

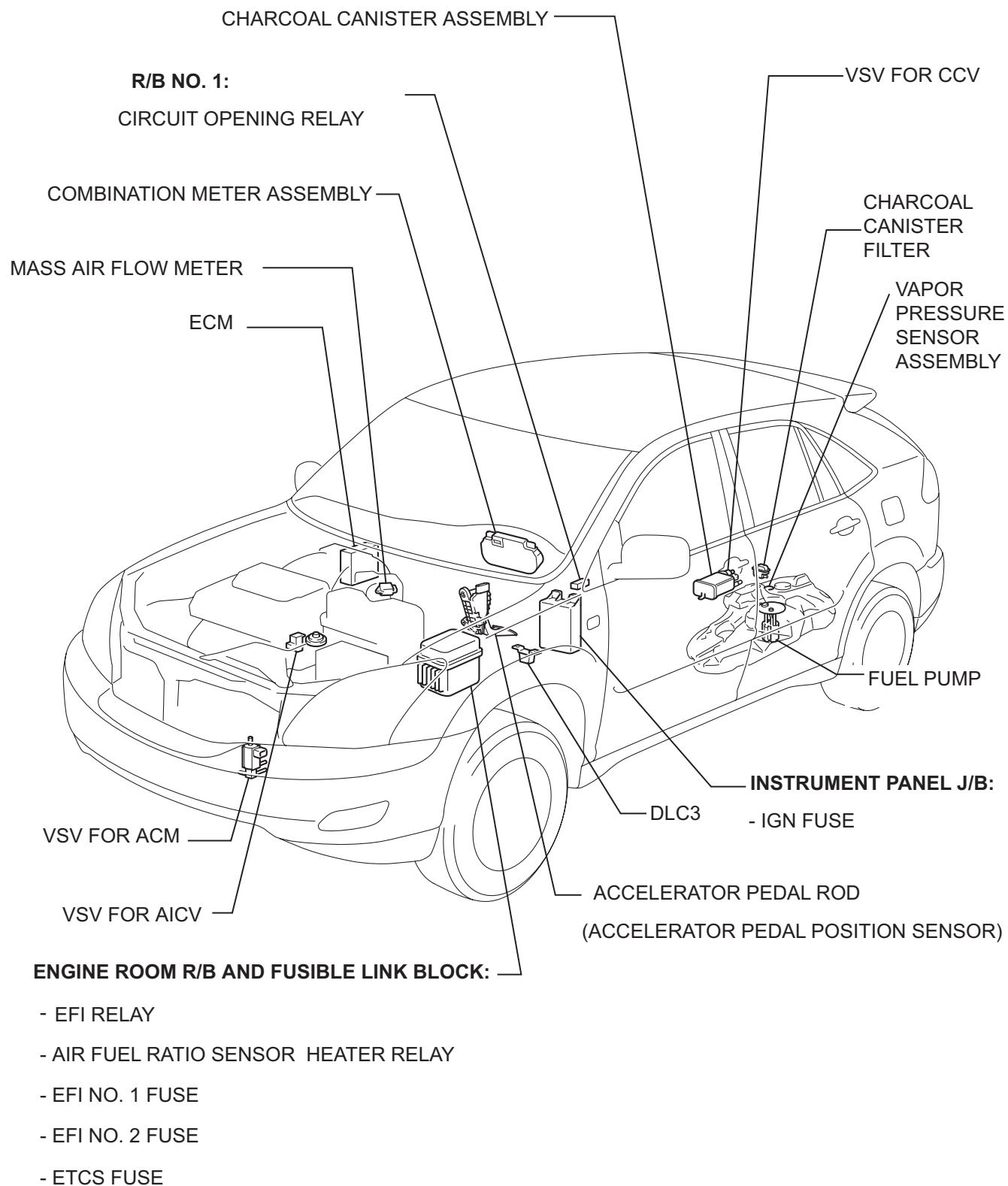
SFI SYSTEM

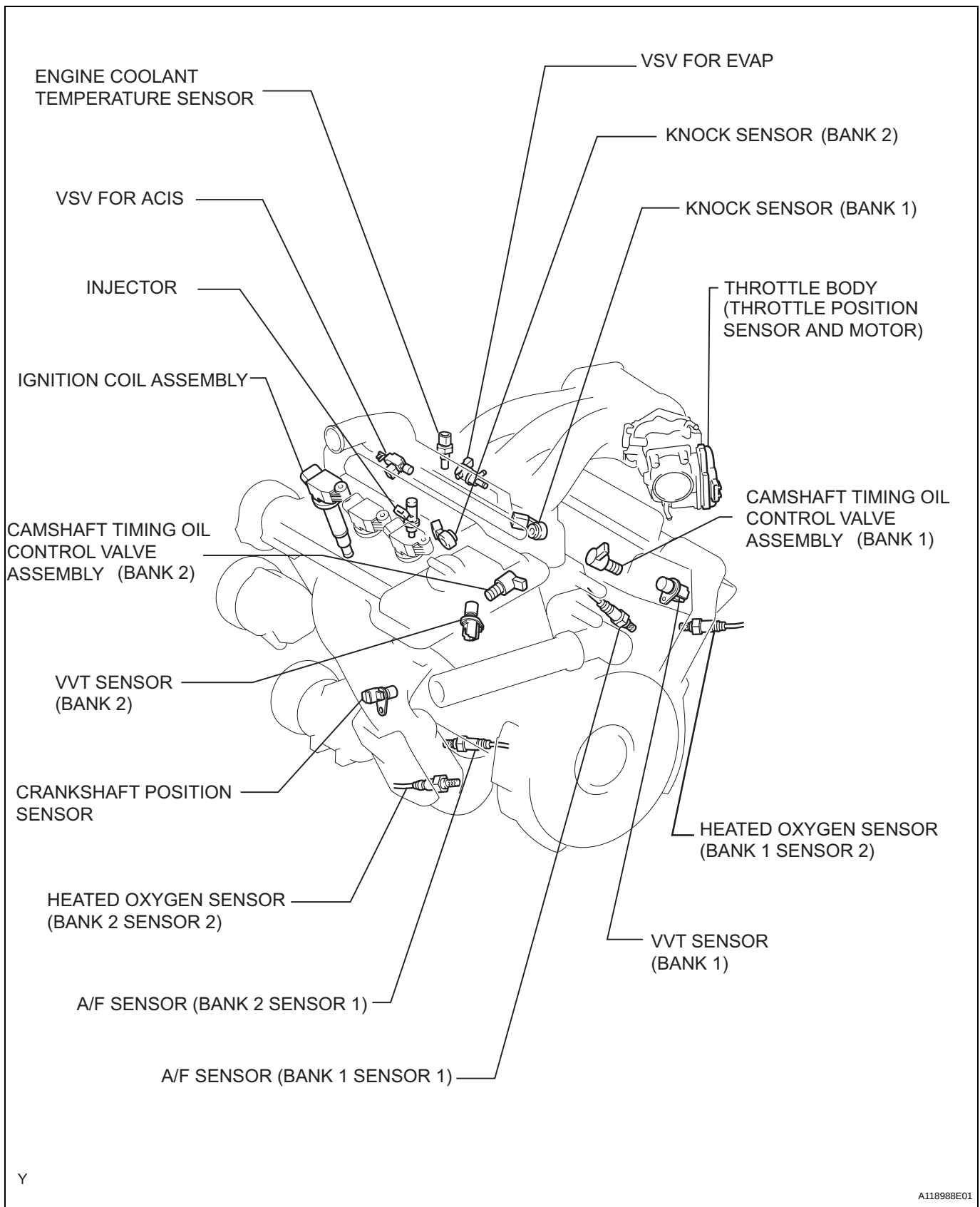
DEFINITION OF TERMS

Terms	Definition
Monitor Description	Description of what ECM monitors and how detects malfunctions (monitoring purpose and its details).
Related DTCs	A 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 and not monitored until 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 defected. "Immediate" means ECM illuminates MIL as soon as malfunction detected. "2 driving cycle" means ECM illuminates MIL if same malfunction detected second time during next sequential driving cycle.

PARTS LOCATION

ES





HOW TO PROCEED WITH TROUBLESHOOTING

HINT:
The intelligent tester should be used in steps 3, 4, 5, 7 and 10.

1

VEHICLE BROUGHT TO WORKSHOP

NEXT

ES

2

CUSTOMER PROBLEM ANALYSIS

NEXT

3

CONNECT INTELLIGENT TESTER TO THE DLC3

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

NEXT

4

CHECK DTC AND FREEZE FRAME DATA

HINT:
Record or print DTCs and freeze frame data, if necessary (See page [ES-28](#)).

NEXT

5

CLEAR DTC AND FREEZE FRAME DATA

NEXT

6

CONDUCT VISUAL INSPECTION

NEXT

7

SET CHECK MODE DIAGNOSIS

NEXT

8 CONFIRM PROBLEM SYMPTOMS

HINT:

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

Result

Result	Proceed to
Malfunction does not occur	A
Malfunction occur	B

B**GO TO STEP 10****A****ES****9 SIMULATE SYMPTOMS****NEXT****10 CHECK DTC**

HINT:

See page [ES-28](#).**Result**

Result	Proceed to
Malfunction code	A
No code	B

B**GO TO STEP 12****A****11 REFER TO DTC CHART**

HINT:

See page [ES-37](#).**NEXT****GO TO STEP 14****12 CONDUCT BASIC INSPECTION**

HINT:

See page [ES-7](#).**Result**

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

B

GO TO STEP 17

A

13

REFER TO PROBLEM SYMPTOMS TABLE

HINT:

See page [ES-22](#).

Result

Result	Proceed to
Malfunctioning circuit confirmed	A
Malfunctioning parts confirmed	B

B

GO TO STEP 17

A

14

CHECK ECM POWER SOURCE CIRCUIT

HINT:

See page [ES-336](#).

NEXT

15

CONDUCT CIRCUIT INSPECTION

Result

Result	Proceed to
Malfunction not confirmed	A
Malfunction confirmed	B

B

GO TO STEP 18

A

16

CHECK FOR INTERMITTENT PROBLEMS

HINT:

See page [ES-7](#).

NEXT

GO TO STEP 18

17

CONDUCT PARTS INSPECTION

NEXT

ES

18 IDENTIFY PROBLEM

NEXT

19 ADJUST AND/OR REPAIR

NEXT

20 CONDUCT CONFIRMATION TEST

NEXT

END

ES

CHECK FOR INTERMITTENT PROBLEMS

HINT:

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

1. Clear the DTCs (See page [ES-28](#)).
2. Switch the ECM from normal mode to check mode using an intelligent tester (See page [ES-29](#)).
3. Perform a simulation test (See page [IN-31](#)).
4. Check and wiggle the harness(es), connector(s) and terminal(s).

BASIC INSPECTION

When the 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

NOTICE:

Carry out this check with the engine stopped and ignition switch OFF.

Result

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

NG**CHARGE OR REPLACE BATTERY****OK**

2 CHECK WHETHER ENGINE WILL CRANK

HINT:

See page [ES-22](#).

NG**PROCEED TO PROBLEM SYMPTOMS TABLE****OK**

3 CHECK WHETHER ENGINE STARTS

NG**GO TO STEP 6****OK**

4 CHECK AIR FILTER

(a) Visually check that the air filter is not excessively contaminated with dirt or oil.

NG**REPLACE AIR FILTER****OK**

5

CHECK IDLING SPEED

HINT:
See page [ES-22](#).

NG

PROCEED TO PROBLEM SYMPTOMS
TABLE

OK

6

CHECK FUEL PRESSURE

HINT:
See page [FU-3](#) (for Fuel system).

NG

PROCEED TO FUEL SYSTEM AND
CONTINUE TO TROUBLESHOOT

OK

7

CHECK FOR SPARK

HINT:
See page [IG-1](#).

NG

PROCEED TO IGNITION SYSTEM AND
CONTINUE TO TROUBLESHOOT

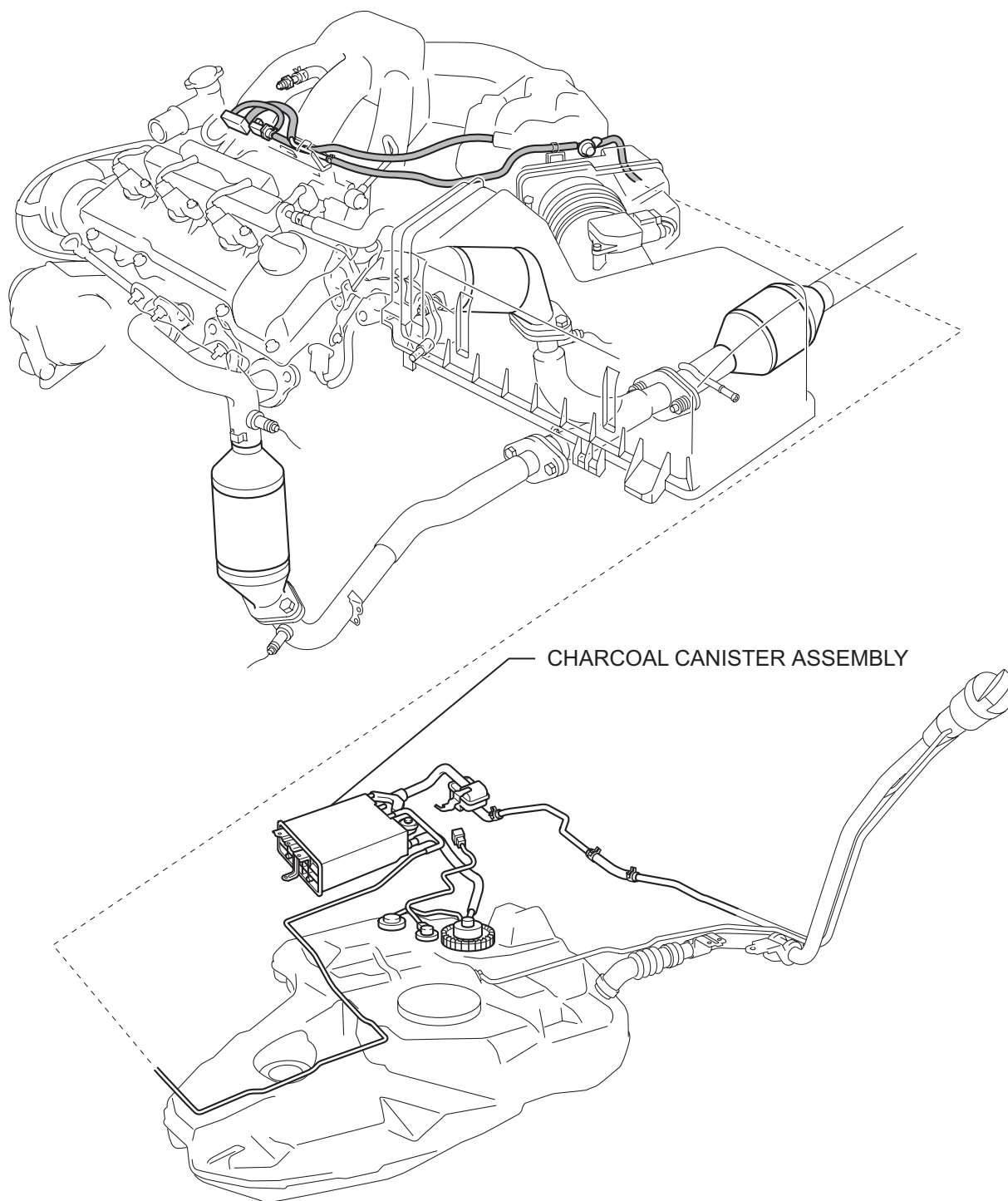
OK

PROCEED TO PROBLEM SYMPTOMS TABLE

ES

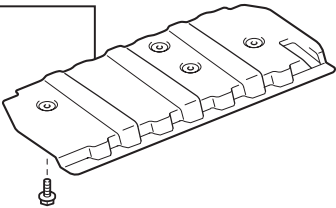
CANISTER

COMPONENTS

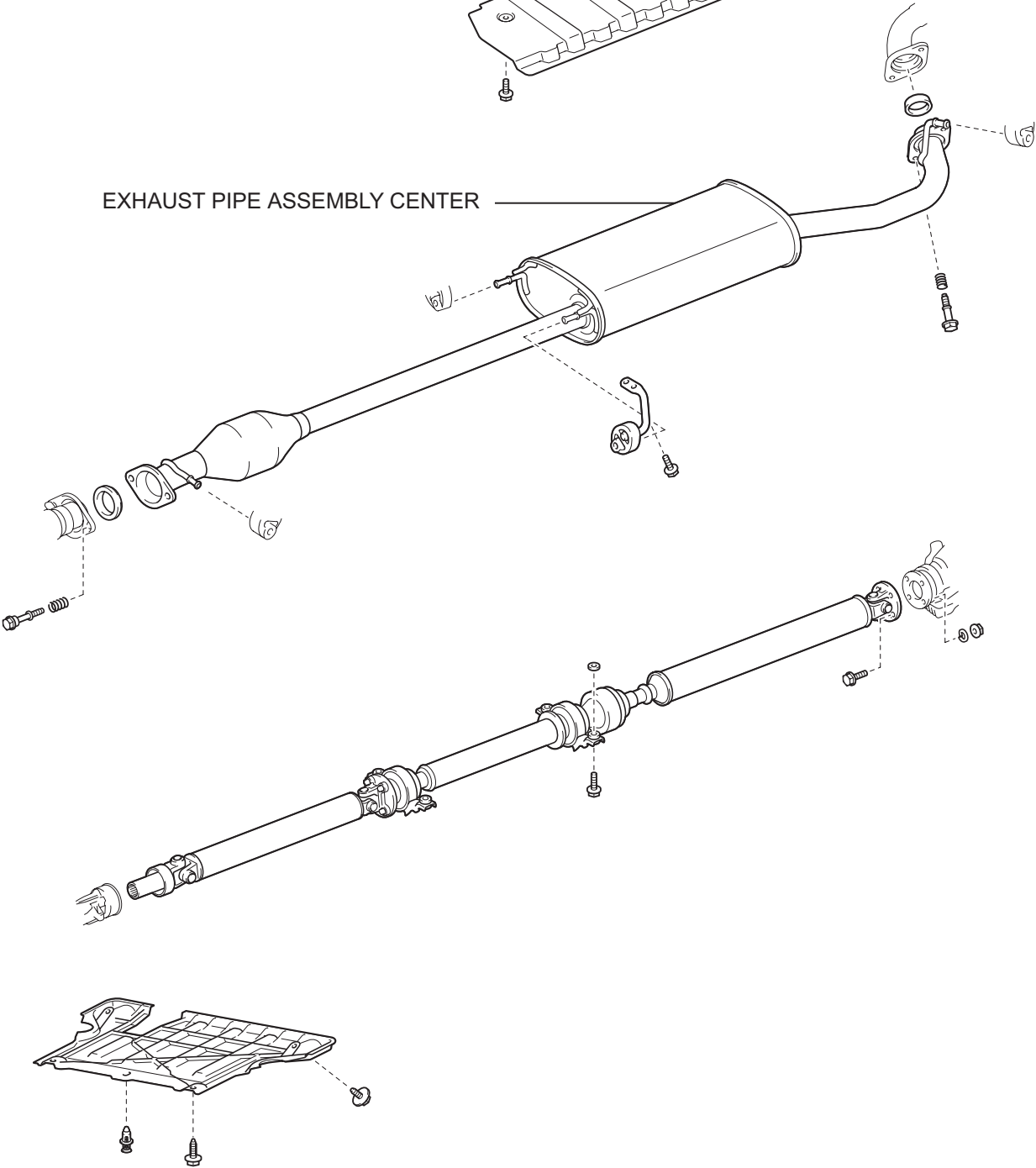


EC

FRONT FLOOR HEAT INSULATOR NO.3



EXHAUST PIPE ASSEMBLY CENTER



EC

REGISTRATION

NOTICE:

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

HINT:

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

1. INPUT INSTRUCTIONS

- (a) Explains the general VIN input instructions using the intelligent tester.
- (b) Intelligent tester
The arrow buttons (UP, DOWN, RIGHT and LEFT) and numerical buttons (0 to 9) are used to input the VIN.
- (c) Cursor Operation
To move the cursor around the tester screen, press the RIGHT and LEFT buttons.
- (d) Alphabetical Character Input
 - (1) Press the UP and DOWN buttons to select the desired alphabetical character.
 - (2) After selection, the cursor should move.
- (e) Numeric Character Input
 - (1) Press the numerical button corresponding to the number that you want to input.
 - (2) After input, the cursor should move.

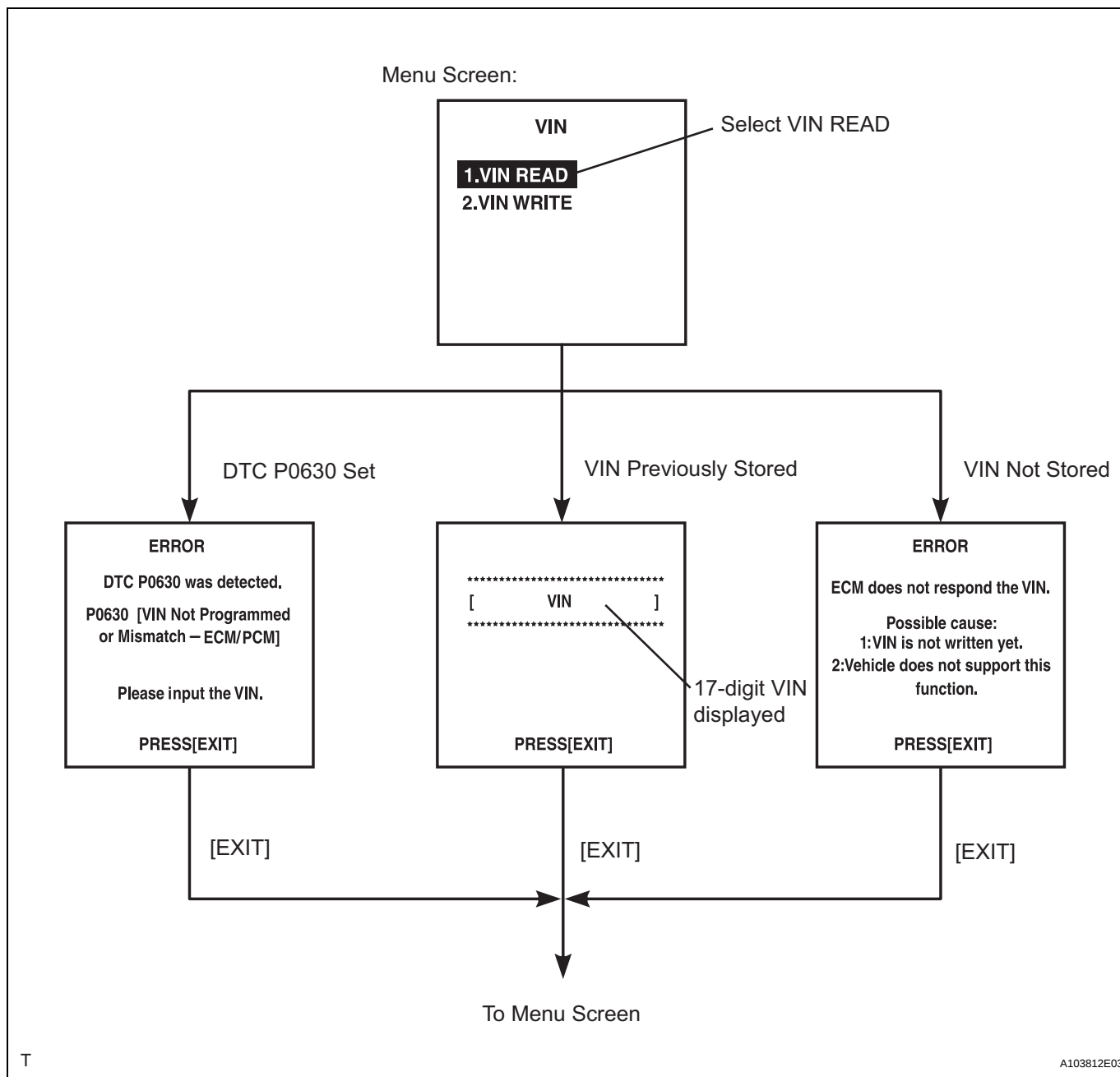
HINT:
Numerical characters can be selected by using the UP and DOWN buttons.
- (f) Correction
 - (1) When correcting the input character(s), put the cursor onto the character using the RIGHT or LEFT buttons.
 - (2) Select or input the correct character using the UP/DOWN buttons, or the numerical buttons.
- (g) Finishing Input Operation
 - (1) Make sure that the input VIN matches the vehicle VIN after input.
 - (2) Press the ENTER button on the tester.

2. READ VIN (Vehicle Identification Number)

- (a) Explains the VIN reading process in a flowchart.
Reading the VIN stored in the ECM is necessary when comparing it to the VIN provided with the vehicle.
- (b) Read VIN using the intelligent tester.
- (c) Check the vehicle's VIN.
- (d) Connect the intelligent tester to the DLC3.
- (e) Turn the ignition switch to ON.
- (f) Turn the tester ON.

- (g) Enter the following menus: DIAGNOSIS /
ENHANCED OBD II / VIN.

ES

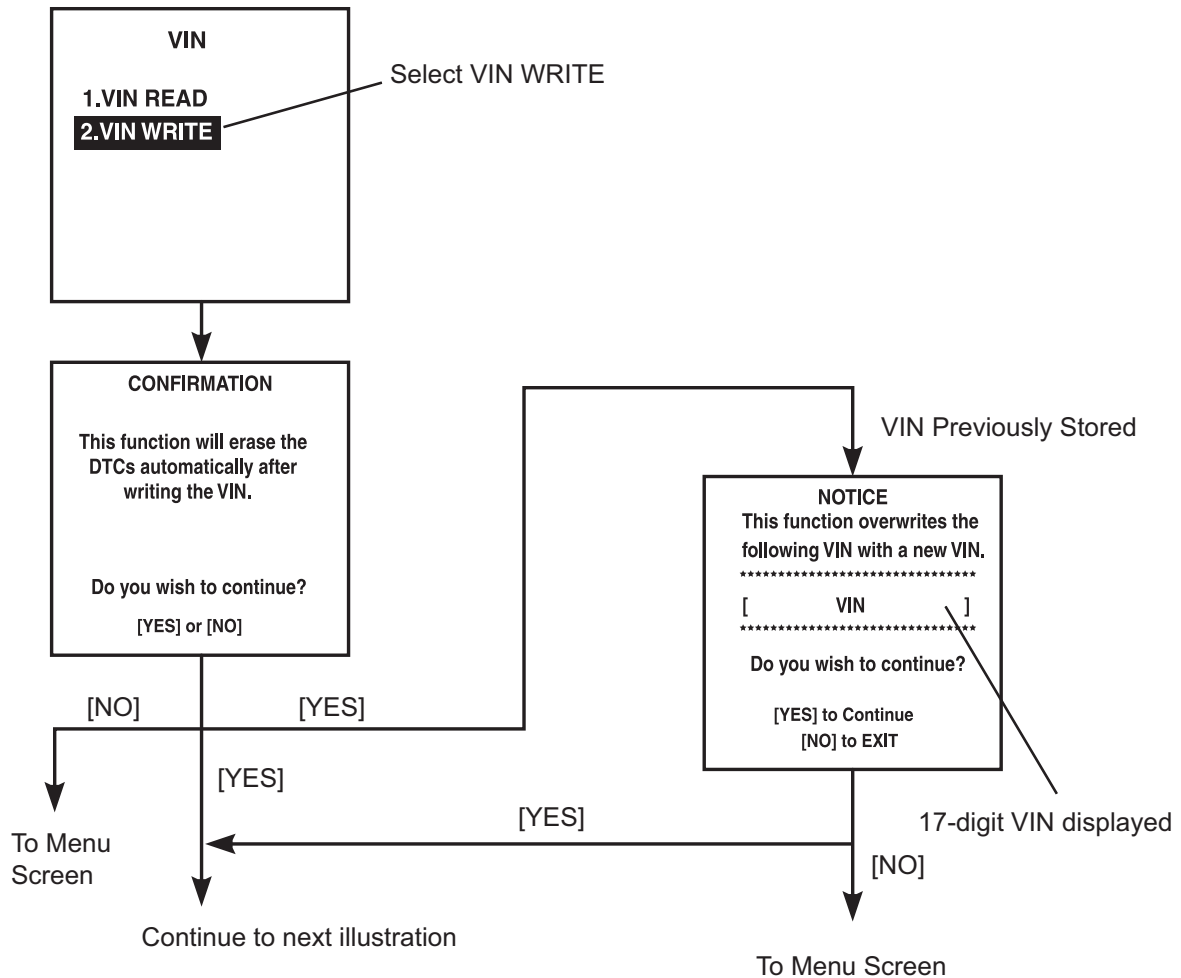


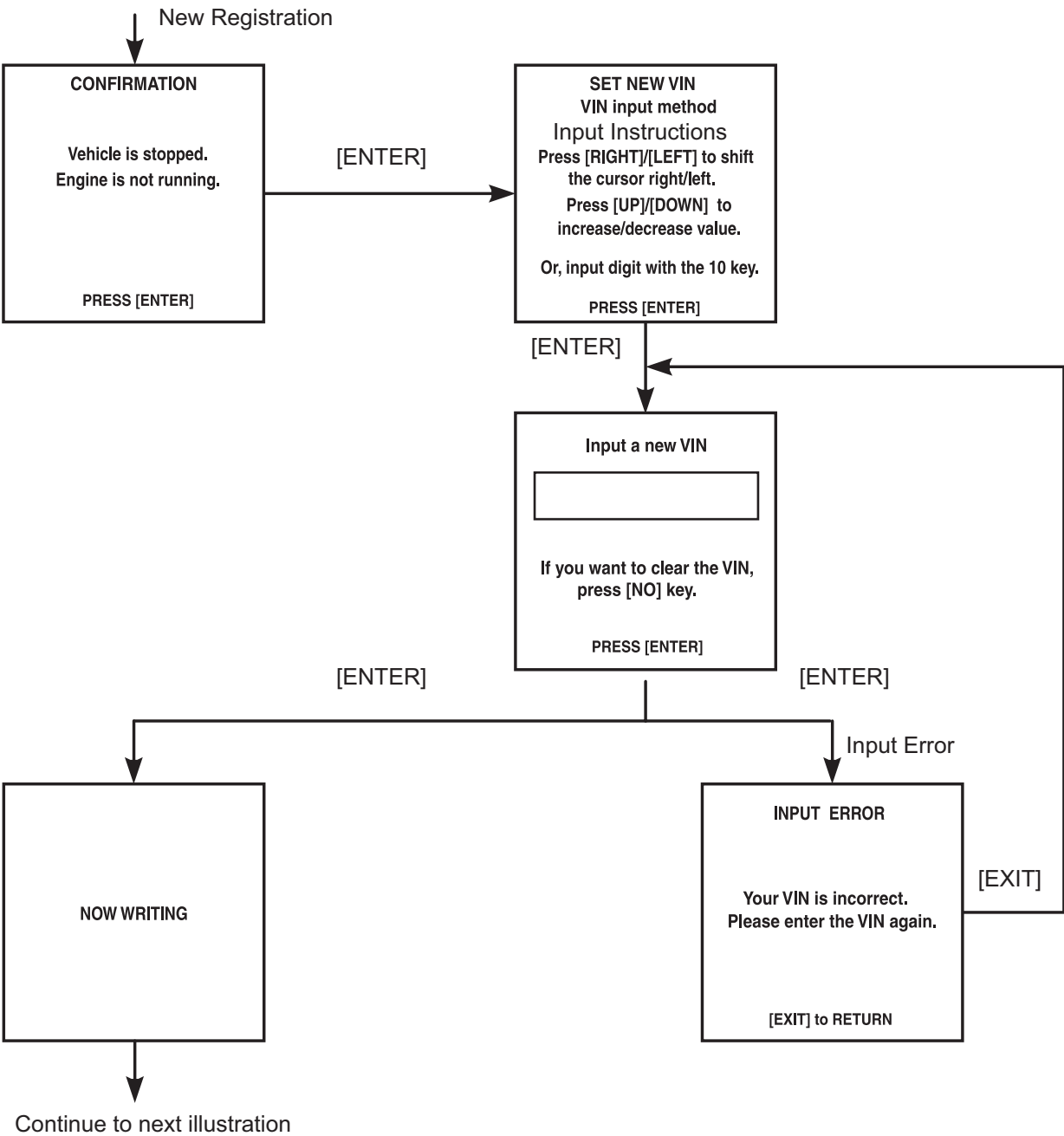
3. WRITE VIN

- (a) Explains the VIN writing process in a flowchart. This process allows the VIN to be input into the ECM. If the ECM is changed, or the ECM VIN and Vehicle VIN do not match, the VIN can be registered, or overwritten in the ECM by following this procedure.
- (b) Write VIN using the intelligent tester.
- (c) Connect the intelligent tester to the DLC3.
- (d) Turn the ignition switch to ON.
- (e) Turn the tester ON.

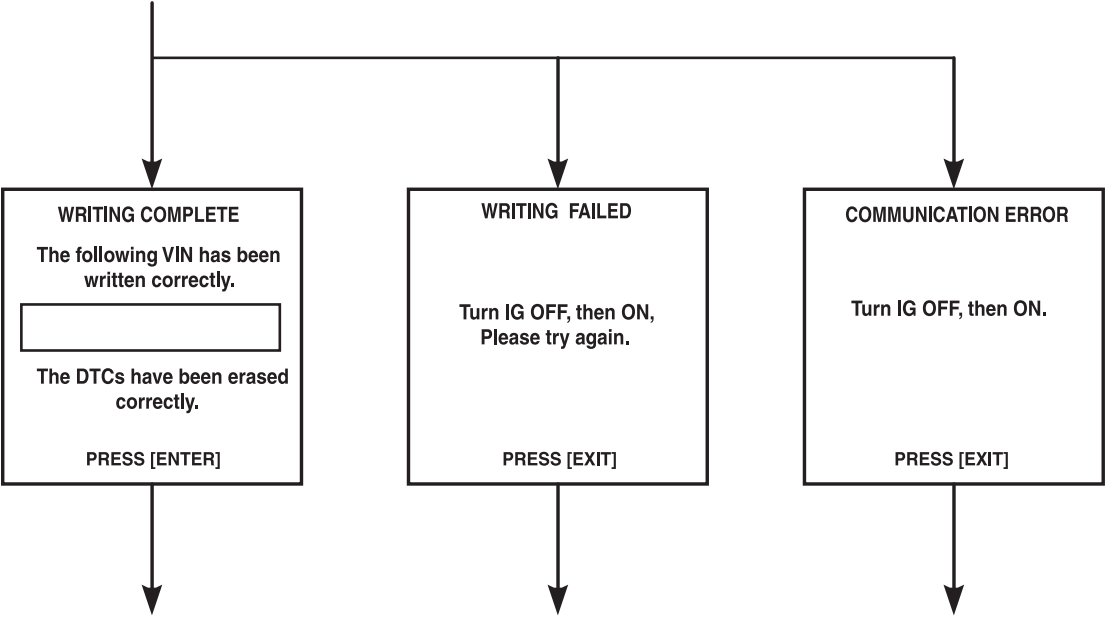
- (f) Enter the following menus: DIAGNOSIS /
ENHANCED OBD II / VIN.

Menu Screen:

**ES**



ES



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ES

INSTALLATION

1. INSTALL CHARCOAL CANISTER ASSEMBLY

Torque: 5.5 N*m (56 kgf*cm, 49 in.*lbf)

2. INSTALL FRONT FLOOR HEAT INSULATOR NO.3

Torque: 4.9 N*m (50 kgf*cm, 43 in.*lbf)

3. INSTALL EXHAUST PIPE ASSEMBLY CENTER

(a) Compression spring inspection

- (1) Using vernier calipers, measure the free length of the compression spring.

Minimum length:

Center x Front No. 3:

41.5 mm (1.634 in.)

Center x Tail:

40.5 mm (1.594 in.)

If the free length is less than minimum, replace the compression spring.

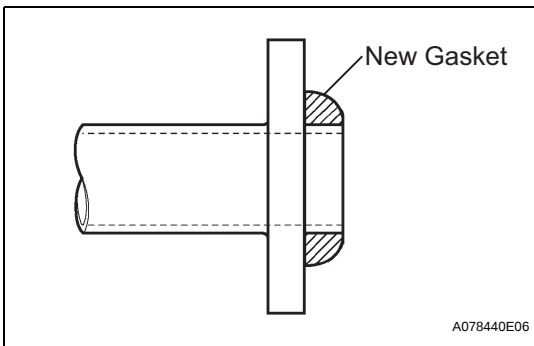
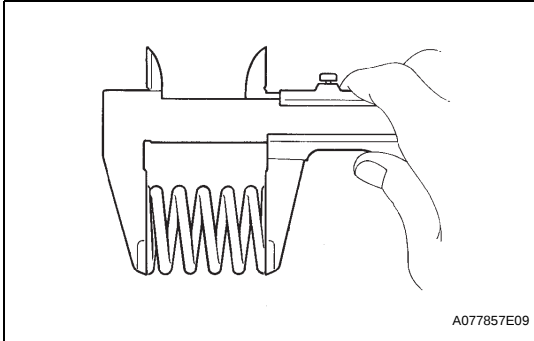
- (b) Install 2 new gaskets to the exhaust pipe front No. 3 and the exhaust pipe center as shown in the illustration.

- (c) Install the exhaust pipe center to the 4 exhaust pipe supports.

- (d) Tighten the 4 bolts and 4 compression springs.

Torque: 48 N*m (490 kgf*cm, 35 ft.*lbf)

4. CHECK FOR EXHAUST GAS LEAKS



O2S TEST RESULT

1. INTRODUCTION

The O2S TEST RESULT refers to the results of the engine control module (ECM) when it monitors the oxygen sensor (O2S), and it can be read using the intelligent tester or the generic OBD II scan tool. Based on this, you can find the O2S's conditions.

The ECM monitors the O2S for various data. You can read the monitor result (TEST DATA) of each monitor item using the O2S TEST RESULT. However, the output value of the TEST DATA is the latest "snapshot" value that is taken after monitoring and therefore it is not dynamic.

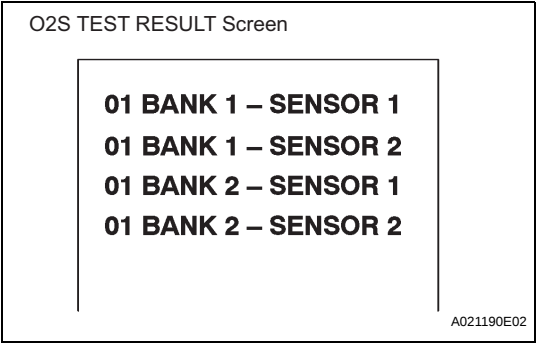
In this repair manual, the description of the O2S TEST RESULT (for O2S related DTCs) are written in a table. This table consists of 5 items:

- 1. TEST ID (a code applied to each TEST DATA)
- 2. Description of TEST DATA
- 3. Conversion Factor (When conversion factor has a value written in the table, multiply the TEST DATA value appearing on the scan tool by the conversion factor value. The result will be the required value.)
- 4. Unit
- 5. Standard Value

If the TEST DATA value appearing on the scan tool is out of the standard value, the O2S is malfunctioning. If it is within the standard value, the O2S is functioning normally. However, if the value is on the borderline of the standard value, the O2S may malfunction very soon.

2. HOW TO READ O2S TEST RESULT USING INTELLIGENT TESTER

- (a) Connect the intelligent tester to the DLC3.
- (b) On the tester screen, select the following menus: DIAGNOSIS / CARB OBDII / O2S TEST RESULT. A list of the O2S equipped on the vehicle will be displayed.



TEST DATA Screen

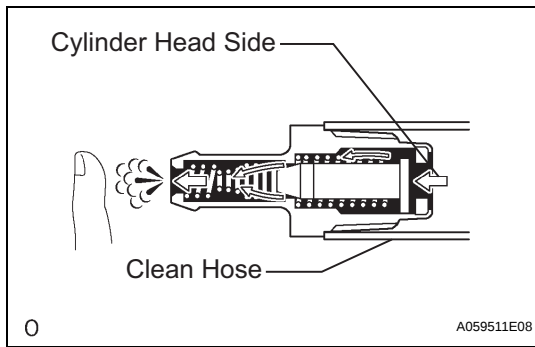
LOW SW V . . . 0.400 V
HIGH SW V . . . 0.550 V
MIN O2S V . . . 0.100 V
MAX O2S V . . . 0.900 V
TIME \$81 17

A021191E02

- (c) Select the desired O2S and press ENTER. The following screen will appear.
- (d) Press HELP and * simultaneously. More information will appear.
- (e) Example:
 - (1) The intelligent tester displays "17" as a value of the "TIME \$81" (see the illustration on the right).
 - (2) Find the conversion factor value of "TIME \$81" in the O2S TEST RESULT chart below. 0.3906 is specified for \$81 in this chart.
 - (3) Multiply "17" in step (1) by 0.3906 (conversion factor) in the step (2).
 $17 \times 0.3906 = 6.6 \%$
 - (4) If the answer is within the standard value, the "TIME \$81" can be confirmed to be normal.

O2S TEST RESULT Chart

TEST ID	Description of TEST DATA	Conversion Factor	Unit	Standard Value
\$81	Percentage of monitoring time when the O2S voltage is less than 0.05 V	Multiply 0.3906	%	Within 60 %



VENTILATION VALVE

INSPECTION

1. INSPECT VENTILATION VALVE SUB-ASSEMBLY

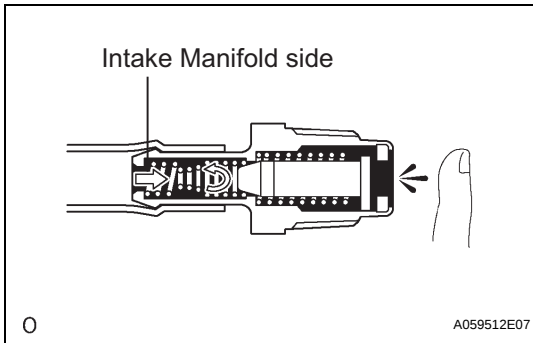
- (a) Install a clean hose to the ventilation valve.
- (b) Inspect the ventilation valve operation.
 - (1) Blow air into the cylinder head side, and check that air passes through easily.

CAUTION:

Do not suck air through the valve.

Petroleum substances inside the valve are harmful.

- (2) Blow air into the intake manifold side, and check that air passes through with difficulty. If operation is not as specified, replace the ventilation valve.
- (c) Remove the clean hose from the ventilation valve.



CHECKING MONITOR STATUS

NOTICE:
The monitor status (mode 6) is not applicable to the heated oxygen sensor (HO2S). However, HO2S test values can be checked by O2S TEST RESULT (mode 5). (See page [ES-13](#))

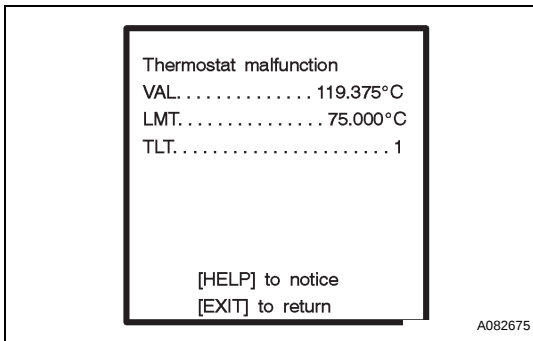
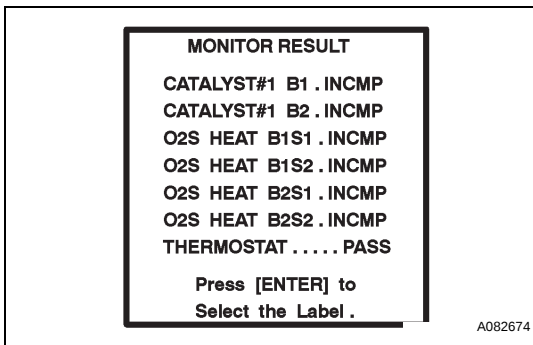
- 1. Outline**
The monitor results and the test values can be checked with the OBDII scan tool.
The engine control module (ECM) monitors the emissions-related components as the thermostat, catalyst converter and evaporative emissions (EVAP), and determines whether they are functioning normally or not. When finished monitoring, the ECM stores the monitor results and the test values.
The monitor result indicates whether the component is functioning normally or not. The test value is the value that was used to determine the monitor result. If the test value is outside the test limit (malfunction criterion), the ECM determines the component is malfunctioning. Some emissions-related components have multiple test values to determine monitor result. If one of these test values is outside test limit, the ECM determines the component is malfunctioning.

- 2. Description**
The test value and test limit information are described as shown in the following table. This information is included under "MONITOR RESULT" in the emissions-related DTC sections:

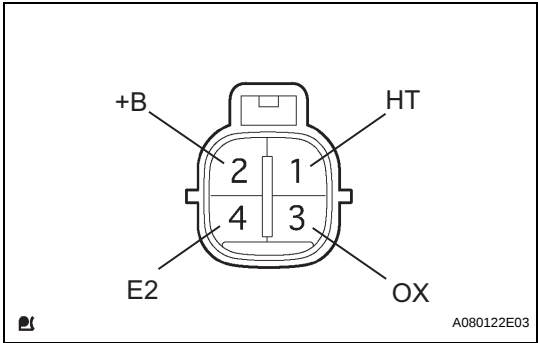
TID \$08: Thermostat

TLT	CID	Unit Conversion	Description of Test Value	Description of Test Limit
1	\$01	Multiply by 0.625 and subtract 40 (°C)	ECT sensor output when estimated ECT has reached to malfunction criterion	Malfunction criterion for thermostat

- TID (Test Identification Data) is assigned to each emissions-related component.
 - TLT (Test Limit Type):
If TLT is 0, the component is malfunctioning when the test value is higher than the test limit.
If TLT is 1, the component is malfunctioning when the test value is lower than the test limit.
 - CID (Component Identification Data) is assigned to each test value.
 - Unit Conversion is used to calculate the test value indicated on generic OBDII scan tools.
- 3. Procedure (using intelligent tester)**
- (a) Connect the intelligent tester to the DLC3.
 - (b) Turn the ignition switch and intelligent tester ON.
 - (c) Clear DTCs.
 - (d) Allow the vehicle to drive, in accordance with the applicable drive pattern described in the READINESS MONITOR DRIVE PATTERN section (See page [ES-16](#)).



- (e) Select the intelligent tester menus: DIAGNOSIS, ENHANCED OBDII, MONITOR INFO and MONITOR RESULT. The monitor result appears after the component name.
- INCMP indicates the component has not been monitored yet.
 - PASS indicates the component is functioning normally.
 - FAIL indicates the component is malfunctioning.
- (f) Select the component and press ENTER. If the monitor result has been PASS or FAIL, the accuracy test value appears.
- VAL indicates the test value.
 - LMT indicates the test limit (malfunction criterion).
 - TLT indicates the test limit type.
- (g) Compare the test value with the test limit.
- If TLT is 0, the component is malfunctioning when the test value is higher than the test limit.
 - If TLT is 1, the component is malfunctioning when the test value is lower than the test limit.
 - If the test value is on the borderline of the test limit, a malfunction is concealed in the component.
- 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.



HEATED OXYGEN SENSOR

INSPECTION

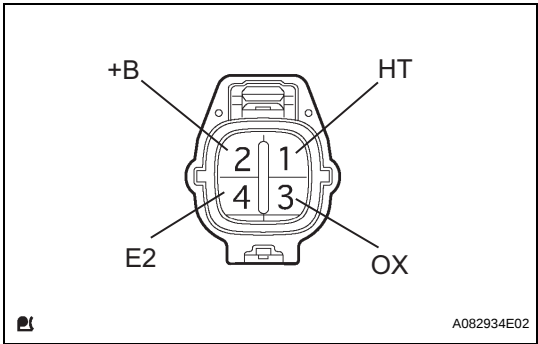
1. INSPECT HEATED OXYGEN SENSOR

- (a) Bank 1 oxygen sensor No. 2
- (1) Using an ohmmeter, measure the resistance between the terminals.

Resistance

Symbols (Terminal No.)	Resistance
HT (1) - +B (2)	11 to 16 Ω at 20°C (68°F)
HT (1) - E2 (4)	No continuity

If the resistance is not as specified, replace the sensor.



2. INSPECT HEATED OXYGEN SENSOR

- (a) Bank 2 oxygen sensor No. 2
- (1) Using an ohmmeter, measure the resistance between the terminals.

Resistance

Symbols (Terminal No.)	Resistance
HT (1) - +B (2)	11 to 16 Ω at 20°C (68°F)
HT (1) - E2 (4)	No continuity

If the resistance is not as specified, replace the sensor.

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 DTC (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.
- The intelligent tester's software must be version 9.0 or newer to view the Readiness Monitor Status. To view the status, enter the following menus: DIAGNOSIS / ENHANCED OBD II / MONITOR INFO / MONITOR STATUS.
- When the Readiness Monitor status reads COMPL (complete), the necessary conditions have been met for running the performance tests for that Readiness Monitor.
- A generic OBD II scan tool can also be used to view the Readiness Monitor status.

HINT:

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

The Readiness Monitor will be reset to INCMPL (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 INCMPL, follow the appropriate Readiness Monitor Drive Pattern to change the status to COMPL.

CAUTION:

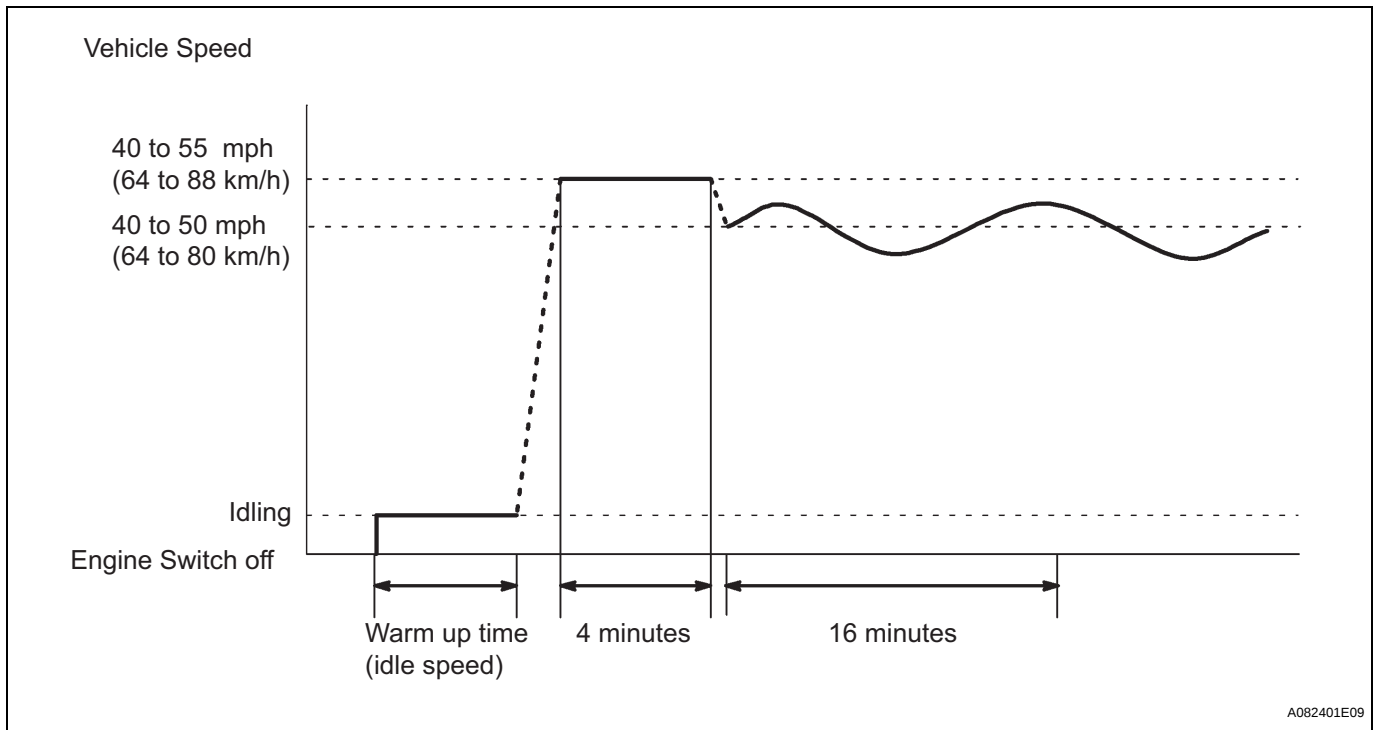
Strictly observe posted speed limits, traffic laws, and road conditions when performing these drive patterns.

NOTICE:

The drive patterns represent the fastest method of satisfying all conditions necessary to achieve complete status for each specific Readiness Monitor. If a drive pattern is 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 (A/F SENSOR TYPE)



(a) Preconditions

The monitor will not run unless:

Step A

- The MIL is OFF.
- Engine Coolant Temperature (ECT) is 80°C (176°F) or higher.
- Intake Air Temperature (IAT) is -10°C (14°F) or higher.

NOTICE:

To complete the readiness test in cold ambient conditions (less than -10°C / 14°F), turn the ignition switch OFF and then back to ON. Perform the drive pattern a second time.

(b) Drive Pattern

Step 1

Connect the intelligent tester to the DLC3 to check Readiness Monitor status and preconditions (refer to step (A)).

Step 2

Drive the vehicle at 40 to 55 mph (64 to 88 km/h) for approximately 4 minutes.

NOTICE:

Drive with smooth throttle operation and avoid sudden acceleration. If IAT was less than 10°C (50°F) when the engine was started, drive the vehicle at 40 to 55 mph (64 to 88 km/h) for an additional 4 minutes.

Step 3

Drive the vehicle allowing speed to fluctuate between 40 to 50 mph (64 to 80 km/h) for approximately 16 minutes.

NOTICE:

Drive with smooth throttle operation and avoid sudden closure of the throttle.

Step 4

Check the status of the readiness monitor on the scan tool display. If the readiness monitor status did not switch to complete, ensure preconditions are met, turn the engine switch off, and then repeat steps 2 and 3.

3. EVAP MONITOR (VACUUM PRESSURE MONITOR)**NOTICE:**

A cold soak must be performed prior to conducting the drive pattern to complete the internal pressure readiness monitor.

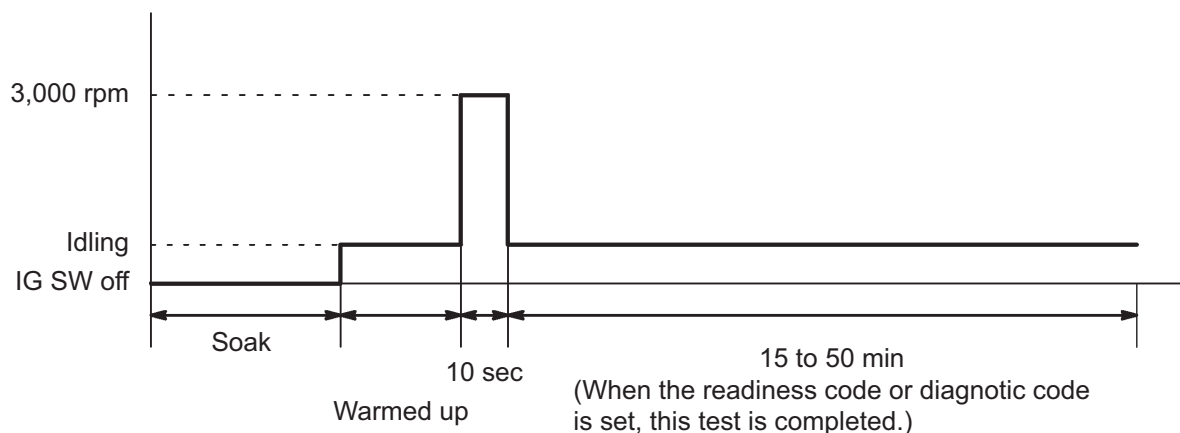
(a) Cold Soak Preconditions

Step B

The monitor will not run unless:

- The MIL is OFF.
- Fuel level is approximately 1/2 to 3/4 full.
- Altitude is 7,800 feet (2,400 m) or less.

(b) Cold Soak Procedure



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Let vehicle cold soak for 8 hours or until "IAT - ECT" must be less than 7°C (13°F).

- Example 1 ECT = 24°C (75°F) IAT = 16°C (60°F)
Difference between ECT and IAT is 8°C (15°F).
→ The monitor will not run because difference between ECT and IAT is greater than 7°C (13°F).

- Example 2 ECT = 21°C (70°F) IAT = 20°C (68°F). Difference between ECT and IAT is 1°C (2°F). → The monitor will run because difference between ECT and IAT is less than 7°C (13°F).

(c) Preconditions

The monitor will not run unless:

- The MIL is OFF.
- Fuel level is approximately 1/2 to 3/4 full.
- The altitude is 7800 feet (2400 m) or less.
- ECT is between 4.4°C and 35°C (40°F and 95°F).
- IAT is between 4.4°C and 35°C (40°F and 95°F).
- The cold soak procedure has been completed.
- Before starting the engine, the difference between ECT and IAT must be less than 7°C (13°F).

HINT:

- Example 1 ECT = 24°C (75°F) IAT = 16°C (60°F). Difference between ECT and IAT is 8°C (15°F). → The monitor will not run because difference between ECT and IAT is greater than 7°C (13°F).
- Example 2 ECT = 21°C (70°F) IAT = 20°C (68°F). Difference between ECT and IAT is 1°C (2°F). → The monitor will run because difference between ECT and IAT is less than 7°C (13°F).

NOTICE:

The readiness test can be completed in cold ambient conditions (less than 4.4°C / 40°F) and / or high altitudes (more than 7,800 ft / 2,400 m). Finish the drive pattern, turn the ignition switch OFF and then ON again, and repeat the drive pattern a second time.

(d) Drive Pattern

- (1) Connect the OBD II scan tool to DLC3 to check monitor status and preconditions (refer to Step B).
- (2) Release pressure in fuel tank by removing the fuel tank cap and then reinstalling it.
- (3) Start the engine and allow it to idle until ECT is 75°C (167°F) or more.
- (4) Run the engine at 3,000 rpm for about 10 seconds.
- (5) With the engine idling, turn the A/C ON to create a slight electrical load. Wait 15 to 50 minutes.

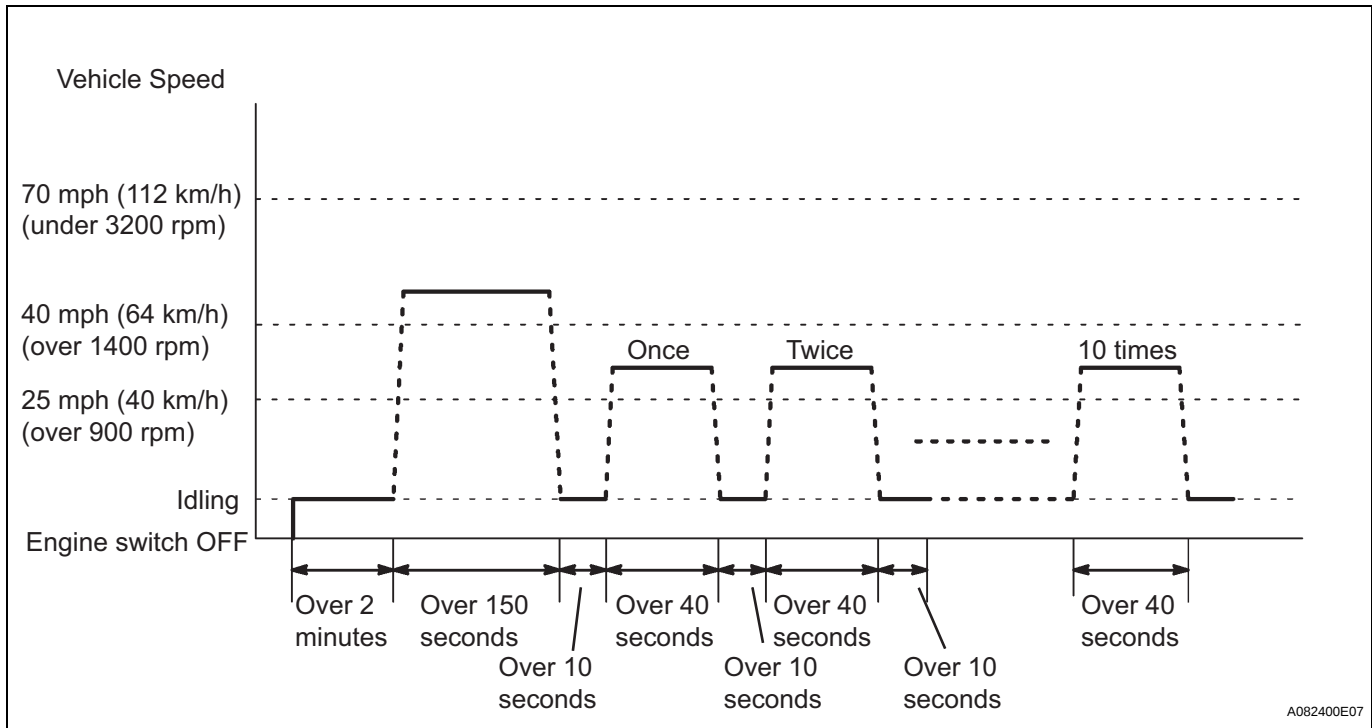
NOTICE:

If the vehicle does not have A/C, put a slight electrical load on the engine by following the steps below:

- Set the parking brake securely.
- Use wheel chocks to secure the tires.
- Move the shift lever to drive (position D) and allow engine to idle for 15 to 50 minutes. Check the readiness monitor status.

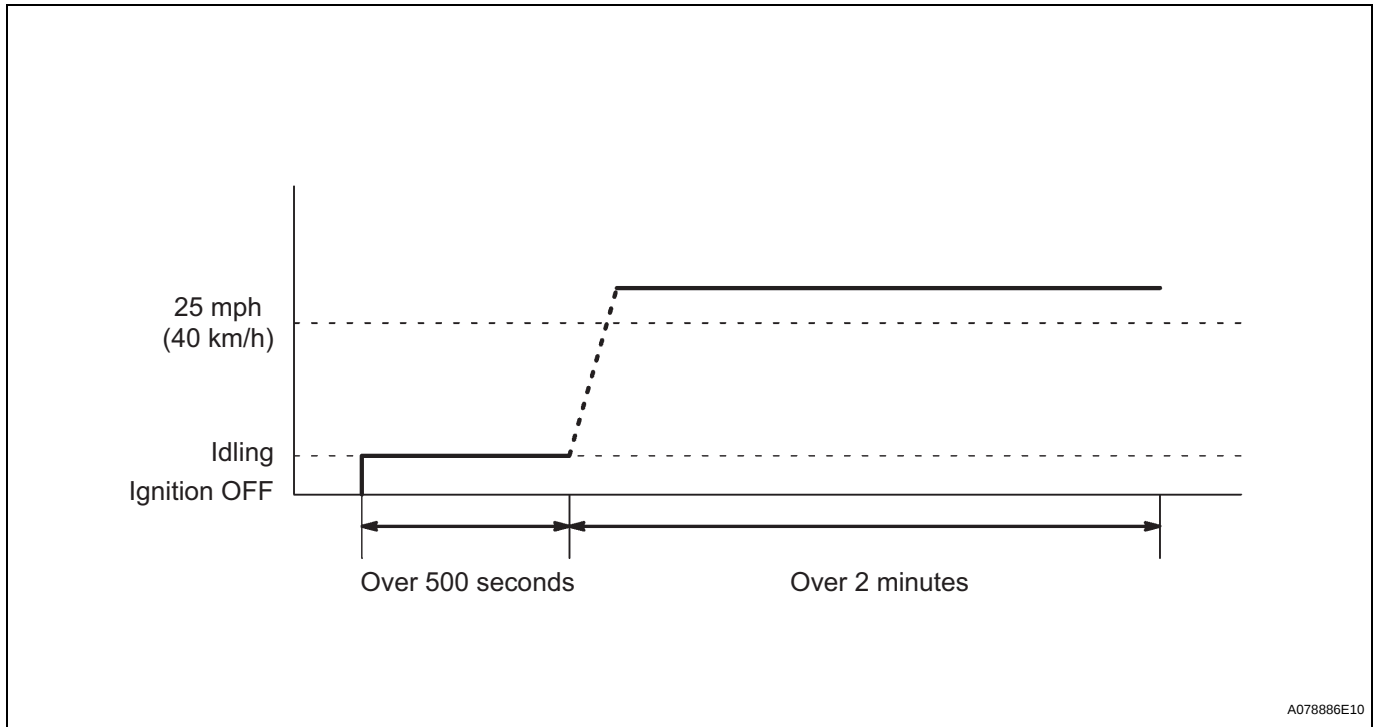
4. OXYGEN / A/F SENSOR MONITOR (FRONT A/F SENSOR AND REAR O2S SYSTEM)

- (a) Preconditions
Step C



The monitor will not run unless:

- (1) The MIL is OFF.
- (b) Drive Pattern
- (1) Connect the OBD II scan tool to the DLC3 to check monitor status and preconditions (refer to step C).
Step (1)
 - (2) Start the engine and allow it to idle for 2 minutes or more.
Step (2)
 - (3) Drive the vehicle at 40 to 70 mph (64 to 112 km/h) for at least 150 seconds.
Step (3)
 - (4) Stop the vehicle and allow the engine to idle for 10 seconds or more.
Step (4)
 - (5) Drive the vehicle at 25 mph (40 km/h) or more for at least 40 seconds.
Step (5)
 - (6) Stop the vehicle and allow the engine to idle for 10 seconds or more.
Step (6)
 - (7) Perform steps (5) and (6) 10 times.
 - (8) Check the readiness monitor status. If the readiness monitor status did not change to "complete", check the preconditions, turn the ignition switch OFF, and repeat steps (1) to (6).

5. OXYGEN / A/F SENSOR HEATER MONITOR**(a) Preconditions****Step D**

The monitor will not run unless:

(1) The MIL is OFF.

(b) Drive Pattern

(1) Connect the OBD II scan tool to the DLC3 to check monitor status and preconditions (refer to step "D").

Step (1)

(2) Start the engine and allow it to idle for 500 seconds or more.

Step (2)

(3) Drive the vehicle at 25 mph (40 km/h) or more for at least 2 minutes.

Step (3)

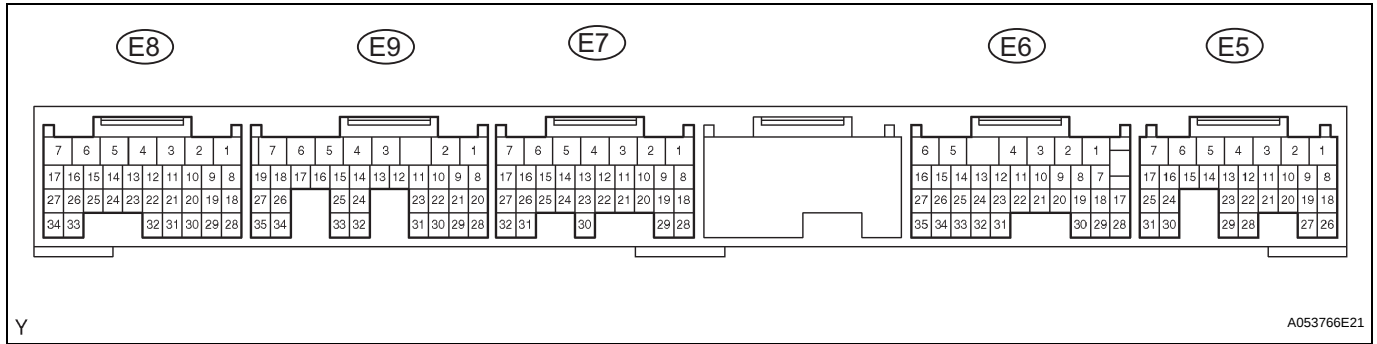
(4) Check the readiness monitor status. If the readiness monitor status did not change to "complete", check the preconditions, turn the ignition switch OFF, and repeat steps (2) to (3).

PROBLEM SYMPTOMS TABLE

SFI SYSTEM

Symptom	Suspected area	See page
Engine does not crank (does not start)	1. Starter	ST-8
	2. ST Relay	ST-13
	3. Park/neutral position switch	AX-42
No initial combustion (does not start)	1. ECM power source circuit	ES-336
	2. Fuel pump control circuit	ES-341
	3. ECM	ES-388
No complete combustion (does not start)	Fuel pump control circuit	ES-341
Difficult to start (engine cranks normally)	1. Starter signal circuit	ES-236
	2. Fuel pump control circuit	ES-341
	3. Compression	EM-1
Difficult to start with cold engine	1. Starter signal circuit	ES-236
	2. Fuel pump control circuit	ES-341
Difficult to start with hot engine	1. Starter signal circuit	ES-236
	2. Fuel pump control circuit	ES-341
High engine idle speed (poor idling)	1. A/C signal circuit (Compressor circuit)	AC-108
	2. ECM power source circuit	ES-336
Low engine idle speed (poor idling)	1. A/C signal circuit (Compressor circuit)	AC-108
	2. Fuel pump control circuit	ES-341
Rough idling (poor idling)	1. Compression	EM-1
	2. Fuel pump control circuit	ES-341
Hunting (poor idling)	1. ECM power source circuit	ES-336
	2. Fuel pump control circuit	ES-341
Hesitation/Poor acceleration (poor driveability)	1. Fuel pump control circuit	ES-341
	2. A/T faulty	AX-38
Surging (poor driveability)	Fuel pump control circuit	ES-341
Engine stalls soon after starting	Fuel pump control circuit	ES-341
Engine stalls during A/C operation	1. A/C signal circuit (Compressor circuit)	AC-108
	2. ECM	ES-388
Unable to refuel/Difficult to refuel	ORVR system	-

TERMINALS OF ECM



HINT:

Each ECM terminal's standard voltage is shown in the table below. In the table, first follow the information under "Condition". Next look under "Symbols (Terminal No.)" for the terminals to be inspected. The standard voltage between the terminals is shown under "Specific Condition". Use the illustration above as a reference for the ECM terminals.

Symbols (Terminal No.)	Wiring Color	Terminal Description	Condition	STD Voltage (V)
BATT (E5-3) - E1 (E7-1)	B - BR	Battery (for measuring the battery voltage and for the ECM memory)	Always	9 to 14
+BM (E6-6) - E1 (E7-1)	LG - BR	Power source of throttle motor	Always	9 to 14
IGSW (E5-9) - E1 (E7-1)	G - BR	Ignition switch	IG switch ON	9 to 14
+B (E5-1) - E1 (E7-1)	L-B - BR	Power source of ECM	IG switch ON	9 to 14
+B2 (E5-2) - E1 (E7-1)	L-B - BR	Power source of ECM	IG switch ON	9 to 14
OC1+ (E7-16) - OC1- (E7-15)	G-W - G-R	Camshaft timing oil control valve (OCV)	IG switch ON	Pulse generation (See page ES-57)
OC2+ (E7-14) - OC2- (E7-13)	L-R - G-B	Camshaft timing oil control valve (OCV)	IG switch ON	Pulse generation (See page ES-57)
MREL (E5-8) - E1 (E7-1)	LG - BR	EFI relay	IG switch ON	9 to 14
VC (E8-18) - E2 (E8-28)	Y - BR	Power source of sensor (a specific voltage)	IG switch ON	4.5 to 5.5
VG (E8-30) - E2G (E8-29)	R - L-W	Mass air flow sensor	Idling, shift lever position P or N position, A/C switch OFF	0.5 to 3.0
THA (E8-20) - E2 (E8-28)	L-B - BR	Intake air temperature sensor	Idling, Intake air temp. 20°C (68°F)	0.5 to 3.4
THW (E8-19) - E2 (E8-28)	G-B - BR	Engine coolant temperature sensor	Idling, Engine coolant temp. 80°C (176°F)	0.2 to 1.0
VTA1 (E8-21) - E2 (E8-28)	R-W - BR	Throttle position sensor (for the engine control)	IG switch ON, Accelerator pedal released	0.5 to 1.2
VTA1 (E8-21) - E2 (E8-28)	R-W - BR	Throttle position sensor (for the engine control)	IG switch ON, Accelerator pedal depressed	3.2 to 4.8
VTA2 (E8-31) - E2 (E8-28)	B-R - BR	Throttle position sensor (for the sensor malfunction detection)	IG switch ON, Accelerator pedal released	2.1 to 3.1
VTA2 (E8-31) - E2 (E8-28)	B-R - BR	Throttle position sensor (for the sensor malfunction detection)	IG switch ON, Accelerator pedal depressed	4.5 to 5.5
VPA (E5-22) - EPA (E5-28)	W - V	Accelerator pedal position sensor (for the engine control)	IG switch ON, Accelerator pedal released	0.5 to 1.1
VPA (E5-22) - EPA (E4-28)	W - V	Accelerator pedal position sensor (for the engine control)	IG switch ON, Accelerator pedal depressed	2.6 to 4.5
VPA2 (E5-23) - EPA2 (E5-29)	R - O	Accelerator pedal position sensor (for the sensor malfunction detection)	IG switch ON, Accelerator pedal released	1.2 to 2.0

Symbols (Terminal No.)	Wiring Color	Terminal Description	Condition	STD Voltage (V)
VPA2 (E5-23) - EPA2 (E5-29)	R - O	Accelerator pedal position sensor (for the sensor malfunction detection)	IG switch ON, Accelerator pedal depressed	3.4 to 5.3
VCPA (E5-26) - EPA (E5-28)	B - V	Power source of accelerator pedal position sensor (for VPA)	IG switch ON	4.5 to 5.5
VCP2 (E5-27) - EPA2 (E5-29)	SB - O	Power source of accelerator pedal position sensor (for VPA2)	IG switch ON	4.5 to 5.5
HA1A (E9-5) - E04 (E9-7) HA2A (E9-4) - E05 (E9-6)	B-W - W-B R-W - W-B	A/F sensor heater	Idling	Below 3.0
HA1A (E9-5) - E04 (E9-7) HA2A (E9-4) - E05 (E9-6)	B-W - W-B R-W - W-B	A/F sensor heater	IG switch ON	9 to 14
A1A+ (E9-22) - E1 (E7-1)	BR - BR	A/F sensor	IG switch ON	3.0 to 3.6
A2A+ (E9-23) - E1 (E7-1)	P - BR	A/F sensor	IG switch ON	3.0 to 3.6
A1A- (E9-30) - E1 (E7-1)	Y- BR	A/F sensor	IG switch ON	2.7 to 3.3
A2A- (E9-31) - E1 (E7-1)	L - BR	A/F sensor	IG switch ON	2.7 to 3.3
HT1B (E9-25) - E2 (E8-28) HT2B (E9-33) - E2 (E8-28)	R-Y - BR W-L - BR	Heated oxygen sensor heater	Idling	Below 3.0
HT1B (E9-25) - E2 (E8-28) HT2B (E9-33) - E2 (E8-28)	R-Y - BR W-L - BR	Heated oxygen sensor heater	IG switch ON	9 to 14
OX1B (E9-21) - E2 (E8-28) OX2B (E9-29) - E2 (E8-28)	W - BR B - BR	Heated oxygen sensor	Maintain engine speed at 2,500 rpm for 2 minutes after warming up	Pulse generation
#10 (E8-1) - E01 (E8-7) #20 (E8-2) - E01 (E8-7) #30 (E8-3) - E01 (E8-7) #40 (E8-4) - E01 (E8-7) #50 (E8-5) - E01 (E8-7) #60 (E9-3) - E01 (E8-7)	L - W-B Y - W-B B - W-B W - W-B B-W - W-B G - W-B	Injector	IG switch ON	9 to 14
#10 (E8-1) - E01 (E8-7) #20 (E8-2) - E01 (E8-7) #30 (E8-3) - E01 (E8-7) #40 (E8-4) - E01 (E8-7) #50 (E8-5) - E01 (E8-7) #60 (E9-3) - E01 (E8-7)	L - W-B Y - W-B B - W-B W - W-B B-W - W-B G - W-B	Injector	Idling	Pulse generation (See page ES-152)
KNK1 (E9-1) - EKNK (E9-28)	B - W	Knock sensor	Maintain engine speed at 4,000 rpm after warming up	Pulse generation (See page ES-165)
KNK2 (E9-2) - EKN2 (E9-20)	R - G	Knock sensor	Maintain engine speed at 4,000 after warming up	Pulse generation (See page ES-165)
VV1+ (E7-27) - NE- (E7-24)	B-W - G	Variable valve timing (VVT) sensor	Idling	Pulse generation (See page ES-170)
VV2+ (E7-26) - NE- (E7-24)	L - G	Variable valve timing (VVT) sensor	Idling	Pulse generation (See page ES-170)
NE+ (E7-25) - NE- (E7-24)	R - G	Crankshaft position sensor	Idling	Pulse generation (See page ES-170)
IGT1 (E8-8) - E1 (E7-1) IGT2 (E8-9) - E1 (E7-1) IGT3 (E8-10) - E1 (E7-1) IGT4 (E8-11) - E1 (E7-1) IGT5 (E8-12) - E1 (E7-1) IGT6 (E8-13) - E1 (E7-1)	R-L - BR P - BR Y-B - BR L-Y - BR G-Y - BR L-R - BR	Ignition coil with igniter (ignition signal)	Idling	Pulse generation (See page ES-182)
IGF1 (E8-24) - E1 (E7-1)	W-R - BR	Ignition coil igniter (ignition confirmation signal)	IG switch ON	4.5 to 5.0
IGF1 (E8-24) - E1 (E7-1)	W-R - BR	Ignition coil igniter (ignition confirmation signal)	Idling	Pulse generation (See page ES-182)
PRG (E8-34) - E1 (E7-1)	G - BR	VSV for EVAP	IG switch ON	9 to 14
CCV (E8-27) - E1 (E7-1)	L - BR	VSV for CCV	IG switch ON	9 to 14
PTNK (E5-21) - E2 (E8-28)	V - BR	Vapor pressure sensor	Ignition switch ON	2.9 to 3.7

Symbols (Terminal No.)	Wiring Color	Terminal Description	Condition	STD Voltage (V)
PTNK (E5-21) - E2 (E8-28)	V - BR	Vapor pressure sensor	Apply vacuum 4.0 kPa (30 mmHg, 1.18 in.Hg)	Below 0.5
SPD (E6-17) - E1 (E7-1)	LG - BR	Speed signal from combination meter	IG switch ON, Rotate driving wheel slowly	Pulse generation (See page ES-218)
STA (E8-17) - E1 (E7-1)	B - BR	Starter signal	Shift lever position P or N, Ignition switch START	9 to 14
STP (E6-19) - E1 (E7-1)	B - BR	Stop light switch	Brake pedal is depressed	7.5 to 14
STP (E6-19) - E1 (E7-1)	B - BR	Stop light switch	Brake pedal is released	Below 1.5
NSW (E8-16) - E1 (E7-1)	B-Y - BR	Park/neutral position switch	IG switch ON, Shift position in P, N	0 to 3.0
NSW (E8-16) - E1 (E7-1)	B-Y - BR	Park/neutral position switch	IG switch ON, Other shift position in P, N	9 to 14
M+ (E7-3) - ME01 (E7-4) M- (E7-2) - ME01 (E7-4)	B - W-B W - W-B	Throttle motor	Idling	Pulse generation
FC (E5-10) - E1 (E7-1)	O - BR	Fuel pump control	IG switch ON	9 to 14
W (E5-11) - E1 (E7-1)	BR - BR	MIL	IG switch ON	Below 3.0
W (E5-11) - E1 (E7-1)	BR - BR	MIL	Idling	9 to 14
ELS (E5-12) - E1 (E7-1)	SB- BR	Electric load	Power outlet OFF	0 to 1.5
ELS (E5-12) - E1 (E7-1)	SB - BR	Electric load	Power outlet ON	7.5 to 14
TC (E5-20) - E1 (E7-1)	BR - BR	Terminal TC of DLC3	IG switch ON	9 to 14
SIL (E5-18) - E1 (E7-1)	GR - BR	Terminal SIL of DLC3	During charge gears	Pulse generation
TACH (E5-5) - E1 (E7-1)	W - BR	Engine speed	Idling	Pulse generation
AICV (E8-33) - E1 (E7-1)	W - BR	VSV for AICV	IG switch ON	9 to 14
ACIS (E8-15) - E1 (E7-1)	R-Y - BR	VSV for ACIS	IG switch ON	9 to 14
ACM (E7-6) - E1 (E7-1)	Y-G - BR	VSV for ACM	IG switch ON	9 to 14
ENG+ (E5-24) - ENG- (E5-30)	LG - L	Electric load (from skid control ECU)	Idling	Pulse generation
TRC+ (E5-25) - TRC- (E5-31)	Y - G	Electric load (from skid control ECU)	Idling	Pulse generation
PSW (E7-10) - E1 (E7-1)	R-W - BR	P/S pressure switch	IG switch ON	9 to 14

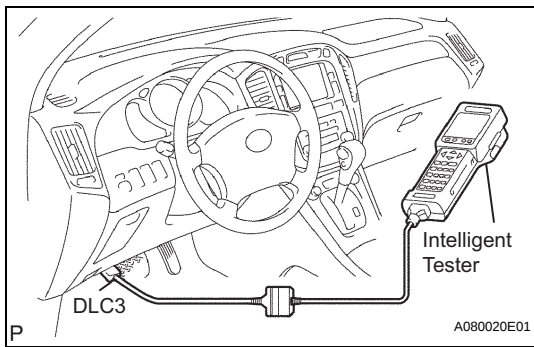


DIAGNOSIS SYSTEM

1. DESCRIPTION

- When troubleshooting On-Board Diagnostic (OBD II) vehicles, the vehicle must be connected to the OBD II scan tool (in compliance with SAE J1978) or the intelligent tester. Various data output from the vehicle's ECM can then be read.
- OBD II regulations require that the vehicle's on-board computer illuminates the Malfunction Indicator Lamp (MIL) on the instrument panel when the computer detects a malfunction in: 1) the emission control system/components, or 2) the powertrain control components (which affect vehicle emissions), or 3) the computer. In addition, the applicable Diagnostic Trouble Codes (DTCs) prescribed by SAE J2012 are recorded in the ECM memory (See page [ES-37](#)).

