SFI SYSTEM

PRECAUTION

NOTICE:

- **Perform the RESET MEMORY (A/T initialization) operation after replacing the automatic transmission assembly, engine assembly or ECM.**
- **Initialize the following systems after disconnecting and reconnecting the cable to the negative (-) battery terminal.**

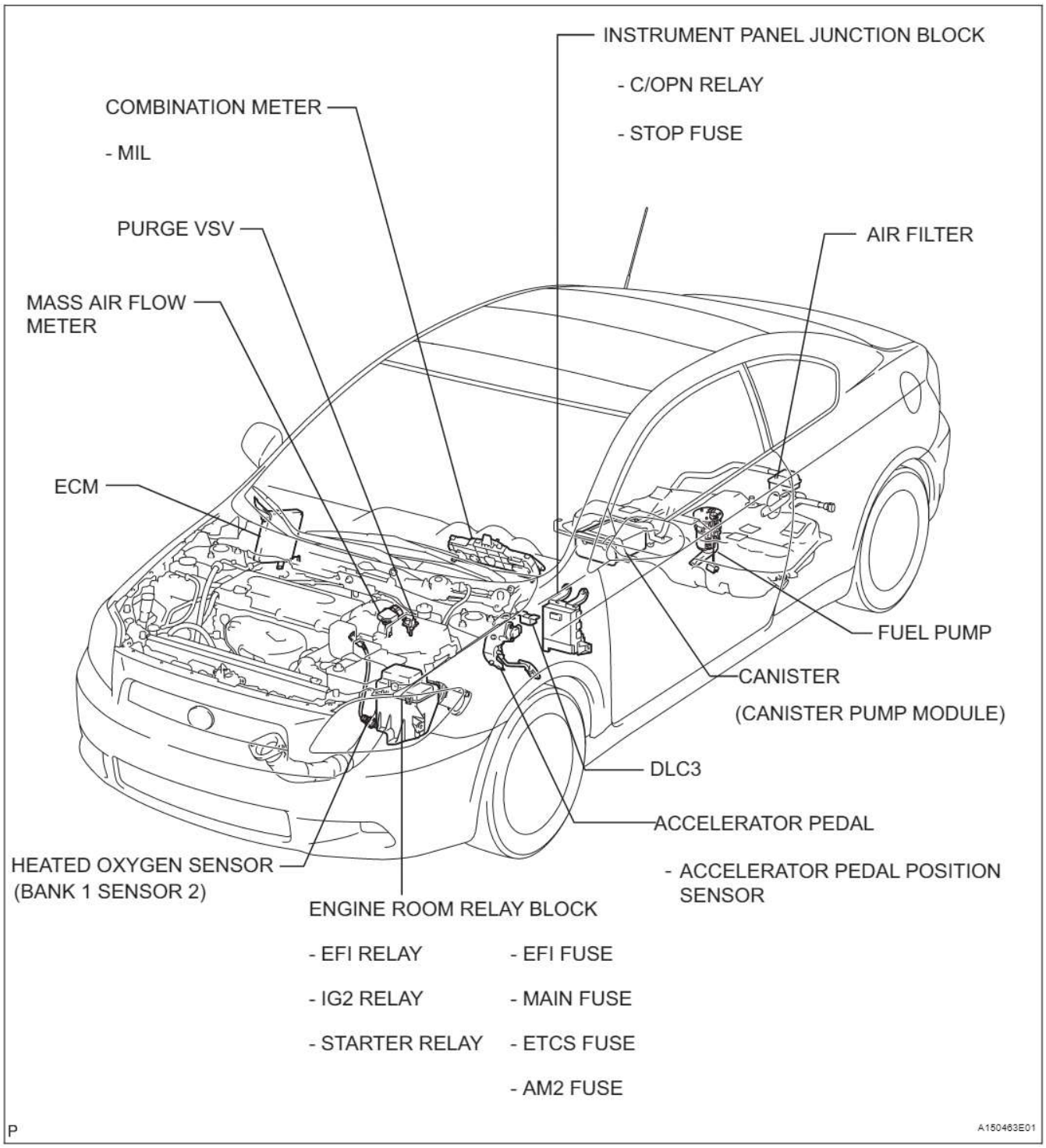
System Name	See procedure
Power Window Control System (with Jam Protection Function)	IN-23
Sliding Roof System	IN-23

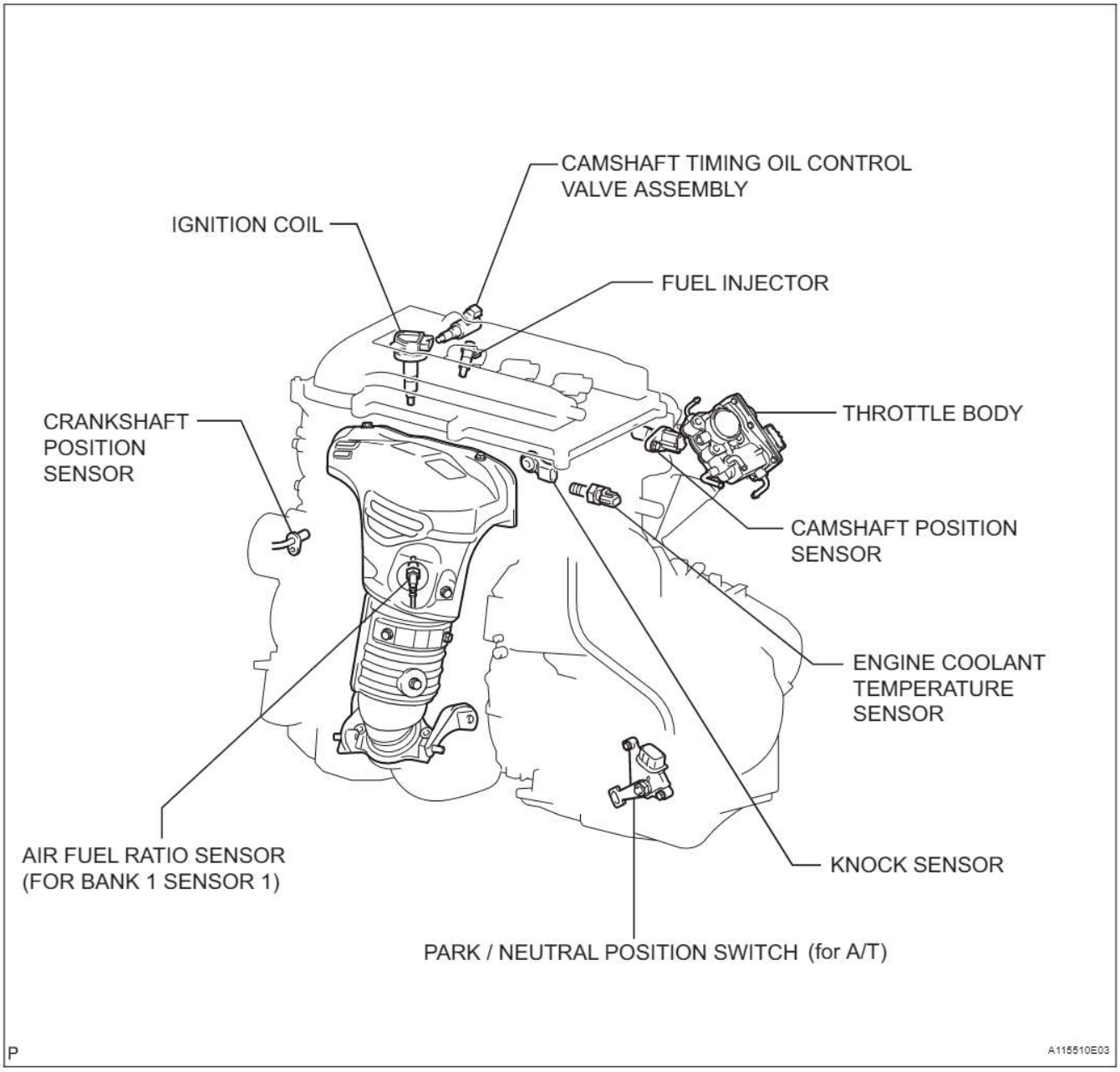
ES

DEFINITION OF TERMS

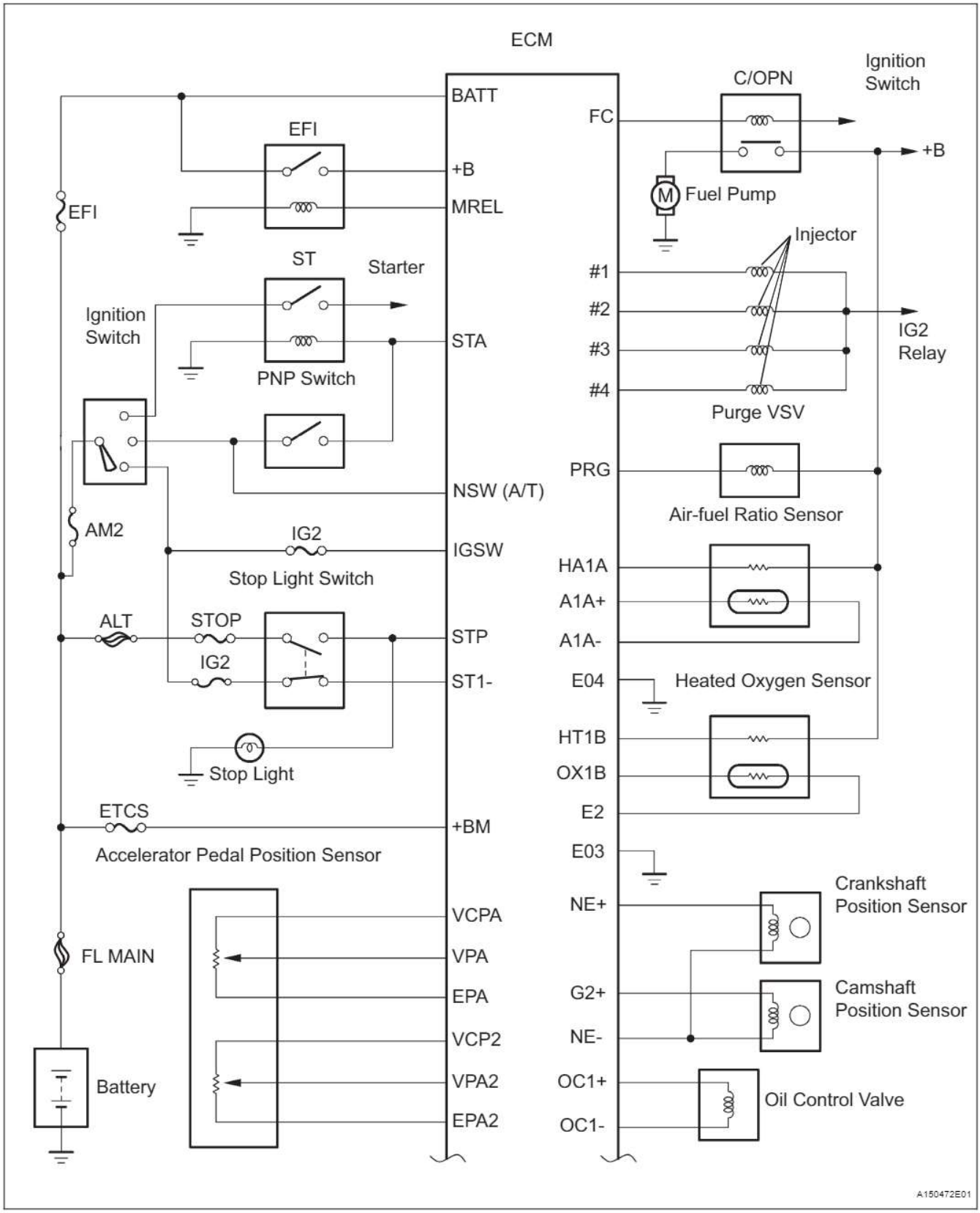
Terms	Definitions
Monitor description	Description of what the ECM monitors and how it detects malfunctions (monitoring purpose and its details).
Related DTCs	A group of diagnostic trouble codes that are output by ECM based on same malfunction detection logic.
Typical enabling condition	Preconditions that allow ECM to detect malfunctions. With all preconditions satisfied, ECM sets DTC when monitored value(s) exceeds malfunction threshold(s).
Sequence of operation	Order of monitor priority, applied if multiple sensors and components are involved in single malfunction detection process. Each sensor and component monitored in turn and not monitored until previous detection operation completed.
Required sensor/components	Sensors and components used by ECM to detect each malfunction.
Frequency of operation	Number of times ECM checks for each malfunction during each driving cycle. "Once per driving cycle" means ECM only performs checks for that malfunction once during single driving cycle. "Continuous" means ECM performs checks for that malfunction whenever enabling conditions are met.
Duration	Minimum time for which ECM must detect continuous deviation in monitored value(s) in order to set DTC. Timing begins when Typical Enabling Conditions are met.
Malfunction thresholds	Value beyond which ECM determines malfunctions exist and sets DTCs.
MIL operation	Timing of MIL illumination after malfunction detected. "Immediate" means ECM illuminates MIL as soon as malfunction detected. "2 driving cycle" means ECM illuminates MIL if same malfunction detected second time during next sequential driving cycle.

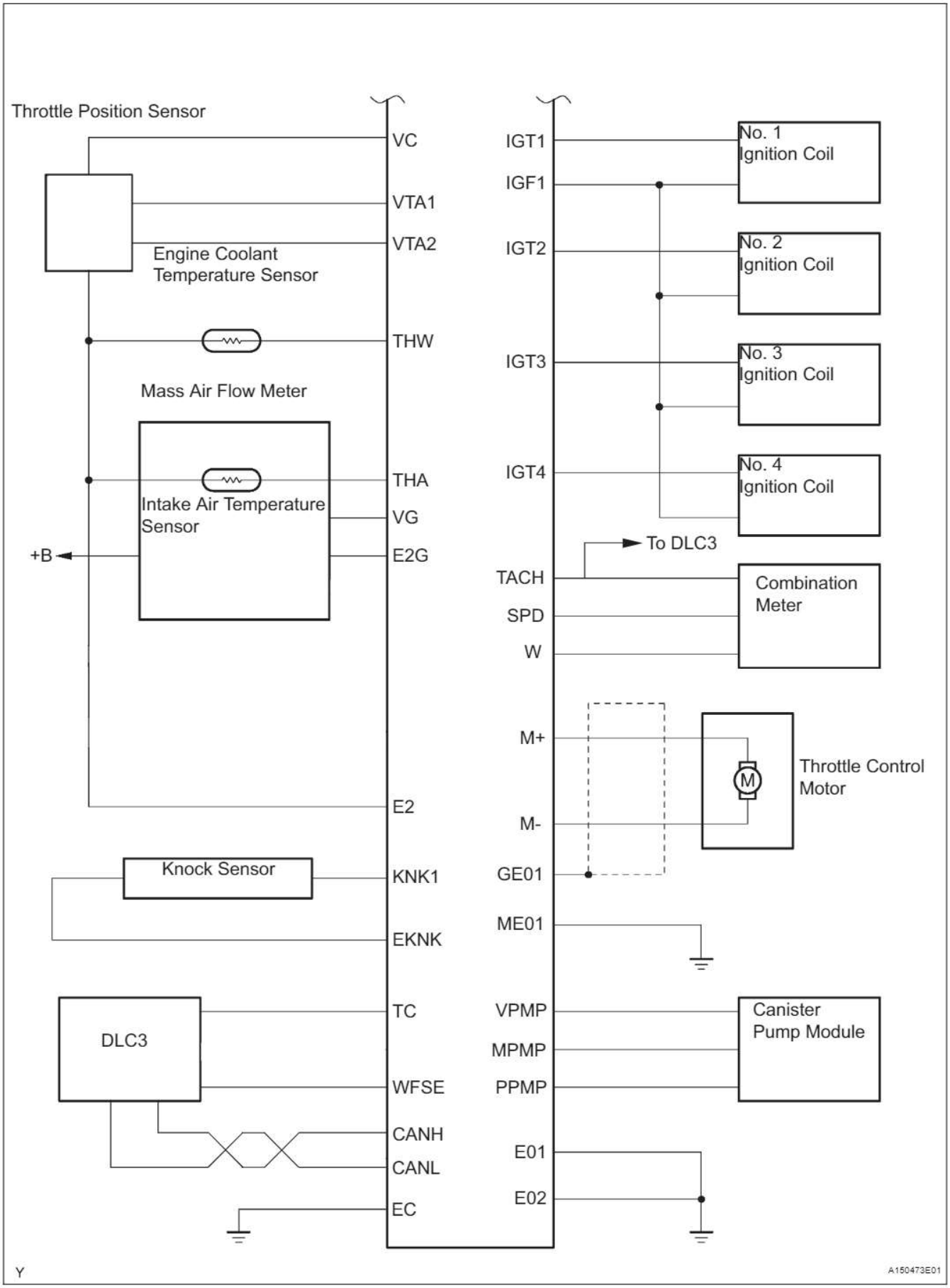
PARTS LOCATION




CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY
IGNITION COIL
FUEL INJECTOR
THROTTLE BODY
CRANKSHAFT POSITION SENSOR
CAMSHAFT POSITION SENSOR
ENGINE COOLANT TEMPERATURE SENSOR
AIR FUEL RATIO SENSOR (FOR BANK 1 SENSOR 1)
KNOCK SENSOR
PARK / NEUTRAL POSITION SWITCH (for A/T)
P
A115510E03

SYSTEM DIAGRAM




Throttle Position Sensor
VC
VTA1
VTA2
Engine Coolant Temperature Sensor
THW
Mass Air Flow Meter
THA
Intake Air Temperature Sensor
VG
+B
E2G
E2
Knock Sensor
KNK1
EKNK
DLC3
TC
WFSE
CANH
CANL
EC
IGT1
IGF1
IGT2
IGT3
IGT4
No. 1 Ignition Coil
No. 2 Ignition Coil
No. 3 Ignition Coil
No. 4 Ignition Coil
To DLC3
TACH
SPD
W
Combination Meter
M+
M-
M
Throttle Control Motor
GE01
ME01
VPMP
MPMP
PPMP
Canister Pump Module
E01
E02
Y
A150473E01

HOW TO PROCEED WITH TROUBLESHOOTING

HINT:
*: Use the intelligent tester.

1	VEHICLE BROUGHT TO WORKSHOP

NEXT

2	CUSTOMER PROBLEM ANALYSIS

NEXT

3	CONNECT INTELLIGENT TESTER TO DLC3*

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

NEXT

4	CHECK DTC AND FREEZE FRAME DATA*

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

NEXT

5	CLEAR DTC AND FREEZE FRAME DATA*

NEXT

6	CONDUCT VISUAL INSPECTION

NEXT

7	SET CHECK MODE DIAGNOSIS*

NEXT

8	CONFIRM PROBLEM SYMPTOMS

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

Result	Proceed to
Malfunction does not occur	A
Malfunction occurs	B

B → GO TO STEP 10

ES

A

9	SIMULATE SYMPTOMS

NEXT

10	CHECK FOR DTC*

Result	Proceed to
Trouble code	A
No code	B

B → GO TO STEP 12

A

11	REFER TO DTC CHART

NEXT

GO TO STEP 14

12	CONDUCT BASIC INSPECTION

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

B → GO TO STEP 17

A

13	REFER TO PROBLEM SYMPTOMS TABLE

Result	Proceed to
Malfunctioning circuit confirmed	A
Malfunctioning parts confirmed	B

B → GO TO STEP 17

A

14	CHECK ECM POWER SOURCE CIRCUIT

ES

NEXT

15	CONDUCT CIRCUIT INSPECTION

Result	Proceed to
Malfunction not confirmed	A
Malfunction confirmed	B

B → GO TO STEP 18

A

16	CHECK FOR INTERMITTENT PROBLEMS

NEXT

GO TO STEP 18

17	CONDUCT PARTS INSPECTION

NEXT

18	IDENTIFY PROBLEM

NEXT

19	ADJUST AND/OR REPAIR

NEXT

20	CONDUCT CONFIRMATION TEST

NEXT

END

CHECK FOR INTERMITTENT PROBLEMS

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

1. **Clear the DTCs (See page ES-32).**
2. **Switch the ECM from normal mode to check mode using an intelligent tester (See page ES-35).**
3. **Perform a simulation test (See page IN-26).**
4. **Check and wiggle the harnesses, connectors and terminals (See page IN-34).**

BASIC INSPECTION

When a malfunction is not confirmed by the DTC check, troubleshooting should be carried out in all circuits considered to be possible causes of the problem. In many cases, by carrying out the basic engine check shown in the following flowchart, the location of the problem can be found quickly and efficiently. Therefore, using this check is essential when engine troubleshooting.

ES

1 CHECK BATTERY VOLTAGE

NOTICE:
Carry out this check with the engine stopped and ignition switch off.

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

NG → **CHARGE OR REPLACE BATTERY**

OK

2 CHECK WHETHER ENGINE CRANKS

NG → **PROCEED TO PROBLEM SYMPTOMS TABLE**

OK

3 CHECK WHETHER ENGINE STARTS

NG → **GO TO STEP 6**

OK

4 CHECK AIR FILTER

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

NG → **REPLACE AIR FILTER**

OK

5 CHECK IDLING SPEED

NG → **PROCEED TO PROBLEM SYMPTOMS TABLE**

OK

6	CHECK FUEL PRESSURE

NG → TROUBLESHOOT FUEL SYSTEM AND PROCEED TO NEXT STEP

OK

7	CHECK FOR SPARK

NG → TROUBLESHOOT IGNITION SYSTEM AND PROCEED TO NEXT STEP

OK

PROCEED TO PROBLEM SYMPTOMS TABLE

ES

REGISTRATION

NOTICE:
The Vehicle Identification Number (VIN) must be input into the replacement ECM.
HINT:
The VIN is in the form of a 17-digit alphanumeric vehicle identification number. An intelligent tester is required to register the VIN.

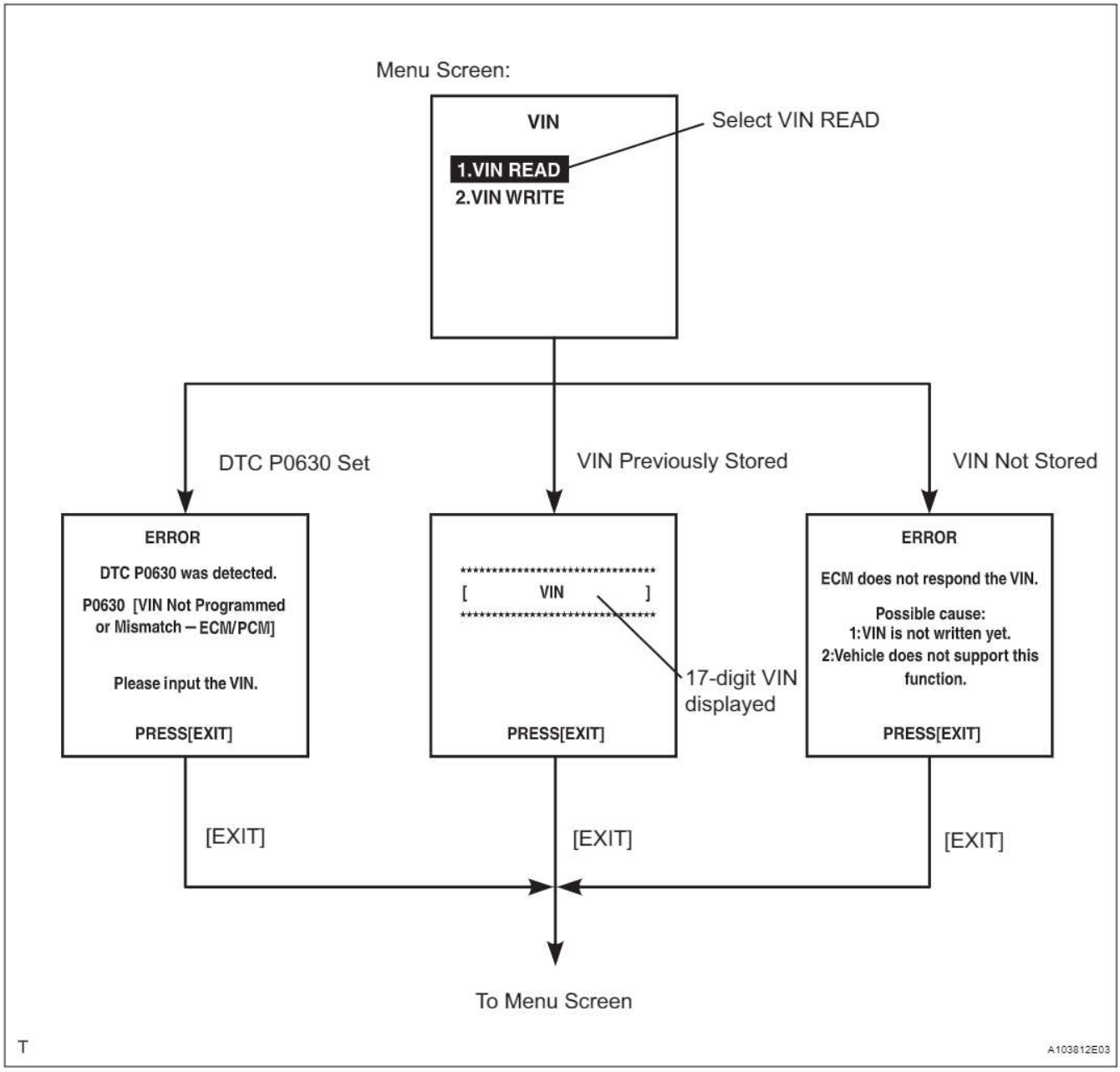
1. INPUT INSTRUCTIONS

(a) The general VIN input instructions using an intelligent tester are explained below.
(b) The arrow buttons (UP, DOWN, RIGHT and LEFT) and numerical buttons (0 to 9) are used, in order to input the VIN.
(c) Cursor Operation
To move the cursor around the tester screen, press the RIGHT and LEFT buttons.
(d) Alphabetical Character Input
(1) Press the UP and DOWN buttons to select the desired alphabetical character.
(2) After selection, the cursor should move.
(e) Numeric Character Input
(1) Press the numerical button corresponding to the number that you want to input.
(2) Select or input the correct character using the UP/DOWN buttons, or the numerical buttons.
HINT:
Numerical characters can also be selected and input using the UP and DOWN buttons.
(f) Correction
(1) After input, the cursor should move.
(2) When correcting the input character(s), put the cursor onto the character using the RIGHT or LEFT buttons.
(g) Finishing Input Operation
(1) Make sure that the input VIN matches the vehicle VIN after input.
(2) Press the ENTER button on the tester.

2. READ VIN (Vehicle Identification Number)

(a) The VIN reading process is explained in a flowchart. This process allows the VIN stored in the ECM to be read in order to confirm that the 2 VINs, provided with the vehicle and stored in the vehicle's ECM, are the same.
(b) Read the VIN using an intelligent tester.
(c) Check the vehicle's VIN.
(d) Connect the intelligent tester to the DLC3.
(e) Turn the ignition switch to the ON position.
(f) Turn the tester on.

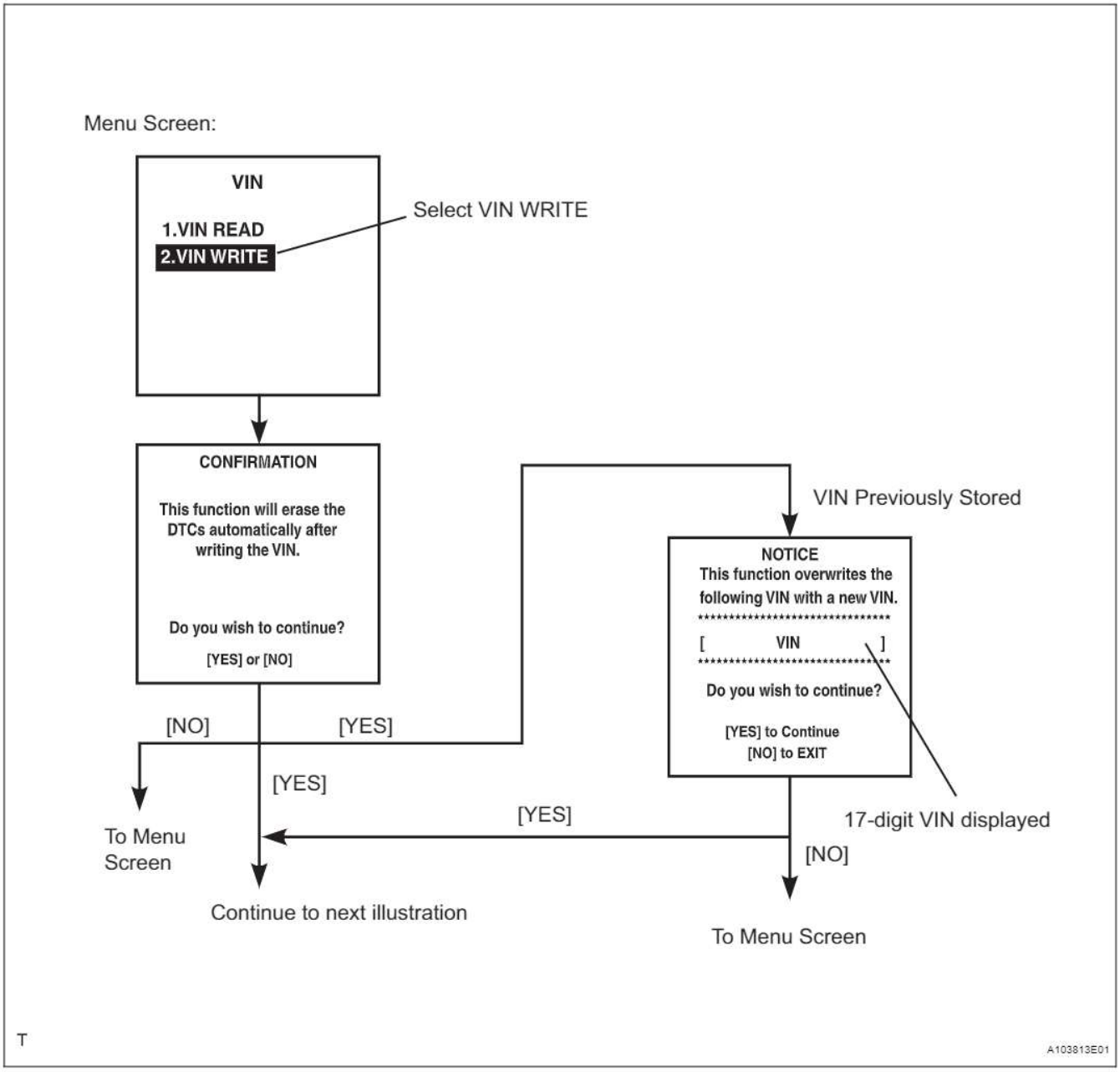
(g) Enter the following menus: DIAGNOSIS / ENHANCED OBD II/ VIN.

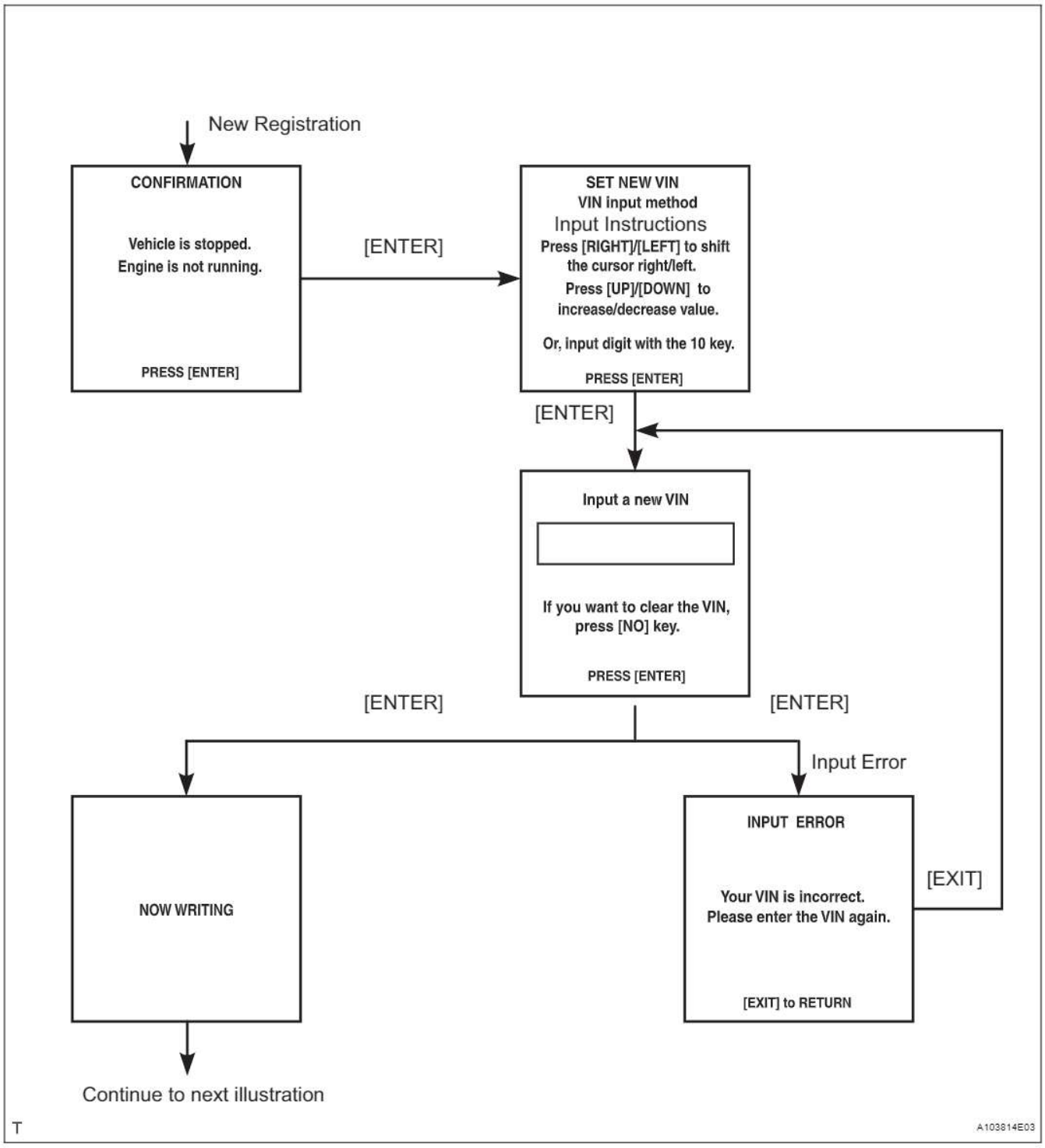


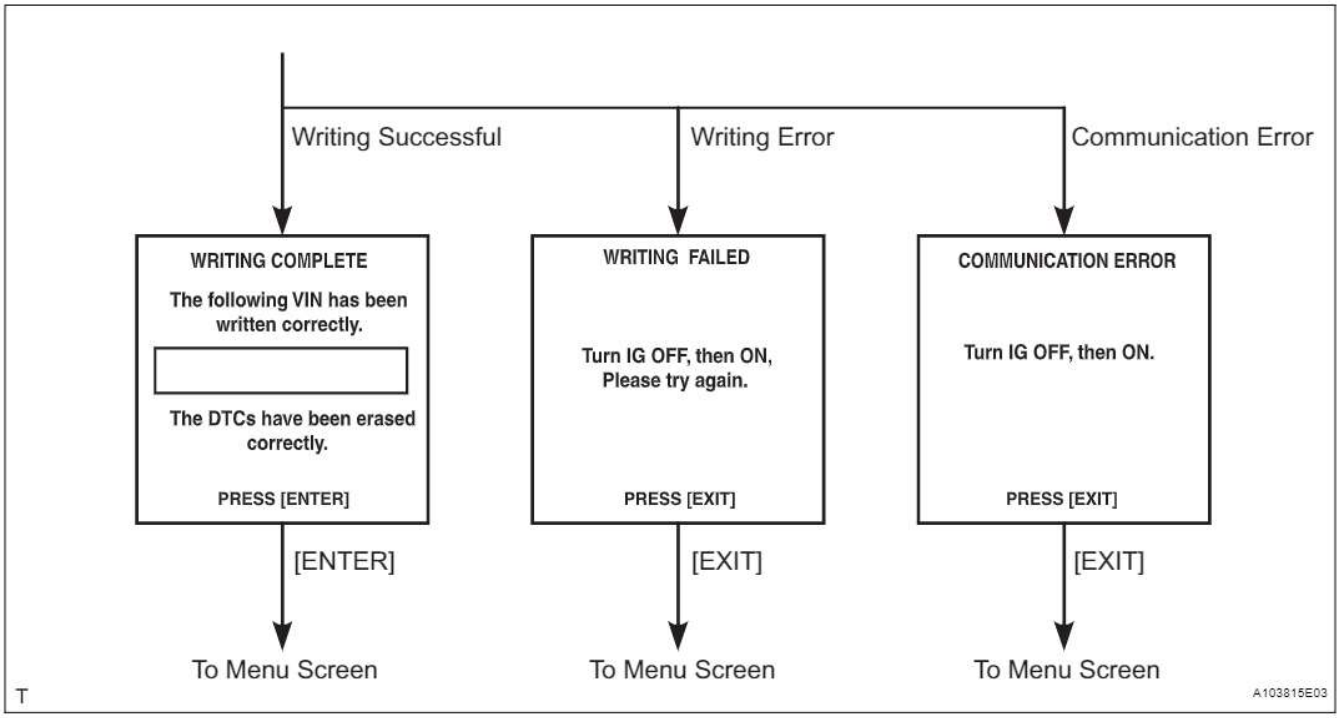
3. WRITE VIN

(a) The VIN writing process is explained in a flowchart. This process allows the VIN to be input into the ECM. If the ECM is changed, or the 2 VINs do not match, the VIN can be registered, or overwritten in the ECM by following this procedure.
(b) Write the VIN using the intelligent tester.
(c) Check the vehicle's VIN.
(d) Connect the intelligent tester to the DLC3.
(e) Turn the ignition switch to the ON position.
(f) Turn the tester on.

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




New Registration
CONFIRMATION
Vehicle is stopped.
Engine is not running.
PRESS [ENTER]
[ENTER]
SET NEW VIN
VIN input method
Input Instructions
Press [RIGHT]/[LEFT] to shift the cursor right/left.
Press [UP]/[DOWN] to increase/decrease value.
Or, input digit with the 10 key.
PRESS [ENTER]
[ENTER]
Input a new VIN
If you want to clear the VIN, press [NO] key.
PRESS [ENTER]
[ENTER]
[ENTER]
Input Error
NOW WRITING
INPUT ERROR
Your VIN is incorrect.
Please enter the VIN again.
[EXIT] to RETURN
[EXIT]
Continue to next illustration
T
A103814E03


Writing Successful
Writing Error
Communication Error
WRITING COMPLETE
The following VIN has been written correctly.
The DTCs have been erased correctly.
PRESS [ENTER]
WRITING FAILED
Turn IG OFF, then ON, Please try again.
PRESS [EXIT]
COMMUNICATION ERROR
Turn IG OFF, then ON.
PRESS [EXIT]
[ENTER]
[EXIT]
[EXIT]
To Menu Screen
To Menu Screen
To Menu Screen
T
A103815E03

CHECKING MONITOR STATUS

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

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

When the test value is not between the minimum and maximum test limits, the ECM (PCM) interprets this as a malfunction. If the test value is on the borderline of the test limits, the component is likely to malfunction in the near future.

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

1. PERFORM MONITOR DRIVE PATTERN

(a) Connect the intelligent tester to the DLC3.

(b) Turn the ignition switch to the ON position and the tester on.

(c) Clear the DTCs (See page ES-32).

(d) Run the vehicle in accordance with the applicable drive pattern described in READINESS MONITOR DRIVE PATTERN (See page ES-18). Do not turn the ignition switch off.

NOTICE:

The test results will be lost if the ignition switch is turned off.

2. ACCESS MONITOR RESULT

(a) Select the following items from the intelligent tester menus: DIAGNOSIS, ENHANCED OBD II, MONITOR INFO and MONITOR RESULT. The monitor status appears after the component name.

- INCMP: The component has not been monitored yet.
- PASS: The component is functioning normally.
- FAIL: The component is malfunctioning.

(b) Confirm that the component is either PASS or FAIL.

(c) Select the component and press ENTER. The accuracy test value appears if the monitor status is either PASS or FAIL.

3. CHECK COMPONENT STATUS

(a) Compare the test value with the minimum test limit (MIN LIMIT) and maximum test limit (MAX LIMIT).

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

4. MONITOR RESULT INFORMATION

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

A/F Sensor (Sensor 1)

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

HO2 Sensor (Sensor 2)

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

Catalyst

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

EVAP

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

Misfire

Monitor ID	Test ID	Scaling	Unit	Description
$A1	$0B	Multiply by 1	Time	Exponential Weighted Moving Average (EWMA) misfire for all cylinders: EWMA = Total misfire counts for last driving cycle * 0.1 + Last EWMA * 0.9 Misfire counts for last 10 driving cycles - Total
$A1	$0C	Multiply by 1	Time	Ignition switch on: Total misfire counts for last driving cycle Engine running: Total misfire counts for current driving cycle Misfire counts for last or current driving cycle - all cylinders

Monitor ID	Test ID	Scaling	Unit	Description
$A2	$0B	Multiply by 1	Time	Exponential Weighted Moving Average (EWMA) misfire for cylinder 1: EWMA = Total misfire counts for last driving cycle * 0.1 + Last EWMA * 0.9 Misfire counts for last 10 driving cycles - Total
$A2	$0C	Multiply by 1	Time	Ignition switch on: Total misfire counts for last driving cycle Engine running: Total misfire counts for current driving cycle Misfire counts for last or current driving cycle - cylinder 1
$A3	$0B	Multiply by 1	Time	Exponential Weighted Moving Average (EWMA) misfire for cylinder 2: EWMA = Total misfire counts for last driving cycle * 0.1 + Last EWMA * 0.9 Misfire counts for last 10 driving cycles - Total
$A3	$0C	Multiply by 1	Time	Ignition switch on: Total misfire counts for last driving cycle Engine running: Total misfire counts for current driving cycle Misfire counts for last or current driving cycle - cylinder 2
$A4	$0B	Multiply by 1	Time	Exponential Weighted Moving Average (EWMA) misfire for cylinder 3: EWMA = Total misfire counts for last driving cycle * 0.1 + Last EWMA * 0.9 Misfire counts for last 10 driving cycles - Total
$A4	$0C	Multiply by 1	Time	Ignition switch on: Total misfire counts for last driving cycle Engine running: Total misfire counts for current driving cycle Misfire counts for last or current driving cycle - cylinder 3
$A5	$0B	Multiply by 1	Time	Exponential Weighted Moving Average (EWMA) misfire for cylinder 4: EWMA = Total misfire counts for last driving cycle * 0.1 + Last EWMA * 0.9 Misfire counts for last 10 driving cycles - Total
$A5	$0C	Multiply by 1	Time	Ignition switch on: Total misfire counts for last driving cycle Engine running: Total misfire counts for current driving cycle Misfire counts for last or current driving cycle - cylinder 4

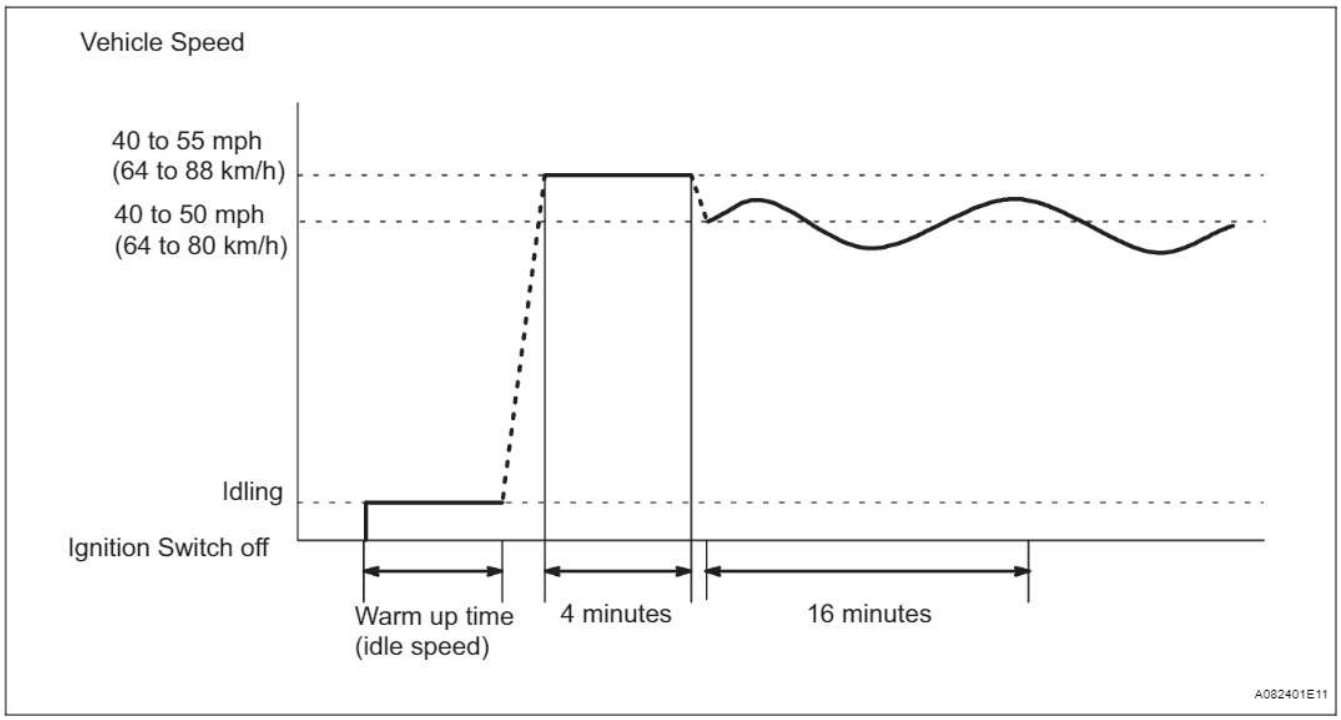
READINESS MONITOR DRIVE PATTERN

1. PURPOSE OF READINESS TESTS

- The On-Board Diagnostic (OBD II) system is designed to monitor the performance of emission related components, and indicate any detected abnormalities with DTCs (Diagnostic Trouble Codes). Since various components need to be monitored during different driving conditions, the OBD II system is designed to run separate monitoring programs called Readiness Monitors.
- The intelligent tester's software must be version 9.0 or newer to view the Readiness Monitor Status. To view the status, enter the following menus: DIAGNOSIS / ENHANCED OBD II / MONITOR INFO / MONITOR STATUS.
- When the Readiness Monitor status reads COMPL (complete), the necessary conditions have been met for running the performance tests for that Readiness Monitor.
- A generic OBD II scan tool can also be used to view the Readiness Monitor status.
  HINT:
  Many state Inspection and Maintenance (I/M) programs require a vehicle's Readiness Monitor status to show COMPL before beginning emissions tests.
  The Readiness Monitor will be reset to INCMPL (incomplete) if:
  - The ECM has lost battery power or blown a fuse.
  - DTCs have been cleared.
  - The conditions for running the Readiness Monitor have not been met.

  If the Readiness Monitor Status shows INCMPL, follow the appropriate Readiness Monitor Drive Pattern to change the status to COMPL.
  CAUTION:
  Strictly observe posted speed limits, traffic laws, and road conditions when performing these drive patterns.
  NOTICE:
  The drive patterns represent the fastest method of satisfying all conditions necessary to achieve complete status for each specific Readiness Monitor. If a drive pattern is interrupted (possibly due to factors such as traffic conditions), the drive pattern can be resumed. In most cases, the Readiness Monitor will still achieve complete status upon completion of the drive pattern.
  To ensure completion of the Readiness Monitors, avoid sudden changes in vehicle load and speed (driving up and down hills and/or sudden acceleration).

2. CATALYST MONITOR (AIR-FUEL RATIO (A/F) SENSOR TYPE)



(a) Preconditions

The monitor will not run unless:

– The MIL is OFF
– Engine Coolant Temperature (ECT) is 75°C (167°F) or higher.
– Intake Air Temperature (IAT) is -10°C (14°F) or higher.

(b) Drive Pattern

Step 1

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

Step 2

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

NOTICE:

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

Step 3

Drive the vehicle allowing speed to fluctuate between 40 to 50 mph (64 to 80 km/h) for approximately 7 minutes.

NOTICE:

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

Step 4

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

3. EVAP SYSTEM MONITOR (KEY OFF TYPE)

(a) Preconditions

The monitor will not run unless:

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

(b) Monitor Conditions

(1) Turn the ignition switch off and wait for 9.5 hours.

HINT:

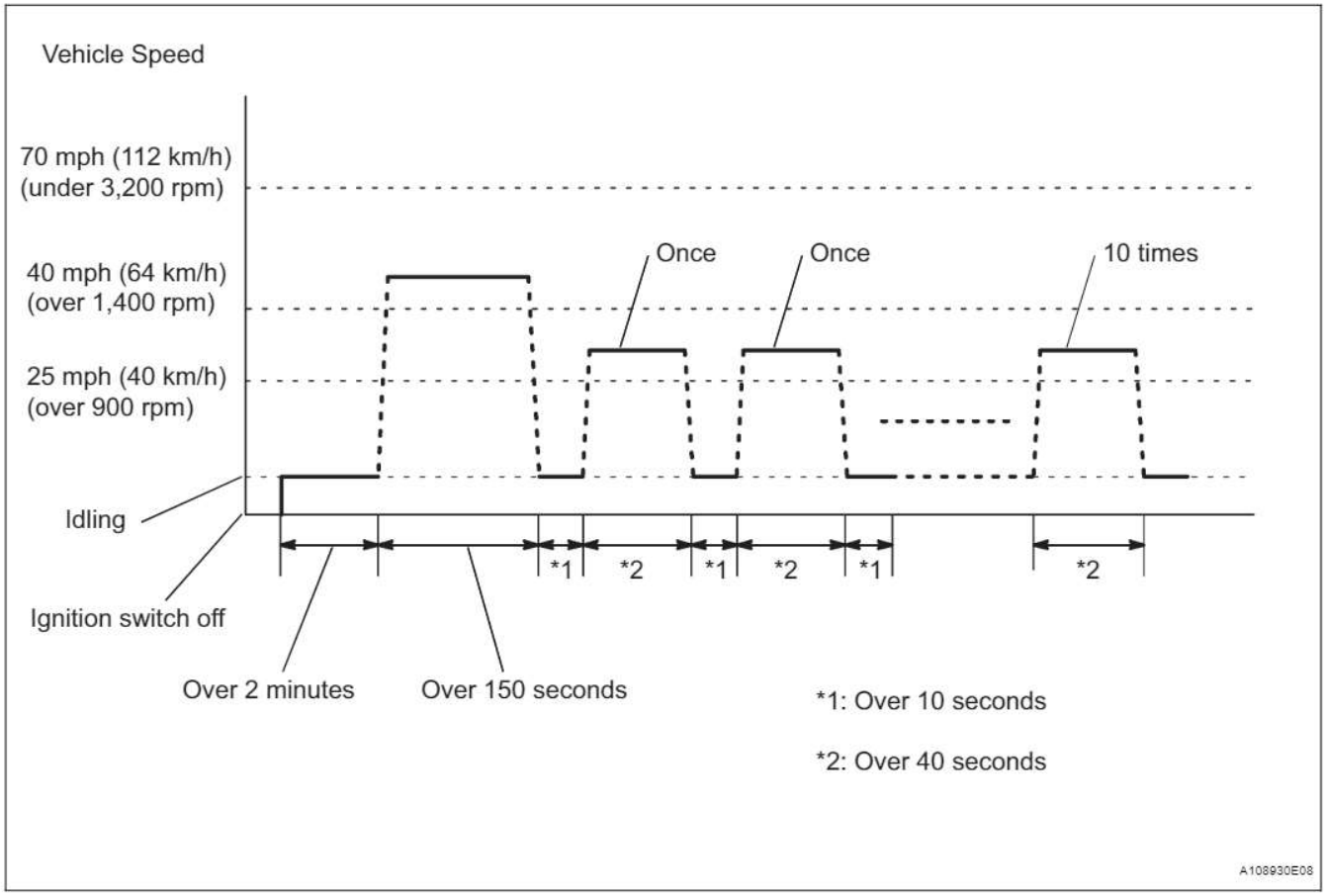
Do not start the engine until checking Readiness Monitor status. If the engine is started, the step described above must be repeated.

(c) Monitor Status

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

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

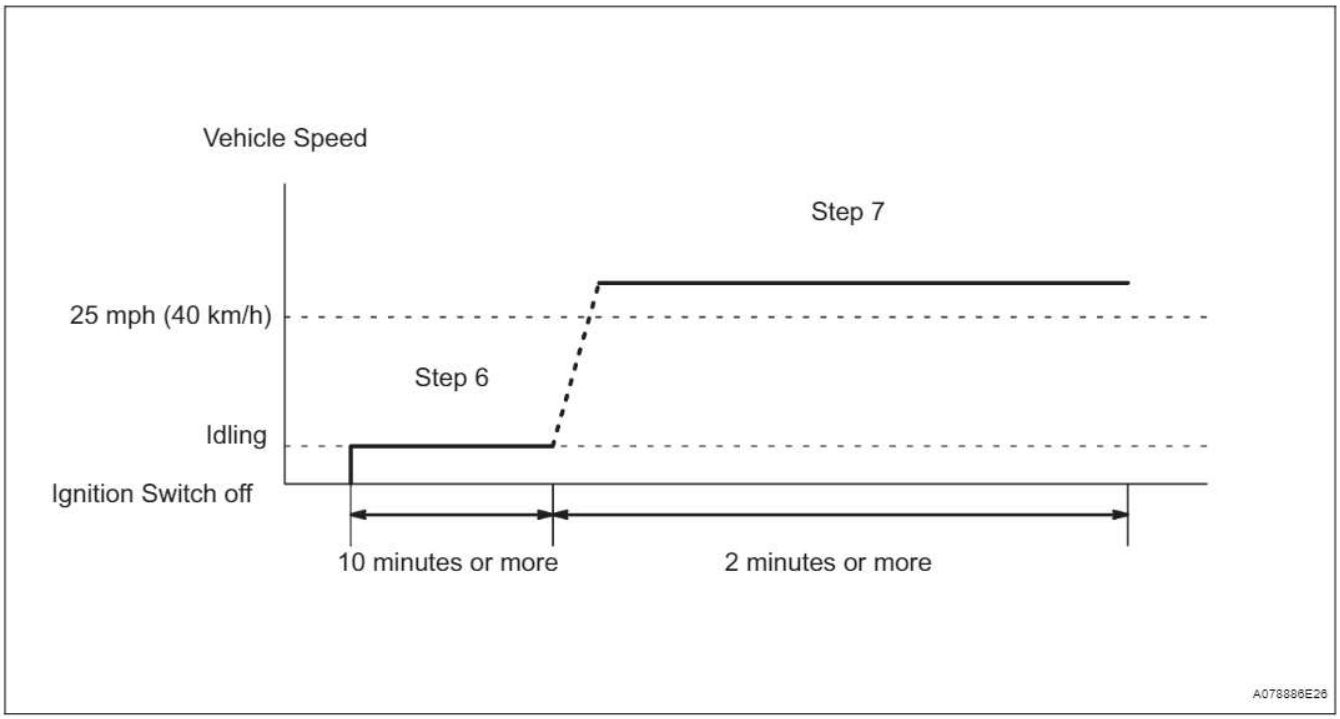
4. AIR-FUEL RATIO (A/F) AND HEATED OXYGEN (HO2) SENSOR MONITORS (FRONT A/F AND REAR HO2 SENSOR TYPE)



(a) Preconditions
The monitor will not run unless:
The MIL is OFF.
(b) Drive Pattern
Step 1
Connect the intelligent tester to the DLC3 to check monitor status and preconditions (refer to step (a)).
Step 2
Start the engine and allow it to idle for 2 minutes or more.
Step 3
Drive the vehicle at 40 to 70 mph (64 to 112 km/h) for at least 150 seconds.
Step 4
Stop the vehicle and allow the engine to idle for 10 seconds or more.
Step 5
Drive the vehicle at 25 to 40 mph (40 to 64 km/h) for at least 40 seconds.
Step 6
Stop the vehicle and allow the engine to idle for 10 seconds or more.
Step 7
Perform steps 5 and 6 ten times.
Step 8

Check the readiness monitor status. If the readiness monitor status did not change to COMPL (complete), check the preconditions, turn the ignition switch off, and repeat steps 1 to 6.

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



(a) Preconditions
The monitor will not run unless:
The MIL is OFF.
(b) Drive Pattern
Step 1
Connect the intelligent tester to the DLC3.
Step 2
Turn the ignition switch to the ON position.
Step 3
Turn the tester on.
Step 4
Clear the DTCs (where set).
Step 5
Start the engine.
Step 6
Allow the engine to idle for 10 minutes or more.
Step 7
Drive the vehicle at 25 mph (40 km/h) or more for at least 2 minutes.
(c) Monitor Status
(1) Check the Readiness Monitor status displayed on the tester.
If the status does not switch to COMPL (complete), make sure that the preconditions have been met, and repeat steps 5 to 7 described in the Drive Pattern above.

PROBLEM SYMPTOMS TABLE

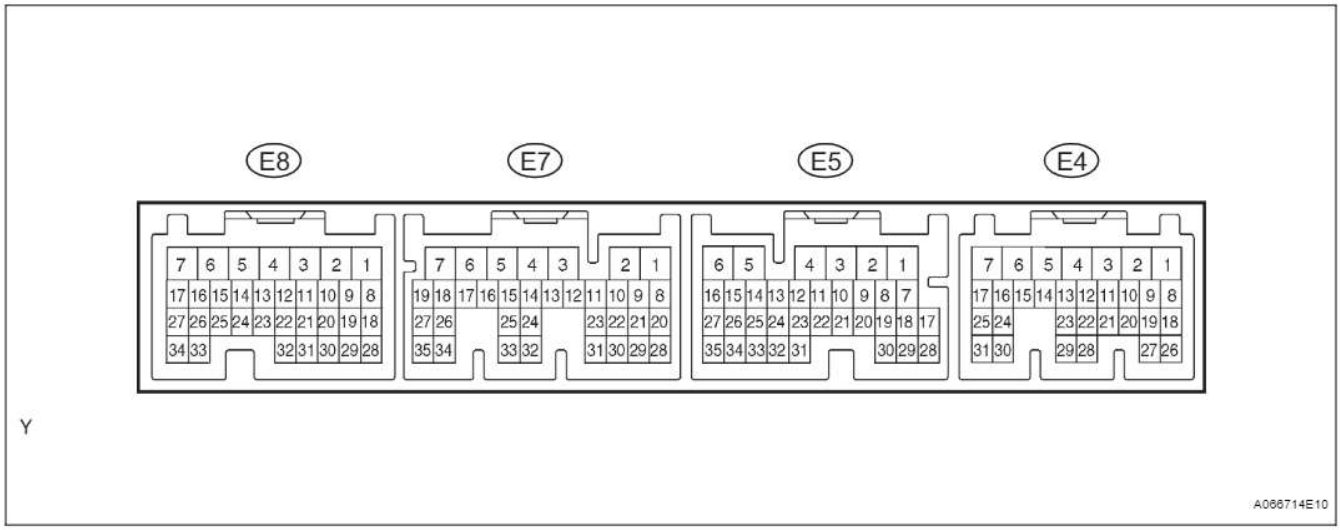
HINT:
When a malfunction is not confirmed by a DTC (Diagnostic Trouble Code) check and the cause of problem cannot be identified through a basic inspection, troubleshoot according to the priority order indicated in the table below.

SFI system

Symptom	Suspected Area	See page
Engine does not crank (Does not start)	1. Immobiliser system	EI-3
	2. Starter	ST-8
	3. STARTER relay	ST-15
No initial combustion (Does not start)	1. ECM power source circuit	ES-346
	2. ECM VC output circuit	ES-351
	3. Fuel pump control circuit	ES-354
	4. ECM	ES-407
Engine cranks normally but difficult to start	1. Fuel pump control circuit	ES-354
	2. Compression	EM-3
Difficult to start with cold engine	1. Start signal circuit	ST-3
	2. Fuel pump control circuit	ES-354
	3. Spark plug	IG-4
	4. Ignition system	IG-4
	5. Injector	FU-9
Difficult to start with warm engine	1. Start signal circuit	ST-3
	2. Fuel pump control circuit	ES-354
	3. Spark plug	IG-4
	4. Ignition system	IG-4
	5. Injector	FU-9
High engine idling speed (Poor idling)	1. A/C signal circuit (compressor circuit)	-
	2. ECM power source circuit	ES-346
	3. Electronic throttle control system	ES-252
	4. Air induction system	-
	5. PCV hose	-
Low engine idling speed (Poor idling)	1. A/C signal circuit (compressor circuit)	-
	2. Fuel pump control circuit	ES-354
	3. Electronic throttle control system	ES-252
	4. Air induction system	-
	5. PCV hose	-
Rough Idling (Poor idling)	1. Compression	EM-3
	2. Fuel pump control circuit	ES-354
	3. Electronic throttle control system	ES-252
	4. Air induction system	-
	5. PCV hose	-
Hunting (Poor idling)	1. ECM power source circuit	ES-346
	2. Fuel pump control circuit	ES-354
	3. Spark plug	IG-4
	4. Ignition system	IG-4
	5. Injector	FU-9
	6. Electronic throttle control system	ES-252
	7. Air induction system	-
	8. PCV hose	-

Symptom	Suspected Area	See page
Hesitation/Poor acceleration (Poor driveability)	1. Fuel pump control circuit	ES-354
	2. A/T faulty*	AX-7
	3. Spark plug	IG-4
	4. Ignition system	IG-4
	5. Injector	FU-7
Surging (Poor driveability)	1. Fuel pump control circuit	ES-354
	3. Spark plug	IG-4
	4. Ignition system	IG-4
	5. Injector	FU-9
Engine stalls soon after starting	1. Fuel pump control circuit	ES-354
	2. Spark plug	IG-4
	3. Ignition system	IG-4
	4. Injector	FU-9
Engine stalls during A/C operation	1. A/C signal circuit (compressor circuit)	-
	2. ECM	ES-407
Unable/difficult to refuel	Refueling valve (canister)	-

TERMINALS OF ECM



HINT:
The standard normal voltage between each pair of the ECM terminals is shown in the table below. The appropriate conditions for checking each pair of the terminals are also indicated. The result of checks should be compared with the standard normal voltage for that pair of the terminals, and displayed in the "Specified Conditions" column. The illustration above can be used as a reference to identify the ECM terminal locations.

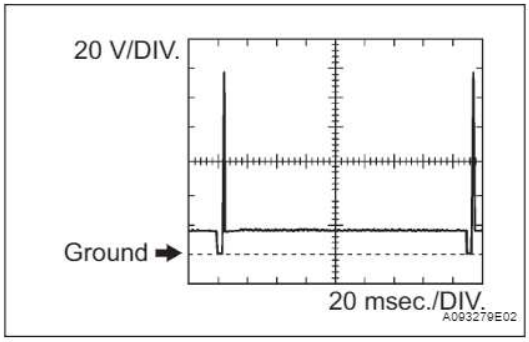
Terminal No. (Symbols)	Wiring Color	Terminal Description	Condition	Specified Condition
E4-3 (BATT) - E8-3 (E1)	V - L	Battery (for measuring battery voltage and for ECM memory)	Always	9 to 14 V
E4-7 (+BM) - E8-3 (E1)	BR - L	Power source of throttle motor	Always	9 to 14 V
E4-9 (IGSW) - E8-3 (E1)	G - L	Ignition switch	Ignition switch ON	9 to 14 V
E4-1 (+B) - E8-3 (E1)	GR - L	Power source of ECM	Ignition switch ON	9 to 14 V
E4-2 (+B2) - E8-3 (E1)	O - L	Power source of ECM	Ignition switch ON	9 to 14 V
E8-13 (OC1+) - E8-12 (OC1-)	Y - W	Camshaft timing oil control valve (OCV)	Ignition switch ON	Pulse generation (See waveform 8)
E4-8 (MREL) - E8-7 (E01)	O - B	EFI relay	Ignition switch ON	9 to 14 V
E8-18 (VC) - E8-28 (E2)	V - R	Power source of sensor (specific voltage)	Ignition switch ON	4.5 to 5.5 V
E7-28 (VG) - E7-30 (E2G)	R - W	Mass air flow meter	Idling, shift lever position P or N position, A/C switch OFF	0.5 to 3.0 V
E7-29 (THA) - E8-28 (E2)	L - R	Intake air temperature sensor	Idling, intake air temp. 20°C (68°F)	0.5 to 3.4 V
E8-32 (THW) - E8-28 (E2)	G - R	Engine coolant temperature sensor	Idling, engine coolant temp. 80°C (176°F)	0.2 to 1.0 V
E8-20 (VTA1) - E8-28 (E2)	LG - R	Throttle position sensor (for engine control)	Ignition switch ON, accelerator pedal released	0.3 to 1.0 V
			Ignition switch ON, accelerator pedal depressed	3.2 to 4.9 V
E8-19 (VTA2) - E8-28 (E2)	BR - R	Throttle position sensor (for sensor malfunction detection)	Ignition switch ON, accelerator pedal released	2.1 to 3.1 V
			Ignition switch ON, accelerator pedal depressed	4.5 to 5.5 V

Terminal No. (Symbols)	Wiring Color	Terminal Description	Condition	Specified Condition
E4-18 (VPA) - E4-20 (EPA)	W - BR	Accelerator pedal position sensor (for engine control)	Ignition switch ON, accelerator pedal released	0.5 to 1.1 V
			Ignition switch ON, accelerator pedal depressed	2.6 to 4.5 V
E4-19 (VPA2) - E4-21 (EPA2)	V - R	Accelerator pedal position sensor (for sensor malfunction detection)	Ignition switch ON, accelerator pedal released	1.2 to 2.0 V
			Ignition switch ON, accelerator pedal depressed	3.4 to 5.3 V
E4-26 (VCPA) - E4-20 (EPA)	L - BR	Power source of accelerator pedal position sensor (for VPA)	Ignition switch ON	4.5 to 5.5 V
E4-27 (VCP2) - E4-21 (EPA2)	P - R	Power source of accelerator pedal position sensor (for VPA2)	Ignition switch ON	4.5 to 5.5 V
E8-1 (HA1A) - E7-7 (E04)	O - W-B	A/F sensor heater	Idling	Below 3.0 V
			Ignition switch ON	9 to 14 V
E8-21 (A1A+) - E8-3 (E1)	O - L	A/F sensor	Ignition switch ON	3.0 to 3.6 V
E8-31 (A1A-) - E8-3 (E1)	W - L	A/F sensor	Ignition switch ON	2.7 to 3.3 V
E8-2 (HT1B) - E7-4 (E03)	L - BR	Heated oxygen sensor heater	Idling	Below 3.0 V
			Ignition switch ON	9 to 14 V
E8-25 (OX1B) - E8-28 (E2)	B - R	Heated oxygen sensor	Maintain engine speed at 2500 rpm for 2 minutes after warming up	Pulse generation (See waveform 6)
E7-6 (#1) - E8-7 (E01) E7-5 (#2) - E8-7 (E01) E7-2 (#3) - E8-7 (E01) E7-1 (#4) - E8-7 (E01)	L - B R - B Y - B W - B	Injector	Ignition switch ON	9 to 14 V
			Idling	Pulse generation (See waveform 1)
E8-29 (KNK1) - E8-30 (EKNK)	R - G	Knock sensor	Maintain engine speed at 4000 rpm after warming up engine	Pulse generation (See waveform 7)
E8-26 (G2+) - E8-34 (NE-)	P - G	Camshaft position sensor	Idling	Pulse generation (See waveform 3)
E8-27 (NE+) - E8-34 (NE-)	R - G	Crankshaft position sensor	Idling	Pulse generation (See waveform 3)
E8-17 (IGT1) - E8-3 (E1) E8-16 (IGT2) - E8-3 (E1) E8-15 (IGT3) - E8-3 (E1) E8-14 (IGT4) - E8-3 (E1)	G - L P - L B - L LG - L	Ignition coil with igniter (ignition signal)	Idling	Pulse generation (See waveform 2)
E8-23 (IGF1) - E8-3 (E1)	V - L	Ignition coil with igniter (ignition confirmation signal)	Ignition switch ON	4.5 to 5.5 V
			Idling	Pulse generation (See waveform 2)
E7-23 (PRG) - E8-7 (E01)	R - B	Purge VSV	Ignition switch ON	9 to 14 V
			Idling	Pulse generation (See waveform 9)
E5-8 (SPD) - E8-3 (E1)	V - L	Speed signal from combination meter	Ignition switch ON, rotate driving wheel slowly	Pulse generation (See waveform 11)
E4-12 (STA) - E8-3 (E1)	B - L	Starter signal	Shift lever position P or N, ignition switch START	9 to 14 V
E5-4 (STP) - E8-3 (E1)	L - L	Stop light switch	Brake pedal is depressed	7.5 to 14 V
			Brake pedal is released	Below 1.5 V
E4-16 (ST1-) - E8-3 (E1)	L - L	Stop light switch (opposite to STP terminal)	Ignition switch ON, Brake pedal is depressed	Below 1.5 V
			Ignition switch ON, Brake pedal is released	7.5 to 14 V
E4-30 (NSW)*1 - E8-3 (E1)	Y - L	Park/neutral position switch	Ignition switch ON, shift position at P or N	0 to 3.0 V
			Ignition switch ON, shift position is not P or N	9 to 14 V

Terminal No. (Symbols)	Wiring Color	Terminal Description	Condition	Specified Condition
E8-5 (M+) - E7-3 (ME01)	B - W-B	Throttle actuator	Idling	Pulse generation (See waveform 4)
E8-4 (M-) - E7-3 (ME01)	W - W-B	Throttle actuator	Idling	Pulse generation (See waveform 5)
E4-25 (FC) - E8-7 (E01)	L - B	Fuel pump control	Ignition switch ON	9 to 14 V
E5-30 (W) - E8-3 (E1)	G - L	MIL	Ignition switch ON	Below 3.0 V
			Idling	9 to 14 V
E4-15 (ELS1) - E8-3 (E1)	B - L	Electric load	Light control switch OFF	0 to 1.5 V
			Light control switch is in TAIL position	9 to 14 V
E5-3 (ELS3) - E8-3 (E1)	O - L	Electric load	Rear defogger switch OFF (Rear defogger system is not operating)	0 to 1.5 V
			Rear defogger switch ON (Rear defogger system is operating)	9 to 14 V
E5-17 (TC) - E8-3 (E1)	R - L	Terminal TC of DLC 3	Ignition switch ON	9 to 14 V
E5-1 (TACH) - E8-3 (E1)	B - L	Engine speed	Idling	Pulse generation (See waveform 10)
E7-32 (PSW) - E8-3 (E1)	R - L	P/S pressure switch	Ignition switch ON	9 to 14 V
E4-5 (VPMP) - E8-7 (E01)	G - B	Vent valve (built into canister pump module)	Ignition switch ON	9 to 14 V
E4-6 (MPMP) - E8-7 (E01)	L - B	Leak detection pump (built into canister pump module)	Leak detection pump OFF	Below 3 V
			Leak detection pump ON	9 to 14 V
E4-31 (PPMP) - E8-28 (E2)	LG - BR	Canister pressure sensor (built into canister pump module)	Ignition switch ON	3 to 3.6 V
E4-14 (FANH) - E8-7 (E01)	GR - B	Fan No. 2, 3 relay	Idling with high engine coolant temperature	Below 1.5 V
E8-10 (ALT) - E8-3 (E1)	Y - L	Generator	Ignition switch ON	9 to 14 V
E5-33 (CANH) - E8-3 (E1)	B - L	CAN communication line	Ignition switch ON	Pulse generation (See waveform 12)
E5-34 (CANL) - E8-3 (E1)	W - L	CAN communication line	Ignition switch ON	Pulse generation (See waveform 13)

HINT:

*1: A/T only

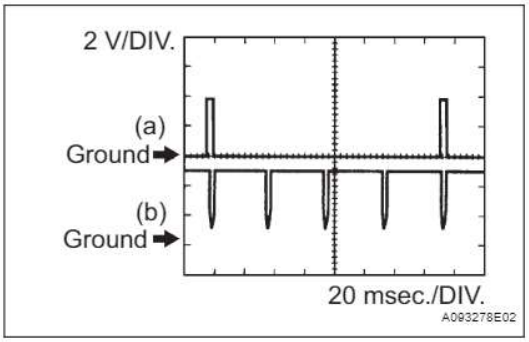


1. WAVEFORM 1
Fuel injector

Item	Content
ECM Terminal Names	Between #1 (to 4) and E01
Tester Ranges	20 V/DIV., 20 msec./DIV.
Conditions	Idling

HINT:

The wavelength becomes shorter as the engine rpm increases.



2. WAVEFORM 2

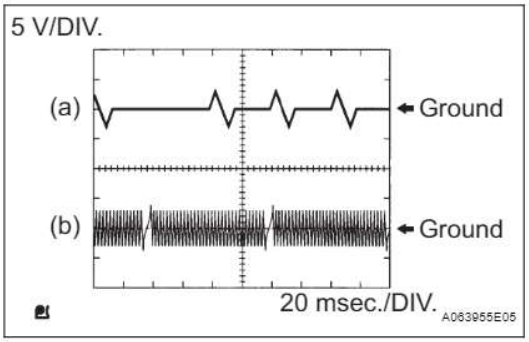
(a) Igniter IGT signal (from ECM to igniter)

Item	Content
ECM Terminal Names	Between IGT (1 to 4) and E1
Tester Ranges	2 V/DIV., 20 msec./DIV.
Conditions	Idling

(b) Igniter IGF signal (from igniter to ECM)

Item	Content
ECM Terminal Names	Between IGF1 and E1
Tester Ranges	2 V/DIV., 20 msec./DIV.
Conditions	Idling

HINT:
The wavelength becomes shorter as the engine rpm increases.



3. WAVEFORM 3

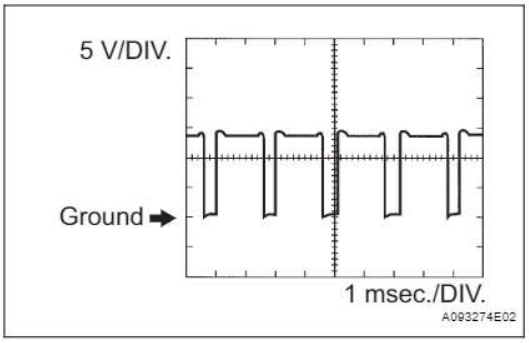
(a) Camshaft position sensor

Item	Content
ECM Terminal Names	Between G2+ and NE-
Tester Ranges	5 V/DIV., 20 msec./DIV.
Conditions	Idling

(b) Crankshaft position sensor

Item	Content
ECM Terminal Names	Between NE+ and NE-
Tester Ranges	5 V/DIV., 20 msec./DIV.
Conditions	Idling

HINT:
The wavelength becomes shorter as the engine rpm increases.

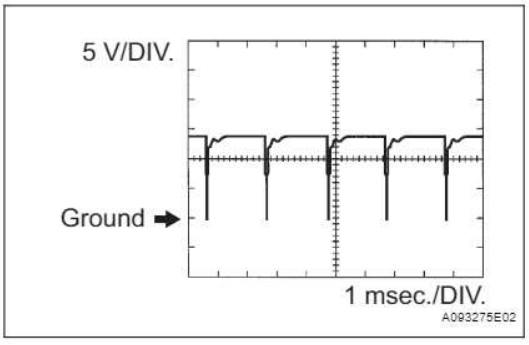


4. WAVEFORM 4

Throttle actuator positive terminal

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

HINT:
The duty ratio varies depending on the throttle actuator operation.

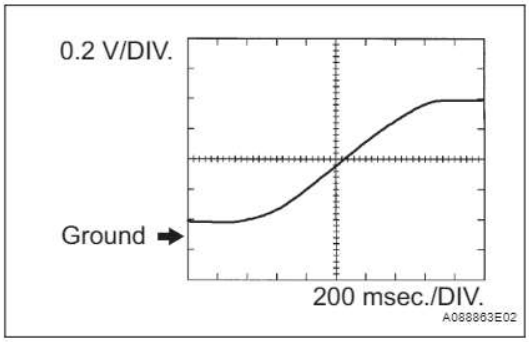


5. WAVEFORM 5

Throttle actuator negative terminal

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

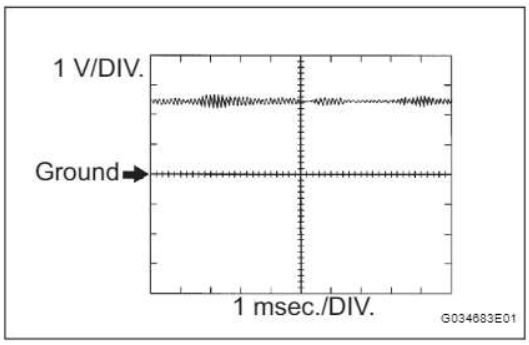
HINT:
The duty ratio varies depending on the throttle actuator operation.



6. WAVEFORM 6
Heated oxygen sensor

Item	Content
ECM Terminal Names	Between OX1B and O1B
Tester Ranges	0.2 V/DIV., 200 msec./DIV.
Conditions	Engine speed maintained at 2,500 rpm for 2 minutes after warming up sensor

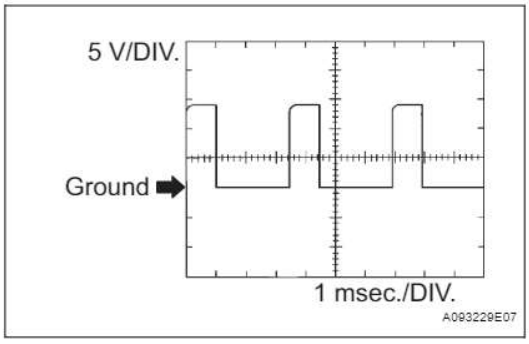
HINT:
In the DATA LIST, item O2S B1S2 shows the ECM input values from the heated oxygen sensor.



7. WAVEFORM 7
Knock sensor

Item	Content
ECM Terminal Names	Between KNK1 and EKNK
Tester Ranges	0.01 to 10 V/DIV., 0.01 to 10 msec./DIV.
Conditions	Engine speed at 4,000 rpm after warming up engine

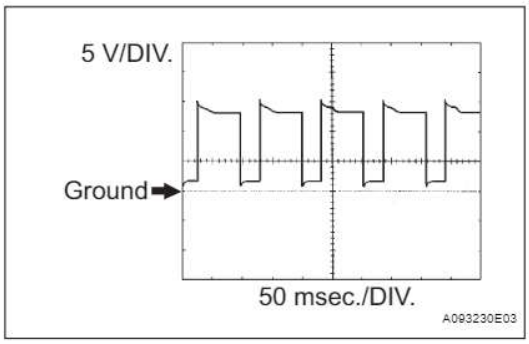
HINT:
- The wavelength becomes shorter as the engine rpm increases.
- The waveforms and amplitudes displayed differ slightly depending on the vehicle.



8. WAVEFORM 8
Camshaft timing oil control valve (OCV)

Item	Content
ECM Terminal Names	Between OC1+ and OC1-
Tester Ranges	5 V/DIV., 1 msec./DIV.
Conditions	Idling

HINT:
The wavelength becomes shorter as the engine rpm increases.

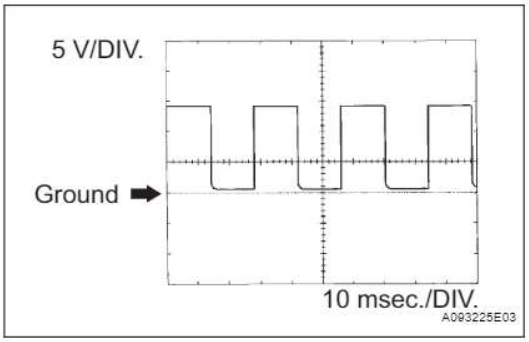


9. WAVEFORM 9
Purge VSV

Item	Content
ECM Terminal Names	Between PRG and E1
Tester Ranges	5 V/DIV., 50 msec./DIV.
Conditions	Idling

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

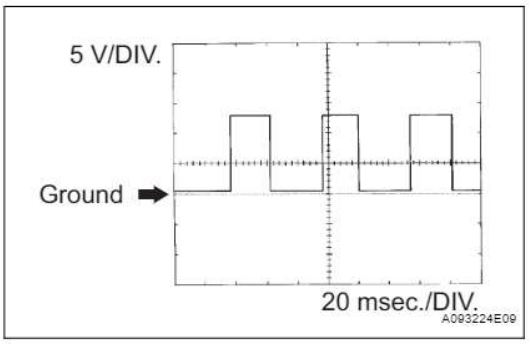
ES



10. WAVEFORM 10
Engine speed signal

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

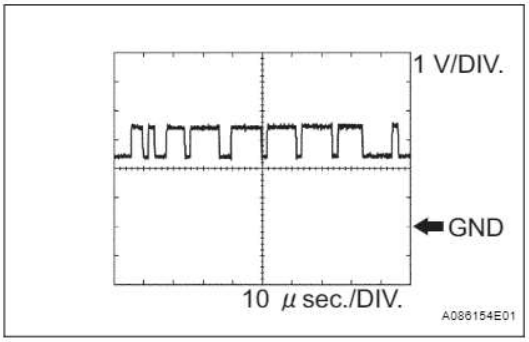
HINT:
The wavelength becomes shorter as the engine rpm increases.



11. WAVEFORM 11
Vehicle speed signal

Item	Content
ECM Terminal Names	Between SPD and E1
Tester Ranges	5 V/DIV., 20 msec./DIV.
Conditions	Driving at 12 mph (20 km/h)

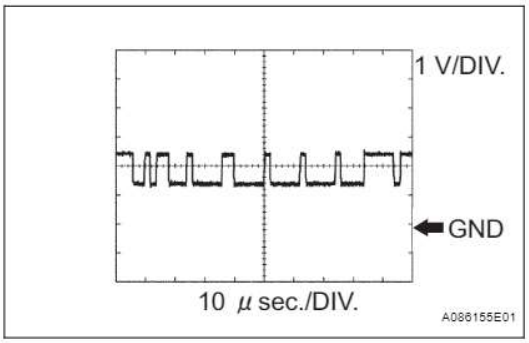
HINT:
The wavelength becomes shorter as the vehicle speed increases.



12. WAVEFORM 12
CAN communication signal:

ECM Terminal Names	Between CANH and E1
Tester Ranges	1 V/DIV., 10 μsec./DIV.
Conditions	Engine stops and ignition switch to the ON position

HINT:
The waveform varies depending on the CAN communication signal.



13. WAVEFORM 13
CAN communication signal:

ECM Terminal Names	Between CANL and E1
Tester Ranges	1 V/DIV., 10 μsec./DIV.
Conditions	Engine stops and ignition switch to the ON position

HINT:
The waveform varies depending on the CAN communication signal.

DIAGNOSIS SYSTEM

1. DESCRIPTION

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

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

(a) The emission control system components

(b) The powertrain control components (which affect vehicle emissions)

(c) The computer itself

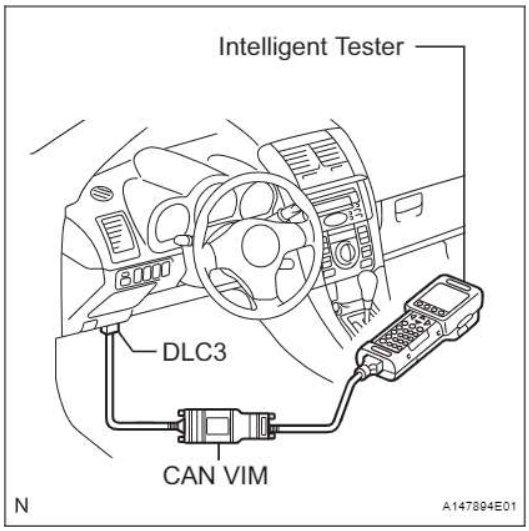
In addition, if the applicable DTCs (Diagnostic Trouble Codes) prescribed by SAE J2012 are not recorded on 3 consecutive trips, the MIL turns off automatically but the DTCs remain recorded in the ECM memory.

To check DTCs, connect the intelligent tester to the DLC3. The tester displays DTCs, freeze frame data, and a variety of the engine data. The DTCs and freeze frame data can be erased with the tester (See page ES-32).

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

Since this system is equipped with the CAN communication, connecting the CAN VIM (Vehicle Interface Module) to the intelligent tester is necessary to display any information from the ECM. (Also the communication between the intelligent tester and the ECM uses CAN communication signals.) When confirming the DTCs and any data of the ECM, connect the CAN VIM between the DLC3 and the intelligent tester.





2. NORMAL MODE AND CHECK MODE

The diagnosis system operates in normal mode during normal vehicle use. In normal mode, 2 trip detection logic is used to ensure accurate detection of malfunctions. Check mode is also available as an option for technicians. In check mode, 1 trip detection logic is used for simulating malfunction symptoms and increasing the system's ability to detect malfunctions, including intermittent problems (intelligent tester only) (See page ES-35).

ES

3. 2 TRIP DETECTION LOGIC

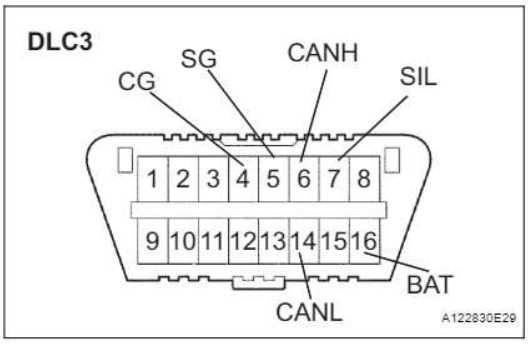
When a malfunction is first detected, the malfunction is temporarily stored in the ECM memory (1st trip). If the same malfunction is detected during the next subsequent drive cycle, the MIL is illuminated (2nd trip).

4. FREEZE FRAME DATA

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

5. DLC3 (Data link Connector 3)

The vehicle's ECM uses ISO 15765-4 for communication protocol. The terminal arrangement of the DLC3 complies with SAE J1962 and matches the ISO 15765-4 format.



Symbols (Terminal No.)	Terminal Description	Condition	Result
SIL (7) - SG (5)	Bus "+" line	During transmission	Pulse generation
CG (4) - Body ground	Chassis ground	Always	Below 1 Ω
SG (5) - Body ground	Signal ground	Always	Below 1 Ω
BAT (16) - Body ground	Battery positive	Always	11 to 14 V
CANH (6) - CANL (14)	CAN bus line	Ignition switch off	54 to 69 Ω
CANH (6) - CG (4)	HIGH-level CAN bus line	Ignition switch off	200 Ω or higher
CANL (14) - CG (4)	LOW-level CAN bus line	Ignition switch off	200 Ω or higher
CANH (6) - BAT (16)	HIGH-level CAN bus line	Ignition switch off	6 kΩ or higher
CANL (14) - BAT (16)	LOW-level CAN bus line	Ignition switch off	6 kΩ or higher

HINT:

The DLC3 is the interface prepared for reading various data from the vehicle's ECM. After connecting the cable of an intelligent tester, turn the ignition switch to the ON position and turn the tester on. If a communication failure message is displayed on the tester screen (on the tester: UNABLE TO CONNECT TO VEHICLE), a problem exists in either the vehicle or tester. In order to identify the location of the problem, connect the tester to another vehicle.

If communication is normal: Inspect the DLC3 on the original vehicle.

If communication is still not possible: The problem is probably in the tester itself. Consult the Service Department listed in the instruction manual.

6. BATTERY VOLTAGE

Battery voltage:

11 to 14 V

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

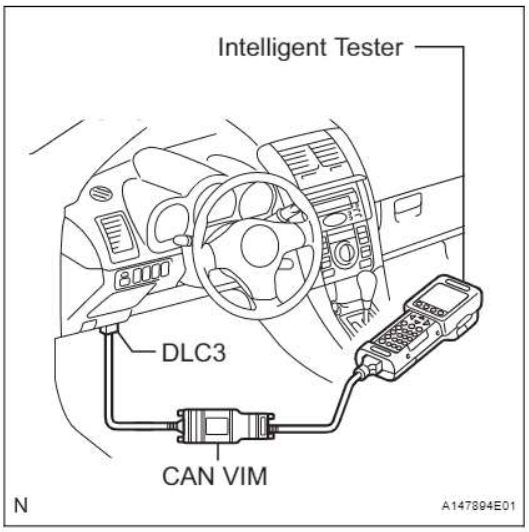
7. **Malfunction Indicator Lamp (MIL)**
   (a) The MIL is illuminated when the ignition switch is first turned to the ON position (the engine is not running).
   (b) The MIL should turn off when the engine is started. If the MIL remains illuminated, the diagnosis system has detected a malfunction or abnormality in the system.
   HINT:
   If the MIL is not illuminated when the ignition switch is first turned to the ON position, check the MIL circuit (See page ES-361).

ES

DTC CHECK / CLEAR

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

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



1. CHECK DTC
(a) Connect the intelligent tester to the DLC3.
(b) Turn the ignition switch to the ON position.
(c) Turn the tester on.
(d) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DTC INFO / CURRENT CODES.
(e) Check the DTC(s) and freeze frame data, and then write them down.
(f) Check the details of the DTC(s) (See page ES-47).

2. CLEAR DTC
(a) Connect the intelligent tester to the DLC3.
(b) Turn the ignition switch to the ON position.
(c) Turn the tester on.
(d) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DTC INFO / CLEAR CODES.
(e) Press the YES button.

3. CLEAR DTC (Without using the intelligent tester)
(a) Perform either one of the following operations:
(1) Disconnect the negative (-) battery cable for more than 1 minute.
(2) Remove the EFI and ETCS fuses from the relay block located inside the engine compartment for more than 1 minute.
NOTICE:
When disconnecting the battery cable, perform the INITIALIZE procedure (See page IN-23).

FREEZE FRAME DATA

1. DESCRIPTION

Freeze frame data records the engine conditions (fuel system, calculated load, engine coolant temperature, fuel trim, engine speed, vehicle speed, etc.) when a malfunction is detected. When troubleshooting, it can help determine if the vehicle was running or stopped, the engine was warmed up or not, the air-fuel ratio was Lean or Rich, and other data from the time the malfunction occurred.

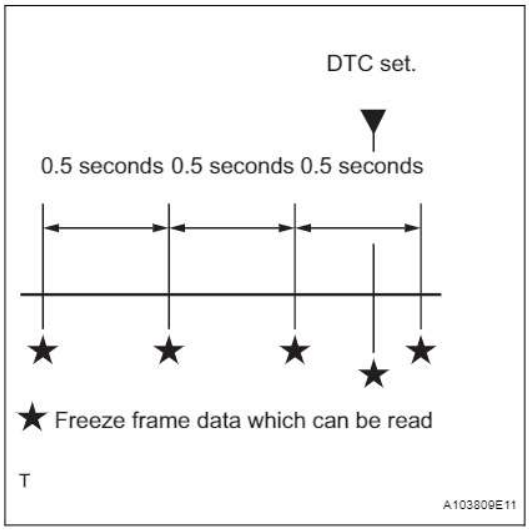
HINT:

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

The ECM records engine conditions in the form of freeze frame data every 0.5 seconds. Using the intelligent tester, 5 separate sets of freeze frame data can be checked.

– 3 data sets before the DTC was set.
– 1 data set when the DTC was set.
– 1 data set after the DTC was set.

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



2. LIST OF FREEZE FRAME DATA

Tester Display	Measurement Item	Diagnostic Note
INJECTOR	Injection period of No. 1 cylinder	-
IGN ADVANCE	Ignition advance	-
CALC LOAD	Calculated load	Calculated load by ECM
VEHICLE LOAD	Vehicle load	-
MAF	Mass air flow volume	If approximately 0.0 g/sec.: • Mass air flow meter power source circuit open or short • VG circuit open or short If 160.0 g/sec. or more: • E2G circuit open
ENGINE SPD	Engine speed	-
VEHICLE SPD	Vehicle speed	Speed indicated on speedometer
COOLANT TEMP	Engine coolant temperature	If -40°C (-40°F), sensor circuit open If 140°C (284°F) or more, sensor circuit shorted
INTAKE AIR	Intake air temperature	If -40°C (-40°F), sensor circuit open If 140°C (284°F) or more, sensor circuit shorted
AIR-FUEL RATIO	Ratio compared to stoichiometric level	-
PURGE DENSITY	Learning value of purge density	-
EVAP PURGE FLOW	Ratio of evaporative purge flow to intake air volume	-
EVAP PURGE VSV	EVAP purge VSV duty ratio	-
KNOCK CRRT VAL	Correction learning value of knocking	-
KNOCK FB VAL	Feedback value of knocking	-
ACCEL POS #1	Absolute Accelerator Pedal Position (APP) No. 1	-
ACCEL POS #2	Absolute APP No. 2	-

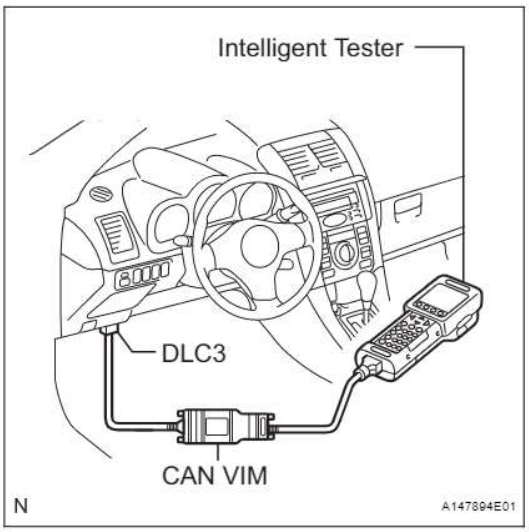
Tester Display	Measurement Item	Diagnostic Note
THROTTLE POS	Throttle sensor positioning	-
THROTTLE POS	Throttle position	-
THROTTLE POS #2	Throttle sensor positioning #2	-
THROTTLE MOT	Throttle motor	-
O2S B1 S2	Heated oxygen sensor output	Performing INJ VOL or A/F CONTROL function of ACTIVE TEST enables technician to check output voltage of sensor
AFS B1 S1	A/F sensor output	Performing INJ VOL or A/F CONTROL function of ACTIVE TEST enables technician to check output voltage of sensor
TOTAL FT #1	Total fuel trim	-
SHORT FT #1	Short-term fuel trim	Short-term fuel compensation used to maintain air-fuel ratio at stoichiometric air-fuel ratio
LONG FT #1	Long-term fuel trim	Overall fuel compensation carried out in long-term to compensate a continual deviation of short-term fuel trim from central valve
FUEL SYS #1	Fuel system status	• OL (Open Loop): Has not yet satisfied conditions to go closed loop • CL (Closed Loop): Using A/F sensor as feedback for fuel control • OL DRIVE: Open loop due to driving conditions (fuel enrichment) • OL FAULT: Open loop due to detected system fault • CL FAULT: Closed loop but A/F sensor, which used for fuel control malfunctioning
O2FT B1 S2	Fuel trim at heated oxygen sensor	-
AF FT B1 S1	Fuel trim at A/F sensor	-
AFS B1 S1	A/F sensor current	-
CAT TEMP B1S1	Estimated catalyst temperature (sensor 1)	-
CAT TEMP B1S2	Estimated catalyst temperature (sensor 2)	-
S O2S B1S2	Sub heated oxygen sensor impedance (sensor 2)	-
INI COOL TEMP	Engine coolant temperature at engine start	-
INI INTAKE TEMP	Intake air temperature at engine start	-
INJ VOL	Injection volume	-
STARTER SIG	Starter switch (STSW) signal	-
PS SW	Power steering signal	-
PS SIGNAL	Power steering signal (history)	Signal status usually ON until ignition switch turned off
CTP SW	Closed throttle position switch	-
A/C SIGNAL	A/C signal	-
PNP SW (NSW)	Park/Neutral Position (PNP) switch signal	-
ELECT LOAD SIG	Electrical load signal	-
STOP LIGHT SW	Stop light switch	-
BATTERY VOLTAGE	Battery voltage	-
ATM PRESSURE	Atmosphere pressure	-
EVAP (Purge) VSV	EVAP Purge VSV	-
FUEL PUMP/SPD	Fuel pump/speed status	-
VVT CTRL B1	VVT control status	-
VACUUM PUMP	Key-off EVAP system leak detection pump status	-
EVAP VENT VAL	Key-off EVAP system vent valve status	-
FAN MOTOR	Electric fan motor	-
TC/TE1	TC and CG (TE1) terminals of DLC3	-
ENG SPEED #1	Engine rpm during No. 1 cylinder fuel cut	Output only when FUEL CUT #1 is performed using ACTIVE TEST

Tester Display	Measurement Item	Diagnostic Note
ENG SPEED #2	Engine rpm during No. 2 cylinder fuel cut	Output only when FUEL CUT #2 is performed using ACTIVE TEST
ENG SPEED #3	Engine rpm during No. 3 cylinder fuel cut	Output only when FUEL CUT #3 is performed using ACTIVE TEST
ENG SPEED #4	Engine rpm during No. 4 cylinder fuel cut	Output only when FUEL CUT #4 is performed using ACTIVE TEST
ENG SPEED ALL	Average of engine rpm values during fuel cut of No. 1 to No. 4 cylinders	Output only when ACTIVE TEST is performed
VVT CHNG ANGL#1	VVT angle	-
VVT OCV DUTY B1	VVT OCV operation duty	-
FC IDL	Fuel cut idle	ON: when throttle valve fully closed and engine speed over 3,500 rpm
FC TAU	Fuel cut during very light load	Fuel cut being performed under very light load to prevent engine combustion from becoming incomplete
IGNITION	Ignition counter	-
CYL #1	Cylinder #1 misfire	Only displayed during idling
CYL #2	Cylinder #2 misfire	Only displayed during idling
CYL #3	Cylinder #3 misfire	Only displayed during idling
CYL #4	Cylinder #4 misfire	Only displayed during idling
CYL ALL	All cylinders misfire	Only displayed during idling
MISFIRE RPM	Engine speed when misfire occurred	-
MISFIRE LOAD	Engine load when misfire occurred	-
MISFIRE MARGIN	Margin to detect engine misfire	-
ENG RUN TIME	Accumulated engine running time	-
TIME DTC CLEAR	Cumulative time after DTC cleared	-
DIST DTC CLEAR	Accumulated distance from DTC cleared	-
WU CYC DTC CLEAR	Warm-up cycle after DTC cleared	-

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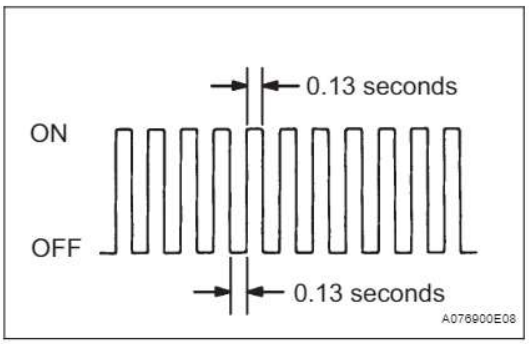
CHECK MODE PROCEDURE

HINT:
Intelligent tester only:
Compared to the normal mode, check mode is more sensitive to malfunctions. Therefore, check mode can detect the malfunctions that cannot be detected by normal mode.
NOTICE:
All the stored DTCs and freeze frame data are erased if: 1) the ECM is changed from normal mode to check mode or vice versa; or 2) the ignition switch is turned from ON position to ACC position or off while in check mode. Before changing modes, always check and make a note of any DTCs and freeze frame data.



1. CHECK MODE PROCEDURE

(a) Check and ensure the following conditions:
  (1) Battery voltage 11 V or more
  (2) Throttle valve fully closed
  (3) Transmission in the P or N position
  (4) A/C switch off
(b) Turn the ignition switch off.
(c) Connect the intelligent tester to the DLC3.
(d) Turn the ignition switch to the ACC position.
(e) Turn the tester on.
(f) Record the current DTCs and freeze frame data.
(g) Enter the following menus: DIAGNOSIS / ENHANCED OBD II/ CHECK MODE.
(h) Switch the ECM from normal mode to check mode.



(i) Make sure the MIL flashes as shown in the illustration.
(j) Start the engine.
(k) Make sure the MIL turns OFF.
(l) Simulate the conditions of the malfunction described by the customer.
(m) Check for DTCs and freeze frame data using the tester.

FAIL-SAFE CHART

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

DTC	Component	Fail-Safe Operation	Fail-Safe Deactivation Condition
P0031 and P0032	Air-Fuel Ratio (A/F) Sensor Heater	ECM turns off A/F sensor heater.	Ignition switch off
P0037 and P0038	Heated Oxygen (HO2) Sensor Heater	ECM turns off HO2 sensor heater.	Ignition switch off
P0100, P0102 and P0103	Mass Air Flow (MAF) Meter	ECM calculates ignition timing according to engine speed and throttle valve position.	Pass condition detected
P0110, P0112 and P0113	Intake Air Temperature (IAT) Sensor	ECM estimates IAT to be 20°C (68°F).	Pass condition detected
P0115, P0117 and P0118	Engine Coolant Temperature (ECT) Sensor	ECM estimates ECT to be 80°C (176°F).	Pass condition detected
P0120, P0121, P0122, P0123, P0220, P0222, P0223, P0604, P0606, P0607, P0657, P2102, P2103, P2111, P2112, P2118, P2119 and P2135	Electronic Throttle Control System (ETCS)	ECM cuts off throttle actuator current and throttle valve returned to 6.5° throttle position by return spring. ECM then adjusts engine output by controlling fuel injection (intermittent fuel-cut) and ignition timing in accordance with accelerator pedal opening angle, to allow vehicle to continue at minimal speed.*	Pass condition detected and then ignition switch turned off
P0325, P0327 and P0328	Knock Sensor	ECM sets ignition timing to maximum retard.	Ignition switch off
P0351 to P0354	Igniter	ECM cuts fuel.	Pass condition detected
P2120, P2121, P2122, P2123, P2125, P2127, P2128 and P2138	Accelerator Pedal Position (APP) Sensor	APP sensor has 2 sensor circuits: Main and Sub. If either of circuits malfunctions, ECM controls engine using other circuit. If both of circuits malfunction, ECM regards accelerator pedal as being released. As a result, throttle valve is closed and engine idles.	Pass condition detected and then ignition switch turned off

HINT:

*: The vehicle can be driven slowly when the accelerator pedal is depressed firmly and slowly. If the accelerator pedal is depressed quickly, the vehicle may speed up and slow down erratically.

DATA LIST / ACTIVE TEST

1. DATA LIST

HINT:

By reading the DATA LIST displayed on the intelligent tester, you can check values, including those of the switches, sensors, and actuators, without removing any parts. Reading the DATA LIST as the first step in troubleshooting is one method of shortening diagnostic time.

NOTICE:

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

(a) Warm up the engine.
(b) Turn the ignition switch off.
(c) Connect the intelligent tester to the DLC3.
(d) Turn the ignition switch to the ON position.
(e) Turn the tester on.
(f) If using the intelligent tester, enter the following menus: DIAGNOSIS / ENHANCED OBD II / DATA LIST.
(g) Check the values by referring to the table below.

ECM:

Tester Display	Measurement Item/Range	Normal Condition	Diagnostic Note
INJECTOR	Injection period of No. 1 cylinder: Min.: 0 ms, Max.: 32.64 ms	1.0 to 3.0 ms: Idling	-
IGN ADVANCE	Ignition timing advance for No. 1 cylinder: Min.: -64 deg, Max.: 63.5 deg	BTDC 8 to 12 deg: Idling	-
CALC LOAD	Calculated load by ECM: Min.: 0%, Max.: 100%	• 10 to 30%: Idling • 10 to 30%: Running without load at 2,500 rpm	Load value
VEHICLE LOAD	Vehicle load: Min.: 0%, Max.: 25,700%	Actual vehicle load	Load percentage in terms of maximum intake air flow amount
MAF	Air flow rate from Mass Air Flow (MAF) meter: Min.: 0 g/sec., Max.: 655.35 g/sec.	1 to 3 g/sec.: Idling 2 to 6 g/sec.: Running without load at 2,500 rpm	If value is approximately 0.0 g/sec.: • MAF meter power source circuit open • VG circuit open or shorted If value is 160.0 g/sec. or more: • E2G circuit open
ENGINE SPD	Engine speed: Min.: 0 rpm, Max.: 16,383.75 rpm	650 to 750 rpm: Idling (Manual transaxle) 610 to 710 rpm: Idling (Automatic transaxle)	-
VEHICLE SPD	Vehicle speed: Min.: 0 km/h, Max.: 255 km/h	Actual vehicle speed	Speed indicated on speedometer
COOLANT TEMP	Engine coolant temperature: Min.: -40°C, Max.: 140°C	80 to 100°C (176 to 212°F): After warming up	• If -40°C (-40°F): sensor circuit open • If 140°C (284°F) or more: sensor circuit shorted
INTAKE AIR	Intake air temperature: Min.: -40°C, Max.: 140°C	Equivalent to ambient air temperature	• If -40°C (-40°F): sensor circuit open • If 140°C (284°F) or more: sensor circuit shorted

Tester Display	Measurement Item/Range	Normal Condition	Diagnostic Note
AIR-FUEL RATIO	Ratio compared to stoichiometric level: Min.: 0, Max.: 1.999	0.8 to 1.2: Idling	• Less than 1 (0 to 0.999) = Lean • Stoichiometric air-fuel ratio = 1 • Greater than 1 (1.001 to 1.999) = Rich
PURGE DENSITY	Learning value of purge density: Min.: -50, Max.: 350	-40 to 10: Idling	-
EVAP PURGE FLOW	Ratio of evaporative purge flow to intake air volume: Min.: 0%, Max.: 102.4%	0 to 10%: Idling	-
EVAP PURGE VSV	EVAP (PURGE) VSV control duty: Min.: 0%, Max.: 100%	10 to 50%: Idling	Order signal from ECM
VAPOR PRES PUMP	Vapor pressure: Min.: 33.853 kPa, Max.: 125.596 kPa	Approximately 100 kPa: Ignition switch to the ON position	EVAP system pressure monitored by canister pressure sensor
VAPOR PRES CALC	Vapor pressure (calculated): Min.: -5.632 kPa, Max.: 715.264 kPa	Approximately 100 kPa: Ignition switch to the ON position	EVAP system pressure monitored by canister pressure sensor
KNOCK CRRT VAL	Knock correction learning value: Min: -64°CA, Max.: 1,984°CA	0 to 20°CA: Driving at 44 mph (70 km/h)	Service data
KNOCK FB VAL	Knock feedback value: Min: -64°CA, Max.: 1,984°CA	-20 to 0°CA: Driving at 44 mph (70 km/h)	Service data
CLUTCH	Clutch current: Min: 0 A, Max.: 2.49 A	-	Indicated when ETCS malfunction
ACCEL POS #1	Absolute Accelerator Pedal Position (APP) sensor No. 1: Min.: 0%, Max.: 100%	10 to 22%: Accelerator pedal released 52 to 90%: Accelerator pedal fully depressed	Read value with ignition switch to the ON position (Do not start engine)
ACCEL POS #2	Absolute APP sensor No. 2: Min.: 0%, Max.: 100%	24 to 40%: Accelerator pedal released 68 to 100%: Accelerator pedal fully depressed	Read value with ignition switch to the ON position (Do not start engine)
ACCEL POS #1	APP sensor No. 1 voltage: Min.: 0 V, Max.: 4.98 V	-	Indicated when ETCS malfunction
ACCEL POS #2	APP sensor No. 2 voltage: Min.: 0 V, Max.: 4.98 V	-	Indicated when ETCS malfunction
ACCEL POS #1	APP sensor No. 1 voltage: Min.: 0 V, Max.: 5 V	0.5 to 1.1 V: Accelerator pedal released 2.6 to 4.5 V: Accelerator pedal fully depressed	Read value with ignition switch to the ON position (Do not start engine)
ACCEL POS #2	APP sensor No. 2 voltage: Min.: 0 V, Max.: 5 V	1.2 to 2.0 V: Accelerator pedal released 3.4 to 5.0 V: Accelerator pedal fully depressed	Read value with ignition switch to the ON position (Do not start engine)
ACCEL IDL POS	Whether or not accelerator pedal position sensor detecting idle: ON or OFF	ON: Idling	-
THRTL LEARN VAL	Throttle valve fully closed (learned value): Min.: 0 V, Max.: 5 V	0.4 to 0.8 V	-
ACCEL SSR #1 AD	APP sensor No. 1 voltage (AD): Min.: 0 V, Max.: 4.9804 V	-	ETCS service data
ACCEL LRN VAL#1	Accelerator fully closed learning value No. 1: Min.: 0 deg, Max.: 124.512 deg	-	ETCS service data
ACCEL LRN VAL#2	Accelerator fully closed learning value No. 2: Min.: 0 deg, Max.: 124.512 deg	-	ETCS service data
FAIL #1	Whether or not fail safe function executed: ON or OFF	ON: ETCS has failed	-

Tester Display	Measurement Item/Range	Normal Condition	Diagnostic Note
FAIL #2	Whether or not fail safe function executed: ON or OFF	ON: ETCS has failed	-
ST1	Brake pedal signal: ON or OFF	ON: Brake pedal depressed	-
SYS GUARD JUDGE	System guard: ON or OFF	-	ETCS service data
OPN MALFUNCTION	Open side malfunction: ON or OFF	-	ETCS service data
THROTTLE POS	Throttle position sensor: Min.: 0%, Max.: 100%	• 10 to 22%: Throttle fully closed • 66 to 98%: Throttle fully open	• Calculated value based on VTA1 • Read value with ignition switch to the ON position (Do not start engine)
THROTTL IDL POS	Whether or not throttle position sensor detecting idle: ON or OFF	ON: Idling	-
THRTL REQ POS	Throttle requirement position: Min.: 0 V, Max.: 5 V	0.5 to 1.0 V: Idling	-
THROTTLE POS	Throttle position: Min.: 0%, Max.: 100%	• 0%: Throttle fully closed • 50 to 80%: Throttle fully open	• Recognition value for throttle opening angle on ECM • Read value with ignition switch to the ON position (Do not start engine)
THROTTLE POS #2	Throttle position No. 2 sensor: Min.: 0%, Max.: 100%	• 42 to 62%: Throttle fully closed • 92 to 100%: Throttle fully open	• Calculated value based on VTA2 • Read value with ignition switch to the ON position (Do not start engine)
THROTTLE POS #1	Throttle position sensor No. 1 voltage: Min.: 0 V, Max.: 4.98 V	-	Indicated when ETCS malfunction
THROTTLE POS #2	Throttle position sensor No. 2 voltage: Min.: 0 V, Max.: 4.98 V	-	Indicated when ETCS malfunction
THROTTLE POS #1	Throttle position sensor No. 1 output voltage: Min.: 0 V, Max.: 5 V	• 0.5 to 1.1 V: Throttle fully closed • 3.3 to 4.9 V: Throttle fully open	Read value with ignition switch to the ON position (Do not start engine)
THROTTLE POS #2	Throttle position sensor No. 2 output voltage: Min.: 0 V, Max.: 5 V	• 2.1 to 3.1 V: Throttle fully closed • 4.6 to 5.0 V: Throttle fully open	Read value with ignition switch to the ON position (Do not start engine)
THRTL COMND VAL	Throttle position command value: Min.: 0 V, Max.: 4.9804 V	0.5 to 4.9 V	Read value with ignition switch to the ON position (Do not start engine)
THROTTLE SSR #1	Throttle sensor opener position No. 1: Min.: 0 V, Max.: 4.9804 V	-	ETCS service data
THROTTLE SSR #2	Throttle sensor opener position No. 2: Min.: 0 V, Max.: 4.9804 V	-	ETCS service data
THRTL SSR #1 AD	Throttle position sensor No. 1 output voltage (AD): Min.: 0 V, Max.: 4.9804 V	0.5 to 4.9 V	Read value with ignition switch to the ON position (Do not start engine)
THROTTLE MOT	Whether or not throttle actuator control permitted: ON or OFF	ON: Idling	Read value with ignition switch to the ON position (Do not start engine)
THROTTLE MOT	Throttle actuator current: Min.: 0 A, Max.: 80 A	0 to 3.0 A: Idling	-

Tester Display	Measurement Item/Range	Normal Condition	Diagnostic Note
THROTTLE MOT	Throttle actuator: Min.: 0%, Max.: 100%	0.5 to 40%: Idling	-
THROTTLE MOT	Throttle motor current: Min.: 0 A, Max.: 19.92 A	-	Indicated when ETCS malfunction
THROTTLE OPN DUTY	Throttle motor opening duty ratio: Min.: 0%, Max.: 100%	-	Indicated when ETCS malfunction
THROTTLE CLS DUTY	Throttle motor closing duty ratio: Min.: 0%, Max.: 100%	-	Indicated when ETCS malfunction
THRTL MOT (OPN)	Throttle actuator duty ratio (open): Min.: 0%, Max.: 100%	0 to 40%: Idling	ETCS service data
THRTL MOT (CLS)	Throttle actuator duty ratio (closed): Min.: 0%, Max.: 100%	0 to 40%: Idling	ETCS service data
O2S B1 S2	Heated oxygen sensor output voltage for sensor 2: Min.: 0 V Max.: 1.275 V	0.1 to 0.9 V: Driving at 44 mph (70 km/h)	Performing INJ VOL or A/F CONTROL function of ACTIVE TEST enables technician to check output voltage of sensor
AFS B1 S1	A/F sensor output voltage for sensor 1: Min.: 0 V Max.: 7.999 V	2.8 to 3.8 V: Idling	Performing INJ VOL or A/F CONTROL function of ACTIVE TEST enables technician to check output voltage of sensor
TOTAL FT #1	Total fuel trim value for fuel system: Min.: -0.5, Max.: 0.496	-0.2 to 0.2	-
SHORT FT #1	Short-term fuel trim: Min.: -100%, Max.: 99.2%	-20 to 20%	Short-term fuel compensation used to maintain air-fuel ratio at stoichiometric air-fuel ratio
LONG FT #1	Long-term fuel trim: Min.: -100%, Max.: 99.2%	-20 to 20%	Overall fuel compensation carried out in long-term to compensate for a continual deviation of short-term fuel trim from central value
FUEL SYS #1	Fuel system status: OL or CL or OL DRIVE or OL FAULT or CL FAULT	CL: Idling after warming up	• OL (Open Loop): Has not yet satisfied conditions to go closed loop • CL (Closed Loop): Using A/F sensor as feedback for fuel control • OL DRIVE: Open loop due to driving conditions (fuel enrichment) • OL FAULT: Open loop due to detected system fault • CL FAULT: Closed loop but A/F sensor, which used for fuel control malfunctioning
FUEL SYS #2	Fuel system status: OL or CL or OL DRIVE or OL FAULT or CL FAULT	-	Not available
O2FT B1 S2	Short-term fuel trim associated with sensor 2: Min.: -100%, Max.: 99.2%	-	-
AF FT B1 S1	Short-term fuel trim associated with sensor 1: Min.: 0, Max.: 1.999	• Value less than 1 (0.000 to 0.999) =Lean • Stoichiometric air-fuel ratio=1 • Value greater than 1 (1.001 to 1.999) = Rich	-
AFS B1 S1	A/F sensor current: Min.: -128 mA, Max.: 127.99 mA	-	-
CAT TEMP B1S1	Estimated catalyst temperature (sensor 1): Min.: -40°C, Max.: 6,513.5°C	-	-

Tester Display	Measurement Item/Range	Normal Condition	Diagnostic Note
CAT TEMP B1S2	Estimated catalyst temperature (sensor 2): Min.: -40°C, Max.: 6,513.5°C	-	-
S O2S B1S2	Sub heated oxygen sensor impedance (sensor 2): Min.: 0 Ω, Max.: 21247.68 Ω	-	-
INI COOL TEMP	Engine coolant temperature at engine start: Min.: -40°C, Max.: 120°C	Close to ambient air temperature	-
INI INTAKE TEMP	Intake air temperature at engine start: Min.: -40°C, Max.: 120°C	Close to ambient air temperature	-
INJ VOL	Injection volume (Cylinder 1): Min.: 0 ml, Max.: 2.048 ml	0 to 0.15 ml: Idling	Quantity of fuel injection volume for 10 times
STARTER SIG	Starter switch (STSW) signal: ON or OFF	ON: Cranking	-
PS SW	Power steering signal: ON or OFF	ON: Power steering operation	-
PS SIGNAL	Power steering signal (history): ON or OFF	ON: When steering wheel first turned after battery terminals connected	Signal status usually ON until battery terminals disconnected
CTP SW	Closed throttle position switch: ON or OFF	• ON: Throttle fully closed • OFF: Throttle open	-
A/C SIGNAL	A/C signal: ON or OFF	ON: A/C ON	-
PNP SW [NSW] *1	PNP switch status: ON or OFF	ON: P or N position	-
ELECT LOAD SIG	Electrical load signal: ON or OFF	ON: Headlights or defogger turned ON	-
STOP LIGHT SW	Stop light switch: ON or OFF	ON: Brake pedal depressed	-
+BM	Whether or not electric throttle control system power inputted: ON or OFF	ON: Ignition switch to the ON position and system normal	-
+BM VOLTAGE	+BM voltage: Min.: 0, Max.: 19.2182	9 to 14 (V): Ignition switch to the ON position and system normal	ETCS service data
BATTERY VOLTAGE	Battery voltage: Min.: 0 V, Max.: 65.535 V	9 to 14 V: Ignition switch to the ON position	-
ACTUATOR POWER	Actuator power supply: ON or OFF	ON: Idling	ETCS service data
ATM PRESSURE	Atmospheric pressure: Min.: 0 kPa, Max.: 255 kPa	Approximately 100 kPa: Ignition switch to the ON position	-
EVAP (Purge) VSV	Purge VSV status: ON or OFF	-	-
FUEL PUMP / SPD	Fuel pump status: ON or OFF	ON: Engine running	Active Test support data
VVT CTRL B1	VVT control (bank 1) status: ON or OFF	-	-
VACUUM PUMP	Key-off EVAP system leak detection pump status: ON or OFF	-	Active Test support data
EVAP VENT VAL	Key-off EVAP system vent valve status: ON or OFF	-	Active Test support data
FAN MOTOR	Electric fan motor: ON or OFF	ON: Electric fan motor operating	-
TC/TE1	TC and CG (TE1) terminals of DLC3: ON or OFF	-	Active Test support data

Tester Display	Measurement Item/Range	Normal Condition	Diagnostic Note
ENG SPEED #1	Engine rpm during No. 1 cylinder fuel cut: Min.: 0 rpm, Max.: 25,600 rpm	-	Output only when FUEL CUT #1 is performed using ACTIVE TEST
ENG SPEED #2	Engine rpm during No. 2 cylinder fuel cut: Min.: 0 rpm, Max.: 25,600 rpm	-	Output only when FUEL CUT #2 is performed using ACTIVE TEST
ENG SPEED #3	Engine rpm during No. 3 cylinder fuel cut: Min.: 0 rpm, Max.: 25,600 rpm	-	Output only when FUEL CUT #3 is performed using ACTIVE TEST
ENG SPEED #4	Engine rpm during No. 4 cylinder fuel cut: Min.: 0 rpm, Max.: 25,600 rpm	-	Output only when FUEL CUT #4 is performed using ACTIVE TEST
ENG SPEED ALL	Average of engine rpm values during fuel cut of No. 1 to No. 4 cylinders: Min.: 0 rpm, Max.: 25,600 rpm	-	Output only when ACTIVE TEST is performed
VVTL AIM ANGL#1 *2	VVT aim angle: Min.: 0%, Max.: 100%	0 to 100%	VVT duty signal value during intrusive operation
VVT CHNG ANGL#1 *2	VVT angle: Min.: 0°FR, Max.: 60°FR	0 to 56°FR	Displacement angle during intrusive operation
VVT OCV DUTY B1 *2	VVT OCV operation duty: Min.: 0%, Max.: 100 %	0 to 100%	Requested duty value for intrusive operation
FC IDL	Fuel cut idle: ON or OFF	ON: Fuel cut operation	FC IDL = "ON" when throttle valve fully closed and engine speed over 3,500 rpm
FC TAU	Fuel cut TAU (Fuel cut with a very light load): ON or OFF	ON: Fuel cut operating	Fuel cut being performed with a very light load to prevent incomplete engine combustion
IGNITION	Ignition counter: Min.: 0, Max.: 400	0 to 400	-
CYL #1, #2, #3, #4	Misfire of cylinder 1 to 4: Min.: 0, Max.: 255	0	-
CYL ALL	All cylinders misfire: Min.: 0, Max.: 255	0	-
MISFIRE RPM	Engine speed when misfire occurs: Min.: 0 rpm, Max.: 6,375 rpm	-	-
MISFIRE LOAD	Engine load when misfire occurs: Min.: 0 g/rev, Max.: 3.98 g/rev	-	-
MISFIRE MARGIN	Margin to detect engine misfire: Min.: -100%, Max.: 99.22%	-100 to 99.22%	Misfire detecting margin
#CODES	Number of codes: Min.: 0, Max.: 255	-	Number of detected DTCs
CHECK MODE	Check mode: ON or OFF	ON: Check mode ON	(See page ES-35)
SPD TEST	Check mode result for vehicle speed sensor: COMPL or INCMPL	-	-
MISFIRE TEST	Check mode result for misfire monitor: COMPL or INCMPL	-	-
OXS1 TEST	Check mode result for HO2 sensor: COMPL or INCMPL	-	-
A/F SSR TEST B1	Check mode result for air-fuel ratio sensor: COMPL or INCMPL	-	-
MIL	MIL status: ON or OFF	ON: MIL ON	-

Tester Display	Measurement Item/Range	Normal Condition	Diagnostic Note
MIL ON RUN DIST	MIL ON run distance: Min.: 0 km, Max.: 65,535 km	Distance after DTC detected	-
MIL ON RUN TIME	Running time from MIL ON: Min.: 0 minutes, Max.: 65,535 minutes	Equivalent to running time after MIL ON	-
ENG RUN TIME	Engine run time: Min.: 0 seconds, Max.: 65,535 seconds	Time after engine start	-
TIME DTC CLEAR	Time after DTC cleared: Min.: 0 minutes, Max.: 65,535 minutes	Equivalent to time after DTCs erased	-
DIST DTC CLEAR	Distance after DTC cleared: Min.: 0 km, Max.: 65,535 km	Equivalent to drive distance after DTCs erased	-
WU CYC DTC CLEAR	Warm-up cycle after DTC cleared: Min.: 0, Max.: 255	-	Number of warm-up cycles after DTC cleared
OBD CERT	OBD requirement	OBD2	-
#CARB CODES	Number of emission related DTCs	-	-
COMP MON	Comprehensive component monitor: NOT AVL or AVAIL	-	-
FUEL MON	Fuel system monitor: NOT AVL or AVAIL	-	-
MISFIRE MON	Misfire monitor: NOT AVL or AVAIL	-	-
EGR MON	EGR monitor: NOT AVL or AVAIL	-	Not available
EGR MON	EGR monitor: COMPL or INCMPL	-	Not available
O2S (A/FS) HTR	O2S (A/FS) heater monitor: NOT AVL or AVAIL	-	-
O2S (A/FS) HTR	O2S (A/FS) heater monitor: COMPL or INCMPL	-	-
O2S (A/FS) MON	O2S (A/FS) monitor: NOT AVL or AVAIL	-	-
O2S (A/FS) MON	O2S (A/FS) monitor: COMPL or INCMPL	-	-
A/C MON	A/C monitor: NOT AVL or AVAIL	-	Not available
A/C MON	A/C monitor: COMPL or INCMPL	-	Not available
2nd AIR MON	Secondary air injection monitor: NOT AVL or AVAIL	-	Not available
2nd AIR MON	Secondary air injection monitor: COMPL or INCMPL	-	Not available
EVAP MON	EVAP monitor: NOT AVL or AVAIL	-	-
EVAP MON	EVAP monitor: COMPL or INCMPL	-	-
HTD CAT MON	Heated catalyst monitor: NOT AVL or AVAIL	-	-
HTD CAT MON	Heated catalyst monitor: COMPL or INCMPL	-	-
CAT MON	Catalyst monitor: NOT AVL or AVAIL	-	-
CAT MON	Catalyst monitor: COMPL or INCMPL	-	-

Tester Display	Measurement Item/Range	Normal Condition	Diagnostic Note
CCM ENA	Comprehensive component monitor: UNABLE or ENABLE	-	-
CCM CMPL	Comprehensive component monitor: COMPL or INCMPL	-	-
FUEL ENA	Fuel system monitor: UNABLE or ENABLE	-	-
FUEL CMPL	Fuel system monitor: COMPL or INCMPL	-	-
MISFIRE ENA	Misfire monitor: UNABLE or ENABLE	-	-
MISFIRE CMPL	Misfire monitor: COMPL or INCMPL	-	-
EGR ENA	EGR monitor: UNABLE or ENABLE	-	Not available
EGR CMPL	EGR monitor: COMPL or INCMPL	-	Not available
HTR ENA	O2S (A/FS) heater monitor: UNABLE or ENABLE	-	-
HTR CMPL	O2S (A/FS) heater monitor: COMPL or INCMPL	-	-
O2S (A/FS) ENA	O2S (A/FS) monitor: UNABLE or ENABLE	-	-
O2S (A/FS) CMPL	O2S (A/FS) monitor: COMPL or INCMPL	-	-
ACRF ENA	A/C monitor: UNABLE or ENABLE	-	Not available
ACRF CMPL	A/C monitor: COMPL or INCMPL	-	Not available
AIR ENA	Secondary air injection system monitor: UNABLE or ENABLE	-	Not available
AIR CMPL	Secondary air injection system monitor: COMPL or INCMPL	-	Not available
EVAP ENA	EVAP monitor: UNABLE or ENABLE	-	-
EVAP CMPL	EVAP monitor: COMPL or INCMPL	-	-
HCAT ENA	Heated catalyst monitor: UNABLE or ENABLE	-	-
HCAT CMPL	Heated catalyst monitor: COMPL or INCMPL	-	-
CAT ENA	Catalyst monitor: UNABLE or ENABLE	-	-
CAT CMPL	Catalyst monitor: COMPL or INCMPL	-	-
MODEL CODE	Identifying model code	ACV40	-
ENGINE TYPE	Identifying engine type	2AZFE	-
CYLINDER NUMBER	Identifying cylinder number: Min.: 0, Max.: 255	4	-
TRANSMISSION	Identifying transmission type	5AT or M/T	-
DESTINATION	Identifying destination	A (America)	-
MODEL YEAR	Identifying model year: Min.: 1,900, Max.: 2,155	2007	-
SYSTEM	Identifying engine system	GASLIN (gasoline engine)	-

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

2. ACTIVE TEST

HINT:
Performing an ACTIVE TEST enables components including the relays, VSV (Vacuum Switching Valve), and actuators, to be operated without removing any parts. The ACTIVE TEST can be performed with the intelligent tester. Performing an ACTIVE TEST as the first step in troubleshooting is one method of shortening diagnostic time.
DATA LIST can be displayed during ACTIVE TEST.

