

EVAP System

RELATED DTCS

DTCs	Monitoring Items	See page
P043E	Reference orifice clogged (built into canister pump module)	ES-251
P043F	Reference orifice high-flow (built into canister pump module)	
P0441	- Purge VSV (Vacuum Switching Valve) stuck closed - Purge VSV stuck open - Purge flow	ES-256
P0450	Canister pressure sensor (built into canister pump module) voltage abnormal fluctuation	ES-263
P0451	- Canister pressure sensor (built into canister pump module) noise - Canister pressure sensor (built into canister pump module) signal becomes fixed/flat	
P0452	Canister pressure sensor (built into canister pump module) voltage low	
P0453	Canister pressure sensor (built into canister pump module) voltage high	
P0455	EVAP gross leak	ES-270
P0456	EVAP small leak	
P2401	Leak detection pump stuck OFF (built into canister pump module)	ES-251
P2402	Leak detection pump stuck ON (built into canister pump module)	
P2419	Vent valve stuck closed (built into canister pump module)	ES-251
P2420	Vent valve stuck open (vent) (built into canister pump module)	ES-375
P2610	Soak timer (built into ECM)	ES-379

If any EVAP system DTCs are set, the malfunctioning area can be determined using the table below.

DTCs Malfunctioning Areas	P043E P043F	P0441	P0450	P0451	P0452	P0453	P0455	P0456	P2401 P2402	P2419	P2420
Reference orifice clogged	●								●	●	
Reference orifice high-flow	●								●	●	
Purge VSV stuck open		●					●				
Purge VSV stuck closed		●									
Canister pressure sensor fixed output				●							
Canister pressure sensor noise				●							
Canister pressure sensor low output			●		●						
Canister pressure sensor high output			●			●					
Gross leak		●					●				
Small leak								●			
Leak detection pump stuck OFF	●								●	●	
Leak detection pump stuck ON	●								●	●	
Vent valve stuck closed	●								●	●	
Vent valve stuck open (vent)											●

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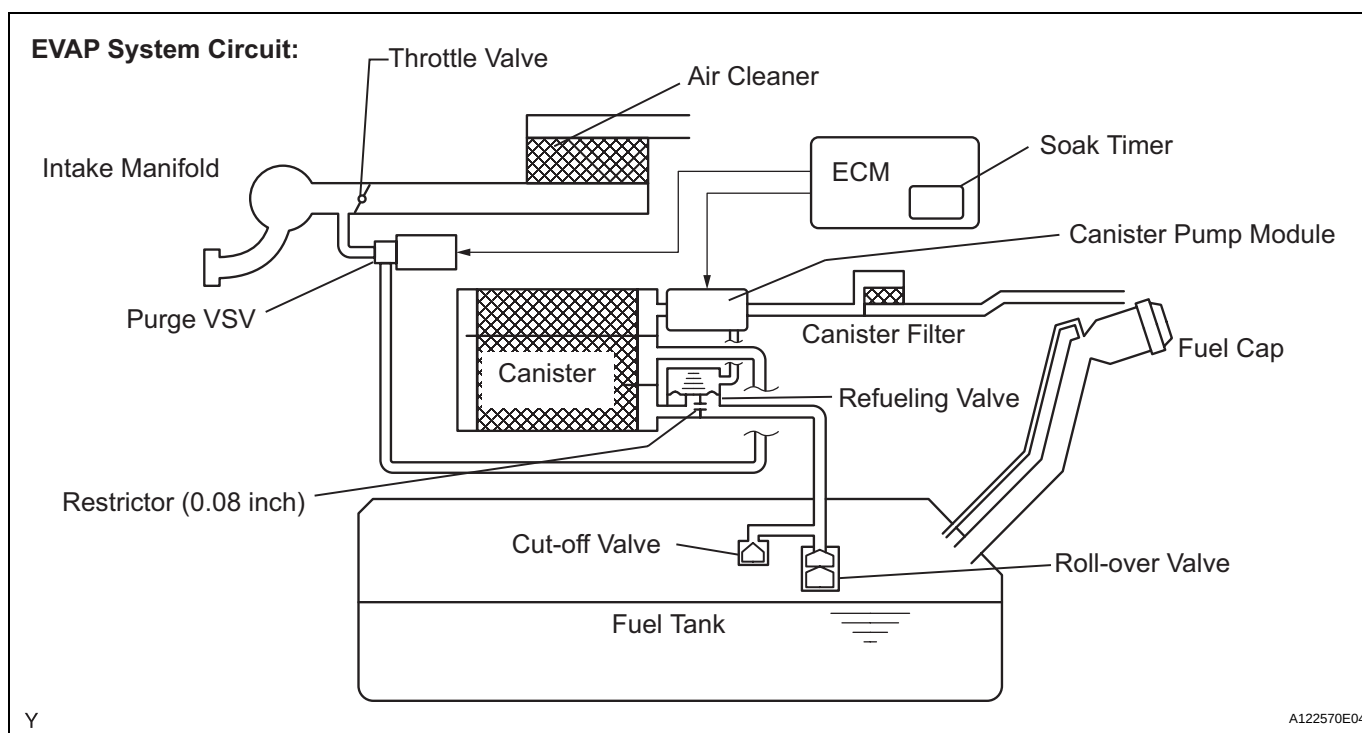
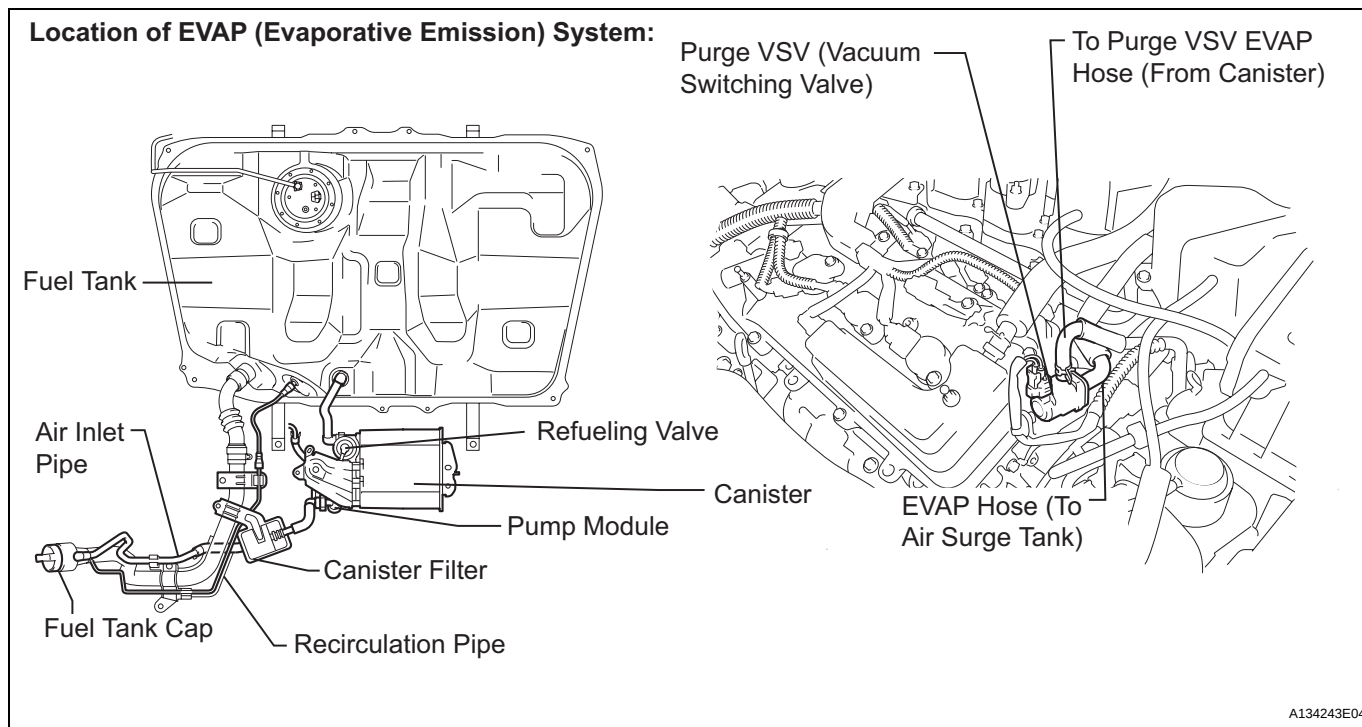
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NOTICE:

If the reference pressure difference between the first and second checks is greater than the specification, all the DTCs relating to the reference pressure (P043E, P043F, P2401, P2402 and P2419) are stored.

DESCRIPTION

**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 atmospheric side of the canister.

While the engine is running, if a predetermined condition (closed-loop, etc.) is met, the purge VSV is opened by the ECM and fuel vapors stored in the canister are purged into the intake manifold. The ECM changes the duty cycle ratio of the purge VSV to control purge flow volume.

The purge flow volume is also determined by the intake manifold pressure. Atmospheric pressure is allowed into the canister through the vent valve to ensure that the purge flow is maintained when negative pressure (vacuum) is applied to the canister.

The following two monitors run to confirm the appropriate EVAP system operation.

1. Key-off monitor

This monitor checks for EVAP (Evaporative Emission) system leaks and canister pump module malfunctions. The monitor starts 5 hours* after the engine switch is turned off. At least 5 hours are required for the fuel to cool down to stabilize the EVAP pressure, thus making the EVAP system monitor more accurate.

The leak detection pump creates negative pressure (vacuum) in the EVAP system and the pressure is measured. Finally, the ECM monitors for leaks from the EVAP system, and malfunctions in both the canister pump module and purge VSV, based on the EVAP pressure.

HINT:

*: If the engine coolant temperature is not below 35°C (95°F) 5 hours after the engine 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 engine switch is turned off, the monitor check starts 2.5 hours later.

2. Purge flow monitor

The purge flow monitor consists of the two monitors. The 1st monitor is conducted every time and the 2nd monitor is activated if necessary.

- The 1st monitor

While the engine is running and the purge VSV (Vacuum Switching Valve) is ON (open), the ECM monitors the purge flow by measuring the EVAP pressure change. If negative pressure is not created, the ECM begins the 2nd monitor.

- The 2nd monitor

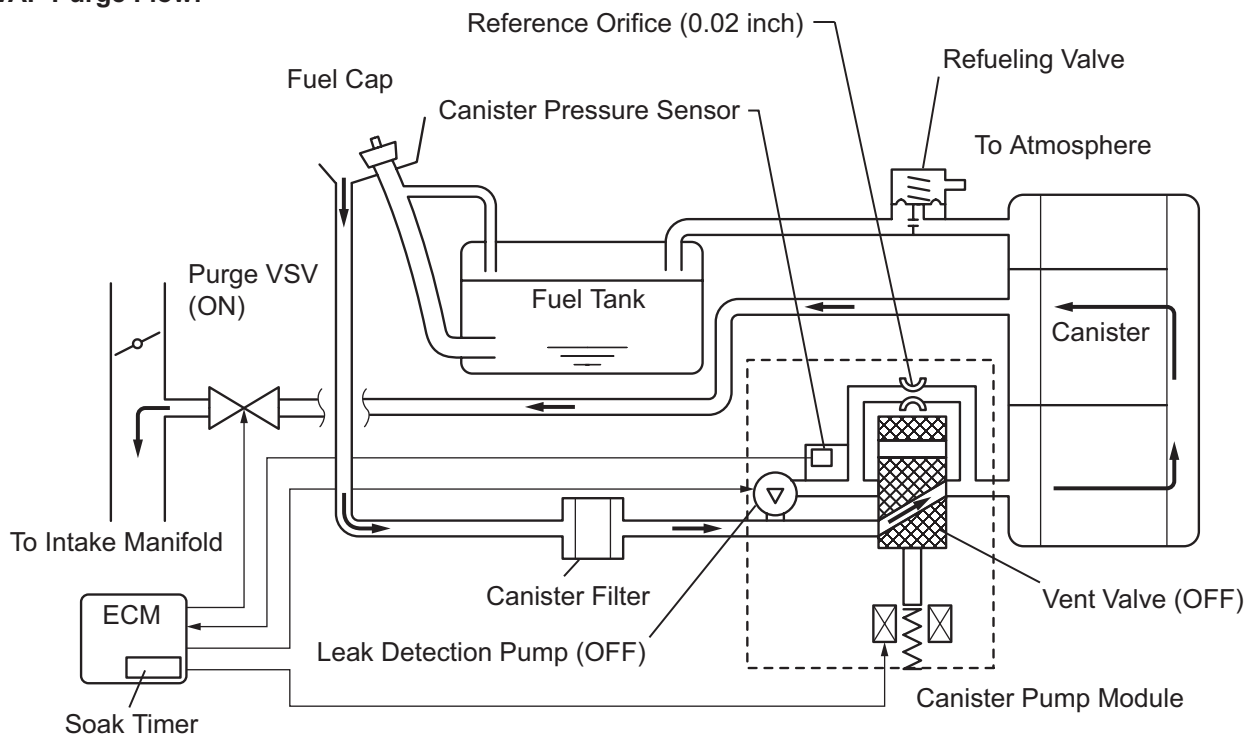
The vent valve is turned OFF (open) and the EVAP pressure is measured. If the variation in the pressure is less than 0.5 kPa-g (3.75 mmHg-g), the ECM interprets this as the purge VSV being stuck closed, and illuminates the MIL and sets DTC P0441 (2 trip detection logic).

Atmospheric pressure check:

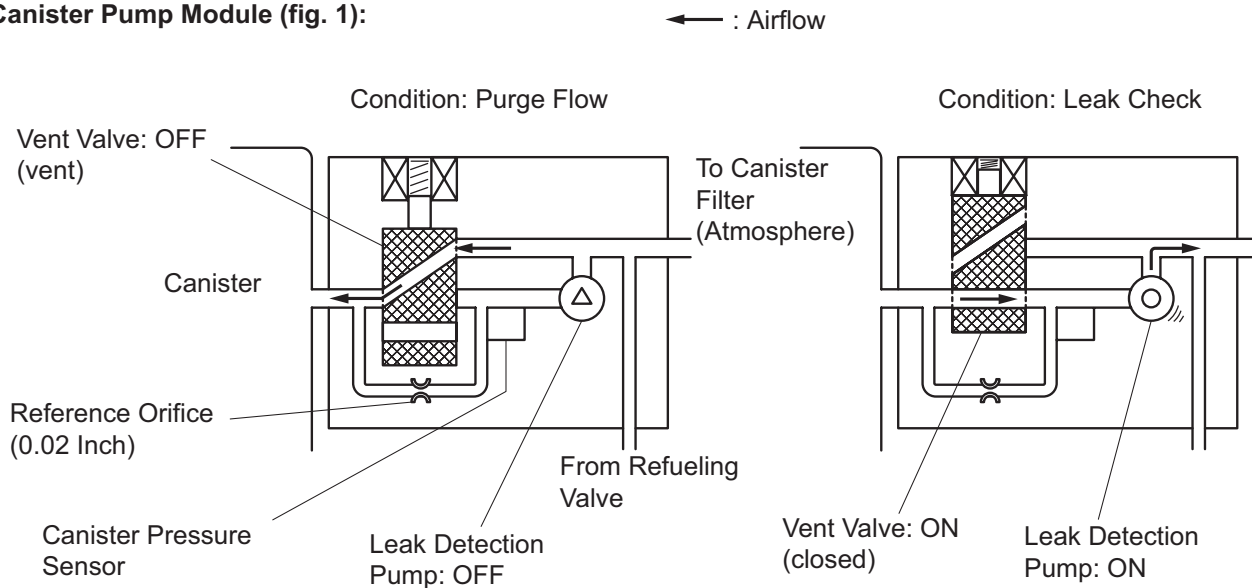
In order to ensure reliable malfunction detection, the variation between the atmospheric pressures, before and after conduction of the purge flow monitor, is measured by the ECM.

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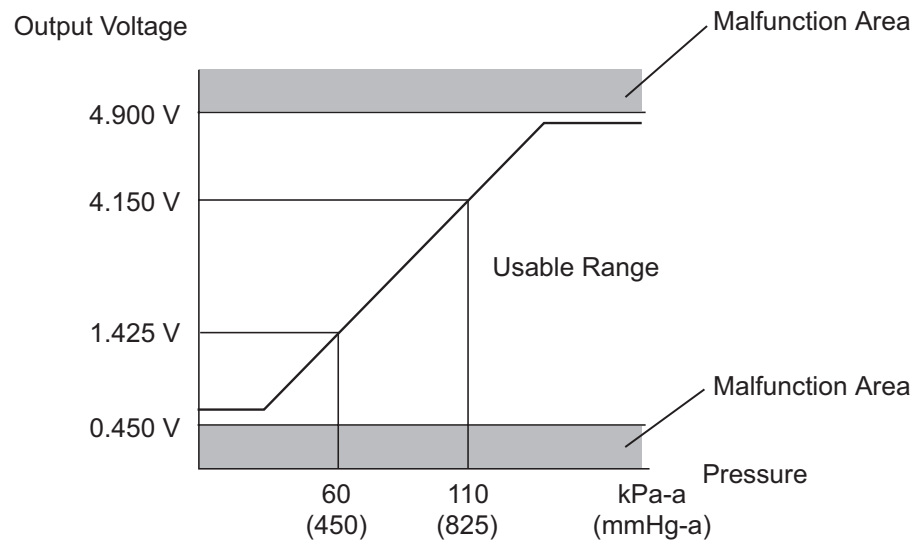
EVAP Purge Flow:



Components	Operations
Canister	Contains activated charcoal to absorb EVAP (Evaporative Emissions) generated in fuel tank.
Cut-off valve	Located in fuel tank. Valve floats and closes when fuel tank is 100 % full.
Purge VSV (Vacuum Switching Valve)	Opens or closes line between canister and intake manifold. ECM uses purge VSV to control EVAP purge flow. In order to discharge EVAP absorbed by canister to intake manifold, ECM opens purge VSV. EVAP discharge volume to intake manifold is controlled by purge VSV duty cycle ratio (current-carrying time) (Open: ON; Closed: OFF).
Refueling valve	Controls EVAP pressure from fuel tank to canister. Valve consists of diaphragm, spring and restrictor (diameter: 0.08 inch). When fuel vapor and pressure inside fuel tank increase, valve opens. While EVAP is purged, valve closes and restrictor prevents large amount of vacuum from affecting pressure in fuel tank. Valve is opened while refueling.
Roll-over valve	Located in fuel tank. Valve is closed by its own weight when vehicle overturns to prevent fuel from spilling out.
Soak timer	Built into ECM. To ensure accurate EVAP monitor, measures 5 hours (+15 min) after engine switch is turned off. This allows fuel to cool down, stabilizing EVAP pressure. When approximately 5 hours have elapsed, ECM is activated (refer to fig. 3).
Canister pump module	Consists of (a) to (d) below. Canister pump module cannot be disassembled.
(a) Vent valve	Vents and closes EVAP system. When ECM turns valve ON, EVAP system is closed. When ECM turns valve off, EVAP system is vented. Negative pressure (vacuum) is created in EVAP system to check for EVAP leaks by closing purge VSV, turning on vent valve (closed) and operating leak detection pump (refer to fig. 1).
(b) Canister pressure sensor	Indicates pressure as voltages. ECM supplies regulated 5 V to canister pressure sensor, and uses feedback from sensor to monitor EVAP system pressure (refer to fig. 2).
(c) Leak detection pump	Creates negative pressure (vacuum) in EVAP system for leak check.
(d) Reference orifice	Has opening with 0.02 inch diameter. Vacuum is produced through orifice by closing purge VSV, turning off vent valve and operating leak detection pump, to monitor reference pressure. Reference pressure indicates small leak of EVAP.

Canister Pump Module (fig. 1):

Canister Pressure Sensor Specification (fig. 2):

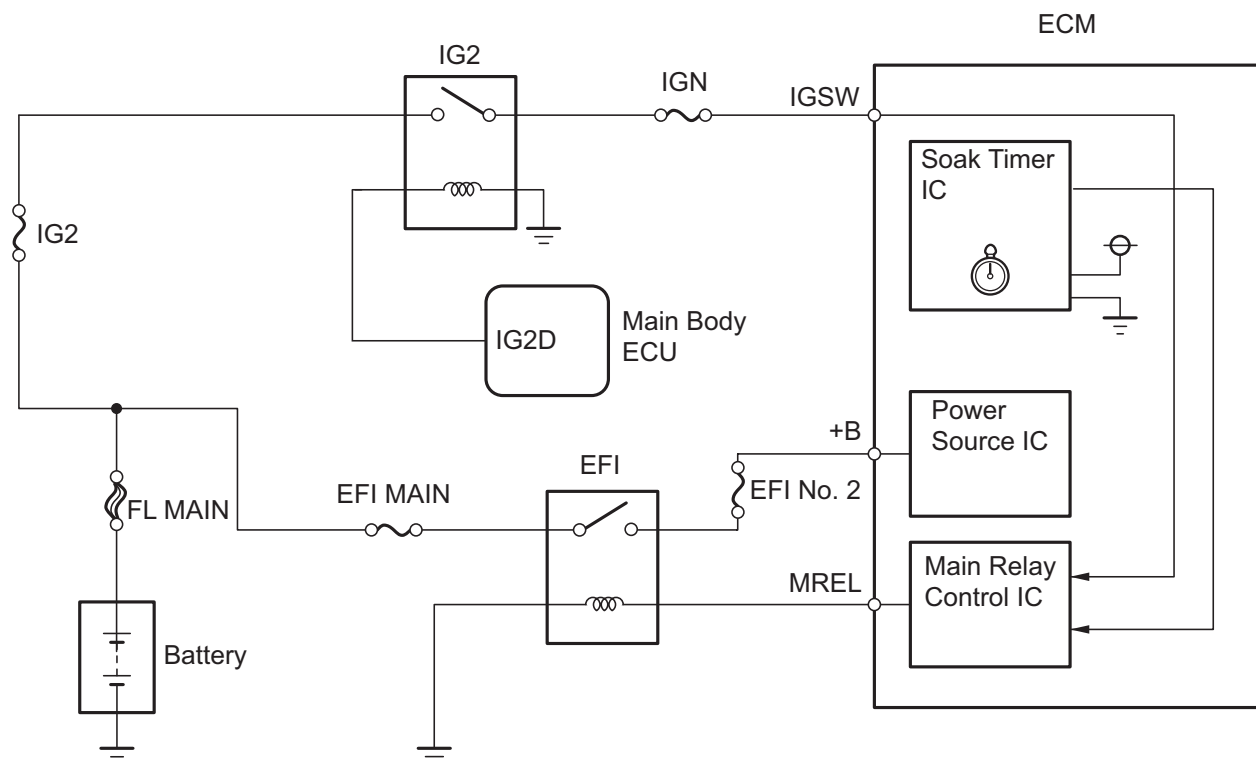


HINT:

Standard atmospheric pressure is 101.3 kPa-a (760 mmHg-a)

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Soak Timer Circuit (fig. 3):



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NOTICE:

HINT:

- Using intelligent tester monitor results enables the EVAP (Evaporative Emission) system to be confirmed.

- Read freeze frame data using the intelligent tester. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can be helpful in determining whether the vehicle was running or stopped, whether the engine was warmed up or not, whether the air-fuel ratio was lean or rich, as well as other data recorded at the time of a malfunction (See page [ES-41](#)).

1**CONFIRM DTC**

- Turn the engine switch off and wait for 10 seconds.
- Turn the engine switch on (IG).
- Turn the engine switch off and wait for 10 seconds.
- Connect an intelligent tester to the DLC3.
- Turn the engine switch on (IG) and turn the tester ON.
- Select the following menu items: DIAGNOSIS / ENHANCED OBD II / DTC INFO / CURRENT CODES.
- Confirm DTCs and freeze frame data.

If any EVAP system DTCs are set, the malfunctioning area can be determined using the table below.

NOTICE:

If the reference pressure difference between the first and second checks is greater than the specification, all the DTCs relating to the reference pressure (P043E, P043F, P2401, P2402 and P2419) are stored.

Malfunctioning Areas \ DTCs	P043E P043F	P0441	P0450	P0451	P0452	P0453	P0455	P0456	P2401 P2402	P2419	P2420
Reference orifice clogged	●								●	●	
Reference orifice high-flow	●								●	●	
Purge VSV stuck open		●					●				
Purge VSV stuck closed		●									
Canister pressure sensor fixed output				●							
Canister pressure sensor noise				●							
Canister pressure sensor low output			●		●						
Canister pressure sensor high output			●			●					
Gross leak		●					●				
Small leak								●			
Leak detection pump stuck OFF	●								●	●	
Leak detection pump stuck ON	●								●	●	
Vent valve stuck closed	●								●	●	
Vent valve stuck open (vent)											●

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NEXT

2

PERFORM EVAP SYSTEM CHECK (AUTO OPERATION)

NOTICE:

- The EVAP SYSTEM CHECK (AUTO OPERATION) consists of 5 steps performed automatically by the intelligent tester. It takes a maximum of approximately 18 minutes.
- Do not perform the EVAP SYSTEM CHECK when the fuel tank is more than 90% full because the cut-off valve may be closed, making the fuel tank leak check unavailable.
- Do not run the engine during this operation.
- When the temperature of the fuel is 35°C (95°F) or more, a large amount of vapor forms and any check results become inaccurate. When performing the EVAP SYSTEM CHECK, keep the temperature below 35°C (95°F).

(a) Clear the DTCs (See page [ES-41](#)).

- (b) On the tester, select the following menu items:
DIAGNOSIS / ENHANCED OBD II / SYSTEM CHECK /
EVAP SYS CHECK / AUTO OPERATION.
- (c) After the EVAP SYSTEM CHECK is completed, check
for pending DTCs by selecting the following menu items:
DIAGNOSIS / ENHANCED OBD II / DTC INFO /
PENDING CODES.

HINT:

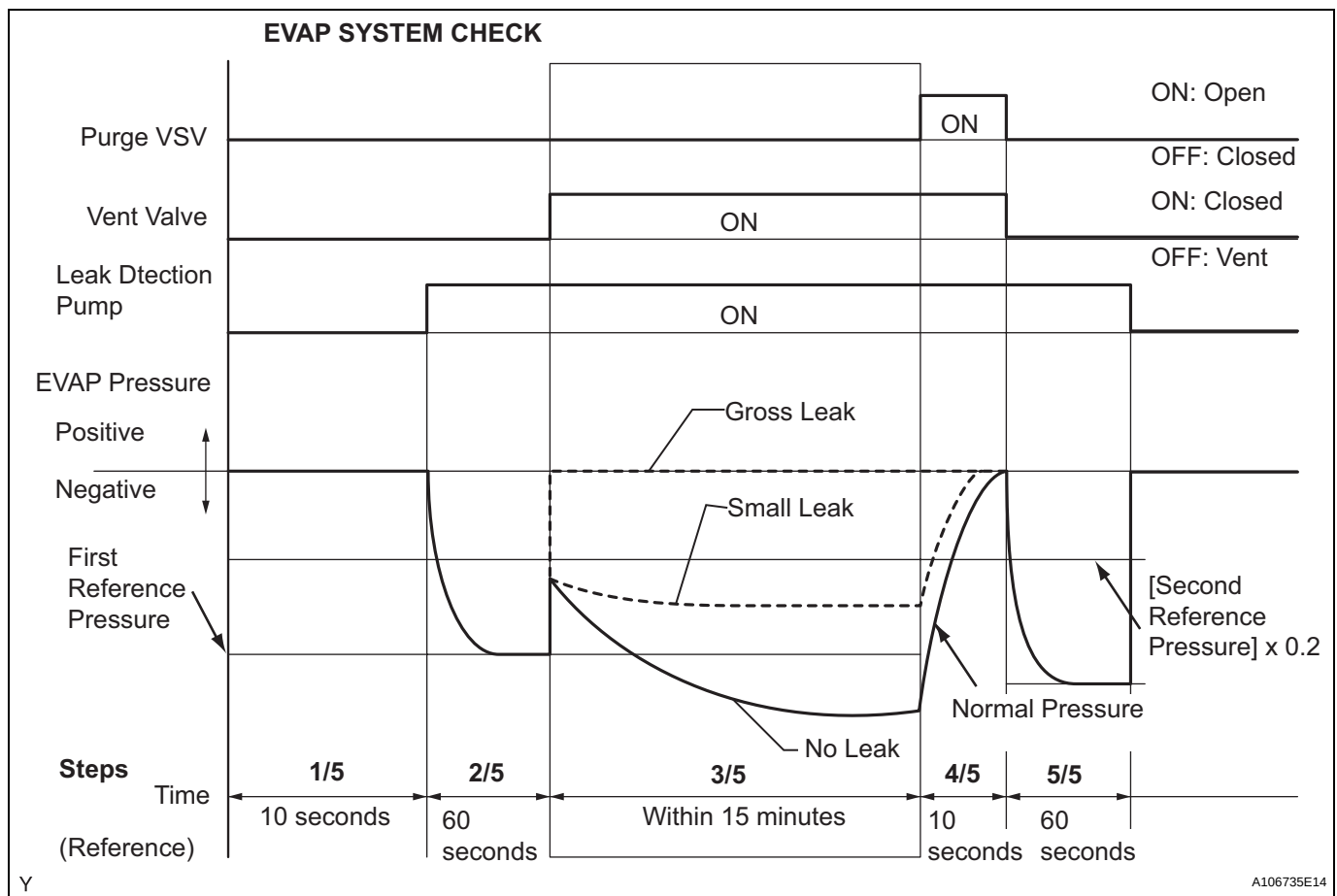
If no pending DTCs are displayed, perform the
MONITOR CONFIRMATION (see "Diagnostic Help"
menu). After this confirmation, check for pending DTCs.
If no DTCs are displayed, the EVAP system is normal.

NEXT

ES

3

PERFORM EVAP SYSTEM CHECK (MANUAL OPERATION)



NOTICE:

- In the EVAP SYSTEM CHECK (MANUAL OPERATION), perform the series of 5 EVAP SYSTEM CHECK steps manually using the intelligent tester.
- Do not perform the EVAP SYSTEM CHECK when the fuel tank is more than 90% full because the cut-off valve may be closed, making the fuel tank leak check unavailable.
- Do not run the engine during this operation.

- When the temperature of the fuel is 35°C (95°F) or more, a large amount of vapor forms and any check results become inaccurate. When performing the EVAP SYSTEM CHECK, keep the temperature below 35°C (95°F).
- (a) Clear the DTCs (See page ES-41).
- (b) Select the following menu items: DIAGNOSIS / ENHANCED OBD II / SYSTEM CHECK / EVAP SYS CHECK / MANUAL OPERATION.

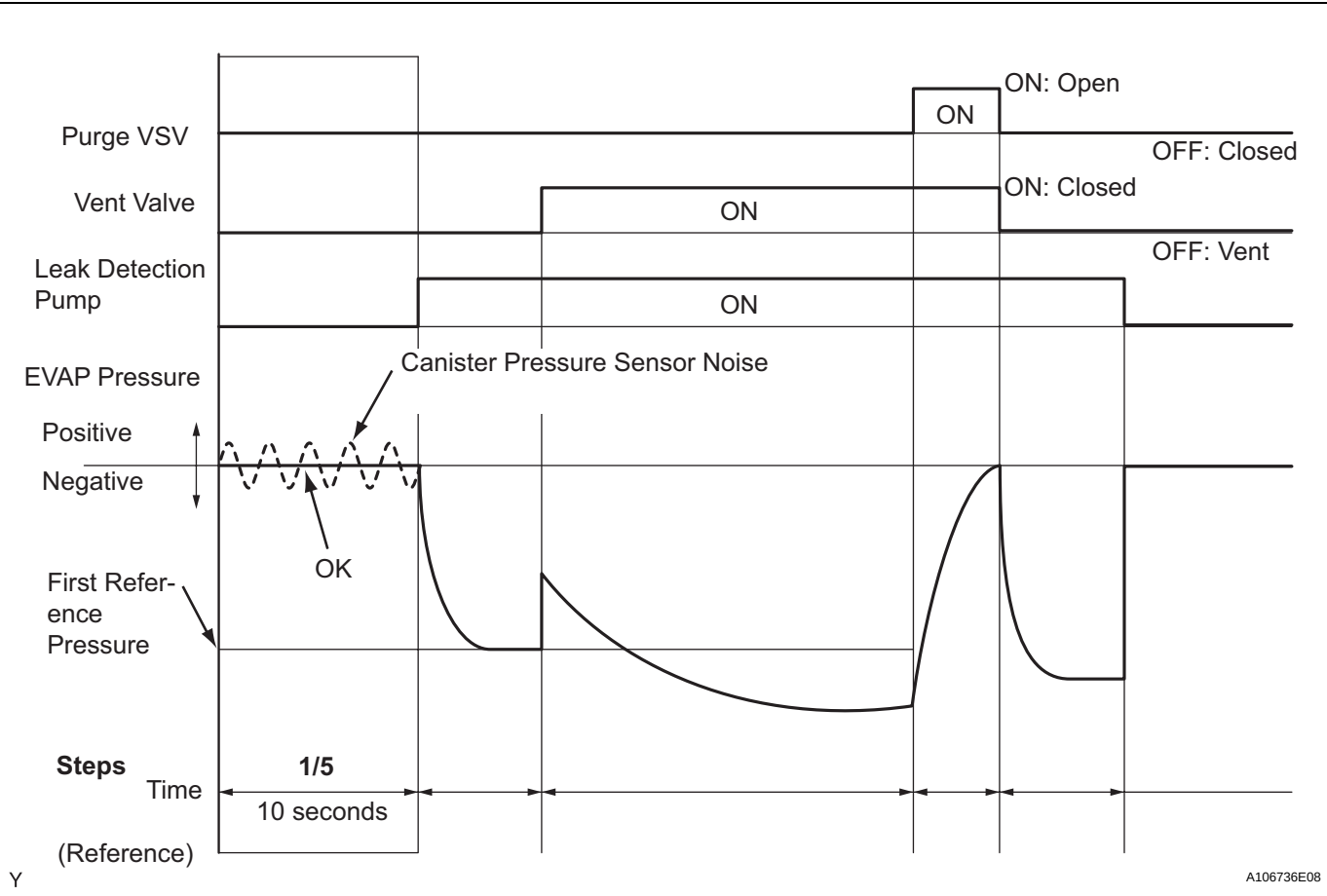
NEXT

ES

4

PERFORM EVAP SYSTEM CHECK (STEP 1/5)

(a) Check the EVAP pressure in step 1/5.



Result

DTCs*	Test Results	Suspected Trouble Areas	Proceed to
-	Virtually no variation in EVAP pressure	Not yet determined	A
P0451	EVAP pressure fluctuates by ± 0.3 kPa-g (2.25 mmHg-g) or more	Canister pressure sensor noise	B

*: These DTCs are already present in the ECM when the vehicle arrives and are confirmed in the "CONFIRM DTC" procedures above.

