on the crankshaft position sensor.

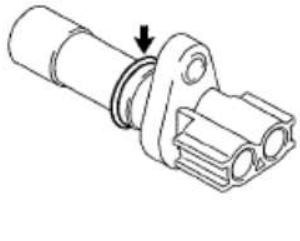


Fig. 358: Locating O-Ring On Crankshaft Position Sensor
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. Install the crankshaft position sensor with the bolt.

Torque: 10 N*m (102 kgf*cm, 7 ft.*lbf)

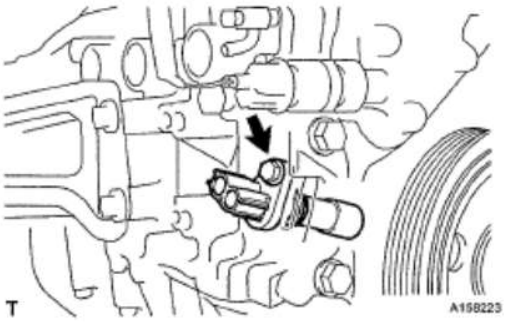


Fig. 359: Locating Crankshaft Position Sensor Bolt
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

c. Connect the crankshaft position sensor connector.

2. **INSPECT FOR OIL LEAK**
3. **INSTALL ENGINE UNDER COVER RH**

Torque: 5.0 N*m (51 kgf*cm, 44 in.*lbf)

ENGINE COOLANT TEMPERATURE SENSOR

COMPONENTS

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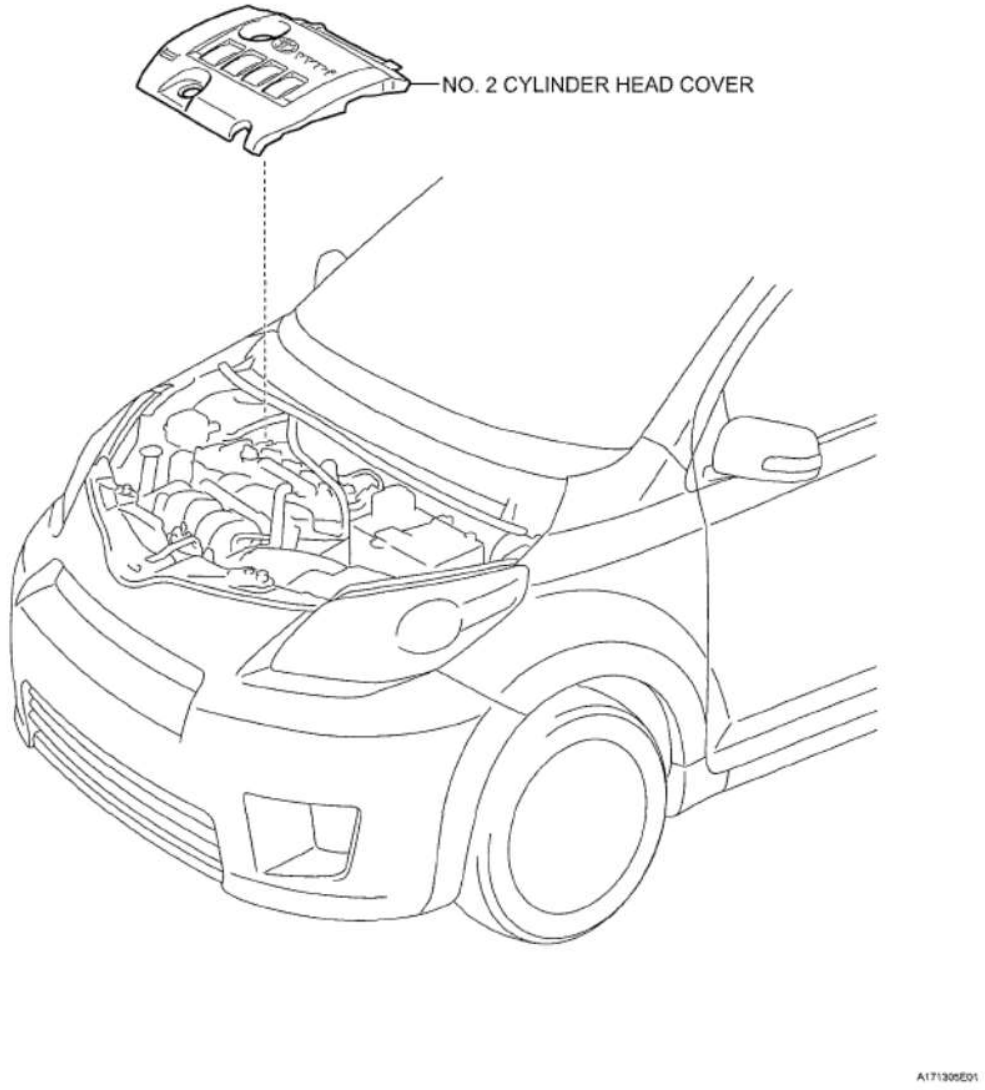


Fig. 360: Identifying Engine Coolant Temperature Sensor Components (1 Of 2)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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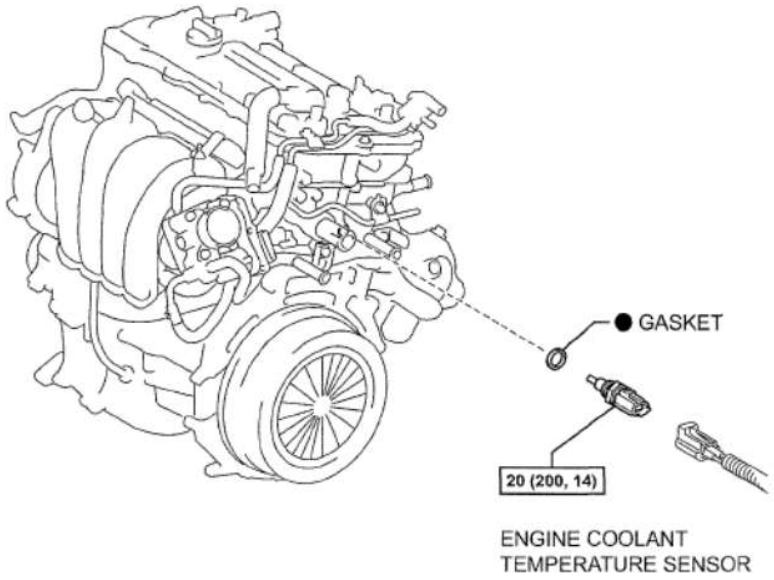


Fig. 361: Identifying Engine Coolant Temperature Sensor Components With Torque Specification (2 Of 2)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

REMOVAL

1. **DRAIN ENGINE COOLANT** (See **REPLACEMENT**)
2. **REMOVE NO. 2 CYLINDER HEAD COVER** (See **REMOVAL**)
3. **REMOVE ENGINE COOLANT TEMPERATURE SENSOR**
   a. Disconnect the engine coolant temperature sensor connector.
   b. Using SST, remove the engine coolant temperature sensor.

   SST 09817-33190

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Fig. 362: Removing Engine Coolant Temperature Sensor
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

RESISTANCE SPECIFICATION

Condition	Specified Condition
Approximately 20°C (68°F)	2.32 k to 2.59 kohms
Approximately 80°C (176°F)	0.310 k to 0.326 kohms

NOTE: When checking the engine coolant temperature sensor in water, keep the terminals dry. After the check, wipe the sensor dry.

If the resistance is not as specified, replace the engine coolant temperature sensor.

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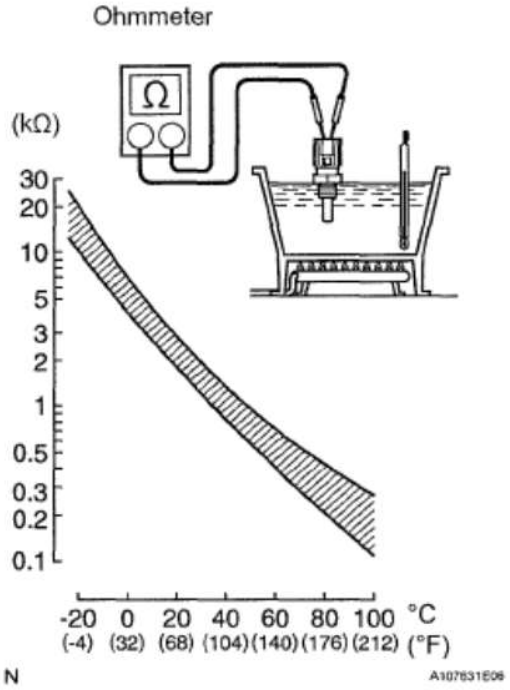


Fig. 363: Measuring Resistance Between Engine Coolant Temperature Sensor Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSTALLATION

1. **INSTALL ENGINE COOLANT TEMPERATURE SENSOR**
   a. Provisionally install the engine coolant temperature sensor through a new gasket.
   b. Using SST, tighten the engine coolant temperature sensor.

   SST 09817-33190

   Torque: 20 N*m (200 kgf*cm, 14 ft.*lbf)

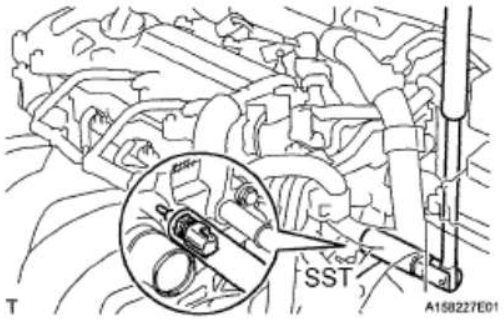


Fig. 364: Installing Engine Coolant Temperature Sensor
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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2. **ADD ENGINE COOLANT** (See **REPLACEMENT**)
3. **INSPECT FOR COOLANT LEAK** (See **ON-VEHICLE INSPECTION**)
4. **INSTALL NO. 2 CYLINDER HEAD COVER** (See **INSTALLATION**)