If the malfunction does not reoccur in 3 consecutive trips, the MIL turns off automatically but the DTCs remain recorded in the ECM memory.

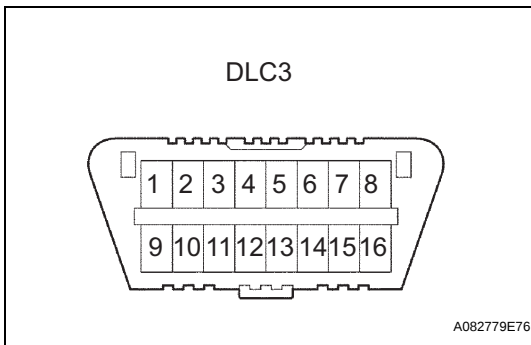


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- To check DTCs, connect the intelligent tester or OBD II scan tool to the Data Link Connector 3 (DLC3) of the vehicle. The intelligent tester or OBD II scan tool also enables you to erase the DTC and check freeze frame data and various forms of engine data (see the instruction manual for the OBD II scan tool or the intelligent tester). The DTC includes SAE controlled codes and manufacturer controlled codes. SAE controlled codes must be set according to the SAE, while manufacturer controlled codes can be set by a manufacturer with certain restrictions (See page [ES-28](#)).
- 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. A "check mode" is also available to technicians as an option. In "check mode", 1 trip detection logic is used for simulating malfunction symptoms and increasing the system's ability to detect malfunctions, including intermittent malfunctions (intelligent tester only) (see page [ES-29](#)).
- *2 trip detection logic: When a malfunction is first detected, the malfunction is temporarily stored in the ECM memory (1st trip). If the ignition switch is turned OFF and then ON again, and the same malfunction is detected again, the MIL will illuminate (2nd trip).
- 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.

Priorities for troubleshooting: When multiple DTCs occur, find out the order in which the DTCs should be inspected by checking the component's DTC chart. If no instructions are written in the DTC chart, check DTCs in following order of priority:

- (a) DTCs other than fuel trim malfunction DTCs (P0171, P0172, P0174 and P0175) and misfire DTCs (P0300 to P0306).
- (b) Fuel trim malfunction DTCs (P0171, P0172, P0174 and P0175).
- (c) Misfire DTCs (P0300 to P0306).



2. CHECK DLC3

The vehicle's ECM uses the ISO 9141-2 communication protocol. The terminal arrangement of the DLC3 complies with SAE J1962 and matches the ISO 9141-2 format.

Symbols	Terminal No.	Names	Reference terminal	Results	Condition
SIL	7	Bus "+" line	5 - Signal ground	Pulse generation	During transmission
CG	4	Chassis ground	Body ground	1 Ω or less	Always
SG	5	Signal ground	Body ground	1 Ω or less	Always
BAT	16	Battery ground	Body ground	9 to 14 V	Always

HINT:

Connect the cable of the OBD II scan tool or the intelligent tester to the DLC3, turn the ignition switch ON and attempt to use the OBD II scan tool or the intelligent tester. If the screen displays UNABLE TO CONNECT TO VEHICLE, a problem exists in the vehicle side or the tester side.

- If the communication is normal when the tool is connected to another vehicle, inspect the DLC3 on the original vehicle.
- If the communication is still impossible when the tool is connected to another vehicle, the problem is probably in the tool itself. Consult the Service Department listed in the tool's instruction manual.

3. CHECK BATTERY VOLTAGE

Battery Voltage:

11 to 14 V

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

4. CHECK THE MIL

- (a) The MIL turns ON when the ignition switch is turned ON and the engine is not running.

HINT:

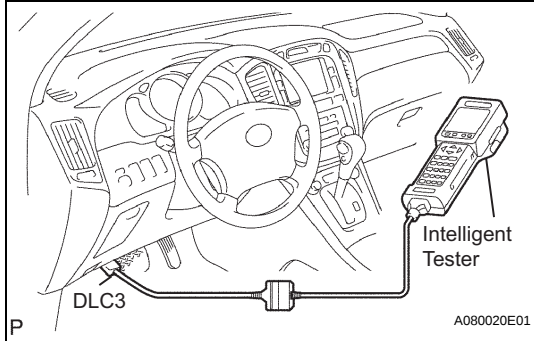
If the MIL does not turn ON, troubleshoot the MIL circuit (See page [ES-361](#)).

- (b) When the engine is started, the MIL should turn OFF. If the lamp remains ON, the diagnosis system has detected a malfunction or abnormality in the system.

DTC CHECK / CLEAR

NOTICE:

- If no DTC appears in normal mode:
On the OBD II scan tool or the intelligent tester, check the pending fault code using the Continuous Test Results function (Mode 7 for SAE J1979).
- 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 will be erased. Before changing modes, always check and make a note of DTCs and freeze frame data.



1. CHECK DTC (Using the OBD II scan tool or intelligent tester)

- Connect the OBD II scan tool or intelligent tester to the DLC3.
- Turn the ignition switch ON.
- Use the OBD II scan tool or the intelligent tester to check the DTCs and freeze frame data and then make a note of them.

For the intelligent tester, enter the following menus: DIAGNOSIS / ENHANCED OBD II / DTC INFO / CURRENT CODES. For the OBD II scan tool, see its instruction manual.

- Confirm the details of the DTCs (See page [ES-37](#)).

NOTICE:

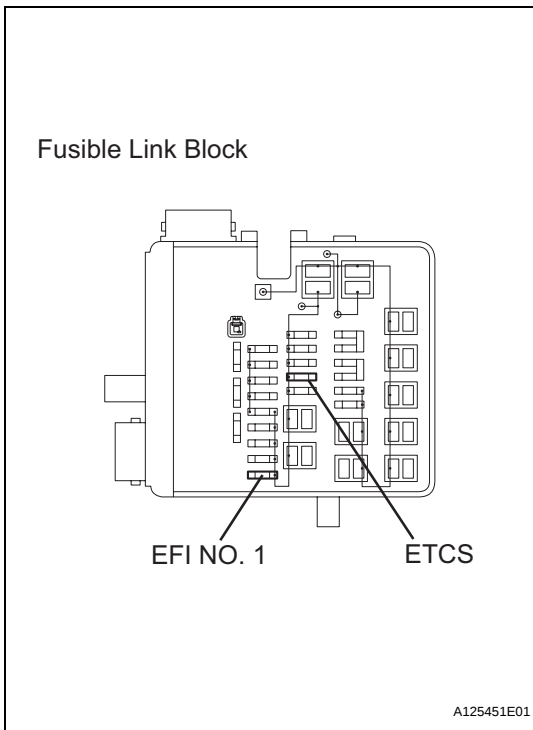
When simulating a symptom with the OBD II scan tool (excluding intelligent tester) to check for DTCs, use the normal mode. For DTCs subject to "2 trip detection logic", perform either of the following actions.

- Turn the ignition switch OFF after the symptom is simulated once. Then repeat the simulation process again. When the problem has been simulated twice, the MIL illuminates and the DTCs are recorded in the ECM.
- Check the pending fault code using the Continuous Test Results function (Mode 7 for SAE J1979) on the OBD II scan tool.

2. CLEAR DTC (Using the OBD II scan tool or intelligent tester)

- Connect the OBD II scan tool or the intelligent tester to the DLC3.
- Turn the ignition switch ON.
- Erase DTCs and freeze frame data with the OBD II scan tool (complying with SAE J1978) or the intelligent tester.

For the intelligent tester: 1) enter the following menus: DIAGNOSIS / ENHANCED OBD II / DTC INFO / CLEAR CODES; and 2) press YES. For the OBD II scan tool, see its instruction manual.



3. CLEAR DTC (Not using the OBD II scan tool or intelligent tester)

- (a) Remove the EFI No. 1 fuse and ETCS fuse from the fusible link block for more than 60 seconds. Or, disconnect the battery terminal for more than 60 seconds.

After disconnecting the battery cable, perform the "INITIALIZE" procedure.

CHECK MODE PROCEDURE

HINT:

Intelligent tester only:

Check mode has a higher sensitivity to detect malfunctions and can detect malfunctions that normal mode cannot detect. Check mode can also detect all the malfunctions that normal mode can detect.

1. CHECK MODE PROCEDURE (Using the intelligent tester)

(a) Make sure that the items below are true:

- (1) Battery positive voltage 11 V or more
- (2) Throttle valve fully closed
- (3) Transmission in the P or N position
- (4) A/C switched OFF

(b) Turn the ignition switch OFF.

(c) Connect the intelligent tester to the DLC3.

(d) Turn the ignition switch ON.

(e) Change the ECM to check mode with the intelligent tester. Enter the following menus: DIAGNOSIS / ENHANCED OBD II / CHECK MODE. Make sure the MIL flashes as shown in the illustration.

NOTICE:

All DTCs and freeze frame data recorded will be erased if: 1) the intelligent tester is used to change the ECM from normal mode to check mode or vice-versa; or 2) during check mode, the ignition switch is turned from ON to ACC or OFF.

(f) Start the engine. The MIL should turn OFF after the engine starts.

(g) Simulate the conditions of the malfunction described by the customer.

(h) After simulating the malfunction conditions, use the intelligent tester diagnosis selector to check the DTC, freeze frame data and other data.

(i) After checking the DTC, inspect the applicable circuit.

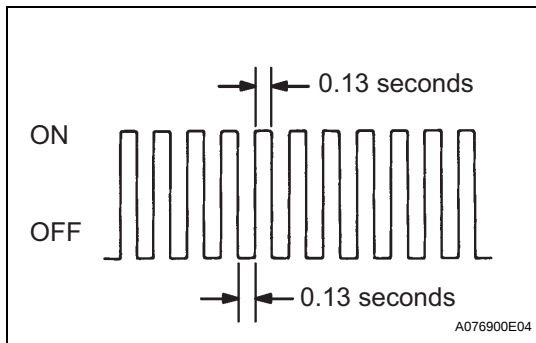
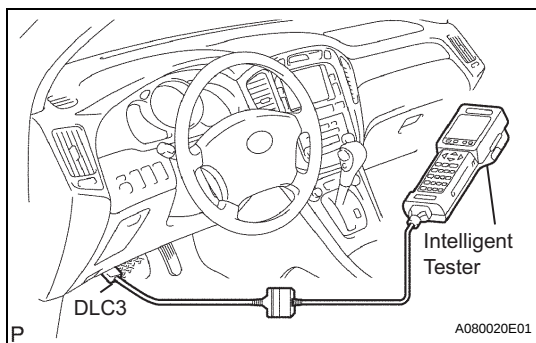
2. CLEAR DTC (Using the OBD II scan tool or intelligent tester)

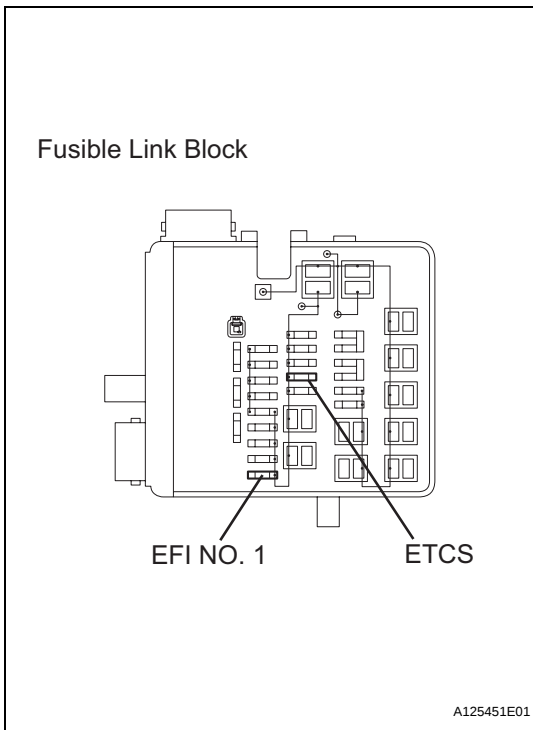
(a) Connect the OBD II scan tool or the intelligent tester to the DLC3.

(b) Turn the ignition switch ON.

(c) Erase DTCs and freeze frame data with the OBD II scan tool (complying with SAE J1978) or the intelligent tester.

For the intelligent tester: 1) enter the following menus: DIAGNOSIS / ENHANCED OBD II / DTC INFO / CLEAR CODES; and 2) press YES. For the OBD II scan tool, see its instruction manual.





3. CLEAR DTC (Not using the OBD II scan tool or intelligent tester)

- (a) Remove the EFI NO. 1 and ETCS fuses from the fusible link block for more than 60 seconds. Or, disconnect the battery cable for more than 60 seconds. After disconnecting the battery terminal, perform the "INITIALIZE" procedure.

FAIL-SAFE CHART

If any of the following codes are recorded, the ECM enters fail-safe mode.

DTC No.	Fail-Safe Operation	Fail Safe Deactivation Condition
P0031 P0032 P0037 P0038 P0051 P0052 P0057 P0058	Turn off heater	Ignition switch OFF
P0100 P0102 P0103	Ignition timing is calculated from engine RPM and TP (Throttle Position)	"Pass" condition detected
P0110 P0112 P0113	IAT (Intake Air Temperature) is fixed at 20°C (68°F)	"Pass" condition detected
P0115 P0117 P0118	ECT (Engine Coolant Temperature) is fixed at 80°C (176°F)	"Pass" condition detected
P0120 P0121 P0122 P0123 P0220 P0222 P0223 P0604 P0606 P0607 P0657 P2102 P2103 P2111 P2112 P2118 P2119 P2135	If the Electronic Throttle Control System (ETCS) has a malfunction, the ECM cuts off current to the throttle actuator. The throttle control valve returns to a predetermined opening angle (approximately 16°) by the force of 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 enable the vehicle to continue at a minimal speed. If the accelerator pedal is depressed firmly and slowly, the vehicle can be driven slowly. If the accelerator pedal is depressed quickly, the vehicle may speed up and slow down erratically.	"Pass" condition is detected and then the ignition switch is turned OFF.
P0325 P0327 P0328 P0330 P0332 P0333	Maximum ignition timing retardation	Ignition switch OFF
P0351 P0352 P0353 P0354 P0355 P0356	Fuel is cut	"Pass" condition detected
P2120 P2121 P2122 P2123 P2125 P2127 P2128 P2138	The accelerator pedal position sensor has 2 (main and sub) sensor circuits. If a malfunction occurs in either of the sensor circuits, the ECM detects the abnormal signal voltage difference between the 2 sensor circuits and switches to fail-safe mode. In fail-safe 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 to be fully closed. In this case, the throttle valve will remain closed as if the engine is idling.	"Pass" condition is detected and the ignition switch is turned OFF.

DATA LIST / ACTIVE TEST

1. DATA LIST

HINT:

Using the intelligent tester's DATA LIST allows switch, sensor, actuator and other item values to be read without removing any parts. Reading the DATA LIST early in troubleshooting is one way to save time.

NOTICE:

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

- Warm up the engine.
- Turn the ignition switch OFF.
- Connect the intelligent tester or the OBD II scan tool to the DLC3.
- Turn the ignition switch ON.
- Turn ON the intelligent tester.
- Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DATA LIST.
- According to the display on tester, read the "DATA LIST".

ES

Intelligent Tester Display	Measurement: Range (Display)	Normal Condition*1	Diagnostic Note
INJECTOR	Injection period of No.1 cylinder: Min.:0 ms, Max.:32.64 ms	1.5 to 2.8 ms: Idling (Inspection mode)	-
IGN ADVANCE	Ignition timing advance for No. 1 cylinder/ Min.: -64 deg., Max.: 63.5 deg.	BTDC 5 to 25° : Idling (Inspection mode)	-
CALC LOAD	Calculated load by ECM: Min.: 0 %, Max.: 100 %	10.4 to 15.6 %: Idling - Running without load (2,500 rpm): 12.1 to 18.2 %	-
MAF	Air flow rate from MAF meter: Min.: 0 g/s , Max.: 655 g/s	2.0 to 3.7 gm/s: Idling - Running without load (2,500 rpm): 2.4 to 4.3 gm/s	If value approximately 0.0 g/s: - Mass air flow meter power source circuit open - VG circuit open or short - If valve is 160.0 g/s or more: - E2G circuit open
ENGINE SPD	Engine speed: Min.: 0 rpm, Max.: 16,383 rpm	Idling: 580 to 750 rpm	-
COOLANT TEMP	Engine coolant temperature: Min.: -40°C, Max.: 140°C	After warming up: 80 to 97°C (176 to 207°F)	- 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, Max.: 140°C	Equivalent to ambient temp. (after cold soak)	
THROTTLE POS	Absolute throttle position sensor/ Minimum: 0 %, Maximum: 100 %	- Throttle fully closed: 10 to 24 % - Throttle fully open: 64 to 96 %	Read value with ignition switch ON (do not start engine)
CTP SW	Closed throttle position switch/ ON or OFF	- Throttle fully closed: ON - Throttle open: OFF	-
VEHICLE SPD	Vehicle speed/ Minimum: 0 km/h, Maximum: 255 km/h	Actual vehicle speed	Speed indicated on speedometer
ACCEL POS #1	Accelerator pedal position sensor No.1 output voltage/ Minimum: 0 V, Maximum: 5 V	- Accelerator pedal released: 0.5 to 1.1 V - Accelerator pedal depressed: 2.6 to 4.5 V	Read value with ignition switch ON (do not start engine)

Intelligent Tester Display	Measurement: Range (Display)	Normal Condition*1	Diagnostic Note
ACCEL POS #2	Accelerator pedal position sensor No. 2 output voltage/ Minimum: 0 V, Maximum: 5 V	- Accelerator pedal released: 1.2 to 2.0 V - Accelerator pedal depressed: 3.4 to 5.3 V	Read value with ignition switch ON (do not start engine)
THROTTLE POS #2	Throttle position No. 2: Min.: 0 V, Max.: 5 V	2.1 to 3.1 V: Throttle fully closed 4.5 to 5.5 V: Throttle fully open	Read value with intrusive operation (active test)
THROTTLE TARGT	Target position of throttle valve/ Minimum: 0 V, Maximum: 5 V	Idling: 0.4 to 1.1 V	-
THROTTLE OPN DUTY	Throttle motor opening duty ratio/ Minimum: 0 %, Maximum: 100 %	Throttle fully closed: 0 %	- When accelerator pedal is depressed, duty ratio is increased - Read value with ignition switch ON (do not start engine)
THROTTLE CLS DUTY	Throttle motor closed duty ratio/ Minimum: 0 %, Maximum: 100 %	Throttle fully open: 0 %	- When accelerator pedal is released quickly, duty ratio is increased - Read the value with ignition switch ON (do not start engine)
THROTTLE MOT	Whether or not throttle actuator control is permitted/ ON or OFF	Idling: ON	Read value with ignition switch ON (do not start engine)
+BM	Whether or not accelerator pedal position sensor is detecting idle/ ON or OFF	Idling: ON	-
ACCEL IDL POS	Whether or not accelerator pedal position sensor is detecting idle/ ON or OFF	Idling: ON	-
THROTTLE IDL POS	Whether or not throttle position sensor is detecting idle/ ON or OFF	Idling: ON	-
FAIL #1	Whether or not fail safe function is executed/ ON or OFF	ETCS has failed: ON	-
FAIL #2	Whether or not fail safe function is executed/ ON or OFF	ETCS has failed: ON	-
THROTTLE INITIAL	Throttle fully closed (learned value) Minimum: 0 V, Maximum: 5 V	0.5 to 0.9 V	-
ACCEL LEARN VAL	Accelerator fully closed (learned value) Minimum: 0 V, Maximum: 5 V	0.4 to 0.8 V	-
THROTTLE MOT	Throttle actuator current Minimum: 0 A, Maximum: 20 A	Idling: 0 to 3.0 A	-
O2S B1 S2	Heated oxygen sensor output voltage for bank 1 sensor 2/ Minimum: 0 V, Maximum: 1.0 V	Driving (50 km/h, 31 mph): 0.1 to 0.9 V	Performing INJ VOL or A/F CONTROL function of ACTIVE TEST enables the technician to check voltage output of each sensor
O2S B2 S2	Heated oxygen sensor output voltage for bank 2 sensor 2/ Minimum: 0 V, Maximum: 1.0 V	Driving (50 km/h, 31 mph): 0.1 to 0.9 V	Performing INJ VOL or A/F CONTROL function of ACTIVE TEST enables the technician to check voltage output of each sensor
AFS B1 S1	A/F sensor output voltage for bank 1 sensor 1/ Minimum: 0 V, Maximum: 7.999 V	Idling 2.8 to 3.8 V	Performing INJ VOL or A/F CONTROL function of ACTIVE TEST enables the technician to check voltage output of each sensor

Intelligent Tester Display	Measurement: Range (Display)	Normal Condition*1	Diagnostic Note
AFS B2 S1	A/F sensor output voltage for bank 2 sensor 1/ Minimum: 0 V, Maximum: 7.999 V	Idling 2.8 to 3.8 V	Performing INJ VOL or A/F CONTROL function of ACTIVE TEST enables the technician to check voltage output of each sensor
VAPOR PRESS	Vapor Pressure/ Minimum: -4.125 kPa, Maximum: 2.125 kPa	Fuel tank cap removed: 0 kPa	Pressure inside of fuel tank as read by the vapor pressure sensor
SHORT FT #1	Short term fuel trim of bank 1/ Minimum: -100 %, Maximum: 100 %	0 +- 20 %	This item is 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/ Minimum: -100 %, Maximum: 100 %	0 +- 20 %	This item is overall, long-term fuel compensation that helps to maintain air-fuel ratio at stoichiometric air-fuel ratio (steadies long term deviations of short-term fuel trim from central value)
TOTAL FT #1	Total fuel trim of bank 1: Average value for fuel trim system of bank 1/ Minimum: 0.5, Maximum: 1.496	Idling: 0.5 to 1.4	-
SHORT FT #2	Short term fuel trim of bank 2/ Minimum: -100 %, Maximum: 100 %	0 +- 20 %	This item is short-term fuel compensation used to maintain air-fuel ratio at stoichiometric air-fuel ratio
LONG FT #2	Long term fuel trim of bank 2/ Minimum: -100 %, Maximum: 100 %	0 +- 20 %	This item is overall, long-term fuel compensation that helps to maintain air-fuel ratio at stoichiometric air-fuel ratio (steadies long term deviation of short-term fuel trim from central value)
TOTAL FT #2	Total fuel trim of bank 2: Average value for fuel trim system of bank 2/ Minimum: 0.5, Maximum: 1.496	Idling: 0.5 to 1.4	-
O2FT B1 S2	Short term fuel trim associated with the bank 1 sensor 2/ Minimum: -100 %, Maximum: 100 %	0 +- 20 %	Same as SHORT FT #1
O2FT B2 S2	Short term fuel trim associated with the bank 2 sensor 2/ Minimum: -100 %, Maximum: 100 %	0 +- 20 %	Same as SHORT FT #2
AF FT B1 S1	Short term fuel trim associated with bank 1 sensor 1/ Minimum: 0, Maximum: 1.999	- Value less than 1 (0.000 to 0.999) = Lean - Stoichiometric air-fuel ratio = 1 - Value greater than 1 (1.001 to 1.999) = Rich	-
AF FT B2 S1	Short term fuel trim associated with bank 2 sensor 1/ Minimum: 0, Maximum: 1.999	- Lean: 0 more than AF FT B2 S1 less than 1 - Stoichiometric air-fuel ratio = 1 - Rich: 1 more than AF FT B2 S1 less than 1.999	-

ES

Intelligent Tester Display	Measurement: Range (Display)	Normal Condition*1	Diagnostic Note
FUEL SYS #1	Fuel system status (Bank 1) / OL or CL or OL DRIVE or OL FAULT or CL FAULT	Idling after warming up: CL	- OL (Open Loop): Has not yet satisfied conditions to go closed loop - CL (Closed Loop): Using heated oxygen sensor(s) as feed back for fuel control - OL DRIVE: Open loop due to driving conditions (fuel enrichment) - OL FAULT: Open loop due to detected system fault - CL FAULT: Closed loop but one of heated oxygen sensors, which is used for fuel control, is malfunctioning
FUEL SYS #2	Fuel system status (Bank 2) / OL or CL or OL DRIVE or OL FAULT or CL FAULT	Idling after warming up: CL	- OL (Open Loop): Has not yet satisfied conditions to go closed loop - CL (Closed Loop): Using heated oxygen sensor(s) as feed back for fuel control - OL DRIVE: Open loop due to driving conditions (fuel enrichment) - OL FAULT: Open loop due to detected system fault - CL FAULT: Closed loop but one of heated oxygen sensors, which is used for fuel control, is malfunctioning
FC IDL	Fuel cut idle/ ON or OFF	Fuel cut operation: ON	FC IDL = ON when throttle valve is fully closed and engine speed is over 1,500 rpm
MIL	MIL status/ ON or OFF	MIL ON: ON	-
STARTER SIG	Starter signal/ ON or OFF	Cranking: ON	-
A/C SIG	A/C signal/ ON or OFF	A/C ON: ON	-
PNP SW [NSW]	PNP switch signal/ ON or OFF	P or N position: ON	-
ELECT LOAD SIG	Electrical load signal/ ON or OFF	- Taillight switch ON: ON - Defogger switch ON: ON	-
STOP LIGHT SW	Stop light switch/ ON or OFF	- Brake pedal depressed: ON - Brake pedal released: OFF	-
PS OIL PRESS SW	Power steering oil pressure switch signal/ ON or OFF	- While turning the steering wheel: ON - While not turning the steering wheel: OFF	Idle-up control is performed when PS is ON
PS SIGNAL	Power steering signal/ ON or OFF	When steering wheel is turned	This signal is usually ON until the Ignition switch is turned OFF
INTAKE CTL VSV1	VSV status for intake control (bank 1)/ ON or OFF	VSV operation: ON	-
INTAKE CTL VSV 2	VSV status for intake control (bank 2)/ ON or OFF	VSV operation: ON	-
FUEL PUMP / SPD	Fuel pump/speed status/ ON/H or OFF/M,L	Idling: ON	-
A/C MAG CLUTCH	A/C magnet clutch status/ ON or OFF	A/C magnet clutch ON: ON	-
EVAP VSV	VSV status for EVAP control/ ON or OFF	VSV operating: ON	EVAP VSV is controlled by the ECM (ground side duty control)
BOOST PRESS VSV	VSV status for boost pressure control/ ON or OFF	VSV operating: ON	-
IGNITION	Ignition counter/ Minimum: 0, Maximum: 600	0 to 600	-

Intelligent Tester Display	Measurement: Range (Display)	Normal Condition*1	Diagnostic Note
CYL #1, #2, #3, #4, #5, #6	Misfire ratio of cylinder 1 to 6/ Minimum: 0 %, Maximum: 50 %	0 %	This item is displayed in only idling
MISFIRE LOAD	Engine load for first misfire range/ Minimum: 0 g/rev, Maximum: 3.98 g/rev.	Misfire 0: 0 g/rev.	-
MISFIRE RPM	Engine RPM for first misfire range/ Minimum: 0 rpm, Maximum: 6,375 rpm	Misfire 0: 0 rpm	-
FC TAU	Fuel Cut TAU: Fuel cut during very light load/ ON or OFF	Fuel cut operating: ON	Fuel cut is being performed under very light load to prevent engine combustion from becoming incomplete
CHECK MODE	Check mode/ ON or OFF	Check mode ON: ON	-

HINT:

*1: If no idling conditions are specified, the transmission gear selector lever should be in the N or P position, and the A/C switch and all accessory switches should be OFF.

2. ACTIVE TEST**HINT:**

Performing the intelligent tester's ACTIVE TEST allows relay, VSV, actuator and other items to be operated without removing any parts. Performing the ACTIVE TEST early in troubleshooting is one way to save time. The DATA LIST can be displayed during the ACTIVE TEST.

- Warm up the engine.
- Turn the ignition switch OFF.
- Connect the intelligent tester or the OBD II scan tool to the DLC3.
- Turn the ignition switch ON.
- Turn ON the intelligent tester or the OBD II scan tool.
- Enter the following menus: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST.
- According to the display on tester, perform the "ACTIVE TEST".

Intelligent Tester Displays	Test Details	Diagnostic Note
INJ VOL	[Test Details] Control injection volume Minimum: -12.5 %, Maximum: 25 % [Vehicle Condition] Engine speed: 3,000 rpm or less	- All injectors are tested at once - Injection volume is gradually changed between -12.5 and 25 %
A/F CONTROL	[Test Details] Control injection volume -12.5 or 25 % (change injection volume -12.5 % or 25 %) [Vehicle Condition] Engine speed: 3,000 rpm or less	Following A/F CONTROL procedure enables technician to check and graph voltage outputs of both the A/F sensor and heated oxygen sensor For displaying graph, enter "ACTIVE TEST / A/F CONTROL / USER DATA", select "AFS B1S1 and O2S B1S2" by pressing "YES" and push "ENTER". Then press "F4"
INTAKE CTL VSV1	[Test Details] Activate VSV for intake control ON or OFF	-
CAN CTRL VSV	[Test Details] Activate VSV for canister control ON or OFF	-
EVAP VSV (ALONE)	[Test Details] Activate EVAP VSV for canister control ON or OFF	-
A/C MAG CLUTCH	[Test Details] Control A/C magnet clutch ON or OFF	-

Intelligent Tester Displays	Test Details	Diagnostic Note
FUEL PUMP / SPD	[Test Details] Control the fuel pump ON or OFF	-
VVT CTRL B1	[Test Details] Active VVT system (Bank 1) ON or OFF	- ON: Rough idle or engine stall - OFF: Normal engine speed
VVT CTRL B2	[Test Details] Active VVT system (Bank 2) ON or OFF	- ON: Rough idle or engine stall - OFF: Normal engine speed
ACM INHIBIT	[Test Details] Control ACM inhibit ON or OFF	-
TC/TE1	[Test Details] Connect TC and TE1 ON or OFF	-
FC IDL PROHBT	[Test Details] Control idle fuel cut prohibit ON or OFF	-

DIAGNOSTIC TROUBLE CODE CHART

HINT:

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

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

SFI SYSTEM

DTC No.	Detection Item	Trouble Area	MIL	Memory	See page
P0010	Camshaft Position "A" Actuator Circuit (Bank 1)	1. Open or short in OCV (bank 1) circuit 2. OCV (bank 1) 3. ECM	Come on	DTC Stored	ES-57
P0011	Camshaft Position "A" - Timing Over-Advanced or System Performance (Bank 1)	1. Valve timing 2. OCV (bank 1) 3. Camshaft timing gear assembly 4. ECM	Come on	DTC Stored	ES-64
P0012	Camshaft Position "A" - Timing Over-Retarded (Bank 1)	1. Valve timing 2. OCV (bank 1) 3. Camshaft timing gear assembly 4. ECM	Come on	DTC Stored	ES-64
P0016	Crankshaft Position - Camshaft Position Correlation (Bank 1 Sensor A)	1. Mechanical system (Timing belt has jumped tooth, belt is stretched) 2. ECM	Come on	DTC Stored	ES-72
P0018	Crankshaft Position - Camshaft Position Correlation (Bank 2 Sensor A)	1. Mechanical system (Timing belt has jumped tooth, belt is stretched) 2. ECM	Come on	DTC Stored	ES-72
P0020	Camshaft Position "A" Actuator Circuit (Bank 2)	1. Open or short in OCV (bank 2) circuit 2. OCV (bank 2) 3. ECM	Come on	DTC Stored	ES-57
P0021	Camshaft Position "A" - Timing Over-Advanced or System Performance (Bank 2)	1. Valve timing 2. OCV (bank 2) 3. Camshaft timing gear assembly 4. ECM	Come on	DTC Stored	ES-64
P0022	Camshaft Position "A" - Timing Over-Retarded (Bank 2)	1. Valve timing 2. OCV (bank 2) 3. Camshaft timing gear assembly 4. ECM	Come on	DTC Stored	ES-64
P0031 *1	Oxygen (A/F) Sensor Heater Control Circuit Low (Bank 1 Sensor 1)	1. Open or short in heater circuit of A/F sensor 2. A/F sensor heater (bank 1 sensor 1) 3. A/F relay 4. ECM	Come on	DTC Stored	ES-74
P0032 *1	Oxygen (A/F) Sensor Heater Control Circuit High (Bank 1 Sensor 1)	1. Open or short in heater circuit of A/F sensor 2. A/F sensor heater (bank 1 sensor 1) 3. A/F relay 4. ECM	Come on	DTC Stored	ES-74

ES

DTC No.	Detection Item	Trouble Area	MIL	Memory	See page
P0037	Oxygen Sensor Heater Control Circuit Low (Bank 1 Sensor 2)	1. Open or short in heater circuit of heated oxygen sensor 2. Heated oxygen sensor heater (bank 1 sensor 2) 3. EFI MAIN relay 4. ECM	Come on	DTC Stored	ES-79
P0038	Oxygen Sensor Heater Control Circuit High (Bank 1 Sensor 2)	1. Open or short in heater circuit of heated oxygen sensor 2. Heated oxygen sensor heater (bank 1 sensor 2) 3. EFI MAIN relay 4. ECM	Come on	DTC Stored	ES-79
P0051 *1	Oxygen (A/F) Sensor Heater Control Circuit Low (Bank 2 Sensor 1)	1. Open or short in heater circuit of A/F sensor 2. A/F sensor heater (bank 2 sensor 1) 3. A/F relay 4. ECM	Come on	DTC Stored	ES-74
P0052 *1	Oxygen (A/F) Sensor Heater Control Circuit High (Bank 2 Sensor 1)	1. Open or short in heater circuit of A/F sensor 2. A/F sensor heater (bank 2 sensor 1) 3. A/F relay 4. ECM	Come on	DTC Stored	ES-74
P0057	Oxygen Sensor Heater Control Circuit Low (Bank 2 Sensor 2)	1. Open or short in heater circuit of A/F sensor 2. A/F sensor heater (bank 2 sensor 2) 3. A/F relay 4. ECM	Come on	DTC Stored	ES-79
P0058	Oxygen Sensor Heater Control Circuit High (Bank 2 Sensor 2)	1. Open or short in heater circuit of A/F sensor 2. A/F sensor heater (bank 2 sensor 2) 3. A/F relay 4. ECM	Come on	DTC Stored	ES-79
P0100	Mass or Volume Air Flow Circuit	1. Open or short in MAF meter circuit 2. MAF meter 3. ECM	Come on	DTC Stored	ES-84
P0101	Mass Air Flow Circuit Range / Performance Problem	MAF meter	Come on	DTC Stored	ES-91
P0102	Mass or Volume Air Flow Circuit Low Input	1. Open or short in MAF meter circuit 2. MAF meter 3. ECM	Come on	DTC Stored	ES-84
P0103	Mass or Volume Air Flow Circuit High Input	1. Open or short in MAF meter circuit 2. MAF meter 3. ECM	Come on	DTC Stored	ES-84

DTC No.	Detection Item	Trouble Area	MIL	Memory	See page
P0110	Intake Air Temperature Circuit Malfunction	1. Open or short in IAT sensor circuit 2. IAT sensor (built in MAF meter) 3. ECM	Come on	DTC Stored	ES-94
P0112	Intake Air Temperature Circuit Low Input	1. Short in IAT sensor circuit 2. IAT sensor (built in MAF meter) 3. ECM	Come on	DTC Stored	ES-94
P0113	Intake Air Temperature Circuit High Input	1. Open in IAT sensor circuit 2. IAT sensor (built in MAF meter) 3. ECM	Come on	DTC Stored	ES-94
P0115	Engine Coolant Temperature Circuit Malfunction	1. Open or short in ECT sensor circuit 2. ECT sensor 3. ECM	Come on	DTC Stored	ES-100
P0116	Engine Coolant Temperature Circuit Range / Performance Problem	1. Thermostat 2. ECT sensor	Come on	DTC Stored	ES-105
P0117	Engine Coolant Temperature Circuit Low Input	1. Short in ECT sensor circuit 2. ECT sensor 3. ECM	Come on	DTC Stored	ES-100
P0118	Engine Coolant Temperature Circuit High Input	1. Open in ECT sensor circuit 2. ECT sensor 3. ECM	Come on	DTC Stored	ES-100
P0120	Throttle Pedal Position Sensor / Switch "A" Circuit Malfunction	1. Throttle position sensor (built in throttle body) 2. ECM	Come on	DTC Stored	ES-107
P0121	Throttle / Pedal Position Sensor / Switch "A" Circuit Range / Performance Problem	Throttle position sensor (built in throttle body)	Come on	DTC Stored	ES-116
P0122	Throttle / Pedal Position Sensor / Switch "A" Circuit Low Input	1. Throttle position sensor (built in throttle body) 2. Short in VTA1 circuit 3. Open in VC circuit 4. ECM	Come on	DTC Stored	ES-107
P0123	Throttle / Pedal Position Sensor / Switch "A" Circuit High Input	1. Throttle position sensor (built in throttle body) 2. Open in VTA1 circuit 3. Open in E2 circuit 4. Short in VC and VTA1 circuits 5. ECM	Come on	DTC Stored	ES-107
P0125	Insufficient Coolant Temperature for Closed Loop Fuel Control	1. Cooling system 2. ECT sensor 3. Thermostat	Come on	DTC Stored	ES-119

DTC No.	Detection Item	Trouble Area	MIL	Memory	See page
P0128	Coolant Thermostat (Coolant Temperature Below Thermostat Regulating Temperature)	1. Thermostat (water inlet) 2. Cooling system 3. ECT sensor 4. ECM	Come on	DTC Stored	ES-122
P0136	Oxygen Sensor Circuit Malfunction (Bank 1 Sensor 2)	1. Open or short in heated oxygen sensor circuit 2. Heated oxygen sensor (bank 1) 3. Heated oxygen sensor heater (bank 1) 4. A/F sensor (bank 1) 5. A/F sensor heater (bank 1) 6. EFI MAIN relay (bank 1)	Come on	DTC Stored	ES-125
P0137	Oxygen Sensor Circuit Low Voltage (Bank 1 Sensor 2)	1. Heated oxygen sensor circuit (bank 1) 2. Heated oxygen sensor (bank 1) 3. Oxygen sensor heater (bank 1)	Come on	DTC Stored	ES-125
P0138	Oxygen Sensor Circuit High Voltage (Bank 1 Sensor 2)	1. Heated oxygen sensor circuit (bank 1) 2. Heated oxygen sensor (bank 1) 3. Oxygen sensor heater (bank 1)	Come on	DTC Stored	ES-125
P0139	Oxygen Sensor Circuit Slow Response (Bank 1 Sensor 2)	1. Short in heated oxygen sensor (bank 1 sensor 2) circuit 2. Short in heated oxygen sensor (bank 1 sensor 2) 3. ECM internal circuit malfunction	Come on	DTC Stored	ES-125
P0156	Oxygen Sensor Circuit Malfunction (Bank 2 Sensor 2)	1. Heated oxygen sensor circuit (bank 2) 2. Heated oxygen sensor (bank 2) 3. Heated oxygen sensor heater (bank 2) 4. A/F sensor (bank 2) 5. A/F sensor heater (bank 2)	Come on	DTC Stored	ES-125
P0157	Oxygen Sensor Circuit Low Voltage (Bank 2 Sensor 2)	1. Heated oxygen sensor circuit (bank 2) 2. Heated oxygen sensor (bank 2) 3. Oxygen sensor heater (bank 2)	Come on	DTC Stored	ES-125

DTC No.	Detection Item	Trouble Area	MIL	Memory	See page
P0158	Oxygen Sensor Circuit High Voltage (Bank 2 Sensor 2)	1. Heated oxygen sensor circuit (bank 2) 2. Heated oxygen sensor (bank 2) 3. Oxygen sensor heater (bank 2)	Come on	DTC Stored	ES-125
P0159	Oxygen Sensor Circuit Slow Response (Bank 2 Sensor 2)	1. Short in heated oxygen sensor (bank 2 sensor 2) circuit 2. Short in heated oxygen sensor (bank 2 sensor 2) 3. ECM internal circuit malfunction	Come on	DTC Stored	ES-125
P0171	System Too Lean (Bank 1)	1. Air induction system 2. Injector blockage 3. MAF meter 4. ECT sensor 5. Fuel pressure 6. Gas leakage in exhaust system 7. Open or short in A/F sensor (bank 1 sensor 1) circuit 8. A/F sensor (bank 1 sensor 1) 9. A/F sensor heater (bank 1 sensor 1) 10. A/F relay 11. A/F sensor heater and A/F relay circuit 12. PCV valve and hose 13. PCV hose connection 14. ECM	Come on	DTC Stored	ES-140
P0172	System Too Rich (Bank 1)	1. Injection leak, blockage 2. MAF meter 3. ECT sensor 4. Ignition system 5. Fuel pressure 6. Gas leakage in exhaust system 7. Open or short in A/F sensor (bank 1 sensor 1) circuit 8. A/F sensor (bank 1 sensor 1) 9. A/F sensor heater (bank 1 sensor 1) 10. A/F relay 11. A/F sensor heater and A/F relay circuits 12. ECM	Come on	DTC Stored	ES-140

ES

DTC No.	Detection Item	Trouble Area	MIL	Memory	See page
P0174	System Too Lean (Bank 2)	1. Air induction system 2. Injector blockage 3. MAF meter 4. ECT sensor 5. Fuel pressure 6. Gas leakage in exhaust system 7. Open or short in A/F sensor (bank 2 sensor 1) circuit 8. A/F sensor (bank 2 sensor 1) 9. A/F sensor heater (bank 2 sensor 1) 10. A/F relay 11. A/F sensor heater and A/F relay circuit 12. PCV valve and hose 13. PCV hose connection 14. ECM	Come on	DTC Stored	ES-140
P0175	System Too Rich (Bank 2)	1. Injection leak, blockage 2. MAF meter 3. ECT sensor 4. Ignition system 5. Fuel pressure 6. Gas leakage in exhaust system 7. Open or short in A/F sensor (bank 2 sensor 1) circuit 8. A/F sensor (bank 2 sensor 1) 9. A/F sensor heater (bank 2 sensor 1) 10. A/F relay 11. A/F sensor heater and A/F relay circuits 12. ECM	Come on	DTC Stored	ES-140
P0220	Throttle / Pedal Position Sensor / Switch "B" Circuit	1. Throttle position sensor (built in throttle body) 2. ECM	Come on	DTC Stored	ES-107
P0222	Throttle / Pedal Position Sensor / Switch "B" Circuit Low Input	1. Throttle position sensor (built in throttle body) 2. Short in VTA2 circuit 3. Open in VC circuit 4. ECM	Come on	DTC Stored	ES-107
P0223	Throttle / Pedal Position Sensor / Switch "B" Circuit High Input	1. Throttle position sensor (built in throttle body) 2. Open in VTA2 circuit 3. Open in E2 circuit 4. Short between VC and VTA2 circuits 5. ECM	Come on	DTC Stored	ES-107

DTC No.	Detection Item	Trouble Area	MIL	Memory	See page
P0300 *3	Random / Multiple Cylinder Misfire Detected	1. Open or short in engine wire harness 2. Connector connection 3. Vacuum hose connection 4. Ignition system 5. Injector 6. Fuel pressure 7. MAF meter 8. ECT sensor 9. Compression pressure 10. Valve clearance 11. Valve timing 12. PCV hose connection 13. PCV valve and hose 14. Air induction system 15. ECM	Come on or flash	DTC Stored	ES-152
P0301	Cylinder 1 Misfire Detected	1. Open or short in engine wire 2. Connector connection 3. Vacuum hose connection 4. Ignition system 5. Injector 6. Fuel pressure 7. MAF meter 8. ECT sensor 9. Compression pressure 10. Valve clearance 11. Valve timing 12. PCV hose connection 13. PCV hose 14. ECM	Come on or flash	DTC Stored	ES-152
P0302	Cylinder 2 Misfire Detected	1. Open or short in engine wire 2. Connector connection 3. Vacuum hose connection 4. Ignition system 5. Injector 6. Fuel pressure 7. MAF meter 8. ECT sensor 9. Compression pressure 10. Valve clearance 11. Valve timing 12. PCV hose connection 13. PCV hose 14. ECM	Come on or flash	DTC Stored	ES-152

DTC No.	Detection Item	Trouble Area	MIL	Memory	See page
P0303	Cylinder 3 Misfire Detected	1. Open or short in engine wire 2. Connector connection 3. Vacuum hose connection 4. Ignition system 5. Injector 6. Fuel pressure 7. MAF meter 8. ECT sensor 9. Compression pressure 10. Valve clearance 11. Valve timing 12. PCV hose connection 13. PCV hose 14. ECM	Come on or flash	DTC Stored	ES-152
P0304	Cylinder 4 Misfire Detected	1. Open or short in engine wire 2. Connector connection 3. Vacuum hose connection 4. Ignition system 5. Injector 6. Fuel pressure 7. MAF meter 8. ECT sensor 9. Compression pressure 10. Valve clearance 11. Valve timing 12. PCV hose connection 13. PCV hose 14. ECM	Come on or flash	DTC Stored	ES-152
P0305	Cylinder 5 Misfire Detected	1. Open or short in engine wire 2. Connector connection 3. Vacuum hose connection 4. Ignition system 5. Injector 6. Fuel pressure 7. MAF meter 8. ECT sensor 9. Compression pressure 10. Valve clearance 11. Valve timing 12. PCV hose connection 13. PCV hose 14. ECM	Come on or flash	DTC Stored	ES-152

DTC No.	Detection Item	Trouble Area	MIL	Memory	See page
P0306	Cylinder 6 Misfire Detected	1. Open or short in engine wire 2. Connector connection 3. Vacuum hose connection 4. Ignition system 5. Injector 6. Fuel pressure 7. MAF meter 8. ECT sensor 9. Compression pressure 10. Valve clearance 11. Valve timing 12. PCV hose connection 13. PCV hose 14. ECM	Come on	DTC Stored	ES-152
P0327	Knock Sensor 1 Circuit Low Input (Bank 1 or Single Sensor)	1. Short in knock sensor 1 circuit 2. Knock sensor 1 3. ECM	Come on	DTC Stored	ES-165
P0328	Knock Sensor 1 Circuit High Input (Bank 1 or Single Sensor)	1. Open in knock sensor 1 circuit 2. Knock sensor 1 3. ECM	Come on	DTC Stored	ES-165
P0332	Knock Sensor 2 Circuit Low Input (Bank 2)	1. Short in knock sensor 2 circuit 2. Knock sensor 2 3. ECM	Come on	DTC Stored	ES-165
P0333	Knock Sensor 2 Circuit High Input (Bank 2)	1. Open in knock sensor 2 circuit 2. Knock sensor 2 3. ECM	Come on	DTC Stored	ES-165
P0335	Crankshaft Position Sensor "A" Circuit	1. Open or short in crankshaft position sensor circuit 2. Crankshaft position sensor 3. Crankshaft timing pulley 4. ECM	Come on	DTC Stored	ES-170
P0339	Crankshaft Position Sensor "A" Circuit Intermittent	1. Open or short in crankshaft position sensor circuit 2. Crankshaft position sensor 3. Crankshaft timing pulley 4. ECM	Come on	DTC Stored	ES-170
P0340	Camshaft Position Sensor Circuit Malfunction	1. Open or short in VVT sensor circuit 2. VVT sensor 3. Camshaft timing pulley 4. Timing belt has jumped tooth 5. ECM	Come on	DTC Stored	ES-176

DTC No.	Detection Item	Trouble Area	MIL	Memory	See page
P0341	Camshaft Position Sensor "A" Circuit Range / Performance (Bank 1 or Single Sensor)	1. Open or short in VVT sensor circuit 2. VVT sensor 3. Camshaft timing pulley 4. Timing belt has jumped tooth 5. ECM	Come on	DTC Stored	ES-176
P0345	Camshaft Position Sensor "A" Circuit (Bank 2)	1. Open or short in VVT sensor circuit 2. VVT sensor 3. Camshaft timing pulley 4. Timing belt has jumped tooth 5. ECM	Come on	DTC Stored	ES-176
P0346	Camshaft Position Sensor "A" Circuit Range / Performance (Bank 2)	1. Open or short in VVT sensor circuit 2. VVT sensor 3. Camshaft timing pulley 4. Timing belt has jumped tooth 5. ECM	Come on	DTC Stored	ES-176
P0351 *2	Ignition Coil "A" Primary / Secondary Circuit	1. Ignition system 2. Open or short in IFG1 or IGT1 circuit from ignition coil with igniter to ECM (ignition coil circuit 1) 3. Ignition coil with igniter (ignition coil 1) 4. ECM	Come on	DTC Stored	ES-182
P0352 *2	Ignition Coil "B" Primary / Secondary Circuit	1. Ignition system 2. Open or short in IFG1 or IGT2 circuit from ignition coil with igniter to ECM (ignition coil circuit 2) 3. Ignition coil with igniter (ignition coil 2) 4. ECM	Come on	DTC Stored	ES-182
P0353 *2	Ignition Coil "C" Primary / Secondary Circuit	1. Ignition system 2. Open or short in IFG1 or IGT3 circuit from ignition coil with igniter to ECM (ignition coil circuit 3) 3. Ignition coil with igniter (ignition coil 3) 4. ECM	Come on	DTC Stored	ES-182
P0354 *2	Ignition Coil "D" Primary / Secondary Circuit	1. Ignition system 2. Open or short in IFG1 or IGT4 circuit from ignition coil with igniter to ECM (ignition coil circuit 4) 3. Ignition coil with igniter (ignition coil 4) 4. ECM	Come on	DTC Stored	ES-182

DTC No.	Detection Item	Trouble Area	MIL	Memory	See page
P0355 *2	Ignition Coil "E" Primary / Secondary Circuit	1. Ignition system 2. Open or short in IFG1 or IGT5 circuit from ignition coil with igniter to ECM (ignition coil circuit 5) 3. Ignition coil with igniter (ignition coil 5) 4. ECM	Come on	DTC Stored	ES-182
P0356 *2	Ignition Coil "F" Primary / Secondary Circuit	1. Ignition system 2. Open or short in IFG1 or IGT6 circuit from ignition coil with igniter to ECM (ignition coil circuit 6) 3. Ignition coil with igniter (ignition coil 6) 4. ECM	Come on	DTC Stored	ES-182
P0420 *2	Catalyst System Efficiency Below Threshold (Bank 1)	1. Gas leakage in exhaust system 2. A/F sensor (bank 1 sensor 1) 3. Heated oxygen sensor (bank 1 sensor 2) 4. Three-way catalytic converter (inside exhaust manifold)	Come on	DTC Stored	ES-190
P0430 *2	Catalyst System Efficiency Below Threshold (Bank 2)	1. Gas leakage in exhaust system 2. A/F sensor (bank 2 sensor 1) 3. Heated oxygen sensor (bank 2 sensor 2) 4. Three-way catalytic converter (inside exhaust manifold)	Come on	DTC Stored	ES-190

DTC No.	Detection Item	Trouble Area	MIL	Memory	See page
P0441 *3	Evaporative Emission Control System Incorrect Purge Flow	1. Vacuum hose has cracks, holes, or is blocked, damaged or disconnected 2. Fuel tank cap is incorrectly installed 3. Fuel tank cap has cracks, or is damaged 4. Open or short in vapor pressure sensor circuit 5. Vapor pressure sensor 6. Open or short in VSV circuit for EVAP 7. EVAP VSV 8. Open or short in VSV circuit for CCV 9. CCV 10. Fuel tank has cracks, holes, or is damaged 11. Charcoal canister has cracks, holes, or is damaged 12. Fuel tank over fill check valve has cracks, or is damaged 13. ECM	Come on	DTC Stored	ES-197
P0442	Evaporative Emission Control System Leak Detected (Small Leak)	1. Vacuum hose has cracks, holes, or is blocked, damaged or disconnected 2. Fuel tank cap is incorrectly installed 3. Fuel tank cap has cracks, or is damaged 4. Open or short in vapor pressure sensor circuit 5. Vapor pressure sensor 6. Open or short in VSV circuit for EVAP 7. EVAP VSV 8. Open or short in VSV circuit for CCV 9. CCV 10. Fuel tank has cracks, holes, or is damaged 11. Charcoal canister has cracks, holes, or is damaged 12. Fuel tank over fill check valve has cracks, or is damaged 13. ECM	Come on	DTC Stored	ES-203

DTC No.	Detection Item	Trouble Area	MIL	Memory	See page
P0446 *3	Evaporative Emission Control System Vent Control Circuit	1. Vacuum hose has cracks, holes, or is blocked, damaged or disconnected 2. Fuel tank cap is incorrectly installed 3. Fuel tank cap has cracks, or is damaged 4. Open or short in vapor pressure sensor circuit 5. Vapor pressure sensor 6. Open or short in VSV circuit for EVAP 7. EVAP VSV 8. Open or short in VSV circuit for CCV 9. CCV 10. Fuel tank has cracks, holes, or is damaged 11. Charcoal canister has cracks, holes, or is damaged 12. Fuel tank over fill check valve has cracks, or is damaged 13. ECM	Come on	DTC Stored	ES-209
P0451	Evaporative Emission Control System Pressure Sensor Range / Performance	1. Open or short in vapor pressure sensor circuit 2. Vapor pressure sensor 3. ECM	Come on	DTC Stored	ES-212
P0452	Evaporative Emission Control System Pressure Sensor / Switch Low Input	1. Open or short in vapor pressure sensor circuit 2. Vapor pressure sensor 3. ECM	Come on	DTC Stored	ES-212
P0453	Evaporative Emission Control System Pressure Sensor / Switch High Input	1. Open or short in vapor pressure sensor circuit 2. Vapor pressure sensor 3. ECM	Come on	DTC Stored	ES-212

DTC No.	Detection Item	Trouble Area	MIL	Memory	See page
P0455	Evaporative Emission Control System Leak Detected (Gross Leak)	1. Vacuum hose has cracks, holes, or is blocked, damaged or disconnected 2. Fuel tank cap is incorrectly installed 3. Fuel tank cap has cracks, or is damaged 4. Open or short in vapor pressure sensor circuit 5. Vapor pressure sensor 6. Open or short in VSV circuit for EVAP 7. EVAP VSV 8. Open or short in VSV circuit for CCV 9. CCV 10. Fuel tank has cracks, holes, or is damaged 11. Charcoal canister has cracks, holes, or is damaged 12. Fuel tank over fill check valve has cracks, or is damaged 13. ECM	Come on	DTC Stored	ES-203
P0456	Evaporative Emission Control System Leak Detected (Very Small Leak)	1. Vacuum hose has cracks, holes, or is blocked, damaged or disconnected 2. Fuel tank cap is incorrectly installed 3. Fuel tank cap has cracks, or is damaged 4. Open or short in vapor pressure sensor circuit 5. Vapor pressure sensor 6. Open or short in VSV circuit for EVAP 7. EVAP VSV 8. Open or short in VSV circuit for CCV 9. CCV 10. Fuel tank has cracks, holes, or is damaged 11. Charcoal canister has cracks, holes, or is damaged 12. Fuel tank over fill check valve has cracks, or is damaged 13. ECM	Come on	DTC Stored	ES-203
P0500	Vehicle Speed Sensor "A"	1. Open or short in speed sensor circuit 2. Speed sensor 3. Combination meter 4. ECM 5. Skid control ECU	Come on	DTC Stored	ES-218

DTC No.	Detection Item	Trouble Area	MIL	Memory	See page
P0503	Vehicle Speed Sensor "A" Intermittent / Erratic / High	1. Open or short in speed sensor circuit 2. Speed sensor 3. Combination meter 4. ECM 5. Skid control ECU	Dose not come on	DTC Stored	ES-218
P0504	Brake Switch "A" / "B" Correlation	1. Short in stop light switch signal circuit 2. Stop light switch 3. ECM	Dose not come on	DTC Stored	ES-221
P0505	Idle Control System Malfunction	1. Electric throttle control system 2. Air induction system 3. PCV hose connection	Come on	DTC Stored	ES-227
P0560	System Voltage	1. Open in back-up power source circuit 2. ECM	Come on	DTC Stored	ES-230
P0604	Internal Control Module Random Access Memory (RAM) Error	ECM	Come on	DTC Stored	ES-234
P0606	ECM / PCM Processor	ECM	Come on	DTC Stored	ES-234
P0607	Control Module Performance	ECM	Come on	DTC Stored	ES-234
P0617	Starter Relay Circuit High	1. Short in park/neutral position switch circuit 2. PNP switch 3. Ignition switch 4. ECM	Come on	DTC Stored	ES-236
P0630	VIN not Programmed or Mismatch - ECM / PCM	ECM	Come on	DTC Stored	ES-242
P0657	Actuator Supply Voltage Circuit / Open	ECM	Come on	DTC Stored	ES-234
P0705	Transmission Range Sensor Circuit Malfunction (PRNDL Input)	1. Short in park/neutral position switch circuit 2. PNP switch 3. ECM	Come on	DTC Stored	ES-244
P1645	Gateway ECU Malfunction	1. Gateway ECU 2. A/C ECU 3. Combination bus	Come on	DTC Not Stored	ES-245
P2102	Throttle Actuator Control Motor Circuit Low	1. Open in throttle control motor circuit 2. Throttle control motor 3. ECM	Come on	DTC Stored	ES-246
P2103	Throttle Actuator Control Motor Circuit High	1. Short in throttle control motor circuit 2. Throttle control motor 3. ECM	Come on	DTC Stored	ES-246
P2111	Throttle Actuator Control System - Stuck Open	1. Throttle control motor circuit 2. Throttle control motor 3. Throttle body 4. Throttle valve	Come on	DTC Stored	ES-249

DTC No.	Detection Item	Trouble Area	MIL	Memory	See page
P2112	Throttle Actuator Control System - Stuck Closed	1. Throttle control motor circuit 2. Throttle control motor 3. Throttle body 4. Throttle valve	Come on	DTC Stored	ES-249
P2118	Throttle Actuator Control Motor Current Range / Performance	1. Open in ETCS power source circuit 2. ETCS fuse 3. ECM	Come on	DTC Stored	ES-252
P2119	Throttle Actuator Control Throttle Body Range / Performance	1. Electronic throttle control system 2. ETCS fuse 3. ECM	Come on	DTC Stored	ES-256
P2120	Throttle / Pedal Position Sensor / Switch "D" Circuit	1. Accelerator pedal position sensor 2. ECM	Come on	DTC Stored	ES-258
P2121	Throttle / Pedal Position Sensor / Switch "D" Circuit Range / Performance	1. Accelerator pedal position sensor circuit 2. Accelerator pedal position sensor 3. ECM	Come on	DTC Stored	ES-267
P2122	Throttle / Pedal Position Sensor / Switch "D" Circuit Low Input	1. Accelerator pedal position sensor 2. Open in VCP1 circuit 3. Open or short to ground in VPA1 circuit 4. ECM	Come on	DTC Stored	ES-258
P2123	Throttle / Pedal Position Sensor / Switch "D" Circuit High Input	1. Accelerator pedal position sensor 2. Open in EPA circuit 3. ECM	Come on	DTC Stored	ES-258
P2125	Throttle / Pedal Position Sensor / Switch "E" Circuit	1. Accelerator pedal position sensor 2. ECM	Come on	DTC Stored	ES-258
P2127	Throttle / Pedal Position Sensor / Switch "E" Circuit Low Input	1. Accelerator pedal position sensor 2. Open in VCP2 circuit 3. Open or short to ground in VPA2 circuit 4. ECM	Come on	DTC Stored	ES-258
P2128	Throttle / Pedal Position Sensor / Switch "E" Circuit High Input	1. Accelerator pedal position sensor 2. Open in EPA2 circuit 3. ECM	Come on	DTC Stored	ES-258
P2135	Throttle / Pedal Position Sensor / Switch "A" / "B" Voltage Correlation	1. Short between VTA1 and VTA2 circuits 2. Throttle position sensor (built in throttle body) 3. ECM	Come on	DTC Stored	ES-107
P2138	Throttle / Pedal Position Sensor / Switch "D" / "E" Voltage Correlation	1. VPA1 and VPA2 circuits are short-circuited 2. Accelerator pedal position sensor 3. ECM	Come on	DTC Stored	ES-258

DTC No.	Detection Item	Trouble Area	MIL	Memory	See page
P2195 *1	Oxygen (A/F) Sensor Signal Stuck Lean (Bank 1 Sensor 1)	1. Open or short in A/F sensor (bank 1 sensor 1) circuit 2. A/F sensor (bank 1 sensor 1) 3. A/F sensor (bank 1 sensor 1) heater 4. A/F relay 5. Air induction system 6. Fuel pressure 7. Injector 8. PCV hose connection 9. ECM	Come on	DTC Stored	ES-271
P2196 *1	Oxygen (A/F) Sensor Signal Stuck Rich (Bank 1 Sensor 1)	1. Open or short in A/F sensor (bank 1 sensor 1) circuit 2. A/F sensor (bank 1 sensor 1) 3. A/F sensor (bank 1 sensor 1) heater 4. A/F relay 5. A/F sensor heater and relay circuit 6. Air induction system 7. Fuel pressure 8. Injector 9. PCV hose connection 10. ECM	Come on	DTC Stored	ES-271
P2197 *1	Oxygen (A/F) Sensor Signal Stuck Lean (Bank 2 Sensor 1)	1. Open or short in A/F sensor (bank 2 sensor 1) circuit 2. A/F sensor (bank 2 sensor 1) 3. A/F sensor (bank 2 sensor 1) heater 4. A/F relay 5. A/F sensor heater and relay circuit 6. Air induction system 7. Fuel pressure 8. Injector 9. PCV hose connection 10. ECM	Come on	DTC Stored	ES-271
P2198 *1	Oxygen (A/F) Sensor Signal Stuck Rich (Bank 2 Sensor 1)	1. Open or short in A/F sensor (bank 2 sensor 1) circuit 2. A/F sensor (bank 2 sensor 1) 3. A/F sensor (bank 2 sensor 1) heater 4. A/F relay 5. A/F sensor heater and relay circuit 6. Air induction system 7. Fuel pressure 8. Injector 9. PCV hose connection 10. ECM	Come on	DTC Stored	ES-271

DTC No.	Detection Item	Trouble Area	MIL	Memory	See page
P2238 *1	Oxygen (A/F) Sensor Pumping Current Circuit Low (Bank 1 Sensor 1)	1. Open or short in A/F sensor (bank 1 sensor 1) circuit 2. A/F sensor (bank 1 sensor 1) 3. A/F sensor (bank 1 sensor 1) heater 4. A/F relay 5. Open or short in A/F sensor heater and relay circuit 6. ECM	Come on	DTC Stored	ES-285
P2239 *1	Oxygen (A/F) Sensor Pumping Current Circuit High (Bank 1 Sensor 1)	1. Open or short in A/F sensor (bank 1 sensor 1) circuit 2. A/F sensor (bank 1 sensor 1) 3. A/F sensor (bank 1 sensor 1) heater 4. A/F relay 5. Open or short in A/F sensor heater and relay circuit 6. ECM	Come on	DTC Stored	ES-285
P2241 *1	Oxygen (A/F) Sensor Pumping Current Circuit Low (Bank 2 Sensor 1)	1. Open or short in A/F sensor (bank 2 sensor 1) circuit 2. A/F sensor (bank 2 sensor 1) 3. A/F sensor (bank 2 sensor 1) heater 4. A/F relay 5. Open or short in A/F sensor heater and relay circuit 6. ECM	Come on	DTC Stored	ES-285
P2242 *1	Oxygen (A/F) Sensor Pumping Current Circuit High (Bank 2 Sensor 1)	1. Open or short in A/F sensor (bank 2 sensor 1) circuit 2. A/F sensor (bank 2 sensor 1) 3. A/F sensor (bank 2 sensor 1) heater 4. A/F relay 5. Open or short in A/F sensor heater and relay circuit 6. ECM	Come on	DTC Stored	ES-285
P2252 *1	Oxygen (A/F) Sensor Reference Ground Circuit Low (Bank 1 Sensor 1)	1. Open or short in A/F sensor (bank 1 sensor 1) circuit 2. A/F sensor (bank 1 sensor 1) 3. A/F sensor (bank 1 sensor 1) heater 4. A/F relay 5. Open or short in A/F sensor heater and relay circuit 6. ECM	Come on	DTC Stored	ES-285

DTC No.	Detection Item	Trouble Area	MIL	Memory	See page
P2253 *1	Oxygen (A/F) Sensor Reference Ground Circuit High (Bank 1 Sensor 1)	1. Open or short in A/F sensor (bank 1 sensor 1) circuit 2. A/F sensor (bank 1 sensor 1) 3. A/F sensor (bank 1 sensor 1) heater 4. A/F relay 5. Open or short in A/F sensor heater and relay circuit 6. ECM	Come on	DTC Stored	ES-285
P2255 *1	Oxygen (A/F) Sensor Reference Ground Circuit Low (Bank 2 Sensor 1)	1. Open or short in A/F sensor (bank 2 sensor 1) circuit 2. A/F sensor (bank 2 sensor 1) 3. A/F sensor (bank 2 sensor 1) heater 4. A/F relay 5. Open or short in A/F sensor heater and relay circuit 6. ECM	Come on	DTC Stored	ES-285
P2256 *1	Oxygen (A/F) Sensor Reference Ground Circuit High (Bank 2 Sensor 1)	1. Open or short in A/F sensor (bank 2 sensor 1) circuit 2. A/F sensor (bank 2 sensor 1) 3. A/F sensor (bank 2 sensor 1) heater 4. A/F relay 5. Open or short in A/F sensor heater and relay circuit 6. ECM	Come on	DTC Stored	ES-285
P2A00	A/F Sensor Circuit Slow Response (Bank 1 Sensor 1)	1. Open or short in A/F sensor (bank 1 sensor 1) circuit 2. A/F sensor (bank 1 sensor 1) 3. A/F sensor heater 4. A/F relay 5. A/F sensor heater and relay circuit 6. Air induction system 7. Fuel pressure 8. Injector 9. PCV hose connection 10. ECM	Come on	DTC Stored	ES-291

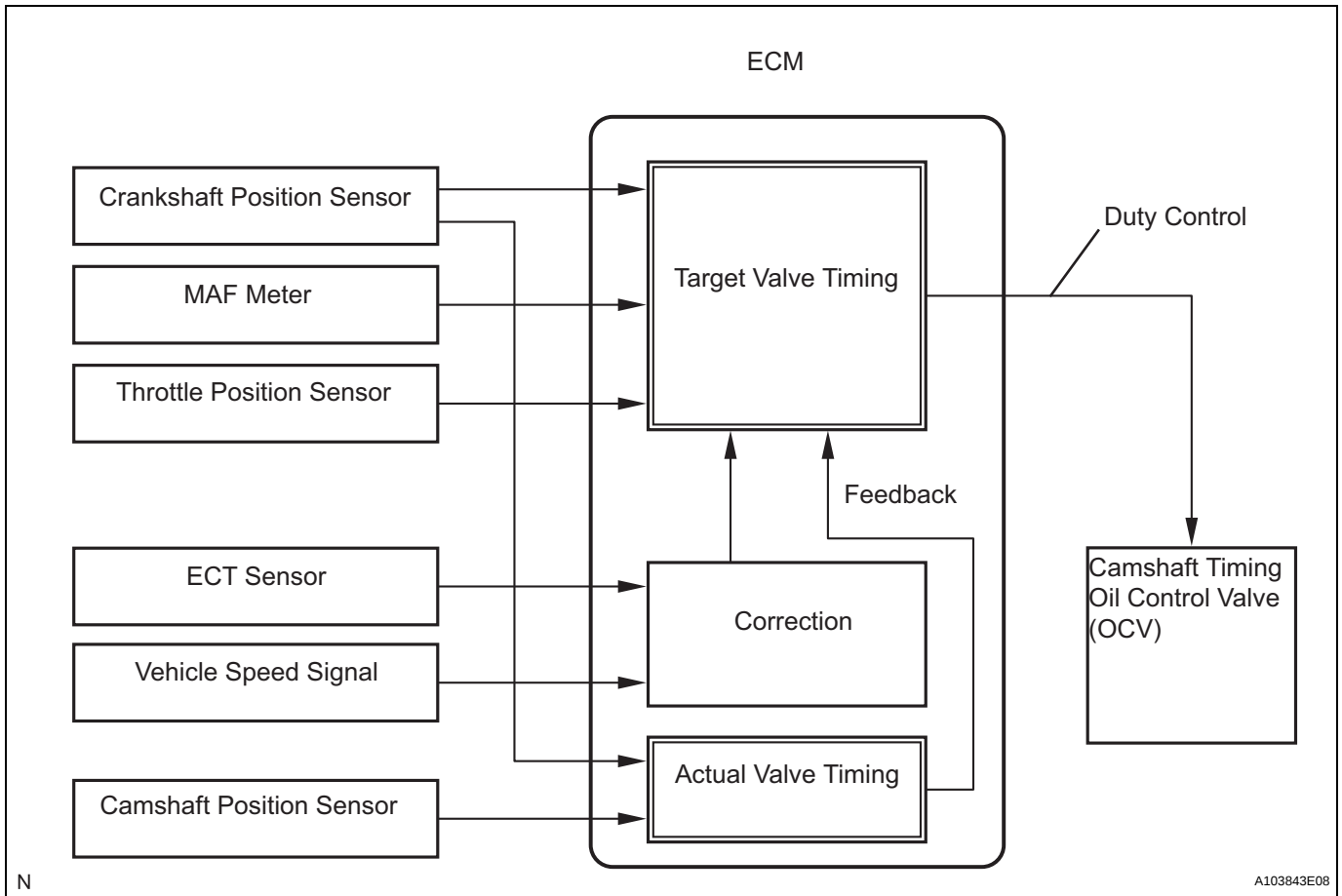
DTC No.	Detection Item	Trouble Area	MIL	Memory	See page
P2A03	A/F Sensor Circuit Slow Response (Bank 2 Sensor 1)	1. Open or short in A/ F sensor (bank 2 sensor 1) circuit 2. A/F sensor (bank 2 sensor 1) 3. A/F sensor heater 4. A/F relay 5. A/F sensor heater and relay circuit 6. Air induction system 7. Fuel pressure 8. Injector 9. PCV hose connection 10. ECM	Come on	DTC Stored	ES-291

- *1: This DTC is related to A/F sensor, although the caption is oxygen sensor.
- *2: This DTC indicates a malfunction related to primary circuit.
- *3: This DTC is not present for Taiwan spec.

DTC	P0010	Camshaft Position "A" Actuator Circuit (Bank 1)
DTC	P0020	Camshaft Position "A" Actuator Circuit (Bank 2)

DESCRIPTION

The Variable Valve Timing (VVT) system includes the ECM, the Oil Control Valve (OCV) and the VVT controller. The ECM sends a target duty-cycle control signal to the OCV. This control signal, sent to the OCV, regulates the oil pressure applied to the VVT controller. Camshaft timing control is performed based on engine operation conditions such as intake air volume, throttle position and engine coolant temperature. The ECM controls the OCV based on the signals output from several sensors. The VVT controller regulates the intake camshaft angle using oil pressure through the OCV. As a result, the relative position between the camshaft and the crankshaft is optimized. Also, the engine torque and fuel economy improve, and exhaust emissions decrease. The ECM detects the actual valve timing using signals from the camshaft position sensor and the crankshaft position sensor. The ECM performs feedback control and verifies target valve timing.



DTC No.	DTC Detection Condition	Trouble Area
P0010 P0020	Open or short OCV circuit (1 trip detection logic)	• Open or short OCV circuit • OCV • ECM

MONITOR DESCRIPTION

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

MONITOR STRATEGY

Related DTCs	P0010: VVT OCV (bank 1) Range Check P0020: VVT OCV (bank 2) Range Check
Required sensors / components (Main)	VVT OCV (Variable Valve Timing oil control valve)
Required sensors / components (Related)	-
Frequency of operation	Continuous
Duration	1 second
MIL operation	Immediate
Sequence of operation	None

TYPICAL ENABLING CONDITIONS

The monitor will run whenever these DTCs are not present	None
Battery voltage	11 V or more
Target duty ratio for the OCV	Less than 70 %
Starter	OFF
Current cut status for the OCV	Not cut

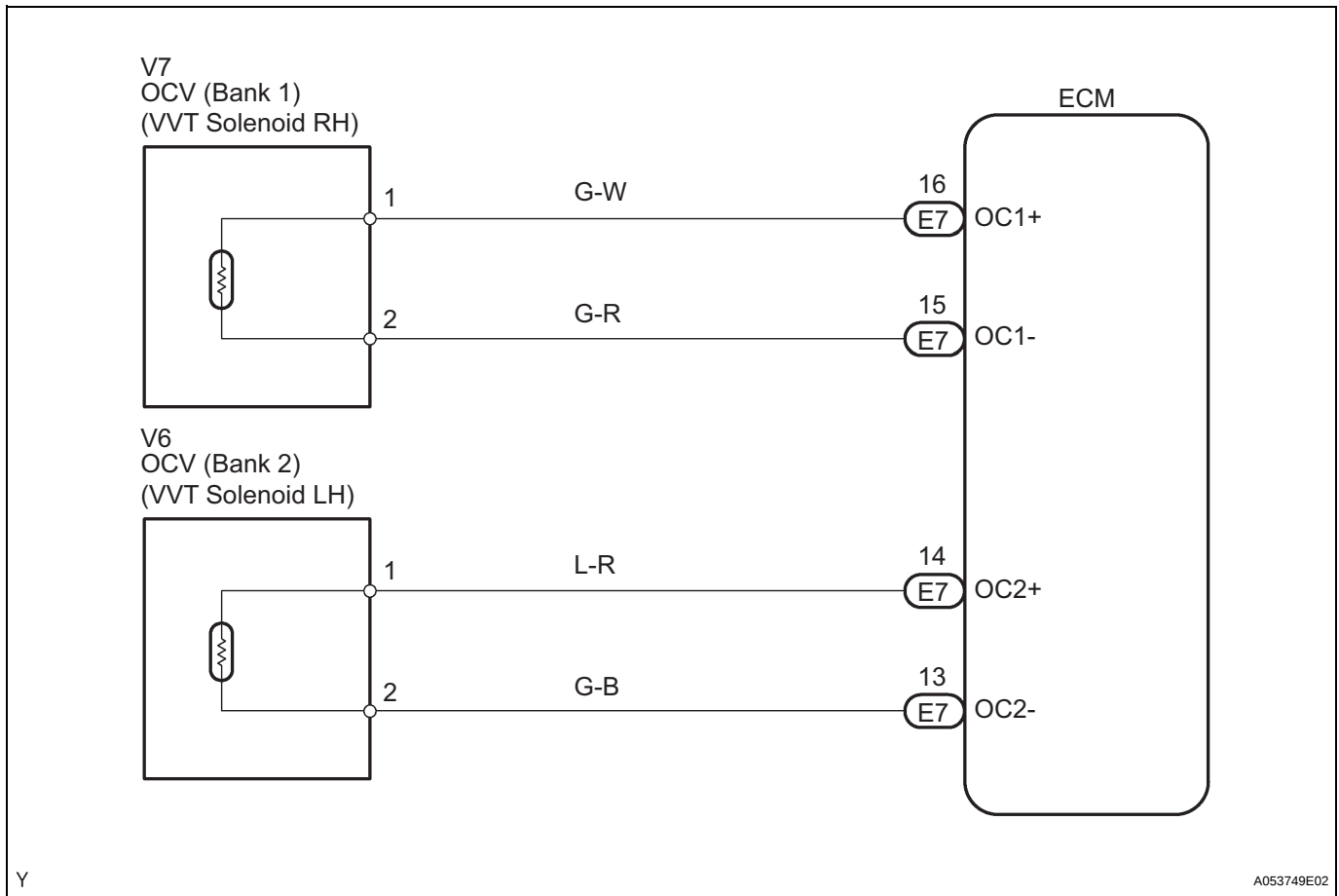
TYPICAL MALFUNCTION THRESHOLDS

Either of the following conditions is met:	Condition 1 or 2
1. OCV duty ratio	100 % (always ON) even though the target duty ratio is less than 70 %
2. OCV duty ratio when ECM supplies current to OCV	3 % or less despite the ECM supplying the current to the OCV

COMPONENT OPERATING RANGE

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



ES

HINT:

- If DTC P0010 is displayed, check the right bank VVT system.
- Bank 1 refers to the bank that includes cylinder No. 1.
- Read freeze frame data using the intelligent tester. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data, from the time the malfunction occurred.

1

PERFORM ACTIVE TEST BY INTELLIGENT TESTER (OCV OPERATION)

- Connect the intelligent tester to the DLC3.
- Turn the ignition switch ON and turn the tester ON.
- Warm up the engine.
- On the tester, enter the following menus: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / VVT CTRL B1 or VVT CTRL B2.
- Using the intelligent tester, operate the OCV and check the engine speed.

OK

Tester Operation	Specified Condition
OCV OFF	Normal engine speed
OCV ON	Rough idle or engine stall

OK

CHECK FOR INTERMITTENT PROBLEMS

NG

2

INSPECT CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY (OCV)

- (a) Reconnect the OCV connector.
- OK:
OCV has no contamination and moves smoothly.

NG

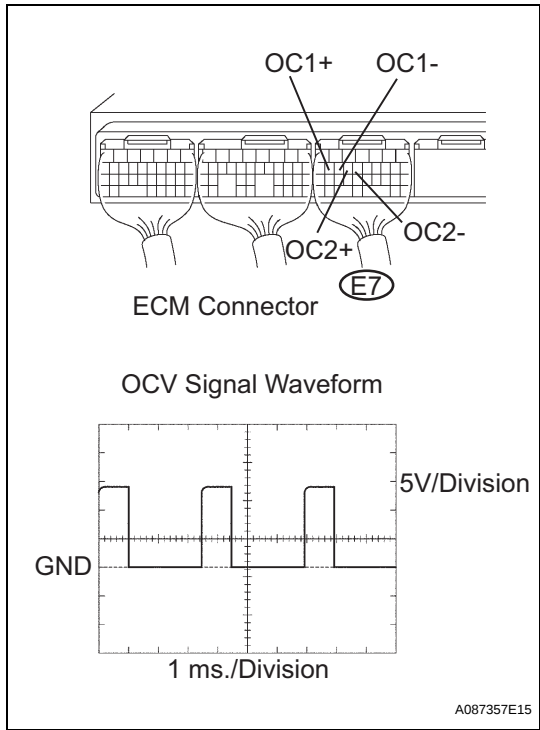
REPLACE CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY

ES

OK

3

INSPECT ECM (OCV SIGNAL)



- (a) During idling, check the waveform of the ECM connector using an oscilloscope.
- Signal waveform**

Tester Connection	Specified Condition
E7-16 (OC1+) - E7-15 (OC1-) E7-14 (OC2+) - E7-13 (OC2-)	Correct waveform is shown in the illustration.

NG

REPLACE ECM

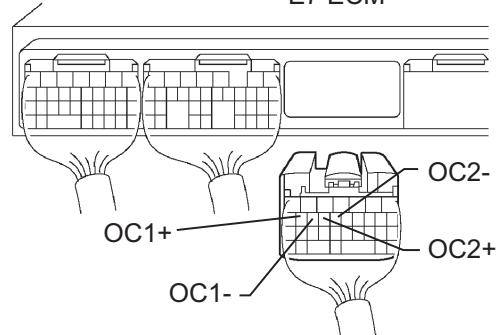
OK

4**CHECK HARNESS AND CONNECTOR (OCV - ECM)****Wire Harness Side:**

V7 (Bank 1)
V6 (Bank 2)
OCV



E7 ECM



A085431E07

- Disconnect the V6 or V7 OCV connector.
- Disconnect the E7 ECM connector.
- Measure the resistance of the wire harness side connectors.

Standard resistance

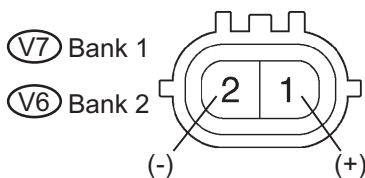
Tester Connection	Specified Condition
V7-1 (OCV) - E7-16 (OC1+) V7-2 (OCV) - E7-15 (OC1-) V6-1 (OCV) - E7-14 (OC2+) V6-2 (OCV) - E7-13 (OC2-)	Below 1 Ω
V7-1 (OCV) or E7-16 (OC1+) - Body ground V7-2 (OCV) or E7-15 (OC1-) - Body ground V6-1 (OCV) or E7-14 (OC2+) - Body ground V6-2 (OCV) or E7-13 (OC2-) - Body ground	10 k Ω or higher

NG

REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

ES

CHECK FOR INTERMITTENT PROBLEMS**1****CHECK CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY (OCV OPERATION)****Component Side:**

Y

A076968E10

- Disconnect the V6 or V7 OCV connector.
- Apply positive battery voltage between the terminals of the OCV.
- Check the engine speed.

OK:

Engine speed is rough idle or engine is stalled.