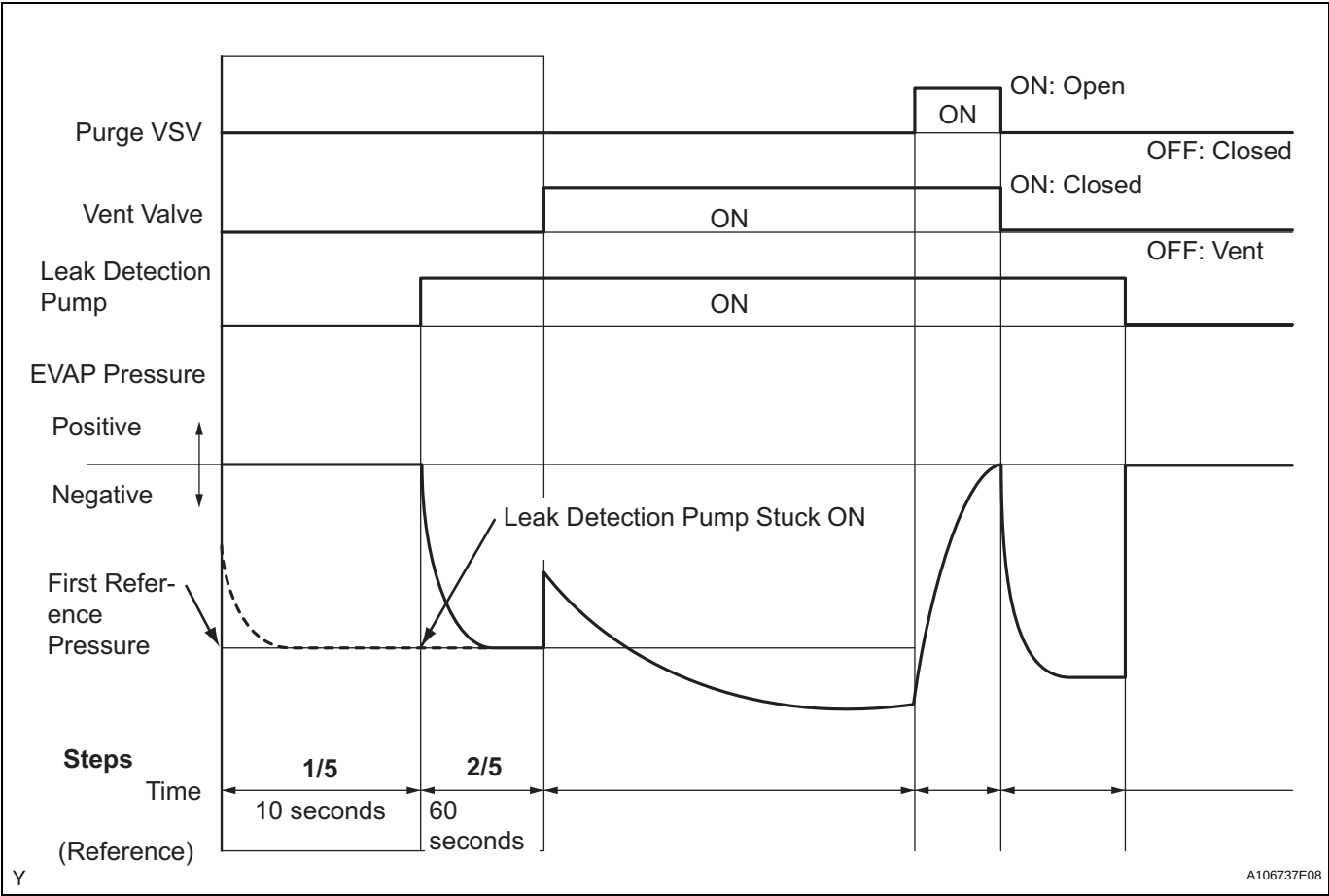
B Go to step 29

A

5 PERFORM EVAP SYSTEM CHECK (STEP 1/5 TO 2/5)

(a) Check the EVAP pressure in steps 1/5 and 2/5.

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Result

DTCs*	Test Results	Suspected Trouble Areas	Proceed to
-	Virtually no variation in EVAP pressure during step 1/5. Then EVAP pressure decreases to reference pressure.	Not yet determined	A
P2402	Small difference between EVAP pressures during steps 1/5 and 2/5	Leak detection pump stuck ON	B

*: These DTCs are already present in the ECM when the vehicle arrives and are confirmed in the "CONFIRM DTC" procedures above.

HINT:

The first reference pressure is the value determined in step 2/5.

B

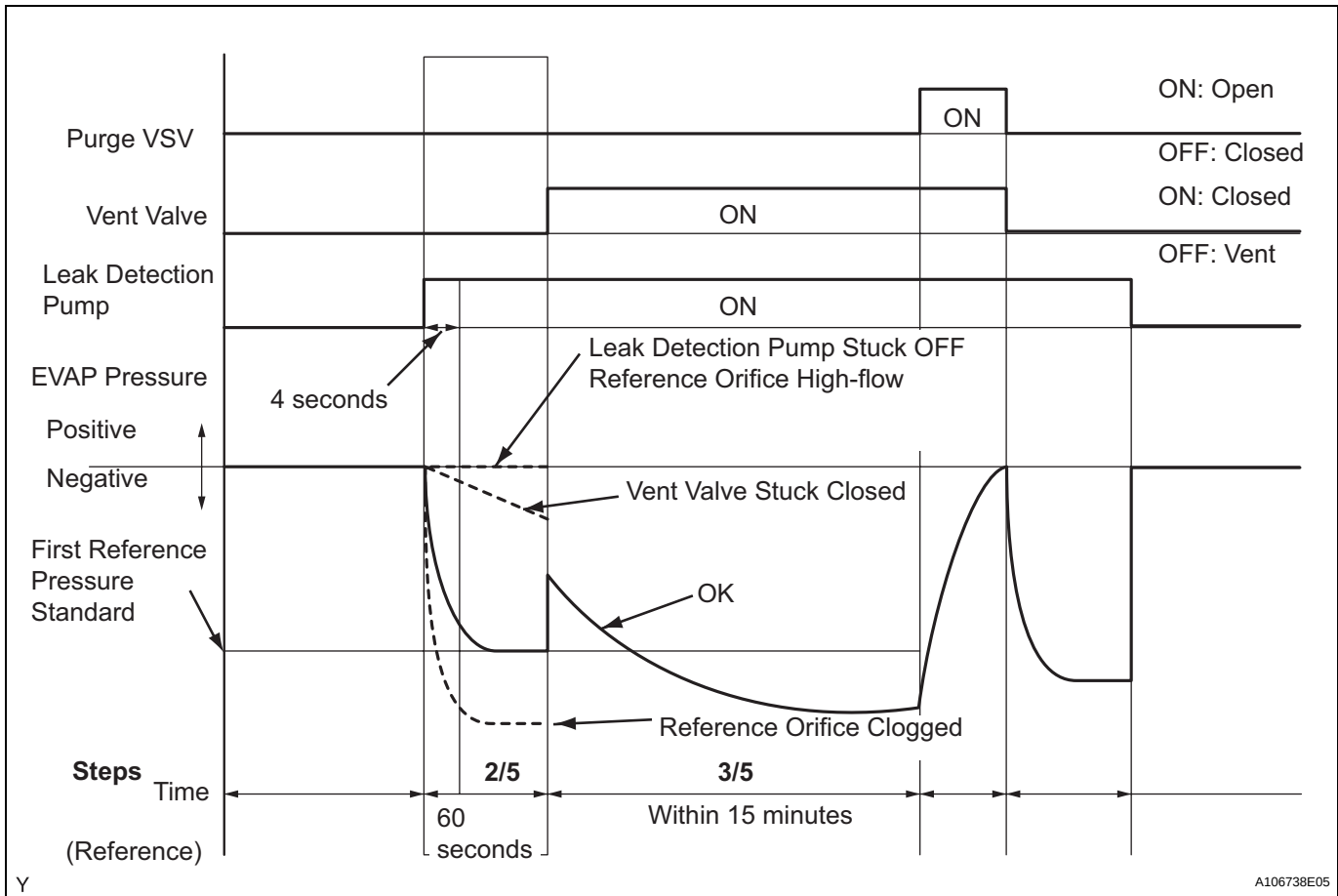
Go to step 22

A

6 PERFORM EVAP SYSTEM CHECK (STEP 2/5)

HINT:

Make a note of the pressures checked in steps "A" and "B" below.



(a) Check the EVAP pressure 4 seconds after the leak detection pump is activated* (Step "A").

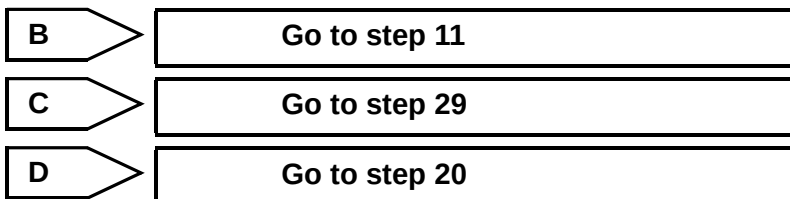
*: The leak detection pump begins to operate as step 1/5 finishes and step 2/5 starts.

(b) Check the EVAP pressure again when it has stabilized. This pressure is the reference pressure (Step "B").

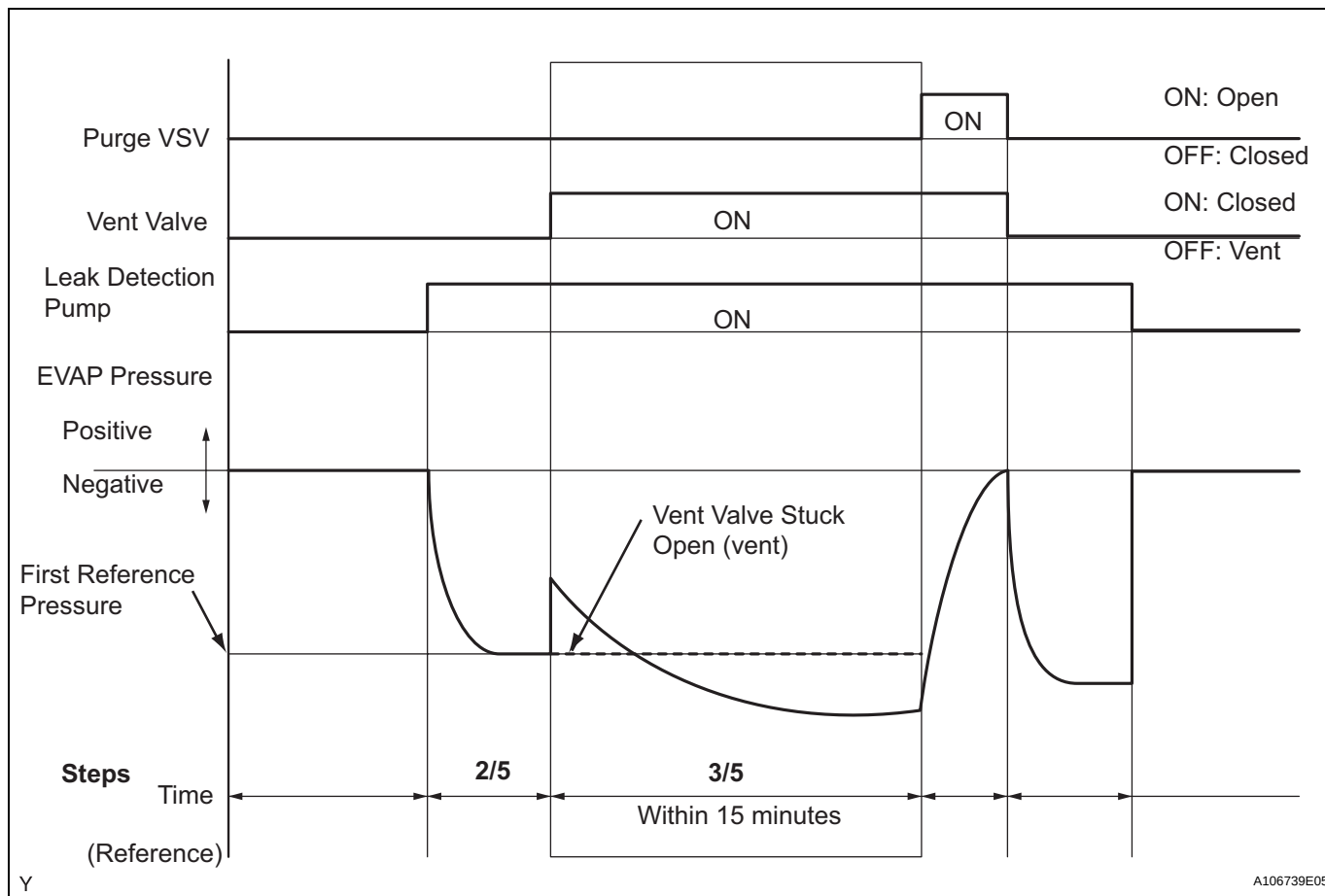
Result

DTCs*	Test Results	Suspected Trouble Areas	Proceed to
-	EVAP pressure in step (b) between -4.85 kPa-g and -1.057 kPa-g (-36.4 mmHg-g and -7.93 mmHg-g)	Not yet determined	A
P043F and P2401	EVAP pressure in step (b) -1.057 kPa-g (-7.93 mmHg-g) or more	- Reference orifice high-flow - Leak detection pump stuck OFF	B
P043E	EVAP pressure in step (b) below -4.85 kPa-g (-36.4 mmHg-g)	Reference orifice clogged	C
P2419	EVAP pressure in step (a) more than -1.057 kPa-g (-7.93 mmHg-g)	Vent valve stuck closed	D

*: These DTCs are already present in the ECM when the vehicle arrives and are confirmed in the "CONFIRM DTC" procedures above.

**A****7 PERFORM EVAP SYSTEM CHECK (STEP 2/5 TO 3/5)**

(a) Check the EVAP pressure increase in step 3/5.

**Result**

DTCs*	Test Results	Suspected Trouble Areas	Proceed to
-	EVAP pressure increases by 0.3 kPa-g (2.25 mmHg-g) or more within 10 seconds of proceeding from step 2/5 to step 3/5	Not yet determined	A
P2420	No variation in EVAP pressure despite proceeding from step 2/5 to step 3/5	Vent valve stuck open (vent)	B
P0451	No variation in EVAP pressure during steps 1/5 through 3/5	Canister pressure sensor malfunction fixed	C

*: These DTCs are already present in the ECM when the vehicle arrives and are confirmed in the "CONFIRM DTC" procedures above.



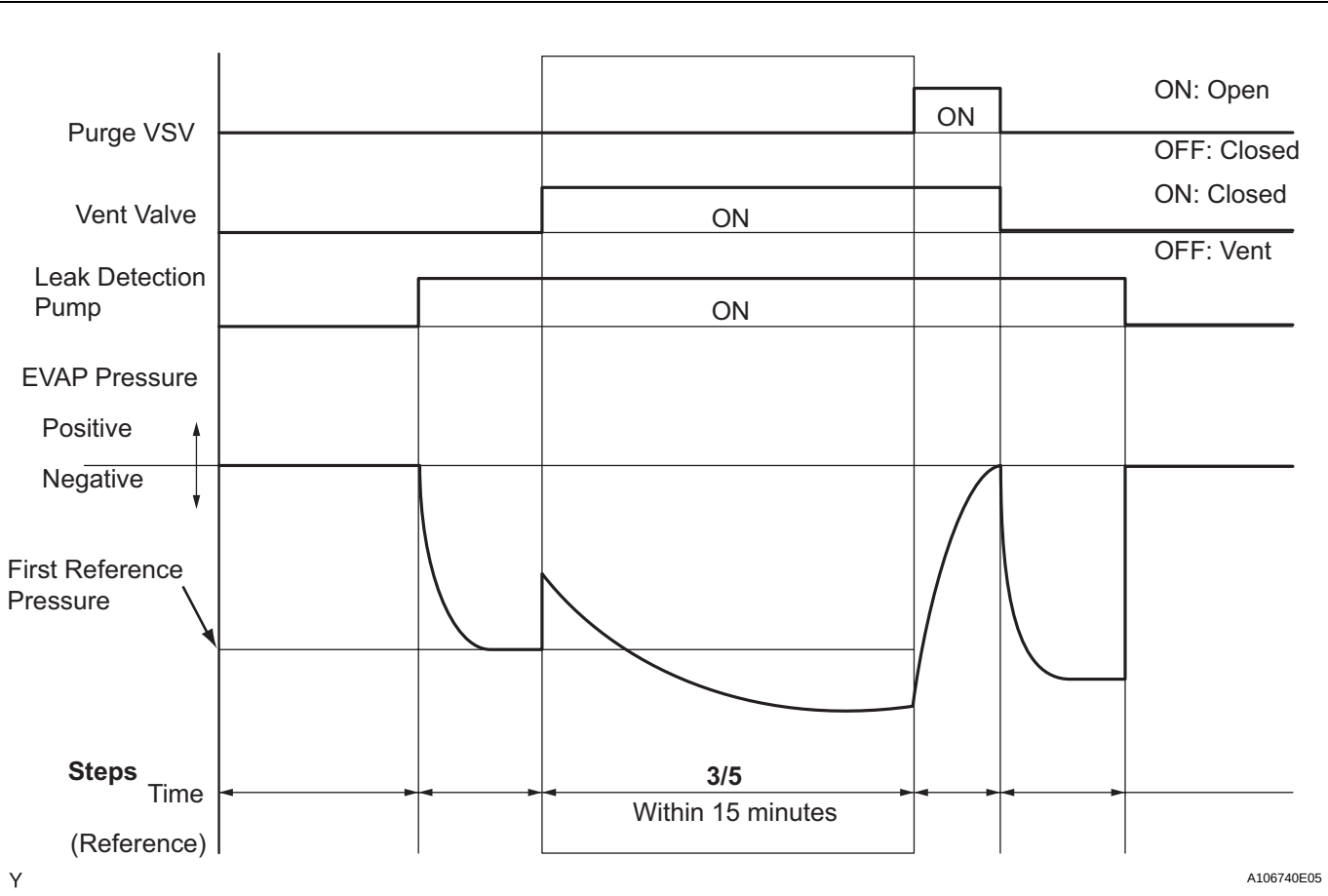
C

Go to step 29

A

8 PERFORM EVAP SYSTEM CHECK (STEP 3/5)

- (a) Wait until the EVAP pressure change is less than 0.1 kPa-g (0.75 mmHg-g) for 30 seconds.

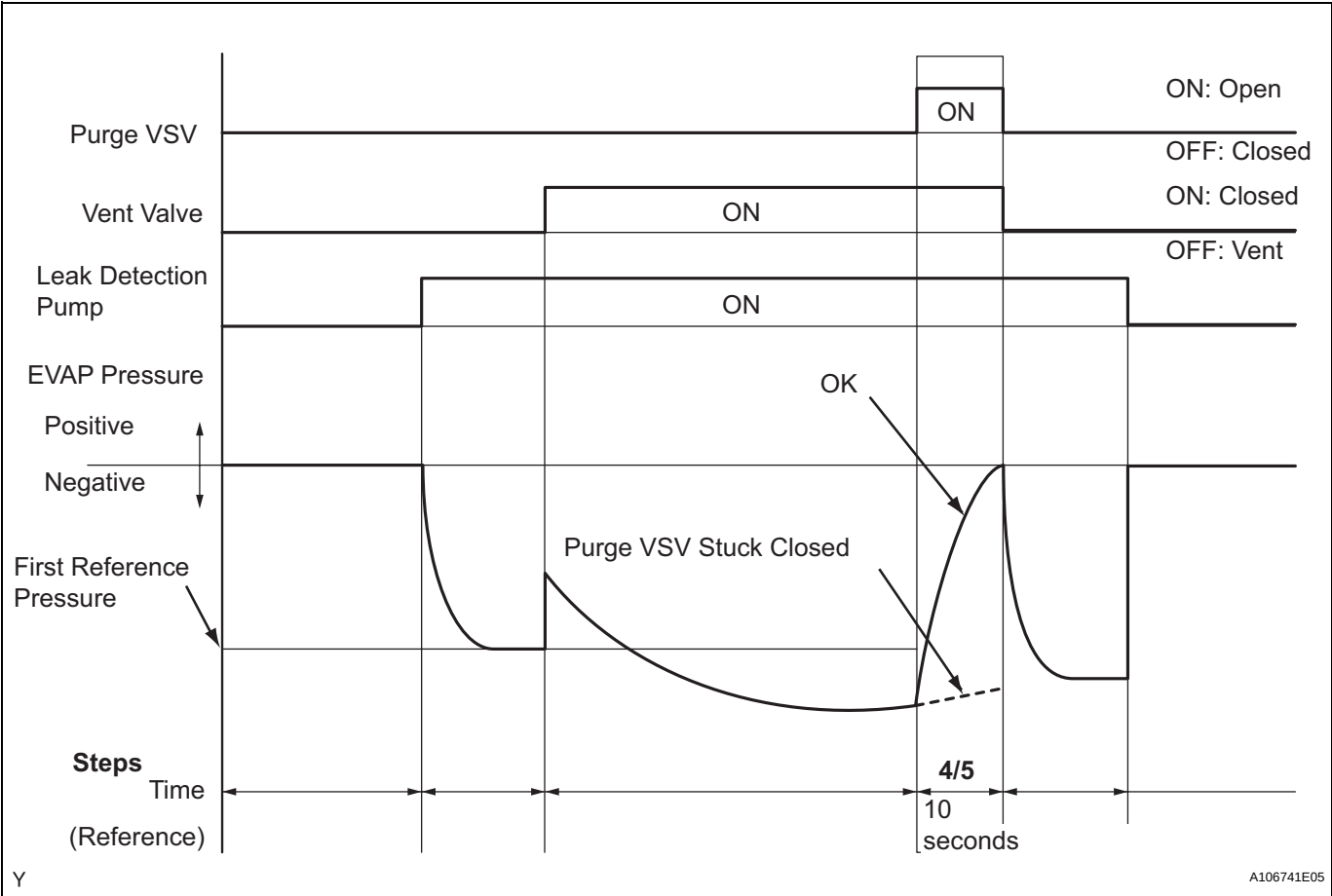


- (b) Measure the EVAP pressure and record it.
HINT:
A few minutes are required for the EVAP pressure to become saturated. When there is little fuel in the fuel tank, it takes up to 15 minutes.

NEXT

9 PERFORM EVAP SYSTEM CHECK (STEP 4/5)

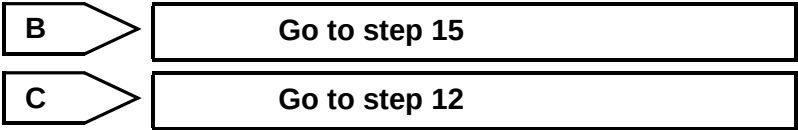
- (a) Check the EVAP pressure in step 4/5.



Result

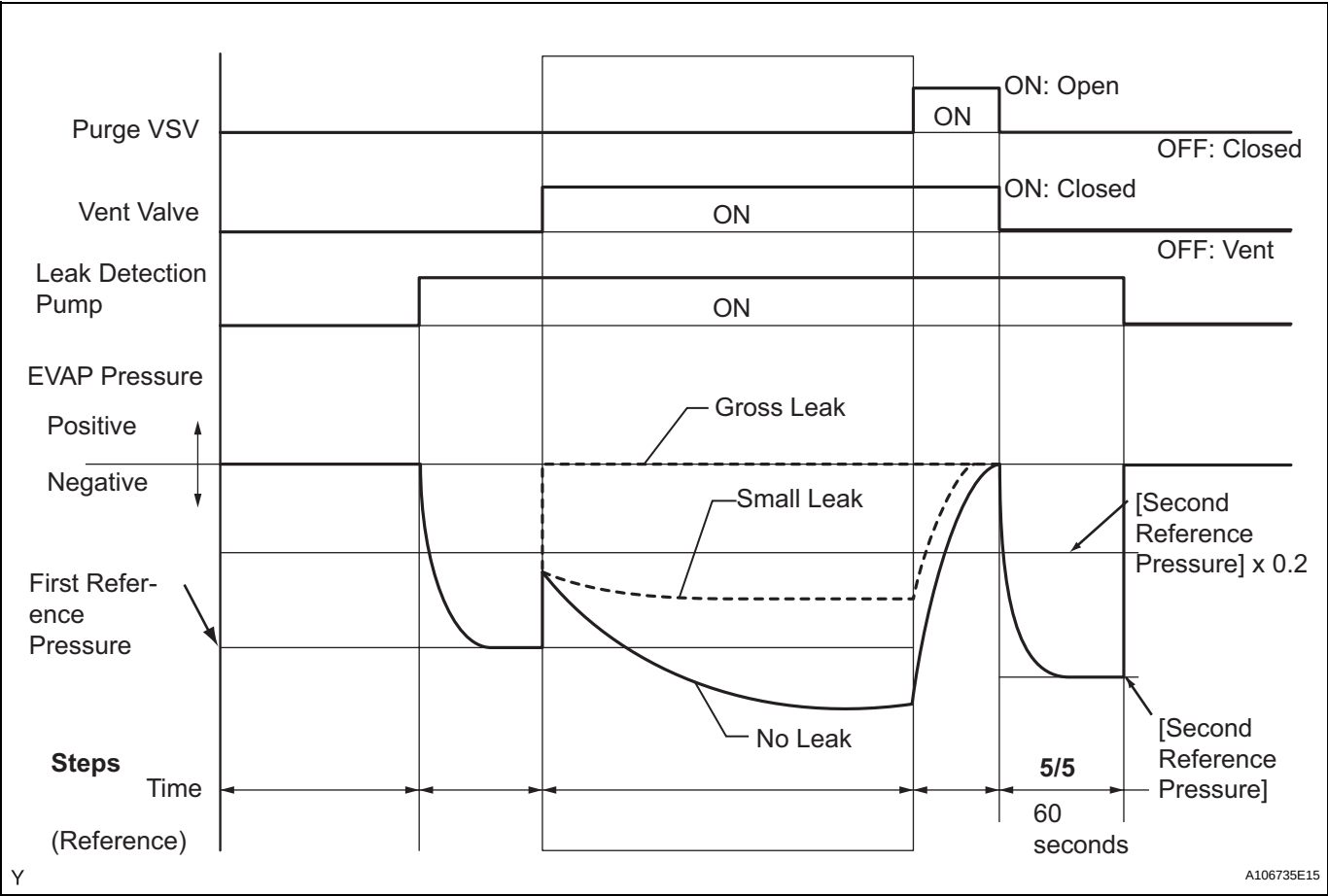
DTCs*	Test Results	Suspected Trouble Areas	Proceed to
-	EVAP pressure increases by 0.3 kPa-g (2.25 mmHg-g) or more within 10 seconds of proceeding from step 3/5 to step 4/5	Not yet determined	A
P0441	EVAP pressure increases by 0.3 kPa-g (2.25 mmHg-g) or more within 10 seconds of proceeding from step 3/5 to step 4/5	Problems in EVAP hose between purge VSV and intake manifold	B
P0441	Variation in EVAP pressure less than 0.3 kPa-g (2.25 mmHg-g) for 10 seconds, after proceeding from step 3/5 to step 4/5	Purge VSV stuck closed	C

*: These DTCs are already present in the ECM when the vehicle arrives and are confirmed in the "CONFIRM DTC" procedures above.



10 PERFORM EVAP SYSTEM CHECK (STEP 5/5)

(a) Check the EVAP pressure in step 5/5.

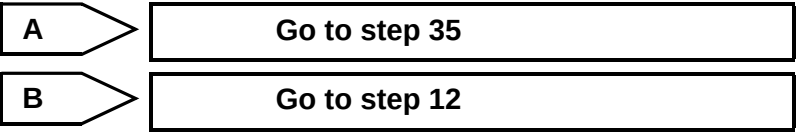


(b) Compare the EVAP pressure in step 3/5 and the second reference pressure (step 5/5).

Result

DTCs*	Test Results	Suspected Trouble Areas	Proceed to
-	EVAP pressure (step 3/5) lower than second reference pressure (step 5/5)	Not yet determined (no leakage from EVAP system)	A
P0441 and P0455	EVAP pressure (step 3/5) higher than [second reference pressure (step 5/5) x 0.2]	- Purge VSV stuck open - EVAP gross leak	B
P0456	EVAP pressure (step 3/5) higher than second reference pressure (step 5/5)	EVAP small leak	B

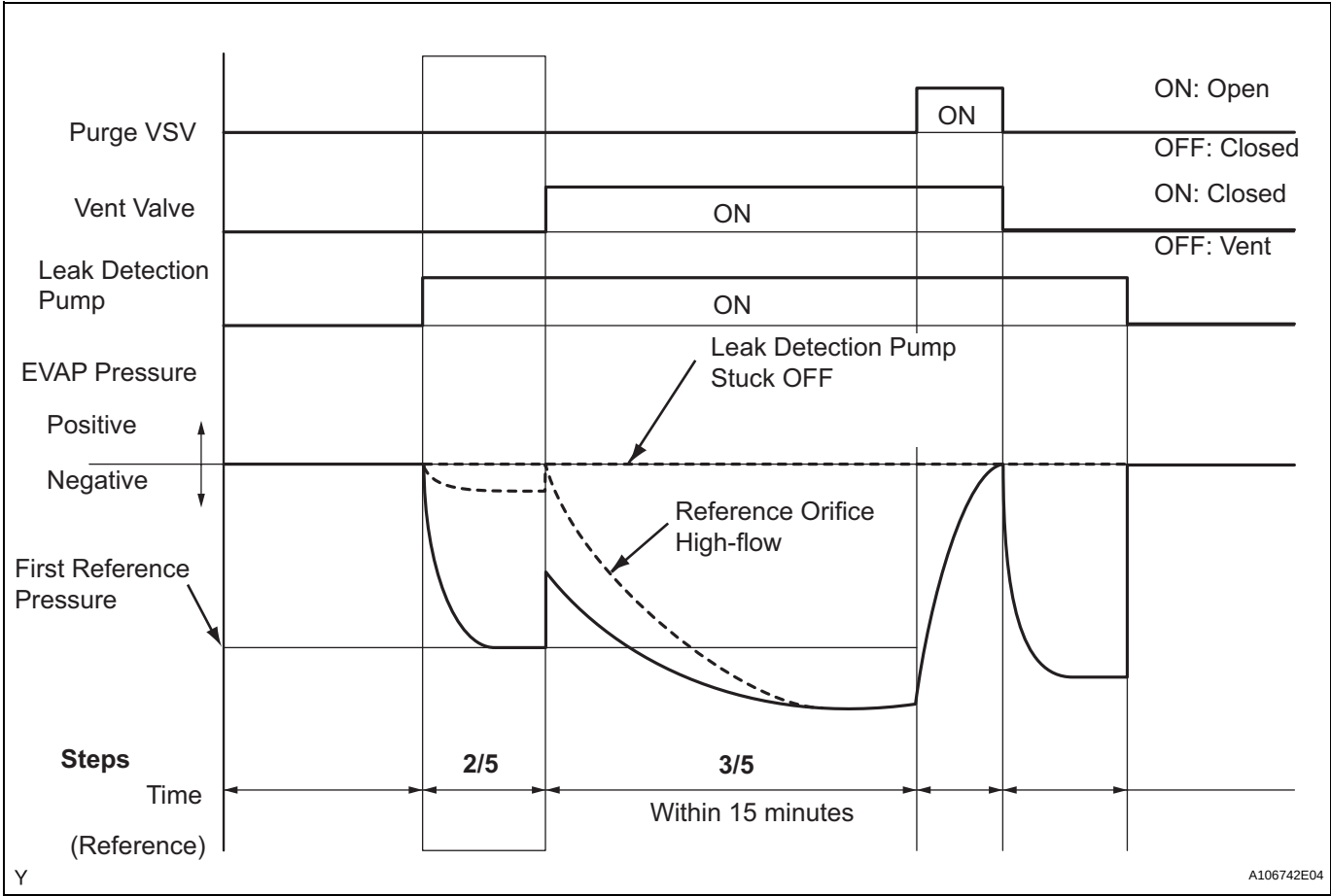
*: These DTCs are already present in the ECM when the vehicle arrives and are confirmed in the "CONFIRM DTC" procedures above.



11

PERFORM EVAP SYSTEM CHECK (STEP 3/5)

(a) Check the EVAP pressure in step 3/5.



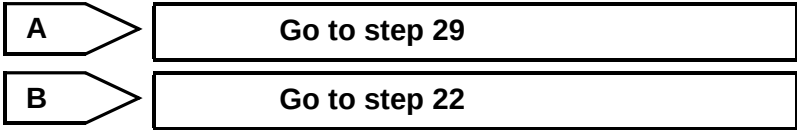
Result

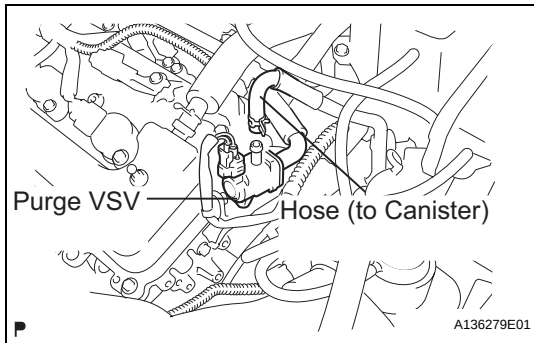
DTCs*	Test Results	Suspected Trouble Areas	Proceed to
P043F	EVAP pressure less than reference pressure measured at 2/5	Reference orifice high-flow	A
P2401	EVAP pressure almost same as reference pressure measured at 2/5	Leak detection pump stuck OFF	B

*: These DTCs are already present in the ECM when the vehicle arrives and are confirmed in the "CONFIRM DTC" procedures above.

HINT:

The first reference pressure is the value determined in step 2/5.



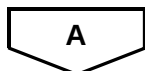
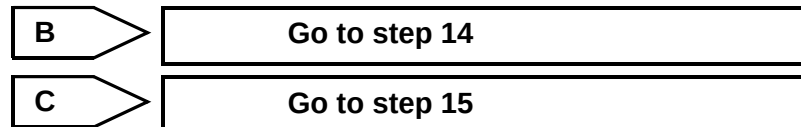
12 PERFORM ACTIVE TEST USING INTELLIGENT TESTER (PURGE VSV)

- (a) On the intelligent tester, select the following menu items: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / EVAP VSV (ALONE).
- (b) Disconnect the hose (connected to the canister) from the purge VSV.
- (c) Start the engine.
- (d) Using the tester, turn off the purge VSV (EVAP VSV: OFF).
- (e) Use your finger to confirm that the purge VSV has no suction.
- (f) Using the tester, turn on the purge VSV (EVAP VSV: ON).
- (g) Use your finger to confirm that the purge VSV has suction.

Result

Test Results	Suspected Trouble Areas	Proceed to
No suction when purge VSV turned OFF, and suction applied when turned ON	Purge VSV normal	A
Suction applied when purge VSV turned OFF	Purge VSV stuck open	B
No suction when purge VSV turned ON	- Purge VSV stuck closed - Problems with EVAP hose between purge VSV and intake manifold	C

- (h) Reconnect the hose.

**13 CHECK FUEL CAP ASSEMBLY**

- (a) Check that the fuel cap is correctly installed and confirm the fuel cap meets OEM specifications.
- (b) Tighten the fuel cap until a click sounds are heard.
HINT:
If an EVAP tester is available, check the fuel cap using the tester.
 1. Remove the fuel cap and install it onto a fuel cap adapter.
 2. Connect an EVAP tester pump hose to the adapter, and pressurize the cap to 3.2 to 3.7 kPa (24 to 28 mmHg) using an EVAP tester pump.
 3. Seal the adapter and wait for 2 minutes.
 4. Check the pressure. If the pressure is 2 kPa (15 mmHg) or more, the fuel cap is normal.

Result

Test Results	Suspected Trouble Areas	Proceed to
Fuel cap correctly installed	-	A

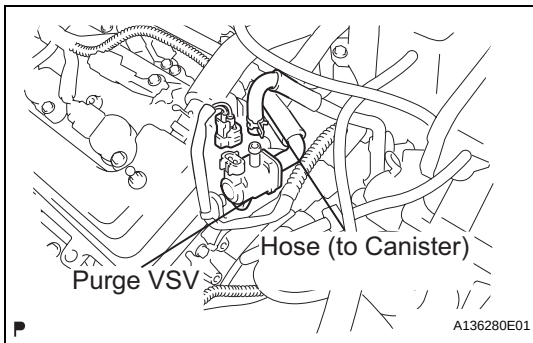
Test Results	Suspected Trouble Areas	Proceed to
Fuel cap loose	- Fuel cap improperly installed - Defective fuel cap - Fuel cap does not meet OEM specifications	B
Defective fuel cap	-	B
No fuel cap	-	C

(c) Reinstall the fuel cap.

A	Go to step 28
B	Go to step 26
C	Go to step 27

ES

14 INSPECT DUTY VACUUM SWITCHING VALVE (PURGE VSV)



- Turn the engine switch off.
- Disconnect the B42 purge VSV connector.
- Disconnect the hose (connected to the canister) from the purge VSV.
- Start the engine.
- Use your finger to confirm that the purge VSV has no suction.

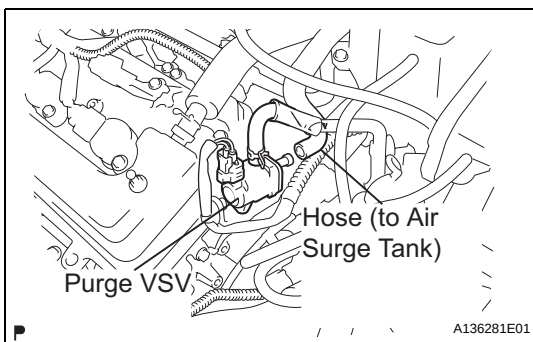
Result

Test Results	Suspected Trouble Areas	Proceed to
No suction	ECM	A
Suction applied	Purge VSV	B

- Reconnect the purge VSV connector.
- Reconnect the hose.

A	Go to step 34
B	Go to step 30

15 CHECK EVAP HOSE (PURGE VSV - AIR SURGE TANK)

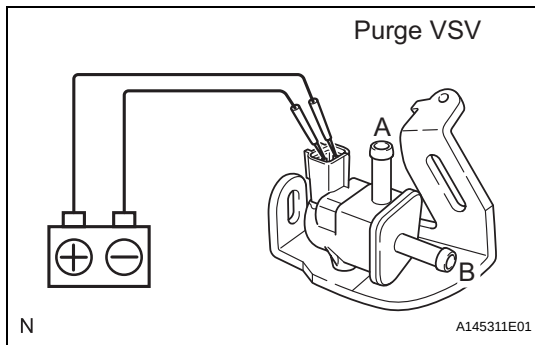


- Disconnect the hose (connected to the air surge tank) from the purge VSV.
- Start the engine.
- Use your finger to confirm that the hose has suction.