(a) Connect the intelligent tester to the DLC3.
(b) Turn the ignition switch to the ON position.
(c) Turn the tester on.
(d) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST.
(e) Perform the ACTIVE TEST by referring to the table below.

ECM:

Tester Display	Test Part	Control Range	Diagnostic Notes
INJ VOL	Change injection volume	Between -12.5 and 24.8%	• All injectors tested at same time • Perform test at less than 3,000 rpm • Injection volume can be changed in 0.1% graduations within control range
A/F CONTROL	Change injection volume	Between -12.5 and 24.8%	• Perform test at less than 3,000 rpm • A/F CONTROL enables checking and graphing of A/F (Air-Fuel Ratio) sensor and Heated Oxygen (HO2) sensor voltage outputs • To conduct test, select following menu items: ACTIVE TEST / A/F CONTROL / USER DATA / AFS B1S1 and O2S B1S2; then press YES and ENTER followed by F4.
EVAP VSV (ALONE)	Activate purge VSV control	ON/OFF	-
VVT CTRL B1	Control VVT (bank 1)	-128 to 127%	Test is possible while vehicle stopped and engine idling
FUEL PUMP / SPD	Activate fuel pump (C/OPN Relay)	ON/OFF	Test is possible when engine stopped
TC/TE1	Turn on and off TC and TE1 connection	ON/OFF	• ON: TC and TE1 connected • OFF: TC and TE1 disconnected
FC IDL PROHBT	Prohibit idling fuel cut control	ON/OFF	-
COOLING FAN	Control electric cooling fan	ON/OFF	-

Tester Display	Test Part	Control Range	Diagnostic Notes
ETCS OPEN SLOW	Throttle actuator	ON: Throttle valve opens slowly	Test is possible when following conditions met: • Engine stopped • Shift position in P • Fully depressing accelerator pedal (APP: 59° or more)
ETCS CLOSE SLOW	Throttle actuator	ON: Throttle valve closes slowly	
ETCS OPEN FAST	Throttle actuator	ON: Throttle valve opens fast	
ETCS CLOSE FAST	Throttle actuator	ON: Throttle valve closes fast	
VVT B1	Control VVT (bank 1)	-128 to 127% This value added to present OCV control duty 100%: Maximum advance -100%: Maximum retard	• Engine stall or rough idle when VVT actuator operated by 100%. • Test is possible while vehicle stopped and engine idling
FUEL CUT #1	Cylinder #1 injector fuel cut	ON/OFF	• Test is possible while vehicle stopped and engine idling • ON: All cylinder injector fuel cut and ignition stop
FUEL CUT #2	Cylinder #2 injector fuel cut	ON/OFF	
FUEL CUT #3	Cylinder #3 injector fuel cut	ON/OFF	
FUEL CUT #4	Cylinder #4 injector fuel cut	ON/OFF	
VACUUM PUMP	Leak detection pump	ON/OFF	-
VENT VALVE	Vent valve	ON/OFF	-
VVT LINEAR B1	Control VVT (bank 1)	-128 to 127% This value added to present OCV control duty 100%: Maximum advance -100%: Maximum retard	Engine stalls or idles roughly when VVT actuator is operated by 100%. Test is possible with vehicle stopped and engine idling.
COMPRESS CHECK	All cylinder injector fuel cut and ignition stop	ON/OFF	*

3. SYSTEM CHECK

HINT:

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

(a) Connect the intelligent tester to the DLC3.
(b) Turn the ignition switch to the ON position.
(c) Turn the tester on.
(d) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / SYSTEM CHECK.
(e) Perform the SYSTEM CHECK by referring to the table below.

Tester Display	Test Part	Control Range	Diagnostic Note
EVAP SYS CHECK (AUTO OPERATION)	Perform 4 steps in order to operate EVAP key-off monitor automatically	-	• If no DTCs in PENDING CODE after performing this test, system functioning normally • Refer to EVAP system (See page ES-314) • Recommended fuel temperature is 35°C (95°F) or less
EVAP SYS CHECK (MANUAL OPERATION)	Perform 4 steps in order to operate EVAP key-off monitor manually	-	• Used to detect malfunctioning parts • Refer to EVAP system (See page ES-314) • Recommended fuel temperature is 35°C (95°F) or less

DIAGNOSTIC TROUBLE CODE CHART

HINT:
Parameters listed in the chart may not be exactly the same as your readings due to the type of instrument or other factors. If a DTC is displayed, check the trouble area for the DTC listed in the table below. For details of each DTC.

DTC Code	Detection Item	Trouble Area	MIL	Memory	See page
P0010	Camshaft Position "A" Actuator Circuit (Bank 1)	1. Open or short in Oil Control Valve circuit 2. Oil control valve 3. ECM	Comes on	DTC stored	ES-58
P0011	Camshaft Position "A" - Timing Over-Advanced or System Performance (Bank 1)	1. Valve timing 2. Oil control valve (OCV) 3. OCV filter 4. Camshaft timing gear assembly 5. ECM	Comes on	DTC stored	ES-63
P0012	Camshaft Position "A" - Timing Over-Retarded (Bank 1)	Same as DTC P0011	Comes on	DTC stored	ES-63
P0016	Crankshaft Position - Camshaft Position Correlation (Bank 1 Sensor A)	1. Mechanical system (Timing chain has jumped tooth or chain stretched) 2. ECM	Comes on	DTC stored	ES-68
P0031	Oxygen Sensor Heater Control Circuit Low (Bank 1 Sensor 1)	1. Open in Air-Fuel Ratio (A/F) sensor heater circuit 2. A/F sensor heater 3. EFI relay 4. ECM	Comes on	DTC stored	ES-70
P0032	Oxygen Sensor Heater Control Circuit High (Bank 1 Sensor 1)	1. Short in A/F sensor heater circuit 2. A/F sensor heater 3. EFI relay 4. ECM	Comes on	DTC stored	ES-70
P0037	Oxygen Sensor Heater Control Circuit Low (Bank 1 Sensor 2)	1. Open in Heated Oxygen (HO2) sensor heater circuit 2. HO2 sensor heater 3. EFI relay 4. ECM	Comes on	DTC stored	ES-74
P0038	Oxygen Sensor Heater Control Circuit High (Bank 1 Sensor 2)	1. Short in HO2 sensor heater circuit 2. HO2 sensor heater 3. EFI relay 4. ECM	Comes on	DTC stored	ES-74
P0100	Mass or Volume Air Flow Circuit	1. Open or short in Mass Air Flow (MAF) meter circuit 2. MAF meter 3. ECM	Comes on	DTC stored	ES-79
P0101	Mass or Volume Air Flow Circuit Range / Performance Problem	MAF meter	Comes on	DTC stored	ES-86
P0102	Mass or Volume Air Flow Circuit Low Input	1. Open in MAF meter circuit 2. MAF meter 3. ECM	Comes on	DTC stored	ES-79

DTC Code	Detection Item	Trouble Area	MIL	Memory	See page
P0103	Mass or Volume Air Flow Circuit High Input	1. Short in MAF meter circuit 2. MAF meter 3. ECM	Comes on	DTC stored	ES-79
P0110	Intake Air Temperature Circuit	1. Open or short in Intake Air Temperature (IAT) sensor circuit 2. IAT sensor (built into MAF meter) 3. ECM	Comes on	DTC stored	ES-88
P0111	Intake Air Temperature Sensor Gradient Too High	Mass air flow meter	Comes on	DTC stored	ES-94
P0112	Intake Air Temperature Circuit Low Input	1. Short in IAT sensor circuit 2. IAT sensor (built into MAF meter) 3. ECM	Comes on	DTC stored	ES-88
P0113	Intake Air Temperature Circuit High Input	1. Open in IAT sensor circuit 2. IAT sensor (built into MAF meter) 3. ECM	Comes on	DTC stored	ES-88
P0115	Engine Coolant Temperature Circuit	1. Open or short in Engine Coolant Temperature (ECT) sensor circuit 2. ECT sensor 3. ECM	Comes on	DTC stored	ES-97
P0116	Engine Coolant Temperature Circuit Range / Performance Problem	ECT sensor	Comes on	DTC stored	ES-102
P0117	Engine Coolant Temperature Circuit Low Input	1. Short in ECT sensor circuit 2. ECT sensor 3. ECM	Comes on	DTC stored	ES-97
P0118	Engine Coolant Temperature Circuit High Input	1. Open in ECT sensor circuit 2. ECT sensor 3. ECM	Comes on	DTC stored	ES-97
P0120	Throttle / Pedal Position Sensor / Switch "A" Circuit	1. Throttle Position (TP) sensor (built into throttle body) 2. ECM	Comes on	DTC stored	ES-105
P0121	Throttle / Pedal Position Sensor / Switch "A" Circuit Range / Performance Problem	TP sensor (built into throttle body)	Comes on	DTC stored	ES-113
P0122	Throttle / Pedal Position Sensor / Switch "A" Circuit Low Input	1. TP sensor (built into throttle body) 2. Short in VTA1 circuit 3. Open in VC circuit 4. ECM	Comes on	DTC stored	ES-105

DTC Code	Detection Item	Trouble Area	MIL	Memory	See page
P0123	Throttle / Pedal Position Sensor / Switch "A" Circuit High Input	1. TP sensor (built into throttle body) 2. Open in VTA1 circuit 3. Open in E2 circuit 4. Short between VC and VTA1 circuit 5. ECM	Comes on	DTC stored	ES-105
P0125	Insufficient Coolant Temperature for Closed Loop Fuel Control	1. Cooling system 2. ECT sensor 3. Thermostat	Comes on	DTC stored	ES-115
P0128	Coolant Thermostat (Coolant Temperature Below Thermostat Regulating Temperature)	1. Thermostat 2. Cooling system 3. ECT sensor 4. ECM	Comes on	DTC stored	ES-118
P0136	Oxygen Sensor Circuit Malfunction (Bank 1 Sensor 2)	1. Open or short in heated oxygen (HO2) sensor (sensor 2) circuit 2. Heated oxygen sensor (sensor 2) 3. Heated oxygen sensor heater (sensor 2) 4. A/F sensor (sensor 1) 5. EFI relay 6. Gas leakage from exhaust system	Comes on	DTC stored	ES-121
P0137	Oxygen Sensor Circuit Low Voltage (Bank 1 Sensor 2)	1. Open in HO2 sensor (sensor 2) circuit 2. Heated oxygen sensor (sensor 2) 3. Heated oxygen sensor heater (sensor 2) 4. EFI relay 5. Gas leakage from exhaust system	Comes on	DTC stored	ES-121
P0138	Oxygen Sensor Circuit High Voltage (Bank 1 Sensor 2)	1. Short in heated oxygen sensor (sensor 2) circuit 2. Short in heated oxygen sensor 3. ECM internal circuit malfunction	Comes on	DTC stored	ES-121
P0141	Oxygen Sensor Heater Circuit Malfunction (Bank 1 Sensor 2)	1. Open or short in HO2 sensor heater circuit 2. HO2 sensor heater (sensor 2) 3. EFI relay 4. ECM	Comes on	DTC stored	ES-74

DTC Code	Detection Item	Trouble Area	MIL	Memory	See page
P0171	System Too Lean (Bank 1)	1. Air induction system 2. Injector blockage 3. MAF meter 4. ECT sensor 5. Fuel pressure 6. Gas leakage from exhaust system 7. Open or short in A/F sensor (sensor 1) circuit 8. A/F sensor (sensor 1) 9. A/F sensor heater (sensor 1) 10. EFI relay 11. A/F sensor heater and EFI relay circuits 12. PCV hose connections 13. PCV valve and hose 14. ECM	Comes on	DTC stored	ES-135
P0172	System Too Rich (Bank 1)	1. Injector leakage or blockage 2. MAF meter 3. ECT sensor 4. Ignition system 5. Fuel pressure 6. Gas leakage from exhaust system 7. Open or short in A/F sensor (sensor 1) circuit 8. A/F sensor (sensor 1) 9. A/F sensor heater (sensor 1) 10. EFI relay 11. A/F sensor heater and EFI relay circuits 12. ECM	Comes on	DTC stored	ES-135
P0220	Throttle / Pedal Position Sensor / Switch "B" Circuit	1. TP sensor (built into throttle body) 2. ECM	Comes on	DTC stored	ES-105
P0222	Throttle / Pedal Position Sensor / Switch "B" Circuit Low Input	1. TP sensor (built into throttle body) 2. Short in VTA2 circuit 3. Open in VC circuit 4. ECM	Comes on	DTC stored	ES-105
P0223	Throttle / Pedal Position Sensor / Switch "B" Circuit High Input	1. TP sensor (built into throttle body) 2. Open in VTA2 circuit 3. Open in E2 circuit 4. Short between VC and VTA2 circuit 5. ECM	Comes on	DTC stored	ES-105

DTC Code	Detection Item	Trouble Area	MIL	Memory	See page
P0300	Random / Multiple Cylinder Misfire Detected	1. Open or short in engine wire harness 2. Connector connections 3. Vacuum hose connections 4. Ignition system 5. Injector 6. Fuel pressure 7. MAF meter 8. ECT sensor 9. Compression pressure 10. Valve clearance 11. Valve timing 12. PCV hose connections 13. PCV valve and hose 14. ECM	Comes on	DTC stored	ES-146
P0301	Cylinder 1 Misfire Detected	Same as DTC P0300	Blinks	DTC stored	ES-146
P0302	Cylinder 2 Misfire Detected	Same as DTC P0300	Blinks	DTC stored	ES-146
P0303	Cylinder 3 Misfire Detected	Same as DTC P0300	Blinks	DTC stored	ES-146
P0304	Cylinder 4 Misfire Detected	Same as DTC P0300	Blinks	DTC stored	ES-146
P0327	Knock Sensor 1 Circuit Low Input (Bank 1 or Single Sensor)	1. Short in knock sensor circuit 2. Knock sensor 3. ECM	Comes on	DTC stored	ES-158
P0328	Knock Sensor 1 Circuit High Input (Bank 1 or Single Sensor)	1. Open in knock sensor circuit 2. Knock sensor 3. ECM	Comes on	DTC stored	ES-158
P0335	Crankshaft Position Sensor "A" Circuit	1. Open or short in Crankshaft Position (CKP) sensor circuit 2. CKP sensor 3. Sensor plate (CKP sensor plate) 4. ECM	Comes on	DTC stored	ES-162
P0339	Crankshaft Position Sensor "A" Circuit Intermittent	Same as DTC P0335	-	DTC stored	ES-162
P0340	Camshaft Position Sensor "A" Circuit (Bank 1 or Single Sensor)	1. Open or short in Camshaft Position (CMP) sensor circuit 2. CMP sensor 3. Camshaft 4. Timing chain has jumped tooth 5. ECM	Comes on	DTC stored	ES-167
P0351	Ignition Coil "A" Primary / Secondary Circuit	1. Ignition system 2. Open or short in IGF1 or IGT circuit (1 to 4) between ignition coil and ECM 3. No. 1 to No. 4 ignition coil with igniters 4. ECM	Comes on	DTC stored	ES-171

DTC Code	Detection Item	Trouble Area	MIL	Memory	See page
P0352	Ignition Coil "B" Primary / Secondary Circuit	Same as DTC P0351	Comes on	DTC stored	ES-171
P0353	Ignition Coil "C" Primary / Secondary Circuit	Same as DTC P0351	Comes on	DTC stored	ES-171
P0354	Ignition Coil "D" Primary / Secondary Circuit	Same as DTC P0351	Comes on	DTC stored	ES-171
P0420	Catalyst System Efficiency Below Threshold (Bank 1)	1. Gas leakage from exhaust system 2. A/F sensor (sensor 1) 3. Heated oxygen sensor (sensor 2) 4. Front exhaust pipe (TWC)	Comes on	DTC stored	ES-179
P043E	Evaporative Emission System Reference Orifice Clog Up	1. Canister pump module 2. Connector/Wire harness (Canister pump module - ECM) 3. ECM	Comes on	DTC stored	ES-186
P043F	Evaporative Emission System Reference Orifice High Flow	1. Canister pump module 2. Connector/Wire harness (Canister pump module - ECM) 3. ECM	Comes on	DTC stored	ES-186
P0441	Evaporative Emission Control System Incorrect Purge Flow	1. Purge VSV 2. Connector/Wire harness (purge VSV-ECM) 3. ECM 4. Canister pump module 5. Leakage from EVAP system	Comes on	DTC stored	ES-191
P0450	Evaporative Emission Control System Pressure Sensor / Switch	1. Canister pump module 2. ECM	Comes on	DTC stored	ES-199
P0451	Evaporative Emission Control System Pressure Sensor Range / Performance	1. Canister pump module 2. Connector/Wire harness (between canister pump module and ECM) 3. ECM	Comes on	DTC stored	ES-199
P0452	Evaporative Emission Control System Pressure Sensor / Switch Low Input	1. Canister pump module 2. Connector/Wire harness (between canister pump module and ECM) 3. ECM	Comes on	DTC stored	ES-199
P0453	Evaporative Emission Control System Pressure Sensor / Switch High Input	1. Canister pump module 2. Connector/Wire harness (between canister pump module and ECM) 3. ECM	Comes on	DTC stored	ES-199

DTC Code	Detection Item	Trouble Area	MIL	Memory	See page
P0455	Evaporative Emission Control System Leak Detected (Gross Leak)	1. Fuel tank cap (loose) 2. Leakage from EVAP line (between canister and fuel tank) 3. Leakage from EVAP line (between purge VSV and canister) 4. Canister pump module 5. Leakage from fuel tank 6. Leakage from canister	Comes on	DTC stored	ES-207
P0456	Evaporative Emission Control System Leak Detected (Very Small Leak)	Same as DTC P0455	Comes on	DTC stored	ES-207
P0500	Vehicle Speed Sensor "A"	1. Open or short in vehicle speed sensor circuit 2. Vehicle speed sensor 3. Combination meter 4. ECM 5. Skid control ECU	Comes on	DTC stored	ES-212
P0504	Brake Switch "A" / "B" Correlation	1. Short in stop light switch signal circuit 2. STOP fuse 3. Stop light switch 4. ECM	-	DTC stored	ES-215
P0505	Idle Control System Malfunction	1. ETCS (Electronic Throttle Control System) 2. Air induction system 3. PCV hose connections 4. ECM	Comes on	DTC stored	ES-220
P050A	Cold Start Idle Air Control System Performance	1. Throttle body assembly 2. MAF meter 3. Air induction system 4. PCV hose connections 5. VVT system 6. Air cleaner filter element 7. ECM	Comes on	DTC stored	ES-223
P050B	Cold Start Ignition Timing Performance	Same as DTC P050A	Comes on	DTC stored	ES-223
P0560	System Voltage	1. Open in backup power source circuit 2. EFI fuse 3. ECM	Comes on	DTC stored	ES-229
P0604	Internal Control Module Random Access Memory (RAM) Error	ECM	Comes on	DTC stored	ES-233
P0606	ECM / PCM Processor	ECM	Comes on	DTC stored	ES-235

DTC Code	Detection Item	Trouble Area	MIL	Memory	See page
P0607	Control Module Performance	ECM	Comes on	DTC stored	ES-238
P0617	Starter Relay Circuit High	1. PNP switch (A/T) 2. Clutch start switch (M/T) 3. Starter relay circuit 4. Ignition switch 5. ECM	Comes on	DTC stored	ES-240
P0630	VIN not Programmed or Mismatch - ECM / PCM	ECM	Comes on	DTC stored	ES-245
P0657	Actuator Supply Voltage Circuit / Open	ECM	Comes on	DTC stored	ES-247
P0724	Brake Switch "B" Circuit High	1. Short in stop light switch signal circuit 2. Stop light switch 2. ECM	Comes on	DTC stored	ES-249
P2102	Throttle Actuator Control Motor Circuit Low	1. Open in throttle actuator circuit 2. Throttle actuator 3. ECM	Comes on	DTC stored	ES-252
P2103	Throttle Actuator Control Motor Circuit High	1. Short in throttle actuator circuit 2. Throttle actuator 3. Throttle valve 4. Throttle body assembly 5. ECM	Comes on	DTC stored	ES-252
P2111	Throttle Actuator Control System - Stuck Open	1. Throttle actuator 2. Throttle body assembly 3. Throttle valve	Comes on	DTC stored	ES-256
P2112	Throttle Actuator Control System - Stuck Closed	Same as DTC P2111	Comes on	DTC stored	ES-256
P2118	Throttle Actuator Control Motor Current Range / Performance	1. Open in ETCS power source circuit 2. ETCS fuse 3. ECM	Comes on	DTC stored	ES-259
P2119	Throttle Actuator Control Throttle Body Range / Performance	1. ETCS 2. ECM	Comes on	DTC stored	ES-264
P2120	Throttle / Pedal Position Sensor / Switch "D" Circuit	1. Accelerator Pedal Position (APP) sensor 2. ECM	Comes on	DTC stored	ES-267
P2121	Throttle / Pedal Position Sensor / Switch "D" Circuit Range / Performance	1. APP sensor 2. ECM	Comes on	DTC stored	ES-275
P2122	Throttle / Pedal Position Sensor / Switch "D" Circuit Low Input	1. APP sensor 2. Open in VCP1 circuit 3. Open or ground short VPA1 circuit 4. ECM	Comes on	DTC stored	ES-267
P2123	Throttle / Pedal Position Sensor / Switch "D" Circuit High Input	1. APP sensor 2. Open in EPA circuit 3. ECM	Comes on	DTC stored	ES-267

DTC Code	Detection Item	Trouble Area	MIL	Memory	See page
P2125	Throttle / Pedal Position Sensor / Switch "E" Circuit	1. APP sensor 2. ECM	Comes on	DTC stored	ES-267
P2127	Throttle / Pedal Position Sensor / Switch "E" Circuit Low Input	1. APP sensor 2. Open in VCP2 circuit 3. Open or ground short VPA2 circuit 4. ECM	Comes on	DTC stored	ES-267
P2128	Throttle / Pedal Position Sensor / Switch "E" Circuit High Input	1. APP sensor 2. Open in EPA2 circuit 3. ECM	Comes on	DTC stored	ES-267
P2135	Throttle / Pedal Position Sensor / Switch "A" / "B" Voltage Correlation	1. Short between VTA1 and VTA2 circuits 2. TP sensor (built into throttle body) 3. ECM	Comes on	DTC stored	ES-105
P2138	Throttle / Pedal Position Sensor / Switch "D" / "E" Voltage Correlation	1. Short between VPA1 and VPA2 circuits 2. APP sensor 3. ECM	Comes on	DTC stored	ES-267
P2195	Oxygen (A/F) Sensor Signal Stuck Lean (Bank 1 Sensor 1)	1. Open or short in A/F sensor (sensor 1) circuit 2. A/F sensor (sensor 1) 3. A/F sensor heater (sensor 1) 4. EFI relay 5. A/F sensor heater and relay circuits 6. Air induction system 7. Fuel pressure 8. Injector 9. ECM	Comes on	DTC stored	ES-278
P2196	Oxygen (A/F) Sensor Signal Stuck Rich (Bank 1 Sensor 1)	Same as DTC P2195	Comes on	DTC stored	ES-278
P2237	Oxygen (A/F) Sensor Pumping Current Circuit / Open (Bank 1 Sensor 1)	1. Open or short in A/F sensor (sensor 1) circuit 2. A/F sensor (sensor 1) 3. ECM	Comes on	DTC stored	ES-291
P2238	Oxygen (A/F) Sensor Pumping Current Circuit Low (Bank 1 Sensor 1)	Same as DTC P2237	Comes on	DTC stored	ES-291
P2239	Oxygen (A/F) Sensor Pumping Current Circuit High (Bank 1 Sensor 1)	Same as DTC P2237	Comes on	DTC stored	ES-291
P2252	Oxygen (A/F) Sensor Reference Ground Circuit Low (Bank 1 Sensor 1)	Same as DTC P2237	Comes on	DTC stored	ES-291
P2253	Oxygen (A/F) Sensor Reference Ground Circuit High (Bank 1 Sensor 1)	Same as DTC P2237	Comes on	DTC stored	ES-291

DTC Code	Detection Item	Trouble Area	MIL	Memory	See page
P2401	Evaporative Emission System Leak Detection Pump Control Circuit Low	1. Canister pump module 2. Connector/Wire harness (between canister pump module and ECM) 3. ECM	Comes on	DTC stored	ES-186
P2402	Evaporative Emission System Leak Detection Pump Control Circuit High	1. Canister pump module 2. Connector/Wire harness (between canister pump module and ECM) 3. ECM	Comes on	DTC stored	ES-186
P2419	Evaporative Emission System Switching Valve Control Circuit Low	1. Canister pump module 2. Connector/Wire harness (between canister pump module and ECM) 3. ECM	Comes on	DTC stored	ES-186
P2420	Evaporative Emission System Switching Valve Control Circuit High	1. Canister pump module 2. Connector/Wire harness (between canister pump module and ECM) 3. ECM	Comes on	DTC stored	ES-298
P2610	ECM / PCM Internal Engine Off Timer Performance	ECM	Comes on	DTC stored	ES-302
P2A00	A/F Sensor Circuit Slow Response (Bank 1 Sensor 1)	1. Open or short in A/F sensor (sensor 1) circuit 2. A/F sensor (sensor 1) 3. A/F sensor heater 4. EFI relay 5. A/F sensor heater and EFI relay circuits 6. Air induction system 7. Fuel pressure 8. Injector 9. PCV valve and hose 10. PCV hose connections 11. ECM	Comes on	DTC stored	ES-304

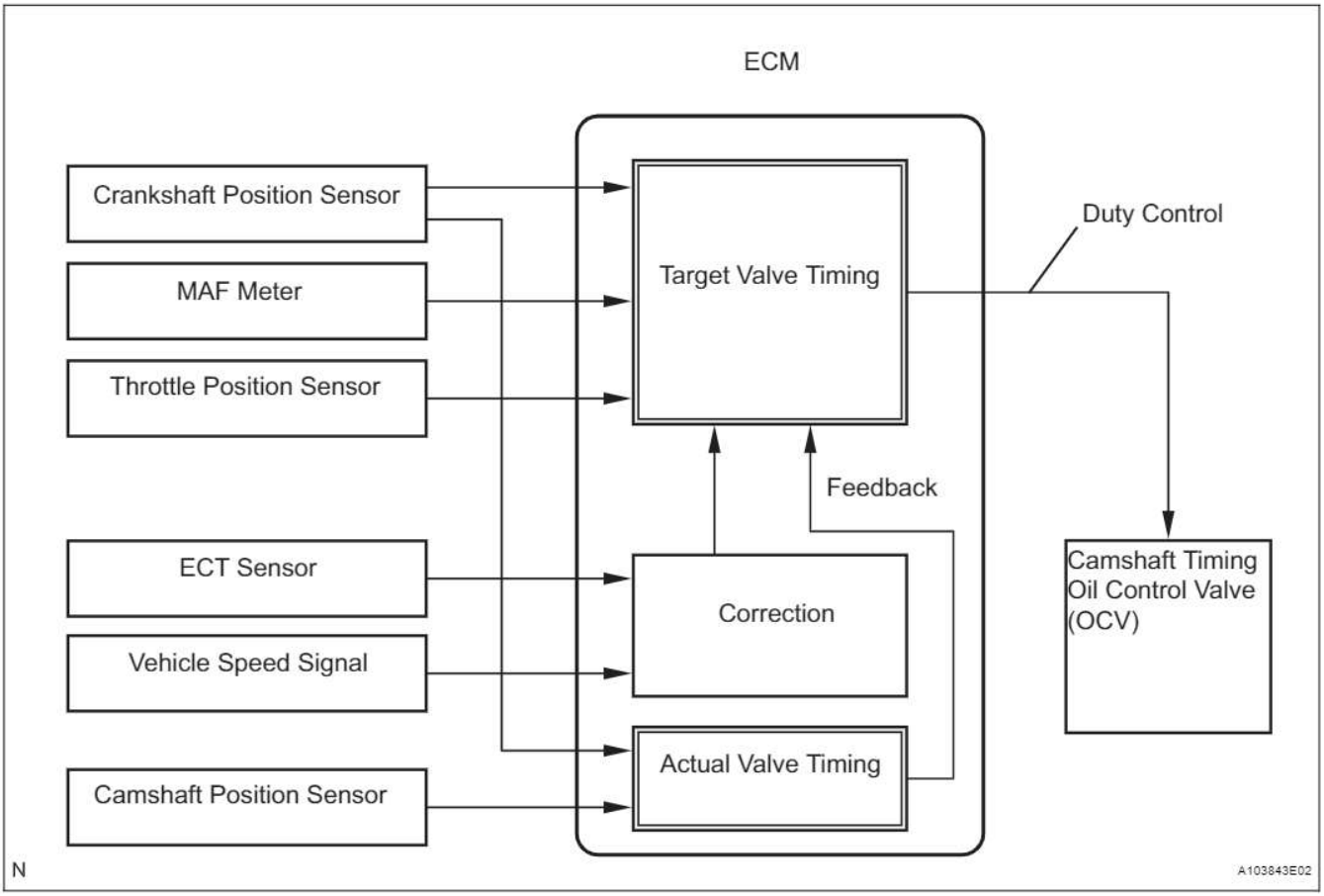
DTC	P0010	Camshaft Position "A" Actuator Circuit (Bank 1)

DESCRIPTION

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

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

ES



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

MONITOR DESCRIPTION

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

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

MONITOR STRATEGY

Related DTCs	P0010: VVT OCV range check
Required Sensors/Components (Main)	VVT OCV (Variable Valve Timing Oil Control Valve)
Required Sensors/Components (Related)	-
Frequency of Operation	Continuous
Duration	1 second
MIL Operation	Immediate
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

Monitor runs whenever the following DTCs are not present	None
When all conditions below are met:	-
Starter	OFF
Ignition switch	ON
Time after ignition switch OFF to ON	0.5 seconds or more

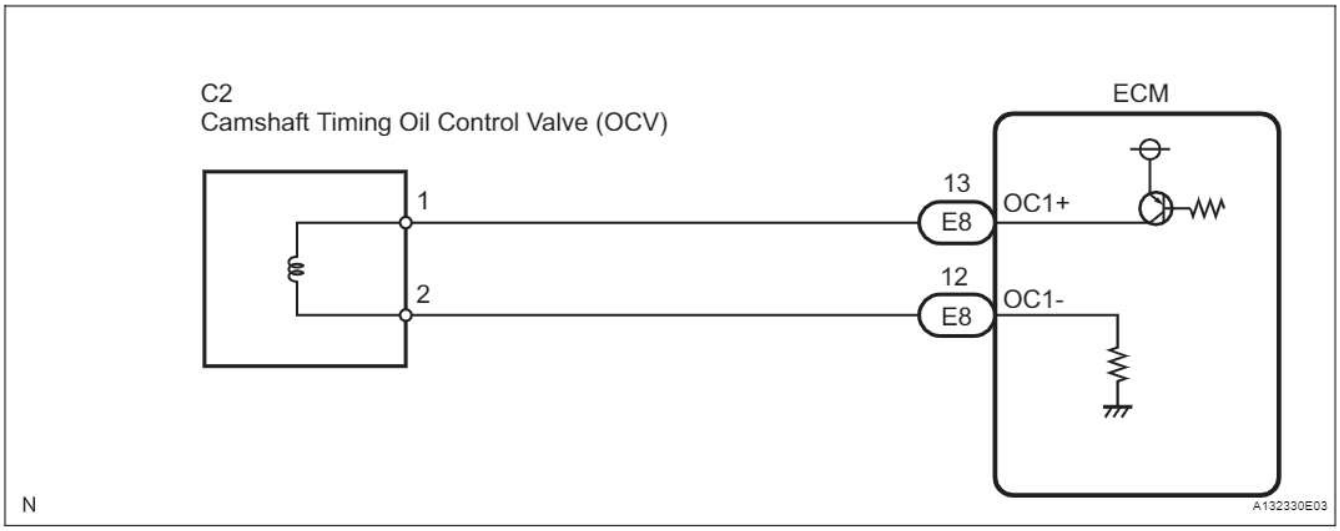
TYPICAL MALFUNCTION THRESHOLDS

One of the following conditions is met:	a, b or c
a. All conditions below are met:	-
Battery voltage	11 V to 13 V
Target duty ratio	Less than 70 %
Output signal duty ratio	100 %
b. All conditions below are met:	-
Battery voltage	13 V or more
Target duty ratio	Less than 80 %
Output signal duty ratio	100 % (always ON)
c. Both conditions below are met:	-
Current cut status	Not cut
Output signal duty ratio	3 % or less

COMPONENT OPERATING RANGE

VVT OCV duty ratio	3 to 100 %

WIRING DIAGRAM



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.

1	PERFORM ACTIVE TEST (OCV OPERATION)

(a) Connect the intelligent tester to the DLC3.
(b) Start the engine and turn the tester on.
(c) Warm up the engine.
(d) On the tester, select the following menu items: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / VVT B1.
(e) Check the engine speed while operating the Oil Control Valve (OCV) using the tester.

OK

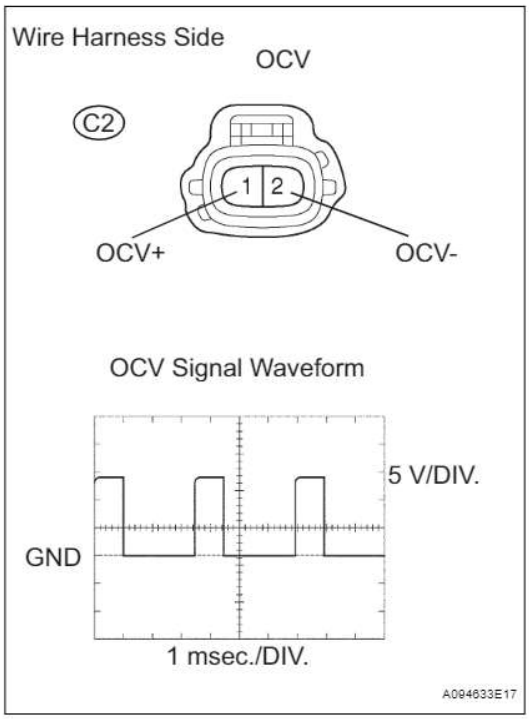
Tester Operation	Specified Condition
-128 % (OCV OFF)	Normal engine speed
127 % (OCV ON)	Engine idles roughly or stalls (soon after OCV switched from OFF to ON)

NG → Go to step 2

OK →

CHECK FOR INTERMITTENT PROBLEMS

2	INSPECT CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY (OCV SIGNAL)



(a) Disconnect the C2 OCV connector.
(b) While idling, check the waveform of the wire harness side connector using an oscilloscope.
OK

Tester Connection	Specified Condition
OCV+ (C2-1) - OCV- (C2-2)	Correct waveform appears as shown

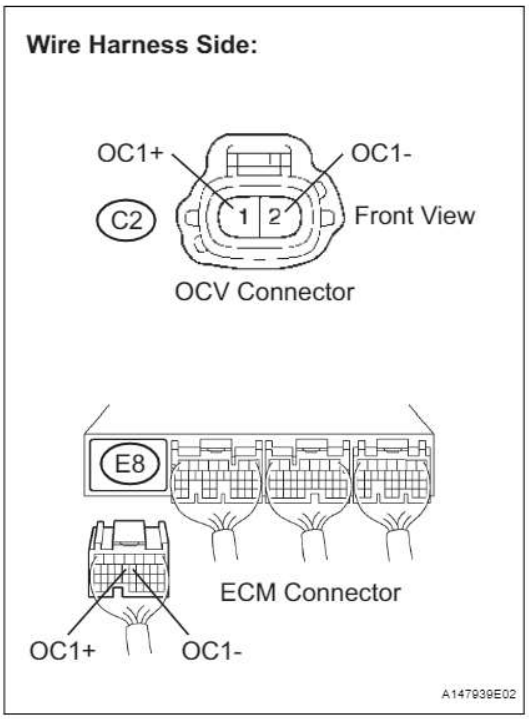
NG → **Go to step 3**

OK

REPLACE CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY

ES

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



(a) Disconnect the OCV connector.
(b) Disconnect the ECM connector.
(c) Measure the resistance according to the value(s) in the table below.

Standard resistance (Check for open)

Tester Connection	Specified Condition
C2-1 (OC1+) - E8-13 (OC1+)	Below 1 Ω
C2-2 (OC1-) - E8-12 (OC1-)	Below 1 Ω

Standard resistance (Check for short)

Tester Connection	Specified Condition
C2-1 (OC1+) or E8-13 (OC1+) - Body ground	10 kΩ or higher
C2-2 (OC1-) or E8-12 (OC1-) - Body ground	10 kΩ or higher

(d) Reconnect the OCV connector.
(e) Reconnect the ECM connector.

NG → REPLACE ECM

OK

REPAIR OR REPLACE HARNESS OR CONNECTOR

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

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

DESCRIPTION

Refer to DTC P0010 (See page ES-58).
HINT:
If DTC P0011 or P0012 is present, check the VVT (Variable Valve Timing) system.

DTC No.	DTC Detection Condition	Trouble Area
P0011	Advanced camshaft timing: With warm engine and engine speed of between 550 rpm and 4,000 rpm, all conditions (1), (2) and (3) met (1 trip detection logic): (1) Difference between target and actual intake valve timings more than 5°CA (Crankshaft Angle) for 4.5 seconds (2) Current intake valve timing fixed (timing changes less than 5°CA in 5 seconds) (3) Variations in VVT controller timing more than 19°CA of maximum delayed timing (malfunction in advance timing)	• Valve timing • Oil control valve (OCV) • OCV filter • Camshaft timing gear assembly • ECM
P0012	Retarded camshaft timing: With warm engine and engine speed of between 550 rpm and 4,000 rpm, all conditions (1), (2) and (3) met (2 trip detection logic): (1) Difference between target and actual intake valve timings more than 5°CA (Crankshaft Angle) for 4.5 seconds (2) Current intake valve timing fixed (timing changes less than 5°CA in 5 seconds) (3) Variations in VVT controller timing 19°CA or less of maximum delayed timing (malfunction in retarded timing)	• Valve timing • OCV • OCV filter • Camshaft timing gear assembly • ECM

ES

MONITOR DESCRIPTION

The ECM optimizes the valve timing using the VVT (Variable Valve Timing) system to control the intake camshaft. The VVT system includes the ECM, the Oil Control Valve (OCV) and the VVT controller. The ECM sends a target duty-cycle control signal to the OCV. This control signal regulates the oil pressure supplied to the VVT controller. The VVT controller can advance or retard the intake camshaft.
If the difference between the target and actual intake valve timings is large, and changes in actual intake valve timing are small, the ECM interprets this as the VVT controller stuck malfunction and sets a DTC.
Example:
A DTC will be set if 1) the difference between the target and actual valve timings is more than 5° of the camshaft angle (CA) and the condition continues for more than 4.5 seconds; or 2) the OCV is forcibly activated 12 times or more.
Advanced cam DTC is subject to "1 trip" detection logic.
Retarded cam DTC is subject to "2 trip" detection logic.

MONITOR STRATEGY

Related DTCs	P0011: Advanced Camshaft Timing P0012: Retarded Camshaft Timing
Required Sensors/Components (Main)	VVT OCV and VVT Actuator
Required Sensors/Components (Related)	Crankshaft position sensor, Camshaft position sensor and Engine coolant temperature sensor

Frequency of Operation	Once per driving cycle
Duration	Within 10 seconds
MIL Operation	Advanced camshaft timing: Immediate Retarded camshaft timing: 2 driving cycles
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

Monitor runs whenever the following DTCs are not present	P0100 - P0103 (MAF sensor) P0115 - P0118 (ECT sensor) P0125 (Insufficient ECT for closed loop) P0335 (CKP sensor) P0340 (CMP sensor) P0351 - P0354 (igniter)
Battery voltage	11 V or more
Engine RPM	550 to 4,000 rpm
Engine coolant temperature	75 to 100°C (167 to 212°F)

ES

TYPICAL MALFUNCTION THRESHOLDS

Advanced camshaft timing:

All of the following conditions are met:	-
Crank angle between reference position and actual intake camshaft angle	67°CA or more
Valve timing	No change at advanced valve timing

Retarded camshaft timing:

All of the following conditions are met:	-
Crank angle between reference position and actual intake camshaft angle	Less than 67°CA
Valve timing	No change at retarded valve timing

If the difference between the target and actual camshaft timings is greater than the specified value, the ECM operates the VVT actuator.
Then, the ECM monitors the camshaft timing change for 5 seconds.

WIRING DIAGRAM

Refer to DTC P0010 (See page ES-60).

INSPECTION PROCEDURE

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

1	**CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P0011 OR P0012)**

(a) Connect the intelligent tester to the DLC3.

(b) Turn the ignition switch to the ON position and turn the tester on.
(c) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DTC INFO / CURRENT CODES.
(d) Read the DTCs.
Result

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

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

ES

B → GO TO DTC CHART

A

2 PERFORM ACTIVE TEST (OPERATE OCV)

(a) Connect the intelligent tester to the DLC3.
(b) Start the engine and turn the tester on.
(c) Warm up the engine.
(d) On the tester, enter the following menus: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / VVT B1.
(e) Check the engine speed while operating the Oil Control Valve (OCV) using the tester.

OK

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

NG → Go to step 4

OK

3 CHECK WHETHER DTC OUTPUT RECURS (DTC P0011 OR P0012)

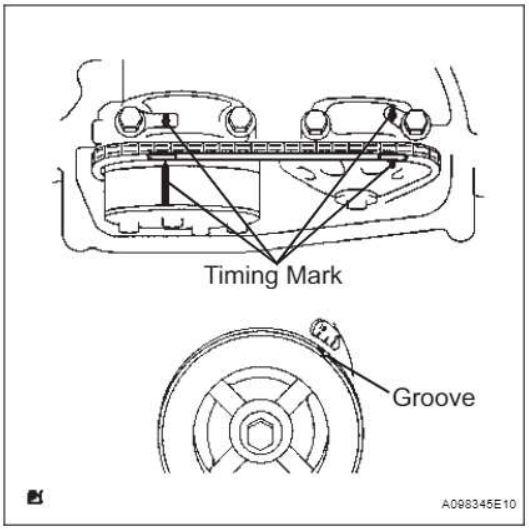
(a) Connect the intelligent tester to the DLC3.
(b) Turn the ignition switch to the ON position and turn the tester on.
(c) Clear the DTCs (See page ES-32).
(d) Start the engine and warm it up.
(e) Switch the ECM from normal mode to check mode using the tester (See page ES-35).
(f) Drive the vehicle for more than 10 minutes.
(g) Read the DTCs using the tester.
OK:
No DTC output.

NG → Go to step 4

OK

END

4	CHECK VALVE TIMING (CHECK FOR LOOSE AND JUMPED TEETH ON TIMING CHAIN)

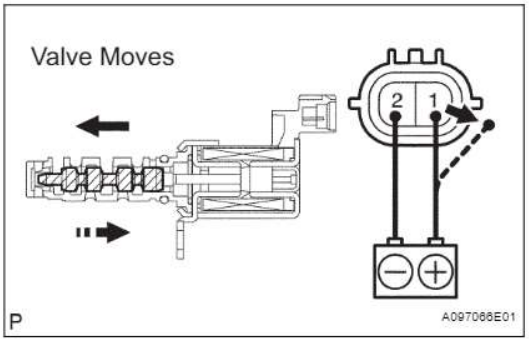


(a) Remove the cylinder head cover (See page EM-115).
(b) Turn the crankshaft pulley until its groove and the timing mark "0" of the timing chain cover are aligned.
(c) Check that each timing mark of the camshaft timing gears is aligned with its corresponding timing mark located on the No. 1 and No. 2 bearing caps as shown in the illustration.
If not, turn the crankshaft by 1 revolution (360°) to align the timing marks as above.
OK:
The timing marks of the camshaft timing gears are aligned with the timing marks located on the No. 1 and No. 2 bearing caps.

NG → **ADJUST VALVE TIMING**

OK

5	INSPECT CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY (OCV)

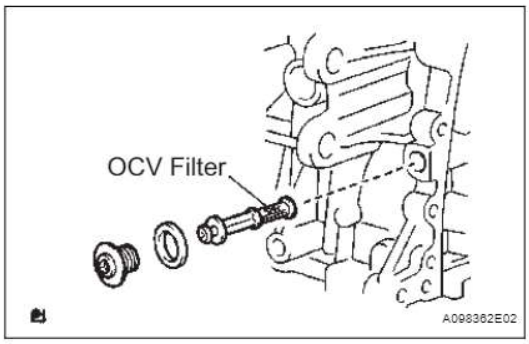


(a) Remove the OCV.
(b) Measure the resistance between the terminals of the OCV.
Standard resistance:
6.9 to 7.9 Ω at 20°C (68°F)
(c) Apply the positive battery voltage to terminal 1 and negative battery voltage to terminal 2. Check the valve operation.
OK:
The valve moves quickly.

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

OK

6	INSPECT OIL CONTROL VALVE FILTER



(a) Remove the generator (See page CH-10).
(b) Remove the OCV filter.
(c) Check that the filter is not clogged.
OK:
The filter is not clogged.

NG → **CLEAN OIL CONTROL VALVE FILTER**

OK

7	REPLACE CAMSHAFT TIMING GEAR ASSEMBLY

After replacing the camshaft timing gear, confirm that the DTC output does not recur.
(a) Connect the intelligent tester to the DLC3.
(b) Turn the ignition switch to the ON position and turn the tester on.
(c) Clear the DTCs (See page ES-32).
(d) Start the engine and warm it up.
(e) Switch the ECM from normal mode to check mode using the tester (See page ES-35).
(f) Drive the vehicle for more than 10 minutes.
(g) Confirm that no DTC is set using the tester.

NEXT

END

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

DESCRIPTION

Refer to DTC P0335 (See page ES-162).

DTC No.	DTC Detection Condition	Trouble Area
P0016	Deviations in crankshaft and camshaft position sensor signals (2 trip detection logic)	• Mechanical system (Timing chain has jumped tooth or chain stretched) • ECM

MONITOR DESCRIPTION

The ECM optimizes the valve timing by using the VVT (Variable Valve Timing) system to control the intake camshaft. The VVT system includes the ECM, the Oil Control Valve (OCV) and the VVT controller.
The ECM sends a target duty-cycle control signal to the OCV. This control signal regulates the oil pressure supplied to the VVT controller. The VVT controller can advance or retard the intake camshaft.
The ECM calibrates the intake valve timing by setting the intake camshaft to the most retarded angle while the engine is idling. The ECM closes the OCV to retard the cam. The ECM stores this value as the VVT learning value. When the difference between the target and actual intake valve timings is 5°CA (Crankshaft Angle) or less, the ECM stores it.
If the VVT learning value matches the following conditions, the ECM determines the existence of a malfunction in the VVT system, and sets the DTC.

- VVT learning value: Less than 27°CA, or more than 49°CA.
- Above condition continues for 18 seconds or more.

This DTC indicates that the intake camshaft has been installed toward the crankshaft at an incorrect angle, caused by factors such as the timing chain having a jumped tooth.
This monitor begins to run after the engine has idled for 5 minutes.

MONITOR STRATEGY

Related DTCs	P0016: Camshaft Timing Misalignment at Idling
Required Sensors/Components (Main)	VVT actuator
Required Sensors/Components (Related)	Camshaft position sensor, Crankshaft position sensor
Frequency of Operation	Once per driving cycle
Duration	Within 1 minute
MIL Operation	2 driving cycles
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

Monitor runs whenever the following DTCs are not present	P0011 (VVT system 1 - advanced) P0012 (VVT system 1 - retarded) P0115 - P0118 (ECT sensor)
Engine RPM	550 to 1,400 rpm

TYPICAL MALFUNCTION THRESHOLDS

One of the following conditions is met:	-
VVT learning value at maximum retarded valve timing	Less than 27.8°CA (crankshaft angle)
VVT learning value at maximum retarded valve timing	More than 48°CA (crankshaft angle)

WIRING DIAGRAM

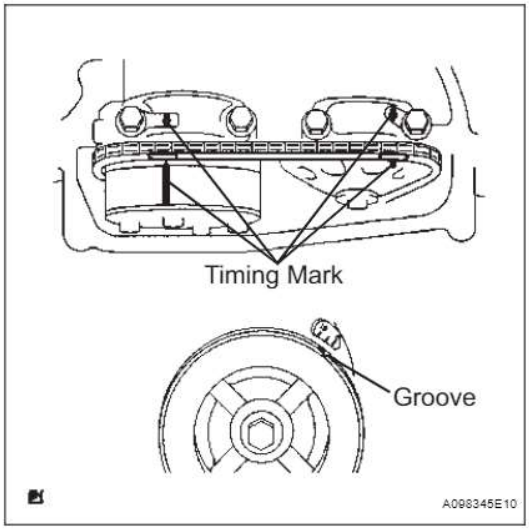
Refer to DTC P0335 (See page ES-164).

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.

1	CHECK VALVE TIMING (CHECK FOR LOOSE AND JUMPED TEETH ON TIMING CHAIN)



(a) Remove the cylinder head cover (See page EM-115).
(b) Turn the crankshaft pulley until its groove and the timing mark "0" of the timing chain cover are aligned.
(c) Check that each timing mark of the camshaft timing gears is aligned with its corresponding timing mark located on the No. 1 and No. 2 bearing caps as shown in the illustration.
If not, turn the crankshaft by 1 revolution (360°) to align the timing marks as above.

OK:

The timing marks of the camshaft timing gears are aligned with the timing marks located on the No. 1 and No. 2 bearing caps.

NG → **ADJUST VALVE TIMING**

OK

2	REPLACE ECM

After replacing the ECM or adjusting intake valve timing, confirm that the DTC output does not recur.

(a) Connect the intelligent tester to the DLC3.
(b) Turn the ignition switch to the ON position.
(c) Turn the tester on.
(d) Clear the DTCs (See page ES-32).
(e) If using the intelligent tester, switch the ECM from normal mode to check mode (See page ES-35).
(f) Start the engine and warm it up.
(g) Allow the engine to idle for 1 minute or more, and then drive the vehicle for 1 minute or more.
(h) Confirm that no DTC is set using the tester.

NEXT

END

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

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

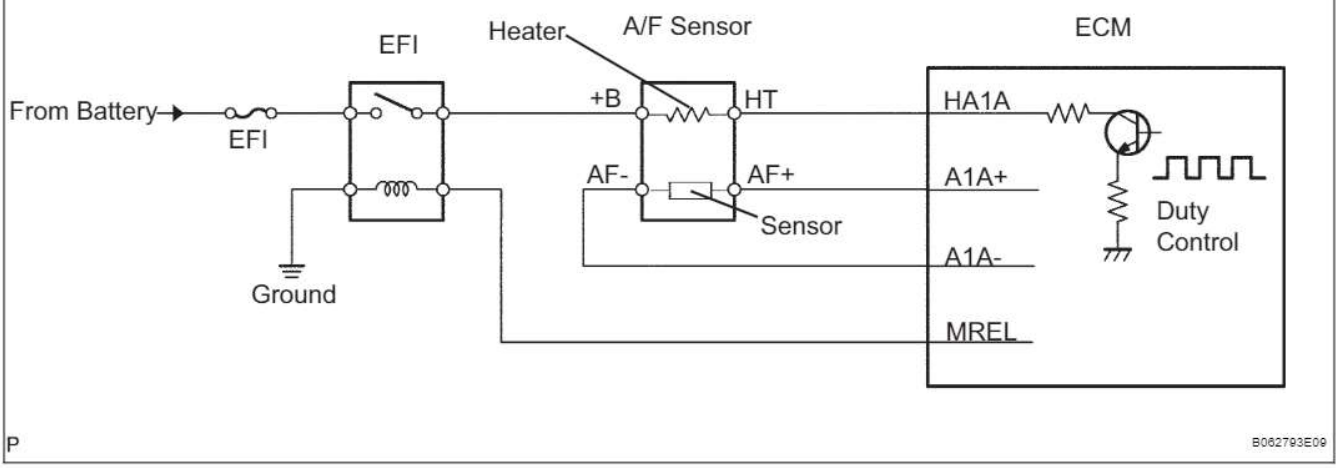
DESCRIPTION

Refer to DTC P2195 (See page ES-278).

HINT:

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

Reference (System Diagram of Sensor 1)



DTC No.	DTC Detection Condition	Trouble Area
P0031	A/F sensor heater current less than 0.8 A (1 trip detection logic)	• Open in A/F sensor heater circuit • A/F sensor heater • EFI relay • ECM
P0032	A/F sensor heater current more than 10 A (1 trip detection logic)	• Short in A/F sensor heater circuit • A/F sensor heater • EFI relay • ECM

MONITOR DESCRIPTION

The ECM uses information from the Air-Fuel Ratio (A/F) sensor to regulate the air-fuel ratio and keep it close to the stoichiometric level. This maximizes the ability of the Three-Way Catalytic Converter (TWC) to purify the exhaust gases.

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

The zirconia element generates a small voltage when there is a large difference in the oxygen concentrations between the exhaust gas and outside air. The platinum coating amplifies this voltage generation.
The A/F sensor is more efficient when heated. When the exhaust gas temperature is low, the sensor cannot generate useful voltage signals without supplementary heating. The ECM regulates the supplementary heating using a duty-cycle approach to adjust the average current in the sensor heater element. If the heater current is outside the normal range, the signal transmitted by the A/F sensor will be inaccurate, as a result, the ECM will be unable to regulate air-fuel ratio properly.
When the current in the A/F sensor heater is outside the normal operating range, the ECM interprets this as a malfunction in the sensor heater and sets a DTC.
Example:
The ECM sets DTC P0032 when the current in the A/F sensor heater is more than 10 A. Conversely, when the heater current is less than 0.8 A, DTC P0031 is set.

MONITOR STRATEGY

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

TYPICAL ENABLING CONDITIONS

P0031:

Monitor runs whenever the following DTCs are not present	None
Battery voltage	10.5 V or more
A/F sensor heater duty-cycle ratio	50 % or more
Time after engine start	10 seconds or more

P0032:

Monitor runs whenever the following DTCs are not present	None
Time after engine start	10 seconds or more

TYPICAL MALFUNCTION THRESHOLDS

P0031:

A/F sensor heater current	Less than 0.8 A

P0032:

A/F sensor heater current	More than 10 A

COMPONENT OPERATING RANGE

A/F sensor heater current	0.9 to 9.9 A

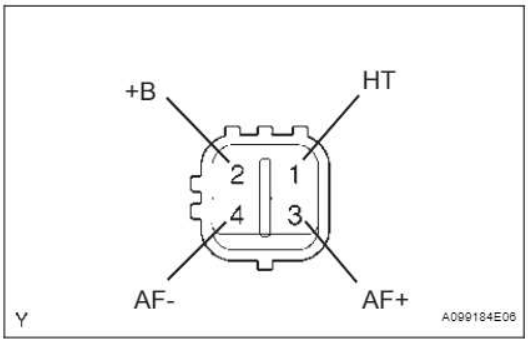
WIRING DIAGRAM

Refer to DTC P2195 (See page ES-281).

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.

1 INSPECT AIR FUEL RATIO SENSOR (HEATER RESISTANCE)



(a) Disconnect the A3 Air-Fuel Ratio (A/F) sensor connector.
(b) Measure the resistance according to the value(s) in the table below.

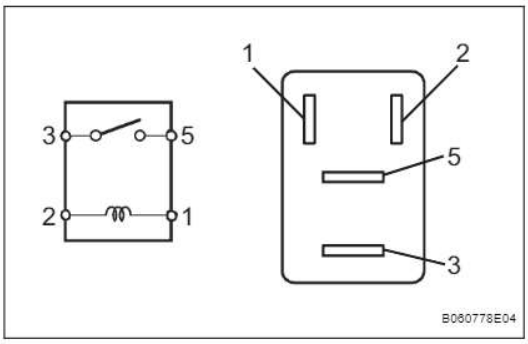
Standard resistance

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

NG → REPLACE AIR FUEL RATIO SENSOR

OK

2 INSPECT EFI RELAY (Marking: EFI)



(a) Remove the EFI relay from the engine room relay block.
(b) Measure the EFI relay resistance according to the value(s) in the table below.

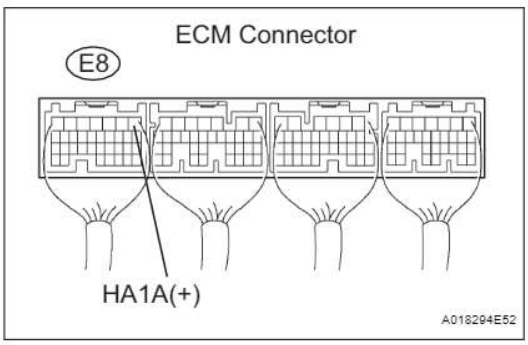
Standard resistance

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

NG → REPLACE EFI RELAY

OK

3 INSPECT ECM (HT1A VOLTAGE)



(a) Turn the ignition switch to the ON position.
(b) Measure the voltage according to the value(s) in the table below.

Standard voltage

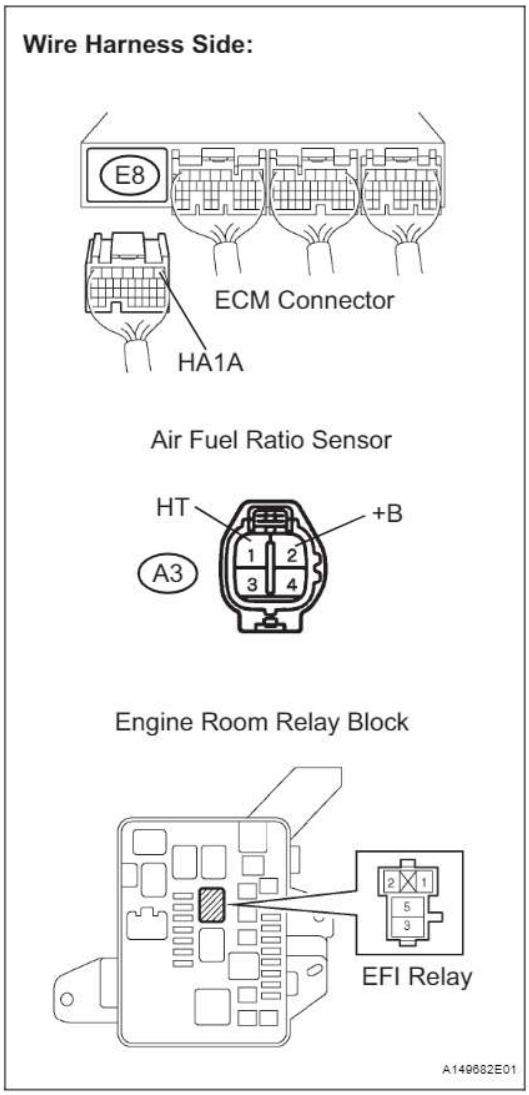
Tester Connection	Specified Condition
HA1A (E8-1) - Body ground	9 to 14 V

NG → Go to step 4

OK

REPLACE ECM

4	CHECK WIRE HARNESS (AIR FUEL RATIO SENSOR - ECM, AIR FUEL RATIO SENSOR - EFI RELAY)



(a) Check the wire harness between the ECM and A/F sensor.
(1) Disconnect the A3 A/F sensor connector.
(2) Disconnect the E8 ECM connector.
(3) Measure the resistance according to the value(s) in the table below.
Standard resistance

Tester Connection	Specified Condition
HT (A3-1) - HA1A (E8-1)	Below 1 Ω
HT (A3-1) or HA1A (E8-1) - Body ground	10 kΩ or higher

(b) Check the wire harness between the A/F sensor and EFI relay.
(1) Disconnect the A3 A/F sensor connector.
(2) Remove the EFI relay from the engine room relay block.
(3) Measure the resistance according to the value(s) in the table below.
Standard resistance

Tester Connection	Specified Condition
+B (A3-2) - EFI relay (3)	Below 1 Ω
+B (A3-2) or EFI relay (3) - Body ground	10 kΩ or higher

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

OK

REPLACE ECM

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

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

DTC	P0141	Oxygen Sensor Heater Circuit Malfunction (Bank 1 Sensor 2)

ES

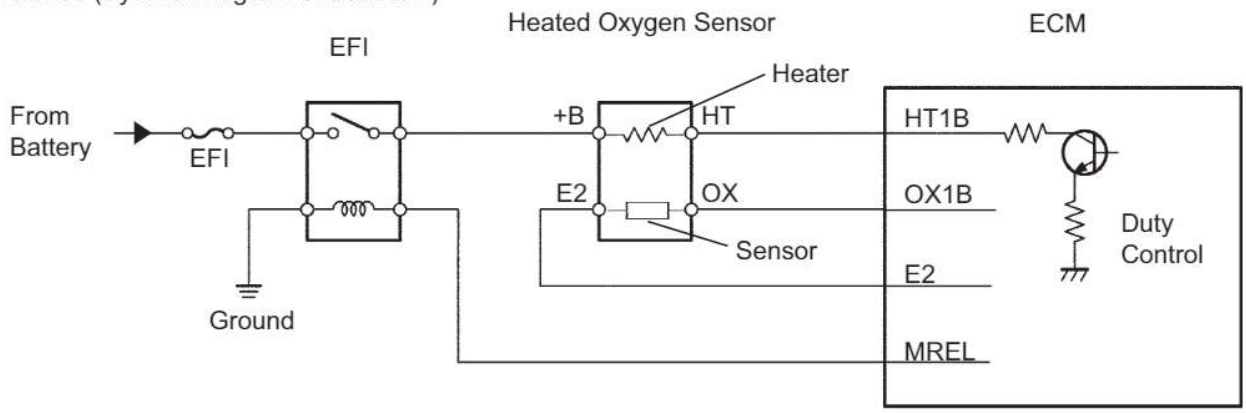
DESCRIPTION

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

HINT:

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

Reference (System Diagram of Sensor 2)



DTC No.	DTC Detection Condition	Trouble Area
P0037	HO2 sensor heater current less than 0.3 A (1 trip detection logic)	• Open in HO2 sensor heater circuit • HO2 sensor heater • EFI relay • ECM
P0038	HO2 sensor heater current more than 2 A (1 trip detection logic)	• Short in HO2 sensor heater circuit • HO2 sensor heater • EFI relay • ECM
P0141	Cumulative heater resistance correction value exceeds threshold (2 trip detection logic)	• Open or short in HO2 sensor heater circuit • HO2 sensor heater (sensor 2) • EFI relay • ECM

MONITOR DESCRIPTION

The sensing portion of the Heated Oxygen (HO2) sensor has a zirconia element which is used to detect the oxygen concentration in the exhaust gas. If the zirconia element is at the appropriate temperature, and the difference between the oxygen concentrations surrounding the inside and outside surfaces of the sensor is large, the zirconia element generates voltage signals. In order to increase the oxygen concentration detecting capacity of the zirconia element, the ECM supplements the heat from the exhaust with heat from a heating element inside the sensor. When the current in the sensor heater is outside the standard operating range, the ECM interprets this as a malfunction in the sensor heater and sets a DTC.
Example:
The ECM sets DTC P0038 when the current in the HO2 sensor heater is more than 2 A. Conversely, when the heater current is less than 0.3 A, DTC P0037 is set.

MONITOR STRATEGY

ES

Related DTCs	P0037: Heated oxygen sensor heater range check (Low current) P0038: Heated oxygen sensor heater range check (High current) P0141: Heated oxygen sensor heater performance
Required Sensors/Components (Main)	Heated oxygen sensor heater
Required Sensors/Components (Related)	-
Frequency of Operation	Continuous: P0037 and P0038 Once per driving cycle: P0141
Duration	1 second: P0037 and P0038 10 seconds: P0141
MIL Operation	Immediate: P0037 and P0038 2 driving cycles: P0141
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

All:

Monitor runs whenever the following DTCs are not present	None

P0037:

Battery voltage	10.5 to 20 V

P0038:

Battery voltage	10.5 to 20 V

P0041:

All of the following conditions are met:	-
Battery voltage	10.5 V or more
Fuel cut	OFF
Time after fuel cut ON to OFF	30 seconds or more
Accumulated heater ON time	100 seconds or more

TYPICAL MALFUNCTION THRESHOLDS

P0037:

Heater current	Less than 0.3 A

P0038:

Heater current	More than 2 A

P0141 (Heater performance monitor check):

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

COMPONENT OPERATING RANGE

Heated Oxygen (HO2) sensor heater current	0.4 to 1 A (when engine idles, HO2 sensor warmed up and battery voltage 11 to 14 V)

MONITOR RESULT

Refer to detailed information on "CHECKING MONITOR STATUS" (See page ES-15).

WIRING DIAGRAM

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

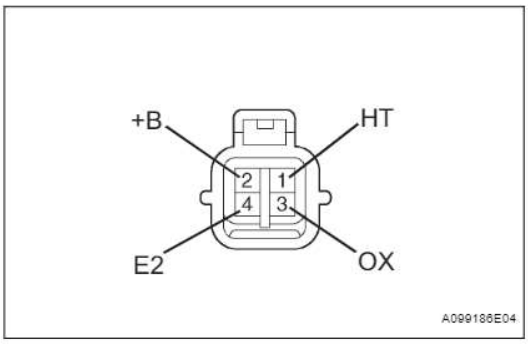
INSPECTION PROCEDURE

ES

HINT:

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

1 INSPECT HEATED OXYGEN SENSOR (HEATER RESISTANCE)



(a) Disconnect the H5 Heated Oxygen (HO2) sensor connector.

(b) Measure the resistance between the terminals of the HO2 sensor connector.

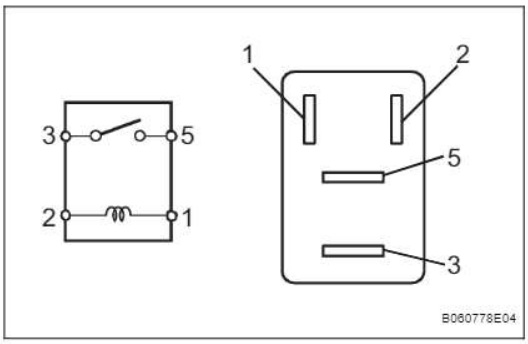
Standard resistance

Tester Connection	Specified Condition
HT (1) - +B (2)	11 to 16 Ω at 20°C (68°F)
HT (1) - E2 (4)	10 kΩ or higher

NG → REPLACE HEATED OXYGEN SENSOR

OK

2 INSPECT EFI RELAY (Marking: EFI)



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

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

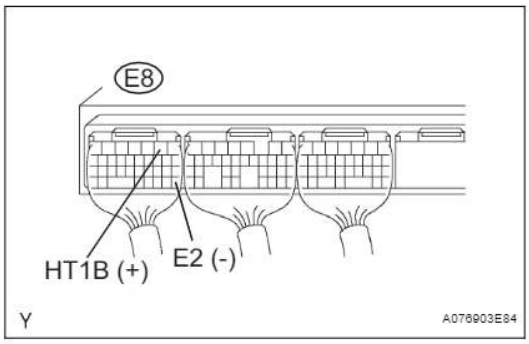
Standard resistance

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

NG → REPLACE EFI RELAY

OK

3	INSPECT ECM (HT1B VOLTAGE)



(a) Turn the ignition switch to the ON position.
(b) Measure the voltage between the terminals of the E8 ECM connector.

Standard voltage

Tester Connection	Specified Condition
HT1B (E8-2) - E2 (E8-28)	9 to 14 V

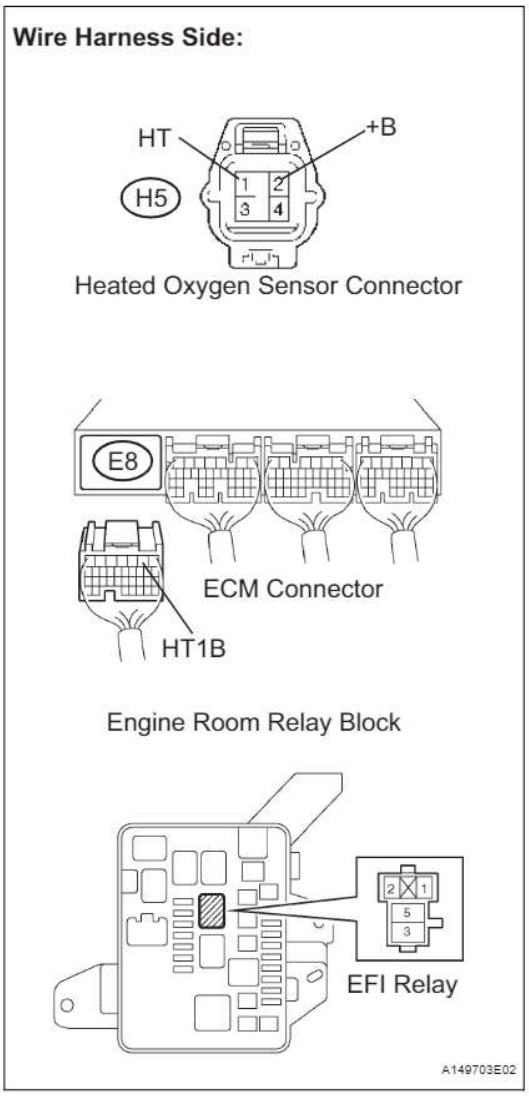
NG → Go to step 4

OK →

REPLACE ECM

ES

4	CHECK WIRE HARNESS (HEATED OXYGEN SENSOR - ECM, EFI RELAY [Marking: EFI])



(a) Check the wire harness between the ECM and HO2 sensor.
(1) Disconnect the H5 HO2 sensor connector.
(2) Disconnect the E8 ECM connector.
(3) Measure the resistance according to the value(s) in the table below.

Standard resistance

Tester Connection	Specified Condition
HT (H5-1) - HT1B (E8-2)	Below 1 Ω
HT (H5-1) or HT1B (E8-2) - Body ground	10 kΩ or higher

(b) Check the wire harness between the HO2 sensor and EFI relay.
(1) Disconnect the H5 HO2 sensor connector.
(2) Remove the EFI relay from the engine room relay block.
(3) Measure the resistance according to the value(s) in the table below.

Standard resistance

Tester Connection	Specified Condition
+B (H5-2) - EFI relay (3)	Below 1 Ω
+B (H5-2) or EFI relay (3) - Body ground	10 kΩ or higher

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

OK

REPLACE ECM

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

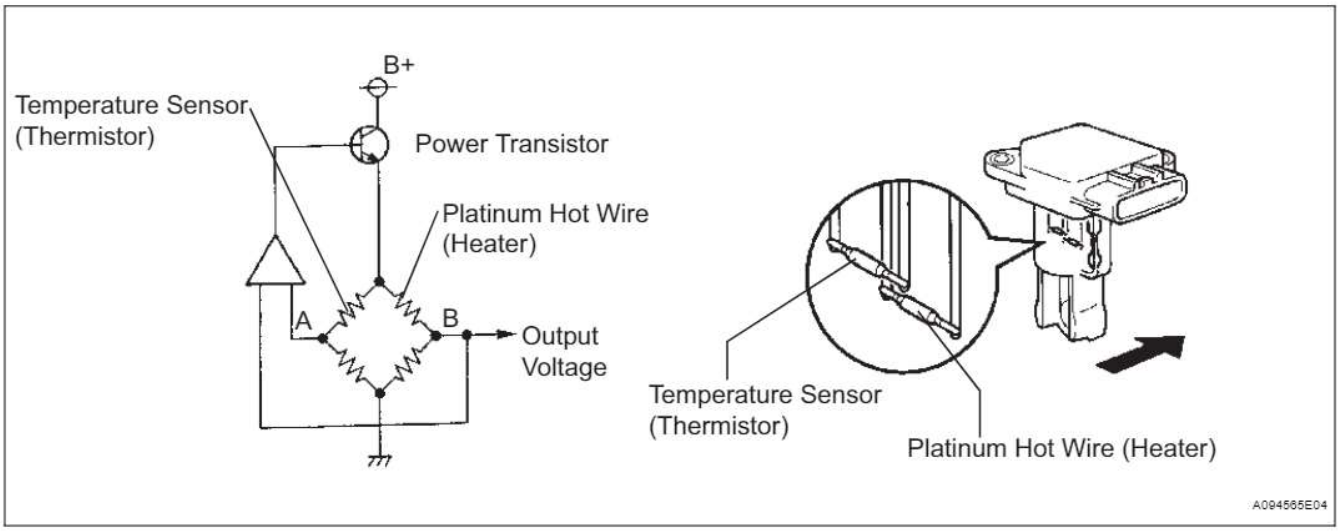
DESCRIPTION

The Mass Air Flow (MAF) meter is a sensor that measures the amount of air flowing through the throttle valve. The ECM uses this information to determine the fuel injection time and to provide appropriate air-fuel ratio. Inside the MAF meter, there is a heated platinum wire which is exposed to the flow of intake air. By applying a specific electrical current to the wire, the ECM heats it to a given temperature. The flow of incoming air cools both the wire and an internal thermistor, affecting their resistance. To maintain a constant current value, the ECM varies the voltage applied to these components in the MAF meter. The voltage level is proportional to the airflow through the sensor, and the ECM uses it to calculate the intake air volume.

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

HINT:

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



DTC No.	DTC Detection Condition	Trouble Area
P0100	MAF meter voltage less than 0.2 V, or more than 4.9 V for 3 seconds (1 trip detection logic)	• Open or short in MAF meter circuit • MAF meter • ECM
P0102	MAF meter voltage less than 0.2 V for 3 seconds (1 trip detection logic)	• Open in MAF meter circuit • MAF meter • ECM
P0103	MAF meter voltage more than 4.9 V for 3 seconds (1 trip detection logic)	• Short in MAF meter circuit • MAF meter • ECM

HINT:
When any of these DTCs are set, check the air-flow rate by selecting the following menu items on the intelligent tester: DIAGNOSIS / ENHANCED OBD II / DATA LIST / ALL / MAF.

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

MONITOR DESCRIPTION

If there is a defect in the MAF meter or an open or short circuit, the voltage level deviates from the normal operating range. The ECM interprets this deviation as a malfunction in the MAF meter and sets a DTC.
Example:
When the sensor voltage output remains less than 0.2 V or more than 4.9 V for more than 3 seconds, the ECM sets a DTC.
If the malfunction is not repaired successfully, a DTC is set 3 seconds after the engine is next started.

MONITOR STRATEGY

Related DTCs	P0100: Mass air flow meter range check (Fluctuating) P0102: Mass air flow meter range check (Low voltage) P0103: Mass air flow meter range check (High voltage)
Required Sensors/Components (Main)	MAF meter
Required Sensors/Components (Related)	Crankshaft position sensor
Frequency of Operation	Continuous
Duration	3 seconds
MIL Operation	Immediate: Engine RPM less than 4,000 rpm 2 driving cycles: Engine RPM 4,000 rpm or more
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

Monitor runs whenever the following DTCs are not present	None

TYPICAL MALFUNCTION THRESHOLDS

P0100:

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

P0102:

MAF meter voltage	Less than 0.2 V

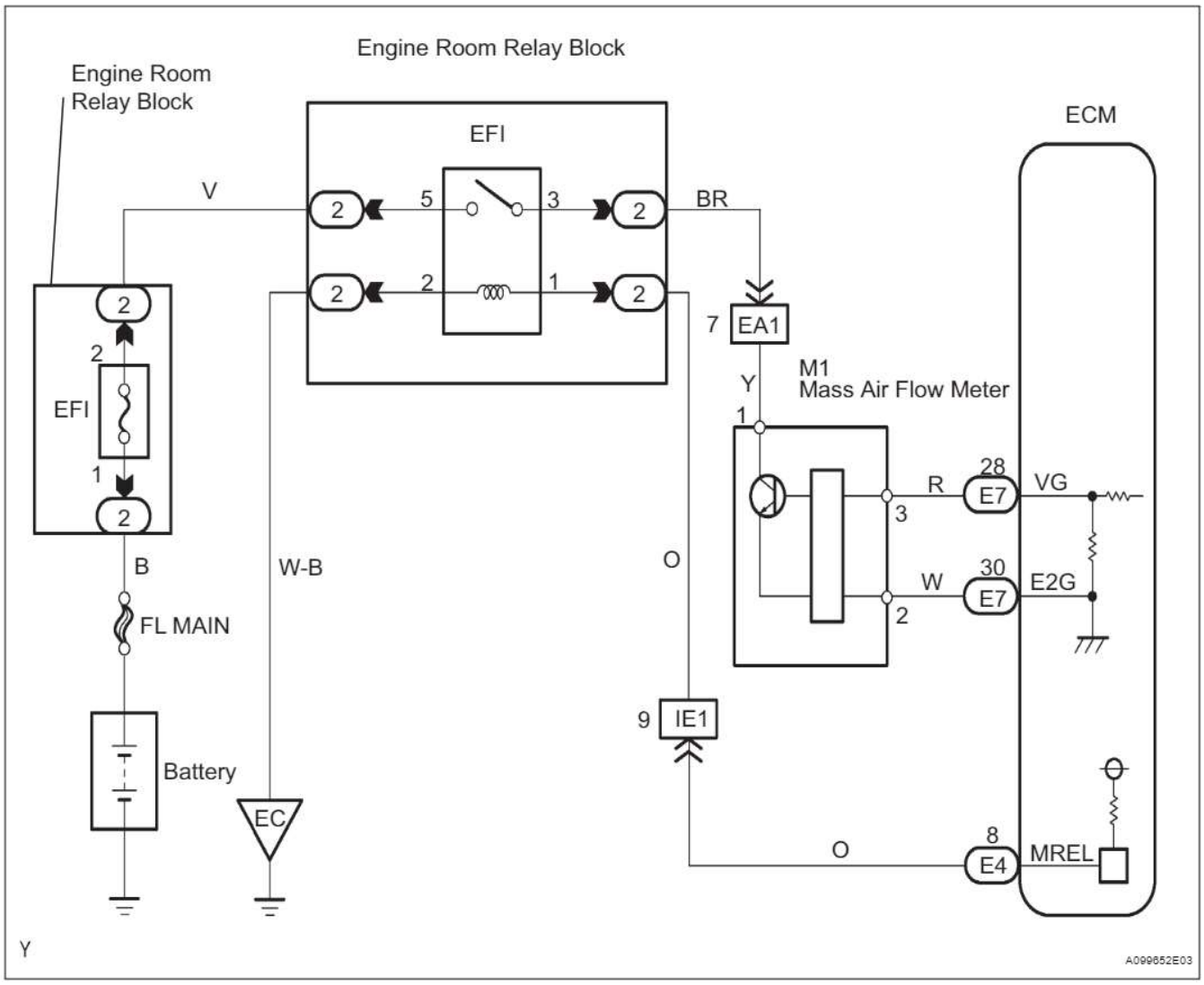
P0103:

MAF meter voltage	More than 4.9 V

COMPONENT OPERATING RANGE

MAF meter voltage	Between 0.4 and 2.2 V

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.

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

(a) Connect the intelligent tester to the DLC3.
(b) Start the engine.
(c) Turn the tester on.
(d) On the tester, select the following menu items: DIAGNOSIS / ENHANCED OBD II / DATA LIST / ALL / MAF.
(e) Read the values displayed on the tester.

Result

Mass Air Flow Rate (gm/s)	Proceed to
0.0	A
271.0 or more	B
Between 1.0 and 270.0 (*)	C

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

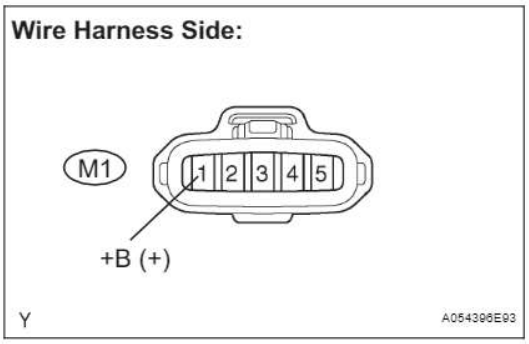
B → Go to step 6

C → CHECK FOR INTERMITTENT PROBLEMS

ES

A

2 INSPECT MASS AIR FLOW METER (POWER SOURCE VOLTAGE)



(a) Disconnect the M1 MAF meter connector.
(b) Turn the ignition switch to the ON position.
(c) Measure the voltage according to the value(s) in the table below.

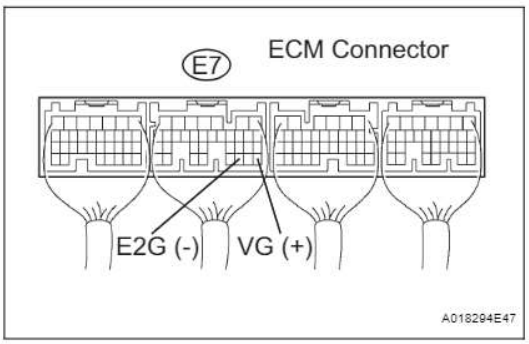
Standard voltage

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

NG → Go to step 5

OK

3 INSPECT ECM (VG VOLTAGE)



(a) Start the engine.
(b) Measure the voltage according to the value(s) in the table below.
HINT:
The transmission gear selector lever should be in the P or N position and the A/C switch should be turned off.

Standard voltage

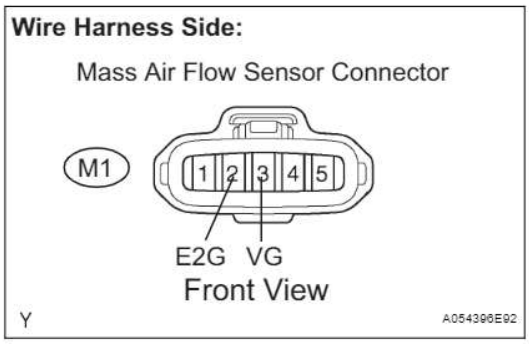
Tester Connection	Condition	Specified Condition
VG (E7-28) - E2G (E7-30)	Engine idling	0.5 to 3.0 V

NG → Go to step 4

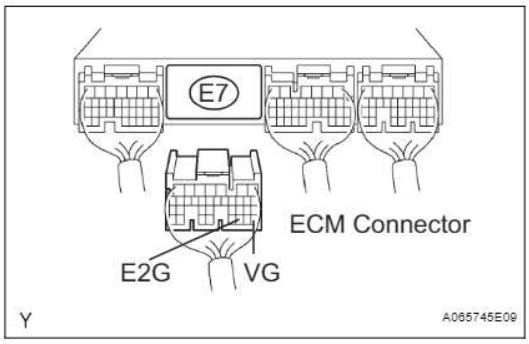
OK

REPLACE ECM

4	CHECK WIRE HARNESS (MASS AIR FLOW METER - ECM)



(a) Disconnect the M1 MAF meter connector.



(b) Disconnect the E7 ECM connector.
(c) Measure the resistance according to the value(s) in the table below.

Standard resistance

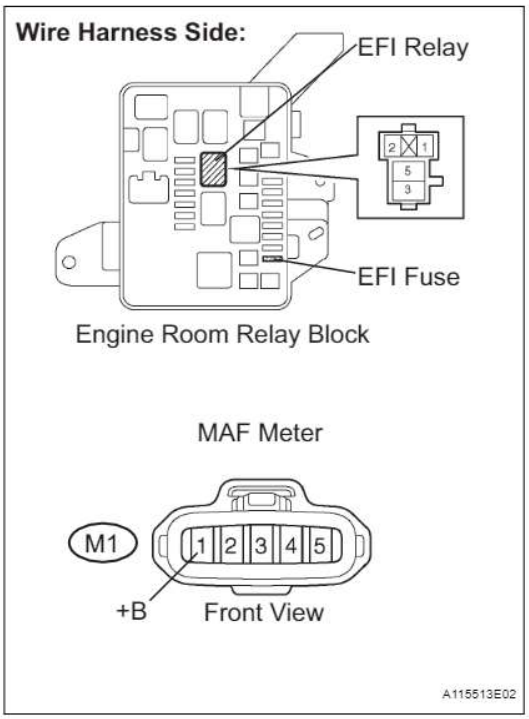
Tester Connection	Specified Condition
VG (M1-3) - VG (E7-28)	Below 1 Ω
E2G (M1-2) - E2G (E7-30)	Below 1 Ω
VG (M1-3) or VG (E7-28) - Body ground	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

REPLACE MASS AIR FLOW METER

5	CHECK WIRE HARNESS (MASS AIR FLOW METER - EFI RELAY [Marking: EFI])



(a) Inspect the EFI fuse.
  (1) Remove the EFI fuse from the engine room relay block.
  (2) Measure the EFI fuse resistance.
    Standard resistance:
      Below 1 Ω
  (3) Reinstall the EFI fuse.
(b) Remove the EFI relay from the engine room relay block.
(c) Disconnect the M1 MAF meter connector.
(d) Measure the resistance according to the value(s) in the table below.
  Standard resistance

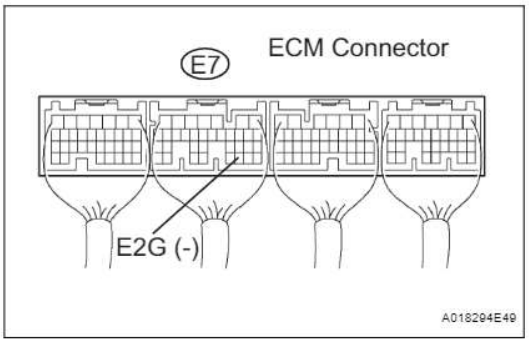
Tester Connection	Specified Condition
+B (M1-1) - EFI relay (3)	Below 1 Ω
+B (M1-1) or EFI relay (3) - Body ground	10 kΩ or higher

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

OK

INSPECT ECM POWER SOURCE CIRCUIT

6	INSPECT ECM (SENSOR GROUND)



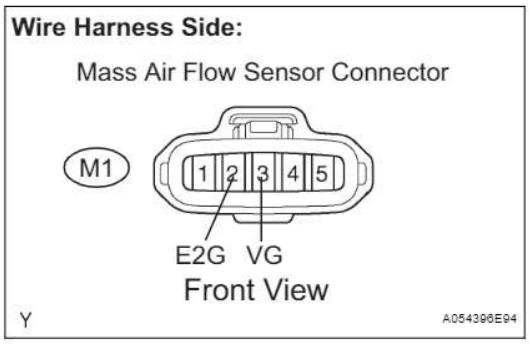
(a) Measure the resistance according to the value(s) in the table below.
  Standard resistance

Tester Connection	Specified Condition
E2G (E7-30) - Body ground	Below 1 Ω

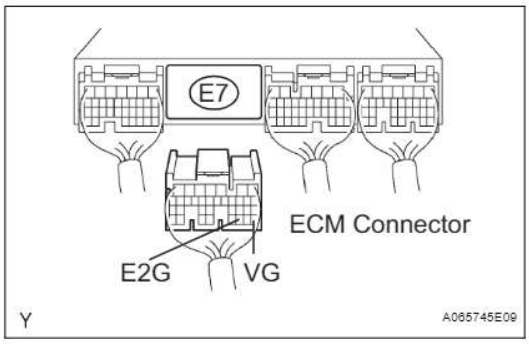
NG → **REPLACE ECM**

OK

7	CHECK WIRE HARNESS (MASS AIR FLOW METER - ECM)



(a) Disconnect the M1 MAF meter connector.



(b) Disconnect the E7 ECM connector.
(c) Measure the resistance according to the value(s) in the table below.

Standard resistance

Tester Connection	Specified Condition
VG (M1-3) - VG (E7-28)	Below 1 Ω
E2G (M1-2) - E2G (E7-30)	Below 1 Ω
VG (M1-3) or VG (E7-28) - Body ground	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

REPLACE MASS AIR FLOW METER

DTC	P0101	Mass or Volume Air Flow Circuit Range / Performance Problem

DESCRIPTION

Refer to DTC P0100 (See page ES-79).

DTC No.	DTC Detection Condition	Trouble Area
P0101	Conditions (a), (b), (c) (d) and (e) continue for more than 10 seconds (2 trip detection logic): (a) Engine running (b) Engine coolant temperature 70°C (158°F) or higher (c) Throttle Position (TP) sensor voltage 0.24 V or more (d) Average engine load value ratio less than 0.85, or more than 1.15 (varies with estimated engine load) Average engine load value ratio = Average engine load based on MAF meter output / Average engine load estimated from driving conditions (e) Average air-fuel ratio less than -20 %, or more than 20 %	• MAF meter • Air induction system • PCV hose connections

ES

MONITOR DESCRIPTION

The MAF meter is a sensor that measures the amount of air flowing through the throttle valve. The ECM uses this information to determine the fuel injection time and to provide an appropriate air-fuel ratio. Inside the MAF meter, there is a heated platinum wire which is exposed to the flow of intake air. By applying a specific electrical current to the wire, the ECM heats it to a specific temperature. The flow of incoming air cools both the wire and an internal thermistor, affecting their resistance. To maintain a constant current value, the ECM varies the voltage applied to these components of the MAF meter. The voltage level is proportional to the airflow through the sensor, and the ECM uses it to calculate the intake air volume.

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

Example:

If the voltage is more than 2.2 V or less than 0.65 V while idling, the ECM determines that there is a malfunction in the MAF meter and sets the DTC.

MONITOR STRATEGY

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

TYPICAL ENABLING CONDITIONS

Monitor runs whenever the following DTCs are not present	P0115 - P0118 (ECT sensor) P0120 - P0223, P2135 (TP sensor) P0125 (Insufficient ECT for closed loop) P0335 (CKP sensor) P0340 (CMP sensor)
Throttle position (TP sensor voltage)	0.24 V or more

Engine	Running
Battery voltage	10.5 V or more
Engine coolant temperature	70°C (158°F) or more
IAT sensor circuit	OK
ECT sensor circuit	OK
CKP sensor circuit	OK
TP sensor circuit	OK
Canister pressure sensor circuit	OK
EVAP leak detection pump	OK
EVAP vent valve	OK

TYPICAL MALFUNCTION THRESHOLDS

Averaged engine load	Less than 0.845 % or more than 1.23 %

WIRING DIAGRAM

Refer to DTC P0100 (See page ES-81).

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.

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

(a) Connect the intelligent tester to the DLC3.
(b) Turn the ignition switch to the ON position.
(c) Turn the tester on.
(d) On the tester, select the following menu items: DIAGNOSIS / ENHANCED OBD II / DATA INFO / CURRENT CODES.
(e) Read the DTCs.

Result

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

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

B → **REPLACE MASS AIR FLOW METER**

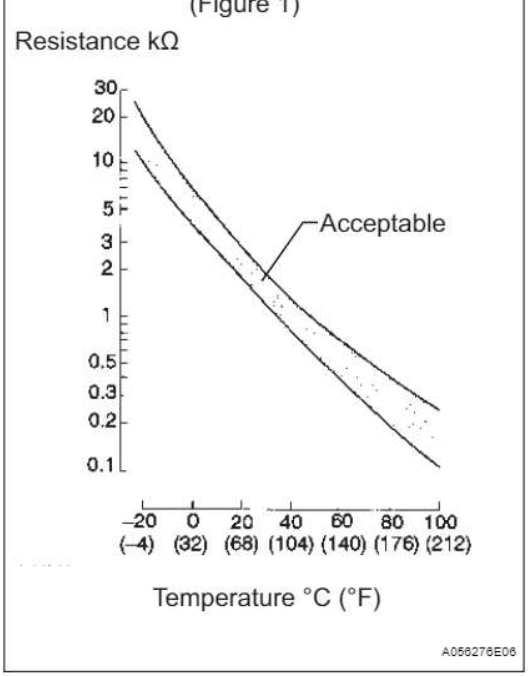
A

GO TO DTC CHART

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

DESCRIPTION

(Figure 1)



The Intake Air Temperature (IAT) sensor, mounted on the Mass Air Flow (MAF) meter, monitors the IAT. The IAT sensor has a built-in thermistor with a resistance that varies according to the temperature of the intake air. When the IAT is low, the resistance of the thermistor increases. When the temperature is high, the resistance drops. These variations in resistance are transmitted to the ECM as voltage changes (see Fig. 1).

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

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

HINT:

When any of DTCs P0110, P0112 and P0113 are set, the ECM enters fail-safe mode. During fail-safe mode, the IAT is estimated to be 20°C (68°F) by the ECM. Fail-safe mode continues until a pass condition is detected.

DTC No.	DTC Detection Condition	Trouble Area
P0110	Open or short in IAT sensor circuit for 0.5 seconds (1 trip detection logic)	• Open or short in IAT sensor circuit • IAT sensor (built into MAF meter) • ECM
P0112	Short in IAT sensor circuit for 0.5 seconds (1 trip detection logic)	• Short in IAT sensor circuit • IAT sensor (built into MAF meter) • ECM
P0113	Open in IAT sensor circuit for 0.5 seconds (1 trip detection logic)	• Open in IAT sensor circuit • IAT sensor (built into MAF meter) • ECM

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

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

MONITOR DESCRIPTION

The ECM monitors the sensor voltage and uses this value to calculate the Intake Air Temperature (IAT). When the sensor output voltage deviates from the normal operating range, the ECM interprets this as a malfunction in the IAT sensor and sets a DTC.
Example:
If the sensor output indicates -40°C (-40°F) for 0.5 seconds or more, the ECM determines that there is an open in the IAT sensor circuit, and sets DTC P0113. Conversely, if the sensor output indicates more than 140°C (284°F) for 0.5 seconds or more, the ECM determines that there is a short in the sensor circuit, and sets DTC P0112.
If the malfunction is not repaired successfully, a DTC is set 0.5 seconds after the engine is next started.

MONITOR STRATEGY

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

TYPICAL ENABLING CONDITIONS

Monitor runs whenever the following DTCs are not present	None

TYPICAL MALFUNCTION THRESHOLDS

P0110:

IAT sensor voltage	Less than 0.18 V, or more than 4.91 V

P0112:

IAT sensor voltage	Less than 0.18 V

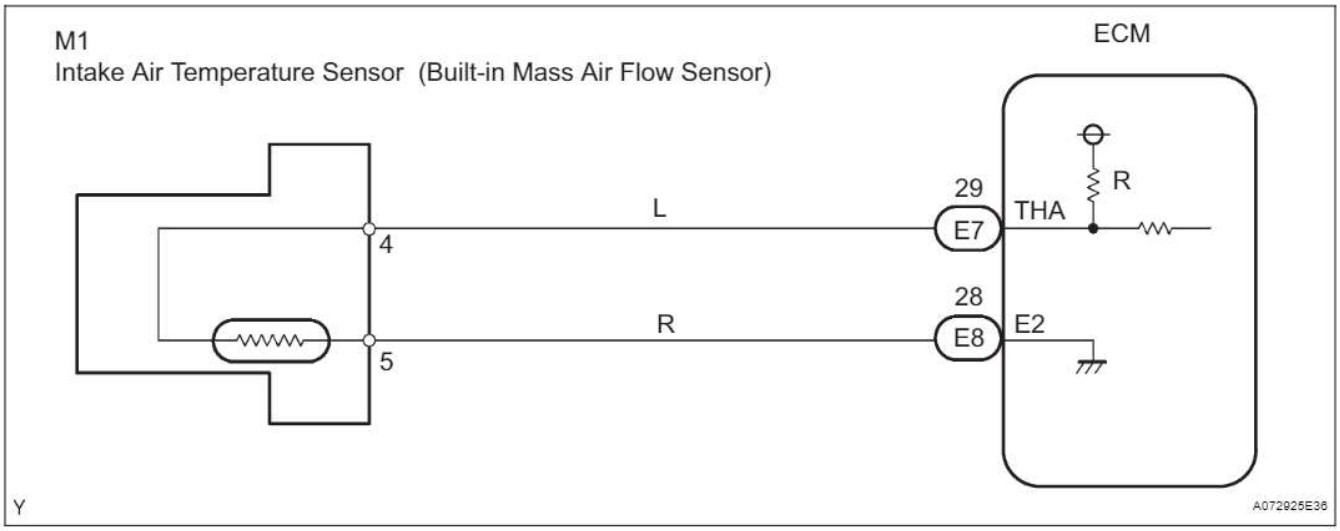
P0113:

IAT sensor voltage	More than 4.91 V

COMPONENT OPERATING RANGE

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

WIRING DIAGRAM



ES

INSPECTION PROCEDURE

HINT:

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

1	READ OUTPUT DTC

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

Result

Display (DTC Output)	Proceed to
P0110	A
P0112	B
P0113	C

B → Go to step 5

C → Go to step 4

A

2	READ VALUE USING INTELLIGENT TESTER (INTAKE AIR TEMPERATURE)

(a) Connect the intelligent tester to the DLC3.
(b) Turn the ignition switch to the ON position.

(c) Turn the tester on.
(d) On the tester, select the following menu items: DIAGNOSIS / ENHANCED OBD II / DATA LIST / ALL / INTAKE AIR.
(e) Read the value displayed on the tester.
Standard:
Same as the actual Intake Air Temperature (IAT).
Result

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

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

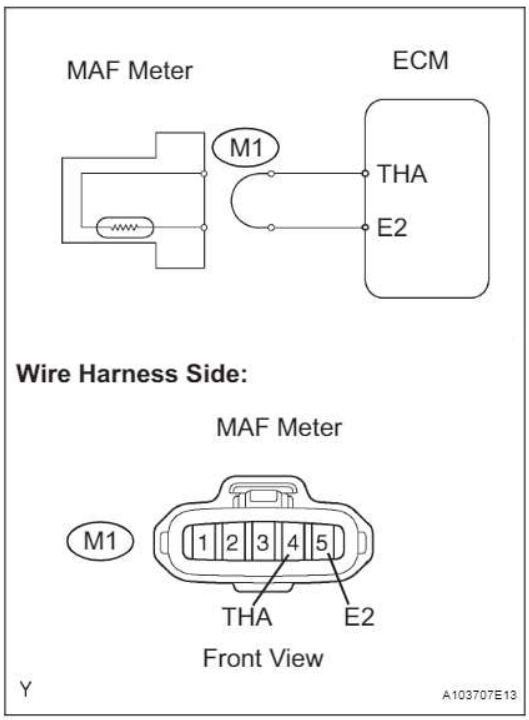
ES

B → **Go to step 5**

C → **CHECK FOR INTERMITTENT PROBLEMS**

A

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

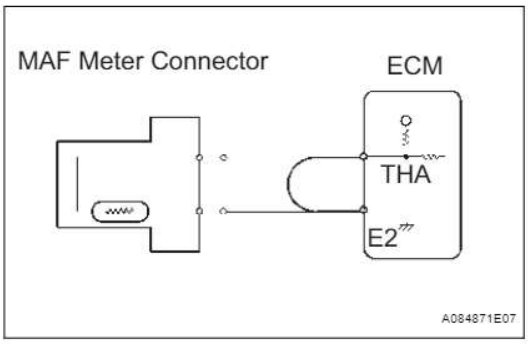


(a) Disconnect the M1 MAF meter connector.
(b) Connect terminals THA of the MAF meter wire harness side connector.
(c) Connect the intelligent tester to the DLC3.
(d) Turn the ignition switch to the ON position and turn the intelligent tester on.
(e) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DATA LIST / ALL / INTAKE AIR.
(f) Read the value.
Standard temperature:
140°C (284°F) or more

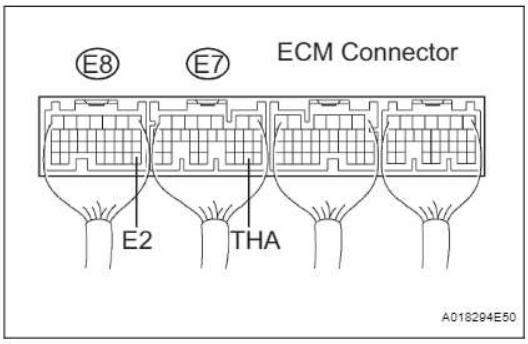
OK → **CONFIRM GOOD CONNECTION TO SENSOR. IF OK, REPLACE MASS AIR FLOW METER**

NG

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



(a) Disconnect the M1 MAF meter connector.



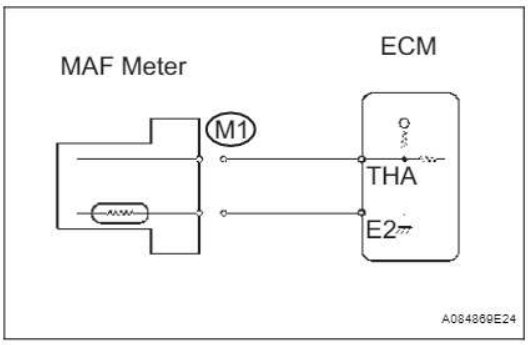
(b) Connect terminals THA and E2 of the E7 and E8 ECM connectors.
HINT:
Before checking, perform visual and contact pressure checks on the ECM connector.
(c) Connect the intelligent tester to the DLC3.
(d) Turn the ignition switch to the ON position.
(e) Turn the tester on.
(f) On the tester, select the following menu items: DIAGNOSIS / ENHANCED OBD II / DATA LIST / ALL / INTAKE AIR.
(g) Read the value displayed on the tester.
Standard temperature:
140°C (284°F) or higher

NG → **CONFIRM GOOD CONNECTION TO ECM. IF OK, REPLACE ECM**

OK

REPAIR OR REPLACE HARNESS OR CONNECTOR

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

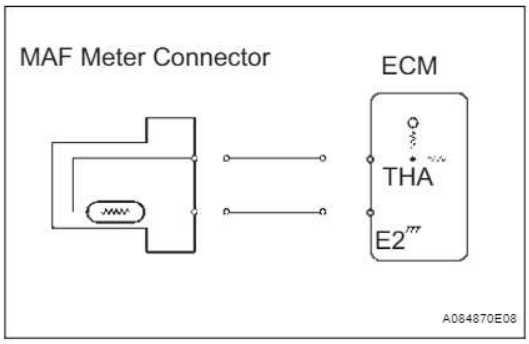


(a) Disconnect the M1 MAF meter connector.
(b) Connect the intelligent tester to the DLC3.
(c) Turn the ignition switch to the ON position.
(d) Turn the tester on.
(e) On the tester, select the following menu items: DIAGNOSIS / ENHANCED OBD II / DATA LIST / ALL / INTAKE AIR.
(f) Read the value displayed on the tester.
Standard temperature:
-40°C (-40°F)

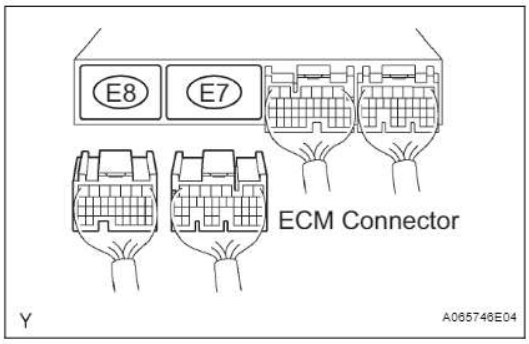
OK → **REPLACE MASS AIR FLOW METER**

NG

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



(a) Disconnect the E7 and E8 ECM connectors.



(b) Connect the intelligent tester to the DLC3.
(c) Turn the ignition switch to the ON position.
(d) Turn the tester on.
(e) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DATA LIST / ALL / INTAKE AIR.
(f) Read the value displayed on the tester.
Standard temperature:
-40°C (-40°F)

NG → **REPLACE ECM**

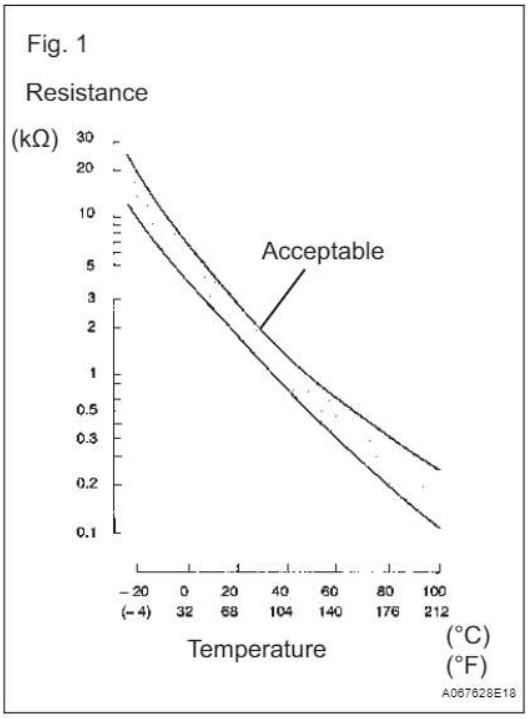
OK

REPAIR OR REPLACE HARNESS OR CONNECTOR

ES

DTC	P0111	Intake Air Temperature Sensor Gradient Too High

DESCRIPTION



The Intake Air Temperature (IAT) sensor, mounted on the Mass Air Flow (MAF) meter, monitors the IAT. The IAT sensor has a built-in thermistor with a resistance that varies according to the temperature of the intake air. When the IAT is low, the resistance of the thermistor increases. When the temperature is high, the resistance drops. These variations in resistance are transmitted to the ECM as voltage changes (See Fig. 1).
The IAT sensor is powered by a 5 V supply from the THA terminal of the ECM, via resistor R.
Resistor R and the IAT sensor are connected in series. When the resistance value of the IAT sensor changes, according to changes in the IAT, the voltage at terminal THA also varies. Based on this signal, the ECM increases the fuel injection volume when the engine is cold to improve driveability.

DTC No.	DTC Detection Condition	Trouble Area
P0111	When either condition below is met: 1. The intake air temperature rise is large, from the previous trip warm-up to the following trip (2 trip detection logic). 2. When the change in the intake air temperature after engine start is less than the threshold value.	Mass air flow meter assembly

MONITOR DESCRIPTION

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

MONITOR STRATEGY

Related DTCs	P0111: Intake air temperature sensor rationality (After engine stop) P0111: Intake air temperature sensor rationality (After cold engine start)
Required Sensors/Components (Main)	Intake Air Temperature (IAT) sensor
Required Sensors/Components (Sub)	-
Frequency of Operation	Once per driving cycle
Duration	5 hours or more
MIL Operation	2 driving cycles
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

ES

All:

Monitor runs whenever the following DTCs are not present	None

After engine stop:

Time after engine start	10 seconds or more
Battery voltage	10.5 V or more
ECT sensor circuit	OK
ECT change since engine	Less than 180°C (356°F)
ECT before engine stop	70°C (158°F) or more
Time that MAF is low before engine stop	70 minutes
Accumulated MAF amount before engine stop	3,131 g or more
Key-off duration	30 minutes

After cold engine start:

Key-off duration	5 hours
Time after engine start	10 seconds or more
ECT sensor circuit	OK
ECT	70°C (158°F) or more
Accumulated MAF amount	3,451 g or more
One of the following conditions 1 or 2 is met:	-
1. Duration while engine load is low	120 seconds or more
2. Duration while engine load is high	10 seconds or more

TYPICAL MALFUNCTION THRESHOLDS

After engine stop:

IAT change	Less than 1°C (2°F)

After cold engine start:

IAT change	Less than 1°C (2°F)

WIRING DIAGRAM

Refer to DTC P0110 (See page ES-88).

INSPECTION PROCEDURE

1	CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P0111)

(a) Connect the intelligent tester to the DLC3.

(b) Turn the ignition switch to the ON position.
(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
P0111 and other DTCs	A
P0111	B

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

ES

B → REPLACE MASS AIR FLOW METER

A

GO TO DTC CHART

DTC	P0115	Engine Coolant Temperature Circuit
DTC	P0117	Engine Coolant Temperature Circuit Low Input
DTC	P0118	Engine Coolant Temperature Circuit High Input

DESCRIPTION

A thermistor is built into the Engine Coolant Temperature (ECT) sensor, of which the resistance value varies according to the ECT.
The structure of the sensor and its connection to the ECM are the same as those of the Intake Air Temperature (IAT) sensor.
HINT:
When any of DTCs P0115, P0117 and P0118 are set, the ECM enters fail-safe mode. During fail-safe mode, the ECT is estimated to be 80°C (176°F) by the ECM. Fail-safe mode continues until a pass condition is detected.

DTC No.	DTC Detection Condition	Trouble Area
P0115	Open or short in ECT sensor circuit for 0.5 seconds (1 trip detection logic)	• Open or short in ECT sensor circuit • ECT sensor • ECM
P0117	Short in ECT sensor circuit for 0.5 seconds (1 trip detection logic)	• Short in ECT sensor circuit • ECT sensor • ECM
P0118	Open in ECT sensor circuit for 0.5 seconds (1 trip detection logic)	• Open in ECT sensor circuit • ECT sensor • ECM

HINT:
When any of these DTCs are set, check the ECT by selecting the following menu items on the intelligent tester: DIAGNOSIS / ENHANCED OBD II / DATA LIST / ALL / COOLANT TEMP.

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

MONITOR DESCRIPTION

The Engine Coolant Temperature (ECT) sensor is used to monitor the ECT. The ECT sensor has a thermistor with a resistance that varies according to the temperature of the engine coolant. When the coolant temperature is low, the resistance in the thermistor increases. When the temperature is high, the resistance drops. These variations in resistance are reflected in the voltage output from the sensor. The ECM monitors the sensor voltage and uses this value to calculate the ECT. When the sensor output voltage deviates from the normal operating range, the ECM interprets this as a fault in the ECT sensor and sets a DTC.
Example:
If the sensor voltage output is -40°C (-40°F) for 0.5 seconds or more, the ECM determines that there is an open in the ECT sensor circuit, and sets DTC P0118. Conversely, if the voltage output is more than 140°C (284°F) for 0.5 seconds or more, the ECM determines that there is a short in the sensor circuit, and sets DTC P0117.
If the malfunction is not repaired successfully, a DTC is set 0.5 seconds after the engine is next started.

MONITOR STRATEGY

Related DTCs	P0115: Engine coolant temperature sensor range check (Fluctuating) P0117: Engine coolant temperature sensor range check (Low resistance) P0118: Engine coolant temperature sensor range check (High resistance)

Required Sensors/Components (Main)	Engine Coolant Temperature (ECT) sensor
Required Sensors/Components (Related)	-
Frequency of Operation	Continuous
Duration	0.5 seconds
MIL Operation	Immediate
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

Monitor runs whenever the following DTCs are not present	None

ES

TYPICAL MALFUNCTION THRESHOLDS

P0115:

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

P0117:

ECT sensor voltage	Less than 0.14 V

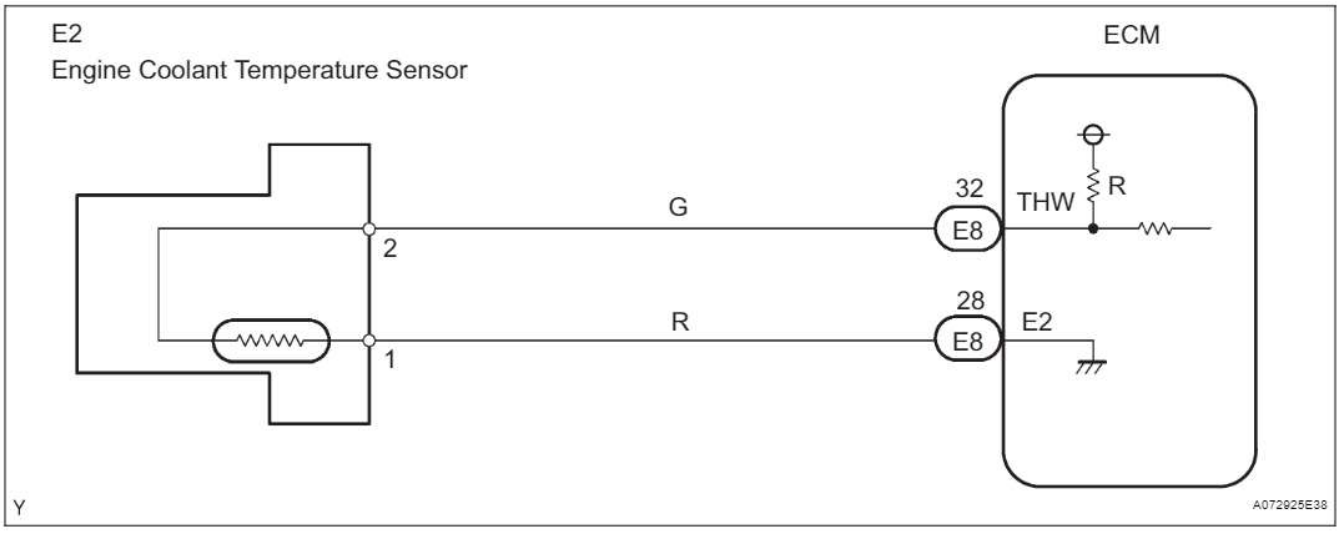
P0118:

ECT sensor voltage	More than 4.91 V

COMPONENT OPERATING RANGE

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

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

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

1	READ OUTPUT DTC

(a) Connect the intelligent tester to the DLC3.
(b) Turn the ignition switch to the ON position.
(c) Turn the tester on.
(d) On the tester, select the following menu items: DIAGNOSIS / ENHANCED OBD II / DTC INFO / CURRENT CODES.
(e) Read the DTCs.