NG

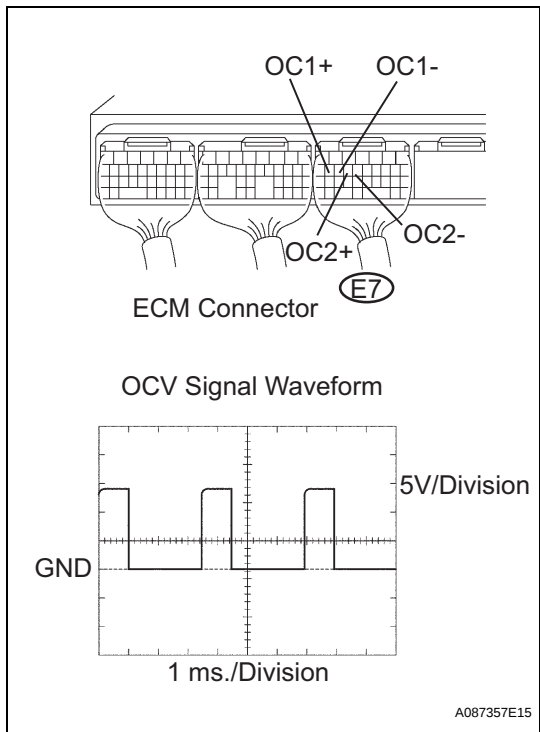
REPLACE CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY

OK

ES

2

CHECK ECM (OCV SIGNAL)



- (a) During idling, check the waveform of the E7 ECM connector using an oscilloscope.

Signal waveform

Tester Connection	Specified Condition
E7-16 (OC1+) - E7-15 (OC1-) E7-14 (OC2+) - E7-13 (OC2-)	Correct waveform is shown in the illustration

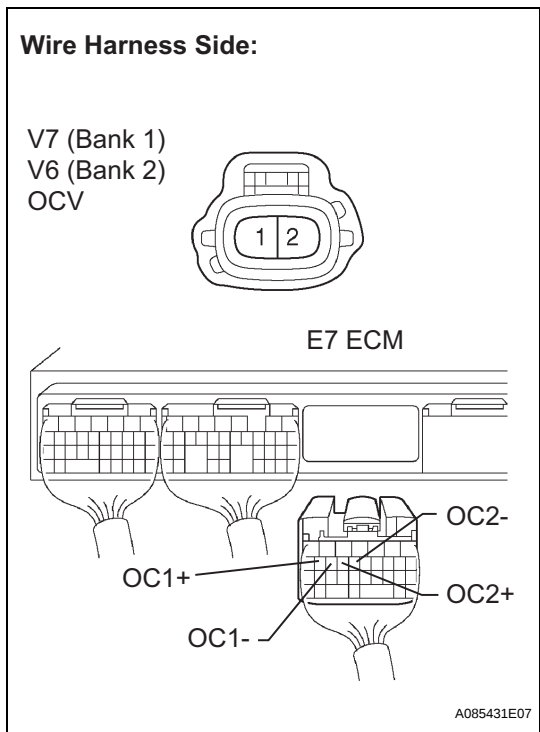
NG

REPLACE ECM

OK

3

CHECK HARNESS AND CONNECTOR (OCV - ECM)



- (a) Disconnect the V6 or V7 OCV connector.
(b) Disconnect the E7 ECM connector.
(c) Measure the resistance of the wire harness side connectors.

Standard resistance

Tester Connection	Specified Condition
V7-1 (OCV) - E7-16 (OC1+) V7-2 (OCV) - E7-15 (OC1-) V6-1 (OCV) - E7-14 (OC2+) V6-2 (OCV) - E7-13 (OC2-)	Below 1 Ω
V7-1 (OCV) or E7-16 (OC1+) - Body ground V7-2 (OCV) or E7-15 (OC1-) - Body ground V6-1 (OCV) or E7-14 (OC2+) - Body ground V6-2 (OCV) or E7-13 (OC2-) - Body ground	10 k Ω or higher

NG

REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

CHECK FOR INTERMITTENT PROBLEMS

ES

DTC	P0011	Camshaft Position "A" - Timing Over-Advanced or System Performance (Bank 1)
DTC	P0012	Camshaft Position "A" - Timing Over-Retarded (Bank 1)
DTC	P0021	Camshaft Position "A" - Timing Over-Advanced or System Performance (Bank 2)
DTC	P0022	Camshaft Position "A" - Timing Over-Retarded (Bank 2)

DESCRIPTION

Refer to DTC P0010 (See page [ES-57](#)).

DTC No.	DTC Detection Condition	Trouble Area
P0011 P0021	After engine is warmed up and engine speed is at 500 to 4,000 rpm, condition (a) continues (1 trip detection logic) (b) Valve timing does not change from current valve timing (Problem of advanced valve timing)	- Valve timing - OCV - Camshaft timing gear assembly - ECM
P0012 P0022	After engine is warmed up and engine speed is at 500 to 4,000 rpm, condition (a) continues (2 trip detection logic) (b) Valve timing does not change from current valve timing (Problem of retarded valve timing)	- Valve timing - OCV - Camshaft timing gear assembly - ECM

MONITOR DESCRIPTION

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

Example:

A DTC will be set if: 1) the difference between the target and actual valve timing is more than 5 degrees of the camshaft angle (CA) and the condition continues for more than 4.5 seconds; or 2) the OCV is forcibly activated 63 times or more.

Advanced cam DTCs are subject to "1 trip" detection logic.

Retarded cam DTCs are subject to "2 trip" detection logic.

MONITOR STRATEGY

Related DTCs	P0011: Advanced camshaft timing (bank 1) P0012: Retard camshaft timing (bank 1) P0021: Advanced camshaft timing (bank 2) P0022: Retard camshaft timing (bank 2)
Required sensors / components (Main)	VVT OCV and Camshaft timing gear
Required sensors / components (Related)	Crankshaft position sensor, camshaft position sensor and Engine coolant temperature sensor
Frequency of operation	Once per drive cycle

Duration	Within 10 seconds
MIL operation	P0011 and P0021: Immediate P0012 and P0022: 2 driving cycles
Sequence of operation	None

TYPICAL ENABLING CONDITIONS

The monitor will run whenever these DTCs are not present.	P0100, P0101, P0102, P0103 (MAF sensor), P0115, P0116, P0117, P0118 (ECT sensor), P0125 (Insufficient ECT for closed loop), P0335 (CKP sensor), P0340, P0341, P0345 (CMP sensor), P0351, P0352, P0353, P0354, P0355, P0356, (Igniter),
Battery voltage	11 V or more
Engine RPM	500 to 4,000 rpm
ECT	75°C (167°F) to 100°C (212°F)

ES

TYPICAL MALFUNCTION THRESHOLDS

P0011 and P0021:

All of the 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 valve timing

P0012 and P0022:

All of the 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 "target" and "actual" camshaft timing is larger 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 (See page [ES-59](#)).

HINT:

Abnormal bank	Problem of advanced OCV	Problem of retarded OCV
Bank 1	P0011	P0012
Bank 2	P0021	P0022

- If DTC P0011 or P0012 is displayed, check the right bank VVT system.
- If DTC P0021 or P0022 is displayed, check the left bank VVT system.

Read freeze frame data using the intelligent tester or the OBD II scan tool. The ECM records vehicle and driving condition information as freeze data the moment a DTC is stored. 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.

1

CHECK VALVE TIMING (CHECK FOR LOOSE AND JUMPING TEETH OF TIMING BELT)

OK:

The matchmarks of crankshaft pulley and camshaft pulley are aligning.

NG

ADJUST VALVE TIMING

OK

2 PERFORM ACTIVE TEST BY INTELLIGENT TESTER (OCV OPERATION)

- (a) Connect the intelligent tester to the DLC3.
- (b) Start the engine and warm it up.
- (c) Turn the ignition switch ON and push the intelligent tester main switch ON.
- (d) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / VVT CTRL B1 or VVT CTRL B2.
- (e) Using the intelligent tester, operate the OCV and check the engine speed.

Standard

Tester Operation	Specified Condition
OCV is OFF	Normal engine speed
OCV is ON	Rough idle or engine stall

NG

Go to step 4

OK

3 CHECK WHETHER DTC OUTPUTS REOCCUR

- (a) Clear the DTCs.
 - (1) Erase the codes using one of the following methods:
 - 1) use the intelligent tester, 2) disconnect the battery cable, or 3) remove the EFI and ETCS fuses for more than 60 seconds.
- HINT:
After disconnecting the battery cable, perform the "INITIALIZE" procedure.
- (b) Start and warm up the engine.
- (c) Drive the vehicle for 10 minutes or more.
- (d) Read output DTC using the intelligent tester.

OK:**No DTC output.****HINT:**

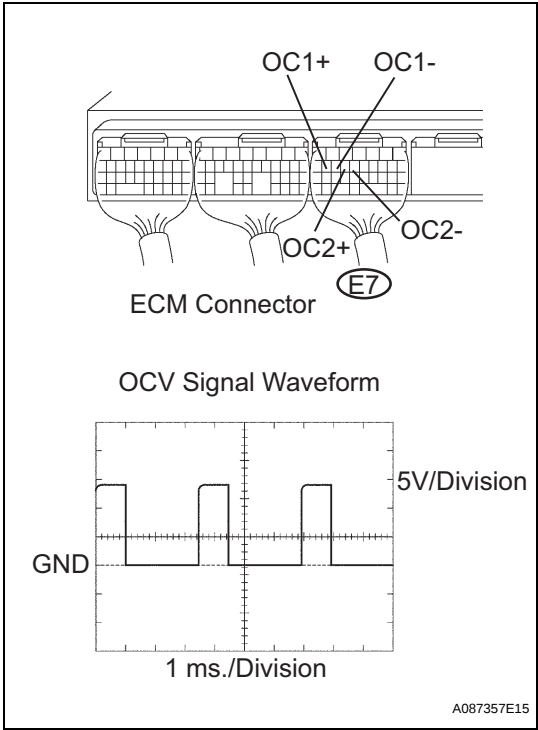
*: DTC P0011, P0012, P0021 or P0022 is output when a foreign object enters in the engine oil system. These codes will stay registered even if the system returns to normal after a short time. Foreign objects are filtered out by the oil filter.

OK

VVT SYSTEM OK

NG

4 CHECK ECM (OCV SIGNAL)



(a) During idling, check the waveform of the ECM connector using an oscilloscope.

Standard

Tester Connection	Specified Condition
E7-16 (OC1+) - E7-15 (OC1-) E7-14 (OC2+) - E7-13 (OC2-)	Correct waveform is shown in the illustration

NG

REPLACE ECM

OK

5 CHECK OIL CONTROL VALVE FILTER

OK:

The filter is not clogged.

NG

REPLACE OIL CONTROL VALVE FILTER

OK

6 CHECK CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY (OCV)

OK:

OCV has no contamination and moves smoothly.

OK

Go to step 8

NG

7 REPLACE CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY (OCV)

NEXT

ES

8 CHECK CAMSHAFT TIMING GEAR ASSEMBLY**OK:**

Camshaft timing gear assembly rotate smoothly when apply pressure.

OK**Go to step 10****NG****9 REPLACE CAMSHAFT TIMING GEAR ASSEMBLY****NEXT****10 CHECK FOR BLOCKAGE (OCV, OIL CHECK VALVE AND OIL HOLE)****OK:**

No blockage.

NG**REPAIR OR REPLACE MALFUNCTION PARTS****OK****11 CHECK ANY OTHER DTCS OUTPUT**

(a) Clear the DTCs.

- (1) Erase the codes using one of the following methods:
1) use the hand held tester, 2) disconnect the battery cable, or 3) remove the EFI NO. 1 and ETCS fuses for more than 60 seconds.

HINT:

After disconnecting the battery cable, perform the "INITIALIZE" procedure.

- (b) Start and warm up the engine.
(c) Drive the vehicle around for 10 minutes or more.
(d) Read output DTC using the intelligent tester.

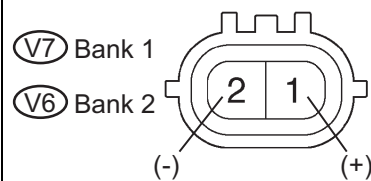
OK:**No DTC output.****HINT:**

*: DTC P0011, P0012, P0021 or P0022 is output when a foreign object enters in the engine oil system. These codes will stay registered even if the system returns to normal after a short time. Foreign objects are filtered out by the oil filter.

OK**VVT SYSTEM OK****NG****REPLACE ECM**

1 CHECK VALVE TIMING (CHECK FOR LOOSE OR JUMPING TEETH OF TIMING BELT)**OK:**

The matchmarks of crankshaft pulley and camshaft pulley are aligned.

NG**ADJUST VALVE TIMING****OK****2 CHECK OPERATION OF OCV****ES****Component Side:**

Y

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- (a) Start the engine.
- (b) Check the engine speed with (*1) and (*2).
 - (1) Disconnect the V6 or V7 OCV connector (*1).
 - (2) Apply battery positive voltage between the terminals of the OCV (*2).

Result

Proceed to	Check (*1)	Check (*2)
A	Normal engine speed	Rough idle or engine stall
B	Conditions other than A	Conditions other than A

B**Go to step 4****A****3 CHECK WHETHER DTC OUTPUTS REOCCUR**

- (a) Clear the DTCs.
 - (1) Erase the codes using one of the following methods:
 - 1) use the hand held tester, 2) disconnect the battery cable, or 3) remove the EFI NO. 1 and ETCS fuses for more than 60 seconds.

HINT:

After disconnecting the battery cable, perform the "INITIALIZE" procedure.

- (b) Start and warm up the engine.
- (c) Drive the vehicle around for 10 minutes or more.
- (d) Read output DTC using the OBD II scan tool.

OK:**No DTC output.****HINT:**

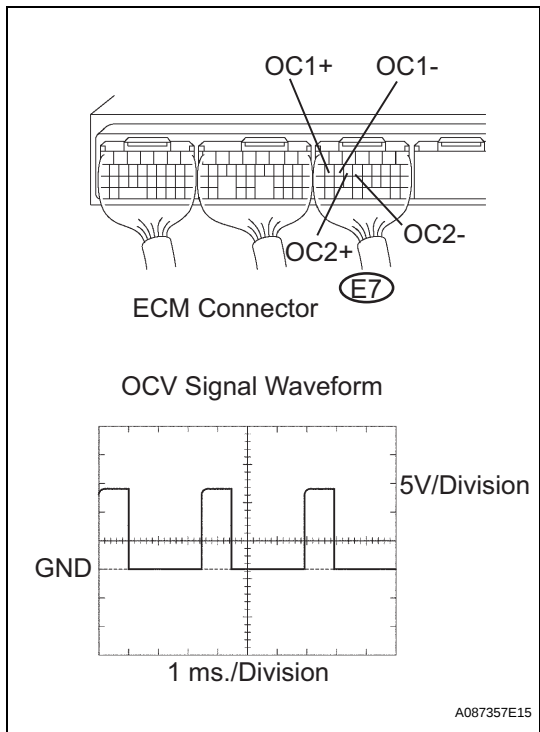
*: DTCs P0011, P0012, P0021 or P0022 is output when a foreign object enters in the engine oil system. These codes will stay registered even if the system returns to normal after a short time. Foreign objects are filtered out by the oil filter.

OK**VVT SYSTEM OK****NG**

ES

4

CHECK ECM (OCV SIGNAL)



(a) During idling, check the waveform of the E7 ECM connector using an oscilloscope.

Standard

Tester Connection	Specified Condition
E7-16 (OC1+) - E7-15 (OC1-) E7-14 (OC2+) - E7-13 (OC2-)	Correct waveform is shown in the illustration

NG

REPLACE ECM

OK

5

CHECK OIL CONTROL VALVE FILTER

OK:
The filter is not clogged.

NG

REPLACE OIL CONTROL VALVE FILTER

OK

6

CHECK CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY (OCV)

OK:
OCV has no contamination and moves smoothly.

OK

Go to step 8

NG

7

REPLACE CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY (OCV)

NEXT

8 CHECK CAMSHAFT TIMING GEAR ASSEMBLY**OK:**

Camshaft timing gear rotates smoothly when pressure is applied.

OK

Go to step 10

NG**9 REPLACE CAMSHAFT TIMING GEAR ASSEMBLY****NEXT****10 CHECK FOR BLOCKAGE (OCV, OIL CHECK VALVE AND OIL HOLE)****OK:**

No blockage.

NG**REPAIR OR REPLACE MALFUNCTION PARTS****OK****11 CHECK ANY OTHER DTCS OUTPUT**

(a) Clear the DTCs.

- (1) Erase the codes using one of the following methods:
1) use the hand held tester, 2) disconnect the battery cable, or 3) remove the EFI NO. 1 and ETCS fuses for more than 60 seconds.

HINT:

After disconnecting the battery cable, perform the "INITIALIZE" procedure.

- (b) Start and warm up the engine.
(c) Drive the vehicle around for 10 minutes or more.
(d) Read output DTC using the OBD II scan tool.

OK:**No DTC output.****HINT:**

*: DTCs P0011, P0012, P0021 or P0022 is output when a foreign object enters in the engine oil system. These codes will stay registered even if the system returns to normal after a short time. Foreign objects are filtered out by the oil filter.

NG**VVT SYSTEM OK****OK****REPLACE ECM****ES**

DTC	P0016	Crankshaft Position - Camshaft Position Correlation (Bank 1 Sensor A)
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DTC	P0018	Crankshaft Position - Camshaft Position Correlation (Bank 2 Sensor A)
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DESCRIPTION

Refer to DTCs P0335 and P0339 (See page [ES-170](#)).

DTC No.	DTC Detection Condition	Trouble Area
P0016	Deviation in crankshaft position sensor signal and VVT sensor 1 signal (2 trip detection logic)	- Mechanical system (timing belt has jumped tooth, belt is stretched) - ECM
P0018	Deviation in crankshaft position sensor signal and VVT sensor 2 signal (2 trip detection logic)	- Mechanical system (timing belt has jumped tooth, belt is stretched) - ECM

MONITOR DESCRIPTION

The ECM optimizes the valve timing using the Variable Valve Timing (VVT) system to control the intake valve camshaft. The VVT system includes the ECM, the Oil Control Valve (OCV) and the VVT controller. The ECM sends a target duty-cycle control signal to the OCV. This control signal, sent to the OCV, regulates the oil pressure applied to the VVT controller. The VVT controller can advance or retard the intake valve camshaft. The ECM calibrates the valve timing of the VVT system by setting the camshaft to the maximum retard angle when the engine is idling. The ECM closes the OCV to retard the cam. The ECM stores this value as a VVT learning value. When the difference between the target valve timing and the actual valve timing is 5 degrees or less, the ECM stores this in its memory.

If the learning value meets both of the following conditions, the ECM interprets this as a defect in the VVT system and sets a DTC.

1. The VVT learning value is less than 26°C (bank 1)/23.2°C (bank 2) or more than 45 °C (bank 1)/39.1°C (bank 2).

The above condition continues for more than 18 seconds.

MONITOR STRATEGY

Related DTCs	P0016: Camshaft timing misalignment at idle (bank 1) P0018: Camshaft timing misalignment at idle (bank 2)
Required sensors/components	VVT actuator
Required sensors/components	Camshaft position sensor, Crankshaft position sensor
Frequency of operation	Once per drive cycle
Duration	Within 1 minute
MIL operation	2 drive cycles
Sequence of operation	None

TYPICAL ENABLING CONDITIONS

Monitor runs whenever following DTCs not present	P0011, P0012, P0021, P0022 (VVT system-Advance, Retard), P0115, P0116, P0117, P0118 (ECT sensor)
Engine RPM	500 to 1,000 rpm

TYPICAL MALFUNCTION THRESHOLDS

One of the following conditions is met:	-
---	---

1. VVT angle when camshaft is retarded maximum	Less than 26°C (Bank 1) Less than 23.2°C (Bank 2)
2. VVT angle when camshaft is retarded maximum	More than 45°C (Bank 1) More than 39.1°C (Bank 2)

WIRING DIAGRAM

Refer to DTC P0335 (See page [ES-172](#)).

HINT:

Read freeze frame data using the intelligent tester or the OBD II scan tool. The ECM records vehicle and driving condition information as freeze data the moment a DTC is stored. 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.

ES

1	CHECK VALVE TIMING (CHECK FOR LOOSE AND A JUMPING TEETH OF TIMING BELT)
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OK:

The matchmarks of the crankshaft pulley and camshaft pulley are aligned.

NG
ADJUST VALVE TIMING
OK
REPLACE ECM

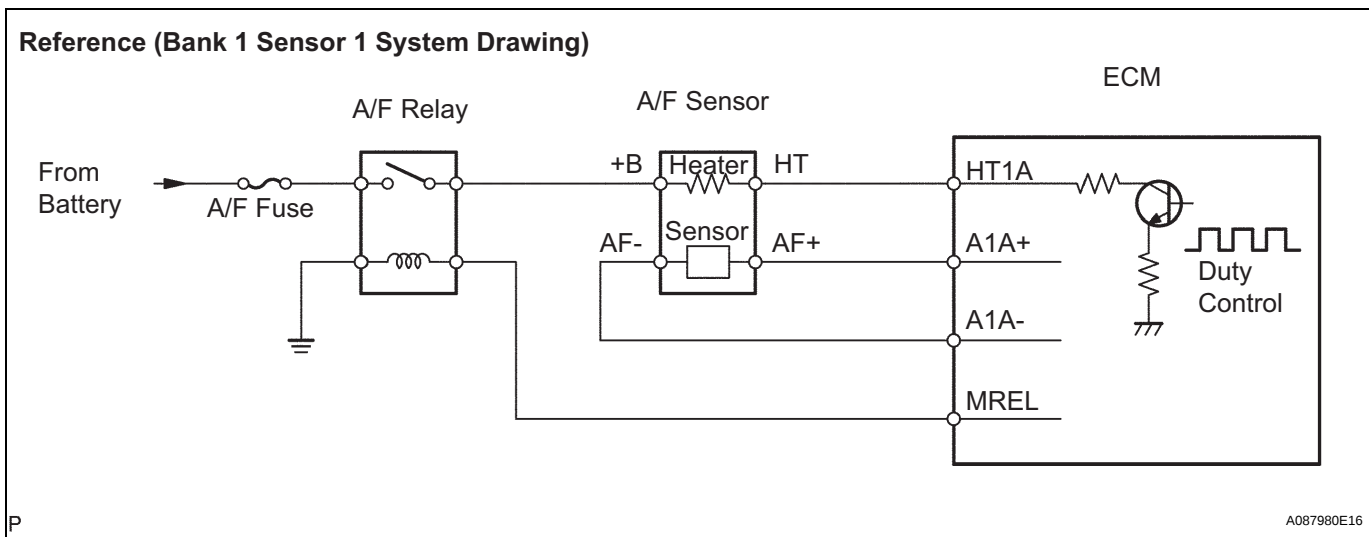
DTC	P0031	Oxygen (A/F) Sensor Heater Control Circuit Low (Bank 1 Sensor 1)
DTC	P0032	Oxygen (A/F) Sensor Heater Control Circuit High (Bank 1 Sensor 1)
DTC	P0051	Oxygen (A/F) Sensor Heater Control Circuit Low (Bank 2 Sensor 1)
DTC	P0052	Oxygen (A/F) Sensor Heater Control Circuit High (Bank 2 Sensor 1)

DESCRIPTION

HINT:

- Although the caption of each detection item (DTC description) says "oxygen sensor", this DTC is related to the "air fuel ratio sensor (A/F sensor)".
- The ECM provides a pulse width modulated control circuit to adjust current through the heater. The A/F sensor heater circuit uses a relay on the +B side of the circuit.

Refer to DTC P2195 (See page [ES-271](#))



DTC No.	DTC Detection Condition	Trouble Area
P0031 P0051	Heater current is 0.8 A or less when heater operates (1 trip detection logic)	- Open or short in heater circuit of A/F sensor - A/F sensor heater - A/F relay - ECM
P0032 P0052	Heater current exceeds 19.7 A when heater operates (1 trip detection logic)	- Open or short in heater circuit of A/F sensor - A/F sensor heater - A/F relay - ECM

HINT:

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

MONITOR DESCRIPTION

The ECM uses the Air-Fuel Ratio sensor (A/F sensor) information to regulate the air-fuel ratio close to the stoichiometric ratio. This maximizes the catalytic converter's ability to purify exhaust gas. The sensor detects oxygen levels in the exhaust gas and sends this signal to the ECM.

The inner surface of the sensor element is exposed to outside air. The outer surface of the sensor element is exposed to exhaust gas. The sensor element is made of platinum coated zirconia and includes an integrated heating element. The zirconia element generates small voltage when there is a large difference in the oxygen concentrations of the exhaust and the outside air. The platinum coating amplifies the voltage generation. When heated, the sensor becomes very efficient. If the temperature of the exhaust is low, the sensor will not generate useful voltage signals without supplemental heating. The ECM regulates the supplemental heating using a duty-cycle approach to regulate the average current in the heater element. If the heater current is out of the normal range, the sensor's output signals will be inaccurate and the ECM cannot regulate the air-fuel ratio properly.

When the heater current is out of the normal operating range, the ECM interprets this as a malfunction and sets a DTC.

ES

MONITOR STRATEGY

Related DTCs	P0031: A/F Sensor Heater (Bank 1) Range Check (Low current) P0032: A/F Sensor Heater (Bank 1) Range Check (High current) P0051: A/F Sensor Heater (Bank 2) Range Check (Low current) P0052: A/F Sensor Heater (Bank 2) Range Check (High current)
Required sensors / components (Main)	A/F sensor heater
Required sensors / components (Related)	-
Frequency of operation	Continuous
Duration	10 seconds
MIL operation	Immediate
Sequence operation	None

TYPICAL ENABLING CONDITIONS

All:

The monitor will run whenever these DTCs are not present	None
Time after engine start	10 seconds or more

P0031 and P0051:

A/F sensor heater duty ratio	50 % or more
Battery voltage	10.5 V or more

TYPICAL MALFUNCTION THRESHOLDS

P0031 and P0051:

A/F sensor heater current	Less than 0.8 A
---------------------------	-----------------

P0032 and P0052:

Hybrid IC high current limiter port	Fail
-------------------------------------	------

COMPONENT OPERATING RANGE

A/F sensor heater current	1.8 to 3.4 A at 20°C (68°F)
---------------------------	-----------------------------

MONITOR RESULT

Refer to "Checking Monitor Status" for detailed information (See page [ES-14](#)).

The test value and test limit information are described as shown in the following table. Check the monitor result and test values after performing the monitor drive pattern (See page [ES-16](#)).

- TID (Test Identification Data) is assigned to each emissions-related component.
- TLT (Test Limit Type) :
If TLT is 0, the component is malfunctioning when the test value is higher than the test limit.
If TLT is 1, the component is malfunctioning when the test value is lower than the test limit.
- CID (Component, Identification Data) is assigned to each test value.
- Unit Conversion is used to calculate the test value indicated on generic OBD II scan tools.

TID \$07: A/F sensor heater

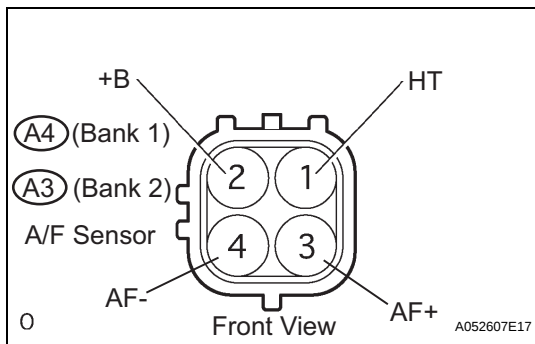
TLT	CID	Unit Conversion	Description of Test Data	Description of Test Limit
1	\$01	Multiply by 0.00017 (A)	Maximum A/F sensor heater current (Bank 1 Sensor 1)	Malfunction threshold for A/F sensor heater
1	\$10	Multiply by 0.00017 (A)	Maximum A/F sensor heater current (Bank 2 Sensor 1)	Malfunction threshold for A/F sensor heater

ES**WIRING DIAGRAM**

Refer to DTC P2195 (See page [ES-275](#)).

HINT:

Read freeze frame data using the intelligent tester or the OBD II scan tool. 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 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.

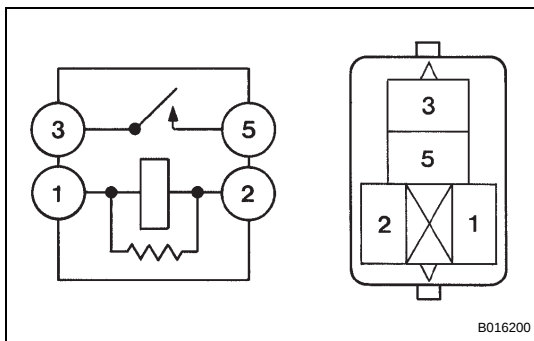
1 INSPECT AIR FUEL RATIO SENSOR (HEATER RESISTANCE)

- Disconnect the A3 or A4 A/F sensor connector.
- Measure the resistance between the terminals of the A/F sensor.

Standard resistance

Tester Connection	Condition	Specified Condition
1 (HT) - 2 (+B)	20°C (68°F)	1.8 to 3.4 Ω
1 (HT) - 4 (AF-)	-	10 kΩ or higher

- Reconnect the A/F sensor connector.

NG**REPLACE AIR FUEL RATIO SENSOR****OK****2 INSPECT AIR FUEL RATIO SENSOR RELAY**

- Remove the A/F relay from the engine room R/B.
- Measure the resistance of the A/F relay.

Standard resistance

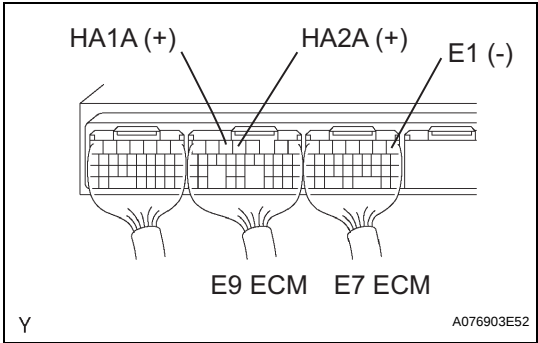
Tester Connection	Specified Condition
1 - 2	Below 1Ω
3 - 5	10 kΩ or higher
3 - 5	Below 1Ω (Apply battery voltage terminals 1 and 2)

- Reinstall the A/F relay.

NG**REPLACE AIR FUEL RATIO SENSOR RELAY**

OK

3 INSPECT ECM (HA1A AND HA2A VOLTAGE)



- (a) Turn the ignition switch ON.
(b) Measure the voltage of the ECM connectors.

Standard voltage

Tester Connection	Specified Condition
E9-5 (HA1A) - E7-1 (E1) E9-4 (HA2A) - E7-1 (E1)	9 to 14 V

HINT:

- The HA1A stands for the A/F sensor bank 1 sensor 1.
- The HA2A stands for the A/F sensor bank 2 sensor 1.

ES

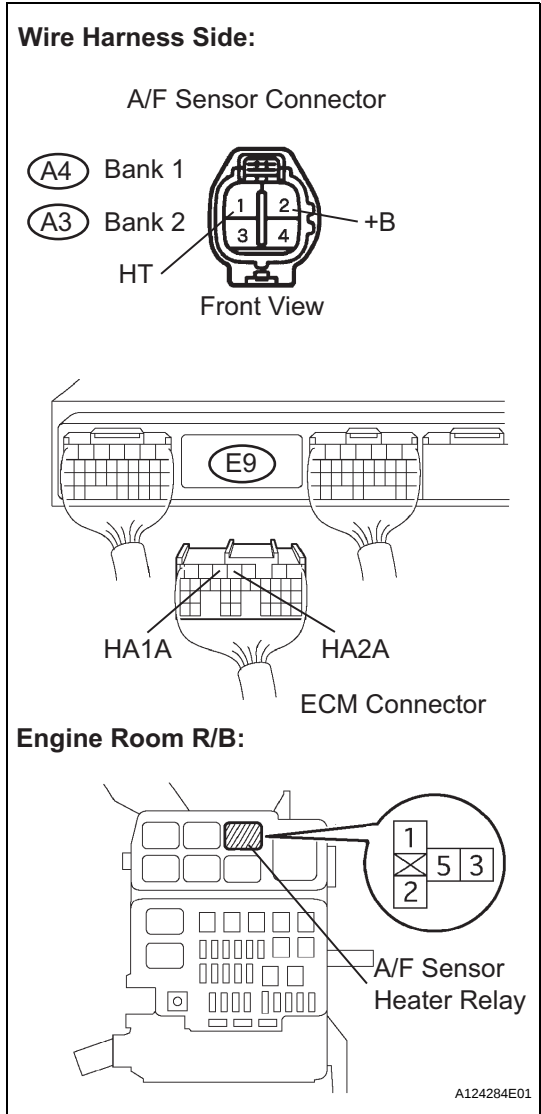
OK

REPLACE ECM

NG

4

CHECK HARNESS AND CONNECTOR (A/F SENSOR - ECM, A/F SENSOR - A/F RELAY)



- (a) Check the wire harness between the ECM and A/F sensors.
- Disconnect the E9 ECM connector.
 - Disconnect the A4 or A3 A/F sensor connector.
 - Measure the resistance of the wire harness side connectors.

Standard resistance

Tester Connection	Specified Condition
A4-1 (HT) - E9-5 (HA1A) A3-1 (HT) - E9-4 (HA2A)	Below 1 Ω
A4-1 (HT) or E9-5 (HA1A) - Body ground A3-1 (HT) or E9-4 (HA2A) - Body ground	10 kΩ or higher

- (b) Check the wire harness between the A/F sensor and A/F relay.
- Disconnect the A3 or A4 A/F sensor connector.
 - Remove the A/F relay from the engine room R/B.
 - Measure the resistance of the wire harness side connectors.

Standard resistance

Tester Connection	Specified Condition
A4-2 (+B) - A/F relay terminal 3 A3-2 (+B) - A/F relay terminal 3	Below 1 Ω
A4-2 (+B) or A/F relay terminal 3 - Body ground A3-2 (+B) or A/F relay terminal 3 - Body ground	10 kΩ or higher

NG

REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

REPLACE ECM

DTC	P0037	Oxygen Sensor Heater Control Circuit Low (Bank 1 Sensor 2)
DTC	P0038	Oxygen Sensor Heater Control Circuit High (Bank 1 Sensor 2)
DTC	P0057	Oxygen Sensor Heater Control Circuit Low (Bank 2 Sensor 2)
DTC	P0058	Oxygen Sensor Heater Control Circuit High (Bank 2 Sensor 2)

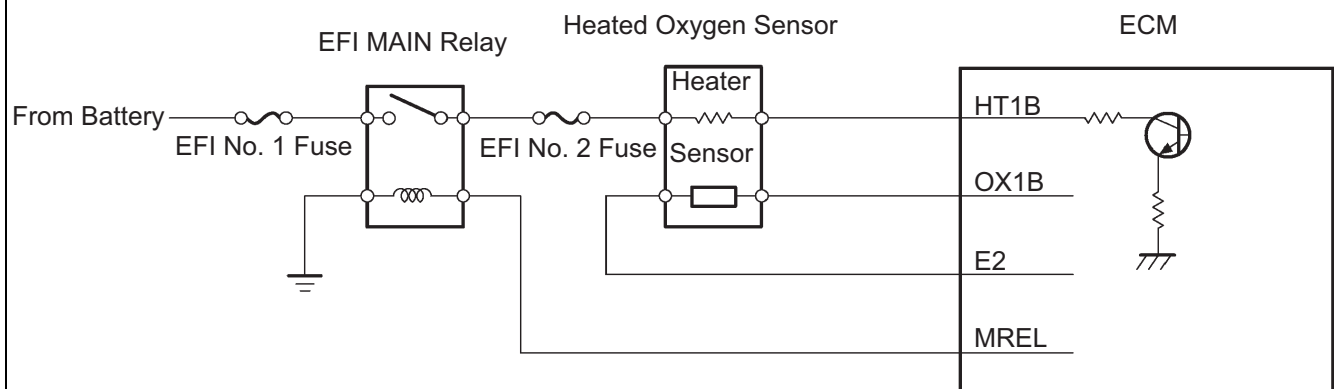
ES

DESCRIPTION

Refer to DTC P0136 (See page [ES-125](#)).

HINT:

The ECM provides a pulse width modulated control circuit to adjust current through the heater. The heated oxygen sensor heater circuit uses a relay on the +B side of the circuit.

Reference (Bank 1 Sensor 2 System Drawing)

Y

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DTC No.	DTC Detection Condition	Trouble Area
P0037 P0057	Heater current is 0.3 A or less when the heater operates with +B greater than 10.5 V (1 trip detection logic)	- Open or short in heater circuit of the heated oxygen sensor - Heated oxygen sensor heater - EFI MAIN relay - ECM
P0038 P0058	Heated current exceeds 2 A when the heater operates (1 trip detection logic)	- Open or short in heater circuit of the heated oxygen sensor - Heated oxygen sensor heater - EFI MAIN relay - ECM

HINT:

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

MONITOR DESCRIPTION

The sensing portion of the heated oxygen sensor has a zirconia element that is used to detect oxygen concentration in the exhaust. If the zirconia element is at the proper temperature and the difference in the oxygen concentration between the inside and outside surfaces of the sensor is large, the zirconia element will generate voltage signals. In order to increase the oxygen concentration detecting capacity in the zirconia element, the ECM supplements the heat from the exhaust with heat from a heating element inside the sensor. When the current in the sensor is out of the standard operating range, the ECM interprets this as a fault in the heated oxygen sensor and sets a DTC.

Example:

The ECM will set a high current DTC if the current in the sensor is more than 2 A when the heater is OFF. Similarly, the ECM will set a low current DTC if the current is less than 0.3 A when the heater is ON.

ES

MONITOR STRATEGY

Related DTCs	P0037: Heated oxygen sensor heater (Bank 1) open/short (Low electrical current) P0038: Heated oxygen sensor heater (Bank 1) open/short (High electrical current) P0057: Heated oxygen sensor heater (Bank 2) open/short (Low electrical current) P0058: Heated oxygen sensor heater (Bank 2) open/short (High electrical current)
Required sensors / components	Heated oxygen sensor heater (Bank 1 and 2)
Required sensors / components	Vehicle Speed Sensor
Frequency of operation	Continuous
Duration	Heated oxygen sensor heater (Bank 1) open/short (Low electrical current) : 0.5 seconds Heated oxygen sensor heater (Bank 2) open/short (Low electrical current) : 0.5 seconds Heated oxygen sensor heater (Bank 1) open/short (High electrical current) : 0.2 seconds Heated oxygen sensor heater (Bank 2) open/short (High electrical current) : 0.2 seconds
MIL operation	Immediate
Sequence operation	None

TYPICAL ENABLING CONDITIONS

All:

Monitor run whenever following DTCs are not present	None
---	------

P0037, P0057:

Battery voltage	10.5 V or more
Engine	Running
Starter	OFF
All heater is turned OFF and intrusive heating is operated when the following conditions are met	(a) and (b)
(a) Heater	ON
(b) Heater current	Less than 0.3 A

P0038, P0058 Case 1:

Battery voltage	10.5 V or more
Engine	Running
Starter	OFF
Intrusive heating	Not operating

P0038 and P0058 Case 2:

Battery voltage	10.5 V or more
All heater is turned OFF and intrusive heating is operated when the following conditions are met	(a) and (b)
(a) Heater	ON

(b) Hybrid IC high current limiter port	Fail
---	------

TYPICAL MALFUNCTION THRESHOLDS

P0037 and P0057:

Heated oxygen sensor heater current during intrusive heating	Less than 0.3 A
--	-----------------

P0038 and P0058 Case 1:

Hybrid IC high current limiter port	Fail
-------------------------------------	------

P0038 and P0058 Case 2:

Heated oxygen sensor heater current during intrusive heating	More than 2 A
--	---------------

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COMPONENT OPERATING RANGE

HO2S heater current	0.4 to 1 A (at idle, warmed-up engine and +B: 11 to 14 V)
---------------------	---

MONITOR RESULT

Refer to "Checking Monitor Status" for detailed information (See page [ES-14](#)).

The test value and test limit information are described as shown in the following table. Check the monitor result and test values after performing the monitor drive pattern (See page [ES-16](#)).

- TID (Test Identification Data) is assigned to each emissions-related component.
- TLT (Test Limit Type):
If TLT is 0, the component is malfunctioning when the test value is higher than the test limit.
If TLT is 1, the component is malfunctioning when the test value is lower than the test limit.
- CID (Component Identification Data) is assigned to each test value.
- Unit Conversion is used to calculate the test value indicated on generic OBD II scan tools.

TID \$04: HO2S heater

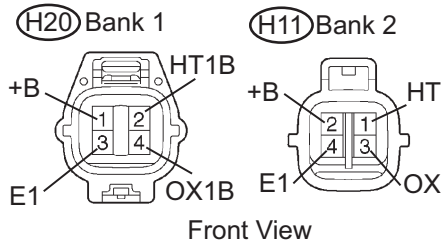
TLT	CID	Unit Conversion	Description of Test Data	Description of Test Limit
1	\$02	Multiply by 0.000076 (A)	Maximum HO2S heater current (Bank 1 Sensor 2)	Malfunction threshold for HO2S heater
1	\$20	Multiply by 0.000076 (A)	Maximum HO2S heater current (Bank 2 Sensor 2)	Malfunction threshold for HO2S heater

WIRING DIAGRAM

Refer to DTC P0136 (See page [ES-130](#)).

HINT:

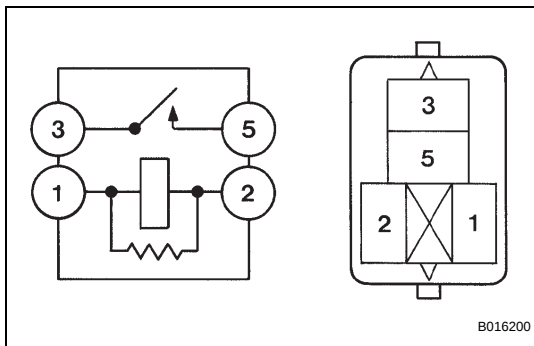
- If DTCs related to different systems that have terminal E2 as the ground terminal are output simultaneously, terminal E2 may have an open circuit.
- Read freeze frame data using the intelligent tester or the OBD II scan tool. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can help determine if the vehicle was 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.

1 INSPECT HEATED OXYGEN SENSOR (HEATER RESISTANCE)**Component Side:**

- (a) Disconnect the H11 or H20 heated oxygen sensor connector.
 (b) Measure the resistance of the heated oxygen sensor terminals.

Standard resistance (bank 1, 2 sensor 2)

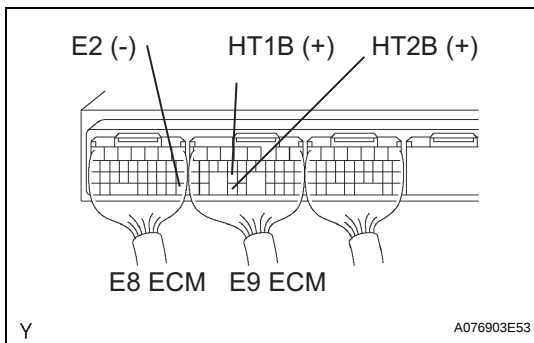
Tester Connection	Condition	Specified Condition
H11-1 (HT) - H11-2 (+B) H20-1 (+B) - H20-2 (HT1B)	20°C (68°F)	11 to 16 Ω

NG**REPLACE HEATED OXYGEN SENSOR****OK****2 INSPECT EFI MAIN RELAY**

- (a) Remove the EFI MAIN relay from the engine room J/B.
 (b) Measure the resistance of the EFI MAIN relay.

Standard resistance

Tester Connection	Specified Condition
1 - 2	Below 1 Ω
3 - 5	10 k Ω or higher
3 - 5	Continuity (when battery voltage is applied to terminals 1 and 2)

NG**REPLACE EFI MAIN RELAY****OK****3 INSPECT ECM (HT1B OR HT2B VOLTAGE)**

- (a) Turn the ignition switch ON.
 (b) Measure the voltage of the ECM connectors.

Standard voltage

Tester Connection	Specified Condition
E9-25 (HT1B) - E8-28 (E2) E9-33 (HT2B) - E8-28 (E2)	9 to 14 V

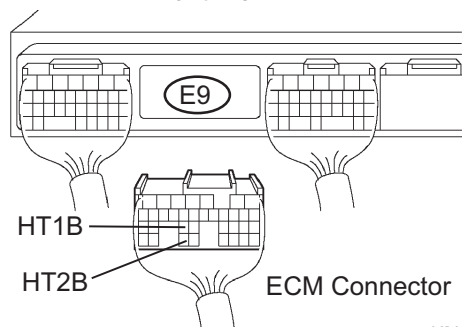
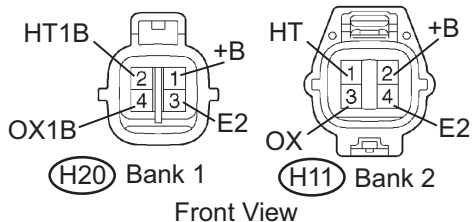
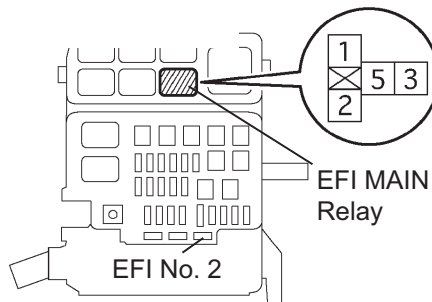
HINT:

- The HT1B stands for the heated oxygen sensor bank 1 sensor 2.
- The HT2B stands for the heated oxygen sensor bank 2 sensor 2.

OK**REPLACE ECM****NG**

4**CHECK HARNESS AND CONNECTOR (HEATED OXYGEN SENSOR - ECM, HEATED OXYGEN SENSOR - EFI RELAY)****Wire Harness Side:**

Heated Oxygen Sensor Connector

**Engine Room R/B and Fusible Link Block:**

A124286E01

- (a) Check the wire harness between the ECM and heated oxygen sensor.
- (1) Disconnect the E9 ECM connector.
 - (2) Disconnect the H11 or H20 heated oxygen sensor connector.
 - (3) Measure the resistance of the wire harness side connectors.

Standard resistance

Tester Connection	Specified Condition
H20-2 (HT1B) - E9-25 (HT1B) H11-1 (HT) - E9-33 (HT2B)	Below 1 Ω
H20-2 (HT1B) or E9-25 (HT1B) - Body ground H11-1 (HT) or E9-33 (HT2B) - Body ground	10 k Ω or higher

- (b) Check the wire harness between the heated oxygen sensor and EFI MAIN relay.
- (1) Disconnect the H11 or H20 heated oxygen sensor connector.
 - (2) Remove the EFI MAIN relay from the engine room J/B.
 - (3) Measure the resistance of the wire harness side connectors.

Standard resistance

Tester Connection	Specified Condition
H11-2 (+B) - EFI relay terminal 3 H20-1 (+B) - EFI relay terminal 3	Below 1 Ω
H11-2 (+B) or EFI relay terminal 3 - Body ground H20-1 (+B) or EFI relay terminal 3 - Body ground	10 k Ω or higher

NG**REPAIR OR REPLACE HARNESS OR CONNECTOR****OK****REPLACE ECM****ES**

DTC	P0100	Mass or Volume Air Flow Circuit
DTC	P0102	Mass or Volume Air Flow Circuit Low Input
DTC	P0103	Mass or Volume Air Flow Circuit High Input

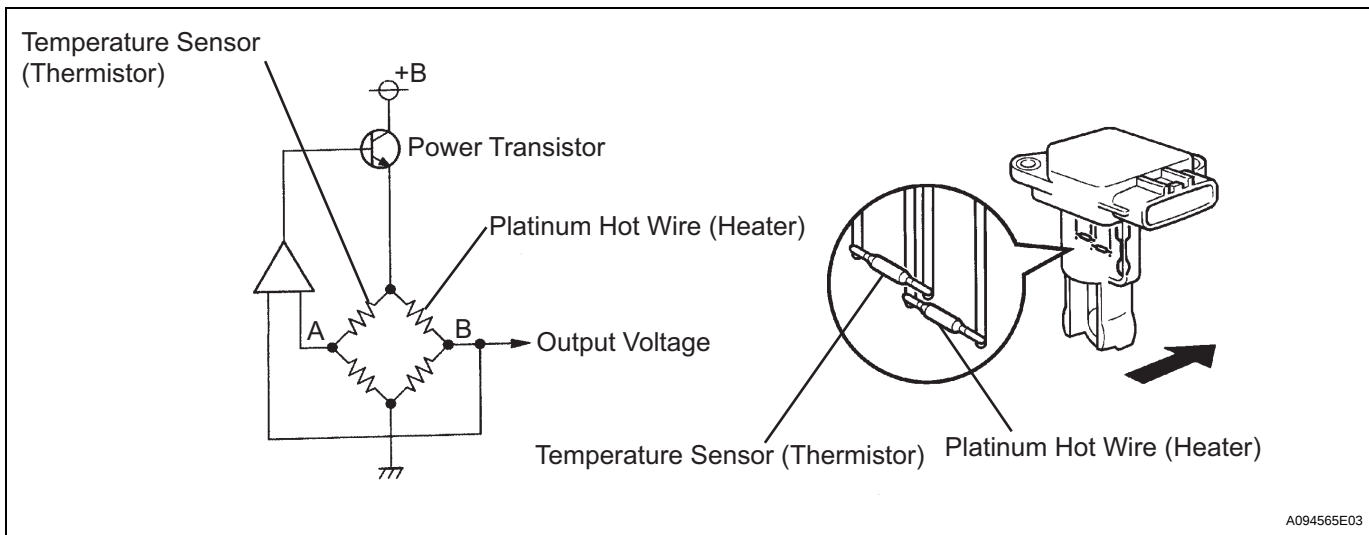
DESCRIPTION

The Mass Air Flow (MAF) meter measures the amount of air flowing through the throttle valve. The ECM uses this information to determine the fuel injection time and provide a proper air fuel ratio. Inside the MAF meter, there is a heated platinum wire exposed to the flow of intake air.

ES

By applying a specific current to the wire, the ECM heats this wire to a given temperature. The flow of incoming air cools the wire and an internal thermistor, changing their resistance. To maintain a constant current value, the ECM varies the voltage applied to these components in the MAF meter. The voltage level is proportional to the air flow through the sensor. The ECM interprets this voltage as the intake air amount.

The circuit is constructed so that the platinum hot wire and temperature sensor provide a bridge circuit, with the power transistor controlled so that the potential of A and B remains equal to maintain the set temperature.



DTC No.	DTC Detection Condition	Trouble Area
P0100	When MAF meter circuit has an open or a short for more than 3 seconds under 4,000 rpm engine speed	- Open or short in MAF meter circuit - MAF meter - ECM
P0102	When MAF meter circuit has an open for more than 3 seconds under 4,000 rpm engine speed	- Open or short in MAF meter circuit - MAF meter - ECM
P0103	When MAF meter circuit has a short for more than 3 seconds under 4,000 rpm engine speed	- Open or short in MAF meter circuit - MAF meter - ECM

HINT:

After confirming DTC P0100, P0102 or P0103, use the intelligent tester or the OBD II scan tool to confirm the MAF ratio from the ALL menu (to reach the ALL menu: DIAGNOSIS / ENHANCED OBD II / DATA LIST / ALL).

Air Flow Value (gm/s)	Malfunction
Approx. 0.0	- Open in MAF meter power source circuit - Open or short in VG circuit
271.0 or more	Open in E2G circuit

MONITOR DESCRIPTION

If there is a defect in the sensor, or an open or short circuit, the voltage level will deviate from the normal operating range. The ECM interprets this deviation as a defect in the MAF meter and sets a DTC.

Example:

The sensor voltage output is less than 0.2 V or more than 4.9 V and either condition continues for more than 3 seconds.

MONITOR STRATEGY

Related DTCs	P0100: MAF Meter Range Check (Chattering) P0102: 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
Frequency of operation	Continuous
Duration	3 seconds
MIL operation	Immediate: Engine RPM is less than 4,000 rpm 2 driving cycles: Engine RPM is 4,000 rpm or more
Sequence operation	None

ES

TYPICAL ENABLING CONDITIONS

Monitor runs whenever following DTCs not present	None
--	------

TYPICAL MALFUNCTION THRESHOLDS

P0100:

MAF meter voltage	Less than 0.2 V, or more than 4.9 V
-------------------	-------------------------------------

P0102:

MAF meter voltage	Less than 0.2 V
-------------------	-----------------

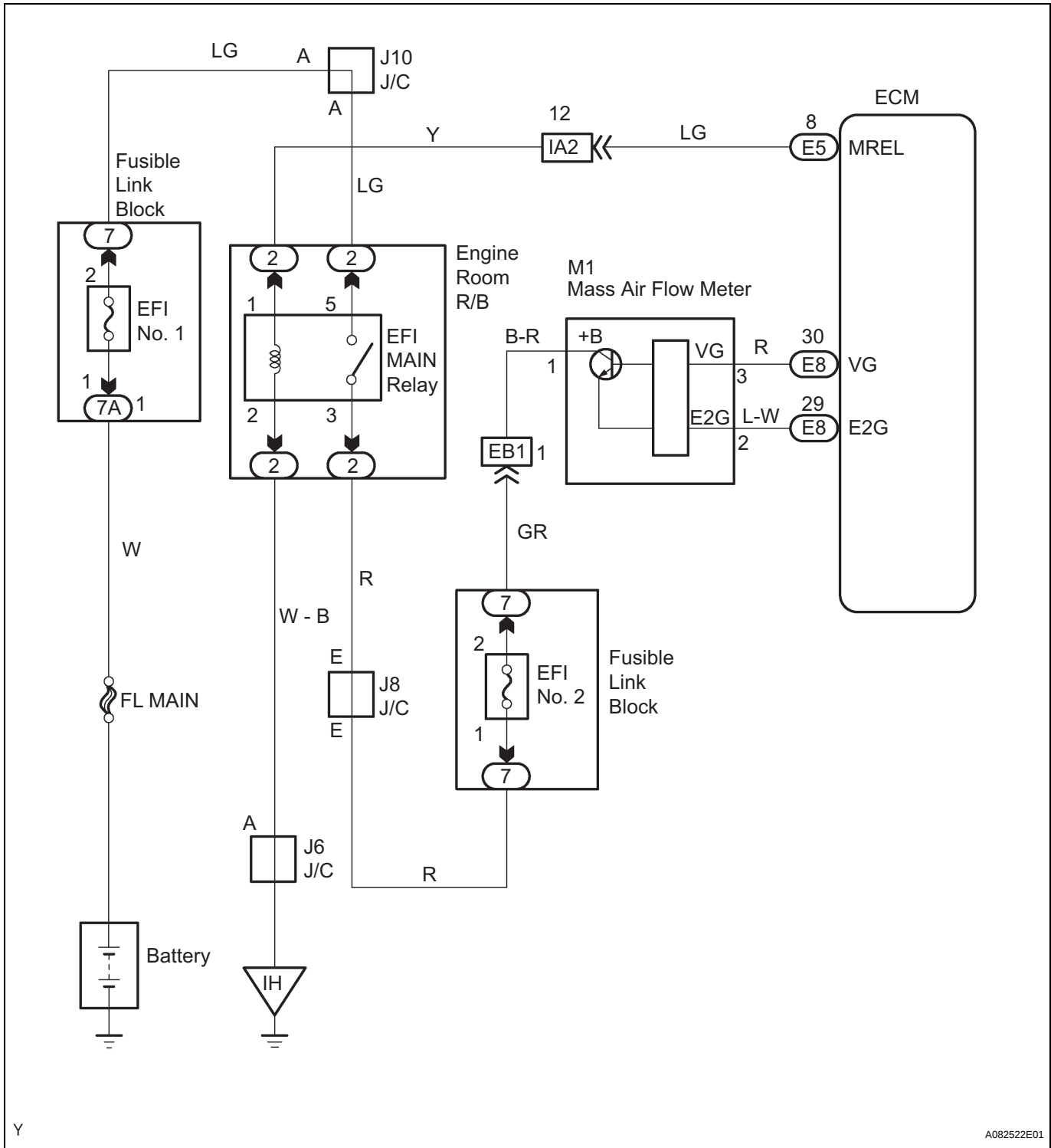
P0103:

MAF meter voltage	More than 4.9 V
-------------------	-----------------

COMPONENT OPERATING RANGE

Mass air flow meter voltage	Between 0.4 V and 2.2 V
-----------------------------	-------------------------

WIRING DIAGRAM



HINT:

Read freeze frame data using the intelligent tester or the OBD II scan tool. 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 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.

1 READ VALUE OF INTELLIGENT TESTER OR OBD II SCAN TOOL (MASS AIR FLOW RATE)

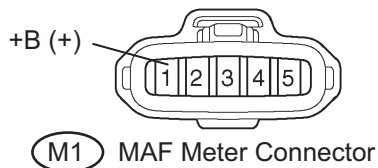
- (a) Connect the intelligent tester or the OBD II scan tool to the DLC3.
- (b) Start the engine.
- (c) Push the intelligent tester or the OBD II scan tool main switch ON.
- (d) On the intelligent tester or the OBD II scan tool, enter the following menus: DIAGNOSIS / ENHANCED OBD II / DATA LIST / ALL / MAF. Read the values.

Result

Air Flow Rate (gm/s)	Proceed to
0.0	A
271.0 or more	B
MAF rate greater than 1 but less than 270.0*	C

HINT:

*: The value must change when the throttle valve is opened or closed.

B**Go to step 6****C****CHECK FOR INTERMITTENT PROBLEMS****A****2 INSPECT MASS AIR FLOW METER (POWER SOURCE VOLTAGE)****Wire Harness Side:**

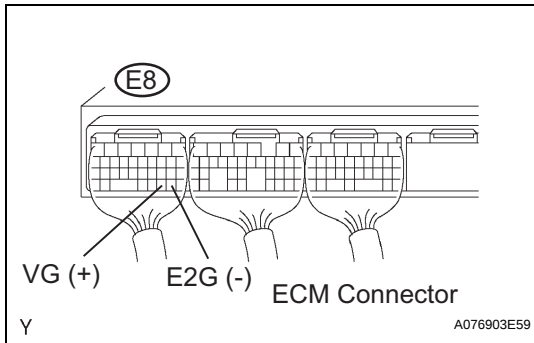
Y

A054396E28

- (a) Turn the ignition switch ON.
 - (b) Disconnect the M1 MAF meter connector.
 - (c) Measure the voltage of the wire harness side connector.
- Standard voltage**

Tester Connection	Specified Condition
M1-1 (+B) - Body ground	9 to 14 V

NG**Go to step 5****OK****ES**

3 INSPECT ECM (VG VOLTAGE)

- (a) Start the engine.
 (b) Measure the voltage of the E8 ECM connector.
 HINT:
 The shift position should be P or N and the A/C switch should be turned OFF.

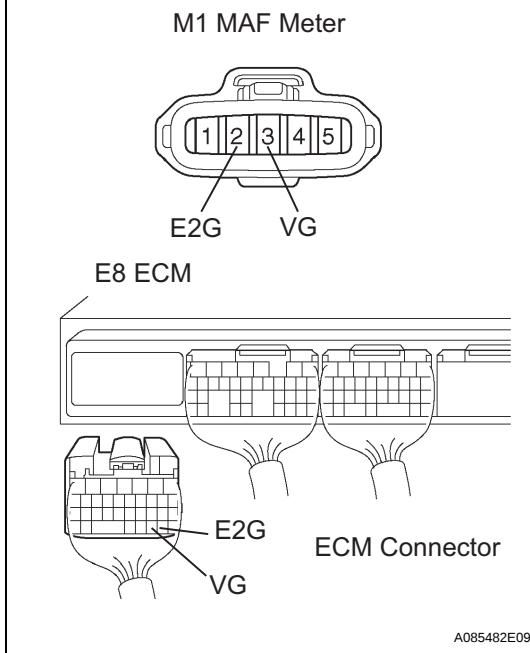
Standard voltage

Tester Connection	Condition	Specified Condition
E8-30 (VG) - E8-29 (E2G)	Engine is idling	0.5 to 3.0 V

OK

REPLACE ECM

NG

4 CHECK HARNESS AND CONNECTOR (MASS AIR FLOW METER - ECM)**Wire Harness Side:**

- (a) Disconnect the M1 MAF meter connector.
 (b) Disconnect the E8 ECM connector.
 (c) Measure the resistance of the wire harness side connectors.

Standard resistance

Tester Connection	Specified Condition
M1-3 (VG) - E8-30 (VG) M1-2 (E2G) - E8-29 (E2G)	Below 1 Ω
M1-3 (VG) or E8-30 (VG) - Body ground	10 k Ω or higher

- (d) Reconnect the MAF meter connector and ECM connector.

NG

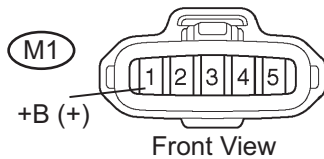
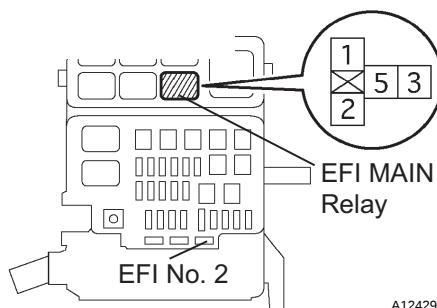
REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

REPLACE MASS AIR FLOW METER

5**CHECK HARNESS AND CONNECTOR (MASS AIR FLOW METER - EFI MAIN RELAY)****Wire Harness Side:**

Mass Air Flow Meter Connector

**Engine Room R/B and Fusible Link Block:**

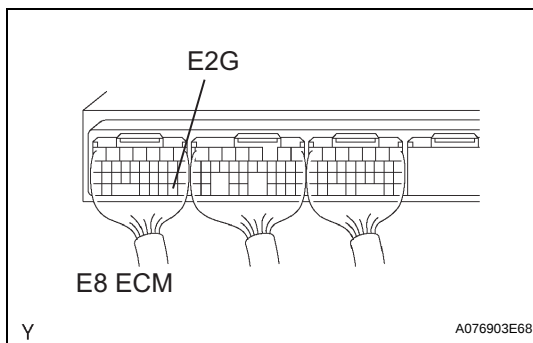
A124290E01

- (a) Check the EFI No. 2 fuse.
 (1) Remove the EFI No. 2 fuse the fusible link block.
 (2) Measure the resistance of the EFI No. 2 fuse.
Standard:
Below 1 Ω
 (3) Reinstall the EFI No. 2 fuse.
 (b) Disconnect the M1 MAF meter connector.
 (c) Remove the EFI MAIN relay from the engine room R/B.
 (d) Measure the resistance of the wire harness side connectors.

Standard resistance

Tester Connection	Specified Condition
M1-1 (+B) - EFI MAIN relay terminal 3	Below 1 Ω
M1-1 (+B) or EFI MAIN relay terminal 3 - Body ground	10 k Ω or higher

- (e) Reconnect the MAF meter connector.
 (f) Reinstall the EFI MAIN relay.

NG**REPAIR OR REPLACE HARNESS OR CONNECTOR****OK****ES****INSPECT ECM POWER SOURCE CIRCUIT****6****INSPECT ECM (SENSOR GROUND)**

Y

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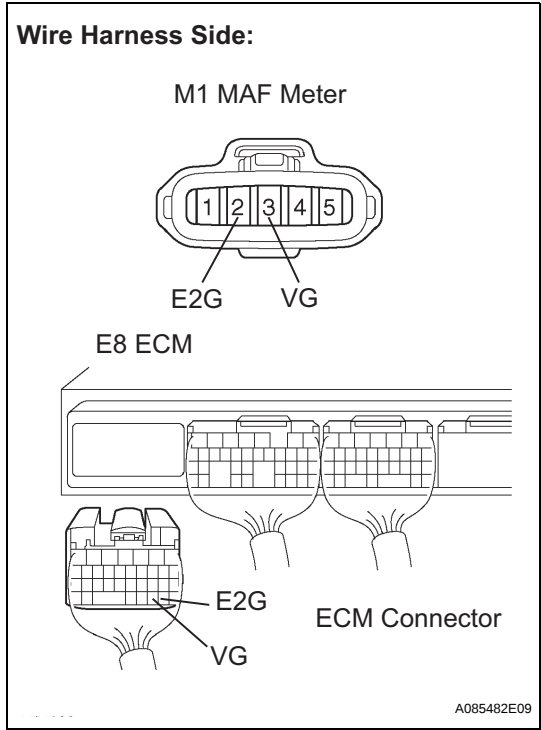
- (a) Measure the resistance of the ECM connector.
Standard resistance

Tester Connection	Specified Condition
E8-29 (E2G) - Body ground	Below 1 Ω

NG**REPLACE ECM****OK**

7

CHECK HARNESS AND CONNECTOR (MASS AIR FLOW METER - ECM)



- (a) Disconnect the M1 MAF meter connector.
- (b) Disconnect the E8 ECM connector.
- (c) Measure the resistance of between the wire harness side connectors.

Standard resistance

Tester Connection	Specified Condition
M1-3 (VG) - E8-30 (VG) M1-2 (E2G) - E8-29 (E2G)	Below 1 Ω
M1-3 (VG) or E8-30 (VG) - Body ground	10 kΩor higher

- (d) Reconnect the MAF meter connector and ECM connector.

NG

REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

REPLACE MASS AIR FLOW METER

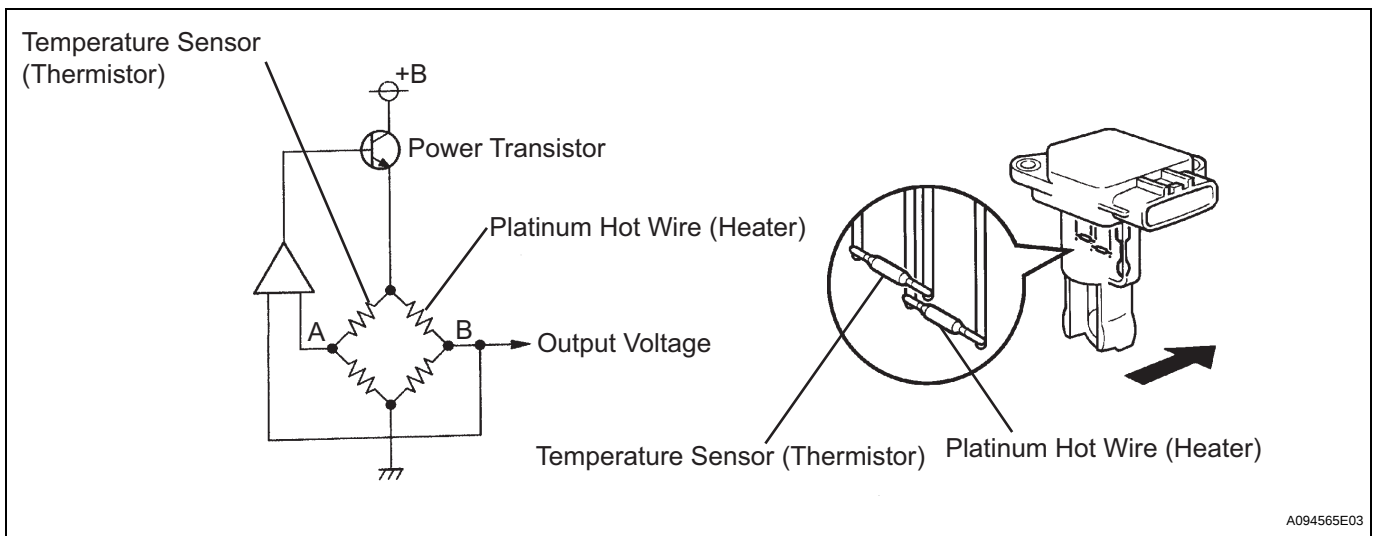
DTC**P0101****Mass Air Flow Circuit Range / Performance Problem****DESCRIPTION**

The Mass Air Flow (MAF) meter is a sensor that measures the amount of air flowing through the valve. The ECM uses this information to determine the fuel injection time and to provide 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 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 provide a bridge circuit, and the power transistor is controlled so that the potentials of A and B remain equal to maintain the predetermined temperature.

HINT:

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



DTC No.	DTC Detection Condition	Trouble Area
P0101	- High voltage: Conditions (a) and (b) continue for more than 10 seconds (2 trip detection logic): (a) Engine speed less than 2,000 rpm (b) Engine coolant temperature 70°C (158°F) or higher - Low voltage: Condition (a) continues for more than 10 seconds (2 trip detection logic): (a) Engine speed more than 300 rpm	MAF meter

MONITOR DESCRIPTION

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

Example:

If the voltage is more than 2.2 V, or less than 0.83 V while idling, the ECM determines that there is a malfunction in the MAF meter and sets the DTC.

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MONITOR STRATEGY

Related DTCs	P0101: Mass air flow meter rationality
Required Sensors/Components (Main)	Mass air flow meter
Required Sensors/Components (Related)	Crankshaft position sensor, engine coolant temperature sensor and throttle position sensor
Frequency of Operation	Continuous
Duration	10 seconds
MIL Operation	2 driving cycles
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

All:

Monitor runs whenever following DTCs not present	P0115, P0116, P0117, P0118 (ECT sensor), P0120, P0122, P0123, P0222, P0223, P2135 (TP sensor), P0125 (Insufficient ECT for closed loop), P0335 (CKP sensor), P0340, P0341 (CMP sensor), P0385 (CKP sensor 2)
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Mass Air Flow Meter Rationality (High Voltage):

Engine speed	Less than 2,000 rpm
Engine coolant temperature	70°C (158°F) or more

Mass Air Flow Meter Rationality (Low Voltage):

Engine speed	More than 300 rpm
Fuel cut	OFF

TYPICAL MALFUNCTION THRESHOLDS

Mass Air Flow Meter Rationality (High Voltage):

Mass air flow meter voltage	More than 2.2 V (varies with throttle position sensor voltage)
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Mass Air Flow Meter Rationality (Low Voltage):

Mass air flow meter voltage	Less than 0.54 V (varies with throttle position sensor voltage)
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WIRING DIAGRAM

Refer to DTC P0100 (See page [ES-86](#)).

HINT:

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

1**CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P0101)**

- (a) Connect the intelligent tester to the DLC3.
- (b) Turn the ignition switch ON.
- (c) Turn the tester ON.
- (d) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DTC INFO / CURRENT CODES.
- (e) Read DTCs.

Result

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

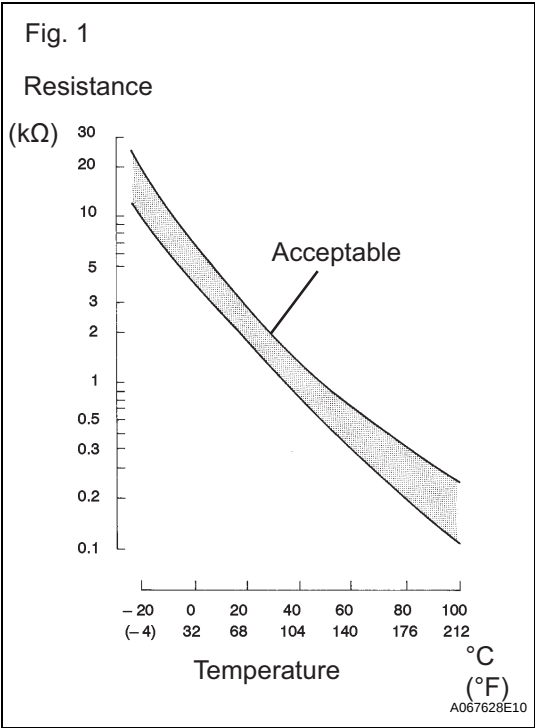
HINT:

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

B**REPLACE MASS AIR FLOW METER****A****GO TO RELEVANT DTC CHART****ES**

DTC	P0110	Intake Air Temperature Circuit Malfunction
DTC	P0112	Intake Air Temperature Circuit Low Input
DTC	P0113	Intake Air Temperature Circuit High Input

DESCRIPTION



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 (Included in ECM) as voltage changes (See Fig. 1).

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 drivability.

HINT:

When any of DTCs P0110, 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 No.	Proceed to	DTC Detection Condition	Trouble Area
P0110	Step 1	Open or short in Intake Air Temperature (IAT) sensor circuit for 0.5 seconds (1 trip detection logic)	- Open or short in IAT sensor circuit - IAT sensor (built into MAF meter) - ECM
P0112	Step 4	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 MAF meter) - ECM
P0113	Step 2	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 MAF meter) - ECM

HINT:

When any of these DTCs are set, check the IAT by entering the following menus on the intelligent tester:
DIAGNOSIS / ENHANCED OBD II / DATA LIST / PRIMARY / INTAKE AIR.

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 -40°C (-40°F) 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 more than 140°C (284°F) for 0.5 seconds or more, the ECM determines that there is a short in the sensor circuit, and sets DTC P0112.

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

MONITOR STRATEGY

Related DTCs	P0110: Intake air temperature sensor open/short (Fluctuating) P0112: Intake air temperature sensor short (Low electrical voltage) P0113: Intake air temperature sensor open (High electrical voltage)
Required Sensors/Components (Main)	Intake Air Temperature (IAT) sensor
Required Sensors/Components (Related)	-
Frequency of Operation	Continuous
Duration	0.5 seconds
MIL Operation	Immediate
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

Monitor runs whenever following DTCs not present	None
--	------

TYPICAL MALFUNCTION THRESHOLDS**P0110:**

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

P0112:

Intake air temperature sensor voltage	Less than 0.18 V
---------------------------------------	------------------

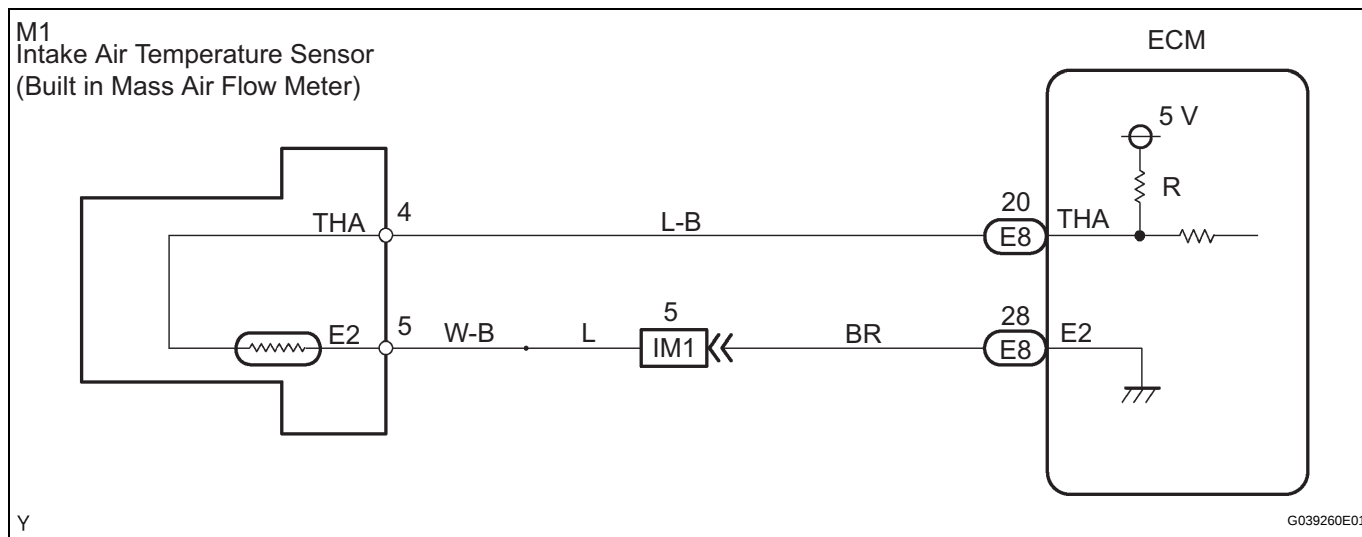
P0113:

Intake air temperature sensor voltage	More than 4.91 V
---------------------------------------	------------------

COMPONENT OPERATING RANGE

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

WIRING DIAGRAM



HINT:

- If other DTCs relating to different systems that have terminal E2 as the ground terminal are output simultaneously, terminal E2 may have an open circuit.
- Read freeze frame data using the intelligent tester. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data, from the time the malfunction occurred.

1

READ VALUE OF INTELLIGENT TESTER OR OBD II SCAN TOOL (INTAKE AIR TEMPERATURE)

- Connect the intelligent tester to the DLC3.
- Turn the ignition switch ON.
- Turn the tester ON.
- Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DATA LIST / PRIMARY / INTAKE AIR.
- Read the value displayed on the tester.

Standard:

Same as actual Intake Air Temperature (IAT).

Result

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

HINT:

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

B

Go to step 4

C

CHECK FOR INTERMITTENT PROBLEMS

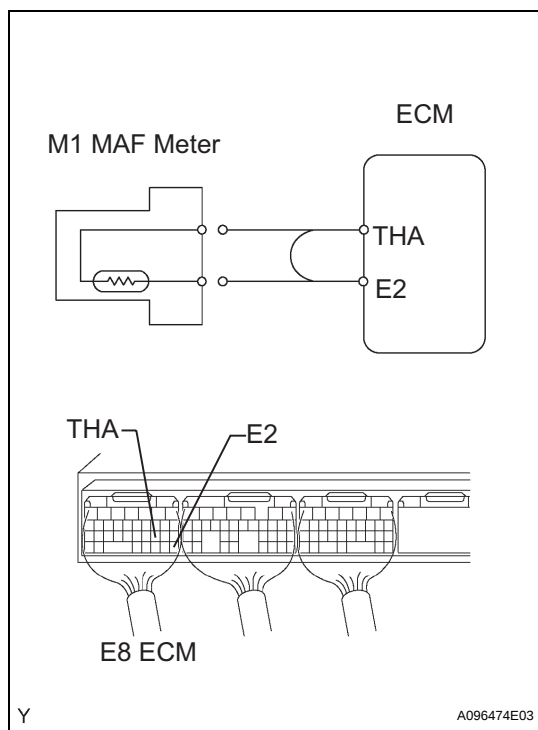
2

ES



NG

3 READ VALUE OF INTELLIGENT TESTER OR OBD II SCAN TOOL (CHECK FOR OPEN IN ECM)



- (a) Disconnect the M1 MAF meter connector.
- (b) Connect terminals THA and E2 of the E8 ECM connector.
HINT:
Before checking, do visual and contact pressure checks on the ECM connector.
- (c) Connect the intelligent tester to the DLC3.
- (d) Turn the ignition switch ON.
- (e) Turn the tester ON.
- (f) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DATA LIST / PRIMARY / INTAKE AIR.
- (g) Read the value displayed on the tester.
Standard:
140°C (284°F) or higher
- (h) Reconnect the MAF meter connector.

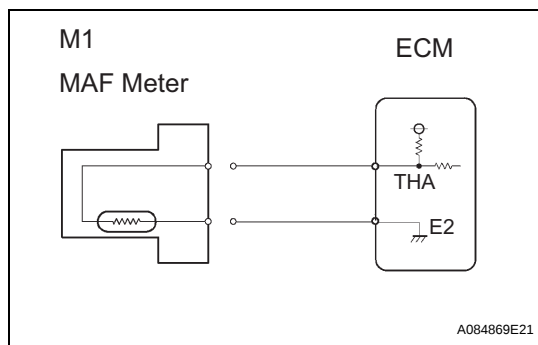
OK

REPAIR OR REPLACE HARNESS OR CONNECTOR

NG

CONFIRM GOOD CONNECTION TO ECM. IF OK, REPLACE ECM

4 READ VALUE OF INTELLIGENT TESTER OR OBD II SCAN TOOL (CHECK FOR SHORT IN WIRE HARNESS)

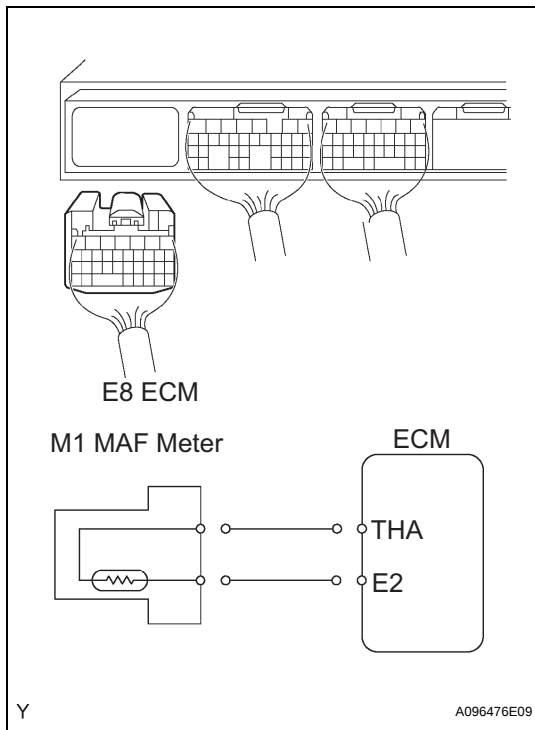


- (a) Disconnect the M1 MAF meter connector.
- (b) Connect the intelligent tester to the DLC3.
- (c) Turn the ignition switch ON.
- (d) Turn the tester ON.
- (e) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DATA LIST / PRIMARY / INTAKE AIR.
- (f) Read the value displayed on the tester.
Standard:
-40°C (-40°F) or higher
- (g) Reconnect the MAF meter connector.