KNOCK SENSOR

COMPONENTS

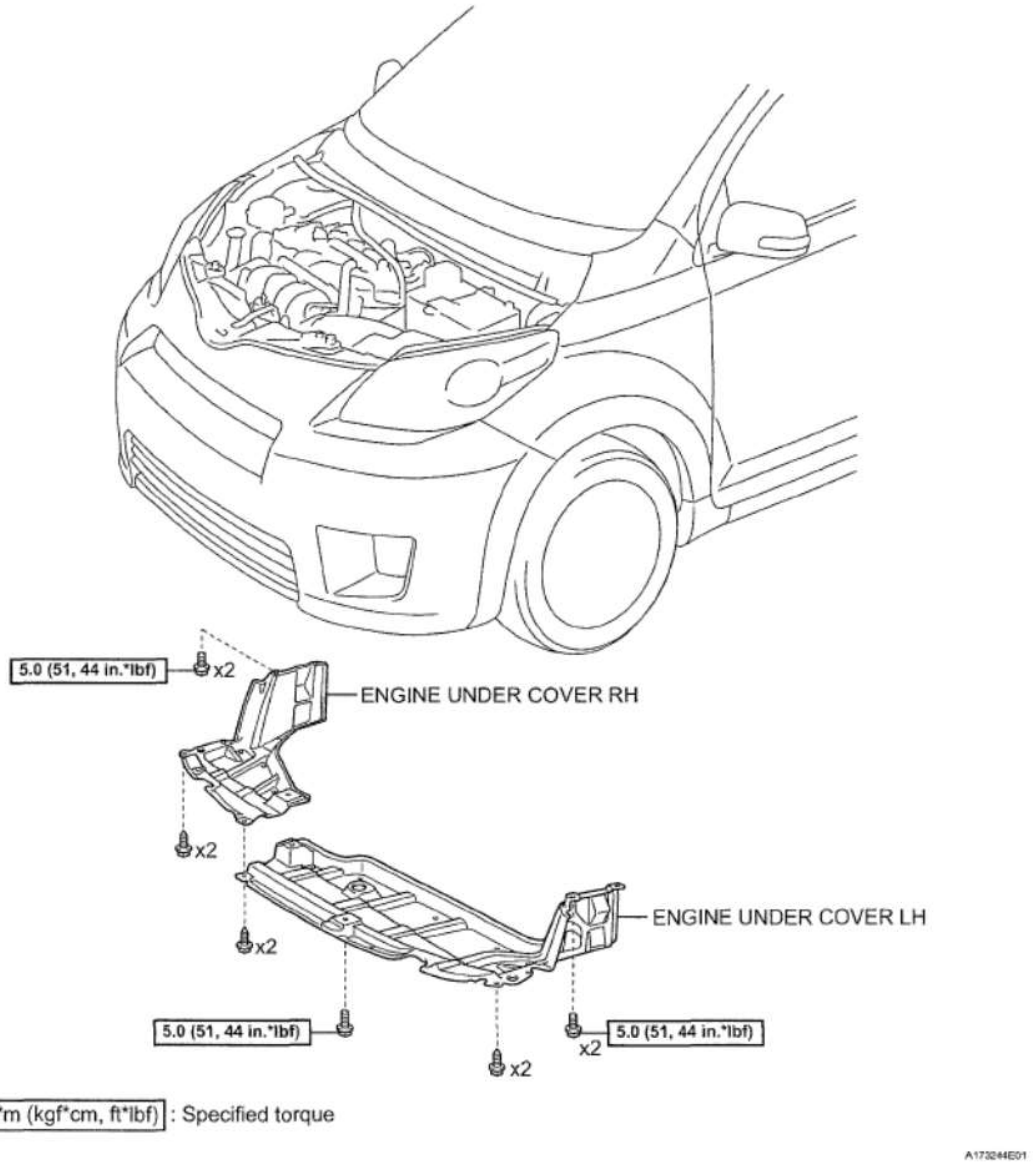


Fig. 365: Identifying Knock Sensor Components With Torque Specifications (1 Of 5)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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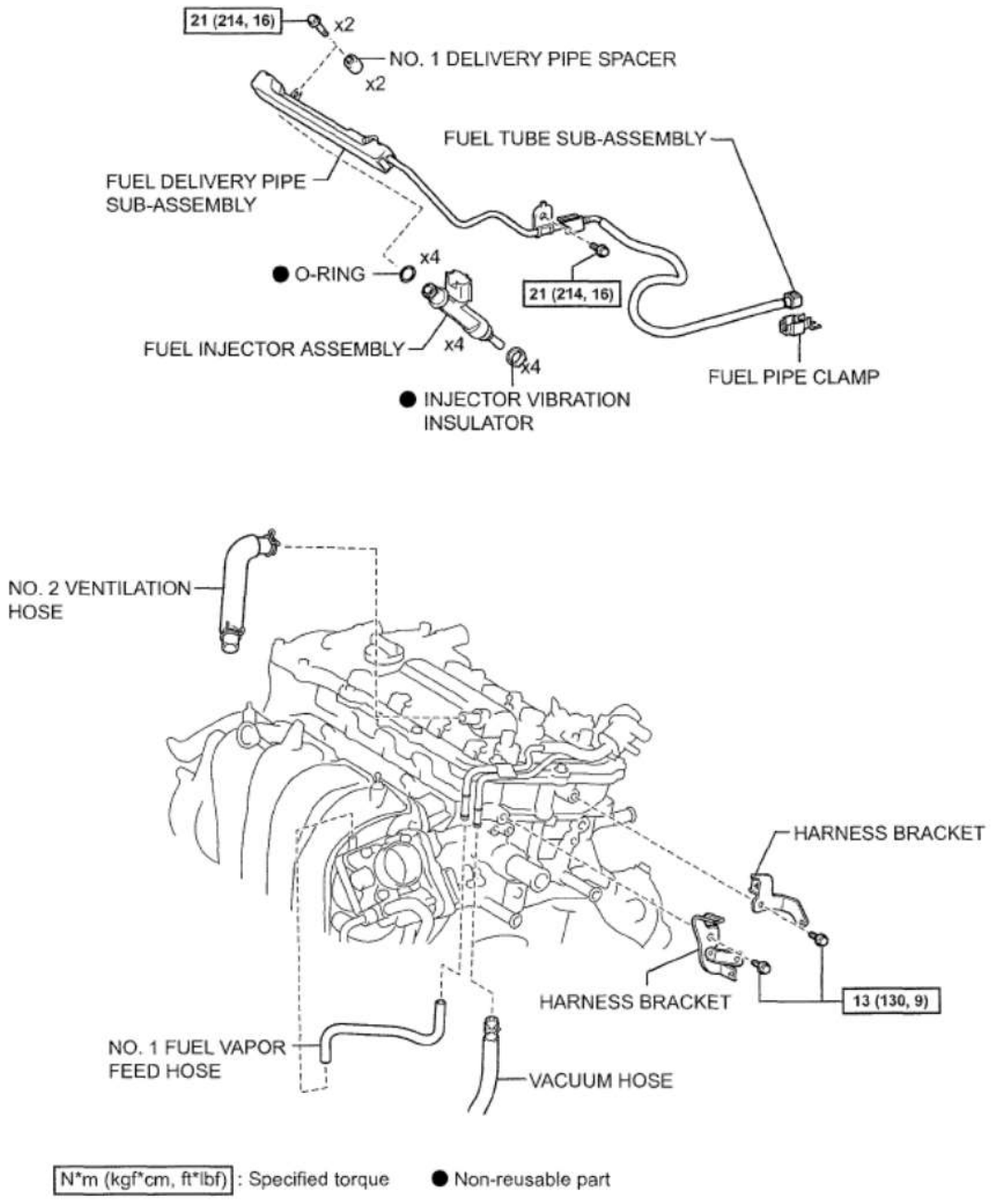


Fig. 366: Identifying Knock Sensor Components With Torque Specifications (2 Of 5)
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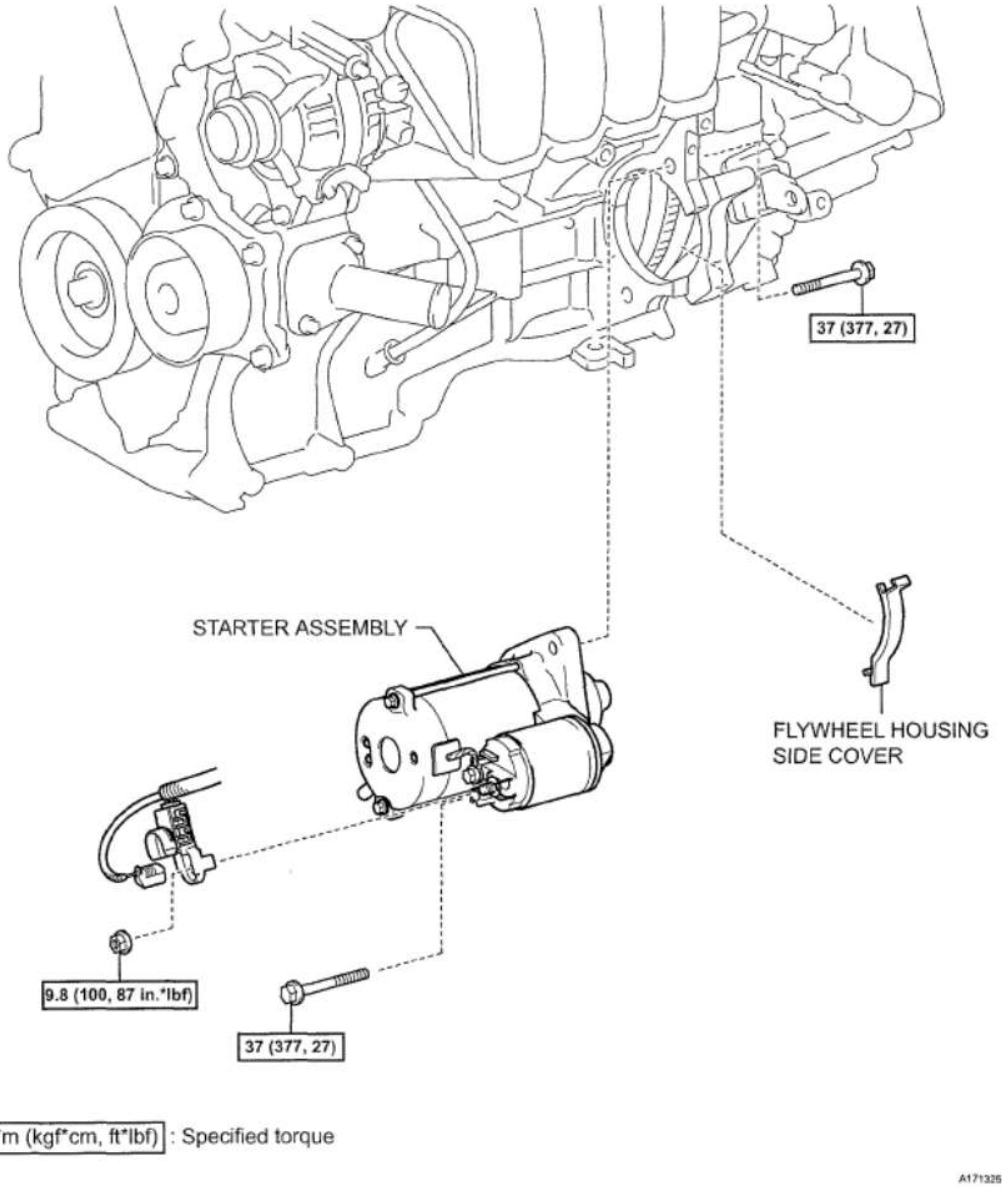


