SFI SYSTEM

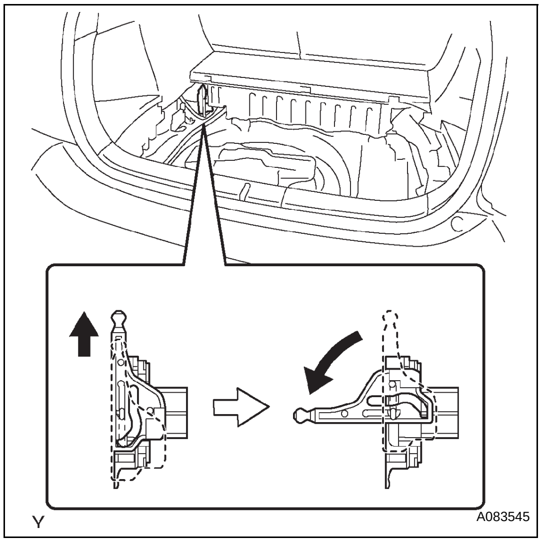
PRECAUTION

1. PRECAUTIONS FOR HIGH-VOLTAGE CIRCUIT INSPECTION AND SERVICE

(a) Technicians to be engaged in inspection and service on high-voltage components and systems should receive special training.

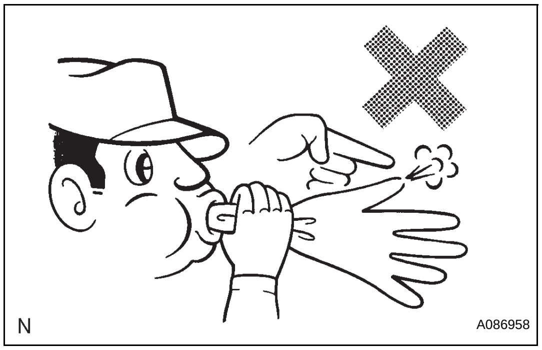
(b) All the high-voltage wire harness connectors are colored orange: the HV battery and other high-voltage components and identified by the "High Voltage" caution labels.
Do not touch these connectors and components before removing the service plug. Remove the service plug prior to touching these connectors and components.

ES



(c) Before inspecting or servicing the high-voltage components/systems, be sure to take safe precautions such as wearing insulated gloves and removing the service plug to prevent electric shock or electrocution. Store the removed service plug in your pocket to prevent other technicians from reinstalling it while you are serving high-voltage components/systems.

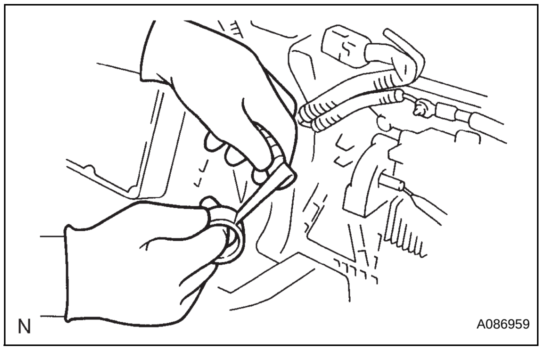
(d) After removing the service plug, wait at least for 5 minutes before touching any of the high-voltage connectors and terminals.
HINT:
At least 5 minutes is required to discharge electricity from the high-voltage condenser inside the inverter.



(e) Before wearing insulted gloves, make sure that they are not rupture, torn or damaged in any other way. Do not wear wet insulated gloves.

(f) When servicing, be careful not to drop metallic materials like a mechanical pencil or tools etc. Causing a short circuit may result.

(g) Wear the insulated gloves before touching a bare high-voltage terminal. Verify that electricity has discharged from the terminal (approximately 0 V) using an electrical tester.



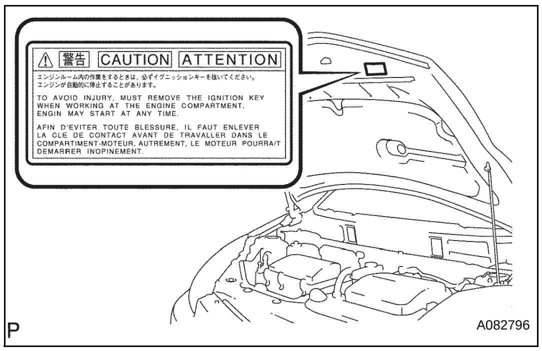
(h) After disconnecting or exposing a high-voltage connector or terminal, insulate it immediately using insulation tape.

(i) The screw of a high-voltage terminal should be tightened firmly to the specified torque. Either insufficient or excessive tightening torque can cause HV system failure.

(j) Call other technicians' attention to prevent accidents during working on the high-voltage components/ systems by posting a sign to notify them (see page IN-5).

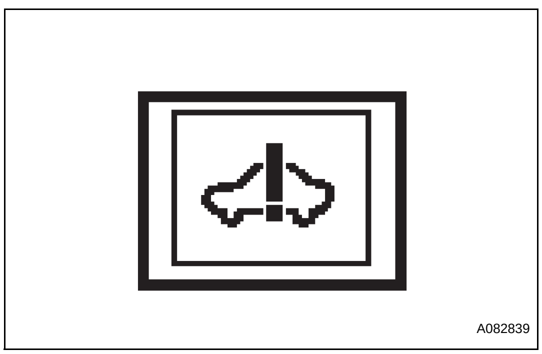
(k) Prior to reinstalling the service plug, again, verify whether or not any parts or tools have been left behind, and check if high-voltage terminal screws have been securely tightened as well as the connectors have been properly reconnected.

ES



2. PRECAUTIONS TO BE OBSERVED WHEN INSPECTING OR SERVICING ENGINE COMPARTMENT

The PRIUS automatically turns the engine ON and OFF when the power switch is ON (READY lamp on the instrument panel is being illuminated). Turn the HV main system OFF before serving inside the engine compartment.



3. INSPECTION

HINT:

When the A/C compressor operation is not required, the engine is warmed up, and the battery is charged properly, the PRIUS automatically stops the engine while the vehicle is at rest. In the case of a continuous engine operation is needed for performing engine maintenance, activate inspection mode. Inspection mode enables the engine to run continuously.

ES

Activating inspection mode (not using the intelligent tester)
Perform the following steps from (1) through (4) in 60 seconds.
(1) Turn the power switch ON (IG).
(2) Fully repress the accelerator pedal twice with the transmission in the P position.
(3) Fully depress the accelerator pedal twice with the transmission in the N position.
(4) Fully depress the accelerator pedal twice with the transmission in the P position.
(5) Check that the HV system warning lamp flashes on the multi-information display.
(6) Start the engine by pushing the power switch, depressing the brake pedal.
Activate inspection mode (Using the intelligent tester)
(1) Connect the intelligent tester to the DLC3.
(2) Turn the power switch ON (IG).
(3) Turn the intelligent tester ON.
(4) Enter the following menus: DIAGNOSIS / OBD / MOBD / HV ECU / ACTIVE TEST / INSPECTION MODE / ON.
(5) Check that the HV system warning flashes on the multi-information display and the master warning lamp is illuminated in the combination meter.
(6) Start the engine by pushing the power switch, depressing the brake pedal.

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Deactivating inspection mode
(1) Turn the power switch OFF. The HV main system turns off simultaneously.

NOTICE:

- **The idling speed in inspection mode is approximately 1,000 rpm. The engine speed increases to 1,500 rpm if the accelerator pedal is depressed by less than 60%. If the accelerator pedal is depressed by more than 60%, the engine speed increases to 2,500 rpm.**
- **If a DTC us set during inspection mode, the master warning lamp and the error warming lamp illuminate on the multi-information display.**
- **When the master warning lamp illuminates during inspection mode, deactivate inspection mode, and check a DTC(s).**
- **Driving the vehicle without deactivating inspection mode may damage the transaxle.**

4. FOR USING FOR OBD II SCAN TOOL OR INTELLIGENT TESTER

CAUTION:

Observe the following items for safety reasons:

- **Read its instruction books before using the scan tool or the tester.**
- **Prevent the tester cable from being caught on the pedals, shift lever and steering wheel when driving the tester connected to the vehicle.**

- **When driving the vehicle for testing purposes using the scan tool or the tester, two persons are required. One is for driving the vehicle, and the other operates the tester.**

5. INITIALIZATION

NOTICE:

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

System Name	See page
Power Window Control System	IN-32

HINT:

Initialization can not be completed by only removing the battery.

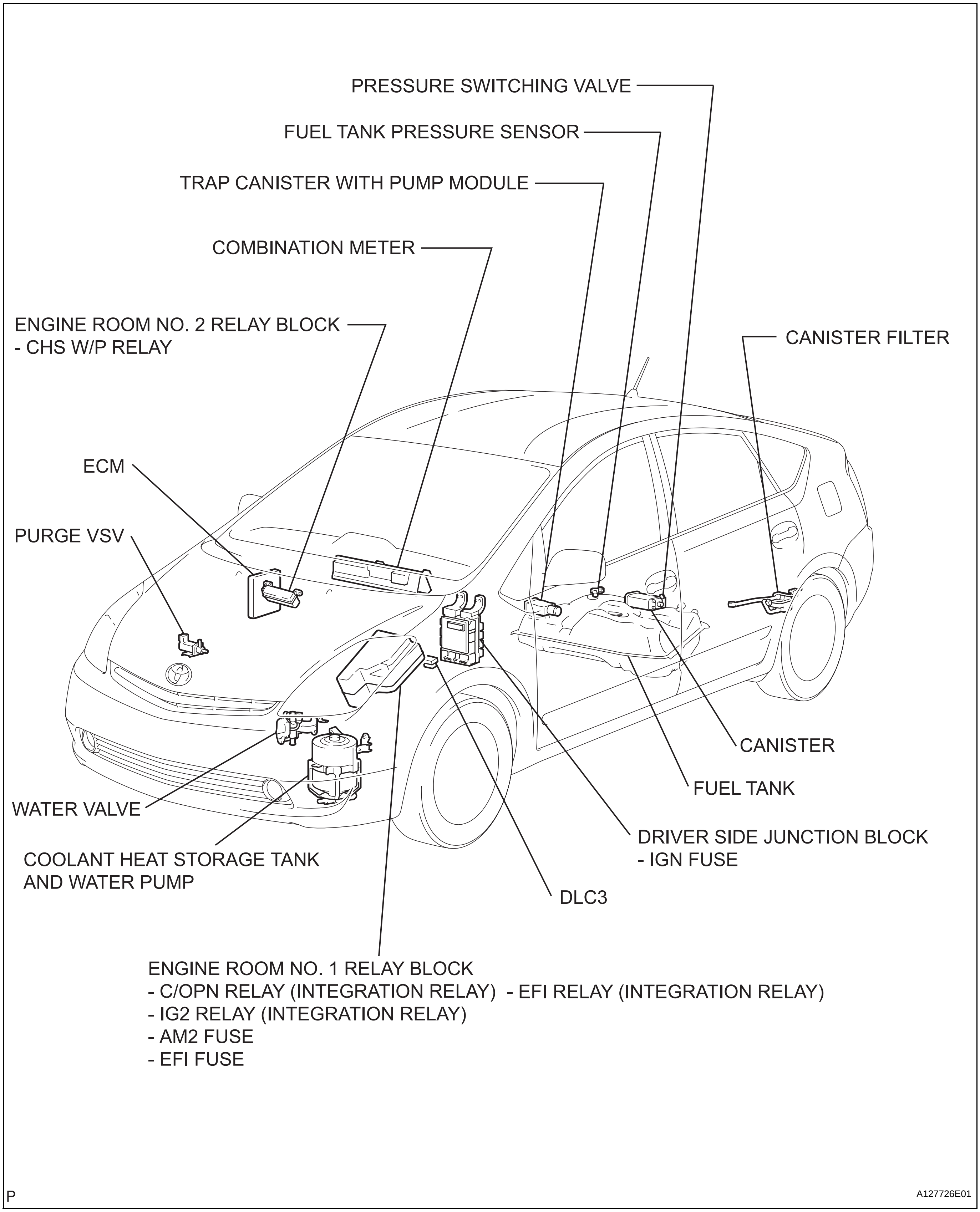
6. NOTICES FOR HYBRID SYSTEM ACTIVATION

- When the warning lamp is illuminated or the battery has been disconnected and reconnected, pressing the switch may not start the system on the first try. If so, press the power switch again.
- With the power switch's power mode changed to ON (IG), disconnect the battery. If the key is not in the key slot during connection, DTC B2779 may be output.

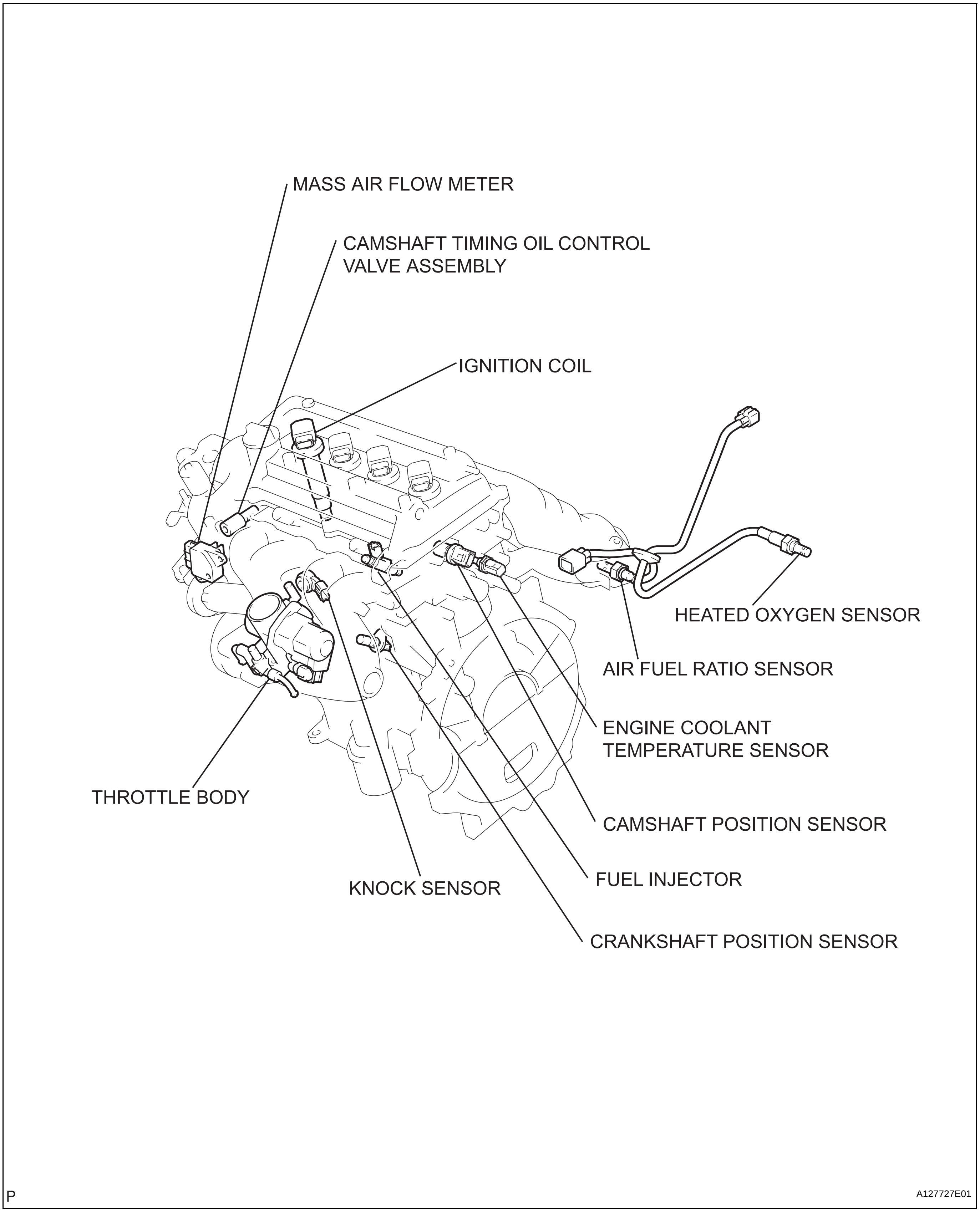
DEFINITION OF TERMS

Terms	Definitions
Monitor description	Description of what the ECM monitors and how it 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 are 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 are met.
Duration	Minimum time for which ECM must detect continuous deviation in monitored value(s) in order to set DTC. Timing begins when Typical Enabling Conditions are met.
Malfunction thresholds	Value beyond which ECM determines malfunctions exist and sets DTCs.
MIL operation	Timing of MIL illumination after malfunction detected. "Immediate" means ECM illuminates MIL as soon as malfunction detected. "2 driving cycle" means ECM illuminates MIL if same malfunction detected second time during next sequential driving cycle.

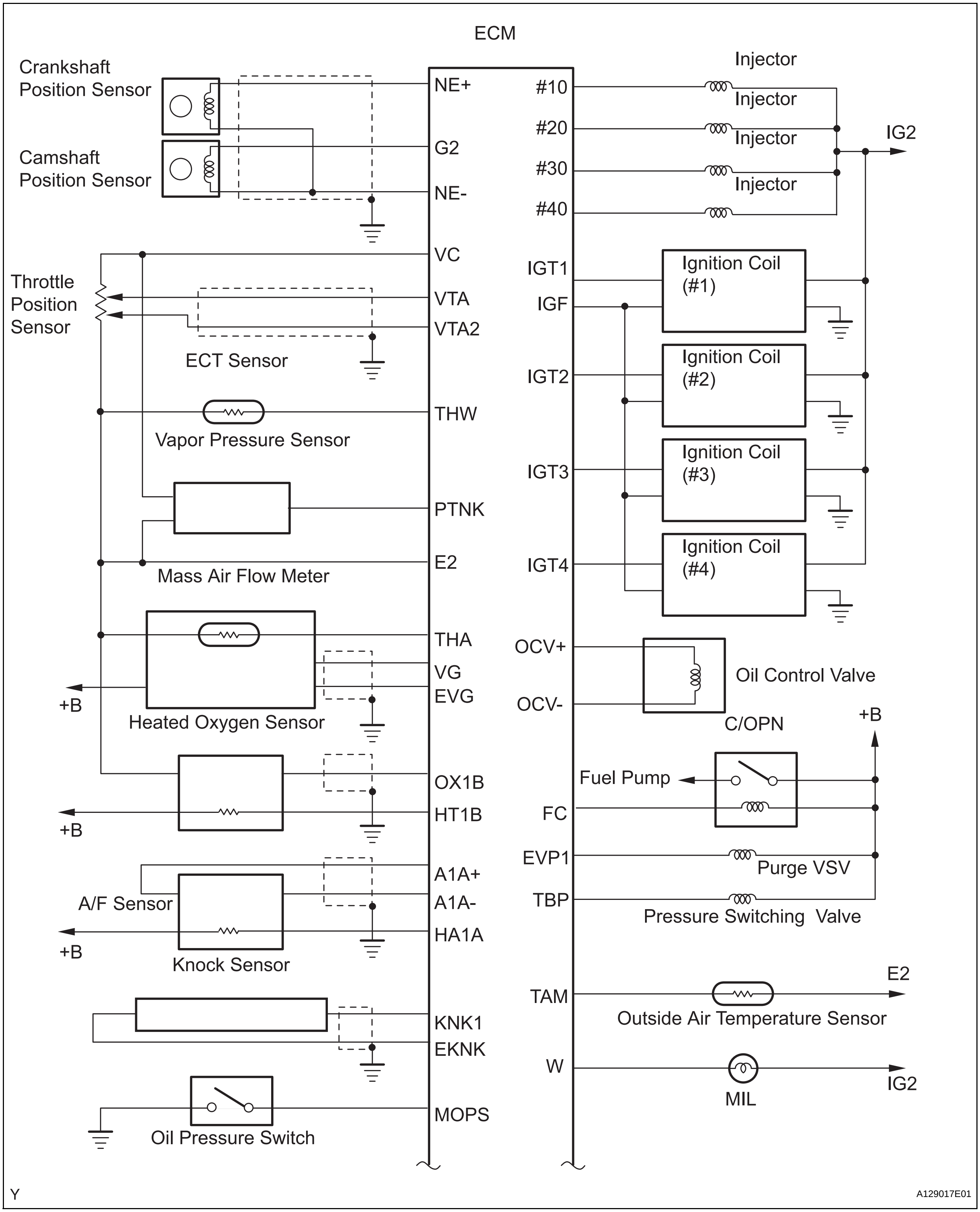
PARTS LOCATION

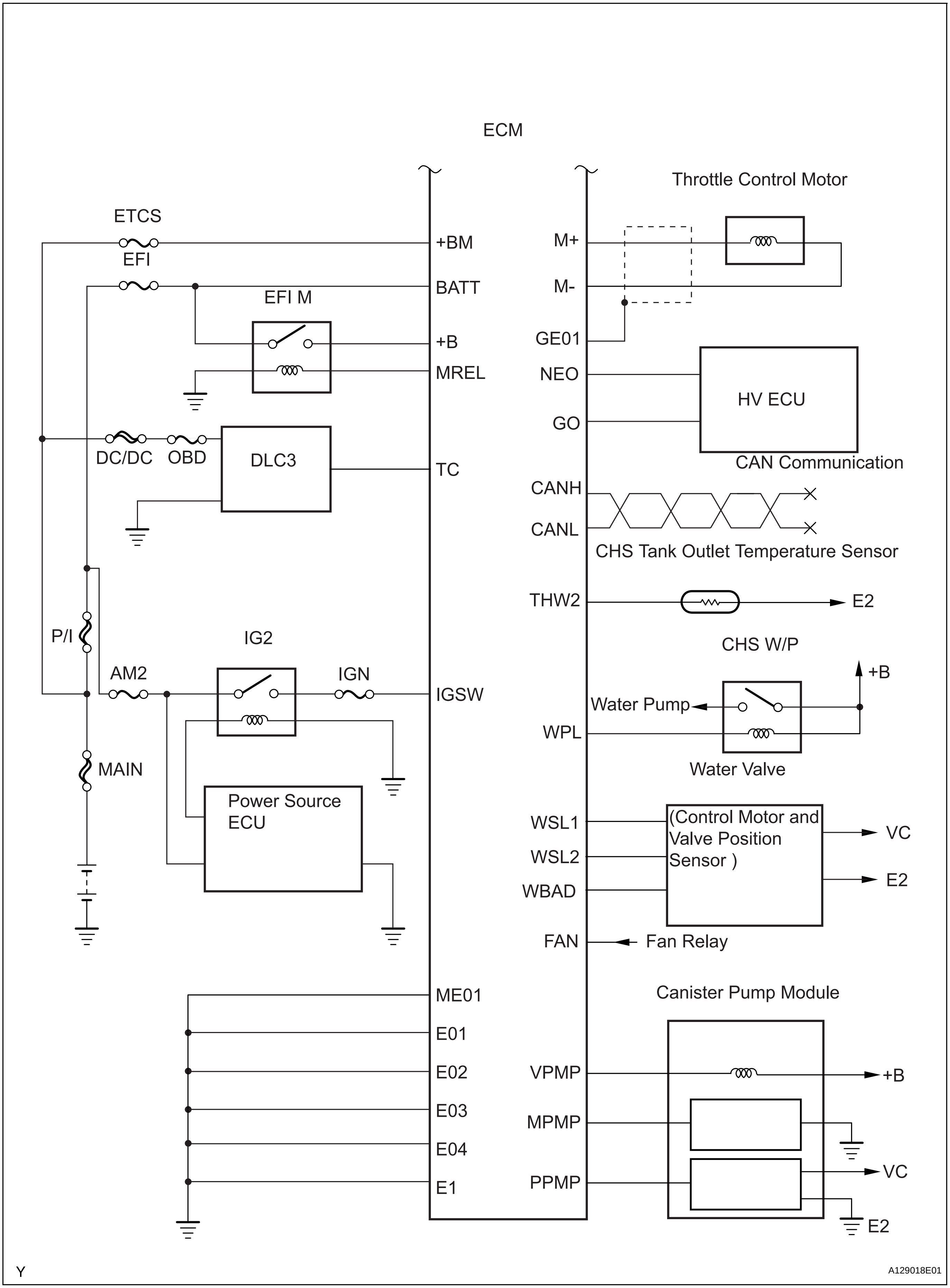


ES


MASS AIR FLOW METER
CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY
IGNITION COIL
HEATED OXYGEN SENSOR
AIR FUEL RATIO SENSOR
ENGINE COOLANT TEMPERATURE SENSOR
THROTTLE BODY
CAMSHAFT POSITION SENSOR
FUEL INJECTOR
KNOCK SENSOR
CRANKSHAFT POSITION SENSOR
P
A127727E01

SYSTEM DIAGRAM




ECM
Throttle Control Motor
ETCS
+BM
M+
EFI
BATT
M-
EFI M
+B
GE01
MREL
NEO
HV ECU
GO
DC/DC
OBD
DLC3
CAN Communication
TC
CANH
CANL
CHS Tank Outlet Temperature Sensor
THW2
E2
P/I
IG2
CHS W/P
+B
AM2
IGN
IGSW
Water Pump
WPL
MAIN
Water Valve
Power Source ECU
WSL1
(Control Motor and Valve Position Sensor)
VC
WSL2
E2
WBAD
FAN
Fan Relay
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E2
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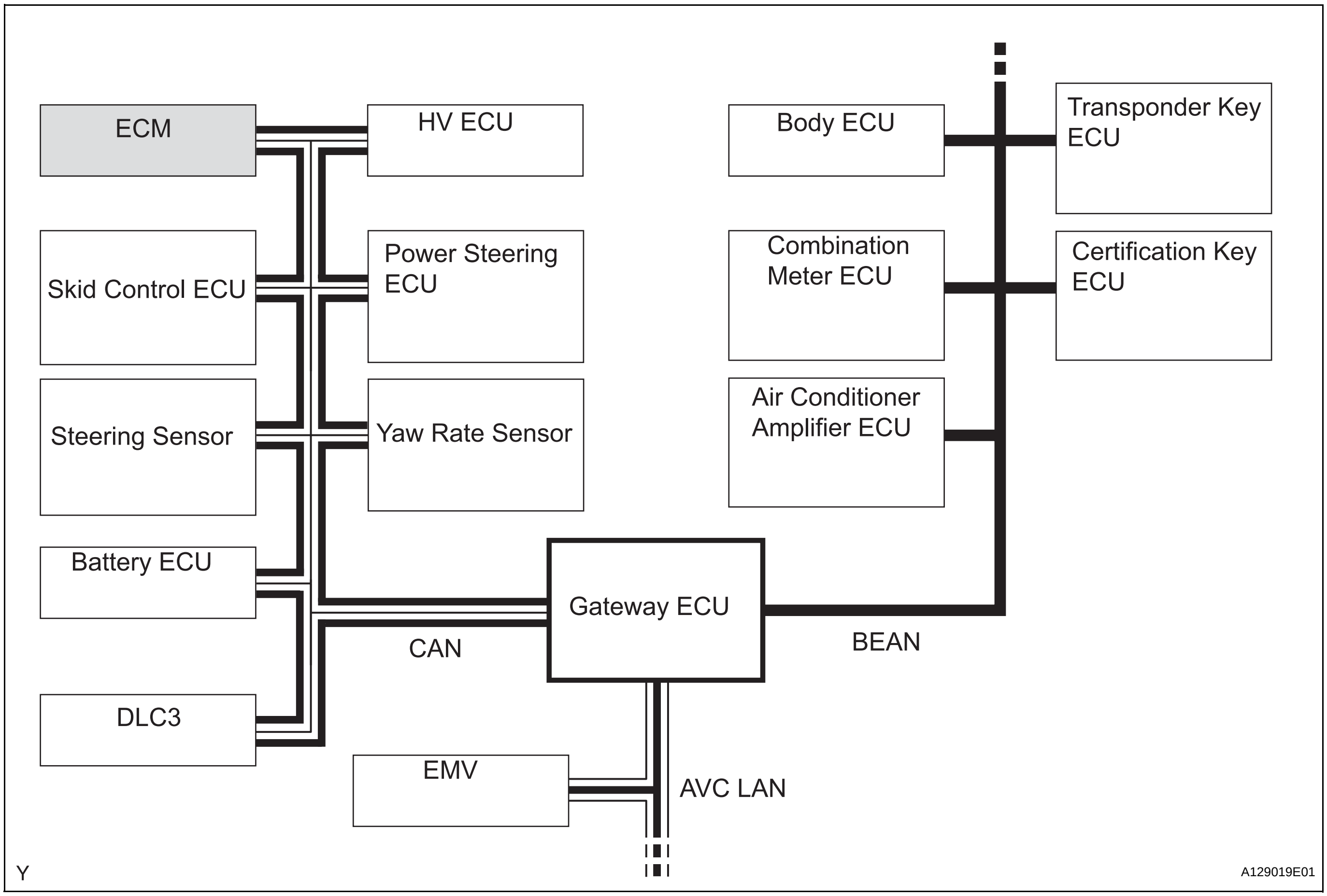


COMMUNICATIONS

The ECM communicates with the following ECM and ECUs using the signals listed below. The following table explains receiving and sending signals by ECM or ECU.

Transmit To	Receive From	Signal	Communication Line
HV ECU	ECM	• Inspection mode signal • MIL illumination requirement • Shift position information • Ready state • Starter ON	CAN
ECM	HV ECU	• Ambient temperature • Intake air temperature • Radiator fan drive • Engine warm-up requirement • Engine rpm	CAN
ECM	Battery ECU	• Engine rpm	CAN
ECM	Power Steering ECU	• Inspection mode	CAN
ECM	Skid Control ECU	• Inspection mode	CAN
ECM	Body ECU	• Inspection mode • Engine rpm	BEAN, CAN
Combination Meter ECU	ECM	• Fuel level	BEAN, CAN
ECM	Combination Meter ECM	• Engine coolant temperature • Engine rpm • Injection volume • Inspection mode • Engine oil pressure switch	BEAN, CAN

Transmit To	Receive From	Signal	Communication Line
ECM	Air Conditioner Amplifier ECU	• Engine coolant temperature • Engine rpm • Ambient temperature • Coolant heat storage water valve close	BEAN, CAN
ECM	Certification ECU	• Engine rpm	BEAN, CAN
ECM	EMV	• Engine coolant temperature • Inspection mode • Engine oil pressure switch	ACV LAN, CAN

HOW TO PROCEED WITH TROUBLESHOOTING

HINT:
*: Use the intelligent tester.

1	VEHICLE BROUGHT TO WORKSHOP

NEXT

2	CUSTOMER PROBLEM ANALYSIS

NEXT

3	CONNECT INTELLIGENT TESTER TO DLC3*

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

NEXT

4	CHECK DTC AND FREEZE FRAME DATA*

HINT:
Record or print DTCs and freeze frame data, if needed.

NEXT

5	CLEAR DTC AND FREEZE FRAME DATA*

NEXT

6	VISUAL INSPECTION

NEXT

7	SETTING CHECK MODE DIAGNOSIS*

NEXT

8	PROBLEM SYMPTOM CONFIRMATION

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

Malfunction does not occur	A
Malfunction occurs	B

B → GO TO STEP 10

A

9	SYMPTOM SIMULATION

NEXT

10	DTC CHECK*

Malfunction code	A
No code	B

B → GO TO STEP 12

A

11	DTC CHART

NEXT

GO TO STEP 14

12	BASIC INSPECTION

Wrong parts not confirmed	A
Wrong parts confirmed	B

B → GO TO STEP 17

A

13	PERFORM SYMPTOMS TABLE

Wrong circuit confirmed	A
Wrong parts confirmed	B

ES

B → GO TO STEP 17

A

14 CHECK ECM POWER SOURCE CIRCUIT

NEXT

15 CIRCUIT INSPECTION

ES

Malfunction not confirmed	A
Malfunction confirmed	B

B → GO TO STEP 18

A

16 CHECK FOR INTERMITTENT PROBLEMS

NEXT

GO TO STEP 18

17 PARTS INSPECTION

NEXT

18 IDENTIFICATION OF PROBLEM

NEXT

19 ADJUSTMENT AND/OR REPAIR

NEXT

20 CONFIRMATION TEST

NEXT

END

CHECK FOR INTERMITTENT PROBLEMS

HINT:

Inspect the vehicle's ECM using check mode. Intermittent problems are easier to detect with the 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-29).
2. Switch the ECM from normal mode to check mode using the intelligent tester (see page ES-32).
3. Perform a simulation test (see page IN-36).
4. Check and wiggle the harness(es), connector(s) and terminal(s) (see page IN-45).
5. Wiggle the harness(s) and connector(s) (see page IN-45).

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:
Perform this check with the engine stopped and power switch OFF.

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

NG → **CHARGE OR REPLACE BATTERY**

OK

2 CHECK WHETHER ENGINE WILL CRANK

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

NG → **PROCEED TO PROBLEM SYMPTOMS TABLE**

OK

PROCEED TO PROBLEM SYMPTOMS TABLE

6	CHECK FUEL PRESSURE

NG → PROCEED TO TROUBLESHOOTING

OK

7	CHECK FOR SPARK

NG → PROCEED TO TROUBLESHOOTING

OK

PROCEED TO PROBLEM SYMPTOMS TABLE

ES

CHECKING MONITOR STATUS

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

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

When the test value is not between the minimum test limit and maximum test limit, the ECM (PCM) interprets this as a malfunction. When the component is not malfunctioning, if the difference of the test value and test limit is very small, the component will malfunction in the near future.

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

1. **PERFORM MONITOR DRIVE PATTERN**
   (a) Connect the intelligent tester to the DLC3.
   (b) Turn the power switch and intelligent tester ON.
   (c) Clear the DTCs (see page ES-29).
   (d) Run the vehicle in accordance with the applicable drive pattern described in READINESS MONITOR DRIVE PATTERN (see page ES-17). DO NOT turn the power switch OFF.
   NOTICE:
   The test results will be lost if the power switch is turned OFF.
2. **ACCESS MONITOR RESULT**
   (a) Select from the intelligent tester menus: DIAGNOSIS / ENHANCED OBD II / MONITOR INFO and MONITOR RESULT. The monitor status appears after the component name.
   - INCMPL: The component has not been monitored yet.
   - PASS: The component is functioning normally.
   - FAIL: The component is malfunctioning.

   (b) Confirm that the component is either PASS or FAIL.
   (c) Select the component and press ENTER. The accuracy test value appears if the monitor status is either PASS or FAIL.
3. **CHECK COMPONENT STATUS**
   (a) Compare the test value with the minimum test limit (MIN LIMIT) and maximum test limit (MAX LIMIT).

(b) If the test value is between the minimum test limit and maximum test limit, the component is functioning normally. If not, the component is malfunctioning. The test value is usually significantly higher or lower than the test limit. If the test value is on the borderline of the test limits, the component will malfunction in near future.
HINT:
The monitor result might on rare occasions be PASS even if the malfunction indicator lamp (MIL) is illuminated. This indicates the system malfunctioned on a previous driving cycle. This might be caused by an intermittent problem.

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

A/F Sensor Bank Sensor 1

Monitor ID	Test ID	Scaling	Unit	Description
$01	$8E	Multiply by 0.0003	No dimension	A/F sensor deterioration level

HO2S Bank Sensor 2

Monitor ID	Test ID	Scaling	Unit	Description
$02	$07	Multiply by 0.001	V	Minimum sensor voltage
$02	$08	Multiply by 0.001	V	Maximum sensor voltage
$02	$8F	Multiply by 0.0003	g	Maximum oxygen storage capacity

Catalyst - Bank 1

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

EVAP

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

Monitor ID	Test ID	Scaling	Unit	Description
$3D	$D7	Multiply by 0.001	kPa	Test value for purge flow insufficient (P0441)

Misfire

Monitor ID	Test ID	Scaling	Unit	Description
$A1	$0B	Multiply by 1	Time	Exponential Weighted Moving Average (EWMA) misfire for all cylinders: Misfire counts for last ten driving cycles - Total
$A1	$0C	Multiply by 1	Time	Misfire rate for all cylinders: Misfire counts for last/current driving cycle - Total
$A2	$0B	Multiply by 1	Time	EWMA misfire for cylinder 1: Misfire counts for last ten driving cycles - Total
$A2	$0C	Multiply by 1	Time	Misfire rate for cylinder 1: Misfire counts for last/ current driving cycle - Total
$A2	$0C	Multiply by 1	Time	Misfire rate for cylinder 1: Misfire counts for last/ current driving cycle - Total
$A3	$0C	Multiply by 1	Time	Misfire rate for cylinder 2: Misfire counts for last/ current driving cycle - Total
$A4	$0B	Multiply by 1	Time	EWMA misfire for cylinder 3: Misfire counts for last ten driving cycles - Total
$A4	$0C	Multiply by 1	Time	Misfire rate for cylinder 3: Misfire counts for last/ current driving cycle - Total
$A5	$0B	Multiply by 1	Time	EWMA misfire for cylinder 4: Misfire counts for last ten driving cycles - Total
$A5	$0C	Multiply by 1	Time	Misfire rate for cylinder 4: Misfire counts for last/ current driving cycle - Total

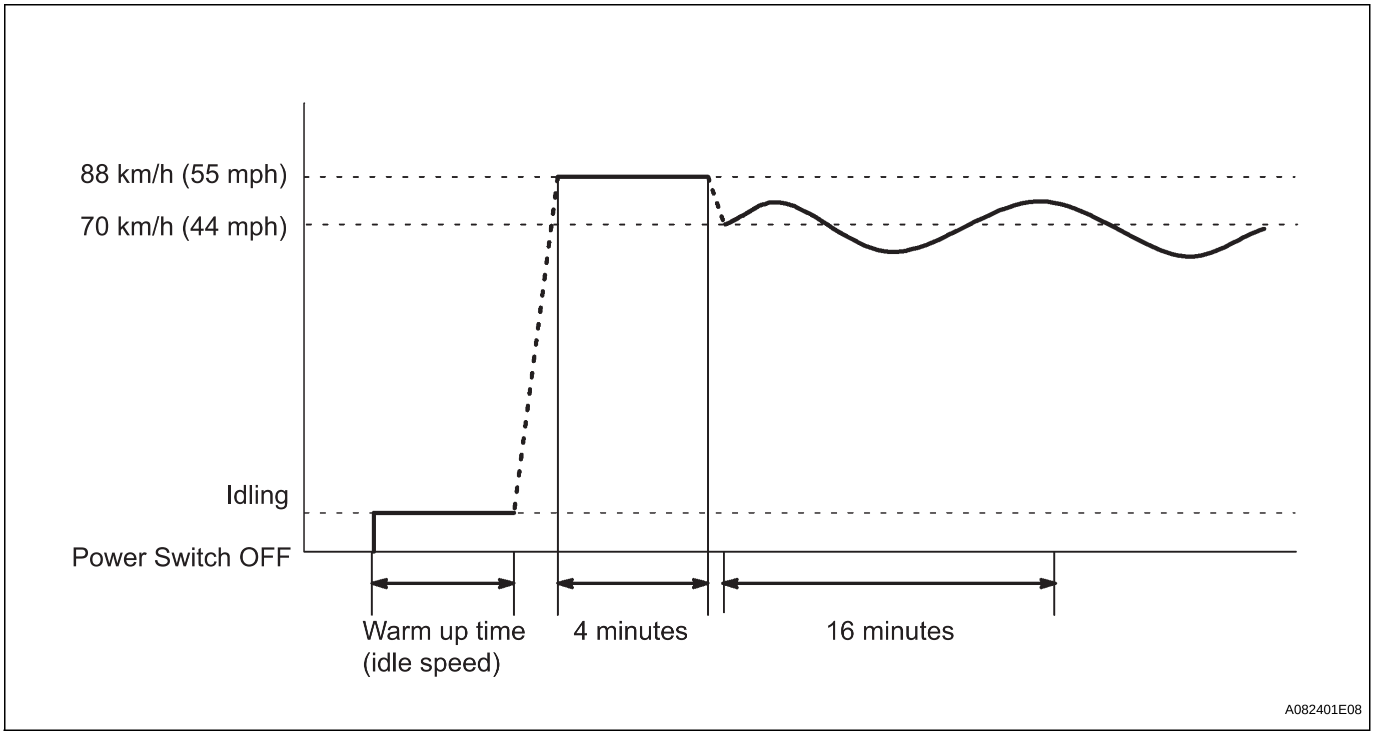
READINESS MONITOR DRIVE PATTERN

1. PURPOSE OF THE READINESS TESTS

- The On-Board Diagnostic (OBD II) system is designed to monitor the performance of emission-related components, and report any detected abnormalities with Diagnostic Trouble Codes (DTCs). 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.
  From the "Enhanced OBD II Menu", select "Monitor Status" to view the readiness monitor status.
- A generic OBD II scan tool can also be used to view the readiness monitor status.
- When the readiness monitor status reads "completer", the necessary conditions have been met for running performance tests for that readiness monitor.
  HINT:
  Many state inspection and Maintenance (IM) programs require a vehicle's readiness monitor status to show "complete".
- The Readiness Monitor will be reset to "incomplete" if:
  - The ECM has lost battery power or a fuse has blown.
  - DTCs have been cleared.
  - The conditions for running the Readiness Monitor have been met.
- If the readiness monitor status shows "incomplete", follow the appropriate readiness monitor drive pattern to change the status to "complete".

CAUTION:
Strictly observe of posted speed limits, traffic laws, and road condition when performing these drive patterns.
NOTICE:
The following drive patterns are the fastest method of completing all the requirements necessary for making the readiness monitor status read "complete".
If forced to momentarily stop a drive pattern due to traffic or other factors, the drive pattern can be resumed. Upon completion of the drive pattern, in most cases, the readiness monitor status will change to "complete".
Sudden changes in vehicle loads and speeds, such as driving up and down hills and / or sudden acceleration, hinder readiness monitor completion.

2. CATALYST MONITOR (A/F SENSOR TYPE)



(a) Preconditions

The monitor will not run unless:

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

NOTICE:

To complete the readiness test in cold ambient conditions (less than -10°C [14°F]), turn the power switch OFF and then turn it ON again. Perform the drive pattern a second time.

(b) Drive Pattern

(1) Connect the intelligent tester or OBD II scan tool to DLC3 to check readiness monitor status and preconditions.

(2) Put the engine in inspection mode (see page ES-1).

(3) Start the engine and warm it up.

(4) Drive the vehicle at 70 to 88 km/h (44 to 55 mph) for approximately 4 minutes (the engine must be run during monitoring).

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 70 to 88 km/h (44 to 55 mph) for additional 4 minutes.

(5) Drive the vehicle allowing speed to fluctuate between 70 to 88 km/h (44 to 55 mph) for about 16 minutes.

NOTICE:

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

(6) Check the status of the readiness monitor on the scan tool display. If readiness monitor status did not switch to complete, verify that the preconditions are met, turn the power switch OFF, and then repeat steps (4) and (5).

3. EVAP MONITOR (KEY OFF TYPE)

(a) Preconditions

The monitor will not run unless:

– The fuel tank is less than 90% full.
– The altitude is less than 8,000 ft (2,450 m).
– The vehicle is stationary.
– The engine coolant temperature is 4.4 to 35°C (40 to 95°F).
– The intake air temperature is 4.4 to 35°C (40 to 95°F).
– Vehicle was driven in an urban area (or on a freeway) for 10 minutes or more.

(b) Monitor Conditions

(1) Turn the power switch OFF and wait for 6 hours.

HINT:

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

(c) Monitor Status

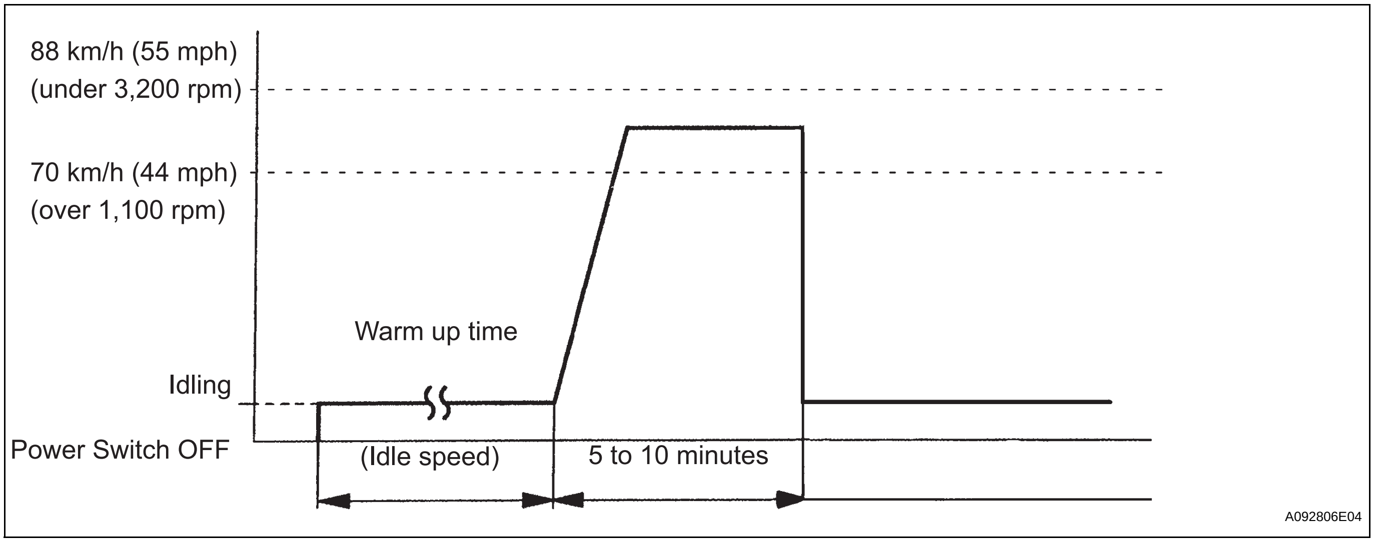
(1) Connect the intelligent tester to the DLC3.

(2) Turn the power switch ON (IG) and turn the tester ON.

(3) Check the Readiness Monitor status displayed on the tester.

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

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

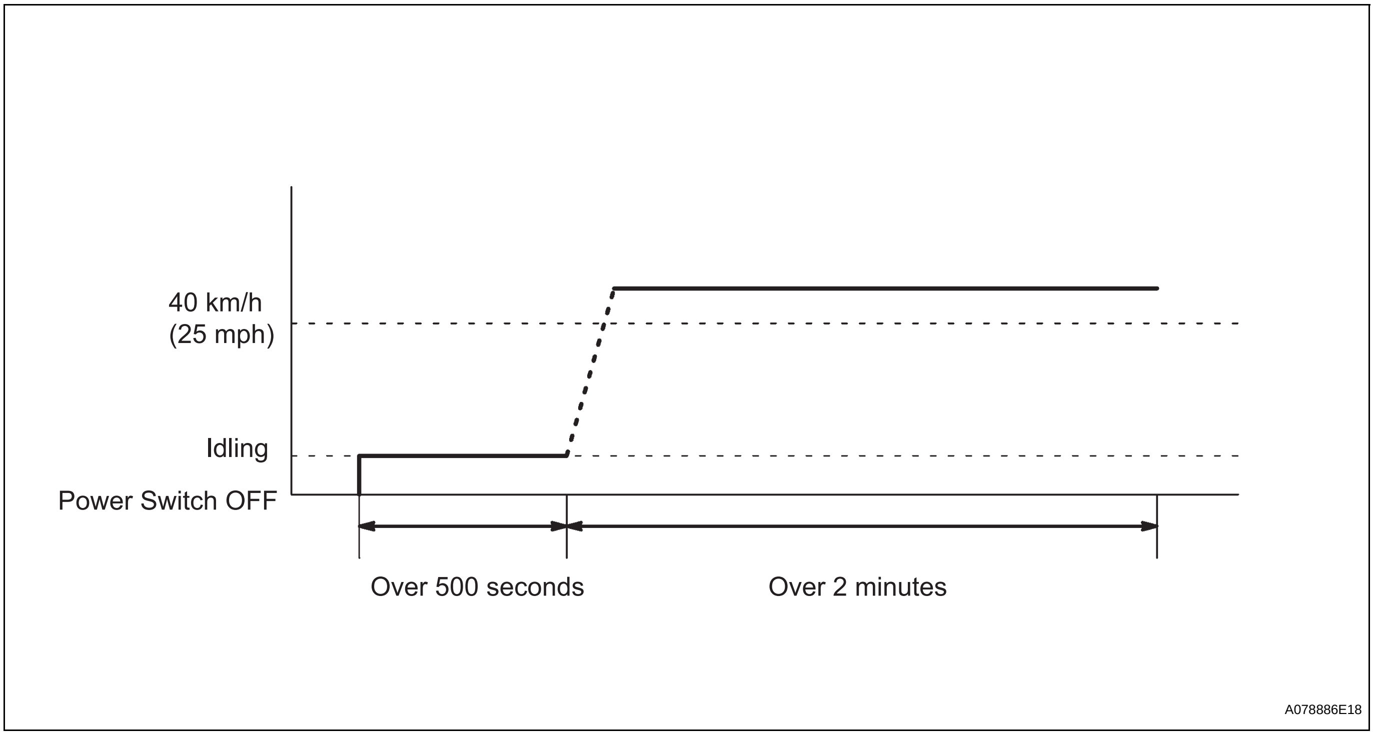


(a) Preconditions
The monitor will not run unless:
MIL is OFF

(b) Drive Pattern
(1) Connect the intelligent tester or OBD II scan tool to DLC3 to check monitor status and preconditions.
(2) Put the engine in inspection mode.
(3) Start the engine and allow it to idle for 2 minutes.
(4) Deactivate the inspection mode and drive the vehicle at 70 to 88 km/h (44 to 55 mph) or more for 5 to 10 minutes.
(5) Check the readiness monitor status. If the readiness monitor status did not switch to "complete", check the preconditions, turn the power switch OFF, and then repeat steps (1) to (4).

NOTICE:
Do not drive the vehicle without deactivating inspection mode, otherwise damaging the transaxle may result.

5. OXYGEN / A/F SENSOR HEATER MONITOR



(a) Preconditions
The monitor will not run unless:
MIL is OFF.

(b) Drive Pattern
(1) Connect the intelligent tester or OBD II scan tool to DLC3 to check monitor status and preconditions.
(2) Put the engine in inspection mode.
(3) Start the engine and allow it to idle for 500 seconds or more.
(4) Deactivate the inspection mode and drive the vehicle at 40 km/h (25 mph) or more at least for 2 minutes.
(5) Check the readiness monitor status. If the readiness monitor status did not change to "complete", check the preconditions, turn the power switch OFF, and repeat steps (2) and (3).

NOTICE:
Do not drive the vehicle without deactivating inspection mode, otherwise damaging the transaxle may result.

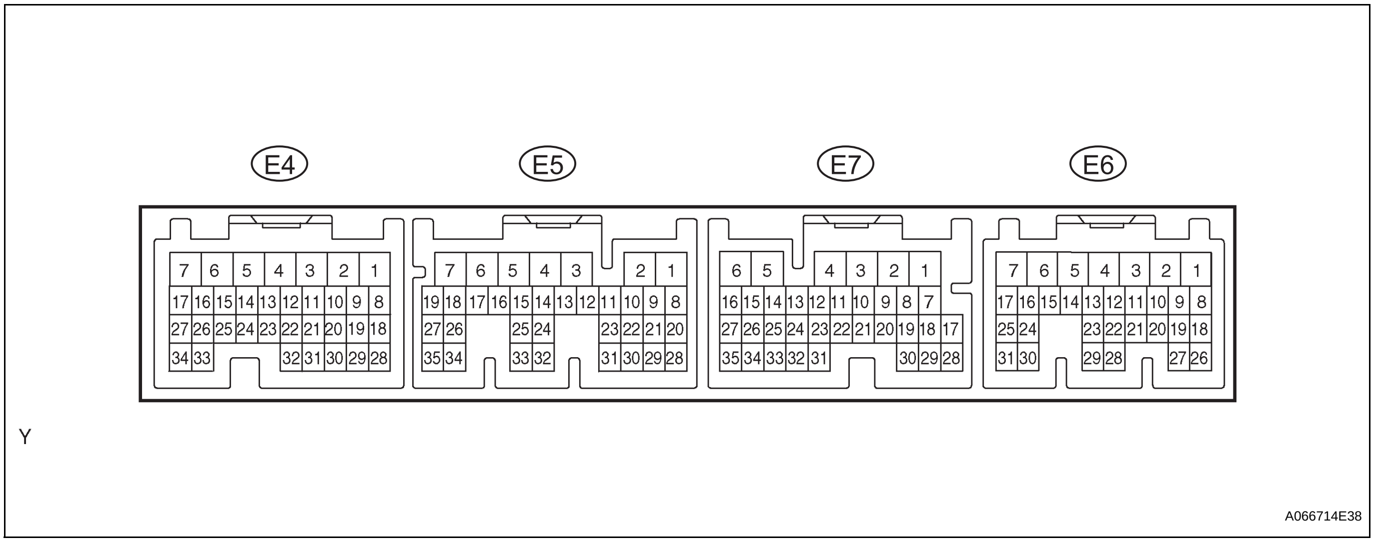
PROBLEM SYMPTOMS TABLE

When the malfunction is not confirmed in the diagnostic trouble code check and the problem still can not be confirmed in the basic inspection, use this table and troubleshoot according to the priority order given below.

Symptom	Suspected area	See page
Engine does not crank (Does not start)	1. No. 1 Motor generator	-
	2. Hybrid control system	HV-20
	3. Immobiliser	EI-5
	4. Smart key system	ST-66
No initial combustion (Does not start)	1. ECM power source circuit	ES-412
	2. Fuel pump control circuit	ES-423
	3. Spark plug	IG-5
	4. Immobiliser system	EI-5
	5. Injector	FU-15
	6. ECM	ES-24
	7. Crankshaft position sensor circuit	ES-159
	8. VC output circuit	ES-418
No complete combustion (Does not start)	1. Fuel pump control circuit	ES-423
	2. Spark plug	IG-5
	3. Immobiliser system	EI-5
	4. Injector	FU-15
	5. Crankshaft position sensor circuit	ES-159
Engine cranks normally but difficult to start	1. Fuel pump control circuit	ES-423
	2. Compression	EM-1
	3. Spark plug	IG-5
	4. Injector	FU-15
	5. Crankshaft position sensor circuit	ES-159
Difficult to start with cold engine	1. Fuel pump control circuit	ES-423
	2. Spark plug	IG-5
	3. Injector	FU-15
	4. Crankshaft position sensor circuit	ES-159
Difficult to start with hot engine	1. Fuel pump control circuit	ES-423
	2. Spark plug	IG-5
	3. Injector	FU-15
	4. Crankshaft position sensor circuit	ES-159
High engine idle speed (Poor idling)	1. ECM power source circuit	ES-412
	2. Electronic throttle control system	ES-329
Low engine idle speed (Poor idling)	1. Fuel pump control circuit	ES-423
	2. Electronic throttle control system	ES-329
	3. Injector	FU-15
Rough idling (Poor idling)	1. Compression	EM-1
	2. Electronic throttle control system	ES-329
	3. Injector	FU-15
	4. Fuel pump control circuit	ES-423
	5. Spark plug	IG-5
Hunting (Poor idling)	1. ECM power source circuit	ES-412
	2. Electronic throttle control system	ES-329
	3. Fuel pump control circuit	ES-423

Symptom	Suspected area	See page
Hesitation/Poor acceleration (Poor driveability)	1. Fuel pump control circuit	ES-423
	2. Injector	FU-15
	3. Spark plug	IG-5
	4. HV transaxle	-
Surging (Poor driveability)	1. Fuel pump control circuit	ES-423
	2. Spark plug	IG-5
	3. Injector	FU-15
Engine stalls soon after starting	1. Fuel pump control circuit	ES-423
	2. Electronic throttle control system	ES-329
	3. Immobiliser	EI-5
	4. Crankshaft position sensor circuit	ES-159
Unable to refuel/Difficult to refuel	1. ORVR system	-

TERMINALS OF ECM



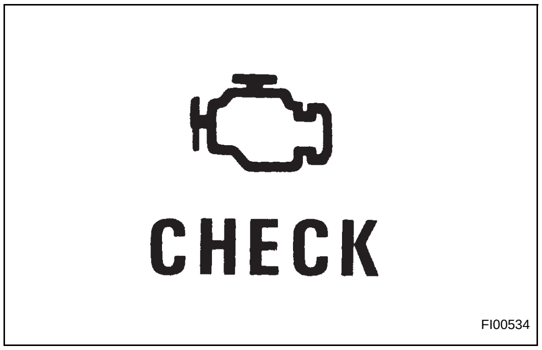
Each ECM terminal's standard voltage is shown in the table below.
In the table, first follow the information under "Condition". Look under "Symbols (Terminals No.)" for the terminals to be inspected. The standard voltage between the terminals is shown under "STD voltage".
Use the illustration above as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

Symbols (Terminal No.)	Wiring Color	Terminal Description	Condition	STD Voltage (V)
BATT (E7-6) - E1 (E5-28)	R - BR	Battery	Always	9 to 14
+B (E7-4) - E1 (E5-28)	B - BR	Power source of ECM	Power switch ON (IG)	9 to 14
+BM (E7-5) - E1 (E5-28)	GR - BR	Power source of ETCS	Always	9 to 14
IGSW (E6-9) - E1 (E5-28)	O - BR	Power switch signal	Power switch ON (IG)	9 to 14
MREL (E7-7) - E1 (E5-28)	G - BR	Main relay control signal	Power switch ON (IG)	9 to 14
VC (E4-18) - E2 (E4-28)	R - BR	Power source of sensor (a specific voltage)	Power switch ON (IG)	4.5 to 5.5
NE+ (E4-33) - NE- (E4-34)	R - G	Crankshaft position sensor	Idling (during inspection mode)	Purge generation (See page ES-159)
G2 (E4-26) - NE- (E4-34)	R - G	Camshaft position sensor	Idling (during inspection mode)	Purge generation (See page ES-159)
VTA (E4-32) - E2 (E4-28)	P - BR	Throttle position sensor	Power switch ON (IG), Throttle valve fully closed	0.5 to 1.2
VTA (E4-32) - E2 (E4-28)	P - BR	Throttle position sensor	HV system ON, During active test to open throttle valve (see page ES-33)	3.2 to 4.8
VTA2 (E4-31) - E2 (E4-28)	L - BR	Throttle position sensor	Power switch ON (IG), Accelerator pedal released	2.0 to 2.9
VTA2 (E4-31) - E2 (E4-28)	L - BR	Throttle position sensor	HV system ON, During active test to open throttle valve (see page ES-33)	4.6 to 5.5
VG (E5-33) - EVG (E5-32)	G - R	Mass air flow meter	Idling (during inspection mode), A/C switch OFF	1.0 to 1.5
THA (E4-20) - E2 (E4-28)	W - BR	Intake air temperature sensor	Idling (during inspection mode), Intake air temperature at 20°C (68°F)	0.5 to 3.4

Symbols (Terminal No.)	Wiring Color	Terminal Description	Condition	STD Voltage (V)
THW (E4-19) - E2 (E4-28)	W - BR	Engine coolant temperature sensor	Idling (during inspection mode), Engine coolant temperature at 80°C (176°F)	0.2 to 1.0
#10 (E4-2) - E01 (E4-7)	Y - BR	Injector	Power switch ON (IG)	9 to 14
#20 (E4-3) - E01 (E4-7)	B - BR	Injector	Power switch ON (IG)	9 to 14
#30 (E4-4) - E01 (E4-7)	L - BR	Injector	Power switch ON (IG)	9 to 14
#40 (E4-5) - E01 (E4-7)	R - BR	Injector	Power switch ON (IG)	9 to 14
IGT1 (E4-8) - E1 (E5-28)	Y - BR	Ignition coil No. 1 (#1) (Ignition signal)	Idling (during inspection mode)	Pulse generation (See page ES-167)
IGT2 (E4-9) - E1 (E5-28)	W - BR	Ignition coil No. 1 (#2) Ignition signal)	Idling (during inspection mode)	Pulse generation (See page ES-167)
IGT3 (E4-10) - E1 (E5-28)	G - BR	Ignition coil No. 1 (#3) Ignition signal)	Idling (during inspection mode)	Pulse generation (See page ES-167)
IGT4 (E4-11) - E1 (E5-28)	Y - BR	Ignition coil No. 1 (#4) Ignition signal)	Idling (during inspection mode)	Pulse generation (See page ES-159)
KNK1 (E5-1) - EKNK (E5-2)	B - W	Knock sensor	Idling (during inspection mode)	Pulse generation (See page ES-154)
IGF (E4-23) - E1 (E5-28)	B - BR	Ignition confirmation signal	Idling (inspection mode)	Pulse generation (See page ES-167)
A1A+ (E5-23) - E1 (E5-28)	G - BR	A/F sensor	Power switch ON (IG)	3.0 to 3.6
A1A- (E5-22) - E1 (E5-28)	R - BR	A/F sensor	Power switch ON (IG)	2.7 to 3.3
OX1B (E6-22) - E2 (E4-28)	Y - BR	Heated oxygen sensor	Maintain engine speed at 2,500 rpm for 2 minutes after warming up	Pulse generation
HA1A (E5-7) - E04 (E4-1)	Y - BR	A/F sensor heater	Idling (during inspection mode)	Below 3.0
HA1A (E5-7) - E04 (E4-1)	Y - BR	A/F sensor heater	Power switch ON (IG)	9 to 14
HT1B (E6-6) - E03 (E6-7)	G - BR	Heated oxygen sensor heater	Idling (during inspection mode)	Below 3.0
HT1B (E6-6) - E03 (E6-7)	G - BR	Heated oxygen sensor heater	Power switch ON (IG)	9 to 14
PTNK (E7-34) - E2 (E4-28)	Y - BR	Vapor pressure sensor	Power switch ON (IG)	2.9 to 3.7
PTNK (E7-34) - E2 (E4-28)	Y - BR	Vapor pressure sensor	Apply vacuum 4.0 kPa	Below 0.5
EVP1 (E5-14) - E1 (E5-28)	R - BR	EVAP VSV	Power switch ON (IG)	9 to 14
TBP (E7-18) - E1 (E5-28)	R - BR	Tank bypass VSV	Power switch ON (IG)	9 to 14
M+ (E5-6) - E1 (E5-28)	L - BR	Throttle actuator control motor	Idling (during inspection mode)	Pulse generation
M- (E5-5) - E1 (E5-28)	P - BR	Throttle actuator control motor	Idling (during inspection mode)	Pulse generation
OCV+ (E4-15) - OCV- (E4-14)	Y - W	Camshaft timing oil control	Power switch ON (IG)	Pulse generation (See page ES-55)
TAM (E7-21) - E2 (E4-28)	W - BR	Outside air temperature sensor	Ambient air temperature 40 to 140°C (-40 to 284°F)	0.8 to 1.3
MOPS (E5-15) - E1 (E5-28)	Y - BR	Engine oil pressure	Power switch ON (IG), not engine running	9 to 14
WBAD (E7-20) - E1 (E5-28)	R - BR	Water valve position signal	Power switch ON (IG)	0.3 to 4.7
THW2 (E7-33) - E2 (E4-28)	W - BR	Coolant heat storage tank outlet temperature sensor	Power switch ON (IG), Coolant temperature at 80°C (176°F)	0.2 to 1.0
WSL1 (E7-24) - WSL2 (E7-23)	Y - V	Water valve motor	Changing valve position	Pulse generation
WPL (E7-15) - E1 (E5-28)	V - BR	CHS water pump	Pre-heat mode	0 to 2

Symbols (Terminal No.)	Wiring Color	Terminal Description	Condition	STD Voltage (V)
FAN (E7-8) - E1 (E5-28)	LG - BR	Cooling fan relay	Power switch ON (IG), Engine coolant temperature less than 94.5°C (202°F)	9 to 14
W (E6-18) - E1 (E5-28)	LG - BR	MIL	Idling (during inspection mode)	9 to 14
W (E6-18) - E1 (E5-28)	LG - BR	MIL	Power switch ON (IG)	Below 3.0
FC (E6-10) - E1 (E5-28)	G - BR	Fuel pump control	Power switch ON (IG)	9 to 14
FC (E6-10) - E1 (E5-28)	G - BR	Fuel pump control	Power switch ON (IG)	Below 3.0
TC (E6-14) - E1 (E5-28)	P - BR	Terminal TC of DLC3	Power switch ON (IG)	9 to 14
NEO (E7-1) - E1 (E5-28)	LG - BR	Revolution signal	Idling (during inspection mode)	Pulse generation
GO (E7-2) - E1 (E5-28)	Y - BR	Revolution signal	Idling (during inspection mode)	Pulse generation
CANH (E6-31) - E1 (E5-28)	B - BR	CAN communication line	Power switch ON (IG)	Pulse generation
CANL (E6-30) - E1 (E5-28)	W - BR	CAN communication line	Power switch ON (IG)	Pulse generation
VPMP (E7-26) - E1 (E5-28)	V - BR	Vent valve (built into pump module)	Power switch ON (IG)	9 to 14
MPMP (E7-13) - E1 (E5-28)	P - BR	Vacuum pump (built into pump module)	Vacuum pump OFF	0 to 3
MPMP (E7-13) - E1 (E5-28)	P - BR	Vacuum pump (built into pump module)	Vacuum pump ON	9 to 14
PPMP (E7-30) - E1 (E5-28)	L - BR	Pressure sensor (built into pump module)	Power switch ON (IG)	3 to 3.6

DIAGNOSIS SYSTEM



1. DESCRIPTION

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

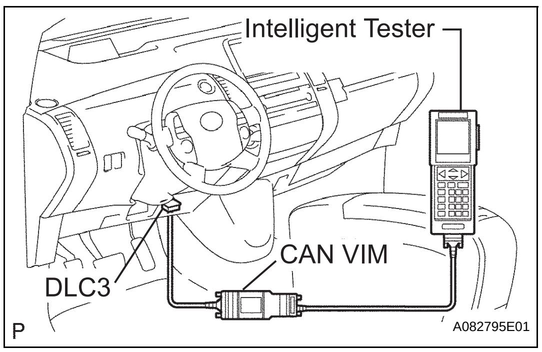
(a) The emission control systems components

(b) The power train control components (which affect vehicle emissions)

(c) The computer itself

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

To check the DTCs, connect the intelligent tester to the DLC3. The tester displays DTCs, freeze frame data, and a variety of engine data. The DTCs and freeze frame data can be erased with the tester. In order to enhance OBD function on vehicles and develop the Off-Board diagnosis system, the Controller Area Network (CAN) communication is used in this system. It minimizes the gap between technician skills and vehicle technology. CAN is a network which uses a pair of data transmission lines that span multiple ECUs and sensors. It allows high speed communication between the systems and simplifies the wire harness connections. The CAN Vehicle Interface Module (CAN VIM) must be connected with the intelligent tester to display any information from the ECM. The intelligent tester and ECM uses CAN communication signals to communicate. Connect the CAN VIM between the intelligent tester and DLC3.



2. NORMAL MODE AND CHECK MODE

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

3. 2 TRIP DETECTION LOGIC

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

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4. FREEZE FRAME DATA

Freeze frame data records the engine conditions (fuel system, calculated engine load, engine coolant temperature, fuel trim, engine speed, vehicle speed, etc.) when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

Priorities for troubleshooting:

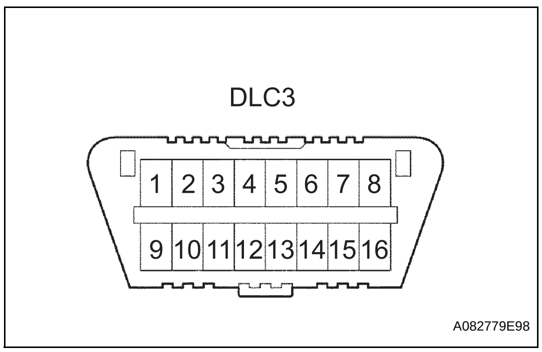
If troubleshooting priorities for multiple DTCs are given in the applicable DTC chart, these priorities should be followed.

If no instructions are given, perform troubleshooting for those DTCs according to the following priorities.

(a) DTCs other than fuel trim malfunction (DTCs P0171 and P0172) and misfire (P0300 to P0304).

(b) Fuel trim malfunction (DTCs P0171 and P0172).

(c) Misfire (DTCs P0300 to P0304).



5. DATA LINK CONNECTOR 3 (DLC3)

The vehicle's ECM uses the ISO 15765-4 for communication protocol. The terminal arrangement of the DLC3 complies with SAE J1962 and matches the ISO 15765-4 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 positive	Body ground	9 to 14 V	Always
CANH	6	CAN "High" line	CANL	54 to 69 Ω	Power switch OFF
CANH	6	CAN "High" line	Battery positive	1 MΩ or higher	Power switch OFF
CANH	6	CAN "High" line	CG	1 kΩ or higher	Power switch OFF
CANL	14	CAN "Low" line	Battery positive	1 MΩ or higher	Power switch OFF
CANL	14	CAN "Low" line	CG	1 kΩ or higher	Power switch OFF

If the result is not as specified, the DLC3 may have a malfunction. Repair or replace the harness and connector.

HINT:

When you use the intelligent tester or OBD scan tool, first connect its cable to the DLC3. Next, turn ON the main power of the PRIUS by pushing the power switch ON (IG). Finally turn the tester or the scan tool ON. If the screen displays UNABLE TO CONNECT TO VEHICLE, a problem exists in the vehicle side or the tester side.

If communication is normal when the tester is connected to another vehicle, inspect the DLC3 of the original vehicle.

If communication is still not possible when the tester is connected to another vehicle, the problem may be in the tester itself. Consult the Service Department listed in the tester's instruction manual.

6. BATTERY VOLTAGE

Battery Voltage:

11 to 14 V

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

7. MIL (Malfunction Indicator Lamp)

(a) The MIL is illuminated when the power switch is first turned ON (the engine is not running).

(b) When the HV main system is activated (READY ON), the MIL should turn off. If the MIL illuminates gain, the diagnosis system has detected malfunction or abnormality in the system.

HINT:

If the MIL is not illuminated when the power switch is first turned ON (IG), check the MIL circuit (see page ES-428).

8. ALL READINESS

For the vehicle, using the intelligent tester allows readiness codes corresponding to all DTCs to be read. When diagnosis (normal or malfunctioning) has been completed, readiness codes are set. Enter the following menus on the intelligent tester: ENHANCED OBD II / MONITOR STATUS.

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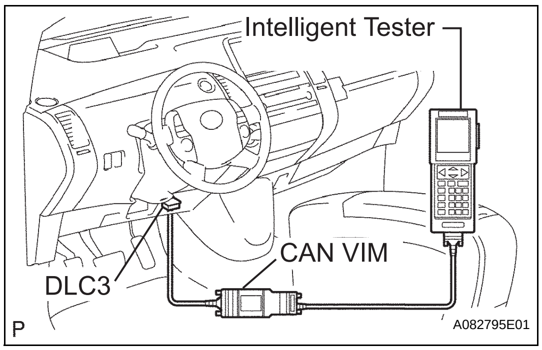
DTC CHECK / CLEAR

NOTICE:

- **If no DTC appears in normal mode:**
  On the OBD II or 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 are erased. Before changing modes, always check and make a note of DTCs and freeze frame data.**

HINT:

- DTCs which are stored in the ECM can be displayed on the intelligent tester. The intelligent tester can display current and pending DTCs.
- Some DTCs are not set if the ECM does not detect the same malfunction again during a second consecutive driving cycle. However, malfunctions detected on only 1 occasion are stored as pending DTCs.



1. CHECK DTC (Using Intelligent Tester)

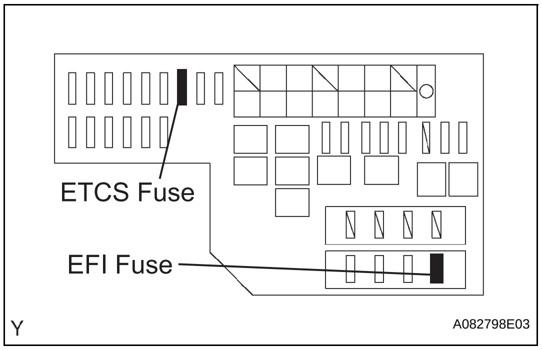
(a) Connect the intelligent tester to the DLC3.
(b) Turn the power switch ON (IG) and turn the tester ON.
(c) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DTC INFO / CURRENT CODES.
(d) Check the DTC(s) and freeze frame data, and then write them down.
(e) Check the details of the DTC(s) (see page ES-42).

NOTICE:
Turn the HV main system OFF (IG OFF) after the symptom is simulated once. Then repeat the simulation process again. When the problem has been simulated again, the MIL illuminates and the DTCs are recorded in the ECM.

2. CLEAR DTC (Using Intelligent Tester)

(a) Connect the intelligent tester to the DLC3.
(b) Turn the power switch ON (IG) and turn the tester ON.
(c) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DTC INFO / CLEAR CODES.
(d) Press the YES button.

NOTICE:
Clearing the DTCs will also clear the freeze frame data, detailed information and operation history data.



3. CLEAR DTC (Without Using Intelligent Tester)

(a) Remove the EFI and ETCS fuses from the engine room relay block from more than 60 seconds, or disconnecting the battery cable for more than 60 seconds.

NOTICE:

When disconnecting the battery cable, perform the "INITIALIZE" procedure (see page IN-32).

FREEZE FRAME DATA

DESCRIPTION

The freeze frame data records the engine condition (fuel system, calculated load, engine coolant temperature, fuel trim, engine speed, vehicle speed, etc.) when malfunction is detected. When troubleshooting, it can help determine if the vehicle was running or stopped, the engine was warmed up or not, the air-fuel ratio was LEAN or RICH and other data. at the time of the malfunction occurred.

HINT:

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

List of freeze frame data

LABEL (Intelligent Tester Display)	Measure Item/Range	Diagnostic Note
CALC LOAD	Calculate load	Calculated load by ECM
COOLANT TEMP	Engine coolant temperature	If the value is -40°C, sensor circuit is open If the value is 140°C, sensor circuit is shorted
SHORT FT #1	Short-term fuel trim	Short-term fuel compensation used to maintain the air-fuel ratio at stoichiometric air-fuel ratio
LONG FT #1	Long-term fuel trim	Overall fuel compensation carried out in long-term to compensate a continual deviation of the short-term fuel trim from the central valve
ENGINE SPD	Engine speed	-
VEHICLE SPD	Vehicle speed	Speed indicated on speedometer
IGN ADVANCE	Ignition advance	-
INTAKE AIR	Intake air temperature	If the value is -40°C, sensor circuit is open If the value is 140°C, sensor circuit is shorted
MAF	Mass air flow volume	If the value is approximately 0.0 g/sec.: • Mass air flow meter power source circuit • VG circuit open or short If the value is 160.0 g/sec. or more: • E2G circuit open
THROTTLE POS	Throttle position	Read the value with the power switch ON (Do not start engine)
O2S B1 S2	Heated oxygen sensor output	Performing the INJ VOL or A/F CONTROL function of the ACTIVE TEST enables the technician to check voltage output of the sensor
O2FT B1 S2	Fuel trim at heated oxygen sensor	Same as SHORT FT #1
ENG RUN TIME	Accumulated engine running time	-
AF FT B1 S1	Fuel trim at A/F sensor	-
AFS B1 S1	A/F sensor output	Performing the INJ VOL or A/F CONTROL function of the ACTIVE TEST enables the technician to check voltage output of the sensor
EVAP PURGE VSV	EVAP purge VSV duty ratio	-
DIST DTC CLEAR	Accumulated distance from DTC cleared	-
CAT TEMP B1 S1	Catalyst temperature	-
CAT TEMP B1 S2	Catalyst temperature	-
BATTERY VOLTAGE	Battery voltage	-
AIR-FUEL RATIO	Air-fuel ratio	-
THROTTLE POS	Throttle sensor positioning	Read the value with the power switch ON (Do not start engine)
AMBIENT TEMP	Ambient air temperature	If the value is -40°C, sensor circuit is open If the value is 140°C, sensor circuit is shorted

LABEL (Intelligent Tester Display)	Measure Item/Range	Diagnostic Note
THROTTLE POS #2	Throttle sensor positioning #2	-
THROTTLE MOT	Throttle motor	-
TIME DTC CLEAR	Cumulative time after DTC cleared	-
KNOCK CRRT VAL	Correction learning value of knocking	-
KNOCK FB VAL	Feedback value of knocking	-
PURGE DENSITY	Learning value of purge density	-
EVAP PURGE FLOW	Purge flow	-
FC IDL	Idle fuel cut	ON: when throttle valve fully closed and engine speed is over 1,500 rpm
FC TAU	FC TAU	The fuel cut is being performed under very light load to prevent the engine combustion from becoming incomplete
VVTL AIM ANGL #1	VVT aim angle	-
VVT CHNG ANGL #1	VVT change angle	-
VVT OCV DUTY B1	VVT OCV operation duty	-
INI COOL TEMP	Initial engine coolant temperature	-
INI INTAKE TEMP	Initial intake air temperature	-
INJ VOL	Injection volume	-
INJECTOR	Injector	-
TOTAL FT #1	Total fuel trim	-
MISFIRE RPM	Misfire RPM	-
MISFIRE LOAD	Misfire load	-
CYL #1	Cylinder #1 misfire rate	Displayed in only idling
CYL #2	Cylinder #2 misfire rate	Displayed in only idling
CYL #3	Cylinder #3 misfire rate	Displayed in only idling
CYL #4	Cylinder #4 misfire rate	Displayed in only idling
CYL ALL	All cylinder misfire rate	Displayed in only idling
IGNITION	Ignition	-
MISFIRE MARGIN	Misfire monitoring	-
ENG OIL PRES SW	Engine oil pressure switch signal	Always ON while engine is running

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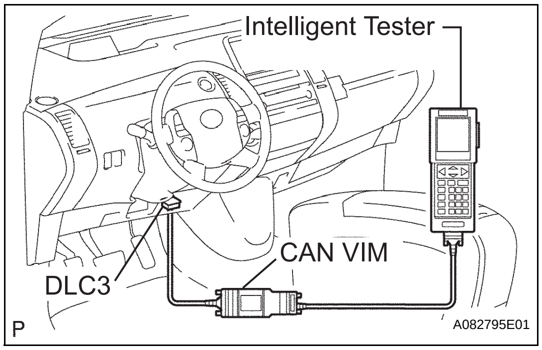
CHECK MODE PROCEDURE

HINT:
Intelligent tester only:
Compared to normal mode, check mode has more sensing ability to detect malfunction. Furthermore, the same diagnostic items which are detected in normal mode can also be detected in check mode.

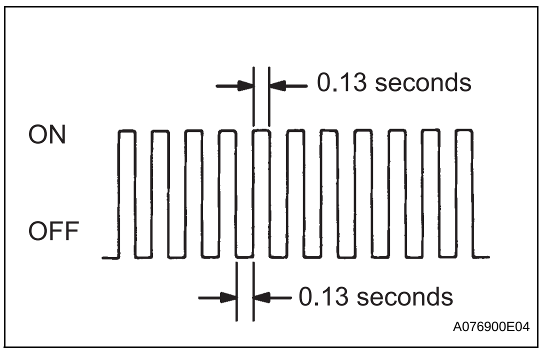


1. CHECK MODE PROCEDURE (Using Intelligent Tester)

(a) Check the initial conditions.
  (1) Battery positive voltage 11 V or more
  (2) Throttle valve fully closed
  (3) Shift position in the P or N
  (4) A/C switched OFF

(b) Connect the intelligent tester to the DLC3.

(c) Turn the power switch ON (IG).



(d) Change the ECM to check mode using the intelligent tester. 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 power switch is switched from ON (IG) to ON (ACC) or OFF.

(e) Start the HV main system (READY ON). The MIL should turn off after the system starts.

(f) Simulate the condition of the malfunction described by the customer.

(g) After simulating the malfunction conditions, check DTCs, freeze frame data and other data using the tester.

(h) After checking DTCs, inspect applicable circuits.

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 Conditions
P0031 P0032 P0037 P0038	Heater is turned OFF	Power switch OFF
P0100 P0102 P0103	Ignition timing is calculated from engine speed and throttle angle	"Pass" condition detected
P0110 P0112 P0113	Intake air temperature is fixed at 20°C (68°F)	"Pass" condition detected
P0115 P0117 P0118	Engine coolant temperature is fixed at 80°C (176°F)	"Pass" condition detected
P0120 P0122 P0123	Fuel cut intermittently and drive on motor mode	Power switch OFF
P0121	Fuel cut intermittently and drive on motor mode	Power switch OFF
P0325	Maximum ignition timing retardation	Power switch OFF
P0351 P0352 P0353 P0354	Fuel cut and drive on motor mode	Power switch OFF
P0657	VTA is fixed at about 16% and fuel cut intermittently and drive on motor mode	Power switch OFF
P1115 P1117 P1118	Engine coolant temperature is fixed at 80°C (176°F)	"Pass" condition detected
P1120 P1122 P1123	Water valve position is fixed at position when DTC is detected	"Pass" condition detected
P2102 P2103	VTA is fixed at about 16% and fuel cut intermittently	Power switch OFF
P2119	VTA is fixed at about 16% and fuel cut intermittently	"Pass" condition detected and power switch OFF
P3190 P3191 P3193	Drive on motor mode	Power switch OFF

DATA LIST / ACTIVE TEST

1. DATA LIST

HINT:

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

(a) Turn the power switch ON (READY) and warm up the engine.
(b) Turn the power switch OFF.
(c) Connect the intelligent tester to the DLC3.
(d) Turn the power switch ON (IG).
(e) Turn the intelligent tester ON.
(f) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DATA LIST.
(g) According to the display on the tester, read items in DATA LIST.

Intelligent tester Display	Measurement Item/Range (Display)	Normal Condition*	Diagnostic Note
INJECTOR	Injection period of the No. 1 cylinder/ Min.: 0 ms, Max.: 32.64 ms	Idling: 1 to 3 ms (Inspection mode)	-
IGN ADVANCE	Ignition timing advance for No. 1 cylinder/ Min.: -64 deg., Max.: 63.5 deg.	Idling: BTDC 7 to 15° (Inspection mode)	-
CALC LOAD	Calculated load by ECM/ Min.: 0%, Max.: 100%	• Idling: 10 to 20% (Inspection mode) • Running without load (1,500 rpm): 10 to 20%	-
VEHICLE LOAD	Vehicle load: Min.: 0 %, Max.: 25,700 %	Actual vehicle load	-
MAF	Air flow rate from MAF meter/ Min.: 0 g/sec., Max.: 655.35 g/sec.	Idling: 3 to 7 g/sec. (1,500 rpm)	If the value is approximately 0.0 g/sec.: • Mass air flow meter power source circuit open • VG circuit open or short If the value is 160.0 g/sec. or more: • E2G circuit open
ENGINE SPD	Engine speed/ Min.: 0 rpm, Max.: 16,383 rpm	Idling 1,000 rpm (when putting the engine in inspection mode)	-
VEHICLE SPD	Vehicle speed/ Min.: 0 km/h, Max.: 255 km/h	Actual vehicle speed	Speed indicated on speedometer
COOLANT TEMP	Engine coolant temperature/ Min.: -40°C, Max.: 140°C	After warming up: 80 to 100°C (176 to 212°F)	• If the value is -40°C (-40°F): sensor circuit is open • If the value is 140°C (284°F): sensor circuit is shorted
INTAKE AIR	Intake air temperature/ Min.: -40°C, Max.: 140°C	Equivalent to ambient air temperature	• If the value is -40°C (-40°F): sensor circuit is open • If the value is 140°C (284°F): sensor circuit is shorted
AIR-FUEL RATIO	Air-fuel ratio: Min.: 0, Max.: 1.999	During idling: 1,500 rpm 0.8 to 1.2	-

Intelligent tester Display	Measurement Item/Range (Display)	Normal Condition*	Diagnostic Note
AMBIENT TEMP	Ambient air temperature/ Min.: -40°C, Max.: 215°C	Equivalent to ambient air temperature	• If the value is -40°C: sensor circuit is open • If the value is 215°C: sensor circuit is shorted
PURGE DENSITY	Learning value of purge density/ Min.: -50, Max.: 350	-40 to 0% Idling (Inspection mode)	Service data
EVAP PURGE FLOW	Purge flow/ Min.: 0%, Max.: 102.4%	Idling: 0 to 100%	-
EVAP PURGE VSV	EVAP (Purge) VSV control duty/ Min.: 0%, Max.: 100%	0 to 100% During idling: 1,500 rpm	Order signal from ECM
VAPOR PRES TANK	Vapor pressure/ Min.: -4.125 kPa, Max.: 2.125 kPa	Fuel tank cap removed: 0 kPa	Pressure inside fuel tank is monitored by the vapor pressure sensor
VAPOR PRES PUMP	Vapor pressure: Min.: 33.853 kPa, Max.: 125.596 kPa	Approximately 100 kPa: Power switch ON (IG)	EVAP system pressure monitored by canister pressure sensor
VAPOR PRES CALC	Vapor pressure (calculated): Min.: -5.632 kPa, Max.: 715.264 kPa	Approximately 100 kPa: Power switch ON (IG)	EVAP system pressure monitored by canister pressure sensor
KNOCK CRRT VAL	Correction learning value of knocking/ Min.: -64 CA, Max.: 1,984 CA	0 to 22°CA Driving: 70 km/h (44 mph)	Service data
KNOCK FB VAL	Feedback value of knocking/ Min.: -64 CA, Max.: 1,984 CA	-22 to 0°CA Driving: 70 km/h (44 mph)	Service data
CLUTCH	Clutch current: Min.: 0 A, Max.: 2.49 A	-	-
ETCS MAG CLUTCH	Electromagnetic Clutch: ON or OFF	-	-
ACCEL IDL POS	Whether or not accelerator pedal position sensor is detecting idle/ ON or OFF	Idling: ON (inspection mode)	-
THRTL LEARN VAL	Throttle valve fully closed (learned value) Min.: 0 V, Max.: 5 V	0.4 to 0.8 V	-
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	-
ST1	Starter signal/ ON or OFF	Cranking: ON	-
SYS GUARD JUDGE	System guard/ ON or OFF	-	ETCS service data
OPN MALFUNCTION	Open side malfunction/ ON or OFF	-	ETCS service data
THROTTLE POS	Absolute throttle position sensor/ Min.: 0%, Max.: 100%	• Throttle fully closed: 10 to 24% • Throttle fully open: 64 to 96%	Read the value with intrusive operation (active test)
THROTTL IDL POS	Whether or not throttle position sensor is detecting idle/ ON or OFF	Idling: ON (inspection mode)	-
THRTL REQ POS	Throttle requirement position/ Min.: 0 V, Max.: 5 V	Idling: 0.5 to 1.0 V (Inspection mode)	-
THROTTLE POS	Throttle sensor positioning/ Min.: 0%, Max.: 100%	Idling 10 to 18% (Inspection mode)	Calculated value based on VTA1
THROTTLE POS #2	Throttle sensor positioning #2/ Min.: 0%, Max.: 100%	-	Calculated value based on VTA2
THROTTLE POS #1	Throttle position sensor No. 1 output voltage/ Min.: 0 V, Max.: 4.98 V	-	ETCS service data

ES

Intelligent tester Display	Measurement Item/Range (Display)	Normal Condition*	Diagnostic Note
THROTTLE POS #2	Throttle position sensor No.2 output voltage/ Min.: 0 V, Max.: 4.98 V	-	ETCS service data
THROTTLE POS #1	Throttle position No. 1/ Min.: 0 V, Max.: 5 V	• Throttle fully closed: 0.5 to 1.2 V • Throttle fully opened : 3.2 to 4.8 V	-
THROTTLE POS #2	Throttle position No. 2/ Min.: 0 V, Max.: 5 V	• Throttle fully closed: 2.0 to 2.9 V • Throttle fully open: 4.6 to 5.5 V	Read the value with intrusive operation (active test)
THRTL COMND VAL	Throttle position command value/ Min.: 0 V, Max.: 4.98 V	0.5 to 4.8 V	ETCS service data
THROTTLE SSR #1	Throttle sensor opener position No. 1/ Min.: 0 V, Max.: 4.98 V	0.6 to 0.9 V	ETCS service data
THROTTLE SSR #2	Throttle sensor opener position No. 2/ Min.: 0 V, Max.: 4.98 V	2.2 to 2.6 V	ETCS service data
THRTL SSR #1 AD	Throttle sensor opener position No.1 (AD)/ Min.: 0 V, Max.: 4.98 V	0.6 to 0.9 V	ETCS service data
THROTTLE MOT	Whether or not throttle motor control is permitted/ ON or OFF	Idling: ON (Inspection mode)	Read the value with the power switch ON (Do not start engine)
THROTTLE MOT	Throttle motor current Min.: 0 A, Max.: 80 A	Idling: 0 to 3.0 A (Inspection mode)	-
THROTTLE MOT	Throttle motor Min.: 0%, Max.: 100%	Idling: 0.5 to 40% (Inspection mode)	-
THROTTLE MOT	Throttle motor current Min.: 0 A, Max.: 19.92 A	Idling: 0 to 3.0 A	-
THROTL OPN DUTY	Throttle motor opening duty ratio/ Min.: 0%, Max.: 100%	During idling: 0 to 40%	When accelerator pedal is depressed, duty ratio is increased
THROTL CLS DUTY	Throttle motor closed duty ratio/ Min.: 0%, Max.: 100%	During idling: 0 to 40%	When accelerator pedal is released quickly, duty ratio is increased
THRTL MOT (OPN)	Throttle motor duty ratio (open)/ Min.: 0%, Max.: 100%	-	ETCS service data
THRTL MOT (CLS)	Throttle motor duty ratio (close)/ Min.: 0%, Max.: 100%	-	ETCS service data
O2S B1 S2	Heated oxygen sensor output voltage for bank 1 sensor 2/ Min.: 0 V, Max.: 1.275 V	Driving: 70 km/h (44 mph) 0.1 to 0.9 V	Performing the INJ VOL or A/F CONTROL function of the ACTIVE TEST enables the technician to check voltage output of the sensor
AFS B1 S1	A/F sensor output voltage for bank 1 sensor 1/ Min.: 0 V, Max.: 7.999 V	Idling 2.8 to 3.8 V (Inspection mode)	Performing the INJ VOL or A/F CONTROL function of the ACTIVE TEST enables the technician to check voltage output of the sensor
TOTAL FT #1	Total fuel trim of bank 1: Average value for fuel trim system of bank 1/ Min.: -0.5, Max.: 0.496	Idling: -0.2 to 0.2 (Inspection mode)	-
SHORT FT #1	Short-term fuel trim of bank 1/ Min.: -100%, Max.: 99.2%	0 +- 20%	This item is the short-term fuel compensation used to maintain the air-fuel ratio at stoichiometric air-fuel ratio

Intelligent tester Display	Measurement Item/Range (Display)	Normal Condition*	Diagnostic Note
LONG FT #1	Long-term fuel trim of bank 1/ Min.: -100%, Max.: 99.2%	0 +- 20%	This item is the overall fuel compensation carried out in long-term to compensate a continual deviation of the short-term fuel trim from the central value
FUEL SYS #1	Fuel system status (Bank1) / OL or CL or OL DRIVE or OL FAULT or CL FAULT	Idling after warming up: CL (Inspection mode)	• OL (Open Loop): Has not yet satisfied conditions to go closed loop • CL (Closed Loop): Using heated oxygen sensor as feedback for fuel control • OL DRIVE: Open loop due to driving conditions (fuel enrichment) • OL FAULT: Open loop due to detected system fault • CL FAULT: Closed loop but heated oxygen sensor, which is used for fuel control is malfunctioning
O2FT B1 S2	Short-term fuel trim associated with the bank 1 sensor 2/ Min.: -100%, Max.: 99.2%	0 +- 20%	Same as SHORT FT #1
AF FT B1 S1	Short-term fuel trim associated with the bank 1 sensor 1/ Min.: 0, Max.: 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	-
CAT TEMP B1S1	Catalyst temperature (Bank 1, Sensor 1)/ Min.: -40°C, Max.: 6,513.5°C	-	-
CAT TEMP B1S2	Catalyst temperature (Bank 1, Sensor 2)/ Min.: -40°C, Max.: 6,513.5°C	-	-
S O2S B1S2	Sub O2S Impedance B1S2: Min.:0 Ω, Max.:21247.68 Ω	5 to 15,000 Ω	-
INI COOL TEMP	Initial engine coolant temperature/ Min.: -40°C, Max.: 120°C	Close to ambient air temperature	Service data
INI INTAKE TEMP	Initial intake air temperature/ Min.: -40°C, Max.: 120°C	Close to ambient air temperature	Service data
INJ VOL	Injection volume (cylinder 1)/ Min.: 0 ml, Max.: 2.048 ml	0 to 0.5 ml	Quantity of fuel injection volume for 10 times
CTP SW	Closed Throttle Position Switch: ON or OFF	• ON: Throttle fully closed • OFF: Throttle open	-
ENG OIL PRES SW	Engine oil pressure switch signal/ 0: OFF / 1: ON	Indicating ON while engine is running	-
+BM	Whether or not electric throttle control system power is inputted/ ON or OFF	Idling: ON (inspection mode)	-
+BM VOLTAGE	+BM voltage/ Min.: 0, Max.: 19.92	Idling: 10 to 15 V	ETCS service data
BATTERY VOLTAGE	Battery voltage/ Min.: 0 V, Max.: 65.535 V	Idling: 9 to 14 V (Inspection mode)	-
ACTUATOR POWER	Actuator power supply/ ON or OFF	Idling ON (Inspection mode)	ETCS service data
EVAP (Purge) VSV	VSV status for EVAP control/ ON or OFF	VSV operating: ON	VSV for EVAP is controlled by the ECM (ground side duty control)
FUEL PUMP / SPD	Fuel pump/speed status/ ON or OFF	Idling: ON (Inspection mode)	-

Intelligent tester Display	Measurement Item/Range (Display)	Normal Condition*	Diagnostic Note
VVT CTRL B1	VVT control status/ ON or OFF	-	Support for VVT active test
VACUUM PUMP	Key-off EVAP system leak detection pump status: ON or OFF	-	Active Test support data
EVAP VENT VAL	Key-off EVAP system vent valve status: ON or OFF	-	Active Test support data
FAN MOTOR	Electric fan motor: ON or OFF	-	Support for fan motor active test
TANK BYPASS VSV	Tank bypass VSV: ON or OFF	-	Support for tank bypass VSV active test
TC/TE1	TC and TE1 terminal of DLC3: ON or OFF	-	-
VVTL AIM ANGL #1	VVT aim angle (bank 1): Min.: 0%, Max.: 100%	Idling: 0%	VVT duty signal value during intrusive operation
VVT CHNG ANGL #1	VVT change angle: Min.: 0°FR, Max.: 60°FR	Idling: 0 to 5 °FR	Displacement angle during intrusive operation
VVT OCV DUTY B1	VVT OCV operation duty: Min.: 0%, Max.:100%	Idling: 0%	Requested duty value for intrusive operation
FC IDL	Fuel cut idle: ON or OFF	Fuel cut operation: ON	FC IDL = "ON" when throttle valve fully closed and engine speed is over 2,800 rpm
FC TAU	Fuel cut TAU: Fuel cut during very light load: ON or OFF	Fuel cut operating: ON	The fuel cut is being performed under very light load to prevent the engine combustion from becoming incomplete
IGNITION	Ignition counter: Min.: 0, Max.: 800	0 to 800	-
CYL #1, #2, #3, #4	Misfire ratio of the cylinder 1 to 4: Min.: 0, Max.: 255	0%	This item is displayed in only idling
CYL ALL	All cylinders misfire rate: Min.: 0, Max.: 255	0 to 35	-
MISFIRE RPM	Engine RPM for first misfire range: Min.: 0 rpm, Max.: 6,375 rpm	Misfire 0: 0 rpm	-
MISFIRE LOAD	Engine load for first misfire range: Min.: 0 g/rev, Max.: 3.98 g/rev	Misfire 0: 0 g/rev	-
MISFIRE MARGIN	Misfire monitoring: MIn.: -100%, Max.: 99.22%	-100 to 99.2%	Misfire detecting margin
#CODES	#Codes: Min.: 0, Max.: 255	-	Number of detected DTCs
CHECK MODE	Check mode: ON or OFF	Check mode ON: ON	(see page ES-32)
MISFIRE TEST	Check mode result for misfire monitor: COMPL or INCMPL	-	-
OXS1 TEST	Check mode result for HO2 sensor: COMPL or INCMPL	-	-
A/F SSR TEST B1	Check mode result for air-fuel ratio sensor: COMPL or INCMPL	-	-
MIL	MIL status: ON or OFF	MIL ON: ON	-
MIL ON RUN DIST	MIL ON Run Distance: Min.: 0 second, Max.: 65,535 seconds	Distance after DTC is detected	-

Intelligent tester Display	Measurement Item/Range (Display)	Normal Condition*	Diagnostic Note
MIL ON RUN TIME	Running time from MIL ON: Min.: 0 minute, Max.: 65,535 minutes	Equivalent to running time after MIL was ON	-
ENG RUN TIME	Engine run time: Min.: 0 second, Max.: 65,535 seconds	Time after engine start	Service data
TIME DTC CLEAR	Time after DTC cleared: Min.: 0 minute, Max.: 65,535 minutes	Equivalent to time after DTCs were erased	-
DIST DTC CLEAR	Distance after DTC cleared: Min.: 0 km/h, Max.: 65535 km/h	Equivalent to drive distance after DTCs were erased	-
WU CYC DTC CLEAR	Warm-up cycle after DTC cleared: Min.: 0, Max.: 255	-	Number of warm-up cycles after DTC is cleared
OBD CERT	OBD requirement	OBD2	-
#CARB CODES	Emission related DTCs	-	Number of emission related DTCs
COMP MON	Comprehensive component monitor: NOT AVL or AVAIL	-	-
FUEL MON	Fuel system monitor: NOT AVL or AVAIL	-	-
MISFIRE MON	Misfire monitor: NOT AVL or AVAIL	-	-
O2S (A/FS) MON	O2S (A/FS) heater monitor: NOT AVL or AVAIL	-	-
O2S (A/FS) MON	O2S (A/FS) heater monitor: COMPL or INCMPL	-	-
EVAP MON	EVAP monitor: NOT AVL or AVAIL	-	-
EVAP MON	EVAP monitor: COMPL or INCMPL	-	-
CAT MON	Catalyst monitor: NOT AVL or AVAIL	-	-
CAT MON	Catalyst monitor: COMPL or INCMPL	-	-
CCM ENA	Comprehensive component monitor: UNABLE or ENABLE	-	-
CCM CMPL	Comprehensive component monitor: COMPL or INCMPL	-	-
FUEL ENA	Fuel system monitor: UNABLE or ENABLE	-	-
FUEL CMPL	Fuel system monitor: COMPL or INCMPL	-	-
MISFIRE ENA	Misfire monitor: UNABLE or ENABLE	-	-
MISFIRE CMPL	Misfire monitor: COMPL or INCMPL	-	-
EGR ENA	EGR Monitor: UNABLE or ENABLE	-	-
EGR CMPL	EGR Monitor: COMPL or INCMPL	-	-
HTR ENA	O2S (A/FS) heater monitor: UNABLE or ENABLE	-	-

Intelligent tester Display	Measurement Item/Range (Display)	Normal Condition*	Diagnostic Note
HTR CMPL	O2S (A/FS) heater monitor: COMPL or INCMPL	-	-
O2S (A/FS) ENA	O2S (A/FS) monitor: UNABLE or ENABLE	-	-
O2S (A/FS) CMPL	O2S (A/FS) monitor: COMPL or INCMPL	-	-
ACRF ENA	A/C Monitor: UNABLE or ENABLE	-	-
ACRF CMPL	A/C Monitor: COMPL or INCMPL	-	-
AIR ENA	2nd Air Monitor: UNABLE or ENABLE	-	-
AIR CMPL	2nd Air Monitor: COMPL or INCMPL	-	-
EVAP ENA	EVAP monitor: UNABLE or ENABLE	-	-
EVAP CMPL	EVAP monitor: COMPL or INCMPL	-	-
HCAT ENA	Heated Catalyst Monitor: UNABLE or ENABLE	-	-
HCAT CMPL	Heated Catalyst Monitor: COMPL or INCMPL	-	-
CAT ENA	Catalyst monitor: UNABLE or ENABLE	-	-
CAT CMPL	Catalyst monitor: COMPL or INCMPL	-	-
CYLINDER NUMBER	Cylinder number: Min.: 0, Max.: 255	-	Identifying the cylinder number
MODEL YEAR	Model year: Min.: 0, Max.: 255	-	Identifying the model year
REQ ENG TRQ	Requested engine torque: Min.: 0 kW, Max.: 16383.75 kW	0 to 57 kW	Flag information for hybrid vehicle
HV TRGT ENG SPD	HV target engine speed: Min.: 0 rpm, Max.: 6375 rpm	0 to 5000 rpm	Flag information for hybrid vehicle
ACT ENGINE TRQ	Actual engine torque: Min.: -128 Nm, Max.: 127 Nm	-128 to 127 Nm	Flag information for hybrid vehicle
EST ENGINE TRQ	Estimated engine torque: Min.: 0 Nm, Max.: 510 Nm	0 to 120 Nm	Flag information for hybrid vehicle
ENG RUN TIME	Engine run time: Min.: 0 second, Max.: 255 seconds	0 to 255 seconds	Flag information for hybrid vehicle
ENGINE RUN TIME	Request engine run time: Min.: 0 second, Max.: 25.5 seconds	0 to 25.5 seconds	Flag information for hybrid vehicle
IGNITION TIME	Judgment time for ignition of engine: Min.: 0 second, Max.: 25.5 seconds	0 to 25.5 seconds	Flag information for hybrid vehicle
OUTPUT TIME	Judgment time for engine output: Min.: 0 second, Max.: 25.5 seconds	0 to 25.5 seconds	Flag information for hybrid vehicle
EST PORT TEMP	Estimated intake port temperature: Min.: -40°C, Max.: 215°C	80 to 100°C	Flag information for hybrid vehicle
FUEL LEVEL	Fuel level: EMPTY or NOT EMP	-	Flag information for hybrid vehicle
ISC LEARNING	ISC Learning: COMPL or INCMPL	-	-

Intelligent tester Display	Measurement Item/Range (Display)	Normal Condition*	Diagnostic Note
FUEL CUT	Fuel cut for engine stop request: OFF or ON	-	Flag information for hybrid vehicle
INDPNDNT OPR	Engine independently operation: NOT OPR or OPERATE	-	Flag information for hybrid vehicle
RACING	Rev-up operation: NOT OPR or OPERATE	-	Flag information for hybrid vehicle
WARM UP	Request warm-up: NOT REQ or REQUEST	-	Flag information for hybrid vehicle
INDPNDNT CNTRL	Engine independently control operation: NOT OPR or OPERATE	-	Flag information for hybrid vehicle
TANK WATER TEMP	CHS tank outlet temperature sensor output: Max: 215°C, Min: -40°C	-	• If the value is -40°C: sensor circuit is open • If the value is 215°C: sensor circuit is shorted
WATER FLW VLV	Water valve position signal: Max: 4.98 V, Min: 0 V	0.45 to 4.6 V	Voltage varies based on valve position
ISC LEARN VAL	ISC learning value: Max: 19.92 L/s, Min: 0 L/s	-	Flag information for hybrid vehicle
DIRECT VAL 1	Direction Val Heat Storage 3 way valve (ctrl side): Max: 5 V, Min: 0 V	2.5 to 4.5 V	-
DIRECT VAL 2	Direction Val Heat Storage 3 way valve (OBD side): Max: 5 V, Min: 0 V	2.5 to 4.5 V	-
MODEL CODE	Identifying model code	NHW20#	-
ENGINE TYPE	Identifying engine type	1NZFXE	-
CYLINDER NUMBER	Identifying cylinder number: Min.: 0, Max.: 255	4	-
MODEL YEAR	Identifying model year: Min.: 1900, Max.: 2155	200#	-
SYSTEM	Identifying engine system	HV	-

HINT:
*: If no condition is specifically stated for "Idling", it means the transaxle position is in the N or P, the A/C switch is OFF and all accessory switches are OFF.

2. ACTIVE TEST

HINT:
Performing ACTIVE TEST using the intelligent tester or the OBD II scan tool allows the relay, VSV, actuator and so on to operate without parts removal. Performing ACTIVE TEST as a first step of troubleshooting is one method to shorten diagnostic time.
It is possible to display DATA LIST during ACTIVE TEST.

(a) Turn the power switch ON (READY) and warm up the engine.
(b) Turn the power switch OFF.
(c) Connect the intelligent tester to the DLC3.
(d) Turn the power switch ON (IG).
(e) Turn the intelligent tester ON.
(f) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST.
(g) According to the display on the tester, perform items in ACTIVE TEST.

Intelligent Tester Display	Test Details	Diagnostic Note
INJ VOL	[Test Details] Control the injection volume Min.: -12.5%, Max.: 24.8% [Vehicle Condition] Engine speed: 3,000 rpm or less	• All injectors are tested at once • Injection volume is gradually changed between -12 and 25%
A/F CONTROL	[Test Details] Control the injection volume -12.5 or 24.8% (Change the injection volume 12.5 % or 25%) [Vehicle Condition] Engine speed: 3,000 rpm or less	The following A/F CONTROL procedure enables the technician to check and graph the voltage outputs of both the A/F sensor and heated oxygen sensor To display the graph, enter ACTIVE TEST / A/F CONTROL / USER DATA, then select "AFS B1S1 and O2S B1S2" or "AFS B2S1 and O2S B2S2" by pressing "YES" button and followed by "ENTER" button and then pressing "F4" button
EVAP VSV (ALONE)	[Test Details] Activate the VSV for EVAP control ON or OFF	(See page ES-207)
TANK BYPASS VSV	[Test Details] Activate the VSV for tank bypass ON or OFF	(See page ES-231)
VVT CTRL B1	[Test Details] Activate the VVT system (Bank 1) ON or OFF	• ON: Rough idle or engine stall • OFF: Normal engine speed (See page ES-55)
FUEL PUMP / SPD	[Test Details] Control the fuel pump ON or OFF	-
TC/TE1	[Test Details] Connect the TC and TE1 ON or OFF	-
FC IDL PROHBT	[Test Details] Control the idle fuel cut prohibit ON or OFF	-
COOLING FAN	[Test Details] Control the electric cooling fan ON or OFF	-
ETCS OPEN/CLOSE SLOW	[Test Details] Control the ETCS opening/closing slow speed ON or OFF	Throttle valve intrusive operation
ETCS OPEN/CLOSE FAST	[Test Details] Control the ETCS opening/closing fast speed ON or OFF	Throttle valve intrusive operation
FUEL CUT #1	[Test Details] Control the cylinder #1 fuel cut ON or OFF (Inspection mode)	Cylinder No. 1 fuel cut for power balance
FUEL CUT #2	[Test Details] Control the cylinder #2 fuel cut ON or OFF (Inspection mode)	Cylinder No. 2 fuel cut for power balance
FUEL CUT #3	[Test Details] Control the cylinder #3 fuel cut ON or OFF (Inspection mode)	Cylinder No. 3 fuel cut for power balance
FUEL CUT #4	[Test Details] Control the cylinder #4 fuel cut ON or OFF (Inspection mode)	Cylinder No. 4 fuel cut for power balance
VVT B1	[Test Details] Control the VVT (bank 1) Min.: -128%, Max.: 127%	-
WATER PUMP	[Test Details] Activate the water pump ON or OFF	Coolant heat storage water pump

Intelligent Tester Display	Test Details	Diagnostic Note
WATER FLW VLV1	[Test Details] Activate the water valve ON or OFF	Unused
WATER FLW VLV2	[Test Details] Activate the water valve ON or OFF	Unused
WATER FLW VLV3	[Test Details] Activate the water valve ON or OFF	Water valve intrusive valve operation (position when engine is in pre-heat mode) (See page ES-304)
WATER FLW VLV4	[Test Details] Activate the water valve ON or OFF	Water valve intrusive valve operation (position when hot coolant recovering) (See page ES-304)
WATER FLW VLV5	[Test Details] Activate the water valve ON or OFF	Water valve intrusive valve operation (position when engine is in normal operation) (See page ES-304)
VACUUM PUMP	[Test Details] Activate the leak detection pump ON or OFF	-
VENT VALVE	[Test Details] Activate the vent valve ON or OFF	-

DIAGNOSTIC TROUBLE CODE CHART

HINT:
Parameters listed in the chart may be different than your readings depending on the type of instrument and other factors.
If any DTCs are displayed during a check mode DTC check, check the circuit for the DTCs listed in the table below. For details of each DTC, refer to the page indicated.

DTC No.	Detection Item	Trouble Area	MIL	Memory	See page
P0010	Camshaft Position "A" Actuator Circuit (Bank 1)	- Open or short in oil control valve circuit - Oil control valve - ECM	Come on	DTC Stored	ES-55
P0011	Camshaft Position "A" - Timing Over-Advanced or System Performance (Bank 1)	- Valve timing - Oil control valve - Camshaft timing gear assembly - ECM	Come on	DTC Stored	ES-59
P0012	Camshaft Position "A" - Timing Over-Retarded (Bank 1)	- Same as DTC P0011	Come on	DTC Stored	ES-59
P0016	Crankshaft Position - Camshaft Position Correlation (Bank 1 Sensor A)	- Mechanical system (timing chain has jumped a tooth, chain stretched) - ECM	Come on	DTC Stored	ES-63
P0031	Oxygen (A/F) Sensor Heater Control Circuit Low (Bank 1 Sensor 1)	- Open or short in heater circuit of A/F sensor - A/F sensor heater - EFI M relay (Integration relay) - ECM	Come on	DTC Stored	ES-65
P0032	Oxygen (A/F) Sensor Heater Control Circuit High (Bank 1 Sensor 1)	- Short in heater circuit of A/F sensor - A/F sensor heater - EFI M relay (Integration relay) - ECM	Come on	DTC Stored	ES-65
P0037	Oxygen Sensor Heater Control Circuit Low (Bank 1 Sensor 2)	- Open or short in heater circuit of the heated oxygen sensor - Heated oxygen sensor heater - EFI M relay (integration relay) - ECM	Come on	DTC Stored	ES-70
P0038	Oxygen Sensor Heater Control Circuit High (Bank 1 Sensor 2)	- Short in heater circuit of the heated oxygen sensor - Heated oxygen sensor heater - EFI M relay (integration relay) - ECM	Come on	DTC Stored	ES-70
P0100	Mass or Volume Air Flow Circuit	- Open or short in mass air flow meter circuit - Mass air flow meter - ECM	Come on	DTC Stored	ES-76

DTC No.	Detection Item	Trouble Area	MIL	Memory	See page
P0101	Mass Air Flow Circuit Range / Performance Problem	- Mass air flow meter	Come on	DTC Stored	ES-83
P0102	Mass or Volume Air Flow Circuit Low Input	- Open in mass air flow meter circuit - Mass air flow meter - ECM	Come on	DTC Stored	ES-76
P0103	Mass or Volume Air Flow Circuit High Input	- Short in mass air flow meter circuit - Mass air flow meter - ECM	Come on	DTC Stored	ES-76
P0110	Intake Air Temperature Circuit	- Open or short in intake air temperature sensor circuit - Intake air temperature sensor (built in mass air flow meter) - ECM	Come on	DTC Stored	ES-85
P0112	Intake Air Temperature Circuit Low Input	- Short in intake air temperature sensor circuit - Intake air temperature sensor (built in mass air flow meter) - ECM	Come on	DTC Stored	ES-85
P0113	Intake Air Temperature Circuit High Input	- Open in intake air temperature sensor circuit - Intake air temperature sensor (built in mass air flow meter) - ECM	Come on	DTC Stored	ES-85
P0115	Engine Coolant Temperature Circuit	- Open or short in engine coolant temperature sensor circuit - Engine coolant temperature sensor - ECM	Come on	DTC Stored	ES-91
P0116	Engine Coolant Temperature Circuit Range / Performance Problem	- Engine coolant temperature sensor	Come on	DTC Stored	ES-97
P0117	Engine Coolant Temperature Circuit Low Input	- Short in engine coolant temperature sensor circuit - Engine coolant temperature sensor - ECM	Come on	DTC Stored	ES-91
P0118	Engine Coolant Temperature Circuit High Input	- Open in engine coolant temperature sensor circuit - Engine coolant temperature sensor - ECM	Come on	DTC Stored	ES-91

DTC No.	Detection Item	Trouble Area	MIL	Memory	See page
P0120	Throttle Pedal Position Sensor / Switch "A" Circuit Malfunction	- Open or short in throttle position sensor circuit - Throttle position sensor (built in throttle body) - ECM	Come on	DTC Stored	ES-100
P0121	Throttle / Pedal Position Sensor / Switch "A" Circuit Range / Performance Problem	- Throttle position sensor (built in throttle body)	Come on	DTC Stored	ES-107
P0122	Throttle / Pedal Position Sensor / Switch "A" Circuit Low Input	- Throttle position sensor - Open in VTA1 circuit - Open in VC circuit (when the VC circuit is open, DTCs P0222 and P2135 are also output simultaneously) - ECM	Come on	DTC Stored	ES-100
P0123	Throttle / Pedal Position Sensor / Switch "A" Circuit High Input	- Throttle position sensor (built in throttle body) - Open in VTA circuit - Open in E2 circuit - VC and VTA circuits are short-circuited - ECM	Come on	DTC Stored	ES-100
P0125	Insufficient Coolant Temperature for Closed Loop Fuel Control	- Cooling system - Engine coolant temperature sensor - Thermostat	Come on	DTC Stored	ES-109
P0128	Coolant Thermostat (Coolant Temperature Below Thermostat Regulating Temperature)	- Thermostat - Cooling system - Engine coolant temperature sensor - ECM	Come on	DTC Stored	ES-112
P0136	Oxygen Sensor Circuit Malfunction (Bank 1 Sensor 2)	- Heated oxygen sensor (bank 1 sensor 2) circuit - Heated oxygen sensor (bank 1 sensor 2) - Heated oxygen sensor heater (bank 1 sensor 2) - A/F sensor (bank 1 sensor 1) - A/F sensor heater	Come on	DTC Stored	ES-115
P0137	Oxygen Sensor Circuit Low Voltage (Bank 1 Sensor 2)	- Heated oxygen sensor (bank 1 sensor 2) circuit - Heated oxygen sensor (bank 1 sensor 2) - Heated oxygen sensor heater (bank 1 sensor 2) - A/F sensor (bank 1 sensor 1) - A/F sensor heater	Come on	DTC Stored	ES-115

DTC No.	Detection Item	Trouble Area	MIL	Memory	See page
P0138	Oxygen Sensor Circuit High Voltage (Bank 1 Sensor 2)	- Heated oxygen sensor (bank 1 sensor 2) circuit - Heated oxygen sensor (bank 1 sensor 2) - Heated oxygen sensor heater (bank 1 sensor 2) - A/F sensor (bank 1 sensor 1) - A/F sensor heater	Come on	DTC Stored	ES-115
P0171	System Too Lean (Fuel Trim)	- Air induction system - Injector has blockage - Mass air flow meter - Engine coolant temperature sensor - Fuel pressure - Gas leakage in exhaust system - Open or short in A/F sensor (bank 1 sensor 1) circuit - A/F sensor (bank 1 sensor 1) - A/F sensor heater (bank 1 sensor 1) - EFI M relay (integration relay) - PCV valve and hose - PCV hose connection - ECM	Come on	DTC Stored	ES-128
P0172	System Too Rich (Bank 1)	- Injector has leakage or blockage - Mass air flow meter - Engine coolant temperature sensor - Ignition system - Fuel pressure - Gas leakage in exhaust system - Open or short in A/F sensor (bank 1 sensor 1) circuit - A/F sensor (bank 1 sensor 1) - A/F sensor heater (bank 1 sensor 1) - EFI M relay (integration relay) - ECM	Come on	DTC Stored	ES-128
P0220	Throttle / Pedal Position Sensor / Switch "B" Circuit	- Open or short in throttle position sensor circuit - Throttle position sensor - ECM	Come on	DTC Stored	ES-100

ES

DTC No.	Detection Item	Trouble Area	MIL	Memory	See page
P0222	Throttle / Pedal Position Sensor / Switch "B" Circuit Low Input	- Throttle position sensor - Open in VTA2 circuit - Open in VC circuit (when the VC circuit is open, DTCs P0122 and P2135 are also output simultaneously)	Come on	DTC Stored	ES-100
P0223	Throttle / Pedal Position Sensor / Switch "B" Circuit High Input	- Throttle position sensor	Come on	DTC Stored	ES-100
P0300	Random / Multiple Cylinder Misfire Detected	- Open or short in engine wire harness - Connector connection - Vacuum hose connection - Ignition system - Injector - Fuel pressure - Mass air flow meter - Engine coolant temperature sensor - Compression pressure - Valve clearance - Valve timing - PCV hose connection - PCV hose - ECM	Comes on/Blink	DTC Stored	ES-141
P0301	Cylinder 1 Misfire Detected	- Same as DTC P0300	Comes on/Blink	DTC Stored	ES-141
P0302	Cylinder 2 Misfire Detected	- Same as DTC P0300	Comes on/Blink	DTC Stored	ES-141
P0303	Cylinder 3 Misfire Detected	- Same as DTC P0300	Comes on/Blink	DTC Stored	ES-141
P0304	Cylinder 4 Misfire Detected	- Same as DTC P0300	Comes on/Blink	DTC Stored	ES-141
P0325	Knock Sensor 1 Circuit	- Open or short in knock sensor circuit - Knock sensor (looseness) - ECM	Come on	DTC Stored	ES-154
P0327	Knock Sensor 1 Circuit Low Input (Bank 1 or Single Sensor)	- Short in knock sensor circuit - Knock sensor - ECM	Come on	DTC Stored	ES-154
P0328	Knock Sensor 1 Circuit High Input (Bank 1 or Single Sensor)	- Open in knock sensor circuit - Knock sensor - ECM	Come on	DTC Stored	ES-154
P0335	Crankshaft Position Sensor "A" Circuit	- Open or short in crankshaft position sensor circuit - Crankshaft position sensor - Signal plate (crankshaft) - ECM	Come on	DTC Stored	ES-159

DTC No.	Detection Item	Trouble Area	MIL	Memory	See page
P0340	Camshaft Position Sensor Circuit Malfunction	- Open or short in camshaft position sensor circuit - Camshaft position sensor - Camshaft timing pulley - Timing chain has jumped a tooth - ECM	Come on	DTC Stored	ES-163
P0341	Camshaft Position Sensor "A" Circuit Range / Performance (Bank 1 or Single Sensor)	- Same as DTC P0340	Come on	DTC Stored	ES-163
P0351	Ignition Coil "A" Primary / Secondary Circuit	- Ignition system - Open or short in IGF or IGT1 circuit between ignition coil with igniter and ECM - No.1 ignition coil with igniter - ECM	Come on	DTC Stored	ES-167
P0352	Ignition Coil "B" Primary / Secondary Circuit	- Ignition system - Open or short in IGF or IGT2 circuit between ignition coil with igniter and ECM - No.2 ignition coil with igniter - ECM	Come on	DTC Stored	ES-167
P0353	Ignition Coil "C" Primary / Secondary Circuit	- Ignition system - Open or short in IGF or IGT3 circuit between ignition coil with igniter and ECM - No.3 ignition coil with igniter - ECM	Come on	DTC Stored	ES-167
P0354	Ignition Coil "D" Primary / Secondary Circuit	- Ignition system - Open or short in IGF or IGT4 circuit between ignition coil with igniter and ECM - No.4 ignition coil with igniter - ECM	Come on	DTC Stored	ES-167
P0420	Catalyst System Efficiency Below Threshold (Bank 1)	- Gas leakage in exhaust system - A/F sensor (bank 1 sensor 1) - Heated oxygen sensor (bank 1 sensor 2) - Three-way catalytic converter (exhaust manifold)	Come on	DTC Stored	ES-177

DTC No.	Detection Item	Trouble Area	MIL	Memory	See page
P043E	Evaporative Emission System Reference Orifice Clog Up	- Canister pump module (Reference orifice, leak detection pump, vent valve) - Connector/wire harness (Canister pump module - ECM) - EVAP system hose (pipe from air inlet port to canister pump module, canister filter, fuel tank vent hose) - ECM	Come on	DTC Stored	ES-184
P043F	Evaporative Emission System Reference Orifice High Flow	- Same as DTC P043E	Come on	DTC Stored	ES-184
P0441	Evaporative Emission Control System Incorrect Purge Flow	- Purge VSV - Connector/wire harness (Purge VSV - ECM) - Canister pump module - Leakage from EVAP system - Leakage from EVAP line (Purge VSV - Intake manifold) - ECM	Come on	DTC Stored	ES-207
P0446	Evaporative Emission Control System Vent Control Circuit	- Pressure swithing valve - EVAP line (Pressure switching valve - Fuel tank) - ECM	Come on	DTC Stored	ES-231
P0450	Evaporative Emission Control System Pressure Sensor Malfunction	- Canister pump module - EVAP system hose (pipe from air inlet port to canister pump module, canister filter, fuel tank vent hose) - Connector/wire harness (Canister pump module - ECM) - ECM	Come on	DTC Stored	ES-245
P0451	Evaporative Emission Control System Pressure Sensor Range / Performance	- Canister pump module - EVAP system hose (pipe from air inlet port to canister pump module, canister filter, fuel tank vent hose) - ECM	Come on	DTC Stored	ES-245
P0452	Evaporative Emission Control System Pressure Sensor / Switch Low Input	- Same as DTC P0450	Come on	DTC Stored	ES-245
P0453	Evaporative Emission Control System Pressure Sensor / Switch High Input	- Same as DTC P0450	Come on	DTC Stored	ES-245

DTC No.	Detection Item	Trouble Area	MIL	Memory	See page
P0455	Evaporative Emission Control System Leak Detected (Gross Leak)	- Fuel cap (loose) - Leakage from EVAP line (Canister - Fuel tank) - Leakage from EVAP line (Purge VSV - Canister) - Canister pump module - Leakage from fuel tank - Leakage from canister	Come on	DTC Stored	ES-259
P0456	Evaporative Emission Control System Leak Detected (Very Small Leak)	- Same as DTC P0455	Come on	DTC Stored	ES-259
P0505	Idle Control System Malfunction	- Open or short in idle speed control (ISC) valve circuit - Idle speed control (ISC) valve has stuck closed - ECM - Air induction system - PCV valve and hose	Come on	DTC Stored	ES-282
P0560	System Voltage	- Open in back up power source circuit - ECM	Come on	DTC Stored	ES-285
P0604	Internal Control Module Random Access Memory (RAM) Error	- ECM	Come on	DTC Stored	ES-289
P0606	ECM / PCM Processor	- ECM	Come on	-	ES-289
P0607	Control Module Performance	- ECM	Come on	DTC Stored	ES-289
P0657	Actuator Supply Voltage Circuit / Open	- ECM	Come on	DTC Stored	ES-289
P1115	Coolant Temperature Sensor Circuit for Coolant Heat Storage System	- Coolant heat storage tank outlet temperature sensor - Open or short in temperature sensor circuit - ECM	Come on	DTC Stored	ES-291
P1116	Coolant Temperature Sensor Circuit Stack for Coolant Heat Storage	- Coolant heat storage tank outlet temperature sensor - Cooling system (clogging)	Come on	DTC Stored	ES-296
P1117	Coolant Temperature Sensor Circuit Low for Coolant Heat Storage	- Coolant heat storage tank outlet temperature sensor - Short in temperature sensor circuit - ECM	Come on	DTC Stored	ES-291

ES

DTC No.	Detection Item	Trouble Area	MIL	Memory	See page
P1118	Coolant Temperature Sensor Circuit High for Coolant Heat Storage	- Coolant heat storage tank outlet temperature sensor - Open in temperature sensor circuit - ECM	Come on	DTC Stored	ES-291
P1120	Coolant Flow Control Valve Position Sensor Circuit	- Open or short in water valve position sensor circuit - Water valve (coolant flow control valve) - ECM	Come on	DTC Stored	ES-298
P1121	Coolant Flow Control Valve Position Sensor Circuit Stuck	- Water valve (coolant flow control valve) - Cooling system (clogging)	Come on	DTC Stored	ES-304
P1122	Coolant Flow Control Valve Position Sensor Circuit Low	- Water valve (coolant flow control valve) - Short in WBAD (valve position signal) circuit - Open in VC circuit - ECM	Come on	DTC Stored	ES-298
P1123	Coolant Flow Control Valve Position Sensor Circuit High	- Water valve (coolant flow control valve) - Open in E2 circuit - VC and WBAD circuits are short-circuited - Open in WBAD circuit - ECM	Come on	DTC Stored	ES-298
P1150	Coolant Path Clog of Coolant Heat Storage System	- Coolant heat storage tank outlet temperature sensor - Water valve (coolant flow control valve) - Cooling system (clogging) - Heat storage tank - ECM	Come on	DTC Stored	ES-308
P1151	Coolant Heat Storage Tank	- Heat storage tank	Come on	DTC Stored	ES-312
P1450	Fuel Tank Pressure Sensor	- Fuel tank pressure sensor - Connector/wire harness (Fuel tank pressure sensor - ECM) - ECM	Come on	DTC Stored	ES-315
P1451	Fuel Tank Pressure Sensor Range/ Performance	- Fuel tank pressure sensor - ECM	Come on	DTC Stored	ES-315
P1452	Fuel Tank Pressure Sensor Low Input	- Fuel tank pressure sensor - Connector/wire harness (Fuel tank pressure sensor - ECM) - ECM	Come on	DTC Stored	ES-315

DTC No.	Detection Item	Trouble Area	MIL	Memory	See page
P1453	Fuel Tank Pressure Sensor High Input	- Fuel tank pressure sensor - Connector/wire harness (Fuel tank pressure sensor - ECM) - ECM	Come on	DTC Stored	ES-315
P1455	Vapor Reducing Fuel Tank System Malfunction	- Fuel Tank	Come on	DTC Stored	ES-327
P2102	Throttle Actuator Control Motor Circuit Low	- Open or short in throttle control motor circuit - Throttle control motor - ECM	Come on	DTC Stored	ES-329
P2103	Throttle Actuator Control Motor Circuit High	- Short in throttle control motor circuit - Throttle control motor - Throttle valve - Throttle body assembly - ECM	Come on	DTC Stored	ES-329
P2111	Throttle Actuator Control System - Stuck Open	- Throttle control motor circuit - Throttle control motor - Throttle body - Throttle valve	Come on	DTC Stored	ES-333
P2112	Throttle Actuator Control System - Stuck Closed	- Throttle control motor circuit - Throttle control motor - Throttle body - Throttle valve	Come on	DTC Stored	ES-333
P2118	Throttle Actuator Control Motor Current Range / Performance	- Open in ETCS power source circuit - ETCS fuse - ECM	Come on	DTC Stored	ES-336
P2119	Throttle Actuator Control Throttle Body Range / Performance	- Electric throttle control system - ECM	Come on	DTC Stored	ES-341
P2135	Throttle / Pedal Position Sensor / Switch "A" / "B" Voltage Correlation	- VTA and VTA2 circuits are short-circuited - Open in VC circuit - Throttle position sensor	Come on	DTC Stored	ES-100
P2195	Oxygen (A/F) Sensor Signal Stuck Lean (Bank 1 Sensor 1)	- Open or short in A/F sensor (bank 1 sensor 1) circuit - A/F sensor (bank 1 sensor 1) - A/F sensor heater - Integration relay - A/F sensor heater and relay circuit - Air induction system - Fuel pressure - Injector - PCV hose connection - ECM	Come on	DTC Stored	ES-344

ES

DTC No.	Detection Item	Trouble Area	MIL	Memory	See page
P2196	Oxygen (A/F) Sensor Signal Stuck Rich (Bank 1 Sensor 1)	- Same as DTC P2195	Come on	DTC Stored	ES-344
P2238	Oxygen (A/F) Sensor Pumping Current Circuit Low (Bank 1 Sensor 1)	- Open or short in A/F sensor (bank 1 sensor 1) - A/F sensor (bank 1 sensor 1) - A/F sensor heater - EFI M relay (integration relay) - A/F sensor heater and relay circuit - ECM	Come on	DTC Stored	ES-357
P2239	Oxygen (A/F) Sensor Pumping Current Circuit High (Bank 1 Sensor 1)	- Same as DTC P2238	Come on	DTC Stored	ES-357
P2252	Oxygen (A/F) Sensor Reference Ground Circuit Low (Bank 1 Sensor 1)	- Same as DTC P2238	Come on	DTC Stored	ES-357
P2253	Oxygen (A/F) Sensor Reference Ground Circuit High (Bank 1 Sensor 1)	- Same as DTC P2238	Come on	DTC Stored	ES-357
P2401	Evaporative Emission Leak Detection Pump Stuck OFF	- Same as DTC P043E	Come on	DTC Stored	ES-184
P2402	Evaporative Emission Leak Detection Pump Stuck ON	- Same as DTC P043E	Come on	DTC Stored	ES-184
P2419	Evaporative Emission Pressure Switching Valve Stuck ON	- Same as DTC P043E	Come on	DTC Stored	ES-184
P2420	Evaporative Emission Pressure Switching Valve Stuck OFF	- Pump module (0.02 inch orifice, vacuum pump, vent valve) - Connector / wire harness (Pump module - ECM) - ECM	Come on	DTC Stored	ES-363
P2601	Coolant Pump Control Circuit Range / Performance	- CHS water pump - CHS water pump relay - Open or short in CHS water pump circuit - ECM	Come on	DTC Stored	ES-384
P2610	ECM / PCM Internal Engine Off Timer Performance	- ECM	Come on	DTC Stored	ES-390

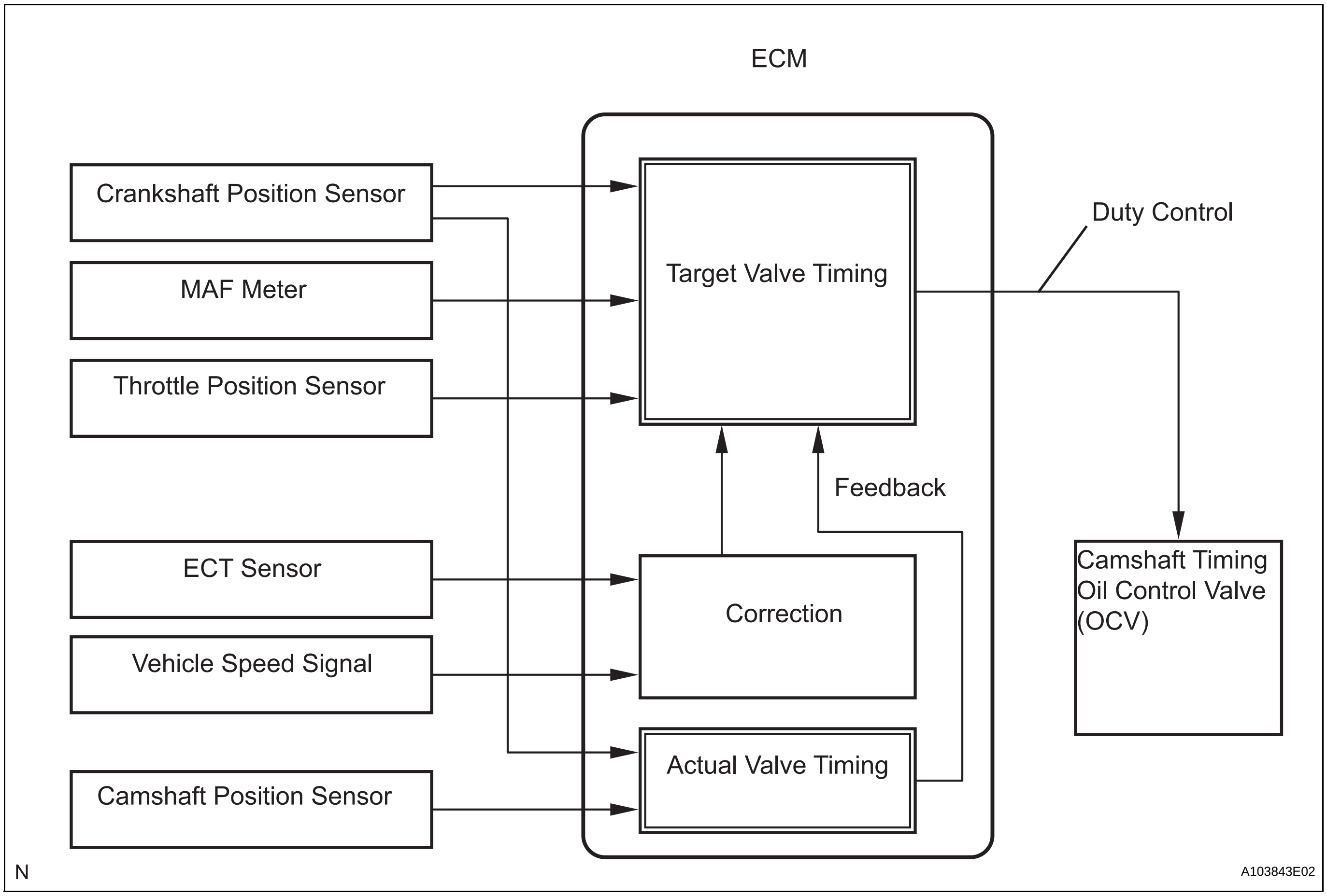
DTC No.	Detection Item	Trouble Area	MIL	Memory	See page
P2A00	A/F Sensor Circuit Slow Response (Bank 1 Sensor 1)	- Open or short in A/F sensor (bank 1 sensor 1) circuit - A/F sensor (bank 1 sensor 1) - A/F sensor heater - EFI M relay (integration relay) - A/F sensor heater and relay circuit - Air induction system - Fuel pressure - Injector - PCV hose connection - ECM	Come on	DTC Stored	ES-392
P3190	Poor Engine Power	- Air induction system - Throttle body - Fuel pressure - Engine - Air flow meter - Lack of fuel - Engine coolant temperature sensor - Crankshaft position sensor - Camshaft position sensor - ECM	Come on	DTC Stored	ES-403
P3191	Engine dose not Start	- Air induction system - Throttle body - Fuel pressure - Engine - Air flow meter - Lack of fuel - Engine coolant temperature sensor - Crankshaft position sensor - Camshaft position sensor - ECM	Come on	DTC Stored	ES-403
P3193	Fuel Run Out	- Lack of fuel - ECM	Come on	DTC Stored	ES-403
U0293	Lost Communication with HV ECU	- Wire harness - HV ECU - ECM	Come on	DTC Stored	ES-410

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

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, applied to the OCV, regulates the oil pressure supplied to the VVT controller. Camshaft timing control is performed based on engine operation condition such as intake air volume, throttle position and engine coolant temperature.

The ECM controls the OCV based on the signals from several sensors. The VVT controller regulates the intake camshaft angle using oil pressure through the OCV. As result, the relative position between the camshaft and the crankshaft is optimized, 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	Open or short in oil control valve circuit	• Open or short in oil control valve circuit • Oil control valve • 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 malfunction and sets a DTC when the actual duty-cycle ratio varies from the target duty-cycle ratio.

MONITOR STRATEGY

Related DTCs	P0010: VVT oil control valve range check
Required sensors/components	OCV
Frequency of operation	Continuous
Duration	1 second
MIL operation	Immediately
Sequence of operation	None

TYPICAL ENABLING CONDITIONS

The monitor will run whenever the following DTCs are not present	None
Battery voltage	11 to 13 V
Target duty ratio	Less than 70%
Current cut status	Not cut

TYPICAL MALFUNCTION THRESHOLDS

Output signal duty for OCV	Output duty is 3% or less despite the ECM supplying the current to the OCV or Output duty is 100%

COMPONENT OPERATING RANGE

Output signal duty for OCV	More than 3% and less than 100%

WIRING DIAGRAM

INSPECTION PROCEDURE

HINT:
Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunction is detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

ES

1	PERFORM ACTIVE TEST BY INTELLIGENT TESTER (OPERATE OCV)

(a) Connect the intelligent tester to the DLC3.
(b) Turn the power switch ON (IG).
(c) Turn the intelligent tester ON.
(d) Put the engine in inspection mode (see page ES-1).
(e) Start the engine and warm it up.
(f) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / VVT CTRL B1.
(g) Using the intelligent tester, operate the OCV and check the engine speed.

OK

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

NOTICE:
Do not drive the vehicle without deactivating inspection mode, otherwise damaging the transaxle may result.

OK → **CHECK FOR INTERMITTENT PROBLEMS**

NG

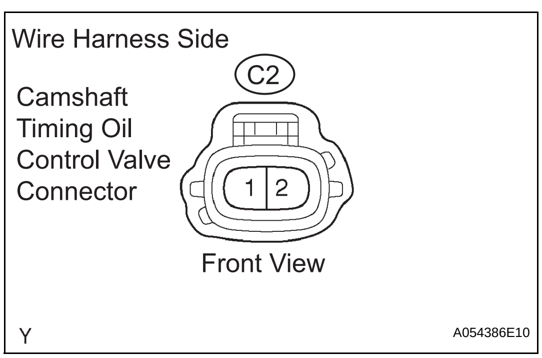
2	INSPECT CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY (OCV)

OK:
OCV has no contamination and moves smoothly.

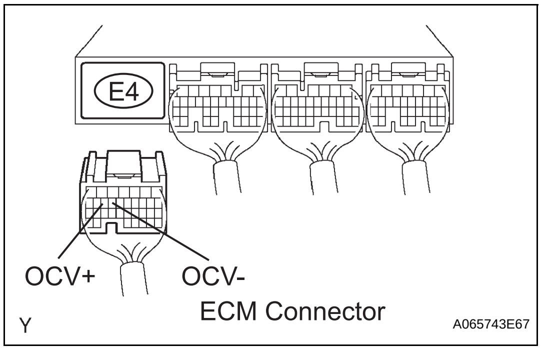
NG → **REPLACE CAMSHAFT TIMING CONTROL VALVE ASSEMBLY**

OK

3	CHECK HARNESS AND CONNECTOR (CAMSHAFT TIMING OIL CONTROL VALVE (OCV) - ECM)



(a) Disconnect the C2 camshaft timing oil control valve connector.



(b) Disconnect the E4 ECM connector.
(c) Measure the resistance between the wire harness side connectors.
Standard resistance (Check for open)

Tester Connection	Specified Condition
C2-1 - E4-15 (OCV+)	Below 1 Ω
C2-2 - E4-14 (OCV-)	Below 1 Ω

Standard resistance (Check for short)

Tester Connection	Specified Condition
C2-1 or E4-15 (OCV+) - Body ground	10 kΩ or higher
C2-2 or E4-14 (OCV-) - Body ground	10 kΩ or higher

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

NG → **REPAIR OR REPLACE HARNESS AND CONNECTOR**

OK

REPLACE ECM

DTC	P0011	Camshaft Position "A" - Timing Over-Advanced or System Performance (Bank 1)

DTC	P0012	Camshaft Position "A" - Timing Over-Retarded (Bank 1)

DESCRIPTION

Refer to DTC P0010 (see page ES-55).

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

MONITOR DESCRIPTION

To monitor the VVT components, the ECM (PCM) measures the valve timing that is calculated by the camshaft position and crankshaft position. The valve timing is usually adjusted in accordance with the driving condition. If the valve timing variation is less than the malfunction criterion, the ECM illuminates the MIL and set a DTC. P0011 is set when the valve timing is in the valve timing advance range. P0012 is set when the valve timing is in valve timing retard range.

MONITOR STRATEGY

Related DTCs	P0011: VVT system advance (bank) P0012: VVT system retard (bank 1)
Required sensors/components	Main sensors: Camshaft timing gear assembly Oil control valve Related sensors: Camshaft position sensor Engine coolant temperature sensor Crankshaft position sensor
Frequency of operation	Once per driving cycle
Duration	10 seconds
MIL operation	P0011: Immediately P0012: 2 driving cycles
Sequence of operation	None

TYPICAL ENABLING CONDITIONS

The monitor will run whenever the following DTCs are not present	P0100 - P0103 (MAF meter) P0115 - P0118 (ECT sensor) P0125 (Insufficient ECT for closed loop) P0335 (CKP sensor) P0340, P0341 (CMP sensor) P0351-P0354 (Igniter)
Battery voltage	11 V or more
Engine speed	900 to 5,000 rpm
Engine coolant temperature	75 to 100°C(167 to 212°F)

TYPICAL MALFUNCTION THRESHOLDS

Following conditions are met:	1 and 2
1. Deviation of valve timing (Target valve timing - Actual valve timing)	More than 5°CA
2. Response of valve timing	No change

WIRING DIAGRAM

Refer to DTC P0010 (see page ES-56).

INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunction is detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

ES

1 CHECK VALVE TIMING (CHECK FOR LOOSE AND A JUMPED TOOTH OF TIMING CHAIN)

OK:

The match marks of crankshaft pulley and camshaft pulley are aligning.

NG → **ADJUST VALVE TIMING**

OK

2 PERFORM ACTIVE TEST BY INTELLIGENT TESTER (OPERATE OCV)

(a) Connect the intelligent tester to the DLC3.
(b) Turn the power switch ON (IG).
(c) Turn the intelligent tester ON.
(d) Put the engine in inspection mode (see page ES-1).
(e) Start the engine and warm it up.
(f) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / VVT CTRL B1.
(g) Using the intelligent tester, operate the OCV and check the engine speed.

OK

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

NOTICE:

Do not drive the vehicle without deactivating inspection mode, otherwise damaging the transaxle may result.

NG → **Go to step 5**

OK

ES

3 CHECK IF DTC OUTPUT RECURS

(a) Clear the DTCs (see page ES-29).
(b) Start the HV main system and warm the engine up.
(c) Drive the vehicle with the shift position in B at vehicle speed of more than 44 mph (70 km/h) approximately for 10 minutes or more.
(d) Read output DTCs using the intelligent tester.

OK:

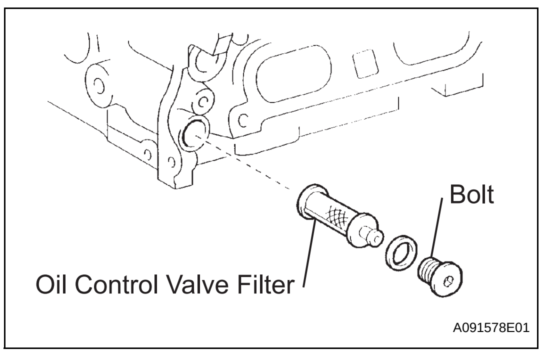
No DTC output.

HINT:
*: DTC P0011 or P0012 is output when a foreign object in engine oil is caught in some part of the 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 INSPECT OIL CONTROL VALVE FILTER



(a) Remove the air cleaner inlet, bolt and oil control valve filter.
(b) Check for blockages in the oil control valve filter.
(c) Reinstall the filter, bolt and air cleaner inlet.

NOTICE:
If necessary, clean the filter.

OK:

The filter has not clogged.

NG → **REPLACE OIL CONTROL VALVE FILTER**

OK ↓

5 INSPECT CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY (OCV)

OK:

OCV has no contamination and moves smoothly.

NG → **REPLACE CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY**

OK ↓

6 REPLACE CAMSHAFT TIMING GEAR ASSEMBLY

NEXT ↓

7	CHECK IF DTC OUTPUT RECURS

(a) Clear the DTCs (see page ES-29).
(b) Start the HV system, and warm the engine up.
(c) Drive the vehicle with the shift position in B at vehicle speed of more than 70 km/h (44 mph) approximately for 10 minutes or more.
(d) Read output DTCs using the intelligent tester.

OK:

No DTC output.

NG → **REPLACE ECM**

OK

END

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

DESCRIPTION

Refer to DTC P0335 (see page ES-159).

DTC No.	DTC Detection Condition	Trouble Area
P0016	Deviation in crankshaft position sensor signal and VVT sensor signal (2 trip detection logic)	• Mechanical system (timing chain has jumped a tooth, chain 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, applied to the OCV, regulates the oil pressure supplied 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 speed is idling. The ECM closes the OCV to retard the cam. The ECM stores this valve as "VVT learned 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 learned value meets both of the following conditions ("a" and "b"), the ECM interprets this as a defect in the VVT system and sets a DTC.
(a) VVT learning value is less than 30°CA (CA: Crankshaft Angle), or more than 46°CA.
(b) Above condition continues for more than 18 second.

MONITOR STRATEGY

Related DTCs	P0016: Deviation in crankshaft position sensor signal and VVT sensor signal
Required sensors/components	Crankshaft position sensor, camshaft position sensor
Frequency of operation	Once per driving cycle
Duration	60 seconds
MIL operation	2 driving cycles
Sequence of operation	None

TYPICAL ENABLING CONDITIONS

The monitor will run whenever the following DTCs are not present	P0011 (VVT System 1 - Advance) P0012 (VVT System 1 - Retard) P0115 - P0118 (ECT sensor)
Engine speed	900 to 5,000 rpm
Valve timing	Maximum valve timing retard

TYPICAL MALFUNCTION THRESHOLDS

Either of the following conditions is met:	(a) or (b)
(a) VVT learned value	Less than 30°CA
(b) VVT learned value	More than 46°CA

WIRING DIAGRAM

Refer to DTC P0335 (see page ES-160).

INSPECTION PROCEDURE

HINT:
Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunction is detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1	CHECK VALVE TIMING (CHECK FOR LOOSE AND A JUMPED TOOTH OF TIMING CHAIN)

OK:
The match marks of crankshaft pulley and camshaft pulley are aligning.

NG → **ADJUST VALVE TIMING (REPAIR OR REPLACE TIMING CHAIN)**

OK

REPLACE ECM

DTC	P0031	Oxygen (A/F) Sensor Heater Control Circuit Low (Bank 1 Sensor 1)

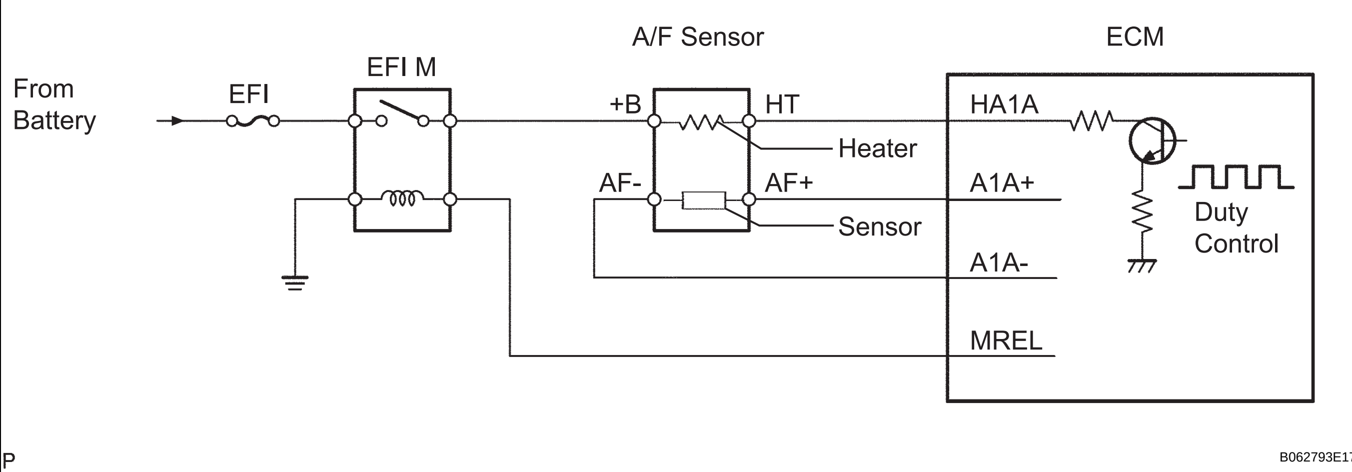
DTC	P0032	Oxygen (A/F) Sensor Heater Control Circuit High (Bank 1 Sensor 1)

DESCRIPTION

Refer to DTC P2195 (see page ES-344).

HINT:
- Although each DTC title says "oxygen sensor," these DTCs are 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.

Reference (Bank 1 Sensor 1 System Diagram)



DTC No.	DTC Detection Condition	Trouble Area
P0031	Heater current is less than 0.8 A when the heater operates (1 trip detection logic)	• Open or short in heater circuit of A/F sensor • A/F sensor heater • EFI M relay (integration relay) • ECM
P0032	Heater current exceeds 10 A when the heater operates (1 trip detection logic)	• Short in heater circuit of A/F sensor • A/F sensor heater • EFI M relay (integration relay) • ECM

HINT:
- Sensor 1 refers to the sensor mounted before the TWC and is located near the engine assembly.
- Sensor 2 refers to the sensor mounted after the TWC and is located far from the engine assembly.

MONITOR DESCRIPTION

The ECM uses the Air-Fuel Ratio (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 gases. 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 the exhaust gas. The sensor element is made of platinum coated zirconia and includes an integrated heating element. The zirconia element generates a small voltage when there is a large difference between 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 output signals will be inaccurate and the ECM can not regulate the air-fuel ratio properly.
When the heater current is out of the normal operating range, the ECM interprets this as malfunction of the sensor and sensor circuit and sets a DTC.

MONITOR STRATEGY

Related DTCs	P0031: A/F sensor heater current (low current) P0032: A/F sensor heater current (high current)
Required sensors/components	A/F sensor, ECM
Frequency of operation	Continuous
Duration	10 seconds
MIL operation	Immediately
Sequence of operation	None

TYPICAL ENABLING CONDITIONS

The monitor will run whenever the following DTCs are not present	P0300 - P0304 (Misfire)
Battery voltage	10.5 V or more
Heater duty ratio-cycle	P0031: 50% or more P0032: More than 0%
Time after engine start	10 seconds or more

TYPICAL MALFUNCTION THRESHOLDS

P0031:

A/F sensor heater current	Less than 0.8 A

P0031:

A/F sensor heater current	More than 10 A

COMPONENT OPERATING RANGE

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

WIRING DIAGRAM

Refer to DTC P2195 (see page ES-347).

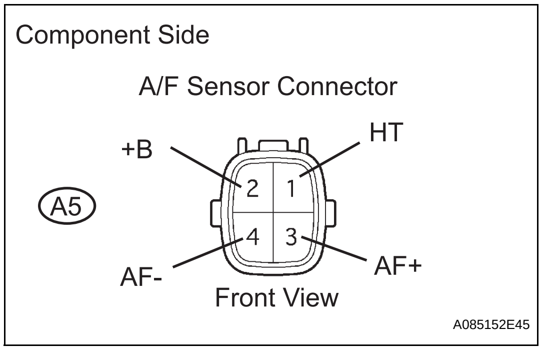
INSPECTION PROCEDURE

HINT:

- When DTC P0032 is detected, proceed to step 4 if the heater resistance is in normal range.
- Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunction is detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

ES

1 INSPECT AIR FUEL RATIO SENSOR (HEATER RESISTANCE)



(a) Disconnect the A5 A/F sensor connector.