Result

Display (DTC Output)	Proceed to
P0115	A
P0117	B
P0118	C

ES

B → **Go to step 5**

C → **Go to step 3**

A

2	READ VALUE USING INTELLIGENT TESTER (ENGINE COOLANT TEMPERATURE)

(a) Connect the intelligent tester to the DLC3.
(b) Turn the ignition switch to the ON position.
(c) Turn the tester on.
(d) On the tester, select the following menu items: DIAGNOSIS / ENHANCED OBD II / DATA LIST / ALL / COOLANT TEMP.
(e) Read the value displayed on the tester.

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

Result

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

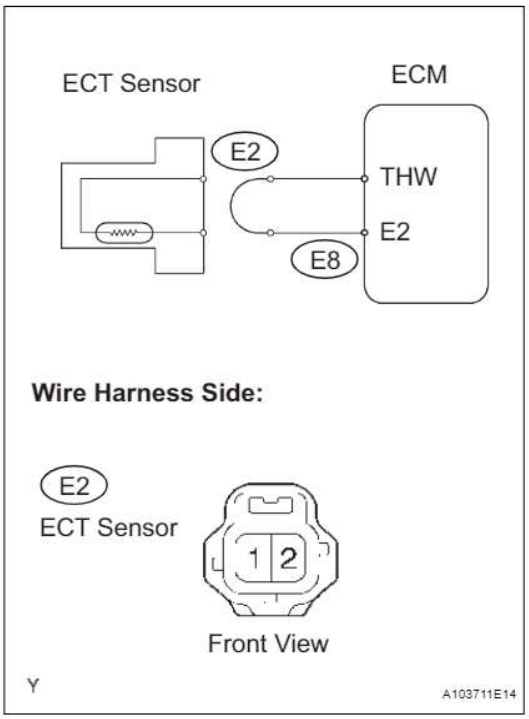
HINT:
- If there is an open circuit, the intelligent tester indicates -40°C (-40°F).
- If there is a short circuit, the intelligent tester indicates 140°C (284°F) or higher.

B → **Go to step 5**

C → **CHECK FOR INTERMITTENT PROBLEMS**

A

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

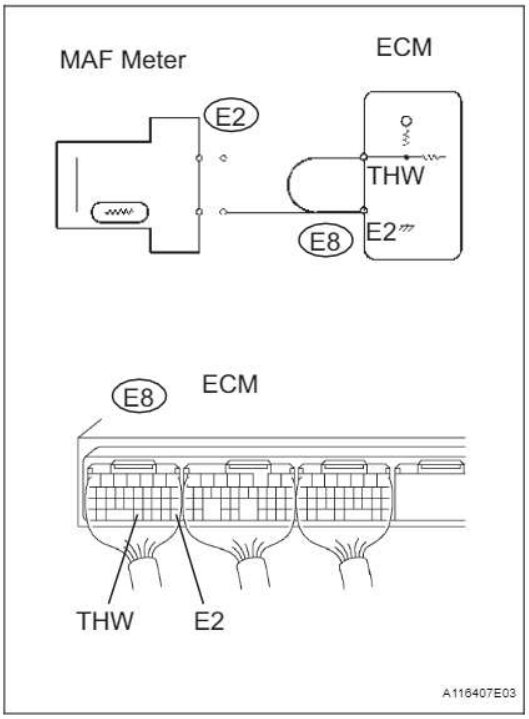


(a) Disconnect the E2 Engine Coolant Temperature (ECT) sensor connector.
(b) Connect terminals 1 and 2 of the ECT sensor connector on the wire harness side.
(c) Connect the intelligent tester to the DLC3.
(d) Turn the ignition switch to the ON position.
(e) Turn the tester on.
(f) On the tester, select the following menu items: DIAGNOSIS / ENHANCED OBD II / DATA LIST / ALL / COOLANT TEMP.
(g) Read the value displayed on the tester.
Standard temperature:
140°C (284°F) or higher

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

NG

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



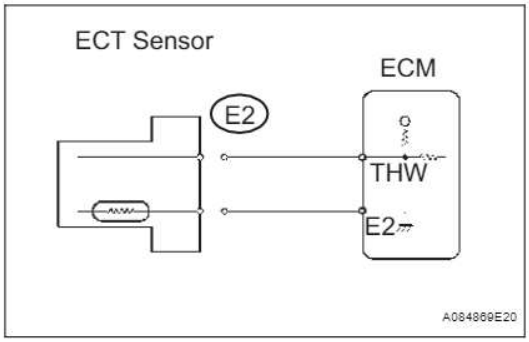
(a) Disconnect the E2 ECT sensor connector.
(b) Connect terminals THW and E2 of the E8 ECM connector.
HINT:
Before checking, perform visual and contact pressure checks on the ECM connector.
(c) Connect the intelligent tester to the DLC3.
(d) Turn the ignition switch to the ON position.
(e) Turn the tester on.
(f) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DATA LIST / ALL / COOLANT TEMP.
(g) Read the value displayed on the tester.
Standard temperature:
140°C (284°F) or higher

OK	REPAIR OR REPLACE HARNESS OR CONNECTOR

NG

CONFIRM GOOD CONNECTION TO ECM. IF OK, REPLACE ECM

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

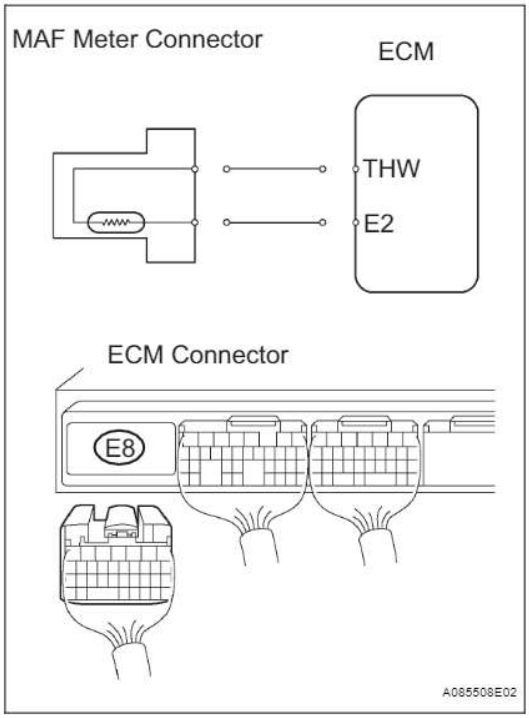


(a) Disconnect the E2 ECT sensor connector.
(b) Connect the intelligent tester to the DLC3.
(c) Turn the ignition switch to the ON position.
(d) Turn the tester on.
(e) On the tester, select the following menu items: DIAGNOSIS / ENHANCED OBD II / DATA LIST / ALL / COOLANT TEMP.
(f) Read the value displayed on the tester.
Standard temperature:
-40°C (-40°F)

OK → **REPLACE ENGINE COOLANT TEMPERATURE SENSOR**

NG

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



(a) Disconnect the E8 ECM connector.
(b) Connect the intelligent tester to the DLC3.
(c) Turn the ignition switch to the ON position.
(d) Turn the tester on.
(e) On the tester, select the following menu items: DIAGNOSIS / ENHANCED OBD II / DATA LIST / ALL / COOLANT TEMP.
(f) Read the value displayed on the tester.
Standard temperature:
-40°C (-40°F)
(g) Reconnect the ECM connector.

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

OK

REPLACE ECM

DTC	P0116	Engine Coolant Temperature Circuit Range / Performance Problem

DESCRIPTION

Refer to DTC P0115 (See page ES-97).

DTC No.	DTC Detection Condition	Trouble Area
P0116	When either of the following conditions is met (2 trip detection logic): • When cold engine started and engine warmed up, Engine Coolant Temperature (ECT) sensor value does not change. • After warmed up engine started, ECT sensor value does not change when engine stopped and then next cold engine start performed.	ECT sensor

ES

MONITOR DESCRIPTION

The ECT sensor is used to monitor the ECT. The ECT sensor has a built-in thermistor with a resistance that varies according to the temperature of the engine coolant. When the ECT is low, the resistance of the thermistor increases. When the temperature is high, the resistance drops. These variations in the resistance are reflected in the voltage output from the ECT sensor.
The ECM monitors the sensor voltage and uses this value to calculate the ECT. If the sensor voltage output deviates from the normal operating range, the ECM interprets this deviation as a malfunction in the ECT sensor and sets the DTC.
Examples:

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

MONITOR STRATEGY

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

TYPICAL ENABLING CONDITIONS

ECT sensor cold start monitor:

Monitor runs whenever the following DTCs are not present	P0100 to P0103: Mass Air Flow (MAF) meter P0110 to P0113: Intake Air Temperature (IAT) sensor
Battery voltage	10.5 V or more
Time after engine start	1 second or more
ECT at engine start	Less than 60°C (140°F)
IAT sensor circuit	OK
Soak time	5 hours or more
Accumulated MAF	814 g or more
Engine	Running

Fuel cut	OFF
Difference between ECT at engine start and IAT	Less than 40°C (72°F)

ECT sensor soak monitor:

Monitor runs whenever the following DTCs are not present	P0100 to P0103: MAF meter P0110 to P0113: IAT sensor
Battery voltage	10.5 V or more
Engine	Running
Soak time	5 hours or more
Either condition (a) or (b) is met:	-
(a) ECT	60°C (140°F) or more
(b) Accumulated MAF	1359 g or more

TYPICAL MALFUNCTION THRESHOLDS

ECT Sensor cold start monitor:

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

ECT Sensor soak monitor:

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

COMPONENT OPERATING RANGE

Engine coolant temperature	ECT sensor value changes in accordance with actual ECT

INSPECTION PROCEDURE

HINT:

- If DTC P0115, P0116, P0117, P0118 and P0125 are output simultaneously, The ECT sensor circuit may be open or shorted. Perform the troubleshooting of DTC P0115, P0117 or P0118 first.
- Read freeze frame data using the intelligent tester. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can be helpful in determining whether the vehicle was running or stopped, whether the engine was warmed up or not, whether the air-fuel ratio was lean or rich, as well as other data recorded at the time of a malfunction.

1	CHECK OTHER DTC OUTPUT (IN ADDITION TO DTC P0116)

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

Result

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

B → GO TO DTC CHART

A

2	INSPECT THERMOSTAT

(a) Remove the thermostat (See page CO-14).
(b) Check the valve opening temperature of the thermostat.
Standard temperature:
80 to 84°C (176 to 183°F)
HINT:
In addition to the above check, confirm that the valve is completely closed when the temperature is below the standard.
(c) Reinstall the thermostat (See page CO-14).

NG → **REPLACE THERMOSTAT**

OK

REPLACE ENGINE COOLANT TEMPERATURE SENSOR

DTC	P0120	Throttle / Pedal Position Sensor / Switch "A" Circuit
DTC	P0122	Throttle / Pedal Position Sensor / Switch "A" Circuit Low Input
DTC	P0123	Throttle / Pedal Position Sensor / Switch "A" Circuit High Input
DTC	P0220	Throttle / Pedal Position Sensor / Switch "B" Circuit
DTC	P0222	Throttle / Pedal Position Sensor / Switch "B" Circuit Low Input
DTC	P0223	Throttle / Pedal Position Sensor / Switch "B" Circuit High Input
DTC	P2135	Throttle / Pedal Position Sensor / Switch "A" / "B" Voltage Correlation

DESCRIPTION

HINT:

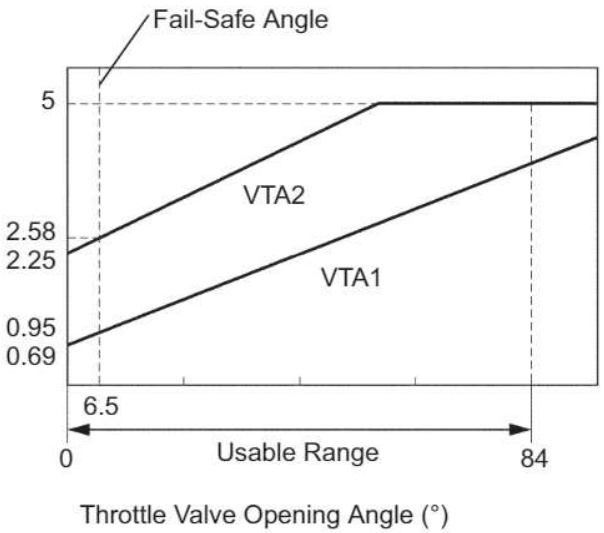
These DTCs relate to the Throttle Position (TP) sensor.

The Throttle Position (TP) sensor is mounted on the throttle body, and detects the opening angle of the throttle valve. This sensor is a non-contact type, and uses Hall-effect elements, in order to yield accurate signals, even in extreme driving conditions, such as at high speeds as well as very low speeds.

The TP sensor has 2 sensor circuits. One circuit sends the VTA1 signal. The other circuit sends the VTA2 signal. VTA1 is used to detect the throttle valve angle and VTA2 is used to detect malfunctions in VTA1. The sensor signal voltages vary between 0 V and 5 V in proportion to the throttle valve opening angle, and are transmitted to the VTA terminals of the ECM.

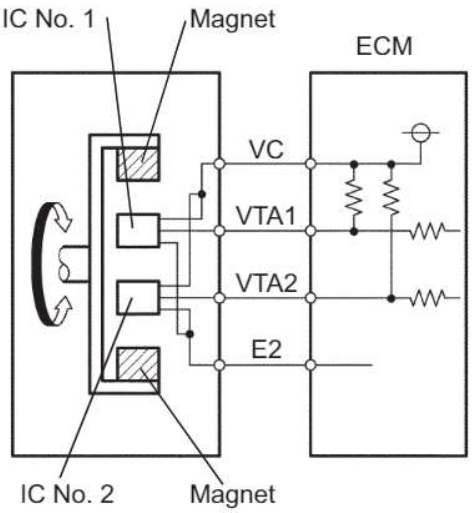
As the valve closes, the sensor output voltage decreases and as the valve opens, the sensor output voltage increases. The ECM calculates the throttle valve opening angle according to these signals and controls the throttle actuator in response to driver inputs. These signals are also used in calculations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

Throttle Position Sensor Output Voltage (V)



Throttle Valve Opening Angle (°)

Throttle Position Sensor



Note:
The throttle valve opening angle detected by the sensor terminal VTA1 is expressed as percentages.

Between 6% and 16%: Throttle valve fully closed

Between 64% and 98%: Throttle valve fully open

Approximately 19%: Fail-safe angle (6.5°)

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DTC No.	DTC Detection Condition	Trouble Area
P0120	Output voltage of VTA1 quickly fluctuates beyond lower and upper malfunction thresholds for 2 seconds when accelerator pedal depressed (1 trip detection logic)	• Throttle Position (TP) sensor (built into throttle body) • ECM
P0122	Output voltage of VTA1 0.2 V or less for 2 seconds when accelerator pedal depressed (1 trip detection logic)	• TP sensor (built into throttle body) • Short in VTA1 circuit • Open in VC circuit • ECM
P0123	Output voltage of VTA1 4.535 V or more for 2 seconds when accelerator pedal depressed (1 trip detection logic)	• TP sensor (built into throttle body) • Open in VTA1 circuit • Open in E2 circuit • Short between VC and VTA1 circuits • ECM
P0220	Output voltage of VTA2 quickly fluctuates beyond lower and upper malfunction thresholds for 2 seconds when accelerator pedal depressed (1 trip detection logic)	• TP sensor (built into throttle body) • ECM

DTC No.	DTC Detection Condition	Trouble Area
P0222	Output voltage of VTA2 1.75 V or less for 2 seconds when accelerator pedal depressed (1 trip detection logic)	• TP sensor (built into throttle body) • Short in VTA2 circuit • Open in VC circuit • ECM
P0223	Output voltage of VTA2 4.8 V or more, and VTA1 between 0.2 V and 2.02 V, for 2 seconds when accelerator pedal depressed (1 trip detection logic)	• TP sensor (built into throttle body) • Open in VTA2 circuit • Open in E2 circuit • Short between VC and VTA2 circuits • ECM
P2135	Either condition (a) or (b) is met (1 trip detection logic): (a) Difference between output voltages of VTA1 and VTA2 0.02 V or less for 0.5 seconds or more (b) Output voltage of VTA1 0.2 V or less, and VTA2 1.75 V or less, for 0.4 seconds or more	• Short between VTA1 and VTA2 circuits • TP sensor (built into throttle body) • ECM

ES

HINT:

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

Reference (Normal Condition)

Tester Display	Accelerator Pedal Fully Released	Accelerator Pedal Fully Depressed
THROTTLE POS	Between 6 % and 16 %	Between 64 % and 98 %
THROTTLE POS #2	Between 2.1 V and 3.1 V	Between 4.5 V and 5.0 V

MONITOR DESCRIPTION

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

- A specific voltage difference is expected between the sensor terminals, VTA1 and VTA2, for each throttle valve opening angle. If the difference between VTA1 and VTA2 is incorrect, the ECM interprets this as a malfunction in the sensor, and sets a DTC.
- VTA1 and VTA2 each has a specific voltage range. If VTA1 or VTA2 is outside the normal operating range, the ECM interprets this as a malfunction in the sensor, and sets a DTC.
- VTA1 and VTA2 should never be close to the same voltage level. If VTA1 is within 0.02 V of VTA2, the ECM determines that there is a short circuit in the sensor, and sets a DTC.

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

MONITOR STRATEGY

Related DTCs	P0120: Throttle position sensor 1 range check (Fluctuating) P0122: Throttle position sensor 1 range check (Low voltage) P0123: Throttle position sensor 1 range check (High voltage) P0220: Throttle position sensor 2 range check (Fluctuating) P0222: Throttle position sensor 2 range check (Low voltage) P0223: Throttle position sensor 2 range check (High voltage) P2135: Throttle position sensor range check (Correlation)
Required Sensors/Components (Main)	Throttle position sensor
Required Sensors/Components (Related)	-
Frequency of Operation	Continuous
Duration	2 seconds: P0120, P0122, P0123, P0220, P0222 and P0223 (Accelerator pedal ON) 10 seconds: P0120, P0122, P0123, P0220, P0222 and P0223 (Accelerator pedal OFF) 0.5 seconds: P2135 Case 1 0.4 seconds: P2135 Case 2
MIL Operation	Immediate

Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

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

TYPICAL MALFUNCTION THRESHOLDS

P0120:

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

P0122:

VTA1 voltage	0.2 V or less

P0123:

VTA1 voltage	4.535 V or more

P0220:

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

P0222:

VTA2 voltage	1.75 V or less

P0223:

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

P2135 Case 1:

Difference between VTA1 and VTA2 voltages	0.02 V or less

P2135 Case 2:

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

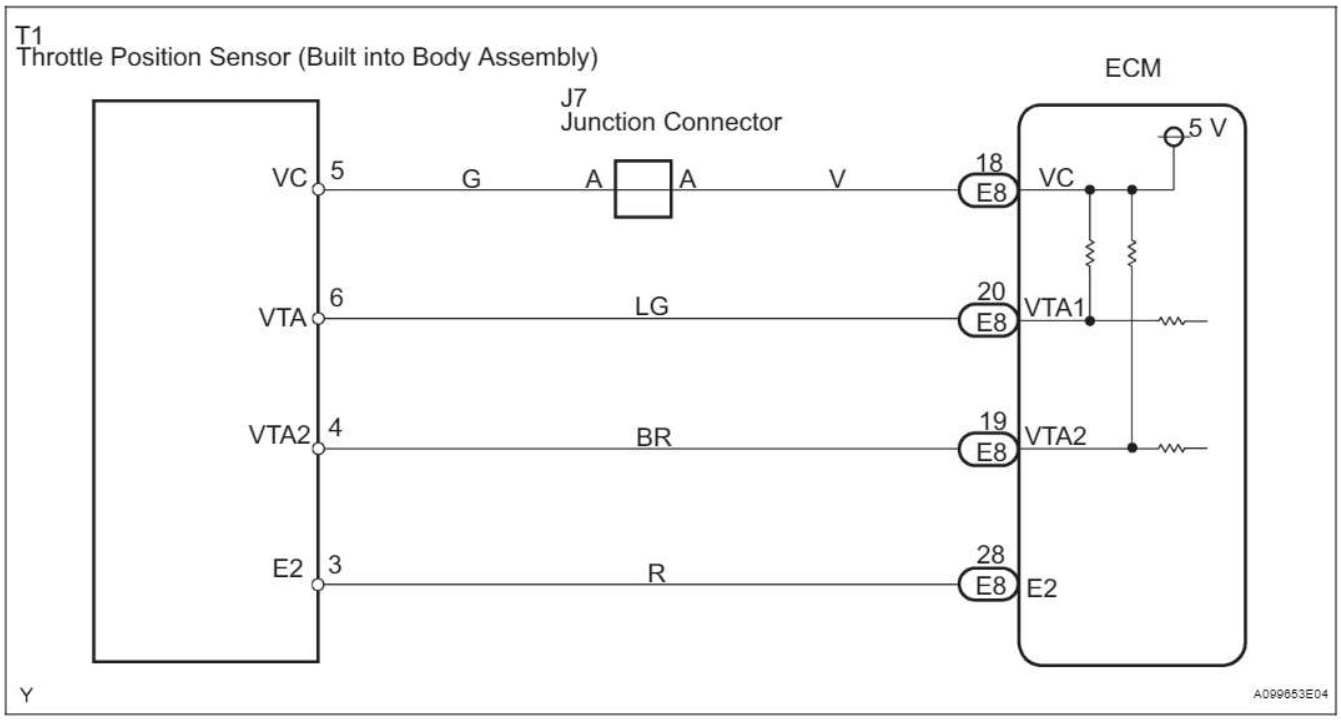
COMPONENT OPERATING RANGE

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

FAIL-SAFE

When any of these DTCs, as well as other DTCs relating to ETCS (Electronic Throttle Control System) malfunctions, are set, the ECM enters fail-safe mode. During fail-safe mode, the ECM cuts the current to the throttle actuator off, and the throttle valve is returned to a 6.5° throttle angle by the return spring. The ECM then adjusts the engine output by controlling the fuel injection (intermittent fuel-cut) and ignition timing, in accordance with the accelerator pedal opening angle, to allow the vehicle to continue at a minimal speed. If the accelerator pedal is depressed firmly and gently, the vehicle can be driven slowly. Fail-safe mode continues until a pass condition is detected, and the ignition switch is then turned off.

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

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

1	READ VALUE USING INTELLIGENT TESTER (THROTTLE POS #1, THROTTLE POS #2)

(a) Connect the intelligent tester to the DLC3.
(b) Turn the ignition switch to the ON position and turn the tester on.
(c) Select the following menu items: DIAGNOSIS / ENHANCED OBD II / DATA LIST / ETCS / THROTTLE POS and THROTTLE POS #2.
(d) Check the values displayed on the tester.

Result

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

TP#1 (VTA1) When AP Released	TP#2 (VTA2) When AP Released	TP#1 (VTA1) When AP Depressed	TP#2 (VTA2) When AP Depressed	Trouble Area	Proceed to
Approximately 19 % (Fail-safe)	Between 0 V and 0.2 V, or 4.5 V and 5.0 V	Approximately 19 % (Fail-safe)	Between 0 V and 0.2 V, or 4.5 V and 5.0 V	VTA2 circuit open or ground short	A
Between 6 % and 16 %	Between 2.1 V and 3.1 V	Between 64 % and 98 % (Not fail-safe)	Between 4.5 V and 5.0 V (Not fail-safe)	TP sensor circuit normal	B

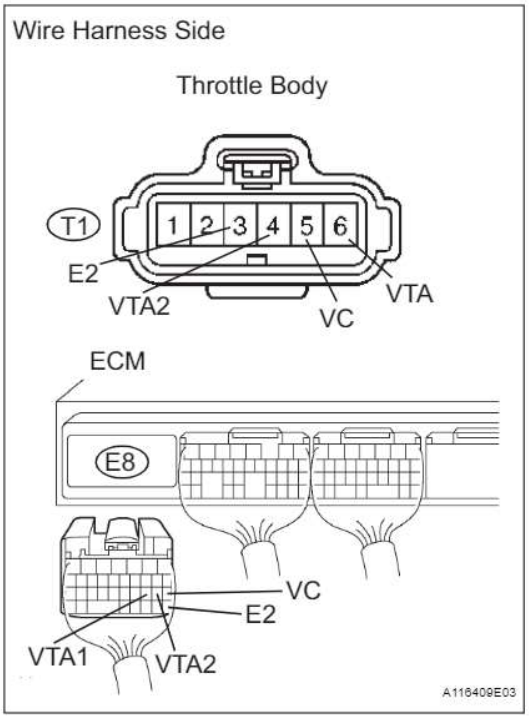
HINT:
- TP#1 denotes THROTTLE POS, and TP#2 denotes THROTTLE POS#2.
- AP denotes Accelerator Pedal.
- VTA1 is expressed as percentages, and VTA2 is expressed as voltages.

ES

B → Go to step 5

A

2 CHECK WIRE HARNESS (THROTTLE POSITION SENSOR - ECM)



(a) Disconnect the T1 throttle body connector.
(b) Disconnect the E8 ECM connector.
(c) Measure the resistance according to the value(s) in the table below.

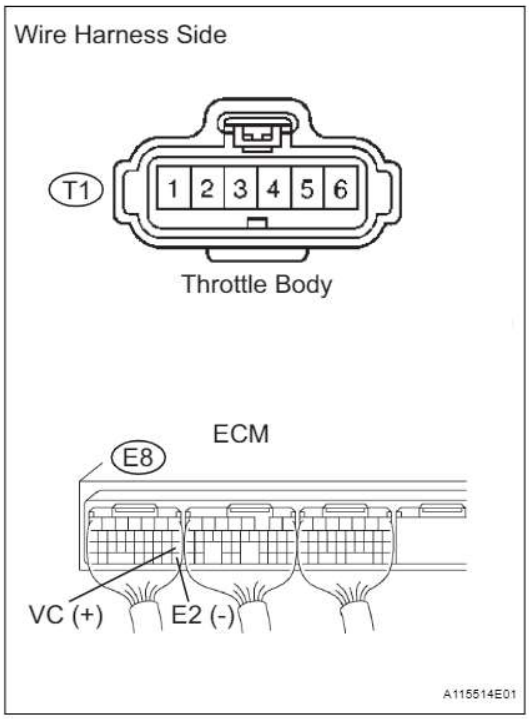
Standard resistance

Tester Connection	Specified Condition
VC (T1-5) - VC (E8-18)	Below 1 Ω
VTA (T1-6) - VTA1 (E8-20)	Below 1 Ω
VTA2 (T1-4) - VTA2 (E8-19)	Below 1 Ω
E2 (T1-3) - E2 (E8-28)	Below 1 Ω
VC (T1-5) or VC (E8-18) - Body ground	10 kΩ or higher
VTA (T1-6) or VTA1 (E8-20) - Body ground	10 kΩ or higher
VTA2 (T1-4) or VTA2 (E8-19) - Body ground	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

3 INSPECT ECM (VC VOLTAGE)



(a) Disconnect the T1 throttle body connector.
(b) Turn the ignition switch to the ON position.
(c) Measure the voltage according to the value(s) in the table below.

Standard voltage

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

NG → **REPLACE ECM**

OK

4 REPLACE THROTTLE BODY

(a) Replace the throttle body (See page ES-382).

NEXT

5 READ OUTPUT DTC (THROTTLE POSITION SENSOR DTCS ARE OUTPUT AGAIN)

(a) Connect the intelligent tester to the DLC3.
(b) Turn the ignition switch to the ON position and turn the tester on.
(c) Clear the DTCs (See page ES-32).
(d) Start the engine.
(e) Allow the engine to idle for 15 seconds or more.
(f) Select the following menu items: DIAGNOSIS / ENHANCED OBD II / DTC INFO / CURRENT CODES.
(g) Read the DTCs.

Result

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

B → **SYSTEM OK**

A

REPLACE ECM

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

DESCRIPTION

HINT:
This DTC relates to the Throttle Position (TP) sensor.
Refer to DTC P0120 (See page ES-105).

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

MONITOR DESCRIPTION

The ECM uses the TP sensor to monitor the throttle valve opening angle.
This sensor transmits 2 signals: VTA1 and VTA2. VTA1 is used to detect the throttle opening angle and VTA2 is used to detect malfunctions in VTA1. The ECM performs several checks to confirm the proper operation of the TP sensor and VTA1.
For each throttle opening angle, a specific voltage difference is expected between the outputs of VTA1 and VTA2. If the voltage output difference between the 2 signals deviates from the normal operating range, the ECM interprets this as a malfunction of the TP sensor. The ECM illuminates the MIL and sets the DTC.
If the malfunction is not repaired successfully, the DTC is set 2 seconds after the engine is next started.

MONITOR STRATEGY

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

TYPICAL ENABLING CONDITIONS

Monitor runs whenever the following DTCs are not present	P0120 - P0223, P2135 (TP sensor)
Either of the following conditions A or B is met:	-
A. Ignition Switch	ON
B. ETCS power	ON

TYPICAL MALFUNCTION THRESHOLDS

Difference in voltage between VAT1 and VTA2 TP sensor 1 - [TP sensor 2 x 0.8 (corrected by learning value)]	Less than 0.8 V, or more than 1.6 V

FAIL-SAFE

When any of these DTCs, as well as other DTCs relating to ETCS (Electronic Throttle Control System) malfunctions, are set, the ECM enters fail-safe mode. During fail-safe mode, the ECM cuts the current to the throttle actuator off, and the throttle valve is returned to a 6.5° throttle angle by the return spring. The ECM then adjusts the engine output by controlling the fuel injection (intermittent fuel-cut) and ignition timing, in accordance with the accelerator pedal opening angle, to allow the vehicle to continue at a minimal speed. If the accelerator pedal is depressed firmly and gently, the vehicle can be driven slowly. Fail-safe mode continues until a pass condition is detected, and the ignition switch is then turned off.

WIRING DIAGRAM

Refer to DTC P0120 (See page ES-109).

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.

1	READ OTHER DTC OUTPUT (IN ADDITION TO DTC P0121)

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

Result

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

HINT:

If any other codes besides P0121 are output, perform the troubleshooting for those codes first.

B → GO TO DTC CHART

A → REPLACE THROTTLE BODY

DTC	P0125	Insufficient Coolant Temperature for Closed Loop Fuel Control

DESCRIPTION

Refer to DTC P0115 (See page ES-97).

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

MONITOR DESCRIPTION

ES

The resistance of the ECT sensor varies in proportion to the actual ECT. The ECM supplies a constant voltage to the sensor and monitors the signal output voltage of the sensor. The signal voltage output varies according to the changing resistance of the sensor. After the engine is started, the ECT is monitored through this signal. If the ECT sensor indicates that the engine is not yet warm enough for closed-loop fuel control, despite a specified period of time having elapsed since the engine was started, the ECM interprets this as a malfunction in the sensor or cooling system and sets the DTC.
Example:
The ECT is 0°C (32°F) at engine start. After 5 minutes running time, the ECT sensor still indicates that the engine is not warm enough to begin closed-loop fuel (air-fuel ratio feedback) control. The ECM interprets this as a malfunction in the sensor or cooling system and sets the DTC.

MONITOR STRATEGY

Related DTCs	P0125: Insufficient engine coolant temperature for closed-loop fuel control
Required Sensors/Components (Main)	Thermostat, cooling system
Required Sensors/Components (Related)	Engine coolant temperature sensor and mass air flow meter
Frequency of Operation	Once per driving cycle
Duration	72.38 seconds: Engine start ECT is -8.34°C (17°F) or more 122.73 seconds: Engine start ECT is -19.45 to -8.34°C (-3 to 17°F) 20 minutes: Engine start ECT is less than -19.45°C (-3°F)
MIL Operation	2 driving cycles
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

Monitor runs whenever the following DTCs are not present	P0100 - P0103 (MAF sensor) P0110 - P0113 (IAT sensor) P0115 - P0118 (ECT sensor)
Thermostat failure	Not detected

TYPICAL MALFUNCTION THRESHOLDS

Time until actual engine coolant temperature reaches closed-loop engine coolant temperature	72.38 seconds: Engine start ECT is -8.34°C (17°F) or more 122.73 seconds: Engine start ECT is -19.45 to -8.34°C (-3 to 17°F) 20 minutes: Engine start ECT is less than -19.45°C (-3°F)

WIRING DIAGRAM

Refer to DTC P0115 (See page ES-98).

INSPECTION PROCEDURE

HINT:

- If any of DTCs P0115, P0116, P0117 or P0118 are output simultaneously with DTC P0125, the Engine Coolant Temperature (ECT) sensor may have an open or a short circuit. Troubleshoot those DTCs first.
- Read freeze frame data using the intelligent tester. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can be helpful in determining whether the vehicle was running or stopped, whether the engine was warmed up or not, whether the air-fuel ratio was lean or rich, as well as other data recorded at the time of a malfunction.

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

ES

(a) Connect the intelligent tester to the DLC3.
(b) Turn the ignition switch to the ON position.
(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
P0125	A
P0125 and other DTCs	B

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

B → **GO TO DTC CHART**

A

2 INSPECT THERMOSTAT

(a) Remove the thermostat (See page CO-14).
(b) Check the valve opening temperature of the thermostat.
Standard temperature:
80 to 84°C (176 to 183°F)
HINT:
In addition to the above check, confirm that the valve is completely closed when the temperature is below the standard.
(c) Reinstall the thermostat (See page CO-14).

NG → **REPLACE THERMOSTAT**

OK

3 CHECK COOLING SYSTEM

(a) Check for defects in the cooling system that might cause the system to be too cold, such as abnormal radiator fan operation or any modifications.

NG → REPAIR OR REPLACE COOLING SYSTEM

OK

REPLACE ENGINE COOLANT TEMPERATURE SENSOR

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

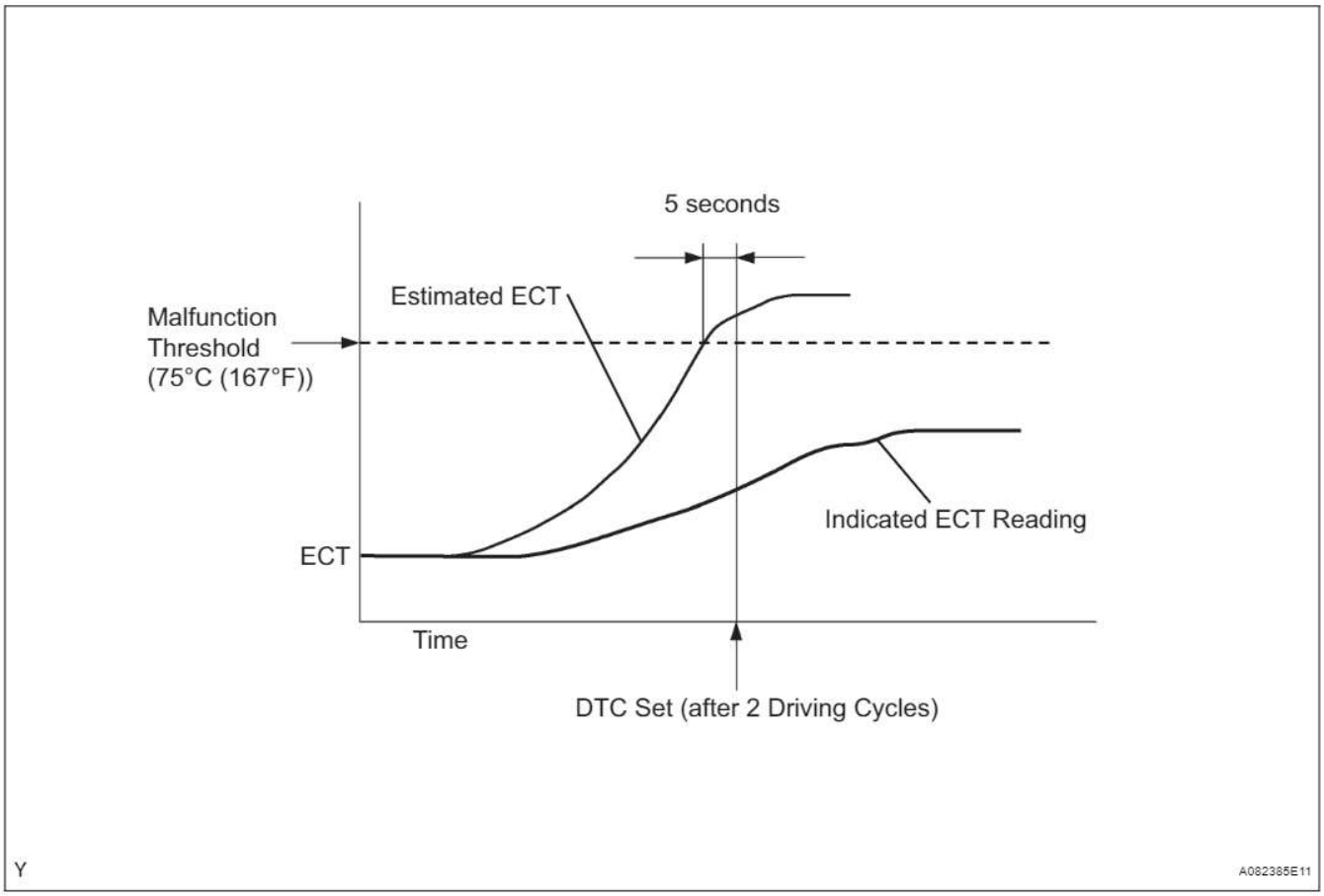
DESCRIPTION

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

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

ES

MONITOR DESCRIPTION



The ECM estimates the coolant temperature based on starting temperature, engine loads, and engine speeds. The ECM then compares the estimated temperature with the actual ECT. When the estimated coolant temperature reaches 75°C (167°F), the ECM checks the actual ECT. If the actual ECT is less than 75°C (167°F), the ECM interprets this as a malfunction in the thermostat or the engine cooling system and sets the DTC.

MONITOR STRATEGY

Related DTCs	P0128: Coolant Thermostat
Required Sensors/Components (Main)	Thermostat

Required Sensors/Components (Related)	Engine Coolant Temperature (ECT) sensor, Intake Air Temperature (IAT) sensor, Vehicle speed sensor
Frequency of Operation	Once per driving cycle
Duration	900 seconds
MIL Operation	2 driving cycles
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

Monitor runs whenever the following DTCs are not present	P0010 (VVT OCV Bank 1) P0011 (VVT System 1 - Advance) P0012 (VVT System 1 - Retard) P0031, P0032, P0051, P0052 (A/F sensor heater - Sensor 1) P0100 - P0103 (MAF meter) P0110 - P0113 (IAT sensor) P0115 - P0118 (ECT sensor) P0125 (Insufficient ECT for Closed Loop) P0171, P0172 (Fuel system) P0300 - P0304 (Misfire) P0335 (CKP sensor) P0340 (CMP sensor) P0351 - P0354 (Igniter) P0500 (VSS) P2196 (A/F sensor - rationality) P2A00 (A/F sensor - slow response)
Battery voltage	11 V or more
Either of the following conditions is met:	1 or 2 is met
1. All of the following conditions are met:	(a), (b) and (c) are met
(a) ECT at engine start - IAT at engine start	-15 to 7°C (-27 to 12.6°F)
(b) ECT at engine start	-10 to 56°C (14 to 132.8°F)
(c) IAT at engine start	-10 to 56°C (14 to 132.8°F)
2. All of the following conditions are met:	(d), (e) and (f) are met
(d) ECT at engine start - IAT at engine start	Higher than 7°C (12.6°F)
(e) ECT at engine start	56°C (132.8°F) or lower
(f) IAT at engine start	-10°C (14°F)
Accumulated time that vehicle speed is 80 mph (128 km/h) or more	Less than 20 seconds

TYPICAL MALFUNCTION THRESHOLDS

Duration that both of the following conditions are met:	Conditions A and B are met
A. Estimated ECT	75°C (167°F) or higher
B. ECT sensor output	Lower than 75°C (167°F)

MONITOR RESULT

Refer to detailed information on "CHECKING MONITOR STATUS" (See page ES-15).

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.

1	CHECK OTHER DTC OUTPUT (IN ADDITION TO DTC P0128)

(a) Connect the intelligent tester to the DLC3.
(b) Turn the ignition switch to the ON position.
(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
P0128	A
P0128 and other DTCs	B

ES

HINT:
If any DTCs other than P0128 are output, troubleshoot those DTCs first.

B → GO TO DTC CHART

A

2	CHECK COOLING SYSTEM

(a) Check for defects in the cooling system that might cause the system to be too cold, such as abnormal radiator fan operation or any modifications.

NG → REPAIR OR REPLACE COOLING SYSTEM

OK

3	INSPECT THERMOSTAT

(a) Remove the thermostat (See page CO-14).
(b) Check the valve opening temperature of the thermostat.
Standard temperature:
80 to 84°C (176 to 183°F)
HINT:
In addition to the above check, confirm that the valve is completely closed when the temperature is below the standard.
(c) Reinstall the thermostat (See page CO-14).

NG → REPLACE THERMOSTAT

OK

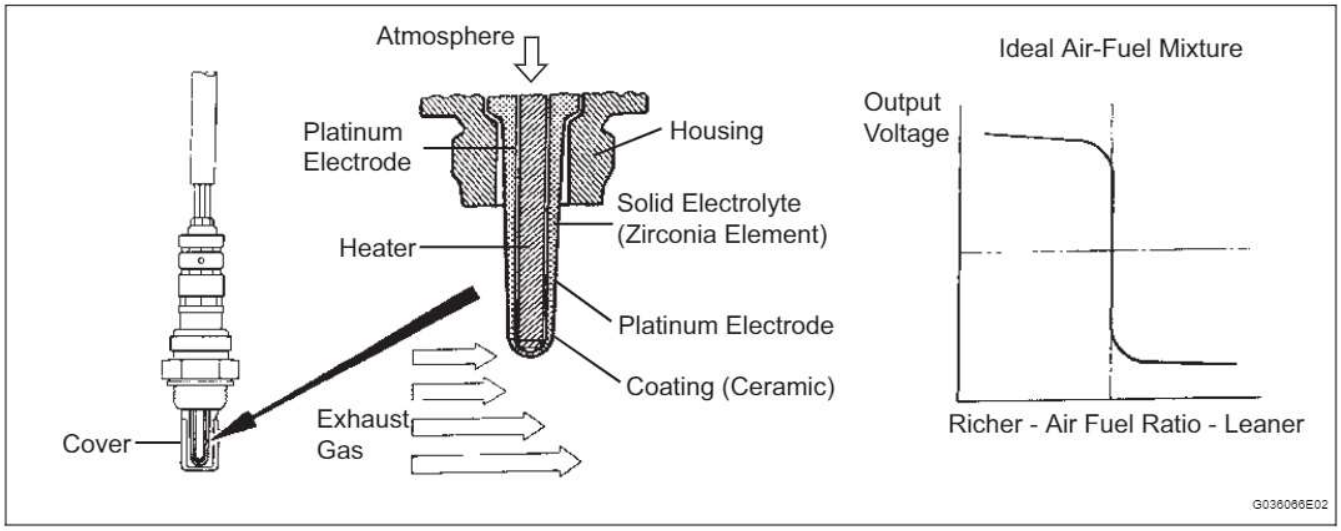
REPLACE ECM

DTC	P0136	Oxygen Sensor Circuit Malfunction (Bank 1 Sensor 2)
DTC	P0137	Oxygen Sensor Circuit Low Voltage (Bank 1 Sensor 2)
DTC	P0138	Oxygen Sensor Circuit High Voltage (Bank 1 Sensor 2)

DESCRIPTION

ES

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 of the engine near the stoichiometric air-fuel ratio. For the purpose of helping the ECM to deliver accurate air-fuel ratio control, the Heated Oxygen (HO2) sensor is used.
The HO2 sensor is located behind the TWC, and detects the oxygen concentration in the exhaust gas. Since the sensor is integrated with the heater that heats the sensing portion, it is possible to detect the oxygen concentration even when the intake air volume is low (the exhaust gas temperature is low).
When the air-fuel ratio becomes lean, the oxygen concentration in the exhaust gas is rich. The HO2 sensor informs the ECM that the post-TWC air-fuel ratio is lean (low voltage, i.e. less than 0.45 V). Conversely, when the air-fuel ratio is richer than the stoichiometric air-fuel level, the oxygen concentration in the exhaust gas becomes lean. The HO2 sensor informs the ECM that the post-TWC air-fuel ratio is rich (high voltage, i.e. more than 0.45 V). The HO2 sensor has the property of changing its output voltage drastically when the air-fuel ratio is close to the stoichiometric level.
The ECM uses the supplementary information from the HO2 sensor to determine whether the air-fuel ratio after the TWC is rich or lean, and adjusts the fuel injection time accordingly. Thus, if the HO2 sensor is working improperly due to internal malfunctions, the ECM is unable to compensate for deviations in the primary air-fuel ratio control.
HINT:
Sensor 2 refers to the sensor mounted behind the Three-Way Catalytic Converter (TWC) and located far from the engine assembly.



DTC No.	DTC Detection Condition	Trouble Area
P0136	• Abnormal voltage output: During active air-fuel ratio control, following conditions (a) and (b) met for certain period of time (2 trip detection logic): (a) Heated Oxygen (HO2) sensor voltage does not decrease to less than 0.59 V (b) HO2 sensor voltage does not increase to more than 0.21 V • Low impedance: Sensor impedance less than 5 Ω for more than 30 seconds when ECM presumes sensor to be warmed up and operating normally (2 trip detection logic):	• Open or short in HO2 sensor (sensor 2) circuit • HO2 sensor (sensor 2) • HO2 sensor heater (sensor 2) • Air-Fuel Ratio (A/F) sensor (sensor 1) • EFI relay • Gas leakage from exhaust system
P0137	• Low voltage (open): During active air-fuel ratio control, following conditions (a) and (b) met for certain period of time (2 trip detection logic): (a) HO2 sensor voltage output less than 0.21 V (b) Target air-fuel ratio rich • High impedance: Sensor impedance 15 kΩ or more for more than 90 seconds when ECM presumes sensor to be warmed up and operating normally (2 trip detection logic):	• Open in HO2 sensor (sensor 2) circuit • HO2 sensor (sensor 2) • HO2 sensor heater (sensor 2) • EFI relay • Gas leakage from exhaust system
P0138	• High voltage (short): During active air-fuel ratio control, following conditions (a) and (b) met for certain period of time (2 trip detection logic): (a) HO2 sensor voltage output more than 0.59 V (b) Target air-fuel ratio lean • Extremely high voltage (short): HO2 sensor voltage output exceeds 1.2 V for more than 10 seconds (2 trip detection logic):	• Short in HO2 sensor (sensor 2) circuit • HO2 sensor (sensor 2) • ECM internal circuit malfunction

ES

MONITOR DESCRIPTION

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

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

MONITOR STRATEGY

Related DTCs	P0136: Heated oxygen sensor output voltage (Abnormal voltage output) P0136: Heated oxygen sensor impedance (Low) P0137: Heated oxygen sensor output voltage (Low voltage) P0137: Heated oxygen sensor impedance (High) P0138: Heated oxygen sensor output voltage (High voltage) P0138: Heated oxygen sensor output voltage (Extremely high)
Required Sensors/Components (Main)	Heated oxygen sensor
Required Sensors/Components (Related)	Crankshaft position sensor, engine coolant temperature sensor, mass air flow meter and throttle position sensor
Frequency of Operation	Once per driving cycle: Active air-fuel ratio control detection Continuous: Other

Duration	20 seconds: Active air-fuel ratio control detection 90 seconds: Heated oxygen sensor impedance (High) 30 seconds: Heated oxygen sensor impedance (Low) 10 seconds: Output voltage (Stuck high)
MIL Operation	2 driving cycles
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

Monitor runs whenever the following DTCs are not present	P0031, P0032 (A/F sensor heater - Sensor 1) P0037, P0038 (O2 Sensor Heater - Sensor 2) P0100 - P0103 (MAF meter) P0110 - P0113 (IAT sensor) P0115 - P0118 (ECT sensor) P0120 - P0223, P2135 (TP sensor) P0125 (Insufficient ECT for Closed Loop) P0171, P0172 (Fuel system) P0300 - P0304 (Misfire) P0335 (CKP sensor) P0340 (CMP sensor) P0500 (VSS) P2196 (A/F sensor - rationality) P2A00 (A/F sensor - slow response)

ES

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

Active air-fuel ratio control	Executing
Active air-fuel ratio control begins when all of the following conditions are met:	-
Battery voltage	11 V or more
Engine coolant temperature	75°C (167°F) or more
Idling	OFF
Engine RPM	Less than 4,000 rpm
A/F sensor status	Activated
Fuel system status	Closed loop
Fuel cut	OFF
Engine load	10 to 80 %
Shift position	4th

Heated Oxygen Sensor Impedance (Low):

Battery voltage	11 V or more
Estimated rear HO2 sensor temperature	Less than 700°C (1,292°F)
ECM monitor	Completed
DTC P0606	Not set

Heated Oxygen Sensor Impedance (High):

Battery voltage	11 V or more
Estimated rear HO2 sensor temperature	450°C (842°F) or more
ECM monitor	Completed
DTC P0606	Not set

Heated Oxygen Sensor Output Voltage (Extremely High):

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

TYPICAL MALFUNCTION THRESHOLDS

Heated Oxygen Sensor Output Voltage (Abnormal Voltage Output):

Either of the following conditions is met:	1 or 2

1. All of the following conditions (a), (b) and (c) are met:	-
(a) Commanded air-fuel ratio	14.3 or less
(b) Rear HO2 sensor voltage	0.21 to 0.59 V
(c) OSC (Oxygen Storage Capacity of Catalyst)	2 g or more
2. All of the following conditions (d), (e) and (f) are met:	-
(d) Commanded air-fuel ratio	14.9 or more
(e) Rear HO2 sensor voltage	0.21 to 0.59 V
(f) OSC	2 g or more

Heated Oxygen Sensor Output Voltage (Low):

All of the following conditions (a), (b) and (c) are met:	-
(a) Commanded air-fuel ratio	14.3 or less
(b) Rear HO2 sensor voltage	Less than 0.21 V
(c) OSC	2 g or more

ES

Heated Oxygen Sensor Output Voltage (High):

All of the following conditions (a), (b) and (c) are met:	-
(a) Commanded air-fuel ratio	14.9 or more
(b) Rear HO2 sensor voltage	More than 0.59 V
(c) OSC	2 g or more

Heated Oxygen Sensor Impedance (Low):

Duration that the following condition is met	30 seconds or more
Heated oxygen sensor impedance	Less than 5 Ω

Heated Oxygen Sensor Impedance (High):

Duration that the following condition is met	90 seconds or more
Heated oxygen sensor impedance	15 kΩ or more

Heated Oxygen Sensor Output Voltage (Extremely High):

Duration that the following condition is met	10 seconds or more
Heated oxygen sensor voltage	1.2 V or more

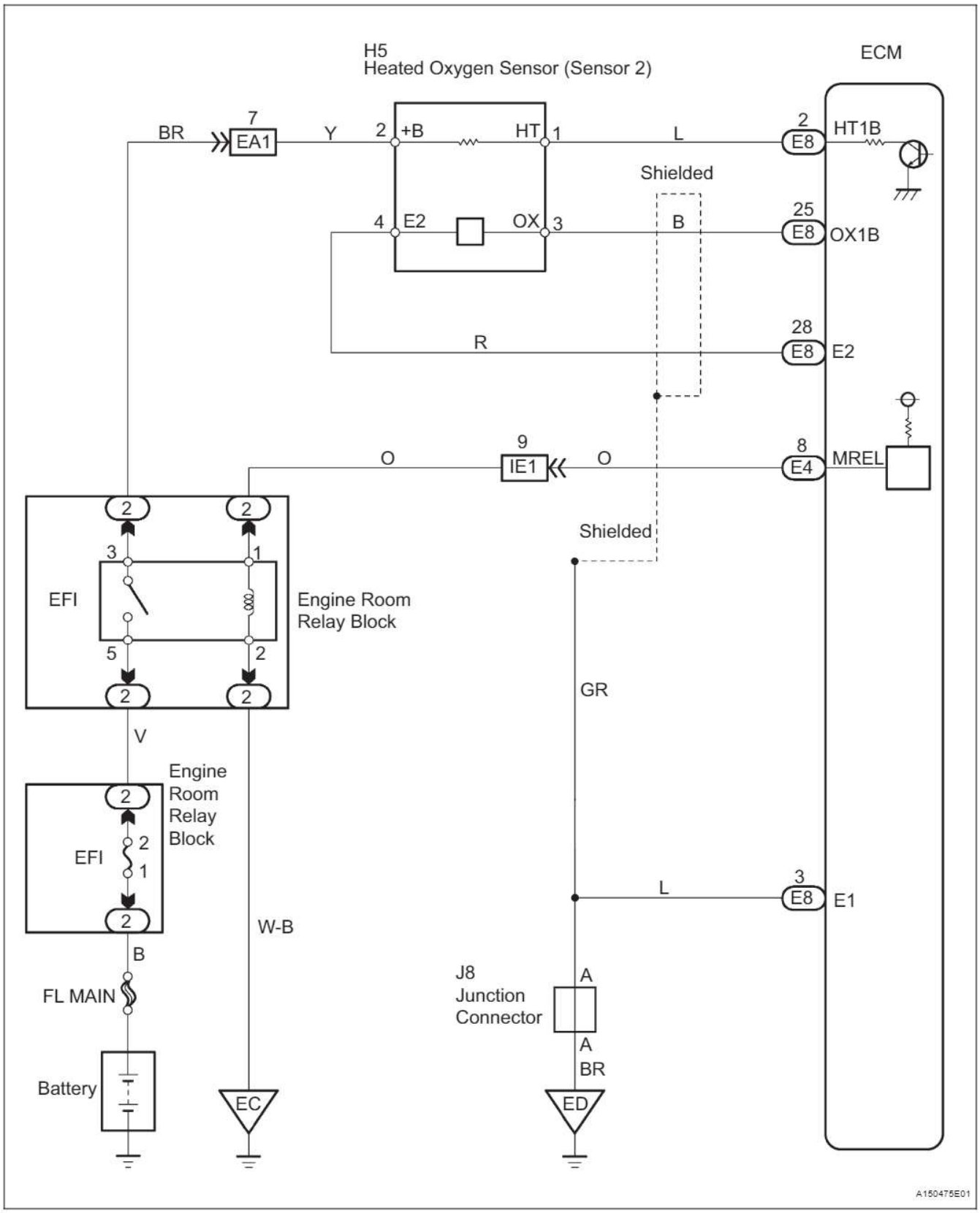
COMPONENT OPERATING RANGE

Duration that the following condition is met	30 seconds or more
Heated oxygen sensor voltage	Varies between 0.1 V and 0.9 V

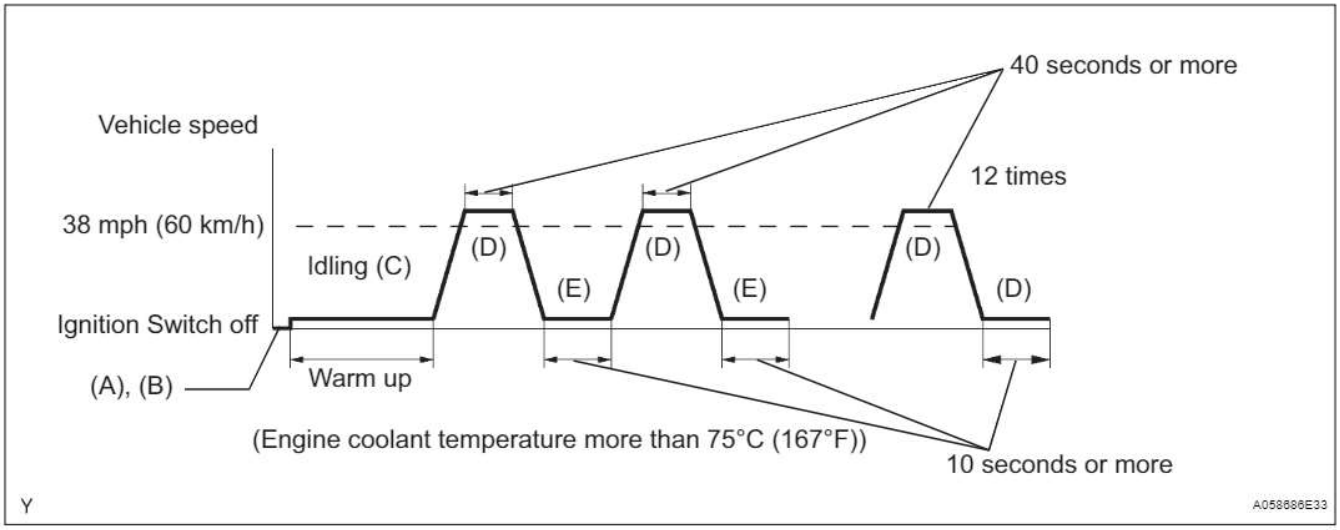
MONITOR RESULT

Refer to CHECKING MONITOR STATUS (See page ES-15).

WIRING DIAGRAM



CONFIRMATION DRIVING PATTERN



(a) Connect the intelligent tester to the DLC3 (Procedure "A").
(b) Switch the ECM from normal mode to check mode using the tester (See page ES-35) (Procedure "B").
(c) Start the engine and warm it up until the engine coolant temperature reaches more than 75°C (167°F) (Procedure "C").
(d) Drive the vehicle at 38 mph (60 km/h) or more for 40 seconds or more (Procedure "D").
(e) Allow the engine to idle for 10 seconds or more (Procedure "E").
(f) Perform Procedure "D" and "E" 12 times (Procedure "F").
HINT:
If a malfunction exists, the MIL illuminates during Procedure "F".
NOTICE:
If the conditions in this test are not strictly followed, malfunctions may not be detected. If you do not have the intelligent tester, turn the ignition switch off after performing Procedure "C" to "F", then perform Procedure "C" to "F" again.

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 tester, select the following menu items: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / A/F CONTROL.
5. Perform the A/F CONTROL operation with the engine in an idling condition (press the RIGHT or LEFT button to change the fuel injection volume).
6. Monitor the voltage outputs of the A/F and HO2 sensors (AFS B1S1 and OS2 B1S2) displayed on the tester.

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

Standard:

Tester Display (Sensor)	Injection Volume	Status	Voltage
AFS B1S1 (A/F)	+25 %	Rich	Less than 3.0

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

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

Case	A/F Sensor (Sensor 1) Output Voltage		HO2 Sensor (Sensor 2) Output Voltage		Main Suspected Trouble Area
1	Injection Volume +25 % -12.5 %		Injection Volume +25 % -12.5 %		-
	Output Voltage More than 3.35 V Less than 3.0 V		Output Voltage More than 0.55 V Less than 0.4 V		
2	Injection Volume +25 % -12.5 %		Injection Volume +25 % -12.5 %		• A/F sensor • A/F sensor heater • A/F sensor circuit
	Output Voltage Almost no reaction		Output Voltage More than 0.55 V Less than 0.4 V		
3	Injection Volume +25 % -12.5 %		Injection Volume +25 % -12.5 %		• Heated oxygen sensor • Heated oxygen sensor heater • Heated oxygen 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-furl 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, select the following menu items on the tester: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / A/F CONTROL / USER DATA / AFS B1S1 and O2S B1S2, and press the YES button and then the ENTER button followed by the F4 button.

HINT:

- If other DTCs relating to different systems that have terminal E2 as the ground terminal are output simultaneously, terminal E2 may have an open circuit.
- Read freeze frame data using the intelligent tester. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can 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.
- If the OX1B wire from the ECM connector is short-circuited to the +B wire, DTC P0136 will be set.

1	READ OUTPUT DTC

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

Result

Display (DTC Output)	Proceed to
P0138, P0139	A
P0137	B
P0136	C

ES

B → Go to step 14

C → Go to step 7

A

2	READ VALUE USING INTELLIGENT TESTER (OUTPUT VOLTAGE OF HEATED OXYGEN SENSOR)

(a) Connect the intelligent tester to the DLC3.
(b) Turn the ignition switch to the ON position and turn the tester on.
(c) Select the following menu items: DIAGNOSIS / ENHANCED OBD II / DATA LIST / ALL / O2S B1S2.
(d) Allow the engine to idle.
(e) Read the Heated Oxygen (HO2) sensor output voltage while idling.

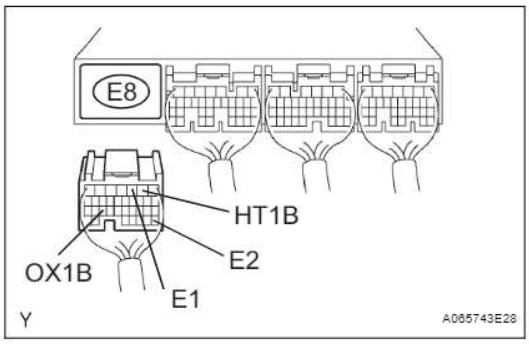
Result

HO2 Sensor Output Voltage	Proceed to
More than 1.2 V	A
Less than 1.0 V	B

B → Go to step 5

A

3 CHECK WIRE HARNESS (FOR SHORT)



(a) Turn the ignition switch off and wait for 5 minutes.
(b) Disconnect the E8 ECM connector.
(c) Measure the resistance according to the value(s) in the table below.

Standard resistance

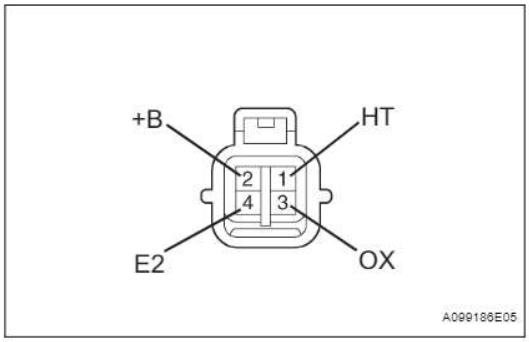
Tester Connection	Specified Condition
HT1B (E8-2) - OX1B (E8-25)	10 kΩ or higher

NG → Go to step 4

OK

REPLACE ECM

4 INSPECT HEATED OXYGEN SENSOR (CHECK FOR SHORT)



(a) Disconnect the H5 HO2 sensor connector.
(b) Measure the resistance of the sensor.

Standard resistance

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

NG → REPLACE HEATED OXYGEN SENSOR

OK

REPAIR OR REPLACE HARNESS OR CONNECTOR

5 PERFORM CONFIRMATION DRIVING PATTERN

NEXT

6 CHECK WHETHER DTC OUTPUT RECURS (DTC P0138, P0139)

(a) On the intelligent tester, select the following menu items: DIAGNOSIS / ENHANCED OBD II / DTC INFO / CURRENT CODES.
(b) Read the DTCs.

Result

Display (DTC Output)	Proceed to
P0138, P0139	A

Display (DTC Output)	Proceed to
No output	B

B → CHECK FOR INTERMITTENT PROBLEMS

A

REPLACE HEATED OXYGEN SENSOR

7	READ VALUE USING INTELLIGENT TESTER (OUTPUT VOLTAGE OF HEATED OXYGEN SENSOR)

ES

(a) Connect the intelligent tester to the DLC3.
(b) Turn the ignition switch to the ON position and turn the tester on.
(c) Start the engine.
(d) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DATA LIST / ALL / O2S B1S2.
(e) After warming up the engine, run the engine at an engine speed of 2,500 rpm for 3 minutes.
(f) Read the output voltage of the HO2 sensor when the engine rpm is suddenly increased.
HINT:
Quickly accelerate the engine to 4,000 rpm 3 times using the accelerator pedal.
Standard:
Fluctuates between 0.4 V or less and 0.5 V or more.

NG → Go to step 14

OK

8	PERFORM CONFIRMATION DRIVING PATTERN

NEXT

9	CHECK WHETHER DTC OUTPUT RECURS (DTC P0136)

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

Display (DTC Output)	Proceed to
P0136	A
No output	B

B → CHECK FOR INTERMITTENT PROBLEMS

A

10	REPLACE HEATED OXYGEN SENSOR

NEXT

11	PERFORM CONFIRMATION DRIVING PATTERN

HINT:
Clear all DTCs before performing the confirmation driving pattern.

NEXT

ES

12	CHECK WHETHER DTC OUTPUT RECURS (DTC P0136)

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

Result

Display (DTC Output)	Proceed to
P0136	A
No output	B

B → REPAIR COMPLETED

A

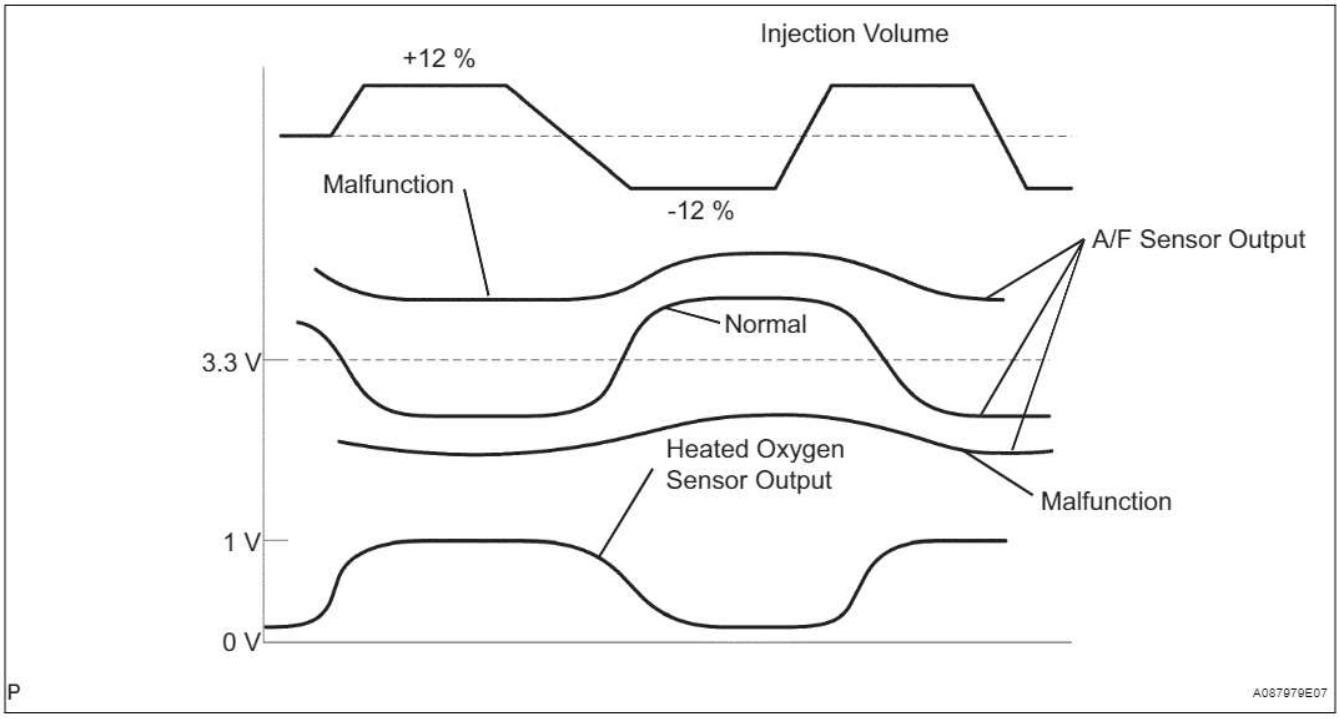
13	PERFORM ACTIVE TEST BY INTELLIGENT TESTER (INJECTION VOLUME)

(a) Connect the intelligent tester to the DLC3.
(b) Start the engine and turn the tester on.
(c) Warm up the engine.
(d) Enter the following menu items: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / INJ VOL.
(e) Change the fuel injection volume using the tester, monitoring the voltage output of Air-Fuel Ratio (A/F) and HO2 sensors displayed on the tester.
HINT:
- Change the fuel injection volume within the range of -12 % and +12 %. The injection volume can be changed in 1 % graduations within the range.
- The A/F sensor is displayed as AFS B1S1, and the HO2 sensor is displayed as O2S B1S2, on the intelligent tester.

Result

Tester Display (Sensor)	Voltage Variation	Proceed to
AFS B1S1 (A/F)	Alternates between more and less than 3.3 V	OK
AFS B1S1 (A/F)	Remains at more than 3.3 V	NG
AFS B1S1 (A/F)	Remains at less than 3.3 V	NG

HINT:
A normal HO2 sensor voltage (O2S B1S2) reacts in accordance with increases and decreases in fuel injection volumes. When the A/F sensor voltage remains at either less or more than 3.3 V despite the HO2 sensor indicating a normal reaction, the A/F sensor is malfunctioning.



NG → REPLACE AIR FUEL RATIO SENSOR

OK →

CHECK FUEL SYSTEM AND EXHAUST SYSTEM

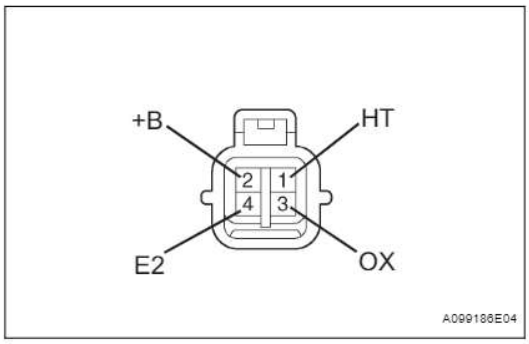
14	INSPECT FOR EXHAUST GAS LEAK

OK:
No gas leakage.

NG → REPAIR OR REPLACE EXHAUST GAS LEAKAGE POINT

OK →

15 INSPECT HEATED OXYGEN SENSOR (HEATER RESISTANCE)



(a) Disconnect the H5 HO2 sensor connector.
(b) Measure the resistance according to the value(s) in the table below.

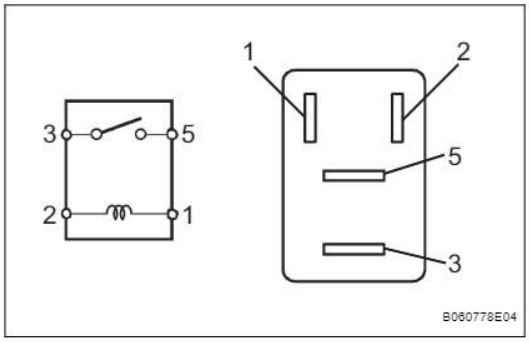
Standard resistance

Tester Connection	Specified Condition
HT (1) - +B (2)	11 to 16 Ω at 20°C (68°F)
HT (1) - E2 (4)	10 kΩ or higher

NG → REPLACE HEATED OXYGEN SENSOR

OK

16 INSPECT EFI RELAY (EFI)



(a) Remove the EFI relay from the engine room relay block.
(b) Measure the relay resistance according to the value(s) in the table below.

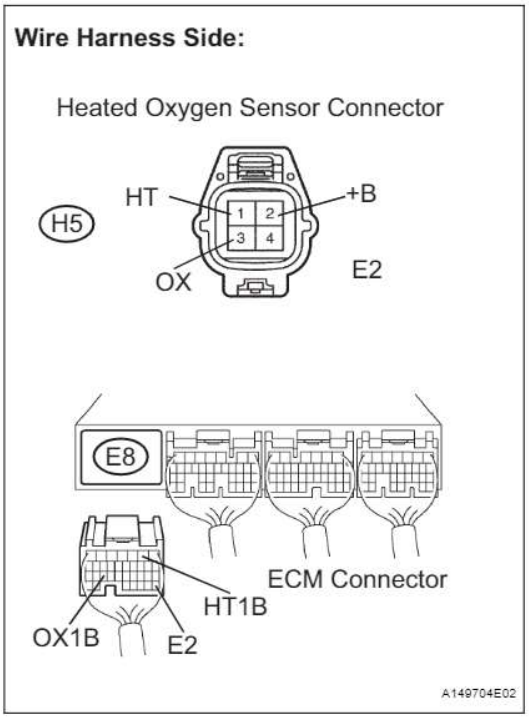
Standard resistance

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

NG → REPLACE EFI RELAY

OK

17	CHECK WIRE HARNESS (HEATED OXYGEN SENSOR - ECM) AND (SENSOR POWER SOURCE)



(a) Disconnect the H5 HO2 sensor connector.
(b) Turn the ignition switch to the ON position.
(c) Measure the voltage according to the value(s) in the table below.

Standard voltage

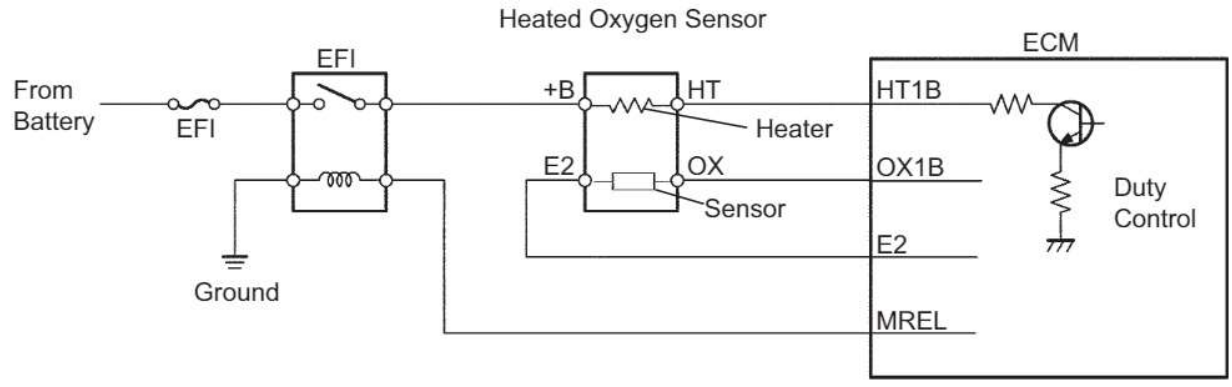
Tester Connection	Specified Condition
+B (H5-2) - Body ground	9 to 14 V

(d) Turn the ignition switch off.
(e) Disconnect the E8 ECM connector.
(f) Measure the resistance according to the value(s) in the table below.

Standard resistance

Tester Connection	Specified Condition
HT (H5-1) - HT1B (E8-2)	Below 1 Ω
OX (H5-3) - OX1B (E8-25)	Below 1 Ω
E2 (H5-4) - E2 (E8-28)	Below 1 Ω
HT (H5-1) or HT1B (E8-2) - Body ground	10 kΩ or higher
OX (H5-3) or OX1B (E8-25) - Body ground	10 kΩ or higher
E2 (H5-4) or E2 (E8-28) - Body ground	10 kΩ or higher

Reference (System Diagram of Sensor 2)



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

REPLACE HEATED OXYGEN SENSOR

DTC	P0171	System Too Lean (Bank 1)

DTC	P0172	System Too Rich (Bank 1)

DESCRIPTION

The fuel trim is related to the feedback compensation value, not to the basic injection time. The fuel trim consists of both the short-term and long-term fuel trims.

The short-term fuel trim is fuel compensation that is used to constantly maintain the air-fuel ratio at stoichiometric levels. The signal from the Air-Fuel Ratio (A/F) sensor indicates whether the air-fuel ratio is rich or lean compared to the stoichiometric ratio. This triggers a reduction in the fuel injection volume if the air-fuel ratio is rich and an increase in the fuel injection volume if it is lean.

Factors such as individual engine differences, wear over time and changes in operating environment cause short-term fuel trim to vary from the central value. The long-term fuel trim, which controls overall fuel compensation, compensates for long-term deviations in the fuel trim from the central value caused by the short-term fuel trim compensation.

If both the short-term and long-term fuel trims are lean or rich beyond predetermined values, it is interpreted as a malfunction, and the ECM illuminates the MIL and sets a DTC.

DTC No.	DTC Detection Condition	Trouble Area
P0171	With warm engine and stable air-fuel ratio feedback, fuel trim considerably in error to lean side (2 trip detection logic)	• Air induction system • Injector blockage • Mass Air Flow (MAF) meter • Engine Coolant Temperature (ECT) sensor • Fuel pressure • Gas leakage from exhaust system • Open or short in A/F sensor (sensor 1) circuit • A/F sensor (sensor 1) • A/F sensor heater (sensor 1) • EFI relay • A/F sensor heater and EFI relay circuits • PCV valve and hose • PCV hose connections • ECM
P0172	With warm engine and stable air-fuel ratio feedback, fuel trim considerably in error to rich side (2 trip detection logic)	• Injector leakage or blockage • MAF meter • ECT sensor • Ignition system • Fuel pressure • Gas leakage from exhaust system • Open or short in A/F sensor (sensor 1) circuit • A/F sensor (sensor 1) • A/F sensor heater (sensor 1) • EFI relay • A/F sensor heater and EFI relay circuits • ECM

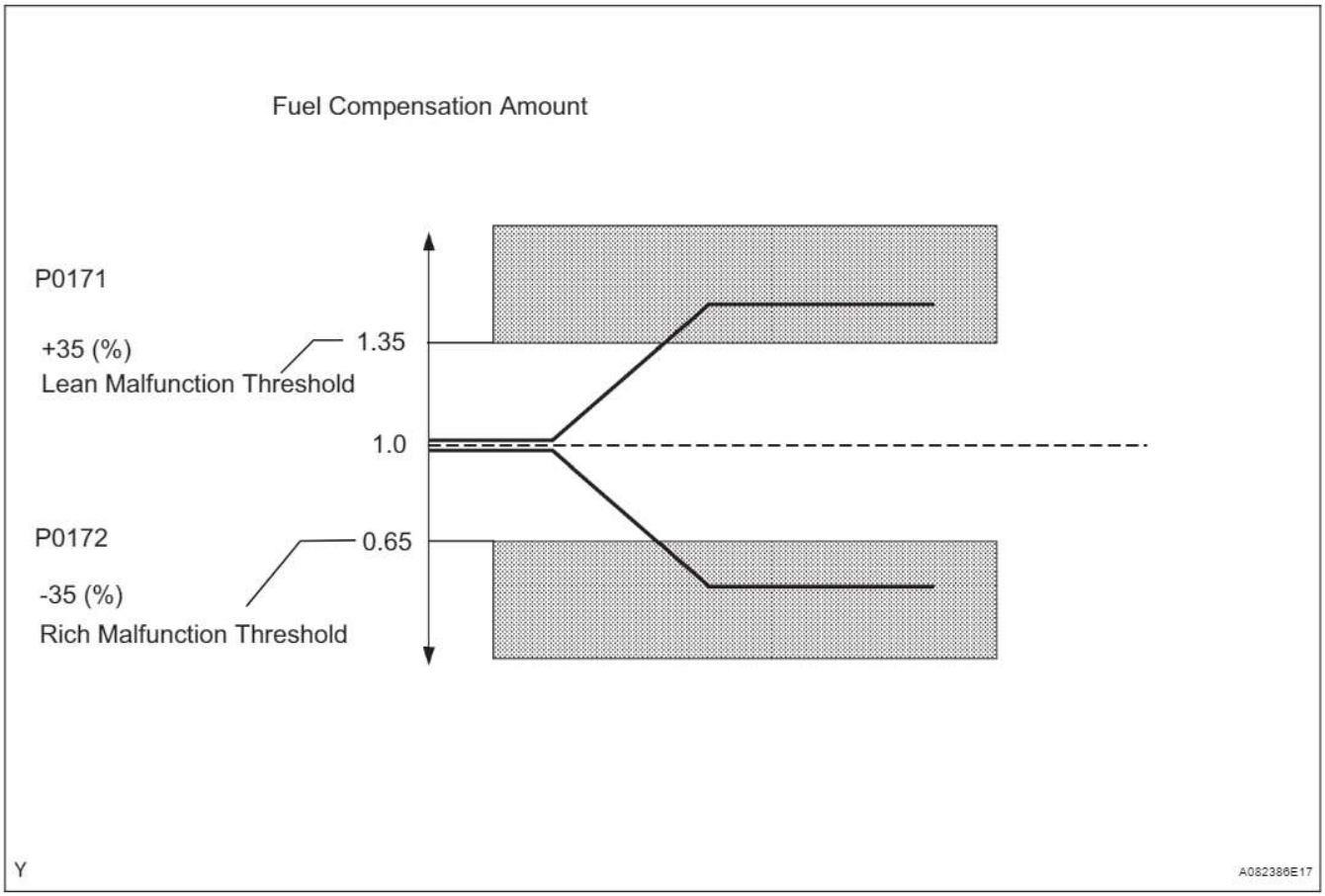
HINT:

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

MONITOR DESCRIPTION

Under closed-loop fuel control, fuel injection volumes that deviate from those estimated by the ECM cause changes in the long-term fuel trim compensation value. The long-term fuel trim is adjusted when there are persistent deviations in the short-term fuel trim values. Deviations from the ECM's estimated fuel injection volumes also affect the average fuel trim learning value, which is a combination of the average short-term fuel trim (fuel feedback compensation value) and the average long-term fuel trim (learning value of the air-fuel ratio). If the average fuel trim learning value exceeds the malfunction thresholds, the ECM interprets this as a fault in the fuel system and sets a DTC.
Example:
The average fuel trim learning value is more than +35% or less than -35%, the ECM interprets this as a fuel system malfunction.

ES



MONITOR STRATEGY

Related DTCs	P0171: Fuel trim lean P0172: Fuel trim rich
Required Sensors/Components (Main)	Fuel system
Required Sensors/Components (Related)	Air-fuel ratio sensor, Mass air flow meter, Crankshaft position sensor
Frequency of Operation	Continuous
Duration	Within 10 seconds
MIL Operation	2 driving cycles
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

Monitor runs whenever the following DTCs are not present	P0010 (VVT OCV Bank 1) P0011 (VVT System 1 - Advance) P0012 (VVT System 1 - Retard) P0031, P0032 (A/F sensor heater - Sensor 1) P0100 - P0103 (MAF meter) P0115 - P0118 (ECT sensor) P0120 - P0223, P2135 (TP sensor) P0125 (Insufficient ECT for Closed Loop) P0335 (CKP sensor) P0340 (CMP sensor) P0500 (VSS)
Fuel system status	Closed-loop
Battery voltage	11 V or more
Either of the following conditions A or B is met:	-
A. Engine RPM	Below 1,100 rpm
B. Intake air amount per revolution	0.22 g/rev or more
Catalyst monitor	Not executed

ES

TYPICAL MALFUNCTION THRESHOLDS

Purge-cut	Executing
Either of the following conditions is met:	-
Average between short-term fuel trim and long-term fuel trim	35% or more (varies with ECT)
Average between short-term fuel trim and long-term fuel trim	-35% or less (varies with ECT)

WIRING DIAGRAM

Refer to DTC P2195 (See page ES-281).

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, select the following menu items: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / A/F CONTROL.
5. Perform the A/F CONTROL operation with the engine in an idling condition (press the RIGHT or LEFT button to change the fuel injection volume).
6. Monitor the voltage outputs of the A/F and HO2 sensors (AFS B1S1 and OS2 B1S2) displayed on the tester.

HINT:

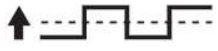
- The A/F CONTROL operation lowers the fuel injection volume by 12.5% or increases the injection volume by 25%.
- Each sensor reacts in accordance with increases and decreases in the fuel injection volume.

Standard:

Tester Display (Sensor)	Injection Volume	Status	Voltage
AFS B1S1 (A/F)	+25%	Rich	Less than 3.0

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

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

Case	A/F Sensor (Sensor 1) Output Voltage		HO2S Voltage (Sensor 2) Output Voltage		Main Suspected Trouble Area
1	Injection Volume +25% -12.5%		Injection Volume +25% -12.5%		-
	Output Voltage More than 3.35 V Less than 3.0 V		Output Voltage More than 0.55 V Less than 0.4 V		
2	Injection Volume +25% -12.5%		Injection Volume +25% -12.5%		• A/F sensor • A/F sensor heater • A/F sensor circuit
	Output Voltage Almost no reaction		Output Voltage More than 0.55 V Less than 0.4 V		
3	Injection Volume +25% -12.5%		Injection Volume +25% -12.5%		• Heated oxygen sensor • Heated oxygen sensor heater • Heated oxygen sensor circuit
	Output Voltage More than 3.35 V Less than 3.0 V		Output Voltage Almost no reaction		
4	Injection Volume +25% -12.5%		Injection Volume +25% -12.5%		• Injector • Fuel pressure • Gas leakage from exhaust system (Air-fuel ratio extremely lean or rich)
	Output Voltage Almost no reaction		Output Voltage Almost no reaction		

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

HINT:

- Read freeze frame data using the intelligent tester. Freeze frame data records the engine conditions when a malfunction is detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.
- A low A/F sensor voltage could be caused by a rich air-fuel mixture. Check for conditions that would cause the engine to run rich.
- A high A/F sensor voltage could be caused by a lean air-fuel mixture. Check for conditions that would cause the engine to run lean.

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

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

Result

Display (DTC Output)	Proceed to
P0171 or P0172	A
P0171 or P0172 and other DTCs	B

HINT:
If any DTCs other than P0171 or P0172 are output, troubleshoot those DTCs first.

B → GO TO DTC CHART

A

2	CHECK PCV HOSE CONNECTIONS

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

NG → REPAIR OR REPLACE PCV HOSE

OK

3	CHECK AIR INDUCTION SYSTEM

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

NG → REPAIR OR REPLACE AIR INDUCTION SYSTEM

OK

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

(a) Connect the intelligent tester to the DLC3.
(b) Start the engine and turn the tester on.
(c) Warm up the engine at an engine speed of 2,500 rpm for approximately 90 seconds.
(d) On the tester, select the following menu items: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / A/F CONTROL.

(e) Perform the A/F CONTROL operation with the engine in an idling condition (press the RIGHT or LEFT button to change the fuel injection volume).

(f) Monitor the voltage outputs of A/F and HO2 sensors (AFS B1S1 and O2S B1S2) displayed on the tester.
HINT:
- The A/F CONTROL operation lowers the fuel injection volume by 12.5% or increases the injection volume by 25%.
- Each sensor reacts in accordance with increases and decreases in the fuel injection volume.

Standard

ES

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

Result

Status AFS B1S1	Status O2S B1S2	A/F Condition and A/F Sensor Condition	Misfire	Suspected Trouble Area	Proceed to
Lean/Rich	Lean/Rich	Normal	-	-	C
Lean	Lean	Actual air-fuel ratio lean	May occur	• PCV valve and hose • PCV hose connections • Injector blockage • Gas leakage from exhaust system • Air induction system • Fuel pressure • Mass Air Flow (MAF) meter • Engine Coolant Temperature (ECT) sensor	A
Rich	Rich	Actual air-fuel ratio rich	-	• Injector leakage or blockage • Gas leakage from exhaust system • Ignition system • Fuel pressure • MAF meter • ECT sensor	A
Lean	Lean/Rich	A/F sensor malfunction	-	A/F sensor	B
Rich	Lean/Rich	A/F sensor malfunction	-	A/F sensor	B

Lean: During A/F CONTROL, the A/F sensor output voltage (AFS) is consistently more than 3.35 V, and the HO2 sensor output voltage (O2S) is consistently less than 0.4 V.
Rich: During A/F CONTROL, the AFS is consistently less than 3.0 V, and the O2S is consistently more than 0.55 V.

B	Go to step 11
C	Go to step 15

A

5	READ VALUE USING INTELLIGENT TESTER (COOLANT TEMP)

(a) Connect the intelligent tester to the DLC3.

(b) Turn the ignition switch to the ON position and turn the tester on.
(c) Select the following menu items: DIAGNOSIS / ENHANCED OBD II / DATA LIST / ALL / COOLANT TEMP.
(d) Read the COOLANT TEMP twice, when the engine is cold and also when warmed up.

Standard:
With cold engine:
Same as ambient air temperature
With warm engine:
Between 75°C and 95°C (167°F and 203°F)

NG → **REPLACE ENGINE COOLANT TEMPERATURE SENSOR**

ES

OK

6	READ VALUE USING INTELLIGENT TESTER (MAF)

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

Standard:
MAF while engine idling:
Between 0.54 gm/s and 4.33 gm/s (shift position: N; A/C: OFF)
MAF at engine speed of 2,500 rpm:
Between 0.58 gm/s and 4.67 gm/s (shift position: N; A/C: OFF)

NG → **REPLACE MASS AIR FLOW METER**

OK

7	CHECK FUEL PRESSURE

(a) Check the fuel pressure (See page FU-2).

NG → **REPAIR OR REPLACE FUEL SYSTEM**

OK

8	INSPECT FOR EXHAUST GAS LEAK

OK:
No gas leakage.

NG → REPAIR OR REPLACE EXHAUST SYSTEM

OK

9	CHECK FOR SPARK AND IGNITION

HINT:
If the spark plugs or ignition system malfunctions, engine misfire may occur. The misfire count can be read using the intelligent tester. Select the following menu items: DIAGNOSIS / ENHANCED OBD II / DATA LIST / ALL / CYL #1 (to CYL #4).

NG → REPAIR OR REPLACE IGNITION SYSTEM

OK

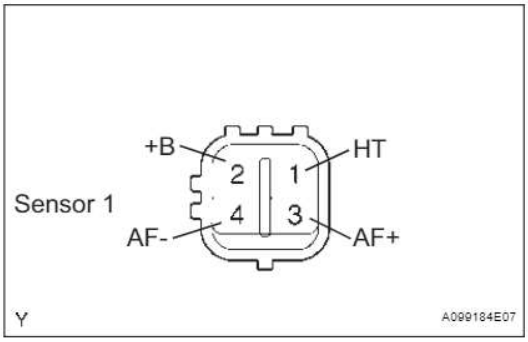
10	INSPECT FUEL INJECTOR (INJECTION AND VALVE)

HINT:
If the injectors malfunction, engine misfire may occur. The misfire count can be read using the intelligent tester. Select the following menu items: DIAGNOSIS / ENHANCED OBD II / DATA LIST / ALL / CYL #1 (to CYL #4).

NG → REPLACE FUEL INJECTOR

OK

11	INSPECT AIR FUEL RATIO SENSOR (HEATER RESISTANCE)



(a) Disconnect the A3 Air-Fuel Ratio (A/F) sensor connector.
(b) Measure the resistance according to the value(s) in the table below.

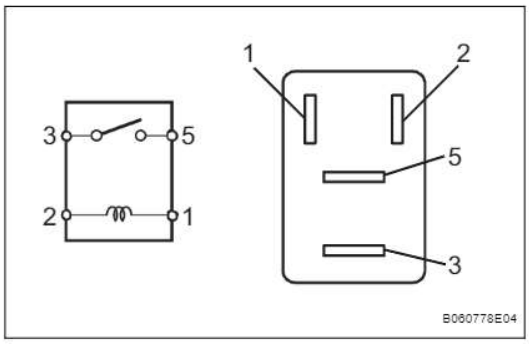
Standard resistance

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

NG → REPLACE AIR FUEL RATIO SENSOR

OK

12 INSPECT EFI RELAY



(a) Remove the EFI relay from the engine room relay block.
(b) Measure the resistance according to the value(s) in the table below.

Standard resistance

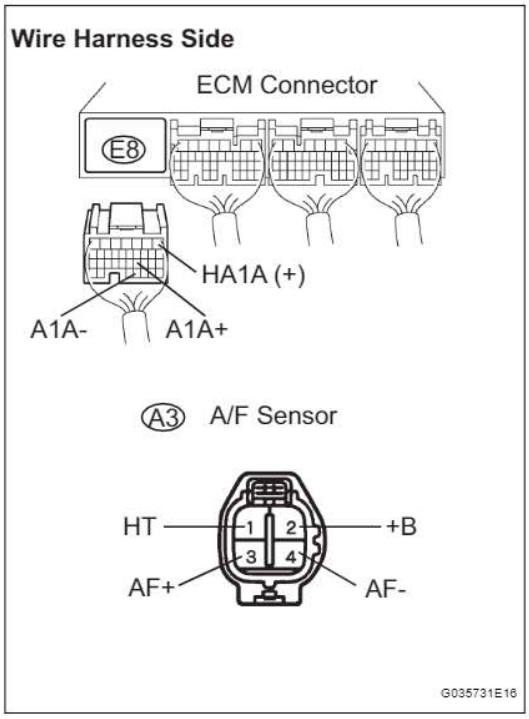
Tester Connection	Specified Condition
3 - 5	10 kΩ or higher
3 - 5	Below 1 Ω (when battery voltage is applied to terminals 1 and 2)

(c) Reinstall the EFI relay.

NG → REPLACE EFI RELAY

OK

13 CHECK WIRE HARNESS (A/F SENSOR - ECM) AND (SENSOR POWER SOURCE)



(a) Disconnect the A3 A/F sensor connector.
(b) Turn the ignition switch to the ON position.
(c) Measure the voltage according to the value(s) in the table below.

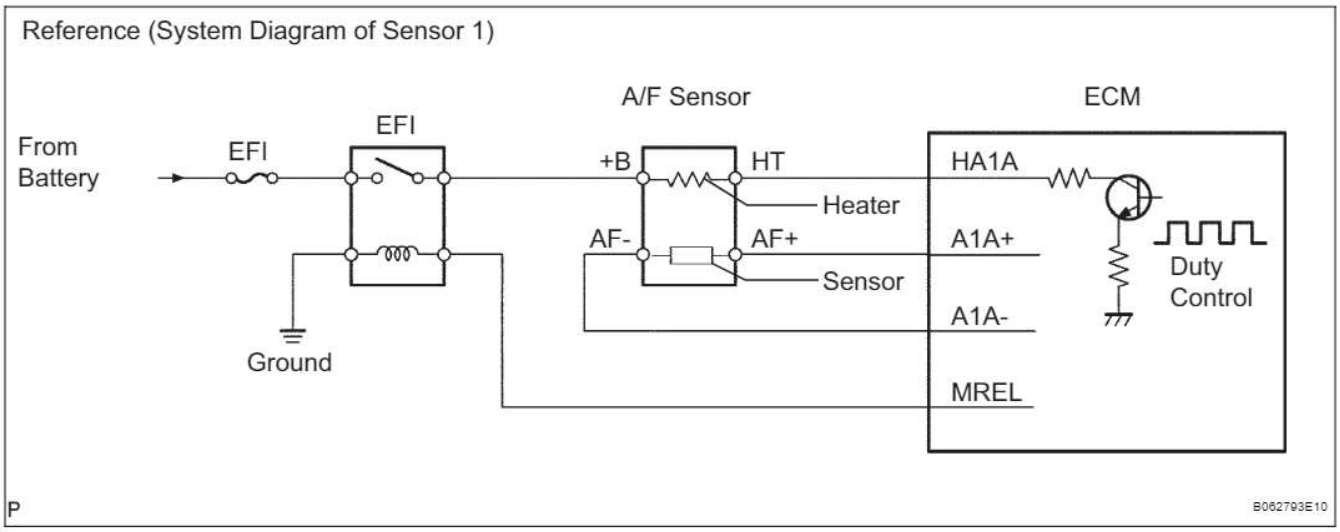
Standard voltage

Tester Connection	Specified Condition
+B (A3-2) - Body ground	9 to 14 V

(d) Turn the ignition switch off.
(e) Disconnect the E8 ECM connector.
(f) Measure the resistance according to the value(s) in the table below.

Standard resistance

Tester Connection	Specified Condition
HT (A3-1) - HA1A (E8-1)	Below 1 Ω
AF+ (A3-3) - A1A+ (E8-21)	Below 1 Ω
AF- (A3-4) - A1A- (E8-31)	Below 1 Ω
HT (A3-1) or HA1A (E8-1) - Body ground	10 kΩ or higher
AF+ (A3-3) or A1A+ (E8-21) - Body ground	10 kΩ or higher
AF- (A3-4) or A1A- (E8-31) - Body ground	10 kΩ or higher



ES

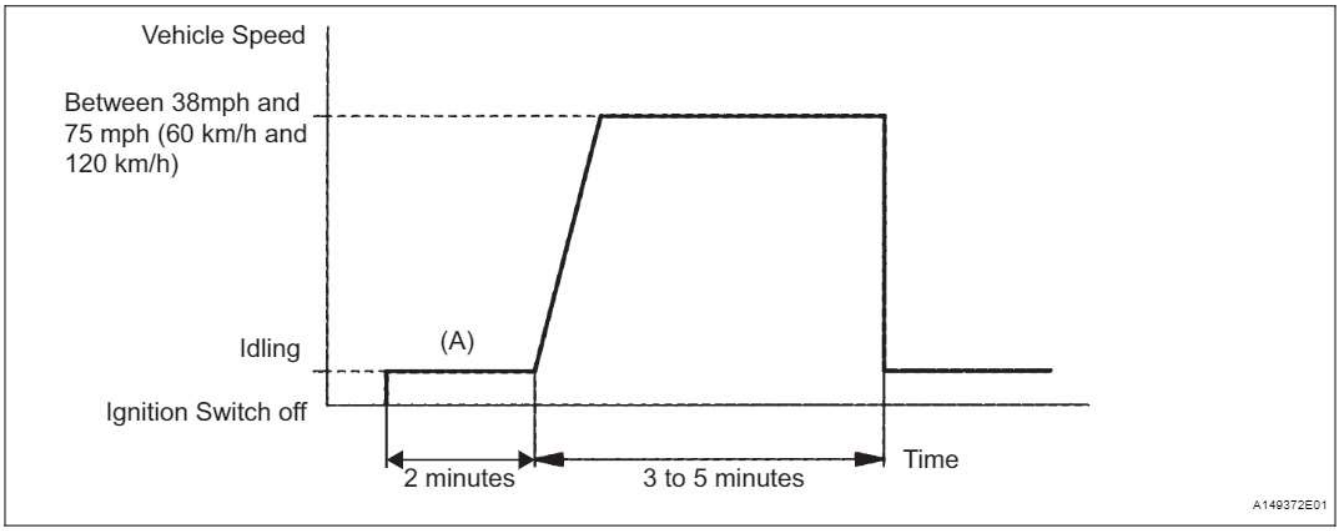
NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

14	REPLACE AIR FUEL RATIO SENSOR

NEXT

15	PERFORM CONFIRMATION DRIVING PATTERN



(a) Connect the intelligent tester to the DLC3.
(b) Turn the ignition switch to the ON position and turn the tester on.
(c) Clear the DTCs (See page ES-32).
(d) Switch the ECM from normal mode to check mode using the tester (See page ES-35).
(e) Start the engine and warm it up with all the accessories switched off (Procedure "A").

(f) Drive the vehicle at between 38 mph to 75 mph (60 km/h to 120 km/h) and at an engine speed of between 1,400 rpm and 3,200 rpm for 3 to 5 minutes (Procedure "B").
HINT:
If the system is still malfunctioning, the MIL will be illuminated during Procedure "A".
NOTICE:
If the conditions in this test are not strictly followed, no malfunction will be detected.

NEXT

16	CHECK WHETHER DTC OUTPUT RECURS (DTC P0171 OR P0172)

ES

(a) On the intelligent tester, select the following menu items: DIAGNOSIS / ENHANCED OBD II / DTC INFO / CURRENT CODES.
(b) Read the DTCs.
Result

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

B → Go to step 5

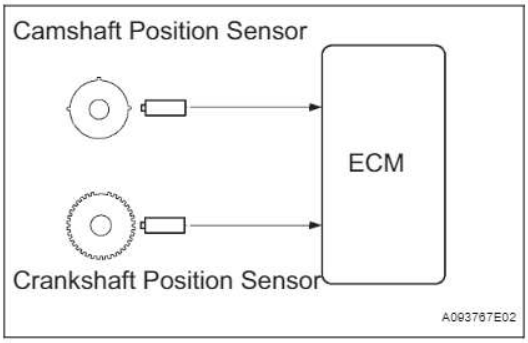
A

END

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

ES

DESCRIPTION



When the engine misfires, high concentrations of hydrocarbons (HC) enter the exhaust gas. Extremely high HC concentration levels can cause increases in exhaust emission levels. High concentrations of HC can also cause increases in the Three-Way Catalytic Converter (TWC) temperature, which may cause damage to the TWC. To prevent this increase in emissions and to limit the possibility of thermal damage, the ECM monitors the misfire rate. When the temperature of the TWC reaches the point of thermal degradation, the ECM blinks the MIL. To monitor misfires, the ECM uses both the Camshaft Position (CMP) sensor and the Crankshaft Position (CKP) sensor. The CMP sensor is used to identify any misfiring cylinders and the CKP sensor is used to measure variations in the crankshaft rotation speed. Misfires are counted when the crankshaft rotation speed variations exceed predetermined thresholds. If the misfire exceeds the threshold levels, and could cause emission deterioration, the ECM illuminates the MIL and sets a DTC.

DTC No.	DTC Detection Condition	Trouble Area
P0300	Simultaneous misfiring of several cylinders detected (2 trip detection logic)	• Open or short in engine wire harness • Connector connection • Vacuum hose connection • Ignition system • Injector • Fuel pressure • Mass Air Flow (MAF) meter • Engine Coolant Temperature (ECT) sensor • Compression pressure • Valve clearance • Valve timing • PCV valve and hose • PCV hose connection • ECM

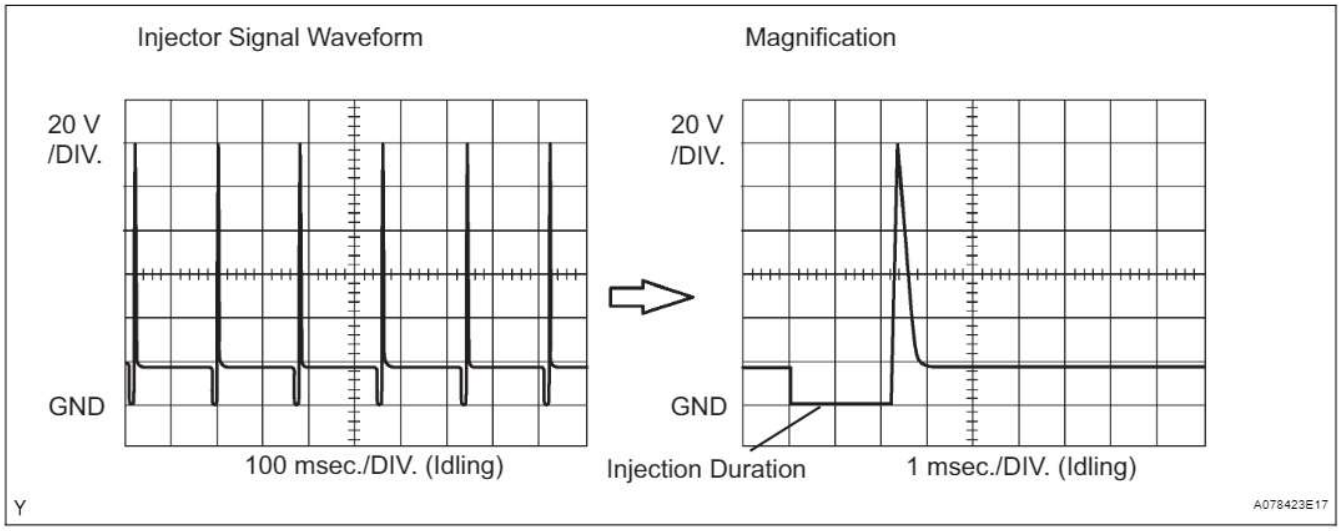
DTC No.	DTC Detection Condition	Trouble Area
P0301 P0302 P0303 P0304	Misfiring of specific cylinder detected (2 trip detection logic)	• Open or short in engine wire harness • Connector connection • Vacuum hose connection • Ignition system • Injector • Fuel pressure • MAF meter • ECT sensor • Compression pressure • Valve clearance • Valve timing • PCV valve and hose • PCV hose connection • ECM

ES

HINT:
When DTCs for misfiring cylinders are randomly set, but DTC P0300 is not set, it indicates that misfires have been detected in different cylinders at different times. DTC P0300 is only set when several misfiring cylinders are detected at the same time.
Reference: Inspection using an oscilloscope
With the engine idling, check the waveform between terminals #1 to #4 and E01 of the ECM connectors.

Item	Content
Terminals	#1 to #4 - E01
Equipment Settings	20 V/DIV., 100 or 1 ms./DIV.
Conditions	Idling

HINT:
The correct waveform is as shown.



MONITOR DESCRIPTION

The ECM illuminates the MIL and sets a DTC when either one of the following conditions, which could cause emission deterioration, is detected. (2 trip detection logic)

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

The ECM flashes the MIL and sets a DTC when either one of the following conditions, which could cause Three-Way Catalytic Converter (TWC) damage, is detected. (2 trip detection logic)

- For every 200 crankshaft revolutions at a high engine rpm, the threshold misfiring percentage is recorded once.
- For every 200 crankshaft revolutions at a normal engine rpm, the threshold misfiring percentage is recorded 3 times.

MONITOR STRATEGY

Related DTCs	P0300: Multiple cylinder misfire P0301: Cylinder 1 misfire P0302: Cylinder 2 misfire P0303: Cylinder 3 misfire P0304: Cylinder 4 misfire
Required Sensors/Components (Main)	Crankshaft position sensor and Camshaft position sensor
Required Sensors/Components (Related)	Engine coolant temperature sensor, Intake air temperature sensor and Mass air flow meter
Frequency of Operation	Continuous
Duration	1, 000 to 4,000 crankshaft revolutions: Emission related misfire 600 crankshaft revolutions: Catalyst damage misfire
MIL Operation	2 driving cycles: Emission related misfire MIL flashes immediately: Catalyst damage misfire
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

All:

Monitor runs whenever the following DTCs are not present	P0100 - P0103 (MAF meter) P0110 - P0113 (IAT sensor) P0115 - P0118 (ECT sensor) P0120 - P0223, P2135 (TP sensor) P0125 (Insufficient ECT for Closed Loop) P0327, P0328 (Knock sensor) P0335 (CKP sensor) P0340 (CMP sensor) P0500 (VSS)
Battery voltage	8 V or higher
VVT system	Not operated by scan tool
Engine RPM	400 to 6,400 rpm
All of the following conditions are met:	1, 2 and 3 are met
1. ECT	-10°C (14°F) or higher
2. Either of the following conditions is met:	(a) or (b) is met
(a) Engine start ECT	Higher than -7°C (19.4°F)
(b) ECT	Higher than 20°C (68°F)
3. Fuel-cut	OFF

Emission-related-misfire:

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

Catalyst-damage-misfire:

All of the following conditions 1, 2 and 3 are met:	Crankshaft 200 revolutions
1. Driving cycles	1st
2. Check Mode	OFF
3. RPM	Less than 2,300 rpm
Except above	Crankshaft 200 revolutions x 3

TYPICAL MALFUNCTION THRESHOLDS

Emission-related-misfire:

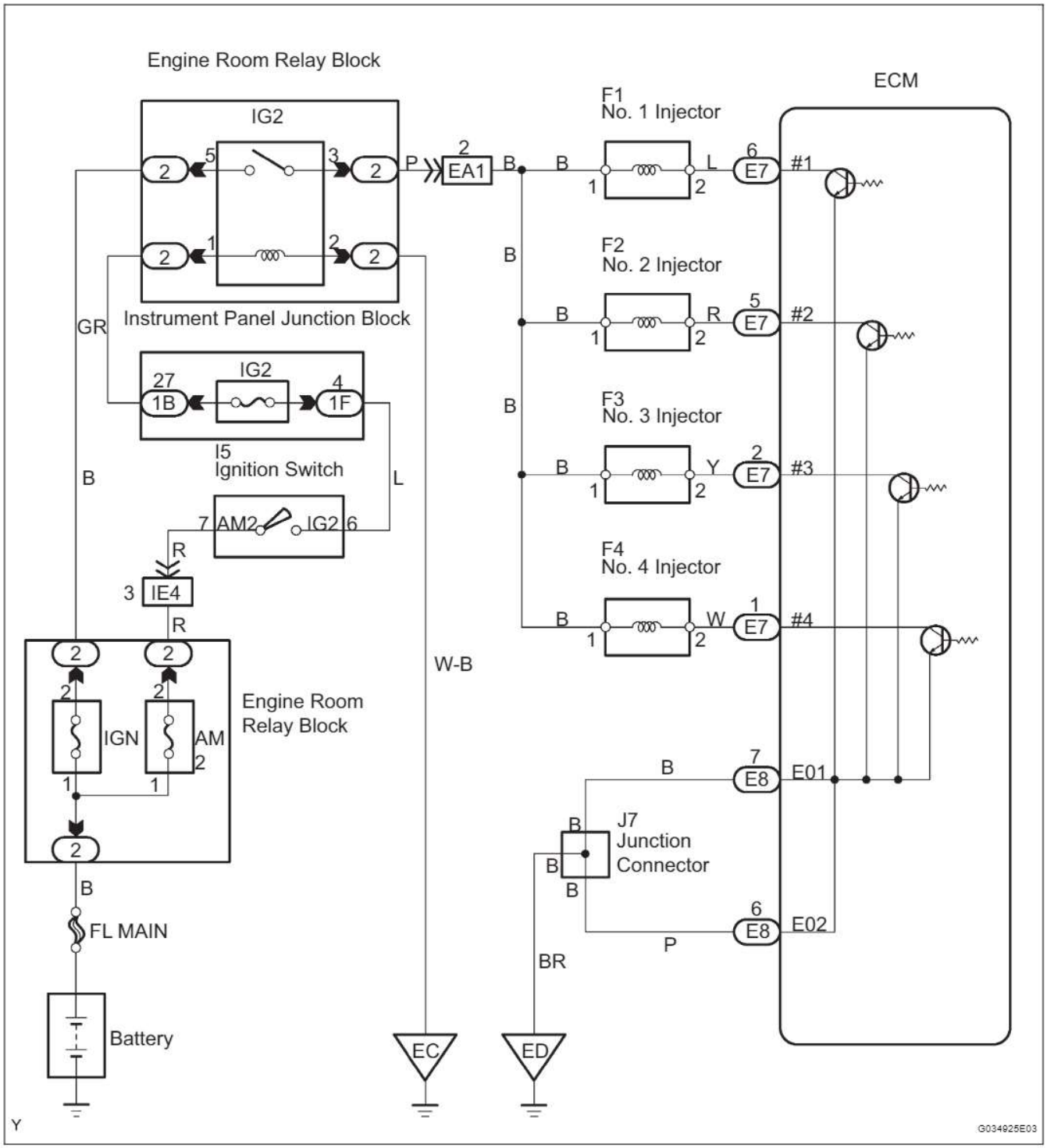
Misfire rate	1.3% or more

Catalyst-damage-misfire:

Number of misfire per 200 revolutions	118 or more (varies with intake air amount and RPM)

WIRING DIAGRAM

Refer to DTC P0351 (See page ES-175) for the wiring diagram of the ignition system.



CONFIRMATION DRIVING PATTERN

1. Connect the intelligent tester to the DLC3.
2. Turn the ignition switch to the ON position.
3. Turn the tester on.
4. Record the DTC(s) and freeze frame data.
5. Using the tester, switch the ECM from normal mode to check mode.
6. Read the misfire counts of each cylinder (CYL #1 to #4) with the engine in an idling condition. If any misfire count is displayed, skip the following confirmation driving pattern.
7. Drive the vehicle several times with the conditions, such as engine rpm and engine load, shown in MISFIRE RPM and MISFIRE LOAD in the DATA LIST.
   HINT:
   In order to store misfire DTCs, it is necessary to drive the vehicle for the period of time shown in the table below, with the MISFIRE RPM and MISFIRE LOAD in the DATA LIST.

ES

Engine RPM	Duration
Idling	3.5 minutes or more
1,000	3 minutes or more
2,000	1.5 minutes or more
3,000	1 minute or more

8. If using the intelligent tester, follow the operations below in order for DTCs to be set by the ECM.
   (a) Drive the vehicle several times with the conditions, such as engine rpm and engine load, stored in the freeze frame data.
   (b) Turn the ignition switch off and then turn it to the ON position again.
   (c) Repeat step (a) described above.
9. Check whether misfires have occurred by checking DTCs and freeze frame data.
   HINT:
   Do not turn the ignition switch off until the stored DTC(s) and freeze frame data have been recorded. When the ECM returns to normal mode (default), the stored DTC(s), freeze frame data and other data will be erased.
10. Record the DTC(s), freeze frame data and misfire counts.
11. Turn the ignition switch off and wait for at least 5 seconds.

INSPECTION PROCEDURE

HINT:

- If any DTCs other than the misfire DTCs are output, troubleshoot those DTCs first.
- Read freeze frame data using the intelligent tester. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can 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.
- If the misfire does not recur when the vehicle is brought to the workshop, reproduce the conditions stored in the freeze frame data.
- If the misfire still cannot be reproduced even though the conditions stored in the freeze frame data have been duplicated, one of the following factors is considered to be a possible cause of the problem:
  (1) The fuel tank is almost empty.
  (2) Improper fuel is used.
  (3) The spark plugs have been contaminated.
  (4) The problem is complex.
- After finishing repairs, check the misfire counts of the cylinders (CYL #1, #2, #3 and #4).
- Be sure to confirm that no misfiring cylinder DTCs are set again by conducting the confirmation driving pattern, after repairs.

- For 6 and 8 cylinder engines, the ECM intentionally does not set the specific misfiring cylinder DTCs at high engine RPM. If misfires occur only in high engine RPM areas, only DTC P0300 is set.
  In the event of DTC P0300 being present, perform the following operations:
  (1) Clear the DTC (See page ES-32).
  (2) Start the engine and conduct the confirmation driving pattern.
  (3) Read the misfiring rates of each cylinder or DTC(s) using the tester.
  (4) Repair the cylinder(s) that has a high misfiring rate or is indicated by the DTC.
  (5) After finishing repairs, conduct the confirmation driving pattern again, in order to verify that DTC P0300 is not set.
- When one of SHORT FT #1, LONG FT #1, SHORT FT #2 or LONG FT #2 in the freeze frame data is outside the range of +-20%, the air-fuel ratio may be rich (-20% or less) or lean (+20% or more).
- When the COOLANT TEMP in the freeze frame data is less than 75°C (167°F), the misfires have occurred only while warming up the engine.

ES

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

(a) Connect the intelligent tester to the DLC3.
(b) Turn the ignition switch to the ON position.
(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
P0300, P0301, P0302, P0303 and/or P0304	A
"P0300, P0301, P0302, P0303 and/or P0304" and other DTCs	B

HINT:
If any DTCs other than P0300, P0301, P0302, P0303 and P0304 are output, troubleshoot those DTCs first.

B → GO TO DTC CHART

A

2	READ VALUE USING INTELLIGENT TESTER (MISFIRE RPM AND MISFIRE LOAD)

NOTICE:
If the intelligent tester is not available, proceed to the next step.

(a) Connect the intelligent tester to the DLC3.
(b) Turn the ignition switch to the ON position and turn the tester on.
(c) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DATA LIST / MISFIRE / MISFIRE RPM and MISFIRE LOAD.
(d) Read and note the MISFIRE RPM and MISFIRE LOAD (engine load) values.
HINT:
The MISFIRE RPM and MISFIRE LOAD indicate the vehicle conditions under which the misfire occurred.

NEXT

3	CHECK CONNECTION OF PCV HOSE

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

NG → REPAIR OR REPLACE PCV HOSE

OK

4	CHECK MISFIRE COUNT (CYL #1, #2, #3 AND #4)

ES

(a) Connect the intelligent tester to the DLC3.
(b) Turn the ignition switch to the ON position.
(c) Turn the tester on.
(d) Clear the DTCs (See page ES-32) (Procedure "A").
(e) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DATA LIST / ALL / CYL #1, #2, #3 and #4 (Procedure "B").
(f) Allow the engine to idle (Procedure "C").
(g) Read each value of CYL #1 to #4 displayed on the tester (Procedure "D").
If no misfire counts occur in any cylinders, perform the following operations:
1. Shift the gear selector lever to the D position.
2. Repeat Procedure "A" and "B" above.
3. Check the CYL #1 to #4.
4. If misfire counts are still not displayed, repeat Procedure "D" and then check the misfire counts again.
(h) Drive the vehicle with the MISFIRE RPM and MISFIRE LOAD noted in step 2.
(i) Read the CYL #1 to #4 or DTCs displayed on the tester.

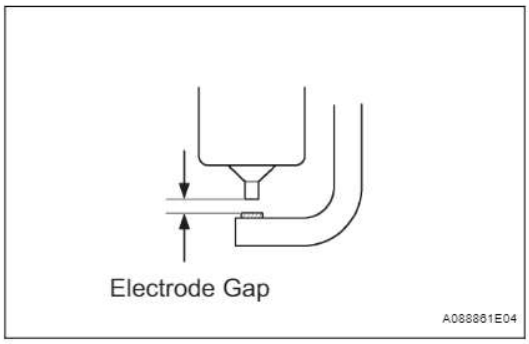
Result

Misfire Count	Proceed to
1 or 2 cylinders have misfire counts	A
3 cylinders or more have misfire counts	B

B → Go to step 13

A

5 CHECK SPARK PLUG



(a) Remove the No. 2 cylinder head cover.
(b) Remove the ignition coil and the spark plug of the misfiring cylinder.
(c) Measure the spark plug electrode gap.
Standard gap:
1.0 to 1.3 mm (0.039 to 0.051 in.)
(d) Check the electrode for carbon deposits.
Recommended spark plug

Manufacturer	Product
DENSO	SK20R11
NGK	IFR6A11

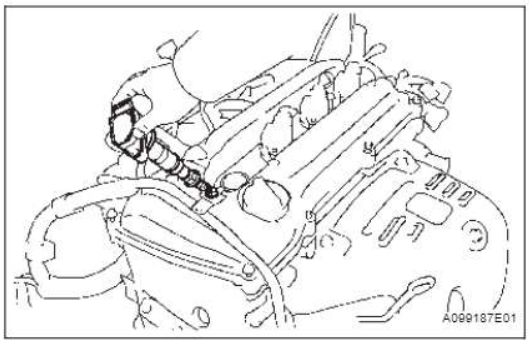
ES

NOTICE:
If the electrode gap is larger than standard, replace the spark plug. Do not adjust the electrode gap.

NG → **REPLACE SPARK PLUG**

OK

6 CHECK SPARK AND IGNITION



(a) Disconnect the injector connectors in order to prevent the engine from starting.
(b) Install the spark plug to the ignition coil.
(c) Attach the spark plug assembly to the cylinder head cover.
(d) Crank the engine for less than 2 seconds and check the spark.
OK:
Sparks jump across electrode gap

NG → **Go to step 8**

OK

7 CHECK CYLINDER COMPRESSION PRESSURE OF MISFIRING CYLINDER

(a) Measure the cylinder compression pressure of the misfiring cylinder.

OK → **Go to step 9**

NG

REPAIR OR REPLACE MALFUNCTION PARTS

8	CHANGE NORMAL SPARK PLUG AND CHECK SPARK OF MISFIRING CYLINDER

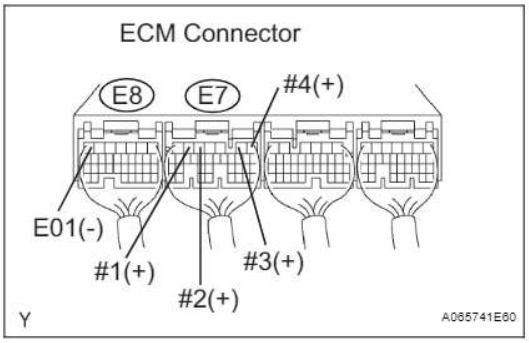
(a) Change the installed spark plug to a spark plug that functions normally.
(b) Perform a spark test.
CAUTION:
Always disconnect each injector connector.
NOTICE:
Do not crank the engine for more than 2 seconds.
(1) Install the spark plug to the ignition coil and connect the ignition coil connector.
(2) Disconnect the injector connectors.
(3) Ground the spark plug.
(4) Check if sparks occur while the engine is being cranked.
OK:
Sparks jump across electrode gap.