Fig. 367: Identifying Knock Sensor Components With Torque Specifications (3 Of 5)
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for Automatic Transaxle:

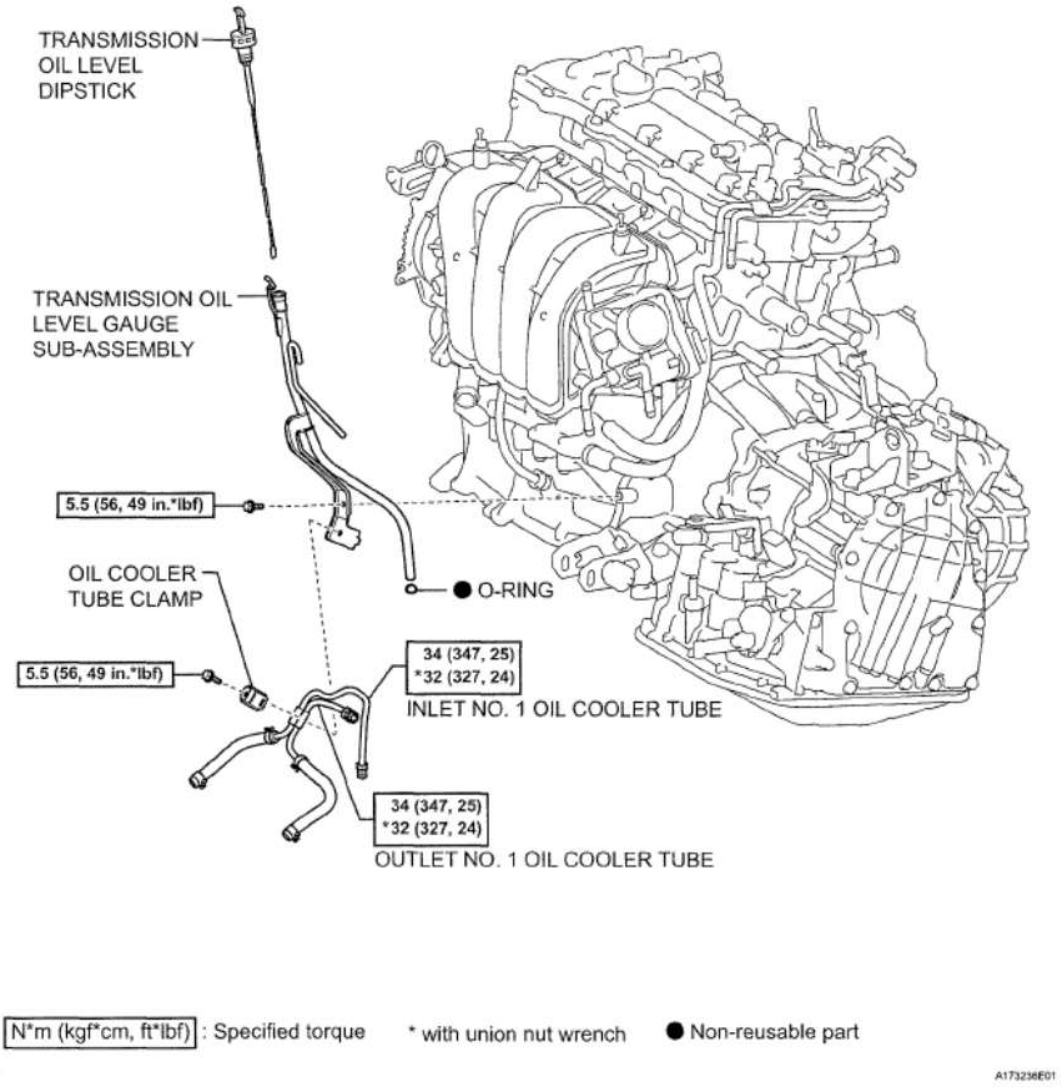


Fig. 368: Identifying Knock Sensor Components With Torque Specifications (4 Of 5)
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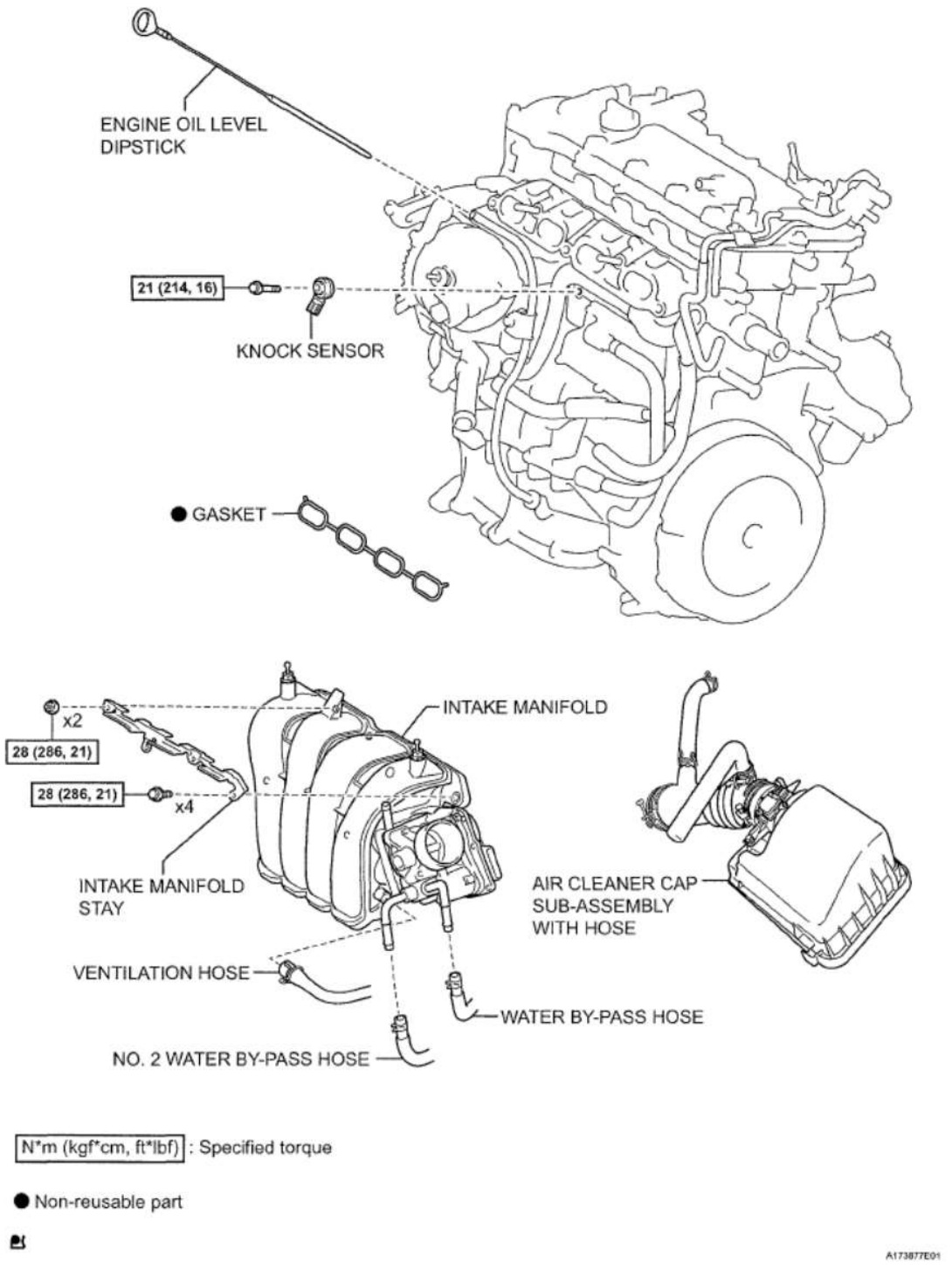


Fig. 369: Identifying Knock Sensor Components With Torque Specifications (5 Of 5)
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REMOVAL

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1. **DISCHARGE FUEL SYSTEM PRESSURE**

   (See **PRECAUTION**)

2. **DISCONNECT CABLE FROM NEGATIVE BATTERY TERMINAL**
3. **REMOVE ENGINE UNDER COVER LH**
4. **REMOVE ENGINE UNDER COVER RH**
5. **DRAIN ENGINE COOLANT** (See **REPLACEMENT**)
6. **REMOVE NO. 2 CYLINDER HEAD COVER** (See **REMOVAL**)
7. **REMOVE AIR CLEANER CAP SUB - ASSEMBLY WITH HOSE** (See **REMOVAL**)
8. **SEPARATE ENGINE WIRE HARNESS** (See **REMOVAL**)
9. **REMOVE HARNESS BRACKET** (See **REMOVAL**)
10. **DISCONNECT NO. 1 FUEL VAPOR FEED HOSE** (See **REMOVAL**)
11. **DISCONNECT VACUUM HOSE** (See **REMOVAL**)
12. **REMOVE FUEL PIPE CLAMP** (See **REMOVAL**)
13. **DISCONNECT FUEL TUBE SUB - ASSEMBLY** (See **REMOVAL**)
14. **REMOVE FUEL DELIVERY PIPE SUB - ASSEMBLY** (See **REMOVAL**)
15. **REMOVE NO. 1 DELIVERY PIPE SPACER** (See **REMOVAL**)
16. **REMOVE INJECTOR VIBRATION INSULATOR** (See **REMOVAL**)
17. **REMOVE STARTER ASSEMBLY** (See **REMOVAL**)
18. **REMOVE ENGINE OIL LEVEL DIPSTICK**
19. **REMOVE OIL COOLER TUBE (for Automatic Transaxle)** (See **REMOVAL**)
20. **REMOVE TRANSMISSION OIL LEVEL GAUGE SUB - ASSEMBLY (for Automatic Transaxle)** (See **REMOVAL**)
21. **REMOVE INTAKE MANIFOLD**
    a. Disconnect the 4 wire harness clamps.

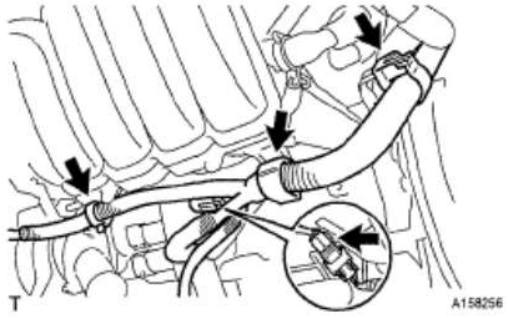


Fig. 370: Locating Wire Harness Clamps
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

    b. Disconnect the ventilation hose.