OK

REPLACE MASS AIR FLOW METER

NG

5**READ VALUE OF INTELLIGENT TESTER OR OBD II SCAN TOOL (CHECK FOR SHORT IN ECM)**

- (a) Disconnect the E8 ECM connector.
- (b) Connect the intelligent tester to the DLC3.
- (c) Turn the ignition switch ON.
- (d) Turn the tester ON.
- (e) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DATA LIST / PRIMARY / INTAKE AIR.
- (f) Read the value displayed on the tester.

Standard:**-40°C (-40°F) or higher**

- (g) Reconnect the ECM connector.

OK**REPAIR OR REPLACE HARNESS OR CONNECTOR****ES****NG****REPLACE ECM**

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 is built into the Engine Coolant Temperature (ECT) sensor, of which the voltage value varies according to the ECT.

ES

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 No.	Proceed to	DTC Detection Condition	Trouble Area
P0115	Step 1	Open or short in Engine Coolant Temperature (ECT) sensor circuit for 0.5 seconds (1 trip detection logic)	- Open or short in ECT sensor circuit - ECT sensor - ECM
P0117	Step 4	Short in Engine Coolant Temperature (ECT) sensor circuit for 0.5 seconds (1 trip detection logic)	- Short in ECT sensor - ECT sensor - ECM
P0118	Step 2	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 entering the following menus on the intelligent tester: DIAGNOSIS / ENHANCED OBD II / DATA LIST / PRIMARY / COOLANT TEMP.

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 and sets a DTC.

Example:

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

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

MONITOR STRATEGY

Related DTCs	P0115: Engine coolant temperature sensor open/short (Fluctuating) P0117: Engine coolant temperature sensor short (Low electrical voltage) P0118: Engine coolant temperature sensor open (High electrical voltage)
Required Sensors/Components (Main)	Engine coolant temperature sensor
Required Sensors/Components (Related)	-
Frequency of Operation	Continuous
Duration	0.5 seconds
MIL Operation	Immediate
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

Monitor runs whenever following DTCs not present	None
--	------

TYPICAL MALFUNCTION THRESHOLDS

P0115:

Engine coolant temperature sensor voltage	Less than 0.14 V or more than 4.91 V
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P0117:

Engine coolant temperature sensor voltage	Less than 0.14 V
---	------------------

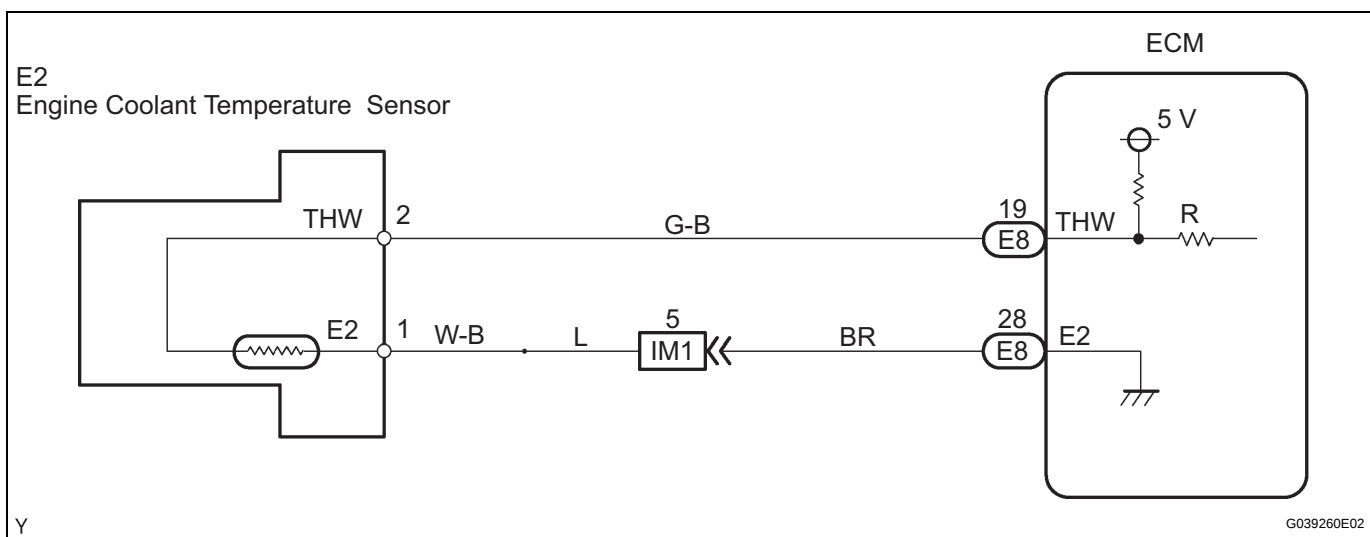
P0118:

Engine coolant temperature sensor voltage	More than 4.91 V
---	------------------

COMPONENT OPERATING RANGE

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

WIRING DIAGRAM



HINT:

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

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

1	READ VALUE OF INTELLIGENT TESTER OR OBD II SCAN TOOL (ENGINE COOLANT TEMPERATURE)
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- (a) Connect the intelligent tester to the DLC3.
- (b) Turn the ignition switch ON.
- (c) Turn the tester ON.
- (d) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DATA LIST / PRIMARY / COOLANT TEMP.
- (e) Read the value displayed on the tester.

Standard:

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

Result

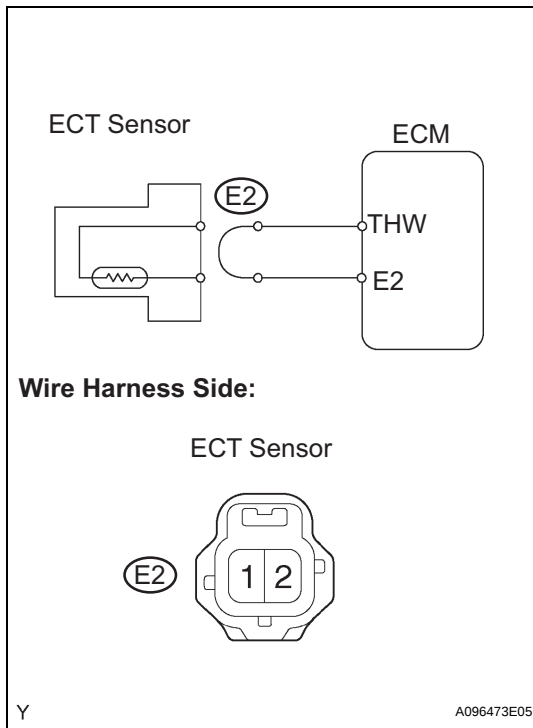
Temperature Displayed	Proceed to
-40°C (-40°F)	A
140°C (284°F) or higher	B
Between 80°C and 97°C (176°F and 207°F)	C

HINT:

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

B	Go to step 4
C	CHECK FOR INTERMITTENT PROBLEMS

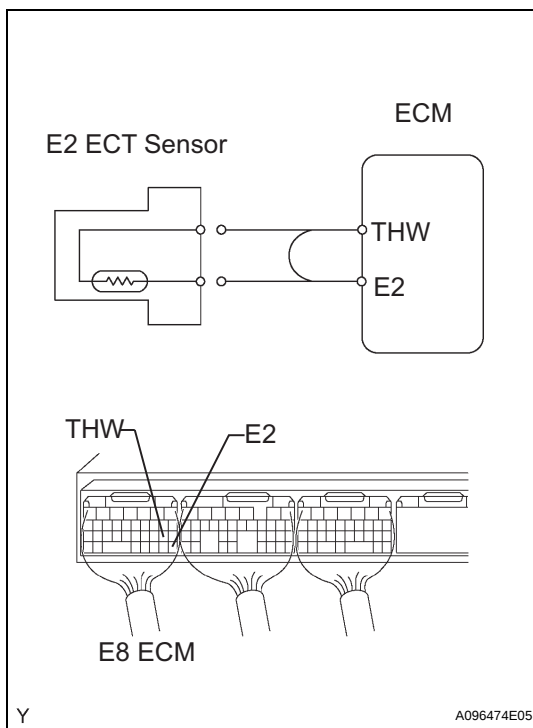


2**READ VALUE OF INTELLIGENT TESTER OR OBD II SCAN TOOL (CHECK FOR OPEN IN WIRE HARNESS)**

- Disconnect the E2 ECT sensor connector.
- Connect terminals 1 and 2 of the E2 ECT sensor wire harness side connector.
- Turn the ignition switch ON.
- On the intelligent tester or the OBD II scan tool, enter the following menus: DIAGNOSIS / ENHANCED OBD II / DATA LIST / ALL / COOLANT TEMP. Read the values.

OK:**Temperature value: 140°C (284°F) or more****OK**

CONFIRM GOOD CONNECTION TO SENSOR. IF OK, REPLACE ENGINE COOLANT TEMPERATURE SENSOR

ES**NG****3****READ VALUE OF INTELLIGENT TESTER OR OBD II SCAN TOOL (CHECK FOR OPEN IN ECM)**

- Disconnect the E2 ECT sensor connector.
- Connect terminals THW and E2 of the E8 ECM connector.

HINT:

Before checking, do a visual and contact pressure check for the ECM connector.

- Turn the ignition switch ON.
- On the intelligent tester or the OBD II scan tool, enter the following menus: DIAGNOSIS / ENHANCED OBD II / DATA LIST / ALL / COOLANT TEMP. Read the values.

OK:**Temperature value: 140°C (284°F) or more****OK**

REPAIR OR REPLACE HARNESS OR CONNECTOR

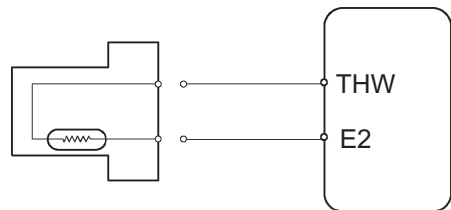
NG

CONFIRM GOOD CONNECTION TO ECM. IF OK, REPLACE ECM

4 READ VALUE OF INTELLIGENT TESTER OR OBD II SCAN TOOL (CHECK FOR SHORT IN WIRE HARNESS)

E2 ECT Sensor

ECM



A075766E22

- Disconnect the E2 ECT sensor connector.
- Turn the ignition switch ON.
- On the intelligent tester or the OBD II scan tool, enter the following menus: DIAGNOSIS / ENHANCED OBD II / DATA LIST / ALL / COOLANT TEMP. Read the values.

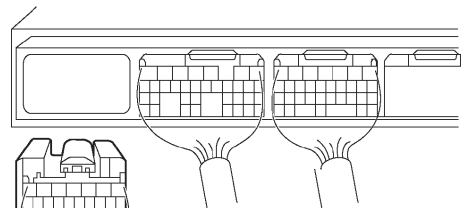
OK:

Temperature value: -40°C (-40°F)

OK

REPLACE ENGINE COOLANT TEMPERATURE SENSOR

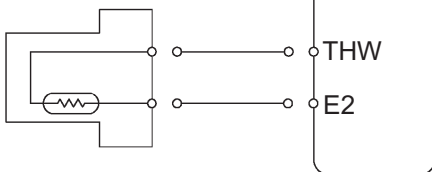
NG

5 READ VALUE OF INTELLIGENT TESTER OR OBD II SCAN TOOL (CHECK FOR SHORT IN ECM)

E8 ECM

E2 ECT Sensor

ECM



A096476E10

- Disconnect the E8 ECM connector.
- Turn the ignition switch ON.
- On the intelligent tester or the OBD II scan tool, enter the following menus: DIAGNOSIS / ENHANCED OBD II / DATA LIST / ALL / COOLANT TEMP. Read the values.

OK:

Temperature value: -40°C (-40°F)

OK

REPAIR OR REPLACE HARNESS OR CONNECTOR

NG

REPLACE ECM

DTC**P0116****Engine Coolant Temperature Circuit Range / Performance Problem****DESCRIPTION**

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

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

DTC No.	DTC Detection Condition	Trouble Area
P0116	Case1: Engine Coolant Temperature (ECT) between 35°C and 60°C (95°F and 140°F) when engine started, and conditions (a) and (b) met (2 trip detection logic): (a) Vehicle driven at varying speeds (accelerated and decelerated) (b) ECT remains within 3°C (5.4°F) of initial ECT Case2: ECT more than 60°C (140°F) when engine started, and conditions (a) and (b) met (6 trip detection logic): (a) Vehicle driven at varying speeds (accelerated and decelerated) (b) ECT measurements remain within 1°C (1.8°F) of initial ECT on 6 successive occasions	• Thermostat • ECT sensor

ES**MONITOR DESCRIPTION**

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

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

Examples:

- Upon starting the engine, the ECT is between 35°C and 60°C (95°F and 140°F). If after driving for 250 seconds, the ECT remains within 3°C (5.4°F) of the starting temperature, the DTC is set (2 trip detection logic).
- Upon starting the engine, the ECT is over 60°C (140°F). If after driving for 250 seconds, the ECM remains within 1°C (1.8°F) of the starting temperature, the DTC is set (6 trip detection logic).

MONITOR STRATEGY

Related DTCs	P0116: Engine coolant temperature sensor output stuck at low engine coolant temperature P0116: Engine coolant temperature sensor output stuck at high engine coolant temperature
Required Sensors/Components (Main)	Engine coolant temperature (ECT) sensor
Required Sensors/Components (Related)	Crankshaft position sensor, intake air temperature sensor and mass air flow meter
Frequency of Operation	Continuous
Duration	250 seconds or more
MIL Operation	2 driving cycles: ECT sensor output stuck at low engine coolant temperature 6 driving cycles: ECT sensor output stuck at high engine coolant temperature
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

All:

The monitor will run whenever this DTC is not present	P0100, P0101, P0102, P0103 (MAF sensor)
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ECT Sensor Stuck at Low ECT:

Cumulative idle off period	250 seconds or more
Speed increase by 18.6 mph (30 km/h) or more	10 times or more
ECT	35 to 60°C (95 to 140°F)
IAT	-6.7°C (20°F) or more

ECT Sensor Stuck at High ECT:

ECT	60°C (140°F) or more
IAT	-6.7°C (20°F) or more
"Stop and go"*1	Once or more
"Steady driving and stop"*2	Once or more

HINT:

- *1: The vehicle is stopped for 20 seconds or more and accelerated to more than 43.5 mph (70 km/h) within 40 seconds.
- *2: Following these steps: 1) the vehicle is driven at 40.4 mph (65 km/h) or more for 30 seconds or more and the vehicle speed reaches 43.5 mph (70 km/h); 2) the vehicle is decelerated from 40.4 mph (65 km/h) to 1.86 mph (3 km/h) or less within 35 seconds; and 3) the vehicle is stopped for 10 seconds.

TYPICAL MALFUNCTION THRESHOLDS

Engine Coolant Temperature Sensor Output Stuck at Low Engine Coolant Temperature:

Variation of engine coolant temperature	Less than 3°C (5.4°F)
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Engine Coolant Temperature Sensor Output Stuck at High Engine Coolant Temperature:

Variation of engine coolant temperature	1°C (1.8°F) or less
---	---------------------

COMPONENT OPERATING RANGE

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

1

REPLACE ENGINE COOLANT TEMPERATURE SENSOR

NEXT

END

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

ES**DESCRIPTION****HINT:**

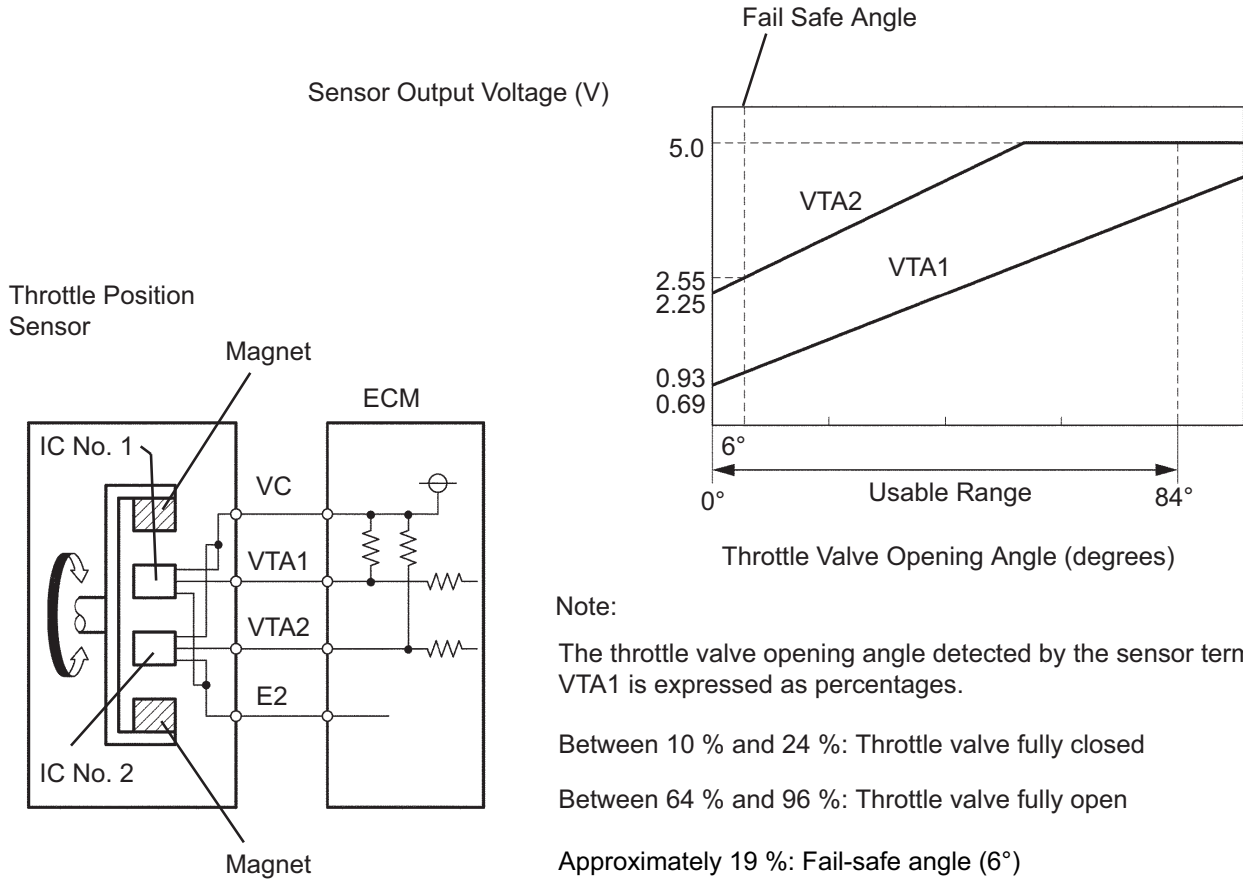
This ETCS (Electrical Throttle Control System) does not use a throttle cable.

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

As the valve closes, the sensor output voltage decreases and as the valve opens, the sensor output voltage increases. The ECM calculates the throttle valve opening angle according to these signals and controls the throttle actuator in response to driver inputs. These signals are also used in calculations such as air-fuel ratio correction, power increase correction and fuel-cut control.

ES



A019802E07

DTC No.	DTC Detection Condition	Trouble Area
P0120	Detection conditions for DTCs P0122 and P0123 are not satisfied but condition (a) is satisfied (a) VTA1 is 0.2 V or less or VTA1 is 4.535 V or more (*1)	- Throttle Position (TP) sensor (built into throttle body) - ECM
P0122	(a) VTA1 is 0.2 V or less (*1)	- TP sensor (built into throttle body) - Short in VTA1 circuit - Open in VC circuit - ECM
P0123	(a) VTA1 is 4.535 V or more (*1)	- TP sensor (built into throttle body) - Open in VTA1 circuit - Open in E2 circuit - Short between VC and VTA1 circuits - ECM
P0220	Detection conditions for DTCs P0222 and P0223 are not satisfied but condition (a) is satisfied (a) VTA2 is 1.75 V or less or VTA2 is 4.8 V or more and VTA1 is 0.2 V or more and VTA1 is 2.02 V or less (*1)	- TP sensor (built into throttle body) - ECM

DTC No.	DTC Detection Condition	Trouble Area
P0222	(a) VTA2 is 1.75 V or less	- TP sensor (built into throttle body) - Short in VTA2 circuit - Open in VC circuit - ECM
P0223	(a) VTA2 is 4.8 V or more, and VTA1 is between 0.2 V and 2.02 V (*1)	- TP sensor (built into throttle body) - Open in VTA2 circuit - Open in E2 circuit - Short between VC and VTA2 circuits - ECM
P2135	Either condition (a) or (b) met: (a) Voltage difference between VTA1 and VTA2 is 0.02 V or less for 0.5 seconds or more (b) VTA1 is 0.2 V or less, and VTA2 1.75 V or less, for 0.4 seconds or more	- Short between VTA1 and VTA2 circuits - TP sensor (built into throttle body) - ECM

*1: Condition (a) of DTC P0120, P0122, P0123, P0220, P0222 or P0223 continues for 2 seconds.
(Open or short in the throttle position sensor circuit)

HINT:

- When any of these DTCs are set, check the throttle valve opening angle by entering the following menus on an intelligent tester: DIAGNOSIS / ENHANCED OBD II / DATA LIST / ETCS / THROTTLE POS AND THROTTLE POS #2.
- THROTTLE POS denotes the VTA1 signal (expressed in percentages), and THROTTLE POS #2 denotes the VTA2 signal (expressed in voltages).

Reference (Normal Condition):

Tester Display	Accelerator Pedal Fully Released	Accelerator Pedal Fully Depressed
THROTTLE POS	10 to 24 %	64 to 96 %
THROTTLE POS #2	2.1 to 3.1 V	4.5 to 5.5 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, and sets a DTC.
- VTA1 and VTA2 each have a specific voltage range. If VTA1 or VTA2 is outside the normal operating range, the ECM interprets this as a malfunction in the sensor, and sets a DTC.
- VTA1 and VTA2 should never be close to the same voltage level. If VTA1 is within 0.02 V of VTA2, the ECM determines that there is a short circuit in the sensor, and sets a DTC.

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)
Required Sensors/Components (Main)	Throttle position sensor
Required Sensors/Components (Related)	-
Frequency of Operation	Continuous
Duration	Accelerator pedal ON: 2 seconds Accelerator pedal OFF: 10 seconds 0.5 seconds or 0.4 seconds (P2135)
MIL Operation	Immediate
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

Monitor runs whenever following DTCs not present	None
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TYPICAL MALFUNCTION THRESHOLDS

P0120:

VTA1 voltage	0.2 V or less, or 4.535 V or more
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P0122:

VTA1 voltage	0.2 V or less
--------------	---------------

P0123:

VTA1 voltage	4.535 V or more
--------------	-----------------

P0220:

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

P0222:

VTA2 voltage	1.75 V or less
--------------	----------------

P0223:

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

P2135:

Either of following conditions A or B met:	Condition A or B
Condition A	-
Difference between VTA1 and VTA2 voltages	0.02 V or less
Condition B	-
VTA1 voltage	0.2 V or less
VTA2 voltage	1.75 V or less

COMPONENT OPERATING RANGE

VTA1 voltage	0.6 to 3.96 V
VTA2 voltage	2.25 to 4.8 V

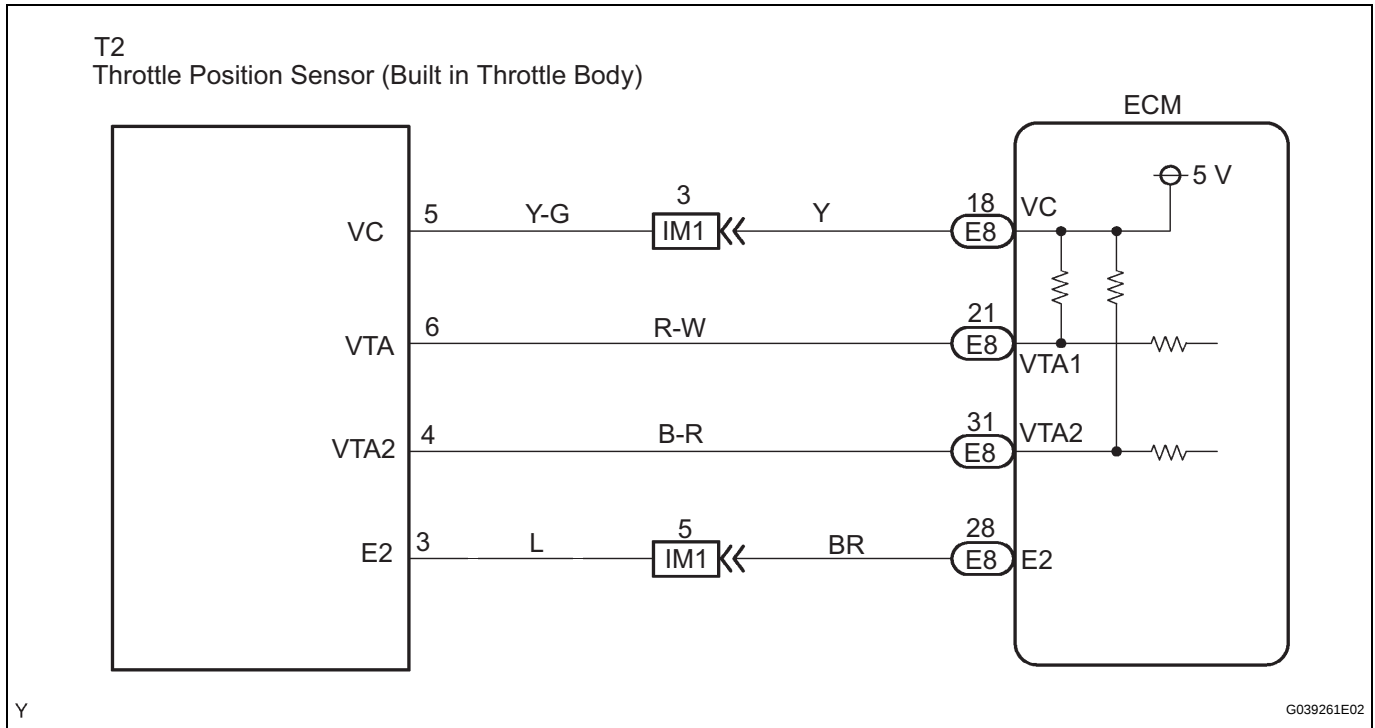
FAIL-SAFE

If the Electronic Throttle Control System (ETCS) has a malfunction, the ECM cuts off current to the throttle actuator. The throttle control valve returns to a predetermined opening angle (approximately 16°) by the force of 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 enable the vehicle to continue at a minimal speed.

If the accelerator pedal is depressed firmly and slowly, the vehicle can be driven slowly.

If a "pass" condition is detected and then the ignition switch is turned OFF, the fail-safe operation will stop and the system will return to normal condition.

WIRING DIAGRAM



HINT:

- If other DTCs relating to different systems that have terminal E2 as the ground terminal are output simultaneously, terminal E2 may have an open circuit.
- Read freeze frame data using the intelligent tester. 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.
- These DTCs relate to the Throttle Position (TP) sensor.

1

READ VALUE OF INTELLIGENT TESTER (THROTTLE POS AND THROTTLE POS #2)

- Connect the intelligent tester to the DLC3.
- Turn the ignition switch ON and turn the intelligent tester ON.
- Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DATA LIST / ETCS / THROTTLE POS and THROTTLE POS #2.
- Check the values displayed on the tester.

Result

TP#1 (VTA1) When AP Released	TP#2 (VTA2) When AP Released	TP#1 (VTA1) When AP Depressed	TP#2 (VTA2) When AP Depressed	Trouble Area	Proceed to
0 %	Between 0 V and 0.2 V	0 %	Between 0 V and 0.2 V	VC circuit open	A
100 %	Between 4.5 V and 5.0 V	100 %	Between 4.5 V and 5.0 V	E2 circuit open	A
0 % or 100 %	Between 2.1 V and 3.1 V (Fail-safe)	0 % or 100 %	Between 2.1 V and 3.1 V (Fail-safe)	VTA1 circuit open or ground short	A

TP#1 (VTA1) When AP Released	TP#2 (VTA2) When AP Released	TP#1 (VTA1) When AP Depressed	TP#2 (VTA2) When AP Depressed	Trouble Area	Proceed to
About 16% (Fail-safe)	Between 0 V and 0.2 V, or 4.5 V and 5.0 V	About 16% (Fail-safe)	Between 0 V and 0.2 V, or 4.5 V and 5.0 V	VTA2 circuit open or ground short	A
Between 10 % and 24 %	Between 2.1 V and 3.1 V	Between 64 % and 96 % (Not fail-safe)	Between 4.5 V and 5.0 V (Not fail-safe)	TP sensor circuit normal	B

HINT:

- TP#1 denotes THROTTLE POS, and TP#2 denotes THROTTLE POS#2.
- AP denotes Accelerator Pedal.
- VTA1 is expressed as percentages, and VTA2 is expressed as voltages.

B

Go to step 5

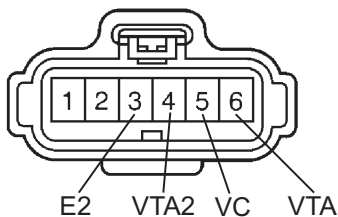
A

2

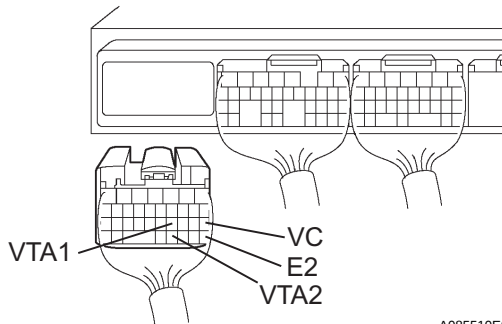
CHECK HARNESS AND CONNECTOR (THROTTLE POSITION SENSOR - ECM)

Wire Harness Side:

T2 Throttle Position Sensor



E8 ECM



A085510E07

- Disconnect the T2 throttle body connector.
- Disconnect the E8 ECM connector.
- Measure the resistance between the terminals of the throttle body and ECM.

Standard resistance (Check for open)

Tester Connection	Specified Condition
VC (T2-5) - VC (E8-18)	Below 1 Ω
VTA (T2-6) - VTA (E8-21)	Below 1 Ω
VTA2 (T2-4) - VTA2 (E8-31)	Below 1 Ω
E2 (T2-3) - E2 (E8-28)	Below 1 Ω

Standard resistance (Check for short)

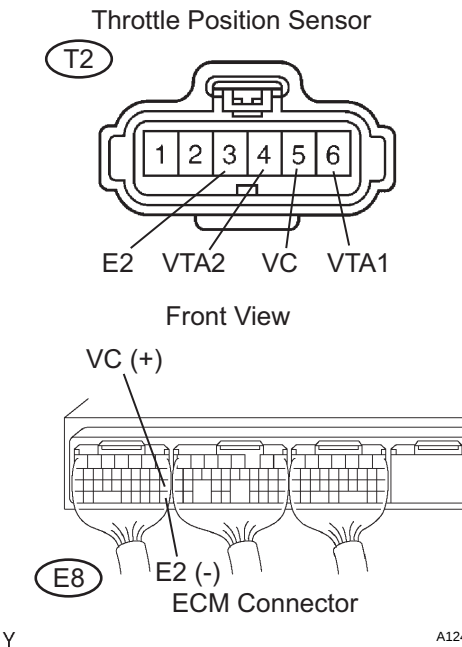
Tester Connection	Specified Condition
VC (T2-5) or VC (E8-18) - Body ground	10 k Ω or higher
VTA (T2-6) or VTA (E8-21) - Body ground	10 k Ω or higher
VTA2 (T2-4) or VTA2 (E8-31) - Body ground	10 k Ω or higher

- Reconnect the throttle body connector.
- Reconnect the ECM connector.

NG

REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

3 INSPECT ECM (VC VOLTAGE)**Wire Harness Side:**

- Disconnect the T2 throttle body connector.
- Turn the ignition switch ON.
- Measure the voltage between the terminals VC and E2 of the E8 ECM connector.

Standard voltage

Tester Connection	Specified Condition
VC (E8-18) - E2 (E8-28)	4.5 to 5.5 V

- Reconnect the throttle body connector.

NG**REPLACE ECM****ES****OK****4 REPLACE THROTTLE BODY ASSEMBLY****NEXT****5 READ OUTPUT DTC (THROTTLE POSITION SENSOR DTCS ARE OUTPUT AGAIN)**

- Connect the intelligent tester to the DLC3.
- Turn the ignition switch ON and turn the tester ON.
- Clear DTCs (See page [ES-28](#)).
- Start the engine.
- Allow the engine to idle for 15 seconds or more.
- Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DTC INFO / CURRENT CODES.
- Read DTCs.

Result

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

B**SYSTEM OK**

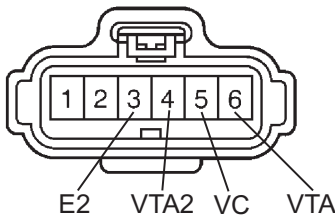
A

REPLACE ECM

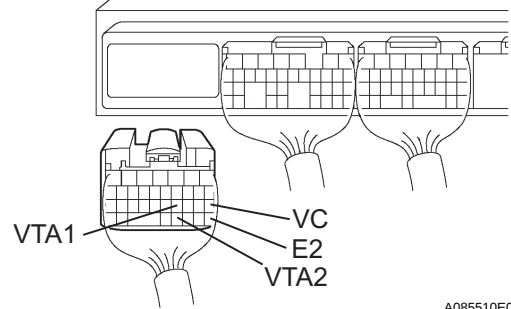
1 CHECK HARNESS AND CONNECTOR (THROTTLE POSITION SENSOR - ECM)

Wire Harness Side:

T2 Throttle Position Sensor



E8 ECM



A085510E07

- (a) Disconnect the T2 throttle position sensor connector.
- (b) Disconnect the E8 ECM connector.
- (c) Measure the resistance of the wire harness side connectors.

Standard resistance

Tester Connection	Specified Condition
T2-5 (VC) - E8-18 (VC) T2-6 (VTA1) - E8-21 (VTA1) T2-4 (VTA2) - E8-31 (VTA2) T2-3 (E2) - E8-28 (E2)	Below 1 Ω
T2-5 (VC) or E8-18 (VC) - Body ground T2-6 (VTA1) or E8-21 (VTA1) - Body ground T2-4 (VTA2) or E8-31 (VTA2) - Body ground	10 kΩ or higher

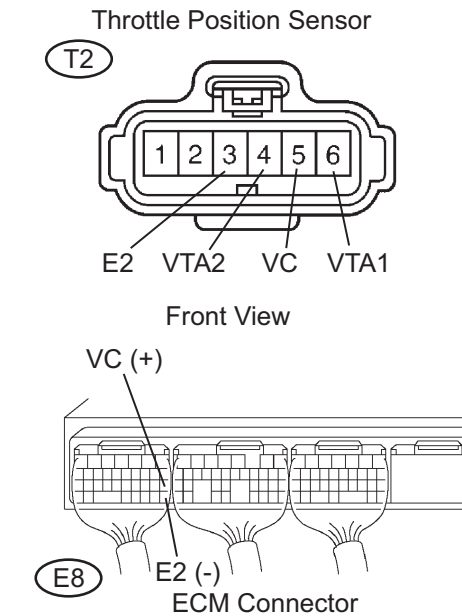
- (d) Reconnect the throttle position sensor connector and ECM connector.

NG

REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

ES

2 INSPECT ECM (VC VOLTAGE)**Wire Harness Side:**

- Disconnect the T2 throttle position sensor connector.
- Turn the ignition switch ON.
- Measure the voltage of the ECM connector.

Standard voltage

Tester Connection	Specified Condition
E8-18 (VC) - E8-28 (E2)	4.5 to 5.5 V

NG**REPLACE ECM****ES****OK****3 REPLACE THROTTLE BODY ASSEMBLY****NEXT****4 READ OUTPUT DTC (THROTTLE POSITION SENSOR DTCS ARE OUTPUT AGAIN)**

- Clear the DTC (See page [ES-28](#)).
- Start the engine.
- Run the engine at idle for 15 seconds or more.
- Read the DTC.

Result

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

B**SYSTEM OK****A****REPLACE ECM**

DTC	P0121	Throttle / Pedal Position Sensor / Switch "A" Circuit Range / Performance Problem
------------	--------------	--

DESCRIPTION**HINT:**

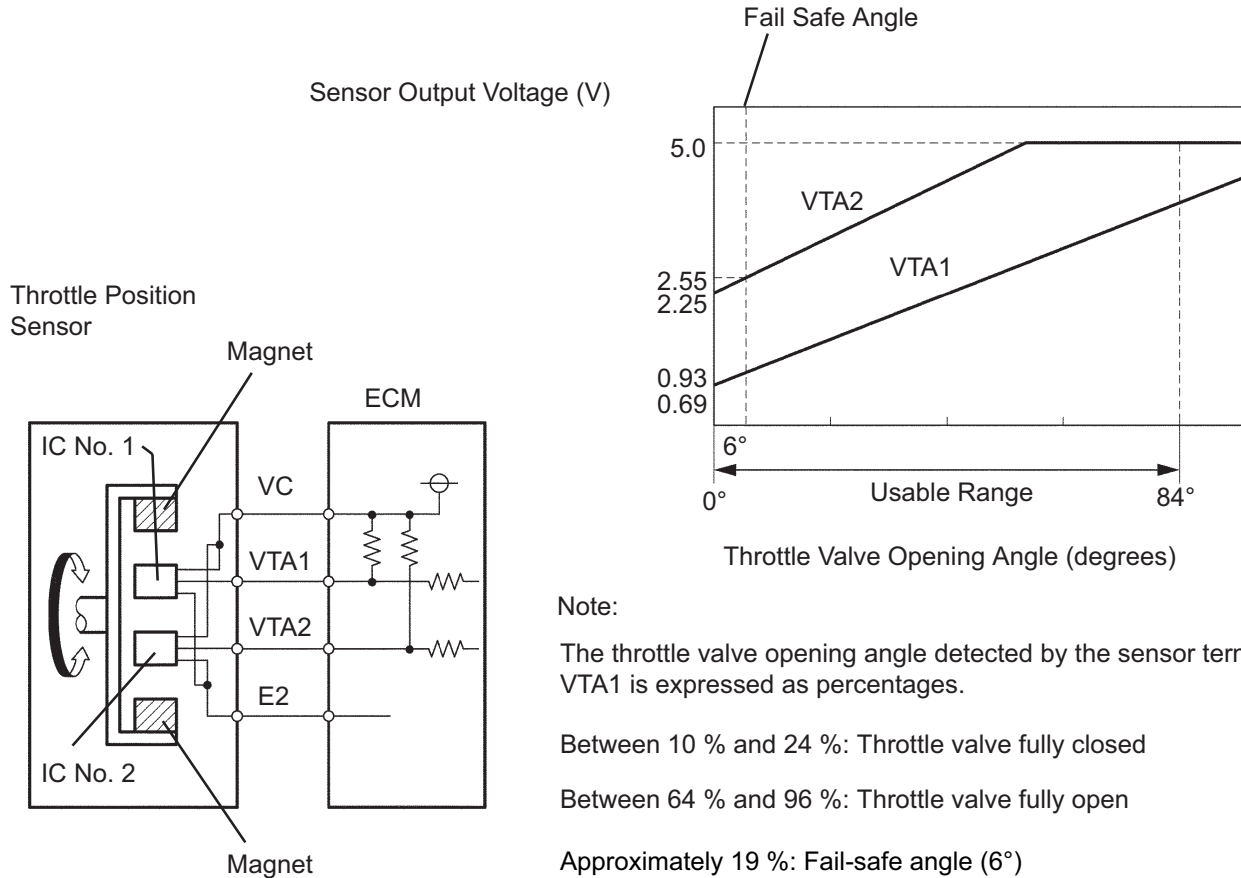
This DTC relates to the Throttle Position (TP) sensor.

This ETCS (Electrical Throttle Control System) does not use a throttle cable.

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

As the valve closes, the sensor output voltage decreases and as the valve opens, the sensor output voltage increases. The ECM calculates the throttle valve opening angle according to these signals and controls the throttle actuator in response to driver inputs. These signals are also used in calculations such as air-fuel ratio correction, power increase correction and fuel-cut control.



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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)	TP sensor (built into throttle body)

MONITOR DESCRIPTION

The ECM uses the 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 of 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

Related DTCs	P0121: 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

ES

Monitor runs whenever following DTCs not present	None
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

Difference in voltage between VAT1 and VTA2 TP sensor 1 - [TP sensor 2 x 0.8 (corrected by learning value)]	Less than 0.8 V or more than 1.6 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 off, and the throttle valve is returned to a 6° throttle angle by the return spring. The ECM then adjusts the engine output by controlling the fuel injection (intermittent fuel-cut) and ignition timing, in accordance with the accelerator pedal opening angle, to allow the vehicle to continue at a minimal speed. If the accelerator pedal is depressed firmly and gently, the vehicle can be driven slowly. Fail-safe mode continues until a pass condition is detected, and the engine switch is then turned off.

HINT:

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

1

REPLACE THROTTLE BODY ASSEMBLY

NEXT

END

DTC	P0125	Insufficient Coolant Temperature for Closed Loop Fuel Control
------------	--------------	--

DESCRIPTION

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

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

DTC No.	DTC Detection Condition	Trouble Area
P0125	Case 1: Engine coolant temperature (ECT) is less than -19.45°C (-3°F) at engine start and following conditions are met (2 trip detection logic): (a) 20 minutes elapsed since engine starts (b) ECT sensor value remains below closed-loop fuel control enabling temperature Case 2: ECT is between -19.45°C and -8.34°C (-3°F and 17°F) at engine start and following conditions are met (2 trip detection logic): (a) 109 seconds elapsed since engine starts (b) ECT sensor value remains below closed-loop fuel control enabling temperature Case 3: ECT is between -8.34°C (17°F) at engine start and following conditions are met (2 trip detection logic): (a) 74 seconds elapsed since engine starts (b) ECT sensor value remains below closed-loop fuel control enabling temperature	• Engine coolant temperature sensor • Cooling system • Thermostat

ES

MONITOR DESCRIPTION

The resistance of the ECT varies in proportion to the actual ECT. The ECT supplies a constant voltage to the sensor and monitors the signal output voltage of the sensor. The signal voltage output varies according to the changing resistance of the sensor. After the engine is started, the 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 0°C (32°F) at engine start. After 5 minutes 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

Related DTCs	P0125: Insufficient engine coolant temperature for closed-loop fuel control
Required Sensors/Components (Main)	Thermostat, cooling system
Required Sensors/Components (Related)	Engine coolant temperature sensor and mass air flow meter
Frequency of Operation	Once per driving cycle
Duration	74 seconds: Closed-loop enable temperature - 8.34°C (17°F) or more 109 seconds: Closed-loop enable temperature - 19.45 to - 8.34°C (- 3 to 17°F) 20 minutes: Less than closed-loop enable temperature - 19.45°C (- 3°F)
MIL Operation	2 driving cycles
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

Monitor runs whenever following DTCs not present	P0100, P0101, P0102, P0103 (MAF sensor) P0110, P0112, P0113 (IAT sensor) P0115, P0116, P0117, P0118 (ECT sensor)
Fuel cut	OFF
Engine	Running
Idle	OFF

TYPICAL MALFUNCTION THRESHOLDS

Time until actual engine coolant temperature reaches closed-loop fuel control enabling temperature	74 seconds or more: Engine coolant temperature at engine start -8.34°C (17°F) or more 109 seconds or more: Engine coolant temperature at engine start -19.45 to -8.35°C (-3 to 17°F) 20 minutes or more: Engine coolant temperature at engine start less than -19.45°C (-3°F)
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WIRING DIAGRAM

Refer to DTC P0115 (See page [ES-101](#)).

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 the intelligent tester. 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 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.

1 CHECK OTHER DTCS OUTPUT (IN ADDITION TO DTC P0125)

- Connect an intelligent tester to the DLC3.
- Turn the ignition switch ON.
- Turn the tester ON.
- Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DTC INFO / CURRENT CODES.
- Read DTCs.

Result

Display (DTC Output)	Proceed to
P0125	A
P0125 and other DTCs	B

HINT:

If any DTCs other than P0125 are output, troubleshoot those DTCs first.

B

GO TO RELEVANT DTC CHART

A

2 INSPECT THERMOSTAT

- Remove the thermostat (See page [CO-18](#)).
- Check the valve opening temperature of the thermostat.

Standard:**80 to 84°C (176 to 183°F)****HINT:**

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

- (c) Reinstall the thermostat (See page [CO-19](#)).

NG**REPLACE THERMOSTAT****OK****3****CHECK COOLING SYSTEM****ES**

- (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.

OK:

There is no modification of cooling system.

NG**REPAIR OR REPLACE COOLING SYSTEM****OK****REPLACE ENGINE COOLANT TEMPERATURE SENSOR**

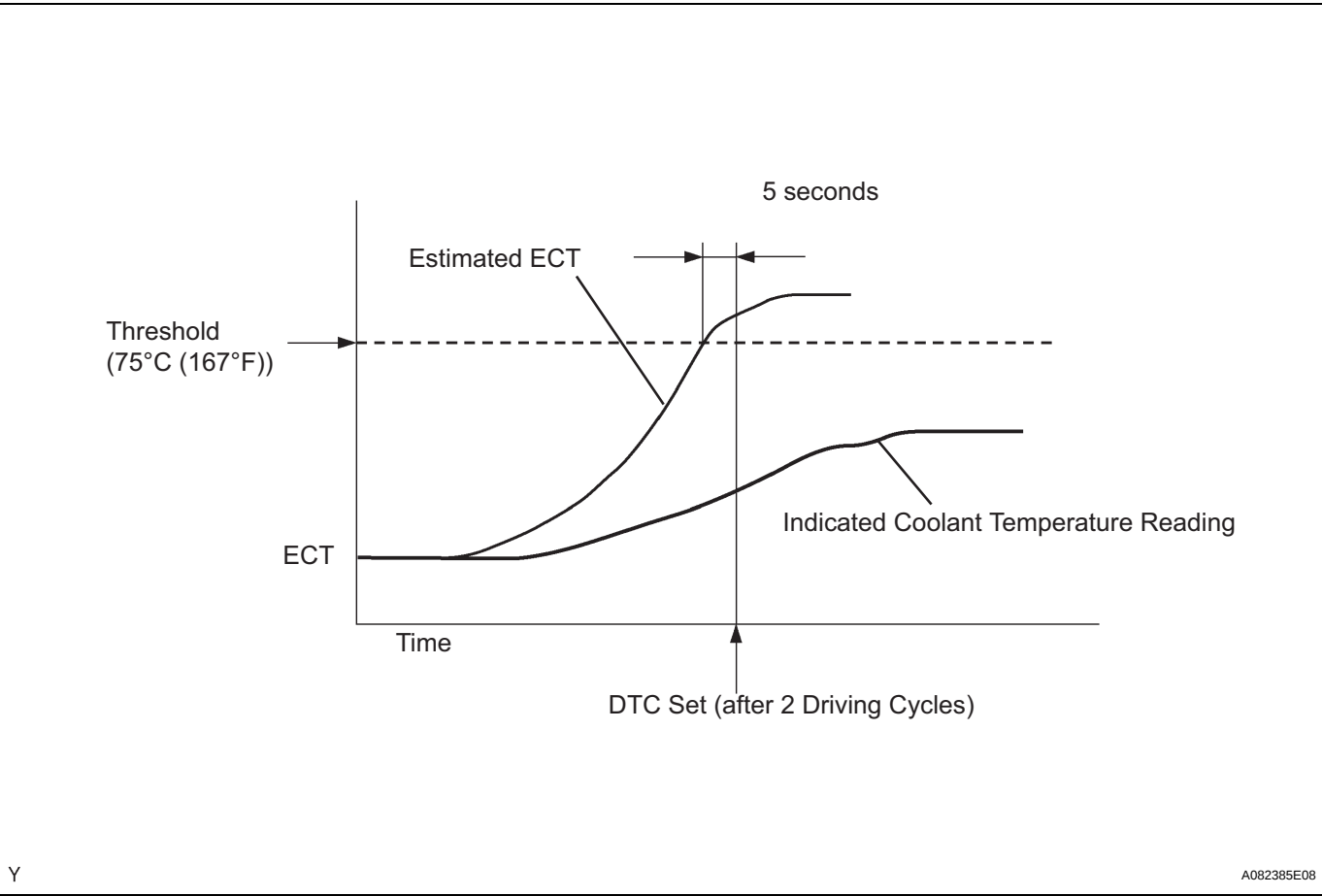
DTC	P0128	Coolant Thermostat (Coolant Temperature Below Thermostat Regulating Temperature)
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DESCRIPTION

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

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

MONITOR DESCRIPTION



The ECM estimates the 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 (167°F), the ECM interprets this as a malfunction in the thermostat or the engine cooling system and sets the DTC.

MONITOR STRATEGY

Related DTCs	P0128: Coolant Thermostat
Required Sensors/Components (Main)	Thermostat
Required Sensors/Components (Related)	Engine Coolant Temperature (ECT) sensor, Intake Air Temperature (IAT) sensor, Vehicle speed sensor
Frequency of Operation	Once per drive cycle

Duration	900 seconds Once per driving cycle
MIL Operation	2 driving cycles
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

Monitor will run whenever this DTC is not present	P0010, P0020 (VVT VSV), P0011, P0012, P0021, P0022 (VVT system-Advance, Retard), P0031, P0032, P0051, P0052 (O2 sensor heater sensor 1), P0031, P0032, P0051, P0052 (A/F sensor heater sensor 1), P0100, P0102, P0103 (MAF sensor), P0110, P0112, P0113 (IAT sensor), P0115, P0116, P0117, P0118 (ECT sensor), P0125 (Insufficient ECT for closed loop), P0136, P0137, P0138 (O2 sensor 1), P0171, P0172, P0174, P0175 (Fuel system), P0300, P0301, P0302, P0303, P0304, P0305, P0306 (Misfire), P0335 (CKP sensor), P0340, P0341 (CMP sensor), P0340, P0341, P0345, P0346 (VVT sensor), P0351, P0352, P0353, P0354, P0355, P0356 (Igniter), P0500 (VSS), P2196, P2198 (A/F sensor (Rationality)), P2A00, P2A03 (A/F 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 132.8°F)
• IAT at engine start	-10 to 56°C (14 to 132.8°F)
2. All of following conditions met:	-
• ECT at engine start - IAT at engine start	More than 7°C (12.6 °F)
• ECT at engine start	56°C (132.8°F) or less
• IAT at engine start	-10°C (14°F) or more
Accumulated time with 128 km/h (80 mph) or more of vehicle speed	Less than 20 seconds

ES

TYPICAL MALFUNCTION THRESHOLDS

Duration that all following conditions (a) and (b) set	5 seconds or more
(a) Simulated ECT	75°C (167°F) or more
(b) ECT sensor output	Less than 75°C (167°F)

MONITOR RESULT

Refer to CHECKING MONITOR STATUS (See page [ES-14](#)).

The test value and test limit information are described as shown in the following table. Check the monitor result and test values after performing the monitor drive pattern (refer to "Confirmation Monitor").

- TID (Test Identification Date) is assigned to each emissions-related component.
- TLT (Test Limit Type):
If TLT is 0, the component is malfunctioning when the test value is higher than the test limit.
If TLT is 1, the component is malfunctioning when the test value is lower than the test limit.
- CID (Component Identification Date) is assigned to each test value.
- Unit Conversion is used to calculate the test value indicated on generic OBD II scan tools.

TID \$08: Thermostat

TILT	CID	Unit Conversion	Description of Test Date	Description of Test Limit
1	\$01	Multiply by 0.625 and subtract 40 (°C)	ECT sensor output when estimated ECT has reached to malfunction criterion	Malfunction criteria for thermostat

HINT:

Read freeze frame data using the intelligent tester. 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 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.

1 INSPECT THERMOSTAT

(a) Inspect the thermostat (See page [CO-19](#)).

NG**REPLACE THERMOSTAT****OK****ES****2 CHECK OTHER DTC OUTPUT (IN ADDITION TO DTC P0128)**

(a) Read the DTC using the intelligent tester or the OBD II scan tool.

Result

Display (DTC Output)	Proceed to
Only P0128 is output	A
P0128 and other DTCs are output	B

HINT:

If any other codes besides P0128 are output, perform the troubleshooting for those DTCs first.

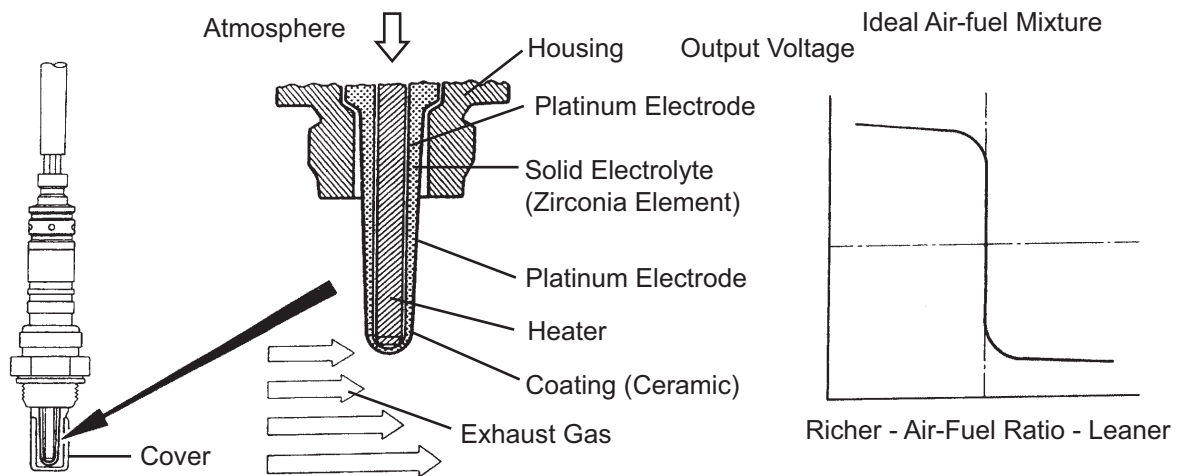
B**GO TO RELEVANT DTC CHART****A****REPLACE ECM**

DTC	P0136	Oxygen Sensor Circuit Malfunction (Bank 1 Sensor 2)
DTC	P0137	Oxygen Sensor Circuit Low Voltage (Bank 1 Sensor 2)
DTC	P0138	Oxygen Sensor Circuit High Voltage (Bank 1 Sensor 2)
DTC	P0139	Oxygen Sensor Circuit Slow Response (Bank 1 Sensor 2)
DTC	P0156	Oxygen Sensor Circuit Malfunction (Bank 2 Sensor 2)
DTC	P0157	Oxygen Sensor Circuit Low Voltage (Bank 2 Sensor 2)
DTC	P0158	Oxygen Sensor Circuit High Voltage (Bank 2 Sensor 2)
DTC	P0159	Oxygen Sensor Circuit Slow Response (Bank 2 Sensor 2)

ES**DESCRIPTION**

The heated oxygen sensor (HO2S) is used to monitor oxygen in the exhaust gas. For optimum catalyst operation, the air fuel mixture (air-fuel ratio) must be maintained near the ideal "stoichiometric" ratio. The HO2S output voltage changes suddenly in the vicinity of the stoichiometric ratio. The ECM adjusts the fuel injection time so that the air-fuel ratio is nearly stoichiometric.

The HO2S generates a voltage between 0.1 and 0.9 volts in response to oxygen in the exhaust gas. If the oxygen in the exhaust gas increases, the air-fuel ratio becomes "Lean". The ECM interprets Lean when the HO2S voltage is below 0.45 volts. If the oxygen in the exhaust gas decreases, the air-fuel ratio becomes "Rich". The ECM interprets Rich when the HO2S voltage is above 0.45 volts.



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DTC No.	DTC Detection Condition	Trouble Area
P0136 P0156	- Either of the following conditions is met (2 trip detection logic): (a) Heated Oxygen (HO2) sensor voltage was lower than 0.05 V for a certain period (b) HO2 sensor did not switch for a certain period	- Open or short in HO2 sensor (bank 1, 2 sensor 2) circuit - HO2 sensor (bank 1, 2 sensor 2) - HO2 sensor heater (bank 1, 2 sensor 2) - Air-Fuel Ratio (A/F) sensor (bank 1, 2 sensor 1)
P0137 P0157	HO2 sensor voltage was lower than 0.03 V for 90 seconds	- Short in HO2 sensor (bank 1, 2 sensor 2) circuit - HO2 sensor (bank 1, 2 sensor 2) - HO2 sensor heater (bank 1, 2 sensor 2)
P0138 P0158	HO2 sensor voltage was 1.2 V or higher for 10 seconds	- Short in HO2 sensor (bank 1, 2 sensor 2) circuit - HO2 sensor (bank 1, 2 sensor 2) - HO2 sensor heater (bank 1, 2 sensor 2)
P0139 P0159	HO2 sensor voltage did not drop during fuel-cut	- Short in HO2 sensor (bank 1, 2 sensor 2) circuit - HO2 sensor (bank 1, 2 sensor 2) - HO2 sensor heater (bank 1, 2 sensor 2)

MONITOR DESCRIPTION

The ECM monitors the rear Heated Oxygen (HO2) sensor to check for the following malfunctions. If any of the malfunctions are detected, the ECM illuminates the MIL and sets a DTC.

- The HO2 sensor output voltage remains above 0.45 V (rich) or below 0.45 V (lean) while the vehicle is accelerated and decelerated for 8 minutes.
- The HO2 sensor output voltage remains at below 0.05 V, for a long period of time while the vehicle is driven.
- The HO2 sensor output voltage does not decrease below 0.2 V (extremely lean condition) within 7 seconds after fuel-cut is performed while the vehicle is decelerated. The ECM interprets this as the sensor response having deteriorated.

MONITOR STRATEGY

Voltage:

Related DTCs	P0136 (bank 1 sensor 2), P0156 (bank 2 sensor 2)
Required Sensors/Components (Main)	HO2S
Required Sensors/Components (Related)	ECT sensor, MAF meter, VSS, CKP sensor, Throttle position sensor
Frequency of Operation	Once per driving cycle
Duration	160 seconds
MIL Operation	2 driving cycle
Sequence of Operation	None

Switching:

Related DTCs	P0136 (bank 1 sensor 2), P0156 (bank 2 sensor 2)
Required Sensors/Components (Main)	HO2S
Required Sensors/Components (Related)	CKP sensor
Frequency of Operation	Once per driving cycle
Duration	480 seconds
MIL Operation	2 driving cycles
Sequence of Operation	None

Low voltage:

Related DTCs	P0137(bank 1 sensor 2), P0157 (bank 2 sensor 2)
Required Sensors/Components (Main)	HO2S
Required Sensors/Components (Related)	MAF meter, HO2 sensor heater
Frequency of Operation	Continuous
Duration	90 seconds
MIL Operation	Immediate
Sequence of Operation	None

High voltage:

Related DTCs	P0138(bank 1 sensor 2), P0158 (bank 2 sensor 2)
Required Sensors/Components (Main)	HO2S
Required Sensors/Components (Related)	None
Frequency of Operation	Continuous
Duration	10 seconds
MIL Operation	Immediate
Sequence of Operation	None

Voltage during fuel-cut:

Related DTCs	P0139(bank 1 sensor 2), P0159 (bank 2 sensor 2)
Required Sensors/Components (Main)	HO2S
Required Sensors/Components (Related)	ECT sensor, MAF meter, HO2 sensor heater
Frequency of Operation	Once per driving cycle
Duration	6 seconds
MIL Operation	2 driving cycles
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS**All:**

Monitor runs whenever following DTCs not present	P0031, P0032, P0051, P0052 (O2 sensor heater sensor 1), P0031, P0032, P0051, P0052 (A/F sensor heater sensor 1), P0037, P0038, P0057, P0058 (O2 sensor heater sensor 2), P0100, P0101, P0102, P0103 (MAF sensor), P0110, P0112, P0103 (IAT sensor), P0115, P0116, P0117, P0118 (ECT sensor), P0120, P0122, P0123, P0220, P0222, P0223, P2135, (TP sensor) P0125 (Insufficient ECT for closed loop), P0136, P0137, P0138 (O2 sensor 1), P0171, P0172, P0174, P0175 (Fuel system), P0300, P0301, P0302, P0303, P0304, P0305, P0306 (Misfire), P0335 (CKP sensor), P0340, P0341 (CMP sensor), P0402 (EGR system (Open)), P0442, P0455, P0456 (EVAP system), P0500 (VSS), P2196, P2198 (A/F sensor (Rationality))
--	---

Voltage:

Engine	Running
Vehicle speed	1.875 mph (3 km/h) or more
Idle	OFF
Fuel cut	OFF

Intake air amount	6g/sec or more
-------------------	----------------

Switching:

All of the following condition are met	Condition 1, 2 and 3
1. Engine	Running
2. Cumulative time when oxygen sensor heater is operating	22 seconds or more
3. Time after engine start	0 second or more

Low voltage:

Battery voltage	11 V or more
Estimated heated oxygen sensor temperature	450°C (842°F) or more

High voltage:

Engine	Running
Battery voltage	11 V or more

Voltage during fuel-cut:

Engine coolant temperature	70°C (158°F) or more
Estimated catalyst temperature	500°C (932°F) or more
Fuel-cut	ON

TYPICAL MALFUNCTION THRESHOLDS**Voltage:**

All of the following conditions are met	Conditions 1, 2, 3, 4 and 5
1. Cumulative sensor monitoring time	160 seconds or more
2. Cumulative time while rear HO2S voltage is less than 0.05 V	96 seconds or more
3. Cumulative time while rear HO2S voltage is more than 0.7 V	Less then 32 seconds
4. Cumulative time while rear HO2S voltage is more than 0.45 V	Less than 48 seconds
5. Maximum time while rear HO2S voltage is more than 0.45 V	Less than 20 seconds

Switching:

All of the following conditions are met:	Conditions 1 and 2
1. Frequency of switch time either less than 0.45 V or 0.6 V or more	0 times
2. Cumulative monitor time* of rear HO2S	480 seconds or more
*: Monitor time is counted when the following conditions are met	Conditions (a) and (b)
(a) Fuel system status	Closed-loop
(b) Idle	OFF

Low voltage:

Duration that rear oxygen sensor is less than 0.03 V	90 seconds or more
--	--------------------

High voltage:

Duration that rear oxygen sensor is 1.2 V or more	10 seconds or more
---	--------------------

Voltage during fuel-cut:

One of the following conditions is met:	Conditions 1 or 2
1. Duration until rear HO2S voltage drops to 0.2 V during fuel-cut start	6 seconds or more
2. Duration that rear HO2S voltage drops from 0.35 to 0.2 V during fuel-cut	1 second or more

COMPONENT OPERATING RANGE

Heated Oxygen sensor voltage	Varies between 0.1 and 0.9 V
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MONITOR RESULT

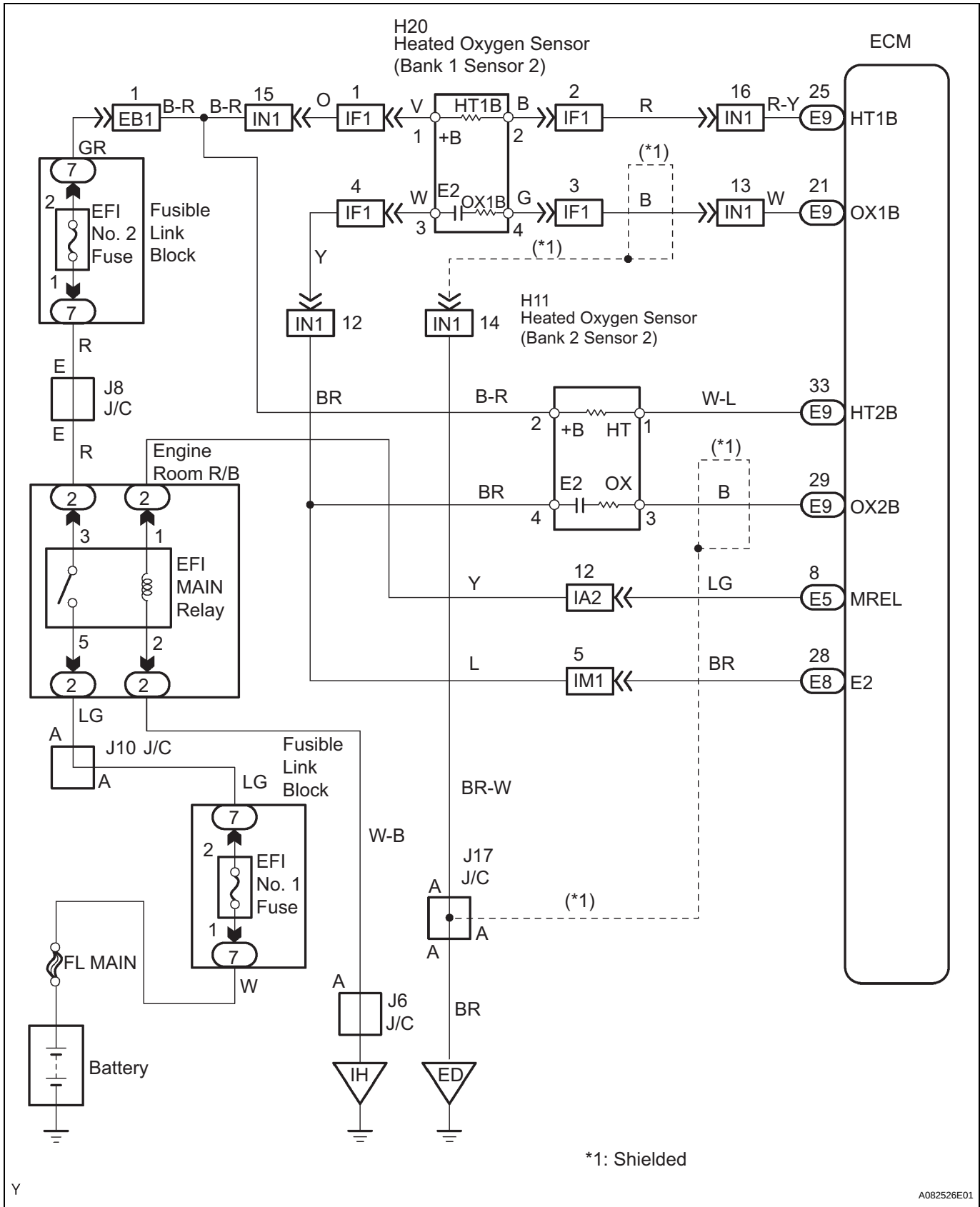
Refer to CHECKING MONITOR STATUS (See page [ES-14](#)).

HO2S bank 1 sensor 2

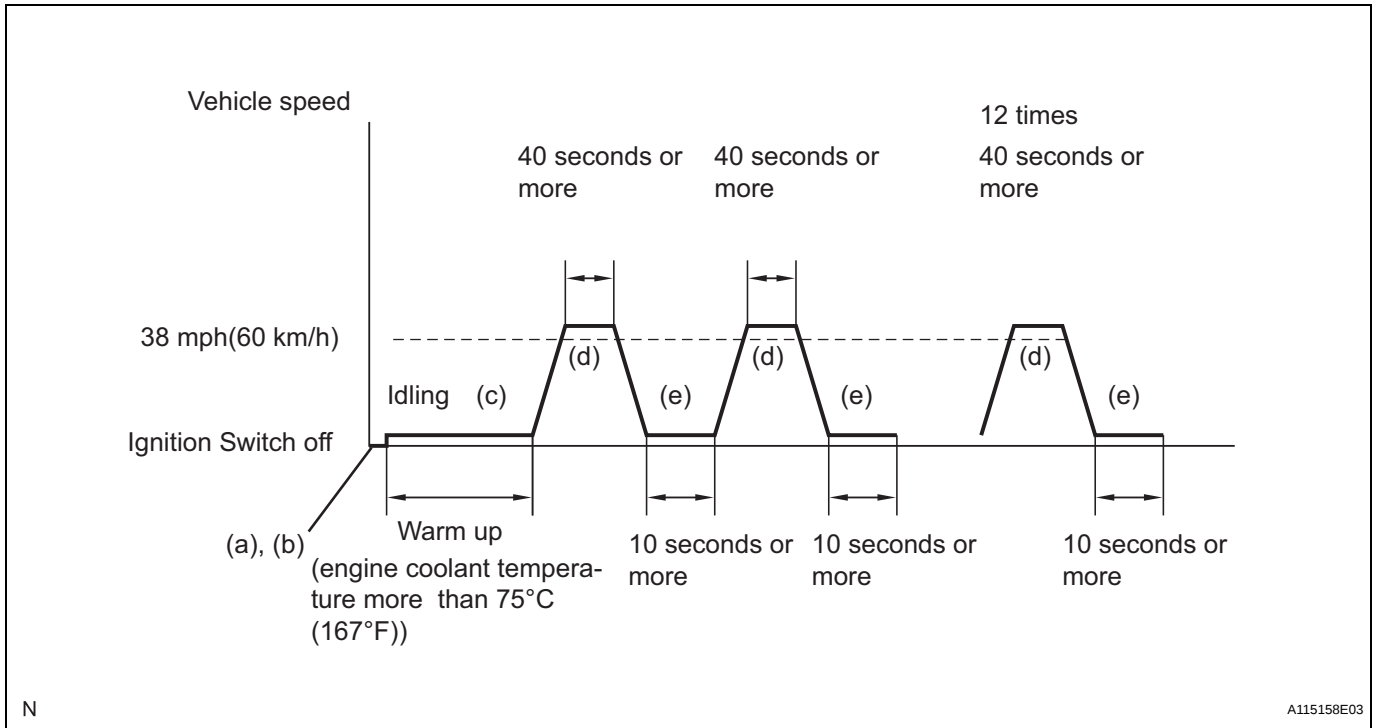
Test ID	Test Item	Description	Unit Conversion	Unit	Standard Value
\$07	MIN HO2S V	Minimum HO2 voltage	Multiply by 0.005	V	Less than malfunction threshold
\$08	MAX HO2S V	Maximum HO2 voltage	Multiply by 0.005	V	More than malfunction threshold
\$31	Time \$31	HO2S switch time form Lean to Rich	Multiply by 0.04096	Second	Less than malfunction threshold
\$32	Time \$32	HO2S switch time form Rich to Lean	Multiply by 0.04096	Second	Less than malfunction threshold
\$37	Time \$37	Time that HO2S voltage drops to 0.2 V after fuel-cut begins	Multiply by 0.04096	Second	Less than malfunction threshold
\$81	Time \$81	Percentage in monitor time when HO2S voltage is lower than 0.05 V	Multiply by 0.04096	%	Less than malfunction threshold
\$84	Time \$84	Percentage in monitor time when HO2S voltage is 0.7 V or higher	Multiply by 0.04096	%	More than malfunction threshold
\$85	Time \$85	Maximum time while HO2S voltage exceeded 0.45 V continuously	Multiply by 0.04096	Second	More than malfunction threshold
\$87	Time \$87	Maximum time while HO2S voltage exceeded 0.45 V or higher	Multiply by 0.04096	%	More than malfunction threshold

If the sensor voltage is outside the standard values, the ECM interprets this as a malfunction and sets a DTC.

WIRING DIAGRAM



CONFIRMATION DRIVING PATTERN



- (a) Connect the intelligent tester to the DLC3.
- (b) Switch the ECM From normal mode to check mode using the tester (See page [ES-29](#)).
- (c) Start the engine and warm it up until the engine coolant temperature reaches more than 75°C (167°F).
- (d) Drive the vehicle at 38 mph (60 km/h) or more for 40 seconds or more.
- (e) Let the engine idle for 10 seconds or more.
- (f) Perform steps (d) and (e) 12 times.

HINT:

If a malfunction exists, the MIL illuminates during step (f).

NOTICE:

If the conditions in this test are not strictly followed, malfunctions may not be detected. If you do not have the intelligent tester, turn the engine switch off after performing steps from (c) to (f), then perform steps (c) to (f) again.

CONFIRMATION DRIVING PATTERN

Warm up the engine and run the engine at 38 mph (60 km/h) for 7 minutes.

CONFIRMATION DRIVING PATTERN

Warm up the engine and run the engine at idle for 30 seconds.

HINT:

Intelligent tester only:

Malfunctioning areas can be identified by performing the A/F CONTROL function provided in the ACTIVE TEST. The A/F CONTROL 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 A/F CONTROL operation using an intelligent tester.

1. Connect the intelligent tester to the DLC3.
2. Start the engine and turn the tester ON.
3. Warm up the engine at engine speed of 2,500 rpm for approximately 90 seconds.
4. On the tester, enter the following menus: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / A/F CONTROL.

5. Perform the A/F CONTROL operation with the engine in an idling condition (press the RIGHT or LEFT button to change the fuel injection volume).
6. Monitor the voltage outputs of the A/F and HO2 sensors (AFS B1S1 and O2S B1S2 or AFS B2S1 and O2S B2S2) displayed on the tester.

HINT:

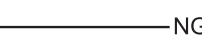
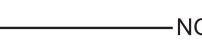
- The A/F CONTROL operation lowers the fuel injection volume by 12.5 % or increases the injection volume by 25 %.
- Each sensor reacts in accordance with increases in the fuel injection volume.

Standard

Tester Display (Sensor)	Injection Volume	Status	Voltage
AFS B1S1 or AFS B2S1 (A/F)	+25 %	Rich	Less than 3.0
AFS B1S1 or AFS B2S1 (A/F)	-12.5 %	Lean	More than 3.35
O2S B1S2 or O2S B2S2 (HO2)	+25 %	Rich	More than 0.55
O2S B1S2 or O2S B2S2 (HO2)	-12.5 %	Lean	Less than 0.4

NOTICE:

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.

Case	A/F Sensor (Sensor 1) Output Voltage		HO2 Sensor (Sensor 2) Output Voltage		Main Suspected Trouble Area
1	Injection Volume +25 % -12.5 %		Injection Volume +25 % -12.5 %		-
	Output Voltage More than 3.35 V Less than 3.0 V		Output Voltage More than 0.55 V Less than 0.4 V		
2	Injection Volume +25 % -12.5 %		Injection Volume +25 % -12.5 %		• A/F sensor • A/F sensor heater • A/F sensor circuit
	Output Voltage Almost no reaction		Output Voltage More than 0.55 V Less than 0.4 V		
3	Injection Volume +25 % -12.5 %		Injection Volume +25 % -12.5 %		• HO2 sensor • HO2 sensor heater • HO2 sensor circuit
	Output Voltage More than 3.35 V Less than 3.0 V		Output Voltage Almost no reaction		
4	Injection volume +25 % -12.5 %		Injection Volume +25 % -12.5 %		• Injector • Fuel pressure • Gas leakage from exhaust system (Air-fuel ratio extremely lean or rich)
	Output Voltage Almost no reaction		Output Voltage Almost no reaction		

- Following the A/F CONTROL procedure enables technicians to check and graph the voltage outputs of both the A/F and HO2 sensors.

- To display the graph, enter the following menus: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / A/F CONTROL / USER DATA / AFS B1S1 and O2S B1S2 or AFS B2S1 and O2S B2S2, and press the YES button and then the ENTER button followed by the F4 button.

HINT:

- If other DTCs relating to different systems that have terminal E2 as the ground terminal are output simultaneously, terminal E2 may have an open circuit.
- Read freeze frame data using the intelligent tester. 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 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 the OX1B wire from the ECM connector is short-circuited to the +B wire, DTC P0136 will be set.
- If the OX2B wire from the ECM connector is short-circuited to the +B wire, DTC P0156 will be set.

1 CHECK OTHER DTC OUTPUT

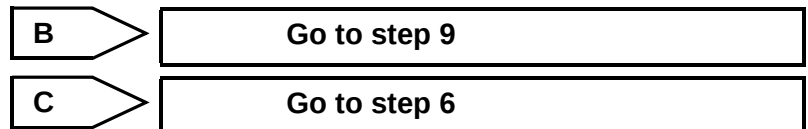
- (a) Read the DTC using the intelligent tester or the OBD II scan tool.

Result

Display (DTC Output)	Proceed to
P0138 and/or P0158 are output	A
P0137 and/or P0157 are output	B
P0136 and/or P0156 are output	C

HINT:

If any other codes besides P0136, P0137, P0138, P0156, P0157 and/or P0158 are output, perform the troubleshooting for those codes first.



A

2 READ VALUE OF INTELLIGENT TESTER OR OBD II SCAN TOOL (OUTPUT VOLTAGE OF HEATED OXYGEN SENSOR)

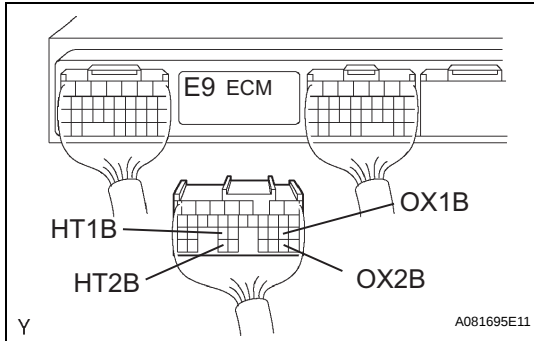
- (a) Connect the intelligent tester or the OBD II scan tool to the DLC3.
- (b) Turn the ignition switch ON. Push the intelligent tester or the OBD II scan tool main switch ON.
- (c) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DATA LIST / ALL / O2S B1S2.
- (d) Run the engine at idle.
- (e) Read the output voltage of the heated oxygen sensor during idling.

Result

Heated oxygen sensor output voltage	Proceed to
More than 1.2 V	A
Less than 1.0 V	B



A

3 CHECK HARNESS AND CONNECTOR (CHECK FOR SHORT)

- Turn the ignition switch OFF and wait for 5 minutes.
- Disconnect the E9 ECM connector.
- Measure the resistance of the wire harness side connectors.

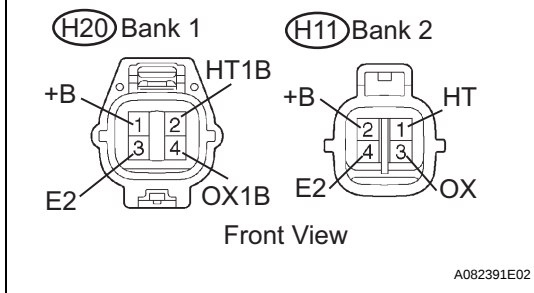
Standard resistance

Tester Connection	Specified Condition
E9-25 (HT1B) - E9-21 (OX1B)	10 kΩ or higher
E9-33 (HT2B) - E9-29 (OX2B)	10 kΩ or higher
E9-25 (HT1B) - Body ground	10 kΩ or higher
E9-33 (HT2B) - Body ground	10 kΩ or higher

OK

REPLACE ECM

NG

4 INSPECT HEATED OXYGEN SENSOR (CHECK FOR SHORT)**Component Side:**

- Disconnect the H20 or H11 heated oxygen sensor connector.
- Measure the resistance of the sensor side connectors.

Standard resistance

Tester Connection	Specified Condition
H20-1 (+B) - H20-3 (E2)	10 kΩ or higher
H20-1 (+B) - H20-4 (OX1B)	10 kΩ or higher
H11-2 (+B) - H11-4 (E2)	10 kΩ or higher
H11-2 (+B) - H11-3 (OX)	10 kΩ or higher

NG

REPAIR OR REPLACE HARNESS OR CONNECTOR

NG

REPLACE HEATED OXYGEN SENSOR**5 READ OUTPUT DTC (CHECK MODE)**

- Change the ECM to check mode with the intelligent tester.
Enter the following menus: DIAGNOSIS / ENHANCED OBD II / CHECK MODE.
- Warm up the engine and drive the vehicle at over 25 mph (40 km/h) for 10 minutes.

HINT:

Driving should be continued for 10 minutes consecutively, but it is not necessary to maintain a speed of 25 mph (40 km/h) during this time.

- (c) Read the DTC.

Result

Display (DTC output)	Proceed to
P0138 and/or P0158 are output	A
No DTC	B

B

CHECK FOR INTERMITTENT PROBLEMS

A

ES

REPLACE HEATED OXYGEN SENSOR

6

READ VALUE OF INTELLIGENT TESTER OR OBD II SCAN TOOL (OUTPUT VOLTAGE OF HEATED OXYGEN SENSOR)

- (a) After warming up the engine, run the engine at 2,500 rpm for 3 minutes.
 (b) Read the output voltage of the heated oxygen sensor when the engine rpm is suddenly increased.

HINT:

Quickly accelerate the engine to 4,000 rpm 3 times by using the accelerator pedal.

Heated oxygen sensor output voltage:

Alternates 0.4 V or less and 0.5 V or more.

OK

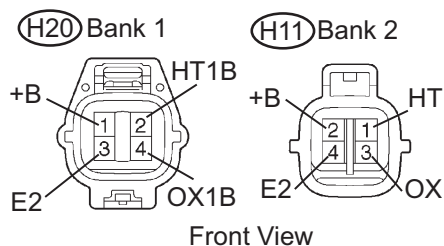
Go to step 10

NG

7

INSPECT HEATED OXYGEN SENSOR (HEATER RESISTANCE)

Component Side:



A082391E02

- (a) Disconnect the H20 or H11 heated oxygen sensor connector.
 (b) Measure the resistance of the heated oxygen sensor terminals.