NG → **REPLACE IGNITION COIL ASSEMBLY THEN CONFIRM THAT THERE IS NO MISFIRE**

OK ↓

REPLACE SPARK PLUG

9	INSPECT ECM TERMINAL OF MISFIRING CYLINDER (#1, #2, #3 AND/OR #4 VOLTAGE)



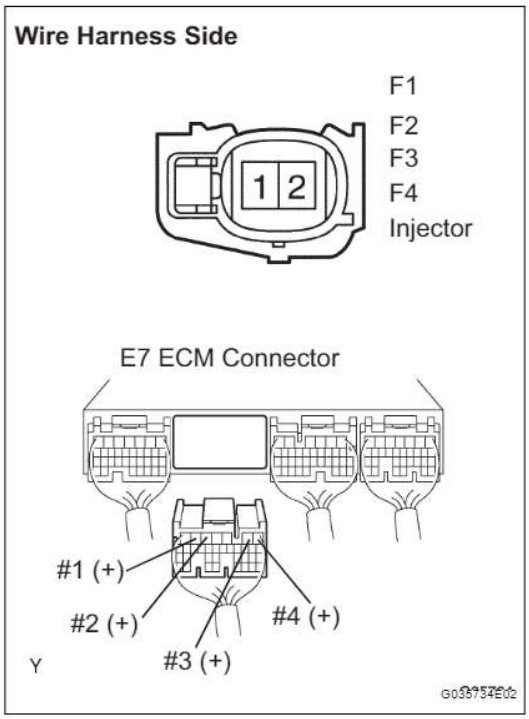
(a) Turn the ignition switch to the ON position.
(b) Measure the voltage according to the value(s) in the table below..
Standard voltage

Tester Connection	Specified Condition
#1 (E7-6) - E01 (E8-7)	9 to 14 V
#2 (E7-5) - E01 (E8-7)	9 to 14 V
#3 (E7-2) - E01 (E8-7)	9 to 14 V
#4 (E7-1) - E01 (E8-7)	9 to 14 V

OK → **Go to step 11**

NG ↓

10 CHECK WIRE HARNESS (INJECTOR - ECM)



(a) Disconnect the injector connector (of the misfiring cylinder).
(b) Disconnect the E7 ECM connector.
(c) Turn the ignition switch to the ON position.
(d) Measure the resistance and voltage according to the value(s) in the table below.

Standard:

Cylinder No. 1

Tester Connection	Specified Condition
F1-1 - Ground	11 to 14 V
F1-2 - Ground	10 kΩ or higher
F1-2 - #1 (E7-6)	Below 1 Ω

Cylinder No. 2

Tester Connection	Specified Condition
F2-1 - Ground	11 to 14 V
F2-2 - Ground	10 kΩ or higher
F2-2 - #2 (E7-5)	Below 1 Ω

Cylinder No. 3

Tester Connection	Specified Condition
F3-1 - Ground	11 to 14 V
F3-2 - Ground	10 kΩ or higher
F3-2 - #3 (E7-2)	Below 1 Ω

Cylinder No. 4

Tester Connection	Specified Condition
F4-1 - Ground	11 to 14 V
F4-2 - Ground	10 kΩ or higher
F4-2 - #4 (E7-1)	Below 1 Ω

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

11 CHECK FUEL INJECTOR OF MISFIRING CYLINDER

(a) Check the injector injection (whether fuel volume is high or low, and whether injection pattern is poor).

NG → REPLACE FUEL INJECTOR ASSEMBLY

OK

12 CHECK VALVE CLEARANCE OF MISFIRING CYLINDER

NG → ADJUST VALVE CLEARANCE

OK

13	CHECK AIR INDUCTION SYSTEM

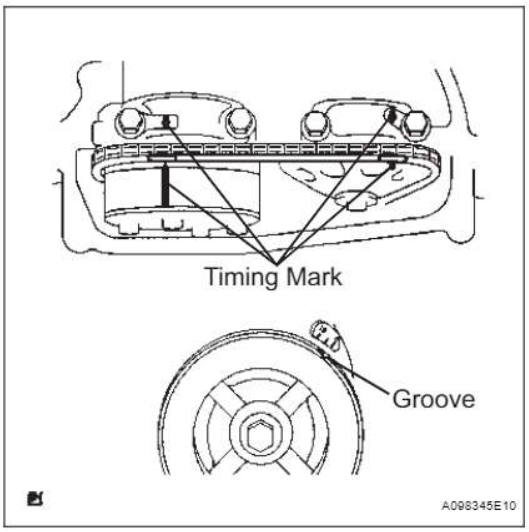
(a) Check the air induction system for vacuum leakage.
OK:
No leakage from air induction system.

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

OK

ES

14	CHECK VALVE TIMING



(a) Remove the cylinder head cover (See page EM-115).
(b) Turn the crankshaft pulley until its groove and the timing mark "0" of the timing chain cover are aligned.
(c) Check that each timing mark of the camshaft timing gears is aligned with its corresponding timing mark located on the No.1 and No.2 bearing caps as shown in the illustration.
If not, turn the crankshaft by 1 revolution (360°) to align the timing marks as above.
OK:
The timing marks of the camshaft timing gears are aligned with the timing marks located on the No. 1 and No. 2 bearing caps.
(d) Reinstall the cylinder head cover (See page EM-80).

NG → **ADJUST VALVE TIMING**

OK

15	CHECK FUEL PRESSURE

(a) Check the fuel pressure (See page FU-2).

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

OK

16	READ VALUE USING INTELLIGENT TESTER (COOLANT TEMP)

(a) Connect the intelligent tester to the DLC3.
(b) Turn the ignition switch to the ON position.
(c) Turn the tester on.
(d) On the tester, select the following menu items: DIAGNOSIS / ENHANCED OBD II / DATA LIST / ALL / COOLANT TEMP.

(e) Read the COOLANT TEMP twice, when the engine is both cold and warmed up.
Standard temperature:
With cold engine:
Same as ambient air temperature
With warm engine:
75 to 95°C (167 to 203°F)

NG → **REPLACE ENGINE COOLANT TEMPERATURE SENSOR**

OK

17	READ VALVE USING INTELLIGENT TESTER

ES

(a) Connect the intelligent tester to the DLC3.
(b) Turn the ignition switch to the ON position.
(c) Turn the tester on.
(d) Enter the following menu items: DIAGNOSIS / ENHANCED OBD II / DATA LIST / ALL / MAF and COOLANT TEMP.
(e) Allow the engine to idle until the COOLANT TEMP reaches 75°C (167°F) or more.
(f) Read the MAF with the engine in an idling condition and at an engine speed of 2,500 rpm.
Standard:
MAF while engine idling:
Between 0.54 gm/s and 4.33 gm/s (shift position: N; A/C: OFF)
MAF at engine speed of 2,500 rpm:
Between 0.58 gm/s and 4.67 gm/s (shift position: N; A/C: OFF)

NG → **REPLACE MASS AIR FLOW METER**

OK

CHECK FOR INTERMITTENT PROBLEMS

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

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

DESCRIPTION

A flat type knock sensor (non-resonant type) has a structure that can detect vibrations between approximately 6 kHz and 15 kHz.

Knock sensors are fitted onto the engine block to detect engine knocking.

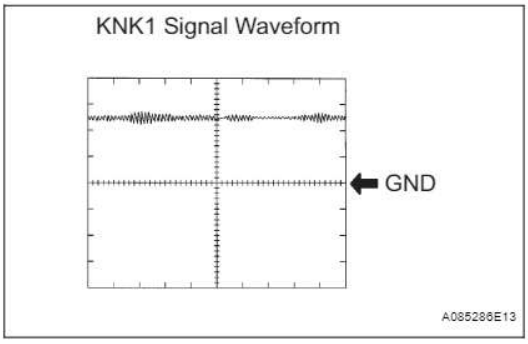
ES

The knock sensor contains a piezoelectric element which generates a voltage when it becomes deformed. The voltage is generated when the engine block vibrates due to knocking. Any occurrence of engine knocking can be suppressed by delaying the ignition timing.

DTC No.	DTC Detection Condition	Trouble Area
P0327	Output voltage of knock sensor less than 0.5 V (1 trip detection logic)	• Short in knock sensor circuit • Knock sensor • ECM
P0328	Output voltage of knock sensor more than 4.5 V (1 trip detection logic)	• Open in knock sensor circuit • Knock sensor • ECM

HINT:

When any of DTCs P0327 and P0328 are set, the ECM enters fail-safe mode. During fail-safe mode, the ignition timing is delayed to its maximum retardation. Fail-safe mode continues until the ignition switch is turned off.



Reference: Inspection using an oscilloscope.

The correct waveform is as shown.

Item	Content
Terminals	KNK1 - EKNK
Equipment Settings	0.01 to 10 V/DIV., 0.01 to 10 msec./DIV.
Conditions	keep engine speed at 4,000 rpm with warm engine

MONITOR DESCRIPTION

If the output voltage transmitted by the knock sensor remains low or high for more than 1 second, the ECM interprets this as a malfunction in the sensor circuit, and sets a DTC.

The monitor for DTCs P0327 and P0328 begins to run when 5 seconds have elapsed since the engine was started.

If the malfunction is not repaired successfully, either DTC P0327 or P0328 is set 5 seconds after the engine is next started.

MONITOR STRATEGY

Related DTCs	P0327: Knock sensor range check (low voltage) P0328: Knock sensor range check (high voltage)
Required Sensors/Components (Main)	Knock sensor
Required Sensors/Components (Related)	-
Frequency of Operation	Continuous
Duration	1 second
MIL Operation	Immediate
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

ES

Monitor runs whenever the following DTCs are not present	None
Battery voltage	10.5 V or more
Time after engine start	5 seconds or more

TYPICAL MALFUNCTION THRESHOLDS

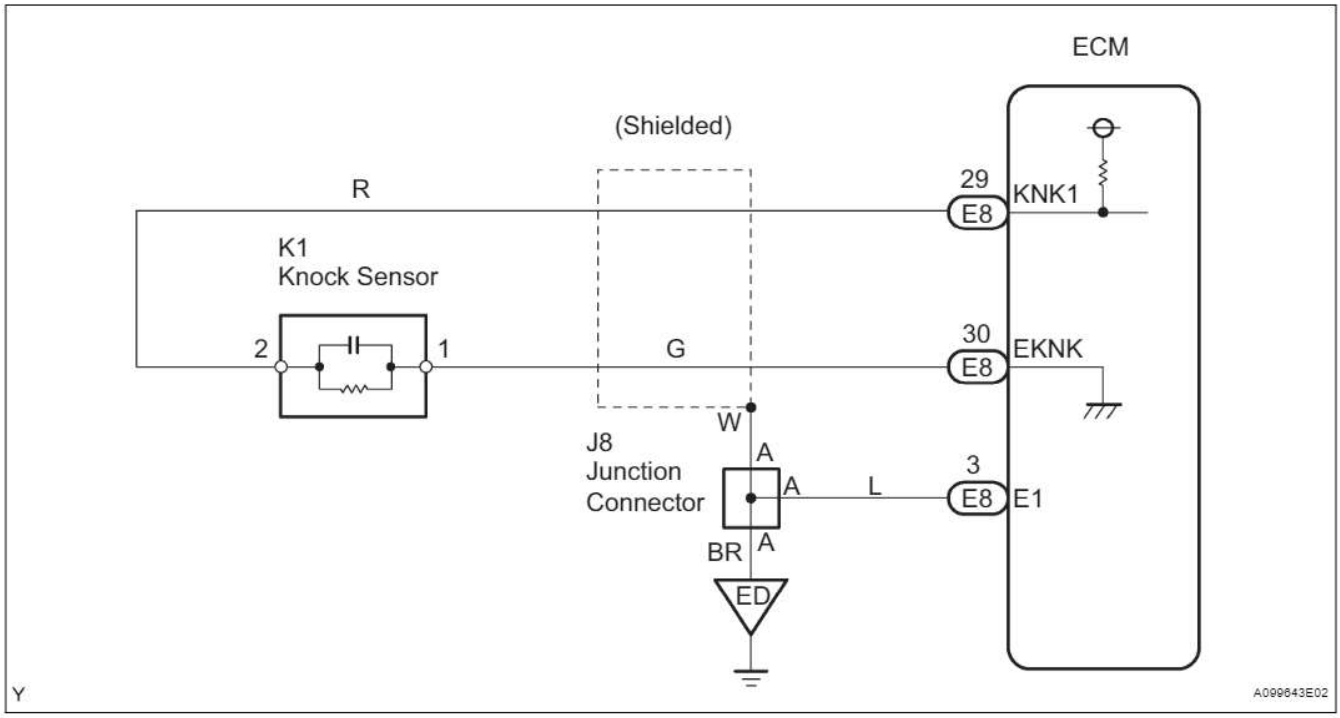
Knock Sensor Range Check (Low voltage) P0327:

Knock sensor voltage	Less than 0.5 V

Knock Sensor Range Check (High voltage) P0328:

Knock sensor voltage	More than 4.5 V

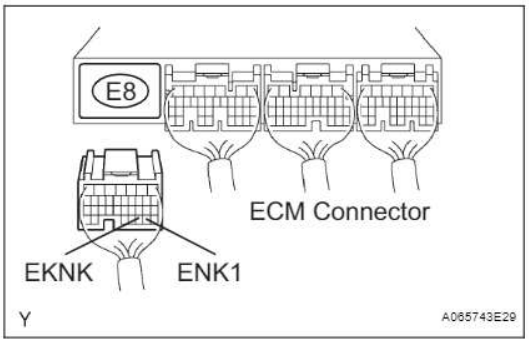
WIRING DIAGRAM



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.

1 CHECK WIRE HARNESS (ECM - KNOCK SENSOR)



(a) Disconnect the E8 ECM connector.
(b) Measure the resistance according to the value(s) in the table below.

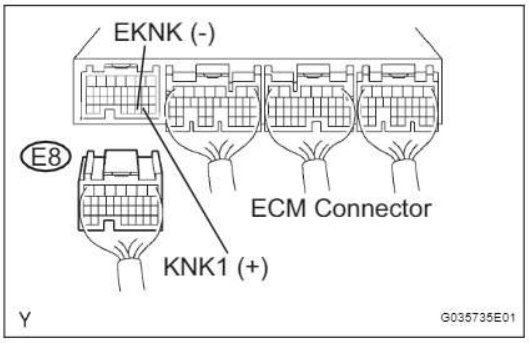
Standard resistance

Tester Connection	Specified Condition
KNK1 (E8-29) - EKNK (E8-30)	120 to 280 kΩ at 20°C (68°F)

NG → **Go to step 3**

OK

2 INSPECT ECM (KNK1 VOLTAGE)



(a) Disconnect the E8 ECM connector.
(b) Turn the ignition switch to the ON position.
(c) Measure the voltage according to the value(s) in the table below.

Standard voltage

Tester Connection	Specified Condition
KNK1 (E8-29) - EKNK (E8-30)	4.5 to 5.5 V

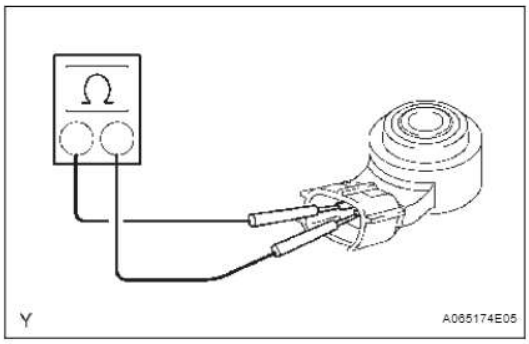
NOTICE:
Fault may be intermittent. Check the wire harness and connectors carefully.

NG → **REPLACE ECM**

OK

CHECK FOR INTERMITTENT PROBLEMS

3	INSPECT KNOCK SENSOR



(a) Remove the knock sensor.
(b) Measure the resistance according to the value(s) in the table below.

Standard resistance

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

NG → REPLACE KNOCK SENSOR

OK

REPAIR OR REPLACE HARNESS OR CONNECTOR

ES

DTC	P0335	Crankshaft Position Sensor "A" Circuit

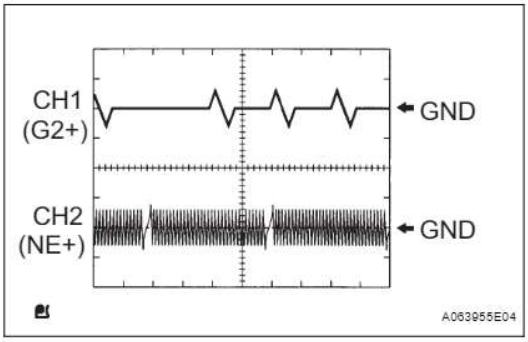
DTC	P0339	Crankshaft Position Sensor "A" Circuit Intermittent

DESCRIPTION

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

ES

DTC No.	DTC Detection Condition	Trouble Area
P0335	When either condition below is met: • No CKP sensor signal to ECM while cranking (1 trip detection logic) • No CKP sensor signal to ECM at engine speed of 600 rpm or more (1 trip detection logic)	• Open or short in CKP sensor circuit • CKP sensor • Sensor plate (CKP sensor plate) • ECM
P0339	Under conditions (a), (b) and (c), no CKP sensor signal to ECM for 0.05 seconds or more (1 trip detection logic): (a) Engine speed 1,000 rpm or more (b) Starter signal OFF (c) 3 seconds or more have lapsed since starter signal switched from ON to OFF	• Open or short in CKP sensor circuit • CKP sensor • Sensor plate (CKP sensor plate) • ECM



Reference: Inspection using an oscilloscope.
HINT:
- The correct waveform is shown.
- G2+ stands for the Camshaft Position (CMP) sensor signal, and NE+ stands for the CKP sensor signal.

Item	Content
Terminals	CH1: G2+ - NE- CH2: NE+ - NE-
Equipment Settings	5 V/Division, 20 ms./Division
Conditions	Cranking or idling

MONITOR DESCRIPTION

If there is no signal from the CKP sensor although the engine is running, the ECM interprets this as a malfunction of the sensor.
If the malfunction is not repaired successfully, a DTC is set 10 seconds after the engine is next started.

MONITOR STRATEGY

Related DTCs	P0335: CKP sensor range check or rationality
Required Sensors/Components (Main)	Crankshaft Position (CKP) sensor
Required Sensors/Components (Related)	Cam position sensor
Frequency of Operation	Continuous
Duration	3 times
MIL Operation	Immediate
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

All:

Monitor runs whenever the following DTCs are not present	None

Case 1:

Time after starter OFF to ON	0.3 seconds or more
Number of CMP sensor signal pulse	6 times
Battery voltage	7 V or more
CMP sensor circuit failure	Not detected
Ignition switch	ON

Case 2:

Starter	OFF
Engine speed	600 rpm or more
Time after starter from ON to OFF	3 seconds or more

TYPICAL MALFUNCTION THRESHOLDS

Case 1:

Number of CKP sensor signal pulse	132 or less, and 174 or more

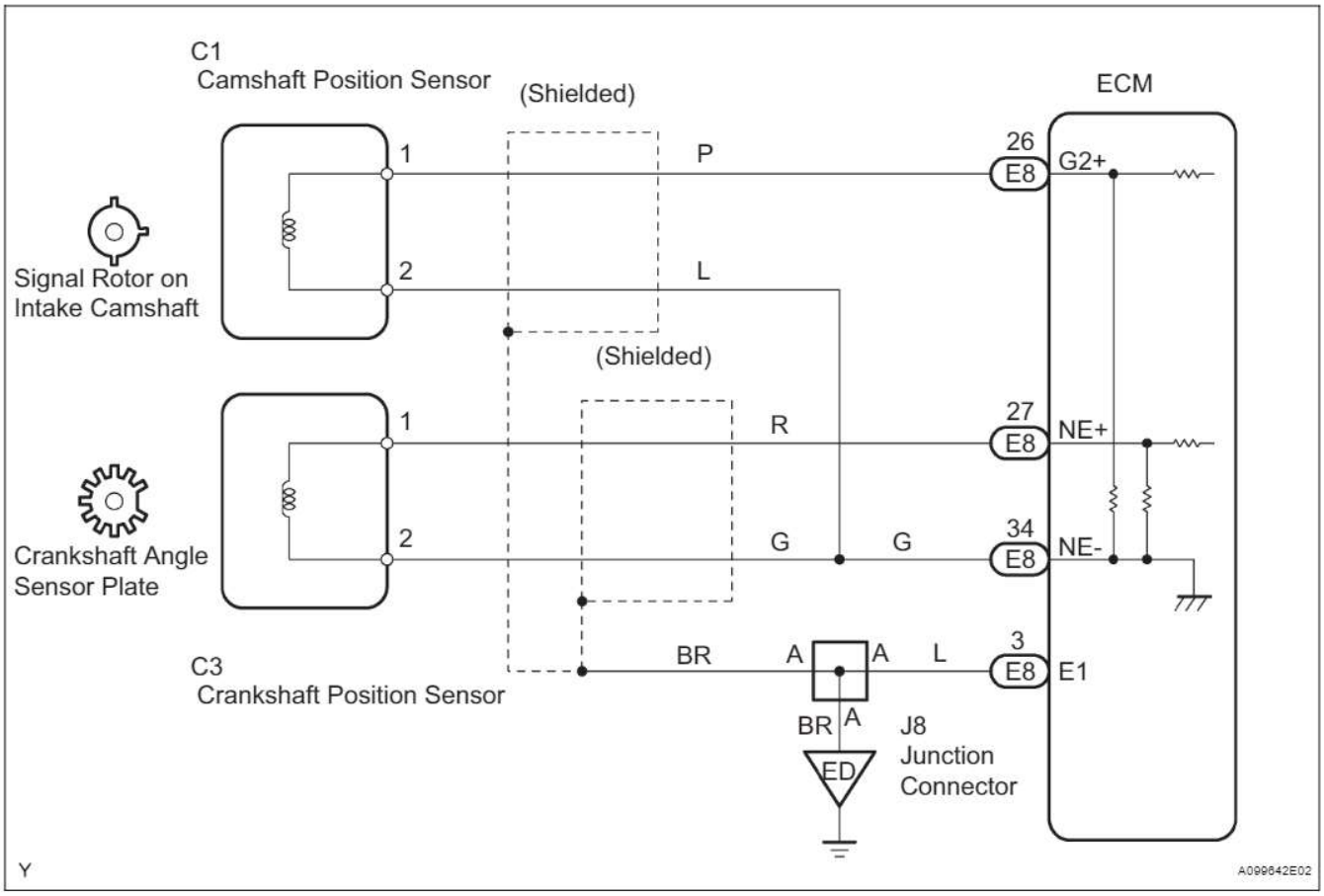
Case 2:

Engine speed signal	No signal

COMPONENT OPERATING RANGE

CKP sensor	• CKP sensor output voltage fluctuates while crankshaft is revolving • 34 CKP sensor signals per crankshaft revolution

WIRING DIAGRAM

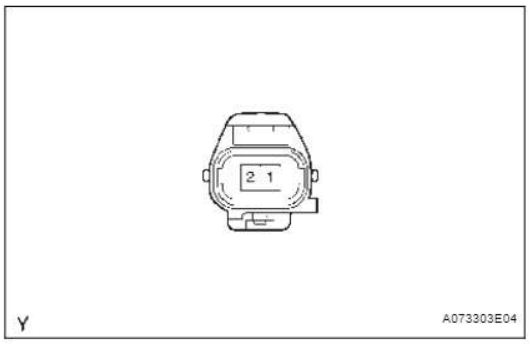


INSPECTION PROCEDURE

HINT:

- If no problem is found by this diagnostic troubleshooting procedure, troubleshoot the engine mechanical systems.
- Check the engine speed. The engine speed can be checked by using the intelligent tester. To check, perform the operations below:
  (a) Connect the intelligent tester to the DLC3.
  (b) Start the engine.
  (c) Turn the tester on.
  (d) If using the intelligent tester, enter the following menus: DIAGNOSIS / ENHANCED OBD II / DATA LIST / ALL / ENGINE SPD.
  The engine speed may be indicated as zero despite the engine revolving normally. This is caused by a lack of NE signals from the Crankshaft Position (CKP) sensor. Alternatively, the engine speed may be indicated as lower than the actual engine speed, if the CKP sensor voltage output is insufficient.
- Read freeze frame data using the intelligent tester. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can be helpful in determining whether the vehicle was running or stopped, whether the engine was warmed up or not, whether the air-fuel ratio was lean or rich, as well as other data recorded at the time of a malfunction.

1 INSPECT CRANKSHAFT POSITION SENSOR



(a) Disconnect the C3 sensor connector.
(b) Measure the resistance according to the value(s) in the table below.

Standard resistance

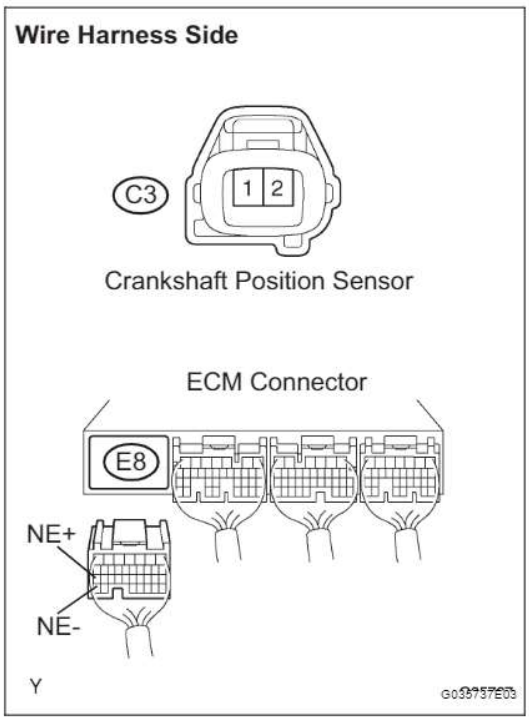
Tester Connection	Specified Condition
1 - 2	985 to 1,600 Ω at cold
1 - 2	1,265 to 1,890 Ω at hot

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

NG → REPLACE CRANKSHAFT POSITION SENSOR

OK

2 CHECK WIRE HARNESS (CRANKSHAFT POSITION SENSOR - ECM)



(a) Disconnect the C3 sensor connector.
(b) Disconnect the E8 ECM connector.
(c) Measure the resistance according to the value(s) in the table below.

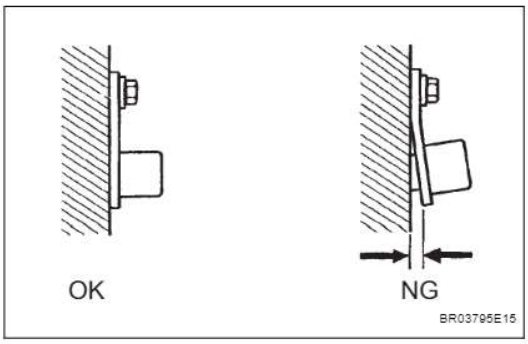
Standard resistance

Tester Connection	Specified Condition
NE+ (C3-1) - NE+ (E8-27)	Below 1 Ω
NE- (C3-2) - NE- (E8-34)	Below 1 Ω
NE+ (C3-1) or NE+ (E8-27) - Body ground	10 kΩ or higher
NE- (C3-2) or NE- (E8-34) - Body ground	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

3	CHECK SENSOR INSTALLATION (CRANKSHAFT POSITION SENSOR)



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

NG → **TIGHTEN SENSOR**

ES

OK

4	CHECK CRANKSHAFT TIMING PULLEY (TEETH OF PLATE)

(a) Check the teeth of the sensor plate.
OK:
Sensor plate does not have any cranks or deformation.

NG → **REPLACE CRANKSHAFT POSITION SENSOR PLATE**

OK

REPLACE ECM

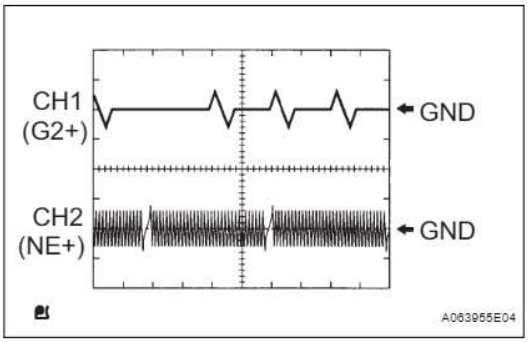
DTC	P0340	Camshaft Position Sensor "A" Circuit (Bank 1 or Single Sensor)

DESCRIPTION

The Camshaft Position (CMP) sensor consists of a magnet and an iron core which is wrapped with copper wire, and is installed onto the cylinder head. When the camshaft rotates, each of 3 teeth on the camshaft passes through the CMP sensor. This activates the internal magnet in the sensor, generating a voltage in the copper wire. The camshaft rotation is synchronized with the crankshaft rotation. When the crankshaft turns twice, the voltage is generated 3 times in the CMP sensor. The generated voltage in the sensor acts as a signal, allowing the ECM to locate the camshaft position. This signal is then used to control ignition timing, fuel injection timing, and the VVT system.

DTC No.	DTC Detection Condition	Trouble Area
P0340	Case 1 • No CMP sensor signal to ECM while cranking (2 trip detection logic) Case 2 • Camshaft/Crankshaft misalignment detected at engine speed of 600 rpm or more (1 trip detection logic)	• Open or short in CMP sensor circuit • CMP sensor • Camshaft • Jumped tooth of timing chain • ECM

HINT:
DTC P0340 indicates a malfunction relating to the CMP sensor (+) circuit (the wire harness between the ECM and CMP sensor, and the CMP sensor itself).



Reference: Inspection using an oscilloscope.
HINT:
- The correct waveform is as shown.
- G2+ stands for the CMP sensor signal, and NE+ stands for the Crankshaft Position (CKP) sensor signal.

Item	Content
Terminals	CH1: G2+ - NE- CH2: NE+ - NE-
Equipment Settings	5 V/DIV., 20 ms./DIV.
Conditions	Cranking or idling

MONITOR DESCRIPTION

If no signal is transmitted by the CMP sensor although the engine is running, or the rotation of the camshaft and the crankshaft is not synchronized, the ECM interprets this as a malfunction of the sensor. If the malfunction is not repaired successfully, a DTC is set 10 seconds after the engine is next started.

MONITOR STRATEGY

Related DTCs	P0340: Camshaft position sensor range check P0340: Camshaft position/crankshaft position misalignment

Required Sensors/Components (Main)	Camshaft Position (CMP) sensor
Required Sensors/Components (Related)	Crankshaft Position (CKP) sensor
Frequency of Operation	Continuous
Duration	4 seconds: CMP sensor range check 5 seconds: Camshaft position/crankshaft position misalignment
MIL Operation	2 driving cycles: CMP sensor range check Immediate: Camshaft position/crankshaft position misalignment
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

Monitor runs whenever the following DTCs are not present	None

ES

Camshaft Position Sensor Range Check:

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

Camshaft Position/Crankshaft Position Misalignment:

Engine speed	600 rpm or more
Starter	OFF

TYPICAL MALFUNCTION THRESHOLDS

Camshaft Position Sensor Range Check:

CMP sensor signal	No signal

Camshaft Position/Crankshaft Position Misalignment:

Camshaft position and crankshaft position phase	Misaligned

COMPONENT OPERATING RANGE

CMP sensor	• CMP sensor output voltage fluctuates while camshaft is revolving • 3 CMP sensor signals per 2 crankshaft revolutions

WIRING DIAGRAM

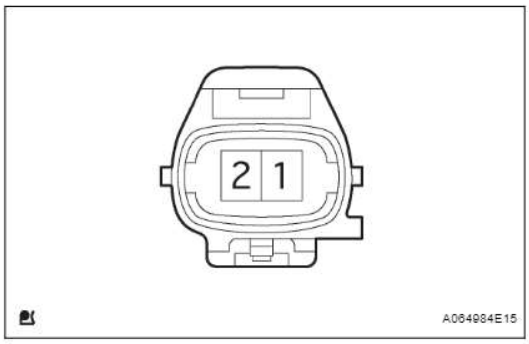
Refer to DTC P0335 (See page ES-164).

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.

1 INSPECT CAMSHAFT POSITION SENSOR (RESISTANCE)



(a) Disconnect the C1 sensor connector.
(b) Measure the resistance according to the value(s) in the table below.

Standard resistance

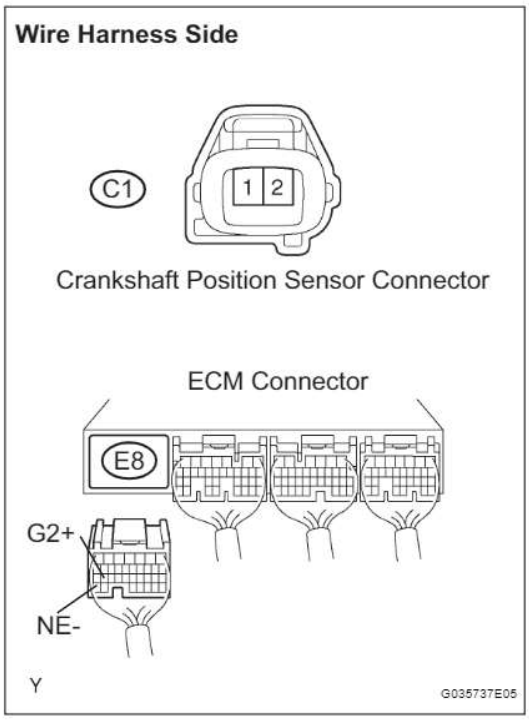
Tester Connection	Specified Condition
1 - 2	835 to 1,400 Ω at cold
1 - 2	1,060 to 1,645 Ω at hot

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

NG → **REPLACE CAMSHAFT POSITION SENSOR**

OK

2 CHECK WIRE HARNESS (CAMSHAFT POSITION SENSOR - ECM)



(a) Disconnect the C1 CMP sensor connector.
(b) Disconnect the E8 ECM connector.
(c) Measure the resistance according to the value(s) in the table below.

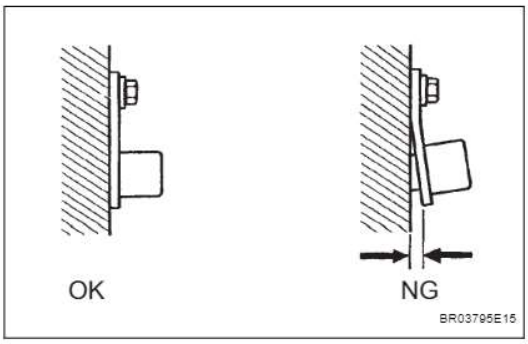
Standard resistance

Tester Connection	Specified Condition
G+ (C1-1) - G2+ (E8-26)	Below 1 Ω
G- (C1-2) - NE- (E8-34)	Below 1 Ω
G+ (C1-1) or G2+ (E8-26) - Body ground	10 kΩ or higher
G- (C1-2) or NE- (E8-34) - Body ground	10 kΩ or higher

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

OK

3	CHECK SENSOR INSTALLATION (CAMSHAFT POSITION SENSOR)



(a) Check the CMP sensor installation.
OK:
Sensor is installed correctly.

NG → **TIGHTEN SENSOR**

ES

OK

4	CHECK CAMSHAFT

(a) Check the teeth of the camshaft.
OK:
Camshaft teeth do not have any cracks or deformation.

NG → **REPLACE CAMSHAFT**

OK

REPLACE ECM

DTC	P0351	Ignition Coil "A" Primary / Secondary Circuit
DTC	P0352	Ignition Coil "B" Primary / Secondary Circuit
DTC	P0353	Ignition Coil "C" Primary / Secondary Circuit
DTC	P0354	Ignition Coil "D" Primary / Secondary Circuit

DESCRIPTION

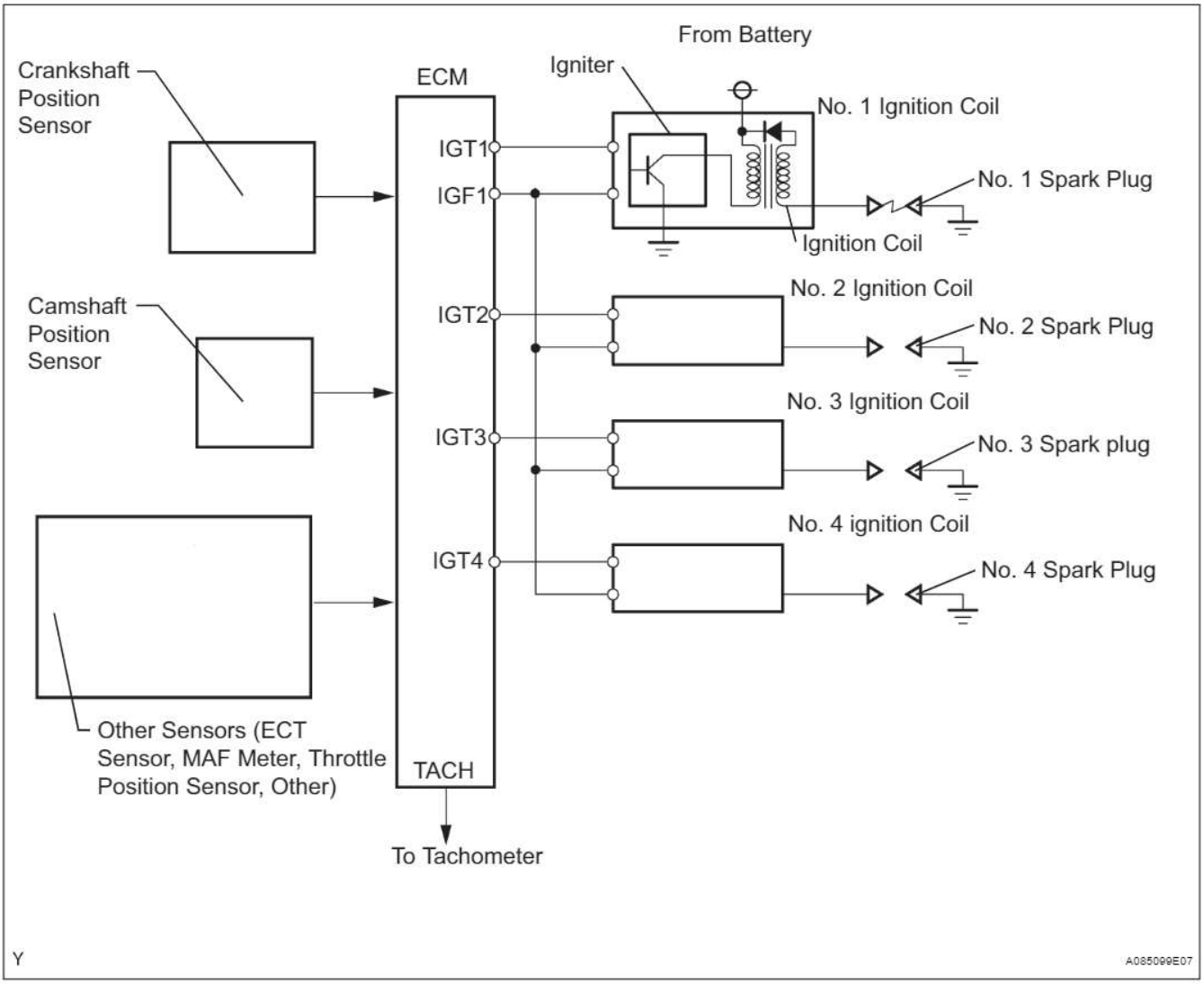
HINT:

- These DTCs indicate malfunctions relating to the primary circuit.
- If DTC P0351 is set, check the No. 1 ignition coil with igniter circuit.
- If DTC P0352 is set, check the No. 2 ignition coil with igniter circuit.
- If DTC P0353 is set, check the No. 3 ignition coil with igniter circuit.
- If DTC P0354 is set, check the No. 4 ignition coil with igniter circuit.

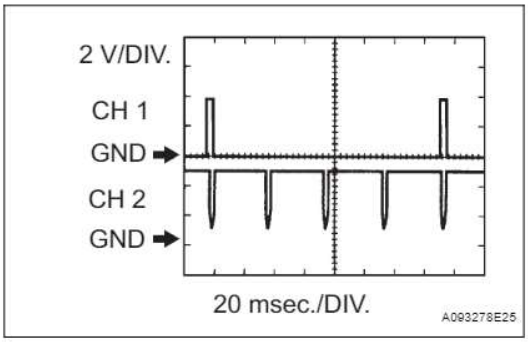
A Direct Ignition System (DIS) is used on this vehicle.

The DIS is a 1-cylinder ignition system in which each cylinder is ignited by one ignition coil and one spark plug is connected to the end of each secondary wiring. A powerful voltage, generated in the secondary wiring, is applied directly to each spark plug. The sparks of the spark plugs pass from the center electrodes to the ground electrodes.

The ECM determines the ignition timing and transmits the ignition (IGT) signals to each cylinder. Using the IGT signal, the ECM turns the power transistor inside the igniter on and off. The power transistor, in turn, switches on and off the current to the primary coil. When the current to the primary coil is cut off, a powerful voltage is generated in the secondary coil. This voltage is applied to the spark plugs, causing them to spark inside the cylinders. As the ECM cuts the current to the primary coil, the igniter sends back an ignition confirmation (IGF) signal to the ECM for each cylinder ignition.



DTC No.	DTC Detection Condition	Trouble Area
P0351 P0352 P0353 P0354	No IGF signal to ECM while engine running (1 trip detection logic)	• Ignition system • Open or short in IGF1 or IGT circuit (1 to 4) between ignition coil with igniter and ECM • No. 1 to No. 4 ignition coils with igniters • ECM

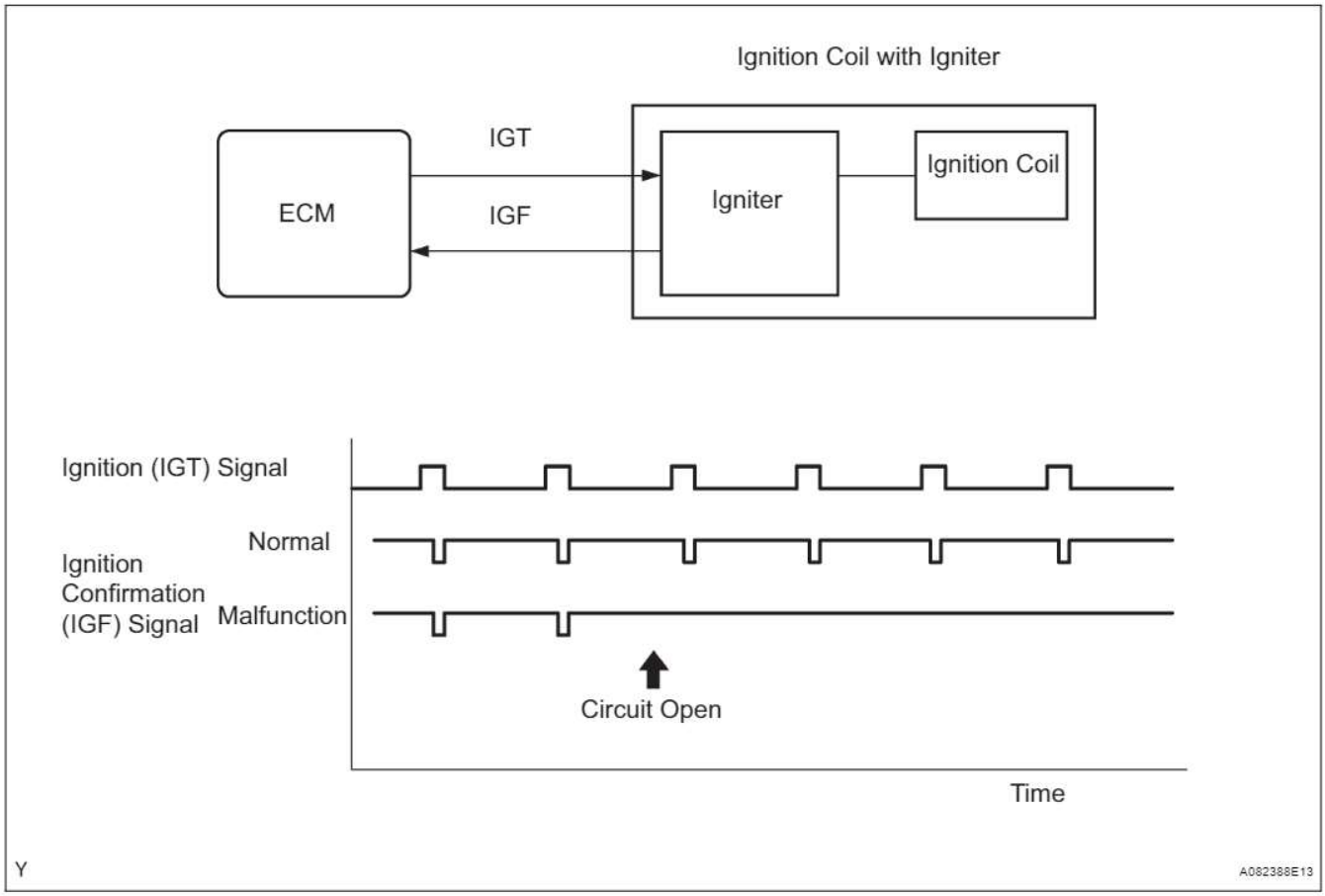


Reference: Inspection using an oscilloscope

While cranking or idling, check the waveform between terminals IGT (1 to 4) and E1, and IGF1 and E1 of the E8 ECM connector.

Item	Content
Terminals	CH1: IGT1, IGT2, IGT3, IGT4 - E1 CH2: IGF1 - E1
Equipment Settings	2 V/DIV., 20 ms./DIV.
Conditions	Cranking or idling

MONITOR DESCRIPTION



If the ECM does not receive any IGF signals although it transmits IGT signals, the ECM interprets this as a fault in the igniter and sets a DTC.
If the malfunction is not repaired successfully, a DTC is set 1 second after the engine is next started.

MONITOR STRATEGY

Related DTCs	P0351: Igniter (Cylinder 1) malfunction P0352: Igniter (Cylinder 2) malfunction P0353: Igniter (Cylinder 3) malfunction P0354: Igniter (Cylinder 4) malfunction
Required Sensors/Components (Main)	Igniter
Required Sensors/Components (Related)	Crankshaft position sensor
Frequency of Operation	Continuous
Duration	0.256 seconds
MIL Operation	Immediate
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

Monitor runs whenever the following DTCs are not present	None
Either of the following conditions A or B is met:	-
A. Engine RPM	1,500 rpm or less
B. Starter	OFF
Either of the following conditions C or D is met:	-
C. Both of the following conditions (a) and (b) are met:	-
(a) Engine speed	500 rpm or less
(b) Battery voltage	6 V or more
D. All of the following conditions (a), (b) and (c) are met:	-
(a) Engine speed	More than 500 rpm
(b) Battery voltage	10 V or more
(c) Number of sparks after CPU reset	5 sparks or more

ES

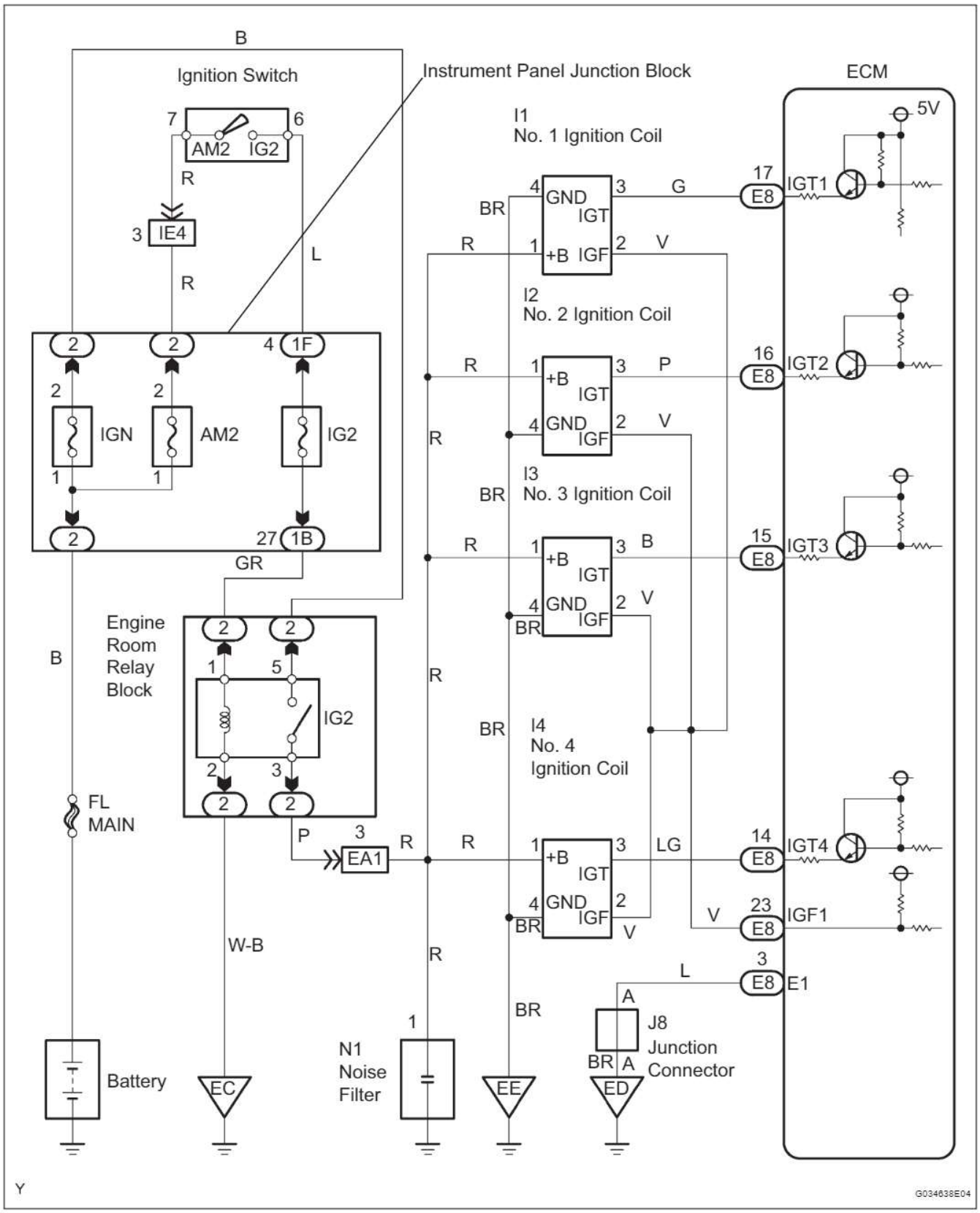
TYPICAL MALFUNCTION THRESHOLDS

IGF signal	ECM does not receive any IGF signal despite ECM sending IGT signal to igniter

COMPONENT OPERATING RANGE

IGF signal	Igniter transmits IGF signal when it receives IGT signal from ECM

WIRING DIAGRAM



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.

1 PERFORM SIMULATION TEST

(a) Connect the intelligent tester to the DLC3.
(b) Turn the ignition switch to the ON position.
(c) Turn the tester on.
(d) Clear the DTCs (See page ES-32).
(e) Shuffle arrangement of the ignition coils with igniters (among No. 1 to No. 4 cylinders).
NOTICE:
Do not shuffle the connectors.
(f) Perform a simulation test.
(g) Check the DTCs displayed on the tester.

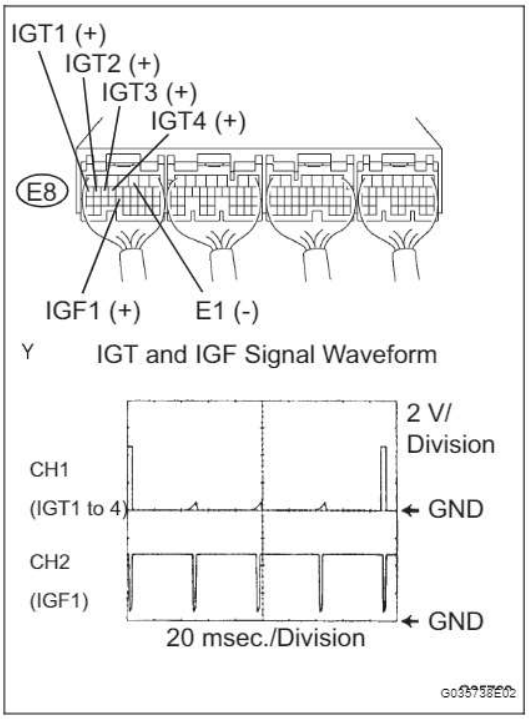
Result

Display (DTC Output)	Proceed to
Same DTCs (that have been erased)	A
Other DTCs	B

B → REPLACE IGNITION COIL ASSEMBLY

A

2 INSPECT ECM (IGT1, IGT2, IGT3, IGT4 AND IGF1 SIGNAL)



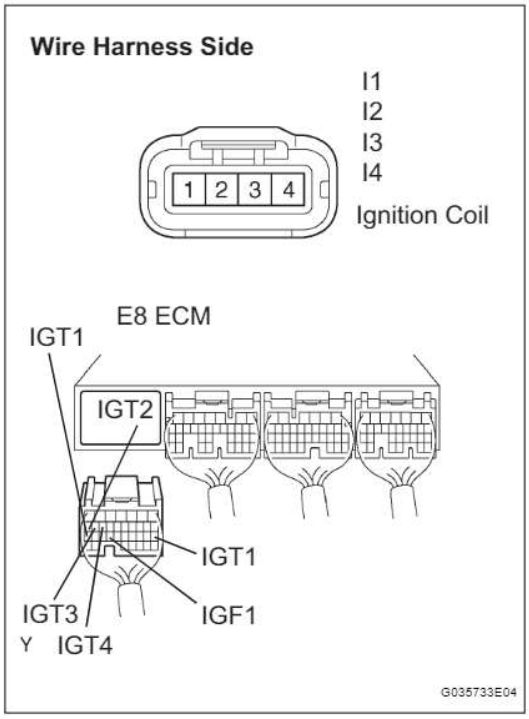
(a) While cranking or idling, check the waveform of the ECM connectors using an oscilloscope.
OK

Tester Connection	Specified Condition
IGT1 (E8-17) - E1 (E8-3)	Correct waveform appears as shown
IGT2 (E8-16) - E1 (E8-3)	Correct waveform appears as shown
IGT3 (E8-15) - E1 (E8-3)	Correct waveform appears as shown
IGT4 (E8-14) - E1 (E8-3)	Correct waveform appears as shown
IGF1 (E8-23) - E1 (E8-3)	Correct waveform appears as shown

NG → REPLACE ECM

OK

3 CHECK WIRE HARNESS (IGNITION COIL ASSEMBLY - ECM)



(a) Disconnect the I1, I2, I3 or I4 ignition coil with igniter connector.
(b) Disconnect the E8 ECM connector.
(c) Measure the resistance according to the value(s) in the table below.

Standard resistance

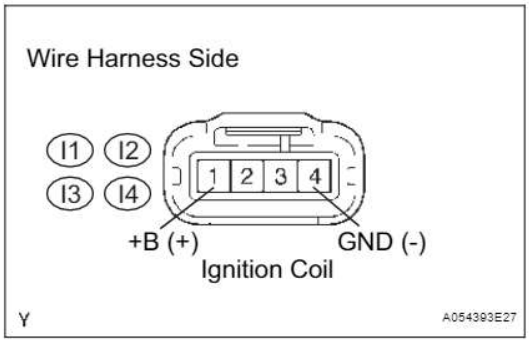
Tester Connection	Specified Condition
IGF (I1-2) - IGF1 (E8-23)	Below 1 Ω
IGF (I2-2) - IGF1 (E8-23)	Below 1 Ω
IGF (I3-2) - IGF1 (E8-23)	Below 1 Ω
IGF (I4-2) - IGF1 (E8-23)	Below 1 Ω
IGT (I1-3) - IGT1 (E8-17)	Below 1 Ω
IGT (I2-3) - IGT2 (E8-16)	Below 1 Ω
IGT (I3-3) - IGT3 (E8-15)	Below 1 Ω
IGT (I4-3) - IGT4 (E8-14)	Below 1 Ω
IGF (I1-2) or IGF1 (E8-23) - Body ground	Below 1 Ω
IGF (I2-2) or IGF1 (E8-23) - Body ground	Below 1 Ω
IGF (I3-2) or IGF1 (E8-23) - Body ground	Below 1 Ω
IGF (I4-2) or IGF1 (E8-23) - Body ground	Below 1 Ω
IGT (I1-3) or IGT1 (E8-17) - Body ground	Below 1 Ω
IGT (I2-3) or IGT2 (E8-16) - Body ground	Below 1 Ω
IGT (I3-3) or IGT3 (E8-15) - Body ground	Below 1 Ω
IGT (I4-3) or IGT4 (E8-14) - Body ground	Below 1 Ω

ES

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

4 INSPECT IGNITION COIL ASSEMBLY (POWER SOURCE)



(a) Disconnect the I1, I2, I3 or I4 ignition coil connector.
(b) Measure the resistance according to the value(s) in the table below.

Standard resistance

Tester Connection	Specified Condition
GND (I1-4) - Body ground	Below 1 Ω
GND (I2-4) - Body ground	Below 1 Ω
GND (I3-4) - Body ground	Below 1 Ω
GND (I4-4) - Body ground	Below 1 Ω

(c) Turn the ignition switch to the ON position.
(d) Measure the voltage according to the value(s) in the table below.

Standard voltage

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

(e) Reconnect the ignition coil connector.

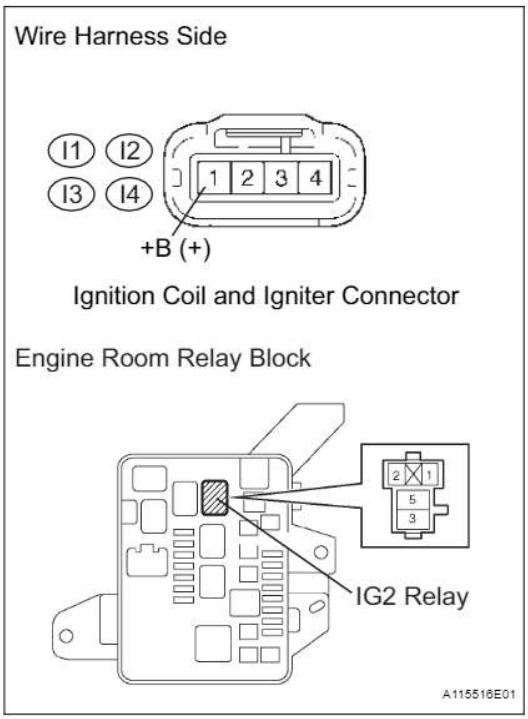
NG → Go to step 5

OK

ES

REPLACE IGNITION COIL ASSEMBLY

5 CHECK WIRE HARNESS (IGNITION COIL ASSEMBLY - IG2 RELAY)



(a) Disconnect the I1, I2, I3 or I4 ignition coil with igniter connector.
(b) Remove the IG2 relay from the engine room relay block.
(c) Measure the resistance according to the value(s) in the table below.

Standard resistance

Tester Connection	Specified Condition
+B (I1-1) - Engine room relay block (IG2 relay terminal 3)	Below 1 Ω
+B (I2-1) - Engine room relay block (IG2 relay terminal 3)	Below 1 Ω
+B (I3-1) - Engine room relay block (IG2 relay terminal 3)	Below 1 Ω
+B (I4-1) - Engine room relay block (IG2 relay terminal 3)	Below 1 Ω
+B (I1-1) or Engine room relay block (IG2 relay terminal 3) - Body ground	10 kΩ or higher
+B (I2-1) or Engine room relay block (IG2 relay terminal 3) - Body ground	10 kΩ or higher
+B (I3-1) or Engine room relay block (IG2 relay terminal 3) - Body ground	10 kΩ or higher
+B (I4-1) or Engine room relay block (IG2 relay terminal 3) - Body ground	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

REPLACE IGNITION COIL ASSEMBLY

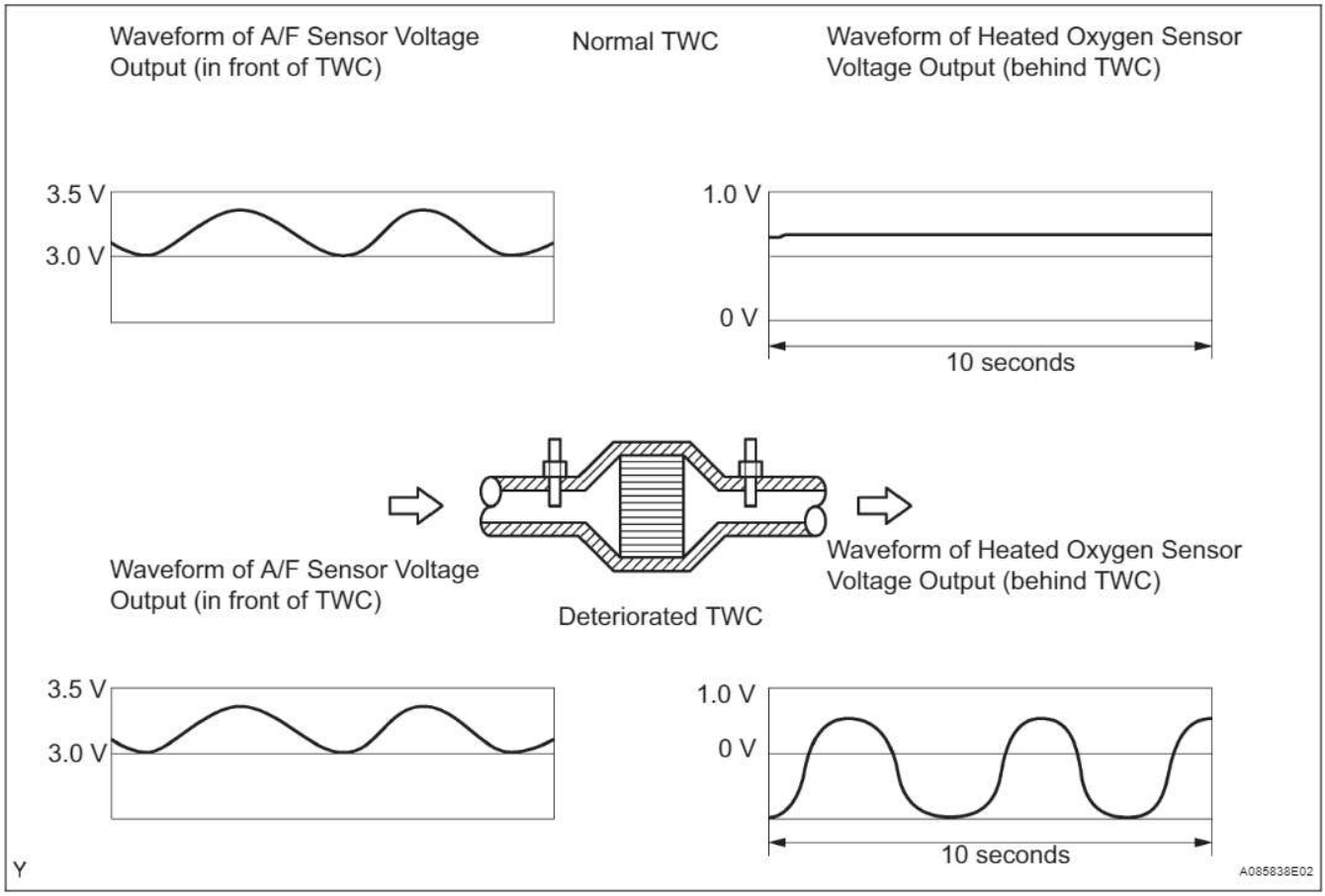
DTC	P0420	Catalyst System Efficiency Below Threshold (Bank 1)

MONITOR DESCRIPTION

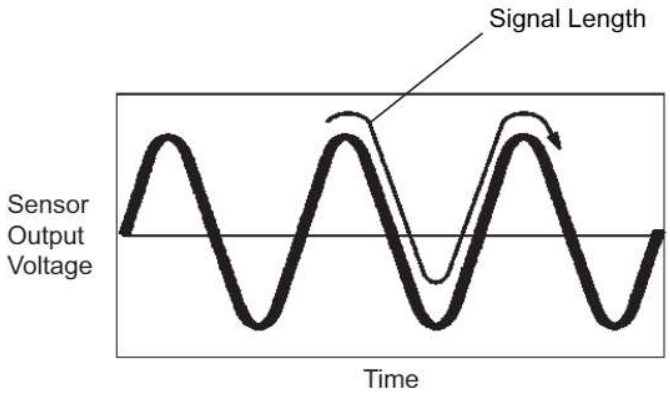
The ECM uses the 2 sensors, mounted in front of and behind the Three-way Catalytic Converter (TWC), to monitor its efficiency.

The first sensor, the Air-Fuel Ratio (A/F) sensor (sensor 1), sends pre-catalyst information to the ECM. The second sensor, the Heated Oxygen (HO2) sensor (sensor 2), sends post-catalyst information to the ECM. The ECM compares the information transmitted by these 2 sensors to determine the efficiency of the TWC performance and its ability to store oxygen.

When the TWC is functioning properly, the variation in the oxygen concentration in the exhaust gas after it has passed through the TWC is small. In this condition, the voltage output of sensor 2 slowly alternates between the rich and lean signal voltages (shown in the illustration below). As the TWC performance efficiency deteriorates, its oxygen storage capacity decreases, and the variation in the oxygen concentration in the exhaust gas increases. As a result, the sensor voltage output fluctuates frequently. While the catalyst monitor is running, the ECM measures the signal lengths of both sensors 1 and 2, and calculates the ratio of the signal lengths to determine the extent of the TWC deterioration. If the deterioration level exceeds the preset threshold, the ECM interprets this as the TWC malfunction. The ECM then illuminates the MIL and sets the DTC.



Heated Oxygen Sensor Signal Length



A082718E04

DTC No.	DTC Detection Condition	Trouble Area
P0420	OSC value smaller than standard value under active air-fuel ratio control (2 trip detection logic)	• Gas leakage from exhaust system • A/F sensor (sensor 1) • HO2 sensor (sensor 2) • Three-Way Catalytic Converter (TWC) (Exhaust manifold)

HINT:

- Sensor 1 refers to the sensor mounted in front of the Three-Way Catalytic Converter (TWC) and located near the engine assembly.
- Sensor 2 refers to the sensor mounted behind the TWC and located far from the engine assembly.

MONITOR STRATEGY

Related DTCs	P0420: Catalyst Deterioration
Required Sensors/Components (Main)	TWC
Required Sensors/Components (Related)	A/F sensor, heated oxygen sensor, intake air temperature sensor, mass air flow meter, crankshaft position sensor and engine coolant temperature sensor
Frequency of Operation	Once per driving cycle
Duration	About 30 seconds
MIL Operation	2 driving cycles
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

Monitor runs whenever the following DTCs are not present	P0011 (VVT System 1 - Advance) P0012 (VVT System 1 - Retard) P0031, 32 (A/F Sensor heater - Sensor 1) P0037, 38 (O2 Sensor heater - Sensor 2) P0100 - P0103 (MAF meter) P0115 - P0118 (ECT sensor) P0120 - P0223, P2135 (TP sensor) P0125 (Insufficient ECT for Closed Loop) P0136 (O2 Sensor - Sensor 2) P0171, P0172 (Fuel system) P0300 - P0304 (Misfire) P0335 (CKP sensor) P0340 (CMP sensor) P0351 - P0354 (Igniter) P0500 (VSS) P2196 (A/F Sensor - rationality) P2A00 (A/F Sensor - slow response)
Battery voltage	11 V or more

Intake air temperature	-10°C (14°F) or more
Engine coolant temperature	75°C (167°F) or more
Atmospheric pressure	76 kPa (570 mmHg) or more
Idling	OFF
Engine RPM	Less than 4,000 rpm
A/F sensor status	Activated
Fuel system status	Closed loop
Engine load	10 to 80%
All of the following conditions (a), (b) and (c) are met:	-
(a) Mass air flow rate	2.5 to 40 g/sec.
(b) Estimated front catalyst temperature	650 to 840°C (1,202 to 1,544°F)
(c) Estimated rear catalyst temperature	400 to 770°C (752 to 1,418°F)
Rear HO2 sensor heater monitor	Completed
Shift position	4th

TYPICAL MALFUNCTION THRESHOLDS

Oxygen Storage Capacity (OSC) of Three-Way Catalytic Converter (TWC)	Less than 0.07 g

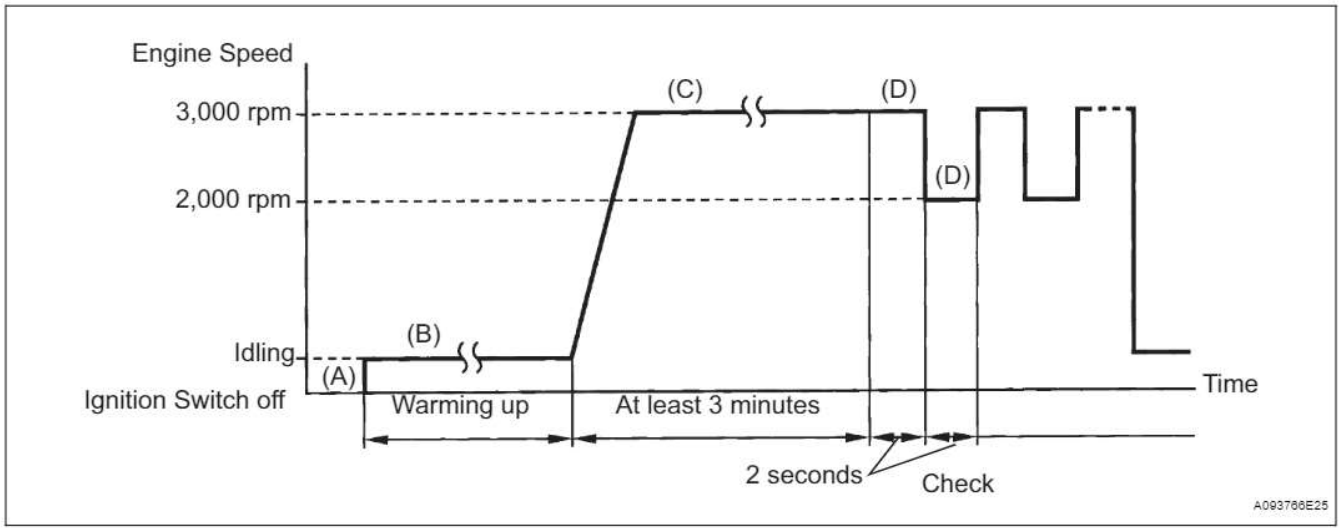
MONITOR RESULT

Refer to detailed information on "CHECKING MONITOR STATUS" (See page ES-15).

CONDITIONING FOR SENSOR TESTING

HINT:

Perform the operation with the engine speeds and time durations described below prior to checking the waveforms of the A/F and HO2 sensors. This is in order to activate the sensors sufficiently to obtain the appropriate inspection results.



(a) Connect the intelligent tester to the DLC3 (Procedure "A").

(b) Start the engine and warm it up with all the accessories switched OFF, until the engine coolant temperature stabilizes (Procedure "B").

(c) Run the engine at an engine speed of between 2,500 rpm and 3,000 rpm for at least 3 minutes (Procedure "C").

(d) While running the engine at 3,000 rpm for 2 seconds and 2,000 rpm for 2 seconds, check the waveforms of the A/F and HO2 sensors using the tester (Procedure "D").

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 tester, select the following menu items: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / A/F CONTROL.
5. Perform the A/F CONTROL operation with the engine in an idling condition (press the RIGHT or LEFT button to change the fuel injection volume).
6. Monitor the voltage outputs of the A/F and HO2 sensors (AFS B1S1 and OS2 B1S2) displayed on the tester.

ES

HINT:

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

Standard

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

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

Case	A/F Sensor (Sensor 1) Output Voltage		HO2S Voltage (Sensor 2) Output Voltage		Main Suspected Trouble Area
1	Injection Volume +25% -12.5%		Injection Volume +25% -12.5%		-
	Output Voltage More than 3.35 V Less than 3.0 V		Output Voltage More than 0.55 V Less than 0.4 V		
2	Injection Volume +25% -12.5%		Injection Volume +25% -12.5%		• A/F sensor • A/F sensor heater • A/F sensor circuit
	Output Voltage Almost no reaction		Output Voltage More than 0.55 V Less than 0.4 V		
3	Injection Volume +25% -12.5%		Injection Volume +25% -12.5%		• Heated oxygen sensor • Heated oxygen sensor heater • Heated oxygen sensor circuit
	Output Voltage More than 3.35 V Less than 3.0 V		Output Voltage Almost no reaction		

Case	A/F Sensor (Sensor 1) Output Voltage		HO2S Voltage (Sensor 2) Output Voltage		Main Suspected Trouble Area
4	Injection Volume +25% -12.5%		Injection Volume +25% -12.5%		• Injector • Fuel pressure • Gas leakage from exhaust system (Air-fuel ratio extremely lean or rich)
	Output Voltage Almost no reaction	NG	Output Voltage Almost no reaction	NG	

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

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.

1 **CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P0420)**

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

Result

Display (DTC Output)	Proceed to
P0420	A
P0420 and other DTCs	B

HINT:
If any DTCs other than P0420 are output, troubleshoot those DTCs first.

B → **GO TO DTC CHART**

A

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

(a) Connect the intelligent tester to the DLC3.
(b) Start the engine and turn the tester on.
(c) Warm up the engine at an engine speed of 2,500 rpm for approximately 90 seconds.
(d) On the tester, select the following menu items: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / A/F CONTROL.

(e) Perform the A/F CONTROL operation with the engine in an idling condition (press the RIGHT or LEFT button to change the fuel injection volume).

(f) Monitor the voltage outputs of the A/F and HO2 sensors (AFS B1S1 and O2S B1S2) displayed on the tester.
HINT:
- The A/F CONTROL operation lowers the fuel injection volume by 12.5% or increases the injection volume by 25%.
- Each sensor reacts in accordance with increases and decreases in the fuel injection volume.

Standard voltage

ES

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

Result

Status AFS B1S1	Status O2S B1S2	A/F Condition and A/F Sensor Condition	Misfire	Suspected Trouble Area	Proceed to
Lean/Rich	Lean/Rich	Normal	-	• Three-Way Catalytic Converter (TWC) • Gas leakage from exhaust system	A
Lean	Lean/Rich	A/F sensor malfunction	-	A/F sensor	B
Rich	Lean/Rich	A/F sensor malfunction	-	A/F sensor	B
Lean/Rich	Lean	HO2 sensor malfunction	-	• HO2 sensor • Gas leakage from exhaust system	C
Lean/Rich	Rich	HO2 sensor malfunction	-	• HO2 sensor • Gas leakage from exhaust system	C
Lean	Lean	Actual air-fuel ratio lean	May occur	• Extremely rich or lean actual air-fuel ratio • Gas leakage from exhaust system	A
Rich	Rich	Actual air-fuel ratio rich	-	• Extremely rich or lean actual air-fuel ratio • Gas leakage from exhaust system	A

Lean: During A/F CONTROL, the A/F sensor output voltage (AFS) is consistently more than 3.35 V, and the HO2 sensor output voltage (O2S) is consistently less than 0.4 V.
Rich: During A/F CONTROL, the AFS is consistently less than 3.0 V, and the O2S is consistently more than 0.55 V.

B → CHECK AND REPLACE AIR FUEL RATIO SENSOR

C → CHECK AND REPLACE HEATED OXYGEN SENSOR, AND CHECK AND REPAIR EXHAUST GAS LEAKAGE

A

3	INSPECT FOR EXHAUST GAS LEAK

OK:
No gas leakage.
NOTICE:
Replace both the front and rear catalysts (front exhaust pipe).

NG → REPAIR OR REPLACE EXHAUST GAS LEAKAGE POINT

OK

REPLACE EXHAUST MANIFOLD CONVERTER

DTC	P043E	Evaporative Emission System Reference Orifice Clog Up
DTC	P043F	Evaporative Emission System Reference Orifice High Flow
DTC	P2401	Evaporative Emission System Leak Detection Pump Control Circuit Low
DTC	P2402	Evaporative Emission System Leak Detection Pump Control Circuit High
DTC	P2419	Evaporative Emission System Switching Valve Control Circuit Low

ES

DTC SUMMARY

DTCs	Monitoring Item	Malfunction Detection Condition	Trouble Area	Detection Timing	Detection Logic
P043E	0.02 inch orifice clogged	P043E, P043F, P2401, P2402, P2419 are present when one of the following conditions is met during key-off EVAP monitor • Reference orifice clogged • Reference orifice high-flow • Leak detection pump OFF malfunction • Leak detection pump ON malfunction • Vent valve ON (close) malfunction	• Pump module • Connector/wire harness (Pump module - ECM) • ECM	While engine switch off	2 trip
P043F	0.02 inch orifice high-flow				
P2401	Vacuum pump stuck OFF				
P2402	Vacuum pump stuck ON				
P2419	Vent valve stuck open (vent)				

HINT:
The 0.02 inch orifice is located inside the pump module.

DESCRIPTION

The circuit description can be found in the EVAP (Evaporative Emission) System (See page ES-314).

INSPECTION PROCEDURE

Refer to the EVAP System (See page ES-314).

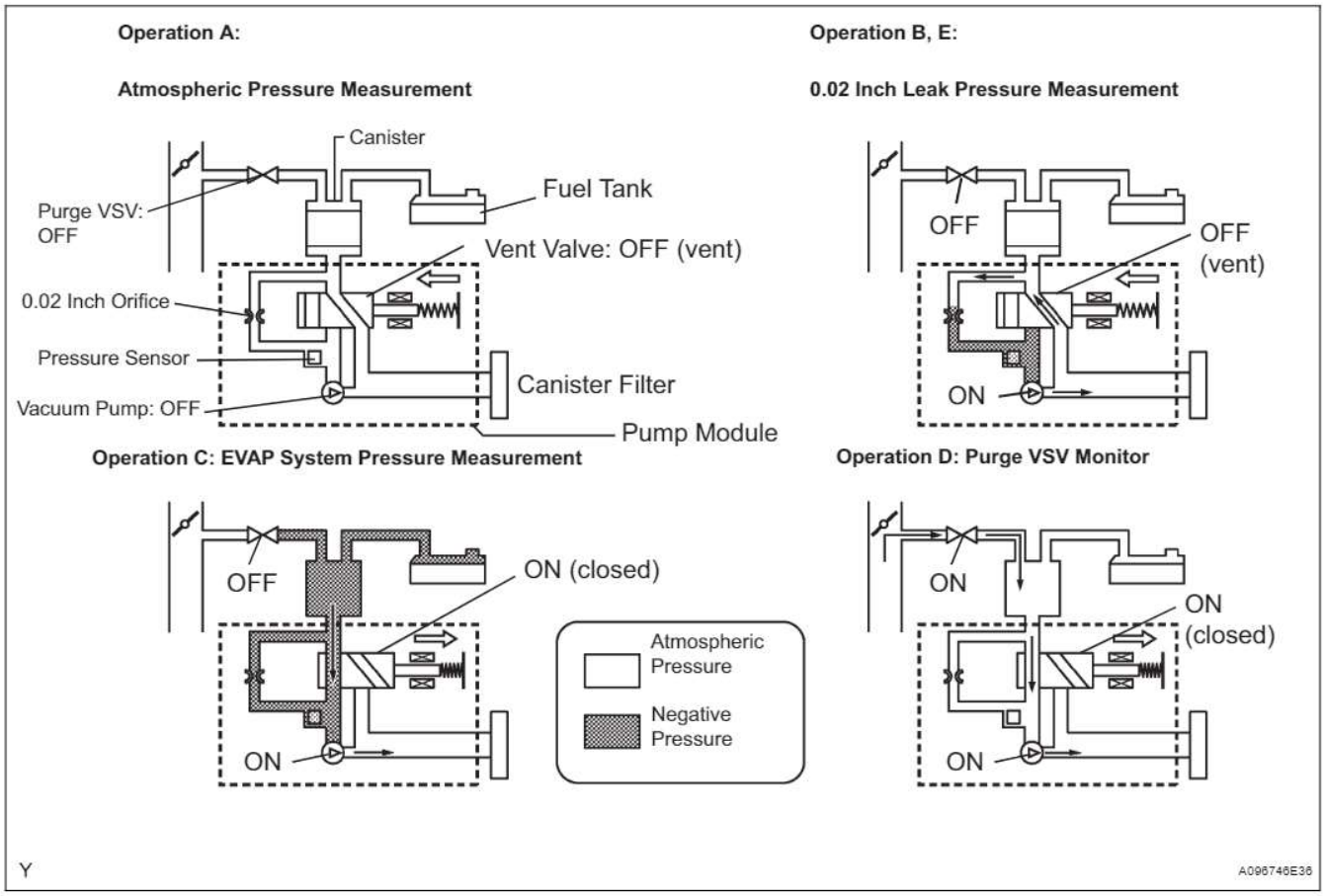
MONITOR DESCRIPTION

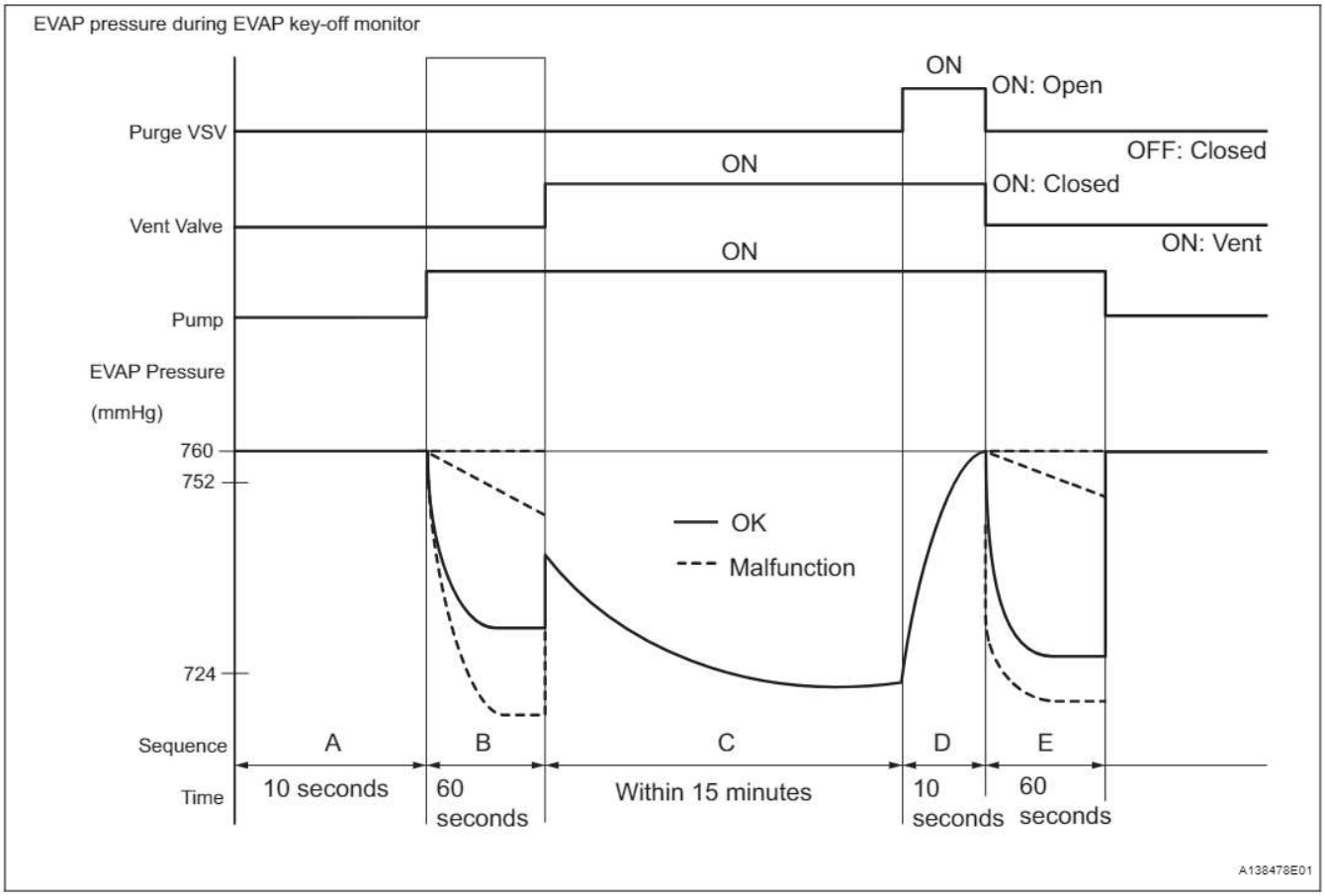
5 hours*1 after the ignition switch is turned off, the electric vacuum pump creates negative pressure (vacuum) in the EVAP (Evaporative Emission) system. The ECM monitors for leaks and actuator malfunctions based on the EVAP pressure.
HINT:
*1: If the engine coolant temperature is not below 35°C (95°F) 5 hours after the ignition switch is turned off, the monitor check starts 2 hours later. If it is still not below 35°C (95°F) 7 hours after the ignition switch is turned off, the monitor check starts 2.5 hours later.

Sequence	Operations	Descriptions	Duration
-	ECM activation	Activated by soak timer, 5 hours (7 or 9.5 hours) after ignition switch is turned off.	-

Sequence	Operations	Descriptions	Duration
A	Atmospheric pressure measurement	Vent valve turned OFF (vent) and EVAP system pressure measured by ECM in order to register atmospheric pressure. If pressure in EVAP system 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 turned ON (closed) to shut EVAP system. Negative pressure (vacuum) is created in EVAP system, and EVAP system pressure is then measured. Write down measured value as it will be used in leak check. If EVAP pressure does not stabilize within 15 minutes, ECM cancels EVAP system monitor.	15 minutes*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 EVAP system is leaking.	60 seconds
F	Final check	Atmospheric pressure is measured and then monitoring result is recorded by ECM.	-

*2: If there is only a small amount of fuel in the fuel tank, stabilizing the EVAP pressure takes longer than usual.





The leak detection pump creates negative pressure through the reference orifice. When the system is normal, the EVAP pressure is within 724 to 752 mmHg* and saturated within a minute.
If not, the ECM interprets this as a malfunction. The ECM will illuminate the MIL and set DTC if this malfunction is detected in a consecutive drive cycle.

*: Typical valve

MONITOR STRATEGY

Related DTCs	P043E: 0.02 inch orifice clog (built-in pump module) P043F: 0.02 inch orifice high-flow (built-in pump module) P2401: Vacuum pump stuck OFF P2402: Vacuum pump stuck ON P2419: Vent valve stuck open (vent)
Required Sensors/Components	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

The monitor runs whenever the following DTCs are not present	None
EVAP key-off monitor runs 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	Below 2.5 mph (4 km/h)

Ignition switch	OFF
Time after key-off	5, 7 or 9.5 hours
EVAP pressure sensor malfunction (P0450, P0451, P0452, P0453)	Not detected
EVAP canister purge valve	Not operated by scan tool
EVAP canister vent valve	Not operated by scan tool
EVAP leak detection pump	Not operated by scan tool
Both of the following conditions 1 and 2 are met before key-off:	Conditions 1 and 2
1. Duration that vehicle is driven	5 minutes or more
2. EVAP purge operation	Performed
ECT	4.4 to 35°C (40 to 95°F)
IAT	4.4 to 35°C (40 to 95°F)

Key-off monitor sequence 1 to 8

1. Atmospheric pressure measurement

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

2. First reference pressure measurement

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

3. EVAP canister vent valve close stuck check

Next sequence runs if the following condition is met:	-
EVAP pressure change after vent valve is ON	0.3 kPa (2.25 mmHg) or more

4. Vacuum introduction

Next sequence runs if the following condition is met:	-
Vacuum introduction time	Saturated within 15 minutes

5. EVAP canister purge valve close stuck check

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

6. Second reference pressure measurement

Next sequence runs if all of 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 runs if the following condition is met:	-
EVAP pressure when vacuum introduction was complete	Lower than second reference pressure

8. Atmospheric pressure measurement

EVAP monitor is complete if the following condition is met:	-
Atmospheric pressure difference between sequence 1 and 8	Within 0.3 kPa (2.25 mmHg)

TYPICAL MALFUNCTION THRESHOLDS

One of the following conditions is met:	-
EVAP pressure just after reference pressure measurement start	More than -1 kPa (-7.5 mmHg)

Reference pressure	Less than -4.85 kPa (-36.384 mmHg)
Reference pressure	-1.057 kPa (-7.929 mmHg) or more
Reference pressure	Not saturated
Difference between first reference pressure and second reference pressure	0.7 kPa (5.25 mmHg) or more

MONITOR RESULT

Refer to CHECKING MONITOR STATUS (See page ES-15).

ES

DTC	P0441	Evaporative Emission Control System Incorrect Purge Flow

DTC SUMMARY

DTC No.	Monitoring Item	Malfunction Detection Condition	Trouble Area	Detection Timing	Detection Logic
P0441	Purge VSV (Vacuum Switching Valve) stuck open	Leak detection pump creates negative pressure (vacuum) in EVAP system and EVAP system pressure measured. Reference pressure measured at start and at end of leak check. If stabilized pressure higher than [second reference pressure x 0.2], ECM determines that purge VSV stuck open.	• Purge VSV • Connector/wire harness (Purge VSV - ECM) • ECM • Canister pump module • Leakage from EVAP system	Ignition switch off	2 trip
P0441	Purge VSV stuck closed	After EVAP leak check performed, purge VSV turned ON (open), and atmospheric air introduced into EVAP system. Reference pressure measured at start and at end of check. If pressure does not return to near atmospheric pressure, ECM determines that purge VSV stuck closed.	• Purge VSV • Connector/wire harness (Purge VSV - ECM) • ECM • Canister pump module • Leakage from EVAP system	Ignition switch off	2 trip
P0441	Purge flow	While engine running, following conditions are successively met: • Negative pressure not created in EVAP system when purge VSV turned ON (open) • EVAP system pressure change less than 0.5 kPa-g (3.75 mmHg-g) when vent valve turned ON (closed) • Atmospheric pressure change before and after purge flow monitor less than 0.1 kPa-g (0.75 mmHg-g)	• Purge VSV • Connector/wire harness (Purge VSV - ECM) • Leakage from EVAP line (Purge VSV - Intake manifold) • ECM	While engine running	2 trip

DESCRIPTION

Refer to the EVAP system (See page ES-314).

INSPECTION PROCEDURE

Refer to the EVAP system (See page ES-314).

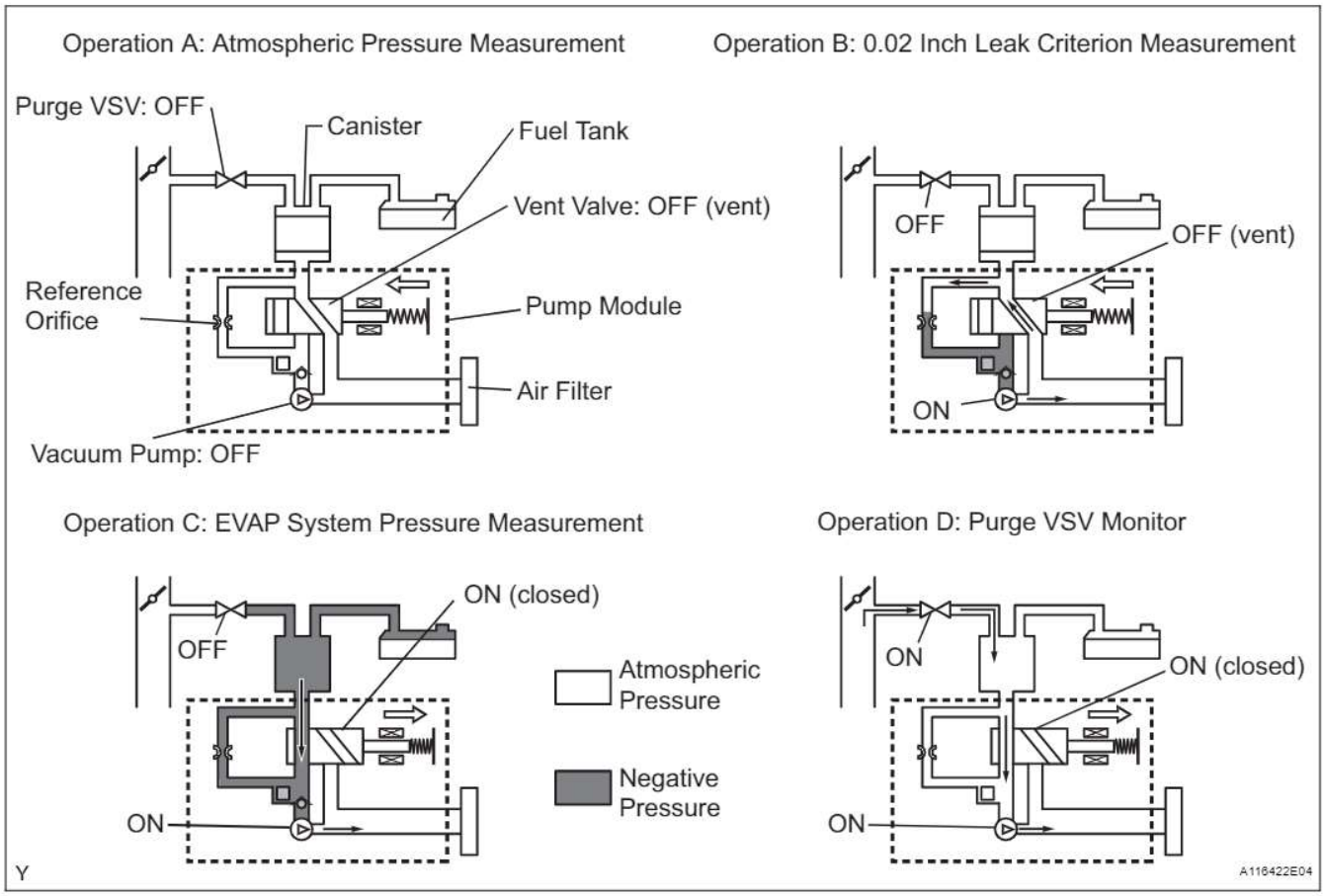
MONITOR DESCRIPTION

The 2 monitors, key-off and purge flow, are used to detect malfunctions relating to DTC P0441. The key-off monitor is initiated by the ECM internal timer, known as the soak timer, 5 hours* after the ignition switch is turned off. The purge flow monitor runs while the engine is running.

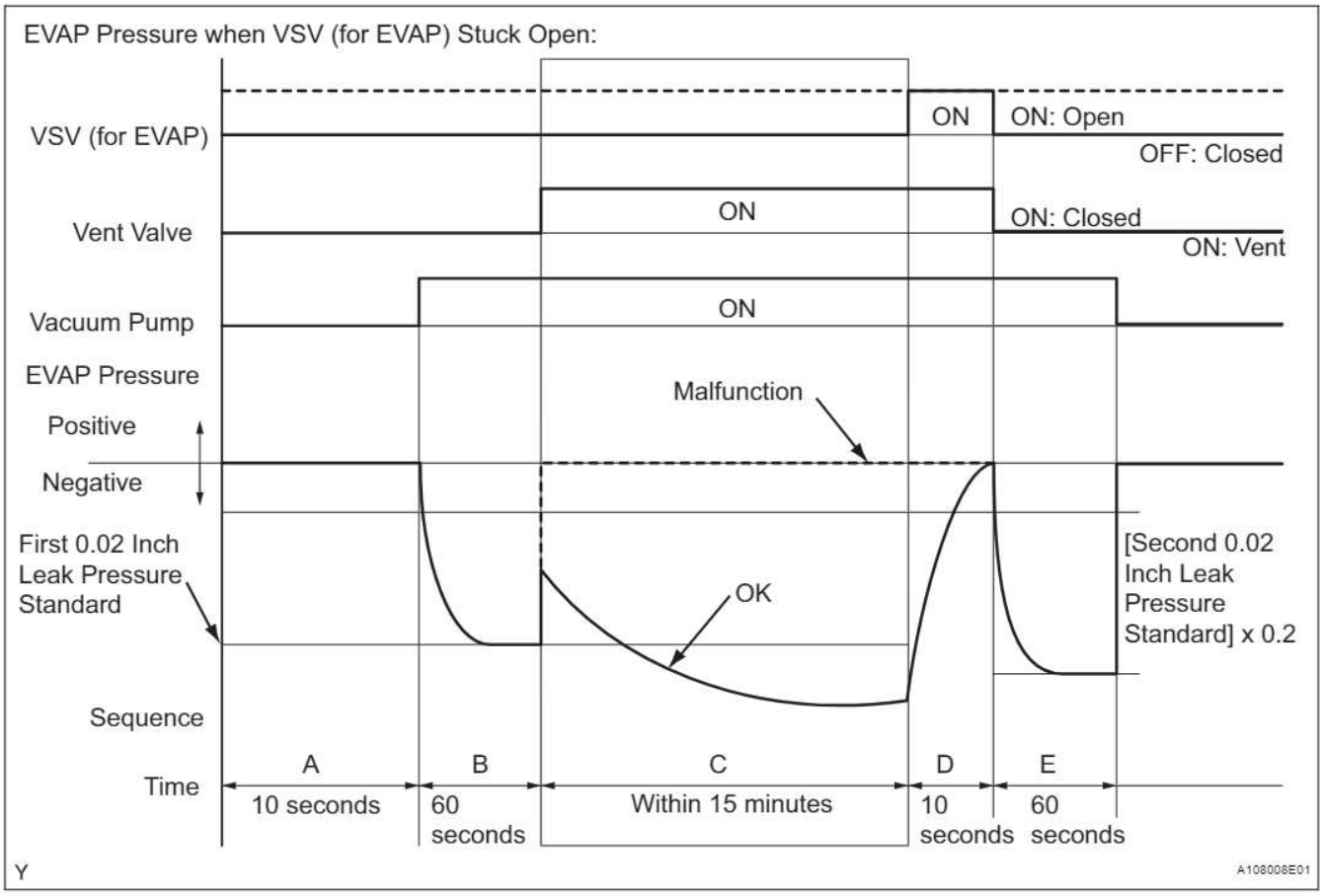
1. **Key-off monitor**
   5 hours* after the ignition switch is turned off, the leak detection pump creates negative pressure (vacuum) in the EVAP system. The ECM monitors for leaks and actuator malfunctions based on the EVAP pressure.
   HINT:
   *: If the engine coolant temperature is not below 35°C (95°F) 5 hours after the ignition switch is turned off, the monitor check starts 2 hours later. If it is still not below 35°C (95°F) 7 hours after the ignition switch is turned off, the monitor check starts 2.5 hours later.

Sequence	Operation	Description	Duration
-	ECM activation	Activated by soak timer 5, 7 or 9.5 hours after ignition switch off.	-
A	Atmospheric pressure measurement	Vent valve turned OFF (vent) and EVAP system pressure measured by ECM in order to register atmospheric pressure. If pressure in EVAP system not between 70 kPa and 110 kPa (525 mmHg and 825 mmHg), ECM cancels EVAP system monitor.	10 seconds
B	First 0.02 inch leak pressure measurement	In order to determine 0.02 inch leak criterion, leak detection pump creates negative pressure (vacuum) through 0.02 inch orifice and then ECM checks if leak detection pump and vent valve operate normally.	60 seconds
C	EVAP system pressure measurement	Vent valve turned ON (closed) to shut EVAP system. Negative pressure (vacuum) created in EVAP system, and EVAP system pressure then measured. Write down measured value as it will be used in leak check. If EVAP pressure does not stabilize within 900 seconds, ECM cancels EVAP system monitor.	900 seconds*
D	Purge VSV monitor	Purge VSV opened and then EVAP system pressure measured by ECM. Large increase indicates normal.	10 seconds
E	Second 0.02 inch leak 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 measured and then monitoring result recorded by ECM.	-

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

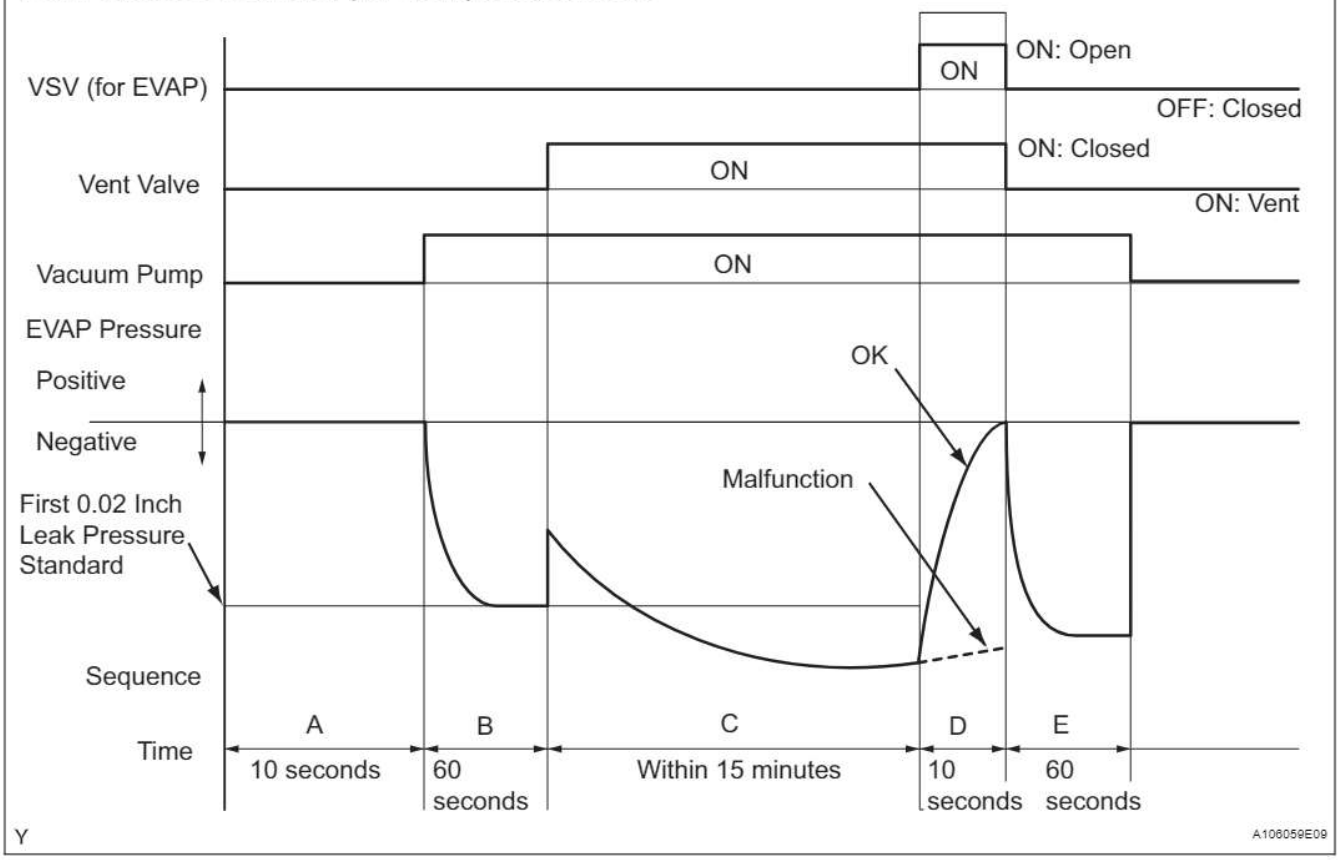


(a) Purge VSV stuck open
In operation C, the leak detection pump creates negative pressure (vacuum) in the EVAP system. The EVAP system pressure is then measured by the ECM using the canister pressure sensor. If the stabilized system pressure is higher than [second 0.02 inch leak criterion x 0.2], the ECM interprets this as the purge Vacuum Switching Valve (VSV) being stuck open. The ECM illuminates the MIL and sets the DTC (2 trip detection logic).

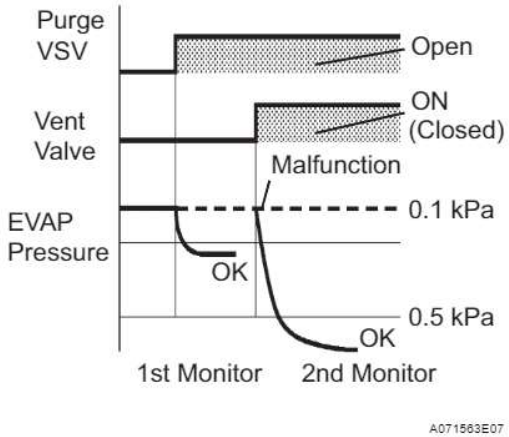


(b) Purge VSV stuck closed
In operation D, the pressure sensor measures the EVAP system pressure. The pressure measurement for the purge VSV monitor begins when the purge VSV is turned ON (open) after the EVAP leak check. When the measured pressure indicates an increase of 0.3 kPa (2.25 mmHg) or more, the purge VSV is functioning normally. If the pressure does not increase, the ECM interprets this as the purge VSV being stuck closed. The ECM illuminates the MIL and sets the DTC (2 trip detection logic).

EVAP Pressure when VSV (for EVAP) Stuck Closed:



EVAP Pressure During Purge Flow Monitor:



2. Purge flow monitor

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

- The 1st monitor
  While the engine is running and the Purge VSV is ON (open), the ECM monitors the purge flow by measuring the EVAP pressure change. If negative pressure is not created, the ECM begins the 2nd monitor.
- The 2nd monitor
  The vent valve is turned ON (closed) and the EVAP pressure is then measured. If the variation in the pressure is less than 0.5 kPa (3.75 mmHg), the ECM interprets this as the Purge VSV being stuck closed, and illuminates the MIL and sets DTC P0441 (2 trip detection logic).

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

MONITOR STRATEGY

Key-off Monitor:

Related DTCs	P0441: Purge VSV stuck open P0441: Purge VSV stuck closed
Required Sensors/Components	Purge VSV and pump module
Frequency of Operation	Once per driving cycle
Duration	Within 15 minutes (varies with amount of fuel in tank)
MIL Operation	2 driving cycles
Sequence of Operation	None

ES

Purge Flow Monitor:

Related DTC	P0441: Purge flow
Required Sensors/Components	Purge VSV and pump module
Frequency of Operation	Once per driving cycle
Duration	Within 10 minutes
MIL Operation	2 driving cycles
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

Key-off Monitor:

Monitor runs whenever these DTCs are not present	P0011, P0012: VVT system P0100 - P0103: MAF sensor P0110 - P0113: IAT sensor P0115 - P0118: ECT sensor P0120 - P0223, P2135: TP sensor P0171, P0172: Fuel trim P0300 - P0304: Misfire P0335: CKP sensor P0340: CMP sensor P0351 - P0354: Igniter P0450, P0452, P0453: Canister pressure sensor P0500: VSS sensor
Atmospheric pressure (absolute pressure)	70 kPa (525 mmHg) or more, and less than 110 kPa (825 mmHg)
Battery voltage	10.5 V or more
Vehicle speed	Below 2.5 mph (4 km/h)
Ignition switch	OFF
Soak time (ignition switch OFF time)	5, 7 or 9.5 hours
Canister pressure sensor malfunction (P0450, P0452, P0453)	Not detected
Purge VSV	Not operated by scan tool
Vent valve	Not operated by scan tool
Leak detection pump	Not operated by scan tool
When both conditions below are met:	Conditions 1 and 2 are met before key off
1. Duration that vehicle is driven	5 minutes or more
2. EVAP purge operation	Performed
Engine coolant temperature	4.4 to 35°C (40 to 95°F)
Intake air temperature	4.4 to 35°C (40 to 95°F)

Key-off monitor sequence 1 to 8

1. Atmospheric pressure measurement

Next sequence runs if the following condition is met:	-
Atmospheric pressure change	Within 0.3 kPa (2.25 mmHg) in 1 second

2. First reference pressure measurement

Next sequence runs if the following conditions are met:	Conditions 1, 2 and 3
1. EVAP pressure just after reference pressure measurement	-1 kPa (-7.5 mmHg) or lower
2. Reference pressure	-4.85 to -1.057 kPa (-36.384 to -7.929 mmHg)
3. Reference pressure	Saturated within 60 seconds

3. EVAP canister vent valve stuck closed check

Next sequence runs if the following condition is met:	-
EVAP pressure change after vent valve is ON	0.3 kPa (2.25 mmHg) or more

ES

4. Vacuum introduction

Next sequence runs if the following condition is met:	-
EVAP pressure	Saturated within 15 minutes

5. EVAP canister purge valve close stuck check

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

6. Second reference pressure measurement

Next sequence runs if all of the following conditions are met:	Conditions 1, 2, 3 and 4
1. EVAP pressure just after reference pressure	-1 kPa-g (-7.5 mmHg-g) or less
2. Reference pressure	-4.85 to -1.057 kPa-g (-36.4 to -7.93 mmHg-g)
3. Reference pressure	Saturated within 60 seconds
4. Reference pressure difference between first and second	Less than 0.7 kPa-g (5.25 mmHg-g)

7. Leak check

Next sequence runs if the following condition is met:	-
EVAP pressure when vacuum introduction is complete	Second reference pressure or less

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-g (2.25 mmHg-g)

Purge Flow Monitor:

Monitor runs whenever the following DTCs are not present	P0011, P0012, P0021, P0022: VVT system P0100 - P0103: MAF sensor P0110 - P0113: IAT sensor P0115 - P0118: ECT sensor P0120 - P2135: TP sensor P0171 - P0175: Fuel trim P0300 - P0308: Misfire P0335: CKP sensor P0340: CMP sensor P0351 - P0358: Igniter P0450, P0452, P0453: Canister pressure sensor P0500: VSS sensor
Engine	Running
Engine coolant temperature	4.4°C (40°F) or more
Intake air temperature	4.4°C (40°F) or more
Canister pressure sensor malfunction	Not detected
Purge VSV	Not operated by scan tool
EVAP system check	Not operated by scan tool
Battery voltage	10 V or more

Duty ratio of purge VSV	8% or more

TYPICAL MALFUNCTION THRESHOLDS

Key-off Monitor: EVAP VSV stuck open

EVAP when vacuum introduction is complete	Higher than reference pressure x 0.2

Key-off Monitor: EVAP VSV stuck close

EVAP change after EVAP canister purge valve is open	Less than 0.3 kPa (2.25 mmHg)

Purge Flow Monitor:

Both of the following conditions are met:	-
EVAP pressure change when purge flow is started	Lower than 0.1 kPa (0.75 mmHg)
EVAP pressure change during purge flow when EVAP pressure switching valve is ON (closed)	Lower than 0.5 kPa (3.75 mmHg)

ES

MONITOR RESULT

Refer to detailed information on Monitor Result (See page ES-15).

DTC	P0450	Evaporative Emission Control System Pressure Sensor / Switch

DTC	P0451	Evaporative Emission Control System Pressure Sensor Range / Performance

DTC	P0452	Evaporative Emission Control System Pressure Sensor / Switch Low Input

DTC	P0453	Evaporative Emission Control System Pressure Sensor / Switch High Input

ES

DTC SUMMARY

DTC No.	Monitoring Item	Malfunction Detection Condition	Trouble Area	Detection Timing	Detection Logic
P0450	Canister pressure sensor voltage abnormal fluctuation	Sensor output voltage rapidly fluctuates beyond upper and lower malfunction thresholds for 0.5 seconds.	• Canister pump module • ECM	• EVAP monitoring (ignition switch off) • Ignition switch on	1 trip
P0451	Canister pressure sensor noise	Sensor output voltage fluctuates frequently within certain time period.	• Canister pump module • Connector/wire harness (canister pump module - ECM) • ECM	• EVAP monitoring (ignition switch off) • Engine running	2 trip
P0451	Canister pressure sensor signal becomes fixed/flat	Sensor output voltage does not vary within certain time period.	• Canister pump module • Connector/wire harness (canister pump module - ECM) • ECM	• EVAP monitoring (ignition switch off)	2 trip
P0452	Canister pressure sensor low input	Sensor output voltage does not vary within certain time period.	• Canister pump module • Connector/wire harness (canister pump module - ECM) • ECM	• EVAP monitoring (ignition switch off) • Ignition switch on	1 trip
P0453	Canister pressure sensor high input	EVAP pressure more than 123.8 kPa for 0.5 seconds.	• Canister pump module • Connector/wire harness (canister pump module - ECM) • ECM	• EVAP monitoring (ignition switch off) • Ignition switch on	1 trip

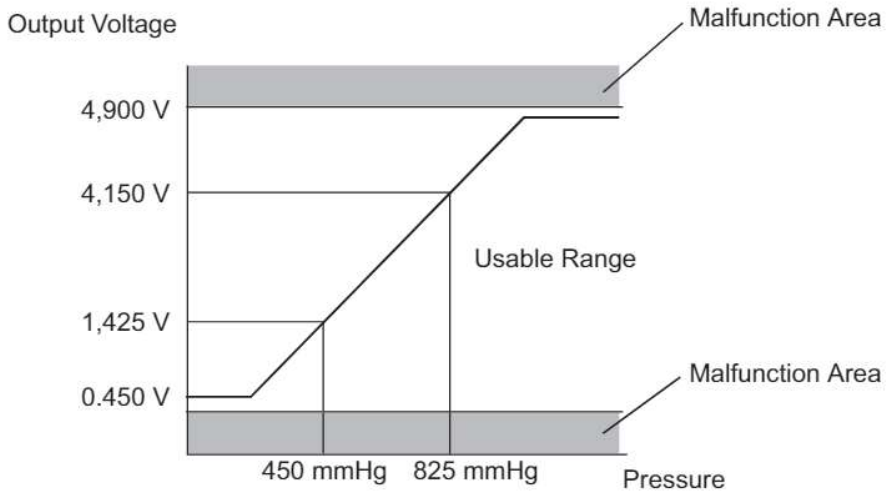
HINT:
The pressure sensor is built into the canister pump module.

DESCRIPTION

The circuit description can be found in the Evaporative Emission (EVAP) system (See page ES-314).

MONITOR DESCRIPTION

Canister Pressure Sensor Specification



HINT:

Standard atmospheric pressure is 759.9 mmHg

A115543E04

1. DTC P0450: Canister pressure sensor voltage abnormal fluctuation
   If the canister pressure sensor voltage output rapidly fluctuates between less than 0.45 V (315.9 mmHg) and more than 4.9 V (928.4 mmHg), the ECM interprets this as an open or short circuit in the canister pressure sensor or its circuit, and stops the EVAP system monitor. The ECM then illuminates the MIL and sets the DTC (1 trip detection logic).
2. DTC P0451: Canister pressure sensor noisy or stuck
   If the canister pressure sensor voltage output fluctuates rapidly for 10 seconds, the ECM stops the EVAP system monitor. The ECM interprets this as noise from the canister pressure sensor, and stops the EVAP system monitor. The ECM then illuminates the MIL and sets the DTC.
   Alternatively, if the sensor voltage output does not change for 10 seconds, the ECM interprets this as the sensor being stuck, and stops the monitor. The ECM then illuminates the MIL and sets the DTC (both of the malfunctions are detected by 2 trip detection logic).
3. DTC P0452: Canister pressure sensor voltage low
   If the canister pressure sensor voltage output is below 0.45 V, the ECM interprets this as an open or short circuit in the canister pressure sensor or its circuit, and stops the EVAP system monitor. The ECM then illuminates the MIL and sets the DTC (1 trip detection logic).
4. DTC P0453: Canister pressure sensor voltage high
   If the canister pressure sensor voltage output is 4.9 V or more, the ECM interprets this as an open or short circuit in the canister pressure sensor or its circuit, and stops the EVAP system monitor. The ECM then illuminates the MIL and sets the DTC (1 trip detection logic).

MONITOR STRATEGY

Related DTCs	P0450: Pressure sensor chattering P0451: Pressure sensor noise P0451: Pressure sensor stuck P0452: Pressure sensor low voltage P0453: Pressure sensor high voltage
Required Sensors/Components	Canister pump module
Frequency of Operation	Once per driving cycle: P0451 sensor fixed/flat Continuous: P0451 sensor noisy, P0450, P0452 and P0453
Duration	0.5 seconds: P0450, P0452 and P0453 2 minutes: P0451
MIL Operation	Immediate: P0450, P0452 and P0453 2 driving cycles: P0451
Sequence of Operation	None

ES

TYPICAL ENABLING CONDITIONS

P0451 (Noise Monitor):

Monitor runs whenever the following DTCs are not present	None
Atmospheric pressure	70 to 110 kPa (525 to 825 mmHg)
Battery voltage	10.5 V or more
Intake air temperature	4.4 to 35°C (40 to 95°F)
Canister pressure sensor malfunction (P0450, P0452, P0453)	Not detected
Either of the following conditions is met:	A or B
A. Engine	Running
B. Time after key off	5, 7 or 9.5 hours

P0451 (Stuck Monitor):

Monitor runs whenever the following DTCs are not present	None
Battery voltage	10.5 V or more
Intake air temperature	4.4 to 35°C (40 to 95°F)
Atmospheric pressure	70 to 110 kPa (525 to 825 mmHg)
Canister pressure sensor malfunction (P0450, P0452, P0453)	Not detected
Time after key off	5, 7 or 9.5 hours

P0450, P0452 and P0453:

Monitor runs whenever the following DTCs are not present	None
Either of the following conditions is met:	(a) or (b)
(a) Ignition switch	ON
(b) Soak timer	ON

TYPICAL MALFUNCTION THRESHOLDS

P0450: Canister pressure sensor chattering

EVAP pressure	Less than 42.1 kPa (315.9 mmHg) or more than 123.8 kPa (928.4 mmHg)

P0451: Canister pressure sensor noise

Frequency that EVAP pressure change is 0.3 kPa (2.25 mmHg) or more	10 times or more in 10 seconds

P0451: Canister pressure sensor stuck

EVAP pressure change during reference pressure	Less than 0.65 kPa (4.87 mmHg)

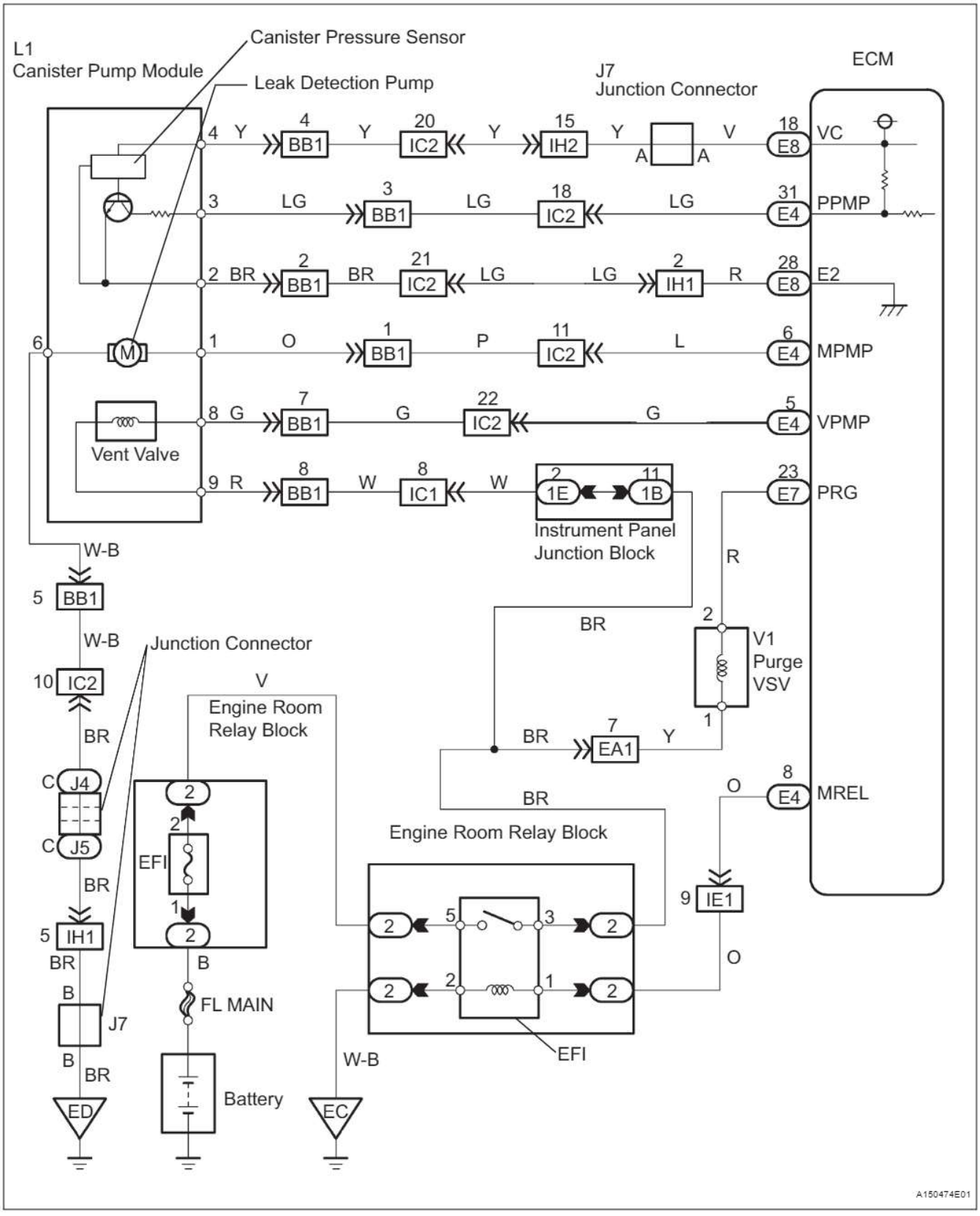
P0452: Canister pressure sensor low voltage

EVAP pressure	Less than 42.1 kPa (315.9 mmHg)

P0453: Canister pressure sensor high voltage

EVAP pressure	More than 123.8 kPa (928.4 mmHg)

WIRING DIAGRAM



INSPECTION PROCEDURE

NOTICE:

- **When a vehicle is brought into the workshop, leave it as it is. Do not change the vehicle condition. For example, do not tighten the fuel tank cap.**
- **Do not disassemble the canister pump module.**
- **The intelligent tester is required to conduct the following diagnostic troubleshooting procedure.**

1	CONFIRM DTC AND EVAP PRESSURE

(a) Connect the intelligent tester to the DLC3.
(b) Turn the ignition switch to the ON position (do not start the engine).
(c) Turn the tester on.
(d) Select the following menu items: DIAGNOSIS / ENHANCED OBD II / DTC INFO / CURRENT CODES.
(e) Read the DTCs.
(f) Select the following menu items: DIAGNOSIS / ENHANCED OBD II / DATA LIST / ALL / VAPOR PRESS.
(g) Read the EVAP (Evaporative Emission) pressure displayed on the tester.