(b) Measure the resistance between the terminals of the A/F sensor connector.

Standard resistance

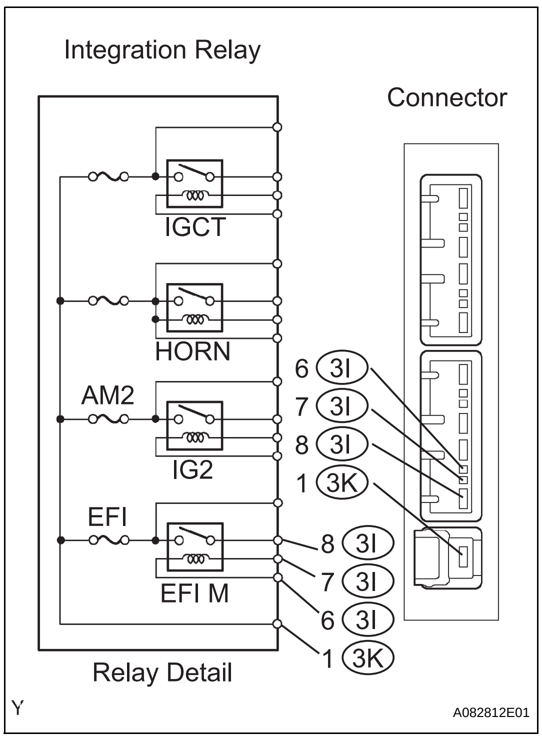
Tester Connection	Specified Condition
1 (HT) - 2 (+B)	1.8 to 3.4 Ω at 20°C (68°F)

(c) Reconnect the A/F sensor connector.

NG → **REPLACE AIR FUEL RATIO SENSOR**

OK

2 INSPECT INTEGRATION RELAY (EFI M RELAY)



(a) Remove the integration relay from the engine room relay block.

(b) Inspect the EFI M relay.

Standard resistance

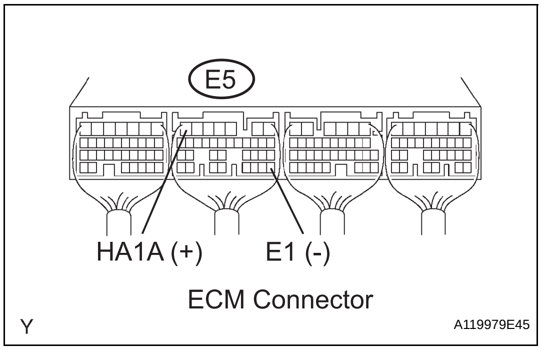
Tester Connection	Specified Condition
3K-1 - 3I-8	10 kΩ or higher
3K-1 - 3I-8	Below 1 Ω (Apply battery voltage to terminals 3I-6 and 3I-7)

(c) Reinstall the integration relay.

NG → **REPLACE INTEGRATION RELAY**

OK

3	CHECK ECM (HA1A VOLTAGE)



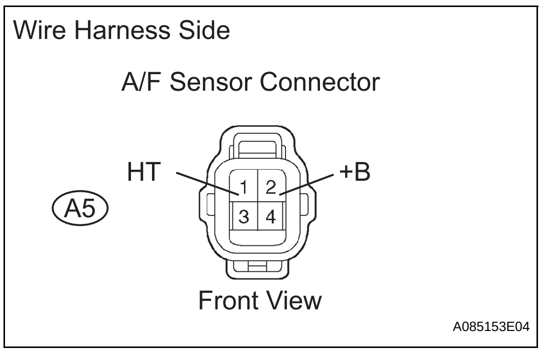
(a) Turn the power switch ON (IG).
(b) Measure the voltage between the applicable terminals of the E5 ECM connector.
Standard voltage

Tester Connection	Specified Condition
E5-7 (HA1A) - E5-28 (E1)	9 to 14 V

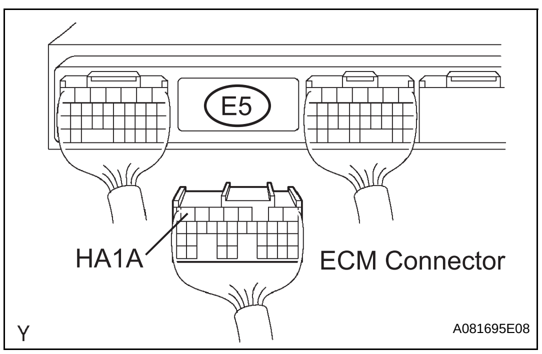
OK → REPLACE ECM

NG

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



(a) Check the harness and the connectors between the ECM and the A/F sensor connectors.
(1) Disconnect the A5 A/F sensor connector.



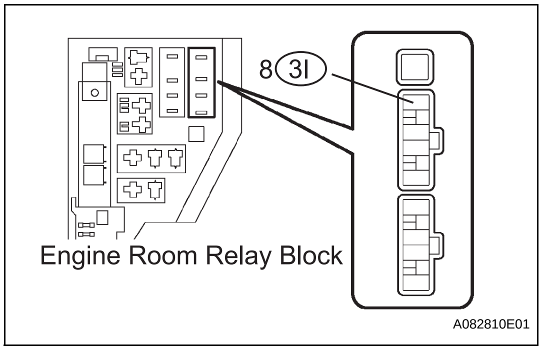
(2) Disconnect the E5 ECM connector.
(3) Measure the resistance between the wire harness side connectors.
Standard resistance (Check for open)

Tester Connection	Specified Condition
A5-1 (HT) - E5-7 (HA1A)	Below 1 Ω

Standard resistance (Check for short)

Tester Connection	Specified Condition
A5-1 (HT) or E5-7 (HA1A) - Body ground	10 kΩ or higher
A5-1 (HT) - A5-2 (+B)	10 kΩ or higher

(4) Reconnect the A/F sensor connector.
(5) Reconnect the ECM connector.
(b) Check the harness and connectors between the A/F sensor connector and the EFI M relay.
(1) Disconnect the A5 A/F sensor connector.



(2) Remove the integration relay from the engine room relay block.

(3) Measure the resistance between the wire harness side connectors.

Standard resistance (Check for open)

Tester Connection	Specified Condition
A5-2 (+B) - 3I-8 (EFI M relay)	Below 1 Ω

Standard resistance (Check for short)

Tester Connection	Specified Condition
A5-2 (+B) or 3I-8 (EFI M relay) - Body ground	10 kΩ or higher

(4) Reconnect the A/F sensor connector.

(5) Reinstall the integration relay.

NG → **REPAIR OR REPLACE HARNESS AND CONNECTOR**

OK

REPLACE ECM

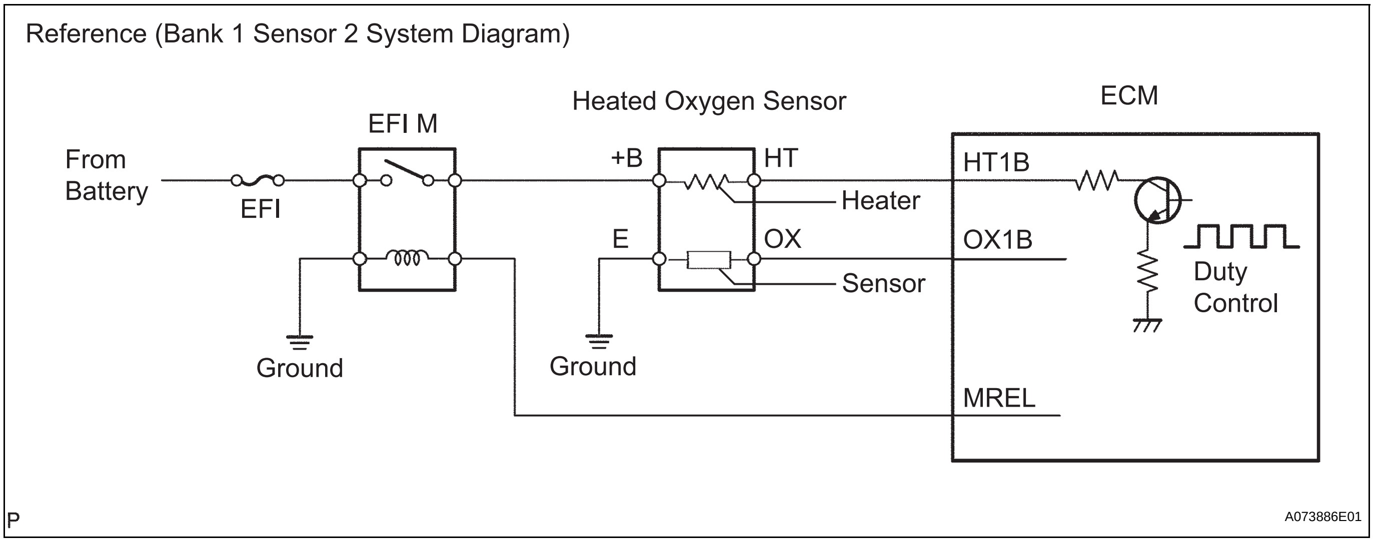
DTC	P0037	Oxygen Sensor Heater Control Circuit Low (Bank 1 Sensor 2)

DTC	P0038	Oxygen Sensor Heater Control Circuit High (Bank 1 Sensor 2)

DESCRIPTION

Refer to DTC P0136 (see page ES-115).
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.

ES



DTC No.	DTC Detection Condition	Trouble Area
P0037	Heater current is less than 0.3 A 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 M relay (integration relay) • ECM
P0038	When the heater operates, heater current exceeds 2 A (1 trip detection logic)	• Short in heater circuit of the heated oxygen sensor • Heated oxygen sensor heater • EFI M relay (integration relay) • ECM

HINT:
- Sensor 1 refers to the sensor mounted before the TWC and is located near the engine assembly.
- Sensor 2 refers to the sensor mounted after the TWC and is located far from the engine assembly.

MONITOR DESCRIPTION

The sensing portion of the heated oxygen sensor has a zirconia element which is used to detect oxygen concentration in the exhaust gas. If the zirconia element is at the proper temperature and difference of the oxygen concentration between the inside and outside surfaces of 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 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 0.25 A when the heater is ON.

MONITOR STRATEGY

Related DTCs	P0037: Heated oxygen sensor heater current bank 1 sensor 2 (low current) P0038: Heated oxygen sensor heater current bank 1 sensor 2 (high current)
Required sensors/components	Main sensors: Heated oxygen sensor Related sensors: Vehicle speed sensor
Frequency of operation	Continuous
Duration	0.5 seconds
MIL operation	1 driving cycle
Sequence of operation	None

TYPICAL ENABLING CONDITIONS

All:

Monitor runs whenever following DTCs not present	None
Battery voltage	10.5 V or more
Engine	Running
Starter	OFF
Catalyst intrusive monitoring	Not operating
Intrusive heating	Not operating

P0037:

When the following conditions are met	0.5 seconds or more
Learned heater current during heater OFF	Completed
Intrusive heating	Not operating
Heating is OFF	Less than 0.1 seconds
Heater current	Less than 0.3 A
Intrusive heating for high current monitor	Not operating
Time after heaters are OFF	1 second or more

P0038:

When the following conditions are met	0.3 seconds or more
Learned heater current during heater OFF	Completed
Intrusive heating	Not operating
Heating is OFF	Less than 0.1 seconds
Heater current	2 A or more
Time after heaters are OFF	1 second or more

TYPICAL MALFUNCTION THRESHOLDS

P0037:

Heated oxygen sensor heater current	Less than 0.3 A (at 0.5 seconds after heater is turned ON)

P0038:

Heated oxygen sensor heater current	More than 2 A (while supplemental heating is OFF)

COMPONENT OPERATING RANGE

Heated oxygen sensor heater current (after engine is warmed up)	0.4 to 1.0 A (at idle and battery voltage 11 to 14 V)

MONITOR RESULT

Refer to detailed information (see page ES-15).

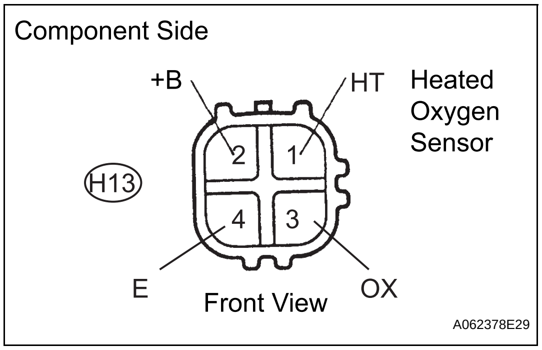
WIRING DIAGRAM

Refer to DTC P0136 (see page ES-121).

INSPECTION PROCEDURE

HINT:
- Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunction is detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.
- When DTC P0038 is detected, proceed to step 4 if the heater resistance is in normal range.

1	INSPECT HEATED OXYGEN SENSOR (HEATER RESISTANCE)



(a) Disconnect the H13 heated oxygen sensor connector.
(b) Measure the resistance between the terminals of the heated oxygen sensor connector.
Standard resistance (Bank 1 sensor 2):

Tester Connection	Specified Condition
H13-1 (HT) - H13-2 (+B)	**11 to 16 Ω at 20°C (68°F)**
H13-1 (HT) - H13-4 (E)	**10 kΩ or higher**

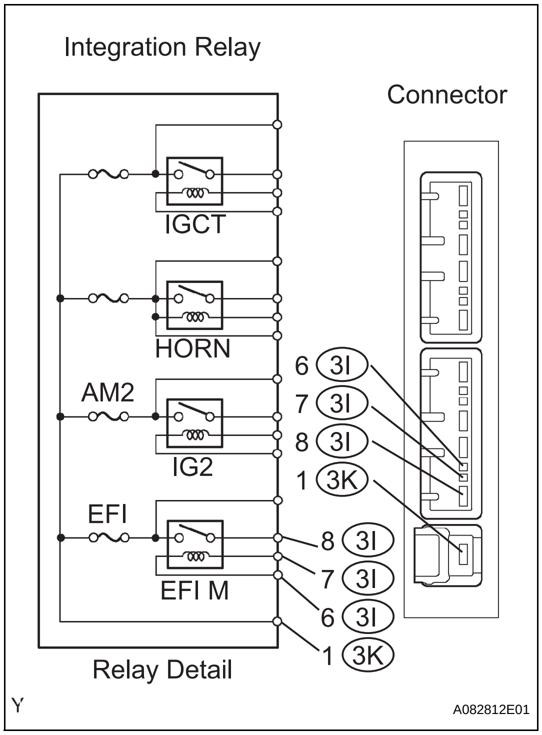
(c) Reconnect the heated oxygen sensor connector.

NG → **REPLACE HEATED OXYGEN SENSOR**

OK

ES

2	INSPECT INTEGRATION RELAY (EFI M RELAY)



(a) Remove the integration relay from the engine room relay block.

(b) Inspect the EFI M relay.

Standard resistance

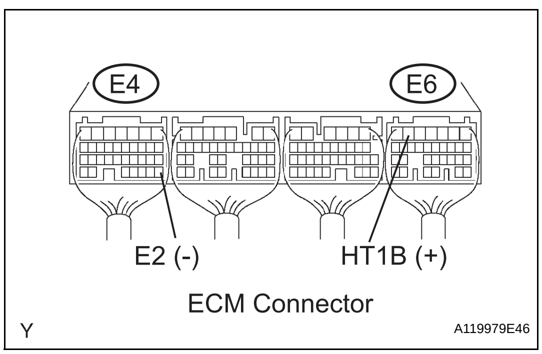
Tester Connection	Specified Condition
3K-1 - 3I-8	10 kΩ or higher
3K-1 - 3I-8	Below 1 Ω (Apply battery voltage to terminals 3I-6 and 3I-7)

(c) Reinstall the integration relay.

NG → REPLACE INTEGRATION RELAY

OK

3	CHECK ECM (HT1B VOLTAGE)



(a) Turn the power switch ON (IG).

(b) Measure the voltage between the applicable terminals of the E4 and E6 ECM connectors.

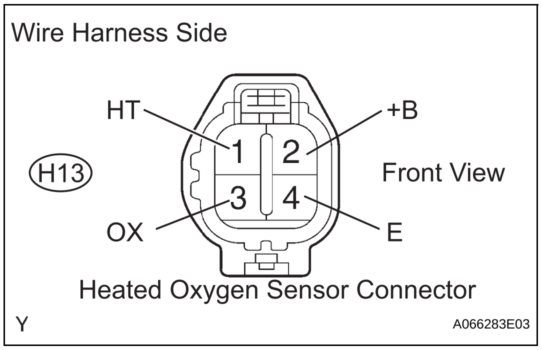
Standard voltage

Tester Connection	Specified Condition
E6-6 (HT1B) - E4-28 (E2)	9 to 14 V

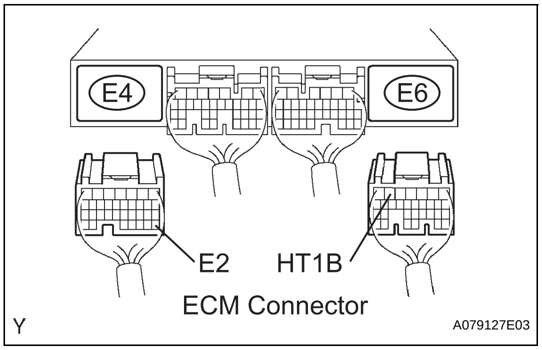
OK → REPLACE ECM

NG

4	CHECK HARNESS AND CONNECTOR (HEATED OXYGEN SENSOR - ECM AND EFI M RELAY)



(a) Check the harness and the connectors between the ECM and the heated oxygen sensor connectors.
  (1) Disconnect the H13 heated oxygen sensor connector.



  (2) Disconnect the E4 and E6 ECM connectors.
  (3) Measure the resistance between the wire harness side connectors.

Standard resistance (Check for open)

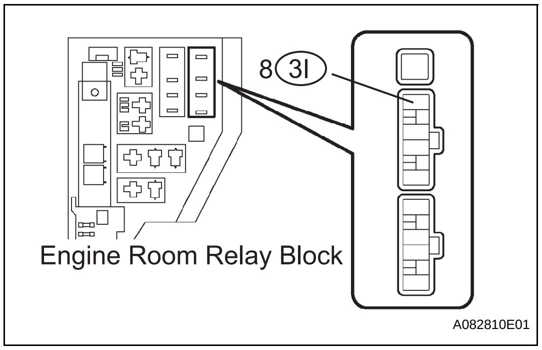
Tester Connection	Specified Condition
H13-1 (HT) - E6-6 (HT1B)	Below 1 Ω
H13-4 (E) - E4-28 (E2)	Below 1 Ω

Standard resistance (Check for short)

Tester Connection	Specified Condition
H13-1 (HT) or E6-6 (HT1B) - Body ground	10 kΩ or higher
H13-1 (HT) - H13-2 (+B)	10 kΩ or higher

  (4) Reconnect the heated oxygen sensor connector.
  (5) Reconnect the ECM connectors.

(b) Check the harness and the connectors between the heated oxygen sensor connector and the EFI M relay.
  (1) Disconnect the H13 heated oxygen sensor connector.
  (2) Remove the integration relay from the engine room relay block.



  (3) Measure the resistance between the wire harness side connectors.

Standard resistance (Check for open)

Tester Connection	Specified Condition
H13-2 (+B) - 3I-8 (EFI M relay)	Below 1 Ω

Standard resistance (Check for short)

Tester Connection	Specified Condition
H13-2 (+B) or 3I-8 (EFI M relay) - Body ground	10 kΩ or higher

  (4) Reconnect the heated oxygen sensor connector.
  (5) Reinstall the integration relay.

NG	REPAIR OR REPLACE HARNESS AND CONNECTOR

OK

REPLACE ECM

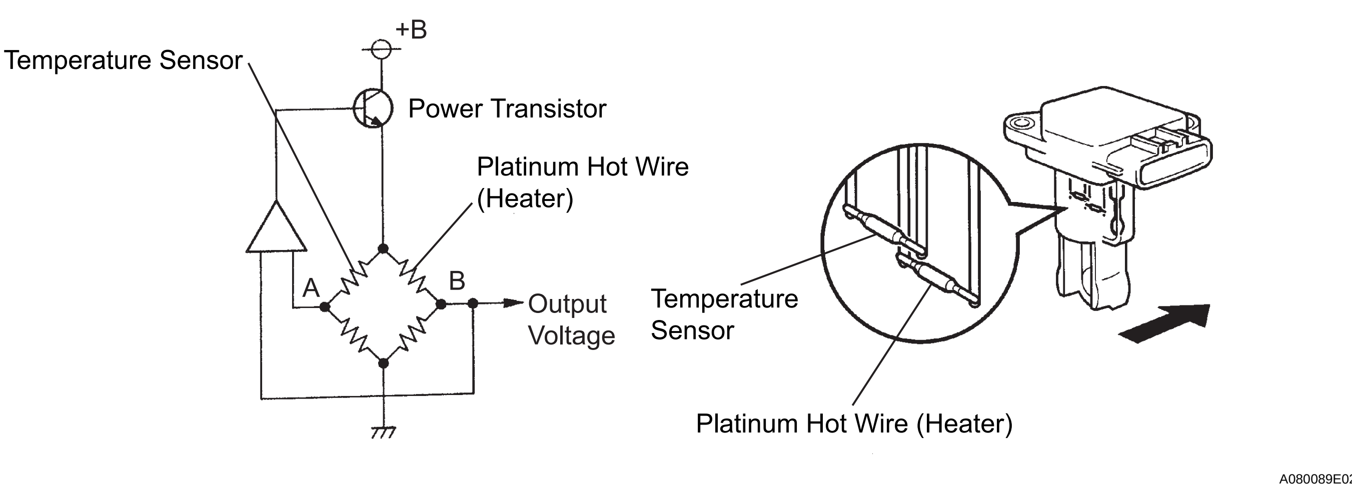
DTC	P0100	Mass or Volume Air Flow Circuit

DTC	P0102	Mass or Volume Air Flow Circuit Low Input

DTC	P0103	Mass or Volume Air Flow Circuit High Input

DESCRIPTION

The MAF (Mass Air Flow) meter measures the amount of air flowing through the throttle valve. The ECM uses this information to determine the fuel injection time and provides a proper air-fuel ratio. Inside the MAF meter, there is a heated platinum wire exposed to the flow of intake air.
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, 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 air flowing 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, and the power transistor is 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 the mass air flow meter circuit has an open or a short for more than 3 seconds	• Open or short in mass air flow meter circuit • Mass air flow meter • ECM
P0102	When the mass air flow meter circuit has an open for more than 3 seconds	• Open or in mass air flow meter circuit • Mass air flow meter • ECM
P0103	When the mass air flow meter circuit has a short for more than 3 seconds	• Short in mass air flow meter circuit • Mass air flow meter • ECM

HINT:
After confirming DTC P0100, P0102 or P0103, confirm the mass air flow ratio in DIAGNOSIS / ENHANCED OBD II / DATA LIST / PRIMARY.

Air Flow Rate (g/sec.)	Malfunction
Approximately 0.0	• Mass air flow meter power source circuit open • VG circuit open or short
271.0 or more	• E2G circuit open

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:
When the sensor voltage output is less than 0.2 V or more than 4.9 V and if either condition continues for more than 3 seconds.

MONITOR STRATEGY

Related DTCs	P0100: Mass air flow meter circuit range check (fluttering) P0102: Mass air flow meter circuit range check (low voltage) P0103: Mass air flow meter circuit range check (high voltage)
Required sensors/components	Mass air flow meter
Frequency of operation	Continuous
Duration	3 seconds
MIL operation	Immediately (when engine speed is less than 4,000 rpm) 2 driving cycles (when engine speed is 4,000 rpm or more)
Sequence of operation	None

TYPICAL ENABLING CONDITIONS

The monitor will run whenever the following DTCs are not present	None

TYPICAL MALFUNCTION THRESHOLDS

P0100:

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

P0102:

Mass air flow meter voltage	Less than 0.2 V

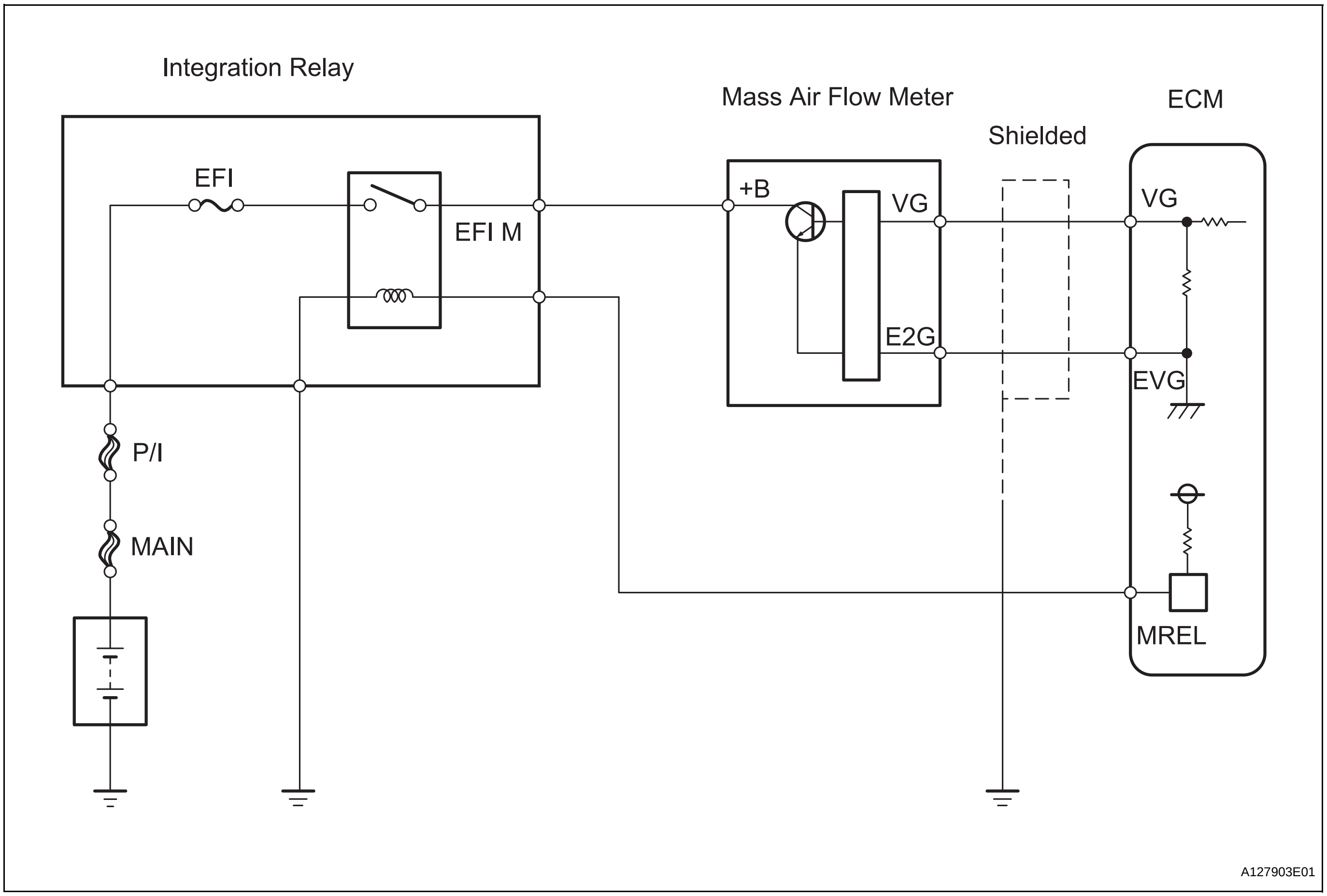
P0103:

Mass air flow meter voltage	More than 4.9 V

COMPONENT OPERATING RANGE

Mass air flow meter voltage	0.4 to 2.2 V

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:
Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunction is detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1	READ VALUE OF INTELLIGENT TESTER (MASS AIR FLOW RATE)

(a) Connect the intelligent tester to the DLC3.
(b) Put the engine in inspection mode (see page ES-1).
(c) Start the engine.
(d) Turn the intelligent tester ON.
(e) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DATA LIST / PRIMARY / MAF.
(f) Read its value using the intelligent tester.

Result

Air Flow Rate (g/sec.)	Proceed to
0.0	A
271.0 or more	B
Between 1.0 and 270.0 (*)	C

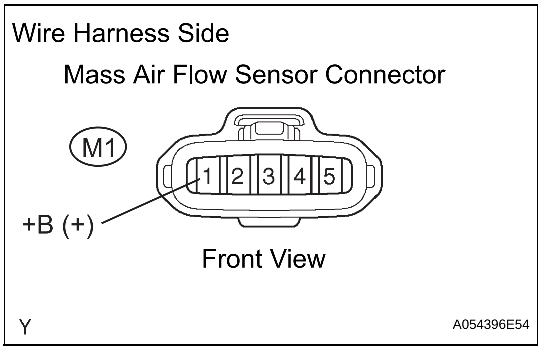
HINT:
*: The value must be changed when the throttle valve is opened or closed.

B → **Go to step 6**

C → **CHECK FOR INTERMITTENT PROBLEMS**

A

2 INSPECT MASS AIR FLOW METER (POWER SOURCE)



(a) Turn the power switch ON (IG).
(b) Disconnect the M1 mass air flow meter connector.
(c) Measure the voltage between the terminal of the wire harness side connector and body ground.
Standard voltage

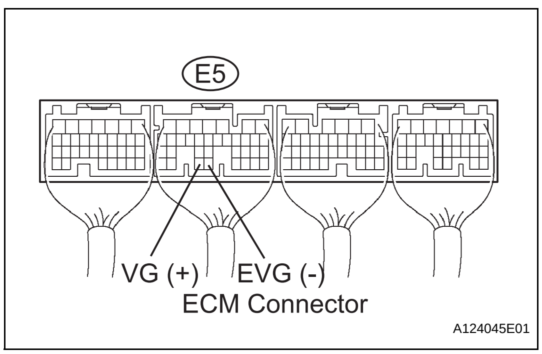
Tester Connection	Specified Condition
M1-1 (+B) - Body ground	9 to 14 V

(d) Reconnect the mass air flow meter connector.

NG → **Go to step 5**

OK

3 CHECK ECM (VG VOLTAGE)



(a) Put the engine in inspection mode (see page ES-1).
(b) Start the engine.
(c) Measure the voltage between the specified terminals of the E5 ECM connector.
HINT:
The A/C switch should be turned OFF.
Standard voltage

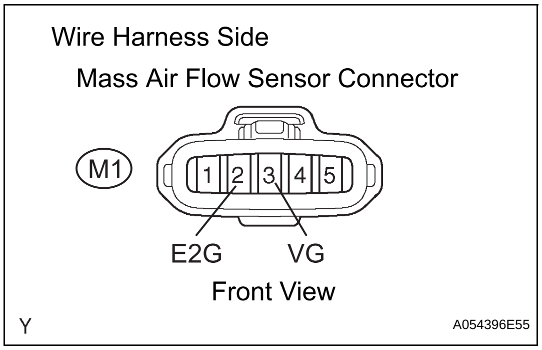
Tester Connection	Condition	Specified Condition
E5-33 (VG) - E5-32 (EVG)	Engine is idling	0.5 to 3.0 V

OK → **REPLACE ECM**

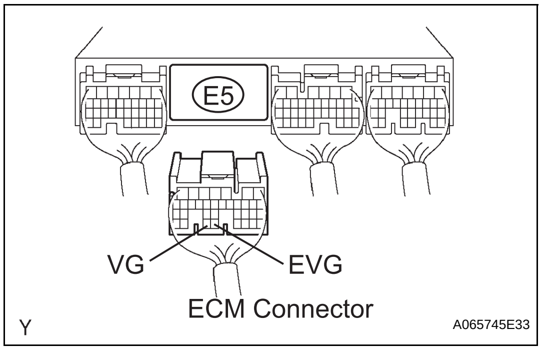
NG

ES

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



(a) Disconnect the M1 mass air flow meter connector.



(b) Disconnect the E5 ECM connector.
(c) Measure the resistance between the wire harness side connectors.

Standard resistance (Check for open)

Tester Connection	Specified Condition
M1-3 (VG) - E5-33 (VG)	Below 1 Ω
M1-2 (E2G) - E5-32 (EVG)	Below 1 Ω

Standard resistance (Check for short)

Tester Connection	Specified Condition
M1-3 (VG) or E5-33 (VG) - Body ground	10 kΩ or higher

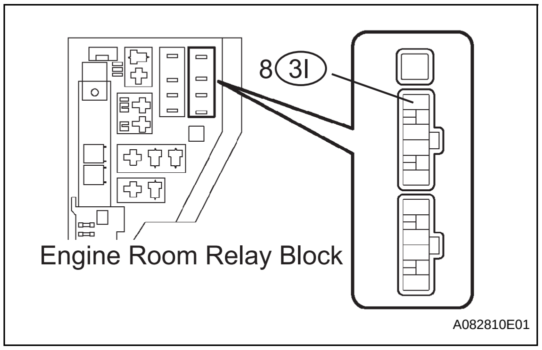
(d) Reconnect the mass air flow meter connector.
(e) Reconnect the ECM connector.

NG → **REPAIR OR REPLACE HARNESS AND CONNECTOR**

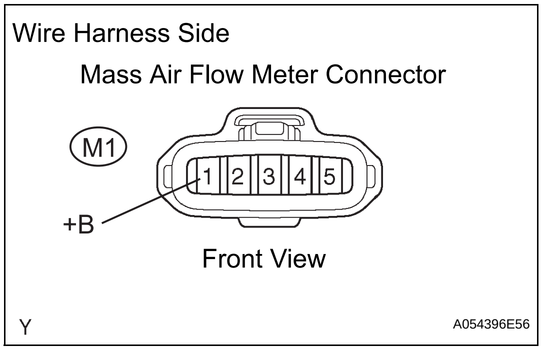
OK

REPLACE MASS AIR FLOW METER

5	CHECK HARNESS AND CONNECTOR (MASS AIR FLOW METER - EFI M RELAY)



(a) Remove the integration relay from the engine room relay block.



(b) Disconnect the M1 mass air flow meter connector.
(c) Measure the resistance between the wire harness side connectors.
Standard resistance (Check for open)

Tester Connection	Specified Condition
M1-1 (+B) - 3I-8 (EFI M relay)	Below 1 Ω

Standard resistance (Check for short)

Tester Connection	Specified Condition
M1-1 (+B) or 3I-8 (EFI M relay) - Body ground	10 kΩ or higher

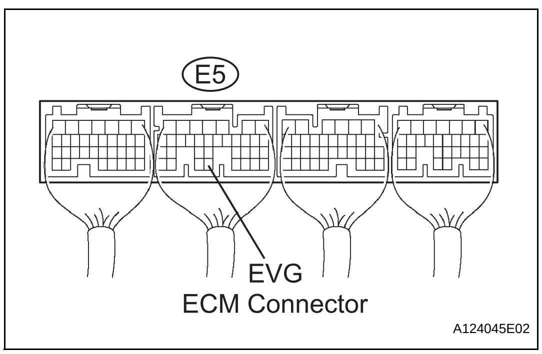
(d) Reconnect the mass air flow meter connector.
(e) Reinstall the integration relay.

NG → **REPAIR OR REPLACE HARNESS AND CONNECTOR**

OK

CHECK ECM POWER SOURCE CIRCUIT

6 CHECK ECM (SENSOR GROUND)



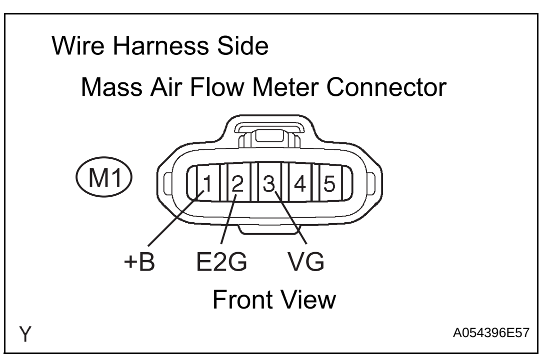
(a) Measure the resistance between the specified terminal of the E5 ECM connector and the body ground.
Standard resistance

Tester Connection	Specified Condition
E5-32 (EVG) - Body ground	Below 1 Ω

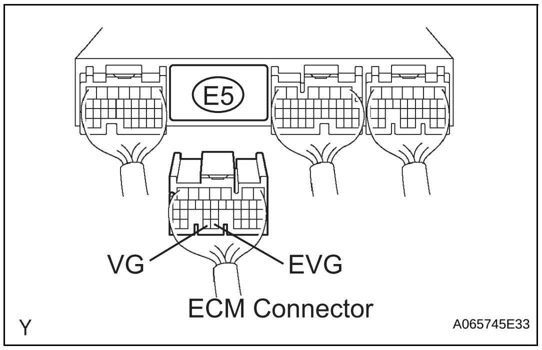
NG → **REPLACE ECM**

OK

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



(a) Disconnect the M1 mass air flow meter connector.



(b) Disconnect the E5 ECM connector.

(c) Measure the resistance between the wire harness side connectors.

Standard resistance (Check for open)

Tester Connection	Specified Condition
M1-3 (VG) - E5-33 (VG)	Below 1 Ω
M1-2 (E2G) - E5-32 (EVG)	Below 1 Ω

Standard resistance (Check for short)

Tester Connection	Specified Condition
M1-3 (VG) or E5-33 (VG) - Body ground	10 kΩ or higher

(d) Reconnect the mass air flow meter connector.

(e) Reconnect the ECM connector.

NG → **REPAIR OR REPLACE HARNESS AND CONNECTOR**

OK

REPLACE MASS AIR FLOW METER

DTC	P0101	Mass Air Flow Circuit Range / Performance Problem

DESCRIPTION

Refer to DTC P0100 (see page ES-76).

DTC No.	DTC Detection Condition	Trouble Area
P0101	MAF meter voltage is higher than MAF meter voltage based on throttle position when the following conditions are met (2 trip detection logic): • Engine coolant temperature is 70°C (158°F) or more • Engine speed is less than 2,000 rpm	• Mass air flow meter
P0101	MAF meter voltage is lower than MAF meter voltage based on throttle position when the following conditions are met (2 trip detection logic): • Fuel cut is not executing • Engine speed is more than 300 rpm	• Mass air flow meter

MONITOR DESCRIPTION

The MAF (Mass Air Flow) meter is a sensor that helps the ECM calculates 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. 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 and the ECM interprets this voltage as the intake air amount. 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:
If the MAF meter voltage is higher than 2.2 V when the engine is idling, the ECM sets P0101 (2 trip detection logic). If the MAF meter voltage is higher than 0.9 V when the throttle valve is opened, the ECM sets P0101 (2 trip detection logic).

MONITOR STRATEGY

Related DTCs	P0101: Mass air flow meter rationality
Required sensors/components	Main sensors: Mass air flow meter Related sensors: Engine speed sensor, engine coolant temperature sensor, throttle position sensor
Frequency of operation	Continuous
Duration	10 seconds
MIL operation	2 driving cycles
Sequence of operation	None

TYPICAL ENABLING CONDITIONS

The monitor will run whenever the following DTCs are not present	P0115 - P0118 (ECT sensor) P0120 - P0223, P2135 (TP sensor) P0125 (Insufficient ECT for closed loop) P0335 (CKP sensor) P0340, P0341 (CMP sensor)

Case1: Mass air flow meter rationality (High voltage)

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

Case2: Mass air flow meter rationality (Low voltage)

Engine speed	More than 300 rpm
Fuel cut	OFF

TYPICAL MALFUNCTION THRESHOLDS

Case1: Mass air flow meter rationality (High voltage)

Mass air flow meter voltage	More than 2.2 V (varies with throttle position)

Case2: Mass air flow meter rationality (Low voltage)

Mass air flow meter voltage	Less than 0.9 V (varies with throttle position)

WIRING DIAGRAM

Refer to DTC P0100 (see page ES-78).

INSPECTION PROCEDURE

HINT:
Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunction is detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1 CHECK OTHER DTC OUTPUT (IN ADDITION TO DTC P0101)

(a) Connect the intelligent tester to the DLC3.
(b) Turn the power switch ON (IG).
(c) Turn the intelligent 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 codes besides P0101 are output, perform troubleshooting for those DTCs first.

B → **REPLACE MASS AIR FLOW METER**

A

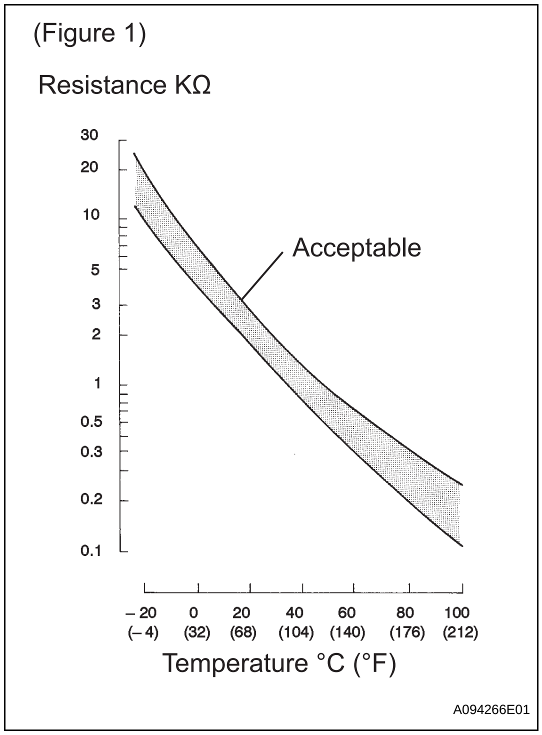
GO TO RELEVANT DTC CHART

DTC	P0110	Intake Air Temperature Circuit

DTC	P0112	Intake Air Temperature Circuit Low Input

DTC	P0113	Intake Air Temperature Circuit High Input

DESCRIPTION



The intake air temperature (IAT) sensor, mounted on the mass air flow (MAF) meter, monitors the intake air temperature. The IAT sensor has a thermistor that varies its resistance depending on the temperature of the intake air. When the air temperature is low, the resistance in the thermistor increases. When the temperature is high, the resistance drops. The variations in resistance are reflected as voltage changes to the ECM terminal (see Figure 1).
The intake air temperature sensor is connected to the ECM (see wiring diagram). The 5 V power source voltage in the ECM is applied to the intake air temperature sensor from terminal THA (THAR) via resistor R.
That is, the resistor R and the intake air temperature sensor are connected in series. When the resistance value of the intake air temperature sensor changes in accordance with changes in the intake air temperature, the voltage at terminal THA (THAR) also changes. Based on this signal, the ECM increases the fuel injection volume to improve the driveability during cold engine operation.

DTC No.	DTC Detection Condition	Trouble Area
P0110	Open or short in intake air temperature sensor circuit for 0.5 seconds	• Open or short in intake air temperature sensor circuit • Intake air temperature sensor (built in mass air flow meter) • ECM
P0112	Short in intake air temperature sensor circuit for 0.5 seconds	• Short in intake air temperature sensor circuit • Intake air temperature sensor (built in mass air flow meter) • ECM

DTC No.	DTC Detection Condition	Trouble Area
P0113	Open in intake air temperature sensor circuit for 0.5 seconds	• Open in intake air temperature sensor circuit • Intake air temperature sensor (built in mass air flow meter) • ECM

HINT:
After confirming DTC P0110, P0112 or P0113, confirm the intake air temperature in DIAGNOSIS / ENHANCED OBD II / DATA LIST / PRIMARY using the intelligent tester.

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

MONITOR DESCRIPTION

The ECM monitors the sensor voltage and uses this value to calculate the intake air temperature. When the sensor output voltage deviates from the normal operating range, the ECM interprets this as a fault in the IAT sensor and sets a DTC.
Example:
When the sensor voltage output is equal to -40°C (-40°F), or more than 140°C (284°F), and either condition continues for 0.5 seconds or more.

MONITOR STRATEGY

Related DTCs	P0110: Intake air temperature sensor range check (fluttering) P0112: Intake air temperature sensor range check (low resistance) P0113: Intake air temperature sensor range check (high resistance)
Required sensors/components	Intake air temperature sensor
Frequency of operation	Continuous
Duration	0.5 seconds
MIL operation	Immediately
Sequence of operation	None

TYPICAL ENABLING CONDITIONS

The monitor will run whenever the following DTCs are not present	None

TYPICAL MALFUNCTION THRESHOLDS

P0110: Intake air temperature sensor range check (fluttering)

Intake air temperature sensor voltage (Intake air temperature)	Less than 0.18 V or more than 4.91 V (More than 140°C (284°F) or -40°C (-40°F) or less)

P0112: Intake air temperature sensor range check (low resistance)

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

P0113: Intake air temperature sensor range check (high resistance)

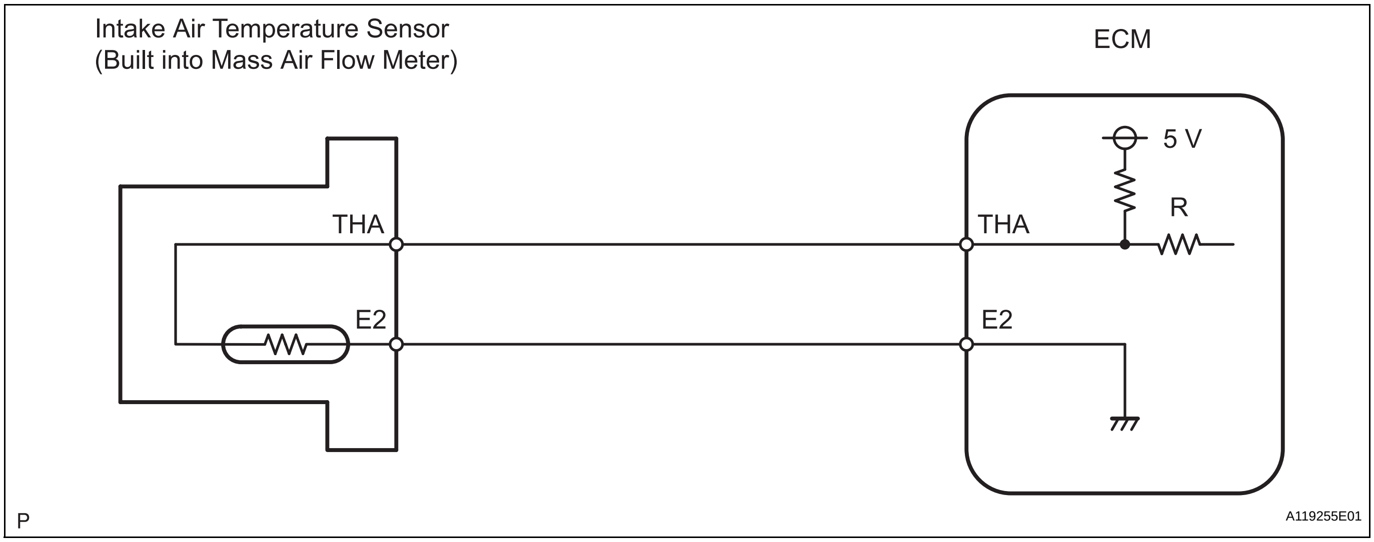
Intake air temperature sensor voltage (Intake air temperature)	More than 4.91 V (-40°C (-40°F) or less)

COMPONENT OPERATING RANGE

Intake air temperature sensor resistance	98.5 Ω (140°C (284°F)) to 156 kΩ (-40°C (-40°F))

ES

WIRING DIAGRAM



INSPECTION PROCEDURE

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. Freeze frame data records the engine condition when malfunction is detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1	READ OUTPUT DTC

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

Result

Display (DTC Output)	Proceed To
P0110/24	A
P0112/24	B
P0113/24	C

B → **Go to step 5**

C → **Go to step 3**

A

2	READ VALUE OF INTELLIGENT TESTER (INTAKE AIR TEMPERATURE)

(a) Connect the intelligent tester to the DLC3.
(b) Turn the power switch ON (IG).
(c) Turn the intelligent tester ON.

(d) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DATA LIST / PRIMARY / INTAKE AIR.
(e) Read the value.
Temperature value:
Same as the ambient air temperature.
Result

Temperature Displayed	Proceed to
-40°C (-40°F)	A
140°C (284°F)	B
OK (Same as ambient air temperature)	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).

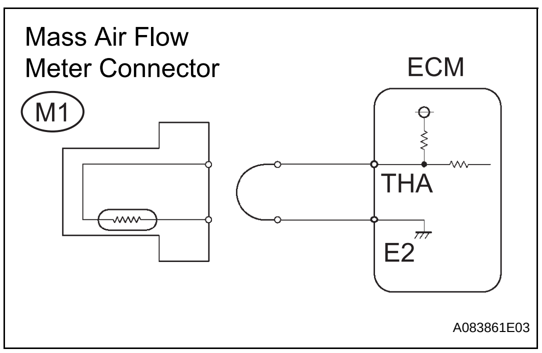
ES

B → **Go to step 5**

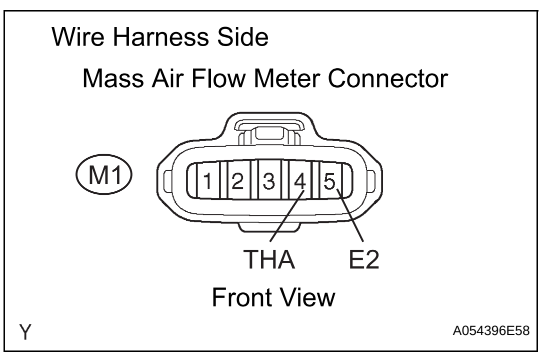
C → **CHECK FOR INTERMITTENT PROBLEMS**

A

3 READ VALUE OF INTELLIGENT TESTER (CHECK FOR OPEN IN WIRE HARNESS)



(a) Disconnect the M1 mass air flow meter connector.

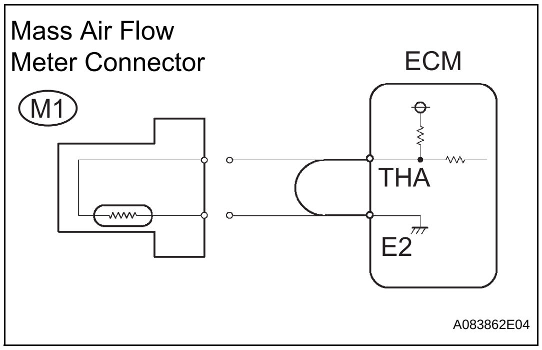


(b) Connect terminals THA and E2 of the mass air flow meter wire harness side connector.
(c) Turn the power switch ON (IG).
(d) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DATA LIST / PRIMARY / INTAKE AIR. Read the value.
OK:
Temperature value: 140°C (284°F)
(e) Reconnect the mass air flow meter connector.

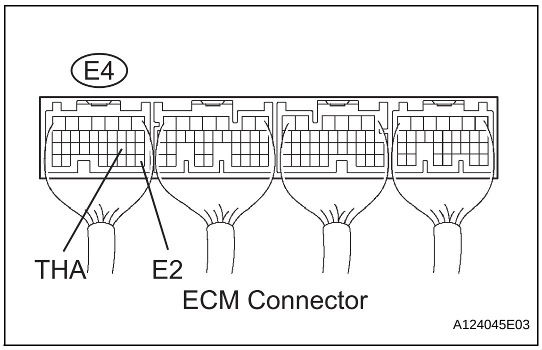
OK → **CONFIRM GOOD CONNECTION AT SENSOR. IF OK, REPLACE MASS AIR FLOW METER**

NG

4 READ VALUE OF INTELLIGENT TESTER (CHECK FOR OPEN IN ECM)



(a) Disconnect the M1 mass air flow meter connector.



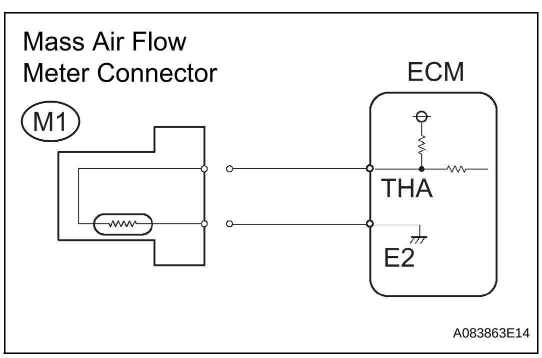
(b) Connect terminals THA and E2 of the E4 ECM connector.
HINT:
Before checking, do a visual and contact pressure check for the ECM connector.
(c) Turn the power switch ON (IG).
(d) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DATA LIST / PRIMARY / INTAKE AIR. Read the value.
OK:
Temperature value: 140°C (284°F)
(e) Reconnect the mass air flow meter connector.

OK → **REPAIR OR REPLACE HARNESS AND CONNECTOR**

NG

CONFIRM GOOD CONNECTION AT ECM. IF OK, REPLACE ECM

5 READ VALUE OF INTELLIGENT TESTER (CHECK FOR SHORT IN WIRE HARNESS)

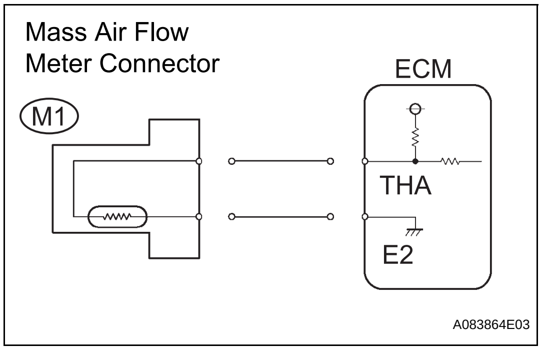


(a) Disconnect the M1 mass air flow meter connector.
(b) Turn the power switch ON (IG).
(c) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DATA LIST / PRIMARY / INTAKE AIR.
(d) Read the value.
OK:
Temperature value: -40°C (-40°F)
(e) Reconnect the mass air flow meter connector.

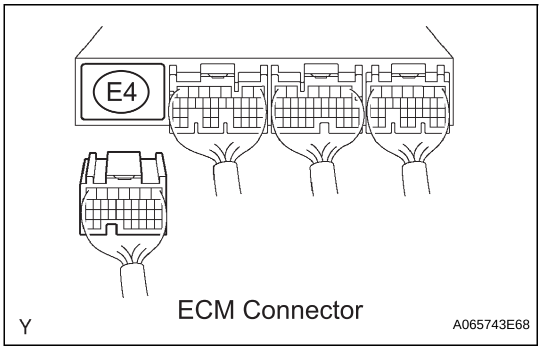
OK → **REPLACE MASS AIR FLOW METER**

NG

6	READ VALUE OF INTELLIGENT TESTER (CHECK FOR SHORT IN ECM)



(a) Disconnect the E4 ECM connector.



(b) Turn the power switch ON (IG).
(c) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DATA LIST / PRIMARY / INTAKE AIR.
(d) Read the value.

OK:

Temperature value: -40°C (-40°F)

(e) Reconnect the mass air flow meter connector.

OK → **REPAIR OR REPLACE HARNESS AND CONNECTOR**

NG

REPLACE ECM

DTC	P0115	Engine Coolant Temperature Circuit

DTC	P0117	Engine Coolant Temperature Circuit Low Input

DTC	P0118	Engine Coolant Temperature Circuit High Input

DESCRIPTION

A thermistor is built in the engine coolant temperature sensor and changes its resistance value according to the engine coolant temperature.
The structure of the sensor and connection to the ECM is the same as those of the intake air temperature sensor.

HINT:
If the ECM detects DTC P0115, P0117 or P0118, it operates the fail-safe function in which the engine coolant temperature is assumed to be 80°C (176°F).

DTC No.	DTC Detection Condition	Trouble Area
P0115	Open or short in engine coolant temperature sensor circuit for 0.5 seconds	• Open or short in engine coolant temperature sensor circuit • Engine coolant temperature sensor • ECM
P0117	Short in engine coolant temperature sensor circuit for 0.5 seconds	• Short in engine coolant temperature sensor circuit • Engine coolant temperature sensor • ECM
P0118	Open in engine coolant temperature sensor circuit for 0.5 seconds	• Open in engine coolant temperature sensor circuit • Engine coolant temperature sensor • ECM

HINT:
After confirming DTC P0115, P0117 or P0118, confirm the engine coolant temperature from DIAGNOSIS / ENHANCED OBD II / DATA LIST / PRIMARY using the intelligent tester.

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

MONITOR DESCRIPTION

The engine coolant temperature (ECT) sensor is used to monitor the engine coolant temperature. The ECT sensor has a thermistor that varies its resistance depending on 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. The variations in resistance are reflected in the voltage output from the sensor. The ECM monitors the sensor voltage and uses this value to calculate the engine coolant temperature. When the sensor output voltage deviates from the normal operating range, the ECM interprets this as a fault in the ECT sensor and sets a DTC.
Example:
When the ECM calculates that the ECT is -40°C (-40°F), or more than 140°C (284°F), and if either condition continues for 0.5 second or more, the ETC will set a DTC.

MONITOR STRATEGY

Related DTCs	P0115: Engine coolant temperature sensor range check (fluttering) P0117: Engine coolant temperature sensor range check (low resistance) P0118: Engine coolant temperature sensor range check (high resistance)

Required sensors/components	Engine coolant temperature sensor
Frequency of operation	Continuous
Duration	0.5 seconds
MIL operation	Immediately
Sequence of operation	None

TYPICAL ENABLING CONDITIONS

The monitor will run whenever the following DTCs are not present	None

TYPICAL MALFUNCTION THRESHOLDS

P0115:

Engine coolant temperature sensor voltage (coolant temperature)	Less than 0.14 V or more than 4.91 V (More than 140°C (284°F) or -40°C (-40°F) or less)

P0117:

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

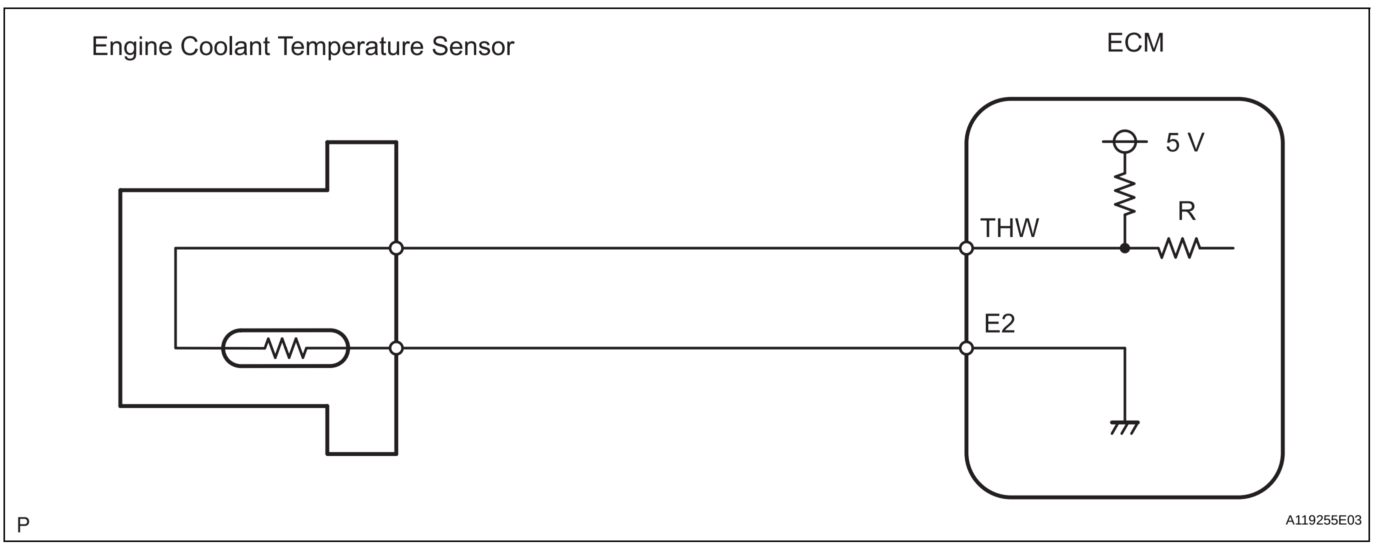
P0118:

Engine coolant temperature sensor voltage (coolant temperature)	More than 4.91 V (-40°C (-40°F) or less)

COMPONENT OPERATING RANGE

Engine coolant temperature sensor resistance	79 Ω (140°C (284°F)) to 156 kΩ (-40°C (-40°F))

WIRING DIAGRAM



INSPECTION PROCEDURE

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. Freeze frame data records the engine condition when malfunction is detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

ES

1 READ OUTPUT DTC

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

Result

Display (DTC Output)	Proceed To
P0115/24	A
P0117/24	B
P0118/24	C

B → **Go to step 5**

C → **Go to step 3**

A

2 READ VALUE OF INTELLIGENT TESTER (ENGINE COOLANT TEMPERATURE)

(a) Connect the intelligent tester to the DLC3.
(b) Turn the power switch ON (IG).
(c) Turn the intelligent tester ON.
(d) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DATA LIST / PRIMARY / COOLANT TEMP.
(e) Read the value.
(f) Measure the coolant temperature using a thermometer and compare the value with the value displayed on the intelligent tester.

Temperature value:
Almost same as the actual engine coolant temperature.

Result

Temperature Displayed	Proceed to
-40°C (-40°F)	A
140°C (284°F)	B
OK (Same as actual engine coolant temperature)	C

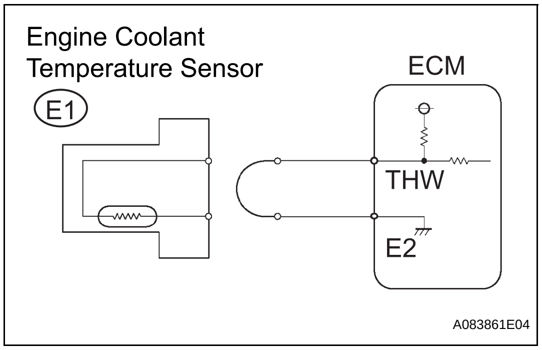
HINT:
- If there is an open circuit, the intelligent tester indicates -40°C (-40°F).
- If there is a short circuit, the intelligent tester indicates 140°C (284°F).

B → **Go to step 5**

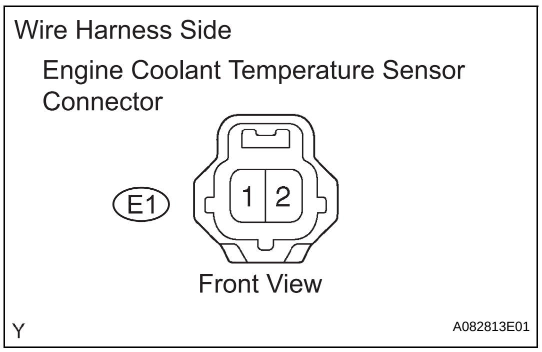
C → **CHECK FOR INTERMITTENT PROBLEMS**

A

3 READ VALUE OF INTELLIGENT TESTER (CHECK FOR OPEN IN WIRE HARNESS)



(a) Disconnect the E1 engine coolant temperature sensor connector.

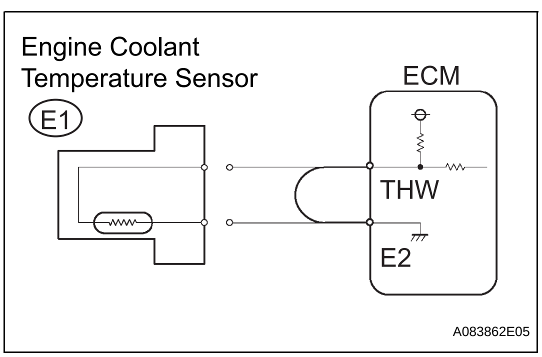


(b) Connect terminals 1 and 2 of the engine coolant temperature sensor wire harness side connector.
(c) Turn the power switch ON (IG).
(d) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DATA LIST / PRIMARY / COOLANT TEMP. Read the value.
OK:
Temperature value: 140°C (284°F)
(e) Reconnect the engine coolant temperature sensor connector.

OK → **CONFIRM GOOD CONNECTION AT SENSOR. IF OK, REPLACE ENGINE COOLANT TEMP. SENSOR**

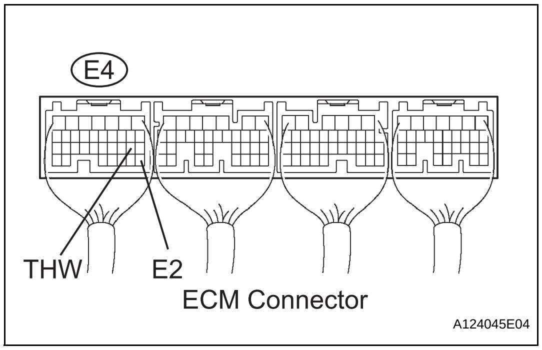
NG

4 READ VALUE OF INTELLIGENT TESTER (CHECK FOR OPEN IN ECM)



(a) Disconnect the E1 engine coolant temperature sensor connector.

ES



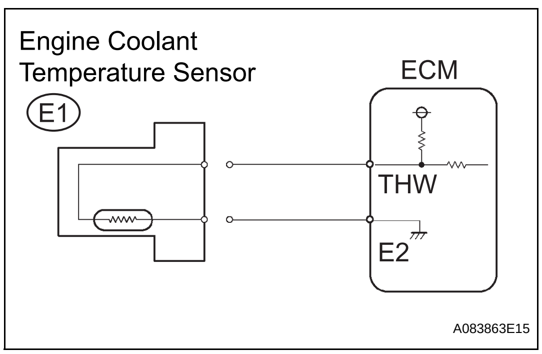
(b) Connect terminals THW and E2 of the E4 ECM connector.
HINT:
Before checking, do a visual and contact pressure check on the ECM connector.
(c) Turn the power switch ON (IG).
(d) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DATA LIST / PRIMARY / COOLANT TEMP. Read the value.
OK:
Temperature value: 140°C (284°F)
(e) Reconnect the engine coolant temperature sensor connector.

OK → **REPAIR OR REPLACE HARNESS AND CONNECTOR**

NG

CONFIRM GOOD CONNECTION AT ECM. IF OK, REPLACE ECM

5 READ VALUE OF INTELLIGENT TESTER (CHECK FOR SHORT IN WIRE HARNESS)

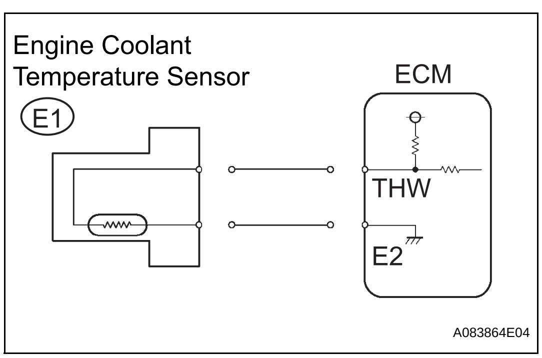


(a) Disconnect the E1 engine coolant temperature sensor connector.
(b) Turn the power switch ON (IG).
(c) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DATA LIST / PRIMARY / COOLANT TEMP.
(d) Read the value.
OK:
Temperature value: -40°C (-40°F)
(e) Reconnect the engine coolant temperature sensor connector.

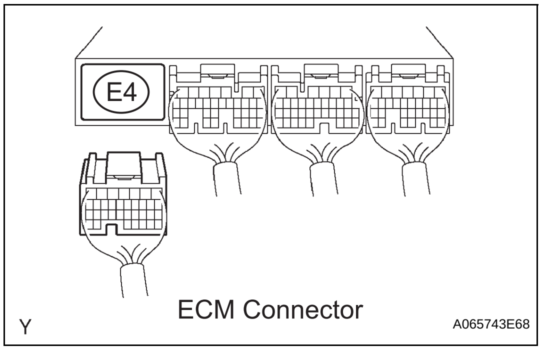
OK → **REPLACE ENGINE COOLANT TEMPERATURE SENSOR**

NG

6 READ VALUE OF INTELLIGENT TESTER (CHECK FOR SHORT IN ECM)



(a) Disconnect the E4 ECM connector.



(b) Turn the power switch ON (IG).
(c) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DATA LIST / PRIMARY / COOLANT TEMP.
(d) Read the value.

OK:

Temperature value: -40°C (-40°F)

(e) Reconnect the ECM connector.

OK → **REPAIR OR REPLACE HARNESS AND CONNECTOR**

NG

REPLACE ECM

ES

DTC	P0116	Engine Coolant Temperature Circuit Range / Performance Problem

DESCRIPTION

Refer to DTC P0115 (see page ES-91).

DTC No.	DTC Detection Condition	Trouble Area
P0116	If the engine coolant temperature (ECT) was between 35°C (95°F) and 60°C (140°F) when starting the engine, and conditions (a) and (b) are met (2 trip detection logic): (a) Vehicle is driven at varying speeds (acceleration and deceleration) for more than 250 seconds (b) ECT remains within 3°C (5.4°F) of the engine starting temperature	• Engine coolant temperature sensor
P0116	If the engine coolant temperature was more than 60°C (140°F) at engine start, and conditions (a) and (b) are met (6 trip detection logic): (a) Vehicle is driven at varying speeds (under acceleration and deceleration) (b) Engine coolant temperature remains within 1°C (1.8°F) of the engine starting temperature, and this is successively recorded 6 times	• Engine coolant temperature sensor

ES

MONITOR DESCRIPTION

The engine coolant temperature (ECT) sensor is used to monitor the engine coolant temperature. The ECT sensor has a thermistor that varies its resistance depending on 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. The variations in resistance are reflected in the voltage output from the sensor. The ECM monitors the sensor voltage and uses this value to calculate the engine coolant temperature. When the sensor output voltage deviates from the normal operating range, the ECM interprets this as a fault in the ECT sensor and sets a DTC.
Examples:
1) Upon starting the engine, the coolant temperature (ECT) was between 35°C (95°F) and 60°C (140°F). If after driving for 250 seconds, the ECT still remains within 3°C (5.4°F) of the starting temperature, a DTC will be set (2 trip detection logic).
2) Upon starting the engine, the coolant temperature (ECT) was over 60°C (140°F). If, after driving for 250 seconds, the ECT still remains within 1°C (1.8°F) of the starting temperature, a DTC will be set (6 trip detection logic).

MONITOR STRATEGY

Case 1: ECT is between 35 and 60°C (95 and 140°F)

Related DTCs	P0116
Required sensors/components (Main)	Engine coolant temperature sensor
Required sensors/components (Related)	-
Frequency of operation	Once per driving cycle
Duration	1 second
MIL operation	2 driving cycles
Sequence of operation	None

Case 2: ECT is higher than 60°C (140°F)

Related DTCs	P0116
Required sensors/components (Main)	Engine coolant temperature sensor

Required sensors/components (Related)	-
Frequency of operation	Once per driving cycle
Duration	0.032 second
MIL operation	6 driving cycles
Sequence of operation	None

TYPICAL ENABLING CONDITIONS

Case 1: ECT is between 35 and 60°C (95 and 140°F)

Monitor will run whenever these DTCs are not present	P0100, P0101, P0102, P0103
Cumulative idle off period	250 seconds or more
Frequency of the following condition (a) is met	10 times
(a) Vehicle speed increase	19 mph (30 km/h) or more
Engine coolant temperature	35 to 60°C (95 to 140°F)
Intake air temperature	-6.7°C (20°F) or higher

Case 2: ECT is higher than 60°C (140°F)

Monitor will run whenever these DTCs are not present	P0100, P0101, P0102, P0103
Engine coolant temperature	60°C (140°F) or higher
Intake air temperature	-6.7°C (20°F) or higher
Frequency that vehicle is driven by the following conditions (a) to (d) is met	Once
(a) Engine idling period	20 seconds or more
(b) Acceleration period: Duration that vehicle speed reaches to 70 km/h (43.5 mph)	Within 40 seconds
(c) Intake air temperature: Duration that vehicle is driven by 65 to 70 km/h (40 to 43.5 mph)	30 seconds or more
(d) Intake air temperature: Duration that vehicle speed drops to 3 km/h (2 mph)	Within 35 seconds

TYPICAL MALFUNCTION THRESHOLDS

Case 1: ECT is between 35 and 60°C (95 and 140°F)

Engine coolant temperature change after engine start	Less than 3°C (5.4°F)

Case 2: ECT is higher than 60°C (140°F)

Engine coolant temperature change after engine start	1°C (1.8°F) or less

COMPONENT OPERATING RANGE

Engine coolant temperature	Changing with the actual engine coolant temperature

WIRING DIAGRAM

Refer to DTC P0115 (see page ES-92).

INSPECTION PROCEDURE

1	READ OUTPUT DTC

(a) Connect an intelligent tester to the DLC3.
(b) Turn the power switch on (IG) and turn the tester on.
(c) Select the following menu items: DIAGNOSIS / ENHANCED OBD II / DTC INFO / CURRENT CODES.

(d) Read DTCs.

Result

Display (DTC Output)	Proceed To
P0116	A
P0116 and other DTCs	B

B → **GO TO RELEVANT DTC CHART**

A

2 INSPECT THERMOSTAT

(a) Remove the thermostat (see page CO-14).

(b) Measure the valve opening temperature of the thermostat.

Standard temperature:

80°C to 84°C (176°F 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-16).

NG → **REPLACE THERMOSTAT**

OK

REPLACE ENGINE COOLANT TEMPERATURE SENSOR

DTC	**P0120**	**Throttle Pedal Position Sensor / Switch "A" Circuit Malfunction**

DTC	**P0122**	**Throttle / Pedal Position Sensor / Switch "A" Circuit Low Input**

DTC	**P0123**	**Throttle / Pedal Position Sensor / Switch "A" Circuit High Input**

DTC	**P0220**	**Throttle / Pedal Position Sensor / Switch "B" Circuit**

DTC	**P0222**	**Throttle / Pedal Position Sensor / Switch "B" Circuit Low Input**

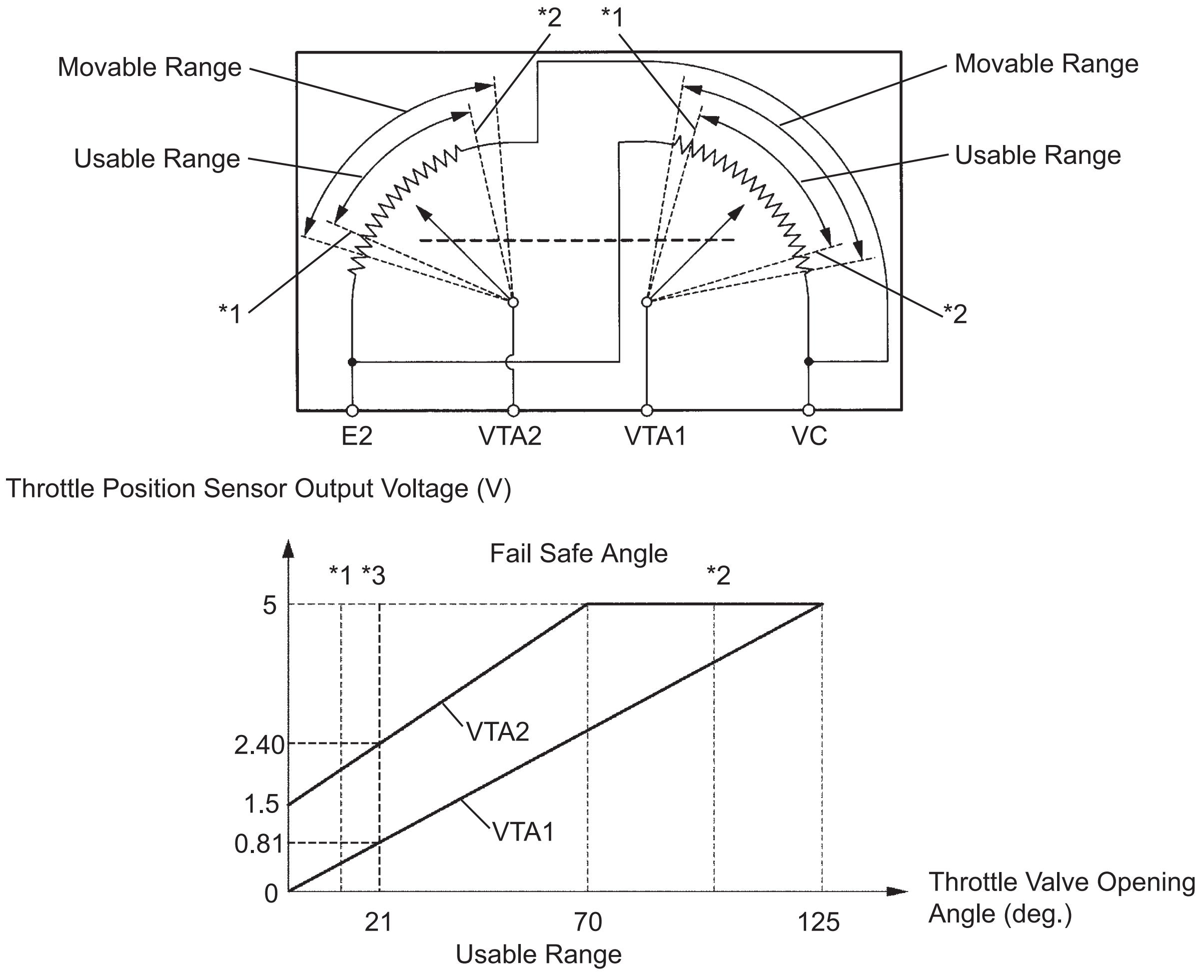
DTC	**P0223**	**Throttle / Pedal Position Sensor / Switch "B" Circuit High Input**

DTC	**P2135**	**Throttle / Pedal Position Sensor / Switch "A" / "B" Voltage Correlation**

DESCRIPTION

HINT:
- This electrical throttle system does not use a throttle cable.
- This is the troubleshooting procedure of the throttle position sensor.

The throttle position sensor is mounted on the throttle body and it has 2 sensor terminals to detect the throttle opening angle and malfunction of the throttle position sensor itself.
The voltage applied to terminals VTA and VTA2 of the ECM changes between 0 V and 5 V in proportion to the opening angle of the throttle valve. The VTA is a signal to indicate the actual throttle valve opening angle which is used for the engine control, and the VTA2 is a signal to indicate the information about the opening angle which is used for detecting malfunction of the sensor.
The ECM judges the current opening angle of the throttle valve from these signals input from terminals VTA and VTA2, and the ECM controls the throttle motor to make the throttle valve angle properly in response to the driving condition.
When malfunction is detected, the throttle valve is locked at a certain opening angle. Also, the whole electronically controlled throttle operation is canceled until the system returns to normal and the power switch is turned OFF.



*1: Throttle Valve Fully Closed (13.5°), VTA1 is 0%
*2: Throttle Valve Fully Open (97.5°), VTA1 is approximately 0%
*3: Fail Safe Angle (16.5°), VTA1 is 3.5%

Note: Throttle valve opening angle detected by the sensor terminal of VTA is expressed as percentage.

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DTC No.	DTC Detection Condition	Trouble Area
-	Conditions of DTC P0120, P0122, P0123, P0220, P0222 or P0223 continues for 2 seconds or more when Idle is ON	-
P0120	Detection conditions for DTCs P0122 and P0123 are not satisfied but condition (a) is satisfied (a) VTA is 0.2V or less, or 4.535 V or more	• Open or short in throttle position sensor circuit • Throttle position sensor • ECM
P0122	VTA is 0.2 V or less	• Short in throttle position sensor circuit • Throttle position sensor • ECM
P0123	VTA is 4.535 V or more	• Open in throttle position sensor circuit • Throttle position sensor • ECM
P0220	Detection conditions for DTCs P0222 and P0223 are not satisfied but condition satisfied VTA2 is 1.75 V or less, or VTA2 is 4.8 V or more	• Open or short in throttle position sensor circuit • Throttle position sensor • ECM

DTC No.	DTC Detection Condition	Trouble Area
P0222	VTA2 is 1.75 V or less	• Short in throttle position sensor circuit • Throttle position sensor • ECM
P0223	VTA2 is 4.8 V or more when VTA is 0.2 or more and 2.02 V or less	• Open in throttle position sensor circuit • Throttle position sensor • ECM
P2135	Condition (a) continues for 0.5 seconds or more, or condition (b) continues for 0.4 seconds or more: (a) Difference between VTA and VTA2 is 0.02 V or less (b) VTA is 0.2 V or less and VTA2 is 1.75 V or less	• Open or short in throttle position sensor circuit • Throttle position sensor • ECM

HINT:

DTC No.	Main Trouble Area
P0122	• Throttle position sensor • Open in VTA1 circuit • VC circuit open (when the VC circuit is open, DTCs P0222 and P2135 are also output simultaneously) • ECM
P0123	• Throttle position sensor (built in throttle body) • Open in VTA circuit • Open in E2 circuit • VC and VTA circuits are short-circuited • ECM
P0222	• Throttle position sensor • Open in VTA2 circuit • VC circuit open (when the VC circuit is open, DTCs P0122 and P2135 are also output simultaneously)
P0223	• Throttle position sensor
P2135	• VTA1 and VTA2 circuits are short-circuited • Open in VC circuit • Throttle position sensor

NOTICE:
When a malfunction is detected, the throttle valve is locked at a certain opening angle. Also, the whole electronically controlled throttle operation is canceled until the system returns to normal and the power switch is turned OFF.

HINT:
- After confirming DTCs, confirm condition of the throttle valve opening angle (THROTTLE POS) and the closed throttle position switch (THROTTLE POS #2) using the intelligent tester.
- THROTTLE POS means the VTA1 signal (expressed as percentage), and THROTTLE POS#2 means the VTA2 signal (expressed as volts).

Tester display	Accelerator pedal released	Accelerator pedal depressed
THROTTLE POS	8 to 20%	64 to 96%
THROTTLE POS #2	1.5 to 2.9 V	3.5 to 5.5 V

MONITOR DESCRIPTION

The ECM uses the throttle position sensor to monitor the throttle valve opening angle.
(a) There is a specific voltage difference between VTA1 and VTA2 for each throttle opening angle.
(b) VTA1 and VTA2 each have a specific voltage operating range.
(c) VTA1 and VTA2 should never be close to the same voltage level.
If the difference between VTA1 and VTA2 is incorrect (a), the ECM interprets this as a fault and will set a DTC.
If VTA1 or VTA2 is out of the normal operating range (b), the ECM interprets this as a fault and will set a DTC.

ES

If VTA1 is within 0.02 V of VTA2 (c), the ECM interprets this as a short circuit in the throttle position sensor system and will set a DTC.

MONITOR STRATEGY

Related DTCs	P0120: Throttle position sensor (sensor 1) range check (fluttering) P0122: Throttle position sensor (sensor 1) range check (low voltage) P0123: Throttle position sensor (sensor 1) range check (high voltage) P0220: Throttle position sensor (sensor 2) range check (fluttering) P0222: Throttle position sensor (sensor 2) range check (low voltage) P0223: Throttle position sensor (sensor 2) range check (high voltage) P2135: Throttle position sensor range check (correlation)
Required sensors/components	Throttle position sensor
Frequency of operation	Continuous
Duration	2 seconds
MIL operation	Immediately
Sequence of operation	None

TYPICAL ENABLING CONDITIONS

The monitor will run whenever the following DTCs are not present	None

TYPICAL MALFUNCTION THRESHOLDS

P0120:

VTA1 voltage	0.2 V or less or 4.535 V or more

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	4.8 V or more (VTA voltage is 0.2 and 2.02 V)

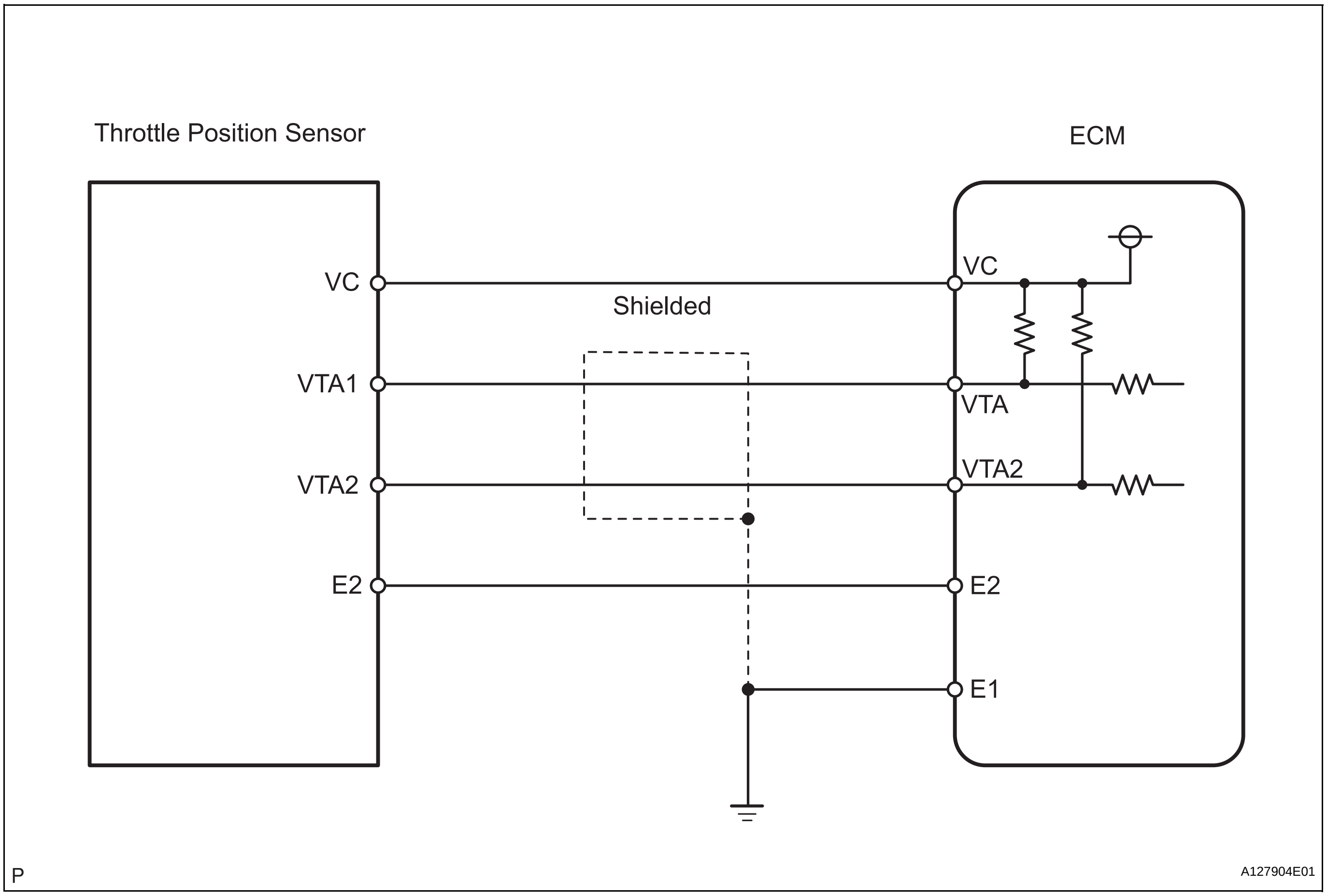
P2135:

Different between VTA1 and VTA2 voltage	0.02 V or less
Both of the following conditions are met:	(a) and (b)
(a) VTA1 voltage	0.2 V or less
(b) VTA2 voltage	1.75 V or less

COMPONENT OPERATING RANGE

Throttle position sensor VTA1 voltage	0.6 to 3.96 V
Throttle position sensor VTA2 voltage	2.25 to 5.0 V

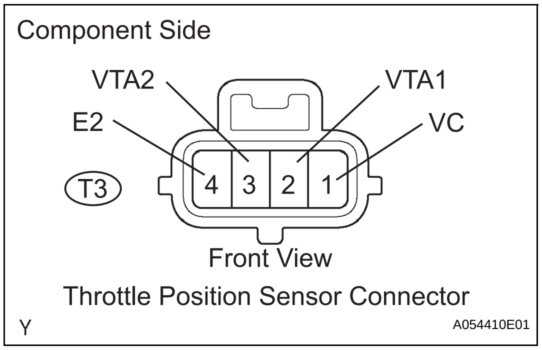
WIRING DIAGRAM



INSPECTION PROCEDURE

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. Freeze frame data records the engine condition when malfunction is detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1	INSPECT THROTTLE POSITION SENSOR (RESISTANCE)



(a) Disconnect the T3 throttle position sensor connector.
(b) Measure the resistance between the terminals of the throttle position sensor.
Standard resistance

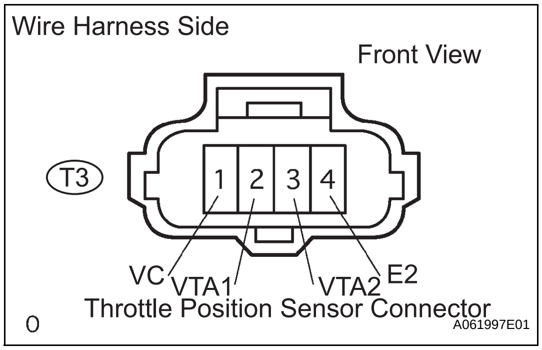
Tester Connection	Specified Condition
1 (VC) - 4 (E2)	1.2 to 3.2 kΩ at 20°C (68°F)
2 (VTA1) - 4 (E2)	1.8 to 10.5 kΩ at 20°C (68°F)
3 (VTA2) - 4 (E2)	1.8 to 10.5 kΩ at 20°C (68°F)

NG → **REPLACE THROTTLE W/MOTOR BODY ASSEMBLY**

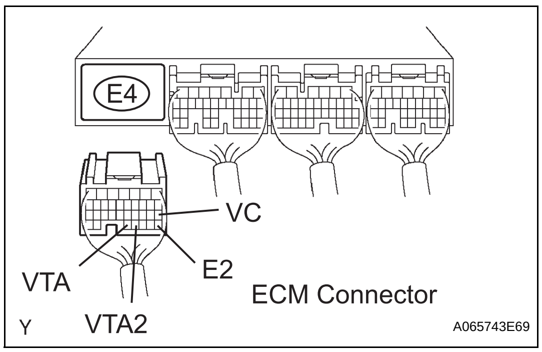
ES

OK

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



(a) Disconnect the T3 throttle position sensor connector.



(b) Disconnect the ECM E4 connector.

(c) Measure the resistance between the wire harness side connectors.

Standard resistance (Check for open)

Tester Connection	Specified Condition
T3-1 (VC) - E4-18 (VC)	Below 1 Ω
T3-2 (VTA1) - E4-32 (VTA)	Below 1 Ω
T3-3 (VTA2) - E4-31 (VTA2)	Below 1 Ω
T3-4 (E2) - E4-28 (E2)	Below 1 Ω

Standard resistance (Check for short)

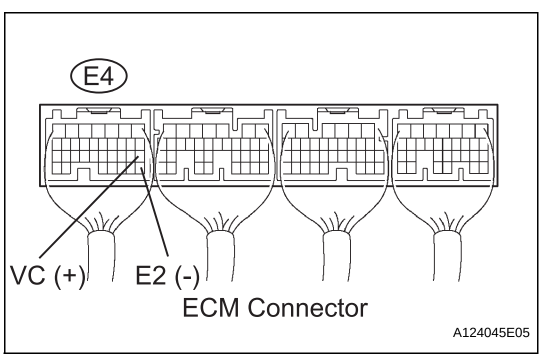
Tester Connection	Specified Condition
E4-18 (VC) - E4-28 (E2)	10 kΩ or higher
E4-32 (VTA) - E4-28 (E2)	10 kΩ or higher
E4-31 (VTA2) - E4-28 (E2)	10 kΩ or higher

(d) Reconnect the ECM connector.

NG → **REPAIR OR REPLACE HARNESS AND CONNECTOR**

OK

3 CHECK ECM (VC - E2)



(a) Turn the power switch ON (IG).

(b) Measure the voltage between terminals VC and E2 of the ECM connector.

Standard voltage

Tester Connection	Specified Condition
E4-18 (VC) - E4-28 (E2)	4.5 to 5.5 V

NG → **REPLACE ECM**

OK

REPLACE THROTTLE W/MOTOR BODY ASSEMBLY

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

DESCRIPTION

Refer to DTC P0120 (see page ES-100).
HINT:
This is the purpose of troubleshooting the throttle position sensor.

DTC No.	DTC Detection Condition	Trouble Area
P0121	Difference between VTA1 and VTA2 is out of threshold for 2 seconds	• Throttle position sensor

MONITOR DESCRIPTION

The ECM uses the throttle position sensor to monitor the throttle valve opening angle.
This sensor has two signals, VTA1 and VTA2. VTA1 is used to detect the throttle opening angle and VTA2 is used to detect malfunction in VTA1. There are several checks that the ECM confirms proper operation of the throttle position sensor and VTA1.
There is a specific voltage difference between VTA1 and VTA2 for each throttle opening angle.
If VTA1 or VTA2 is out of the normal operating range, the ECM interprets this as a fault and will set a DTC.
If VTA1 is within 0.02 V of VTA2, the ECM interprets this as a short circuit in the throttle position sensor system and will set a DTC.
If the voltage output difference of the VTA1 and VTA2 deviates from the normal operating range, the ECM interprets this as malfunction of the throttle position sensor. The ECM will turn on the MIL and a DTC is set.

FAIL-SAFE

If the Electronic Throttle Control System (ETCS) has malfunction, the ECM cuts off current to the throttle control motor. 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 to drive.
If the accelerator pedal is depressed firmly and slowly, the vehicle can be driven slowly.
If a "pass" condition is detected and then the power switch is turned OFF, the fail-safe operation will stop and the system will return to normal condition.

MONITOR STRATEGY

Related DTCs	P0121: Throttle position sensor rationality
Required sensors/components	Throttle position sensor
Frequency of operation	Continuous
Duration	2 seconds
MIL operation	Immediately
Sequence of operation	None

TYPICAL ENABLING CONDITIONS

The monitor will run whenever the following DTCs are not present	None
VTA2 voltage	Less than 4.6 V

TYPICAL MALFUNCTION THRESHOLDS

Different between VTA1 and VTA2 [VTA1 - (VTA2 x 0.8 to 1.2)]* *: Corrected by learning value	Less than 0.8 V and more than 1.6 V

INSPECTION PROCEDURE

HINT:
Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunction is detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1 CHECK ANY OTHER DTCS OUTPUT

(a) Connect an intelligent tester to the DLC3.
(b) Turn the power switch on (IG) and turn the tester on.
(c) Select the following menu items: DIAGNOSIS / ENHANCED OBD II / DTC INFO / CURRENT CODES.
(d) Read DTCs.

Result

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

B → **GO TO RELEVANT DTC CHART**

A ↓

REPLACE THROTTLE W/MOTOR BODY ASSEMBLY

DTC	P0125	Insufficient Coolant Temperature for Closed Loop Fuel Control

DESCRIPTION

Refer to DTC P0115 (see page ES-91).

DTC No.	DTC Detection Condition	Trouble Area
P0125	Engine coolant temperature hardly changes for 58 seconds after engine start (2 trip detection logic)	• Cooling system • Engine coolant temperature sensor • Thermostat
P0125	Engine coolant temperature hardly changes for 109 seconds after engine start (2 trip detection logic)	• Cooling system • Engine coolant temperature sensor • Thermostat
P0125	Engine coolant temperature hardly changes for 20 minutes after engine start (2 trip detection logic)	• Cooling system • Engine coolant temperature sensor • Thermostat

HINT:
ECT represents engine coolant temperature, and IAT represents intake air temperature.

MONITOR DESCRIPTION

The engine coolant temperature (ECT) sensor is used to monitor the temperature of the engine coolant. The resistance of the sensor varies with the actual engine coolant temperature. The ECM applies voltage to the sensor and the varying resistance of the sensor causes the signal voltage to vary. The ECM monitors the ECT signal voltage after engine start-up. If, after sufficient time has passed, the sensor still reports that the engine is not warm enough for closed-loop fuel control, the ECM interprets this as a fault in the sensor or cooling system and sets a DTC.
Example:
The engine coolant temperature was 0°C (32°F) at engine start. After driving 5 minutes, the ECT sensor still indicates that the engine is not warm enough to begin the air-fuel ratio feedback control. The ECM interprets this as a fault in the sensor or cooling system and will set a DTC.

MONITOR STRATEGY

Related DTCs	P0125
Required sensors/components (Main)	Engine coolant temperature sensor, cooling system, thermostat
Required sensors/components (Related)	Cooling system, thermostat
Frequency of operation	Once per driving cycle
Duration	58 seconds (Case 1) 109 seconds (Case 2) 1,200 seconds (Case 3)
MIL operation	2 driving cycles
Sequence of operation	None

TYPICAL ENABLING CONDITIONS

Case 1

Monitor will run whenever these DTCs are not present	P0100 - P0103 (MAF meter) P0110 - P0113 (IAT sensor) P0115 - P0118 (ECT sensor)
Engine coolant or intake air temperature at engine start	1.66°C (35°F) or more

Case 2

Monitor will run whenever these DTCs are not present	P0100 - P0103 (MAF meter) P0110 - P0113 (IAT sensor) P0115 - P0118 (ECT sensor)
Engine coolant or intake air temperature at engine start	Between -9.5°C (15°F) and 1.66°C (35°F)

Case 3

Monitor will run whenever these DTCs are not present	P0100 - P0103 (MAF meter) P0110 - P0113 (IAT sensor) P0115 - P0118 (ECT sensor)
Engine coolant or intake air temperature at engine start	Lower than -9.5°C (15°F)

TYPICAL MALFUNCTION THRESHOLDS

Engine coolant temperature	Less than 10°C (50°F)

WIRING DIAGRAM

Refer to DTC P0115 (see page ES-92).

INSPECTION PROCEDURE

HINT:

- If DTCs P0115, P0116, P0117, P0118 and P0125 are output simultaneously, engine coolant temperature sensor circuit may be open or short. Perform troubleshooting on DTC P0115, P0117 or P0118 first.
- Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunction is detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

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

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

Result

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

HINT:
If any other codes besides P0125 are output, perform troubleshooting for those DTCs first.

B → **GO TO RELEVANT DTC CHART**

A

2 INSPECT THERMOSTAT

(a) Check the valve opening temperature of the thermostat.

OK:

Thermostat valve begins to open at temperature of 80 to 84°C (176 to 183°F)

HINT:
Also check that the valve is completely closed below temperature shown above.

NG → **REPLACE THERMOSTAT**

OK ↓

REPLACE ENGINE COOLANT TEMPERATURE SENSOR

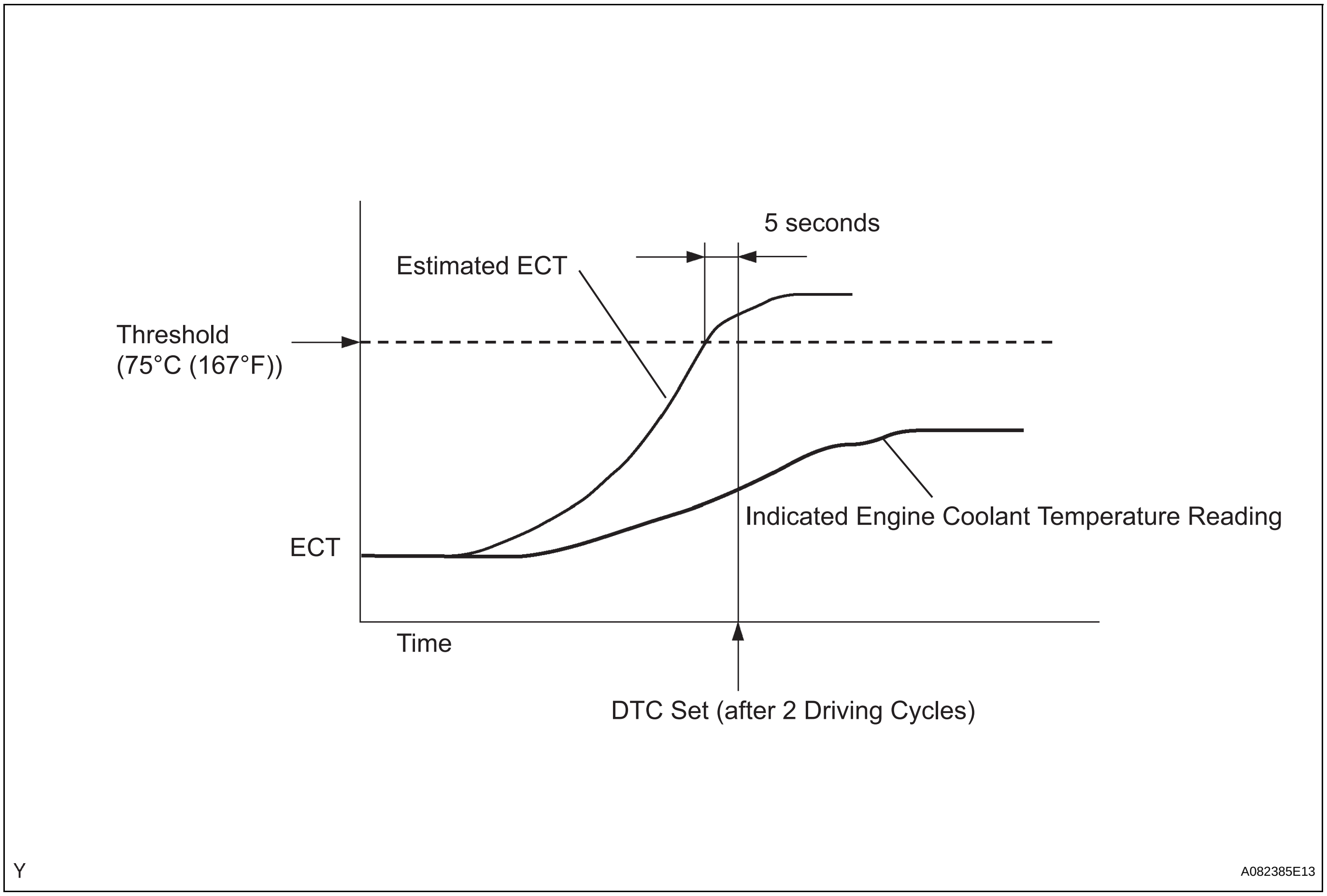
DTC P0128 Coolant Thermostat (Coolant Temperature Below Thermostat Regulating Temperature)

DESCRIPTION

HINT:
This is the purpose of detecting the "thermostat" malfunction.
If the engine coolant temperature (ECT) does not reach 75°C (167°F) despite sufficient warm-up time has elapsed.

DTC No.	DTC Detection Condition	Trouble Area
P0128	Conditions (a), (b) and (c) are met: (a) Cold start (b) After sufficient warm-up time has elapsed (c) Engine coolant temperature is less than 75°C (167°F)	• Thermostat • Cooling system • Engine coolant temperature sensor • ECM

MONITOR DESCRIPTION



The ECM estimates the engine coolant temperature (ECT) based on engine starting temperature, engine loads and engine speed. The ECM then compares the estimated ECT with the actual ECT. When the estimated ECT reaches 75°C (167°F), the ECM check the actual ECT. If the actual ECT is less than 75°C (167°F), the ECM will interpret this as a fault in thermostat or the engine cooling system and set a DTC.

MONITOR STRATEGY

Related DTCs	P0128: Thermostat

Required sensors/components	Main: Engine coolant temperature sensor, engine cooling system, thermostat Related: Intake air temperature sensor, vehicle speed sensor
Frequency of operation	Once per driving cycle
Duration	15 minutes
MIL operation	2 driving cycles
Sequence of operation	None

TYPICAL ENABLING CONDITIONS

The monitor will run whenever the following DTCs are not present	P0010 (VVT OCV) P0011 (VVT system 1 - Advance) P0012 (VVT system 1 - Retard) P0031, P0032 (A/F sensor heater - Sensor 1) P0100 - P0103 (MAF meter) P0110 - P0113 (IAT sensor) P0115 - P0118 (ECT sensor) P0125 (Insufficient ECT for closed loop) P0171, P0172 (Fuel system) P0300 - P0304 (Misfire) P0335 (CKP sensor) P0340, P0341 (CMP sensor) P0351-P0354 (Igniter) P0500 (VSS) P2196 (A/F sensor - Rationality) P2A00 (A/F sensor - Slow response)
When one of the following condition 1 or 2 is met	-
1. When all of the following conditions are met	-
Battery voltage	11 V or more
Intake air temperature (at engine start)	-10°C(14°F) or more, and 56°C (132.8°F) or less
Engine coolant temperature (at engine start)	-10°C(14°F) or more, and 56°C (132.8°F) or less
ECT at engine start - IAT at engine start	-15 to 7°C (-27 to 12.6°F)
2. When all of the following conditions are met	-
ECT at engine start - IAT at engine start	Higher than 7°C (12.6°F)
ECT at engine start	56°C (132.8°F) or lower
IAT at engine start	-10°C (14°F) or higher
Accumulated time that vehicle speed is 128 km/h (80 mph) or more	Less than 20 seconds

TYPICAL MALFUNCTION THRESHOLDS

(1) Estimated engine coolant temperature	75°C(167°F) or more
(2) Estimated engine coolant temperature sensor output value	Less than 75°C (167°F)
Duration of both (1) and (2)	5 seconds or more

COMPONENT OPERATING RANGE

Engine coolant temperature sensor output value after warm-up	75°C(167°F) or more

MONITOR RESULT

Refer to detailed information (see page ES-15).

INSPECTION PROCEDURE

HINT:
Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunction is detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1	CHECK COOLING SYSTEM

(a) Check that there is a defect in the cooling system which causes overcooling, such as abnormal radiator fan operation, modified cooling system and so on.
OK:
There is no modification of cooling system.

NG → **REPAIR OR REPLACE COOLING SYSTEM**

OK ↓

2	INSPECT THERMOSTAT

(a) Check the valve opening temperature of the thermostat.
OK:
Thermostat valve begins to open at temperature of 80 to 84°C (176 to 183°F).
HINT:
Also check the valve is completely closed below the temperature shown above.

NG → **REPLACE THERMOSTAT**

OK ↓

REPLACE ECM

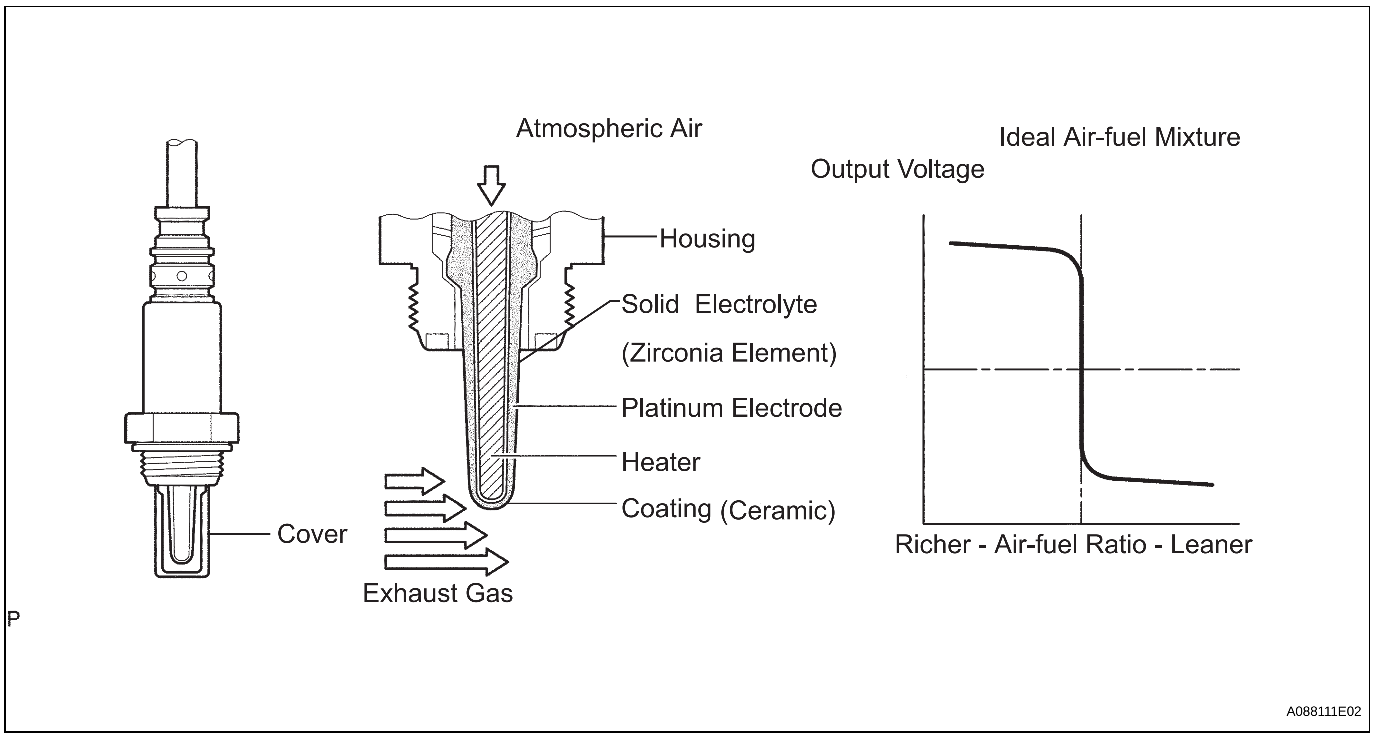
DTC	P0136	Oxygen Sensor Circuit Malfunction (Bank 1 Sensor 2)

DTC	P0137	Oxygen Sensor Circuit Low Voltage (Bank 1 Sensor 2)

DTC	P0138	Oxygen Sensor Circuit High Voltage (Bank 1 Sensor 2)

DESCRIPTION

The heated oxygen sensor is used to monitor oxygen concentration in the exhaust gas. For optimum catalytic converter operation, the air-fuel mixture must be maintained near the ideal "stoichiometric" ratio. The oxygen sensor 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 ratio.
When the air-fuel ratio becomes LEAN, the oxygen concentration in the exhaust gas increases. The heated oxygen sensor informs the ECM of the LEAN condition (low voltage, i.e. less than 0.45 V).
When the air-fuel ratio is RICHER than the stoichiometric air-fuel ratio, the oxygen will be vanished from the exhaust gas. The heated oxygen sensor informs the ECM of the RICH condition (high voltage, i.e. more than 0.45 V).
The heated oxygen sensor includes a heater which heats the zirconia element. The heater is controlled by the ECM. When the intake air volume is low (the temperature of the exhaust gas is low), current flows to the heater in order to heat the sensor for the accurate oxygen concentration detection.



DTC No.	DTC Detection Condition	Trouble Area
P0136	• Problem in heated oxygen sensor voltage • Heated oxygen sensor impedance is too low	• Heated oxygen sensor (bank 1 sensor 2) circuit • Heated oxygen sensor (bank 1 sensor 2) • Heated oxygen sensor heater (bank 1 sensor 2) • A/F sensor (bank 1 sensor 1) • A/F sensor heater

DTC No.	DTC Detection Condition	Trouble Area
P0137	• Heated oxygen sensor impedance is too high • Problem in heated oxygen sensor output (low voltage side)	• Heated oxygen sensor (bank 1 sensor 2) circuit • Heated oxygen sensor (bank 1 sensor 2) • Heated oxygen sensor heater (bank 1 sensor 2) • A/F sensor (bank 1 sensor 1) • A/F sensor heater
P0138	• Problem in heated oxygen sensor output (high voltage side)	• Heated oxygen sensor (bank 1 sensor 2) circuit • Heated oxygen sensor (bank 1 sensor 2) • Heated oxygen sensor heater (bank 1 sensor 2) • A/F sensor (bank 1 sensor 1) • A/F sensor heater

MONITOR DESCRIPTION

Active Air-Fuel Ratio Control

Usually the ECM performs the air-fuel ratio control so that the A/F sensor output indicates a near stoichiometric air-fuel ratio. This vehicle includes "active air-fuel ratio control" besides the regular air-fuel ratio control. The ECM performs the "active air-fuel ratio control" to detect deterioration in a catalyst and the heated oxygen sensor malfunction. (Refer to the diagram below)

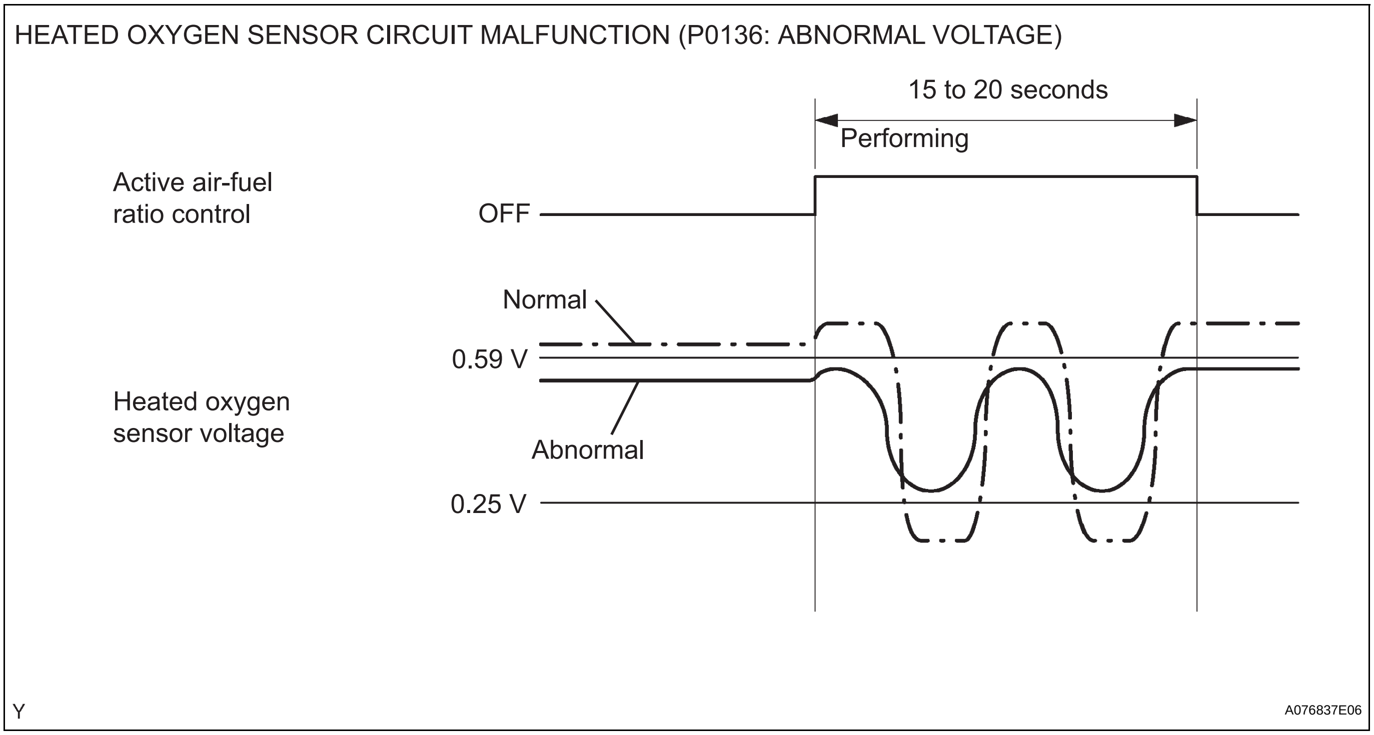
The "Active air-fuel ratio control" is performed for approximately 15 to 20 seconds during a vehicle driving with a warm engine. Under the "active air-fuel ratio control", the air-fuel ratio is forcibly regulated to go LEAN or RICH by the ECM.

If the ECM detects malfunction, it is recorded in the following DTCs: DTC P0136 (Abnormal Voltage Output), DTC P0137 (Circuit Open) and P0138 (Circuit Short).

Abnormal Voltage Output of Heated Oxygen Sensor (DTC P0136)

As the ECM is performing the "active air-fuel ratio control", the air-fuel ratio is forcibly regulated to go RICH or LEAN. If the sensor is not functioning properly, the voltage output variation is smaller.

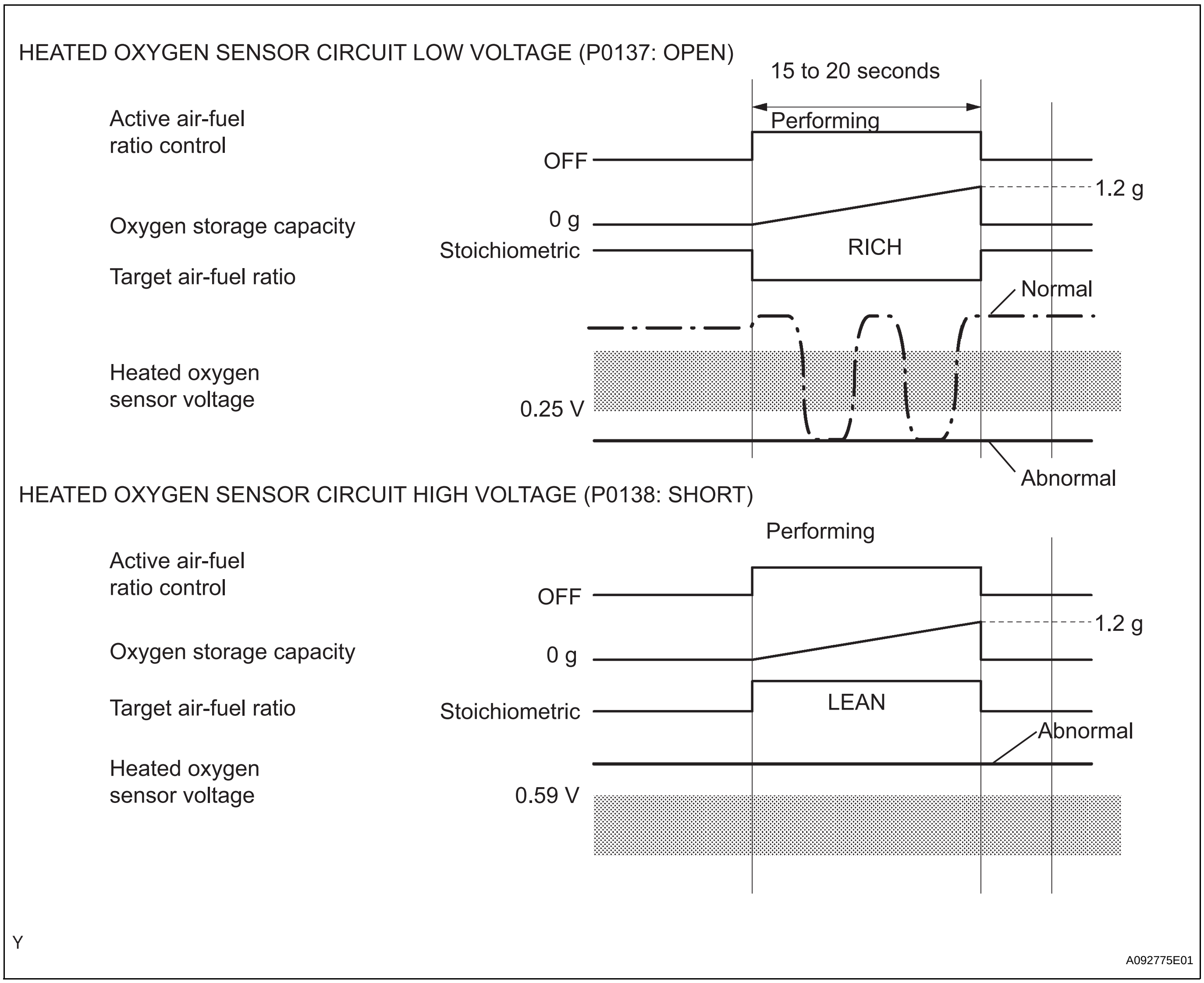
Under the "active air-fuel ratio control", if the maximum voltage output of the heated oxygen sensor is less than 0.59 V, or the minimum voltage output is 0.25 V or more, the ECM determines that it is abnormal voltage output of the sensor (DTC P0136).



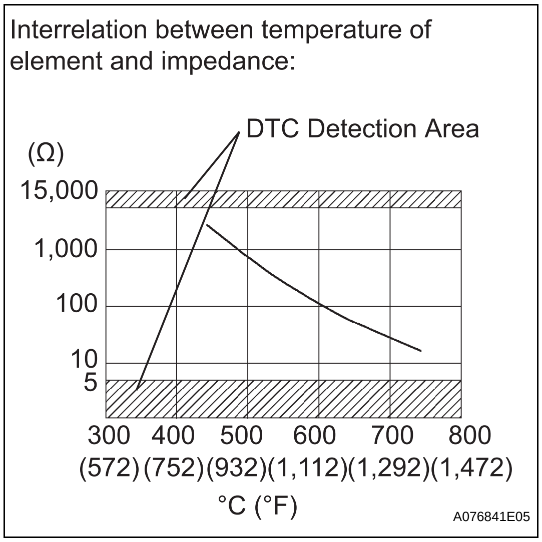
Oxygen Storage Capacity Detection in the Heated Oxygen Sensor Circuit (P0136, P0137 or P0138)

Under "active air-fuel ratio control", the ECM calculates the Oxygen Storage Capacity (OSC)* in the catalyst by forcibly regulating the air-fuel ratio to go RICH (or LEAN).
If the heated oxygen sensor has an open or short, or the voltage output by the sensor noticeably decreases, the OSC will indicate extraordinary high value. Even if the ECM attempts to continue regulating the air-fuel ratio to go RICH (or LEAN), the heated oxygen sensor output does not change.
When the value of OSC calculated by the ECM reaches 1.2 gram under the active air-fuel ratio control, although the targeted air-fuel ratio is RICH but the voltage output of the heated oxygen sensor is 0.25 V or less (LEAN), the ECM determines that it is an abnormal low voltage (DTC P0137). Also, the targeted air-fuel ratio is LEAN but the voltage output is 0.59 V or more (RICH), it is determined that the voltage output of the sensor is abnormally high (DTC P0138).
In addition to the OSC detection, if the fluctuation of the sensor voltage output is in a specific narrow range (more than 0.25 V and less than 0.59) despite the ECM ordering the air-fuel ratio to go RICH or LEAN while the OSC is above 1.2 gram, the ECM interprets this as a malfunction in the heated oxygen sensor circuit (DTC P0136).

*Oxygen Storage Capacity (OSC): A catalyst has a capability for storing oxygen. The OSC and the emission purification capacity of the catalyst are mutually related. The ECM judges if the catalyst has deteriorated based on the calculated OSC value (see page ES-177).



HINT:
DTC P0138 is also set if the voltage output from the heated oxygen sensor is more than 1.2 V for 10 seconds or more.
Heated oxygen sensor impedance



During normal feedback control of the air-fuel ratio, there are small variations in the exhaust gas oxygen concentration. In order to continuously monitor the slight variation of the signal from the oxygen sensor while the engine is running, the impedance* of the sensor is measured by the ECM. The ECM detects that there is malfunction in the sensor when the measured impedance deviates from the standard range.
*: The effective resistance in an alternating current electrical circuit.
HINT:
- The impedance can not be measured with an ohmmeter.
- DTC P0136 indicates deterioration of the heated oxygen sensor. The ECM sets the DTC by calculating the impedance of the sensor after the typical enabling conditions are satisfied (2 driving-cycles).
- DTC P0137 indicates an open or short circuit in the heated oxygen sensor system (2 driving-cycles). The ECM sets this DTC when the impedance of the sensor exceeds the threshold 15 kΩ.

MONITOR STRATEGY

Case 1: Output voltage (Active A/F control method)

Related DTCs	P0136
Required sensors/components (main)	Heated oxygen sensor (bank 1 sensor 2)
Required sensors/components (related)	A/F sensor
Frequency of operation	Once per driving cycle
Duration	20 seconds
MIL operation	1 driving cycles
Sequence of operation	None

Case 2: Low impedance

Related DTCs	P0136
Required sensors/components (main)	Heated oxygen sensor (bank 1 sensor 2)
Required sensors/components (related)	None
Frequency of operation	Continuously
Duration	30 seconds
MIL operation	2 driving cycles
Sequence of operation	None

Case 3: High impedance

Related DTCs	P0137
Required sensors/components (main)	Heated oxygen sensor (bank 1 sensor 2)
Required sensors/components (related)	None
Frequency of operation	Continuously
Duration	155 seconds

MIL operation	2 driving cycles
Sequence of operation	None

Case 4: Low voltage (Active A/F control method)

Related DTCs	P0137
Required sensors/components (main)	Heated oxygen sensor (bank 1 sensor 2)
Required sensors/components (related)	A/F sensor
Frequency of operation	Once per driving cycle
Duration	20 seconds
MIL operation	1 driving cycles
Sequence of operation	None

Case 5: High voltage (Active A/F control method)

Related DTCs	P0138
Required sensors/components (main)	Heated oxygen sensor (bank 1 sensor 2)
Required sensors/components (related)	A/F sensor
Frequency of operation	Once per driving cycle
Duration	20 seconds
MIL operation	1 driving cycles
Sequence of operation	None

Case 6: High voltage

Related DTCs	P0138
Required sensors/components (main)	Heated oxygen sensor (bank 1 sensor 2)
Required sensors/components (related)	None
Frequency of operation	Continuously
Duration	10 seconds
MIL operation	2 driving cycles
Sequence of operation	None

TYPICAL ENABLING CONDITIONS

Monitor will run whenever these DTCs are not present	P0031, P0032 (A/F sensor heater - Sensor 1) P0037, P0038 (O2 sensor heater - Sensor 2) P0100 - P0103 (MAF meter) P0110 - P0113 (IAT sensor) P0115 - P0118 (ECT sensor) P0120 - P0223, P2135 (TP sensor) P0125 (Insufficient ECT for closed loop) P0171, P0172 (Fuel system) P0300 - P0304 (Misfire) P0335 (CKP sensor) P0340, P0341 (CMP sensor) P0442 - P0456 (EVAP system) P0500 (VSS) P2196 (A/F sensor - Rationality) P2A00 (A/F sensor - Slow response)

Case 1: Output voltage (Active A/F control method)

Active A/F control	Executing
Active A/F control begins when the following conditions are met	-
Battery voltage	11.5 V or higher
Engine coolant temperature	75°C (167°F) or higher
Idle	OFF
Engine speed	Less than 3,200 rpm
A/F sensor status	Activated
Duration after fuel-cut: OFF	10 seconds or more

Engine load	10 to 70%

Case 2: Low impedance

Estimated sensor temperature	Lower than 750°C (1,382°F)

Case 3: High impedance

Estimated sensor temperature	450°C (842°F) or higher
Intake air amount	More than 0 g/sec.

Case 4: Low voltage (Active A/F control method)

Same as case 1

Case 5: High voltage (Active A/F control method)

Same as case 1

Case 6: High voltage

Engine	Running
Battery voltage	10.5 V or higher

TYPICAL MALFUNCTION THRESHOLDS

Case 1: Output voltage (Active A/F control method)

Either of the following conditions 1 or 2 set	-
1. All of following conditions (a), (b) and (c) set	-
(a) Commanded air-fuel ratio	14.3 or less
(b) Sensor voltage	0.25 to 0.59 V
(c) OSC (Oxygen Storage Capacity of catalyst)	1.2 g or more
2. All of following conditions (d), (e) and (f) set	-
(d) Commanded air-fuel ratio	14.9 or more
(e) Rear HO2S voltage	0.25 to 0.59 V
(f) OSC (oxygen storage capacity of catalyst)	1.2 g or more

Case 2: Low impedance

Sensor impedance	Less than 5 Ω

Case 3: High impedance

Sensor impedance	15,000 Ω or higher

Case 4: Low voltage (Active A/F control method)

All of following conditions (a), (b) and (c) set	-
(a) Commanded air-fuel ratio	14.3 or less
(b) Sensor voltage	Less than 0.25 V
(c) OSC (Oxygen Storage Capacity of catalyst)	1.2 g or more

Case 5: High voltage (Active A/F control method)

All of following conditions (d), (e) and (f) set	-
(d) Commanded air-fuel ratio	14.9 or more
(e) Sensor voltage	More than 0.59 V
(f) OSC (Oxygen Storage Capacity of catalyst)	1.2 g or more

Case 6: High voltage

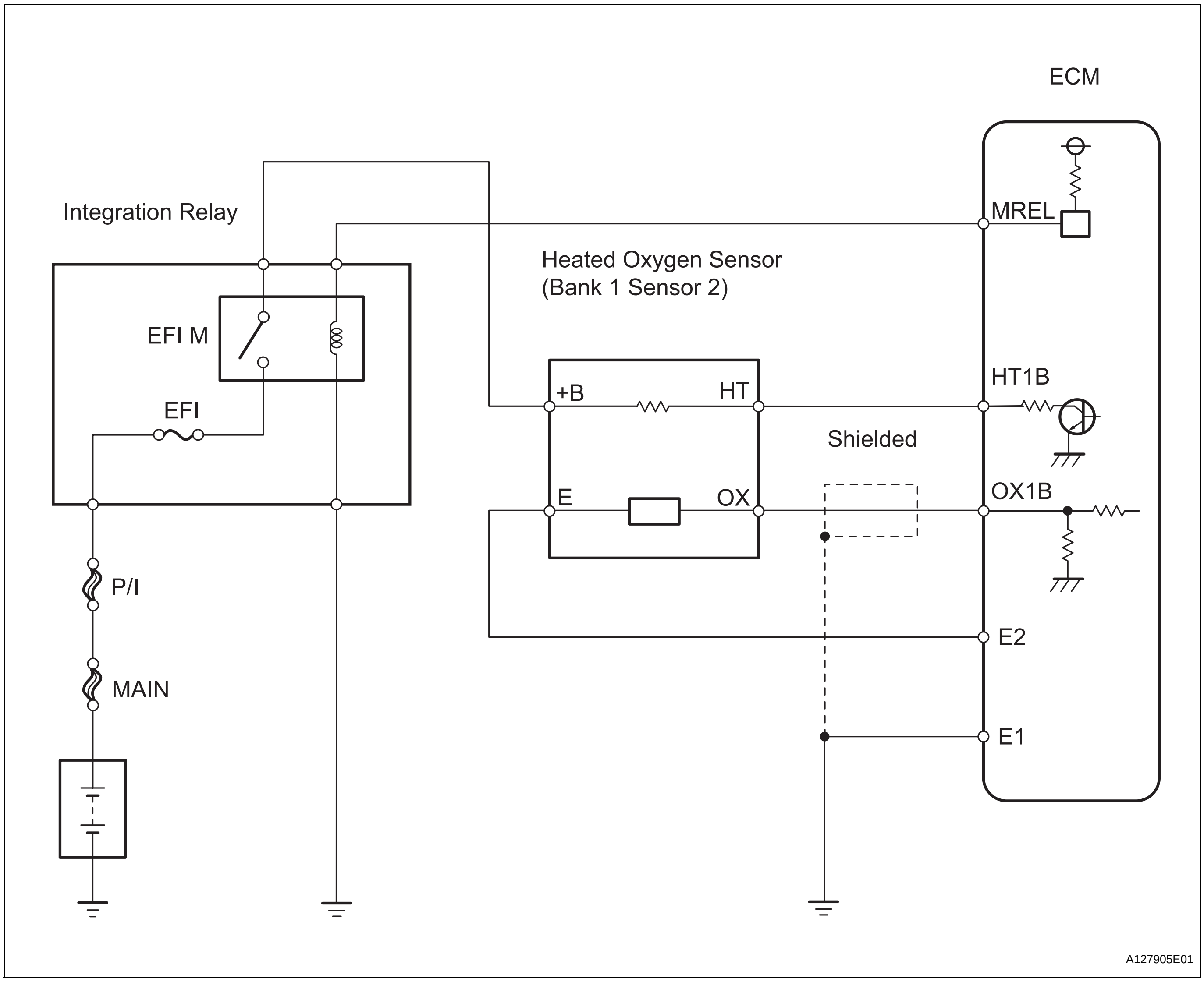
Sensor voltage	1.2 V or more

MONITOR RESULT

Refer to detailed information (see page ES-15).

ES

WIRING DIAGRAM

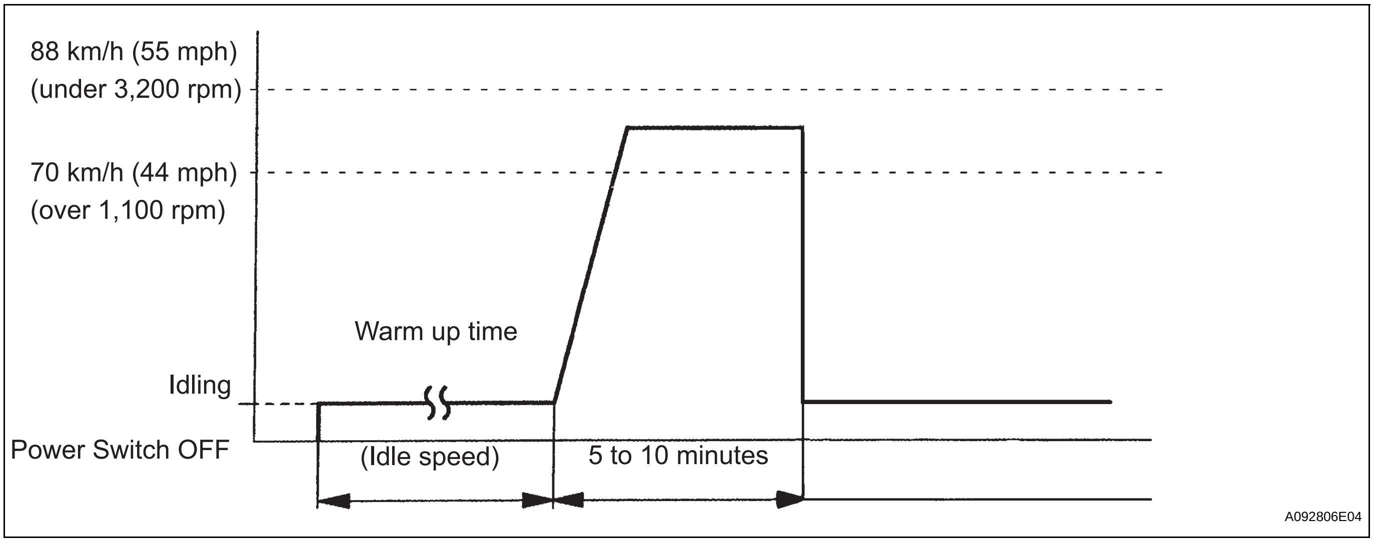


CONFIRMATION DRIVING PATTERN

1. For DTC P0136 and P0137

HINT:

Performing this confirmation pattern will activate the DTC detection (P0136) of the ECM. This is very useful for verifying the completion of a repair.



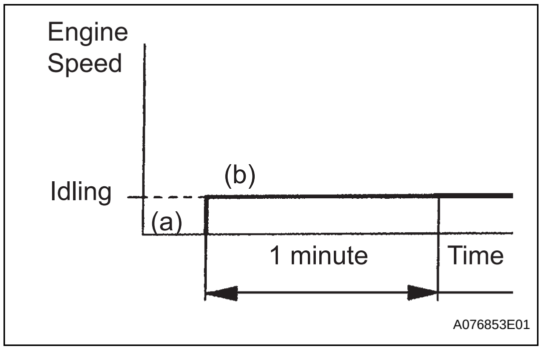
(a) Clear the DTCs (see page ES-29).
(b) Put the engine in inspection mode (see page ES-1).
(c) Start the engine and warm it up with all the accessory switches OFF.
(d) Deactivate the inspection mode and drive the vehicle at 70 to 112 km/h (44 to 70 mph) for 5 to 10 minutes.
(e) Read DTCs.

NOTICE:

- **If the conditions in this test are not strictly followed, no malfunction will be detected. If you do not have the intelligent tester, turn the power switch OFF after performing steps (c) and (e), then perform step (d) again.**
- **Do not drive the vehicle without deactivating inspection mode, otherwise damaging the transaxle may result.**

2. For DTC P0138

HINT:
Performing this confirmation pattern will activate the DTC detection (P0138) of the ECM. This is very useful for verifying the completion of a repair.



(a) Clear the DTCs (see page ES-29).
(b) Put the engine in inspection mode (see page ES-1).
(c) Start the engine and let the engine idle for 1 minute.
(e) Read DTCs.

NOTICE:
If the conditions in this test are not strictly followed, no malfunction will be detected.

INSPECTION PROCEDURE

HINT:
Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunction is detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1 CHECK OTHER DTC OUTPUT (IN ADDITION TO DTC P0136, P0137 AND/OR P0138)

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

Result

Display (DTC output)	Proceed to
P0136, P0137 and/or P0138	A
P0136, P0137 and/or P0138, and other DTCs	B

HINT:
If any other codes besides P0136, P0137 and/or P0138 are output, perform troubleshooting for those DTCs first.

B → **GO TO RELEVANT DTC CHART**

A

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

HINT:
Malfunctioning areas can be found by performing the ACTIVE TEST / A/F CONTROL operation. The A/F CONTROL operation can determine if the A/F sensor, heated oxygen sensor or other potential trouble area are malfunctioning or not.

(a) Perform A/F CONTROL operation using the intelligent tester.
HINT:
The A/F CONTROL operation lowers the injection volume 12.5% or increases the injection volume 25%.
(1) Connect the intelligent tester to the DLC3.
(2) Turn the power switch ON (IG).
(3) Put the engine in inspection mode (see page ES-1).
(4) Warm up the engine by running the engine at 2,500 rpm, depressing the accelerator pedal more than 60% for approximately 90 seconds.
(5) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / A/F CONTROL.
(6) Perform the A/F CONTROL operation with the engine in an idle condition (press the right or left button).

Result:

A/F sensor reacts in accordance with increase and decrease of injection volume:
+25% → rich output: Less than 3.0 V
-12.5% → lean output: More than 3.35 V
Heated oxygen sensor reacts in accordance with increase and decrease of injection volume:
+25% → rich output: More than 0.55 V
-12.5% → lean output: Less than 0.4 V

NOTICE:
The A/F sensor output has a few seconds of delay and the heated oxygen sensor output has about 20 seconds of delay at maximum.

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	OK	Output Voltage More than 0.55 V Less than 0.4 V	OK	
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	NG	Output Voltage More than 0.55 V Less than 0.4 V	OK	
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	OK	Output Voltage Almost no reaction	NG	
4	Injection Volume +25% -12.5%		Injection Volume +25% -12.5%		• Fuel Injector • Fuel pressure • Gas leakage from exhaust system (Air-fuel ratio extremely or lean rich)
	Output Voltage Almost no reaction	NG	Output Voltage Almost no reaction	NG	

The following A/F CONTROL procedure enables the technician to check and graph the voltage output of both A/F sensor and heated oxygen sensor.
To display the graph, enter ACTIVE TEST/ A/F CONTROL / USER DATA, select "AFS B1S1 and O2S B1S2" by pressing the "YES" button followed by the "ENTER" button and then the "F4" button.

- A high A/F sensor voltage could be caused by a RICH air-fuel mixture. Check the conditions that would cause the engine to run with the RICH air-fuel mixture.
- A low A/F sensor voltage could be caused by a LEAN air-fuel mixture. Check the conditions that would cause the engine to run with the LEAN air-fuel mixture.

ES

Result

Output voltage of A/F sensor	Output voltage of heated oxygen sensor	Proceed to
OK	OK	A
NG	OK	B
OK	NG	C
NG	NG	D

B → GO TO DTC P2238

C → Go to step 5

D → GO TO DTC P0171

A

3 PERFORM CONFIRMATION DRIVING PATTERN

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

GO

4 READ OUTPUT DTCS (DTC P0136, P0137 AND/OR P0138 ARE OUTPUT AGAIN)

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

Result

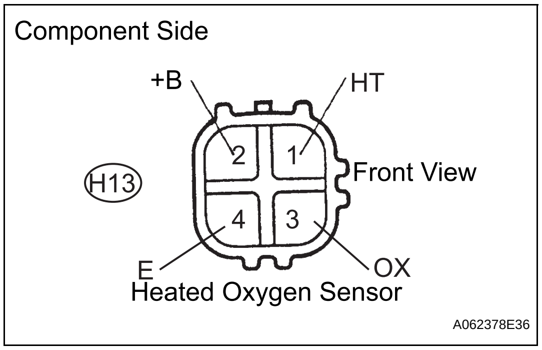
Display (DTC output)	Proceed to
P0136, P0137 and/or P0138	A
P0136, P0137 and/or P0138, and other DTCs	B

B → REPLACE HEATED OXYGEN SENSOR

A

CHECK FOR INTERMITTENT PROBLEMS

5	INSPECT HEATED OXYGEN SENSOR (HEATER RESISTANCE)



(a) Disconnect the H13 heated oxygen sensor connector.
(b) Measure the resistance between the terminals of the heated oxygen sensor connector.
Standard resistance

Tester Connection	Specified Condition
H13-1 (HT) - H13-2 (+B)	11 to 16 Ω at 20°C (68°F)
H13-1 (HT) - H13-4 (E)	10 kΩ or higher

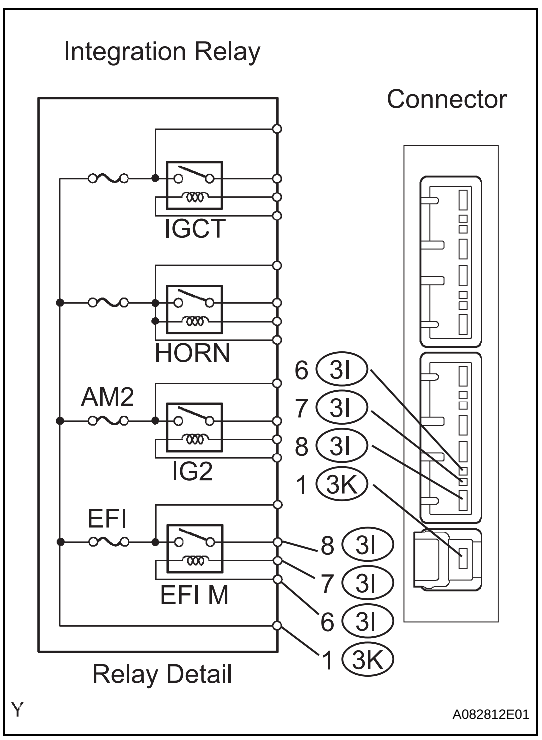
(c) Reconnect the heated oxygen sensor connector.

NG → **REPLACE HEATED OXYGEN SENSOR**

ES

OK

6	INSPECT INTEGRATION RELAY (EFI M RELAY)



(a) Remove the integration relay from the engine room relay block.
(b) Inspect the EFI M relay.
Standard resistance

Tester Connection	Specified Condition
3K-1 - 3I-8	10 kΩ or higher
3K-1 - 3I-8	Below 1 Ω (Apply battery voltage to terminals 3I-6 and 3I-7)

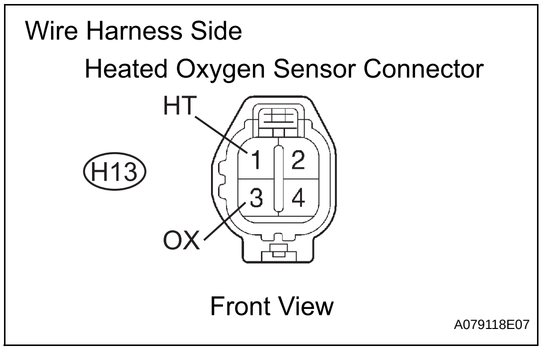
(c) Reinstall the integration relay.

NG → **REPLACE INTEGRATION RELAY**

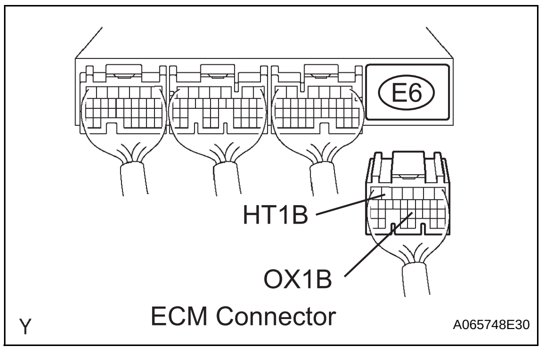
OK

ES

7 CHECK HARNESS AND CONNECTOR (HEATED OXYGEN SENSOR - ECM)



(a) Disconnect the H13 heated oxygen sensor connector.



(b) Disconnect the E6 ECM connectors.

(c) Measure the resistance between the wire harness side connectors.

Standard resistance (Check for open)

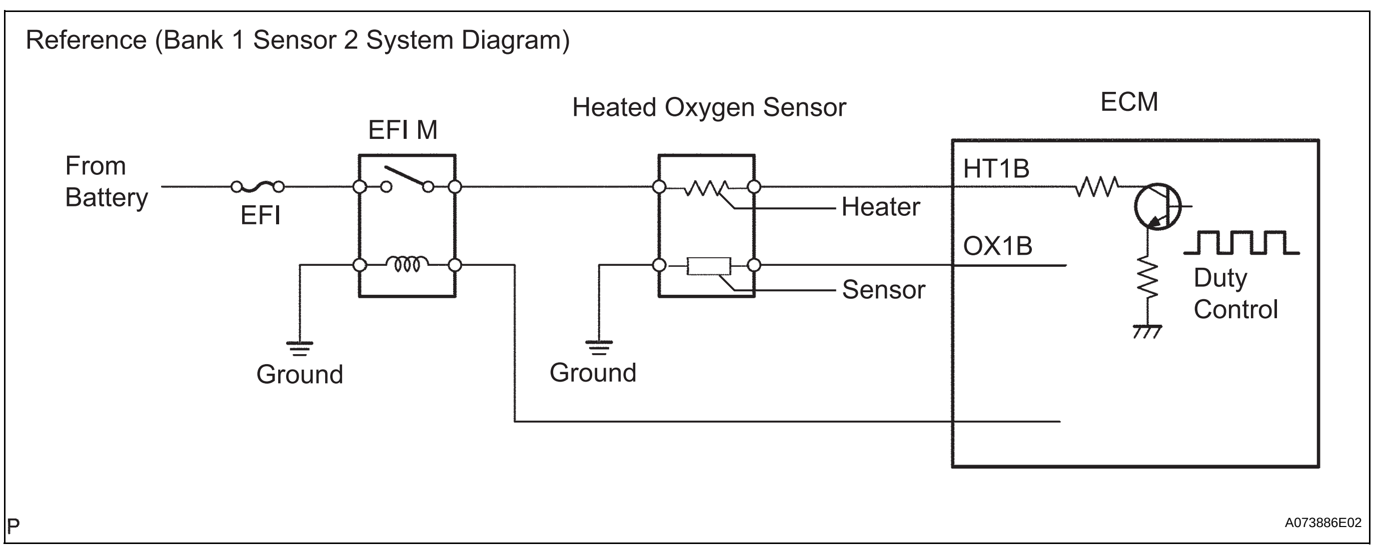
Tester Connection	Specified Condition
H13-1 (HT) - E6-6 (HT1B)	Below 1 Ω
H13-3 (OX) - E6-22 (OX1B)	Below 1 Ω

Standard resistance (Check for short)

Tester Connection	Specified Condition
H13-1 (HT) or E6-6 (HT1B) - Body ground	10 kΩ or higher
H13-3 (OX) or E6-22 (OX1B) - Body ground	10 kΩ or higher

(d) Reconnect the heated oxygen sensor connector.

(e) Reconnect the ECM connector.



NG → **REPAIR OR REPLACE HARNESS AND CONNECTOR**

OK

REPLACE HATED OXYGEN SENSOR

DTC	P0171	System Too Lean (Fuel Trim)

DTC	P0172	System Too Rich (Bank 1)

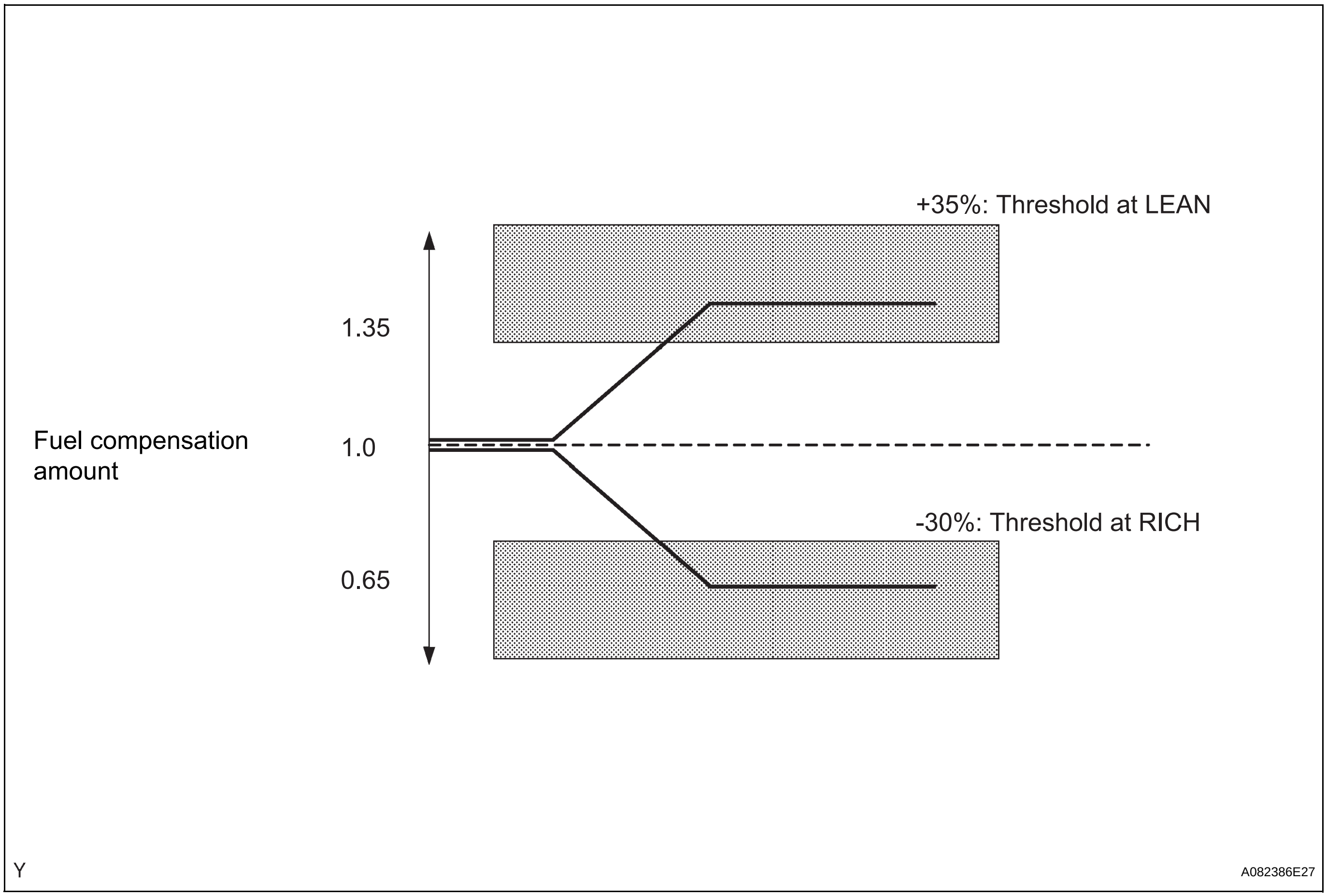
DESCRIPTION

The fuel trim is related to the feedback compensation value, not to the basic injection time. The fuel trim includes the short-term fuel trim and the long-term fuel trim.
The short-term fuel trim is the short-term fuel compensation used to maintain the air-fuel ratio at stoichiometric air-fuel ratio. The signal from the A/F sensor indicates whether the air-fuel ratio is RICH or LEAN compared to the stoichiometric air-fuel ratio. This variance triggers a reduction in the fuel volume if the air-fuel ratio is RICH, and an increase in the fuel volume if it is LEAN.
The long-term fuel trim is the overall fuel compensation carried out in long-term to compensate for a continual deviation of the short-term fuel trim from the central value, due to individual engine differences, wear overtime and changes in the operating environment.
If both the short-term fuel trim and the long-term fuel trim are LEAN or RICH beyond a certain value, it is detected as a malfunction and the MIL is illuminated and DTC is set.