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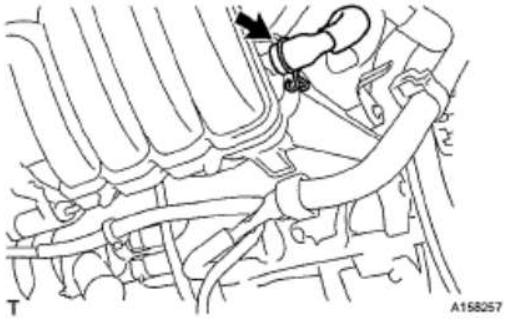


Fig. 371: Locating Ventilation Hose
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

c. Disconnect the throttle body connector.

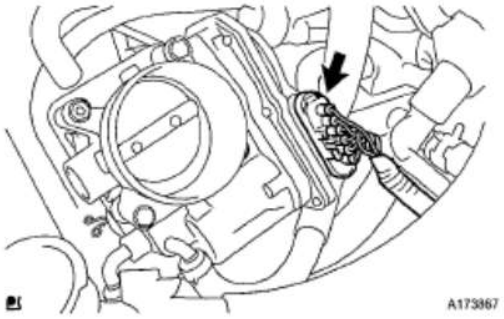


Fig. 372: Locating Throttle Body Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

d. Disconnect the water by-pass hose and No. 2 water by-pass hose.

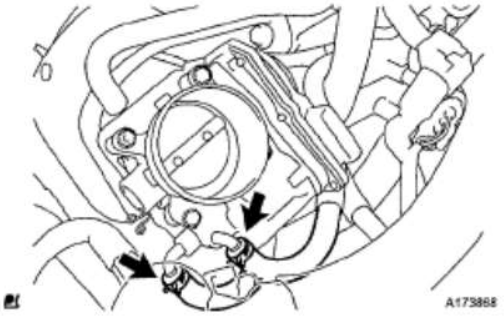


Fig. 373: Locating Water By-Pass Hoses
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

e. Remove the 4 bolts and 2 nuts and remove the intake manifold and intake manifold stay.

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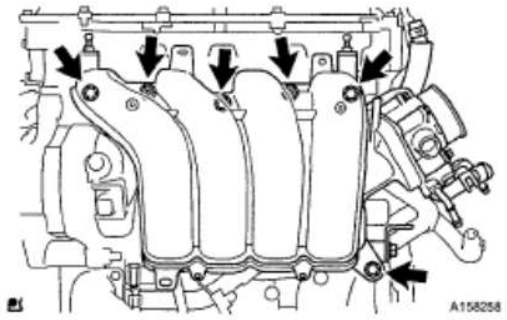


Fig. 374: Locating Intake Manifold Bolts And Nuts
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

22. **REMOVE KNOCK SENSOR**
    a. Disconnect the knock sensor connector.

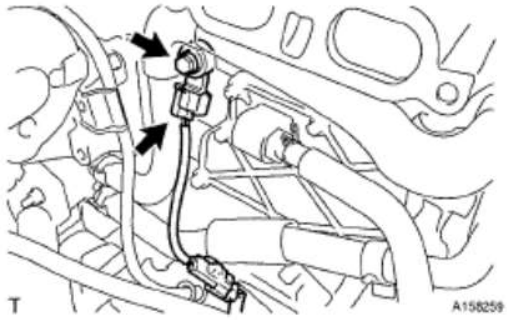


Fig. 375: Locating Knock Sensor Bolt And Knock Sensor Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

    b. Remove the bolt and remove the knock sensor.

INSPECTION

1. **INSPECT KNOCK SENSOR**
    a. Measure the resistance according to the value(s) in the table below.

Standard resistance

RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
1 - 2	20°C (68°F)	120 to 280 kohms

If the result is not as specified, replace the knock sensor.

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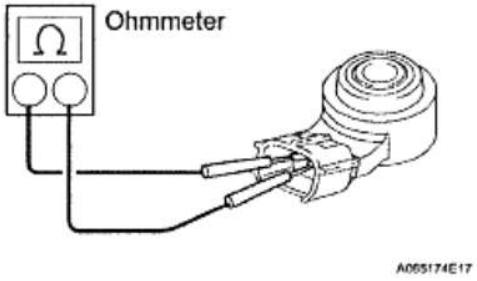


Fig. 376: Measuring Resistance Between Knock Sensor Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSTALLATION

1. **INSTALL KNOCK SENSOR**
   a. Install the knock sensor with the bolt as shown in the illustration.

   Torque: 21 N*m (214 kgf*cm, 16 ft.*lbf)

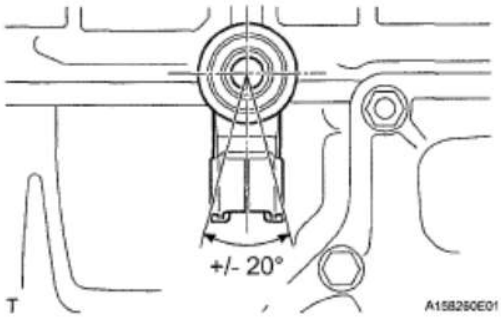


Fig. 377: Installing Knock Sensor
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

   b. Connect the knock sensor connector.

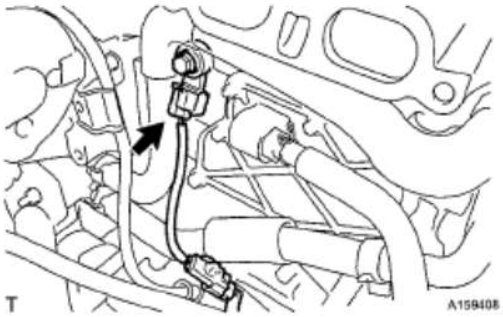


Fig. 378: Locating Knock Sensor Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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2. **INSTALL INTAKE MANIFOLD**
   a. Install a new gasket onto the intake manifold.
   b. Install the intake manifold and intake manifold stay with the 4 bolts and 2 nuts.

Torque: 28 N*m (286 kgf*cm, 21 ft.*lbf)

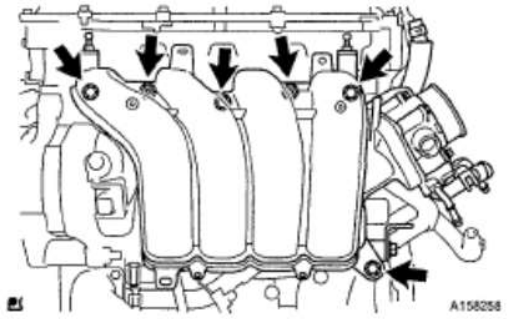


Fig. 379: Locating Intake Manifold Bolts And Nuts
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

   c. Connect the water by-pass hose and the No. 2 water by-pass hose.

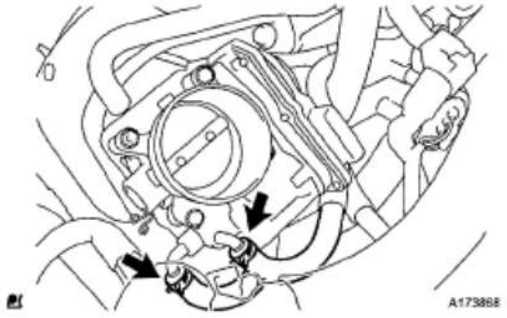
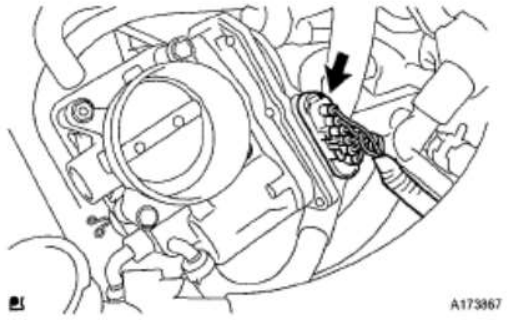


Fig. 380: Locating Water By-Pass Hoses
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

   d. Connect the throttle body assembly connector.



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Fig. 381: Locating Throttle Body Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

e. Connect the ventilation hose.

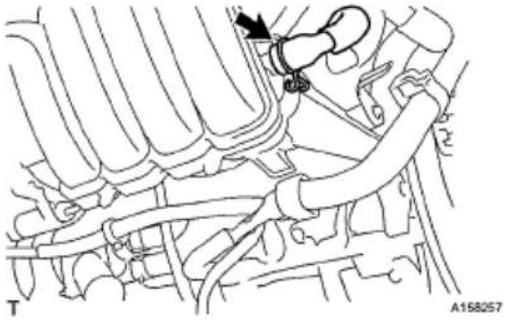


Fig. 382: Locating Ventilation Hose
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

f. Connect the 4 wire harness clamps.

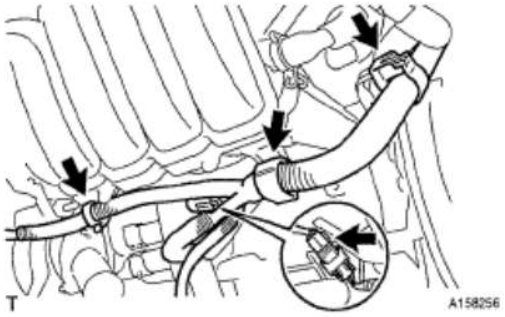


Fig. 383: Locating Wire Harness Clamps
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

3. **INSTALL TRANSMISSION OIL LEVEL GAUGE SUB - ASSEMBLY (for Automatic Transaxle)** (See **INSTALLATION**)
4. **INSTALL OIL COOLER TUBE (for Automatic Transaxle)** (See **INSTALLATION**)
5. **INSTALL ENGINE OIL LEVEL DIPSTICK**
6. **INSTALL STARTER ASSEMBLY** (See **INSTALLATION**)
7. **INSTALL INJECTOR VIBRATION INSULATOR** (See **INSTALLATION**)
8. **INSTALL NO. 1 DELIVERY PIPE SPACER** (See **INSTALLATION**)
9. **INSTALL FUEL DELIVERY PIPE SUB - ASSEMBLY** (See **INSTALLATION**)
10. **CONNECT FUEL TUBE SUB - ASSEMBLY** (See **INSTALLATION**)
11. **INSTALL FUEL PIPE CLAMP** (See **INSTALLATION**)
12. **CONNECT VACUUM HOSE** (See **INSTALLATION**)

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13. **CONNECT NO. 1 FUEL VAPOR FEED HOSE** (See **INSTALLATION**)
14. **INSTALL HARNESS BRACKET** (See **INSTALLATION**)
15. **INSTALL ENGINE WIRE HARNESS** (See **INSTALLATION**)
16. **INSTALL AIR CLEANER CAP SUB - ASSEMBLY WITH HOSE** (See **INSTALLATION**)
17. **CONNECT CABLE TO NEGATIVE BATTERY TERMINAL**