Result

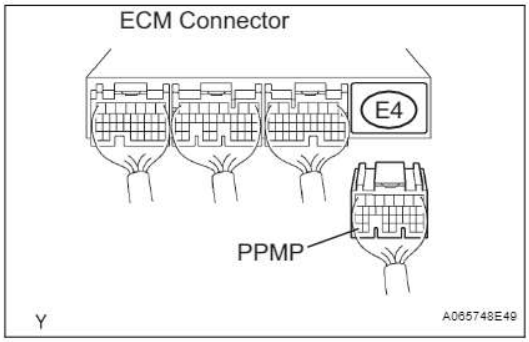
Display (DTC Output)	Test Result	Suspected Trouble Area	Proceed to
P0451	-	Canister pressure sensor	C
P0452	Less than 45 kPa (430 mmHg)	• Wire harness/connector (ECM - canister pressure sensor) • Canister pressure sensor • Short in ECM circuit	A
P0453	More than 120 kPa (900 mmHg)	• Wire harness/connector (ECM - canister pressure sensor) • Canister pressure sensor • Open in ECM circuit	B

B → Go to step 4

C → GO TO EVAP INSPECTION PROCEDURE

A

2	CHECK WIRE HARNESS (CANISTER PUMP MODULE - ECM)



(a) Turn the ignition switch off.
(b) Disconnect the E4 ECM connector.
(c) Measure the resistance between the PPMP terminal of the ECM connector and body ground.

Result

Test Result	Suspected Trouble Area	Proceed to
10 kΩ or less	• Wire harness/connector (ECM - canister pressure sensor) • Short in canister pressure sensor circuit	A
10 kΩ or more	• Wire harness/connector (ECM - canister pressure sensor) • Short in ECM circuit	B

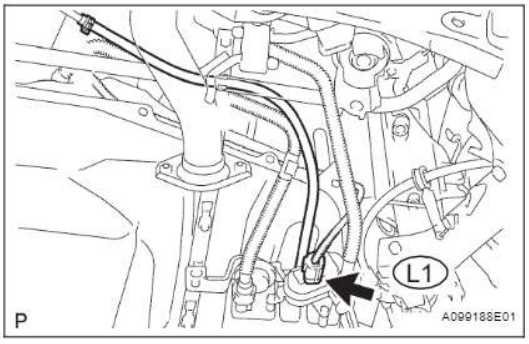
(d) Reconnect the ECM connector.

B → Go to step 7

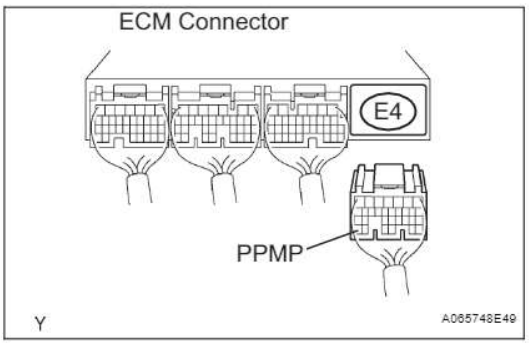
A

ES

3 CHECK WIRE HARNESS (CANISTER PUMP MODULE - ECM)



(a) Disconnect the L1 canister pump module connector.



(b) Disconnect the E4 ECM connector.
(c) Measure the resistance between the PPMP terminal of the ECM connector and body ground.

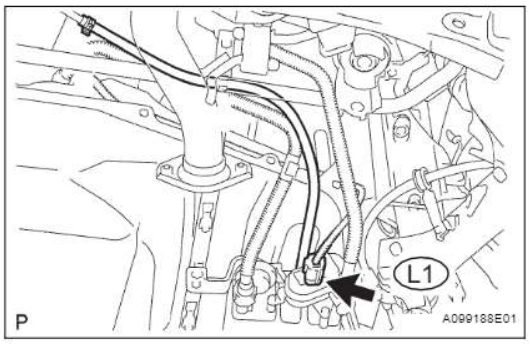
Result

Test Result	Suspected Trouble Area	Proceed to
10 kΩ or less	Short in canister pressure sensor circuit	A
10 kΩ or more	Short in wire harness/connector (ECM - canister pressure sensor)	B

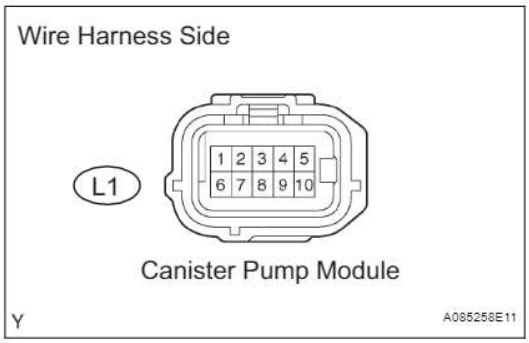
A → Go to step 5

B → Go to step 6

4	CHECK WIRE HARNESS (CANISTER PUMP MODULE - ECM)



(a) Disconnect the L1 canister pump module connector.



(b) Turn the ignition switch to the ON position.
(c) Measure the voltage and resistance according to the value(s) in the table below.

Standard voltage

Tester Connection	Specified Condition
L1-4 - Body ground	4.5 to 5.5 V
L1-3 - Body ground	4.5 to 5.5 V

Standard resistance

Tester Connection	Specified Condition
L1-2 - Body ground	Below 1 Ω

Result

Test Result	Suspected Trouble Area	Proceed to
Voltage and resistance within standard ranges	Open in canister pressure sensor circuit	A
Voltage and resistance outside standard ranges	Open in wire harness/connector (ECM - canister pressure sensor)	B

B → Go to step 6

A

5	INSPECT CANISTER

NEXT → Go to step 8

6	REPAIR OR REPLACE WIRE HARNESS

HINT:
If the exhaust tail pipe has been removed, go to the next step before reinstalling it.

NEXT → Go to step 8

7	REPLACE ECM

NEXT → Go to step 8

8	CHECK WHETHER DTC OUTPUT RECURS (AFTER REPAIR)

(a) Connect the intelligent tester to the DLC3.
(b) Turn the ignition switch to the ON position and turn the tester on.
(c) Wait for at least 60 seconds.
(d) On the tester, select the following menu items: DIAGNOSIS/ENHANCED OBD II/DTC INFO/PENDING CODES.
HINT:
If no pending DTC is displayed on the tester, the repair has been successfully completed.

ES

NEXT

COMPLETED

DTC	P0455	Evaporative Emission Control System Leak Detected (Gross Leak)

DTC	P0456	Evaporative Emission Control System Leak Detected (Very Small Leak)

DTC SUMMARY

DTC No.	Monitoring Item	Malfunction Detection Condition	Trouble Area	Detection Timing	Detection Logic
P0455	EVAP gross leak	Leak detection pump creates negative pressure (vacuum) in EVAP system and EVAP system pressure measured. Reference pressure measured at start and at end of leak check. If stabilized pressure higher than [second reference pressure x 0.2], ECM determines that EVAP system has large leak.	• Fuel tank cap (loose) • Leakage from EVAP line (canister - Fuel tank) • Leakage from EVAP line (purge VSV - canister) • Canister pump module • Leakage from fuel tank • Leakage from canister	While ignition switch off	2 trip
P0456	EVAP small leak	Leak detection pump creates negative pressure (vacuum) in EVAP system and EVAP system pressure measured. Reference pressure measured at start and at end of leak check. If stabilized pressure higher than second reference pressure, ECM determines that EVAP system has small leak.	Same above	While ignition switch off	2 trip

DESCRIPTION

The circuit description can be found in the Evaporative Emission (EVAP) system (See page ES-314).

INSPECTION PROCEDURE

Refer to the EVAP system (See page ES-314).

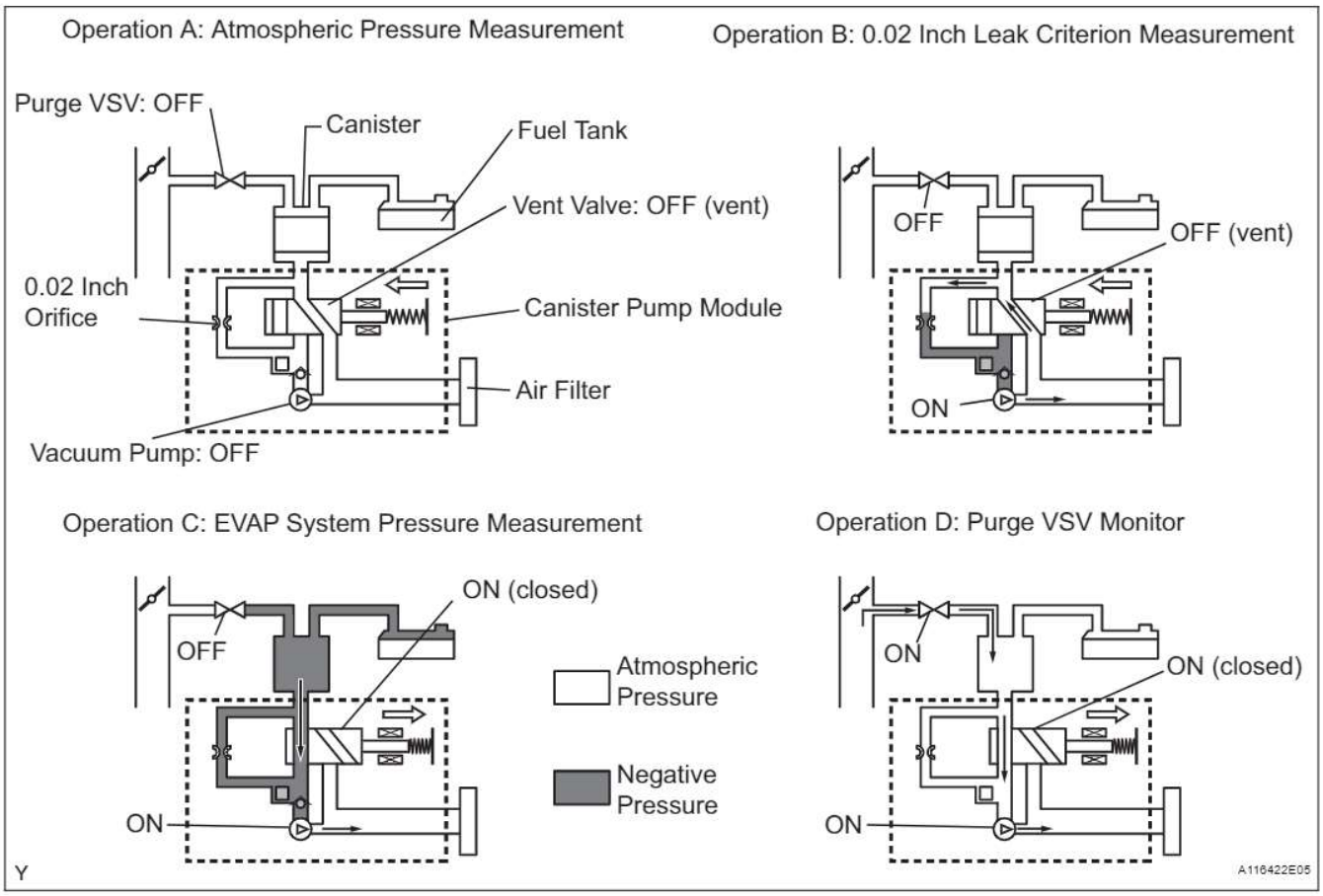
MONITOR DESCRIPTION

5 hours* after the ignition switch is turned off, the leak detection pump creates negative pressure (vacuum) in the EVAP system. The ECM monitors for leaks and actuator malfunctions based on the EVAP pressure.
HINT:
*: If the engine coolant temperature is not below 35°C (95°F) 5 hours after the ignition switch is turned off, the monitor check starts 2 hours later. If it is still not below 35°C (95°F) 7 hours after the ignition switch is turned off, the monitor check starts 2.5 hours later.

Sequence	Operation	Description	Duration
-	ECM activation	Activated by soak timer 5, 7 or 9.5 hours after ignition switch off.	-
A	Atmospheric pressure measurement	Vent valve turned OFF (vent) and EVAP system pressure measured by ECM in order to register atmospheric pressure. If pressure in EVAP system is not between 70 kPa and 110 kPa (525 mmHg and 825 mmHg), ECM cancels EVAP system monitor.	10 seconds

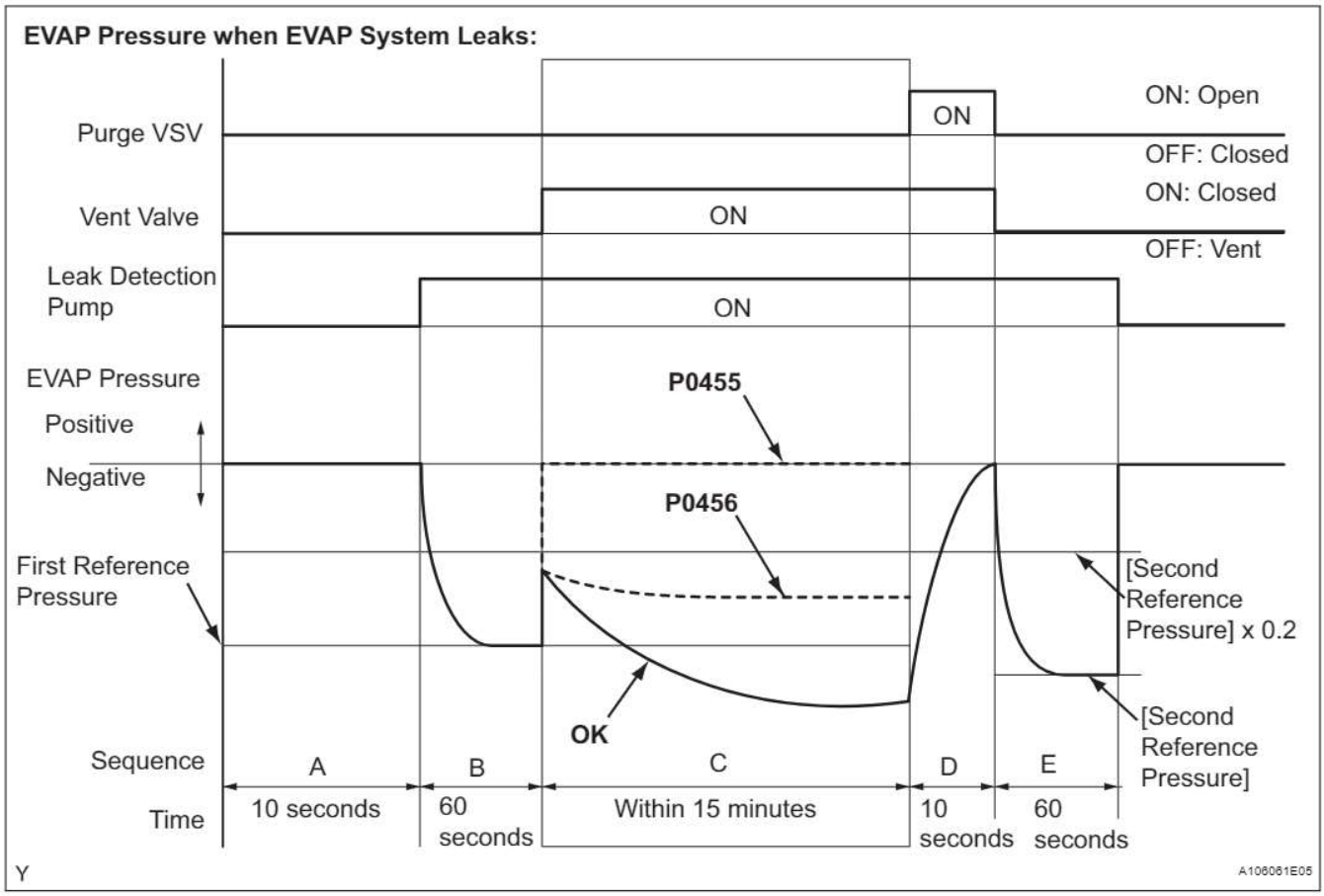
Sequence	Operation	Description	Duration
B	First 0.02 inch leak pressure measurement	In order to determine 0.02 inch leak pressure standard, vacuum pump creates negative pressure (vacuum) through 0.02 inch orifice and then ECM checks if vacuum pump and vent valve operate normally.	60 seconds
C	EVAP system pressure measurement	Vent valve turned ON (closed) to shut EVAP system. Negative pressure (vacuum) is created in EVAP system, and EVAP system pressure is then measured. Write down measured value as it will be used in leak check. If EVAP pressure does not stabilize within 15 minutes, ECM cancels EVAP system monitor.	15 minutes*2
D	Purge VSV monitor	Purge VSV 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 measured and then monitoring result 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.



1. P0455: EVAP gross leak
   In Operation C, the leak detection pump creates negative pressure (vacuum) in the EVAP system and the EVAP system pressure is measured. If the stabilized system pressure is higher than [second 0.02 inch leak pressure standard x 0.2] (near atmospheric pressure), the ECM determines that the EVAP system has a large leak, illuminates the MIL and sets the DTC (2 trip detection logic).

2. P0456: EVAP very small leak
In Operation C, the leak detection pump creates negative pressure (vacuum) in the EVAP system and the EVAP system pressure is measured. If the stabilized system pressure is higher than the second 0.02 inch leak pressure standard, the ECM determines that the EVAP system has a small leak, illuminates the MIL and sets the DTC (2 trip detection logic).



MONITOR STRATEGY

Related DTCs	P0455: Gross leak detected P0456: Very small leak (0.020 inch hole) detected
Required Sensors/Components	Purge VSV and pump module
Frequency of Operation	Once per driving cycle
Duration	Within 15 minutes
MIL Operation	2 driving cycles
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

Monitor runs whenever the following DTCs are not present	None
Atmospheric pressure	70 to 110 kPa (525 to 825 mmHg)
Battery voltage	10.5 V or more
Vehicle speed	Below 4 km/h (2.5 mph)
Ignition switch	OFF
Time after key off	5, 7 or 9.5 hours
Canister pressure sensor malfunction (P0450, P0451, P0452 and P0453)	Not detected
Purge valve	Not operated by scan tool

Vent valve	Not operated by scan tool
Leak detection pump	Not operated by scan tool
Both of the following conditions are met:	Condition 1 and 2 are met before key off
1. Duration that vehicle is driven	5 minutes or more
2. EVAP purge operation	Performed
Engine coolant temperature	4.4 to 35°C (40 to 95°F)
Intake air temperature	4.4 to 35°C (40 to 95°F)

Key-off monitor sequence 1 to 8

1. Atmospheric pressure measurement

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

ES

2. First reference pressure measurement

Next sequence runs if the following conditions are met:	-
EVAP pressure just after reference pressure measurement start	-1 kPa (-7.5 mmHg) or lower
Reference pressure	-4.85 to -1.057 kPa (-36.4 to -7.93 mmHg)
Reference pressure	Saturated within 60 seconds

3. Vent valve stuck closed check

Next sequence runs if the following condition is met:	-
EVAP pressure change after vent valve is ON (closed)	0.3 kPa (2.25 mmHg) or more

4. Vacuum introduction

Next sequence runs if the following condition is met:	-
EVAP pressure	Saturated within 15 minutes

5. Purge valve stuck closed check

Next sequence runs if the following condition is met:	-
EVAP pressure change after purge VSV ON (open)	0.3 kPa (2.25 mmHg) or more

6. Second reference pressure measurement

Next sequence runs if all of the following conditions are met:	Conditions 1, 2, 3 and 4
1. EVAP pressure just after reference pressure	-1 kPa-g (-7.5 mmHg-g) or less
2. Reference pressure	-4.85 to -1.057 kPa-g (-36.4 to -7.93 mmHg-g)
3. Reference pressure	Saturated within 60 seconds
4. Reference pressure difference between first and second	Less than 0.7 kPa-g (5.25 mmHg-g)

7. Leak check

Next sequence runs if the following condition is met:	-
EVAP pressure when vacuum introduction is complete	Second reference pressure or less

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-g (2.25 mmHg-g)

TYPICAL MALFUNCTION THRESHOLDS

P0455: EVAP gross leak

EVAP pressure when vacuum introduction is complete	Higher than reference pressure x 0.2

P0456: EVAP small leak

EVAP pressure when vacuum introduction is complete	Between reference pressure and reference pressure x 0.2

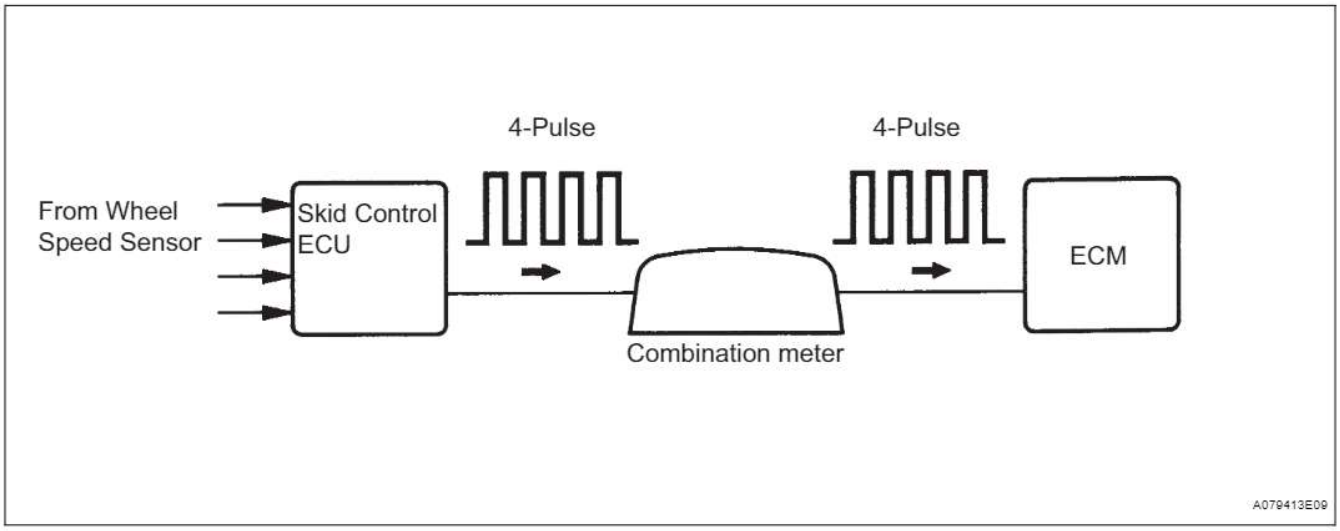
MONITOR RESULT

Refer to CHECKING MONITOR STATUS (See page ES-15).

DTC	P0500	Vehicle Speed Sensor "A"

DESCRIPTION

Vehicles, which are equipped with ABS (Anti-Lock Brake System), detect the vehicle speed using the skid control ECU and wheel speed sensor. The wheel speed sensor monitors the wheel rotation speed and sends a signal to the skid control ECU. The skid control ECU converts the wheel speed signal into a 4-pulse signal and transmits it to the ECM via the combination meter. The ECM determines the vehicle speed based on the frequency of the pulse signal.



DTC No.	DTC Detection Condition	Trouble Area
P0500	While vehicle being driven, no vehicle speed sensor signal is transmitted to ECM (1 trip detection logic: Automatic transaxle) (2 trip detection logic: Manual transaxle)	• Open or short in vehicle speed sensor circuit • Vehicle speed sensor • Combination meter • ECM • Skid control ECU

MONITOR DESCRIPTION

Automatic Transaxle Models:
The ECM assumes that the vehicle is being driven when the transmission counter gear indicates more than 300 rpm and over 30 seconds have passed since the Park/Neutral Position (PNP) switch was turned OFF. If there is no signal from the vehicle speed sensor, despite these conditions being met, the ECM interprets this as a malfunction in the sensor. The ECM then illuminates the MIL and sets the DTC.
Manual Transaxle Models:
The ECM assumes that the vehicle is being driven while the vehicle speed sensor signal is being transmitted by the combination meter. If there is no signal from the No. 1 vehicle speed sensor despite this condition being met, the ECM interprets this as a malfunction in the sensor. The ECM then illuminates the MIL and sets the DTC.

MONITOR STRATEGY

Related DTCs	P0500: Vehicle speed sensor "A" pulse input error
Required Sensors/Components (Main)	Vehicle Speed Sensor (VSS), Combination meter and skid control ECU
Required Sensors/Components (Related)	PNP switch, Engine Coolant Temperature (ECT) sensor, Crankshaft Position (CKP) sensor and Mass Air Flow (MAF) meter
Frequency of Operation	Continuous
Duration	2 seconds: Automatic transaxle 8 seconds: Manual transaxle
MIL Operation	Immediate: Automatic transaxle 2 driving cycles: Manual transaxle

Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

Monitor runs whenever the following DTCs are not present	P0120 - P0223, P2135 (TP sensor)

M/T:

Battery voltage	8 V or more
Ignition switch	ON
Starter	OFF
ECT	70°C (158°F) or more
Engine speed	2,000 to 4,500 rpm
Engine load	33.7 % or more
ECT sensor circuit fail	Not detected
MAF sensor circuit fail	Not detected

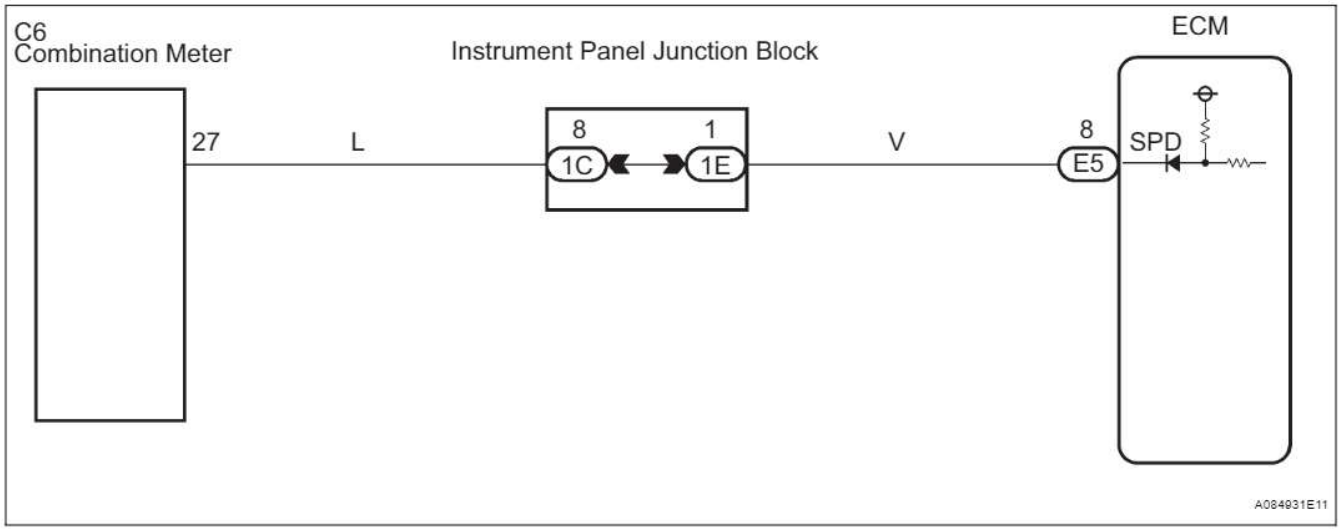
A/T:

Battery voltage	8 V or more
Time after ignition switch turned to the ON position	3 seconds or more
Transmission counter gear speed	300 rpm or more
Engine	Running
Either of the following conditions (a) or (b) is met:	-
(a) The following conditions 1 and 2 are met:	-
1. ECT and ECT sensor	20°C (68°F) or more, and sensor does not malfunction (P0115 or P0116)
2. Time after PNP switch turned off	10 seconds or more
(b) The following conditions 1 and 2 are met:	-
1. ECT and ECT sensor	Less than 20°C (68°F), and sensor malfunction (P0115 or P0116)
2. Time after PNP switch turned off	30 seconds or more

TYPICAL MALFUNCTION THRESHOLDS

Vehicle speed sensor signal	No signal

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.

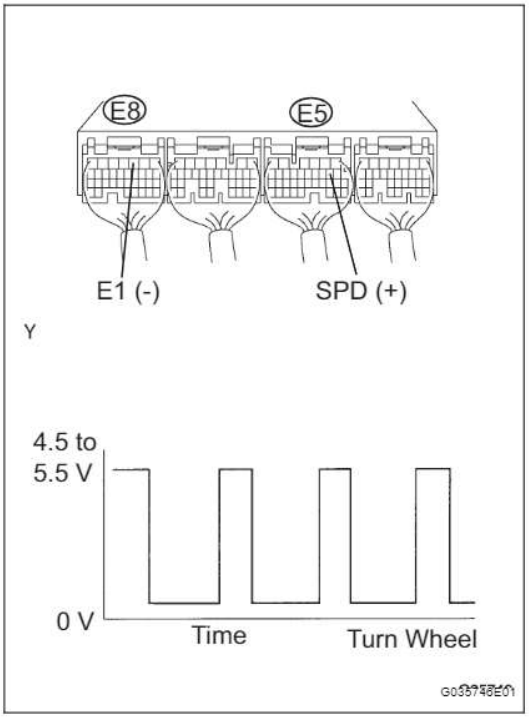
1 CHECK OPERATION OF SPEEDOMETER

(a) Drive the vehicle and check if the operation of the speedometer in the combination meter is normal.
HINT:
The vehicle speed sensor is operating normally if the speedometer reading is normal.

NG → **CHECK SPEEDOMETER CIRCUIT**

OK

2 INSPECT ECM (SPD VOLTAGE)



(a) Shift the transmission gear selector lever to the neutral position.
(b) Jack up the vehicle.
(c) Turn the ignition switch to the ON position.
(d) Measure the voltage according to the value(s) in the table below as the wheel is turned slowly.

Standard voltage

Tester Connection	Specified Condition
SPD (E5-8) - E1 (E8-3)	Voltage generated intermittently

HINT:
The output voltage should fluctuate up and down similarly to the diagram shown when the wheel is turned slowly.

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

OK

REPLACE ECM

DTC	P0504	Brake Switch "A" / "B" Correlation

DESCRIPTION

The stop light switch is a duplex system that transmits 2 signals: STP and ST1-. These 2 signals are used by the ECM to monitor whether or not the brake system is working properly. If the signals, which indicate the brake pedal is being depressed and released, are detected simultaneously, the ECM interprets this as a malfunction in the stop light switch and sets the DTC.

HINT:

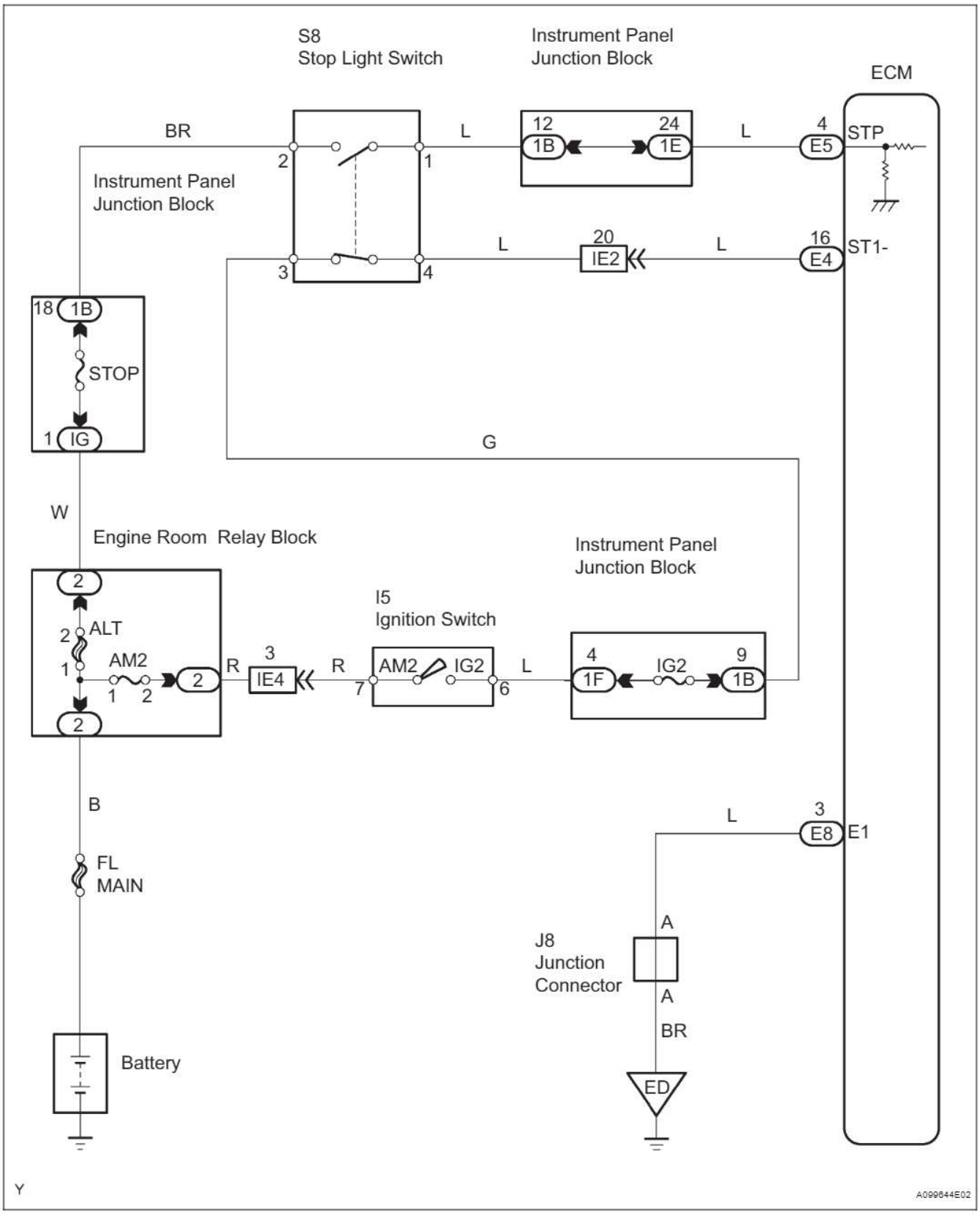
The normal conditions are as shown in the table below. The signals can be read using the intelligent tester.

Signal	Brake Pedal Released	In Transition	Brake Pedal Depressed
STP	OFF	ON	ON
ST1-	ON	ON	OFF

ES

DTC No.	DTC Detection Condition	Trouble Area
P0504	Conditions (a), (b) and (c) continue for 0.5 seconds or more (1 trip detection logic): (a) Ignition switch to the ON position (b) Brake pedal released (c) STP signal OFF when ST1- signal OFF	• Short in stop light switch signal circuit • STOP fuse • Stop light switch • ECM

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.

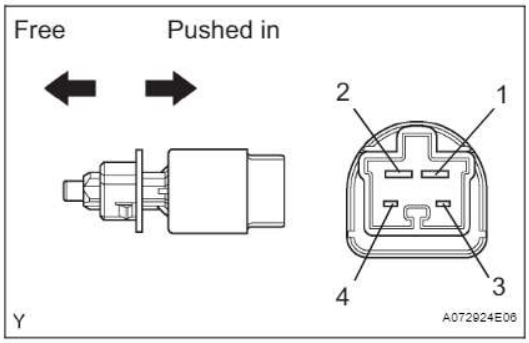
1 CHECK OPERATION OF STOP LIGHT

(a) Check whether the stop lights turn on and off normally when the brake pedal is depressed and released.
OK:
Stop lights turn ON when brake pedal is depressed.

NG → **REPAIR OR REPLACE STOP LIGHT SWITCH CIRCUIT**

OK

2 INSPECT STOP LIGHT SWITCH



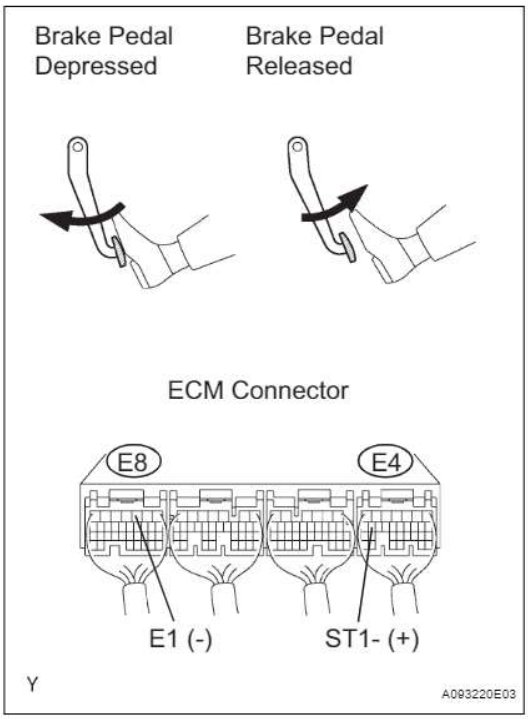
(a) Remove the stop light switch assembly.
(b) Measure the resistance according to the value(s) in the table below.
Standard resistance

Switch Position	Tester Connection	Specified Condition
Switch pin free	1 - 2	Below 1 Ω
Switch pin free	3 - 4	10 kΩ or higher
Switch pin pushed in	1 - 2	10 kΩ or higher
Switch pin pushed in	3 - 4	Below 1 Ω

NG → **REPLACE STOP LIGHT SWITCH**

OK

3	READ VALUE USING INTELLIGENT TESTER (STP SIGNAL AND ST1 - VOLTAGE)



(a) Connect the intelligent tester to the DLC3.
(b) Turn the ignition switch to the ON position and turn the tester on.
(c) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DATA LIST / ALL / STOP LIGHT SW.
(d) Check the STP signal when the brake pedal is depressed and released.

Standard operation

Brake Pedal Operation	Specified Condition
Depressed	STP signal ON
Released	STP signal OFF

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

Standard voltage

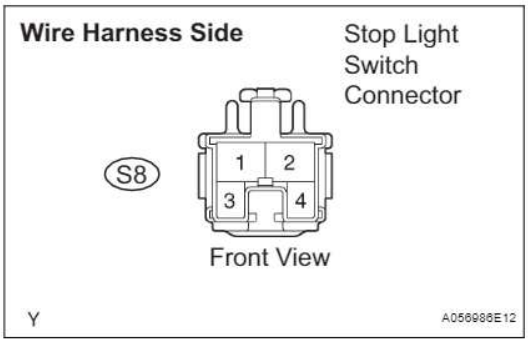
Tester Connection	Brake Pedal Operation	Specified Condition
ST1- (E4-16) - E1 (E8-3)	Depressed	Below 1.5 V
ST1- (E4-16) - E1 (E8-3)	Released	7.5 to 14 V

OK → Go to step 4

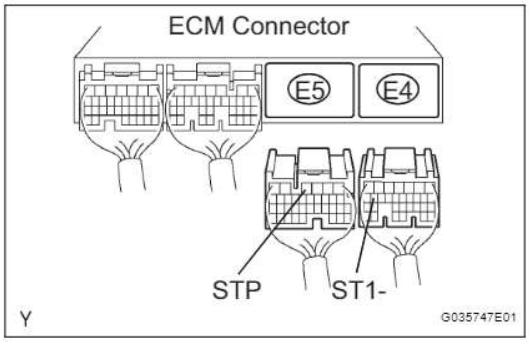
NG

CHECK FOR INTERMITTENT PROBLEMS

4	CHECK WIRE HARNESS (STOP LIGHT SWITCH - ECM)



(a) Disconnect the S8 stop light switch connector.



(b) Disconnect the E4 and E5 ECM connectors.
(c) Measure the resistance according to the value(s) in the table below.

Standard resistance

Tester Connection	Specified Condition
Stop light switch (S8-1) - STP (E5-4)	Below 1 Ω
Stop light switch (S8-4) - ST1- (E4-16)	Below 1 Ω

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

OK

REPLACE ECM

ES

DTC	P0505	Idle Control System Malfunction

DESCRIPTION

The idling speed is controlled by the ETCS (Electronic Throttle Control System). The one valve type throttle body ETCS is comprised of: 1) the throttle actuator, which operates the throttle valve; 2) the Throttle Position (TP) sensor, which detects the opening angle of the throttle valve; 3) the Accelerator Pedal Position (APP) sensor, which detects the accelerator pedal position; and 4) the ECM, which controls the ETCS. Based on the target idling speed, the ECM controls the throttle actuator to provide the proper throttle valve opening angle.

DTC No.	DTC Detection Condition	Trouble Area
P0505	Idling speed continues to vary greatly from target idling speed (2 trip detection logic)	• ETCS • Air induction system • PCV hose connections • ECM

ES

MONITOR DESCRIPTION

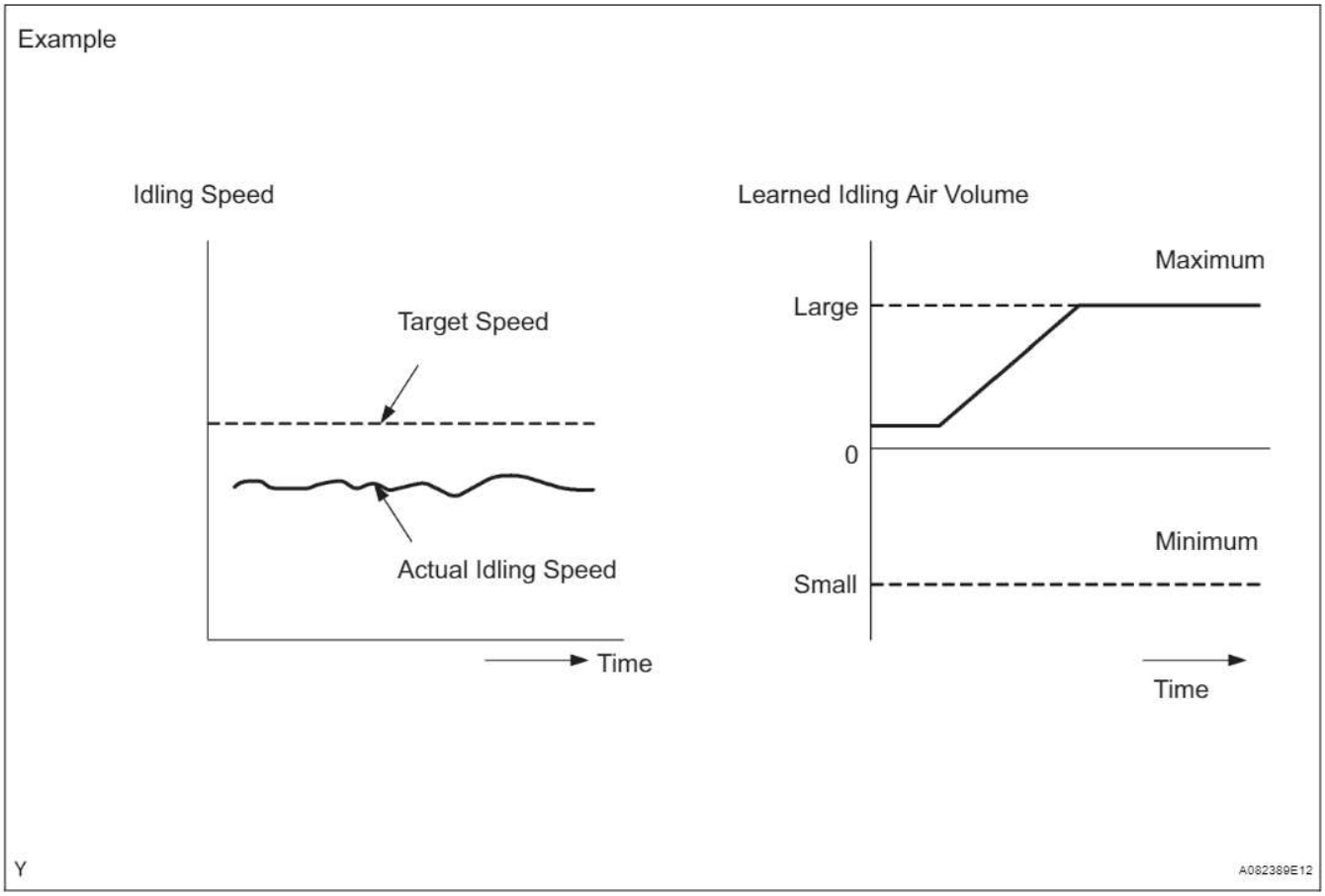
The ECM monitors the idling speed and idling air flow volume to conduct Idle Speed Control (ISC). The ECM determines that the ISC system is malfunctioning if the following conditions are met:

- The learned idling air flow volume remains at the maximum or minimum volumes 5 times or more during a drive cycle.
- While driving at 6 mph (10 km/h) or more, the actual engine idling speed varies from the target idling speed by between 100 rpm and 200 rpm 5 times or more during a drive cycle.

Example:

If the actual idling speed varies from the target idling speed by more than 200 rpm* 5 times during a drive cycle, the ECM illuminates the MIL and sets the DTC.

*: Threshold idling speed varies with engine load.



MONITOR STRATEGY

Related DTCs	P0505: ISC Function
Required Sensors/Components (Main)	ETCS
Required Sensors/Components (Related)	Crankshaft position sensor, Engine coolant temperature sensor, and Vehicle speed sensor
Frequency of Operation	Once per driving cycle: Functional check Continuous: Range check
Duration	10 minutes: Functional check 10 seconds: Range check
MIL Operation	2 driving cycles: Functional check Immediate: Range check
Sequence of Operation	None

ES

TYPICAL ENABLING CONDITIONS

Monitor runs whenever the following DTCs are not present	None
Engine	Running

TYPICAL MALFUNCTION THRESHOLDS

Either of the following conditions 1 or 2 is met:	-
1. Frequency that both of the following conditions (a) and (b) are met:	5 times or more
(a) Engine RPM - Target engine RPM	Less than -100 rpm, or more than 150 rpm
(b) Vehicle condition	Stop after vehicle was driven at 6.25 mph (10 km/h) or more
2. Frequency that both of the following conditions (c) and (d) are met:	Once
(c) Engine RPM - Target engine RPM	Below -100 rpm, or 150 rpm or more (A/C: OFF)
(d) IAC flow rate learning value	1.3 L/sec or less, or 6 L/sec or more

INSPECTION PROCEDURE

HINT:

- The following conditions may also cause DTC P0505 to be set:
  The throttle valve is not fully closed. (e.g. The accelerator pedal is slightly depressed by something such as a floor carpet overlapping the accelerator pedal.)
- 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.

1	CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P0505)

(a) Connect the intelligent tester to the DLC3.
(b) Turn the ignition switch to the ON position.
(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
P0505	A
P0505 and other DTCs	B

HINT:
If any DTCs other than P0505 are output, troubleshoot those DTCs first.

B → GO TO DTC CHART

A

ES

2 CHECK PCV HOSE CONNECTIONS

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

NG → REPAIR OR REPLACE PCV HOSE

OK

3 CHECK AIR INDUCTION SYSTEM

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

NG → REPAIR OR REPLACE AIR INDUCTION SYSTEM

OK

4 CHECK THROTTLE VALVE

(a) Check the throttle valve condition.

NG → REPLACE THROTTLE BODY

OK

REPLACE ECM

DTC	P050A	Cold Start Idle Air Control System Performance

DTC	P050B	Cold Start Ignition Timing Performance

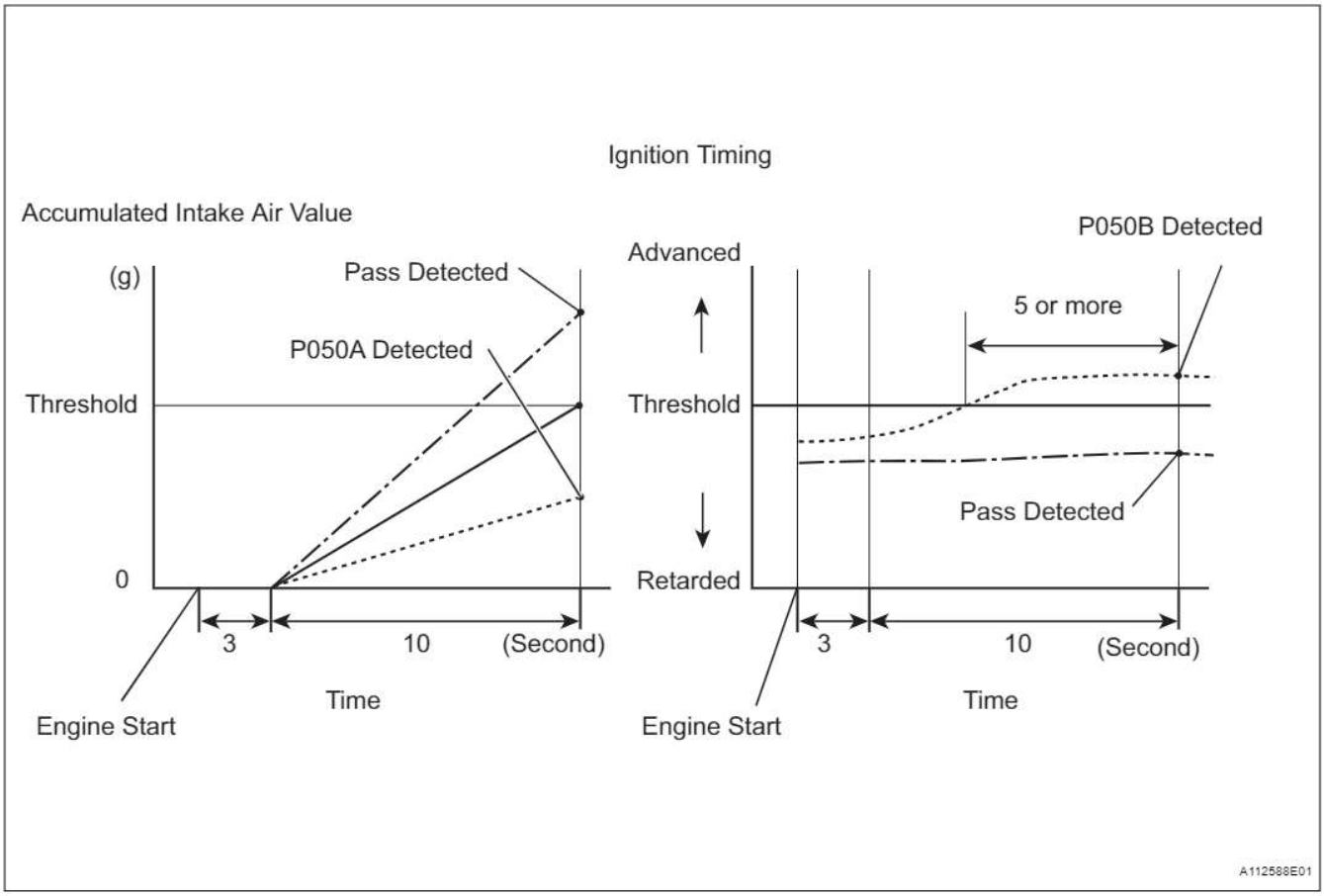
DESCRIPTION

The Electronic Throttle Control System (ETCS) controls the engine idling speed. The ETCS operates the throttle actuator to open and close the throttle valve, and adjusts the intake air amount to achieve the target idling speed.
In addition, the ECM retards the ignition timing and the ETCS increases the intake air amount to quickly increase the catalyst temperature at cold start to reduce emissions.

DTC No.	DTC Detection Condition	Trouble Area
P050A	Accumulated intake air amount during 10 seconds of idling after cold start is less than threshold (2 trip detection logic)	• Throttle body assembly • Mass air flow meter • Air induction system • PCV hose connections • VVT system • Air cleaner filter element • ECM
P050B	Ignition timing retard value insufficient for 5 seconds or more during 10 seconds of P050A monitoring duration at cold start (2 trip detection logic)	• Throttle body assembly • Mass air flow meter • Air induction system • PCV hose connections • VVT system • Air cleaner filter element • ECM

ES

MONITOR DESCRIPTION



The ECM monitors the intake air amount during idling and the ignition timing.
When the Engine Coolant Temperature (ECT) is between -10°C and 50°C (14°F and 122°F), the ECM calculates the idling intake air amount for 10 seconds, beginning 3 seconds after the engine starts.
When the accumulated value is below the threshold, the ECM interprets this as a malfunction in the Idle Speed Control (ISC) system at cold start.
The ECM also monitors the ignition timing at cold start, and judges it to be incorrect when it is advanced to the same value for a warm engine for 5 seconds or more of the 10 second monitoring period.
Example:
P050A is detected when all conditions below are met (2 trip detection logic).
1. The ECT is between -10°C and 50°C (14°F and 122°F) when the engine starts.
2. The engine idles for 13 seconds after engine start.
3. The accumulated intake air amount is below the threshold.

The ECM sets the DTC and illuminates the MIL 13 seconds after the engine is next started.

ES

NOTICE:

When the negative battery terminal is disconnected during inspection or repairs, the ISC learning values are cleared. The ISC learning must be performed by warming up the engine and idling for 5 minutes with the ECT at 75°C (167°F) or more because DTCs cannot be detected with the ISC learning values cleared.

MONITOR STRATEGY

Related DTCs	P050A: Idle speed control problem at cold P050B: Idle ignition timing problem at cold
Required Sensors/Components (Main)	Mass air flow meter
Required Sensors/Components (Related)	Engine Coolant Temperature (ECT) sensor, Throttle position sensor, Vehicle speed sensor
Frequency of Operation	Once per driving cycle
Duration	10 seconds
MIL Operation	2 driving cycles
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

P050A:

Battery voltage	8 V or more
Time after engine start	3 seconds or more
Starter	OFF
ECT at engine start	-10°C (14°F) or more
ECT	-10°C to 50°C (14°F to 122°F)
Engine idling time	3 seconds or more
Fuel-cut	OFF
Vehicle speed	Less than 1.875 mph (3 km/h)
Time after shift position changed (A/T)	1 second or more
Atmospheric pressure	76 kPa (570 mmHg) or more

P050B:

Battery voltage	8 V or more
Time after engine start	3 seconds or more
Starter	OFF
ECT at engine start	-10°C (14°F) or more
ECT	-10°C to 50°C (14°F to 122°F)
Engine idling time	3 seconds or more
Fuel-cut	OFF
Vehicle speed	Less than 1.875 mph (3 km/h)

TYPICAL MALFUNCTION THRESHOLDS

P050A:

Accumulated air flow amount (A/T)	Varies with ECT (Example: Less than 1.44 g)

P050B:

Accumulated time when ignition timing retard value insufficient	5 seconds or more

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.

ES

1 CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P050A AND/OR P050B)

(a) Connect the intelligent tester to the DLC3.
(b) Turn the ignition switch to the ON position.
(c) Turn the tester on.
(d) Select the following the menu items: DIAGNOSIS / ENHANCED OBD II / DTC INFO / CURRENT CODES.
(e) Read the DTCs.

Result

Display (DTC Output)	Proceed to
P050A and/or P050B	A
P050A and/or P050B and other DTCs	B

HINT:
If any DTCs other than P050A and P050B are output, troubleshoot those DTCs first.

B → GO TO DTC CHART

A

2 READ VALUE USING INTELLIGENT TESTER (FUEL TRIM)

HINT:
Calculate the total fuel trim values to check the characteristic deviation of the mass air flow meter.
(a) Connect the intelligent tester to the DLC3.
(b) Turn the ignition switch to the ON position.
(c) Turn the tester on.
(d) Select the following menu items: DIAGNOSIS / ENHANCED OBD II / DATA LIST / PRIMARY / SHORT FT #1 and LONG FT #1.
(e) Read the values displayed on the tester.
(f) Add together the SHORT FT #1 and LONG FT #1 values to obtain the total FUEL TRIM.

OK:
Total of SHORT FT #1 and LONG FT #1 values is between -20% and 20%.

OK → Go to step 12

NG

3 PERFORM ACTIVE TEST USING INTELLIGENT TESTER (OPERATE OCV)

(a) Connect the intelligent tester to the DLC3.
(b) Start the engine and turn the tester on.
(c) Warm up the engine.
(d) Select the following menu items: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / VVT CTRL B1.
(e) Check the engine speed while operating the Oil Control Valve (OCV) using the tester.

OK

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

NG → Go to step 8

OK

4 CHECK PCV HOSE CONNECTIONS

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

NG → Go to step 9

OK

5 CHECK AIR INDUCTION SYSTEM

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

NG → Go to step 10

OK

6 CHECK AIR CLEANER FILTER ELEMENT SUB-ASSEMBLY

(a) Visually check that the air cleaner filter element is not excessively contaminated with dirt or oil.
OK:
Air cleaner filter element is not excessively contaminated with dirt or oil.

NG → Go to step 11

OK

7	REPLACE MASS AIR FLOW METER

NEXT → Go to step 15

8	CHECK AND REPAIR VVT SYSTEM

NEXT → Go to step 15

ES

9	REPAIR OR REPLACE PCV HOSE

NEXT → Go to step 15

10	REPAIR OR REPLACE AIR INDUCTION SYSTEM

NEXT → Go to step 15

11	REPLACE AIR CLEANER FILTER ELEMENT SUB-ASSEMBLY

NEXT → Go to step 15

12	CHECK THROTTLE VALVE

(a) Check for deposits around the throttle valve and throttle valve condition.

OK:

No deposits around the throttle valve and the throttle valve moves smoothly.

NG → Go to step 14

OK

13	REPLACE ECM

NEXT → Go to step 15

14	REPAIR OR REPLACE THROTTLE BODY ASSEMBLY

NEXT → Go to step 15

15	CHECK WHETHER DTC OUTPUT RECURS (DTC P050A AND/OR P050B)

NOTICE:
In this operation, the engine must be cold (the same level as the engine coolant temperature recorded in the freeze frame data).

(a) Connect the intelligent tester to the DLC3.
(b) Turn the ignition switch to the ON position.
(c) Turn the tester on.
(d) Clear the DTCs (See page ES-32).
(e) Switch the ECM from normal mode to check mode using the tester (See page ES-35).
(f) Start the engine to idle for a minute.
OK:
Stable fast idling.
(g) Read DTCs.
OK:
No DTC output.

ES

NEXT

END

DTC	P0560	System Voltage

MONITOR DESCRIPTION

The battery supplies electricity to the ECM even when the ignition switch is off. This power allows the ECM to store data such as DTC history, freeze frame data and fuel trim values. If the battery voltage falls below a minimum level, these memories are cleared and the ECM determines that there is a malfunction in the power supply circuit. When the engine is next started, the ECM illuminates the MIL and sets the DTC.

DTC No.	DTC Detection Condition	Trouble Area
P0560	Open in ECM backup power source circuit (1 trip detection logic)	• Open in back up power source circuit • EFI fuse • ECM

ES

HINT:
If DTC P0560 is set, the ECM does not store other DTCs.

MONITOR STRATEGY

Related DTCs	P0560: ECM system voltage
Required Sensors/Components (Main)	ECM
Required Sensors/Components (Related)	-
Frequency of Operation	Continuous
Duration	3 seconds
MIL Operation	Immediate (MIL illuminated after next engine start)
Sequence of Operation	None

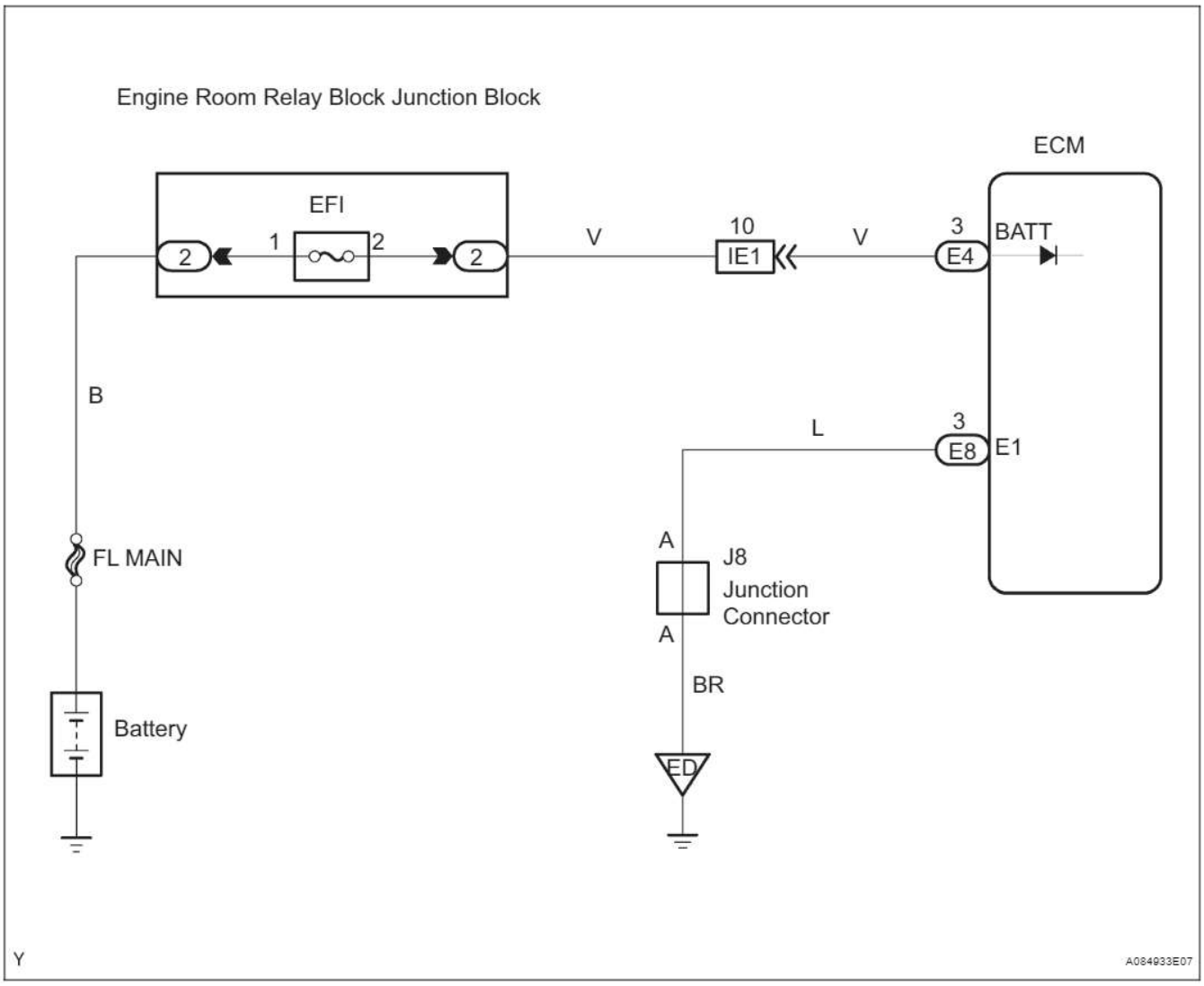
TYPICAL ENABLING CONDITIONS

Monitor runs whenever the following DTCs are not present	None

TYPICAL MALFUNCTION THRESHOLDS

ECM power source	Less than 3.5 V

WIRING DIAGRAM



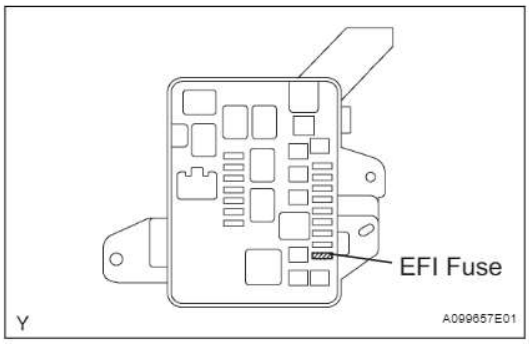
ES

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.

1 **CHECK FUSE (EFI FUSE)**

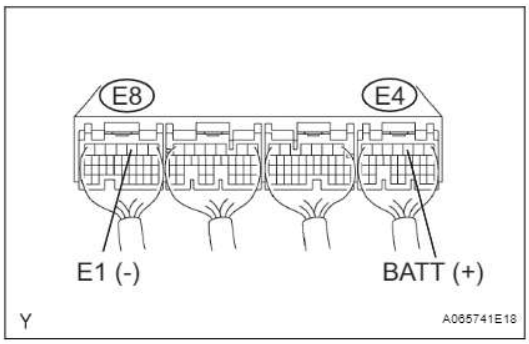


(a) Remove the EFI fuse from the engine room relay block.
(b) Measure the resistance of the fuse.
Standard resistance:
Below 1 Ω

NG → **CHECK FOR SHORT IN ALL HARNESSES AND COMPONENTS CONNECTED TO FUSE**

OK

2 **INSPECT ECM (BATT VOLTAGE)**



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

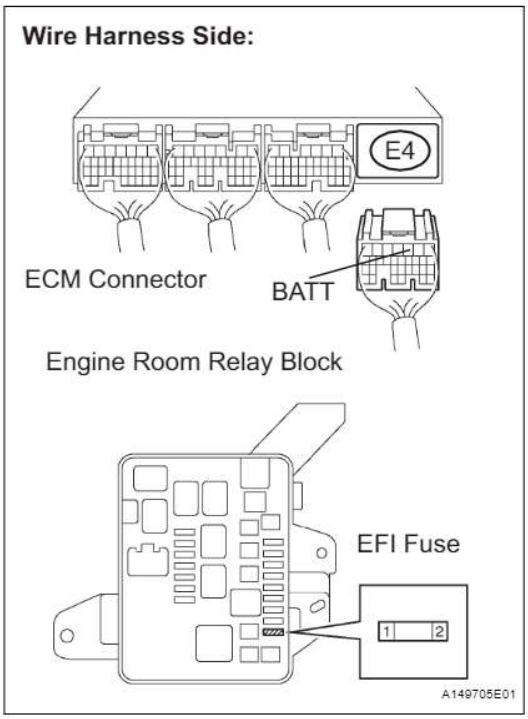
Tester Connection	Specified Condition
BATT (E4-3) - E1 (E8-3)	9 to 14 V

NG → **Go to step 3**

OK

REPLACE ECM

3	CHECK WIRE HARNESS (ECM - EFI FUSE, EFI FUSE - BATTERY)



(a) Check the wire harness between the EFI fuse and ECM.
(1) Remove the EFI fuse from the engine room relay block.
(2) Disconnect the E4 ECM connector.
(3) Measure the resistance according to the value(s) in the table below.
Standard resistance

Tester Connection	Specified Condition
EFI fuse (2) - BATT (E4-3)	Below 1 Ω
EFI fuse (2) or BATT (E4-3) - Body ground	10 kΩ or higher

(b) Check the wire harness between the EFI fuse and battery.
(1) Remove the EFI fuse from the engine room relay block.
(2) Disconnect the cable from the positive (+) battery terminal.
(3) Measure the resistance according to the value(s) in the table below.
Standard resistance

Tester Connection	Specified Condition
Battery positive terminal - EFI fuse (1)	Below 1 Ω
Battery positive terminal or EFI fuse (1) - Body ground	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

4	INSPECT BATTERY

(a) Check that the battery is not depleted.

NG → REPLACE BATTERY

OK

CHECK AND REPLACE ENGINE ROOM RELAY BLOCK

DTC	P0604	Internal Control Module Random Access Memory (RAM) Error

DESCRIPTION

The ECM continuously monitors its internal memory status. This self-check ensures that the ECM is functioning properly. It is diagnosed by internal "mirroring" of the main CPU and sub CPU to detect the Random Access Memory (RAM) errors. If outputs from these CPUs are different and deviate from the standards, the ECM will illuminate the MIL and set a DTC immediately.

DTC	DTC Setting Condition	Trouble Area
P0604	ECM RAM errors	ECM

MONITOR STRATEGY

Related DTC	P0604: ECM RAM error
Required sensors/Components	ECM
Frequency of Operation	Continuous
Duration	16 seconds
MIL Operation	Immediate
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

Monitor runs whenever the following DTCs are not present	None

TYPICAL MALFUNCTION THRESHOLDS

Main CPU and sub CPU mirroring	Fail

INSPECTION PROCEDURE

1	CHECK OTHER DTC OUTPUT (IN ADDITION TO DTC P0604)

(a) Connect the intelligent tester to the DLC3.
(b) Turn the ignition switch to the ON position.
(c) Turn the tester on.
(d) Clear the DTC.
(e) Turn the ignition switch off.
(f) Disconnect the battery negative terminal and wait for 1 minute.
(g) Connect the battery negative terminal.
(h) Turn the ignition switch to the ON position.
(i) Enter the following menus: DIAGNOSIS / ENHANCED II / DTC INFO / CURRENT CODES.
(j) Read the DTCs.

Result

Display (DTC output)	Proceed to
P0604	A
No output DTC	B

B → CHECK FOR INTERMITTENT PROBLEMS

A

REPLACE ECM (See page ES-407)

DTC	P0606	ECM / PCM Processor

DESCRIPTION

The ECM continuously monitors its internal processors (CPUs), A/F sensor transistors and heated oxygen sensor (HO2S) transistors. This self-check ensures that the ECM is functioning properly. These are diagnosed by internal "mirroring" of the main and sub CPUs to detect the processors error. If outputs from the processors deviate from the standards, the ECM will illuminate the MIL and set a DTC immediately.

DTC	DTC Setting Condition	Trouble Area
P0606	• ECM CPUs malfunction • A/F sensor transistors malfunction • HO2S transistors malfunction	• Exhaust gas leak • HO2 Sensor • ECM

MONITOR STRATEGY

Related DTC	P0606: ECM range check
Required sensors/Components (main)	ECM
Required sensors/Components (sub)	APP sensor, TP sensor, Brake switch, Cruise control, A/F sensor, HO2 sensor
Frequency of Operation	Continuous
Duration	60 seconds
MIL Operation	Immediate
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

Monitor runs whenever the following DTCs are not present	None
Engine	Running
Estimated A/F sensor temperature	450 to 800°C (842 to 1,472°F)
Estimated HO2S temperature	450 to 800°C (842 to 1,472°F)

TYPICAL MALFUNCTION THRESHOLDS

Difference of main APP and sub APP	0.3 V or more
Difference of main TP and sub TP	0.3 V or more
Difference of main brake switch signal and sub brake switch signal	Different
Cruise control	Fail
A/F sensor transistors	Fail
HO2S transistors	Fail

INSPECTION PROCEDURE

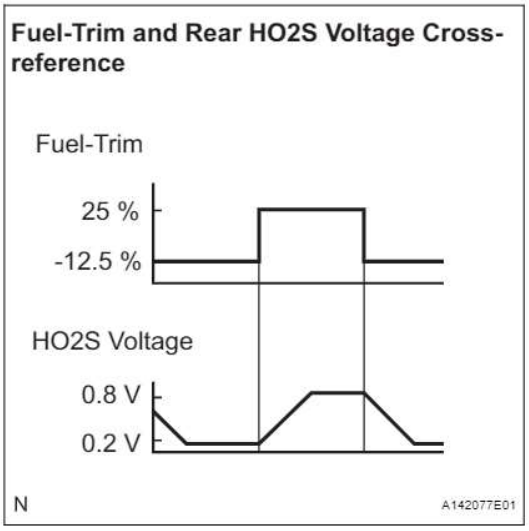
1	CHECK FOR EXHAUST GAS LEAK

(a) Allow the engine to idle.
(b) Check for exhaust gas leak around the heated oxygen sensor.
OK:
No leak from the heated oxygen sensor.

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

OK

2	CHECK HEATED OXYGEN SENSOR



(a) Connect the intelligent tester to the DLC3.
(b) Start the engine and turn the tester on.
(c) Warm up the engine at an engine speed of 2,500rpm for approximately 90 seconds.
(d) Enter the following menus: DIAGNOSIS / ENHANCED II / ACTIVE TEST / A/F CONTROL.
(e) Perform the A/F CONTROL operation with the engine in an idling condition (press the RIGHT or LEFT button to change the fuel injection volume).
(f) Monitor the voltage outputs of the HO2 sensors (O2S B1S2) displayed on the tester.
HINT:
- The A/F CONTROL operation lowers the fuel injection volume by 12.5% or increases the injection volume by 25%.
- Each sensor reacts in accordance with increases in the fuel injection volume.

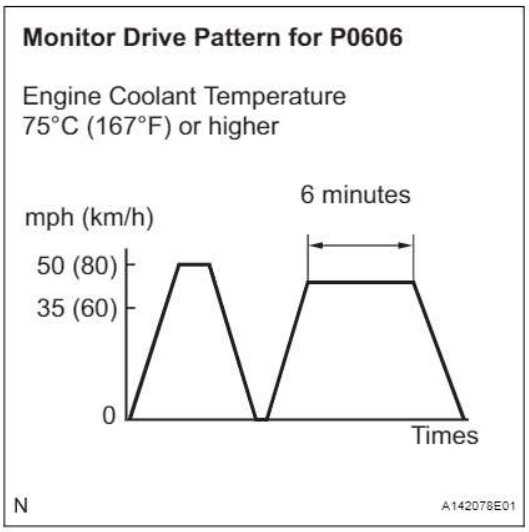
Standard voltage

Tester Display (Sensor)	Injection Volume	Voltage
O2S B1S2	-12.5%	Less than 0.2 V
	+25%	More than 0.8 V

NG → REPLACE HEATED OXYGEN SENSOR (See page EC-21)

OK

3	CHECK WHETHER DTC OUTPUT RECURS (IN ADDITION TO DTC P0606)



(a) Connect the intelligent tester to the DLC3.
(b) Turn the ignition switch to the ON position.
(c) Turn the tester on.
(d) Clear the DTC.
(e) Turn the ignition switch off.
(f) Disconnect the battery negative terminal and wait for 1 minute.
(g) Connect the battery negative terminal.
(h) Start the engine.
(i) Perform the drive pattern.
  (1) Warm up the engine.
  (2) Accelerate the vehicle to 50 mph (80 km/h) and stop the vehicle.
  (3) Drive the vehicle at 35 to 50 mph (60 to 80 km/h) for 5 minutes or more.
(j) Enter the following menus: DIAGNOSIS / ENHANCED II / DTC INFO / CURRENT CODES.
(k) Read the DTCs.

Result

Display (DTC output)	Proceed to
P0606	A
No output DTC	B

B → CHECK FOR INTERMITTENT PROBLEMS

A

REPLACE ECM (See page ES-407)

ES

DTC	P0607	Control Module Performance

DESCRIPTION

The ECM continuously monitors its main and sub CPUs. This self-check ensures that the ECM is functioning properly. If outputs from the CPUs are different and deviate from the standards, the ECM will illuminate the MIL and set a DTC immediately.
The ECM also monitors the cruise control cancel circuit. If this circuit malfunctions, the ECM will set a DTC immediately (MIL is not illuminated).

DTC No.	DTC Detection Condition	Trouble Area
P0607	• ECM main CPU error • ECM sub CPU error • Cruise control cancel circuit malfunction	ECM

ES

NOTICE:
First check for an exhaust gas leak around the HO2S if P0606 is present. An exhaust gas leak generates noise in the HO2S output. The ECM may interpret this as an HO2S transistor malfunction.

MONITOR STRATEGY

Related DTC	P0607: ECM CPU malfunction
Required sensors/Components	ECM
Frequency of Operation	Continuous
Duration	Within 1 second
MIL Operation	Immediate
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

Monitor runs whenever the following DTCs are not present	None

TYPICAL MALFUNCTION THRESHOLDS

Either of the following conditions is met:	Condition A or B
A. All of the following conditions are met:	Conditions (a), (b) and (c)
(a) CPU reset	1 time or more
(b) Learned TP - learned APP	0.4 V or more
(c) Throttle actuator	OFF
B. CPU reset	2 times or more

INSPECTION PROCEDURE

1	CHECK WHETHER DTC OUTPUT RECURS (IN ADDITION TO DTC P0607)

(a) Connect the intelligent tester to the DLC3.
(b) Turn the ignition switch to the ON position.
(c) Turn the tester on.
(d) Clear the DTC.
(e) Turn the ignition switch off.
(f) Disconnect the battery negative terminal and wait for 1 minute.
(g) Connect the battery negative terminal.

(h) Turn the ignition switch to the ON position.
(i) Enter the following menus: DIAGNOSIS / ENHANCED II / DTC INFO / CURRENT CODES.
(j) Read the DTCs.

Result

Display (DTC output)	Proceed to
P0607	A
No output DTC	B

B → CHECK FOR INTERMITTENT PROBLEMS

A → REPLACE ECM

ES

DTC	P0617	Starter Relay Circuit High

DESCRIPTION

While the engine is cranked, the positive battery voltage is applied to terminal STA of the ECM.
If the ECM detects the Starter Control (STA) signal while the vehicle is being driven, it determines that there is a malfunction in the STA circuit. The ECM then illuminates the MIL and sets the DTC.
This monitor runs when the vehicle is driven at 12.4 mph (20 km/h) for over 20 seconds.

DTC No.	DTC Detection Condition	Trouble Area
P0617	Conditions (a), (b) and (c) are met when positive (+B) battery voltage 10.5 V or more applied to ECM for 20 seconds (1 trip detection logic): (a) Vehicle speed 12.4 mph (20 km/h) or more (b) Engine speed 1,000 rpm or more (c) STA signal ON	• Park/Neutral Position (PNP) switch (A/T*) • Clutch start switch (M/T*) • Starter relay circuit • Ignition switch • ECM

*: A/T denotes Automatic Transaxle models and M/T denotes Manual Transaxle models.

MONITOR STRATEGY

Related DTCs	P0617: Starter signal
Required Sensors/Components (Main)	STARTER relay, PNP switch, Clutch start switch and Ignition switch
Required Sensors/Components (Related)	Vehicle Speed Sensor (VSS), Crankshaft Position (CKP) sensor
Frequency of Operation	Continuous
Duration	20 seconds
MIL Operation	Immediate
Sequence of Operation	None

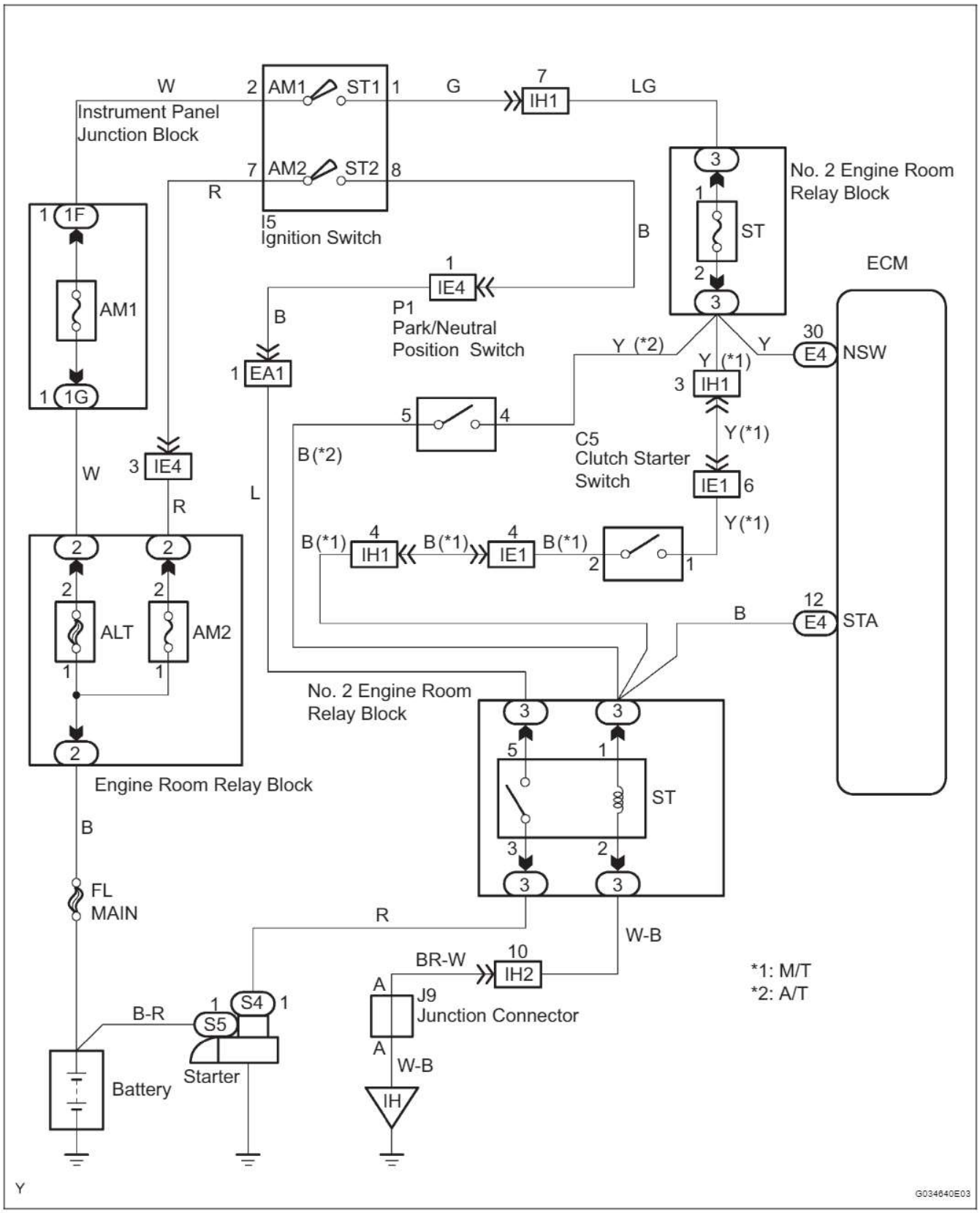
TYPICAL ENABLING CONDITIONS

Monitor runs whenever the following DTCs are not present	None
Battery voltage	10.5 V or more
Vehicle speed	12.4 mph (20 km/h) or more
Engine speed	1,000 rpm or more

TYPICAL MALFUNCTION THRESHOLDS

Starter signal	ON

WIRING DIAGRAM



INSPECTION PROCEDURE

HINT:

- The following troubleshooting flowchart is based on the premise that the engine is cranked normally. If the engine does not crank, proceed to the problem symptoms table (See page ES-23).
- 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.

1 READ VALUE USING INTELLIGENT TESTER (STARTER SIGNAL)

ES

(a) Connect the intelligent tester to the DLC3.
(b) Turn the ignition switch to the ON position and turn the tester on.
(c) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DATA LIST / ALL / STARTER SIG.
(d) Check the value displayed on the tester when the ignition switch is turned to the ON and START positions.

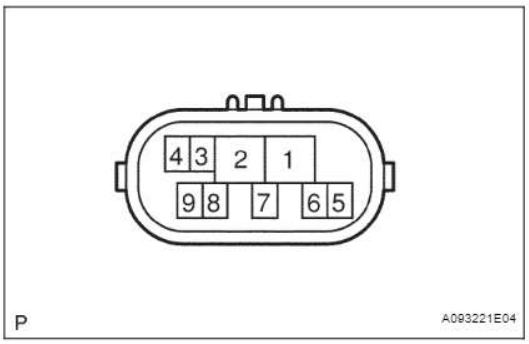
Result

Ignition Switch Position	STARTER SIG
ON	OFF
START	ON

OK → **REPLACE ECM**

NG

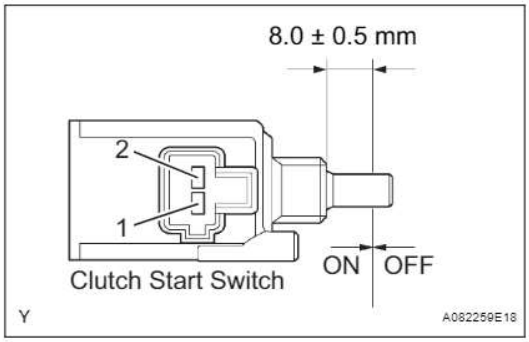
2 INSPECT PARK/NEUTRAL POSITION SWITCH OR CLUTCH START SWITCH



(a) Inspect the Park/Neutral Position (PNP) switch (for A/T models).
(1) Disconnect the P1 PNP switch connector.
(2) Measure the resistance when the transmission gear selector lever is moved to each position.

Standard resistance

Gear Selector Lever Position	Tester Connection	Specified Condition
P	2 - 6, 4 - 5	Below 1 Ω
R	1 - 2	Below 1 Ω
N	2 - 9, 4 - 5	Below 1 Ω
D	2 - 7	Below 1 Ω
2	2 - 3	Below 1 Ω
L	2 - 8	Below 1 Ω



(b) Inspect the clutch start switch (for M/T models).
(1) Disconnect the C5 clutch start switch connector.
(2) Measure the resistance when the clutch start switch is ON and OFF.
Standard resistance

Switch Position	Tester Connection	Specified Condition
ON (pushed)	1 - 2	Below 1 Ω
OFF (free)	1 - 2	10 kΩ or higher

NG → **REPLACE PARK/NEUTRAL POSITION SWITCH OR CLUTCH START SWITCH (GO TO NEXT STEP AFTER REPLACEMENT)**

OK

ES

3 READ VALUE USING INTELLIGENT TESTER (STARTER SIGNAL)

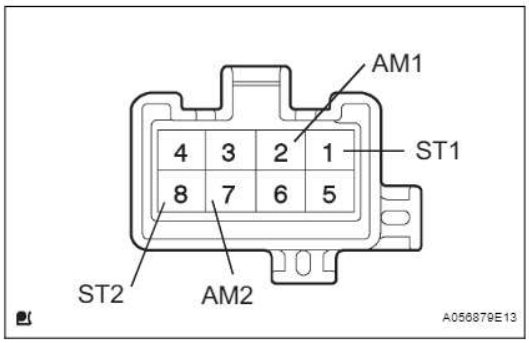
(a) Connect the intelligent tester to the DLC3.
(b) Turn the ignition switch to the ON position and turn the tester on.
(c) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DATA LIST / ALL / STARTER SIG.
(d) Check the value displayed on the tester when the ignition switch is turned to the ON and START positions.
Result

Ignition Switch Position	STARTER SIG
ON	OFF
START	ON

OK → **SYSTEM OK**

NG

4 INSPECT IGNITION OR STARTER SWITCH ASSEMBLY



(a) Disconnect the I5 ignition switch connector.
(b) Measure the resistance according to the value(s) in the table below.
Standard resistance

Switch Position	Tester Connection	Specified Condition
LOCK	All Terminals	10 kΩ or higher
START	ST1 (1) - AM1 (2) ST2 (8) - AM2 (7)	Below 1 Ω

NG → **REPLACE IGNITION OR STARTER SWITCH ASSEMBLY (GO TO NEXT STEP AFTER REPLACEMENT)**

OK

5	READ VALUE USING INTELLIGENT TESTER (STARTER SIGNAL)

(a) Connect the intelligent tester to the DLC3.
(b) Turn the ignition switch to the ON position and turn the tester on.
(c) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DATA LIST / ALL / STARTER SIG.
(d) Check the value displayed on the tester when the ignition switch is turned to the ON and START positions.

Result

Ignition Switch Position	STARTER SIG
ON	OFF
START	ON

ES

OK → SYSTEM OK

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

DTC	P0630	VIN not Programmed or Mismatch - ECM / PCM

DESCRIPTION

DTC P0630 is set if the Vehicle Indication Number (VIN) is not stored in the ECM or the input VIN is not accurate. Input the VIN with the intelligent tester (See page ES-11).

DTC No.	DTC Detection Condition	Trouble Area
P0630	• VIN not stored in ECM • Input VIN incorrect (1 trip detection logic)	ECM

MONITOR STRATEGY

Related DTCs	P0630: VIN not programmed
Required Sensors/Components (Main)	ECM
Required Sensors/Components (Related)	-
Frequency of Operation	Continuous
Duration	0.325 seconds
MIL Operation	Immediate
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

Battery voltage	8 V or more
Ignition switch	ON
Starter	OFF

TYPICAL MALFUNCTION THRESHOLDS

VIN code	Not programmed

COMPONENT OPERATING RANGE

VIN code	Programmed

INSPECTION PROCEDURE

1	READ CURRENT DTC

NOTICE:
If P0630 is set, the VIN must be input to the ECM using the intelligent tester. However, all DTCs are cleared automatically by the tester when inputting the VIN. If DTCs other than P0630 are set, check them first.

NEXT

2	INPUT VIN WITH INTELLIGENT TESTER

NEXT

END

DTC	P0657	Actuator Supply Voltage Circuit / Open

DESCRIPTION

The ECM monitors the output voltage to the throttle actuator. This self-check ensures that the ECM is functioning properly. The output voltage is usually 0 V when the ignition switch is turned off. If the output voltage is higher than 7 volts when the ignition switch is turned off, the ECM will illuminate the MIL and set a DTC when the ignition switch is turned on.

DTC	DTC Detection Condition	Trouble Area
P0657	Throttle actuator power supply error	ECM

MONITOR STRATEGY

Related DTC	P0657: ETCS power supply
Required sensors/Components (main)	ECM
Required sensors/Components (sub)	Throttle actuator
Frequency of Operation	Once per driving cycle
Duration	Within 1 second
MIL Operation	Immediate
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

Monitor will run whenever this DTC is not present	None
Ignition switch	From ON to OFF

TYPICAL MALFUNCTION THRESHOLDS

Throttle actuator power supply	7 V or more

INSPECTION PROCEDURE

1	CHECK WHETHER DTC OUTPUT RECURS (IN ADDITION TO DTC P0657)

(a) Connect the intelligent tester to the DLC3.
(b) Turn the ignition switch to the ON position.
(c) Turn the tester on.
(d) Clear the DTC.
(e) Turn the ignition switch off.
(f) Disconnect the battery negative terminal and wait for 1 minute.
(g) Connect the battery negative terminal.
(h) Turn the ignition switch to the ON position for 10 seconds.
(i) Turn the ignition switch off.
(j) Turn the ignition switch to the ON position.
(k) Enter the following menus: DIAGNOSIS / ENHANCED II / DTC INFO / CURRENT CODES.
(l) Read the DTCs.

Result

Display (DTC output)	Proceed to
P0657	A
No output DTC	B

B → CHECK FOR INTERMITTENT PROBLEMS

A

REPLACE ECM

ES

DTC	P0724	Brake Switch "B" Circuit High

DESCRIPTION

The purpose of this circuit is to prevent the engine from stalling while driving in the lock-up condition when the brakes are suddenly applied.
When the brake pedal is depressed, this switch sends a signal to the ECM. Then the ECM cancels the operation of the lock-up clutch while braking is in progress.

DTC No.	DTC Detection Condition	Trouble Area
P0724	Stop light switch remains ON even when vehicle is driven in GO (18.63 mph (30 km/h) or more) and STOP (less than 1.86 mph (3 km/h)) pattern 5 times (2 trip detection logic)	• Short in stop light switch signal circuit • Stop light switch • ECM

ES

MONITOR DESCRIPTION

This DTC indicates that the stop light switch remains ON. When the stop light switch remains ON during GO and STOP driving, the ECM interprets this as a fault in the stop light switch. Then the MIL illuminates and the ECM stores the DTC. The vehicle must GO (18.63 mph (30 km/h) or more) and STOP (less than 1.86 mph (3 km/h)) 5 times for 2 driving cycles in order for the DTC to be output.

MONITOR STRATEGY

Related DTCs	P0724: Stop light switch/Range check/Rationality
Required sensors/Components	Stop light switch, Vehicle speed sensor
Frequency of operation	Continuous
Duration	GO and STOP 5 times
MIL operation	2 driving cycles
Sequence of operation	None

TYPICAL ENABLING CONDITIONS

The monitor will run whenever this DTC is not present.	None
Battery voltage	8 V or more
Starter	OFF
Ignition switch	ON
GO (Vehicle speed is 18.63 mph (30 km/h) or more)	Once
STOP (Vehicle speed is less than 1.86 mph (3 km/h))	Once

TYPICAL MALFUNCTION THRESHOLDS

Brake switch	Stuck ON

WIRING DIAGRAM

Refer to DTC P0504 (See page ES-215).

INSPECTION PROCEDURE

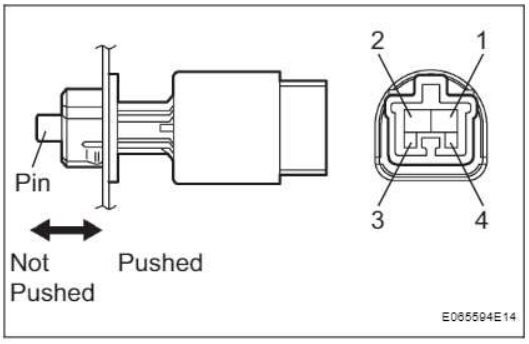
HINT:
Using the intelligent tester's DATA LIST allows switch, sensor, actuator and other item values to be read without removing any parts. Reading the DATA LIST early in troubleshooting is one way to save time.
NOTICE:
In the table below, the values listed under "Normal Condition" are reference values. Do not depend solely on these reference values when deciding whether a part is faulty or not.

1. Warm up the engine.
2. Turn the ignition switch off.
3. Connect the intelligent tester to the CAN VIM. Then connect the CAN VIM to the DLC3.
4. Turn the ignition switch to the ON position.
5. Turn the intelligent tester on.
6. Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DATA LIST.
7. Follow the instructions on the tester and read the DATA LIST.

Item	Measurement Item/Range	Normal Condition	Diagnostic Note
STOP LIGHT SW	Stop light switch status/ ON or OFF	• Brake pedal is depressed: ON • Brake pedal is released: OFF	-

ES

1 INSPECT STOP LIGHT SWITCH



(a) Remove the A3 stop light switch.
(b) Measure the resistance according to the value(s) in the table below.

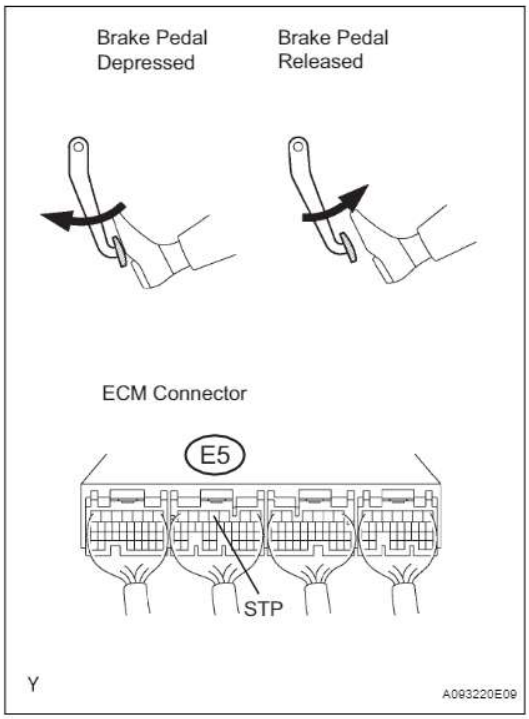
Standard resistance

Tester Connection	Switch Condition	Specified Condition
1 - 2	Pin pushed (pedal released)	Below 1 Ω
1 - 2	Pin not pushed (pedal depressed)	10 kΩ or higher
3 - 4	Pin pushed (pedal released)	10 kΩ or higher
3 - 4	Pin not pushed (pedal depressed)	Below 1 Ω

NG → **REPLACE STOP LIGHT SWITCH**

OK

2	CHECK WIRE HARNESS (ECM - BATTERY)



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

Standard voltage

Tester Connection	Condition	Specified Condition
E5-4 (STP) - Body ground	Brake pedal is depressed	10 to 14 V
E5-4 (STP) - Body ground	Brake pedal is released	Below 1 V

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

REPLACE ECM

DTC	P2102	Throttle Actuator Control Motor Circuit Low

DTC	P2103	Throttle Actuator Control Motor Circuit High

DESCRIPTION

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

HINT:

ES

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 (1 trip detection logic): • Hybrid IC diagnosis failure • Hybrid IC current limiter port failure	• 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 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: 2 seconds P2103: 0.1 second or 0.6 seconds
MIL Operation	Immediate
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

Monitor runs whenever the following DTCs are not present	None

P2102:

Throttle actuator	Activated

Duty ratio to open throttle actuator	80% or more
Throttle actuator power supply	8 V or more

P2103:

Throttle actuator	Activated
Throttle actuator power supply	8 V or more
Battery voltage	8 V or more
Starter	OFF

TYPICAL MALFUNCTION THRESHOLDS

P2102:

Throttle actuator current	Less than 0.5 A

P2103:

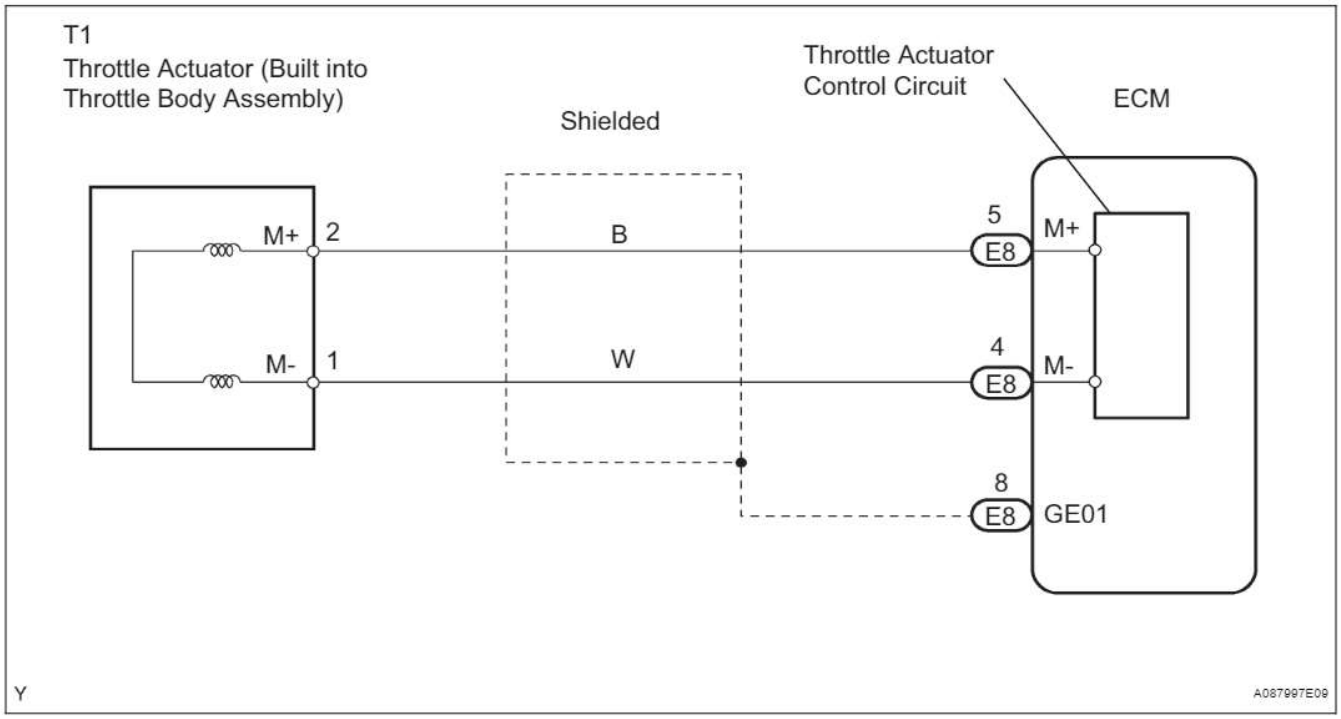
Hybrid IC current limiter port	Fail

ES

FAIL-SAFE

When any of these DTCs, as well as other DTCs relating to ETCS (Electronic Throttle Control System) malfunctions, are set, the ECM enters fail-safe mode. During fail-safe mode, the ECM cuts the current to the throttle actuator off, and the throttle valve is returned to a 6.5° throttle angle by the return spring. The ECM then adjusts the engine output by controlling the fuel injection (intermittent fuel-cut) and ignition timing, in accordance with the accelerator pedal opening angle, to allow the vehicle to continue at a minimal speed. If the accelerator pedal is depressed firmly and gently, the vehicle can be driven slowly. Fail-safe mode continues until a pass condition is detected, and the ignition switch is then turned off.

WIRING DIAGRAM



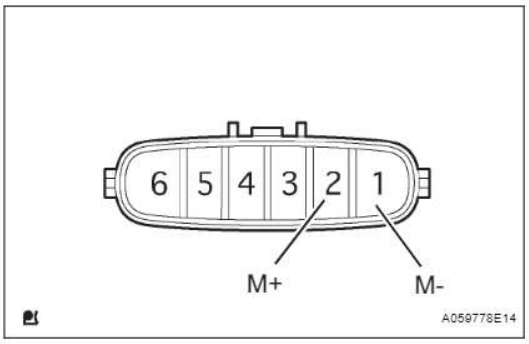
INSPECTION PROCEDURE

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.
- 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.

ES

1 INSPECT THROTTLE BODY (THROTTLE ACTUATOR RESISTANCE)



(a) Disconnect the T1 throttle body connector.
(b) Measure the resistance according to the value(s) in the table below.

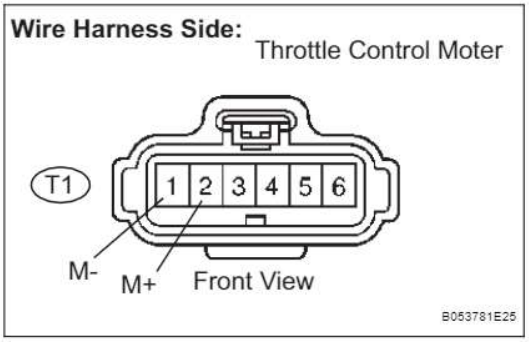
Standard resistance

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

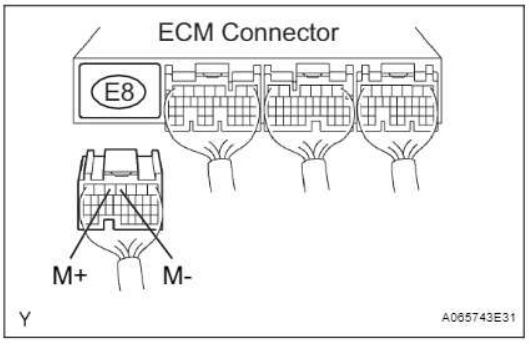
NG → **REPLACE THROTTLE BODY**

OK

2 CHECK WIRE HARNESS (THROTTLE ACTUATOR - ECM)



(a) Disconnect the T1 throttle body connector.



(b) Disconnect the E8 ECM connector.
(c) Measure the resistance according to the value(s) in the table below.

Standard resistance

Tester Connection	Specified Condition
M+ (T1-2) - M+ (E8-5)	Below 1 Ω
M- (T1-1) - M- (E8-4)	Below 1 Ω
M+ (T1-2) or M+ (E8-5) - Body ground	10 kΩ or higher
M- (T1-1) or M- (E8-4) - Body ground	10 kΩ or higher

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

OK

3	INSPECT THROTTLE BODY

(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

OK

REPLACE ECM

DTC	P2111	Throttle Actuator Control System - Stuck Open

DTC	P2112	Throttle Actuator Control System - Stuck Closed

DESCRIPTION

The throttle actuator is operated by the ECM, and opens and closes the throttle valve using gears. The opening angle of the throttle valve is detected by the Throttle Position (TP) sensor, which is mounted on the throttle body. The TP sensor provides feedback to the ECM in order that it can control the throttle actuator, and therefore the throttle valve, appropriately in response to driver inputs.

HINT:

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

DTC No.	DTC Detection Condition	Trouble Area
P2111	Throttle actuator does not close when signaled by ECM (1 trip detection logic)	• Throttle actuator • Throttle body assembly • Throttle valve
P2112	Throttle actuator does not open when signaled by ECM (1 trip detection logic)	• Throttle actuator • Throttle body assembly • 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 (Related)	-
Frequency of Operation	Continuous
Duration	0.5 seconds
MIL Operation	Immediate
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

All:

Monitor runs whenever the following DTCs are not present	None

P2111 (Throttle actuator stuck open):

All of the following conditions are met:	-
System guard*	ON
Throttle actuator current	2 A or more
Throttle actuator close duty ratio	80% or more

P2112 (Throttle actuator stuck closed):

All of the following conditions are met:	-
System guard*	ON
Throttle actuator current	2 A or more
Throttle actuator open duty-cycle	80% or more

* System guard sets when the 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

FAIL-SAFE

When any of these DTCs, as well as other DTCs relating to ETCS (Electronic Throttle Control System) malfunctions, are set, the ECM enters fail-safe mode. During fail-safe mode, the ECM cuts the current to the throttle actuator off, and the throttle valve is returned to a 6.5° throttle angle by the return spring. The ECM then adjusts the engine output by controlling the fuel injection (intermittent fuel-cut) and ignition timing, in accordance with the accelerator pedal opening angle, to allow the vehicle to continue at a minimal speed. If the accelerator pedal is depressed firmly and gently, the vehicle can be driven slowly. Fail-safe mode continues until a pass condition is detected, and the ignition switch is then turned off.

WIRING DIAGRAM

Refer to DTC P2102 (See page ES-253).

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.

1	CHECK OTHER DTC OUTPUT (IN ADDITION TO DTC P2111 OR P2112)

(a) Connect the intelligent tester to the DLC3.
(b) Turn the ignition switch to the ON position.
(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
P2111 or P2112	A
P2111 or P2112 and other DTCs	B

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

B → GO TO DTC CHART

A

2 CHECK 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.

ES

NG → REPLACE THROTTLE BODY

OK

3 CHECK DTC OUTPUT

(a) Connect the intelligent tester to the DLC3.
(b) Turn the ignition switch to the ON position.
(c) Turn the tester on.
(d) Clear the DTCs (See page ES-32).
(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

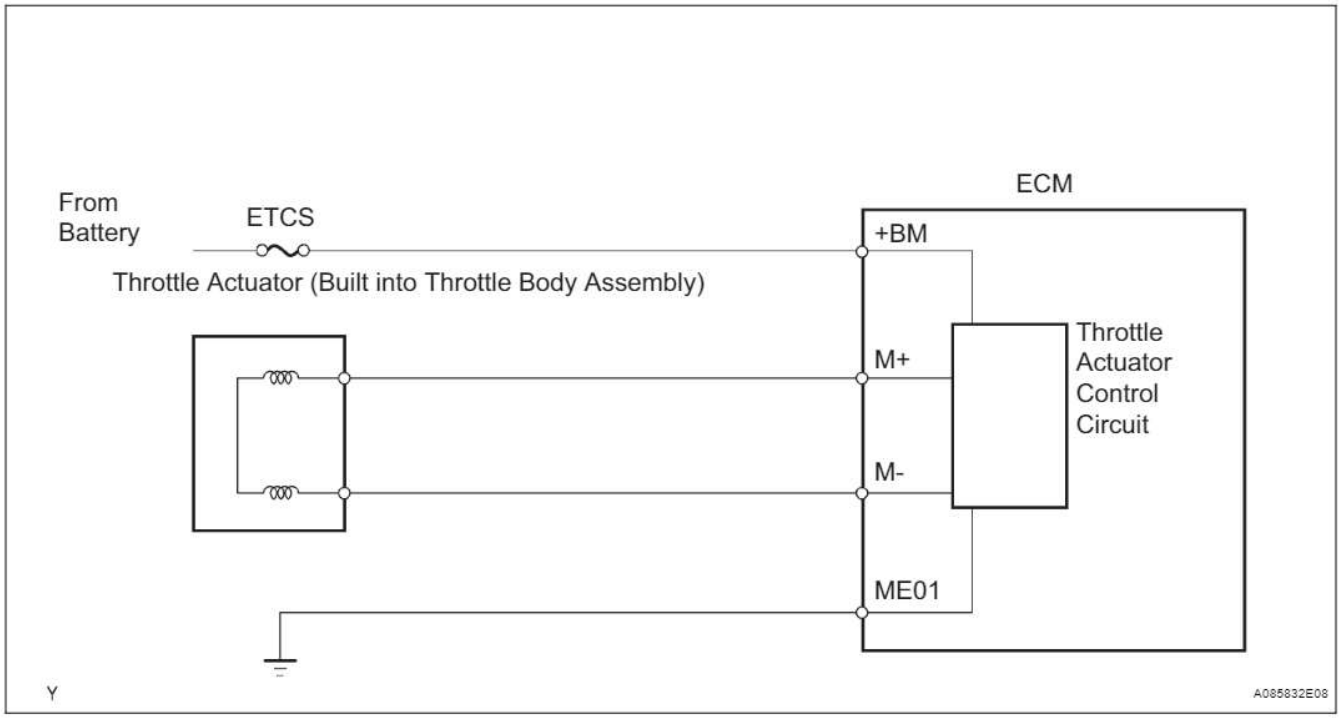
A

CHECK FOR INTERMITTENT PROBLEM

DTC	P2118	Throttle Actuator Control Motor Current Range / Performance

DESCRIPTION

The ETCS (Electronic Throttle Control System) has a dedicated power supply circuit. The voltage (+BM) is monitored and when it is low (less than 4 V), the ECM determines that there is a malfunction in the ETCS and cuts off the current to the throttle actuator.
When the voltage becomes unstable, the ETCS itself becomes unstable. For this reason, when the voltage is low, the current to the throttle actuator is cut. If repairs are made and the system returns to normal, turn the ignition switch 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.



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, a 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 (Related)	None
Frequency of Operation	Continuous
Duration	0.8 seconds

MIL Operation	Immediate
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

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

TYPICAL MALFUNCTION THRESHOLDS

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

ES

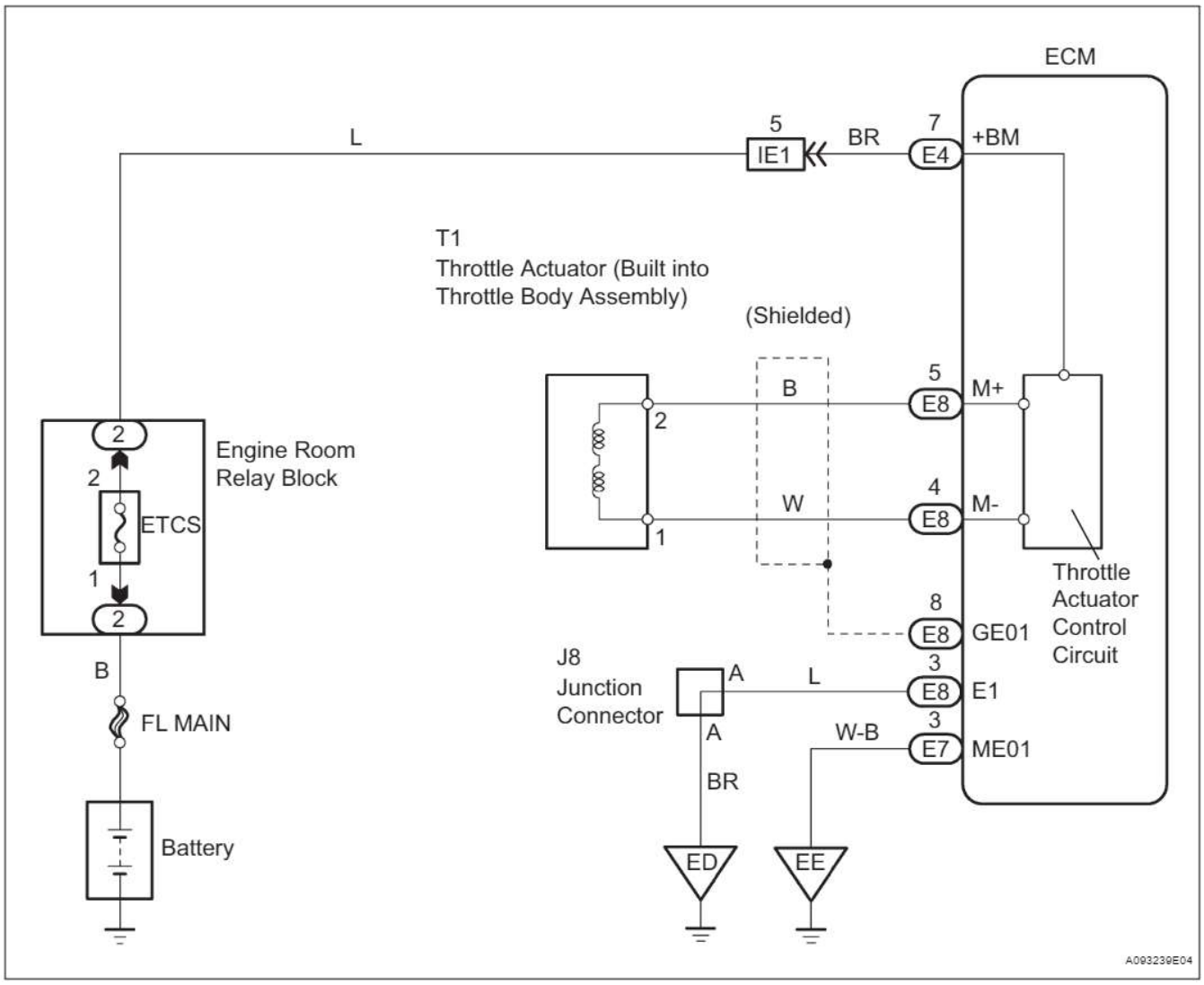
COMPONENT OPERATING RANGE

Throttle actuator power supply voltage	9 to 14 V

FAIL-SAFE

When any of these DTCs, as well as other DTCs relating to ETCS (Electronic Throttle Control System) malfunctions, are set, the ECM enters fail-safe mode. During fail-safe mode, the ECM cuts the current to the throttle actuator off, and the throttle valve is returned to a 6.5° throttle angle by the return spring. The ECM then adjusts the engine output by controlling the fuel injection (intermittent fuel-cut) and ignition timing, in accordance with the accelerator pedal opening angle, to allow the vehicle to continue at a minimal speed. If the accelerator pedal is depressed firmly and gently, the vehicle can be driven slowly. Fail-safe mode continues until a pass condition is detected, and the ignition switch is then turned off.

WIRING DIAGRAM

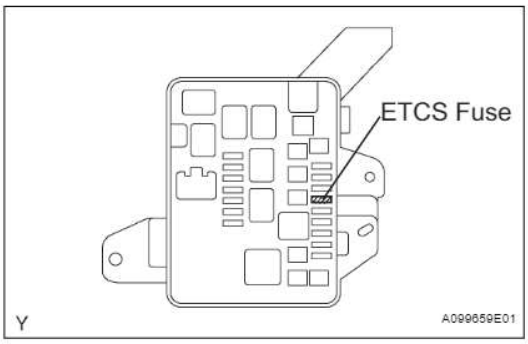


INSPECTION PROCEDURE

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.

1 CHECK FUSE (ETCS)

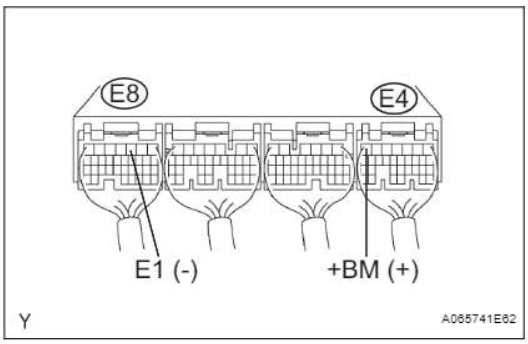


(a) Remove the ETCS fuse from the engine room relay block.
(b) Measure the resistance of the fuse.
Standard resistance:
Below 1 Ω

NG → **CHECK FOR SHORT IN ALL HARNESSES AND COMPONENTS CONNECTED TO FUSE**

OK

2 INSPECT ECM (+BM VOLTAGE)



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

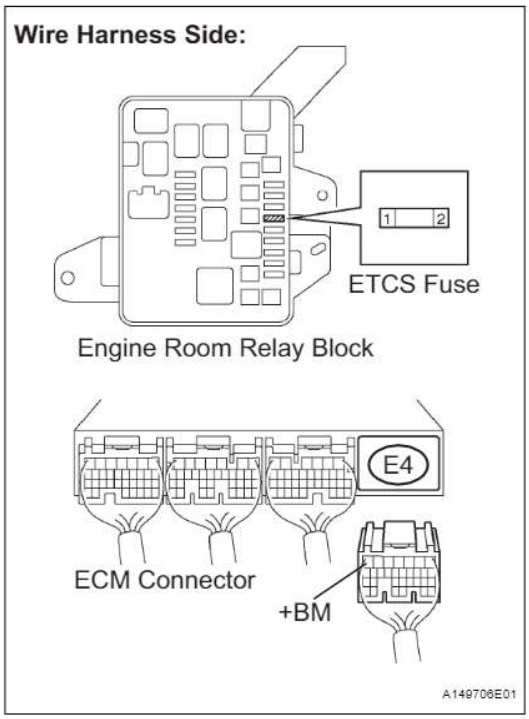
Tester Connection	Specified Condition
+BM (E4-7) - E1 (E8-3)	9 to 14 V

NG → **Go to step 3**

OK

CHECK FOR INTERMITTENT PROBLEMS

3	CHECK WIRE HARNESS (ECM - ETCS FUSE, ETCS FUSE - BATTERY)



(a) Check the wire harness between the ETCS fuse and ECM.
(1) Remove the ETCS fuse from the engine room relay block.
(2) Disconnect the E4 ECM connector.
(3) Measure the resistance according to the value(s) in the table below.
Standard resistance

Tester Connection	Specified Condition
ETCS fuse (2) - +BM (E4-7)	Below 1 Ω
ETCS fuse (2) or +BM (E4-7) - Body ground	10 kΩ or higher

(b) Check the wire harness between the ETCS fuse and positive (+) battery cable.
(1) Remove the ETCS fuse from the engine room relay block.
(2) Disconnect the cable from the positive (+) battery cable.
(3) Measure the resistance according to the value(s) in the table below.
Standard resistance

Tester Connection	Specified Condition
Positive battery cable terminal - ETCS fuse (1)	Below 1 Ω
Positive battery cable terminal or ETCS fuse (1) - Body ground	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

REPLACE ECM

DTC	P2119	Throttle Actuator Control Throttle Body Range / Performance

DESCRIPTION

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

DTC 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 2 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 the accelerator pedal being fully depressed (throttle valve fully open).