DTC No.	DTC Detection Condition	Trouble Area
P0171	When air-fuel ratio feedback is stable after warming up engine, fuel trim is considerably in error on LEAN side (2 trip detection logic)	• Air induction system • Injector blockage • Mass air flow meter • Engine coolant temperature sensor • Fuel pressure • Gas leakage in exhaust system • Open or short in A/F sensor (bank 1, sensor 1) circuit • A/F sensor (bank 1, sensor 1) • A/F sensor heater (bank 1, sensor 1) • EFI M relay • PCV valve and hose • PCV hose connection • ECM
P0172	When air-fuel ratio feedback is stable after warming up engine, fuel trim is considerably in error on RICH side (2 trip detection logic)	• Injector leak, blockage • Mass air flow meter • Engine coolant temperature sensor • Ignition system • Fuel pressure • Gas leakage in exhaust system • Open or short in A/F sensor (bank 1, sensor 1) circuit • A/F sensor (bank 1, sensor 1) • A/F sensor heater • EFI M relay • ECM

HINT:
- When DTC P0171 is recorded, the actual air-fuel ratio is on the LEAN side. When DTC P0172 is recorded, the actual air-fuel ratio is on the RICH side.
- If the vehicle runs out of fuel, the air-fuel ratio is LEAN and DTC P0171 may be recorded. The MIL then illuminates.
- If the total of the short-term fuel trim value and long-term fuel trim value is between +33% and -30% (engine coolant temperature is more than 75°C (167°F)), the system is functioning normally.

MONITOR DESCRIPTION



Under closed-loop fuel control, fuel injection amount that deviates from the ECM's estimated fuel amount will cause a change in the long-term fuel trim compensation value. This long-term fuel trim is adjusted when there are persistent deviations in the short-term fuel trim values. And the deviation from the simulated fuel injection amount by the ECM affects a smoothed fuel trim learning value. The smoothed fuel trim learning value is the combination of smoothed short-term fuel trim (fuel feedback compensation value) and smoothed long-term fuel trim (learning value of the air-fuel ratio). When the smoothed fuel trim learning value exceeds the DTC threshold, the ECM interprets this as a fault in the fuel system and sets a DTC.

Example:

The smoothed fuel trim leaning value is more than +33% or less than -30%.

The ECM interprets this as a failure in the fuel system.

DTC P0171 indicates that the air-fuel mixture is extremely LEAN, and P0172 indicates extremely RICH.

MONITOR STRATEGY

Related DTCs	P0171: Fuel system lean (bank 1) P0172: Fuel system rich (bank 1)
Required sensors/components	Main: A/F sensor Related: Engine coolant temperature sensor, mass air flow meter, crankshaft position sensor
Frequency of operation	Continuous
Duration	10 seconds
MIL operation	2 driving cycles
Sequence of operation	None

TYPICAL ENABLING CONDITIONS

The monitor will run whenever the following DTCs are not present	P0010 (VVT OCV) P0011 (VVT system 1 - Advance) P0012 (VVT system 1 - Retard) P0031, P0032 (A/F sensor heater - Sensor 1) P0100 - P0103 (MAF meter) P0115 - P0118 (ECT sensor) P0120 - P0223, P2135 (TP sensor) P0125 (Insufficient ECT for closed loop) P0335 (CKP sensor) P0340, P0341 (CMP sensor) P0351-P0354 (Igniter) P0500 (VSS)
Battery voltage	11 V or more
Fuel system: Closed-loop	More than 13 seconds
One of the following condition is met:	(a) or (b)
(a) Engine speed	Less than 1,100 rpm
(b) Intake air amount per revolution	0.22 g/rev or more
Warm-up condition enables air-fuel ratio learning control	Conditions are met

TYPICAL MALFUNCTION THRESHOLDS

Following condition is continued for 3 seconds	(a) or (b)
(a) Smoothed fuel trim learning value (lean)	33% or more
(b) Smoothed fuel trim learning value (rich)	-30% or less

WIRING DIAGRAM

Refer to DTC P2195 (see page ES-347).

INSPECTION PROCEDURE

HINT:

Malfunctioning areas can be found by performing the ACTIVE TEST / A/F CONTROL operation. The A/F CONTROL operation can determine if the A/F sensor, heated oxygen sensor or other potential trouble area are malfunctioning or not.

(a) Perform the ACTIVE TEST A/F CONTROL operation.

HINT:

The A/F CONTROL operation lowers the injection volume 12.5% or increases the injection volume 25%.

(1) Connect the intelligent tester to the DLC3.

(2) Turn the power switch ON (IG).

(3) Put the engine in inspection mode (see page ES-1).

(4) Warm up the engine by running the engine at 2,500 rpm, depressing the accelerator pedal more than 60% for approximately 90 seconds.

(5) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / A/F CONTROL.

(6) Perform the A/F CONTROL operation with the engine in an idle condition (press the right or left button).

Result:

A/F sensor reacts in accordance with increase and decrease of injection volume:
+25% → rich output: Less than 3.0 V
-12.5% → lean output: More than 3.35 V
Heated oxygen sensor reacts in accordance with increase and decrease of injection volume:
+25% → rich output: More than 0.55 V
-12.5% → lean output: Less than 0.4 V

NOTICE:
The A/F sensor output has a few seconds of delay and the heated oxygen sensor output has about 20 seconds of delay at maximum.

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	OK	Output Voltage More than 0.55 V Less than 0.4 V	OK	
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	NG	Output Voltage More than 0.55 V Less than 0.4 V	OK	
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	OK	Output Voltage Almost no reaction	NG	
4	Injection Volume +25% -12.5%		Injection Volume +25% -12.5%		• Fuel Injector • Fuel pressure • Gas leakage from exhaust system (Air-fuel ratio extremely or lean rich)
	Output Voltage Almost no reaction	NG	Output Voltage Almost no reaction	NG	

The following A/F CONTROL procedure enables the technician to check and graph the voltage output of both A/F sensor and heated oxygen sensor.
To display the graph, enter ACTIVE TEST/ A/F CONTROL/USER DATA, select "AFS B1S1 and O2S B1S2" by pressing the "YES" button followed by the "ENTER" button and then the "F4" button.
HINT:
- Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunction is detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.
- A high A/F sensor voltage could be caused by a RICH air-fuel mixture. Check the conditions that would cause the engine to run with the RICH air-fuel mixture.
- A low A/F sensor voltage could be caused by a LEAN air-fuel mixture. Check the conditions that would cause the engine to run with the LEAN air-fuel mixture.

1	CHECK AIR INDUCTION SYSTEM

(a) Check for vacuum leaks in the air induction system.
OK:
No vacuum leakage.

NG → **REPAIR OR REPLACE AIR INDUCTION SYSTEM**

OK

2	CHECK CONNECTION OF PCV HOSE

OK:
PCV hose is connected correctly and PCV hose is not damaged.

NG → **REPAIR OR REPLACE PCV HOSE**

OK

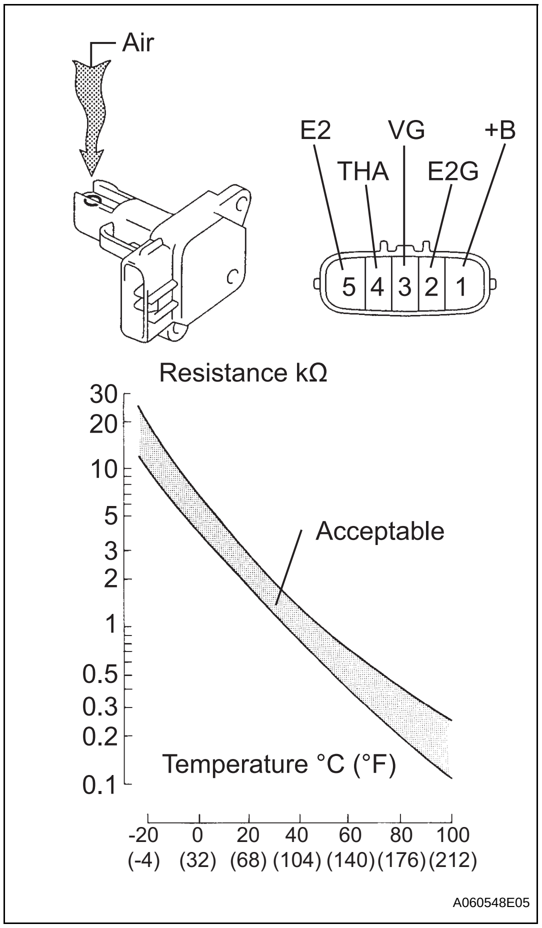
3	INSPECT FUEL INJECTOR ASSEMBLY (INJECTION AND VOLUME)

OK:
Injection volume: 36 to 46 cm^3 (2.1 to 2.8 cu in.) per 15 seconds.

NG → **REPLACE FUEL INJECTOR ASSEMBLY**

OK

4	INSPECT MASS AIR FLOW METER



(a) Remove the mass air flow meter.
(b) Inspect the output voltage.
(1) Apply battery voltage across terminals +B and E2G.
(2) Connect the positive (+) tester probe to terminal VG, and negative (-) tester probe to terminal E2G.
(3) Blow air into the mass air flow meter, and check that the voltage fluctuates.
Standard voltage

Tester Connection	Specified Condition
3 (VG) - 2 (E2G)	Sensor output voltage fluctuates between 0.3 V and 4.8 V

(c) Inspect the resistance.
(1) Measure the resistance between the terminals of the mass air flow meter.
Standard resistance

Tester Connection	Specified Condition
4 (THA) - 5 (E2)	13.6 to 18.4 kΩ at -20°C (-4°F)
4 (THA) - 5 (E2)	2.21 to 2.69 kΩ at 20°C (68°F)
4 (THA) - 5 (E2)	0.49 to 0.67 kΩ at 60°C (140°F)

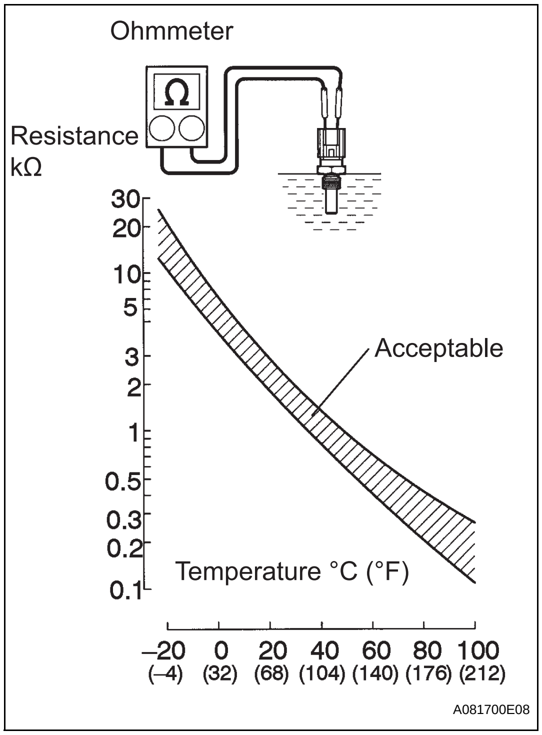
(d) Reinstall the mass air flow meter.

NG → **REPLACE MASS AIR FLOW METER**

ES

OK

5 INSPECT ENGINE COOLANT TEMPERATURE SENSOR (RESISTANCE)



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

Standard resistance

Tester Connection	Specified Condition
1 - 2	2 to 3 kΩ at 20°C (68°F)
1 - 2	0.2 to 0.4 kΩ at 80°C (176°F)

NOTICE:
When checking the engine coolant temperature sensor in water, be careful not to allow water to contact 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

6 CHECK SPARK AND IGNITION

OK:
Sparks occurs.

NG → **REPAIR OR REPLACE IGNITION SYSTEM COMPONENTS**

OK

7 CHECK FUEL PRESSURE

OK:
Fuel pressure: 304 to 343 kPa (3.1 to 3.5 kgf/cm^2, 44 to 50 psi)

NG → **REPAIR OR REPLACE FUEL SYSTEM**

OK

8	CHECK FOR EXHAUST GAS LEAKAGE

OK:
No gas leak.

NG → **REPAIR OR REPLACE EXHAUST GAS LEAKAGE POINT**

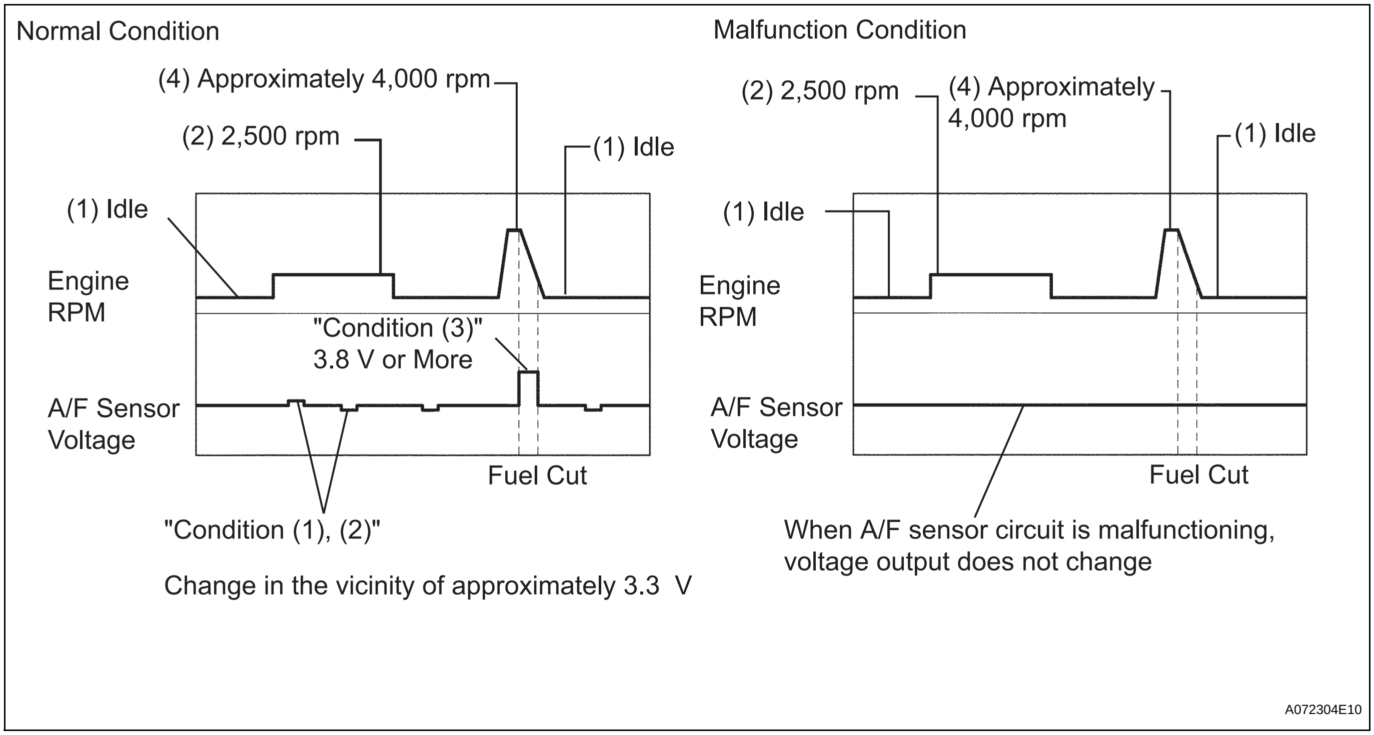
OK

9	READ VALUE OF INTELLIGENT TESTER (OUTPUT VOLTAGE OF AIR FUEL RATIO SENSOR [BANK 1 SENSOR 1])

(a) Connect the intelligent tester to the DLC 3.
(b) Put the engine in inspection mode (see page ES-1).
(c) Warm up the A/F sensors (bank 1 sensor 1) by running the engine at 2,500 rpm with the accelerator pedal depressed more than 60 % for approximately 90 seconds.
(d) Read A/F sensor voltage output on the intelligent tester.
(e) Enter the following menus: ENHANCED OBD II / SNAPSHOT / MANUAL SNAPSHOT / USER DATA.
(f) Select "AFS B1 S1/ENGINE SPD" and press button "YES".
(g) Monitor the A/F sensor voltage carefully.
(h) Check the A/F sensor voltage output under the following conditions:
  (1) Put the engine in inspection mode and allow the engine to idle for 30 seconds.
  (2) Put the engine in inspection mode and running the engine at 2,500 rpm with the accelerator pedal depressed more than 60% (where engine RPM is not suddenly changed).
  (3) Deactivate the inspection mode and drive the vehicle with shift position "B" range.
  (4) Accelerate the vehicle to 70 km/h (44 mph) and quickly release the accelerator pedal so that the throttle valve is fully closed.

CAUTION:
- **Strictly observe of posted speed limits, traffic laws, and road conditions when performing these drive patterns.**
- **Do not drive the vehicle without deactivating inspection mode, otherwise damaging the transaxle may result.**

OK:
Condition (1) and (2)
Voltage changes in the vicinity of 3.3 V (between approximately 3.1 to 3.5 V) as shown in the illustration.
Condition (4)
A/F sensor voltage increases to 3.8 V or more during engine deceleration (when fuel cut) as shown in the illustration.



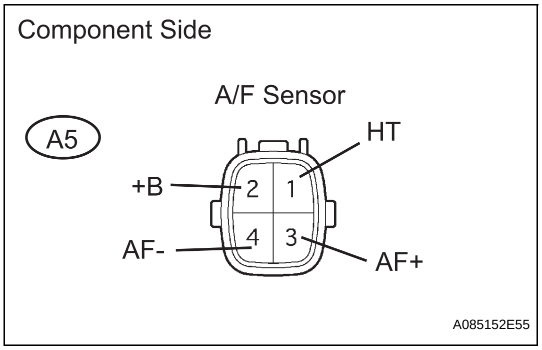
HINT:

- Whenever the output voltage of the A/F sensor remains at approximately 3.3 V (see diagram Malfunction Condition) under any condition as well as the above conditions, the A/F sensor may have an open-circuit. (This will happen also when the A/F sensor heater has an open-circuit.)
- Whenever the output voltage of the A/F sensor remains at a certain value of approximately 3.8 V or more, or 2.8 V or less (see diagram Malfunction Condition) under any condition as well as the above conditions, the A/F sensor may have a short-circuit.
- The ECM will stop fuel injection (fuel cut) during engine deceleration. This will cause a LEAN condition and should result in a momentary increase in A/F sensor voltage output.
- The ECM must establish a closed throttle position learned value to perform fuel cut. If the battery terminal was reconnected, the vehicle must be driven over 10 mph to allow the ECM to learn the closed throttle position.
- When the vehicle is driven:
  The output voltage of the A/F sensor may be below 2.8 V during fuel enrichment. For the vehicle, this translates to a sudden increase in speed with the accelerator pedal fully depressed when trying to overtake another vehicle. The A/F sensor is functioning normally.
- The A/F sensor is a current output element, and therefore the current is converted into voltage inside the ECM. If measuring voltage at connectors of A/F sensor or ECM, you will observe a constant voltage.

OK	**Go to step 17**

NG

10 INSPECT AIR FUEL RATIO SENSOR (HEATER RESISTANCE)



(a) Disconnect the A5 A/F sensor connector.
(b) Measure the resistance between the terminals of the A/F sensor.
Standard resistance

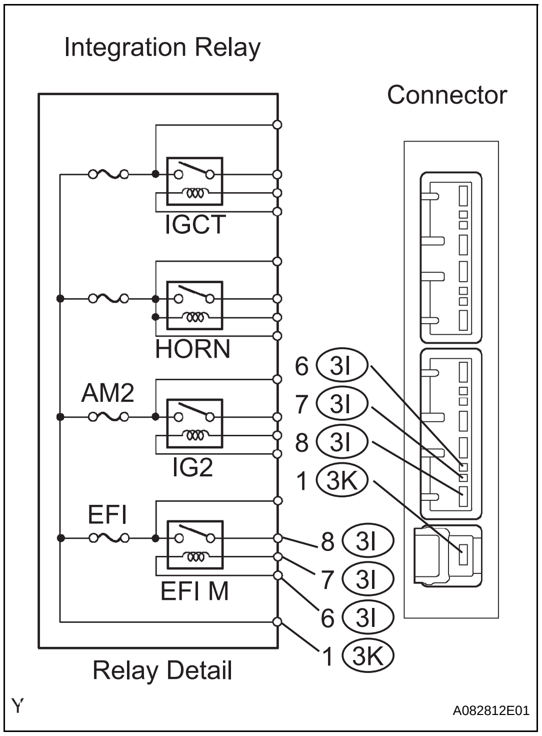
Tester Connection	Specified Condition
1 (HT) - 2 (+B)	1.8 to 3.4 Ωat 20°C (68°F)

(c) Reconnect the A/F sensor connector.

NG → **REPLACE AIR FUEL RATIO SENSOR**

OK

11 INSPECT INTEGRATION RELAY (EFI M RELAY)



(a) Remove the integration relay from the engine room relay block.
(b) Inspect the EFI M relay.
Standard resistance

Tester Connection	Specified Condition
3K-1 - 3I-8	10 kΩ or higher
3K-1 - 3I-8	Below 1 Ω (Apply battery voltage to terminals 3I-6 and 3I-7)

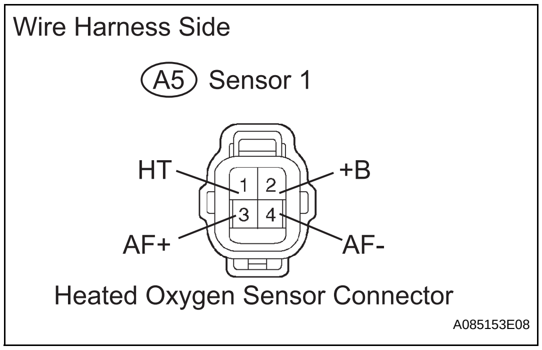
(c) Reinstall the integration relay.

NG → **REPLACE INTEGRATION RELAY**

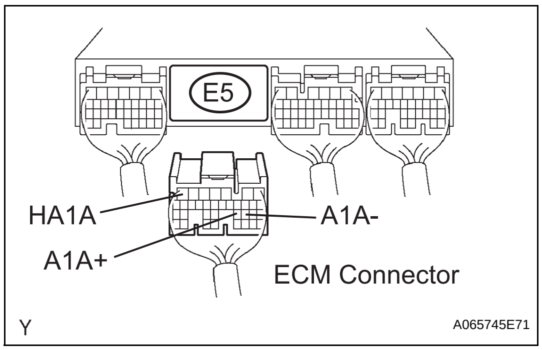
OK

ES

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



(a) Disconnect the A5 A/F sensor connector.



(b) Disconnect the E5 ECM connector.

(c) Measure the resistance between the wire harness side connectors.

Standard resistance (Check for open)

Tester Connection	Specified Condition
A5-3 (AF+) - E5-23 (A1A+)	Below 1 Ω
A5-4 (AF-) - E5-22 (A1A-)	Below 1 Ω
A5-1 (HT) - E5-7 (HA1A)	Below 1 Ω

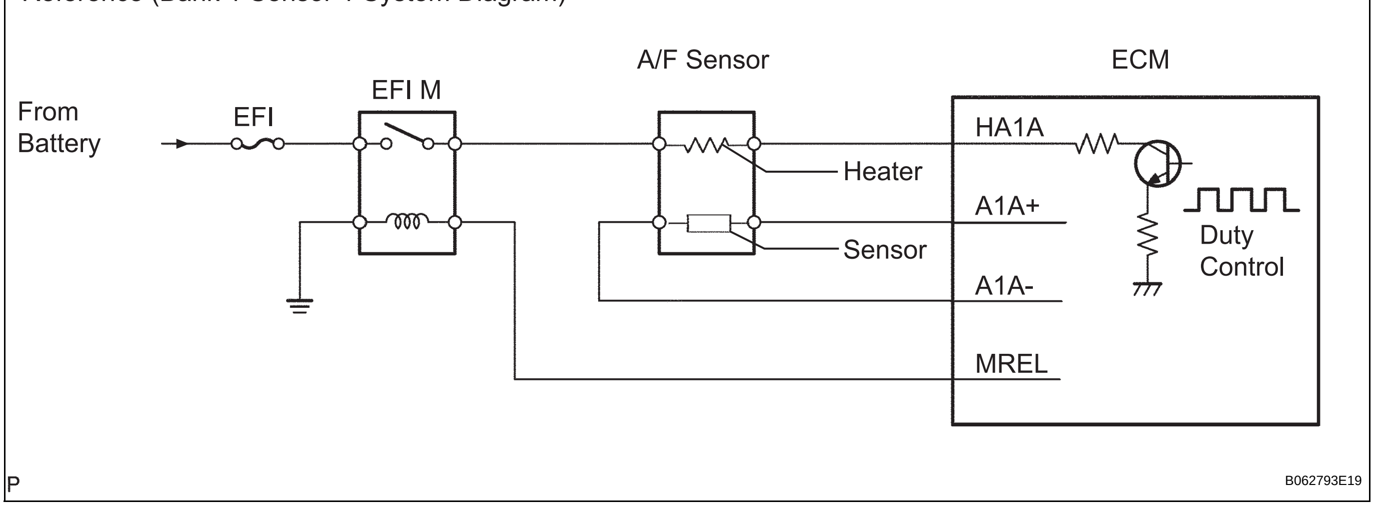
Standard resistance (Check for short)

Tester Connection	Specified Condition
A5-3 (AF+) or E5-23 (A1A+) - Body ground	10 kΩ or higher
A5-4 (AF-) or E5-22 (A1A-) - Body ground	10 kΩ or higher
A5-1 (HT) or E5-7 (HA1A) - Body ground	10 kΩ or higher

(d) Reconnect the A/F sensor connector.

(e) Reconnect the ECM connector.

Reference (Bank 1 Sensor 1 System Diagram)



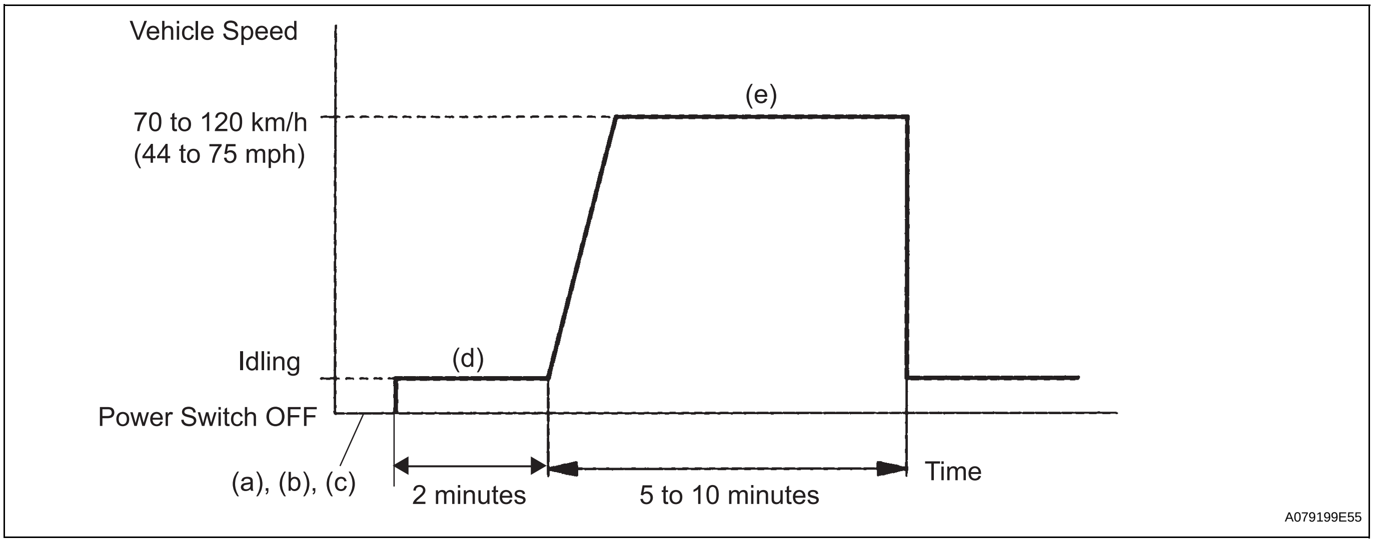
NG → **REPAIR OR REPLACE HARNESS AND CONNECTOR**

OK

13	REPLACE AIR FUEL RATIO SENSOR

GO

14	PERFORM CONFIRMATION DRIVING PATTERN



(a) Clear the DTCs (see page ES-29).
(b) Connect the intelligent tester to the DLC3.
(c) Switch the ECM from normal mode to check mode using the intelligent tester (see page ES-32).
(d) Put the engine in inspection mode, and start the engine and warm it up with all the accessory switches OFF.
(e) Deactivate inspection mode and drive the vehicle at 70 to 120 km/h (44 to 75 mph) and engine speed of 1,100 to 3,200 rpm for 5 to 10 minutes.

HINT:
If malfunction exists, the MIL will be illuminated during step (e).

NOTICE:

- **If the conditions in this test are not strictly followed, no malfunction will be detected. If you do not have an intelligent tester, turn the power switch OFF after performing steps (d) and (e), then perform step (e) again.**
- **Do not drive the vehicle without deactivating inspection mode, otherwise damaging the transaxle may result.**

GO

15	READ OUTPUT DTCS (SEE IF DTC P0171 AND/OR P0172 ARE OUTPUT AGAIN)

(a) Connect the intelligent tester to the DLC3.

(b) Turn the power switch ON (IG).
(c) Turn the intelligent tester ON.
(d) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DTC INFO / CURRENT CODES.
(e) Read DTCs using the intelligent tester.

Result

Display (DTC Output)	Proceed to
No output	A
P0171 and/or P0172	B

B → **REPLACE ECM AND PERFORM CONFIRMATION DRIVING PATTERN**

ES

A ↓

16 CONFIRM IF VEHICLE HAS RUN OUT OF FUEL IN PAST

NO → **CHECK FOR INTERMITTENT PROBLEMS**

YES ↓

DTCS ARE CAUSED BY RUNNING OUT OF FUEL (DTCS P0171 AND/OR P0172)

17 PERFORM CONFIRMATION DRIVING PATTERN

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

GO ↓

18 READ OUTPUT DTCS (SEE IF DTC P0171 AND/OR P0172 ARE OUTPUT AGAIN)

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

Result

Display (DTC Output)	Proceed to
No output	A
P0171 and/or P0172	B

B → **Go to step 22**

A ↓

19 REPLACE AIR FUEL RATIO SENSOR

GO

20 PERFORM CONFIRMATION DRIVING PATTERN

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

GO

21 READ OUTPUT DTCS (SEE IF DTC P0171 AND/OR P0172 ARE OUTPUT AGAIN)

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

Result

Display (DTC Output)	Proceed to
No output	A
P0171 and/or P0172	B

B → **REPLACE ECM AND PERFORM CONFIRMATION DRIVING PATTERN**

A

22 CONFIRM IF VEHICLE HAS RUN OUT OF FUEL IN PAST

NO → **CHECK FOR INTERMITTENT PROBLEMS**

YES

DTCS ARE CAUSED BY RUNNING OUT OF FUEL

DTC	P0300	Random / Multiple Cylinder Misfire Detected

DTC	P0301	Cylinder 1 Misfire Detected

DTC	P0302	Cylinder 2 Misfire Detected

DTC	P0303	Cylinder 3 Misfire Detected

DTC	P0304	Cylinder 4 Misfire Detected

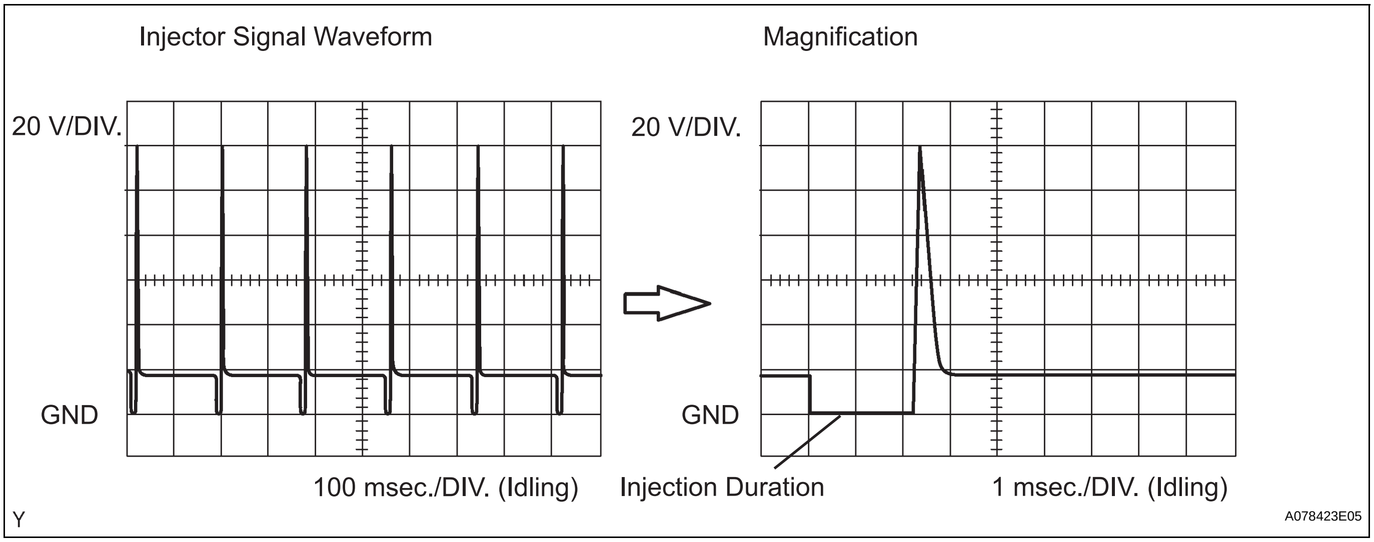
DESCRIPTION

When a misfire occurs in the engine, hydrocarbons (HC) enter the exhaust gas in high concentrations. If this HC concentration is high enough, there could be an increase in exhaust emissions levels. High concentrations of HC can also cause to temperature of the catalyst to increase, possibly damaging the catalyst. To prevent this increase in emissions and limit the possibility of thermal damage, the ECM monitors the misfire rate. When the temperature of the catalyst reaches a point of thermal degradation, the ECM will blink the MIL. For monitoring misfire, the ECM uses both the camshaft position sensor and the crankshaft position sensor. The camshaft position sensor is used to identify misfiring cylinders and the crankshaft position sensor is used to measure variations in the crankshaft rotation speed. The misfire counter increments when crankshaft rotation speed variations exceed threshold values.
If the misfiring rate exceeds the threshold value and could cause emissions deterioration, the ECM illuminates the MIL.

DTC No.	DTC Detection Condition	Trouble Area
P0300	Misfiring of random cylinders is detected during any particular 200 or 1,000 revolutions 1 trip detection logic: MIL blinks 2 trip detection logic: MIL illuminates	• Open or short in engine wire harness • Connector connection • Vacuum hose connection • Ignition system • Injector • Fuel pressure • Mass air flow meter • Engine coolant temperature sensor • Compression pressure • Valve clearance • Valve timing • PCV hose connection • PCV hose • ECM
P0301 P0302 P0303 P0304	• For any particular 200 revolutions of engine, misfiring is detected which can cause catalyst overheating (This causes MIL to blink) • For any particular 1,000 revolutions of engine, misfiring is detected which causes a deterioration in emissions (2 trip detection logic)	• Open or short in engine wire harness • Connector connection • Vacuum hose connection • Ignition system • Injector • Fuel pressure • Mass air flow meter • Engine coolant temperature sensor • Compression pressure • Valve clearance • Valve timing • PCV hose connection • PCV hose • ECM

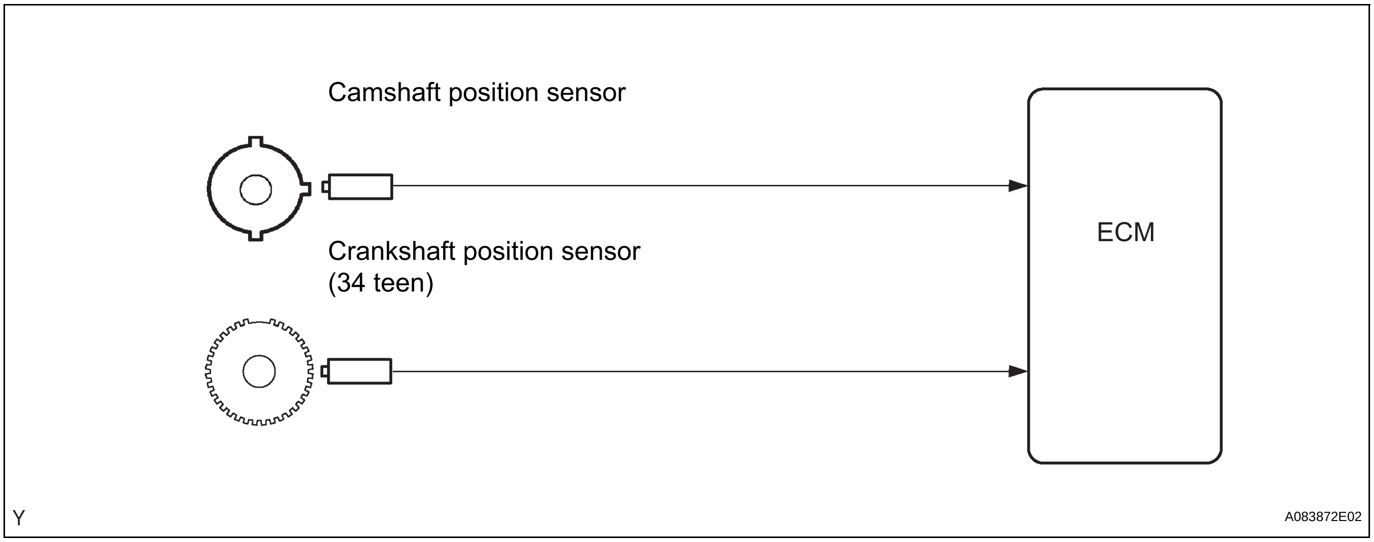
NOTICE:
When several codes for a misfiring cylinder are recorded repeatedly but no random misfire code is recorded, it indicates that the misfires have been detected and recorded at different times.
Reference: Inspection using oscilloscope

With the engine idling, check the waveform between terminals #10 to #40 and E01 of the ECM connectors.
HINT:
The correct waveform is as shown.



ES

MONITOR DESCRIPTION



The ECM illuminates the MIL (2 trip detection logic) if:
- The percent misfire exceeds the specified limit per 1,000 engine revolutions. One occurrence of excessive misfire during engine start will set the MIL. After engine start, four occurrences of excessive misfire set the MIL.

The ECM blinks the MIL (immediately) if:
- The threshold for percent of misfire causing catalyst damage is reached 1 time in 200 engine revolutions at a high rpm, and 3 times in 200 engine revolutions at a normal rpm.
- The threshold for percent of misfire causing catalyst damage is reached.

MONITOR STRATEGY

Related DTCs	P0300: Random/Multiple cylinder misfire detected P0301: Cylinder 1 misfire detected P0302: Cylinder 2 misfire detected P0303: Cylinder 3 misfire detected P0304: Cylinder 4 misfire detected

Required sensors/components	Main: Camshaft position sensor, crankshaft position sensor Related: Engine coolant temperature sensor, intake air temperature sensor, throttle position sensor
Frequency of operation	Continuous
Duration	Every 1,000 revolutions: Every 200 revolutions:
MIL operation	2 driving cycles: MIL ON Immediately: MIL blinking (catalyst deteriorating)
Sequence of operation	None

TYPICAL ENABLING CONDITIONS

Monitor runs whenever following DTCs not present	P0100 - P0103 (MAF meter) P0110 - P0113 (IAT sensor) P0115 - P0118 (ECT sensor) P0120 - P0223, P2135 (TP sensor) P0125 (Insufficient ECT for closed loop) P0325 - P0328 (knock sensor) P0335 (CKP sensor) P0340 (CMP sensor) P0500 (VSS)
Battery voltage	8 V or more
Throttle position learning	Completed
VVT system	Not operated by scan tool
Engine RPM	850 to 5,300 rpm
Both of following conditions 1 and 2 met	-
1. Engine coolant temperature (ECT)	-10°C (14°F) or more
2. Either of following conditions (a) or (b) met	-
(a) ECT at engine start	More than -7°C (19°F)
(b) ECT	More than 20°C (68°F)
Fuel cut	OFF

Monitor period of emission-related-misfire:

First 1,000 revolution 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	1st
2. Check mode	OFF
3. Engine RPM	Less than 3,400 rpm
Except above	Crankshaft 200 revolutions

TYPICAL MALFUNCTION THRESHOLDS

Emission - related - misfire

Misfire rate	2 % or more

Catalyst - damage - misfire (MIL blinks)

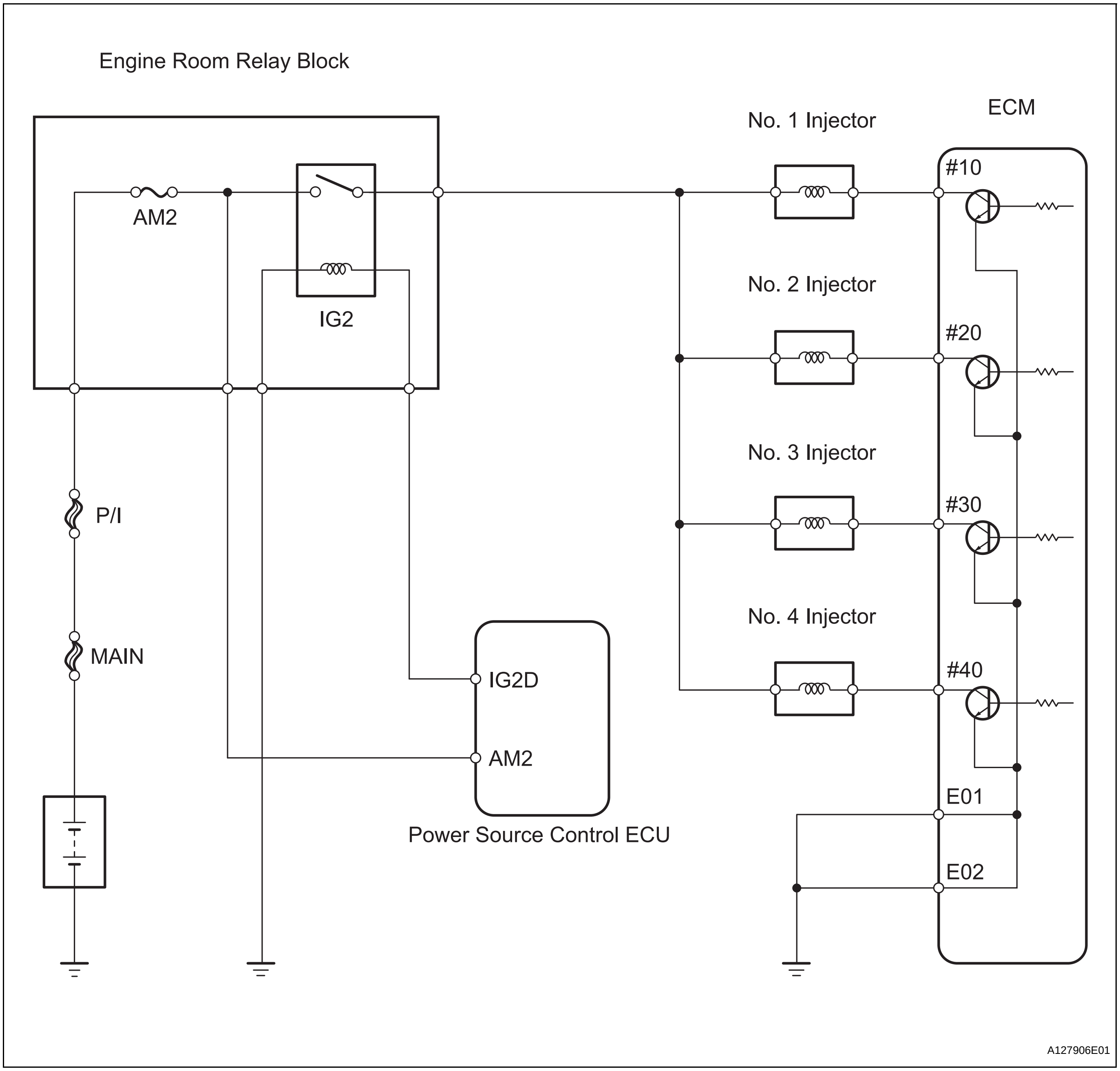
Number of misfire per 200 revolution	108 or more (varies with intake air amount and RPM)

MONITOR RESULT

Refer to detailed information (see page ES-15).

WIRING DIAGRAM

HINT:
Refer to DTC P0351 (see page ES-171) for the wiring diagram of the ignition system.



CONFIRMATION DRIVING PATTERN

(a) Connect the intelligent tester to the DLC3.
(b) Record DTCs and the freeze frame data.
(c) Switch the ECM from normal mode to check mode using the intelligent tester (see page ES-32).
(d) Read the value on the misfire counter for each cylinder when idling. If the value is displayed on the misfire counter, skip the following procedure of confirmation driving.
(e) Drive the vehicle several times with an engine speed (ENGINE SPD), engine load (CALC LOAD) and other data stored in the freeze frame data.
If you have no intelligent tester, turn the power switch OFF after the symptom is simulated once. Then repeat the simulation process again.

NOTICE:
In order to memorize the misfire DTCs, it is necessary to drive with MISFIRE RPM and MISFIRE LOAD in the DATA LIST for the period of time in the chart below. Take care not to turn the power switch OFF. Turning the power switch OFF switches the diagnosis system from check mode to normal mode and all DTCs, freeze frame data and other data are erased.

Engine Speed	Time
Idling (Inspection mode)	3 minutes 30 seconds or more
1,000 rpm	3 minutes or more
2,000 rpm	1 minute 30 seconds or more
3,000 rpm	1 minute or more

(f) Check if there is a misfire, DTC and the freeze frame data. Record DTCs, freeze frame data and misfire counter data.

(g) Turn the power switch OFF and wait at least for 5 seconds.

INSPECTION PROCEDURE

HINT:
- If DTCs besides misfire DTCs are memorized simultaneously, troubleshoot the non-misfire DTCs first.
- Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunction is detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.
- If 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 repairs, confirm that there is no misfire (see confirmation driving pattern).
- When either of SHORT FT #1 and LONG FT #1 in the freeze frame data is over the range of +-20%, there is a possibility that the air-fuel ratio is inclining either to 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 reason may be because of the driving the vehicle with lack of fuel, use of improper fuel, a stain on the ignition plug, etc.
- Be sure to check the value on the misfire counter after repairs.

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

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

Result

Display (DTC output)	Proceed to
P0300, P0301, P0302, P0303 and/or P0304	**A**
P0300, P0301, P0302, P0303 and/or P0304, and other DTCs	**B**

HINT:
If any other codes besides P0300, P0301, P0302, P0303 or P0304 are output, perform 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 connectors.
(b) Check the vacuum hose piping for disconnection or breakage.
OK:
Connected correctly and no damage on wire harness.

NG → **REPAIR OR REPLACE, THEN CONFIRM THAT THERE IS NO MISFIRE**

ES

OK

3	CHECK CONNECTION OF PCV HOSE

OK:
PCV hose is connected correctly, and has no damage.

NG → **REPAIR OR REPLACE PCV HOSE**

OK

4	READ VALUE OF INTELLIGENT TESTER (NUMBER OF MISFIRE CYLINDER)

(a) Connect the intelligent tester to the DLC3.
(b) Turn the power switch ON (IG).
(c) Turn the intelligent tester ON.
(d) Put the engine in inspection mode (see page ES-1).
(e) Start the engine.
(f) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DATA LIST / USER DATA / CYL#1 - CYL#4.
(g) Read the number of misfire cylinders on the intelligent tester.
Result

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

B → **Go to step 15**

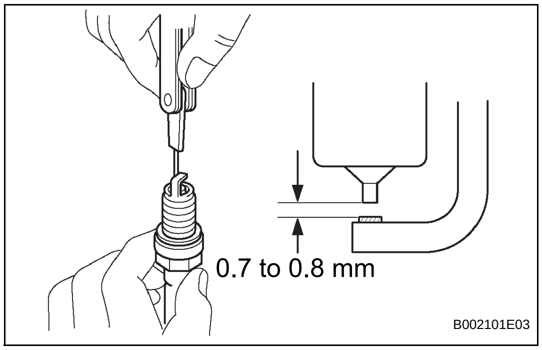
A

5	CHECK SPARK PLUG AND SPARK OF MISFIRING CYLINDER

(a) Remove the ignition coil.
(b) Remove the spark plug.

(c) Check the spark plug type.
Recommended spark plug:

DENSO made	SK16R11



(d) Check the spark plug electrode gap.
Electrode gap:
0.7 to 0.8 mm (0.028 to 0.032 in.)
Maximum electrode gap:
1.16 mm (0.046 in.)
NOTICE:
If adjusting the gap of a new spark plug, bend only the base of the ground electrode. Do not touch the tip. Never attempt to adjust the gap on the used plug.

(e) Check the electrode for carbon deposits.

(f) Perform a spark test.
CAUTION:
Absolutely disconnect the 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.
OK:
Spark jumps across electrode gap.

(g) Reinstall the spark plug.

(h) Reinstall the ignition coil.

OK → **Go to step 8**

NG

6	CHANGE NORMAL SPARK PLUG AND CHECK SPARK OF MISFIRING CYLINDER

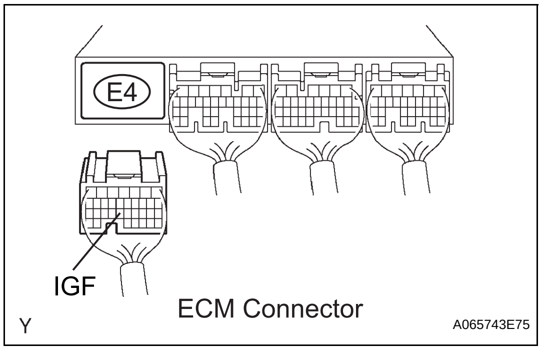
(a) Change to the normal spark plug.

(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.
OK:
Spark jumps across electrode gap.

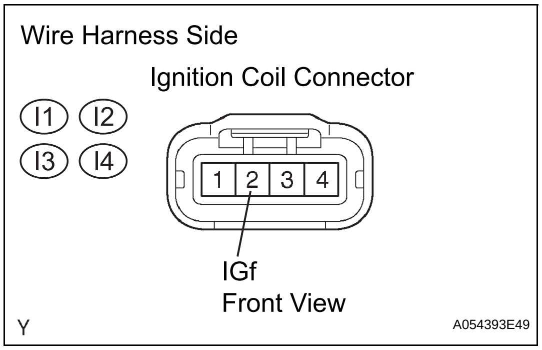
OK → **REPLACE SPARK PLUG**

NG

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



(a) Check the harness and connectors between the ignition coil and ECM (IGF terminal) connectors.



(1) Disconnect the I1, I2, I3 or I4 ignition coil connector.
(2) Disconnect the E4 ECM connector.
(3) Measure the resistance between the wire harness side connectors.

Standard resistance (Check for open)

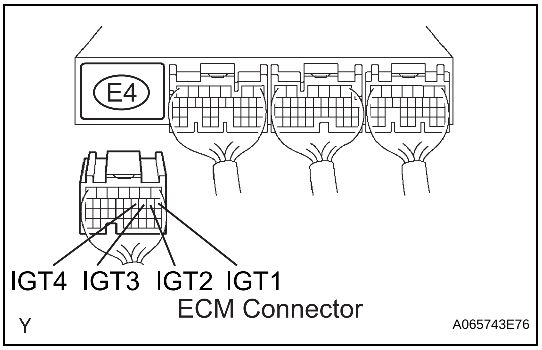
Tester Connection	Specified Condition
I1-2 (IGf) - E4-23 (IGF)	Below 1 Ω
I2-2 (IGf) - E4-23 (IGF)	Below 1 Ω
I3-2 (IGf) - E4-23 (IGF)	Below 1 Ω
I4-2 (IGf) - E4-23 (IGF)	Below 1 Ω

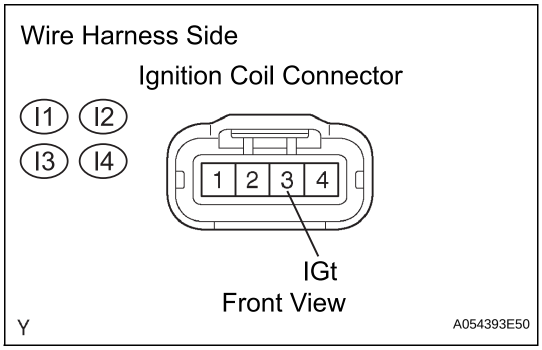
Standard resistance (Check for short)

Tester Connection	Specified Condition
I1-2 (IGf) or E4-23 (IGF) - Body ground	10 kΩ or higher
I2-2 (IGf) or E4-23 (IGF) - Body ground	10 kΩ or higher
I3-2 (IGf) or E4-23 (IGF) - Body ground	10 kΩ or higher
I4-2 (IGf) or E4-23 (IGF) - Body ground	10 kΩ or higher

(4) Reconnect the ignition coil connector.
(5) Reconnect the ECM connector.

(b) Check the harness and connectors between the ignition coil and ECM (IGT terminal) connectors.





(1) Disconnect the I1, I2, I3 or I4 ignition coil connector.
(2) Disconnect the E4 ECM connector.
(3) Measure the resistance between the wire harness side connectors.

Standard resistance (Check for open)

Tester Connection	Specified Condition
I1-3 (IGt) - E4-8 (IGT1)	Below 1 Ω
I2-3 (IGt) - E4-9 (IGT2)	Below 1 Ω
I3-3 (IGt) - E4-10 (IGT3)	Below 1 Ω
I4-3 (IGt) - E4-11 (IGT4)	Below 1 Ω

Standard resistance (Check for short)

Tester Connection	Specified Condition
I1-3 (IGt) or E4-8 (IGT1) - Body ground	10 kΩ or higher
I2-3 (IGt) or E4-9 (IGT2) - Body ground	10 kΩ or higher
I3-3 (IGt) or E4-10 (IGT3) - Body ground	10 kΩ or higher
I4-3 (IGt) or E4-11 (IGT4) - Body ground	10 kΩ or higher

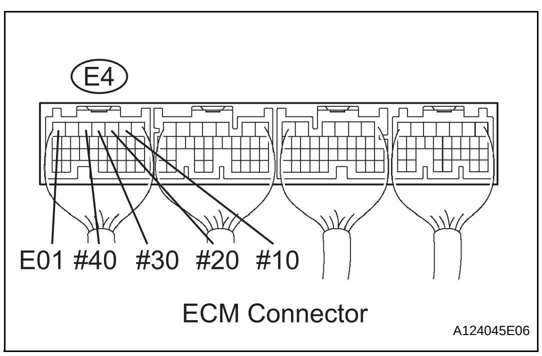
(4) Reconnect the ignition coil connector.
(5) Reconnect the ECM connector.

OK → **REPLACE IGNITION COIL (THEN CONFIRM THAT THERE IS NO MISFIRE)**

NG

REPAIR OR REPLACE HARNESS AND CONNECTOR

8 CHECK ECM TERMINAL OF MISFIRING CYLINDER (#10. #20. #30 OR #40 VOLTAGE)



(a) Turn the power switch ON (IG).
(b) Measure the voltage between the applicable terminals of the E4 ECM connector.

Standard voltage

Tester Connection	Specified condition
E4-2 (#10) - E4-7 (E01)	9 to 14 V
E4-3 (#20) - E4-7 (E01)	9 to 14 V
E4-4 (#30) - E4-7 (E01)	9 to 14 V
E4-5 (#40) - E4-7 (E01)	9 to 14 V

OK → **Go to step 11**

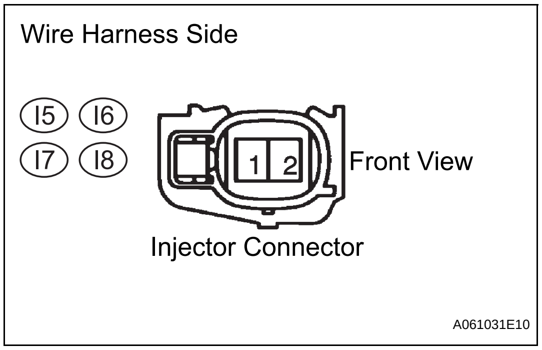
NG

9 INSPECT FUEL INJECTOR RESISTANCE OF MISFIRING CYLINDER

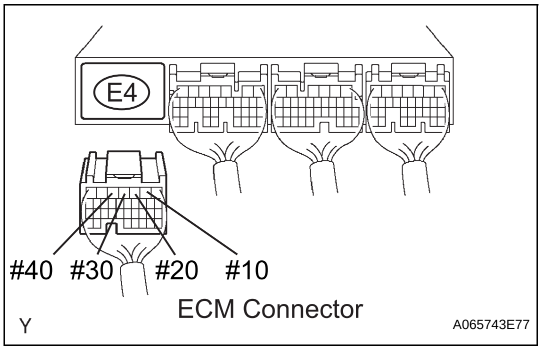
NG → **REPLACE FUEL INJECTOR ASSEMBLY**

OK

10	CHECK HARNESS AND CONNECTOR OF MISFIRING CYLINDER (INJECTOR - ECM, INJECTOR - IG2 RELAY)



(a) Check the harness and connectors between the injector connector and ECM connector.



(1) Disconnect the I5, I6, I7 or I8 injector connector.
(2) Disconnect the E4 ECM connector.
(3) Measure the resistance between the wire harness side connectors.

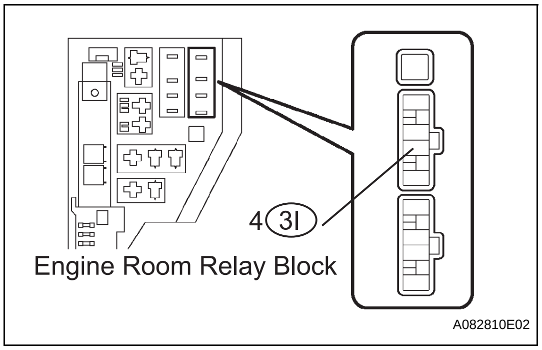
Standard resistance (Check for open)

Tester Connection	Specified Condition
I5-2 (Injector) - E4-2 (#10)	Below 1 Ω
I6-2 (Injector) - E4-3 (#20)	Below 1 Ω
I7-2 (Injector) - E4-4 (#30)	Below 1 Ω
I8-2 (Injector) - E4-5 (#40)	Below 1 Ω

Standard resistance (Check for short)

Tester Connection	Specified Condition
I5-2 (Injector) or E4-2 (#10) - Body ground	10 kΩ or higher
I6-2 (Injector) or E4-3 (#20) - Body ground	10 kΩ or higher
I7-2 (Injector) or E4-4 (#30) - Body ground	10 kΩ or higher
I8-2 (Injector) or E4-5 (#40) - Body ground	10 kΩ or higher

(4) Reconnect the injector connector.
(5) Reconnect the ECM connector.



(b) Check the harness and connectors between the injector connector and IG2 relay.
(1) Disconnect the I5, I6, I7 or I8 injector connector.
(2) Remove the integration relay from the engine room relay block.
(3) Measure the resistance between the wire harness side connectors.

Standard resistance (Check for open)

Tester Connection	Specified Condition
I5-1 (Injector) - 3I-4 (IG2 relay)	Below 1 Ω
I6-1 (Injector) - 3I-4 (IG2 relay)	Below 1 Ω
I7-1 (Injector) - 3I-4 (IG2 relay)	Below 1 Ω
I8-1 (Injector) - 3I-4 (IG2 relay)	Below 1 Ω

ES

Standard resistance (Check for short)

Tester Connection	Specified Condition
I5-1 (Injector) or 3I-4 (IG2 relay) - Body ground	10 kΩ or higher
I6-1 (Injector) or 3I-4 (IG2 relay) - Body ground	10 kΩ or higher
I7-1 (Injector) or 3I-4 (IG2 relay) - Body ground	10 kΩ or higher
I8-1 (Injector) or 3I-4 (IG2 relay) - Body ground	10 kΩ or higher

(4) Reconnect the injector connector.
(5) Reinstall the integration relay connector.

NG → **REPAIR OR REPLACE HARNESS AND CONNECTOR**

OK

11 INSPECT FUEL INJECTOR INJECTION AND VOLUME OF MISFIRING CYLINDER

OK:

Injection volume: 36 to 46 cm^3 (2.1 to 2.8 cu in.) per 15 seconds.

NG → **REPLACE FUEL INJECTOR ASSEMBLY**

OK

12 CHECK CYLINDER COMPRESSION PRESSURE OF MISFIRING CYLINDER

OK:

Compression pressure: 728 kPa (7.4 kgf/cm^2, 106 psi)
Minimum pressure: 537 kPa (5.4 kgf/cm^2, 77 psi)

NG → **REPAIR OR REPLACE**

OK

13 CHECK VALVE CLEARANCE OF MISFIRING CYLINDER

OK:

Valve clearance (cold):
Intake: 0.17 to 0.23 mm (0.007 to 0.009 in.)
Exhaust: 0.27 to 0.33 mm (0.011 to 0.013 in.)

NG → **ADJUST VALVE CLEARANCE**

OK

14 SWITCH STEP BY NUMBER OF MISFIRE CYLINDER

HINT:
- If the "1 or 2 cylinders", proceed to A.

- If the "more than 3 cylinders", proceed to B.

B → **CHECK FOR INTERMITTENT PROBLEMS**

A

15	**CHECK VALVE TIMING (CHECK FOR LOOSENESS OR A JUMPED TOOTH OF THE TIMING CHAIN)**

OK:
The match marks of crankshaft pulley and camshaft pulley are aligning.

NG → **ADJUST VALVE TIMING (REPAIR OR REPLACE TIMING CHAIN)**

ES

OK

16	**CHECK FUEL PRESSURE**

OK:
Fuel pressure: 304 to 343 kPa (3.1 to 3.5 kgf/cm^2, 44 to 50 psi)

NG → **CHECK AND REPLACE FUEL PUMP, PRESSURE REGULATOR, FUEL PIPE LINE AND FILTER**

OK

17	**READ VALUE OF INTELLIGENT TESTER (INTAKE AIR TEMPERATURE AND MASS AIR FLOW RATE)**

(a) Connect the intelligent tester to the DLC3.
(b) Turn the power switch ON (IG).
(c) Turn the intelligent tester ON.
(d) Check the intake air temperature.
  (1) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DATA LIST / PRIMARY / INTAKE AIR.
  (2) Read the value.
  Temperature:
  Equivalent to ambient air temperature.
(e) Check the air flow rate.
  (1) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DATA LIST / PRIMARY / MAF.
  (2) Read the value.

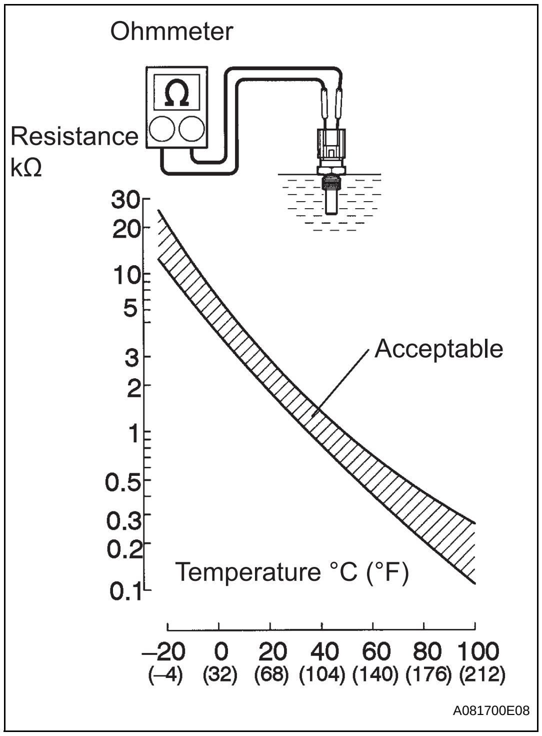
OK

Condition	Air flow rate (g/sec.)
Power switch ON (do not start engine)	0.0
Idling (Inspection mode)	3.2 to 4.7
Running without load (Inspection mode, engine speed of 2,500 rpm)	13.1 to 18.9
During vehicle running (Vehicle speed of more than 38 mph)	Air flow rate fluctuates

NG → **REPLACE MASS AIR FLOW METER**

OK

18 INSPECT ENGINE COOLANT TEMPERATURE SENSOR (RESISTANCE)



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

Tester Connection	Specified Condition
1 - 2	2 to 3 kΩ at 20°C (68°F)
1 - 2	0.2 to 0.4 kΩ at 80°C (176°F)

NOTICE:
When checking the engine coolant temperature sensor in water, be careful not to allow water to contact 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.

NG → **REPLACE ENGINE COOLANT TEMPERATURE SENSOR**

OK

19 SWITCH STEP BY NUMBER OF MISFIRE CYLINDER

HINT:
- If the "1 or 2 cylinders", proceed to A.
- If the "more than 3 cylinders", proceed to B.

B → **Go to step 5**

A

CHECK FOR INTERMITTENT PROBLEMS

DTC	P0325	Knock Sensor 1 Circuit

DTC	P0327	Knock Sensor 1 Circuit Low Input (Bank 1 or Single Sensor)

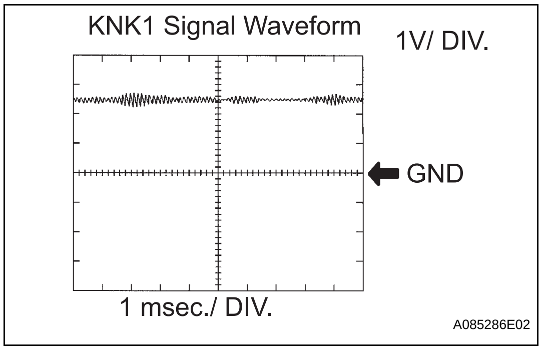
DTC	P0328	Knock Sensor 1 Circuit High Input (Bank 1 or Single Sensor)

DESCRIPTION

A flat type knock sensor (non-resonant type) has the structure that can detect vibration in a wider band of the frequency from about 6 kHz to 15 kHz and has the following features.
Knock sensors are fitted on the cylinder block to detect engine knocking.
The knock sensor contains a piezoelectric element which generates voltage when it becomes deformed.
The generation of the voltage occurs when the cylinder block vibrates due to the knocking. If the engine knocking occurs, in order to suppress it, the ignition timing is retarded.

DTC No.	DTC Detection Condition	Trouble Area
P0325	Knock sensor signal level remains at low for 1 second	• Open or short in knock sensor circuit • Knock sensor (under-torqued or looseness) • ECM
P0327	Output voltage of the knock sensor is less than 0.5 V	• Short in knock sensor circuit • Knock sensor • ECM
P0328	Output voltage of the knock sensor is more than 4.5 V	• Open in knock sensor circuit • Knock sensor • ECM

HINT:
If the ECM detects the DTC P0325,P0327 and P0328, it enters fail-safe mode in which the corrective retarded angle value is set to its maximum value.
Reference: Inspection by using an oscilloscope.



(1) After warming up, run the engine at 2,500 rpm, check the waveform between terminals KNK1 and EKNK of the ECM connector.

MONITOR DESCRIPTION

The knock sensor, located on the cylinder block, detects spark knocks. When the spark knocks occur, the sensor picks-up vibrates 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 the normal range, the ECM interprets this as a fault in the knock sensor and sets a DTC.

MONITOR STRATEGY

Related DTCs	P0325: Knock sensor (bank 1) range check or rationality P0327: Knock sensor (bank 1) range check (low voltage) P0328: Knock sensor (bank 1) range check (high voltage)
Required sensors/components (main)	Main: Knock sensor Related: Crankshaft position sensor, Camshaft position sensor, Engine coolant temperature sensor, Mass air flow meter
Frequency of operation	Continuous
Duration	1 second
MIL operation	Immediately
Sequence of operation	None

TYPICAL ENABLING CONDITIONS

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

TYPICAL MALFUNCTION THRESHOLDS

Case 1: P0325

Knock sensor voltage	Less than 0.5 V and more than 4.5 V

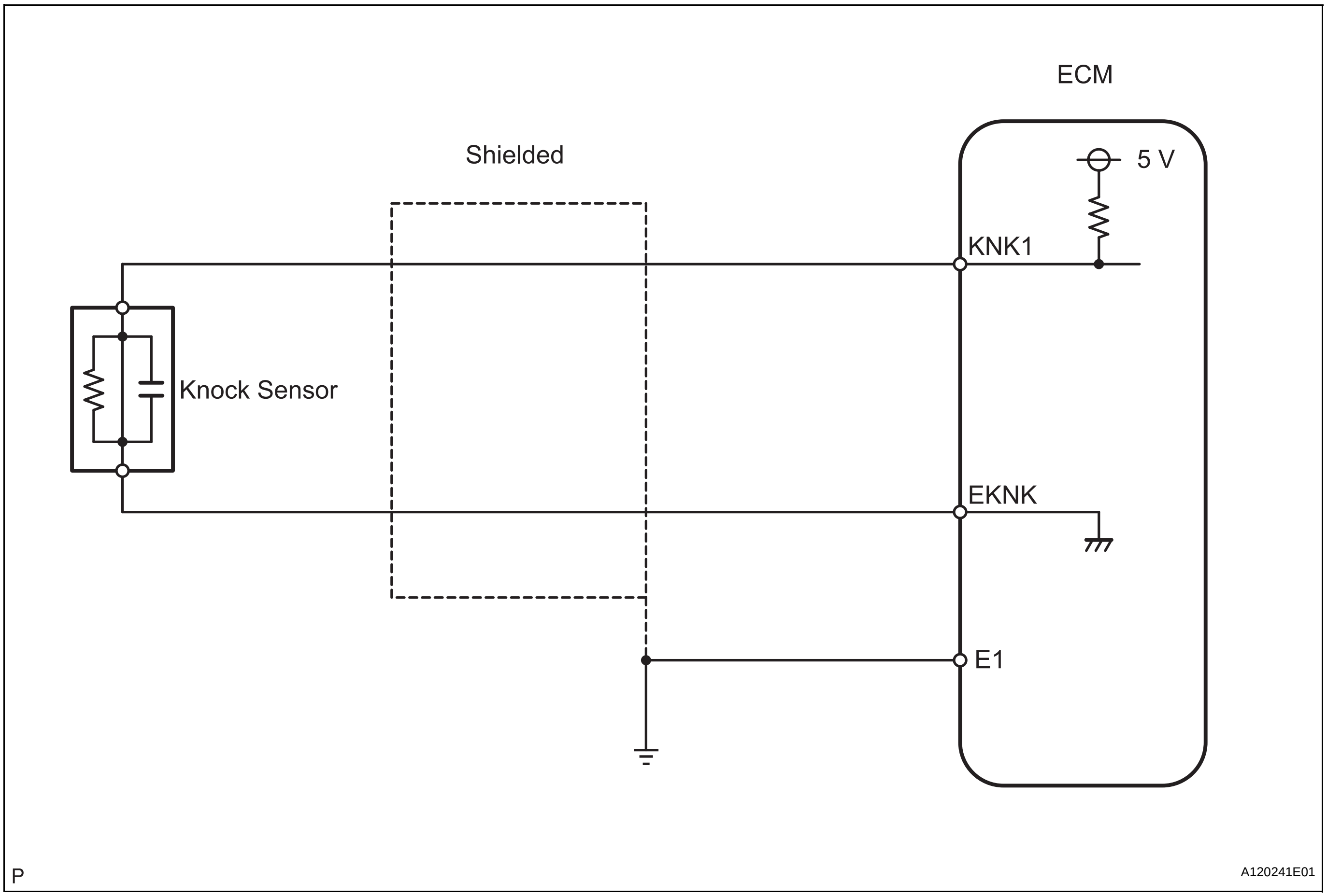
Case 2: P0327

Knock sensor voltage	Less than 0.5 V

Case 3: P0328

Knock sensor voltage	More than 4.5 V

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:
Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunction is detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1	READ OUTPUT DTCS

(a) Connect the intelligent tester to the DLC3.
(b) Turn the power switch ON (IG).
(c) Turn the intelligent tester ON.
(d) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DTC INFO / CURRENT CODES.
(e) Clear the DTCs.
(f) Put the engine in inspection mode (see page ES-1).
(g) Warm up the engine.
(h) Run the engine at 2,500 rpm for 10 seconds or more.
(i) Read DTCs.

Result

Display (DTC output)	Proceed to
P0325	A
P0325, P0327 and/or P0328	B

Display (DTC output)	Proceed to
No output	C

B → Go to step 3

C → CHECK FOR INTERMITTENT PROBLEMS

A

2 INSPECT KNOCK SENSOR

(a) Check the knock sensor installation.

OK:

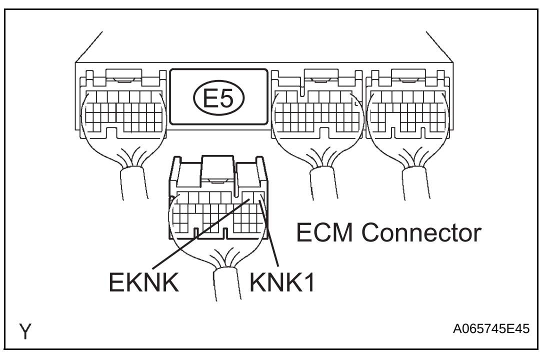
Torque: 20 N*m(204 kgf*cm, 15 ft.*lbf)

NG → SECURELY REINSTALL SENSOR

OK

REPLACE KNOCK SENSOR

3 CHECK HARNESS AND CONNECTOR (ECM - KNOCK SENSOR)



(a) Disconnect the E5 ECM connector.

(b) Measure the resistance between the terminals of the E5 ECM connector.

Standard resistance

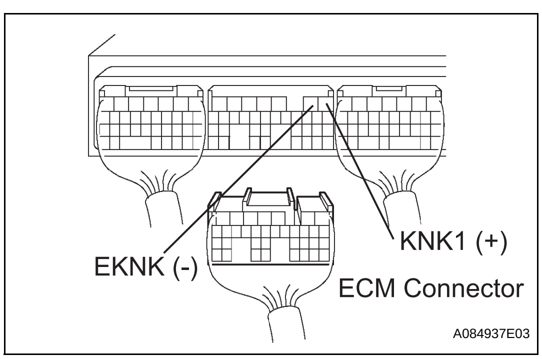
Tester Connection	Specified Condition
E5-1 (KNK1) - E5-2 (EKNK)	120 to 280 kΩ at 20°C (68°F)

(c) Reconnect the ECM connector.

NG → Go to step 5

OK

4 INSPECT ECM (KNK1 - EKNK VOLTAGE)



(a) Disconnect the E5 ECM connector.

(b) Turn the power switch ON (IG).

(c) Measure the voltage between the terminals of the E5 ECM terminals.

Standard voltage

Tester Connection	Specified Condition
E5-1 (KNK1) - E5-2 (EKNK)	4.5 to 5.5 V

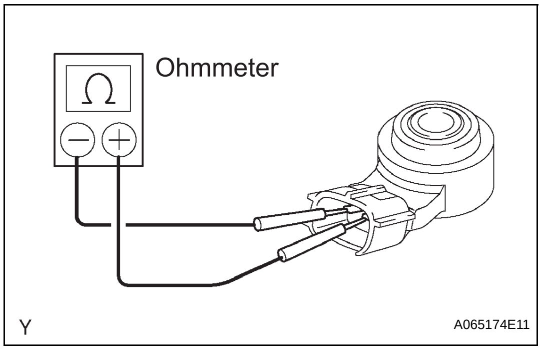
(d) Reconnect the ECM connector

NG → REPLACE ECM

OK

CHECK FOR INTERMITTENT PROBLEMS

5	INSPECT KNOCK SENSOR



(a) Remove the knock sensor.

(b) Measure the resistance between the terminals.

Standard resistance

Tester Connection	Specified Condition
K1-2 (KNK1) - K1-1 (EKNK)	120 to 280 kΩ at 20°C (68°F)

(c) Reinstall the knock sensor.

NG → REPLACE KNOCK SENSOR

OK

REPAIR OR REPLACE HARNESS AND CONNECTOR

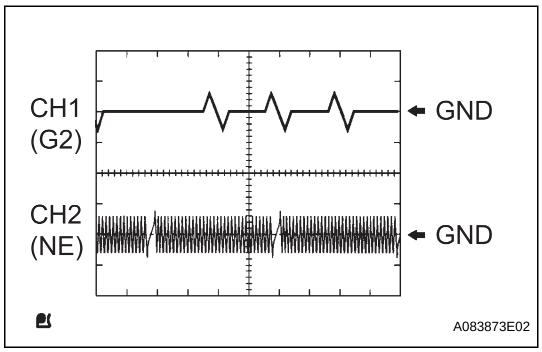
DTC	P0335	Crankshaft Position Sensor "A" Circuit

DESCRIPTION

The crankshaft position sensor (CKP) system consists of a crankshaft position sensor plate and a pick-up coil. The sensor plate has 34 teeth and is installed on the crankshaft. The pick-up coil is made of an iron core and magnet. The sensor plate rotates and as each tooth passes through the pick-up coil, a pulse signal is created. The pick-up coil generates 34 signals per engine revolution. Based on these signals, the ECM calculates the crankshaft position and engine RPM. Using these calculations, the fuel injection time and ignition timing are controlled.

DTC No.	DTC Detection Condition	Trouble Area
P0335	No crankshaft position sensor signal to ECM (2 trip detection logic)	• Open or short in crankshaft position sensor circuit • Crankshaft position sensor • Signal plate (crankshaft) • ECM

Reference: Inspection using an oscilloscope.



HINT:
The correct waveform is as shown.

Item	Contents
Terminal	CH1: G2 - NE- CH2: NE+ - NE-
Equipment Setting	5 V/DIV., 20 ms/DIV.
Condition	During cranking or idling

MONITOR DESCRIPTION

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

MONITOR STRATEGY

Related DTCs	P0335: Crankshaft position sensor range check or rationality
Required sensors/components	Crankshaft position sensor
Frequency of operation	Continuous
Duration	4.7 seconds
MIL operation	2 driving cycles
Sequence of operation	None

TYPICAL ENABLING CONDITIONS

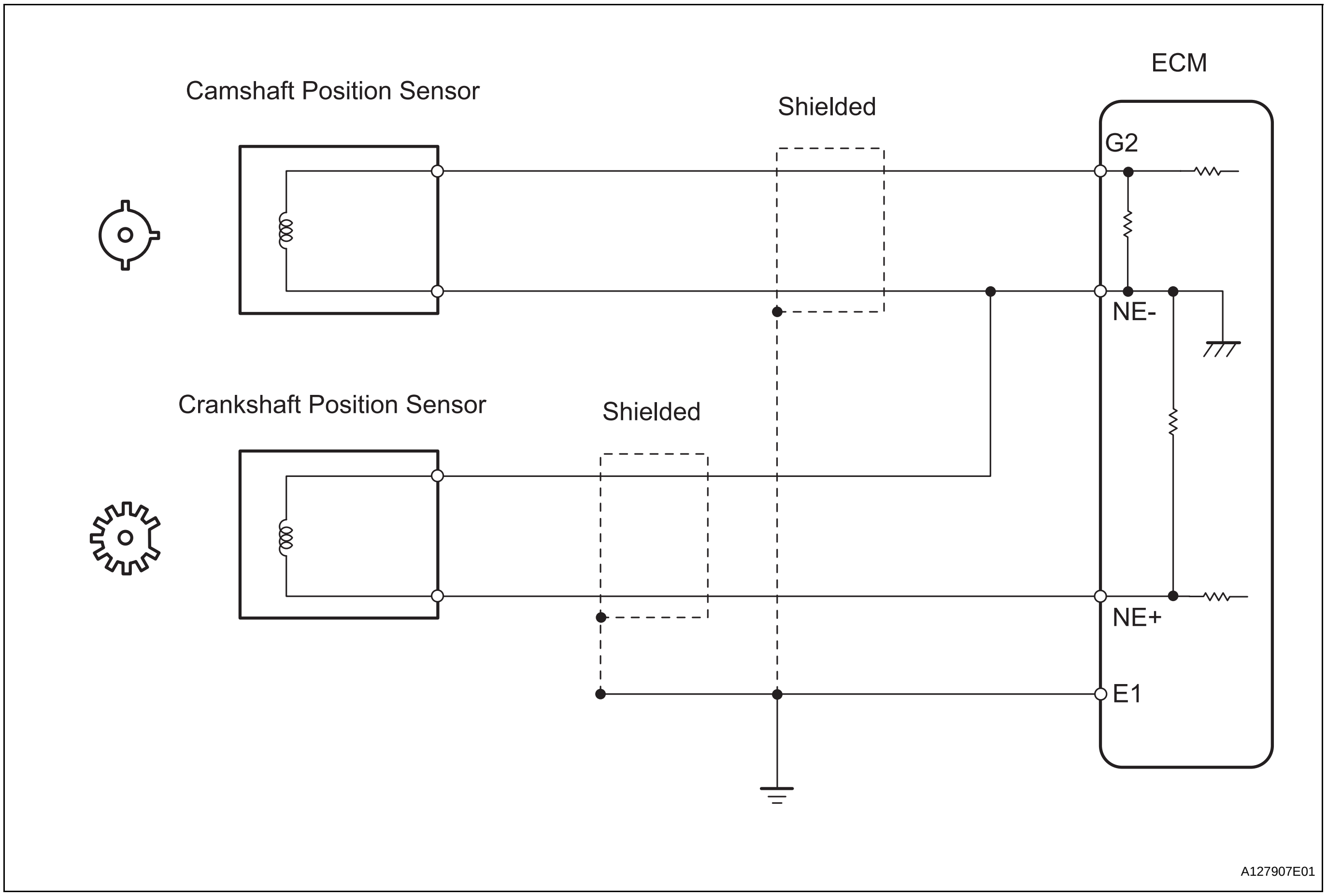
The monitor will run whenever the following DTCs are not present	None
Power switch	ON

Engine rotating signal from HV ECU	HV ECU judges that the engine is running

TYPICAL MALFUNCTION THRESHOLDS

Engine speed signal	No signal for 4.7 seconds

WIRING DIAGRAM



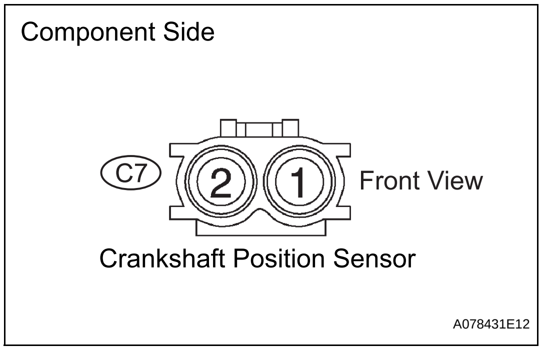
INSPECTION PROCEDURE

HINT:

- Perform troubleshooting on DTC P0335 first. If no trouble is found, troubleshoot the engine mechanical systems.
- Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunction is detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.
- READ VALUE OF INTELLIGENT TESTER
  (a) Connect the intelligent tester to the DLC3.
  (b) Turn the power switch ON (IG).
  (c) Turn the intelligent tester ON.
  (d) Put the engine in inspection mode (see page ES-1).
  (e) Start the engine.
  (f) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DATA LIST / PRIMARY / ENGINE SPD.
  (g) Read the value.

- The engine speed can be observed in DATA LIST using the intelligent tester. If there is no NE signal from the crankshaft position sensor despite the engine revolving, the engine speed will be indicated as zero. If voltage output from the crankshaft position sensor is insufficient, the engine speed will be indicated as lower PRM (than the actual RPM).

1 INSPECT CRANKSHAFT POSITION SENSOR (RESISTANCE)



(a) Disconnect the C7 crankshaft position sensor connector.
(b) Measure the resistance between the terminals of the crankshaft position sensor connector.
Standard resistance

Tester Connection	Specified Condition
1 - 2	985 to 1,600 Ω at cold
1 - 2	1,265 to 1,890 Ω at hot

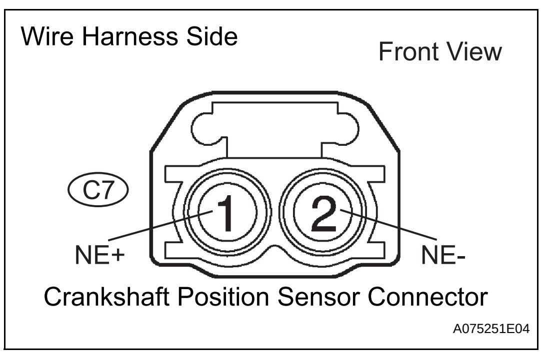
NOTICE:
Terms "cold" and "hot" refer to the temperature of the sensor. "Cold" means approximately -10 to 50°C (14 to 122°F). "Hot" means approximately 50 to 100°C (122 to 212°F).

(c) Reconnect the crankshaft position sensor connector.

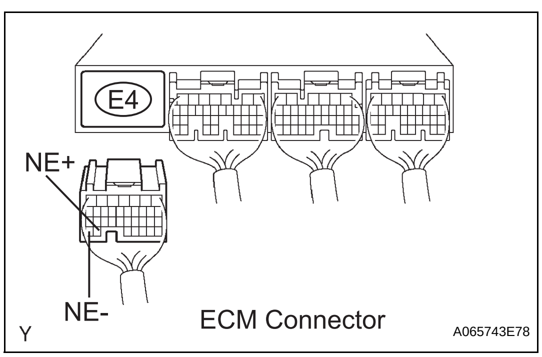
NG → **REPLACE CRANKSHAFT POSITION SENSOR**

OK

2 CHECK HARNESS AND CONNECTOR (CRANKSHAFT POSITION SENSOR - ECM)



(a) Disconnect the C7 crankshaft position sensor connector.



(b) Disconnect the E4 ECM connector.
(c) Measure the resistance between the wire harness side connectors.
Standard resistance (Check for open)

Tester Connection	Specified Condition
C7-1 (NE+) - E4-33 (NE+)	Below 1 Ω
C7-2 (NE-) - E4-34 (NE-)	Below 1 Ω

Standard resistance (Check for short)

Tester Connection	Specified Condition
C7-1 (NE+) or E4-33 (NE+) - Body ground	10 kΩ or higher
C7-2 (NE-) or E4-34 (NE-) - Body ground	10 kΩ or higher

(d) Reconnect the crankshaft position sensor connector.
(e) Reconnect the ECM connector.

NG → **REPAIR OR REPLACE HARNESS AND CONNECTOR**

OK

3 CHECK SENSOR INSTALLATION (CRANKSHAFT POSITION SENSOR)

(a) Check that the crankshaft position sensor is properly installed.
OK:
Sensor is installed correctly.

ES

NG → **SECURELY REINSTALL SENSOR**

OK

4 CHECK CRANKSHAFT POSITION SENSOR PLATE (TEETH OF SENSOR PLATE [CRANKSHAFT])

(a) Check the teeth of the sensor plate.
OK:
No deformation on the teeth of sensor plate.

NG → **REPLACE CRANKSHAFT POSITION SENSOR PLATE**

OK

REPLACE ECM

DTC	P0340	Camshaft Position Sensor Circuit Malfunction

DTC	P0341	Camshaft Position Sensor "A" Circuit Range / Performance (Bank 1 or Single Sensor)

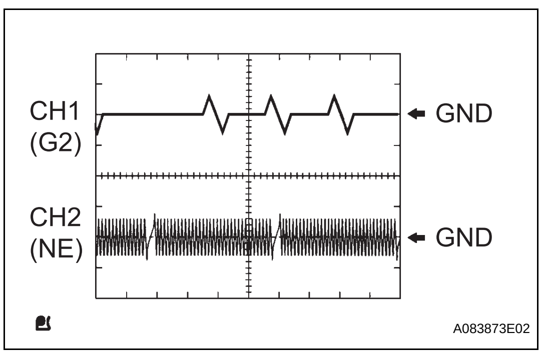
DESCRIPTION

The variable valve timing (VVT) sensor consists of a magnet, iron core and pickup coil.
The variable valve (VV) signal plate has 3 teeth on its outer circumference and is installed on the camshaft. When the camshafts rotate, the protrusion on the signal plate and the air gap on the pickup coil change, causing fluctuations in the magnetic field and generating voltage in the pickup coil.
This sensor monitors a timing rotor located on the camshaft and is used to detect an camshaft angle by the ECM. The camshaft rotation synchronizes with the crankshaft rotation, and this sensor communicates the rotation of the camshaft timing rotor as a pulse signal to the ECM. Based on the signal, the ECM controls fuel injection time and ignition timing.

ES

DTC No.	DTC Detection Condition	Trouble Area
P0340	No camshaft position sensor signal to ECM at engine speed of 600 rpm or more (1 trip detection logic)	• Open or short in camshaft position sensor circuit • Camshaft position sensor • Camshaft timing pulley • Timing chain has jumped a tooth • ECM
P0341	While crankshaft rotates twice, camshaft position sensor signal is input to ECM 12 times or more (1 trip detection logic) HINT: Under normal condition, the camshaft position sensor signal is input into the ECM 3 times per 2 engine revolutions	• Open or short in camshaft position sensor circuit • Camshaft position sensor • Camshaft timing pulley • Timing chain has jumped a tooth • ECM

Reference: Inspection using an oscilloscope.



HINT:
The correct waveform is as shown.

Item	Contents
Terminal	CH1: G2 - NE- CH2: NE+ - NE-
Equipment Setting	5 V/DIV., 20 ms/DIV.
Condition	During cranking or idling

MONITOR DESCRIPTION

If there is no signal from the VVT sensor even though the engine is turning, or if the rotation of the camshaft and the crankshaft is not synchronized, the ECM interprets this as a malfunction of the sensor.

MONITOR STRATEGY

Related DTCs	P0340: Camshaft position sensor (bank 1) range check or rationality P0341: Camshaft position sensor (bank 1) range check or rationality
Required sensors/components	Main: Camshaft position sensor Related: Crankshaft position sensor, engine speed sensor
Frequency of operation	Continuous
Duration	5 seconds
MIL operation	Immediately
Sequence of operation	None

TYPICAL ENABLING CONDITIONS

P0340:

The monitor will run whenever the following DTCs are not present	None
Engine speed	600 rpm or more

P0341:

The monitor will run whenever the following DTCs are not present	None
Engine rotating signal from HV ECU	HV ECU judges that engine is running
Engine revolution angle	720 °CA*

*: CA stands for Crankshaft Angle.

TYPICAL MALFUNCTION THRESHOLDS

P0340:

Crankshaft/camshaft synchronization	Not synchronized (judged by comparing the crankshaft position with the camshaft position)
Camshaft position sensor signal	No input in appropriate timing

P0341:

Crankshaft/Camshaft synchronization	Not synchronized
Camshaft position sensor count	12 or more / 720°CA* (= 2 engine revolutions)

COMPONENT OPERATING RANGE

Camshaft position sensor signal input every 720°CA	3 times

WIRING DIAGRAM

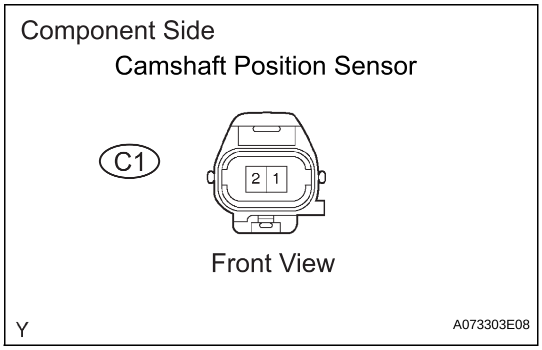
Refer to DTC P0335 (see page ES-160).

INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunction is detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1 INSPECT CAMSHAFT POSITION SENSOR (RESISTANCE)



(a) Disconnect the C1 camshaft position sensor connector.

(b) Measure the resistance between the terminals of camshaft position sensor connector.

Standard resistance

Tester Connection	Specified Condition
1 - 2	1,630 to 2,740 Ω at cold
1 - 2	2,065 to 3,225 Ω at hot

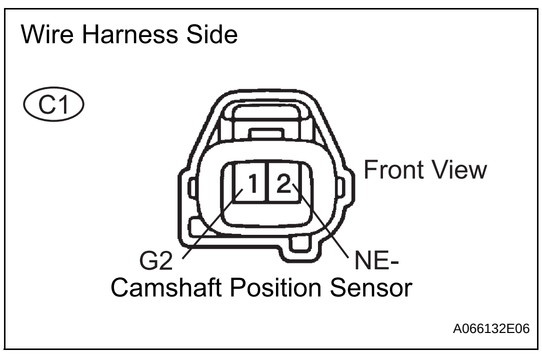
NOTICE:
Terms "cold" and "hot" refer to the temperature of the sensor. "Cold" means approximately -10 to 50°°C (14 to 122°F). "Hot" means approximately 50 to 100°C (122 to 212°F).

(c) Reconnect the camshaft position sensor connector.

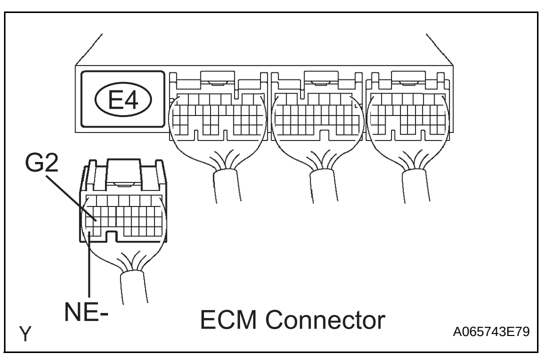
NG → **REPLACE CAMSHAFT POSITION SENSOR**

OK

2 CHECK HARNESS AND CONNECTOR (CAMSHAFT POSITION SENSOR - ECM)



(a) Disconnect the C1 camshaft position sensor connector.



(b) Disconnect the E4 ECM connector.

(c) Measure the resistance between the wire harness side connectors.

Standard resistance (Check for open)

Tester Connection	Specified Condition
C1-1 (G2) - E4-26 (G2)	Below 1 Ω
C1-2 (NE-) - E4-34 (NE-)	Below 1 Ω

Standard resistance (Check for short)

Tester Connection	Specified Condition
C1-1 (G2) or E4-26 (G2) - Body ground	10 kΩ or higher
C1-2 (NE-) or E4-34 (NE-) - Body ground	10 kΩ or higher

(d) Reconnect the camshaft position sensor connector.

(e) Reconnect the ECM connector.

NG → **REPAIR OR REPLACE HARNESS AND CONNECTOR**

OK

3	CHECK SENSOR INSTALLATION (CAMSHAFT POSITION SENSOR)

(a) Check that the camshaft position sensor is properly installed.
OK:
Sensor is installed correctly.

NG → **SECURELY REINSTALL SENSOR**

OK

4	CHECK CAMSHAFT TIMING GEAR ASSEMBLY

(a) Remove the camshaft.
(b) Check the camshaft lobes.
OK:
No deformation on the camshaft lobe.

NG → **REPLACE CAMSHAFT TIMING GEAR ASSEMBLY**

OK

REPLACE ECM

DTC	P0351	Ignition Coil "A" Primary / Secondary Circuit

DTC	P0352	Ignition Coil "B" Primary / Secondary Circuit

DTC	P0353	Ignition Coil "C" Primary / Secondary Circuit

DTC	P0354	Ignition Coil "D" Primary / Secondary Circuit

DESCRIPTION

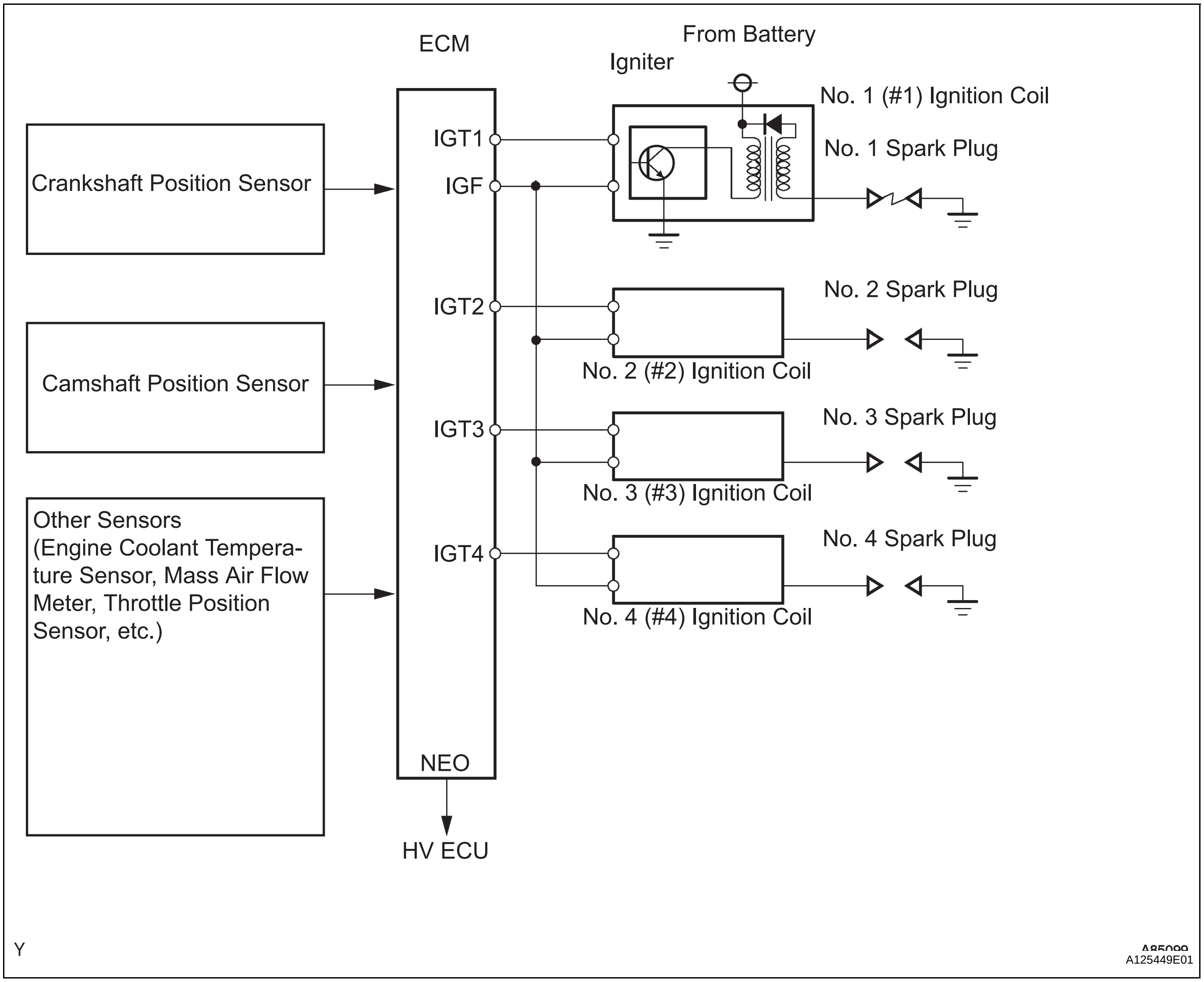
HINT:

- These DTCs indicate malfunction related to the primary circuit.
- If DTC P0351 is displayed, check the No.1 (#1) ignition coil circuit.
- If DTC P0352 is displayed, check the No.2 (#2) ignition coil circuit.
- If DTC P0353 is displayed, check the No.3 (#3) ignition coil circuit.
- If DTC P0354 is displayed, check the No.4 (#4) ignition coil circuit.

A Direct Ignition System (DIS) is used on this vehicle.

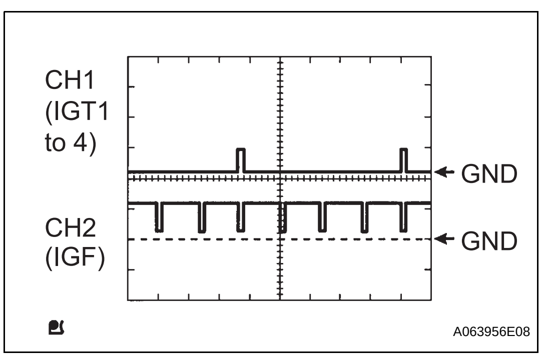
The DIS is a 1-cylinder ignition system which ignites one cylinder with one ignition coil. In the 1-cylinder ignition system, the one spark plug is connected to the end of the secondary winding. High voltage generated in the secondary winding is applied directly to the spark plug. The spark of the spark plug passes from the center electrode to the ground electrode.

The ECM determines the ignition timing and outputs the ignition (IGT) signals for each cylinder. Using the IGT signal, the ECM turns ON and OFF the power transistor inside the igniter and this switches ON and OFF the current to the primary coil. When the current flow to the primary coil is cut off, high-voltage is generated in the secondary coil and this voltage is applied to the spark plugs to spark inside the cylinders. As the ECM cuts the current to the primary coil, the igniter sends back the ignition confirmation (IGF) signal to the ECM.



DTC No.	DTC Detection Condition	Trouble Area
P0351 P0352 P0353 P0354	No IGF signal to ECM while engine is running	• Ignition system • Open or short in IGF or IGT circuit from ignition coil with igniter to ECM (ignition coil circuit 1 through 4) • Ignition coil with igniter (ignition coil circuit 1 through 4) • ECM

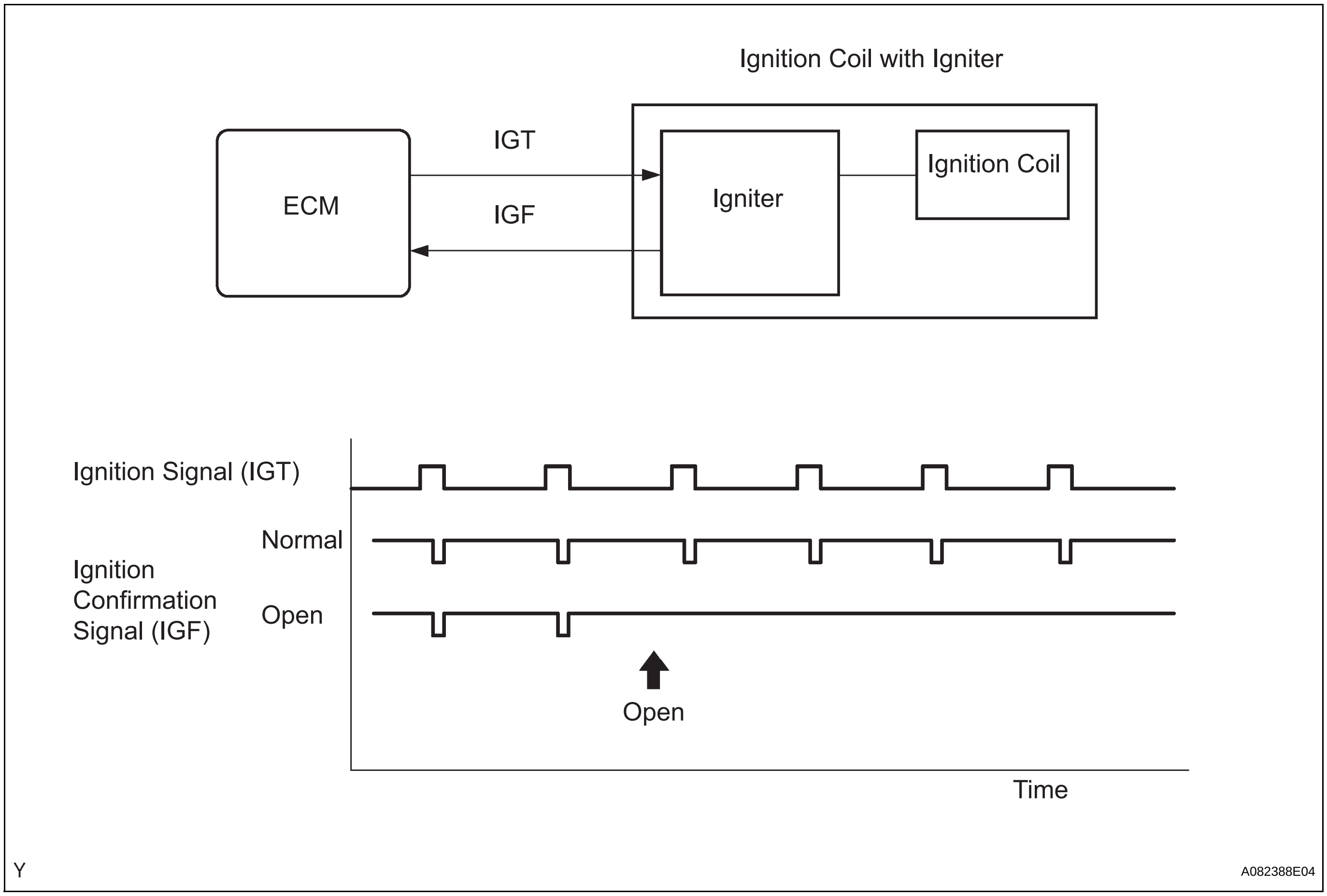
Reference: Inspection using an oscilloscope.



HINT:
The correct waveform is as shown.

Item	Contents
Terminal	CH1: IGT1, IGT2, IGT3, IGT4 - E1 CH2: IGF - E1
Equipment Setting	2 V/DIV., 20 ms/DIV.
Condition	While the engine is cranking or idling

MONITOR DESCRIPTION



If the ECM does not receive the ignition confirmation (IGF) signal after sending the ignition (IGT) signal, the ECM interprets this as a fault in the igniter and sets a DTC.

MONITOR STRATEGY

Related DTCs	P0351: Ignition coil with igniter circuit (#1) malfunction P0352: Ignition coil with igniter circuit (#2) malfunction P0353: Ignition coil with igniter circuit (#3) malfunction P0354: Ignition coil with igniter circuit (#4) malfunction
Required sensors/components	Igniter
Frequency of operation	Continuous
Duration	0.256 seconds
MIL operation	Immediately
Sequence of operation	None

TYPICAL ENABLING CONDITIONS

The monitor will run whenever the following DTCs are not present	None
Engine speed	1,500 rpm or less
Either of the following conditions is met:	(a) or (b)
(a) Following conditions are met:	1 & 2
1. Engine speed	500 rpm or less
2. Battery voltage	6 V or more
(b) Following conditions are met:	1 & 2
1. Engine speed	More than 500 rpm
2. Battery voltage	10 V or more

TYPICAL MALFUNCTION THRESHOLDS

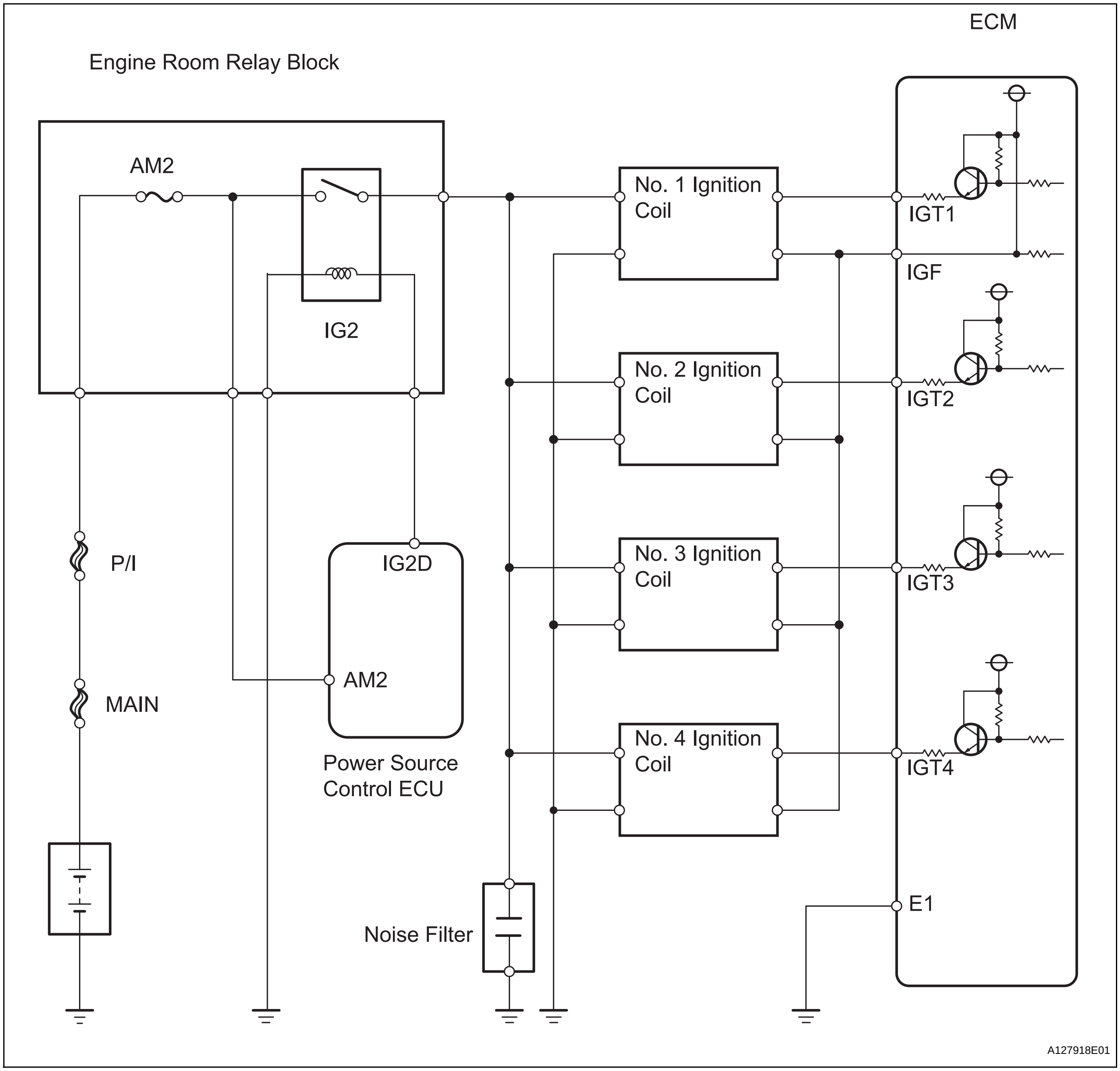
Ignition signal fail count*	More than 2 times

*: Counted when the IGF signal is not returned to the ECM despite sending the IGT signal.

COMPONENT OPERATING RANGE

Number of IGF signals	Equals the number of IGT signals

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunction is detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1	CHECK SPARK PLUG AND SPARK OF MISFIRING CYLINDER

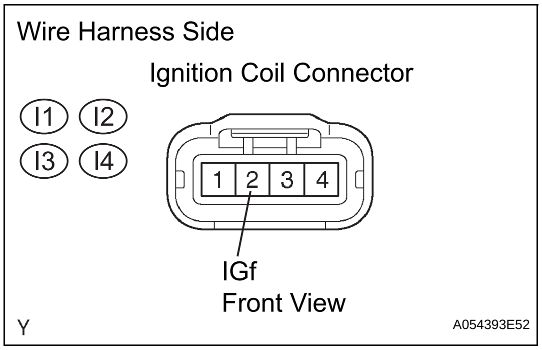
OK:

Spark occurs.

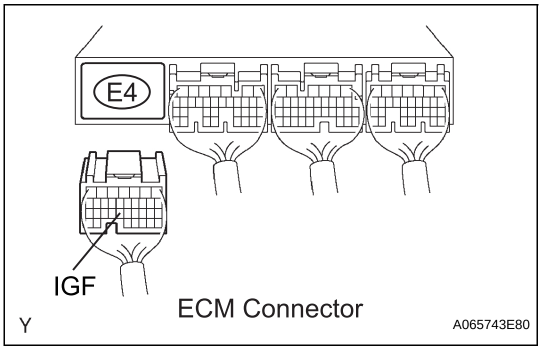
NG → **Go to step 4**

OK

2 CHECK HARNESS AND CONNECTOR (IGNITION COIL - ECM (IGF SIGNAL TERMINAL))



(a) Disconnect the I1, I2, I3 or I4 ignition coil and igniter connector.



(b) Disconnect the E4 ECM connector.
(c) Measure the resistance between the wire harness side connectors.

Standard resistance (Check for open)

Tester Connection	Specified Condition
I1-2 (IGf) - E4-23 (IGF)	Below 1 Ω
I2-2 (IGf) - E4-23 (IGF)	Below 1 Ω
I3-2 (IGf) - E4-23 (IGF)	Below 1 Ω
I4-2 (IGf) - E4-23 (IGF)	Below 1 Ω

Standard resistance (Check for short)

Tester Connection	Specified Condition
I1-2 (IGf) or E4-23 (IGF) - Body ground	10 kΩ or higher
I2-2 (IGf) or E4-23 (IGF) - Body ground	10 kΩ or higher
I3-2 (IGf) or E4-23 (IGF) - Body ground	10 kΩ or higher
I4-2 (IGf) or E4-23 (IGF) - Body ground	10 kΩ or higher

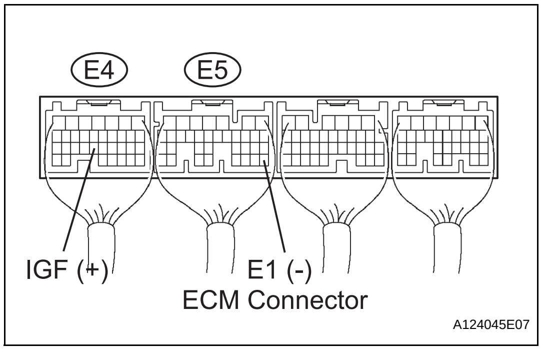
(d) Reconnect the ignition coil and igniter connector.
(e) Reconnect the ECM connector.

NG → **REPAIR OR REPLACE HARNESS AND CONNECTOR**

OK

ES

3	CHECK ECM (IGF VOLTAGE)



(a) Disconnect the I1, I2, I3 or I4 ignition coil and igniter connector.
(b) Turn the power switch ON (IG).
(c) Measure the voltage between the specified terminals of the E4 and E5 ECM connectors.

Standard voltage

Tester Connection	Specified Condition
E4-23 (IGF) - E5-28 (E1)	4.5 to 5.5 V

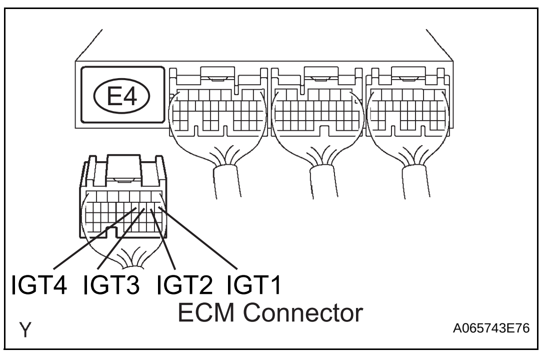
(d) Reconnect the ignition coil and igniter connector.

NG → **REPLACE ECM**

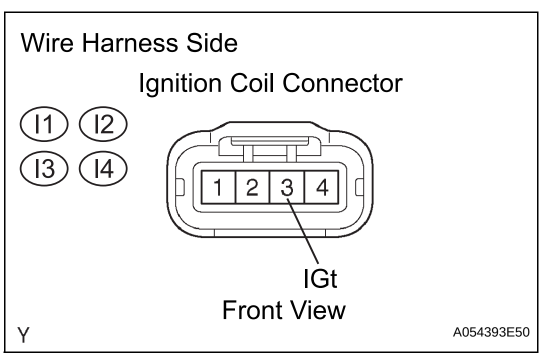
OK

REPLACE IGNITION COIL

4	CHECK HARNESS AND CONNECTOR (IGNITION - ECM (IGT SIGNAL TERMINAL))



(a) Disconnect the I1, I2, I3 or I4 ignition coil and igniter connector.



(b) Disconnect the E4 ECM connector.
(c) Measure the resistance between the wire harness side connectors.

Standard resistance (Check for open)

Tester Connection	Specified Condition
I1-3 (IGt) - E4-8 (IGT1)	Below 1 Ω
I2-3 (IGt) - E4-9 (IGT2)	Below 1 Ω
I3-3 (IGt) - E4-10 (IGT3)	Below 1 Ω
I4-3 (IGt) - E4-11 (IGT4)	Below 1 Ω

Standard resistance (Check for short)

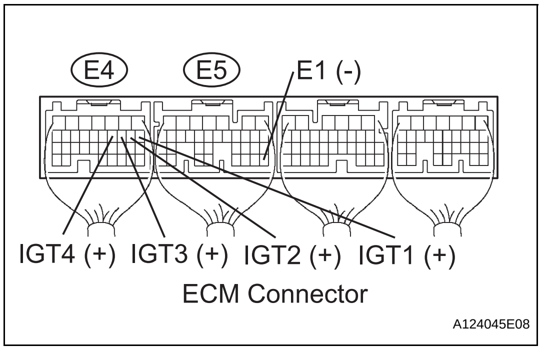
Tester Connection	Specified Condition
I1-3 (IGT) or E4-8 (IGT1) - Body ground	10 kΩ or higher
I2-3 (IGT) or E4-9 (IGT2) - Body ground	10 kΩ or higher
I3-3 (IGT) or E4-10 (IGT3) - Body ground	10 kΩ or higher
I4-3 (IGT) or E4-11 (IGT4) - Body ground	10 kΩ or higher

(d) Reconnect the ignition coil and igniter connector.
(e) Reconnect the ECM connector.

NG → **REPAIR OR REPLACE HARNESS AND CONNECTOR**

OK

5 CHECK ECM (IGT1, IGT2, IGT3 OR IGT4 VOLTAGE)



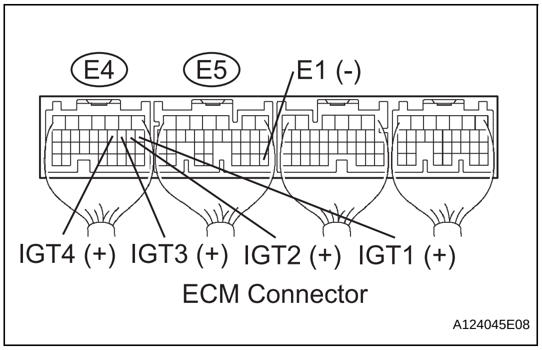
(a) Measure the voltage between the applicable terminals of the E4 and E5 ECM connectors when the engine is cranked.
Standard voltage

Tester Connection	Specified Condition
E4-8 (IGT1) - E5-28 (E1)	0.1 to 4.5 V
E4-9 (IGT2) - E5-28 (E1)	0.1 to 4.5 V
E4-10 (IGT3) - E5-28 (E1)	0.1 to 4.5 V
E4-11 (IGT4) - E5-28 (E1)	0.1 to 4.5 V

NG → **REPLACE ECM**

OK

6 CHECK ECM (IGT1, IGT2, IGT3 OR IGT4 VOLTAGE)



(a) Disconnect the I1, I2, I3 or I4 ignition coil and igniter connector.
(b) Measure the voltage between the applicable terminals of the E4 and E5 ECM connectors when the engine is cranked.
Standard voltage

Tester Connection	Specified Condition
E4-8 (IGT1) - E5-28 (E1)	4.5 V or more
E4-9 (IGT2) - E5-28 (E1)	4.5 V or more
E4-10 (IGT3) - E5-28 (E1)	4.5 V or more
E4-11 (IGT4) - E5-28 (E1)	4.5 V or more

(c) Reconnect the ignition coil and igniter connector.

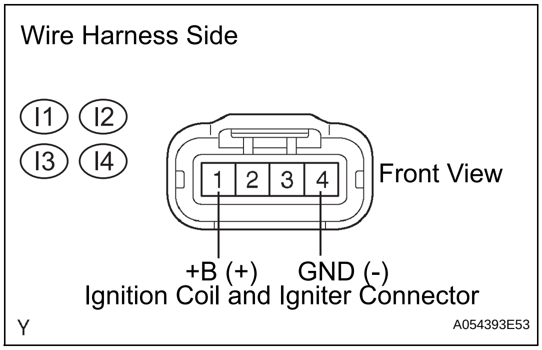
NG → **REPLACE ECM**

OK

ES

ES

7 CHECK IGNITION COIL (POWER SOURCE)



(a) Disconnect the I1, I2, I3 or I4 ignition coil and igniter connector.
(b) Turn the power switch ON (IG).
(c) Measure the voltage between the terminal of the wire harness side connector and body ground.

Standard voltage

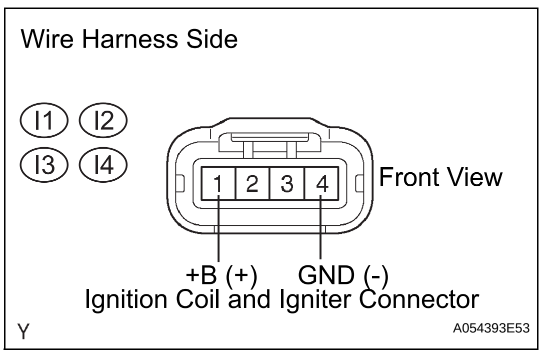
Tester Connection	Specified Condition
I1-1 (+B) - I1-4 (GND)	9 to 14 V
I2-1 (+B) - I2-4 (GND)	9 to 14 V
I3-1 (+B) - I3-4 (GND)	9 to 14 V
I4-1 (+B) - I4-4 (GND)	9 to 14 V

(d) Reconnect the ignition coil and igniter connector.

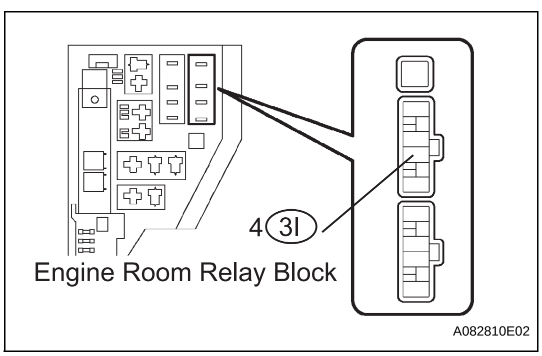
OK → **REPLACE IGNITION COIL**

NG

8 CHECK HARNESS AND CONNECTOR (IGNITION COIL - IG2 RELAY)



(a) Disconnect the I1, I2, I3 or I4 ignition coil and igniter connector.



(b) Remove the integration relay from engine room relay block.
(c) Measure the resistance between the wire harness side connectors.

Standard resistance (Check for open)

Tester Connection	Specified Condition
I1-1 (+B) - 3I-4 (IG2 relay)	Below 1 Ω
I2-1 (+B) - 3I-4 (IG2 relay)	Below 1 Ω
I3-1 (+B) - 3I-4 (IG2 relay)	Below 1 Ω
I4-1 (+B) - 3I-4 (IG2 relay)	Below 1 Ω
I1-4 (GND) - Body ground	Below 1 Ω
I2-4 (GND) - Body ground	Below 1 Ω
I3-4 (GND) - Body ground	Below 1 Ω
I4-4 (GND) - Body ground	Below 1 Ω

Standard resistance (Check for short)

Tester Connection	Specified Condition
I1-1 (+B) or 3I-4 (IG2 relay) - Body ground	10 kΩ or higher

Tester Connection	Specified Condition
I2-1 (+B) or 3I-4 (IG2 relay) - Body ground	10 kΩ or higher
I3-1 (+B) or 3I-4 (IG2 relay) - Body ground	10 kΩ or higher
I4-1 (+B) - 3I-4 (IG2 relay)	10 kΩ or higher

(d) Reconnect the ignition coil and igniter connector.
(e) Reinstall the integration relay.

NG → **REPAIR OR REPLACE HARNESS AND CONNECTOR**

OK

REPLACE IGNITION COIL

DTC	P0420	Catalyst System Efficiency Below Threshold (Bank 1)

MONITOR DESCRIPTION

The ECM uses 2 sensors mounted before and after the three-way catalytic converter (TWC) to monitor its' efficiency. The air-fuel ratio (A/F) sensor (sensor 1) sends pre-catalyst information to the ECM. The heated oxygen (O2) sensor (sensor 2) sends post-catalyst information to the ECM.
In order to detect deterioration in the catalyst, the ECM calculates Oxygen Storage Capacity (OSC) in the catalyst based on voltage output of the sensor 2 while performing "active air-fuel ratio control" instead of the conventional detecting method which uses the locus ratio.
The OSC is an indication value of the catalyst oxygen storage capacity and is used for representing how much the catalyst can store oxygen. When the vehicle is being driven with a warm engine, the active air-fuel ratio control is performed for approximately 15 to 20 seconds. When it is performed, the air-fuel ratio is forcibly regulated to go LEAN or RICH by the ECM, and if a RICH and LEAN cycle of the sensor 2 is long, the OSC will become greater. The greater OSC and capability of the catalyst are mutually related. The ECM judges if the catalyst has deteriorated based on the calculated OSC value. The ECM will illuminate the MIL and a DTC will be set.

DTC No.	DTC Detection Condition	Trouble Area
P0420	OSC value is smaller than the standard value under "active air-fuel ratio control"	• Exhaust manifold with front catalyst and exhaust front pipe with rear catalyst • Gas leakage in exhaust system • A/F sensor • Heated oxygen sensor

HINT:
- Sensor 1 refers to the sensor mounted before the TWC and is located near the engine assembly.
- Sensor 2 refers to the sensor mounted after the TWC and is located far from the engine assembly.

MONITOR STRATEGY

Related DTCs	P0420: Bank 1 catalyst is deterioration
Required sensors/components	Main: A/F sensor, heated oxygen sensor Related: Mass air flow meter, engine coolant temperature sensor, engine speed sensor, intake air temperature sensor
Frequency of operation	Once per driving cycle
Duration	30 seconds
MIL operation	2 driving cycles
Sequence of operation	None

TYPICAL ENABLING CONDITIONS

The monitor will run whenever the following DTCs are not present	P0011 (VVT system 1 - Advance) P0012 (VVT system 1 - Retard) P0031, P0032 (A/F sensor heater - Sensor 1) P0037, P0038 (O2 sensor heater - Sensor 2) P0100 - P0103 (MAF meter) P0115 - P0118 (ECT sensor) P0120 - P0223, P2135 (TP sensor) P0125 (Insufficient ECT for closed loop) P0136 (O2 sensor - Sensor 2) P0171, P0172 (Fuel system) P0300 - P0304 (Misfire) P0335 (CKP sensor) P0340, P0341 (CMP sensor) P0351-P0354 (Igniter) P0442 - P0456 (EVAP system) P0500 (VSS) P2196 (A/F sensor - Rationality) P2A00 (A/F sensor - Slow response)
Battery voltage	11.5 V or more
Altitude	Less than 2,400 m (8,000 ft)
Intake air temperature	-10 °C (14°F) or more
Idle	OFF
Engine speed	Less than 3,200 rpm
Engine coolant temperature	75°C (157°F) or more
Estimated catalyst temperature conditions are met:	1 & 2
1. Upstream estimated catalyst temperature	Less than 800°C (1,508°F), and 430°C (806°F) or more
2. Downstream estimated catalyst temperature	Less than 675°C (1,292°F), and 290°C (554°F) or more
Fuel system status	Closed-loop

TYPICAL MALFUNCTION THRESHOLDS

Oxygen storage capacity	Less than 0.03 g

MONITOR RESULT

Refer to detailed information (see page ES-15).

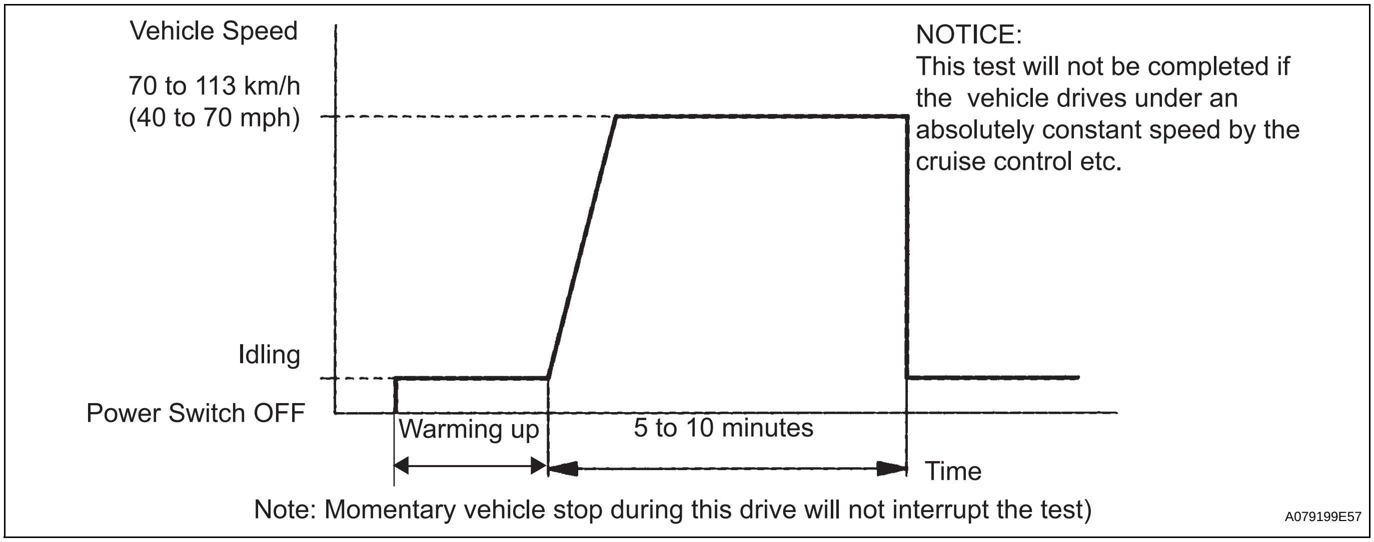
CONFIRMATION DRIVING PATTERN

PURPOSE (see page ES-17)

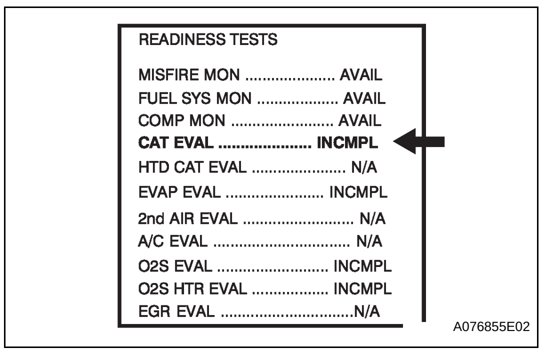
HINT:

Performing this confirmation pattern will activate the catalyst monitoring by the ECM. This is very useful for verifying the completion of repairs.

ES



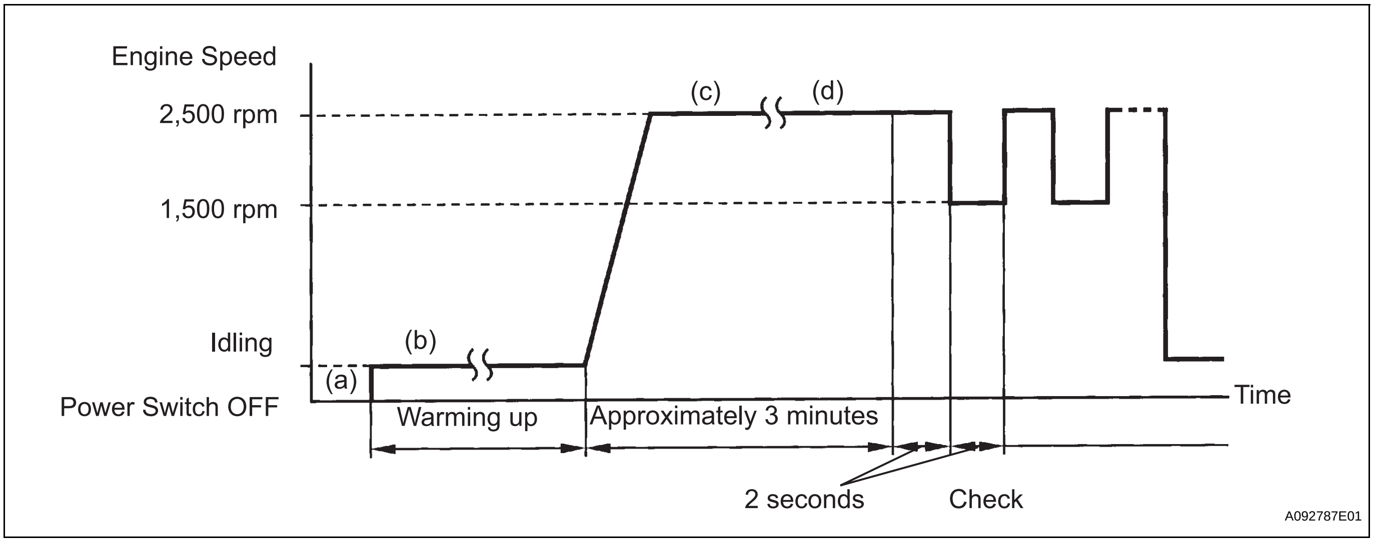
(a) Clear the DTCs.
(b) Connect the intelligent tester to the DLC3.
(c) Enter the following menus: DIAGNOSIS / CARB OBD II / READINESS TESTS. Check that CAT EVAL is INCMPL (incomplete).



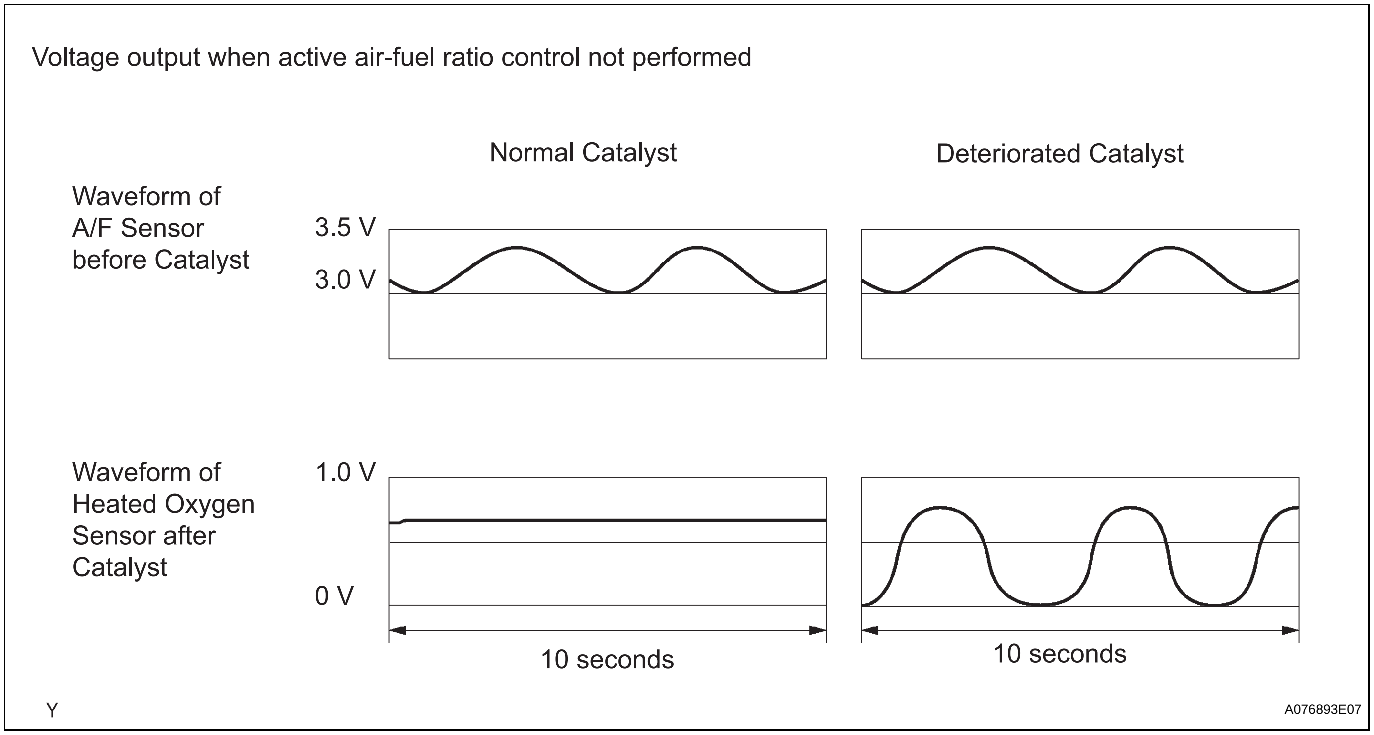
(d) Drive the vehicle according to the confirmation driving pattern. Note the state of the Readiness Tests. They will change to COMPL (complete) as the CAT evaluation monitors operate.
(e) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DTC INFO / PENDING CODES. Check if any DTC (any pending code) is set.
If the READINESS CODE of CAT EVAL was INCMPL and any DTC (includes pending codes) was not set, extend the driving time.

NOTICE:
If you do not have the intelligent tester, perform again the same confirmation driving pattern after turning OFF the power switch upon finishing the first confirmation driving pattern.

CONDITIONING FOR SENSOR TESTING



(a) Connect the intelligent tester to the DLC3.
(b) Put the engine in inspection mode (see page ES-1).
(c) Start the engine and warm it up with all the accessories switched OFF until the engine coolant temperature becomes table.
(d) Run the engine at 2,500 rpm for approximately 3 minutes.
(e) Run the engine at 2,500 rpm for 2 seconds and then 1,500 rpm for 2 seconds.
(f) Check the waveform of the oxygen sensor (sensor 2).
HINT:
If output of the A/F sensor or the heated oxygen sensor does not fluctuate or has noise, the sensor may be malfunctioning.
If voltage output of both sensors remain at LEAN or RICH, the air-fuel ratio may be extremely LEAN or RICH. In such a case, perform the following A/F CONTROL operation in ACTIVE TEST using the intelligent tester. If the catalyst has deteriorated, the voltage output of the heated oxygen sensor fluctuates up and down widely even under normal driving ("active air-fuel ratio control" is not performed).



INSPECTION PROCEDURE

HINT:

- Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunction is detection. 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.
- Malfunctioning areas can be found by performing the ACTIVE TEST / A/F CONTROL operation. The A/F CONTROL operation can determine if the A/F sensor, heated oxygen sensor or other potential trouble area are malfunctioning or not.
  (a) Perform the ACTIVE TEST A/F CONTROL operation..
- The A/F CONTROL operation lowers the injection volume 12.5% or increases the injection volume 25%.
  (1) Connect the intelligent tester to the DLC3.
  (2) Turn the power switch ON (IG).
  (3) Put the engine in inspection mode (see page ES-1).
  (4) Warm up the engine by running the engine at 2,500 rpm, depressing the accelerator pedal more than 60% for approximately 90 seconds.
  (5) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / A/F CONTROL.
  (6) Perform the A/F CONTROL operation with the engine in an idle condition (press the right or left button).

  Result:

  A/F sensor reacts in accordance with increase and decrease of injection volume:
  +25% → rich output: Less than 3.0 V
  -12.5% → lean output: More than 3.35 V
  Heated oxygen sensor reacts in accordance with increase and decrease of injection volume:
  +25% → rich output: More than 0.55 V
  -12.5% → lean output: Less than 0.4 V

NOTICE:

The A/F sensor output has a few seconds of delay and the heated oxygen sensor output has about 20 seconds of delay at maximum.

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	 OK	Output Voltage More than 0.55 V Less than 0.4 V	 OK	
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	NG	Output Voltage More than 0.55 V Less than 0.4 V	 OK	
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	 OK	Output Voltage Almost no reaction	NG	

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%		• Fuel Injector • Fuel pressure • Gas leakage from exhaust system (Air-fuel ratio extremely or lean rich)
	Output Voltage Almost no reaction	NG	Output Voltage Almost no reaction	NG	

The following A/F CONTROL procedure enables the technician to check and graph the voltage output of both A/F sensor and heated oxygen sensor.
To display the graph, enter ACTIVE TEST/ A/F CONTROL/USER DATA, select "AFS B1S1 and O2S B1S2" by pressing the "YES" button followed by the "ENTER" button and then the "F4" button.

ES

1 CHECK OTHER DTC OUTPUT (IN ADDITION TO DTC P0420)

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

Result

Display (DTC Output)	Proceed to
P0420	A
P0420 and other DTCs	B

HINT:
If any other codes besides P0420 are output, perform troubleshooting for those DTCs first.

B → **GO TO RELEVANT DTC CHART**

A

2 CHECK FOR EXHAUST GUS LEAKAGE

OK:
No gas leakage.

NG → **REPAIR OR REPLACE EXHAUST GAS LEAKAGE POINT**

OK

3 INSPECT AIR FUEL RATIO SENSOR (BANK 1 SENSOR 1)

NG → **REPLACE AIR FUEL RATIO SENSOR**

OK

4	INSPECT HEATED OXYGEN SENSOR (BANK 1 SENSOR 2)

NG → **REPLACE HEATED OXYGEN SENSOR**

OK

REPLACE THREE-WAY CATALYTIC CONVERTER (REPLACE FRONT PIPE)

DTC	P043E	Evaporative Emission System Reference Orifice Clog Up

DTC	P043F	Evaporative Emission System Reference Orifice High Flow

DTC	P2401	Evaporative Emission Leak Detection Pump Stuck OFF

DTC	P2402	Evaporative Emission Leak Detection Pump Stuck ON

DTC	P2419	Evaporative Emission Pressure Switching Valve Stuck ON

DTC SUMMARY

DTC No.	Monitoring Items	Malfunction Detection Conditions	Trouble Areas	Detection Timing	Detection Logic
P043E P043F P2401 P2402 P2419	Reference orifice clogged	P043E, P043F, P2401, P2402 and P2419 are present when one of the following conditions is met during key-off EVAP monitor: • EVAP pressure just after reference pressure measurement greater than 752 mmHg-a • Reference pressure less than 724 mmHg-a • Reference pressure greater than 752 mmHg-a • Reference pressure is not saturated • Reference pressure difference between first and second is 5 mmHg-g or more HINT: These values are typical	• Canister pump module (Reference orifice, leak detection pump, vent valve) • Connector/wire harness (Canister pump module - ECM) • EVAP system hose (pipe from air inlet port to canister pump module, canister filter, fuel tank vent hose) • ECM	Power switch OFF	2 trip

DESCRIPTION

NOTICE:

In this vehicle's EVAP system, turning ON the vent valve does not seal off the EVAP system. To check for leaks in the EVAP system, disconnect the air inlet vent hose and apply pressure from the atmosphere side of the canister.

While the engine is running, if a predetermined condition (closed loop, etc.) is met, the purge VSV is opened by the ECM and stored fuel vapors in the canister are purged to the intake manifold. The ECM changes the duty cycle ratio of the purge VSV to control purge flow volume.

The purge flow volume is also determined by the intake manifold pressure. Atmospheric pressure is allowed into the canister through the vent valve to ensure that the purge flow is maintained when the negative pressure (vacuum) is applied to the canister.

Key-off monitor

This monitor checks for Evaporative Emission (EVAP) system leaks and canister pump module malfunctions. The monitor starts 5 hours* after the power switch is turned OFF. More than 5 hours are required to allow the fuel to cool down to stabilize the Fuel Tank Pressure (FTP), thus making the EVAP system monitor more accurate.

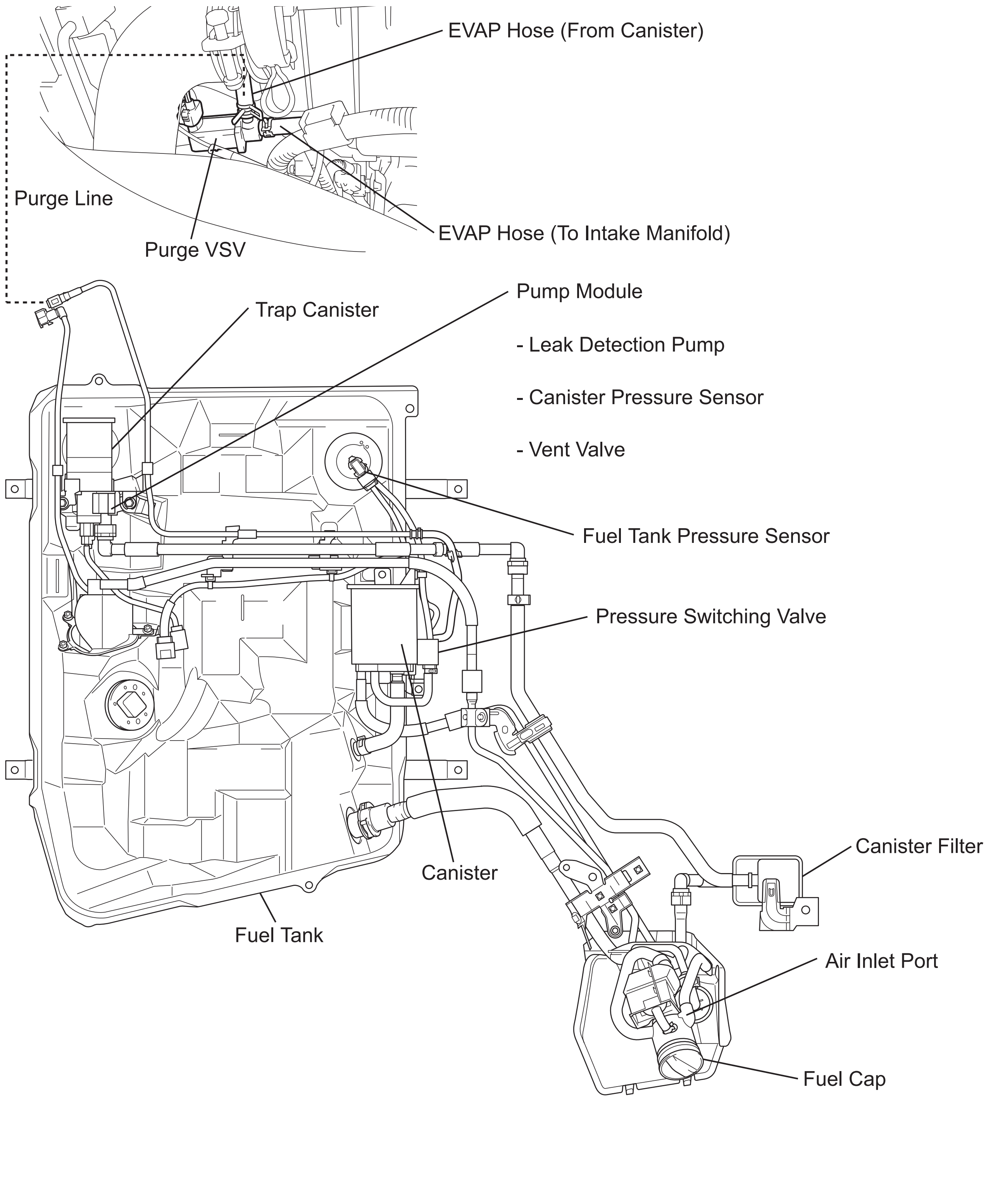
The leak detection pump creates negative pressure (vacuum) in the EVAP system and the pressure is measured. Finally, the ECM monitors for leaks from the EVAP system and malfunctions in both the canister pump module and purge VSV, based on the EVAP pressure.

HINT:

*: If the engine coolant temperature is not below 35°C (95°F) 5 hours after the power switch is turned OFF, the monitor check starts 2 hours later. If it is still not below 35°C (95°F) 7 hours after the power switch is turned OFF, the monitor check starts 2.5 hours later.