Standard resistance

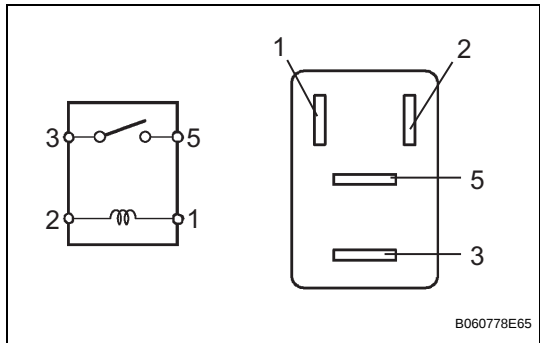
Tester Connection	Condition	Specified Condition
H20-2 (HT1B) - H20-1 (+B)	20°C (68°F)	11 to 16 Ω
H11-1 (HT) - H11-2 (+B)	20°C (68°F)	11 to 16 Ω
H20-2 (HT1B) - H20-1 (+B)	800°C (1,472°F)	23 to 32 Ω
H11-1 (HT) - H11-2 (+B)	800°C (1,472°F)	23 to 32 Ω

NG

REPLACE HEATED OXYGEN SENSOR

OK

8 INSPECT EFI MAIN RELAY



- (a) Remove the EFI MAIN relay from the engine room R/B.
- (b) Measure the resistance of the EFI MAIN relay.

Standard resistance

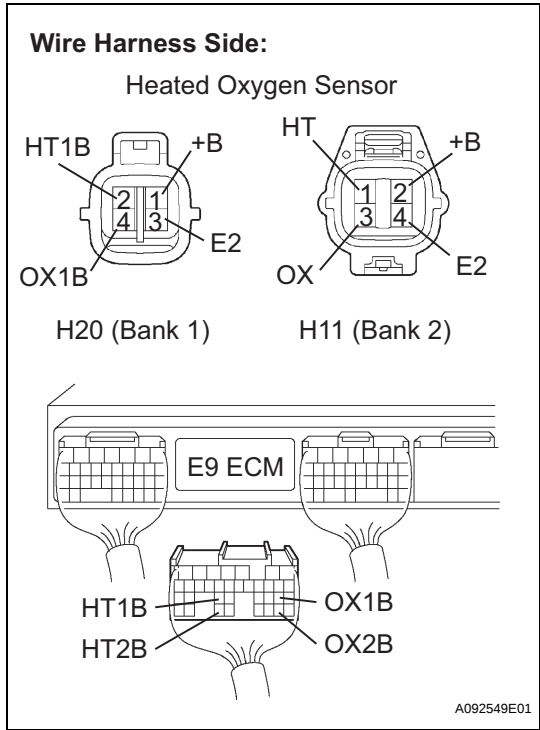
Tester Connection	Specified Condition
3 - 5	10 kΩ or higher
3 - 5	Below 1 Ω (when battery voltage is applied to terminals 1 and 2)

NG

REPLACE EFI MAIN RELAY

OK

9 CHECK HARNESS AND CONNECTOR

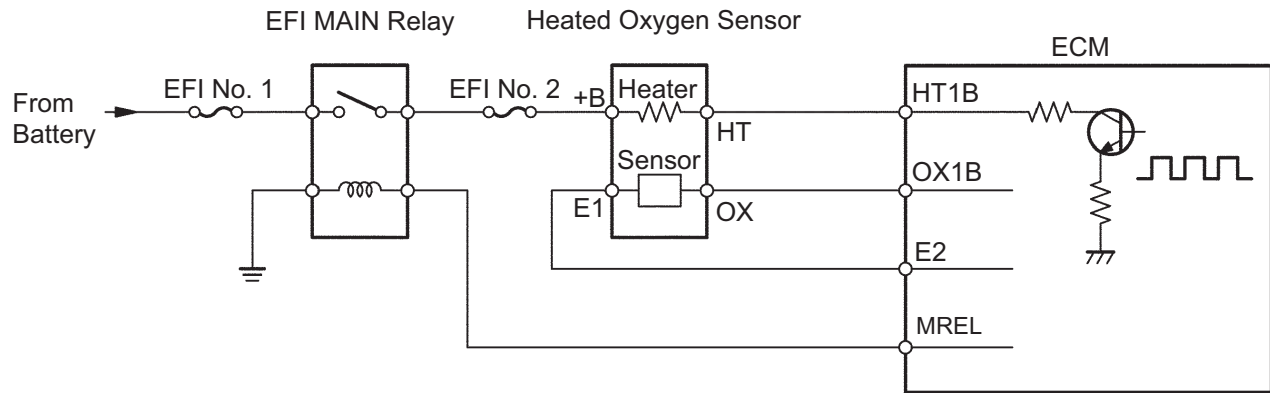


- (a) Check the wire harness between the ECM and heated oxygen sensor.
 - (1) Disconnect the H20 or H11 heated oxygen sensor connector.
 - (2) Disconnect the E9 ECM connector.
 - (3) Measure the resistance of the wire harness side connectors.

Standard resistance

Tester Connection	Specified Condition
H20-4 (OX1B) - E9-21 (OX1B)	Below 1 Ω
H20-2 (HT1B) - E9-25 (HT1B)	Below 1 Ω
H11-3 (OX) - E9-29 (OX2B)	Below 1 Ω
H11-1 (HT) - E9-33 (HT2B)	Below 1 Ω
H20-4 (OX1B) or E9-21 (OX1B) - Body ground	10 kΩ higher
H20-2 (HT1B) or E9-25 (HT1B) - Body ground	10 kΩ higher
H11-3 (OX) or E9-29 (OX2B) - Body ground	10 kΩ higher
H11-1 (HT) or E9-33 (HT2B) - Body ground	10 kΩ higher

- (4) Reconnect the H20 or H11 heated oxygen sensor connector.
- (5) Reconnect the E9 ECM connector.

Reference (Bank 1 Sensor 2 System Drawing)

A090346E01

NG

REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

REPLACE HEATED OXYGEN SENSOR**10 PERFORM CONFIRMATION DRIVING PATTERN**

HINT:

Clear all DTCs prior to performing the confirmation driving pattern.

NEXT

11 READ OUTPUT DTC (DTC P0136 AND/OR P0156 ARE OUTPUT AGAIN)

(a) Read the DTC using the intelligent tester or the OBD II scan tool.

Result

Display (DTC Output)	Proceed to
P0136 and/or P0156 are not output again	A
P0136 and/or P0156 are output again	B

A

CHECK FOR INTERMITTENT PROBLEMS

B

12 REPLACE HEATED OXYGEN SENSOR

NEXT

ES

13

PERFORM CONFIRMATION DRIVING PATTERN

HINT:
Clear all DTCs prior to performing the confirmation driving pattern.

NEXT

14

READ OUTPUT DTC (DTC P0136 AND/OR P0156 ARE OUTPUT AGAIN)

- (a) Read the DTC using the intelligent tester or the OBD II scan tool.

Result

Display (DTC Output)	Proceed to
P0136 and/or P0156 are not output again	A
P0136 and/or P0156 are output again	B

A

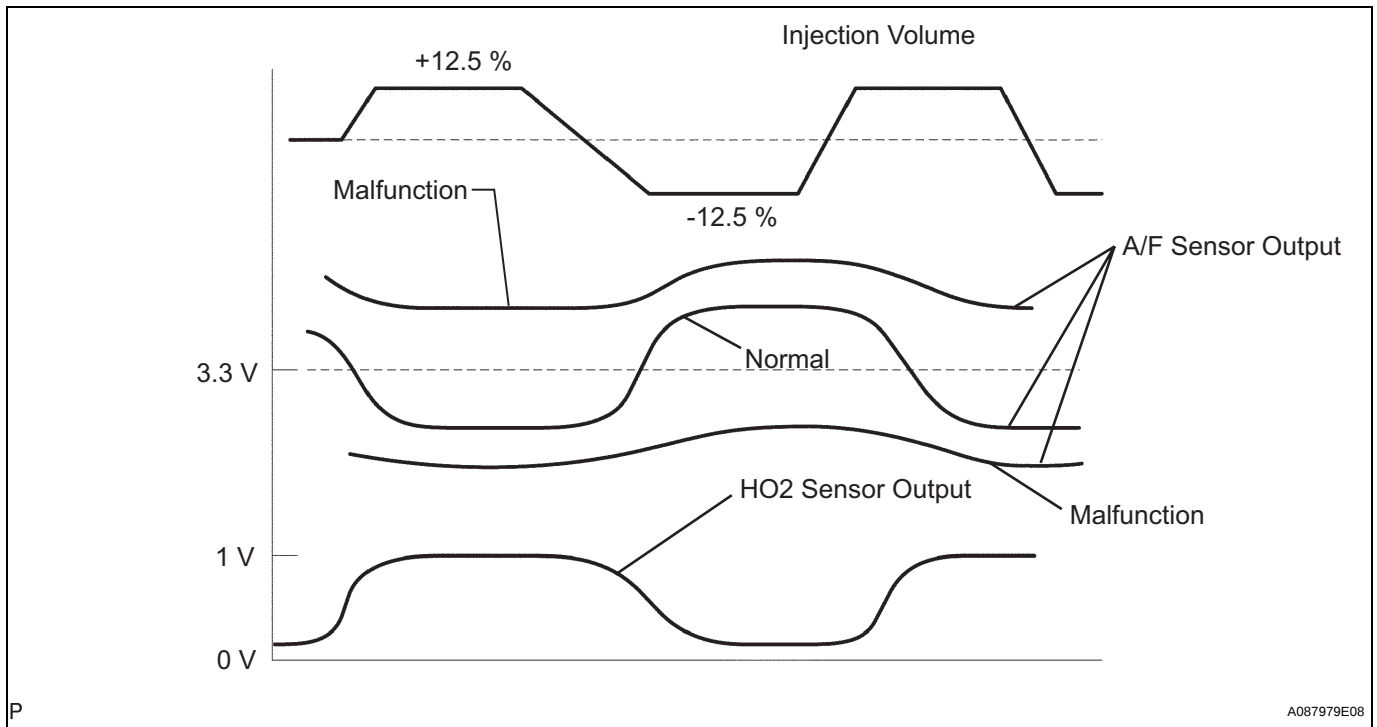
REPAIR COMPLETED

B

15

PERFORM ACTIVE TEST BY INTELLIGENT TESTER

- (a) Start the engine and warm it up.
(b) Connect the intelligent tester to the DLC3.
(c) Turn the ignition switch ON. Push the intelligent tester main switch ON.
(d) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / INJ VOL.
(e) Using the intelligent tester, change the injection volume to check the A/F sensor output and heated oxygen sensor output values below.



HINT:

Change the injection volume from -12.5 % to +12.5 %.

Result:

A/F sensor output remains more than 3.3 V or A/F sensor output remains less than 3.3 V
(Heated oxygen sensor reacts in accordance with increase and decrease of injection volume)

OK

REPLACE AIR FUEL RATIO SENSOR

NG

CHECK AND REPAIR EXTREMELY RICH OR LEAN ACTUAL AIR FUEL RATIO (INJECTOR, FUEL PRESSURE, GAS LEAKAGE FROM EXHAUST SYSTEM, ETC.)

ES

DTC	P0171	System Too Lean (Bank 1)
DTC	P0172	System Too Rich (Bank 1)
DTC	P0174	System Too Lean (Bank 2)
DTC	P0175	System Too Rich (Bank 2)

DESCRIPTION

The fuel trim is related to the feedback compensation value, not to the basic injection time. The fuel trim consists of both the short-term and the 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 No.	DTC Detection Condition	Trouble Area
P0171 P0174	With warm engine and stable air-fuel ratio feedback, fuel trim considerably in error to lean side (2 trip detection logic)	• Air induction system • Injector blockage • Mass Air Flow (MAF) meter • Engine Coolant Temperature (ECT) sensor • Fuel pressure • Gas leakage from exhaust system • Open or short in A/F sensor (bank 1, 2 sensor 1) circuit • A/F sensor (bank 1, 2 sensor 1) • A/F sensor heater (bank 1, 2 sensor 1) • A/F relay • A/F sensor heater and A/F relay circuits • PCV valve and hose • PCV hose connections • ECM
P0172 P0175	With warm engine and stable air-fuel ratio feedback, fuel trim considerably in error to rich side (2 trip detection logic)	• Injector leakage or blockage • MAF meter • ECT sensor • Ignition system • Fuel pressure • Gas leakage from exhaust system • Open or short in A/F sensor (bank 1, 2 sensor 1) circuit • A/F sensor (bank 1, 2 sensor 1) • A/F sensor heater (bank 1, 2 sensor 1) • A/F relay • A/F sensor heater and A/F relay circuits • ECM

HINT:

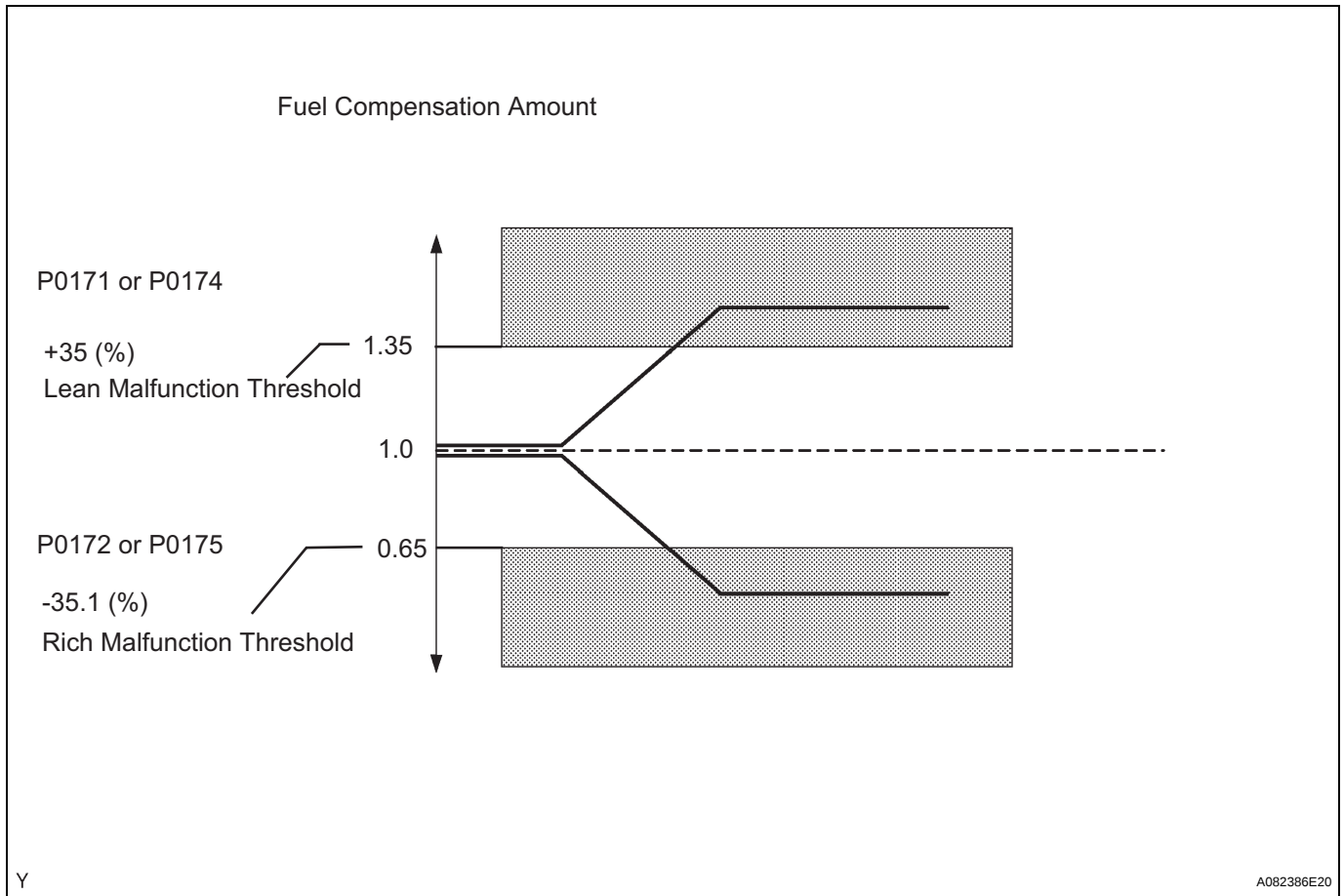
- When DTC P0171 or P0174 is set, the actual air-fuel ratio is on the lean side. When DTC P0172 or P0175 is set, the actual air-fuel ratio is on the rich side.
- If the vehicle runs out of fuel, the air-fuel ratio is lean and DTC P0171 or P0174 may be set. The MIL is then illuminated.
- When the total of the short-term and long-term fuel trim values is within the malfunction threshold (and the engine coolant temperature is more than 75°C [167°F]), the system is functioning normally.

MONITOR DESCRIPTION

Under closed-loop fuel control, fuel injection volumes that deviate from those estimated by the ECM cause changes in the long-term fuel trim compensation value. The long-term fuel trim is adjusted when there are persistent deviations in the short-term fuel trim values. Deviations from the ECM's estimated fuel injection volumes also affects 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 threshold, 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.



ES

MONITOR STRATEGY

Related DTCs	P0171: Fuel trim Lean (bank 1) P0172: Fuel trim Rich (bank 1) P0174: Fuel trim Lean (bank 2) P0175: Fuel trim Rich (bank 2)
Required Sensors/Components (Main)	Fuel system
Required Sensors/Components (Related)	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

Monitor runs whenever following DTCs not present	P0010, P0020 (VVT VSV), P0011, P0012, P0021, P0022 (VVT system-Advance, Retard), P0031, P0032, P0051, P0052 (O2 sensor heater sensor 1), P0031, P0032, P0051, P0052 (A/F sensor heater sensor 1), P0100, P0101, P0102, P0103 (MAF sensor), P0115, P0116, P0117, P0118 (ECT sensor), P0120, P0121, P0122, P0123, P0220, P0222, P0223, P2135 (TP sensor), P0125 (Insufficient ECT for closed loop), P0335 (CKP sensor), P0340, P0341 (CMP sensor), P0340, P0341 (CMP sensor), P0351, P0352, P0353, P0354, P0355, P0356 (Igniter), P0500 (VSS), P0510 (Idle switch)
Fuel system status	Closed loop for more than 13 seconds
Battery voltage	11 V or more
Either of following conditions 1 or 2 set	-
1. Engine RPM	Below 1,100 rpm
2. Intake air amount per revolution	0.22 g/rev or more

TYPICAL MALFUNCTION THRESHOLDS

EVAP purge-cut	Executing
Either of following conditions 1 or 2 is 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 (See page [ES-275](#)).

HINT:

Intelligent tester only:

Malfunctioning areas can be identified by performing the A/F CONTROL function provided in the ACTIVE TEST. The A/F CONTROL 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 A/F CONTROL operation using an intelligent tester.

1. Connect the intelligent tester to the DLC3.
2. Start the engine and turn the tester ON.
3. Warm up the engine at engine speed of 2,500 rpm for approximately 90 seconds.
4. On the tester, enter the following menus: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / A/F CONTROL.
5. Perform the A/F CONTROL operation with the engine in an idling condition (press the RIGHT or LEFT button to change the fuel injection volume.)
6. Monitor the output voltages of the A/F and HO2 sensors (AFS B1S1 and O2S B1S2 or AFS B2S1 and O2S B2S2) displayed on the tester.

HINT:

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

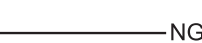
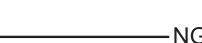
Standard

Tester Display (Sensor)	Injection Volume	Status	Voltage
AFS B1S1 or AFS B2S1 (A/F)	+25 %	Rich	Less than 3.0
AFS B1S1 or AFS B2S1 (A/F)	-12.5 %	Lean	More than 3.35

Tester Display (Sensor)	Injection Volume	Status	Voltage
O2S B1S2 or O2S B2S2 (HO2)	+25 %	Rich	More than 0.55
O2S B1S2 or O2S B2S2 (HO2)	-12.5 %	Lean	Less than 0.4

NOTICE:

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.

Case	A/F Sensor (Sensor 1) Output Voltage		HO2 Sensor (Sensor 2) Output Voltage		Main Suspected Trouble Area
1	Injection Volume +25 % -12.5 %		Injection Volume +25 % -12.5 %		-
	Output Voltage More than 3.35 V Less than 3.0 V		Output Voltage More than 0.55 V Less than 0.4 V		
2	Injection Volume +25 % -12.5 %		Injection Volume +25 % -12.5 %		- A/F sensor - A/F sensor heater - A/F sensor circuit
	Output Voltage Almost no reaction		Output Voltage More than 0.55 V Less than 0.4 V		
3	Injection Volume +25 % -12.5 %		Injection Volume +25 % -12.5 %		- HO2 sensor - HO2 sensor heater - HO2 sensor circuit
	Output Voltage More than 3.35 V Less than 3.0 V		Output Voltage Almost no reaction		
4	Injection volume +25 % -12.5 %		Injection Volume +25 % -12.5 %		- Injector - Fuel pressure - Gas leakage from exhaust system (Air-fuel ratio extremely lean or rich)
	Output Voltage Almost no reaction		Output Voltage Almost no reaction		

- Following the A/F CONTROL procedure enables technicians to check and graph the voltage outputs of both the A/F and HO2 sensors.
- To display the graph, enter the following menus: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / A/F CONTROL / USER DATA / AFS B1S1 and O2S B1S2 or AFS B2S1 and O2S B2S2, and press the YES button and then the ENTER button followed by the F4 button.

HINT:

- Read freeze frame data using the intelligent tester. 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 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.
- 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 rich air-fuel mixture. Check for conditions that would cause the engine to run lean.

1 CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P0171, P0172, P0174 OR P0175)

- (a) Connect the intelligent tester to the DLC3.
- (b) Turn the ignition switch ON and turn the tester ON.
- (c) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DTC INFO / CURRENT CODES.
- (d) Read DTCs.

Result

Display (DTC output)	Proceed to
P0171, P0172, P0174 or P0175	A
P0171, P0172, P0174 or P0175 and other DTCs	B

HINT:

If any DTCs other than P0171, P0172, P0174 or P0175 are output, troubleshoot those DTCs first.

B

GO TO DTC CHART

A

2 CHECK PCV HOSE

OK:

PCV hose is connected correctly and is not damaged.

NG

REPAIR OR REPLACE PCV HOSE

OK

3 CHECK AIR INDUCTION SYSTEM

- (a) Check the air induction system for vacuum leakage.

OK:

No leakage from air induction system.

NG

REPAIR OR REPLACE AIR INDUCTION SYSTEM

OK

4 PERFORM ACTIVE TEST BY INTELLIGENT TESTER (A/F CONTROL)

- (a) Connect the intelligent tester to the DLC3.
- (b) Start the engine and turn the tester ON.
- (c) Warm up the engine at an engine speed of 2,500 rpm for approximately 90 seconds.
- (d) On the tester, enter the following menus: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / A/F CONTROL.
- (e) Perform the A/F CONTROL operation with the engine in an idling condition (press the RIGHT or LEFT button to change the fuel injection volume).

- (f) Monitor the outputs voltages of A/F and HO2 sensors (AFS B1S1 and O2S B1S2 or AFS B2S1 and O2S B2S2) displayed on the tester.

HINT:

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

Standard

Tester Display (Sensor)	Injection Volume	Status	Voltage
AFS B1S1 or AFS B2S1 (A/F)	+25 %	Rich	Less than 3.0
AFS B1S1 or AFS B2S1 (A/F)	-12.5 %	Lean	More than 3.35
O2S B1S2 or O2S B2S2 (HO2)	+25 %	Rich	More than 0.55
O2S B1S2 or O2S B2S2 (HO2)	-12.5 %	Lean	Less than 0.4

ES**Result**

Status AFS B1S1 or AFS B2S1	Status O2S B1S2 or O2S B2S2	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 leakage 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 leakage from exhaust system • Ignition system • Fuel pressure • MAF meter • ECT sensor	A
Lean	Lean/Rich	A/F sensor malfunction	-	• A/F sensor	B
Rich	Lean/Rich	A/F sensor malfunction	-	• A/F sensor	B

Lean: During A/F CONTROL, 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 A/F CONTROL, the AFS is consistently less than 3.0 V, and the O2S is consistently more than 0.55 V.

B**Go to step 10****C****Go to step 14****A****5****READ VALUE OF INTELLIGENT TESTER (COOLANT TEMP)**

- (a) Connect the intelligent tester to the DLC3.
- (b) Turn the ignition switch ON and turn the tester ON.
- (c) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DATA LIST / PRIMARY / COOLANT TEMP.
- (d) Read the COOLANT TEMP twice, when the engine is both cold and warmed up.

Standard:**With cold engine:****Same as ambient air temperature.****With warm engine:****Between 75 and 95°C (167 and 203°F)****NG****REPLACE ENGINE COOLANT TEMPERATURE SENSOR****OK****6****READ VALUE OF INTELLIGENT TESTER (MAF)**

- (a) Connect the intelligent tester to the DLC3.
- (b) Turn the tester ON.
- (c) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DATA LIST / PRIMARY / MAF and COOLANT TEMP.
- (d) Allow the engine to idle until the COOLANT TEMP reaches 75°C (167°F) or more.
- (e) Read the MAF with the engine in an idling condition and at an engine speed of 2,500 rpm.

Standard:**MAF while engine idling:****Between 2.1 g/s and 3.1 g/s (shift position: N, A/ C: OFF).****MAF at an engine speed of 2,500 rpm:****Between 7.8 g/s and 11.4 g/s (shift position: N, A/ C: OFF).****NG****REPLACE MASS AIR FLOW METER****OK****7****CHECK FUEL PRESSURE**

- (a) Check the fuel pressure (See page [FU-3](#)).

Standard:**304 to 343 kPa (3.1 to 3.5 kgf/cm², 44.1 to 49.7 psi)****NG****CHECK AND REPLACE FUEL PUMP,
PRESSURE REGULATOR, FUEL PIPE LINE
AND FILTER****OK****8****CHECK FOR EXHAUST GAS LEAKAGE****OK:****No gas leakage.****NG****REPAIR OR REPLACE EXHAUST SYSTEM****OK****9****CHECK FOR SPARKS AND IGNITION****HINT:**

If the spark plugs or ignition system malfunctions, engine misfire may occur. The misfire count can be read using an intelligent tester. Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DATA LIST / MISFIRE / CYL #1 (to CYL #6).

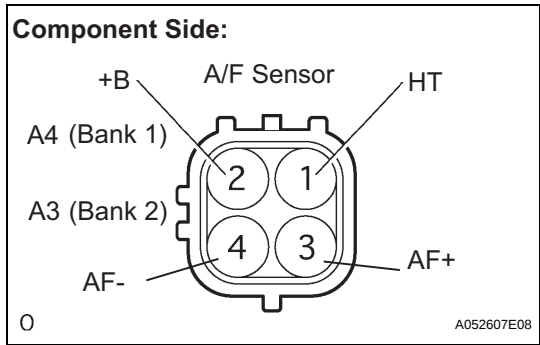
NG**REPAIR OR REPLACE IGNITION SYSTEM****OK****10****INSPECT FUEL INJECTOR ASSEMBLY (INJECTION AND VOLUME)****HINT:**

If the injectors malfunction, engine misfire may occur. The misfire count can be read using the intelligent tester. Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DATA LIST / PRIMARY / CYL #1 (to CYL #6).

NG**REPLACE FUEL INJECTOR ASSEMBLY****OK****ES**

11

INSPECT AIR FUEL RATIO SENSOR (HEATER RESISTANCE)



- (a) Disconnect the A3 or A4 A/F sensor connector.
(b) Measure the resistance between the terminals of the A/F sensor connector.

Standard resistance

Tester Connection	Specified Condition
HT - +B	1.8 Ω to 3.4 Ω at 20°C (68°F)
HT - AF+, AF-	10 k Ω or higher

- (c) Reconnect the A/F sensor connector.

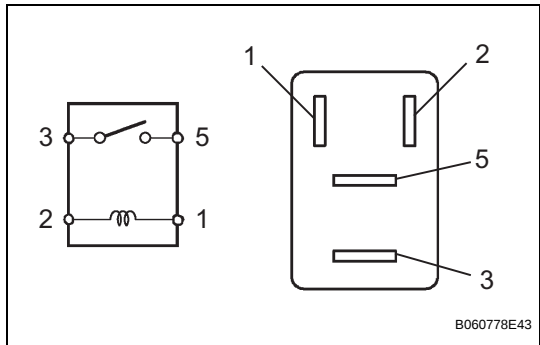
NG

REPLACE AIR FUEL RATIO SENSOR

OK

12

INSPECT AIR FUEL RATIO SENSOR RELAY



- (a) Remove the A/F relay from the engine room R/B.
(b) Measure the A/F relay resistance.

Standard resistance

Tester Connection	Specified Condition
3 - 5	10 k Ω or higher
3 - 5	Below 1 Ω (when battery voltage applied to terminals 1 and 2)

- (c) Reinstall the A/F relay.

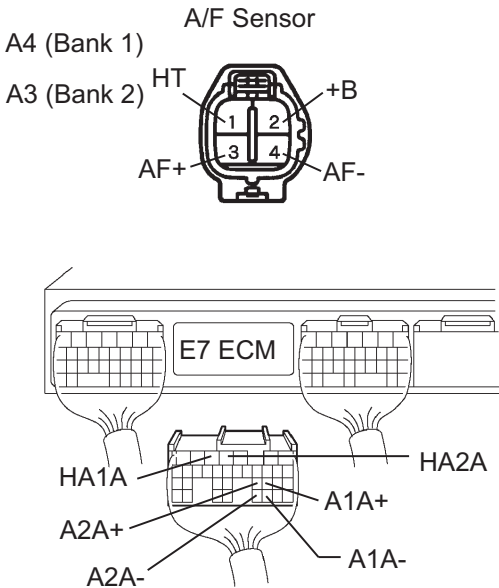
NG

REPLACE AIR FUEL RATIO SENSOR RELAY

OK

13 CHECK HARNESS AND CONNECTOR (A/F SENSOR - ECM)

Wire Harness Side:



- (a) Disconnect the A3 or A4 A/F sensor connector.
- (b) Disconnect the E7 ECM connector.
- (c) Measure the resistance of the wire harness side connectors.

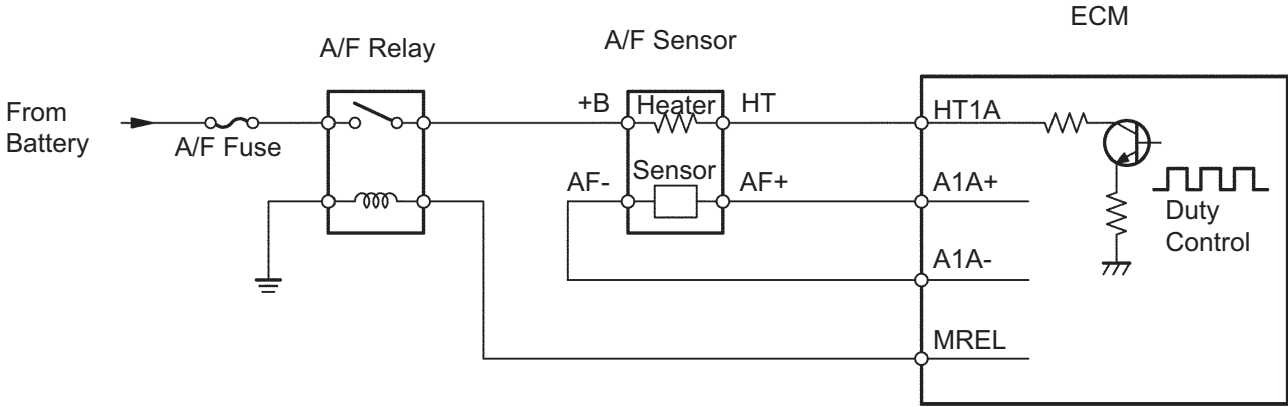
Standard resistance

Tester Connection	Specified Condition
A3-3 (AF+) - E7-22 (A1A+) A3-4 (AF-) - E7-30 (A1A-) A3-1 (HT) - E7-5 (HA1A) A4-3 (AF+) - E7-23 (A2A+) A4-4 (AF-) - E7-31 (A2A-) A4-1 (HT) - E7-4 (HA2A)	Below 1 Ω
A3-3 (AF+) or E7-22 (A1A+) - Body ground A3-4 (AF-) or E7-30 (A1A-) - Body ground A3-1 (HT) or E7-5 (HA1A) - Body ground A4-3 (AF+) or E7-23 (A2A+) - Body ground A4-4 (AF-) or E7-31 (A2A-) - Body ground A4-1 (HT) or E7-4 (HA2A) - Body ground	10 k Ω or higher

- (d) Reconnect the E7 ECM connector.
- (e) Reconnect the A3 or A4 A/F sensor connector.

ES

Reference (Bank 1 Sensor 1 System Drawing)



NG

REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

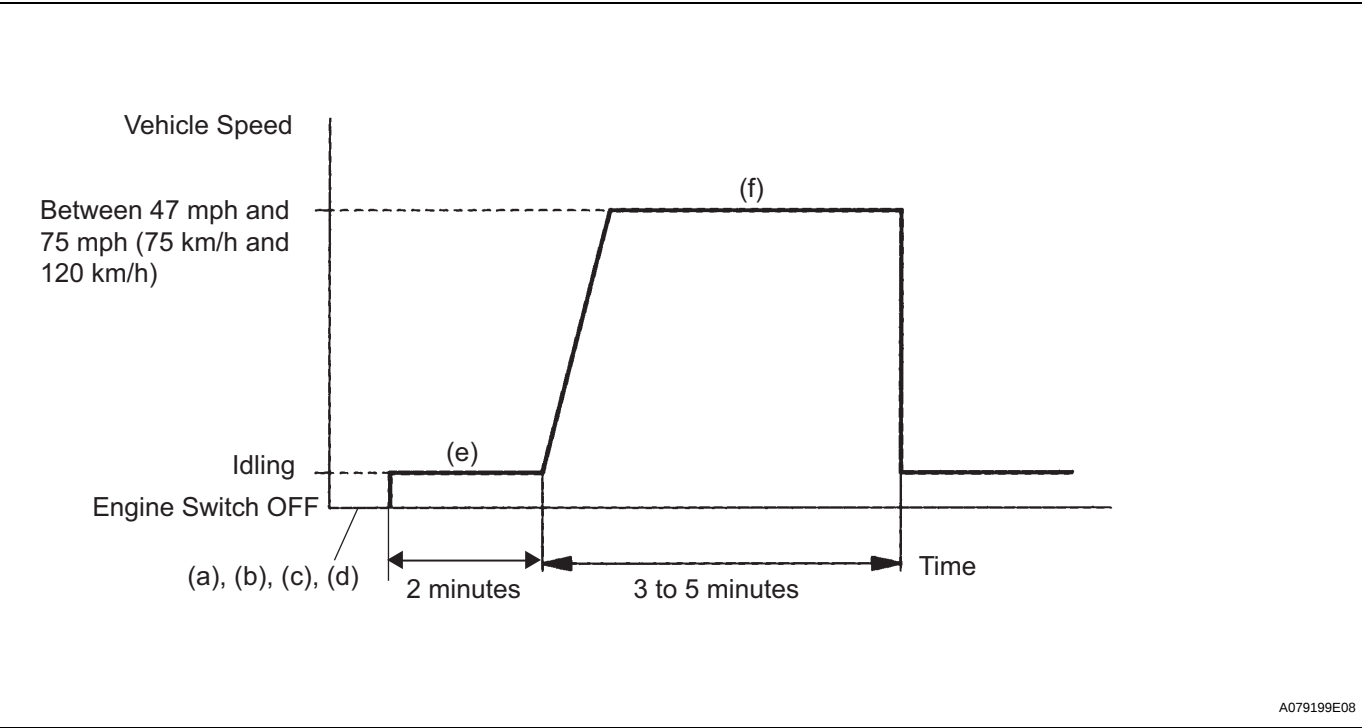
14 REPLACE AIR FUEL RATIO SENSOR

NEXT

15

PERFORM CONFIRMATION DRIVING PATTERN

(a) Connect the intelligent tester to the DLC3 (a).



- (b) Turn the ignition switch ON and turn the tester ON (b).
 - (c) Clear DTCs (c) (See page ES-28).
 - (d) Switch the ECM from normal mode to check mode using the tester (d) (See page ES-29).
 - (e) Start the engine and warm it up with all the accessories switched OFF (e).
 - (f) Drive the vehicle at between 47 mph and 75 mph (75 km/h and 120 km/h) and at an engine speed of between 1,400 rpm and 3,200 rpm for 3 to 5 minutes (f).
- HINT:
If the system is still malfunctioning, the MIL will be illuminated during step (f).
- NOTICE:**
If the conditions in this test are not strictly followed, no malfunction will be detected.

NEXT

16

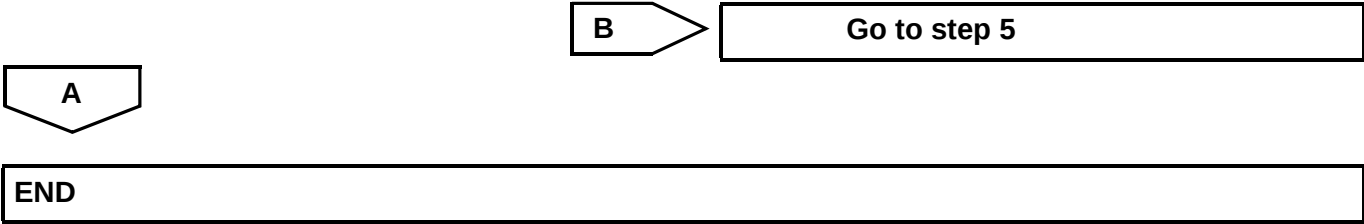
CHECK WHETHER DTC OUTPUTS REOCCUR (DTC P0171, P0172, P0174 OR P0175)

- (a) On the intelligent tester, enter the following menus: DIAGNOSIS / ENHANCED OBD II / DTC INFO / CURRENT CODES.
- (b) Read DTCs.

Result

Display (DTC output)	Proceed to
No output	A

Display (DTC output)	Proceed to
P0171, P0172, P0174 or P0175	B



DTC	P0300	Random / Multiple Cylinder Misfire Detected
DTC	P0301	Cylinder 1 Misfire Detected
DTC	P0302	Cylinder 2 Misfire Detected
DTC	P0303	Cylinder 3 Misfire Detected
DTC	P0304	Cylinder 4 Misfire Detected
DTC	P0305	Cylinder 5 Misfire Detected
DTC	P0306	Cylinder 6 Misfire Detected

DESCRIPTION

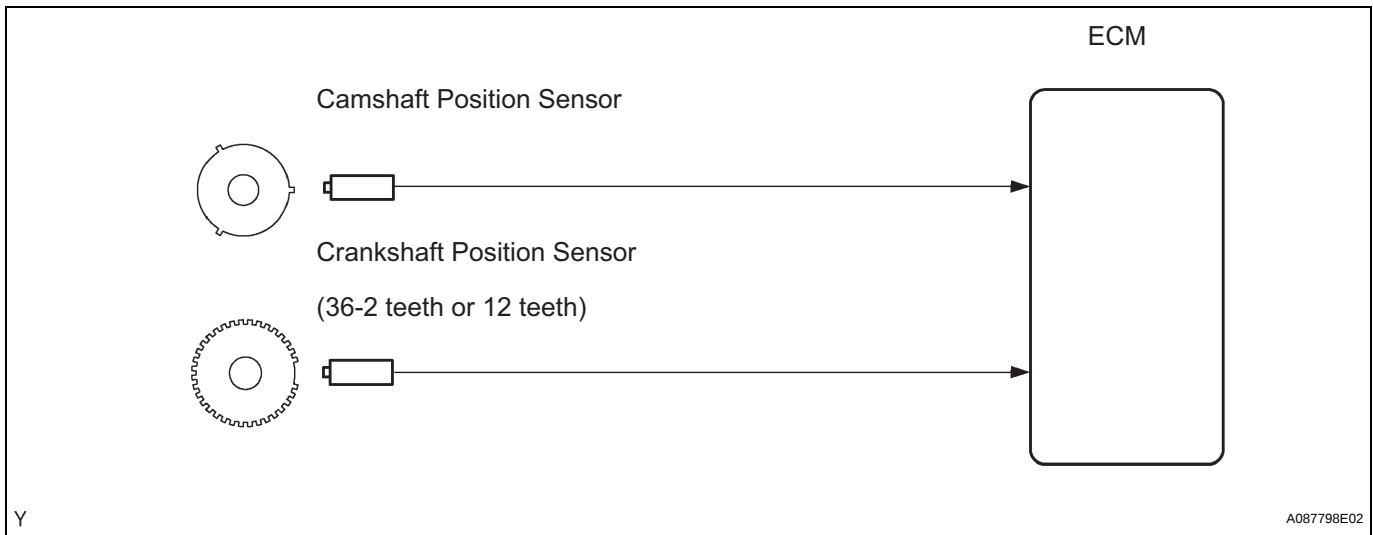
When the engine misfires, high concentrations of hydrocarbons (HC) enter the exhaust gas. Extremely high HC concentration levels can cause increase in exhaust emission levels. High concentrations of HC can also cause increases in the Three-Way Catalytic Converter (TWC) temperature, which may cause damage 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 exceeds the threshold levels, and could cause emission deterioration, the ECM illuminates the MIL and set a DTC.

DTC No.	DTC Detection Condition	Trouble Area
P0300	Simultaneous misfiring of several cylinder detected (2 trip detection logic)	• Open or short in engine wire harness • Connector connection • Vacuum hose connections • Ignition system • 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

DTC No.	DTC Detection Condition	Trouble Area
P0301 P0302 P0303 P0304 P0305 P0306	Misfiring of specific cylinder detected (2 trip detection logic)	• Open or short in engine wire harness • Connector connection • Vacuum hose connections • Ignition system • 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

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).

- Within the first 1,000 crankshaft revolutions of the engine starting, an excessive misfiring rate (approximately 20 to 50 misfires per 1,000 crankshaft revolutions) occurs once.
- After the first 1,000 crankshaft revolutions, an excessive misfiring rate (approximately 20 to 60 misfires per 1,000 crankshaft revolutions) occurs 4 times in sequential crankshaft revolutions.

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).

- 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

Related DTCs	P0300: Multiple cylinder misfire P0301: Cylinder 1 misfire P0302: Cylinder 2 misfire P0303: Cylinder 3 misfire P0304: Cylinder 4 misfire P0305: Cylinder 5 misfire P0306: Cylinder 6 misfire
Required Sensors/Components (Main)	Injector, Ignition coil, Spark plug
Required Sensors/Components (Related)	Crankshaft, Camshaft, Engine coolant temperature and intake air temperature sensors and Mass air flow meter
Frequency of Operation	Continuous
Duration	1,000 to 4,000 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:

Monitor runs whenever following DTCs not present	P0100, P0101, P0102, P0103 (MAF sensor), P0110, P0112, P0113 (IAT sensor), P0115, P0116, P0117, P0118 (ECT sensor), P0120, P0121, P0122, P0123, P0220, P0222, P0223, P2135 (TP sensor), P0125 (Insufficient ECT for closed loop), P0327, P0328, P0332, P0333 (Knock sensor), P0335 (CKP sensor), P0340, P0341 (CMP sensor), P0500 (VSS), P0510 (Idle switch)
Battery voltage	8 V or more
Throttle position learning	Completed
VVT system	No operate by scan tool
Engine RPM	450 to 5,900 rpm
All of the following conditions are met	Condition 1, 2 and 3
1. Engine Coolant Temperature (ECT)	-10°C (14°F) or more
2. Either of the following conditions is met	Condition (a) or (b)
(a) IAT	-10°C (14°F) or more
(b) ECT	75°C (167°F) or more
3. Either of the following conditions is met	Condition (a) or (b)
(a) ECT at engine start	More than -7°C (19.4°F)
(b) ECT	More than 20°C (68°F)
Fuel cut	OFF

Monitor period of emission-related-misfire:

First 1,000 revolutions after engine start, or Check Mode	Crankshaft 1,000 revolutions
Except above	Crankshaft 1,000 revolutions x 4

Monitor period of catalyst-damaged-misfire (MIL blinks):

All of following conditions 1, 2 and 3 met	Crankshaft 200 revolutions x 3
1. Driving cycles	1 set
2. Check mode	OFF
3. Engine RPM	Less than 3,000 rpm
Except above	Crankshaft 200 revolutions x 3

TYPICAL MALFUNCTION THRESHOLDS

Monitor period of emission-related-misfire:

Misfire rate	1.82 % or more
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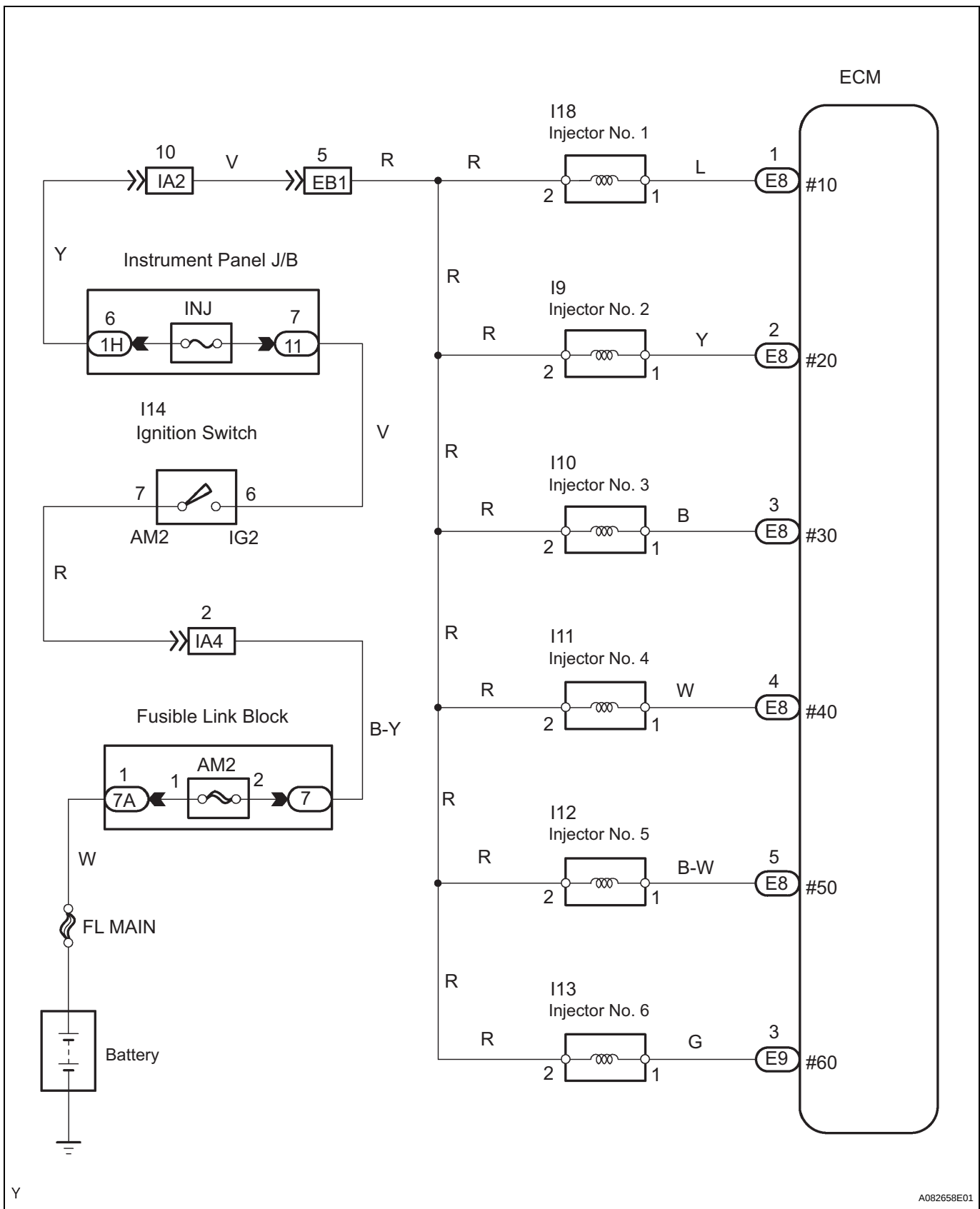
Monitor period of catalyst-damage-misfire (MIL blinks):

Number of misfire per 200 revolutions	77 or more (varies with intake air amount and RPM)
Paired cylinders misfire	Detected

WIRING DIAGRAM

Refer to DTC P0351 for the wiring diagram of the ignition system (See page [ES-186](#)).

ES



- Read freeze frame data using the intelligent tester or the OBD II scan tool. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, it is useful for determining whether the vehicle was running or stopped, the engine was warmed up or not, the air-fuel ratio was lean or rich, etc. at the time of the malfunction.
- If the misfire does not occur when the vehicle is brought to the workshop, the misfire can be confirmed by reproducing the condition of the freeze frame data. Also, after finishing the repair, confirm that there is no misfire (see confirmation driving pattern).
- On 6 and 8 cylinder engines, cylinder specific misfire fault codes are disabled at high engine speeds. If the misfire starts in a high engine speed area or the misfire occurs only in a high engine speed area, only the general fault code P0300 will be stored.
When only a general misfire fault code like P0300 is stored:
 - (a) Erase the general misfire fault code from the ECM using the intelligent tester or OBD II scan tool.
 - (b) Start the engine and drive the confirmation pattern.
 - (c) Read the value of the misfire ratio for each cylinder. Or read the DTC.
 - (d) Perform repairs on the cylinder that has a high misfire ratio. Or repair the cylinder indicated by the DTC.
 - (e) After finishing repairs, drive the confirmation pattern again and confirm that no misfire occurs.
- When either of SHORT FT #1, LONG FT #1, SHORT FT #2 or LONG FT #2 in the freeze frame data is over the range of $\pm 20\%$, there is a possibility that the air-fuel ratio is becoming RICH (-20% or less) or LEAN ($+20\%$ or more).
- When COOLANT TEMP in the freeze frame data is less than 80°C (176°F), there is a possibility of misfire only during engine warm-up.
- If the misfire cannot be reproduced, the following reasons may apply: 1) the vehicle has low fuel, 2) improper fuel is being used, and 3) the ignition plug is contaminated.
- Be sure to check the value on the misfire counter after the repair.

ES

1**CHECK OTHER DTC OUTPUT (IN ADDITION TO MISFIRE DTCS)**

- (a) Read the DTC using the intelligent tester or the OBD II scan tool.

Result

Display (DTC Output)	Proceed to
Only "P0300, P0301, P0302, P0303, P0304, P0305 and/or P0306" are output	A
"P0300, P0301, P0302, P0303, P0304, P0305 or P0306" and other DTCs are output	B

HINT:

If any other codes besides "P0300, P0301, P0302, P0303, P0304, P0305 or P0306" are output, perform the troubleshooting for those DTCs first.

B**GO TO RELEVANT DTC CHART****A****2****CHECK WIRE HARNESS, CONNECTOR AND VACUUM HOSE IN ENGINE ROOM**

- (a) Check the connection conditions of the wire harness and connector.
- (b) Check for the disconnection, piping and break of the vacuum hose.

NG

REPAIR OR REPLACE, THEN CONFIRM THAT THERE IS NO MISFIRE

OK

3

CHECK PCV HOSE

NG

REPAIR OR REPLACE PCV HOSE

OK

ES

4

READ VALUE OF INTELLIGENT TESTER OR OBD II SCAN TOOL (NUMBER OF MISFIRE)

- (a) Connect the intelligent tester or the OBD II scan tool to the DLC3.
- (b) Turn the ignition switch ON and push the intelligent tester or the OBD II scan tool main switch ON.
- (c) Start the engine.
- (d) Select the item "DIAGNOSIS/ENHANCED OBD II/DATA LIST/ALL/CYL#1 - CYL#6".
- (e) Read the number of misfire on the intelligent tester or the OBD II scan tool.

HINT:

When a misfire is not reproduced, be sure to branch below based on the stored DTC.

Result

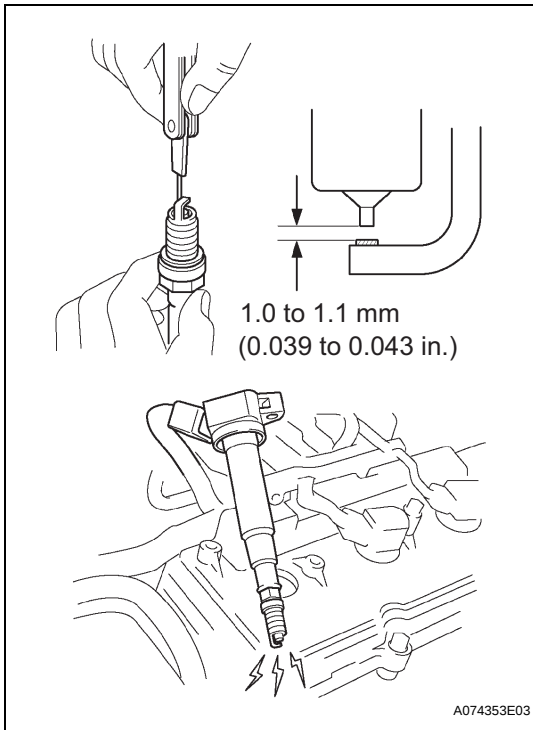
High Misfire Rate Cylinder	Proceed to
1 or 2 cylinders	A
More than 3 cylinders	B

B

Go to step 15

A

5 CHECK SPARK PLUG AND SPARK OF MISFIRING CYLINDER



- (a) Remove the ignition coil assembly.
- (b) Remove the spark plug.
- (c) Check the spark plug type.

Recommended spark plug:

DENSO made	SK20R11
NGK made	IFR6A11

- (d) Check the spark plug electrode gap.

Electrode gap:

1.0 to 1.1 mm (0.039 to 0.043 in.)

Maximum electrode gap:

1.3 mm (0.051 in.)

NOTICE:

If adjusting the gap of a new spark plug, bend only the base the ground electrode. Do not touch the tip. Never attempt to adjust the gap on a used plug.

- (e) Check the electrode for carbon deposits.
- (f) Perform a spark test.

CAUTION:

Absolutely disconnect the each injector connectors.

NOTICE:

Do not crank the engine for more than 2 seconds.

- (1) Install the spark plug to the ignition coil, and connect the ignition coil connector.
- (2) Disconnect the injector connector.
- (3) Ground the spark plug.
- (4) Check if spark occurs while the engine is being cranked.

Standard:

Spark jumps across electrode gap.

- (g) Reinstall the spark plug.
- (h) Reinstall the ignition coil assembly.

OK

Go to step 8

NG

6 CHANGE NORMAL SPARK PLUG AND CHECK SPARK OF MISFIRING CYLINDER

- (a) Change to the normal spark plug.
- (b) Perform a spark test.

CAUTION:

Absolutely disconnect each injector connector.

NOTICE:

Do not crank the engine for more than 2 seconds.

- (1) Install the spark plug to the ignition coil, and connect the ignition coil connector.
- (2) Disconnect the injector connector.
- (3) Ground the spark plug.
- (4) Check if spark occurs while the engine is being cranked.

Standard:
Spark jumps across electrode gap.

OK

REPLACE SPARK PLUG

NG

7

CHECK HARNESS AND CONNECTOR OF MISFIRING CYLINDER (IGNITION COIL - ECM)

OK

REPLACE IGNITION COIL ASSEMBLY (THEN
CONFIRM THAT THERE IS NO MISFIRE)

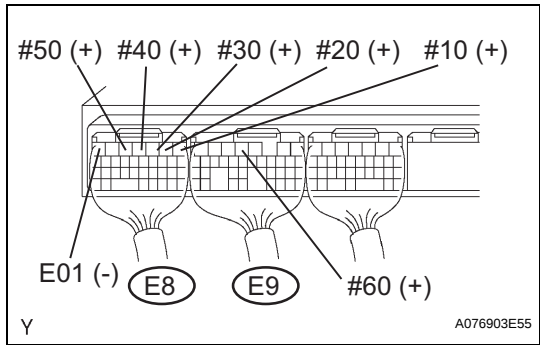
ES

NG

REPAIR OR REPLACE HARNESS OR CONNECTOR

8

INSPECT ECM TERMINAL OF MISFIRING CYLINDER (#10, #20, #30, #40, #50 OR #60 VOLTAGE)



- (a) Turn the ignition switch ON.
(b) Measure the voltage between the applicable terminals of the E8 and E9 ECM connectors.

Standard voltage

Tester Connection	Specified Condition
#10 (E8-1) - E01 (E8-7)	9 to 14 V
#20 (E8-2) - E01 (E8-7)	9 to 14 V
#30 (E8-3) - E01 (E8-7)	9 to 14 V
#40 (E8-4) - E01 (E8-7)	9 to 14 V
#50 (E8-5) - E01 (E8-7)	9 to 14 V
#60 (E9-31) - E01 (E8-7)	9 to 14 V

OK

Go to step 11

NG

9

INSPECT FUEL INJECTOR RESISTANCE OF MISFIRING CYLINDER

- (a) Inspect the fuel injector. (See page [FU-13](#))

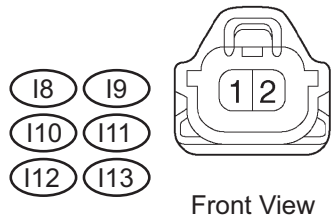
NG

REPLACE FUEL INJECTOR ASSEMBLY

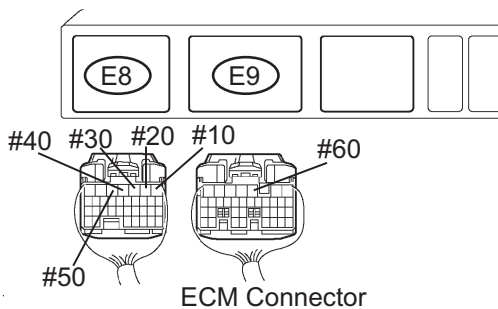
OK

10**CHECK HARNESS AND CONNECTOR OF MISFIRING CYLINDER (INJECTOR - ECM, INJECTOR - IGNITION SWITCH)****Wire Harness Side:**

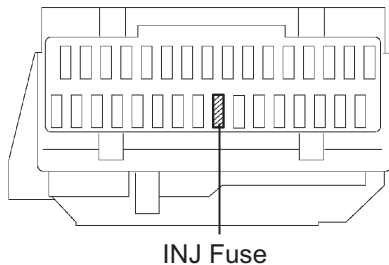
Injector Connector



Front View



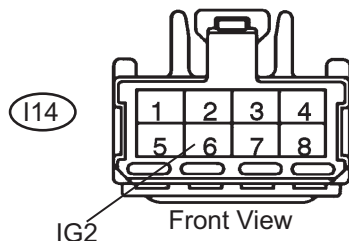
ECM Connector

Instrument Panel J/B:

INJ Fuse

Wire Harness Side:

Injector Switch Connector



Front View

A124476E01

- (a) Check the harness and the connector between the injector connector and the ECM connector.
 - (1) Disconnect the I8, I9, I10, I11, I12 or I13 injector connector.
 - (2) Disconnect the E8 or E9 ECM connector.
 - (3) Check the resistance between the wire harness side connectors.

Standard resistance

Tester Connection	Specified Condition
Injector (I8-1) - #10 (E8-1)	Below 1 Ω
Injector (I9-1) - #20 (E8-2)	Below 1 Ω
Injector (I10-1) - #30 (E8-3)	Below 1 Ω
Injector (I11-1) - #40 (E8-4)	Below 1 Ω
Injector (I12-1) - #50 (E8-5)	Below 1 Ω
Injector (I13-1) - #60 (E9-3)	Below 1 Ω
Injector (I8-1) or #10 (E8-1) - Body ground	10 k Ω or higher
Injector (I9-1) or #20 (E8-2) - Body ground	10 k Ω or higher
Injector (I10-1) or #30 (E8-3) - Body ground	10 k Ω or higher
Injector (I11-1) or #40 (E8-4) - Body ground	10 k Ω or higher
Injector (I12-1) or #50 (E8-5) - Body ground	10 k Ω or higher
Injector (I13-1) or #60 (E9-3) - Body ground	10 k Ω or higher

- (4) Reconnect the injector connector.
- (5) Reconnect the ECM connector.
- (b) Check the harness and the connector between the injector connector and the ignition switch connector.
 - (1) Check the INJ fuse.
 - Remove the INJ fuse from the instrument panel J/B.
 - Measure the resistance of the INJ fuse.

Standard resistance:**Below 1 Ω**

- Reinstall the INJ fuse.

- (2) Disconnect the I8, I9, I10, I11, I12 or I13 injector connector.
- (3) Disconnect the I14 ignition switch connector.
- (4) Check the resistance between the wire harness side connectors.

Standard resistance

Tester Connection	Specified Condition
Injector (I8-2) - IG2 (I14-6)	Below 1 Ω
Injector (I9-2) - IG2 (I14-6)	Below 1 Ω
Injector (I10-2) - IG2 (I14-6)	Below 1 Ω
Injector (I11-2) - IG2 (I14-6)	Below 1 Ω
Injector (I12-2) - IG2 (I14-6)	Below 1 Ω
Injector (I13-2) - IG2 (I14-6)	Below 1 Ω
Injector (I8-2) or IG2 (I14-6) - Body ground	10 k Ω or higher
Injector (I9-2) or IG2 (I14-6) - Body ground	10 k Ω or higher

ES

Tester Connection	Specified Condition
Injector (I10-2) or IG2 (I14-6) - Body ground	10 kΩ or higher
Injector (I11-2) or IG2 (I14-6) - Body ground	10 kΩ or higher
Injector (I12-2) or IG2 (I14-6) - Body ground	10 kΩ or higher
Injector (I13-2) or IG2 (I14-6) - Body ground	10 kΩ or higher

- (5) Reconnect the injector connector.
 (6) Reconnect the ignition switch connector.

NG

REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

ES

11 INSPECT FUEL INJECTOR INJECTION AND VOLUME OF MISFIRING CYLINDER

- (a) Inspect the fuel injector. (See page [FU-13](#))

NG

REPLACE FUEL INJECTOR ASSEMBLY

OK

12 CHECK CYLINDER COMPRESSION PRESSURE OF MISFIRING CYLINDER

- (a) Inspect cylinder compression pressure. (See page [EM-3](#))

NG

REPAIR OR REPLACE CYLINDER HEAD ASSEMBLY

OK

13 CHECK VALVE CLEARANCE OF MISFIRING CYLINDER

- (a) Inspect the valve clearance. (See page [EM-10](#))

NG

ADJUST VALVE CLEARANCE

OK

14 SWITCH STEP BY NUMBER OF MISFIRE CYLINDER (REFER RESULT OF STEP 4)

HINT:

- If the result of step 4 is "1 or 2 cylinders", proceed to A.
- If the result of step 4 is "more than 3 cylinders", proceed to B.

B

CHECK FOR INTERMITTENT PROBLEMS

A

15 CHECK VALVE TIMING

- (a) Check for looseness or jumping teeth of the timing belt
(See page [EM-25](#)).

NG**ADJUST VALVE TIMING (REPAIR OR
REPLACE TIMING BELT)****OK****16 CHECK FUEL PRESSURE**

- (a) Check the fuel pressure (See page [FU-3](#)).

Standard:**304 to 343 kPa (3.1 to 3.5 kgf/cm², 44.1 to 49.7 psi)****NG****CHECK AND REPLACE FUEL PUMP,
PRESSURE REGULATOR, FUEL PIPE LINE
AND FILTER****OK****17 READ VALUE OF INTELLIGENT TESTER OR OBD II SCAN TOOL (INTAKE AIR
TEMPERATURE AND MASS AIR FLOW RATE)**

- (a) Connect the intelligent tester or the OBD II scan tool to the DLC3.
(b) Turn the ignition switch ON.
(c) Check the intake air temperature.
(1) Select the item "DIAGNOSIS/ENHANCED OBD II/
DATA LIST/ALL/INTAKE AIR" and read its value
displayed on the intelligent tester or the OBD II scan
tool.

Temperature:**Equivalent to ambient temperature**

- (d) Check the air flow rate.
(1) Select the item "DIAGNOSIS/ENHANCED OBD II/
DATA LIST/ALL/MAF" and read its value displayed
on the intelligent tester or the OBD II scan tool.

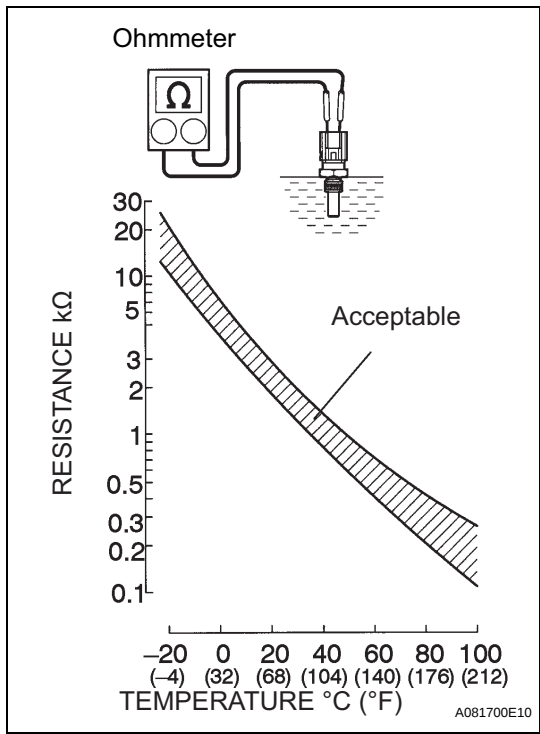
Standard

Condition	Air Flow Rate (gm/s)
Ignition switch ON (do not start engine)	0
Idling	4 to 6
Running without load (2,500 rpm)	13 to 20
Idling to quickly accelerating	Air flow rate fluctuates

NG**REPLACE MASS AIR FLOW SENSOR****OK****ES**

18

INSPECT ENGINE COOLANT TEMPERATURE SENSOR (RESISTANCE)



- (a) Remove the engine coolant temperature sensor.
- (b) Measure the resistance between the terminals.

Standard resistance

Tester Connection	Specified Condition
1 - 2	2.32 to 2.59 kΩ (20°C (68°F))
	0.310 to 0.326 kΩ (80°C (176°F))

NOTICE:
In case of checking the engine coolant temperature sensor in the water, be careful not to allow water to go into the terminals. After checking, dry the sensor.

HINT:

Alternate procedure: Connect an ohmmeter to the installed engine coolant temperature sensor and read the resistance. Use an infrared thermometer to measure the engine temperature in the immediate vicinity of the sensor. Compare these values to the resistance/temperature graph. Change the engine temperature (warm up or allow to cool down) and repeat the test.

- (c) Reinstall the engine coolant temperature sensor.

NG

REPLACE ENGINE COOLANT TEMPERATURE SENSOR

OK

19

SWITCH STEP BY NUMBER OF MISFIRING CYLINDER (REFER RESULT OF STEP 4)

- HINT:**
- If the result of step 4 is "1 or 2 cylinders", proceed to A.
 - If the result of step 4 is "more than 3 cylinders", proceed to B.

B

Go to step 5

A

CHECK FOR INTERMITTENT PROBLEMS

DTC	P0327	Knock Sensor 1 Circuit Low Input (Bank 1 or Single Sensor)
DTC	P0328	Knock Sensor 1 Circuit High Input (Bank 1 or Single Sensor)
DTC	P0332	Knock Sensor 2 Circuit Low Input (Bank 2)
DTC	P0333	Knock Sensor 2 Circuit High Input (Bank 2)

DESCRIPTION

A flat type knock sensor (non-resonant type) can detect vibrations in a wide band of frequency (about 6 kHz to 15 kHz) and has the following features:

- Knock sensors are fitted on the cylinder block to detect the engine knocking.
- The sensor contains a piezoelectric element which generates a voltage when the cylinder block vibrates due to knocking. If engine knocking occurs, the ignition timing is retarded to suppress it.

DTC No.	DTC Detection Condition	Trouble Area
P0327 P0332	Output voltage of the knock sensor 1 or 2 is 0.5 V or less	• Short in knock sensor 1 or 2 circuit • Knock sensor 1 or 2 • ECM
P0328 P0333	Output voltage of the knock sensor 1 or 2 is 4.5 V or more	• Open in knock sensor 1 or 2 circuit • Knock sensor 1 or 2 • ECM

MONITOR DESCRIPTION

The knock sensor, located on the cylinder block, detects spark knock. When spark knock occurs, the sensor picks up vibrations in a specific frequency range. When the ECM detects the voltage in this frequency range, it retards the ignition timing to suppress the spark knock.

The ECM also senses background engine noise with the knock sensor and uses this noise to check for faults in the sensor. If the knock sensor signal level is too low for more than 10 seconds, and if the knock sensor output voltage is out of normal range, the ECM interprets this as a fault in the knock sensor and sets a DTC.

MONITOR STRATEGY

Related DTCs	P0327: Knock Sensor (Bank 1) Range Check (Low voltage) P0328: Knock Sensor (Bank 1) Range Check (High voltage) P0332: Knock Sensor (Bank 2) Range Check (Low voltage) P0333: Knock Sensor (Bank 2) Range Check (High voltage)
Required sensors / components (Main)	Knock Sensor
Required sensors / components (Related)	MAF meter, Crankshaft position sensor, ECT sensor
Frequency of operation	Continuous
Duration	1 second
MIL operation	Immediate
Sequence operation	None

TYPICAL ENABLING CONDITIONS

The monitor will run whenever these DTCs are not present	None
Battery voltage	10.5 V or more
Time after engine start	5 seconds or more

ES

Ignition switch	ON
Starter	OFF

TYPICAL MALFUNCTION THRESHOLDS

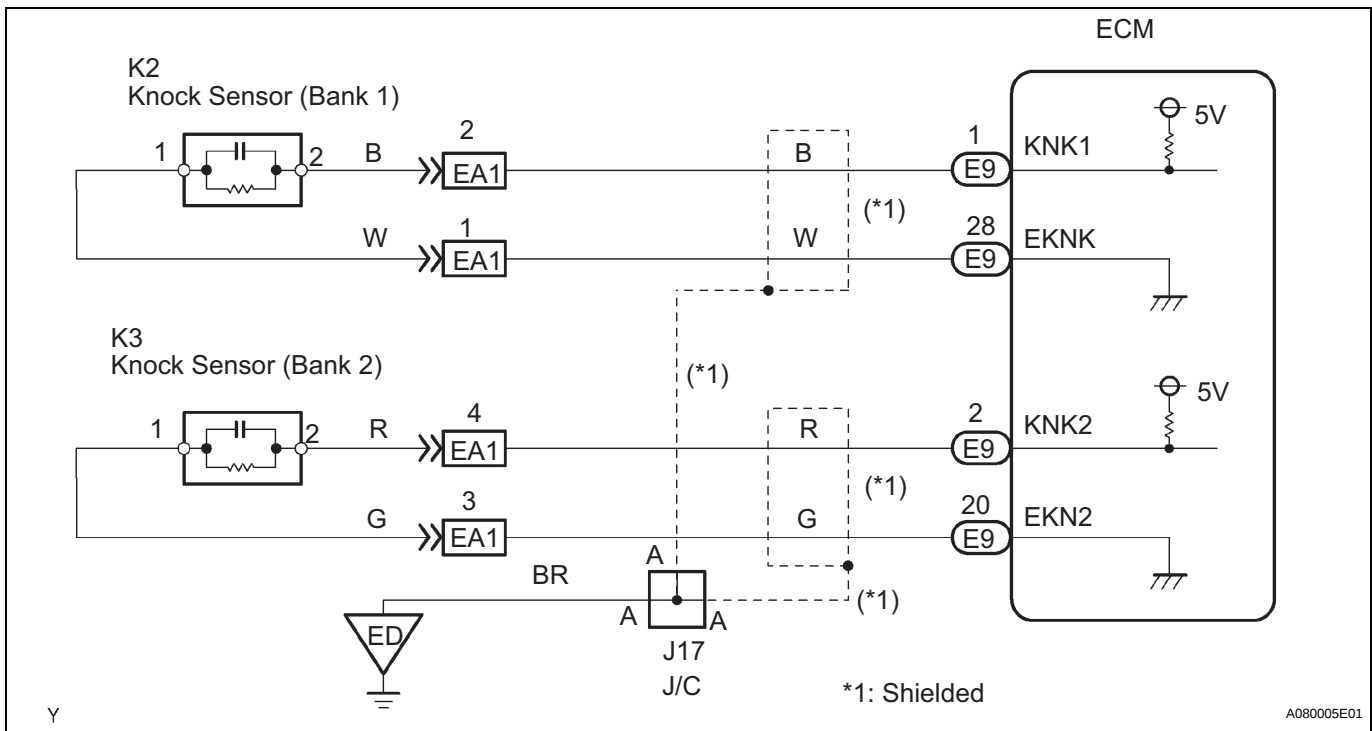
Knock Sensor Range Check (Low voltage):

Knock sensor Voltage	Less than 0.5 V
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Knock Sensor Range Check (High voltage):

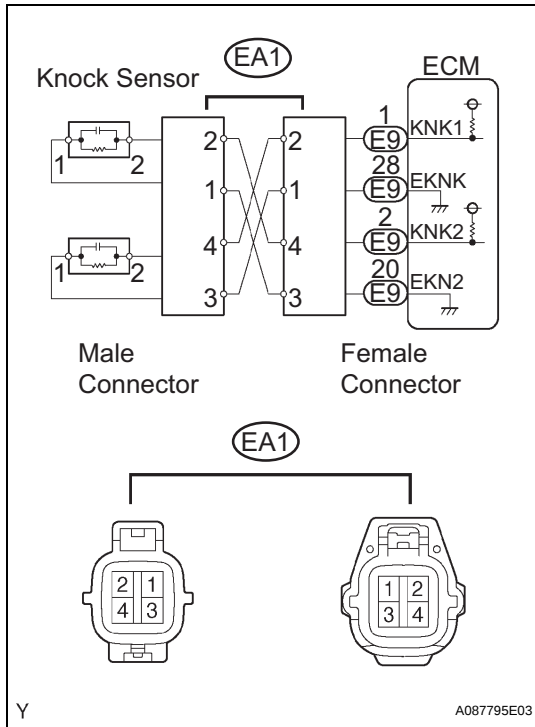
Knock sensor voltage	More than 4.5 V
----------------------	-----------------

WIRING DIAGRAM



HINT:

- DTC P0327 and P0328 are for the bank 1 knock sensor circuit.
- DTC P0332 and P0333 are for the bank 2 knock sensor circuit.
- Read freeze frame data using the intelligent tester. 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 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.

1 READ OUTPUT DTC (CHECK KNOCK SENSOR CIRCUIT)

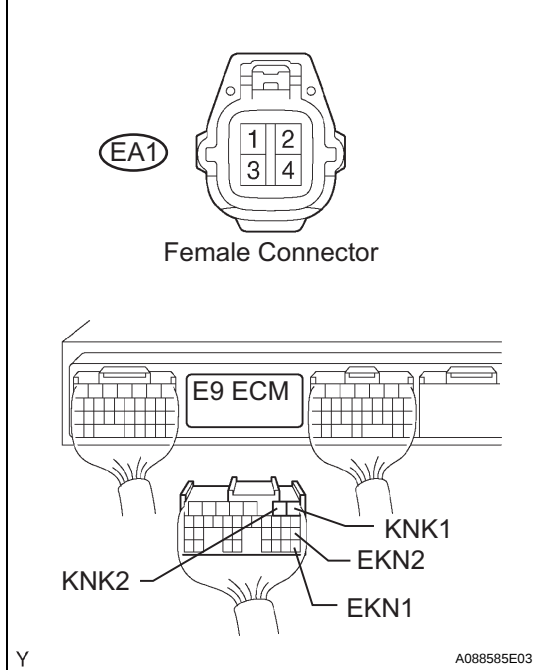
- (a) Disconnect the EA1 connector.
 (b) Using lead wires, connect the EA1 terminals as follows.

Male Connector - Female Connector	
Terminal 2	Terminal 4
Terminal 1	Terminal 3
Terminal 4	Terminal 2
Terminal 3	Terminal 1

- (c) Warm up the engine.
 (d) Run the engine at 3,000 rpm for 10 seconds or more.
 (e) Check the DTC (See page ES-28).

Result

Display	Proceed to
DTC same as when vehicle brought in P0327, P0328 → P0327, P0328 or P0332, P0333 → P0332, P0333	A
DTC different from when vehicle brought in P0327, P0328 → P0332, P0333 or P0332, P0333 → P0327, P0328	B

B**Go to step 4****A****2 CHECK HARNESS AND CONNECTOR (EA1 FEMALE CONNECTOR - ECM)****Wire Harness Side:**

- (a) Disconnect the EA1 connector.
 (b) Disconnect the E9 ECM connector.
 (c) Measure the resistance of the wire harness side connector.

Standard resistance

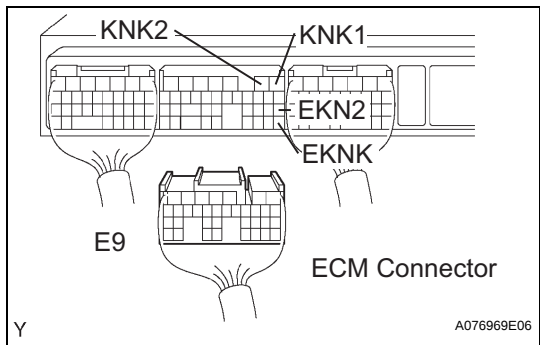
Tester Connection	Specified Condition
2 of EA1 female connector - E9-1 (KNK1) 1 of EA1 female connector - E9-28 (EKNK) 4 of EA1 female connector - E9-2 (KNK2) 3 of EA1 female connector - E9-20 (EKN2)	Below 1 Ω
2 of EA1 female connector or E9-1 (KNK1) - Body ground 1 of EA1 female connector or E9-28 (EKNK) - Body ground 4 of EA1 female connector or E9-2 (KNK2) - Body ground 3 of EA1 female connector or E9-20 (EKN2) - Body ground	10 k Ω or higher

NG**REPAIR OR REPLACE HARNESS OR CONNECTOR**

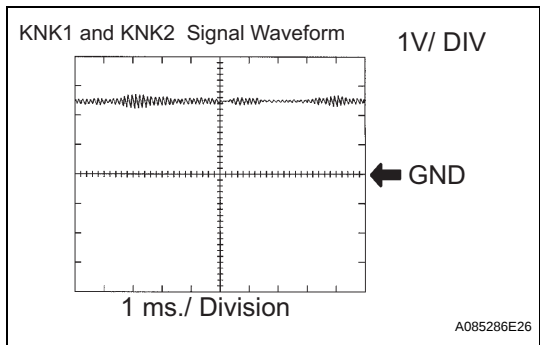
OK

3

CHECK ECM (KNK1, KNK2 VOLTAGE)



- (a) Disconnect the E9 ECM connector.
(b) Turn the ignition switch ON.



- (c) Measure the voltage of ECM terminals.
Standard voltage

Tester Connection	Specified Condition
E9-1 (KNK1) - E9-28 (EKNK) E9-2 (KNK2) - E9-20 (EKN2)	4.5 to 5.5 V

Reconnect the E9 ECM connector.
HINT:
Reference: Inspection using an oscilloscope.
After warming up, run the engine at 4,000 rpm and check the waveform between terminal KNK1 and EKNK of the ECM connector.

Standard voltage

Tester Connection	Specified Condition
E9-1 (KNK1) - E9-28 (EKNK) E9-2 (KNK2) - E9-20 (EKN2)	Correct waveform is as shown

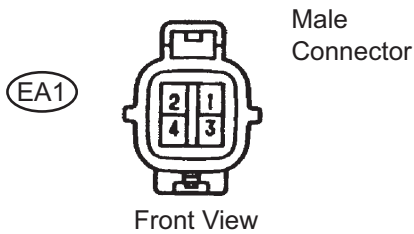
NOTICE:
Fault may be intermittent. Check harness and connectors carefully and retest.

NG

REPLACE ECM

OK

CHECK FOR INTERMITTENT PROBLEMS

4 INSPECT KNOCK SENSOR (RESISTANCE)**Wire Harness Side:**

A073938E05

- (a) Disconnect the EA1 connector.
 (b) Measure the resistance between the terminals of the EA1 male connector.

Standard resistance

Tester Connection	Specified Condition
2 - 1 of EA1 male connector 4 - 3 of EA1 male connector	120 to 280 k Ω

OK

CHECK FOR INTERMITTENT PROBLEMS

NG

5 CHECK HARNESS AND CONNECTOR (EA1 MALE CONNECTOR - KNOCK SENSOR)**HINT:**

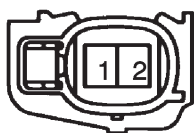
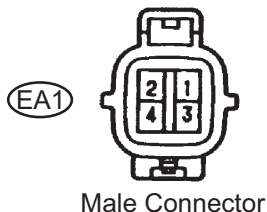
- If DTC P0327 has changed to P0328, or if DTC P0332 has changed to P0333, check the knock sensor circuit on the bank 1 side.
- If DTC P0332 has changed to P0327, or if DTC P0333 has changed to P0338, check the knock sensor circuit on the bank 2 side.

- (a) Disconnect the EA1 connector.
 (b) Disconnect the K2 or K3 knock sensor connector.
 (c) Measure the resistance of the wire harness side connectors.