    Torque: 5.4 N*m (55 kgf*cm, 48 in.*lbf)

18. **ADD ENGINE COOLANT** (See **REPLACEMENT**)
19. **INSPECT FOR COOLANT LEAK** (See **ON-VEHICLE INSPECTION**)
20. **INSPECT FOR FUEL LEAK**

    (See **PRECAUTION**)

21. **INSTALL NO. 2 CYLINDER HEAD COVER** (See **INSTALLATION**)
22. **INSTALL ENGINE UNDER COVER RH**

    Torque: 5.0 N*m (51 kgf*cm, 44 in.*lbf)

23. **INSTALL ENGINE UNDER COVER LH**

    Torque: 5.0 N*m (51 kgf*cm, 44 in.*lbf)

AIR FUEL RATIO SENSOR

COMPONENTS

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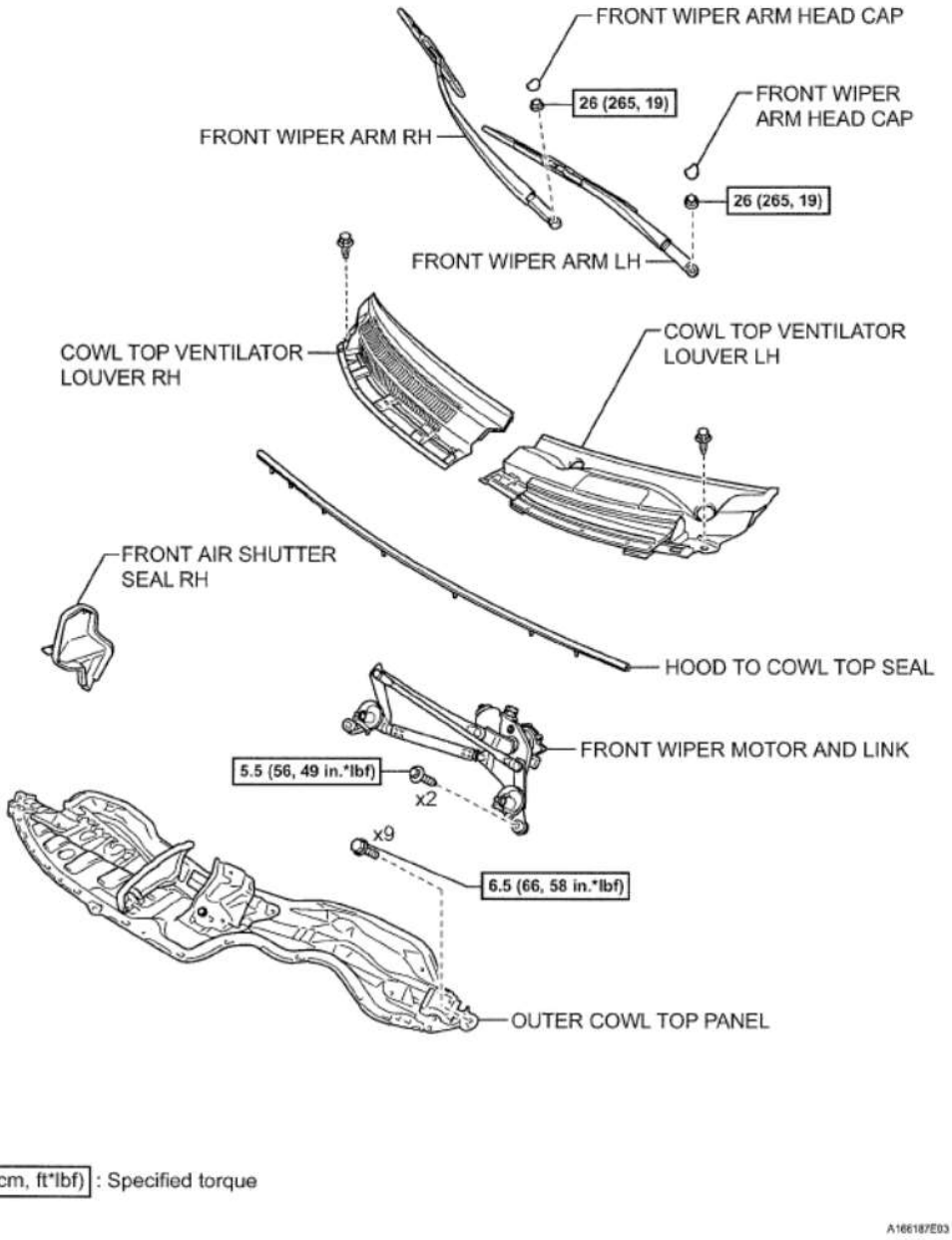


Fig. 384: Identifying Air Fuel Ratio Sensor Components With Torque Specifications (1 Of 2)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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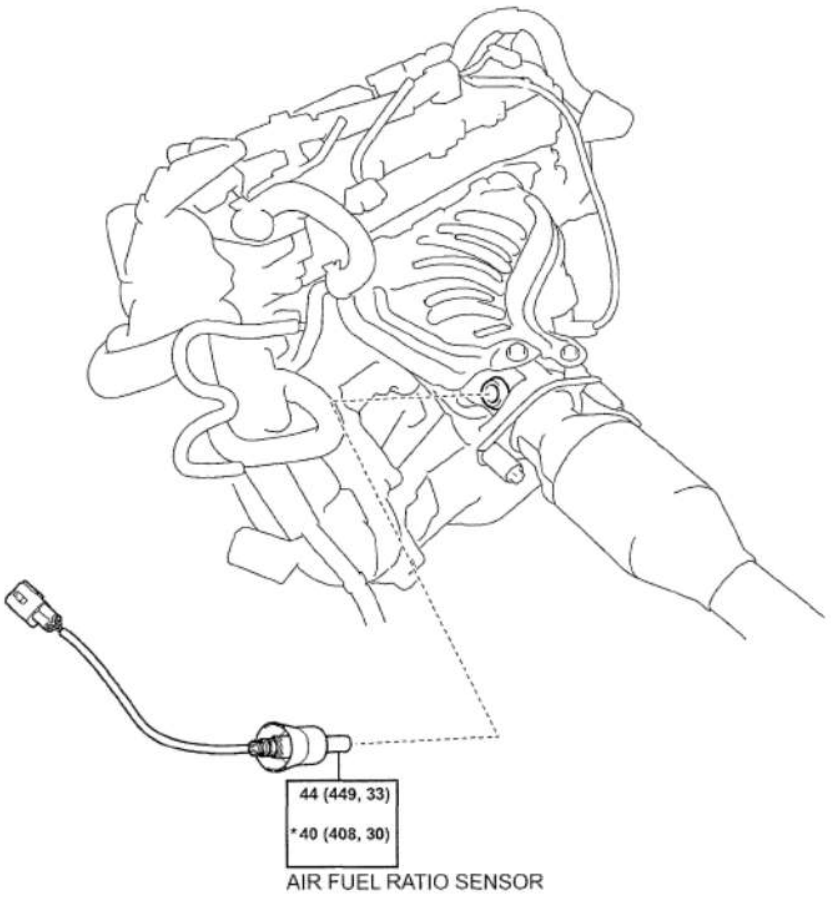


Fig. 385: Identifying Air Fuel Ratio Sensor Components With Torque Specification (2 Of 2)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

REMOVAL

1. **REMOVE FRONT WIPER ARM HEAD CAP** (See **REMOVAL**)
2. **REMOVE FRONT WIPER ARM AND BLADE ASSEMBLY LH** (See **REMOVAL**)
3. **REMOVE FRONT WIPER ARM AND BLADE ASSEMBLY RH** (See **REMOVAL**)
4. **REMOVE HOOD TO COWL TOP SEAL** (See **REMOVAL**)
5. **REMOVE COWL TOP VENTILATOR LOUVER RH** (See **REMOVAL**)
6. **REMOVE COWL TOP VENTILATOR LOUVER LH** (See **REMOVAL**)
7. **REMOVE FRONT WIPER MOTOR AND LINK** (See **REMOVAL**)
8. **REMOVE FRONT AIR SHUTTER SEAL RH** (See **REMOVAL**)
9. **REMOVE COWL TOP PANEL OUTER** (See **REMOVAL**)

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10. **REMOVE NO. 2 CYLINDER HEAD COVER** (See **REMOVAL**)
11. **REMOVE AIR FUEL RATIO SENSOR**
    a. Disconnect the air fuel ratio sensor connector and clamp.

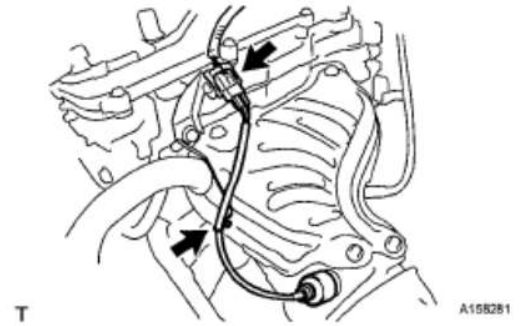


Fig. 386: Locating Air Fuel Ratio Sensor Connector And Clamp
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

    b. Using SST, remove the air fuel ratio sensor.

SST 09224-00010

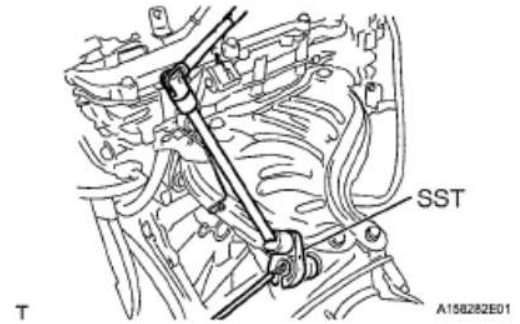


Fig. 387: Removing Air Fuel Ratio Sensor
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSPECTION

1. **INSPECT AIR FUEL RATIO SENSOR**
    a. Measure the resistance according to the value(s) in the table below.

Standard resistance

RESISTANCE SPECIFICATION

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

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If the result is not as specified, replace the air fuel ratio sensor.

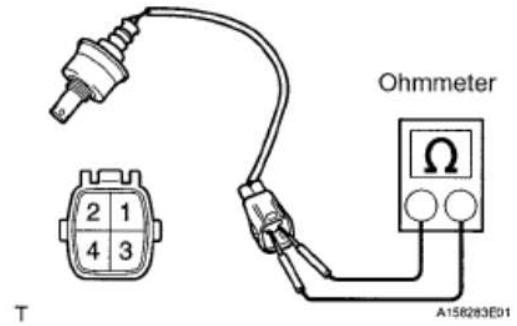


Fig. 388: Measuring Resistance Between Air Fuel Ratio Sensor Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSTALLATION

1. **INSTALL AIR FUEL RATIO SENSOR**
   a. Using SST, install the air fuel ratio sensor.