ES

Location


EVAP Hose (From Canister)
Purge Line
Purge VSV
EVAP Hose (To Intake Manifold)
Trap Canister
Pump Module
- Leak Detection Pump
- Canister Pressure Sensor
- Vent Valve
Fuel Tank Pressure Sensor
Pressure Switching Valve
Canister Filter
Canister
Fuel Tank
Air Inlet Port
Fuel Cap
A131350E01

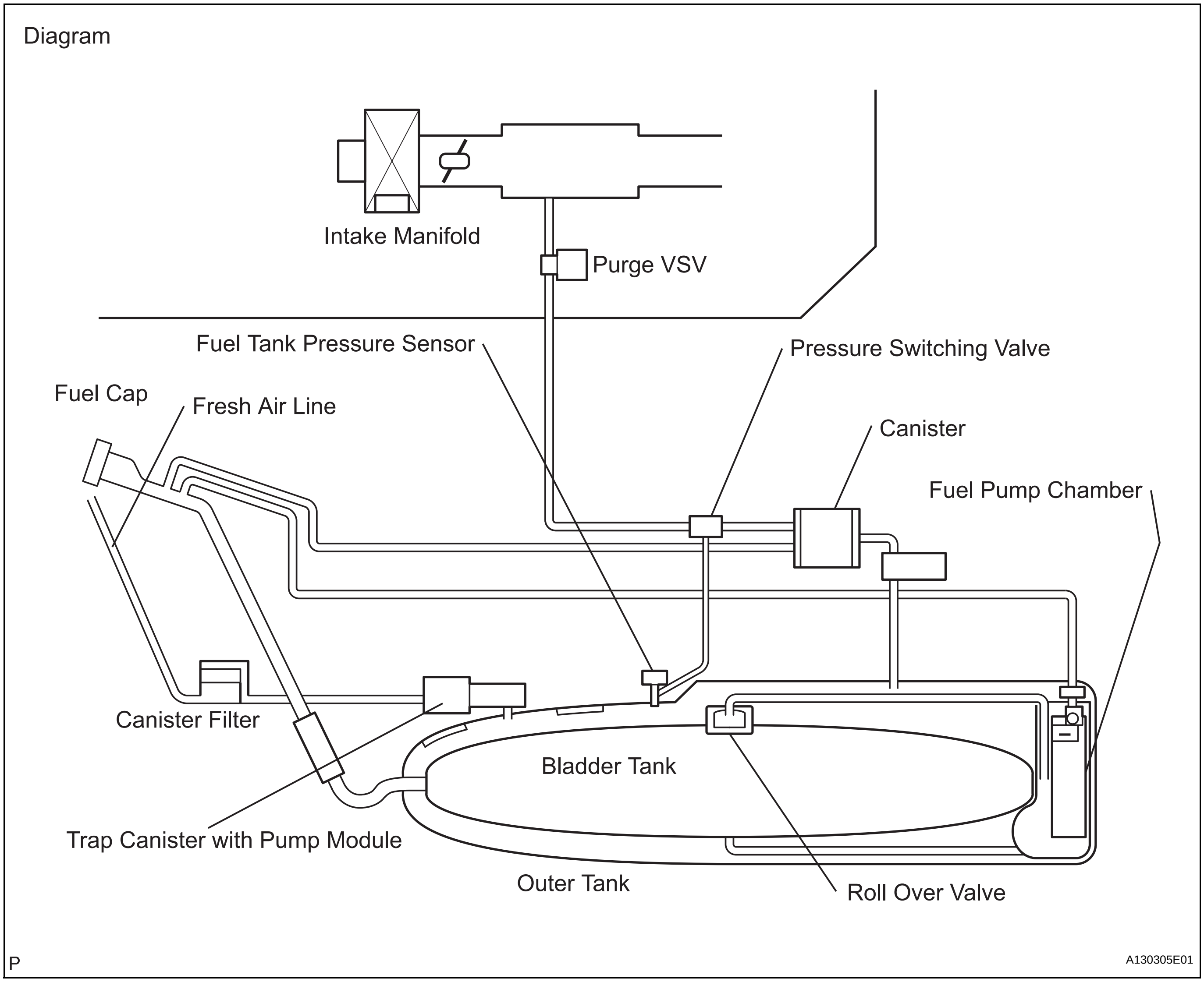
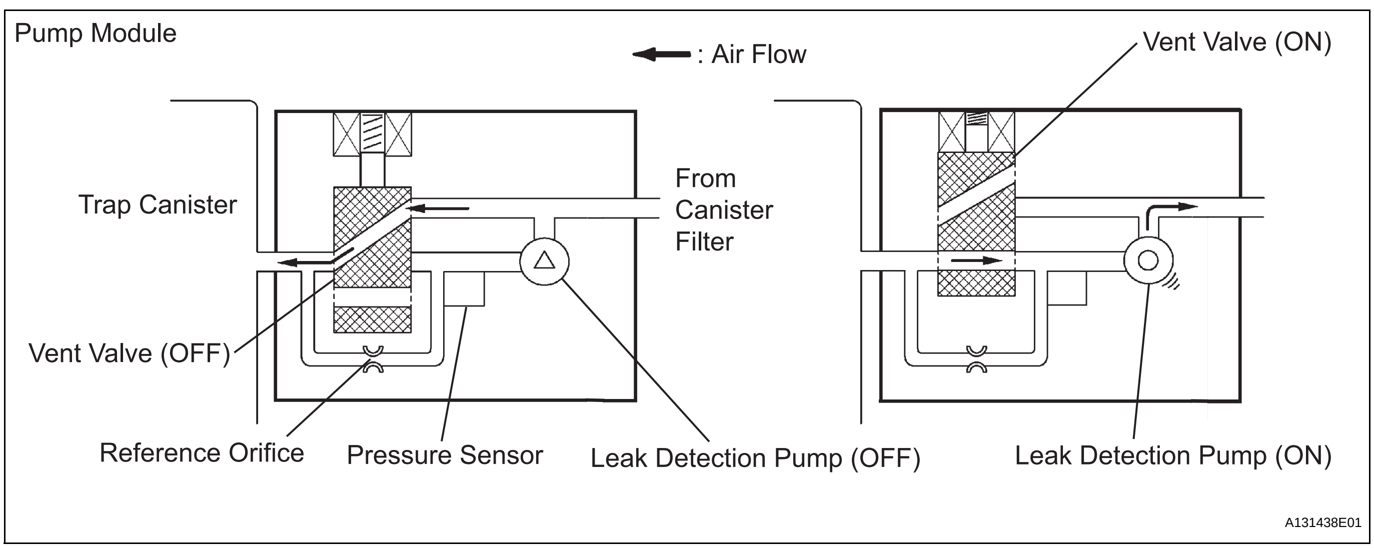
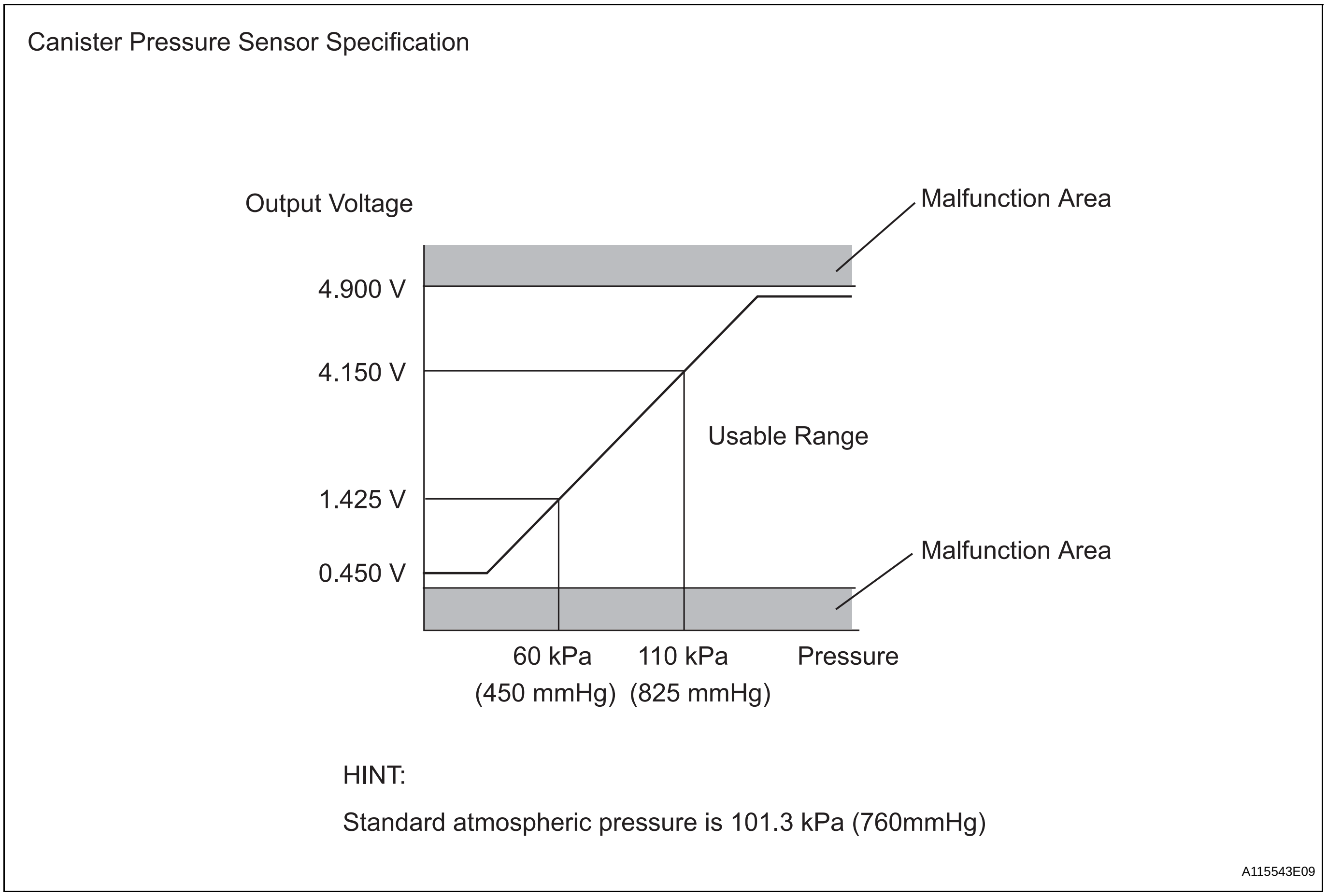


Diagram
Intake Manifold
Purge VSV
Fuel Tank Pressure Sensor
Pressure Switching Valve
Fuel Cap
Fresh Air Line
Canister
Fuel Pump Chamber
Canister Filter
Bladder Tank
Trap Canister with Pump Module
Outer Tank
Roll Over Valve
P
A130305E01


Pump Module
: Air Flow
Vent Valve (ON)
Trap Canister
From
Canister
Filter
Vent Valve (OFF)
Reference Orifice
Pressure Sensor
Leak Detection Pump (OFF)
Leak Detection Pump (ON)
A131438E01



Components	Operations
Canister, Trap canister	Contains activated charcoal to absorb EVAP generated in fuel tank.
Cut-off valve	Located in fuel tank. Valve floats and closes when fuel tank 100% full.
Purge Vacuum Switching Valve (VSV)	Opens or closes line between canister and intake manifold. ECM uses purge VSV to control EVAP purge flow. In order to discharge EVAP absorbed by canister to intake manifold, ECM opens purge VSV. EVAP discharge volume to intake manifold controlled by purge VSV duty cycle ratio (current-carrying time) (open: ON; closed: OFF).
Roll-over valve	Located in fuel tank. Valve closes by its own weight when vehicle overturns to prevent fuel from spilling out.
Soak timer	Built into ECM. To ensure accurate EVAP monitor, measures 5 hours (+-15 min) after power switch OFF. This allows fuel to cool down, stabilizing Fuel Tank Pressure (FTP). When approximately 5 hours elapsed, ECM activates.
Pressure switching valve	The pressure switching valve located on the canister is used to detect leakage from the bladder tank into the fuel tank. The valve opens during the bladder tank leak check. Then, the fuel tank's fuel vapor flows to the intake manifold without passing the canister.
Pump module	Consists of (a) to (d) below. pump module cannot be disassembled.
(a) Vent valve	Vents and closes EVAP system. When ECM turns valve ON, EVAP system closed. When ECM turns valve OFF, EVAP system vented. Negative pressure (vacuum) created in EVAP system to check for EVAP leaks by closing purge VSV, turning vent valve ON (closed) and operating leak detection pump.
(b) Canister pressure sensor	Indicates pressure as voltage. ECM supplies regulated 5 V to canister pressure sensor, and uses feedback from sensor to monitor EVAP system pressure.
(c) Leak detection pump	Creates negative pressure (vacuum) in EVAP system for leak check.

Components	Operations
(d) Reference orifice	Has opening with 0.02 inch diameter. Vacuum produced through orifice by closing purge VSV, turning vent valve OFF and operating leak detection pump to monitor 0.02 inch leak criterion. 0.02 inch leak criterion indicates small leak of EVAP.

MONITOR DESCRIPTION

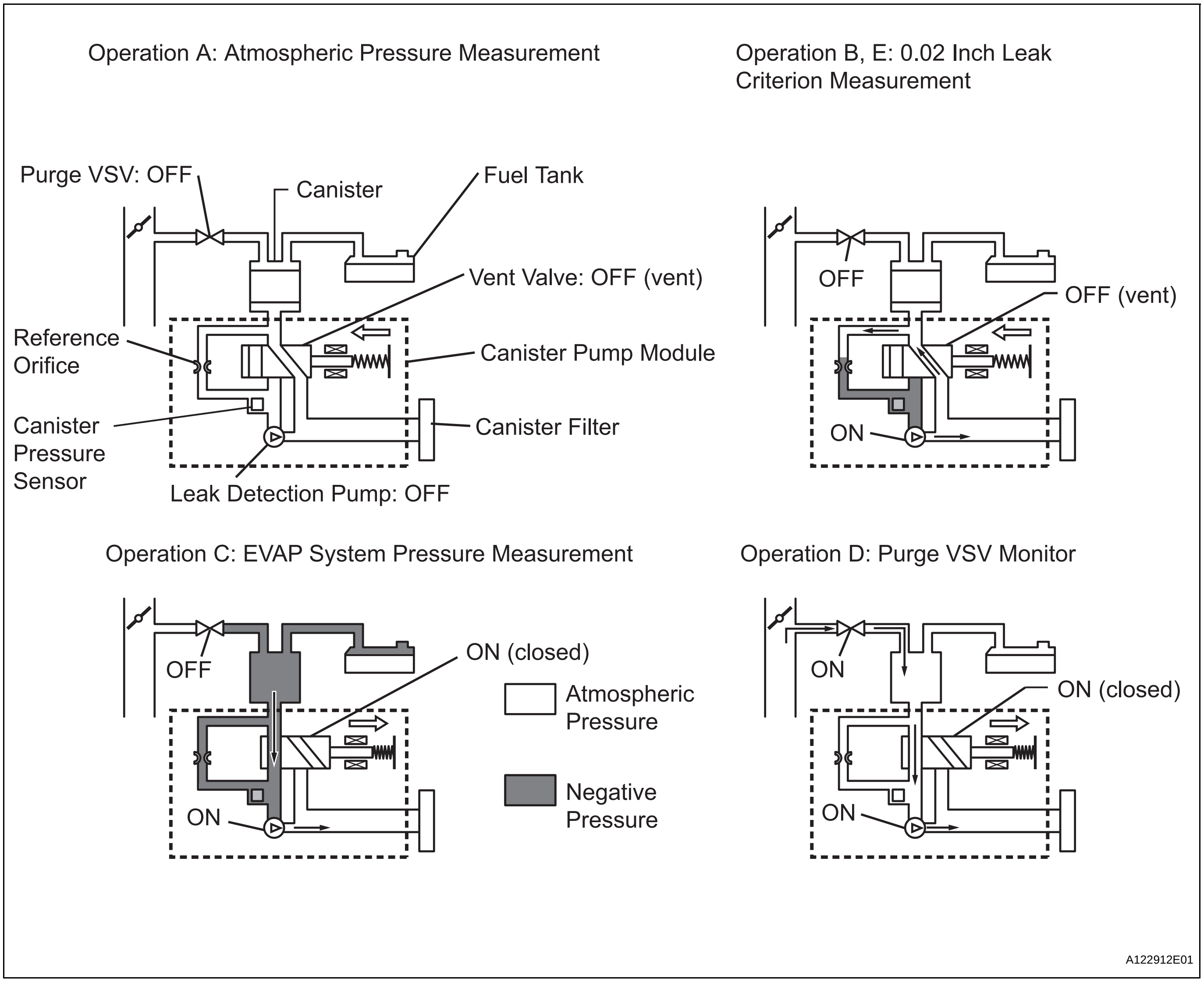
5 hours* after the power switch is turned OFF, the leak detection pump creates negative pressure (vacuum) in the EVAP system. The ECM monitors for leaks and actuator malfunctions based on the EVAP pressure.

HINT:

*: If the engine coolant temperature is not below 35°C (95°F) 5 hours after the power switch is turned OFF, the monitor check starts 2 hours later. If it is still not below 35°C (95°F) 7 hours after the power switch is turned OFF, the monitor check starts 2.5 hours later.

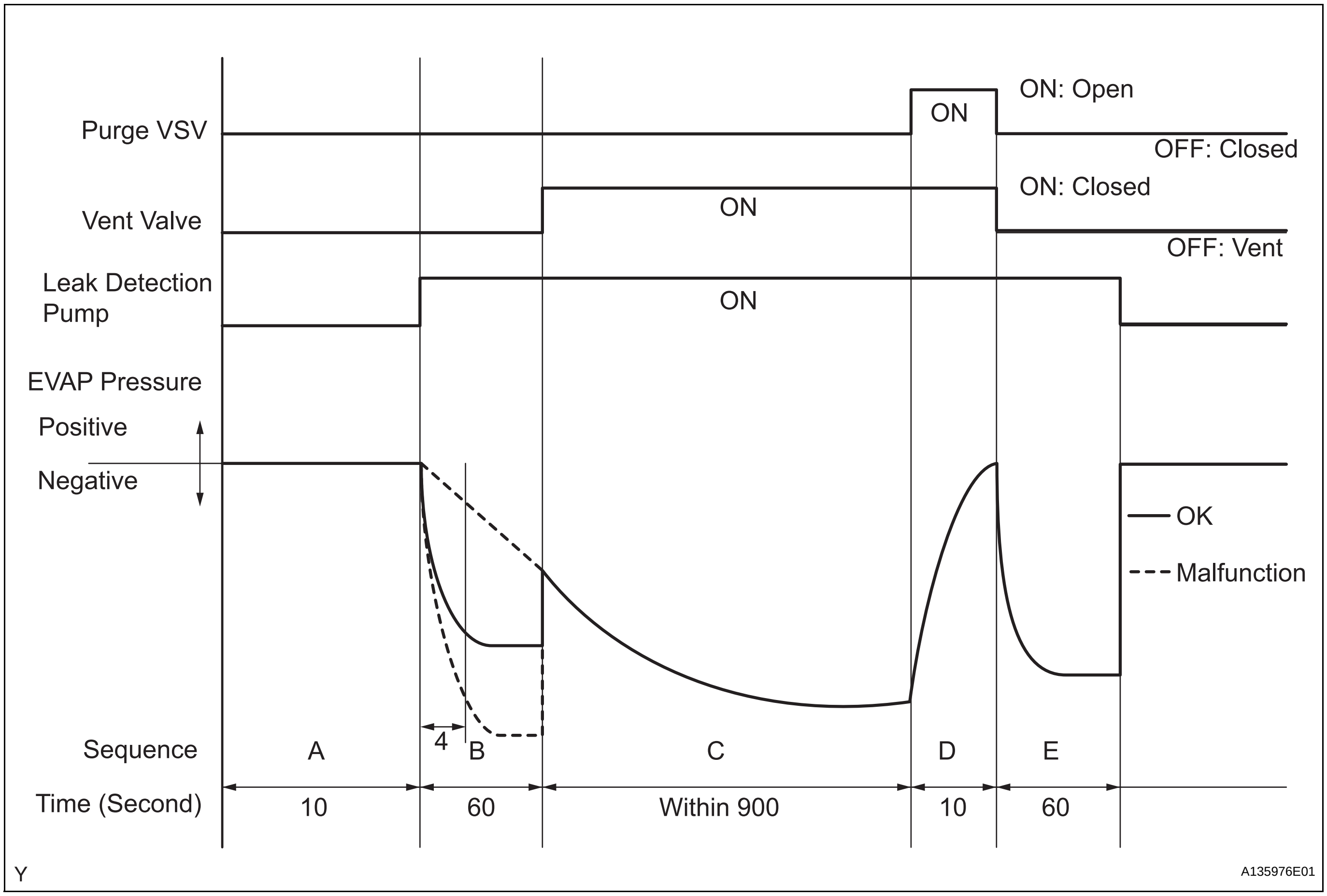
Sequence	Operations	Descriptions	Duration
-	ECM activation	Activated by soak timer 5, 7 or 9.5 hours after power switch OFF.	-
A	Atmospheric pressure measurement	Vent valve turned OFF (vent) and EVAP system pressure measured by ECM in order to register atmospheric pressure. If pressure in EVAP system not between 70 kPa and 110 kPa (525 mmHg and 825 mmHg), ECM cancels EVAP system monitor.	10 seconds
B	First 0.02 inch leak criterion measurement	In order to determine 0.02 inch leak criterion, leak detection pump creates negative pressure (vacuum) through reference orifice and then ECM checks if leak detection pump and vent valve operate normally.	60 seconds
C	EVAP system pressure measurement	Vent valve turned ON (closed) to shut EVAP system. Negative pressure (vacuum) created in EVAP system, and EVAP system pressure then measured. Write down measured value as it will be used in leak check. If EVAP pressure does not stabilize within 900 seconds, ECM cancels EVAP system monitor.	900 seconds*
D	Purge VSV monitor	Purge VSV opened and then EVAP system pressure measured by ECM. Large increase indicates normal.	10 seconds
E	Second 0.02 inch leak criterion measurement	After second 0.02 inch leak criterion measurement, leak check performed by comparing first and second 0.02 inch leak criterion. If stabilized system pressure higher than second 0.02 inch leak criterion, ECM determines that EVAP system leaking.	60 seconds
-	Final check	Atmospheric pressure measured and then monitoring result recorded by ECM.	-

*: If only a small amount of fuel is in the fuel tank, it takes longer for the EVAP pressure to stabilize.



In sequences B and E, the leak detection pump creates negative pressure (vacuum) through the reference orifice. If the pressure is lower than 724 mmHg-a, higher than 752 mmHg-a, is not saturated and the pressure difference at sequences B and E is large, the ECM interprets this as a clog malfunction in the reference orifice, and stops the EVAP system monitor. The ECM then illuminates the MIL and sets the DTC (2 trip detection logic).

These values vary with atmospheric pressure. Atmospheric pressure = 760 mmHg-a = 101.3 kPa



MONITOR STRATEGY

Required Sensors/Components	Purge VSV and canister pump module
Frequency of Operation	Once per driving cycle
Duration	Maximum 15 seconds
MIL Operation	2 driving cycles
Sequence of 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 (Misfire) P0335 (CKP sensor) P0340, P0341 (CMP sensor) P0351, P0352, P0353, P0354 (Igniter) P0450, P0452, P0453 (EVAP press sensor) P0500 (VSS)
Atmospheric pressure	70 to 110 kPa (525 to 825 mmHg)
Battery voltage	10.5 V or higher
Vehicle speed	Less than 4 km/h (2.5 mph)
Power switch	OFF
Time after key off	5 or 7 or 9.5 hours

Purge VSV	Not operated by scan tool
Vent valve	Not operated by scan tool
Leak detection pump	Not operated by scan tool
Both of the following conditions 1 and 2 are met before key off	-
1. Duration that vehicle has been driven	5 minutes or more
2. EVAP purge operation	Performed
ECT	4.4 to 35°C (40 to 95°F)
IAT	4.4 to 35°C (40 to 95°F)

1. Key-off monitor sequence 1 to 8

1. Atmospheric pressure measurement

Next sequence is run if the following condition is met	-
Atmospheric pressure change	Within 0.3 kPa (2.25 mmHg) in 1 second

2. First reference pressure measurement

Next sequence is run if the following conditions are met	-
EVAP pressure just after reference pressure measurement start	-1 kPa (-7.5 mmHg) or lower
Reference pressure	-4.85 to -1.05 kPa (726 to 754 mmHg)
Reference pressure	Saturated within 60 seconds

3. Vent valve stuck closed check

Next sequence is run if the following condition is met	-
EVAP pressure change after vent valve is ON	0.3 kPa (2.25 mmHg) or more

4. Vacuum introduction

Next sequence is run if the following condition is met	-
EVAP pressure	Saturated within 900 seconds

5. Purge VSV stuck closed check

Next sequence is run if the following condition is met	-
EVAP pressure change after purge VSV is open	0.3 kPa (2.25 mmHg) or more

6. Second reference pressure measurement

Next sequence is run if the following conditions are met	-
EVAP pressure just after reference pressure measurement	-1 kPa (-7.5 mmHg) or lower
Reference pressure	-4.85 to -1.05 kPa (726 to 754 mmHg)
Reference pressure	Saturated within 60 seconds
Reference pressure difference between first and second	Less than 0.7 kPa (5.25 mmHg)

7. Leak check

Next sequence is run if the following condition is met	-
EVAP pressure when vacuum introduction is complete	Lower than second reference pressure

8. Atmospheric pressure measurement

EVAP monitor is complete if the following condition is met	-
Atmospheric pressure difference between sequence 1 and 8	Within 0.3 kPa (2.25 mmHg)

TYPICAL MALFUNCTION THRESHOLDS

"Saturated" indicates that the EVAP pressure change is less than 0.1 kPa (0.75 mmHg) in 30 seconds.

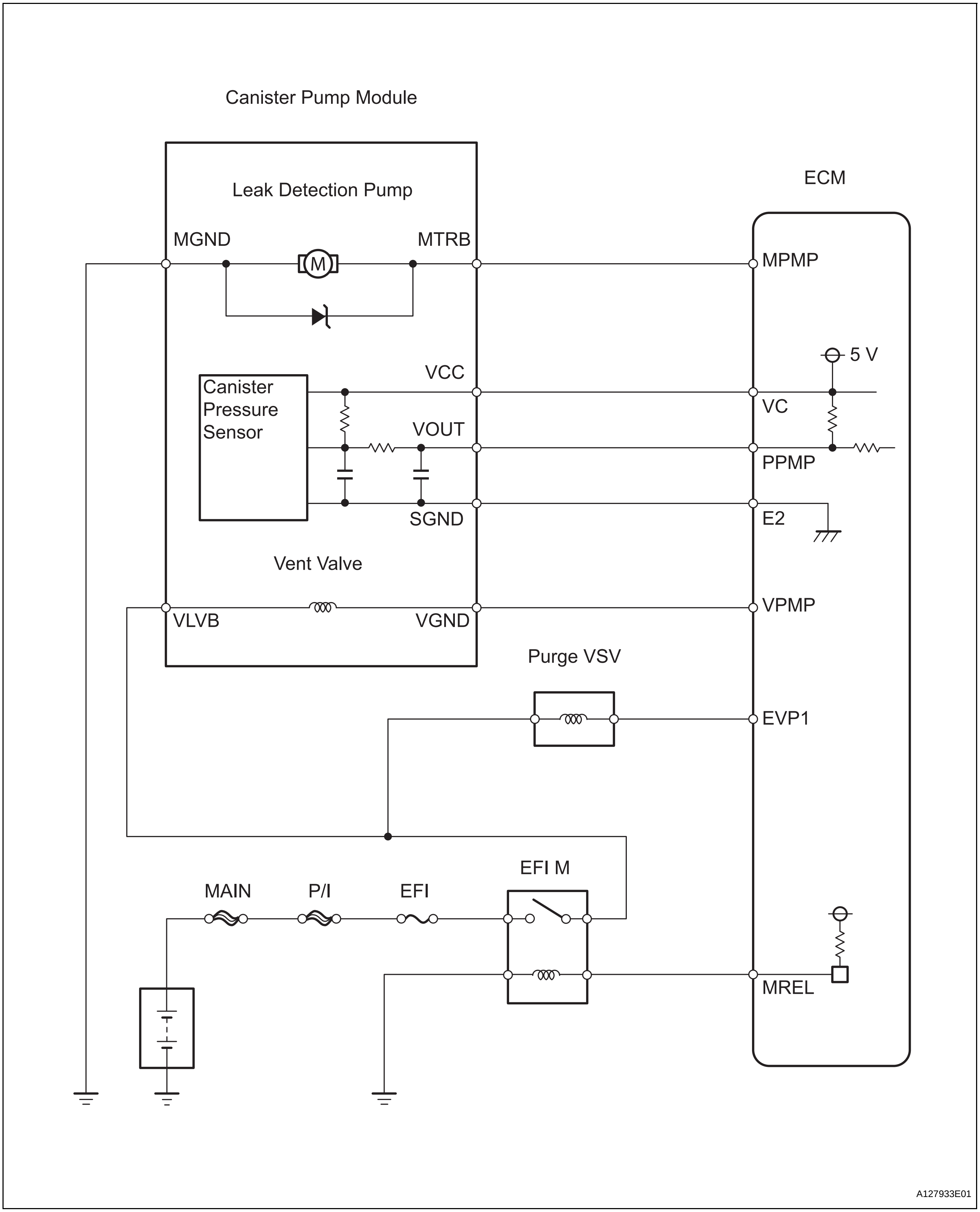
One of following conditions met	-
FTP when just after reference pressure measurement began	Higher than -1 kPa (755 mmHg)
Reference pressure	Less than -4.85 kPa (726 mmHg)
Reference pressure	-1.05 kPa (754 mmHg) or higher
Reference pressure	Not saturated

Reference pressure difference between first and second	0.7 kPa (5.25 mmHg) or more

MONITOR RESULT

Refer to CHECKING MONITOR STATUS (see page ES-15).

WIRING DIAGRAM



INSPECTION PROCEDURE

NOTICE:

The intelligent tester is required to conduct the following diagnostic troubleshooting procedure.

HINT:
- Using the intelligent tester monitor results enable the EVAP system to be confirmed.
- Read freeze frame data using the intelligent tester. Freeze frame data records the engine conditions when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1	CONFIRM DTC

(a) Turn the power switch OFF and wait for 10 seconds.
(b) Turn the power switch ON (IG).
(c) Turn the power switch OFF and wait for 10 seconds.
(d) Connect the intelligent tester to the DLC3.
(e) Turn the power switch ON (IG).
(f) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DTC INFO / CURRENT CODES.
(g) Check if DTC P0446 is output.

NO → **Go to step 5**

YES

2	PERFORM EVAP SYSTEM CHECK

(a) Note the freeze frame data and DTCs.
(b) Clear DTCs.
(c) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / SYSTEM CHECK / EVAP SYS CHECK / AUTO OPERATION.
(d) After the system check is finished, check for pending DTCs.

OK:
No DTC is present.

NG → **Go to step 6**

OK

3	CHECK OPERATION FOR PRESSURE SWITCHING VALVE

(a) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / TANK BYPASS VSV.
(b) Touch the pressure switching valve (TANK BYPASS VSV) to feel the operating vibration.

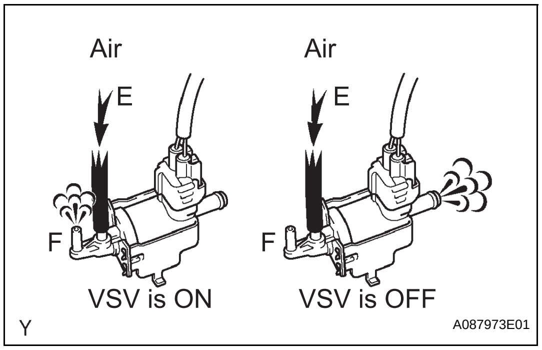
OK:
The pressure switching valve is operated by the ACTIVE TEST.

NG → **Go to step 18**

OK

ES

4 CHECK PRESSURE SWITCHING VALVE



(a) Turn the power switch OFF.
(b) Remove the pressure switching valve (see page EC-31).
(c) Reconnect the pressure switching valve connector.
(d) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / TANK BYPASS VSV.
(e) Check the airflow for the pressure switching valve.
OK:
The pressure switching valve operates normally.

NG	Go to step 19
OK	Go to step 33

ES

5 PERFORM EVAP SYSTEM CHECK

(a) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / SYSTEM CHECK / EVAP SYS CHECK / AUTO OPERATION.
(b) After the system check is finished, check for pending DTCs.
OK:
DTCs are present.

NG	CHECK INTERMITTENT PROBLEMS

OK

6 CHECK DTC

(a) Check the DTCs that were present at the EVAP system check.
OK:
P043E, P043F, P2401, P2402 and P2419 are present.

NG	Go to step 10

OK

7 CHECK VENT VALVE CLOSE STUCK

(a) Allow the engine to idle.
(b) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / EVAP VSV.
(c) Turn the EVAP VSV ON (purge VSV open) and check the VAPOR PRESS (EVAP pressure) for 10 seconds.
OK:
EVAP pressure is higher than 755 mmHg.

NG	Go to step 20

OK

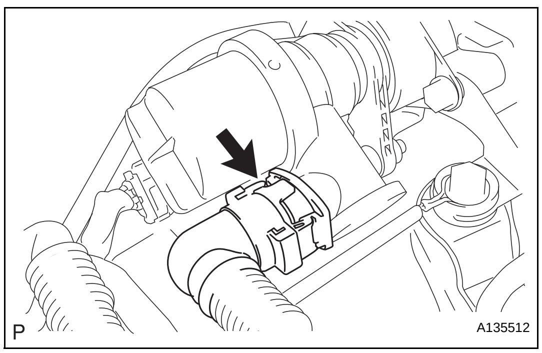
8	CHECK LEAK DETECTION PUMP OPERATION

(a) Turn the power switch OFF.
(b) Turn the power switch ON (IG).
(c) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / VACUUM PUMP.
(d) Touch the pump module to feel the operating vibration.
OK:
The leak detection pump is operated by the ACTIVE TEST.

NG → **Go to step 21**

OK

9	CHECK TRAP CANISTER



(a) Disconnect the vent hose from the pump module.
(b) Check that no moisture is in the pump module or the vent hose.
OK:
No moisture.

OK → **Go to step 22**

NG → **Go to step 23**

10	CHECK DTC

(a) Check the DTCs that were present at the EVAP system check.
OK:
P0441, P0455 and/or P0456 are present.

NG → **Go to step 16**

OK

11	CHECK INSTALLATION FOR FUEL CAP

(a) Remove the fuel cap.
(b) Reinstall the fuel cap.
(c) Clear DTCs.
(d) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / SYSTEM CHECK / EVAP SYS CHECK / AUTO OPERATION.
(e) After the system check is finished, check for pending DTCs.

HINT:
If no DTC is present, this indicates that the fuel cap is loosened.

OK:

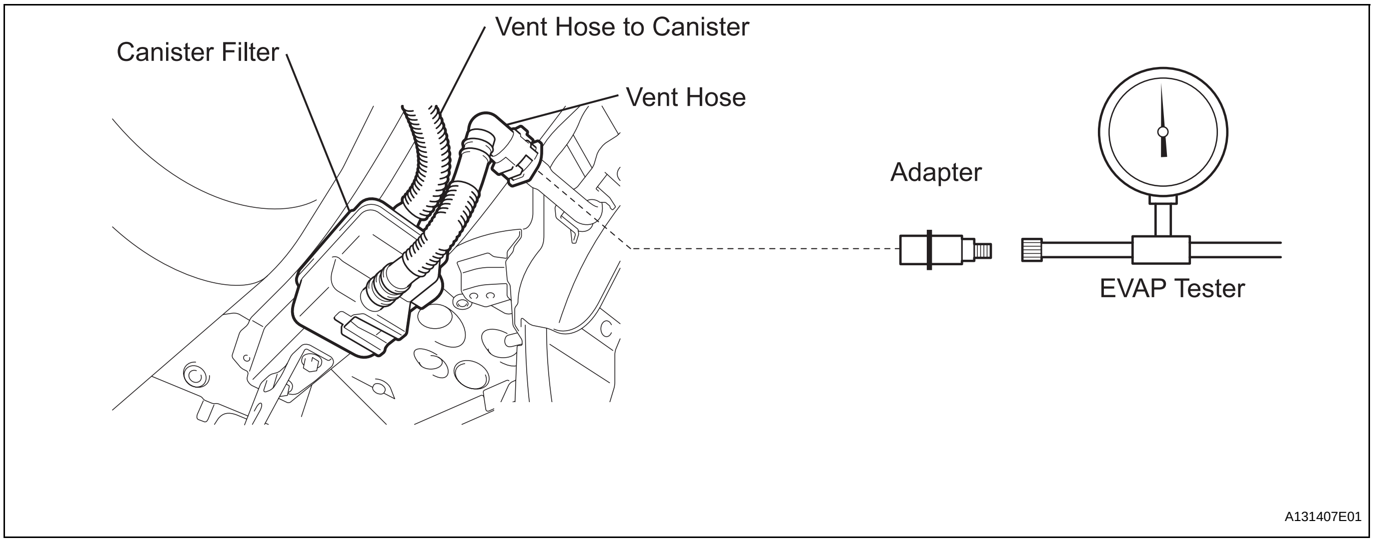
No DTC is present.

OK → **REPAIR COMPLETED**

NG

12 LOCATE LEAK POINT

(a) Disconnect the vent hose (fresh air line) as shown in the illustration.



(b) Connect the pressure gauge and air pump as shown in the illustration.

(c) Pressurize the EVAP system until 24 to 28 mmHg.

(d) Locate the leak point.

HINT:
If the EVAP system has leakage, a whistling sound may be heard.

OK:

The leak point is found.

OK → **Go to step 24**

NG

13 CHECK FUEL CAP

Check that the fuel cap meets OEM specifications.

HINT:
If an EVAP tester is available, perform the fuel cap test according to the tester's instructions.

OK:

Fuel cap meets OEM specifications.

NG → **Go to step 25**

OK

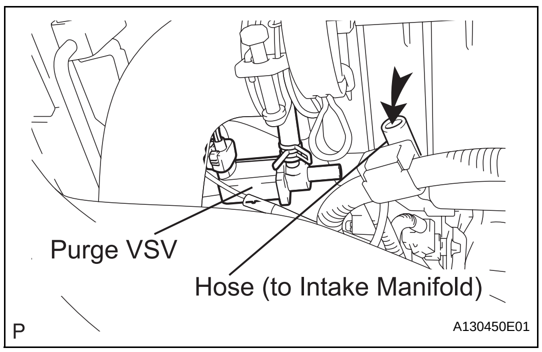
14 CHECK OPERATION FOR PURGE VSV

(a) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / EVAP VSV.
(b) Touch the purge VSV to feel the operating vibration.
OK:
The purge VSV (EVAP VSV) is operated by the ACTIVE TEST.

NG	**Go to step 26**

OK

15 CHECK INTAKE MANIFOLD PRESSURE



(a) Disconnect the purge VSV hose that is connected to the throttle body.
(b) Allow the engine to idle.
(c) Check that the hose has suction using your finger.
OK:
The hose has suction.

NG	**Go to step 27**
OK	**Go to step 28**

16 CHECK DTC

(a) Check the DTCs that were present at the EVAP system check.
OK:
P0451 is not present.

NG	**Go to step 9**

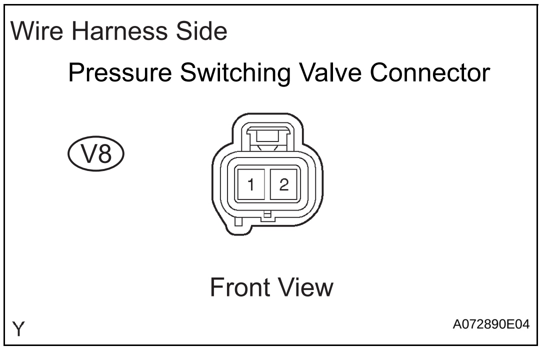
OK

17 CHECK OPERATION FOR VENT VALVE

(a) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / VENT VALVE.
(b) Touch the pump module to feel the operating vibration.
OK:
The vent valve is operated by the ACTIVE TEST.

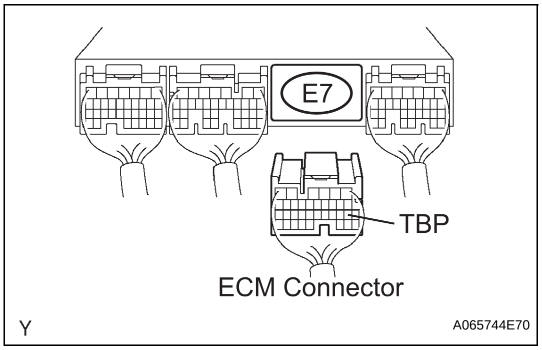
OK	**Go to step 9**
NG	**Go to step 29**

18	CHECK HARNESS AND CONNECTOR (PRESSURE SWITCHING VALVE - ECM AND EFI M RELAY)



(a) Check the harness and the connectors between the pressure switching valve and the ECM.

(1) Disconnect the V8 pressure switching valve connector.



(2) Disconnect the E7 ECM connector.

(3) Measure the resistance between the wire harness side connectors.

Standard resistance (Check for open)

Tester Connection	Specified Condition
V8-1 (Pressure switching valve) - E7-18 (TBP)	Below 1 Ω

Standard resistance (Check for short)

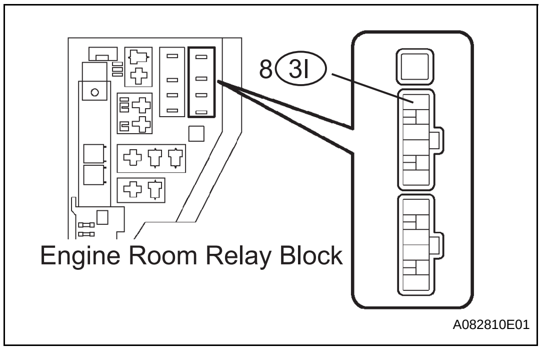
Tester Connection	Specified Condition
V8-1 (Pressure switching valve) or E7-18 (TBP) - Body ground	10 kΩ higher

(4) Reconnect the pressure switching valve connector.

(5) Reconnect the ECM connector.

(b) Check the harness and the connectors between the pressure switching valve and the EFI M relay.

(1) Disconnect the V8 pressure switching valve connector.



(2) Remove the integration relay from the engine room relay block.

(3) Measure the resistance between the wire harness side connector.

Standard resistance (Check for open)

Tester Connection	Specified Condition
V8-2 (Pressure switching valve) - 3I-8 (EFI M relay)	Below 1 Ω

Standard resistance (Check for short)

Tester Connection	Specified Condition
V8-2 (Pressure switching valve) or 3I-8 (EFI M relay) - Body ground	10 kΩ or higher

(4) Reconnect the pressure switching valve connector.

(5) Reinstall the integration relay.

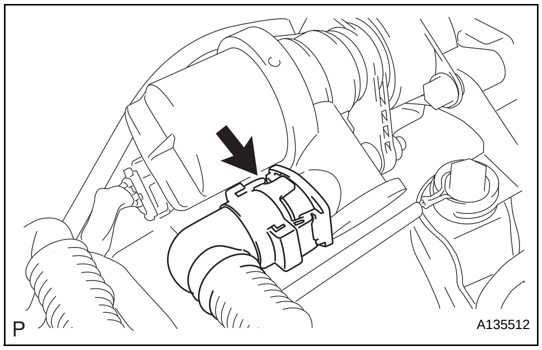
NG	**Go to step 30**
OK	**Go to step 31**

19 REPLACE PRESSURE SWITCHING VALVE

Replace the pressure switching valve (see page EC-31).

NEXT	Go to step 34

20 CHECK FOR VENT HOSE CLOG



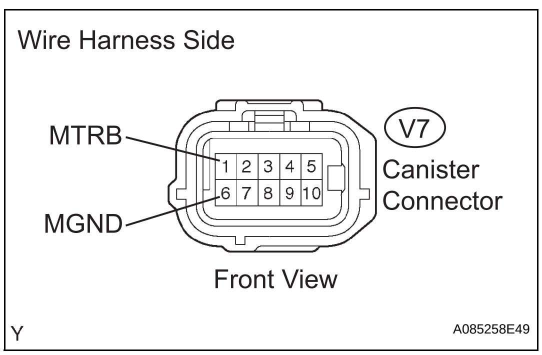
(a) Turn the power switch OFF.
(b) Disconnect the vent hose (fresh air line) as shown in the illustration.
(c) Allow the engine to idle.
(d) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / EVAP VSV.
(e) Turn the purge VSV (EVAP VSV) ON and check the EVAP pressure (VAPOR PRESS) for 10 seconds.

OK:

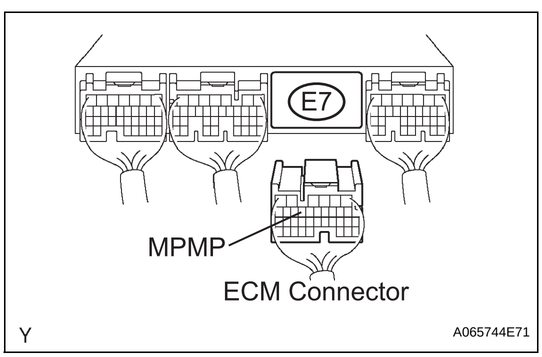
EVAP pressure is higher than 755 mmHg.

NG	Go to step 22
OK	Go to step 32

21 CHECK HARNESS AND CONNECTOR (LEAK DETECTION PUMP - ECM)



(a) Disconnect the V7 canister connector



(b) Disconnect the E7 ECM connector.
(c) Measure the resistance between the wire harness side connector.

Standard resistance (Check for open)

Tester Connection	Specified Condition
V7-1 (MTRB) - E7-13 (MPMP)	Below 1 Ω
V7-6 (MGND) - Body ground	Below 1 Ω

Standard resistance (Check for short)

Tester Connection	Specified Condition
V7-1 (MTRB) or E7-13 (MPMP) - Body ground	10 kΩ higher

(d) Reconnect the canister connector.
(e) Reconnect the ECM connector.

NG	Go to step 30
OK	Go to step 31

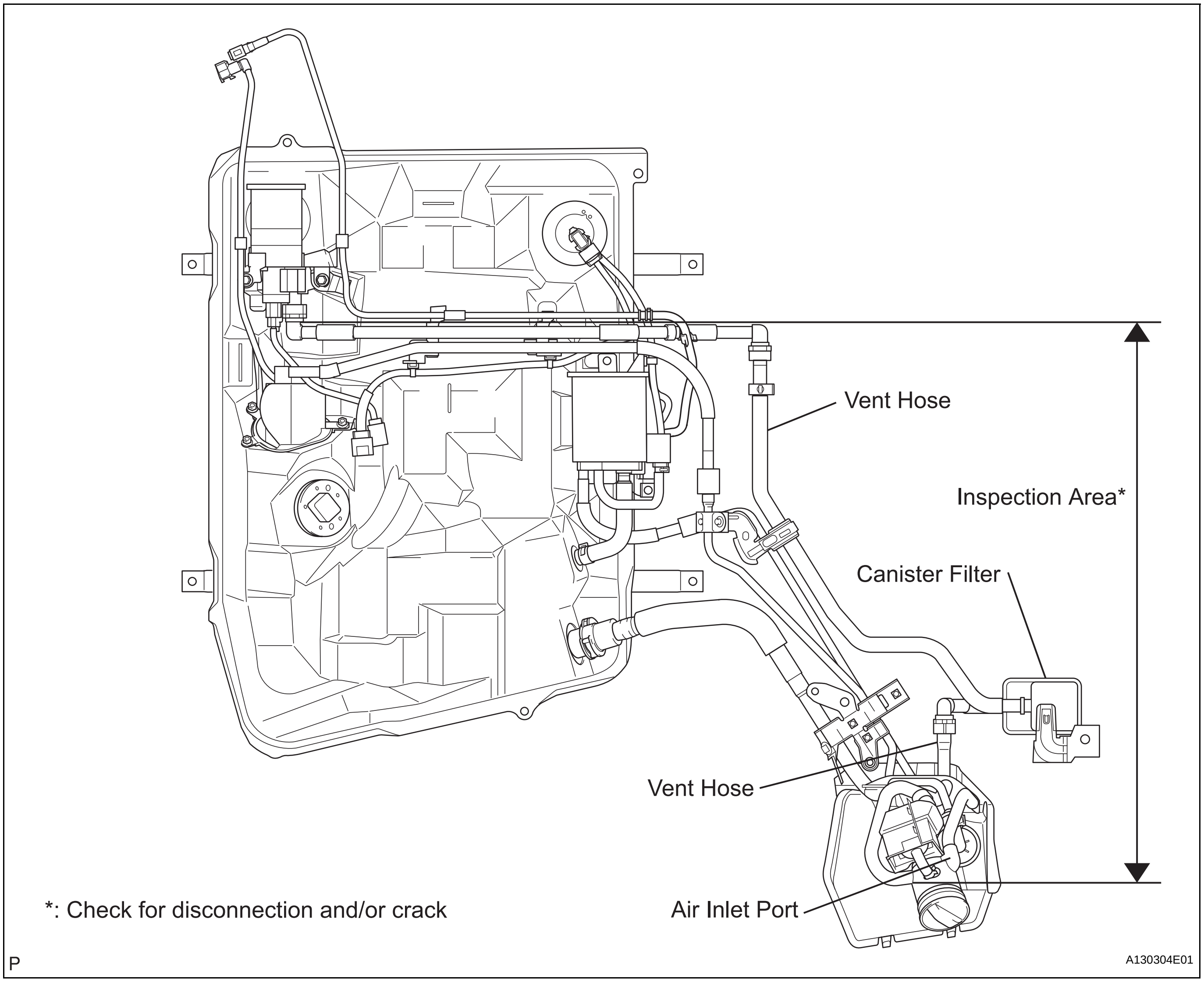
22 REPLACE TRAP CANISTER WITH PUMP MODULE

Replace the trap canister with pump module (see page EC-17).

NEXT	Go to step 34

23 CHECK FOR VENT HOSE DAMAGE

Check for hose damage as shown in the illustration. If necessary, replace the vent hose.



NEXT	Go to step 22

24 REPAIR OR REPLACE LEAK POINT

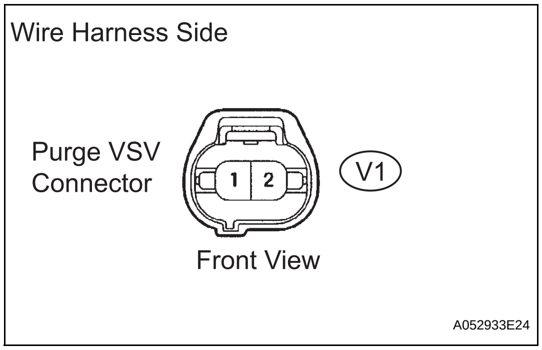
NEXT → Go to step 34

25 REPLACE FUEL CAP

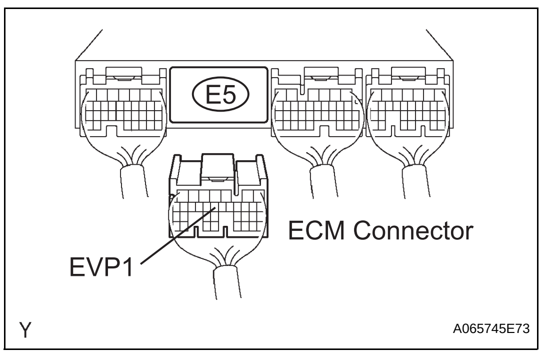
NEXT → Go to step 34

ES

26 CHECK HARNESS AND CONNECTOR (PURGE VSV - ECM)



(a) Disconnect the V1 purge VSV connector.



(b) Disconnect the E5 ECM connector.

(c) Check the harness and the connectors between the ECM and the purge VSV connectors.

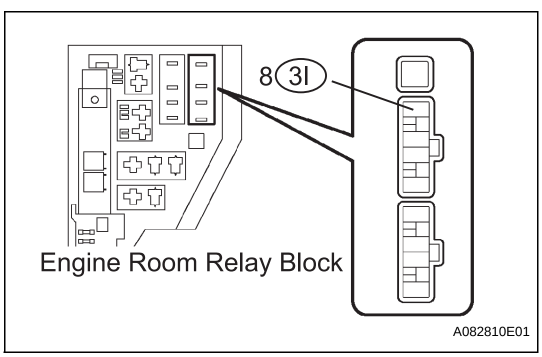
(1) Measure the resistance between the wire harness side connector.

Standard resistance (Check for open)

Tester Connection	Specified Condition
V1-1 - E5-14 (EVP1)	Below 1 Ω

Standard resistance (Check for short)

Tester Connection	Specified Condition
V1-1 or E5-14 (EVP1) - Body ground	10 kΩ higher



(d) Remove the integration relay from the engine room relay block.

(e) Check the harness and connectors between the purge VSV connector and the EFI M relay.

(1) Measure the resistance between the wire harness side connectors.

Standard resistance (Check for open)

Tester Connection	Specified Condition
V1-2 - 3I-8 (EFI M relay)	Below 1 Ω

Standard resistance (Check for short)

Tester Connection	Specified Condition
V1-2 or 3I-8 (EFI M relay) - Body ground	10 kΩ higher

(f) Reconnect the purge VSV connector.

(g) Reconnect the ECM connector.

(h) Reinstall the integration relay.

NG	Go to step 30
OK	Go to step 31

27 REPLACE HOSE (PURGE VSV - THROTTLE BODY)

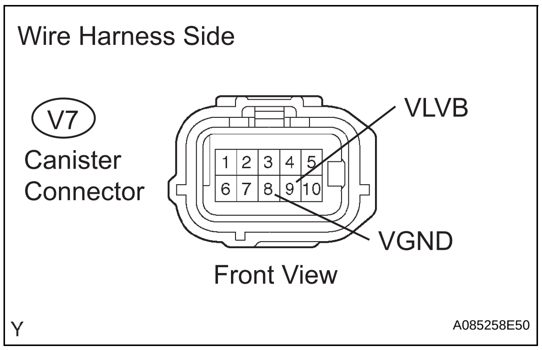
NEXT	Go to step 34

28 REPLACE PURGE VSV

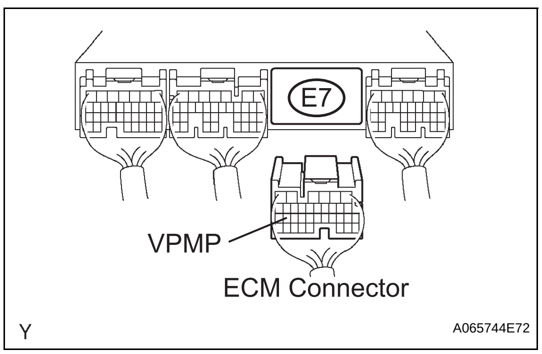
Replace the purge VSV (see page EC-23).

NEXT	Go to step 34

29 CHECK HARNESS AND CONNECTOR (VENT VALVE - ECM)



(a) Disconnect the V7 canister connector.



(b) Disconnect the E7 ECM connector.

(c) Check the harness and the connectors between the ECM and the canister connectors.

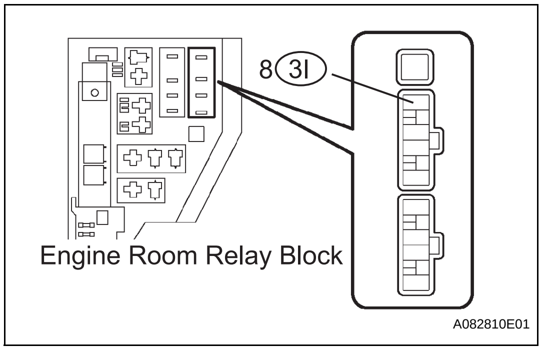
(1) Measure the resistance between the wire harness side connector.

Standard resistance (Check for open)

Tester Connection	Specified Condition
V7-8 (VGND) - E7-26 (VPMP)	Below 1 Ω

Standard resistance (Check for short)

Tester Connection	Specified Condition
V7-8 (VGND) or E7-26 (VPMP) - Body ground	10 kΩ higher



(d) Remove the integration relay from the engine room relay block.
(e) Check the harness and connectors between the canister connector and the EFI M relay.
(1) Measure the resistance between the wire harness side connectors.

Standard resistance (Check for open)

Tester Connection	Specified Condition
V7-9 (VLVB) - 3I-8 (EFI M relay)	Below 1 Ω

Standard resistance (Check for short)

Tester Connection	Specified Condition
V7-9 (VLVB) or 3I-8 (EFI M relay) - Body ground	10 kΩ higher

(f) Reconnect the canister connector.
(g) Reconnect the ECM connector.
(h) Reinstall the integration relay.

NG → **Go to step 30**

OK → **Go to step 31**

30 REPAIR OR REPLACE HARNESS AND CONNECTOR

NEXT → **Go to step 34**

31 REPLACE ECM

Replace the ECM (see page ES-469).

NEXT → **Go to step 34**

32 CHECK AND REPLACE VENT HOSE OR CANISTER FILTER

NEXT → **Go to step 34**

33 REPLACE HOSE (PRESSURE SWITCHING VALVE AND FUEL TANK)

NEXT

34 PERFORM EVAP SYSTEM CHECK

(a) Turn the power switch ON (IG).
(b) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / SYSTEM CHECK / EVAP SYS CHECK / AUTO OPERATION.
(c) After the system check is finished, check for pending DTCs.

OK:
No DTC is present.

NG → **Go to step 6**

OK

35 PERFORM EVAP MONITOR DRIVE PATTERN

(a) Check that the following conditions are met:
- Fuel level is 1/8 to 7/8.
- Engine coolant temperature (ECT) is 4.4 to 35°C (40 to 95°F).
- Intake air temperature (IAT) is 4.4 to 35°C (40 to 95°F).
- Difference of ECT and IAT is less than 7°C (13°F).

(b) Enter the check mode. Enter the following menus: DIAGNOSIS / ENHANCED OBD II / CHECK MODE.
(c) Allow the engine to idle until the ECT is 75°C (167°F).
(d) Drive the vehicle at 50 km/h (30 mph) or faster and maintain that speed for 60 seconds or more.
(e) Stop the vehicle. Do not turn the power switch OFF.
(f) Check that the EVAP monitor status is complete. Enter the following menus: DIAGNOSIS / ENHANCED OBD II / MONITOR STATUS.
(g) If the EVAP monitor is incomplete, drive the vehicle at 50 km/h (30 mph) or faster and maintain that speed for 120 seconds or more. After that, recheck the EVAP monitor status.
(h) Check for pending DTCs.

OK:
No DTC is present.

NG → **Go to step 2**

OK

REPAIR COMPLETED

ES

DTC P0441 Evaporative Emission Control System Incorrect Purge Flow

DTC SUMMARY

DTC No.	Monitoring Items	Malfunction Detection Conditions	Trouble Areas	Detection Timing	Detection Logic
P0441	Purge Vacuum Switching Valve (VSV) stuck open	Leak detection pump creates negative pressure (vacuum) in EVAP system and EVAP system pressure measured. 0.02 inch leak criterion measured at start and at end of leak check. If stabilized pressure higher than [second 0.02 inch leak criterion x 0.15], ECM determines that purge VSV stuck open.	• Purge VSV • Connector/wire harness (purge VSV - ECM) • ECM • Canister pump module • Leakage from EVAP system	While power switch OFF	2 trip
P0441	Purge VSV stuck closed	After EVAP leak check performed, purge VSV turned ON (open), and atmospheric air introduced into EVAP system. 0.02 inch leak criterion measured at start and at end of leak check. If pressure does not return to near atmospheric pressure, ECM determines that purge VSV stuck closed.	• Purge VSV • Connector/wire harness (purge VSV - ECM) • ECM • Canister pump module • Leakage from EVAP system	While power switch OFF	2 trip
P0441	Purge flow	While engine running, following conditions are met: • Negative pressure not created in EVAP system when purge VSV turned ON (open) • Atmospheric pressure change before and after purge flow monitor less than 0.93 kPa (7 mmHg)	• Purge VSV • Connector/wire harness (purge VSV - ECM) • Leakage from EVAP line (purge VSV - Intake manifold) • ECM	While engine running	2 trip

DESCRIPTION

NOTICE:

In this vehicle's EVAP system, turning ON the vent valve does not seal off the EVAP system. To check for leaks in the EVAP system, disconnect the air inlet vent hose and apply pressure from the atmosphere side of the canister.

While the engine is running, if a predetermined condition (closed loop, etc.) is met, the purge VSV is opened by the ECM and stored fuel vapors in the canister are purged to the intake manifold. The ECM changes the duty cycle ratio of the purge VSV to control purge flow volume.

The purge flow volume is also determined by the intake manifold pressure. Atmospheric pressure is allowed into the canister through the vent valve to ensure that the purge flow is maintained when the negative pressure (vacuum) is applied to the canister.

Key-off monitor

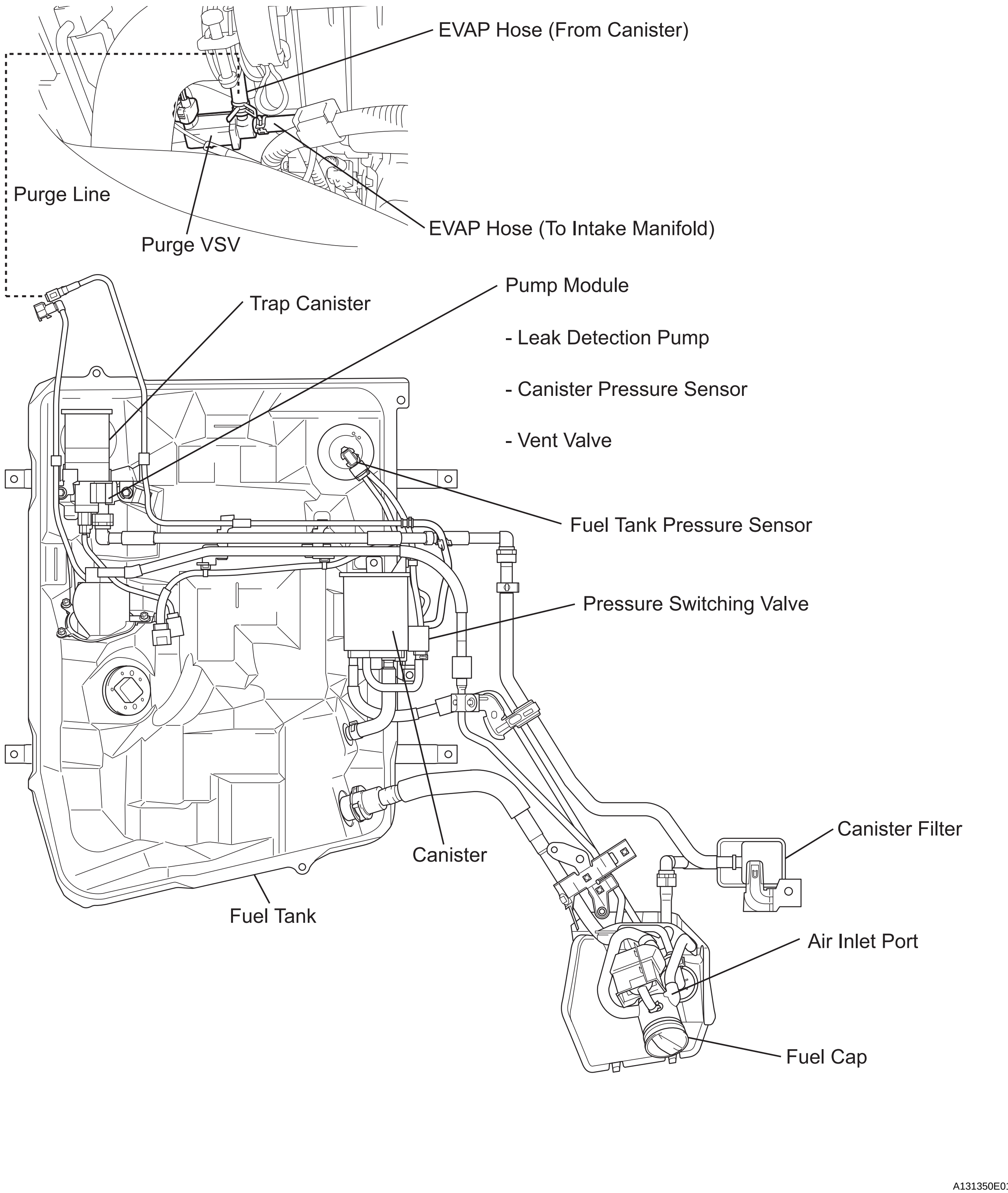
This monitor checks for Evaporative Emission (EVAP) system leaks and canister pump module malfunctions. The monitor starts 5 hours* after the power switch is turned OFF. More than 5 hours are required to allow the fuel to cool down to stabilize the Fuel Tank Pressure (FTP), thus making the EVAP system monitor more accurate.

The leak detection pump creates negative pressure (vacuum) in the EVAP system and the pressure is measured. Finally, the ECM monitors for leaks from the EVAP system and malfunctions in both the canister pump module and purge VSV, based on the EVAP pressure.

HINT:

*: If the engine coolant temperature is not below 35°C (95°F) 5 hours after the power switch is turned OFF, the monitor check starts 2 hours later. If it is still not below 35°C (95°F) 7 hours after the power switch is turned OFF, the monitor check starts 2.5 hours later.

Location


EVAP Hose (From Canister)
Purge Line
Purge VSV
EVAP Hose (To Intake Manifold)
Pump Module
- Leak Detection Pump
- Canister Pressure Sensor
- Vent Valve
Trap Canister
Fuel Tank Pressure Sensor
Pressure Switching Valve
Canister Filter
Canister
Fuel Tank
Air Inlet Port
Fuel Cap
A131350E01

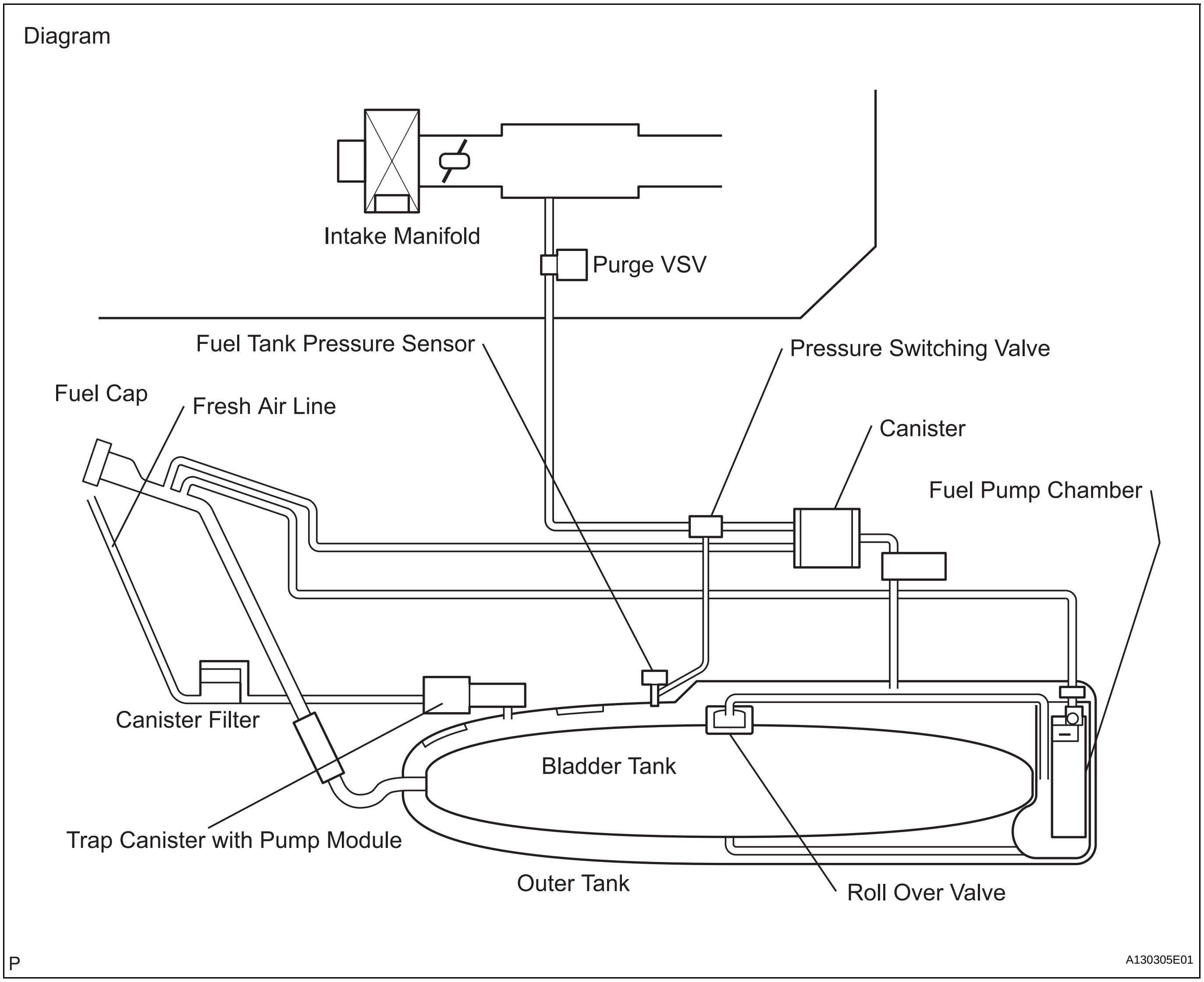
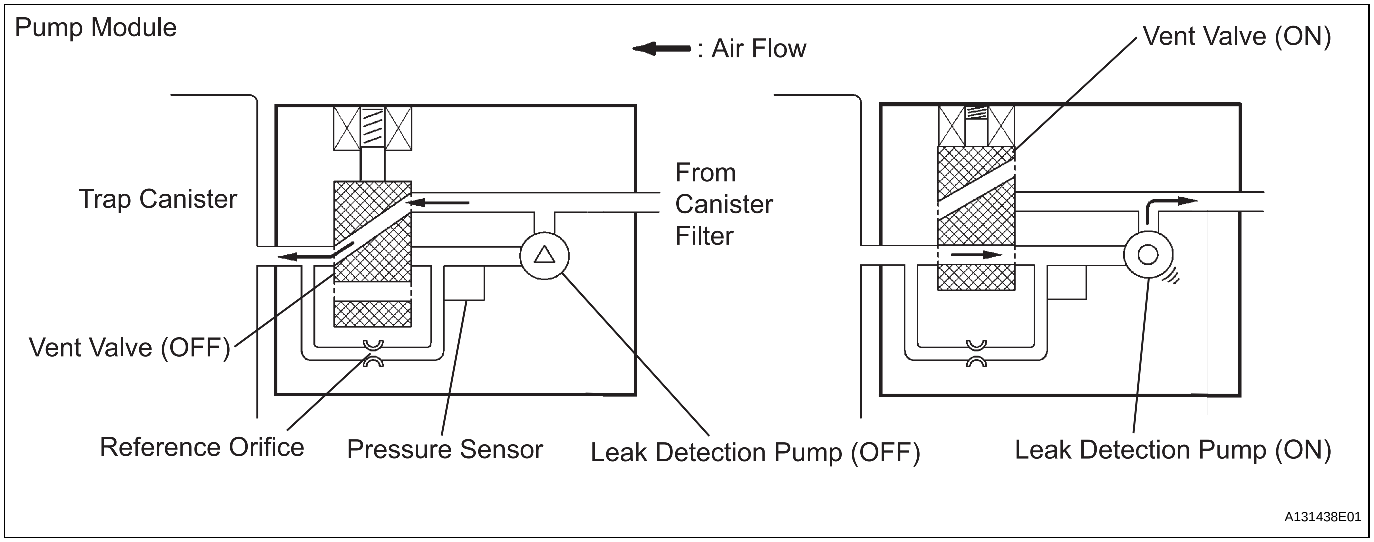
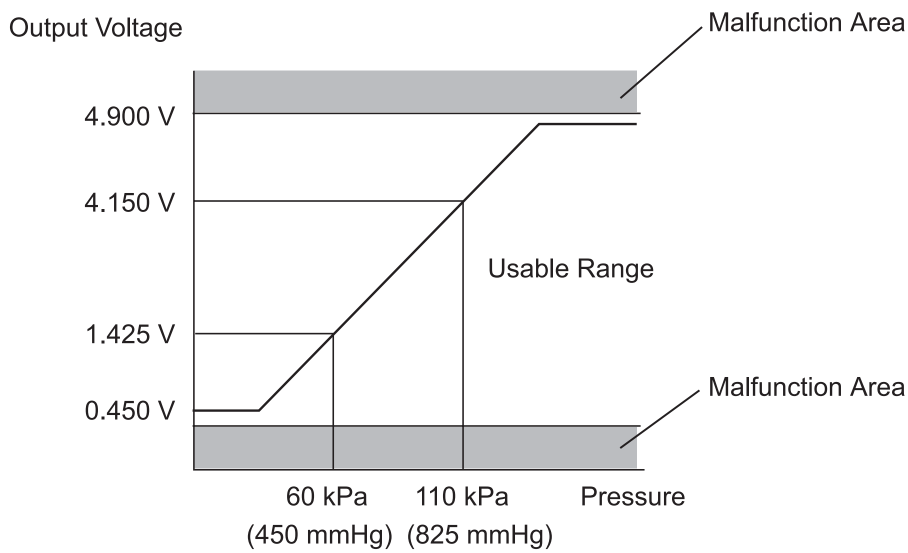


Diagram
Intake Manifold
Purge VSV
Fuel Tank Pressure Sensor
Pressure Switching Valve
Fuel Cap
Fresh Air Line
Canister
Fuel Pump Chamber
Canister Filter
Bladder Tank
Trap Canister with Pump Module
Outer Tank
Roll Over Valve
P
A130305E01


Pump Module
: Air Flow
Vent Valve (ON)
Trap Canister
From Canister Filter
Vent Valve (OFF)
Reference Orifice
Pressure Sensor
Leak Detection Pump (OFF)
Leak Detection Pump (ON)
A131438E01

Canister Pressure Sensor Specification



HINT:

Standard atmospheric pressure is 101.3 kPa (760mmHg)

A115543E09

Components	Operations
Canister, Trap canister	Contains activated charcoal to absorb EVAP generated in fuel tank.
Cut-off valve	Located in fuel tank. Valve floats and closes when fuel tank 100% full.
Purge Vacuum Switching Valve (VSV)	Opens or closes line between canister and intake manifold. ECM uses purge VSV to control EVAP purge flow. In order to discharge EVAP absorbed by canister to intake manifold, ECM opens purge VSV. EVAP discharge volume to intake manifold controlled by purge VSV duty cycle ratio (current-carrying time) (open: ON; closed: OFF).
Roll-over valve	Located in fuel tank. Valve closes by its own weight when vehicle overturns to prevent fuel from spilling out.
Soak timer	Built into ECM. To ensure accurate EVAP monitor, measures 5 hours (+-15 min) after power switch OFF. This allows fuel to cool down, stabilizing Fuel Tank Pressure (FTP). When approximately 5 hours elapsed, ECM activates.
Pressure switching valve	The pressure switching valve located on the canister is used to detect leakage from the bladder tank into the fuel tank. The valve opens during the bladder tank leak check. Then, the fuel tank's fuel vapor flows to the intake manifold without passing the canister.
Pump module	Consists of (a) to (d) below. Pump module cannot be disassembled.
(a) Vent valve	Vents and closes EVAP system. When ECM turns valve ON, EVAP system closed. When ECM turns valve OFF, EVAP system vented. Negative pressure (vacuum) created in EVAP system to check for EVAP leaks by closing purge VSV, turning vent valve ON (closed) and operating leak detection pump (refer to fig. 1).
(b) Canister pressure sensor	Indicates pressure as voltage. ECM supplies regulated 5 V to canister pressure sensor, and uses feedback from sensor to monitor EVAP system pressure (refer to fig. 2).
(c) Leak detection pump	Creates negative pressure (vacuum) in EVAP system for leak check.

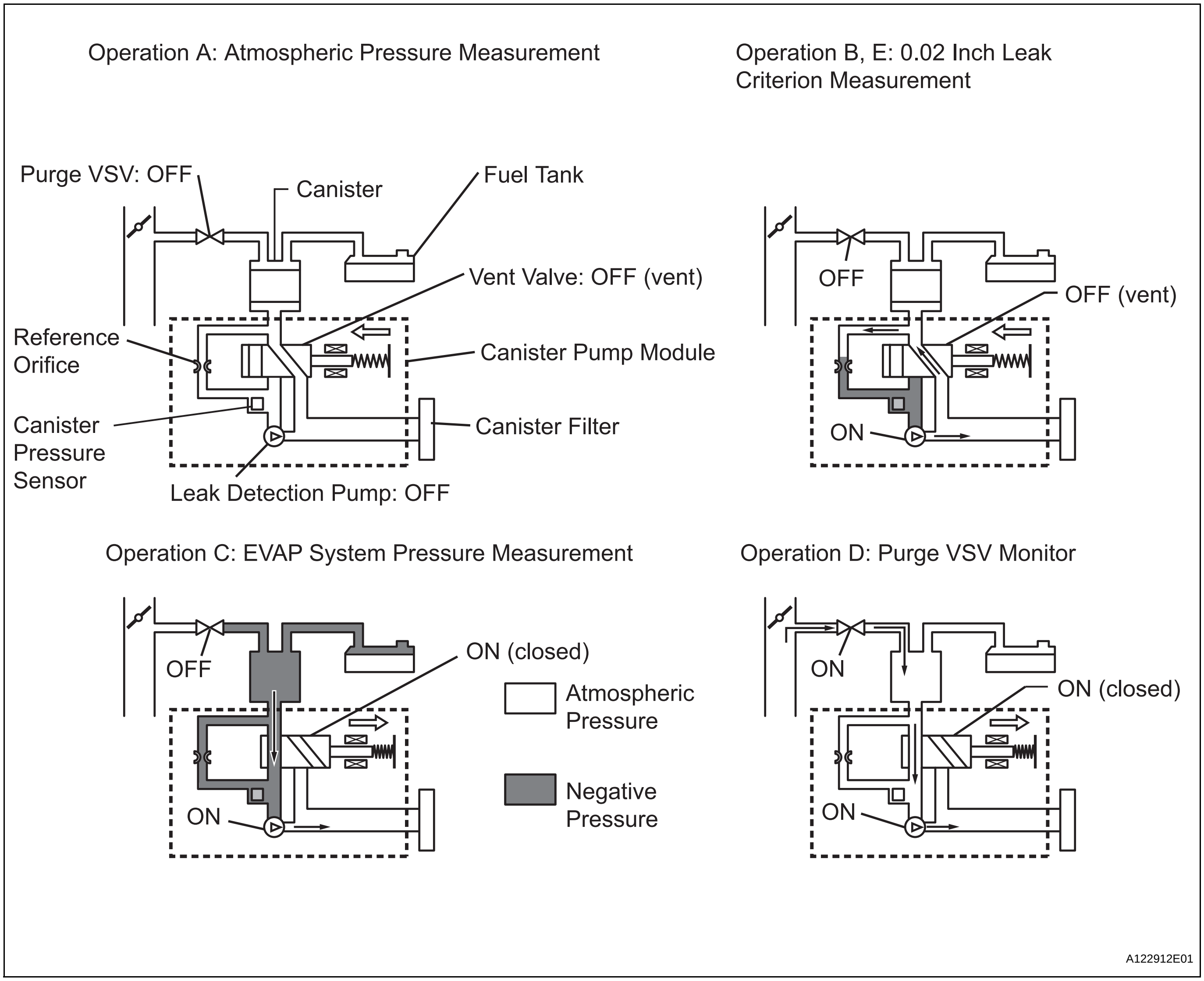
Components	Operations
(d) Reference orifice	Has opening with 0.02 inch diameter. Vacuum produced through orifice by closing purge VSV, turning vent valve OFF and operating leak detection pump to monitor 0.02 inch leak criterion. 0.02 inch leak criterion indicates small leak of EVAP.

MONITOR DESCRIPTION

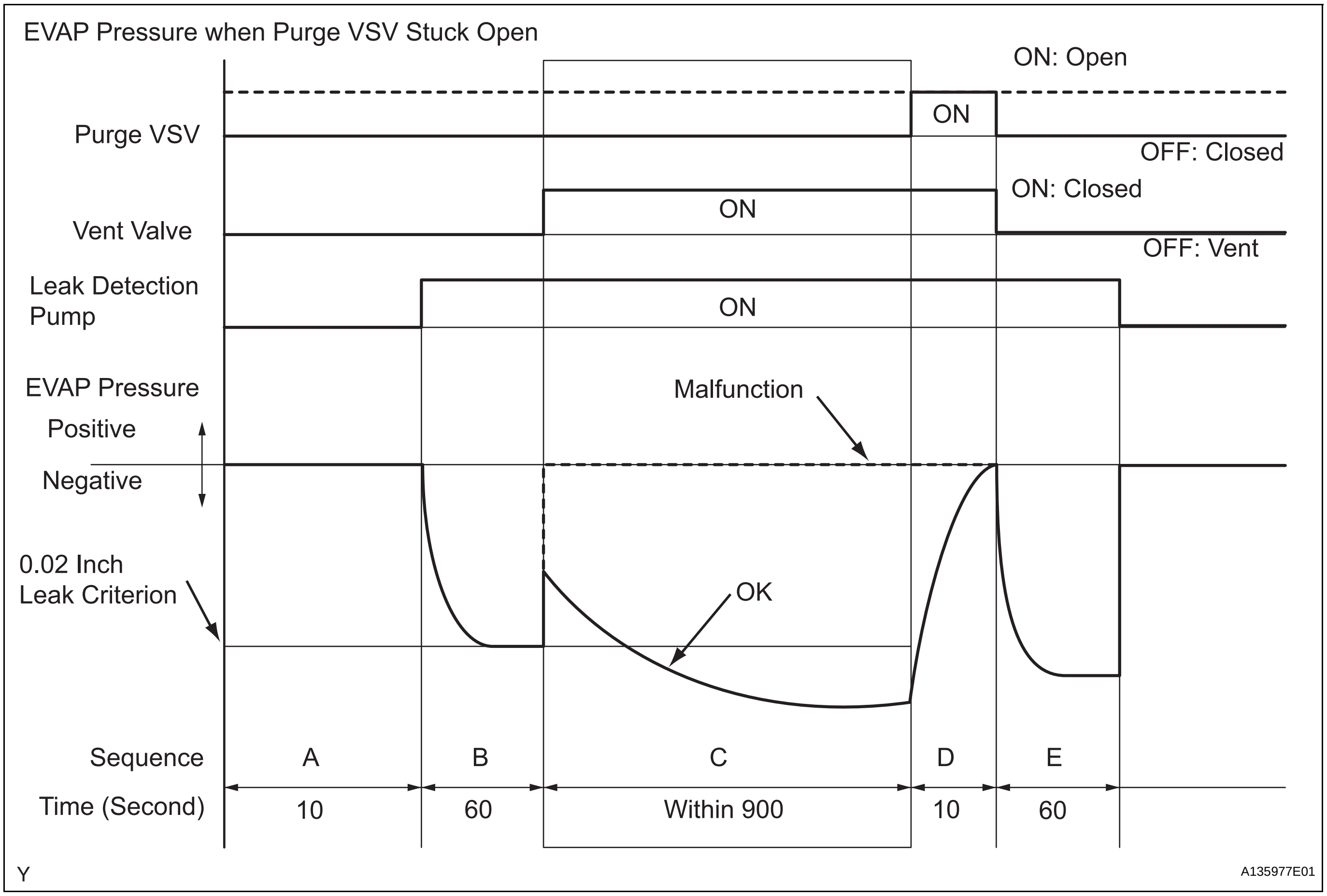
1. Key-off monitor
   5 hours* after the power switch is turned OFF, the leak detection pump creates negative pressure (vacuum) in the EVAP system. The ECM monitors for leaks and actuator malfunctions based on the EVAP pressure.
   HINT:
   *: If the engine coolant temperature is not below 35°C (95°F) 5 hours after the power switch is turned OFF, the monitor check starts 2 hours later. If it is still not below 35°C (95°F) 7 hours after the power switch is turned OFF, the monitor check starts 2.5 hours later.

Sequence	Operations	Descriptions	Duration
-	ECM activation	Activated by soak timer 5, 7 or 9.5 hours after power switch OFF.	-
A	Atmospheric pressure measurement	Vent valve turned OFF (vent) and EVAP system pressure measured by ECM in order to register atmospheric pressure. If pressure in EVAP system not between 70 kPa and 110 kPa (525 mmHg and 825 mmHg), ECM cancels EVAP system monitor.	10 seconds
B	First 0.02 inch leak criterion measurement	In order to determine 0.02 inch leak criterion, leak detection pump creates negative pressure (vacuum) through reference orifice and then ECM checks if leak detection pump and vent valve operate normally.	60 seconds
C	EVAP system pressure measurement	Vent valve turned ON (closed) to shut EVAP system. Negative pressure (vacuum) created in EVAP system, and EVAP system pressure then measured. Write down measured value as it will be used in leak check. If EVAP pressure does not stabilize within 900 seconds, ECM cancels EVAP system monitor.	900 seconds*
D	Purge VSV monitor	Purge VSV opened and then EVAP system pressure measured by ECM. Large increase indicates normal.	10 seconds
E	Second 0.02 inch leak criterion measurement	After second 0.02 inch leak criterion measurement, leak check performed by comparing first and second 0.02 inch leak criterion. If stabilized system pressure higher than second 0.02 inch leak criterion, ECM determines that EVAP system leaking.	60 seconds
-	Final check	Atmospheric pressure measured and then monitoring result recorded by ECM.	-

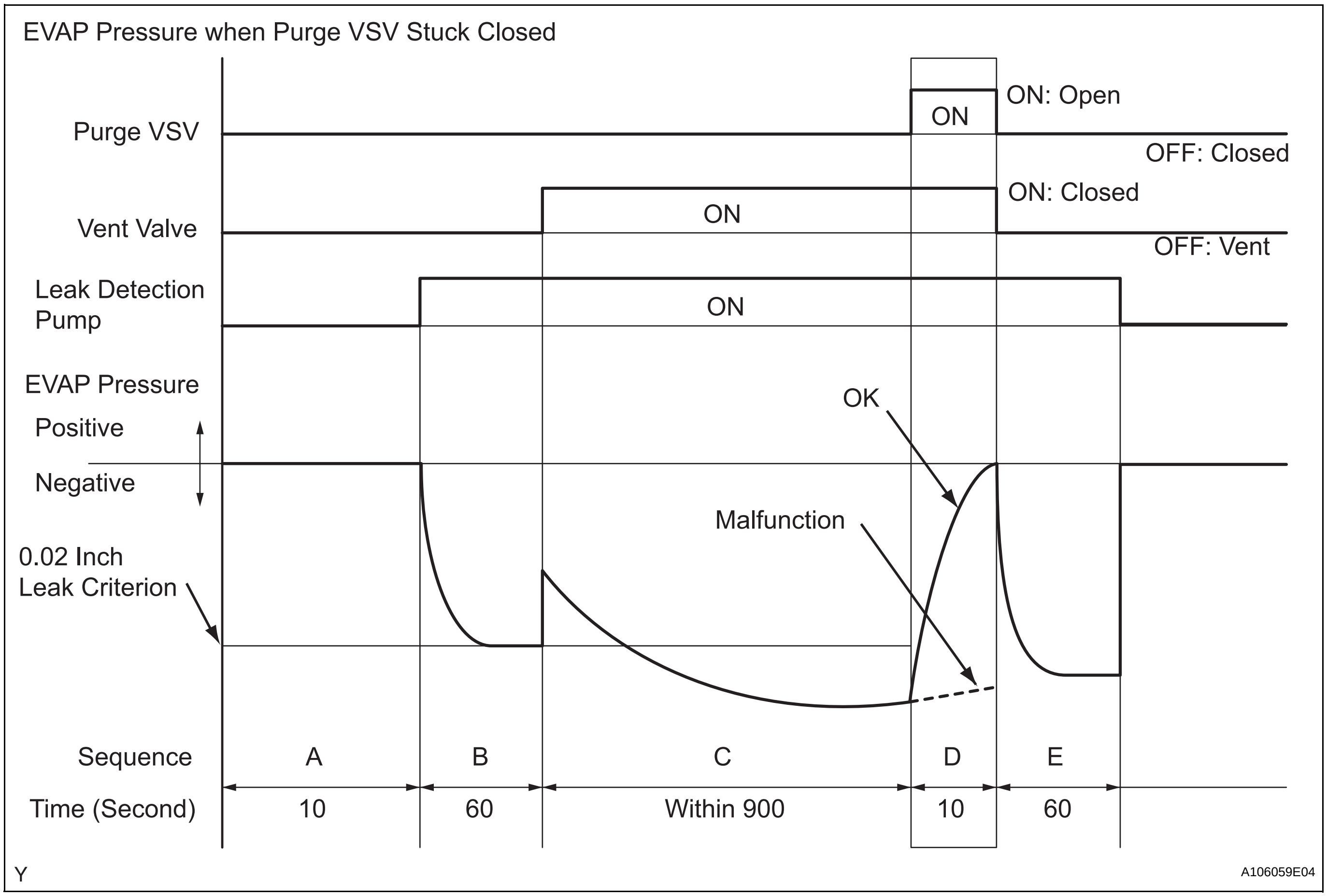
*: If only a small amount of fuel is in the fuel tank, it takes longer for the EVAP pressure to stabilize.



(a) Purge VSV stuck open
In operation C, the leak detection pump creates negative pressure (vacuum) in the EVAP system. The EVAP system pressure is then measured by the ECM using the canister pressure sensor. If the stabilized system pressure is higher than [second 0.02 inch leak criterion x 0.15], the ECM interprets this as the purge Vacuum Switching Valve (VSV) being stuck open. The ECM illuminates the MIL and sets the DTC (2 trip detection logic).



(b) Purge VSV stuck closed
In operation D, the canister pressure sensor measures the EVAP system pressure. The pressure measurement for the purge VSV monitor begins when the purge VSV is turned ON (open) after the EVAP leak check. When the measured pressure indicates an increase of 0.3 kPa (2.25 mmHg) or more, the purge VSV is functioning normally. If the pressure does not increase, the ECM interprets this as the purge VSV being stuck closed. The ECM illuminates the MIL and sets the DTC (2 trip detection logic).



(c) Purge flow
While the engine running, the purge VSV opens to purge the fuel vapor according to the engine condition. The ECM check the EVAP pressure when the purge VSV opens.
If the pressure dose not change, the ECM interprets this as a malfunction. The ECM illuminates the MIL and sets DTC (2 trip detection logic).

MONITOR STRATEGY

Related DTCs	P0441: Purge VSV stuck open P0441: Purge VSV stuck closed P0441: Purge flow
Required Sensors/Components	Purge VSV and canister pump module
Frequency of Operation	Once per driving cycle
Duration	Maximum 15 seconds
MIL Operation	2 driving cycles
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

Purge Flow Monitor:

Monitor runs whenever following DTC not present	-

Engine	Running
ECT	4.4°C (40°F) or more
IAT	4.4°C (40°F) or more
EVAP control system pressure sensor malfunction	Not detected
Purge VSV	Not detected by scan tool
EVAP system check	Not detected by scan tool
Battery voltage	11 V or higher
Purge duty cycle	15% or more

Purge VSV Stuck:

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 (Misfire) P0335 (CKP sensor) P0340, P0341 (CMP sensor) P0351, P0352, P0353, P0354 (Igniter) P0450, P0452, P0453 (EVAP press sensor) P0500 (VSS)
Atmospheric pressure	70 to 110 kPa (525 to 825 mmHg)
Battery voltage	10.5 V or higher
Vehicle speed	Less than 4 km/h (2.5 mph)
Power switch	OFF
Time after key off	5 or 7 or 9.5 hours
Purge VSV	Not operated by scan tool
Vent valve	Not operated by scan tool
Leak detection pump	Not operated by scan tool
Both of the following conditions 1 and 2 are met before key off	-
1. Duration that vehicle has been driven	5 minutes or more
2. EVAP purge operation	Performed
ECT	4.4 to 35°C (40 to 95°F)
IAT	4.4 to 35°C (40 to 95°F)

1. Key-off monitor sequence 1 to 8

1. Atmospheric pressure measurement

Next sequence is run if the following condition is met	-
Atmospheric pressure change	Within 0.3 kPa (2.25 mmHg) in 1 second

2. First reference pressure measurement

Next sequence is run if the following conditions are met	-
EVAP pressure just after reference pressure measurement start	-1 kPa (-7.5 mmHg) or lower
Reference pressure	-4.85 to -1.05 kPa (726 to 754 mmHg)
Reference pressure	Saturated within 60 seconds

3. Vent valve stuck closed check

Next sequence is run if the following condition is met	-
EVAP pressure change after vent valve is ON	0.3 kPa (2.25 mmHg) or more

4. Vacuum introduction

Next sequence is run if the following condition is met	-
EVAP pressure	Saturated within 900 seconds

5. Purge VSV stuck closed check

Next sequence is run if the following condition is met	-
EVAP pressure change after purge valve is open	0.3 kPa (2.25 mmHg) or more

6. Second reference pressure measurement

Next sequence is run if the following conditions are met	-
EVAP pressure just after reference pressure measurement	-1 kPa (-7.5 mmHg) or lower
Reference pressure	-4.85 to -1.05 kPa (726 to 754 mmHg)
Reference pressure	Saturated within 60 seconds
Reference pressure difference between first and second	Less than 0.7 kPa (5.25 mmHg)

7. Leak check

Next sequence is run if the following condition is met	-
EVAP pressure when vacuum introduction is complete	Lower than second reference pressure

8. Atmospheric pressure measurement

EVAP monitor is complete if the following condition is met	-
Atmospheric pressure difference between sequence 1 and 8	Within 0.3 kPa (2.25 mmHg)

TYPICAL MALFUNCTION THRESHOLDS

"Saturated" indicates that the EVAP pressure change is less than 0.1 kPa (0.75 mmHg) in 30 seconds.

Purge Flow Monitor:

EVAP pressure change when purge flow is started	Lower than 0.93 kPa (7 mmHg)

Key-off Monitor: Purge VSV stuck open

FTP when vacuum introduction complete	Higher than reference pressure x 0.15

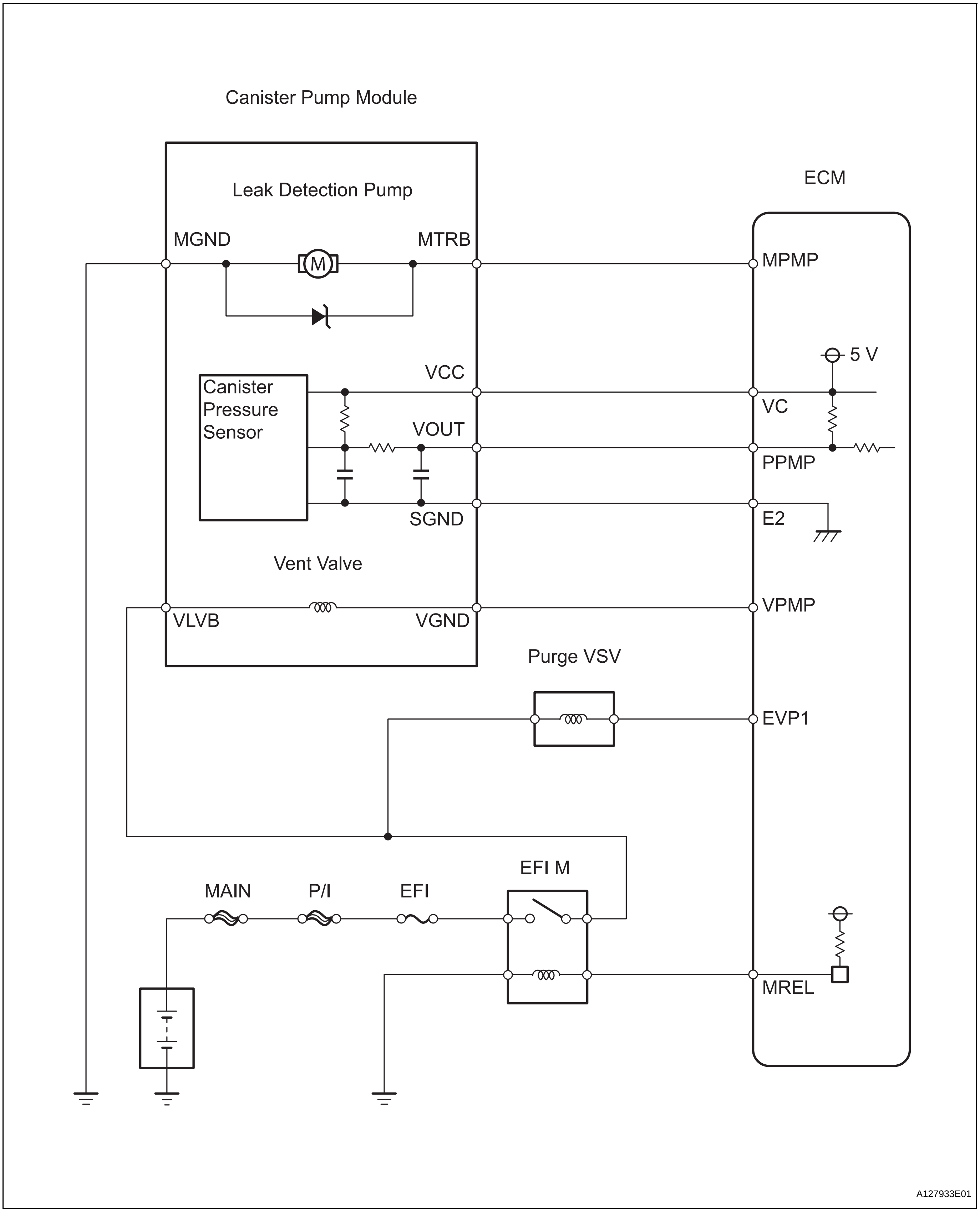
Key-off Monitor: Purge VSV stuck closed

FTP change after purge VSV ON (open)	Less than 0.3 kPa (2.25 mmHg)

MONITOR RESULT

Refer to CHECKING MONITOR STATUS (see page ES-15).

WIRING DIAGRAM



INSPECTION PROCEDURE

NOTICE:

The intelligent tester is required to conduct the following diagnostic troubleshooting procedure.

HINT:
- Using the intelligent tester monitor results enable the EVAP system to be confirmed.
- Read freeze frame data using the intelligent tester. Freeze frame data records the engine conditions when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1	CONFIRM DTC

(a) Turn the power switch OFF and wait for 10 seconds.
(b) Turn the power switch ON (IG).
(c) Turn the power switch OFF and wait for 10 seconds.
(d) Connect the intelligent tester to the DLC3.
(e) Turn the power switch ON (IG).
(f) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DTC INFO / CURRENT CODES.
(g) Check if DTC P0446 is output.

NO → **Go to step 5**

ES

YES

2	PERFORM EVAP SYSTEM CHECK

(a) Note the freeze frame data and DTCs.
(b) Clear DTCs.
(c) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / SYSTEM CHECK / EVAP SYS CHECK / AUTO OPERATION.
(d) After the system check is finished, check for pending DTCs.

OK:
No DTC is present.

NG → **Go to step 6**

OK

3	CHECK OPERATION FOR PRESSURE SWITCHING VALVE

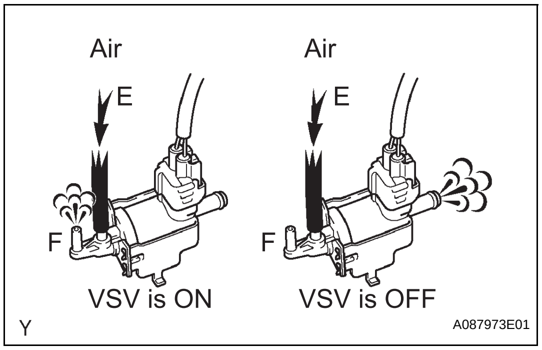
(a) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / TANK BYPASS VSV.
(b) Touch the pressure switching valve (TANK BYPASS VSV) to feel the operating vibration.

OK:
The pressure switching valve is operated by the ACTIVE TEST.

NG → **Go to step 18**

OK

4	CHECK PRESSURE SWITCHING VALVE



(a) Turn the power switch OFF.
(b) Remove the pressure switching valve (see page EC-31).
(c) Reconnect the pressure switching valve connector.
(d) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / TANK BYPASS VSV.
(e) Check the airflow for the pressure switching valve.
OK:
The pressure switching valve operates normally.

NG → **Go to step 19**

OK → **Go to step 33**

ES

5	PERFORM EVAP SYSTEM CHECK

(a) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / SYSTEM CHECK / EVAP SYS CHECK / AUTO OPERATION.
(b) After the system check is finished, check for pending DTCs.
OK:
DTCs are present.

NG → **CHECK INTERMITTENT PROBLEMS**

OK

6	CHECK DTC

(a) Check the DTCs that were present at the EVAP system check.
OK:
P043E, P043F, P2401, P2402 and P2419 are present.

NG → **Go to step 10**

OK

7	CHECK VENT VALVE CLOSE STUCK

(a) Allow the engine to idle.
(b) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / EVAP VSV.
(c) Turn the EVAP VSV ON (purge VSV open) and check the VAPOR PRESS (EVAP pressure) for 10 seconds.
OK:
EVAP pressure is higher than 755 mmHg.

NG → **Go to step 20**

OK

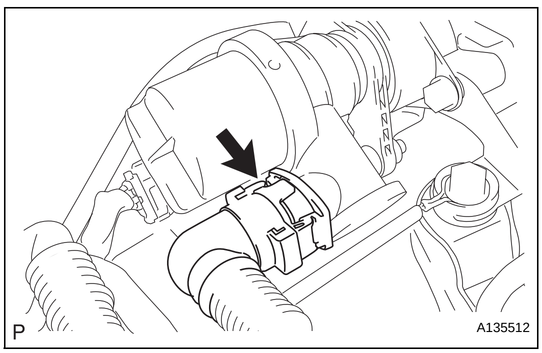
8	CHECK LEAK DETECTION PUMP OPERATION

(a) Turn the power switch OFF.
(b) Turn the power switch ON (IG).
(c) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / VACUUM PUMP.
(d) Touch the pump module to feel the operating vibration.
OK:
The leak detection pump is operated by the ACTIVE TEST.

NG → **Go to step 21**

OK

9	CHECK TRAP CANISTER



(a) Disconnect the vent hose from the pump module.
(b) Check that no moisture is in the pump module or the vent hose.
OK:
No moisture.

OK → **Go to step 22**

NG → **Go to step 23**

10	CHECK DTC

(a) Check the DTCs that were present at the EVAP system check.
OK:
P0441, P0455 and/or P0456 are present.

NG → **Go to step 16**

OK

11	CHECK INSTALLATION FOR FUEL CAP

(a) Remove the fuel cap.
(b) Reinstall the fuel cap.
(c) Clear DTCs.
(d) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / SYSTEM CHECK / EVAP SYS CHECK / AUTO OPERATION.
(e) After the system check is finished, check for pending DTCs.

HINT:
If no DTC is present, this indicates that the fuel cap is loosened.

OK:

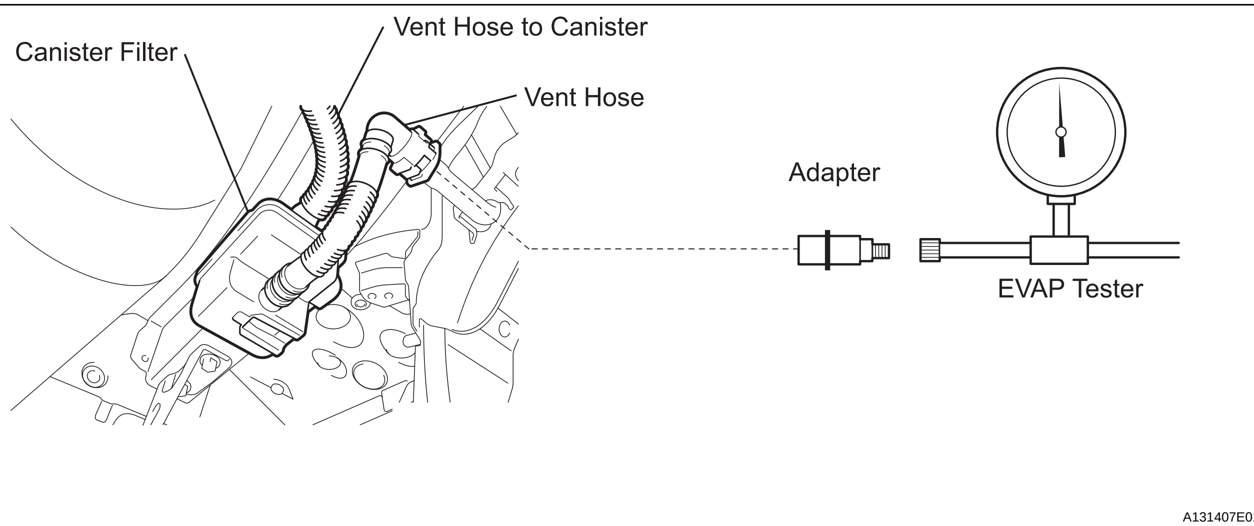
No DTC is present.

OK → **REPAIR COMPLETED**

NG

12 LOCATE LEAK POINT

(a) Disconnect the vent hose (fresh air line) as shown in the illustration.



(b) Connect the pressure gauge and air pump as shown in the illustration.

(c) Pressurize the EVAP system until 24 to 28 mmHg.

(d) Locate the leak point.

HINT:
If the EVAP system has leakage, a whistling sound may be heard.

OK:

The leak point is found.

OK → **Go to step 24**

NG

13 CHECK FUEL CAP

Check that the fuel cap meets OEM specifications.

HINT:
If an EVAP tester is available, perform the fuel cap test according to the tester's instructions.

OK:

Fuel cap meets OEM specifications.

NG → **Go to step 25**

OK

14 CHECK OPERATION FOR PURGE VSV

(a) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / EVAP VSV.

(b) Touch the purge VSV to feel the operating vibration.

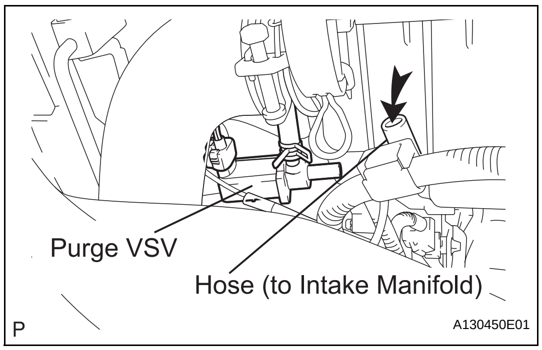
OK:

The purge VSV (EVAP VSV) is operated by the ACTIVE TEST.

NG → **Go to step 26**

OK

15 CHECK INTAKE MANIFOLD PRESSURE



(a) Disconnect the purge VSV hose that is connected to the throttle body.

(b) Allow the engine to idle.

(c) Check that the hose has suction using your finger.

OK:

The hose has suction.

NG → **Go to step 27**

OK → **Go to step 28**

16 CHECK DTC

(a) Check the DTCs that were present at the EVAP system check.

OK:

P0451 is not present.

NG → **Go to step 9**

OK

17 CHECK OPERATION FOR VENT VALVE

(a) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / VENT VALVE.

(b) Touch the pump module to feel the operating vibration.

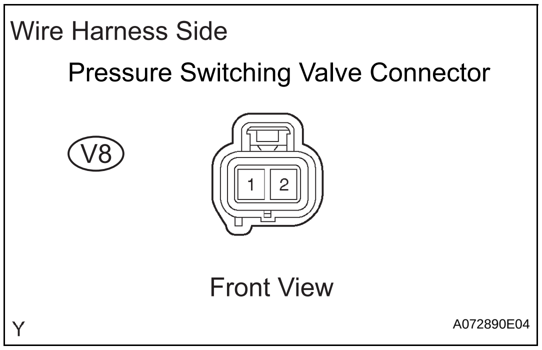
OK:

The vent valve is operated by the ACTIVE TEST.

OK → **Go to step 9**

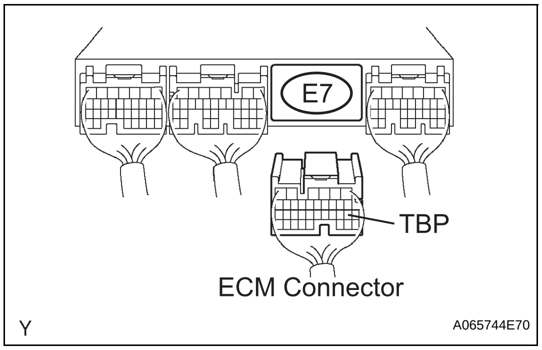
NG → **Go to step 29**

18	CHECK HARNESS AND CONNECTOR (PRESSURE SWITCHING VALVE - ECM AND EFI M RELAY)



(a) Check the harness and the connectors between the pressure switching valve and the ECM.
(1) Disconnect the V8 pressure switching valve connector.

ES



(2) Disconnect the E7 ECM connector.
(3) Measure the resistance between the wire harness side connectors.

Standard resistance (Check for open)

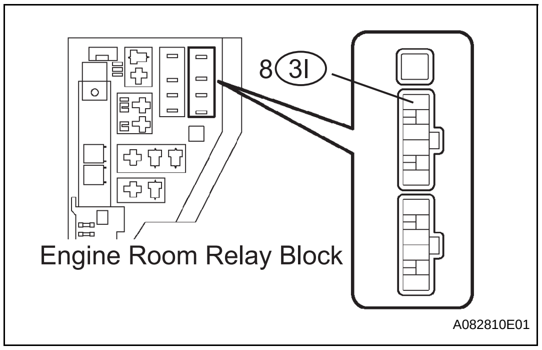
Tester Connection	Specified Condition
V8-1 (Pressure switching valve) - E7-18 (TBP)	Below 1 Ω

Standard resistance (Check for short)

Tester Connection	Specified Condition
V8-1 (Pressure switching valve) or E7-18 (TBP) - Body ground	10 kΩ higher

(4) Reconnect the pressure switching valve connector.
(5) Reconnect the ECM connector.

(b) Check the harness and the connectors between the pressure switching valve and the EFI M relay.
(1) Disconnect the V8 pressure switching valve connector.



(2) Remove the integration relay from the engine room relay block.
(3) Measure the resistance between the wire harness side connector.

Standard resistance (Check for open)

Tester Connection	Specified Condition
V8-2 (Pressure switching valve) - 3I-8 (EFI M relay)	Below 1 Ω

Standard resistance (Check for short)

Tester Connection	Specified Condition
V8-2 (Pressure switching valve) or 3I-8 (EFI M relay) - Body ground	10 kΩ or higher

(4) Reconnect the pressure switching valve connector.
(5) Reinstall the integration relay.

NG	Go to step 30
OK	Go to step 31

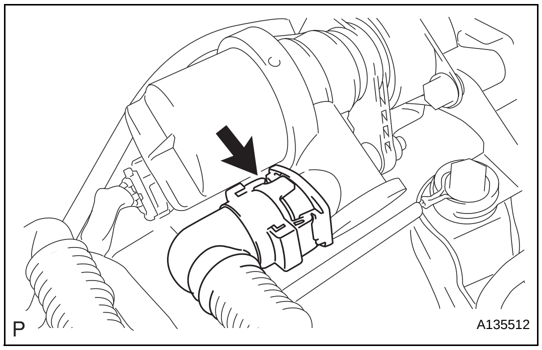
ES

19 REPLACE PRESSURE SWITCHING VALVE

Replace the pressure switching valve (see page EC-31).

NEXT → Go to step 34

20 CHECK FOR VENT HOSE CLOG



(a) Turn the power switch OFF.
(b) Disconnect the vent hose (fresh air line) as shown in the illustration.
(c) Allow the engine to idle.
(d) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / EVAP VSV.
(e) Turn the purge VSV (EVAP VSV) ON and check the EVAP pressure (VAPOR PRESS) for 10 seconds.

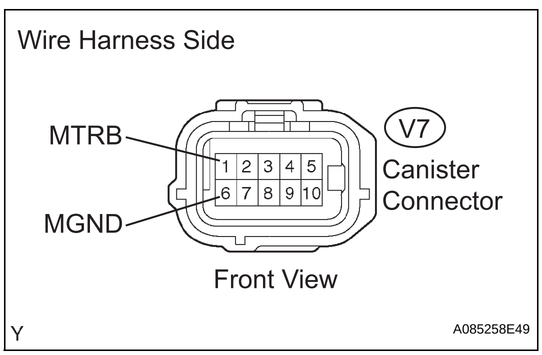
OK:

EVAP pressure is higher than 755 mmHg.

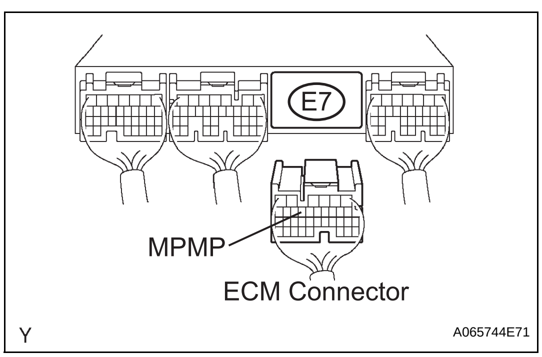
NG → Go to step 22

OK → Go to step 32

21 CHECK HARNESS AND CONNECTOR (LEAK DETECTION PUMP - ECM)



(a) Disconnect the V7 canister connector



(b) Disconnect the E7 ECM connector.
(c) Measure the resistance between the wire harness side connector.

Standard resistance (Check for open)

Tester Connection	Specified Condition
V7-1 (MTRB) - E7-13 (MPMP)	Below 1 Ω
V7-6 (MGND) - Body ground	Below 1 Ω

Standard resistance (Check for short)

Tester Connection	Specified Condition
V7-1 (MTRB) or E7-13 (MPMP) - Body ground	10 kΩ higher

(d) Reconnect the canister connector.
(e) Reconnect the ECM connector.

NG	Go to step 30
OK	Go to step 31

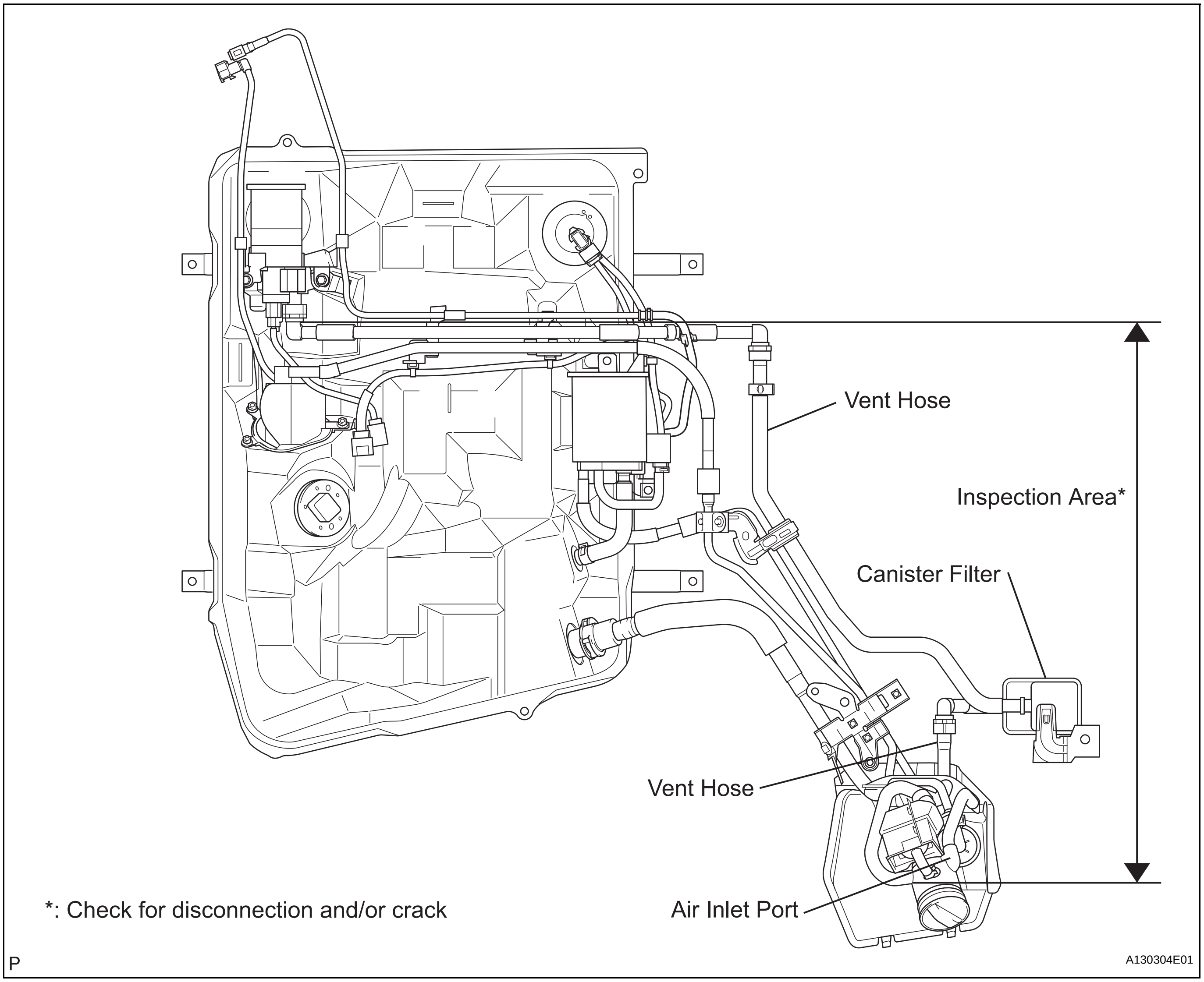
22 REPLACE TRAP CANISTER WITH PUMP MODULE

Replace the trap canister with pump module (see page EC-17).

NEXT	Go to step 34

23 CHECK FOR VENT HOSE DAMAGE

Check for hose damage as shown in the illustration. If necessary, replace the vent hose.



NEXT	Go to step 22

24	REPAIR OR REPLACE LEAK POINT

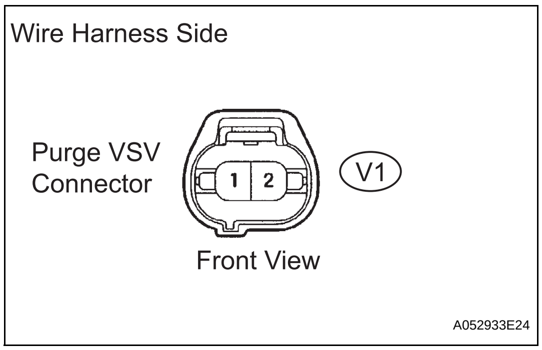
NEXT → **Go to step 34**

25	REPLACE FUEL CAP

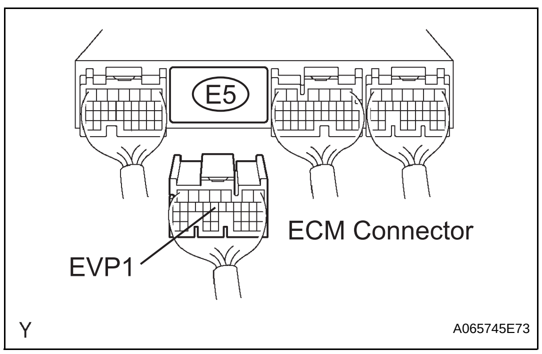
NEXT → **Go to step 34**

ES

26	CHECK HARNESS AND CONNECTOR (PURGE VSV - ECM)



(a) Disconnect the V1 purge VSV connector.

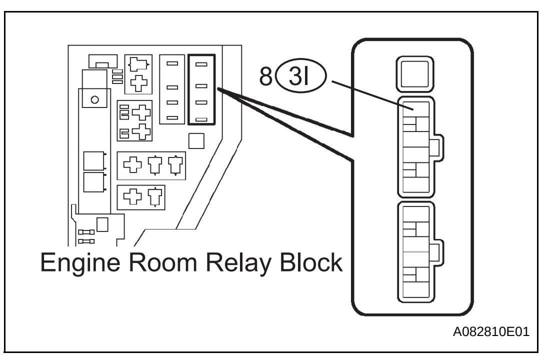


(b) Disconnect the E5 ECM connector.
(c) Check the harness and the connectors between the ECM and the purge VSV connectors.
(1) Measure the resistance between the wire harness side connector.
Standard resistance (Check for open)

Tester Connection	Specified Condition
V1-1 - E5-14 (EVP1)	Below 1 Ω

Standard resistance (Check for short)

Tester Connection	Specified Condition
V1-1 or E5-14 (EVP1) - Body ground	10 kΩ higher



(d) Remove the integration relay from the engine room relay block.
(e) Check the harness and connectors between the purge VSV connector and the EFI M relay.
(1) Measure the resistance between the wire harness side connectors.
Standard resistance (Check for open)

Tester Connection	Specified Condition
V1-2 - 3I-8 (EFI M relay)	Below 1 Ω

Standard resistance (Check for short)

Tester Connection	Specified Condition
V1-2 or 3I-8 (EFI M relay) - Body ground	10 kΩ higher

(f) Reconnect the purge VSV connector.
(g) Reconnect the ECM connector.

(h) Reinstall the integration relay.

NG	Go to step 30
OK	Go to step 31

27 REPLACE HOSE (PURGE VSV - THROTTLE BODY)

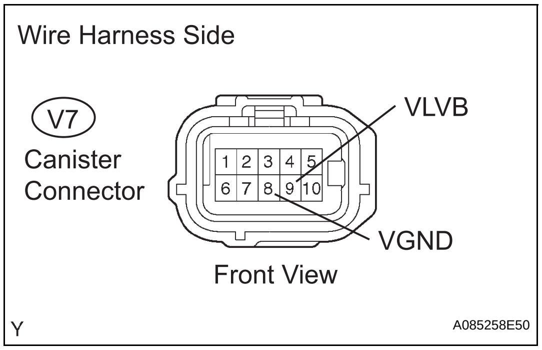
NEXT	Go to step 34

28 REPLACE PURGE VSV

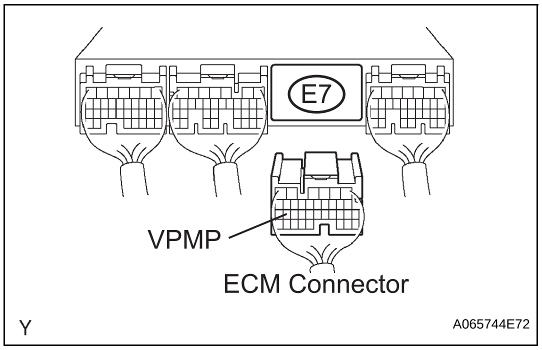
Replace the purge VSV (see page EC-23).

NEXT	Go to step 34

29 CHECK HARNESS AND CONNECTOR (VENT VALVE - ECM)



(a) Disconnect the V7 canister connector.



(b) Disconnect the E7 ECM connector.

(c) Check the harness and the connectors between the ECM and the canister connectors.

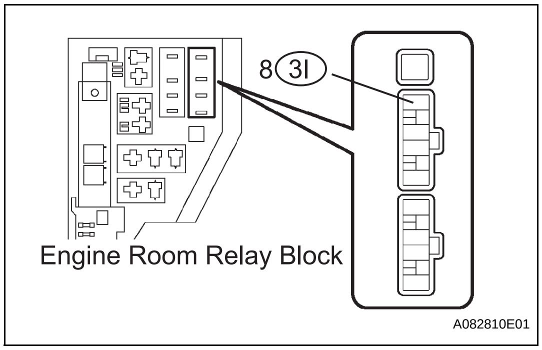
(1) Measure the resistance between the wire harness side connector.

Standard resistance (Check for open)

Tester Connection	Specified Condition
V7-8 (VGND) - E7-26 (VPMP)	Below 1 Ω

Standard resistance (Check for short)

Tester Connection	Specified Condition
V7-8 (VGND) or E7-26 (VPMP) - Body ground	10 kΩ higher



(d) Remove the integration relay from the engine room relay block.

(e) Check the harness and connectors between the canister connector and the EFI M relay.

(1) Measure the resistance between the wire harness side connectors.

Standard resistance (Check for open)

Tester Connection	Specified Condition
V7-9 (VLVB) - 3I-8 (EFI M relay)	Below 1 Ω

Standard resistance (Check for short)

Tester Connection	Specified Condition
V7-9 (VLVB) or 3I-8 (EFI M relay) - Body ground	10 kΩ higher

(f) Reconnect the canister connector.

(g) Reconnect the ECM connector.

(h) Reinstall the integration relay.

NG	Go to step 30
OK	Go to step 31

30 REPAIR OR REPLACE HARNESS AND CONNECTOR

NEXT	Go to step 34

31 REPLACE ECM

Replace the ECM (see page ES-469).

NEXT	Go to step 34

32 CHECK AND REPLACE VENT HOSE OR CANISTER FILTER

NEXT	Go to step 34

33 REPLACE HOSE (PRESSURE SWITCHING VALVE AND FUEL TANK)

NEXT

34 PERFORM EVAP SYSTEM CHECK

(a) Turn the power switch ON (IG).

(b) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / SYSTEM CHECK / EVAP SYS CHECK / AUTO OPERATION.

(c) After the system check is finished, check for pending DTCs.

OK:
No DTC is present.

NG → **Go to step 6**

OK

35	PERFORM EVAP MONITOR DRIVE PATTERN

(a) Check that the following conditions are met:
- Fuel level is 1/8 to 7/8.
- Engine coolant temperature (ECT) is 4.4 to 35°C (40 to 95°F).
- Intake air temperature (IAT) is 4.4 to 35°C (40 to 95°F).
- Difference of ECT and IAT is less than 7°C (13°F).

(b) Enter the check mode. Enter the following menus: DIAGNOSIS / ENHANCED OBD II / CHECK MODE.
(c) Allow the engine to idle until the ECT is 75°C (167°F).
(d) Drive the vehicle at 50 km/h (30 mph) or faster and maintain that speed for 60 seconds or more.
(e) Stop the vehicle. Do not turn the power switch OFF.
(f) Check that the EVAP monitor status is complete. Enter the following menus: DIAGNOSIS / ENHANCED OBD II / MONITOR STATUS.
(g) If the EVAP monitor is incomplete, drive the vehicle at 50 km/h (30 mph) or faster and maintain that speed for 120 seconds or more. After that, recheck the EVAP monitor status.
(h) Check for pending DTCs.
OK:
No DTC is present.

NG → **Go to step 2**

OK

REPAIR COMPLETED

DTC	P0446	Evaporative Emission Control System Vent Control Circuit

DESCRIPTION

DTC	DTC Detection Condition	Trouble Area
P0446	One of the following condition is met while vehicle is driving (2 trip detection logic): • No change in fuel tank pressure when purge VSV and pressure switching valve are opened • No change in fuel tank pressure when fuel tank is depressurized until 740 mmHg and purge VSV is closed	• Leak from EVAP system • Pressure switching valve • Purge VSV • Vent valve • Fuel tank pressure sensor

ES

This DTC is designed to detect the pressure switching valve (3-way VSV) malfunction. If the malfunction is detected while the vehicle is running, the ECM illuminates the MIL and sets a DTC (2 detection logic). The pressure switching valve located on the canister is used to detect leakage from the bladder tank into the fuel tank. The valve opens during the bladder tank leak check. Then, the fuel tank's fuel vapor flows to the intake manifold without passing the canister.

MONITOR DESCRIPTION

Pressure switching valve is stuck OFF (Closed)

The pressure switching valve opens when the purge VSV opens while the vehicle is running. Then, the fuel tank pressure drops 2 mmHg or more when the pressure switching valve is normal. If the pressure does not change, the ECM interprets this as a malfunction. The ECM illuminates the MIL and sets a DTC (2 trip detection logic).

Pressure switching valve is stuck ON (Open)

In order to depressurize the fuel tank, the pump module's vent valve is turned ON (close) when the purge VSV opens while the vehicle is running. After the fuel tank pressure drops 20 mmHg, the purge VSV closes. Then, the fuel tank pressure rises slightly when the pressure switching valve is normal. If the pressure rises quickly, the ECM interprets this as a malfunction. The ECM illuminates the MIL and sets a DTC (2 trip detection logic).

MONITOR STRATEGY

Related DTCs	P0466: Pressure switching valve fixed
Required Sensors/Components	Pressure switching valve
Frequency of Operation	Once per driving cycle
Duration	Within 10 seconds
MIL Operation	2 driving cycles
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

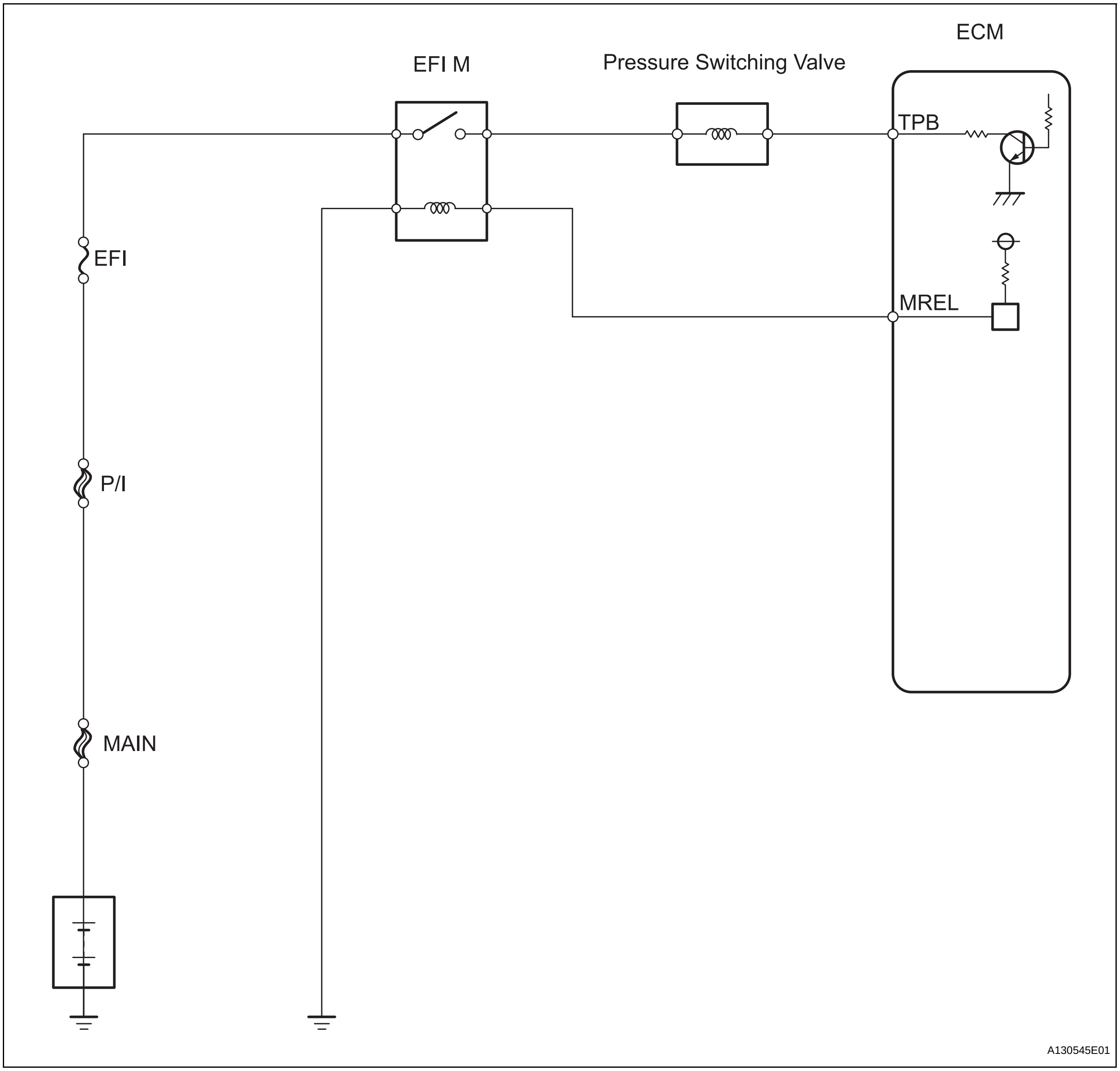
Monitor runs whenever following DTC not present	P0441: Purge VSV P1450 - P1453: FTP sensor
Altitude	Less than 2,400 m (8,000 ft.)
Battery voltage	11 V or more
IAT at engine start - ECT at engine start	-7 to 11°C (-12.6 to 20°F)
ECT at engine start	4.4 to 35°C (40 to 95°F)
IAT at engine start	4.4 to 35°C (40 to 95°F)
Vehicle speed	Constant between 45 and 130 km/h (28 and 80 mph)
Time after engine start	Less than 30 minutes
HV ECU	OK

Fail-safe via HV ECU	Not executed
Purge flow volume	0.08 g/sec. or more

TYPICAL MALFUNCTION THRESHOLDS

Either of following condition 1 or 2 is met	-
1. Following conditions are met	-
FTP change when pressure switching valve is ON	0.267 kPa (2 mmHg) or more
FTP	-2.667 kPa (740 mmHg) or higher
FTP increase after 20 mmHg vacuum is applied to fuel tank	1.333 kPa (10 mmHg) or more

WIRING DIAGRAM



INSPECTION PROCEDURE

1	CONFIRM DTC

(a) Turn the power switch OFF and wait for 10 seconds.
(b) Turn the power switch ON (IG).
(c) Turn the power switch OFF and wait for 10 seconds.
(d) Connect the intelligent tester to the DLC3.
(e) Turn the power switch ON (IG).
(f) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DTC INFO / CURRENT CODES.
(g) Check if DTC P0446 is output.

NO → **Go to step 5**

YES

2	PERFORM EVAP SYSTEM CHECK

(a) Note the freeze frame data and DTCs.
(b) Clear DTCs.
(c) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / SYSTEM CHECK / EVAP SYS CHECK / AUTO OPERATION.
(d) After the system check is finished, check for pending DTCs.

OK:
No DTC is present.

NG → **Go to step 6**

OK

3	CHECK OPERATION FOR PRESSURE SWITCHING VALVE

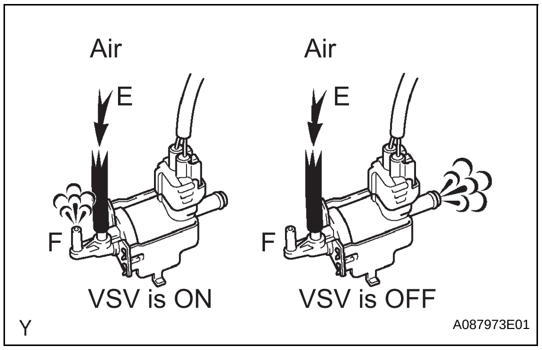
(a) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / TANK BYPASS VSV.
(b) Touch the pressure switching valve (TANK BYPASS VSV) to feel the operating vibration.

OK:
The pressure switching valve is operated by the ACTIVE TEST.

NG → **Go to step 18**

OK

4	CHECK PRESSURE SWITCHING VALVE



(a) Turn the power switch OFF.
(b) Remove the pressure switching valve (see page EC-31).
(c) Reconnect the pressure switching valve connector.
(d) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / TANK BYPASS VSV.
(e) Check the airflow for the pressure switching valve.

OK:

The pressure switching valve operates normally.

NG → **Go to step 19**

OK → **Go to step 33**

5	PERFORM EVAP SYSTEM CHECK

(a) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / SYSTEM CHECK / EVAP SYS CHECK / AUTO OPERATION.
(b) After the system check is finished, check for pending DTCs.

OK:

DTCs are present.

NG → **CHECK INTERMITTENT PROBLEMS**

OK

6	CHECK DTC

(a) Check the DTCs that were present at the EVAP system check.

OK:

P043E, P043F, P2401, P2402 and P2419 are present.

NG → **Go to step 10**

OK

7	CHECK VENT VALVE CLOSE STUCK

(a) Allow the engine to idle.
(b) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / EVAP VSV.
(c) Turn the EVAP VSV ON (purge VSV open) and check the VAPOR PRESS (EVAP pressure) for 10 seconds.

OK:

EVAP pressure is higher than 755 mmHg.

NG → **Go to step 20**

OK

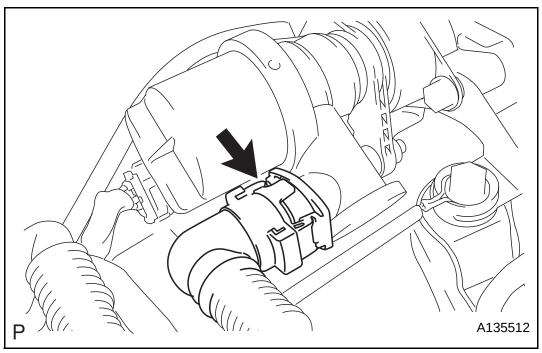
8	CHECK LEAK DETECTION PUMP OPERATION

(a) Turn the power switch OFF.
(b) Turn the power switch ON (IG).
(c) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / VACUUM PUMP.
(d) Touch the pump module to feel the operating vibration.
OK:
The leak detection pump is operated by the ACTIVE TEST.

NG → **Go to step 21**

OK

9	CHECK TRAP CANISTER



(a) Disconnect the vent hose from the pump module.
(b) Check that no moisture is in the pump module or the vent hose.
OK:
No moisture.

OK → **Go to step 22**

NG → **Go to step 23**

10	CHECK DTC

(a) Check the DTCs that were present at the EVAP system check.
OK:
P0441, P0455 and/or P0456 are present.

NG → **Go to step 16**

NG

11	CHECK INSTALLATION FOR FUEL CAP

(a) Remove the fuel cap.
(b) Reinstall the fuel cap.
(c) Clear DTCs.
(d) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / SYSTEM CHECK / EVAP SYS CHECK / AUTO OPERATION.
(e) After the system check is finished, check for pending DTCs.

HINT:
If no DTC is present, this indicates that the fuel cap is loosened.

OK:

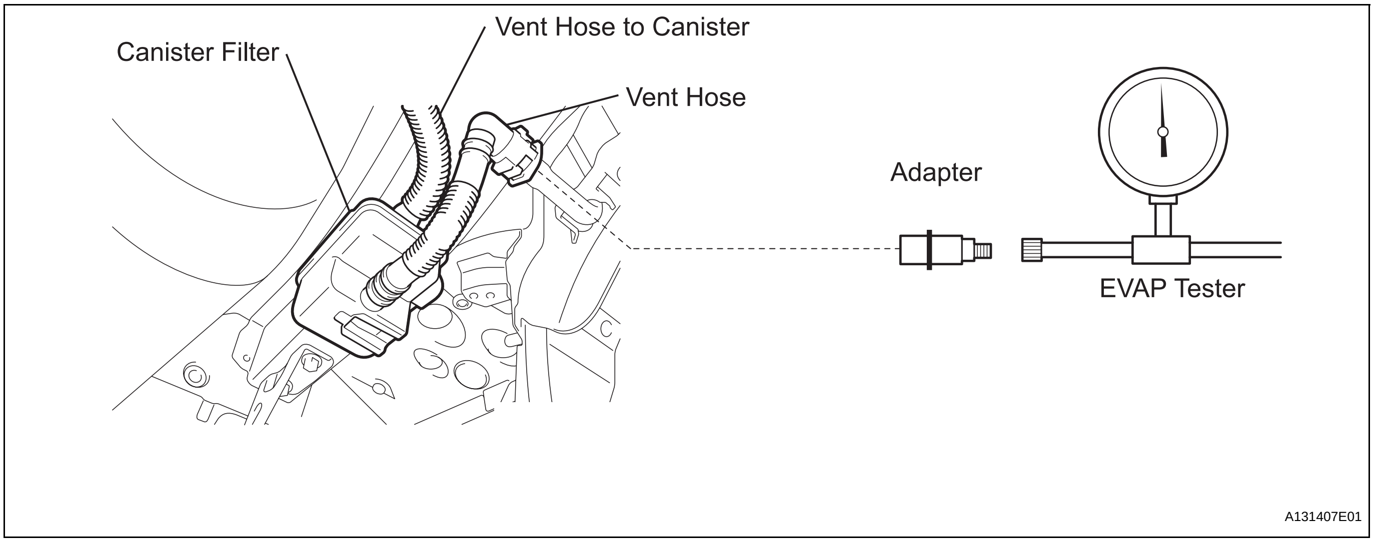
No DTC is present.

OK → **REPAIR COMPLETED**

NG

12 LOCATE LEAK POINT

(a) Disconnect the vent hose (fresh air line) as shown in the illustration.



(b) Connect the pressure gauge and air pump as shown in the illustration.

(c) Pressurize the EVAP system until 24 to 28 mmHg.

(d) Locate the leak point.

HINT:
If the EVAP system has leakage, a whistling sound may be heard.

OK:

The leak point is found.

OK → **Go to step 24**

NG

13 CHECK FUEL CAP

Check that the fuel cap meets OEM specifications.

HINT:
If an EVAP tester is available, perform the fuel cap test according to the tester's instructions.

OK:

Fuel cap meets OEM specifications.

NG → **Go to step 25**

ES

OK

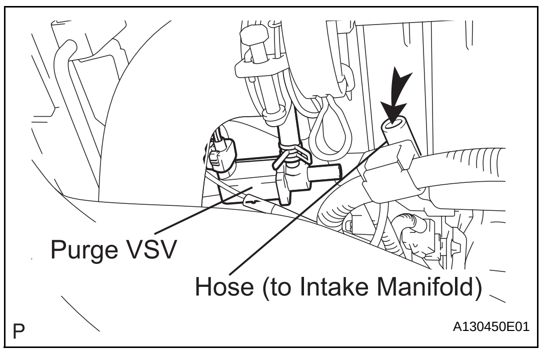
14	CHECK OPERATION FOR PURGE VSV

(a) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / EVAP VSV.
(b) Touch the purge VSV to feel the operating vibration.
OK:
The purge VSV (EVAP VSV) is operated by the ACTIVE TEST.

NG → **Go to step 26**

OK

15	CHECK INTAKE MANIFOLD PRESSURE



(a) Disconnect the purge VSV hose that is connected to the throttle body.
(b) Allow the engine to idle.
(c) Check that the hose has suction using your finger.
OK:
The hose has suction.

NG → **Go to step 27**

OK → **Go to step 28**

16	CHECK DTC

(a) Check the DTCs that were present at the EVAP system check.
OK:
P0451 is not present.

NG → **Go to step 9**

OK

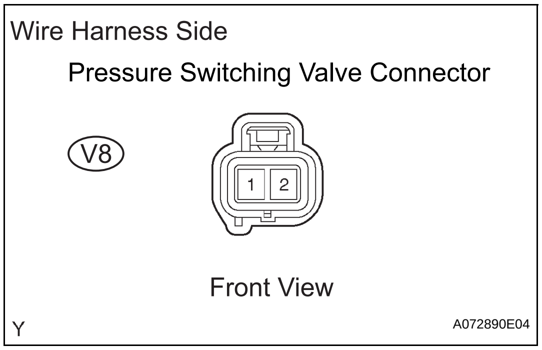
17	CHECK OPERATION FOR VENT VALVE

(a) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / VENT VALVE.
(b) Touch the pump module to feel the operating vibration.
OK:
The vent valve is operated by the ACTIVE TEST.

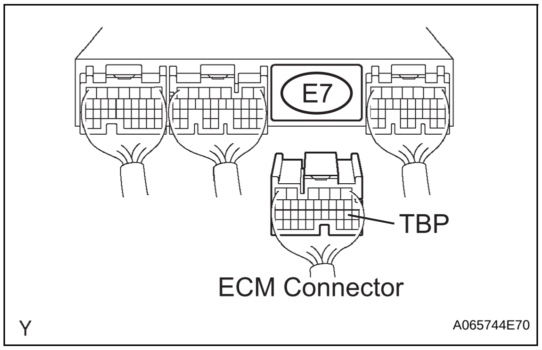
OK → **Go to step 9**

NG → **Go to step 29**

18	CHECK HARNESS AND CONNECTOR (PRESSURE SWITCHING VALVE - ECM AND EFI M RELAY)



(a) Check the harness and the connectors between the pressure switching valve and the ECM.
(1) Disconnect the V8 pressure switching valve connector.



(2) Disconnect the E7 ECM connector.
(3) Measure the resistance between the wire harness side connectors.

Standard resistance Check for open)

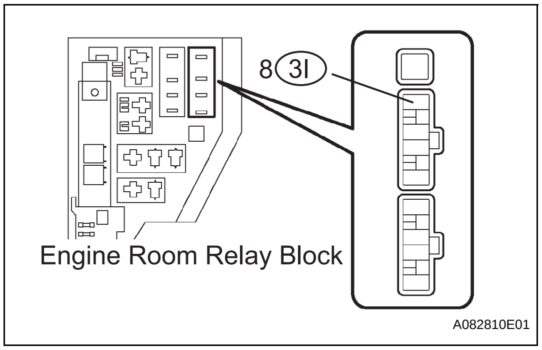
Tester Connection	Specified Condition
V8-1 (Pressure switching valve) - E7-18 (TBP)	Below 1 Ω

Standard resistance (Check for short)

Tester Connection	Specified Condition
V8-1 (Pressure switching valve) or E7-18 (TBP) - Body ground	10 kΩ higher

(4) Reconnect the pressure switching valve connector.
(5) Reconnect the ECM connector.

(b) Check the harness and the connectors between the pressure switching valve and the EFI M relay.
(1) Disconnect the V8 pressure switching valve connector.
(2) Remove the integration relay from the engine room relay block.



(3) Measure the resistance between the wire harness side connector.

Standard resistance (Check for open)

Tester Connection	Specified Condition
V8-2 (Pressure switching valve) - 3I-8 (EFI M relay)	Below 1 Ω

Standard resistance (Check for short)

Tester Connection	Specified Condition
V8-2 (Pressure switching valve) or 3I-8 (EFI M relay) - Body ground	10 kΩ or higher

(4) Reconnect the pressure switching valve connector.
(5) Reinstall the integration relay.

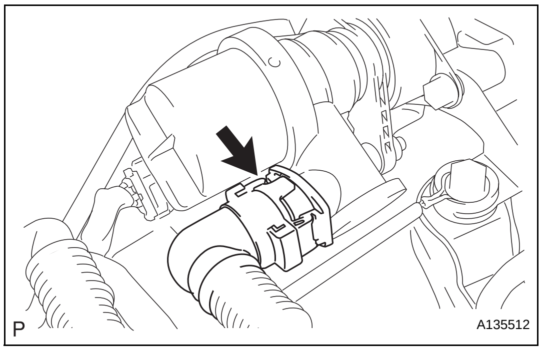
NG	Go to step 30
OK	Go to step 31

19	REPLACE PRESSURE SWITCHING VALVE

Replace the pressure switching valve (see page EC-31).

NEXT → **Go to step 34**

20	CHECK FOR VENT HOSE CLOG



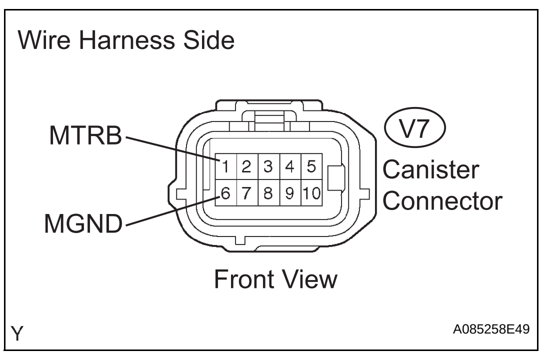
(a) Turn the power switch OFF.
(b) Disconnect the vent hose (fresh air line) as shown in the illustration.
(c) Allow the engine to idle.
(d) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / EVAP VSV.
(e) Turn the purge VSV (EVAP VSV) ON and check the EVAP pressure (VAPOR PRESS) for 10 seconds.

OK:
EVAP pressure is higher than 755 mmHg.

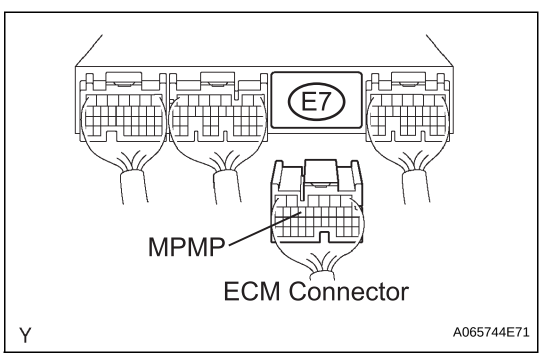
NG → **Go to step 22**

OK → **Go to step 32**

21	CHECK HARNESS AND CONNECTOR (LEAK DETECTION PUMP - ECM)



(a) Disconnect the V7 canister connector



(b) Disconnect the E7 ECM connector.
(c) Measure the resistance between the wire harness side connector.

Standard resistance (Check for open)

Tester Connection	Specified Condition
V7-1 (MTRB) - E7-13 (MPMP)	Below 1 Ω
V7-6 (MGND) - Body ground	Below 1 Ω

Standard resistance (Check for short)

Tester Connection	Specified Condition
V7-1 (MTRB) or E7-13 (MPMP) - Body ground	10 kΩ higher

(d) Reconnect the canister connector.
(e) Reconnect the ECM connector.

NG	Go to step 30
OK	Go to step 31

22 REPLACE TRAP CANISTER WITH PUMP MODULE

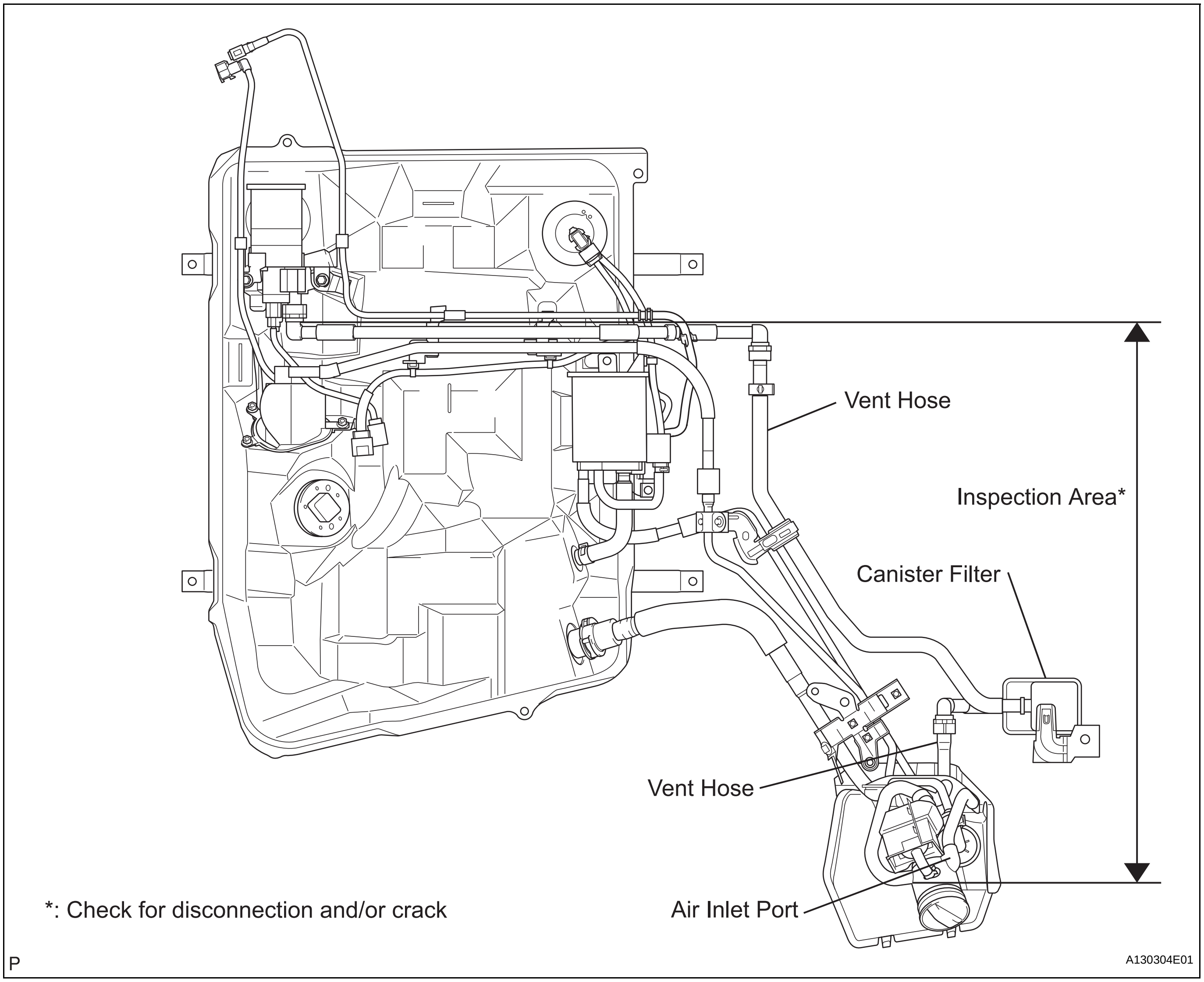
Replace the trap canister with pump module (see page EC-17).