Standard resistance

Tester Connection	Specified Condition
2 of EA1 male connector - K2-2 1 of EA1 male connector - K2-1 4 of EA1 male connector - K3-2 3 of EA1 male connector - K3-1	Below 1 Ω
2 of EA1 male connector or K2-2 - Body ground 1 of EA1 male connector or K2-1 - Body ground 4 of EA1 male connector or K3-2 - Body ground 3 of EA1 male connector or K3-1 - Body ground	10 k Ω or higher

NG

REPAIR OR REPLACE HARNESS AND CONNECTOR**Wire Harness Side:**

(K2) (Bank 1) (K3) (Bank 2)

A085847E03

OK

REPLACE KNOCK SENSOR

ES

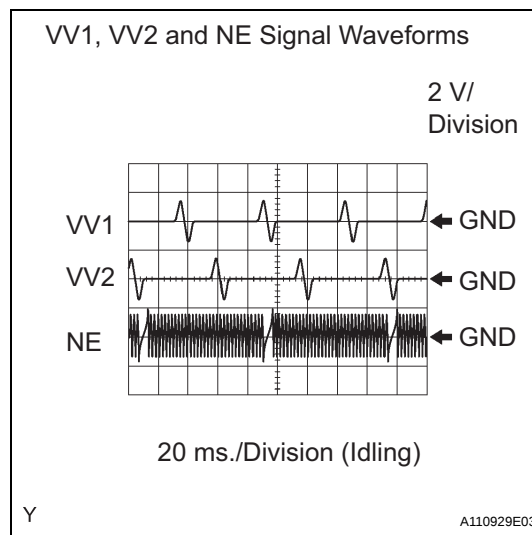
DTC	P0335	Crankshaft Position Sensor "A" Circuit
DTC	P0339	Crankshaft Position Sensor "A" Circuit Intermittent

DESCRIPTION

The crankshaft position sensor (NE signal) consists of a magnet, iron core and pickup coil. The NE signal plate (crankshaft position sensor plate) has 34 teeth and is installed on the crankshaft. The NE signal sensor generates 34 signals for each engine revolution. This sensor monitors a plate (timing rotor) located on the crankshaft timing pulley and is used by the ECM to detect crankshaft angle and engine speed (RPM/NE). As the crankshaft timing pulley rotates through an engine revolution, this sensor communicates the rotation of the NE signal plate as a pulse signal to the ECM. Based on the signal, the ECM controls fuel injection time and ignition timing.

DTC No.	DTC Detection Condition	Trouble Area
P0335	No CKP sensor signal to ECM while engine running (Engine rotating signal from ECM) (1 trip detection logic)	• Open or short in CKP sensor circuit • CKP sensor • CKP sensor plate • ECM
P0335	No crankshaft position sensor signal to ECM with engine speed 600 rpm or more (2 trip detection logic)	• Open or short in crankshaft position sensor circuit • Crankshaft position sensor • Crankshaft timing pulley • ECM
P0339	No crankshaft position sensor signal is input to ECM for 0.05 seconds. or more, and conditions (a), (b) and (c) are met: (a) Engine is at 1,000 rpm or more (b) STA signal is OFF (c) 3 seconds or more have elapsed after STA signal is switched from ON to OFF	• Open or short in crankshaft position sensor circuit • Crankshaft position sensor • Crankshaft timing pulley • ECM

Reference: Inspection using an oscilloscope.



HINT:

- The correct waveform is as shown.
- VV1+ and VV2+ stands for the VVT sensor signal, and NE+ stands for the CKP sensor signal.

Item	Content
Terminals	VV1+ - NE- VV2+ - NE- NE+ - NE-
Equipment Settings	5 V/Division, 20ms/Division

Item	Content
Conditions	Cranking or idling

MONITOR DESCRIPTION

If there is no signal from the crankshaft position sensor despite the engine revolving, the ECM interprets this as a malfunction of the sensor.

If the malfunction is not repaired successfully, these DTCs are set 10 seconds after the engine is next started.

MONITOR STRATEGY

Related DTCs	P0335: CKP sensor range check during cranking P0335: CKP sensor range check during engine running
Required Sensors/Components (Main)	Crankshaft Position (CKP) sensor
Required Sensors/Components (Related)	-
Frequency of Operation	Continuous
Duration	4.7 seconds: CKP sensor range check during cranking 0.016 seconds: CKP sensor range check during engine running
MIL Operation	2 driving cycles
Sequence of Operation	None

ES

TYPICAL ENABLING CONDITIONS

All:

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

Crankshaft Position Sensor Range Check During Cranking:

Starter	ON
Minimal battery voltage while starter is ON	Less than 11 V

Crankshaft Position Sensor Range Check During Engine Running:

Engine RPM	600 rpm or more
Starter	OFF
Time after starter turns from ON to OFF	3 seconds or more

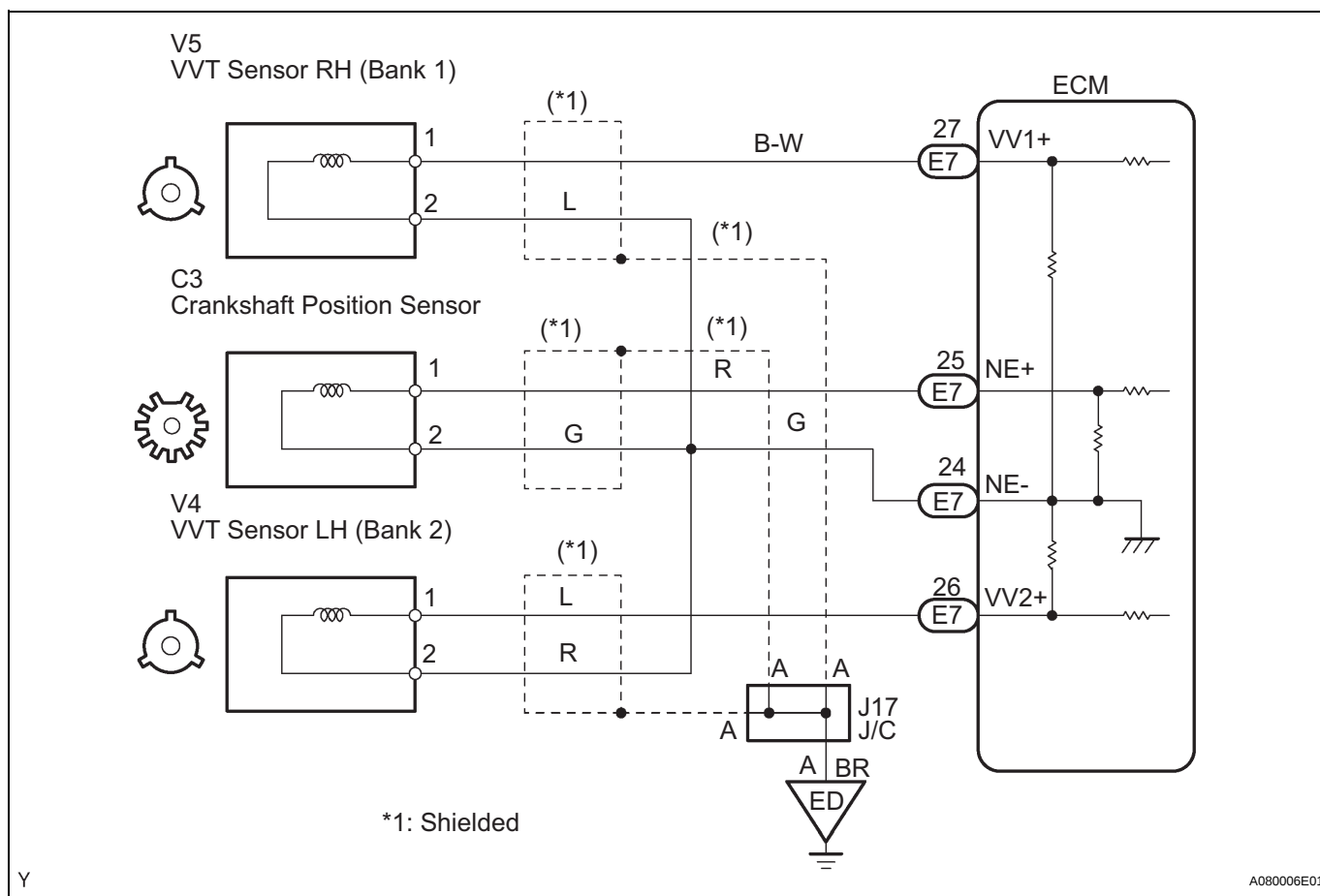
TYPICAL MALFUNCTION THRESHOLDS

CKP signal	No signal
------------	-----------

COMPONENT OPERATING RANGE

Crankshaft position sensor signal	Crankshaft position sensor voltage fluctuates when the crankshaft rotates 34 crankshaft position sensor signals per 1 revolution of crankshaft
-----------------------------------	--

WIRING DIAGRAM



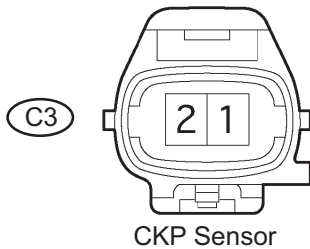
HINT:

- If no problem is found by this diagnostic troubleshooting procedure, troubleshooting the engine mechanical system.
- Check the engine speed. The engine speed can be checked by using the intelligent tester. To check, follow the operation below:
 - Connect the intelligent tester to the DLC3.
 - Start the engine.
 - Turn the tester ON
 - Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DATA LIST / PRIMARY / ENGINE SPD.

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 intelligent tester. 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 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.

1 INSPECT CRANKSHAFT POSITION SENSOR (RESISTANCE)

Component Side:



- (a) Disconnect the C3 crankshaft position (CKP) sensor connector.
- (b) Measure the resistance of the between terminal 1 and 2.
Standard resistance

Tester Connection	Condition	Specified Condition
1 - 2	Cold	1,630 to 2,740 Ω
1 - 2	Hot	2,065 to 3,225 Ω

HINT:

Terms cold and hot refer to the temperature of the coils. "Cold" means approximately -10 to 50°C (14 to 122°F). "Hot" means approximately 50 to 100°C (122 to 212°F).

- (c) Reconnect the CKP sensor connector.

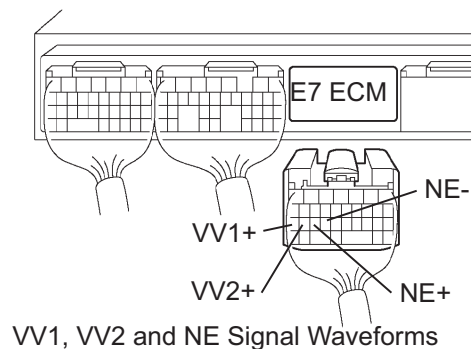
Reference

Inspection using the oscilloscope.

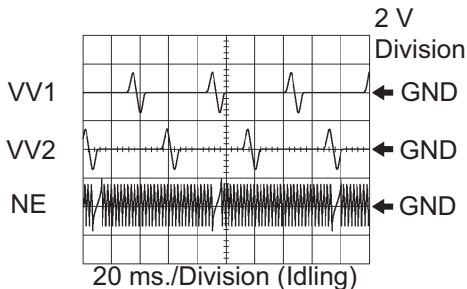
During cranking or idling, check the waveform of the ECM connector.

Standard

Tester Connection	Specified Condition
VV1+ (E7-27) - NE- (E7-24)	Correct waveform is as shown
VV2+ (E7-26) - NE- (E7-24)	Correct waveform is as shown
NE+ (E7-25) - NE- (E7-24)	Correct waveform is as shown



VV1, VV2 and NE Signal Waveforms



NG

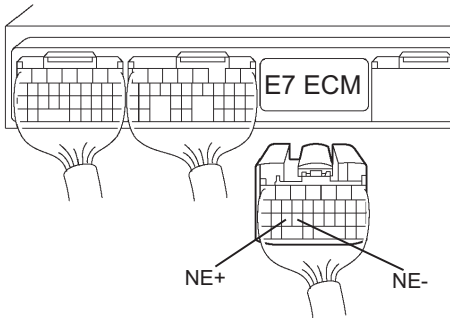
REPLACE CRANKSHAFT POSITION SENSOR

OK

ES

2 CHECK HARNESS AND CONNECTOR (CRANKSHAFT POSITION SENSOR - ECM)**Wire Harness Side:**

C3 Crankshaft Position Sensor



A085533E11

- (a) Disconnect the C3 CKP sensor connector.
- (b) Disconnect the E7 ECM connector.
- (c) Measure the resistance of the wire harness side connectors.

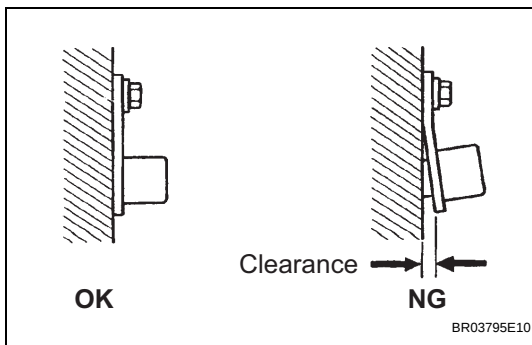
Standard resistance (Check for open)

Tester Connection	Specified Condition
C3-1 - E7-25 (NE+)	Below 1 Ω
C3-2 - E7-24 (NE-)	Below 1 Ω

Standard resistance (Check for short)

Tester Connection	Specified Condition
C3-1 or E7-25 (NE+) - Body ground	10 k Ω or higher
C3-2 or E7-24 (NE-) - Body ground	10 k Ω or higher

- (d) Reconnect the ECM connector.
- (e) Reconnect the CKP sensor connector.

NG**REPAIR OR REPLACE HARNESS OR CONNECTOR****OK****3 CHECK SENSOR INSTALLATION (CRANKSHAFT POSITION SENSOR)**

BR03795E10

- (a) Check the CKP sensor installation.

OK:**Sensor is installed correctly.****NG****TIGHTEN SENSOR****OK****4 CHECK CRANKSHAFT TIMING PULLEY**

- (a) Check the teeth of the sensor plate.

OK:**Sensor plate does not have any crack or deformation.****NG****REPLACE CRANKSHAFT TIMING PULLEY**

OK

REPLACE ECM

ES

DTC	P0340	Camshaft Position Sensor Circuit Malfunction
DTC	P0341	Camshaft Position Sensor "A" Circuit Range / Performance (Bank 1 or Single Sensor)
DTC	P0345	Camshaft Position Sensor "A" Circuit (Bank 2)
DTC	P0346	Camshaft Position Sensor "A" Circuit Range / Performance (Bank 2)

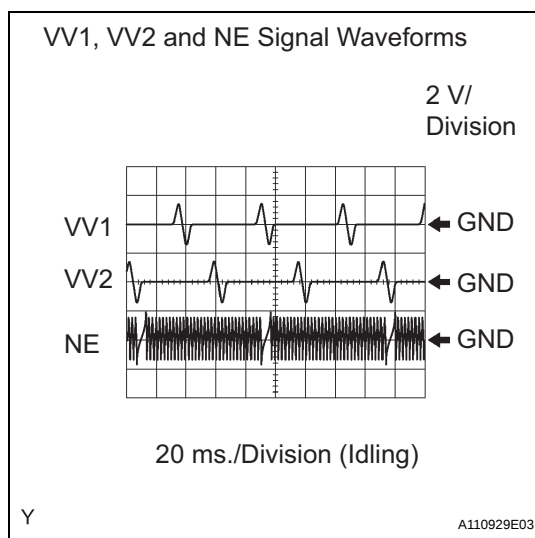
ES DESCRIPTION

The intake camshaft's Variable Valve Timing (VVT) sensor (G signal) consists of a magnet and MRE element.

The VVT camshaft drive gear has a sensor plate with 3 teeth on its outer circumference. When the gear rotates, changes occur in the air gaps between the sensor plate and pickup coil, which affects the magnet. As a result, the resistance of the MRE material fluctuates. The VVT sensor converts the gear 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.

The crankshaft angle sensor plate has 34 teeth. The pickup coil generates 34 signals for each engine revolution. Based on the G signal and actual crankshaft angle, the ECM detects the normal crankshaft angle. Also, based on the NE signal, the ECM detects the engine speed.

DTC No.	DTC Detection Condition	Trouble Area
P0340 P0345	- No VVT sensor signal to ECM during cranking. (1 trip detection logic) - No VVT sensor signal to ECM with engine speed 600 rpm or more (1 trip detection logic)	- Open or short in VVT sensor - VVT sensor - Camshaft timing gear - Jumped tooth of timing belt - ECM
P0341	While crankshaft rotates twice, VVT sensor signal is input to ECM 12 times or more. (1 trip detection logic)	- Open or short in VVT sensor - VVT sensor - Camshaft timing gear - Jumped tooth of timing belt - ECM
P0346	While crankshaft rotates twice, VVT sensor signal is input to ECM 5 times or more. (1 trip detection logic)	- Open or short in VVT sensor - VVT sensor - Camshaft timing gear - Jumped tooth of timing belt - ECM



Reference: Inspection using an oscilloscope

HINT:

- The correct waveform is shown.
- VV1+ and VV2+ stand for the VVT sensor signal, and NE+ stands for the CKP sensor signal.

Item	Content
Terminals	NE+ - NE- VV1+ - NE- VV2+ - NE-
Equipment Settings	5 V/Division, 20 ms./Division
Conditions	Cranking or idling

MONITOR DESCRIPTION

If no signal is transmitted by the VVT sensor despite the engine revolving, or the rotations of the camshaft and the crankshaft are not synchronized, the ECM interprets this as a malfunction of the sensor.

ES

MONITOR STRATEGY

Related DTCs	P0340: CMP Sensor (Bank 1) Range Check P0340: CMP/CKP Misalignment (Bank 1) P0341: CMP Sensor (Bank 1) Malfunction P0345: CMP Sensor (Bank 2) Range Check P0345: CMP/CKP Misalignment (Bank 2) P0346: CMP Sensor (Bank 2) Malfunction
Required Sensors / Components (Main)	CMP (Crankshaft position) sensor
Required Sensors / Components (Related)	CKP sensor
Frequency of operation	Continuous
Duration	5 seconds
MIL Operation	2 driving cycles: CMP Sensor Range Check Immediate: CMP/CKP Misalignment and CMP Malfunction CMP Sensor Malfunction
Sequence operation	None

TYPICAL ENABLING CONDITIONS

All:

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

CMP Sensor Range Check P0340:

Starter	ON
Minimum battery voltage while starter is ON	Less than 11 V

CMP/CKP Misalignment P0340 :

Engine RPM	600 rpm or more
Starter	OFF

VVT Sensor Range Check P0345 (Case 1):

Starter	ON
Minimum battery voltage while starter is ON	Less than 11 V

VVT Sensor Range Check P0345 (Case 2):

Engine RPM	600 rpm or more
Starter	OFF
Battery voltage	8 V or more
Ignition switch	ON

TYPICAL MALFUNCTION THRESHOLDS

CMP Sensor Range Check P0340:

CMP Signal	No signal
------------	-----------

CMP/CKP Misalignment P0340:

Alignment is judged using CMP-CKP input timing CMP sensor signal input in appropriate timing	No signal
--	-----------

CMP Sensor (Bank 1) Malfunction P0341:

CMP and CKP phase	Misaligned
CMP signal per 2 revolutions crankshaft	12 signals or more

VVT Sensor Range Check P0345 (Case 1):

VVT sensor signal	No signal
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VVT Sensor Range Check P0345 (Case 2):

VVT sensor signal	No signal
-------------------	-----------

VVT Sensor (Bank 2) Malfunction P0346:

VVT sensor signal count	12 signals or more
-------------------------	--------------------

COMPONENT OPERATING RANGE

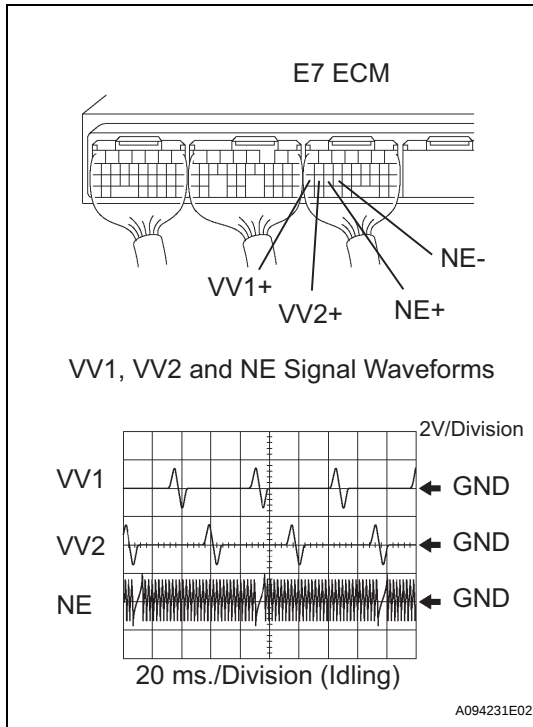
VVT sensor voltage	Camshaft position sensor voltage fluctuates when the crankshaft rotates 3 camshaft position signals per 1 revolution camshaft 3 camshaft position signals per 2 revolutions camshaft
--------------------	--

WIRING DIAGRAM

Refer to DTC P0335 (See page [ES-172](#)).

HINT:

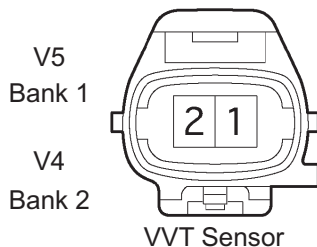
Read freeze frame data using the intelligent tester. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, if the engine was warmed up or not, if the air-fuel ratio was LEAN or RICH, and other data from the time the malfunction occurred.

1 CHECK ECM TERMINAL VOLTAGE (VV1+, VV2+, NE+ AND NE- TERMINALS)

- (a) Inspect the ECM using an oscilloscope.
 (1) While the engine is idling, check the waveform between the terminals of the ECM connector.

Standard

Tester Connection	Specified Condition
E7-27 (VV1+) - E7-24 (NE-)	Correct waveform shown
E7-26 (VV2+) - E7-24 (NE-)	Correct waveform shown
E7-25 (NE+) - E7-24 (NE-)	Correct waveform shown

NG**REPLACE VVT SENSOR****ES****OK****2 CHECK VVT SENSOR (SENSOR RESISTANCE)****Wire Harness Side:**

- (a) Disconnect the V4 or V5 VVT sensor connector.
 (b) Measure the resistance between the terminals of the sensor.

Standard resistance

Tester Connection	Specified Condition
1 - 2	835 to 1,400 Ω at cold
1 - 2	1,060 to 1,645 Ω at hot

- (c) Reconnect the VVT sensor connector.

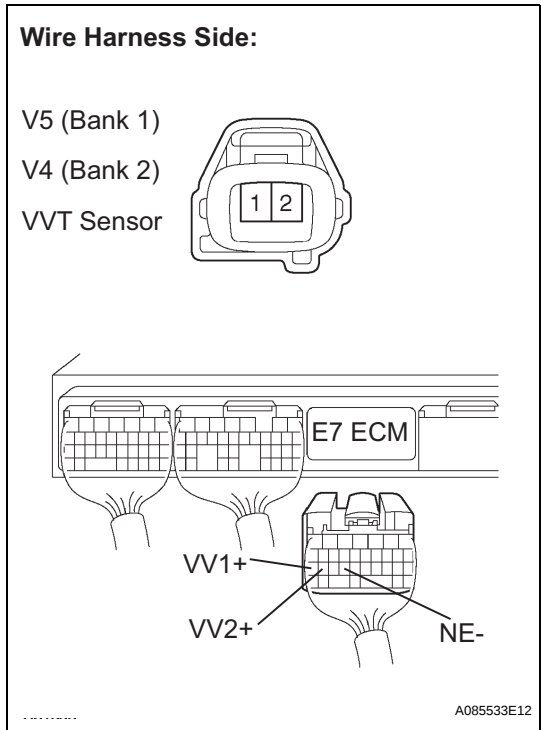
HINT:

In the above section, the terms "cold" and "hot" refer to the temperature of the coils. "Cold" means approximately -10°C to 50°C (14°F to 122°F). "Hot" means approximately 50°C to 100°C (122°F to 212°F).

NG**REPAIR OR REPLACE HARNESS AND CONNECTOR****OK**

3

CHECK HARNESS AND CONNECTOR (VVT SENSOR - ECM)



- (a) Disconnect the V4 or V5 VVT sensor connector.
- (b) Disconnect the E7 ECM connector.
- (c) Measure the resistance between the terminals of the VVT sensor and ECM.

Standard resistance

Tester Connection	Specified Condition
V5-1 - E7-27 (VV1+)	Below 1 Ω
V4-1 - E7-26 (VV2+)	Below 1 Ω
V4 or V5-2 - E7-24 (NE-)	Below 1 Ω
V5-1 or E7-27 (VV1+) - Body ground	10 kΩ or higher
V4 -1 or E7-26 (VV2+) - Body ground	10 kΩ or higher
2 of V4 or V5 or E7-24 (NE-) - Body ground	10 kΩ or higher

- (d) Reconnect the VVT sensor connector.
- (e) Reconnect the ECM connector.

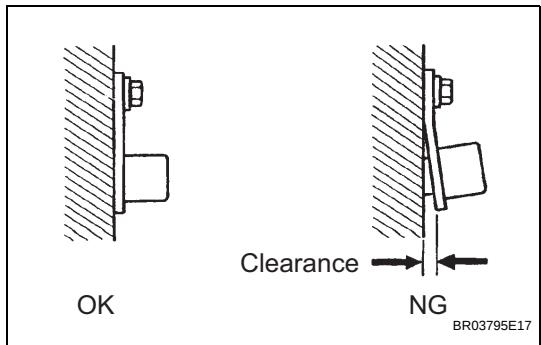
NG

REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

4

CHECK SENSOR INSTALLATION (VVT SENSOR)



- (a) Check the CKP sensor installation.

OK:
Sensor is installed correctly.

NG

TIGHTEN SENSOR

OK

5

CHECK CAMSHAFT TIMING PULLEY

- (a) Check the teeth of the signal plate.

OK:
Sensor plate teeth do not have any cracks or deformation.

NG

REPLACE CAMSHAFT TIMING PULLEY

OK

REPLACE ECM

ES

DTC	P0351	Ignition Coil "A" Primary / Secondary Circuit
DTC	P0352	Ignition Coil "B" Primary / Secondary Circuit
DTC	P0353	Ignition Coil "C" Primary / Secondary Circuit
DTC	P0354	Ignition Coil "D" Primary / Secondary Circuit
DTC	P0355	Ignition Coil "E" Primary / Secondary Circuit
DTC	P0356	Ignition Coil "F" Primary / Secondary Circuit

DESCRIPTION

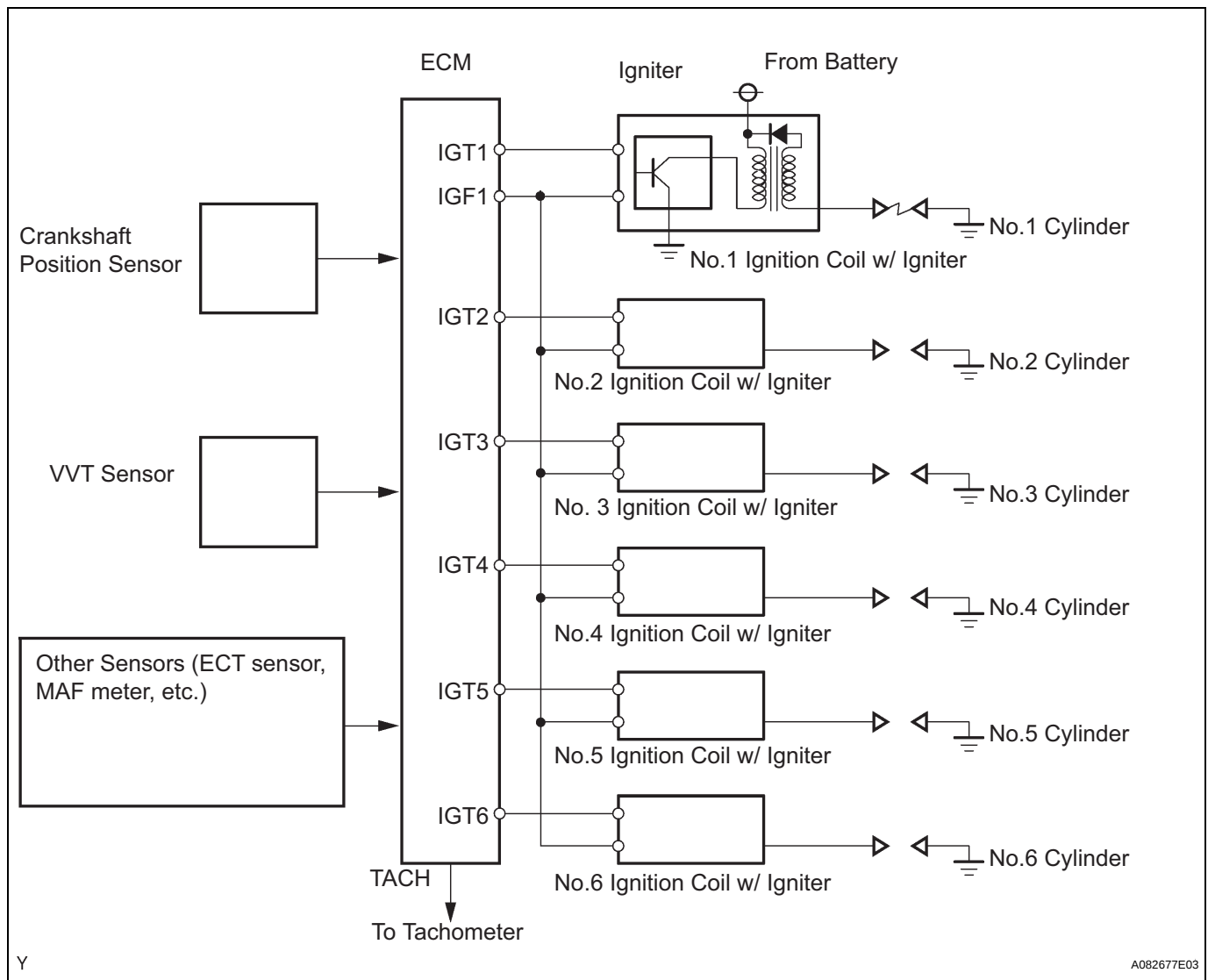
HINT:

- These DTCs indicate malfunctions relating to the primary circuit.
- IF DTC P0351 is set, check No. 1 ignition coil circuit.
- IF DTC P0352 is set, check No. 2 ignition coil circuit.
- IF DTC P0353 is set, check No. 3 ignition coil circuit.
- IF DTC P0354 is set, check No. 4 ignition coil circuit.
- IF DTC P0355 is set, check No. 5 ignition coil circuit.
- IF DTC P0356 is set, check No. 6 ignition coil circuit.

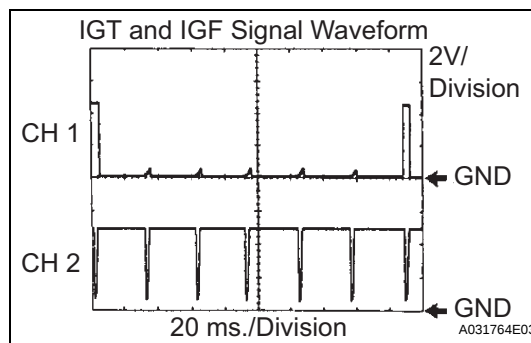
A Direct Ignition System (DIS) is used on this vehicle.

The DIS is a 1-cylinder ignition system in which each cylinder is ignited by one ignition coil and 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 (Included in ECM) determines the ignition timing and transmits the ignition signals (IGT) 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 signal (IGF) to the ECM, for each cylinder ignition.



DTC No.	DTC Detection Condition	Trouble Area
P0351 P0352 P0353 P0354 P0355 P0356	No IGF signal to ECM while engine running (1 trip detection logic)	- Ignition system - Open or short in IGF1 and IGT circuit (1 to 6) between ignition coil and ECM - No. 1 to No. 6 ignition coils - ECM

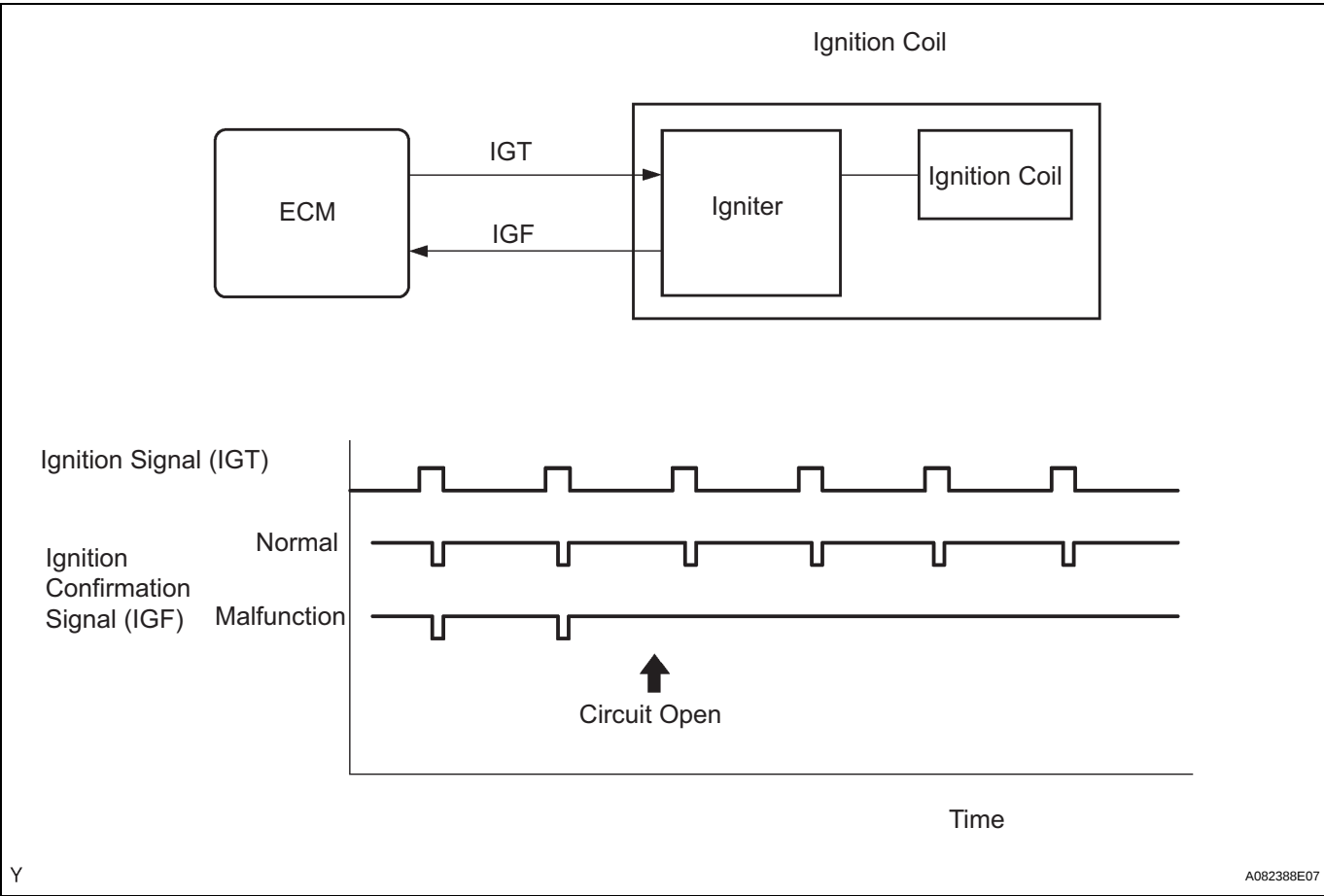


Reference: Inspection using an oscilloscope.

While cranking or idling the engine, check the waveform between terminals IGT (1 to 6) and E1, and IGF1 and E1 of the ECM connector.

Item	Content
Terminals	CH1: IGT1, IGT2, IGT3, IGT4, IGT5, IGT6 - E1 CH2: IGF1 - E1
Equipment Settings	2 V/Division, 20 ms/Division
Conditions	Cranking or idling

MONITOR DESCRIPTION



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

Related DTCs	P0351: Igniter (cylinder 1) malfunction P0352: Igniter (cylinder 2) malfunction P0353: Igniter (cylinder 3) malfunction P0354: Igniter (cylinder 4) malfunction P0355: Igniter (cylinder 5) malfunction P0356: Igniter (cylinder 6) malfunction
Required Sensors/Components (Main)	Igniter (Cylinder 1 to 6)
Frequency of Operation	Continuous
Duration	0.256 seconds and 4 sparks
MIL Operation	Immediate
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

The monitor will runs whenever these DTCs are not present	None
Either of the following condition is met	Condition 1 or 2
1. Starter	OFF
2. Engine RPM	1,500 rpm or less
Either of the following condition is met	Condition (a) or (b)
(a) All of the following conditions are met	-
Engine RPM	500 rpm or less
Battery voltage	6 V or more
(b) All of the following conditions are met	-
Engine RPM	More than 500 rpm
Battery voltage	10 V or more
Number of sparks after CPU is reset	5 sparks or more

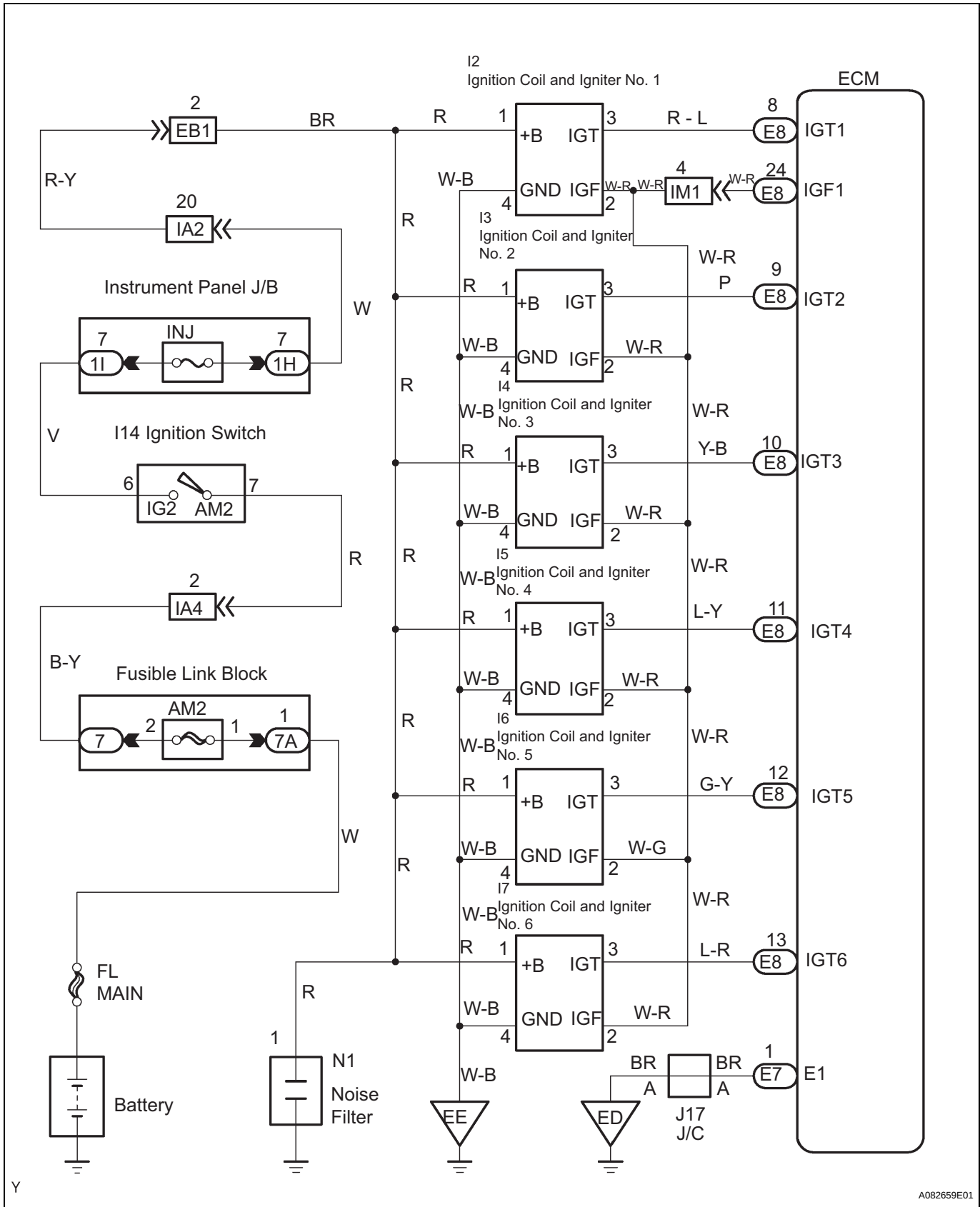
ES**TYPICAL MALFUNCTION THRESHOLDS**

Ignition signal fail count	More than 2 times
Ignition signal fail count is on the right:	When IGF does not return despite sending IGT

COMPONENT OPERATING RANGE

IGF signal	Igniter transmits IGF signal when it receives IGT signal from ECM
------------	---

WIRING DIAGRAM



HINT:

- Read freeze frame data using the intelligent tester. 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 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.

1 PERFORM SIMULATION TEST

- Clear the DTC(s) (See page ES-28).
- Change the arrangement of the ignition coils (with igniters).

NOTICE:

Do not change the location of the connectors.

- Reform a simulation test.

Result

Display (DTC Output)	Proceed to
Same DTCs (that have been erased)	A
Other DTCs	B

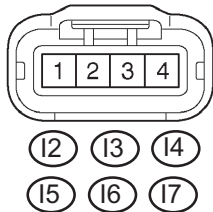
B

REPLACE IGNITION COIL ASSEMBLY

A

2 INSPECT IGNITION COIL ASSEMBLY (POWER SOURCE)**Wire Harness Side:**

Ignition Coil Connector



Y

A054393E51

- Disconnect the I2, I3, I4, I5, I6 or I7 ignition coil connector.
- Turn the ignition switch ON.
- Measure the voltage between the terminal of the wire harness side connector and body ground.

Standard voltage

Tester Connection	Specified Condition
I2-1 (+B) - Body ground	9 to 14 V
I3-1 (+B) - Body ground	9 to 14 V
I4-1 (+B) - Body ground	9 to 14 V
I5-1 (+B) - Body ground	9 to 14 V
I6-1 (+B) - Body ground	9 to 14 V
I7-1 (+B) - Body ground	9 to 14 V

- Measure the resistance between the wire harness side connectors.

Standard resistance

Tester Connection	Specified Condition
I2-4 (GND) - Body ground	Below 1 Ω
I3-4 (GND) - Body ground	Below 1 Ω
I4-4 (GND) - Body ground	Below 1 Ω
I5-4 (GND) - Body ground	Below 1 Ω
I6-4 (GND) - Body ground	Below 1 Ω
I7-4 (GND) - Body ground	Below 1 Ω

NG

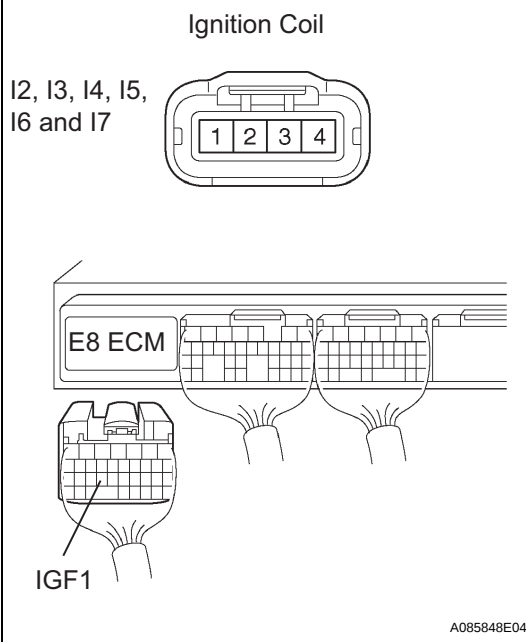
REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

3

CHECK HARNESS AND CONNECTOR (IGNITION COIL ASSEMBLY - ECM)

Wire Harness Side:



- Disconnect the I2, I3, I4, I5, I6 or I7 ignition coil connector.
- Disconnect the ECM E8connectors.
- Measure the resistance between the wire harness side connectors.

Standard resistance (Check for open)

Tester Connection	Specified Condition
I2-2 (IGF) - E8-24 (IGF1)	Below 1 Ω
I3-2 (IGF) - E8-24 (IGF1)	Below 1 Ω
I4-2 (IGF) - E8-24 (IGF1)	Below 1 Ω
I5-2 (IGF) - E8-24 (IGF1)	Below 1 Ω
I6-2 (IGF) - E8-24 (IGF1)	Below 1 Ω
I7-2 (IGF) - E8-24 (IGF1)	Below 1 Ω

Standard resistance (Check for short)

Tester Connection	Specified Condition
I2-2 (IGF) - E8-24 (IGF1) - Body ground	10 k Ω or higher
I3-2 (IGF) - E8-24 (IGF1) - Body ground	10 k Ω or higher
I4-2 (IGF) - E8-24 (IGF1) - Body ground	10 k Ω or higher
I5-2 (IGF) - E8-24 (IGF1) - Body ground	10 k Ω or higher
I6-2 (IGF) - E8-24 (IGF1) - Body ground	10 k Ω or higher
I7-2 (IGF) - E8-24 (IGF1) - Body ground	10 k Ω or higher

Standard resistance (Check for open)

Tester Connection	Specified Condition
I2-3 (IGT) - E8-8 (IGT1)	Below 1 Ω
I3-3 (IGT) - E8-9 (IGT2)	Below 1 Ω
I4-3 (IGT) - E8-10 (IGT3)	Below 1 Ω
I5-3 (IGT) - E8-11 (IGT4)	Below 1 Ω
I6-3 (IGT) - E8-12 (IGT5)	Below 1 Ω
I7-3 (IGT) - E8-13 (IGT6)	Below 1 Ω

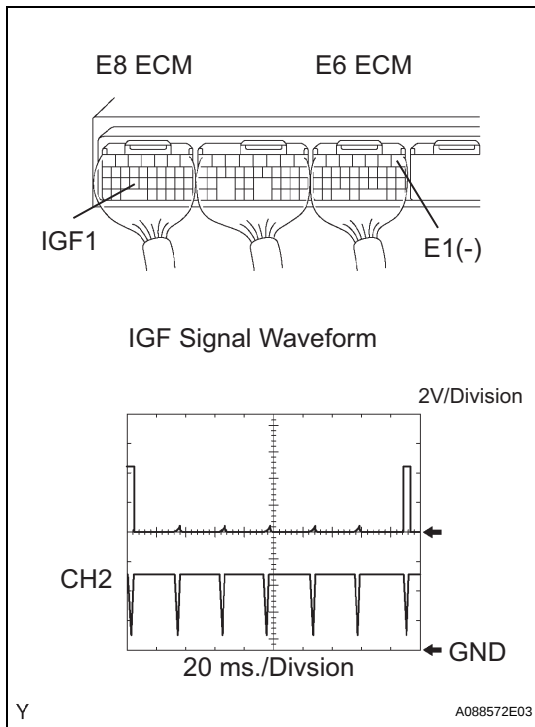
Standard resistance (Check for short)

Tester Connection	Specified Condition
I2-3 (IGT) - E8-8 (IGT1) - Body ground	10 k Ω or higher
I3-3 (IGT) - E8-9 (IGT2) - Body ground	10 k Ω or higher
I4-3 (IGT) - E8-10 (IGT3) - Body ground	10 k Ω or higher
I5-3 (IGT) - E8-11 (IGT4) - Body ground	10 k Ω or higher
I6-3 (IGT) - E8-12 (IGT5) - Body ground	10 k Ω or higher
I7-3 (IGT) - E8-13 (IGT6) - Body ground	10 k Ω or higher

NG

REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

4 CHECK ECM (IGT1, IGT2, IGT3, IGT4, IGT5, IGT6, IGF1 SIGNAL)

- Inspect using an oscilloscope.
- Start the engine.
- Check the waveform of the ECM connectors.

Standard

Tester Connection	Specified Condition
E8-24 (IGF1) - E6-1 (E1) E8-8 (IGT1) - E6-1 (E1) E8-9 (IGT2) - E6-1 (E1) E8-10 (IGT3) - E6-1 (E1) E8-11 (IGT4) - E6-1 (E1) E8-12 (IGT5) - E6-1 (E1) E8-13 (IGT6) - E6-1 (E1)	Correct waveform is shown

NG

REPLACE ECM

ES

OK

5 CHECK IF DTC OUTPUT RECURS

- Clear the DTC (See page [ES-28](#)).
- Connect the intelligent tester to the DLC3.
- Turn the ignition switch ON and turn the intelligent tester ON.
- Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DTC INFO / CURRENT CODES.
- Read DTC.

Result

Display (DTC Output)	Proceed to
P0351, P0352, P0353, P0354, P0355 and/or P0356 are output	A
No output	B

B

SYSTEM OK

A

REPLACE ECM

DTC	P0420	Catalyst System Efficiency Below Threshold (Bank 1)
DTC	P0430	Catalyst System Efficiency Below Threshold (Bank 2)

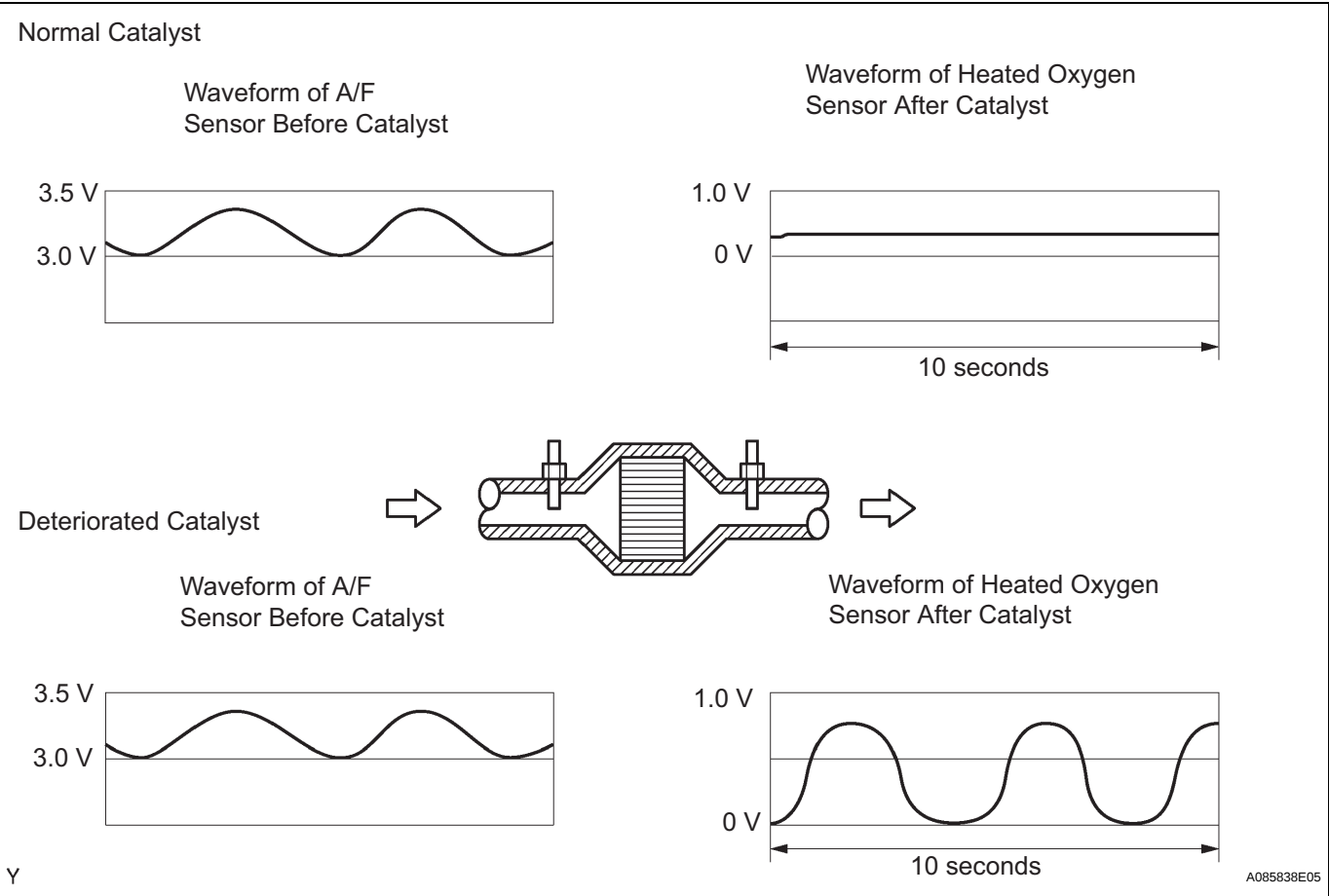
MONITOR DESCRIPTION

The ECM uses the two sensors, mounted in front of and behind the Three-way Catalytic Converter (TWC), to monitor its efficiency.

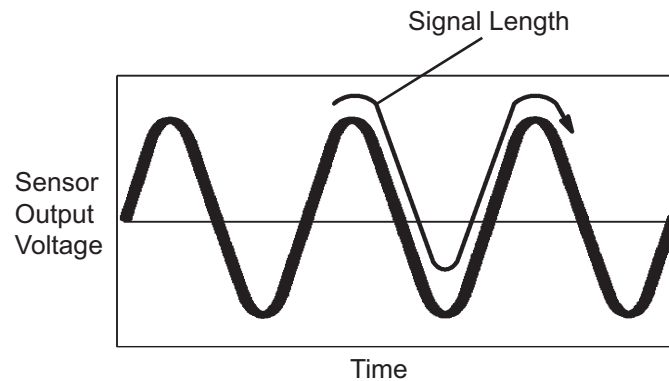
The first sensor, the Air-Fuel Ratio (A/F) sensor (sensor 1), sends pre-catalyst information to the ECM.

The second sensor, the Heated Oxygen (HO2) sensor (sensor 2), sends post-catalyst information to the ECM. The ECM compares the information transmitted by these two sensors to determine the efficiency of the TWC performance and its ability to store oxygen.

When the TWC is functioning properly, the variation in the oxygen concentration in the exhaust gas, after it has passed through the TWC, is small. As a result, the voltage output of sensor 2 slowly alternates between the rich and lean signal voltages (shown in the illustration below). As the TWC performance efficiency deteriorates, its oxygen storage capacity decreases, and the variation in the oxygen concentration in the exhaust gas increases. As a result, the sensor voltage output fluctuates frequently. While the catalyst monitor is running, the ECM measures the signal length of both sensors 1 and 2, and calculate the ratio of the signal lengths to determine the extent of the TWC deterioration. If the deterioration level exceeds the preset threshold, the ECM interprets this as the TWC malfunction. The ECM then illuminates the MIL and sets the DTC.



Heated Oxygen Sensor Signal Length



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ES

DTC No.	DTC Detection Condition	Trouble Area
P0420	After engine and TWC warmed up, and while vehicle driven within set vehicle and engine speeds, waveform of Heated Oxygen (HO2) sensor (bank 1 sensor 2) alternates frequently between rich and lean (2 trip detection logic)	- Gas leakage from exhaust system - A/F sensor (bank 1 sensor 1) - HO2 sensor (bank 1 sensor 2) - Three-Way Catalytic Converter (TWC) (Exhaust manifold)
P0430	After engine and catalyst are warmed up, and while vehicle is driven within set vehicle and engine speed ranges: Waveform of heated oxygen sensor (bank 2 sensor 2) alternates frequently between rich and lean (2 trip detection logic)	- Gas leakage from exhaust system - A/F sensor (bank 2 sensor 1) - HO2 sensor (bank 2 sensor 2) - Three-Way Catalytic Converter (TWC) (Exhaust manifold)

HINT:

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

MONITOR STRATEGY

Related DTCs	P0420: Catalyst (Bank 1) detection P0430: Catalyst (Bank 2) detection
Required Sensors/Components (Main)	TWC
Required Sensors/Components (Related)	A/F sensor, heated oxygen sensor, intake air temperature sensor, mass air flow meter, crankshaft position sensor and engine coolant temperature sensor
Frequency of Operation	Once per driving cycle
Duration	150 seconds or more
MIL Operation	2 driving cycles
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

Monitor will run whenever this DTC is not present	P0011, P0012, P0021, P0022 (VVT system-Advance, Retard), P0031, P0032, P0051, P0052 (O2 sensor heater sensor 1), P0037, P0038, P0057, P0058 (O2 sensor heater sensor 2), P0100, P0101, P0102, P0103 (MAF sensor), P0115, P0116, P0117, P0118 (ECT sensor), P0120, P0123, P0220, P0222, P0223, P2135, (TP sensor), P0125 (Insufficient ECT for closed loop), P0136, P0137, P0138, (O2 sensor 1), P0134, P0154 (O2 sensor, A/F sensor (No activity) sensor 1), P0136, P0156 (O2 sensor 2), P0171, P0172, P0174, P0175 (Fuel system), P0300, P0301, P0302, P0303, P0305, P0306, P0308, (Misfire), P0335 (CKP sensor), P0340, P0341 (CMP sensor), P0351, P0352, P0353, P0354, P0355, P0356, P0358 (Igniter), P0385 (CKP sensor 2), P0500 (VSS), P2196, P2198 (A/F sensor (Rationality)), P2A00, P2A03 (A/F sensor (Slow response))
Accumulated time that all of the following conditions are met	30 seconds or more
Battery voltage	11 V or more
Intake air temperature	-10°C (14°F) or more
Idle status	OFF
Mass air flow rate	6 to 45 g/sec.
Engine RPM	Less than 3,000 rpm
Engine coolant temperature sensor	75°C (167°F) or more
Fuel system status	Closed loop
Rich experience after fuel cut	Yes
A/F sensor	Activated
Rear HO2S	Activated
Estimated catalyst temperature	Both of following conditions 1 and 2 met
1. Upstream catalyst temperature	500 to 800°C (932 to 1472°F) or more
2. Downstream catalyst temperature	500 to 800°C (932 to 1472°F) or more

TYPICAL MALFUNCTION THRESHOLDS

Rear HO2S locus length	15 V or more (varies with A/F sensor locus length)
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MONITOR RESULT

Refer to CHECKING MONITOR STATUS (See page [ES-14](#)).

The monitor result (mode 6) allows the OBD scan tool to display the monitor status, test value and test limit. A problem in this component can be found by comparing the test value and test limit. The procedure is described in "CHECKING MONITOR STATUS".

- TID (Test Identification Data) is assigned to each emission-related component.
- TLT (Test Limit Type):
If TLT is 0, the component is malfunctioning when the test value is higher than the test limit.
If TLT is 1, the component is malfunctioning when the test value is lower than the test limit.
- CID (Component Identification) is assigned to each test value.
- Unit Conversation is used to calculate the test value indicated on generic OBD scan tools.

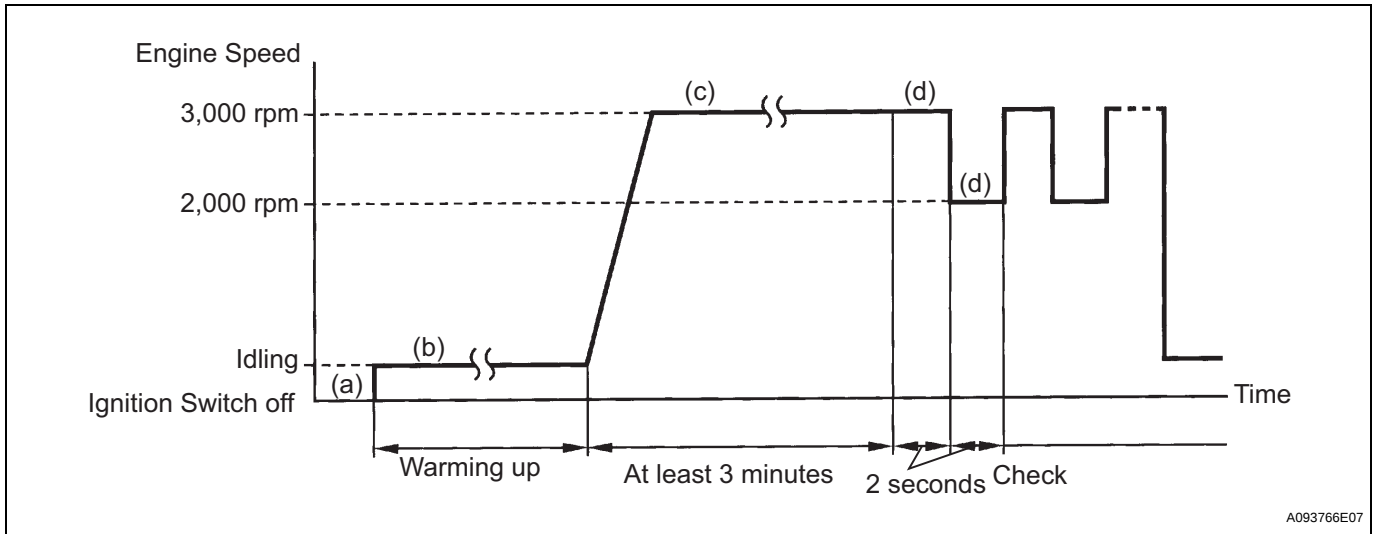
TID \$01: Catalyst - Using A/F Sensor and HO2S

TLT	CID	Unit Conversion	Description of Test Value	Description of Test Limit
0	\$01	Multiply by 0.0078 (no dimension)	Catalyst deterioration level (bank 1): Determined by waveform of A/F sensor and HO2S	Malfunction criterion for catalyst deterioration
0	\$02	Multiply by 0.0078 (no dimension)	Catalyst deterioration level (bank 1): Determined by waveform of A/F sensor and HO2S	Malfunction criterion for catalyst deterioration

CONDITIONING FOR SENSOR TESTING

HINT:

Perform the operation with the engine speeds and time durations described below prior to checking the waveforms of the A/F and HO2 sensors. This is in order to activate the sensors sufficiently to obtain the appropriate inspection results.



1. Connect the intelligent tester to the DLC3 (a).
2. Start the engine and warm it up with all the accessories switched OFF, until the engine coolant temperature stabilizes (b).
3. Run the engine at engine speed of between 2,500 rpm and 3,000 rpm for at least 3 minutes (c).
4. While running the engine at 3,000 rpm for 2 seconds and 2,000 rpm for 2 seconds, check the waveforms of the A/F and HO2 sensors using the tester or scan tool (d).

NOTICE:

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.

Case	A/F Sensor (Sensor 1) Output Voltage		HO2 Sensor (Sensor 2) Output Voltage		Main Suspected Trouble Area
1	Injection Volume +25 % -12.5 %		Injection Volume +25 % -12.5 %		-
	Output Voltage More than 3.35 V Less than 3.0 V		Output Voltage More than 0.55 V Less than 0.4 V		
2	Injection Volume +25 % -12.5 %		Injection Volume +25 % -12.5 %		• A/F sensor • A/F sensor heater • A/F sensor circuit
	Output Voltage Almost no reaction		Output Voltage More than 0.55 V Less than 0.4 V		
3	Injection Volume +25 % -12.5 %		Injection Volume +25 % -12.5 %		• HO2 sensor • HO2 sensor heater • HO2 sensor circuit
	Output Voltage More than 3.35 V Less than 3.0 V		Output Voltage Almost no reaction		

Case	A/F Sensor (Sensor 1) Output Voltage		HO2 Sensor (Sensor 2) Output Voltage		Main Suspected Trouble Area
4	Injection volume +25 % -12.5 %		Injection Volume +25 % -12.5 %		- Injector - Fuel pressure - Gas leakage from exhaust system (Air-fuel ratio extremely lean or rich)
	Output Voltage Almost no reaction	—————NG	Output Voltage Almost no reaction	—————NG	

- Following the A/F CONTROL procedure enables technicians to check and graph the output voltages of both the A/F and HO2 sensors.
- To display the graph, enter the following menus on the tester: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / A/F CONTROL / USER DATA / AFS B1S1 and O2S B1S2 or AFS B2S1 and O2S B2S2, and press the YES button and then the ENTER button followed by the F4 button.

ES

HINT:

Read freeze frame data using the intelligent tester. 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 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.

1	CHECK OTHER DTCS OUTPUT (IN ADDITION TO DTC P0420 AND/OR P0430)
----------	--

- Connect the intelligent tester to the DLC3.
- Turn the ignition switch ON and turn the tester ON.
- Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DTC INFO / CURRENT CODES.
- Read DTCs.

Result

Display (DTC output)	Proceed to
P0420 and/or P0430	A
P0420 and/or P0430 and other DTCs	B

HINT:

If any DTCs other than P0420 or P0430 are output, troubleshoot those DTCs first.

B

GO TO DTC CHART

A

2	PERFORM ACTIVE TEST BY INTELLIGENT TESTER (A/F CONTROL)
----------	--

- Connect the intelligent tester to the DLC3.
- Start the engine and turn the tester ON.
- Warm up the engine at engine speed of 2,500 rpm for approximately 90 seconds.
- On the tester, enter the following menus: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / A/F CONTROL.
- Perform the A/F CONTROL operation with the engine in an idling condition (press the RIGHT or LEFT button to change the fuel injection volume.).

6. Monitor the output voltages of the A/F and HO2 sensors (AFS B1S1 and O2S B1S2 or AFS B2S1 and O2S B2S2) displayed on the tester.

HINT:

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

Standard

Tester Display (Sensor)	Injection Volume	Status	Voltage
AFS B1S1 or AFS B2S1 (A/F)	+25 %	Rich	Less than 3.0
AFS B1S1 or AFS B2S1 (A/F)	-12.5 %	Lean	More than 3.35
O2S B1S2 or O2S B2S2 (HO2)	+25 %	Rich	More than 0.55
O2S B1S2 or O2S B2S2 (HO2)	-12.5 %	Lean	Less than 0.4

Result

Status AFS B1S1 or AFS B2S1	Status O2S B1S2 or O2S B2S2	A/F Condition and A/F and HO2 Sensor Conditions	Misfire	Main Suspected Trouble Areas	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	May occur	• A/F sensor	B
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	C
Lean	Lean	Actual air-fuel ratio lean	May occur	• Extremely rich or lean actual air-fuel ratio • Gas leakage from exhaust system	A
Rich	Rich	Actual air-fuel ratio lean	-	• Extremely rich or lean actual air-fuel ratio • Gas leakage from exhaust system	A

Lean: During A/F CONTROL, 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 A/F CONTROL, the AFS is consistently less than 3.0 V, and the O2S is consistently more than 0.55 V.
Lean/Rich: During A/F CONTROL of the ACTIVE TEST, the output voltage of the HO2 sensor alternates correctly.

B

CHECK AND REPLACE AIR FUEL RATIO SENSOR

C

CHECK AND REPLACE HEATED OXYGEN SENSOR, AND CHECK AND REPAIR EXHAUST GAS LEAKAGE

A

ES

3

CHECK FOR EXHAUST GAS LEAKAGE

OK:
No gas leakage.

NG

REPAIR OR REPLACE EXHAUST GAS LEAKAGE POINT

OK

REPLACE THREE-WAY CATALYTIC CONVERTER (EXHAUST MANIFOLD LH OR RH)

DTC	P0441	Evaporative Emission Control System Incorrect Purge Flow
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DESCRIPTION

The circuit description can be found in the EVAP System (See page [ES-309](#)).

Refer to the EVAP System (See page [ES-313](#)).

MONITOR DESCRIPTION

The ECM tests the Evaporative Emissions (EVAP) system using the fuel tank pressure sensor, Canister Close Valve (CCV), and EVAP VSV. The ECM closes the EVAP system and creates negative pressure (vacuum) into it. The ECM then monitors the internal pressure using the fuel tank pressure sensor (refer to the Leak Check graphic).

P0441

The EVAP VSV has the following features:

1. Purges the evaporative emissions from the fuel tank to the intake manifold.
2. Works with the CCV to create negative pressure (vacuum) inside the fuel tank and performs leak tests.

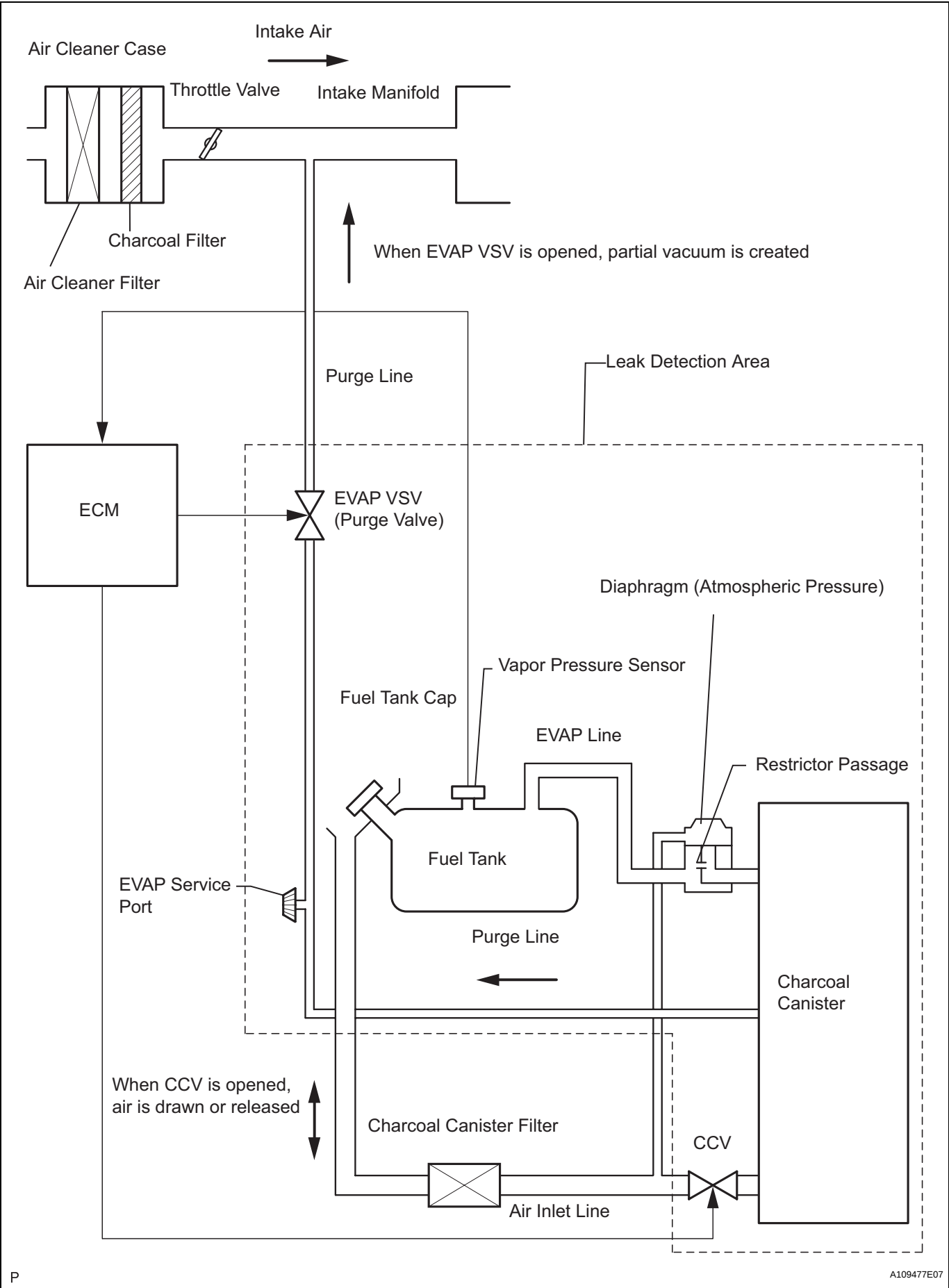
When the EVAP VSV remains open or closed, the ECM sets DTC P0441.

The ECM checks if the EVAP VSV is "stuck closed". The ECM commands the EVAP VSV to open while the CCV is closed. Under these circumstances, a high negative pressure (vacuum) should develop in the fuel tank. If no negative pressure develops, the ECM determines that the EVAP VSV remains closed despite the open command. The ECM will turn on the MIL and set a DTC.

The ECM also checks if the EVAP VSV is "stuck open". The ECM commands the EVAP VSV to close while the CCV is closed and the pressure in the fuel tank is the same as ambient pressure. Under these circumstances, the pressure in the fuel tank should remain at ambient pressure. If negative pressure develops in the fuel tank, the ECM determines that the EVAP VSV remains open despite the close command. The ECM will turn on the MIL and set a DTC.

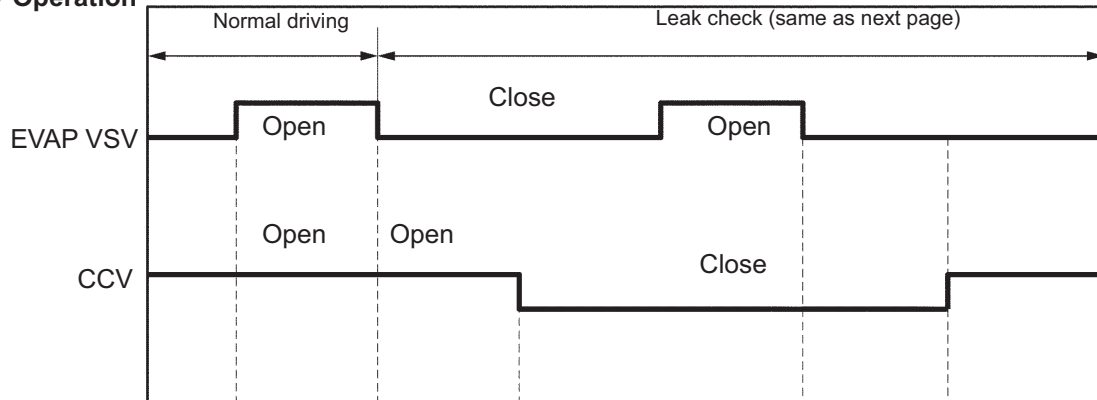
DTC No.	DTC Detection Condition	Trouble Area
P0441	• Pressure in charcoal canister and fuel tank does not drop during purge control (2 trip detection logic) • During purge cut-off, negative pressure enters charcoal canister and fuel tank (2 trip detection logic)	• Vacuum hose has cracks, holes, or is blocked, damaged or disconnected • Fuel tank cap is incorrectly installed • Fuel tank cap has cracks or is damaged • Open or short in vapor pressure sensor circuit • Vapor pressure sensor • Open or short in EVAP VSV circuit • EVAP VSV • Open or short in CCV circuit • CCV • Fuel tank has cracks, holes, or is damaged • Charcoal canister has cracks, holes, or is damaged • Fuel tank over fill check valve has cracks, or is damaged • ECM

ES

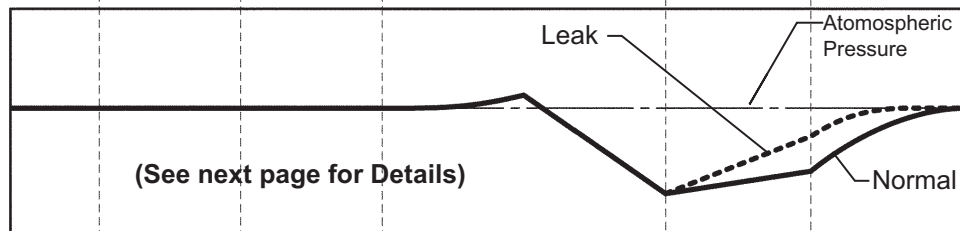


VSV Malfunction Condition and Leak Check

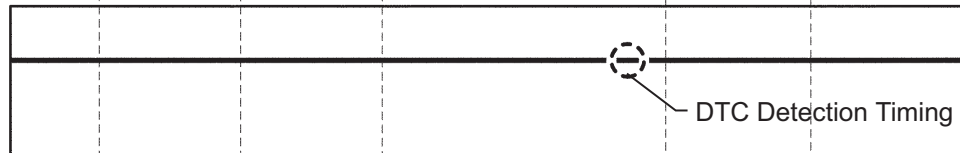
EVAP VSV is Open: ON
CCV is Open: OFF

VSV Operation**Pressure in Fuel Tank**

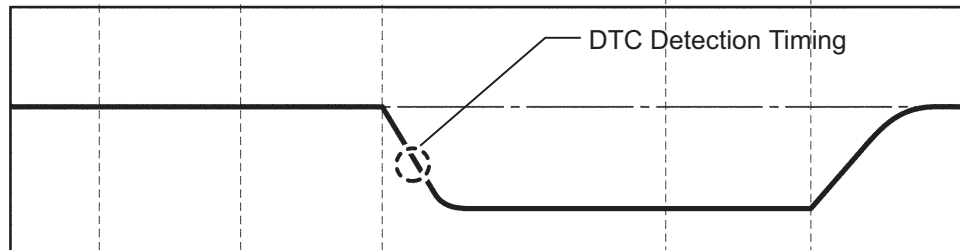
Normal Condition or
EVAP System Leak
(Normal System Line)



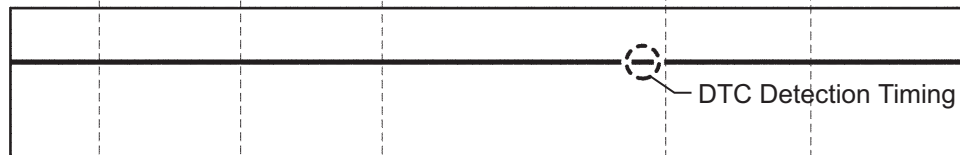
EVAP VSV Close
Malfunction (P0441)



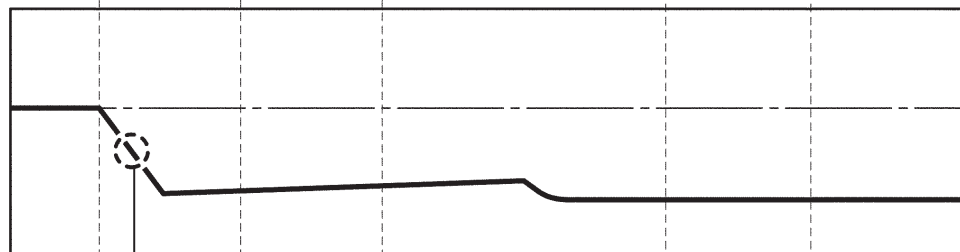
EVAP VSV Open
Malfunction (P0441)



CCV Open
Malfunction (P0446)



CCV Close
Malfunction (P0446)



DTC Detection Timing

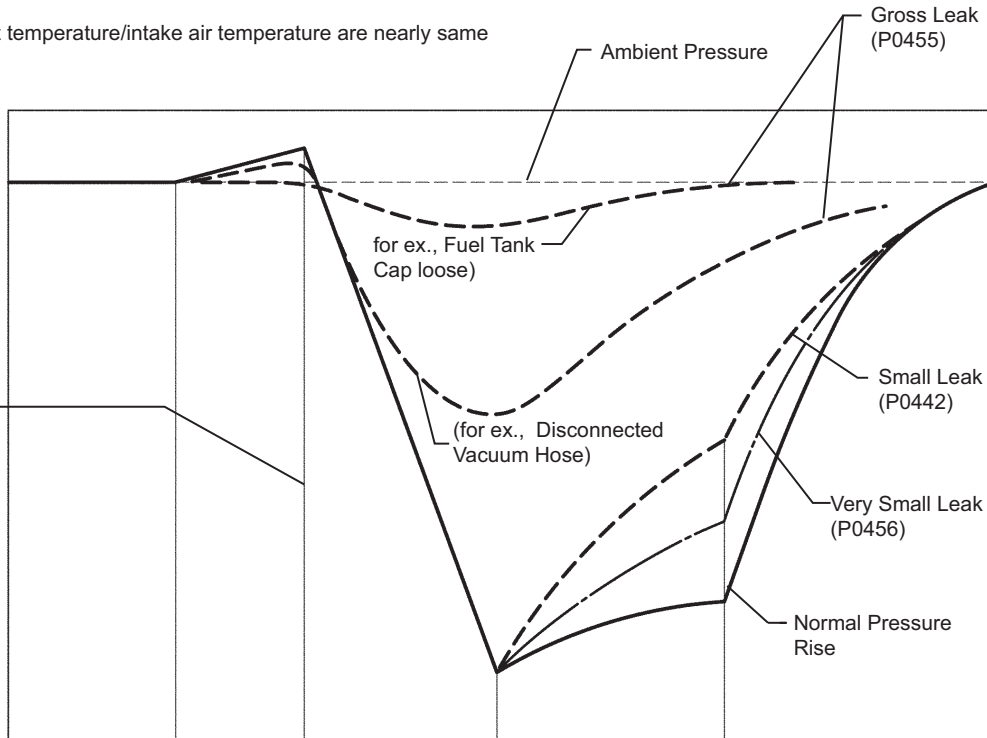
Leak check

Initial Condition:

- Cold Start
- Engine coolant temperature/intake air temperature are nearly same

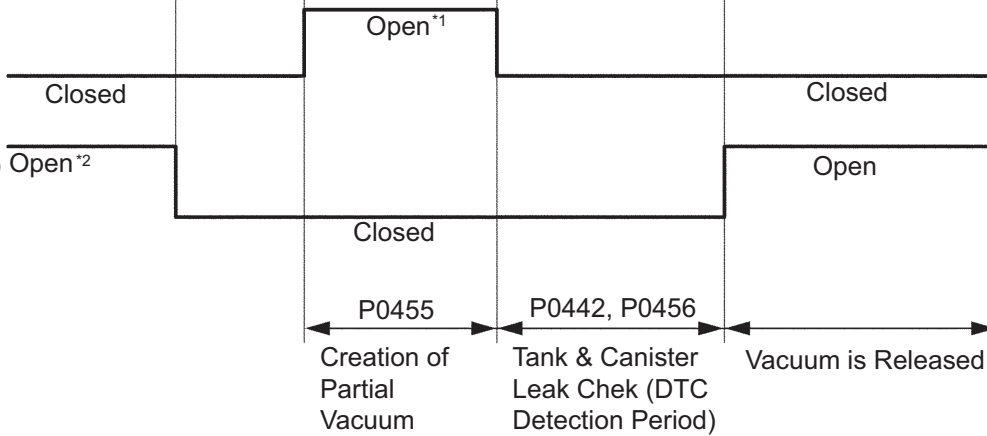
FTP: Pressure in Fuel Tank (Vapor Pressure)

Start of Creation of Negative Pressure



EVAP VSV (Operation)

CCV (Operation)



*1: EVAP VSV is Open: ON

*2: CCV is Open : OFF

MONITOR STRATEGY

Related DTCs	P0441: Purge VSV stuck open P0441: purge VSV stuck close
Required sensors / components (Main)	CCV, EVAP canister, EVAP hose, Fuel cap, Fuel tank and Purge VSV
Required sensors / components (Related)	ECT sensor, FTP sensor, IAT sensor, MAF meter, Vehicle speed sensor
Frequency of operation	Once per driving cycle
Duration	Within 60 seconds
MIL operation	2 driving cycles
Sequence operation	None

TYPICAL ENABLING CONDITIONS

The monitor will run whenever these DTCs are not present	P0011, P0012, P0021, P0022 (VVT system-Advance, Retard), P0100, P0101, P0102, P0103 (MAF sensor), P0110, P0112, P0113 (IAT sensor), P0115, P0116, P0117, P0118 (ECT sensor), P0120, P0122, P0123, P0220, P0222, P0223, P2135,(TP sensor), P0125 (Insufficient ECT for closed loop), P0171, P0172, P0174, P0175 (Fuel system), P0300, P0301, P0302, P0303, P0304, P0305, P0306 (Misfire), P0335 (CKP sensor), P0340, P0341 (CMP sensor), P0351, P0352, P0353, P0354, P0355, P0356, (Igniter), P0500 (VSS), P0510 (Idle switch)
Battery voltage	11 V or more
Altitude	Less than 7,870 ft. (2,400 m)
EVAP pressure sensor malfunction	Not detected
IAT at engine start - ECT at engine start	-7 to 11.1°C (-12.6 to 20°F)
EVAP VSV and CCV	Not operated by scan tool
EVAP purge duty cycle	6 % or more (vary with MAF)
Refuel	No refuel during EVAP monitor
EVAP pressure	-12.75 mmHg (-1.7 kPa) or more
ECT at engine start	4.4 to 35°C (39.9 to 95°F)
IAT at engine start	4.4 to 35°C (39.9 to 95°F)
IAT	4.4°C (39.9°F) or more
Vehicle speed change	Steady speed
Time after engine start	Within 50 minutes
EVAP pressure change	Minimum change (driving on fairly smooth road)
Fuel level	Less than 90 %

TYPICAL MALFUNCTION THRESHOLDS

Purge VSV stuck close P0441:

FTP change during vacuum introduction	Less than 5.25 mmHg (0.7 kPa)
---------------------------------------	-------------------------------

Purge VSV stuck open P0441:

Duration that the following condition is met:	4 seconds or more
EVAP pressure before vacuum introduction	Less than -10 mmHg (-1.333 kPa)

MONITOR RESULT

Refer to "CHECKING MONITOR STATUS" for detailed information (See page [ES-14](#)).