Result

Test Results	Suspected Trouble Areas	Proceed to
Suction applied	EVAP hose between purge VSV and intake manifold normal	A
No suction	- Intake manifold port - EVAP hose between purge VSV and intake manifold	B

(d) Reconnect the hose.

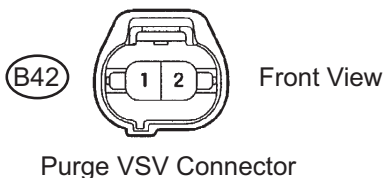
B**Go to step 25****A****ES 16 INSPECT DUTY VACUUM SWITCHING VALVE (PURGE VSV)**

- Remove the purge VSV.
- Apply the battery voltage to the terminals of the purge VSV.
- Using an air gun, confirm that air flows from port A to port B.

Result

Test Results	Suspected Trouble Areas	Proceed to
Air flows	Purge VSV normal	A
No air flow	Purge VSV	B

(d) Install the purge VSV.

B**Go to step 30****A****17 CHECK HARNESS AND CONNECTOR (POWER SOURCE OF PURGE VSV)****Wire Harness Side:**

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- Disconnect the B42 purge VSV connector.
- Turn the engine switch on (IG).
- Measure the voltage between terminal 2 of the purge VSV connector and body ground.

Result

Test Results	Suspected Trouble Areas	Proceed to
9 to 14 V	Normal	A
Other than result above	Wire harness or connectors between purge VSV and ECM	B

(d) Reconnect the purge VSV connector.

B

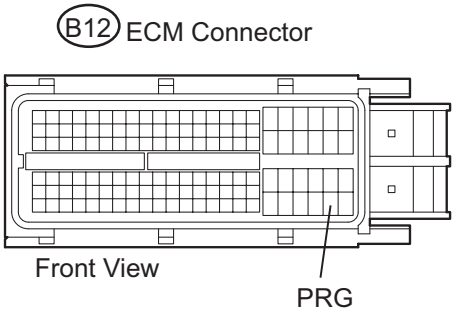
Go to step 31

A

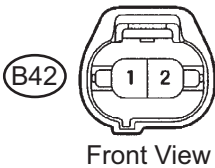
18

CHECK HARNESS AND CONNECTOR (PURGE VSV - ECM)

Wire Harness Side:



Purge VSV Connector



A112616E07

- (a) Disconnect the B12 ECM connector and the B42 purge VSV connector.
(b) Measure the resistance.

Standard resistance

Tester Connection	Specified Condition
B12-108 (PRG) - B42-2 (Purge VSV)	Below 1 Ω
B12-108 (PRG) - Body ground	10 kΩ or higher
B42-2 (Purge VSV) - Body ground	10 kΩ or higher

- (c) Reconnect the purge VSV connector.
(d) Reconnect the ECM connector.

OK

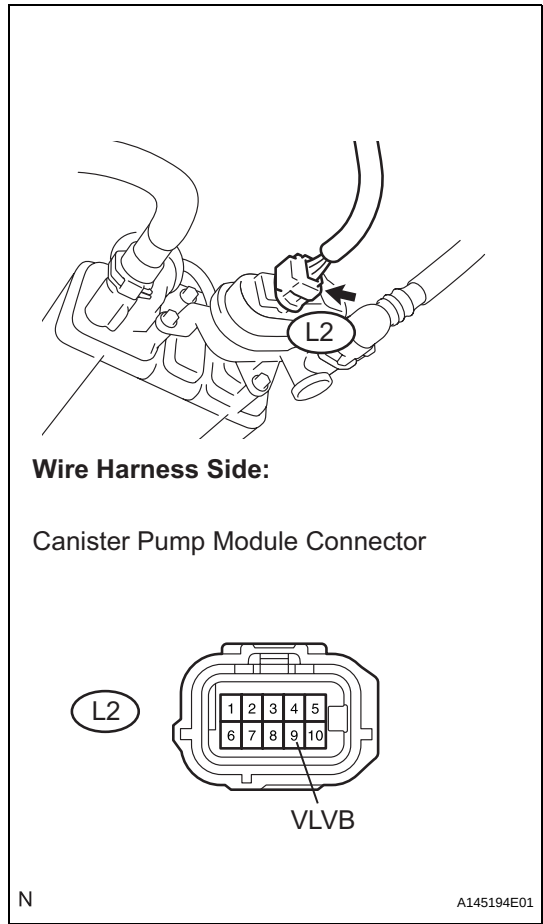
Go to step 34

NG

Go to step 31

ES

19INSPECT CANISTER PUMP MODULE (POWER SOURCE FOR VENT VALVE)



- (a) Turn the engine switch off.
- (b) Disconnect the L2 canister pump module connector.
- (c) Turn the engine switch on (IG).
- (d) Measure the voltage between the VLVB terminal of the canister pump module connector and body ground.

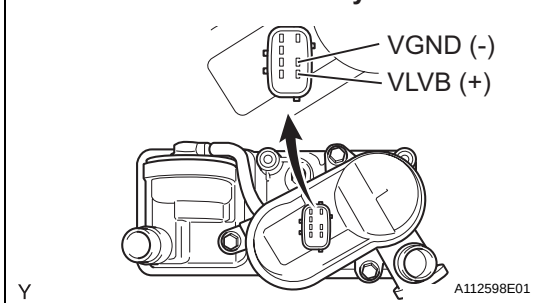
Result

Test Results	Suspected Trouble Areas	Proceed to
9 to 14 V	1. Wire harness between vent valve and ECM 2. Vent valve 3. ECM	A
Below 3 V	Power source wire harness of vent valve	B

- (e) Reconnect the canister pump module connector.

A

BGo to step 31

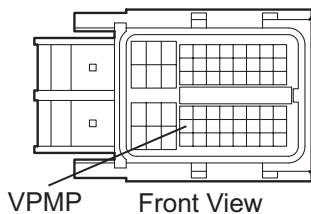
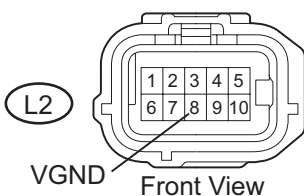
20 INSPECT CANISTER PUMP MODULE (VENT VALVE OPERATION)**Charcoal Canister Assembly:**

- Turn the engine switch off.
- Disconnect the L2 canister pump module connector.
- Apply battery voltage to the VLVB and VGND terminals of the canister pump module.
- Touch the canister pump module to confirm the vent valve operation.

Result

Test Results	Suspected Trouble Areas	Proceed to
Operating	1. Wire harness between vent valve and ECM 2. ECM	A
Not operating	Vent valve	B

- Reconnect the canister connector.

B**Go to step 29****A****21 CHECK HARNESS AND CONNECTOR (ECM - CANISTER PUMP MODULE)****Wire Harness Side:****(A10) ECM Connector****Canister Pump Module Connector**

A112621E19

- Disconnect the A10 ECM connector.
- Disconnect the L2 canister pump module connector.
- Measure the resistance between the VPMP terminal of the ECM connector and the VGND terminal of the canister pump module connector.

Result

Test Results	Suspected Trouble Areas	Proceed to
Below 1 Ω	ECM	A
10 k Ω or higher	Wire harness between ECM and canister pump module	B

- (d) Reconnect the ECM connector.
- (e) Reconnect the canister pump module connector.

A

Go to step 34

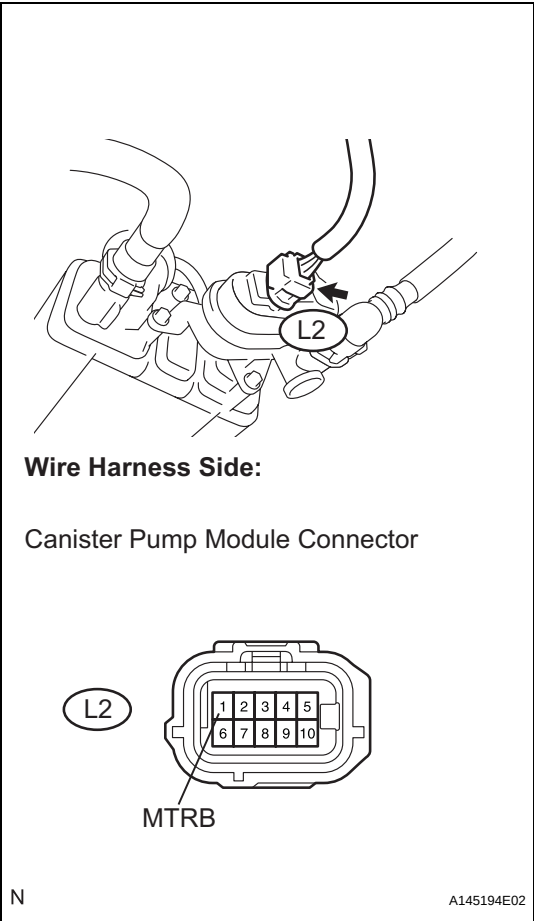
B

Go to step 31

22

PERFORM ACTIVE TEST USING INTELLIGENT TESTER (VACUUM PUMP (ALONE))

ES



- (a) Turn the engine switch off.
- (b) Disconnect the L2 canister pump module connector.
- (c) Turn the engine switch on (IG).
- (d) On the intelligent tester, select the following menu items: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / VACUUM PUMP.
- (e) Measure the voltage between the MTRB terminal of the canister pump module connector and body ground when the leak detection pump is turned ON and OFF using the tester.

Result

Test Results	Suspected Trouble Areas	Proceed to
Below 3 V when OFF 9 to 14 V when ON	1. Wire harness between leak detection pump and body ground 2. Leak detection pump	A
Below 3 V when OFF and ON	1. Wire harness between leak detection pump and ECM 2. ECM	B

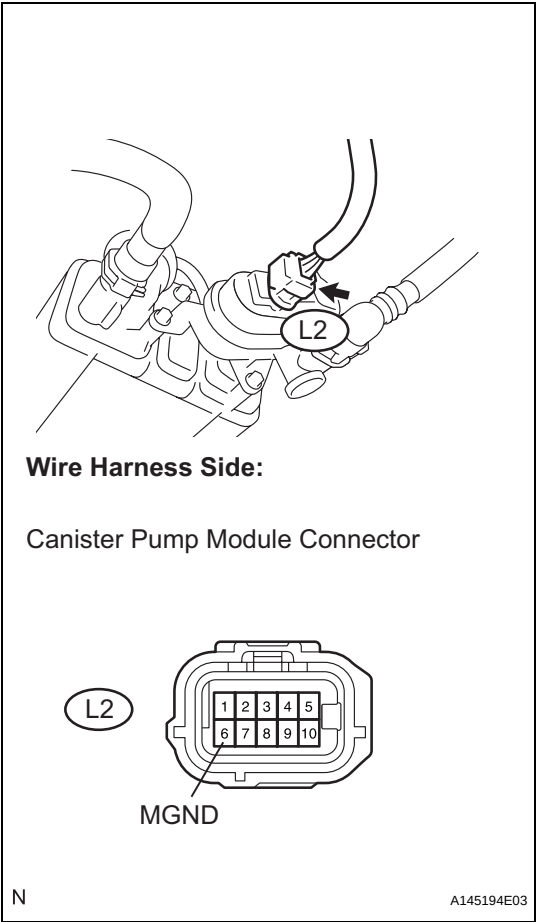
A

B

Go to step 24

23 CHECK HARNESS AND CONNECTOR (CANISTER PUMP MODULE - BODY GROUND)

ES



- (a) Turn the engine switch off.
- (b) Disconnect the L2 canister pump module connector.
- (c) Measure the resistance between the MGND terminal of the canister pump module connector and body ground.

Result

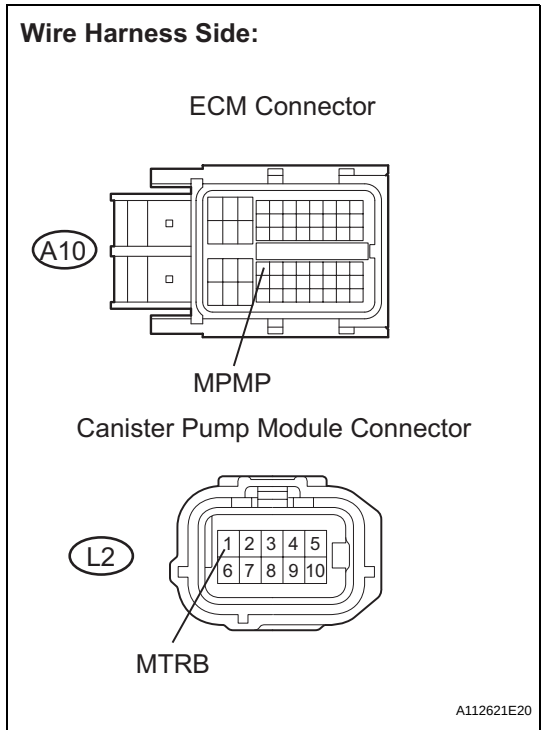
Test Results	Suspected Trouble Areas	Proceed to
Below 1 Ω	Leak detection pump	A
10 k Ω or higher	Wire harness between canister pump module and body ground	B

- (d) Reconnect the canister pump module connector.

A	Go to step 29
B	Go to step 31

24

CHECK HARNESS AND CONNECTOR (ECM - CANISTER PUMP MODULE)



- (a) Turn the engine switch off.
- (b) Disconnect the L2 canister pump module connector.
- (c) Disconnect the A10 ECM connector.
- (d) Measure the resistance between the MPMP terminal of the ECM connector and the MTRB terminal of the canister pump module connector.

Result

Test Results	Suspected Trouble Areas	Proceed to
Below 1 Ω	ECM	A
10 k Ω or higher	Wire harness between ECM and canister pump module	B

- (e) Reconnect the canister pump module connector.
- (f) Reconnect the ECM connector.

A

Go to step 34

B

Go to step 31

25

INSPECT INTAKE MANIFOLD (EVAP PURGE PORT)

- (a) Stop the engine.
- (b) Disconnect the EVAP hose from the intake manifold.
- (c) Start the engine.
- (d) Use your finger to confirm that the port of the intake manifold has suction.

Result

Test Results	Suspected Trouble Areas	Proceed to
Suction applied	EVAP hose between intake manifold and purge VSV	A
No suction	Intake manifold	B

- (e) Reconnect the EVAP hose.

A

Go to step 32

B

Go to step 33

26 CORRECTLY REINSTALL OR REPLACE FUEL CAP

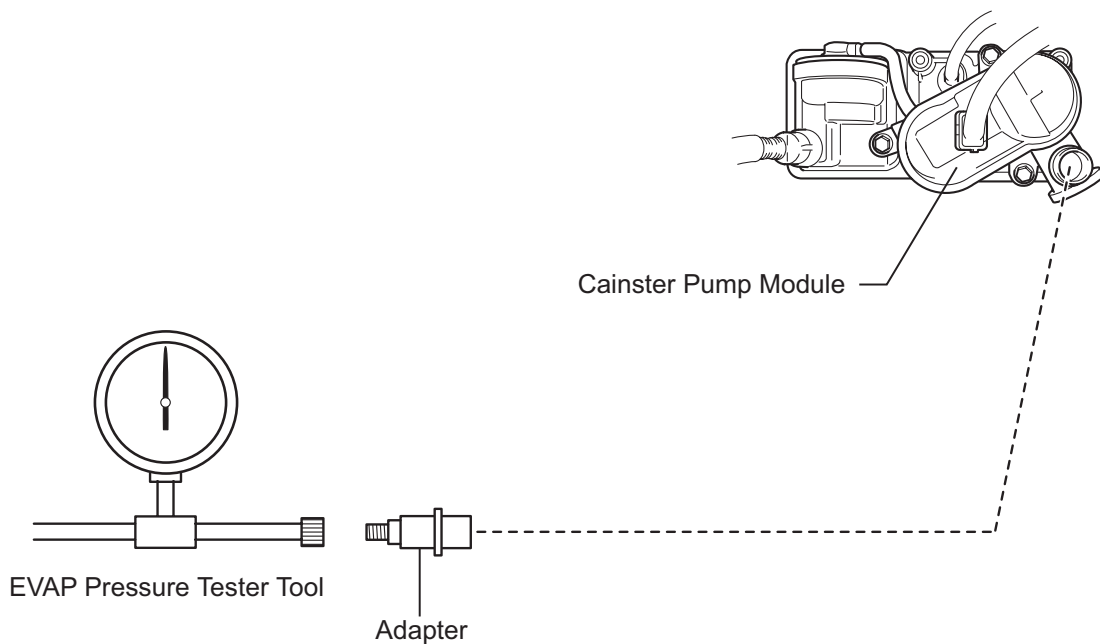
HINT:

- When reinstalling the fuel cap, tighten it until a few click sounds are heard.
- When replacing the fuel cap, use a fuel cap that meets OEM specifications, and install it until a click sounds are heard.

NEXT**Go to step 36****27 REPLACE FUEL CAP**

HINT:

When installing the fuel cap, tighten it until a few click sounds are heard.

NEXT**Go to step 36****28 LOCATE EVAP LEAK PART**

A137044E01

- (a) Disconnect the vent hose.
- (b) Connect the EVAP pressure tester tool to the canister pump module with the adapter.

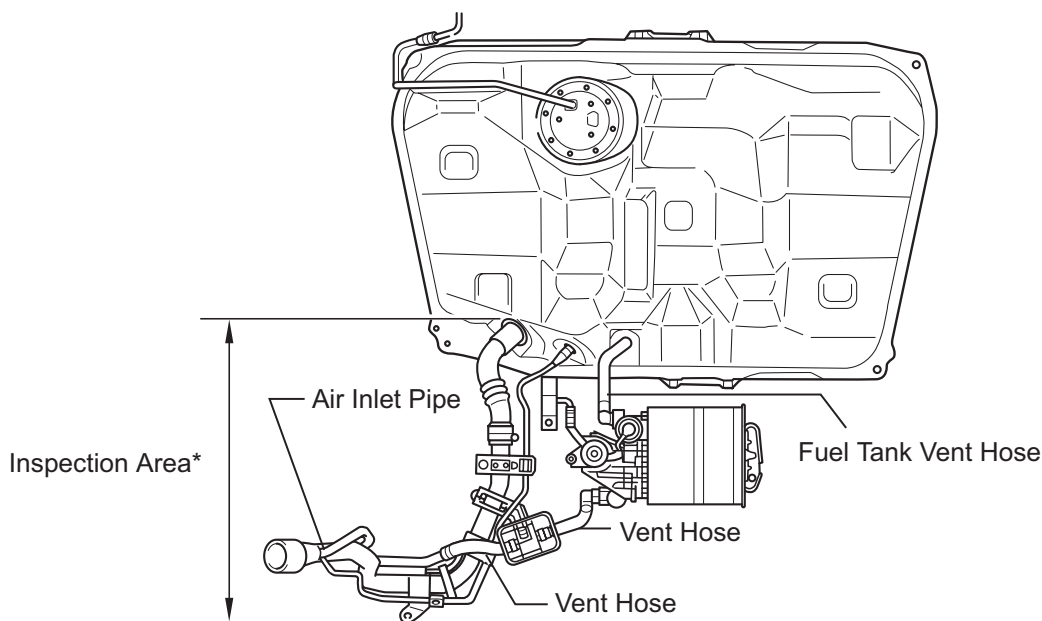
- (c) Pressurize the EVAP system to 3.2 to 3.7 kPa (24 to 28 mmHg).
- (d) Apply soapy water to the piping and connecting parts of the EVAP system.
- (e) Look for areas where bubbles appear. This indicates the leak point.
- (f) Repair or replace the leak point.

HINT:

Disconnect the hose between the canister and the fuel tank from the canister. Block the canister side and conduct an inspection. In this way, the fuel tank can be excluded as an area suspected of causing fuel leaks.

NEXT**Go to step 36****ES****29 REPLACE CHARCOAL CANISTER ASSEMBLY**

- (a) Replace the canister assembly (See page [EC-9](#)).



*: Check for disconnection and/or crack

N

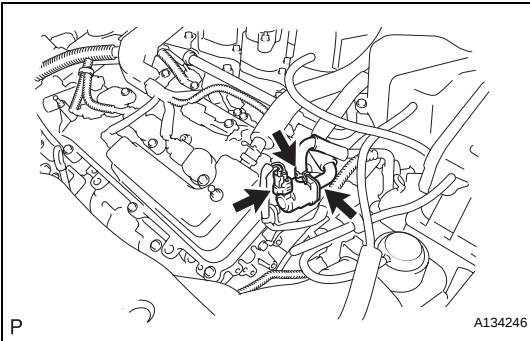
A132283E05

NOTICE:

When replacing the canister, check the canister pump module interior and related pipes for water, fuel and other liquids. If liquids are present, check for disconnections and/or cracks in the following: 1) the pipe from the air inlet pipe to the canister pump module; 2) the canister filter; and 3) the fuel tank vent hose.

NEXT

Go to step 36

30 REPLACE DUTY VACUUM SWITCHING VALVE (PURGE VSV)

- (a) Disconnect the connector and the hoses from the purge VSV.
- (b) Remove the purge VSV (See page [EC-13](#)).
- (c) Install a new purge VSV (See page [EC-14](#)).
- (d) Reconnect the connector and hoses.

NEXT

Go to step 36

ES

31 REPAIR OR REPLACE HARNESS OR CONNECTOR

NEXT

Go to step 36

32 REPLACE EVAP HOSE (INTAKE MANIFOLD - PURGE VSV)

NEXT

Go to step 36

33 INSPECT INTAKE MANIFOLD (EVAP PURGE PORT)

- (a) Check that the EVAP purge port of the intake manifold is not clogged. If necessary, replace the intake manifold.

NEXT

Go to step 36

34 REPLACE ECM

- (a) Replace the ECM (See page [ES-543](#)).

NEXT

Go to step 36

35 REPAIR OR REPLACE PARTS AND COMPONENTS INDICATED BY OUTPUT DTCS

- (a) Repair the malfunctioning areas indicated by the DTCs that had been confirmed when the vehicle was brought in.

NEXT

Go to step 36

36	PERFORM EVAP SYSTEM CHECK (AUTO OPERATION)
-----------	---

NOTICE:

- The EVAP SYSTEM CHECK (AUTO OPERATION) consists of 5 steps performed automatically by the intelligent tester. It takes a maximum of approximately 18 minutes.
 - Do not perform the EVAP SYSTEM CHECK when the fuel tank is more than 90% full because the cut-off valve may be closed, making the fuel tank leak check unavailable.
 - Do not run the engine in this step.
 - When the temperature of the fuel is 35°C (95°F) or more, a large amount of vapor forms and any check results become inaccurate. When performing an EVAP SYSTEM CHECK, keep the temperature below 35°C (95°F).
- (a) Clear the DTCs (See page [ES-41](#)).
 - (b) On the intelligent tester, select the following menu items: DIAGNOSIS / ENHANCED OBD II / SYSTEM CHECK / EVAP SYS CHECK / AUTO OPERATION.
 - (c) After the SYSTEM CHECK is completed, check for pending DTCs by selecting the following menu items: DIAGNOSIS / ENHANCED OBD II / DTC INFO / PENDING CODES.

HINT:

If no pending DTCs are found, the repair has been successfully completed.

NEXT

COMPLETED

CONFIRMATION DRIVING PATTERN**HINT:**

After a repair, check Monitor Status by performing the Key-Off Monitor Confirmation and Purge Flow Monitor Confirmation described below.

1. KEY-OFF MONITOR CONFIRMATION**(a) Preconditions**

The monitor will not run unless:

- The vehicle has been driven for 10 minutes or more (in a city area or on a freeway).
- The fuel tank is less than 90 % full.
- The altitude is less than 8,000 ft (2,400 m).
- The Engine Coolant Temperature (ECT) is between 4.4°C and 35°C (40°F and 95°F).
- The Intake Air Temperature (IAT) is between 4.4°C and 35°C (40°F and 95°F).
- The vehicle remains stationary (the vehicle speed is 0 mph (0 km/h)).

(b) Monitor Conditions

1. Allow the engine to idle for at least 5 minutes.
2. Turn the engine switch off and wait for 6 hours (8 or 10.5 hours).

HINT:

Do not start the engine until checking MONITOR STATUS. If the engine is started, the steps described above must be repeated.

- (c) Monitor Status
1. Connect the intelligent tester to the DLC3.
 2. Turn the engine switch on (IG) and turn the tester on.
 3. Select the following menu items: DIAGNOSIS / ENHANCED OBD II / MONITOR STATUS.
 4. Check the Monitor Status displayed on the tester.

HINT:

If INCMP is displayed, the monitor is not complete. Make sure that the preconditions have been met, and perform the Monitor Conditions again.

2. PURGE FLOW MONITOR CONFIRMATION (P0441)

HINT:

Perform this monitor confirmation after the Key-Off Monitor Confirmation shows COMPL (complete).

(a) Preconditions

The monitor will not run unless:

- The vehicle has been driven for 10 minutes or more (in a city area or on a freeway)
- The ECT is between 4.4°C and 35°C (40°F and 95°F)
- The IAT is between 4.4°C and 35°C (40°F and 95°F)

(b) Monitor Conditions

1. Release the pressure from the fuel tank by removing and reinstalling the fuel cap.
2. Warm the engine up until the ECT reaches more than 75°C (167°F).
3. Increase the engine speed to 3,000 rpm once.
4. Allow the engine to idle and turn A/C ON for 1 minute.

(c) Monitor Status

1. Turn the engine switch off (if ON or the engine is running).
2. Connect the intelligent tester to the DLC3.
3. Turn the engine switch on (IG) and turn the tester on.
4. Select the following menu items: DIAGNOSIS / ENHANCED OBD II / MONITOR STATUS.
5. Check the Monitor Status displayed on the tester.

HINT:

If INCMP is displayed, the monitor is not complete. Make sure that the preconditions have been met, and perform the Monitor Conditions again.

MONITOR RESULT

Refer to CHECKING MONITOR STATUS (See page [ES-20](#)).

DTC**U0101****Lost Communication with TCM****DESCRIPTION**

The Transmission Control Module (TCM) and ECM perform 2-way communications with each other via the Controller Area Network (CAN). The TCM sends signals to the ECM concerning required engine rpm, required engine torques, warning indicators in the combination meter, DTCs and other data. The ECM sends signals to the TCM concerning engine rpm, opening angles of the throttle valve, temperature of intake air, temperature of engine coolant, engine torques and other data. If the TCM cannot communicate with the ECM, the TCM will conclude that there is a malfunction in the CAN system, illuminate the MIL and set a DTC.

DTC No.	DTC Detection Condition	Trouble Area
U0101	No communication from TCM	• Open or short in TCM and ECM circuit • TCM • ECM

MONITOR STRATEGY

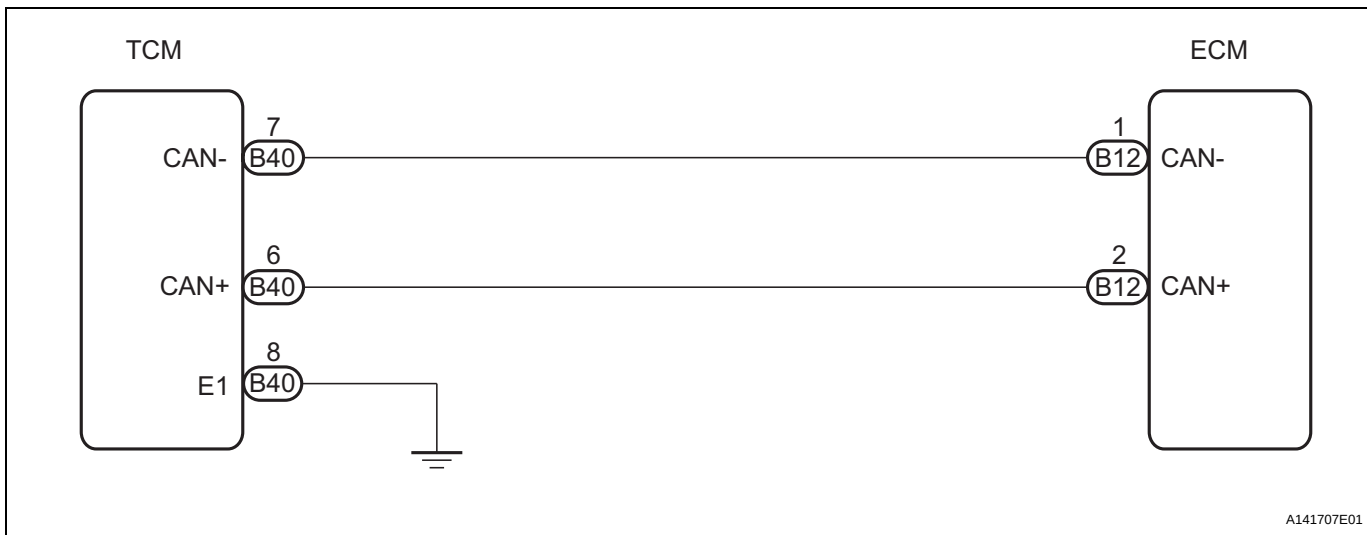
Related DTCs	U0101: Verify communication
Required Sensors/Components (Main)	ECM
Required Sensors/Components (Sub)	-
Frequency of Operation	Continuous
Duration	1.25 seconds
MIL Operation	immediate
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

Monitor runs whenever following DTCs are not present	None
Battery Voltage	10.5 V or more (0.5 second or more)
Engine switch	ON
Starter	OFF

TYPICAL MALFUNCTION THRESHOLDS

Communication signal	Lost communication with TCM
----------------------	-----------------------------



INSPECTION PROCEDURE

1 CHECK OTHER DTC OUTPUT (IN ADDITION TO DTC U0101)

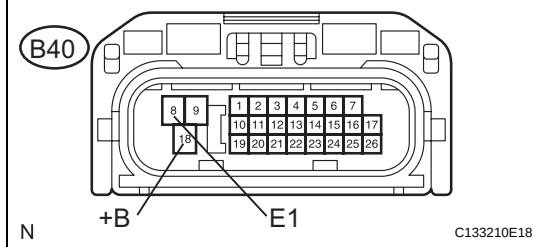
- (a) Connect the intelligent tester to the DLC3.
- (b) Turn the engine switch on (IG).
- (c) Turn the tester on.
- (d) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DTC INFO / CURRENT CODES.
- (e) Read the DTCs.

Result

Display (DTC output)	Proceed to
U0101	A
U0101 and other DTCs	B

ES**B****GO TO DTC CHART (See page ES-59)****A****2 CHECK TCM TERMINAL VOLTAGE (+B AND E1 TERMINALS)****Wire Harness Side:**

TCM Connector (Front View)



- (a) Disconnect the TCM connector.
- (b) Turn the engine switch on (IG).
- (c) Measure the voltage according to the value(s) in the table below.

Standard voltage

Tester Connection	Specified Condition
B40-18 (+B) - B40-8 (E1)	9 to 14 V

- (d) Turn the engine switch off.
- (e) Measure the resistance according to the value(s) in the table below.

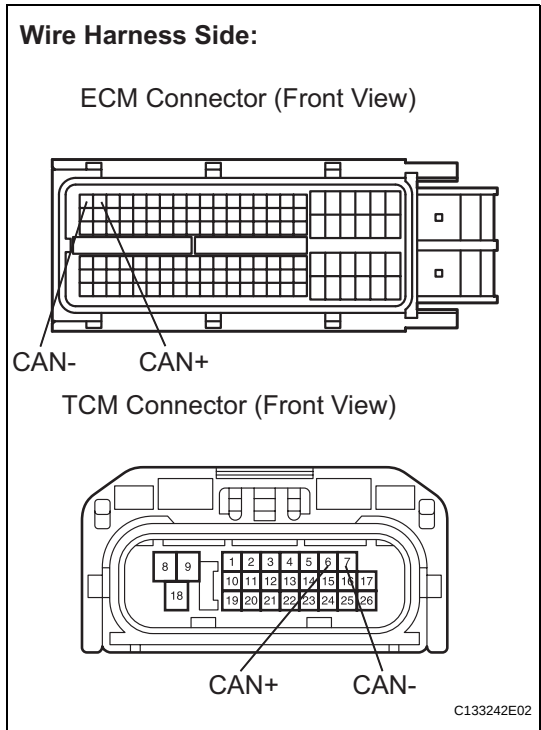
Standard resistance

Tester Connection	Specified Condition
B40-8 (E1) - Body ground	Below 1 Ω

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

3

CHECK HARNESS AND CONNECTOR



- (a) Disconnect the B40 TCM connector.
- (b) Disconnect the B12 ECM connector.
- (c) Measure the resistance according to the value(s) in the table below.

Standard resistance

Tester Connection	Specified Condition
B40-6 (CAN+) - B12-2 (CAN+)	Below 1 Ω
B40-7 (CAN-) - B12-1 (CAN-)	Below 1 Ω
B40-6 (CAN+) or B12-2 (CAN+) - Body ground	1 MΩ or more
B40-7 (CAN-) or B12-1 (CAN-) - Body ground	1 MΩ or more

NG

REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

4

REPLACE ECM

- (a) Replace the ECM (See page ES-543).
- NOTICE:**
Replace the ECM with an ECM from a normally functioning vehicle of the same model.

NEXT

5

CHECK IF DTC RECURS

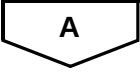
- (a) Connect the intelligent tester to the DLC3.
- (b) Clear the DTC.
- (c) Start the engine.
- (d) Read the DTCs.

Result

Display (DTC Output)	Proceed to
U0101	A
No DTC	B

B

REPLACE ECM (See page ES-543)



A

REPLACE TCM (See page [ES-543](#))

DTC	P2A00	A/F Sensor Circuit Slow Response (Bank 1 Sensor 1)
DTC	P2A03	A/F Sensor Circuit Slow Response (Bank 2 Sensor 1)

DESCRIPTION

HINT:

- DTC P2A00 indicates malfunctions related to the bank 1 A/F sensor.
- DTC P2A03 indicates malfunctions related to the bank 2 A/F sensor.
- Bank 1 refers to the bank that includes cylinder No. 1.
- Bank 2 refers to the bank that includes cylinder No. 2.
- Sensor 1 refers to the sensor mounted in front of the Three-Way Catalytic Converter (TWC) and located near the engine assembly.
- Although the DTC titles say oxygen sensor, these DTCs relate to the Air-Fuel Ratio (A/F) sensor.

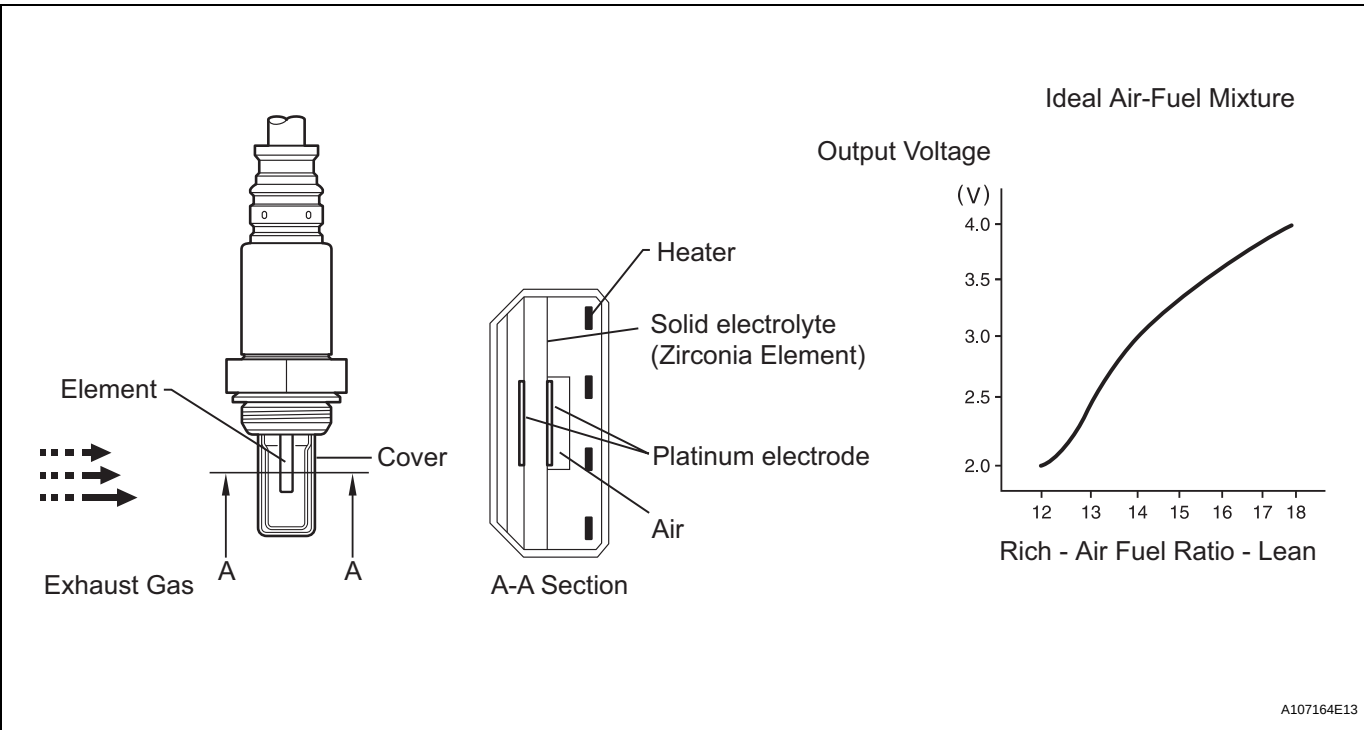
The A/F sensor generates voltage* that corresponds to the actual air-fuel ratio. This sensor voltage is used to provide the ECM with feedback so that it can control the air-fuel ratio. The ECM determines the deviation from the stoichiometric air-fuel ratio level, and regulates the fuel injection time. If the A/F sensor malfunctions, the ECM is unable to control the air-fuel ratio accurately.