NEXT	Go to step 34

ES

23 CHECK FOR VENT HOSE DAMAGE

Check for hose damage as shown in the illustration. If necessary, replace the vent hose.



NEXT	Go to step 22

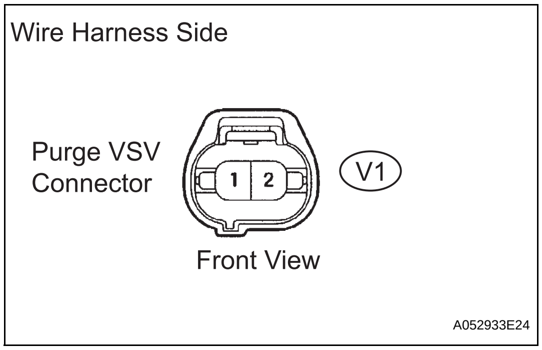
24	REPAIR OR REPLACE LEAK POINT

NEXT → Go to step 34

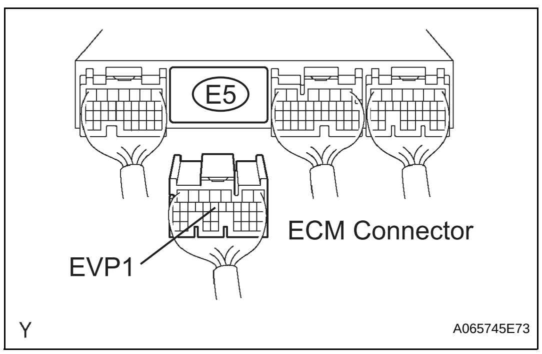
25	REPLACE FUEL CAP

NEXT → Go to step 34

26	CHECK HARNESS AND CONNECTOR (PURGE VSV - ECM)



(a) Disconnect the V1 purge VSV connector.



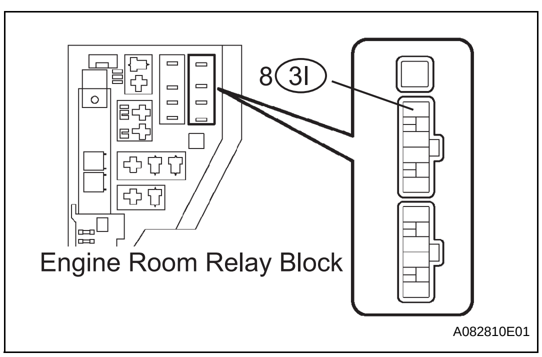
(b) Disconnect the E5 ECM connector.
(c) Check the harness and the connectors between the ECM and the purge VSV connectors.
(1) Measure the resistance between the wire harness side connector.

Standard resistance (Check for open)

Tester Connection	Specified Condition
V1-1 - E5-14 (EVP1)	Below 1 Ω

Standard resistance (Check for short)

Tester Connection	Specified Condition
V1-1 or E5-14 (EVP1) - Body ground	10 kΩ higher



(d) Remove the integration relay from the engine room relay block.
(e) Check the harness and connectors between the purge VSV connector and the EFI M relay.
(1) Measure the resistance between the wire harness side connectors.

Standard resistance (Check for open)

Tester Connection	Specified Condition
V1-2 - 3I-8 (EFI M relay)	Below 1 Ω

Standard resistance (Check for short)

Tester Connection	Specified Condition
V1-2 or 3I-8 (EFI M relay) - Body ground	10 kΩ higher

(f) Reconnect the purge VSV connector.
(g) Reconnect the ECM connector.

(h) Reinstall the integration relay.

NG	Go to step 30
OK	Go to step 31

27 REPLACE HOSE (PURGE VSV - THROTTLE BODY)

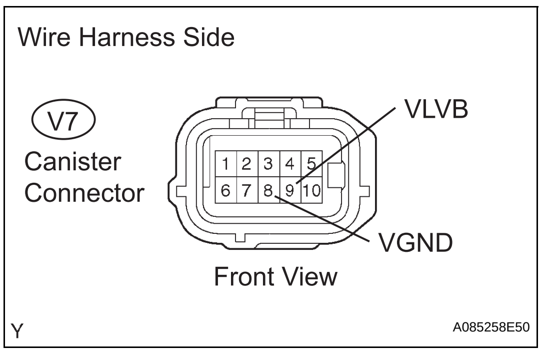
NEXT	Go to step 34

28 REPLACE PURGE VSV

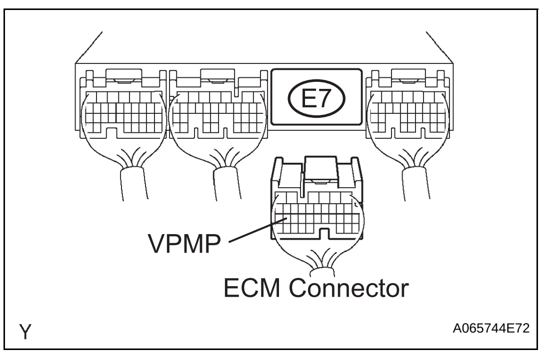
Replace the purge VSV (see page EC-23).

NEXT	Go to step 34

29 CHECK HARNESS AND CONNECTOR (VENT VALVE - ECM)



(a) Disconnect the V7 canister connector.



(b) Disconnect the E7 ECM connector.

(c) Check the harness and the connectors between the ECM and the canister connectors.

(1) Measure the resistance between the wire harness side connector.

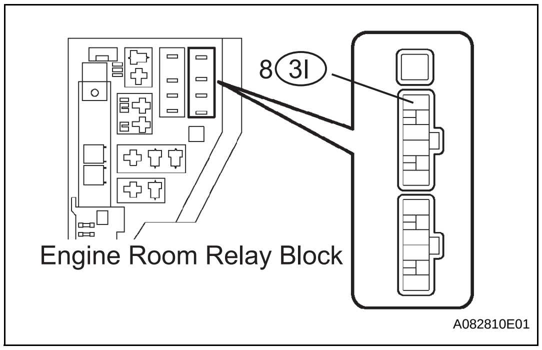
Standard resistance (Check for open)

Tester Connection	Specified Condition
V7-8 (VGND) - E7-26 (VPMP)	Below 1 Ω

Standard resistance (Check for short)

Tester Connection	Specified Condition
V7-8 (VGND) or E7-26 (VPMP) - Body ground	10 kΩ higher

ES



(d) Remove the integration relay from the engine room relay block.

(e) Check the harness and connectors between the canister connector and the EFI M relay.

(1) Measure the resistance between the wire harness side connectors.

Standard resistance (Check for open)

Tester Connection	Specified Condition
V7-9 (VLVB) - 3I-8 (EFI M relay)	Below 1 Ω

Standard resistance (Check for short)

Tester Connection	Specified Condition
V7-9 (VLVB) or 3I-8 (EFI M relay) - Body ground	10 kΩ higher

(f) Reconnect the canister connector.

(g) Reconnect the ECM connector.

(h) Reinstall the integration relay.

NG → **Go to step 30**

OK → **Go to step 31**

30 REPAIR OR REPLACE HARNESS AND CONNECTOR

NEXT → **Go to step 34**

31 REPLACE ECM

Replace the ECM (see page ES-469).

NEXT → **Go to step 34**

32 CHECK AND REPLACE VENT HOSE OR CANISTER FILTER

NEXT → **Go to step 34**

33 REPLACE HOSE (PRESSURE SWITCHING VALVE AND FUEL TANK)

NEXT

34 PERFORM EVAP SYSTEM CHECK

(a) Turn the power switch ON (IG).

(b) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / SYSTEM CHECK / EVAP SYS CHECK / AUTO OPERATION.

(c) After the system check is finished, check for pending DTCs.

ES

OK:
No DTC is present.

NG → **Go to step 6**

OK

35	PERFORM EVAP MONITOR DRIVE PATTERN

(a) Check that the following conditions are met:
- Fuel level is 1/8 to 7/8.
- Engine coolant temperature (ECT) is 4.4 to 35°C (40 to 95°F).
- Intake air temperature (IAT) is 4.4 to 35°C (40 to 95°F).
- Difference of ECT and IAT is less than 7°C (13°F).

(b) Enter the check mode. Enter the following menus: DIAGNOSIS / ENHANCED OBD II / CHECK MODE.
(c) Allow the engine to idle until the ECT is 75°C (167°F).
(d) Drive the vehicle at 50 km/h (30 mph) or faster and maintain that speed for 60 seconds or more.
(e) Stop the vehicle. Do not turn the power switch OFF.
(f) Check that the EVAP monitor status is complete. Enter the following menus: DIAGNOSIS / ENHANCED OBD II / MONITOR STATUS.
(g) If the EVAP monitor is incomplete, drive the vehicle at 50 km/h (30 mph) or faster and maintain that speed for 120 seconds or more. After that, recheck the EVAP monitor status.
(h) Check for pending DTCs.
OK:
No DTC is present.

NG → **Go to step 2**

OK

REPAIR COMPLETED

ES

DTC	P0450	Evaporative Emission Control System Pressure Sensor Malfunction

DTC	P0451	Evaporative Emission Control System Pressure Sensor Range / Performance

DTC	P0452	Evaporative Emission Control System Pressure Sensor / Switch Low Input

DTC	P0453	Evaporative Emission Control System Pressure Sensor / Switch High Input

DTC SUMMARY

DTC No.	Monitoring Items	Malfunction Detection Conditions	Trouble Area	Detection Timing	Detection logic
P0450	Canister pressure sensor voltage abnormal fluctuation	Sensor output voltage rapidly fluctuates beyond upper and lower malfunction thresholds for 0.5 seconds.	• Canister pump module • ECM	• EVAP monitoring (power switch OFF) • Power switch ON (IG)	1 trip
P0451	Canister pressure sensor noisy	Sensor output voltage fluctuates frequently in certain time period.	• Canister pump module • EVAP system hose (pipe from air inlet port to canister pump module, canister filter, fuel tank vent hose) • ECM	• EVAP monitoring (power switch OFF) • Engine running	2 trip
P0451	Canister pressure sensor stuck	Sensor output voltage does not vary in certain time period.	• Canister pump module • EVAP system hose (pipe from air inlet port to canister pump module, canister filter, fuel tank vent hose) • ECM	• EVAP monitoring (power switch OFF)	2 trip
P0452	Canister pressure sensor voltage low	Sensor output voltage less than 0.45 V for 0.5 seconds.	• Canister pump module • Connector/wire harness (canister pump module - ECM) • ECM	• EVAP monitoring (power switch OFF) • Power switch ON (IG)	1 trip
P0453	Canister pressure sensor voltage high	Sensor output voltage more than 4.9 V for 0.5 seconds.	• Canister pump module • Connector/wire harness (canister pump module - ECM) • ECM	• EVAP monitoring (power switch OFF) • Power switch ON (IG)	1 trip

HINT:
The canister pressure sensor is built into the canister pump module.

DESCRIPTION

NOTICE:

In this vehicle's EVAP system, turning ON the vent valve does not seal off the EVAP system. To check for leaks in the EVAP system, disconnect the air inlet vent hose and apply pressure from the atmosphere side of the canister.

While the engine is running, if a predetermined condition (closed loop, etc.) is met, the purge VSV is opened by the ECM and stored fuel vapors in the canister are purged to the intake manifold. The ECM changes the duty cycle ratio of the purge VSV to control purge flow volume.

The purge flow volume is also determined by the intake manifold pressure. Atmospheric pressure is allowed into the canister through the vent valve to ensure that the purge flow is maintained when the negative pressure (vacuum) is applied to the canister.

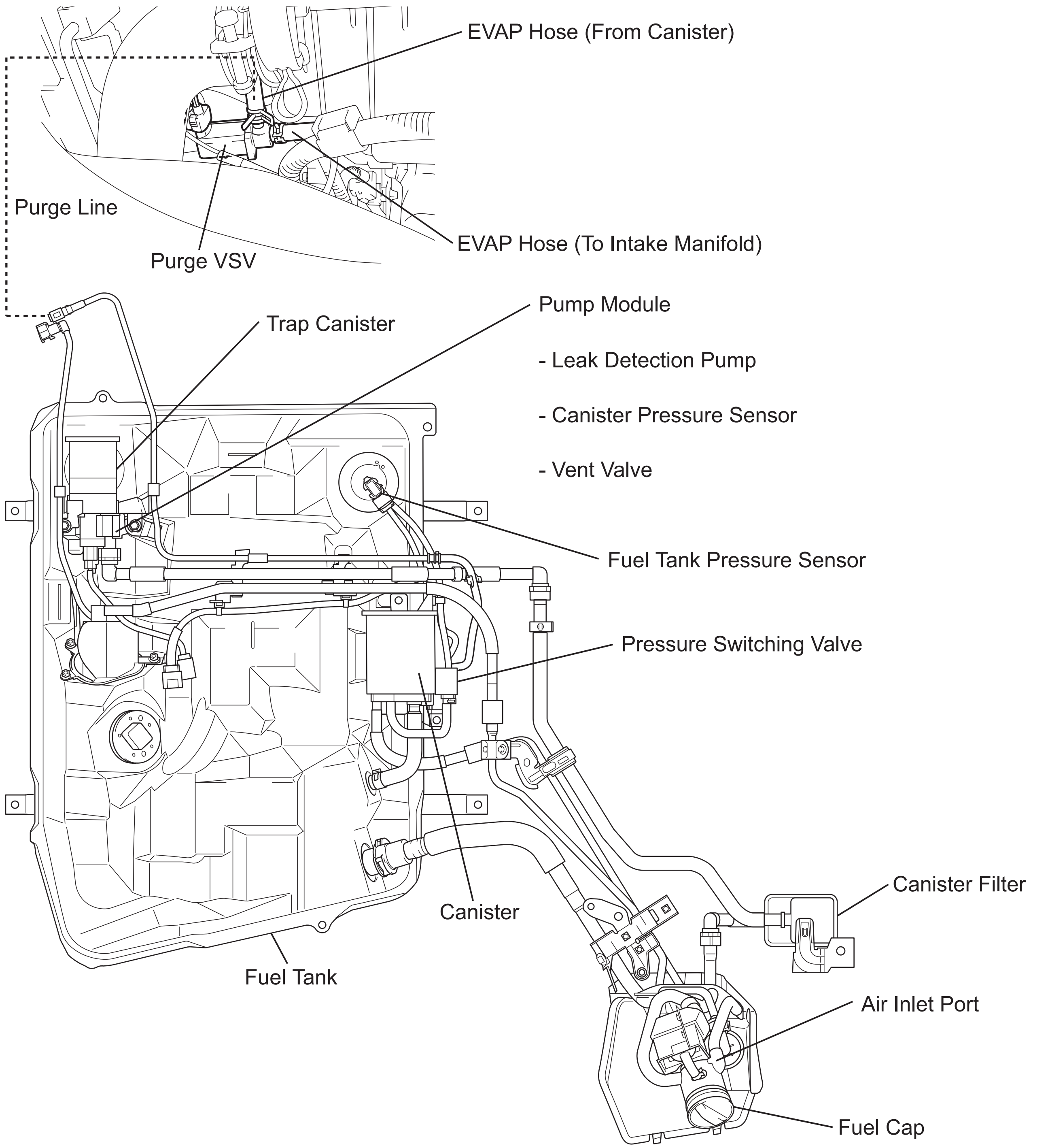
Key-off monitor

This monitor checks for Evaporative Emission (EVAP) system leaks and canister pump module malfunctions. The monitor starts 5 hours* after the power switch is turned OFF. More than 5 hours are required to allow the fuel to cool down to stabilize the Fuel Tank Pressure (FTP), thus making the EVAP system monitor more accurate.

The leak detection pump creates negative pressure (vacuum) in the EVAP system and the pressure is measured. Finally, the ECM monitors for leaks from the EVAP system and malfunctions in both the canister pump module and purge VSV, based on the EVAP pressure.

HINT:
*: If the engine coolant temperature is not below 35°C (95°F) 5 hours after the power switch is turned OFF, the monitor check starts 2 hours later. If it is still not below 35°C (95°F) 7 hours after the power switch is turned OFF, the monitor check starts 2.5 hours later.

Location


EVAP Hose (From Canister)
Purge Line
Purge VSV
EVAP Hose (To Intake Manifold)
Trap Canister
Pump Module
- Leak Detection Pump
- Canister Pressure Sensor
- Vent Valve
Fuel Tank Pressure Sensor
Pressure Switching Valve
Canister Filter
Canister
Fuel Tank
Air Inlet Port
Fuel Cap
A131350E01

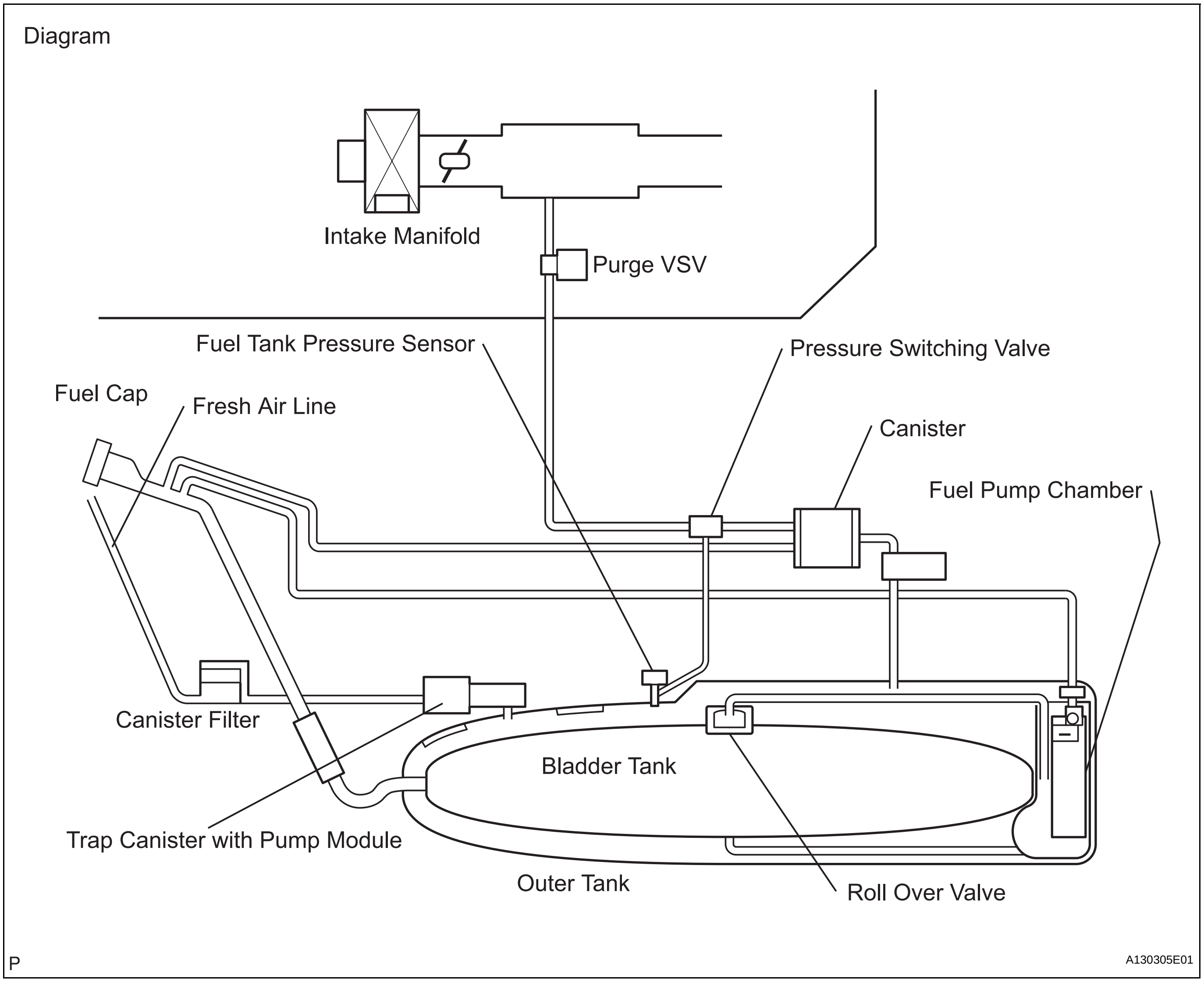
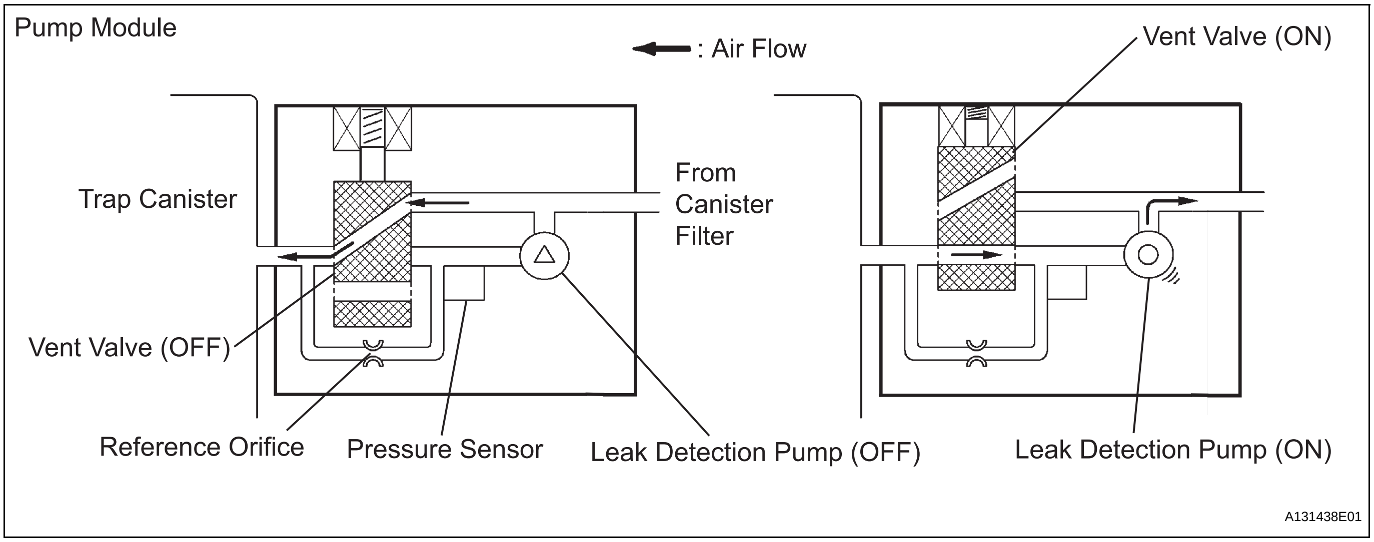
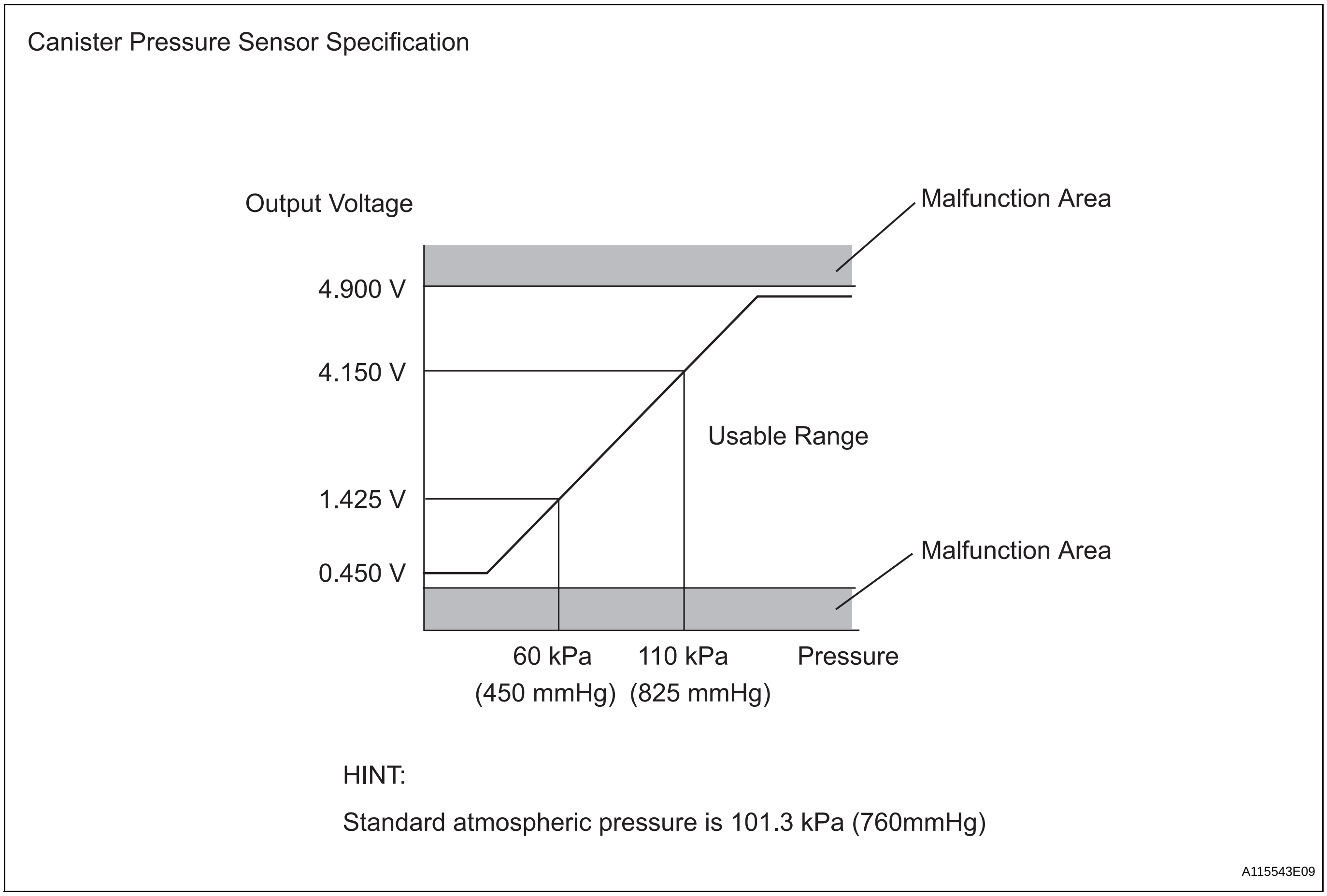


Diagram
Intake Manifold
Purge VSV
Fuel Tank Pressure Sensor
Pressure Switching Valve
Fuel Cap
Fresh Air Line
Canister
Fuel Pump Chamber
Canister Filter
Bladder Tank
Trap Canister with Pump Module
Outer Tank
Roll Over Valve
P
A130305E01


Pump Module
: Air Flow
Vent Valve (ON)
Trap Canister
From
Canister
Filter
Vent Valve (OFF)
Reference Orifice
Pressure Sensor
Leak Detection Pump (OFF)
Leak Detection Pump (ON)
A131438E01

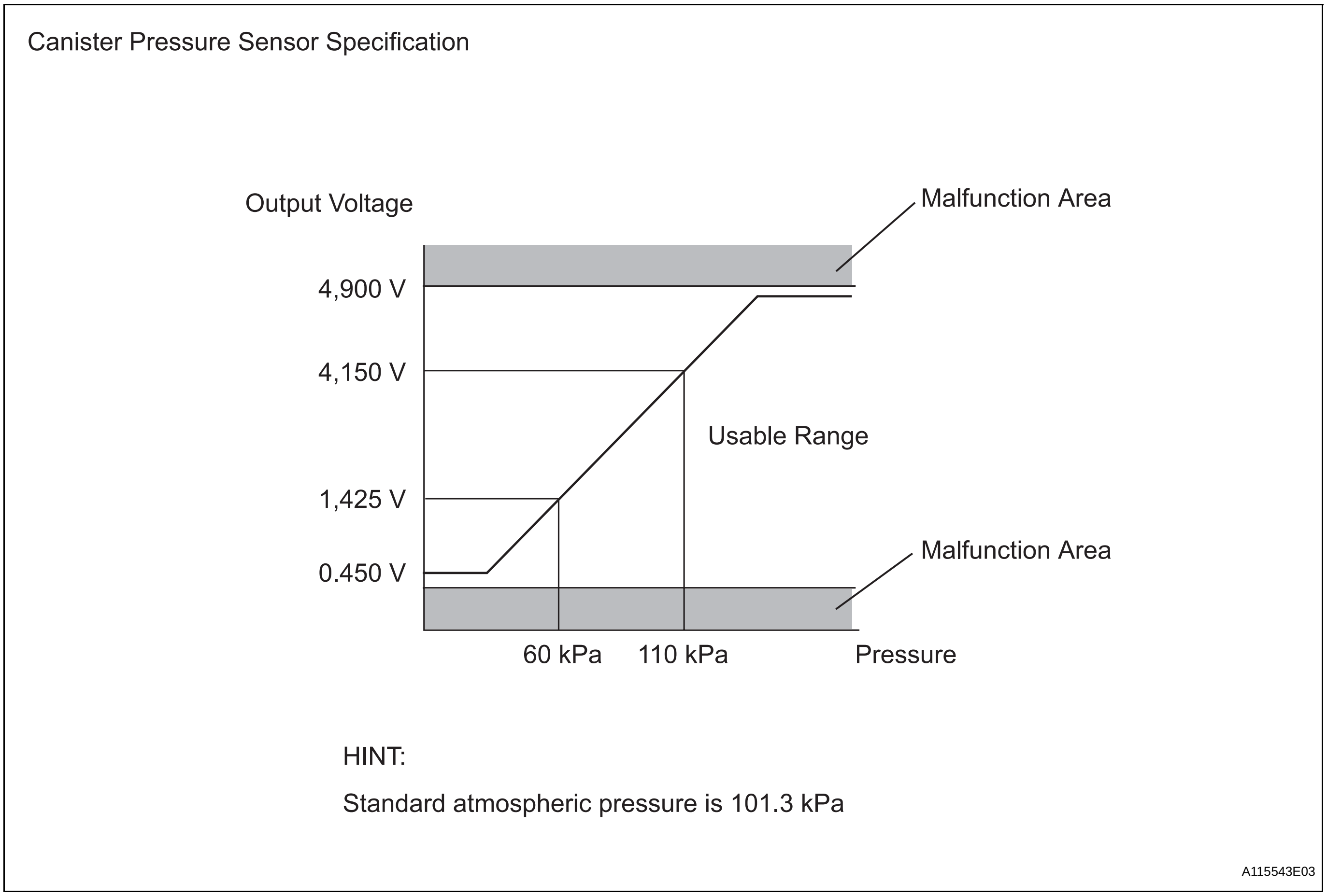
ES



Components	Operations
Canister, Trap canister	Contains activated charcoal to absorb EVAP generated in fuel tank.
Cut-off valve	Located in fuel tank. Valve floats and closes when fuel tank 100% full.
Purge Vacuum Switching Valve (VSV)	Opens or closes line between canister and intake manifold. ECM uses purge VSV to control EVAP purge flow. In order to discharge EVAP absorbed by canister to intake manifold, ECM opens purge VSV. EVAP discharge volume to intake manifold controlled by purge VSV duty cycle ratio (current-carrying time) (open: ON; closed: OFF).
Roll-over valve	Located in fuel tank. Valve closes by its own weight when vehicle overturns to prevent fuel from spilling out.
Soak timer	Built into ECM. To ensure accurate EVAP monitor, measures 5 hours (+-15 min) after power switch OFF. This allows fuel to cool down, stabilizing Fuel Tank Pressure (FTP). When approximately 5 hours elapsed, ECM activates.
Pressure switching valve	The pressure switching valve located on the canister is used to detect leakage from the bladder tank into the fuel tank. The valve opens during the bladder tank leak check. Then, the fuel tank's fuel vapor flows to the intake manifold without passing the canister.
Pump module	Consists of (a) to (d) below. pump module cannot be disassembled.
(a) Vent valve	Vents and closes EVAP system. When ECM turns valve ON, EVAP system closed. When ECM turns valve OFF, EVAP system vented. Negative pressure (vacuum) created in EVAP system to check for EVAP leaks by closing purge VSV, turning vent valve ON (closed) and operating leak detection pump.
(b) Canister pressure sensor	Indicates pressure as voltage. ECM supplies regulated 5 V to canister pressure sensor, and uses feedback from sensor to monitor EVAP system pressure.
(c) Leak detection pump	Creates negative pressure (vacuum) in EVAP system for leak check.

Components	Operations
(d) Reference orifice	Has opening with 0.02 inch diameter. Vacuum produced through orifice by closing purge VSV, turning vent valve OFF and operating leak detection pump to monitor 0.02 inch leak criterion. 0.02 inch leak criterion indicates small leak of EVAP.

MONITOR DESCRIPTION



(a) DTC P0450: Canister pressure sensor voltage abnormal fluctuation
If the canister pressure sensor voltage output rapidly fluctuates between less than 0.45 V and more than 4.9 V, the ECM interprets this as an open or short circuit malfunction in the canister pressure sensor or its circuit, and stops the EVAP system monitor. The ECM then illuminates the MIL and sets the DTC (1 trip detection logic).

(b) DTC P0451: Canister pressure sensor noisy or stuck
If the canister pressure sensor voltage output fluctuates rapidly for 10 seconds, the ECM stops the EVAP system monitor. The ECM interprets this as noise from the canister pressure sensor, and stops the EVAP system monitor. The ECM then illuminates the MIL and sets the DTC.
Alternatively, if the sensor voltage output does not change for 10 seconds, the ECM interprets this as the sensor being stuck, and stops the monitor. The ECM then illuminates the MIL and sets the DTC. (Both of the malfunctions are detected by 2 trip detection logic).

(c) DTC P0452: Canister pressure sensor voltage low
If the canister pressure sensor voltage output is below 0.45 V, the ECM interprets this as an open or short circuit malfunction in the canister pressure sensor or its circuit, and stops the EVAP system monitor. The ECM then illuminates the MIL and sets the DTC (1 trip detection logic).

(d) DTC P0453: Canister pressure sensor voltage high
If the canister pressure sensor voltage output is 4.9 V or more, the ECM interprets this as an open or short circuit malfunction in the canister pressure sensor or its circuit, and stops the EVAP system monitor. The ECM then illuminates the MIL and sets the DTC (1 trip detection logic).

MONITOR STRATEGY

Required Sensors/Components	Canister pump module
Frequency of Operation	Continuous
Duration	Within 15 minutes
MIL Operation	Immediate: P0450, P0452, P0453 2 driving cycles: P0451
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

P0451 (Noise Monitor):

Monitor runs whenever following DTCs are not present	None
Atmospheric pressure	70 to 110 kPa (525 to 825 mmHg) [absolute pressure]
Battery voltage	10.5 V or more
Intake air temperature	4.4 to 35 °C (40 to 95°F)
EVAP canister pressure sensor malfunction (P0450, P0452, P0453)	Not detected
Either of following conditions is met	A or B
A. Engine	Running
B. Soak time (power switch OFF time)	5 hours

Example of restart time

First time	7 hours
Second time	9 hours and 30 minutes

P0451 (Stuck Monitor):

Monitor runs whenever following DTCs are not present	None
Atmospheric pressure	70 to 110 kPa (525 to 825 mmHg)
Battery voltage	10.5 V or more
Intake air temperature	4.4 to 35°C (40 to 95°F)
EVAP pressure sensor malfunction	Not detected
Soak time (power switch OFF time)	5 hours

Example of restart time

First time	7 hours
Second time	9 hours and 30 minutes

P0450, P0452 and P0453:

Monitor runs whenever following DTCs are not present	None
When either of following condition is met	(a) or (b)
(a) Power switch	ON
(b) Soak timer	ON

TYPICAL MALFUNCTION THRESHOLDS

1. P0450: Canister pressure sensor chattering

EVAP pressure	Less than 42.1 kPa (315.9 mmHg) or more than 123.8 kPa (928.4 mmHg)

2. P0451: Canister pressure sensor noise

Pressure variation indicated by canister pressure sensor in 10 seconds	More than +-0.3 kPa (+-2.25 mmHg) 10 times

3. P0451: Canister pressure sensor stuck

EVAP pressure change during reference pressure in 10 seconds	Less than 1 kPa (7.5 mmHg)

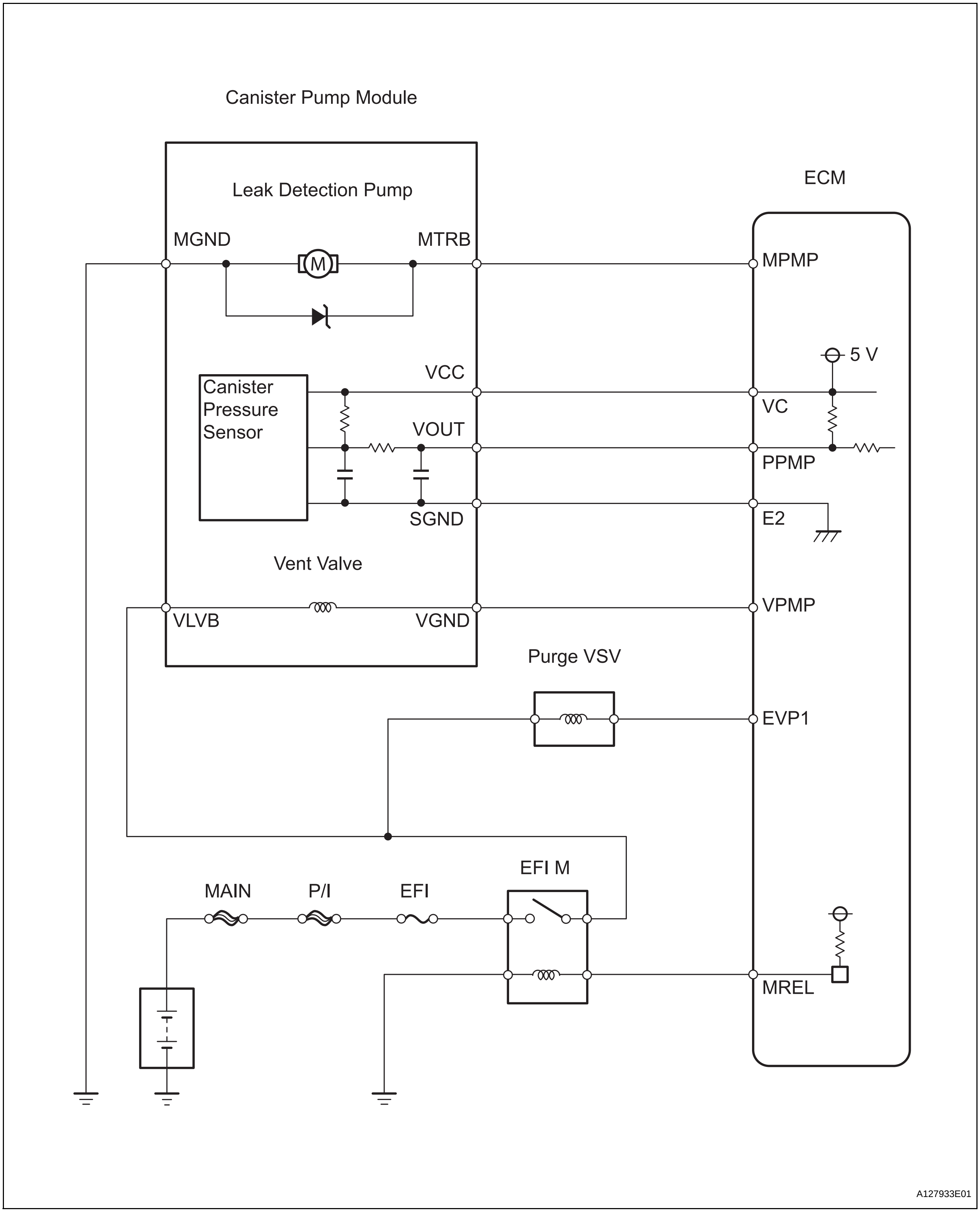
4. P0452: Canister pressure sensor low voltage

EVAP pressure	Less than 42.1 kPa (315.9 mmHg)

5. P0453: Canister pressure sensor high voltage

EVAP pressure	More than 123.8 kPa (928.4 mmHg)

WIRING DIAGRAM



INSPECTION PROCEDURE

NOTICE:

- **When a vehicle is brought into the workshop, leave it as it is. Do not change the vehicle condition. For example, do not tighten the fuel cap.**
- **Do not disassemble the canister pump module.**
- **The intelligent tester is required to conduct the following diagnostic troubleshooting procedure.**

1	CONFIRM DTC AND EVAP PRESSURE

(a) Connect the intelligent tester to the DLC3.
(b) Turn the power switch ON (IG) and turn the intelligent tester ON.
(c) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DTC INFO / CURRENT CODES.
(d) Read the values.
(e) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DATA LIST / EVAP / VAPOR PRESS.
(f) Read the EVAP pressure displayed on the intelligent tester.

Result

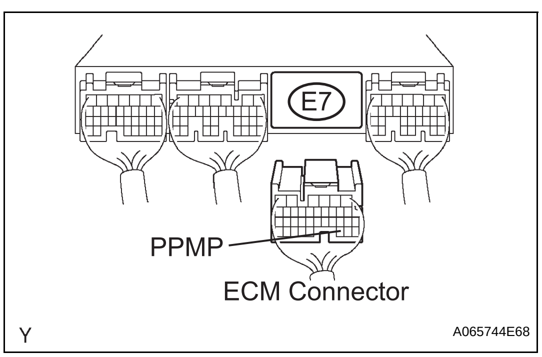
Display (DTC Output)	Test Result	Suspected Trouble Areas	Proceed to
P0451	-	• Canister pressure sensor	A
P0452	Less than 45 kPa (430 mmHg)	• Wire harness/connector (ECM - canister pressure sensor) • Canister pressure sensor • Short in ECM circuit	B
P0453	More than 120 kPa (900 mmHg)	• Wire harness/connector (ECM - canister pressure sensor) • Canister pressure sensor • Open in ECM circuit	C

A → **Go to step 5**

C → **Go to step 4**

B

2	CHECK HARNESS AND CONNECTOR (CANISTER PUMP MODULE - ECM)



(a) Turn the power switch OFF.
(b) Disconnect the E7 ECM connector.
(c) Measure the resistance between the PPMP (E7-30) terminal of the ECM connector and the body ground.

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Result

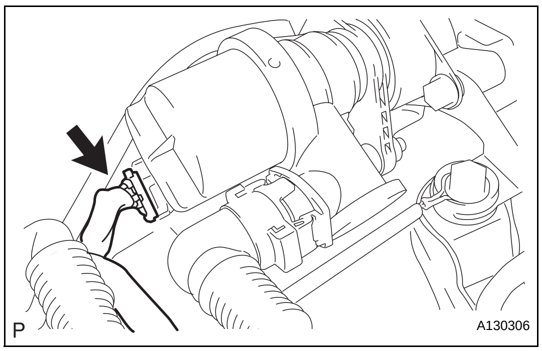
Test Results	Suspected Trouble Areas	Proceed to
10 Ω or less	• Wire harness/connector (ECM - canister pressure sensor) • Short in canister pressure sensor circuit	A
10 kΩ or more	• Wire harness/connector (ECM - canister pressure sensor) • Short in ECM circuit	B

B → **Go to step 7**

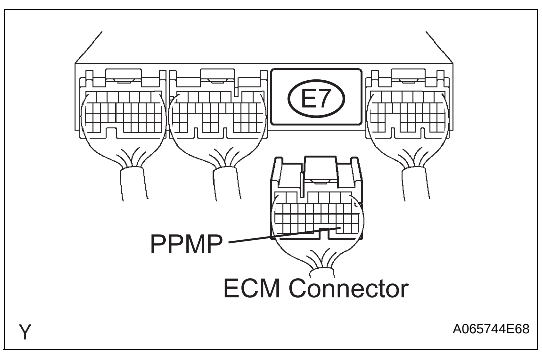
A

ES

3 CHECK HARNESS AND CONNECTOR (CANISTER PUMP MODULE - ECM)



(a) Disconnect the V7 canister connector.
(b) Disconnect the E7 ECM connector.



(c) Measure the resistance between the PPMP (E7-30) terminal of the ECM connector and the body ground.

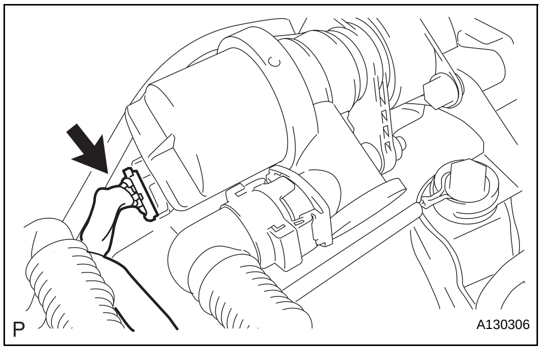
Result

Test Results	Suspected Trouble Areas	Proceed to
10 kΩ or more	• Short in canister pressure sensor circuit	A
10 kΩ or less	• Short in wire harness/connector (ECM - canister pressure sensor)	B

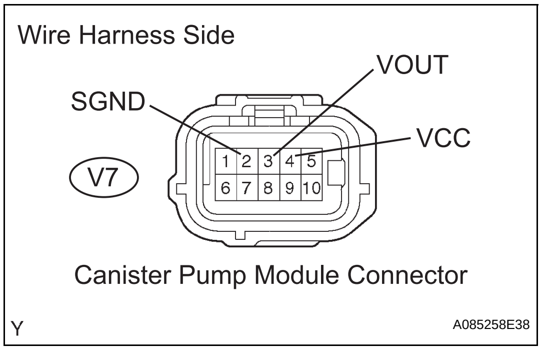
B → **Go to step 6**

A

4 CHECK HARNESS AND CONNECTOR (CANISTER PUMP MODULE - ECM)



(a) Disconnect the V7 canister connector.



(b) Turn the power switch ON (IG).

(c) Measure the voltage and resistance of the canister pump module connector.

Standard voltage

Tester Connection	Specified Condition
V7-4 (VCC) - Body ground	4.5 to 5.0 V
V7-3 (VOUT) - Body ground	4.5 to 5.0 V

Standard resistance

Tester Connection	Specified Condition
V7-2 (SGND) - Body ground	100 Ω or less

Result

Test Results	Suspected Trouble Areas	Proceed to
Voltage and resistance within standard ranges	• Open in canister pressure sensor circuit	A
Voltage and resistance outside standard ranges	• Open in wire harness/connector (ECM - canister pressure sensor)	B

B → **Go to step 6**

A

5 REPLACE CANISTER ASSEMBLY

(a) Replace the canister assembly (see page EC-9).

NOTICE:
When replacing the canister, check the canister pump module interior and related pipes for water, fuel or other liquids. If liquids are present, check for disconnections and/or cracks in the following: 1) the pipe from the air inlet port to the canister pump module; 2) the canister filter; and 3) the fuel tank vent hose.

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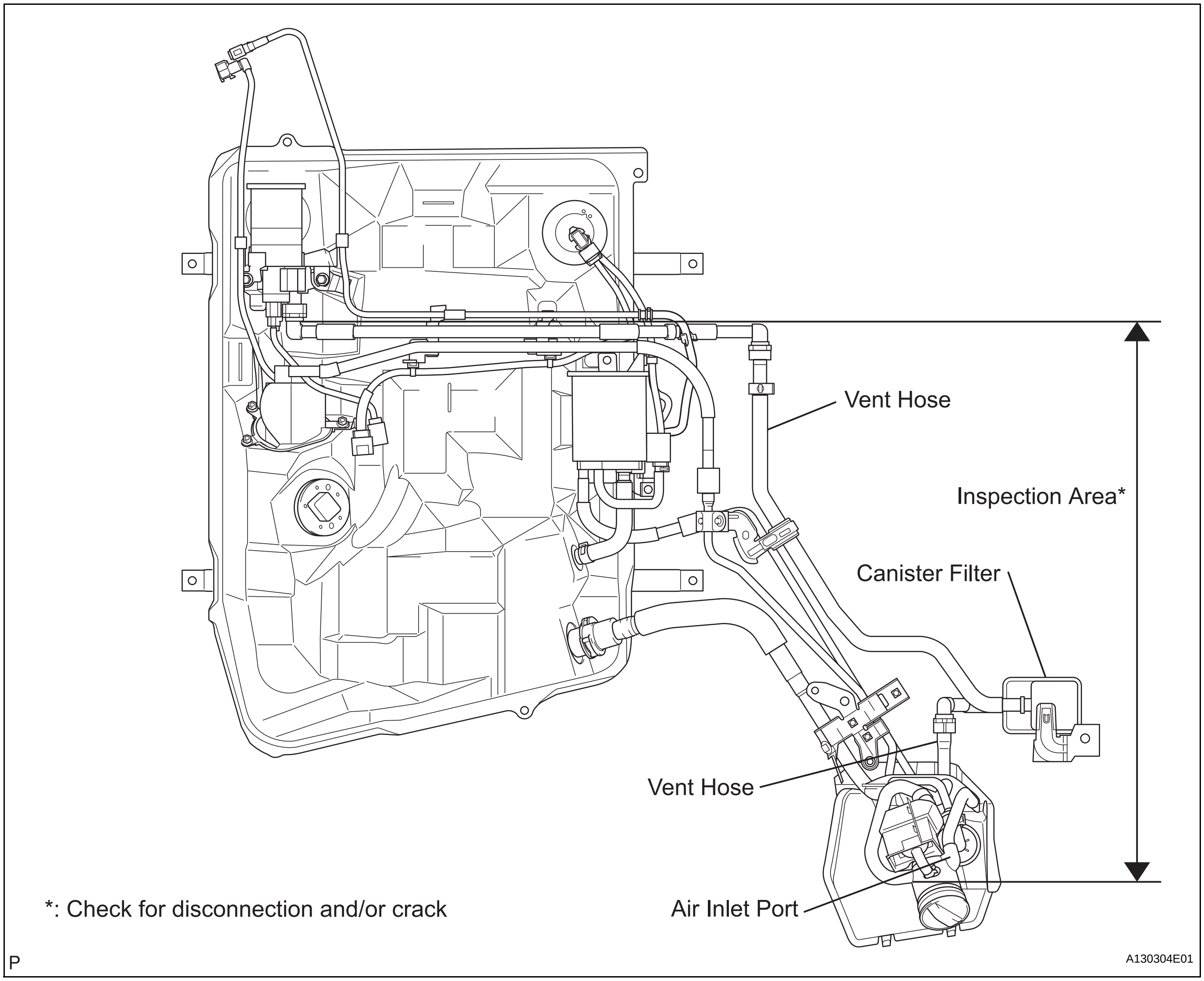

NEXT | **Go to step 8**

6 REPAIR OR REPLACE HARNESS OR CONNECTOR

HINT:
If the exhaust tailpipe has been removed, go to the next step before reinstalling it.

NEXT | **Go to step 8**

7 REPLACE ECM

(a) Replace the ECM (see page ES-469).

NEXT | **Go to step 8**

8 CHECK WHETHER DTC OUTPUT RECURS (AFTER REPAIR)

(a) Connect the intelligent tester to the DLC3.

(b) Turn the power switch ON (IG) and turn the intelligent tester ON.
(c) Wait for at least 60 seconds.
(d) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DTC INFO / PENDING CODES.
HINT:
If no pending DTC is displayed on the intelligent tester, the repair has been successfully completed.

NEXT

COMPLETED

DTC	P0455	Evaporative Emission Control System Leak Detected (Gross Leak)

DTC	P0456	Evaporative Emission Control System Leak Detected (Very Small Leak)

DTC SUMMARY

DTC No.	Monitoring Items	Malfunction Detection Conditions	Trouble Area	Detection Timing	Detection Logic
P0455	EVAP gross leak	Leak detection pump creates negative pressure (vacuum) in EVAP system and EVAP system pressure measured. 0.02 inch leak criterion measured at start and at end of leak check. If stabilized pressure higher than [second 0.02 inch leak criterion x 0.15], ECM determines that EVAP system has large leakage.	• Fuel cap (loose) • Leakage from EVAP line (canister - fuel tank) • Leakage from EVAP line (purge VSV - canister) • Canister pump module • Leakage from fuel tank • Leakage from canister	While power switch OFF	2 trip
P0456	EVAP small leak	Leak detection pump creates negative pressure (vacuum) in EVAP system and EVAP system pressure measured. 0.02 inch leak criterion measured at start and at end of leak check. If stabilized pressure higher than second 0.02 inch leak criterion, ECM determines that EVAP system has small leakage.	Same as above	While power switch OFF	2 trip

DESCRIPTION

NOTICE:
In this vehicle's EVAP system, turning ON the vent valve does not seal off the EVAP system. To check for leaks in the EVAP system, disconnect the air inlet vent hose and apply pressure from the atmosphere side of the canister.

While the engine is running, if a predetermined condition (closed loop, etc.) is met, the purge VSV is opened by the ECM and stored fuel vapors in the canister are purged to the intake manifold. The ECM changes the duty cycle ratio of the purge VSV to control purge flow volume.
The purge flow volume is also determined by the intake manifold pressure. Atmospheric pressure is allowed into the canister through the vent valve to ensure that the purge flow is maintained when the negative pressure (vacuum) is applied to the canister.

Key-off monitor

This monitor checks for Evaporative Emission (EVAP) system leaks and canister pump module malfunctions. The monitor starts 5 hours* after the power switch is turned OFF. More than 5 hours are required to allow the fuel to cool down to stabilize the Fuel Tank Pressure (FTP), thus making the EVAP system monitor more accurate.

The leak detection pump creates negative pressure (vacuum) in the EVAP system and the pressure is measured. Finally, the ECM monitors for leaks from the EVAP system and malfunctions in both the canister pump module and purge VSV, based on the EVAP pressure.

HINT:

*: If the engine coolant temperature is not below 35°C (95°F) 5 hours after the power switch is turned OFF, the monitor check starts 2 hours later. If it is still not below 35°C (95°F) 7 hours after the power switch is turned OFF, the monitor check starts 2.5 hours later.

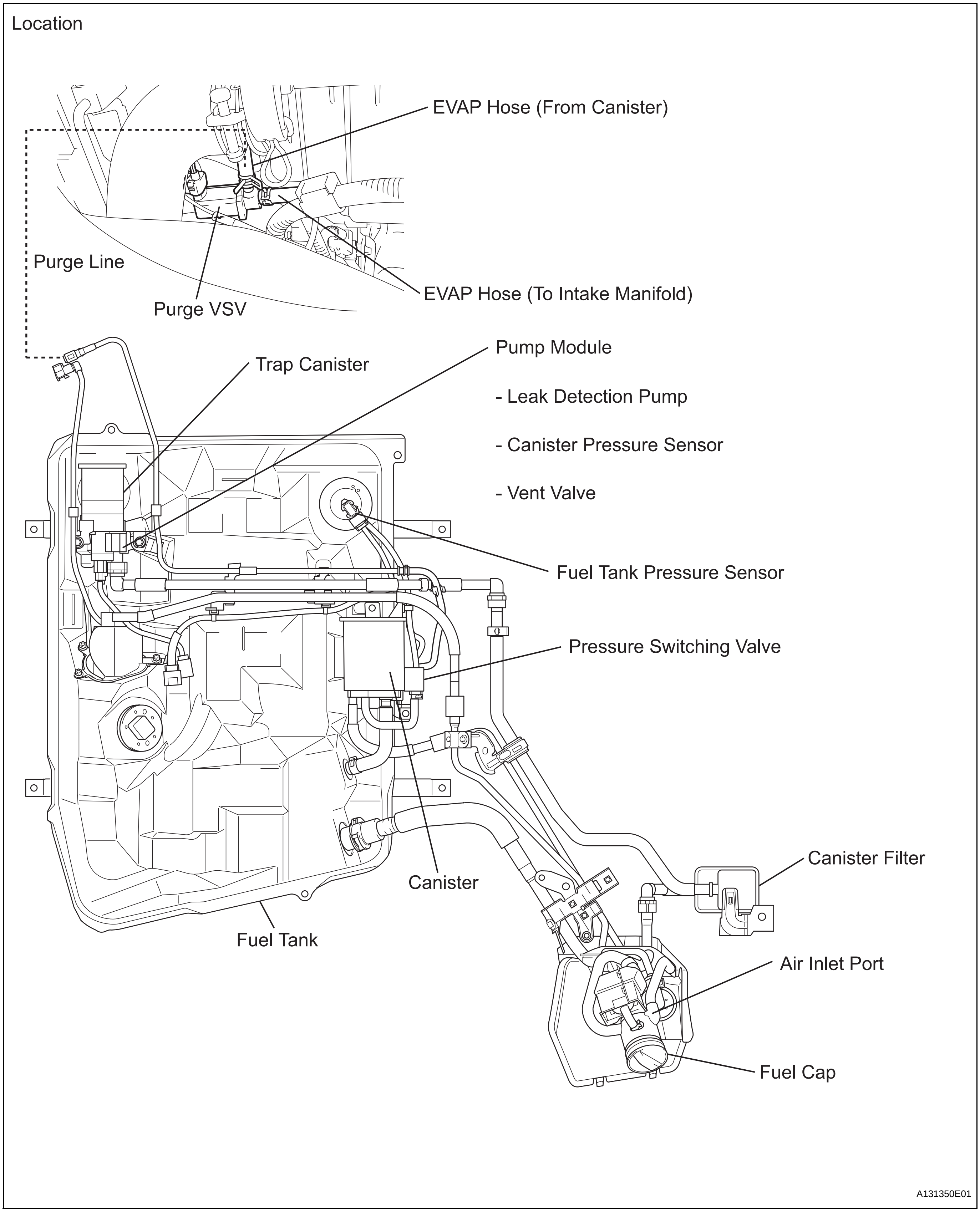
Location
EVAP Hose (From Canister)
Purge Line
Purge VSV
EVAP Hose (To Intake Manifold)
Trap Canister
Pump Module
- Leak Detection Pump
- Canister Pressure Sensor
- Vent Valve
Fuel Tank Pressure Sensor
Pressure Switching Valve
Canister Filter
Canister
Fuel Tank
Air Inlet Port
Fuel Cap
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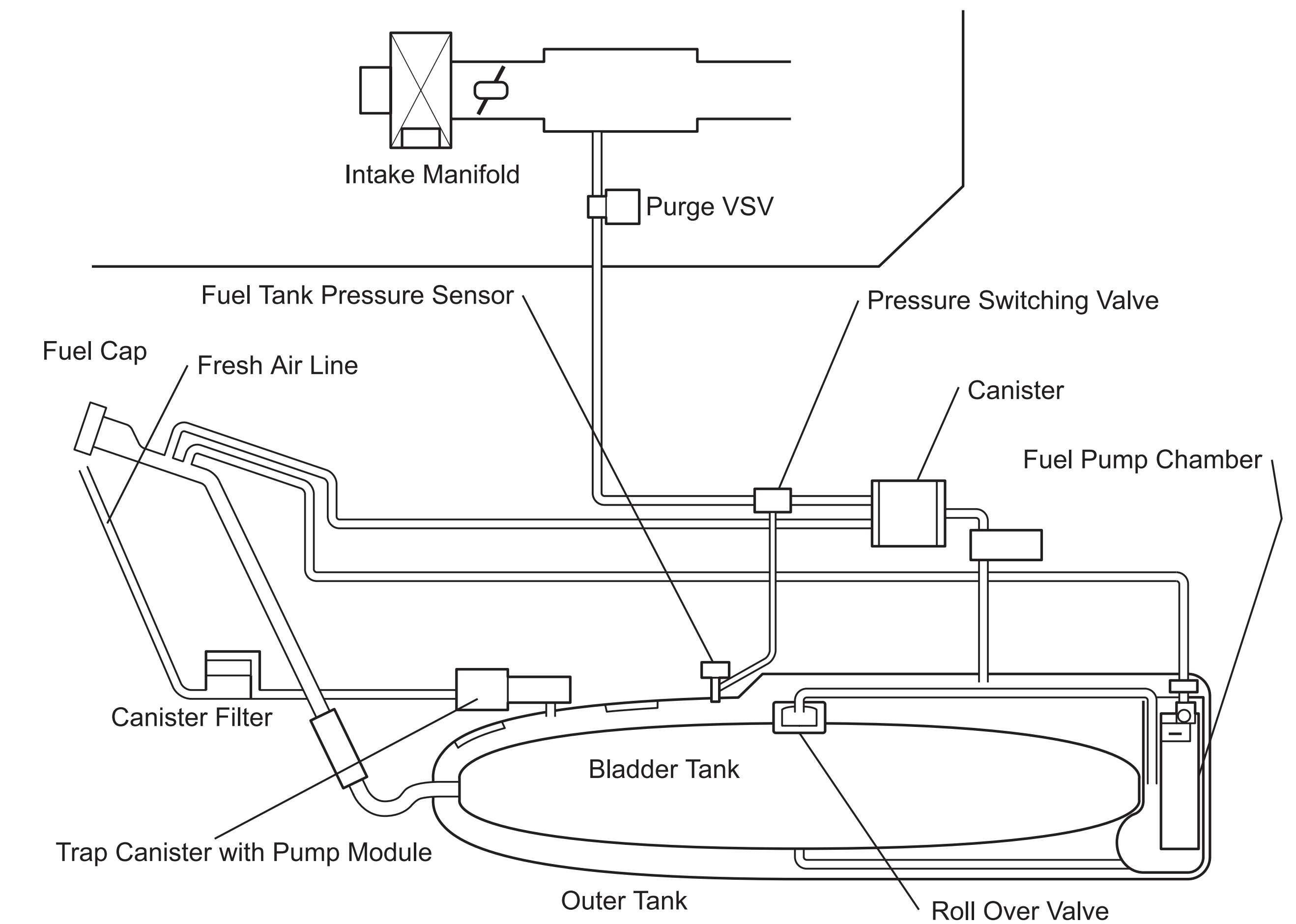
Diagram



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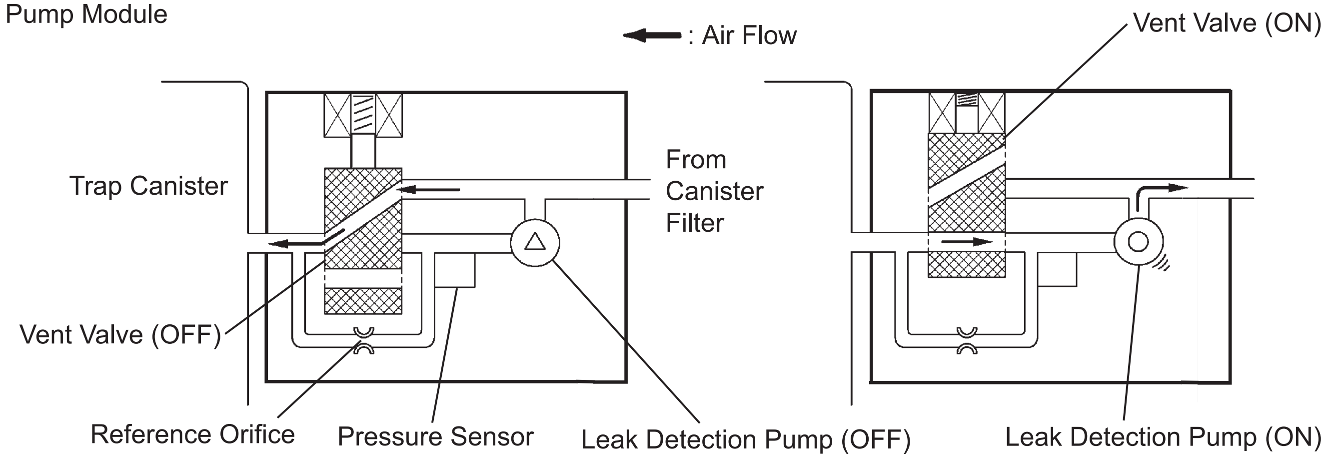
Pump Module



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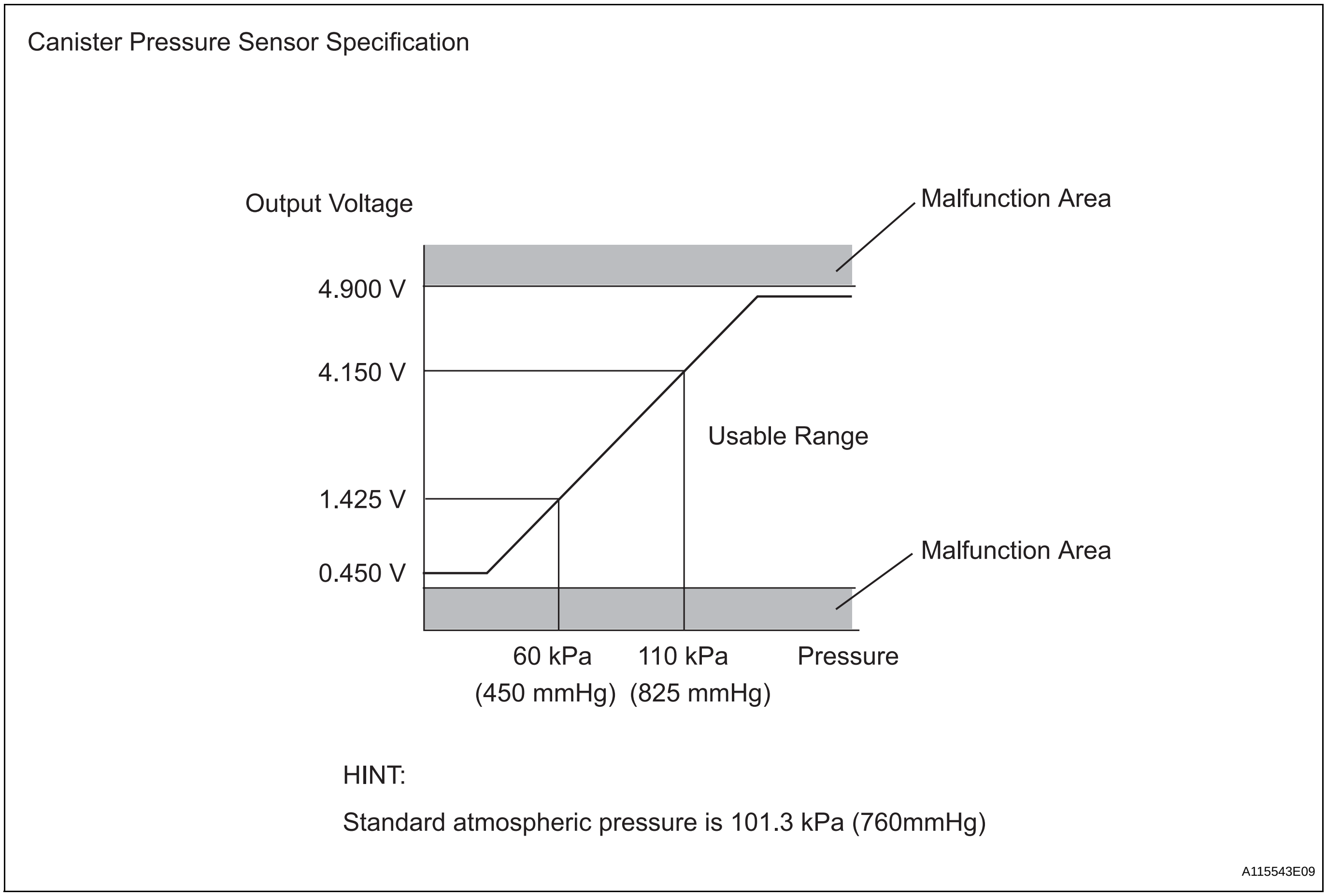


Components	Operations
Canister, Trap canister	Contains activated charcoal to absorb EVAP generated in fuel tank.
Cut-off valve	Located in fuel tank. Valve floats and closes when fuel tank 100% full.
Purge Vacuum Switching Valve (VSV)	Opens or closes line between canister and intake manifold. ECM uses purge VSV to control EVAP purge flow. In order to discharge EVAP absorbed by canister to intake manifold, ECM opens purge VSV. EVAP discharge volume to intake manifold controlled by purge VSV duty cycle ratio (current-carrying time) (open: ON; closed: OFF).
Roll-over valve	Located in fuel tank. Valve closes by its own weight when vehicle overturns to prevent fuel from spilling out.
Soak timer	Built into ECM. To ensure accurate EVAP monitor, measures 5 hours (+-15 min) after power switch OFF. This allows fuel to cool down, stabilizing Fuel Tank Pressure (FTP). When approximately 5 hours elapsed, ECM activates.
Pressure switching valve	The pressure switching valve located on the canister is used to detect leakage from the bladder tank into the fuel tank. The valve opens during the bladder tank leak check. Then, the fuel tank's fuel vapor flows to the intake manifold without passing the canister.
Pump module	Consists of (a) to (d) below. Pump module cannot be disassembled.
(a) Vent valve	Vents and closes EVAP system. When ECM turns valve ON, EVAP system closed. When ECM turns valve OFF, EVAP system vented. Negative pressure (vacuum) created in EVAP system to check for EVAP leaks by closing purge VSV, turning vent valve ON (closed) and operating leak detection pump (refer to fig. 1).
(b) Canister pressure sensor	Indicates pressure as voltage. ECM supplies regulated 5 V to canister pressure sensor, and uses feedback from sensor to monitor EVAP system pressure (refer to fig. 2).
(c) Leak detection pump	Creates negative pressure (vacuum) in EVAP system for leak check.

Components	Operations
(d) Reference orifice	Has opening with 0.02 inch diameter. Vacuum produced through orifice by closing purge VSV, turning vent valve OFF and operating leak detection pump to monitor 0.02 inch leak criterion. 0.02 inch leak criterion indicates small leak of EVAP.

MONITOR DESCRIPTION

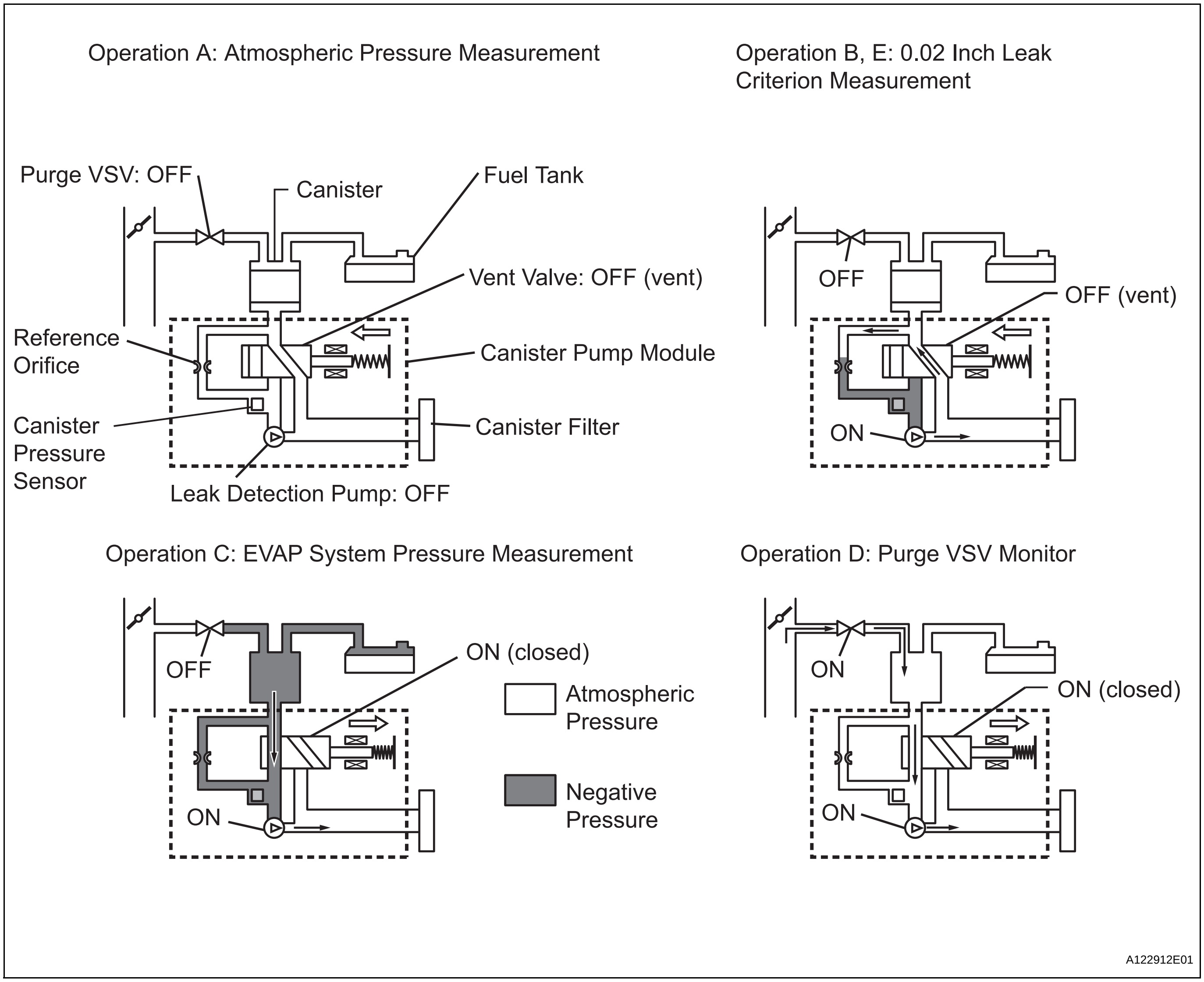
5 hours* after the power switch is turned OFF, the leak detection pump creates negative pressure (vacuum) in the EVAP system. The ECM monitors for leaks and actuator malfunctions based on the EVAP pressure.

HINT:

*: If the engine coolant temperature is not below 35°C (95°F) 5 hours after the power switch is turned OFF, the monitor check starts 2 hours later. If it is still not below 35°C (95°F) 7 hours after the power switch is turned OFF, the monitor check starts 2.5 hours later.

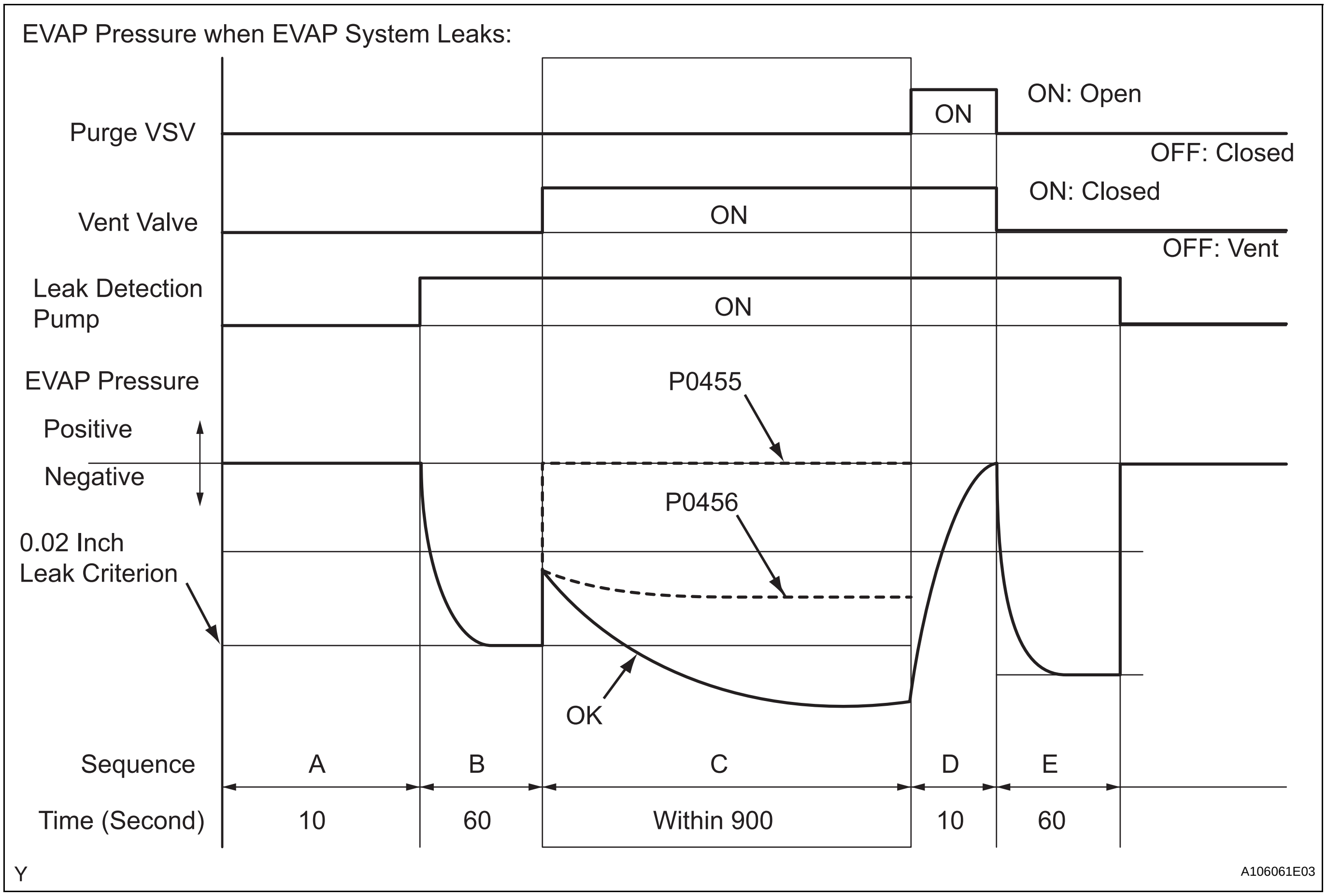
Sequence	Operations	Descriptions	Duration
-	ECM activation	Activated by soak timer 5, 7 or 9.5 hours after power switch OFF.	-
A	Atmospheric pressure measurement	Vent valve turned OFF (vent) and EVAP system pressure measured by ECM in order to register atmospheric pressure. If pressure in EVAP system not between 70 kPa and 110 kPa (525 mmHg and 825 mmHg), ECM cancels EVAP system monitor.	10 seconds
B	First 0.02 inch leak criterion measurement	In order to determine 0.02 inch leak criterion, leak detection pump creates negative pressure (vacuum) through reference orifice and then ECM checks if leak detection pump and vent valve operate normally.	60 seconds
C	EVAP system pressure measurement	Vent valve turned ON (closed) to shut EVAP system. Negative pressure (vacuum) created in EVAP system, and EVAP system pressure then measured. Write down measured value as it will be used in leak check. If EVAP pressure does not stabilize within 900 seconds, ECM cancels EVAP system monitor.	900 seconds*
D	Purge VSV monitor	Purge VSV opened and then EVAP system pressure measured by ECM. Large increase indicates normal.	10 seconds
E	Second 0.02 inch leak criterion measurement	After second 0.02 inch leak criterion measurement, leak check performed by comparing first and second 0.02 inch leak criterion. If stabilized system pressure higher than second 0.02 inch leak criterion, ECM determines that EVAP system leaking.	60 seconds
-	Final check	Atmospheric pressure measured and then monitoring result recorded by ECM.	-

*: If only a small amount of fuel is in the fuel tank, it takes longer for the EVAP pressure to stabilize.



1. P0455: EVAP gross leak
   In operation C, the leak detection pump creates negative pressure (vacuum) in the EVAP system and the EVAP system pressure is measured. If the stabilized system pressure is higher than [second 0.02 inch leak criterion x 0.15] (near atmospheric pressure), the ECM determines that the EVAP system has a large leakage, illuminates the MIL and sets the DTC (2 trip detection logic).

2. P0456: EVAP very small leak
   In operation C, the leak detection pump creates negative pressure (vacuum) in the EVAP system and the EVAP system pressure is measured. If the stabilized system pressure is higher than the second 0.02 inch leak criterion, the ECM determines that the EVAP system has a small leakage, illuminates the MIL and sets the DTC (2 trip detection logic).



MONITOR STRATEGY

Required Sensors/Components	Purge VSV and canister pump module
Frequency of Operation	Once per driving cycle
Duration	Maximum 15 seconds
MIL Operation	2 driving cycles
Sequence of 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 (Misfire) P0335 (CKP sensor) P0340, P0341 (CMP sensor) P0351, P0352, P0353, P0354 (Igniter) P0450, P0452, P0453 (EVAP press sensor) P0500 (VSS)
Atmospheric pressure	70 to 110 kPa (525 to 825 mmHg)

Battery voltage	10.5 V or higher
Vehicle speed	Less than 4 km/h (2.5 mph)
Power switch	OFF
Time after key off	5 or 7 or 9.5 hours
Purge VSV	Not operated by scan tool
Vent valve	Not operated by scan tool
Leak detection pump	Not operated by scan tool
Both of the following conditions 1 and 2 are met before key off	-
1. Duration that vehicle has been driven	5 minutes or more
2. EVAP purge operation	Performed
ECT	4.4 to 35°C (40 to 95°F)
IAT	4.4 to 35°C (40 to 95°F)

1. Key-off monitor sequence 1 to 8

1. Atmospheric pressure measurement

Next sequence is run if the following condition is met	-
Atmospheric pressure change	Within 0.3 kPa (2.25 mmHg) in 1 second

2. First reference pressure measurement

Next sequence is run if the following conditions are met	-
EVAP pressure just after reference pressure measurement start	-1 kPa (-7.5 mmHg) or lower
Reference pressure	-4.85 to -1.05 kPa (726 to 754 mmHg)
Reference pressure	Saturated within 60 seconds

3. Vent valve stuck closed check

Next sequence is run if the following condition is met	-
EVAP pressure change after vent valve is ON	0.3 kPa (2.25 mmHg) or more

4. Vacuum introduction

Next sequence is run if the following condition is met	-
EVAP pressure	Saturated within 900 seconds

5. Purge VSV stuck closed check

Next sequence is run if the following condition is met	-
EVAP pressure change after purge valve is open	0.3 kPa (2.25 mmHg) or more

6. Second reference pressure measurement

Next sequence is run if the following conditions are met	-
EVAP pressure just after reference pressure measurement	-1 kPa (-7.5 mmHg) or lower
Reference pressure	-4.85 to -1.05 kPa (726 to 754 mmHg)
Reference pressure	Saturated within 60 seconds
Reference pressure difference between first and second	Less than 0.7 kPa (5.25 mmHg)

7. Leak check

Next sequence is run if the following condition is met	-
EVAP pressure when vacuum introduction is complete	Lower than second reference pressure

8. Atmospheric pressure measurement

EVAP monitor is complete if the following condition is met	-
Atmospheric pressure difference between sequence 1 and 8	Within 0.3 kPa (2.25 mmHg)

TYPICAL MALFUNCTION THRESHOLDS

"Saturated" indicates that the EVAP pressure change is less than 0.1 kPa (0.75 mmHg) in 30 seconds.

P0455: EVAP gross leak

FTP when vacuum introduction complete	Higher than reference pressure x 0.15

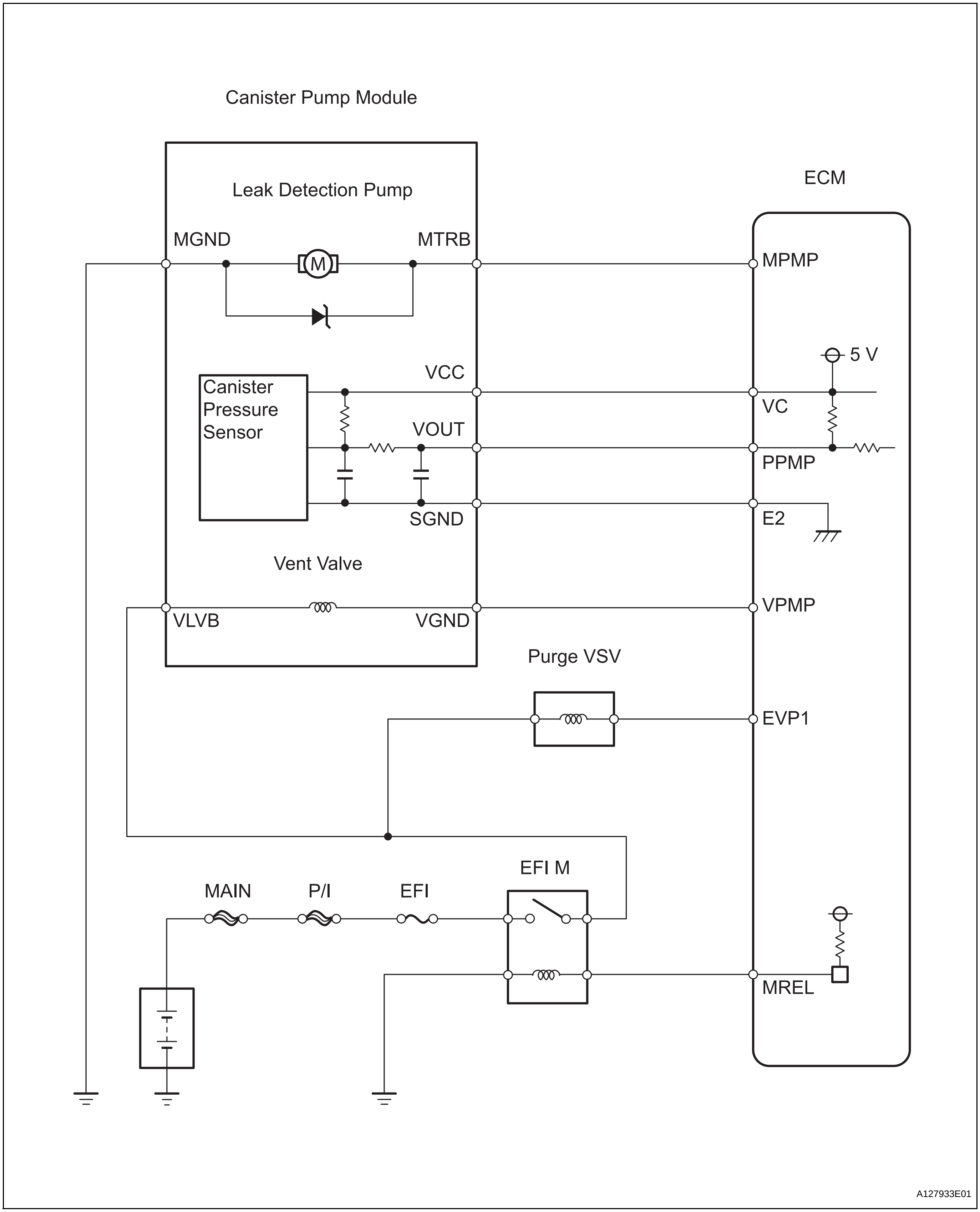
P0456: EVAP small leak

FTP when vacuum introduction complete	Between "reference pressure" and "reference pressure x 0.15"

MONITOR RESULT

Refer to CHECKING MONITOR STATUS (see page ES-15).

WIRING DIAGRAM



INSPECTION PROCEDURE

NOTICE:

The intelligent tester is required to conduct the following diagnostic troubleshooting procedure.

HINT:
- Using the intelligent tester monitor results enable the EVAP system to be confirmed.
- Read freeze frame data using the intelligent tester. Freeze frame data records the engine conditions when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1	CONFIRM DTC

(a) Turn the power switch OFF and wait for 10 seconds.
(b) Turn the power switch ON (IG).
(c) Turn the power switch OFF and wait for 10 seconds.
(d) Connect the intelligent tester to the DLC3.
(e) Turn the power switch ON (IG).
(f) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DTC INFO / CURRENT CODES.
(g) Check if DTC P0446 is output.

NO → **Go to step 5**

YES

2	PERFORM EVAP SYSTEM CHECK

(a) Note the freeze frame data and DTCs.
(b) Clear DTCs.
(c) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / SYSTEM CHECK / EVAP SYS CHECK / AUTO OPERATION.
(d) After the system check is finished, check for pending DTCs.

OK:
No DTC is present.

NG → **Go to step 6**

OK

3	CHECK OPERATION FOR PRESSURE SWITCHING VALVE

(a) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / TANK BYPASS VSV.
(b) Touch the pressure switching valve (TANK BYPASS VSV) to feel the operating vibration.

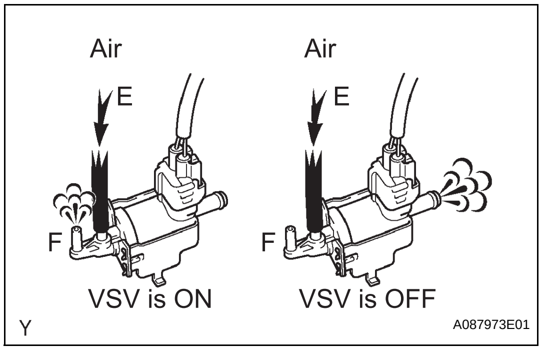
OK:
The pressure switching valve is operated by the ACTIVE TEST.

NG → **Go to step 18**

OK

ES

4	CHECK PRESSURE SWITCHING VALVE



(a) Turn the power switch OFF.
(b) Remove the pressure switching valve (see page EC-31).
(c) Reconnect the pressure switching valve connector.
(d) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / TANK BYPASS VSV.
(e) Check the airflow for the pressure switching valve.

OK:

The pressure switching valve operates normally.

NG → **Go to step 19**

OK → **Go to step 33**

5	PERFORM EVAP SYSTEM CHECK

(a) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / SYSTEM CHECK / EVAP SYS CHECK / AUTO OPERATION.
(b) After the system check is finished, check for pending DTCs.

OK:

DTCs are present.

NG → **CHECK INTERMITTENT PROBLEMS**

OK

6	CHECK DTC

(a) Check the DTCs that were present at the EVAP system check.

OK:

P043E, P043F, P2401, P2402 and P2419 are present.

NG → **Go to step 10**

OK

7	CHECK VENT VALVE CLOSE STUCK

(a) Allow the engine to idle.
(b) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / EVAP VSV.
(c) Turn the EVAP VSV ON (purge VSV open) and check the VAPOR PRESS (EVAP pressure) for 10 seconds.

OK:

EVAP pressure is higher than 755 mmHg.

NG → **Go to step 20**

ES

OK

8	CHECK LEAK DETECTION PUMP OPERATION

(a) Turn the power switch OFF.
(b) Turn the power switch ON (IG).
(c) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / VACUUM PUMP.
(d) Touch the pump module to feel the operating vibration.

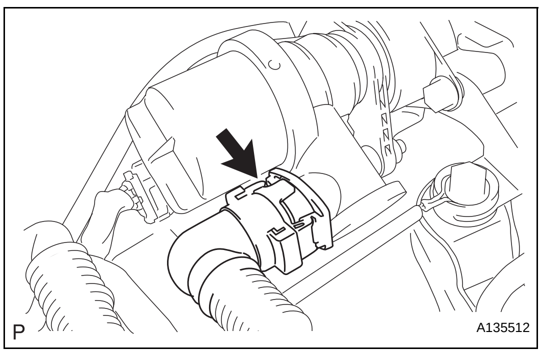
OK:

The leak detection pump is operated by the ACTIVE TEST.

NG → Go to step 21

OK

9	CHECK TRAP CANISTER



(a) Disconnect the vent hose from the pump module.
(b) Check that no moisture is in the pump module or the vent hose.

OK:

No moisture.

OK → Go to step 22

NG → Go to step 23

10	CHECK DTC

(a) Check the DTCs that were present at the EVAP system check.

OK:

P0441, P0455 and/or P0456 are present.

NG → Go to step 16

OK

11	CHECK INSTALLATION FOR FUEL CAP

(a) Remove the fuel cap.
(b) Reinstall the fuel cap.
(c) Clear DTCs.
(d) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / SYSTEM CHECK / EVAP SYS CHECK / AUTO OPERATION.
(e) After the system check is finished, check for pending DTCs.

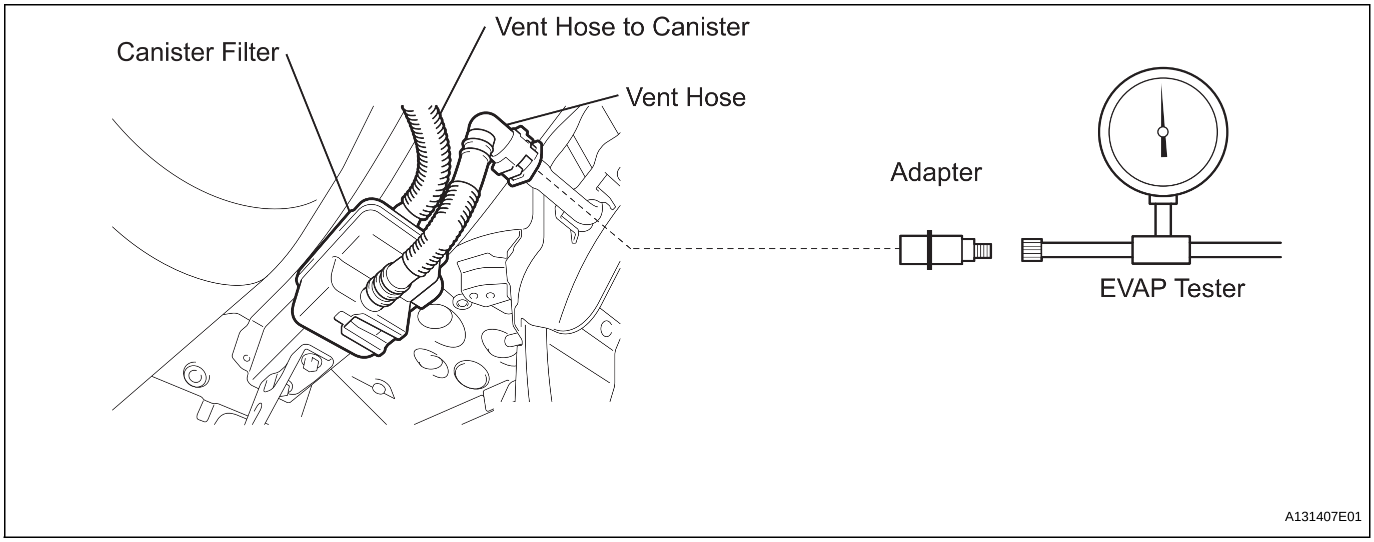
HINT:
If no DTC is present, this indicates that the fuel cap is loosened.
OK:
No DTC is present.

OK → **REPAIR COMPLETED**

NG

12 LOCATE LEAK POINT

(a) Disconnect the vent hose (fresh air line) as shown in the illustration.



(b) Connect the pressure gauge and air pump as shown in the illustration.
(c) Pressurize the EVAP system until 24 to 28 mmHg.
(d) Locate the leak point.
HINT:
If the EVAP system has leakage, a whistling sound may be heard.
OK:
The leak point is found.

OK → **Go to step 24**

NG

13 CHECK FUEL CAP

Check that the fuel cap meets OEM specifications.
HINT:
If an EVAP tester is available, perform the fuel cap test according to the tester's instructions.
OK:
Fuel cap meets OEM specifications.

NG → **Go to step 25**

OK

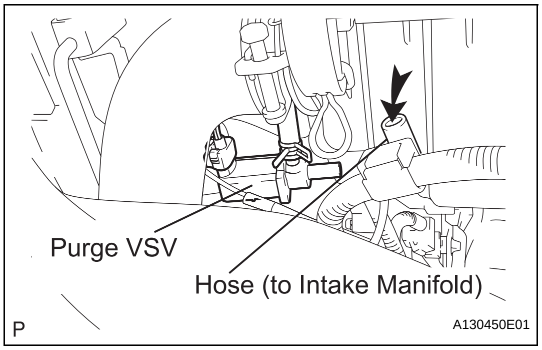
14 CHECK OPERATION FOR PURGE VSV

(a) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / EVAP VSV.
(b) Touch the purge VSV to feel the operating vibration.
OK:
The purge VSV (EVAP VSV) is operated by the ACTIVE TEST.

NG	**Go to step 26**

OK

15 CHECK INTAKE MANIFOLD PRESSURE



(a) Disconnect the purge VSV hose that is connected to the throttle body.
(b) Allow the engine to idle.
(c) Check that the hose has suction using your finger.
OK:
The hose has suction.

NG	**Go to step 27**
OK	**Go to step 28**

16 CHECK DTC

(a) Check the DTCs that were present at the EVAP system check.
OK:
P0451 is not present.

NG	**Go to step 9**

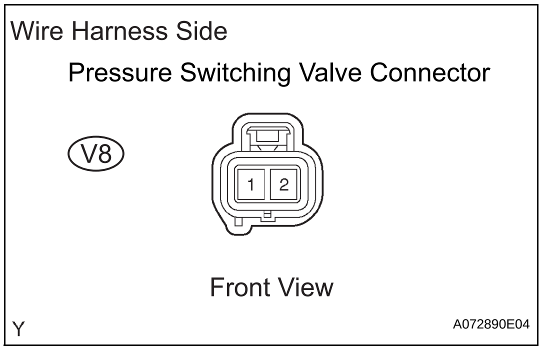
OK

17 CHECK OPERATION FOR VENT VALVE

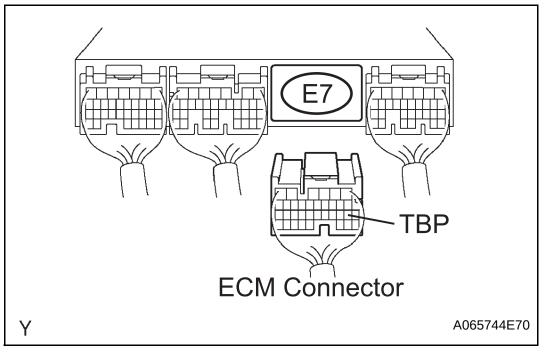
(a) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / VENT VALVE.
(b) Touch the pump module to feel the operating vibration.
OK:
The vent valve is operated by the ACTIVE TEST.

OK	**Go to step 9**
NG	**Go to step 29**

18	CHECK HARNESS AND CONNECTOR (PRESSURE SWITCHING VALVE - ECM AND EFI M RELAY)



(a) Check the harness and the connectors between the pressure switching valve and the ECM.
  (1) Disconnect the V8 pressure switching valve connector.



  (2) Disconnect the E7 ECM connector.
  (3) Measure the resistance between the wire harness side connectors.

Standard resistance (Check for open)

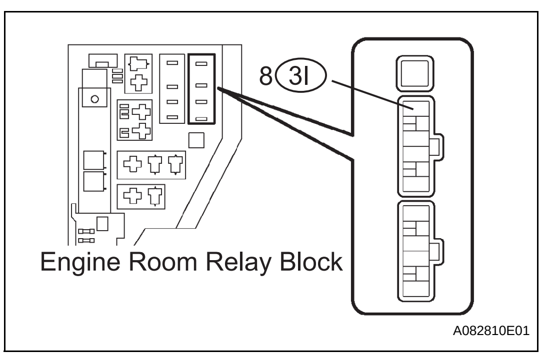
Tester Connection	Specified Condition
V8-1 (Pressure switching valve) - E7-18 (TBP)	**Below 1 Ω**

Standard resistance (Check for short)

Tester Connection	Specified Condition
V8-1 (Pressure switching valve) or E7-18 (TBP) - Body ground	**10 kΩ higher**

  (4) Reconnect the pressure switching valve connector.
  (5) Reconnect the ECM connector.

(b) Check the harness and the connectors between the pressure switching valve and the EFI M relay.
  (1) Disconnect the V8 pressure switching valve connector.
  (2) Remove the integration relay from the engine room relay block.



  (3) Measure the resistance between the wire harness side connector.

Standard resistance (Check for open)

Tester Connection	Specified Condition
V8-2 (Pressure switching valve) - 3I-8 (EFI M relay)	**Below 1 Ω**

Standard resistance (Check for short)

Tester Connection	Specified Condition
V8-2 (Pressure switching valve) or 3I-8 (EFI M relay) - Body ground	**10 kΩ or higher**

  (4) Reconnect the pressure switching valve connector.
  (5) Reinstall the integration relay.

NG	**Go to step 30**
OK	**Go to step 31**

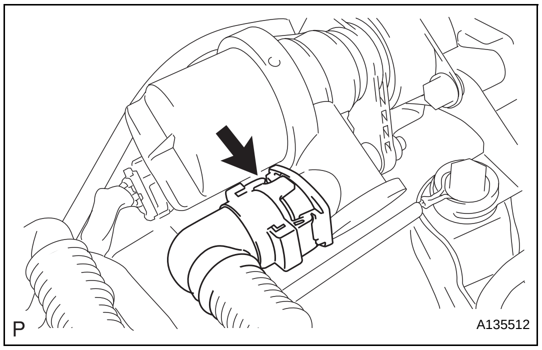
ES

19	REPLACE PRESSURE SWITCHING VALVE

Replace the pressure switching valve (see page EC-31).

NEXT → Go to step 34

20	CHECK FOR VENT HOSE CLOG

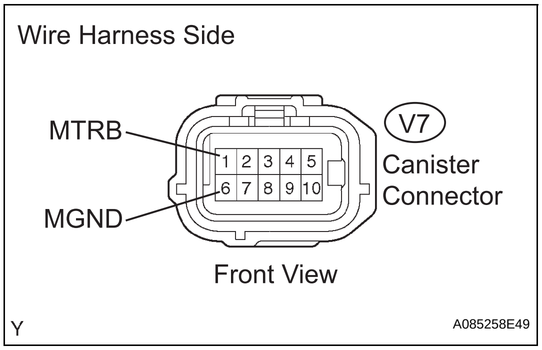


(a) Turn the power switch OFF.
(b) Disconnect the vent hose (fresh air line) as shown in the illustration.
(c) Allow the engine to idle.
(d) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / EVAP VSV.
(e) Turn the purge VSV (EVAP VSV) ON and check the EVAP pressure (VAPOR PRESS) for 10 seconds.
OK:
EVAP pressure is higher than 755 mmHg.

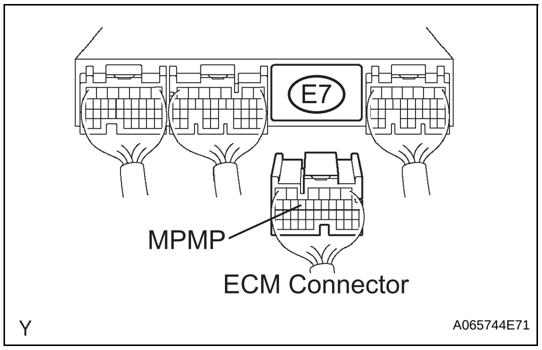
NG → Go to step 22

OK → Go to step 32

21	CHECK HARNESS AND CONNECTOR (LEAK DETECTION PUMP - ECM)



(a) Disconnect the V7 canister connector



(b) Disconnect the E7 ECM connector.
(c) Measure the resistance between the wire harness side connector.
Standard resistance (Check for open)

Tester Connection	Specified Condition
V7-1 (MTRB) - E7-13 (MPMP)	Below 1 Ω
V7-6 (MGND) - Body ground	Below 1 Ω

Standard resistance (Check for short)

Tester Connection	Specified Condition
V7-1 (MTRB) or E7-13 (MPMP) - Body ground	10 kΩ higher

(d) Reconnect the canister connector.
(e) Reconnect the ECM connector.

NG	Go to step 30
OK	Go to step 31

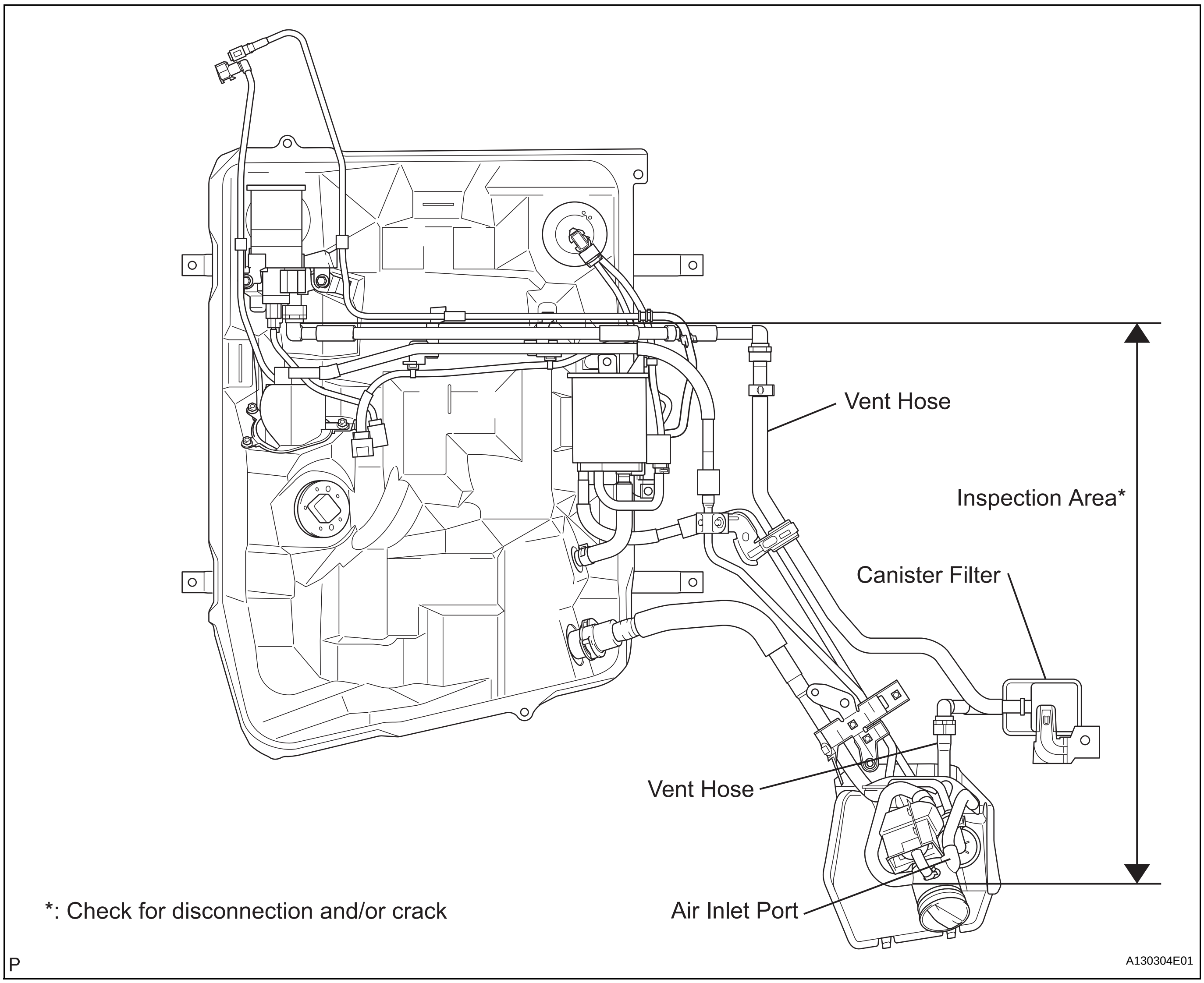
22 REPLACE TRAP CANISTER WITH PUMP MODULE

Replace the trap canister with pump module (see page EC-17).

NEXT	Go to step 34

23 CHECK FOR VENT HOSE DAMAGE

Check for hose damage as shown in the illustration. If necessary, replace the vent hose.



NEXT	Go to step 22

24 REPAIR OR REPLACE LEAK POINT

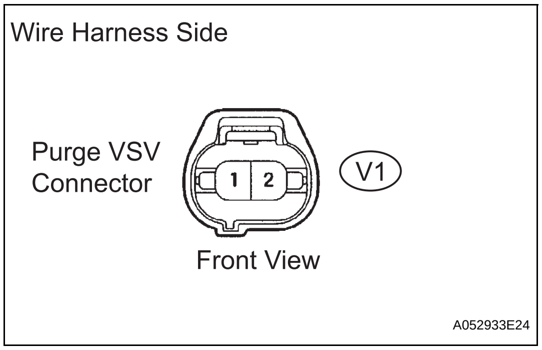
NEXT → Go to step 34

25 REPLACE FUEL CAP

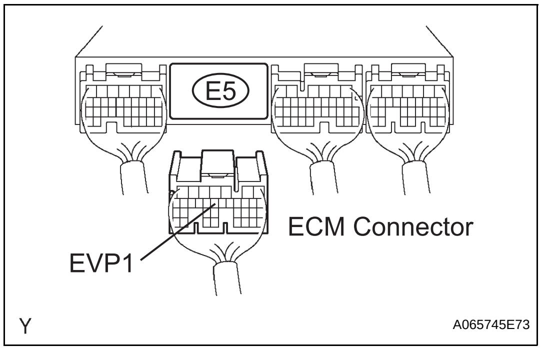
NEXT → Go to step 34

ES

26 CHECK HARNESS AND CONNECTOR (PURGE VSV - ECM)



(a) Disconnect the V1 purge VSV connector.



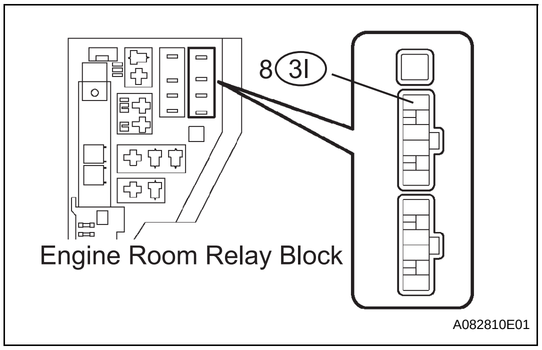
(b) Disconnect the E5 ECM connector.
(c) Check the harness and the connectors between the ECM and the purge VSV connectors.
(1) Measure the resistance between the wire harness side connector.

Standard resistance (Check for open)

Tester Connection	Specified Condition
V1-1 - E5-14 (EVP1)	Below 1 Ω

Standard resistance (Check for short)

Tester Connection	Specified Condition
V1-1 or E5-14 (EVP1) - Body ground	10 kΩ higher



(d) Remove the integration relay from the engine room relay block.
(e) Check the harness and connectors between the purge VSV connector and the EFI M relay.
(1) Measure the resistance between the wire harness side connectors.

Standard resistance (Check for open)

Tester Connection	Specified Condition
V1-2 - 3I-8 (EFI M relay)	Below 1 Ω

Standard resistance (Check for short)

Tester Connection	Specified Condition
V1-2 or 3I-8 (EFI M relay) - Body ground	10 kΩ higher

(f) Reconnect the purge VSV connector.
(g) Reconnect the ECM connector.

(h) Reinstall the integration relay.

NG	Go to step 30
OK	Go to step 31

27 REPLACE HOSE (PURGE VSV - THROTTLE BODY)

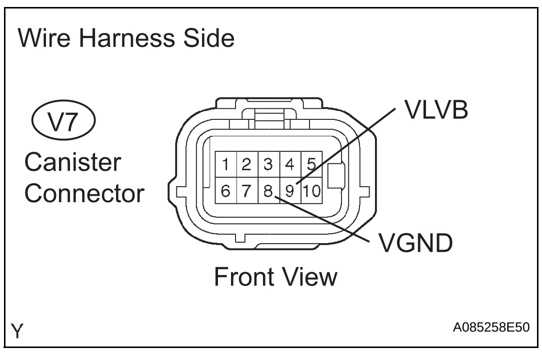
NEXT	Go to step 34

28 REPLACE PURGE VSV

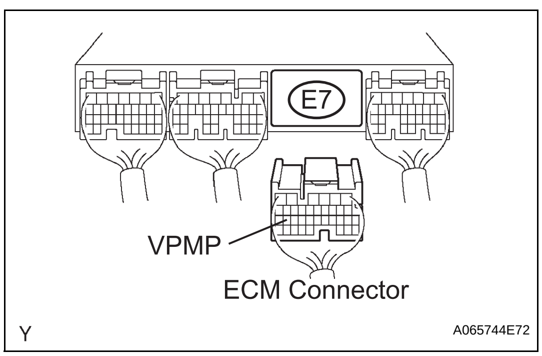
Replace the purge VSV (see page EC-23).

NEXT	Go to step 34

29 CHECK HARNESS AND CONNECTOR (VENT VALVE - ECM)



(a) Disconnect the V7 canister connector.



(b) Disconnect the E7 ECM connector.

(c) Check the harness and the connectors between the ECM and the canister connectors.

(1) Measure the resistance between the wire harness side connector.

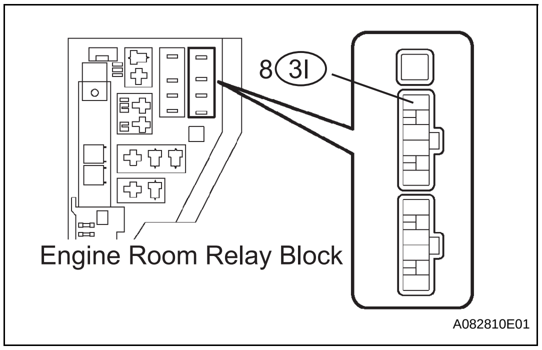
Standard resistance (Check for open)

Tester Connection	Specified Condition
V7-8 (VGND) - E7-26 (VPMP)	Below 1 Ω

Standard resistance (Check for short)

Tester Connection	Specified Condition
V7-8 (VGND) or E7-26 (VPMP) - Body ground	10 kΩ higher

ES



(d) Remove the integration relay from the engine room relay block.
(e) Check the harness and connectors between the canister connector and the EFI M relay.
(1) Measure the resistance between the wire harness side connectors.

Standard resistance (Check for open)

Tester Connection	Specified Condition
V7-9 (VLVB) - 3I-8 (EFI M relay)	Below 1 Ω

Standard resistance (Check for short)

Tester Connection	Specified Condition
V7-9 (VLVB) or 3I-8 (EFI M relay) - Body ground	10 kΩ higher

(f) Reconnect the canister connector.
(g) Reconnect the ECM connector.
(h) Reinstall the integration relay.

NG → Go to step 30

OK → Go to step 31

30 REPAIR OR REPLACE HARNESS AND CONNECTOR

NEXT → Go to step 34

31 REPLACE ECM

Replace the ECM (see page ES-469).

NEXT → Go to step 34

32 CHECK AND REPLACE VENT HOSE OR CANISTER FILTER

NEXT → Go to step 34

33 REPLACE HOSE (PRESSURE SWITCHING VALVE AND FUEL TANK)

NEXT

34 PERFORM EVAP SYSTEM CHECK

(a) Turn the power switch ON (IG).
(b) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / SYSTEM CHECK / EVAP SYS CHECK / AUTO OPERATION.
(c) After the system check is finished, check for pending DTCs.

ES

OK:
No DTC is present.

NG → **Go to step 6**

OK

35 PERFORM EVAP MONITOR DRIVE PATTERN

(a) Check that the following conditions are met:
- Fuel level is 1/8 to 7/8.
- Engine coolant temperature (ECT) is 4.4 to 35°C (40 to 95°F).
- Intake air temperature (IAT) is 4.4 to 35°C (40 to 95°F).
- Difference of ECT and IAT is less than 7°C (13°F).

(b) Enter the check mode. Enter the following menus: DIAGNOSIS / ENHANCED OBD II / CHECK MODE.
(c) Allow the engine to idle until the ECT is 75°C (167°F).
(d) Drive the vehicle at 50 km/h (30 mph) or faster and maintain that speed for 60 seconds or more.
(e) Stop the vehicle. Do not turn the power switch OFF.
(f) Check that the EVAP monitor status is complete. Enter the following menus: DIAGNOSIS / ENHANCED OBD II / MONITOR STATUS.
(g) If the EVAP monitor is incomplete, drive the vehicle at 50 km/h (30 mph) or faster and maintain that speed for 120 seconds or more. After that, recheck the EVAP monitor status.
(h) Check for pending DTCs.

OK:
No DTC is present.

NG → **Go to step 2**

OK

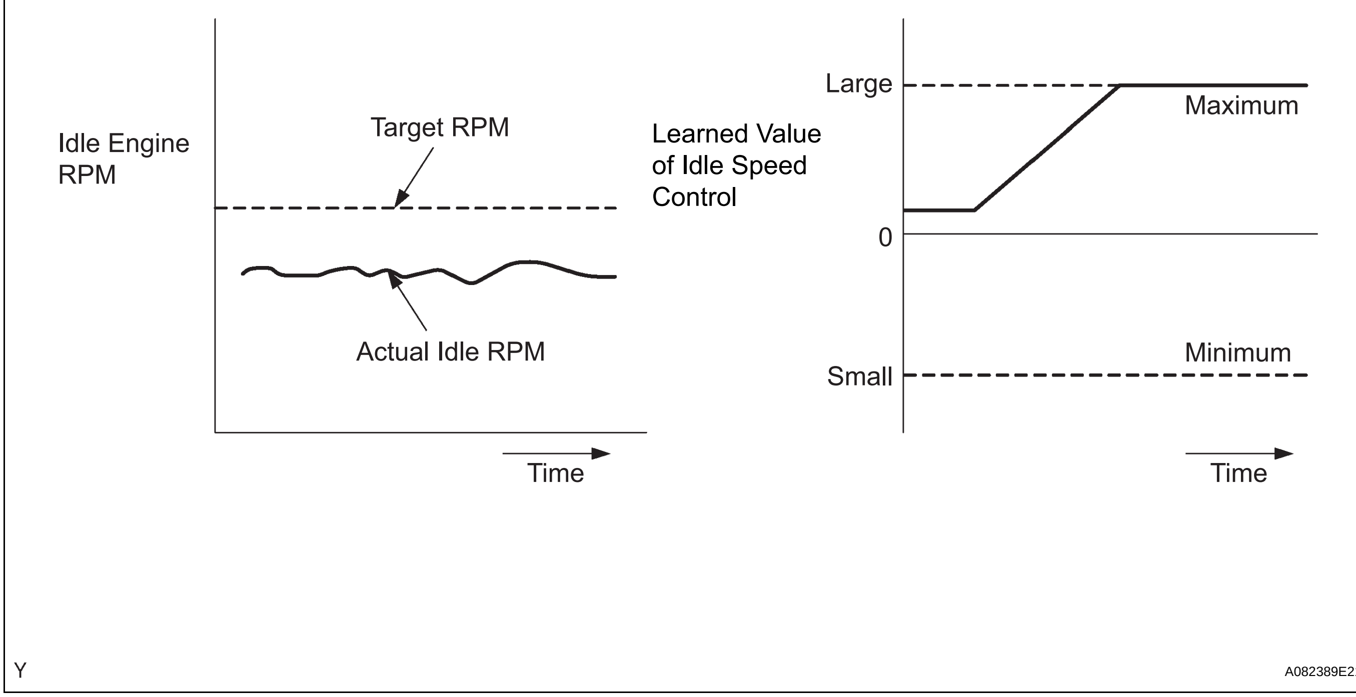
REPAIR COMPLETED

ES

DTC	P0505	Idle Control System Malfunction

MONITOR DESCRIPTION

The idle speed is controlled by the Electronic Throttle Control System (ETCS).
The ETCS is composed of the throttle motor which operates the throttle valve, and the throttle position sensor which detects the opening angle of the throttle valve.
The ECM controls the throttle motor to provide the proper throttle valve opening angle to obtain the target idle speed.
The ECM regulates the idle speed by opening and closing the throttle valve using the ETCS. If the actual idle RPM varies more than a specified amount or a learned value of the idle speed control remains at the maximum or minimum five times or more during a trip, the ECM concludes that there is a problem in the idle speed control ECM function. The ECM will turn on the MIL and a DTC is set.
Example:
If the actual idle RPM varies from the target idle RPM by more than 200 (*1) rpm five times during a drive cycle, the ECM will turn on the MIL and a DTC is set.
HINT:
*1: RPM threshold varies depending on engine loads.



DTC No.	DTC Detection Condition	Trouble Area
P0505	Idle speed continues to vary greatly from target speed (1 trip detection logic)	• Electric throttle control system • Air induction system • PCV hose connection • ECM

MONITOR STRATEGY

Related DTCs	P0505: Idle air control malfunction (Functional check)

Required sensors/components	Main: Crankshaft position sensor Related: Vehicle speed sensor, engine coolant temperature sensor
Frequency of operation	Once per driving cycle
Duration	10 minutes
MIL operation	2 driving cycles
Sequence of operation	None

TYPICAL ENABLING CONDITIONS

The monitor will run whenever the following DTCs are not present	None
Engine	Running

TYPICAL MALFUNCTION THRESHOLDS

Following conditions are met: (during idling after driving for more than 6.2 mph (10 km/h) per cycle)	A, B and C
A. Either of following conditions is met:	1 or 2
1. Deviation of engine speed (when shift position N or A/C ON)	Less than -100 rpm, or more than 200 rpm
2. Deviation of engine speed (when shift position D or A/C OFF)	Less than -100 rpm, or more than 150 rpm
B. IAC flow rate (learned value)	0.6 L/sec or less or 4.5 L/sec or more
C. Number of detection	5 times/trip

INSPECTION PROCEDURE

HINT:
Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunction is detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1 CHECK OTHER DTC OUTPUT (IN ADDITION TO DTC P0505)

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

Result

Display (DTC output)	Proceed to
P0505	**A**
P0505 and other DTCs	**B**

HINT:
If any other codes besides P0505 are output, perform troubleshooting for those DTCs first.

B → **GO TO RELEVANT DTC CHART**

A

2	CHECK CONNECTION OF PCV HOSE

OK:
PCV hose is connected correctly and has no damage.

NG → **REPAIR OR REPLACE PCV HOSE**

OK

3	CHECK AIR INDUCTION SYSTEM

(a) Check for vacuum leaks in the air induction system.
OK:
No leakage in the air induction system.

NG → **REPAIR OR REPLACE AIR INDUCTION SYSTEM**

OK

CHECK ELECTRIC THROTTLE CONTROL SYSTEM

DTC P0560 System Voltage

MONITOR DESCRIPTION

The battery supplies electricity to the ECM even if the power switch is OFF. This electricity allows the ECM to store DTC history, freeze frame data, fuel trim values, and other data. If the battery voltage falls below a minimum level, the ECM will conclude that there is a fault in the power supply circuit. The next time the engine starts, the ECM will turn on the MIL and a DTC will be set.

DTC No.	DTC Detection Condition	Trouble Area
P0560	Open in back-up power source circuit	• Open in back-up power source circuit • ECM

HINT:
If DTC P0560 is present, the ECM will not store other DTCs.

MONITOR STRATEGY

Related DTCs	P0560: System voltage malfunction
Required sensors/components (main)	ECM
Frequency of operation	Continuous
Duration	3 seconds
MIL operation	Immediately
Sequence of operation	None

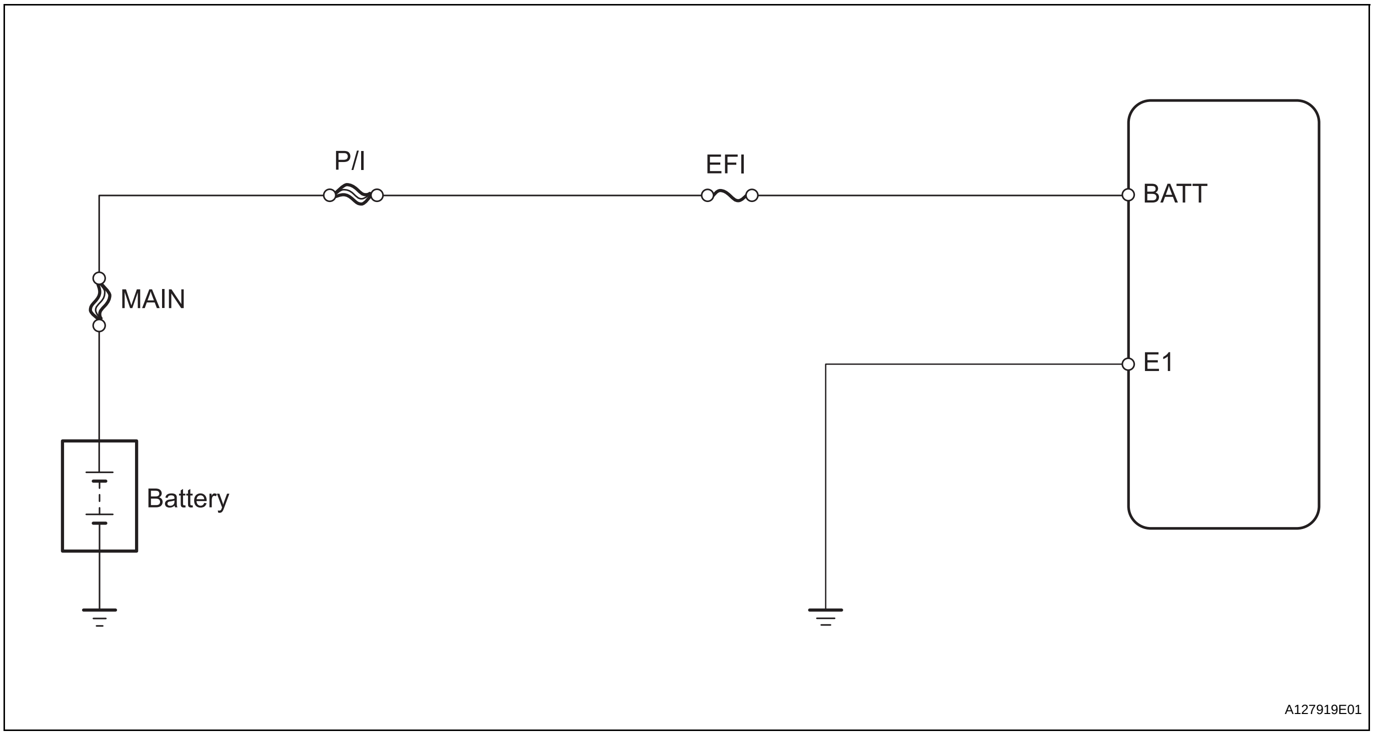
TYPICAL ENABLING CONDITIONS

The monitor will run whenever the following DTCs are not present	None
Stand-by RAM	Initialized

TYPICAL MALFUNCTION THRESHOLDS

Battery voltage	Less than 3.5 V

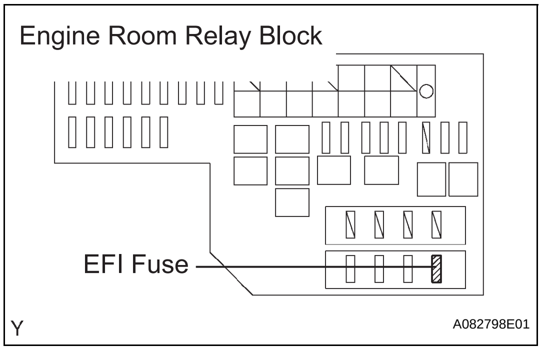
WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:
Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunction is detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1	CHECK FUSE (EFI FUSE)

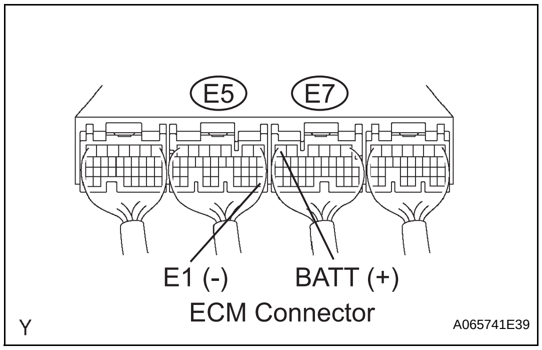


(a) Remove the EFI fuse from the engine room relay block.
(b) Measure the resistance of the EFI fuse.
Standard resistance:
Below 1 Ω
(c) Reinstall the EFI fuse.

NG → **CHECK FOR SHORT IN ALL HARNESS AND COMPONENTS CONNECTED TO FUSE**

OK

2	CHECK ECM (BATTERY VOLTAGE)



(a) Measure the voltage between the specified terminals of the E5 and E7 ECM connectors.

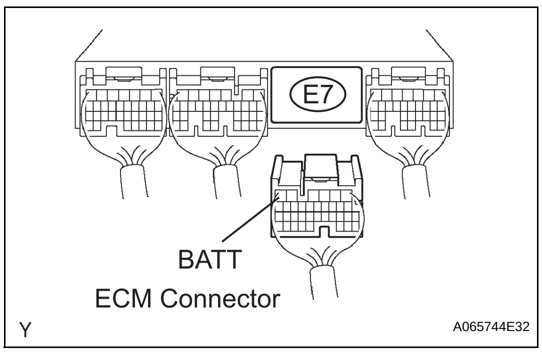
Standard voltage

Tester Connection	Specified Condition
E7-6 (BATT) - E5-28 (E1)	9 to 14 V

OK → REPLACE ECM

NG

3	CHECK HARNESS AND CONNECTOR (ECM - EFI FUSE, EFI FUSE - BATTERY)



(a) Check the harness and the connectors between the EFI fuse and the ECM connector.
  (1) Remove the integration relay from the engine room relay block.
  (2) Disconnect the E7 ECM connector.
  (3) Measure the resistance between the wire harness side connectors.

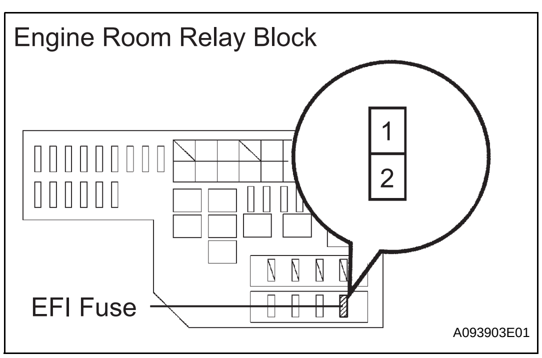
Standard resistance (Check for open)

Tester Connection	Specified Condition
2 (EFI fuse) - E7-6 (BATT)	Below 1 Ω

Standard resistance (Check for short)

Tester Connection	Specified Condition
2 (EFI fuse) or E7-6 (BATT) - Body ground	10 kΩ or higher

  (4) Reinstall the integration relay.
  (5) Reconnect the ECM connector.



(b) Check the harness and the connectors between the EFI fuse and the battery.
  (1) Remove the integration relay from the engine room relay block.
  (2) Disconnect the positive battery terminal.
  (3) Measure the resistance between the wire harness side connectors.

Standard resistance (Check for open)

Tester Connection	Specified Condition
Battery positive terminal - 1 (EFI fuse)	Below 1 Ω

Standard resistance (Check for short)

Tester Connection	Specified Condition
Battery positive terminal or 1 (EFI fuse) - Body ground	10 kΩ or higher

  (4) Reinstall the integration relay.

(5) Reconnect the positive battery terminal.

NG → **REPAIR OR REPLACE HARNESS AND CONNECTOR**

OK

CHECK AND REPLACE ENGINE ROOM RELAY BLOCK

DTC	P0604	Internal Control Module Random Access Memory (RAM) Error

DTC	P0606	ECM / PCM Processor

DTC	P0607	Control Module Performance

DTC	P0657	Actuator Supply Voltage Circuit / Open

MONITOR DESCRIPTION

ES

The ECM continuously monitors its internal memory status, internal circuits, and output signals to the throttle actuator. This self-check ensures that the ECM is functioning properly. If any malfunction is detected, the ECM will set the appropriate DTC and illuminate the MIL.
The ECM memory status is diagnosed by internal "mirroring" of the main CPU and the sub CPU to detect random access memory (RAM) errors. The two CPUs also perform continuous mutual monitoring. The ECM sets a DTC if: 1) output from the 2 CPUs are different and deviate from the standards, 2) the signals to the throttle actuator deviate from the standards, 3) malfunction is found in the throttle actuator supply voltage, and 4) any other ECM malfunction is found.

DTC No.	DTC Detection Condition	Trouble Area
P0604 P0606 P0607 P0657	ECM internal errors	• ECM

MONITOR STRATEGY

Related DTCs	P0604: ECM RAM errors P0606: ECM CPU malfunction P0657: ETCS power supply function of ECM malfunction
Required sensors/components	ECM
Frequency of operation	Continuous: P0604, P0606, P0607 Once per driving cycle: P0657
Duration	Within 4 minutes
MIL operation	Immediately
Sequence of operation	None

TYPICAL ENABLING CONDITIONS

The monitor will run whenever the following DTCs are not present	None

TYPICAL MALFUNCTION THRESHOLDS

ECM RAM errors:

Difference between main and sub CPUs output	Larger than the specified range

ECM CPU malfunction:

Difference between throttle position of main CPU and throttle position of sub CPU	0.3 V or more

Electronic throttle control system power supply function of ECM malfunction:

Electronic throttle control system power supply when power switch is turned from OFF to ON	7 V or more

INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunction is detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1	CHECK ECM VOLTAGE (IN ADDITION TO DTC P0604 / P0606 / 0P607 / P0657)

(a) Connect the intelligent tester to the DLC3.
(b) 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
P0604 or P0606 or P0607 or P0657	A
P0604 or P0606 or P0607 or P0657 and other DTCs	B

B → **GO TO RELEVANT DTC CHART**

A

REPLACE ECM

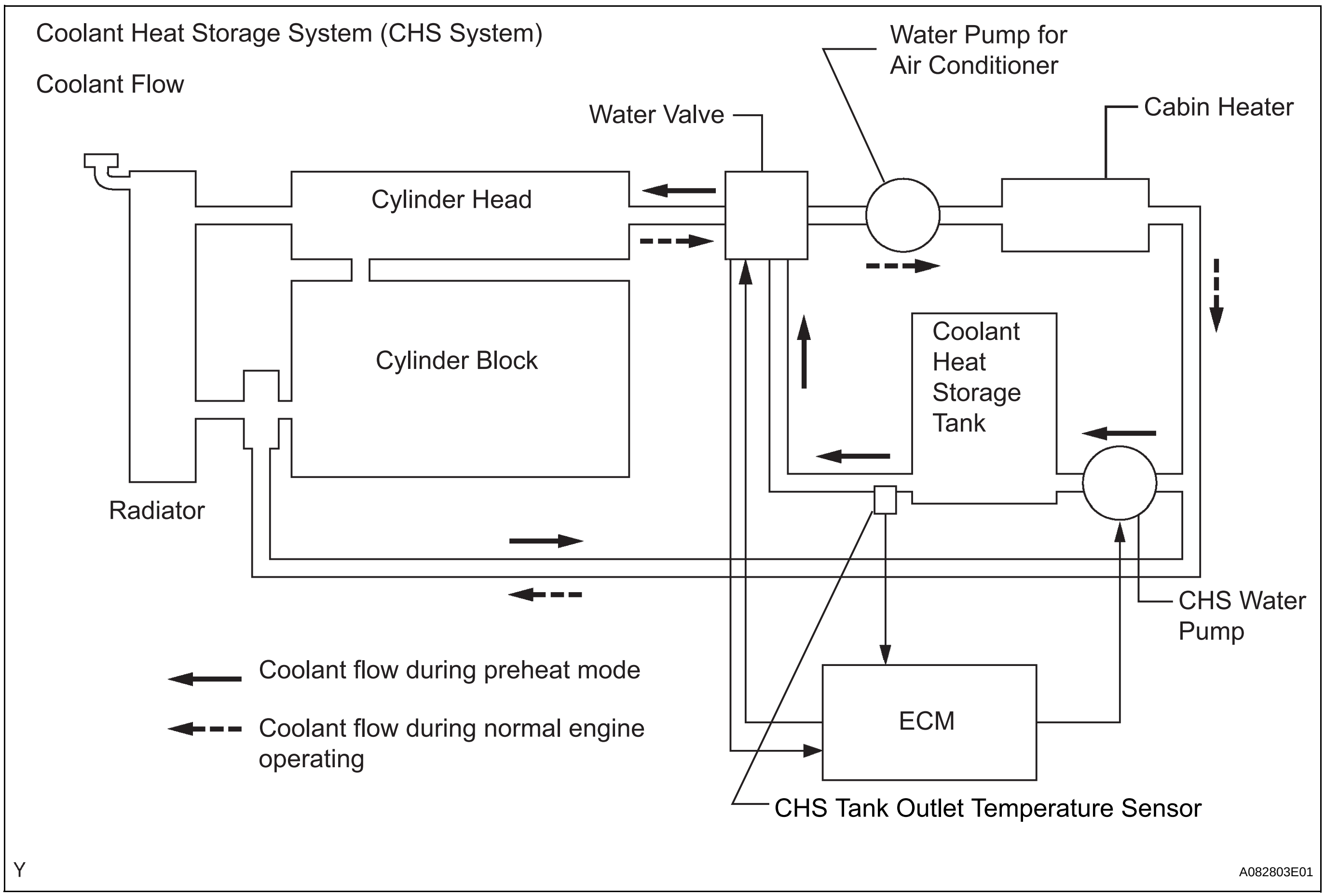
DTC	P1115	Coolant Temperature Sensor Circuit for Coolant Heat Storage System

DTC	P1117	Coolant Temperature Sensor Circuit Low for Coolant Heat Storage

DTC	P1118	Coolant Temperature Sensor Circuit High for Coolant Heat Storage

DESCRIPTION

HINT:
Although each DTC title says "Coolant Temperature Sensor", these DTCs are related to the coolant heat storage tank outlet temperature sensor.



This system uses an electric pump to supply hot coolant stored in the coolant heat storage tank into the cylinder head of the engine, in order to optimize engine starting combustion and reduce the amount of unburned gas that is discharged while the engine is started. Before the engine starts, the ECM operates the electric water pump to direct the hot coolant in the heat storage tank into the engine, in order to heat the cylinder head (this process is called "preheat mode"). The duration of the operation of the electric water pump is variable, depending on the temperature of the cylinder head. During the normal operation of the engine, the water valve opens the passage between the cylinder head and the heater and closes the passage between the cylinder head and the tank. During preheat mode in which the cylinder head is heated, the water valve opens the passage between the tank and the cylinder head, in order to allow the coolant to flow from the tank to the cylinder head. At this time, in order to warm up the intake port quickly before the engine is started, the coolant flows in the reverse direction.

The sensor for the system, which is provided at the tank outlet, is constructed similarly to the engine coolant temperature sensor and is connected to the ECM. The CHS tank outlet temperature sensor has a built in thermistor, whose resistance varies with the coolant temperature.

HINT:

If the ECM detects the DTC P0115, P0117 or P0118, it operates the fail-safe function in which the engine coolant temperature is assumed to be 80°C (176°F).

DTC No.	DTC Detection Condition	Trouble Area
P1115	Open or short in CHS tank outlet temperature sensor circuit for 0.5 seconds	• Open or short in CHS tank outlet temperature sensor circuit • CHS tank outlet temperature sensor • ECM
P1117	Short in CHS tank outlet temperature sensor circuit	• Short in CHS tank outlet temperature sensor circuit • CHS tank outlet temperature sensor • ECM
P1118	Open in CHS tank outlet temperature sensor circuit	• Open in CHS tank outlet temperature sensor circuit • CHS tank outlet temperature sensor • ECM

ES

MONITOR DESCRIPTION

The ECM monitors the sensor voltage and uses this value to control the coolant heat storage (CHS) system properly. If the sensor output voltage deviates from the normal operating range, the ECM determines that the CHS tank outlet temperature sensor circuit has malfunctioned, and outputs a DTC.

Example:

A sensor output voltage of -40°C (-40°F) or 140°C (284°F) is determined to be malfunction.

MONITOR STRATEGY

Related DTCs	P1115: Coolant temperature sensor circuit for coolant heat storage system P1117: Coolant temperature sensor circuit low for coolant heat storage system P1118: Coolant temperature sensor circuit high for coolant heat storage system
Required sensors/components	Coolant heat storage tank outlet temperature sensor
Frequency of operation	Continuous
Duration	0.5 seconds
MIL operation	Immediately
Sequence of operation	None

TYPICAL ENABLING CONDITIONS

The monitor will run whenever the following DTCs are not present	None

TYPICAL MALFUNCTION THRESHOLDS

P1115:

Sensor resistance (coolant temperature at CHS tank outlet)	Less than 0.14 V or more than 4.91 V (more than 140°C (284°F) or -40°C (-40°F) or less)

P1117:

Sensor resistance (coolant temperature at CHS tank outlet)	Less than 0.14 V (more than 140°C (284°F))

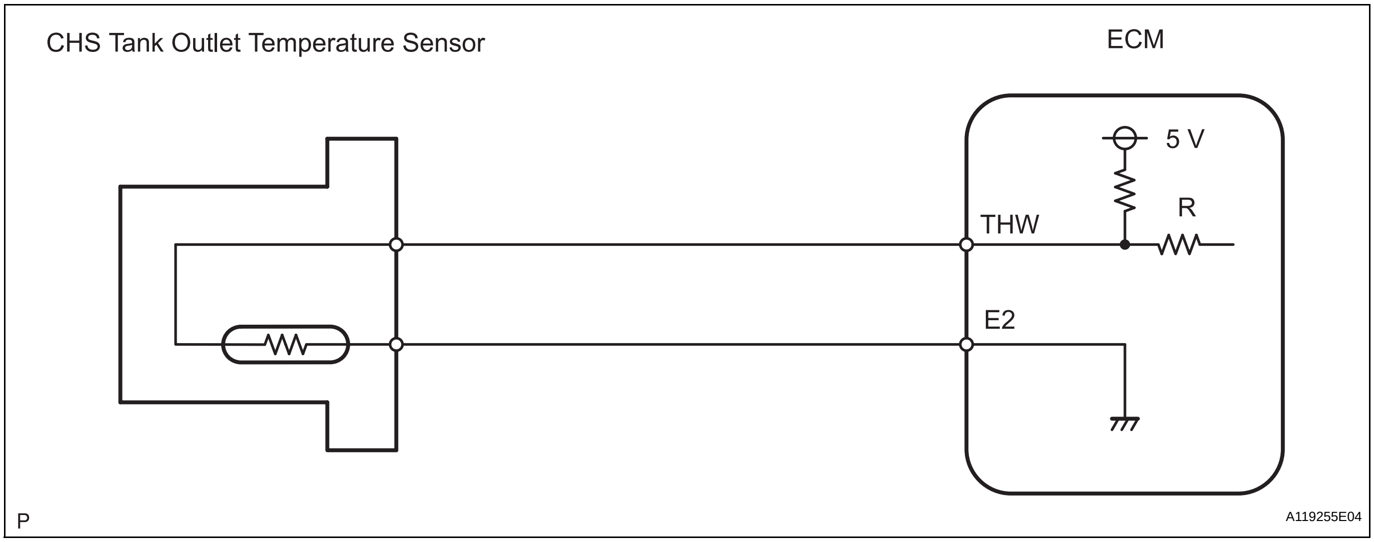
P1118:

Sensor resistance (coolant temperature at CHS tank outlet)	More than 4.19 V (-40°C (-40°F) or less)

COMPONENT OPERATING RANGE

Sensor resistance	79 Ω (140°C (284°F)) to 156 kΩ (-40°C (-40°F))

WIRING DIAGRAM



INSPECTION PROCEDURE

CAUTION:

Be careful when replacing any part in the system or changing the coolant because the coolant in the heat storage tank is hot even if the engine is cold.

HINT:

- If different DTCs related to different systems that have terminal E2 as the ground terminal are output simultaneously, terminal E2 may have an open circuit.
- To check the coolant heat storage (CHS) system, the ECM may cause the water pump of the CHS system to operate 5 hours after the power switch has been turned OFF.
- Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunction is detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1	READ VALUE OF INTELLIGENT TESTER

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

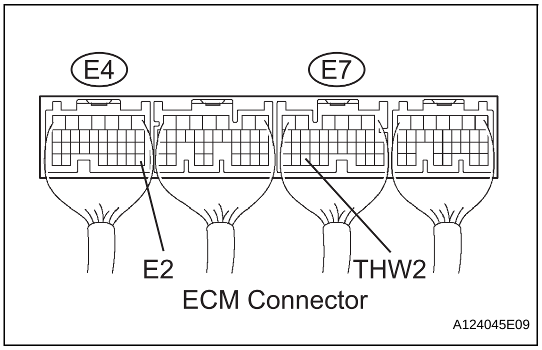
Result

Display (DTC Output)	Proceed to
P1115	A
P1117	B
P1118	B

B → **Go to step 3**

A

2	CHECK ECM (THW2 - E2 VOLTAGE)



(a) Turn the power switch ON (IG).
(b) Measure voltage between the terminals THW2 and E2 of the ECM E4 and E7 connector.
Standard voltage

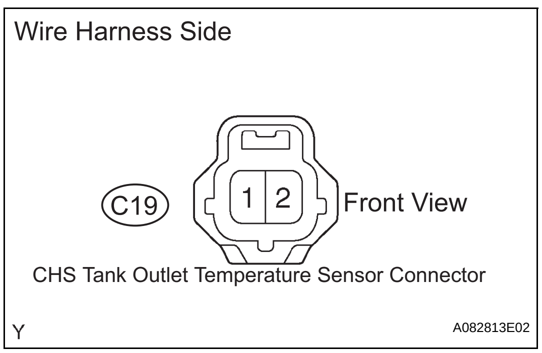
Water Temperature °C (°F)	Voltage
20 (68)	0.5 to 3.4 V
60 (140)	0.2 to 1.0 V

OK → **CHECK FOR INTERMITTENT PROBLEMS**

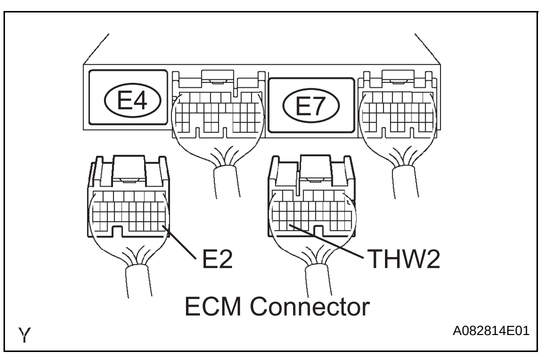
ES

NG

3	CHECK HARNESS AND CONNECTOR (CHS TANK OUTLET TEMPERATURE SENSOR - ECM)



(a) Check the harness and the connectors between the coolant heat storage tank outlet temperature sensor and the ECM connectors.
(1) Disconnect the C19 engine coolant heat storage tank outlet temperature sensor connector.



(2) Disconnect the E4 and E7 ECM connector.
(3) Measure the resistance between the wire harness side connectors.
Standard resistance (Check for open)

Tester Connection	Specified Condition
C19-2 (CHS temperature sensor) - E7-33 (THW2)	Below 1 Ω
C19-1 (CHS temperature sensor) - E4-28 (E2)	Below 1 Ω

Standard resistance (Check for short)

Tester Connection	Specified Condition
C19-2 (CHS temperature sensor) or E7-33 (THW2) - Body ground	10 kΩ or higher

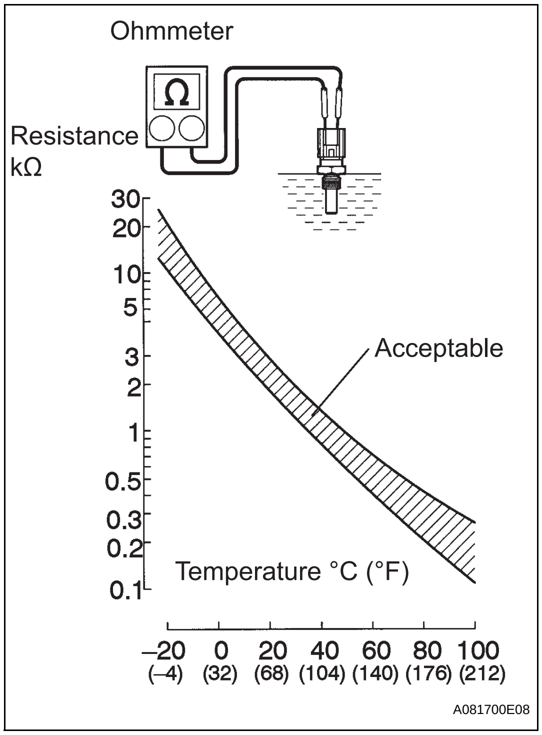
(4) Reconnect the coolant heat storage tank outlet temperature sensor connector.
(5) Reconnect the ECM connector.

NG → **REPAIR OR REPLACE HARNESS AND CONNECTOR**

ES

OK

4 INSPECT TEMPERATURE SENSOR (CHS TANK OUTLET TEMPERATURE SENSOR)



(a) Remove the coolant heat storage (CHS) tank outlet temperature sensor.

(b) Measure the resistance between the terminals.

Standard resistance

Tester Connection	Specified Condition
1 - 2	2 to 3 kΩ at 20°C (68°F)
1 - 2	0.2 to 0.4 kΩ at 80°C (176°F)

NOTICE:
In case of checking the CHS tank outlet temperature sensor in the water, be careful not to allow water to contact the terminals. After checking, dry the sensor.

HINT:
Alternate procedure: Connect an ohmmeter to the installed CHS tank outlet temperature sensor and read the resistance. Use an infrared thermometer to measure the CHS tank outlet 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 coolant heat storage tank outlet temperature sensor.

NG → **REPLACE TEMPERATURE SENSOR**

OK

REPLACE ECM

DTC	P1116	Coolant Temperature Sensor Circuit Stack for Coolant Heat Storage

DESCRIPTION

Refer to DTC P1115 (see page ES-291).

DTC No.	DTC Detection Condition	Trouble Area
P1116	• Temperature change during hot coolant recovering: 3°C (1.8°F) or less • Difference between CHS tank outlet temperature and engine coolant temperature during hot coolant recovering: More than 25°C (45°F)	• Coolant heat storage tank outlet temperature sensor • Cooling system (clogging)

ES

MONITOR DESCRIPTION

The coolant heat storage (CHS) tank outlet temperature sensor is used for monitoring coolant temperature in the vicinity of the outlet port of the heat storage tank of the CHS system. The resistance of the sensor increases when the CHS tank outlet temperature is low, and conversely, the resistance decreases when the temperature is high. The changes in resistance are reflected in the voltage that is output by the sensor. The ECM monitors the sensor voltage and uses this value to control CHS system properly.
If the sensor output voltage deviates from the normal operating range, the ECM determines that the CHS tank outlet temperature sensor circuit has malfunctioned, and sets a DTC.
Examples:
1) No changes occur in the CHS tank outlet temperature sensor signal (over 1°C [1.8°F]) after a predetermined length of time has elapsed from the start of the coolant recovering.
2) A significant difference (over 25°C [45°F]) exists between the engine coolant temperature signal and the CHS tank outlet temperature sensor signal after a predetermined length of time has elapsed from the start of the coolant recovering.