MONITOR STRATEGY

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

TYPICAL ENABLING CONDITIONS

Monitor runs whenever the following DTCs are not present	None
System guard*	ON
*System guard sets when the 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 of the following conditions A or B is met:	-
A. Commanded closed TP - current closed TP	0.3 V or more for 1 second
B. Commanded open TP - current open TP	0.3 V or more for 0.6 seconds

FAIL-SAFE

When any of these DTCs, as well as other DTCs relating to ETCS (Electronic Throttle Control System) malfunctions, are set, the ECM enters fail-safe mode. During fail-safe mode, the ECM cuts the current to the throttle actuator off, and the throttle valve is returned to a 6.5° throttle angle by the return spring. The ECM then adjusts the engine output by controlling the fuel injection (intermittent fuel-cut) and ignition timing, in accordance with the accelerator pedal opening angle, to allow the vehicle to continue at a minimal speed. If the accelerator pedal is depressed firmly and gently, the vehicle can be driven slowly. Fail-safe mode continues until a pass condition is detected, and the ignition switch is then turned off.

WIRING DIAGRAM

Refer to DTC P2102 (See page ES-253).

INSPECTION PROCEDURE

ES

HINT:

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

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

(a) Connect the intelligent tester to the DLC3.
(b) Turn the ignition switch to the ON position.
(c) Turn the tester on.
(d) On the tester, select the following menu items: 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.

B → GO TO DTC CHART

A

2	CHECK WHETHER DTC OUTPUT RECURS (DTC P2119)

(a) Connect the intelligent tester to the DLC3.
(b) Turn the ignition switch to the ON position.
(c) Turn the tester on.
(d) Clear the DTCs (See page ES-32).
(e) Allow the engine to idle for 15 seconds.

CAUTION:
Exercise extreme care and take precautions at Procedure "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) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DTC INFO / CURRENT CODES.
(i) Read the DTCs.
HINT:
The voltage output of the throttle position sensor can be checked during Procedure "B" using the intelligent tester. Variations in the voltage output indicate that the throttle actuator is in operation. To check the voltage output using the intelligent tester, enter the following menus: DIAGNOSIS / ENHANCED OBD II / DATA LIST / ALL / THROTTLE POS #1.
OK:
No DTC output.

ES

NG → **REPLACE THROTTLE BODY**

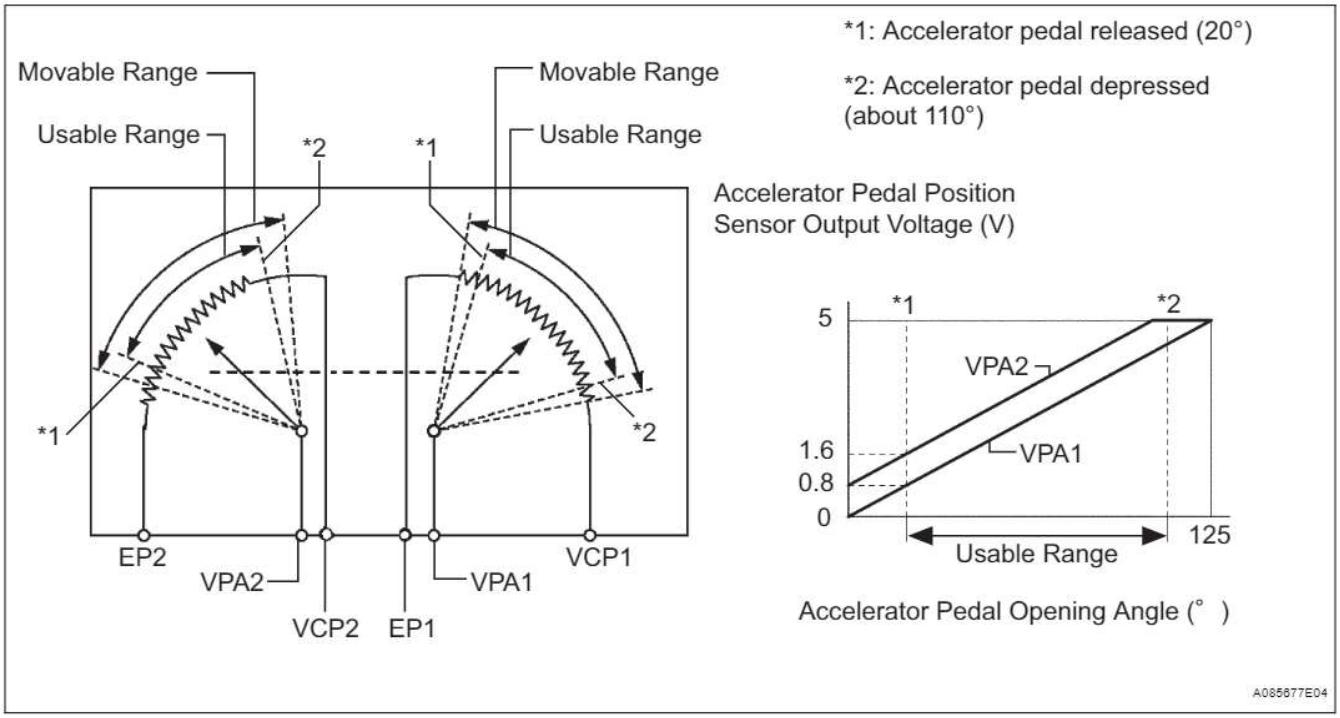
OK

NORMAL

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

DESCRIPTION

HINT:
These DTCs relate to the Accelerator Pedal Position (APP) sensor.
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: VPA1 (main) and VPA2 (sub). The voltage, which is applied to terminals VPA1 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 VPA1 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 VPA1 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 VPA1 and VPA2, and controls the throttle actuator according to these signals.



DTC No.	DTC Detection Condition	Trouble Area
P2120	VPA1 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	VPA1 0.4 V or less for 0.5 seconds or more when accelerator pedal fully released (1 trip detection logic)	• APP sensor • Open in VCP1 circuit • Open or ground short in VPA1 circuit • ECM
P2123	VPA1 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 1.2 V or less for 0.5 seconds or more when accelerator pedal 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 4.8 V or more (b) VPA1 between 0.4 V and 3.45 V	• APP sensor • Open in EPA2 circuit • ECM
P2138	Condition (a) or (b) continues for 2.0 seconds or more (1 trip detection logic): (a) Difference between VPA1 and VPA2 0.02 V or less (b) VPA1 0.4 V or less and VPA2 1.2 V or less	• Short between VPA1 and VPA2 circuits • APP sensor • ECM

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

Trouble Area	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 0.2 V	0 to 0.2 V	0 to 0.2 V	0 to 0.2 V
Open or ground short in VPA circuit	0 to 0.2 V	1.2 to 2.0 V	0 to 0.2 V	3.4 to 5.0 V

Trouble Area	ACCEL POS #1 When AP Released	ACCEL POS #2 When AP Released	ACCEL POS #1 When AP Depressed	ACCEL POS #2 When AP Depressed
Open or ground short in VPA2 circuit	0.5 to 1.1 V	0 to 0.2 V	2.5 to 4.5 V	0 to 0.2 V
EPA circuit open	4.5 to 5.0 V	4.5 to 5.0 V	4.5 to 5.0 V	4.5 to 5.0 V
Normal condition	0.5 to 1.1 V	1.2 to 2.0 V	2.5 to 4.5 V	3.4 to 5.0 V

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

MONITOR DESCRIPTION

When either of the voltage outputs of VPA1 or VPA2 deviates from the standard range, or the difference between the voltage outputs of the 2 sensor circuits is less than the threshold, the ECM determines that there is a malfunction in the APP sensor. The ECM then illuminates the MIL and sets a DTC.
Example:
When the voltage output of VPA1 drops below 0.4 V for more than 0.5 seconds while the accelerator pedal is being 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.

ES

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 (Related)	-
Frequency of Operation	Continuous
Duration	0.5 seconds: P2120, P2122, P2125 and P2127 2.0 seconds: P2123, P2128 and P2138
MIL Operation	Immediate
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

Monitor runs whenever the following DTCs are not present	None
Either of the following conditions 1 or 2 is met:	-
1. Ignition switch	ON
2. Throttle actuator power	ON

TYPICAL MALFUNCTION THRESHOLDS

P2120:

Either of the following conditions 1 or 2 is met:	-
1. VPA voltage when VPA2 voltage 0.04 V or more	0.4 V or less
2. VPA voltage	4.8 V or more

P2122:

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

P2123:

VPA voltage	4.8 V or more

P2125:

Either of the following conditions 1 or 2 is met:	-
1. VPA2 voltage when VPA voltage 0.04 V or more	1.2 V or less
2. VPA2 voltage when VPA 0.4 to 3.45 V	4.8 V or more

P2127:

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

P2128:

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

P2138:

Either of the following conditions 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

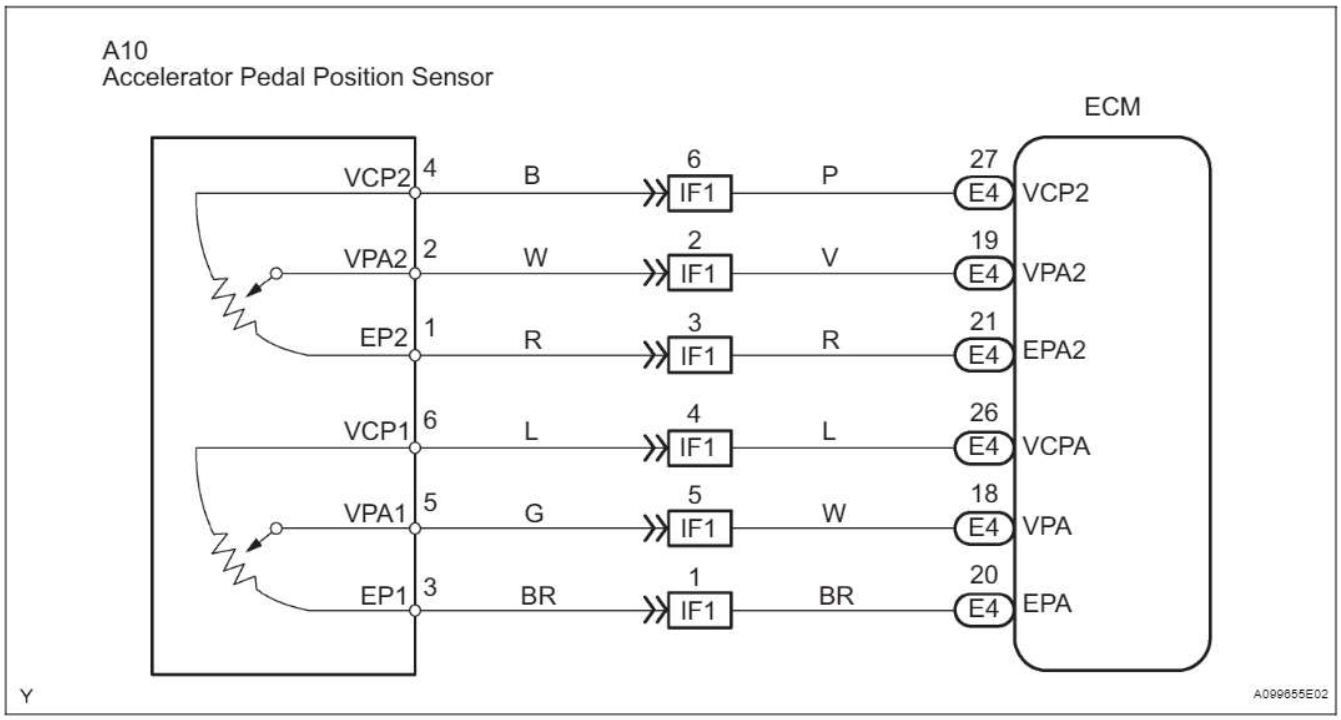
COMPONENT OPERATING RANGE

VPA1 voltage	0.5 to 4.5 V
VPA2 voltage	1.2 to 5.3 V
Difference between VPA and VAP2 voltages	More than 0.02 V

FAIL-SAFE

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

WIRING DIAGRAM

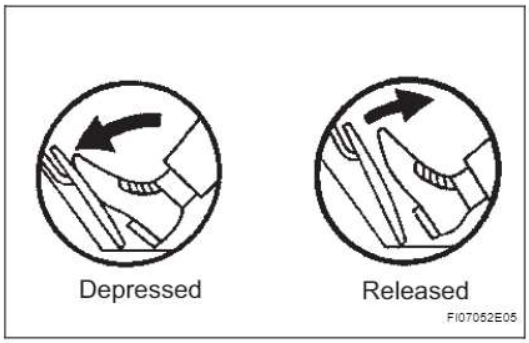


ES

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.

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



(a) Connect the intelligent tester to the DLC3.
(b) Turn the ignition switch to the ON position 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 values displayed on the tester.

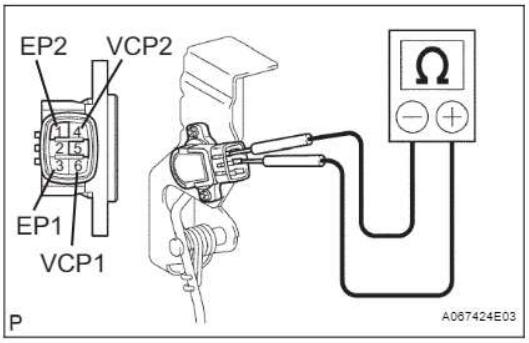
Standard voltage

Accelerator Pedal Operation	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 6

NG

2 INSPECT ACCELERATOR PEDAL ASSEMBLY (ACCELERATOR PEDAL POSITION SENSOR)



(a) Disconnect the A10 sensor connector.
(b) Measure the resistance according to the value(s) in the table below.

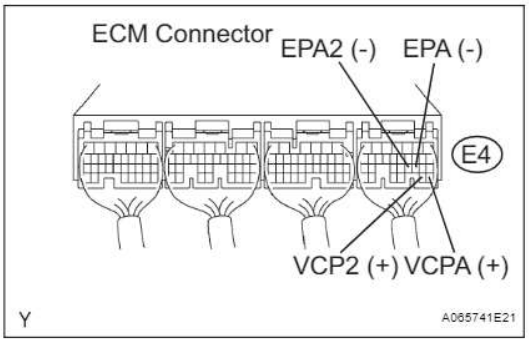
Standard resistance

Tester Connection	Specified Condition
3 - 6	1.5 to 6.0 kΩ at 20°C (68°F)
1 - 4	1.5 to 6.0 kΩ at 20°C (68°F)

NG → REPLACE ACCELERATOR PEDAL ASSEMBLY

OK

3 INSPECT ECM (VCPA AND VCP2 VOLTAGE)



(a) Turn the ignition switch to the ON position.
(b) Measure the voltage between the terminals of the E4 ECM connector.

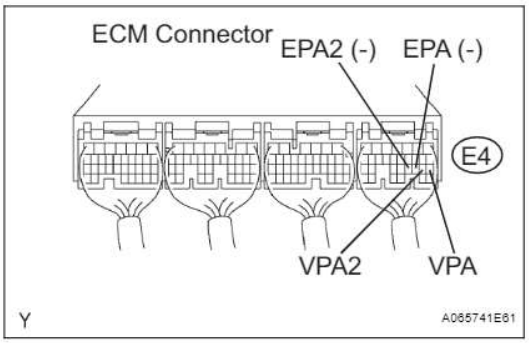
Standard voltage

Tester Connection	Specified Condition
VCPA (E4-26) - EPA (E4-20)	Between 4.5 to 5.5 V
VCP2 (E4-27) - EPA2 (E4-21)	Between 4.5 to 5.5 V

NG → REPLACE ECM

OK

4 INSPECT ECM (VPA AND VPA2 VOLTAGE)



(a) Turn the ignition switch to the ON position.
(b) Measure the voltage according to the value(s) in the table below.

Standard voltage

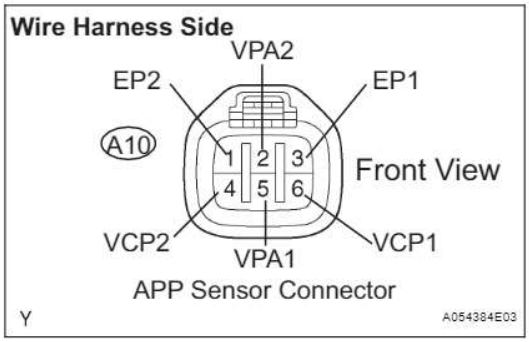
Accelerator Pedal Operation	Tester Connection	Specified Condition
Released	VPA (E4-18) - EPA (E4-20)	0.5 to 1.1 V
Depressed	VPA (E4-18) - EPA (E4-20)	2.6 to 4.5 V
Released	VPA2 (E4-19) - EPA2 (E4-21)	1.2 to 2.0 V
Depressed	VPA2 (E4-19) - EPA2 (E4-21)	3.4 to 5.3 V

NG → Go to step 5

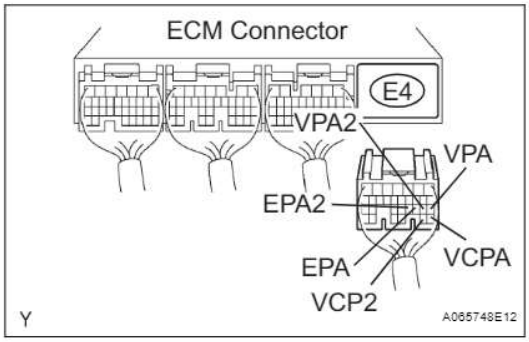
OK

REPLACE ECM

5 CHECK WIRE HARNESS (ECM - ACCELERATOR PEDAL POSITION SENSOR)



(a) Disconnect the A10 APP sensor connector.



(b) Disconnect the E4 ECM connector.
(c) Measure the resistance according to the value(s) in the table below.

Standard resistance

Tester Connection	Specified Condition
VPA1 (A10-5) - VPA (E4-18)	Below 1 Ω
EP1 (A10-3) - EPA (E4-20)	Below 1 Ω
VCP1 (A10-6) - VCPA (E4-26)	Below 1 Ω
VPA2 (A10-2) - VPA2 (E4-19)	Below 1 Ω
EP2 (A10-1) - EPA2 (E4-21)	Below 1 Ω
VCP2 (A10-4) - VCP2 (E4-27)	Below 1 Ω
VPA1 (A10-5) or VPA (E4-18) - Body ground	10 kΩ or higher
EP1 (A10-3) or EPA (E4-20) - Body ground	10 kΩ or higher
VCP1 (A10-6) or VCPA (E4-26) - Body ground	10 kΩ or higher
VPA2 (A10-2) or VPA2 (E4-19) - Body ground	10 kΩ or higher
EP2 (A10-1) or EPA2 (E4-21) - Body ground	10 kΩ or higher
VCP2 (A10-4) or VCP2 (E4-27) - Body ground	10 kΩ or higher

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

OK

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

(a) Connect the intelligent tester to the DLC3.
(b) Turn the ignition switch to the ON position and turn the tester on.
(c) Clear the DTCs (See page ES-32).
(d) Allow the engine to idle for 15 seconds.
(e) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DTC INFO / CURRENT CODES.

(f) Read the DTCs.

Result

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

B → CHECK FOR INTERMITTENT PROBLEMS

A

REPLACE ECM

ES

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

DESCRIPTION

HINT:
This DTC relates to the Accelerator Pedal Position (APP) sensor.
Refer to DTC P2120 (See page ES-267).

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

ES

MONITOR DESCRIPTION

When the difference between the voltage outputs of VPA1 and VPA2 deviates from the standard range, the ECM determines that there is a malfunction in the APP sensor. The ECM then illuminates the MIL and sets the DTC.
If the malfunction has not been repaired successfully, the DTC is set 1 second after the engine is started.

MONITOR STRATEGY

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

TYPICAL ENABLING CONDITIONS

Monitor runs whenever the 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

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

WIRING DIAGRAM

Refer to DTC P2120 (See page ES-271).

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.

1 CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P2121)

(a) Connect the intelligent tester to the DLC3.
(b) Turn the ignition switch to the ON position.
(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
P2121	A
P2121 and other DTCs	B

HINT:
If any DTCs other than P2121 are output, troubleshoot those DTCs first.

B → GO TO DTC CHART

A

2 REPLACE ACCELERATOR PEDAL ASSEMBLY

(a) Replace the accelerator pedal assembly (See page ES-410).

NEXT

3 CHECK WHETHER DTC OUTPUT RECURS (DTC P2121)

(a) Connect the intelligent tester to the DLC3.
(b) Turn the ignition switch to the ON position.
(c) Turn the tester on.
(d) Clear the DTCs (See page ES-32).
(e) Allow the engine to idle for a minute.
(f) Rev up the engine several times.
(g) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DTC INFO / CURRENT CODES.
(h) Read the DTCs.

Result

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

B → CHECK FOR INTERMITTENT PROBLEMS

A

REPLACE ECM

DTC	P2195	Oxygen (A/F) Sensor Signal Stuck Lean (Bank 1 Sensor 1)

DTC	P2196	Oxygen (A/F) Sensor Signal Stuck Rich (Bank 1 Sensor 1)

DESCRIPTION

HINT:

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

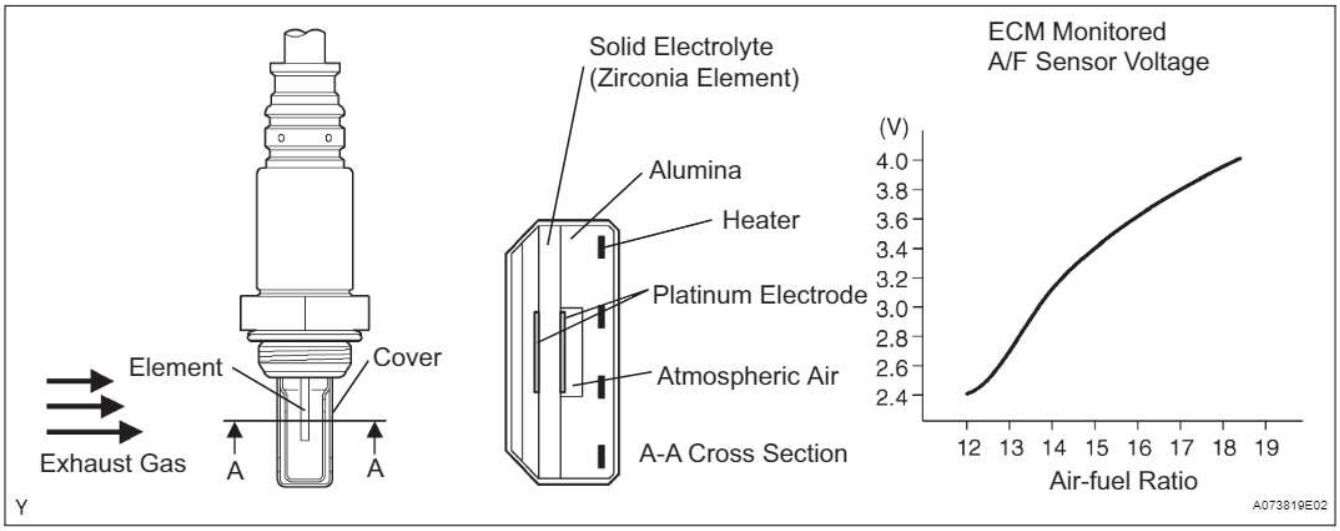
ES

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

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



DTC No.	DTC Detection Condition	Trouble Area
P2195	Conditions (a) and (b) continue for 10 seconds or more (2 trip detection logic): (a) A/F sensor voltage more than 3.8 V (b) Heated Oxygen (HO2) sensor voltage 0.15 V or more	• Open or short in A/F sensor (sensor 1) circuit • A/F sensor (sensor 1) • A/F sensor (sensor 1) heater • EFI relay • A/F sensor heater and relay circuits • Air induction system • Fuel pressure • Injector • ECM
	While fuel-cut operation performed (during vehicle deceleration), A/F sensor 3.6 mA or more for 3 seconds (2 trip detection logic)	

DTC No.	DTC Detection Condition	Trouble Area
P2196	Conditions (a) and (b) continue for 2 seconds or more (2 trip detection logic): (a) A/F sensor voltage less than 2.8 V (b) HO2 sensor voltage less than 0.85 V	• Open or short in A/F sensor (sensor 1) circuit • A/F sensor (sensor 1) • A/F sensor (sensor 1) heater • EFI relay • A/F sensor heater and relay circuits • Air induction system • Fuel pressure • Injector • ECM
	While fuel-cut operation performed (during vehicle deceleration), A/F sensor current less than 1.0 mA for 3 seconds (2 trip detection logic)	

HINT:

- When any of these DTCs are set, check the A/F sensor voltage output by entering the following menus on the intelligent tester: DIAGNOSIS / ENHANCED OBD II / DATA LIST / ALL / AFS B1S1.
- Short-term fuel trim values can also be read using the intelligent tester.
- The ECM regulates the voltage at the A1A+ and A1A- terminals of the ECM at a constant level. Therefore, the A/F sensor voltage output cannot be confirmed without using the intelligent tester.

ES

MONITOR DESCRIPTION

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

Example:

If the A/F sensor voltage output is less than 2.8 V (very rich condition) for 10 seconds, despite the HO2 sensor voltage output being less than 0.85 V, the ECM sets DTC P2196. Alternatively, if the A/F sensor voltage output is more than 3.8 V (very lean condition) for 10 seconds, despite the HO2 sensor voltage output being 0.15 V or more, DTC P2195 is set.

MONITOR STRATEGY

Related DTCs	P2195: A/F sensor signal stuck lean P2196: A/F sensor signal stuck rich
Required Sensors/Components (Main)	A/F sensor
Required Sensors/Components (Related)	HO2 sensor
Frequency of Operation	Continuous
Duration	10 seconds: Sensor voltage detection monitor 3 seconds: Sensor current detection monitor
MIL Operation	2 driving cycles
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

All:

Monitor runs whenever the following DTCs are not present	P0031, P0032 (A/F sensor heater - Sensor 1) P0037, P0038 (O2 sensor heater - Sensor 2) P0100 - P0103 (MAF meter) P0110 - P0113 (IAT sensor) P0115 - P0118 (ECT sensor) P0120 - P0223, P2135 (TP sensor) P0125 (Insufficient ECT for Closed Loop) P0136 (HO2 Sensor - Sensor 2) P0171, P0172 (Fuel system) P0300 - P0304 (Misfire) P0335 (CKP sensor) P0340 (CMP sensor) P0500 (VSS)

P2195 (Lean side malfunction):

Time while all of the 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

P2196 (Rich side malfunction):

Time while all of the following conditions are met	2 seconds or more
Rear HO2 sensor voltage	Below 0.6 V
Time after engine start	30 seconds or more
A/F sensor status	Activated
Fuel system status	Closed-loop
Engine	Running

ES

P2195 (sensor current high), P2196 (sensor current low):

Battery voltage	11 V or higher
ECT	75°C (167°F) or higher
Atmospheric pressure	76 kPa (570 mmHg) or higher
A/F sensor status	Activated
Continuous time of fuel-cut	3 to 10 seconds

TYPICAL MALFUNCTION THRESHOLDS

P2195 (Lean side malfunction):

A/F sensor voltage	More than 3.8 V for 10 seconds

P2196 (Rich side malfunction):

A/F sensor voltage	Less than 2.8 V for 10 seconds

P2195 (sensor current high)

A/F sensor current	3.6 mA or more

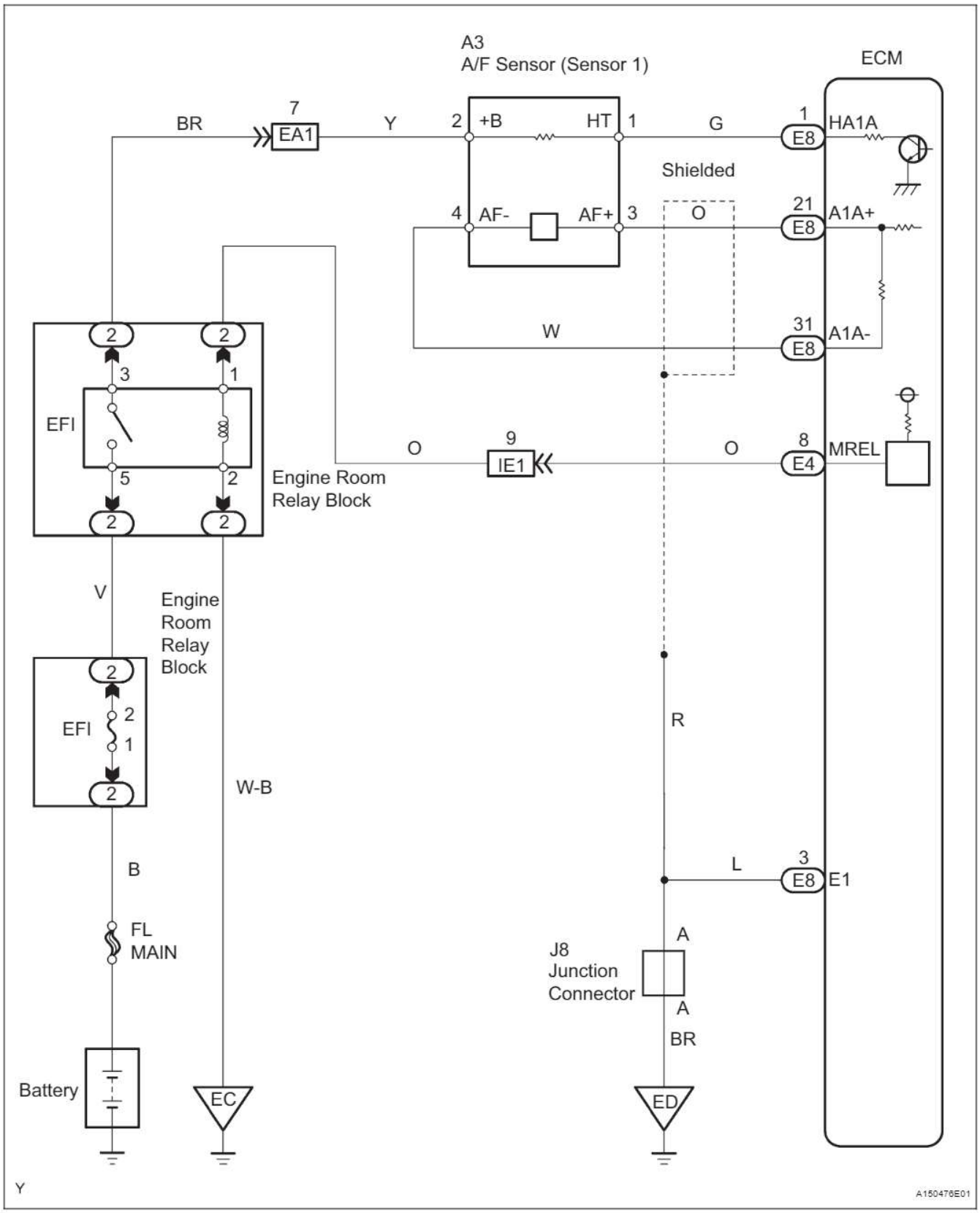
P2196 (sensor current low)

A/F sensor current	Less than 1 mA

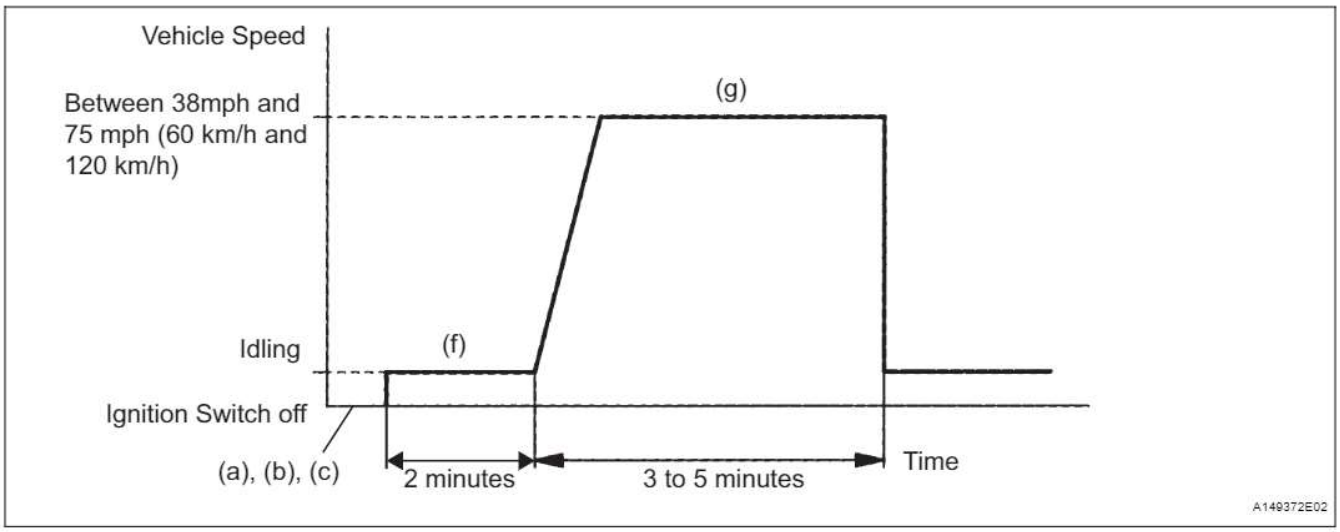
MONITOR RESULT

Refer to CHECKING MONITOR STATUS (See page ES-15).

WIRING DIAGRAM



CONFIRMATION DRIVING PATTERN



(a) Connect the intelligent tester to the DLC3.
(b) Turn the ignition switch to the ON position.
(c) Turn the tester on.
(d) Clear the DTCs (See page ES-32).
(e) Switch the ECM from normal mode to check mode using the tester (See page ES-35).
(f) Start the engine and warm it up for 2 minutes with all the accessories switched OFF.
(g) Drive the vehicle at between 38 to 75 mph (60 to 120 km/h) and at an engine speed of between 1,400 rpm and 3,200 rpm for 3 to 5 minutes.

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

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.

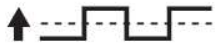
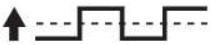
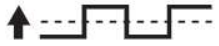
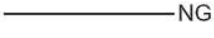
1. Connect the intelligent tester to the DLC3.
2. Start the engine and turn the tester on.
3. Warm up the engine at an engine speed of 2,500 rpm for approximately 90 seconds.
4. Enter the following menus: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / A/F CONTROL.
5. Perform the A/F CONTROL operation with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

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

Standard:

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

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

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

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

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.
- 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.
- *: Use the driving pattern described in "CONFIRMATION DRIVING PATTERN" above.

1	CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO P2195 OR P2196)

(a) Connect the intelligent tester to the DLC3.
(b) Turn the ignition switch to the ON position.
(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
P2195 or P2196	A
P2195 or P2196 and other DTCs	B

HINT:
If any DTCs other than P2195 or P2196 are output, troubleshoot those DTCs first.

B → GO TO DTC CHART

ES

A

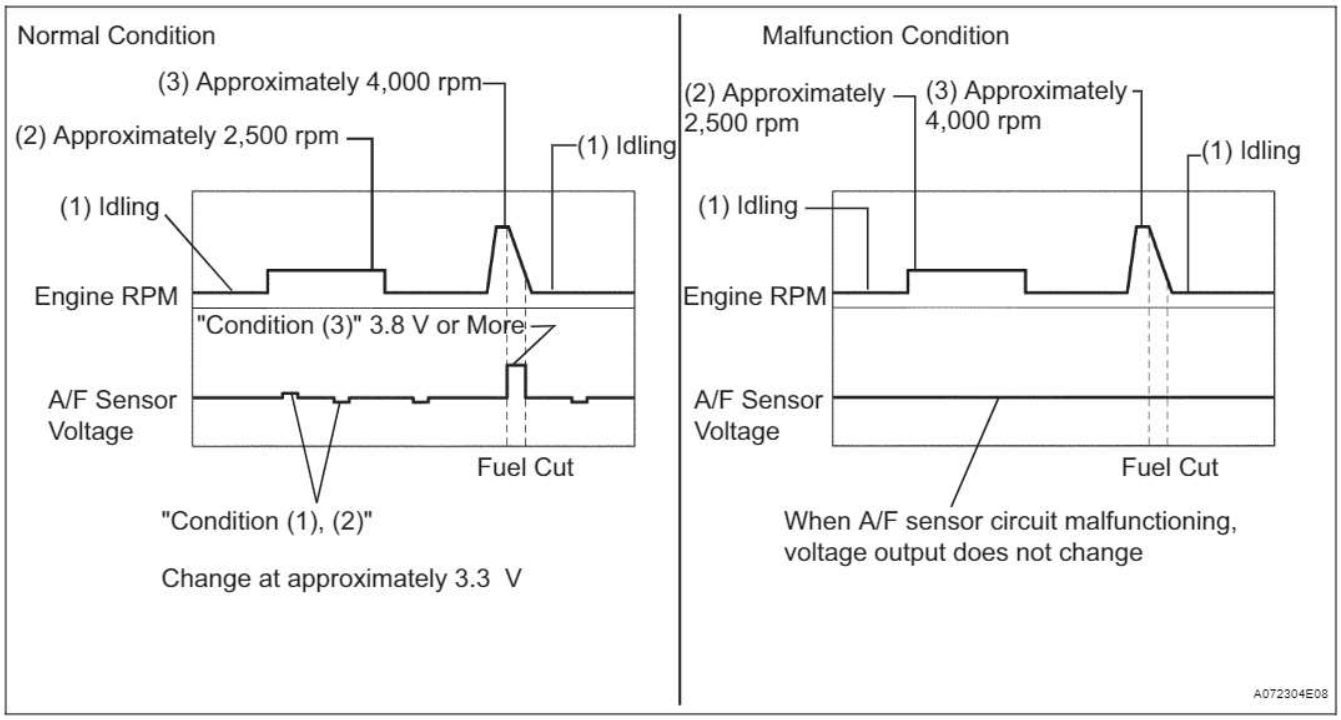
2 READ VALUE USING INTELLIGENT TESTER (OUTPUT VOLTAGE OF A/F SENSOR)

(a) Connect the intelligent tester to the DLC3.
(b) Start the engine.
(c) Turn the tester on.
(d) Warm up the Air-Fuel Ratio (A/F) sensor at an engine speed of 2,500 rpm for 90 seconds.
(e) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / SNAPSHOT / MANUAL SNAPSHOT / USER DATA / AFS B1S1 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.

Standard voltage

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

For more information, see the diagrams below.



HINT:

- If the output voltage of the A/F sensor remains at approximately 3.3 V (see 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 Malfunction Condition diagram) under any conditions, including those above, the A/F sensor may have a short circuit.
- The ECM stops fuel injection (fuel cut) during engine deceleration. This causes a lean condition and results in a momentary increase in the A/F sensor output voltage.
- The ECM must establish a closed throttle valve position learning value to perform fuel cut. If the battery terminal has been reconnected, the vehicle must be driven over 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 9

OK

3	PERFORM CONFIRMATION DRIVING PATTERN*

ES

NEXT

4	CHECK WHETHER DTC OUTPUT RECURS (DTC P2195 OR P2196)

(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
P2195 or P2196	A
No output	B

B → Go to step 8

A

5	REPLACE AIR FUEL RATIO SENSOR

NEXT

6	PERFORM CONFIRMATION DRIVING PATTERN*

NEXT

7	CHECK WHETHER DTC OUTPUT RECURS (DTC P2195 OR P2196)

(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 or P2196	B

B → REPLACE ECM AND PERFORM CONFIRMATION DRIVING PATTERN

A

8 CONFIRM WHETHER VEHICLE HAS RUN OUT OF FUEL IN PAST

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

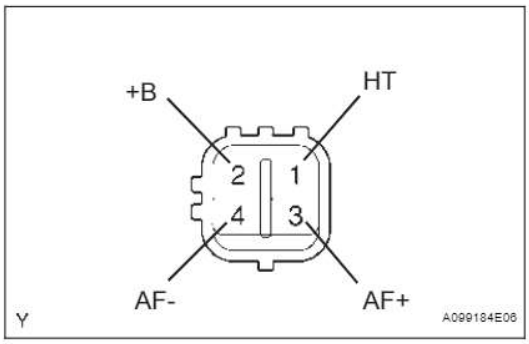
NO → CHECK FOR INTERMITTENT PROBLEMS

YES

DTC CAUSED BY RUNNING OUT OF FUEL

ES

9 INSPECT AIR FUEL RATIO SENSOR (HEATER RESISTANCE)



(a) Disconnect the A3 sensor connector.
(b) Measure the resistance according to the value(s) in the table below.

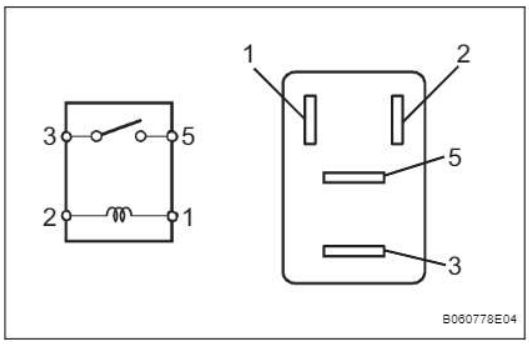
Standard resistance

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

NG → REPLACE AIR FUEL RATIO SENSOR

OK

10 INSPECT EFI RELAY (EFI)



(a) Remove the EFI relay from the engine room relay block.
(b) Measure the resistance according to the value(s) in the table below.

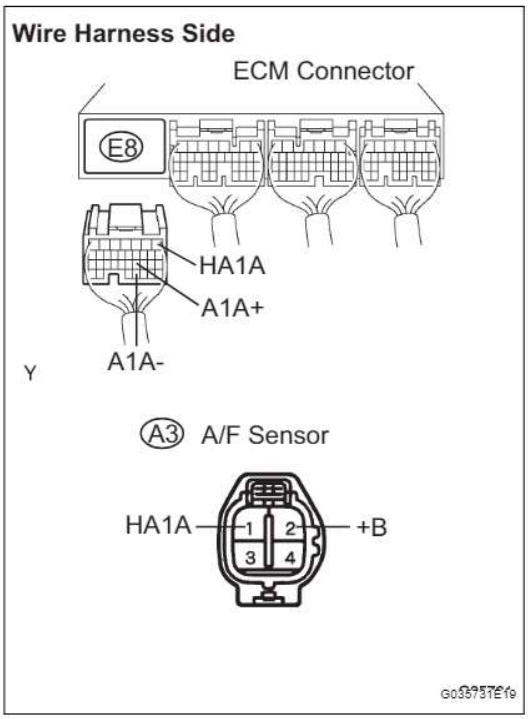
Standard resistance

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

NG → REPLACE EFI RELAY

OK

11 CHECK WIRE HARNESS (A/F SENSOR - ECM) AND (SENSOR POWER SOURCE)



(a) Disconnect the A3 sensor connector.
(b) Turn the ignition switch to the ON position.
(c) Measure the voltage according to the value(s) in the table below.

Standard voltage

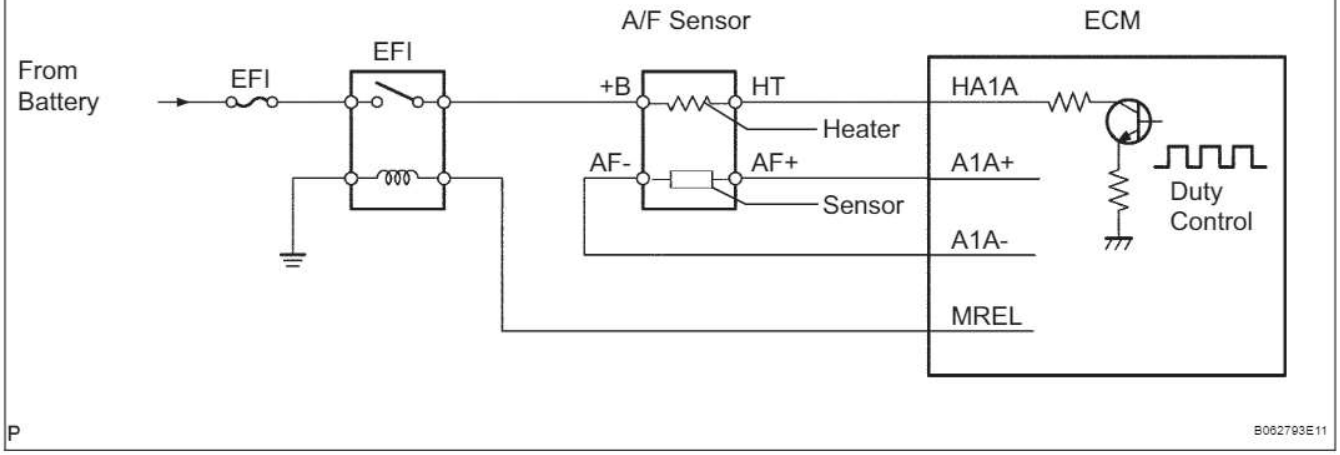
Tester Connection	Specified Condition
+B (A3-2) - Body ground	Between 9 V and 14 V

(d) Turn the ignition switch off.
(e) Disconnect the E8 ECM connector.
(f) Measure the resistance according to the value(s) in the table below.

Standard resistance

Tester Connection	Specified Condition
HT (A3-1) - HA1A (E8-1)	Below 1 Ω
AF+ (A3-3) - A1A+ (E8-21)	Below 1 Ω
AF- (A3-4) - A1A- (E8-31)	Below 1 Ω
HT (A3-1) or HA1A (8-1) - Body ground	10 kΩ or higher
AF+ (A3-3) or A1A+ (E8-21) - Body ground	10 kΩ or higher
AF- (A3-4) or A1A- (E8-31) - Body ground	10 kΩ or higher

Reference (System Diagram of Sensor 1)



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

12 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

13 CHECK FUEL PRESSURE

(a) Check the fuel pressure (See page FU-2).

NG → REPAIR OR REPLACE FUEL SYSTEM

OK

14 INSPECT FUEL INJECTOR ASSEMBLY

(a) Check the injector injection (whether fuel volume is high or low, and whether injection pattern is poor).

NG → REPLACE FUEL INJECTOR ASSEMBLY

OK

15 REPLACE AIR FUEL RATIO SENSOR

NEXT

16 PERFORM CONFIRMATION DRIVING PATTERN*

NEXT

17 CHECK WHETHER DTC OUTPUT RECURS (DTC P2195 OR P2196)

(a) Read the DTCs using the intelligent tester.
(b) If using the intelligent tester, select the following menu items: DIAGNOSIS / ENHANCED OBD II / DTC INFO / CURRENT CODES.

Result

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

B → REPLACE ECM AND PERFORM CONFIRMATION DRIVING PATTERN

A

18 CONFIRM WHETHER VEHICLE HAS RUN OUT OF FUEL IN PAST

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

NO → CHECK FOR INTERMITTENT PROBLEMS

YES

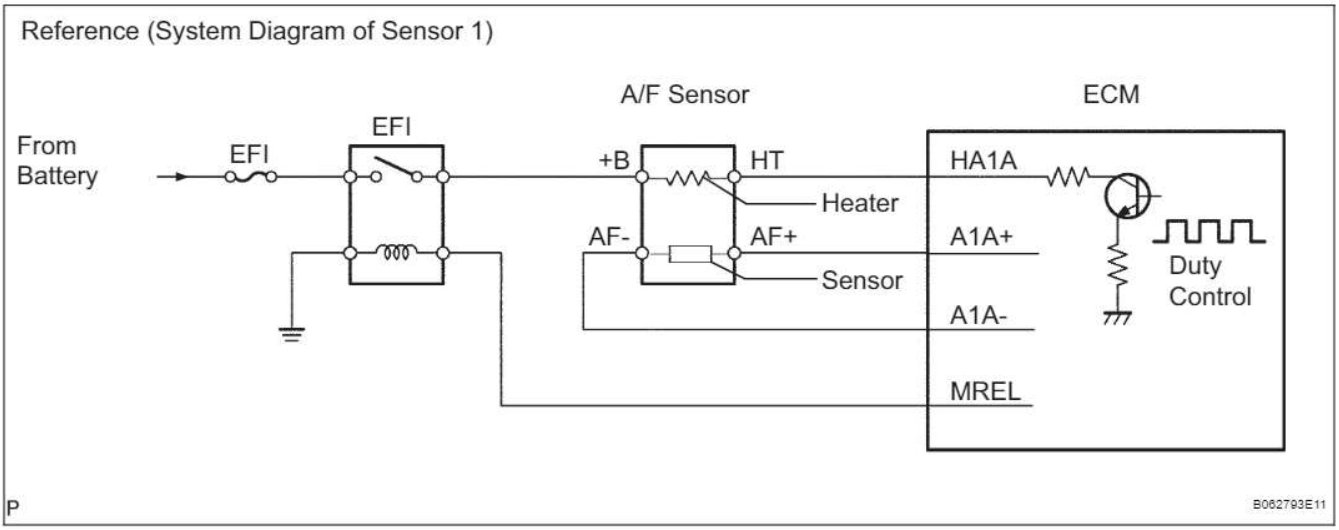
DTC CAUSED BY RUNNING OUT OF FUEL

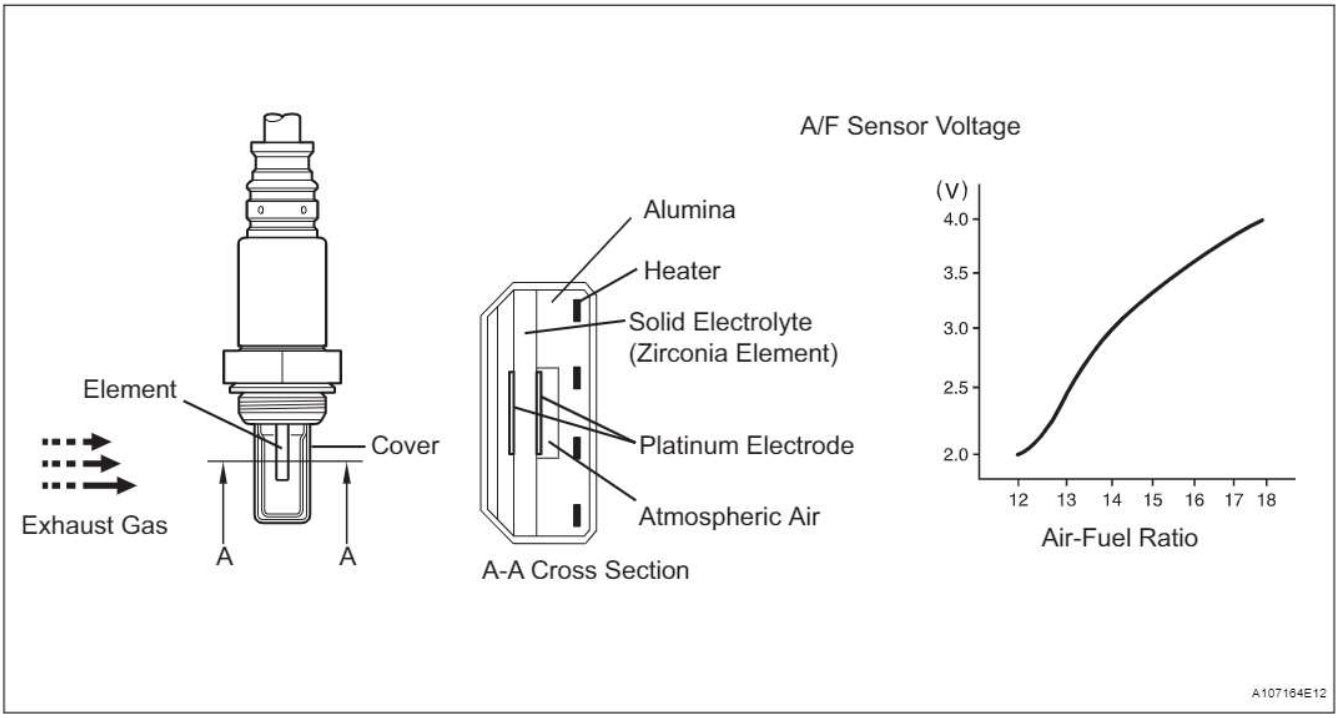
DTC	P2237	Oxygen (A/F) Sensor Pumping Current Circuit / Open (Bank 1 Sensor 1)
DTC	P2238	Oxygen (A/F) Sensor Pumping Current Circuit Low (Bank 1 Sensor 1)
DTC	P2239	Oxygen (A/F) Sensor Pumping Current Circuit High (Bank 1 Sensor 1)
DTC	P2252	Oxygen (A/F) Sensor Reference Ground Circuit Low (Bank 1 Sensor 1)
DTC	P2253	Oxygen (A/F) Sensor Reference Ground Circuit High (Bank 1 Sensor 1)

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

DESCRIPTION

These DTCs are set when there is an open or short in the A/F sensor circuit, or if A/F sensor output drops. To detect these problems, the voltage of the A/F sensor is monitored when turn the ignition switch to the ON position, and the admittance (admittance is an electrical term that indicates the ease of flow of current) is checked while driving. If the voltage of the A/F sensor is between 0.6 V and 4.5 V, it is considered normal. If the voltage is out of the specified range, or the admittance is less than the standard value, the ECM will determine that there is a malfunction in the A/F sensor. If the same malfunction is detected in next driving cycle, the MIL will be illuminated and a DTC will be stored.
The A/F sensor, which is located between the exhaust manifold and catalyst, consists of alloyed metal elements and a heater.
Depending on the engine operating conditions, the heater heats the sensor elements to activate them. Battery voltage is applied to the heater, the sensor ground is controlled by the ECM using a duty ratio. The sensor elements convert the oxygen concentration in the exhaust gas into voltage values to output. Based on the voltage, the ECM determines the air-fuel ratio and regulates the fuel injection volume depending on the air-fuel ratio and engine operating conditions. The voltage changes between 0.6 V and 4.5 V while the engine is running. If the air-fuel ratio is LEAN, which means the oxygen concentration in the exhaust gas is high, the voltage is high. If the air-fuel ratio is RICH, which means the oxygen concentration in the exhaust gas is low, the voltage is low.





DTC No.	DTC Detection Condition	Trouble Area
P2237	Open in the circuit between terminals AF+ and AF- of the AF sensor while engine is running (2 trip detection logic)	• Open or short in A/F sensor (sensor 1) circuit • A/F sensor (sensor 1) • ECM
P2238	Any of the following conditions are met (2 trip detection logic): • AF sensor output drops while engine is running. • Voltage at terminal AF+ is 0.5 V or less. • Voltage difference between terminals AF+ and AF- is 0.1 V or less.	• Open or short in A/F sensor (sensor 1) circuit • A/F sensor (sensor 1) • ECM
P2239	AF+ voltage more than 4.5 V (2 trip detection logic)	• Open or short in A/F sensor (sensor 1) circuit • A/F sensor (sensor 1) • ECM
P2252	AF- voltage 0.5 V or less (2 trip detection logic)	• Open or short in A/F sensor (sensor 1) circuit • A/F sensor (sensor 1) • ECM
P2253	AF- voltage more than 4.5 V (2 trip detection logic)	• Open or short in A/F sensor (sensor 1) circuit • A/F sensor (sensor 1) • ECM

MONITOR DESCRIPTION

These DTCs are output when there is an open or short in the A/F sensor circuit, or if A/F sensor output drops. To detect these problems, the voltage of the A/F sensor is monitored when the ignition switch is turned to the ON position, and the admittance (admittance is an electrical term that indicates the ease of flow of current) is checked while driving. If the voltage of the A/F sensor is between 0.6 V and 4.5 V, it is considered normal. If the voltage is out of the specified range, or the admittance is less than the standard value, the ECM will determine that there is a malfunction in the A/F sensor. If the same malfunction is detected in the next driving cycle, the MIL will be illuminated and a DTC will be stored.

MONITOR STRATEGY

Related DTCs	P2237: A/F sensor open circuit between AF+ and AF- P2238: A/F sensor short circuit between AF+ and AF- P2238: A/F sensor short circuit between AF+ and GND P2238: A/F sensor admittance low P2239: A/F sensor short circuit between AF+ and +B P2252: A/F sensor short circuit between AF- and GND P2253: A/F sensor short circuit between AF- and +B
Required Sensors/Components (Main)	A/F sensor
Required Sensors/Components (Related)	Engine Coolant Temperature (ECT) sensor, Crankshaft position sensor
Frequency of Operation	Continuous
Duration	10 seconds
MIL Operation	2 driving cycles
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

All:

Monitor runs whenever following DTCs are not present	P0031, P0032 (A/F sensor heater - Sensor 1) P0100 - P0103 (MAF meter) P0110 - P0113 (IAT sensor) P0115 - P0118 (ECT sensor) P0120 - P0223, P2135 (TP sensor) P0125 (Insufficient ECT for closed loop) P0171, P0172 (Fuel trim) P0300 - P0304 (Misfire) P0335 (CKP sensor) P0340 (CMP sensor) P0441 - P0456, P2401 - P2420 (EVAP system) P0500 (VSS)

P2237: (A/F sensor open circuit between AF+ and AF-)

Estimated sensor temperature	450 to 550°C (842 to 1022°F)
Engine	Running
Battery voltage	11 V or more

P2238: (A/F sensor admittance low)

Estimated sensor temperature	700 to 800°C (1292 to 1472°F)
ECT	10°C (50°F) or more
Fuel cut	Not executed

Except P2237 (A/F sensor open circuit between AF+ and AF-) and P2238 (A/F sensor admittance low)

Battery voltage	11 V or more
Ignition switch	ON
Time after ignition switch is OFF to ON	5 seconds or more

TYPICAL MALFUNCTION THRESHOLDS

P2237: (A/F sensor open circuit between AF+ and AF-)

A/F sensor admittance	Below 0.002 1/Ω

P2238: (A/F sensor admittance low)

A/F sensor admittance	Below 0.015 1/Ω

P2238: (A/F sensor short circuit between AF+ and AF-)

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

P2238: (A/F sensor short circuit between AF+ and GND)

AF+ terminal voltage	0.5 V or less

ES

P2239: (A/F sensor short circuit between AF+ and +B)

AF+ terminal voltage	More than 4.5 V

P2252: (A/F sensor short circuit between AF- and GND)

AF- terminal voltage	0.5 V or less

P2253: (A/F sensor short circuit between AF- and +B)

AF- terminal voltage	More than 4.5 V

COMPONENT OPERATING RANGE

A/F sensor admittance	0.002 to 0.079 1/Ω
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

WIRING DIAGRAM

Refer to DTC 2195 (See page ES-281).

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, select the following menu items: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / A/F CONTROL.
5. Perform the A/F CONTROL operation with the engine idling (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) 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%.
- The sensors react in accordance with increases and decreases in the fuel injection volume.

Standard

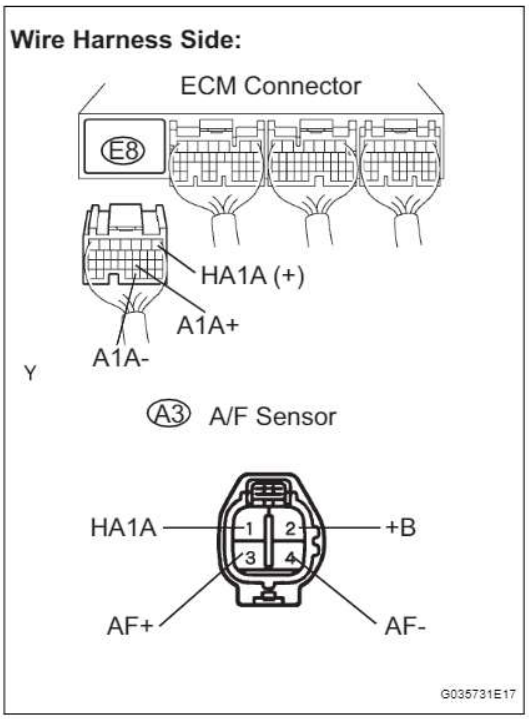
Tester Display (Sensor)	Injection Volume	Status	Voltage
AFS B1 S1(A/F)	+25%	Rich	Less than 3.0
AFS B1 S1(A/F)	-12.5%	Lean	More than 3.35
O2S B1 S2 (HO2)	+25%	Rich	More than 0.5
O2S B1 S2 (HO2)	-12.5%	Lean	Less than 0.4

NOTICE:
The A/F sensor has an output delay of a few seconds and the HO2 sensor has a maximum output delay of approximately 20 seconds.

Case	A/F Sensor (Sensor 1) Output Voltage		HO2 Sensor (Sensor 2) Output Voltage		Main Suspected Trouble Area
1	Injection Volume +25% -12.5%		Injection Volume +25% -12.5%		-
	Output Voltage More than 3.35 V Less than 3.0 V		Output Voltage More than 0.5 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 0.5 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, select the following menu items on the tester: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / A/F CONTROL / USER DATA / AFS B1 S1 and O2S B1 S2; then press the YES button and then the ENTER button followed by the F4 button.
HINT:
Read freeze frame data using the intelligent tester. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

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



(a) Disconnect the A3 A/F sensor connector.
(b) Disconnect the E8 ECM connector.
(c) Measure the resistance between the terminals of the wire harness side connectors.

Standard resistance (Check for open)

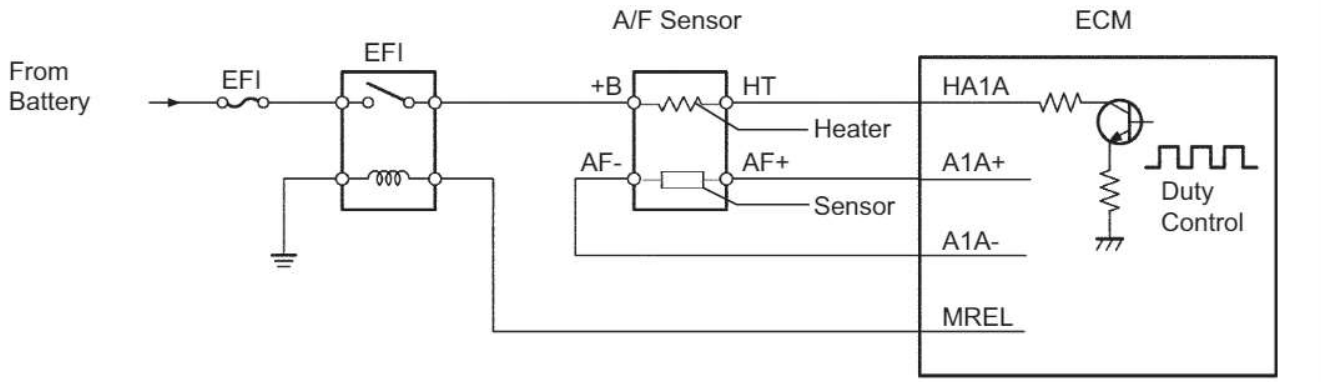
Tester Connection	Specified Condition
AF+ (A3-3) - A1A+ (E8-21)	Below 1 Ω
AF- (A3-4) - A1A- (E8-31)	Below 1 Ω

Standard resistance (Check for short)

Tester Connection	Specified Condition
AF+ (A3-3) - A1A+ (E8-21) - Body ground	10 kΩ or higher
AF- (A3-4) - A1A- (E8-31) - Body ground	10 kΩ or higher

(d) Reconnect the ECM connector.
(e) Reconnect the A/F sensor connector.

Reference (System Diagram of Sensor 1)



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

2	REPLACE AIR-FUEL RATIO SENSOR

NEXT

3	CHECK WHETHER DTC OUTPUT RECURS

(a) Connect the intelligent tester to the DLC3.
(b) Turn the ignition switch to the ON position and turn the tester on.
(c) Clear the DTCs (See page ES-32).
(d) Start the engine.
(e) Allow the engine to idle for 5 minutes or more.
(f) Select the following menu items: DIAGNOSIS / ENHANCED OBD II / DTC INFO / PENDING CODES.
(g) Read pending DTCs.

Result

Display (DTC Output)	Proceed to
No output	A
P2237, P2238, P2239, P2252 or P2253	B

B → REPLACE ECM

A

END

DTC	P2420	Evaporative Emission System Switching Valve Control Circuit High

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-314).

INSPECTION PROCEDURE

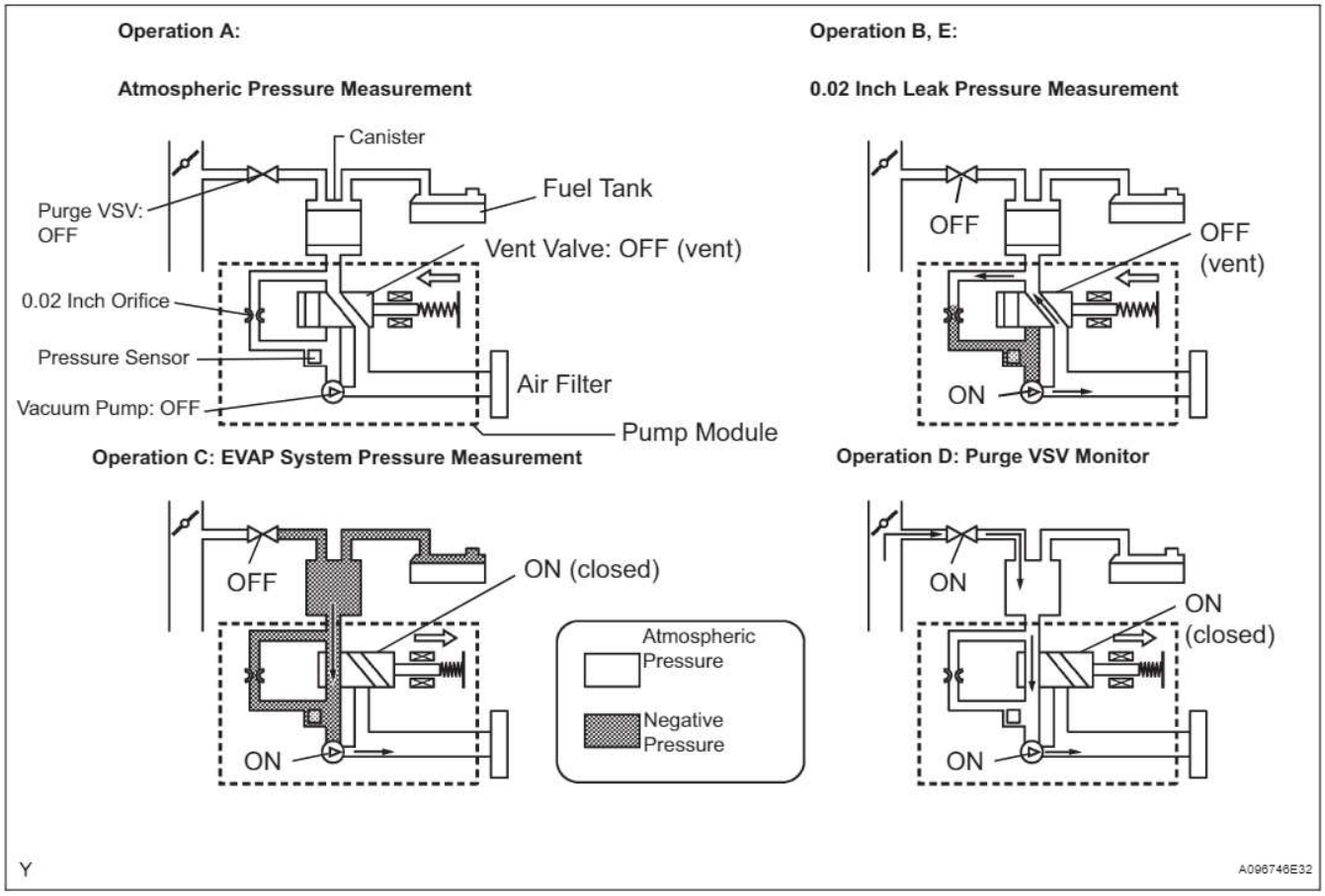
Refer to the EVAP system (See page ES-314).

MONITOR DESCRIPTION

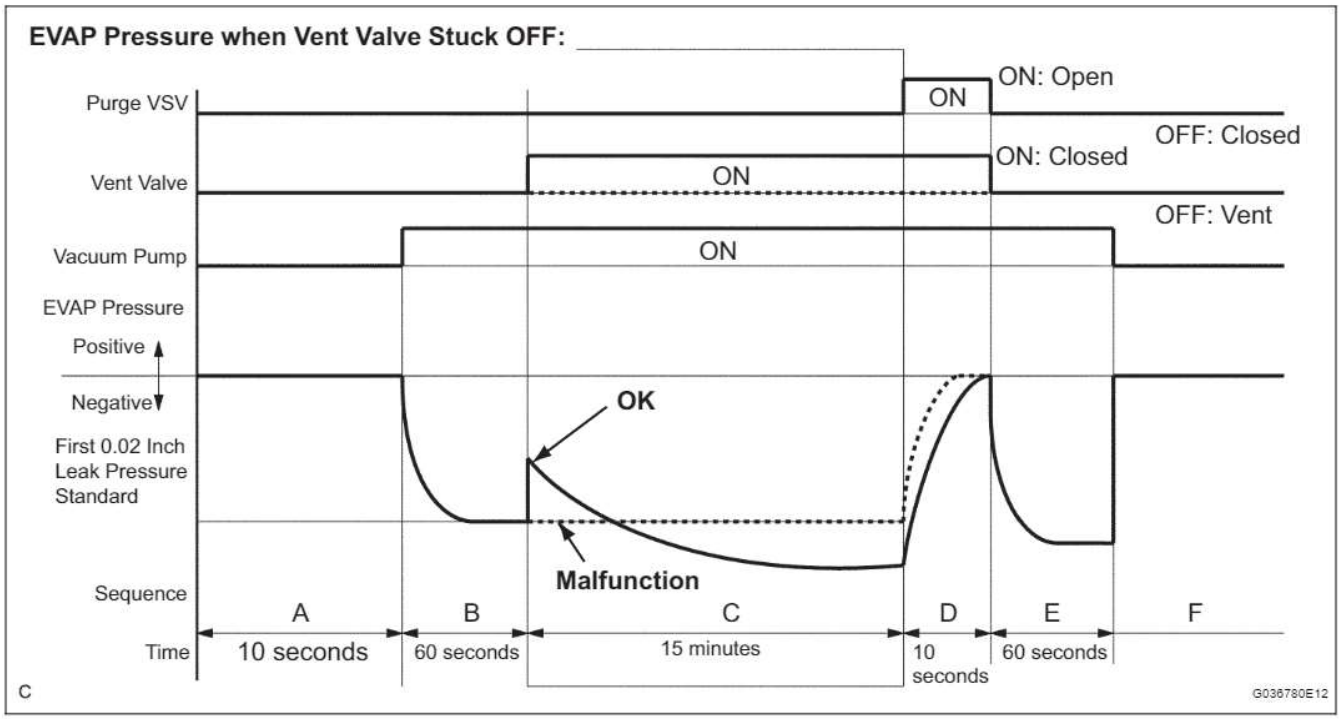
5 hours*1 after the ignition switch is turned off, the electric vacuum pump creates negative pressure (vacuum) in the EVAP (Evaporative Emission) system. The ECM monitors for leaks and actuator malfunctions based on the EVAP pressure.
HINT:
*1: If the engine coolant temperature is not below 35°C (95°F) 5 hours after the ignition switch is turned off, the monitor check starts 2 hours later. If it is still not below 35°C (95°F) 7 hours after the ignition switch is turned off, the monitor check starts 2.5 hours later.

Sequence	Operation	Description	Duration
-	ECM activation	Activated by soak timer, 5 hours (7 or 9.5 hours) after ignition switch is turned off.	-
A	Atmospheric pressure measurement	Vent valve is turned OFF (vent) and EVAP system pressure is measured by ECM in order to register atmospheric pressure. If pressure in EVAP system is not between 70 kPa and 110 kPa (525 mmHg and 825 mmHg), ECM cancels EVAP system monitor.	10 seconds
B	First 0.02 inch leak pressure measurement	In order to determine 0.02 inch leak pressure standard, 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

Monitor runs whenever the following 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, 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 runs 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 runs 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 runs 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 runs if the following condition is met:	-
EVAP pressure	Saturated within 15 minutes

5. EVAP canister purge valve close stuck check

Next sequence runs 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 runs 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 runs if the following condition is met:	-
EVAP pressure when vacuum introduction is complete	Lower than second reference pressure

8. Atmospheric pressure measurement

EVAP monitor is complete if the following condition is met:	-
Atmospheric pressure difference between sequence 1 and 8	Within 0.3 kPa (2.25 mmHg)

TYPICAL MALFUNCTION THRESHOLDS

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

MONITOR RESULT

Refer to CHECKING MONITOR STATUS (See page ES-15).

DTC	P2610	ECM / PCM Internal Engine Off Timer Performance

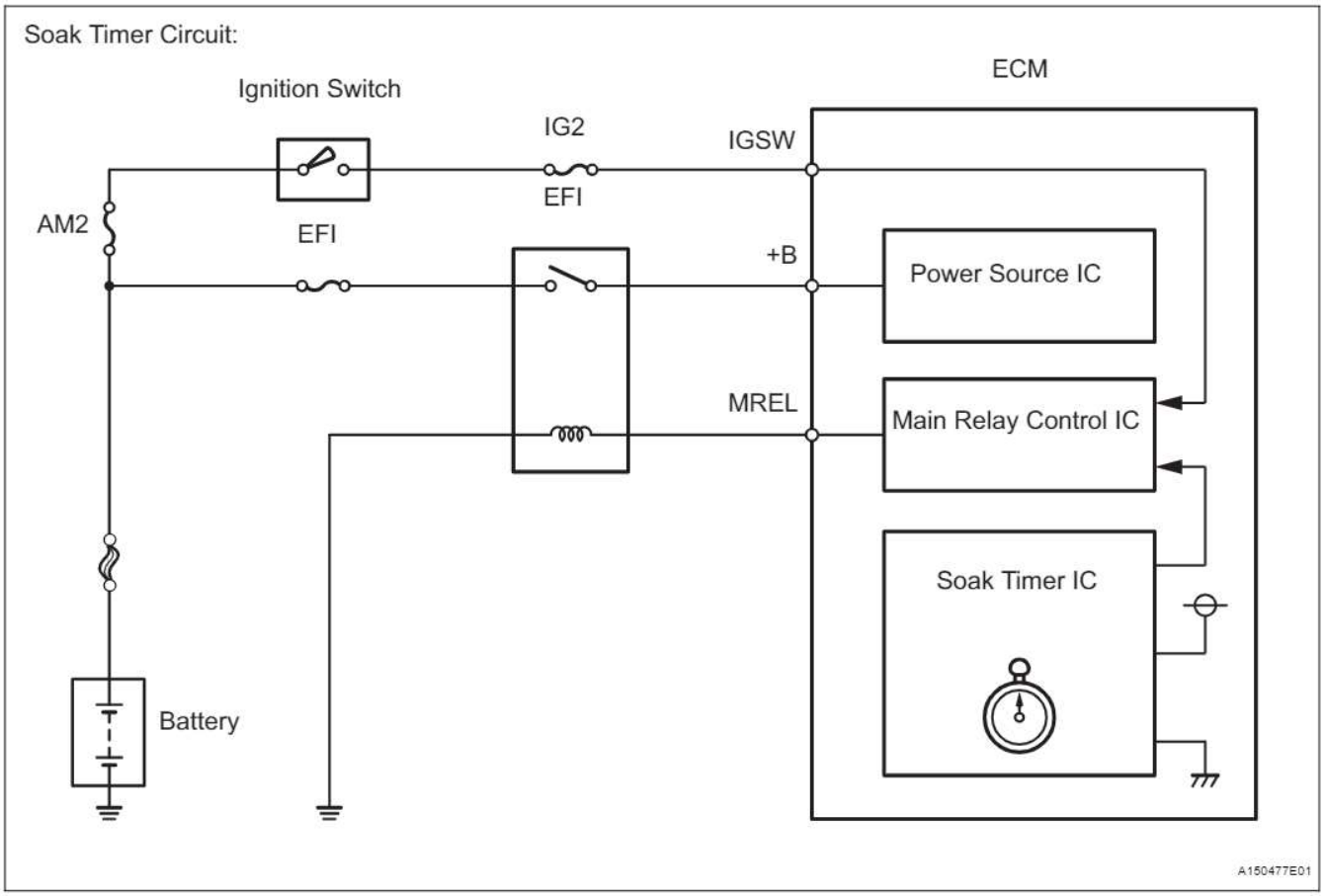
DTC SUMMARY

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

DESCRIPTION

ES

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



MONITOR DESCRIPTION

5 hours after the ignition switch is turned off, the soak timer activates the ECM to begin the EVAP system monitor. While the engine is running, the ECM monitors the synchronization of the soak timer and the CPU clock. If the soak timer and CPU clock 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

Monitor runs whenever the following DTCs are not present	None
Ignition switch	ON
Engine	Running

TYPICAL MALFUNCTION THRESHOLDS

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

ES

INSPECTION PROCEDURE

HINT:

- DTC P2610 is set if an internal ECM problem is detected. Diagnostic procedures are not required. ECM replacement is required.
- Read freeze frame data using the 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.

1	REPLACE ECM

(a) Replace the ECM (See page ES-407).

NEXT

2	CHECK WHETHER DTC OUTPUT RECURS

(a) Connect the intelligent tester to the DLC3.
(b) Turn the ignition switch to the ON position.
(c) Clear the DTCs (See page ES-32).
(d) Start the engine and wait for 10 minutes or more.
(e) On the tester, select 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.

NEXT

END

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

DESCRIPTION

HINT:

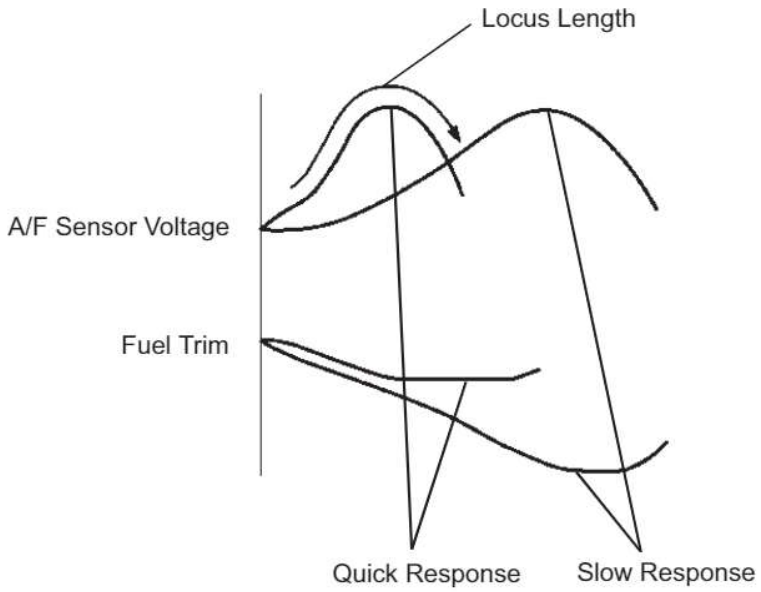
Sensor 1 refers to the sensor mounted in front of the Three-Way Catalytic Converter (TWC) and located near the engine assembly.

Refer to DTC P2195 (See page ES-278).

DTC No.	DTC Detection Condition	Trouble Area
P2A00	Calculated value of air-fuel ratio (A/F) sensor response rate deterioration level less than threshold (2 trip detection logic)	• Open or short in A/F sensor (sensor 1) circuit • A/F sensor (sensor 1) • A/F sensor heater (sensor 1) • EFI relay • A/F sensor heater and EFI relay circuits • Air induction system • Fuel pressure • Injector • PCV valve and hose • PCV hose connection • ECM

ES

MONITOR DESCRIPTION



The output voltage of the A/F sensor varies in proportion to the air-fuel ratio. Based on these voltage variations, the ECM determines whether the actual air-fuel ratio is rich or lean, and makes adjustments to bring it close to the stoichiometric level. In addition, the ECM checks the fuel injection volume compensation value to determine whether the A/F sensor response time is normal or slow. The ECM calculates the ratio of the variations in both the A/F sensor output voltage and the fuel trim value.

MONITOR STRATEGY

Related DTCs	P2A00: Air-Fuel Ratio (A/F) sensor 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	60 seconds
MIL Operation	2 driving cycles
Sequence of Operation	None

TYPICAL ENABLING CONDITIONS

Monitor runs whenever the following DTCs are not present	P0031, P0032 (A/F sensor heater - Sensor 1) P0100 - P0103 (MAF meter) P0110 - P0113 (IAT sensor) P0115 - P0118 (ECT sensor) P0120 - P0223, P2135 (TP sensor) P0125 (Insufficient ECT for Closed Loop) P0171, P0172 (Fuel system) P0300 - P0304 (Misfire) P0335 (CKP sensor) P0340 (CMP sensor) P0500 (VSS) P2196 (A/F sensor - rationality)
Active A/F control	Performing
Active A/F control performed when the following conditions are met:	-
Engine coolant temperature	75°C (167°F) or more
Battery voltage	11 V 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
Intake air amount	4 to 16 g/sec.

TYPICAL MALFUNCTION THRESHOLDS

Response rate deterioration level	Less than 0.12 V

MONITOR RESULT

Refer to detailed information on "CHECKING MONITOR STATUS" (See page ES-15).

WIRING DIAGRAM

Refer to DTC P2195 (See page ES-281).

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. Enter the following menus: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / A/F CONTROL.
5. Perform the A/F CONTROL operation with the engine in an idling condition (press the RIGHT or LEFT button to change the fuel injection volume).
6. Monitor the output voltages of the A/F and HO2 sensors (AFS B1S1 and O2S B1S2 or AFS B2S1 and O2S B2S2) displayed on the tester.

HINT:

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

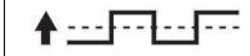
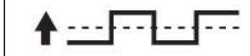
ES

Standard:

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

NOTICE:

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

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

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

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

HINT:

- DTC P2A00 may be also set when the air-fuel ratio is stuck at 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.

ES

1 CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P2A00)

(a) Connect the intelligent tester to the DLC3.
(b) Turn the ignition switch to the ON position.
(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
P2A00	A
P2A00 and other DTCs	B

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

B → GO TO DTC CHART

A

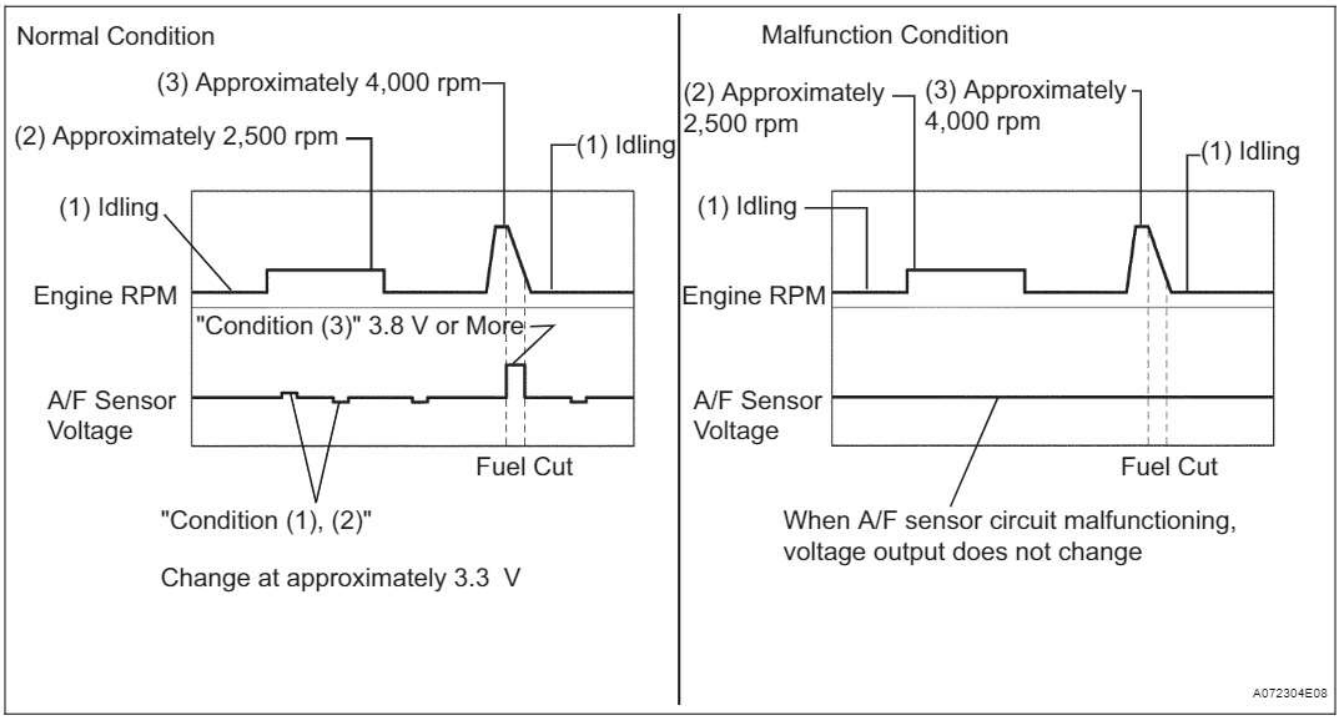
2 READ VALUE USING INTELLIGENT TESTER (OUTPUT VOLTAGE OF A/F SENSOR)

(a) Connect the intelligent tester to the DLC3.
(b) Start the engine.
(c) Turn the tester on.
(d) Warm up the Air-Fuel Ratio (A/F) sensor at an engine speed of 2,500 rpm for 90 seconds.
(e) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / SNAPSHOT / MANUAL SNAPSHOT / USER DATA / AFS B1S1 and ENGINE SPD.
(f) Check the A/F sensor voltage 3 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.

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)

For more information, see the diagrams below.



HINT:

- If the output voltage of the A/F sensor remains at approximately 3.3 V (see 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 Malfunction Condition diagram) under any conditions, including those above, the A/F sensor may have a short circuit.
- The ECM stops fuel injection (fuel cut) during engine deceleration. This causes a lean condition and results in a momentary increase in the A/F sensor output voltage.
- The ECM must establish a closed throttle valve position learning value to perform fuel cut. If the battery terminal has been reconnected, the vehicle must be driven over 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 9

OK

3	PERFORM CONFIRMATION DRIVING PATTERN

NEXT

4	CHECK WHETHER DTC OUTPUT RECURS (DTC P2A00)

(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
P2A00	A
No output	B

B → Go to step 8

A

5	REPLACE AIR FUEL RATIO SENSOR

NEXT

6	PERFORM CONFIRMATION DRIVING PATTERN

NEXT

7	CHECK WHETHER DTC OUTPUT RECURS (DTC P2A00)

(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	B

B → REPLACE ECM AND PERFORM CONFIRMATION DRIVING PATTERN

A

8 CONFIRM WHETHER VEHICLE HAS RUN OUT OF FUEL IN PAST

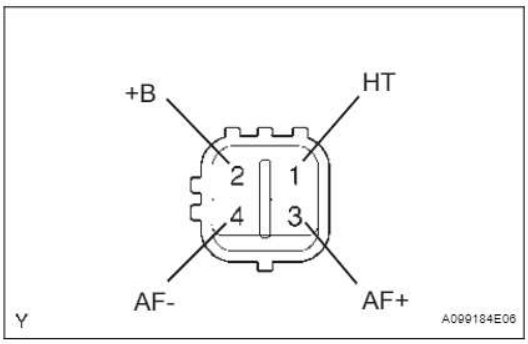
(a) Has the vehicle run out of fuel in the past?

NO → CHECK FOR INTERMITTENT PROBLEMS

YES

DTC CAUSED BY RUNNING OUT OF FUEL

9 INSPECT AIR FUEL RATIO SENSOR (HEATER RESISTANCE)



(a) Disconnect the A3 A/F sensor connector.
(b) Measure the resistance according to the value(s) in the table below.

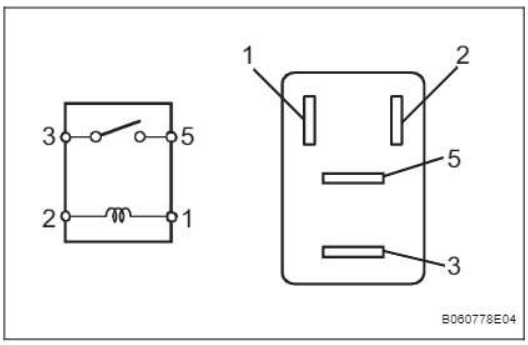
Standard resistance

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

NG → REPLACE AIR FUEL RATIO SENSOR

OK

10 INSPECT EFI RELAY (Marking: EFI)



(a) Remove the EFI relay from the engine room relay block.
(b) Measure the resistance according to the value(s) in the table below.

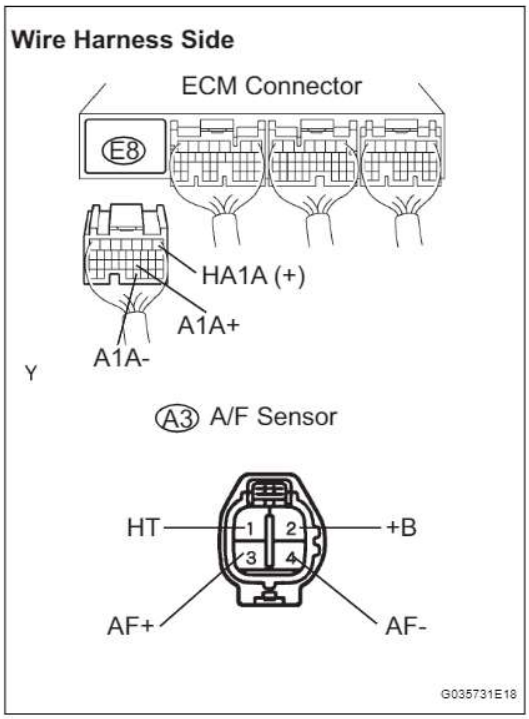
Standard resistance

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

NG → REPLACE EFI RELAY

OK

11 CHECK WIRE HARNESS (A/F SENSOR -ECM) AND (SENSOR POWER SOURCE)



(a) Disconnect the A3 A/F sensor connector.
(b) Turn the ignition switch to the ON position.
(c) Measure the voltage according to the value(s) in the table below.

Standard voltage

Tester Connection	Specified Condition
+B (A3-2) - Body ground	9 to 14 V

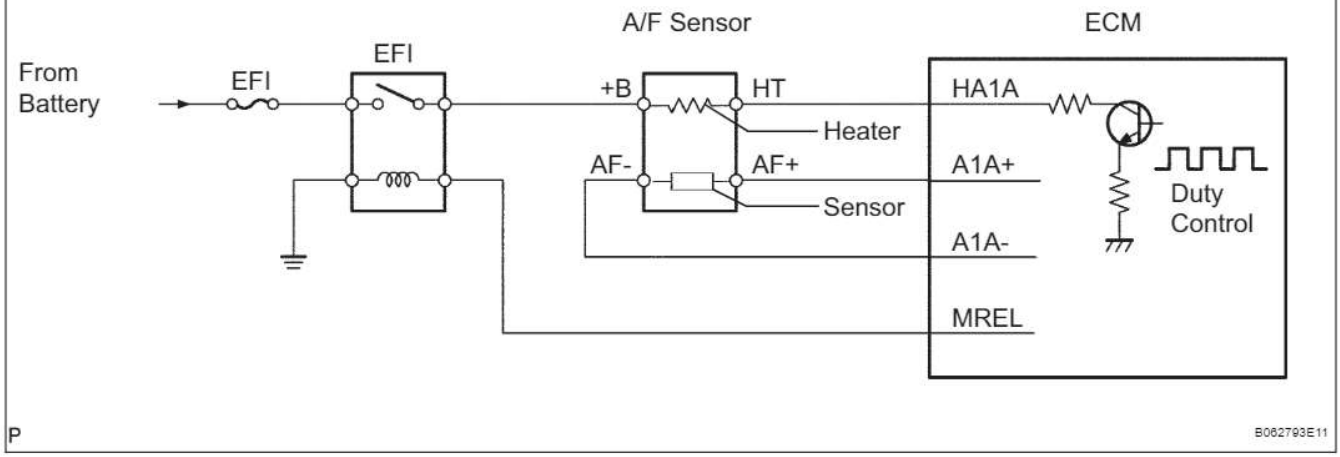
(d) Turn the ignition switch off.
(e) Disconnect the E8 ECM connector.
(f) Measure the resistance according to the value(s) in the table below.

Standard resistance

Tester Connection	Specified Condition
HT (A3-1) - HA1A (E8-1)	Below 1 Ω
AF+ (A3-3) - A1A+ (E8-21)	Below 1 Ω
AF- (A3-4) - A1A- (E8-31)	Below 1 Ω
HT (A3-1) or HA1A (E8-1) - Body ground	10 kΩ or higher
AF+ (A3-3) or A1A+ (E8-21) - Body ground	10 kΩ or higher
AF- (A3-4) or A1A- (E8-31) - Body ground	10 kΩ or higher

ES

Reference (System Diagram of Sensor 1)



NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

12 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

13 CHECK PCV HOSE CONNECTIONS

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

NG → REPAIR OR REPLACE PCV HOSE

OK

14 CHECK FUEL PRESSURE

(a) Check the fuel pressure.

NG → REPAIR OR REPLACE FUEL SYSTEM

OK

15 INSPECT FUEL INJECTOR

(a) Check the injector injection (whether fuel volume is high or low, and whether injection pattern is poor).

NG → REPLACE FUEL INJECTOR

OK

16 REPLACE AIR FUEL RATIO SENSOR

NEXT

17 PERFORM CONFIRMATION DRIVING PATTERN

NEXT

18 CHECK WHETHER DTC OUTPUT RECURS (DTC P2A00)

(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	B

B → REPLACE ECM AND PERFORM CONFIRMATION DRIVING PATTERN

A

19	CONFIRM WHETHER VEHICLE HAS RUN OUT OF FUEL IN PAST

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

NO → CHECK FOR INTERMITTENT PROBLEMS

YES

DTC CAUSED BY RUNNING OUT OF FUEL

EVAP System

RELATED DTCS

DTCs	Monitoring Items	See page
P043E	Reference orifice clogged (built into canister pump module)	ES-186
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-191
P0450	Canister pressure sensor (built into canister pump module) voltage abnormal fluctuation	ES-199
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-207
P0456	EVAP small leak	
P2401	Leak detection pump stuck OFF (built into canister pump module)	ES-186
P2402	Leak detection pump stuck ON (built into canister pump module)	
P2419	Vent valve stuck closed (built into canister pump module)	ES-186
P2420	Vent valve stuck open (vent) (built into canister pump module)	ES-298
P2610	Soak timer (built into ECM)	ES-302

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)											●

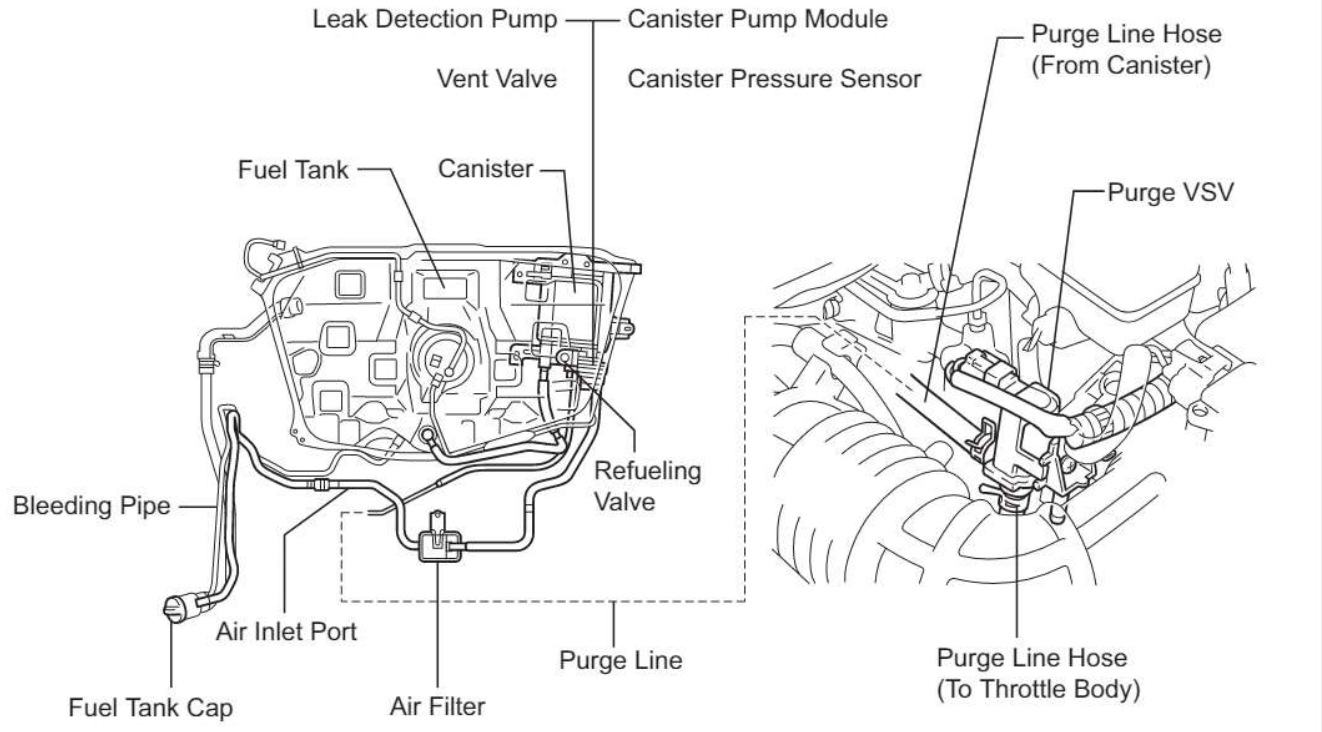
Y

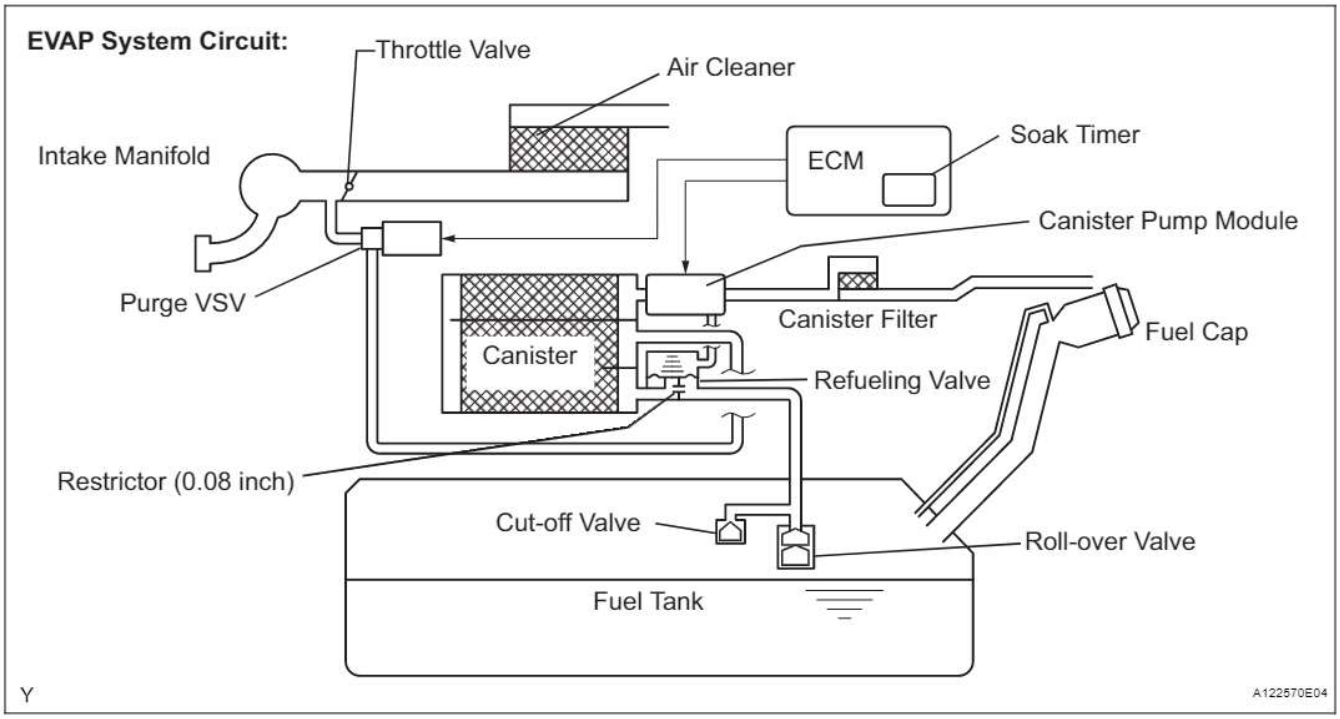
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NOTICE:
If the reference pressure difference between the first and second checks is greater than the specification, all the DTCs relating to the reference pressure (P043E, P043F, P2401, P2402 and P2419) are stored.

DESCRIPTION

Location of EVAP (Evaporative Emission) system





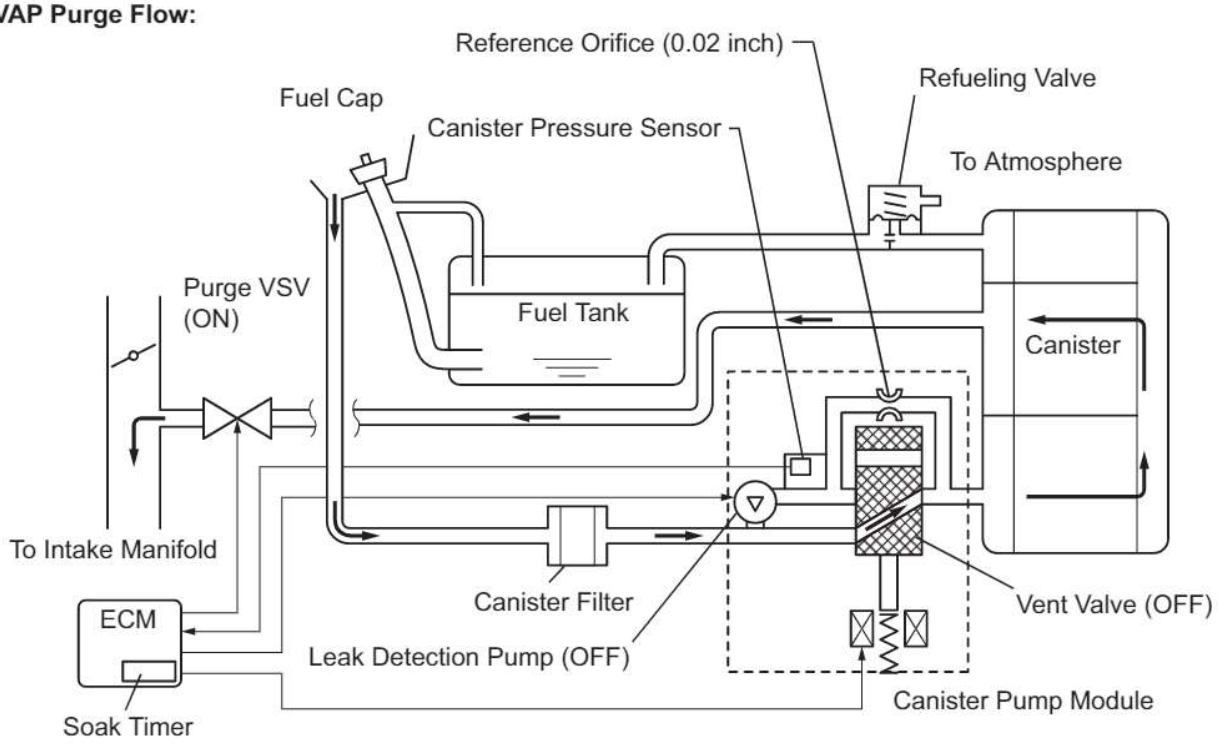
NOTICE:
In this vehicle's EVAP system, turning ON the vent valve does not seal off the EVAP system. To check for leaks in the EVAP system, disconnect the air inlet vent hose and apply pressure from the atmospheric side of the canister.

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 ignition 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 ignition switch is turned off, the monitor check starts 2 hours later. If it is still not below 35°C (95°F) 7 hours after the ignition switch is turned off, the monitor check starts 2.5 hours later.
2. **Purge flow monitor**
   The purge flow monitor consists of the two monitors. The 1st monitor is 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).

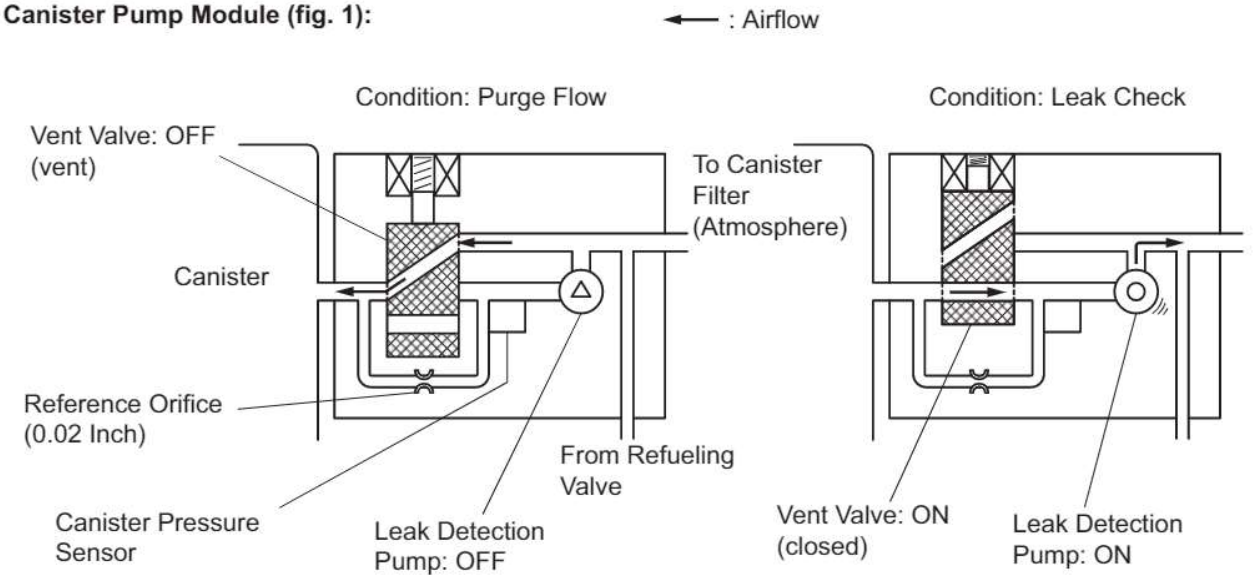
Atmospheric pressure check:
In order to ensure reliable malfunction detection, the variation between the atmospheric pressures, before and after conduction of the purge flow monitor, is measured by the ECM.

EVAP Purge Flow:



Component	Operation
Canister	Contains activated charcoal to absorb EVAP (Evaporative Emissions) generated in fuel tank.
Cut-off valve	Located in fuel tank. Valve floats and closes when fuel tank is 100% full.
Purge VSV (Vacuum Switching Valve)	Opens or closes line between canister and intake manifold. ECM uses purge VSV to control EVAP purge flow. In order to discharge EVAP absorbed by canister to intake manifold, ECM opens purge VSV. EVAP discharge volume to intake manifold is controlled by purge VSV duty cycle ratio (current-carrying time) (Open: ON; 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.

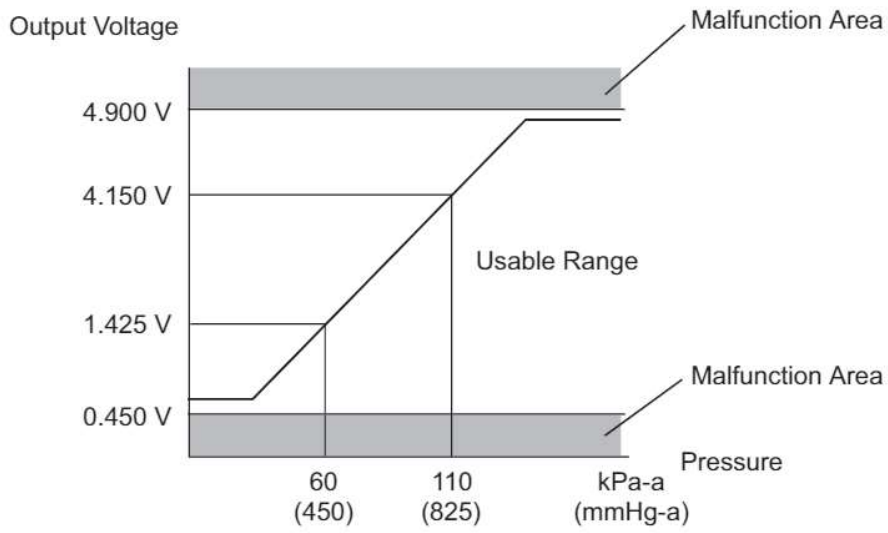
Canister Pump Module (fig. 1):



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A115902E02

Canister Pressure Sensor Specification (fig. 2):

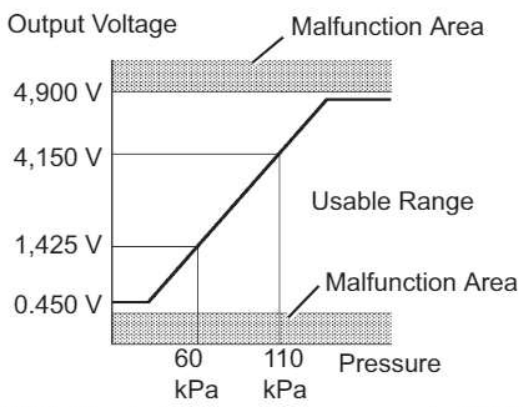


HINT:

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

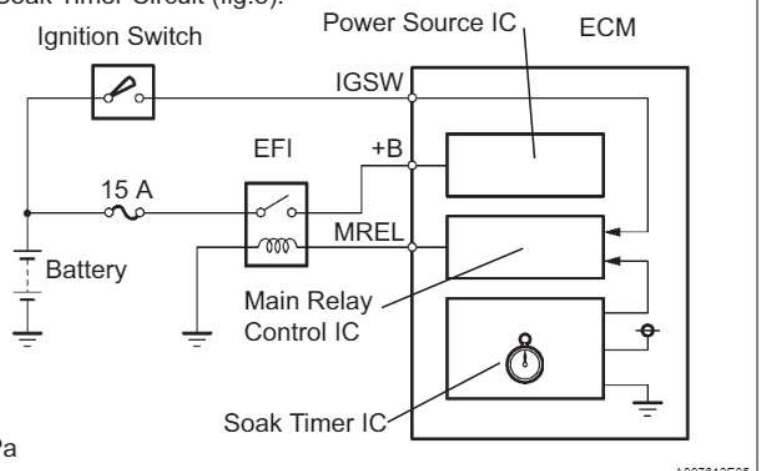
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Canister Pressure Sensor Specification (fig.2):

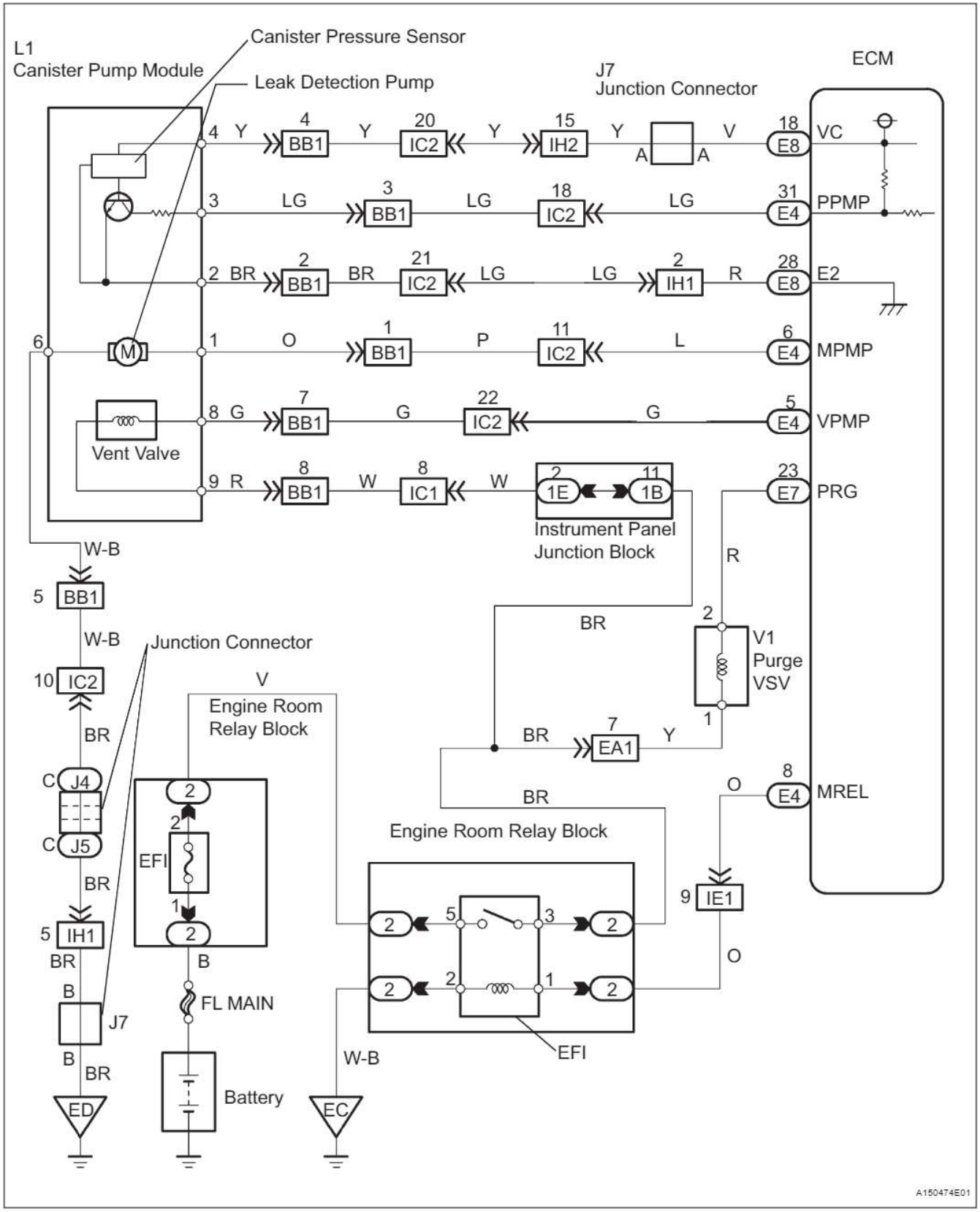


HINT: Standard atmospheric pressure is 101.3 kPa

Soak Timer Circuit (fig.3):



WIRING DIAGRAM



INSPECTION PROCEDURE

NOTICE:

The intelligent tester is required to conduct the following diagnostic troubleshooting procedure.

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-33).

1	CONFIRM DTC

ES

(a) Turn the ignition switch off and wait for 10 seconds.
(b) Turn the ignition switch to the ON position.
(c) Turn the ignition switch off and wait for 10 seconds.
(d) Connect an intelligent tester to the DLC3.
(e) Turn the ignition switch to the ON position and turn the tester on.
(f) Select the following menu items: DIAGNOSIS / ENHANCED OBD II / DTC INFO / CURRENT CODES.
(g) Confirm DTCs and freeze frame data.
If any EVAP system DTCs are set, the malfunctioning area can be determined using the table below.
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.

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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ES

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).**

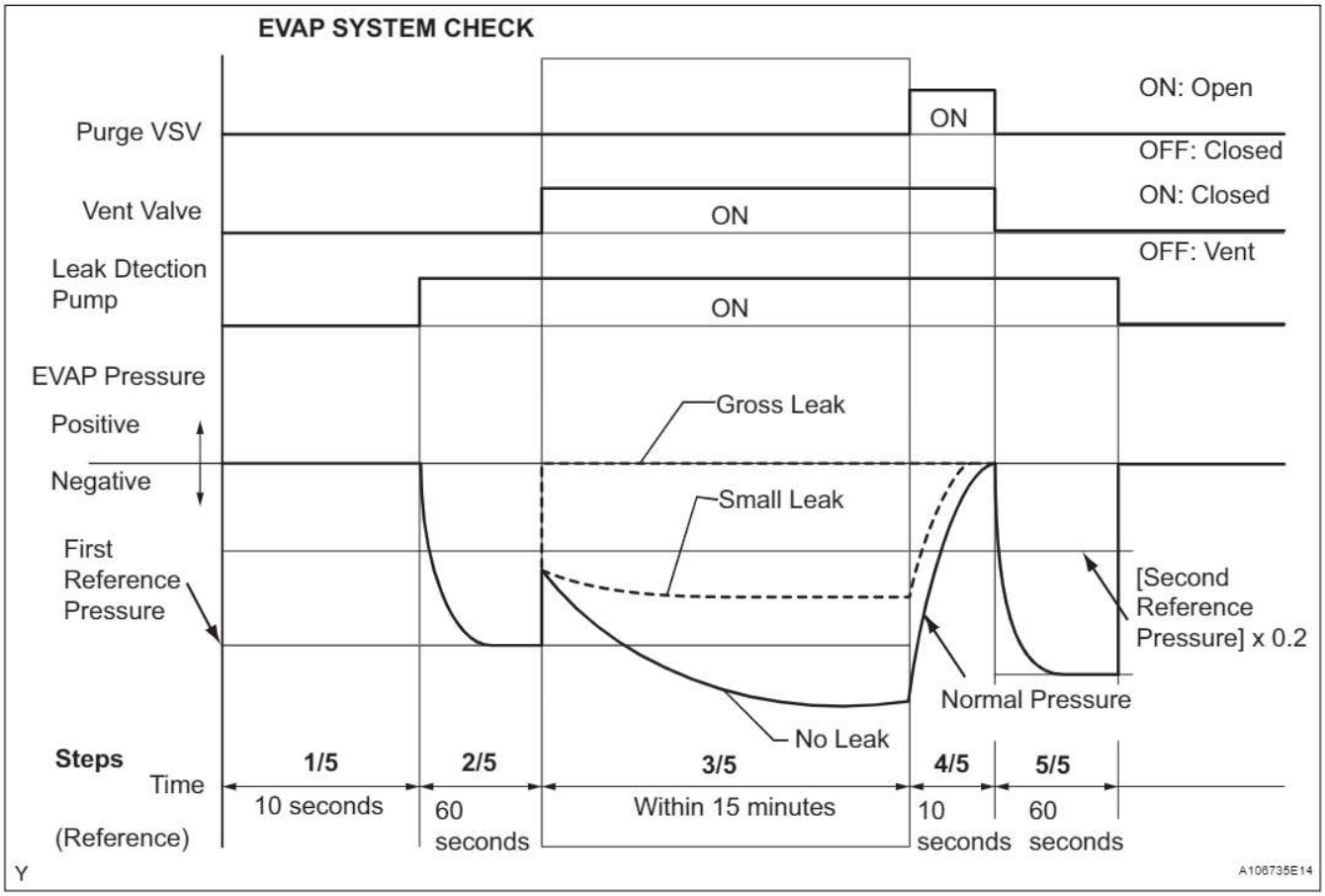
(a) Clear the DTCs (See page ES-32).