The A/F sensor is the planar type and is integrated with the heater, which heats the solid electrolyte (zirconia element). This heater is controlled by the ECM. When the intake air volume is low (the exhaust gas temperature is low), a current flows into the heater to heat the sensor, in order to facilitate accurate oxygen concentration detection. In addition, the sensor and heater portions are narrower than the conventional type. The heat generated by the heater is conducted to the solid electrolyte through the alumina, therefore the sensor activation is accelerated.

A three-way catalytic converter (TWC) is used in order to convert the carbon monoxide (CO), hydrocarbon (HC), and nitrogen oxide (NOx) into less harmful substances. To allow the TWC to function effectively, it is necessary to keep the air-fuel ratio of the engine near the stoichiometric air-fuel ratio.

*: Value changes inside the ECM. Since the A/F sensor is the current output element, a current is converted to a voltage inside the ECM. Any measurements taken at the A/F sensor or ECM connectors will show a constant voltage.

ES

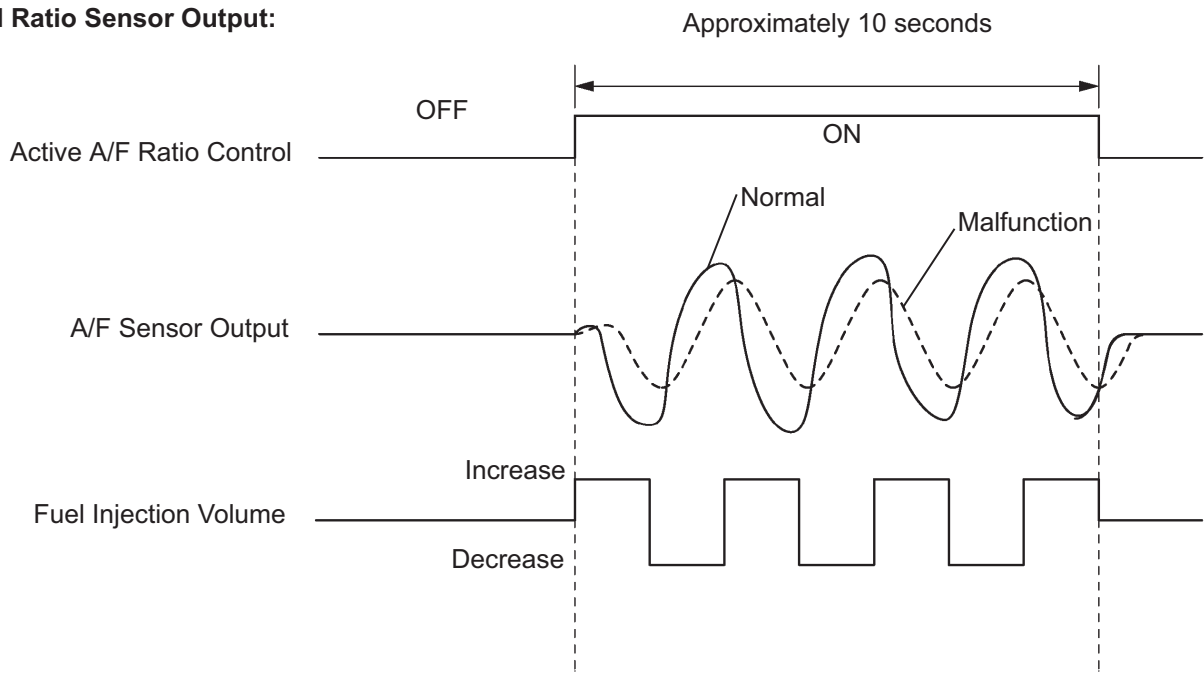


DTC No.	DTC Detection Conditions	Trouble Area
P2A00 P2A03	Calculated value for air-fuel ratio (A/F) sensor response rate deterioration level is less than threshold	• Open or short in A/F sensor circuit • A/F sensor • ECM

MONITOR DESCRIPTION

After the engine is warmed up, the ECM performs air-fuel ratio feedback control to maintain the air-fuel ratio at the stoichiometric level. In addition, active A/F ratio control is performed for approximately 10 seconds after preconditions are met in order to measure the A/F sensor response rate. During active A/F ratio control, the ECM forcibly increases and decreases the injection volume by a certain amount, based on the stoichiometric air-fuel ratio learned during normal air-fuel ratio control, and measures the A/F sensor response rate. The ECM receives a signal from the A/F sensor while performing active A/F ratio control and uses it to calculate the A/F sensor response rate deterioration level. If the value for A/F sensor response rate deterioration level is less than the threshold, the ECM interprets this as a malfunction and sets the DTC.

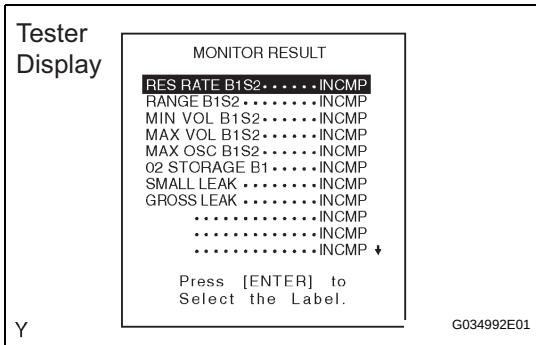
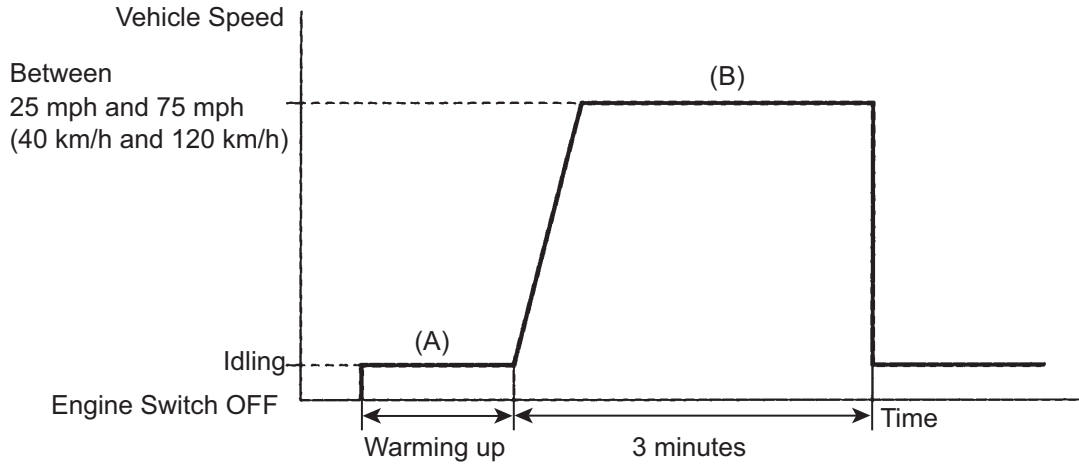
Air-fuel Ratio Sensor Output:



CONFIRMATION DRIVING PATTERN

HINT:

Performing this confirmation pattern will activate the A/F sensor response monitor.



1. Connect an intelligent tester to the DLC3.

2. Turn the engine switch on (IG).
3. Turn the tester on.
4. Clear the DTCs (where set).
5. Select the following menu items: DIAGNOSIS / ENHANCED OBD II / MONITOR INFO / MONITOR RESULT.
6. Check that RES RATE B1S1 is INCOMP.
7. Start the engine and warm it up (Procedure "A").
8. Drive the vehicle at between 25 mph and 75 mph (40 km/h and 120 km/h) for 3 minutes. However, the vehicle should be driven at a constant speed (Procedure "B").
9. Check the monitor result values on the intelligent tester by selecting the following menu items: DIAGNOSIS / ENHANCED OBD II / MONITOR INFO / TEST RESULT.
10. If the values indicated on the tester do not change, perform READINESS MONITOR DRIVE PATTERN for the A/F sensor and the heated oxygen sensor (See page [ES-341](#)).

HINT:

Completion of all A/F sensor monitors is required to change the value in TEST RESULT.

11. Note the value of the Monitor Result.
12. Select the following menu items: DIAGNOSIS / ENHANCED OBD II / DTC INFO / PENDING CODES.
13. Check if any DTCs (any pending DTCs) are set.

MONITOR STRATEGY

Related DTCs	P2A00: A/F sensor (Bank 1) slow response P2A03: A/F sensor (Bank 2) slow response
Required Sensors/Components (Main)	A/F sensor
Required Sensors/Components (Related)	Vehicle speed sensor, Crankshaft position sensor
Frequency of Operation	Once per driving cycle
Duration	10 to 15 seconds
MIL Operation	2 driving cycles
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

Monitor runs whenever following DTCs are not present	P0031, P0032, P0051, P0052 (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, P0173, P0174 (Fuel system) P0300 - P0308 (Misfire) P0335 (CKP sensor) P0340, P0341 (CMP sensor) P0500 (VSS) P2196, P2198 (A/F sensor - rationality)
Battery voltage	11 V or more
ECT	75°C (167°F) or more
Idle	OFF
Engine rpm	Less than 4,000 rpm
A/F sensor status	Activated
Fuel-cut	OFF
Engine load	10 to 70 %
Shift position	2 or more
Catalyst monitor	Not yet
MAF	2.5 to 15 g/sec.

TYPICAL MALFUNCTION THRESHOLDS

Response rate deterioration level	Less than 0.18 V
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MONITOR RESULT

Refer to CHECKING MONITOR STATUS (See page [ES-20](#)).

WIRING DIAGRAM

Refer to DTC P2195 (See page [ES-353](#)).

INSPECTION PROCEDURE

HINT:

Intelligent tester only:

Malfunctioning areas can be identified by performing the A/F CONTROL function provided in the ACTIVE TEST. The A/F CONTROL function can help to determine whether the Air-fuel Ratio (A/F) sensor, Heated Oxygen (HO2) sensor and other potential trouble areas are malfunctioning.

The following instructions describe how to conduct the A/F CONTROL operation using the intelligent tester.

1. Connect the intelligent tester to the DLC3.
2. Start the engine and turn the tester on.
3. Warm up the engine at an engine speed of 2,500 rpm for approximately 90 seconds.
4. On the intelligent tester, enter the following menus: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / A/F CONTROL.
5. Perform the A/F CONTROL operation with the engine in an idling condition (press the RIGHT or LEFT button to change the fuel injection volume).
6. Monitor the output voltages of the A/F and HO2 sensors (AFS B1 S1 and O2S B1 S2 or AFS B2 S1 and O2S B2 S2) displayed on the tester.

HINT:

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

Tester Display (Sensor)	Injection Volume	Status	Voltage
AFS B1 S1 or AFS B2 S1 (A/F)	+25 %	Rich	Less than 3.0 V
AFS B1 S1 or AFS B2 S1 (A/F)	-12.5 %	Lean	More than 3.35 V
O2S B1 S2 or O2S B2 S2 (HO2)	+25 %	Rich	More than 0.55 V
O2S B1 S2 or O2S B2 S2 (HO2)	-12.5 %	Lean	Less than 0.4 V

NOTICE:

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

Case	A/F Sensor (Sensor 1) Output Voltage		HO2 Sensor (Sensor 2) Output Voltage		Main Suspected Trouble Areas
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 Areas
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 %		- Injector - Fuel pressure - Gas leakage from exhaust system (Air-fuel ratio extremely lean or rich)
	Output Voltage Almost no reaction	—————NG	Output Voltage Almost no reaction	—————NG	

- Following the A/F CONTROL procedure enables technicians to check and graph the voltage outputs of both the A/F and HO2 sensors.
- To display the graph, enter the following menus: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / A/F CONTROL / USER DATA / AFS B1 S1 and O2S B1 S2 or AFS B2 S1 and O2S B2 S2, and press the YES button and then the ENTER button followed by the F4 button.

HINT:

- DTC P2A00 or P2A03 may also be set, when the air-fuel ratio is stuck rich or lean.
- A low A/F sensor voltage could be caused by a rich air-fuel mixture. Check for conditions that would cause the engine to run rich.
- A high A/F sensor voltage could be caused by a lean air-fuel mixture. Check for conditions that would cause the engine to run lean.
- Read freeze frame data using the intelligent tester. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can be helpful in determining whether the vehicle was running or stopped, whether the engine was warmed up or not, whether the air-fuel ratio was lean or rich, as well as other data recorded at the time of a malfunction (See page [ES-41](#)).

1

CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P2A00 AND/OR P2A03)

- Connect the intelligent tester to the DLC3.
- Turn the engine switch on (IG).
- Turn the tester on.
- Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DTC INFO / CURRENT CODES.
- Read the DTCs.

Result

Display (DTC Output)	Proceed to
P2A00 and/or P2A03	A
P2A00 and/or P2A03 and other DTCs	B

HINT:
If any DTCs other than P2A00 or P2A03 are output,
troubleshoot those DTCs first.

B

GO TO DTC CHART (See page ES-59)

A

2INSPECT AIR FUEL RATIO SENSOR (HEATER RESISTANCE)

Component Side:

Air Fuel Ratio Sensor

B3

Bank 1

2

1

4

3

+B

HT

AF-

AF+

B4

Bank 2

2

1

4

3

+B

HT

AF-

AF+

A140627E03

- (a) Disconnect the B3 or B4 A/F sensor connector.
(b) Measure the resistance according to the value(s) in the table below.

Standard resistance (Bank 1 sensor 1)

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

Standard resistance (Bank 2 sensor 1)

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

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

NG

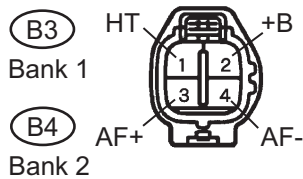
REPLACE AIR FUEL RATIO SENSOR (See page EC-19)

OK

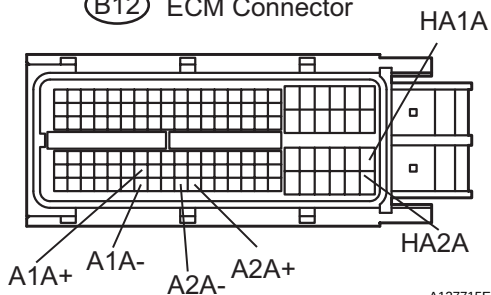
3 CHECK HARNESS AND CONNECTOR (A/F SENSOR - ECM)

Wire Harness Side:

Air Fuel Ratio Sensor Connector



(B12) ECM Connector



- Disconnect the B3 and B4 A/F sensor connectors.
- Turn the engine switch on (IG).
- Measure the voltage according to the value(s) in the table below.

Standard voltage

Tester Connection	Specified Condition
+B (B3-2) - Body ground	9 to 14 V
+B (B4-2) - Body ground	9 to 14 V

- Turn the engine switch off.
- Disconnect the B12 ECM connector.
- Measure the resistance according to the value(s) in the table below.

Standard resistance (Check for open)

Tester Connection	Specified Condition
HT (B3-1) - HA1A (B12-86)	Below 1 Ω
AF+ (B3-3) - A1A+ (B12-93)	Below 1 Ω
AF- (B3-4) - A1A- (B12-116)	Below 1 Ω
HT (B4-1) - HA2A (B12-109)	Below 1 Ω
AF+ (B4-3) - A2A+ (B12-120)	Below 1 Ω
AF- (B4-4) - A2A- (B12-119)	Below 1 Ω

Standard resistance (Check for short)

Tester Connection	Specified Condition
HT (B3-1) or HA1A (B12-86) - Body ground	10 k Ω or higher
AF+ (B3-3) or A1A+ (B12-93) - Body ground	10 k Ω or higher
AF- (B3-4) or A1A- (B12-116) - Body ground	10 k Ω or higher
HT (B4-1) or HA2A (B12-109) - Body ground	10 k Ω or higher
AF+ (B4-3) or A2A+ (B12-120) - Body ground	10 k Ω or higher
AF- (B4-4) or A2A- (B12-119) - Body ground	10 k Ω or higher

- Reconnect the ECM connector.
- Reconnect the A/F sensor connectors.

NG

REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

4 PERFORM CONFIRMATION DRIVING PATTERN

NEXT

5 CHECK WHETHER DTC OUTPUT RECURS (DTC P2A00 AND/OR P2A03)

- Read the DTCs using the intelligent tester.
- Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DTC INFO / CURRENT CODES.

Result

Display (DTC Output)	Proceed to
P2A00 and/or P2A03	A
No output	B

B**REPLACE ECM (See page [ES-543](#))****A****6****REPLACE AIR FUEL RATIO SENSOR**(a) Replace the air fuel ratio sensor (See page [EC-19](#)).**NEXT****7****PERFORM CONFIRMATION DRIVING PATTERN****NEXT****8****CHECK WHETHER DTC OUTPUT RECURS (DTC P2A00 AND/OR P2A03)**

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

Result

Display (DTC Output)	Proceed to
No output	A
P2A00 and/or P2A03	B

B**REPLACE ECM (See page [ES-543](#))****A****END****ES**

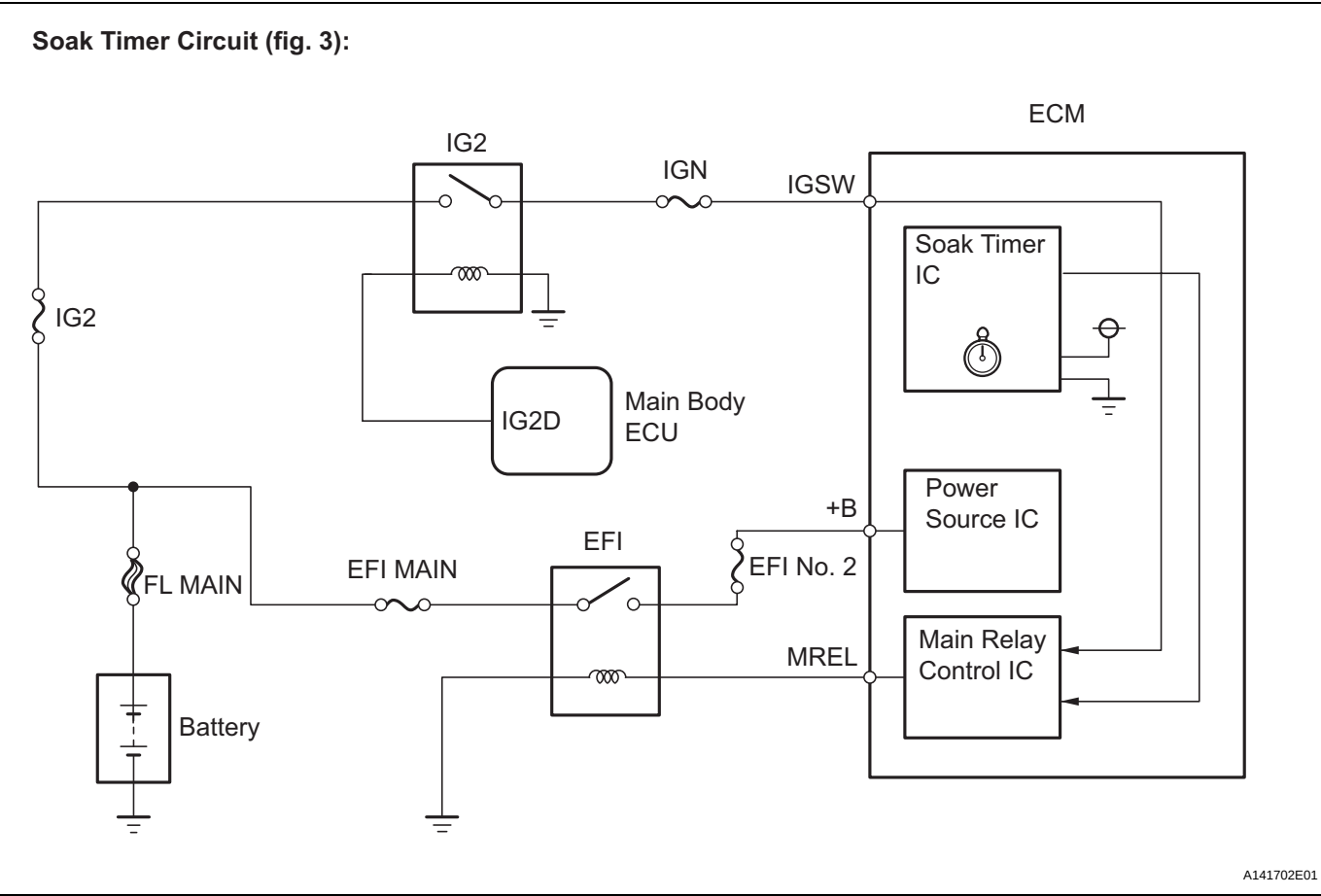
DTC	P2610	ECM / PCM Internal Engine Off Timer Performance
-----	-------	---

DTC SUMMARY

DTC No.	Monitoring Item	DTC Detection Condition	Trouble Area	Detection Timing	Detection Logic
P2610	Soak timer (built into ECM)	ECM internal malfunction	ECM	Engine running	2 trip

DESCRIPTION

To ensure the accuracy of the EVAP (Evaporative Emission) monitor values, the soak timer, which is built into the ECM, measures 5 hours (+/- 15 minutes) from when the engine switch is turned off, before the monitor is run. This allows the fuel to cool down, which stabilizes the Fuel Tank Pressure (FTP). When 5 hours have elapsed, the ECM turns on.



MONITOR DESCRIPTION

5 hours after the engine switch is turned off, the soak timer activates the ECM to begin the EVAP system monitor. While the engine is running, the ECM monitors the synchronization of the soak timer and the CPU clock. If these two are not synchronized, the ECM interprets this as a malfunction, illuminates the MIL and sets the DTC (2 trip detection logic).

MONITOR STRATEGY

Required Sensors/Components	ECM
Frequency of Operation	Once per driving cycle

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

TYPICAL ENABLING CONDITIONS

Case 1:

Engine switch	ON
Engine	Running
Battery voltage	8 V or more
Starter	OFF

Case 2:

Internal engine OFF timer (elapsed time from engine stop)	10 to 300 minutes
Battery voltage	8 V or more
Engine switch	ON
Starter	OFF

Case 3:

Internal engine OFF timer (elapsed time from engine stop)	310 minutes
Battery voltage	8 V or more
Engine switch	ON
Starter	OFF

TYPICAL MALFUNCTION THRESHOLDS

Case 1:

Soak timer measurement when ECM CPU clock counts 10 minutes	Less than 7 minutes or more than 13 minutes
---	---

Case 2:

ECM had the started record by internal engine OFF timer	Yes
---	-----

Case 3:

ECM had the started record by internal engine OFF timer	No
---	----

INSPECTION PROCEDURE

HINT:

- DTC P2610 is set if an internal ECM problem is detected. In this case, diagnostic procedures are not required. ECM replacement is required.
- Read freeze frame data using the intelligent tester. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can be helpful in determining whether the vehicle was running or stopped, whether the engine was warmed up or not, whether the air-fuel ratio was lean or rich, as well as other data recorded at the time of a malfunction (See page [ES-41](#)).

1 REPLACE ECM

(a) Replace the ECM (See page [ES-543](#)).

NEXT

ES

2	CHECK WHETHER DTC OUTPUT RECURS
----------	--

- (a) Connect the intelligent tester to the DLC3.
- (b) Turn the engine switch on.
- (c) Clear the DTCs (See page [ES-41](#)).
- (d) Start the engine and wait for 10 minutes or more.
- (e) On the tester, enter the following menu items:
DIAGNOSIS / ENHANCED OBD II / DTC / INFO /
PENDING CODES.
- (f) If no pending DTC is displayed, the repair has been
successfully completed.

ES

NEXT

END

DTC	P2420	Evaporative Emission System Switching Valve Control Circuit High
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DTC SUMMARY

DTC No.	Monitoring Item	DTC Detection Condition	Trouble Area	Detection Timing	Detection Logic
P2420	Vent valve stuck open (vent)	The following condition is met during key-off EVAP monitor EVAP pressure change when vent valve is closed (ON) is less than 2.3 mmHg	- Pump module (0.02 inch orifice, vacuum pump, vent valve) - Connector / wire harness (Pump module - ECM) - ECM	Engine switch off	2 trip

ES**DESCRIPTION**

The circuit description can be found in the EVAP (Evaporative Emission) system (See page [ES-395](#)).

INSPECTION PROCEDURE

Refer to the EVAP system (See page [ES-395](#)).

MONITOR DESCRIPTION

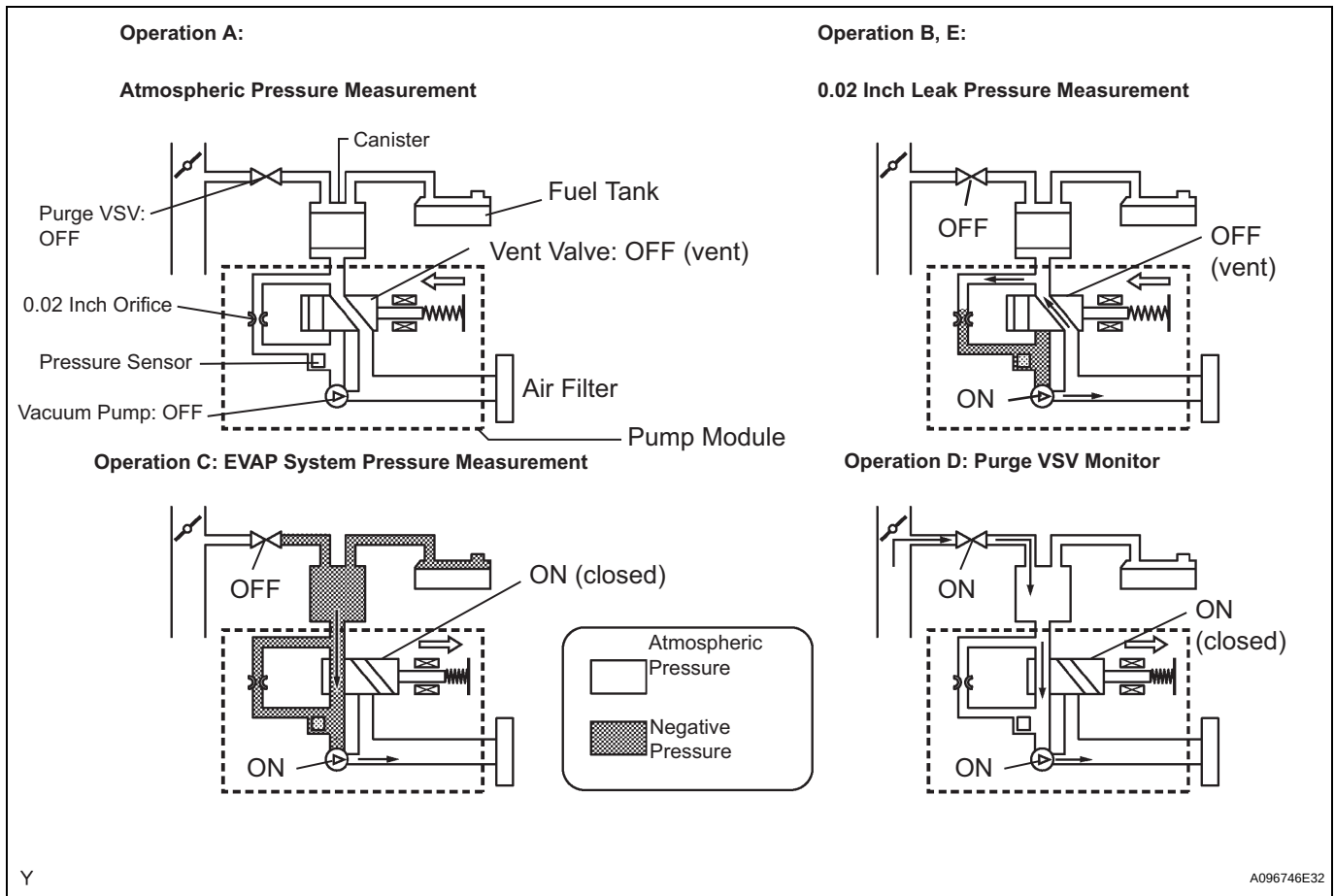
5 hours^{*1} after the engine switch is turned off, the electric vacuum pump creates negative pressure (vacuum) in the EVAP (Evaporative Emission) system. The ECM monitors for leaks and actuator malfunctions based on the EVAP pressure.

HINT:

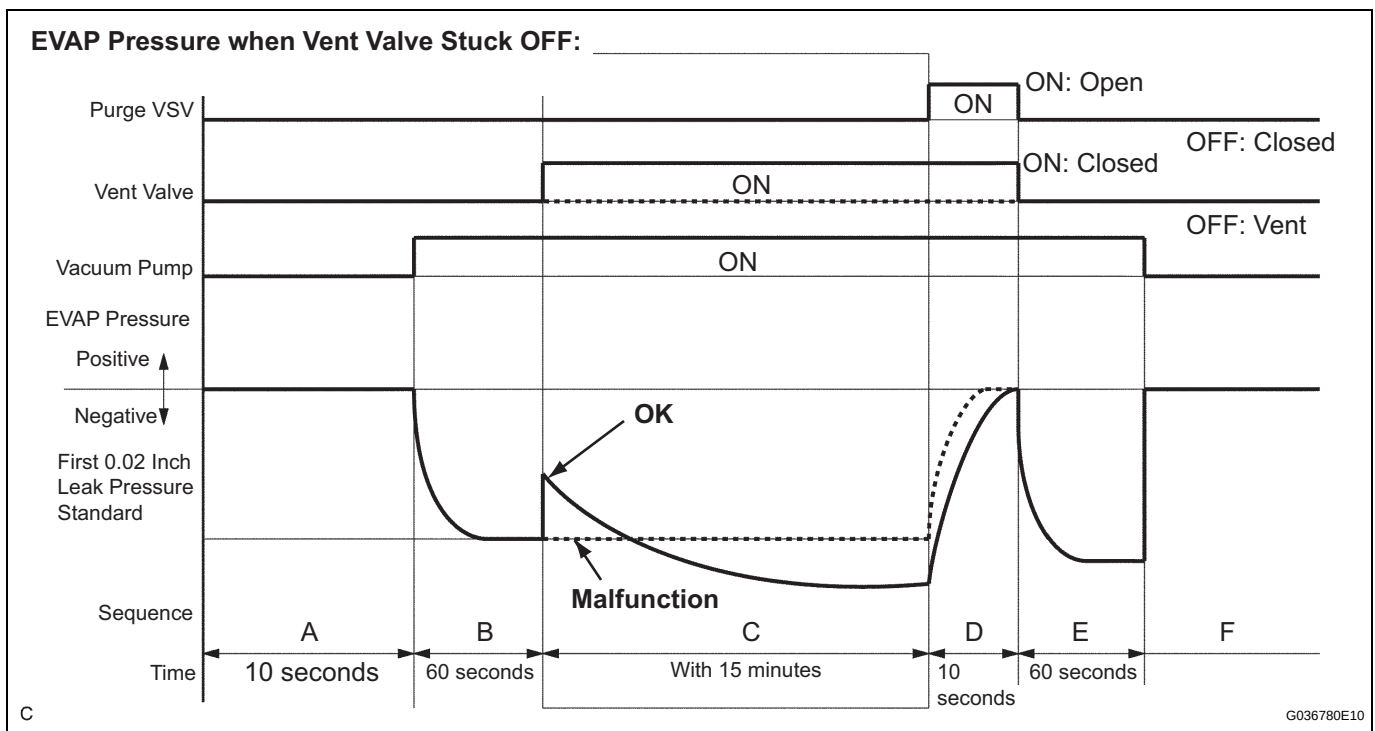
^{*1}: If the engine coolant temperature is not below 35°C (95°F) 5 hours after the engine switch is turned off, the monitor check starts 2 hours later. If it is still not below 35°C (95°F) 7 hours after the engine switch is turned off, the monitor check starts 2.5 hours later.

Sequence	Operations	Descriptions	Duration
-	ECM activation	Activated by soak timer, 5 hours (7 or 9.5 hours) after engine switch is turned off.	-
A	Atmospheric pressure measurement	Vent valve is turned OFF (vent) and EVAP system pressure is measured by ECM in order to register atmospheric pressure. If pressure in EVAP system is not between 70 kPa and 110 kPa (525 mmHg and 825 mmHg), ECM cancels EVAP system monitor.	10 seconds
B	First 0.02 inch leak pressure measurement	In order to determine 0.02 inch leak pressure standard, vacuum pump creates negative pressure (vacuum) through 0.02 inch orifice and then ECM checks if vacuum pump and vent valve operate normally.	60 seconds
C	EVAP system pressure measurement	Vent valve is turned ON (closed) to shut EVAP system. Negative pressure (vacuum) is created in EVAP system, and then EVAP system pressure is measured. Write down measured value as they will be used in leak check. If EVAP pressure does not stabilize within 15 minutes, ECM cancels EVAP system monitor.	15 minutes ^{*2}
D	Purge VSV monitor	Purge VSV is opened and then EVAP system pressure is measured by ECM. Large increase indicates normal.	10 seconds
E	Second 0.02 inch leak pressure measurement	After second 0.02 inch leak pressure measurement, leak check is performed by comparing first and second 0.02 inch leak pressure standards. If stabilized system pressure is higher than second 0.02 inch leak pressure standard, ECM determines that there is a leak in EVAP system.	60 seconds
F	Final check	Atmospheric pressure is measured and then monitoring result is recorded by ECM.	-

^{*2}: If only a small amount of fuel is in the fuel tank, it takes longer for the EVAP pressure to stabilize.



The vent valve turns ON (closes) and the EVAP (Evaporative Emission) system pressure is then measured by the ECM, using the pressure sensor, to conduct an EVAP leak check. If the pressure does not increase when the vent valve is open, the ECM interprets this as the vent valve being stuck open. The ECM illuminates the MIL and sets the DTC.



MONITOR STRATEGY

Related DTC	P2420: Vent valve stuck open (vent)
Required Sensors/Components	Purge VSV and pump module
Frequency of Operation	Once per driving cycle
Duration	Within 2 minutes
MIL Operation	2 driving cycles
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

ES

The monitor will run whenever these DTCs are not present	None
Key-off monitor is run when all of the following conditions are met	-
Atmospheric pressure	70 to 110 kPa (525 to 825 mmHg)
Battery voltage	10.5 V or more
Vehicle speed	2.5 mph (4 km/h) or less
Engine switch	OFF
Time after key-off	5 or 7 or 9.5 hours
EVAP pressure sensor malfunction (P0450, P0452, P0453)	Not detected
EVAP canister purge valve	Not operated by scan tool
EVAP canister vent valve	Not operated by scan tool
EVAP leak detection pump	Not operated by scan tool
Both of the following conditions 1 and 2 are 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)

Key-off monitor sequence 1 to 8

1. Atmospheric pressure measurement

Next sequence is run if the following condition is met	-
Atmospheric pressure change	Less than 0.3 kPa (2.25 mmHg) in 1 second

2. First reference pressure measurement

Next sequence is run if the following conditions are met	Conditions 1, 2 and 3
1. EVAP pressure just after reference pressure measurement start	-1 kPa (-7.5 mmHg) or less
2. Reference pressure	-4.85 to -1.057 kPa (-36.384 to -7.929 mmHg)
3. Reference pressure	Saturated

3. EVAP canister vent valve close stuck check

Next sequence is run if the following condition is met	-
EVAP pressure change after vent valve is turned 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 15 minutes

5. EVAP canister purge valve close stuck check

Next sequence is run if the following condition is met	-
EVAP pressure change after purge valve is opened	0.3 kPa (2.25 mmHg) or more

6. Second reference pressure measurement

Next sequence is run if the following conditions are met	Conditions 1, 2, 3 and 4
1. EVAP pressure just after reference pressure	-1 kPa (-7.5 mmHg) or less
2. Reference pressure	-4.85 to -1.057 kPa (-36.384 to -7.929 mmHg)
3. Reference pressure	Saturated
4. Difference between first reference pressure and second reference pressure	Less than 0.7 kPa (5.25 mmHg)

7. Leak check

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)

ES**TYPICAL MALFUNCTION THRESHOLDS**

EVAP pressure change after EVAP canister vent valve is turned ON	Less than 0.3 kPa (2.25 mmHg)
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MONITOR RESULT

Refer to CHECKING MONITOR STATUS (See page [ES-20](#)).