MONITOR STRATEGY

Related DTCs	P1116 : Coolant temperature sensor circuit range check (stuck)
Required sensors/components	Main: Coolant heat storage tank outlet temperature sensor Related: Engine coolant temperature sensor
Frequency of operation	Once per driving cycle
Duration	45 seconds
MIL operation	2 driving cycles
Sequence of operation	None

TYPICAL ENABLING CONDITIONS

The monitor will run whenever the following DTCs are not present	None
Coolant heat storage system malfunction	Not detected
Coolant heat recovering	ON
Difference between engine coolant temperature and CHS tank outlet temperature	More than 30°C (54°F)

TYPICAL MALFUNCTION THRESHOLDS

Temperature variation of CHS tank outlet during hot coolant recovery	3°C or less

Difference between temperatures of CHS tank outlet and engine coolant during hot coolant recovery	More than 25°C (45°F)

WIRING DIAGRAM

Refer to DTC P1115 (see page ES-293).

INSPECTION PROCEDURE

CAUTION:

Be careful when replacing any part in the system or changing the coolant because the coolant in the heat storage tank is hot even if the engine is cold.

HINT:

- To check the coolant heat storage (CHS) system, the ECM may cause the water pump of the CHS system to operate 5 hours after the power switch has been turned OFF.
- Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunction is detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1	CHECK OTHER DTC OUTPUT (IN ADDITION TO DTC P1116)

(a) Connect the intelligent tester to the DLC3.
(b) Turn the power switch ON (IG).
(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
P1116	A
P1116 and other DTCs	B

HINT:
If any other codes besides P1116 are output, perform troubleshooting for those DTCs first.

B → **GO TO RELEVANT DTC CHART**

A

2	CHECK COOLING SYSTEM (CHECK FOR CLOGGING IN THE COOLANT SYSTEM)

OK:
Coolant passage has no blockage.

NG → **REPAIR OR REPLACE COOLING SYSTEM**

OK

REPLACE TEMPERATURE SENSOR (CHS TANK OUTLET TEMPERATURE SENSOR)

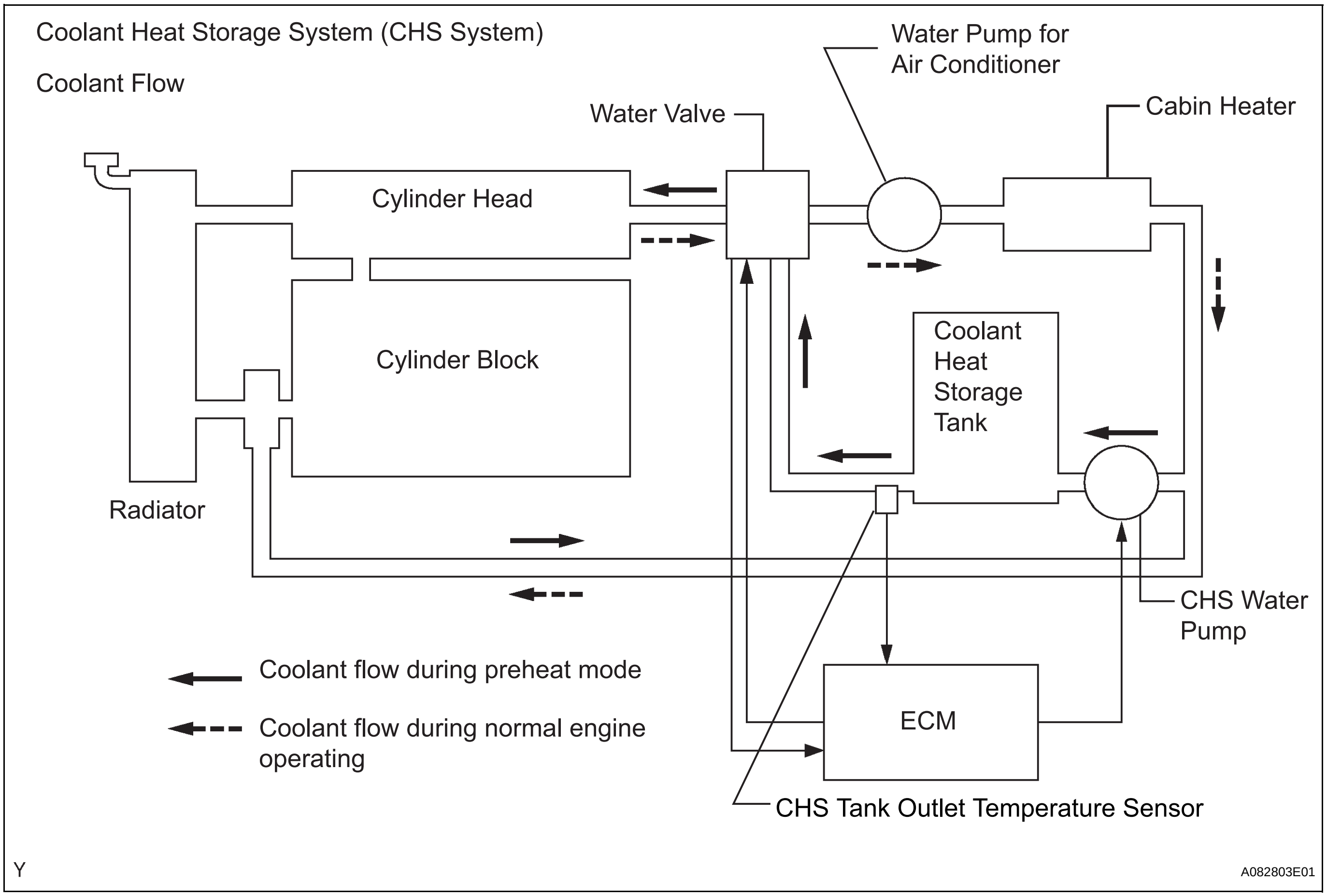
DTC	P1120	Coolant Flow Control Valve Position Sensor Circuit

DTC	P1122	Coolant Flow Control Valve Position Sensor Circuit Low

DTC	P1123	Coolant Flow Control Valve Position Sensor Circuit High

ES

DESCRIPTION

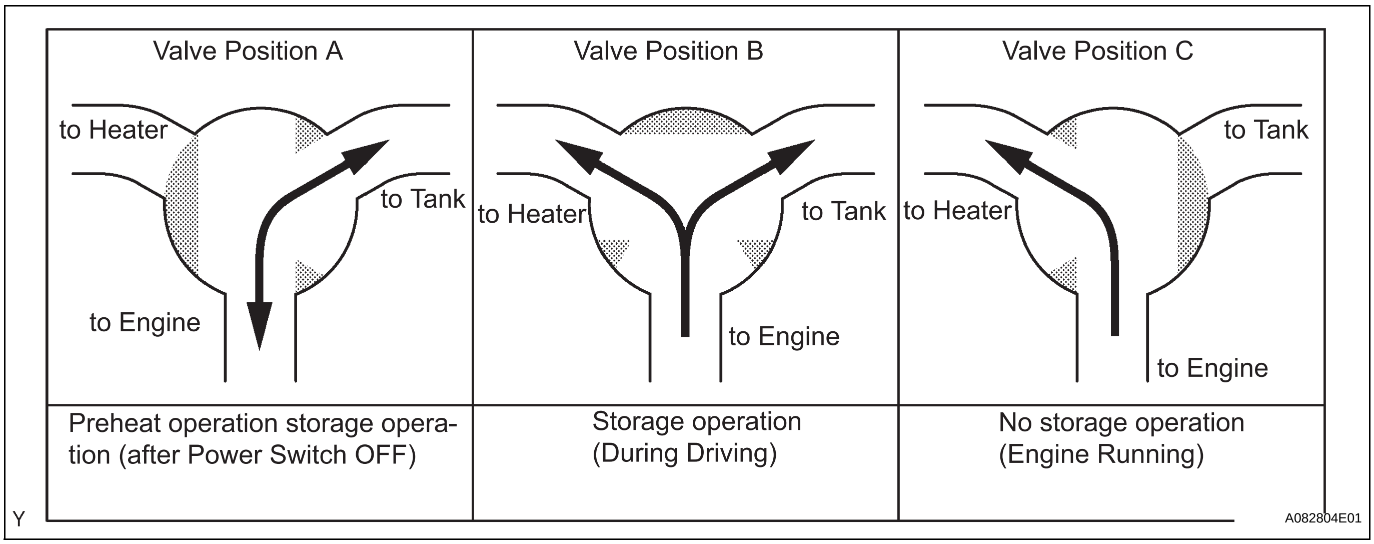


This system uses an electric pump to supply hot coolant stored in the heat storage tank into the cylinder head of the engine, in order to optimize engine starting combustion and reduce the amount of unburned gas that is discharged while the engine is started. Before the engine starts, the ECM operates the electric water pump to direct the hot coolant in the heat storage tank into the engine, in order to heat the cylinder head (this process is called "preheat mode"). The duration of the operation of the electric water pump is variable, depending on the temperature of the cylinder head. During the normal operation of the engine, the water valve opens the passage between the cylinder head and the heater and closes the passage between the cylinder head and the tank. During preheat mode in which the cylinder head is heated, the water valve opens the passage between the tank and the cylinder head, in order to allow the coolant to flow from the tank to the cylinder head. At this time, in order to warm up the intake port quickly before the engine is started, the coolant flows in the reverse direction.
The water valve for the coolant heat storage (CHS) system, which is located at the heater hoses, controls the coolant passages to the engine, heater core, and the CHS tank in accordance with the operating conditions of the system.

The water valve consists of a water valve, valve position sensor, and valve control motor. The potentiometer, which is coupled coaxially to the water valve, converts the valve position into voltage and transmits it to the ECM in the form of a position signal.

DTC No.	DTC Detection Condition	Trouble Area
P1120	Water valve position sensor voltage is less than 0.2 V or more than 4.8 V	• Open or short in water valve position sensor circuit • Water valve (coolant flow control valve) • ECM
P1122	Water valve position sensor voltage stays less than 0.2 V for 2 seconds or more	• Water valve (coolant flow control valve) • Short in WBAD circuit • Open in VC circuit • ECM
P1123	Water valve position sensor voltage stays more than 4.8 V for 2 seconds or more	• Water valve (coolant flow control valve) • Short in WBAD circuit • Open in E2 circuit • VC and WBAD circuits are short-circuited • ECM

MONITOR DESCRIPTION



A potentiometer is provided in the coolant heat storage (CHS) system. The ECM uses the valve position signal output by the water valve for effecting control that is appropriate for the operating condition of the engine. The water valve effects control in three steps as indicated below, and the ECM determines the position of the valve according to the voltage of the respective step.

If the signal output by the water valve exceeds the normal range, the ECM determines that a malfunction has occurred in the water valve position sensor circuit and outputs a DTC.

Water Valve Operation

System Condition	Valve Position	Coolant Flow
Normal engine operation	C	Engine to Cabin heater
Preheat mode	A	Coolant heat storage tank to Engine
Coolant recovering (after engine stop)	A	Engine to Coolant heat storage tank
Coolant recovering (while engine is running)	B	Engine to Cabin heater and Coolant heat storage tank
Soak mode	A	Coolant heat storage tank to Engine

MONITOR STRATEGY

Related DTCs	• P1120: Coolant flow control valve (water valve) position sensor circuit range check (fluttering) • P1122: Coolant flow control valve (water valve) position sensor circuit range check (low voltage) • P1123: Coolant flow control valve (water valve) position sensor circuit range check (high voltage)
Required sensors/components	Water valve position sensor
Frequency of operation	Continuous
Duration	2 seconds
MIL operation	Immediately
Sequence of operation	None

TYPICAL ENABLING CONDITIONS

The monitor will run whenever the following DTCs are not present	None

TYPICAL MALFUNCTION THRESHOLDS

P1120:

Water valve position signal	Less than 0.2 V or more than 4.8 V

P1122:

Water valve position signal	Less than 0.2 V

P1123:

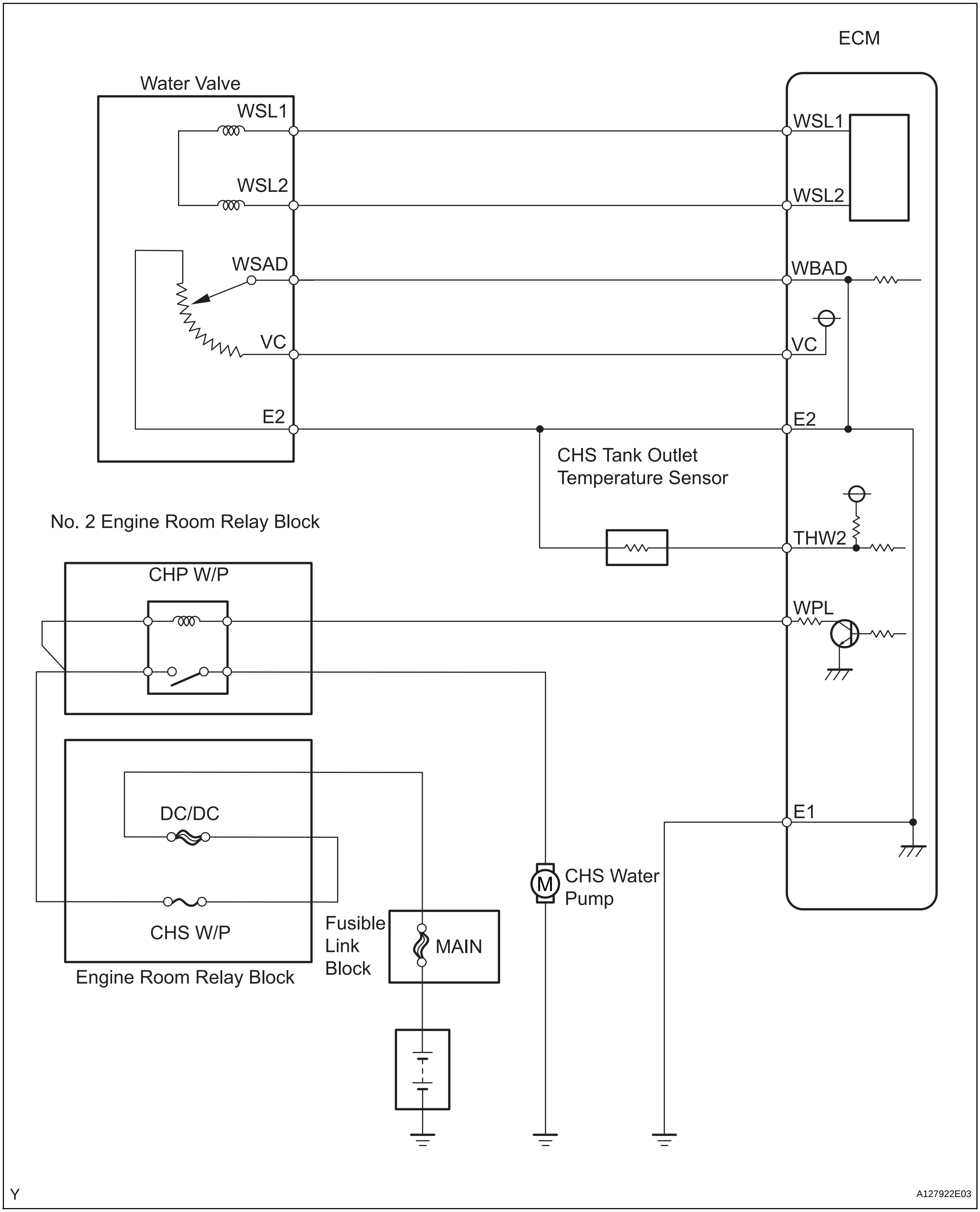
Water valve position signal	More than 4.8 V

COMPONENT OPERATING RANGE

Water valve position signal	0.4 to 2.2 V

ES

WIRING DIAGRAM



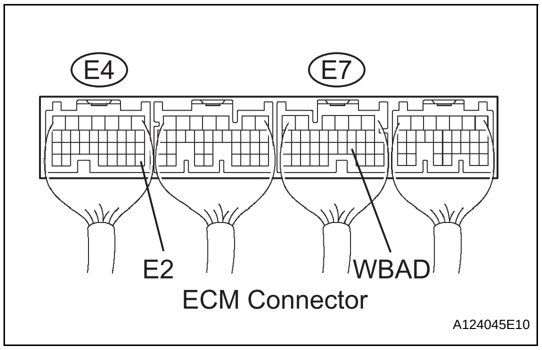
INSPECTION PROCEDURE

HINT:

Although each DTC title says "Coolant Flow Control Valve", these DTCs are related to the water valve.

CAUTION:
Be careful when replacing any part in the system or changing the coolant because the coolant in the heat storage tank is hot even if the engine is cold.
HINT:
- To check the coolant heat storage (CHS) system, the ECM may cause the water pump of the CHS system to operate 5 hours after the power switch has been turned OFF.
- Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunction is detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1 CHECK ECM (WBAD - E2 VOLTAGE)



(a) Turn the power switch ON (IG).
(b) Measure voltage between the terminals WBAD and E2 of the E4 and E7 ECM connectors.
Standard voltage

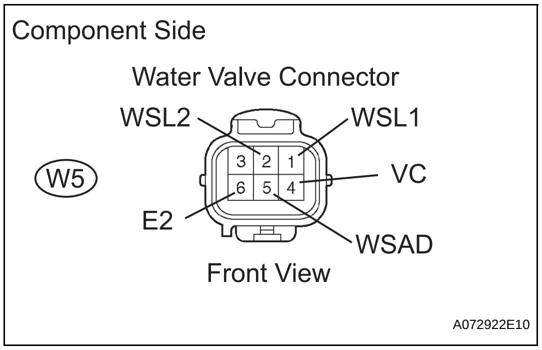
Water Valve	Specified Condition
Valve position "A" (Preheat mode)	Approximately 2.5 V
Valve position "B" (Recovering mode)	Approximately 3.5 V
Valve position "C" (Normal Operation)	Approximately 4.5 V

HINT:
After the HV main system is turned OFF (READY to IG OFF condition), the valve position will be set to position A.

OK → **CHECK FOR INTERMITTENT PROBLEMS**

NG ↓

2 INSPECT WATER M/BRACKET VALVE ASSEMBLY



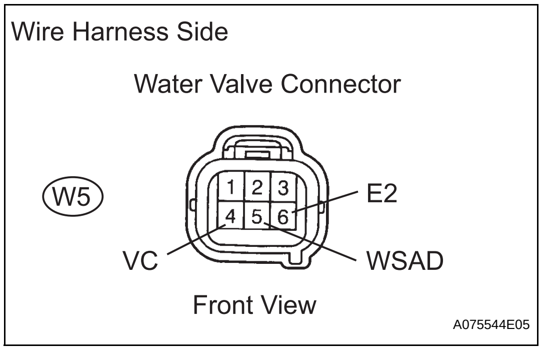
(a) Disconnect the W5 water valve connector.
(b) Measure resistance between terminals WSL1 and WSL2 of the water valve connector.
(c) Measure resistance between terminals WSAD and E2 of the water valve connector.
Standard resistance

Tester Connection	Specification Condition
1 (WSL1) - 2 (WSL2)	Approximately 0.04 kΩ
5 (WSAD) - 6 (E2)	0.2 to 5.7 kΩ

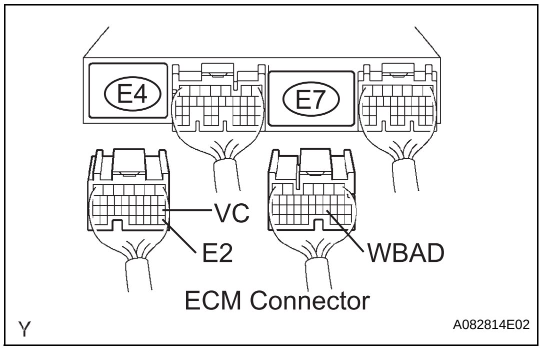
NG → **REPLACE WATER W/BRACKET VALVE ASSEMBLY**

OK ↓

3	CHECK HARNESS AND CONNECTOR (WATER VALVE - ECM)



(a) Disconnect the W5 water valve connector.



(b) Disconnect the E4 and E7 ECM connectors.
(c) Measure the resistance between the wire harness side connectors.

Standard resistance (Check for open)

Tester Connection	Specified Condition
W5-5 (Water valve) - E7-20 (WBAD)	Below 1 Ω
W5-4 (Water valve) - E4-18 (VC)	Below 1 Ω
W5-6 (Water valve) - E4-28 (E2)	Below 1 Ω

Standard resistance (Check for short)

Tester Connection	Specified Condition
W5-5 (Water valve) or E7-20 (WBAD) - Body ground	10 kΩ or higher

(d) Reconnect the water valve connector.
(e) Reconnect the ECM connectors.

NG → **REPAIR OR REPLACE HARNESS AND CONNECTOR**

OK

REPLACE ECM

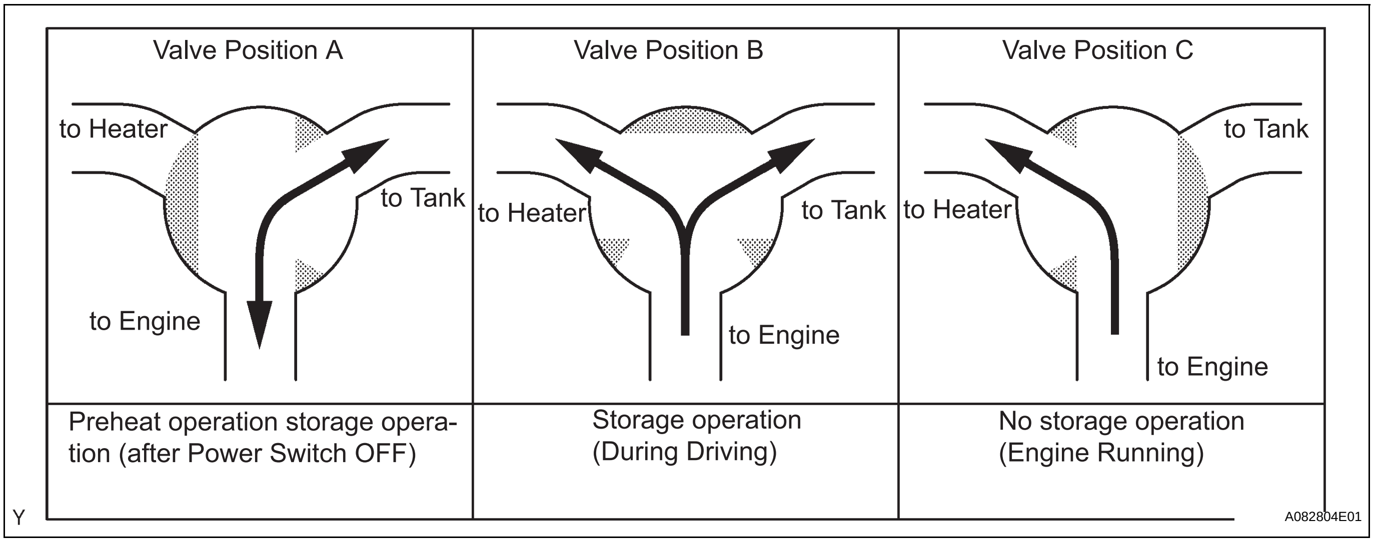
DTC	P1121	Coolant Flow Control Valve Position Sensor Circuit Stuck

DESCRIPTION

Refer to DTC P1120 (see page ES-298).

DTC No.	DTC Detection Condition	Trouble Area
P1121	• Water valve position sensor output voltage: No change despite the ECM sending a valve control signal or slow response • CHS tank outlet temperature sensor output: 60°C (140°F) or more (when hot coolant recovering starts) • CHS tank outlet temperature sensor output: No change despite the hot coolant is recovered	• Water valve • Cooling system (clogging) • ECM

MONITOR DESCRIPTION



The ECM monitors the position of the water valve based on the valve position signal that is output by the water valve position sensor (potentiometer), which is coupled coaxially to the valve. The water valve effects control in three steps as indicated above, and the ECM determines the position of the valve according to the voltage of the respective step.
In order to ensure the proper monitoring of the water valve, the ECM checks for malfunctions with the combination of the output of the potentiometer and CHS tank outlet temperature sensor.
If no changes occur in the valve position signal that is being input into the ECM or if the response signal from the water valve is very slow, despite of the ECM commanding the water valve motor to operate the ECM determines that malfunction has occurred in the water valve position sensor circuit, and sets a DTC.

MONITOR STRATEGY

Potentiometer detection

Related DTCs	P1121: Coolant flow control valve position sensor circuit stuck
Required sensors/components	Main: Water valve Related: CHS tank outlet temperature sensor
Frequency of operation	Once per driving cycle

Duration	20 seconds
MIL operation	2 driving cycle
Sequence of operation	None

Tank outlet coolant temperature detection

Related DTCs	P1121: Coolant flow control valve position sensor circuit stuck
Required sensors/components	Main: Water valve Related: CHS tank outlet temperature sensor
Frequency of operation	Once per driving cycle
Duration	10 seconds
MIL operation	2 driving cycle
Sequence of operation	None

TYPICAL ENABLING CONDITIONS

Potentiometer detection

The monitor will run whenever the following DTCs are not present	None
Coolant heat storage system malfunction	Not detected
Battery voltage	10 V or more
Engine coolant temperature	0°C (32°F) or more
Water valve operation	Commanded
Response time of valve movement	Time under calculation with valve position

Tank outlet coolant temperature detection

The monitor will run whenever the following DTCs are not present	None
Coolant heat storage system malfunction	Not detected
Battery voltage	10 V or more
System status	During recovering
CHS tank outlet temperature difference between preheating start and engine start	20°C (36°F) or more
Difference between engine coolant temperature and CHS tank outlet temperature	More than 30°C (54°F)

TYPICAL MALFUNCTION THRESHOLDS

Potentiometer detection

Either of the following conditions is met:	(a) or (b)
(a) Potentiometer output difference [D divided C] C: Difference between previous and current target D: Difference between potentiometer output and previous target	10% or more
(b) Potentiometer output deviation from target	0.1 V or more

Tank outlet coolant temperature detection

Either of the following conditions is met:	(a) or (b)
(a) Heat storage tank outlet coolant temperature when recover starts	60°C (108°F) or more
(b) Heat storage tank outlet coolant temperature difference during water valve check	Less than 3°C (5.4°F)

WIRING DIAGRAM

Refer to DTC P1120 (see page ES-301).

INSPECTION PROCEDURE

HINT:
- Although each DTC title says "Coolant Flow Control Valve", these DTCs are related to the water valve.
- CHS stands for Coolant Heat Storage.

CAUTION:
Be careful when replacing any part in the system or changing the coolant because the coolant in the heat storage tank is hot even if the engine is cold.

HINT:
- If DTCs P1121 and P1150 are detected simultaneously, there may be malfunction in the water valve system.
- If DTC P1121 is detected, coolant passages may be clogged.
- To check the coolant heat storage (CHS) system, the ECM may cause the water pump of the CHS system to operate 5 hours after the power switch has been turned OFF.
- Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunction is detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1 CHECK OTHER DTC OUTPUT (IN ADDITION TO DTC P1121)

(a) Connect the intelligent tester to the DLC3.
(b) Turn the power switch ON (IG).
(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
P1121	A
P1121 and other DTCs	B

HINT:
If any other codes besides P1121 are output, perform troubleshooting for those DTCs first.

B → **GO TO RELEVANT DTC CHART**

A

2 PERFORM ACTIVE TEST BY INTELLIGENT TESTER

(a) Connect the intelligent tester to the DLC3.
(b) Turn the power switch ON (IG).
(c) Turn the tester ON.
(d) Put the engine in inspection mode (see page ES-1).
(e) Start the engine and warm it up.
(f) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / WATER FLW VLV3, WATER FLW VLV4 or WATER FLW VLV5.
(g) Measure the voltage between terminals WBAD and E2 of the ECM connector.

Standard voltage

Tester Operation	Specified Condition
"WATER FLW VLV 3" ON	Approximately 2.5 V
"WATER FLW VLV 4" ON	Approximately 3.5 V
"WATER FLW VLV 5" ON	Approximately 4.5 V

NG → **REPLACE WATER W/BRACKET VALVE ASSEMBLY**

OK

ES

3 CHECK COOLING SYSTEM (CHECK FOR CLOGGING IN THE COOLANT SYSTEM)

OK:
Coolant passages are not clogged.

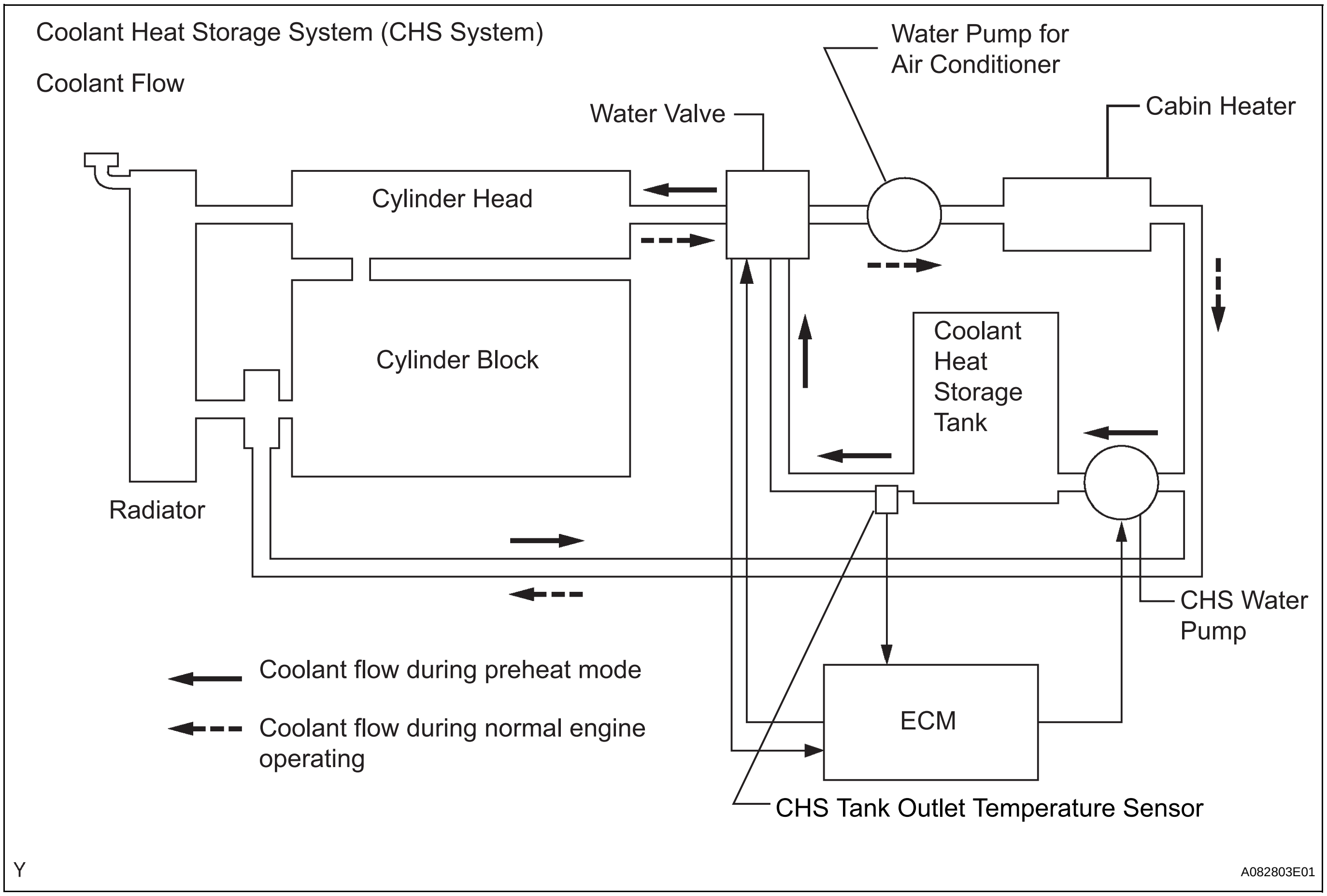
NG → **REPAIR OR REPLACE COOLING SYSTEM**

OK

REPLACE ECM

DTC	P1150	Coolant Path Clog of Coolant Heat Storage System

DESCRIPTION



This system uses an electric pump to supply hot coolant stored in the coolant heat storage (CHS) tank into the cylinder head of the engine, in order to optimize engine starting combustion and reduce the amount of unburned gas that is discharged while the engine is started. Before the engine starts, the ECM operates the electric water pump to direct the hot coolant in the CHS tank into the engine, in order to heat the cylinder head (this process is called "preheat mode"). The duration of the operation of the electric water pump is variable, depending on the temperature of the cylinder head. During normal operation of the engine, the water valve opens the passage between the cylinder head and the heater and closes the passage between the cylinder head and the tank. During the preheat mode in which the cylinder head is heated, the water valve opens the passage between the tank and the cylinder head, in order to allow the coolant to flow from the tank to the cylinder head. At this time, in order to warm up the intake port quickly before the engine is started, the coolant flows in the reverse direction.
This system consists of the CHS tank, CHS water pump, CHS tank outlet temperature sensor, water valve, and a soak timer that is built in the ECM.

DTC No.	DTC Detection Condition	Trouble Area
P1150	Following conditions are met: • Change in CHS tank outlet temperature and engine coolant temperature after water pump is ON during preheat mode: below 2°C (3.6°F) • Change in CHS tank outlet temperature as water valve is opened to tank, on a warm engine: below 3°C (5.4°F)	• CHS tank outlet temperature sensor • Water valve (coolant flow control valve) • Cooling system (clogging) • ECM

ES

MONITOR DESCRIPTION

The ECM detects malfunction in the coolant heat storage (CHS) system with the CHS tank outlet temperature signal, the position of the water valve and the engine running condition. In order to ensure the reliable malfunction detection, the ECM detects coolant passage clogging malfunction in two ways. Thus, when the following two detection conditions are met, the ECM determines that the coolant passage has clogged and sets a DTC.

- When starting the engine, a variation in the CHS tank outlet temperature and engine coolant temperature before and after preheating is below 2°C (3.6°F).
- After the engine is warmed up, a variation in the CHS tank outlet temperature when the ECM opens the water valve is below 3°C (5.4°F).

MONITOR STRATEGY

Related DTCs	P1150: Coolant path clog up for coolant heat storage system
Required sensors/components (main)	CHS tank outlet temperature sensor
Frequency of operation	Once per driving cycle
Duration	10 seconds
MIL operation	1 driving cycle
Sequence of operation	None

TYPICAL ENABLING CONDITIONS

The monitor will run whenever the following DTCs are not present	None
Coolant heat storage system malfunction	Not detected
Coolant heat storage water pump operation time	3 seconds or more
Variation in CHS tank coolant temperature and engine coolant temperature before and after preheating	2°C (3.6°F) or less
Engine coolant temperature	65°C(149°F) or more

TYPICAL MALFUNCTION THRESHOLDS

Variation in CHS tank coolant temperature during passage clogging check	Less than 3°C (5.4°F)

WIRING DIAGRAM

Refer to DTC P1115 (see page ES-293).

INSPECTION PROCEDURE

CAUTION:

Be careful when replacing any part in the system or changing the coolant because the coolant in the heat storage tank is hot even if the engine and the radiator are cold.

HINT:

- The detection of this DTC may indicate that the coolant heat storage (CHS) tank outlet water temperature sensor stuck or the water valve stuck.
- If DTC P1121 is detected, coolant passages may be clogged.
- To check the coolant heat storage (CHS) system, the ECM may cause the water pump of the CHS system to operate 5 hours after the power switch has been turned OFF.
- Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunction is detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

ES

1	CHECK OTHER DTC OUTPUT (IN ADDITION TO DTC P1150)

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

Result

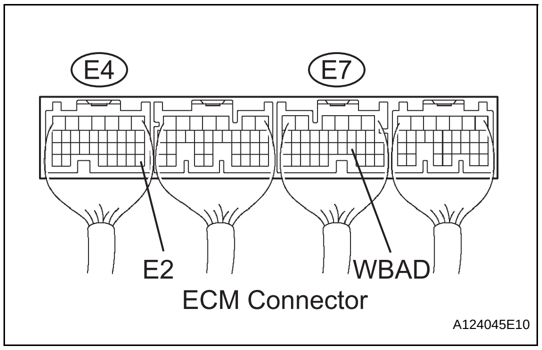
Display (DTC Output)	Proceed to
P1150	A
P1150 and other DTCs	B

HINT:
If any other codes besides P1150 are output, perform troubleshooting for those DTCs first.

B → **GO TO RELEVANT DTC CHART**

A

2	PERFORM ACTIVE TEST BY INTELLIGENT TESTER



(a) Connect the intelligent tester to the DLC3.
(b) Turn the power switch ON (IG).
(c) Turn the tester ON.
(d) Put the engine in inspection mode (see page ES-1).
(e) Start the engine and warm it up.
(f) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / WATER FLW VLV3, WATER FLW VLV4 or WATER FLW VLV5.
(g) Measure the voltage between terminals WBAD and E2 of the ECM connector.

Standard voltage

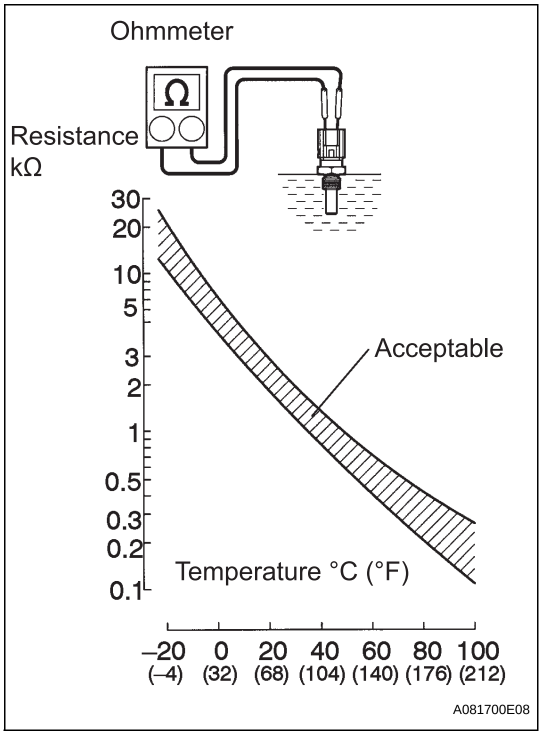
Tester Operation	Specified Condition
"WATER FLW VLV 3" ON	Approximately 2.5 V
"WATER FLW VLV 4" ON	Approximately 3.5 V
"WATER FLW VLV 5" ON	Approximately 4.5 V

NG → **REPLACE WATER W/BRACKET VALVE ASSEMBLY**

OK

ES

3 INSPECT TEMPERATURE SENSOR



(a) Remove the CHS tank outlet temperature sensor.
(b) Measure the resistance between the terminals.

Standard resistance

Tester Connection	Specified Condition
1 - 2	2 to 3 kΩ at 20°C (68°F)
1 - 2	0.2 to 0.4 kΩ at 80°C (176°F)

NOTICE:
In case of checking the CHS tank outlet temperature sensor in the water, be careful not to allow water to contact the terminals. After checking, dry the sensor.

HINT:
Alternate procedure: Connect an ohmmeter to the installed CHS tank outlet temperature sensor and read the resistance. Use an infrared thermometer to measure the CHS tank outlet 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 CHS tank outlet temperature sensor.

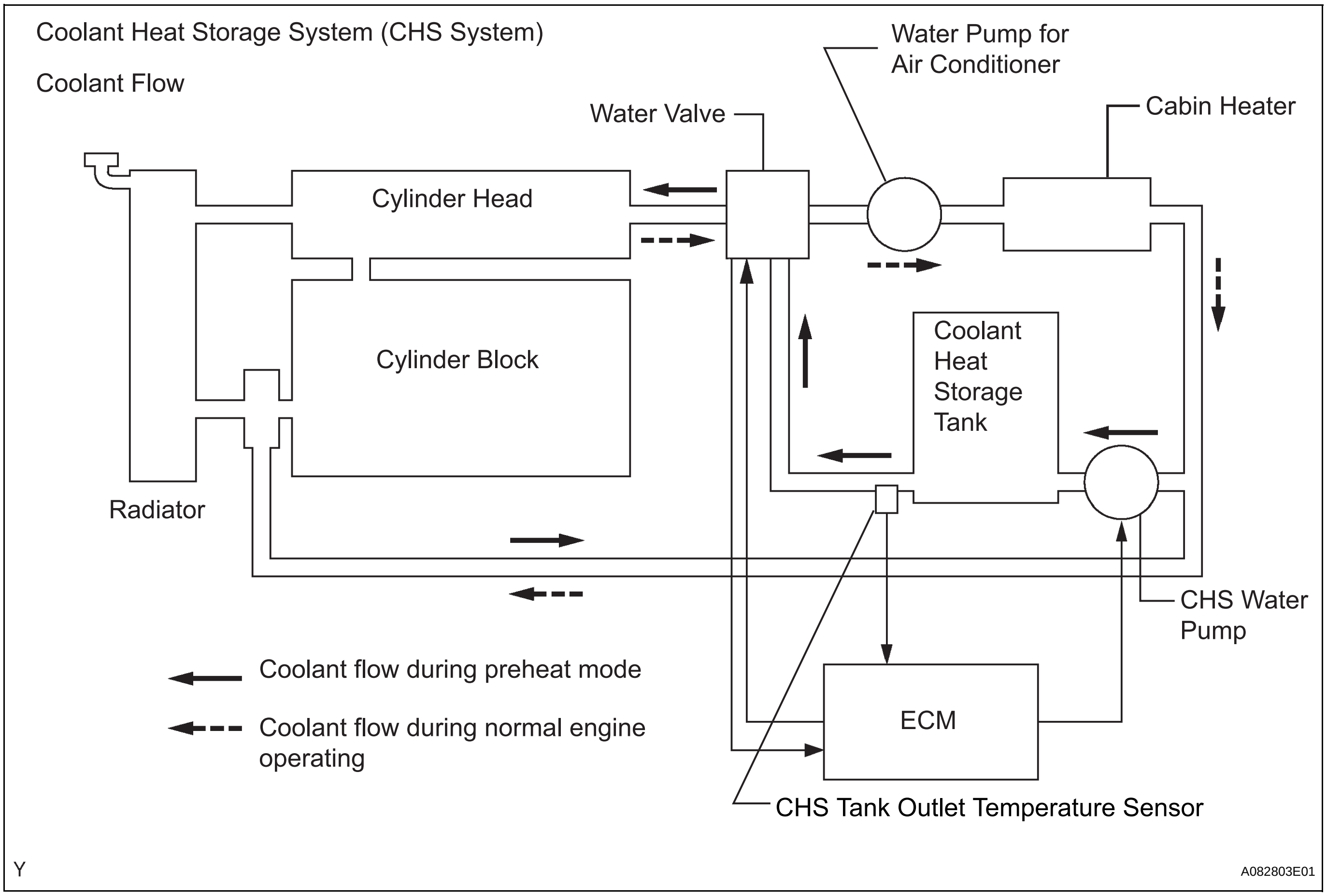
NG → **REPLACE TEMPERATURE SENSOR**

OK

CHECK COOLING SYSTEM (CHECK FOR CLOGGING IN THE COOLING SYSTEM)

DTC	P1151	Coolant Heat Storage Tank

DESCRIPTION



This system uses an electric pump to supply hot coolant stored in the coolant heat storage (CHS) tank into the cylinder head of the engine, in order to optimize engine starting combustion and reduce the amount of unburned gas that is discharged while the engine is started. Before the engine starts, the ECM operates the electric water pump to direct the hot coolant in the CHS tank into the engine, in order to heat the cylinder head (this process is called "preheat mode"). The duration of the operation of the electric water pump is variable, depending on the temperature of the cylinder head. During normal operation of the engine, the water valve opens the passage between the cylinder head and the heater and closes the passage between the cylinder head and the tank. During the preheat mode in which the cylinder head is heated, the water valve opens the passage between the tank and the cylinder head, in order to allow the coolant to flow from the tank to the cylinder head. At this time, in order to warm up the intake port quickly before the engine is started, the coolant flows in the reverse direction.
This system consists of the CHS tank, CHS water pump, CHS tank outlet temperature sensor, water valve, and a soak timer that is built in the ECM.

DTC No.	DTC Detection Condition	Trouble Area
P1151	Following conditions are successively met: • CHS tank outlet temperature during preheating: below 50°C (122°F) (2 trip detection condition) • CHS tank outlet temperature during soaking: 30°C (54°F) or more lower than during coolant recovering	• Coolant heat storage tank

MONITOR DESCRIPTION

The ECM detects malfunction in the coolant heat storage (CHS) system with the CHS tank coolant temperature, the position of the water valve, the running condition of the engine and the operating condition of the soak timer. The soak timer built in the ECM prompts the ECM to actuate the water pump 5 hours after the HV main system has been turned OFF by using the power switch. The ECM then checks the heat retention condition of the CHS tank. In order to ensure the reliable malfunction detection, the ECM detects the CHS tank heat retention malfunction in two ways. thus, when the following two detection conditions are consecutively met, the ECM determines that the heat retention has deteriorated and sets a DTC.
(1) During preheating, the CHS tank outlet water temperature is below 50°C (122°F) (2 trip detection logic).
(2) During soaking, the CHS tank outlet temperature is more than 30°C (86°F) lower than that during the got coolant recovery.

MONITOR STRATEGY

Related DTCs	P1151: Coolant heat storage tank
Required sensors/components	CHS tank outlet temperature sensor
Frequency of operation	Once per driving cycle
Duration	10 seconds
MIL operation	2 driving cycles
Sequence of operation	None

TYPICAL ENABLING CONDITIONS

The monitor will run whenever the following DTCs are not present	None
Coolant heat storage system malfunction	Not detected
Coolant heat storage water pump operation time	3 seconds or more
Storage coolant temperature	More than 65°C (149°F)

TYPICAL MALFUNCTION THRESHOLDS

Difference storage coolant temperature and heat storage tank outlet coolant temperature	30°C (54°F) or more

INSPECTION PROCEDURE

CAUTION:
Be careful when replacing any part in the system or changing the coolant because the coolant in the heat storage tank is hot even if the engine and the radiator are cold.
NOTICE:
If air breeding is not performed completely, this DTC may be detected after changing the coolant.
HINT:
- To check the coolant heat storage (CHS) system, the ECM may cause the water pump of the CHS system to operate 5 hours after the power switch has been turned OFF.
- Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunction is detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1	REPLACE COOLANT HEAT STORAGE TANK

NEXT

REPAIR COMPLETED

DTC	P1450	Fuel Tank Pressure Sensor

DTC	P1451	Fuel Tank Pressure Sensor Range/Performance

DTC	P1452	Fuel Tank Pressure Sensor Low Input

DTC	P1453	Fuel Tank Pressure Sensor High Input

DTC SUMMARY

DTC No.	Monitoring Item	DTC Detection Condition	Trouble Area	Detection Timing	Detection Logic
P1450	Pressure sensor abnormal voltage fluctuation	Sensor output voltage rapidly fluctuates beyond upper and lower malfunction thresholds for 7 seconds.	• Fuel tank pressure sensor • ECM	• Power switch ON (IG)	1 trip
P1451	Pressure sensor abnormal voltage fluctuation	Sensor output voltage fluctuates frequently in certain time period.	• Fuel tank pressure sensor • Connector/wire harness (Fuel tank pressure sensor - ECM) • ECM	• EVAP monitoring (power switch OFF) • Engine running	2 trips
P1451	Pressure sensor constant voltage	Sensor output voltage does not vary in certain time period.	• Fuel tank pressure sensor • Connector/wire harness (Fuel tank pressure sensor - ECM) • ECM	• Engine running)	2 trips
P1452	Pressure sensor voltage low	Sensor output is less than -3,999 Pa for 7 seconds.	• Fuel tank pressure sensor • Connector/wire harness (Fuel tank pressure sensor - ECM) • ECM	• EVAP monitoring (power switch OFF) • Power switch ON (IG)	1 trip
P1453	Pressure sensor voltage high	Sensor output 1,999 Pa for 7 seconds.	• Fuel tank pressure sensor • Connector/wire harness (Fuel tank pressure sensor - ECM) • ECM	• EVAP monitoring (power switch OFF) • Power switch ON (IG)	1 trip

DESCRIPTION

NOTICE:

In this vehicle's EVAP system, turning ON the vent valve does not seal off the EVAP system. To check for leaks in the EVAP system, disconnect the air inlet vent hose and apply pressure from the atmosphere side of the canister.

While the engine is running, if a predetermined condition (closed loop, etc.) is met, the purge VSV is opened by the ECM and stored fuel vapors in the canister are purged to the intake manifold. The ECM changes the duty cycle ratio of the purge VSV to control purge flow volume.

The purge flow volume is also determined by the intake manifold pressure. Atmospheric pressure is allowed into the canister through the vent valve to ensure that the purge flow is maintained when the negative pressure (vacuum) is applied to the canister.

Key-off monitor

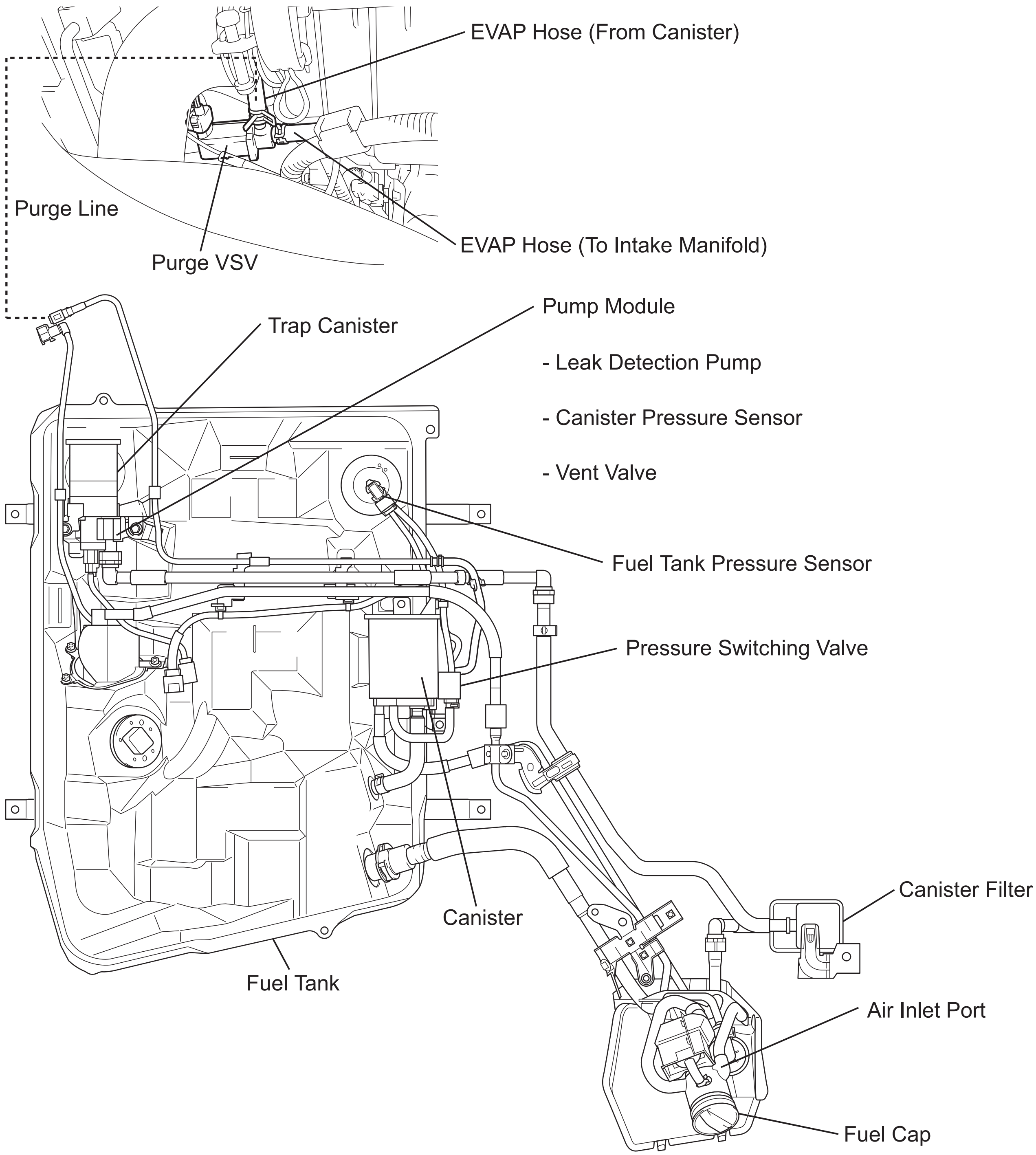
This monitor checks for Evaporative Emission (EVAP) system leaks and canister pump module malfunctions. The monitor starts 5 hours* after the power switch is turned OFF. More than 5 hours are required to allow the fuel to cool down to stabilize the Fuel Tank Pressure (FTP), thus making the EVAP system monitor more accurate.

The leak detection pump creates negative pressure (vacuum) in the EVAP system and the pressure is measured. Finally, the ECM monitors for leaks from the EVAP system and malfunctions in both the canister pump module and purge VSV, based on the EVAP pressure.

HINT:

*: If the engine coolant temperature is not below 35°C (95°F) 5 hours after the power switch is turned OFF, the monitor check starts 2 hours later. If it is still not below 35°C (95°F) 7 hours after the power switch is turned OFF, the monitor check starts 2.5 hours later.

Location


EVAP Hose (From Canister)
Purge Line
EVAP Hose (To Intake Manifold)
Purge VSV
Pump Module
- Leak Detection Pump
- Canister Pressure Sensor
- Vent Valve
Trap Canister
Fuel Tank Pressure Sensor
Pressure Switching Valve
Canister Filter
Canister
Fuel Tank
Air Inlet Port
Fuel Cap
A131350E01

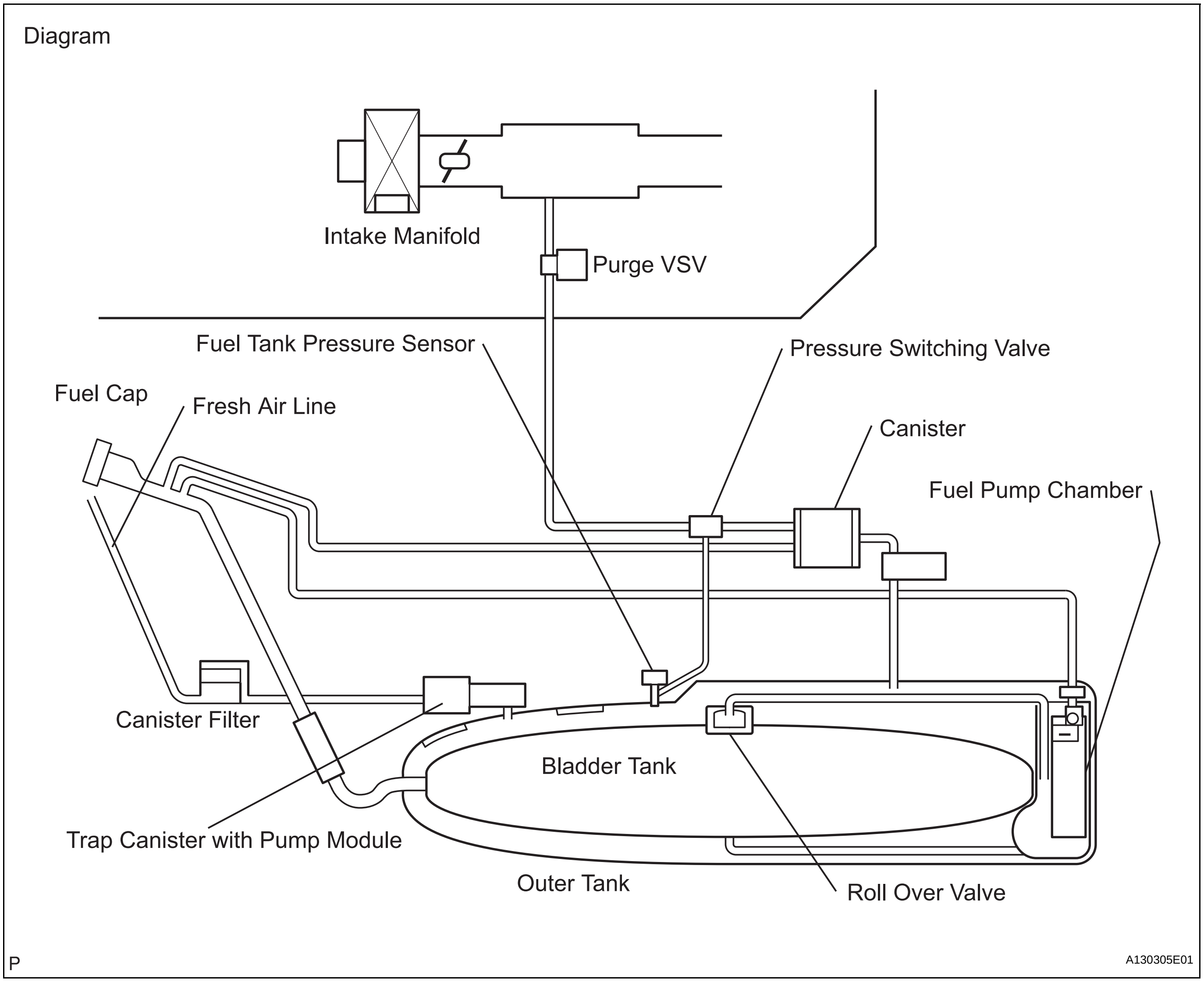
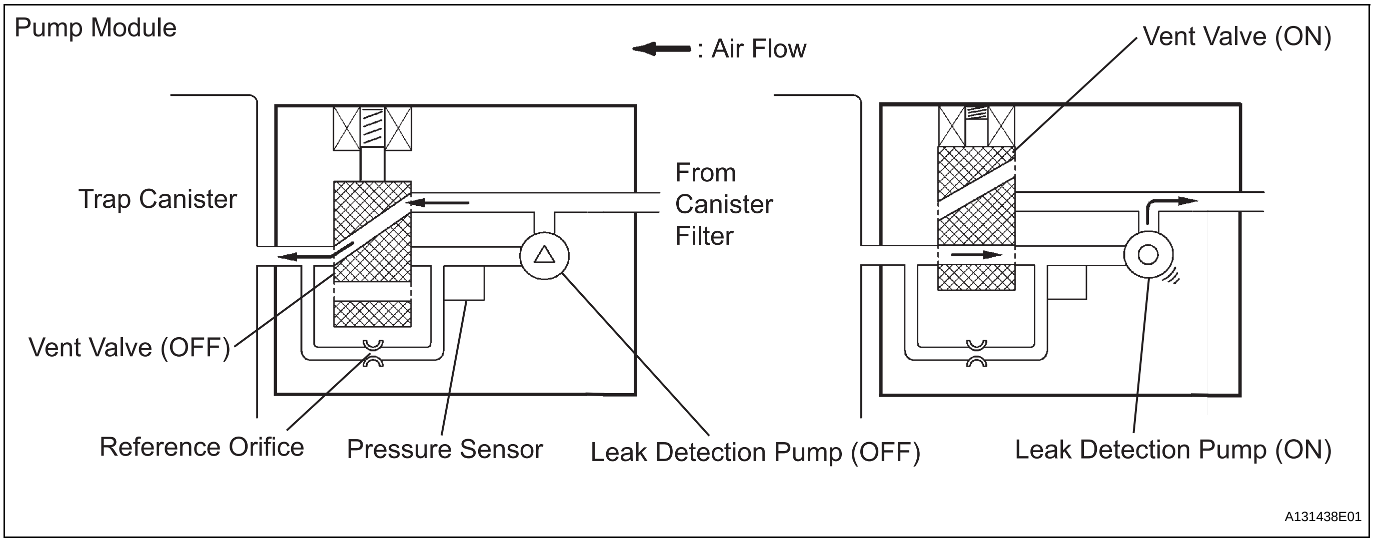
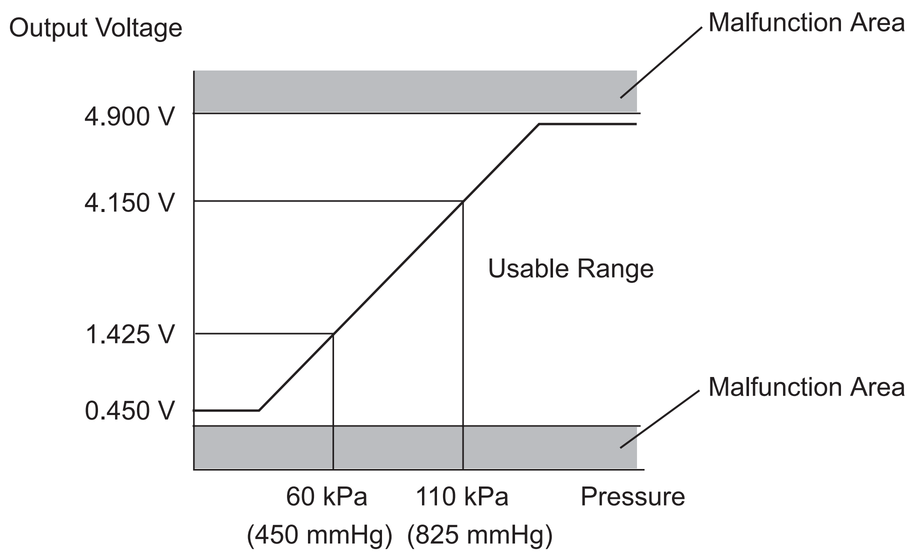


Diagram
Intake Manifold
Purge VSV
Fuel Tank Pressure Sensor
Pressure Switching Valve
Fuel Cap
Fresh Air Line
Canister
Fuel Pump Chamber
Canister Filter
Bladder Tank
Trap Canister with Pump Module
Outer Tank
Roll Over Valve
P
A130305E01


Pump Module
: Air Flow
Vent Valve (ON)
Trap Canister
From Canister Filter
Vent Valve (OFF)
Reference Orifice
Pressure Sensor
Leak Detection Pump (OFF)
Leak Detection Pump (ON)
A131438E01

ES

Canister Pressure Sensor Specification



HINT:

Standard atmospheric pressure is 101.3 kPa (760mmHg)

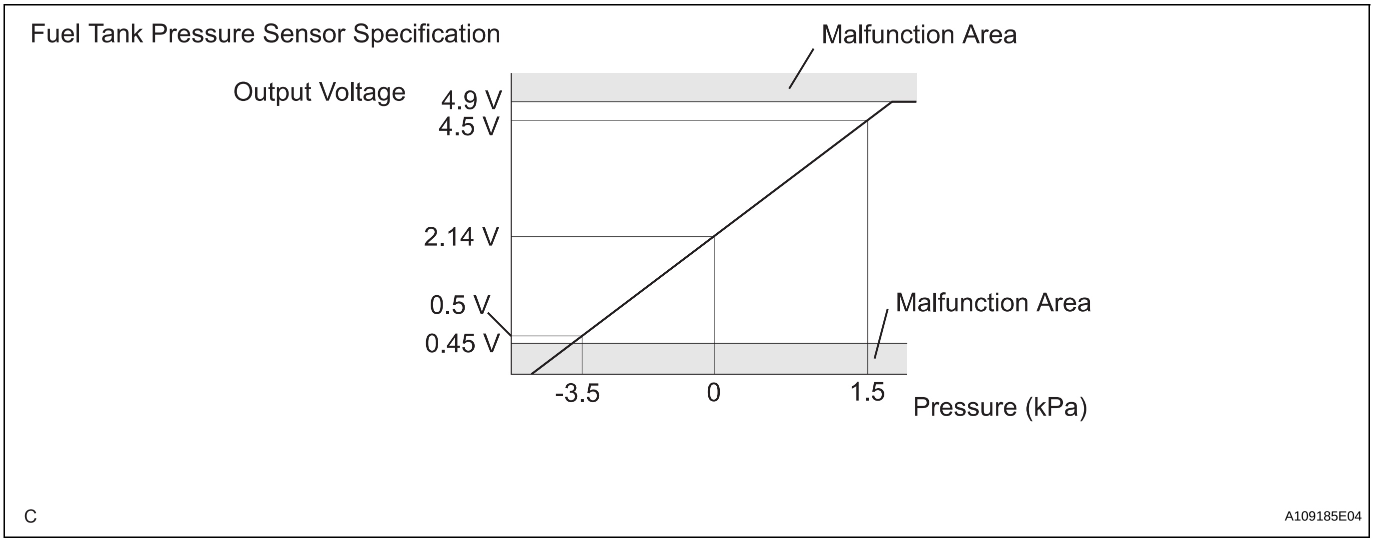
A115543E09

Components	Operations
Canister, Trap canister	Contains activated charcoal to absorb EVAP generated in fuel tank.
Cut-off valve	Located in fuel tank. Valve floats and closes when fuel tank 100% full.
Purge Vacuum Switching Valve (VSV)	Opens or closes line between canister and intake manifold. ECM uses purge VSV to control EVAP purge flow. In order to discharge EVAP absorbed by canister to intake manifold, ECM opens purge VSV. EVAP discharge volume to intake manifold controlled by purge VSV duty cycle ratio (current-carrying time) (open: ON; closed: OFF).
Roll-over valve	Located in fuel tank. Valve closes by its own weight when vehicle overturns to prevent fuel from spilling out.
Soak timer	Built into ECM. To ensure accurate EVAP monitor, measures 5 hours (+-15 min) after power switch OFF. This allows fuel to cool down, stabilizing Fuel Tank Pressure (FTP). When approximately 5 hours elapsed, ECM activates.
Pressure switching valve	The pressure switching valve located on the canister is used to detect leakage from the bladder tank into the fuel tank. The valve opens during the bladder tank leak check. Then, the fuel tank's fuel vapor flows to the intake manifold without passing the canister.
Pump module	Consists of (a) to (d) below. pump module cannot be disassembled.
(a) Vent valve	Vents and closes EVAP system. When ECM turns valve ON, EVAP system closed. When ECM turns valve OFF, EVAP system vented. Negative pressure (vacuum) created in EVAP system to check for EVAP leaks by closing purge VSV, turning vent valve ON (closed) and operating leak detection pump.
(b) Canister pressure sensor	Indicates pressure as voltage. ECM supplies regulated 5 V to canister pressure sensor, and uses feedback from sensor to monitor EVAP system pressure.
(c) Leak detection pump	Creates negative pressure (vacuum) in EVAP system for leak check.

Components	Operations
(d) Reference orifice	Has opening with 0.02 inch diameter. Vacuum produced through orifice by closing purge VSV, turning vent valve OFF and operating leak detection pump to monitor 0.02 inch leak criterion. 0.02 inch leak criterion indicates small leak of EVAP.

MONITOR DESCRIPTION

1. DTC P1451: Pressure sensor abnormal voltage fluctuation or being constant
   If the pressure sensor output voltage fluctuates rapidly for 10 seconds, the ECM stops the EVAP system monitor. The ECM interprets this as the pressure sensor voltage fluctuating, and stops the EVAP system monitor. The ECM then illuminates the MIL and sets the DTC.
   Alternatively, if the sensor output voltage does not change for 10 seconds, the ECM interprets this as the sensor voltage being constant, and stops the monitor. The ECM then illuminates the MIL and sets the DTC.
   (Both the malfunctions are detected by 2 trip detection logic).



2. DTC P1452: Pressure sensor voltage low
   If the pressure sensor output voltage is below 0.45 V, the ECM interprets this as an open or short circuit malfunction in the pressure sensor or its circuit, and stops the EVAP system monitor. The ECM then illuminates the MIL and sets the DTC (1 trip detection logic).
3. DTC P1453: Pressure sensor voltage high
   If the pressure sensor voltage output is 4.9 V or more, the ECM interprets this as an open or short circuit malfunction in the pressure sensor or its circuit, and stops the EVAP system monitor. The ECM then illuminates the MIL and sets the DTC (1 trip detection logic).

MONITOR STRATEGY

Required Sensors/Components	Pump module
Frequency of Operation	Once per driving cycle: P1451 sensor constant voltage Continuous: P1451 sensor abnormal voltage fluctuation, P1452 and P1453
Duration	Within 10 seconds
MIL Operation	2 driving cycles
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

P1450, P1452, P1453:

Engine	Running
Time after engine start	Less than 10 seconds

ECT at engine start	10 to 35°C (50 to 95°F)
IAT at engine start	10 to 35°C (50 to 95°F)
ECT at engine start - IAT at engine start	Less than 12°C (53.6°F)

P1451:

Altitude	Less than 2,400 m (8,000 ft.)
Battery voltage	11 V or higher
Conditions	Power switch ON (IG) and DLC3 connector OFF or OBD check mode ON and idle ON
Throttle position learning	Completed
Canister pressure sensor	No malfunction
IAT at engine start - ECT at engine start	-7 to 11.1°C (19.4 to 52°F)
Purge VSV and pressure switching valve	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)

TYPICAL MALFUNCTION THRESHOLDS

P1450:

Fuel tank pressure	Less than -3,999 Pa (-30 mmHg) or 1,999 Pa (15 mmHg) or more

P1451 (Noise Monitor):

Sensor output change 0.667 kPa or more during 5 to 15 seconds after idling and vehicle stop	7 times or more

P1451 (Stuck Monitor):

Not to make pass determination	20 minutes or more

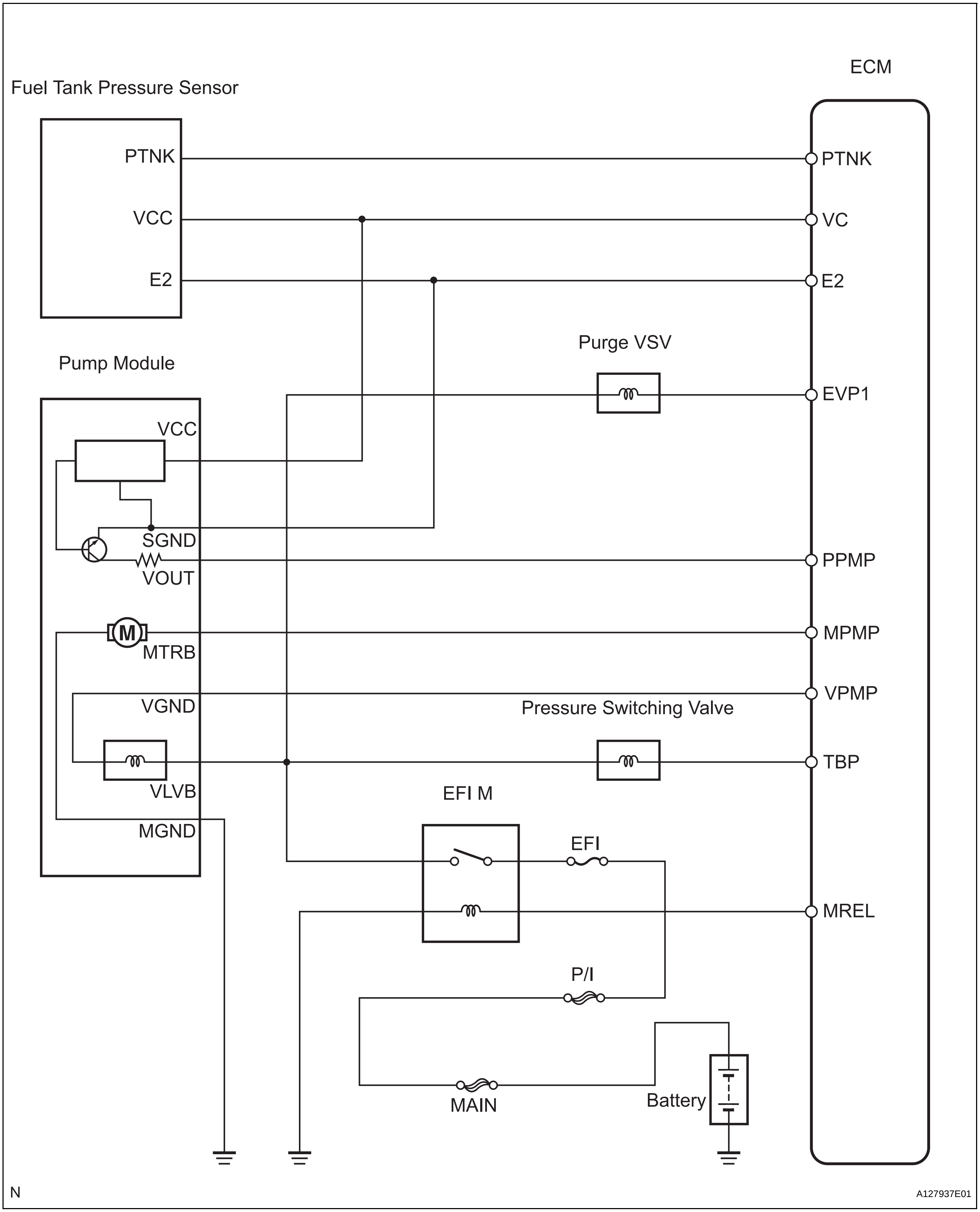
P1452:

Fuel tank pressure	Less than -3,999 Pa (-30 mmHg)

P1453:

Fuel tank pressure	1,999 Pa (15 mmHg) or more

WIRING DIAGRAM



INSPECTION PROCEDURE

NOTICE:

- **When a vehicle is brought into the workshop, leave it as it is. Do not change the vehicle condition. For example, do not tighten the fuel tank cap.**
- **Do not disassemble the pump module.**
- **The intelligent tester is required to conduct the following diagnostic troubleshooting procedure.**

1 CONFIRM DTC AND FUEL TANK PRESSURE

(a) Connect the intelligent tester to the DLC3.
(b) Turn the power switch ON (IG).
(c) Turn the tester on.
(d) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DTC INFO / CURRENT CODES.
(e) Read DTCs.
(f) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DATA LIST / EVAP / VAPOR PRESS TANK.
(g) Read the EVAP (Evaporative Emission) pressure displayed on the tester.

Result

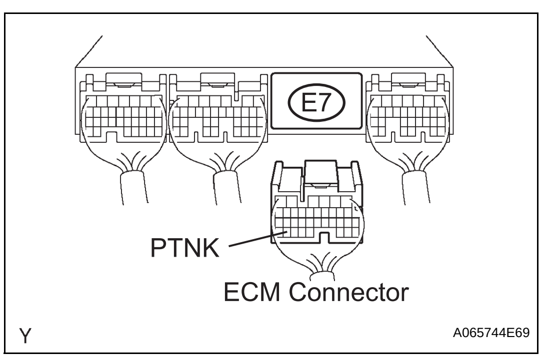
Display (DTC Output)	Test Result	Suspected Trouble Area	Proceed to
P1451	-	• Pressure sensor	C
P1450 and/or P1452	Less than -17.187 kPa (-128.93 mmHg)	• Wire harness/connector (ECM - pressure sensor) • Pressure sensor • Short in ECM circuit	A
P1450 and/or P1453	More than 23.5 kPa (176.69 mmHg)	• Wire harness/connector (ECM - pressure sensor) • Pressure sensor • Open in ECM circuit	B

B → **Go to step 4**

C → **GO TO EVAP INSPECTION PROCEDURE**

A ↓

2 CHECK HARNESS AND CONNECTOR (FUEL TANK PRESSURE SENSOR - ECM)



(a) Turn the power switch OFF.
(b) Disconnect the E7 ECM connector.
(c) Measure the resistance between the PTNK terminal of the ECM connector and the body ground.

Result

Test Result	Suspected Trouble Area	Proceed to
10 Ω or less	• Wire harness/connector (ECM - pressure sensor) • Short in pressure sensor circuit	A
10 kΩ or more	• Wire harness/connector (ECM - pressure sensor) • Short in ECM (included in HV Control ECU) circuit	B

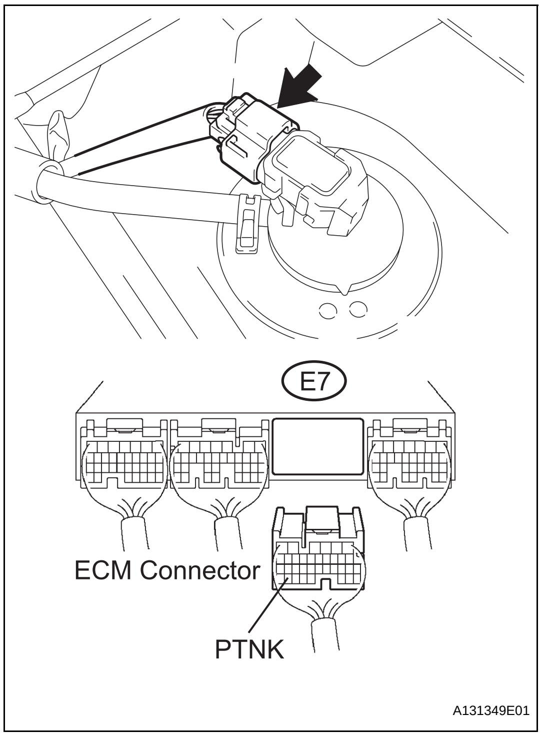
(d) Reconnect the ECM connector.

B → **Go to step 7**

A

ES

3 CHECK HARNESS AND CONNECTOR (FUEL TANK PRESSURE SENSOR - ECM)



(a) Remove the fuel tank assembly.
(b) Disconnect the V6 fuel tank pressure sensor connector.
(c) Disconnect the E7 ECM connector.
(d) Measure the resistance between the PTNK terminal of the ECM connector and the body ground.

Result

Test Result	Suspected Trouble Area	Proceed to
10 kΩ or more	• Short in pressure sensor circuit	A
10 Ω or less	• Short in wire harness/connector (ECM - pressure sensor)	B

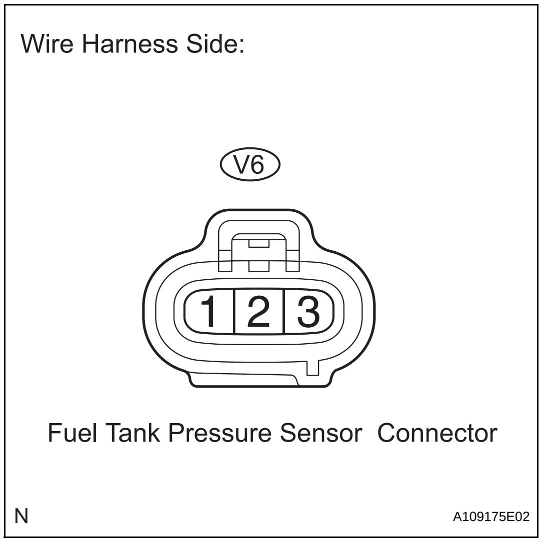
(e) Reconnect the pressure sensor connector.
(f) Reconnect the ECM connector.

A → **Go to step 5**

B → **Go to step 6**

ES

4	CHECK HARNESS AND CONNECTOR (FUEL TANK PRESSURE SENSOR - ECM)



(a) Remove the fuel tank assembly.
(b) Disconnect the V6 fuel tank pressure sensor connector.
(c) Turn the power switch ON (IG).
(d) Measure the voltage and resistance according to the value(s) in the table below.

Standard voltage

Tester Connection	Specified Condition
V6-3 - Body ground	4.5 to 5.0 V

Standard resistance

Tester Connection	Specified Condition
V6-2 - Body ground	100 Ω or less

Result

Test Result	Suspected Trouble Area	Proceed to
Voltage and resistance within standard ranges	• Open in pressure sensor circuit	A
Voltage and resistance outside standard ranges	• Open in wire harness/connector (ECM - pressure sensor)	B

(e) Reconnect the canister connector.

B → Go to step 6

A

5	REPLACE FUEL TANK PRESSURE SENSOR

NEXT → Go to step 8

6	REPAIR OR REPLACE HARNESS AND CONNECTOR

HINT:
If the exhaust tail pipe has been removed, go to the next step before reinstalling it.

NEXT → Go to step 8

7	REPLACE ECM

NEXT → Go to step 8

8	CHECK WHETHER DTC OUTPUT RECURS (AFTER REPAIR)

(a) Connect the intelligent tester to the DLC3.
(b) Turn the power switch ON (IG) and turn the tester on.
(c) Wait for at least 60 seconds.
(d) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DTC INFO / PENDING CODES.
HINT:
If no pending DTC is displayed on the tester, the repair has been successfully completed.

NEXT

COMPLETED

DTC	P1455	Vapor Reducing Fuel Tank System Malfunction

DESCRIPTION

Using the heated oxygen sensor and pressure switching VSV, the ECM detects fuel leaks from inside a bladder tank the fuel tank.
Based on signals from the heated oxygen sensor while the VSV for purge flow switching valve is ON, the ECM judges if fuel is leaked from the bladder tank or not.

DTC No.	DTC Detection Condition	Trouble Area
P1455	When VSV for purge flow switching valve is ON, vapor density of air which flows from purge VSV into intake manifold is high	• Hose and pipe for EVAP system • Fuel system • ECM

MONITOR DESCRIPTION

The ECM detects leakage of evaporative emissions from the bladder membrane by using the heated oxygen sensor and pressure switching valve. By opening the purge VSV and then closing the pressure switching valve, air in the outer tank is drawn into the intake manifold.
The ECM checks concentration of hydrocarbon (HC) molecules in the air drawn from the bladder membrane area. Also, the ECM checks the sensor output before and after closing the pressure switching valve. If there is change in the HC concentration when the pressure switching valve is opened or closed, the ECM will conclude that the bladder membrane is leaking. The ECM will illuminates the MIL and a DTC is set.

MONITOR STRATEGY

Related DTCs	P1455: Vapor reducing fuel tank system leak detected (small leak) monitor
Required sensors/components (main)	Fuel tank
Frequency of operation	Once per driving cycle
Duration	None
MIL operation	2 driving cycles
Sequence of operation	None

TYPICAL ENABLING CONDITIONS

Monitor runs whenever following DTC not present	None
Engine	Running
ECT	4.4°C (40°F) or more
IAT	4.4°C (40°F) or more
EVAP control system pressure sensor malfunction	Not detected
Purge VSV	Not detected by scan tool
EVAP system check	Not detected by scan tool
Battery voltage	11 V or higher
Purge duty cycle	15% or more

TYPICAL MALFUNCTION THRESHOLDS

Vapor concentration in purge air	Less than -7 to -4% (depending on intake air temperature)
FAF smoothing value	Less than 5%
VSV for purge flow switching valve	No malfunction
Purge air volume after purge flow switching valve monitoring	2 g or more

MONITOR RESULT

Refer to detailed information (see page ES-15).

INSPECTION PROCEDURE

HINT:
Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunction is detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1	CHECK OTHER DTC OUTPUT (IN ADDITION TO DTC P1455)

ES

(a) Connect the intelligent tester to the DLC3.
(b) Turn the power switch ON (IG).
(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
P1455	A
P1455 and other DTCs	B

HINT:
If any other codes besides P1455 are output, perform troubleshooting for those DTCs first.

B → **GO TO RELEVANT DTC CHART**

A

2	INSPECT FUEL TANK ASSEMBLY

(a) Remove the fuel tank (see page FU-23).
(b) Drain fuel from the tank and turn it upside down.

OK:
Fuel does not come out from anywhere except the main fuel hose.

OK → **REPLACE ECM**

NG

REPLACE FUEL TANK ASSEMBLY

DTC	P2102	Throttle Actuator Control Motor Circuit Low

DTC	P2103	Throttle Actuator Control Motor Circuit High

DESCRIPTION

The throttle motor is operated by the ECM and it opens and closes the throttle valve.
The opening angle of the throttle valve is detected by the throttle position sensor which is mounted on the throttle body. The throttle position sensor provides feedback to the ECM. This feedback allows the ECM to control the throttle motor and monitor the throttle opening angle as the ECM responds to driver inputs.
HINT:
This Electrical Throttle Control System (ETCS) does not use a throttle cable.

DTC No.	DTC Detection Condition	Trouble Area
P2102	Conditions (a) and (b) continue for 2.0 seconds: (a) Throttle control motor output duty is 80% or more (b) Throttle control motor current is less than 0.5 A	• Open in throttle control motor circuit • Throttle control motor • ECM
P2103	Following conditions are met. • Hybrid IC diagnosis signal: Fail • Hybrid IC current limiter port: Fail When electric throttle actuator is ON (i.e. actuator power ON or actuator power supply voltage is 8 V or more)	• Short in throttle control motor circuit • Throttle control motor • Throttle valve • Throttle body assembly • ECM

MONITOR DESCRIPTION

The ECM monitors the flow of electrical current through the electronic throttle motor, and detects malfunction or open circuits in the throttle motor based on the value of the electrical current. When the current deviates from the standard values, the ECM concludes that there is a fault in the throttle motor. Or, if the throttle valve is not functioning properly (for example, stuck ON), the ECM concludes that there is a fault in the throttle motor and turns on the MIL and a DTC is set.
Example:
When the current is more than 10 A. Or, the current is less than 0.5 A when the motor driving duty ratio is more than 80%. The ECM concludes that the current is deviated from the standard values, turns on the MIL and a DTC is set.

FAIL-SAFE

If the Electronic Throttle Control System (ETCS) has a malfunction, the ECM cuts off current to the throttle control motor. 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 to drive.
If the accelerator pedal is depressed firmly and slowly, the vehicle can be driven slowly.
If a "pass" condition is detected and then the power switch is turned OFF, the fail-safe operation will stop and the system will return to normal condition.

MONITOR STRATEGY

P2102: Throttle actuator control motor current (low current)

Related DTCs	P2102: Throttle actuator control motor current (low current)
Required sensors/components	Throttle actuator motor
Frequency of operation	Continuous
Duration	2 seconds
MIL operation	Immediately

Sequence of operation	None

P2103: Throttle actuator control motor current (high current)

Related DTCs	P2103: Throttle actuator control motor current (high current)
Required sensors/components	Throttle actuator motor
Frequency of operation	Continuous
Duration	0.6 seconds
MIL operation	Immediately
Sequence of operation	None

TYPICAL ENABLING CONDITIONS

P2102: Throttle actuator control motor current (low current)

The monitor will run whenever the following DTCs are not present	None
Throttle motor	ON
Difference between motor current of present and 0.016 second ago	Less than 0.2 A

P2103: Throttle actuator control motor current (high current)

The monitor will run whenever the following DTCs are not present	None
Throttle motor	ON

TYPICAL MALFUNCTION THRESHOLDS

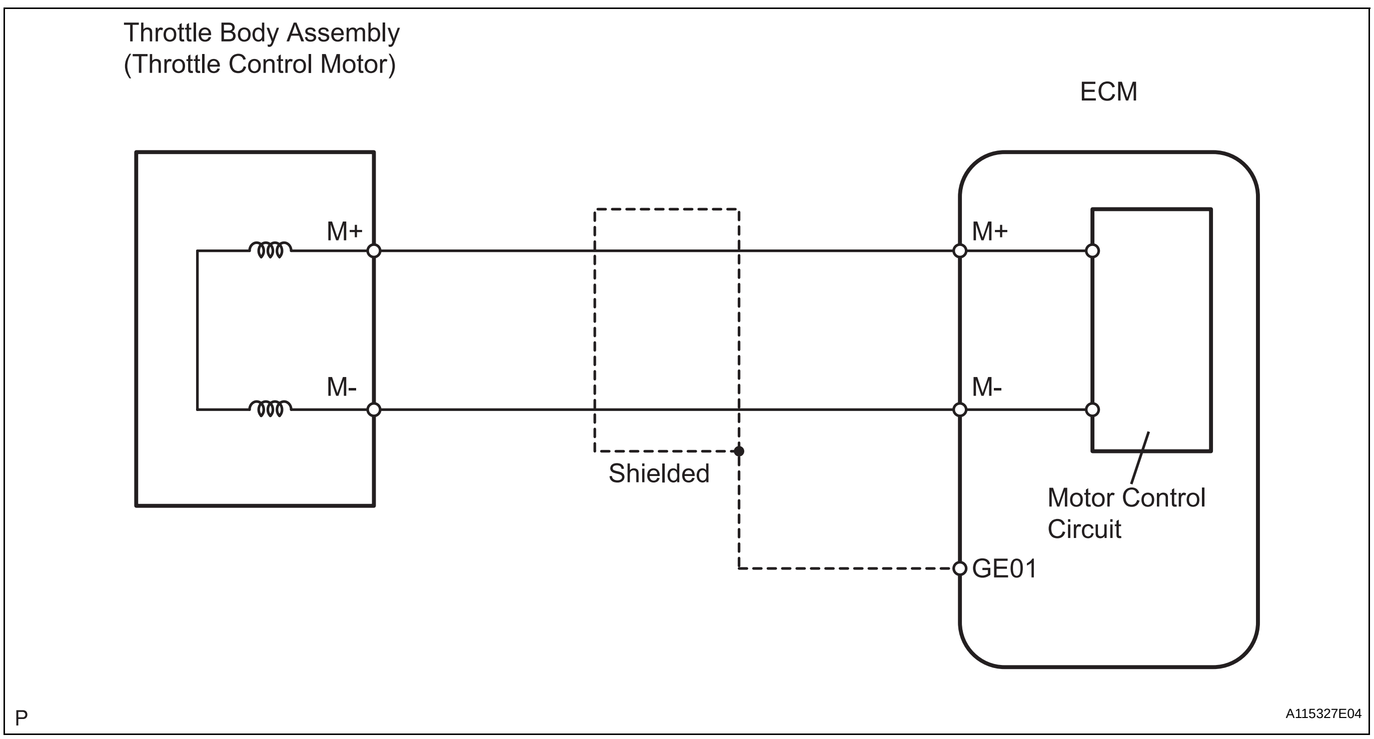
P2102: Throttle actuator control motor current (low current)

Throttle motor current	Less than 0.5 A (when motor drive duty is 80% or more)

P2103: Throttle actuator control motor current (high current)

Hybrid IC	Fail

WIRING DIAGRAM



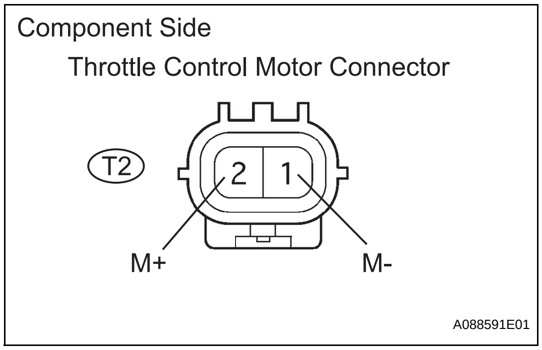
ES

INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunction is detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1 INSPECT THROTTLE W/MOTOR BODY ASSEMBLY (THROTTLE CONTROL MOTOR)



(a) Disconnect the throttle control motor connector.

(b) Measure the motor resistance between terminals 1 (M-) and 2 (M+).

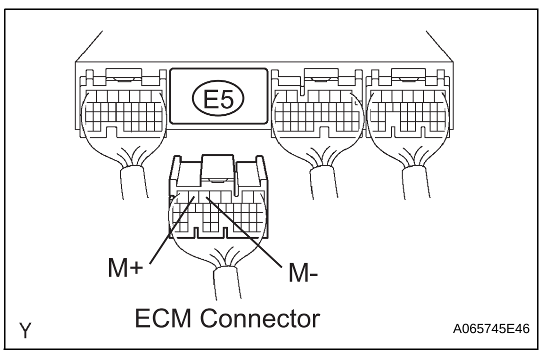
Standard resistance

Tester Connection	Specified Condition
1 (M-) - 2 (M+)	0.3 to 100 Ω at 20°C (68°F)

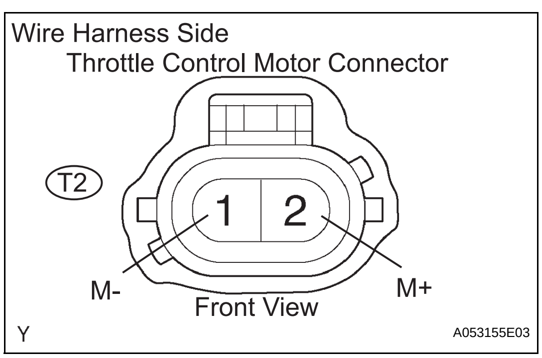
NG → **REPLACE THROTTLE W/MOTOR BODY ASSEMBLY**

OK

2 CHECK HARNESS AND CONNECTOR (ECM - THROTTLE CONTROL MOTOR)



(a) Disconnect the E5 ECM connector.



(b) Disconnect the T2 throttle control motor connector.

(c) Measure the resistance between the wire harness side connectors.

Standard resistance (Check for open)

Tester Connection	Specified Condition
2 (Throttle control motor) - E5-6 (M+)	Below 1 Ω
1 (Throttle control motor) - E5-5 (M-)	Below 1 Ω

Standard resistance (Check for short)

Tester Connection	Specified Condition
2 (Throttle control motor) or E5-6 (M+) - Body ground	10 kΩ or higher
1 (Throttle control motor) or E5-5 (M-) - Body ground	10 kΩ or higher

(d) Reconnect the ECM connector and the throttle control motor connector.

NG → **REPAIR OR REPLACE HARNESS AND CONNECTOR**

OK

3	INSPECT THROTTLE W/MOTOR BODY ASSEMBLY

(a) Visually check between the throttle valve and the housing for foreign objects.
Also, check if the valve can open and close smoothly.
OK:
The throttle valve is not contaminated by foreign objects and can move smoothly.

NG → **REMOVE FOREIGN OBJECT AND CLEAN THROTTLE BODY**

OK

REPLACE ECM

DTC	P2111	Throttle Actuator Control System - Stuck Open

DTC	P2112	Throttle Actuator Control System - Stuck Closed

DESCRIPTION

The throttle motor is operated by the ECM and it opens and closes the throttle valve using gears. The opening angle of the throttle valve is detected by the throttle position sensor, which is mounted on the throttle body. The throttle position sensor provides to ECM with feedback to control the throttle motor and set the throttle valve angle in response to driver input.

HINT:

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

DTC No.	DTC Detection Condition	Trouble Area
P2111	Throttle motor locked during ECM orders to open	• Throttle control motor circuit • Throttle control motor • Throttle body • Throttle valve
P2112	Throttle motor locked during ECM orders to close	• Throttle control motor circuit • Throttle control motor • Throttle body • Throttle valve

MONITOR DESCRIPTION

The ECM concludes that there is malfunction of the ETCS when the throttle valve remains at a fixed angle despite high drive current supplying from the ECM. The ECM will turn on the MIL and a DTC is set.

FAIL-SAFE

If the Electronic Throttle Control System (ETCS) has malfunction, the ECM cuts off current to the throttle control motor. 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 to drive.

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

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

MONITOR DESCRIPTION

Related DTCs	P2111: Throttle motor actuator lock (open) P2112: Throttle motor actuator lock (closed)
Main sensors/components	Throttle actuator motor
Frequency of operation	Continuous
Duration	0.5 seconds
MIL operation	Immediately
Sequence of operation	None

TYPICAL ENABLING CONDITIONS

P2111:

The monitor will run whenever the following DTCs are not present	None
Throttle motor current	2 A or more
Throttle motor duty to open	80% or more

P2112:

The monitor will run whenever the following DTCs are not present	None
Throttle motor current	2 A or more
Throttle motor duty to close	80% or more

TYPICAL MALFUNCTION THRESHOLDS

Difference between throttle position sensor output voltage of present and 16 milliseconds ago	Less than 0.1 V

WIRING DIAGRAM

Refer to DTC P2102 (see page ES-330).

INSPECTION PROCEDURE

Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunction is detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1	CHECK OTHER DTC OUTPUT (IN ADDITION TO DTC P2111 AND/OR P2112)

(a) Connect the intelligent tester to the DLC3.
(b) Turn the power switch ON (IG).
(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
P2111 or P2112	A
P2111 or P2112, and other DTCs	B

HINT:
If any other codes besides P2111 and/or P2112 are output, perform troubleshooting for those DTCs first.

B → **GO TO RELEVANT DTC CHART**

A

2	INSPECT THROTTLE W/MOTOR BODY ASSEMBLY (VISUALLY CHECK THROTTLE VALVE)

(a) Check for contamination between the throttle valve and the housing. If necessary, clean the throttle body. And check that the throttle valve moves smoothly.

B → **REPLACE THROTTLE W/MOTOR BODY ASSEMBLY**

OK

3	CHECK IF DTC OUTPUT RECURS (DTC P2111 AND/OR P2112)

(a) Connect the intelligent tester to the DLC3.
(b) Turn the power switch ON (IG).
(c) Turn the tester ON.
(d) Clear the DTC.
(e) Put the engine in inspection mode (see page ES-1).
(f) Start the engine, and depress and release the accelerator pedal quickly (fully open and fully close).
(g) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DTC INFO / CURRENT CODES.
(h) Start the engine, and depress and release the accelerator pedal quickly (fully open and fully close).
(i) Read DTCs.

Result

Display (DTC output)	Proceed to
No output	A
P2111 and/or P2112	B

B → **REPLACE ECM**

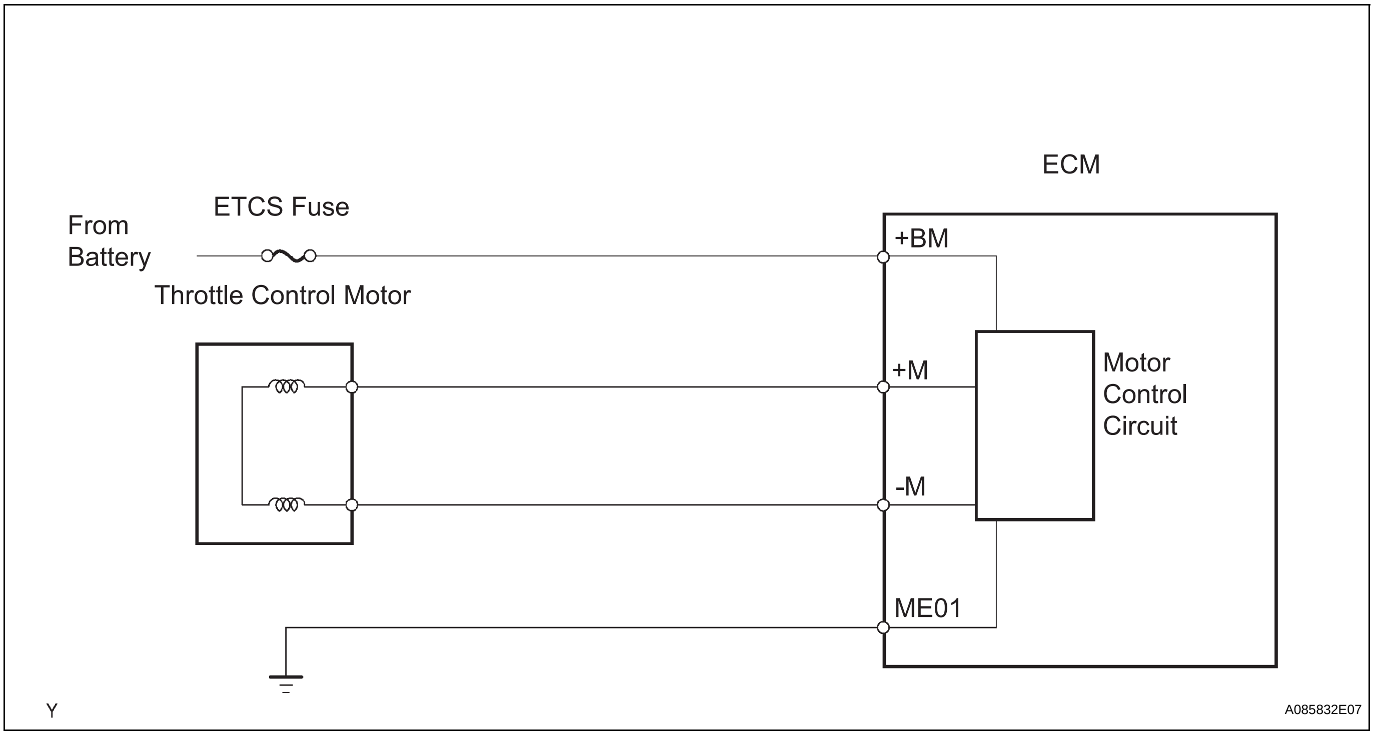
A ↓

CHECK FOR INTERMITTENT PROBLEMS

DTC	P2118	Throttle Actuator Control Motor Current Range / Performance

DESCRIPTION

The Electronic Throttle Control System (ETCS) has a dedicated power supply circuit. The voltage (+BM) is monitored and when the voltage is low (less than 4 V), the ECM concludes that the ETCS has a fault and current to the throttle control motor is cut.
When the voltage becomes unstable, the ETCS itself becomes unstable. For this reason, when the voltage is low, the current to the motor is cut. If repairs are made and the system has returned to normal, turn the power switch OFF. The ECM then allows current to flow to the motor and the motor can be restarted.
HINT:
This Electrical Throttle Control System (ETCS) does not use a throttle cable.



DTC No.	DTC Detection Condition	Trouble Area
P2118	Open in ETCS power source circuit	• Open in ETCS power source circuit • ETCS fuse • ECM

MONITOR DESCRIPTION

The ECM monitors the battery supply voltage applied to the electronic throttle motor. When the power supply voltage drops below the threshold, the ECM concludes that there is an open in the power supply circuit. A DTC is set and the MIL is turned on.

FAIL-SAFE

If the Electronic Throttle Control System (ETCS) has malfunction, the ECM cuts off current to the throttle control motor. 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 to drive.
If the accelerator pedal is depressed firmly and slowly, the vehicle can be driven slowly.

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

MONITOR STRATEGY

Related DTCs	P2118: Throttle actuator motor power supply line range check (low voltage)
Required sensors/components	Throttle actuator motor
Frequency of operation	Continuous
Duration	0.8 seconds
MIL operation	Immediately
Sequence of operation	None

TYPICAL ENABLING CONDITIONS

The monitor will run whenever the following DTCs are not present	None
Actuator power	ON
Battery voltage	8 V or more

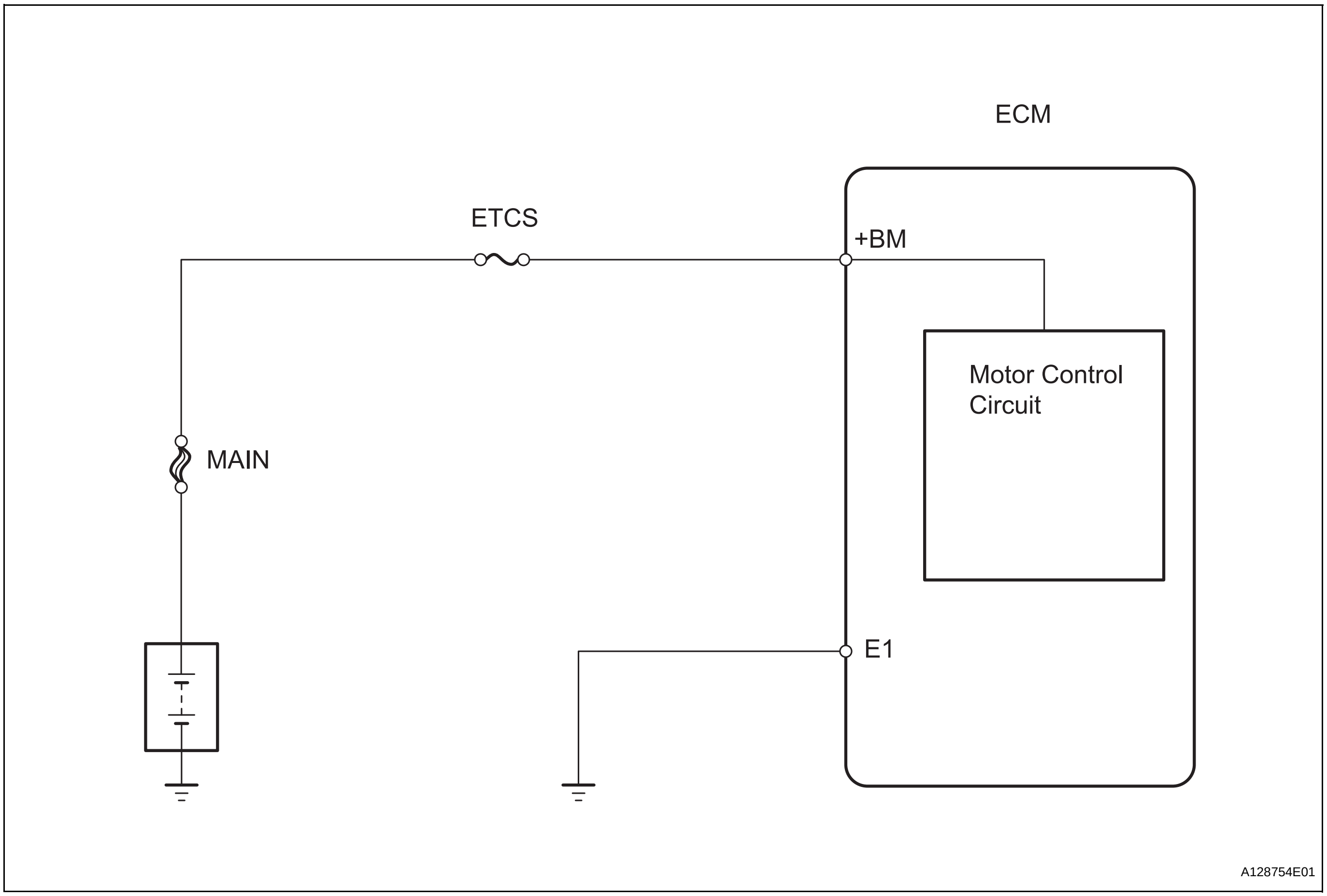
TYPICAL MALFUNCTION THRESHOLDS

Throttle actuator motor power supply voltage	Less than 4 V

COMPONENT OPERATING RANGE

Throttle actuator motor power supply voltage	9 to 14 V

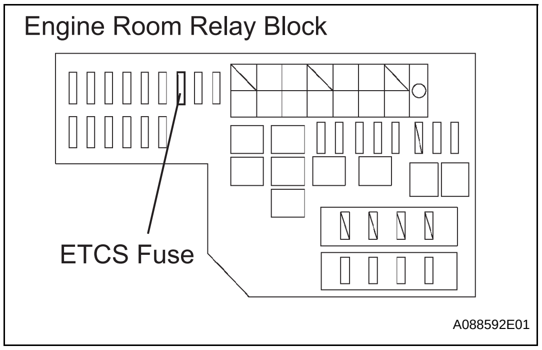
WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:
Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunction is detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1	INSPECT FUSE (ETCS FUSE)



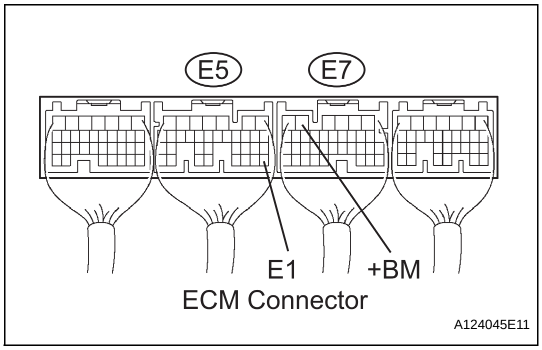
(a) Remove the ETCS fuse from the engine room relay block.
(b) Check the resistance of the ETCS fuse.
Standard resistance:
Below 1 Ω
(c) Reinstall the ETCS fuse.

NG → **CHECK FOR SHORT IN ALL HARNESS AND COMPONENTS CONNECTED FUSE**

OK

ES

2	CHECK ECM (+BM VOLTAGE)



(a) Measure the voltage between the specified terminals of the E5 and E7 ECM connectors.

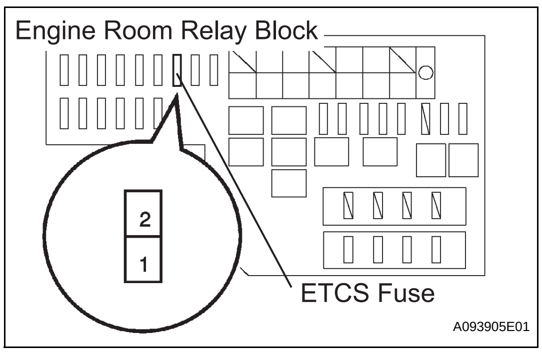
Standard voltage

Tester Connection	Specified Condition
E7-5 (+BM) - E5-28 (E1)	9 to 14 V

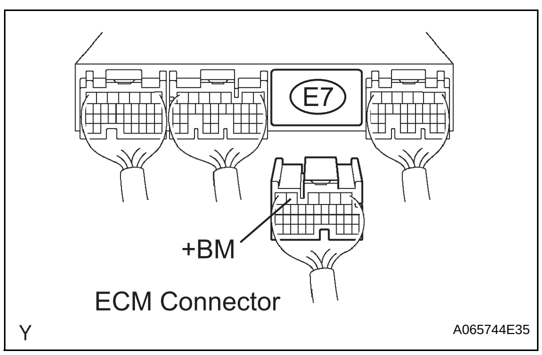
OK → **REPLACE ECM**

NG

3	CHECK HARNESS AND CONNECTOR (ECM - ETCS FUSE, ETCS FUSE - BATTERY)



(a) Check the harness and the connectors between the ETCS fuse and the ECM connector.
   (1) Remove the ETCS fuse from the engine room relay block.



   (2) Disconnect the E7 ECM connector.
   (3) Measure the resistance between the wire harness side connectors.

Standard resistance (Check for open)

Tester Connection	Specified Condition
2 (ETCS fuse) - E7-5 (+BM)	Below 1 Ω

Standard resistance (Check for short)

Tester Connection	Specified Condition
2 (ETCS fuse) or + E7-5 (BM) - Body ground	10 kΩ or higher

   (4) Reinstall the ETCS fuse.
   (5) Reconnect the ECM connector.

(b) Check the harness and the connectors between the ETCS fuse and the battery.
   (1) Remove the ETCS fuse from the engine room relay block.
   (2) Disconnect the positive battery terminal.
   (3) Measure the resistance between the wire harness side connectors.

Standard resistance (Check for open)

Tester Connection	Specified Condition
Battery positive terminal - 1 (ETCS fuse)	Below 1 Ω

Standard resistance (Check for short)

Tester Connection	Specified Condition
Battery positive terminal or 1 (ETCS fuse) - Body ground	10 kΩ or higher

(4) Reinstall the ETCS fuse.
(5) Reconnect the positive battery terminal.

NG → **REPAIR OR REPLACE HARNESS AND CONNECTOR**

OK

CHECK AND REPLACE FUSIBLE LINK BLOCK ASSEMBLY

DTC	P2119	Throttle Actuator Control Throttle Body Range / Performance

DESCRIPTION

The Electric Throttle Control System (ETCS) is composed of a throttle motor that operates the throttle valve, a throttle position sensor that detects the opening angle of the throttle valve, an accelerator pedal position sensor that detects the accelerator pedal position, and the ECM that controls the ETCS system. The ECM operates the throttle motor to position the throttle valve for proper response to driver inputs. The throttle position sensor, mounted on the throttle body, provides this signal to the ECM so that the ECM can regulate the throttle motor.

DTC No.	DTC Detection Condition	Trouble Area
P2119	Throttle opening angle continues to vary greatly from its target angle	• Electric throttle control system • ECM

MONITOR DESCRIPTION

The ECM determines the "actual" throttle valve angle based on the throttle position sensor signal. The "actual" throttle valve position is compared to the "target" throttle valve position commanded by the ECM. If the difference of these two values exceeds a specified limit, the ECM interprets this as a fault in the ETCS system. The ECM turns on the MIL and a DTC is set.

FAIL-SAFE

If the Electronic Throttle Control System (ETCS) has malfunction, the ECM cuts off current to the throttle control motor. 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 to drive.
If the accelerator pedal is depressed firmly and slowly, the vehicle can be driven slowly.
If a "pass" condition is detected and then the power switch is turned OFF, the fail-safe operation will stop and the system will return to normal condition.

MONITOR STRATEGY

Related DTCs	P2119: Electronic throttle control system failure
Required sensors/components	Main: Throttle actuator motor Related: Throttle position sensor
Frequency of operation	Continuous
Duration	Within 1 second
MIL operation	Immediately
Sequence of operation	None

TYPICAL ENABLING CONDITIONS

The monitor will run whenever the following DTCs are not present	None

TYPICAL MALFUNCTION THRESHOLDS

Difference between commanded throttle valve position and current throttle valve position	0.3 V or more

COMPONENT OPERATING RANGE

Commanded throttle valve position	Same as current throttle valve position

WIRING DIAGRAM

Refer to DTC P2102 (see page ES-330).

INSPECTION PROCEDURE

HINT:

Read freeze frame data using intelligent tester. Freeze frame data records the engine condition when malfunction is detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1 CHECK OTHER DTC OUTPUT (IN ADDITION TO DTC P2119)

(a) Connect the intelligent tester to the DLC3.
(b) Turn the power switch ON (IG).
(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
P2119	A
P2119 and other DTCs	B

HINT:

If any other codes besides P2119 are output, perform troubleshooting for those DTCs first.

B → **GO TO RELEVANT DTC CHART**

A

2 CHECK IF DTC OUTPUT RECURS

(a) Clear the DTCs (see page ES-29).
(b) Allow the engine to idle for 15 seconds.
(c) Securely apply the parking brake, and place the shift position in D.
(d) Depress the brake pedal securely and the accelerator pedal fully for 5 seconds.
(e) Read DTCs.

HINT:

Actual throttle position (TP) sensor voltage can be confirmed using the intelligent tester [DATA LIST / USER DATA /THROTTLE POS #1].

OK:

No DTC output.

OK → **SYSTEM OK**

NG

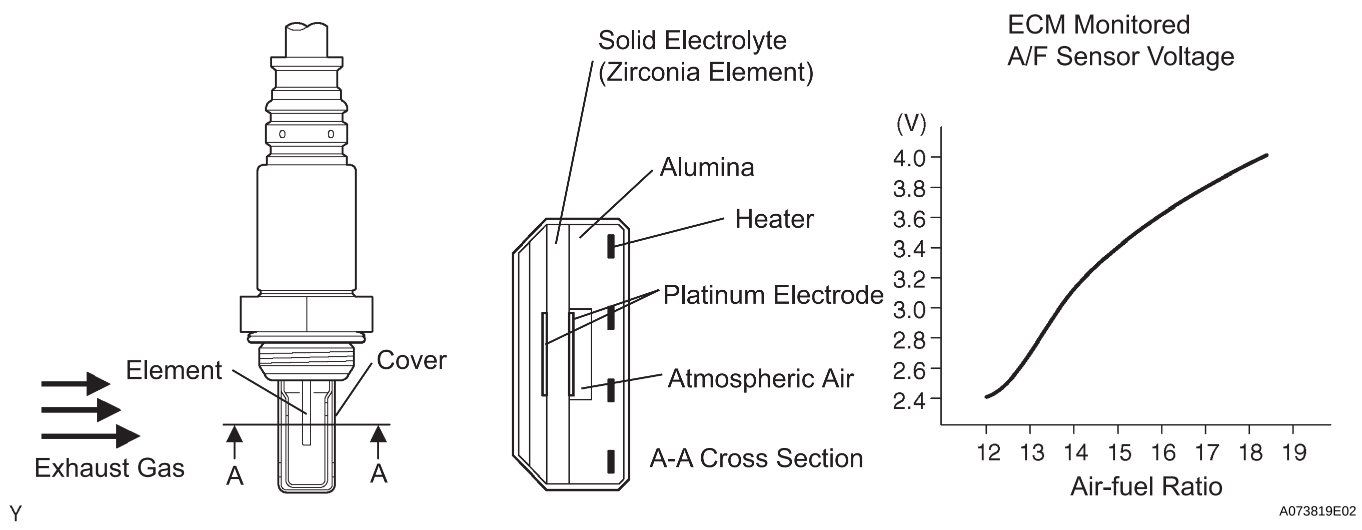
REPLACE THROTTLE W/MOTOR BODY ASSEMBLY

DTC	P2195	Oxygen (A/F) Sensor Signal Stuck Lean (Bank 1 Sensor 1)

DTC	P2196	Oxygen (A/F) Sensor Signal Stuck Rich (Bank 1 Sensor 1)

DESCRIPTION

The air-fuel ratio (A/F) sensor provides output voltage* which is almost equal to the existing air-fuel ratio. The A/F sensor output voltage is used to provide feedback for the ECM to control the air-fuel ratio.
With the A/F sensor output, the ECM can determine deviation from the stoichiometric air-fuel ratio and control proper injection time. If the A/F sensor is malfunctioning, the ECM is unable to accurately control the air-fuel ratio.
The A/F sensor is equipped with a heater which heats the zirconia element. The heater is also controlled by the ECM. When the intake air volume is low (the temperature of the exhaust gas is low), current flows to the heater to heat the sensor to facilitate detection of accurate oxygen concentration.
The A/F sensor is a planar type. Compared to a conventional type, the sensor and heater portions are narrower. Because the heat of the heater is conducted through the alumina to zirconia (of the sensor portion), sensor activation is accelerated.
To obtain a high purification rate of carbon monoxides (CO), hydrocarbons (HC) and nitrogen oxides (NOx) components of the exhaust gas, a three-way catalytic converter is used. The converter is most efficient when the air-fuel ratio is maintained near the stoichiometric air-fuel ratio.
*: The voltage value changes inside the ECM only.



DTC No.	DTC Detection Condition	Trouble Area
P2195	Conditions (a) and (b) continue for 2 seconds or more : (a) A/F sensor voltage is more than 3.8 V. (b) Rear oxygen sensor voltage is 0.15 V or more.	• Open or short in A/F sensor (bank 1 sensor 1) circuit • A/F sensor (bank 1 sensor 1) • A/F sensor heater • Integration relay • A/F sensor heater and relay circuit • Air induction system • Fuel pressure • Injector • PCV hose connection • ECM
	A/F sensor current is 3.6 mA or more.	

DTC No.	DTC Detection Condition	Trouble Area
P2196	Conditions (a) and (b) continue for 2 seconds or more : (a) A/F sensor voltage is less than 2.8 V. (b) Rear oxygen sensor voltage is less than 0.6 V.	• Open or short in A/F sensor (bank 1 sensor 1) circuit • A/F sensor (bank 1 sensor 1) • A/F sensor heater • Integration relay • A/F sensor heater and relay circuit • Air induction system • Fuel pressure • Injector • PCV hose connection • ECM
	A/F sensor current is less than 1.4 mA.	

HINT:
- Sensor 1 refers to the sensor closest to the engine assembly.
- After confirming DTC P2195 and P2196, use the intelligent tester to confirm voltage output of A/F sensor (AFS B1 S1) from the "DIAGNOSIS / ENHANCED OBD II / DATA LIST / PRIMARY."
- The A/F sensor's output voltage and the short-term fuel trim value can be read using the intelligent tester.
- The ECM controls the voltage of the A1A+, and A1A- terminals of the ECM to a fixed voltage. Therefore, it is impossible to confirm the A/F sensor output voltage without the intelligent tester.
- The OBD II scan tool (excluding the intelligent tester) displays the one fifth of the A/F sensor output voltage which is displayed on the intelligent tester.

MONITOR DESCRIPTION

Under the air-fuel ratio feedback control, if the voltage output of the A/F sensor indicates RICH or LEAN for a certain period of time or more, the ECM concludes that there is a fault in the A/F sensor system. The ECM will turn on the MIL and a DTC is set.
If the A/F sensor voltage output is less than 2.8 V (indicates very RICH) 10 seconds even though voltage output of the heated oxygen sensor output voltage is less than 0.6 V, the ECM sets DTC P2196 Also, if the heated oxygen sensor output voltage is 0.15 V or more, but the A/F sensor voltage output is more than 3.8 V (indicates very LEAN) for 10 seconds, DTC P2195 or is set.

MONITOR STRATEGY

Related DTCs	P2195: A/F sensor signal stuck lean P2196: A/F sensor signal stuck rich
Required sensors/components	Main: A/F sensor Related: Heated oxygen 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	P0031, P0032 (A/F sensor heater - Sensor 1) P0037, P0038 (O2 sensor heater - Sensor 2) P0100 - P0103 (MAF meter) P0110 - P0113 (IAT sensor) P0115 - P0118 (ECT sensor) P0120 - P0223, P2135 (TP sensor) P0125 (Insufficient ECT for Closed Loop) P0136 (O2 sensor - sensor 2) P0171, P0172 (Fuel system) P0300 - P0304 (Misfire) P0335 (CKP sensor) P0340 (CMP sensor) P0455, P0456 (EVAP system) P0500 (VSS)

Sensor voltage detection monitor (Lean side malfunction P2195):

Duration while all of following conditions met	2 seconds or more
Rear HO2 sensor voltage	0.15 V or more
Time after engine start	30 seconds or more
A/F sensor status	Activated
Fuel system status	Closed-loop
Engine	Running

Sensor voltage detection monitor (Rich side malfunction P2196):

Duration while all of following conditions met	2 seconds or more
Rear HO2 sensor voltage	Below 0.6 V
Time after engine start	30 seconds or more
A/F sensor status	Activated
Fuel system status	Closed-loop
Engine	Running

Sensor current detection monitor P2195 and P2196:

Battery voltage	11 V or more
Atmospheric pressure	76 kPa (570 mmHg) or more
A/F sensor status	Activated
Continuous time of fuel cut	3 to 10 seconds
ECT	75°C (167°F) or more

TYPICAL MALFUNCTION THRESHOLDS

Sensor voltage detection monitor (Lean side malfunction P2195)

A/F sensor output voltage	More than 3.8 V

Sensor voltage detection monitor (Rich side malfunction P2196)

A/F sensor output voltage	Less than 2.8 V

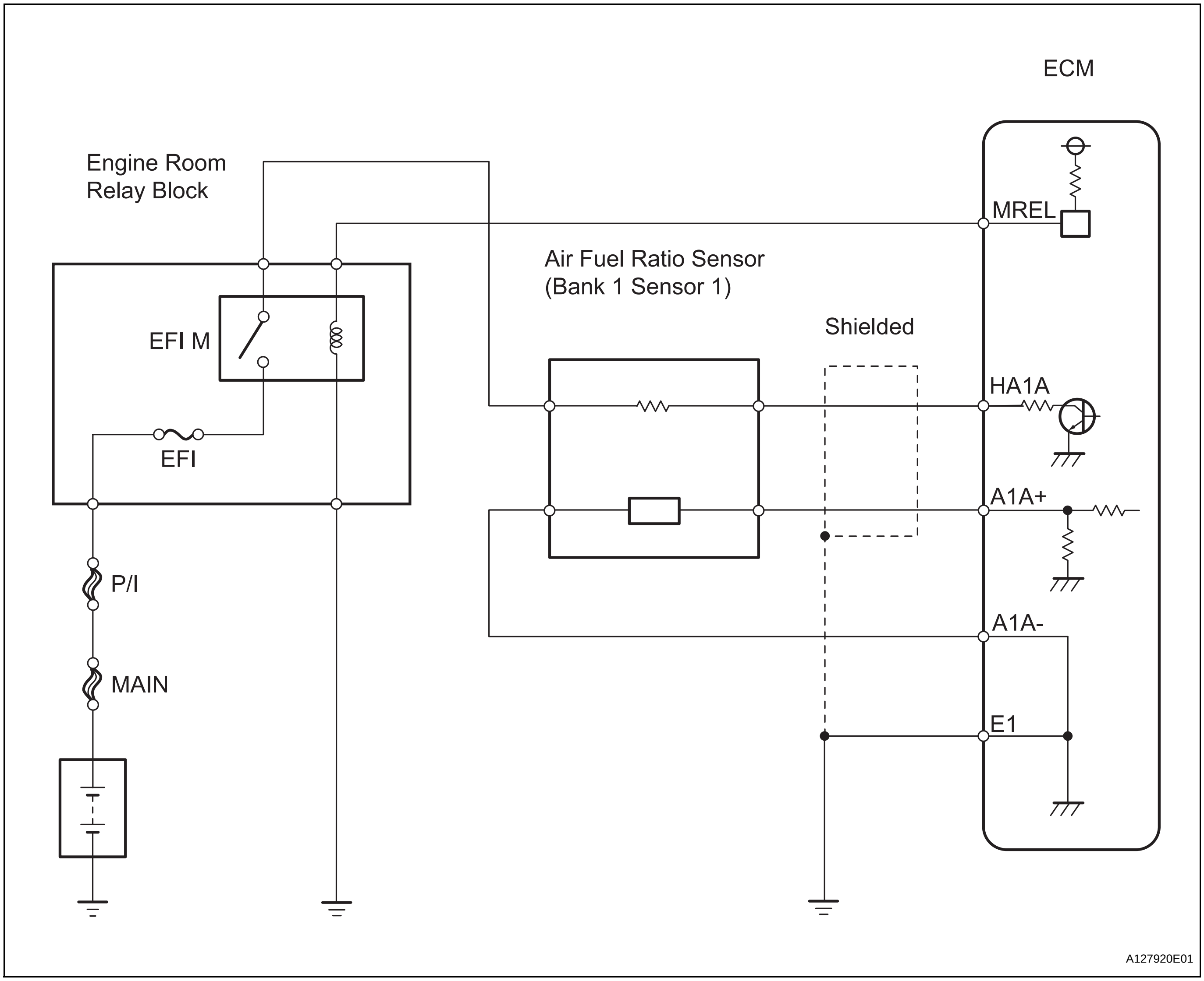
Sensor current detection monitor P2195

A/F sensor current	3.6 mA or more

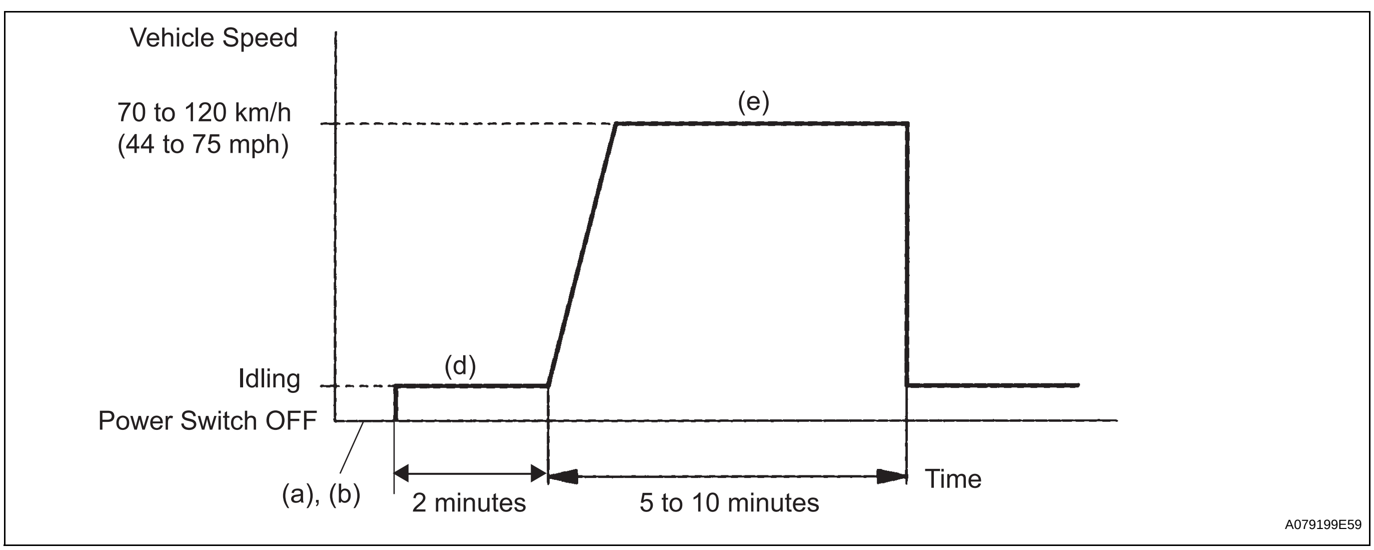
Sensor current detection monitor P2196

A/F sensor current	Less than 1.4 mA

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 intelligent tester (see page ES-29).

(c) Put the engine in inspection mode (see page ES-1).
(d) Start the engine and warm it up with all the accessory switches OFF.
(e) Deactivate the inspection mode and drive the vehicle at 70 to 120 km/h (44 to 75 mph) for 5 to 10 minutes (the engine must be run during monitoring).
HINT:
If malfunction exists, the MIL will be illuminated during step (d).
NOTICE:
- **If the conditions in this test are not strictly followed, no malfunction will be detected. If you do not have the intelligent tester, turn the power switch OFF after performing steps (d) and (e), then perform steps (d) and (e) again.**
- **Do not drive the vehicle without deactivating inspection mode, otherwise damaging the transaxle may result.**

INSPECTION PROCEDURE

HINT:
- Although each DTC title says "oxygen sensor", these DTCs are related to the A/F sensor.
- Malfunctioning areas can be found by performing the ACTIVE TEST / A/F CONTROL operation. The A/F CONTROL operation can determine if the A/F sensor, heated oxygen sensor or other potential trouble area are malfunctioning or not.

(a) Perform the ACTIVE TEST A/F CONTROL operation.
HINT:
The A/F CONTROL operation lowers the injection volume 12.5% or increases the injection volume 25%.
(1) Connect the intelligent tester to the DLC3.
(2) Turn the power switch ON (IG).
(3) Put the engine in inspection mode (see page ES-1).
(4) Warm up the engine by running the engine at 2,500 rpm, depressing the accelerator pedal more than 60% for approximately 90 seconds.
(5) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / A/F CONTROL.
(6) Perform the A/F CONTROL operation with the engine in an idle condition (press the right or left button).
Result:
A/F sensor reacts in accordance with increase and decrease of injection volume:
+25% → rich output: Less than 3.0 V
-12.5% → lean output: More than 3.35 V
Heated oxygen sensor reacts in accordance with increase and decrease of injection volume:
+25% → rich output: More than 0.55 V
-12.5% → lean output: Less than 0.4 V
NOTICE:
The A/F sensor output has a few seconds of delay and the heated oxygen sensor output has about 20 seconds of delay at maximum.

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		

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

The following A/F CONTROL procedure enables the technician to check and graph the voltage output of both A/F sensor and heated oxygen sensor.
To display the graph, enter ACTIVE TEST/ A/F CONTROL/USER DATA, select "AFS B1S1 and O2S B1S2" by pressing the "YES" button followed by the "ENTER" button and then the "F4" button.
HINT:
- Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunction is detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.
- A high A/F sensor voltage could be caused by a RICH air-fuel mixture. Check the conditions that would cause the engine to run with the RICH air-fuel mixture.
- A low A/F sensor voltage could be caused by a LEAN air-fuel mixture. Check the conditions that would cause the engine to run with the LEAN air-fuel mixture.

1 CHECK OTHER DTC OUTPUT (IN ADDITION TO DTC A/F SENSOR DTCS)

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

Result

Display (DTC output)	Proceed to
A/F sensor circuit DTC	A
A/F sensor circuit DTCs and other DTCs	B

HINT:
If any other codes besides A/F sensor DTCs are output, perform troubleshooting for those DTCs first.

B → GO TO RELEVANT DTC CHART

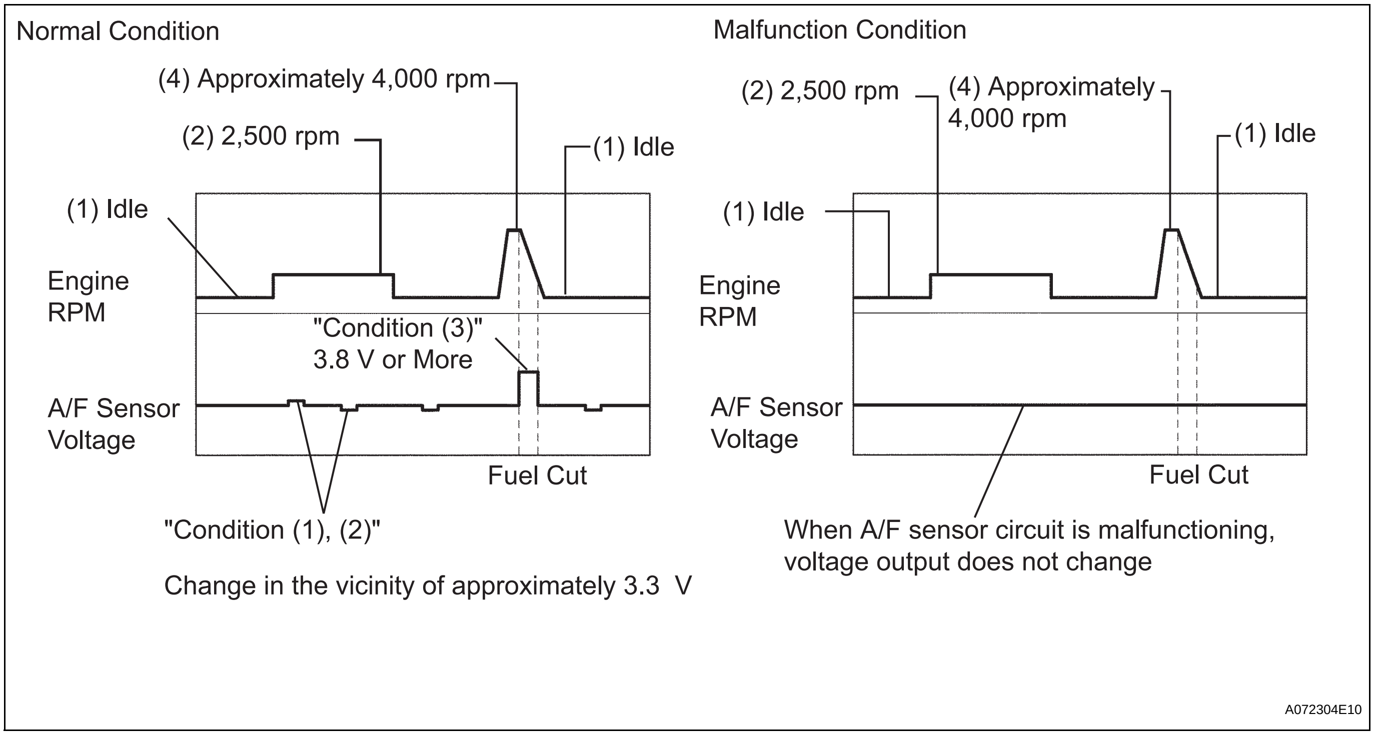
A

2	READ VALUE OF INTELLIGENT TESTER (OUTPUT VOLTAGE OF A/F SENSOR)

(a) Connect the intelligent tester to the DLC 3.
(b) Put the engine in inspection mode (see page ES-1).
(c) Warm up the A/F sensors (bank 1 sensor 1) by running the engine at 2,500 rpm with the accelerator pedal depressed more than 60 % for approximately 90 seconds.
(d) Read A/F sensor voltage output on the intelligent tester.
(e) Enter the following menus: ENHANCED OBD II / SNAPSHOT / MANUAL SNAPSHOT / USER DATA.
(f) Select "AFS B1 S1/ENGINE SPD" and press button "YES".
(g) Monitor the A/F sensor voltage carefully.
(h) Check the A/F sensor voltage output under the following conditions:
  (1) Put the engine in inspection mode and allow the engine to idle for 30 seconds.
  (2) Put the engine in inspection mode and running the engine at 2,500 rpm with the accelerator pedal depressed more than 60% (where engine RPM is not suddenly changed).
  (3) Deactivate the inspection mode and drive the vehicle with shift position "B" range.
  (4) Accelerate the vehicle to 70 km/h (44 mph) and quickly release the accelerator pedal so that the throttle valve is fully closed.

CAUTION:
- **Strictly observe of posted speed limits, traffic laws, and road conditions when performing these drive patterns.**
- **Do not drive the vehicle without deactivating inspection mode, otherwise damaging the transaxle may result.**

OK:
Condition (1) and (2)
Voltage changes in the vicinity of 3.3 V (between approximately 3.1 to 3.5 V) as shown in the illustration.
Condition (4)
A/F sensor voltage increases to 3.8 V or more during engine deceleration (when fuel cut) as shown in the illustration.



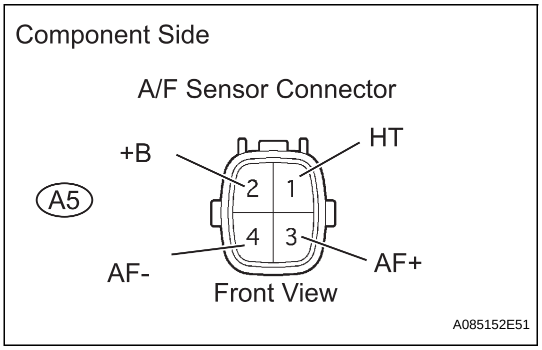
HINT:

- Whenever the output voltage of the A/F sensor remains at approximately 3.3 V (see diagram Malfunction Condition) under any condition as well as the above conditions, the A/F sensor may have an open-circuit. (This will happen also when the A/F sensor heater has an open-circuit.)
- Whenever the output voltage of the A/F sensor remains at a certain value of approximately 3.8 V or more, or 2.8 V or less (see diagram Malfunction Condition) under any condition as well as the above conditions, the A/F sensor may have a short-circuit.
- The ECM will stop fuel injection (fuel cut) during engine deceleration. This will cause a LEAN condition and should result in a momentary increase in A/F sensor voltage output.
- The ECM must establish a closed throttle position learned value to perform fuel cut. If the battery terminal was reconnected, the vehicle must be driven over 10 mph to allow the ECM to learn the closed throttle position.
- When the vehicle is driven:
  The output voltage of the A/F sensor may be below 2.8 V during fuel enrichment. For the vehicle, this translates to a sudden increase in speed with the accelerator pedal fully depressed when trying to overtake another vehicle. The A/F sensor is functioning normally.
- The A/F sensor is a current output element, and therefore the current is converted into voltage inside the ECM. If measuring voltage at connectors of A/F sensor or ECM, you will observe a constant voltage.

OK	Go to step 13

NG

3	INSPECT AIR FUEL RATIO SENSOR (RESISTANCE OF A/F SENSOR HEATER)



(a) Disconnect the A5 A/F sensor connector.
(b) Measure the resistance between the terminals of the A/F sensor.
Standard resistance

Tester Connection	Resistance
1 (HT) - 2 (+B)	1.8 to 3.4 Ω at 20°C (68°F)

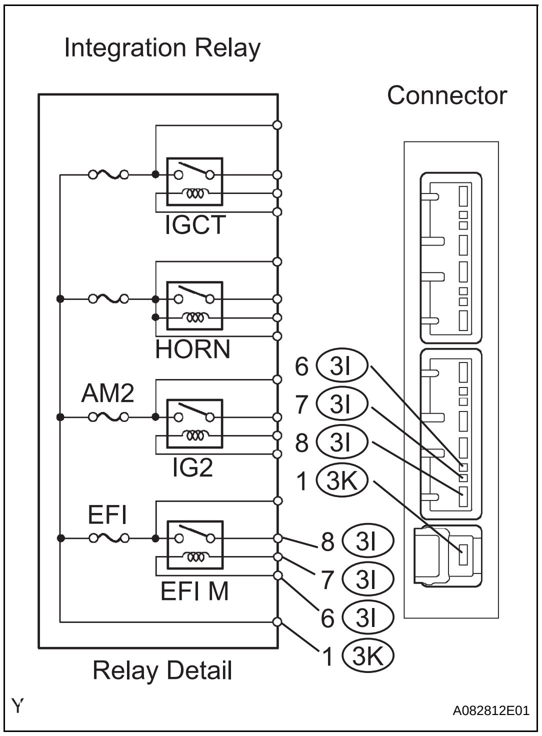
(c) Reconnect the A/F sensor connector.

NG → **REPLACE AIR FUEL RATIO SENSOR**

ES

OK

4	INSPECT INTEGRATION RELAY (EFI M RELAY)



(a) Remove the integration relay from the engine room relay block.
(b) Inspect the EFI M relay.
Standard resistance

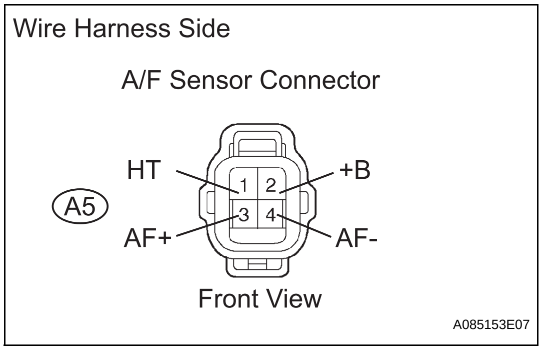
Tester Connection	Specified Condition
3K-1 - 3I-8	10 kΩ or higher
3K-1 - 3I-8	Below 1 Ω (Apply battery voltage to terminals 3I-6 and 3I-7)

(c) Reinstall the integration relay.

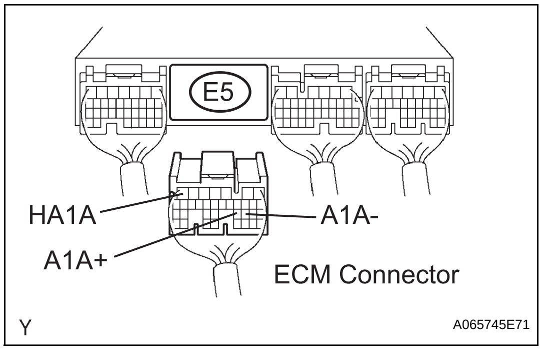
NG → **REPLACE INTEGRATION RELAY**

OK

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



(a) Disconnect the A5 A/F sensor connector.



(b) Disconnect the E5 ECM connector.
(c) Check the resistance between the wire harness side connectors.

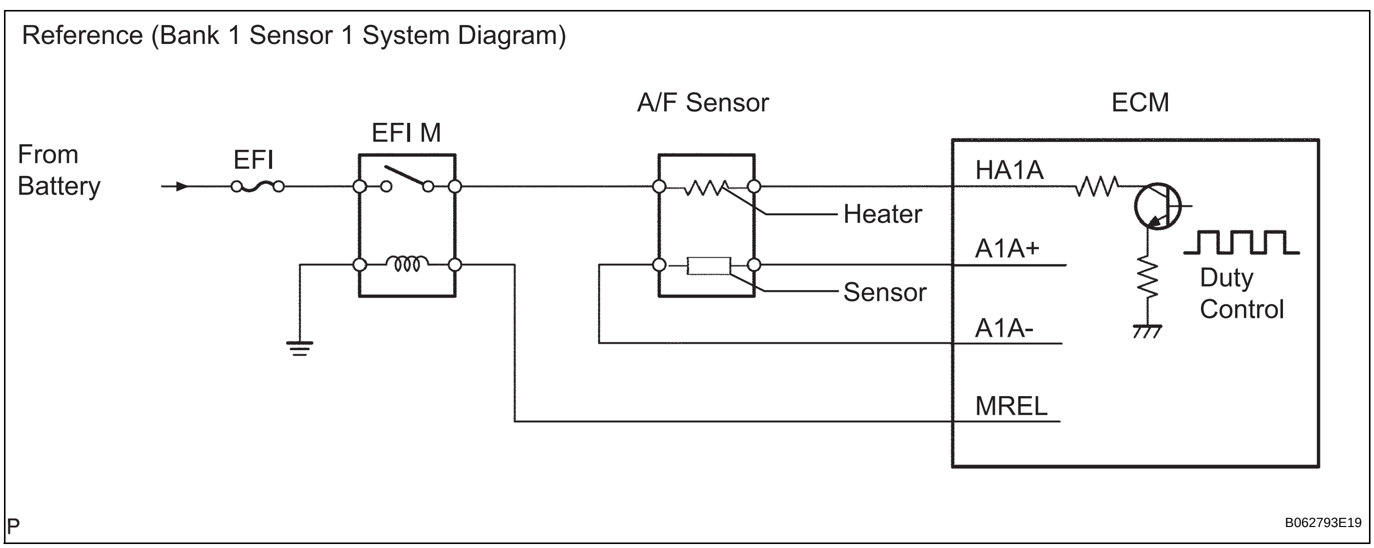
Standard resistance (Check for open)

Tester Connection	Specified Condition
A5-3 (AF+) - E5-23 (A1A+)	Below 1 Ω
A5-4 (AF-) - E5-22 (A1A-)	Below 1 Ω
A5-1 (HT) - E5-7 (HA1A)	Below 1 Ω

Standard resistance (Check for short)

Tester Connection	Specified Condition
A5-3 (AF+) or E5-23 (A1A+) - Body ground	10 kΩ or higher
A5-4 (AF-) or E5-22 (A1A-) - Body ground	10 kΩ or higher
A5-1 (HT) or E5-7 (HA1A) - Body ground	10 kΩ or higher

(d) Reconnect the A/F sensor connector.
(e) Reconnect the ECM connector.



NG → **REPAIR OR REPLACE HARNESS AND CONNECTOR**

OK

6	CHECK AIR INDUCTION SYSTEM

(a) Check for vacuum leaks in the air induction system.

OK:

No leakage in the air induction system.

NG → **REPAIR OR REPLACE AIR INDUCTION SYSTEM**

OK

7	CHECK FUEL PRESSURE

OK:

Fuel pressure: 304 to 343 kPa (3.1 to 3.5 kgf/cm^2, 44 to 50 psi)

NG → **REPAIR OR REPLACE FUEL SYSTEM**

OK

8	INSPECT FUEL INJECTOR ASSEMBLY

(a) Check injector injection (high or low fuel injection quantity or poor injection pattern).

OK:

Injection volume: 36 to 46 cm^3 (2.1 to 2.8 cu in.) per 15 seconds.

NG → **REPLACE FUEL INJECTOR ASSEMBLY**

OK

9	REPLACE AIR FUEL RATIO SENSOR

GO

10	PERFORM CONFIRMATION DRIVING PATTERN

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

GO

11	READ OUTPUT DTCS (SEE IF A/F SENSOR DTCS ARE OUTPUT AGAIN)

(a) Connect the intelligent tester to the DLC3.
(b) Turn the power switch ON (IG).

ES

(c) Turn the intelligent tester ON.
(d) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DTC INFO / CURRENT CODES.
(e) Read DTCs using the intelligent tester.

Result

Display (DTC Output)	Proceed to
No output	A
A/F sensor circuit DTCs	B

B → **REPLACE ECM AND PERFORM CONFIRMATION DRIVING PATTERN**

ES

A

12 CONFIRM IF VEHICLE HAS RUN OUT OF FUEL IN PAST

OK:
Vehicle has run out of fuel in past.

NO → **CHECK FOR INTERMITTENT PROBLEMS**

YES

DTCS ARE CAUSED BY RUNNING OUT OF FUEL

13 PERFORM CONFIRMATION DRIVING PATTERN

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

GO

14 READ OUTPUT DTCS (SEE IF A/F SENSOR DTCS ARE OUTPUT AGAIN)

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

Result

Display (DTC Output)	Proceed to
A/F sensor circuit DTCs	A
No output	B

B → **Go to step 18**

A

15 REPLACE AIR FUEL RATIO SENSOR

GO

16 PERFORM CONFIRMATION DRIVING PATTERN

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

GO

ES

17 READ OUTPUT DTCS (SEE IF A/F SENSOR DTCS ARE OUTPUT AGAIN)

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

Result

Display (DTC Output)	Proceed to
No output	A
A/F sensor circuit DTCs	B

B → **REPLACE ECM AND PERFORM CONFIRMATION DRIVING PATTERN**

A

18 CONFIRM IF VEHICLE HAS RUN OUT OF FUEL IN PAST

OK:
Vehicle has run out of fuel in past.

NO → **CHECK FOR INTERMITTENT PROBLEMS**

YES

DTCS ARE CAUSED BY RUNNING OUT OF FUEL

ES

DTC	P2238	Oxygen (A/F) Sensor Pumping Current Circuit Low (Bank 1 Sensor 1)

DTC	P2239	Oxygen (A/F) Sensor Pumping Current Circuit High (Bank 1 Sensor 1)

DTC	P2252	Oxygen (A/F) Sensor Reference Ground Circuit Low (Bank 1 Sensor 1)

DTC	P2253	Oxygen (A/F) Sensor Reference Ground Circuit High (Bank 1 Sensor 1)

DESCRIPTION

Refer to DTC P2195 (see page ES-344).

DTC No.	DTC Detection Condition	Trouble Area
P2238	• AF+ is 0.5 V or less for 5 seconds or more • A/F sensor admittance: Less than 0.022 1/Ω	• Open or short in A/F sensor circuit • A/F sensor • A/F sensor heater • EFI M relay • A/F sensor heater and relay circuit • ECM
P2239	AF+ is more than 4.5 V for 5 seconds or more	• Open or short in A/F sensor circuit • A/F sensor • A/F sensor heater • EFI M relay • A/F sensor heater and relay circuit • ECM
P2252	AF- is 0.5 V or less for 5 seconds or more	• Open or short in A/F sensor circuit • A/F sensor • A/F sensor heater • EFI M relay • A/F sensor heater and relay circuit • ECM
P2253	AF- is more than 4.5 V for 5 seconds or more	• Open or short in A/F sensor circuit • A/F sensor • A/F sensor heater • EFI M relay • A/F sensor heater and relay circuit • ECM

MONITOR DESCRIPTION

The air fuel ratio (A/F) sensor has a characteristic that it varies its voltage output in proportion to the air-fuel ratio. If impedance (alternating current resistance) or voltage output of the sensor extraordinarily deviates from the standard range, the ECM determines to detect an open or short malfunction in the A/F sensor circuit.

MONITOR STRATEGY

Related DTCs	P2238: A/F sensor pumping current circuit low P2239: A/F sensor pumping current circuit high P2252: A/F sensor reference ground circuit low P2253: A/F sensor reference ground circuit high

Required sensors/components (main)	Main: A/F sensor Related: Engine speed sensor, vehicle speed sensor, engine coolant temperature sensor
Frequency of operation	Continuous
Duration	10 seconds
MIL operation	2 driving cycles
Sequence of operation	None

TYPICAL ENABLING CONDITIONS

"General precondition" is defined as follows:

Battery voltage	10.5 V or more
Power switch	ON
Time after power switch from OFF to ON	5 seconds or more

"A/F sensor admittance precondition" is defined as follows:

Engine coolant temperature	Closed - loop fuel control or more
Engine	Running
Time after A/F sensor heating	20 seconds or more

P2238: A/F sensor pumping current circuit low
(AF+, AF- open)

The monitor will run whenever the following DTCs are not present	None
Time while A/F sensor admittance precondition is met	10 seconds or more

P2238: A/F sensor pumping current circuit low
(AF+, AF- short)

General precondition	Met

P2238: A/F sensor pumping current circuit low
(AF+, GND short)

General precondition	Met

P2239: A/F sensor pumping current circuit high

General precondition	Met

P2252: A/F sensor reference ground circuit low

General precondition	Met

P2253: A/F sensor reference ground circuit high

General precondition	Met

TYPICAL MALFUNCTION THRESHOLDS

P2238: A/F sensor pumping current circuit low
(AF+, AF- open)

A/F sensor admittance	Less than 0.022 1/Ω

P2238: A/F sensor pumping current circuit low
(AF+, AF- short)

A/F sensor admittance	0.1 V or less

P2238: A/F sensor pumping current circuit low
(AF+, GND short)

Difference between voltage of terminals AF+ and AF-	0.5 V or less

P2239: A/F sensor pumping current circuit high
(AF+, +B, VCC short)

AF+ terminal voltage (AF+ and +B, or AF+ and VCC short)	More than 4.5 V

P2252: A/F sensor reference ground circuit low

AF- terminal voltage (AF- and GND short)	0.5 V or less

P2253: A/F sensor reference ground circuit high

AF- terminal voltage (AF- and +B, or AF- and VCC short)	More than 4.5 V

WIRING DIAGRAM

Refer to DTC P2195 (see page ES-347).