(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.

ES NEXT

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).**

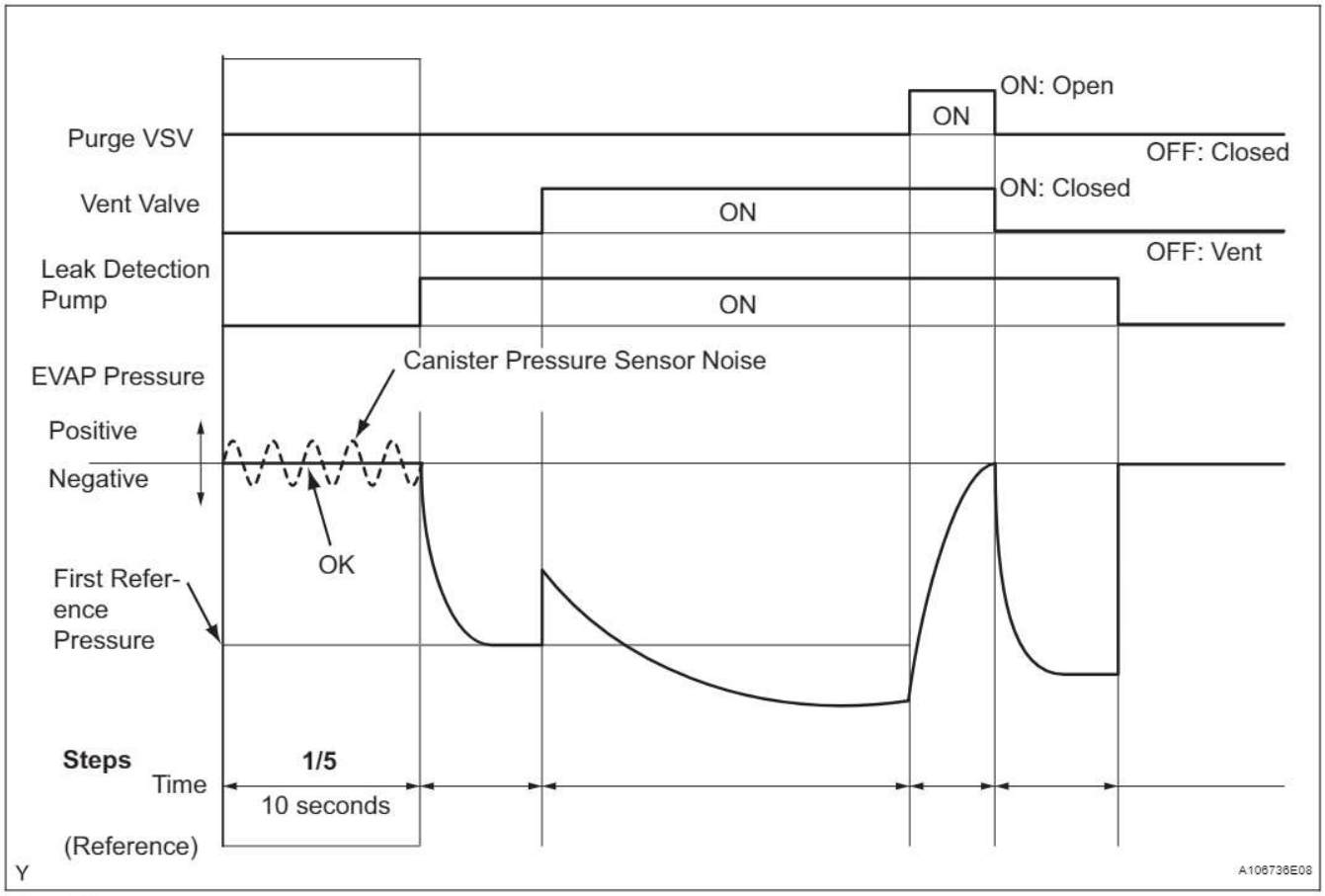
(a) Clear the DTCs (See page ES-32).
(b) Select the following menu items: DIAGNOSIS / ENHANCED OBD II / SYSTEM CHECK / EVAP SYS CHECK / MANUAL OPERATION.

NEXT

4	PERFORM EVAP SYSTEM CHECK (STEP 1/5)

ES

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



Result

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

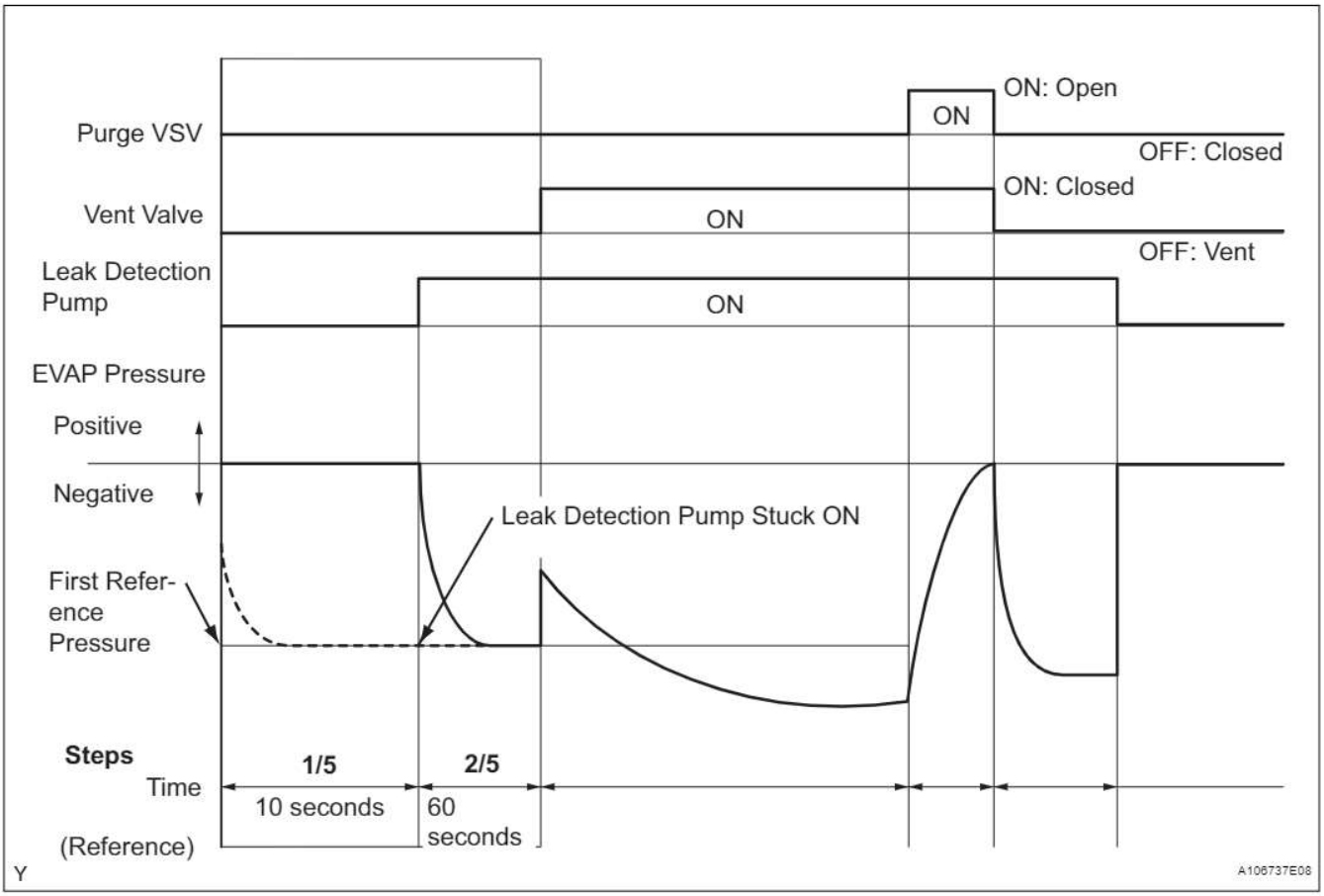
*: These DTCs are already present in the ECM when the vehicle arrives and are confirmed in the "CONFIRM DTC" procedures above.

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.



Result

DTCs*	Test Result	Suspected Trouble Area	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

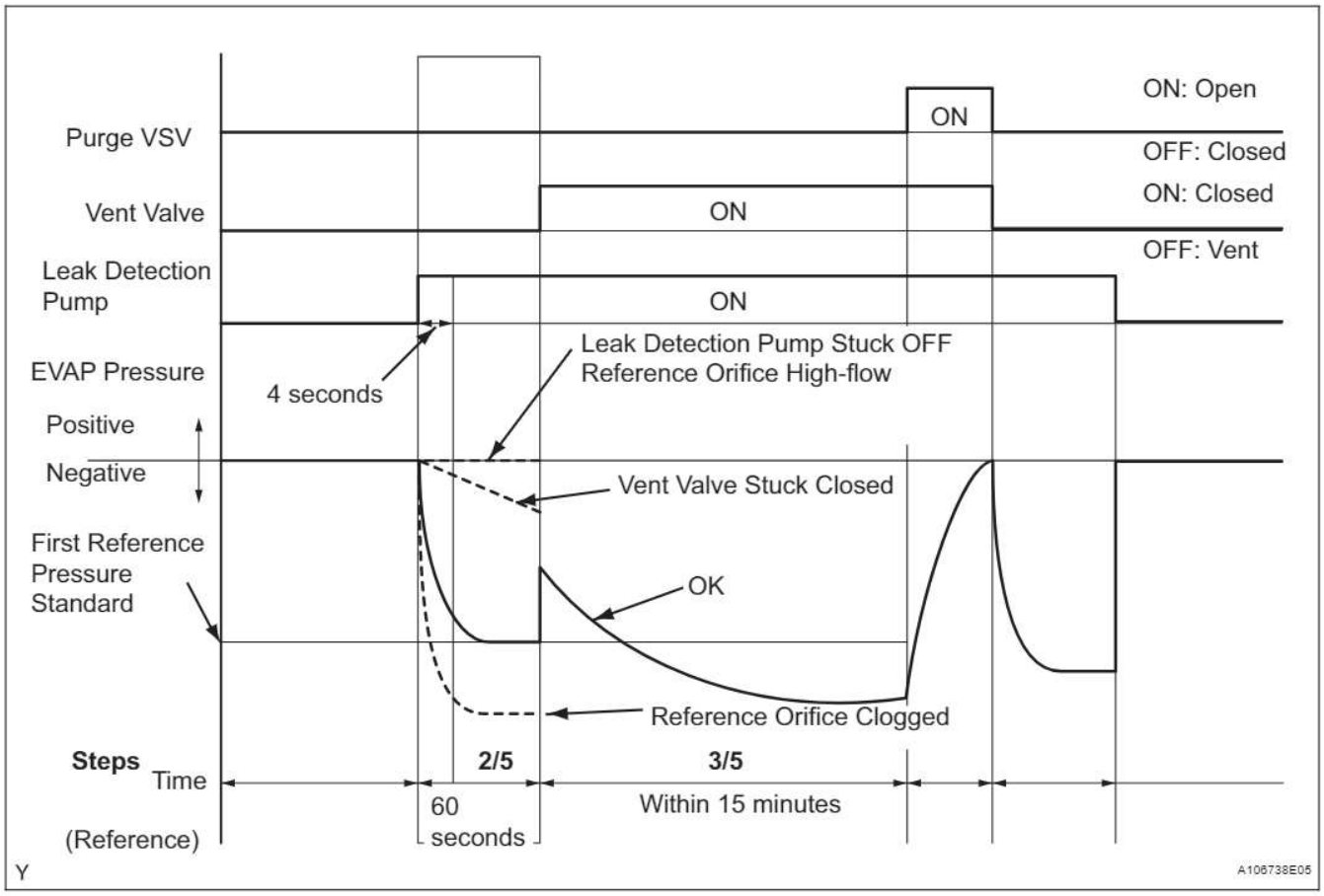
*: These DTCs are already present in the ECM when the vehicle arrives and are confirmed in the "CONFIRM DTC" procedures above.
HINT:
The first reference pressure is the value determined in step 2/5.

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 Result	Suspected Trouble Area	Proceed to
-	EVAP pressure in step (b) between -4.85 kPa-g and -1.057 kPa-g (-36.4 mmHg-g and -7.93 mmHg-g)	Not yet determined	A
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

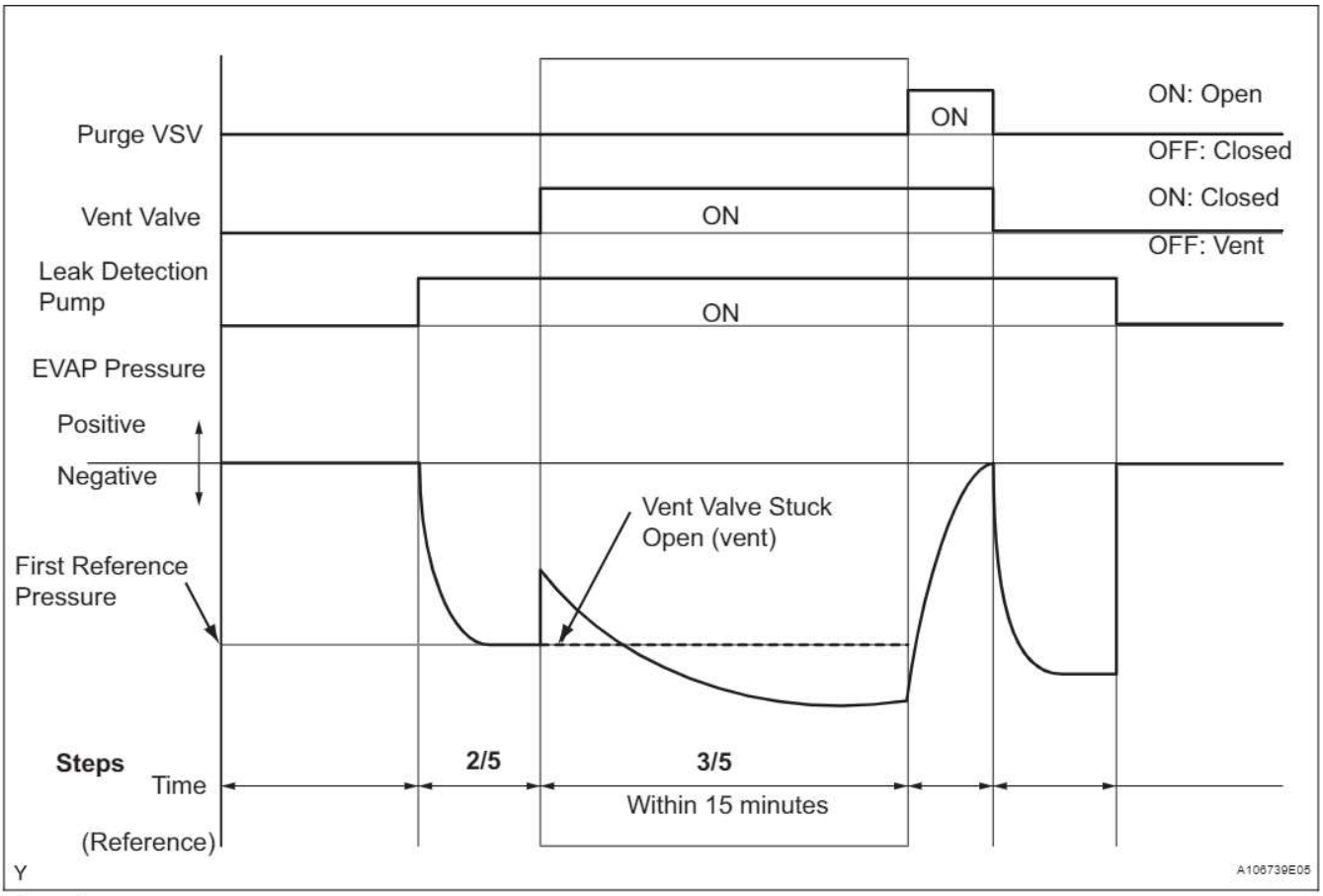
*: These DTCs are already present in the ECM when the vehicle arrives and are confirmed in the "CONFIRM DTC" procedures above.

B	Go to step 11
C	Go to step 29
D	Go to step 20

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

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

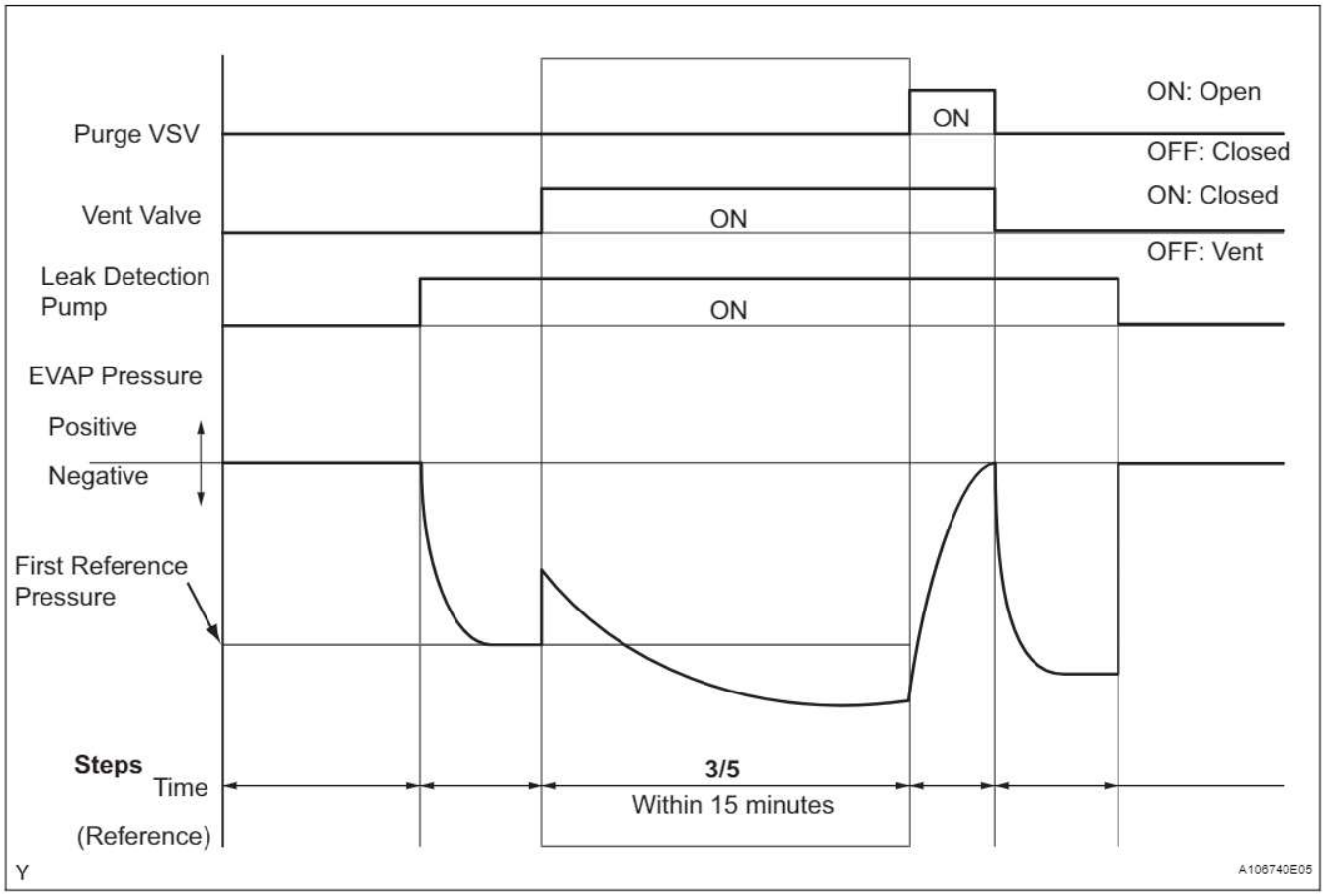
B	Go to step 19

C	Go to step 29

A

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.

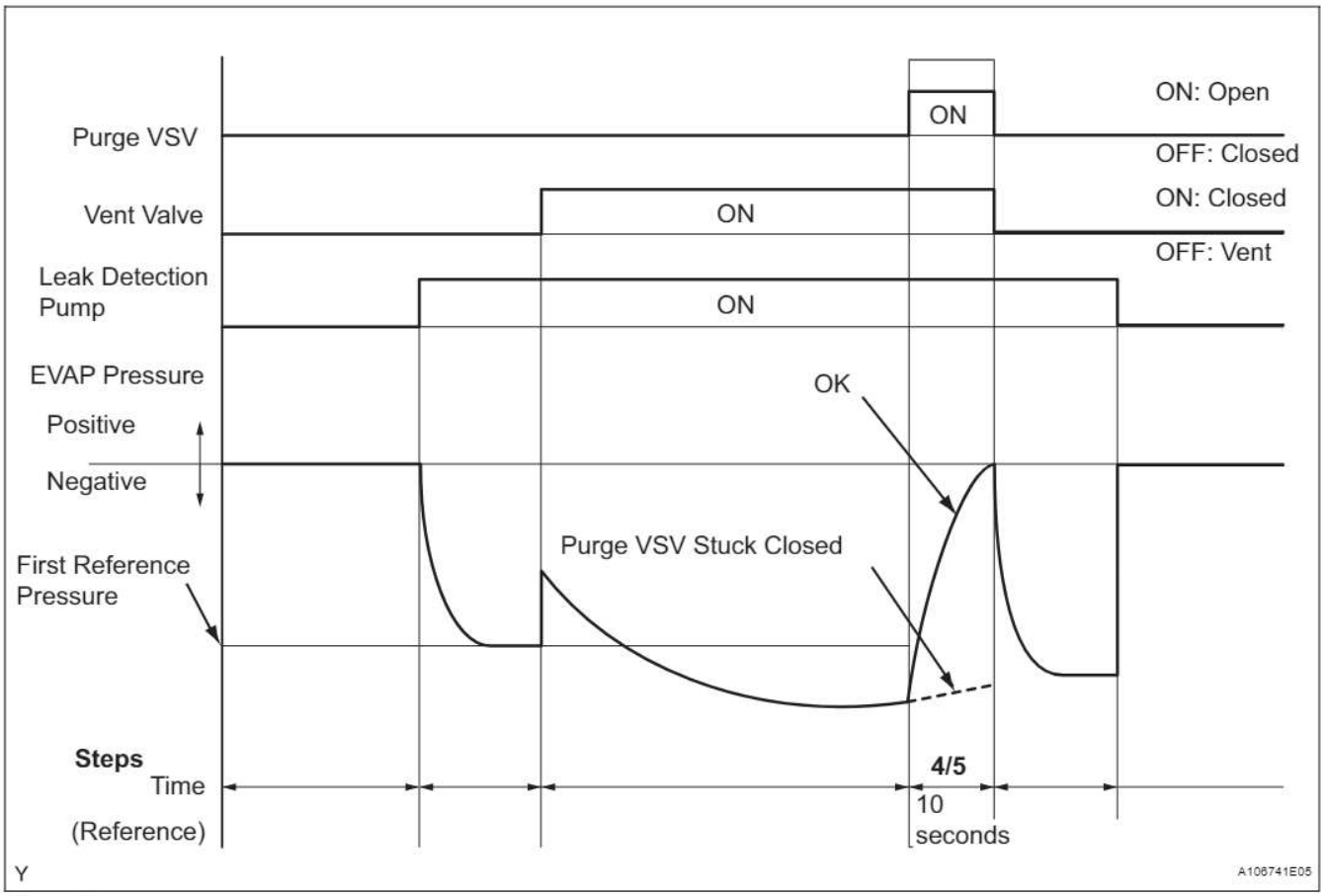


(b) Measure the EVAP pressure and record it.
HINT:
A few minutes are required for the EVAP pressure to become saturated. When there is little fuel in the fuel tank, it takes up to 15 minutes.

NEXT

9	PERFORM EVAP SYSTEM CHECK (STEP 4/5)

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



Result

DTCs*	Test Result	Suspected Trouble Area	Proceed to
-	EVAP pressure increases by 0.3 kPa-g (2.25 mmHg-g) or more within 10 seconds of proceeding from step 3/5 to step 4/5	Not yet determined	A
P0441	EVAP pressure increases by 0.3 kPa-g (2.25 mmHg-g) or more within 10 seconds of 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.

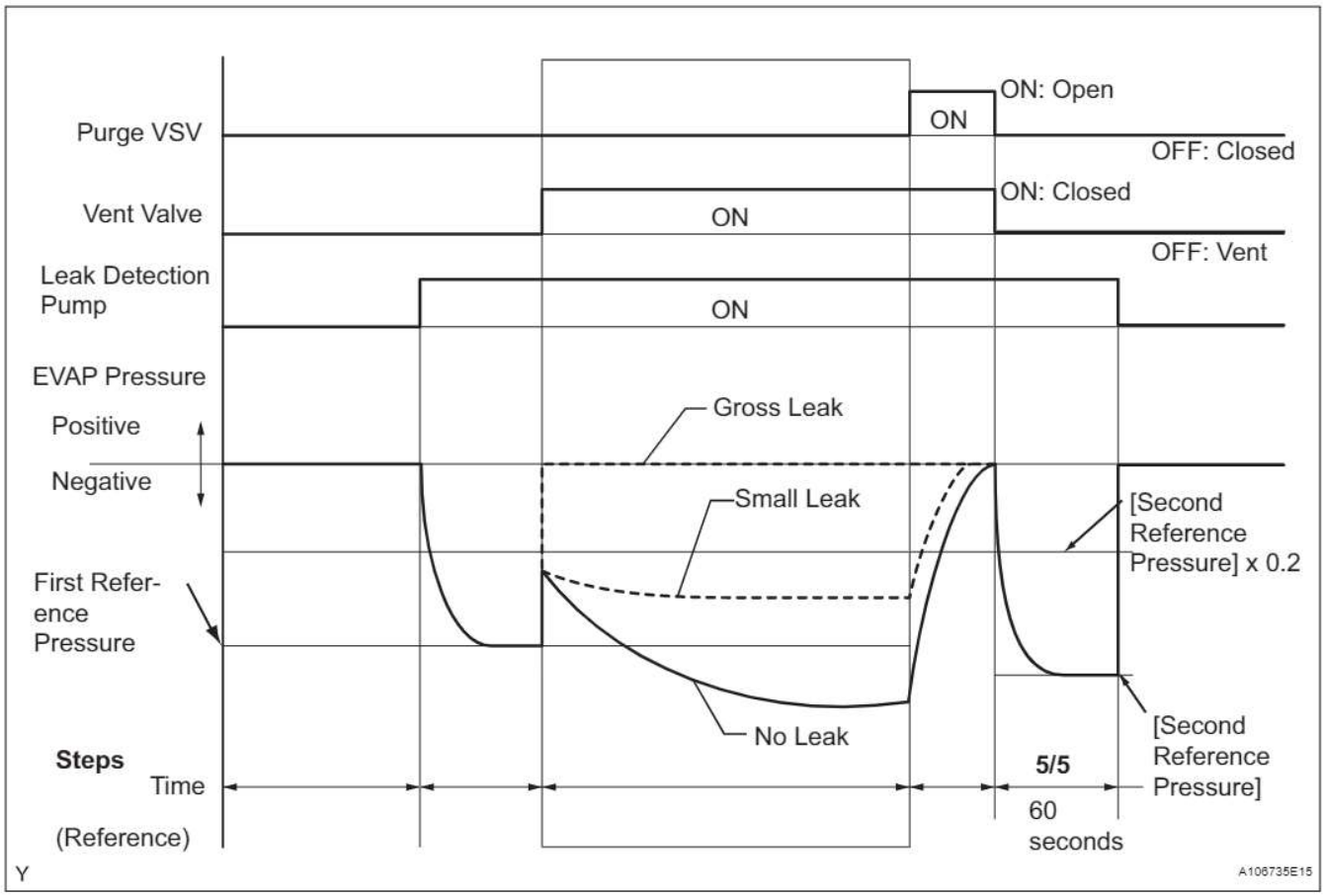
B → Go to step 15

C → Go to step 12

A

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

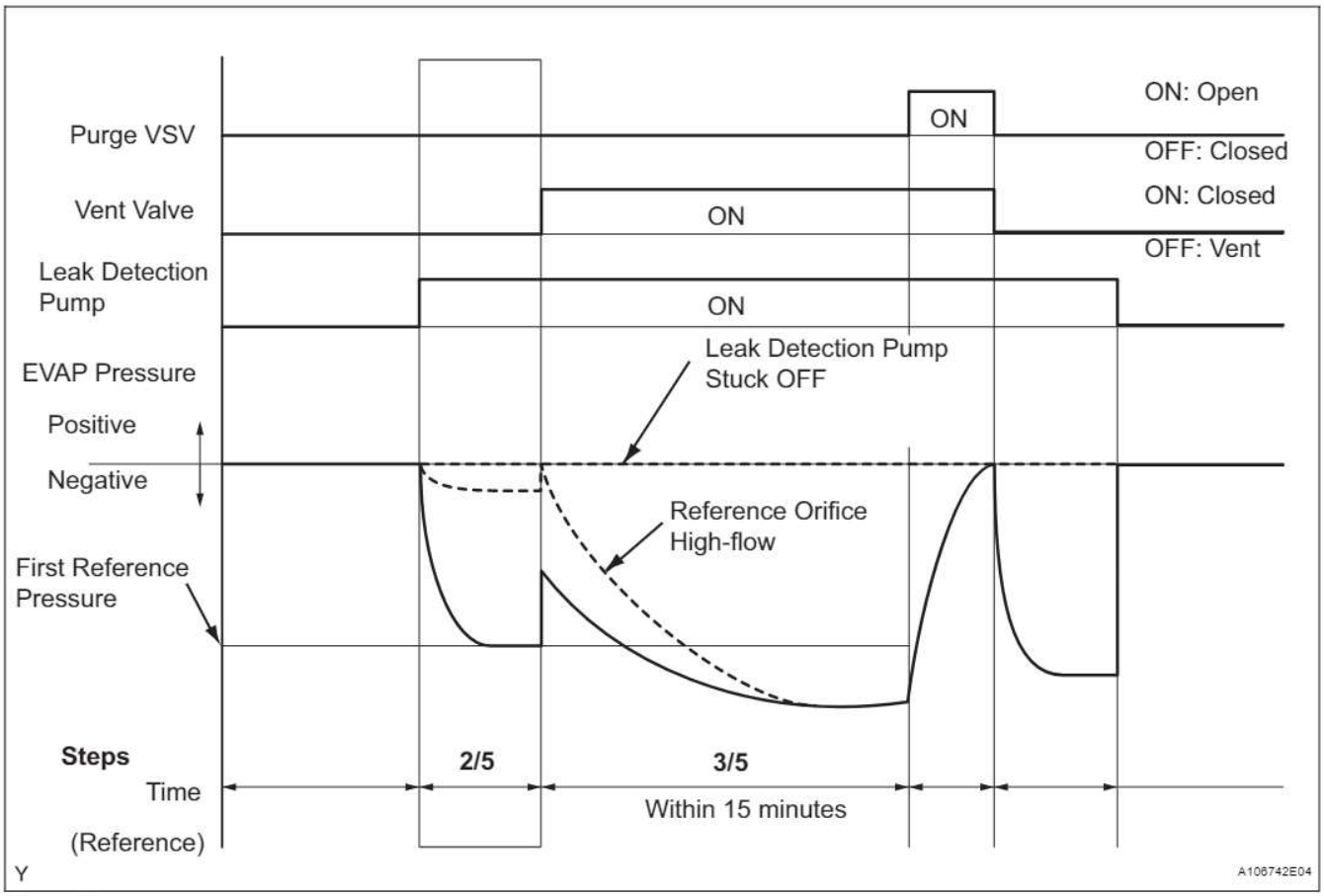
DTCs*	Test Result	Suspected Trouble Area	Proceed to
-	EVAP pressure (step 3/5) lower than second reference pressure (step 5/5)	Not yet determined (no leakage from EVAP system)	A
P0441 and P0455	EVAP pressure (step 3/5) higher than [second reference pressure (step 5/5) x 0.2]	• Purge VSV stuck open • 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.

A	Go to step 35
B	Go to step 12

11	PERFORM EVAP SYSTEM CHECK (STEP 3/5)

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



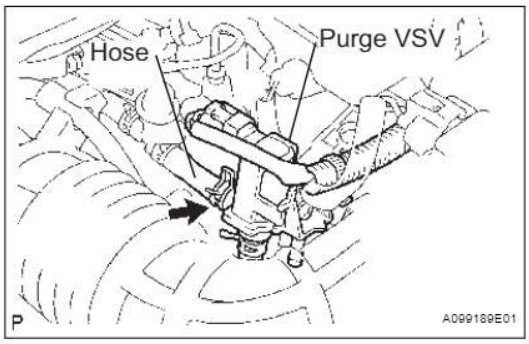
Result

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

*: These DTCs are already present in the ECM when the vehicle arrives and are confirmed in the "CONFIRM DTC" procedures above.
HINT:
The first reference pressure is the value determined in step 2/5.

A	Go to step 29
B	Go to step 22

12 PERFORM ACTIVE TEST USING 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.

ES

Result

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

(h) Reconnect the hose.

B → Go to step 14

C → Go to step 15

A

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 Result	Suspected Trouble Area	Proceed to
Fuel cap correctly installed	-	A

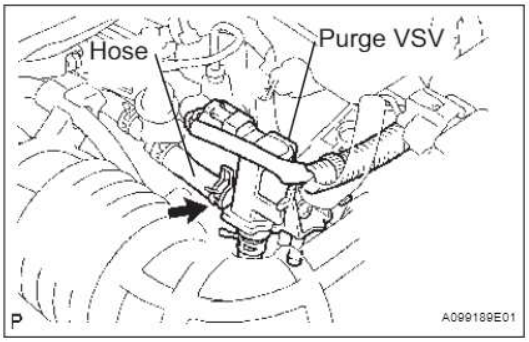
Test Result	Suspected Trouble Area	Proceed to
Fuel cap loose	• Fuel cap improperly installed • Defective fuel cap • Fuel cap does not meet OEM specifications	B
Defective fuel cap	-	B
No fuel cap	-	C

(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)



(a) Turn the ignition switch off.
(b) Disconnect the V1 purge VSV connector.
(c) Disconnect the hose (connected to the canister) from the purge VSV.
(d) Start the engine.
(e) Use your finger to confirm that the purge VSV has no suction.

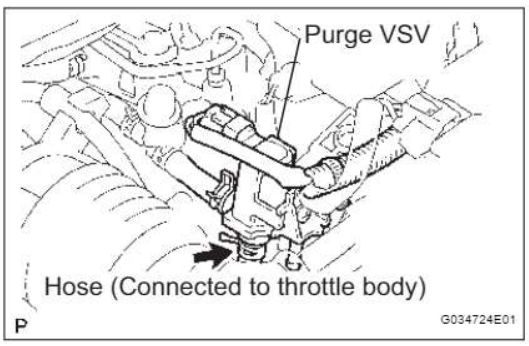
Result

Test Result	Suspected Trouble Area	Proceed to
No suction	ECM	A
Suction applied	Purge VSV	B

(f) Reconnect the purge VSV connector.
(g) Reconnect the hose.

A	Go to step 34
B	Go to step 30

15 CHECK EVAP HOSE (PURGE VSV - INTAKE MANIFOLD)



(a) Disconnect the hose (connected to the intake manifold) from the purge VSV.
(b) Start the engine.
(c) Use your finger to confirm that the hose has suction.

Result

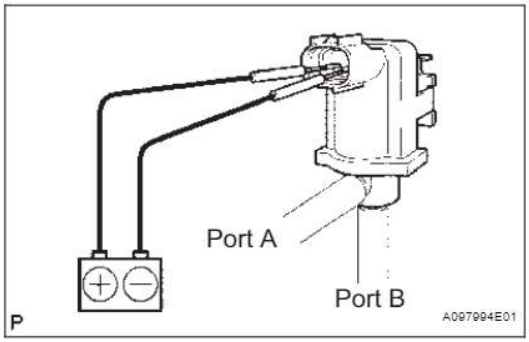
Test Result	Suspected Trouble Area	Proceed to
Suction applied	EVAP hose between purge VSV and intake manifold normal	A
No suction	• Intake manifold port • EVAP hose between purge VSV and intake manifold	B

(d) Reconnect the hose.

B → Go to step 25

A

16 INSPECT DUTY VACUUM SWITCHING VALVE (PURGE VSV)



(a) Remove the purge VSV.
(b) Apply the battery voltage to the terminals of the purge VSV.
(c) Using an air gun, confirm that air flows from port A to port B.

Result

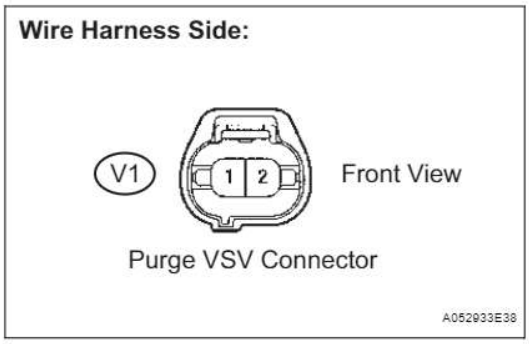
Test Result	Suspected Trouble Area	Proceed to
Air flows	Purge VSV normal	A
No air flow	Purge VSV	B

(d) Install the purge VSV.

B → Go to step 30

A

17 CHECK HARNESS AND CONNECTOR (POWER SOURCE OF PURGE VSV)



(a) Disconnect the V1 purge VSV connector.
(b) Turn the ignition switch to the ON position.
(c) Measure the voltage between terminal 2 of the purge VSV connector and body ground.

Result

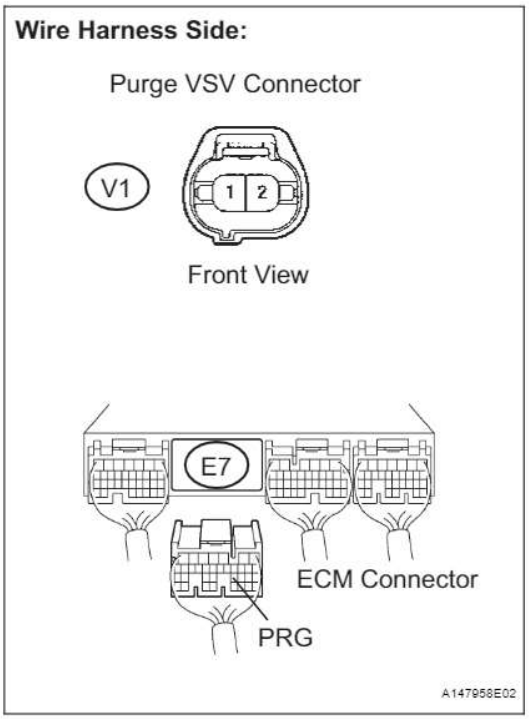
Test Result	Suspected Trouble Area	Proceed to
11 to 14 V	Normal	A
Other than result above	Wire harness or connectors between purge VSV and ECM	B

(d) Reconnect the purge VSV connector.

B	Go to step 31

A

18 CHECK HARNESS AND CONNECTOR (PURGE VSV - ECM)



(a) Disconnect the E7 ECM connector and the V1 purge VSV connector.
(b) Measure the resistance according to the value(s) in the table below..

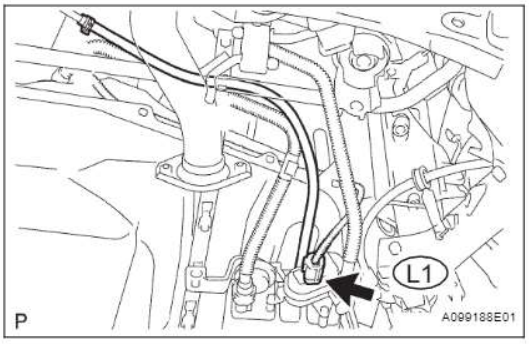
Standard resistance

Tester Connection	Specified Condition
E7-23 (PRG) - V1-2 (Purge VSV)	Below 1 Ω
E7-23 (PRG) - Body ground	10 kΩ or higher
V1-2 (Purge VSV) - Body ground	10 kΩ or higher

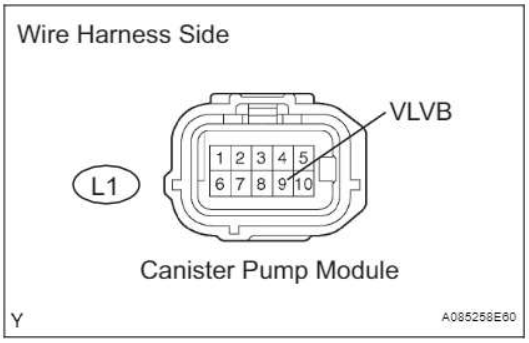
(c) Reconnect the purge VSV connector.
(d) Reconnect the ECM connector.

OK	Go to step 34
NG	Go to step 31

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



(a) Turn the ignition switch off.
(b) Disconnect the L1 canister pump module connector.
(c) Turn the ignition switch to the ON position.



(d) Measure the voltage between the VLVB terminal of the canister pump module connector and body ground.

Result

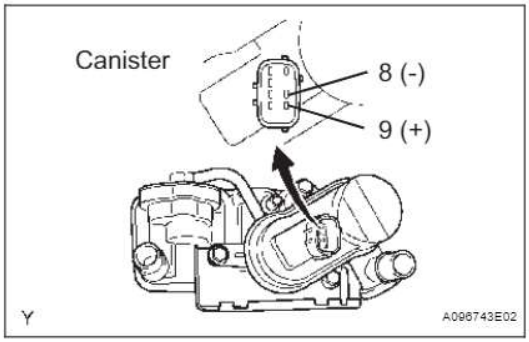
Test Result	Suspected Trouble Area	Proceed to
9 to 14 V	1. Wire harness between vent valve and ECM 2. Vent valve 3. ECM	A
Below 3 V	Power source wire harness of vent valve	B

(e) Reconnect the canister pump module connector.

B → Go to step 31

A

20 INSPECT CANISTER PUMP MODULE (VENT VALVE OPERATION)



(a) Turn the ignition switch off.
(b) Disconnect the L1 canister pump module connector.
(c) Apply battery voltage to the 9 and 8 terminals of the canister pump module.
(d) Touch the canister pump module to confirm the vent valve operation.

Result

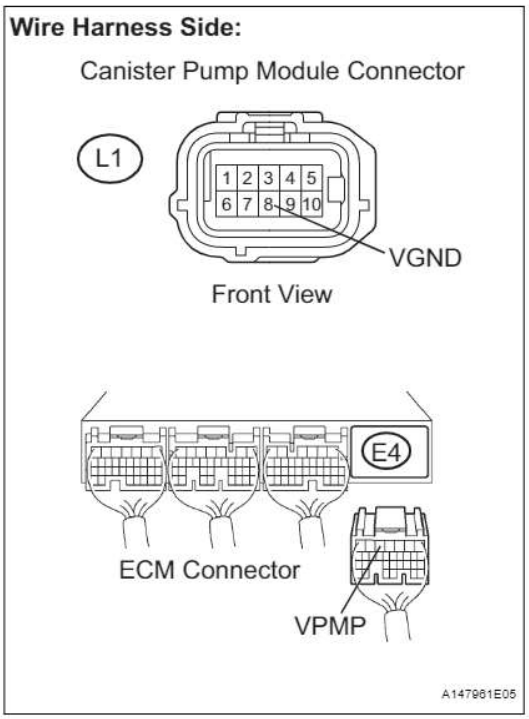
Test Result	Suspected Trouble Area	Proceed to
Operating	1. Wire harness between vent valve and ECM 2. ECM	A
Not operating	Vent valve	B

(e) Reconnect the canister connector.

B → Go to step 29

A

21 CHECK HARNESS AND CONNECTOR (ECM - CANISTER PUMP MODULE)



(a) Disconnect the E4 ECM connector.
(b) Disconnect the L1 canister pump module connector.
(c) Measure the resistance between the VPMP terminal of the ECM connector and the VGND terminal of the canister pump module connector.

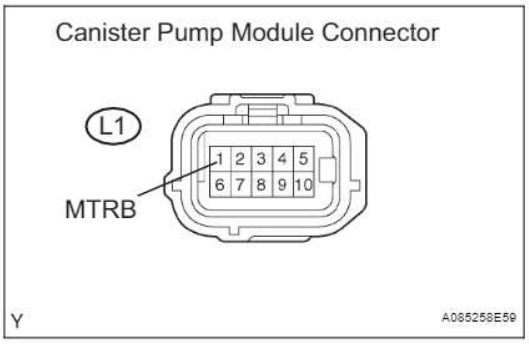
Result

Test Result	Suspected Trouble Area	Proceed to
Below 1 Ω	ECM	A
10 kΩ 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))



(a) Turn the ignition switch off.
(b) Disconnect the L1 canister pump module connector.
(c) Turn the ignition switch to the ON position.
(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.

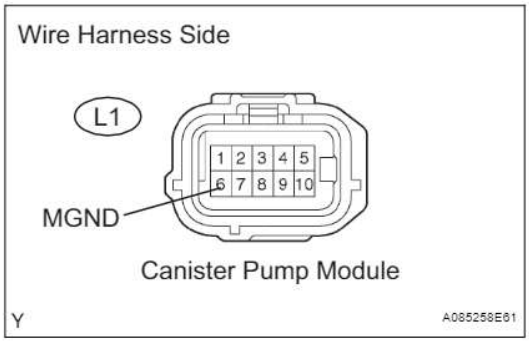
Result

Test Result	Suspected Trouble Area	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

B → Go to step 24

A

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



(a) Turn the ignition switch off.
(b) Disconnect the L1 canister pump module connector.
(c) Measure the resistance between the MGND terminal of the canister pump module connector and body ground.

Result

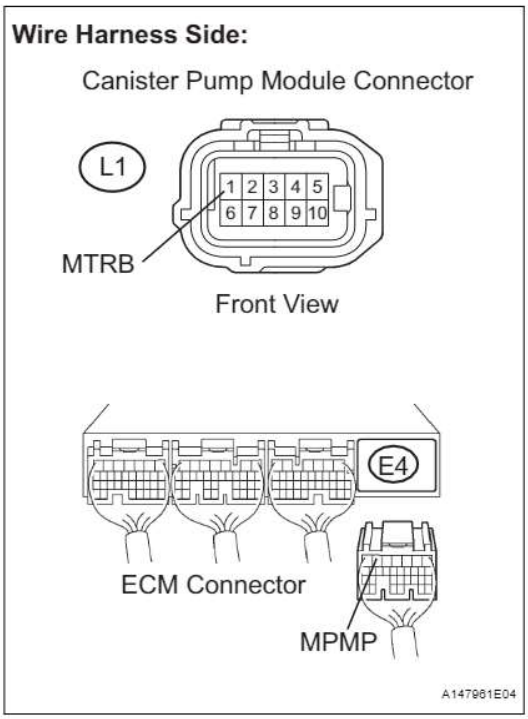
Test Result	Suspected Trouble Area	Proceed to
Below 1 Ω	Leak detection pump	A
10 kΩ or higher	Wire harness between canister pump module and body ground	B

(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 ignition switch off.
(b) Disconnect the L1 canister pump module connector.
(c) Disconnect the E4 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 Result	Suspected Trouble Area	Proceed to
Below 1 Ω	ECM	A
10 kΩ 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 Result	Suspected Trouble Area	Proceed to
Suction applied	EVAP hose between intake manifold and purge VSV	A
No suction	Intake manifold	B

(e) Reconnect the EVAP hose.

A	Go to step 32
B	Go to step 33

26	CORRECTLY REINSTALL OR REPLACE FUEL 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

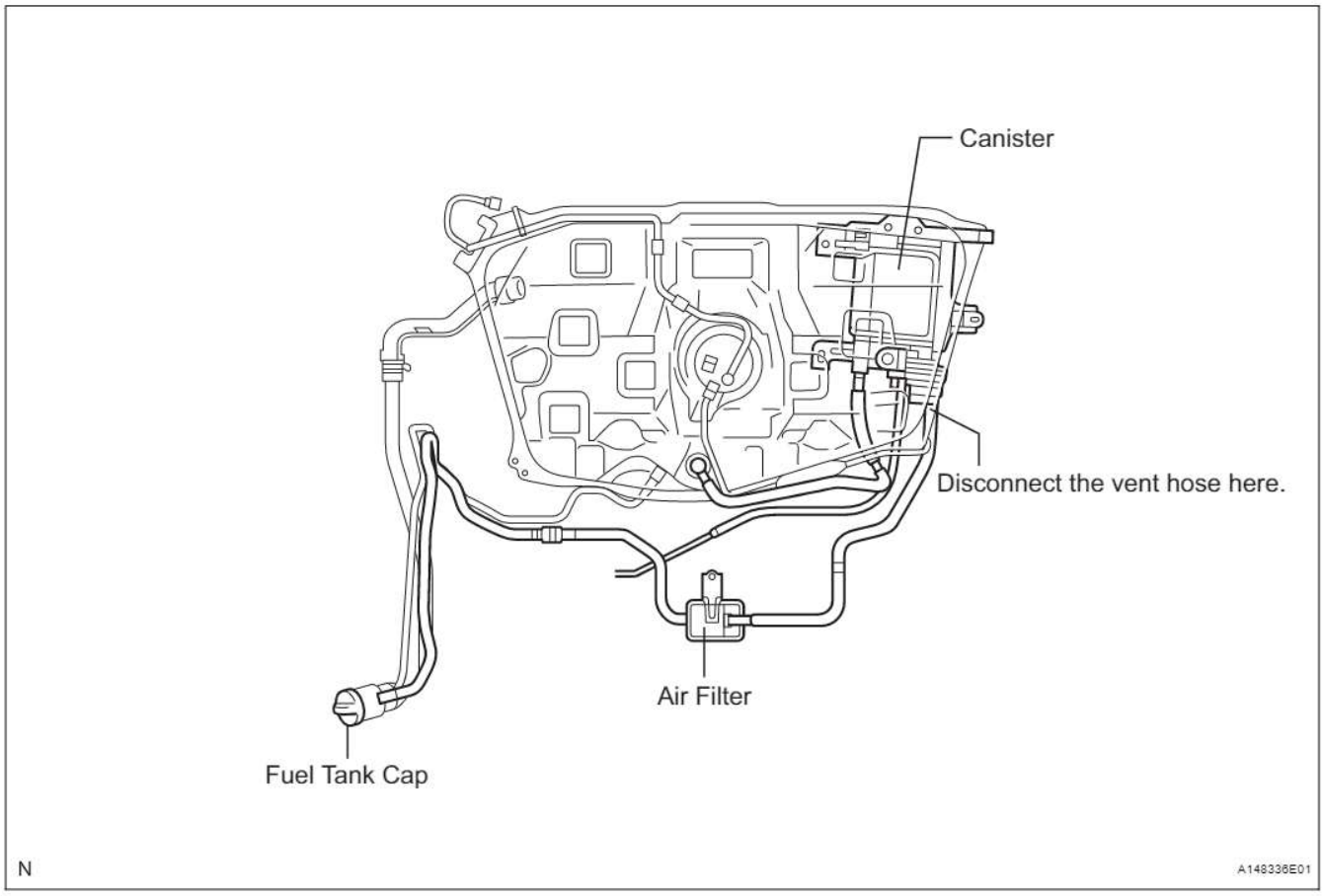
27	REPLACE FUEL CAP

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

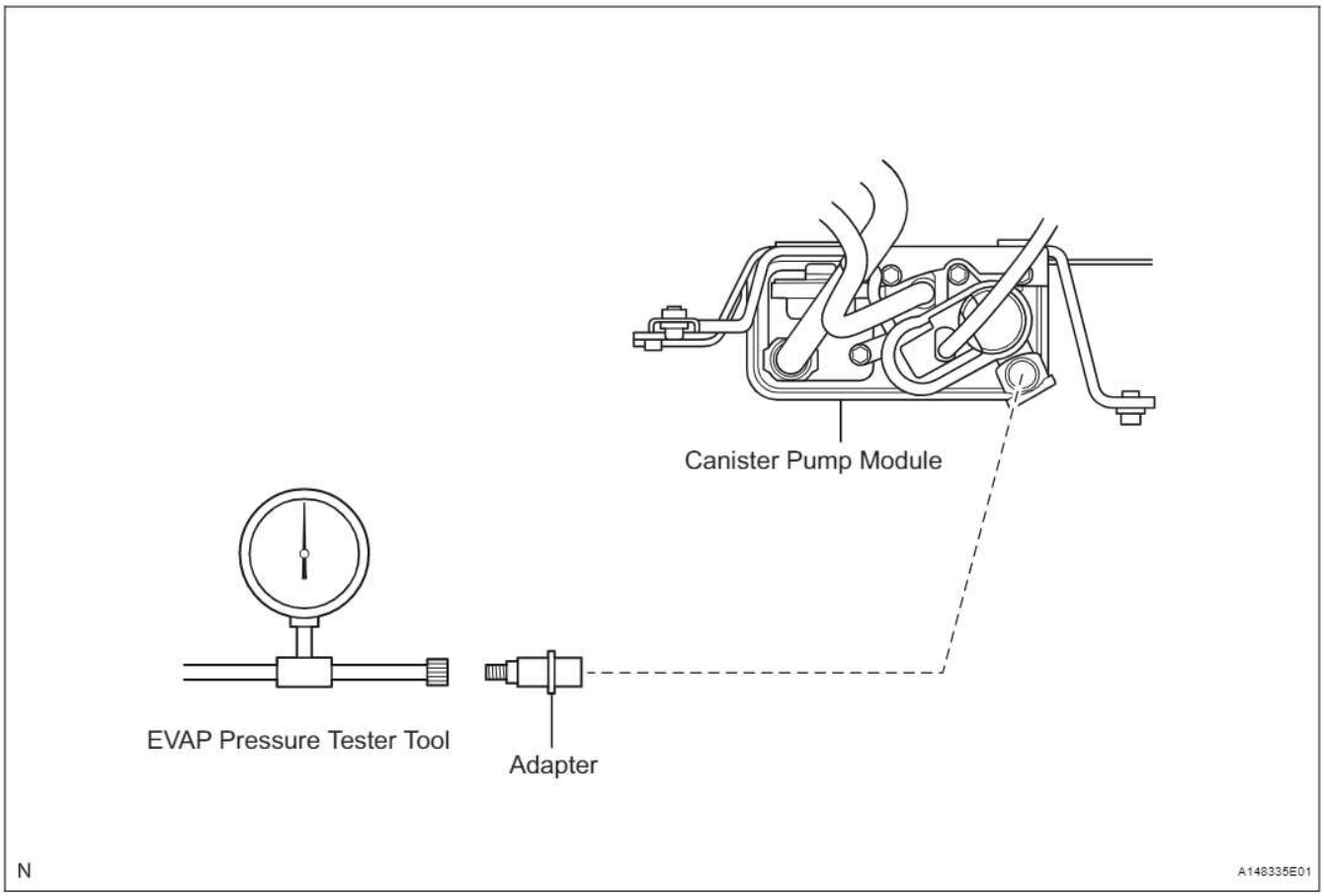
NEXT	Go to step 36

28	LOCATE EVAP LEAK PART

(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.

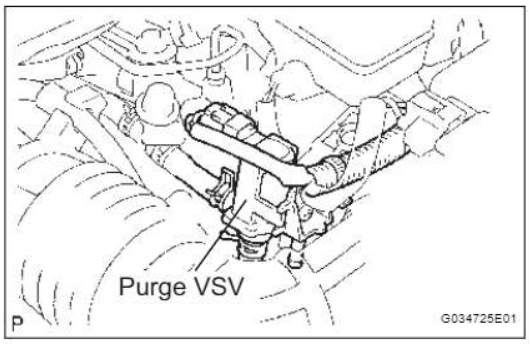
NEXT	Go to step 36

29	REPLACE CHARCOAL CANISTER ASSEMBLY

(a) Replace the canister assembly (See page EC-5).

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.
(c) Install a new purge VSV.
(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-407).

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-32).

(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 ignition switch off and wait for 6 hours (8 or 10.5 hours).
HINT:
Do not start the engine until checking MONITOR STATUS. If the engine is started, the steps described above must be repeated.

(c) Monitor Status
1. Connect the intelligent tester to the DLC3.
2. Turn the ignition switch to the ON position 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 ignition switch off (if ON or the engine is running).
2. Connect the intelligent tester to the DLC3.
3. Turn the ignition switch to the ON position 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

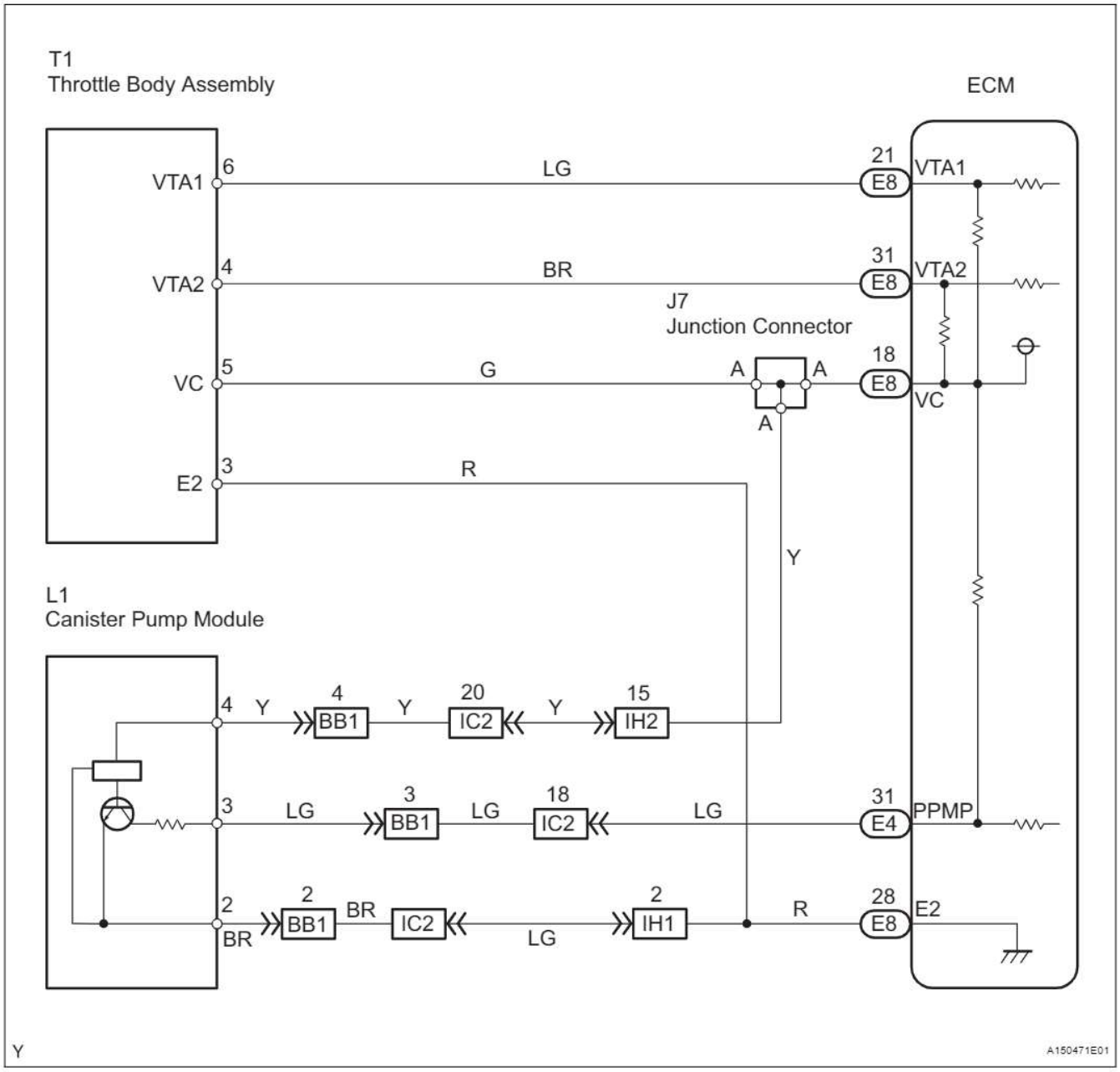
Refer to CHECKING MONITOR STATUS (See page ES-15).

VC Output Circuit

DESCRIPTION

The VC voltage (5 V) is generated in the ECM. The voltage is used to supply power to the throttle position sensor, canister pump module, etc.

WIRING DIAGRAM



INSPECTION PROCEDURE

1	CHECK MIL

(a) Check that MIL (Malfunction Indicator Lamp) lights up when turning the ignition switch to the ON position.

Standard:
MIL lights up

OK → **SYSTEM OK**

NG

2 CHECK CONNECTION BETWEEN INTELLIGENT TESTER AND ECM

(a) Connect the intelligent tester to the DLC3.
(b) Turn the ignition switch to the ON position and turn the intelligent tester on.
(c) Check the communication between the intelligent tester and ECM.

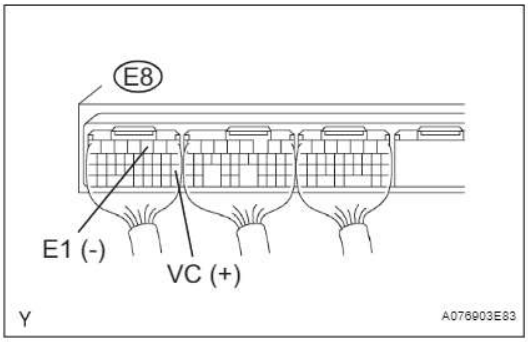
Result

Condition	Proceed to
Communication is possible	A
Communication is not possible	B

A → **GO TO MIL CIRCUIT**

B

3 INSPECT ECM (VC VOLTAGE)



(a) Turn the ignition switch to the ON position.
(b) Measure the voltage according to the value(s) in the table below.

Standard voltage

Tester Connection	Specified Condition
E8-18 (VC) - E8-3 (E1)	Voltage is not 5 V

NEXT

4 CHECK MIL (THROTTLE POSITION SENSOR)

(a) Disconnect the T1 throttle body connector.
(b) Turn the ignition switch to the ON position.
(c) Check the MIL.

Result

Condition	Proceed to
MIL illuminates	A
MIL does not illuminate	B

A → **REPLACE THROTTLE BODY**

B

5	CHECK MIL (CANISTER PUMP MODULE)

(a) Disconnect the T1 throttle body connector.
(b) Turn the ignition switch to the ON position.
(c) Check the MIL.

Result

Condition	Proceed to
MIL illuminates	A
MIL does not illuminate	B

A → REPLACE CANISTER

B

6	CHECK WIRE HARNESS (ECM - BODY GROUND)

(a) Disconnect the T1 throttle body connector.
(b) Disconnect the L1 canister pump module connector.
(c) Disconnect the E8 ECM connector.
(d) Measure the resistance according to the value(s) in the table below.

Standard resistance

Tester Connection	Specified Condition
E8-18 (VC) - Body ground	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

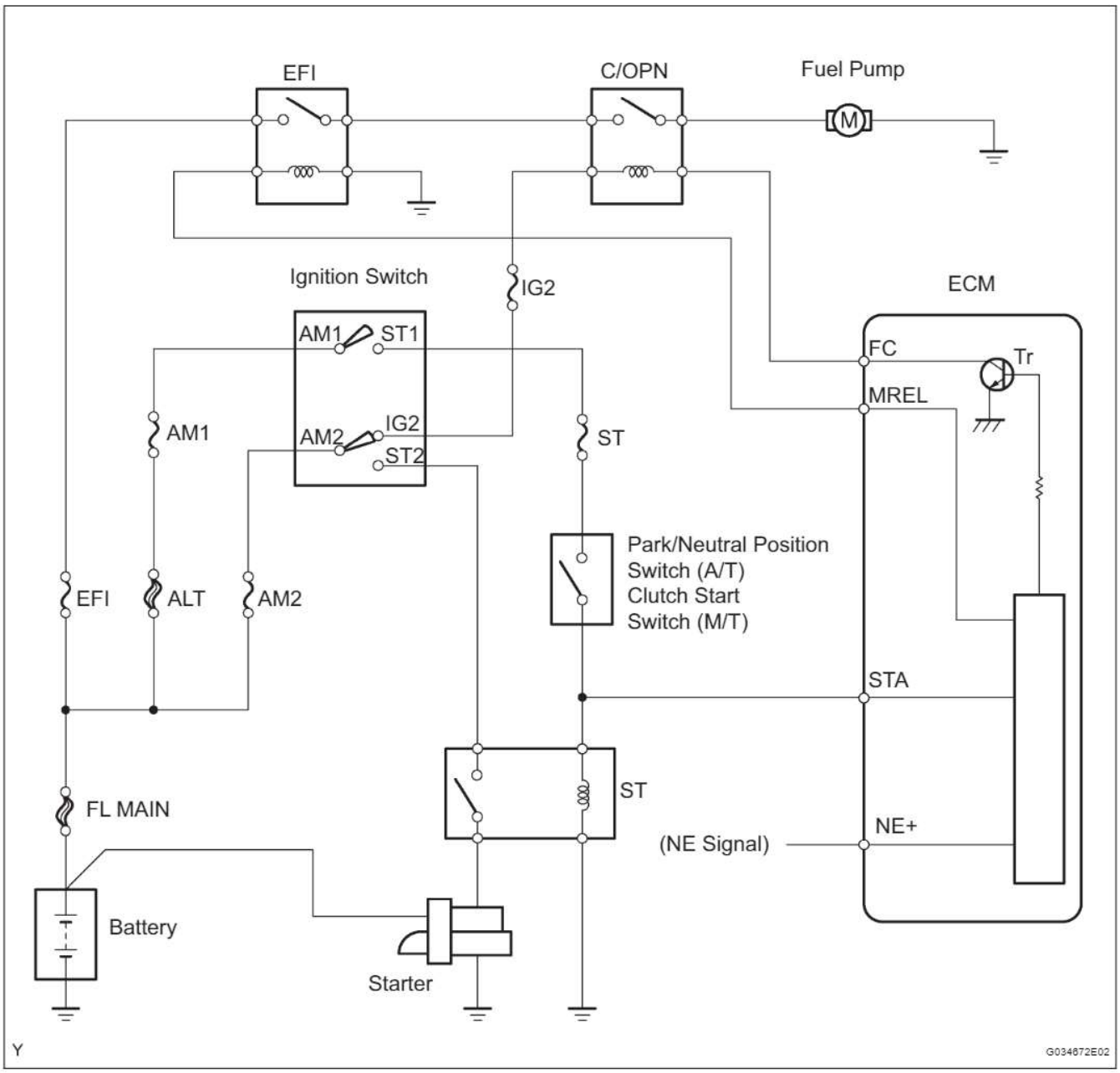
OK

REPLACE ECM

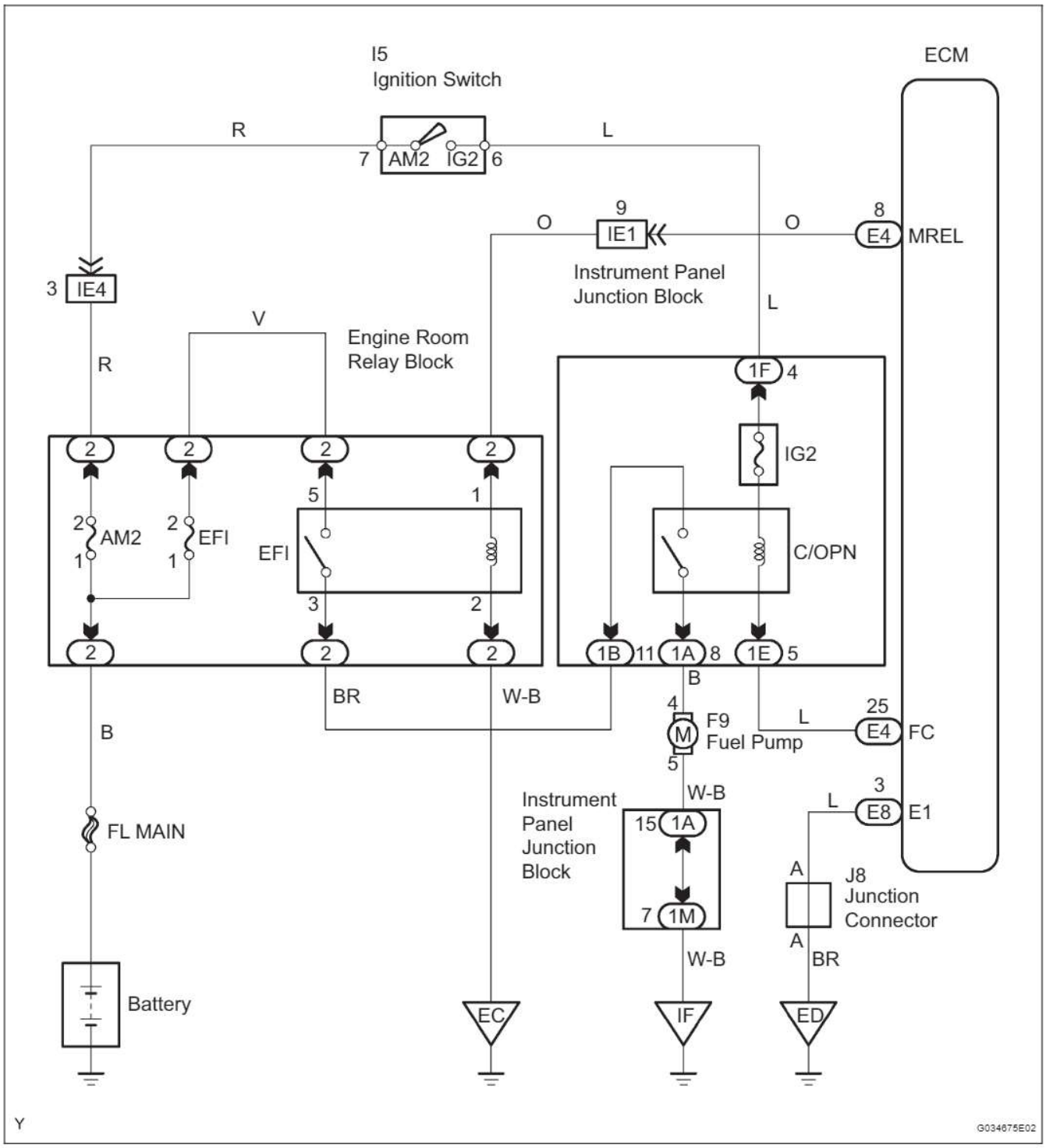
Fuel Pump Control Circuit

DESCRIPTION

When the engine is cranked, a current flows from terminal ST2 of the ignition switch into the starter relay (Marking: ST) coil and a current also flows into terminal STA of the ECM (STA signal).
When the STA and NE signals are received by the ECM, Tr (power transistor) is switched ON, allowing a current to flow into the circuit opening relay coil. The circuit opening relay (Marking: C/OPN) switches ON, power is supplied to the fuel pump and the fuel pump operates.
While the NE signal is being generated (engine running), the ECM keeps Tr ON, therefore keeping the circuit opening relay ON, so that the fuel pump continues to operate.



WIRING DIAGRAM



INSPECTION PROCEDURE

1	PERFORM ACTIVE TEST USING INTELLIGENT TESTER (OPERATION OF CIRCUIT OPENING RELAY)

(a) Connect the intelligent tester to the DLC3.
(b) Turn the ignition switch to the ON position and turn the tester on.

(c) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / FUEL PUMP/SPD.
(d) Check whether operating sounds can be heard while operating the relay using the tester.
OK:
Operating sounds can be heard from relay.

OK → **Go to step 7**

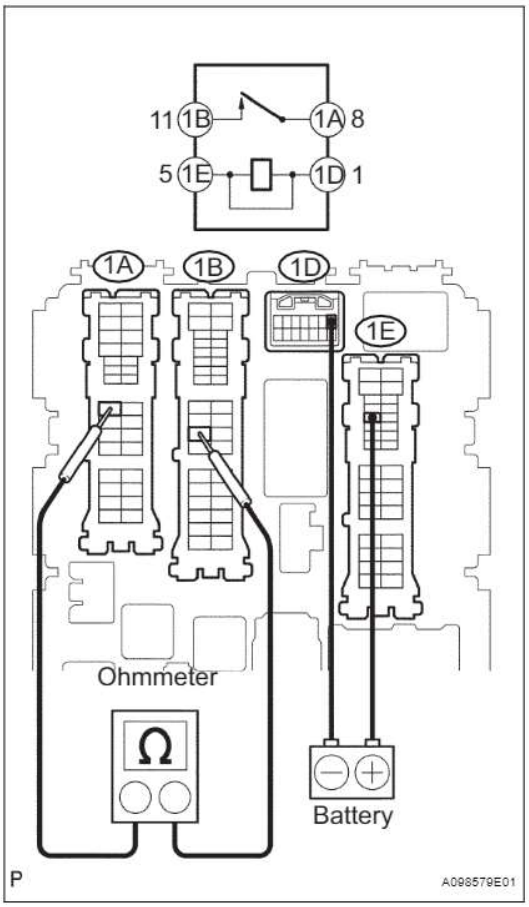
NG

2 INSPECT ECM POWER SOURCE CIRCUIT

NG → **REPAIR OR REPLACE POWER SOURCE CIRCUIT**

OK

3 INSPECT CIRCUIT OPENING RELAY (C/OPN)



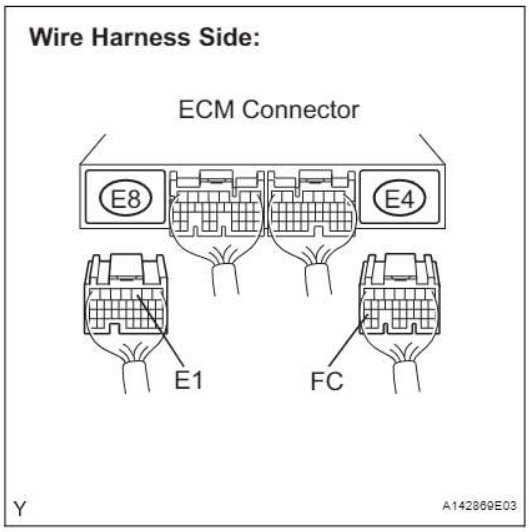
(a) Disconnect the 1A, 1B, 1D and 1E instrument panel junction block connectors.
(b) Measure the resistance according to the value(s) in the table below.
Standard resistance

Tester Connection	Specified Condition
1B (11) - 1A (8)	10 kΩ or higher
1B (11) - 1A (8)	Below 1 Ω (when battery voltage is applied to terminals 1E (5) and 1D (1))

NG → **REPLACE INSTRUMENT PANEL JUNCTION BLOCK ASSEMBLY**

OK

4	INSPECT ECM (FC VOLTAGE)



(a) Disconnect the E4 and E8 connectors.
(b) Turn the ignition switch to the ON position.
(c) Measure the voltage according to the value(s) in the table below.

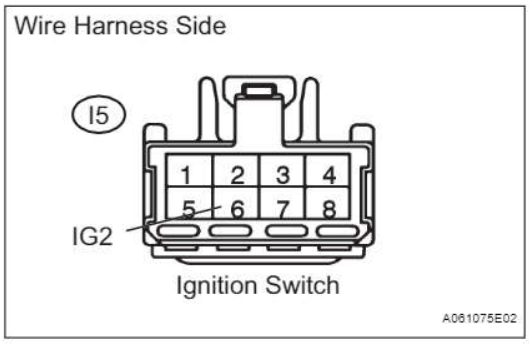
Standard voltage

Tester Connection	Specified Condition
FC (E4-25) - E1 (E8-1)	9 to 14 V

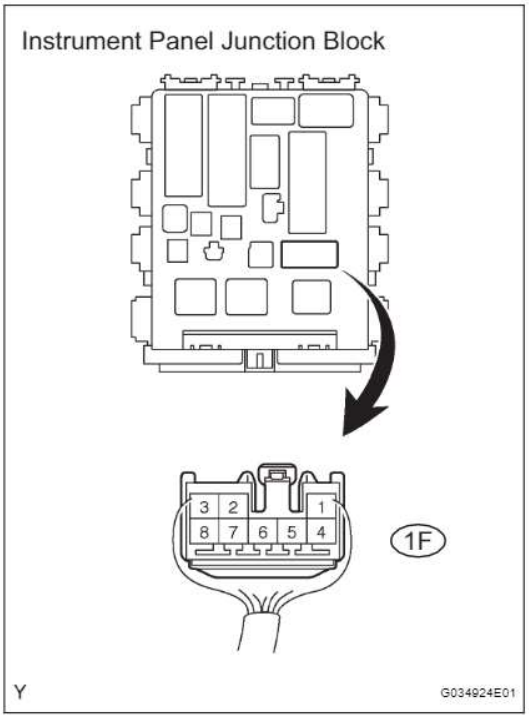
OK → REPLACE ECM

NG

5	CHECK WIRE HARNESS (IGNITION SWITCH - CIRCUIT OPENING RELAY (C/OPN))



(a) Disconnect the I5 ignition switch connector.



(b) Disconnect the 1F instrument panel junction block connector.

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

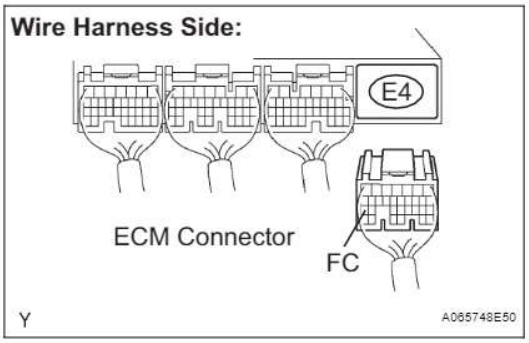
Standard resistance

Tester Connection	Specified Condition
IG2 (I5-6) - Instrument panel junction block (1F-4)	Below 1 Ω
IG2 (I5-6) or Instrument panel junction block (1F-4) - Body ground	10 kΩ or higher

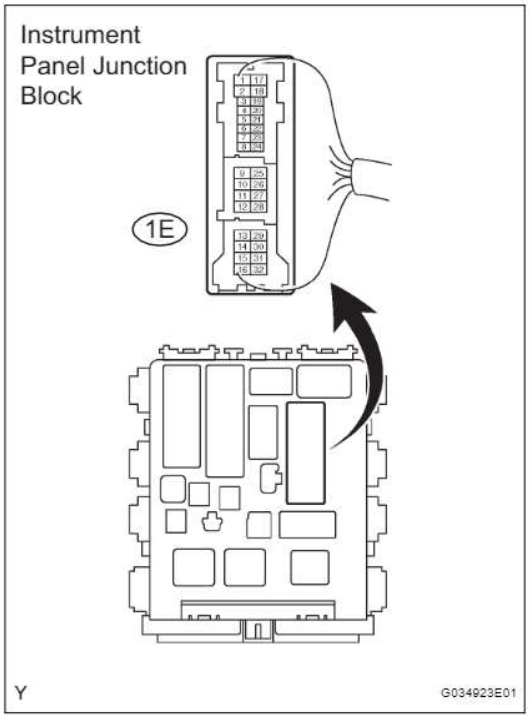
NG → **REPAIR OR REPLACE HARNESS OR CONNECTOR**

OK

6	CHECK WIRE HARNESS (ECM - CIRCUIT OPENING RELAY)



(a) Disconnect the E4 ECM connector.



(b) Disconnect the 1E instrument panel junction block connector.

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

Standard resistance

Tester Connection	Specified Condition
FC (E4-25) - Instrument panel junction block (1E-5)	Below 1 Ω
FC (E4-25) or Instrument panel junction block (1E-5) - Body ground	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

ES

OK

REPLACE ECM

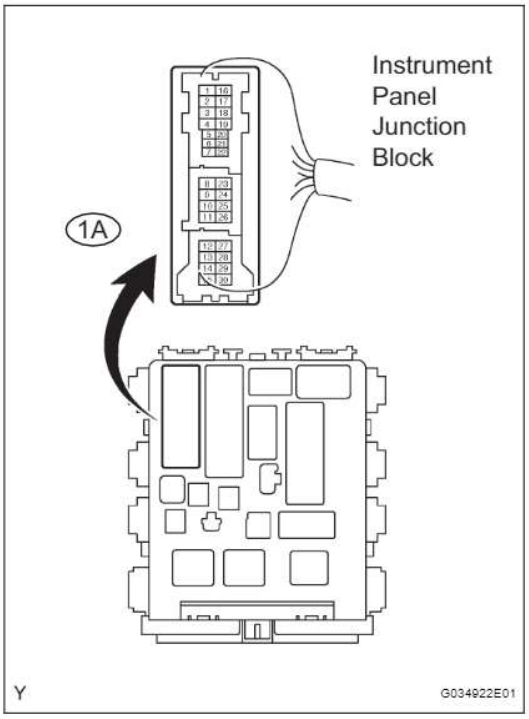
7	INSPECT FUEL PUMP

(a) Inspect the fuel pump (See page FU-21).

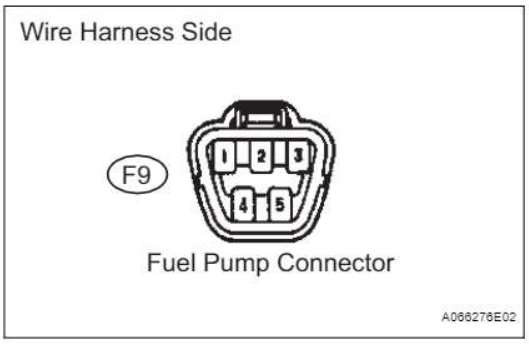
NG → REPLACE FUEL PUMP

OK

8	CHECK WIRE HARNESS (FUEL PUMP - CIRCUIT OPENING RELAY (C/OPN), BODY GROUND)



(a) Disconnect the 1A instrument panel junction block connector.



(b) Disconnect the F9 fuel pump connector.
(c) Measure the resistance according to the value(s) in the table below.

Standard resistance

Tester Connection	Specified Condition
Instrument panel junction block (1A-8) - Fuel pump (F9-4)	Below 1 Ω
Fuel pump (F9-5) - Body ground	Below 1 Ω
Instrument panel junction block (1A-8) or Fuel pump (F9-4) - Body ground	10 kΩ or higher

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

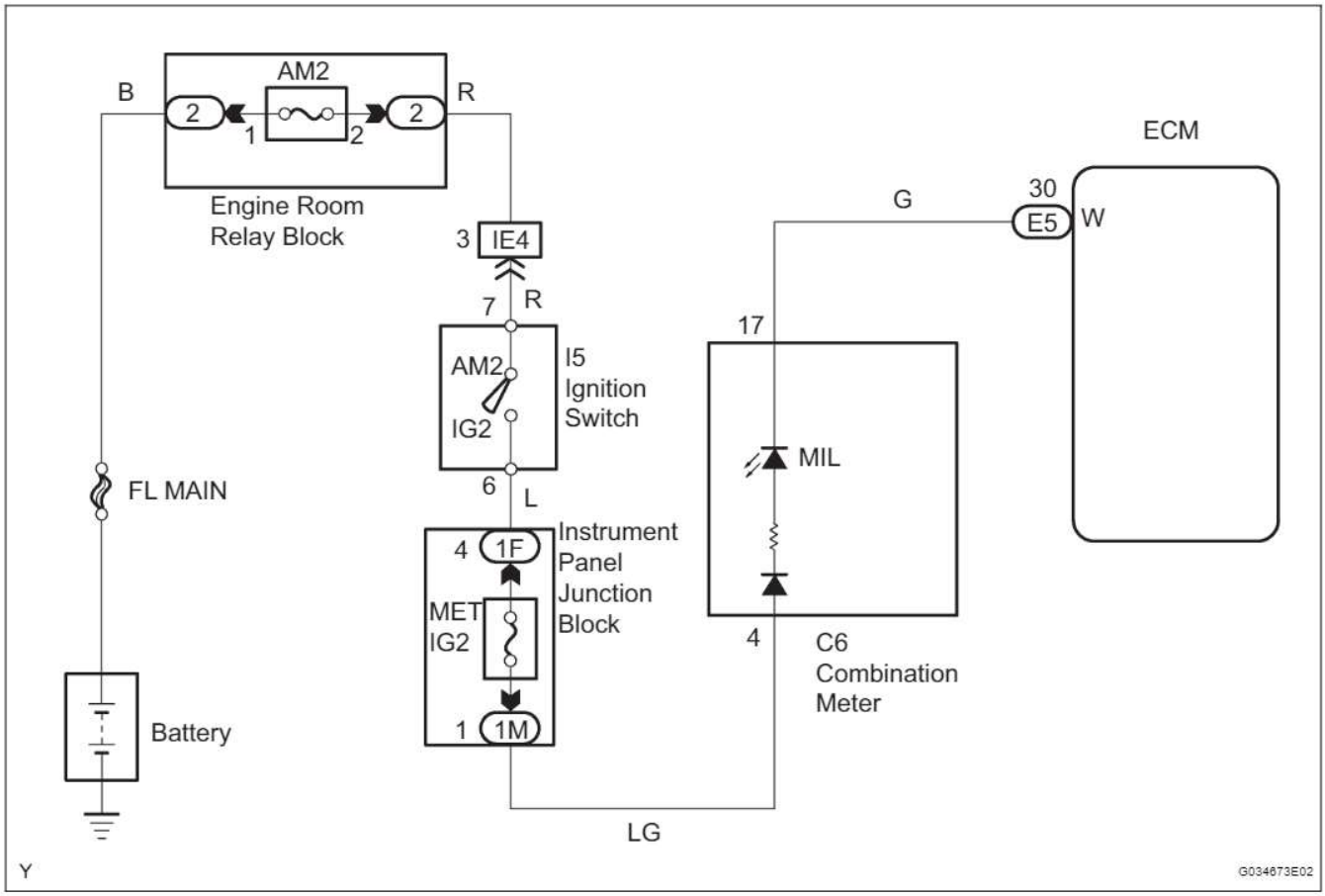
CHECK AND REPAIR HARNESS AND CONNECTOR (EFI RELAY - CIRCUIT OPENING RELAY)

MIL Circuit

DESCRIPTION

The Malfunction Indicator Lamp (MIL) is used to indicate vehicle malfunction detected by the ECM.
By turning the ignition switch to the ON position, power is supplied to the MIL circuit, and the ECM provides the circuit ground which illuminates the MIL.
The MIL operation can be checked visually. When the ignition switch is first turned to the ON position, the MIL should be illuminated and should then turn off. If the MIL remains illuminated or is not illuminated, conduct the following troubleshooting procedure using the intelligent tester.

WIRING DIAGRAM



INSPECTION PROCEDURE

1	CHECK THAT MIL IS ILLUMINATED

(a) Perform troubleshooting in accordance with the chart below.
Result

Condition	Proceed to
MIL remains illuminated	A
MIL not illuminated	B

B → Go to step 4

A

2	CHECK WHETHER MIL TURNS OFF

(a) Connect the intelligent tester to the DLC3.
(b) Turn the ignition switch to the ON position.
(c) Turn the tester on.
(d) Check whether any DTCs have been stored (See page ES-32). Note them down if necessary.
(e) Clear the DTCs (See page ES-32).
(f) Check if the MIL turns off.

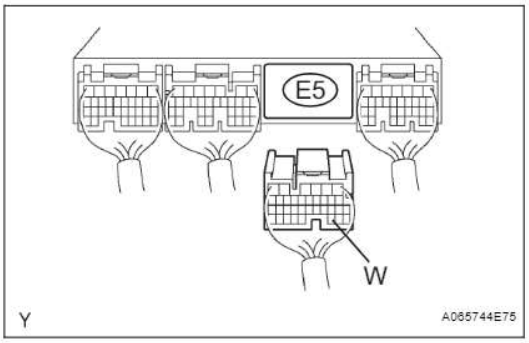
OK:

MIL should turn off.

OK	REPAIR CIRCUIT INDICATED BY OUTPUT DTC

NG

3	CHECK WIRE HARNESS (FOR SHORT)



(a) Disconnect the E5 ECM connector.
(b) Turn the ignition switch to the ON position.
(c) Check that the MIL is not illuminated.

OK:

MIL is not illuminated

OK	REPLACE ECM

NG

CHECK AND REPAIR HARNESS AND CONNECTOR (COMBINATION METER - ECM)

4	CHECK THAT MIL IS ILLUMINATED

(a) Check if the MIL is illuminated when the ignition switch is turned to the ON position.

OK:

MIL should be illuminated.

OK	SYSTEM OK

NG

5	CHECK THAT ENGINE STARTS

(a) Turn the ignition switch to the ON position.
(b) Start the engine.

Result

Result	Proceed to
Engine starts	A
Engine does not start*	B

HINT:
*: The intelligent tester cannot communicate with the ECM.

B → GO TO VC OUTPUT CIRCUIT

A

6	INSPECT COMBINATION METER (MIL CIRCUIT)

(a) See the combination meter troubleshooting procedure (See page ME-4).

NG → REPAIR OR REPLACE BULB OR COMBINATION METER ASSEMBLY

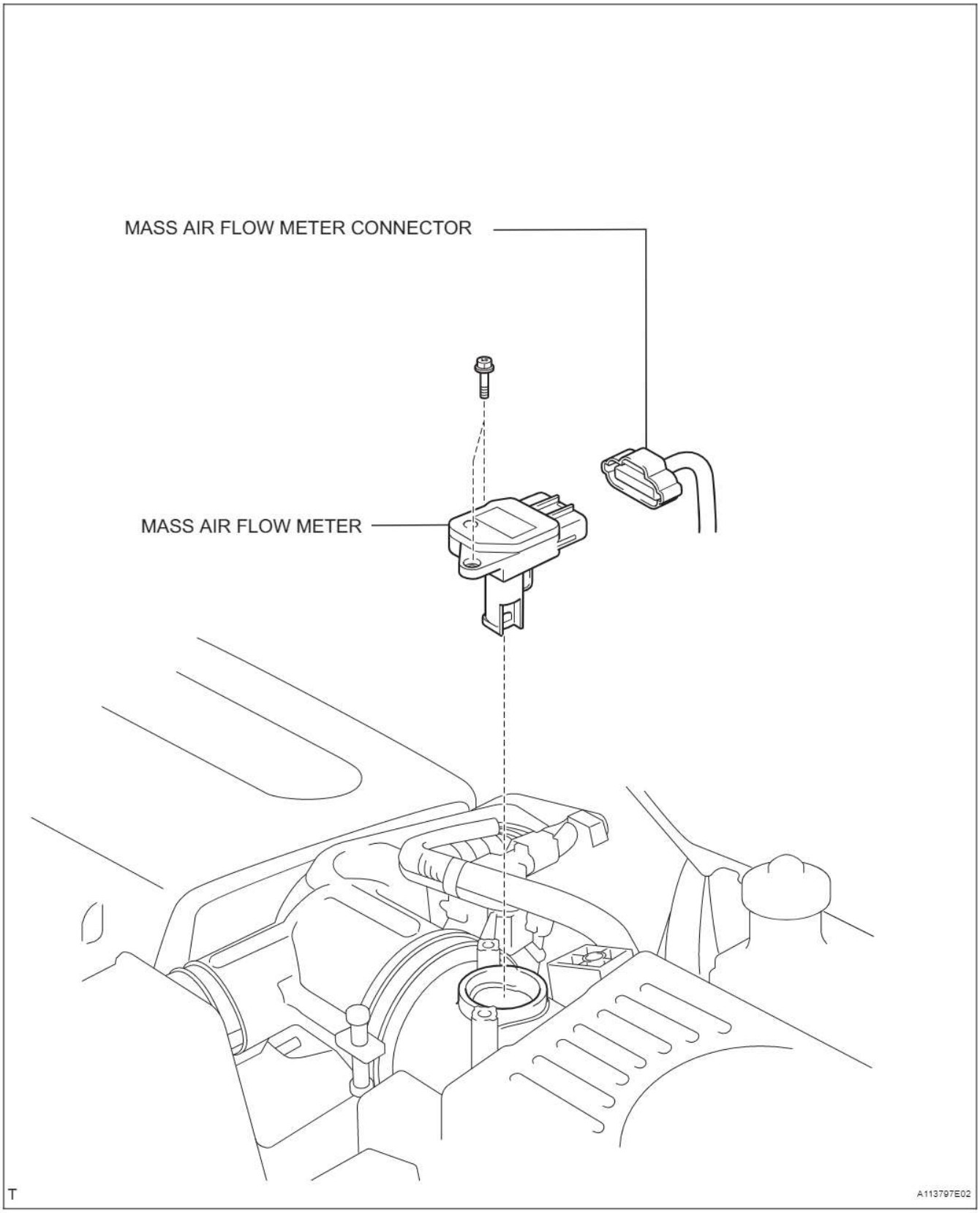
OK

CHECK AND REPAIR HARNESS AND CONNECTOR (COMBINATION METER - ECM)

ES

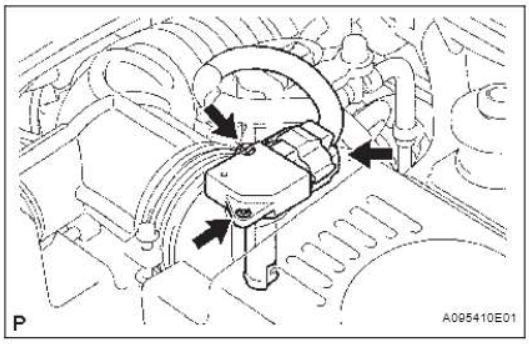
MASS AIR FLOW METER

COMPONENTS



REMOVAL

1. **DISCONNECT CABLE FROM NEGATIVE BATTERY TERMINAL**
   CAUTION:
   Wait at least 90 seconds after disconnecting the cable from the negative (-) battery terminal to prevent airbag and seat belt pretensioner activation.

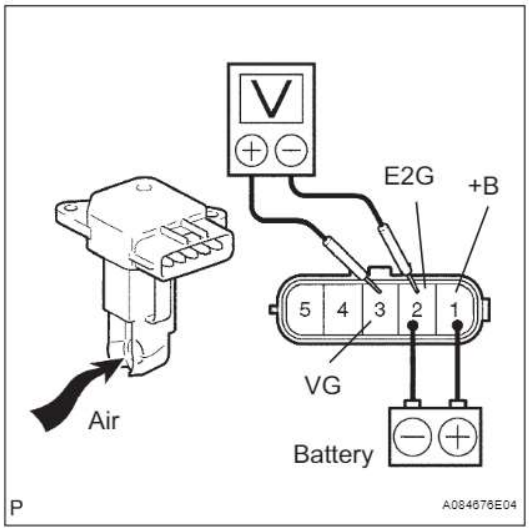


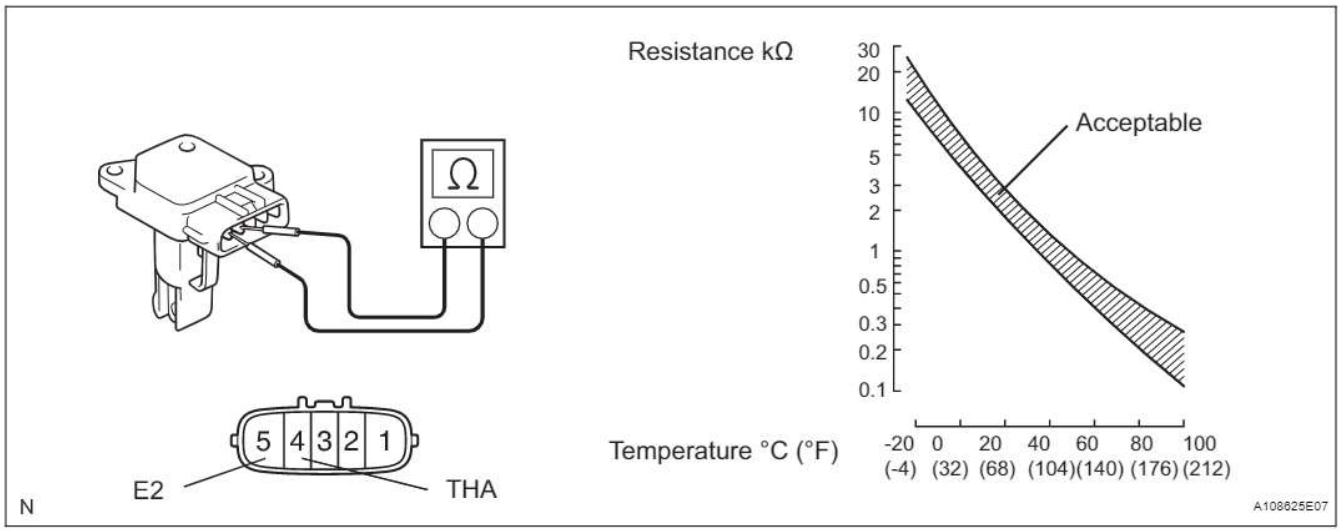
2. **REMOVE MASS AIR FLOW METER**
   (a) Disconnect the mass air flow meter connector.
   (b) Remove the 2 screws and mass air flow meter.

ES

INSPECTION

1. **INSPECT MASS AIR FLOW METER**
   (a) Measure the voltage to check the mass air flow sensor.
      (1) Apply battery voltage across terminals 1 (+B) and 2 (E2G).
      (2) Using a voltmeter, connect the positive (+) tester probe to terminal 3 (VG), and negative (-) tester probe to terminal 2 (E2G).
      (3) Blow air into the mass air flow meter, and then check that the voltage fluctuates.
      If the voltage does not fluctuate, replace the mass air flow meter.
   (b) Measure the resistance to check the intake air temperature sensor.

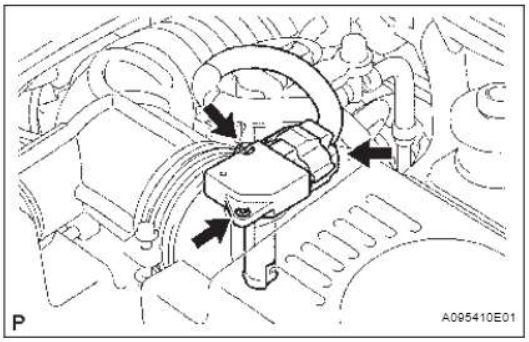




(1) Using an ohmmeter, measure the resistance between the terminals 4 (THA) and 5 (E2).
Standard resistance

Tester Connection	Specified Condition
4 (THA) - 5 (E2)	13.6 to 18.4 kΩ at -20°C (-4°F)
4 (THA) - 5 (E2)	2.21 to 2.69 kΩ at 20°C (68°F)
4 (THA) - 5 (E2)	0.493 to 0.667 kΩ at 60°C (140°F)

If the result is not as specified, replace the mass air flow meter.

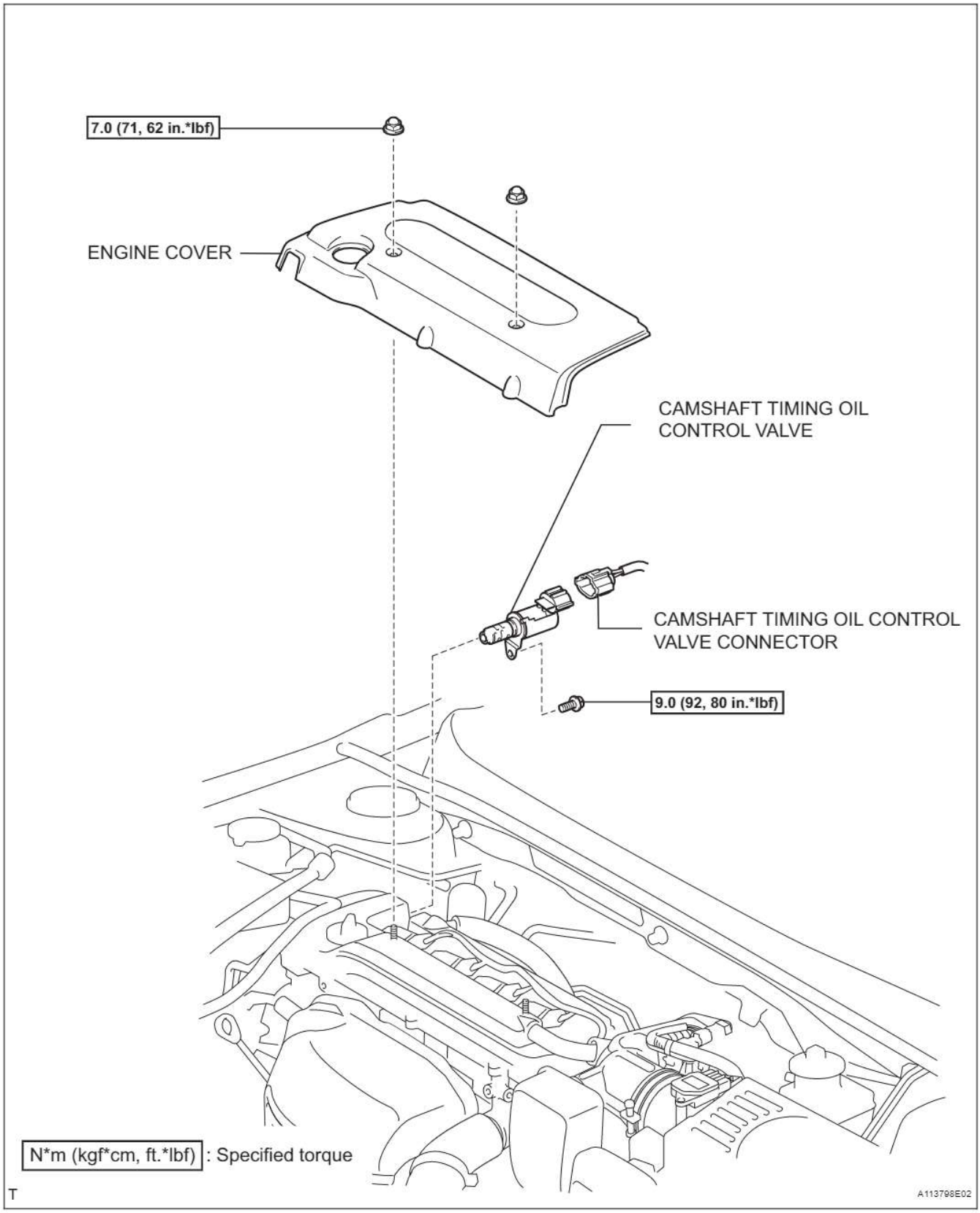


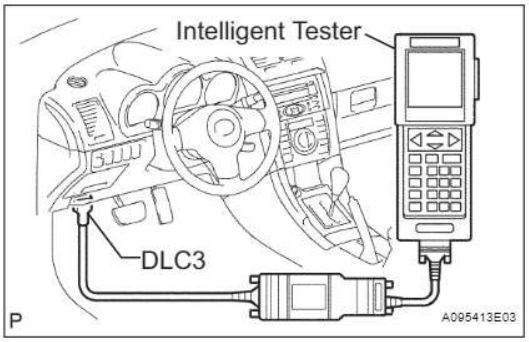
INSTALLATION

1. **INSTALL MASS AIR FLOW METER**
   (a) Install the mass air flow meter with the 2 screws.
   NOTICE:
   Make sure that the O-ring is not cracked or jammed when installing.
   (b) Connect the mass air flow meter connector.
2. **CONNECT CABLE TO BATTERY NEGATIVE TERMINAL**
3. **PERFORM INITIALIZATION**
   (a) Perform initialization (see page IN-23).
   NOTICE:
   Certain systems need to be initialized after disconnecting and reconnecting the cable from the negative (-) battery terminal.

CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY

COMPONENTS





ON-VEHICLE INSPECTION

1. CHECK CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY

(a) Check the operation.
  (1) Connect the intelligent tester to the DLC3.
  (2) Turn the ignition switch ON.
  (3) Turn the Intelligent tester main switch ON.
  (4) Start and warm up the engine.
  (5) Select the menu items: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / VVT CTRL B1.
  (6) Operate the OCV using the intelligent tester, and then check the engine speed.

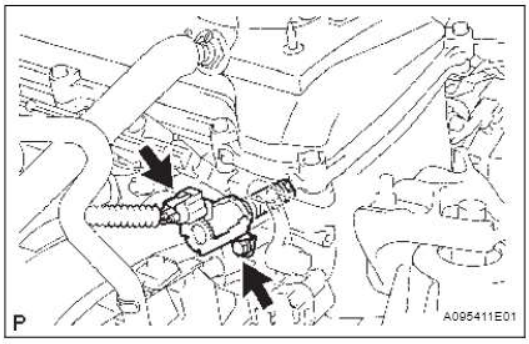
Standard condition

Tester Operation	Specified Condition
OCV is OFF	Normal engine speed
OCV is ON	Rough idling or engine stalls

If the operation is not as specified, check the oil control valve, wire harness and ECM.

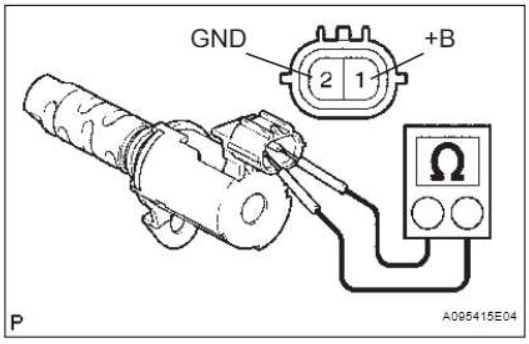
REMOVAL

1. **DISCONNECT CABLE FROM NEGATIVE BATTERY TERMINAL**
   CAUTION:
   Wait at least 90 seconds after disconnecting the cable from the negative (-) battery terminal to prevent airbag and seat belt pretensioner activation.
2. **REMOVE ENGINE COVER (See page ES-382)**
3. **REMOVE CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY**
   (a) Disconnect the oil control valve connector.
   (b) Remove the bolt and oil control valve.



INSPECTION

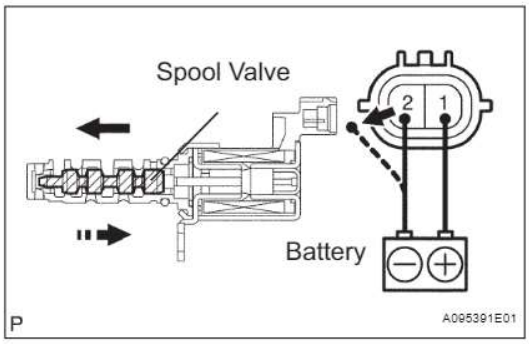
1. **INSPECT CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY**
   (a) Measure the resistance of the oil control valve.
   Standard resistance



Tester Connection	Specified Condition
1 (+B) - 2 (GND)	6.9 to 7.9 Ω at 20°C (68°F)

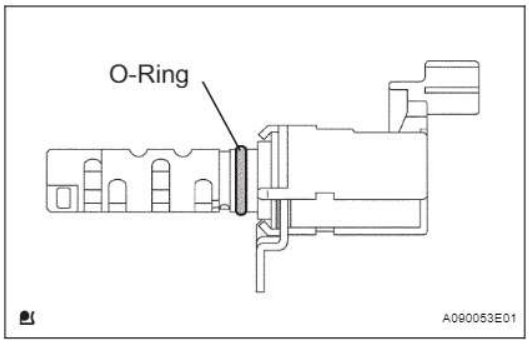
If the result is not as specified, replace the oil control valve assembly.

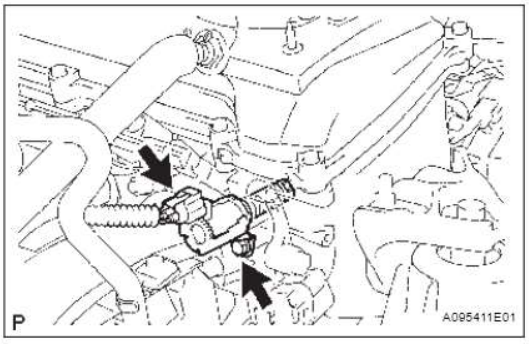
(b) Check the operation.
(1) Apply battery voltage across the terminals and check that the spool valve operates.
NOTICE:
Check that the spool valve is not stuck.
HINT:
The spool valve may not return if foreign objects are caught in it. This may cause subtle pressure leaks to the advance side, and a DTC may be set.



INSTALLATION

1. **INSTALL CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY**
   (a) Apply a light coat of engine oil to the O-ring of the oil control valve.





(b) Install the oil control valve with the bolt.
Torque: 9.0 N*m (92 kgf*cm, 80 in.*lbf)
NOTICE:
Make sure that the O-ring is not cracked or jammed.
(c) Connect the oil control valve connector.

2. **CONNECT CABLE TO NEGATIVE BATTERY TERMINAL**

3. **CHECK FOR ENGINE OIL LEAKS**
(a) Start the engine, and check that there are no oil leaks.

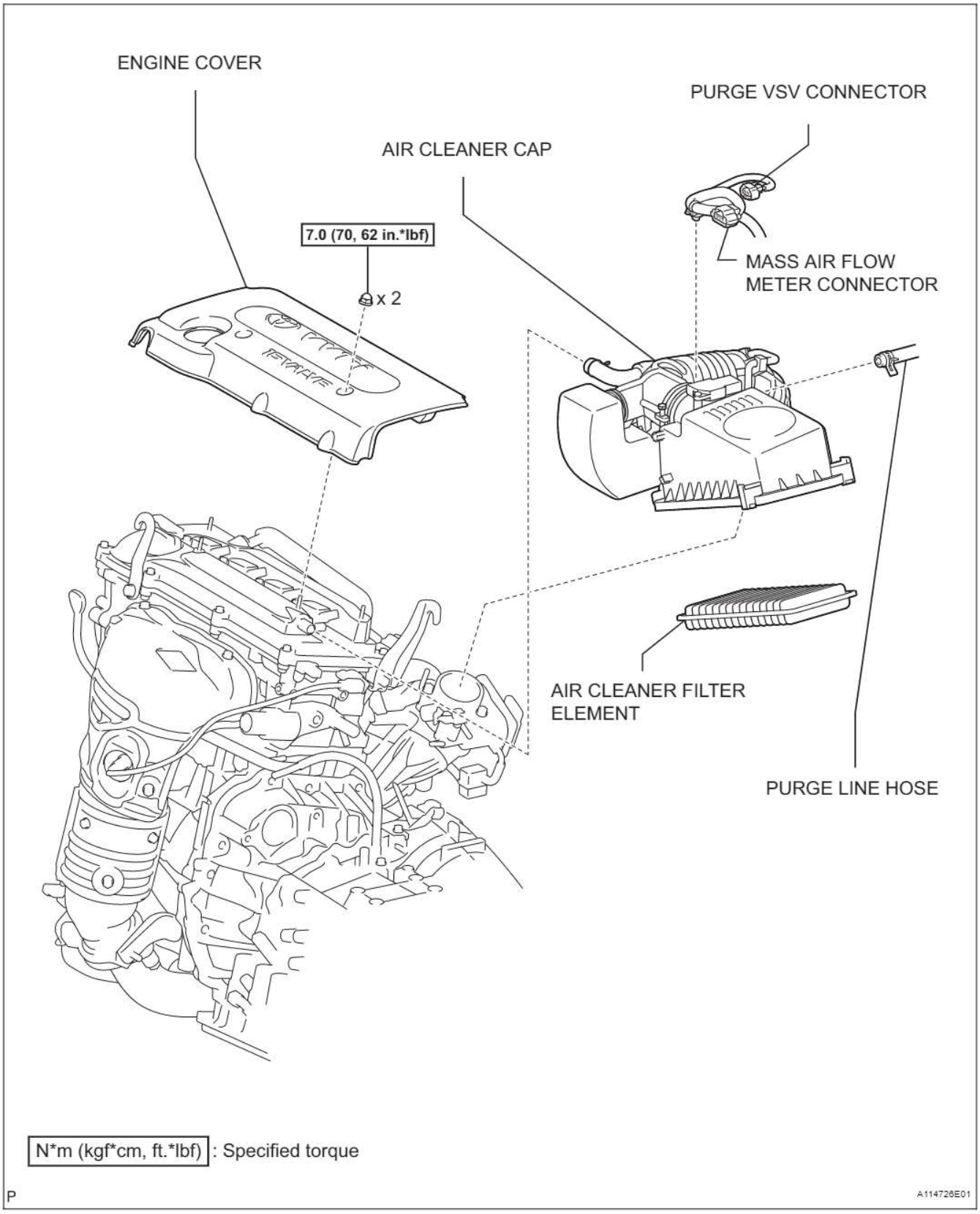
4. **INSTALL ENGINE COVER (See page ES-389)**

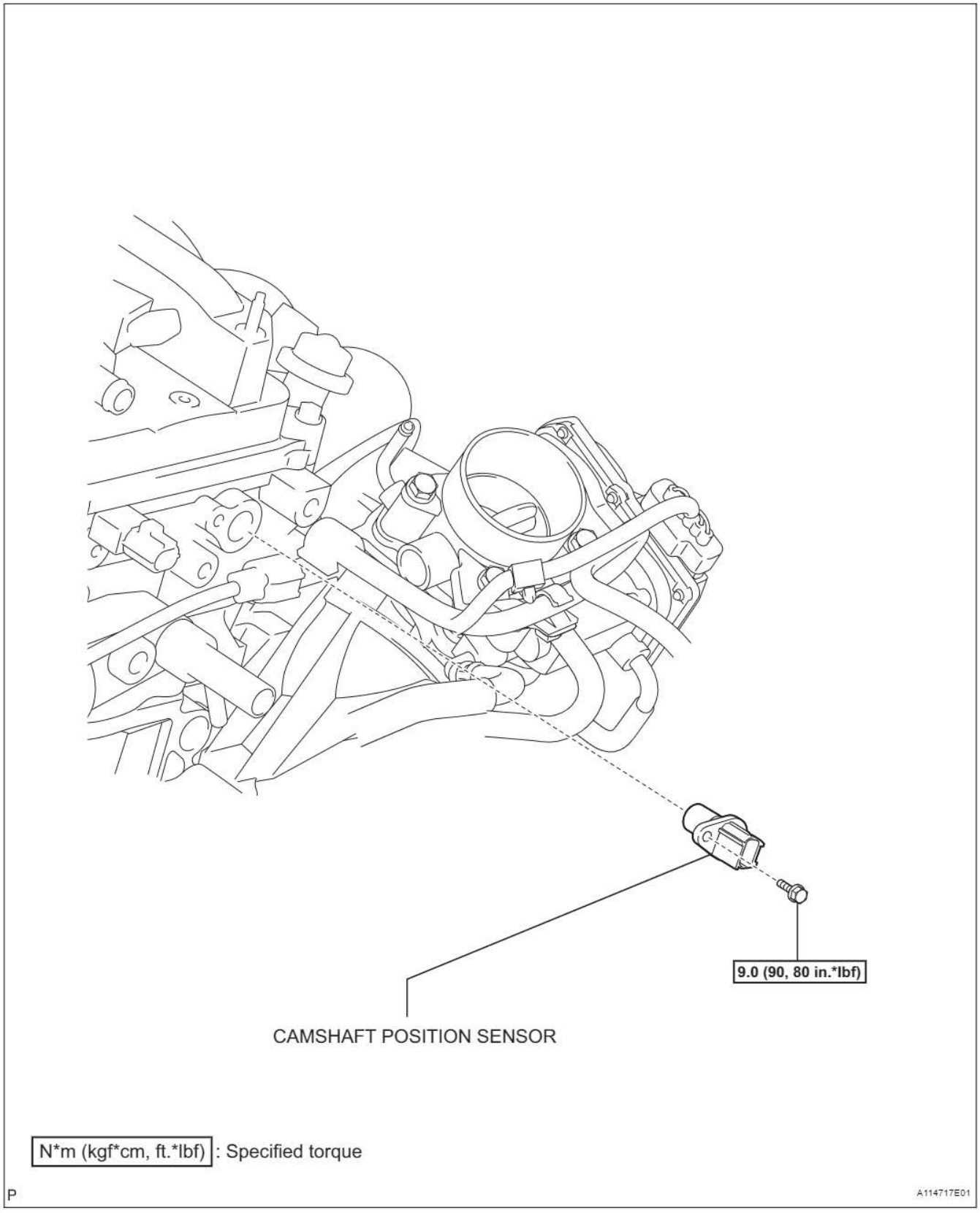
5. **PERFORM INITIALIZATION**
(a) Perform initialization (see page IN-23).
NOTICE:
Certain systems need to be initialized after disconnecting and reconnecting the cable from the negative (-) battery terminal.

ES

CAMSHAFT POSITION SENSOR

COMPONENTS

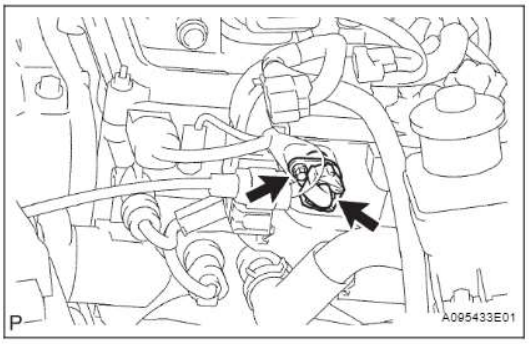



9.0 (90, 80 in.*lbf)
CAMSHAFT POSITION SENSOR
N*m (kgf*cm, ft.*lbf) : Specified torque
P
A114717E01

ES

REMOVAL

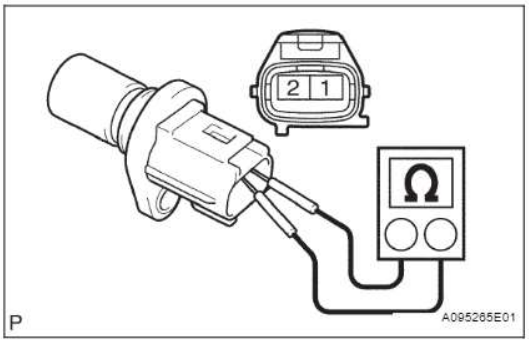
1. **DISCONNECT CABLE FROM NEGATIVE BATTERY TERMINAL**
   CAUTION:
   Wait at least 90 seconds after disconnecting the cable from the negative (-) battery terminal to prevent airbag and seat belt pretensioner activation.
2. **REMOVE ENGINE COVER (See page ES-382)**
3. **REMOVE AIR CLEANER CAP (See page ES-383)**
4. **REMOVE CAMSHAFT POSITION SENSOR**
   (a) Disconnect the sensor connector.
   (b) Remove the bolt and sensor.