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	P2241	Oxygen (A/F) Sensor Pumping Current Circuit Low (Bank 2 Sensor 1)
DTC	P2242	Oxygen (A/F) Sensor Pumping Current Circuit High (Bank 2 Sensor 1)
DTC	P2252	Oxygen (A/F) Sensor Reference Ground Circuit Low (Bank 1 Sensor 1)
DTC	P2253	Oxygen (A/F) Sensor Reference Ground Circuit High (Bank 1 Sensor 1)
DTC	P2255	Oxygen (A/F) Sensor Reference Ground Circuit Low (Bank 2 Sensor 1)
DTC	P2256	Oxygen (A/F) Sensor Reference Ground Circuit High (Bank 2 Sensor 1)

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

- Although the DTC titles include oxygen sensor, these DTCs relate to the Air-Fuel Ratio (A/F) sensor.
- Sensor 1 refers to the sensor mounted in front of the Three-Way Catalytic Converter (TWC) and located near the engine assembly.

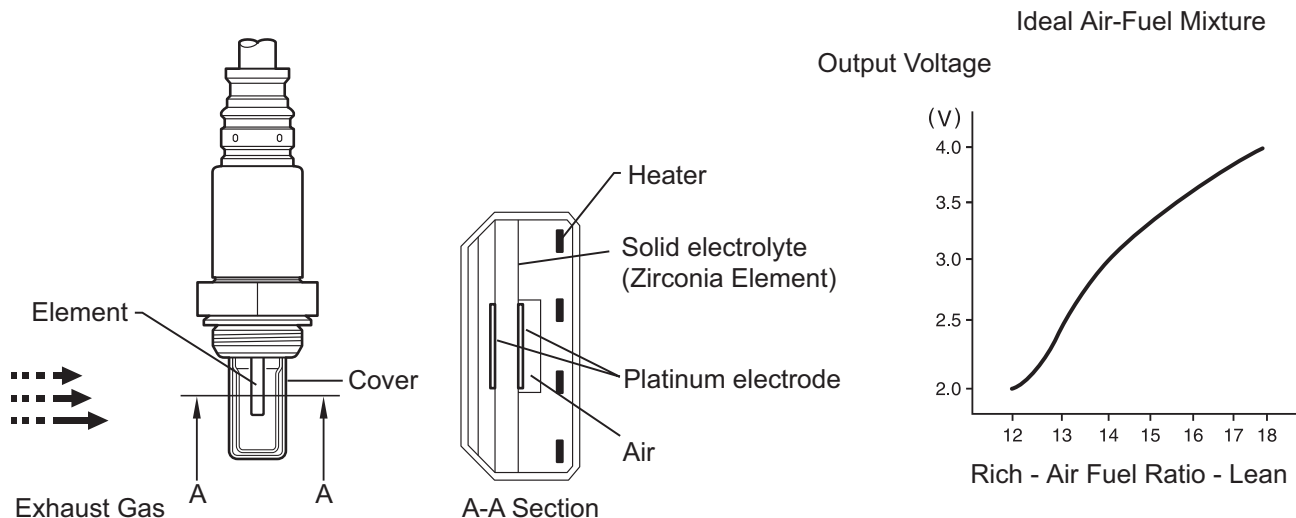
The A/F sensor generates voltage* that corresponds to the actual air-fuel ratio. This sensor voltage is used to provide the ECM with feedback so that it can control the air-fuel ratio. The ECM determines the deviation from the stoichiometric air-fuel ratio level, and regulates the fuel injection time. If the A/F sensor malfunctions, the ECM is unable to control the air-fuel ratio accurately.

The A/F sensor is the planar type and is integrated with the heater, which heats the solid electrolyte (zirconia element). This heater is controlled by the ECM. When the intake air volume is low (the exhaust gas temperature is low), a current flows into the heater to heat the sensor, in order to facilitate accurate oxygen concentration detection. In addition, the sensor and heater portions are narrower than the conventional type. The heat generated by the heater is conducted to the solid electrolyte through the alumina, therefore the sensor activation is accelerated.

A three-way catalytic converter (TWC) is used in order to convert the carbon monoxide (CO), hydrocarbon (HC), and nitrogen oxide (NOx) into less harmful substances. To allow the TWC to function effectively, it is necessary to keep the air-fuel ratio of the engine near the stoichiometric air-fuel ratio.

*: Value changes inside the ECM. Since the A/F sensor is the current output element, a current is converted to a voltage inside the ECM. Any measurements taken at the A/F sensor or ECM connectors will show a constant voltage.

ES



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DTC No.	DTC Detection Condition	Trouble Area
P2238 P2241	- Case 1: Condition (a) or (b) continues for 5.0 seconds or more (1 trip detection logic): (a) AF+ voltage is 0.5 V or less (b) (AF+) - (AF-) = 0.1 V or less - Case 2: A/F sensor admittance: Less than 0.022 1/Ω (2 trip detection logic)	- Open or short in A/F sensor (bank 1, 2 sensor 1) circuit - A/F sensor (bank 1, 2 sensor 1) - A/F sensor heater - A/F sensor heater relay - A/F sensor heater and relay circuits - ECM
P2239 P2242	AF+ voltage is more than 4.5 V for 5.0 seconds or more (2 trip detection logic)	- Open or short in A/F sensor (bank 1, 2 sensor 1) circuit - A/F sensor (bank 1, 2 sensor 1) - A/F sensor heater - A/F sensor heater relay - A/F sensor heater and relay circuits - ECM
P2252 P2255	AF- voltage is 0.5 V or less for 5.0 seconds or more (2 trip detection logic)	- Open or short in A/F sensor (bank 1, 2 sensor 1) circuit - A/F sensor (bank 1, 2 sensor 1) - A/F sensor heater - A/F sensor heater relay - A/F sensor heater and relay circuits - ECM
P2253 P2256	AF- voltage is more than 4.5 V for 5.0 seconds or more (2 trip detection logic)	- Open or short in A/F sensor (bank 1, 2 sensor 1) circuit - A/F sensor (bank 1, 2 sensor 1) - A/F sensor heater - A/F sensor heater relay - A/F sensor heater and relay circuits - ECM

HINT:

- DTCs P2238, P2239, P2252 and P2253 indicate malfunctions related to the bank 1 A/F sensor circuit.
- DTCs P2241, P2242, P2255 and P2256 indicate malfunctions related to the bank 2 A/F sensor circuit.
- Bank 1 refers to the bank that includes cylinder No. 1.
- Bank 2 refers to the bank that includes cylinder No. 2.

MONITOR DESCRIPTION

The Air-Fuel Ratio (A/F) sensor varies its output voltage in proportion to the air-fuel ratio. If the A/F sensor impedance (alternating current resistance) or output voltage deviates greatly from the standard range, the ECM determines that there is an open or short malfunction in the A/F sensor circuit.

MONITOR STRATEGY

Related DTCs	P2238: A/F sensor (Bank 1) open circuit between AF+ and AF- P2238: A/F sensor (Bank 1) short circuit between AF+ and AF- P2238: A/F sensor (Bank 1) short circuit between AF+ and GND P2239: A/F sensor (Bank 1) short circuit between AF+ and +B P2241: A/F sensor (Bank 2) open circuit between AF+ and AF- P2241: A/F sensor (Bank 2) short circuit between AF+ and AF- P2241: A/F sensor (Bank 2) short circuit between AF+ and GND P2242: A/F sensor (Bank 2) short circuit between AF+ and +B P2252: A/F sensor (Bank 1) short circuit between AF- and GND P2253: A/F sensor (Bank 1) short circuit between AF- and +B P2255: A/F sensor (Bank 2) short circuit between AF- and GND P2256: A/F sensor (Bank 2) short circuit between AF- and +B
Required Sensors/Components (Main)	A/F sensor
Required Sensors/Components (Sub)	Engine Coolant Temperature (ECT) sensor, Crankshaft position sensor
Frequency of Operation	Once per driving cycle
Duration	10 seconds
MIL Operation	2 driving cycles
Sequence of Operation	None

ES

TYPICAL ENABLING CONDITIONS

Monitor runs whenever following DTCs are not present	P0031, P0032, P0051, P0052 (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 - P0308 (Misfire) P0335 (CKP sensor) P0500 (VSS)
--	--

P2238 and P2241 (open circuit between AF+ and AF-):

AF+ terminal voltage	0.5 to 4.5 V
AF- terminal voltage	0.5 to 4.5 V
Difference between AF+ and AF- terminal voltages	0.1 to 0.8 V
ECT	5°C (41°F) or more (Varies with ECT at engine start)
Engine condition	Running
Fuel-cut	OFF
Time after engine start	10 seconds or more
A/F sensor heater duty-cycle	ON
Time after A/F sensor heating	5 seconds or more
Battery voltage	11 V or more
Engine switch	ON

Others:

Battery voltage	10.5 V or more
Engine switch	ON

TYPICAL MALFUNCTION THRESHOLDS

P2238 and P2241 (Open circuit between AF+ and AF-):

A/F sensor admittance	Below 0.022 1/Ω
-----------------------	-----------------

P2238 and P2241 (Short circuit between AF+ and GND):

AF+ terminal voltage	0.5 V or less
----------------------	---------------

P2238 and P2241 (Short circuit between AF+ and AF-):

Difference between AF+ and AF- terminal voltages	0.1 v or less
--	---------------

P2239 and P2242 (Short circuit between AF+ and +B):

AF+ terminal voltage	More than 4.5 V
----------------------	-----------------

P2252 and P2255 (Short circuit between AF- and GND):

AF- terminal voltage	0.5 V or less
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P2253 and P2256 (Short circuit between AF- and +B):

AF- terminal voltage	More than 4.5 V
----------------------	-----------------

WIRING DIAGRAM

Refer to DTC P2195 (See page [ES-353](#)).

INSPECTION PROCEDURE

HINT:

Intelligent tester only:

Malfunctioning areas can be identified by performing the A/F CONTROL function provided in the ACTIVE TEST. The A/F CONTROL function can help to determine whether the Air-Fuel Ratio (A/F) sensor, Heated Oxygen (HO2) sensor and other potential trouble areas are malfunctioning.

The following instructions describe how to conduct the A/F CONTROL operation using the intelligent tester.

1. Connect the intelligent tester to the DLC3.
2. Start the engine and turn the tester on.
3. Warm up the engine at an engine speed of 2,500 rpm for approximately 90 seconds.
4. On the tester, enter the following menus: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / A/F CONTROL.
5. Perform the A/F CONTROL operation with the engine in an idling condition (press the RIGHT or LEFT button to change the fuel injection volume).
6. Monitor the output voltages of the A/F and HO2 sensors (AFS B1 S1 and O2S B1 S2 or AFS B2 S1 and O2S B2 S2) displayed on the tester.

HINT:

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

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

NOTICE:

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

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

- Following the A/F CONTROL procedure enables technicians to check and graph the output voltages of both the A/F and HO2 sensors.
- To display the graph, enter the following menus: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / A/F CONTROL / USER DATA / AFS B1 S1 and O2S B1 S2 or AFS B2 S1 and O2S B2 S2, and press the YES button and then the ENTER button followed by the F4 button.

HINT:

- Read freeze frame data using the intelligent tester. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can be helpful in determining whether the vehicle was running or stopped, whether the engine was warmed up or not, whether the air-fuel ratio was lean or rich, as well as other data recorded at the time of a malfunction (See page [ES-41](#)).

ES

1INSPECT AIR FUEL RATIO SENSOR (HEATER RESISTANCE)

Component Side:

Air Fuel Ratio Sensor

Diagram of Air Fuel Ratio Sensor (Bank 1) showing terminals 1 (HT), 2 (+B), 3 (AF+), and 4 (AF-). A circled B3 indicates Bank 1.

Diagram of Air Fuel Ratio Sensor (Bank 2) showing terminals 1 (HT), 2 (+B), 3 (AF+), and 4 (AF-). A circled B4 indicates Bank 2.

A140627E03

- (a) Disconnect the B3 or B4 A/F sensor connector.
- (b) Measure the resistance according to the value(s) in the table below.

Standard resistance (Bank 1 sensor 1)

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

Standard resistance (Bank 2 sensor 1)

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

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

NG

REPLACE AIR FUEL RATIO SENSOR (See page EC-19)

OK

2INSPECT A/F FUSE

Engine Room Relay Block

Diagram of Engine Room Relay Block showing the location of the A/F fuse.

A135031E01

- (a) Remove the A/F fuse from the engine room junction block.
- (b) Measure the A/F fuse resistance.
- Standard resistance:
Below 1 Ω
- (c) Reinstall the A/F fuse.

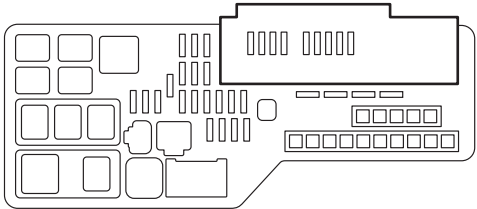
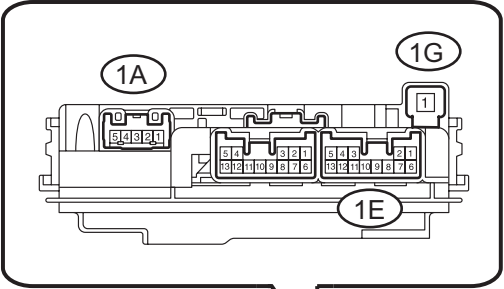
NG

REPLACE A/F FUSE

OK

3 INSPECT ENGINE ROOM JUNCTION BLOCK (A/F RELAY)

Engine Room Junction Block



Engine Room Relay Block

A140654E01

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

Standard resistance

Tester Connection	Specified Condition
1G-1 - 1A-4	10 kΩ or higher
1G-1 - 1A-4	Below 1 Ω (Apply battery voltage between terminals 1E-6 and 1E-10)

- (c) Reinstall the engine room junction block.

NG

REPLACE ENGINE ROOM JUNCTION BLOCK

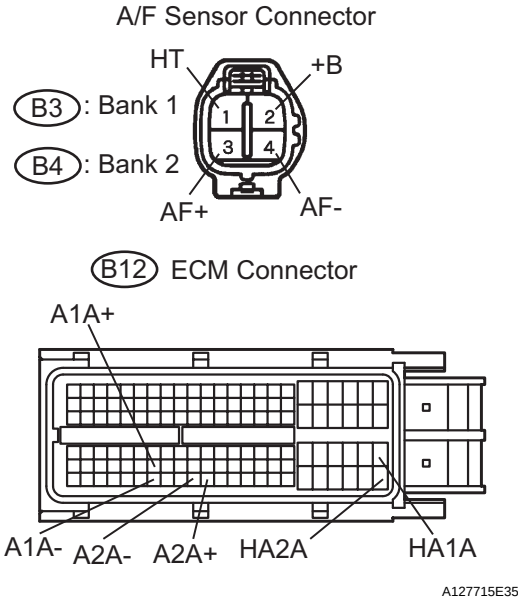
OK

ES

4

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

Wire Harness Side:



- Disconnect the B3 and B4 A/F sensor connectors.
- Turn the engine switch on (IG).
- Measure the voltage according to the value(s) in the table below.

Standard voltage

Tester Connection	Specified Condition
+B (B3-2) - Body ground	9 to 14 V
+B (B4-2) - Body ground	9 to 14 V

- Turn the engine switch off.
- Disconnect the B12 ECM connector.
- Measure the resistance according to the value(s) in the table below.

Standard resistance (Check for open)

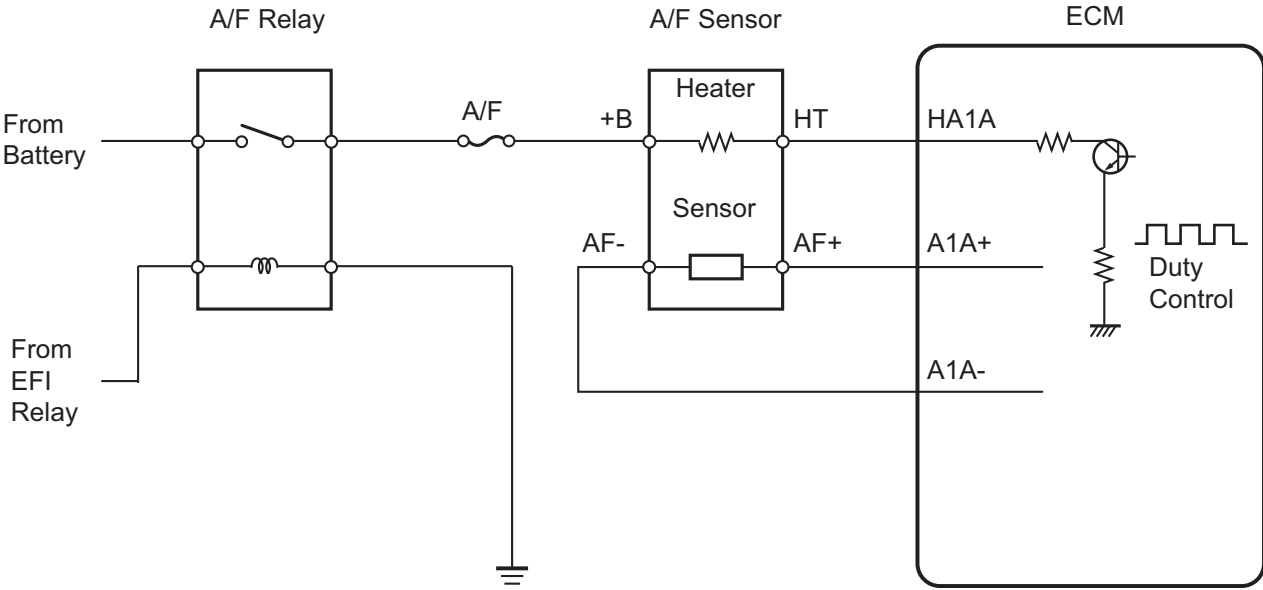
Tester Connection	Specified Condition
HT (B3-1) - HA1A (B12-86)	Below 1 Ω
AF+ (B3-3) - A1A+ (B12-93)	Below 1 Ω
AF- (B3-4) - A1A- (B12-116)	Below 1 Ω
HT (B4-1) - HA2A (B12-109)	Below 1 Ω
AF+ (B4-3) - A2A+ (B12-120)	Below 1 Ω
AF- (B4-4) - A2A- (B12-119)	Below 1 Ω

Standard resistance (Check for short)

Tester Connection	Specified Condition
HT (B3-1) or HA1A (B12-86) - Body ground	10 k Ω or higher
AF+ (B3-3) or A1A+ (B12-93) - Body ground	10 k Ω or higher
AF- (B3-4) or A1A- (B12-116) - Body ground	10 k Ω or higher
HT (B4-1) or HA2A (B12-109) - Body ground	10 k Ω or higher
AF+ (B4-3) or A2A+ (B12-120) - Body ground	10 k Ω or higher
AF- (B4-4) or A2A- (B12-119) - Body ground	10 k Ω or higher

- Reconnect the ECM connector.
- Reconnect the A/F sensor connectors.

Reference (System Diagram of Bank 1 Sensor 1):



A133850E11

NG

REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

REPLACE ECM (See page [ES-543](#))

ES

DTC	P2195	Oxygen (A/F) Sensor Signal Stuck Lean (Bank 1 Sensor 1)
DTC	P2196	Oxygen (A/F) Sensor Signal Stuck Rich (Bank 1 Sensor 1)
DTC	P2197	Oxygen (A/F) Sensor Signal Stuck Lean (Bank 2 Sensor 1)
DTC	P2198	Oxygen (A/F) Sensor Signal Stuck Rich (Bank 2 Sensor 1)

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

- Although the DTC titles include oxygen sensor, these DTCs relate to the Air-Fuel Ratio (A/F) sensor.
- Sensor 1 refers to the sensor mounted in front of the Three-Way Catalytic Converter (TWC) and located near the engine assembly.

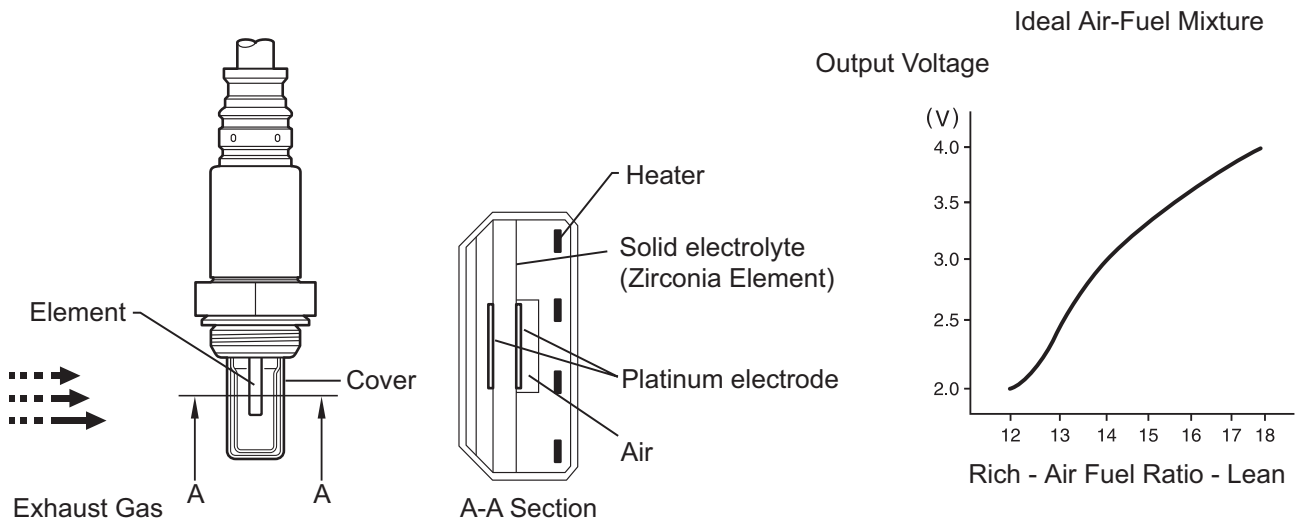
The A/F sensor generates voltage* that corresponds to the actual air-fuel ratio. This sensor voltage is used to provide the ECM with feedback so that it can control the air-fuel ratio. The ECM determines the deviation from the stoichiometric air-fuel ratio level, and regulates the fuel injection time. If the A/F sensor malfunctions, the ECM is unable to control the air-fuel ratio accurately.

The A/F sensor is the planar type and is integrated with the heater, which heats the solid electrolyte (zirconia element). This heater is controlled by the ECM. When the intake air volume is low (the exhaust gas temperature is low), a current flows into the heater to heat the sensor, in order to facilitate accurate oxygen concentration detection. In addition, the sensor and heater portions are narrower than the conventional type. The heat generated by the heater is conducted to the solid electrolyte through the alumina, therefore the sensor activation is accelerated.

A three-way catalytic converter (TWC) is used in order to convert the carbon monoxide (CO), hydrocarbon (HC), and nitrogen oxide (NOx) into less harmful substances. To allow the TWC to function effectively, it is necessary to keep the air-fuel ratio of the engine near the stoichiometric air-fuel ratio.

*: Value changes inside the ECM. Since the A/F sensor is the current output element, a current is converted to a voltage inside the ECM. Any measurements taken at the A/F sensor or ECM connectors will show a constant voltage.

ES



A107164E14

DTC No.	DTC Detection Condition	Trouble Area
P2195 P2197	Conditions (a) and (b) continue for 2 seconds or more (2 trip detection logic): (a) Air-Fuel Ratio (A/F) sensor voltage is more than 3.8 V (b) Heated Oxygen (HO2) sensor voltage is 0.15 V or more	- Open or short in A/F sensor (bank 1, 2 sensor 1) circuit - A/F sensor (bank 1, 2 sensor 1) - A/F sensor (bank 1, 2 sensor 1) heater - A/F sensor heater relay - A/F sensor heater and relay circuits - Air induction system - Injector - ECM
P2195 P2197	While fuel-cut operation is performed (during vehicle deceleration), air-fuel ratio (A/F) sensor current is 3.6 mA or more for 3 seconds (2 trip detection logic)	- A/F sensor - ECM
P2196 P2198	Conditions (a) and (b) continue for 2 seconds or more (2 trip detection logic): (a) A/F sensor voltage is less than 2.8 V (b) HO2 sensor voltage is less than 0.85 V	- Open or short in A/F sensor (bank 1, 2 sensor 1) circuit - A/F sensor (bank 1, 2 sensor 1) - A/F sensor (bank 1, 2 sensor 1) heater - A/F sensor heater relay - A/F sensor heater and relay circuits - Air induction system - Injector - ECM
P2196 P2198	While fuel-cut operation is performed (during vehicle deceleration), air-fuel ratio (A/F) sensor current is 1.4 mA for 3 seconds (2 trip detection logic)	- A/F sensor - ECM

HINT:

- DTCs P2195 and P2196 indicate malfunctions related to the bank 1 A/F sensor circuit.
- DTCs P2197 and P2198 indicate malfunctions related to the bank 2 A/F sensor circuit.
- Bank 1 refers to the bank that includes cylinder No. 1.
- Bank 2 refers to the bank that includes cylinder No. 2.
- When any of these DTCs are set, check the A/F sensor output voltage by entering the following menus on the intelligent tester: DIAGNOSIS / ENHANCED OBD II / DATA LIST / PRIMARY / AFS B1S1.
- Short-term fuel trim values can also be read using an intelligent tester.
- The ECM regulates the voltages at the A1A+, A2A+, A1A- and A2A- terminals of the ECM to a constant level. Therefore, the A/F sensor output voltage cannot be confirmed without using the intelligent tester.

- If an A/F sensor malfunction is detected, the ECM sets a DTC.

MONITOR DESCRIPTION

Sensor voltage detection monitor

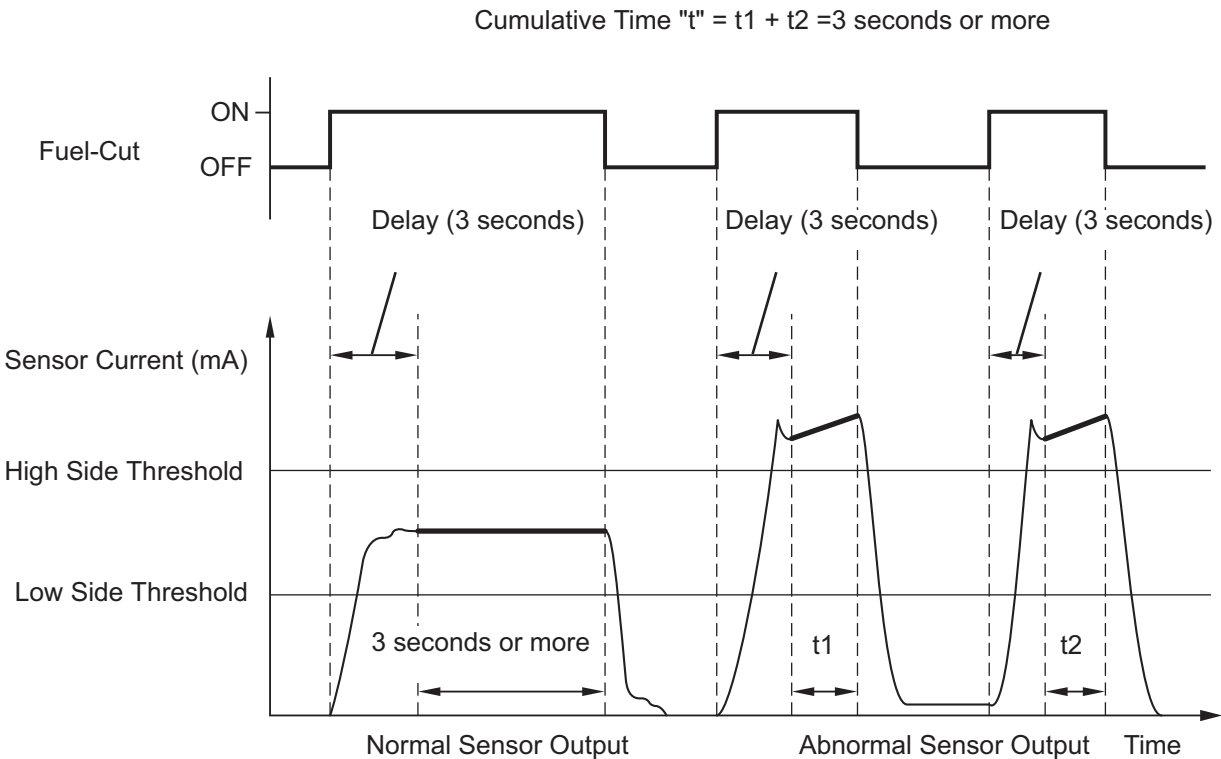
Under the air-fuel ratio feedback control, if the A/F sensor output voltage indicates rich or lean for a certain period of time, the ECM determines that there is a malfunction in the A/F sensor. The ECM illuminates the MIL and sets a DTC.

Example:

- (1) If the A/F sensor voltage output is less than 2.8 V (very rich condition) for 10 seconds, despite the HO2 sensor output voltage being less than 0.6 V, the ECM sets DTC P2196. Alternatively, if the A/F sensor output voltage is more than 3.8 V (very lean condition) for 15 seconds, despite the HO2 sensor output voltage being 0.15 V or more, DTC P2195 is set.
- (2) Sensor current detection monitor
- (3) A rich air-fuel mixture causes a low A/F sensor current, and a lean air-fuel mixture causes a high A/F sensor current. Therefore, the sensor output becomes low during acceleration, and it becomes high during deceleration with the throttle valve fully closed. The ECM monitors the A/F sensor current during fuel-cut and detects any abnormal current values.
- (4) If the A/F sensor output is 3.6 mA or more for more than 3 seconds of cumulative time, the ECM interprets this as a malfunction in the A/F sensor and sets DTC P2195 (high-side stuck). If the A/F sensor output is 1.0 mA or less for more than 3 seconds of cumulative time, the ECM sets DTC P2196 (low-side stuck).

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Air Fuel Ratio Sensor Current Monitor



N

A107165E05

MONITOR STRATEGY

Related DTCs	P2195: A/F sensor (Bank 1) signal stuck lean P2196: A/F sensor (Bank 1) signal stuck rich P2197: A/F sensor (Bank 2) signal stuck lean P2198: A/F sensor (Bank 2) signal stuck rich
--------------	--

Required Sensors/Components (Main)	A/F sensor
Required Sensors/Components (Related)	HO2 sensor
Frequency of Operation	Continuous
Duration	10 seconds
MIL Operation	2 driving cycles
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

Sensor voltage detection monitor (Lean side malfunction P2195, P2197):

The monitor will run whenever these DTCs are not present	P0031, P0032, P0051, P0052 (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) P0136, P0156 (HO2 Sensor - Sensor 2) P0171, P0172 (Fuel system) P0300 - P0308 (Misfire) P0335 (CKP sensor) P0340, P0341 (CMP sensor) P0500 (VSS)
Time while all of following conditions are 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, P2198):

The monitor will run whenever these DTCs are not present	P0031, P0032, P0051, P0052 (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) P0136, P0156 (HO2 Sensor - Sensor 2) P0171, P0172 (Fuel system) P0300 - P0308 (Misfire) P0335 (CKP sensor) P0340, P0341 (CMP sensor) P0500 (VSS)
Time while all of following conditions are met:	2 seconds or more
Rear HO2 sensor voltage	Less than 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 (High and low side malfunction P2195, P2196, P2197 and P2198):

Monitor runs whenever following DTCs are not present	P0031, P0032, P0051, P0052 (A/F sensor heater - Sensor 1) P0037, P0038, P0057, P0058 (HO2 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, P0156 (O2 Sensor - Sensor 2) P0171, P0172 (Fuel system) P0300 - P0308 (Misfire) P0335 (CKP sensor) P0340, P0341 (CMP sensor) P0500 (VSS)
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

ES

TYPICAL MALFUNCTION THRESHOLDS**Sensor voltage detection monitor (Lean side malfunction P2195, P2197):**

A/F sensor voltage	More than 3.8 V
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Sensor voltage detection monitor (Rich side malfunction P2196, P2198):

A/F sensor voltage	Less than 2.8 V
--------------------	-----------------

Sensor current detection monitor (High side malfunction P2195, P2197):

A/F sensor current	3.6 mA or more
--------------------	----------------

Sensor current detection monitor (Low side malfunction P2196, P2198):

A/F sensor current	Less than 1.4 mA
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MONITOR RESULT

Refer to CHECKING MONITOR STATUS (See page [ES-45](#)).

ES

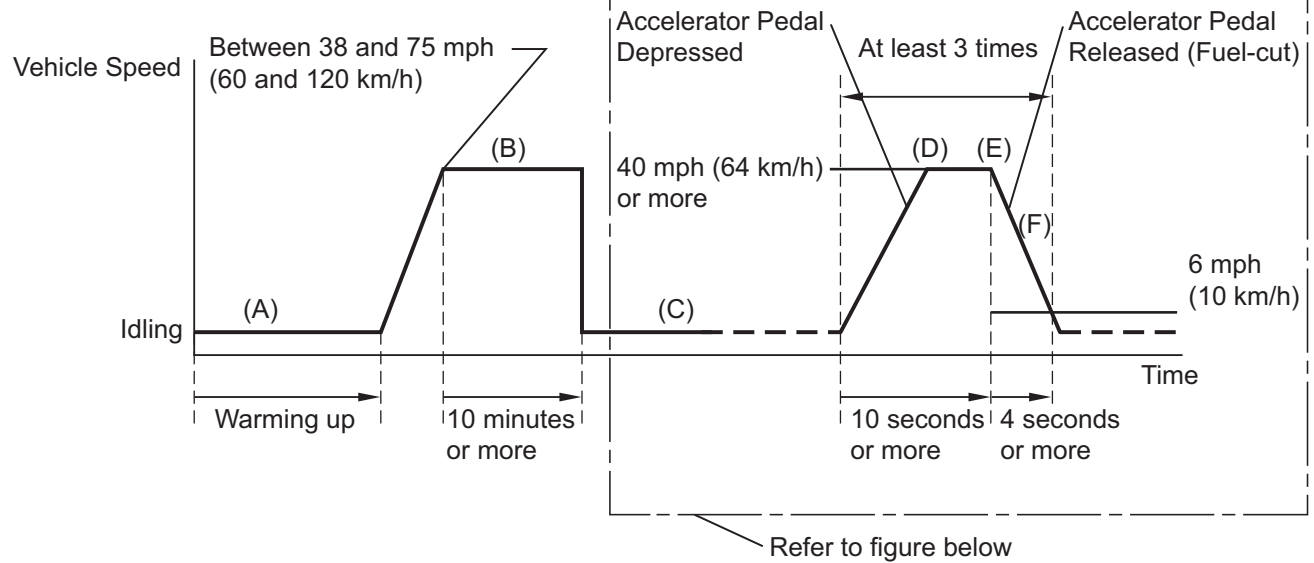


CONFIRMATION DRIVING PATTERN

This confirmation driving pattern is used in steps 2, 4, 7, 17 and 21 of the following diagnostic troubleshooting procedure when using an intelligent tester.