INSPECTION PROCEDURE

HINT:
- Although the each DTC title says "oxygen sensor", these DTCs are related to the A/F sensor.
- Malfunctioning areas can be found by performing the ACTIVE TEST / A/F CONTROL operation. The A/F CONTROL operation can determine if the A/F sensor, heated oxygen sensor or other potential trouble area are malfunctioning or not.

(a) Perform the ACTIVE TEST A/F CONTROL operation.
HINT:
The A/F CONTROL operation lowers the injection volume 12.5% or increases the injection volume 25%.
(1) Connect the intelligent tester to the DLC3.
(2) Turn the power switch ON (IG).
(3) Put the engine in inspection mode (see page ES-1).
(4) Warm up the engine by running the engine at 2,500 rpm, depressing the accelerator pedal more than 60% for approximately 90 seconds.
(5) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / A/F CONTROL.
(6) Perform the A/F CONTROL operation with the engine in an idle condition (press the right or left button).

Result:
A/F sensor reacts in accordance with increase and decrease of injection volume:
+25% → rich output: Less than 3.0 V
-12.5% → lean output: More than 3.35 V
Heated oxygen sensor reacts in accordance with increase and decrease of injection volume:
+25% → rich output: More than 0.55 V
-12.5% → lean output: Less than 0.4 V

NOTICE:
The A/F sensor output has a few seconds of delay and the heated oxygen sensor output has about 20 seconds of delay at maximum.

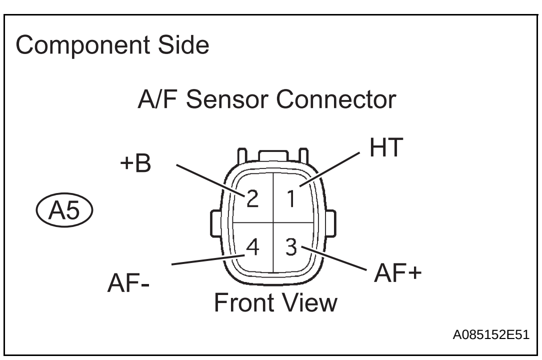
Case	A/F Sensor (Sensor 1) Output Voltage		HO2 Sensor (Sensor 2) Output Voltage		Main Suspected Trouble Area
1	Injection Volume +25% -12.5%		Injection Volume +25% -12.5%		-
	Output Voltage More than 3.35 V Less than 3.0 V		Output Voltage More than 0.55 V Less than 0.4 V		

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

The following A/F CONTROL procedure enables the technician to check and graph the voltage output of both A/F sensor and heated oxygen sensor.
To display the graph, enter ACTIVE TEST/ A/F CONTROL/USER DATA, select "AFS B1S1 and O2S B1S2" by pressing the "YES" button followed by the "ENTER" button and then the "F4" button.
HINT:

- Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunction is detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.
- A high A/F sensor voltage could be caused by a RICH air-fuel mixture. Check the conditions that would cause the engine to run with the RICH air-fuel mixture.
- A low A/F sensor voltage could be caused by a LEAN air-fuel mixture. Check the conditions that would cause the engine to run with the LEAN air-fuel mixture.

1 INSPECT AIR FUEL RATIO SENSOR (RESISTANCE OF A/F SENSOR HEATER)



(a) Disconnect the A5 A/F sensor connector.
(b) Measure the resistance between the terminals of the A/F sensor.
Standard resistance

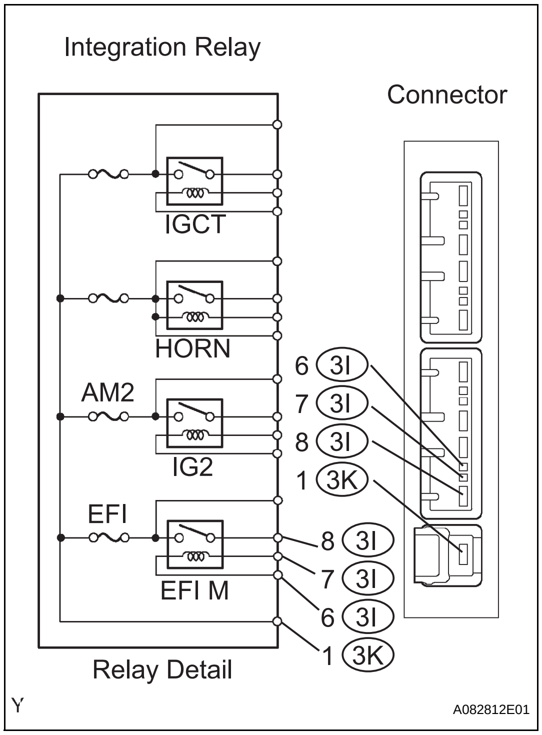
Tester Connection	Resistance
1 (HT) - 2 (+B)	**1.8 to 3.4 Ω at 20°C (68°F)**

(c) Reconnect the A/F sensor connector.

NG → **REPLACE AIR FUEL RATIO SENSOR**

OK

2	INSPECT INTEGRATION RELAY (EFI M RELAY)



(a) Remove the integration relay from the engine room relay block.

(b) Inspect the EFI M relay.

Standard resistance

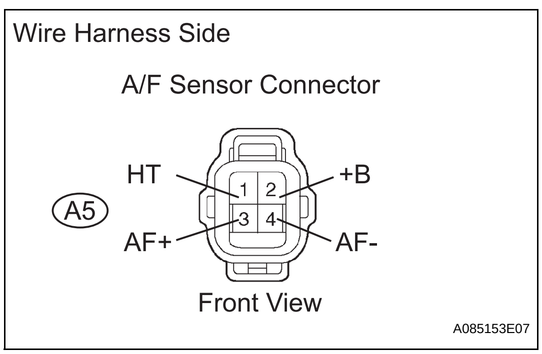
Tester Connection	Specified Condition
3K-1 - 3I-8	10 kΩ or higher
3K-1 - 3I-8	Below 1 Ω (Apply battery voltage to terminals 3I-6 and 3I-7)

(c) Reinstall the integration relay.

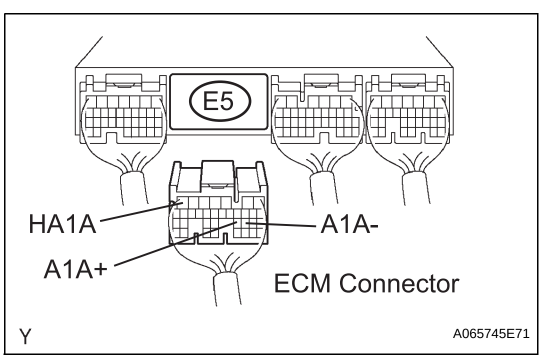
NG → **REPLACE INTEGRATION RELAY**

OK

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



(a) Disconnect the A5 A/F sensor connector.



(b) Disconnect the E5 ECM connector.

(c) Check the resistance between the wire harness side connectors.

Standard resistance (Check for open)

Tester Connection	Specified Condition
A5-3 (AF+) - E5-23 (A1A+)	Below 1 Ω
A5-4 (AF-) - E5-22 (A1A-)	Below 1 Ω
A5-1 (HT) - E5-7 (HA1A)	Below 1 Ω

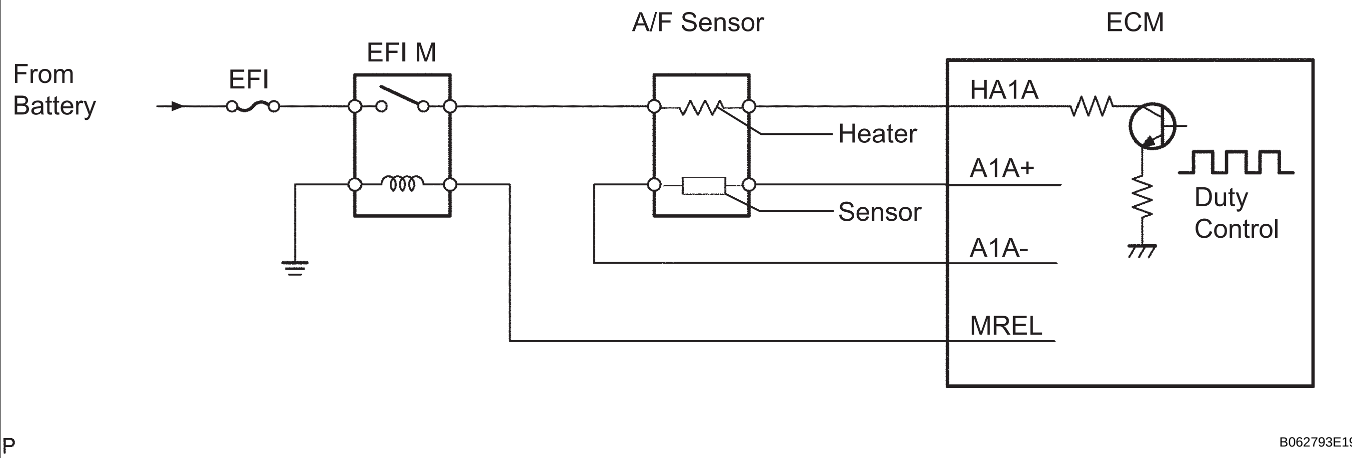
Standard resistance (Check for short)

Tester Connection	Specified Condition
A5-3 (AF+) or E5-23 (A1A+) - Body ground	10 kΩ or higher

Tester Connection	Specified Condition
A5-4 (AF-) or E5-22 (A1A-) - Body ground	10 kΩ or higher
A5-1 (HT) or E5-7 (HA1A) - Body ground	10 kΩ or higher

(d) Reconnect the A/F sensor connector.
(e) Reconnect the ECM connector.

Reference (Bank 1 Sensor 1 System Diagram)



NG → **REPAIR OR REPLACE HARNESS AND CONNECTOR**

OK

REPLACE ECM

DTC	P2420	Evaporative Emission Pressure Switching Valve Stuck OFF

DTC SUMMARY

DTC No.	Monitoring Items	Malfunction Detection Conditions	Trouble Areas	Detection Timing	Detection Logic
P2420	Vent valve stuck open (vent)	The following condition is met during key-off EVAP monitor: • EVAP pressure change when vent valve is closed (ON) less than 0.3 kPa-g (2.25 mmHg-g)	• Canister pump module (reference orifice, leak detection pump, vent valve) • Connector/wire harness (canister pump module - ECM) • ECM	Power switch OFF	2 trip

DESCRIPTION

NOTICE:

In this vehicle's EVAP system, turning ON the vent valve does not seal off the EVAP system. To check for leaks in the EVAP system, disconnect the air inlet vent hose and apply pressure from the atmosphere side of the canister.

While the engine is running, if a predetermined condition (closed loop, etc.) is met, the purge VSV is opened by the ECM and stored fuel vapors in the canister are purged to the intake manifold. The ECM changes the duty cycle ratio of the purge VSV to control purge flow volume.

The purge flow volume is also determined by the intake manifold pressure. Atmospheric pressure is allowed into the canister through the vent valve to ensure that the purge flow is maintained when the negative pressure (vacuum) is applied to the canister.

Key-off monitor

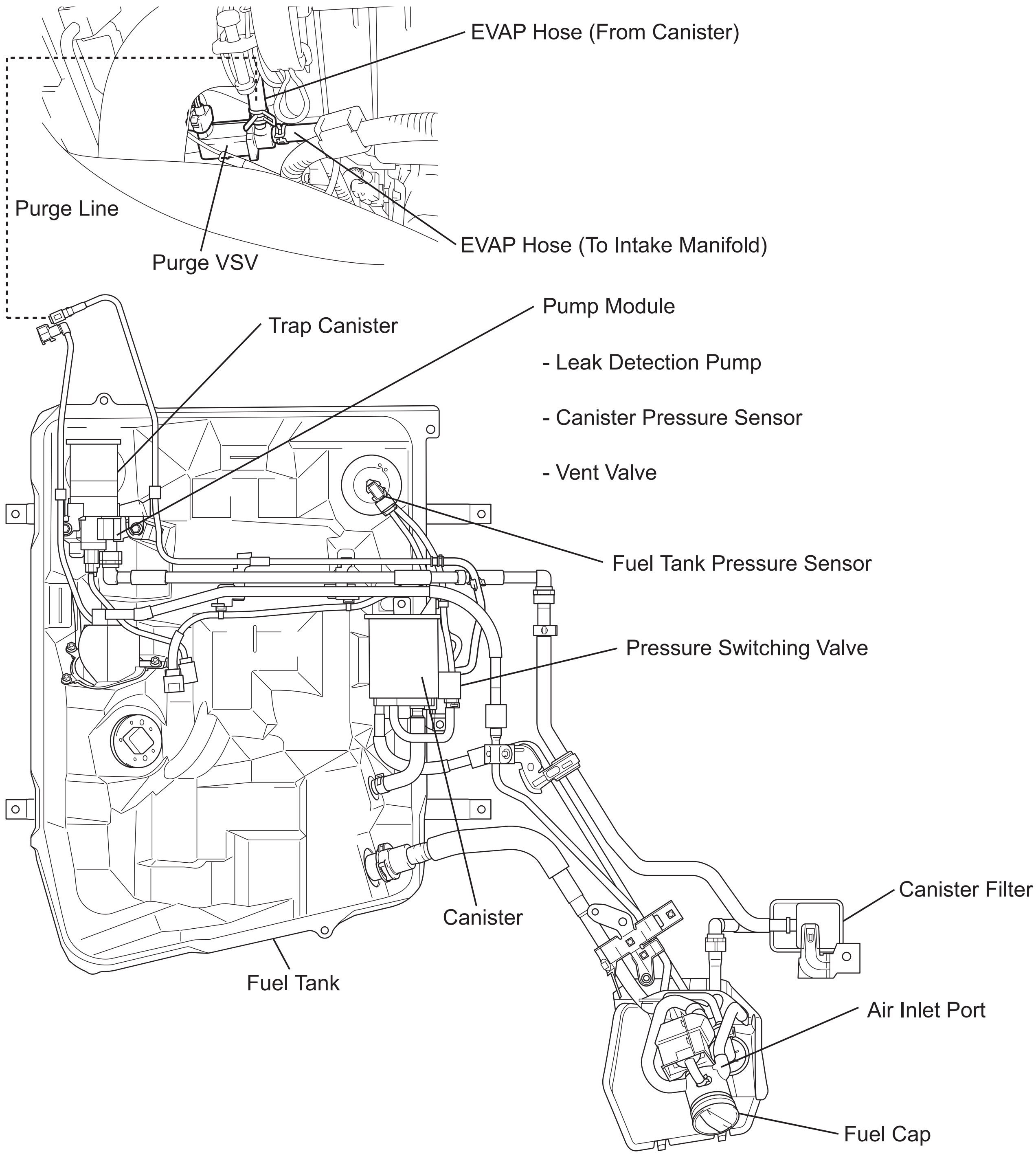
This monitor checks for Evaporative Emission (EVAP) system leaks and canister pump module malfunctions. The monitor starts 5 hours* after the power switch is turned OFF. More than 5 hours are required to allow the fuel to cool down to stabilize the Fuel Tank Pressure (FTP), thus making the EVAP system monitor more accurate.

The leak detection pump creates negative pressure (vacuum) in the EVAP system and the pressure is measured. Finally, the ECM monitors for leaks from the EVAP system and malfunctions in both the canister pump module and purge VSV, based on the EVAP pressure.

HINT:

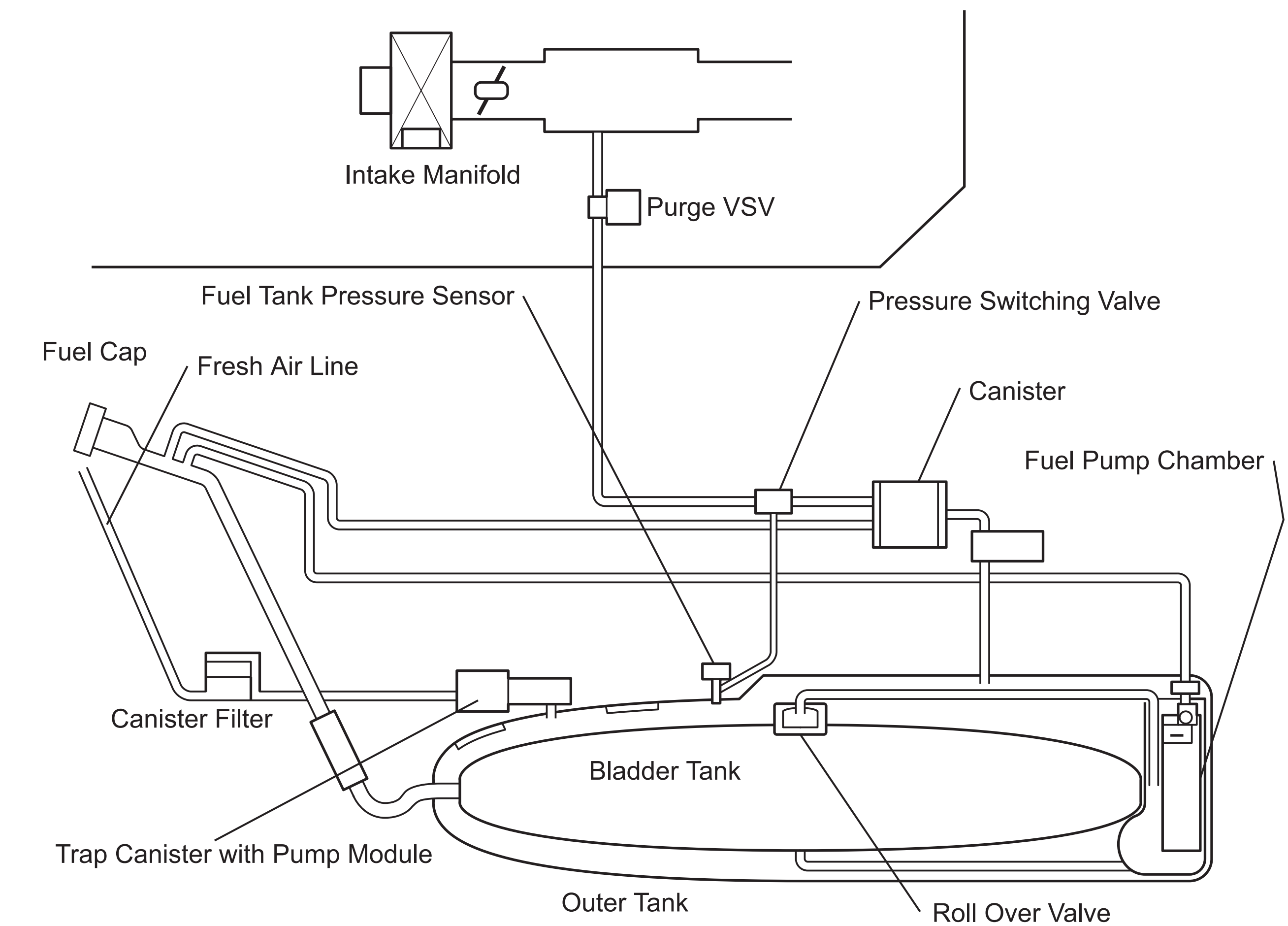
*: If the engine coolant temperature is not below 35°C (95°F) 5 hours after the power switch is turned OFF, the monitor check starts 2 hours later. If it is still not below 35°C (95°F) 7 hours after the power switch is turned OFF, the monitor check starts 2.5 hours later.

Location



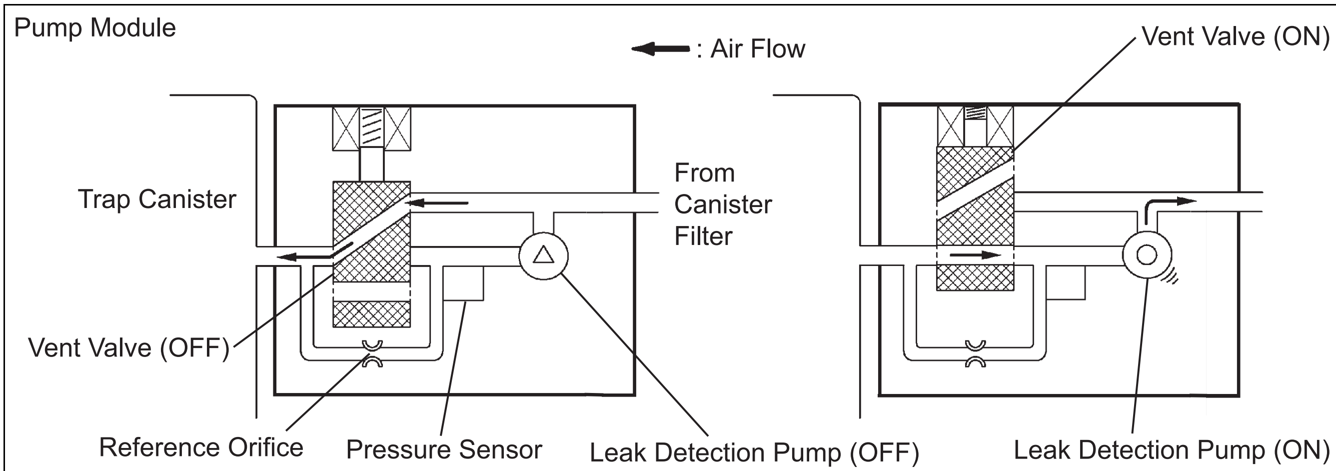
A131350E01

Diagram

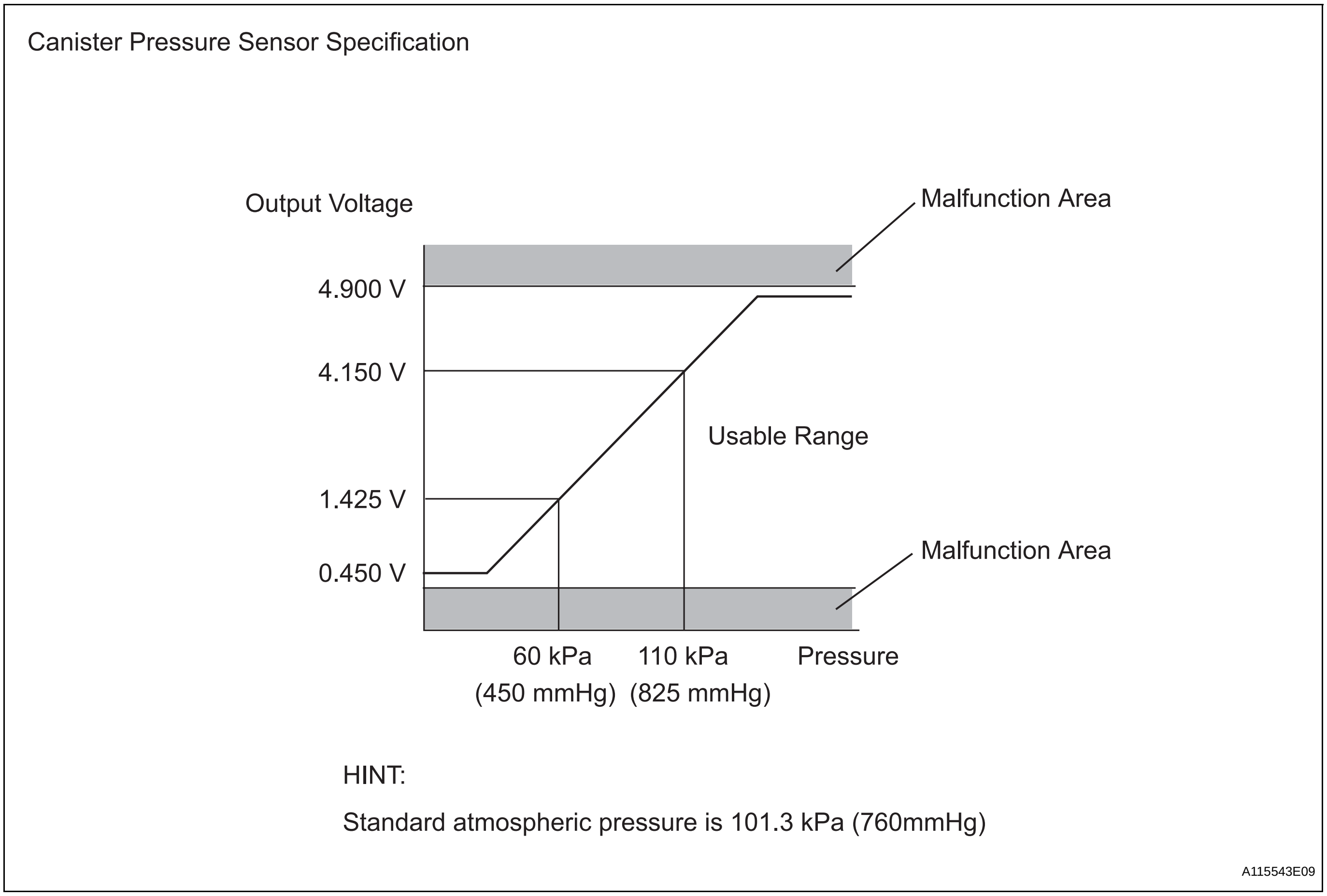


P A130305E01

Pump Module



A131438E01



Components	Operations
Canister, Trap canister	Contains activated charcoal to absorb EVAP generated in fuel tank.
Cut-off valve	Located in fuel tank. Valve floats and closes when fuel tank 100% full.
Purge Vacuum Switching Valve (VSV)	Opens or closes line between canister and intake manifold. ECM uses purge VSV to control EVAP purge flow. In order to discharge EVAP absorbed by canister to intake manifold, ECM opens purge VSV. EVAP discharge volume to intake manifold controlled by purge VSV duty cycle ratio (current-carrying time) (open: ON; closed: OFF).
Roll-over valve	Located in fuel tank. Valve closes by its own weight when vehicle overturns to prevent fuel from spilling out.
Soak timer	Built into ECM. To ensure accurate EVAP monitor, measures 5 hours (+-15 min) after power switch OFF. This allows fuel to cool down, stabilizing Fuel Tank Pressure (FTP). When approximately 5 hours elapsed, ECM activates.
Pressure switching valve	The pressure switching valve located on the canister is used to detect leakage from the bladder tank into the fuel tank. The valve opens during the bladder tank leak check. Then, the fuel tank's fuel vapor flows to the intake manifold without passing the canister.
Pump module	Consists of (a) to (d) below. Pump module cannot be disassembled.
(a) Vent valve	Vents and closes EVAP system. When ECM turns valve ON, EVAP system closed. When ECM turns valve OFF, EVAP system vented. Negative pressure (vacuum) created in EVAP system to check for EVAP leaks by closing purge VSV, turning vent valve ON (closed) and operating leak detection pump (refer to fig. 1).
(b) Canister pressure sensor	Indicates pressure as voltage. ECM supplies regulated 5 V to canister pressure sensor, and uses feedback from sensor to monitor EVAP system pressure (refer to fig. 2).
(c) Leak detection pump	Creates negative pressure (vacuum) in EVAP system for leak check.

Components	Operations
(d) Reference orifice	Has opening with 0.02 inch diameter. Vacuum produced through orifice by closing purge VSV, turning vent valve OFF and operating leak detection pump to monitor 0.02 inch leak criterion. 0.02 inch leak criterion indicates small leak of EVAP.

MONITOR DESCRIPTION

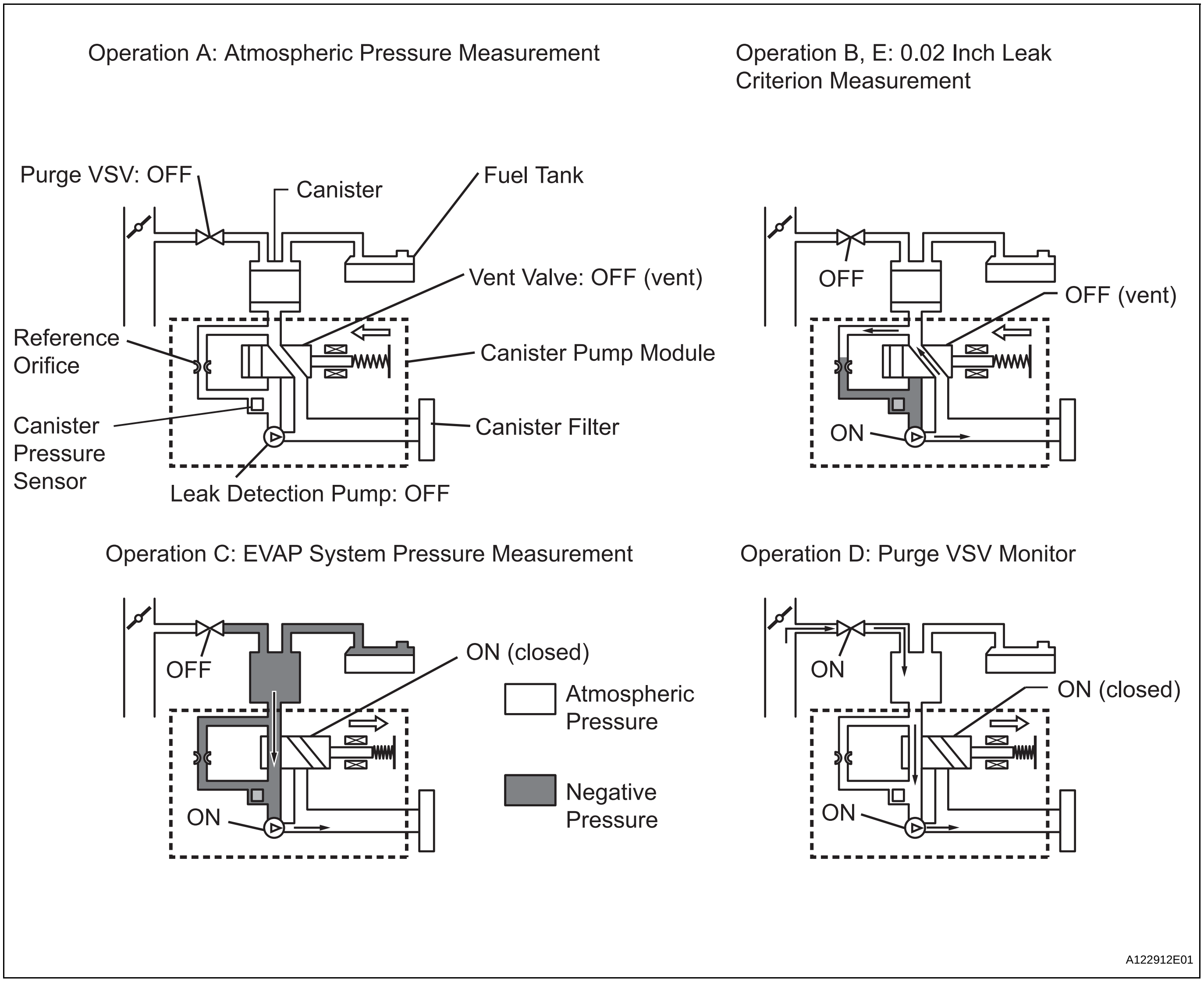
5 hours* after the power switch is turned OFF, the leak detection pump creates negative pressure (vacuum) in the EVAP system. The ECM monitors for leaks and actuator malfunctions based on the EVAP pressure.

HINT:

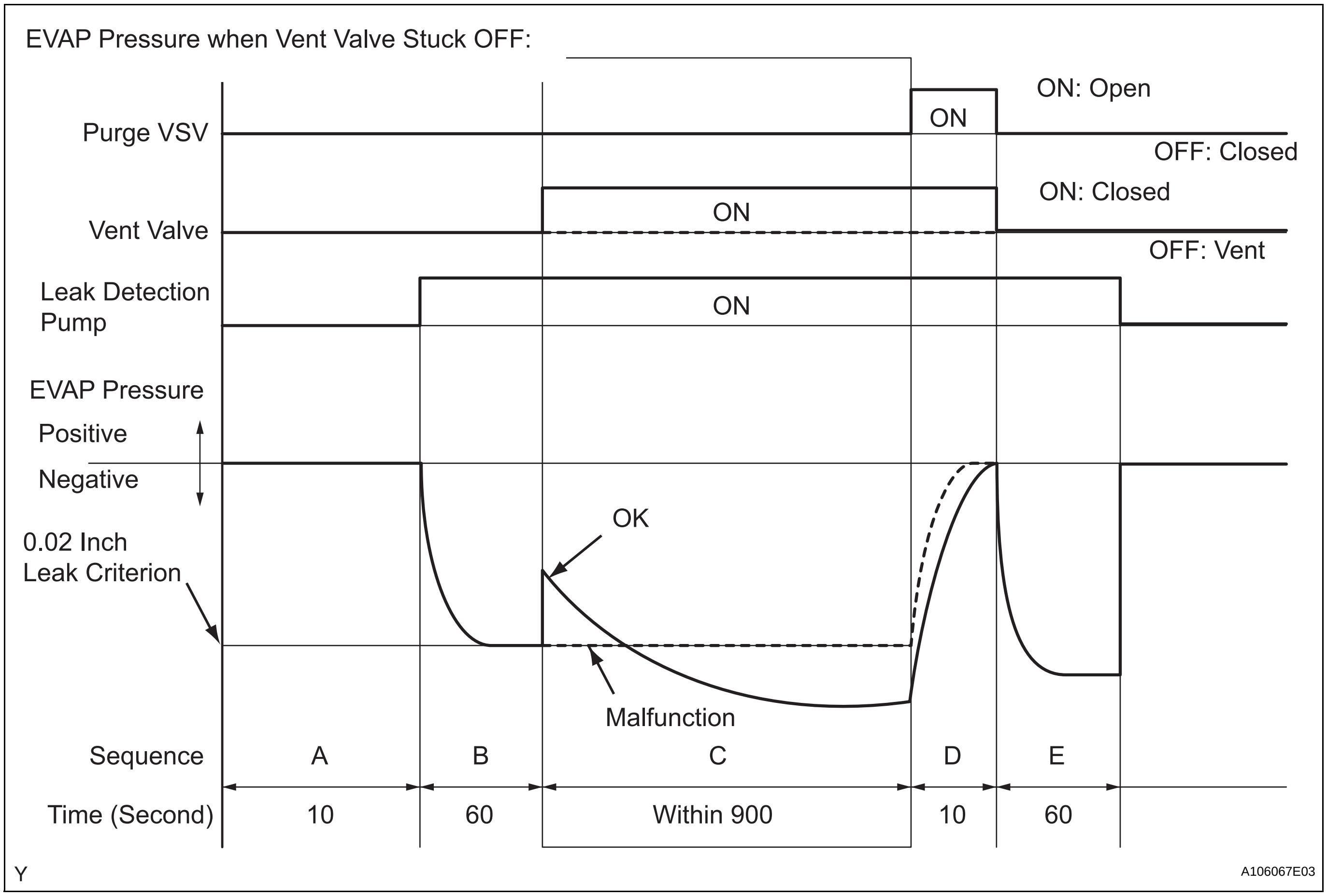
*: If the engine coolant temperature is not below 35°C (95°F) 5 hours after the power switch is turned OFF, the monitor check starts 2 hours later. If it is still not below 35°C (95°F) 7 hours after the power switch is turned OFF, the monitor check starts 2.5 hours later.

Sequence	Operations	Descriptions	Duration
-	ECM activation	Activated by soak timer 5, 7 or 9.5 hours after power switch OFF.	-
A	Atmospheric pressure measurement	Vent valve turned OFF (vent) and EVAP system pressure measured by ECM in order to register atmospheric pressure. If pressure in EVAP system not between 70 kPa and 110 kPa (525 mmHg and 825 mmHg), ECM cancels EVAP system monitor.	10 seconds
B	First 0.02 inch leak criterion measurement	In order to determine 0.02 inch leak criterion, leak detection pump creates negative pressure (vacuum) through reference orifice and then ECM checks if leak detection pump and vent valve operate normally.	60 seconds
C	EVAP system pressure measurement	Vent valve turned ON (closed) to shut EVAP system. Negative pressure (vacuum) created in EVAP system, and EVAP system pressure then measured. Write down measured value as it will be used in leak check. If EVAP pressure does not stabilize within 900 seconds, ECM cancels EVAP system monitor.	900 seconds*
D	Purge VSV monitor	Purge VSV opened and then EVAP system pressure measured by ECM. Large increase indicates normal.	10 seconds
E	Second 0.02 inch leak criterion measurement	After second 0.02 inch leak criterion measurement, leak check performed by comparing first and second 0.02 inch leak criterion. If stabilized system pressure higher than second 0.02 inch leak criterion, ECM determines that EVAP system leaking.	60 seconds
-	Final check	Atmospheric pressure measured and then monitoring result recorded by ECM.	-

*: If only a small amount of fuel is in the fuel tank, it takes longer for the EVAP pressure to stabilize.


Operation A: Atmospheric Pressure Measurement
Operation B, E: 0.02 Inch Leak Criterion Measurement
Purge VSV: OFF
Canister
Fuel Tank
Vent Valve: OFF (vent)
Reference Orifice
Canister Pump Module
Canister Pressure Sensor
Canister Filter
Leak Detection Pump: OFF
OFF
OFF (vent)
ON
Operation C: EVAP System Pressure Measurement
Operation D: Purge VSV Monitor
OFF
ON (closed)
Atmospheric Pressure
Negative Pressure
ON
ON
ON (closed)
ON
A122912E01

1. P2420: Vent valve stuck open (vent)
   In operation C, the vent valve turns ON (closes) and the EVAP system pressure is then measured by the ECM using the canister pressure sensor to conduct an EVAP leak check. If pressure does not drop when the vent valve is open, the ECM interprets this as the vent valve being stuck open. The ECM illuminates the MIL and sets the DTC.



MONITOR STRATEGY

Required Sensors/Components	Purge VSV and canister pump module
Frequency of Operation	Once per driving cycle
Duration	Maximum 15 seconds
MIL Operation	2 driving cycles
Sequence of 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 (Misfire) P0335 (CKP sensor) P0340, P0341 (CMP sensor) P0351, P0352, P0353, P0354 (Igniter) P0450, P0452, P0453 (EVAP press sensor) P0500 (VSS)
Atmospheric pressure	70 to 110 kPa (525 to 825 mmHg)

Battery voltage	10.5 V or higher
Vehicle speed	Less than 4 km/h (2.5 mph)
Power switch	OFF
Time after key off	5, 7 or 9.5 hours
Purge VSV	Not operated by scan tool
Vent valve	Not operated by scan tool
Leak detection pump	Not operated by scan tool
Both of the following conditions 1 and 2 are met before key off	-
1. Duration that vehicle has been driven	5 minutes or more
2. EVAP purge operation	Performed
ECT	4.4 to 35°C (40 to 95°F)
IAT	4.4 to 35°C (40 to 95°F)

1. Key-off monitor sequence 1 to 8

1. Atmospheric pressure measurement

Next sequence is run if the following condition is met	-
Atmospheric pressure change	Within 0.3 kPa (2.25 mmHg) in 1 second

2. First reference pressure measurement

Next sequence is run if the following conditions are met	-
EVAP pressure just after reference pressure measurement start	1 kPa (7.5 mmHg) or lower
Reference pressure	-4.85 to -1.05 kPa (726 to 754 mmHg)
Reference pressure	Saturated within 60 seconds

3. Vent valve stuck closed check

Next sequence is run if the following condition is met	-
EVAP pressure change after vent valve is ON	0.3 kPa (2.25 mmHg) or more

4. Vacuum introduction

Next sequence is run if the following condition is met	-
EVAP pressure	Saturated within 900 seconds

5. Purge VSV stuck closed check

Next sequence is run if the following condition is met	-
EVAP pressure change after purge valve is open	0.3 kPa (2.25 mmHg) or more

6. Second reference pressure measurement

Next sequence is run if the following conditions are met	-
EVAP pressure just after reference pressure measurement	1 kPa (7.5 mmHg) or lower
Reference pressure	-4.85 to -1.05 kPa (726 to 754 mmHg)
Reference pressure	Saturated within 60 seconds
Reference pressure difference between first and second	Less than 0.7 kPa (5.25 mmHg)

7. Leak check

Next sequence is run if the following condition is met	-
EVAP pressure when vacuum introduction is complete	Lower than second reference pressure

8. Atmospheric pressure measurement

EVAP monitor is complete if the following condition is met	-
Atmospheric pressure difference between sequence 1 and 8	Within 0.3 kPa (2.25 mmHg)

TYPICAL MALFUNCTION THRESHOLDS

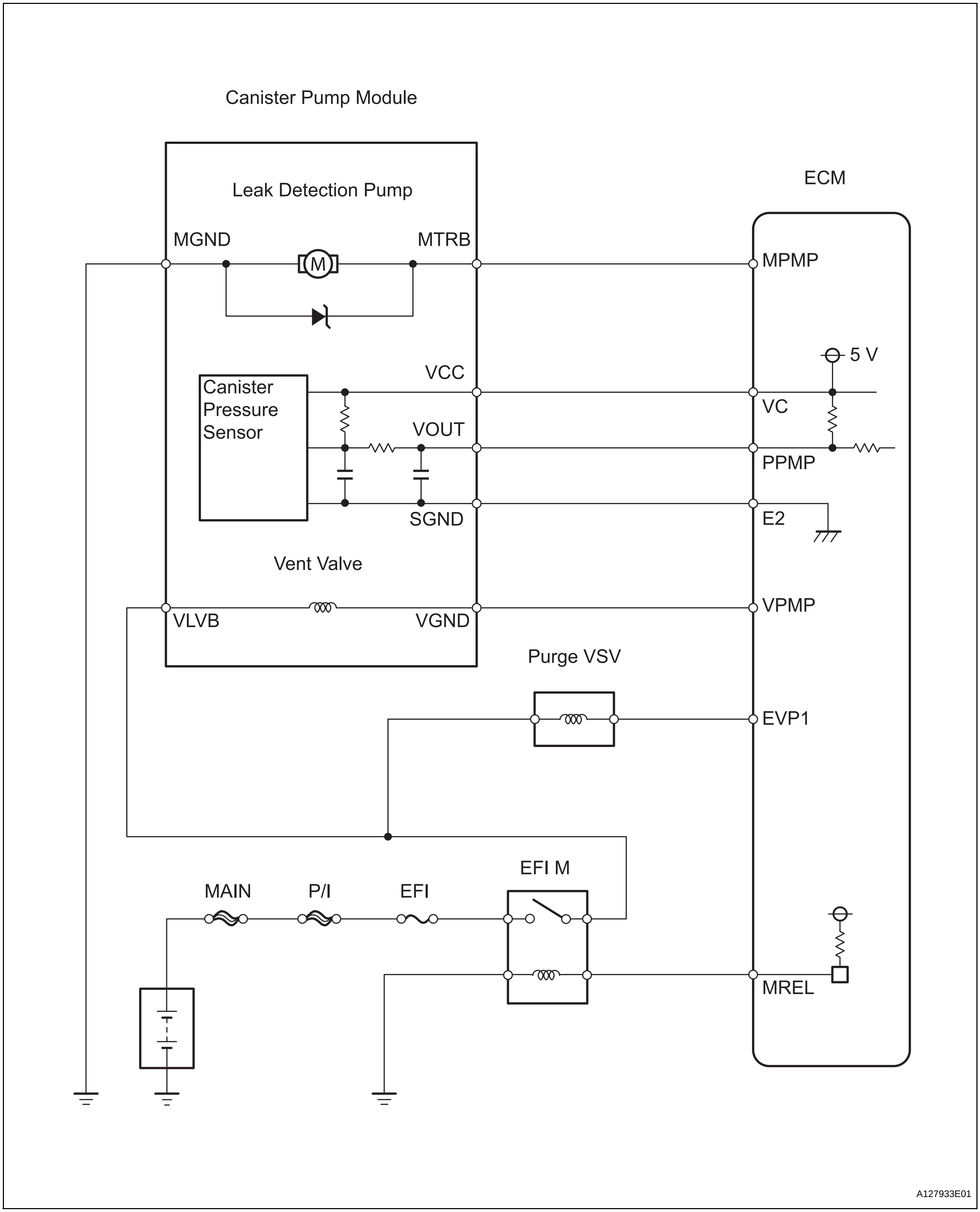
1. P2420: Vent valve stuck open (vent)

EVAP pressure change after EVAP canister vent valve is ON	Less than 0.3 kPa (2.25 mmHg)

MONITOR RESULT

Refer to CHECKING MONITOR STATUS (see page ES-15).

WIRING DIAGRAM



INSPECTION PROCEDURE

NOTICE:

The intelligent tester is required to conduct the following diagnostic troubleshooting procedure.

HINT:

- Using the intelligent tester monitor results enable the EVAP system to be confirmed.
- Read freeze frame data using the intelligent tester. Freeze frame data records the engine conditions when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1	CONFIRM DTC

(a) Turn the power switch OFF and wait for 10 seconds.
(b) Turn the power switch ON (IG).
(c) Turn the power switch OFF and wait for 10 seconds.
(d) Connect the intelligent tester to the DLC3.
(e) Turn the power switch ON (IG).
(f) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DTC INFO / CURRENT CODES.
(g) Check if DTC P0446 is output.

NO → **Go to step 5**

YES

2	PERFORM EVAP SYSTEM CHECK

(a) Note the freeze frame data and DTCs.
(b) Clear DTCs.
(c) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / SYSTEM CHECK / EVAP SYS CHECK / AUTO OPERATION.
(d) After the system check is finished, check for pending DTCs.

OK:

No DTC is present.

NG → **Go to step 6**

OK

3	CHECK OPERATION FOR PRESSURE SWITCHING VALVE

(a) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / TANK BYPASS VSV.
(b) Touch the pressure switching valve (TANK BYPASS VSV) to feel the operating vibration.

OK:

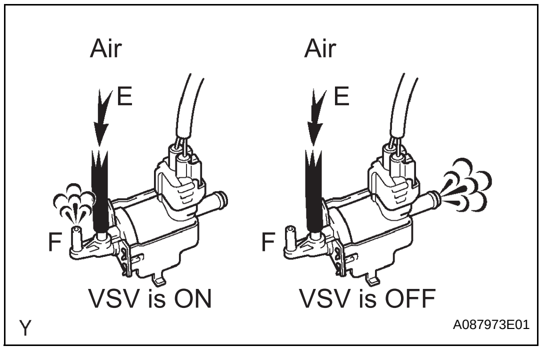
The pressure switching valve is operated by the ACTIVE TEST.

NG → **Go to step 18**

ES

OK

4 CHECK PRESSURE SWITCHING VALVE



(a) Turn the power switch OFF.
(b) Remove the pressure switching valve (see page EC-31).
(c) Reconnect the pressure switching valve connector.
(d) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / TANK BYPASS VSV.
(e) Check the airflow for the pressure switching valve.

OK:

The pressure switching valve operates normally.

NG → **Go to step 19**

OK → **Go to step 33**

5 PERFORM EVAP SYSTEM CHECK

(a) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / SYSTEM CHECK / EVAP SYS CHECK / AUTO OPERATION.
(b) After the system check is finished, check for pending DTCs.

OK:

DTCs are present.

NG → **CHECK INTERMITTENT PROBLEMS**

OK

6 CHECK DTC

(a) Check the DTCs that were present at the EVAP system check.

OK:

P043E, P043F, P2401, P2402 and P2419 are present.

NG → **Go to step 10**

OK

7 CHECK VENT VALVE CLOSE STUCK

(a) Allow the engine to idle.
(b) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / EVAP VSV.
(c) Turn the EVAP VSV ON (purge VSV open) and check the VAPOR PRESS (EVAP pressure) for 10 seconds.

OK:

EVAP pressure is higher than 755 mmHg.

NG → **Go to step 20**

OK

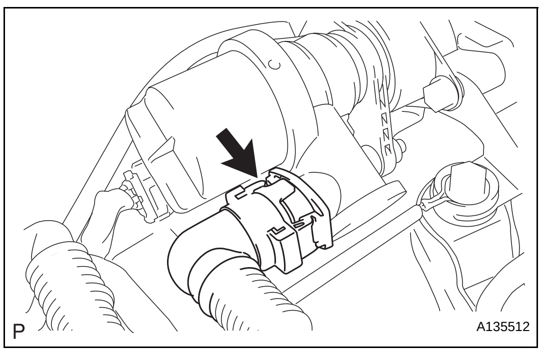
8 CHECK LEAK DETECTION PUMP OPERATION

(a) Turn the power switch OFF.
(b) Turn the power switch ON (IG).
(c) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / VACUUM PUMP.
(d) Touch the pump module to feel the operating vibration.
OK:
The leak detection pump is operated by the ACTIVE TEST.

NG → **Go to step 21**

OK

9 CHECK TRAP CANISTER



(a) Disconnect the vent hose from the pump module.
(b) Check that no moisture is in the pump module or the vent hose.
OK:
No moisture.

OK → **Go to step 22**

NG → **Go to step 23**

10 CHECK DTC

(a) Check the DTCs that were present at the EVAP system check.
OK:
P0441, P0455 and/or P0456 are present.

NG → **Go to step 16**

OK

11 CHECK INSTALLATION FOR FUEL CAP

(a) Remove the fuel cap.
(b) Reinstall the fuel cap.
(c) Clear DTCs.
(d) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / SYSTEM CHECK / EVAP SYS CHECK / AUTO OPERATION.

(e) After the system check is finished, check for pending DTCs.
HINT:
If no DTC is present, this indicates that the fuel cap is loosened.
OK:
No DTC is present.

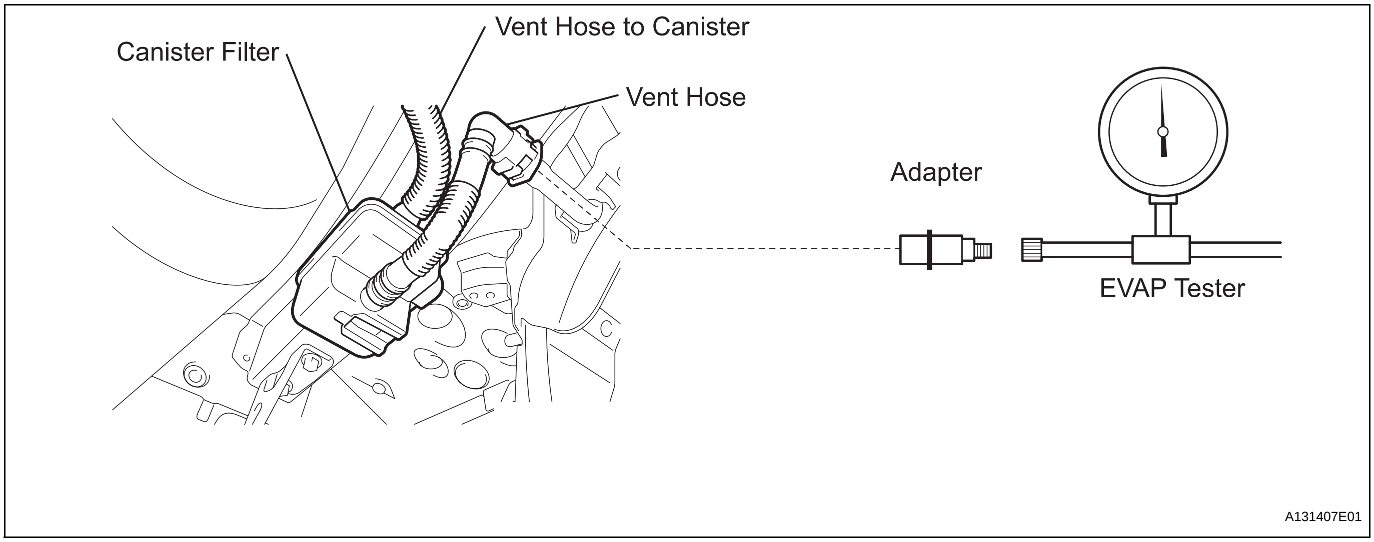
OK → **REPAIR COMPLETED**

NG

12	LOCATE LEAK POINT

ES

(a) Disconnect the vent hose (fresh air line) as shown in the illustration.



(b) Connect the pressure gauge and air pump as shown in the illustration.
(c) Pressurize the EVAP system until 24 to 28 mmHg.
(d) Locate the leak point.
HINT:
If the EVAP system has leakage, a whistling sound may be heard.
OK:
The leak point is found.

OK → **Go to step 24**

NG

13	CHECK FUEL CAP

Check that the fuel cap meets OEM specifications.
HINT:
If an EVAP tester is available, perform the fuel cap test according to the tester's instructions.
OK:
Fuel cap meets OEM specifications.

NG → **Go to step 25**

OK

14 CHECK OPERATION FOR PURGE VSV

(a) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / EVAP VSV.

(b) Touch the purge VSV to feel the operating vibration.

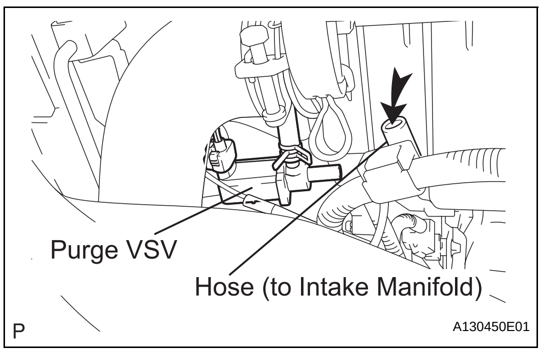
OK:

The purge VSV (EVAP VSV) is operated by the ACTIVE TEST.

NG → **Go to step 26**

OK

15 CHECK INTAKE MANIFOLD PRESSURE



(a) Disconnect the purge VSV hose that is connected to the throttle body.

(b) Allow the engine to idle.

(c) Check that the hose has suction using your finger.

OK:

The hose has suction.

NG → **Go to step 27**

OK → **Go to step 28**

16 CHECK DTC

(a) Check the DTCs that were present at the EVAP system check.

OK:

P0451 is not present.

NG → **Go to step 9**

OK

17 CHECK OPERATION FOR VENT VALVE

(a) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / VENT VALVE.

(b) Touch the pump module to feel the operating vibration.

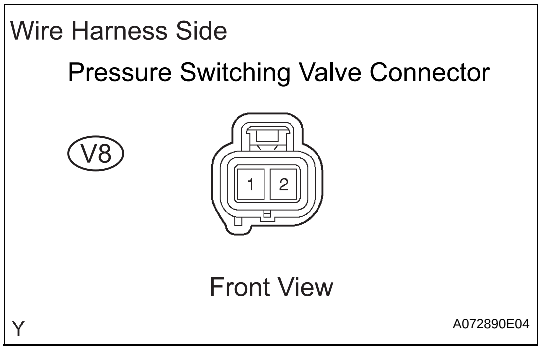
OK:

The vent valve is operated by the ACTIVE TEST.

OK → **Go to step 9**

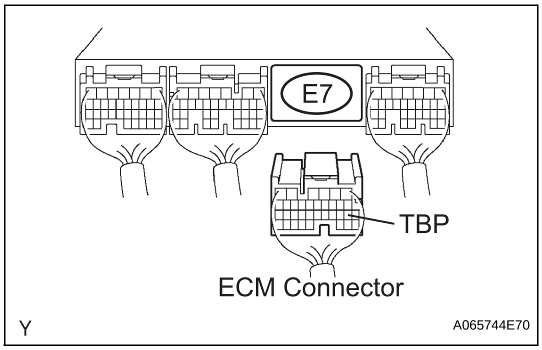
NG → **Go to step 29**

18	CHECK HARNESS AND CONNECTOR (PRESSURE SWITCHING VALVE - ECM AND EFI M RELAY)



(a) Check the harness and the connectors between the pressure switching valve and the ECM.

(1) Disconnect the V8 pressure switching valve connector.



(2) Disconnect the E7 ECM connector.

(3) Measure the resistance between the wire harness side connectors.

Standard resistance (Check for open)

Tester Connection	Specified Condition
V8-1 (Pressure switching valve) - E7-18 (TBP)	Below 1 Ω

Standard resistance (Check for short)

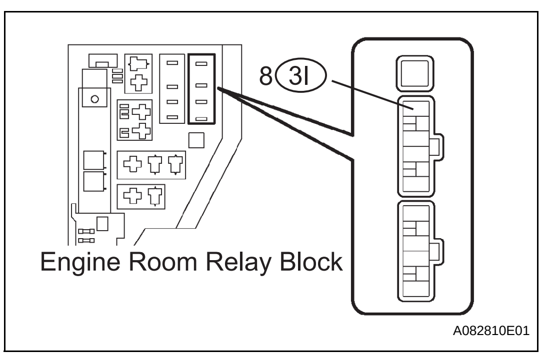
Tester Connection	Specified Condition
V8-1 (Pressure switching valve) or E7-18 (TBP) - Body ground	10 kΩ higher

(4) Reconnect the pressure switching valve connector.

(5) Reconnect the ECM connector.

(b) Check the harness and the connectors between the pressure switching valve and the EFI M relay.

(1) Disconnect the V8 pressure switching valve connector.



(2) Remove the integration relay from the engine room relay block.

(3) Measure the resistance between the wire harness side connector.

Standard resistance (Check for open)

Tester Connection	Specified Condition
V8-2 (Pressure switching valve) - 3I-8 (EFI M relay)	Below 1 Ω

Standard resistance (Check for short)

Tester Connection	Specified Condition
V8-2 (Pressure switching valve) or 3I-8 (EFI M relay) - Body ground	10 kΩ or higher

(4) Reconnect the pressure switching valve connector.

(5) Reinstall the integration relay.

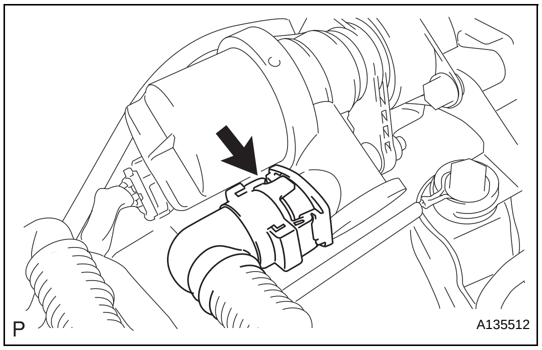
NG	**Go to step 30**
OK	**Go to step 31**

19	REPLACE PRESSURE SWITCHING VALVE

Replace the pressure switching valve (see page EC-31).

NEXT → **Go to step 34**

20	CHECK FOR VENT HOSE CLOG

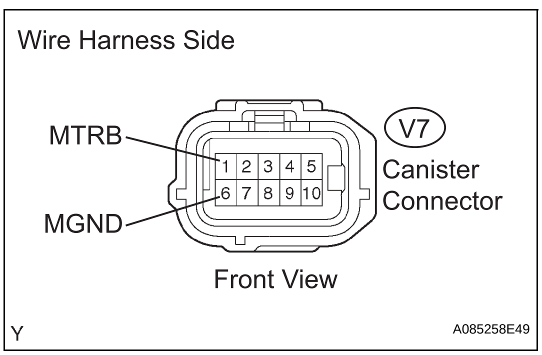


(a) Turn the power switch OFF.
(b) Disconnect the vent hose (fresh air line) as shown in the illustration.
(c) Allow the engine to idle.
(d) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / EVAP VSV.
(e) Turn the purge VSV (EVAP VSV) ON and check the EVAP pressure (VAPOR PRESS) for 10 seconds.
OK:
EVAP pressure is higher than 755 mmHg.

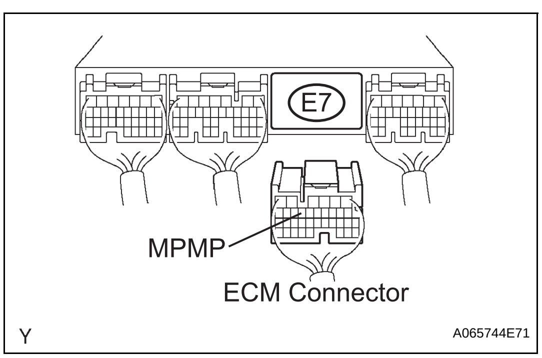
NG → **Go to step 22**

OK → **Go to step 32**

21	CHECK HARNESS AND CONNECTOR (LEAK DETECTION PUMP - ECM)



(a) Disconnect the V7 canister connector



(b) Disconnect the E7 ECM connector.
(c) Measure the resistance between the wire harness side connector.
Standard resistance (Check for open)

Tester Connection	Specified Condition
V7-1 (MTRB) - E7-13 (MPMP)	Below 1 Ω
V7-6 (MGND) - Body ground	Below 1 Ω

Standard resistance (Check for short)

Tester Connection	Specified Condition
V7-1 (MTRB) or E7-13 (MPMP) - Body ground	10 kΩ higher

(d) Reconnect the canister connector.
(e) Reconnect the ECM connector.

NG	Go to step 30
OK	Go to step 31

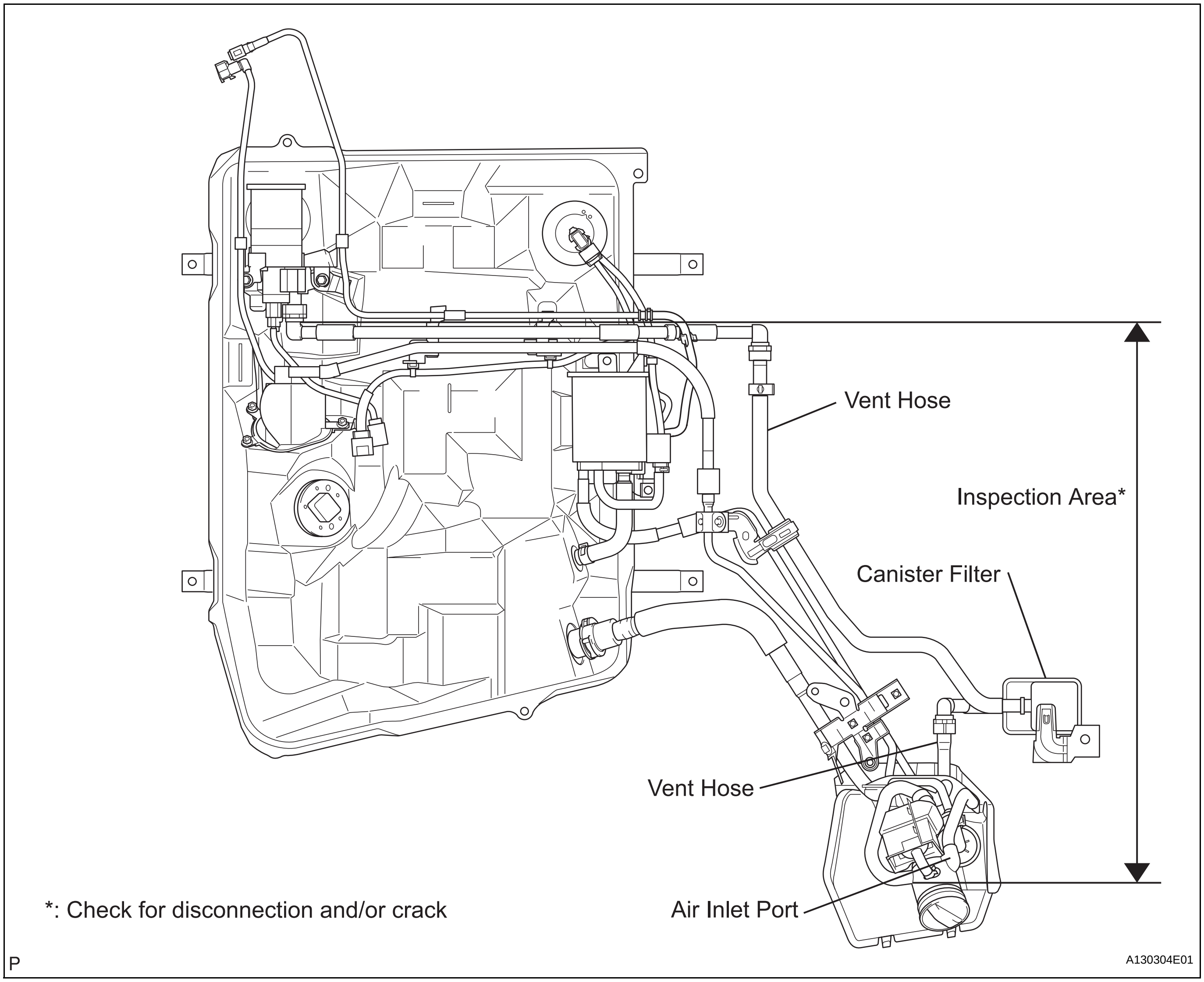
22 REPLACE TRAP CANISTER WITH PUMP MODULE

Replace the trap canister with pump module (see page EC-17).

NEXT	Go to step 34

23 CHECK FOR VENT HOSE DAMAGE

Check for hose damage as shown in the illustration. If necessary, replace the vent hose.



NEXT	Go to step 22

24	REPAIR OR REPLACE LEAK POINT

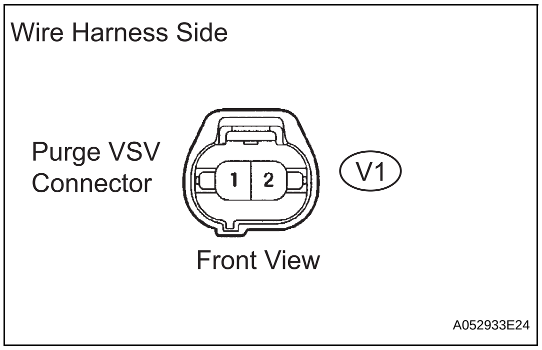
NEXT — Go to step 34

25	REPLACE FUEL CAP

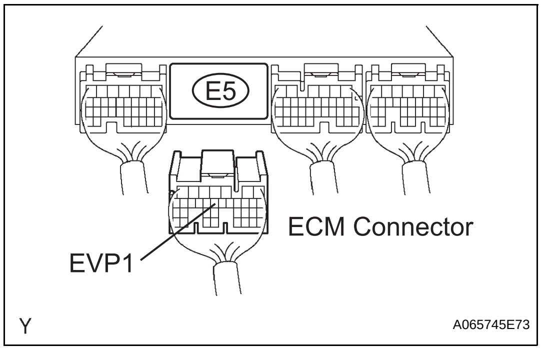
NEXT — Go to step 34

ES

26	CHECK HARNESS AND CONNECTOR (PURGE VSV - ECM)



(a) Disconnect the V1 purge VSV connector.

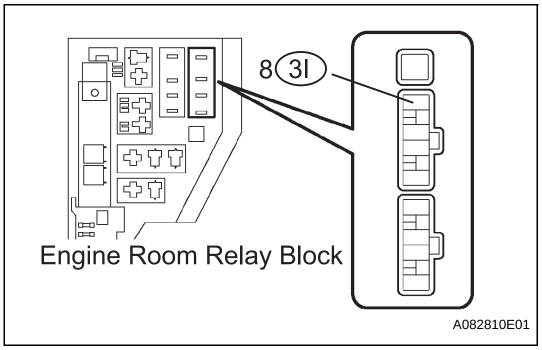


(b) Disconnect the E5 ECM connector.
(c) Check the harness and the connectors between the ECM and the purge VSV connectors.
  (1) Measure the resistance between the wire harness side connector.
  Standard resistance (Check for open)

Tester Connection	Specified Condition
V1-1 - E5-14 (EVP1)	Below 1 Ω

Standard resistance (Check for short)

Tester Connection	Specified Condition
V1-1 or E5-14 (EVP1) - Body ground	10 kΩ higher



(d) Remove the integration relay from the engine room relay block.
(e) Check the harness and connectors between the purge VSV connector and the EFI M relay.
  (1) Measure the resistance between the wire harness side connectors.
  Standard resistance (Check for open)

Tester Connection	Specified Condition
V1-2 - 3I-8 (EFI M relay)	Below 1 Ω

Standard resistance (Check for short)

Tester Connection	Specified Condition
V1-2 or 3I-8 (EFI M relay) - Body ground	10 kΩ higher

(f) Reconnect the purge VSV connector.
(g) Reconnect the ECM connector.

(h) Reinstall the integration relay.

NG	Go to step 30
OK	Go to step 31

27 REPLACE HOSE (PURGE VSV - THROTTLE BODY)

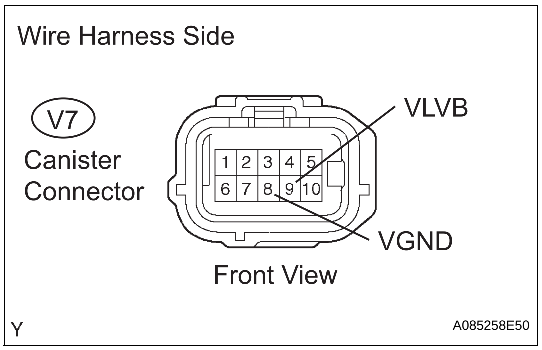
NEXT	Go to step 34

28 REPLACE PURGE VSV

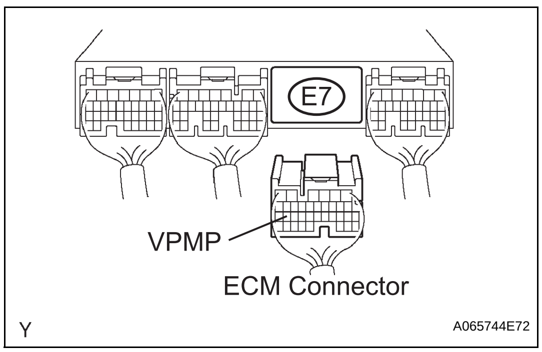
Replace the purge VSV (see page EC-23).

NEXT	Go to step 34

29 CHECK HARNESS AND CONNECTOR (VENT VALVE - ECM)



(a) Disconnect the V7 canister connector.



(b) Disconnect the E7 ECM connector.

(c) Check the harness and the connectors between the ECM and the canister connectors.

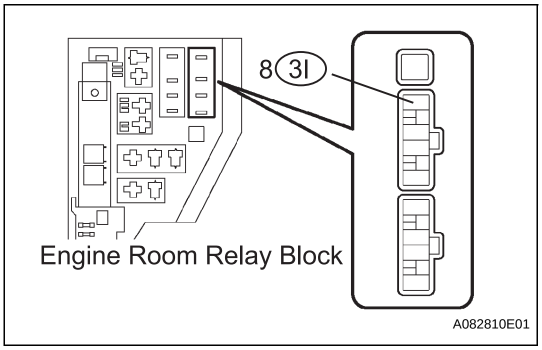
(1) Measure the resistance between the wire harness side connector.

Standard resistance (Check for open)

Tester Connection	Specified Condition
V7-8 (VGND) - E7-26 (VPMP)	Below 1 Ω

Standard resistance (Check for short)

Tester Connection	Specified Condition
V7-8 (VGND) or E7-26 (VPMP) - Body ground	10 kΩ higher



(d) Remove the integration relay from the engine room relay block.

(e) Check the harness and connectors between the canister connector and the EFI M relay.

(1) Measure the resistance between the wire harness side connectors.

Standard resistance (Check for open)

Tester Connection	Specified Condition
V7-9 (VLVB) - 3I-8 (EFI M relay)	Below 1 Ω

Standard resistance (Check for short)

Tester Connection	Specified Condition
V7-9 (VLVB) or 3I-8 (EFI M relay) - Body ground	10 kΩ higher

(f) Reconnect the canister connector.

(g) Reconnect the ECM connector.

(h) Reinstall the integration relay.

NG → Go to step 30

OK → Go to step 31

ES

30 REPAIR OR REPLACE HARNESS AND CONNECTOR

NEXT → Go to step 34

31 REPLACE ECM

Replace the ECM (see page ES-469).

NEXT → Go to step 34

32 CHECK AND REPLACE VENT HOSE OR CANISTER FILTER

NEXT → Go to step 34

33 REPLACE HOSE (PRESSURE SWITCHING VALVE AND FUEL TANK)

NEXT

34 PERFORM EVAP SYSTEM CHECK

(a) Turn the power switch ON (IG).

(b) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / SYSTEM CHECK / EVAP SYS CHECK / AUTO OPERATION.

(c) After the system check is finished, check for pending DTCs.

OK:
No DTC is present.

NG → **Go to step 6**

OK

35 PERFORM EVAP MONITOR DRIVE PATTERN

(a) Check that the following conditions are met:
- Fuel level is 1/8 to 7/8.
- Engine coolant temperature (ECT) is 4.4 to 35°C (40 to 95°F).
- Intake air temperature (IAT) is 4.4 to 35°C (40 to 95°F).
- Difference of ECT and IAT is less than 7°C (13°F).

(b) Enter the check mode. Enter the following menus: DIAGNOSIS / ENHANCED OBD II / CHECK MODE.
(c) Allow the engine to idle until the ECT is 75°C (167°F).
(d) Drive the vehicle at 50 km/h (30 mph) or faster and maintain that speed for 60 seconds or more.
(e) Stop the vehicle. Do not turn the power switch OFF.
(f) Check that the EVAP monitor status is complete. Enter the following menus: DIAGNOSIS / ENHANCED OBD II / MONITOR STATUS.
(g) If the EVAP monitor is incomplete, drive the vehicle at 50 km/h (30 mph) or faster and maintain that speed for 120 seconds or more. After that, recheck the EVAP monitor status.
(h) Check for pending DTCs.
OK:
No DTC is present.

NG → **Go to step 2**

OK

REPAIR COMPLETED

DTC P2601 Coolant Pump Control Circuit Range / Performance

DESCRIPTION

The coolant heat storage system uses an electric pump to supply hot coolant stored in the CHS tank into the cylinder head of the engine, in order to optimize engine starting combustion and reduce the amount of unburned gas that is discharged while the engine is started. Before the engine starts, the ECM operates the electric water pump to direct the hot coolant in the CHS tank into the engine, in order to heat the cylinder head (this process is called "preheat mode"). This system consists of the CHS tank, CHS water pump, CHS tank outlet temperature sensor, water valve, and a soak timer that is built in the ECM.

DTC No.	DTC Detection Condition	Trouble Area
P2601	Following conditions are successively met: • Difference in CHS tank outlet water temperature and engine coolant temperatures before and after starting preheating: within 2°C (3.6°F) • Change in CHS tank outlet water temperature during soaking: Below 1°C (1.8°F) of its temperature before CHS water pump is ON	• CHS water pump • CHS water pump relay • Open or short in CHS water pump circuit • ECM

MONITOR DESCRIPTION

The ECM detects malfunction in the coolant heat storage (CHS) system with the CHS tank coolant temperature, the position of the water valve, the running condition of the engine and the operating condition of the soak timer.

The soak timer built in the ECM prompts the ECM to actuate the water pump 5 hours after the HV system has been turned OFF by using the power switch. The ECM then checks the HV main system based on variations in the CHS tank outlet temperature (soak mode).

In order to ensure the reliable malfunction detection, the ECM detects the CHS water pump malfunction DTC in two ways. Thus, when the following two detection conditions are consecutively met, the ECM determines that there is malfunction in the water pump circuit and sets the DTC.

(1) Difference in the CHS tank outlet temperature and the engine coolant temperature before and after starting preheating at engine start (system start) is below 2°C (3.6°F).

(2) Variation in the CHS tank outlet temperature during soak mode is within 1°C (1.8°F) of its temperature before the CHS water pump was ON.

MONITOR STRATEGY

Related DTCs	P2601: Coolant pump control circuit range/performance
Required sensors/components	Coolant heat storage tank outlet temperature sensor
Frequency of operation	Once per driving cycle
Duration	10 seconds
MIL operation	1 driving cycle
Sequence of operation	None

TYPICAL ENABLING CONDITIONS

The monitor will run whenever the following DTCs are not present	None
Coolant heat storage system malfunction	Not detected
CHS water pump operation time	3 seconds or more
Variation in CHS tank outlet temperature and engine coolant temperature before and after preheating	2°C (3.6°F) or less
Storage coolant temperature	More than 65°C (149°F)

TYPICAL MALFUNCTION THRESHOLDS

Difference in CHS tank outlet coolant temperature before and after CHS water pump ON	Less than 1°C (1.8°F)

WIRING DIAGRAM

Refer to DTC P1120 (see page ES-301).

INSPECTION PROCEDURE

CAUTION:

Be careful when replacing any part in the CHS system or changing the coolant because the coolant in the CHS tank is hot even if the engine and the radiator are cold.

ES

NOTICE:

If air bleeding is not performed completely, this DTC may be detected after changing the coolant.

HINT:

- CHS stands for Coolant Heat Storage.
- Although the DTC title says "Coolant Pump", this DTC is related to the CHS water pump.
- The detection of this DTC indicates a malfunction in both the CHS water pump and the CHS W/P relay. Therefore, make sure to also check the relay when this DTC is output.
- To check the coolant heat storage (CHS) system, the ECM may cause the water pump of the CHS system to operate 5 hours after the power switch has been turned OFF.
- Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunction is detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1 CHECK OTHER DTC OUTPUT (IN ADDITION TO DTC P2601)

(a) Connect the intelligent tester to the DLC3.
(b) Turn the power switch ON (IG).
(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
P2601	A
P2601 and other DTCs	B

HINT:
If any other codes besides P2601 are output, perform troubleshooting for those DTCs first.

B → **GO TO RELEVANT DTC CHART**

A

2 PERFORM ACTIVE TEST BY INTELLIGENT TESTER (OPERATE WATER PUMP)

(a) Connect the intelligent tester to the DLC3.
(b) Turn the power switch ON (IG).
(c) Turn the tester ON.

(d) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / WATER PUMP.

(e) Check that the CHS W/P relay operates and the operating sounds of the water pump occurs.

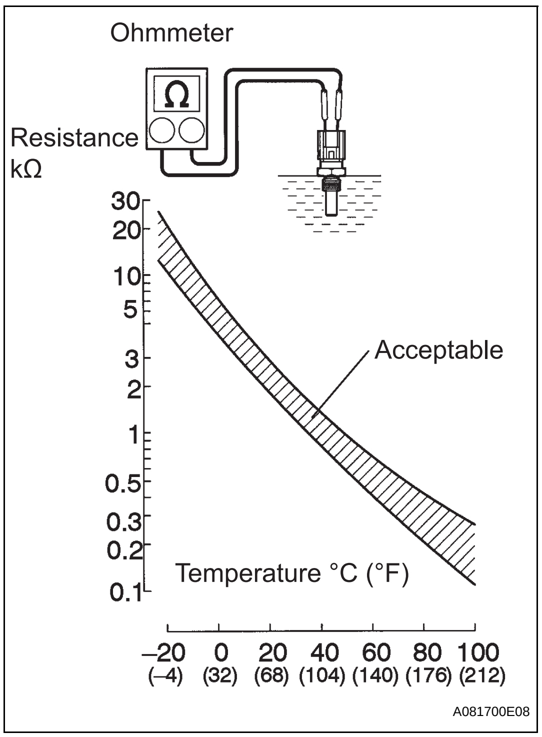
Result

Tester operation	Specified Condition
WATER PUMP ON	CHS W/P relay and water pump operates

NG → **Go to step 5**

OK

3 INSPECT TEMPERATURE SENSOR (CHS TANK OUTLET TEMPERATURE SENSOR)



(a) Remove the coolant heat storage (CHS) tank outlet temperature sensor.

(b) Measure the resistance between the terminals.

Standard resistance

Tester Connection	Specified Condition
1 - 2	2 to 3 kΩ at 20°C (68°F)
1 - 2	0.2 to 0.4 kΩ at 80°C (176°F)

NOTICE:
In case of checking the CHS tank outlet temperature sensor in the water, be careful not to allow water to contact the terminals. After checking, dry the sensor.

HINT:
Alternate procedure: Connect an ohmmeter to the installed CHS tank outlet temperature sensor and read the resistance. Use an infrared thermometer to measure the CHS tank outlet 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.

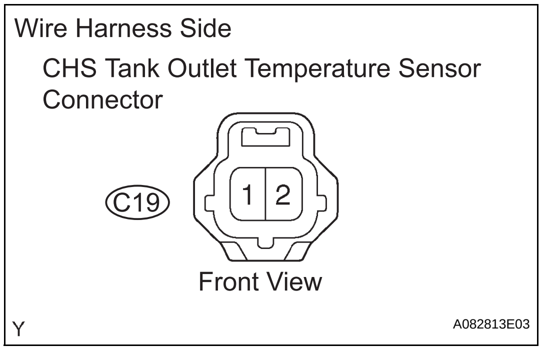
(c) Reinstall the coolant heat storage tank outlet temperature sensor.

NG → **REPLACE TEMPERATURE SENSOR**

OK

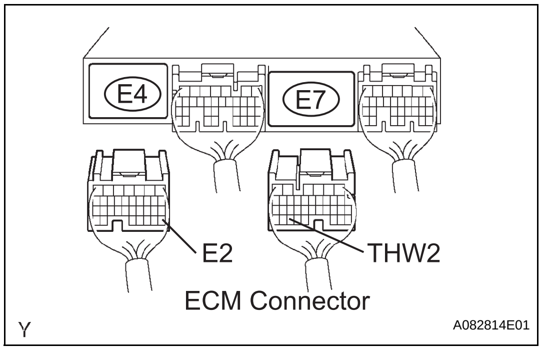
ES

4	CHECK HARNESS AND CONNECTOR (ECM - CHS TANK OUTLET TEMPERATURE SENSOR)



(a) Check the harness and the connectors between the CHS tank outlet temperature sensor connector and the ECM connector.

(1) Disconnect the C19 CHS tank outlet temperature sensor connector.



(2) Disconnect the E4 and E7 ECM connectors.

(3) Measure the resistance between the wire harness side connectors.

Standard resistance (Check for open):

Tester Connection	Specified Condition
C19-2 (CHS tank outlet temperature sensor) - E7-33 (THW2)	Below 1 Ω
C19-1 (CHS tank outlet temperature sensor) - E4-28 (E2)	Below 1 Ω

Standard resistance (Check for short):

Tester Connection	Specified Condition
C19-2 (CHS tank outlet temperature sensor) or E7-33 (THW2) - Body ground	10 kΩ or higher

(4) Reconnect the CHS tank outlet temperature sensor connector.

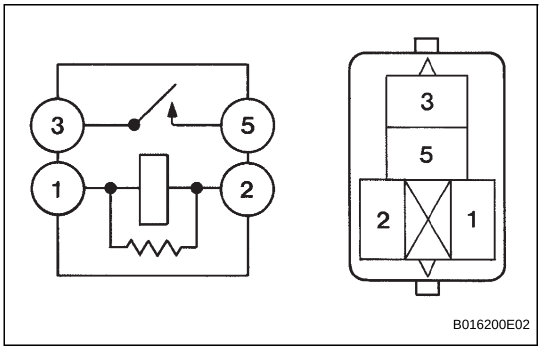
(5) Reconnect the ECM connectors.

NG → **REPAIR OR REPLACE HARNESS AND CONNECTOR**

OK

REPLACE ECM

5 INSPECT COOLANT HEAT STORAGE WATER PUMP RELAY (CHS WATER PUMP RELAY)



(a) Remove the CHS W/P relay from the engine room No. 2 relay block.
(b) Inspect the CHS W/P relay.
Standard resistance

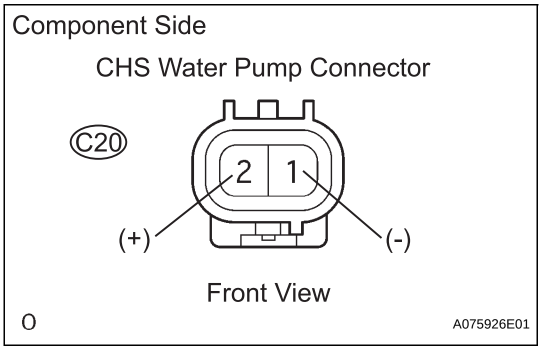
Tester Connection	Specified Condition
3 - 5	Below 1 Ω
3 - 5	10 kΩ or higher (Apply battery voltage to terminals 1 and 2)

(c) Reinstall the CHS W/P relay.

NG → **REPLACE COOLANT HEAT STORAGE WATER PUMP RELAY**

OK

6 INSPECT WATER W/MOTOR & BRACKET PUMP ASSEMBLY



(a) Disconnect the C20 CHS water pump connector.
(b) Measure the resistance between the terminals of the water pump.
Standard resistance

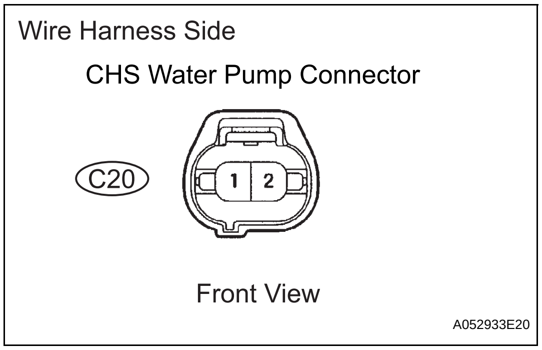
Tester Connection	Specified Condition
1 - 2	0.3 to 100 Ω

(c) Reconnect the CHS water pump connector.

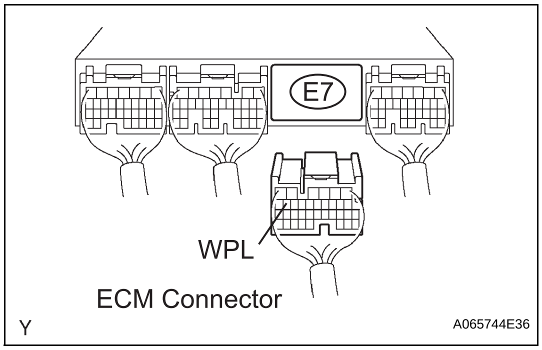
NG → **REPLACE WATER W/MOTOR & BRACKET PUMP ASSEMBLY**

OK

7 CHECK HARNESS AND CONNECTOR (CHS W/P RELAY - WATER PUMP AND ECM, WATER PUMP - GROUND)



(a) Check the harness and the connectors between the CHS water pump connector and the ECM connector.
 (1) Remove the CHS W/P relay from the engine room No. 2 relay block.



(2) Disconnect the E7 ECM connector.
(3) Measure the resistance between the wire harness side connectors.

Standard resistance (Check for open)

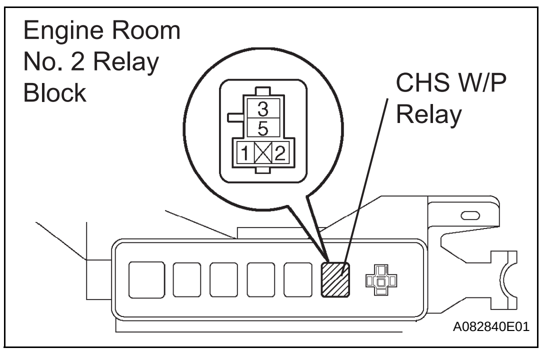
Tester Connection	Specified Condition
E7-15 (WPL) - 2 (CHS W/P relay)	Below 1 Ω

Standard resistance (Check for short)

Tester Connection	Specified Condition
2 (CHS W/P relay) or E7-15 (WPL) - Body ground	10 kΩ or higher

(4) Reinstall the integration relay.
(5) Reconnect the ECM connector.

(b) Check the harness and the connectors between the CHS water pump connector and the CHS W/P relay.



(1) Disconnect the CHS water pump connector.
(2) Remove the CHS W/P relay from the engine room relay block No.2.
(3) Measure the resistance between the wire harness side connectors.

Standard resistance (Check for open)

Tester Connection	Specified Condition
2 (CHS water pump) - 5 (CHS W/P relay)	Below 1 Ω
1 (CHS water pump) - Body ground	Below 1 Ω

Standard resistance (Check for short)

Tester Connection	Specified Condition
2 (CHS water pump) or 5 (CHS W/P relay) - Body ground	10 kΩ or higher

(4) Reconnect the CHS water pump connector.
(5) Reinstall the integration relay.

NG → **REPAIR OR REPLACE HARNESS AND CONNECTOR**

OK

REPLACE ECM

DTC	P2610	ECM / PCM Internal Engine Off Timer Performance

MONITOR DESCRIPTION

To check the heat retention of the tank in the coolant heat storage (CHS) system, the ECM may cause the water pump of the CHS system to operate 5 hours after the power switch has been turned OFF.
A timer and a clock are contained in the ECM internal circuit, and the timer starts when the power switch is turned OFF (this process is called the "soak mode").
When the HV main system is started at the power switch, the ECM monitors its internal circuit. If the ECM detects a deviation between the clock and the timer, or an abnormal condition during a comparison between the starting history and the length of time the HV main power has been turned OFF, the ECM determines that its internal circuit has malfunction and sets a DTC.

DTC No.	DTC Detection Condition	Trouble Area
P2610	ECM internal error	• ECM

MONITOR STRATEGY

Related DTCs	P2610: ECM internal engine off timer performance
Required sensors/components (main)	ECM
Frequency of operation	Once per driving cycle
Duration	600 seconds
MIL operation	2 driving cycles
Sequence of operation	None

TYPICAL ENABLING CONDITIONS

The monitor will run whenever the following DTCs are not present	None
Engine	Running

TYPICAL MALFUNCTION THRESHOLDS

Case 1

Time internal engine off timer clock reads when CPU clock has elapsed 600 seconds	Less than 420 seconds or more than 780 seconds

Case 2

Presents of history that ECM had woken up by internal engine off timer	YES
Time period vehicle has been soaked	Less than programmed period

Case 3

Presents of history that ECM had woken up by internal engine off timer	NO
Time period vehicle has been soaked	More than or equal to programmed period

INSPECTION PROCEDURE

HINT:
Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunction is detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1	REPLACE ECM

NEXT

REPAIR COMPLETED

DTC	P2A00	A/F Sensor Circuit Slow Response (Bank 1 Sensor 1)

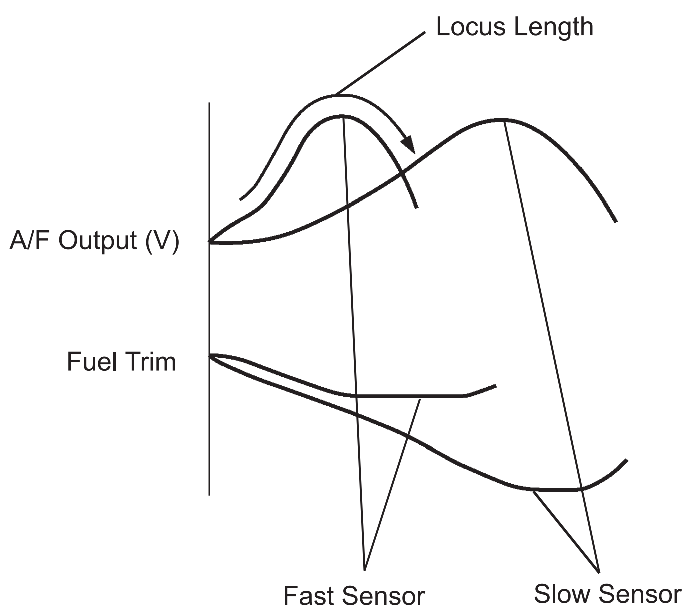
DESCRIPTION

Refer to DTC P2195 (see page ES-344).

DTC No.	DTC Detection Condition	Trouble Area
P2A00	When A/F sensor output voltage change is below compared to fuel trim change, ECM judges that A/F sensor circuit response is slow if conditions (a), (b) and (c) are met (2 trip detection logic): (a) After engine is warmed up (b) Engine speed is 1,100 rpm or more (c) Vehicle speed 37.5 mph (60 km/h) or more	• Open or short in A/F sensor (bank 1 sensor 1) circuit • A/F sensor (bank 1 sensor 1) • A/F sensor heater • EFI M relay • A/F sensor heater and relay circuit • Air induction system • Fuel pressure • Injector • PCV hose connection • ECM

HINT:
Sensor 1 refers to the sensor mounted before the TWC and is located near the engine assembly.

MONITOR DESCRIPTION



Y
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The air fuel-ratio (A/F) sensor varies its output voltage in proportion to the air-fuel ratio. Based on the output voltage, the ECM determines if the air-fuel ratio is RICH or LEAN and adjusts the stoichiometric air-fuel ratio.
The ECM also checks the fuel injection volume compensation value to check if the A/F sensor is deteriorating or not. The output voltage variation, known as locus length, should be high when the air-fuel ratio fluctuates.

When the A/F sensor response rate has deteriorated, the locus length should be short.
The ECM concludes that there is malfunction in the A/F sensor when the locus length is short and the response rate has deteriorated.

MONITOR STRATEGY

Related DTCs	P2A00: A/F sensor circuit slow response
Required sensors/components	Main: A/F sensor Related: Engine speed sensor, vehicle speed sensor
Frequency of operation	Once per driving cycle
Duration	60 seconds
MIL operation	2 driving cycles
Sequence of operation	None

TYPICAL ENABLING CONDITIONS

The monitor will run whenever the following DTCs are not present	P0031, P0032 (A/F sensor heater - Sensor 1) P0100 - P0103 (MAF meter) P0110 - P0113 (IAT sensor) P0115 - P0118 (ECT sensor) P0120 - P0223, P2135 (TP sensor) P0125 (Insufficient ECT for closed loop) P0171, P0172 (Fuel system) P0300 - P0304 (Misfire) P0335 (CKP sensor) P0340, P0341 (CMP sensor) P0442 - P0456 (EVAP system) P0500 (VSS) P2196 (A/F sensor - Rationality)
Engine	Running
Time after first engine start	120 seconds
Fuel system status	Closed-loop
A/F sensor status	Activated
Idle	OFF
Time after idle off	2 seconds or more
Engine speed	1,100 rpm or more, and less than 3,400 rpm
Vehicle speed	37.5 mph (60 km/h) or more, and Less than 75 mph (120 km/h)
Fuel cut	OFF
Time after fuel cut is off	3 seconds or more

TYPICAL MALFUNCTION THRESHOLDS

Response rate deterioration level	8 or more

COMPONENT OPERATING RANGE

Heated oxygen sensor heater current	0.4 to 1.0 A (during idling and battery voltage 11 to 14 V)

MONITOR RESULT

Refer to detailed information (see page ES-15).

WIRING DIAGRAM

Refer to DTC P2195 (see page ES-347).

ES

INSPECTION PROCEDURE

HINT:

Malfunctioning areas can be found by performing the ACTIVE TEST / A/F CONTROL operation. The A/F CONTROL operation can determine if the A/F sensor, heated oxygen sensor or other potential trouble area are malfunctioning or not.

(a) Perform the ACTIVE TEST A/F CONTROL operation.

HINT:

The A/F CONTROL operation lowers the injection volume 12.5% or increases the injection volume 25%.

(1) Connect the intelligent tester to the DLC3.

(2) Turn the power switch ON (IG).

(3) Put the engine in inspection mode (see page ES-1).

(4) Warm up the engine by running the engine at 2,500 rpm, depressing the accelerator pedal more than 60% for approximately 90 seconds.

(5) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / A/F CONTROL.

(6) Perform the A/F CONTROL operation with the engine in an idle condition (press the right or left button).

Result:

A/F sensor reacts in accordance with increase and decrease of injection volume:
+25% → rich output: Less than 3.0 V
-12.5% → lean output: More than 3.35 V
Heated oxygen sensor reacts in accordance with increase and decrease of injection volume:
+25% → rich output: More than 0.55 V
-12.5% → lean output: Less than 0.4 V

NOTICE:

The A/F sensor output has a few seconds of delay and the heated oxygen sensor output has about 20 seconds of delay at maximum.

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	 OK	Output Voltage More than 0.55 V Less than 0.4 V	 OK	
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	NG	Output Voltage More than 0.55 V Less than 0.4 V	 OK	
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	 OK	Output Voltage Almost no reaction	NG	
4	Injection Volume +25% -12.5%		Injection Volume +25% -12.5%		• Fuel Injector • Fuel pressure • Gas leakage from exhaust system (Air-fuel ratio extremely or lean rich)
	Output Voltage Almost no reaction	NG	Output Voltage Almost no reaction	NG	

The following A/F CONTROL procedure enables the technician to check and graph the voltage output of both A/F sensor and heated oxygen sensor.
To display the graph, enter ACTIVE TEST/ A/F CONTROL/USER DATA, select "AFS B1S1 and O2S B1S2" by pressing the "YES" button followed by the "ENTER" button and then the "F4" button.
HINT:
- DTC P2A00 may be also detected, when the air-fuel ratio stays RICH or LEAN.
- Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunction is detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.
- A high A/F sensor voltage could be caused by a RICH air-fuel mixture. Check the conditions that would cause the engine to run with the RICH air-fuel mixture.
- A low A/F sensor voltage could be caused by a LEAN air-fuel mixture. Check the conditions that would cause the engine to run with the LEAN air-fuel mixture.

1 CHECK OTHER DTC OUTPUT (IN ADDITION TO A/F SENSOR DTC)

(a) Connect the intelligent tester to the DLC3.
(b) Turn the power switch ON (IG).
(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
P2A00	A
P2A00 and other DTCs	B

HINT:
If any other code besides P2A00 are output, perform troubleshooting for those DTCs first.

B → **GO TO RELEVANT DTC CHART**

A

2 READ VALUE OF INTELLIGENT TESTER (OUTPUT VOLTAGE OF A/F SENSOR)

(a) Connect the intelligent tester to the DLC 3.
(b) Put the engine in inspection mode (see page ES-1).
(c) Warm up the A/F sensors (bank 1 sensor 1) by running the engine at 2,500 rpm with the accelerator pedal depressed more than 60 % for approximately 90 seconds.
(d) Read A/F sensor voltage output on the intelligent tester.
(e) Enter the following menus: ENHANCED OBD II / SNAPSHOT / MANUAL SNAPSHOT / USER DATA.
(f) Select "AFS B1 S1/ENGINE SPD" and press button "YES".
(g) Monitor the A/F sensor voltage carefully.
(h) Check the A/F sensor voltage output under the following conditions:
(1) Put the engine in inspection mode and allow the engine to idle for 30 seconds.

(2) Put the engine in inspection mode and running the engine at 2,500 rpm with the accelerator pedal depressed more than 60% (where engine RPM is not suddenly changed).

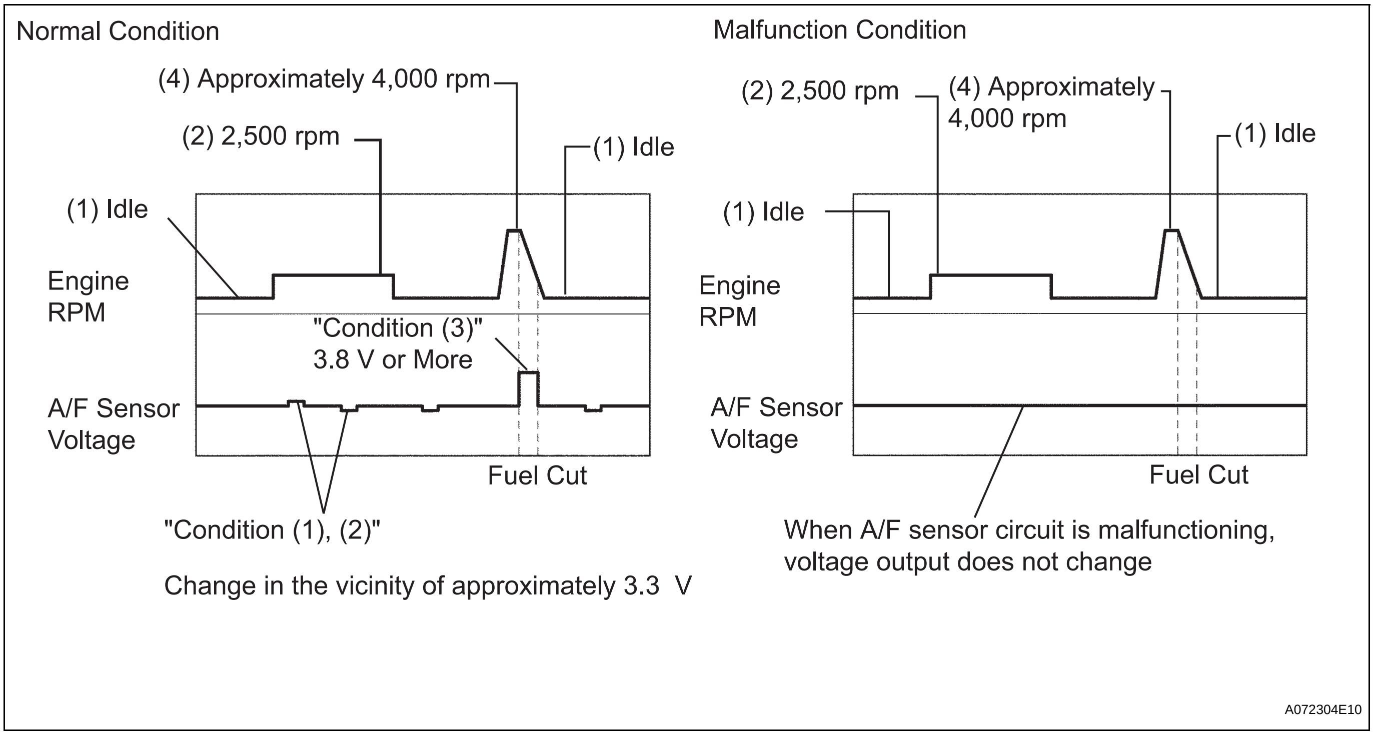
(3) Deactivate the inspection mode and drive the vehicle with shift position "B" range.

(4) Accelerate the vehicle to 70 km/h (44 mph) and quickly release the accelerator pedal so that the throttle valve is fully closed.

CAUTION:
- **Strictly observe of posted speed limits, traffic laws, and road conditions when performing these drive patterns.**
- **Do not drive the vehicle without deactivating inspection mode, otherwise damaging the transaxle may result.**

OK:

Condition (1) and (2)
Voltage changes in the vicinity of 3.3 V (between approximately 3.1 to 3.5 V) as shown in the illustration.
Condition (4)
A/F sensor voltage increases to 3.8 V or more during engine deceleration (when fuel cut) as shown in the illustration.



HINT:
- Whenever the output voltage of the A/F sensor remains at approximately 3.3 V (see diagram Malfunction Condition) under any condition as well as the above conditions, the A/F sensor may have an open-circuit. (This will happen also when the A/F sensor heater has an open-circuit.)

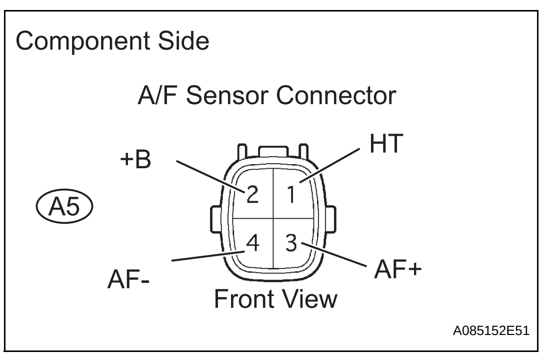
ES

- Whenever the output voltage of the A/F sensor remains at a certain value of approximately 3.8 V or more, or 2.8 V or less (see diagram Malfunction Condition) under any condition as well as the above conditions, the A/F sensor may have a short-circuit.
- The ECM will stop fuel injection (fuel cut) during engine deceleration. This will cause a LEAN condition and should result in a momentary increase in A/F sensor voltage output.
- The ECM must establish a closed throttle position learned value to perform fuel cut. If the battery terminal was reconnected, the vehicle must be driven over 10 mph to allow the ECM to learn the closed throttle position.
- When the vehicle is driven:
  The output voltage of the A/F sensor may be below 2.8 V during fuel enrichment. For the vehicle, this translates to a sudden increase in speed with the accelerator pedal fully depressed when trying to overtake another vehicle. The A/F sensor is functioning normally.
- The A/F sensor is a current output element, and therefore the current is converted into voltage inside the ECM. If measuring voltage at connectors of A/F sensor or ECM, you will observe a constant voltage.

OK → **Go to step 14**

NG

3 INSPECT AIR FUEL RATIO SENSOR (RESISTANCE OF A/F SENSOR HEATER)



(a) Disconnect the A5 A/F sensor connector.
(b) Measure the resistance between the terminals of the A/F sensor.
Standard resistance

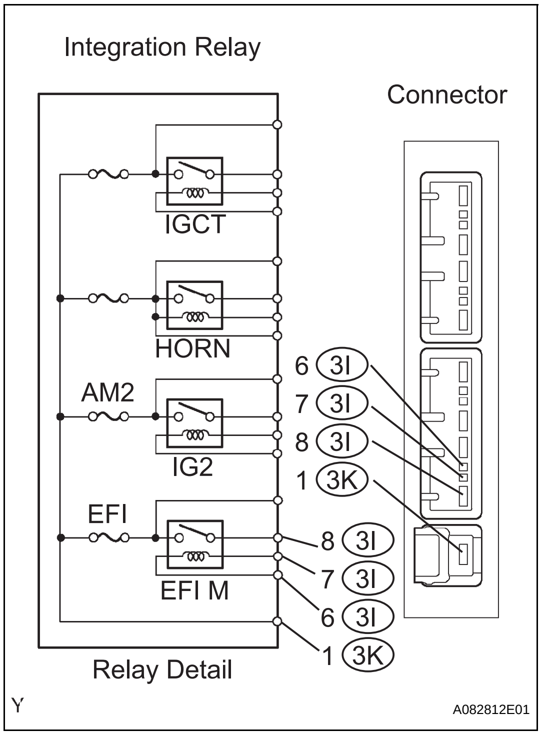
Tester Connection	Resistance
1 (HT) - 2 (+B)	1.8 to 3.4 Ω at 20°C (68°F)

(c) Reconnect the A/F sensor connector.

NG → **REPLACE AIR FUEL RATIO SENSOR**

OK

4	INSPECT INTEGRATION RELAY (EFI M RELAY)



(a) Remove the integration relay from the engine room relay block.
(b) Inspect the EFI M relay.
Standard resistance

Tester Connection	Specified Condition
3K-1 - 3I-8	10 kΩ or higher
3K-1 - 3I-8	Below 1 Ω (Apply battery voltage to terminals 3I-6 and 3I-7)

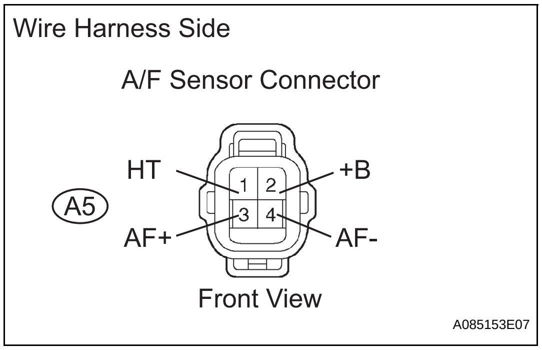
(c) Reinstall the integration relay.

ES

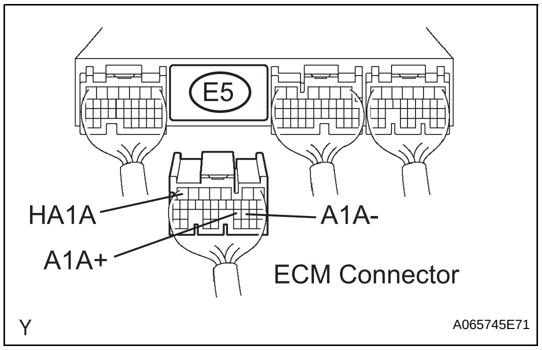
NG → **REPLACE INTEGRATION RELAY**

OK

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



(a) Disconnect the A5 A/F sensor connector.



(b) Disconnect the E5 ECM connector.
(c) Measure the resistance between the wire harness side connectors.
Standard resistance (Check for open)

Tester Connection	Specified Condition
A5-3 (AF+) - E5-23 (A1A+)	Below 1 Ω
A5-4 (AF-) - E5-22 (A1A-)	Below 1 Ω
A5-1 (HT) - E5-7 (HA1A)	Below 1 Ω

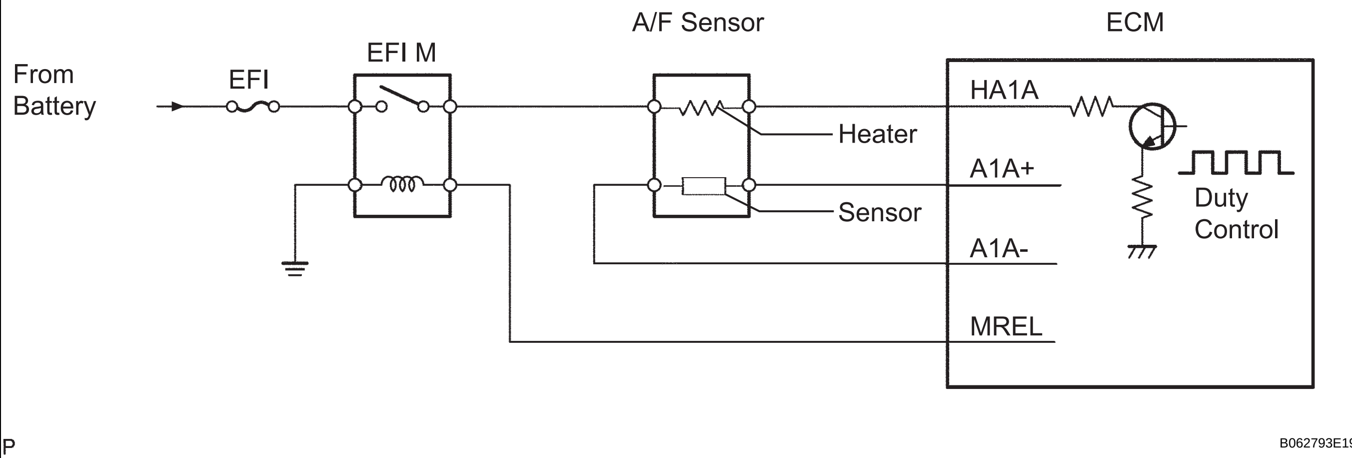
Standard resistance (Check for short)

Tester Connection	Specified Condition
A5-3 (AF+) or E5-23 (A1A+) - Body ground	10 kΩ or higher

Tester Connection	Specified Condition
A5-4 (AF-) or E5-22 (A1A-) - Body ground	10 kΩ or higher
A5-1 (HT) or E5-7 (HA1A) - Body ground	10 kΩ or higher

(d) Reconnect the A/F sensor connector.
(e) Reconnect the ECM connector.

Reference (Bank 1 Sensor 1 System Diagram)



NG → **REPAIR OR REPLACE HARNESS AND CONNECTOR**

OK

6 CHECK AIR INDUCTION SYSTEM

(a) Check for vacuum leaks in the air induction system.
OK:
There is no leakage in the air induction system.

NG → **REPAIR OR REPLACE AIR INDUCTION SYSTEM**

OK

7 CHECK CONNECTION OF PCV HOSE

OK:
PCV hose is connected correctly and PCV hose has no damage.

NG → **REPAIR OR REPLACE PCV HOSE**

OK

8	CHECK FUEL PRESSURE

OK:

Fuel pressure: 304 to 343 kPa (3.1 to 3.5 kgf/cm^2, 44 to 50 psi)

NG → **REPAIR OR REPLACE FUEL SYSTEM**

OK

9	INSPECT FUEL INJECTOR ASSEMBLY

(a) Check the injector injection (high or low fuel injection quantity or poor injection pattern).

OK:

Injection volume: 36 to 46 cm^3 (2.1 to 2.8 cu in.) per 15 seconds.

NG → **REPLACE FUEL INJECTOR ASSEMBLY**

OK

10	REPLACE AIR FUEL RATIO SENSOR

GO

11	PERFORM CONFIRMATION DRIVING PATTERN

HINT:

Clear all DTCs prior to performing the confirmation driving pattern (see page ES-347).

GO

12	READ OUTPUT DTC (SEE IF A/F SENSOR DTC IS OUTPUT AGAIN)

(a) Connect the intelligent tester to the DLC3.
(b) Turn the power switch ON (IG).
(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
No output	A
P2A00 again.	B

B → **REPLACE ECM AND PERFORM CONFIRMATION DRIVING PATTERN**

ES

A

13 CONFIRM IF VEHICLE HAS RUN OUT OF FUEL IN PAST

OK:

Vehicle has run out of the fuel in the past.

NO → **CHECK FOR INTERMITTENT PROBLEMS**

YES

ES

DTC IS CAUSED BY RUNNING OUT OF FUEL

14 PERFORM CONFIRMATION DRIVING PATTERN

HINT:

Clear all DTCs prior to performing the confirmation driving pattern (see page ES-347).

GO

15 READ OUTPUT DTC (SEE IF A/F SENSOR DTC IS OUTPUT AGAIN)

(a) Connect the intelligent tester to the DLC3.
(b) Turn the power switch ON (IG).
(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
P2A00	A
No output	B

B → **Go to step 19**

A

16 REPLACE AIR FUEL RATIO SENSOR

GO

17 PERFORM CONFIRMATION DRIVING PATTERN

HINT:

Clear all DTCs prior to performing the confirmation driving pattern (see page ES-347).

GO

18	READ OUTPUT DTC (SEE IF A/F SENSOR DTC IS OUTPUT AGAIN)

(a) Connect the intelligent tester to the DLC3.
(b) Turn the power switch ON (IG).
(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
No output	A
P2A00	B

B → **REPLACE ECM AND PERFORM CONFIRMATION DRIVING PATTERN**

A

19	CONFIRM IF VEHICLE HAS RUN OUT OF FUEL IN PAST

OK:
Vehicle has run out of the fuel in the past.

NO → **CHECK FOR INTERMITTENT PROBLEMS**

YES

DTC IS CAUSED BY RUNNING OUT OF FUEL

DTC	P3190	Poor Engine Power

DTC	P3191	Engine dose not Start

DTC	P3193	Fuel Run Out

DESCRIPTION

From the HV ECU, the ECM receives data such as power output required for the engine (required output), estimated torque produced by the engine (estimated torque), engine RPM of control target (target RPM), whether the engine is in start mode or not. Then, based on the required output and target RPM, the ECM calculates a target torque that is to be produced by the engine and compares it with the estimated torque. If the estimated torque is very low compared with the target torque, or the engine start mode continues for the specific duration calculated by water temperature, an abnormal condition is detected.

DTC No.	DTC Detection Condition	Trouble Area
PP3190	Following conditions continue at a fixed engine RPM or a fixed length of time: • Communication with HV ECU is normal • Engine RPM is a fixed value or more • Engine start mode is not active • Target torque is a fixed value • Ratio of estimated torque against target torque is less than 20%	• Air induction system • Throttle body • Fuel pressure • Engine • Mass Air flow meter • Out of fuel • Engine coolant temperature sensor • Crankshaft position sensor • Camshaft position sensor • ECM
PP3191	Following conditions continue at a fixed engine RPM or a fixed length of time: • Communication with HV ECU is normal • Engine RPM is a fixed value or more • Engine start mode is not active	• Air induction system • Throttle body • Fuel pressure • Engine • Mass Air flow meter • Out of fuel • Engine coolant temperature sensor • Crankshaft position sensor • Camshaft position sensor • ECM
PP3193	Following conditions are met: • Fuel low level signal input into ECM • Detection condition for P3190 or P3191 is satisfied	• Out of fuel • ECM

MONITOR DESCRIPTION

The ECM and HV control ECU are connected by a communication line called CAN. The ECM sends information on the engine speed and other data to the HV control ECU while the HV control ECU sends the information such as a requirement for the engine power to the ECM using the CAN communication line.

When the communication between the ECM and HV control ECU is normal and the following items becomes specific condition, the ECM will illuminates the MIL and sets a DTC.

(a) Engine speed
(b) Power switch
(c) Target torque
(d) Ratio of target torque against estimated torque
(e) Fuel level

MONITOR STRATEGY

Related DTCs	P3190: Poor engine power P3191: Engine does not start P3193: Fuel run out

Required sensors/components	Main sensors: Crankshaft position sensor Related sensors: HV control ECU
Frequency of operation	Continuous
Duration	100 engine revolutions and 6 seconds
MIL operation	Immediately
Sequence of operation	None

TYPICAL ENABLING CONDITIONS

The monitor will run whenever the following DTCs are not present	None
Fuel cut operation	Not operated
Engine speed	750 rpm or more (varies with engine coolant temperature)

TYPICAL MALFUNCTION THRESHOLDS

Case1: P3190

Time for low engine torque	100 engine revolutions or more, or 6 seconds or more (varies with engine coolant temperature)

Case2: P3191

Engine start no-determination time (receive from HV ECU)	100 engine revolutions or more, and 6 seconds or more (varies with engine coolant temperature)

Case3: P3193

Time for low engine torque or Engine start no-determination time	100 engine revolutions or more, and 6 seconds or more (varies with engine coolant temperature)

INSPECTION PROCEDURE

HINT:
Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunction is detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1	CHECK OTHER DTC OUTPUT (IN ADDITION TO DTC P3190, P3191 AND/OR P3193)

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

Display (DTC output)	Proceed to
P3190, P3191 and/or P3193	A
P3190, P3191 and/or P3193, and other DTCs	B

HINT:
If any other codes besides P3190, P3191 and/or P3193 are output, perform troubleshooting for those DTCs first.

B	GO TO RELEVANT DTC CHART

A

2	CHECK SHORTAGE OF FUEL

NG → REFILL FUEL

OK

3	CHECK AIR INDUCTION SYSTEM

OK:
The air induction system has no leakage and blockages.

NG → REPAIR OR REPLACE AIR INDUCTION SYSTEM

OK

4	CHECK FOR UNUSUAL NOISE OR VIBRATION WHEN STARTING ENGINE OR REVVING UP

OK:
Unusual noise and vibration do not occur.

NG → REPAIR OR REPLACE

OK

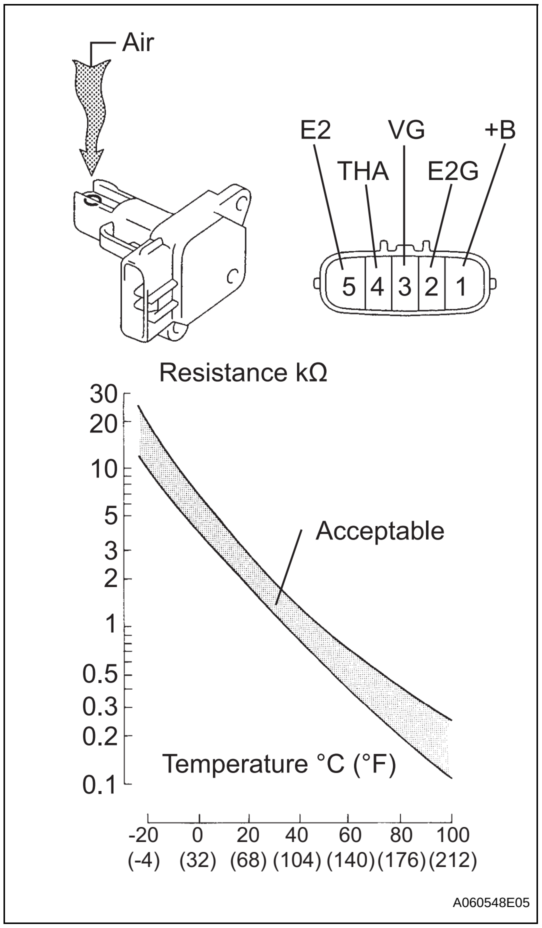
5	CHECK FUEL PRESSURE

OK:
Fuel pressure: 304 to 343 kPa (3.1 to 3.5 kgf/cm^2, 44 to 50 psi)

NG → CHECK AND REPAIR FUEL SYSTEM

OK

6	INSPECT MASS AIR FLOW METER



(a) Remove the mass air flow meter.

(b) Inspect output voltage.

(1) Apply battery voltage across terminals +B and E2G.

(2) Connect the positive (+) tester probe to terminal VG, and negative (-) tester probe to terminal E2G.

(3) Blow air into the mass air flow meter, and check that the voltage fluctuates.

Standard voltage

Tester Connection	Specified Condition
3 (VG) - 2 (E2G)	Sensor output voltage fluctuates between 0.3 V and 4.8 V

(c) Inspect resistance.

(1) Measure the resistance between the terminals of the mass air flow meter.

Standard resistance

Tester Connection	Specified Condition
4 (THA) - 5 (E2)	13.6 to 18.4 kΩ at -20°C (-4°F)
4 (THA) - 5 (E2)	2.21 to 2.69 kΩ at 20°C (68°F)
4 (THA) - 5 (E2)	0.49 to 0.67 kΩ at 60°C (140°F)

(d) Reinstall the mass air flow meter.

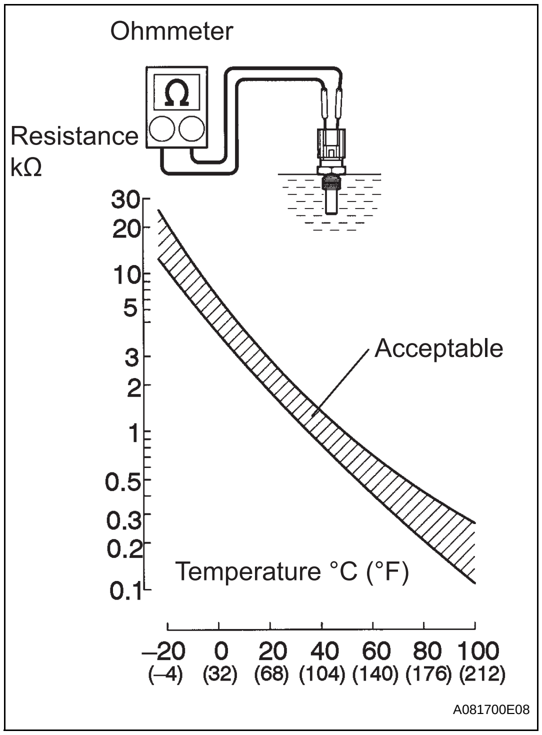
NG → **REPLACE MASS AIR FLOW METER**

OK

ES

ES

7 INSPECT ENGINE COOLANT TEMPERATURE SENSOR



(a) Remove the engine coolant temperature sensor.

(b) Measure the resistance between the terminals of the engine coolant temperature sensor.

Standard resistance

Tester Connection	Specified Condition
1 - 2	2 to 3 kΩ at 20°C (68°F)
1 - 2	0.2 to 0.4 kΩ at 80°C (176°F)

NOTICE:
When checking the engine coolant temperature sensor in water, be careful not to allow water to contact the terminals. After checking, dry the sensor.

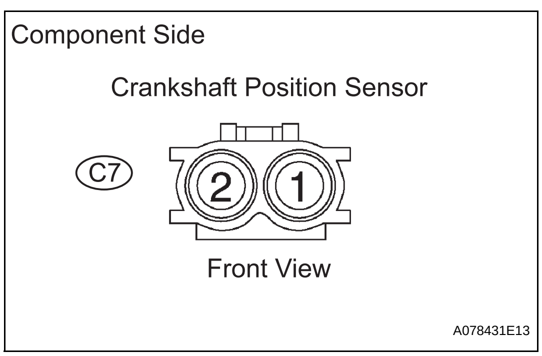
HINT:
Alternate procedure: Connect an ohmmeter to the installed engine coolant temperature sensor and read the resistance. Use an infrared thermometer to measure the engine temperature in the immediate vicinity of the sensor. Compare these values to the resistance/temperature graph. Change the engine 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

8 INSPECT CRANKSHAFT POSITION SENSOR



(a) Disconnect the C7 crankshaft position sensor connector.

(b) Measure the resistance between the terminals of the crankshaft position sensor connector.

Standard resistance

Tester Connection	Specified Condition
1 - 2	985 to 1,600 Ω at cold
1 - 2	1,265 to 1,890 Ω at hot

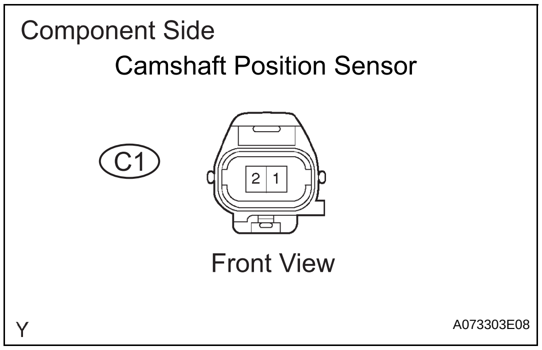
(c) Reconnect the crankshaft position sensor connector.

NOTICE:
Terms "cold" and "hot" refer to the temperature of the sensor. "Cold" means approximately -10 to 50 °C (14 to 122°F). "Hot" means approximately 50 to 100°C (122 to 212°F).

NG → **REPLACE CRANKSHAFT POSITION SENSOR**

OK

9 INSPECT CAMSHAFT POSITION SENSOR



(a) Disconnect the C1 camshaft position sensor connector.
(b) Measure the resistance between the terminals of camshaft position sensor connector.
Standard resistance

Tester Connection	Specified Condition
1 - 2	1,630 to 2,740 Ω at cold
1 - 2	2,065 to 3,225 Ω at hot

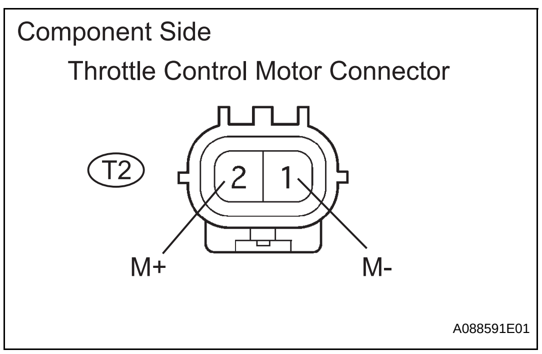
(c) Reconnect the camshaft position sensor connector.
NOTICE:
Terms "cold" and "hot" refer to the temperature of the sensor. "Cold" means approximately -10 to 50 °C (14 to 122°F). "Hot" means approximately 50 to 100°C (122 to 212°F).

NG → **REPLACE CAMSHAFT POSITION SENSOR**

ES

OK

10 INSPECT THROTTLE CONTROL MOTOR



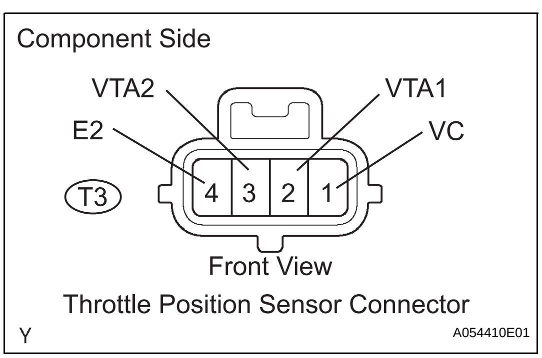
(a) Disconnect the throttle control motor connector.
(b) Using an ohmmeter, measure the motor resistance between terminals 1 (M-) and 2 (M+).
Standard resistance

Tester Connection	Specified Condition
1 - 2	0.3 to 100 Ω at 20°C (68°F)

NG → **REPLACE THROTTLE CONTROL MOTOR**

OK

11 INSPECT THROTTLE POSITION SENSOR



(a) Disconnect the throttle position sensor connector.
(b) Measure the resistance between the terminals of the throttle position sensor.
Standard resistance

Tester Connection	Specified Condition
1 (VC) - 4 (E2)	1.2 to 3.2 kΩ at 20°C (68°F)
2 (VTA1) - 4 (E2)	1.8 to 10.5 kΩ at 20°C (68°F)
3 (VTA2) - 4 (E2)	1.8 to 10.5 kΩ at 20°C (68°F)

NG → **REPLACE THROTTLE POSITION SENSOR**

OK

REPLACE ECM

DTC U0293 Lost Communication with HV ECU

DESCRIPTION

The Controller Area Network (CAN) is a serial data communication system for real-time application. It is a multiplex communication system designed for on-vehicle use that provides a superior communication speed of 500 kbps and a capability to detect malfunction. Through the combination of the CANH and CANL bus lines, the CAN is able to maintain communication based on differential voltage.

HINT:

- Malfunction in the CAN bus (communication line) can be checked through the DLC3 connector, except in case of an open circuit in the DLC3 sub bus line.
- DTCs pertaining to CAN communication can be accessed through the use of the intelligent tester II (with CAN extension module).
- Malfunction in the DLC3 sub bus line cannot be detected through CAN communication, even though the DLC3 connector is connected to CAN communication.

DTC No.	DTC Detection Condition	Trouble Area
U0293	When communication with HV ECU is interrupted	• Wire harness • HV ECU • ECM

MONITOR DESCRIPTION

The ECM and the HV control ECU are connected through a set of communication lines on the CAN, in order to maintain mutual communication. The ECM uses the communication lines to transmit the engine speed or other pieces of information to the HV control ECU. The HV control ECU transmits signals such as a engine torque request signal to the ECM.

A few seconds after the power switch is turned ON (IG), the ECM starts checking for any malfunction in the communication with the HV ECU. If the ECM detects a malfunction in the communication, the ECM sets a DTC and illuminates the MIL.

MONITOR STRATEGY

Related DTCs	U0293: Lost communication with HV ECU
Required sensors/components	ECM
Frequency of operation	Continuous
Duration	0.68 seconds
MIL operation	Immediately
Sequence of operation	None

TYPICAL ENABLING CONDITIONS

The monitor will run whenever the following DTCs are not present	None
Power switch	ON

TYPICAL MALFUNCTION THRESHOLDS

Communication signal	No signal from HV ECU

WIRING DIAGRAM

Refer to CAN Communication System (see page CA-4).

INSPECTION PROCEDURE

Refer to CAN Communication System (see page CA-6).

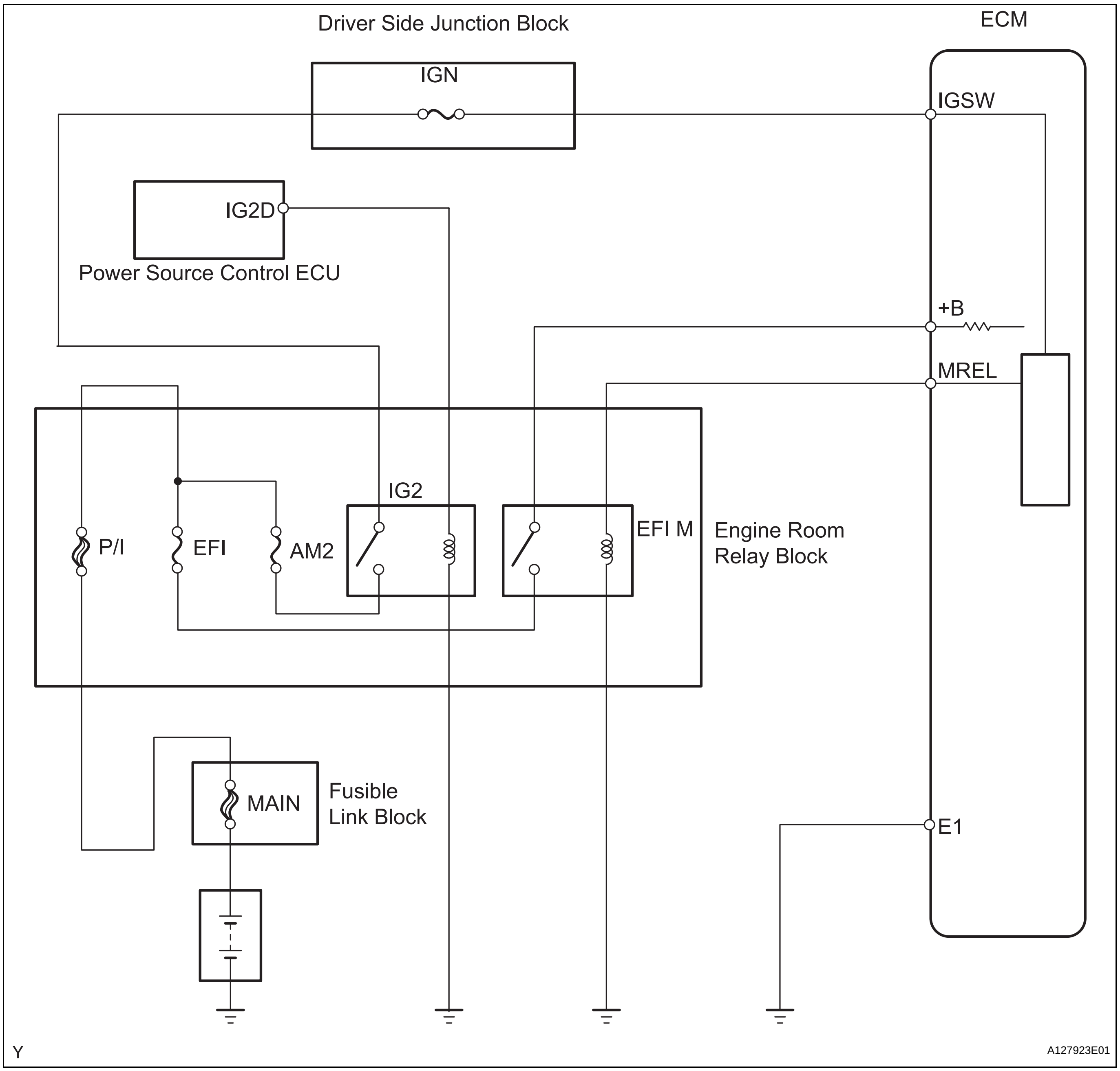
HINT:
Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunction is detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

ECM Power Source Circuit

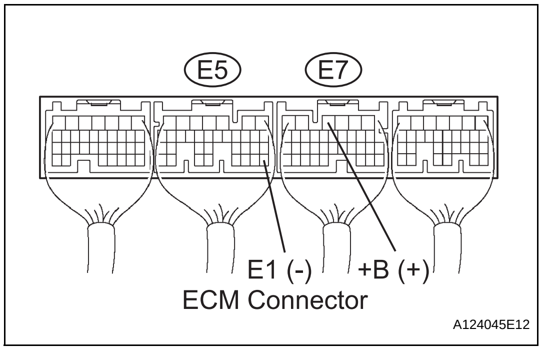
DESCRIPTION

The power source circuit of the hybrid system differs from the conventional power source circuit in the method in which the battery voltage is supplied to IGSW terminal of the ECM. The hybrid system has adopted one relay to serve as the power switch, which is controlled by the power source control ECU. When the HV system is turned ON, the power source control ECU actuates the IG2 relay, which applies the battery voltage to IGSW terminal of the ECM. This causes the MREL terminal to transmit a signal to the EFI M relay. Then, the current that passes through the contact points of the EFI M relay (which is actuated by the MREL signal) flows to the +B terminal of the ECM.
When the power switch is turned OFF, the ECM keeps the EFI M relay ON for a maximum of 2 seconds, in order to initialize the throttle valve.

WIRING DIAGRAM



1	CHECK ECM (+B VOLTAGE)



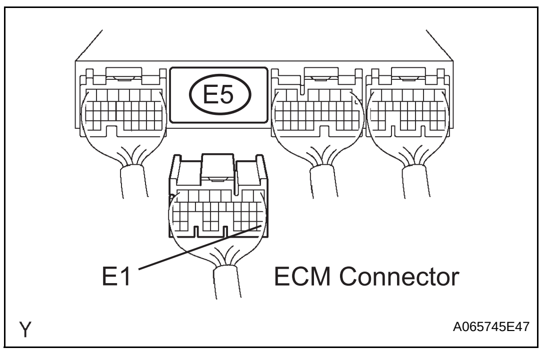
(a) Turn the power switch ON (IG).
(b) Measure the voltage between the specified terminals of the E5 and E7 ECM connectors.
Standard voltage

Tester Connection	Specified Condition
E7-4 (+B) - E5-28 (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 E5 ECM connector.
(b) Measure the resistance between the wire harness side connectors.
Standard resistance (Check for open)

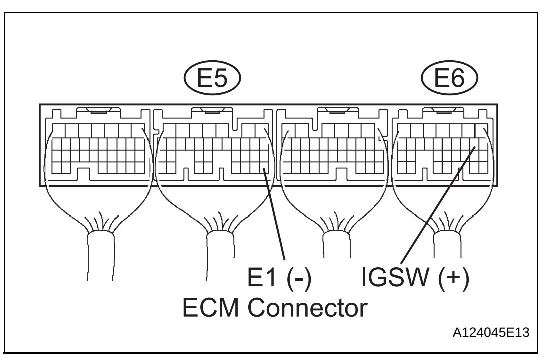
Tester Connection	Specified Condition
E5-28 (E1) - Body ground	Below 1 Ω

(c) Reconnect the ECM connector.

NG → **REPAIR OR REPLACE HARNESS AND CONNECTOR**

OK

3	CHECK ECM (IGSW VOLTAGE)



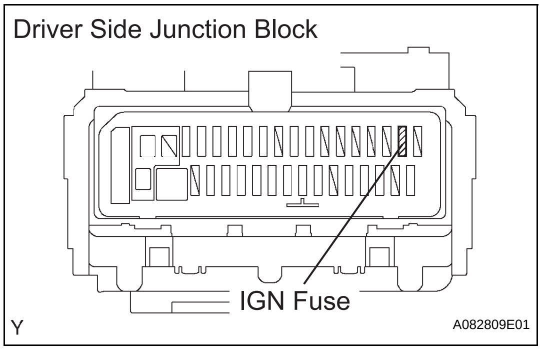
(a) Turn the power switch ON (IG).
(b) Measure the voltage between the specified terminals of the E5 and E6 ECM connectors.
Standard voltage

Tester Connection	Specified Condition
E6-9 (IGSW) - E5-28 (E1)	9 to 14 V

OK → **Go to step 7**

NG

4	INSPECT FUSE (IGN FUSE)

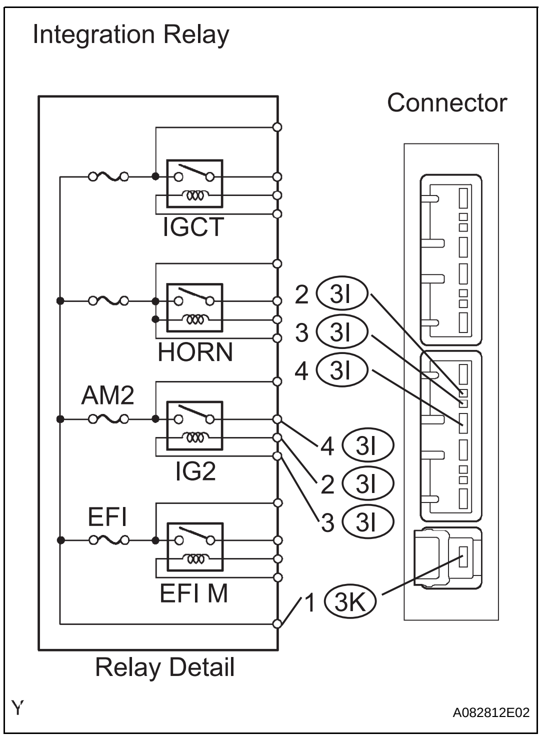


(a) Remove the IGN fuse from the driver side junction block.
(b) Measure the resistance of the IGN fuse.
Standard resistance:
Below 1 Ω
(c) Reinstall the IGN fuse.

NG → **CHECK FOR SHORT IN ALL HARNESS AND COMPONENTS CONNECTED TO FUSE**

OK

5	INSPECT INTEGRATION RELAY (IG2 RELAY)



(a) Remove the integration relay from the engine room relay block.
(b) Inspect the EFI M relay.
Standard resistance

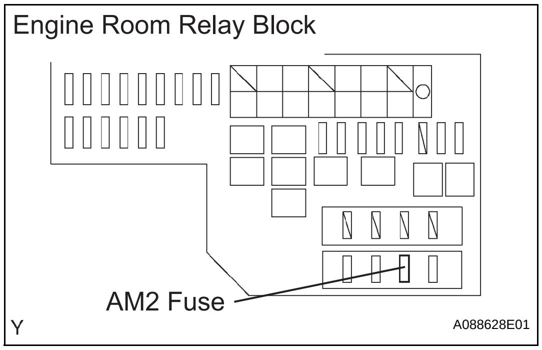
Tester Connection	Specified Condition
3K-1 - 3I-4	10 kΩ or higher
3K-1 - 3I-4	Below 1 Ω (Apply battery voltage to terminals 3I-2 and 3I-3)

(c) Reinstall the integration relay.

NG → **REPLACE INTEGRATION RELAY**

OK

6	INSPECT FUSE (AM2 FUSE)



(a) Remove the AM2 fuse from the engine room relay block.
(b) Measure the resistance of the AM2 fuse.
Standard resistance:
Below 1 Ω
(c) Reinstall the AM2 fuse.

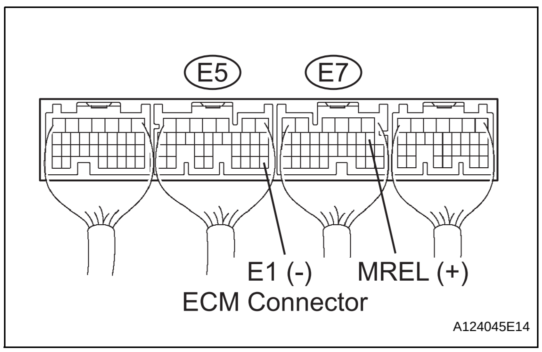
NG → **CHECK FOR SHORT IN ALL HARNESS AND COMPONENTS CONNECTED TO FUSE**

ES

OK

CHECK AND REPAIR HARNESS AND CONNECTOR (BATTERY - IG2 RELAY, IG2 RELAY - ECM)

7	CHECK ECM (MREL VOLTAGE)



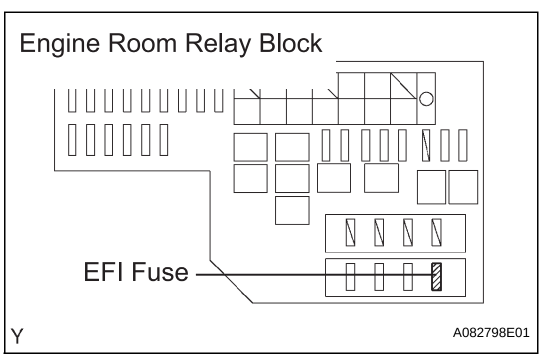
(a) Turn the power switch ON (IG).
(b) Measure the voltage between the specified terminals of the E5 and E7 ECM connectors.
Standard voltage

Tester Connection	Specified Condition
E7-7 (MREL) - E5-28 (E1)	9 to 14 V

NG → **REPLACE ECM**

OK

8	INSPECT FUSE (EFI FUSE)

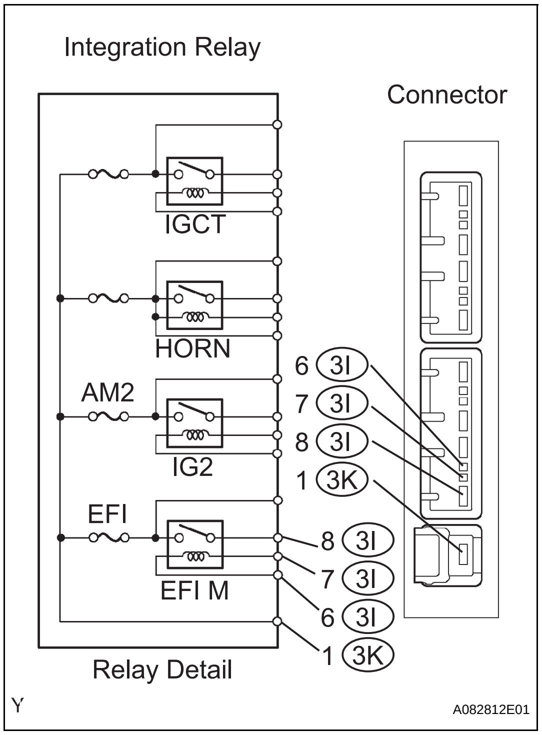


(a) Remove the EFI fuse from the engine room relay block.
(b) Measure the resistance of the EFI fuse.
Standard resistance:
Below 1 Ω
(c) Reinstall the EFI fuse.

NG → **CHECK FOR SHORT IN ALL HARNESS AND COMPONENTS CONNECTED TO FUSE**

OK

9	INSPECT INTEGRATION RELAY (EFI M RELAY)



(a) Remove the integration relay from the engine room relay block.
(b) Inspect the EFI M relay.
Standard resistance

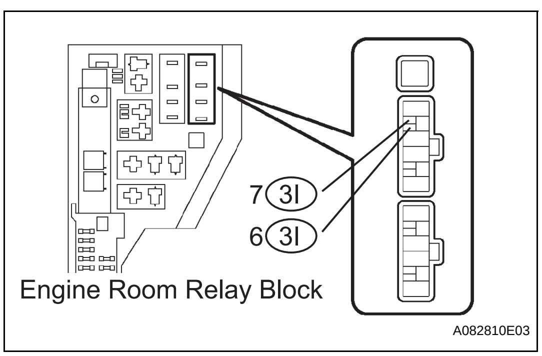
Tester Connection	Specified Condition
3K-1 - 3I-8	10 kΩ or higher
3K-1 - 3I-8	Below 1 Ω (Apply battery voltage to terminals 3I-6 and 3I-7)

(c) Reinstall the integration relay.

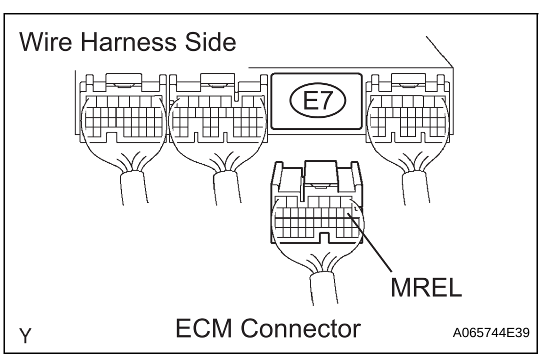
NG → **REPLACE INTEGRATION RELAY**

OK

10	CHECK HARNESS AND CONNECTOR (EFI M RELAY - ECM, EFI M RELAY - BODY GROUND)



(a) Check the harness and connectors between the EFI M relay and ECM connector.
(1) Remove the integration relay from the engine room relay block.



(2) Disconnect the E7 ECM connector.
(3) Measure the resistance between the wire harness side connectors.
Standard resistance (Check for open)

Tester Connection	Specified Condition
3I-6 (EFI M relay) - E7-7 (MREL)	Below 1 Ω

Standard resistance (Check for short)

Tester Connection	Specified Condition
3I-6 (EFI M relay) or E7-7 (MREL) - Body ground	10 kΩ or higher

(4) Reinstall the integration relay.

ES

(5) Reconnect the ECM connector.

(b) Check the harness and the connectors between the EFI M relay and the body ground.

(1) Remove the integration relay from the engine room relay block.

(2) Measure the resistance between the wire harness side connector and the body ground.

Standard resistance (Check for open)

Tester Connection	Specified Condition
3I-7 (EFI M relay) - Body ground	Below 1 Ω

(3) Reinstall the integration relay.

NG → **REPAIR OR REPLACE HARNESS AND CONNECTOR**

OK

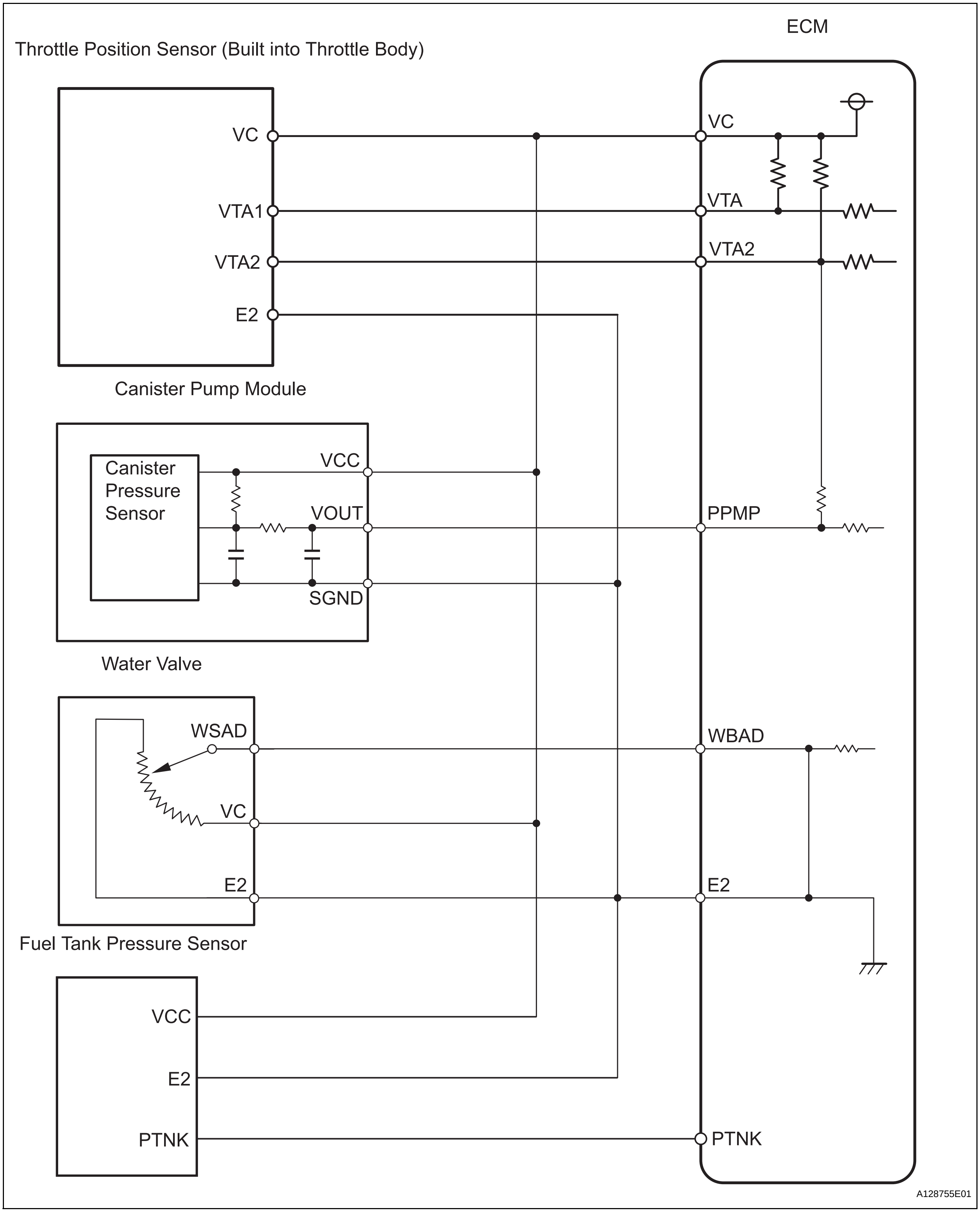
CHECK AND REPAIR HARNESS AND CONNECTOR (TERMINAL +B OF ECM - BATTERY POSITIVE TERMINAL)

VC Output Circuit

DESCRIPTION

The VC voltage (5 V) is generated in the ECM. The voltage is used to supply power to the throttle position sensor, canister pump module, etc.