The test value and test limit information are described as shown in the following table. Check the monitor result and test values after performing the monitor drive pattern (See page [ES-16](#)).

- TID (Test Identification Data) is assigned to each emissions-related component.
- TLT (Test Limit Type):
 - If TLT is 0, the component is malfunctioning when the test value is higher than the test limit.
 - If TLT is 1, the component is malfunctioning when the test value is lower than the test limit.

- CID (Component Identification Data) is assigned to each test value.
- Unit Conversion is used to calculate the test value indicated on generic OBD II scan tools.

TID \$02: EVAP system - LEV II Vacuum monitor

TLT	CID	Unit Conversion	Description of Test Data	Description of Test Limit
1	\$01	Multiply by 0.183 (mmHg)	Test value of EVAP VSV stuck close: Determined by fuel tank pressure change during vacuum introduction	Malfunction criteria for EVAP VSV stuck closed
0	\$02	Multiply by 0.0655 (seconds)	Test value of EVAP VSV stuck open: Determined by duration that fuel tank pressure is higher than criteria	Malfunction criteria for EVAP VSV stuck open
0	\$03	Multiply by 0.0655 (seconds)	Test value of canister closed valve (CCV): Determined by duration that fuel tank pressure is lower than criteria	Malfunction criteria for Canister Closed Valve (CCV)
0	\$04	Multiply by 0.0458 (mmHg)	Test value 0.04 inch leak: Determined by fuel tank pressure change	Malfunction criteria for 0.04 inch leak
0	\$05	Multiply by 0.0458 (mmHg)	Test value 0.02 inch leak: Determined by fuel tank pressure change	Malfunction criteria for 0.02 inch leak

DTC	P0442	Evaporative Emission Control System Leak Detected (Small Leak)
DTC	P0455	Evaporative Emission Control System Leak Detected (Gross Leak)
DTC	P0456	Evaporative Emission Control System Leak Detected (Very Small Leak)

DESCRIPTION

The circuit description can be found in the EVAP System (See page [ES-309](#)).

ES

Refer to the EVAP System (See page [ES-313](#)).

MONITOR DESCRIPTION

The ECM tests the Evaporative Emissions (EVAP) system using the fuel tank pressure sensor, Canister Close Valve (CCV), and EVAP VSV. The ECM closes the EVAP system and creates negative pressure (vacuum) into it. The ECM then monitors the internal pressure using the fuel tank pressure sensor (refer to the Leak Check graphic).

P0442, P0455 and P0456

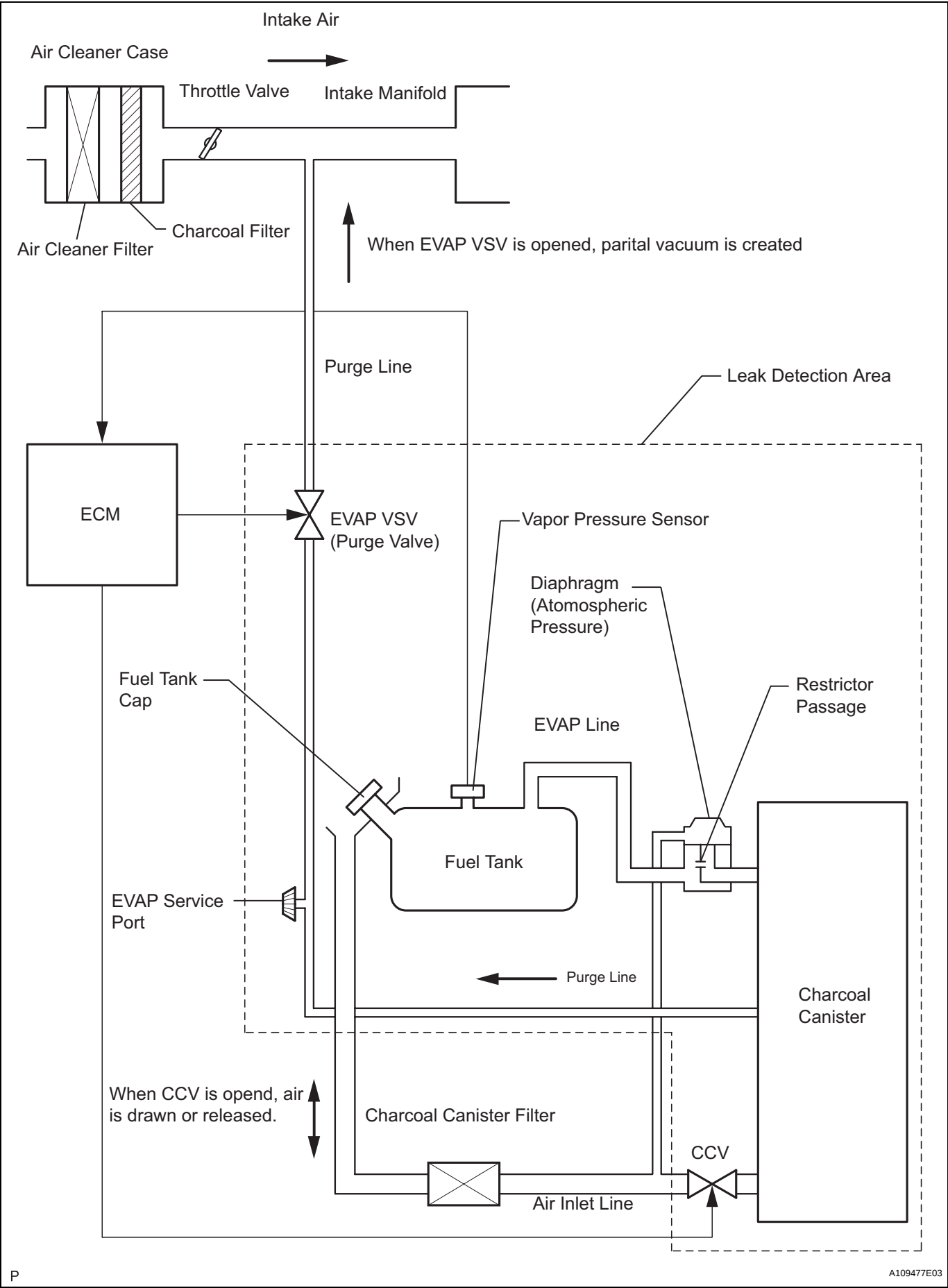
When there is a leak in the evaporative emission system, the ECM sets DTC P0442, P0445 or P0456. The ECM checks if the EVAP has leaks. First, the ECM opens the EVAP VSV while the CCV is closed. After a sufficient amount of time has passed, a high negative pressure (vacuum) will develop in the fuel tank as air is drawn into the intake manifold. The EVAP VSV is then closed. The ECM then monitors the pressure increase (loss of vacuum) in the fuel tank. If the pressure rises beyond a specified amount, the ECM determines that the system has a leak, turns on the MIL and sets a DTC.

The ECM has DTCs for small and large leaks:

1. DTC P0442 is set when the internal fuel tank pressure has a large increase and the EVAP system has a small leak.
2. DTC P0455 is set when the EVAP system has a very large leak. The ECM tries to create negative pressure (vacuum) in the fuel tank by opening the EVAP VSV while the CCV is closed. However, the fuel tank pressure does not decrease beyond a specified threshold.
3. DTC P0456 is set when the internal fuel tank pressure increases slightly and the EVAP system has a very small leak.

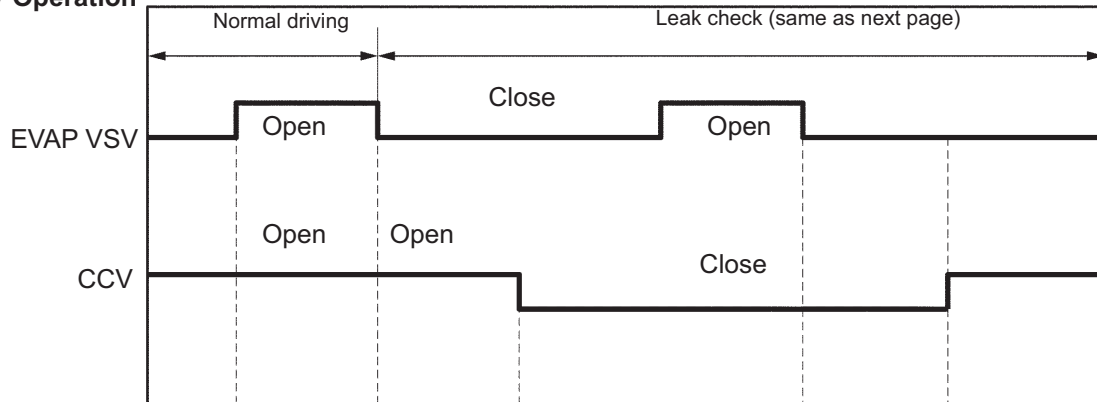
DTC No.	DTC Detection Condition	Trouble Area
P0442 P0455 P0456	• Cold engine start. • EVAP VSV has been operated and turned OFF, sealing negative pressure (vacuum) in system. • ECM begins to monitor fuel tank pressure increase and one of the following occurs (2 trip detection logic): (a) Rapid, sharp increase in pressure occurs, indicating small leak in EVAP system. DTC P0442 is set. (b) Negative pressure (vacuum) is not strong enough, indicating large hole in EVAP system. DTC P0455 is set. (c) Increase in pressure above expected amount occurs, indicating small leak in EVAP system. DTC P0456 is set.	• Vacuum hose has cracks, holes, or is blocked, damaged or disconnected • Fuel tank cap is incorrectly installed • Fuel tank cap has cracks or is damaged • Open or short in vapor pressure sensor circuit • Vapor pressure sensor • Open or short in EVAP VSV circuit • EVAP VSV • Open or short in CCV circuit • CCV • Fuel tank has cracks, holes, or is damaged • Charcoal canister has cracks, holes, or is damaged • Fuel tank over fill check valve has cracks, or is damaged • ECM

ES

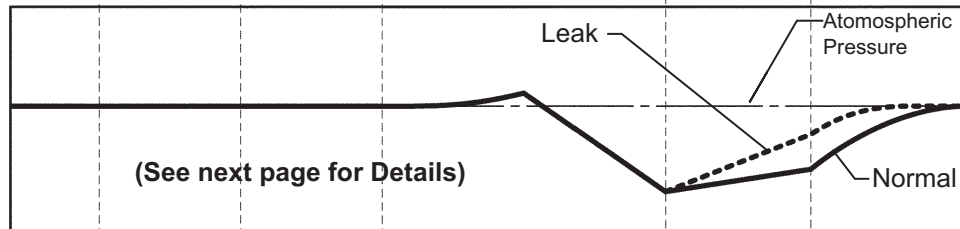


VSV Malfunction Condition and Leak Check

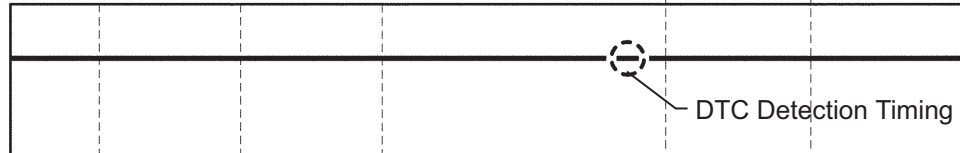
EVAP VSV is Open: ON
CCV is Open: OFF

VSV Operation**Pressure in Fuel Tank**

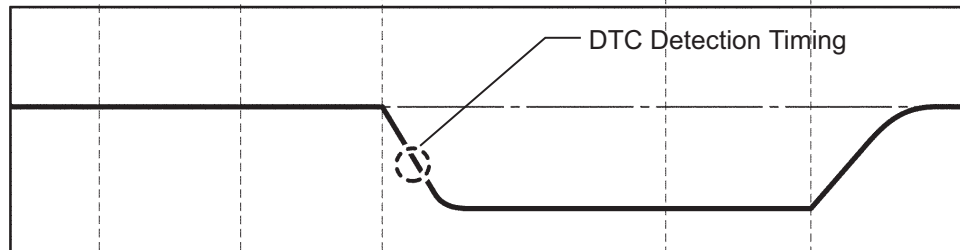
Normal Condition or
EVAP System Leak
(Normal System Line)



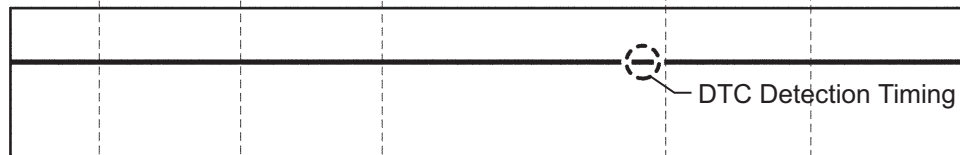
EVAP VSV Close
Malfunction (P0441)



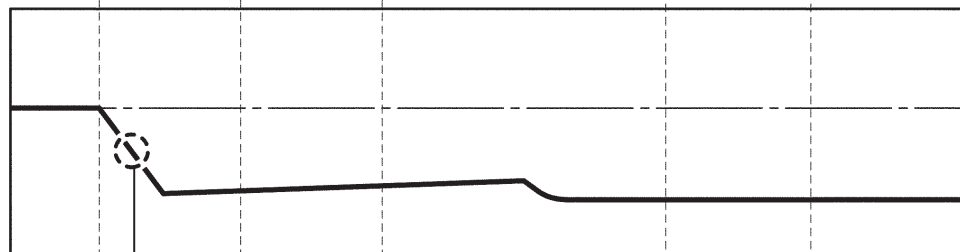
EVAP VSV Open
Malfunction (P0441)



CCV Open
Malfunction (P0446)



CCV Close
Malfunction (P0446)



DTC Detection Timing

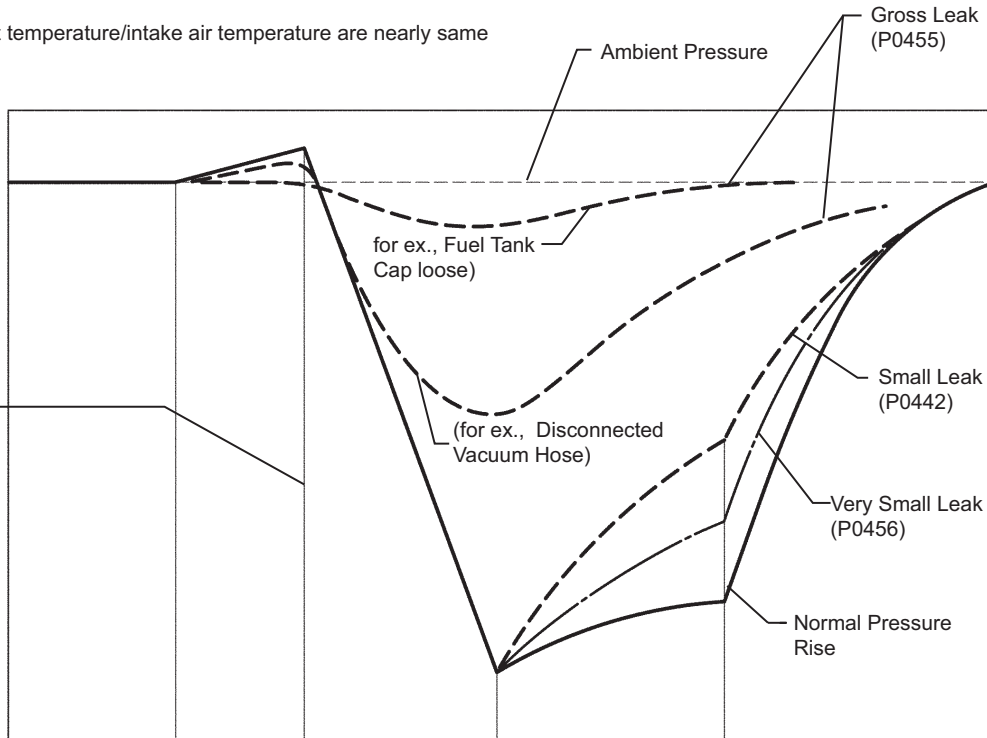
Leak check

Initial Condition:

- Cold Start
- Engine coolant temperature/intake air temperature are nearly same

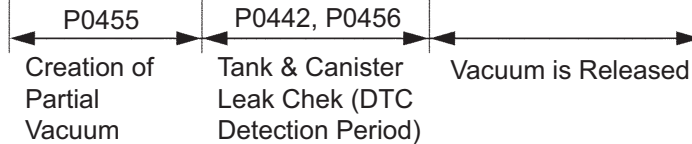
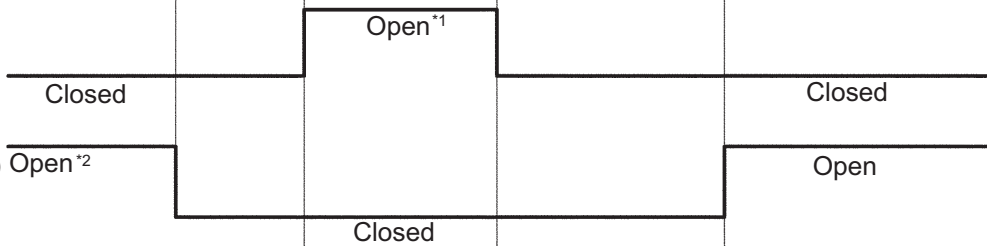
FTP: Pressure in Fuel Tank (Vapor Pressure)

Start of Creation of Negative Pressure



EVAP VSV (Operation)

CCV (Operation)



*1: EVAP VSV is Open: ON

*2: CCV is Open : OFF

MONITOR STRATEGY

Related DTCs	P0442: EVAP 0.04 inch leak P0455: EVAP gross leak P0456: EVAP 0.02 inch leak
Required sensors / components (Main)	CCV, EVAP canister, EVAP hose, Fuel cap, Fuel tank and Purge VSV
Required sensors / components (Related)	ECT sensor, FTP sensor, IAT sensor, MAF meter, Vehicle speed sensor
Frequency of operation	Once per driving cycle
Duration	Within 90 seconds
MIL operation	2 driving cycles
Sequence operation	None

TYPICAL ENABLING CONDITIONS

All:

The monitor will run whenever these DTCs are not present	P0011, P0012, P0021, P0022 (VVT system-Advance, Retard), P0100, P0101, P0102, P0103 (MAF sensor), P0110, P0112, P0113 (IAT sensor), P0115, P0116, P0117, P0118 (ECT sensor), P0120, P0122, P0123, P0220, P0222, P0223, P2135 (TP sensor), P0125 (Insufficient ECT for closed loop), P0171, P0172, P0174, P0175 (Fuel system), P0300, P0301, P0302, P0303, P0304, P0305, P0306 (Misfire), P0335 (CKP sensor), P0340, P0341 (CMP sensor), P0351, P0352, P0353, P0354, P0355, P0356, (Igniter), P0500 (VSS), P0510 (Idle switch)
Battery voltage	11 V or more
Altitude	Less than 7,870 ft. (2,400 m)
EVAP pressure sensor malfunction	Not detected
IAT at engine start - ECT at engine start	-7 to 11.1°C (-12.6 to 20°F)
EVAP VSV and CCV	Not operated by scan tool
EVAP purge duty cycle	6 % or more (vary with MAF)
Refuel	No refuel during EVAP monitor
EVAP pressure	-12.75 mmHg (-1.7 kPa) or more

EVAP 0.02 inch leak P0456:

ECT at engine start	4.4 to 32°C (39.9 to 89.6°F)
IAT at engine start	4.4 to 32°C (39.9 to 89.6°F)
IAT	4.4°C (39.9°F) or more
Vehicle speed change	Steady speed
Time after engine start	Within 50 minutes
EVAP pressure change	Minimum change (driving on fairly smooth road)
Fuel level	Less than 90 %
EVAP 0.04 inch leak	Not detected
EVAP CCV malfunction	Not detected
Vehicle speed	Less than 81.25 mph (130 km/h)
EVAP purge VSV malfunction	Not detected

Others:

ECT at engine start	4.4 to 35°C (39.9 to 95°F)
IAT at engine start	4.4 to 35°C (39.9 to 95°F)
IAT	4.4°C (39.9°F) or more
Vehicle speed change	Steady speed
Time after engine start	Within 50 minutes
EVAP pressure change	Minimum change (driving on fairly smooth road)
Fuel level	Less than 90 %

TYPICAL MALFUNCTION THRESHOLDS

EVAP 0.04 inch leak P0442:

Both of the following conditions are met:	Condition 1 and 2
1. FTP change for 5 seconds from -20 mmHg (-2.67 kPa)	1.2 mmHg (0.16 kPa) or more
2. FTP change for 5 seconds from -17 mmHg (-2.27 kPa)	1.2 mmHg (0.16 kPa) or more

EVAP 0.02 inch leak P0456:

Both of the following conditions are met:	Condition 1 and 2
1. FTP change for 5 seconds when FTP is -17 mmHg (-2.27 kPa)	0.5 mmHg (0.07 kPa) or more
2. FTP change for 5 seconds when FTP is -20 mmHg (-2.67 kPa)	0.5 mmHg (0.07 kPa) or more

ES

EVAP gross leak P0455:

FTP when vacuum introduction completed	-7 mmHg (-0.933 kPa) or more
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MONITOR RESULT

Refer to "CHECKING MONITOR STATUS" for detailed information (See page [ES-14](#)).

The test value and test limit information are described as shown in the following table. Check the monitor result and test values after performing the monitor drive pattern (See page [ES-16](#)).

- TID (Test Identification Data) is assigned to each emissions-related component.
- TLT (Test Limit Type):
If TLT is 0, the component is malfunctioning when the test value is higher than the test limit.
If TLT is 1, the component is malfunctioning when the test value is lower than the test limit.
- CID (Component Identification Data) is assigned to each test value.
- Unit Conversion is used to calculate the test value indicated on generic OBD II scan tools.

TID \$02: EVAP system - LEV II Vacuum monitor

TLT	CID	Unit Conversion	Description of Test Data	Description of Test Limit
1	\$01	Multiply by 0.183 (mmHg)	Test value of EVAP VSV stuck close: Determined by fuel tank pressure change during vacuum introduction	Malfunction criteria for EVAP VSV stuck closed
0	\$02	Multiply by 0.0655 (seconds)	Test value of EVAP VSV stuck open: Determined by duration that fuel tank pressure is higher than criteria	Malfunction criteria for EVAP VSV stuck open
0	\$03	Multiply by 0.0655 (seconds)	Test value of canister closed valve (CCV): Determined by duration that fuel tank pressure is lower than criteria	Malfunction criteria for Canister Closed Valve (CCV)
0	\$04	Multiply by 0.0458 (mmHg)	Test value 0.04 inch leak: Determined by fuel tank pressure change	Malfunction criteria for 0.04 inch leak
0	\$05	Multiply by 0.0458 (mmHg)	Test value 0.02 inch leak: Determined by fuel tank pressure change	Malfunction criteria for 0.02 inch leak

DTC**P0446****Evaporative Emission Control System Vent Control Circuit****DESCRIPTION**

The circuit description can be found in the EVAP System (See page [ES-309](#)).

Refer to the EVAP System (See page [ES-313](#)).

MONITOR DESCRIPTION

The ECM tests the Evaporative Emissions (EVAP) system using the fuel tank pressure sensor, Canister Close Valve (CCV), and EVAP VSV. The ECM closes the EVAP system and creates negative pressure (vacuum) into it. The ECM then monitors the internal pressure using the fuel tank pressure sensor (See page [ES-212](#)).

P0446 (FOR SYSTEM DIAGRAM AND DTC DETECTION TIMING CHART, REFER TO DTC P0441)(See page [ES-197](#)).

The CCV is open under normal conditions. The CCV has the following features:

1. Draws fumes from the fuel tank into the charcoal canister after the EVAP VSV purges the EVAP from the fuel tank into the intake manifold,.
2. Relieves pressure inside the fuel tank when the pressure has suddenly risen.
3. Works with the EVAP VSV to create negative pressure (vacuum) inside the fuel tank and performs leak tests.

The ECM checks if the CCV is "stuck closed". The ECM commands the CCV to open while the EVAP VSV is open. If high negative pressure (vacuum) develops in the fuel tank and stays for more than 4 seconds, the ECM determines that the CCV remains closed despite the open command. The ECM will turn on the MIL and set a DTC. The engine coolant temperature is not related to the output of this DTC.

The ECM also has a method for checking if the CCV is "stuck open". The ECM commands the CCV to close while the EVAP VSV is open. If a sufficient amount of negative pressure does not develop in the fuel tank, the ECM determines that the CCV remains open despite the close command. The ECM will turn on the MIL and set a DTC.

DTC No.	DTC Detection Condition	Trouble Area
P0446	Open or close malfunction in CCV (2 trip detection logic)	• Vacuum hose has cracks, holes, or is blocked, damaged or disconnected • Fuel tank cap is incorrectly installed • Fuel tank cap has cracks or is damaged • Open or short in vapor pressure sensor circuit • Vapor pressure sensor • Open or short in EVAP VSV circuit • EVAP VSV • Open or short in CCV circuit • CCV • Fuel tank has cracks, holes, or is damaged • Charcoal canister has cracks, holes, or is damaged • Fuel tank over fill check valve has cracks, or is damaged • ECM

MONITOR STRATEGY

Related DTCs	P0446: CCV stuck open P0446: CCV stuck closed
Required sensors / components (Main)	CCV, EVAP canister, EVAP hose, Fuel cap, Fuel tank and Purge VSV
Required sensors / components (Related)	ECT sensor, FTP sensor, IAT sensor, MAF meter, Vehicle speed sensor
Frequency of operation	Once per driving cycle
Duration	Within 60 seconds

MIL operation	2 driving cycles
Sequence operation	None

TYPICAL ENABLING CONDITIONS

The monitor will run whenever these DTCs are not present	P0011, P0012, P0021, P0022 (VVT system-Advance, Retard), P0100, P0101, P0102, P0103 (MAF sensor), P0110, P0112, P0113 (IAT sensor), P0115, P0116, P0117, P0118 (ECT sensor), P0120, P0122, P0123, P0220, P0222, P0223, P2135, (TP sensor), P0125 (Insufficient ECT for closed loop), P0171, P0172, P0174, P0175 (Fuel system), P0300, P0301, P0302, P0303, P0304, P0305, P0306 (Misfire), P0335 (CKP sensor), P0340, P0341 (CMP sensor), P0351, P0352, P0353, P0354, P0355, P0356, (Igniter), P0500 (VSS), P0510 (Idle switch)
Battery voltage	11 V or more
Altitude	Less than 7,870 ft. (2,400 m)
EVAP pressure sensor malfunction	Not detected
IAT at engine start - ECT at engine start	-7 to 11.1°C (-12.6 to 20°F)
EVAP VSV and CCV	Not operated by scan tool
EVAP purge duty cycle	6 % or more (vary with MAF)
Refuel	No refuel during EVAP monitor
EVAP pressure	-12.75 mmHg (-1.7 kPa) or more
ECT at engine start	4.4 to 35°C (39.9 to 95°F)
IAT at engine start	4.4 to 35°C (39.9 to 95°F)
IAT	4.4°C (39.9°F) or more
Vehicle speed change	Steady speed
Time after engine start	Within 50 minutes
EVAP pressure change	Minimum change (driving on fairly smooth road)
Fuel level	Less than 90 %

TYPICAL MALFUNCTION THRESHOLDS

CCV stuck close P0446:

Duration that the following conditions are met:	4 seconds or more
1. Accumulated purge volume	0.5 g or more
2. FTP	Less than -12.75 mmHg (-1.7 kPa)

CCV stuck open P0446:

Purge VSV stuck closed	Detected
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MONITOR RESULT

Refer to "checking monitor status" for detailed information (See page [ES-14](#)).

The test value and test limit information are described as shown in the following table. Check the monitor result and test values after performing the monitor drive pattern (See page [ES-16](#)).

- TID (Test Identification Data) is assigned to each emissions-related component.
- TLT (Test Limit Type):
If TLT is 0, the component is malfunctioning when the test value is higher than the test limit.
If TLT is 1, the component is malfunctioning when the test value is lower than the test limit.
- CID (Component Identification Data) is assigned to each test value.
- Unit Conversion is used to calculate the test value indicated on generic OBD II scan tools.

TID \$02: EVAP system - LEV II Vacuum monitor

TLT	CID	Unit Conversion	Description of Test Data	Description of Test Limit
1	\$01	Multiply by 0.183 (mmHg)	Test value of EVAP VSV stuck close: Determined by fuel tank pressure change during vacuum introduction	Malfunction criteria for EVAP VSV stuck closed

TLT	CID	Unit Conversion	Description of Test Data	Description of Test Limit
0	\$02	Multiply by 0.0655 (seconds)	Test value of EVAP VSV stuck open: Determined by duration that fuel tank pressure is higher than criteria	Malfunction criteria for EVAP VSV stuck open
0	\$03	Multiply by 0.0655 (seconds)	Test value of canister closed valve (CCV): Determined by duration that fuel tank pressure is lower than criteria	Malfunction criteria for Canister Closed Valve (CCV)
0	\$04	Multiply by 0.0458 (mmHg)	Test value 0.04 inch leak: Determined by fuel tank pressure change	Malfunction criteria for 0.04 inch leak
0	\$05	Multiply by 0.0458 (mmHg)	Test value 0.02 inch leak: Determined by fuel tank pressure change	Malfunction criteria for 0.02 inch leak

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

MONITOR DESCRIPTION

ES

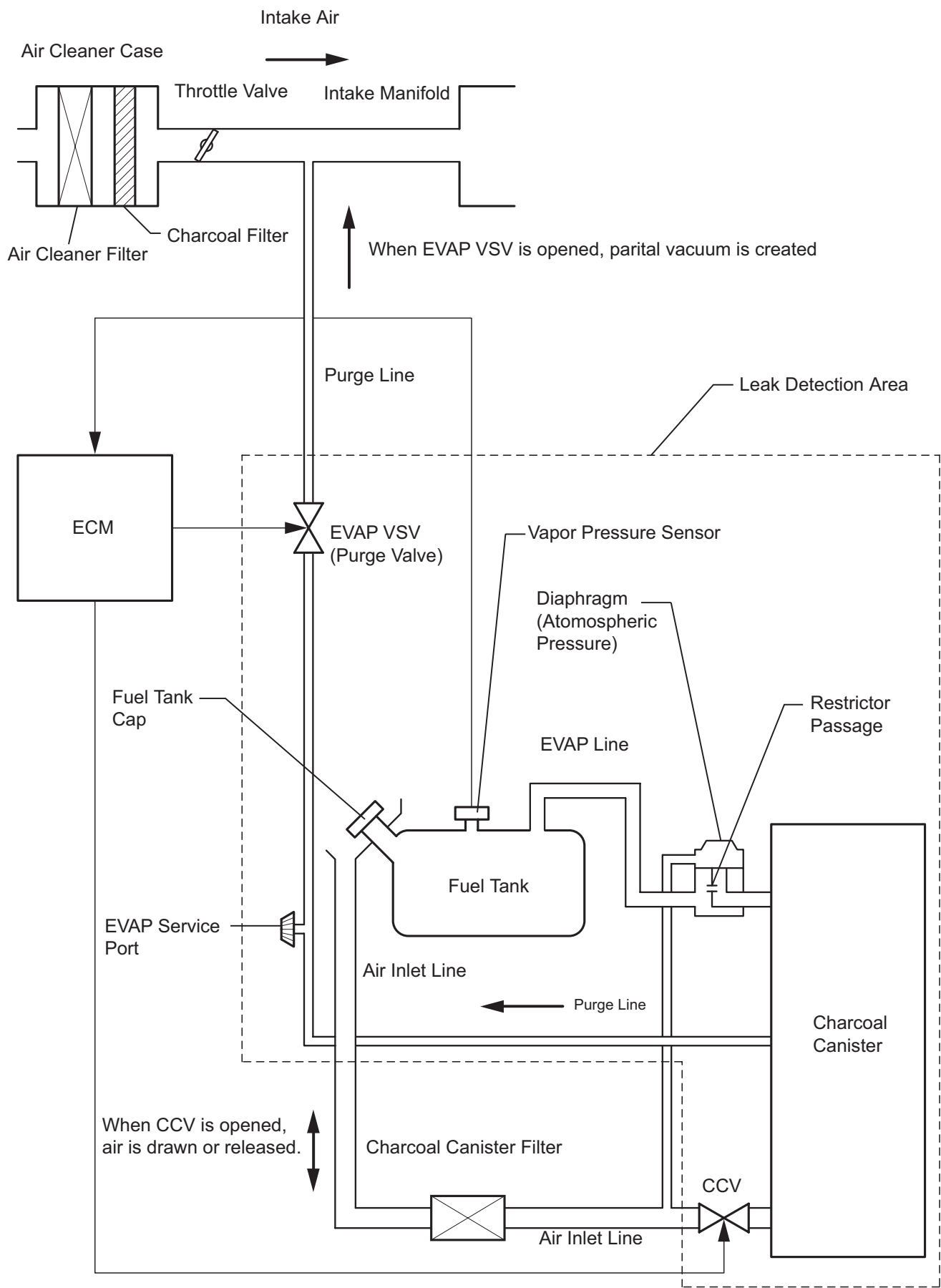
DTC "P0451, P0452 or P0453" is recorded by the ECM when the vapor pressure sensor malfunctions.

P0451

The ECM monitors the vapor pressure sensor in 2 ways. One method examines the fluctuation of the electrical signal while the engine is idling. If the pressure signal varies beyond the specified range more than 7 times, the ECM interprets this as a fault in the vapor pressure sensor. The ECM also verifies that the pressure signal changes within the specified range. If the output of the sensor does not vary for 5 minutes while the intake air amount is changing, the ECM interprets this as a fault in the vapor pressure sensor. DTC P0451 will be set when either of the faults occurs and the ECM will turn on the MIL.

P0452 and P0453

When pressure indicated by the vapor pressure sensor deviates below -3.999 kPa (-30 mmHg) or above 1.999 kPa (15 mmHg), the ECM interprets this as a malfunction in the vapor pressure sensor. The ECM will turn on the MIL and a DTC will be set.



DTC No.	DTC Detection Condition	Trouble Area
P0451	Vapor pressure sensor output changes extremely under the following conditions: - Vapor pressure sensor output changes often while vehicle speed is 0 mph (0 km/h) and the engine is idling 5 sec. to 10 sec. (2 trip detection logic) - Vapor pressure sensor output is stuck 5 minutes (2 trip detection logic)	- Open or short in vapor pressure sensor circuit - Vapor pressure sensor - ECM
P0452	Vapor pressure sensor output remains less than -30 mmHg: (2 trip detection logic)	- Open or short in vapor pressure sensor circuit - Vapor pressure sensor - ECM
P0453	Vapor pressure sensor output remains more than 15 mmHg: (2 trip detection logic)	- Open or short in vapor pressure sensor circuit - Vapor pressure sensor - ECM

ES

MONITOR STRATEGY

Related DTCs	P0451: EVAP pressure Sensor Noise P0451: EVAP pressure Sensor Stuck P0452: EVAP pressure Sensor Range Check (Low voltage) P0453: EVAP pressure Sensor Range Check (High voltage)
Required sensors / components (Main)	EVAP pressure sensor
Required sensors / components (Related)	ECT sensor, IAT sensor
Frequency of operation	Once per driving cycle
Duration	7 seconds: EVAP pressure Sensor Range Check 45 seconds: EVAP pressure Sensor Noise 5 minutes: EVAP pressure Sensor Stuck
MIL operation	2 driving cycles
Sequence operation	None

TYPICAL ENABLING CONDITIONS

All:

The monitor will run whenever these DTCs are not present	None
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EVAP pressure Sensor Noise P0451:

Altitude	Less than 7,870 ft. (2,400 m)
Battery voltage	11 V or more
EVAP pressure sensor malfunction (P0450, P0452, P0453)	Not detected
IAT at engine start - ECT at engine start	-7 to 11.1°C (-12.6 to 20°F)
EVAP VSV, CCV	Not operated by scan tool
ECT at engine start	4.4 to 35°C (40 to 95°F)
IAT at engine start	4.4 to 35°C (40 to 95°F)

EVAP pressure Sensor Stuck P0451:

Altitude	Less than 7,870 ft. (2,400 m)
Battery voltage	11 V or more
EVAP pressure sensor malfunction (P0450, P0452, P0453)	Not detected
IAT at engine start - ECT at engine start	-7 to 11.1°C (-12.6 to 20°F)
EVAP VSV, CCV	Not operated by scan tool
ECT at engine start	4.4 to 35°C (40 to 95°F)
IAT at engine start	4.4 to 35°C (40 to 95°F)
Time after engine start	5 seconds or more
0.04 inch leak	Not detected
0.02 inch leak	Not detected

CCV malfunction	Not detected
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EVAP pressure Sensor Range Check P0452, P0453:

ECT at engine start	10 to 35°C (50 to 95°F)
IAT at engine start	10 to 35°C (50 to 95°F)
Difference between engine start ECT and engine start IAT	Less than 12°C (21.6°F)
Engine condition	Running

TYPICAL MALFUNCTION THRESHOLDS**EVAP pressure Sensor Noise P0451:**

EVAP pressure change after the vehicle stop	A lot of change for a short time
---	----------------------------------

EVAP pressure Sensor Stuck P0451:

EVAP pressure change	No change for 5 minutes
----------------------	-------------------------

ES**EVAP pressure Sensor Range Check (Low voltage) P0452:**

EVAP pressure	Less than -30 mmHg (-3.999 kPa)
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EVAP pressure Sensor Range Check (High voltage) P0453:

EVAP pressure	15 mmHg (1.999 kPa) or more
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COMPONENT OPERATING RANGE

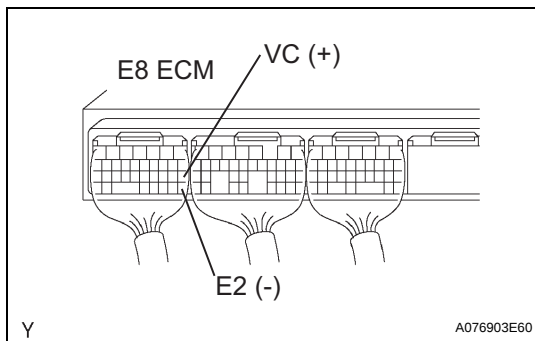
EVAP pressure	-26 to 11 mmHg (-3.5 to 1.5 kPa) or more [734 to 771 mmHg]
---------------	--

WIRING DIAGRAM

Refer to the EVAP System (See page [ES-312](#)).

HINT:

- If DTCs related to different systems that have terminal E2 as the ground terminal are output simultaneously, terminal E2 may have an open circuit.
- Always troubleshoot DTCs P0441 (purge flow), P0446 (VSV for CCV), P0451, P0452 and P0453 (evaporative pressure sensor) before troubleshooting DTCs P0442, P0455 and P0456.
- Read freeze frame data using the intelligent tester or the OBD II scan tool. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, it is useful for determining whether the vehicle was running or stopped, the engine was warmed up or not, the air-fuel ratio was lean or rich, etc. at the time of the malfunction.
- When the ENGINE RUN TIME in the freeze frame data is less than 200 seconds, carefully check the vapor pressure sensor.

1 CHECK ECM (VC VOLTAGE)

- Turn the ignition switch ON.
- Measure the voltage of the ECM connector.

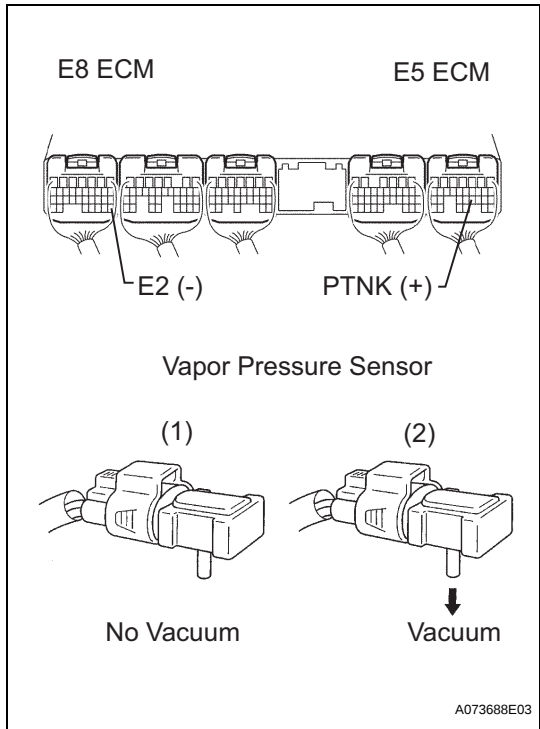
Standard voltage

Tester Connection	Specified Condition
E8-18 (VC) - E8-28 (E2)	4.5 to 5.5 V

NG**REPLACE ECM**

OK

2 CHECK ECM (PTNK VOLTAGE)



- (a) Turn the ignition switch ON.
- (b) Measure the voltage of the ECM connectors.
 - (1) Disconnect the vacuum hose from the vapor pressure sensor.

Standard voltage (1)

Tester Connection	Specified Condition
E5-21 (PTNK) - E8-28 (E2)	2.9 to 3.7 V

- (2) Using a MITYVAC (Hand-held Vacuum Pump), apply a vacuum of 4.0 kPa (30 mmHg, 1.18 in.Hg) to the vapor pressure sensor.

NOTICE:

The vacuum applied to the vapor pressure sensor must be less than 66.7 kPa (500 mmHg, 19.7 in.Hg).

Standard voltage (2)

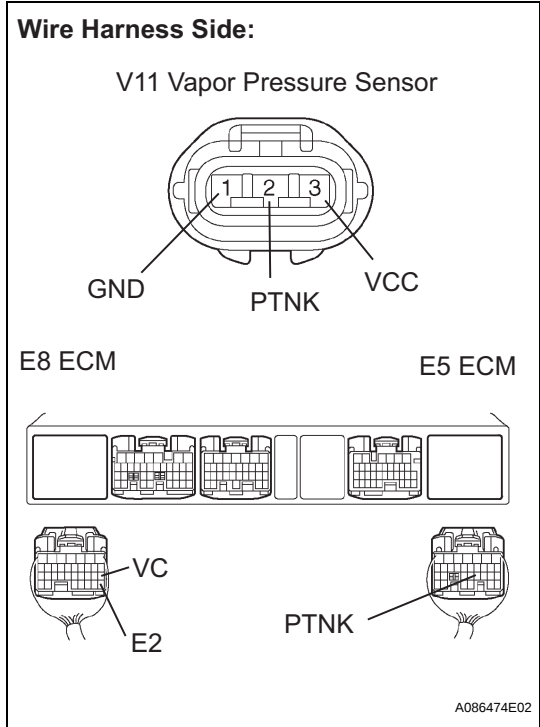
Tester Connection	Specified Condition
E5-21 (PTNK) - E8-28 (E2)	0.5 V or less

OK

REPLACE ECM

NG

3 CHECK WIRE HARNESS (VAPOR PRESSURE SENSOR ASSEMBLY - ECM)



- (a) Disconnect the V11 vapor pressure sensor connector.
- (b) Disconnect the E5 and E8 ECM connectors.
- (c) Measure the resistance of the wire harness side connectors.

Standard resistance

Tester Connection	Specified Condition
V11-2 (PTNK) - E5-21 (PTNK) V11-1 (GND) - E8-28 (E2) V11-3 (VCC) - E8-18 (VC)	Below 1 Ω
V11-2 (PTNK) or E5-21 (PTNK) - Body ground V11-3 (VCC) or E8-18 (VC) - Body ground	10 kΩ or higher

NG

REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

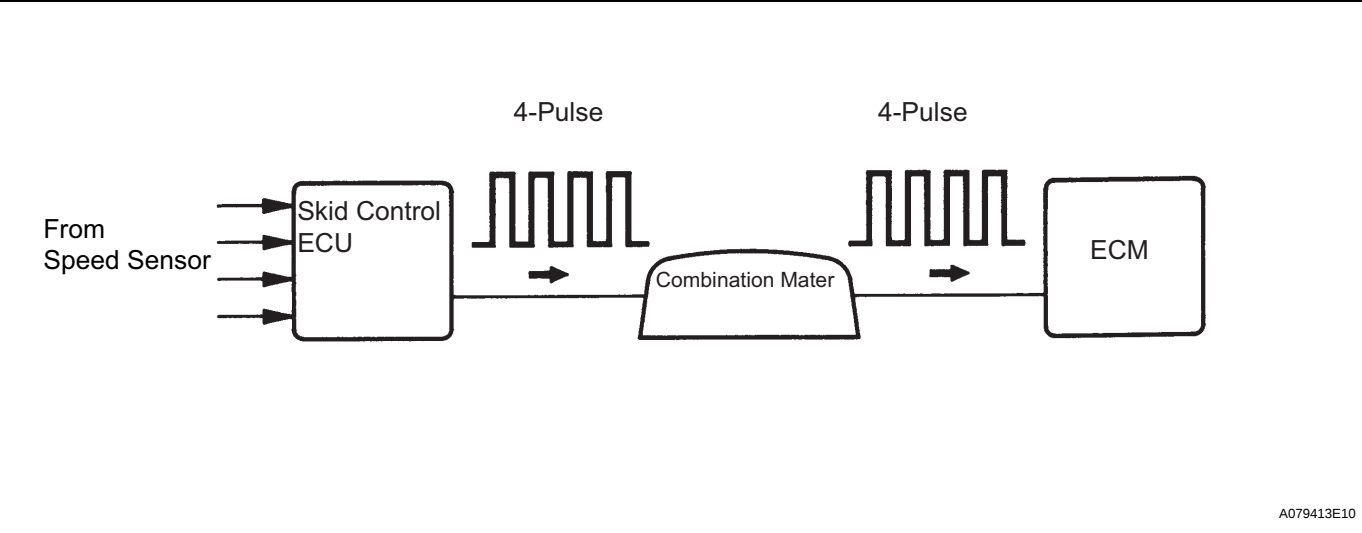
REPLACE VAPOR PRESSURE SENSOR ASSEMBLY

ES

DTC	P0500	Vehicle Speed Sensor "A"
DTC	P0503	Vehicle Speed Sensor "A" Intermittent / Erratic / High

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.



DTC No.	DTC Detection Condition	Trouble Area
P0500 P0503	The ECM detects the following conditions simultaneously for 2 second (1 trip detection logic): - No SPD (speed sensor) signal while ECM detects NC (transmission counter gear) signal is more than 300 RPM. - Park/Neutral position switch is OFF (When shift lever is in other than P and N positions)	- Open or short in speed sensor circuit - Speed sensor - Combination meter - ECM - Skid control ECU

MONITOR DESCRIPTION

The ECM assumes that the vehicle is being driven when the transmission counter gear indicates more than 300 rpm and over 30 seconds have passed since the park/neutral position switch was turned OFF. If there is no signal from the vehicle speed sensor with these conditions satisfied, the ECM concludes that the vehicle speed sensor is malfunctioning. The ECM will turn on the MIL and a DTC will be set.

MONITOR STRATEGY

Related DTCs	P0500: Vehicle Speed Sensor Circuit
Required sensors / components (Main)	Vehicle speed sensor, Combination meter, ABS ECU
Required sensors / components (Related)	Countergear Speed (CS) sensor, PNP switch, ECT sensor
Frequency of operation	Continuous
Duration	2 seconds
MIL operation	Immediate
Sequence operation	None

TYPICAL ENABLING CONDITIONS

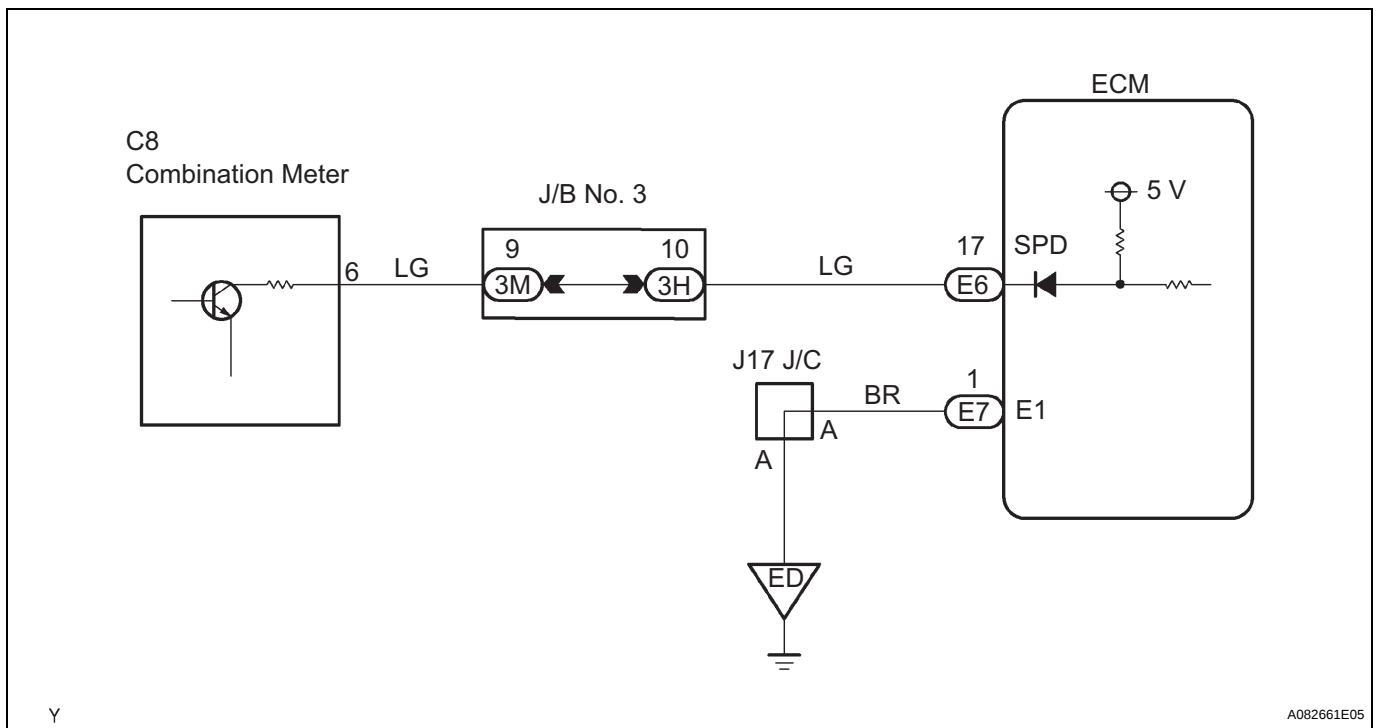
The monitor will run whenever these DTCs are not present	P0120, P0122, P0123, P0220, P0222, P0223, P2135 (TP sensor)
Transmission counter gear speed	300 rpm or more
Engine condition	Running
Battery voltage	8 V or more
Ignition switch	ON
Starter	OFF
Either of the following conditions is met:	Condition 1 or 2
Condition 1	-
Engine coolant temperature	20°C (68°F) or more
ECT sensor	Not malfunction (P0115 or P0116)
Time after PNP switch ON to OFF	10 seconds or more
Condition 2	-
Engine coolant temperature	Less than 20°C (68°F)
ECT sensor	Malfunction (P0115 or P0116)
Time after PNP switch ON to OFF	30 seconds or more

ES

TYPICAL MALFUNCTION THRESHOLDS

Vehicle speed sensor signal	No pulse input
-----------------------------	----------------

WIRING DIAGRAM



HINT:

Read freeze frame data using the intelligent tester or the OBD II scan tool. 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 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.

1

CHECK OPERATION OF SPEEDOMETER

- (a) Drive the vehicle and check if operation of the speedometer in the combination meter is normal.
- HINT:
The vehicle speed sensor is operating normally if the speedometer display is normal.

NG

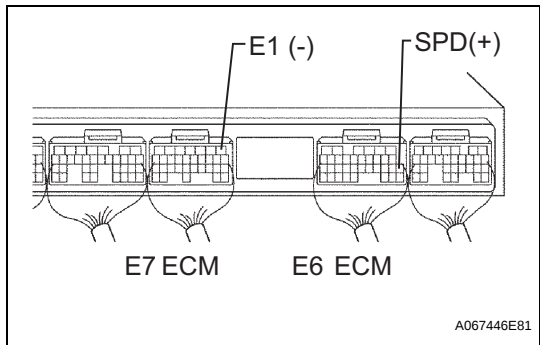
CHECK SPEEDOMETER CIRCUIT

OK

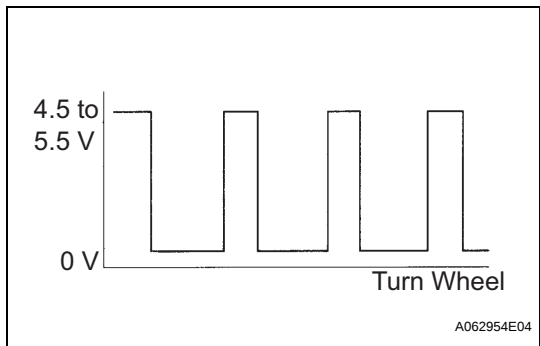
ES

2

INSPECT ECM (SPD VOLTAGE)



- (a) Shift the lever to the neutral position.
- (b) Jack up the vehicle.
- (c) Turn the ignition switch ON.



- (d) Measure the voltage of the ECM connectors as the wheel is turned slowly.

Standard

Tester Connection	Specified Condition
E6-17 (SPD) - E7-1 (E1)	Generated intermittently

HINT:
The output voltage should fluctuate up and down similarly to the diagram on the left when the wheel is turned slowly.

NG

REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

REPLACE ECM

DTC**P0504****Brake Switch "A" / "B" Correlation****DESCRIPTION**

In addition to turning on the stop lights, the stop light switch signals are used for a variety of engine, transmission, and suspension functions as well as being an input for diagnostic checks. It is important that the switch operates properly, therefore this switch is designed with 2 complementary signal outputs: STP and ST1-. The ECM analyzes these signal outputs to detect malfunctions in the stop light switch.

HINT:

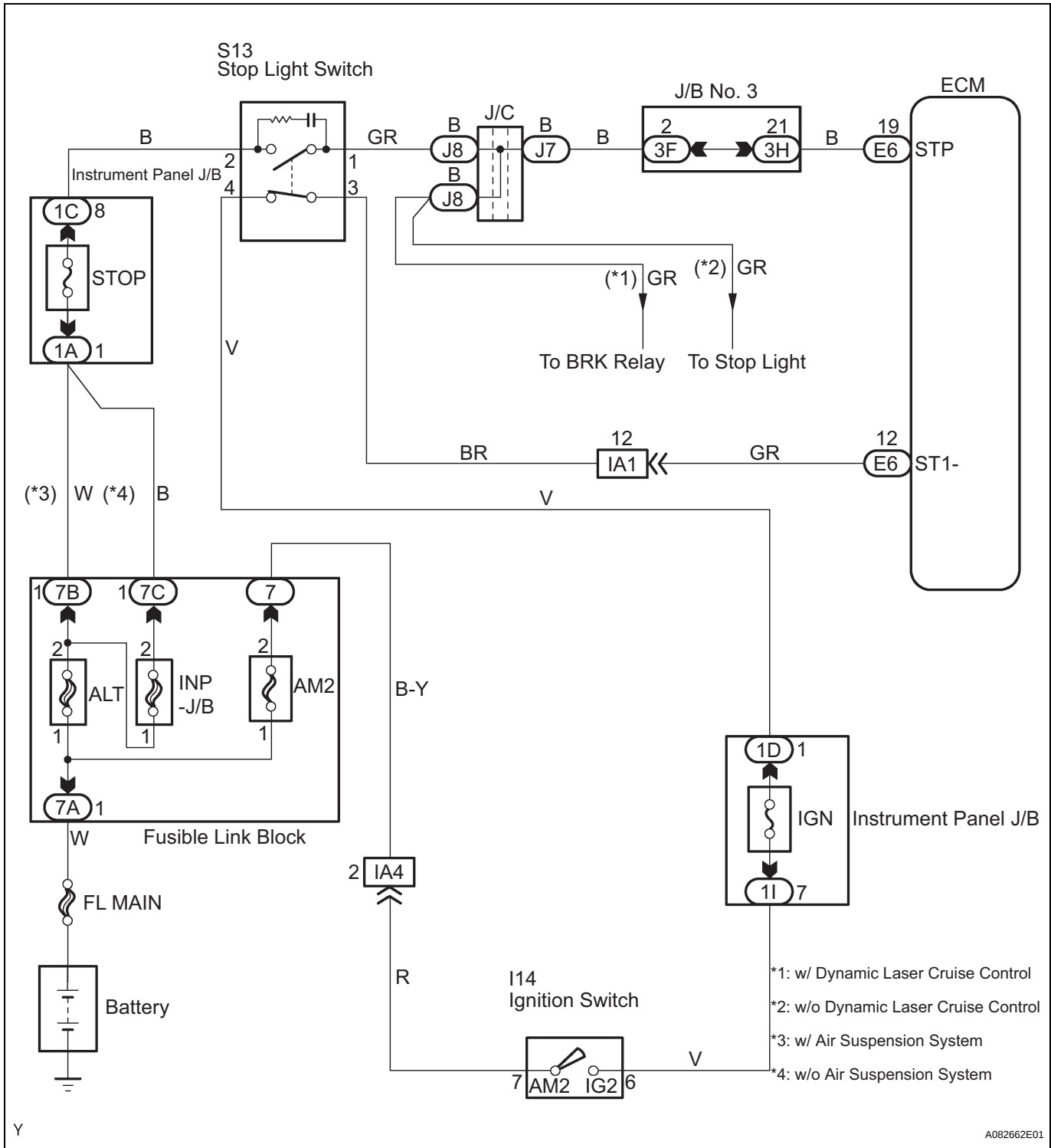
Normal condition is as shown in the table.

Signal	Brake pedal released	In transition	Brake pedal depressed
STP	OFF	ON	ON
ST1-	ON	ON	OFF

ES

DTC No.	DTC Detection Condition	Trouble Area
P0504	Conditions (a), (b) and (c) continue for 0.5 seconds or more: (a) Ignition switch ON (b) Brake pedal released (c) STP signal is OFF when the ST1- signal is OFF	• Short in stop light switch signal circuit • Stop light switch • ECM

WIRING DIAGRAM



HINT:

Read freeze frame data using the intelligent tester or the OBD II scan tool. 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 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.

1 CHECK STOP LIGHT SWITCH

- (a) Check if the stop lights turn on and off normally when the brake pedal is depressed and released.

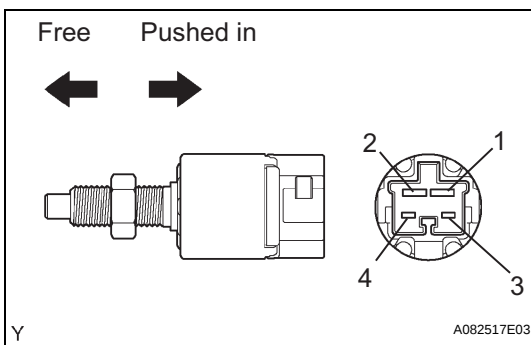
OK:

The stop lights turn on when you depress the brake pedal.

NG

REPAIR OR REPLACE STOP LIGHT SWITCH

OK

2 INSPECT STOP LIGHT SWITCH ASSEMBLY

- (a) Measure the resistance of the switch terminals.

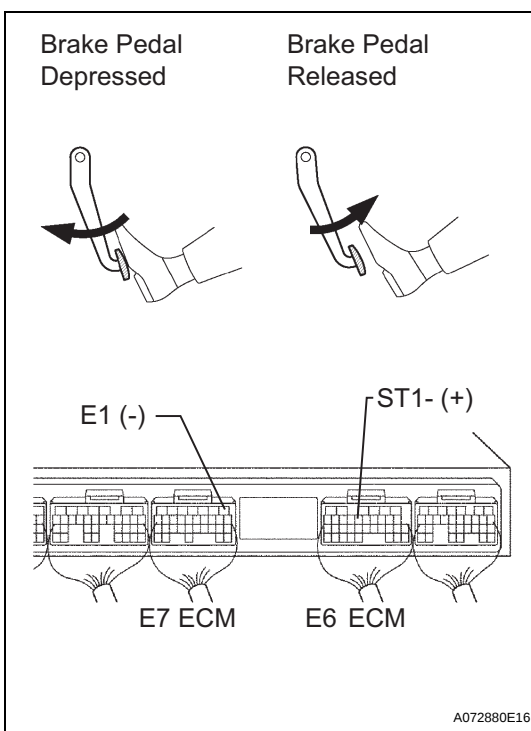
Standard resistance

Switch condition	Tester Connection	Specified Condition
Switch pin free	1 - 2	Below 1 Ω
Switch pin free	3 - 4	10 k Ω or higher
Switch pin pushed in	1 - 2	10 k Ω or higher
Switch pin pushed in	3 - 4	Below 1 Ω

NG

REPLACE STOP LIGHT SWITCH ASSEMBLY

OK

3 READ VALUE OF INTELLIGENT TESTER (STP SIGNAL, ST1 - VOLTAGE)

- (a) Turn the ignition switch ON.
 (b) On the intelligent tester, enter the following menus:
 DIAGNOSIS / ENHANCED OBD II / DATA LIST / ALL / STOP LIGHT SW. Read the values.

Standard

Brake Pedal Condition	Specified Condition
Depressed	STP Signal ON
Released	STP Signal OFF

- (c) Measure the voltage of the ECM connectors.

Standard voltage

Tester Connection	Brake Pedal Condition	Specified Condition
E6-12 (ST1-) - E7-1 (E1)	Depressed	Below 1.5 V
E6-12 (ST1-) - E7-1 (E1)	Released	7.5 to 14 V

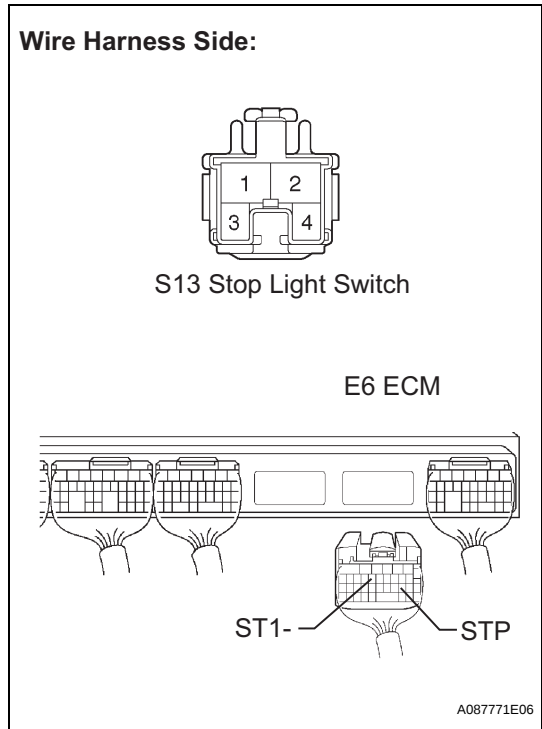
OK

CHECK FOR INTERMITTENT PROBLEMS

ES

NG

4 CHECK HARNESS AND CONNECTOR (STOP LIGHT SWITCH - ECM)



- (a) Disconnect the S13 stop light switch connector.
- (b) Disconnect the E6 ECM connector.
- (c) Measure the resistance of the wire harness side connectors.

Standard resistance

Tester Connection	Specified Condition
S13-1 - E6-19 (STP) S13-4 - E6-12 (ST1-)	Below 1 Ω

- (d) Reconnect the stop light switch connector and ECM connector.

NG

REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

REPLACE ECM

1 CHECK STOP LIGHT (OPERATION)

- (a) Check if the stop lights turn on and off normally when the brake pedal is depressed and released.

OK:

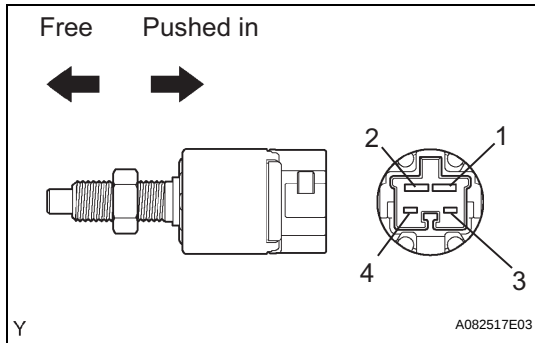
The stop lights turn on when you depress the brake pedal.

NG

REPAIR OR REPLACE STOP LIGHT SWITCH CIRCUIT

OK

2 INSPECT STOP LIGHT SWITCH ASSEMBLY



(a) Measure the resistance of the switch terminals.

Standard resistance

Switch condition	Tester Connection	Specified Condition
Switch pin free	1 - 2	Below 1 Ω
Switch pin free	3 - 4	10 k Ω or higher
Switch pin pushed in	1 - 2	10 k Ω or higher
Switch pin pushed in	3 - 4	Below 1 Ω

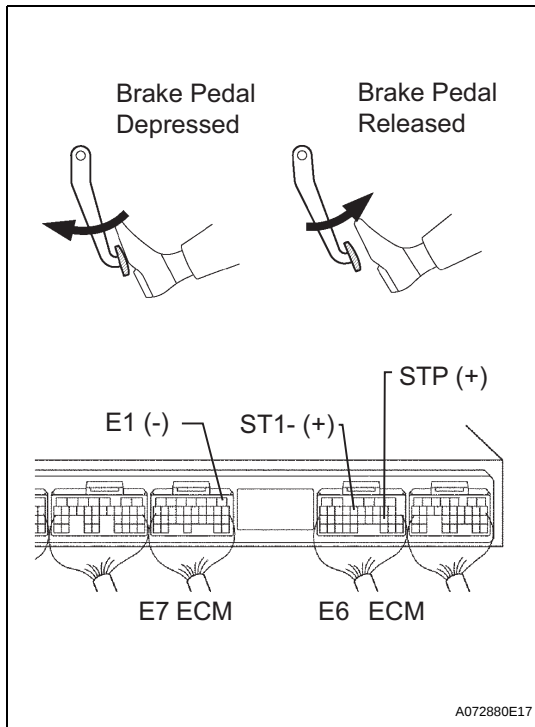
NG

REPLACE STOP LIGHT SWITCH ASSEMBLY

ES

OK

3 INSPECT ECM (STP, ST1 - VOLTAGE)



(a) Turn the ignition switch ON.

(b) Measure the voltage of the ECM connectors.

Standard voltage

Tester Connection	Brake Pedal Condition	Specified Condition
E6-19 (STP) - E7-1 (E1)	Depressed	7.5 to 14 V
E6-19 (STP) - E7-1 (E1)	Released	Below 1.5 V
E6-12 (ST1-) - E7-1 (E1)	Depressed	Below 1.5 V
E6-12 (ST1-) - E7-1 (E1)	Released	7.5 to 14 V

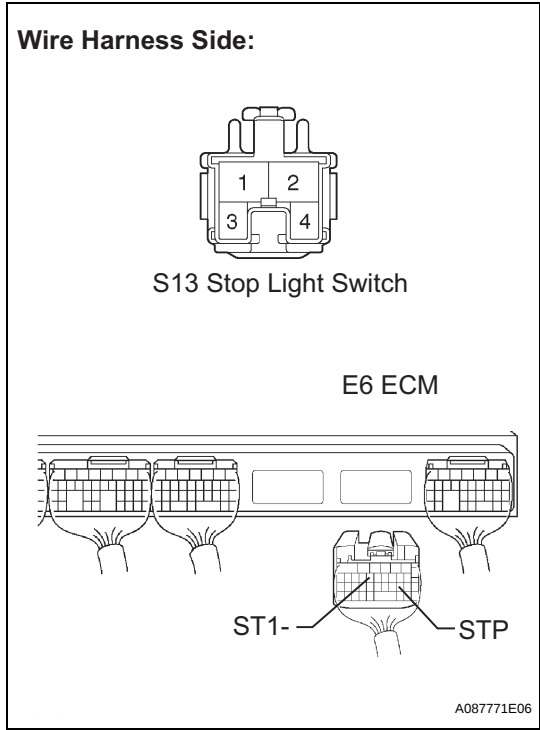
OK

CHECK FOR INTERMITTENT PROBLEMS

NG

4

CHECK HARNESS AND CONNECTOR (STOP LIGHT SWITCH - ECM)



- (a) Disconnect the S13 stop light switch connector.
- (b) Disconnect the E6 ECM connector.
- (c) Measure the resistance of the wire harness side connectors.

Standard resistance

Tester Connection	Specified Condition
S13-1 - E6-19 (STP) S13-4 - E6-12 (ST1-)	Below 1 Ω

- (d) Reconnect the stop light switch connector and ECM connector.

NG

REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

REPLACE ECM

EVAP System

DESCRIPTION

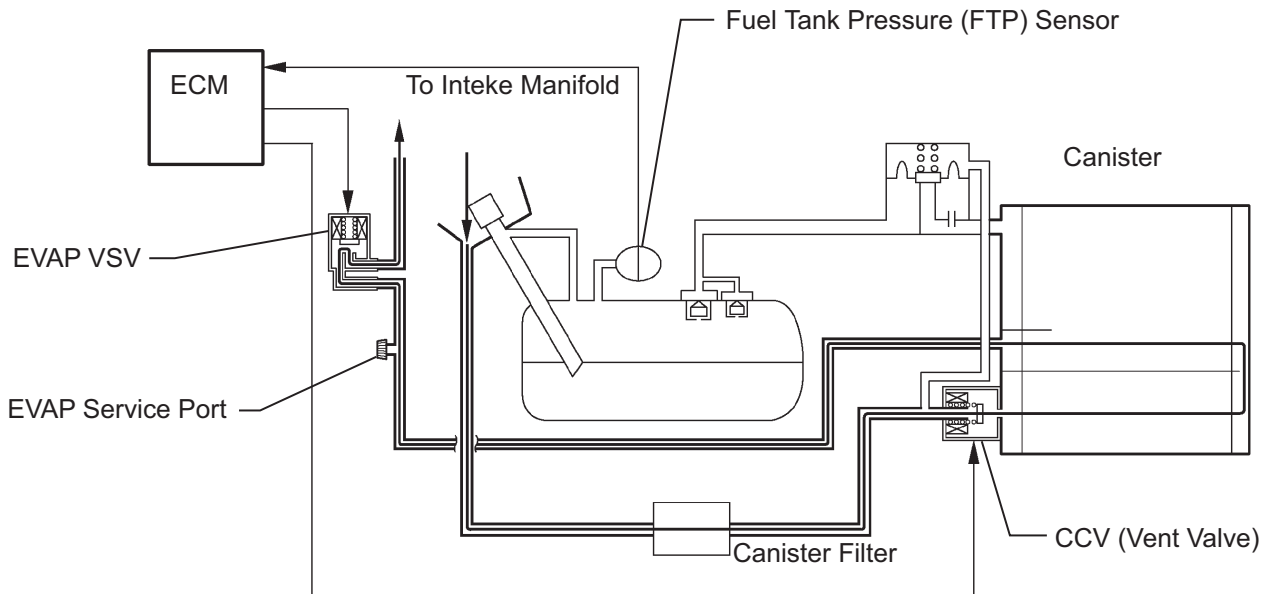
When predetermined conditions (closed loop, etc.) are met, the EVAP VSV is opened and stored fuel vapor in the canister is purged to the intake manifold. The ECM changes duty-cycle to the EVAP VSV to control purge flow volume. Purge flow volume is determined by the intake manifold pressure. Atmospheric pressure is allowed into the canister through the vent valve (CCV) to ensure that purge flow is maintained when negative pressure (vacuum) is applied to the canister. This EVAP system contains following components:

Components

Components	Operation
Canister	Contains activated charcoal to absorb EVAP that is created in fuel tank.
EVAP VSV	Opens or closes line between canister and intake manifold to control EVAP purge flow. EVAP VSV is opened and purges fuel vapor absorbed by canister to intake manifold. ECM changes duty-cycle of purge VSV to control purge volume (ON is open, OFF is closed).
Refueling Valve	Controls EVAP pressure from fuel tank to canister. Valve has diaphragm, spring and restrictor. When fuel tank pressure increase, valve opens. When EVAP is purging, valve closes and restrictor prevents strong of vacuum from affecting pressure in fuel tank. When valve opens, refueling is possible.
Service Port	Used for connecting vacuum gauge for inspecting EVAP system.
Vent Valve (CCV)	Vents and seals EVAP system. When CCV is turned ON, EVAP system is closed. When CCV is turned OFF, EVAP system is vented. When vacuum introduction, EVAP VSV is opened and CCV is closed.
Fuel Tank Pressure (FTP) Sensor	Indicates pressure as voltage. 5 V is supplied by ECM. ECM detects EVAP system pressure using this voltage.

ES

DIAGRAM



V

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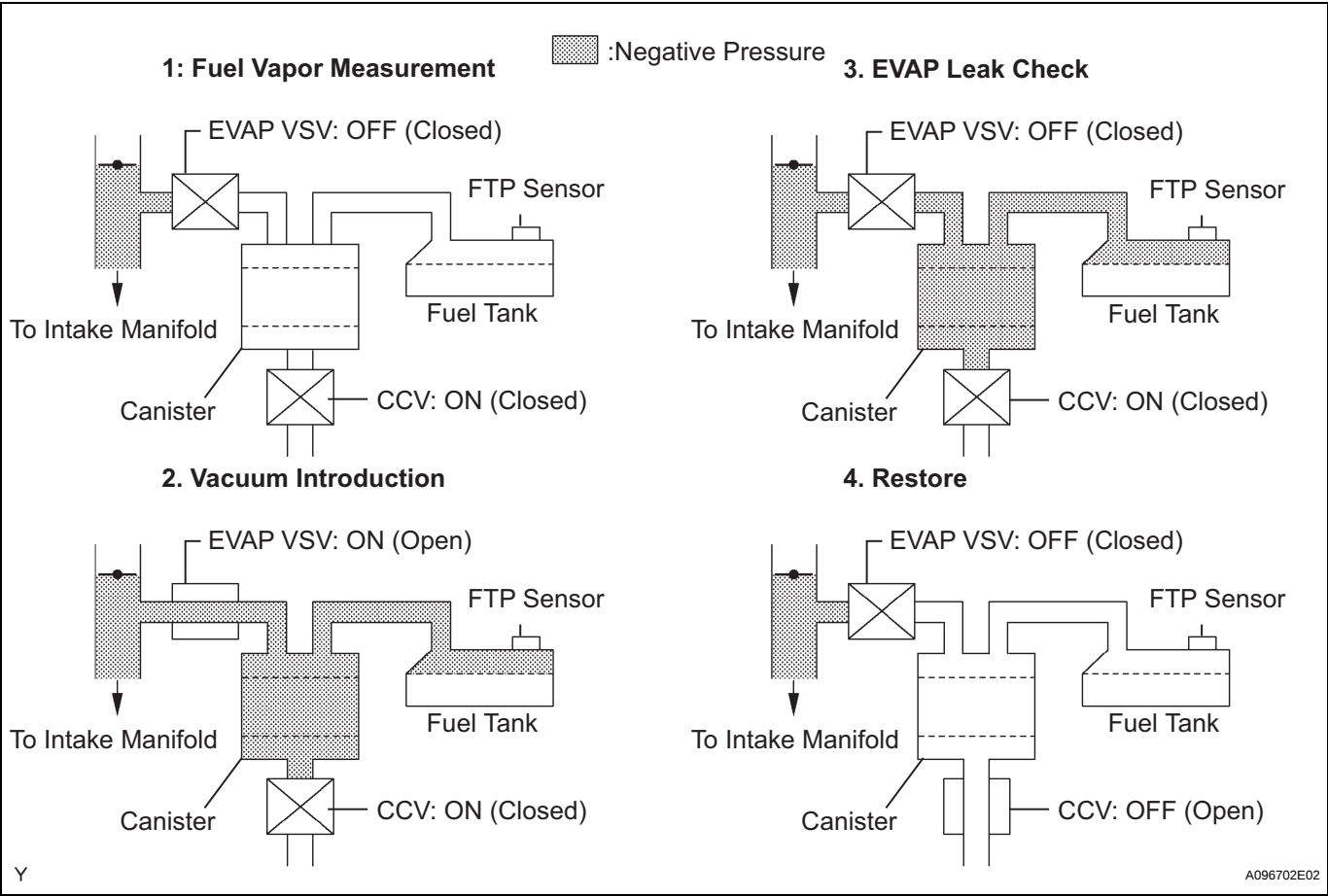
MONITOR DESCRIPTION

The EVAP monitor's purpose is to check for EVAP leaks and EVAP VSV and CCV malfunctions. The monitor performs the check by first introducing the intake manifold's negative pressure (vacuum) to the EVAP system. Then, the monitor records change in the EVAP system's pressure levels. The monitor runs when the following conditions are met:

- The engine coolant and intake air temperatures are 4 to 35°C (40 to 90°C).