INSPECTION

1. **INSPECT CAMSHAFT POSITION SENSOR**
   (a) Measure the resistance of the sensor.
   Standard resistance

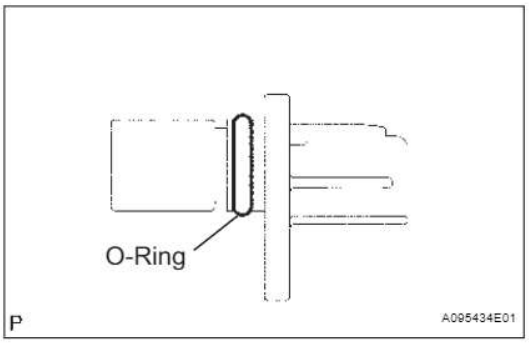
Tester Connection	Specified Condition
1 (G+) - 2 (G-)	835 to 1,400 Ω at cold
1 (G+) - 2 (G-)	1,060 to 1,645 Ω at hot

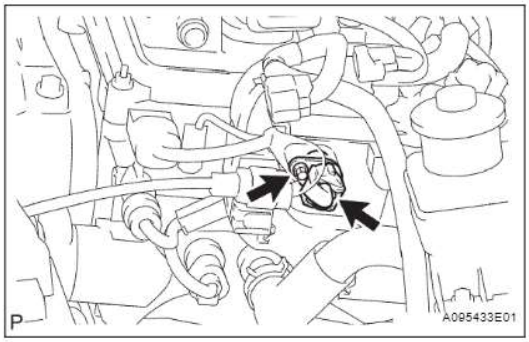


NOTICE:
Cold and Hot mean the temperature of the coils themselves. Cold is from -10 to 50°C (14 to 122 °F) and Hot is from 50 to 100°C (122 to 212°F).
If the result is not as specified, replace the camshaft position sensor.

INSTALLATION

1. **INSTALL CAMSHAFT POSITION SENSOR**
   NOTICE:
   Make sure that the O-ring is not cracked or jammed when installing.
   (a) Apply a light coat of engine oil to the O-ring of the sensor.





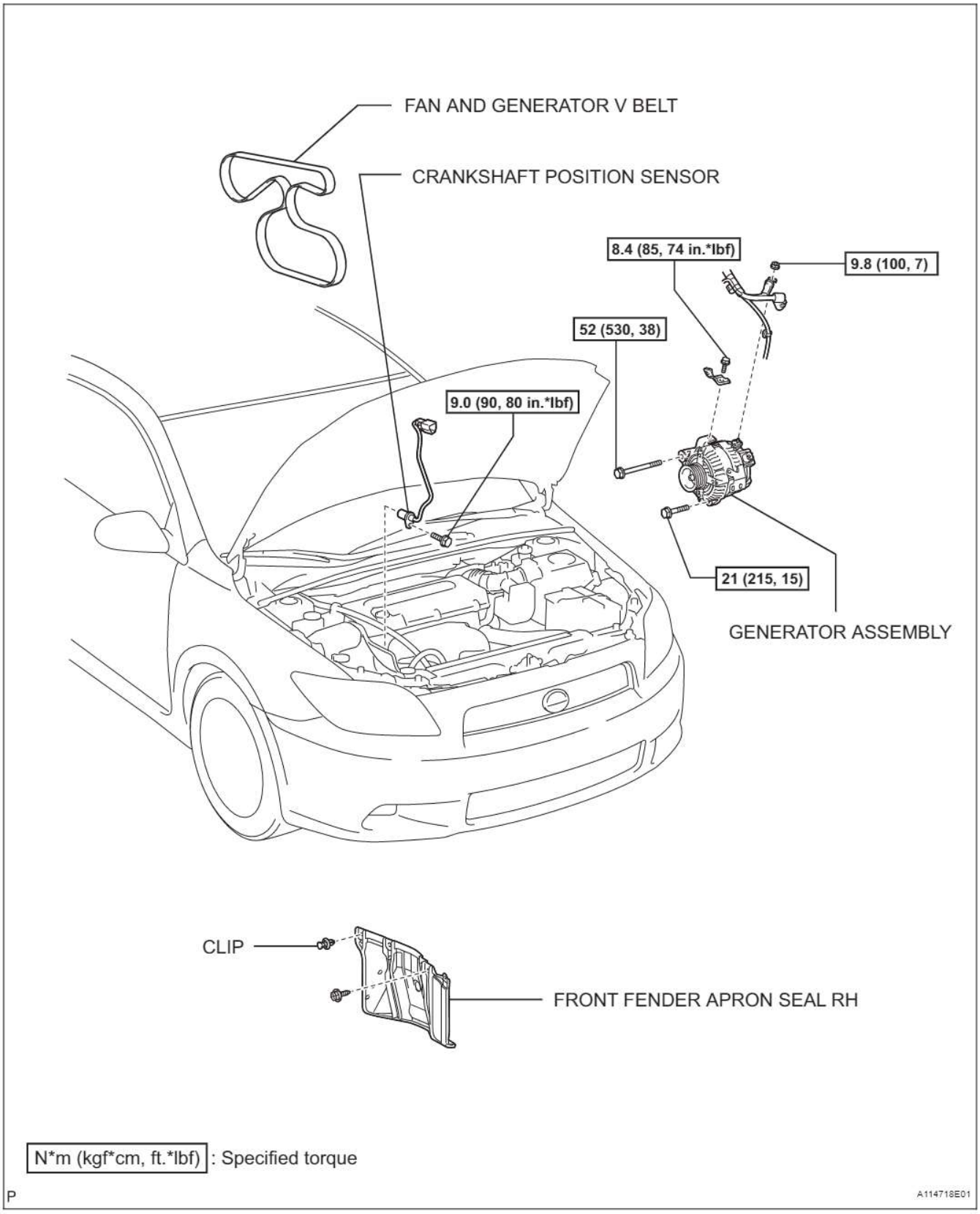
(b) Install the sensor with the bolt.
Torque: 9.0 N*m (90 kgf*cm, 80 in.*lbf)
(c) Connect the sensor connector.

2. **INSTALL AIR CLEANER CAP (See page ES-387)**
3. **CONNECT CABLE TO NEGATIVE BATTERY TERMINAL**
4. **CHECK FOR ENGINE OIL LEAKAGE**
5. **INSTALL ENGINE COVER (See page ES-389)**
6. **PERFORM INITIALIZATION**
   (a) Perform initialization (see page IN-23).
   NOTICE:
   Certain systems need to be initialized after disconnecting and reconnecting the cable from the negative (-) battery terminal.

ES

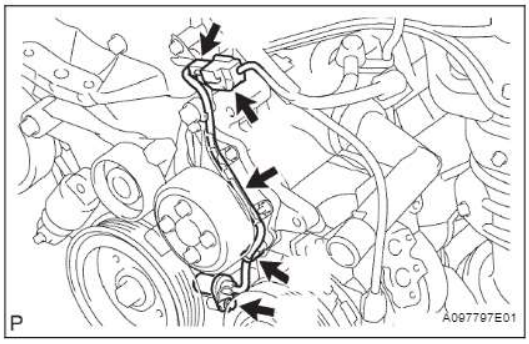
CRANKSHAFT POSITION SENSOR

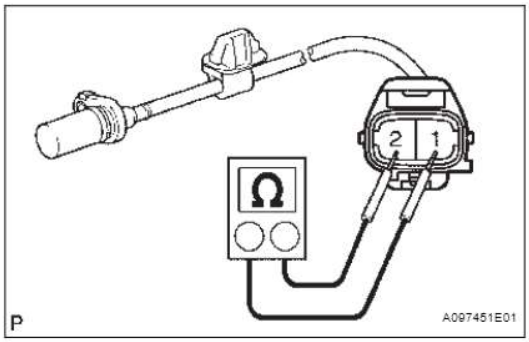
COMPONENTS



REMOVAL

1. **DISCONNECT CABLE FROM NEGATIVE BATTERY TERMINAL**
   CAUTION:
   Wait at least 90 seconds after disconnecting the cable from the negative (-) battery terminal to prevent airbag and seat belt pretensioner activation.
2. **REMOVE FRONT FENDER APRON SEAL RH (See page CH-10)**
3. **REMOVE FAN AND GENERATOR V BELT (See page EM-6)**
4. **REMOVE GENERATOR ASSEMBLY (See page CH-10)**
5. **REMOVE CRANKSHAFT POSITION SENSOR**
   (a) Disconnect the sensor connector.
   (b) Remove the connector clamp.
   (c) Remove the wire harness from the wire harness clamp bracket.
   (d) Remove the wire harness clamp.
   (e) Remove the bolt and sensor.





INSPECTION

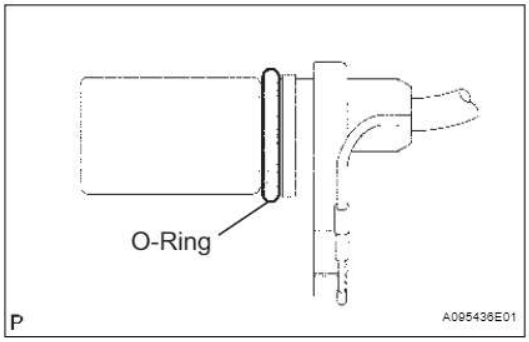
1. **INSPECT CRANKSHAFT POSITION SENSOR**
   (a) Measure the resistance of the sensor.
   Standard resistance

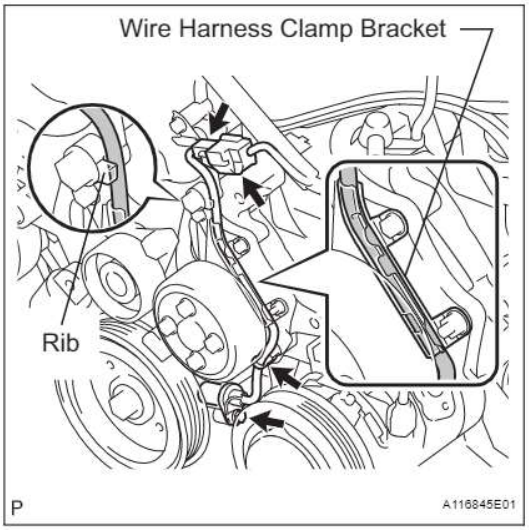
Tester Connection	Specified Condition
1 (NE+) - 2 (NE-)	985 to 1,600 Ω at cold
1 (NE+) - 2 (NE-)	1,265 to 1,890 Ω at hot

NOTICE:
Cold and Hot mean the temperature of the coils themselves. Cold is from -10 to 50°C (14 to 122°F) and Hot is from 50 to 100°C (122 to 212°F).
If the result is not as specified, replace the crankshaft position sensor.

INSTALLATION

1. **INSTALL CRANKSHAFT POSITION SENSOR**
   NOTICE:
   Make sure that the O-ring is not cracked or jammed when installing.
   (a) Apply a light coat of engine oil to the O-ring of the sensor.





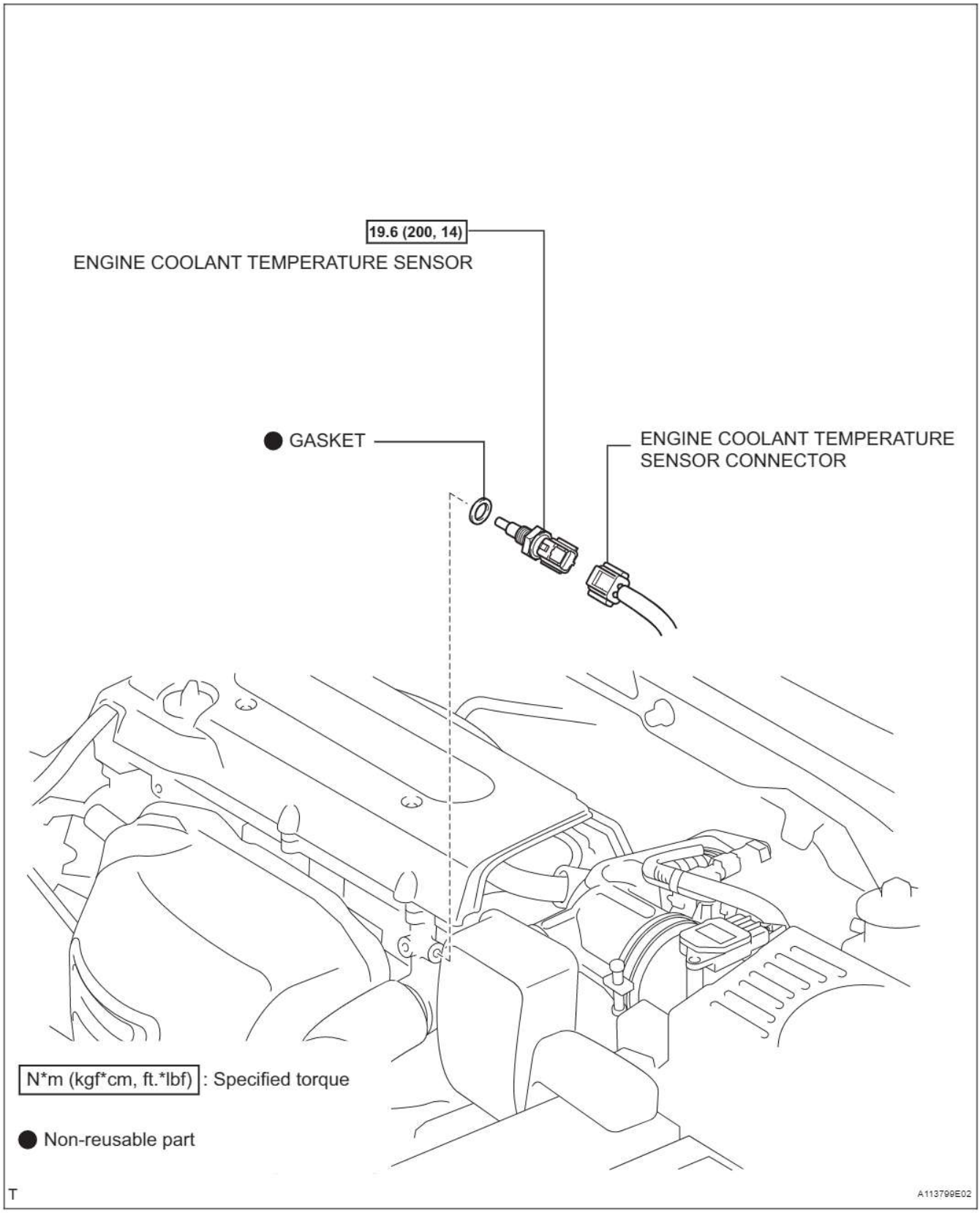
(b) Install the sensor with the bolt.
Torque: 9.0 N*m (90 kgf*cm, 80 in.*lbf)
(c) Install the wire harness clamp.
(d) Install the connector clamp.
(e) Connect the sensor connector.
(f) Confirm that the wire harness of the sensor is secured to the wire harness clamp bracket through the back of the rib of the timing chain cover.

2. **INSTALL GENERATOR ASSEMBLY (See page CH-17)**
3. **INSTALL FAN AND GENERATOR V BELT (See page EM-6)**
4. **CONNECT CABLE TO NEGATIVE BATTERY TERMINAL**
5. **CHECK FOR ENGINE OIL LEAKAGE**
6. **INSTALL FRONT FENDER APRON SEAL RH (See page CH-18)**
7. **PERFORM INITIALIZATION**
   (a) Perform initialization (see page IN-23).
   NOTICE:
   Certain systems need to be initialized after disconnecting and reconnecting the cable from the negative (-) battery terminal.

ES

ENGINE COOLANT TEMPERATURE SENSOR

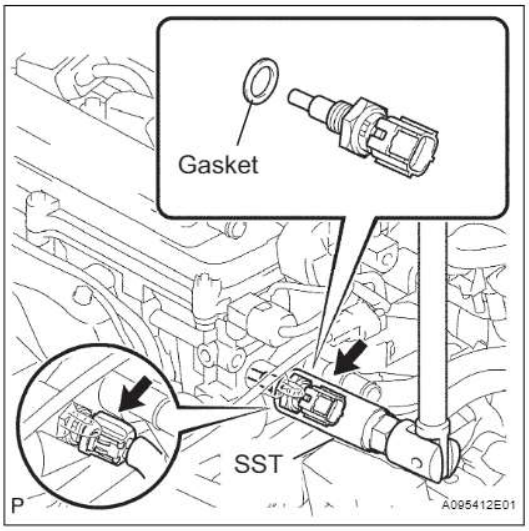
COMPONENTS



ES

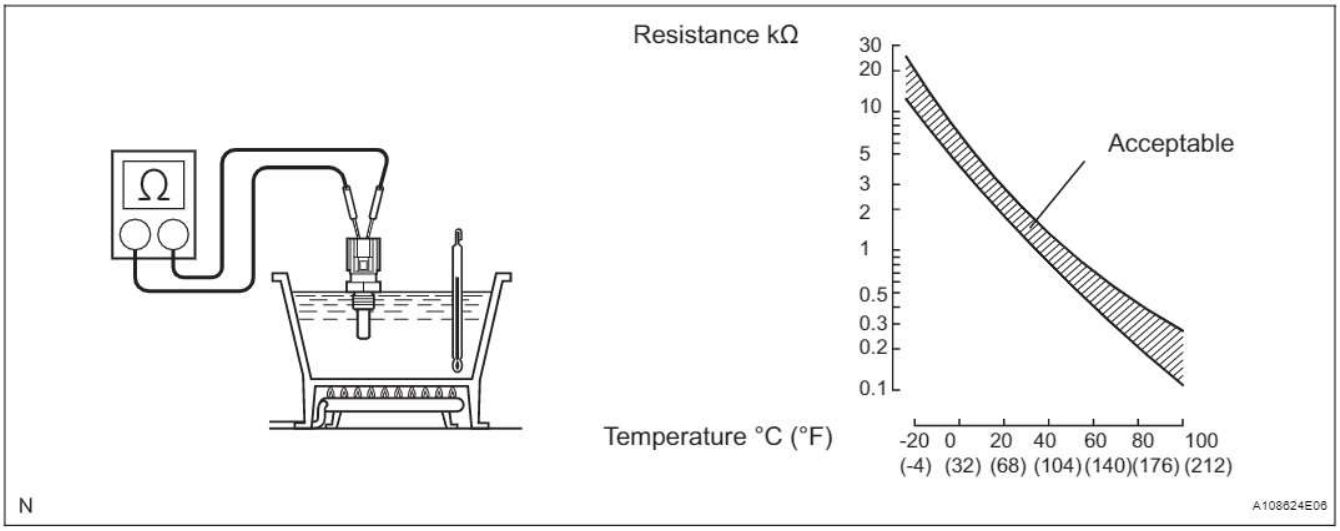
REMOVAL

1. **DRAIN ENGINE COOLANT (See page CO-6)**
2. **DISCONNECT CABLE FROM NEGATIVE BATTERY TERMINAL**
   CAUTION:
   Wait at least 90 seconds after disconnecting the cable from the negative (-) battery terminal to prevent airbag and seat belt pretensioner activation.
3. **REMOVE ENGINE COOLANT TEMPERATURE SENSOR**
   (a) Disconnect the sensor connector.
   (b) Using SST, remove the sensor and gasket.
   SST 09817-33190



INSPECTION

1. **INSPECT ENGINE COOLANT TEMPERATURE SENSOR**
   (a) Measure the resistance of the sensor.

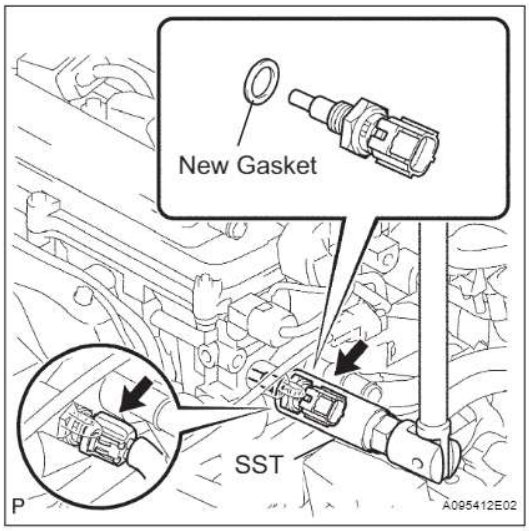


Standard resistance

Tester Connection	Specified Condition
1 (E2) - 2 (THW)	2.32 to 2.59 kΩ at 20°C (68°F)
1 (E2) - 2 (THW)	0.310 to 0.326 kΩ at 80°C (176°F)

NOTICE:
If checking the sensor in water, be careful not to allow water to contact the terminals. After checking, wipe the water off the sensor.
If the result is not as specified, replace the sensor.

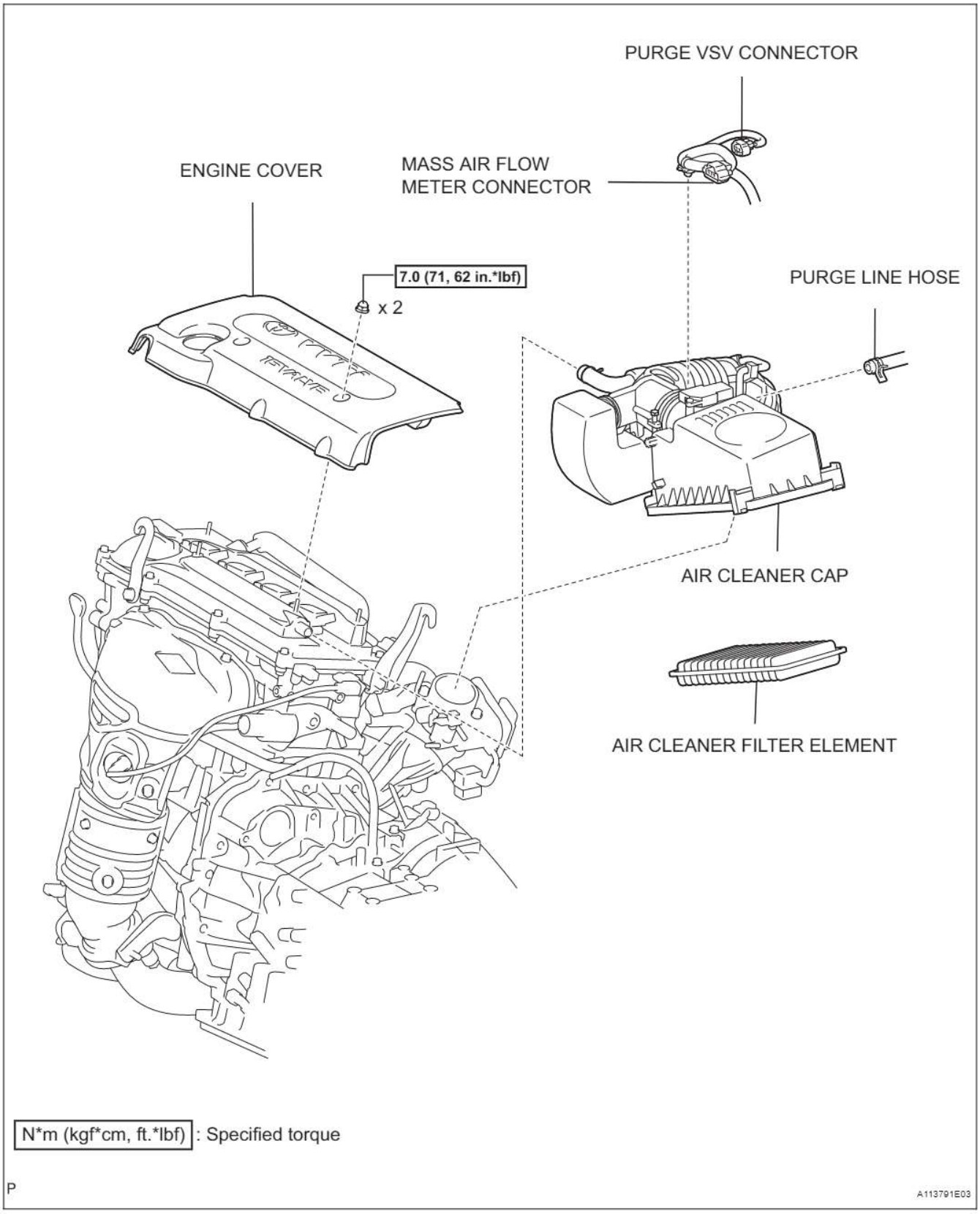
INSTALLATION

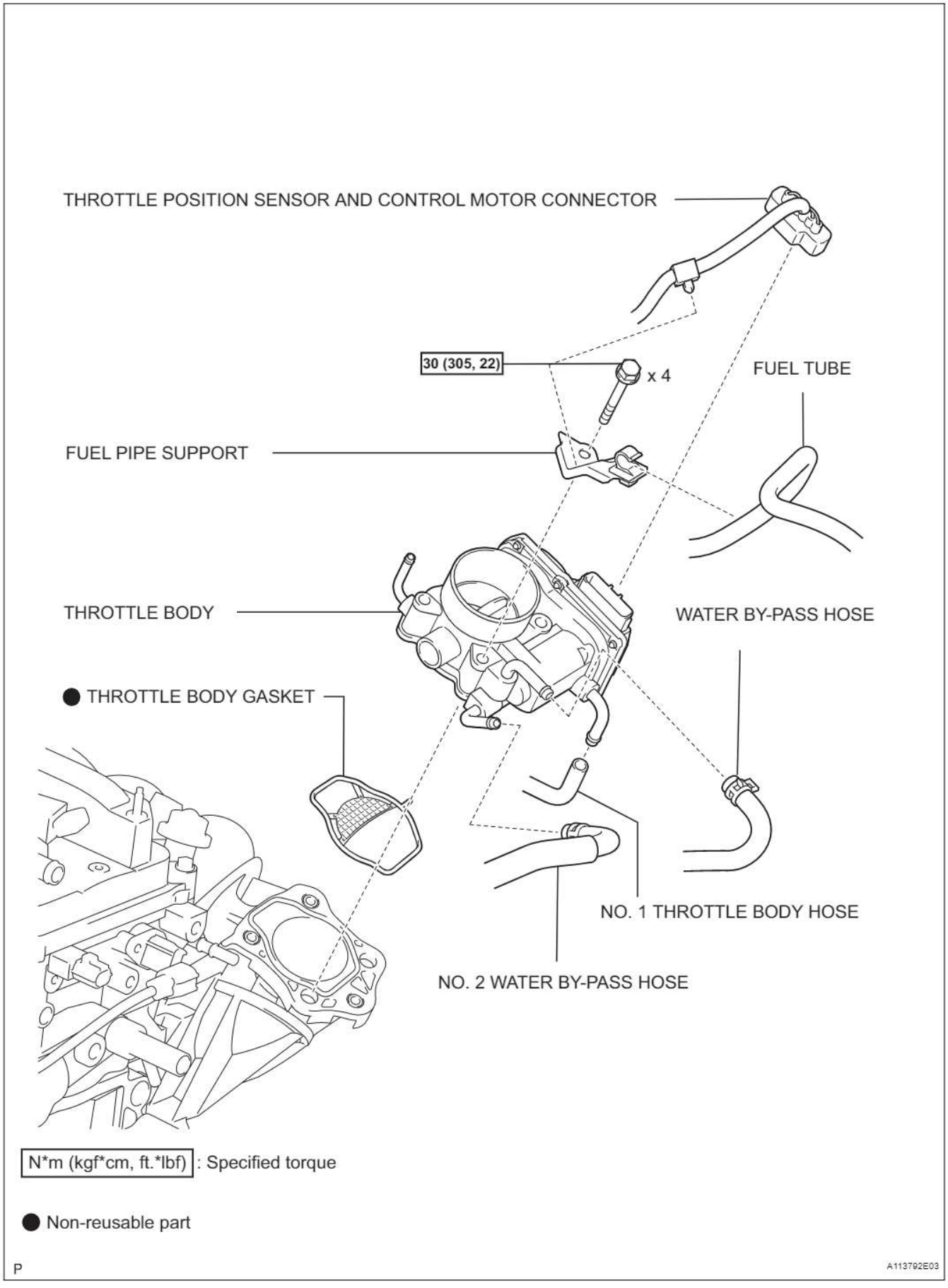


1. **INSTALL ENGINE COOLANT TEMPERATURE SENSOR**
   (a) Install a new gasket onto the sensor.
   (b) Using SST, install the sensor.
   SST 09817-33190
   Torque: 19.6 N*m (200 kgf*cm, 14 ft.*lbf)
   (c) Connect the sensor connector.
2. **CONNECT CABLE TO NEGATIVE BATTERY TERMINAL**
3. **ADD ENGINE COOLANT (See page CO-6)**
4. **CHECK FOR COOLANT LEAKAGE (See page CO-1)**
5. **PERFORM INITIALIZATION**
   (a) Perform initialization (see page IN-23).
   NOTICE:
   Certain systems need to be initialized after disconnecting and reconnecting the cable from the negative (-) battery terminal.

THROTTLE BODY

COMPONENTS

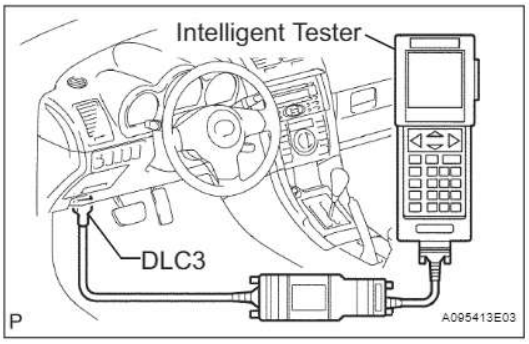



THROTTLE POSITION SENSOR AND CONTROL MOTOR CONNECTOR
30 (305, 22)
x 4
FUEL TUBE
FUEL PIPE SUPPORT
THROTTLE BODY
WATER BY-PASS HOSE
● THROTTLE BODY GASKET
NO. 1 THROTTLE BODY HOSE
NO. 2 WATER BY-PASS HOSE
N*m (kgf*cm, ft.*lbf) : Specified torque
● Non-reusable part
P
A113792E03

ON-VEHICLE INSPECTION

1. CHECK THROTTLE BODY

(a) Check the throttle control motor operating sounds.
  (1) Turn the ignition switch ON.
  (2) When pressing the accelerator pedal, check the operating sound of the running motor. Make sure that no friction noises emit from the motor. If friction noise exists, replace the throttle body.



(b) Check the throttle position sensor.
  (1) Connect the intelligent tester to the DLC3.
  (2) Turn the ignition switch ON.
  (3) Push the intelligent tester main switch ON.
  (4) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DATA LIST / THROTTLE POS.
  (5) Depress the accelerator pedal. When the throttle valve is fully opened, check that the value of "THROTTLE POS" is within the specification.

Standard throttle valve opening percentage:
60% or more

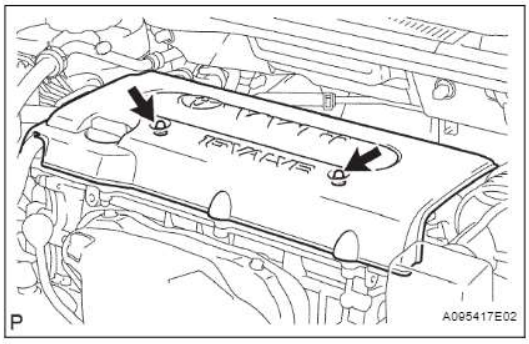
NOTICE:

When checking the standard throttle valve opening percentage, the shift lever should be in the N position.

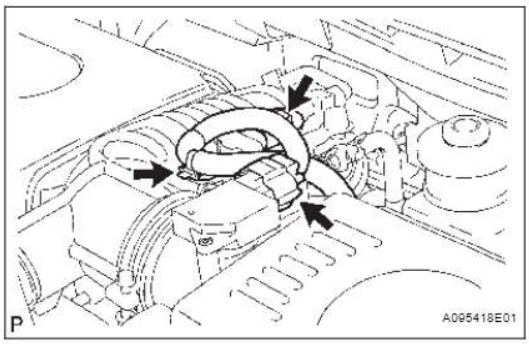
If the percentage is less than 60%, replace the throttle body.

REMOVAL

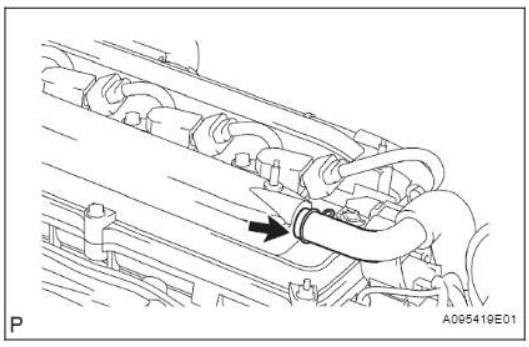
1. **DRAIN ENGINE COOLANT (See page CO-6)**
2. **DISCONNECT CABLE FROM NEGATIVE BATTERY TERMINAL**
   CAUTION:
   Wait at least 90 seconds after disconnecting the cable from the negative (-) battery terminal to prevent airbag and seat belt pretensioner activation.
3. **REMOVE ENGINE COVER**
   (a) Remove the 2 nuts and engine cover.



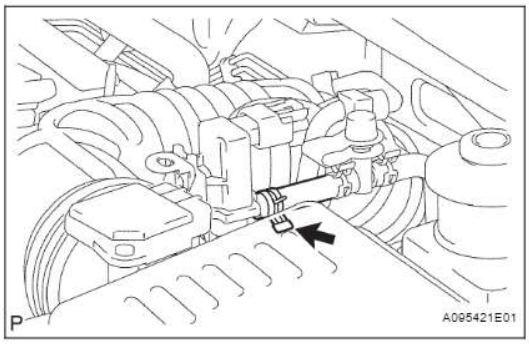
4. **REMOVE AIR CLEANER CAP**
   (a) Disconnect the mass air flow meter connector.
   (b) Disconnect the purge VSV connector.
   (c) Remove the wire harness clamp.

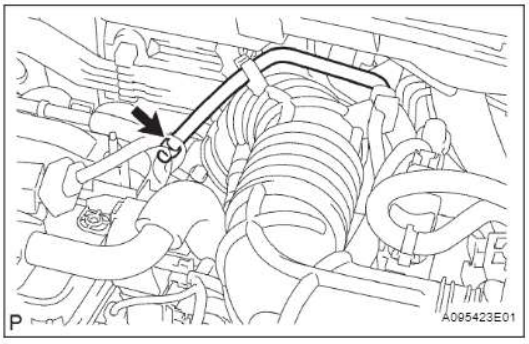


   (d) Disconnect the No. 2 ventilation hose from the cylinder head cover.

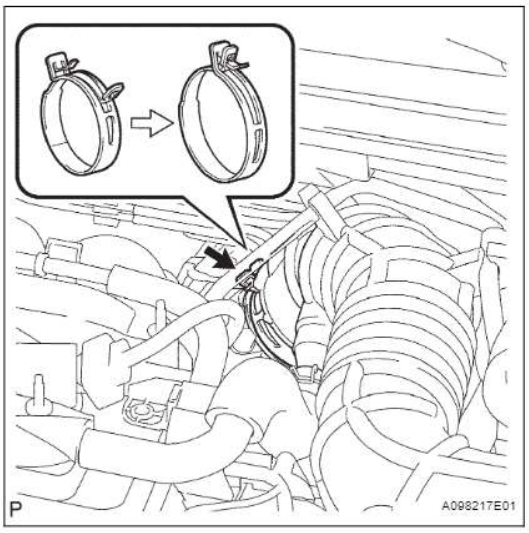


   (e) Disconnect the purge line hose from the purge VSV.

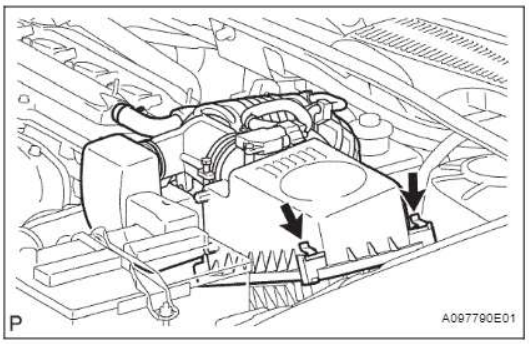




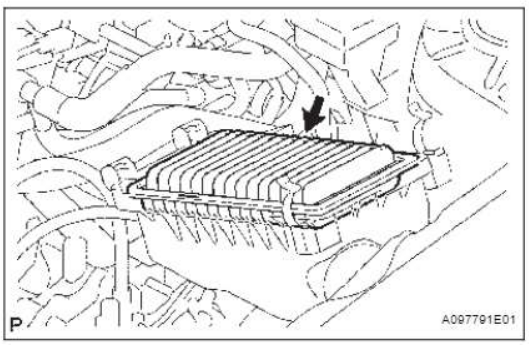
(f) Disconnect the purge line hose from the throttle body.



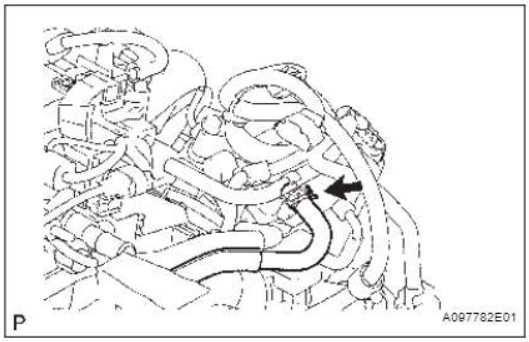
(g) Lock the No. 1 air cleaner hose clamp, and then disconnect the No. 1 air cleaner hose from the throttle body.



(h) Unfasten the 2 hook clamps, and then remove the air cleaner cap.

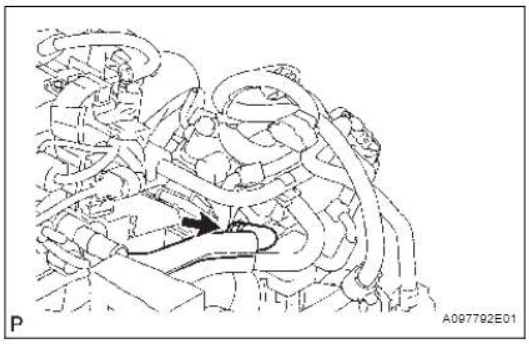


(i) Remove the air cleaner filter element from the air cleaner case.

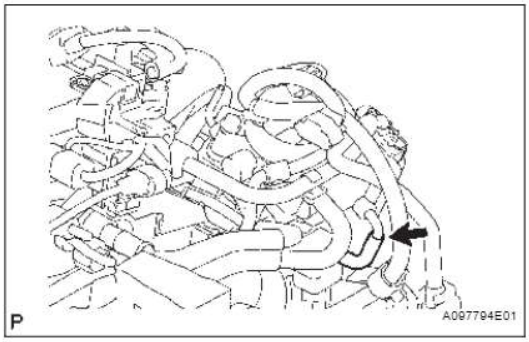


5. REMOVE THROTTLE BODY

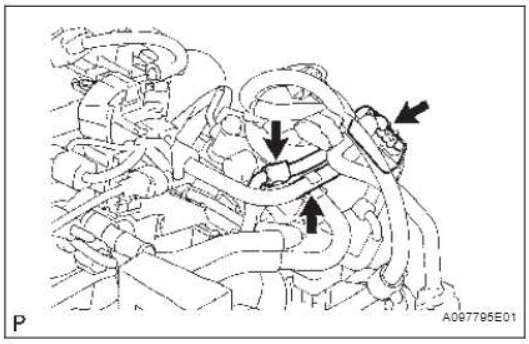
(a) Disconnect the water by-pass hose from the throttle body.



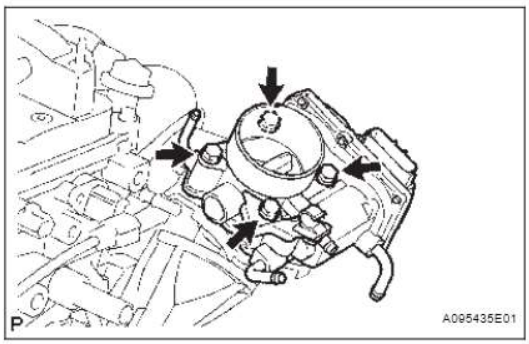
(b) Disconnect the No. 2 water by-pass hose from the throttle body.



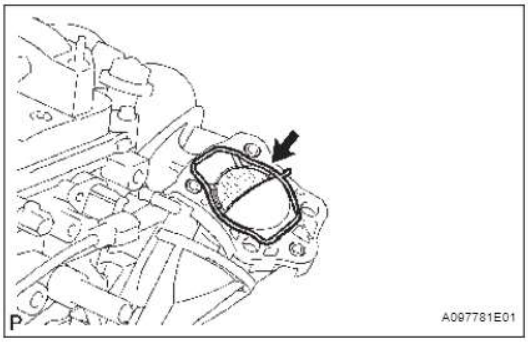
(c) Disconnect the No. 1 throttle body hose from the throttle body.



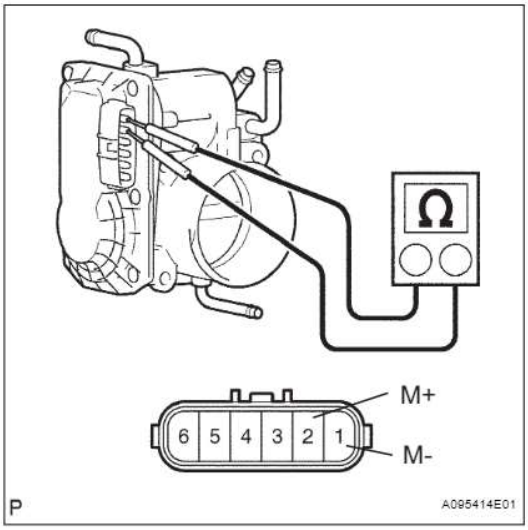
(d) Disconnect the throttle position sensor and control motor connector.
(e) Remove the wire harness clamp.
(f) Remove the fuel tube from the clamp.



(g) Remove the 4 bolts, and then remove the fuel pipe support and throttle body.



(h) Remove the gasket from the intake manifold.



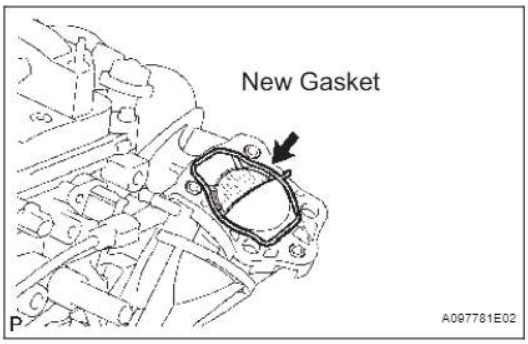
INSPECTION

1. INSPECT THROTTLE BODY

(a) Measure the resistance of the throttle control motor.
Standard resistance

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

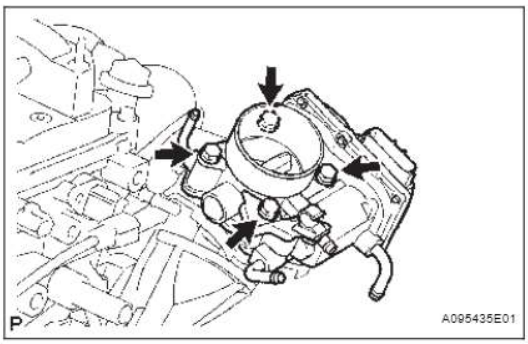
If the result is not as specified, replace the throttle body.



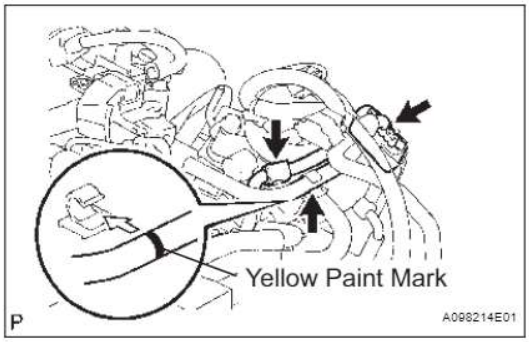
INSTALLATION

1. INSTALL THROTTLE BODY

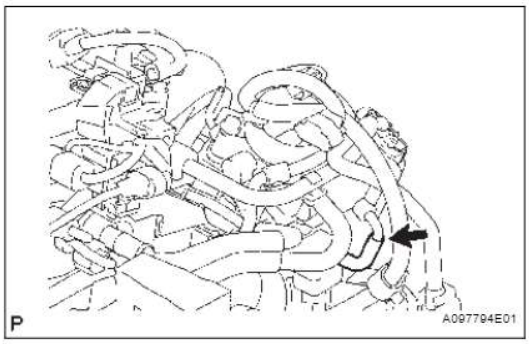
(a) Install a new gasket onto the intake manifold.



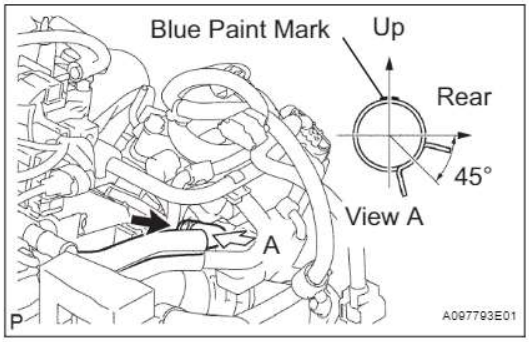
(b) Install the throttle body and fuel pipe clamp with the 4 bolts.
Torque: 30 N*m (305 kgf*cm, 22 in.*lbf)



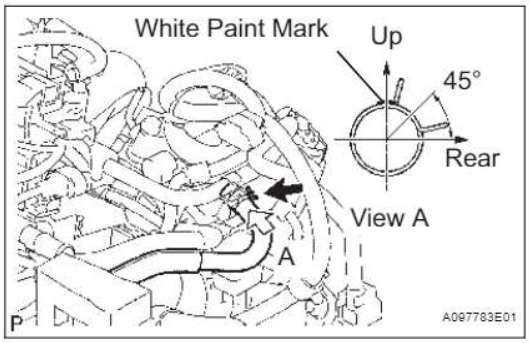
(c) Fit the fuel tube into the clamp.
(d) Install the wire harness clamp.
(e) Connect the throttle position sensor and control motor connector.



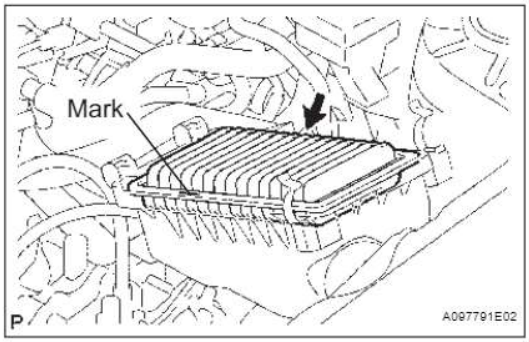
(f) Connect the No. 1 throttle body hose to the throttle body.



(g) Connect the No. 2 water by-pass hose to the throttle body.
NOTICE:
Make sure that the paint mark and hose clamp are at the correct angle.

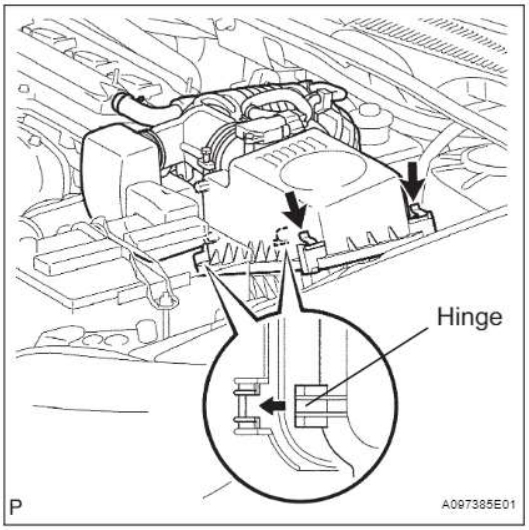


(h) Connect the water by-pass hose to the throttle body.
NOTICE:
Make sure that the paint mark and hose clamp are at the correct angle.

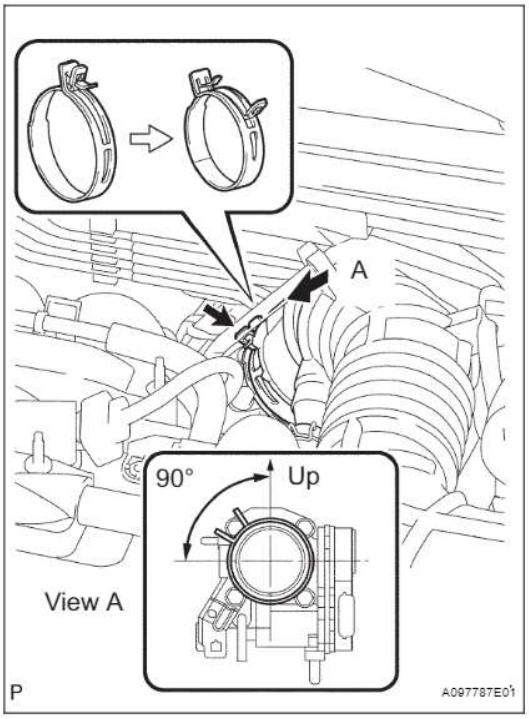


2. INSTALL AIR CLEANER CAP

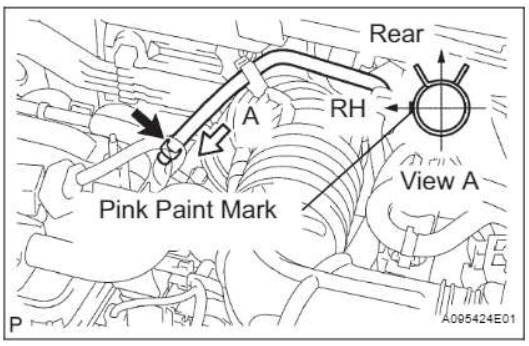
(a) Install the air cleaner filter element onto the air cleaner case.
NOTICE:
Make sure that the air cleaner filter element is in the correct direction when installing.



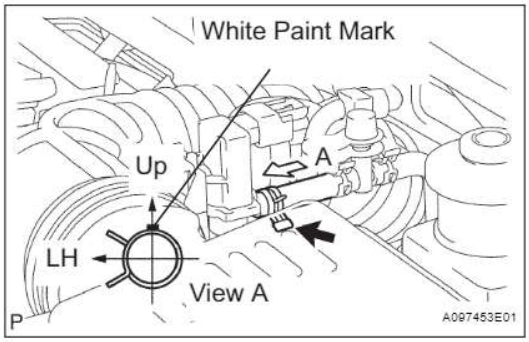
(b) Insert the hinge part of the air cleaner cap into the air cleaner case, then hang the 2 hook clamps.



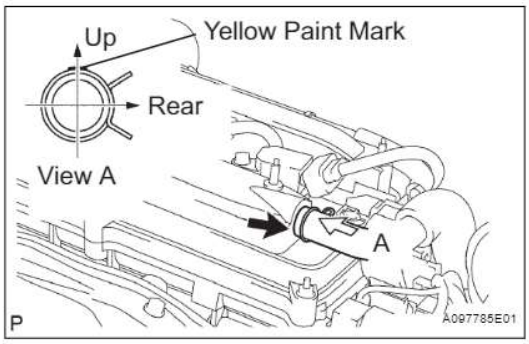
(c) Align the matchmarks of the No. 1 air cleaner hose and throttle body, and then connect the air cleaner hose No. 1 to the throttle body and unfasten the No. 1 air cleaner hose clamp.
NOTICE:
Make sure that the hose clamp is at the correct angle.



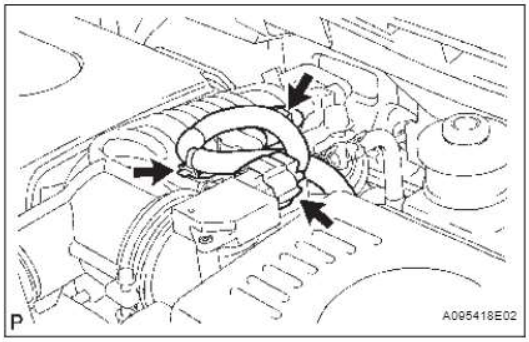
(d) Connect the purge line hose to the throttle body.
NOTICE:
Make sure that the paint mark and hose clamp are at the correct angle.



(e) Connect the purge line hose to the purge VSV.
NOTICE:
Make sure that the paint mark and hose clamp are at the correct angle.



(f) Connect the No. 2 ventilation hose to the cylinder head cover.
NOTICE:
Make sure that the paint mark and hose clamp are at the correct angle.

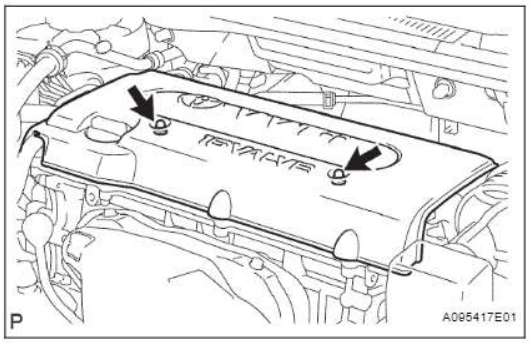


(g) Install the wire harness clamp.
(h) Connect the purge VSV connector.
(i) Connect the mass air flow meter connector.

3. CONNECT CABLE TO NEGATIVE BATTERY TERMINAL

4. ADD ENGINE COOLANT (See page CO-6)

5. CHECK FOR ENGINE COOLANT LEAKAGE (See page CO-1)

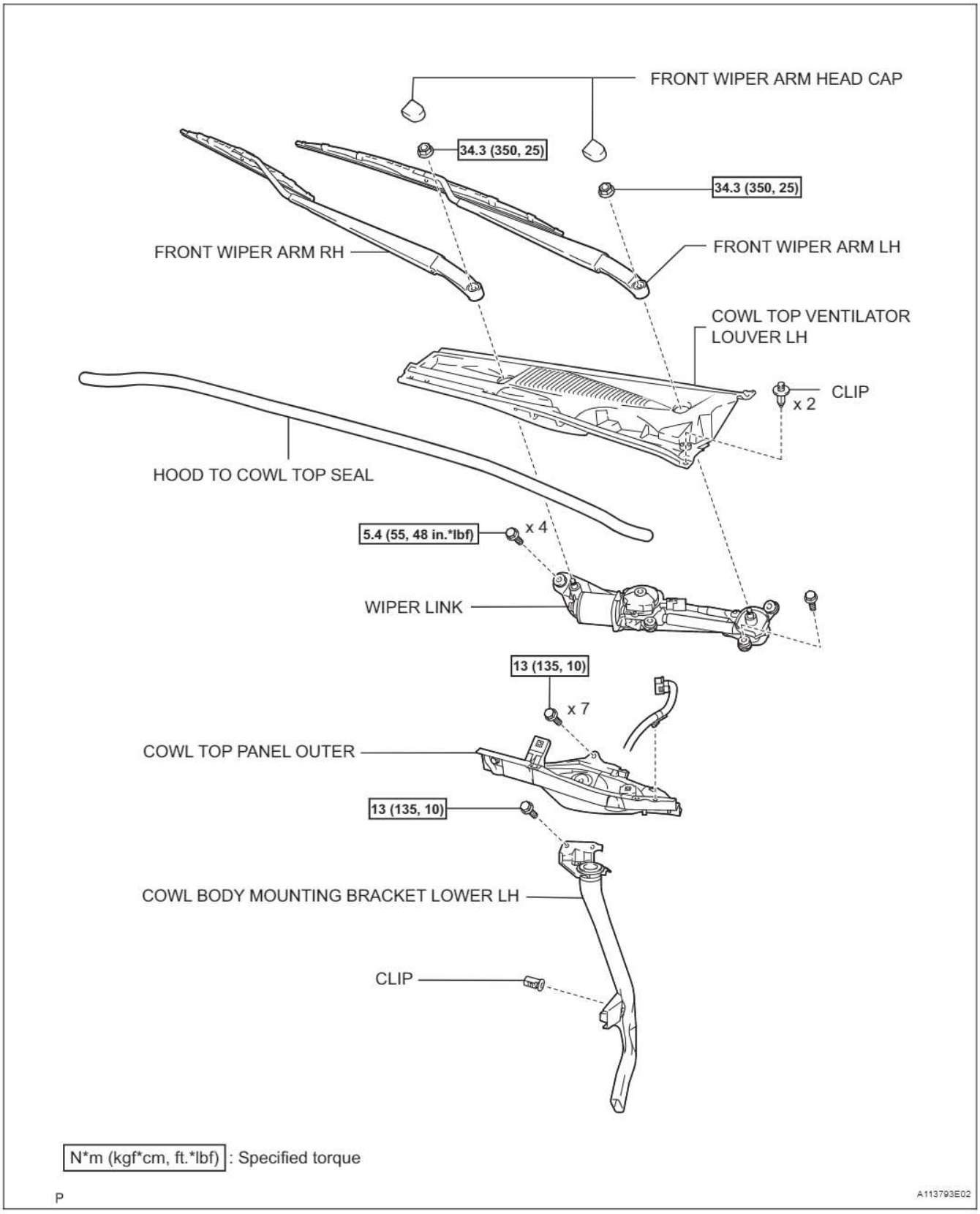


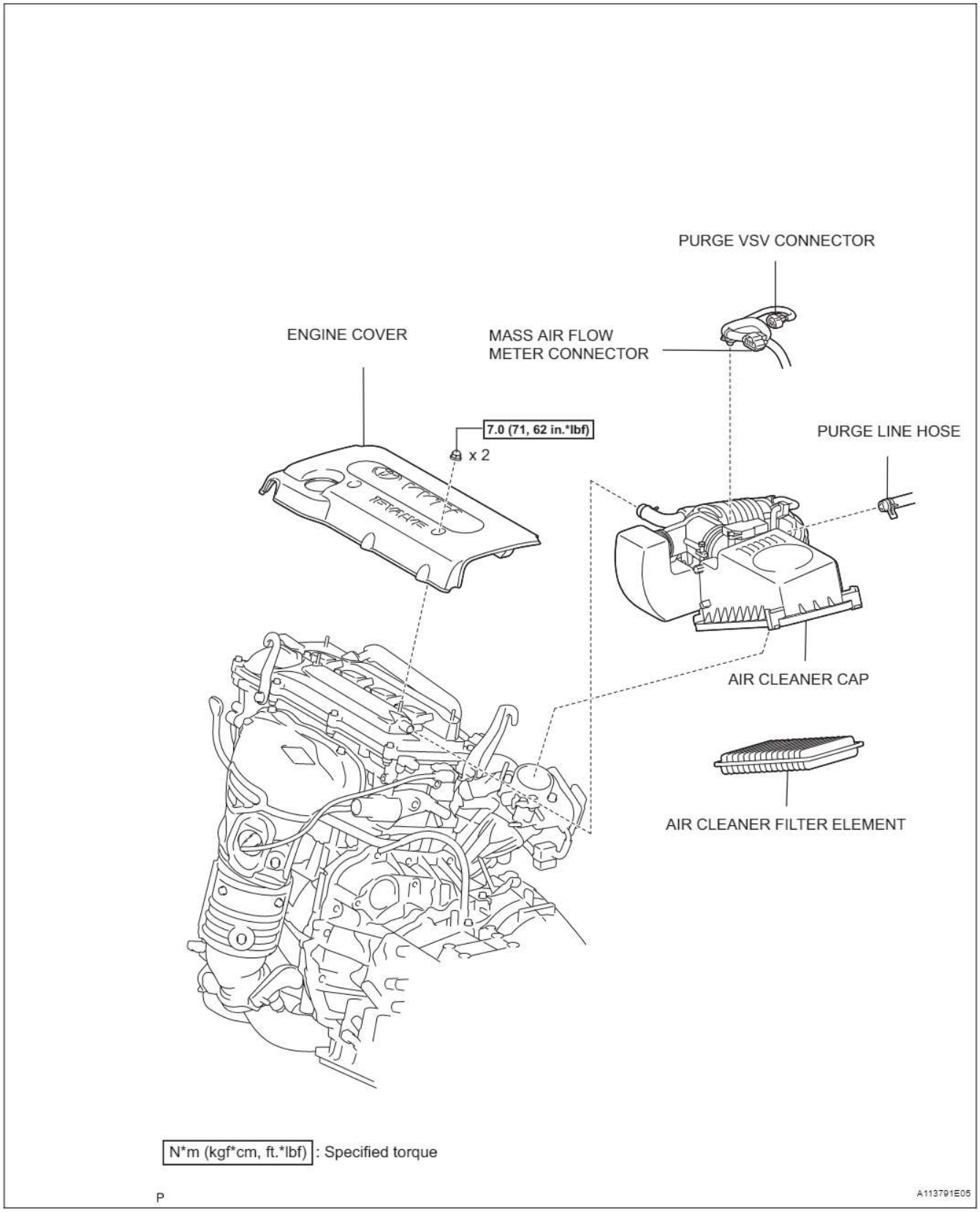
6. INSTALL ENGINE COVER
(a) Install the cover with the 2 nuts.
Torque: 7.0 N*m (71 kgf*cm, 62 in.*lbf)

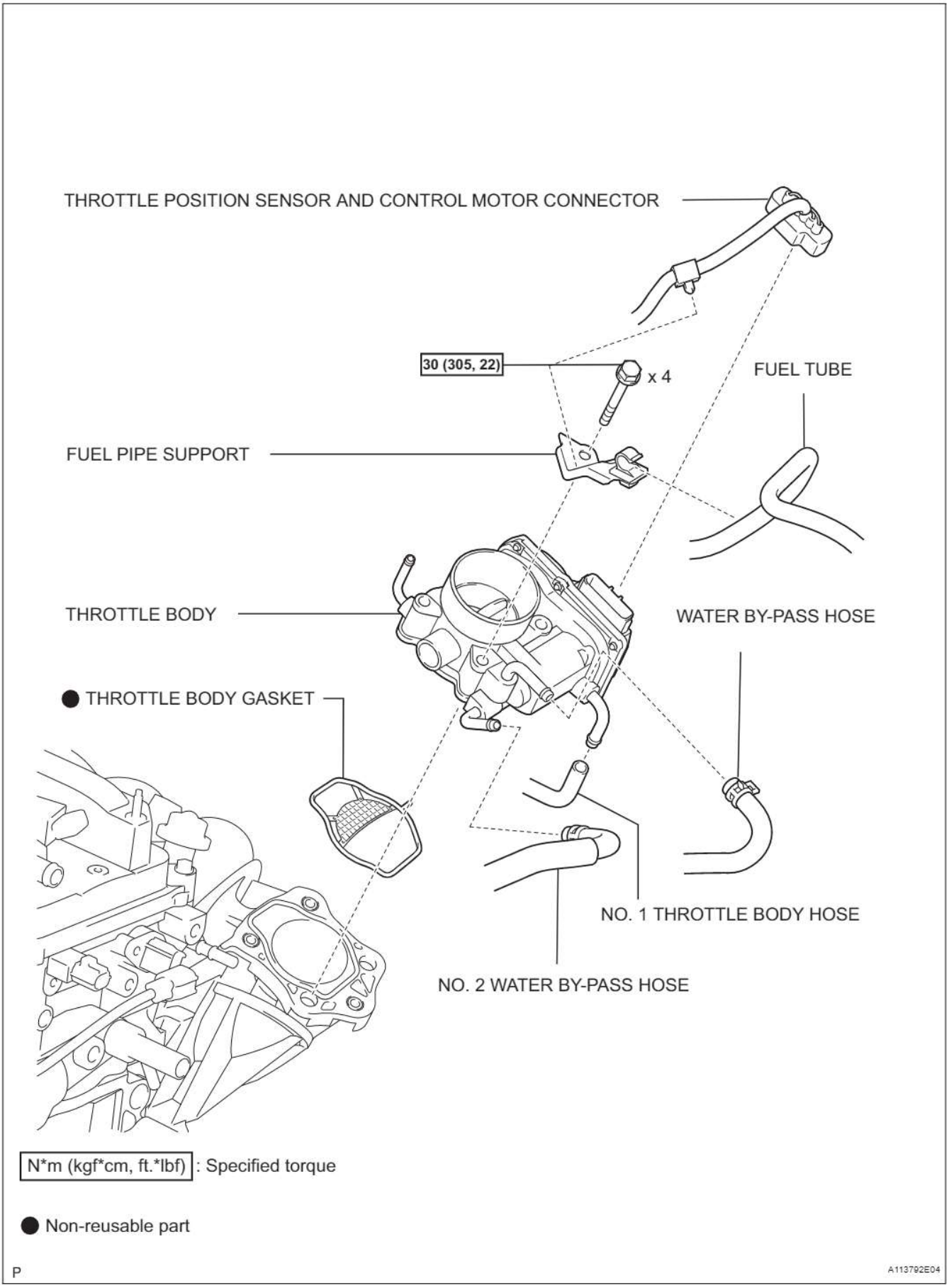
7. PERFORM INITIALIZATION
(a) Perform initialization (see page IN-23).
NOTICE:
Certain systems need to be initialized after disconnecting and reconnecting the cable from the negative (-) battery terminal.

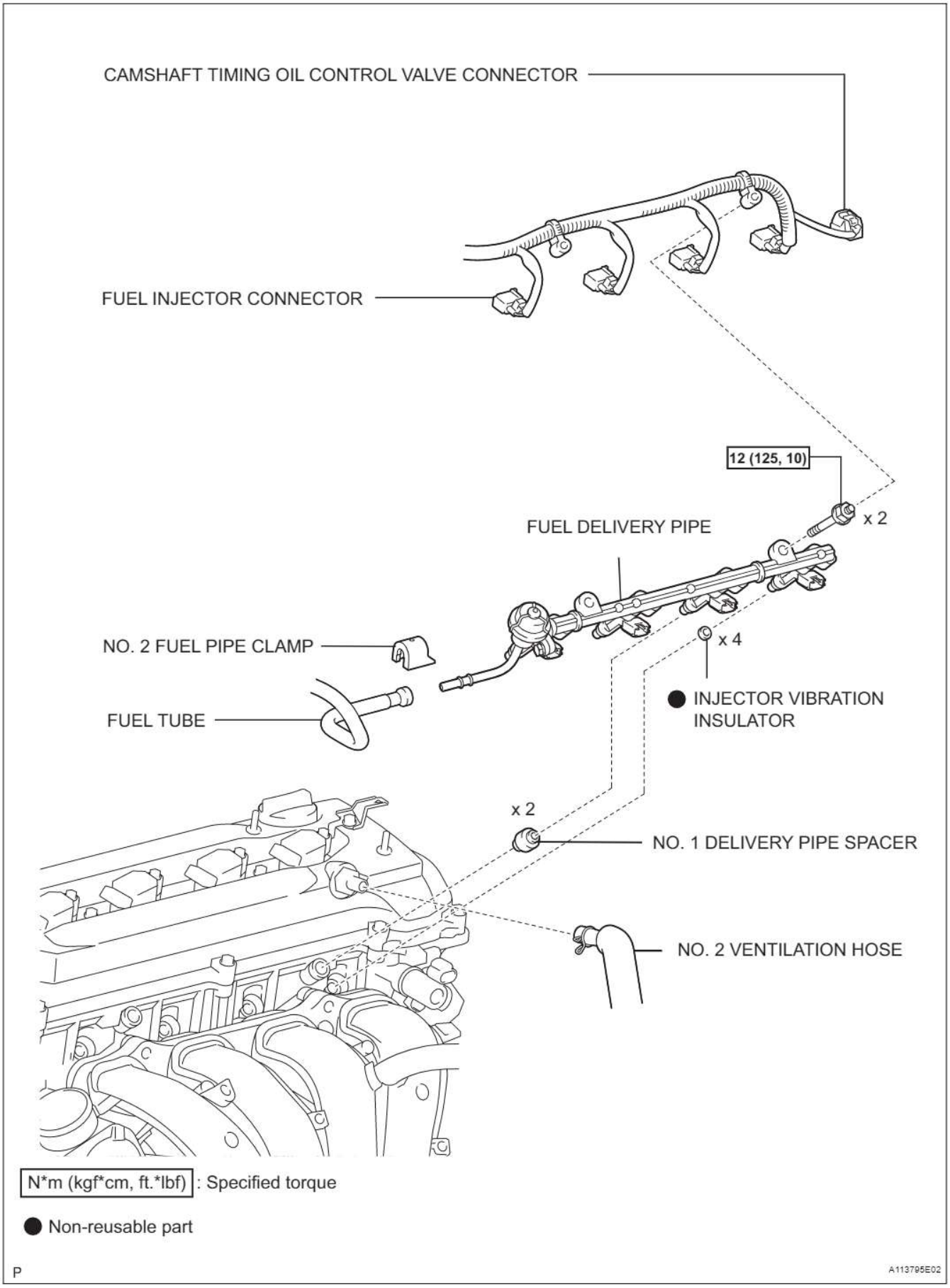
KNOCK SENSOR

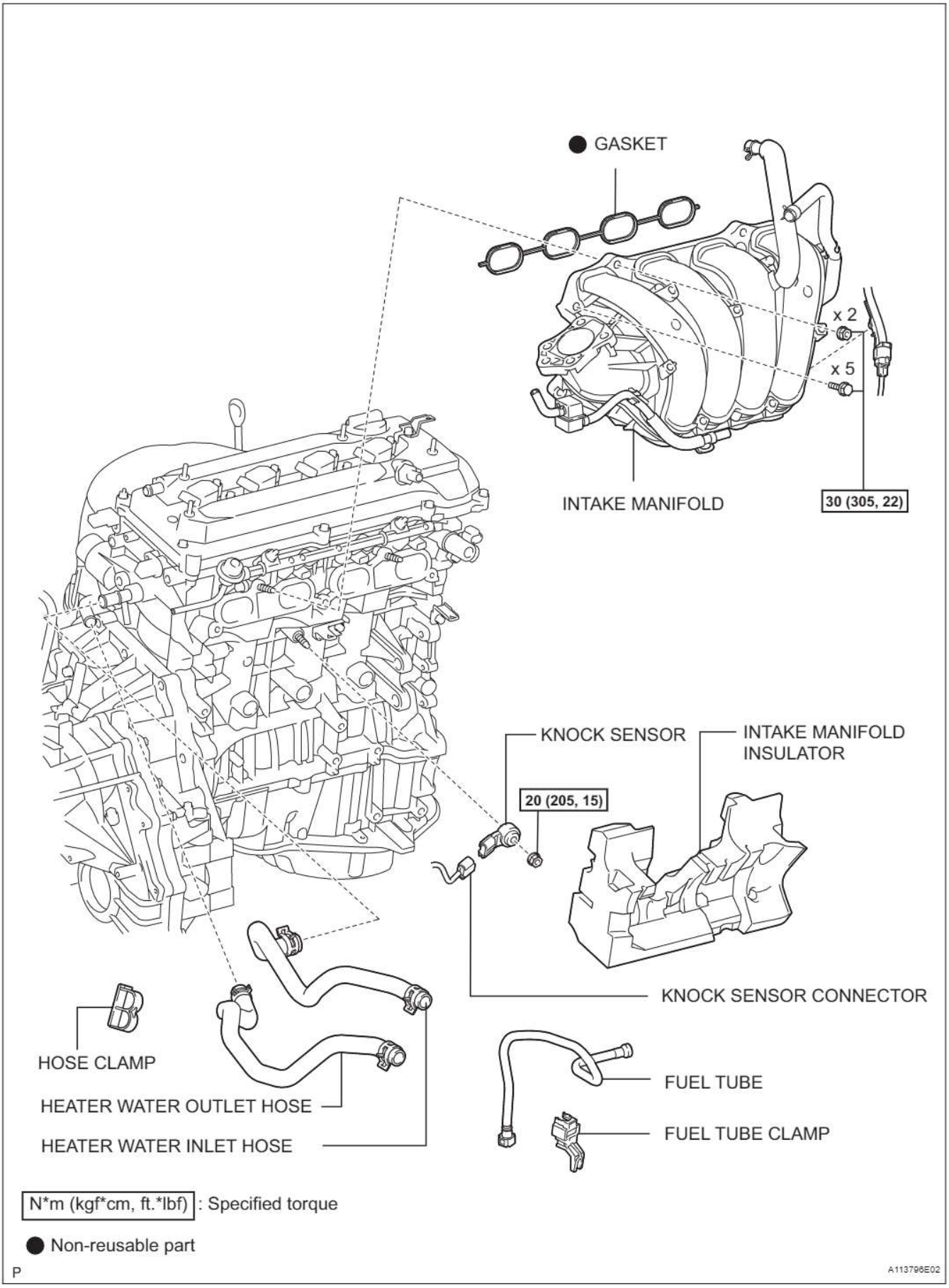
COMPONENTS




PURGE VSV CONNECTOR
ENGINE COVER
MASS AIR FLOW METER CONNECTOR
7.0 (71, 62 in.*lbf)
x 2
PURGE LINE HOSE
AIR CLEANER CAP
AIR CLEANER FILTER ELEMENT
N*m (kgf*cm, ft.*lbf) : Specified torque
P
A113791E05

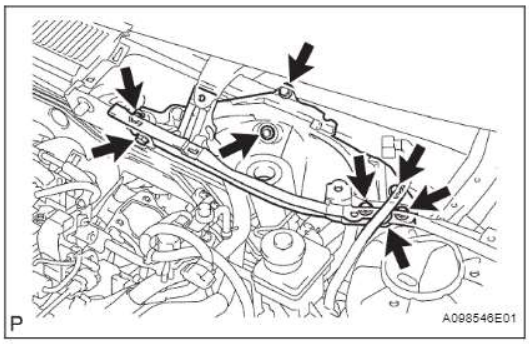

THROTTLE POSITION SENSOR AND CONTROL MOTOR CONNECTOR
30 (305, 22)
x 4
FUEL TUBE
FUEL PIPE SUPPORT
THROTTLE BODY
WATER BY-PASS HOSE
● THROTTLE BODY GASKET
NO. 1 THROTTLE BODY HOSE
NO. 2 WATER BY-PASS HOSE
N*m (kgf*cm, ft.*lbf) : Specified torque
● Non-reusable part
P
A113792E04

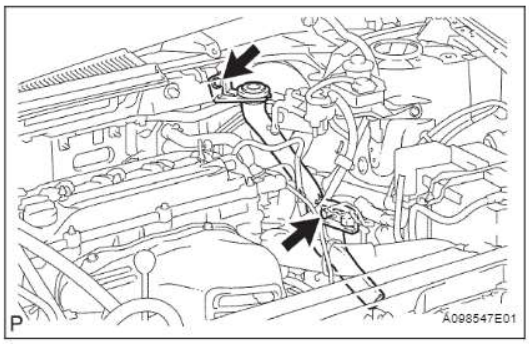

CAMSHAFT TIMING OIL CONTROL VALVE CONNECTOR
FUEL INJECTOR CONNECTOR
12 (125, 10)
x 2
FUEL DELIVERY PIPE
NO. 2 FUEL PIPE CLAMP
x 4
FUEL TUBE
INJECTOR VIBRATION INSULATOR
x 2
NO. 1 DELIVERY PIPE SPACER
NO. 2 VENTILATION HOSE
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part
P
A113795E02


GASKET
x 2
x 5
INTAKE MANIFOLD
30 (305, 22)
KNOCK SENSOR
INTAKE MANIFOLD INSULATOR
20 (205, 15)
KNOCK SENSOR CONNECTOR
HOSE CLAMP
HEATER WATER OUTLET HOSE
HEATER WATER INLET HOSE
FUEL TUBE
FUEL TUBE CLAMP
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part
P
A113796E02

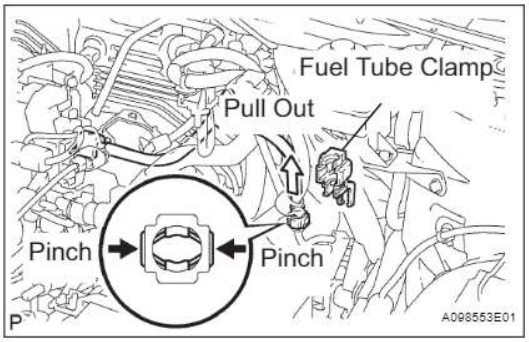
REMOVAL

1. DISCHARGE FUEL SYSTEM PRESSURE (See page FU-7)
2. DRAIN COOLANT (See page CO-6)
3. DISCONNECT CABLE FROM NEGATIVE BATTERY TERMINAL
   CAUTION:
   Wait at least 90 seconds after disconnecting the cable from the negative (-) battery terminal to prevent airbag and seat belt pretensioner activation.
4. REMOVE FRONT WIPER ARM HEAD CAP (See page WW-4)
5. REMOVE FRONT WIPER ARM LH (See page WW-4)
6. REMOVE FRONT WIPER ARM RH (See page WW-4)
7. REMOVE HOOD TO COWL TOP SEAL (See page WW-4)
8. REMOVE COWL TOP VENTILATOR LOUVER LH (See page WW-4)
9. REMOVE WIPER LINK (See page WW-5)
10. REMOVE COWL TOP PANEL OUTER
    (a) Remove the wire harness clamp.
    (b) Remove the 7 bolts and panel.





11. REMOVE COWL BODY MOUNTING BRACKET LOWER LH
    (a) Remove the bolt, clip and bracket.
12. REMOVE ENGINE COVER (See page ES-382)
13. REMOVE AIR CLEANER CAP (See page ES-383)
14. REMOVE THROTTLE BODY (See page ES-384)
15. REMOVE FUEL DELIVERY PIPE (See page FU-8)



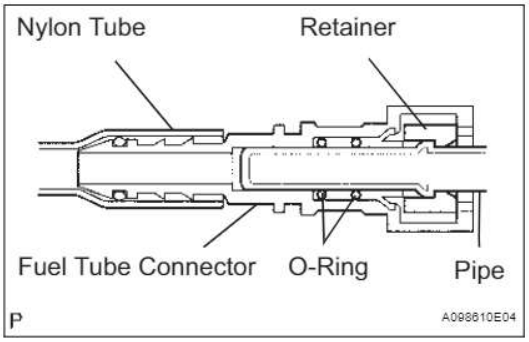
16. REMOVE FUEL TUBE

(a) Remove the fuel tube clamp.

(b) Pinch the retainer as illustrated, and then pull the fuel tube connector out of the pipe.

NOTICE:

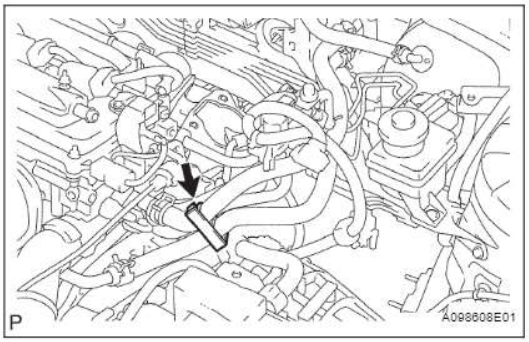
- **Remove any dirt and foreign objects on the fuel tube connector before performing this work.**



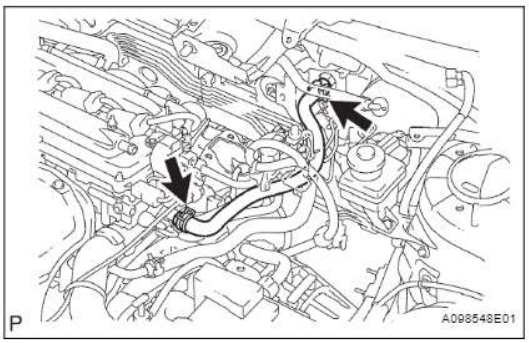
- **When disconnecting the connector, do not damage the connector and pipe, and do not allow foreign matter to contact the connector and pipe. Damage or foreign matter may damage the O-ring that seals the pipe and lead to leaks.**
- **Perform this work by hand. Do not use any tools.**
- **Do not forcibly bend, twist or turn the nylon tube.**
- **Protect the disconnected part by covering it with a plastic bag after disconnecting the fuel tube.**
- **If the fuel tube connector and pipe are stuck, push and pull to release them.**

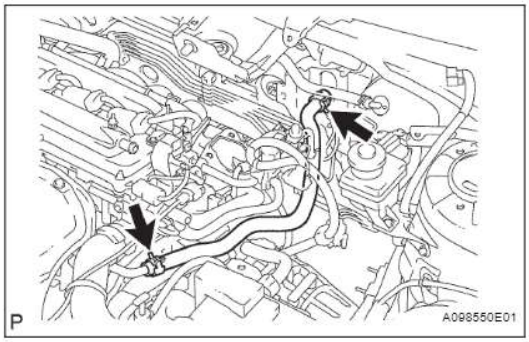
17. REMOVE HEATER WATER INLET HOSE

(a) Remove the hose clamp.



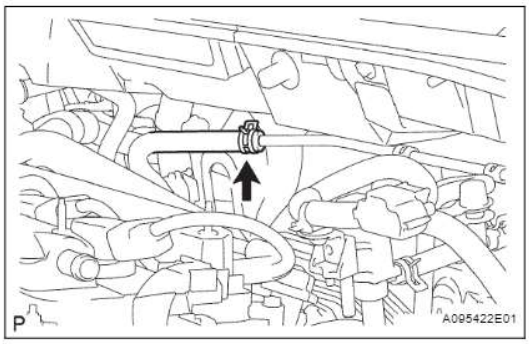
(b) Remove the heater water inlet hose from the heater radiator unit and cylinder head.





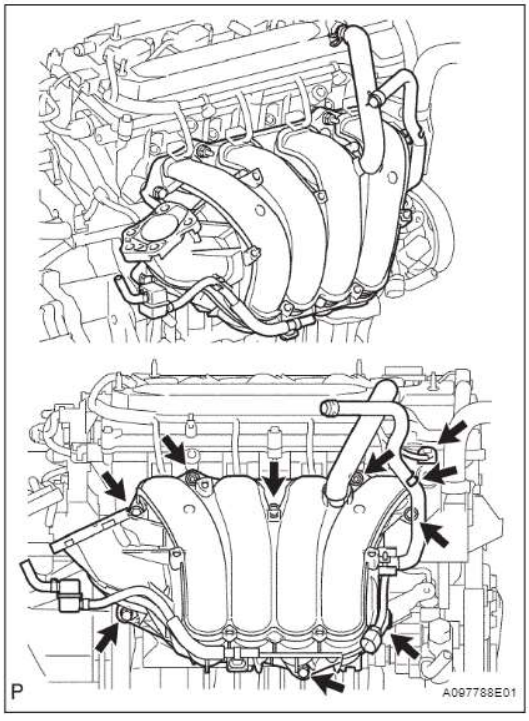
18. REMOVE HEATER WATER OUTLET HOSE

(a) Remove the heater water outlet hose from the heater radiator unit and water by-pass pipe.

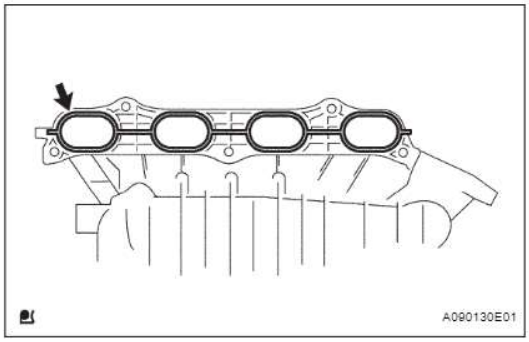


19. REMOVE INTAKE MANIFOLD

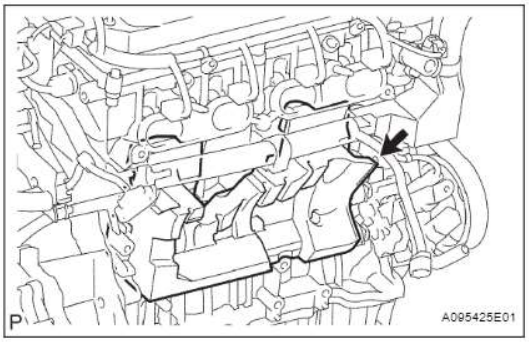
(a) Disconnect the union to check valve hose from the brake booster.



(b) Disconnect the camshaft timing oil control valve connector.
(c) Remove the wire harness clamp.
(d) Remove the union to check valve hose from the vacuum hose clamp.
(e) Remove the 5 bolts, 2 nuts and intake manifold.

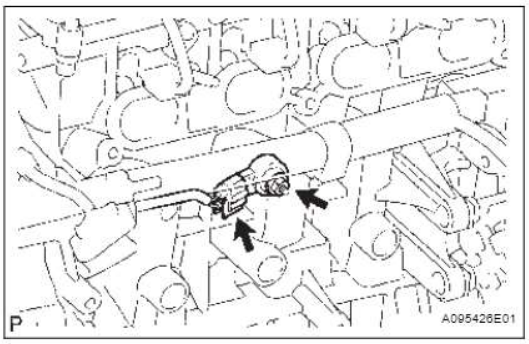


(f) Remove the gasket from the intake manifold.



20. REMOVE INTAKE MANIFOLD INSULATOR

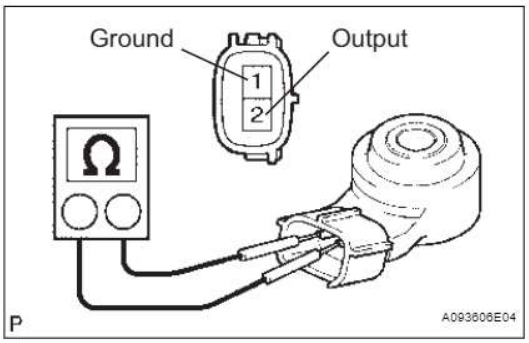
(a) Remove the intake manifold insulator from the cylinder block.



21. REMOVE KNOCK SENSOR

(a) Disconnect the sensor connector.

(b) Remove the nut and sensor.



INSPECTION

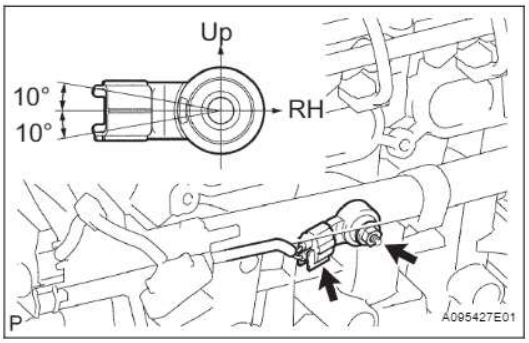
1. INSPECT KNOCK SENSOR

(a) Measure the resistance of the sensor.

Standard resistance

Tester Connection	Specified Condition
1 (Ground) - 2 (Output)	120 to 280 kΩ at 20°C (68°F)

If the result is not as specified, replace the knock sensor.



INSTALLATION

1. INSTALL KNOCK SENSOR

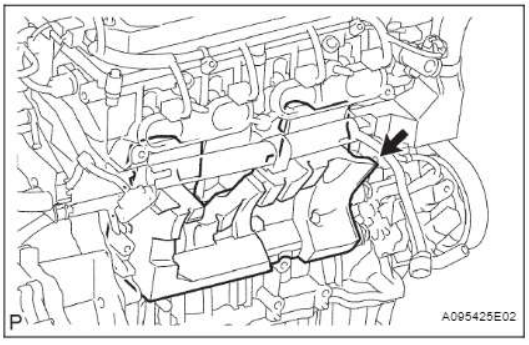
(a) Install the sensor with the nut.

Torque: 20 N*m (205 kgf*cm, 15 ft.*lbf)

NOTICE:

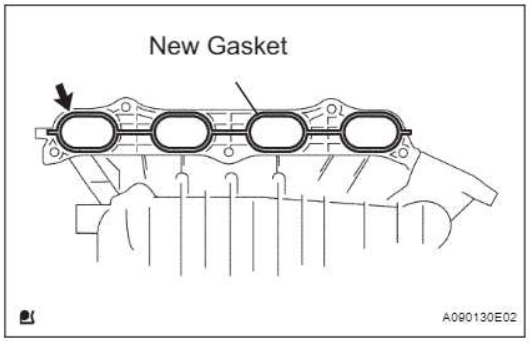
Make sure that the knock sensor is in the correct direction.

(b) Connect the sensor connector.



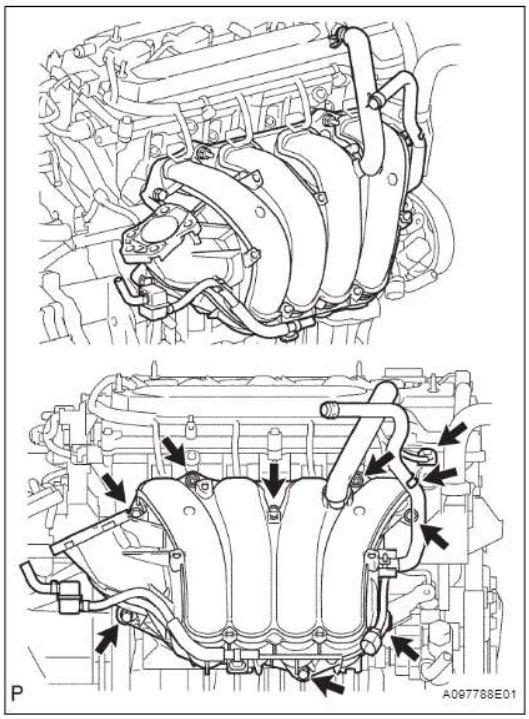
2. INSTALL INTAKE MANIFOLD INSULATOR

(a) Install the intake manifold insulator onto the cylinder block.



3. INSTALL INTAKE MANIFOLD

(a) Install a new gasket into the intake manifold.

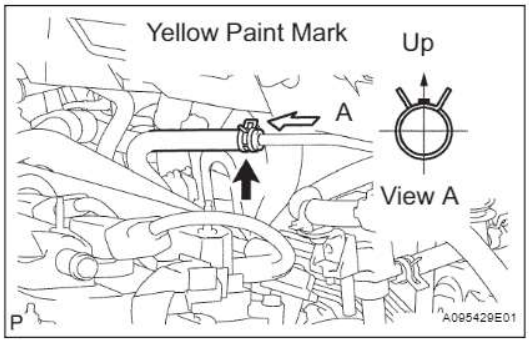


(b) Install the intake manifold with the 5 bolts and 2 nuts.
Torque: 30 N*m (305 kgf*cm, 22 ft.*lbf)

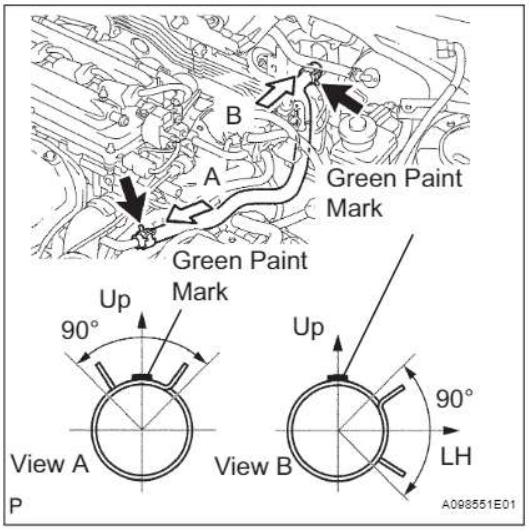
(c) Fit the union to check valve hose into the vacuum hose clamp.

(d) Install the wire harness clamp.

(e) Connect the camshaft timing oil control valve connector.



(f) Connect the union to check valve hose to the brake booster.
NOTICE:
Make sure that the paint mark and hose clamp are at the correct angle.

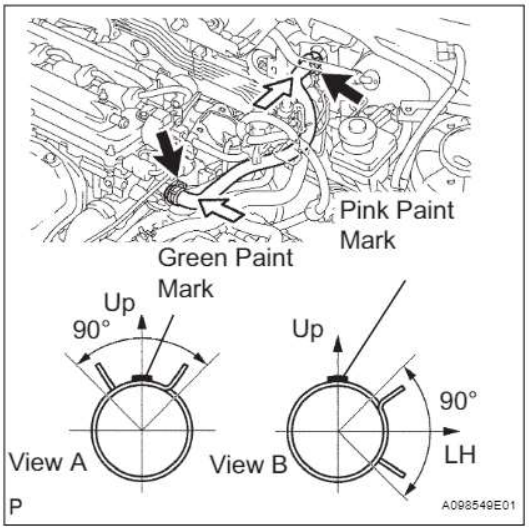


4. CONNECT HEATER WATER OUTLET HOSE

(a) Install the heater water outlet hose to the water by-pass pipe and heater radiator unit.

NOTICE:

Make sure that the paint mark and hose clamp are at the correct angle.

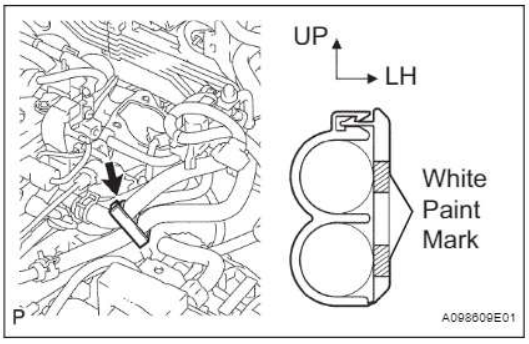


5. CONNECT HEATER WATER INLET HOSE

(a) Install the heater water inlet hose to the cylinder head and heater radiator unit.

NOTICE:

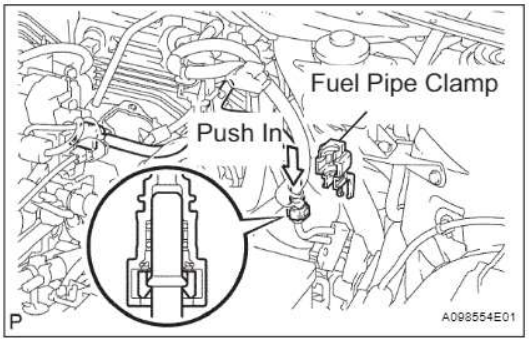
Make sure that the paint mark and hose clamp are at the correct angle.



(b) Install the hose clamp.

NOTICE:

Make sure that the paint mark and hose clamp are at the correct angle.



6. INSTALL FUEL TUBE

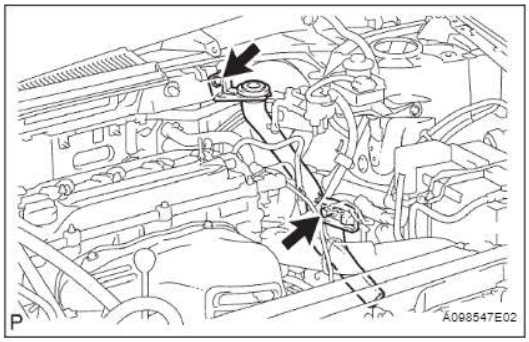
(a) Align the fuel tube connector with the pipe, and then push the fuel tube connector until the retainer makes a "click" sound to connect the fuel tube to the pipe.

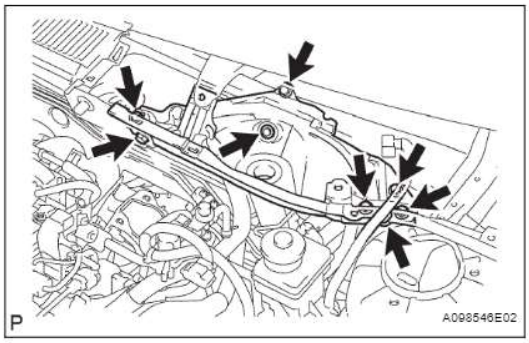
NOTICE:

- **Check that there are no scratches or foreign objects around the connected part of the fuel tube connector and pipe before performing this work.**

- **After connecting the fuel tube connector, check that the fuel tube connector and pipe are securely connected by pulling them.**

7. **INSTALL FUEL DELIVERY PIPE (See page FU-11)**
8. **INSTALL THROTTLE BODY (See page ES-386)**
9. **INSTALL AIR CLEANER CAP (See page ES-387)**
10. **INSTALL COWL BODY MOUNTING BRACKET LOWER LH**
    (a) Install the bracket with the bolt and clip.
    Torque: 13 N*m (135 kgf*cm, 10 ft.*lbf)





11. **INSTALL COWL TOP PANEL OUTER**
    (a) Install the panel with the 7 bolts.
    Torque: 13 N*m (135 kgf*cm, 10 ft.*lbf)
    (b) Install the wire harness clamp.
12. **INSTALL WIPER LINK (See page WW-7)**
13. **CONNECT CABLE TO NEGATIVE BATTERY TERMINAL**
14. **ADD ENGINE COOLANT (See page CO-6)**
15. **CHECK FOR ENGINE COOLANT LEAKAGE (See page CO-1)**
16. **CHECK FOR FUEL LEAKAGE (See page FU-2)**
17. **INSTALL ENGINE COVER (See page ES-389)**
18. **INSTALL COWL TOP VENTILATOR LOUVER LH (See page WW-7)**
19. **INSTALL HOOD TO COWL TOP SEAL (See page WW-7)**
20. **INSTALL FRONT WIPER ARM RH (See page WW-8)**
21. **INSTALL FRONT WIPER ARM LH (See page WW-7)**
22. **REMOVE FRONT WIPER ARM HEAD CAP**
23. **PERFORM INITIALIZATION**
    (a) Perform initialization (see page IN-23).
    NOTICE:
    Certain systems need to be initialized after disconnecting the cable from the negative (-) battery terminal.

ES

IG1 RELAY

ON-VEHICLE INSPECTION

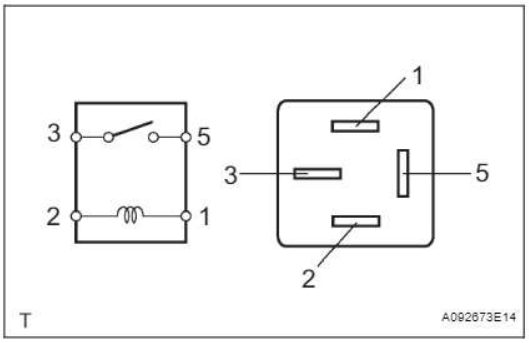
1. REMOVE RELAY (Marking: IG1)

(a) Remove the IG1 relay from the instrument panel junction block.

2. INSPECT RELAY

(a) Measure the IG1 relay resistance.

Standard resistance



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

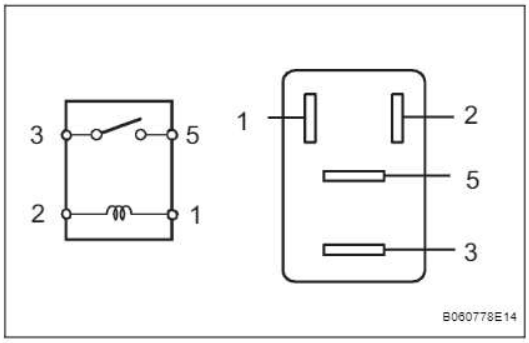
If the result is not as specified, replace the relay.

3. INSTALL RELAY

IG2 RELAY

ON-VEHICLE INSPECTION

1. **REMOVE IG2 RELAY (Marking: IG2)**
   (a) Remove the engine room relay block cover.
   (b) Remove the IG2 relay from the engine room relay block.



2. **INSPECT IG2 RELAY**
   (a) Measure the EFI relay resistance.
   Standard resistance

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

If the result is not as specified, replace the relay.

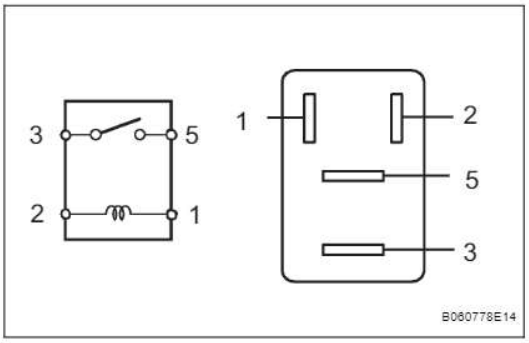
3. **INSTALL IG2 RELAY**

ES

EFI RELAY

ON-VEHICLE INSPECTION

1. **REMOVE EFI RELAY (Marking: EFI)**
   (a) Remove the engine room relay block cover.
   (b) Remove the EFI relay from the engine room relay block.



2. **INSPECT EFI RELAY**
   (a) Measure the EFI relay resistance.
   Standard resistance

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

If the result is not as specified, replace the relay.

3. **INSTALL EFI RELAY**

CIRCUIT OPENING RELAY

ON-VEHICLE INSPECTION

1. **DISCONNECT CABLE FROM NEGATIVE BATTERY TERMINAL**
   CAUTION:
   Wait at least 90 seconds after disconnecting the cable from the negative (-) battery terminal to prevent airbag and seat belt pretensioner activation.

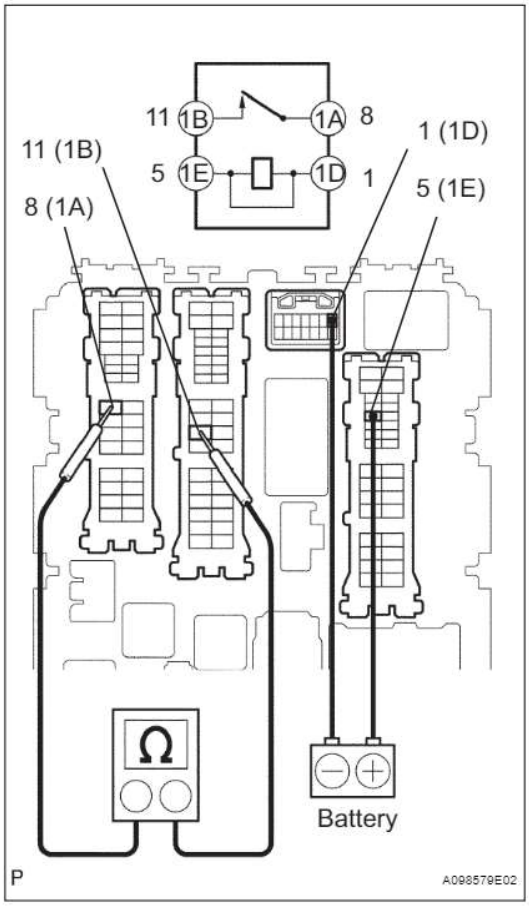
2. **INSPECT CIRCUIT OPENING RELAY**
   (a) Measure the resistance between the terminals.
   Standard resistance

Tester Connection	Specified Condition
1B (11) - 1A (8)	10 kΩ or higher
1B (11) - 1A(8)	Below 1 Ω (when battery voltage is applyed to terminals 1E (5) and 1D (1))

   If the result is not as specified, replace the instrument panel junction block.

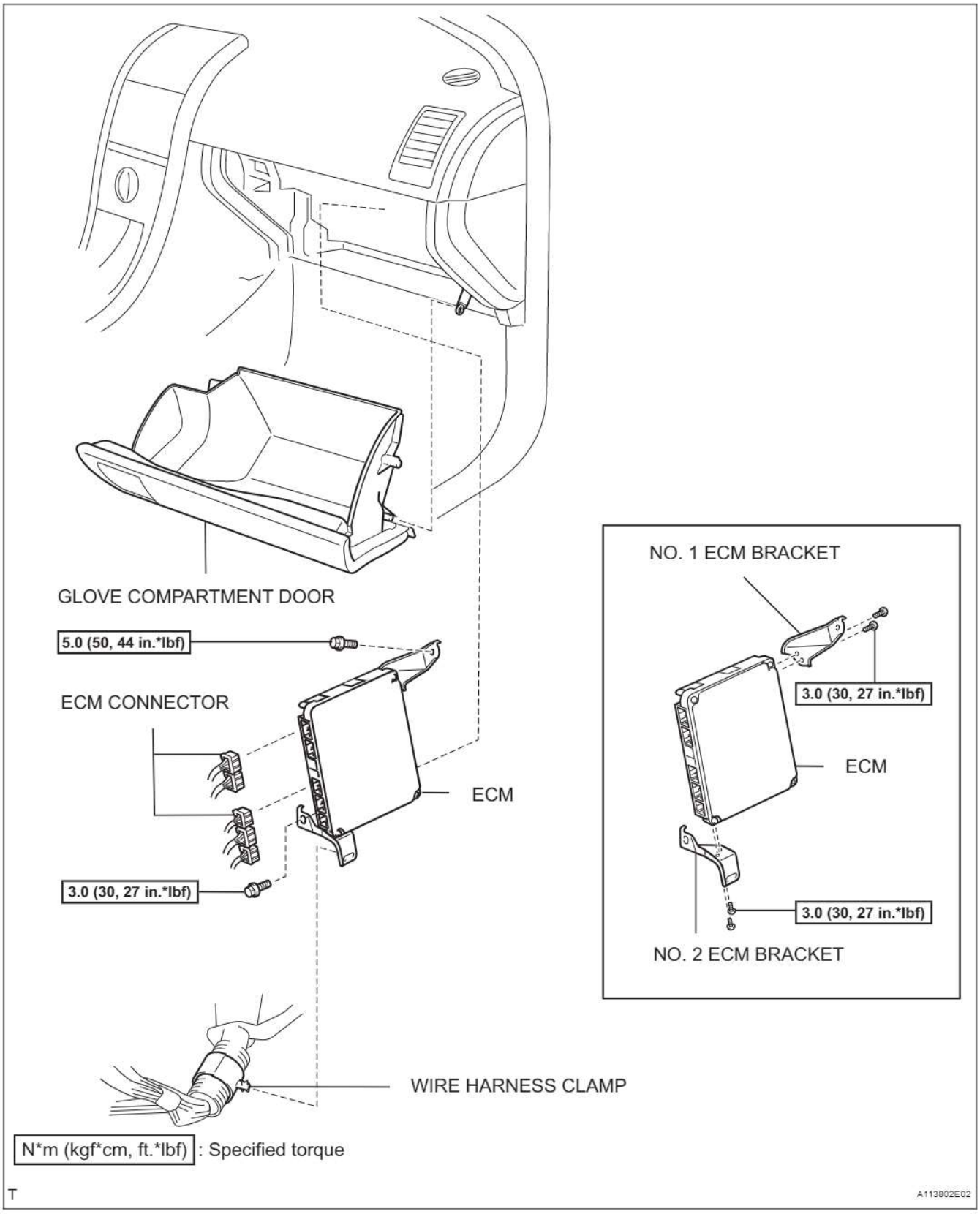
3. **CONNECT CABLE TO NEGATIVE BATTERY TERMINAL**

4. **PERFORM INITIALIZATION**
   (a) Perform initialization (see page IN-23).
   NOTICE:
   Certain systems need to be initialized after disconnecting and reconnecting the cable from the negative (-) battery



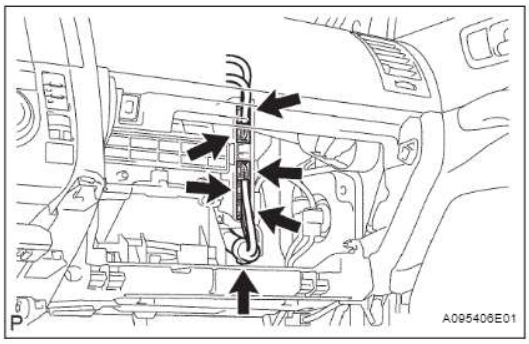
ECM

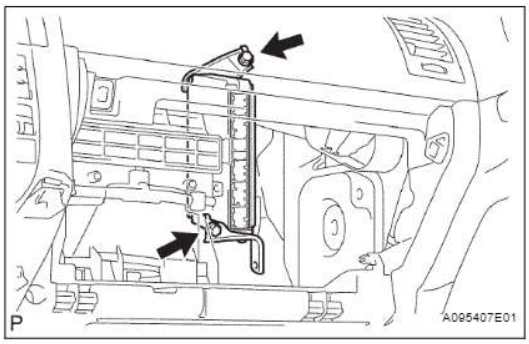
COMPONENTS



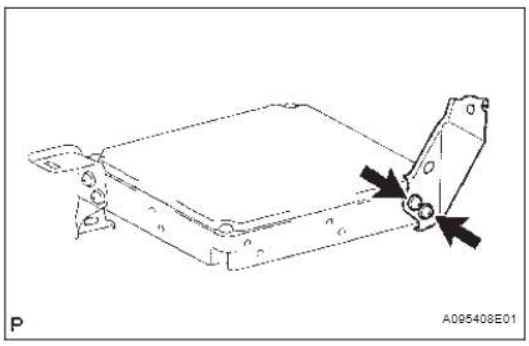
REMOVAL

1. **DISCONNECT CABLE FROM NEGATIVE BATTERY TERMINAL**
   CAUTION:
   Wait at least 90 seconds after disconnecting the cable from the negative (-) battery terminal to prevent airbag and seat belt pretensioner activation.
2. **REMOVE GLOVE COMPARTMENT DOOR (See page IP-6)**
3. **REMOVE ECM**
   (a) Disconnect the wire harness clamp.
   (b) Disconnect the 5 ECM connectors.

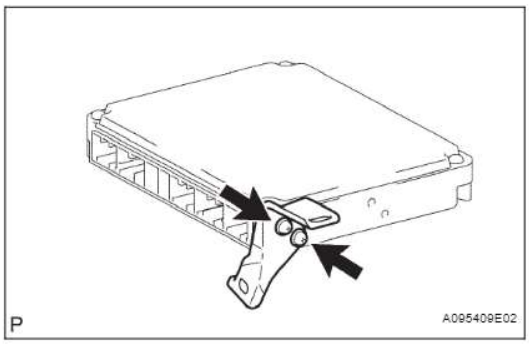




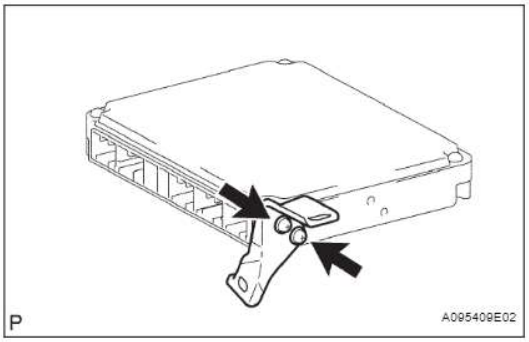
(c) Remove the bolt, screw and ECM.



(d) Remove the 2 screws and No. 1 ECM bracket.

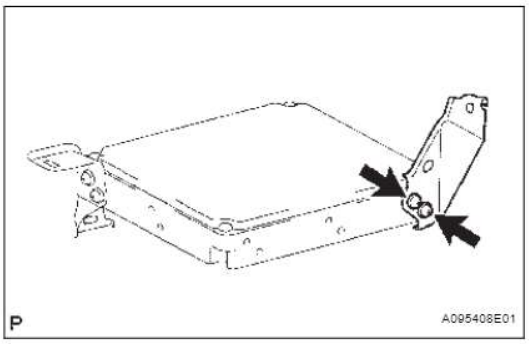


(e) Remove the 2 screws and No. 2 ECM bracket.

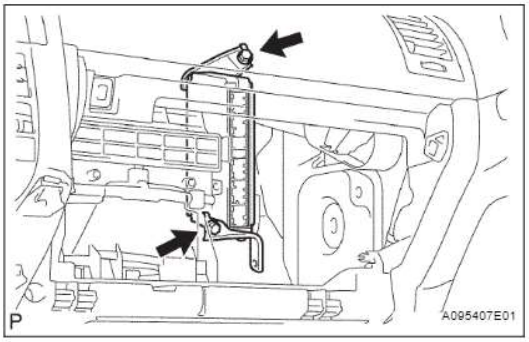


INSTALLATION

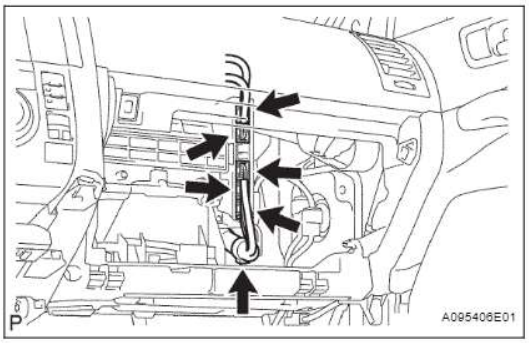
1. **INSTALL ECM**
   (a) Install the No. 2 ECM bracket with the 2 screws.
   Torque: 3.0 N*m (30 kgf*cm, 27 in.*lbf)



   (b) Install the No. 1 ECM bracket with the 2 screws.
   Torque: 3.0 N*m (30 kgf*cm, 27 in.*lbf)



   (c) Install the ECM with the bolt and screw.
   Torque: 5.0 N*m (50 kgf*cm, 44 in.*lbf) for bolt
   3.0 N*m (30 kgf*cm, 27 in.*lbf) for screw



   (d) Connect the 5 ECM connectors.
   (e) Install the wire harness clamp.

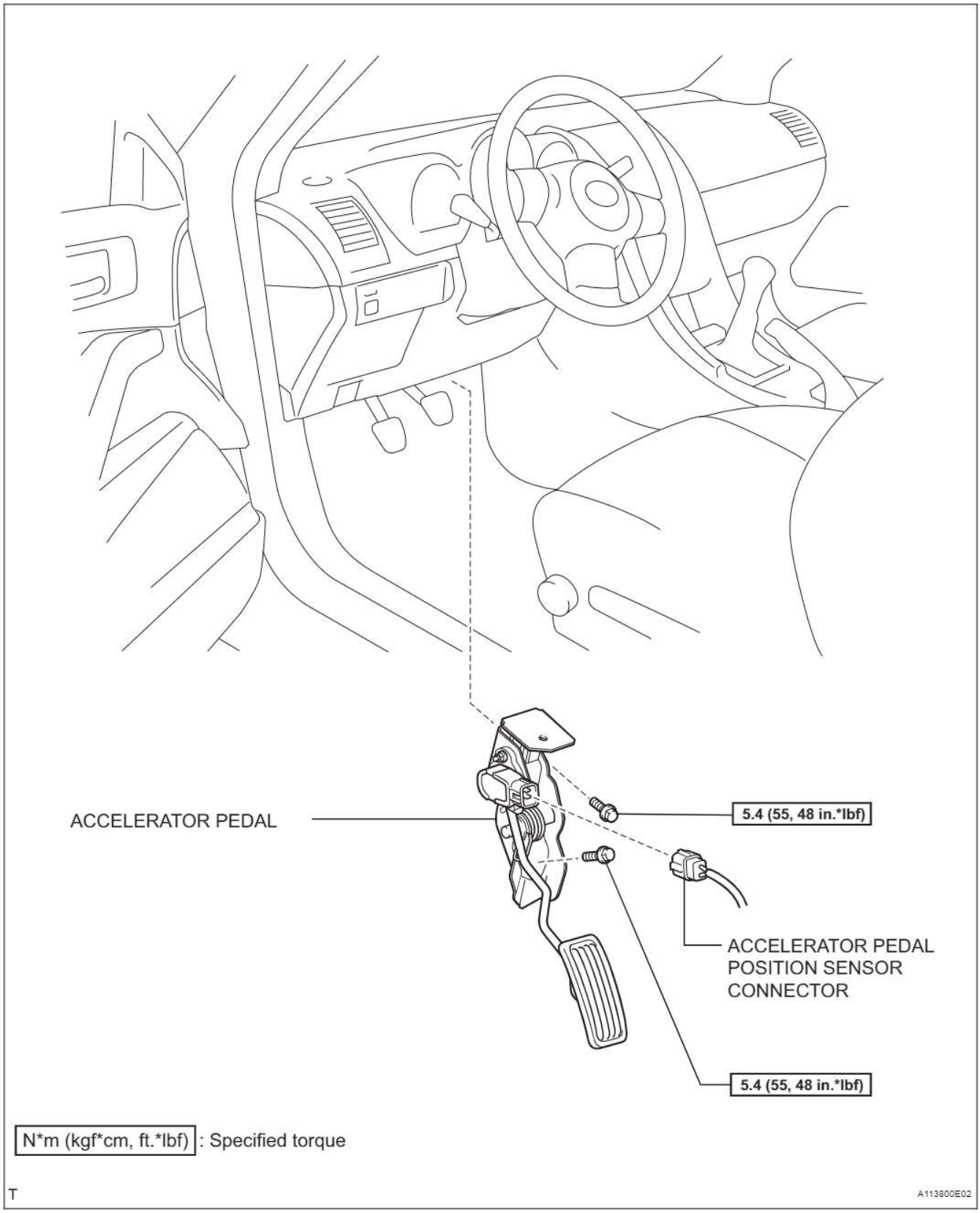
2. **INSTALL GLOVE COMPARTMENT DOOR (See page IP-11)**

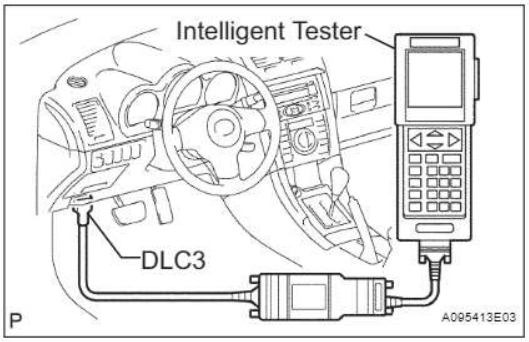
3. **CONNECT CABLE TO NEGATIVE BATTERY TERMINAL**

4. **PERFORM INITIALIZATION**
   (a) Perform initialization (see page IN-23).
   NOTICE:
   Certain systems need to be initialized after disconnecting and reconnecting the cable from the negative (-) battery terminal.

ACCELERATOR PEDAL

COMPONENTS





ON-VEHICLE INSPECTION

1. CHECK ACCELERATOR PEDAL

(a) Check the voltage.

(1) Connect the intelligent tester to the DLC3.

(2) Turn the ignition switch ON.

(3) Turn the intelligent tester ON.

(4) Select the menu items: DIAGNOSIS / ENHANCED OBD II / DATA LIST / ALL / ACCEL POS #1, ACCEL POS #2.

(5) Operate the accelerator pedal, and then check that the ACCEL POS #1 and ACCEL POS #2 values are within the specifications.

Standard voltage (ACCEL POS #1)

Accelerator Pedal Condition	Specified Condition
Released	0.5 to 1.1 V
Depressed	2.5 to 4.5 V

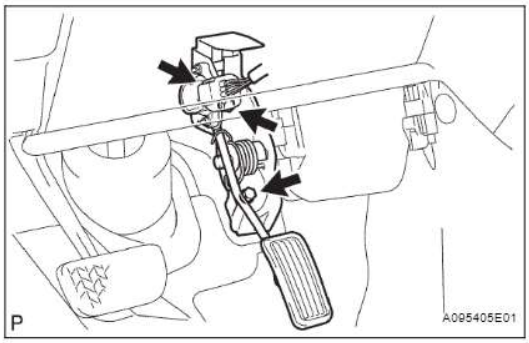
Standard voltage (ACCEL POS #2)

Accelerator Pedal Condition	Specified Condition
Released	1.2 to 2.0 V
Depressed	3.4 to 5.0 V

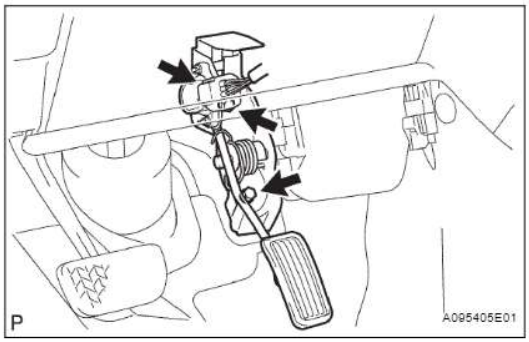
If the result is not as specified, check the accelerator pedal, wire harness or ECM.

REMOVAL

1. **DISCONNECT CABLE FROM NEGATIVE BATTERY TERMINAL**
   CAUTION:
   Wait at least 90 seconds after disconnecting the cable from the negative (-) battery terminal to prevent airbag and seat belt pretensioner activation.



2. **REMOVE ACCELERATOR PEDAL**
   (a) Disconnect the accelerator pedal position sensor connector.
   (b) Remove the 2 bolts and accelerator pedal.



INSTALLATION

1. **INSTALL ACCELERATOR PEDAL**
   (a) Install the accelerator pedal with the 2 bolts.
   Torque: 5.4 N*m (55 kgf*cm, 48 in.*lbf)
   (b) Connect the accelerator pedal position sensor connector.

2. **CONNECT CABLE TO NEGATIVE BATTERY TERMINAL**

3. **PERFORM INITIALIZATION**
   (a) Perform initialization (see page IN-23).
   NOTICE:
   Certain systems need to be initialized after disconnecting and reconnecting the cable from the negative (-) battery terminal.