WIRING DIAGRAM



INSPECTION PROCEDURE

1	CHECK MIL

(a) Check that MIL (Malfunction Indicator Lamp) lights up when turning the power switch ON (IG).
OK:
MIL lights up

OK → SYSTEM IS OK

NG

2	CHECK CONNECTION BETWEEN INTELLIGENT TESTER AND ECM

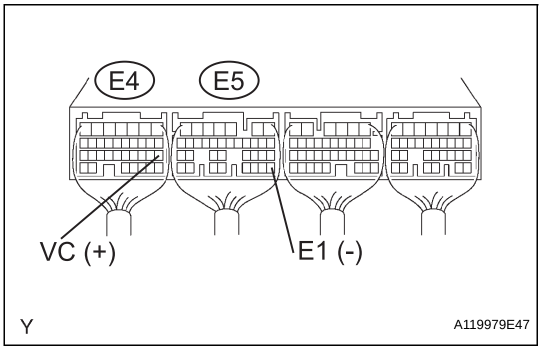
(a) Connect the intelligent tester to the DLC3.
(b) Turn the power switch ON (IG) and turn the intelligent tester ON.
(c) Check the connection between the intelligent tester and ECM.
Result

Condition	Proceed to
Communication is possible	A
Communication is not possible	B

A → GO TO MIL CIRCUIT

B

3	CHECK ECM (VC VOLTAGE)



(a) Turn the power switch ON (IG).
(b) Measure the voltage of the ECM connector.
Standard voltage

Tester Connection	Proceed to
E4-18 (VC) - E5-28 (E1)	Voltage is not 5 V

NEXT

4	CHECK MIL (THROTTLE POSITION SENSOR)

(a) Disconnect the T3 throttle body connector.
(b) Turn the power switch ON (IG).
(c) Check the MIL.

Result

Condition	Proceed to
MIL illuminates	A
MIL does not illuminate	B

A → **REPLACE THROTTLE BODY**

B

5 CHECK MIL (WATER VALVE)

(a) Disconnect the W5 water valve connector.
(b) Turn the power switch ON (IG).
(c) Check the MIL.

Result

Condition	Proceed to
MIL illuminates	A
MIL does not illuminate	B

A → **REPLACE WATER VALVE**

B

6 CHECK MIL (CANISTER PUMP MODULE)

(a) Disconnect the V7 canister pump module connector.
(b) Turn the power switch ON (IG).
(c) Check the MIL.

Result

Condition	Proceed to
MIL illuminates	A
MIL does not illuminate	B

A → **REPLACE CHARCOAL CANISTER ASSEMBLY**

B

7 CHECK MIL (VAPOR PRESSURE SENSOR)

(a) Disconnect the V6 vapor pressure sensor connector.
(b) Turn the power switch ON (IG).
(c) Check the MIL.

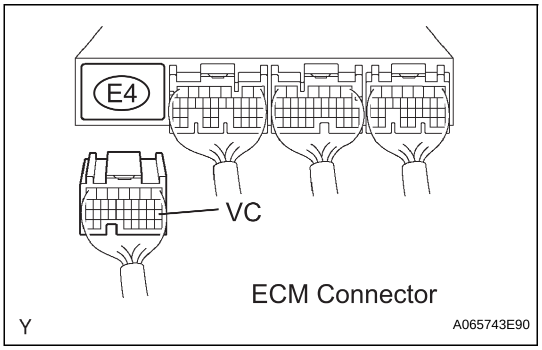
Result

Condition	Proceed to
MIL illuminates	A
MIL does not illuminate	B

A → **REPLACE VAPOR PRESSURE SENSOR**

B

8 CHECK HARNESS AND CONNECTOR (ECM - BODY GROUND)



(a) Disconnect the T3 throttle body connector.
(b) Disconnect the W5 water valve connector.
(c) Disconnect the V7 canister pump module connector.
(d) Disconnect the V6 vapor pressure sensor connector.
(e) Disconnect the E4 ECM connector.
(f) Measure the resistance of the wire harness side connector.

Standard resistance

Tester Connection	Specified Condition
E4-18 (VC) - Body ground	10 kΩ or higher

NG → **REPAIR OR REPLACE HARNESS AND CONNECTOR**

OK

REPLACE ECM

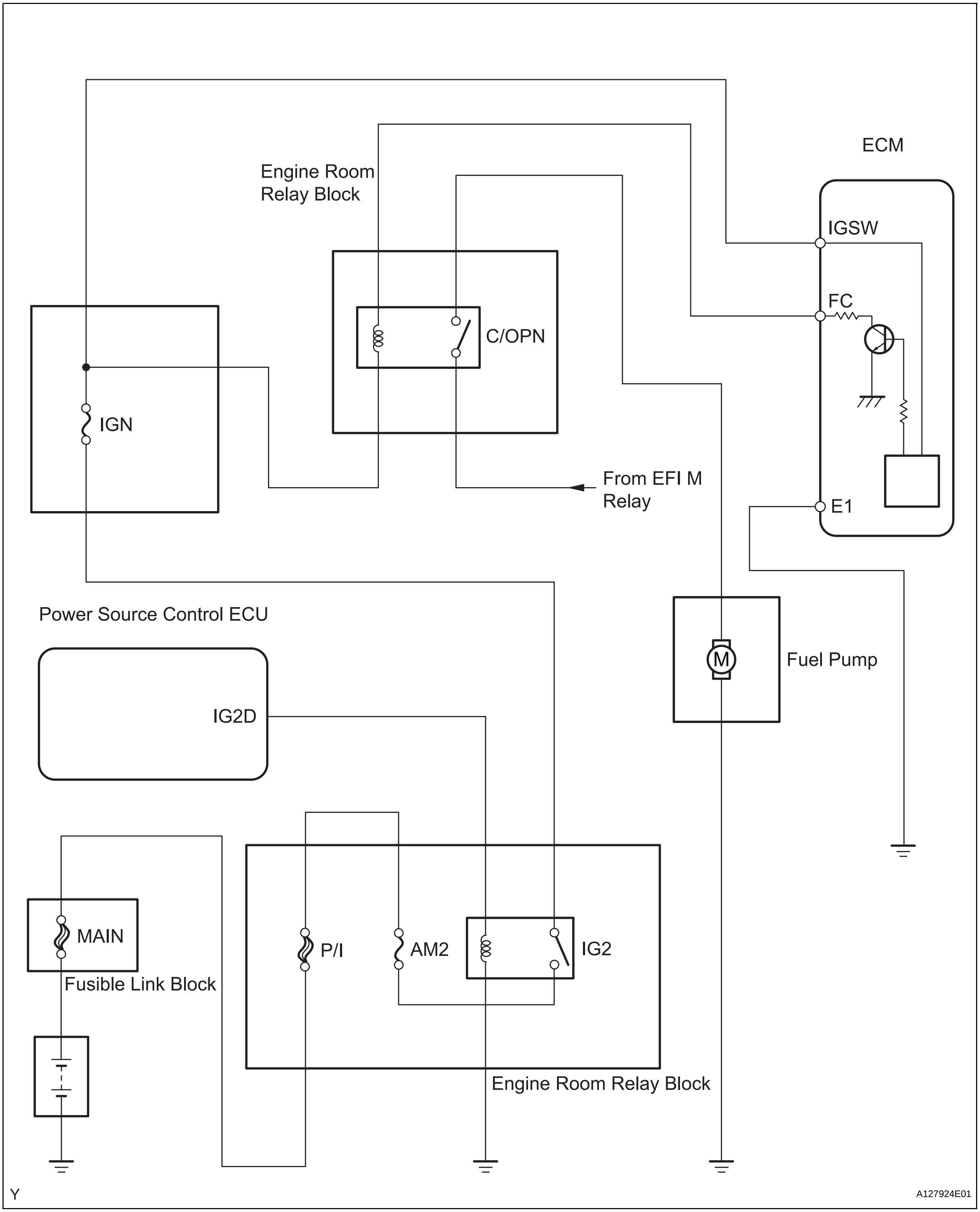
Fuel Pump Control Circuit

DESCRIPTION

The fuel pump is operated by the ECM according to the vehicle running condition. After the ECM receives the engine start requirement signal from the HV control ECU, an NE signal comes in immediately when the engine is cranked by MG1 (basically, the fuel pump can operate while the NE signal is generated). The ECM grounds the FC terminal line after receiving NE signal. It causes to energize the coil in the circuit opening relay, and the current flows to the fuel pump.

When the signal to stop the engine comes from the HV control ECU to the ECM, or when the fuel cut operation is performed such as decelerating by the engine brake, the fuel pump is stopped.

WIRING DIAGRAM



INSPECTION PROCEDURE

1	PERFORM ACTIVE TEST BY INTELLIGENT TESTER (OPERATE CIRCUIT OPENING RELAY)

(a) Connect the intelligent tester to the DLC3.
(b) Turn the power switch ON (IG).
(c) Turn the tester ON.
(d) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / FUEL PUMP / SPD.
(e) Check the relay operation while operating it with the tester.
OK:
Operating noise can be heard from the relay.

OK **PROCEED TO NEXT CIRCUIT INSPECTION SHOWN IN PROBLEMS TABLE**

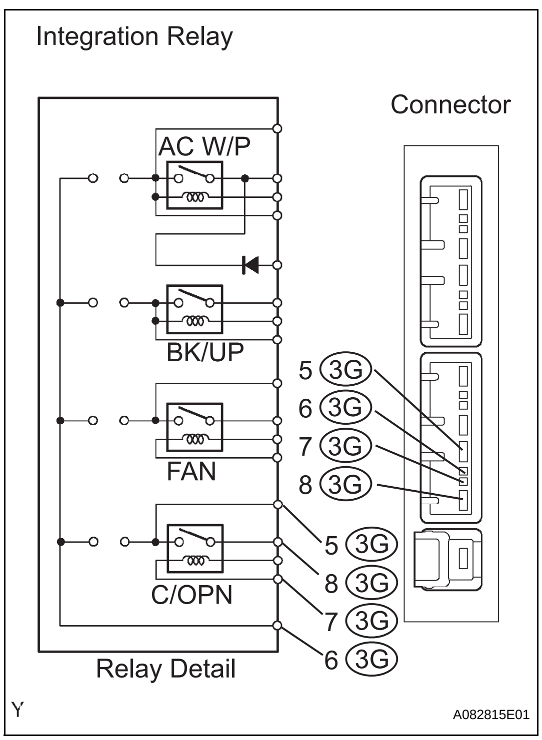
NG

2	INSPECT POWER SOURCE CIRCUIT

NG → **REPAIR OR REPLACE POWER SOURCE CIRCUIT COMPONENTS**

OK

3	INSPECT INTEGRATION RELAY (C/OPN RELAY)



(a) Remove the integration relay from the engine room relay block.
(b) Inspect the circuit opening relay.
Standard resistance

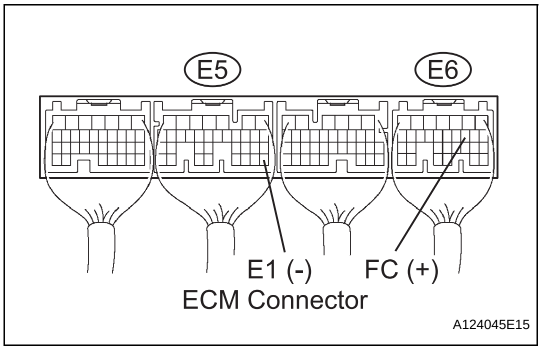
Tester Connection	Specified Condition
3G-5 - 3G-8	10 kΩ or higher
3G-5 - 3G-8	Below 1 Ω (Apply battery voltage to terminals 3G-6 and 3G-7)

(c) Reinstall the integration relay.

NG → **REPLACE INTEGRATION RELAY**

OK

4 CHECK ECM (FC VOLTAGE)



(a) Turn the power switch ON (IG).
(b) Measure the voltage between the specified terminals of the E5 and E6 ECM connectors.
Standard voltage

Tester Connection	Specified Condition
E6-10 (FC) - E5-28 (E1)	9 to 14 V

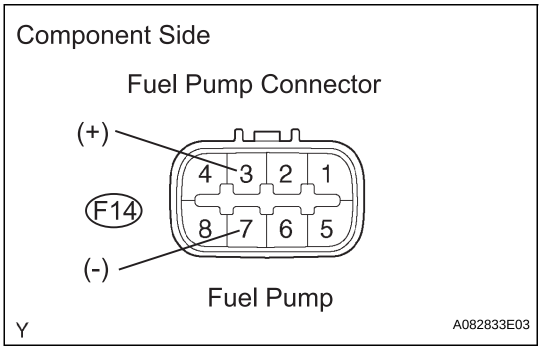
GO → **Go to step 5**

ES

NG

CHECK AND REPAIR HARNESS AND CONNECTOR

5 INSPECT FUEL PUMP



(a) Disconnect the F14 fuel pump connector.
(b) Inspect the fuel pump resistance.
(1) Measure the resistance between terminals 3 and 7.
Standard resistance

Tester Connection	Specified Condition
3 - 7	0.2 to 3.0 Ω at 20°C (68°F)

(c) Inspect the fuel pump operation.
(1) Apply battery voltage to the fuel pump terminals. Check that the pump operates.

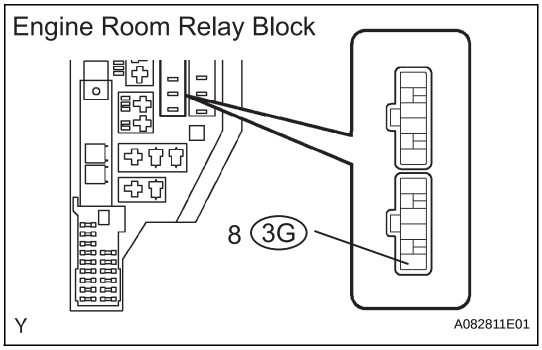
NOTICE:
- **These tests must be done quickly (within 10 seconds) to prevent the coil from burning out.**
- **Keep fuel pump as far away from the battery as possible.**
- **Always do the switching at the battery side.**

(d) Reconnect the fuel pump connector.

NG → **REPAIR OR REPLACE FUEL TANK ASSEMBLY**

OK

6 CHECK HARNESS AND CONNECTOR (C/OPN RELAY - FUEL PUMP, FUEL PUMP - BODY GROUND)



(a) Check the harness and the connectors between the circuit opening relay and the fuel pump connector.

(1) Remove the integration relay from the engine room relay block.

(2) Disconnect the F14 fuel pump connector.

(3) Measure the resistance between the wire harness side connectors.

Standard resistance (Check for open)

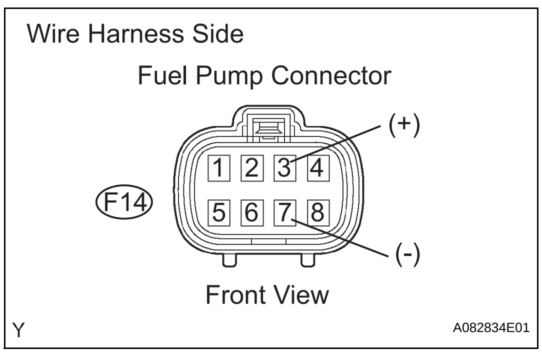
Tester Connection	Specified Condition
3G-8 (Circuit opening relay) - F14-3 (Fuel pump)	**Below 1 Ω**

Standard resistance (Check for short)

Tester Connection	Specified Condition
3G-8 (Circuit opening relay) or F14-3 (Fuel pump) - Body ground	**10 kΩ or higher**

(4) Reinstall the integration relay.

(5) Reconnect the fuel pump connector.



(b) Check the harness and the connectors between the fuel pump connector and the body ground.

(1) Disconnect the F14 fuel pump connector.

(2) Measure the resistance between the wire harness side connector and the body ground.

Standard resistance (Check for open)

Tester Connection	Specified Condition
F14-7 (Fuel pump) - Body ground	**Below 1 Ω**

(3) Reconnect the fuel pump connector.

NG → **REPAIR OR REPLACE HARNESS AND CONNECTOR**

OK

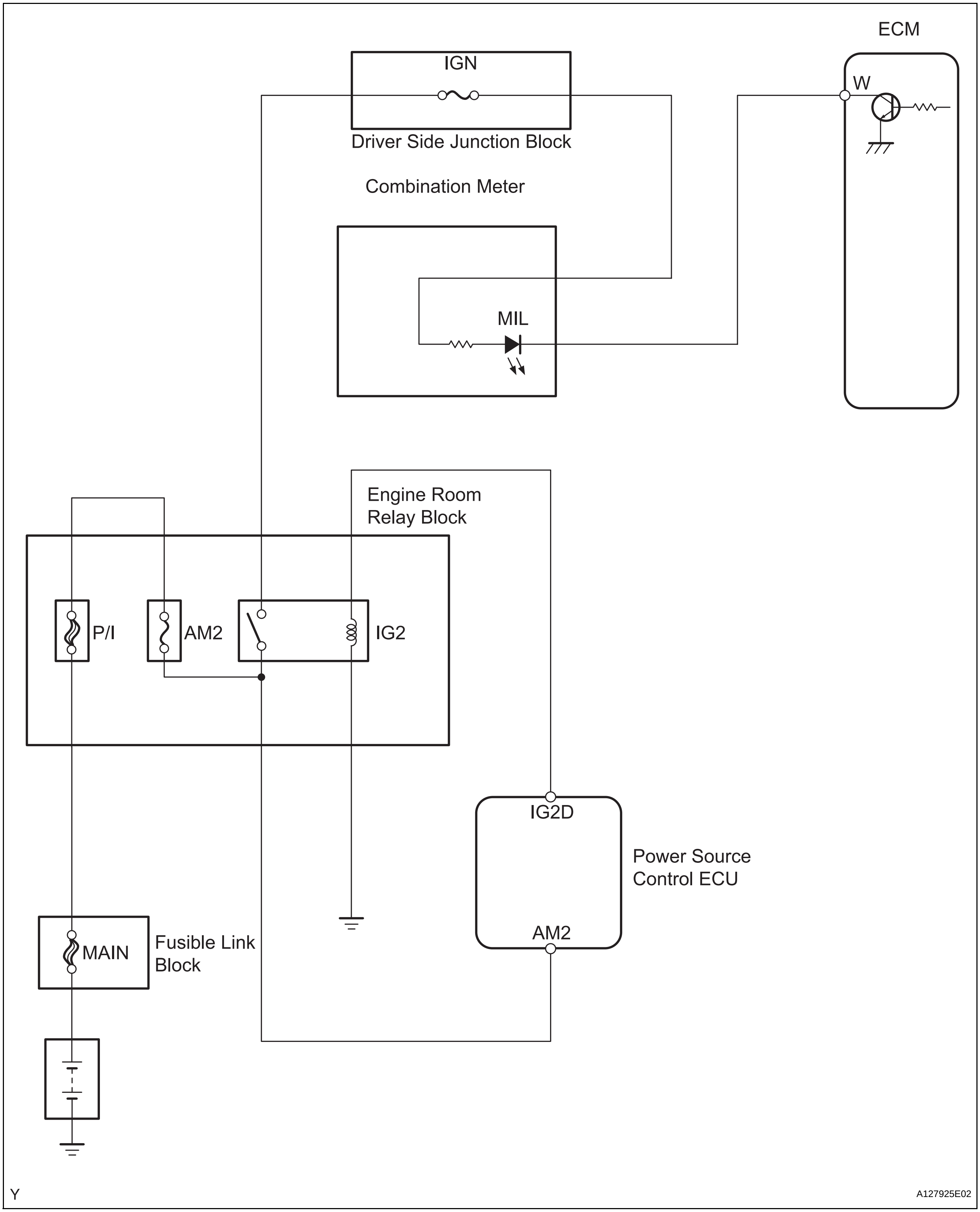
REPLACE ECM

MIL Circuit

DESCRIPTION

The IG2 relay energized by the power source control ECU applies the battery voltage to the malfunction indicator lamp (MIL) in the combination meter while the main system is turned ON.
When it is necessary, the ECM grounds the W terminal line and illuminates the MIL.
In order to perform functional check visually, the MIL is illuminated when the power switch is first turned ON (IG).
If the MIL is ON or OFF all of the time, use the procedure below to troubleshoot it. The MIL is used to indicate vehicle malfunction which was detected by the ECM. Follow this procedure using the intelligent tester or the OBD II scan tool to determine cause of the problem and to check the MIL.

WIRING DIAGRAM



INSPECTION PROCEDURE

1	CHECK MIL CONDITION

(a) Perform troubleshooting in accordance with the chart below.

Result

Condition	Proceed to
MIL remains ON	A
MIL does not illuminate	B

B → **Go to step 4**

ES

A

2	CLEAR DTC

(a) Connect the intelligent tester to the DLC3.
(b) Turn the power ON (IG).
(c) Turn the tester ON.
(d) Read DTCs (see page ES-29).
(e) Clear the DTCs (see page ES-29).
(f) Check the MIL is not illuminated.

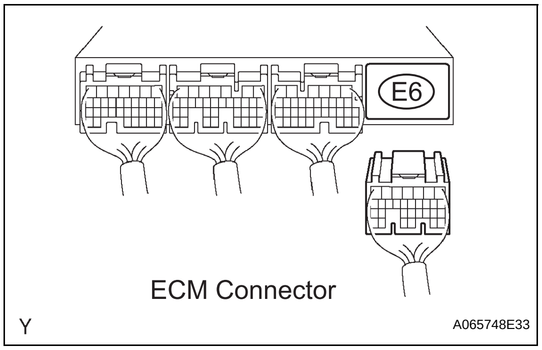
OK:

MIL is not illuminated.

OK → **REPAIR CIRCUITS INDICATED BY OUTPUT DTCS**

NG

3	CHECK HARNESS AND CONNECTOR (CHECK FOR SHORT IN WIRE HARNESS)



(a) Disconnect the E6 ECM connector.
(b) Turn the power switch ON (IG).
(c) Check the MIL is not illuminated.

OK:

MIL is not illuminated.

(d) Reconnect the ECM connector.

OK → **REPLACE ECM**

NG

CHECK AND REPAIR HARNESS AND CONNECTOR (COMBINATION METER - ECM)

ES

4 CHECK THAT MIL IS ILLUMINATED

(a) Check that MIL is illuminated when the power switch is turned ON (IG).

Standard:

MIL is illuminated.

OK → **SYSTEM OK**

NG ↓

5 CHECK THAT ENGINE STARTS

(a) Turn the power switch to ON (IG).

(b) Start the engine.

Result

Result	Proceed To
Engine starts	A
Engine does not start*	B

HINT:

*: The intelligent tester cannot communicate with the ECM.

B → **GO TO VC OUTPUT CIRCUIT**

A ↓

6 INSPECT COMBINATION METER ECU (MIL CIRCUIT)

(a) See the combination meter troubleshooting (see page ME-11).

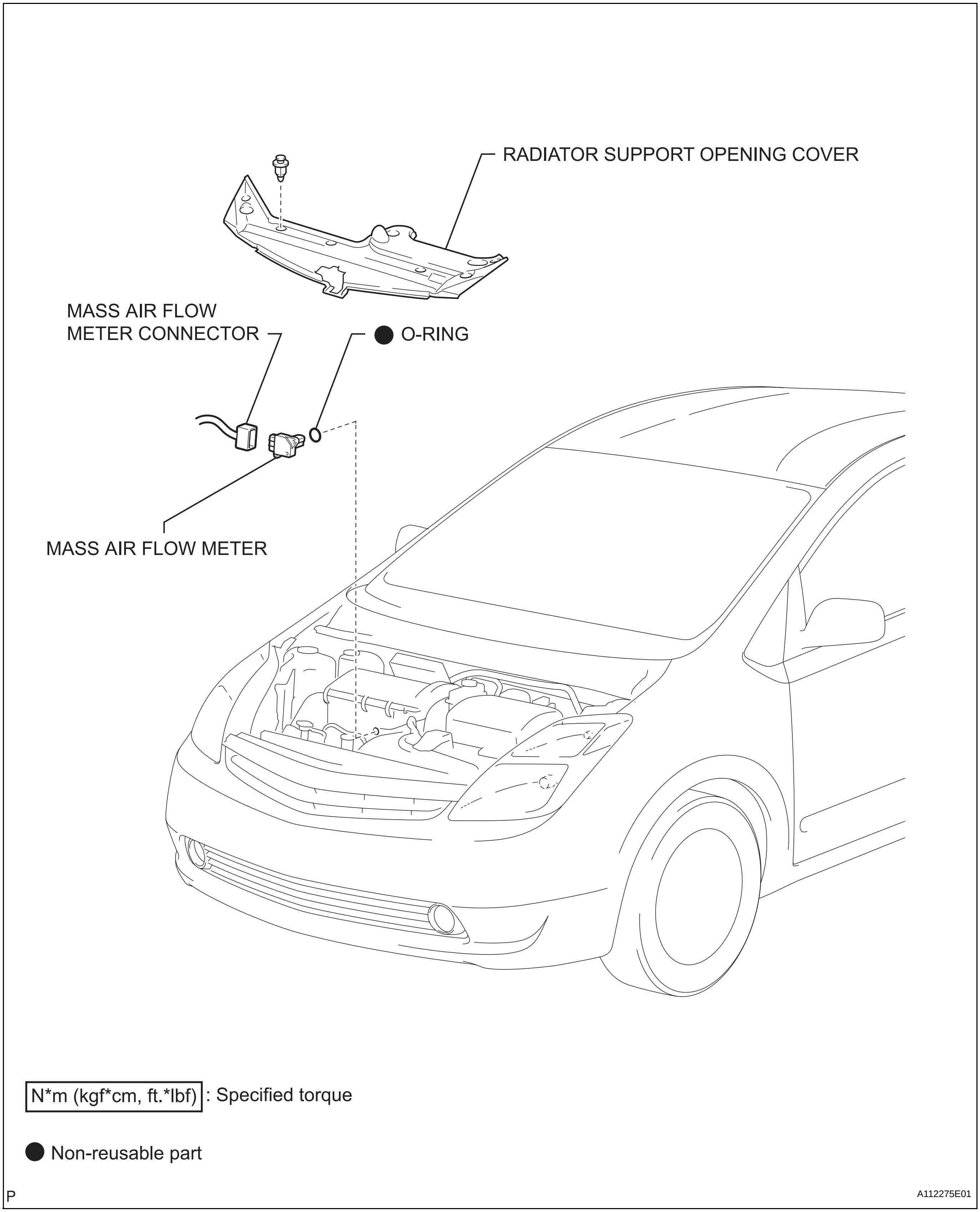
NG → **REPAIR OR REPLACE BULB OR COMBINATION METER ASSEMBLY**

OK ↓

CHECK AND REPAIR HARNESS AND CONNECTOR (COMBINATION METER - ECM)

MASS AIR FLOW METER

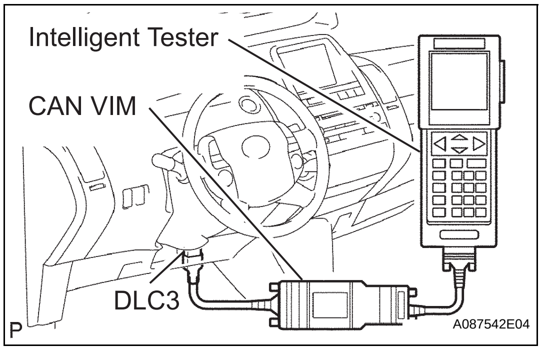
COMPONENTS



ON-VEHICLE INSPECTION

NOTICE:

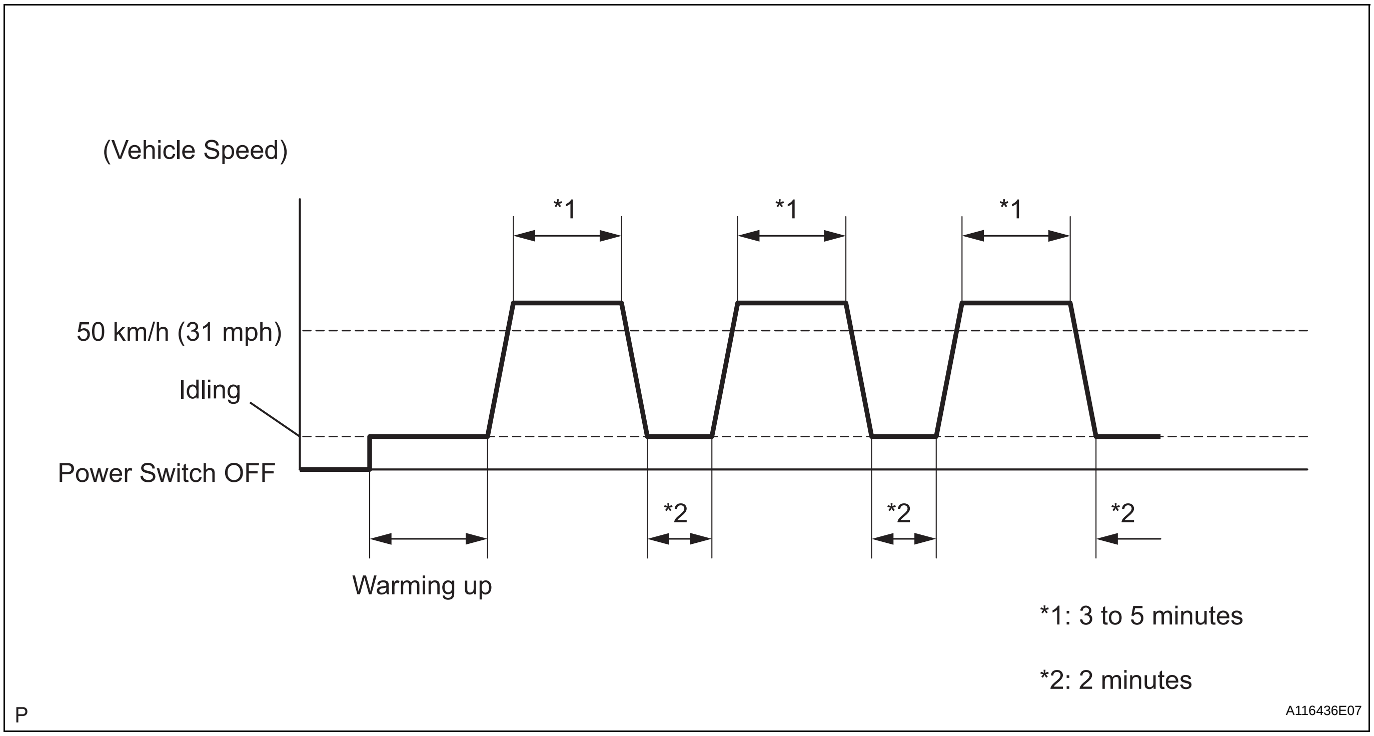
- **Perform the MAF meter inspection according to the procedures below.**
- **Only replace the MAF meter when both the LONG FT#1 value and MAF value in the DATA LIST (with the engine stopped) are not within the normal operating range.**



1. CHECK MASS AIR FLOW METER

(a) Perform confirmation driving pattern.

(1) Connect the intelligent tester to the DLC3.
(2) Turn the power switch ON.
(3) Turn the intelligent tester ON.
(4) Clear the DTCs (see page ES-29).
(5) Start the engine and warm it up with all accessory switches OFF (until the engine coolant temperature is 75°C (167°F) or more).
(6) Drive the vehicle at 50 km/h (31 mph) or more for 3 minutes or more*1.
(7) Let the engine to idle (accelerator pedal fully released) for 2 minutes or more*2.
(8) Perform steps *1 and *2 at least 3 times.



(b) Read value using intelligent tester (LONG FT#1).

(1) Enter the following menus: Powertrain / Engine and ECT / Data List / Long FT#1.
(2) Read the values displayed on the tester.

Standard value:

Within -15 to +15 %

If the result is not within the specified range, perform the inspection below.

(c) Read value using intelligent tester (MAF).

NOTICE:

- **Turn off the engine.**
- **Perform the inspection with the vehicle indoors and on a level surface.**
- **Perform the inspection of the MAF meter while it is installed to the air cleaner case (installed to the vehicle).**
- **During the test, do not use the exhaust air duct to perform suction on the exhaust pipe.**

(1) Turn the power switch ON (ACC).

(2) Turn the power switch ON (do not start the engine).

(3) Turn the intelligent tester ON.

(4) Enter the following menus: Powertrain / Engine and ECT / Data List / MAF.

(5) Wait 30 seconds, and read the values on the intelligent tester.

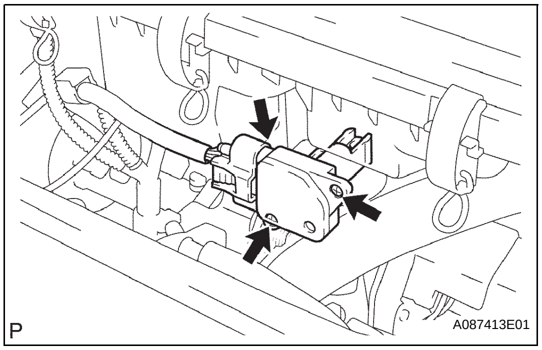
Standard condition:

Less than 0.07 g/sec.

- If the result is not as specified, replace the MAF meter.
- If the result is within the specified range, inspect the cause of the extremely rich or lean air fuel ratio (see page ES-128).

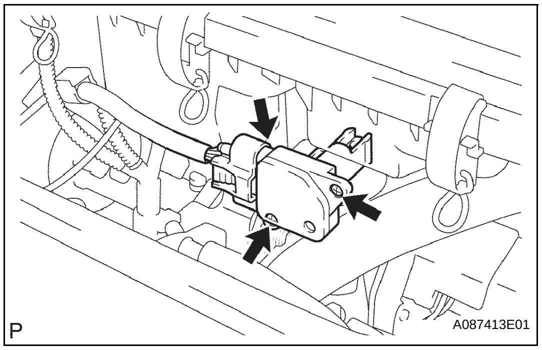
REMOVAL

1. **DISCONNECT CABLE FROM NEGATIVE BATTERY TERMINAL**
   CAUTION:
   Wait at least 90 seconds after disconnecting the cable from the negative (-) battery terminal to prevent airbag and seat belt pretensioner activation.
2. **REMOVE RADIATOR SUPPORT OPENING COVER (See page ES-450)**
3. **REMOVE MASS AIR FLOW METER**



   (a) Disconnect the MAF meter connector.
   (b) Remove the 2 screws and MAF meter.

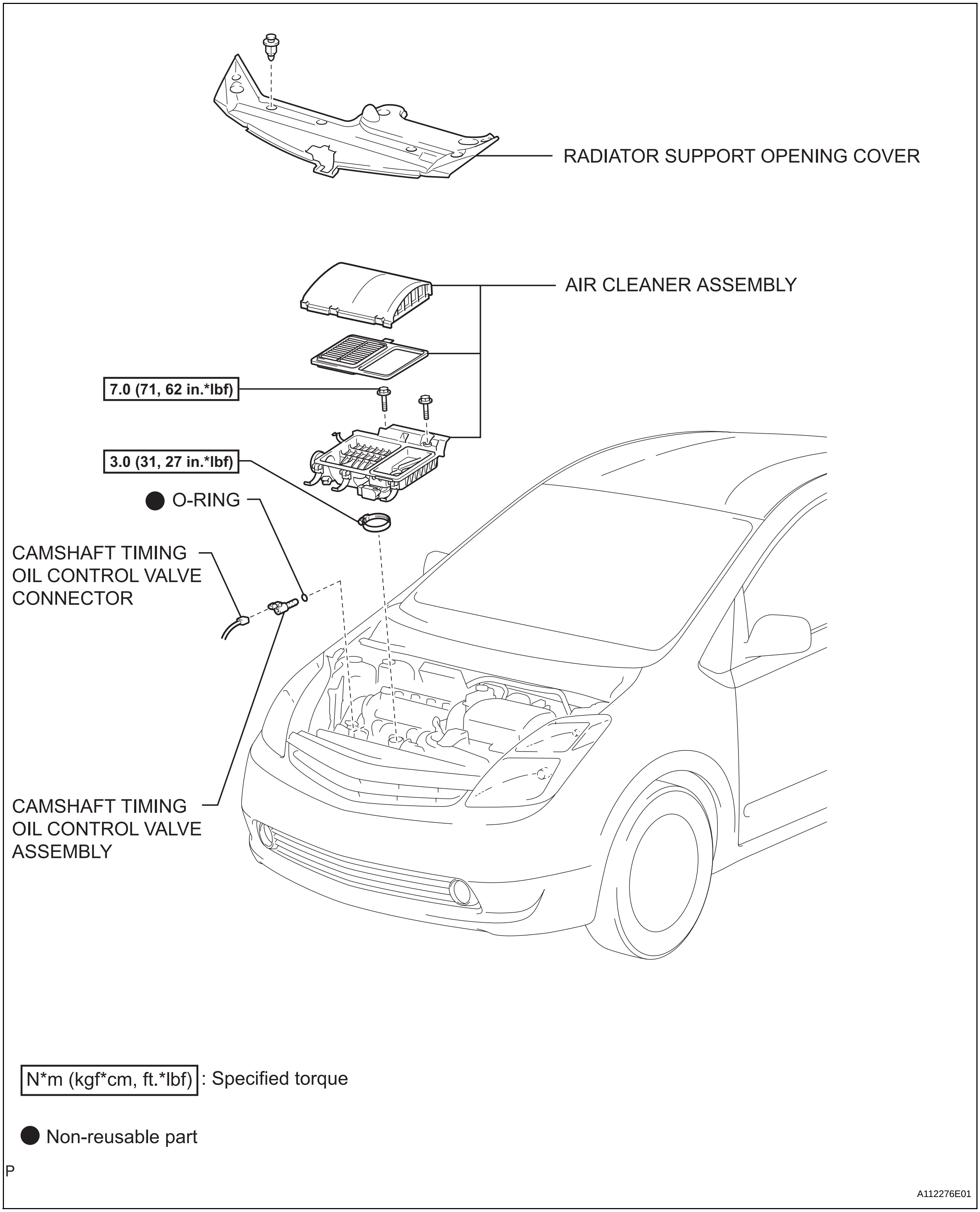
INSTALLATION



1. **INSTALL MASS AIR FLOW METER**
   (a) Install a new O-ring to the MAF meter.
   (b) Install the MAF meter with the 2 screws.
   (c) Connect the MAF meter connector.
2. **CONNECT CABLE TO NEGATIVE BATTERY TERMINAL**
3. **INSTALL RADIATOR SUPPORT OPENING COVER (See page ES-454)**
4. **PERFORM INITIALIZATION**
   (a) Perform initialization (see page IN-32).
   NOTICE:
   Certain systems need to be initialized after disconnecting and reconnecting the cable from the negative (-) battery terminal.

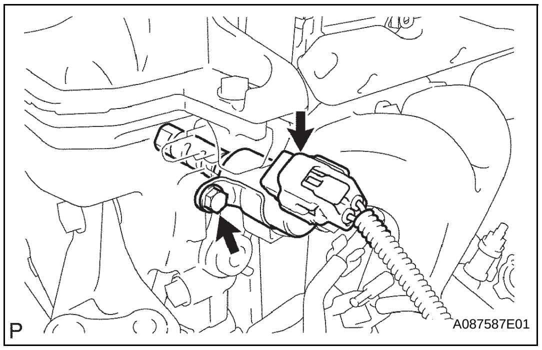
CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY

COMPONENTS



REMOVAL

1. **DISCONNECT CABLE FROM NEGATIVE BATTERY TERMINAL**
   CAUTION:
   Wait at least 90 seconds after disconnecting the cable from the negative (-) battery terminal to prevent airbag and seat belt pretensioner activation.
2. **REMOVE RADIATOR SUPPORT OPENING COVER (See page ES-450)**
3. **REMOVE AIR CLEANER ASSEMBLY (See page ES-450)**



4. **REMOVE CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY**
   (a) Disconnect the camshaft timing oil control valve connector.
   (b) Remove the bolt and camshaft timing oil control valve.

INSPECTION

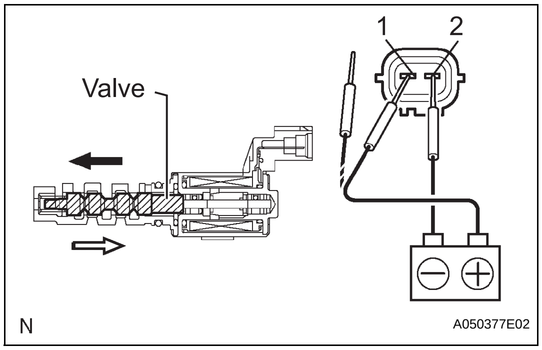
1. **INSPECT CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY**

(a) Measure the resistance of the oil control valve.

Standard resistance:

6.9 to 7.9 Ω at 20°C (68°F)

If the result is not as specified, replace the camshaft timing oil control valve assembly.



(b) Inspect the operation.

(1) Connect the battery positive (+) lead to terminal 1 and negative (-) lead to terminal 2, and inspect the movement of the valve.

Specified condition

Condition	Specified Condition
Battery positive (+) voltage is applied	Valve moves in black arrow direction shown in illustration
Battery positive (+) voltage is cut off	Valve moves in white arrow direction shown in illustration

If the result is not as specified, replace the camshaft timing oil control valve assembly.

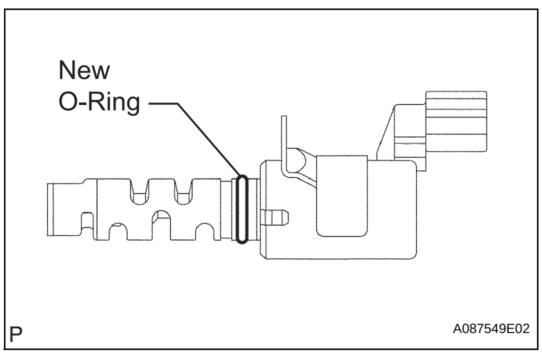
NOTICE:

Confirm that the valve moves freely and is not stuck in any position.

HINT:

Foreign objects in the oil can cause subtle pressure leaks in the valve. The pressure leaks will cause the cam to advance. This condition will usually set a DTC.

INSTALLATION



1. **INSTALL CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY**

(a) Apply a light coat of engine oil to a new O-ring, then install it to the camshaft timing oil control valve.

(b) Install the camshaft timing oil control valve with the bolt.

Torque: 7.5 N*m (76 kgf*cm, 66 in.*lbf)

NOTICE:

Be careful that the O-ring is not cracked or jammed when installing it.

(c) Connect the camshaft timing oil control valve connector.

2. **INSTALL AIR CLEANER ASSEMBLY (See page ES-453)**

3. **CONNECT CABLE TO NEGATIVE BATTERY TERMINAL**

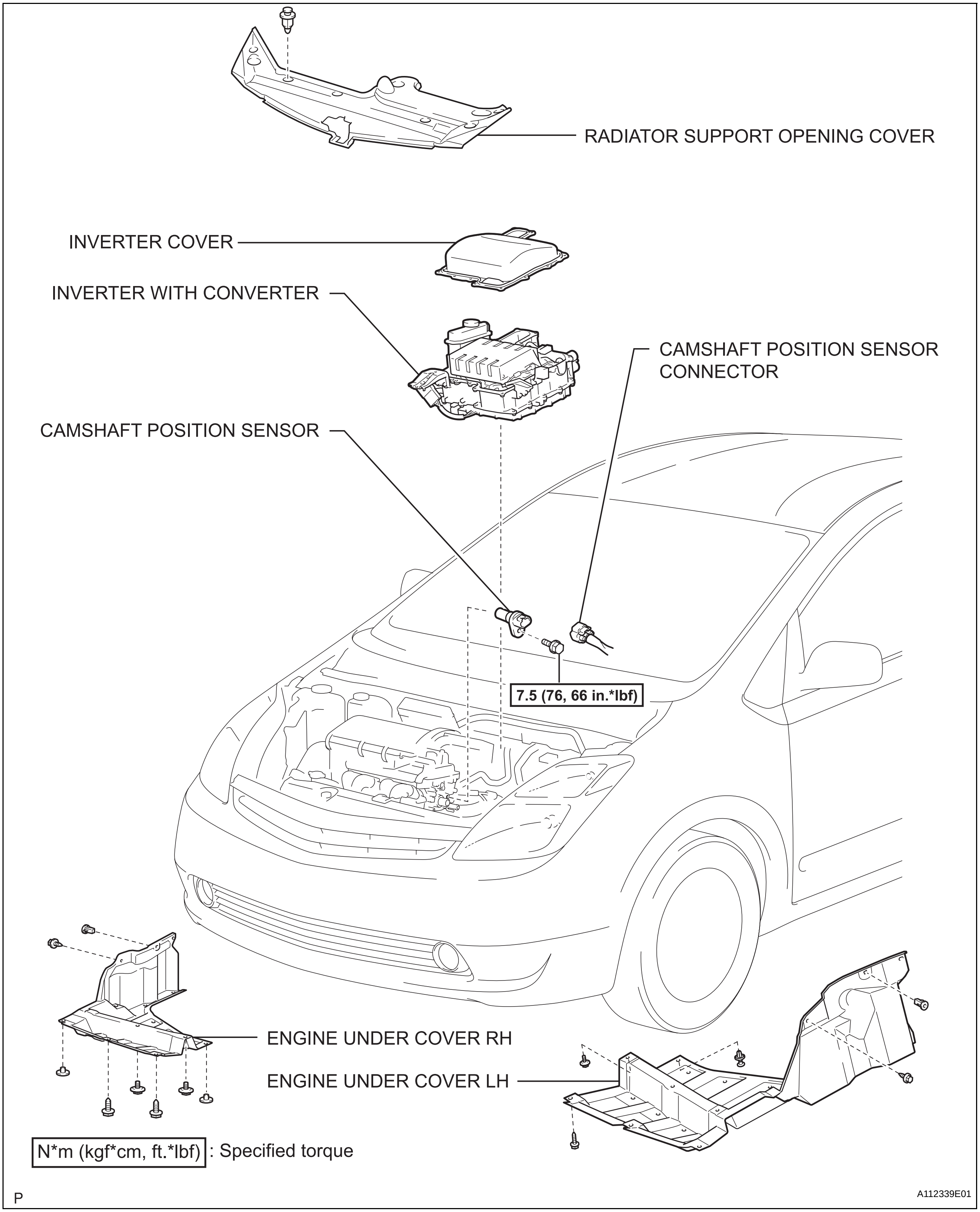
4. **CHECK FOR ENGINE OIL LEAKS**

5. **INSTALL RADIATOR SUPPORT OPENING COVER (See page ES-454)**

6. **PERFORM INITIALIZATION**
   (a) Perform initialization (see page IN-32).
   NOTICE:
   Certain systems need to be initialized after disconnecting and reconnecting the cable from the negative (-) battery terminal.

CAMSHAFT POSITION SENSOR

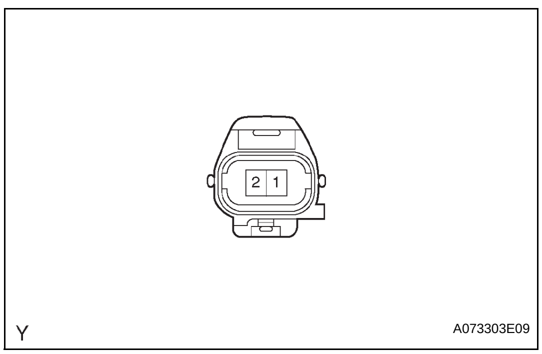
COMPONENTS



REMOVAL

1. **REMOVE RADIATOR SUPPORT OPENING COVER (See page ES-450)**
2. **REMOVE ENGINE UNDER COVER LH**
3. **REMOVE ENGINE UNDER COVER RH**
4. **DRAIN ENGINE COOLANT (See page CO-6)**
5. **DRAIN HV COOLANT (See page HX-58)**
6. **DISCONNECT CABLE FROM NEGATIVE BATTERY TERMINAL**
   CAUTION:
   Wait at least 90 seconds after disconnecting the cable from the negative (-) battery terminal to prevent airbag and seat belt pretensioner activation.
7. **REMOVE INVERTER WITH CONVERTER**
   (a) Remove the inverter with converter (see page HV-530).
8. **REMOVE CAMSHAFT POSITION SENSOR**
   (a) Disconnect the sensor connector.
   (b) Remove the bolt and sensor.

INSPECTION



1. **INSPECT CAMSHAFT POSITION SENSOR**
   (a) Measure the resistance of the sensor.
   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

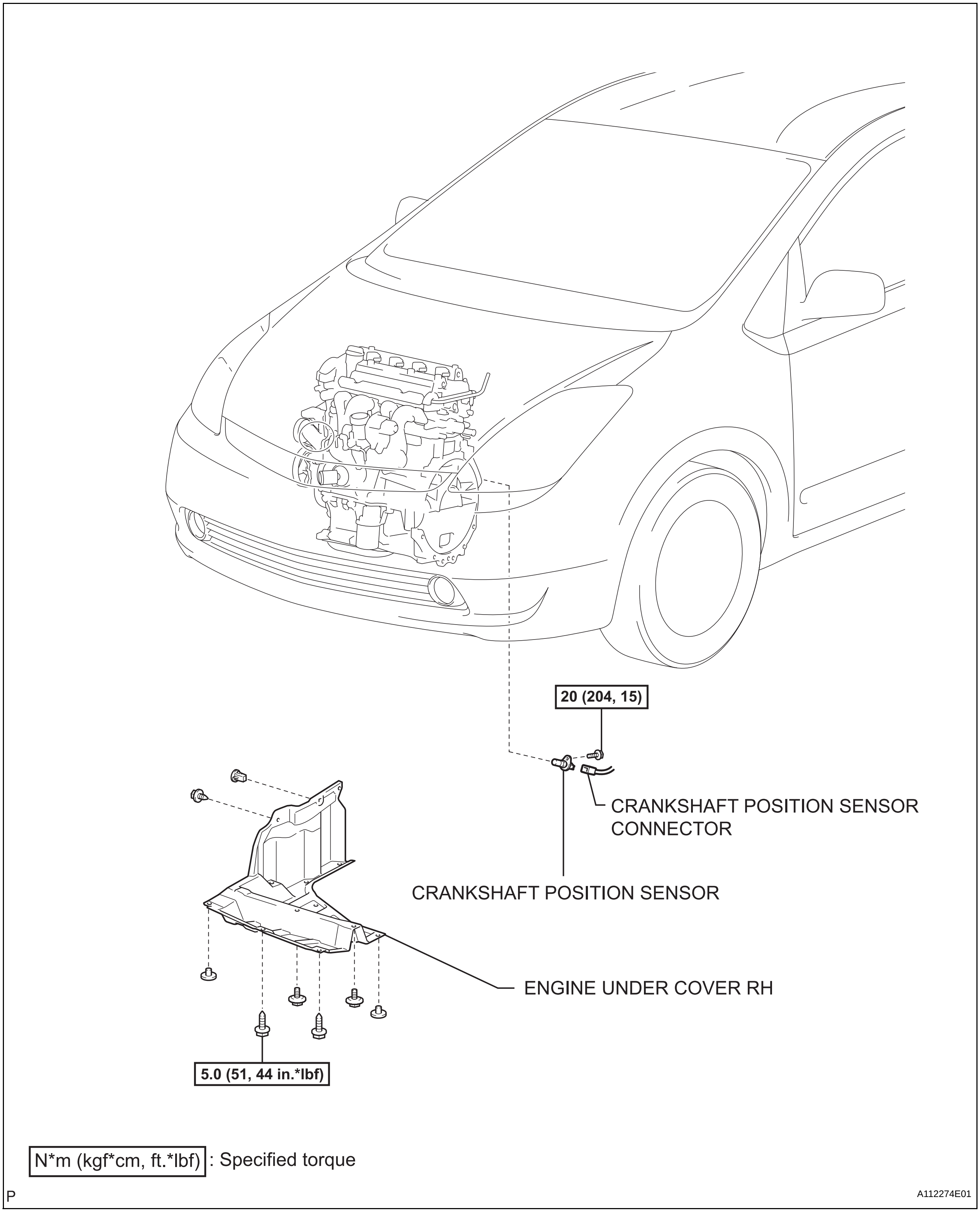
NOTICE:
The terms "Cold" and "Hot" refer to the temperature of the sensor. "Cold" means approximately -10 to 50°C (14 to 122°F). "Hot" means approximately 50 to 100°C (122 to 212°F).
If the result is not as specified, replace the camshaft position sensor.

INSTALLATION

1. **INSTALL CAMSHAFT POSITION SENSOR**
   (a) Install the sensor with the bolt.
   Torque: 7.5 N*m (76 kgf*cm, 66 in.*lbf)
   (b) Connect the sensor connector.
2. **INSTALL INVERTER WITH CONVERTER**
   (a) Install the inverter with converter (see page HV-535).
3. **CONNECT CABLE TO NEGATIVE BATTERY TERMINAL**
4. **ADD HV COOLANT (See page HX-58)**
5. **ADD ENGINE COOLANT (See page CO-7)**
6. **CHECK FOR ENGINE COOLANT LEAKS (See page CO-2)**
7. **CHECK FOR HV COOLANT LEAKS**
8. **INSTALL RADIATOR SUPPORT OPENING COVER (See page ES-454)**
9. **INSTALL ENGINE UNDER COVER RH**
10. **INSTALL ENGINE UNDER COVER LH**
11. **PERFORM INITIALIZATION**
   (a) Perform initialization (see page IN-32).
   NOTICE:
   Certain systems need to be initialized after disconnecting and reconnecting the cable from the negative (-) battery terminal.

CRANKSHAFT POSITION SENSOR

COMPONENTS



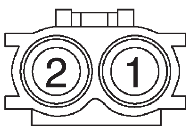
REMOVAL

1. **DISCONNECT CABLE FROM NEGATIVE BATTERY TERMINAL**
   CAUTION:
   Wait at least 90 seconds after disconnecting the cable from the negative (-) battery terminal to prevent airbag and seat belt pretensioner activation.

2. **REMOVE ENGINE UNDER COVER RH**

3. **REMOVE CRANKSHAFT POSITION SENSOR**
   (a) Disconnect the sensor connector.
   (b) Remove the bolt and sensor.

INSPECTION



A078431E11

1. **INSPECT CRANKSHAFT POSITION SENSOR**
   (a) Measure the resistance of the sensor.
   Standard resistance

Tester Connection	Condition	Specified Condition
1 - 2	Cold	985 to 1,600 Ω
1 - 2	Hot	1,265 to 1,890 Ω

NOTICE:
The terms "Cold" and "Hot" refer to the temperature of the sensor. "Cold" means approximately -10 to 50°C (14 to 122°F). "Hot" means approximately 50 to 100°C (122 to 212°F).
If the result is not as specified, replace the crankshaft position sensor.

INSTALLATION

1. **INSTALL CRANKSHAFT POSITION SENSOR**
   (a) Install the sensor with the bolt.
   Torque: 7.5 N*m (76 kgf*cm, 66 in.*lbf)
   (b) Connect the sensor connector.

2. **INSTALL ENGINE UNDER COVER RH**

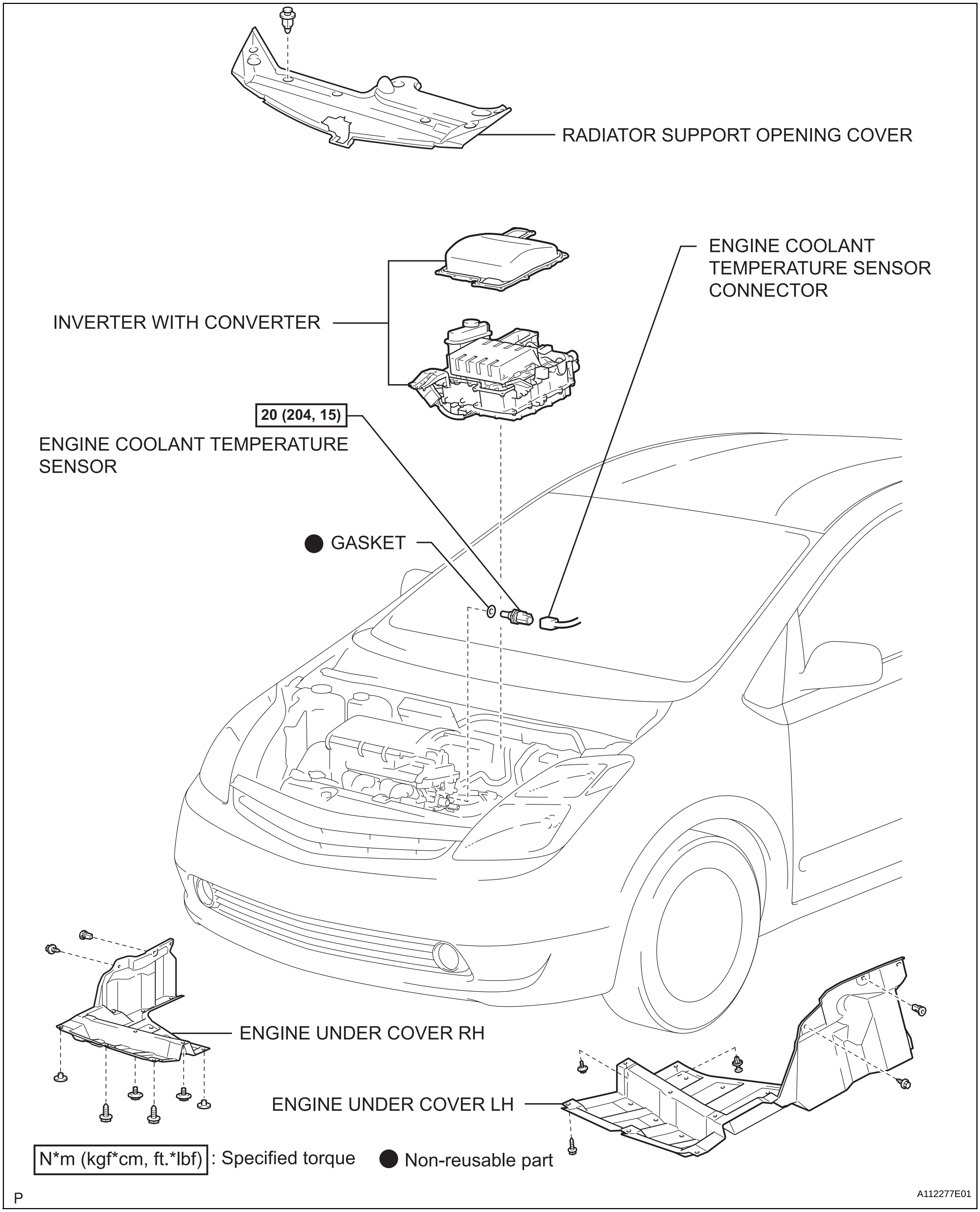
3. **CONNECT CABLE TO NEGATIVE BATTERY TERMINAL**

4. **PERFORM INITIALIZATION**
   (a) Perform initialization (see page IN-32).
   NOTICE:
   Certain systems need to be initialized after disconnecting and reconnecting the cable from the negative (-) battery terminal.

ES

ENGINE COOLANT TEMPERATURE SENSOR

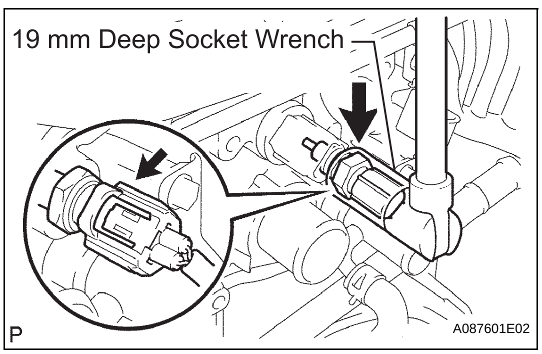
COMPONENTS



REMOVAL

CAUTION:
The hybrid system uses high voltage circuits, so improper handling could cause an electric shock or leakage. During servicing (e.g. installing or removing the parts, replacing the parts), be sure to follow the procedures below.

1. **REMOVE RADIATOR SUPPORT OPENING COVER (See page ES-450)**
2. **REMOVE ENGINE UNDER COVER LH**
3. **REMOVE ENGINE UNDER COVER RH**
4. **DRAIN ENGINE COOLANT (See page CO-6)**
5. **DRAIN HV COOLANT (See page HX-58)**
6. **DISCONNECT CABLE FROM NEGATIVE BATTERY TERMINAL**
   CAUTION:
   Wait at least 90 seconds after disconnecting the cable from the negative (-) battery terminal to prevent airbag and seat belt pretensioner activation.
7. **REMOVE INVERTER WITH CONVERTER**
   (a) Remove the inverter with converter (see page HV-530).
8. **REMOVE ENGINE COOLANT TEMPERATURE SENSOR**



   (a) Disconnect the sensor connector.
   (b) Using a 19 mm deep socket wrench, remove the sensor and gasket.

INSPECTION

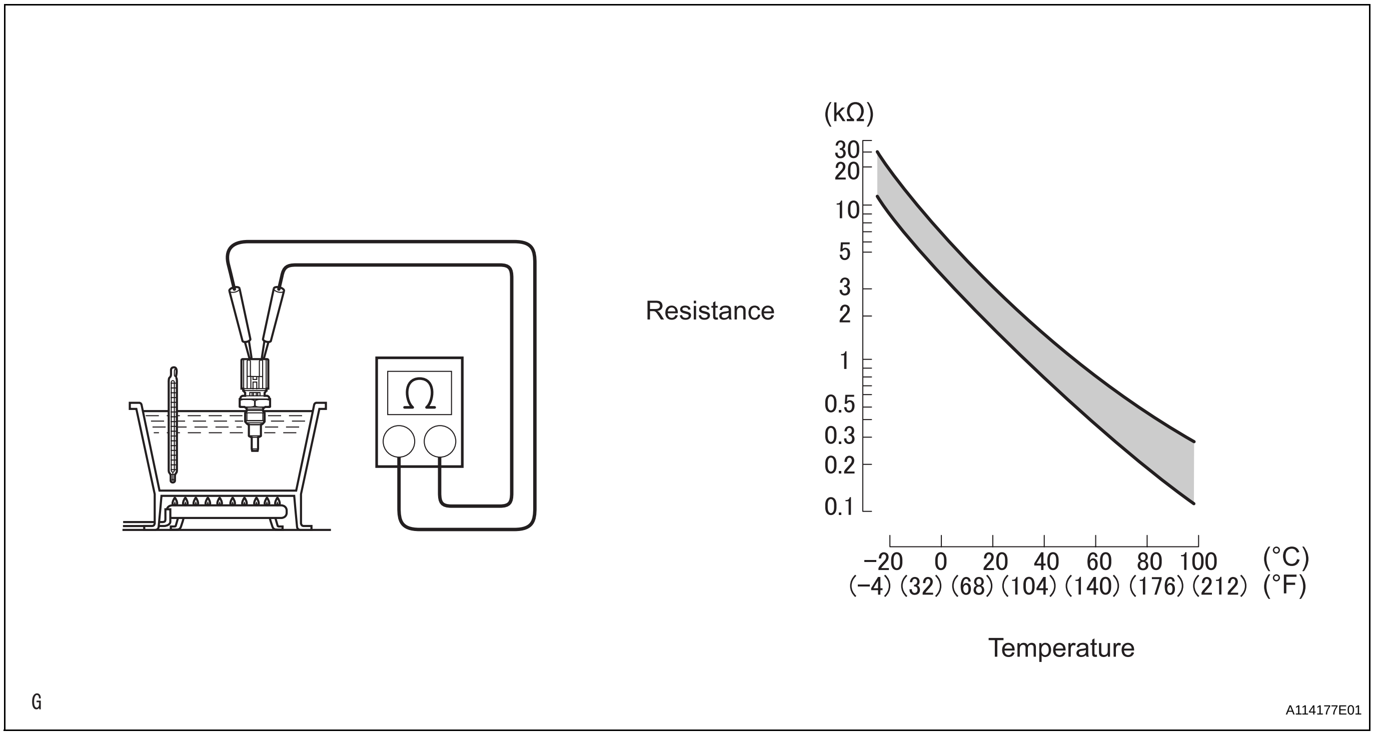
1. INSPECT ENGINE COOLANT TEMPERATURE SENSOR

(a) Measure the resistance of the sensor.

Standard resistance

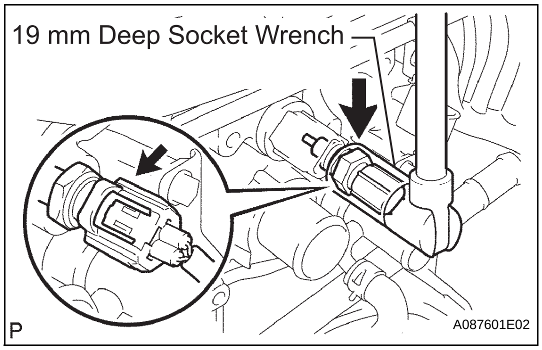
Tester Connection	Condition	Specified Condition
1 - 2	20°C (68°F)	2.32 to 2.59 kΩ
1 - 2	80°C (176°F)	0.310 to 0.326 kΩ

NOTICE:
If checking the sensor in water, be careful not to allow water to contact the terminals. After checking, dry the sensor.



If the result is not as specified, replace the engine coolant temperature sensor.

INSTALLATION



1. INSTALL ENGINE COOLANT TEMPERATURE SENSOR

(a) Using a 19 mm deep socket wrench, install a new gasket and the sensor.

Torque: 20 N*m (204 kgf*cm, 15 ft.*lbf)

(b) Connect the sensor connector.

2. INSTALL INVERTER WITH CONVERTER

(a) Install the inverter with converter (see page HV-535).

3. CONNECT CABLE TO NEGATIVE BATTERY TERMINAL

4. ADD ENGINE COOLANT (See page CO-7)

5. ADD HV COOLANT (See page HX-58)

6. CHECK FOR ENGINE COOLANT LEAKS (See page CO-2)

7. CHECK FOR HV COOLANT LEAKS

8. INSTALL ENGINE UNDER COVER RH

9. INSTALL ENGINE UNDER COVER LH

10. INSTALL RADIATOR SUPPORT OPENING COVER (See page ES-454)

11. PERFORM INITIALIZATION

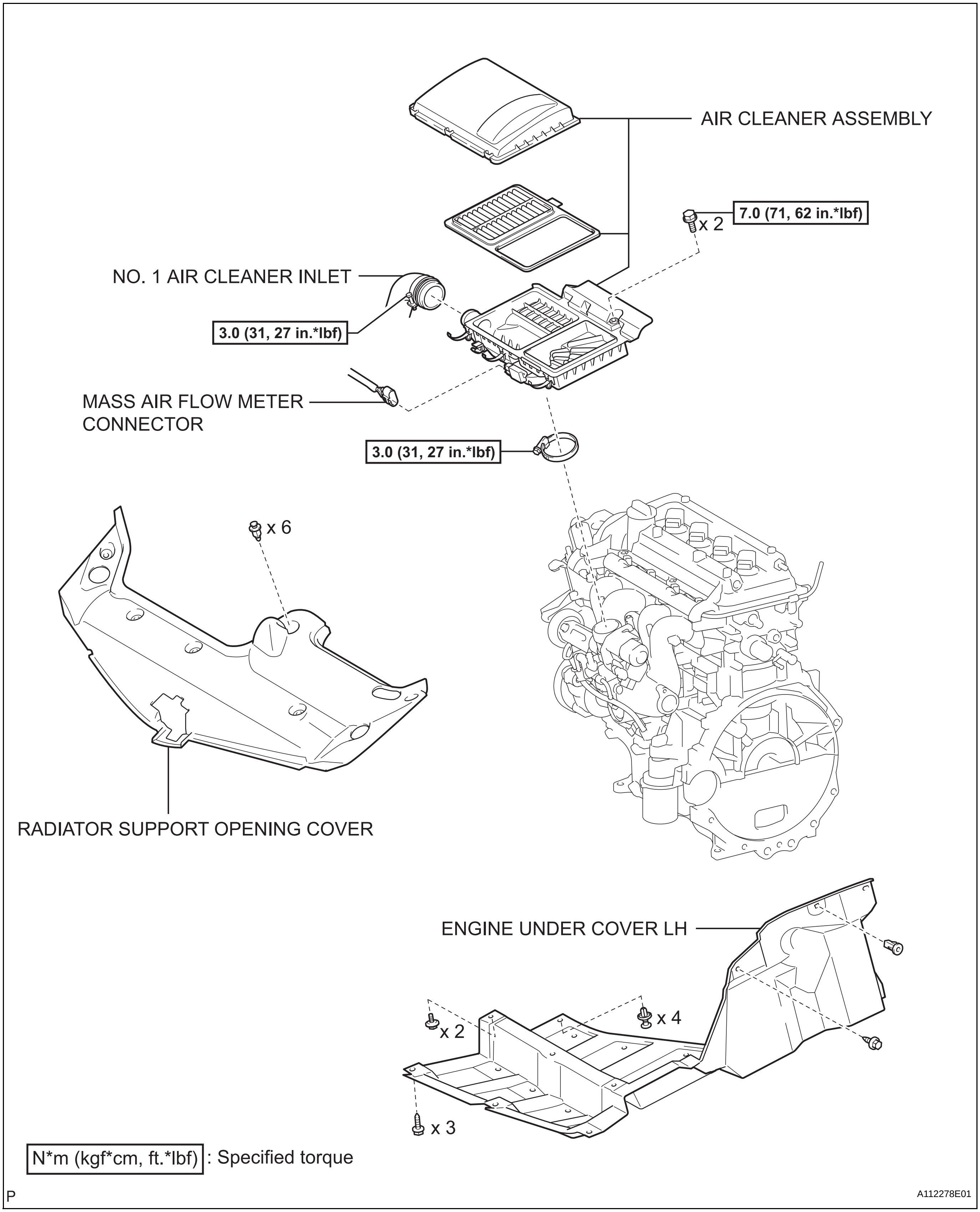
(a) Perform initialization (see page IN-32).

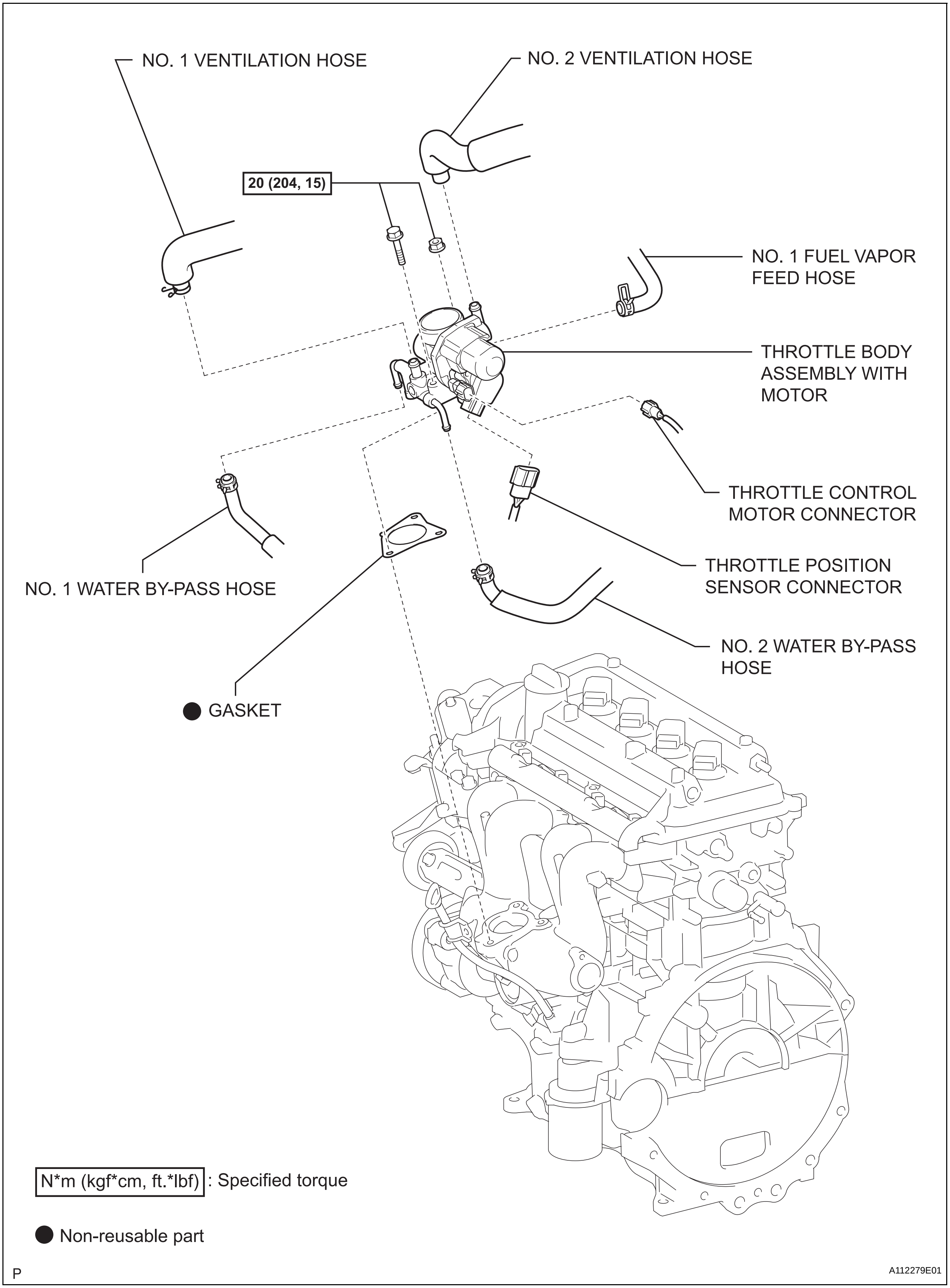
NOTICE:

Certain systems need to be initialized after disconnecting and reconnecting the cable from the negative (-) battery terminal.

THROTTLE BODY

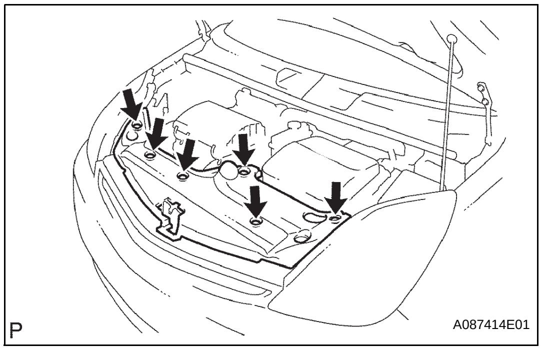
COMPONENTS



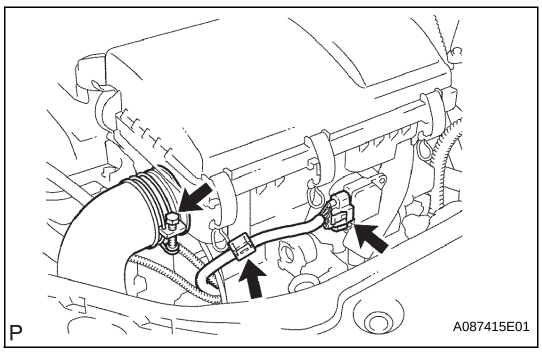

NO. 1 VENTILATION HOSE
NO. 2 VENTILATION HOSE
20 (204, 15)
NO. 1 FUEL VAPOR FEED HOSE
THROTTLE BODY ASSEMBLY WITH MOTOR
THROTTLE CONTROL MOTOR CONNECTOR
THROTTLE POSITION SENSOR CONNECTOR
NO. 1 WATER BY-PASS HOSE
NO. 2 WATER BY-PASS HOSE
GASKET
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part
P
A112279E01

REMOVAL

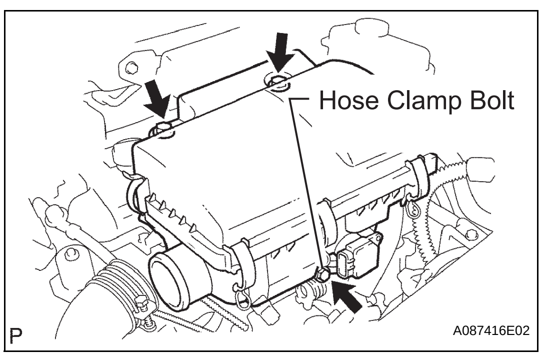
1. **DISCONNECT CABLE FROM NEGATIVE BATTERY TERMINAL**
   CAUTION:
   Wait at least 90 seconds after disconnecting the cable from the negative (-) battery terminal to prevent airbag and seat belt pretensioner activation.
2. **REMOVE ENGINE UNDER COVER LH**
3. **DRAIN ENGINE COOLANT (See page CO-6)**
4. **REMOVE RADIATOR SUPPORT OPENING COVER**
   (a) Remove the 6 clips and radiator support opening cover.



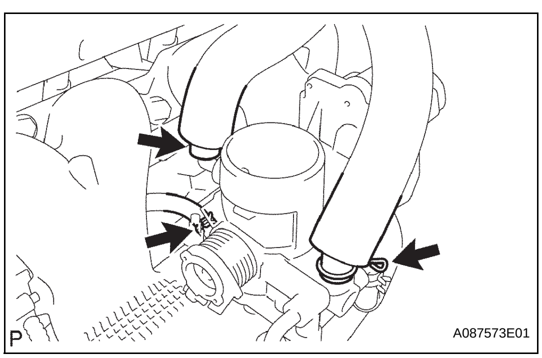
5. **REMOVE AIR CLEANER ASSEMBLY**
   (a) Disconnect the MAF meter connector.
   (b) Disconnect the wire harness from the wire harness clamp.
   (c) Loosen the hose clamp bolt, and then disconnect the No. 1 air cleaner inlet.

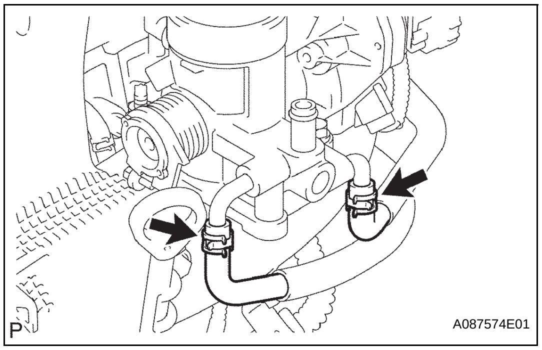


   (d) Remove the 2 bolts.
   (e) Loosen the hose clamp bolt, and then remove the air cleaner.

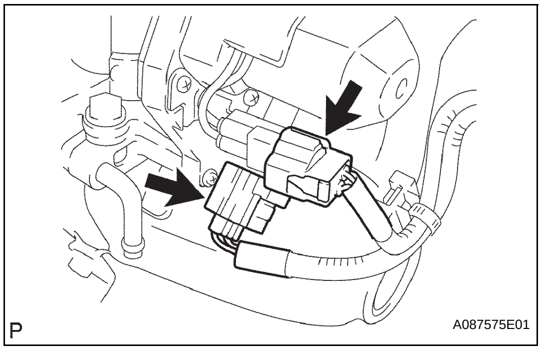


6. **REMOVE THROTTLE BODY ASSEMBLY WITH MOTOR**
   (a) Disconnect the ventilation hose.
   (b) Disconnect the No. 2 ventilation hose.
   (c) Disconnect the No. 1 fuel vapor feed hose.

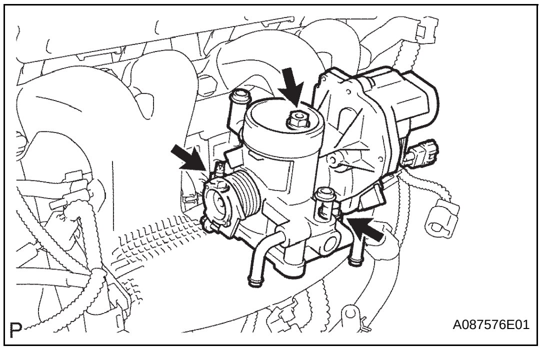




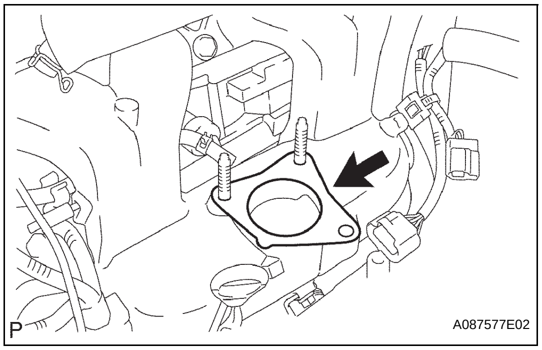
(d) Disconnect the water by-pass hose.
(e) Disconnect the No. 2 water by-pass hose.



(f) Disconnect the throttle control motor connector.
(g) Disconnect the throttle position sensor connector.

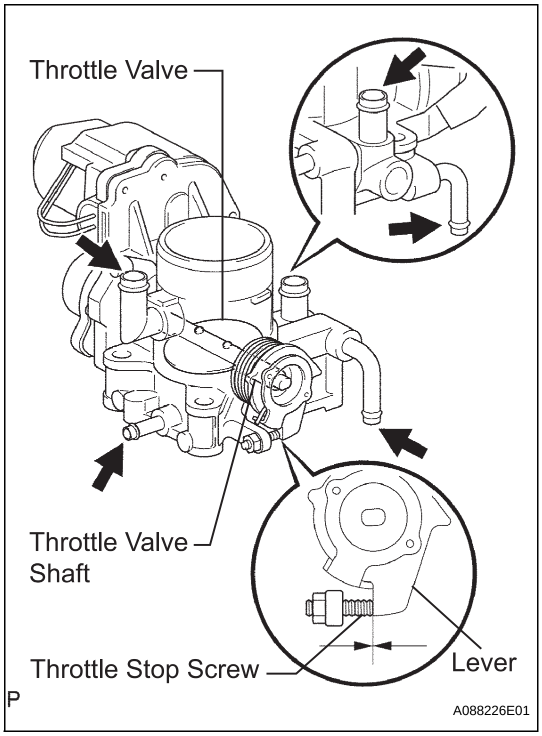


(h) Remove the bolt, 2 nuts and throttle with motor body.



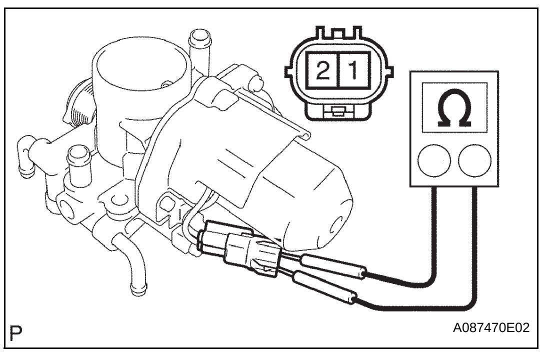
(i) Remove the gasket from the intake manifold.

INSPECTION

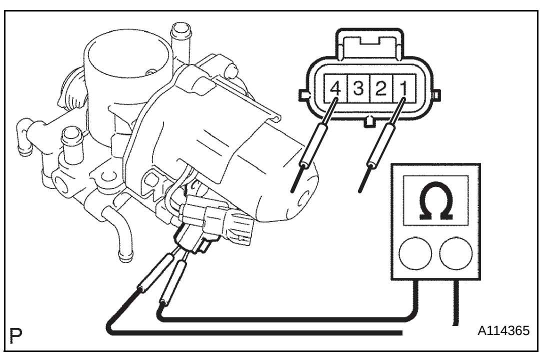


1. INSPECT THROTTLE WITH MOTOR BODY ASSEMBLY

(a) Check the appearance.
  (1) Check that the throttle valve shaft does not rattle.
  (2) Check that each port is not clogged.
  (3) Check that the throttle valve opens and closes smoothly.
  (4) Check that there is no clearance between the throttle stop screw and lever when the throttle valve is fully closed.
  NOTICE:
  Do not adjust the throttle stop screw.

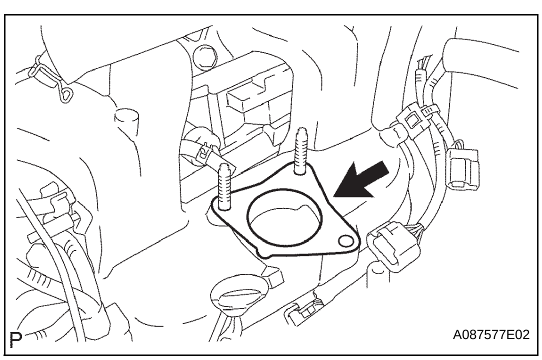


(b) Inspect the resistance of the throttle control motor.
  (1) Using an ohmmeter, measure the resistance between the terminals.
  Standard resistance:
  50 MΩ or more at 25°C (77°F)
  If the resistance is not as specified, replace the throttle with motor body.



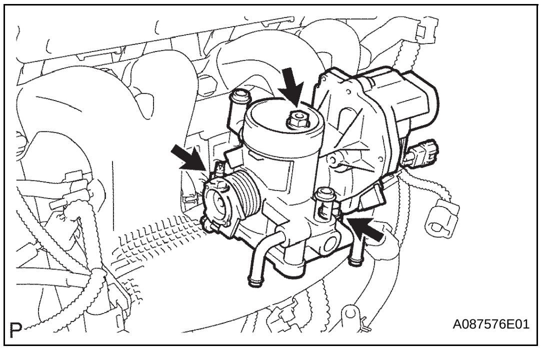
(c) Inspect the resistance of the throttle position sensor.
  (1) Using an ohmmeter, measure the resistance between terminals 1 and 4.
  Standard resistance:
  1.2 to 3.5 kΩ at 25°C (77°F)
  If the resistance is not as specified, replace the throttle with motor body.

INSTALLATION

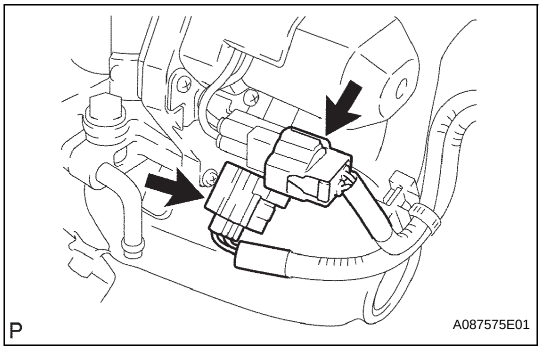


1. INSTALL THROTTLE BODY ASSEMBLY WITH MOTOR

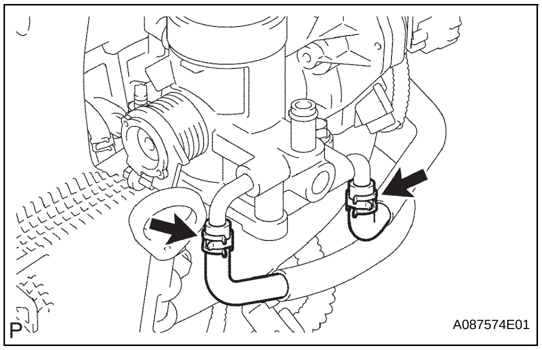
(a) Install a new gasket to the intake manifold.



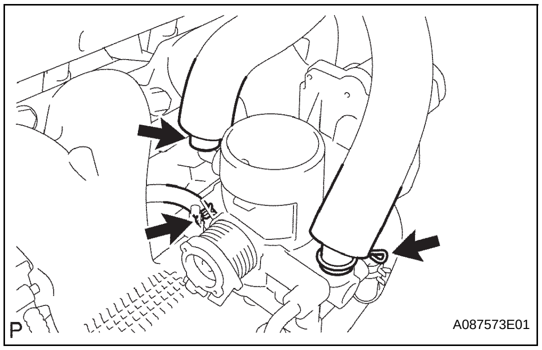
(b) Install the throttle with motor body with the bolt and 2 nuts.
Torque: 20 N*m (204 kgf*cm, 15 ft.*lbf)



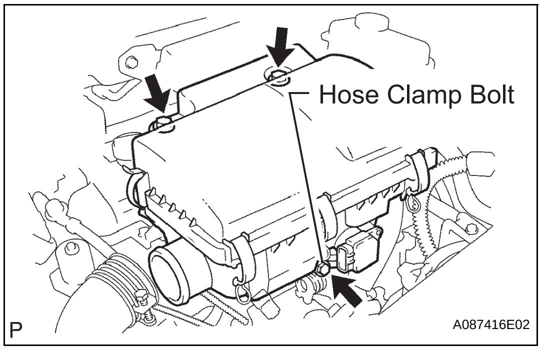
(c) Connect the throttle position sensor connector.
(d) Connect the throttle control motor connector.



(e) Connect the No. 2 water by-pass hose.
(f) Connect the water by-pass hose.



(g) Connect the No. 1 fuel vapor feed hose.
(h) Connect the No. 2 ventilation hose.
(i) Connect the ventilation hose.



2. INSTALL AIR CLEANER ASSEMBLY

(a) Install the air cleaner with the 2 bolts.
Torque: 7.0 N*m (71 kgf*cm, 62 in.*lbf)
(b) Tighten the hose clamp bolt.
Torque: 3.0 N*m (31 kgf*cm, 27 in.*lbf)
(c) Connect the No. 1 air cleaner inlet, and tighten the hose clamp bolt.
Torque: 3.0 N*m (31 kgf*cm, 27 in.*lbf)
(d) Connect the MAF meter connector.

3. CONNECT CABLE TO NEGATIVE BATTERY TERMINAL

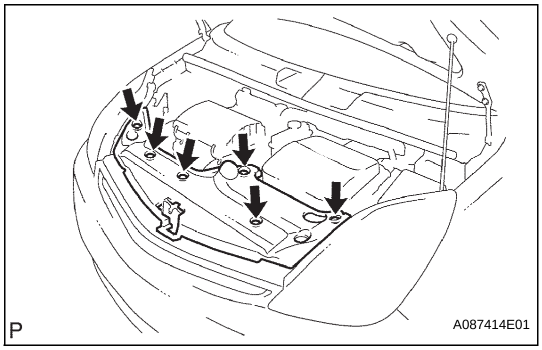
4. ADD ENGINE COOLANT (See page CO-7)

5. CHECK FOR ENGINE COOLANT LEAKS (See page CO-2)

6. INSTALL ENGINE UNDER COVER LH

7. INSTALL RADIATOR SUPPORT OPENING COVER

(a) Install the cover with the 6 clips.



8. PERFORM INITIALIZATION

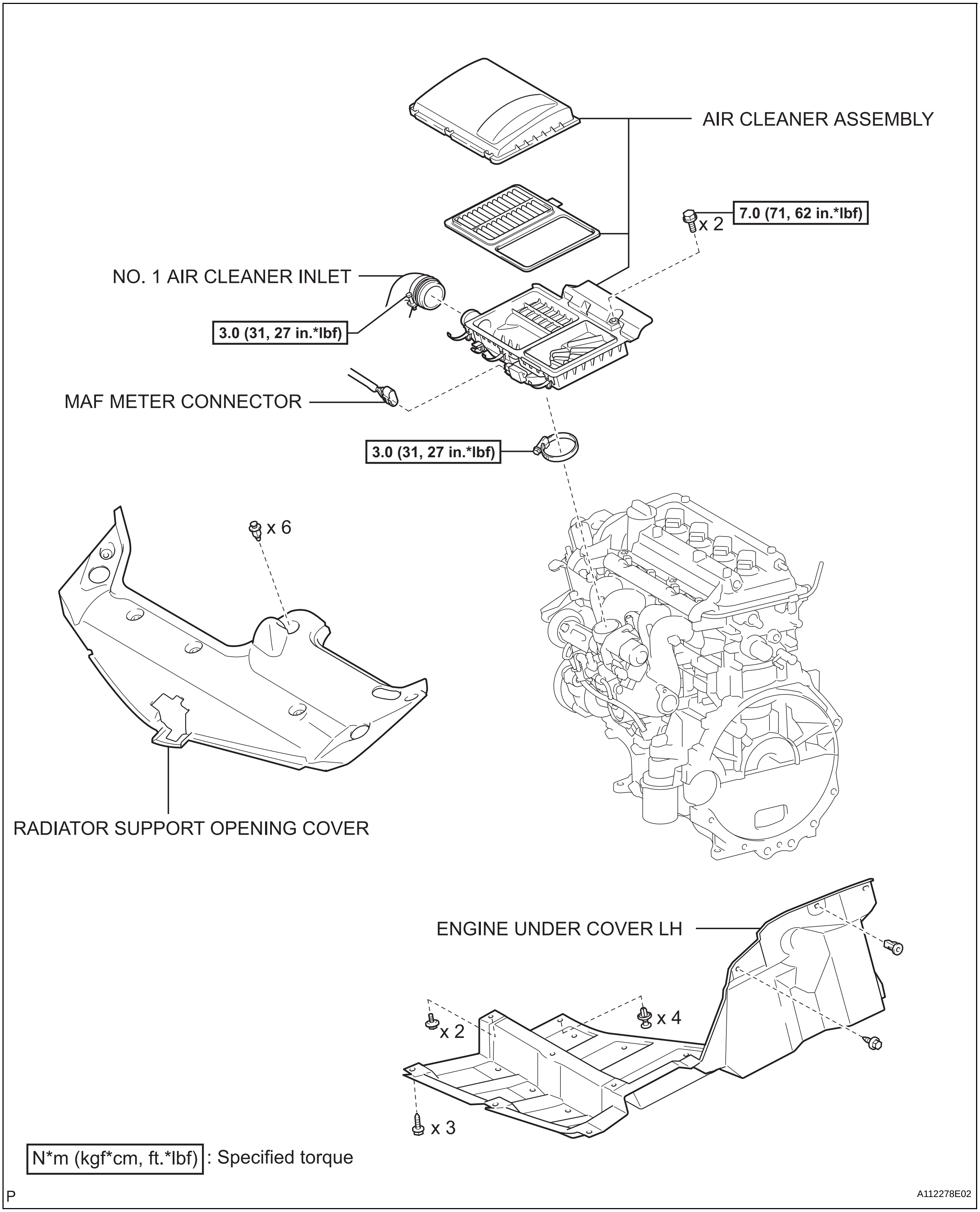
(a) Perform initialization (see page IN-32).

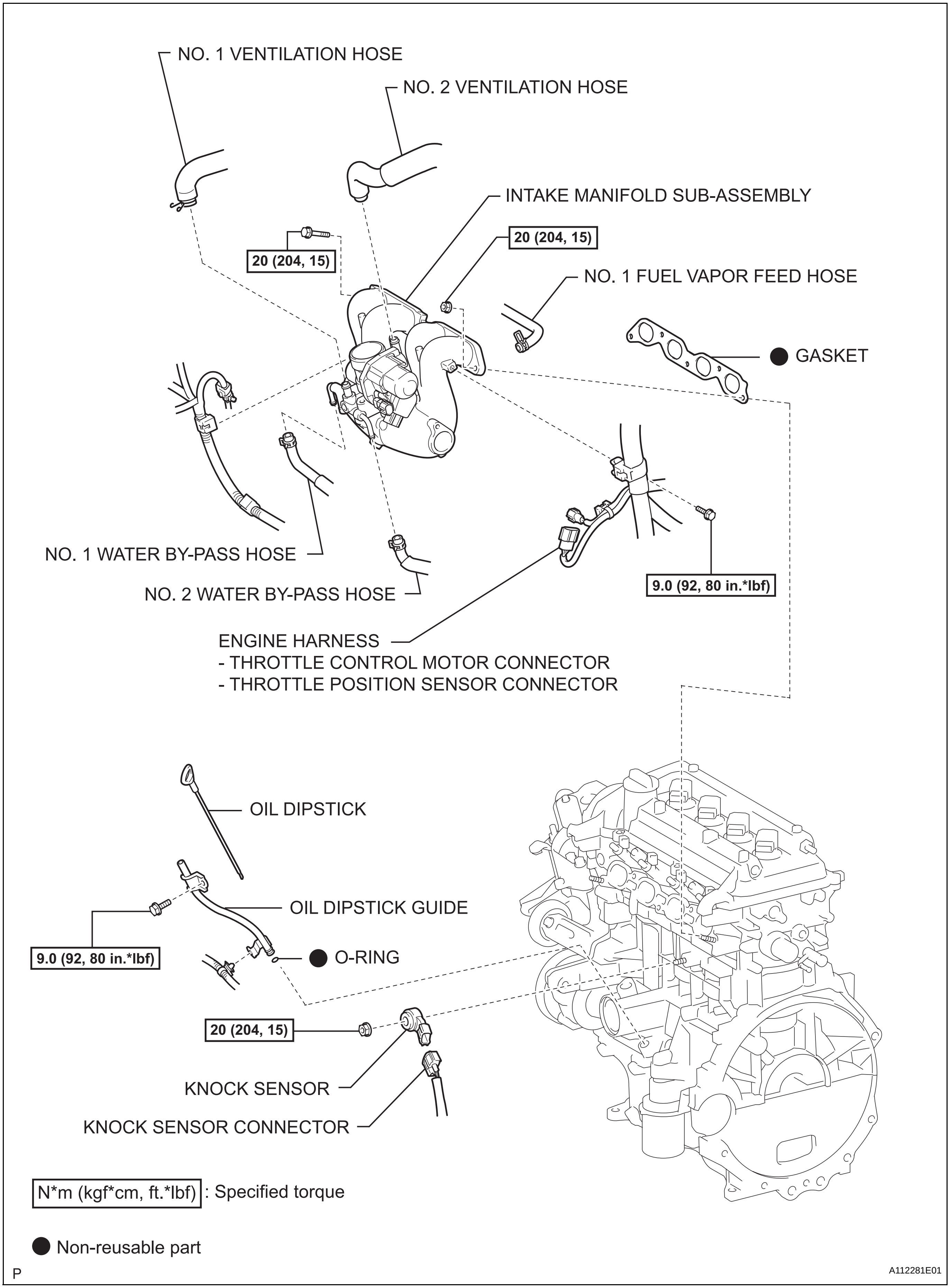
NOTICE:

Certain systems need to be initialized after disconnecting and reconnecting the cable from the negative (-) battery terminal.

KNOCK SENSOR

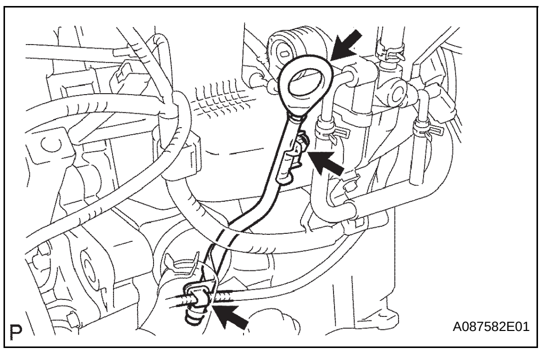
COMPONENTS



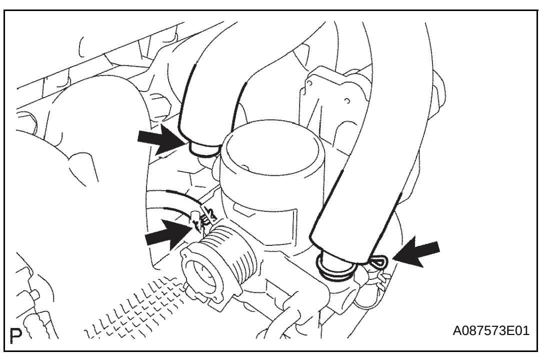

NO. 1 VENTILATION HOSE
NO. 2 VENTILATION HOSE
INTAKE MANIFOLD SUB-ASSEMBLY
20 (204, 15)
20 (204, 15)
NO. 1 FUEL VAPOR FEED HOSE
GASKET
NO. 1 WATER BY-PASS HOSE
NO. 2 WATER BY-PASS HOSE
9.0 (92, 80 in.*lbf)
ENGINE HARNESS
- THROTTLE CONTROL MOTOR CONNECTOR
- THROTTLE POSITION SENSOR CONNECTOR
OIL DIPSTICK
OIL DIPSTICK GUIDE
9.0 (92, 80 in.*lbf)
O-RING
20 (204, 15)
KNOCK SENSOR
KNOCK SENSOR CONNECTOR
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part
P
A112281E01

REMOVAL

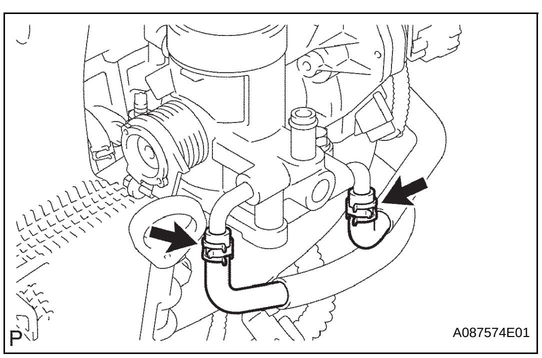
1. **DISCONNECT CABLE FROM NEGATIVE BATTERY TERMINAL**
   CAUTION:
   Wait at least 90 seconds after disconnecting the cable from the negative (-) battery terminal to prevent airbag and seat belt pretensioner activation.
2. **REMOVE RADIATOR SUPPORT OPENING COVER (See page ES-450)**
3. **REMOVE ENGINE UNDER COVER LH**
4. **DRAIN ENGINE COOLANT (See page CO-6)**
5. **REMOVE AIR CLEANER ASSEMBLY (See page ES-450)**



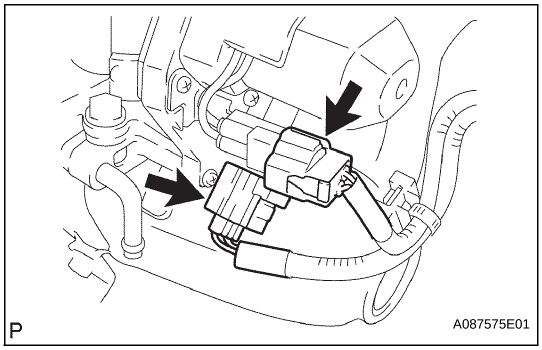
6. **REMOVE OIL DIPSTICK GUIDE**
   (a) Remove the dipstick.
   (b) Disconnect the wire harness clamp.
   (c) Remove the bolt and dipstick guide.



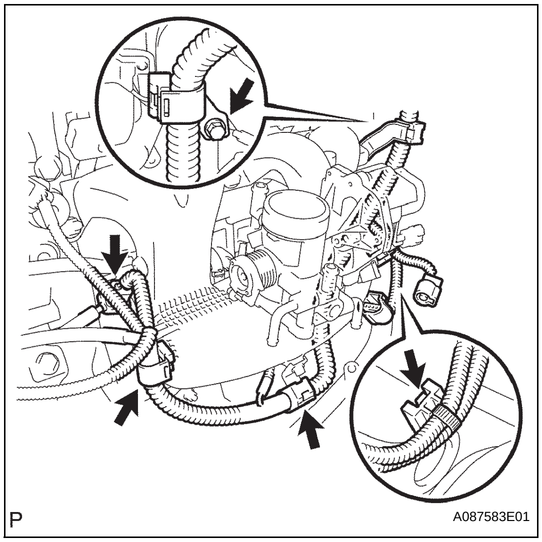
7. **REMOVE INTAKE MANIFOLD SUB-ASSEMBLY**
   (a) Disconnect the ventilation hose from the throttle with motor body.
   (b) Disconnect the No. 2 ventilation hose.
   (c) Disconnect the No. 1 fuel vapor feed hose.



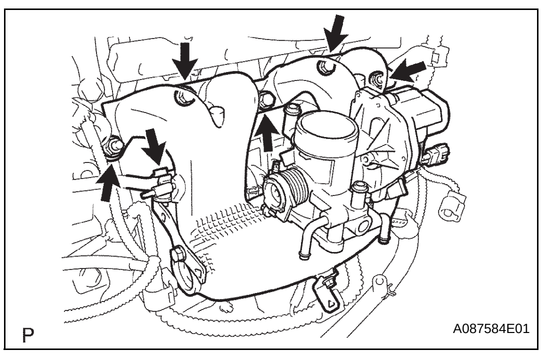
   (d) Disconnect the water by-pass hose.
   (e) Disconnect the No. 2 water by-pass hose.



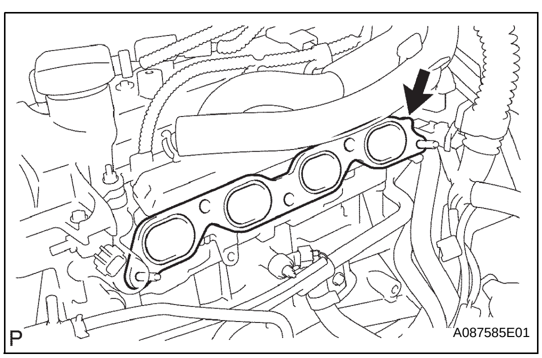
(f) Disconnect the throttle control motor connector.
(g) Disconnect the throttle position sensor connector.



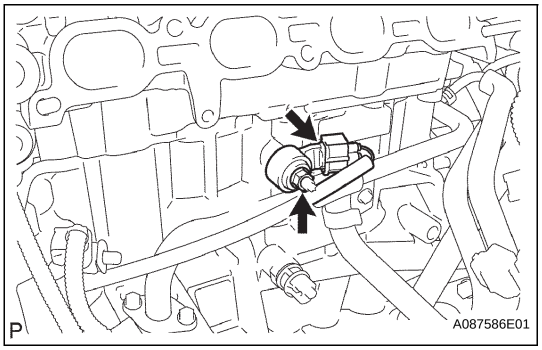
(h) Disconnect the 3 wire harness clamps.
(i) Disconnect the connector clamp.
(j) Remove the bolt and harness clamp bracket.



(k) Remove the No. 1 fuel vapor feed hose from the hose clamp.
(l) Remove the 3 bolts, 2 nuts and intake manifold.

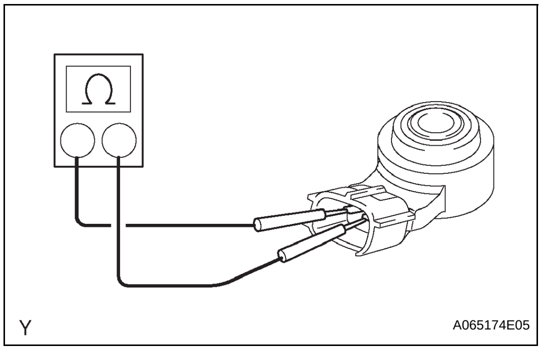


(m) Remove the gasket from the cylinder head.



8. **REMOVE KNOCK SENSOR**
   (a) Disconnect the knock sensor connector.
   (b) Remove the nut and sensor.

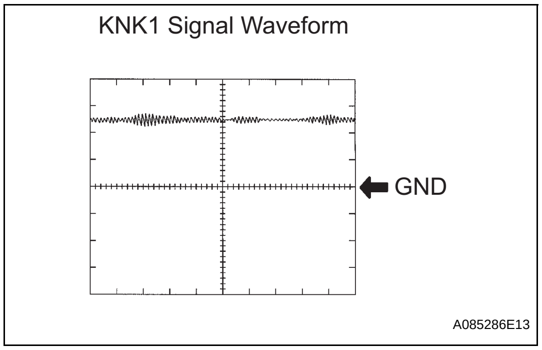
INSPECTION



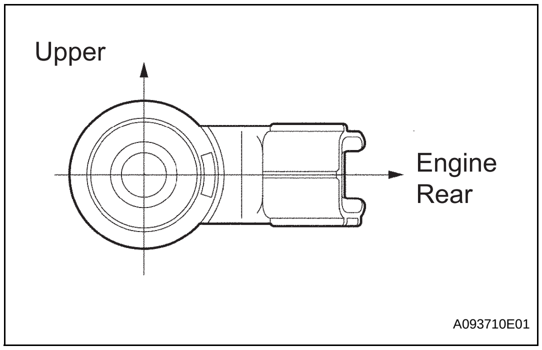
1. **INSPECT KNOCK SENSOR**
   (a) Measure the resistance of the sensor.
   Standard resistance:
   120 to 280 kΩ at 20°C (68°F)
   If the result is not as specified, replace the knock sensor.
   - A flat type knock sensor (non-resonant type) has a structure that can detect vibrations between approximately 6 kHz and 15 kHz.
   - Knock sensors are fitted onto the engine block to detect engine knocking.
   - The knock sensor contains a piezoelectric element which generates a voltage when it becomes deformed. The voltage is generated when the engine block vibrates due to knocking. Any occurrence of engine knocking can be suppressed by delaying the ignition timing.

DTC No.	DTC Detection Condition	Trouble Area
P0327	Output voltage of knock sensor is 0.5 V or less (1 trip detection logic)	• Short in knock sensor circuit • Knock sensor • ECM
P0328	Output voltage of knock sensor is 4.5 V or more (1 trip detection logic)	• Open in knock sensor circuit • Knock sensor • ECM

HINT:
When either of the DTCs P0327 and P0328 are set, the ECM enters fail-safe mode. During fail-safe mode, the power timing is delayed to its maximum retardation. Fail-safe mode continues until the power switch OFF.
Reference: Inspection using an oscilloscope.
The correct waveform is shown.

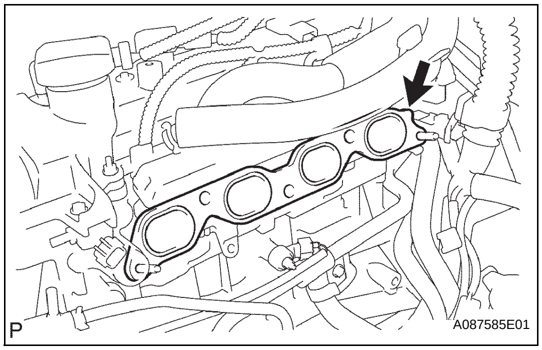


Items	Contents
Terminals	KNK1 - EKNK
Equipment Settings	0.01 to 10 V/Division, 0.01 to 10 msec./ Division
Conditions	Keep engine speed at 4,000 rpm with warm engine

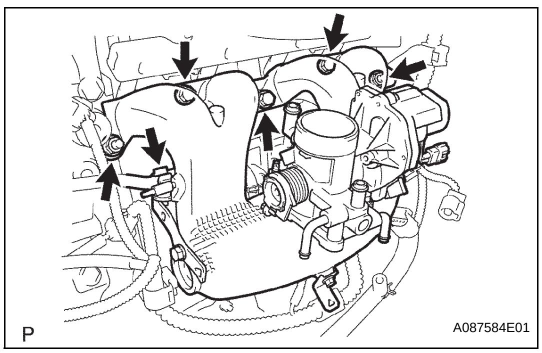


INSTALLATION

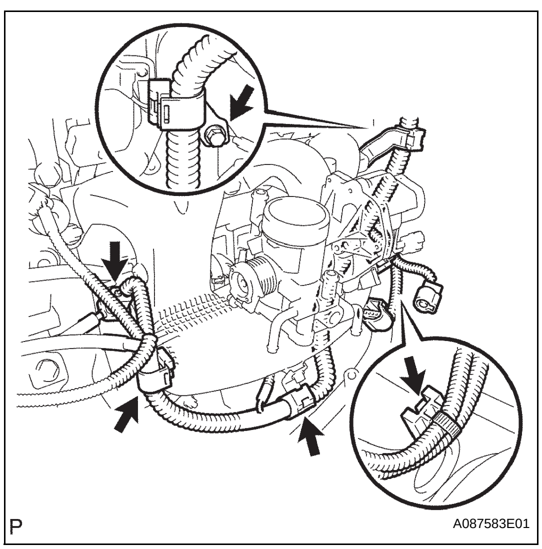
1. **INSTALL KNOCK SENSOR**
   (a) Install the knock sensor with the nut.
   Torque: 20 N*m (204 kgf*cm, 15 ft.*lbf)
   NOTICE:
   Be careful to install the knock sensor in the correct direction.
   (b) Connect the knock sensor connector.



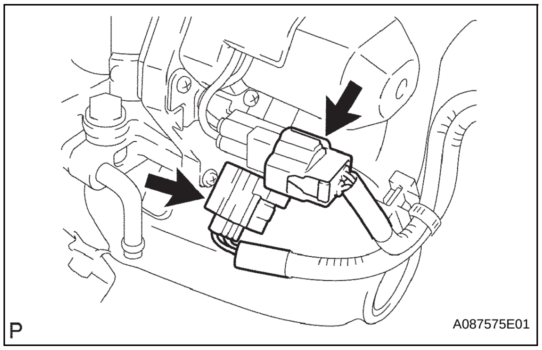
2. **INSTALL INTAKE MANIFOLD**
   (a) Install a new gasket to the cylinder head.



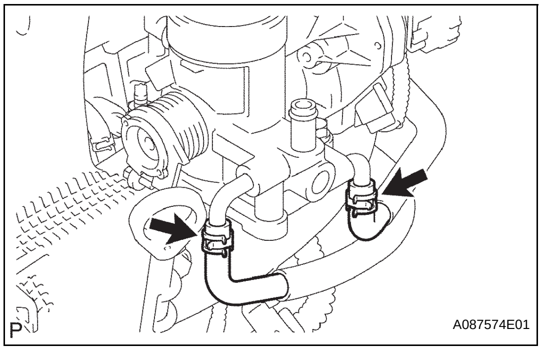
   (b) Install the intake manifold with the 3 bolts and 2 nuts.
   Torque: 20 N*m (204 kgf*cm, 15 ft.*lbf)
   (c) Install the No. 1 fuel vapor feed hose to the hose clamp.



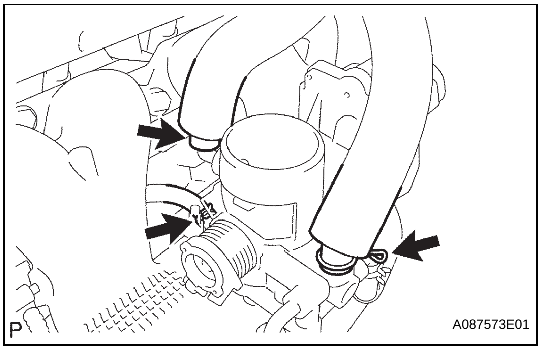
   (d) Install the harness clamp bracket with the bolt.
   Torque: 9.0 N*m (92 kgf*cm, 80 in.*lbf)
   (e) Install the connector clamp.
   (f) Install the 3 wire harness clamps.



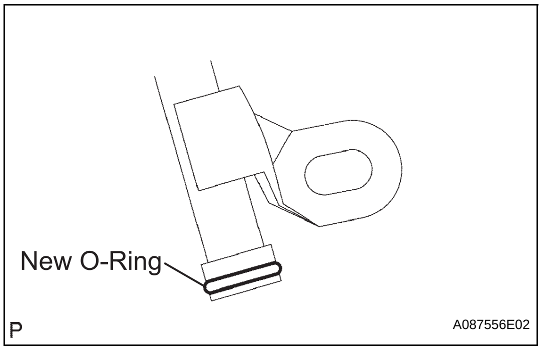
(g) Connect the throttle position sensor connector.
(h) Connect the throttle control motor connector.



(i) Connect the No. 2 water by-pass hose.
(j) Connect the water by-pass hose.

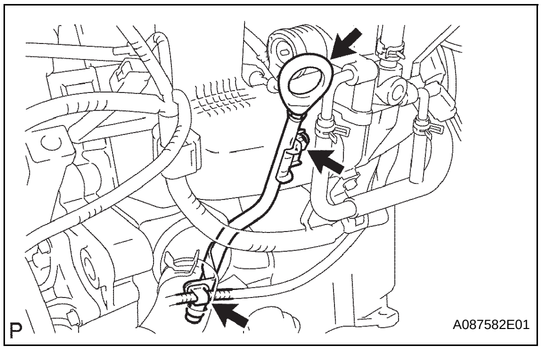


(k) Connect the No. 1 fuel vapor feed hose.
(l) Connect the No. 2 ventilation hose.
(m) Connect the ventilation hose.



3. INSTALL OIL DIPSTICK GUIDE

(a) Apply a light coat of engine oil to a new O-ring and install it to the dipstick guide.



(b) Install the dipstick guide with the bolt.
Torque: 9.0 N*m (92 kgf*cm, 80 in.*lbf)
NOTICE:
Be careful that the O-ring is not cracked or jammed when installing it.
(c) Connect the wire harness clamp.
(d) Install the dipstick.

4. INSTALL AIR CLEANER ASSEMBLY (See page ES-453)

5. CONNECT CABLE TO NEGATIVE BATTERY TERMINAL

6. ADD ENGINE COOLANT (See page CO-7)

7. CHECK FOR ENGINE COOLANT LEAKS (See page CO-2)

8. INSTALL ENGINE UNDER COVER LH

9. INSTALL RADIATOR SUPPORT OPENING COVER (See page ES-454)

10. PERFORM INITIALIZATION

(a) Perform initialization (see page IN-32).

NOTICE:

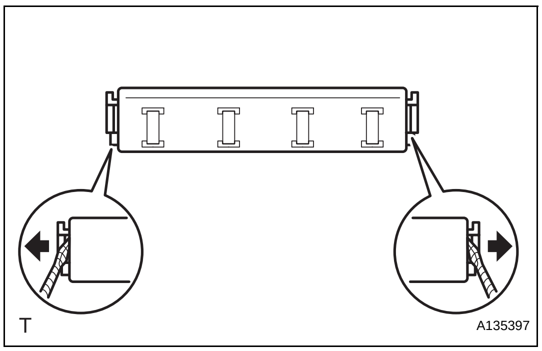
Certain systems need to be initialized after disconnecting and reconnecting the cable from the negative (-) battery terminal.

EFI RELAY

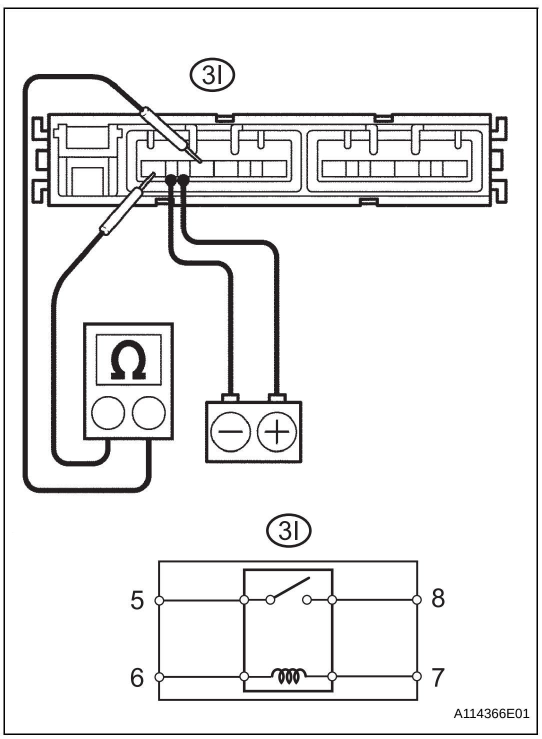
ON-VEHICLE INSPECTION

1. **DISCONNECT CABLE FROM NEGATIVE BATTERY TERMINAL**
   CAUTION:
   Wait at least 90 seconds after disconnecting the cable from the negative (-) battery terminal to prevent airbag and seat belt pretensioner activation.

2. **INSPECT INTEGRATION RELAY (UNIT B: EFI RELAY M RELAY)**
   NOTICE:
   - **The EFI relay is built into the integration relay (unit B: EFI MAIN).**
   - **Some relays are built into the integration relay. The integration relay cannot be disassembled. If there is a malfunction in the circuit of the integration relay, replace the integration relay.**



(a) Using a screwdriver, detach the 2 claws and disconnect the integration relay from the engine room No. 1 junction block.
HINT:
Tape the screwdriver tip before use.
(b) Disconnect the 3 connectors from the integration relay.



(c) Measure the resistance between the terminals.
Standard resistance

Tester Connection	Specified Condition
3I-5 - 3I-8	10 kΩ or higher
3I-5 - 3I-8	Below 1 Ω (when battery voltage is applied to terminals 3I-6 and 3I-7)

If the result is not as specified, replace the integration relay.
(d) Connect the 3 connectors to the integration relay.
(e) Install the integration relay to the engine room No. 1 junction block.

3. **CONNECT CABLE TO NEGATIVE BATTERY TERMINAL**

4. **PERFORM INITIALIZATION**
   (a) Perform initialization (see page IN-32).
   NOTICE:
   Certain system need to be initialized after disconnecting and reconnecting the cable from the negative (-) battery terminal.

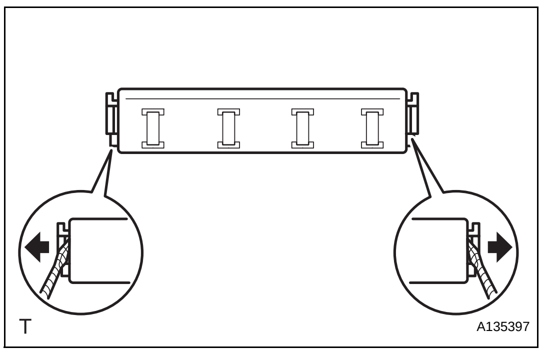
ES

CIRCUIT OPENING RELAY

ON-VEHICLE INSPECTION

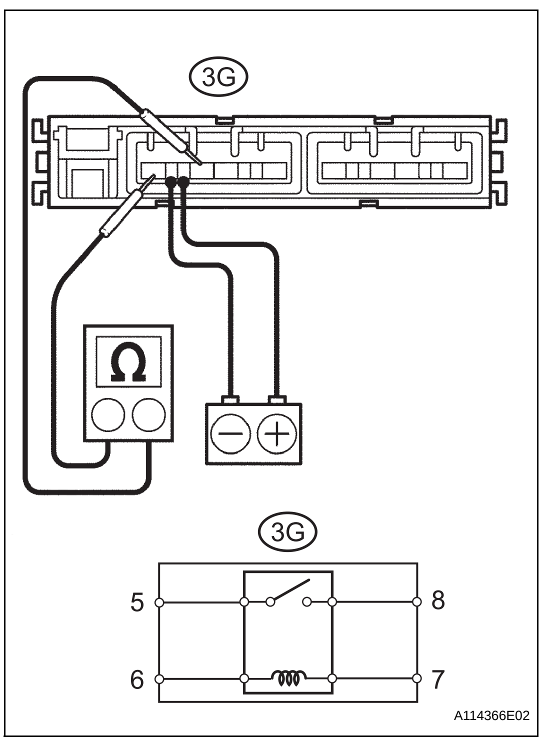
1. **DISCONNECT CABLE FROM NEGATIVE BATTERY TERMINAL**
   CAUTION:
   Wait at least 90 seconds after disconnecting the cable from the negative (-) battery terminal to prevent airbag and seat belt pretensioner activation.

2. **INSPECT INTEGRATION RELAY (UNIT C: C/OPN RELAY)**
   NOTICE:
   - **The EFI relay is built into the integration relay (unit C: C/OPN RELAY).**
   - **Some relays are built into the integration relay. The integration relay cannot be disassembled. If there is a malfunction in the circuit of the integration relay, replace the integration relay.**



(a) Using a screwdriver, detach the 2 claws and disconnect the integration relay from the No. 1 engine room junction block.
HINT:
Tape the screwdriver tip before use.

(b) Disconnect the 2 connectors from the integration relay.



(c) Measure the resistance between the terminals.
Standard resistance

Tester Connection	Specified Condition
3G-5 - 3G-8	10 kΩ or higher
3G-5 - 3G-8	Below 1 Ω (when battery voltage is applied to terminals 3G-6 and 3G-7)

If the result is not as specified, replace the integration relay.

(d) Connect the 2 connectors to the integration relay.

(e) Install the integration relay to the engine room No. 1 junction block.

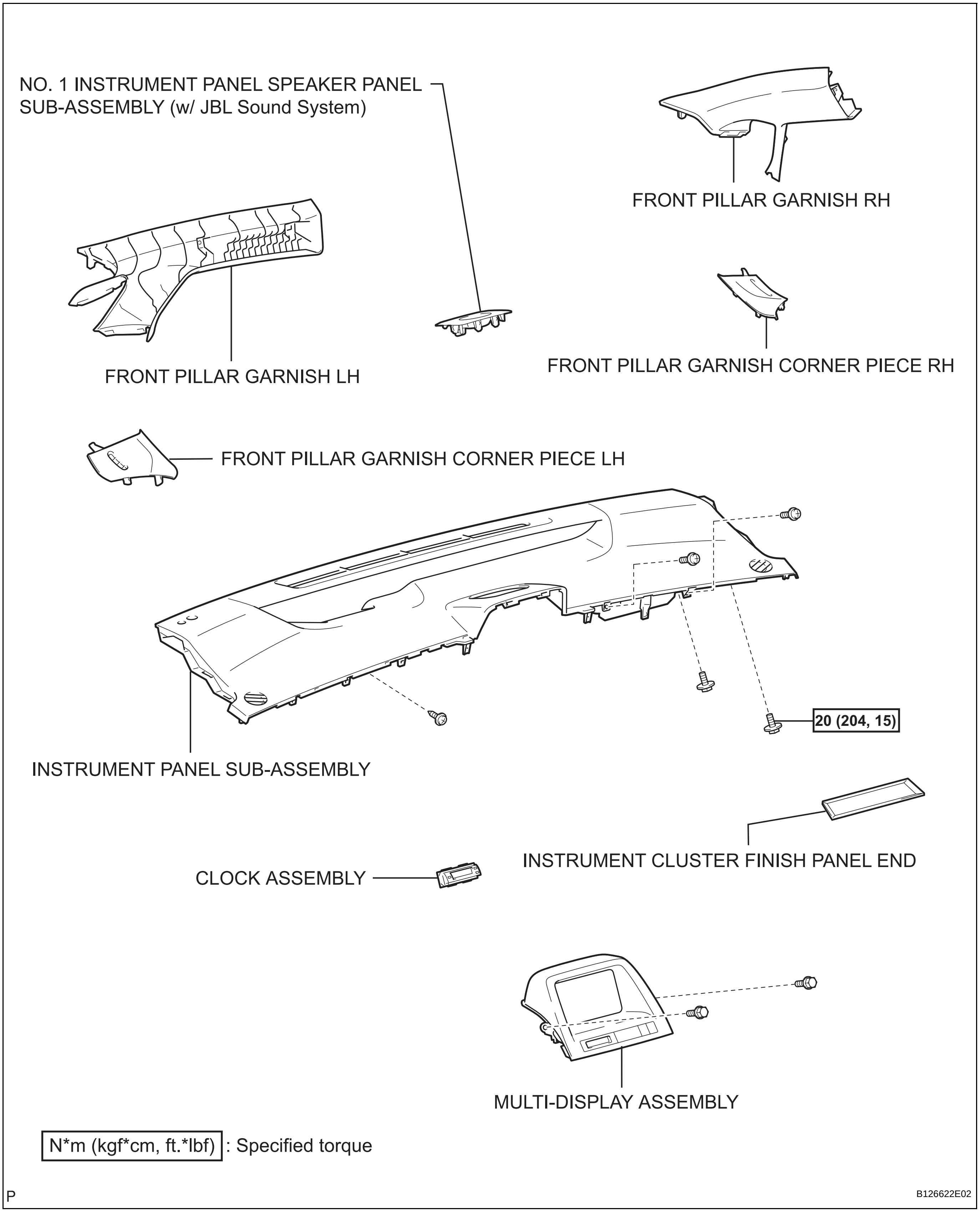
3. **CONNECT CABLE TO NEGATIVE BATTERY TERMINAL**

4. **PERFORM INITIALIZATION**
   (a) Perform initialization (see page IN-32).
   NOTICE:
   Certain system need to be initialized after disconnecting and reconnecting the cable from the negative (-) battery terminal.

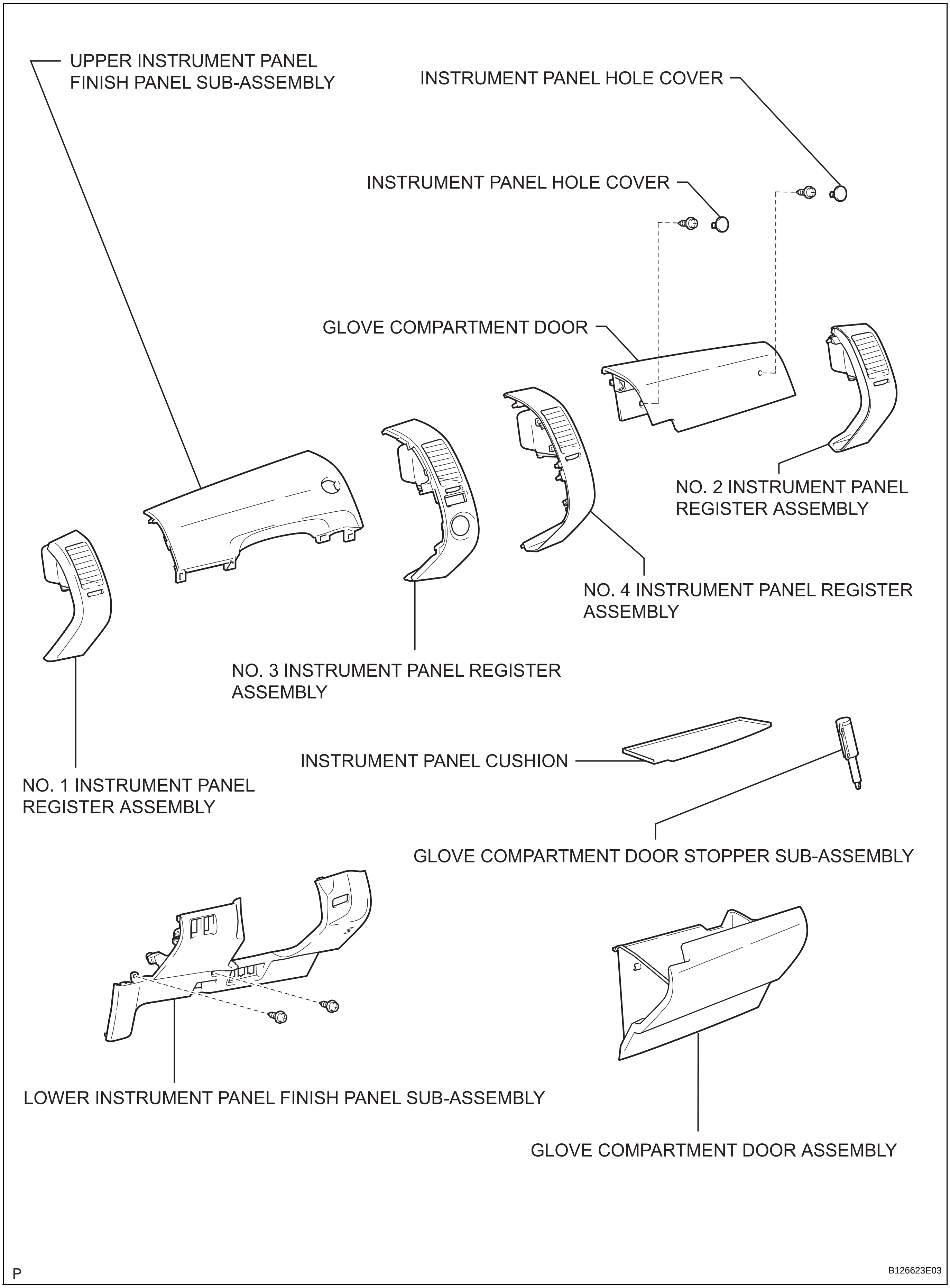
ES

ECM

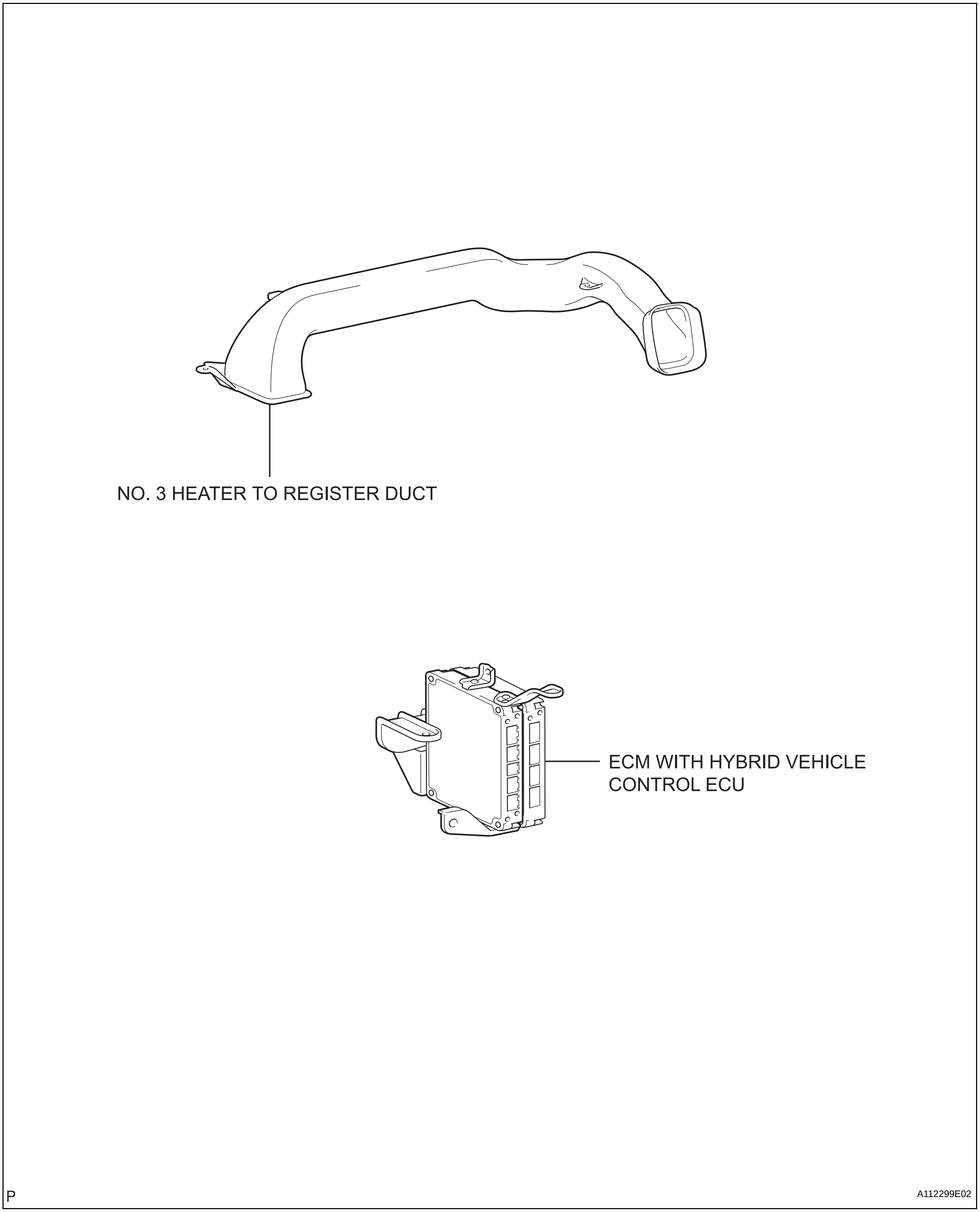
COMPONENTS



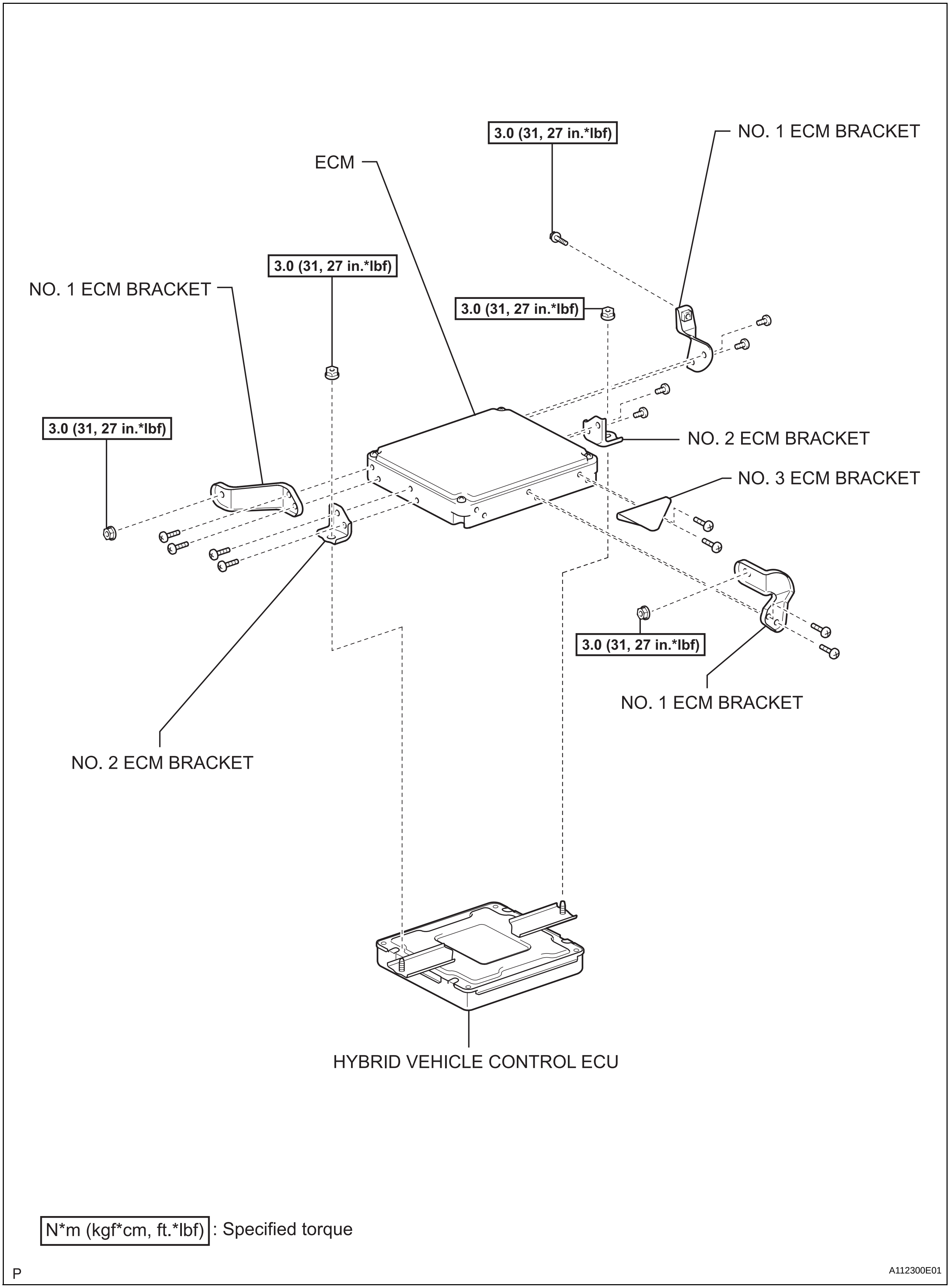
ES


UPPER INSTRUMENT PANEL FINISH PANEL SUB-ASSEMBLY
INSTRUMENT PANEL HOLE COVER
INSTRUMENT PANEL HOLE COVER
GLOVE COMPARTMENT DOOR
NO. 2 INSTRUMENT PANEL REGISTER ASSEMBLY
NO. 4 INSTRUMENT PANEL REGISTER ASSEMBLY
NO. 3 INSTRUMENT PANEL REGISTER ASSEMBLY
INSTRUMENT PANEL CUSHION
NO. 1 INSTRUMENT PANEL REGISTER ASSEMBLY
GLOVE COMPARTMENT DOOR STOPPER SUB-ASSEMBLY
LOWER INSTRUMENT PANEL FINISH PANEL SUB-ASSEMBLY
GLOVE COMPARTMENT DOOR ASSEMBLY
P
B126623E03

ES


NO. 3 HEATER TO REGISTER DUCT
ECM WITH HYBRID VEHICLE CONTROL ECU
P
A112299E02

ES


3.0 (31, 27 in.*lbf)
NO. 1 ECM BRACKET
ECM
3.0 (31, 27 in.*lbf)
NO. 1 ECM BRACKET
3.0 (31, 27 in.*lbf)
3.0 (31, 27 in.*lbf)
NO. 2 ECM BRACKET
NO. 3 ECM BRACKET
3.0 (31, 27 in.*lbf)
NO. 1 ECM BRACKET
NO. 2 ECM BRACKET
HYBRID VEHICLE CONTROL ECU
N*m (kgf*cm, ft.*lbf) : Specified torque
P
A112300E01

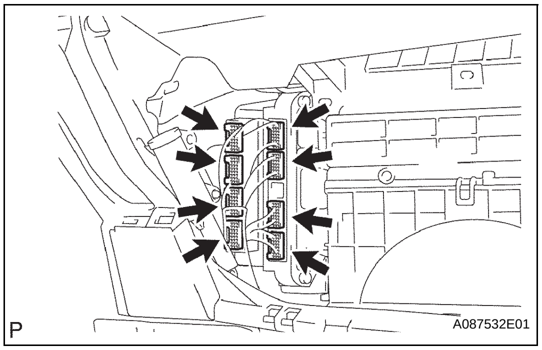
REMOVAL

1. **DISCONNECT CABLE FROM NEGATIVE BATTERY TERMINAL**
   CAUTION:
   Wait at least 90 seconds after disconnecting the cable from the negative (-) battery terminal to prevent airbag and seat belt pretensioner activation.

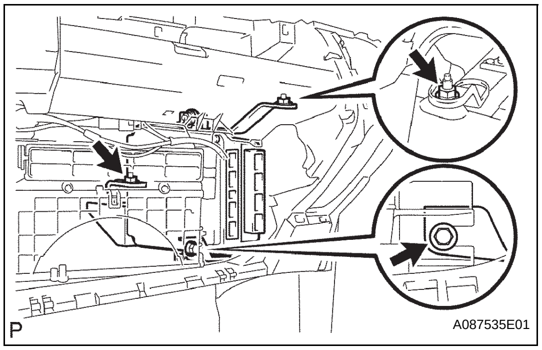
2. **REMOVE INSTRUMENT PANEL SUB-ASSEMBLY**
   (a) Remove the instrument panel (see page IP-5).

3. **REMOVE NO. 3 HEATER TO REGISTER DUCT (See page AC-147)**

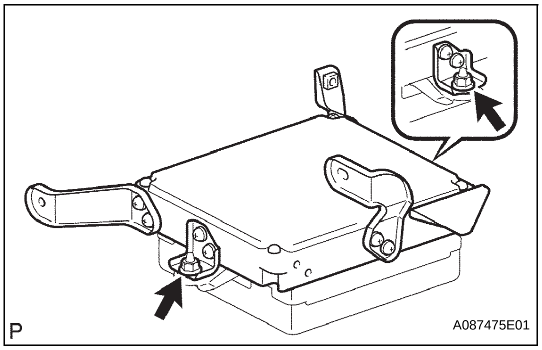
4. **REMOVE ECM**
   (a) Disconnect the 4 ECM connectors.
   (b) Disconnect the 4 hybrid vehicle control ECU connectors.

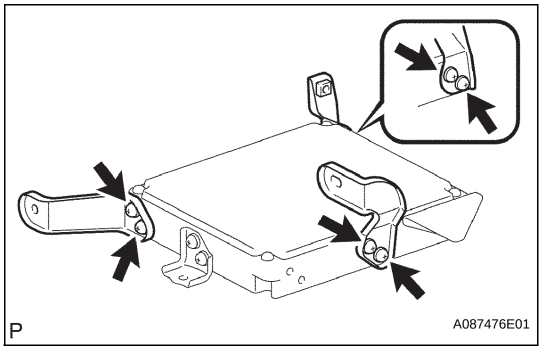


   (c) Remove the 2 nuts and bolt, and ECM with bracket.

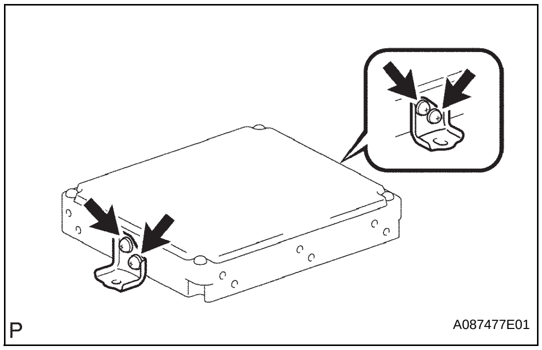


   (d) Remove the 2 nuts and ECM.

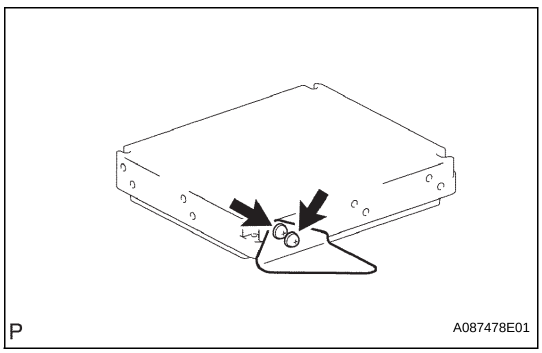




(e) Remove the 6 screws and 3 No. 1 ECM brackets.



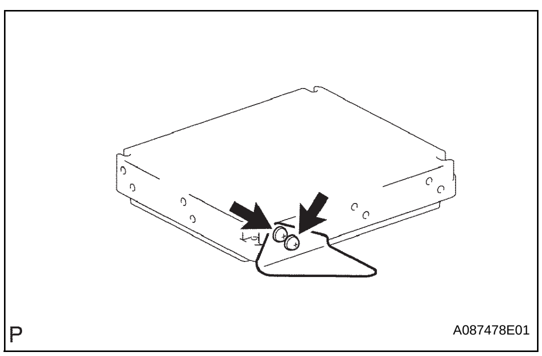
(f) Remove the 4 screws and 2 No. 2 ECM brackets.



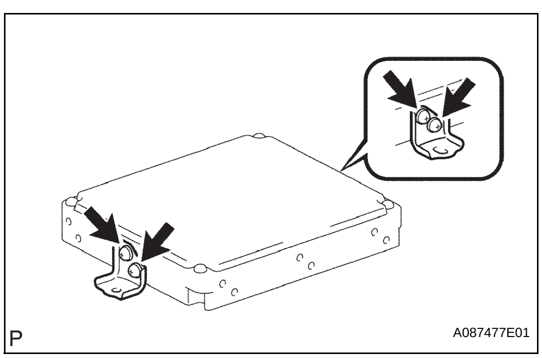
(g) Remove the 2 screws and No. 3 ECM bracket.

INSTALLATION

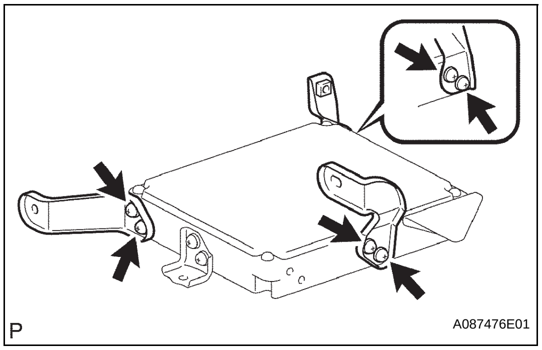
1. INSTALL ECM



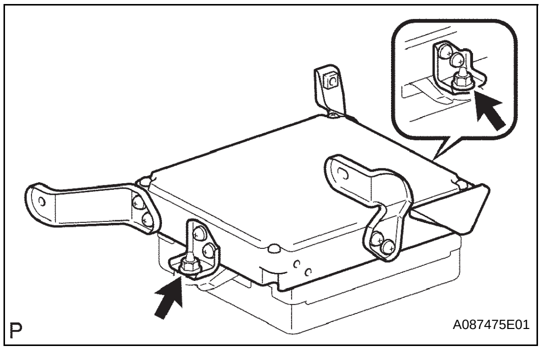
(a) Install the No. 3 ECM bracket with the 2 screws.



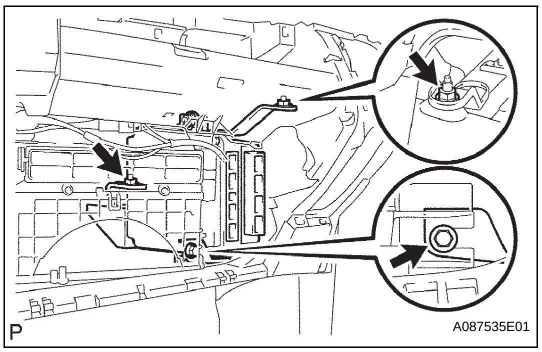
(b) Install the 2 No. 2 ECM brackets with the 4 screws.



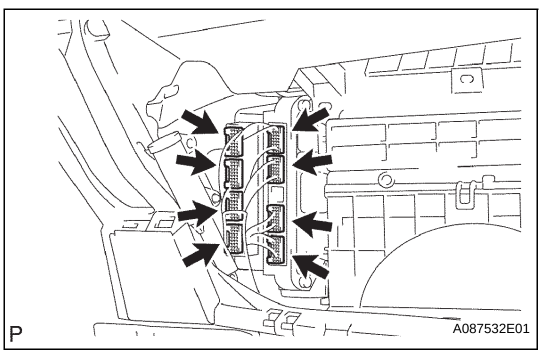
(c) Install the 3 No. 1 ECM brackets with the 6 screws.



(d) Install the ECM with the 2 nuts.
Torque: 3.0 N*m (31 kgf*cm, 27 in.*lbf)



(e) Install the ECM with bracket with the 2 nuts and bolt.
Torque: 3.0 N*m (31 kgf*cm, 27 in.*lbf)



(f) Connect the 4 hybrid vehicle control ECU connectors.
(g) Connect the 4 ECM connectors.

2. INSTALL NO. 3 HEATER TO REGISTER DUCT (See page AC-159)

3. INSTALL INSTRUMENT PANEL SUB-ASSEMBLY
(a) Install the instrument panel (see page IP-11).

4. CONNECT CABLE TO NEGATIVE BATTERY TERMINAL

5. PERFORM INITIALIZATION
(a) Perform initialization (see page IN-32).
NOTICE:
Certain systems need to be initialized after disconnecting and reconnecting the cable from the negative (-) battery terminal.