SST 09224-00010

Torque: without SST

44 N*m (449 kgf*cm, 33 ft.*lbf)

with SST

40 N*m (408 kgf*cm, 30 ft.*lbf)

NOTE:

- **This torque value is effective when SST is parallel to the torque wrench.**
- **This torque value can be obtained by using a torque wrench with a fulcrum length of 300 mm (11.81 in.) and SST of 30 mm (1.18 in.) (See REPAIR INSTRUCTION).**
- **Use a torque wrench with a fulcrum length of 300 mm (11.81 in.).**

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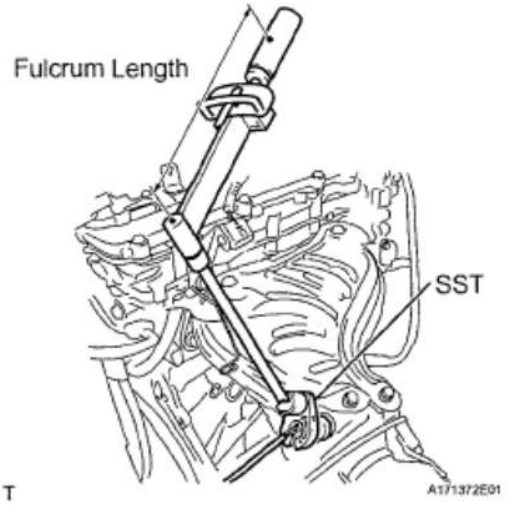


Fig. 389: Installing Air Fuel Ratio Sensor
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. Connect the air fuel ratio sensor connector and clamp.

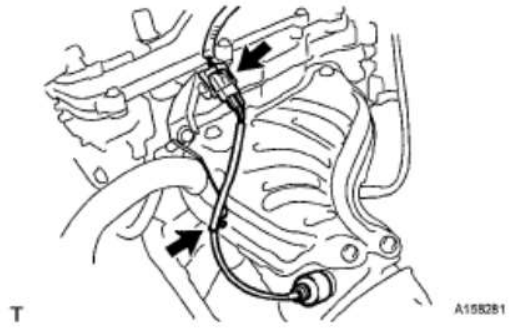


Fig. 390: Locating Air Fuel Ratio Sensor Connector And Clamp
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

2. **INSTALL NO. 2 CYLINDER HEAD COVER** (See **INSTALLATION**)
3. **INSTALL COWL TOP PANEL OUTER** (See **INSTALLATION**)
4. **INSTALL FRONT AIR SHUTTER SEAL RH** (See **INSTALLATION**)
5. **INSTALL WINDSHIELD WIPER MOTOR AND LINK** (See **INSTALLATION**)
6. **INSTALL COWL TOP VENTILATOR LOUVER LH** (See **INSTALLATION**)
7. **INSTALL COWL TOP VENTILATOR LOUVER RH** (See **INSTALLATION**)
8. **INSTALL HOOD TO COWL TOP SEAL** (See **INSTALLATION**)
9. **INSTALL FRONT WIPER ARM AND BLADE ASSEMBLY LH** (See **INSTALLATION**)
10. **INSTALL FRONT WIPER ARM AND BLADE ASSEMBLY RH** (See **INSTALLATION**)
11. **INSTALL FRONT WIPER ARM HEAD CAP** (See **INSTALLATION**)

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12. **INSPECT FOR EXHAUST GAS LEAK**

HEATED OXYGEN SENSOR

COMPONENTS

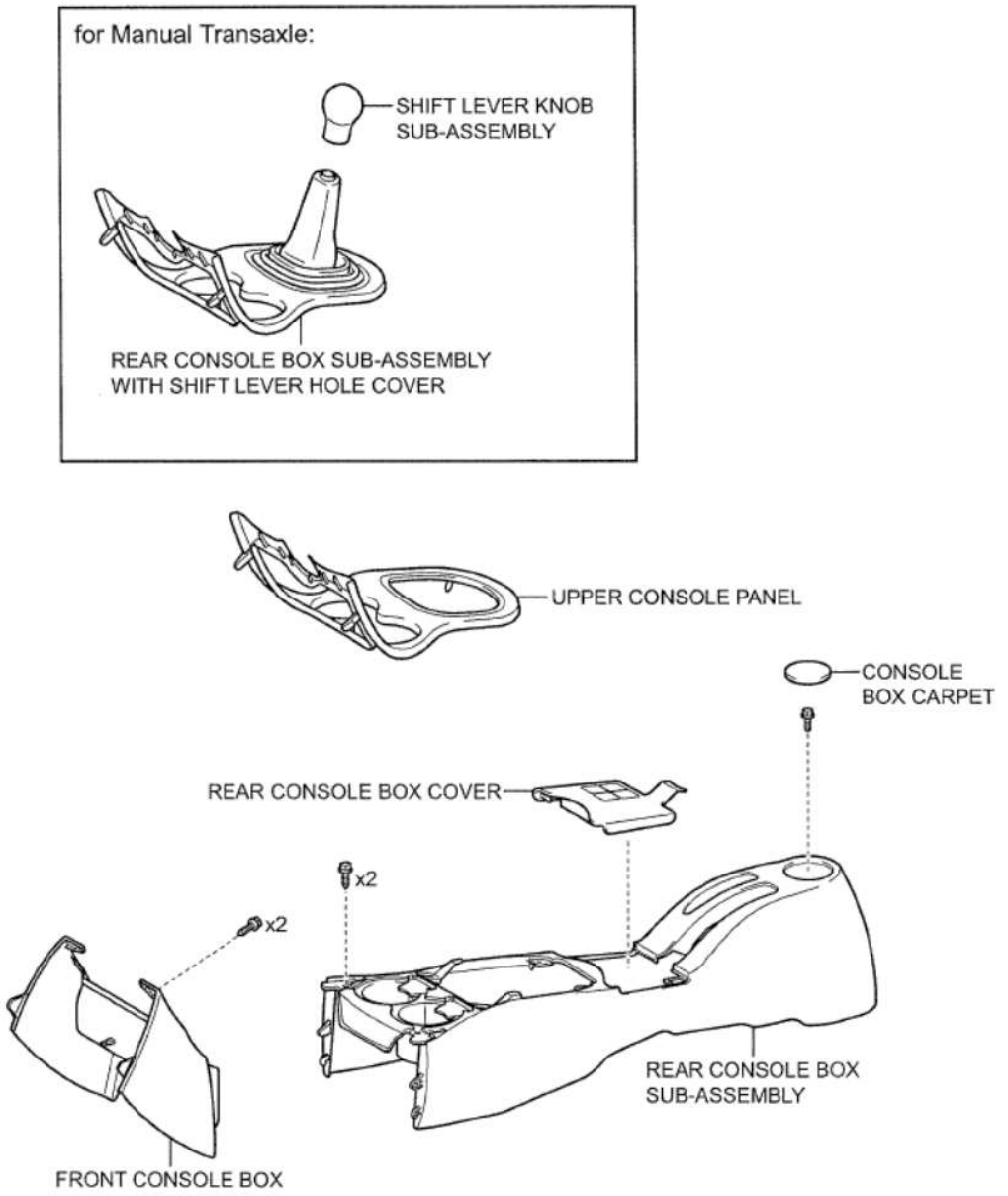
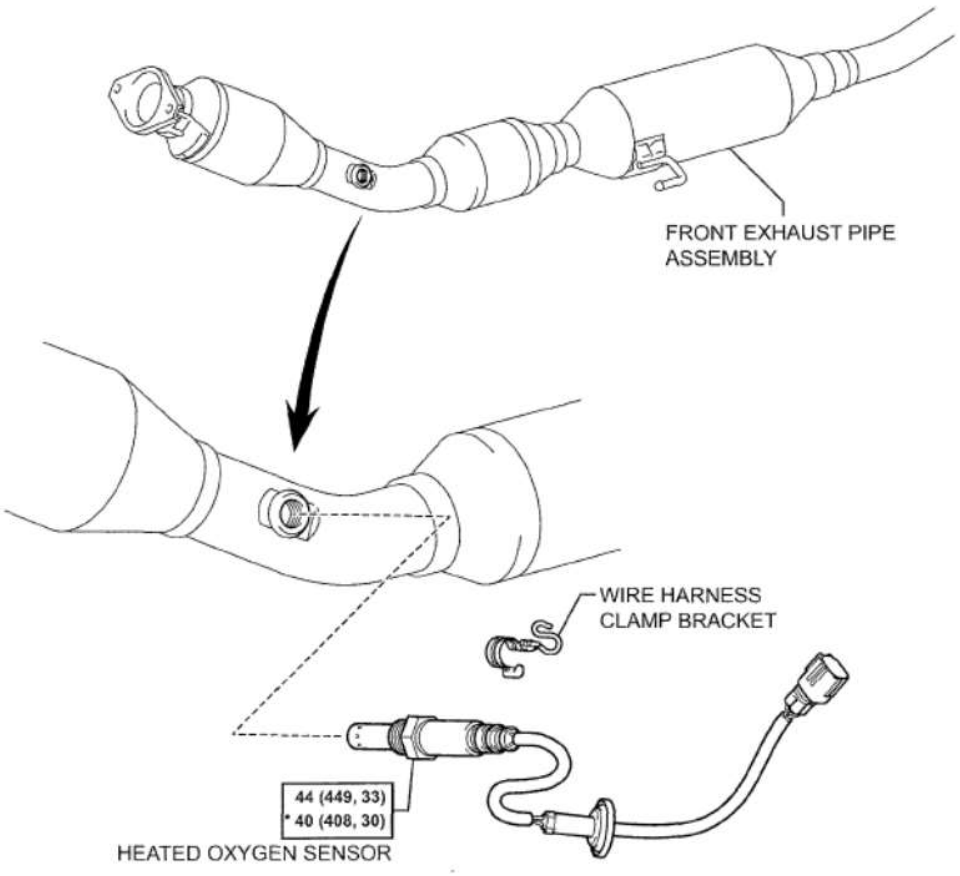


Fig. 391: Identifying Heated Oxygen Sensor Components (1 Of 2)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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N*m (kgf*cm, ft*lbf) : Specified torque * For use with SST

T A171355E01

Fig. 392: Identifying Heated Oxygen Sensor Components With Torque Specification (2 Of 2)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

REMOVAL

1. **REMOVE SHIFT LEVER KNOB SUB - ASSEMBLY (for Manual Transaxle)** (See **REMOVAL**)
2. **REMOVE UPPER CONSOLE PANEL** (See **REMOVAL**)
3. **REMOVE REAR CONSOLE BOX COVER** (See **REMOVAL**)
4. **REMOVE CONSOLE BOX CARPET** (See **REMOVAL**)
5. **REMOVE REAR CONSOLE BOX SUB - ASSEMBLY** (See **REMOVAL**)
6. **REMOVE FRONT CONSOLE BOX** (See **REMOVAL**)
7. **REMOVE HEATED OXYGEN SENSOR**
   a. Disconnect the heated oxygen sensor connector.