Monitor Driving Pattern

ECT: 75°C (167°F) or more



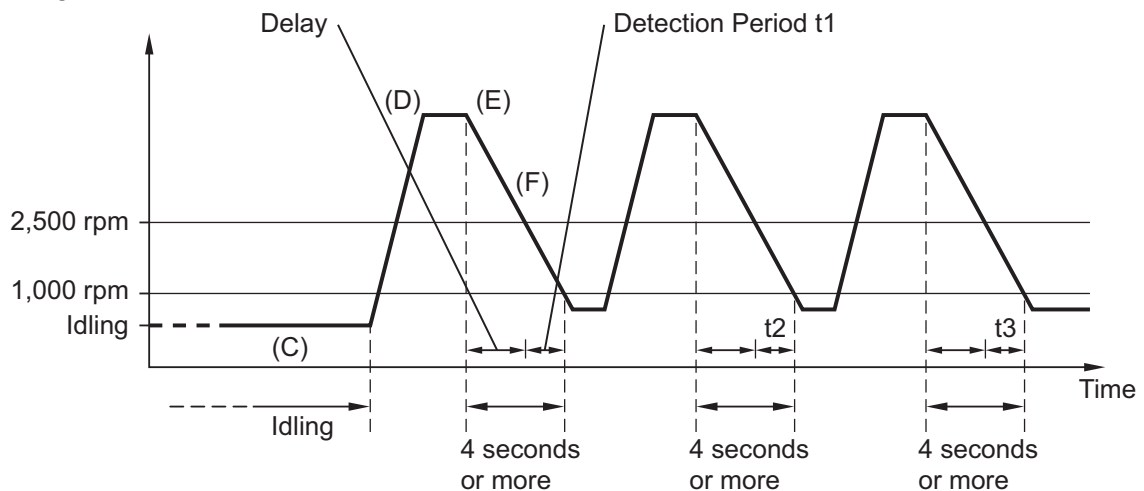
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A107162E21

Driving Pattern Detail for (C) through (F)

Cumulative Detection Period "t" = $t_1 + t_2 + t_3 = 3$ seconds or more

Reference Engine RPM



N

A107163E08

1. Connect an intelligent tester to the DLC3.
2. Turn the engine switch on (IG).
3. Turn the tester on.
4. Clear the DTCs.
5. Start the engine, and warm it up until the ECT reaches 75°C (167°F) or higher (Procedure "A").
6. On the intelligent tester, enter the following menus to check the fuel-cut status: DIAGNOSIS / ENHANCED OBD II / DATA LIST / USER DATA / FC IDLE.
7. Drive the vehicle at between 38 mph (60 km/h) and 75 mph (120 km/h) for at least 10 minutes (Procedure "B").
8. Change the transmission to the 2nd gear (Procedure "C").

9. Drive the vehicle at a proper vehicle speed to perform fuel-cut operation (refer to the following HINT) (Procedure "D").
HINT:
Fuel-cut is performed when the following conditions are met:
 - Accelerator pedal is fully released.
 - Engine speed is 2,500 rpm or more (fuel injection resumes at 1,000 rpm).
10. Accelerate the vehicle to 40 rpm (64 km/h) or more by depressing the accelerator pedal for at least 10 seconds (Procedure "E").
11. Soon after performing procedure E above, release the accelerator pedal for at least 4 seconds without depressing the brake pedal, in order to execute fuel-cut control (Procedure "F").
12. Allow the vehicle to decelerate until the vehicle speed declines to less than 6 mph (10 km/h).
13. Repeat procedure from C through F above at least 3 times in one driving cycle.

HINT:

Completion of all A/F sensor monitors is required to change the value in TEST RESULT.

CAUTION:

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

INSPECTION PROCEDURE

HINT:

Malfunctioning areas can be identified by performing the A/F CONTROL function provided in the ACTIVE TEST. The A/F CONTROL function can help to determine whether the Air-fuel Ratio (A/F) sensor, Heated Oxygen (HO2) sensor and other potential trouble areas are malfunctioning.

The following instructions describe how to conduct the A/F CONTROL operation using the intelligent tester.

1. Connect the intelligent tester to the DLC3.
2. Start the engine and turn the tester on.
3. Warm up the engine at an engine speed of 2,500 rpm for approximately 90 seconds.
4. On the intelligent tester, enter the following menus: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / A/F CONTROL.
5. Perform the A/F CONTROL operation with the engine in an idling condition (press the RIGHT or LEFT button to change the fuel injection volume).
6. Monitor the output voltages of the A/F and HO2 sensors (AFS B1 S1 and O2S B1 S2 or AFS B2 S1 and O2S B2 S2) displayed on the tester.

HINT:

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

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

NOTICE:

The Air-Fuel Ratio (A/F) sensor has an output delay of a few seconds and the HO2S (sensor 2) output has a maximum output delay of 20 seconds.

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

- Following the A/F CONTROL procedure enables technicians to check and graph the voltage outputs of both the A/F and HO2 sensors.
- To display the graph, enter the following menus on the tester: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / A/F CONTROL / USER DATA / AFS B1 S1 and O2S B 1S2 or AFS B2 S1 and O2S B2 S2 and press the YES button and then the ENTER button followed by the F4 button.

HINT:

- Read freeze frame data using the intelligent tester. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can be helpful in determining whether the vehicle was running or stopped, whether the engine was warmed up or not, whether the air-fuel ratio was lean or rich, as well as other data recorded at the time of a malfunction (See page [ES-41](#)).
- A low A/F sensor voltage could be caused by a rich air-fuel mixture. Check for conditions that would cause the engine to run rich.
- A high A/F sensor voltage could be caused by a lean air-fuel mixture. Check for conditions that would cause the engine to run lean.

1**CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO P2195, P2196, 2197 OR P2198)**

- Connect the intelligent tester to the DLC3.
- Turn the engine switch on (IG).
- Turn the tester on.
- Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DTC INFO / CURRENT CODES.
- Read the DTCs.

Result

Display (DTC Output)	Proceed to
P2195, P2196, P2197, or P2198	A
P2195, P2196, P2197, or P2198 and other DTCs	B

HINT:

If any DTCs other than P2195, P2196, P2197 or P2198 are output, troubleshoot those DTCs first.

B

GO TO DTC CHART (See page ES-59)

A

ES

2

READ VALUE OF INTELLIGENT TESTER (TEST VALUE OF A/F SENSOR)

- Connect the intelligent tester to the DLC3.
- Turn the engine switch on (IG) and turn the tester on.
- Clear the DTCs.
- Allow the vehicle to drive in accordance with the driving pattern described in the CONFIRMATION DRIVING PATTERN.
- Enter the following menus: DIAGNOSIS / ENHANCED OBD II / MONITOR INFO / MONITOR STATUS.
- Check the status of O2S MON is COMPL.
If the status is still INCMPL, drive the vehicle according to the driving pattern again.

HINT:

- AVAIL indicates that the component has not been monitored yet.
- COMPL indicates that the component is functioning normally.
- INCMPL indicates that the component is malfunctioning.

- Enter the following menus: DIAGNOSIS / ENHANCED OBD II / MONITOR INFO / TEST RESULT / RANGE B1 S1, then press the ENTER button.
- Check the test value of the A/F sensor output current during fuel-cut.

Result

Test Value	Proceed to
Within normal range (1.4 mA or more, and less than 3.6 mA)	A
Outside normal range (Less than 1.4 mA, or 3.6 mA or more)	B

B

Go to step 20

A

3

READ VALUE OF INTELLIGENT TESTER (OUTPUT VOLTAGE OF A/F SENSOR)

- Connect the intelligent tester to the DLC3.
- Start the engine.
- Turn the tester on.

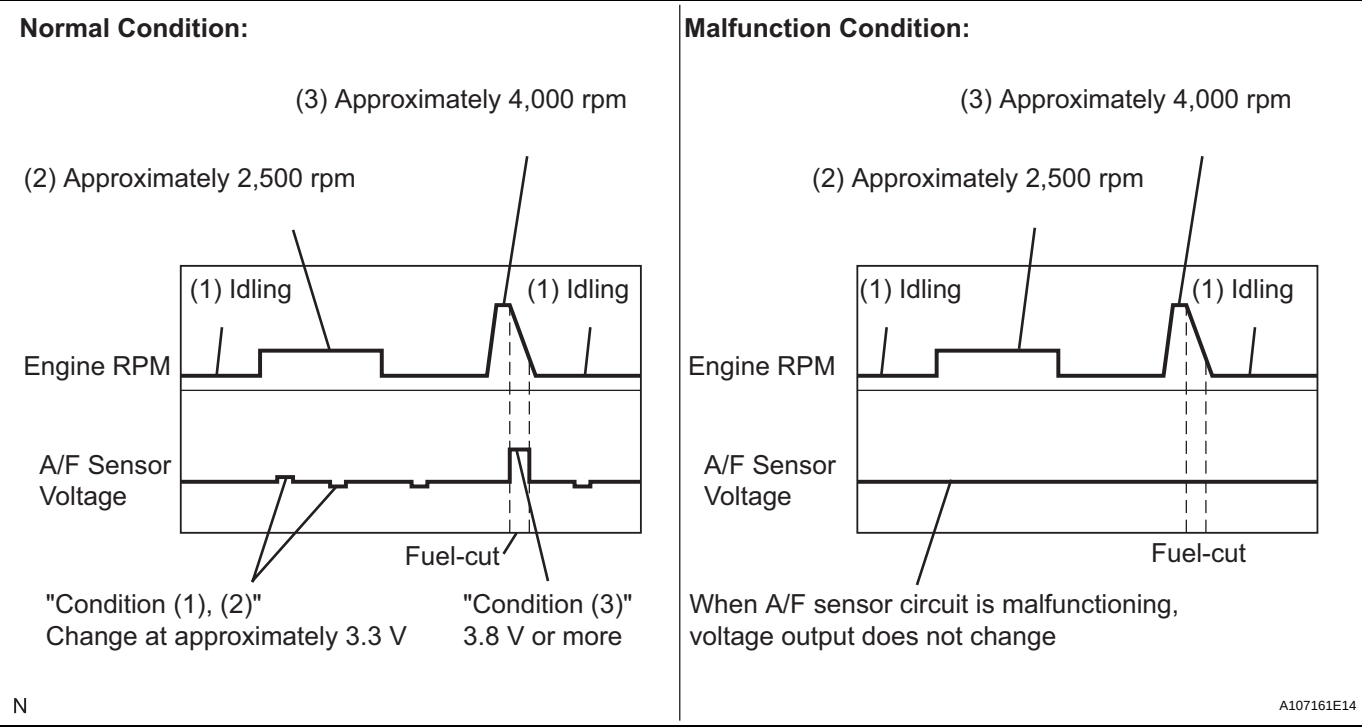
- (d) Warm up the Air-Fuel Ratio (A/F) sensor at an engine speed of 2,500 rpm for 90 seconds.
- (e) On the tester, enter the following menus: DIAGNOSIS / ENHANCED OBD II / SNAPSHOT / MANUAL SNAPSHOT / USER DATA / AFS B1 S1 or AFS B2 S1 and ENGINE SPD.
- (f) Check the A/F sensor voltage three times, when the engine is in each of the following conditions:
 - (1) While idling (check for at least 30 seconds)
 - (2) At an engine speed of approximately 2,500 rpm (without any sudden changes in engine speed)
 - (3) Raise the engine speed to 4,000 rpm and then quickly release the accelerator pedal so that the throttle valve is fully closed.

ES

Standard voltage

Condition	A/F Sensor Voltage Variation	Reference
(1) and (2)	Changes at approximately 3.3 V	Between 3.1 V and 3.5 V
(3)	Increases to 3.8 V or more	This occurs during engine deceleration (when fuel-cut performed)

- HINT:
- For more information, see the diagrams below.



- If the output voltage of the A/F sensor remains at approximately 3.3 V (see the Malfunction Condition diagram) under any conditions, including those above, the A/F sensor may have an open circuit. (This will also happen if the A/F sensor heater has an open circuit.)
- If the output voltage of the A/F sensor remains at either approximately 3.8 V or more, or 2.8 V or less (see the Malfunction Condition diagram) under any conditions, including those above, the A/F sensor may have a short circuit.

ES

- The ECM stops fuel injection (fuel cut) during engine deceleration. This causes a lean condition and results in a momentary increase in the A/F sensor output voltage.
- The ECM must establish a closed throttle valve position learning value to perform fuel cut. If the battery terminal has been reconnected, the vehicle must be driven at over 10 mph (16 km/h) to allow the ECM to learn the closed throttle valve position.
- When the vehicle is driven:
The output voltage of the A/F sensor may be below 2.8 V during fuel enrichment. For the vehicle, this translates to a sudden increase in speed with the accelerator pedal fully depressed when trying to overtake another vehicle. The A/F sensor is functioning normally.
- The A/F sensor is a current output element; therefore, the current is converted into a voltage inside the ECM. Measuring the voltage at the connectors of the A/F sensor or ECM will show a constant voltage result.

NG

Go to step 10

OK

4 PERFORM CONFIRMATION DRIVING PATTERN

NEXT

5 CHECK WHETHER DTC OUTPUT RECURS (DTC P2195, P2196, P2197 OR P2198)

- Read the DTCs using the intelligent tester.
- Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DTC INFO / CURRENT CODES.

Result

Display (DTC Output)	Proceed to
P2195, P2196, P2197, or P2198	A
No output	B

B

Go to step 9

A

6 REPLACE AIR FUEL RATIO SENSOR

- Replace the air fuel ratio sensor (See page [EC-19](#)).

NEXT

7 PERFORM CONFIRMATION DRIVING PATTERN

NEXT

8 CHECK WHETHER DTC OUTPUT RECURS (DTC P2195, P2196, P2197 OR P2198)

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

Result

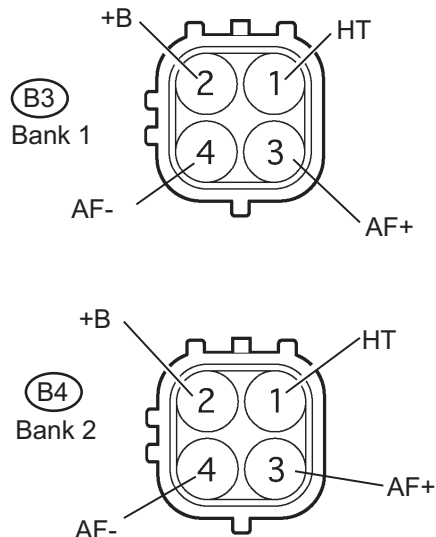
Display (DTC Output)	Proceed to
No output	A
P2195, P2196, P2197, or P2198	B

B**REPLACE ECM (See page ES-543)****ES****A****9 CONFIRM IF VEHICLE HAS RUN OUT OF FUEL IN PAST**

- (a) Has the vehicle run out of fuel in the past?

NO**CHECK FOR INTERMITTENT PROBLEMS****YES****DTC CAUSED BY RUNNING OUT OF FUEL****10 INSPECT AIR FUEL RATIO SENSOR (HEATER RESISTANCE)****Component Side:**

Air Fuel Ratio Sensor



A140627E03

- (a) Disconnect the B3 or B4 A/F sensor connector.
- (b) Measure the resistance according to the value(s) in the table below.

Standard resistance (Bank 1 sensor 1)

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

Standard resistance (Bank 2 sensor 1)

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

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

NG**REPLACE AIR FUEL RATIO SENSOR (See page EC-19)****OK**

11INSPECT FUSE (A/F FUSE)

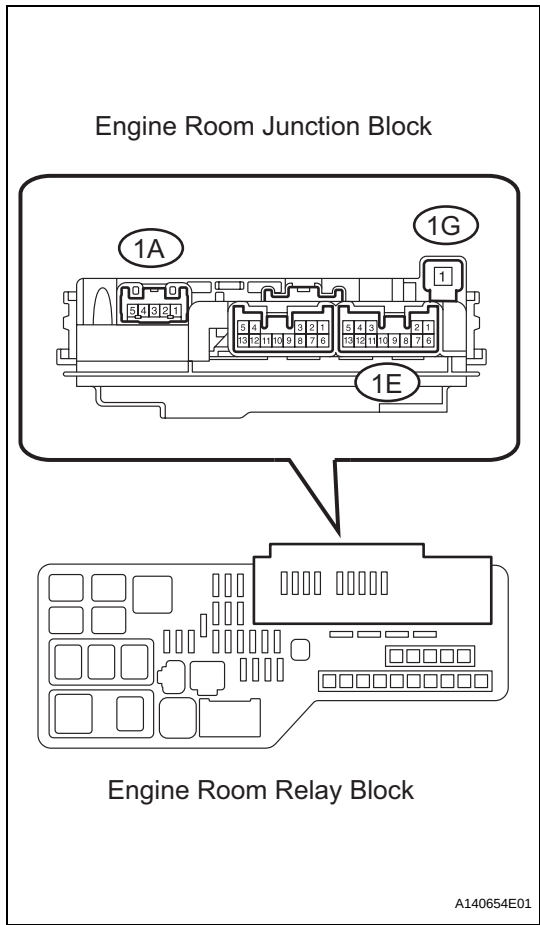
- (a) Remove the A/F fuse from the integration relay.
- (b) Measure the A/F fuse resistance.
- Standard resistance:
- Below 1 Ω
- (c) Reinstall the A/F fuse.

NGREPLACE A/F FUSE

OK

ES

12INSPECT ENGINE ROOM JUNCTION BLOCK (A/F RELAY)



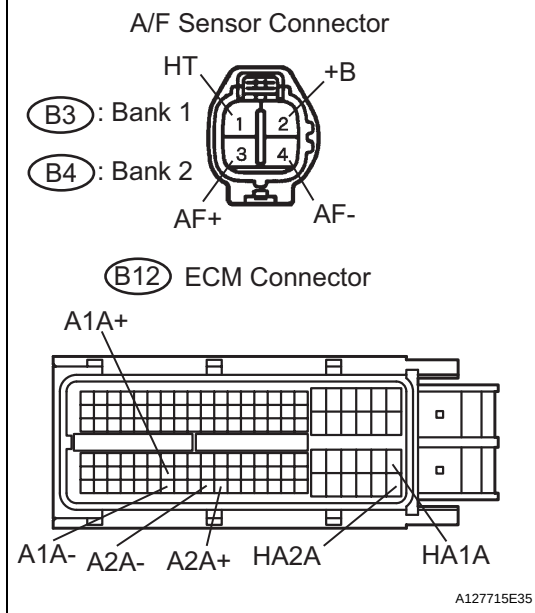
- (a) Remove the engine room junction block from the engine room R/B.
- (b) Inspect the A/F relay.
- (1) Measure the A/F relay resistance.
- Standard resistance

Tester Connection	Specified Condition
1G-1 - 1A-4	10 kΩ or higher
1G-1 - 1A-4	Below 1 Ω (Apply battery voltage between terminals 1E-9 and 1E-10)

- (c) Reinstall the engine room junction block.

NGREPLACE ENGINE ROOM JUNCTION BLOCK

OK

13**CHECK HARNESS AND CONNECTOR (A/F SENSOR - ECM)****Wire Harness Side:**

- Disconnect the B3 and B4 A/F sensor connectors.
- Turn the engine switch on (IG).
- Measure the voltage according to the value(s) in the table below.

Standard voltage

Tester Connection	Specified Condition
+B (B3-2) - Body ground	9 to 14 V
+B (B4-2) - Body ground	9 to 14 V

- Turn the engine switch off.
- Disconnect the B12 ECM connector.
- Measure the resistance according to the value(s) in the table below.

Standard resistance (Check for open)

Tester Connection	Specified Condition
HT (B3-1) - HA1A (B12-86)	Below 1 Ω
AF+ (B3-3) - A1A+ (B12-93)	Below 1 Ω
AF- (B3-4) - A1A- (B12-116)	Below 1 Ω
HT (B4-1) - HA2A (B12-109)	Below 1 Ω
AF+ (B4-3) - A2A+ (B12-120)	Below 1 Ω
AF- (B4-4) - A2A- (B12-119)	Below 1 Ω

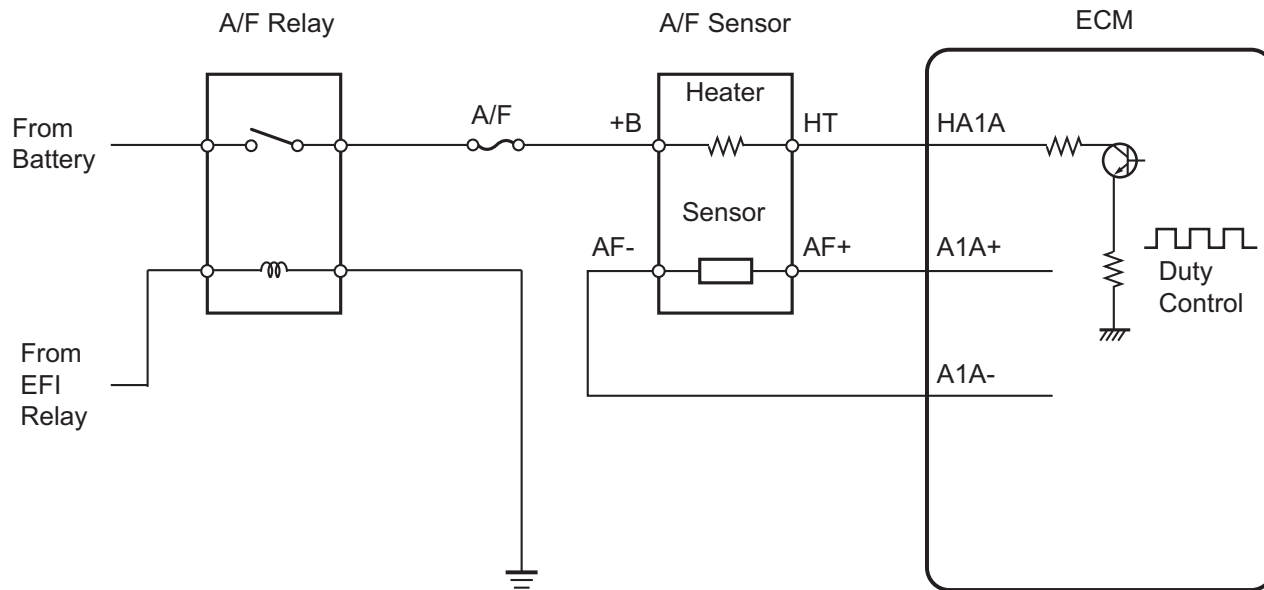
Standard resistance (Check for short)

Tester Connection	Specified Condition
HT (B3-1) or HA1A (B12-86) - Body ground	10 k Ω or higher
AF+ (B3-3) or A1A+ (B12-93) - Body ground	10 k Ω or higher
AF- (B3-4) or A1A- (B12-116) - Body ground	10 k Ω or higher
HT (B4-1) or HA2A (B12-109) - Body ground	10 k Ω or higher
AF+ (B4-3) or A2A+ (B12-120) - Body ground	10 k Ω or higher
AF- (B4-4) or A2A- (B12-119) - Body ground	10 k Ω or higher

- Reconnect the ECM connector.
- Reconnect the A/F sensor connectors.

ES

Reference (System Diagram of Bank 1 Sensor 1):



A133850E11

NG

REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

14 CHECK AIR INDUCTION SYSTEM

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

OK:

No leakage from air induction system.

NG

REPAIR OR REPLACE AIR INDUCTION SYSTEM

OK

15 CHECK FUEL PRESSURE (HIGH PRESSURE SIDE AND LOW PRESSURE SIDE)

- (a) Check the fuel pressure.

NG

REPAIR OR REPLACE FUEL SYSTEM

OK

16 REPLACE AIR FUEL RATIO SENSOR

- (a) Replace the air fuel ratio sensor (See page
- [EC-19](#)
-).

NEXT

17 PERFORM CONFIRMATION DRIVING PATTERN**NEXT****18 CHECK WHETHER DTC OUTPUT RECURS (DTC P2195, P2196, P2197 OR P2198)**

- (a) Read the DTCs using the intelligent tester.
- (b) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DTC INFO / PENDING CODES.

Result

Display (DTC Output)	Proceed to
No output	A
P2195, P2196, P2197 or P2198	B

B**REPAIR OR REPLACE ECM****A****19 CONFIRM IF VEHICLE HAS RUN OUT OF FUEL IN PAST**

- (a) Has the vehicle run out of fuel in the past?

NO**CHECK FOR INTERMITTENT PROBLEMS****YES****DTC CAUSED BY RUNNING OUT OF FUEL****20 REPLACE AIR FUEL RATIO SENSOR**

- (a) Replace the air fuel ratio sensor (See page [EC-19](#)).

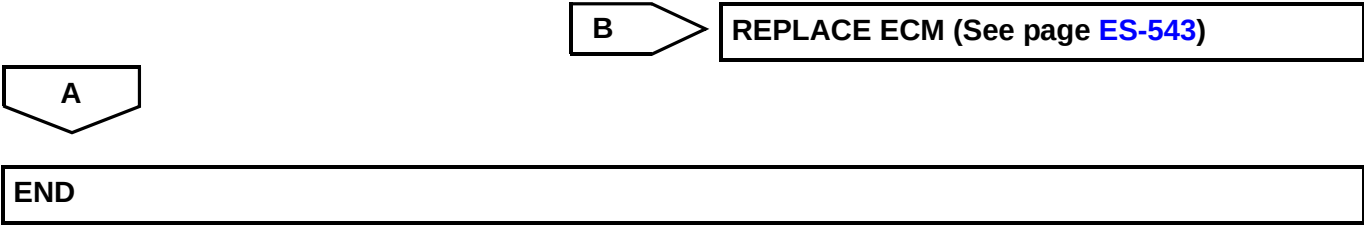
NEXT**21 PERFORM CONFIRMATION DRIVING PATTERN****NEXT****22 CHECK WHETHER DTC OUTPUT RECURS (DTC P2195, P2196, P2197 OR P2198)**

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

ES

Result

Display (DTC Output)	Proceed to
No output	A
P2195, P2196, P2197 or P2198 (A/F sensor pending DTCs)	B



DTC**P2121****Throttle / Pedal Position Sensor / Switch "D"
Circuit Range / Performance****DESCRIPTION**

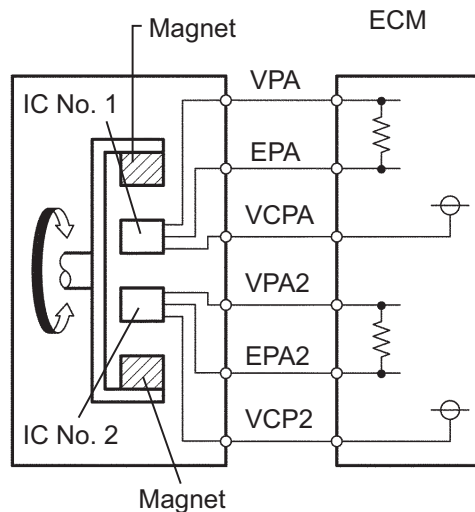
This ETCS (Electronic Throttle Control System) does not use a throttle cable.

The Accelerator Pedal Position (APP) sensor is mounted on the accelerator pedal bracket and has 2 sensor circuits: VPA (main) and VPA2 (sub). This sensor is a non-contact type, and uses Hall-effect elements, in order to yield accurate signals, even in extreme driving conditions, such as at high speeds as well as very low speeds. The voltage, which is applied to terminals VPA and VPA2 of the ECM, varies between 0 V and 5 V in proportion to the operating angle of the accelerator pedal (throttle valve). A signal from VPA indicates the actual accelerator pedal opening angle (throttle valve opening angle) and is used for engine control. A signal from VPA2 conveys the status of the VPA circuit and is used to check the APP sensor itself.

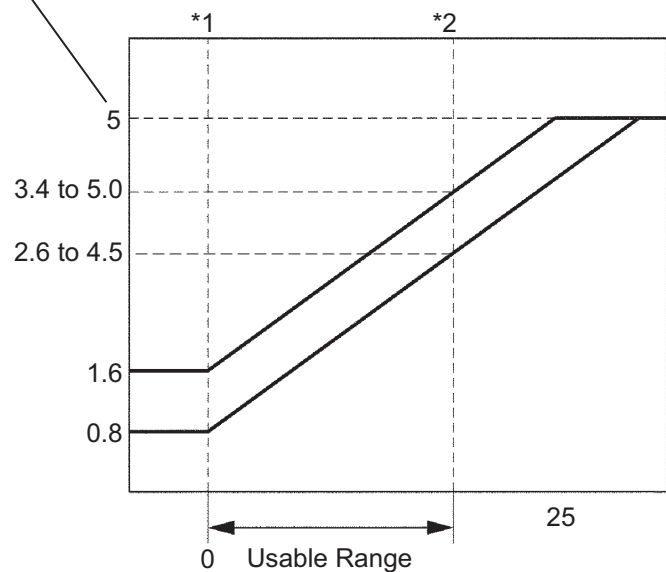
The ECM monitors the actual accelerator pedal opening angle (throttle valve opening angle) through the signals from VPA and VPA2, and controls the throttle actuator according to these signals.

ES

Accelerator Pedal Position Sensor



Accelerator Pedal Position Sensor Output Voltage (V)



Accelerator Pedal Turning Angle (deg)

*1: Accelerator Pedal Fully Released

*2: Accelerator Pedal Fully Depressed

A019803E27

DTC No.	DTC Detection Condition	Trouble Area
P2121	Difference between VPA and VPA2 is less than 0.4 V, or more than 1.2 V for 0.5 seconds (1 trip detection logic)	- Accelerator Pedal Position (APP) sensor - ECM

MONITOR DESCRIPTION

The accelerator pedal position sensor is mounted on the accelerator pedal bracket. The accelerator pedal position sensor has 2 sensor elements and 2 signal outputs: VPA and VPA2. VPA is used to detect the actual accelerator pedal angle (used for engine control) and VPA2 is used to detect malfunctions in VPA. When the difference between the output voltages of VPA and VPA2 deviates from the standard, the ECM determines that the accelerator pedal position sensor is malfunctioning. The ECM turns on the MIL and the DTC is set.

MONITOR STRATEGY

Related DTCs	P2121: Accelerator pedal position (APP) sensor rationality
Required Sensors/Components (Main)	APP sensor
Required Sensors/Components (Sub)	-
Frequency of Operation	Continuous
Duration	0.5 seconds
MIL Operation	Immediate
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

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

TYPICAL MALFUNCTION THRESHOLDS

Difference between VPA1 voltage (learned value) and VPA2 voltage (learned value)	Less than 0.4 V, or more than 1.2 V
--	-------------------------------------

FAIL-SAFE

The accelerator pedal position sensor has two (main and sub) sensor circuits. If a malfunction occurs in either of the sensor circuits, the ECM detects the abnormal signal voltage difference between the two sensor circuits and switches to limp mode. In limp mode, the functioning circuit is used to calculate the accelerator pedal opening angle to allow the vehicle to continue driving. If both circuits malfunction, the ECM regards the opening angle of the accelerator pedal as being fully closed. In this case, the throttle valve remains closed as if the engine is idling.

If a pass condition is detected and then the engine switch is turned off, the fail-safe operation stops and the system returns to a normal condition.

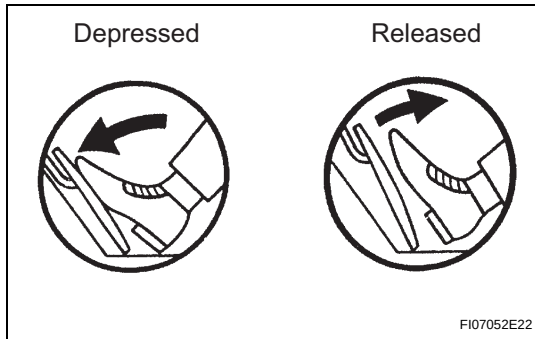
WIRING DIAGRAM

Refer to DTC P2120 (See page [ES-341](#)).

INSPECTION PROCEDURE

HINT:

- Read freeze frame data using the intelligent tester. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can be helpful in determining whether the vehicle was running or stopped, whether the engine was warmed up or not, whether the air-fuel ratio was lean or rich, as well as other data recorded at the time of a malfunction (See page [ES-41](#)).
- This DTC relates to the Accelerator Pedal Position (APP) sensor.

1 READ VALUE OF INTELLIGENT TESTER (ACCEL POS #1 AND ACCEL POS #2)

- Connect the intelligent tester to the DLC3.
- Turn the engine switch on (IG) and turn the tester on.
- Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DATA LIST / ALL / ACCEL POS #1 and ACCEL POS #2.
- Read the values displayed on the tester.

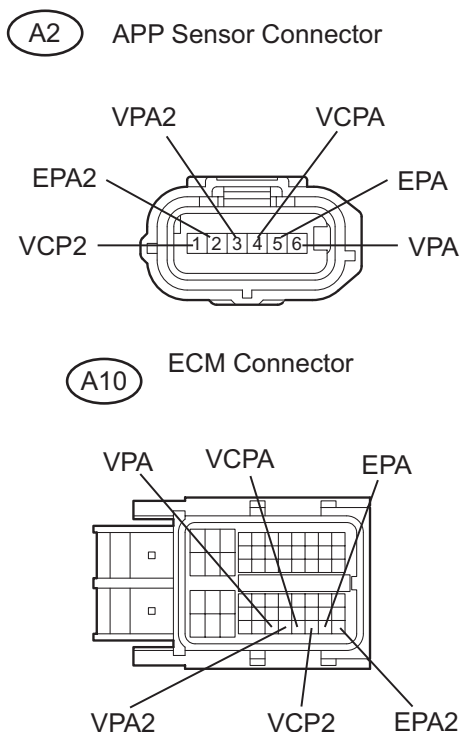
Standard voltage

Accelerator Pedal Condition	ACCEL POS #1 (AP#1)	ACCEL POS #2 (AP#2)
Released	0.5 to 1.1 V	1.2 to 2.0 V
Depressed	2.6 to 4.5 V	3.4 to 5.0 V

OK

Go to step 3

NG

2 CHECK HARNESS AND CONNECTOR (ACCELERATOR PEDAL POSITION SENSOR - ECM)**Wire Harness Side Front View:**

- Disconnect the A2 Accelerator Pedal Position (APP) sensor connector.
- Disconnect the A10 ECM connector.
- Measure the resistance according to the value(s) in the table below.

Standard resistance (Check for open)

Tester Connection	Specified Condition
VPA (A2-6) - VPA (A10-55)	Below 1 Ω
EPA (A2-5) - EPA (A10-59)	Below 1 Ω
VCPA (A2-4) - VCPA (A10-57)	Below 1 Ω
VPA2 (A2-3) - VPA2 (A10-56)	Below 1 Ω
EPA2 (A2-2) - EPA2 (A10-60)	Below 1 Ω
VCP2 (A2-1) - VCP2 (A10-58)	Below 1 Ω

Standard resistance (Check for short)

Tester Connection	Specified Condition
VPA (A2-6) or VPA (A10-55) - body ground	10 k Ω or higher
EPA (A2-5) or EPA (A10-59) - body ground	10 k Ω or higher
VCPA (A2-4) or VCPA (A10-57) - body ground	10 k Ω or higher
VPA2 (A2-3) or VPA2 (A10-56) - body ground	10 k Ω or higher
EPA2 (A2-2) or EPA2 (A10-60) - body ground	10 k Ω or higher
VCP2 (A2-1) or VCP2 (A10-58) - body ground	10 k Ω or higher

- Reconnect the APP sensor connector.
- Reconnect the ECM connector.

NG

REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

3

REPLACE ACCELERATOR PEDAL ROD ASSEMBLY

NEXT

4

CHECK WHETHER DTC OUTPUT RECURS (ACCELERATOR PEDAL POSITION SENSOR DTCS)

- (a) Connect the intelligent tester to the DLC3.
- (b) Turn the engine switch on (IG) and turn the tester on.
- (c) Clear the DTCs (See page [ES-41](#)).
- (d) Start the engine.
- (e) Allow the engine to idle for 15 seconds.
- (f) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DTC INFO / CURRENT CODES.
- (g) Read the DTCs.