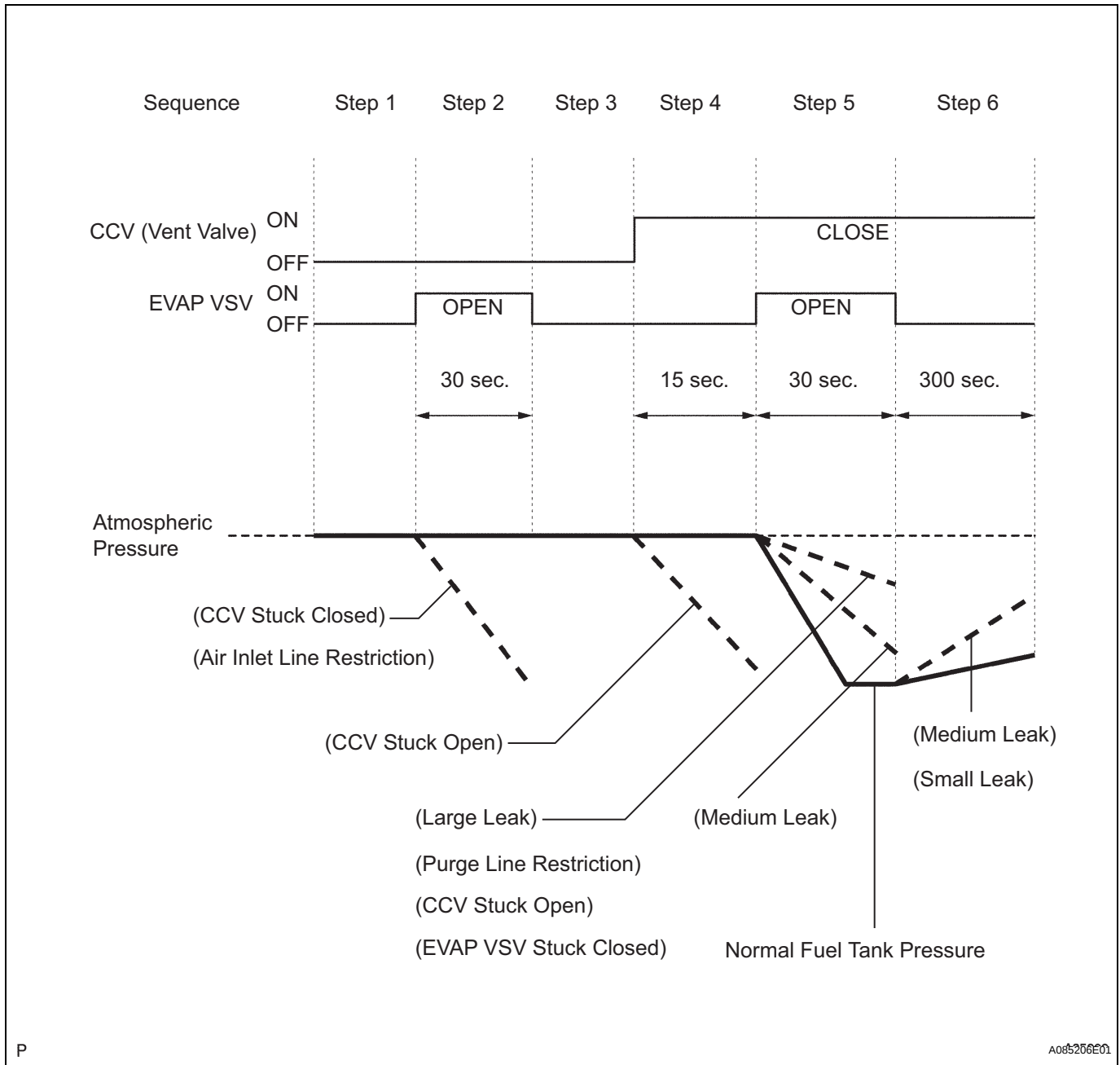
- The engine is idling or the vehicle is being driven at a steady speed.
- The fuel tank pressure is stabilized.

LEV II EVAP Monitor Process



Sequence	Operation	Description
1	Fuel vapor measurement	EVAP VSV is turned OFF (closed) and EVAP pressure is measured. If EVAP pressure is not stable, EVAP monitor is canceled to prevent inaccurate monitor.
2	Vacuum introduction	EVAP VSV is turned ON (open) and CCV is turned ON (closed). As a result, intake manifold pressure (vacuum) is introduced to EVAP system.
3	EVAP leak check	EVAP VSV is turned OFF (closed) to seal EVAP system. EVAP pressure increase is measured for 5 seconds when EVAP pressure is -20 mmHg and -17 mmHg. If increase is large, ECM concludes EVAP system has leak.
4	Restore	CCV is turned OFF (open) to finish EVAP monitor.

LEV II EVAP Monitor Sequence



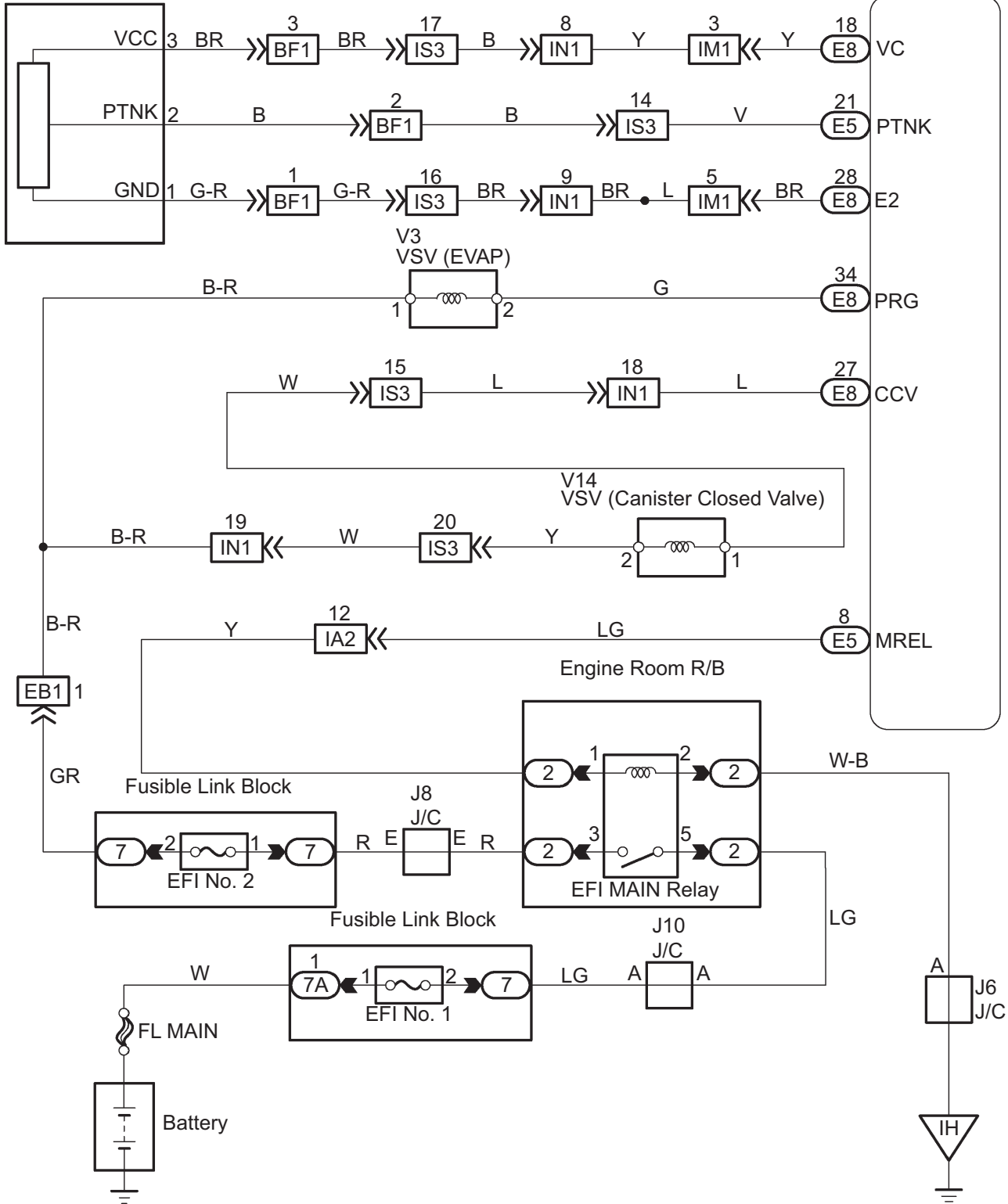
ES

Related DTCs

DTCs	Monitoring Item
P0441	EVAP VSV stuck closed EVAP VSV stuck open
P0442	EVAP small leak (0.04 inch)
P0446	Vent valve (CCV) stuck closed CCV stuck open
P0451	Fuel tank pressure (FTP) sensor malfunction
P0452	FTP sensor low output
P0453	FTP sensor high output
P0455	EVAP gross leak
P0456	EVAP small leak (0.02 inch)

WIRING DIAGRAM

V11
Vapor Pressure Sensor



HINT:

Read 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 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.

1**CHECK OTHER DTC OUTPUT (IN ADDITION TO DTC P041, P0442, P0446 AND/OR P0456)****Result**

Display (DTC output)	Proceed to
Only P0441, P0442, P0446 and /or P0456 are output	A
P0451, P0452 and P453 are output	B

HINT:

If any other DTCs besides P0441, P0442, P0446 and/or P0456 are output, perform the troubleshooting for those DTCs first (reference: P0451, P0452, P0453 are vapor pressure sensor malfunctions).

B**GO TO RELEVANT DTC CHART****A****2****CHECK CURRENT AND PENDING DTC**

- Check current DTCs. Select the intelligent tester menus: DIAGNOSIS, ENHANCED OBDII, DTC INFO and CURRENT DTCS.
- Check pending DTCs. Select the intelligent tester menus: DIAGNOSIS, ENHANCED OBDII, DTC INFO and PENDING DTCS.

Result

Current DTC	Pending DTC	Conclusion
Set	Set	System has been malfunctioning. Problem can be specified.
Set	-	System was malfunctioning in previous driving cycle. Problem may be specified.
-	Set	System is malfunctioning. This is intermittent problem and caused by fuel tank cap loosening. Otherwise, this problem may be difficult to eliminate.

HINT:

- The ECM stores the current DTC and illuminates the MIL when an emission-related component is malfunctioning in 2 consecutive driving cycles (2 trips). The MIL is turned OFF, if the component is functioning normally in 3 consecutive driving cycles. The ECM erases the current DTC, if the component is functioning normally in 40 consecutive driving cycles.
- The ECM stores the pending DTC when If the component is malfunctioning in present driving cycle (1 trip).
- The ECM erases the pending DTC, if the component is functioning normally in the next driving cycle.

NEXT**ES**

3 PREDICT POSSIBLE MALFUNCTION AREA (MANUAL OPERATION)

(a) Predict possible malfunction area using the matrix below.

EVAP DTC Matrix

Malfunction Area	DTCs
EVAP VSV stuck closed	P0441, P0466, P0455
EVAP VSV stuck open	P0441
EVAP small leak (0.04 inch)	P0442
CCV stuck closed	P0446
CCV stuck open	P0441, P0446, P0455
FTP sensor malfunction	P0451
FTP sensor low output	P0452
FTP sensor high output	P0453
Gross leak	P0441, P0455
EVAP small leak (0.02 inch)	P0442, P0456

DTCs	Suspected Malfunction Area
P0441 only	EVAP VSV stuck open
P0446 only	CCV (vent valve) stuck open
P0442 and/or P0456	Small leak

NEXT

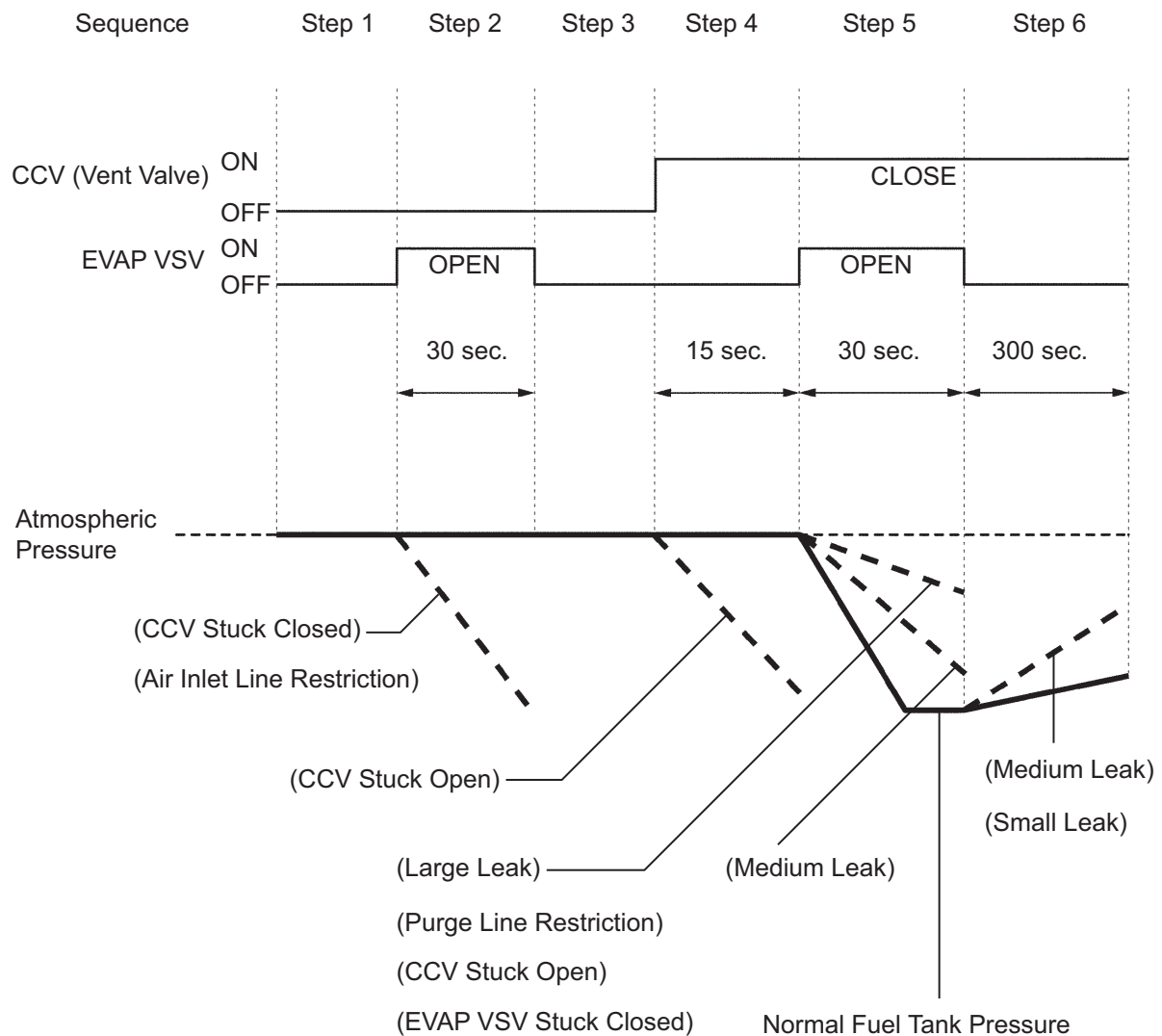
4 PERFORM EVAP SYSTEM CHECK

NOTICE:

The EVAP system check can be used for confirmation after the EVAP system repair. Check DTCs after performing the EVAP system check. If no pending DTC is set, the EVAP system is functioning normally and the repair is complete.

- Select the "mmHg" unit. Select the intelligent tester menus: DIAGNOSIS, SETUP, UNIT CONVERSION and VAPOR PRESS.
- Allow the engine to idle.
- Perform the EVAP system check to find a malfunction area. Select the intelligent tester menus: DIAGNOSIS, ENHANCED OBD II, SYSTEM CHECK and LEV II SYS CHECK.
- Read NOTICE and press ENTER.

Diagram of LEV II EVAP System Check



P

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HINT:

The EVAP system check is the most accurate when the following conditions are being set:

- Atmospheric pressure is 762 mmHg (sea level).
- The engine coolant and intake air temperatures are 4 to 35°C (40 to 90°F).
- The fuel tank level is 1/4 to 3/4.

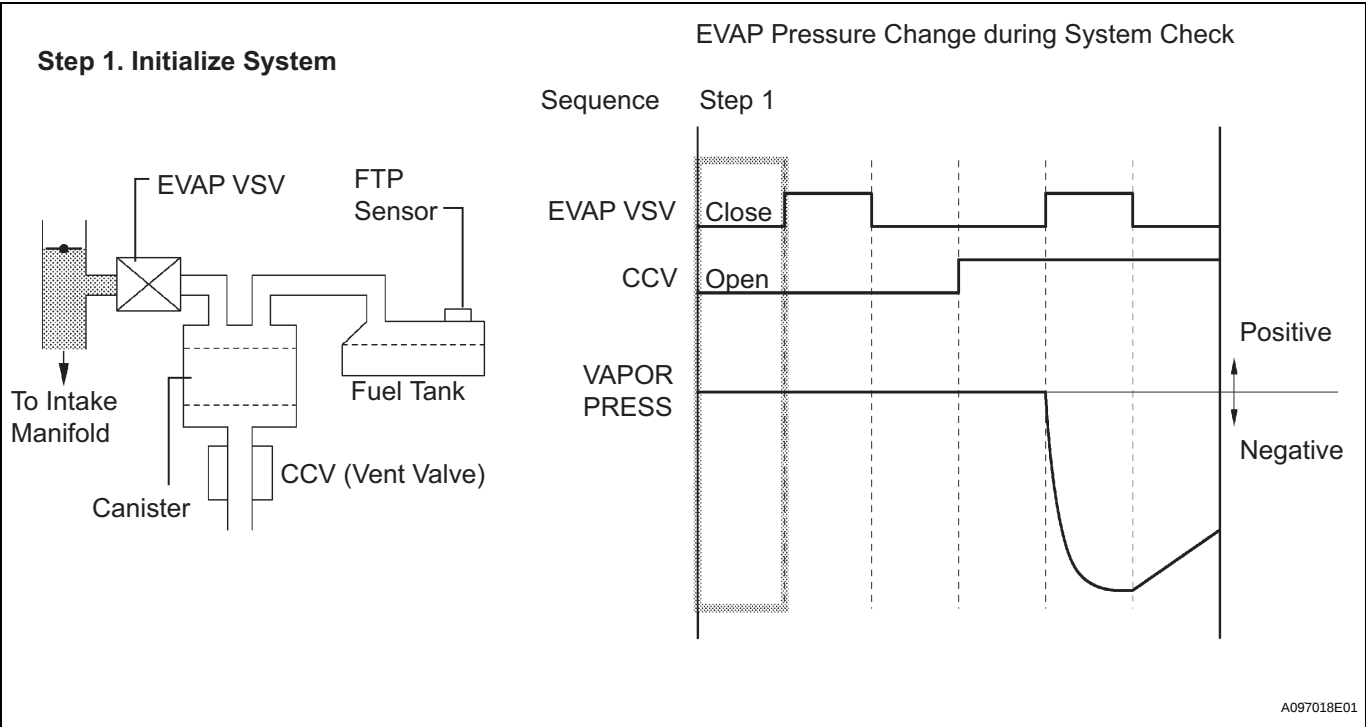
NEXT

5

PERFORM EVAP SYSTEM CHECK STEP 1 (INITIALIZE SYSTEM)

(a) Perform step 1.

ES



LEVII SYSTEM CHECK
Step 1. Initialize system

EVAP VSV.....CLOSE
CCV.....OPEN
VAPOR PRESS
.....762 mmHg-a
Time 030 seconds
Press [RIGHT]

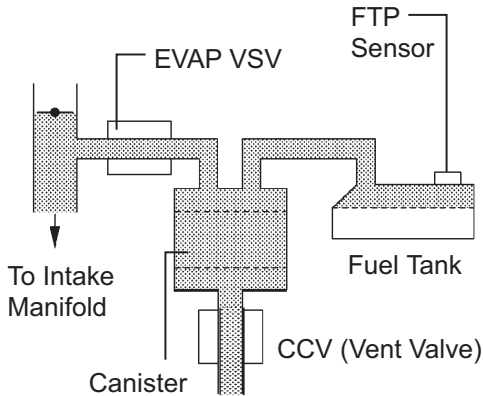
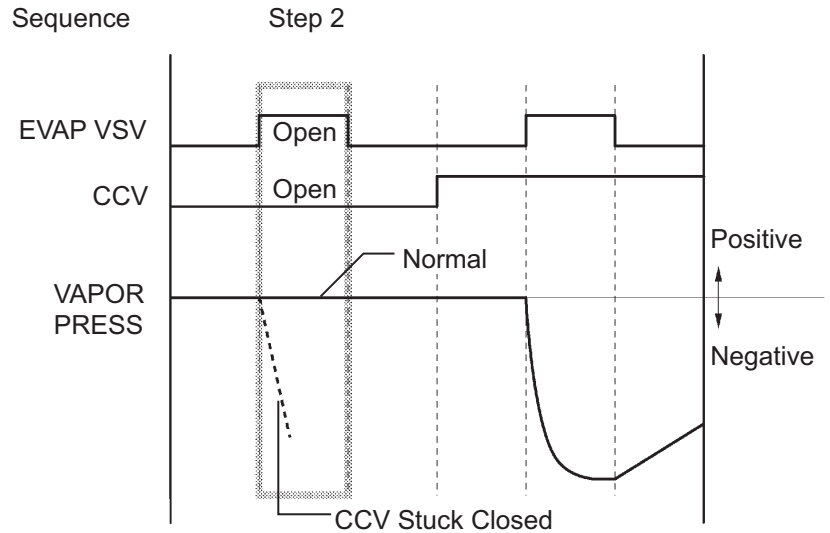
P A096682

(b) Wait for 30 seconds.

NEXT

6 PERFORM EVAP SYSTEM CHECK STEP 2 (CHECK FOR CCV)

(a) Press RIGHT to go to step 2.

Step 2. Check for CCV**EVAP Pressure Change during System Check**

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LEVII SYSTEM CHECK
Step 2. Check for CCV

EVAP VSV.....OPEN
 CCV.....OPEN
 VAPOR PRESS
762 mmHg-a
 Time 030 seconds
 Press [RIGHT]

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(b) Wait for 30 seconds and check VAPOR PRESS (EVAP pressure).

Result

VAPOR PRESS	Conclusion	Proceed to
Higher than 752 mmHg-a (-10 mmHg-g)	Trouble area has not been found yet.	OK
Lower than 752 mmHg-a (-10 mmHg-g)	Following problems are suspected: - Air inlet line restriction - Canister filter restriction - CCV (vent valve) stuck closed	NG

HINT:

In this step, the intake manifold pressure (vacuum) is applied to the EVAP system. However, the fuel tank pressure does not drop due to the CCV (vent valve) open.

NG

Go to step 11

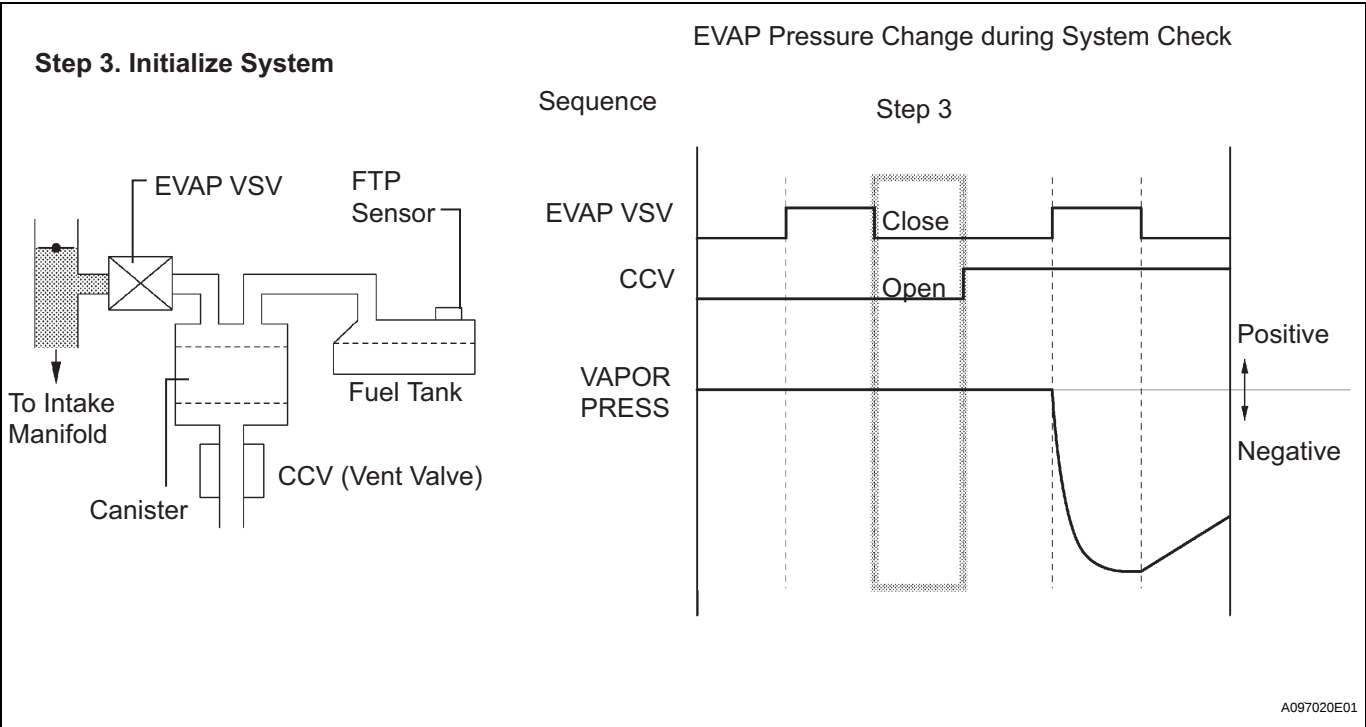
OK

7**PERFORM EVAP SYSTEM CHECK STEP 3 (INITIALIZE SYSTEM)**

(a) Press RIGHT to go to step 3.

ES

ES



LEVII SYSTEM CHECK
Step 3. Initialize system

EVAP VSV.....CLOSE
CCV.....OPEN
VAPOR PRESS
.....762 mmHg-g
Time 030 seconds

Press [RIGHT]

P

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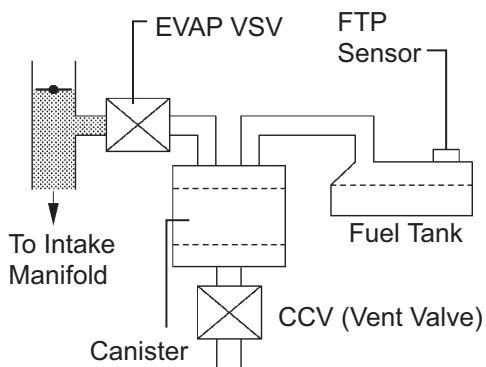
(b) Wait for 30 seconds.

NEXT

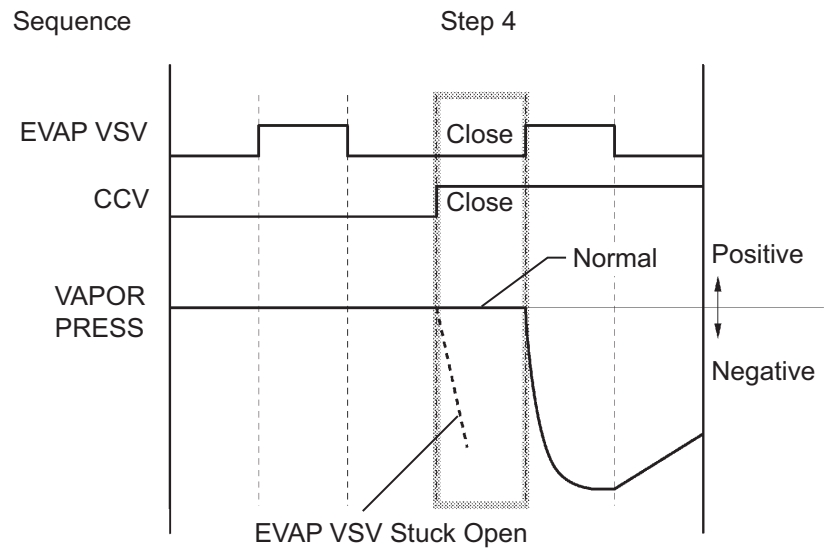
8

PERFORM EVAP SYSTEM CHECK STEP 4 (CHECK FOR EVAP VSV STUCK OPEN)

(a) Press RIGHT to go to step 4.

Step 4. Check for EVAP VSV

EVAP Pressure Change during System Check



A097021E01

LEVII SYSTEM CHECK
Step 4. Check for EVAP VSV
stuck open

EVAP VSV.....CLOSE
 CCVCLOSE
 VAPOR PRESS
762 mmHg-g
 Time 015 seconds
 Press [RIGHT]

P

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(b) Wait for 15 seconds and check VAPOR PRESS (EVAP pressure).

Result

VAPOR PRESS	Conclusion	Proceed to
Higher than 758 mmHg-a (-4 mmHg-g)	Trouble area has not been found yet	OK
Lower than 758 mmHg-a (-4 mmHg-g)	EVAP VSV stuck open	NG

NG

Go to step 14

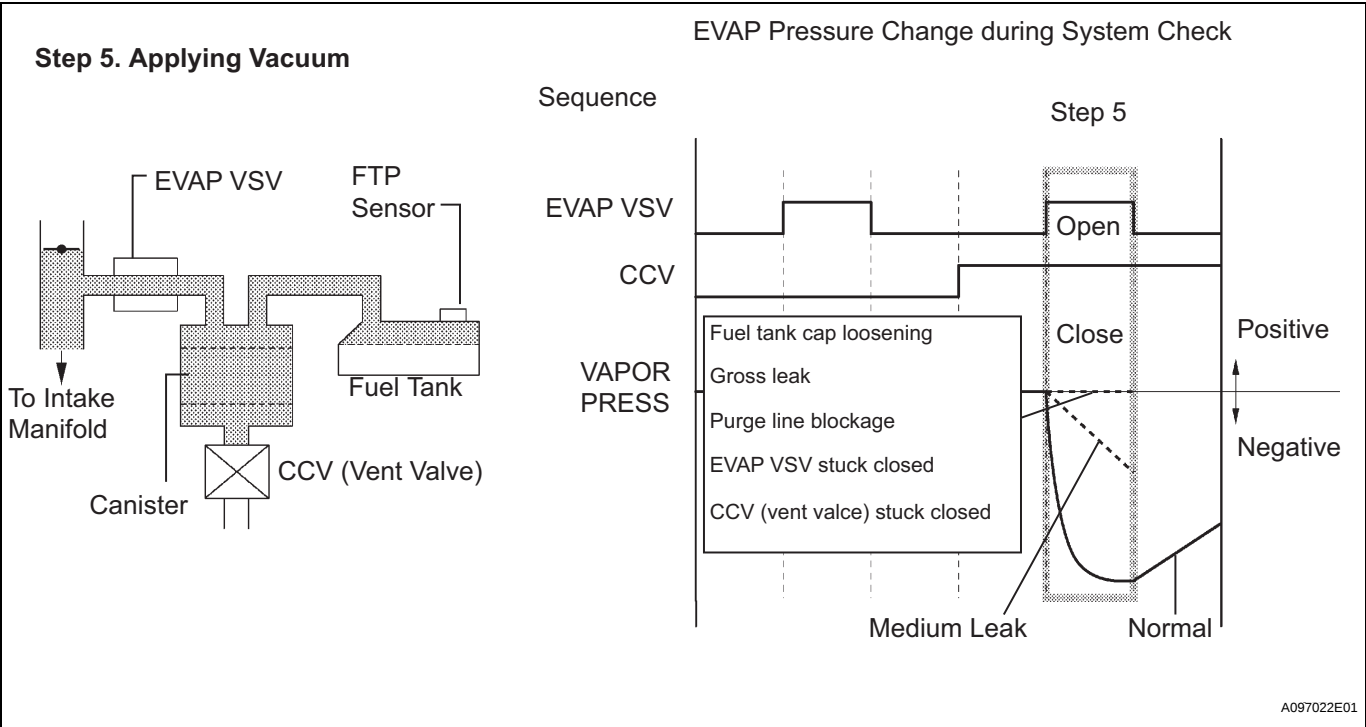
OK

9**PERFORM EVAP SYSTEM CHECK STEP 5 (APPLYING VACUUM)**

(a) Press RIGHT to go to step 5.

ES

ES



LEVII SYSTEM CHECK
Step 5. Applying vacuum

EVAP VSV.....OPEN
CCV.....CLOSE
VAPOR PRESS
.....740 mmHg-a
Time 030 seconds
Press [RIGHT]

P

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LEVII SYSTEM CHECK
5. Applying vacuum
To avoid the damage,
EVAP VSV was closed.
EVAP VSV.....CLOSE
CCV.....CLOSE
VAPOR PRESS
.....740 mmHg-a
Time 030 seconds
Press [RIGHT]

P

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ERROR
Scantool could not
activate the VSV
related to the EVAP
system.
Please check the
vehicle condition
and try again.
Press [ENTER]

P

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(b) Wait for 30 seconds and check VAPOR PRESS (EVAP pressure).

- If the pressure is lower than 740 mmHg-a (-22 mmHg-g), the intelligent tester closes the EVAP VSV.
- If the pressure is lower than 735 mmHg-a (-27 mmHg-g), the intelligent tester cancels the EVAP system check.

Result

VAPOR PRESS	Conclusion	Proceed to
Lower than 748 mmHg-a (-14 mmHg-g)	Trouble area has not been found yet.	A

VAPOR PRESS	Conclusion	Proceed to
756 to 768 mmHg-a (-6 to 6 mmHg-g)	Following problems are suspected: - Fuel tank cap loosening - Gross leak ?EVAP VSV stuck closed - CCV (vent valve) stuck open - Purge line blockage between fuel tank and canister	B
748 to 755 mmHg-a (-14 to -7 mmHg-g)	Medium leak	C

B

Go to step 15

C

Go to step 18

A

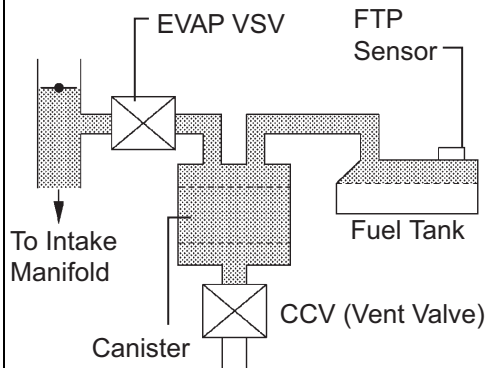
ES

10

PERFORM EVAP SYSTEM CHECK STEP 6 (LEAK CHECK FOR EVAP SYSTEM)

- (a) Press RIGHT to go to step 6 when the VAPOR PRESS (EVAP pressure) is lower than 742 mmHg-a (-20 mmHg-g).

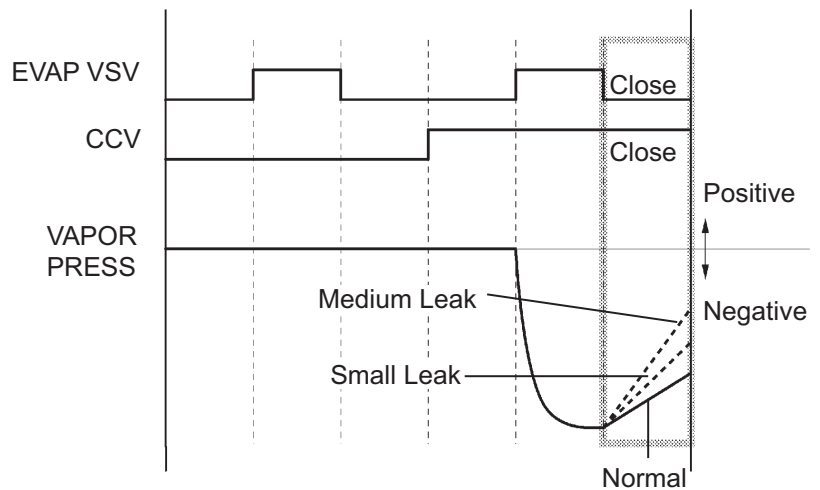
Step 6. Leak Check for EVAP System



EVAP Pressure Change during System Check

Sequence

Step 6



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LEVII SYSTEM CHECK

Step 6. Leak check for EVAP system

EVAP VSV.....CLOSE

CCV.....CLOSE

VAPOR PRESS

.....752 mmHg-g

Time 300 seconds

Press [RIGHT]

P

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- (b) Wait for 300 seconds and check VAPOR PRESS (EVAP pressure).

Result

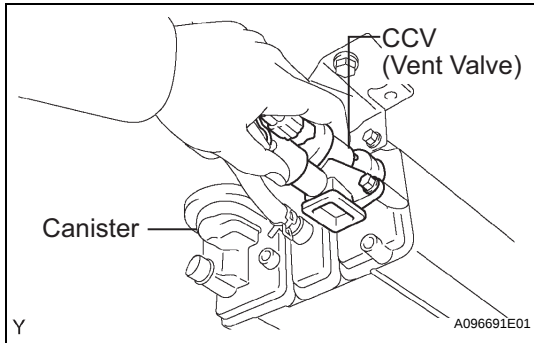
VAPOR PRESS	Conclusion	Proceed to
Less than 758 mmHg-a (-4 mmHg-g)	EVAP system is functioning normally	OK
Higher than 758 mmHg-a (-4 mmHg-g)	Leakage	NG

NG

Go to step 18

OK

GO TO STEP 40

11 CHECK CCV

- (a) Turn the ignition switch OFF.
- (b) Turn the ignition switch ON.
- (c) Switch the CCV (vent valve) using the intelligent tester. Select the intelligent tester menus: DIAGNOSIS, ENHANCED OBD II, ACTIVE TEST and CAN CTRL VSV.
- (d) Touch the CCV and check the operation during switching the CCV.

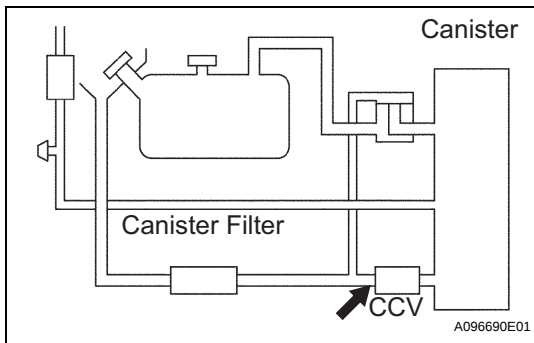
Result

CCV (Vent Valve)	Conclusion	Proceed to
CCV is operated	CCV is functioning normally.	OK
CCV is not operated	CCV is malfunctioning.	NG

NG

Go to step 25

OK

12 CHECK AIR INLET LINE RESTRICTION

- (a) Disconnect the air inlet line from the CCV.
- (b) Remove and reinstall the fuel tank cap to release the fuel tank pressure.
- (c) Allow the engine to idle.

- (d) Perform step 2 of the EVAP system check.
- (e) Wait for 30 seconds and check VAPOR PRESS (EVAP pressure).

Result

VAPOR PRESS	Conclusion	Proceed to
Higher than 752 mmHg-a (-10 mmHg-g)	Blockage in canister filter	A
Lower than 752 mmHg-a (-10 mmHg-g)	Blockage in CCV (vent valve) or canister	B

- (f) Reconnect the air inlet line to the CCV.

B

Go to step 13

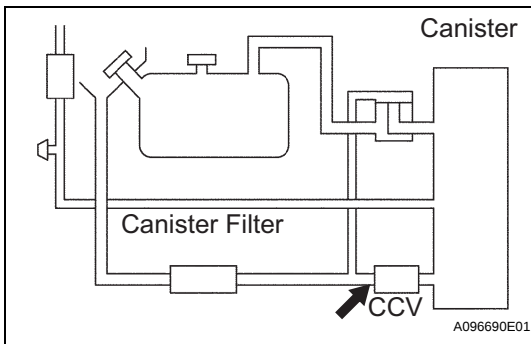
LEVII SYSTEM CHECK
Step 2. Check for CCV

EVAP VSV.....OPEN
CCV.....OPEN
VAPOR PRESS
.....762 mmHg-a
Time 030 seconds

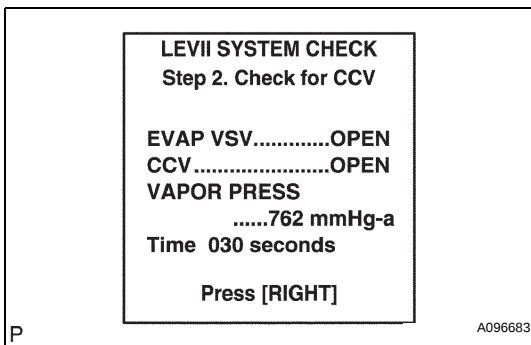
Press [RIGHT]

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A

REPLACE CANISTER FILTER**13 CHECK CANISTER BLOCKAGE**

- (a) Turn the ignition switch OFF.
- (b) Remove the CCV from the canister.
- (c) Remove and reinstall the fuel tank cap to release the fuel tank pressure.
- (d) Allow the engine to idle.



- (e) Perform step 2 of the EVAP system check.
- (f) Wait for 30 seconds and check VAPOR PRESS (EVAP pressure).

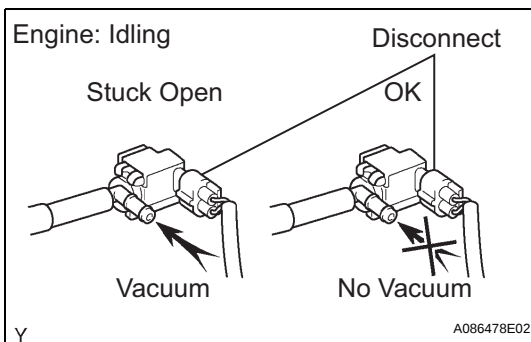
Result

VAPOR PRESS	Conclusion	Proceed to
Higher than 752 mmHg-a (-10 mmHg-g)	CCV (vent valve) stuck closed	A
Lower than 752 mmHg-a (-10 mmHg-g)	Blockage in canister	B

B

CHECK AND REPLACE CHARCOAL CANISTER ASSEMBLY

A

REPLACE CCV (VENT VALVE)**14 CHECK EVAP VSV (FOR EVAP VSV STUCK OPEN)**

- (a) Turn the ignition switch OFF.
- (b) Disconnect the purge hose of the canister from the EVAP VSV.
- (c) Disconnect the EVAP VSV connector.
- (d) Allow the engine to idle.
- (e) Touch the EVAP VSV port to check the vacuum.

Result

EVAP VSV	Conclusion	Proceed to
Vacuum is applied.	EVAP VSV is malfunctioning.	A
No vacuum is applied.	Electrical circuit of EVAP VSV is malfunctioning.	B

ES

B

Go to step 29

A

REPLACE EVAP VSV

15

CHECK FUEL TANK CAP ASSEMBLY

- (a) Remove the fuel tank cap and reinstall it until a few click sound is heard.
- (b) Clear the DTCs.
- (c) Check pending DTCs after the EVAP system check if no pending DTC is set, the DTC(s) was set due to the fuel cap loosening.
If necessary, replace the fuel cap.

NG

Go to step 16

OK

REPAIR IS COMPLETE

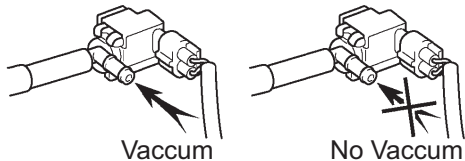
16

CHECK EVAP VSV (FOR EVAP VSV STUCK CLOSED)

If EVAP VSV is functioning normally:

VSV is ON

VSV is OFF



Y

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- (a) Disconnect the purge hose of the canister from the EVAP VSV.
- (b) Allow the engine to idle.
- (c) Switch the EVAP VSV using the intelligent tester. Select the intelligent tester menus: DIAGNOSIS, ENHANCED OBD II, ACTIVE TEST and EVAP VSV.
- (d) Touch the EVAP VSV port to check the vacuum.
- Result

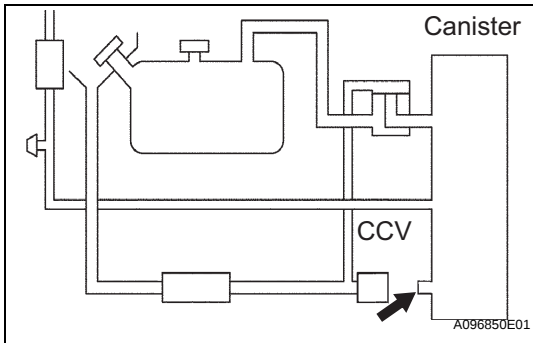
EVAP VSV	Conclusion	Proceed to
Vacuum is applied when EVAP VSV is ON. No vacuum is applied when EVAP VSV is OFF.	EVAP VSV is functioning normally.	OK
No vacuum is applied when EVAP VSV is ON.	Electrical circuit of EVAP VSV is malfunctioning.	NG

HINT:
The EVAP VSV can be tested with the EVAP Test Equipment (go to step 39).

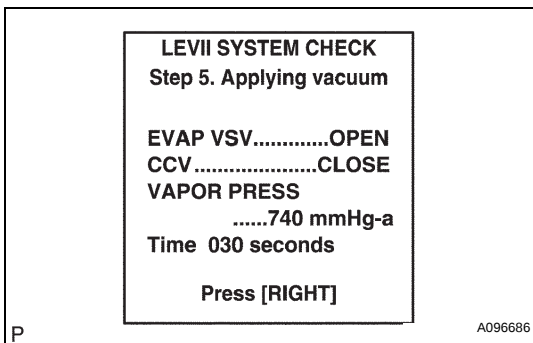
NG

Go to step 31

OK

17 CHECK CCV (FOR CCV STUCK OPEN)

- Turn the ignition switch OFF.
- Remove the CCV (vent valve) and plug the canister.
- Allow the engine to idle.



- Apply vacuum to the EVAP system with the EVAP system check. Perform step 5 "Applying Vacuum".
- Wait for 30 seconds and check the VAPOR PRESS (EVAP pressure).

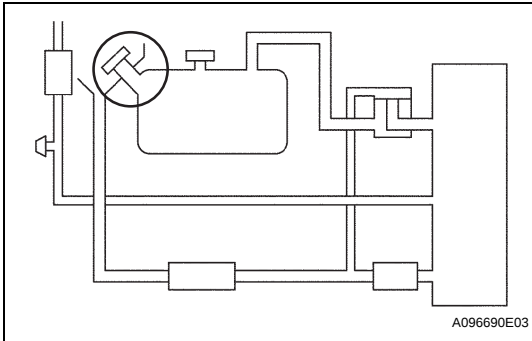
Result

VAPOR PRESS	Conclusion	Proceed to
Lower than 747 mmHg-a (-15 mmHg-g)	CCV (vent valve) stuck open	A
Higher than 747 mmHg-a (-15 mmHg-g)	Blockage in canister Blockage in purge line (Fuel tank - Canister) Blockage in purge line (Fuel tank - EVAP VSV)	B

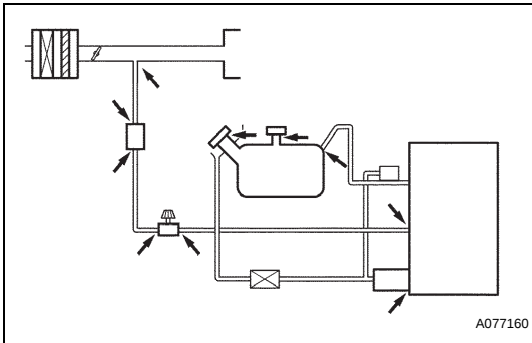
B**Go to step 20****A****GO TO STEP 24****18 CHECK FUEL TANK CAP ASSEMBLY**

- Remove the fuel tank cap and reinstall it until a few click sound is heard.
- Clear the DTCs.
- Check pending DTCs after the EVAP system check. If no pending DTC is set, the DTC(s) was set due to the fuel cap loosening.
If necessary, replace the fuel cap.

NG**Go to step 19****OK****REPAIR IS COMPLETE****ES**

19 CHECK FILLER NECK DAMAGE

- (a) Remove the fuel tank cap.
 - (b) Visually inspect the filler neck for damage.
 - (c) Reinstall the fuel tank cap.
- HINT:
A leak point may be found with the EVAP Test Equipment (go to step 36).

NG**REPLACE FUEL TANK INLET PIPE****OK****20 CHECK PURGE LINE (CANISTER - FUEL TANK)**

- (a) Check that the pipes and hoses are connected correctly.
- (b) Check that the pipes and hoses are not loose or disconnected.
- (c) Check the pipes and hoses have no damage or blockage.

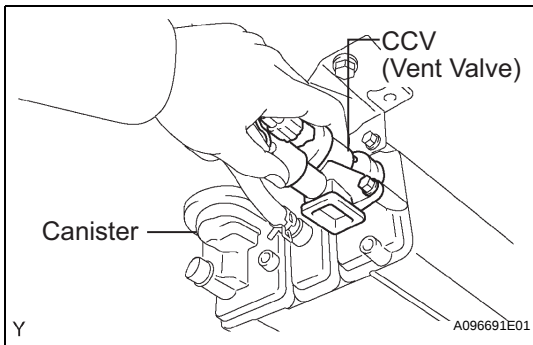
NG**REPLACE PURGE HOSE****OK****21 CHECK PURGE LINE (CANISTER - EVAP VSV)**

- (a) Check that the pipes and hoses are connected correctly.
- (b) Check that the pipes and hoses are not loose or disconnected.
- (c) Check the pipes and hoses have no damage or blockage.

B**REPLACE PURGE HOSE****OK****22 INSPECT CANISTER****NG****REPLACE CANISTER****OK**

23 INSPECT FUEL TANK ASSEMBLY

- (a) Check that the fuel tank has no damage.
- (b) Check the fuel inlet pipe has no damage.
- (c) Check leakage from the fuel pump unit

NG**REPAIR OR REPLACE DEFECTIVE OR
DAMAGED PARTS****OK****GO TO STEP 40****ES****24 CHECK CCV**

- (a) Stop the engine and turn the ignition switch ON.
- (b) Switch the CCV (vent valve) using the intelligent tester. Select the intelligent tester menus: DIAGNOSIS, ENHANCED OBD II, ACTIVE TEST and CAN CTRL VSV.
- (c) Touch the CCV and check the operation during switching the CCV.

Result

CCV (Vent Valve)	Conclusion	Proceed to
CCV is operated	Electrical circuit of CCV is functioning normally.	A
CCV is not operated	Electrical circuit of CCV is malfunctioning.	B

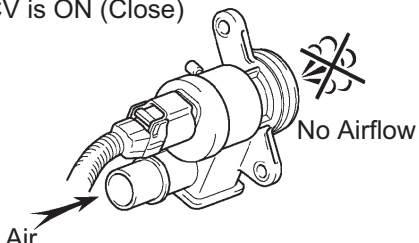
B**Go to step 26****A**

25

CHECK CCV

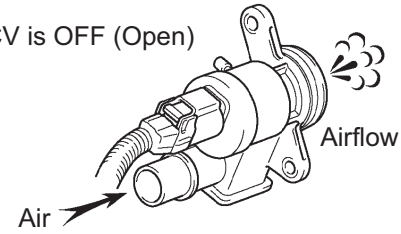
If CCV (vent valve) is functioning normally:

CCV is ON (Close)



No Airflow

CCV is OFF (Open)



Airflow

Y

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- (a) Turn the ignition switch OFF.
- (b) Remove the CCV (vent valve).
- (c) Connect the CCV connector.
- (d) Turn the ignition switch ON.
- (e) Switch the CCV using the intelligent tester. Select the intelligent tester menus: DIAGNOSIS, ENHANCED OBD II, ACTIVE TEST and CAN CTRL VSV.
- (f) Apply air to the CCV port using an air gun and check the airflow.

Result

CCV (Vent Valve)	Conclusion	Proceed to
Air flows when CCV is OFF (open). Air does not flows when CCV is ON (close).	CCV is functioning normally. Electrical circuit of CCV is malfunctioning.	A
Air flows when CCV is ON (close). Air does not flows when CCV is OFF (open).	CCV is malfunctioning.	B

B

REPLACE CCV

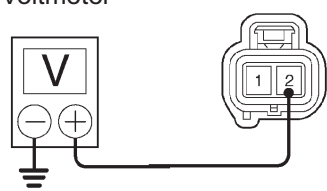
A

26

CHECK WIRE HARNESS (CCV - POWER SOURCE)

Wire Harness Side Connector of CCV

Voltmeter



A096694E01

- (a) Turn the ignition switch OFF.
- (b) Disconnect the CCV connector.
- (c) Turn the ignition switch ON.
- (d) Measure the voltage between terminal 2 of the wire harness side connector and body ground.

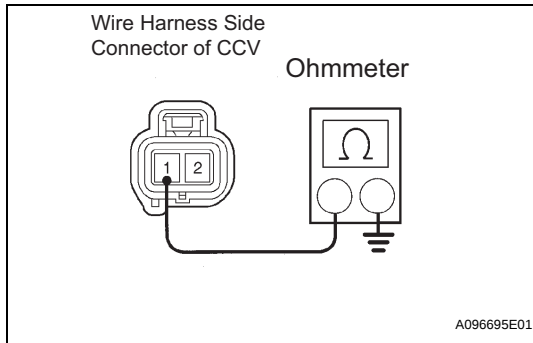
Result

Voltage	Conclusion	Proceed to
Battery voltage	Wire harness (CCV - Power source) is OK.	OK
0 to 3 V	Wire harness (CCV - Power source) is short circuit.	NG

B

REPAIR OR REPLACE HARNESS OR CONNECTOR

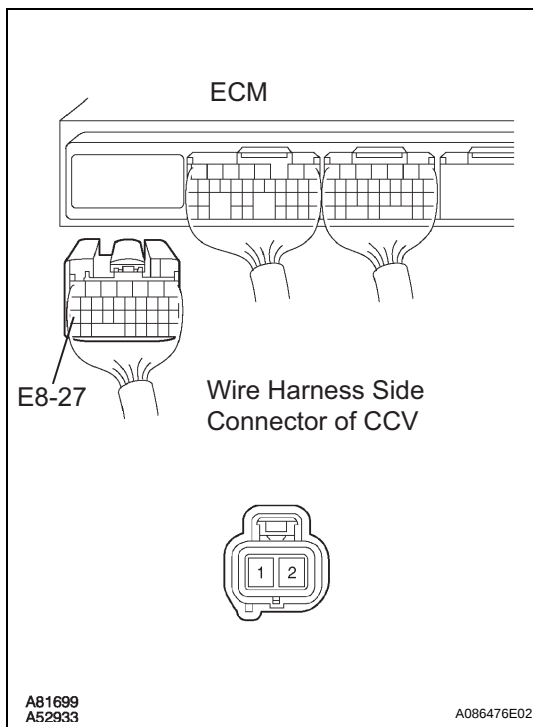
OK

27 CHECK WIRE HARNESS AND CONNECTOR (CCV - ECM)

- (a) Switch the CCV using the intelligent tester. Select the intelligent tester menus: DIAGNOSIS, ENHANCED OBD II, ACTIVE TEST and CAN CTRL VSV.
- (b) Measure the resistance between terminal 1 of the wire harness side connector and body ground.

Result

Resistance	Conclusion	Proceed to
More than 10 k Ω when CCV is OFF. Less than 10 Ω when CCV is ON.	ECM and wire harness (CCV - ECM) are OK. CCV is malfunctioning.	OK
No change	Either of wire harness (CCV - ECM) or ECM is malfunctioning.	NG

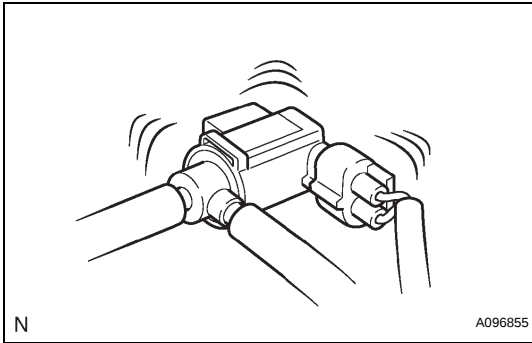
NG**Go to step 28****OK****ES****REPLACE CCV****28 CHECK HARNESS AND CONNECTOR (CCV - ECM)**

- (a) Check the wire harness between the ECM and CCV.
- (b) Turn the ignition switch OFF.
- (c) Disconnect the E8 ECM connector.
- (d) Measure the resistance between the CCV and ECM wire harness side connectors.

Standard resistance

Tester Connection	Specified Condition
1 (CCV) - E8-27 (ECM)	Less than 10 Ω
1 (CCV) - Body ground	More than 10 k Ω

NG**REPAIR OR REPLACE HARNESS OR CONNECTOR****OK****REPLACE ECM**

29 CHECK EVAP VSV

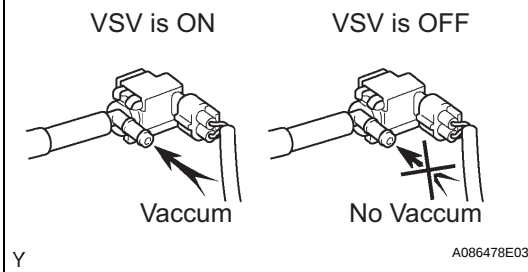
- Turn the ignition switch ON.
- Switch the EVAP VSV using the intelligent tester. Select the intelligent tester menus: DIAGNOSIS, ENHANCED OBD II, ACTIVE TEST and EVAP VSV (Alone).
- Listen to click sounds to check the EVAP VSV operation.

Result

EVAP VSV	Conclusion	Proceed to
Operated	Electrical circuit of EVAP VSV is functioning normally.	OK
Not operated	Electrical circuit of EVAP VSV is malfunctioning.	NG

NG**Go to step 32****OK****30 CHECK EVAP VSV**

If EVAP VSV is functioning normally:



- Disconnect the purge hose of the canister from the EVAP VSV.
- Start the engine.
- Switch the EVAP VSV using the intelligent tester. Select the intelligent tester menus: DIAGNOSIS, ENHANCED OBD II, ACTIVE TEST and EVAP VSV.
- Touch the EVAP VSV port to check the vacuum.

Result

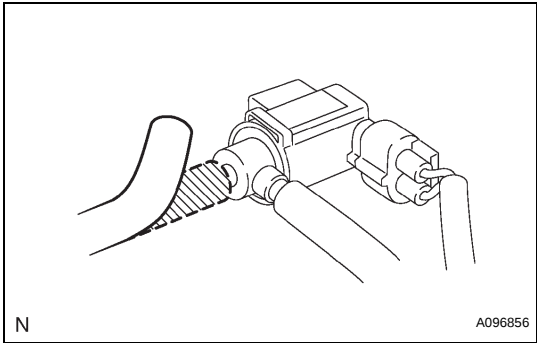
EVAP VSV	Conclusion	Proceed to
Vacuum is applied when EVAP VSV is ON. No vacuum is applied when EVAP VSV is OFF.	EVAP VSV is functioning normally.	OK
No vacuum is applied when EVAP VSV is ON.	Electrical circuit of EVAP VSV is malfunctioning.	NG

HINT:

The EVAP VSV can be tested with the EVAP Test Equipment (go to step 39).

NG**Go to step 32****OK**

31 CHECK PURGE LINE (EVAP VSV - THROTTLE BODY)



- (a) Check that the vacuum hoses are connected correctly.
- (b) Check that the vacuum hoses are not loose or disconnected.
- (c) Check the vacuum hoses and tubes for cracks, holes, damage, or blockage.

NG

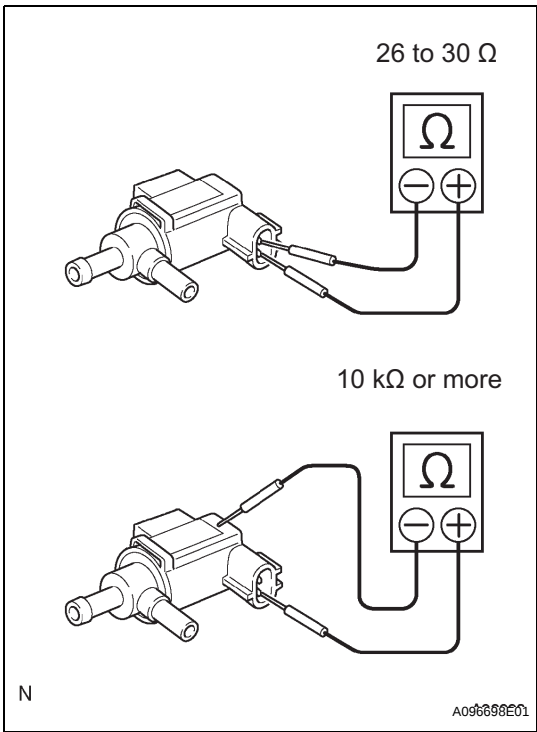
REPLACE PURGE HOSE

OK

ES

REPLACE EVAP VSV

32 INSPECT EVAP VSV



- (a) Turn the ignition switch OFF.
- (b) Disconnect the EVAP VSV connector.
- (c) Measure the resistance of the EVAP VSV.

Standard resistance

Tester Connection	Specified Condition
Between terminals	26 to 30 Ω at 20°C (68°F)
Each terminal - Body ground	10 k Ω or more

NG

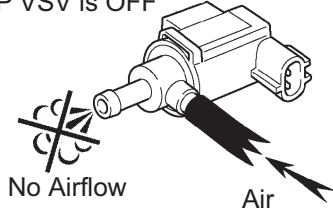
REPLACE EVAP VSV

OK

33 INSPECT EVAP VSV

If EVAP VSV is functioning normally:

EVAP VSV is OFF



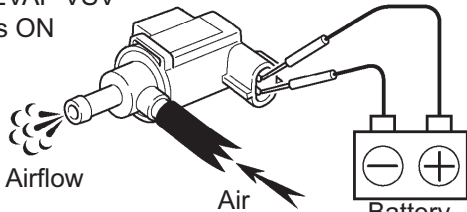
N

A096920E01

- (a) Remove the EVAP VSV.
- (b) Apply air to the EVAP VSV using an air gun, check the airflow.

If EVAP VSV is functioning normally:

EVAP VSV
is ON



N

A096700E01

- (c) Apply battery positive voltage across the terminals.
- (d) Apply air to the EVAP VSV using an air gun, check the airflow.

Result

EVAP VSV	Conclusion	Proceed to
Air does not flow when EVAP VSV is OFF. Air flows when EVAP VSV is ON.	EVAP VSV is functioning normally.	OK
Air flows when EVAP VSV is OFF. Air does not flow when EVAP VSV is ON.	Electrical circuit of EVAP VSV is malfunctioning.	NG

NG

REPLACE EVAP VSV

OK

34 CHECK HARNESS AND CONNECTOR (EVAP VSV - POWER SOURCE)

Wire Harness Side Connector of EVAP VSV



A096692E01

- (a) Turn the ignition switch ON.
- (b) Measure the voltage between the terminal 1 of the wire harness side and body ground.

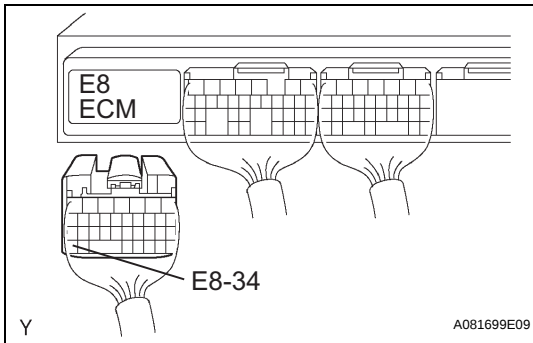
Result

Voltage	Conclusion	Proceed to
Battery voltage	Wire harness (EVAP VSV - Power source) is OK.	OK
0 to 3 V	Wire harness (EVAP VSV - Power source) is short circuit.	NG

NG

REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

35 CHECK HARNESS AND CONNECTOR (EVAP VSV - ECM)

- (a) Turn the ignition switch OFF.
- (b) Disconnect the E8 ECM connector.
- (c) Turn the ignition switch ON.
- (d) Measure the voltage between the terminal 34 of the wire harness side and body ground.

Result

Voltage	Conclusion	Proceed to
Battery voltage	Wire harness (EVAP VSV - ECM) is OK.	OK
0 to 3 V	Wire harness (EVAP VSV - ECM) is short circuit.	NG

NG**REPAIR OR REPLACE HARNESS OR CONNECTOR****OK****REPLACE ECM****36 CHECK FUEL TANK CAP ASSEMBLY**

- (a) Connect the fuel tank cap to the gas cap adaptor.
- (b) Connect the pressure hose from the pump to the gas cap adaptor.
- (c) Plug the gas cap adaptor port.
- (d) Turn the pump ON and pressurize the gas cap adaptor by 24 - 28 mmHg. If the pressure does not reach to 24 mmHg within 45 seconds, stop the pump. The fuel tank cap is malfunctioning.
- (e) Turn the pump OFF and seal the pressure line to maintain the pressure.
- (f) Measure the pressure change for 2 minutes. If the pressure drops to lower than 15 mmHg, the fuel tank cap is malfunctioning.

Standard:

The fuel tank cap keeps the pressure that is 15 mmHg or higher.

NG**REPLACE FUEL TANK CAP ASSEMBLY****OK****37 CHECK LEAK****NOTICE:**

DO NOT apply the EVAP system to the pressure that is higher than 35 mmHg. The EVAP system will be damaged.

ES

ES

- (a) Connect the pressure line from the pump to the EVAP service port.
- (b) Turn the ignition switch ON but the engine is not running.
- (c) Turn the CCV (vent valve) is ON (close) using the intelligent tester. Select the intelligent tester menus: DIAGNOSIS, ENHANCED OBD II, ACTIVE TEST and CAN CTRL VSV.
- (d) Turn the pump ON and pressurize the EVAP system by 24 - 28 mmHg.
- (e) Turn the pump OFF and seal the pressure line to maintain the pressure. If the pressure does not reach to 24 mmHg within 45 seconds, stop the pump. A leakage is in the EVAP system. If the system has a small leak, a whistling sound may be heard.
- (f) Measure the pressure change for 2 minutes. If the pressure drops to lower than 15 mmHg, a leakage is in the EVAP system.

Standard:

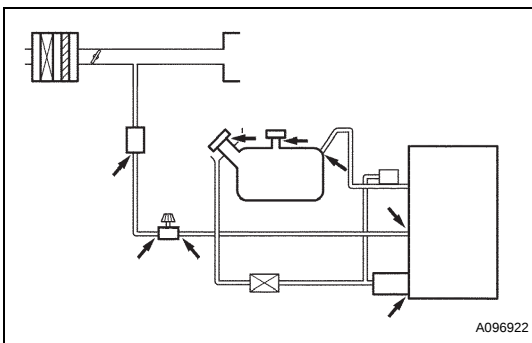
The EVAP system keeps the pressure that is 15 mmHg or higher.

NG

Go to step 38

OK

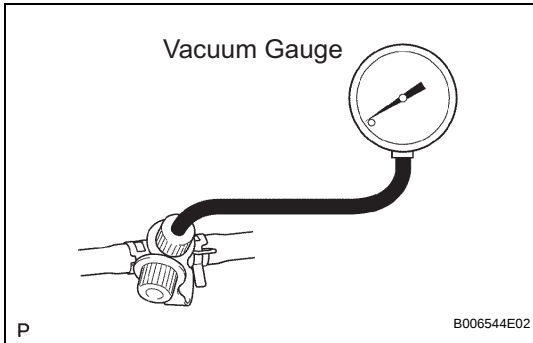
NO LEAKAGE IN EVAP SYSTEM

38 LOOK FOR LEAK POINT

- (a) Apply the soapy water on suspected components.
- (b) Turn the CCV (vent valve) is ON (close) using the intelligent tester. Select the intelligent tester menus: DIAGNOSIS, ENHANCED OBD II, ACTIVE TEST and CAN CTRL VSV.
- (c) Turn the pump ON and pressurize the EVAP system by 24 - 28 mmHg.
- (d) Turn the pump OFF and seal the pressure line to maintain the pressure. If the pressure does not reach to 24 mmHg within 45 seconds, stop the pump.
- (e) Check bubbles to find the leak point:
 - EVAP service port
 - Canister
 - Hose connections/Lines
 - Fuel cap
 - Fuel filler neck
 - Purge line
 - EVAP VSV
 - CCV (vent valve)
 - Fuel pump sending unit
- (f) Repair or replace the leak component.
- (g) Perform the EVAP system check to confirm no leak.

NEXT

GO TO STEP 4

39 CHECK EVAP VSV

- (a) Connect the vacuum gauge to the EVAP service port.
- (1) Start the engine.
 - (2) Switch the EVAP VSV using the intelligent tester. Select the intelligent tester menus: DIAGNOSIS, ENHANCED OBD II, ACTIVE TEST and EVAP VSV.
 - (3) Check the vacuum when switching the EVAP VSV. If the vacuum gauge indicates negative value when the EVAP VSV is ON, the EVAP VSV is functioning normally.

OK:

The vacuum gauge indicates negative value when the EVAP VSV is ON.

NG

Go to step 31

OK

GO TO STEP 17

40 CHECK MONITOR STATUS AND DTC

- (a) Clear DTCs.
- (b) Perform a drive pattern test (See page [ES-16](#))
- (c) Check that the monitor result is PASS.
- (d) Confirm no pending DTC.

NEXT

REPAIR IS COMPLETE

ES

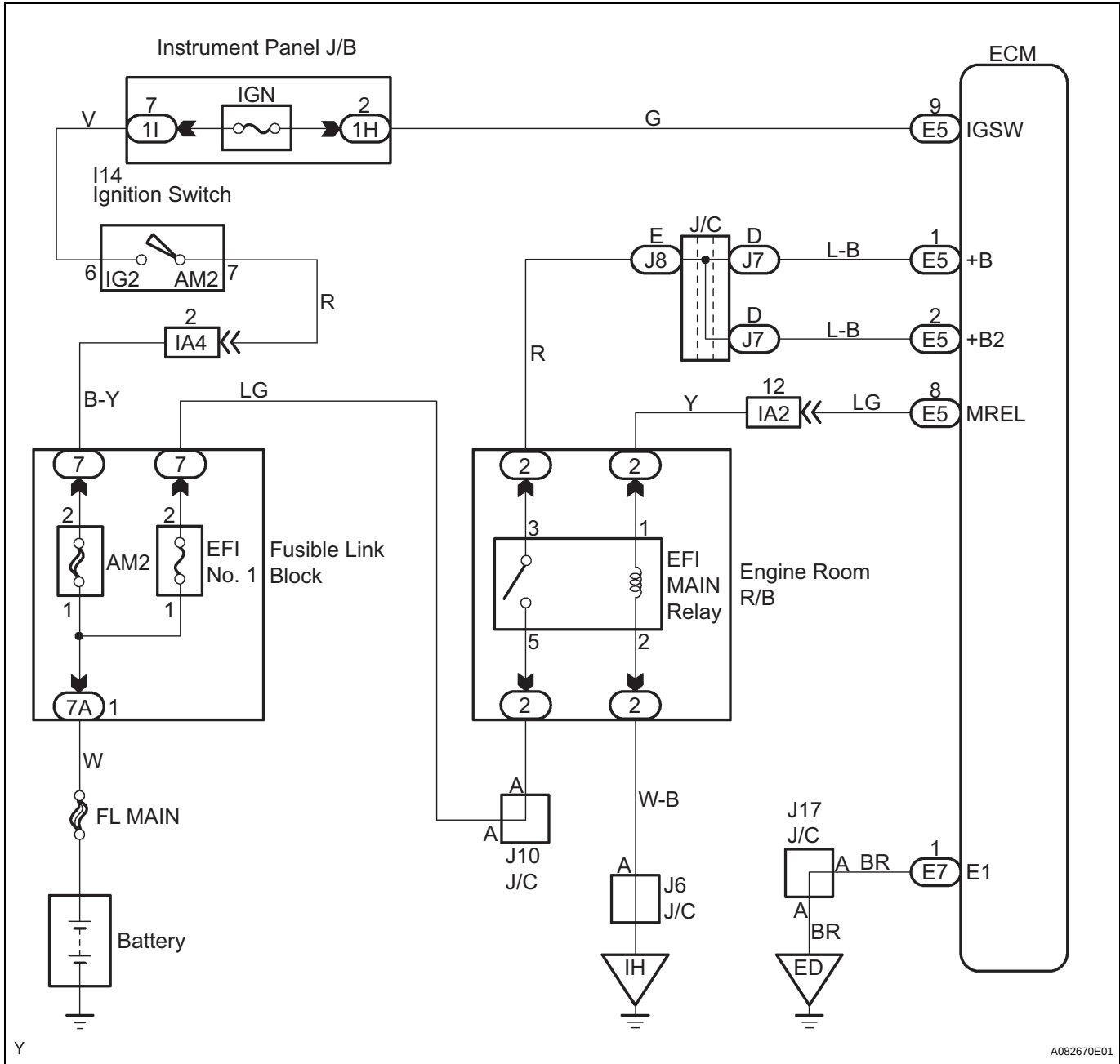
ECM Power Source Circuit

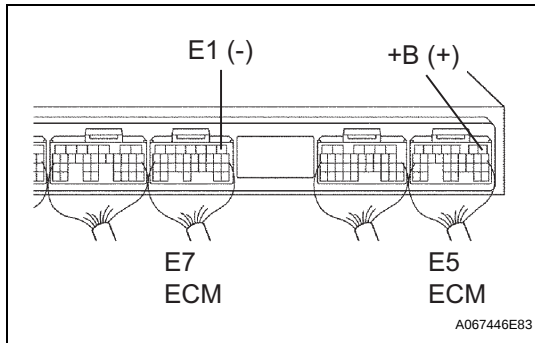
DESCRIPTION

When the ignition switch is turned ON, battery voltage is applied to terminal IGSW of the ECM. The ECM "MREL" output signal causes current to flow to the coil, closing the contacts of the EFI relay (marked: EFI) and supplying power to terminal +B of the ECM.

If the ignition switch is turned OFF, the ECM holds the EFI relay ON for a maximum of 2 seconds to allow the initial setting of the throttle valve.

WIRING DIAGRAM



1 INSPECT ECM (+B VOLTAGE)

- (a) Turn the ignition switch ON.
 (b) Measure the voltage of the ECM connectors.

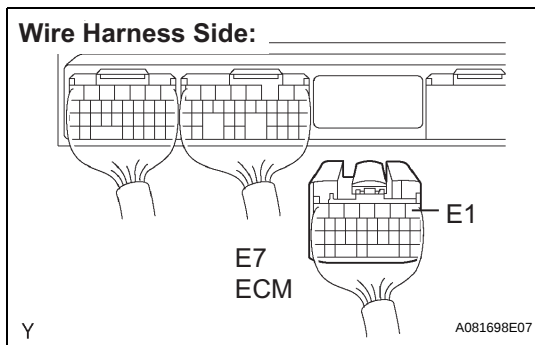
Standard voltage

Tester Connection	Specified Condition
E5-1 (+B) - E7-1 (E1)	9 to 14 V

OK

**PROCEED TO NEXT CIRCUIT INSPECTION
SHOWN ON PROBLEM SYMPTOMS TABLE**

NG

2 CHECK HARNESS AND CONNECTOR (ECM - BODY GROUND)

- (a) Disconnect the E7 ECM connector.
 (b) Measure the resistance of the wire harness side connectors.

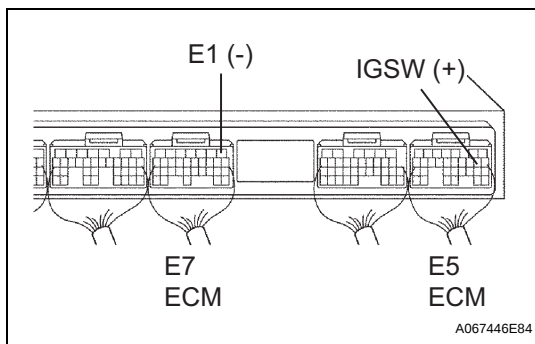
Standard resistance

Tester Connection	Specified Condition
E7-1 (E1) - Body ground	Below 1 Ω

NG

**REPAIR OR REPLACE HARNESS OR
CONNECTOR**

OK

3 INSPECT ECM (IGSW VOLTAGE)

- (a) Turn the ignition switch ON.
 (b) Measure the voltage of the ECM connectors.

Standard voltage

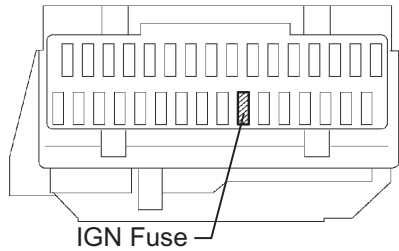
Tester Connection	Specified Condition
E5-9 (IGSW) - E7-1 (E1)	9 to 14 V

OK

Go to step 6

NG

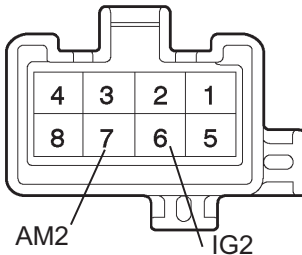
ES

4 CHECK IGN FUSE**Instrument Panel J/B:**

A081918E01

- (a) Remove the IGN fuse from the instrument panel J/B.
 (b) Measure the resistance of the IGN fuse.

Standard resistance:
Below 1 Ω

NG**REPLACE IGN FUSE****OK****5 INSPECT IGNITION OR STARTER SWITCH ASSEMBLY****I14
Ignition
Switch**

A056879E25

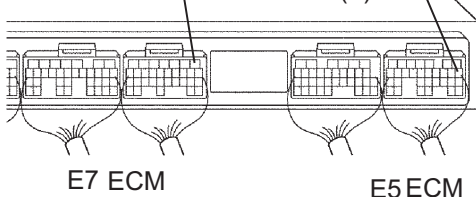
- (a) Measure the resistance of the switch terminals shown in the chart below.

Standard resistance

Tester Connection	Switch Condition	Specified Condition
6 (IG2) - 7 (AM2)	LOCK	10 k Ω or higher
6 (IG2) - 7 (AM2)	ON	Below 1 Ω

NG**REPLACE IGNITION OR STARTER SWITCH ASSEMBLY****OK**

CHECK AND REPLACE HARNESS AND CONNECTOR (BATTERY - IGNITION SWITCH, IGNITION SWITCH - ECM)

6 INSPECT ECM (MREL VOLTAGE)**E1 (-)****MREL (+)****E7 ECM****E5 ECM**

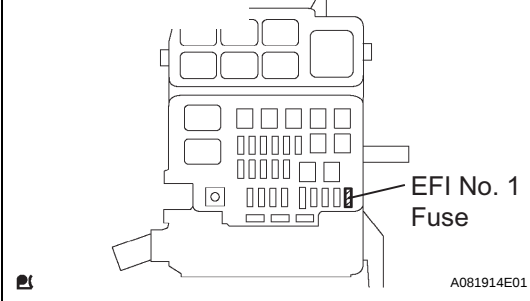
A067446E85

- (a) Turn the ignition switch ON.
 (b) Measure the voltage of the ECM connectors.

Standard voltage

Tester Connection	Specified Condition
E5-8 (MREL) - E7-1 (E1)	9 to 14 V

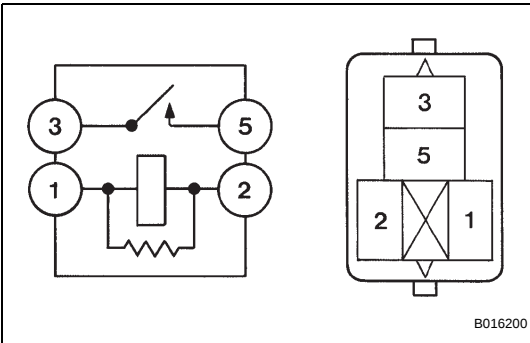
NG**REPLACE ECM****OK**

7 CHECK EFI NO.1 FUSE**Fusible Link Block:**

- (a) Remove the EFI No. 1 fuse from the fusible link block.
 (b) Measure the resistance of the EFI No. 1 fuse.

Standard resistance:**Below 1 Ω**

- (c) Install the EFI NO. 1 fuse.

NG**REPLACE EFI NO.1 FUSE****OK****8 INSPECT EFI MAIN RELAY**

- (a) Remove the EFI MAIN relay from the engine room R/B.
 (b) Measure the resistance of the EFI MAIN relay.

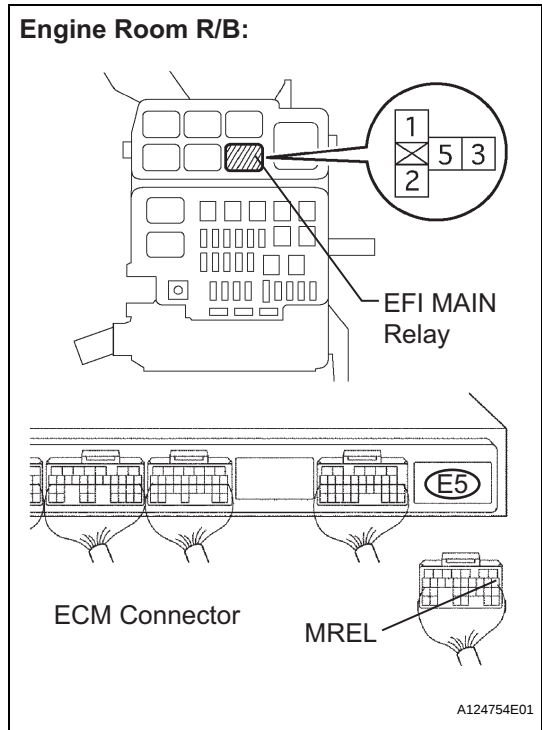
Standard resistance

Tester Connection	Specified Condition
1 - 2	Below 1 Ω
3 - 5	10 k Ω or higher
3 - 5	Below 1 Ω (when battery voltage is applied to terminals 1 and 2)

NG**REPLACE EFI MAIN RELAY****OK****ES**

9

CHECK HARNESS AND CONNECTOR (EFI MAIN RELAY- ECM, EFI MAIN RELAY - BODY GROUND)



- (a) Check the wire harness between the EFI MAIN relay and ECM.
- (1) Remove the EFI MAIN relay from the engine room R/B.
 - (2) Disconnect the E5 ECM connector.
 - (3) Measure the resistance of the wire harness side connectors.

Standard resistance

Tester Connection	Specified Condition
R/B EFI MAIN relay terminal 1 - E5-8 (MREL)	Below 1 Ω
R/B EFI MAIN relay terminal 1 or E5-8 (MREL) - Body ground	10 k Ω or higher

- (b) Check the wire harness between the EFI MAIN relay and body ground.
- (1) Remove the EFI MAIN relay from the engine room R/B.
 - (2) Measure the resistance between the wire harness side connector.

Standard resistance

Tester Connection	Specified Condition
R/B EFI MAIN relay terminal 2 - Body ground	Below 1 Ω

NG

REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

CHECK AND REPAIR HARNESS AND CONNECTOR (TERMINAL +B OF ECM - BATTERY POSITIVE TERMINAL)