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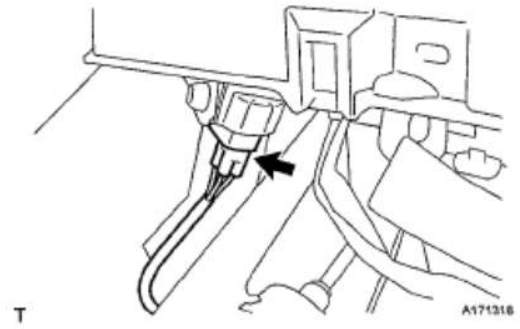


Fig. 393: Locating Heated Oxygen Sensor Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. Remove the grommet and pull the sensor connector out of the cabin through the floor panel.
c. Remove the wire harness clamp bracket.

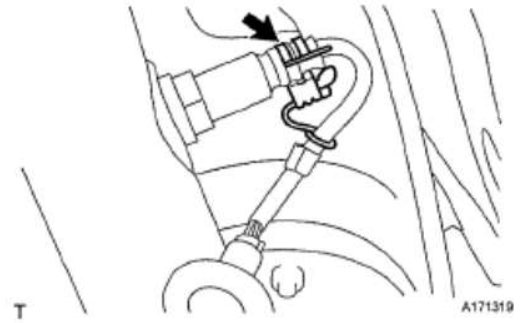


Fig. 394: Locating Wire Harness Clamp Bracket
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

d. Using SST, remove heated oxygen sensor.

SST 09224-00010

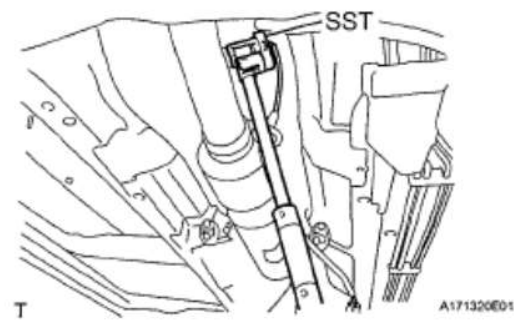


Fig. 395: Removing Heated Oxygen Sensor
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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INSPECTION

1. **INSPECT HEATED OXYGEN SENSOR**
   a. Measure the resistance according to the value(s) in the table below.

Standard resistance

RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
2 (HT) - 4 (+B)	20°C (68°F)	11 to 16 ohms
2 (HT) - 3 (E)	Always	10 kohms or higher

If the result is not as specified, replace the heated oxygen sensor.

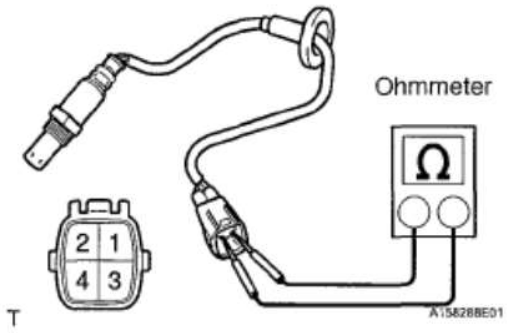


Fig. 396: Measuring Resistance Between Heated Oxygen Sensor Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSTALLATION

1. **INSTALL HEATED OXYGEN SENSOR**
   a. Using SST, install the heated oxygen sensor onto the front exhaust pipe.

SST 09224-00010

Torque: without SST

44 N*m (449 kgf*cm, 33 ft.*lbf)

with SST

40 N*m (408 kgf*cm, 30 ft.*lbf)

NOTE:

- **This torque value can be obtained by using a torque wrench with a fulcrum length of 300 mm (11.81 in.) and SST of 30 mm (1.18 in.) (See REPAIR INSTRUCTION).**

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- **This torque value is effective when SST is parallel to the torque wrench.**

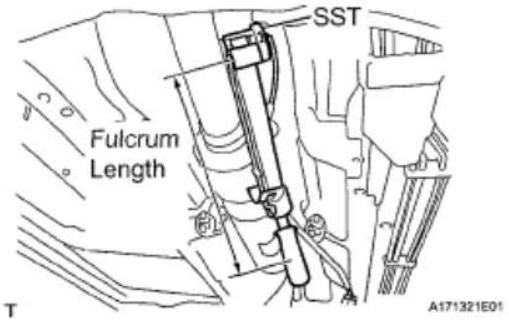


Fig. 397: Installing Heated Oxygen Sensor
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. Pass the sensor connector through the floor panel and install the grommet.
c. Install the wire harness clamp bracket.

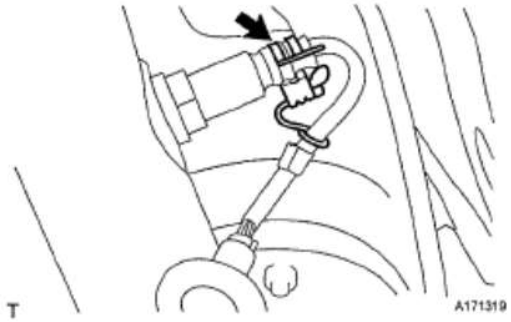


Fig. 398: Locating Wire Harness Clamp Bracket
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

d. Connect the heated oxygen sensor connector.

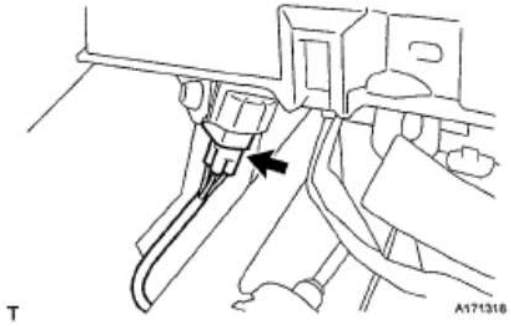


Fig. 399: Locating Heated Oxygen Sensor Connector

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2. **INSPECT FOR EXHAUST GAS LEAK**
3. **INSTALL FRONT CONSOLE BOX** (See **INSTALLATION**)
4. **INSTALL REAR CONSOLE BOX SUB - ASSEMBLY** (See **INSTALLATION**)
5. **INSTALL CONSOLE BOX CARPET** (See **INSTALLATION**)
6. **INSTALL REAR CONSOLE BOX COVER** (See **INSTALLATION**)
7. **INSTALL UPPER CONSOLE PANEL** (See **INSTALLATION**)
8. **INSTALL SHIFT LEVER KNOB SUB - ASSEMBLY (for Manual Transaxle)** (See **INSTALLATION**)

INTEGRATION RELAY

COMPONENTS

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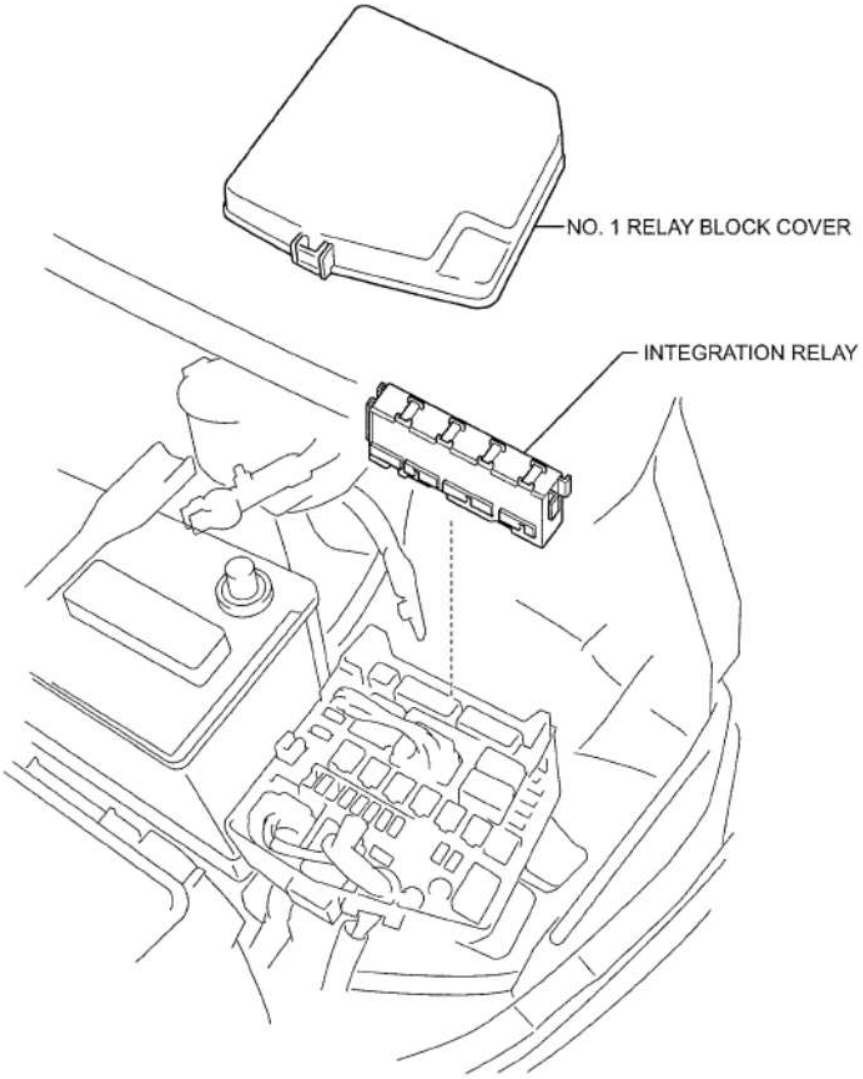


Fig. 400: Identifying Integration Relay Components
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

REMOVAL

1. **REMOVE NO. 1 RELAY BLOCK COVER**
2. **REMOVE INTEGRATION RELAY**
   a. Using a screwdriver with its tip wrapped in protective tape, disengage the 2 claws and disconnect the integration relay.

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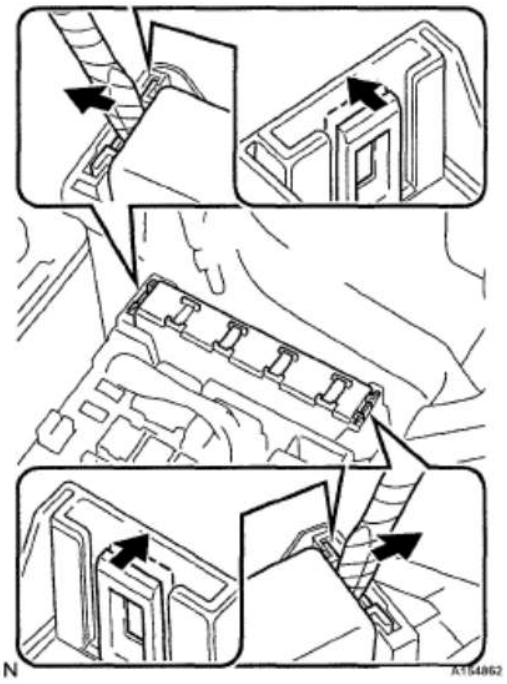


Fig. 401: Removing Integration Relay
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. Disconnect the 3 connectors.