Result

Display (DTC Output)	Proceed to
P2121	A
No output	B

B

END

A

REPLACE ECM (See page [ES-543](#))

DTC	P2120	Throttle / Pedal Position Sensor / Switch "D" Circuit
DTC	P2122	Throttle / Pedal Position Sensor / Switch "D" Circuit Low Input
DTC	P2123	Throttle / Pedal Position Sensor / Switch "D" Circuit High Input
DTC	P2125	Throttle / Pedal Position Sensor / Switch "E" Circuit
DTC	P2127	Throttle / Pedal Position Sensor / Switch "E" Circuit Low Input
DTC	P2128	Throttle / Pedal Position Sensor / Switch "E" Circuit High Input
DTC	P2138	Throttle / Pedal Position Sensor / Switch "D" / "E" Voltage Correlation

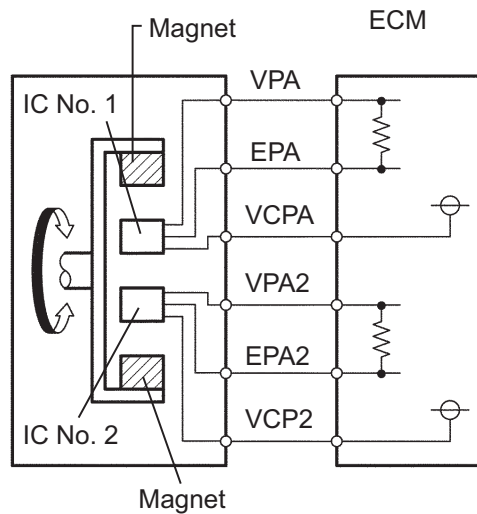
DESCRIPTION

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

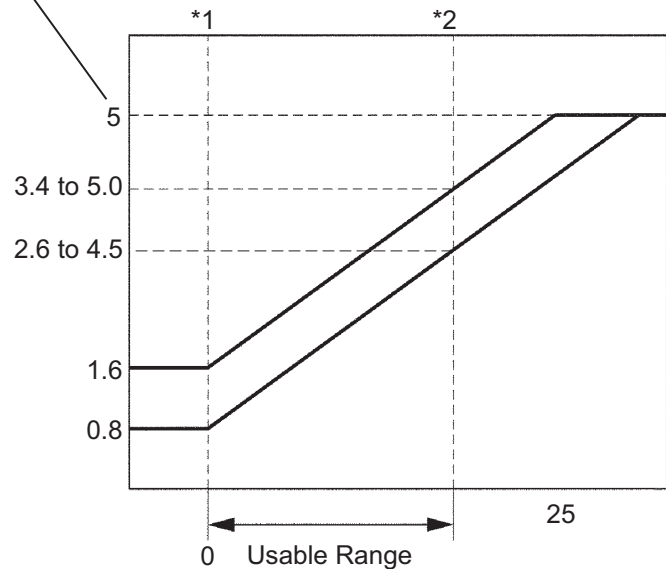
The Accelerator Pedal Position (APP) sensor is mounted on the accelerator pedal bracket and has 2 sensor circuits: VPA (main) and VPA2 (sub). This sensor is a non-contact type, and uses Hall-effect elements, in order to yield accurate signals, even in extreme driving conditions, such as at high speeds as well as very low speeds. The voltage, which is applied to terminals VPA and VPA2 of the ECM, varies between 0 V and 5 V in proportion to the operating angle of the accelerator pedal (throttle valve). A signal from VPA indicates the actual accelerator pedal opening angle (throttle valve opening angle) and is used for engine control. A signal from VPA2 conveys the status of the VPA circuit and is used to check the APP sensor itself.

The ECM monitors the actual accelerator pedal opening angle (throttle valve opening angle) through the signals from VPA and VPA2, and controls the throttle actuator according to these signals.

Accelerator Pedal Position Sensor



Accelerator Pedal Position Sensor Output Voltage (V)



Accelerator Pedal Turning Angle (deg)

*1: Accelerator Pedal Fully Released

*2: Accelerator Pedal Fully Depressed

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DTC No.	DTC Detection Condition	Trouble Area
P2120	VPA fluctuates rapidly beyond upper and lower malfunction thresholds for 0.5 seconds or more (1 trip detection logic)	- Accelerator Pedal Position (APP) sensor - ECM
P2122	VPA is 0.4 V or less for 0.5 seconds or more when accelerator pedal is fully released (1 trip detection logic)	- APP sensor - Open in VCP1 circuit - Open or ground short in VPA circuit - ECM
P2123	VPA is 4.8 V or more for 2.0 seconds or more (1 trip detection logic)	- APP sensor - Open in EPA circuit - ECM
P2125	VPA2 fluctuates rapidly beyond upper and lower malfunction thresholds for 0.5 seconds or more (1 trip detection logic)	- APP sensor - ECM
P2127	VPA2 is 1.2 V or less for 0.5 seconds or more when accelerator pedal is fully released (1 trip detection logic)	- APP sensor - Open in VCP2 circuit - Open or ground short in VPA2 circuit - ECM
P2128	Conditions (a) and (b) continue for 2.0 seconds or more (1 trip detection logic): (a) VPA2 is 4.8 V or more (b) VPA is between 0.4 V and 3.45 V	- APP sensor - Open in EPA2 circuit - ECM

DTC No.	DTC Detection Condition	Trouble Area
P2138	Condition (a) or (b) continues for 2.0 seconds or more (1 trip detection logic): (a) Difference between VPA and VPA2 is 0.02 V or less (b) VPA is 0.4 V or less and VPA2 is 1.2 V or less	- Short between VPA and VPA2 circuits - APP sensor - ECM

HINT:

When any of these DTCs are set, check the APP sensor voltage by entering the following menus on the intelligent tester: DIAGNOSIS / ENHANCED OBD II / DATA LIST / PRIMARY / ACCEL POS #1 and ACCEL POS #2.

Trouble Areas	ACCEL POS #1 When AP Released	ACCEL POS #2 When AP Released	ACCEL POS #1 When AP Depressed	ACCEL POS #2 When AP Depressed
VCP circuit open	0 to 0.4 V	0 to 1.2 V	0 to 0.4 V	0 to 1.2 V
Open or ground short in VPA circuit	0 to 0.4 V	1.2 to 2.0 V	0 to 0.4 V	3.4 to 5.0 V
Open or ground short in VPA2 circuit	0.5 to 1.1 V	0 to 0.2 V	2.6 to 4.5 V	0 to 0.2 V
EPA circuit open	4.5 to 5.0 V	4.5 to 5.0 V	4.5 to 5.0 V	4.5 to 5.0 V
Normal condition	0.5 to 1.1 V	1.2 to 2.0 V	2.6 to 4.5 V	3.4 to 5.0 V

HINT:

- Accelerator pedal positions are expressed as voltages.
- AP denotes Accelerator Pedal.

MONITOR DESCRIPTION

When either of the output voltages of VPA or VPA2 deviates from the standard range, or the difference between the output voltages of the 2 sensor circuits is less than the threshold, the ECM determines that there is a malfunction in the APP sensor. The ECM then illuminates the MIL and sets a DTC.

Example:

When the output voltage of VPA drops below 0.4 V for more than 0.5 seconds when the accelerator pedal is fully depressed, DTC P2122 is set.

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

MONITOR STRATEGY

Related DTCs	P2120: Accelerator Pedal Position (APP) sensor 1 range check (fluctuating) P2122: APP sensor 1 range check (low voltage) P2123: APP sensor 1 range check (high voltage) P2125: APP sensor 2 range check (fluctuating) P2127: APP sensor 2 range check (low voltage) P2128: APP sensor 2 range check (high voltage) P2138: APP sensor range check (correlation)
Required Sensors/Components (Main)	APP sensor
Required Sensors/Components (Sub)	-
Frequency of Operation	Continuous
Duration	Accelerator Pedal Position (APP) sensor 1 range check (fluctuating): 0.5 seconds APP sensor 1 range check (low voltage): 0.5 seconds APP sensor 1 range check (high voltage): 2 seconds APP sensor 2 range check (fluctuating): 0.5 seconds APP sensor 2 range check (low voltage): 0.5 seconds APP sensor 2 range check (high voltage): 2 seconds APP sensor range check (correlation): 2 seconds
MIL Operation	Immediate
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

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

TYPICAL MALFUNCTION THRESHOLDS

P2120:

Either of the following conditions is met:	-
VPA voltage when VPA2 is 0.04 V or more	0.4 V or less
VPA voltage	4.8 V or more

P2122:

VPA voltage when VPA2 is 0.04 V or more	0.4 V or less
---	---------------

P2123:

VPA voltage	4.8 V or more
-------------	---------------

P2125:

Either of the following conditions is met:	-
VPA2 voltage when VPA 0.04 V or more	1.2 V or less
VPA2 voltage when VPA 0.4 to 3.45 V	4.8 V or more

P2127:

VPA2 voltage when VPA is 0.04 V or more	1.2 V or less
---	---------------

P2128:

VPA2 voltage when VPA is 0.4 to 3.45 V	4.8 V or more
--	---------------

P2138:

Either following condition A or B is met:	-
Condition A	-
Difference between VPA and VPA 2 voltages	0.02 V or less
Condition B	-
VPA voltage	0.4 V or less
VPA2 voltage	1.2 V or less

COMPONENT OPERATING RANGE

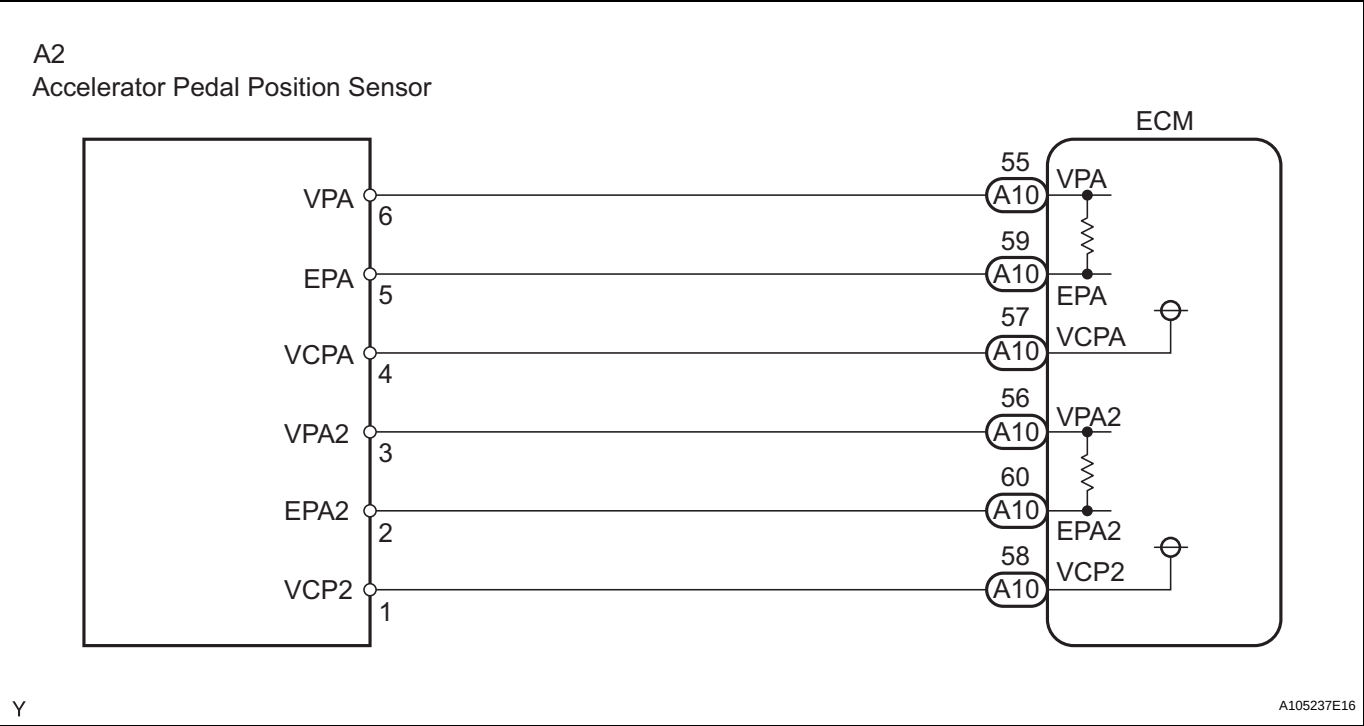
Parameter	Standard Value
VPA voltage	0.4 V to 4.8 V
VPA2 voltage	0.5 V to 4.8 V
Difference between VPA and VPA2 voltages	More than 0.02 V

FAIL-SAFE

When any of DTCs P2120, P2121, P2122, P2123, P2125, P2127, P2128 and P2138 are set, the ECM enters fail-safe mode. If either of the 2 sensor circuits malfunctions, the ECM uses the remaining circuit to calculate the accelerator pedal position to allow the vehicle to continue driving. If both of the circuits malfunction, the ECM regards the accelerator pedal as being released. As a result, the throttle valve is closed and the engine idles.

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

WIRING DIAGRAM



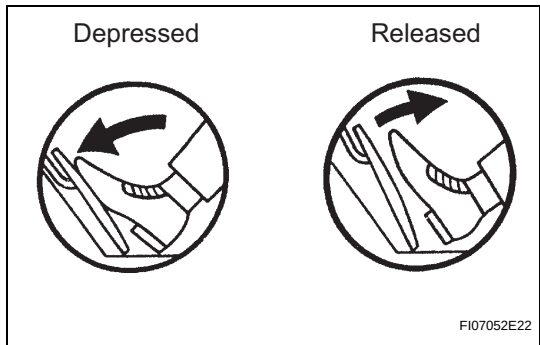
INSPECTION PROCEDURE

HINT:

- Read freeze frame data using the intelligent tester. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can be helpful in determining whether the vehicle was running or stopped, whether the engine was warmed up or not, whether the air-fuel ratio was lean or rich, as well as other data recorded at the time of a malfunction (See page [ES-41](#)).
- These DTCs relate to the Accelerator Pedal Position (APP) sensor.

1

READ VALUE OF INTELLIGENT TESTER (ACCEL POS #1 AND ACCEL POS #2)



- (a) Connect the intelligent tester to the DLC3.
- (b) Turn the engine switch on (IG) and turn the tester on.
- (c) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DATA LIST / ALL / ACCEL POS #1 and ACCEL POS #2.
- (d) Read the value displayed on the tester.

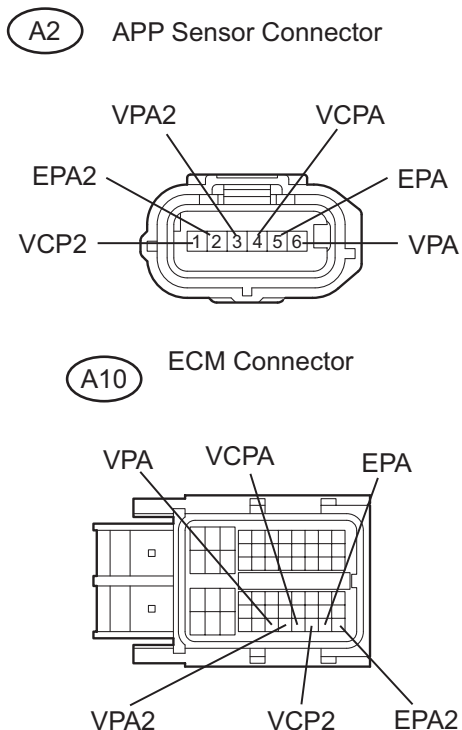
Standard voltage

Accelerator Pedal Condition	ACCEL POS #1 (AP#1)	ACCEL POS #2 (AP#2)
Released	0.5 to 1.1 V	1.2 to 2.0 V
Depressed	2.6 to 4.5 V	3.4 to 5.0 V

OK

Go to step 5

NG

2**CHECK HARNESS AND CONNECTOR (ACCELERATOR PEDAL POSITION SENSOR - ECM)****Wire Harness Side Front View:**

- Disconnect the A2 Accelerator Pedal Position (APP) sensor connector.
- Disconnect the A10 ECM connector.
- Measure the resistance according to the value(s) in the table below.

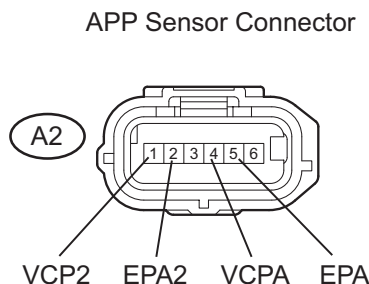
Standard resistance (Check for open)

Tester Connection	Specified Condition
VPA (A2-6) - VPA (A10-55)	Below 1 Ω
EPA (A2-5) - EPA (A10-59)	Below 1 Ω
VCPA (A2-4) - VCPA (A10-57)	Below 1 Ω
VPA2 (A2-3) - VPA2 (A10-56)	Below 1 Ω
EPA2 (A2-2) - EPA2 (A10-60)	Below 1 Ω
VCP2 (A2-1) - VCP2 (A10-58)	Below 1 Ω

Standard resistance (Check for short)

Tester Connection	Specified Condition
VPA (A2-6) or VPA (A10-55) - body ground	10 k Ω or higher
EPA (A2-5) or EPA (A10-59) - body ground	10 k Ω or higher
VCPA (A2-4) or VCPA (A10-57) - body ground	10 k Ω or higher
VPA2 (A2-3) or VPA2 (A10-56) - body ground	10 k Ω or higher
EPA2 (A2-2) or EPA2 (A10-60) - body ground	10 k Ω or higher
VCP2 (A2-1) or VCP2 (A10-58) - body ground	10 k Ω or higher

- Reconnect the APP sensor connector.
- Reconnect the ECM connector.

NG**REPAIR OR REPLACE HARNESS OR CONNECTOR****OK****3****INSPECT ACCELERATOR PEDAL POSITION SENSOR (VCPA AND VCP2 VOLTAGE)****Wire Harness Side Front View:**

- Disconnect the A2 APP sensor connector.
- Turn the engine switch on (IG).
- Measure the voltage according to the value(s) in the table below.

Standard voltage

Tester Connection	Specified Condition
VCPA (A2-4) - EPA (A2-5)	4.5 to 5.0 V
VCP2 (A2-1) - EPA2 (A2-2)	4.5 to 5.0 V

- Reconnect the APP sensor connector.

NG**REPLACE ECM (See page ES-543)**

OK

4 REPLACE ACCELERATOR PEDAL ROD ASSEMBLY

NEXT

5 CHECK WHETHER DTC OUTPUT RECURS (ACCELERATOR PEDAL POSITION SENSOR DTCS)

ES

- (a) Connect the intelligent tester to the DLC3.
- (b) Turn the engine switch on (IG) and turn the tester on.
- (c) Clear the DTCs (See page ES-41).
- (d) Start the engine.
- (e) Allow the engine to idle for 15 seconds.
- (f) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DTC INFO / CURRENT CODES.
- (g) Read the DTCs.

Result

Display (DTC Output)	Proceed to
P2120, P2122, P2123, P2125, P2127, P2128, and/or P2138	A
No output	B

B SYSTEM IS OK

A

REPLACE ECM (See page ES-543)

DTC	P2119	Throttle Actuator Control Throttle Body Range / Performance
------------	--------------	--

SYSTEM DESCRIPTION

The Electronic Throttle Control System (ETCS) is composed of the throttle actuator, Throttle Position (TP) sensor, Accelerator Pedal Position (APP) sensor, and ECM. The ECM operates the throttle actuator to regulate the throttle valve in response to driver inputs. The TP sensor detects the opening angle of the throttle valve, and provides the ECM with feedback so that the throttle valve can be appropriately controlled by the ECM.

DTC No.	DTC Detection Condition	Trouble Area
P2119	Throttle valve opening angle continues to vary greatly from target opening angle (1 trip detection logic)	- ETCS - ECM

ES

MONITOR DESCRIPTION

The ECM determines the actual opening angle of the throttle valve from the TP sensor signal. The actual opening angle is compared to the target opening angle commanded by the ECM. If the difference between these two values is outside the standard range, the ECM interprets this as a malfunction in the ETCS. The ECM then illuminates the MIL and sets the DTC.

If the malfunction is not repaired successfully, the DTC is set when the accelerator pedal is quickly released (to close the throttle valve) after the engine speed reaches 5,000 rpm by fully depressing the accelerator pedal (fully open the throttle valve).

MONITOR STRATEGY

Related DTCs	P2119: ETCS malfunction
Required Sensors/Components (Main)	Throttle actuator
Required Sensors/Components (Sub)	-
Frequency of Operation	Continuous
Duration	1 second
MIL Operation	Immediate
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

Monitor runs whenever following DTCs are not present	None
System guard*	ON
*System guard is set when following conditions are met:	-
Throttle actuator	ON
Throttle actuator duty calculation	Executing
TP sensor	Fail determined
Throttle actuator current-cut operation	Not executing
Throttle actuator power supply	4 V or more
Throttle actuator	Fail determined

TYPICAL MALFUNCTION THRESHOLDS

Either following condition A or B is met	-
A. Commanded closed TP - current closed TP	0.3 V or more for 1 second
B. Commanded open TP - current open TP	0.3 V or more for 0.6 seconds

FAIL-SAFE

When this DTC, as well as other DTCs relating to ETCS (Electronic Throttle Control System) malfunctions, is set, the ECM enters fail-safe mode. During fail-safe mode, the ECM cuts the current to the throttle actuator off, and the throttle valve is returned to a 6° throttle angle by the return spring. The ECM then adjusts the engine output by controlling the fuel injection (intermittent fuel-cut) and ignition timing, in accordance with the accelerator pedal opening angle, to allow the vehicle to continue running at a minimal speed. If the accelerator pedal is depressed firmly and gently, the vehicle can be driven slowly. Fail-safe mode continues until a pass condition is detected, and the engine switch is then turned off.

WIRING DIAGRAM

Refer to DTC P2102 (See page ES-325).

ES INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can be helpful in determining whether the vehicle was running or stopped, whether the engine was warmed up or not, whether the air-fuel ratio was lean or rich, as well as other data recorded at the time of a malfunction (See page ES-41).

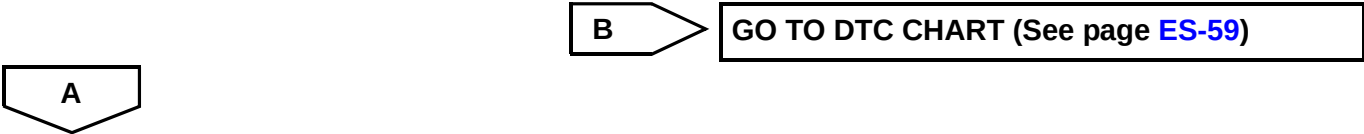
1 CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P2119)

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

Result

Display (DTC Output)	Proceed to
P2119	A
P2119 and other DTCs	B

HINT:
If any DTCs other than P2119 are output, troubleshoot those DTCs first.



2 CHECK WHETHER DTC OUTPUT RECURS (DTC P2119)

- (a) Connect the intelligent tester to the DLC3.
 - (b) Turn the engine switch on (IG).
 - (c) Turn the tester on.
 - (d) Clear the DTCs (See page ES-41).
 - (e) Allow the engine to idle for 15 seconds.
- CAUTION:**
Exercise extreme care and take precautions at procedures "A" and "B" below. Failure to do so may result in the vehicle unexpectedly rolling away.

- (f) Securely apply the parking brake and move the gear selector lever to the D position (Procedure "A").
- (g) While depressing the brake pedal securely, fully depress the accelerator pedal for 5 seconds (Procedure "B").
- (h) On the tester, enter the following menus: DIAGNOSIS / ENHANCED OBD II / DTC INFO / CURRENT CODES.
- (i) Read the DTCs.

HINT:

The output voltage of the throttle position sensor can be checked during procedure "B" using the intelligent tester. Variations in the output voltage indicate that the throttle actuator is in operation. To check the output voltage using the intelligent tester, enter the following menus: DIAGNOSIS / ENHANCED OBD II / DATA LIST / PRIMARY / THROTTLE POS #1.

OK:

No DTC output.

NG

REPLACE THROTTLE BODY ASSEMBLY
(See page [ES-519](#))

OK**END****ES**

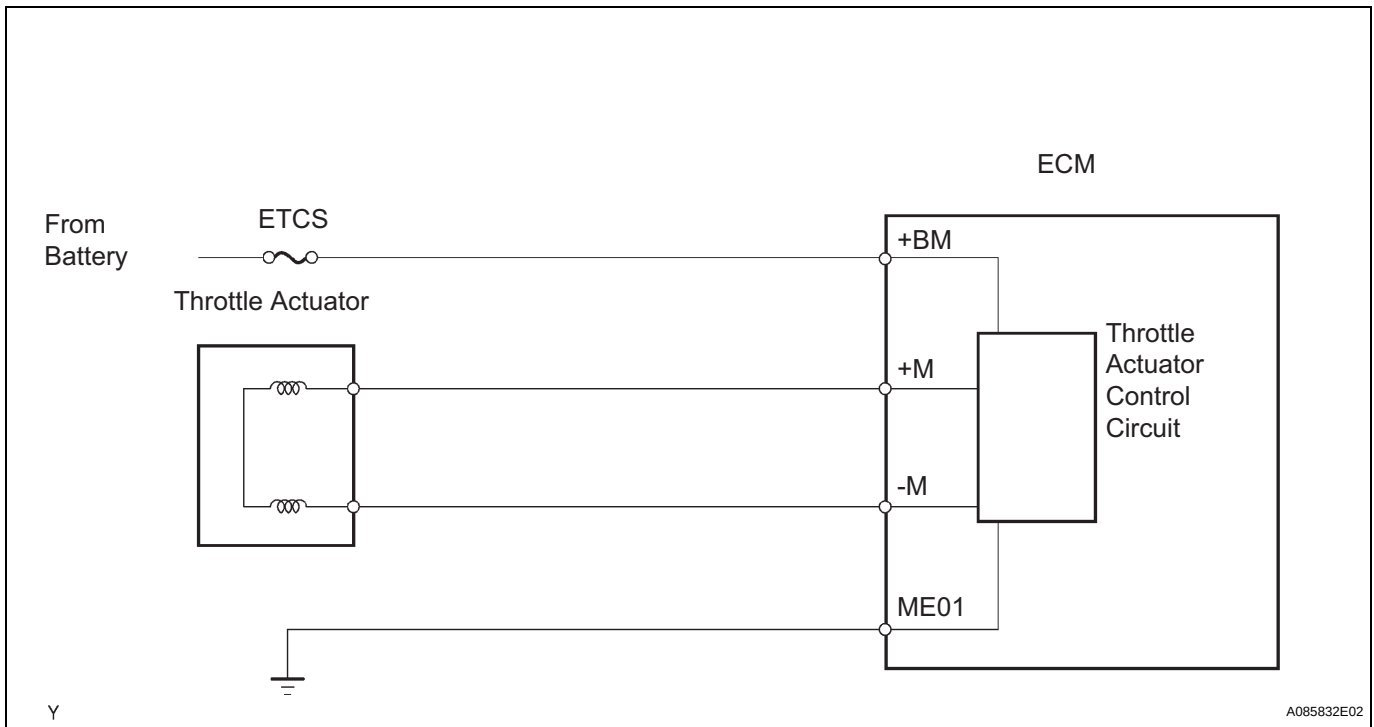
DTC**P2118****Throttle Actuator Control Motor Current Range / Performance****DESCRIPTION**

The ETCS (Electronic Throttle Control System) has a dedicated power supply circuit. When the monitored voltage (+BM) is low (less than 4 V), the ECM determines that there is a malfunction in the ETCS and cuts off the current to the throttle actuator.

When the voltage becomes unstable, the ETCS itself becomes unstable. For this reason, when the voltage is low, the current to the throttle actuator is cut. If repairs are made and the system returns to normal, turn the engine switch off. The ECM then allows the current to flow to the throttle actuator so that it can be restarted.

HINT:

The ETCS does not use a throttle cable.

ES

A085832E02

DTC No.	DTC Detection Condition	Trouble Area
P2118	Open in ETCS power source (+BM) circuit (1 trip detection logic)	- Open in ETCS power source circuit - ETCS fuse - ECM

MONITOR DESCRIPTION

The ECM monitors the battery supply voltage applied to the throttle actuator.

When the power supply voltage (+BM) drops below 4 V for 0.8 seconds or more, the ECM interprets this as an open in the power supply circuit (+BM). The ECM illuminates the MIL and sets the DTC.

If the malfunction is not repaired successfully, the DTC is set 5 seconds after the engine is next started.

MONITOR STRATEGY

Related DTCs	P2118: Throttle actuator power supply
Required Sensors/Components (Main)	Throttle actuator, throttle valve, ETCS fuse
Required Sensors/Components (Sub)	None
Frequency of Operation	Continuous
Duration	0.8 seconds

MIL Operation	Immediate
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

Monitor runs whenever following DTCs are not present	None
Battery voltage	8 V or more
Throttle actuator power	ON

TYPICAL MALFUNCTION THRESHOLDS

Throttle actuator power supply voltage (+BM)	Less than 4 V
--	---------------

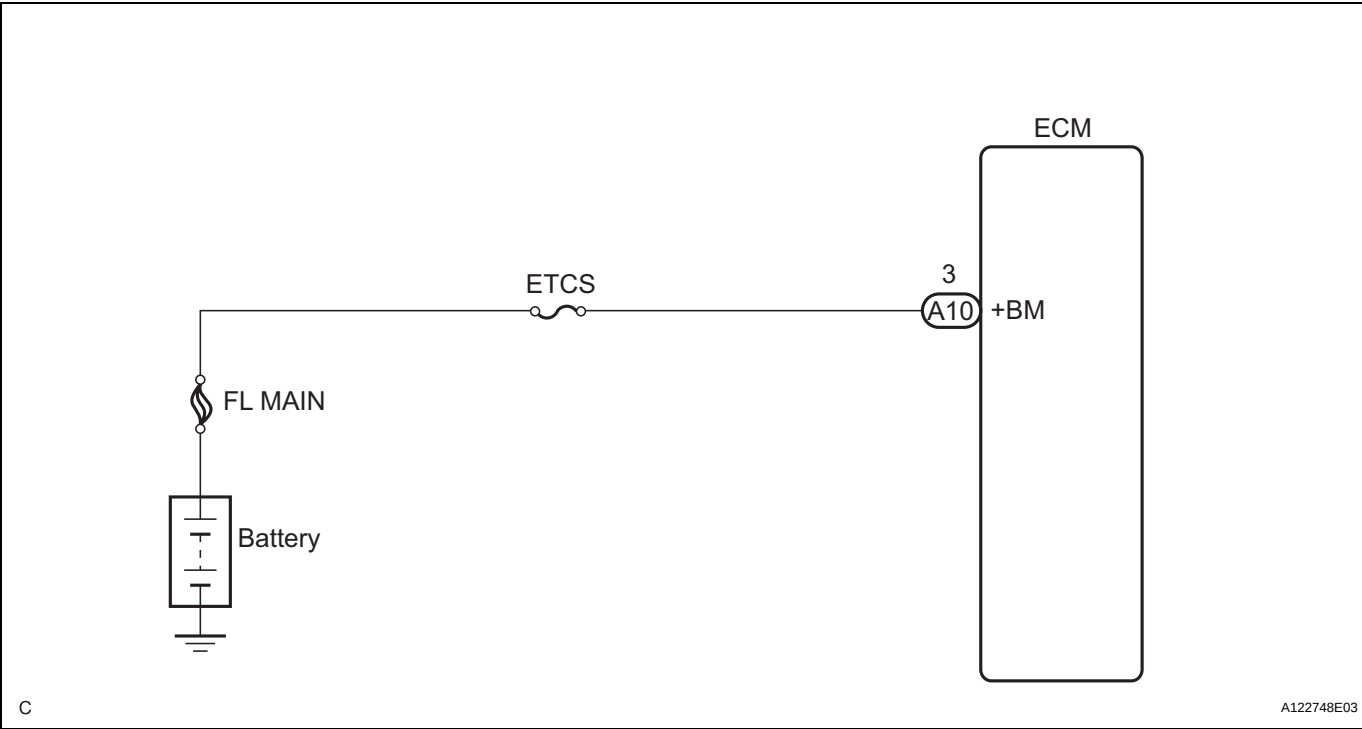
COMPONENT OPERATING RANGE

Throttle actuator power supply voltage	9 to 14 V
--	-----------

FAIL-SAFE

When this DTC, as well as other DTCs relating to ETCS (Electronic Throttle Control System) malfunctions, is set, the ECM enters fail-safe mode. During fail-safe mode, the ECM cuts the current to the throttle actuator off, and the throttle valve is returned to a 6° throttle angle by the return spring. The ECM then adjusts the engine output by controlling the fuel injection (intermittent fuel-cut) and ignition timing, in accordance with the accelerator pedal opening angle, to allow the vehicle to continue running at a minimal speed. If the accelerator pedal is depressed firmly and gently, the vehicle can be driven slowly. Fail-safe mode continues until a pass condition is detected, and the engine switch is then turned off.

WIRING DIAGRAM



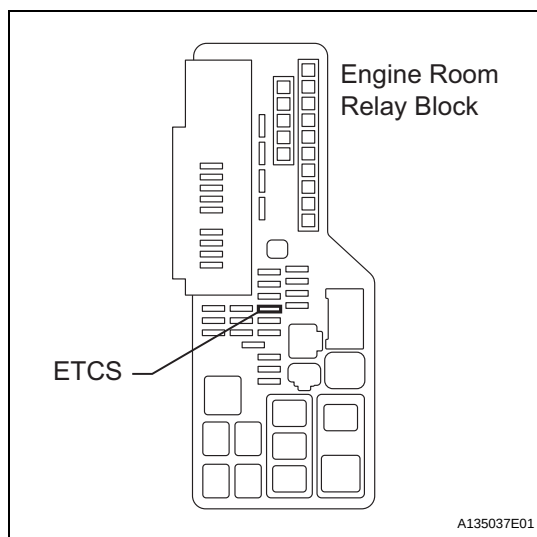
INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can be helpful in determining whether the vehicle was running or stopped, whether the engine was warmed up or not, whether the air-fuel ratio was lean or rich, as well as other data recorded at the time of a malfunction (See page [ES-41](#)).

1

CHECK FUSE (ETCS FUSE)



(a) Remove the ETCS fuse from the engine room R/B.

(b) Measure the resistance of the ETCS fuse.

Standard resistance:

Below 1 Ω

(c) Reinstall the ETCS fuse.

NG

REPLACE ETCS FUSE

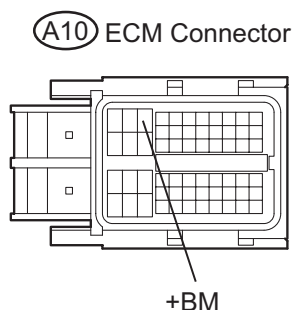
ES

OK

2

INSPECT ECM (+BM VOLTAGE)

Wire Harness Side:



(a) Disconnect the A10 ECM connector.

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

Standard voltage

Tester Connection	Specified Condition
+BM (A10-3) - Body ground	9 to 14 V

(c) Reconnect the ECM connector.

OK

CHECK FOR INTERMITTENT PROBLEMS

NG

3

CHECK HARNESS AND CONNECTOR (ECM - ETCS FUSE, ETCS FUSE - BATTERY)

Engine Room Junction Block

ETCS

1 2

(A10) ECM Connector

+BM

A140650E02

- (a) Check the harness and connector between the ETCS fuse and ECM.
- (1) Remove the ETCS fuse from the engine room R/B.
 - (2) Disconnect the A10 ECM connector.
 - (3) Measure the resistance according to the value(s) in the table below.

Standard resistance (Check for open)

Tester Connection	Specified Condition
Engine room R/B ETCS fuse terminal 2 - +BM (A10-3)	Below 1 Ω

Standard resistance (Check for short)

Tester Connection	Specified Condition
Engine room R/B ETCS fuse terminal 2 or +BM (A10-3) - Body ground	10 k Ω or higher

- (4) Reinstall the ETCS fuse.
 - (5) Reconnect the ECM connector.
- (b) Check the harness and connector between the ETCS fuse and positive battery cable.
- (1) Remove the ETCS fuse from the engine room R/B.
 - (2) Disconnect the negative battery terminal.
 - (3) Disconnect the positive battery terminal.
 - (4) Measure the resistance according to the value(s) in the table below.

Standard resistance (Check for open)

Tester Connection	Specified Condition
Positive battery terminal - Engine room R/B ETCS fuse terminal 1	Below 1 Ω

Standard resistance (Check for short)

Tester Connection	Specified Condition
Positive battery terminal or Engine room R/B ETCS fuse terminal 1 - Body ground	10 k Ω or higher

- (5) Reinstall the ETCS fuse.
- (6) Reconnect the positive battery terminal.
- (7) Reconnect the negative battery terminal.

NG

REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

REPLACE ECM (See page [ES-543](#))

ES

DTC	P2111	Throttle Actuator Control System - Stuck Open
DTC	P2112	Throttle Actuator Control System - Stuck Closed

SYSTEM DESCRIPTION

The throttle actuator is operated by the ECM, and opens and closes the throttle valve using the gears. The opening angle of the throttle valve is detected by the Throttle Position (TP) sensor, which is mounted on the throttle body. The TP sensor provides feedback to the ECM. This feedback allows the ECM to appropriately control the throttle actuator and monitor the throttle opening angle as the ECM responds to driver inputs.

HINT:

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

DTC No.	DTC Detection Condition	Trouble Area
P2111	ECM signals throttle actuator to close, but actuator is stuck (1 trip detection logic)	• Throttle actuator • Throttle body • Throttle valve
P2112	ECM signals throttle actuator to open, but actuator is stuck (1 trip detection logic)	• Throttle actuator • Throttle body • Throttle valve

MONITOR DESCRIPTION

The ECM determines that there is a malfunction in the ETCS when the throttle valve remains at a fixed angle despite a high drive current from the ECM. The ECM illuminates the MIL and sets a DTC. If the malfunction is not repaired successfully, a DTC is set when the accelerator pedal is fully depressed and released quickly (to fully open and close the throttle valve) after the engine is next started.