INSPECTION

1. **INSPECT INTEGRATION RELAY**
   a. Inspect the EFI fuse.
      1. Disconnect the fuse.
      2. Using an ohmmeter, measure the resistance of the fuse.

         Standard resistance

         RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
EFI fuse	Always	Below 1 ohms

   b. Inspect the EFI relay.
      1. Measure the resistance according to the value(s) in the table below.

         Standard resistance

         RESISTANCE SPECIFICATION

Tester		Specified

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Connection	Condition	Condition
A1 - C1	When battery voltage absent	Below 1 ohms
A1 - A4	When battery voltage absent	10 kohms or higher
A4 - C1	When battery voltage absent	10 kohms or higher
A1 - A4	Apply battery voltage between terminals A2 and A3	Below 1 ohms
A4 - C1	Apply battery voltage between terminals A2 and A3	Below 1 ohms

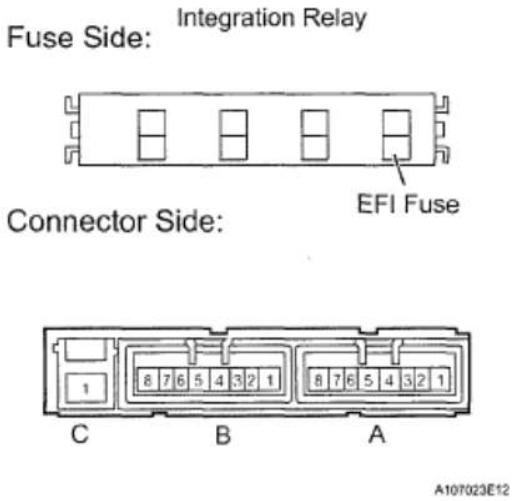


Fig. 402: Identifying Integration Relay Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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.

c. Inspect the cooling fan relay.
   1. Measure the resistance according to the value(s) in the table below.

Standard resistance

RESISTANCE SPECIFICATION

Tester Connection	Condition	Resistance
B5-B8	When battery voltage absent	10 kohms or higher
	When battery voltage applied to terminals B6 and B7	Below 1 ohms

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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.

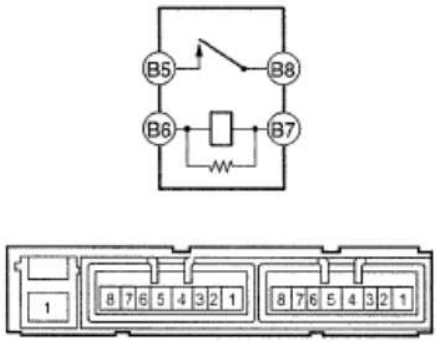


Fig. 403: Identifying Cooling Fan Relay Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

d. Inspect the IG2 relay.
   1. Measure the resistance according to the value(s) in the table below.

Standard resistance

RESISTANCE SPECIFICATION

Tester Connection	Condition	Resistance
B1 - B4	When battery voltage absent	10 kohms or higher
	When battery voltage applied to terminals B2 and B3	Below 1 ohms

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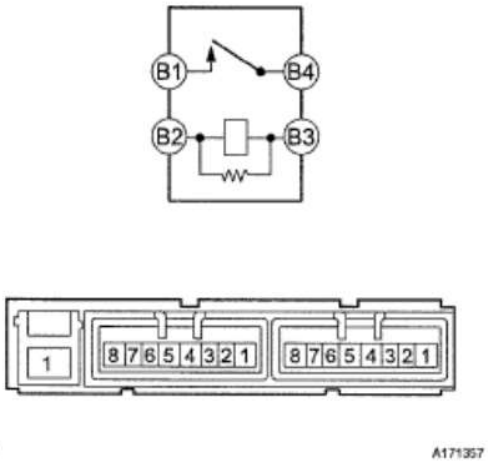


Fig. 404: Identifying IG2 Relay Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSTALLATION

1. **INSTALL INTEGRATION RELAY**
   a. Connect the 3 connectors.
   b. Attach the integration relay to the engine room relay block.
2. **INSTALL NO. 1 RELAY BLOCK COVER**

IGNITION RELAY NO. 1

COMPONENTS

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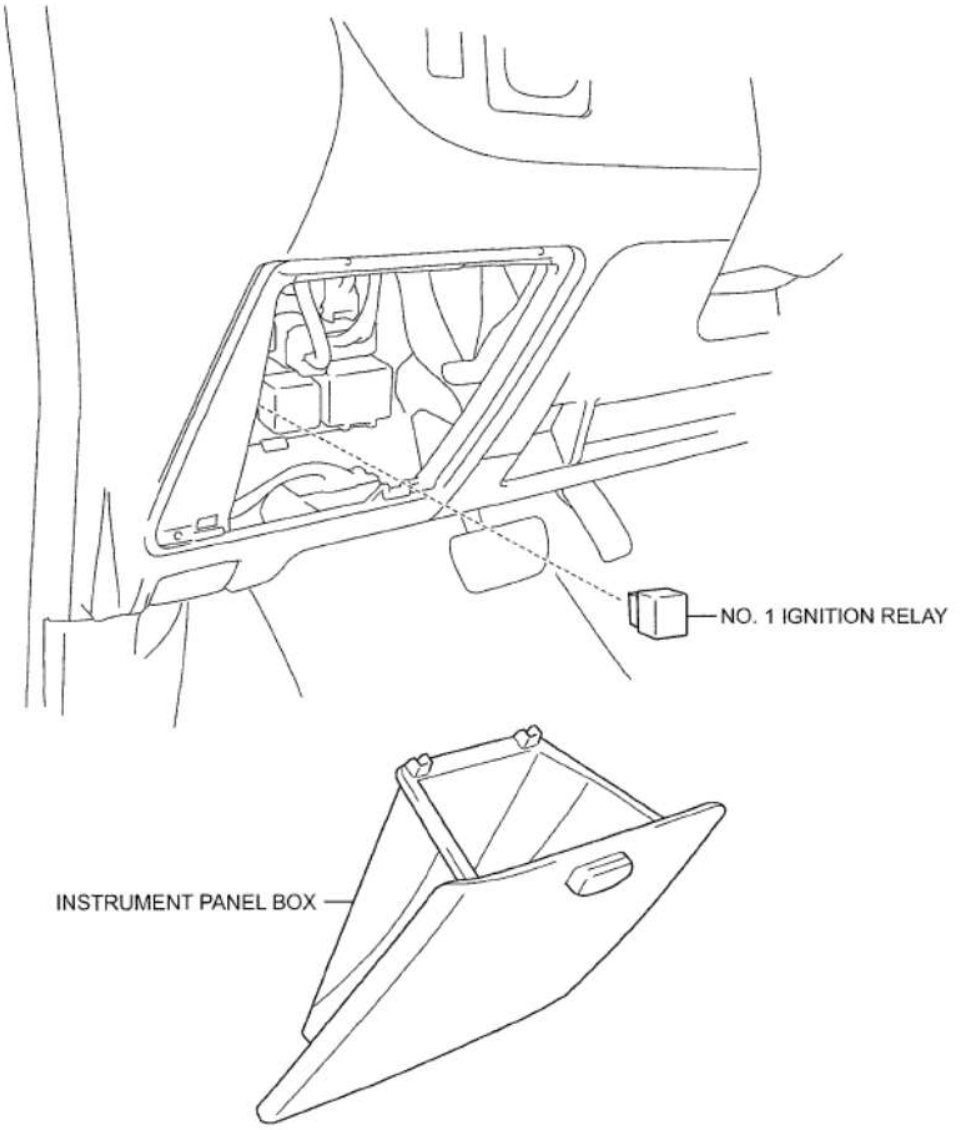


Fig. 405: Identifying Ignition Relay No 1 Components
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

REMOVAL

1. **REMOVE INSTRUMENT PANEL BOX** (See **REMOVAL**)
2. **REMOVE NO. 1 IGNITION RELAY**
   a. Remove the No. 1 ignition relay.

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2008 ENGINE PERFORMANCE 2ZR-FE Engine Control System - xD

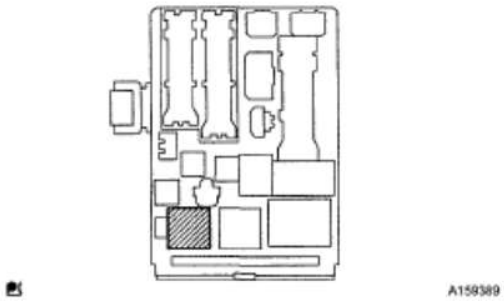


Fig. 406: Identifying No 1 Ignition Relay
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSPECTION

1. **INSPECT NO. 1 IGNITION RELAY**
   a. Check the resistance.
      1. Measure the resistance according to the value (s) in the table below.

Standard resistance

RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
3 - 5	When battery voltage applied to terminals 1 and 2	Below 1 ohms
	When battery voltage absent	10 kohms or higher

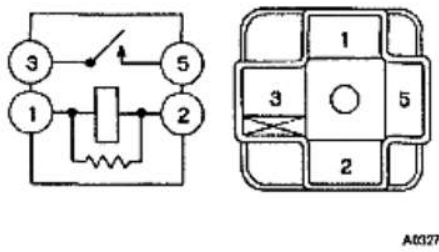


Fig. 407: Identifying No 1 Ignition Relay Connector Terminals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

If the result is not as specified, replace the ignition relay.

INSTALLATION

1. **INSTALL NO. 1 IGNITION RELAY**
   a. Install the No. 1 ignition relay.

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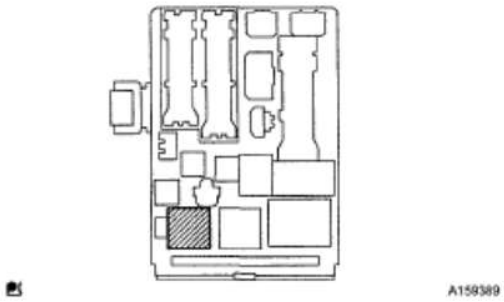


Fig. 408: Identifying No 1 Ignition Relay
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

2. **INSTALL INSTRUMENT PANEL BOX** (See **INSTALLATION**)

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