MONITOR STRATEGY

Related DTCs	P2111: Throttle actuator stuck open P2112: Throttle actuator stuck closed
Required Sensors/Components (Main)	Throttle actuator
Required Sensors/Components (Sub)	-
Frequency of Operation	Continuous
Duration	0.5 seconds
MIL Operation	Immediate
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

All:

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

P2111 (Throttle actuator stuck open):

System guard*	ON
Throttle actuator current	2 A or more
Duty cycle to close throttle	80 % or more

P2112 (Throttle actuator stuck closed):

System guard*	ON
Throttle actuator current	2 A or more
Duty cycle to open throttle	80 % or more

*System guard is set when following conditions are met:	-
Throttle actuator	ON
Throttle actuator duty calculation	Executing
Throttle position sensor	Fail determined
Throttle actuator current-cut operation	Not executing
Throttle actuator power supply	4 V or more
Throttle actuator	Fail determined

TYPICAL MALFUNCTION THRESHOLDS

P2111 (Throttle actuator stuck open):

TP sensor voltage change	No change
--------------------------	-----------

P2112 (Throttle actuator stuck closed):

TP sensor voltage change	No change
--------------------------	-----------

ES

FAIL-SAFE

When either of these DTCs, as well as other DTCs relating to ETCS (Electronic Throttle Control System) malfunctions, is set, the ECM enters fail-safe mode. During fail-safe mode, the ECM cuts the current to the throttle actuator off, and the throttle valve is returned to a 6° throttle angle by the return spring. The ECM then adjusts the engine output by controlling the fuel injection (intermittent fuel-cut) and ignition timing, in accordance with the accelerator pedal opening angle, to allow the vehicle to continue running at a minimal speed. If the accelerator pedal is depressed firmly and gently, the vehicle can be driven slowly. Fail-safe mode continues until a pass condition is detected, and the engine switch is then turned off.

WIRING DIAGRAM

Refer to DTC P2102 (See page [ES-323](#)).

INSPECTION PROCEDURE

HINT:

Read freeze frame data using the intelligent tester. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can be helpful in determining whether the vehicle was running or stopped, whether the engine was warmed up or not, whether the air-fuel ratio was lean or rich, as well as other data recorded at the time of a malfunction (See page [ES-41](#)).

1

CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P2111 or P2112)

- Connect the intelligent tester to the DLC3.
- Turn the engine switch on (IG).
- Turn the tester on.
- Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DTC INFO / CURRENT CODES.
- Read the DTCs.

Result

Display (DTC Output)	Proceed to
P2111 or P2112	A
P2111 or P2112 and other DTCs	B

HINT:

If any DTCs other than P2111 or P2112 are output, troubleshoot those DTCs first.

A

B

GO TO DTC CHART (See page [ES-59](#))

2

INSPECT THROTTLE BODY (VISUALLY CHECK THROTTLE VALVE)

- (a) Check for contamination between the throttle valve and the housing. If necessary, clean the throttle body. And check that the throttle valve moves smoothly.

OK:

Throttle valve is not contaminated with foreign objects and moves smoothly.

NG

REPLACE THROTTLE BODY ASSEMBLY
(See page [ES-519](#))

OK

3

CHECK WHETHER DTC OUTPUT RECURS (DTC P2111 OR P2112)

- (a) Connect the intelligent tester to the DLC3.
(b) Turn the engine switch on (IG).
(c) Turn the tester on.
(d) Clear the DTCs (See page [ES-41](#)).
(e) Start the engine, and fully depress and release the accelerator pedal quickly (to fully open and close the throttle valve).
(f) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DTC INFO / CURRENT CODES.
(g) Read the DTCs.

Result

Display (DTC Output)	Proceed to
No DTC	A
P2111 or P2112	B

B

REPLACE ECM (See page [ES-543](#))

A

CHECK FOR INTERMITTENT PROBLEMS

DTC	P2102	Throttle Actuator Control Motor Circuit Low
DTC	P2103	Throttle Actuator Control Motor Circuit High

SYSTEM DESCRIPTION

The throttle actuator is operated by the ECM and opens and closes the throttle valve using the gears. The opening angle of the throttle valve is detected by the Throttle Position (TP) sensor, which is mounted on the throttle body. The TP sensor provides feedback to the ECM. This feedback allows the ECM to appropriately control the throttle actuator and monitor the throttle opening angle as the ECM responds to driver inputs.

HINT:

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

DTC No.	DTC Detection Condition	Trouble Area
P2102	Conditions (a) and (b) continue for 2.0 seconds (1 trip detection logic): (a) Throttle actuator duty ratio 80 % or more (b) Throttle actuator current 0.5 A or less	- Open in throttle actuator circuit - Throttle actuator - ECM
P2103	Either of the following conditions is met: - Hybrid IC diagnosis signal fails - Hybrid IC current limiter port fails	- Short in throttle actuator circuit - Throttle actuator - Throttle valve - Throttle body assembly - ECM

MONITOR DESCRIPTION

The ECM monitors the electrical current through the electronic actuator, and detects malfunctions and open circuits in the throttle actuator based on this value. If the current is outside the standard range, the ECM determines that there is a malfunction in the throttle actuator. In addition, if the throttle valve does not function properly (for example, stuck on), the ECM determines that there is a malfunction. The ECM then illuminates the MIL and sets a DTC.

Example:

When the electrical current is more than 10 A, or less than 0.5 A and the throttle actuator duty ratio exceeds 80 %, the ECM interprets this as the current being outside the standard range, and illuminates the MIL and sets a DTC.

If the malfunction is not repaired successfully, a DTC is set when the engine is quickly revved up to a high rpm several times after the engine has idled for 5 seconds after engine start.

MONITOR STRATEGY

Related DTCs	P2102: Throttle actuator current (low current) P2103: Throttle actuator current (high current)
Required Sensors/Components (Main)	Throttle actuator (throttle body)
Required Sensors/Components (Related)	None
Frequency of Operation	Continuous
Duration	P2102 (Throttle actuator current (low current)): 2 seconds P2103 (Throttle actuator current (high current)): 25 times or 0.6 seconds
MIL Operation	Immediate
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

All:

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

P2102:

Throttle motor	ON
Duty-cycle ratio to open throttle actuator	80 % or more
Throttle actuator power supply	8 V or more
Current motor current - Motor current before 0.016 sec.	Less than 0.2 A

P2103:

Throttle motor	ON
Either following condition 1 or 2 is met:	-
1. Throttle actuator power supply	8 V or more
2. Throttle actuator power	ON
Battery voltage	8 V or more
Starter	OFF

ES

TYPICAL MALFUNCTION THRESHOLDS**P2102:**

Throttle actuator current	Less than 0.5 A
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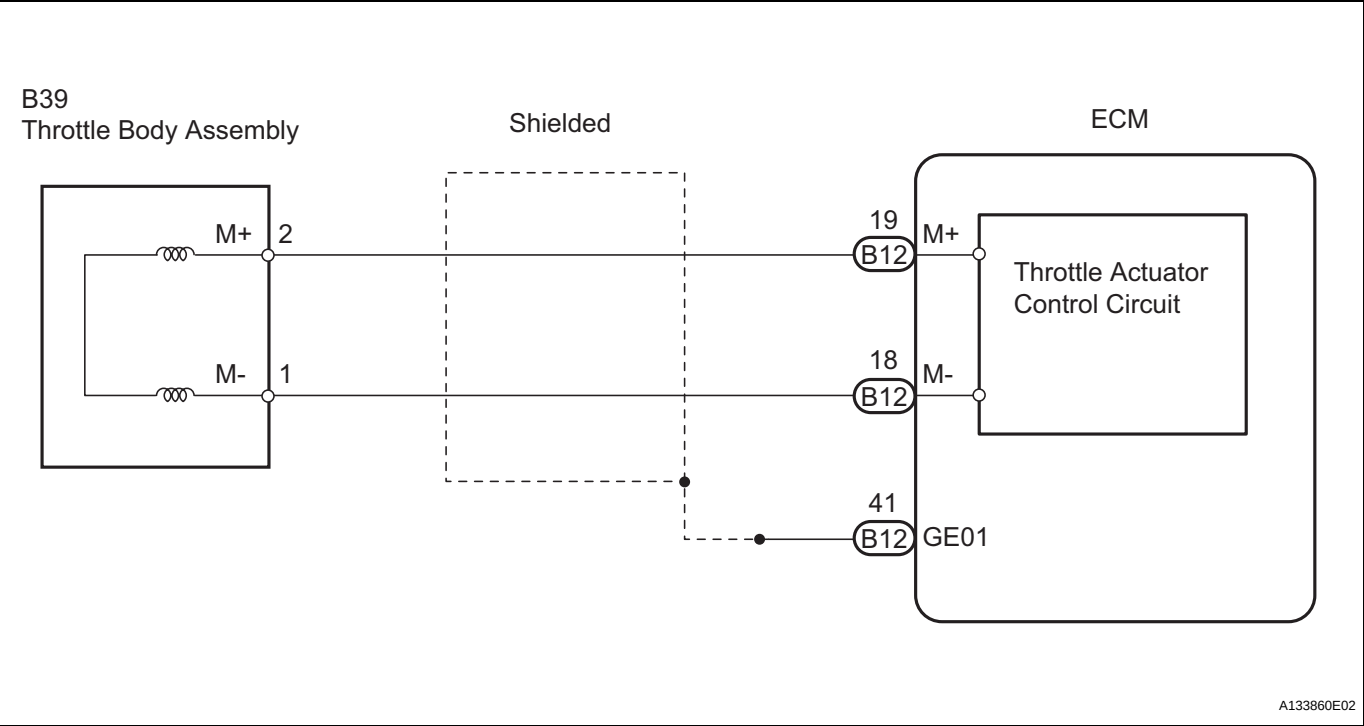
P2103:

Either of following conditions is met:	A or B
A. Hybrid IC diagnosis signal	Fail
B. Hybrid IC current limiter port	Fail

FAIL-SAFE

When either of these DTCs, as well as other DTCs relating to ETCS (Electronic Throttle Control System) malfunctions, is set, the ECM enters fail-safe mode. During fail-safe mode, the ECM cuts the current to the throttle actuator off, and the throttle valve is returned to a 6° throttle angle by the return spring. The ECM then adjusts the engine output by controlling the fuel injection (intermittent fuel-cut) and ignition timing, in accordance with the accelerator pedal opening angle, to allow the vehicle to continue running at a minimal speed. If the accelerator pedal is depressed gently, the vehicle can be driven slowly. Fail-safe mode continues until a pass condition is detected, and the engine switch is then turned off.

WIRING DIAGRAM

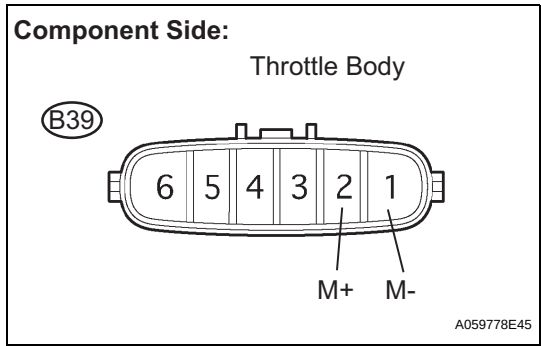


INSPECTION PROCEDURE

HINT:

- Read freeze frame data using an intelligent tester. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can be helpful in determining whether the vehicle was running or stopped, whether the engine was warmed up or not, whether the air-fuel ratio was lean or rich, as well as other data recorded at the time of a malfunction (See page ES-41).
- The throttle actuator current (THROTTLE MOT) and the throttle actuator duty ratio (THROTTLE OPN / THROTTLE CLS) can be read using the intelligent tester. However, the ECM shuts off the throttle actuator current when the ETCS malfunctions.

1 INSPECT THROTTLE BODY (RESISTANCE OF THROTTLE CONTROL MOTOR)



- (a) Disconnect the B39 throttle body connector.
- (b) Measure the resistance according to the value(s) in the table below.

Standard resistance

Tester Connection	Condition	Specified Condition
M+ (B39-2) - M- (B39-1)	20°C (68°F)	0.3 to 100 Ω

- (c) Reconnect the throttle body connector.

NG

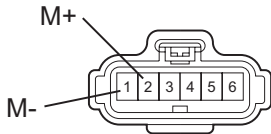
REPLACE THROTTLE BODY (See page ES-519)

OK

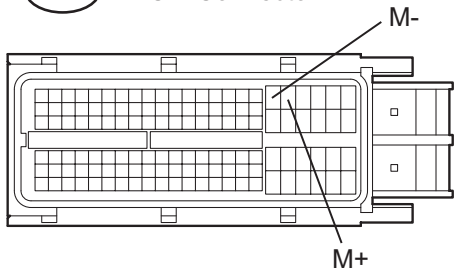
2 CHECK HARNESS AND CONNECTOR (THROTTLE CONTROL MOTOR - ECM)

Wire Harness Side Front View:

B39 Throttle Body Connector



B12 ECM Connector



A115662E12

- (a) Disconnect the B39 throttle body connector.
- (b) Disconnect the B12 ECM connector.
- (c) Measure the resistance according to the value(s) in the table below.

Standard resistance (Check for open)

Tester Connection	Specified Condition
M+ (B39-2) - M+ (B12-19)	Below 1 Ω
M- (B39-1) - M- (B12-18)	Below 1 Ω

Standard resistance (Check for short)

Tester Connection	Specified Condition
M+ (B39-2) or M+ (B12-19) - Body ground	10 kΩ or higher
M- (B39-1) or M- (B12-18) - Body ground	10 kΩ or higher

- (d) Reconnect the throttle body connector.
- (e) Reconnect the ECM connector.

NG

REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

3 INSPECT THROTTLE BODY (VISUALLY CHECK THROTTLE VALVE)

- (a) Check for foreign objects between the throttle valve and the housing.

NG

REMOVE FOREIGN OBJECT AND CLEAN THROTTLE BODY

OK

4 INSPECT THROTTLE VALVE

- (a) Check if the throttle valve opens and closes smoothly.

NG

REPLACE THROTTLE BODY (See page [ES-519](#))

OK

REPLACE ECM (See page [ES-543](#))

ES

DTC	P0705	Transmission Range Sensor Circuit Malfunction (PRNDL Input)
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DESCRIPTION

The park/neutral position switch detects the shift lever position and sends signals to the ECM.

DTC No.	DTC Detection Condition	Trouble Area
P0705	(A) Any 2 or more signals of the following are ON simultaneously (2-trip detection logic): • P input signal is ON. • N input signal is ON. • R input signal is ON. • D input signal is ON. (B) Any 2 or more signals of the following are ON simultaneously (2-trip detection logic): • NSW input signal is ON. • R input signal is ON. • D input signal is ON. (C) Any of following conditions is met for 2.0 sec. or more in the S position (2-trip detection logic): • NSW input signal is ON. • P input signal is ON. • N input signal is ON. • R input signal is ON. (D) All switches are OFF simultaneously for NSW, P, R, N and D.	• Short in park/neutral position switch circuit • Park/neutral position switch • ECM

MONITOR DESCRIPTION

These DTCs indicate a problem with the park/neutral position switch and the wire harness in the park/neutral position switch circuit.

The park/neutral position switch detects the shift lever position and sends a signal to the ECM.

For security, the park/neutral position switch detects the shift lever position so that the engine can be started only when the shift lever is in the P or N position.

The park/neutral position switch sends a signal to the ECM according to the shift position (P, R, N or D).

The ECM determines that there is a problem with the switch or related parts if it receives more than 1 position signal simultaneously. The ECM will turn on the MIL and store the DTC.

MONITOR STRATEGY

Related DTCs	P0705: Park/neutral position switch/Verify switch input
Required sensors/Components	Park/neutral position switch
Frequency of operation	Continuous
Duration	2 sec.
MIL operation	2 driving cycles
Sequence of operation	None

TYPICAL ENABLING CONDITIONS**All:**

The monitor will run whenever this DTC is not present.	None
Engine switch	ON
Battery voltage	10.5 V or more

Condition (C):

One of the following conditions is met:	Condition (a), (b), (c) or (d)
(a) Park Neutral position switch	ON
(b) Park position switch	ON

(c) Neutral position switch	ON
(d) R range position switch	ON

TYPICAL MALFUNCTION THRESHOLDS

1. One of the following conditions is met: Conditions (A), (B) and (C)

Condition (A):

Number of the following signal input at the same time	2 or more
Park position switch	ON
Neutral position switch	ON
R range position switch	ON
D range position switch	ON

Condition (B):

Number of the following signal input at the same time	2 or more
Park neutral position switch	ON
R range switch	ON
D range switch	ON

Condition (C):

"M" switch	ON
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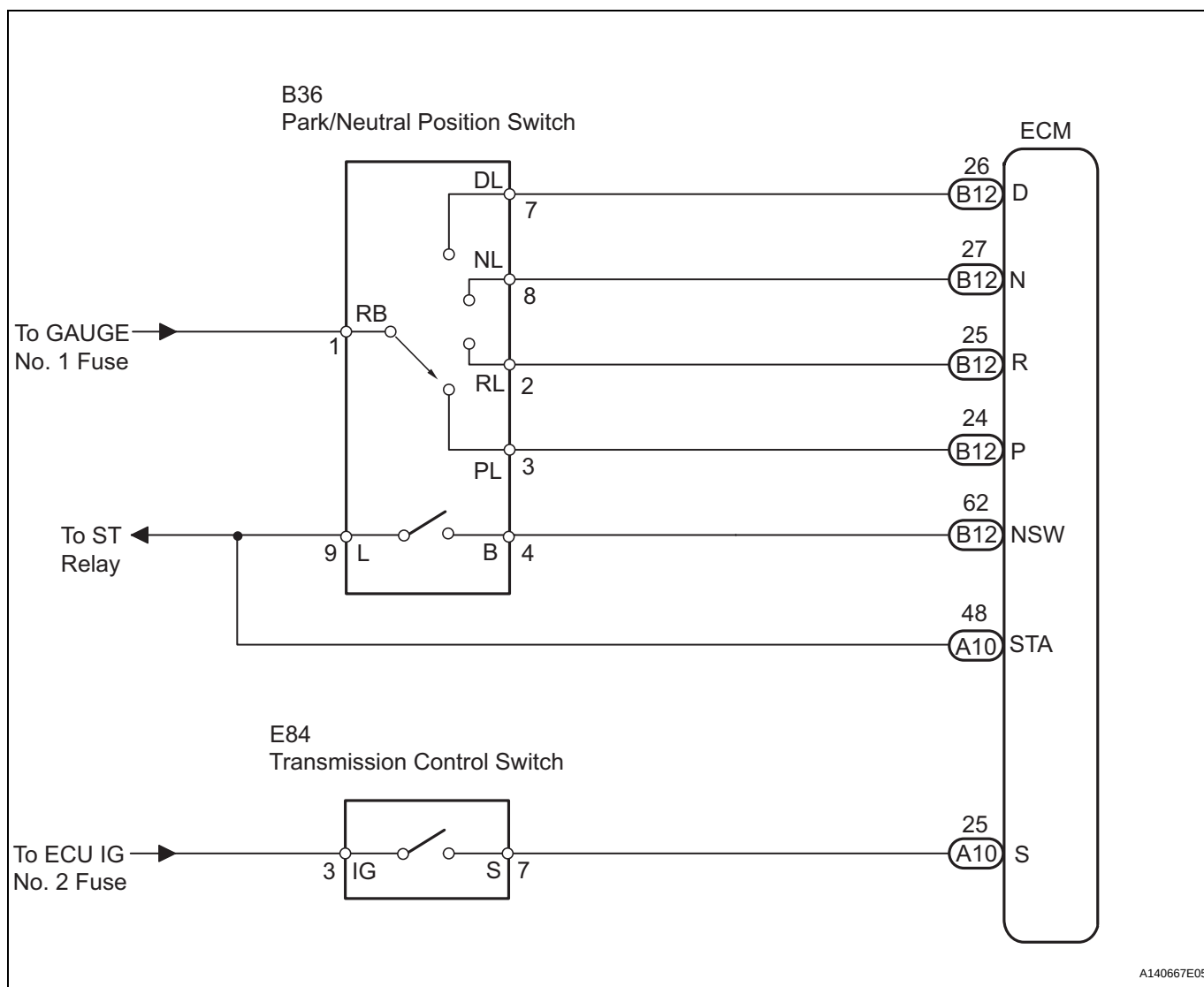
Condition (D):

Park position switch	OFF
Neutral position switch	OFF
Park neutral position switch	OFF
R range switch	OFF
D range switch	OFF

COMPONENT OPERATING RANGE

Park/neutral Position switch	The park/neutral position switch sends only one signal to the ECM.
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WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

According to the DATA LIST displayed by the intelligent tester, you can read the value of the switch, sensor, actuator and so on without parts removal. Reading the DATA LIST as the first step of troubleshooting is one method 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.

1. READ DATA LIST

- Turn the engine switch off.
- Connect the intelligent tester together with the CAN VIM (controller area network vehicle interface module) to the DLC3.
- Turn the engine switch on (IG).
- Turn on the tester.
- Select the item "DIAGNOSIS / ENHANCED OBD II / DATA LIST".

(f) According to the display on the tester, read the "DATA LIST".

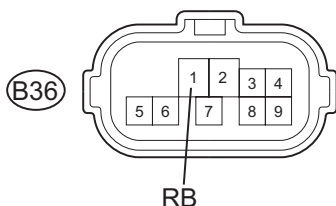
Item	Measurement Item / Range (Display)	Normal Condition	Diagnostic Note
PNP SW [NSW]	PNP SW Status / ON or OFF	Shift lever position is; P and N: ON Except P or N: OFF	When the shift lever position displayed on the intelligent tester differs from the actual position, adjustment of the PNP switch or the shift cable may be incorrect.
REVERSE	PNP SW Status / ON or OFF	Shift lever position is; R: ON Except R: OFF	↑
DRIVE	PNP SW Status / ON or OFF	Shift lever position is; D and S: ON Except D or S: OFF	↑

ES

1 CHECK HARNESS AND CONNECTOR (BATTERY - PARK/NEUTRAL POSITION SWITCH)

Wire Harness Side:

Park/Neutral Position SW



Y

C117645E26

- Disconnect the park/neutral position switch connector.
- Turn the engine switch on (IG).
- Measure the voltage according to the value(s) in the table below.

Standard voltage

Tester Connection	Specified Condition
RB (B36-1) - Body ground	10 to 14 V

NG

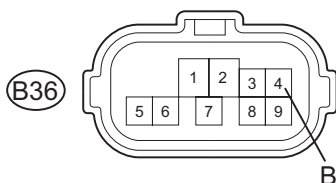
REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

2 CHECK ECM (OUTPUT SIGNAL)

Wire Harness Side:

Park/Neutral Position SW



Y

C117645E27

- Turn the engine switch on (IG).
- Measure the voltage according to the value(s) in the table below.

Standard voltage

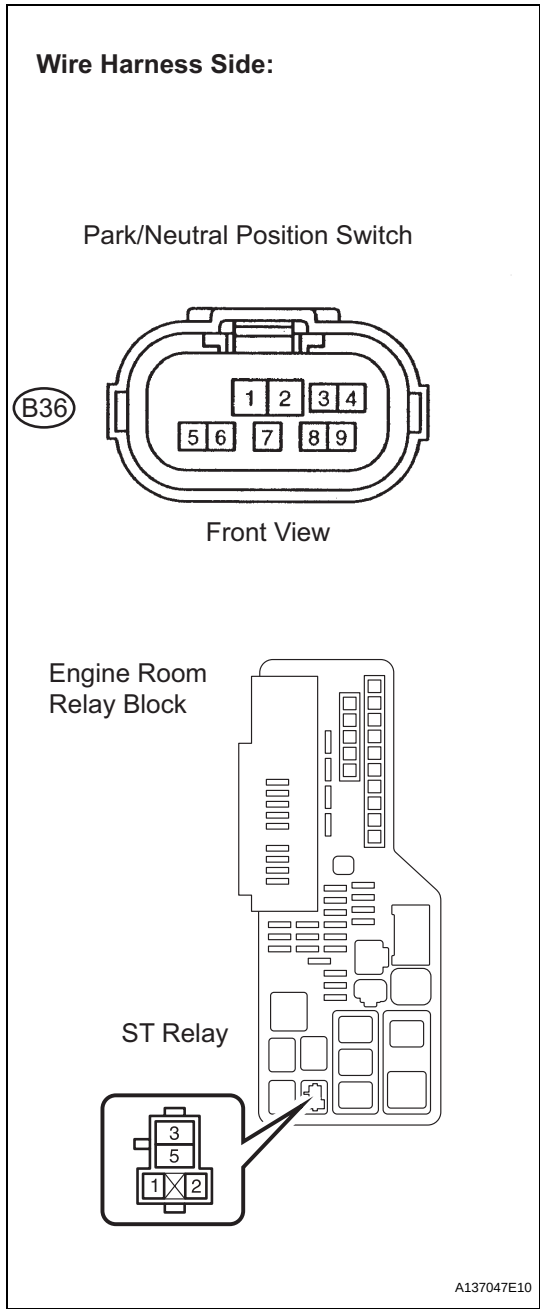
Tester Connection	Specified Condition
RB (B36-4) - Body ground	Below 3 V

NG

Go to step 11

OK

3 CHECK HARNESS AND CONNECTOR (PARK/NEUTRAL POSITION SWITCH - ST RELAY)



- (a) Disconnect the B36 park/neutral position switch connector.
 - (b) Remove the ST relay from the engine room relay block.
 - (c) Measure the resistance according to the value(s) in the table below.
- Standard resistance (check for open)**

Tester Connection	Specified Condition
L (B36-9) - ST relay terminal 1	Below 1 Ω

Standard resistance (check for open)

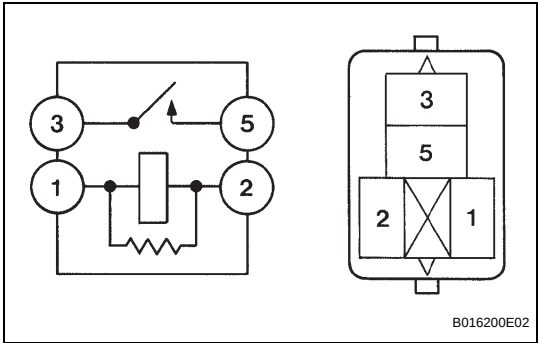
Tester Connection	Specified Condition
L (B36-9) or ST relay terminal 1 - Body ground	10 kΩ or higher

- (d) Reinstall the ST relay.
- (e) Reconnect the park/neutral position switch connector.

NG REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

4 INSPECT ST RELAY



- (a) Remove the ST relay from the engine room relay block.
- (b) Measure the resistance between the terminals.

Standard resistance

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

- (c) Reinstall the ST relay.

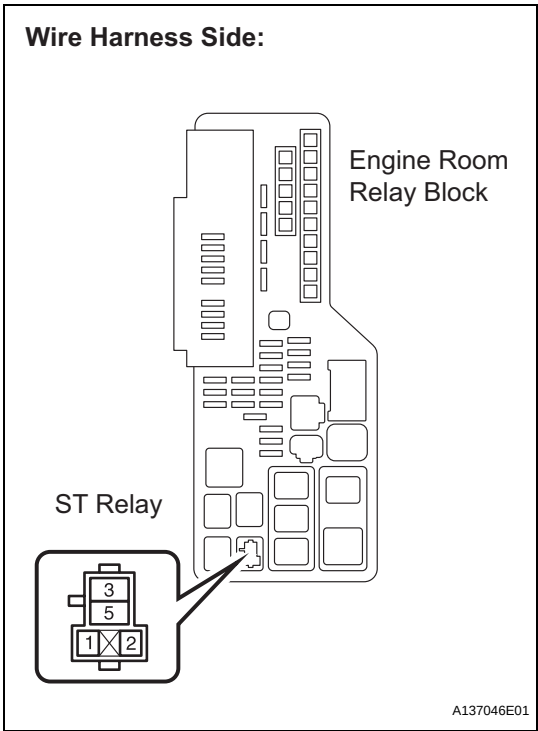
NG

REPLACE ST RELAY

OK

ES

5 CHECK HARNESS AND CONNECTOR (ST RELAY - BODY GROUND)



- (a) Remove the ST relay from the engine room relay block.
- (b) Measure the resistance between the terminals.

Standard resistance

Tester connection	Specified Condition
ST relay terminal 2 - Body ground	Below 1 Ω

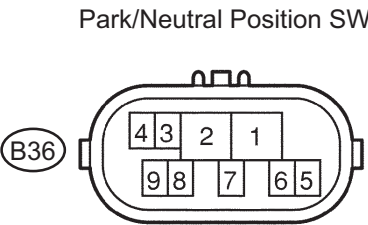
NG

REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

6INSPECT PARK/NEUTRAL POSITION SWITCH ASSEMBLY

Component Side:



- (a) Disconnect the B36 park/neutral position switch connector.
- (b) Measure the resistance according to the value(s) in the table below when the shift lever is moved to each position.

Standard resistance

Shift Position	Tester Connection	Specified Condition
P	1 - 3 and 4 - 9	Below 1 Ω
Except P		10 kΩ or higher
R	1 - 2	Below 1 Ω
Except R		10 kΩ or higher
N	1 - 8 and 4 - 9	Below 1 Ω
Except N		10 kΩ or higher
D, S, "+" and "-"	1 - 7	Below 1 Ω
Except D, S, "+" and "-"		10 kΩ or higher

- (c) Reconnect the park/neutral position switch connector.

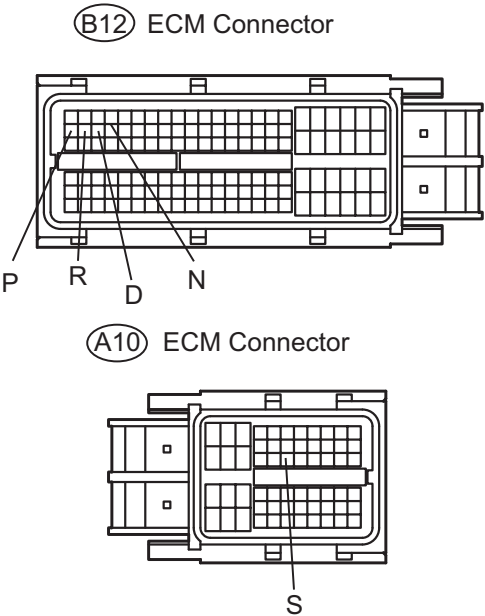
NG

REPLACE PARK/NEUTRAL POSITION SWITCH ASSEMBLY (See page AX-184)

OK

7CHECK HARNESS AND CONNECTOR

Wire Harness Side:



- (a) Disconnect the ECM connectors.
- (b) Turn the engine switch on (IG), and measure the voltage according to the value(s) in the table below when the shift lever is moved to each position.

Standard voltage

Shift Position	Tester Connection	Specified Condition
P	B12-24 (P) - Body ground	10 to 14 V
Except P		Below 1 V
N	B12-27 (N) - Body ground	10 to 14 V
Except N		Below 1 V
R	B12-25 (R) - Body ground	10 to 14 V*
Except R		Below 1 V
D and S	B12-26 (D) - Body ground	10 to 14 V
Except D and S		Below 1 V
S, "+" and "-"	A10-25 (S) - Body ground	10 to 14 V
Except S, "+" and "-"		Below 1 V

HINT:

*: The voltage will drop slightly due to lighting up of the back up light.

(c) Reconnect the ECM connectors.

NG

REPAIR OR REPLACE HARNESS OR CONNECTOR

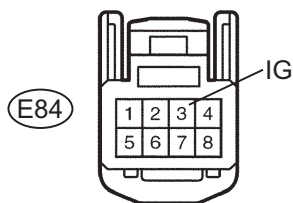
OK

8

CHECK HARNESS AND CONNECTOR

Wire Harness Side:

Transmission Control Switch



C110345E27

- Disconnect the transmission control switch connector from the shift lock control unit assembly.
- Turn the engine switch on (IG).
- Measure the voltage according to the value(s) in the table below.

Standard voltage

Tester Connection	Specified Condition
IG (E84-3) - Body ground	10 to 14 V

- Reconnect the transmission control switch connector.

NG

REPAIR OR REPLACE HARNESS OR CONNECTOR

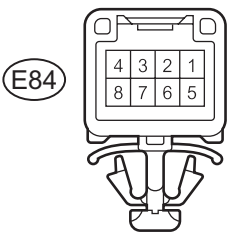
OK

ES

9INSPECT TRANSMISSION CONTROL SWITCH

Component Side:

Transmission Control Switch



C136860E07

- (a) Disconnect the E84 transmission control switch connector.
- (b) Measure the resistance according to the value(s) in the table below when the shift lever is moved to each position.

Standard resistance

Shift Position	Tester Connection	Specified Condition
S, "+" and "-"	3 - 7	Below 1 Ω
Except S, "+" and "-"		10 kΩ or higher

- (c) Reconnect the transmission control switch.

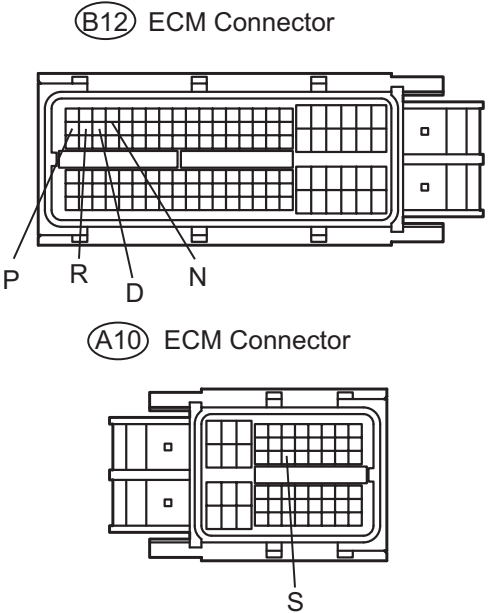
NG

REPLACE TRANSMISSION CONTROL SWITCH

OK

10CHECK HARNESS AND CONNECTOR

Wire Harness Side:



C136857E08

- (a) Disconnect the ECM connectors.
- (b) Turn the engine switch on (IG), and measure the voltage according to the value(s) in the table below when the shift lever is moved to each position.

Standard voltage

Shift Position	Tester Connection	Specified Condition
P	B12-24 (P) - Body ground	10 to 14 V
Except P		Below 1 V
N	B12-27 (N) - Body ground	10 to 14 V
Except N		Below 1 V

Shift Position	Tester Connection	Specified Condition
R	B12-25 (R) - Body ground	10 to 14 V *
Except R		Below 1 V
D and S	B12-26 (D) - Body ground	10 to 14 V
Except D and S		Below 1 V
S, "+" and "-"	A10-25 (S) - Body ground	10 to 14 V
Except S, "+" and "-"		Below 1 V

HINT:

The voltage will drop slightly due to lighting up of the back up light.

- (c) Reconnect the ECM connectors.

NG

REPAIR OR REPLACE HARNESS OR CONNECTOR

ES

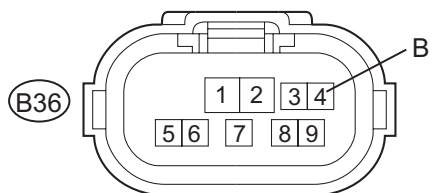
OK

REPLACE ECM (See page [ES-543](#))

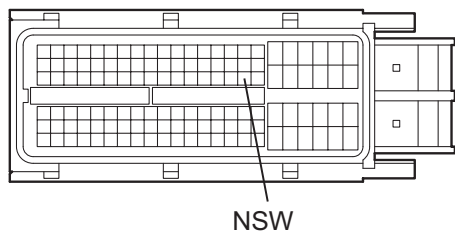
11**CHECK HARNESS AND CONNECTOR (PARK/NEUTRAL POSITION SWITCH - ECM)**

Wire Harness Side:

Park/Neutral Position SW



(B12) ECM Connector



C136861E11

- (a) Disconnect the ECM connectors.
 (b) Turn the engine switch off.
 (c) Measure the resistance according to the value(s) in the table below.

Standard resistance (Check for open)

Tester Connection	Specified Condition
B (B36-4) - NSW (B12-62)	Below 1 Ω

Standard resistance (Check for short)

Tester Connection	Specified Condition
B (B36-4) or NSW (B12-62) - Body ground	10 k Ω or higher

NG

REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

REPLACE ECM (See page [ES-543](#))